NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2: Preliminary Environmental Studies

TOWNSHIP OF IGNACE AND AREA, ONTARIO

APM-REP-07000-0206

MAY 2018

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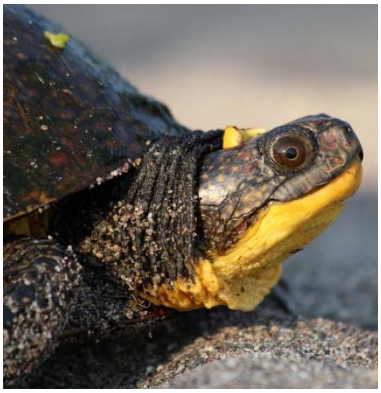
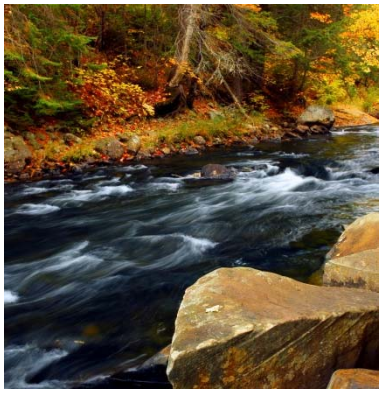
Phase 2: Preliminary Environmental Studies
Township of Ignace and Area, Ontario

Summary Report

APM-REP-07000-0206
Version 1.1

24 May 2018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VERSION HISTORY

Version	Date	Modifications
Version 0.1 DRAFT	14-Dec-2017	Drafted by KMajor & BTibble
Version 0.2 DRAFT	22-Dec-2017	Incorporation of NWMO feedback.
Version 1.0	16-Feb-2018	Incorporation of NWMO comments. Summary. Edits for clarity and consistency.
Version 1.1	24-May-2018	Incorporation of NWMO comments.

Summary

In 2016, as part of Phase 2 of the preliminary environmental studies in the area, the NWMO initiated a series of initial desktop and field studies in four general potentially suitable areas identified during Phase 1 preliminary assessment. The objective of these initial field studies was to advance understanding of the environment of the general potentially suitable area, and assess whether it is possible to identify general potential repository areas (PRAs). Investigations were undertaken by Tulloch Engineering Inc. (Tulloch), as part of Phase 2 preliminary environmental studies where aerial geophysical data is available.

Building on the findings of the Phase 1 report, Tulloch gathered more than 100 collections of environmental information from federal, provincial and local sources. This information was compiled into a series of preliminary natural features maps for each of the four potentially suitable areas. Tulloch biologists searched and cross-referenced this information in order to identify / predict potential environmental sensitivities across the Phase 2 study area. The sensitivities can be considered in terms of protected habitats (i.e. significant wildlife habitat) and protected species (i.e. species at risk or rare species). Preliminary maps were used as a basis for field studies. Field studies sought to ground-truth the information in order to verify accuracy and completeness.

Field studies confirmed that ecosite information obtained from the Ministry of Natural Resources and Forestry (MNRF) accurately divided wetlands from uplands areas, accurately mapped the boundaries of habitat types in most cases, and provide reasonable approximations of the vegetation and soil conditions that can be anticipated in a given space.

Information relating to rare vegetation communities was lacking for the Ignace area. Tulloch reviewed MNRF ecosite information for uncommon plant species that could imply the presence of rare vegetation communities. Only two of the eight potentially rare communities identified in this way were confirmed as significant wildlife habitat once verified in the field. Two additional rare communities (Black Ash Swamps) were encountered unexpectedly in the field.

Information relating to Moose Aquatic Feeding Areas was observed to be generally correct regarding site candidacy as significant wildlife habitat but field verification should be performed when the bloom of freshwater vegetation has peaked (from mid-June to the end of July).

Field verification of the Stream Reach Classification generally agreed with the desktop mapping and the ecological importance of the observed differences between the desktop mapping and observations was minimal. At the largest scale investigated the fish species distributions throughout the Phase 2 Study Area appeared to be driven by the underlying geology and soil types, which in turn affect the water chemistry (physiochemical) of the habitat conditions. At the finest scale investigated, the streams appear to be undergoing continued fragmentation due to ongoing beaver activity. This is typical for Northern Ontario. All fish species encountered during fishing and trapping efforts are considered common throughout northwestern Ontario, and no sensitive or rare species were observed.

Members of the Wabigoon Lake Ojibway Nation accompanied Tulloch staff throughout the field studies to supplement field observations with traditional knowledge.

Results and observations from the field studies were incorporated into the preliminary maps for the creation of a final series of natural features maps. Natural Features maps were then summarized into a set of environmental sensitivity maps displaying all known (or suspected) sensitive areas along with recommended / industry standard protective boundaries.

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LIST OF APPENDICES

1. INTRODUCTION

Who, What, Where and Why.

The Nuclear Waste Management Organization (NWMO) is implementing Adaptive Phased Management (APM) for the long-term care of used nuclear fuel. This includes a site selection process for identifying an informed and willing host for a deep geological repository. The Township of Ignace, located in northeastern Ontario, expressed interest in participating in the site selection process.

The site selection process consists of a number of steps, with each step requiring increasingly detailed evaluations of the potential suitability of the area to host the APM project. The Phase 1 preliminary assessment report (Golder 2013) provided high level descriptions of the biological and physical environment within the community and surrounding area which, along with geoscientific information, was used to evaluate the potential for a facility to be safely constructed and operated in the vicinity.

In 2016, as part of Phase 2 of the preliminary environmental studies in the area, the NWMO initiated a series of initial desktop and field studies in four general potentially suitable areas identified during Phase 1 preliminary assessment (Figure 1). The objective of these initial field studies was to advance understanding of the environment of the general potentially suitable area, and assess whether it is possible to identify general potential repository areas. Investigations were undertaken by Tulloch Engineering Inc. (Tulloch) as part of Phase 2 preliminary environmental studies where aerial and geophysical information was available. The purpose of these studies was to update the description of the environmental features and conditions within these areas, where necessary (Tulloch 2018).

Data pertaining to known or potential ecological features was assessed, including ecological land classification ecosites (a scientific method to organize, classify and evaluate ecosystems for the purposes of land resource management), candidate significant wildlife habitat, stream reach classification (a method of identifying stream hierarchy to infer stream size), and potential habitat availability and use by species at risk. This environmental information is useful in evaluating the overall potential to safely construct and operate the APM project in the area. The information can be used as an input to the integrated assessment of the suitability of the areas of study for the project and to identify possible environmental risks associated with siting activities (e.g., borehole drilling) to avoid, mitigate, and/or monitor potential effects.

This report serves as documentation of environmental investigations undertaken to date in the Ignace area, and includes a summary of Phase 1 and Phase 2 studies.

2. STEP 1: INFORMATION GATHERING

What is already known about the area?

2.1 Phase 2 Study Area

Phase 2 preliminary environmental desktop assessments advanced information presented in the Phase 1 reports and updated the environmental data compiled for the potentially suitable area based on new information, enhanced desktop studies and field verification. Studies focused on a geographically large area that was determined to be potentially suitable following Phase 1 integrated studies and for which aerial geophysics data was collected during Phase 2 geoscientific studies. For this report, the four areas are referred to as the Revel, Indian Lake East, Basket Lake, and Indian Lake West blocks. See Figure 1 in Appendix A.

2.2 Information Sources

Building on the findings of the Phase 1 report (Golder 2013), Tulloch gathered more than 100 collections of environmental information from federal, provincial and local sources. Some overlap existed in the types of information gained from each source, but information from multiple sources needed to be combined and considered together to be confident in the completeness of the background review.

Sources included:

- Land Information Ontario
- Natural Resources Canada
- Dryden District of the Ontario Ministry of Natural Resources and Forestry
- Natural Heritage Information Center (of the MNRF)
- Ontario Forest Resource Inventory (of the MNRF)
- Forestry Information
- Other Sources

2.3 Early Mapping

Information collected throughout the information gathering step was compiled into a series of preliminary natural features maps for each of the four potentially suitable areas. Tulloch biologists searched and cross-referenced the information from the various sources in order to expand beyond the basic information and identify / predict potential environmental sensitivities across the Phase 2 study area. The sensitivities can be considered in terms of protected habitats (i.e. significant wildlife habitat) and protected species (i.e. species at risk or rare species).

Preliminary maps were used as a basis for field studies. They are not included in this summary report as these early maps were augmented and modified based on the observations and results of the field studies. See Section 4 below for the final maps.

2.3.1 Protected Habitat (Significant Wildlife Habitat)

Certain habitat types are considered important because they are rare, they support critical life functions of rare or important species, or because they support large congregations of wildlife. These habitats are classified as significant wildlife habitat and are defined by the Significant Wildlife Habitat Technical Guide (MNR 2000) and through guidelines (criterion schedules) established regionally. Significant wildlife habitat is protected under the Provincial Policy Statement, which is issued under the Ontario Planning Act.

Records of confirmed or candidate significant Wildlife Habitat, Significant Wetlands, and Areas of Natural and Scientific Interest were gathered from discussions with the Ministry of Natural Resources and Forestry (MNRF) and through records collected from Land Information Ontario. Candidate significant wildlife habitat refers to areas identified as having a potential to be significant but that require on-site assessments to confirm. Significant wildlife habitat in the Ignace area was defined according the Significant Wildlife Habitat Criteria Schedules for Ecoregion 3E (MNRF 2015).

Tulloch reviewed forest information collected from the Ontario Forest Resource Inventory program of the MNRF for high densities of uncommon tree species that could suggest the presence of rare forest types. Some rare forest types can qualify for protected as significant wildlife habitat. For the Ignace area, these include forests with the following:

- More than 35% Red and/or White Pine
- More than 35% Black Ash
- More than 35% White Elm
- More than 35% Oak
- More than 35% Red and/or Sugar Maple
- More than 35% Yellow Birch

Tulloch also reviewed *Ecosite* information from the Ontario Forest Resource Inventory in combination with soils information from the Northern Ontario Engineering Geology Terrain Study to identify areas that could potential qualify as one of four types of rare vegetation community, as follows:

- Cliff and Talus Slopes
- Rock Barrens
- Sand Dunes
- Hardwood Swamps

These reviews produced a total of 53 candidate rare communities within the Phase 2 study area. Red and White Pine represented 46 (87%) of the candidate rare communities and the remainder spread evenly among Red and Sugar Maple (2), Hardwood Swamps (2), Sand Dunes (1), Rock Barrens (1) and Cliffs (1). In order to confirm significance, candidate rare vegetation communities require field verification to confirm the presence of adequate quantities of targeted species or to confirm the presence of specific indicator species

2.3.2 Protected Species (Species at Risk and Locally Rare)

Many plant and wildlife species are protected in Ontario, and these protections result from several legal documents. The provincial Endangered Species Act (ESA 2007) and the federal Species at Risk Act (SARA 2002) protect all Threatened and Endangered species as well as the habitat they require to survive. Bird species that migrate between Canada and the United States are protected under the federal Migratory Birds Convention Act (MBCA 1994). Most other bird species that are "wild by nature" are protected under the provincial Fish and Wildlife Conservation Act (FWCA 1997). The Fish and Wildlife Conservation Act also provided special protection to many species of reptile, amphibian, mammal and insect.

Tulloch reviewed the Phase 1 Desktop Assessment Environment Report for the Township of Ignace (Golder 2013) and updated lists of species at risk available from federal and provincial databases / information requests. These data were compiled in a list of protected species at risk that may occur in the Ignace area based on the current state of legislation and available information (Table 1).

In addition, the MNRF identified three species considered locally rare as present in the Ignace area; Brook Cinquefoil (*Potentilla rivalis*; SH), Vasey's Rush (*Juncus vaseyi*; S3) and Macoun's Arctic Butterfly (*Oeneis macounii*; S3). Locally rare considered species that are very uncommon and may be vulnerable to extirpation.

Records varied from well-defined point data (e.g. an individual Bald Eagle nest) to large 300+ km^2 areas reflecting uncertainty in exact observation location (typically information that predates GPS mapping technology). Records of protected species must be interpreted with care as they only reflect species that have been *observed* in an area. The absence of a record could mean that a species is absent from the area or that searches for that species have not occurred in the area.

Table 1 – Twenty species at risk identified within the Kenora Region of the MNRF.

Common Name	Scientific Name	Status in Canada	Status in Ontario
BIRDS			
American White Pelican	*Pelecanus erythrorhynchos*	No Status	Threatened
Bald Eagle	*Haliaeetus leucocephalus*	No Status	Special Concern
Bank Swallow	*Riparia riparia*	No Status	Threatened
Barn Swallow	*Hirundo rustica*	No Status	Threatened
Black Tern	*Chlidonias niger*	No Status	Special Concern
Bobolink	*Dolichonyx oryzivorus*	No Status	Threatened
Canada Warbler	*Wilsonia canadensis*	Threatened	Special Concern
Common Nighthawk	*Chordeiles minor*	Threatened	Special Concern
Eastern Whip-poor-will	*Antrostomus vociferus*	Threatened	Threatened
Eastern Wood-Pewee	*Contopus virens*	No status	Special Concern
Golden Eagle	*Aquila chrysaetos*	No Status	Endangered
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Special Concern
Peregrine Falcon	*Falco peregrinus*	Special Concern	Special Concern
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Not at Risk
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern
Yellow Rail	*Coturnicops noveboracensis*	Special Concern	Special Concern
MAMMALS			
American Badger	*Taxidea taxus*	Endangered	Endangered
Caribou	*Rangifer tarandus*	Threatened	Threatened
Cougar or Mountain Lion	*Puma concolor*	Information Deficient	Endangered
Eastern Small-footed Myotis	*Myotis leibii*	Endangered	Endangered
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered
Northern Long-eared Myotis	*Myotis septentrionalis*	Endangered	Endangered
Polar Bear	*Ursus maritimus*	Special Concern	Threatened
Wolverine	*Gulo gulo*	No Status	Threatened
REPTILES / AMPHIBIANS			
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern
FISH			
Lake Sturgeon	*Acipenser fulvescens*	No Status	Threatened
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	Threatened
INSECTS			
Monarch Butterfly	Danaus plexippus	Special Concern	Special Concern
PLANTS			
Showy Goldenrod	*Solidago speciosa*	Endangered	Threatened
Western Silvery Aster	*Symphyotrichum sericeum*	Threatened	Endangered

2.3.3 Ecosite Mapping

The ecological land classification system of Ontario is a standardized method produced by the MNRF for describing habitat based on properties of the soil and plant community. This system includes 224 different habitat types, or '*ecosites'*, each with a specific definition that outlines a range in soil texture, moisture content and chemistry as well as the dominant species of the plant community. Ecosites are mapped across the natural landscape, with each ecosite representing an area of relatively uniform habitat. Ecosites help inform land-use planning as they allow biologists to predict the types of wildlife that can occur in an area and as they can be used to identify rare vegetation community types.

Ecosite information has been produced for the Ignace area by the Ontario Forest Resource Inventory program of the MNRF. Throughout central and northern Ontario, the Ontario Forest Resource Inventory program inventories forests and wetlands based on the interpretation of high-resolution aerial photography in combination with generalized soils information obtained for an area. Over 5000 ecosites were identified by the MNRF within the Phase 2 Study Area.

2.3.4 Stream Reach Classification

Stream Reach Classification was a desktop exercise that focused on applying available information collected for the Natural Features Mapping to categorize streams throughout the Phase 2 study area according to the types of habitat they were likely to support. The classification was based on existing information of known permanent and intermittent streams acquired from Land Information Ontario in combination with ecosite information from the MNRF and topographic information acquired from GeoGratis.

Stream Reach Classification was performed only on streams; lakes and waterbodies greater than 20 m across were not classified. Streams were classified according to eight categories. Reaches in direct contact with wetlands were assigned the uppercase letter 'W' with a lowercase letter denoting the type of wetland; marsh (m), fen (f), bog (b) and swamp (s). This yielded four classes; 'Wm', 'Wf', 'Wb' and 'Ws'. A fifth class, 'Wu' was used to denote streams passing through unclassified wetlands (wetland type was unknown). Streams that did not pass through wetlands were classified by Strahler stream order (Strahler, 1957). Headwater systems were considered Strahler orders 1 and 2 and denoted as 'H1' and 'H2', respectively. All higher order streams were denoted as 'O' and 'U' was used if Strahler order was unknown.

Stream classes were further subdivided into subclasses. Wetland ecosites were sub-classified based on mineral versus organic substrate type; denoted with the lowercase suffixes 'm' and 'o', respectively. Upland classes were subdivided based on the texture type and moisture class of the surrounding ecosite and grouped according to the major keys of the ecological land classification system (MNR 2009); suffixes 2 through 12 were applied to upland stream classes.

Waterbodies were not classified in the field for this report. Where information was available, waterbodies are depicted and considered according to one of three possible thermal regimes (cold, cool and warm). Thermal regime is a general classification of a waterbody's typical summer water temperature, and is a broad indicator of a waterbody's health or sensitivity to disturbance. A waterbody's thermal regime is determined by scientists using measured summer water temperatures, dominant fish species, or benthic invertebrate community present, or a combination of these indicators. Thermal regime is influenced by factors like water depth, groundwater input, productivity and water chemistry. Thermal regime information was acquired from Land Information Ontario. Little information was available regarding the thermal regimes of streams in the Ignace area.

2.3.5 Environmental Sensitivity Mapping

Environmental sensitivities gathered during Natural Feature Mapping were compiled for a summary of site sensitivity and for the selection of smaller (10 km^2) field verification plots. Protective buffers were assigned to each feature type based on standard mitigation practices. Most buffers reflect best practices outlined by MNRF significant wildlife habitat protocols. A list of feature types and buffers applied are provided in Table 2.

Table 2 –Buffers applied around known and potential environmental sensitivities identified during the Natural Features Mapping.

Sensitivity	Buffer Width (m)	Justification
Wetlands	120[a]	Convention used for the protection of provincially significant wetlands.
Waterbodies	30[a]	Minimum buffer recommended by ECC is 30m (*How Much is Enough? 3rd ed., ECC 2013)*, Manitoba Conservation (*Manitoba Conservation Forest Practices Guidebook*, MC 2008), and the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* (MNRF 2010)
Streams	30[a]	Minimum buffer recommended by ECC is 30m (*How Much is Enough? 3rd ed., ECC 2013)* and Manitoba Conservation (*Manitoba Conservation Forest Practices Guidebook*, MC 2008
Moose Late Wintering Area	300	SWH 3E Criteria Schedule
Moose Aquatic Feeding Habitat	120[a]	SWH 3E Criteria Schedule
Waterfowl Stop-over and Staging Area	100 (to 300)[a]	SWH 3E Criteria Schedule
Red-tailed Hawk Nesting Site	100	SWH 3E Criteria Schedule
Trumpeter Swan Nesting Site	150[b]	SWH 3E Criteria Schedule (Colonial Nesting - Ground)
Tundra Swan Nesting Site	150[b]	SWH 3E Criteria Schedule (Colonial Nesting - Ground)
Bald Eagle Nesting Site	400 (to 800)[a]	SWH 3E Criteria Schedule
Unknown Hawk/Owl Nesting Site	400[b]	SWH 3E Criteria Schedule
Rare Vegetation Communities	Ecosite Boundary	SWH 3E Criteria Schedule

NOTE: a = minimum buffer width. Actual buffer width and form dependent on local conditions; b = No species-specific buffer guidelines. Used buffer guidelines for species with similar habitat requirements.

3. STEP 2: FIELD STUDIES

How accurate is the collected information?

Information collected for the Natural Feature Maps was produced by a variety of different organizations for a variety of different purposes. Some of the information was preliminary and required field verification. Other information was provided at a high level, and field studies were warranted to improve accuracy and precision. Field studies performed by Tulloch were designed to ground-truth and improve on the Natural Features information.

3.1 Site Selection

The four potentially suitable areas were too large to study in their entirety. Instead, representative field verification areas were selected to be studied so that inferences could be made to the remainder of the Phase 2 study area. The objectives of the field studies were to:

1. To confirm and further describe environmental sensitivities identified during desktop studies.
2. To confirm the relative absence of sensitivities in areas indicated as minimally sensitive during desktop studies.
3. To investigate areas that present knowledge gaps.

Several knowledge gaps were identified during desktop studies. In some instances, these gaps reflected the methods and priorities of the projects responsible producing the information. Other gaps resulted from variations in study effort across the Ignace area. Specific knowledge gaps identified during desktop studies include:

- The Ontario Forest Resource Inventory program of the MNRF classified the natural landscape according to the ecological land classification system of Ontario based on the interpretation of aerial photographs and general information about site history and soil properties. Although some ecosites were ground-truthed by the MNRF, this truthing was restricted only to forested sites. Wetlands and other non-wooded ecosites may not have undergone the same rigour of verification.

- The Ontario Forest Resource Inventory program of the MNRF mapped ecosites at a relatively high level, with 8 ha selected as the minimum mappable size for most ecosite types. Distinct forest communities smaller than 8 ha would not have been mapped. As a result, rare vegetation communities smaller than 8 ha may have been underrepresented in the ecosite information obtained from the MNRF.

- The ability to identify habitat suitable for protected species within the Phase 2 Study Area based on ecosite alone is limited. Ecosite types reflect primarily a combination of soil substrate and dominant vegetation form (usually the forest canopy) properties. Habitat suitability for SAR species that required other habitat attributes (e.g. attributes pertaining to forest understory, forest floor, edge habitat, etc.) cannot be readily deciphered based on ecosites alone.

- Certain protected habitat types (e.g. Moose Aquatic Feeding Areas) provided by Land Information Ontario required field verification to confirm significance.
- Information pertaining to streams throughout the Phase 2 study area was often incomplete, which reduced the ability to completely classify some watercourses.

Seventeen areas were selected for potential field verification (Figure 1 in Appendix A). At the time of plot selection, it was unclear how many plots could be studied given a reasonable amount of effort. To accommodate this level of uncertainly, Tulloch and the NWMO elected to select a large number of plots and to prioritize these plots as low, medium or high priority. Field studies visited as many plots as possible in order of priority. Fourteen of the 17 Field Verification Plots were studied.

