NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2 Geoscientific Preliminary Assessment

Lineament Interpretation

TOWNSHIP OF MANITOUWADGE AND AREA, ONTARIO

APM-REP-01332-0214

APRIL 2017

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Phase 2 Geoscientific Preliminary Assessment

Lineament Interpretation, Township of Manitouwadge and Area, Ontario

Report Prepared for

Nuclear Waste Management Organization

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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Phase 2 Geoscientific Preliminary Assessment, Lineament Interpretation, Township of Manitouwadge and Area, Ontario

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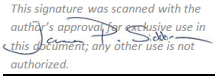
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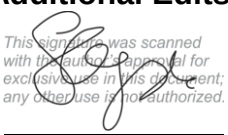
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Executive Summary

This technical report documents the results of an updated surficial and geophysical lineament interpretation study conducted as part of the Phase 2 Geoscientific Preliminary Assessment to further assess the suitability of the Manitouwadge area to safely host a deep geological repository. This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (AECOM, 2014).

The purpose of the Phase 2 lineament interpretation was to provide an updated interpretation of the geological and structural characteristics of the bedrock units within the area identified in the Phase 1 desktop assessment. The assessment area considered for the lineament study includes the area covered by the newly acquired Phase 2 airborne surveys (SGL, 2017) and is divided into three blocks (Block A, B, and C). The interpretation of lineaments was conducted using the new high-resolution airborne magnetic and digital elevation data (DEM), as well as high-resolution digital aerial imagery.

The lineament interpretation followed a systematic workflow involving three steps. The first step included an independent lineament interpretation by two individual interpreters for each data set and assignment of a certainty level (low, medium, or high) of the interpreted lineaments. The second step involved the integration of the interpreted lineaments for each individual data set and a determination of reproducibility. The third and final step involved the integration of the lineament interpretations for the surficial data sets (DEM and digital aerial imagery) followed by the integration of the combined surficial data set with the aeromagnetic data set, with determination of coincidence in each integration step. Over the course of these three steps, a comprehensive list of attributes for each lineament was compiled. The four key lineament attributes and characteristics used in the assessment include certainty, length, density, and orientation.

Geophysical lineaments were interpreted using the newly acquired high-resolution aeromagnetic data (SGL, 2017), which provides a significant improvement to the overall resolution and quality of aeromagnetic data compared with the available data interpreted during the Phase 1 preliminary assessment. Lineaments interpreted using the aeromagnetic data are typically less affected by the presence of overburden than surficial data sets, and more likely reflect potential structures at depth that may or may not have surficial expressions. The geophysical lineament interpretation identified 755 lineaments, including 319 brittle, 211 dyke, and 225 unclassified lineaments through the Manitouwadge Phase 2 assessment area. The reproducibility assessment identified coincidence for 61%, and a lack of coincidence for 39% of all geophysical lineaments, with 36% assigned the highest level of certainty (three), while 37% were assigned a moderate certainty value of two, and 27% were assigned a low certainty value of one. Brittle lineaments occur in three dominant orientations throughout all blocks: southeast, north, and northeast. Dyke lineaments occur throughout the three blocks in the same three dominant orientations (southeast, north, and northeast), corresponding to Matachewan, Marathon and Biscotasing dyke swarms respectively. The density of the brittle and dyke lineaments is variable throughout the three blocks. Areas of higher brittle and dyke density correspond to clusters of tightly spaced brittle and dyke lineaments, and the intersection of these lineament clusters. Unclassified lineaments define several domains throughout Phase 2 lineament assessment area, including a network of spaced east-west unclassified lineaments in Block A, a high concentration of unclassified lineaments roughly defining the boundary of the Fourbay Lake pluton in Block B, and a pervasive northeast-trending network coincident and subparallel to the contact between metavolcanic and gabbroic rocks, and granitic intrusive rocks in the north of Block C.

Surficial lineaments were interpreted using the high-resolution digital elevation data (DEM) from the airborne surveys, and high-resolution digital aerial imagery with a ground resolution cell of 0.4 metres. Surficial lineaments were interpreted as linear traces along topographic features such as valleys, escarpments, and drainage patterns such as rivers, streams and linear lakeshore lines. These linear traces may represent the expression of bedrock fractures on the land surface. However, it is uncertain what proportion of surficial lineaments represent actual geological structures and if so, whether the structures extend to significant depth. The observed distribution and density of surficial lineaments is highly influenced by the presence of overburden cover and water bodies, which can mask the surface expressions of potential fractures. The combination of interpreted DEM and digital aerial lineaments yielded 1218 integrated surficial lineaments

throughout the three blocks of the Manitouwadge Phase 2 assessment area. The reproducibility assessment identified coincidence for 33% of the surficial lineaments and a lack of coincidence for 67% of all surficial lineaments, with 20% assigned the highest level of certainty (three), while 40% were assigned a moderate certainty value of two, and 47% were assigned a low certainty value of one. Surficial lineaments trend dominantly northeast, but also include significant populations of north-northeast-, and southeast-trending lineaments. The dominant glacial flow direction was also in from northeast to southwest, therefore care must be taken when evaluating northeast-trending surficial lineaments to ensure they are related to bedrock features. Surficial lineament density is variable throughout the three blocks, with higher density areas typically occurring as isolated clusters and along northwest and northeast trends. Zones of elevated density result from multiple closely spaced subparallel northwest- and northeast-trending surficial lineaments, and the intersections of these lineament clusters. Certain low density areas within the surficial data are the result of overburden, including the northeast-trending low density zone coincident with the Black River in the south of Block B.

The integration of the geophysical and surficial lineament data sets resulted in the final integrated lineament data set. This data set identified 1763 lineaments, including 1282 brittle, 218 dyke, and 263 unclassified lineaments through the Manitouwadge Phase 2 assessment area. The reproducibility assessment between geophysical and surficial features revealed that 43% of the interpreted geophysical lineaments were also interpreted in at least one of the two surficial data sets. In general, reproducibility values for the final integrated data reveal a low coincidence between surficial and magnetic lineaments. For all subareas, only 13% of the final integrated lineaments were identified in all three data sets, and 22% of the final integrated lineaments were identified in two of the three data sets. Lineaments that were reproduced in all three data sets (RA_2=3), and lineaments with the highest certainty value (3) typically represent the longest lineaments (i.e. greater than 5 kilometres). The orientation and distribution of brittle and dyke lineaments is similar to that documented for the geophysical lineaments (southeast, north and northeast orientations). A notable exception to this is the abundance of northeast-trending final integrated lineaments, which is due to the dominance of this trend in the integrated surficial data set. As with the geophysical and surficial data sets, the density of the final integrated brittle and dyke lineaments is variable throughout the assessment area. Areas of higher brittle and dyke density correspond to clusters of closely spaced lineaments, and the intersection of these lineament clusters. The distribution and density of unclassified lineaments is similar to that described for the geophysical lineaments. Brittle lineaments of all orientations are observed to offset and truncate, and be offset and truncated by all other brittle and dyke lineament orientations. The complexity and inconsistency of the structural relationships observed between all brittle lineaments suggest a protracted deformation history that likely includes multiple generations of brittle reactivation.

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1 Introduction

This technical report documents the results of an updated geophysical and surficial lineament interpretation study conducted as part of the Phase 2 Geoscientific Preliminary Assessment to further assess the suitability of the Manitouwadge area to safely host a deep geological repository. This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (NWMO, 2014; AECOM, 2014). The Phase 1 Geoscientific Desktop Preliminary assessment identified several potentially suitable areas warranting further studies, such as high-resolution geophysical surveys and geological mapping.

The purpose of the Phase 2 lineament interpretation was to provide an updated interpretation of the geological and structural characteristics of the bedrock units within the potentially suitable areas identified in the Phase 1 desktop assessment. The assessment areas considered for the lineament study include the areas covered by the newly acquired Phase 2 airborne geophysical surveys (SGL, 2017).

The interpretation of geophysical lineaments was conducted using newly acquired high-resolution airborne magnetic data (SGL, 2017). The interpretation of surficial lineaments was conducted using newly acquired digital elevation data (SGL, 2017) and high-resolution digital aerial imagery of the area (Forest Resource Inventory digital aerial imagery; OMNR, 2009).

1.1 Scope of Work and Work Program

The scope of work for this study includes the completion of a structural lineament interpretation of remote sensing data for the Manitouwadge area in northeastern Ontario (Figure 1). The lineament study involved the interpretation of remotely-sensed data sets, including surficial (digital elevation and digital aerial imagery) and geophysical (magnetic) data sets (SGL, 2017) for the Manitouwadge area. The investigation interpreted lineament locations and orientations in terms of their potential impact as bedrock structural features (e.g., individual fractures or fracture zones) and evaluated their relative timing relationships within the context of the local and regional geological setting. For the purpose of this report, a lineament was defined as "a linear or curvi-linear geophysical, DEM or surficial feature." The approach undertaken in this lineament investigation is based on the following:

- Lineaments were interpreted using newly acquired high-resolution aeromagnetic and digital elevation data (SGL, 2017), and purchased high-resolution digital aerial imagery (Forest Resource Inventory digital aerial imagery; OMNR, 2009);
- Lineament interpretations for each data set were made by two specialist interpreters using a standardized workflow;
- Lineaments were interpreted as having an unclassified, brittle, or dyke character by each interpreter;
- Lineaments were analyzed based on an evaluation of the quality and limitations of the available data sets;
- Lineaments were evaluated using: age relationships; reproducibility tests, particularly the coincidence of lineaments identified by different interpreters; coincidence of lineaments interpreted from different data sets; and comparison to literature and mapped geology;
- Classification was applied to indicate the significance of lineaments based on certainty, length and reproducibility.

These elements help to address the issues of uncertainty, subjectivity and reproducibility normally associated with lineament investigations. Their incorporation into the methodology increases the confidence in the resulting lineament interpretation.

1.2 Assessment Area

The Manitouwadge Phase 2 assessment area used for the lineament assessment and interpretation includes three separate blocks (Blocks A, B, and C), totalling approximately 1,060 square kilometres (km^2) in area (Figure 1), and was provided by NWMO as a shape file. Block A comprises 138 km^2, Block B comprises 626 km^2, and Block C comprises 296 km^2.

The approximate coordinates defining the boundaries of the Phase 2 lineament assessment areas are listed in Table 1 (UTM NAD83, Zone 13N).

Table 1: Bounding Coordinates of the Phase 2 Lineament Assessment Areas in the Manitouwadge Area, Ontario

X UTM	Y UTM	Block
585,365	5,478,385	A
573,045	5,478,385	A
585,365	5,489,560	A
573,045	5,489,560	A
599,500	5,419,174	B
566,261	5,419,174	B
566,261	5,431,000	B
572,464	5,431,000	B
579,000	5,440,785	B
599,500	5,440,785	B
622,713	5,425,000	C
611,087	5,425,000	C
622,713	5,450,500	C
611,087	5,450,500	C

(UTM NAD83 Zone 13N)

1.3 Qualifications of SRK and SRK Team

The SRK Group comprises more than 1,400 professionals, offering expertise in a wide range of resource engineering disciplines. The independence of the SRK Group is ensured by the fact that it holds no equity in any project it investigates and that its ownership rests solely with its staff. These facts permit SRK to provide its clients with conflict-free and objective recommendations on crucial issues. SRK has a proven track record in undertaking independent assessments of mineral resources and mineral reserves, project evaluations and audits, technical reports and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies, and financial institutions worldwide. Through its work with a large number of major international mining companies, the SRK Group has established a reputation for providing valuable consultancy services to the global mining industry.

The lineament interpretation and the compilation of this report were completed by Mr. Carl Nagy, PGeo, and Mr. Blair Hrabi, PGeo. Dr. James P. Siddorn, PGeo served as a technical advisor and reviewed lineament interpretations and drafts of this report prior to their delivery to the NWMO as per SRK internal quality management procedures.

Following is a brief description of the qualifications of the project team members.

Mr. Carl Nagy, MSc, PGeo is a Consultant (Structural Geology) who specializes in structural interpretations of remotely sensed data, structural analyses of ore deposits, and bedrock mapping. He has completed multiple regional to detailed scale lineament interpretations of remotely sensed data, including the Phase 1 lineament interpretations for the Manitouwadge (SRK, 2014a) and White River (SRK, 2014b) areas, and the Phase 2 lineament interpretation for the Creighton area (SRK, 2015a). In this study, Mr. Nagy was the lead interpreter and the report author.

Mr. Blair Hrabi, MSc, PGeo is a Principal Consultant (Structural Geology) with 20 years of experience gained in the exploration industry, government geological surveys, and academic settings. He specializes in evaluating the structural controls of mineral deposits, the compilation and integration of diverse data sets to understand the evolution and geometry of complex, mineralized terranes, and the structural interpretation of aeromagnetic and other remotely sensed data. Mr. Hrabi was the project lead for the Phase 1 observation of general geological features (OGGF) in Creighton, Saskatchewan (SRK, 2015a) and Ignace (SRK, 2015c), Ontario. In this study, Mr. Hrabi was the second interpreter.

Dr. James Siddorn, PGeo is a Practice Leader (Structural Geology) and specialist in applied structural interpretation of remotely sensed data combined with the structural analysis of ore deposits. Dr. Siddorn has conducted numerous detailed interpretations of magnetic and electromagnetic data sets for gold and diamond exploration, and rock mechanics/hydrogeological engineering studies. He oversaw the Phase 1 structural lineament interpretations for the Schreiber (SRK, 2013a), Ear Falls (SRK, 2013b), White River (SRK, 2014b), and Manitouwadge (SRK, 2014a) areas, as well as the Phase 2 structural lineament interpretations for the Creighton (SRK, 2015a), Schreiber (SRK, 2015b), and Ignace (SRK, 2015c) areas. In this study, Dr. Siddorn was the senior reviewer.

Mr. Jason Adam is an Associate Consultant (GIS) who has a broad experience in GIS (geographical information systems). Mr. Adam provided GIS support for the study, mainly in the preparation of figures, under the direction of Mr. Nagy.

2 Summary of Geology

The geology of the Manitouwadge area is described in detail in the Phase 1 Geoscientific Desktop Preliminary Assessment (AECOM, 2014). The following sections provide a brief description of the geologic setting, bedrock geology, structural history and mapped structures, metamorphism, and Quaternary geology of the Manitouwadge area. The focus of the following subsections are the bedrock units identified during Phase 1 as being potentially suitable to host a deep geological repository and the important structural features in proximity to these units.

2.1 Geological Setting

The Manitouwadge area is located within the Archean Superior Province of northern Ontario. The Superior Province is a stable craton created from a collage of ancient plates and accreted juvenile arc terranes that were progressively amalgamated over a period of more than 2 Ga (e.g., Percival et al., 2006). The Superior Province covers an area of approximately 1,500,000 km^2 and is divided into east-trending subprovinces, including the Wawa and Quetico subprovinces. The Manitouwadge Block A is located entirely within the Quetico Subprovince, whereas Blocks B and C are located entirely within the Wawa Subprovince (Figure 2).

The Quetico Subprovince is an expansive geological domain comprised predominantly of metasedimentary rocks (Zaleski et al., 1995). Numerous granitic intrusions, and rare mafic to ultramafic intrusions are also located throughout the Quetico Subprovince (Williams, 1989; Sutcliffe, 1991).

The Wawa Subprovince is comprised of multiple units of volcanic and associated metasedimentary rocks (greenstone belts) separated by extensive granitic plutons and batholiths. These volcanic and metasedimentary units typically occur in elongate narrow geometries and represent volumetrically a relatively minor percentage of the bedrock. The surrounding granitic bodies are composed primarily of tonalite to granodiorite, and represent the vast majority of the rock present throughout the subprovince.

Three generations of Paleoproterozoic diabase dyke swarms, ranging in age from ca. 2.473 to 2.101 Ga intrude all bedrock units in the Manitouwadge area (Hamilton et al., 2002; Buchan and Ernst, 2004; Halls et al., 2006).

2.2 Bedrock Geology

The main bedrock geology units present within the three Manitouwadge blocks include the metasedimentary rocks of the Quetico Subprovince (Block A) and predominantly gneissic tonalite rocks of the Black-Pic batholith (Blocks B and C) of the Wawa Subprovince. Additional relevant geological units include the Fourbay Lake pluton located in Block B, and two gabbroic intrusions, a granite-granodiorite intrusion and a unit of mafic metavolcanic rocks, located within Block C (Figure 2). The southern boundary of a granite-granodiorite intrusion is located along the northern boundary of Block A, but is not considered significant as only a minor amount of this intrusion is located within the interpretation area (see Section 2.3.5). The bedrock in the Manitouwadge area has experienced several generations of ductile and brittle deformation, and the individual rock units have been subjected to varying amounts of metamorphism ranging from amphibolite to granulite facies

metamorphism (Williams and Breaks, 1996). In addition, three generations of Proterozoic diabase dykes transect all bedrock units.

A detailed description of these bedrock units, and structural and metamorphic events, can be found in the Phase 1 Geoscientific Desktop Preliminary Assessment (AECOM, 2014), and key points are summarized in the following subsections. A description of the bedrock geology units surrounding, but not included within the individual Phase 2 Manitouwadge lineament interpretation areas, can also be found in the aforementioned reference, and are not repeated here.

2.2.1 Quetico Subprovince

Metasedimentary Rocks

Metasedimentary rocks of the Quetico Subprovince occur in the northern portion of the Manitouwadge area and entirely underlie Block A, with the exception of the northernmost boundary, which is located along the contact of a granite-granodiorite intrusion (Figure 2).

Metasedimentary rocks of the Quetico Subprovince include wackes, pelites, and arenites, as well as varying amounts of ironstone, conglomerate, and siltstone (Williams and Breaks, 1996; Zaleski et al., 1999). Rocks within the Quetico Subprovince have experienced varying degrees of metamorphism ranging from amphibolite to granulite facies, and deformation, and commonly exhibit gneissic and migmatitic textures (Percival, 1989; Williams and Breaks, 1996; Zaleski et al., 1999). Extensive deformation can be observed in the form of numerous small-scale folds, shear zones, and boudinaged units (Williams and Breaks, 1996). Evidence of extensive metamorphism includes significant volumes of leucosome, resulting from partial melting and segregation during high-grade metamorphism (Williams and Breaks, 1996).

The Quetico Subprovince has been interpreted to be an accretionary prism of an Archean volcanic island-arc system, which developed where the Wawa and Wabigoon belts formed converging arcs (Percival and Williams, 1989). The timing of the Quetico-Wawa belt accretion has been constrained to between ca. 2.689 Ga and 2.684 Ga (Percival, 1989), and the metasedimentary rocks have been dated at 2.700 to 2.688 Ga (Percival, 1989; Zaleski et al., 1999).

Granite - Granodiorite Intrusion

The southern boundary of a granite-granodiorite intrusion straddles the northern boundary of the Manitouwadge Block A (Figure 2). Similar intrusions have been mapped elsewhere in the region, and described as quartzofeldspathic gneisses (Coates, 1970) and biotite leucogranite (Percival, 1989). In general, granitic rocks in the Quetico Subprovince are typically medium- to coarse-grained and massive (Percival, 1989).

2.2.2 Wawa Subprovince

Black-Pic Batholith

The Black-Pic batholith is a regionally extensive intrusion located within the Wawa Subprovince, encompassing an area of approximately 3,000 km^2. With the exception of several relatively small intrusions (e.g., Fourbay Lake pluton in Block B, gabbroic intrusions in Block C), the bedrock underlying Blocks B and C is entirely contained within this batholith (Figure 2).

The Black-Pic batholith comprises a multi-phase suite of hornblende-biotite monzodiorite, foliated tonalite, and pegmatitic granite, with subordinate foliated diorite, granodiorite, granite and crosscutting aplitic to pegmatitic dykes (Williams and Breaks, 1989; Zaleski and Peterson, 1993). Local lithological variations occur throughout the batholith, including upper levels of the tonalite,

which are frequently cut by granitic sheets of pegmatite and aplite, and are generally more massive (Williams and Breaks, 1989). Also present throughout the batholith are zones of migmatized sedimentary rocks and massive granodiorite to granite. The contact between these rocks and the tonalitic rocks is gradational and associated with extensive sheeting of the tonalitic unit (Williams and Breaks, 1989; Williams et al., 1991).

The Black-Pic batholith is a structural dome with foliation dips that are shallow to moderate outward from the centre (Williams and Breaks, 1989; 1990). Structurally deeper levels of the tonalite suite contain a strong sub-horizontal foliation and a weak north-trending mineral elongation lineation (Williams and Breaks, 1989).

The age of emplacement of the Black-Pic batholith has been constrained by U-Pb (zircon) dating of the oldest recognized phase of the tonalite at ca. 2.720 Ga (Jackson et al., 1998). A younger monzodioritic phase has also been dated at ca. 2.689 Ga (Zaleski et al., 1999).

Fourbay Lake Pluton

The Fourbay Lake pluton is an approximately 64 km^2 elliptical-shaped intrusion located in the southwest corner of the Manitouwadge Block B (Figure 2). The pluton is mapped as a pyroxene-hornblende-biotite granodiorite (Milne, 1968), and as a hornblende–biotite ± clinopyroxene quartz monzodiorite (Beakhouse, 2001). The latter mapping also indicated the pluton exhibited a massive and medium-grained granular texture.

U-Pb (zircon) age dating of the Fourbay Lake pluton yielded an age of ca. 2.678 Ga (Beakhouse, 2001). The pluton has been interpreted as an intrusion in a series of late stage, likely post-tectonic plutons situated along the central axis of the Black-Pic batholith (Williams and Breaks, 1996).

The Fourbay Lake pluton is evident in geophysical data, and clearly distinguished from the Black-Pic batholith by a prominent aeromagnetic anomaly with clearly defined boundaries (e.g., Milne, 1968 and PGW, 2014). The elevated magnetic signature relative to the surrounding Black-Pic batholith, may be due to the abundance Fe and Fe-Ti oxides (~1-2 percent) within the pluton (Williams and Breaks, 1996).

Granite-Granodiorite Intrusion

An unnamed, northeast-trending granite-granodiorite pluton is depicted in the central portion of Block C (outlined but not labeled on Figure 2). This geological unit is present in the compilation map of the area (Johns and McIlraith, 2003a and b), and is based on previous geological maps (Giguere, 1972). No associated aeromagnetic anomaly is visible based on historic geophysical data (PGW, 2014; Figure 4).

Faries-Moshkinabi Intrusion

The Faries-Moshkinabi intrusion is an east-northeast–trending linear intrusion located between Blocks B and C, and in the northern portion of Block C (Figure 2). The intrusion comprises a series of mafic and ultramafic rocks including websterite, hornblendite, metagabbro, gabbro, anorthositic gabbro, gabbroic anorthosite, and anorthosite (Giguere, 1972). The portion of the intrusion located in Block C is thought to have originally been connected to the gabbroic intrusions immediately to the west (Williams and Breaks, 1996). Within Block C, the Faries-Moshkinabi intrusion is in contact to the north with a relatively narrow unit of metavolcanic rocks of the Manitouwadge greenstone belt. The contact between the Faries-Moshkinabi intrusion and the Black-Pic batholith is a thrust-modified tectonic breccia, composed of centimetre- to metre-scale blocks of anorthosite, metawacke, and granitic rocks (Williams and Breaks, 1996).

Bulldozer Lake Intrusion

The informally named Bulldozer Lake intrusion (AECOM, 2014) is an ellipsoidal gabbroic intrusion, approximately 15 by 10 kilometres, in the southwest corner of Block C (Figure 2). The Bulldozer Lake intrusion is apparent in geophysical data, and can be differentiated from the surrounding Black-Pic batholith by an elevated magnetic signature (PGW, 2014). No additional information on this pluton, including its depth, was documented in the reviewed literature.

Supracrustal Rocks

Supracrustal rocks of the Wawa Subprovince, proximal to the Manitouwadge lineament assessment area, include the Manitouwadge and the Schreiber-Hemlo greenstone belts.

The Manitouwadge greenstone belt comprises a semi-continuous suite of metavolcanic and meta-sedimentary rocks and associated intrusions situated along the northern boundary of the Wawa Subprovince (Figure 2). A relatively narrow unit of mafic volcanic rocks of the Manitouwadge greenstone belt is located in the northern portion of Block C, whilst the remainder of the greenstone belt is located outside the Phase 2 lineament assessment areas, and is therefore only summarized briefly within this report.

The Manitouwadge greenstone belt comprises strongly metamorphosed wackes and siltstones, mafic to felsic volcanic rocks, iron formations, and volcanogenic massive sulphide deposits. Locally, sedimentary and volcanic rocks are intercalated both along strike and down dip (Milne, 1969). Within Block C, and between Blocks B and C, the Faries-Moshkinabi gabbroic intrusion is in contact with the volcanic rocks of the Manitouwadge greenstone belt. Throughout the greenstone belt, bedding is rarely observed, and is typically transposed into planar fabrics due to extensive deformation (Zaleski et al., 1999).

The western part of the Schreiber-Hemlo greenstone belt occurs to the west of the Phase 2 lineament assessment area. The belt in this location comprises mafic metavolcanic rocks and associated intrusions of the Schreiber assemblage (Williams et al., 1991).

2.2.3 Mafic Dykes

Three diabase dyke swarms are known to crosscut the Manitouwadge area (Figure 2), including:

- Northwest-trending Matachewan dykes (ca. 2.473 Ga; Buchan and Ernst, 2004). This dyke swarm is one of the largest in the Canadian Shield. Individual dykes are generally up to 10 metres wide, and have vertical to subvertical dips. Matachewan dykes are mainly quartz-diabase dominated by plagioclase, augite, and quartz (Osmani, 1991).
- North-northeast–trending Marathon dykes (ca. 2.121 Ga; Buchan et al., 1996; Hamilton et al., 2002). These dykes form a fan-shaped distribution pattern around the northern, eastern, and western flanks of Lake Superior. The dykes vary in orientation from northwest to northeast, and occur as steep to subvertical sheets, typically a few metres to tens of metres thick, but occasionally up to 75 metres thick (Hamilton et al., 2002). The Marathon dykes are quartz-diabase dominated by equigranular to subophitic clinopyroxene and plagioclase (Osmani, 1991).
- Northeast-trending Biscotasing dykes (ca. 2.167 Ga; Hamilton et al., 2002). Locally, Marathon dykes also trend northeast and cannot be separated with confidence from the Biscotasing Suite dykes.

The three dyke swarms in the Manitouwadge area are generally distinguishable by their unique strike directions, crosscutting relationships and, to a lesser extent, by the amplitude of the associated magnetic anomalies.

2.3 Structural History

Information on the structural history of the Manitouwadge area is based predominantly on structural investigations of the Manitouwadge and Dayohessarah greenstone belts (Polat, 1998; Peterson and Zaleski, 1999) and the Hemlo gold deposit and surrounding region (Muir, 2003). Additional studies by Lin (2001), Percival et al. (2006), and Williams and Breaks (1996) have also contributed to the structural understanding of the area. The aforementioned studies were performed at various scales and from various perspectives. Consequently, the following summary of the structural history of the Manitouwadge area should be considered as a best-fit model that incorporates relevant findings from all studies. The structural history of the Manitouwadge area is described below and summarized in Table 2.

The Manitouwadge area straddles a structurally complex boundary between the metasedimentary-migmatitic Quetico Subprovince and the volcano-plutonic Wawa Subprovince within the Archean Superior Province. The structural history of the Manitouwadge and nearby Schreiber-Hemlo greenstone belts is generally well characterized and includes multiple phases of deformation (Polat et al., 1998; Peterson and Zaleski, 1999; Lin, 2001; and Muir, 2003). Polat et al. (1998) interpreted the Schreiber-Hemlo and surrounding greenstone belts to represent collages of oceanic plateaus, oceanic arcs, and subduction-accretion complexes amalgamated through subsequent episodes of compressional and transpressional collision.

Table 2: Summary of the Geological and Structural History of the Manitouwadge Area (adapted from AECOM, 2014)

Approximate Time Period (years before present)	Geological Event
2.89 to 2.77 Ga	Progressive growth and early evolution of the Wawa-Abitibi terrane by collision, and ultimately accretion, of distinct geologic terranes
2.770 – 2.673 Ga	- ca. 2.720 Ga: Volcanism and subordinate sedimentation associated with the formation of the Manitouwadge greenstone belt - ca. <2.693: Deposition of sedimentary rocks in the Manitouwadge greenstone belt and the Quetico Subprovince - ca. 2.720-2.678 Ga: Inferred emplacement of granitoid intrusions in the Manitouwadge area. Emplacement of the Pukaskwa and Black-Pic gneissic complexes at ca. 2.72 Ga Emplacement of Loken Lake pluton (ca. 2.687 Ga), Nama Creek pluton (2.680 Ga), and Fourbay Lake pluton (ca. 2.678 Ga) - ca. 2.719 to 2.673 Ga: Four generations of brittle-ductile deformation (D_1-D_4) D1: ca. 2.719 – 2.691 Ga D2: ca. 2.691 – 2.683 Ga D3: ca. 2.682 – 2.679 Ga D4: ca. 2.679 – 2.673 Ga
2.675 to 2.669 Ga	Peak metamorphism of the Manitouwadge greenstone belt
< 2.673 Ga	Two phases of brittle deformation (D_5-D_6)
2.666 to 2.650 Ga	Peak metamorphism of the Quetico Subprovince
2.5 to 2.100 Ga	- ca. 2.5 Ga: Supercontinent fragmentation and rifting in Lake Superior area; development of the Southern Province - ca. 2.473 Ga: Emplacement of the Matachewan dyke swarm - ca. 2.167 Ga: Emplacement of Biscotasing dyke swarm - ca. 2.121 Ga: Emplacement of the Marathon dyke swarm
1.9 to 1.7 Ga	Penokean Orogeny in Lake Superior and Lake Huron areas; possible deposition and subsequent erosion in the Manitouwadge area
1.150 to 1.090 Ga	Rifting and formation of the Midcontinent Rift structure - ca. 1.1 Ga
540 to 355 Ma	Possible coverage of the area by marine seas and deposition of carbonate and clastic rocks subsequently removed by erosion
145 to 66 Ma	Possible deposition of marine and terrestrial sediments of Cretaceous age, subsequently removed by erosion
2.6 to 0.01 Ma	Periods of glaciation and deposition of glacial sediments

On the basis of overprinting relationships between different structures, Polat et al. (1998) suggested that the Schreiber-Hemlo greenstone belt underwent at least two main episodes of deformation. These deformation events can be correlated with observations from Peterson and Zaleski (1999) and Muir (2003), who reported at least five and six generations of structural elements, respectively. Two of these generations of structures account for most of the ductile strain, and although others can be distinguished on the basis of crosscutting relationships, they are likely the products of progressive deformation events. Integration of the structural histories detailed in Williams and Breaks (1996), Polat et al. (1998), Peterson and Zaleski (1999), Lin (2001), and Muir (2003) suggest that six deformation events occurred within the Manitouwadge area. The first four deformation events (D_1-D_4) are associated with ductile and brittle-ductile deformation. D_5 and D_6 were associated with a

combination of brittle deformation and fault propagation through all rock units in the Manitouwadge area. The main characteristics of each deformation event are summarized below.

The earliest recognizable deformation phase (D_1) is associated with rarely preserved small-scale isoclinal (F_1) folds, ductile shear zones that truncate stratigraphy, and a general lack of penetrative foliation development. Peterson and Zaleski (1999) reported that an S_1 foliation is only preserved locally in outcrop and in thin section. D_1 deformation is poorly constrained to between ca. 2.719 and ca. 2.691 Ga (Muir, 2003).

D_2 structural elements include prevalent open to isoclinal F_2 folds, an axial planar S_2 foliation, and L_2 mineral elongation lineations (Peterson and Zaleski, 1999). Muir (2003) interpreted D_2 to have resulted from progressive north-northeast to northeast directed compression that was coincident with the intrusion of various plutons. The S_2 foliation is the dominant meso- to macro-scale regional fabric evident across the study area. Ductile flow of volcano-sedimentary rocks between more competent batholiths may also have occurred during D_2 deformation. This generation of deformation is constrained to between ca. 2.691 and ca. 2.683 Ga (Muir, 2003).

D_3 deformation was the result of northwest-southeast shortening during regional dextral transpression. D_3 structural elements include macroscale F_3 folds, including the regional scale isoclinal fold developed within the Manitouwadge greenstone belt, and local shear fabrics that exhibit a dextral sense of motion and overprint D_2 structures (Peterson and Zaleski, 1999; Muir, 2003). D_3 deformation did not develop an extensive penetrative axial planar and (or) crenulation cleavage. D_3 deformation is constrained to between ca. 2.682 and ca. 2.679 Ga (Muir, 2003).

D_4 structural elements include isolated northeast-plunging F_4 kink folds with a Z-asymmetry, and associated small-scale fractures and faults overprinting D_3 structures. D_3-D_4 interference relationships are best developed in the Manitouwadge greenstone belt and in rocks of the Quetico Subprovince. D_4 deformation is roughly constrained to between ca. 2.679 and ca. 2.673 Ga (Muir, 2003).

Details of structural features associated with the D_5 and D_6 deformation events are limited in the literature to brittle and brittle-ductile faults of various scales and orientations (Lin, 2001; Muir, 2003). Within the Hemlo greenstone belt, Muir (2003) suggested that local D_5 and D_6 faults offset the Marathon and Biscotasing dyke swarms (all ca. 2.2 Ga), and as such, suggested that in the Hemlo region D_5 and D_6 faults propagated after ca. 2.2 Ga. However, since there are no absolute age constraints on specific events, the entire D_5-D_6 interval of brittle deformation can only be constrained to a post-2.673 Ga timeframe that may include many periods of re-activation attributable to any of several post-Archean tectonic events.