Preference in site selection was given to areas that could meet one or more of the above objectives while still providing reasonable site access. A summary of the selected areas and studied is provided in Table 3. Field survey effort is shown in Figures 2A to 2D in Appendix A.

Table 3 - Proposed field verification areas including justification for selection and sensitive features associated with each proposed area.

Plot	Area (km^2)	Field Study Priority	Field Studies Received	Justification	Sensitivities
A1	8.0	High	Yes Land and Water	Selected due to a minimum of sensitivities.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Areas (two at Class 3) • Vasey's Rush (rare) element occurrence
A2	10.0	Moderate	Yes Land and Water	Selected to verify stream reach classification and significant Moose Aquatic Feeding Areas.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Areas (Class 3) • Moose Aquatic Feeding Areas (Class 4) • Macoun's Butterfly (rare) element occurrence
A3	8.0	Moderate	Yes Land and Water	Selected due to a minimum of sensitivities.	• Streams • Waterbodies • Wetlands
A4	10.0	Low	Yes Land and Water	Selected to verify potentially rare ecosites.	• Streams • Waterbodies • Wetlands

Plot	Area (km^2)	Field Study Priority	Field Studies Received	Justification	Sensitivities
A5	10.0	High	None	Selected to verify stream reach classification and due to area remoteness.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Areas (Class 3)
B1	19.1	High	Yes Land and Water	Selected as representative of the Basket Lake block	• Streams • Waterbodies • Wetlands • Snapping Turtle (special concern) element occurrence.
C1	10.0	None	None	Selected due to a minimum of sensitivities.	• Streams • Waterbodies • Wetlands • Macoun's Butterfly (rare) element occurrence
C2	10.0	High	Yes Land and Water	Selected to verify potentially significant Moose Aquatic Feeding Area	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Area (Class 3) • Rare Vegetation Community – Red Pine • Brook Cinquefoil (rare) element occurrence
C3	10.0	High	Yes Land and Water	Selected to verify stream reach classification and significant Moose Aquatic Feeding Area.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Area (Class 3) • Moose wintering areas

Plot	Area (km^2)	Field Study Priority	Field Studies Received	Justification	Sensitivities
					• Macoun's Butterfly (rare) element occurrence
C4	10.0	Low	Yes Land and Water	Selected due to known presence of SAR species and to verify wetland ELC classification.	• Streams • Waterbodies • Wetlands • 2015 Eastern Whip-poor-will Observations • 2015 Common Nighthawk Observations • Moose Aquatic Feeding Area (Class 3)
D1	10.0	High	Yes Land and Water	Selected due to a minimum of sensitivities and proximity to key infrastructure (highway & utilities).	• Streams • Waterbodies • Unclassified wetlands
D2	10.0	High	Yes Land and Water	Selected due to a minimum of sensitivities and to verify potentially rare ecosites.	• Streams • Waterbodies • Rare Vegetation Community – White Pine • Unclassified wetlands
D3	10.0	Moderate	Yes Land and Water	Selected to verify unclassified wetlands.	• Streams • Waterbodies • Unclassified wetlands • Potentially Rare Vegetation Community – Sand Dune

Plot	Area (km^2)	Field Study Priority	Field Studies Received	Justification	Sensitivities
D4	8.0	Low	None	Selected for the verification of wetland types and comparison of wetland and watercourse habitat on varied geologic landforms.	• Streams • Waterbodies • Wetlands
E1	10.0	Moderate	Yes Land and Water	Selected for the verification of Moose Aquatic Feeding Areas.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Areas (Class 3)
E2	8.0	High	Yes Land and Water	Selected for the high concentration of rare pine stands.	• Streams • Waterbodies • Wetlands • Moose Aquatic Feeding Areas (Class 3) • Rare Vegetation Communities – Red Pine
E3	8.0	Low	Yes Water Only	Selected for the potential presence of rare vegetation communities.	• Streams • Waterbodies • Wetlands • Rare Vegetation Communities – Rock, Red Pine, Maple

3.2 Timing and Focus of Field Studies

Field studies were performed in September and October of 2016 by a crew of 11 Biologists, and Environmental Technicians divided into four teams. Half the teams focused exclusively on forest and wetland habitat; these teams were led by terrestrial biologists. The remaining two teams focused exclusively on lake and stream habitat and were led by aquatic biologists. Each team was accompanied by a guide from the Wabigoon Lake Ojibway Nation.

Field protocols performed by Tulloch biologists conformed to seven types of assessment:

Land Habitat

- Ecosite Classification
- Rare Vegetation Community Assessments
- Moose Aquatic Feeding Area Assessments
- Habitat Assessments for Protected Species
- Forestry Information Review

Water Habitat

- Stream Reach Classification Assessments
- Fish Community Surveys

3.3 Ecosite Classification

3.3.1 Field Methods

Tulloch biologists visited a representative sample of ecosites classified by the MNRF to ground-truth the aerial interpreted forest community and to more fully assess soils. Soils were sampled (up to 1.2 m deep) using purpose-built soil augers; properties of their colour, moisture content and texture were measured. In forested ecosites, the composition of the treed canopy (overstory) was described using a Forestry Prism, which accurately measured the quantity of each tree species in the canopy. Midstory and understory plant cover were estimated visually and dominant / secondary species were noted for each. Ecosites were classified according to the Boreal Manual of the Ecosites of Ontario Operational Draft (MNR 2009) and the Boreal Ecosites Factsheets (MNR 2012).

3.3.2 Field Results

A total of 137 ecosites were visited and ground-truthed in the field. These areas belonged to 36 different classifications of ecosite. Field assessments found that the MNRF's predicted ecosite classifications correctly differentiated upland and wetland ecosystems with 97% accuracy. The boundaries between ecosites appear accurate in 82% of instances. Within ecosites, information collected by Tulloch in the field agreed with, or was similar to, the MNRF's predicted Ecosite classification 78% of the time. Differences between MNRF predicted and Tulloch observed conditions reflected four factors (in order of frequency):

Environmental variability within large ecosite areas. The Forest Resources Inventory program of the MNRF maps ecosites at a higher level than is typically applied in land-use planning for the purposes of site development; eight hectares is used as the minimum mappable size for most ecosite types. Distinct forest communities smaller than 8 ha were frequently not mapped. Soil properties, including moisture, depth and nutrient richness, were also highly variable across the landscape.

Gaps in information available to MNRF aerial photo interpreters. Wetland ecosite typing emphasizes subtleties in soil chemistry and structure; information that would not have been available to MNRF aerial photo interpreters. Many soil properties can only be determined through the on-site excavation of samples and by searching for plant indicator species. As a result, MNRF predicted ecosites for wetland habitats represented educated guesses that often approximated the true to ecosite type.

Elapsed time since the eFRI imagery was collected. MNRF imagery used to classify the ecosites of the Ignace area was collected in 2007. During field investigations, some changes were apparent from the interim 9 years. Recent natural (e.g. beaver activity, wind damage) and artificial (e.g. logging and other vegetation clearing) disturbances resulted in disagreement between predicted and observed ecosite types.

Errors in photo interpretation. In general, photo interpretation as produced by the MNRF was accurate in terms of delineations and reasonable in terms of classification. But among the 5000+ ecosite polygons supplied by the MNRF, even a high degree of accuracy will yield some errors. Errors usually reflected the species composition of a polygon. In some instances, forestry prisms indicated different proportions of tree species than were predicted by the MNRF from aerial photographs. Dominant plants in some wetlands differed from MNRF predictions.

3.4 Rare Vegetation Communities

3.4.1 Field Methods

Tulloch biologists visited potential rare vegetation communities and performed searches on foot and by boat to confirm the presence or absence of uncommon plant species. Tulloch biologists also remained vigilant while working and travelling within the Phase 2 study area for the incidental observation of unexpected rare vegetation communities. Each potentially rare vegetation community was classified to ecosite.

3.4.2 Results

Tulloch biologists visited eight potential rare vegetation communities; all identified as having large components of Red Pine or White Pine in the forest canopy. Pure stands of these species are uncommon in the Boreal Forests of Ontario. Only two of the Red Pine / White Pine stands (25%) were found to have enough of the target species (>35% canopy dominance) to qualify as rare forests (Photograph 1). Two previously unknown rare vegetation communities were discovered unexpectedly on the landscape; both were Black Ash dominated hardwood swamps (Photographs 2 and 3).

3.5 Moose Aquatic Feeding Area Assessments

Moose Aquatic Feeding Areas are wetland habitats identified as a type of significant wildlife habitat that may receive provincial protection under the Provincial Policy Statement. These feeding areas are ranked by the MNRF on a scale of class 1 to class 4; representing an increasing potential for the area to support high quality freshwater vegetation for Moose. Classes are determined based criteria outlined in the Selected Wildlife and Habitat Features: Inventory Manual (MNR 1997) which includes the wetland type and the quantity/composition of freshwater vegetation present. Moose Aquatic Feeding Areas are considered significant wildlife habitat if ranked to classes 3 and 4.

3.5.1 Methods

The MNRF maintains an inventory of potential Moose Aquatic Feeding Areas across much of Ontario that is typically produced from observations made from aircrafts and / or aerial photographs. A total of 271 feeding areas were identified within the Phase 2 study area, of which 48 were noted as Class 3 or Class 4 suggesting potential significance. Tulloch biologists visited and assessed potential Moose Aquatic Feeding Areas either on foot (with the aid of binocular) or by boat to evaluate site conditions against MNRF criteria. Moose sign (e.g. tracks and scats) was noted if observed. In some instances, field observations were supplemented with traditional knowledge shared by Anishinaabe guides who were experienced in traversing and hunting the areas under consideration.

3.5.2 Results

Tulloch biologists visited 36 Moose Aquatic Feeding Areas identified by the MNRF, of which 19 were estimated to belong to Classes 1 and 2 (not significant) and 15 predicted to belong to Classes 3 and 4 (significant wildlife habitat).

Overall, 85% of field observations agree with MNRF predicted levels of significance. Boundaries of the feeding areas were only moderately accurate and required modification in one third (34%) of instances. Inaccuracies in the boundaries of the feeding areas may reflect, in part, the relatively dynamic nature of floating vegetation communities which can move and change over the course of several years.

Timing of these field studies were not ideal for the evaluation of Moose Aquatic Feeding Areas. MNRF inventory protocol suggest that field assessments targeting this habitat should typically be performed from mid-June to the end of July when the bloom of freshwater vegetation has peaked (MNRF 2015). The timing of Tulloch field assessment (September) was later than recommended by the MNRF and freshwater vegetation was observed to be past its summer prime. None-the-less, much floating and submerged vegetation was observed as present within the assessed wetlands (Photograph 4) and in wetlands observed incidentally throughout the Ignace area. Moose sign (tracks, trails, scats, rubs, browse, ruts and beds) was noted within or around over half (58%) of investigated Moose Aquatic Feeding Areas (Photograph 5) and several moose were observed visually or acoustically in the field. The prevalence of moose activity provided insights into Moose Aquatic Feeding Area habitat usage.

With few exceptions, Tulloch believes rankings obtained during field assessment are accurate but, due to the non-ideal survey timing, Tulloch recommends de-emphasizing individual ranks and instead focusing of overall significance (i.e. classes 1 and 2 vs. classes 3 and 4) which is of greater certainty. The level of significance will have implications to NWMO site selection; habitat classes 1 and 2 have been identified as an environmental consideration, while significant wildlife habitat (classes 3 and 4) receive legislative protection. All Moose Aquatic Feeding Areas classified by the MNRF as classes 3 or 4 should be considered significant unless confirmed to the contrary in the field.

3.6 Habitat Assessments for Protected Species

3.6.1 Field Methods

Where possible, Tulloch biologists visited the sites of historical species records to view habitat confirmed to support species of conservation concern. These habitats provided opportunities to observe and describe the specific habitat preferences of these species for the Ignace area. Where historical records related to a broad area, Tulloch biologists remained vigilant when working within the area for incidental observations of the species.

3.6.2 Results

Tulloch Biologists visited the locations of historical records for all seven species associated with the Phase 2 study area. Eastern whip-poor-will and common nighthawk were identified by the MNRF Wildlife Assessment Program in 2015 in an area corresponding to TULLOCH field verification plot C4. This location accounted for 8 records within close proximity. Tulloch biologists investigated the site under the assumption that it may serve as an example of the specific habitat preferences of these species in the Ignace area. The site was found to be a mature poplar/birch stand on fresh sandy soils above boulder till. The site was bordering several hectares of recent clearcut to the south (Photograph 6) and perforated centrally by a small (0.5 ha) wetland marsh. This combination of soil and vegetation types appeared ideally suited to both bird species; mature forest edges with well-drained sandy substrates to permit concealed ground nesting, and open spaces (clearcut and wetland) to allow efficient foraging for insects. As this habitat combination and soil type was observed to be common throughout the Ignace Phase 2 study area, the potential for both eastern whip-poor-will and common nighthawk to be present at sites throughout the Ignace area is considered high.

A search for suitable snapping turtle nesting and overwintering habitat was performed along some southern portions of riparian habitat on OGF lake number 400176639 in Tulloch field verification plot B1. The MNRF identified snapping turtle as using some portion of this lake in 2009. Field observations found rocky and vegetated shorelines suitable for turtle basking and partially isolated bays with floating and submerged freshwater vegetation suitable for foraging. Although no prime nesting habitat was observed, surrounding soils substrates were sandy and, with over 10km of shoreline, are likely to provide opportunities for nesting habitat. As the conditions within and around this lake were observed to be common throughout the Phase 2 study area, the potential for snapping turtle to be present at sites throughout the Ignace area is considered high.

Bald eagles were observed at three locations within the Phase 2 study area. Eagles were observed on two separate occasions at two locations along the north and west shorelines of Camp Lake. No evidence of nesting was observed in any instance. Field observations in combination with nesting sites provided by the MNRF suggest bald eagle is common for the Ignace area.

Prior to commencing field investigations, Tulloch created and provided field staff with identification cards outlining the rare plant and insect species associated with the Ignace area and maps

delineating the element occurrences within which the species had previously been observed. Despite remaining vigilant for rare species while working and travelling in vicinity of four rare vegetation records, no rare species were observed.

3.7 Forestry Information Review

Logging and forest management (silvicultural) information was collected for the English River Forest (Resolute Forest Products), Wabigoon Forest (Domtar) and Dryden Forest (Dryden Forest Management Company), with each managing roughly 60%, 39% and 1% of the total Phase 2 study area, respectively.

3.7.1 Field Methods

Tulloch biologists verified forestry information accuracy on foot and by truck throughout the Phase 2 study area. Where available, recent aerial imagery (since 2007) was also used to update forestry information and supplement field observations.

3.7.2 Results

Logging and forest management (silvicultural) were observed to be important factors influencing the age, structure and species composition of forests throughout the Phase 2 study area. Some areas, particularly those within the Wabigoon Forests, have undergone extensive logging and present as a mosaic of even-aged stands at various stages of regeneration.

Information obtained from forest managers (forestry license holders) was observed in the field to be generally accurate but incomplete. Tulloch biologists surveyed harvested sites by road and while in transit on site. Mapped areas of past harvest were observed to consistently correspond accurately to field observation, however; seven areas of recent harvest (six in the Wabigoon Forest and one in the English River Forest) were observed in the field that had not been included in the supplied information. The boundaries of these six clearcuts were estimated in the field and added to the Natural Features Mapping.

Recent aerial imagery was referenced from DigitalGlobe (Google Earth Pro, photos dated 2013 through 2015). This imagery allowed the accurate mapping of cuts discovered in the field and illustrated an additional 13 recent cuts not included in the forestry management information; 12 Wabigoon Forest, 1 English River Forest. These 13 harvests were mapped based on the aerial images. In total, 20 recent (post-2007) harvests occupying 677ha were added to the forest management information; 613ha in the Wabigoon Forest and 64ha in the English River Forest.

3.8 Stream Reach Classification Assessments

The focus of field studies along the classified streams was to identify trends in habitat characteristics among the various categories of the classification system.

3.8.1 Field Methods

Freshwater habitat assessment generally followed the methods outlined in Section 4.0 of the *Environmental Guide for Fish and Fish Habitat*, (Ontario Ministry of Transportation, 2009), and Chapter 4 of *Fisheries Techniques, Second Edition* (Murphy and Willis, 1996). The following habitat metrics were measured or recorded during the freshwater field assessments:

- Aquatic habitat type;
- Field measurements for water chemistry (temperature, dissolved oxygen, conductivity, pH);
- Substrate (stream bottom) composition;
- Stream channel morphology;
- Habitat suitability for use by fish;
- Vegetation types along the stream edge;
- Presence of groundwater seeps; and,
- Confirm reach breaks identified during the desktop mapping exercise.

Field confirmation focused on the primary stream reach categorization. Habitat type was defined based on the definition of each 'channel unit' as defined in the *Aquatic Habitat Inventory: Glossary* (Armantrout, 1998). Field observations were compared with the desktop mapping and Stream Reach Classification, as well as the results of the wetland evaluations to determine the level of confidence of the classification.

3.8.2 Results

In general, the field verification of the stream reaches agreed with the desktop delineation. Of the 129 reaches investigated in the Phase 2 Study Area, 30 (24%) were reclassified following the field verification. These reclassifications were of minor consequence to the ecological function of the systems. The observed differences between the desktop and field reach classifications were driven by four main factors:

- The inability to differentiate between similar wetland types from aerial imagery;
- Natural progression of wetland types over time (i.e. beaver pond → fen → meadow marsh);
- Seasonal changes in surface flows; and,
- Changes in habitat due to beaver activity.

The majority of the reclassified reaches resulted from wetland-fens being improperly identified from aerial imagery, which accounted for ten (33%) of the reclassified reaches. These reaches were reclassified as meadow marshes or early thicket swamps. The remaining reclassifications

resulted from observed differences in soil type (organic vs mineral soils), or through beaver activity within headwater reaches.

Headwater watercourses (reach class H, U and O) were mostly moderate to high gradient riffle-pool-run sequences or cascades with coarse substrate (sand / gravel / cobble / rubble) in various proportions. Although beaver activity was often observed, the proportion of the reach impounded was much less frequent or severe than that observed in the lower gradient areas.

These reaches typically provided limited overwintering habitat. However, when accessible to fish, these reaches could provide important spawning habitat for spawning fish. Reach breaks in these reaches were more permanent compared to low gradient reaches, typically not differing much from the desktop delineation except in areas impacted by beaver activity. The upper reaches of headwater (H1 or H2) sections were often subsurface or seasonal, with the most frequently observed occurrences of groundwater inflows.

Reach breaks in the lower reaches were more variable than those observed in the upper, headwater reaches. Breaks in the lower reaches were often presumed to be driven by beaver activity, causing marked changes in stream-edge (riparian) vegetation communities and stream morphology. However, the impacts of the beaver activity on each system appeared to be in relatively constant and, over the watercourse as a whole, there appeared to be little loss or gain in the different wetland types.

The ecological importance of the observed differences between the desktop and field stream delineations was minimal. At the largest scale investigated, the fish species distributions throughout the Phase 2 study area appeared to be driven by underlying geology and soil types, which in turn affect the water chemistry (physiochemical) of the habitat conditions. At the finest scale investigated, the surface watercourses throughout the Phase 2 study area appears to undergo continuing fragmentation due to ongoing beaver activity. This is typical for Northern Ontario.

3.9 Fish Community Surveys

The goal of the fish surveys was to evaluate the species present in streams and lakes throughout the Phase 2 study area. Emphasis was placed on sampling water features for which no information could be found during the natural features mapping.

3.9.1 Field Methods

Fish sampling was conducted throughout the Phase 2 study area under a MNRF fish collection permit. Fish collection effort targeted existing road crossings and accessible sections of watercourses bound by barriers to fish passage. Fish sampling gear included backpack electrofishing, short-set gill nets, targeted dip-netting, and baited Gee minnow traps. Fish sampling was conducted as per the methods outlined in *Fisheries Techniques, Second Edition* (Murphy and Willis, 1996).

All fish captured were identified to species by qualified fisheries biologists and all large-bodied fish (sport or traditionally targeted species) were measured for length and weight. A subset of small bodied fish was measured for length and weight, and the remainder was enumerated and released.

3.9.2 Results

The primary methods for fish collection were baited minnow traps (1,466.2 hours of effort) and backpack electrofishing (10,524 'electroseconds' of effort). Gill netting was conducted in one unnamed lake in the Revell block (3.2 hours of effort), and targeted dip netting was conducted at two sites.

A total of 11 fish species were observed during the 2016 field sampling (Table 4), including three large bodied fish species (White Sucker, Burbot, and Yellow Perch), and eight small bodied, or baitfish, species (Finescale Dace, Pearl Dace, Brook Stickleback, Longnose Dace, Blacknose Shiner, Iowa Darter, Northern Redbelly Dace, and Central Mudminnow). All fish species encountered are considered common throughout northwestern Ontario, and no sensitive or rare species were observed. One species observed during the field investigations, Central Mudminnow, was not reported in the background information search of publicly available resources. The discovery of this species is not unexpected as existing fisheries information was only available for large lakes and limited information was available for smaller waterbodies and streams around Ignace.

All fish communities encountered were indicators of cool water habitat (Table 4), with the exception of one species, Burbot, which is an indicator of cold water habitat. Burbot were observed in a tributary to an unnamed lake that drains to Basket Lake; a known cold-water lake. These findings generally agree with the known cool and cold water thermal regimes for lakes in the area, as identified by the MNRF.

Table 4 – Listing of fish species documented during the preliminary field investigations.