2.3.1 Mapped Structures and Named Faults

In the Manitouwadge area, in both the Quetico and Wawa subprovinces, numerous faults are indicated on public domain geological maps (Figure 2). These faults display four dominant orientations: north, northeast, northwest, and east. Despite the interpretation of multiple mapped faults, few of these structures are named. All mapped faults are considered to be associated with D_5-D_6 brittle deformation.

Surrounding the Manitouwadge lineament interpretation blocks, several named structures are present, including the north-trending Cadawaja, Slim Lake and Fox Creek faults, and the northwest-trending Mose Lake fault, all of which offset folded stratigraphy within the Manitouwadge greenstone belt (Chown, 1957; Peterson and Zaleski, 1999). The southern portions of the Cadawaja and Fox Creek faults extend into the northern portion of Manitouwadge Block B (Figure 2). Named east-trending structures are also present in the area surrounding the three blocks, including the Agam

Lake, Rabbitskin Lake, and Little Nama Lake faults, which mimic the outline of the Manitouwadge greenstone belt and subprovince boundary, and are typically offset by north-trending faults. Mapping and interpretation of aeromagnetic data (e.g., Miles, 1998), indicates that all mapped faults offset the regional fabric throughout the Manitouwadge area.

Of the aforementioned mapped structures, the north-trending Cadajwa, Slim Lake and Fox Creek faults were mapped as sinistral strike-slip faults (Miles, 1998). The Fox Creek fault exhibits a 60 metre sinistral strike-separation of the Geco VMS deposit combined with a minor east side up vertical displacement (Milne, 1998). The Cadawaja fault offsets the stratigraphy on the southern edge of the Manitouwadge greenstone belt by 500 metres (Miles, 1998). The east-trending Agam Lake fault was mapped primarily as a brittle strike-slip fault (Chown, 1957). This structure in part follows the volcanic-sedimentary contact and locally may represent a reactivated ductile shear zone (Peterson and Zaleski, 1999).

The north-, northwest- and northeast-trending faults are subparallel and locally adjacent to Marathon, Matachewan, and Biscotasing dykes. Locally, these dykes are offset by younger generations of brittle faulting (e.g., Miles, 1998).

2.4 Metamorphism

In the Manitouwadge area, the metamorphic grade of the exposed rocks of the Manitouwadge greenstone belt ranges from greenschist to upper amphibolite facies (James et al., 1978; Petersen, 1984; Pan and Fleet, 1992). To the north, metasedimentary rocks of the Quetico Subprovince exhibit granulite facies metamorphic conditions close to the boundary between the Wawa and Quetico subprovinces (Williams and Breaks, 1989, 1990; Zaleski and Peterson 1995; Pan et al., 1994). The area overprinted by granulite facies metamorphism is defined by an approximately 10 kilometres wide orthopyroxene zone that extends from the western portion of the Manitouwadge area westward for over 100 kilometres (Pan et al., 1998). Outside the orthopyroxene zone, the granulite facies rocks grade into regional upper amphibolite facies rocks that are typical of this part of the Quetico Subprovince (Pan et al., 1998).

Geothermobarometric and geochronological calculations by Pan et al. (1994) and Pan et al. (1998) in the Manitouwadge area and surroundings, indicate that low pressure-high temperature, amphibolite facies metamorphism in metasedimentary rocks of the Quetico Subprovince had been in place before ca. 2.666 Ga, in agreement with the period ca. 2.671-2.665 Ga estimated by Percival and Sullivan (1988). In the Manitouwadge area, this prograde amphibolite facies regional metamorphism would have been initiated ca. 2.675 Ga, increasing after ca. 2.666 Ga and reaching granulite facies under a thermal peak of 680-700 degrees Celsius (°C) and 4-6 Kbar perhaps ca. 2.658 Ga. Granulite facies metamorphism lasted until ca. 2.650 Ga, after which a retrograde event occurred at 550-660°C and 3-4 Kbar. After retrogression, hydrothermal alteration occurred at 200-400°C, 1-2 Kbar.

To the south of the greenstone belt, the Black-Pic batholith and other smaller plutons typically display greenschist facies metamorphism (AECOM, 2014). Locally, higher metamorphic grades up to upper amphibolite facies are recorded in rocks along the margins of plutons. No records exist that suggest that rocks in the Manitouwadge area may have been affected by thermotectonic overprints related to post-Archean events.

2.5 Quaternary Geology

Quaternary geology of the Manitouwadge area is described in detail in the remote sensing and terrain evaluation completed as part of the Phase 1 Geoscientific Desktop Preliminary assessment (AECOM, 2014). An overview of the relevant Quaternary features are presented in Figure 3 and summarized below.

The Quaternary sediments in the Manitouwadge area comprise glacial and post-glacial materials that overlie the bedrock. All glacial landforms and related materials are associated with the Wisconsinan glaciation, which began approximately 115,000 years ago (Barnett, 1992). Throughout the majority of the Manitouwadge area, bedrock outcrops are common and the terrain is dominantly classified, for surficial purposes, as a bedrock-drift complex, i.e., thin drift cover that only locally achieves thicknesses that mask or subdue the bedrock topography (Figure 3). When present, drifts overlying bedrock are typically limited in thickness and the ground surface reflects the bedrock topography (Kristjansson and Geddes, 1986). Beyond bedrock-drift complexes, valleys and lowland areas area present, which typically exhibit extensive and thick surficial deposits, frequently in a linear geometry.

In Manitouwadge Block A, and to a limited extent within the other blocks, significant areas are covered by ground moraine (till). Two styles of till are documented: moderately loose, stony, sandy till of local derivation that forms a discontinuous veneer over the bedrock, and a calcareous, silt dominated till that contains abundant non-local pebble lithologies derived from the James Bay Lowland (Geddes and Kristjansson, 1984; Geddes et al., 1985). Till thickness in the Manitouwadge area is variable and while depths of several metres are present locally; thicknesses are typically less than 3 metres (AECOM, 2014).

In Manitouwadge Block B, and to a limited extent within the other blocks, glaciolacustrine sediments cover significant areas and trend dominantly to the northeast. These sediments comprise stratified to laminated sand, silt and clay that were deposited during the incursion of glacial lakes into the Manitouwadge area (Prest, 1970; Gartner and McQuay, 1980; Kettles and Way Nee, 1998). The thickness of glaciolacustrine deposits is variable, ranging from several tens of metres to a relative thin drape over bedrock (Kettles and Way Nee, 1998).

In Manitouwadge Block C, and to a limited extent within the other blocks, glaciofluvial outwash deposits cover significant areas. Deposits are generally well-sorted and consist predominantly of stratified sand (Kristjansson and Geddes, 1986). The thicknesses of the outwash deposits are anticipated to be variable.

Minor organic-rich alluvial deposits and eolian deposits are also locally present throughout the Manitouwadge area, and have limited extents. Alluvial deposits are organic-rich, consist of sand, silt and clay, and are typically present along water courses. Eolian deposits consist of sand and are present as dunes developed on certain glacial deposits (Gartner and McQuay, 1980; Kristjansson and Geddes, 1986; Kettles and Way Nee, 1998).

Glacial striae in the Manitouwadge area record that the last direction of glacial movement was toward the south-southwest (Kristjansson and Geddes, 1986).

3 Methodology

The structural lineament interpretation of the Manitouwadge area was based on high-resolution remote sensing data sets, including a high-resolution airborne magnetic survey contracted by the NWMO to Sander Geophysics Limited (SGL, 2017), digital elevation data (DEM) collected during the airborne magnetic survey (SGL, 2017), and high-resolution Ontario Ministry of Natural Resources Forest Resources Inventory (FRI) digital aerial imagery procured from Land Information Ontario (OMNR, 2009).

3.1 Source Data Description

All data were assessed for quality, enhanced, and reviewed before use in the lineament interpretation. The geophysical data were used to evaluate potential deeper bedrock structures, and were instrumental in identifying potential bedrock structures beneath areas of surficial cover. Furthermore, the geophysical data were instrumental in establishing the age relationships among the different lineament sets. Topographic (DEM) and FRI digital aerial imagery data sets were used to identify surficial lineaments expressed in the topography, drainage, and vegetation. For this study, the best resolution data available was used for the lineament interpretation.

3.1.1 High-resolution Aeromagnetic Data

Sander Geophysics Limited (SGL) completed a fixed-wing high-resolution airborne magnetic survey in the Manitouwadge area (SGL, 2017; Figure 4). The survey area included three separate blocks, encompassing Blocks A, B, and C (Figure 4).

The airborne survey in the Manitouwadge area included 13,957 kilometres of flight lines covering a surface area of approximately 1,040 km^2. Flight operations were conducted out of the CYMG Airport, in Manitouwadge, Ontario, using a Cessna 208B Grand Caravan. Data were acquired along traverse lines flown in a north-south direction spaced at 100 metres, and control lines flown east-west spaced at 500 metres. The survey was flown at a target altitude of 80 metres above ground level, with an average ground speed of 100 knots (approximately 185 kilometres/hour). The survey acquisition parameters are listed below:

- Traverse line spacing of 100 metres
- Traverse line azimuth of 000 - 180°
- Control line spacing of 500 metres
- Control line azimuth of 090 - 270°
- Grid cell size of 25 metres
- Targeted sensor height of 80 metres
- Acquisition date of July 23 to October 7, 2015

Acquired data were processed by SGL (SGL, 2017) and provided to SRK as GRD files. The following products of the high-resolution airborne magnetic survey were available for this structural lineament interpretation:

- Reduction to the pole of the total magnetic intensity
- First vertical derivative of the reduction to the pole of the total magnetic intensity
- Second vertical derivative of the reduction to the pole of the total magnetic intensity

- Tilt derivative of the reduction to the pole of the total magnetic intensity

The reduced to pole total magnetic intensity, first and second vertical derivatives, and tilt derivative grids were converted to ERS images, shaded by intensity, and the data ranges and colour were enhanced in ERMapper to highlight potential structures. Ultimately, a series of compressed raster images was created in ERMapper for use in ArcGIS.

3.1.2 Digital Elevation Model

Digital elevation data (DEM) were collected during the magnetic survey conducted by SGL (SGL, 2017). The survey acquisition parameters are identical to those described for the high-resolution magnetic data in Section 3.1.1.

DEM data were processed by SGL and provided to SRK as GRD files. The data grid was then converted to an ERS image, and the data ranges, hill shading (using sun angles of 000°, 045°, and 315°), and colour ranges of the DEM were enhanced in ERMapper to highlight potential structures (Figure 5). Compressed raster images were created in ERMapper for use in ArcGIS.

3.1.3 High-resolution Digital Aerial Imagery

High-resolution digital aerial imagery was obtained from the Ontario Ministry of Natural Resources Forest Resources Inventory (FRI) (OMNR, 2009).

Digital aerial imagery was collected using a Leica ADS40 Airborne Digital Sensor. The ADS40 sensor captures multispectral bands simultaneously at the same true resolution, and therefore produces a four-band, truly co-registered and equal resolution imagery (not pan sharpened) from the data acquisition. The spectral ranges and spatial resolution of each band are listed in Table 3.

Table 3: FRI Digital Aerial Imagery Band Ranges and Resolution

Band	Range (nm)	Resolution (m)
Panchromatic	465 - 680	0.2
Blue	428 - 492	0.4
Green	533 - 587	0.4
Red	608 - 662	0.4

Prior to release to the public, the imagery tiles were run through a bidirectional reflectance distribution function (BRDF) process to remove atmospheric distortions associated with sun angles. Subsequently, blocks of orthorectified tile imagery were compiled and processed to be normalized using the brightest and darkest values within the multi-date acquisition. Each image consists of a mosaic of 5-by-5-kilometre orthorectified tiles of four-band data.

A natural colour composite of the FRI digital aerial imagery was created in ArcGIS and utilized for the lineament interpretations (Figure 6).

3.2 Lineament Interpretation Workflow

The structural lineament study of the Manitouwadge area was conducted to identify the location and orientation of potential individual fractures or fracture zones and to evaluate their relative timing relationships within the context of the local and regional geological setting.

Lineaments were interpreted using a workflow designed to address issues of subjectivity and reproducibility that are inherent to any lineament interpretation. The workflow followed a set of detailed guidelines using the high-resolution airborne geophysical (magnetic) and high-resolution surficial (DEM and FRI digital aerial imagery) data sets described above. Throughout the report the term geophysical lineaments refers to structures interpreted from the high-resolution magnetic data. The interpretation guidelines involved three steps:

- Step 1: Independent lineament interpretation by two individual interpreters for each data set and assignment of certainty level (1, 2, or 3 representing low, medium and high certainty);
- Step 2: Integration of lineament interpretations for each individual data set and first determination of reproducibility;
- Step 3: Integration of lineament interpretations for the surficial data sets (DEM and digital aerial imagery) followed by integration of the combined surficial data set with the geophysical data set, with determination of coincidence in each integration step.

Each identified lineament feature was classified in an attribute table in ArcGIS. The description of the attribute fields used is included in Table 4. Fields 1 to 9, and Fields 19 and 20 were populated during Step 1. Fields 10 and 11 were populated during Step 2. Fields 12 to 18 were populated during Step 3.

The interpreted geophysical and final integrated lineaments were classified into four general categories based on a working knowledge of the structural history and bedrock geology of the Manitouwadge area. These categories include form lines, unclassified, brittle and dyke lineaments, described as follows:

- **Form lines:** Features interpreted to represent the internal fabric of the rock units (including sedimentary or volcanic layering, tectonic foliation or gneissosity, and magmatic foliation). Form lines are typically characterized by semi-continuous linear to curvi-linear magnetic highs that appear to define the grain of the rock units. See Figure A1 for example.
- **Unclassified lineaments**: Linear to curvi-linear features that do not exhibit characteristics to easily form an interpretation, and are therefore unclassified. Possible interpretations may include ductile shear zones (intensification of foliation across a narrow zone) or brittle-ductile shear zones (intensification of foliation across a narrow zone with associated fracturing). Unclassified structures were typically characterized by curvi-linear magnetic lows and commonly truncated or offset the internal fabric of the rock (i.e., form lines). Alternatively, these unclassified structures may represent the internal fabric of the rock (foliation or gneissosity), in particular in domains where they are subparallel to the form lines, or possible brittle structures. Additional field investigations are required to determine the true nature of these lineaments. See Appendix A: Figure A2 for example.
- **Brittle lineaments:** Features interpreted as fractures (joints or joint sets, faults or fault zones, and veins or vein sets). This category also includes brittle partings interpreted to represent discontinuous re-activation parallel to the ductile fabric (e.g., form lines). Brittle lineaments are commonly characterized by continuous magnetic lows, offsets of magnetic highs, offset of form lines, and offset of unclassified lineaments, and breaks in topography and vegetation. At the desktop stage of the investigation, this category also includes features of unknown affinity. See Figure A3 for example.
- **Dyke lineaments**: Features interpreted as dykes, on the basis of their distinct character (e.g., scale orientation, geophysical signature and topographic expression). Dykes were dominantly interpreted from the magnetic data set, and are typically characterized by

continuous linear magnetic highs. The interpretation of dykes is also combined with pre-existing knowledge of the bedrock geology of the study area. See Figure A4 for example.

A detailed description of the three workflow steps and the methodology for determining the associated attribute fields for each interpreted lineament is provided below.

Table 4: Attribute Table Fields Populated for the Lineament Interpretation

ID	Attribute	Brief Description
1	Rev_ID	Reviewer initials
2	Feat_ID	Feature identifier
3	Data_typ	Data set used (MAG, DEM, FRI)
4	Feat_typ	Type of feature used to identify each lineament Digital Aerial Imagery: A. Lineaments drawn along straight or curved lake shorelines B. Lineaments drawn along straight or curved changes in intensity or texture (i.e., vegetation) C. Lineaments drawn down centre of thin rivers or streams D. Lineaments drawn along a linear chain of lakes E. Other (if other, define in comments) Digital Elevation Model: A. Lineaments drawn along straight or curved topographic valleys B. Lineaments drawn along straight or curved slope walls C. Other (if other, define in comments) Airborne Geophysics (magnetic and electromagnetic data): A. Lineaments drawn along straight or curved magnetic high B. Lineaments drawn along straight or curved magnetic low C. Lineaments drawn along straight or curved steep gradient D. Other (if other, define in comments)
5	Name	Name of feature (if known)
6	Certain	Value describing the interpreters confidence in the feature being related to bedrock structure (1-low, 2-medium or 3-high)
7	Length*	Length of feature is the sum of individual lengths of mapped polylines and is expressed in kilometres
8	Width**	Width of feature; this assessment is categorized into 5 bin classes: A. < 100 metres B. 100 – 250 metres C. 250 – 500 metres D. 500 – 1,000 metres E. > 1,000 metres
9	Azimuth	Lineament orientation expressed as degree rotation between 0 and 180 degrees
10	Buffer_RA_1	Buffer zone width for first reproducibility assessment (in metres)
11	RA_1	Feature value (1 or 2) based on reproducibility assessment
12	Buffer_RA_2	Buffer zone width for coincidence assessment (in metres)
13	RA_2	Feature value (1, 2 or 3) based on coincidence assessment
14	MAG	Feature identified in geophysical data set (Y or Blank)
15	DEM	Feature identified in DEM data set (Y or Blank)
16	FRI	Feature identified in FRI digital aerial imagery data set (Y or Blank)
17	F_Width	Final interpretation of the width of feature
18	Rel_age	Interpretation of relative age of feature, in accord with regional structural history
19	Comment	Comment field for additional relevant information on a feature
20	Object	Geological element identified, e.g., form lines, unclassified lineament, brittle lineament, dyke lineament.

* The length of each interpreted feature is calculated based on the sum of all segment lengths that make up that lineament.

** The width of each interpreted feature is determined by expert judgment and utilization of a GIS-based measurement tool. Width determination takes into account the nature of the feature as assigned in the Feature type (Feat_typ) attribute.

3.2.1 Step 1: Lineament Interpretation and Certainty Level

To accommodate the generation of the best possible unbiased lineament interpretation, two individual interpreters followed an identical process for structural lineament analysis during Step 1. The first step of the lineament interpretation was to have each individual interpreter independently produce GIS lineament maps, and detailed attribute tables, for each of the three data sets. Step 1 of the structural lineament analysis was conducted up to a scale of 1:25,000 and followed a designated workflow.

The interpretation of magnetic data followed a two-step process. The first step involved the drawing of form lines (Figure 7). Form lines were drawn along linear to curvi-linear magnetic highs as seen in the high-resolution first vertical derivative magnetic data. Locally, where the magnetic contrast was low, the tilt angle derivative data were used to enhance magnetic features. The form lines were interpreted to trace the geometry of stratigraphy, or tectonic foliation within metavolcanic and metasedimentary rocks, and the internal fabric (foliation or magmatic layering) within granitoid batholiths and gneissic rocks. Magnetic highs associated with dykes (i.e., linear crosscutting magnetic highs in orientations identified in the literature as dyke orientations) were not included in this process. Form line construction highlighted discontinuities between form lines (e.g., form lines intersecting or truncating) that may represent structures (faults, folds), unconformities, or intrusive contacts. The process of drawing form lines was instrumental in highlighting other lineaments in the magnetic data.

The second step involved drawing a structural base layer that represented all interpreted lineaments regardless of interpreted age, type (e.g., unclassified, brittle or dyke), or kinematics. Evidence for lineaments was derived from several sources in the magnetic data, including discontinuities between form lines, offset of magnetic units, or the presence of linear magnetic lows or highs. The first vertical derivative magnetic data was used mainly with the tilt angle derivative data to further enhance this interpretation.

The lineament interpretation of DEM data involved tracing linear or curvi-linear features along topographic valleys, slope walls, and any other relevant features that were visible in a colour shaded DEM derived from the airborne geophysical survey data. Similarly, the lineament interpretation of digital aerial imagery involved tracing linear or curvi-linear features along visible shore lines, changes in colour intensity or texture (e.g., vegetation), linear rivers and streams, and along linear chains of features associated with lakes that were visible in the FRI imagery.

Lineaments from each of the data sets were assigned attributes by each interpreter to characterize what type of feature the lineament corresponded to, the interpreter's certainty that the lineament represented a bedrock structure, and the approximate width of the topographic feature.

Lineaments identified in the DEM and or the digital aerial imagery that were interpreted to be related to glacial events were excluded from the lineament interpretation data set. The following criteria were utilized to decide whether a DEM or digital aerial imagery lineament should be excluded:

- The lineament coincided with a mapped ice-flow feature, moraine, or esker;
- The lineament was parallel to known eskers or moraines and was marked by narrow, curving ridges;
- The lineament was parallel to the local ice flow direction and was accompanied by drumlin-shaped hills in the DEM data set.

The Step 1 lineament analysis resulted in the generation of one interpretation for each data set (e.g., magnetic, DEM, digital aerial imagery) for each interpreter, resulting in a total of six individual GIS layer-based interpretations. Where evident, lineament segments were merged, and lineament lengths calculated, resulting in final lineament lengths that corresponded to the sum of all merged segments.

During Step 1, identified lineaments were attributed with Fields 1 to 9, and Fields 19 and 20 (Comment and Object attribute) as listed in Table 4.

3.2.2 Step 2: Lineament Reproducibility Assessment 1 (RA_1)

During Step 2, individual lineament interpretations produced by each interpreter were compared for each data set (e.g., two individual DEM lineament interpretations). This included a reproducibility assessment based on the coincidence, or lack thereof, of the interpreted lineaments within a data set specific buffer zone. The two individual lineament interpretations for each data set were then integrated and a single interpretation was generated for each data set (Figures 8 to 10). A discussion of the parameters used during this step follows.

Buffer Size Selection

Buffer sizes for lineaments in each data set were based on the magnetic grid resolution. The buffer size was determined using trial-and-error over a selected portion of the lineament interpretation. A buffer size of five times the grid cell resolution (25 metres) was selected as it provided a balanced result for assessing reproducibility. A buffer of 125 metres (either side of the lineament) was generated for the magnetic data. Given that the DEM data were extracted from the same survey, the same buffer size was applied to the DEM data. A 125-metre buffer was also applied to the digital aerial imagery data in order to be consistent with the magnetic and DEM buffer size.

The buffer size widths were included in the attribute fields of each interpretation file (Table 4). The buffers were used as an initial guide to determine coincidence between lineaments, with the expert judgement of the interpreter ultimately determining which lineaments were coincident.

Reproducibility Assessment

The generation of an integrated lineament interpretation for each data set, including the reproducibility assessment, followed a three-step process:

- Lineament buffers were generated for both individual Step 1 interpretations. The lead interpreter's Step 1 lineaments were then overlain on top of these buffers, and all lineaments that occurred within overlapping buffers were carried forward and copied into a new file for Step 2. These lineaments were attributed with a reproducibility value (RA_1; Table 4) of two in the Step 2 attribute table. In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward. During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted to better reflect the underlying data.
- The remaining lineaments in the lead Step 1 interpretation were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included adapting the shape and extent of individual lineaments to increase the accuracy of spatial location or length of the lineament, and carrying the adapted lineament forward into the Step 2 interpretation file. These lineaments were attributed a RA_1 value of one in the Step 2 attribute table. Where it was determined by the two interpreters that these features were not representative of potential bedrock structure, they were removed from the data set.

- Finally, the second Step 1 lineament interpretation was overlain on top of the Step 2 integrated file, and all remaining lineaments in the second interpreter's Step 1 interpretation were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included adapting the shape and extent of individual lineaments to increase the accuracy of spatial location or length of the lineament, and carrying the adapted lineament forward into the Step 2 interpretation file. These lineaments were attributed a RA_1 value of one in the Step 2 attribute table. All remaining lineaments that were attributed a certainty value of one were analyzed by both interpreters, and removed if it was determined that these features were not representative of potential bedrock structures.

As specified above, the decision on whether or not to adapt the shape and extent of an individual lineament, or whether the lineament was carried forward to the next step was based on analysis of the specified lineament with the available imagery and a discussion between the two interpreters. If a lineament was drawn continuously by one interpreter but as individual, spaced, or disconnected segments by the other interpreter, the longer lineament, or the lineament that most accurately represented the underlying feature was carried forward to the Step 2 interpretation with a RA_1 value of two.

The resulting Step 2 interpretations for each data set (e.g., magnetics, DEM, and FRI digital aerial imagery) were then slightly refined to avoid any structurally inconsistent or geologically improbable relationships. Any modifications of lineaments were minor, took place within the limits of the assigned buffer zone, and respected the underlying data.

3.2.3 Step 3: Coincidence Assessment (RA_2)

During Step 3, the integrated lineament interpretations for each data set were amalgamated into one final interpretation. First, lineaments derived from the DEM and digital aerial imagery were merged to produce an integrated surficial lineament data set. Subsequently, the geophysical lineaments were integrated with the integrated surficial lineaments to produce a final integrated interpretation. A discussion of the parameters used during this step follows below.

Surficial Lineament Integration

The FRI digital aerial imagery data have a resolution of 40 centimetres while the DEM data have a resolution of approximately 25 metres. Furthermore, the orientation of minor and intermediate topographic features as identified in the DEM can be ambiguous due to the resolution of the data, while these features could be drawn with greater precision from the FRI digital aerial imagery. Therefore, lineaments derived from the FRI data were used as the lead data set, and lineaments drawn from DEM data were used as the secondary data set.

A buffer of 125 metres (five times the resolution of the DEM data) was generated around the DEM lineaments and the FRI lineaments were overlain on top of this buffer. Similar to the procedure in RA_1, all lineaments that occurred within overlapping buffers were carried forward and copied into a new file. These lineaments were attributed with a RA_2 reproducibility value of two (RA_2; Table 4). In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward. During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted within the boundaries of the buffer to better reflect the underlying data.

All remaining lineaments were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included minor adaptations to the shape and extent of individual lineaments, within the limitations of the buffer, to increase the accuracy of

spatial location, length of the lineament, and (or) preserve structural relationships. All these lineaments were then carried over and attributed with an RA_2 value of one in the attribute table (RA_2; Table 4). No lineaments were removed or significantly modified at this stage of the integration.

Final Lineament Integration

The geophysical data supplied important information regarding structures in the subsurface. Therefore, for this step of the interpretation, the lineaments derived from geophysical data were given precedence over lineaments derived from surficial data, since the latter primarily provided information regarding the surface expression of potential structures.

On this premise, all lineaments derived from the magnetic data were included in the final interpretation. A buffer of 125 metres (five times the resolution of the geophysical and DEM data) was generated around the integrated surficial lineaments, and the geophysical lineaments were overlain on top of this buffer. This buffer size was included as an attribute field for all interpreted lineaments (Buffer RA_2; Table 4). Similar to the procedure in RA_1, all lineaments that occurred within overlapping buffers were carried forward and copied into a new file. These lineaments were attributed with a RA_2 reproducibility value of two or three, depending on how many surficial data sets they were observed in (RA_2; Table 4). During this process, based upon insight gained from analyzing the separate interpretations together, the geometry of the lineament that was carried forward was occasionally adapted within the boundaries of the buffer to better reflect the underlying data.

The following rules were applied for determining coincidence between the data set specific lineament maps:

- If any coincidence of lineaments occurred between the two lineament data sets, the longest lineament was carried forward and attributed as derived from two (or more) data sets, regardless of the length of overlap between the lineaments. This meant that if any part of a lineament derived from one data set was identified in another data set, it was considered that this lineament was reproduced. In addition, if two lineaments were deemed coincident, the highest certainty value from either lineament was carried forward.
- A lineament derived from DEM and (or) FRI digital aerial imagery data that occurred within the buffer of a lineament derived from geophysical data was attributed as reproduced in the relevant data sets, if the orientation of the lineaments did not deviate significantly.
- Short (less than 500 metres) discontinuous DEM and FRI digital aerial imagery data lineaments that were at low angles to geophysical data lineaments but extended outside the geophysical lineament buffer were considered to be coincident.
- Short (less than 500 metres) DEM and FRI digital aerial imagery data lineaments that were at high angles to geophysical data lineaments, largely overlapped with the buffer zone from the geophysical data lineament, and had no further continuity (i.e., singular elements), were carried forward to the final interpretation. This was done on the basis that these short segments may represent a bedrock structure, and as such, should be contained within the final integrated data set.

All remaining lineaments were then manually analyzed by both interpreters on the basis of the available imagery for each data set. In some instances, this included minor adaptations to the shape and extent of individual lineaments, within the limitations of the buffer, to increase the accuracy of spatial location, length of the lineament, and or preserve structural relationships. All these lineaments were then carried over and attributed with an RA_2 value of one (or two if observed in both surficial data sets) in the attribute table (RA_2; Table 4). No lineaments were removed or significantly

modified at this stage of the integration. This resulted in a combined interpretation with lineaments derived from the magnetic and surficial data sets.

During this process, each lineament was attributed with a text field highlighting in which data sets it was identified. The final reproducibility value (RA_2; Table 4) was then calculated as the sum of the number of data sets in which each lineament was identified, i.e., a value of 1 to 3.

Subsequently, the relative age of each lineament was interpreted and populated in the attribute table (Rel_Age; Table 4). This incorporated a working knowledge of the structural history of the Manitouwadge area, combined with an understanding of the fault characteristics in each lineament population (e.g., unclassified, brittle, dyke). The structural history of the area is described in Section 2.3, based on the existing literature.

3.2.4 Lineament Trends

An analysis of lineament trends revealed different sets of structures, which can then be related to the known structural history of the area. Lineament orientations were assessed for each data set as a whole, within individual blocks, and within distinct geological units, to determine the dominant lineament trends, and potential conjugate sets.

Lineament orientations (azimuth) were calculated using ET EasyCalculate 10, an add-in extension to ArcGIS. This add-in provides a function (polyline_GetAzimuth.cal) that calculates the azimuth of each polyline at a user-specified point and populates an assigned attribute field. SRK used the mid-point of each interpreted lineament to calculate the azimuth. A limitation is acknowledged, however, for calculating a single orientation for curvi-linear structures.

Rose diagrams are circular or semi-circular histograms that depict orientation (azimuthal) data and frequency for each data bin. The histogram peaks show the frequency of occurrence of lineament orientations within each bin. Rose diagrams were produced in Spheristat, with frequencies divided into 10-degree bins, and weighted by length. The length weighting uses a linear function directly related to the lineament length, whereby a lineament with a length of 2 kilometres will have twice the weighting of a lineament with a length of 1 kilometre.

3.2.5 Lineament Length

Lineament lengths were calculated using a simple geometrical calculation of the total length of the polyline in ArcGIS. The length distribution of the various integrated data sets was analyzed through a comparison of summary statistics, histograms, and cumulative frequency plots. Histograms and summary statistics were computed using the Stanford Geostatistical Modelling Software (SGeMS). Histogram bins were computed using arbitrary 500-metre bins.

There is no information available on the depth extent into the bedrock of the lineaments interpreted for the Manitouwadge area. In the absence of available information, the interpreted length can be used as a proxy for the depth extent of the identified structures (Nur, 1982). A preliminary assumption may be that the longer interpreted lineaments in the Manitouwadge area may extend to greater depths than the shorter interpreted lineaments. However, this is highly dependent on the style and structural history of a given fault.

3.2.6 Lineament Density

Lineament density analyses were conducted using the ArcGIS Analysis and Spatial Analyst toolsets, and included creating lineament line density plots and lineament intersection point density plots for the magnetic, surficial, and final integrated lineament data sets.

Lineament line density of all interpreted lineaments in the Manitouwadge area was determined by examining the statistical density of individual lineaments using ArcGIS Spatial Analyst. A grid cell size of 50 metres and a search radius of 1.25 kilometres (equivalent to half the size of the longest boundary of the minimum area size of a potential siting area) were used. The spatial analysis used a circular search radius examining the lengths of polylines intersected within the circular search radius around each grid cell.

The lineament intersection point density of all intersecting lineaments in the Manitouwadge area was determined by extracting all points where two or more lineaments intersected, and then calculating the statistical density of these intersection points. Lineament intersections were extracted using the ArcGIS Analysis Tools Intersect function. The density distribution of these points was then calculated in ArcGIS Spatial Analyst by defining a neighbourhood around each raster cell centre, calculating the number of points that fall within the neighbourhood, and dividing by the area of the neighbourhood. A grid cell size of 50 metres and a search radius of 1.25 kilometres (equivalent to half the size of the longest boundary of the minimum area size of a potential siting area) were used.

4 Lineament Interpretation Results

The following section describes the results of the lineament interpretation for the Manitouwadge area based on analysis of the geophysical and surficial (DEM, FRI digital aerial imagery) data sets. Lineaments interpreted and integrated from the various data sets are presented below and in Figures 7-13. A summary of lineament statistics is presented in Appendix B. For the purpose of analyzing lineament interpretation results for the Manitouwadge lineament assessment area, lineaments that extend greater than 7.5 kilometres, are between 2.5 to 7.5 kilometres and are less than 2.5 kilometres are considered long, moderate and short in length, respectively.

4.1 Geophysical Lineaments (RA_1)

The interpretation of magnetic data allows for the identification of form lines, unclassified, brittle, and dyke lineaments. Form lines traced from the magnetic data set are shown in Appendix A: Figure A1 and Figure 7, and are interpreted to represent the internal fabric of the rock units, including the geometry of the stratigraphy of the greenstone belts or the internal fabric (foliation and magmatic layering) within plutonic and gneissic rocks. Discontinuities between form lines highlight potential brittle-ductile and brittle structures (potential shear zones and/or fractures), unconformities, or intrusive contacts. Therefore, they constitute an essential data component that should be used along with the first vertical derivative of the magnetic data for interpreting unclassified and brittle lineaments. A brief discussion of form lines is included in this report to provide context to the lineament interpretation, but were not included in the statistical analyses of the lineament data sets.