Common Name	Species Name	Thermal Regime*	Study Areas Observed
Finescale Dace	*Chrosomus neogaeus*	Cool	A, C, E
Pearl Dace	*Margariscus nachtriebi*	Cool	C
Brook Stickleback	*Culaea inconstans*	Cool	C, E
Longnose Dace	*Rhinichthys cataractae*	Cool	C
White Sucker	*Catostomus commersonii*	Cool	A
Yellow Perch	*Perca flavescens*	Cool	A, E
Blacknose Shiner	*Notropis heterolepis*	Cool	A
Iowa Darter	*Etheostoma exile*	Cool	A
Northern Redbelly Dace	*Chrosomus eos*	Cool	C, E
Central Mudminnow	*Umbra limi*	Cool	C, E
Burbot	*Lota lota*	Cold	B
*Species' thermal regime taken from www.ontariofishes.ca			

3.10 Incidental Observations

Moose sign (tracks, trails, scats, rubs, browse, ruts and beds), Black Bear sign (tracks and scats), spruce grouse and roughed grouse were observed to be prevalent throughout the Phase 2 Study Area. In addition, 30 other direct wildlife observations were noted incidentally while in transit on site (Table 5). Selected examples provided in Photographs 7 to 12.

Table 5 – Listing of 30 wildlife observations documented incidentally while on site in Ignace.

Type	Common Name	Scientific Name	Observations
Birds	Bald Eagle	*Haliaeetus leucocephalus*	3
	Belted Kingfisher	*Megaceryle alcyon*	1
	Eastern Whip-poor-will (heard)	*Caprimulgus vociferus*	1
	Grey Jay	*Perisoreus canadensis*	1
	Red-tailed Hawk	*Buteo jamaicensis*	4
	Rough-legged Hawk	*Buteo lagopus*	1
	Winter Wren	*Troglodytes hiemalis*	1
Amphibians	Eastern Red-spotted Newt	*Notophthalmus viridescens*	1
Reptiles	Eastern Gartersnake	*Thamnophis sirtalis*	3
	Western Painted Turtle	*Chrysemys picta*	1
Mammals	Eastern Wolf	*Canis lycaon*	6
	Moose (seen, heard, remnants)	*Alces alces*	9
	River Otter	*Lontra canadensis*	2

Photograph 1 – Rare pine forest (B048) with a nearly pure Red Pine canopy. Candidate SWH.

Photograph 2 – Rare hardwood swamp (B130) with a nearly pure Black Ash canopy. Candidate SWH.

Photograph 3 – Rare hardwood swamp (B130) with Black Ash dominated canopy. Candidate SWH.

Photograph 4 – Class 4 moose aquatic feeding area with prolific aquatic vegetation. Candidate SWH.

Photograph 5 – Example of a moose rut observed adjacent a moose aquatic feeding area.

Photograph 6 – NHIC Element Occurrence for Eastern Whip-poor-will. Habitat suitable for the nesting and foraging of the endangered species.

Photograph 7 – Eastern Spotted Newt in Red Eft phase.

Photograph 8 – Remains of a bull Moose.

Photograph 9 – Basking Eastern Gartersnake.

Photograph 10 – Remains of a Western Painted Turtle.

Photograph 11 – Black Bear track.

Photograph 12 – Cow Moose.

3.11 First Nations Traditional Knowledge

All Tulloch field staff attended cultural awareness training hosted by Wabigoon Lake Ojibway Nation prior to working in the field. Cultural field protocols provided by WLON were followed throughout the program, and Tulloch field staff attended ceremonies at the invitation of WLON team members.

Throughout the field investigations, Tulloch staff were accompanied by guides from the Wabigoon Lake Ojibway Nation. Anishinaabe guides provided Tulloch biologists insights into traditional and contemporary knowledge and land uses within the areas of assessment. Insights included past wildlife observations (e.g. moose use of aquatic feeding areas), surficial water connectivity, and traditional natural values on the land (e.g. medicines). Guides also recorded additional incidental wildlife observations including wildlife sign and vocalizations.

Anishinaabe guides assisted Tulloch staff with navigation and field logistics that promoted greater assessment efficiency and increased safety while working in the remote wilderness.

Finally, the guides provided Tulloch staff insights into Anishinaabe culture, language and traditional beliefs. Tulloch staff participated in traditional ceremony and made daily offerings of tobacco as a show of respect for the land, its inhabitants and its history.

3.12 Field Studies Summary

Ecosite information produced by the Forest Resources Inventory program of the MNRF are intended to support mid-level land use planning purposes, especially as they pertain to forest management. Field studies confirmed that MNRF predicted ecosite classifications in the Ignace area accurately divided wetlands from uplands areas (97% accuracy), accurately mapped the boundaries of community types in most cases (82% accuracy), and provide reasonable approximations of the vegetation and soil conditions that can be anticipated in a given space (77% of plots agreed with, or were similar to, expected ecosite codes).

Four factors drove differences between the MNRF predicted and Tulloch observed ecosite codes, namely; (1) environmental variability within large ecosite polygons, (2) gaps in information available to MNRF aerial interpreters, (3) elapsed time since the aerial photographs were collected and (4) occasional errors in aerial interpretation.

As a general observation, the challenge encountered by MNRF ecosite classification in the Ignace area is that some of the subtler differences among the 224 ecosite types within the Ontario ecological land classification system are beyond what can reasonably be expected from aerial photo interpretation. It is only through the excavation of soil samples and the on-site measure of the vegetation community (as with forestry prisms or similar), that an accurate classification of a site can be achieved.

Information relating to rare vegetation communities is lacking for the Ignace area. Tulloch reviewed MNRF ecosite information for uncommon plant species that could imply the presence

of rare vegetation communities. Only two of the eight potentially rare communities (25%) identified in this way (both Red Pine stands) were confirmed as significant wildlife habitat once verified in the field. Two additional rare communities (Black Ash Swamps) were encountered unexpectedly in the field.

Information relating to Moose Aquatic Feeding Areas was observed to be generally correct regarding site candidacy as significant wildlife habitat (80% accuracy) but field verification should be performed when the bloom of freshwater vegetation has peaked (from mid-June to the end of July).

Forestry information appeared accurate but incomplete, especially in relation to the Wabigoon Forest where over 600 ha of post-2007 harvest was observed beyond what was identified by the Sustainable Forest License holder. A combination of field observations and recent aerial imagery (where available) was used to update the forestry information for this area.

Field verification of the Stream Reach Classification generally agreed with the desktop mapping and the ecological importance of the observed differences between the desktop mapping and observations was minimal. At the largest scale investigated the fish species distributions throughout the Phase 2 Study area appeared to be driven by the underlying geology and soil types, which in turn affect the water chemistry (physiochemical) of the habitat conditions. At the finest scale investigated, the streams appear to be undergoing continued fragmentation due to ongoing beaver activity. This is typical for Northern Ontario. All fish species encountered during fishing and trapping efforts are considered common throughout northwestern Ontario, and no sensitive or rare species were observed.

Members of the Wabigoon Lake Ojibway Nation accompanied Tulloch staff throughout the field studies to supplement field observations with traditional knowledge.

4. STEP 3: NATURAL FEATURES MAPPING

Bringing the Desktop and Field Studies Together.

Information and observations collected during the field studies were gathered into the early natural features maps to add and modify the mapped information. These modified natural features maps better reflected the actual site conditions as ground-truth by Tulloch biologists. This final set of natural features maps includes eight maps for each potentially suitable area. All figures are provided in Appendix A.

4.1 Features Common to All Maps

For consistency and in an attempt to provide visual reference, all natural features maps were plotted with several features in common. Specifically:

- A maximum scale of 1:150,000 was selected as an appropriate level of detail for natural features mapping at the Withdrawal Area level. Where space permitted, a smaller scale was used for display purposes to maximize usable page space.
- Basic infrastructure, including transportation networks (e.g. highways, local roads, resource roads), rail lines, and utility lines, were included on all maps for reference purposes.
- Surface water features, including lakes and streams, were included on all maps for reference purposes.
- Topographic information as provided by GeoGratis (Natural Resources Canada) was used to simulate relief on most maps.
- Maps were equipped with a dynamic legend that referenced only feature types present within the field of view. As a result, many information features that were referenced in the creation of the natural features maps do not appear on the final products.

4.2 Map 1: Land Use (Figures 3A to 3D)

Current land uses within the Phase 2 Study area were identified and mapped. Features include administrative boundaries, a variety of public and private infrastructure, protected areas, and other environmental considerations.

Administrative areas include municipality and township boundaries as well as patent (private) land parcels, ecodistrict and trapping area boundaries.

Public and private infrastructure includes public recreational sites (e.g. camping, fishing and picnic areas), tourism establishments (e.g. outfitter lodges, marinas and commercial campgrounds), trail networks (including canoe routes), aggregate extraction areas, airports, existing and decommissioned waste management areas (e.g. dumps, landfills and associated attenuation zones), groundwater wells, boat caches and research plots.

Protected areas include provincial parks, conservation reserves and provincial nature reserves.

Other environmental constraints included natural heritage areas, significant ecological areas, enhanced management areas, provincially significant wetlands and areas of natural and scientific interest.

4.3 Map 2: Elevation and Topographic Features (Figures 4A to 4D)

Topography and land elevation information (Digital Elevation Models) was provided by GeoGratis (Natural Resources Canada). The Phase 2 Study area is mapped using colour gradients that reflect local elevations that range from 358 m above sea level to 531 m above sea level. Also included are the boundaries of watersheds and sub-watersheds.

4.4 Map 3: Geologic Terrain (Figures 5A to 5D)

Surface geology and soils information for the Ignace Area was collected from the Northern Ontario Engineering Geology Terrain Study (Ontario Ministry of Northern Development and Mines). This information included mode of deposition, local relief, material types and drainage.

4.5 Map 4: Wildlife Habitat Maps (Figures 6A to 6D)

Known wildlife habitat information was obtained for the area within and around the Phase 2 study area. Wildlife habitat mapping includes all areas known to support quality habitat for critical life stages of land and freshwater wildlife. Land-based interests included breeding areas, fawning/calving sites, nursery areas, feeding areas, staging areas, travel corridors, wintering area and sites for denning and nesting. Freshwater interests include fish spawning sites, nursery areas, staging areas, feeding areas and travel corridors.

Also included are land cover features, specifically, woodland and wetland areas. Where information exists, waterbodies are colour coded by thermal regime.

4.6 Map 5: Protected Species: Historical Records Maps (Figures 7A to 7D)

NHIC records regarding known observations of provincially tracked species (i.e. Element Occurrences) in and around the Phase 2 study area were obtained through a sensitive information request to the Natural Heritage Information Centre of the MNRF. Provincially tracked species included all species deemed ‘at-risk’ and those that are considered locally rare. Maps depicting the individual historical records are derived from ‘Medium Sensitive’ information acquired from the MNRF and required transformation prior to general circulation. Transformation included reducing the exact location of each observation to a 1 km square situated on a standardized grid. Information presented in the Protected Species: Historical Records Maps has been rendered non-sensitive for the purposes of general circulation.

4.7 Map 6: Stream Rach Classification (Figures 8A to 8D)

Stream Reach Classification was a desktop exercise that focused on applying available information collected for the natural features mapping to categorize streams throughout the Phase 2 study area according to the types of habitat they were likely to support. The Classification was based on existing information of known permanent and intermittent streams acquired from Land Information Ontario in combination Ecosite information from the MNRF and topographic information acquired from GeoGratis.

4.8 Map 7: Ecological Land Classification Ecosites (Figures 9A to 9D)

The ecological land classification system of Ontario is a standardized way of describing habitat based on the soil and plant community. For any given natural space, properties of the soil's texture and moisture content can be combined with the types of vegetation present to classify the habitat into one of over 200 possible ecosites. Each ecosite has a well-defined range of habitat possibilities and can be used to make predictions regarding the types of plants and wildlife likely to occupy the area. Ecosite information for the Ignace area was collected from the Ontario Forest Resource Inventory of the MNRF.

4.9 Map 8: Environmental Sensitivity Buffers & Field Plot Mapping (Figures 10A to 10D)

Environmental sensitivities gathered during natural features mapping were compiled for a summary of site sensitivity. Protective buffers were assigned to each feature type based on standard mitigation practices. Most buffers reflect best practices outlined by MNRF significant wildlife habitat protocols. A list of feature types and buffers applied are provided in Table 2.

5. CLOSING

Final thoughts and next steps.

The Phase 2 environment work is ongoing. This report presents a summary preliminary Phase 2 – environmental desktop and field work completed in 2016. The scope of the summary report includes the results of extensive environmental desktop studies addressing the four potentially suitable areas in the Ignace area, as well as field studies intended to calibrate and ground truth information yielded form the desktop studies.

Building on the findings of the Phase 1 Report (Golder 2013), Tulloch gathered more than 100 collections of environmental information from federal, provincial and local sources. This information was assembled into a series of early natural features maps. Tulloch biologists reviewed and cross-referenced these collections to infer more about the natural landscape and its habitat. Inferences included identifying potential rare vegetation communities and Stream Reach Classification.

In September and October 2016, Tulloch biologists ground-truthed the collected information by performing on-site studies at representative locations across fourteen field verification plots. Field observations and collected information was incorporated into a final set of natural features maps that better reflected on-site conditions. The final natural features maps are included in the summary report. The accuracy and completeness of the various types of information incorporated into the final maps are discussed.

Tulloch believes that the information incorporated into the Natural Features Mapping provides a good high-level overview of existing environmental conditions within the Phase 2 Study Area and can serve as a basis for initial evaluations of the relative sensitivity of areas selected by the NWMO for further study. Field verification has underscored the need to continue with finer-scaled and detailed environmental investigations as the site selection process continues. Specifically, the goals of detailed environmental investigations could contribute to the site selection process by: (1) confirming the local presence/absence of natural features as previously mapped, (2) confirming the potential sensitivity of the existing natural environment, (3) describing the local habitat at a finer scale, and (4) filling knowledge gaps inherent in the information including local wildlife usage (i.e. migratory birds, species at risk, freshwater communities).

Tulloch Environmental has used its best professional judgement to obtain the most up to date and accurate information, and to interpret this information to provide accurate maps of the Phase 2 study area, and associated conclusions. All maps, observations and results are representative of the state of available information and the environmental conditions as of the completion of this work in 2016. Many species are migratory and may occur within an area in some years, but not others. Habitats (e.g. wetlands and vegetation communities) also change over time as the result of natural and human influences / disturbances.

Tulloch would like to extent its gratitude to the Ignace and Wabigoon communities for their hospitality and logistical support of the course of these studies.

Best Regards,

Tulloch Engineering Inc.

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APPENDIX A

Figures & Maps

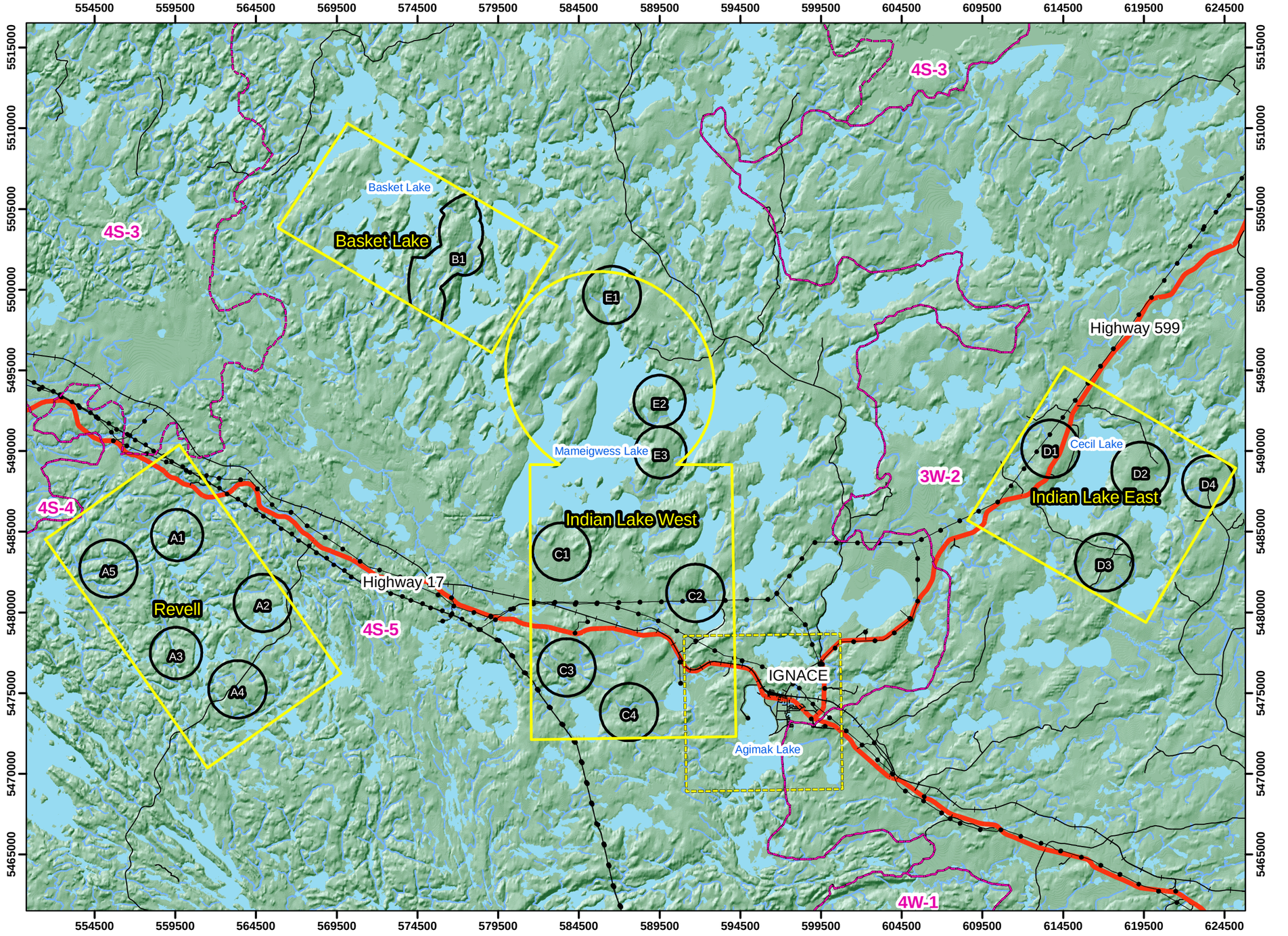
APPENDIX A – FIGURES AND MAPS

Contents

TULLOCH
ENGINEERING

NWMO Ignace APM Phase II

Potentially Suitable Areas
Ignace Regional Map



Legend

- Potentially Suitable Areas
- Field Studies Plot
- Highway
- Local Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Municipality of Ignace
- Ecodistrict

FIGURE 1
PROJECT: 165010
DATE: 24/05/2018

SCALE: 1:250,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, OHN Waterbody, OHN Watercourse. Updated January 2015 through

Data Provided by Natural Resources Canada (GeoGratis):
CDEM Hillshade (Ignace Region). Retrieved July 2016.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Potential Suitable Areas (Ignace) Field Verification Effort Map

554500 559500 564500 569500 574500 579500 584500 589500 594500 599500 604500 609500 614500 619500 624500

5510000 5505000 5500000 5495000 5490000 5485000 5480000 5475000 5470000 5465000 5460000

Basket Lake
B1
E1
E2
E3
Indian Lake West
C1
C2
C3
C4
Indian Lake East
D1
D2
D3
D4
A1
A2
A3
A4
A5
Revell

0 5 10 20 30 40 Kilometers

Legend

- Potentially Suitable Area
- Field Studies Plot
- Expressway / Highway
- Local Road; Resource / Recreation; Winter
- Rail Line
- Utility Line
- Waterbody
- Watercourse

Land-based Assessment Points

- Ecological Land Classification
- Candidate Rare Vegetation
- Moose Aquatic Feeding Area
- Forestry Data (on-site)
- Forestry Data (aerial interp.)
- Species at Risk Records
- Incidental Wildlife Observation
- Terrestrial Biologist (Tracks)
- Field Verified Areas

Freshwater Assessment Points

- Electro Fishing
- Gill Net
- Minnow Trap
- Water Quality
- Habitat Assessment
- Aquatic Biologist (Tracks)

FIGURE 2
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:250,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

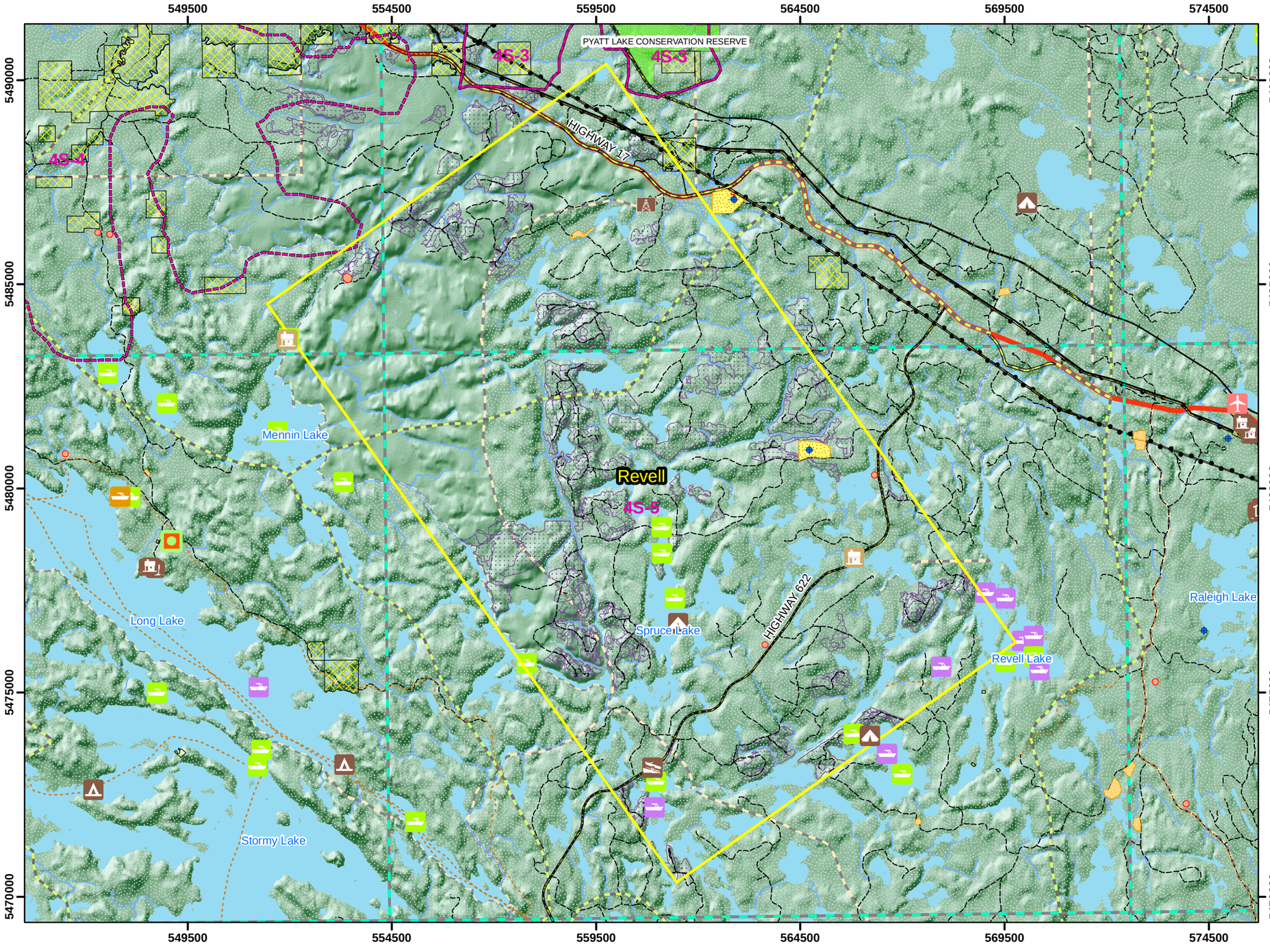
Data Provided by Tulloch Engineering:
September 2016 field verification data: Terrestrial Assessment Points, Aquatic Assessment Points, Field Verified Polygons,Terrestrial Biologist Tracks, Aquatic Biologist Tracks, Incidental Wildlife Observations.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Revell Block
Land Use Map