Within the Manitouwadge Phase 2 lineament assessment area, 755 geophysical lineaments were interpreted and classified as brittle, dyke, or unclassified lineaments. Each of these lineaments were identified and merged by the two interpreters based on interpretation from the geophysical data (Figure 8). Of the total number of geophysical lineaments, 319 were interpreted as brittle lineaments, 211 as dyke lineaments, and 225 were interpreted as unclassified lineaments. The length of all geophysical lineaments ranges from 0.14 to 27.77 kilometres, with a median of 2.37 kilometres and a mean of 3.69 kilometres. Of the total geophysical lineaments, the reproducibility assessment identified coincidence between two interpreters for 463 lineaments (61%; RA_1 = 2) and a lack of coincidence for 292 lineaments (39%; RA_1 = 1). For the 319 brittle lineaments, the reproducibility assessment identified coincidence between two interpreters for 170 lineaments (53%; RA_1 = 2) and a lack of coincidence for 149 lineaments (47%; RA_1 = 1). While for the 211 dyke lineaments the coincidence between the two interpreters increased to 173 lineaments (82%; RA_1 = 2) with lack of coincidence for 38 lineaments (18%; RA_1 = 1).

Of the 755 lineaments interpreted, 272 (36%) were assigned the highest level of certainty (three), while 280 (37%) were assigned a moderate certainty value of two, and 203 (27%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. For the 319 brittle lineaments, 52 (16%) were assigned the highest level of certainty (three), while 140 (44%) were assigned a certainty value of two, and 127 (40%) were assigned a lower certainty value of one. For the 211 dyke lineaments the certainty increased, with 159 (75%) assigned the highest level of certainty (three), 46 (22%) assigned a certainty value of two, and 6 (3%) were assigned a lower certainty value of one. Appendix B presents a summary of geophysical lineaments statistics for all three blocks (Block A, B, and C).

Azimuth data weighted by length for the interpreted brittle lineaments display a dominant northeast-trending lineament orientation (one high confidence peak at 035°), as well as significant southeast-

and north-trending orientations (one high confidence peak at 126°, and one medium confidence peak at 002°, respectively) (see rose diagram inset Figure 8 and Table 5). Southeast-trending brittle lineaments are abundant, through-going and continuous. Northeast-trending brittle lineaments are both long and continuous, and shorter and segmented. North-trending brittle lineaments are also long, but commonly segmented, disjointed and locally offset along other lineaments. In general, the style of the different orientations of brittle lineaments (i.e., length, continuity, etc.) closely resembles the style of the dyke lineaments in the equivalent orientations.

Azimuth data weighted by length for the interpreted dyke lineaments display three dominant lineament orientations: southeast, northeast, and north (with high confidence peaks at 137°, 023°, and 002°) (see rose diagram inset in Figure 8 and Table 5). The southeast, northeast, and north lineament orientations correspond to the Matachewan, Biscotasing, and Marathon dyke sets, respectively. Southeast-trending Matachewan dyke lineaments are the most continuous and can occur in swarms or clusters that manifest as multiple tightly spaced dyke lineaments. Northeast-trending Biscotasing lineaments are continuous, but less abundant, and often occur as single isolated dyke lineaments. North-trending Marathon dyke lineaments are abundant, commonly segmented and disjointed, and semi-continuous.

Azimuth data weighted by length for the interpreted unclassified lineaments display a dominant east-west orientation, with a single, high confidence peak at 080° (see rose diagram inset in Figure 8 and Table 5). The range in orientations of unclassified lineaments is similar to the orientations of the form lines.

Table 5: Summary of Geophysical Lineament Orientations for the Manitouwadge Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	035	024 - 050	12.7	High
	SE-NW	126	110 - 132	9.3	High
	N-S	002	358 - 006	7.5	Medium
Dyke	SE-NW	137	130 - 144	22.5	High
	N-S	002	358 - 008	16.3	High
	NNE-SSW	023	019 - 026	12.8	High
Unclassified	E-W	080	059 - 093	17.1	High

Geophysical Lineaments - Block A

A total of 129 geophysical lineaments were interpreted in Block A (Figure 8a). Of these lineaments, 20 were interpreted as brittle lineaments, 38 as dyke lineaments, and 71 were interpreted as unclassified lineaments. The lengths of geophysical lineaments within this block range from 0.14 to 14.4 kilometres, with a median length of 2.19 kilometres and a mean length of 3.2 kilometres. Of the 129 lineaments interpreted in Block A, 63 (49%) were assigned the highest level of certainty (three), while 50 (39%) were assigned moderate certainty values of two, and 16 (12%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The assessment of reproducibility indicated that 83 (64%; RA_1 = 2) of the geophysical lineaments in Block A were coincident between both interpreters, whereas the remaining 46 (36%; RA_1 = 1) were identified by one interpreter.

Few brittle lineaments were interpreted in Block A, in part due to the low magnetic susceptibility contrast of the bedrock throughout much of this area (SGL, 2017; Figure 8a). Azimuth data weighted by length for the interpreted brittle lineaments in Block A display a range of orientations including northeast (one high confidence peak at 045°), southeast (one high confidence peak at 125°), north-northeast (one medium confidence peak at 015°), and north (one medium to low confidence peak at

000°) (see rose diagram inset Figure 8 and Table 6). Azimuth data weighted by length for the dyke lineaments in Block A highlight the dominant southeast-trending dykes (one high confidence peak at 138°), and to a lesser degree, northeast and north-northeast-trending dykes (two medium confidence peaks at 038°, and 018°, respectively) (see rose diagram inset in Figure 8a and Table 6). These three orientations of dykes (southeast, north, and northeast) correspond to the Matachewan, Marathon and Biscotasing dyke swarms, respectively (Figure 8a). Azimuth data weighted by length for the unclassified geophysical lineaments display the dominant east-west orientation with a single, high confidence peak at 083° (see rose diagram inset in Figure 8a and Table 6).

Table 6: Summary of Geophysical Lineament Orientations for the Manitouwadge Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	045	044 - 049	23.9	High
	SE-NW	125	123 - 127	22.7	High
	NNE-SSW	015	012 - 018	16.1	Medium
	N-S	000	353 - 003	7.4	Medium - Low
Dyke	SE-NW	138	135 - 141	33.4	High
	NNE-SSW	018	011 - 024	11.5	Medium
	NE-SW	038	035 - 047	10.4	Medium
Unclassified	E-W	083	075 - 093	42.5	High

Geophysical Lineaments - Block B

A total of 384 geophysical lineaments were interpreted in Block B (Figure 8b). Of these lineaments, 190 were interpreted as brittle lineaments, 94 as dyke lineaments and 100 were interpreted as unclassified lineaments. The lengths of geophysical lineaments within this block range from 0.16 to 27.77 kilometres, with a median length of 2.7 kilometres and a mean length of 3.96 kilometres. Of the 384 lineaments interpreted in Block B, 120 (31%) were assigned the highest level of certainty (three), while 132 (34%) were assigned moderate certainty values of two, and 132 (34%) were assigned a low certainty value of one. 231 (60%; RA_1 = 2) of the geophysical lineaments in Block B were coincident between both interpreters, whereas the remaining 153 (40%; RA_1 = 1) were identified by one interpreter.

Brittle lineaments in Block B are dominantly northeast- and east-southeast-trending with one high confidence peak at 035° and one medium to high confidence peak at 115°, respectively (see rose diagram inset in Figure 8b and Table 7). These lineaments are roughly subparallel to the Biscotasing and Matachewan dyke lineaments, respectively (Figure 8b). Both dominant orientations of brittle lineaments are linear, and relatively continuous. In addition, southeast (one medium confidence peak at 128°), north-northeast (one medium confidence peak at 018°) lineaments trends were identified (Table 7). Several north-trending brittle lineaments (one medium to low confidence peak at 178°), subparallel to the Marathon dyke lineaments were also identified. The orientation and presence of brittle lineaments was roughly similar throughout the Black-Pic batholith and the Fourbay Lake pluton, with the exception of the northeast portion of Block B (in the Black-Pic batholith), which contains less brittle lineaments, particularly less east southeast- to southeast-trending brittle lineaments. Locally, east southeast- to southeast-trending-trending brittle lineaments offset north and northeast-trending brittle and dyke lineaments (see offsets along continuous southeast-trending brittle lineament that bisects the Fourbay Lake pluton). However, east southeast- to southeast-trending brittle lineaments are also truncated by northeast-trending brittle lineaments. The brittle lineament orientations are generally consistent with the dominant orientations of dyke lineaments identified in Block B: north, southeast, and north-northeast to northeast. These orientations correspond to the Marathon, Matachewan, and Biscotasing dykes, respectively (Figure 8b). Azimuth

data weighted by length for the dyke lineaments display three dominant orientations that are north-, north-northeast-, and southeast-trending (three high confidence peaks at 003°, 021°, and 137°, respectively), and a subsidiary northeast-trending orientation (one medium to low confidence peak at 035°) (see rose diagram inset in Figure 8b and Table 7). Azimuth data weighted by length for the unclassified geophysical lineaments exhibit a range of orientations, including east-northeast (one medium to high confidence peak at 076°), east-southeast (one medium confidence peak at 110°), and north-south (one medium confidence peak at 008°, and one medium to low confidence peak at 171°) trending lineaments (see rose diagram inset in Figure 8b and Table 7).

Table 7: Summary of Geophysical Lineament Orientations for the Manitouwadge Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	035	032 - 039	16.7	High
	ESE-WNW	115	110 - 118	9.2	Medium - High
	SE-NW	128	126 - 130	7.6	Medium
	NNE-SSW	018	014 - 021	7.5	Medium
	N-S	178	175 - 181	6.1	Medium - Low
Dyke	N-S	003	000 - 006	25.4	High
	SE-NW	137	134 - 139	14.7	High
	NNE-SSW	021	018 - 024	14.4	High
	NE-SW	035	033 - 037	6.9	Medium - Low
Unclassified	ENE-WSW	076	066 - 093	12.1	Medium - High
	ESE-WNW	110	105 - 113	10.0	Medium
	N-S	008	002 - 014	7.6	Medium
	N-S	171	167 - 175	6.7	Medium - Low

Geophysical Lineaments - Block C

A total of 242 geophysical lineaments were interpreted in Block C (Figure 8c). Of these lineaments, 54 were interpreted as brittle-ductile lineaments, 109 as brittle lineaments, and 79 as dyke lineaments. The lengths of geophysical lineaments within this block range from 0.14 to 19.65 kilometres, with a median length of 2.25 kilometres and a mean length of 3.53 kilometres. Of the 242 lineaments interpreted in Block C, 89 (37%) were assigned the highest level of certainty (three), while 98 (40%) were assigned moderate certainty values of two, and 55 (23%) were assigned a low certainty value of one. The assessment of reproducibility indicated that 149 (62%; RA_1 = 2) of the geophysical lineaments in Block C were coincident between both interpreters, whereas the remaining 93 (38%; RA_1 = 1) were identified by one interpreter.

The azimuths of brittle lineaments weighted by length display three dominant orientations of brittle lineaments identified in Block C: southeast- (one high confidence peak at 140° and one medium to high confidence peak at 126°), north- (one medium to high confidence peak at 003°), and north-northeast- to northeast-trending brittle lineaments (one medium to high confidence peak at 028°, and one medium to low confidence peak at 040°) with subsidiary east-trending lineaments also observed (one medium to low confidence peak at 085°) (see rose diagram inset in Figure 8c and Table 8). These orientations of brittle lineaments are all moderate to long and linear. However, unlike the other Manitouwadge blocks, north-trending brittle lineaments tend to be more abundant and well-developed in Block C. An additional set of shorter and somewhat discontinuous east-west to west-northwest–trending brittle lineaments was also observed in Block C. Orientations of interpreted dyke lineaments within Block C are consistent with the dominant brittle lineaments (Figure 8c). Southeast-trending dyke lineaments occur throughout the entirety of Block C, corresponding to the Matachewan dyke swarm, locally form clusters of tightly spaced dyke lineaments. Northeast- and

north-northeast–trending dyke lineaments are also observed in Block C, corresponding to Biscotasing and Marathon dykes, respectively. Azimuth data weighted by length for the dyke lineaments display all three orientations, and highlight the predominance of the southeast-trending Matachewan dyke lineaments with two high confidence peaks at 140° and 025°, and one medium confidence peak at 001° (see rose diagram inset in Figure 8c and Table 8).

The northwest portion of Block C is characterized by well-developed northeast-trending form lines and pervasive continuous curvi-linear to anastomosing northeast-trending unclassified lineaments (Figure 8c). Azimuth data weighted by length for the unclassified lineaments display a range of orientations from east-northeast (one high confidence peak at 068°) to northeast (one medium to high confidence peak at 048°) (see rose diagram inset in Figure 8c and Table 8).

Table 8: Summary of Geophysical Lineament Orientations for the Manitouwadge Area (Block C)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	SE - NW	140	138 - 143	12.5	High
	SE - NW	126	124 - 129	11.8	Medium - High
	N-S	003	000 - 006	10.9	Medium - High
	NNE-SSW	028	025 - 030	10.4	Medium - High
	E-W	085	083 - 089	6.9	Medium - Low
	NE-SW	040	037 - 042	6.9	Medium - Low
Dyke	SE-NW	140	133 - 145	28.5	High
	NNE-SSW	025	021 - 028	15.1	High
	N-S	001	359 - 004	9.5	Medium
Unclassified	ENE-WSW	068	057 - 073	27.6	High
	NE-SW	048	044 - 050	14.0	Medium - High

4.2 Surficial Lineaments

Surficial lineaments include lineaments interpreted from the DEM and FRI digital aerial imagery data sets, and are shown on Figures 9 and 10, respectively. Unlike the lineaments identified from the magnetic data, surficial lineaments cannot be easily differentiated into brittle, dyke, and unclassified lineaments based solely upon their expression in surficial data. Therefore, all surficial lineaments are classified only by the data set from which they were identified (i.e., DEM lineament and FRI lineament). An overview of the results of the surficial lineament interpretation is provided below.

4.2.1 DEM Lineaments (RA_1)

A total of 524 DEM lineaments were interpreted within the Manitouwadge Phase 2 lineament assessment area. These data comprise lineaments that were identified and merged by the two interpreters based on interpretation from the DEM data (Figure 9). The length of all DEM lineaments ranges from 0.27 to 28.46 kilometres, with a median of 2.35 kilometres and a mean of 3.38 kilometres. Of the 524 lineaments interpreted, 144 (27 %) were assigned the highest level of certainty (three), while 193 (37%) were assigned a moderate certainty values of two, and 187 (36%) were assigned a low certainty values of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. Of the total DEM lineaments, 326 lineaments were coincident between the two interpreters (62%; RA_1 = 2) and there was a lack of coincidence for 198 lineaments (38%; RA_1 = 1). Appendix B presents a summary of DEM lineaments statistics per block (Block A, B and C).

Azimuth data weighted by length for the interpreted DEM lineaments display a dominant northeast lineament set (one high confidence peak at 045°) as well as minor north (one medium confidence peak at 002°), east northeast (one medium to low confidence peak at 073°), and southeast (one medium to low confidence peak at 130°) orientations (see rose diagram inset in Figure 9 and Table 9). Throughout all three blocks, northeast-trending DEM lineaments are typically abundant, long and continuous. However, the northeast orientation is also coincident with the dominant glacial flow direction (Figure 3). North-trending DEM lineaments are less abundant, but when present are typically long and continuous. Southeast-trending DEM lineaments are moderately abundant, variable in length, and often segmented and disjointed. The concentration of lineaments is directly influenced by the degree of topography in a given area, i.e., areas with subdued topography and a lack of elevation contrast impede the interpretation of DEM lineaments. This can be observed in all three Manitouwadge blocks, where low relief regions (colored blue in Figure 9) are characterized by a relatively low number of interpreted DEM lineaments.

Table 9: Summary of DEM Lineament Orientations for the Manitouwadge Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	NE-SW	045	027 - 048	17	High
	N-S	002	357 - 007	7.4	Medium
	ENE-WSW	073	069 - 074	6.1	Medium - Low
	SE-NW	130	126 - 137	5.9	Medium - Low

DEM Lineaments - Block A

A total of 86 DEM lineaments were interpreted in Block A (Figure 9a). The lengths of all DEM lineaments within this block range from 0.27 to 11.29 kilometres, with a median length of 1.68 kilometres and a mean length of 2.45 kilometres. Of the 86 lineaments, 21 (24%) were assigned the highest level of certainty (three), while 32 (37%) were assigned moderate certainty values of two, and 33 (38%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. Sixty-one (71%; RA_1 = 2) DEM lineaments in Block A were coincident between both interpreters, whereas the remaining 25 (29%; RA_1 = 1) were identified by one interpreter.

Azimuth data weighted by length for the DEM lineaments within Block A exhibit a dominantly northeast orientation (one high confidence peak at 043°) as well as minor north (one medium confidence peak at 175°), southeast (one medium confidence peak at 132°), east-northeast (one medium confidence peak at 073°), and east-southeast (one medium to low confidence peak at 109°) orientations (see rose diagram inset in Figure 9a and Table 10). A low number of DEM lineaments were interpreted in a north-trending valley in the western portion of Block A, due to subdued topography and the presence of overburden.

Table 10: Summary of DEM Lineament Orientations for the Manitouwadge Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	NE-SW	043	037 - 048	17.7	High
	SE-NW	132	130 - 136	10.6	Medium
	ENE-WSW	073	070 - 078	10.2	Medium
	N-S	175	173 - 188	8.9	Medium
	ESE-WNW	109	106 - 113	6.5	Medium - Low

DEM Lineaments - Block B

A total of 237 DEM lineaments were interpreted in Block B (Figure 9b). The lengths of all DEM lineaments within this block range from 0.55 to 28.46 kilometres, with a median length of 2.95 kilometres and a mean length of 4.12 kilometres. Of the 237 lineaments interpreted in Block B, 61 (26%) were assigned the highest level of certainty (three), while 89 (37%) were assigned moderate certainty values of two, and 87 (37%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 149 (63%; RA_1 = 2) of the DEM lineaments in Block B were coincident between both interpreters, whereas the remaining 88 (37%; RA_1 = 1) were identified by one interpreter.

DEM lineaments within Block B display a dominant northeast to north-northeast orientation (two high confidence peaks at 048° and 030°, respectively) as well as minor southeast (one medium to low confidence peak at 125°), and north (one medium to low confidence peak at 001°) orientations (see rose diagram inset in Figure 9b and Table 11). North-trending lineaments are less abundant, but when present, are typically long and continuous. Southeast-trending lineaments are short to long, distributed throughout Block B and often discontinuous. Few moderately long east-west lineaments are also present in the northeast portion of Block B. A low number of DEM lineaments were interpreted in the south-central western portion of Block B, due to subdued topography and the presence of overburden along the Black River valley.

Table 11: Summary of DEM Lineament Orientations for the Manitouwadge Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	NE-SW	048	044 - 050	19.9	High
	NNE-SSW	030	027 - 033	17.6	High
	SE-NW	125	117 - 130	5.9	Medium - Low
	N-S	001	358 - 006	5.8	Medium - Low

DEM Lineaments - Block C

A total of 201 DEM lineaments were interpreted in Block C (Figure 9c). The lengths of all DEM lineaments within this block range from 0.44 to 19.73 kilometres, with a median length of 2.28 kilometres and a mean length of 2.9 kilometres. Of the 201 lineaments interpreted in Block C, 62 (31%) were assigned the highest level of certainty (three), while 72 (36%) were assigned moderate certainty values of two, and 67 (33%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 116 (58%; RA_1 = 2) of the DEM lineaments in Block C were coincident between both interpreters, whereas the remaining 85 (42%; RA_1 = 1) were identified by one interpreter.

DEM lineaments within Block C display a dominant northeast to east-northeast orientation (two high confidence peaks at 043° and 071°, respectively) as well as subsidiary north (one medium to high confidence peak at 003°), and southeast (one medium to low confidence peak at 141°) orientations (see rose diagram inset in Figure 9c and Table 12). Long continuous linear to curvi-linear northeast-trending lineaments are most abundant in the northern portion of Block C, along and adjacent to thin slivers of northeast-trending metavolcanic and gabbroic rocks. Shorter linear northeast-trending lineaments are distributed throughout the remainder of Block C. North-trending DEM lineaments are typically long, linear, and relatively continuous. In contrast, southeast-trending lineaments are moderate to short and segmented, and distributed throughout Block C. Anastomosing curvi-linear northeast- to east-west–trending lineaments are present in the central portion of Block C.

Table 12: Summary of DEM Lineament Orientations for the Manitouwadge Area (Block C)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
DEM	NE-SW	043	039 - 045	16.2	High
	ENE-WSW	071	064 - 077	10.9	High
	N-S	003	359 - 008	9.8	Medium - High
	SE-NW	141	128 - 150	6.7	Medium - Low

4.2.2 FRI Digital Aerial Imagery Lineaments (RA_1)

A total of 1123 FRI lineaments were interpreted within the Manitouwadge Phase 2 assessment areas (Figure 10). This comprises lineaments that were identified and merged by the two interpreters based on interpretation from the FRI digital aerial imagery (FRI) data (Figure 10). The length of all FRI lineaments ranges from 0.11 to 16.99 kilometres, with a median of 1.0 kilometres and a mean of 1.44 kilometres. Of the 1123 lineaments interpreted, 142 (13 %) were assigned the highest level of certainty (three), while 470 (42%) were assigned a moderate certainty value of two, and 511 (46%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. Of the total FRI lineaments, the reproducibility assessment identified coincidence for 538 lineaments (48%; RA_1 = 2) and a lack of coincidence for 585 lineaments (52%; RA_1 = 1). Appendix B presents a summary of FRI lineaments statistics per block (Block A, B and C).

Azimuth data weighted by length for the interpreted FRI lineaments display a dominant but broad north-northeast orientation (one high confidence peak at 033°) as well as minor southeast and north orientations (see rose diagram inset in Figure 10 and Table 13). Throughout all three blocks, northeast-trending FRI lineaments are moderately abundant, and locally continuous. However, the northeast orientation is coincident with the dominant trend of glacial flow, and therefore, despite efforts to exclude glacial features, lineaments in this orientation may be overemphasized (Figure 3). Southeast-trending FRI lineaments are also moderately abundant, and often segmented and disjointed. North-trending FRI lineaments are less abundant, but when present, can be moderate to long and continuous. The concentration of lineaments is directly influenced by the exposure of bedrock and quality of surficial features in a given area. Areas characterized by well-defined lake boundaries, breaks in vegetation, linear rivers, etc., often yield numerous FRI lineaments, versus areas with high overburden and subdued surficial features, which impede the interpretation of digital aerial imagery lineaments. This can be observed in all three Manitouwadge blocks, where regions of subdued surficial features (such as the centre of Block A, seen in Figure 10) are characterized by a relatively low number of interpreted FRI lineaments. Unlike the DEM or geophysical lineaments, the features observed in the FRI imagery are often short and discontinuous, due to the way in which bedrock features manifest in digital aerial imagery.

Table 13: Summary of FRI Lineament Orientations for the Manitouwadge Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NNE-SSW	033	017 - 050	14.5	High

FRI Lineaments - Block A

A total of 175 FRI lineaments were interpreted in Block A (Figure 10a). The lengths of all FRI lineaments within this block range from 0.23 to 12.37 kilometres, with a median length of 0.85

kilometres and a mean length of 1.13 kilometres. Of the 175 lineaments interpreted in Block A, 12 (7%) were assigned the highest level of certainty (three), while 79 (45%) were assigned moderate certainty values of two, and 84 (48%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 82 (47%; RA_1 = 2) of the FRI lineaments in Block A were coincident between both interpreters, whereas the remaining 93 (53%; RA_1 = 1) were identified by one interpreter only.

Azimuth data weighted by length for the FRI lineaments within Block A exhibit a dominant north northeast orientation (two high confidence peaks at 015° and 030°), and minor southeast (one medium confidence peak at 135°), and north-south (one medium to low confidence peak at 176°) orientations (see rose diagram inset in Figure 10a and Table 14). With the exception of a single long northeast-trending lineament that transects the centre of Block A and certain north-trending lineaments along the western boundary of the area, all remaining lineaments are relatively short in length. In certain areas, the shorter discontinuous lineaments occur along strike from each other and may correspond to the same underlying bedrock structure. A low number of FRI lineaments were interpreted in the central portion of Block A, due to the presence of abundant overburden.

Table 14: Summary of FRI Lineament Orientations for the Manitouwadge Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NNE-SSW	030	027 - 046	14.7	High
	NNE-SSW	015	012 - 018	14.3	High
	SE-NW	135	131 - 140	7.6	Medium
	N-S	176	172 - 180	6.5	Medium - Low

FRI Lineaments - Block B

A total of 612 FRI lineaments were interpreted in Block B (Figure 10b). The lengths of all FRI lineaments within this block range from 0.11 to 16.99 kilometres, with a median length of 0.97 kilometres and a mean length of 1.42 kilometres. Of the 612 lineaments interpreted in Block B, 85 (14%) were assigned the highest level of certainty (three), while 254 (42%) were assigned moderate certainty values of two, and 273 (45%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 294 (48%; RA_1 = 2) of the FRI lineaments in Block B were coincident between both interpreters, whereas the remaining 318 (52%; RA_1 = 1) were identified by one interpreter only.

FRI lineaments within Block B exhibit a dominant north-northeast orientation (one high confidence peak at 030°) as well as a minor southeast and north orientation (see rose diagram inset in Figure 10b and Table 15). North-trending lineaments are less abundant, but when present, are often moderate to long and continuous. A moderately long north-trending FRI lineament located in central-western portion of Block B (transects Barehead Lake) may represent the southern continuation of the sinistral north-trending Cadawaja fault that offsets the Manitouwadge greenstone belt (north of Block B). Northwest-trending lineaments are distributed throughout Block B, and locally form a series of segmented lineaments along strike from each other, likely representing the same underlying bedrock feature. Few east-west lineaments are present throughout the area.

Table 15: Summary of FRI Lineament Orientations for the Manitouwadge Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NNE-SSW	030	018 - 047	18.3	High

FRI Lineaments - Block C

A total of 336 FRI lineaments were interpreted in Block C (Figure 10c). The lengths of all FRI lineaments within this block range from 0.19 to 11.85 kilometres, with a median length of 1.11 kilometres and a mean length of 1.65 kilometres. Of the 336 lineaments interpreted in Block C, 45 (13%) were assigned the highest level of certainty (three), while 137 (41%) were assigned moderate certainty values of two, and 154 (46%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 162 (48%; RA_1 = 2) of the FRI lineaments in Block C were coincident between both interpreters, whereas the remaining 174 (52%; RA_1 = 1) were identified by one interpreter only.

Azimuth data weighted by length for the FRI lineaments within Block C exhibit a dominant north-northeast to northeast orientation (two high confidence peaks at 019° and 040°) as well as a minor southeast orientation (one medium to low confidence peak at 130°) (see rose diagram inset in Figure 10c and Table 16). North-northeast-, to northeast-trending lineaments are most abundant in the northern portion of Block C, along and adjacent to thin northeast-trending metavolcanic and gabbroic rocks. North-trending FRI lineaments, although not abundant, are typically long and continuous. In particular, a north-trending lineament in the eastern portion of Block C extends for almost the entire length of the block (Figure 10c). Southeast-trending lineaments are distributed throughout Block C, and include two moderate to long southeast-trending FRI lineaments that transect the central and northern portions of Block C (Figure 10c). The distribution of lineaments throughout Block C is relatively uniform, with the exception of the northern portion of Block C, where northeast-trending lineaments subparallel to thin units of metavolcanic and gabbroic rocks dominate. In the very southern portion of Block C, there is a relatively small area sparsely populated with lineaments, due to the presence of significant overburden (Figure 10c).

Table 16: Summary of FRI Lineament Orientations for the Manitouwadge Area (Block C)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
FRI	NE-SW	040	035 - 053	14.0	High
	NNE-SSW	019	014 - 023	9.8	High
	SE-NW	130	127 - 134	6.7	Medium - Low

4.3 Integrated Surficial Lineaments (RA_2)

The lineaments interpreted based on DEM and FRI digital aerial imagery data were integrated into a single set of surficial lineaments following the methodology outlined in Section 3. Similar to the interpretation of DEM and FRI lineaments, surficial lineaments cannot be differentiated into unclassified, brittle, and dyke lineaments based solely upon their expression in surficial data, and are, therefore, all classified as surficial lineaments. The integrated surficial lineaments are shown in Figure 11 on the mapped bedrock geology based on the Ontario Geological Survey (OGS 2011). The figure also shows mapped faults and mapped dykes, based on either field mapping evidence or an interpretation from historic aeromagnetic data. An overview of the results of the integrated surficial lineaments is provided below and summarized in Appendix B.

The integration of DEM and FRI lineaments yielded a total of 1218 surficial lineaments (Figure 11). The length of all surficial lineaments ranges from 0.15 to 20.6 kilometres, with a median of 1.26 kilometres and a mean of 2.03 kilometres. In general, lineaments interpreted from the digital aerial image data are significantly shorter than those interpreted from the DEM data (see Sections 4.2.1 and 4.2.2). Of the 1218 integrated surficial lineaments, 246 (20 %) were assigned the highest level of

certainty (three), while 489 (40%) were assigned a moderate certainty value of two, and 483 (40%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. A total of 396 lineaments (33%; RA_2 = 2) were coincident in both the DEM and FRI data sets whereas 822 lineaments occurred in only one of the two data sets (67%; RA_2 = 1).

Azimuth data weighted by length for the interpreted surficial lineaments display a dominant but broad northeast orientation (one high confidence peak at 040°), as well as a north-northeast (one high confidence peak at 020°), and a minor southeast orientation (one medium to low confidence peak at 128°) (see rose diagram inset in Figure 11 and Table 17). The northeast-trending surficial lineaments tend to be relatively long and continuous, and are typically more abundant compared to other lineament orientations. However, the northeast (or southwest) orientation is also coincident with the dominant trend of glacial flow (Figure 3). Southeast-trending surficial lineaments are moderately abundant, variable in length, and locally segmented and disjointed. North-northeast-trending surficial lineaments can be moderate to long and continuous.

Table 17: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Manitouwadge Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated Surficial Lineaments	NE-SW	040	030 - 055	14.5	High
	NNE-SSW	020	011 - 025	10.0	High
	SE-NW	128	110 - 133	5.7	Medium - Low

Integrated Surficial Lineaments - Block A

211 integrated surficial lineaments were interpreted in Block A (Figure 11a). The lengths of all surficial lineaments within this block range from 0.21 to 13.76 kilometres, with a median length of 1.04 kilometres and a mean length of 1.56 kilometres. Of the 211 lineaments interpreted in Block A, 29 (14%) were assigned the highest level of certainty (three), while 94 (45%) were assigned moderate certainty values of two, and 88 (42%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 42 (20%; RA_2 = 2) of the surficial lineaments in Block A were coincident between both the DEM and FRI lineament data sets, whereas the remaining 169 (80%; RA_2 = 1) were only identified in a single surficial data set.

Azimuth data weighted by length for the surficial lineaments within Block A exhibit dominantly northeast to north-northeast orientations (two high confidence peaks at 038° and 015°), as well as minor southeast (one medium confidence peak at 137°), east-west (one medium confidence peak at 080°), and north-south-trending orientations (one medium to low confidence peak at 173°) (see rose diagram inset in Figure 11a and Table 18). Occasional east-trending lineaments exhibit a slight curvi-linear geometry, and are often segmented.

Table 18: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Manitouwadge Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated Surficial Lineaments	NE-SW	038	029 - 048	16.7	High
	NNE-SSW	015	010 - 020	10.8	High
	SE-NW	137	131 - 142	8.1	Medium
	E-W	080	071 - 094	7.2	Medium
	N-S	173	168 - 178	6.6	Medium - Low

Integrated Surficial Lineaments - Block B

A total of 615 integrated surficial lineaments were interpreted in Block B (Figure 11b). The length of all integrated surficial lineaments within this block range from 0.16 to 20.6 kilometres, with a median length of 1.29 kilometres and a mean length of 2.2 kilometres. Of the 615 lineaments interpreted in Block B, 126 (20%) were assigned the highest level of certainty (three), while 237 (39%) were assigned moderate certainty values of two, and 252 (41%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 197 (32%; RA_2 = 2) of the integrated surficial lineaments in Block B were coincident between both data sets, whereas the remaining 418 (68%; RA_2 = 1) were only identified in a single surficial data set.

Azimuth data weighted by length for the integrated surficial lineaments within Block B exhibit dominant broad northeast to north-northeast orientations (two high confidence peaks at 043° and 017°) as well as a minor southeast orientation (one medium confidence peak at 122°) (see rose diagram inset in Figure 11b and Table 19). Both the north-northeast-trending and northeast-trending lineaments are relatively long, linear, and continuous compared to other lineament orientations. A long north-trending lineament located in central-western portion of Block B (transects Barehead Lake) may represent the southern continuation of the sinistral north-trending Cadawaja fault that offsets the Manitouwadge greenstone belt (north of Block B). Southeast-trending lineaments are typically short to moderate lengths, and are often segmented throughout Block B. East-west trending lineaments are also present, mainly in the northeast portion of Block B.

Table 19: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Manitouwadge Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated	NE-SW	043	029 - 055	14.8	High
Surficial	NNE-SSW	017	011 - 024	12.2	High
Lineaments	ESE-WNW	122	112 - 129	6.5	Medium

Integrated Surficial Lineaments - Block C

A total of 392 surficial lineaments were interpreted in Block C (Figure 11c). The lengths of all surficial lineaments within this block range from 0.15 to 13.66 kilometres, with a median length of 1.39 kilometres and a mean length of 2.03 kilometres. Of the 392 lineaments interpreted in Block C, 91 (23%) were assigned the highest level of certainty (three), while 158 (40%) were assigned moderate certainty values of two, and 143 (36%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. A total of 157 (40%; RA_2 = 2) of the surficial lineaments in Block C were coincident between both surficial data sets, whereas the remaining 235 (60%; RA_2 = 1) were only identified in either the DEM or FRI imagery data sets.