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Line
- Utility Line
- Trail Segment
- Watercourses
- Waterbodies
- Ecodistrict
- Trapline Licence Area - In Use
- Bait Fish Harvest Area - In Use
- Bear Management Area
- Patent Land
- Crown Land Dispositions
- Conservation Reserve
- Harvested Forest (since 2007)
- Research Plot
- Aggregate Site (non-MTO)
- Aggregate Site (MTO)

Land Use Features

- Access Point
- Boat Cache, Commercial
- Boat Cache, Private
- Boat Cache, Resource Harvest
- Designated Camping Site
- Aerodrome - Abandoned
- Dump/Landfill - Operating
- Main Base Lodge
- Outpost Camp
- Trapper Cabin
- Building
- Tower
- Groundwater Well

Figure 3A
PROJECT: 165010
DATE: 24/05/2018

SCALE: 1:100,000
Datum: NAD83
Projection: UTM Zone 15N

TULLOCH ENVIRONMENTAL

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Trail Segment, OTN Trailhead, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, Research Plot, Aggregate Site Authorized Active, MTO Aggregates, Trapline, Recreation Point, Tourism Establishment Area, Airport - Official, Airport - Other, Fishing Access Point, Petrolium Well, Waste Management Site, Waste Management Attenuation Zone, Patent Land External, Federal Protected Area, Crown Game Preserve, Provincial Park Regulated Area, Conservation Reserve, ANSI, Natural Heritage Area, Significant Ecological Area, NGO Nature Reserve, Municipal Park, Evaluated Wetlands, Bear Management Area, Crown Land Non-freehold Dispositions, Baitfish Harvest Area. Updated January 2015 through February 2017.

Data Provided by Natural Resources Canada (GeoGratis):
CDEM Hillshade (Ignace Region). CANVEC Aggregate, Building, Dam, Leisure Area, Oil & Gas Site, Pipeline, Power Line, Residential Area, Ritual Cultural Area, Tank, Tower, Transformer Station, Valve, Waste. Retrieved July 2016.

Data Provided by the Ontario Ministry of the Environment and Climate Change:
Water Well Information System well locations. Last updated June 2015.

Data Provided by Sustainable Forest License (SFL) Holders:
Silvicultural data for harvests from 2007 to 2016 obtained for the English River Forest (Resolute Forest Products), Wabigoon Forest (Domtar) and Dryden Forest (Dryden Forest Management Company)

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

NWMO Ignace APM Phase II

Basket Lake Block

Land Use Map

564500 569500 574500 579500 584500

5510000 5505000 5500000

4S-3 4S-5 4S-3

Basket Lake Basket Lake Abamategwia Lake Indian Lake West Hook Lake

Legend

- Potentially Suitable Area
- Local Road
- Other Road
- Trail Segment
- Watercourses
- Waterbodies
- Ecodistrict
- Trapline Licence Area - In Use
- Bait Fish Harvest Area - In Use
- Bear Management Area
- Patent Land
- Crown Land Dispositions
- Harvested Forest (since 2007)
- Research Plot

Land Use Features

- Boat Cache, Commercial
- Boat Cache, Resource Harvest
- Main Base Lodge
- Outpost Camp
- Trapper Cabin
- Building
- Groundwater Well

0 1.25 2.5 5 7.5 10 Kilometers

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Figure 3B

PROJECT: 165010

DATE: 24/05/2018

SCALE: 1:71,000

Datum: NAD83

Projection: UTM Zone 15N

TULLOCH ENVIRONMENTAL

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Trail Segment, OTN Trailhead, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, Research Plot, Aggregate Site Authorized Active, MTO Aggregates, Trapline, Recreation Point, Tourism Establishment Area, Airport - Official, Airport - Other, Fishing Access Point, Petrolium Well, Waste Management Site, Waste Management Attenuation Zone, Patent Land External, Federal Protected Area, Crown Game Preserve, Provincial Park Regulated Area, Conservation Reserve, ANSI, Natural Heritage Area, Significant Ecological Area, NGO Nature Reserve, Municipal Park, Evaluated Wetlands, Bear Management Area, Crown Land Non-freehold Dispositions, Baitfish Harvest Area. Updated January 2015 through February 2017.

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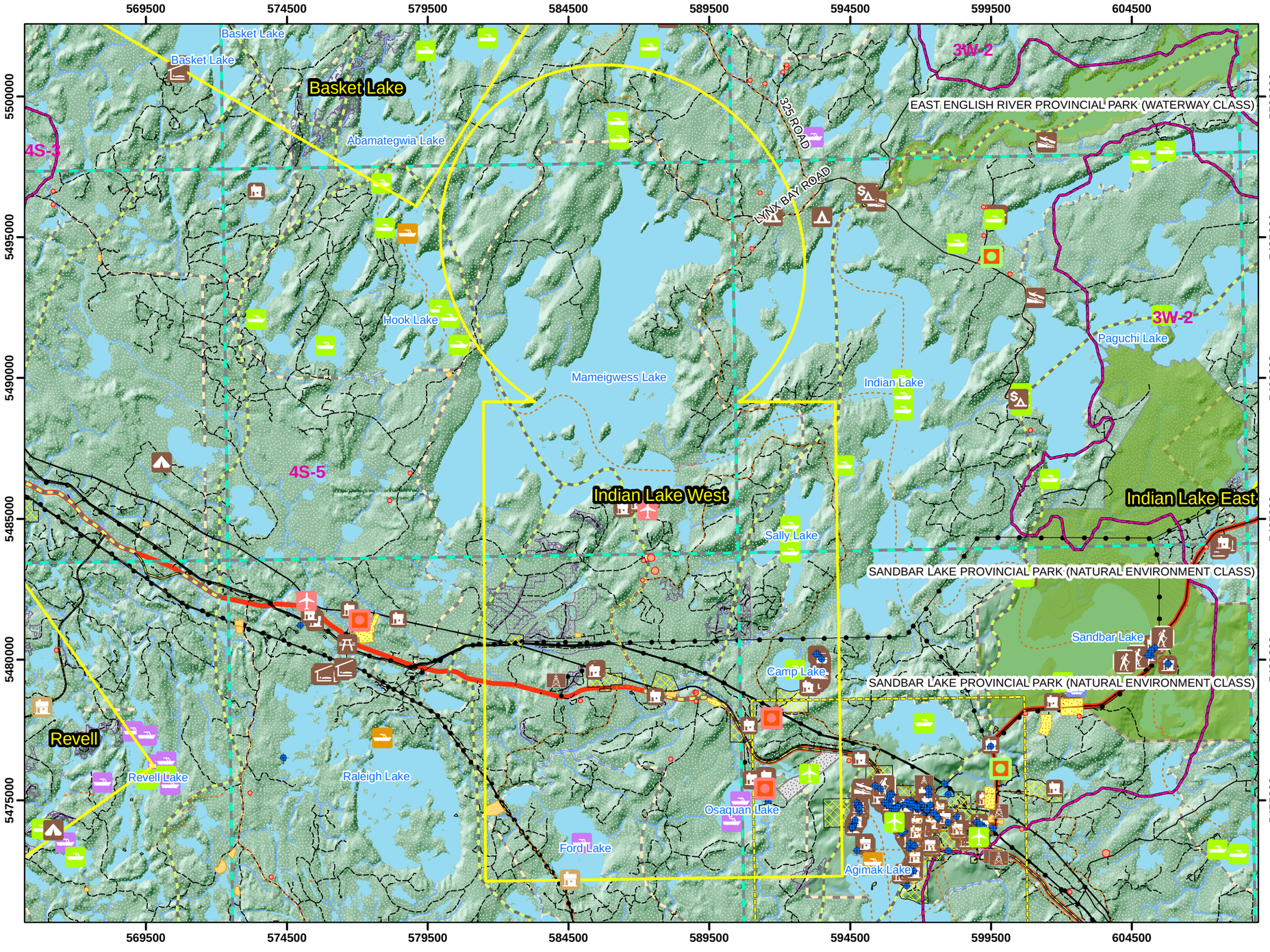
Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

NWMO Ignace APM Phase II

Indian Lake West Block

Land Use Map



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Line
- Utility Line
- Trail Segment
- Watercourses
- Waterbodies
- Municipality of Ignace
- Ecodistrict
- Trapline Licence Area - In Use
- Bait Fish Harvest Area - In Use
- Bear Management Area
- Patent Land
- Crown Land Dispositions
- Provincial Park
- Harvested Forest (since 2007)
- Research Plot
- Aggregate Site (non-MTO)
- Aggregate Site (MTO)
- Waste Management Attenuation Zone

Land Use Features

- Access Point
- Boat Cache, Commercial
- Boat Cache, Private
- Boat Cache, Resource Harvest
- Designated Camping Site
- Picnic Site
- Aerodrome - Abandoned
- Aerodrome - Active
- Commercial Campground
- Dump/Landfill - Closed
- Dump/Landfill - Operating
- Main Base Lodge
- Marina/Dock
- Outpost Camp
- Trapper Cabin
- Trailhead
- Building
- Tower
- Groundwater Well

Figure 3C

PROJECT: 165010

DATE: 24/05/2018

SCALE: 1:145,000

Datum: NAD83

Projection: UTM Zone 15N

TULLOCH ENVIRONMENTAL

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Trail Segment, OTN Trailhead, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, Research Plot, Aggregate Site Authorized Active, MTO Aggregates, Trapline, Recreation Point, Tourism Establishment Area, Airport - Official, Airport - Other, Fishing Access Point, Petrolium Well, Waste Management Site, Waste Management Attenuation Zone, Patent Land External, Federal Protected Area, Crown Game Preserve, Provincial Park Regulated Area, Conservation Reserve, ANSI, Natural Heritage Area, Significant Ecological Area, NGO Nature Reserve, Municipal Park, Evaluated Wetlands, Bear Management Area, Crown Land Non-freehold Dispositions, Baitfish Harvest Area. Updated January 2015 through February 2017.

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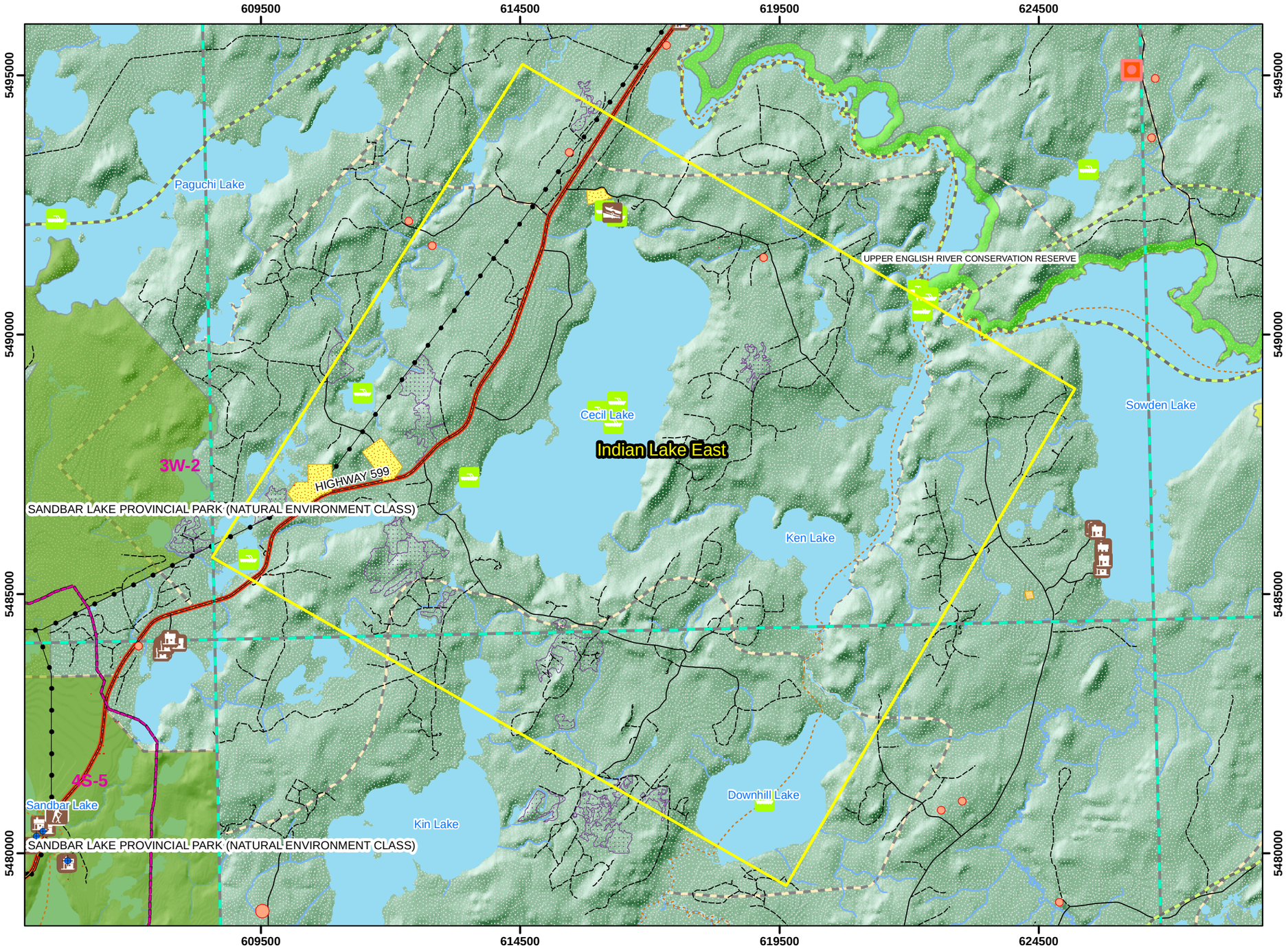
Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

NWMO Ignace APM Phase II

Indian Lake East Block

Land Use Map



0 1.5 3 6 9 12 Kilometers

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Utility Line
- Trail Segment
- Watercourses
- Waterbodies
- Ecodistrict
- Trapline Licence Area - In Use
- Bait Fish Harvest Area - In Use
- Bear Management Area
- Patent Land
- Crown Land Dispositions
- Provincial Park
- Conservation Reserve
- Significant Ecological Area
- Harvested Forest (since 2007)
- Research Plot
- Aggregate Site (non-MTO)
- Aggregate Site (MTO)

Land Use Features

- Access Point
- Boat Cache, Commercial
- Dump/Landfill - Closed
- Trailhead
- Building
- Groundwater Well

Figure 3D

PROJECT: 165010

DATE: 24/05/2018

SCALE: 1:79,000

Datum: NAD83

Projection: UTM Zone 15N

TULLOCH ENVIRONMENTAL

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Trail Segment, OTN Trailhead, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, Research Plot, Aggregate Site Authorized Active, MTO Aggregates, Trapline, Recreation Point, Tourism Establishment Area, Airport - Official, Airport - Other, Fishing Access Point, Petrolium Well, Waste Management Site, Waste Management Attenuation Zone, Patent Land External, Federal Protected Area, Crown Game Preserve, Provincial Park Regulated Area, Conservation Reserve, ANSI, Natural Heritage Area, Significant Ecological Area, NGO Nature Reserve, Municipal Park, Evaluated Wetlands, Bear Management Area, Crown Land Non-freehold Dispositions, Baitfish Harvest Area. Updated January 2015 through February 2017.

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Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

NWMO Ignace APM Phase II

Revell Block

Elevation and Topographic Features

549500 554500 559500 564500 569500 574500

5490000 5485000 5480000 5475000 5470000

HIGHWAY 17

HIGHWAY 622

Mennin Lake

Revell

Long Lake

Spruce Lake

Revell Lake

Raleigh Lake

Stormy Lake

0 2 4 8 12 16 Kilometers

Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Line
- Utility Line
- Watercourse
- Primary Watershed
- Secondary Watershed
- Tertiary Watershed
- Quartenary Watershed
- Waterbody

Digital Elevation Model (DEM)

High : 531 Metres ASL

Low : 358 Metres ASL

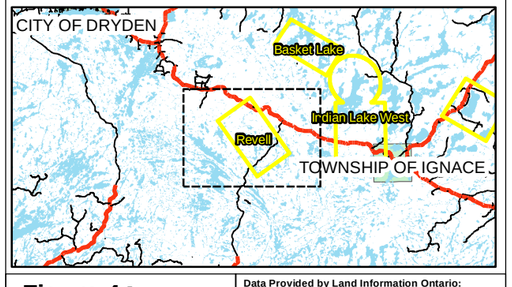


Figure 4A
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:100,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, Watershed Primarily, Watershed Secondary, Watershed Tertiary, Watershed Quarternary. Updated January 2015 through June

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Digital Elevation Model (Ignace Region). Retrieved July 2016.

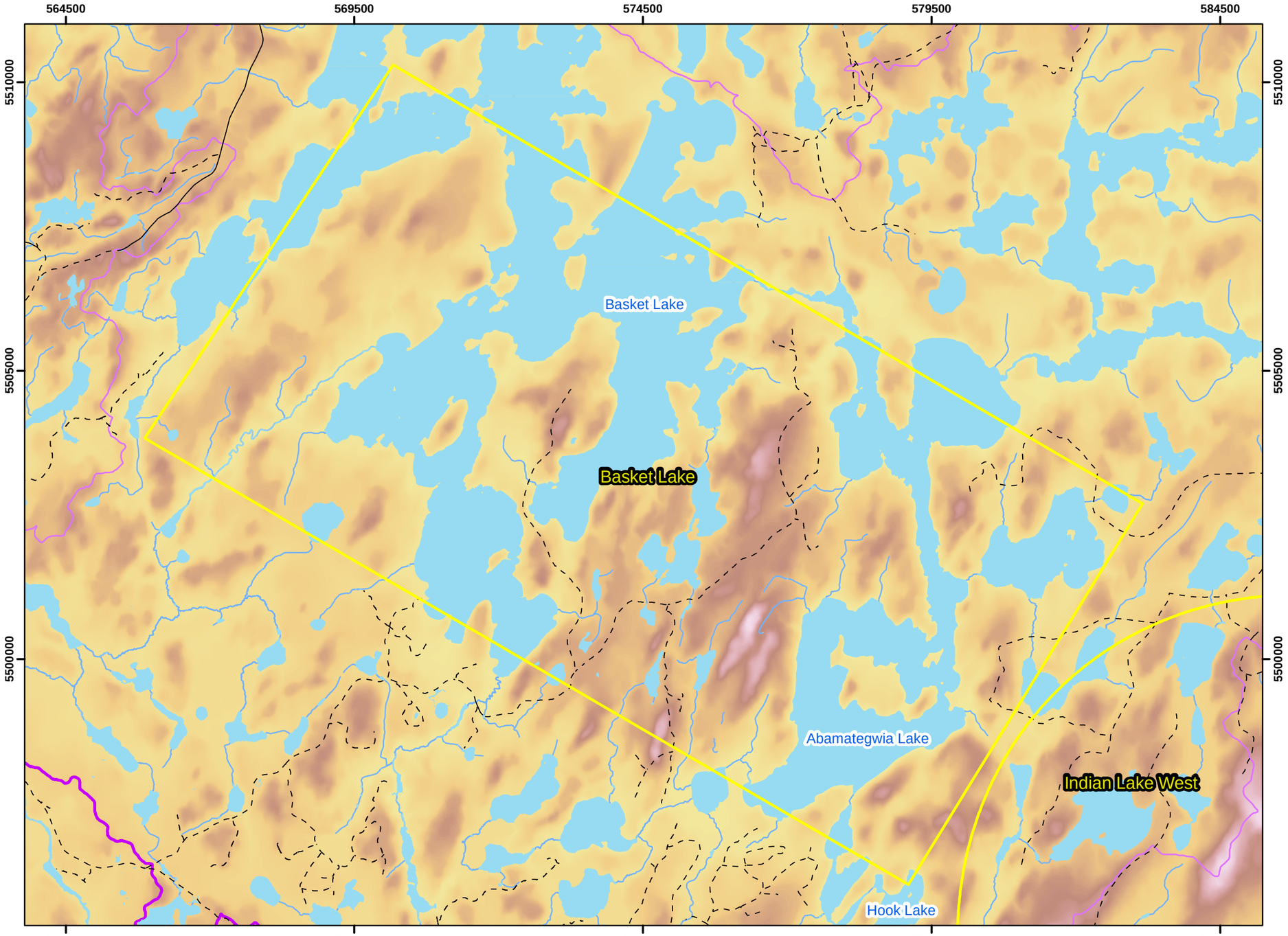
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

Elevation and Topographic Features



Legend

- Potentially Suitable Area
- Local Road
- Other Road
- Watercourse
- Primary Watershed
- Secondary Watershed
- Tertiary Watershed
- Quartenary Watershed
- Waterbody

Digital Elevation Model (DEM)

High : 531 Metres ASL

Low : 358 Metres ASL

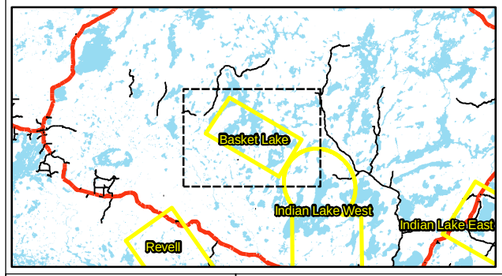


Figure 4B
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:71,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, Watershed Primarily, Watershed Secondary, Watershed Tertiary, Watershed Quarternary. Updated January 2015 through June

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Digital Elevation Model (Ignace Region). Retrieved July 2016.

0 1.25 2.5 5 7.5 10 Kilometers

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

Elevation and Topographic Features

Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Line
- Utility Line
- Watercourse
- Primary Watershed
- Secondary Watershed
- Tertiary Watershed
- Quartenary Watershed
- Waterbody

Digital Elevation Model (DEM)

High : 531 Metres ASL

Low : 358 Metres ASL

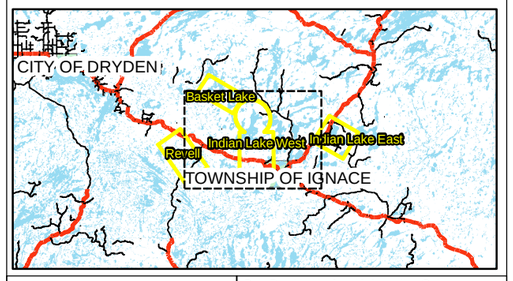


Figure 4C
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:145,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, Watershed Primarily, Watershed Secondary, Watershed Tertiary, Watershed Quarternary. Updated January 2015 through June

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Digital Elevation Model (Ignace Region). Retrieved July 2016.

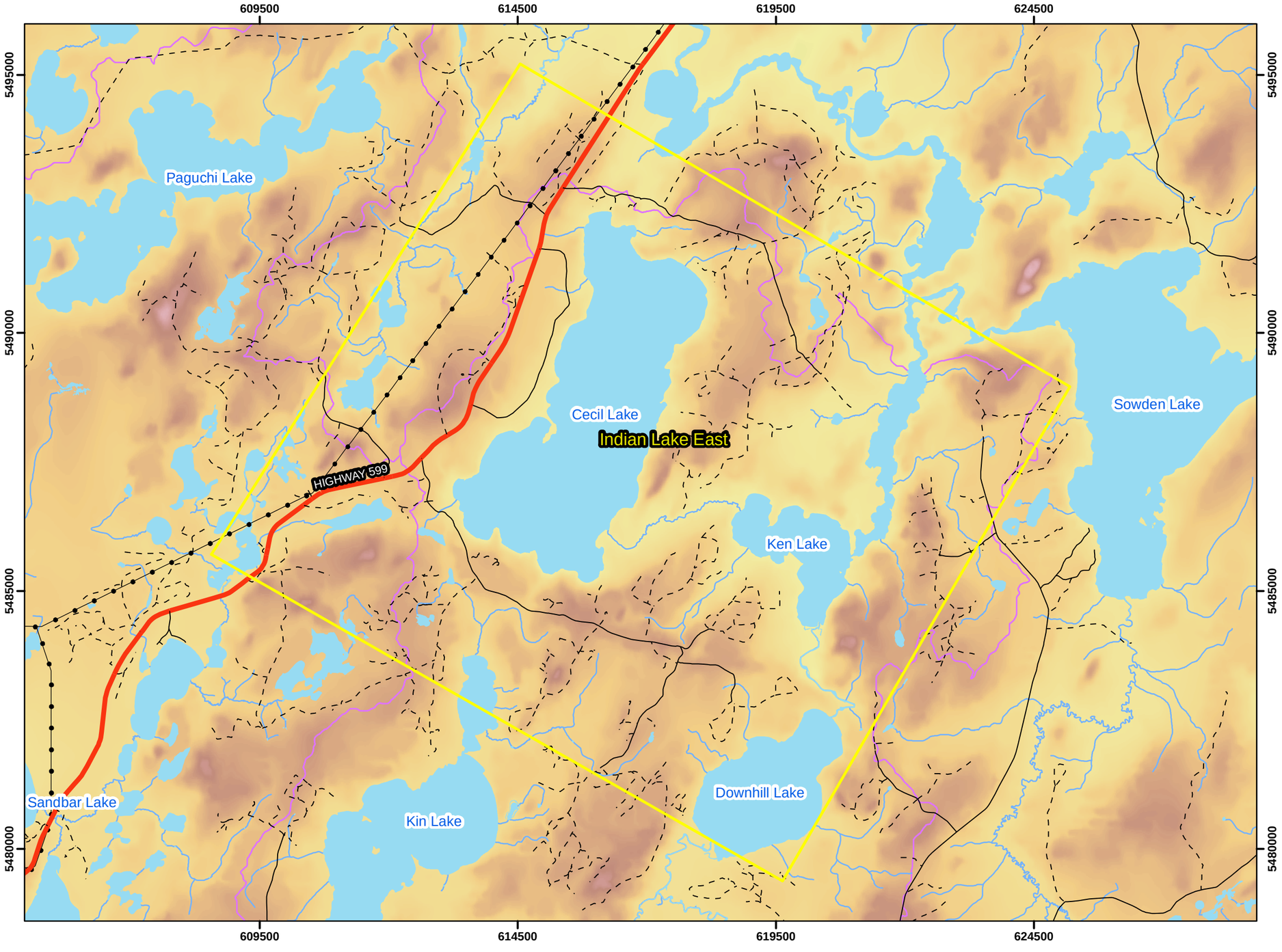
TULLOCH ENVIRONMENTAL

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

NWMO Ignace APM Phase II

Indian Lake East Block

Elevation and Topographic Features



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Utility Line
- Watercourse
- Primary Watershed
- Secondary Watershed
- Tertiary Watershed
- Quartenary Watershed
- Waterbody

Digital Elevation Model (DEM)

High : 531 Metres ASL

Low : 358 Metres ASL

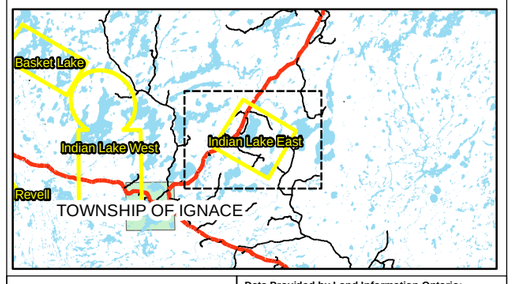


Figure 4D

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:79,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, Watershed Primarily, Watershed Secondary, Watershed Tertiary, Watershed Quarternary. Updated January 2015 through June

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Digital Elevation Model (Ignace Region). Retrieved July 2016.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Revell Block
Geologic Terrain

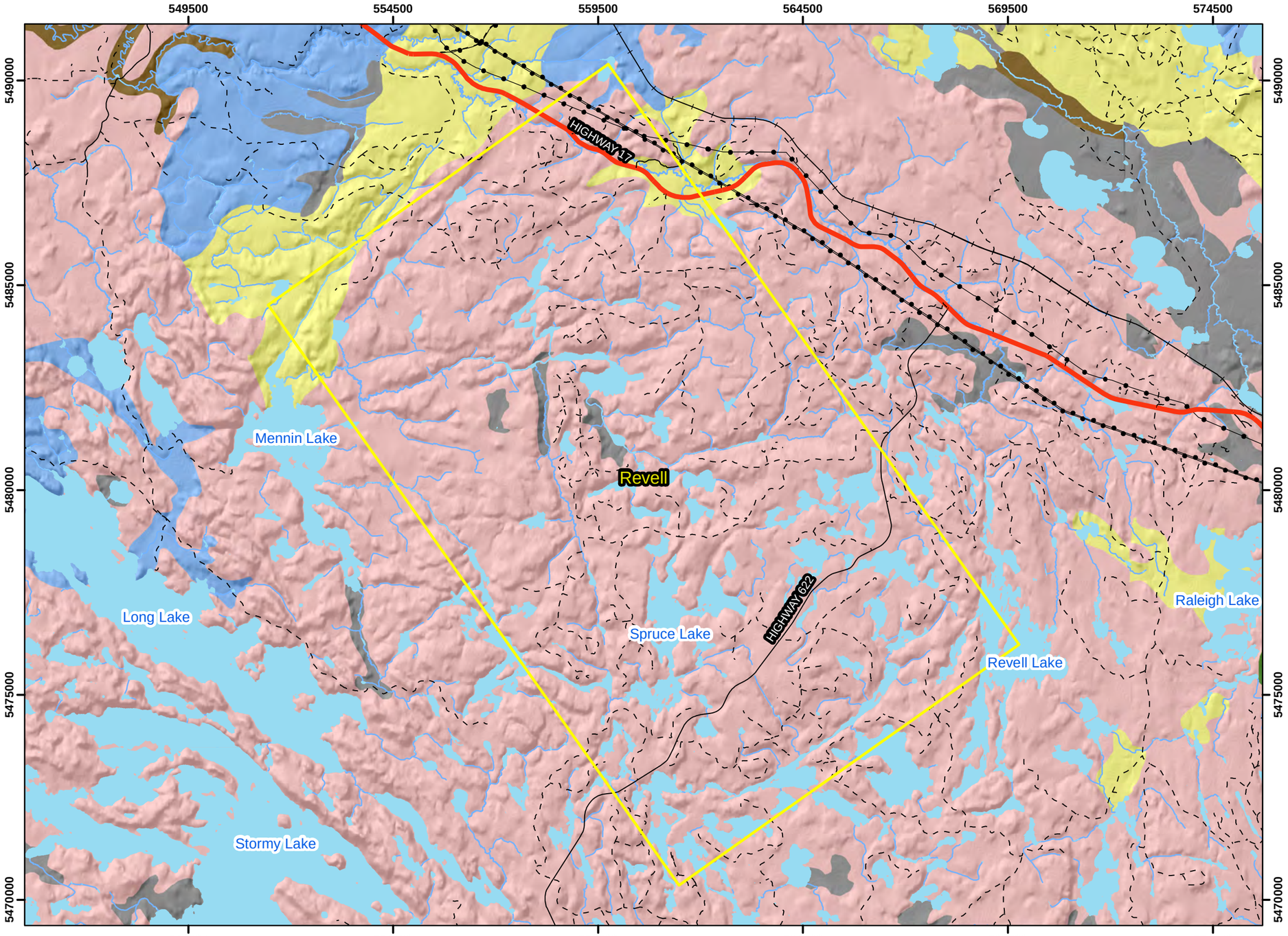
Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody

Geologic Terrain (NOEGTS)

LANDFORM

- Morainal
- Eskers, Kames, Outwash Plains
- Glaciolacustrine
- Alluvial
- Organics
- Bedrock Dominated



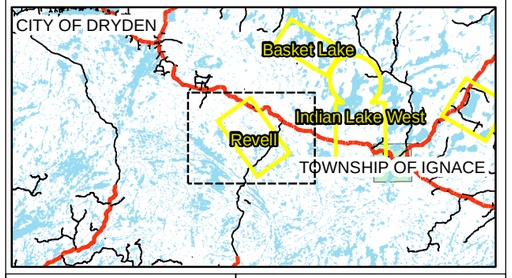


Figure 5A
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:100,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track. Updated January 2015 through June 2016.

Data Provided by the Ministry of Northern Development and Mines:
NOEGTS Geology Terrain. Updated May 2014.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Project Located At: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\3-1-1 Natural Features Maps
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block
Geologic Terrain

564500 569500 574500 579500 584500

5510000 5505000 5500000

Basket Lake

Basket Lake

Abamategwia Lake

Indian Lake West

Hook Lake

Legend

- Potentially Suitable Area
- Local Road
- Other Road
- Watercourse
- Waterbody

Geologic Terrain (NOEGTS)

LANDFORM

- Morainal
- Eskers, Kames, Outwash Plains
- Glaciolacustrine
- Alluvial
- Organics
- Bedrock Dominated

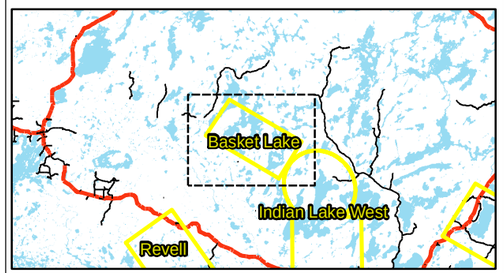


Figure 5B
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:71,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
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Data Provided by the Ministry of Northern Development and Mines:
NOEGTS Geology Terrain. Updated May 2014.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

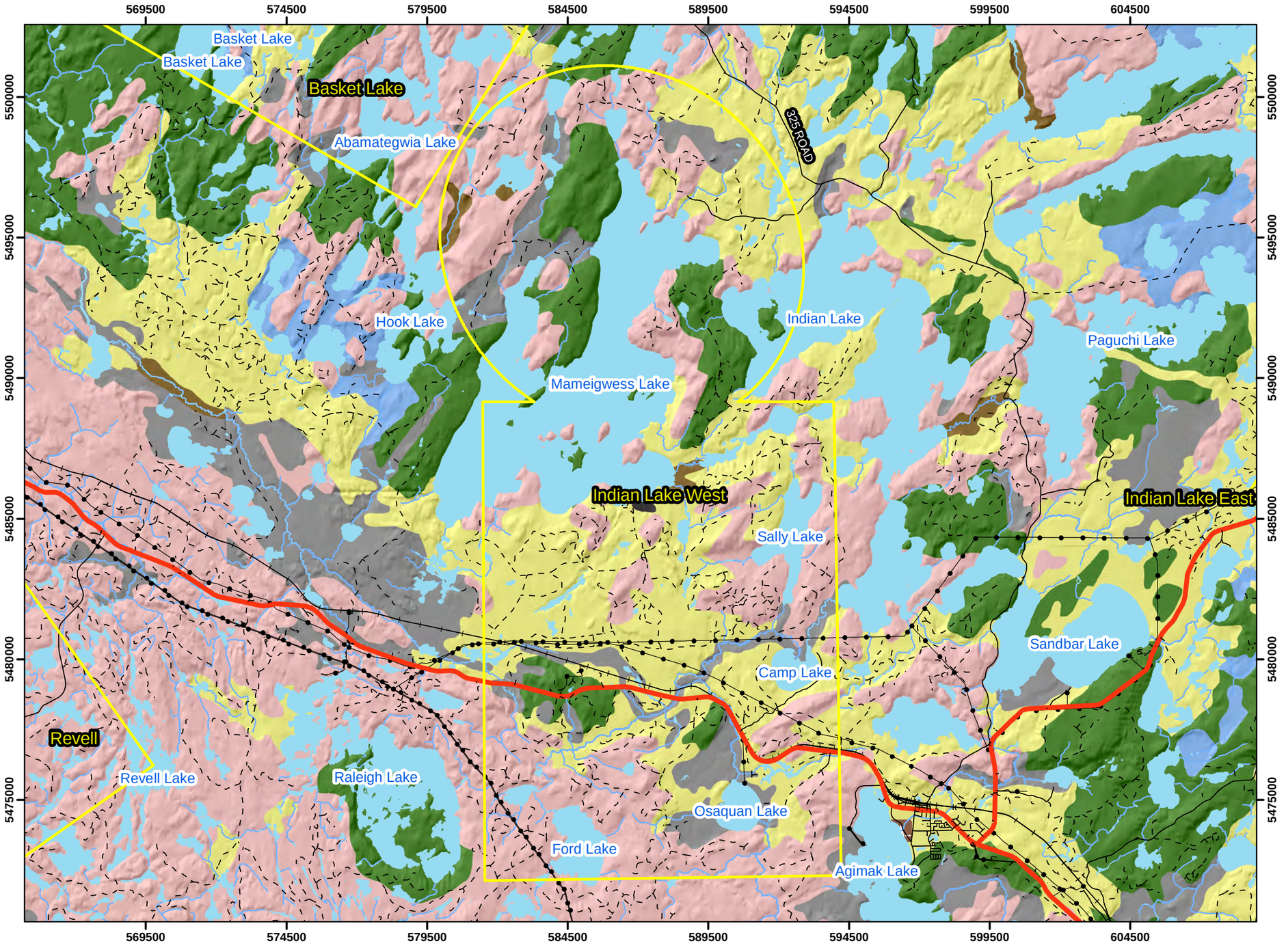
0 1.25 2.5 5 7.5 10 Kilometers

Project Located At: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\3-1-1 Natural Features Maps
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block
Geologic Terrain



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Constructed Dam
- Rail Line
- Utility Line
- Watercourse
- Waterbody

Geologic Terrain (NOEGTS)

LANDFORM

- Anthropogenic
- Morainal
- Eskers, Kames, Outwash Plains
- Glaciolacustrine
- Alluvial
- Sand Dunes
- Organics
- Bedrock Dominated

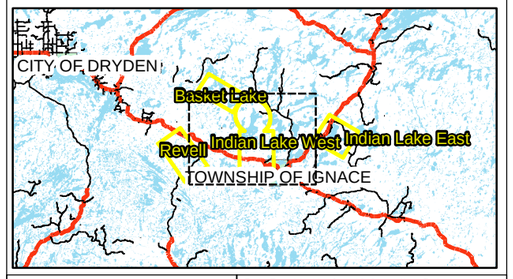


Figure 5C
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:145,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track. Updated January 2015 through June 2016.

Data Provided by the Ministry of Northern Development and Mines:
NOEGTS Geology Terrain. Updated May 2014.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Project Located At: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\3-1-1 Natural Features Maps
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake East Block
Geologic Terrain

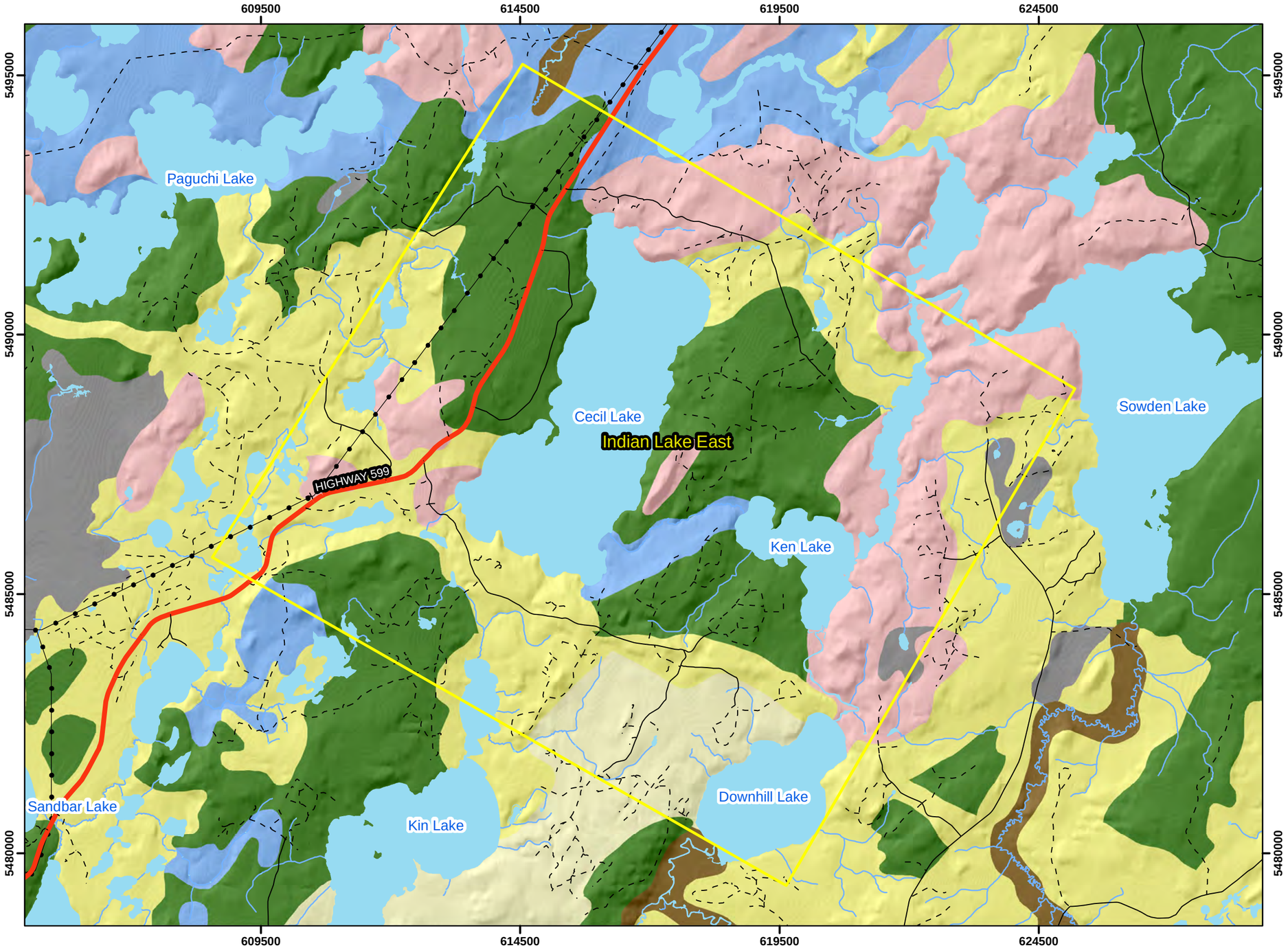
Legend

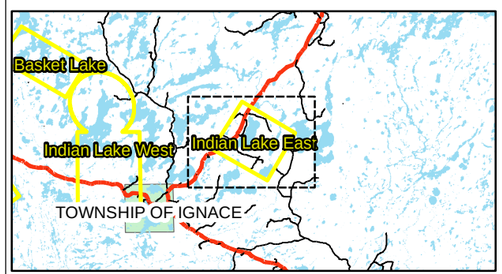
- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Utility Line
- Watercourse
- Waterbody

Geologic Terrain (NOEGTS)

LANDFORM

- Morainal
- Eskers, Kames, Outwash Plains
- Glaciolacustrine
- Alluvial
- Sand Dunes
- Organics
- Bedrock Dominated





0 1.5 3 6 9 12 Kilometers

Figure 5D
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:79,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track. Updated January 2015 through June 2016.