Azimuth data weighted by length for the surficial lineaments within Block C exhibit a dominant broad northeast orientation (two high confidence peaks at 040° and 055°), a north-south orientation (one high confidence peak at 003°), a north-northeast orientation (one medium to high confidence peak at 022°), as well as a minor southeast orientation (one medium confidence peak at 130°) (see rose diagram inset in Figure 11c and Table 20). Northeast-trending lineaments are most abundant in the northern portion of Block C, along and adjacent to thin northeast-trending metavolcanic and gabbroic rocks. The majority of north-trending lineaments are present in the central northern portion of Block C and are moderate to long and continuous. Southeast-trending lineaments are shorter compared to other orientation sets.

Table 20: Summary of Integrated Surficial Lineament (RA_2) Orientations for the Manitouwadge Area (Block C)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Integrated Surficial Lineaments	NE-SW	040	035 - 048	14.6	High
	NE-SW	055	050 - 058	11.4	High
	N-S	003	000 - 008	9.6	High
	NNE-SSW	022	018 - 027	8.3	Medium - High
	SE-NW	130	127 - 135	7.3	Medium

4.4 Integrated Final Lineaments (RA_2)

The final integrated lineament data set produced by merging all lineaments interpreted from the geophysical (Figure 12) and surficial (DEM and aerial imagery, Figure 11) data is presented on Figure 13. Based upon the geophysical interpretation, and the geological understanding of the area, the final integrated lineaments were differentiated into brittle, dyke, and unclassified lineaments. An overview of the results of the final integrated lineaments is provided below, summarized in Appendix B, and presented in Figure 13.

The integration of geophysical and surficial lineament sets produced a total of 1763 final integrated lineaments (Figure 13), of which 1282 were interpreted as brittle lineaments, 218 as dyke lineaments, and 263 interpreted as unclassified lineaments. The length of all final integrated lineaments ranges from 0.14 to 27.75 kilometres, with a median of 1.54 kilometres and a mean of 2.53 kilometres. Of the 1763 final integrated lineaments, 541 (31 %) were assigned the highest level of certainty (three), while 676 (38%) were assigned a certainty value of two, and 546 (31%) were assigned a certainty value of one. The certainty value reflects the certainty that the interpreted lineament represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 220 lineaments (12%; RA_2 = 3), and coincidence in two out of three data sets for 394 lineaments (22%; RA_2 = 2). A total of 1149 (65%) lineaments were not coincident with any other data set (RA_2 = 1).

Azimuth data for brittle lineaments exhibit a dominant, broad northeast-trending lineament orientation (one high confidence peak at 038°), as well as a minor southeast-trending orientation (one medium confidence peak at 127°) (see rose diagram inset in Figure 13 and Table 21). Azimuth data weighted by length for the interpreted dyke lineaments display three well-defined lineament sets, trending southeast, north-south, and northeast (with two high confidence peaks at 138°, and 008°, and one medium to high confidence peak at 035°, respectively) (see rose diagram inset in Figure 13 and Table 21). Southeast-trending dyke lineaments correspond to the Matachewan dyke swarm, are pervasive through the area and commonly occur in clusters that manifest as multiple tightly spaced dyke lineaments. North-northeast-trending dyke lineaments, interpreted as part of the Biscotasing dyke swarm, are less abundant, and often occur as single isolated dyke lineaments. The north-south-trending dyke lineaments, interpreted as part of the Marathon dyke swarm, are abundant and commonly segmented and disjointed. In general, the southeast and northeast-trending brittle lineament orientations closely resemble the orientations of Matachewan and Biscotasing dyke lineaments, respectively. No strong correlation is observed between with the north-south-trending Marathon dyke lineaments and the brittle lineaments. Azimuth data weighted by length for the interpreted unclassified lineaments display a dominant east-northeast orientation with a single, high confidence peak at 073° (see rose diagram inset in Figure 13 and Table 21).

Table 21: Summary of Integrated Final Lineament (RA_2) Orientations for the Manitouwadge Area

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	038	022 - 051	14.2	High
	SE-NW	127	115 - 136	6.3	Medium
Dyke	SE-NW	138	133 - 146	20.6	High
	N-S	008	001 - 020	13.8	High
	NE-SW	035	030 - 041	9.2	Medium - High
Unclassified	ENE-WSW	073	061 - 093	17.2	High

Final Integrated Lineaments - Block A

A total of 297 final integrated lineaments were interpreted in Block A (Figure 13a). Of these lineaments, 178 were interpreted as brittle lineaments, 40 as dyke lineaments, and 79 were interpreted as unclassified lineaments. The lengths of the final integrated lineaments within this block range from 0.35 to 14.57 kilometres, with a median length of 1.24 kilometres and a mean length of 2.18 kilometres. Of the 297 lineaments interpreted in Block A, 91 (31%) were assigned the highest level of certainty (three), while 128 (43%) were assigned moderate certainty values of two, and 78 (26%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 20 lineaments (7%; RA_2 = 3), and coincidence in two out of three data sets for 59 lineaments (20%; RA_2 = 2). A total of 218 (73%) lineaments were not coincident with any other data set (RA_2 = 1).

Brittle lineaments within Block A exhibit dominant northeast orientation (one high confidence peak at 043°), within subsidiary north-northeast (one medium to high confidence peak at 018°), north-south (one medium confidence peak at 179°), and southeast orientations (one medium confidence peak at 137°) (see rose diagram inset in Figure 13a and Table 22). These orientations roughly correspond to the orientation of the main dyke lineaments. All brittle lineament sets vary from short to long, and locally offset and truncate each other. Azimuth data weighted by length for the dyke lineaments display one dominant southeast orientation (one high confidence peak at 138°), and two subsidiary northeast, and north-northeast orientations (one medium to high confidence peak at 038°, and one medium confidence peak at 020°) (see rose diagram inset in Figure 13a and Table 22). The southeast dyke lineament orientation corresponds to the Matachewan dyke swarm, while the northeast and north-northeast orientations correspond to the Biscotasing and Marathon dyke swarms, respectively (Figure 13a). Similar to the geophysical lineaments within Block A, the southeast-trending Matachewan dykes are long, continuous, abundant, and occur in spaced clusters, while the Biscotasing dykes are long, continuous and occur in isolation (i.e., not as clusters). Rare and segmented north-northeast trending Marathon dykes were also identified. Lineaments interpreted as unclassified within Block A are predominantly east-west–trending (one high confidence peak at 083°) and tend to be evenly distributed throughout the block (see rose diagram inset in Figure 13a and Table 22). Fewer northeast-trending unclassified lineaments are present and are typically restricted to the southeast portion of Block A.

Table 22: Summary of Integrated Final Lineament (RA_2) Orientations for the Manitouwadge Area (Block A)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	043	032 - 049	17.9	High
	NNE-SSW	018	010 - 023	9.5	Medium - High
	N-S	179	170 - 183	7.8	Medium
	SE-NW	137	127 - 147	7.7	Medium
Dyke	SE-NW	138	132 - 141	34.0	High
	NE-SW	038	034 - 042	15.3	Medium - High
	NNE-SSW	020	012 - 025	11.0	Medium
Unclassified	E-W	083	074 - 093	42.4	High

Final Integrated Lineaments - Block B

A total of 909 final integrated lineaments were interpreted in Block B (Figure 13a). Of these lineaments, 707 were interpreted as brittle lineaments, 96 as dyke lineaments, 106 were interpreted as unclassified lineaments. The lengths of the final integrated lineaments within this block range from 0.23 to 27.75 kilometres, with a median length of 1.64 kilometres and a mean length of 2.68 kilometres. Of the 909 lineaments interpreted in Block B, 261 (29%) were assigned the highest level of certainty (three), while 330 (36%) were assigned moderate certainty values of two, and 318 (35%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 111 lineaments (12%; RA_2 = 3), and coincidence in two out of three data sets for 203 lineaments (22%; RA_2 = 2). A total of 595 (65%) lineaments were not coincident with any other data set (RA_2 = 1).

Brittle lineaments within Block B exhibit a dominant northeast orientation (one high confidence peak at 038°), and a minor east-southeast orientation (one medium to low orientation peak at 121°) (see rose diagram inset in Figure 13b and Table 23). Azimuth data weighted by length for the dyke lineaments within Block B exhibit a dominant north-south-trending orientation (one high confidence peak at 008°) corresponding to the Marathon dyke swarm, with minor southeast (one medium confidence peak at 141°), north-northeast (one medium confidence peak at 031°), south-southeast (one medium to low confidence peak at 162°), and east-southeast orientations (one medium to low confidence peak at 120°) (see rose diagram inset in Figure 13b and Table 23). The northeast and southeast orientations, correspond to the Biscotasing and Matachewan dyke swarms, respectively (Figure 13b). Similar to the geophysical lineaments, the southeast-trending Matachewan dykes occur as a cluster of long continuous dyke lineaments that transect the centre of Block B, whereas the north–trending Marathon dyke lineaments are long, segmented and are distributed throughout the Black-Pic batholith within Block B. A single southeast-trending dyke lineament transects the Fourbay Lake Pluton. Azimuth data weighted by length for unclassified lineaments display a dominant east-west orientation (one high confidence peak at 090°), in addition to a diffuse pattern of other orientations including east-southeast (one medium to high confidence peak at 105°, and one medium to low confidence peak at 122°), east-northeast (one medium confidence peak at 072°), and north-northeast (two medium to low confidence peaks at 016° and 033°) (see rose diagram inset in Figure 13b and Table 23). The unclassified lineaments occur in three separate zones within Block B (Figure 13b). These zones include predominantly east-west trending lineaments throughout the northern portion of Block B, north- to northeast-trending curvi-linear to semi-circular lineaments adjacent to the boundary of the Fourbay Lake pluton, and curvi-linear east-west to north trending lineaments in the southeast portion of Block B.

Table 23: Summary of Integrated Final Lineament (RA_2) Orientations for the Manitouwadge Area (Block B)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	038	020 - 050	15.3	High
	ESE-WNW	121	110 - 133	6.4	Medium - Low
Dyke	N-S	008	358 - 013	24.1	High
	SE-NW	141	137 - 150	9.5	Medium
	NNE-SSW	031	027 - 035	8.6	Medium
	SSE-NNW	162	160 - 164	6.7	Medium - Low
	ESE-WNW	120	112 - 126	5.9	Medium - Low
Unclassified	E-W	090	081 - 098	13.4	High
	ESE-WNW	105	100 - 113	10.8	Medium - High
	ENE-WSW	072	068 - 077	9.6	Medium
	ESE-WNW	122	118 - 127	7.2	Medium - Low
	NNE-SSW	033	030 - 035	7.0	Medium - Low
	NNE-SSW	016	012 - 019	6.4	Medium - Low

Integrated Final Lineaments - Block C

A total of 557 final integrated lineaments were interpreted in Block C (Figure 13c). Of these lineaments, 397 were interpreted as brittle lineaments, 82 as dyke lineaments, and 78 were interpreted as unclassified lineaments. The lengths of the final integrated lineaments within this block range from 0.24 to 17.62 kilometres, with a median length of 1.53 kilometres and a mean length of 2.46 kilometres. Of the 557 lineaments interpreted in Block B, 189 (34%) were assigned the highest level of certainty (three), while 218 (39%) were assigned moderate certainty values of two, and 150 (27%) were assigned a low certainty value of one. The certainty value reflects the certainty that the interpreted structure represents a bedrock feature. The reproducibility assessment identified coincidence in all three data sets for 89 lineaments (16%; RA_2 = 3), and coincidence in two out of three data sets for 132 lineaments (24%; RA_2 = 2). A total of 336 (60%) lineaments were not coincident with any other data set (RA_2 = 1).

Brittle lineaments within Block C exhibit a dominant broad north-northeast to northeast lineament orientation (two high confidence peaks at 023° and 038°), and subsidiary southeast (one medium to high confidence peak at 130°), and north-south orientations (one medium to low confidence peak at 005°) (see rose diagram inset in Figure 13c and Table 24). These orientations roughly correspond to the orientation of the main dyke lineaments. Azimuth data weighted by length for the dyke lineaments within Block C are dominated by southeast-trending dyke lineaments (one high confidence peak at 140°), and also contain less abundant northeast-trending dyke lineaments (one medium confidence peak at 034°) (see rose diagram inset in Figure 13c and Table 24). The southeast-trending dyke lineaments correspond to the Matachewan dyke swarm and tend to occur as a cluster of longer continuous dyke lineaments, whereas the northeast-trending lineaments correspond with Biscotasing dykes that commonly occur as isolated lineaments. Azimuth data weighted by length for the interpreted unclassified lineaments display a dominant east-northeast orientation with a single, high confidence peak at 068° (see rose diagram inset in Figure 13c and Table 24). The east-northeast-trending unclassified lineaments are located within the northern portion of Block C (Figure 13c), and form a network of pervasive unclassified lineaments coincident with a narrow unit of east-northeast trending metavolcanic rocks of the Manitouwadge greenstone belt, and a narrow-subparallel gabbroic intrusion.

Table 24: Summary of Integrated Final Lineament (RA_2) Orientations for the Manitouwadge Area (Block C)

Lineament Type	Orientation Set	Peak (deg)	Range (deg)	Frequency (%)	Confidence
Brittle	NE-SW	038	031 - 053	11.3	High
	NNE-SSW	023	020 - 027	9.3	High
	SE-NW	130	123 - 141	8.0	Medium - High
	N-S	005	357 - 011	6.5	Medium - Low
Dyke	SE-NW	140	131 - 152	32.3	High
	NE-SW	034	013 - 040	10.7	Medium
Unclassified	ENE-WSW	068	051 - 079	32.3	High

5 Discussion

This lineament interpretation provides an understanding of potential structures within the bedrock units of the Manitouwadge Phase 2 assessment areas. The results of the lineament interpretation, including lineament reproducibility and coincidence, orientation, length, and density are discussed below. The relationship of the integrated lineament data sets relative to the regional structural history and their relative ages are also discussed.

5.1 Lineament Reproducibility (RA_1) and Coincidence (RA_2)

Lineament reproducibility and coincidence are assessed in several steps during the analysis (as outlined in Section 3). First, the two individual interpretations for each data set are integrated to produce single data set specific (RA_1) interpretations. During this step, the reproducibility (RA_1 value) of each lineament is assessed (as outlined in Section 3.2.2). Secondly, the individual data set interpretations are integrated to produce the final integrated (RA_2) data set. During this step, the coincidence (RA_2 value) between lineaments identified in the various data sets was evaluated (as outlined in Section 3.2.3). A summary of reproducibility and coincidence values is presented in Section 4 and Appendix B.

The evaluation of RA_1 data for all blocks and lineament types (Geophysical, DEM, FRI) reveals a moderate to high reproducibility between interpreters for the geophysical lineaments (61% of lineaments RA_1=2) and DEM lineaments (62% of lineaments RA_1=2), and a moderate reproducibility for the FRI lineaments (48% of lineaments RA_1=2). The lower reproducibility between interpreters for the FRI lineaments relative to the other data sets can be attributed to the occasional subtle nature of the features defining the FRI lineaments. For example, a change in vegetation defining a lineament in the FRI data set is typically less pronounced than a change in topography that may define that same lineament in the DEM data set. Furthermore, considerable cultural influence in Block B (i.e., logging) locally inhibited the FRI lineament interpretation and may have also contributed to the lower reproducibility of FRI lineaments.

Reproducibility values (RA_1) are relatively consistent between lineaments types and blocks (Blocks A, B and C), with the exception of dyke lineaments identified from the geophysical data set, which exhibited a higher than average reproducibility (RA_1 = 82% for dyke lineaments in all blocks). The high reproducibility for dyke lineaments is expected, as their geophysical signatures are typically well-defined (long continuous magnetic highs), and therefore easily interpreted. Lineaments with low reproducibility values are the result of differences in the individual lineament interpretations from each interpreter for the same data set, and can be attributed to the judgement and subjectivity of the expert carrying out the interpretation.

Coincidence between lineaments identified from the DEM and FRI data sets were evaluated for the second reproducibility assessment (RA_2). A total of 33% of the surficial lineaments were interpreted in both the DEM and FRI data sets. The coincidence between lineaments of these data sets is in part explained by the fact that lineaments interpreted from the FRI imagery and the digital elevation data represent surficial expressions of the same bedrock feature. For example, a lineament drawn along a stream channel shown on the FRI imagery is expected to be coincident with a lineament that captures the trend of the associated topographic valley expressed in the digital elevation data. The lack of coincidence between the two surficial data sets may be the result of several factors, including, the difference in resolution, and the different styles in which structures manifest in the DEM and FRI data sets. The DEM data were collected during the magnetic survey

(25 metre grid cell size), and is a much lower resolution than the FRI imagery (0.4 metres resolution). Therefore, a structure that is apparent in the FRI imagery may not be apparent in the DEM data. Alternatively, a structure present in the DEM data may be represented as multiple structures within the higher resolution FRI data. The way in which bedrock structures are expressed in the DEM and FRI data set may also account for the lack of coincidence. For example, certain structures observed in the DEM data may be obscured by vegetation in the FRI data, and conversely, structures defined by a change in vegetation in the FRI data may not have a topographic expression in the DEM data.