Data Provided by the Ministry of Northern Development and Mines:
NOEGTS Geology Terrain. Updated May 2014.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

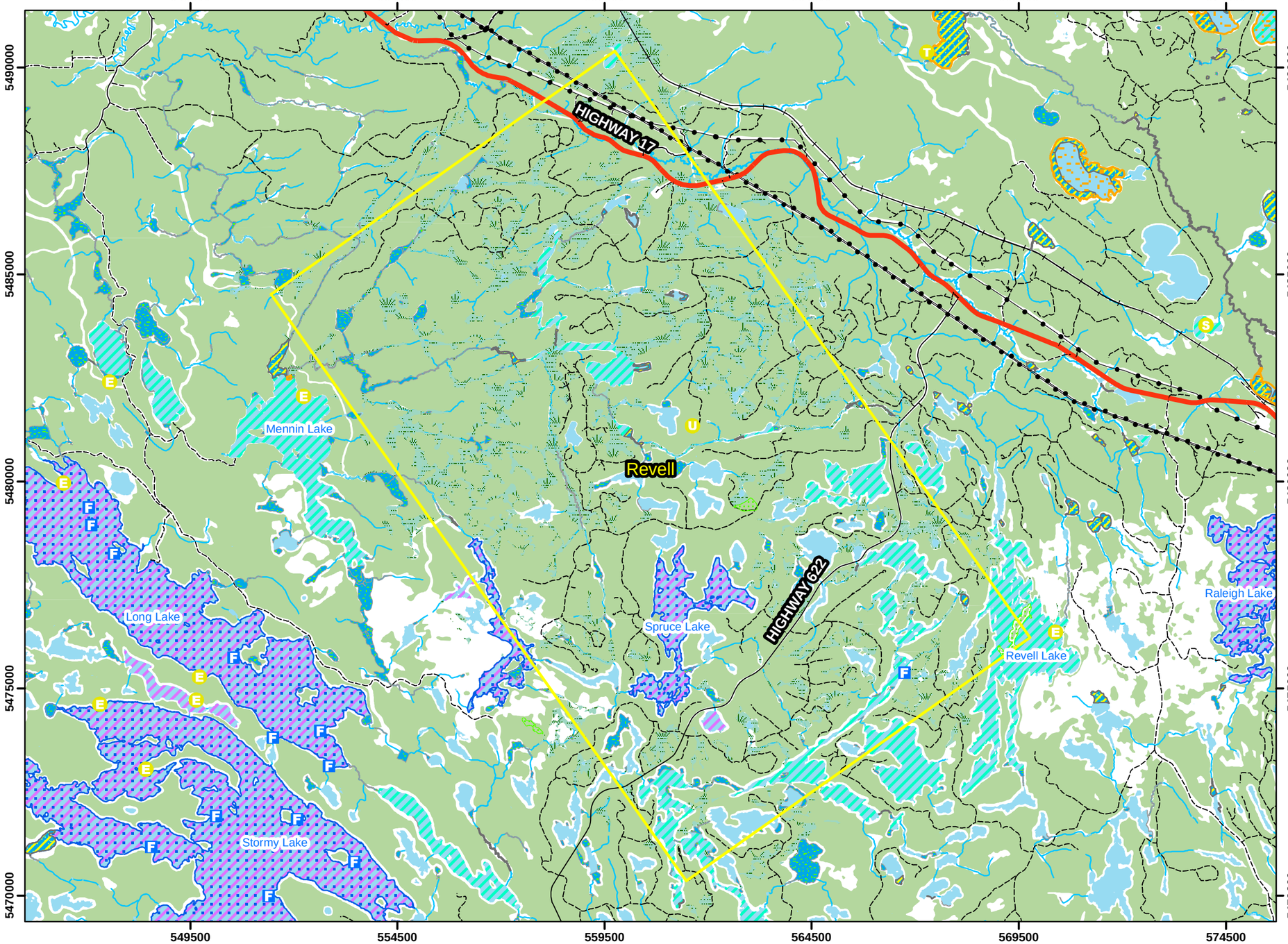
Project Located At: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\3-1-1 Natural Features Maps
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Revell Block

Wildlife Habitat



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)
- Lake Trout Lake
- Wild Rice
- ELC Wetland
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- E — Eagle Nesting Site
- S — Trumpeter Swan Nesting Site
- T — Tundra Swan Nesting Site
- U — Unidentified Hawk/Owl Nest
- F — Fish Spawning Habitat

Rare Vegetation Candidates

- Rare Primary Ecosite

Kilometers

0 2 4 8 12 16

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Figure 6A

PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:100,000
Datum: NAD83
Projection: UTM Zone 15N

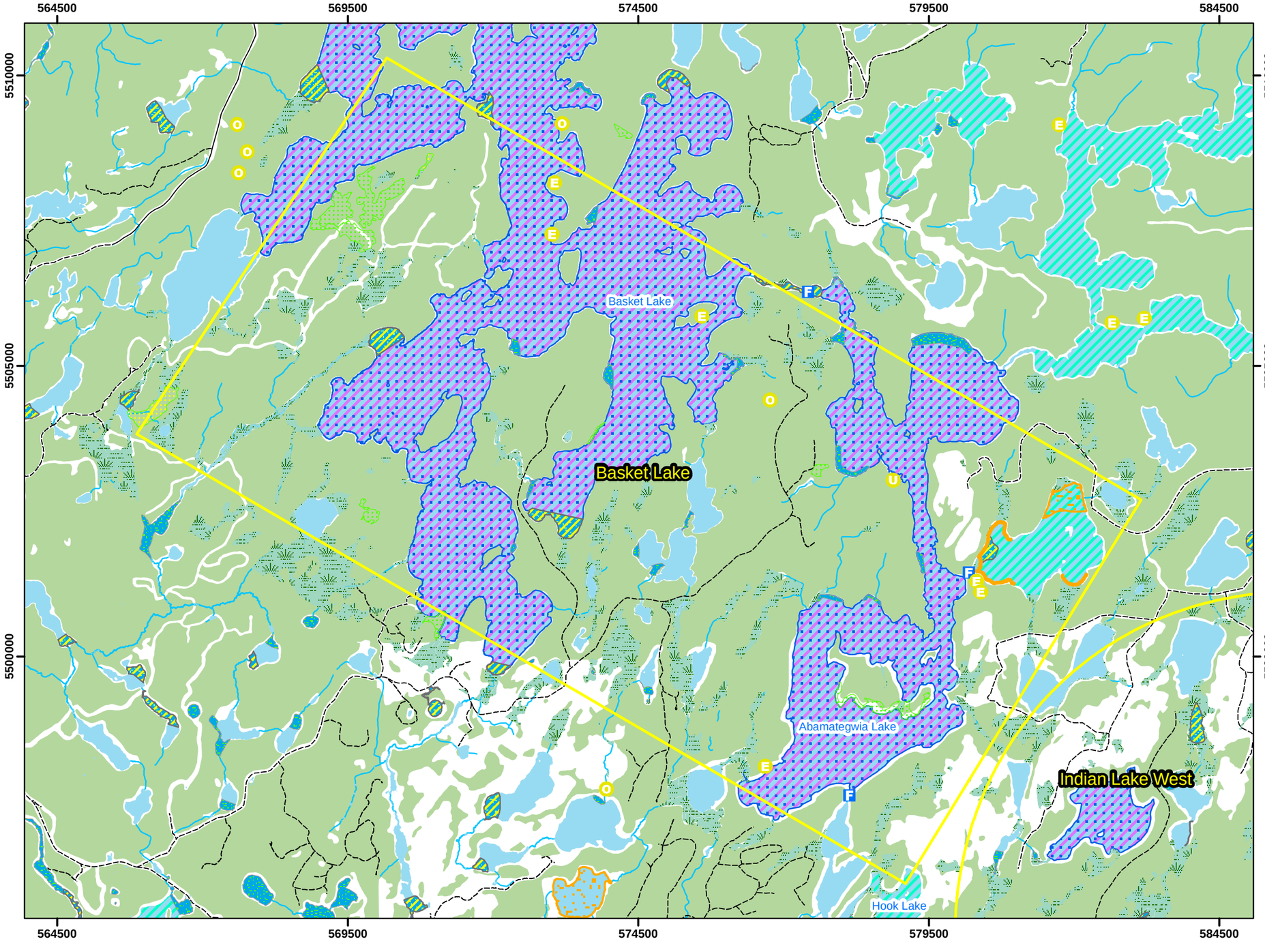
Data Provided by Land Information Ontario:
MNR Road Segment, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7.5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish, Lake Trout Lakes, Wild Rice.
Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.
Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

Wildlife Habitat



Legend

- Potentially Suitable Area
- Local Road
- Resource / Recreation Road
- Watercourse
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)
- Lake Trout Lake
- Wild Rice
- ELC Wetland
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- E — Eagle Nesting Site
- O — Osprey Nesting Site
- U — Unidentified Hawk/Owl Nest
- F — Fish Spawning Habitat

Rare Vegetation Candidates

- Rare Primary Ecosite
- Rare Secondary Ecosite

Figure 6B

PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:70,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segment, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland
(Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish, Lake Trout Lakes, Wild Rice.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

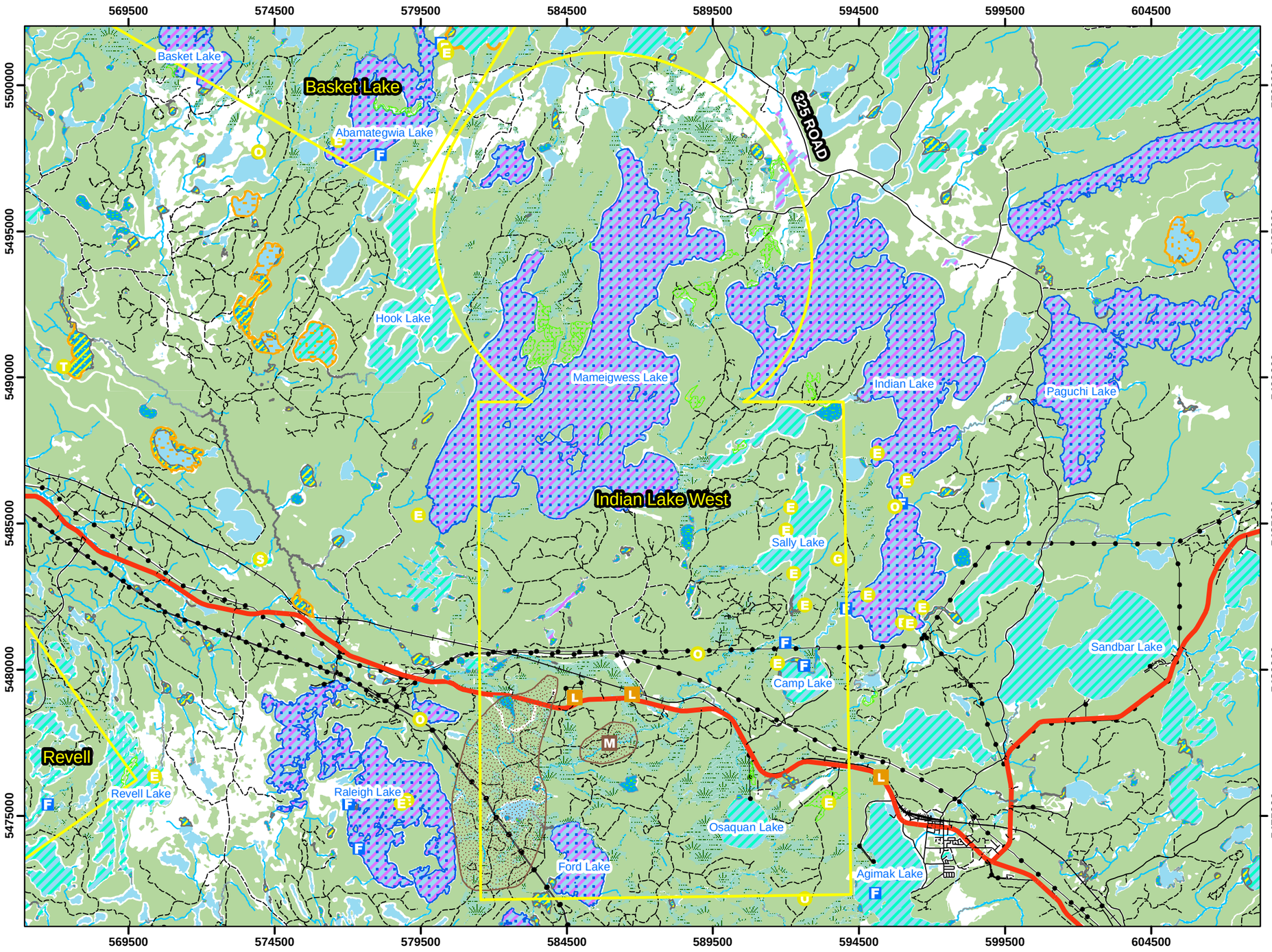
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

Wildlife Habitat



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)
- Lake Trout Lake
- Wild Rice
- ELC Wetland
- Upland Moose Habitat
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- M — Moose Late Wintering Area
- L — Mineral Lick
- E — Eagle Nesting Site
- G — Great Blue Heron Nesting Site
- O — Osprey Nesting Site
- S — Trumpeter Swan Nesting Site
- T — Tundra Swan Nesting Site
- U — Unidentified Hawk/Owl Nest
- F — Fish Spawning Habitat

Rare Vegetation Candidates

- Rare Primary Ecosite
- Rare Secondary Ecosite

Figure 6C

PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:140,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segment, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish, Lake Trout Lakes, Wild Rice.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

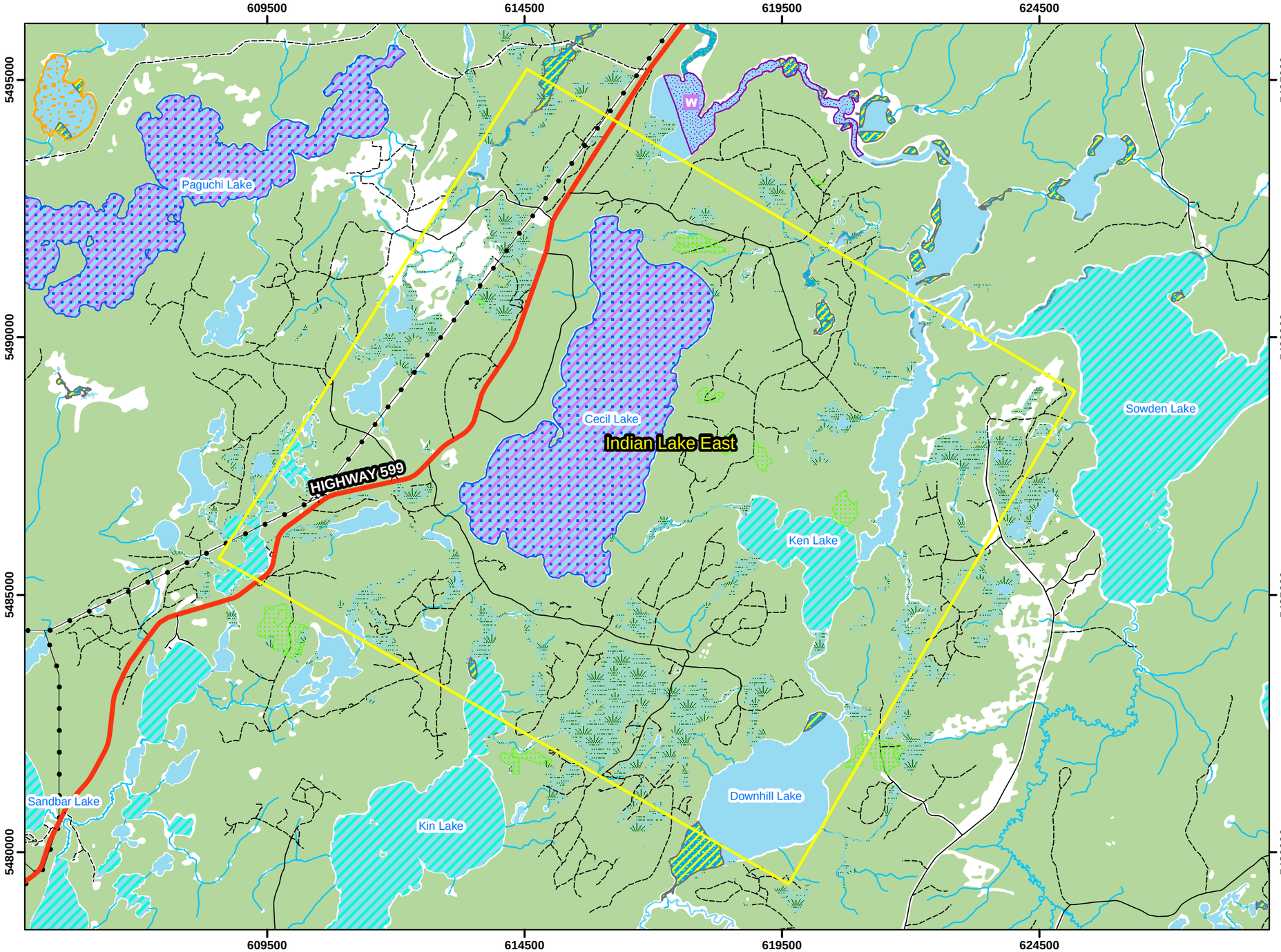
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake East Block

Wildlife Habitat



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Utility Line
- Watercourse
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)
- Lake Trout Lake
- Wild Rice
- ELC Wetland
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- Lowland Waterfowl Habitat
- W Waterfowl Staging Area

Rare Vegetation Candidates

- Rare Primary Ecosite

0 1.5 3 6 9 12 Kilometers

Figure 6D

PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:80,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segment, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7.5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish, Lake Trout Lakes, Wild Rice.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

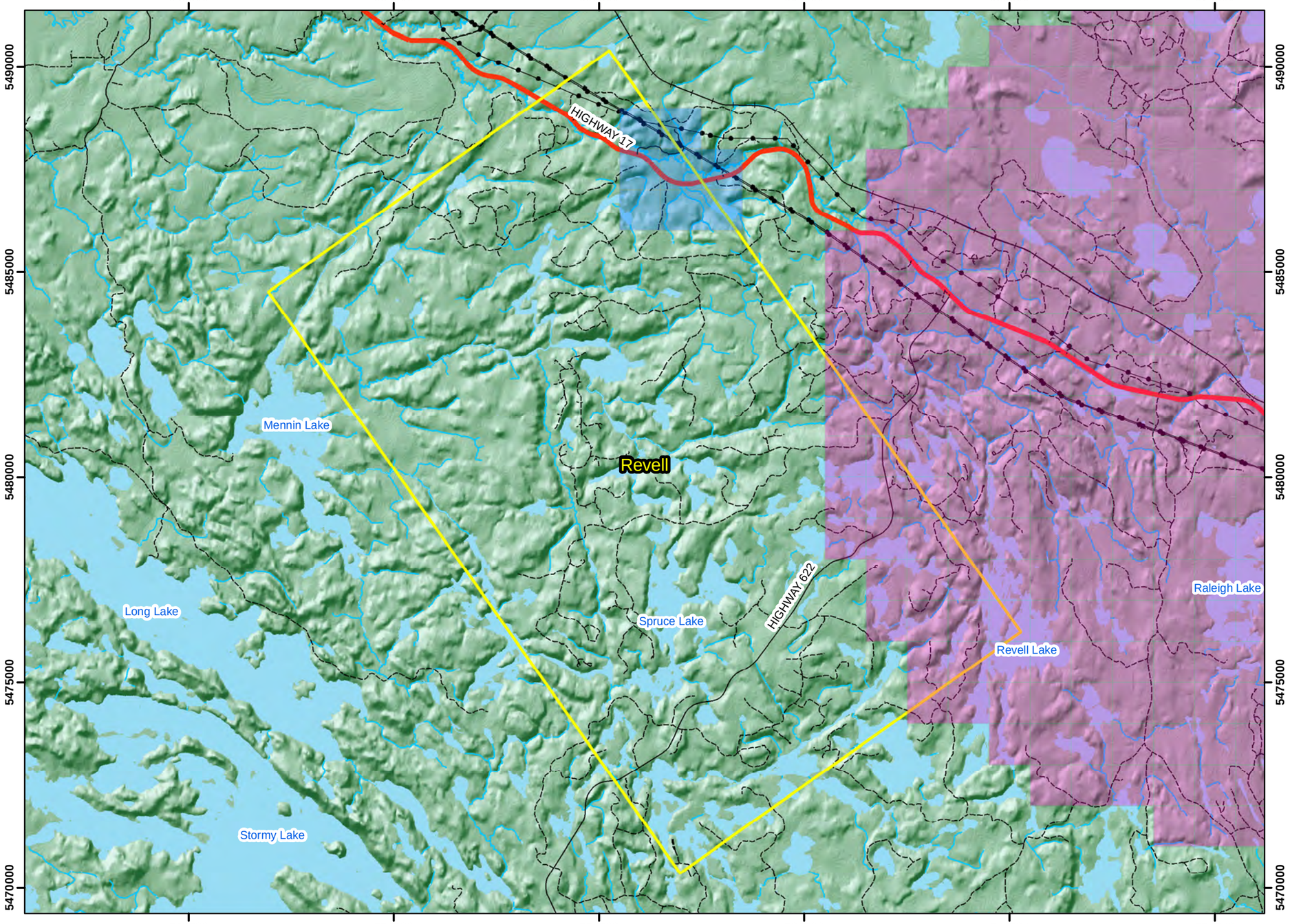
NWMO Ignace APM Phase II

Revell Block

Protected Species Records

Legend

- Potentially Suitable Area
- Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Vasey's Rush (RA)
- Macoun's Arctic Butterfly (RA)



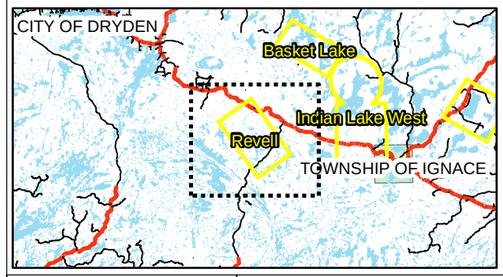


Figure 7A

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:100,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN

Data Provided by the Natural Heritage Information Centre:
Observational and element occurrence records for provincially tracked species. Data generalized to 1km grid.

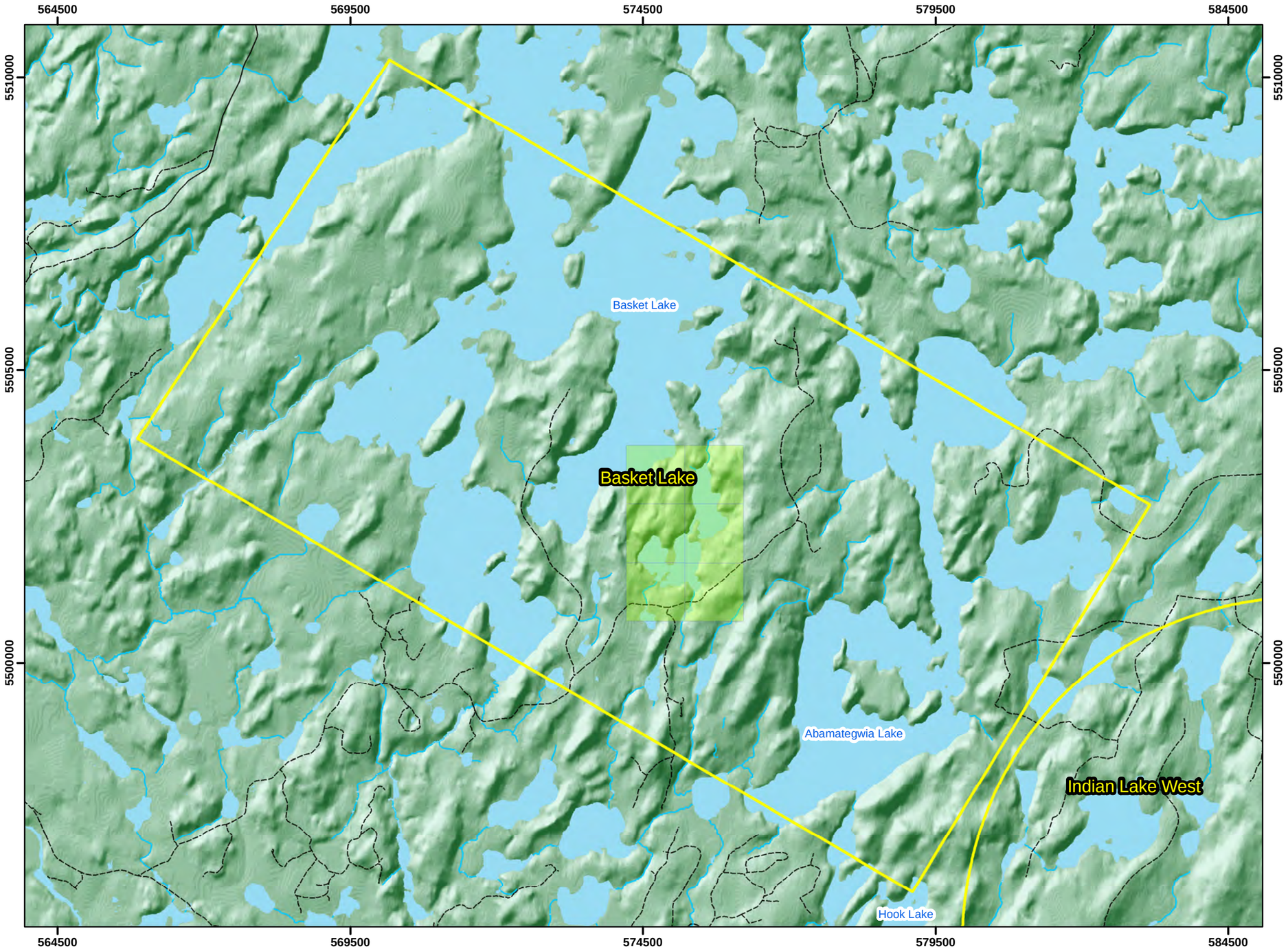
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

Protected Species Records



Legend

- Potentially Suitable Area
- Local Road
- Resource / Recreation Road
- Watercourse
- Waterbody
- Snapping Turtle (SPC)

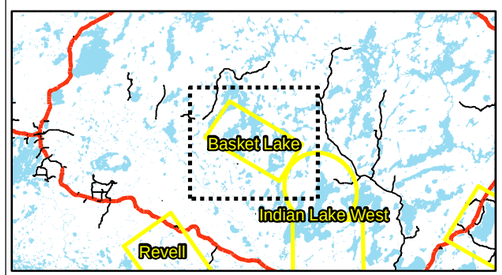


Figure 7B

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:70,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN

Data Provided by the Natural Heritage Information Centre:
Observational and element occurrence records for provincially tracked species. Data generalized to 1km grid.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

Protected Species Records

Legend

- Potentially Suitable Area
- Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Bald Eagle (SPC)
- Common Nighthawk (SPC)
- Eastern Whip-poor-will (THR)
- Snapping Turtle (SPC)
- Brook Cinquefoil (RA)
- Macoun's Arctic Butterfly (RA)

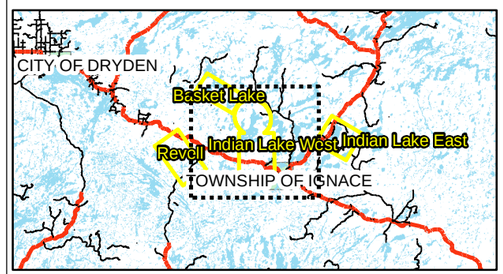


Figure 7C
PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:140,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN

Data Provided by the Natural Heritage Information Centre:
Observational and element occurrence records for provincially tracked species. Data generalized to 1km grid.

TULLOCH ENVIRONMENTAL

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Kilometers
0 2.75 5.5 11 16.5 22

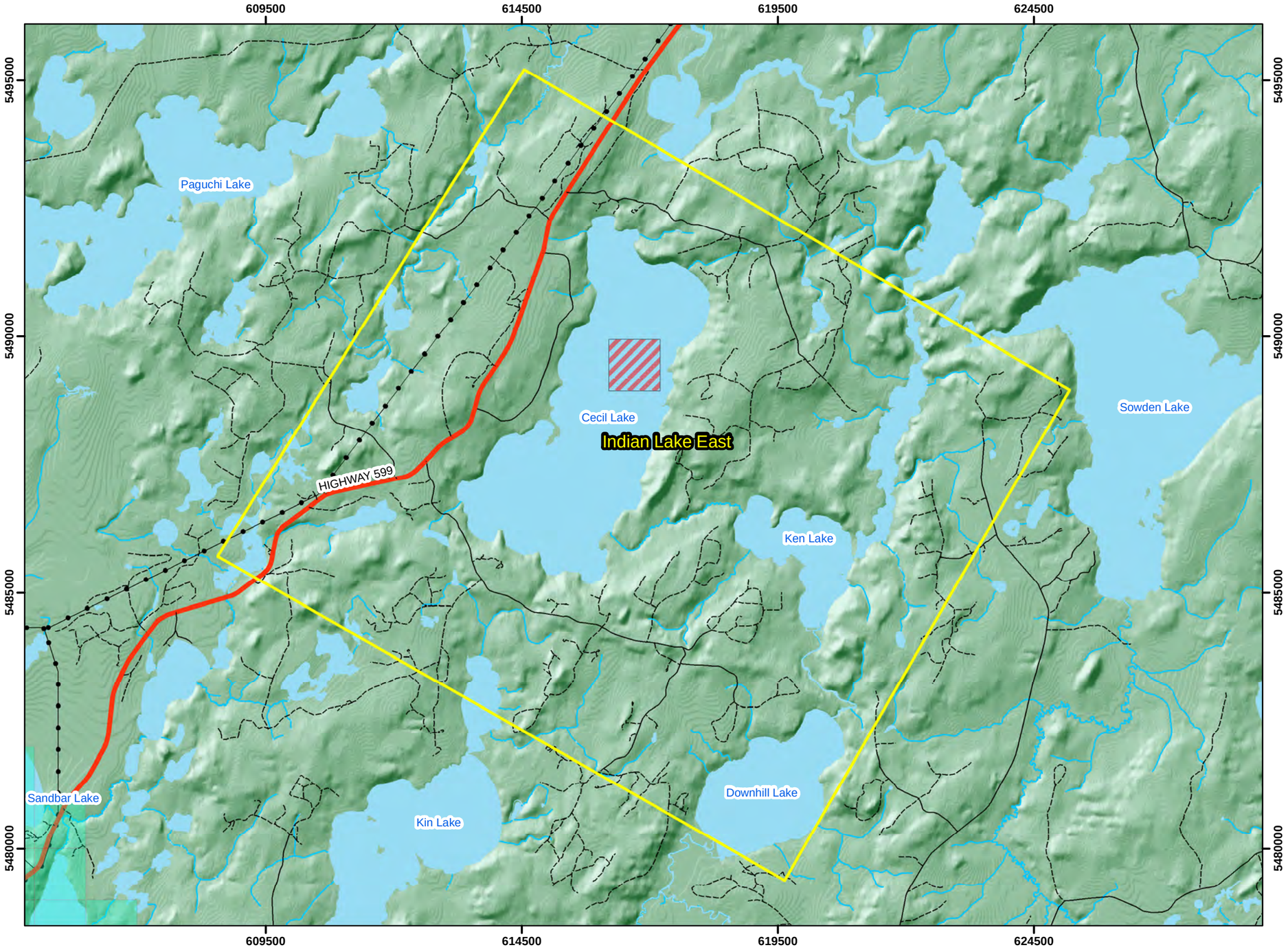
NWMO Ignace APM Phase II

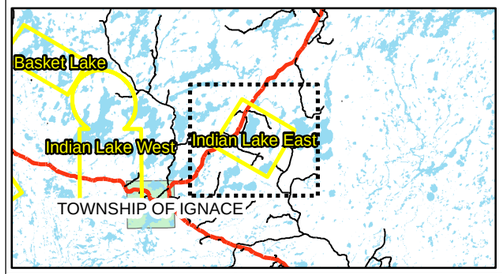
Indian Lake East Block

Protected Species Records

Legend

- Potentially Suitable Area
- Highway
- Local Road
- Resource / Recreation Road
- Utility Line
- Watercourse
- Waterbody
- Bald Eagle (SPC)
- Brook Cinquefoil (RA)





0 1.5 3 6 9 12 Kilometers

Figure 7D

PROJECT: 165010
DATE: 16/02/2018

SCALE: 1:80,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN

Data Provided by the Natural Heritage Information Centre:
Observational and element occurrence records for provincially tracked species. Data generalized to 1km grid.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Revell Block

Stream Reach Classification

549500 554500 559500 564500 569500 574500

5490000 5485000 5480000 5475000 5470000

HIGHWAY 17

HIGHWAY 622

Mennin Lake

Revell

Long Lake

Spruce Lake

Raleigh Lake

Revell Lake

Stormy Lake

0 2 4 8 12 16 Kilometers

Legend

- Potentially Suitable Area
- Highway
- Local Road
- Rail Line
- Utility Line
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)

Stream Reach Class

- H1
- H2
- O
- U
- Wf
- Wm
- Ws

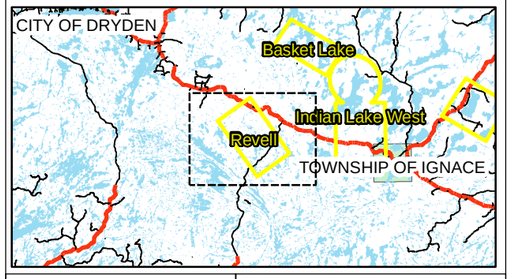


Figure 8A

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:100,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, OIH Watercourse, Watershed. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Hillshadel (Ignace Region). Retrieved July 2016.

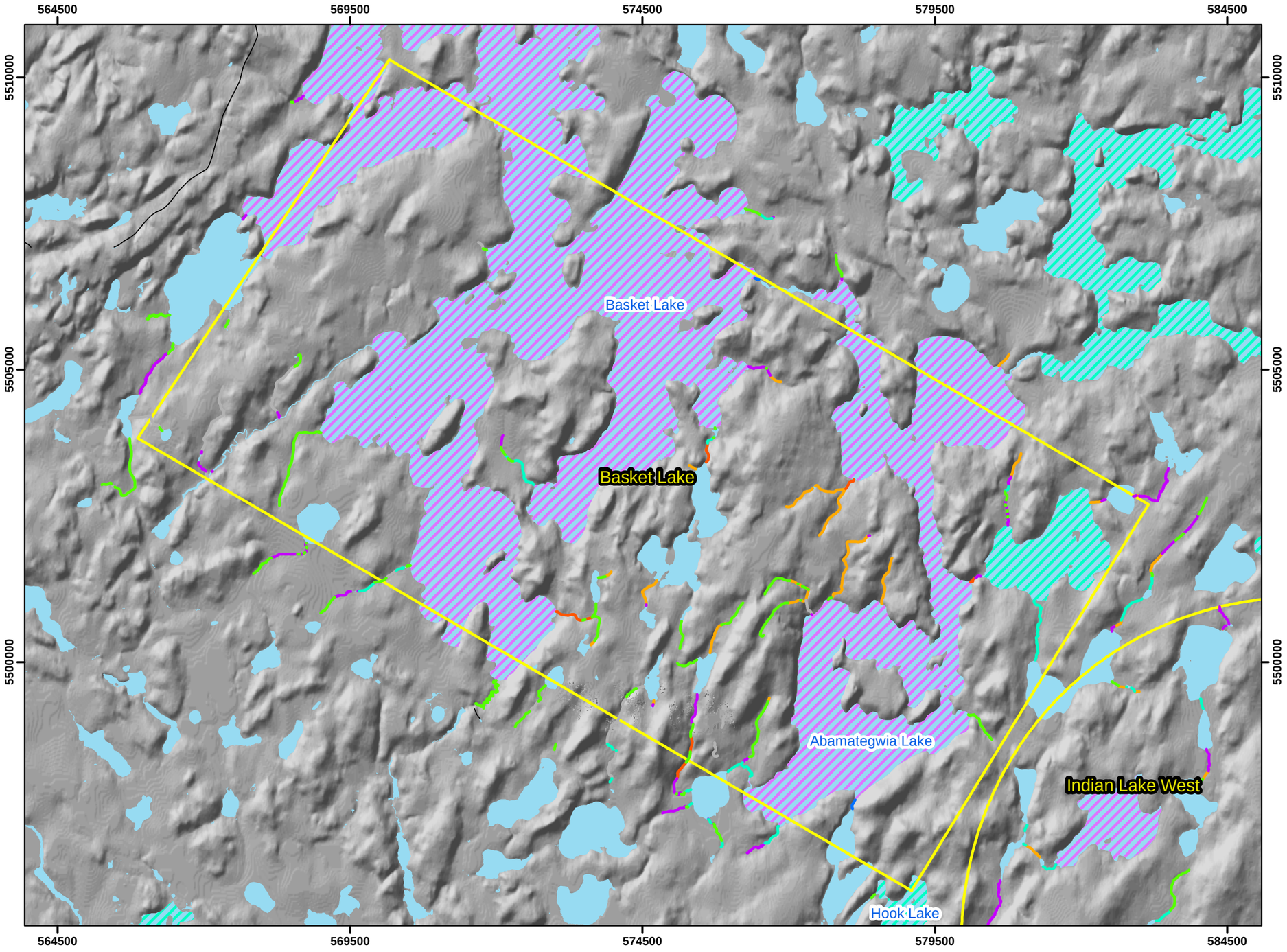
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W: and on Tulloch Sudbury Server pathed as J:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

Stream Reach Classification



Legend

- Potentially Suitable Area
- Local Road
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)

Stream Reach Class

- H1
- H2
- O
- U
- Wf
- Wm
- Ws

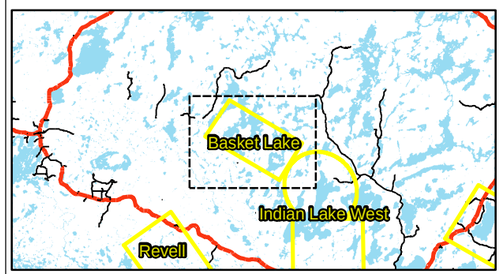


Figure 8B

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:70,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, OIH Watercourse, Watershed. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Hillshadel (Ignace Region). Retrieved July 2016.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W: and on Tulloch Sudbury Server pathed as J:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

Stream Reach Classification

564500 569500 574500 579500 584500 589500 594500 599500 604500 609500

5500000 5495000 5490000 5485000 5480000 5475000

Basket Lake
Basket Lake
Basket Lake
Abamategwia Lake
325 ROAD
Hook Lake
Indian Lake
Paguchi Lake
Mameigwess Lake
Indian Lake West
Indian Lake East
Sally Lake
Sandbar Lake
Camp Lake
Revell
Revell Lake
Raleigh Lake
Willow Narrows Lake
Osaquan Lake
Ford Lake
Agimak Lake

0 3 6 12 18 24 Kilometers

Legend

- Potentially Suitable Area
- Highway
- Local Road
- Rail Line
- Utility Line
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)

Stream Reach Class

- H1
- H2
- O
- U
- Wb
- Wf
- Wm
- Ws

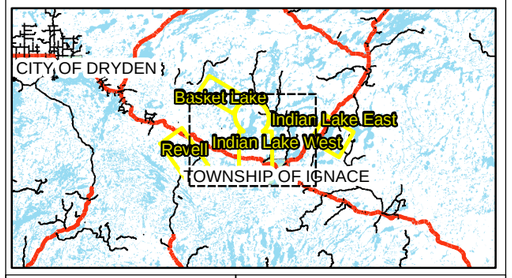


Figure 8C

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:150,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, OIH Watercourse, Watershed. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Hillshadel (Ignace Region). Retrieved July 2016.

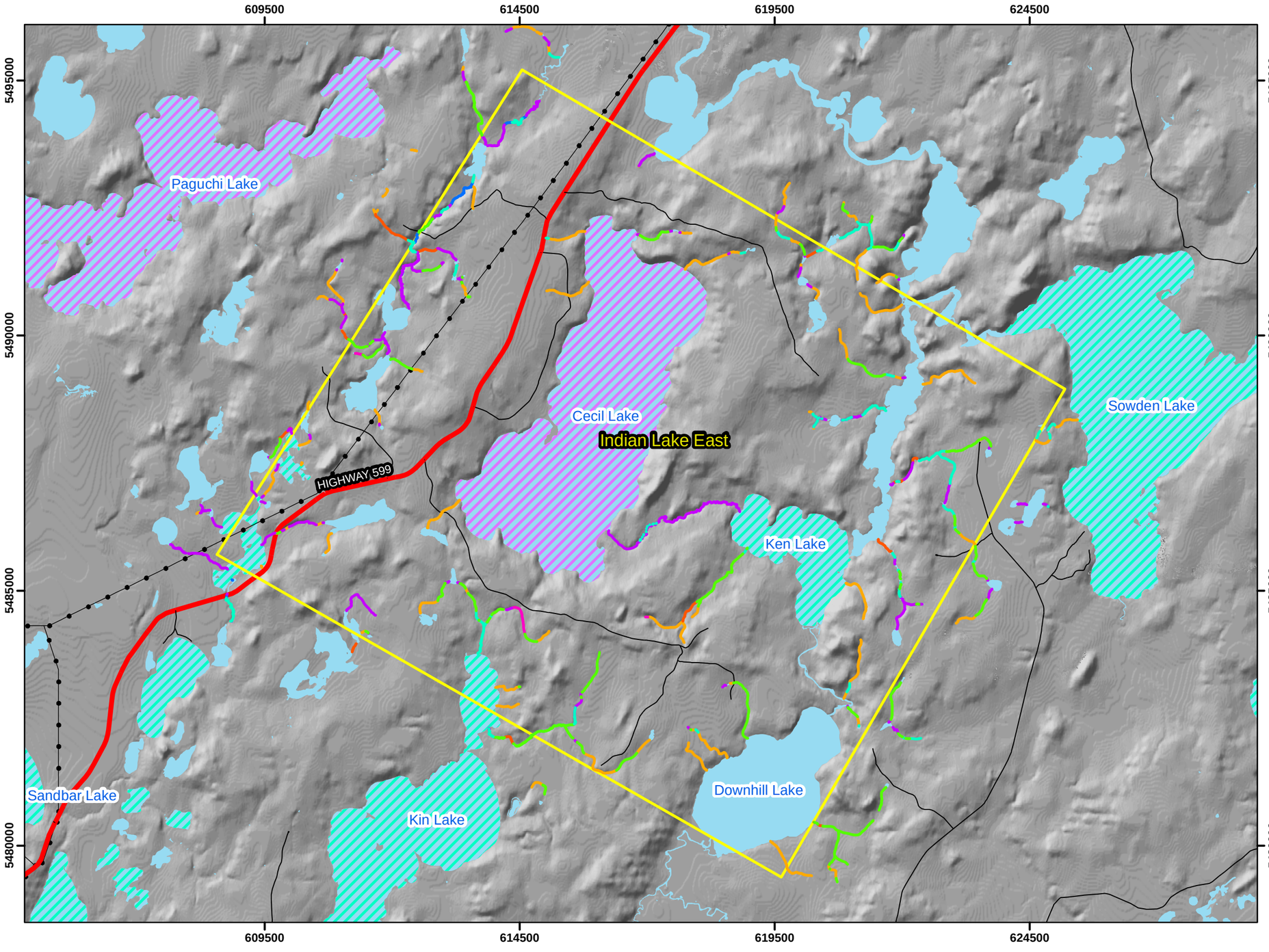
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W: and on Tulloch Sudbury Server pathed as J:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake East Block

Stream Reach Classification



Legend

- Potentially Suitable Area
- Highway
- Local Road
- Utility Line
- Waterbody (Unknown Regime)
- Waterbody (Cold Regime)
- Waterbody (Cool Regime)

Stream Reach Class

- H1
- H2
- O
- Wb
- Wf
- Wm
- Ws

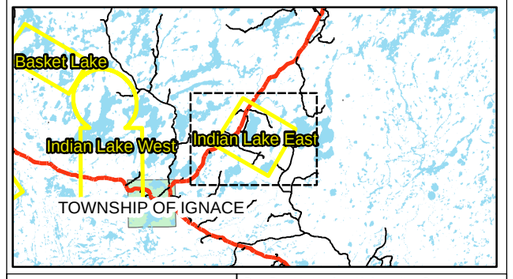


Figure 8D

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:80,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody, OIH Watercourse, Watershed. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Hillshadel (Ignace Region). Retrieved July 2016.

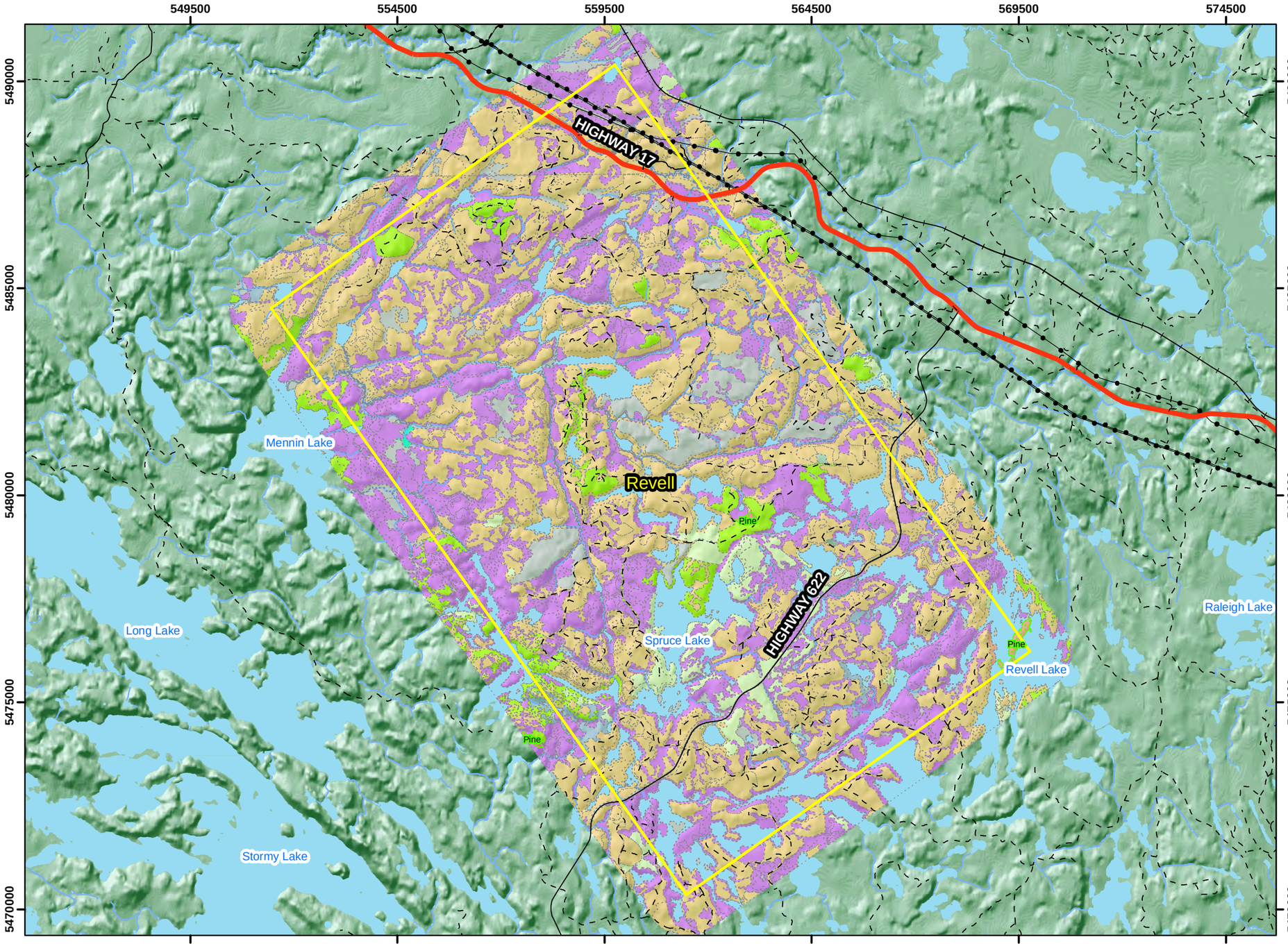
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W: and on Tulloch Sudbury Server pathed as J:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Revell Block

eFRI Ecosite Map



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Way
- Utility Line
- Watercourse
- Waterbody

Rare Vegetation Candidates

- Rare Primary Ecosite

FRI Ecosite Delineation (AOI plus 1000m)

Leading Species

- Non-woody/Non-vegetated
- Balsam Fir
- White Birch
- Larch
- Balsam Poplar
- Jack Pine
- Red Pine
- Trembling Aspen
- White Pine
- Black Spruce

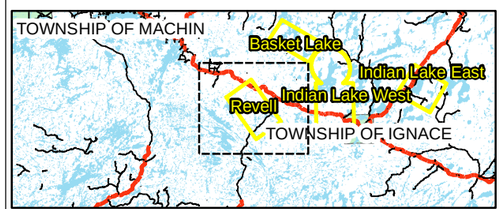


Figure 9A

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:100,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, OHN Waterbody, OHN Watercourse. Updated January 2015 through June 2016.

Data Provided by the Ministry of Natural Resources and Forestry:
eFRI Ecosite Classification. Obtained 06/07/2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

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Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

eFRI Ecosite Map

564500 569500 574500 579500 584500

5510000 5505000 5500000

Pine
Hardwood Swamp
Pine
Pine
Pine
Basket Lake
Hardwood Swamp
Cliff
Basket Lake
Maple
Hardwood Swamp
Pine
Maple
Abamategwia Lake
Indian Lake West
Hook Lake

0 1.25 2.5 5 7.5 10 Kilometers

Legend

- Potentially Suitable Area
- Local Road
- Other Road
- Watercourse
- Waterbody

Rare Vegetation Candidates

- Rare Primary Ecosite
- Rare Secondary Ecosite

FRI Ecosite Delineation (AOI plus 1000m)

Leading Species

- Non-woody/Non-vegetated
- Black Ash
- Balsam Fir
- White Birch
- White Cedar
- Larch
- Red Maple
- Jack Pine
- Red Pine
- Trembling Aspen
- White Pine
- Black Spruce
- White Spruce

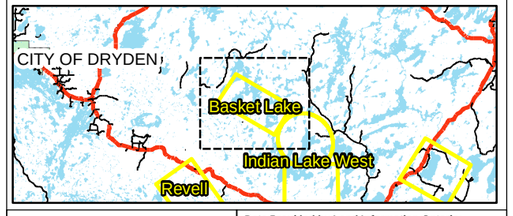

Figure 9B

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:70,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario: MNR Road Network, Utility Line, ORWN Track, OHN Waterbody, OHN Watercourse. Updated January 2015 through June 2016.

Data Provided by the Ministry of Natural Resources and Forestry: eFRI Ecosite Classification. Obtained 06/07/2016.

Data Provided by the Natural Resources Canada (GeoGratis): CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Data Provided by Tulloch Engineering: Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

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Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

eFRI Ecosite Map

Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Rail Way
- Utility Line
- Watercourse
- Waterbody

Rare Vegetation Candidates

- Rare Primary Ecosite
- Rare Secondary Ecosite

FRI Ecosite Delineation (AOI plus 1000m)

Leading Species

- Non-woody/Non-vegetated
- Balsam Fir
- White Birch
- White Cedar
- Larch
- Red Maple
- Jack Pine
- Red Pine
- Trembling Aspen
- White Pine
- Black Spruce
- White Spruce

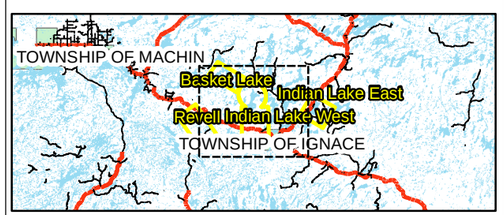

Figure 9C

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:140,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, OHN Waterbody, OHN Watercourse. Updated January 2015 through June 2016.

Data Provided by the Ministry of Natural Resources and Forestry:
eFRI Ecosite Classification. Obtained 06/07/2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

TULLOCH ENVIRONMENTAL

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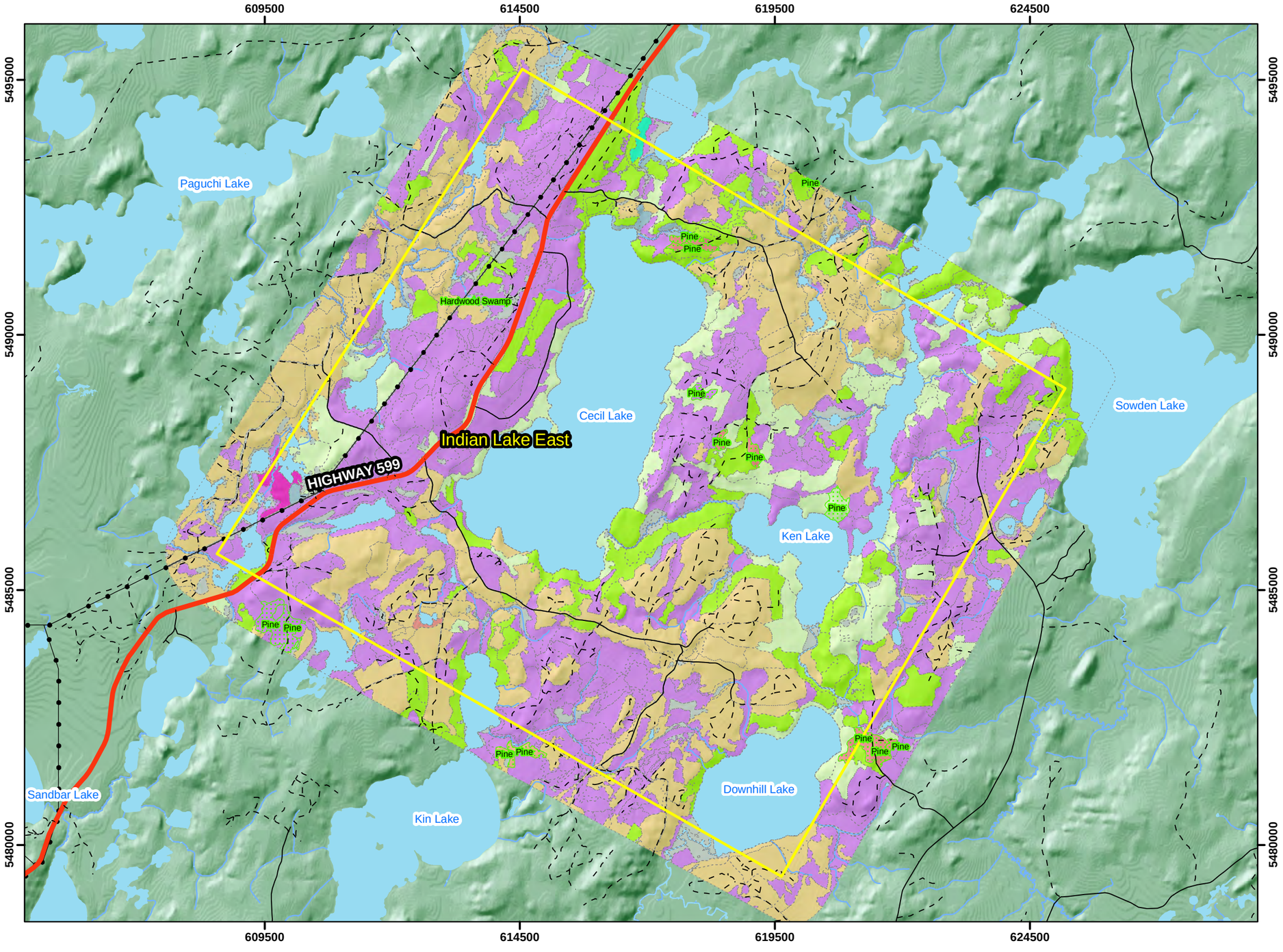
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

0 2.75 5.5 11 16.5 22 Kilometers

NWMO Ignace APM Phase II

Indian Lake East Block

eFRI Ecosite Map



Legend

- Potentially Suitable Area
- TransCanada Highway
- Local Road
- Other Road
- Utility Line
- Watercourse
- Waterbody

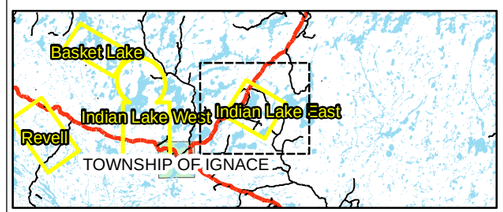
Rare Vegetation Candidates

- Rare Primary Ecosite

FRI Ecosite Delineation (AOI plus 1000m)

Leading Species

- Non-woody/Non-vegetated
- Black Ash
- Balsam Fir
- White Birch
- Larch
- Jack Pine
- Red Pine
- Trembling Aspen
- White Pine
- Black Spruce
- White Spruce



0 1.5 3 6 9 12 Kilometers

Figure 9D

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:80,000

Datum: NAD83

Projection: UTM Zone 15N

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, OHN Waterbody, OHN Watercourse. Updated January 2015 through June 2016.

Data Provided by the Ministry of Natural Resources and Forestry:
eFRI Ecosite Classification. Obtained 06/07/2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Colour Hillside (Ignace Region). Retrieved July 2016.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

TULLOCH ENVIRONMENTAL

NWMO Ignace
APM Phase II

Revell Block
Sensitivity Buffers & Field Plots

Legend

- Potentially Suitable Area
- Field Verification Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Waterbody (30m)
- Watercourses (30m)
- Wetland >2ha (120m)
- SWH Candidate Rare Primary Ecosite
- SWH Moose Aquatic Feeding (upland 120m)
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- Nesting Sites (Various)

549500 554500 559500 564500 569500 574500

5490000 5485000 5480000 5475000 5470000

HIGHWAY 17
HIGHWAY 622
A1
A2
A3
A4
A5
Revell
Mennin Lake
Long Lake
Spruce Lake
Revell Lake
Raleigh Lake
Stormy Lake

0 2 4 8 12 16 Kilometers

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

Figure 10A

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:100,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

N

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Basket Lake Block

Sensitivity Buffers & Field Plots

564500 569500 574500 579500 584500

5510000 5505000 5500000

Basket Lake

Basket Lake

B1

E1

Abamategwia Lake

Indian Lake West

Hook Lake

Legend

- Potentially Suitable Area
- Field Verification Area
- Local Road
- Resource / Recreation Road
- Watercourse
- Waterbody
- Waterbody (30m)
- Watercourses (30m)
- Wetland >2ha (120m)
- SWH Candidate Rare Primary Ecosite
- SWH Candidate Rare Secondary Ecosite
- SWH Moose Aquatic Feeding (upland 120m)
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- Nesting Sites (Various)
- Fish Spawning Site

0 1.25 2.5 5 7.5 10 Kilometers

Figure 10B

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:71,000

Datum: NAD83

Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

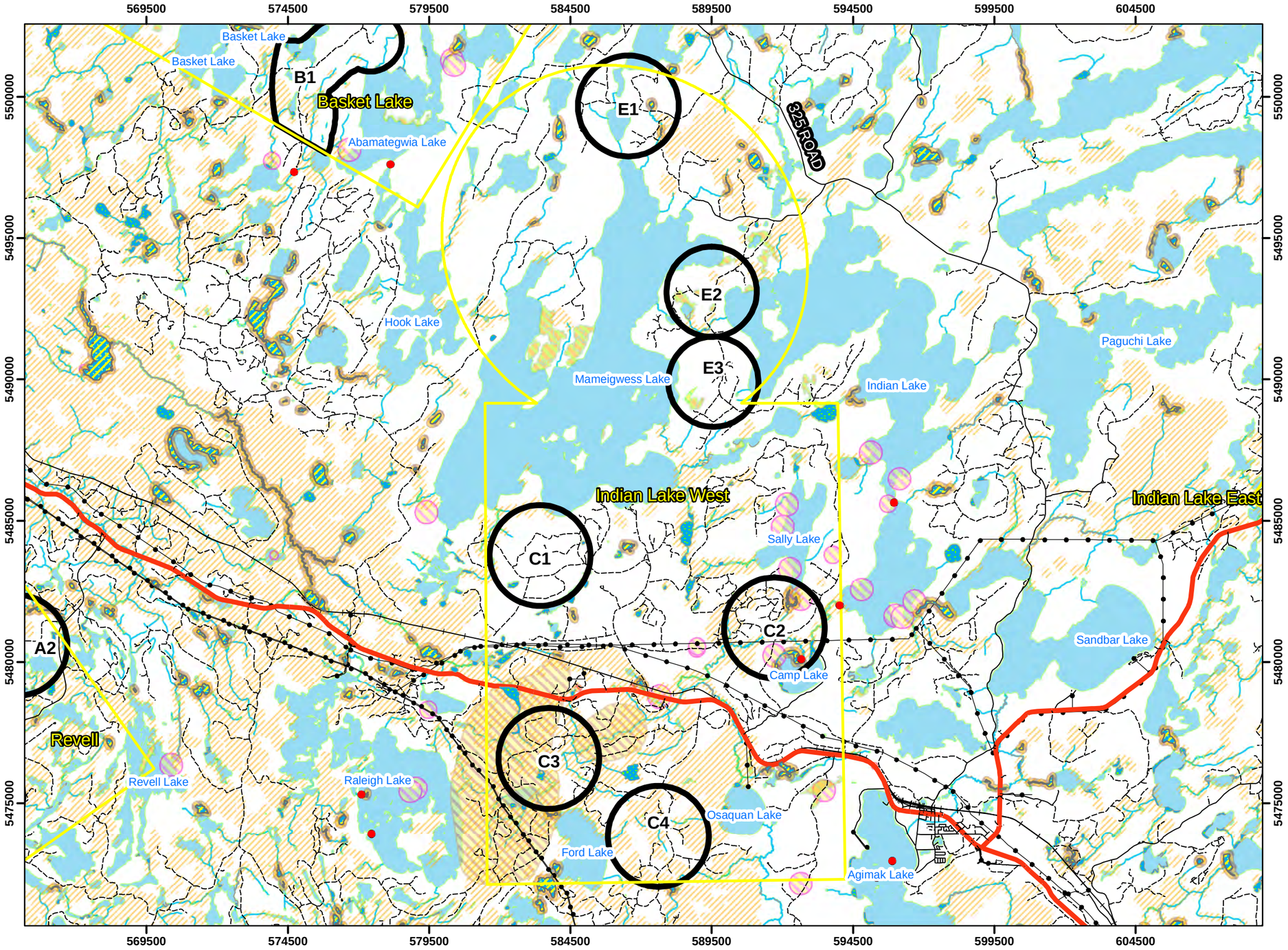
J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake West Block

Sensitivity Buffers & Field Plots



Legend

- Potentially Suitable Area
- Field Verification Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Waterbody (30m)
- Watercourses (30m)
- Wetland >2ha (120m)
- SWH Candidate Rare Primary Ecosite
- SWH Candidate Rare Secondary Ecosite
- SWH Moose Wintering (300m)
- SWH Mineral Lick (120m)
- SWH Moose Aquatic Feeding (upland 120m)
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- Nesting Sites (Various)
- Fish Spawning Site

Figure 10C

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:145,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL

NWMO Ignace APM Phase II

Indian Lake East Block

Sensitivity Buffers & Field Plots

Legend

- Potentially Suitable Area
- Field Verification Area
- TransCanada Highway
- Local Road
- Resource / Recreation Road
- Utility Line
- Watercourse
- Waterbody
- Waterbody (30m)
- Watercourses (30m)
- Wetland >2ha (120m)
- SWH Waterfowl Staging (100m)
- SWH Candidate Rare Primary Ecosite
- SWH Moose Aquatic Feeding (upland 120m)
- Moose Aquatic Feeding Area (Not Significant)
- Moose Aquatic Feeding Area (Significant)
- Nesting Sites (Various)

609500 614500 619500 624500

5495000 5490000 5485000 5480000

Paguchi Lake
Cecil Lake
Indian Lake East
Ken Lake
Sowden Lake
Sandbar Lake
Kin Lake
Downhill Lake
HIGHWAY 599
D1
D2
D3
D4

0 1.5 3 6 9 12 Kilometers

Figure 10D

PROJECT: 165010

DATE: 16/02/2018

SCALE: 1:79,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildlife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\X-2 TM1-L Summary Report
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

TULLOCH ENVIRONMENTAL