The coincidence assessment (RA_2) between geophysical and surficial features revealed that 43% of the interpreted geophysical lineaments were also interpreted in at least one of the two surficial data sets. When considering the final integrated lineament data set, 13% of these lineaments were identified in all three data sets, and 22% of the final integrated lineaments were identified in two of the three data sets. The remaining 65% of the integrated lineaments lack coincidence and were only identified in a single data set. When evaluating coincidence of the specific types of lineaments (i.e., brittle, dyke and unclassified), of the 1282 brittle lineaments interpreted in the final integrated lineament data set, 11% were identified in all three data sets, and 25% were identified in two of the three data sets. The remaining 64% of the brittle lineaments lack any coincidence and were only identified in a single data set. Over half of the brittle lineaments that lack coincidence with any other data set were derived from the FRI data.

The coincidence assessment confirms that dyke lineaments interpreted from the geophysical data were also in part expressed within the surficial data. Of the 218 dyke lineaments interpreted, 31% of these lineaments were coincident with at least one of the two surficial data sets, and 16% where interpreted in both surficial data sets.

For the 263 unclassified lineaments interpreted in the final integrated lineament data set, 15% of the unclassified lineaments were identified in all three data sets, and 18% were identified in two of the three data sets. The remaining 67% of the unclassified lineaments lack any coincidence and were only identified in a single data set.

The lack of coincidence between different sets of lineaments may be attributed to multiple factors, including:

- Deeper structures identified in the magnetic data may not have a surficial expression
- Certain structures identified in the magnetic data may have a subdued or no surficial expression
- Surface expression of geophysical lineaments may be masked by the presence of overburden (e.g., large river valleys covered by Quaternary sediments)
- Structures identified in the surficial data may not extend to significant depths and therefore may not be recognizable in the magnetic data
- Structures identified in the surficial data may not possess sufficient magnetic susceptibility contrast to be recognized in the magnetic data

Considering the above factors, it is necessary to objectively analyze the results of the RA_2 assessment with the understanding that RA_2 = 1 does not necessarily imply a low degree of confidence that the specified lineament represents a true bedrock structure. Lineaments that were coincident in two or three data sets were commonly long and continuous. Within the magnetic data, these lineaments were defined by continuous magnetic lows or highs, whereas in the surficial data sets, these lineaments were defined by continuous topographic valleys, long linear lakes and vegetation changes.

5.2 Lineament Trends

The orientations of the dominant lineaments sets within the Manitouwadge Phase 2 assessment area can be observed visually (Figures 8-13), and via length weighted azimuth plots (see rose diagram insets in Figures 8-13). Length weighted lineament trends within the Manitouwadge assessment area provide a strong indication of lineament sets with preferred azimuths. In some cases, there are similarities and differences observed between the lineament trends identified in each of the data sets. A summary of lineament orientation data for all blocks is presented in Appendix A: Figure A5.

Lineament trends identified from both the geophysical and surficial lineament data sets within the Manitouwadge area display five dominant orientations: southeast, north-south, northeast, north-northeast, and east to east-northeast. Of these lineament orientations, the southeast-, northeast- and north-trending lineaments are well defined in all lineament data sets. The fourth dominant east to east-northeast lineament orientation is predominantly observed in the geophysical lineament data set, but is also present within the surficial data sets. Within the geophysical data set, the east to east-northeast trend is typically associated with unclassified lineaments.

Length weighted orientation data for the geophysical lineaments exhibit dominant northeast to north-northeast, southeast-, and north-trending lineament orientations (Figure 12). Geophysical lineaments can also be subdivided into orientation sets based on lineament type (i.e. brittle, dyke, unclassified lineaments). The dyke lineament orientations exhibit three distinct orientations trending southeast (one high confidence peak at 137°), north (one high confidence peak at 002°) and north-northeast (one high confidence peak at 023°), representing the Matachewan, Marathon, and Biscotasing dyke swarms, respectively (Table 5). The southeast-trending dyke lineaments often occur as separated clusters of tightly spaced dyke lineaments. In contrast, north-trending dyke lineaments are typically widely spaced and distributed throughout the assessment area, whereas north-northeast trending dyke lineaments typically occur in isolation. The orientation of brittle lineaments interpreted in the geophysical data show similar trends as the dyke lineaments, with high confidence peaks at 126°, and 035°, and a medium confidence peak at 002°, however their orientations are commonly more broadly distributed towards the southeast, northeast, and north (Table 5). In addition, interpreted brittle lineaments also show a minor east-trending orientation, potentially related to the Quetico-Wawa subprovince boundary, to which they are sub-parallel.

Surficial lineaments exhibit two dominant broad northeast and north-northeast trends (one high confidence peak at 040°, and one high confidence peak at 020°, respectively), and a minor southeast trend (one medium to low confidence peak at 128°) (Table 17). Consistent with the brittle lineaments interpreted from the geophysical data set, the surficial lineament orientations display trends that are coincident with the orientations of the Matachewan, Marathon, and Biscotasing dyke swarms. The dominant northeast-trending surficial lineaments are oriented parallel to the main glacial flow direction (seen in Figure 3). Despite efforts to not interpret glacially derived features, (e.g., drumlins, eskers, etc.), the coincidence in their orientation may generate some uncertainty in whether or not all northeast-trending lineaments represent bedrock structures. The northeast trending surficial lineaments are also coincident with northeast-oriented geophysical lineaments, suggesting that northeast-trending lineaments are an expression of both glacial and bedrock features.

The final integrated lineament data set exhibits similar trends as observed in the geophysical and surficial data sets. Although the final integrated brittle and dyke lineaments exhibit similar trends, minor differences the frequency and length of lineaments within the dominant peaks differ between the dyke and brittle lineaments. The orientations of the final integrated brittle lineaments exhibit a dominant, broad northeast-trend (one high confidence peak at 038°), and a minor trend (one medium confidence peak at 127°), whereas the final integrated dyke lineaments exhibit three well-defined

lineament sets, trending southeast, north-south, and northeast (with two high confidence peaks at 138°, and 008°, and one medium to high confidence peak at 035°, respectively) (Figure 13 and Table 21).

The orientation of unclassified lineaments exhibit a dominant east- to east-northeast-trend, with a single, high confidence peak at 073°. These easterly trending unclassified lineaments are most dominant throughout the Quetico metasedimentary rocks in Block A (Figure 8a), the Black-Pic batholith in the northern portion of Block B (Figure 8b), and subparallel to the thin northeast-trending mafic metavolcanic and gabbroic rocks in the northern portion of Block C (Figure 8c). Additional unclassified lineaments can be observed in Block B, trending north to northeast in a semi-circular pattern, subparallel to the boundary of the Fourbay Lake pluton (Figure 8b).

5.2.1 Relationship between Lineament Sets and Regional Stress Field

The principal neotectonic stress orientation in central North America is generally oriented approximately east-northeast (63 degrees ± 28 degrees; Zoback ,1992) although anomalous stress orientations have also been reported in the mid-continent that include a 90-degree change in azimuth of the maximum compressive stress axis (Brown et al., 1995) and a local north-south maximum horizontal compressive stress (Haimson, 1990). Local variations, and other potential complicating factors involved in characterizing crustal stresses, including the effect of shear stress induced by mantle flow at the base of the lithosphere (Bokelmann, 2002; Bokelmann and Silver, 2002), the degree of coupling between the North American plate and the underlying mantle (Forte et al., 2010), the effects of crustal depression and Holocene rebound, and the influence of the thick lithospheric mantle root under the Canadian Shield, make it premature to correlate the regional neotectonic stress orientation with the orientation of interpreted lineaments.

However, it is possible to broadly speculate on the potential behavior of the identified lineaments if they were to be reactivated by the regional east-northeast neotectonic stress regime. Four dominant orientations of lineaments were interpreted: northwest, north, northeast, and east to east-northeast. Should the identified lineaments be reactivated under the current stress regime, the northwest and north oriented lineaments would likely reactivate as reverse dip-slip to oblique-slip faults depending on their strike and dip, and the northeast and east to east-northeast oriented lineaments would likely reactivate as strike-slip to oblique-slip faults.

5.3 Lineament Length

Interpreted geophysical, surficial and final integrated lineaments classified by length are presented in Figures 14, 15 and 16. The distributions of lineament lengths are displayed on histograms and cumulative frequency plots (see inset plots on Figures 14-16). On these plots, the x-axis represents the bin lengths for the lineaments (km), and the left y-axis represents the percentage of the total number of interpreted lineaments contained within that length bin. The blue line represents the cumulative frequencies expressed as a fraction between 0 and 1, which can be considered equivalent to probability. The probability is labeled on the right y-axis of the plot. Length statistics are summarized in Appendix A: Figure A6, and Appendix B. Lineament lengths displayed and reported in the figures, statistics tables, and histogram plots only reflect the length of the portion of the lineament that is contained within the individual lineament assessment blocks (i.e., any portion of a lineament that is contained within Block A, B, or C). Therefore, the lineament lengths do not necessarily reflect the full length of all lineaments, as lineaments were only traced within the assessment area and could extend beyond its borders.

Overall, lineament lengths for the geophysical brittle and dyke, surficial, and final integrated lineaments display a similar histogram distribution, with a minor skewed distribution of lengths

toward shorter lineaments in the surficial lineaments data set. For each of the lineament data sets the majority of lineaments tend to have lengths of less than 5 kilometres. Approximately 77% of the geophysical brittle and dyke lineaments and approximately 93% of the surficial lineaments have lengths which are less than 5 km. The geophysical brittle and dyke lineaments contain a higher number of long lineaments relative to the integrated surficial lineaments. This is most apparent for lineaments in the 5-10 kilometre range shown in the histograms, which were less commonly interpreted from the surficial data sets (Figures 14-16, and Appendix A: Figure A6).

The comparison of median and mean values for all geophysical, surficial, and final integrated lineaments reveals a roughly similar length distribution as described above (Appendix B). The geophysical lineaments exhibit the longest overall mean (3.69 kilometres) and median (2.37 kilometres), whereas the integrated surficial lineaments exhibit the shortest mean (2.03 kilometres) and median (1.26 kilometres). As described above, this is likely due to the style in which bedrock structures are represented in the geophysical data set (long and continuous lineaments) versus in surficial data sets (short discontinuous and segmented lineaments). The final integrated lineaments exhibit an intermediate mean (2.53 kilometres) and median (1.54 kilometres), as would be expected as these lineament are the result of the combination of the slightly longer geophysical and slightly shorter surficial lineaments.

The difference in length between lineaments interpreted from geophysical and surficial data sets can in part be explained by the nature of the lineaments interpreted from each data set. From the geophysical data, lineaments are typically characterized by long continuous magnetic lows or highs (e.g. dykes). Conversely, surficial lineaments are typically characterized by a combination of breaks in topography, vegetation and bedrock, and elongated lakes. These surficial features are not as continuous as the lineaments interpreted from geophysical data, often due to their interruption by overburden. This resulted in the interpretation of shorter surficial lineaments relative to the geophysical lineaments.

Analysis of lineament length relative to coincidence values for all final integrated lineaments indicate that lineaments coincident in all three data sets (RA_2=3) are typically longer (mean = 6.51 kilometres, median = 5.09 kilometres) than lineaments reproduced in two (RA_2=2; mean = 2.89 kilometres, median = 2.05 kilometres) or only one (RA_2_1; mean = 1.65 kilometres, median = 1.16 kilometres) data sets. This is to be expected, as lineaments observed in all three data sets are more likely to represent significant bedrock structures.

Similarly, an analysis of lineament length relative to certainty values for the final integrated lineaments indicate that lineaments with the highest certainty value (3), are typically longer (mean = 4.44 kilometres, median = 3.14 kilometres), than those with certainty values of 2 (mean = 1.99 kilometres, median = 1.58 kilometres) and 1 (mean = 1.31 kilometres, median = 1.02 kilometres). Again, this is to be expected as lineaments assigned the highest certainty are most likely to represent significant bedrock structures.

The evaluation of lineament length relative to lineament orientation, indicate that longer lineaments are approximately evenly distributed in all of the dominant lineament orientations. For example, a relatively similar number of long lineaments are interpreted in northwest, north, and northeast orientations in both the geophysical and surficial lineament data sets. The majority of these long lineaments correspond to dykes in the three dominant regional orientations. An exception to this, include a high number of northeast-trending surficial lineaments. However as noted previously, this orientation of surficial lineament is also coincident with the orientation of glacial flow.

Although there is no information available on the depth extent of the interpreted lineaments for the Manitouwadge Phase 2 assessment area, the length information described above can be used as a

proxy for depth extent. Therefore, a preliminary assumption may be that the longer interpreted lineaments may extend to greater depths than the shorter interpreted lineaments.

5.4 Density

Analyses of lineament and lineament intersection density were conducted for the Manitouwadge Phase 2 Assessment areas, as described in Section 3.2.6, and are presented in Figures 17 to 21 (lineament density) and 22 to 27 (lineament intersection density).

5.4.1 Lineament Density

An analysis of lineament density for each data set and block is presented below and in Figures 17 to 21. Locally, lineament densities appear to be lower at the margins of the assessment areas. This arises as lineaments are only traced to the margins of the blocks, and when generating density plots, this can result in an apparent low lineament density around the border of each block.

Geophysical Lineament Density

As the nature of unclassified lineaments is unknown at this stage (potential to represent ductile shear zones, brittle-ductile shear zones or the internal fabric of the rock units, etc), density analyses for geophysical lineaments were conducted with and without the unclassified lineaments. Figure 17 shows the lineament density of the brittle and dyke lineaments, and Figure 18 includes the unclassified lineaments in the calculation of lineament density.

Throughout all three blocks, lineament density analyses of brittle and dyke lineaments reveal a relatively low and uniform background lineament density, and multiple zones of elevated lineament density, particularly in Block C (Figure 17). Zones of elevated lineament density occur within most geological units and are typically the result of clusters of tightly spaced brittle and (or) dyke lineaments, in particular in areas were these lineament clusters intersect.

The density of brittle and dyke lineaments in Block A is variable and include minor zones of higher density (Figure 17a). Zones of elevated lineament density occur throughout Block A where a series of northwest-trending Matachewan dyke and subparallel brittle lineaments intersect a northeast-trending Biscotasing dyke and subparallel brittle lineaments. The low number of brittle lineaments interpreted in Block A may in part be due to the low magnetic susceptibility of the Quetico metasedimentary rocks, which may mask the presence of brittle structures. When also considering east-west trending unclassified lineaments in the lineament density calculation for Block A, the density is locally enhanced in broad zones that are typically elongated in an east-west orientation (Figure 18a).

Brittle and dyke lineaments exhibit several zones of high density throughout Block B, dominantly within the central-western portion of the block (Figure 17b). These zones of higher density typically correspond to tightly spaced clusters of dyke and or brittle lineaments, and the intersection of these lineament clusters. Additional unclassified lineaments are interpreted in several areas throughout Block B, including an east-west trending domain along the northern portion of the area, and a curvi-linear domain adjacent to the eastern boundary of the Fourbay Lake pluton (Figure 18b). Including the unclassified lineaments in the lineament density calculation locally enhances the density in these areas; however, the nature of these lineaments remains uncertain.

Brittle and dyke lineaments within Block C exhibit a higher density relative to the other two blocks (Figure 17c). In particular, the southwestern quadrant of Block C exhibits a high brittle and dyke lineament density, due to tightly spaced clusters of brittle and dyke lineaments, and the intersections

of these lineament clusters. A large zone of lower brittle and dyke lineament density is located in the north of Block C, and corresponds to an area with a high density of northeast-trending unclassified lineaments, coincident and subparallel to thin northeast-trending metavolcanic and gabbroic rocks (Figure 18c). By including unclassified lineaments in the density calculation, this zone shows a high lineament density (Figure 18c). The true nature of these unclassified lineaments cannot be ascertained from the lineament study; however their distribution in Block C defines a distinct structural domain. An additional area of relatively lower lineament density (including unclassified, brittle, and dyke lineaments) is present in the central-eastern portion of Block C, west of a north-trending oval shaped north-trending granite-granodiorite intrusion (Figure 17c, 18c).

Surficial Lineament Density

Zones of elevated lineament densities typically occur along or at the intersection of tightly spaced northwest-, north-, and northeast- trending surficial lineaments. The density of surficial lineaments is in part related to the presence of overburden. In order to properly assess surficial lineament density, it is necessary to take into account the location of surficial features (river valleys, glacial till cover, etc.), as the ability to interpret surficial lineaments was limited in these areas.

The density of surficial lineaments throughout Block A is relatively low and exhibit with several zones of elevated lineament densities (Figure 19a). Areas of higher surficial lineament coincide with a higher density of shorter surficial lineaments. The presences of additional surficial lineaments may be masked by the significant amount of overburden covering the bedrock throughout Block A. The area of highest surficial lineament density coincides with the area around Lauri Lake. Locally, areas of low surficial lineament density are located proximal to the boundary of Block A and may represent an artifact of the lineament traces terminating at the boundary of the block.

Block B is characterized by a variable surficial lineament density with several broad but isolated zones of higher lineament density (Figure 19b). Zones of higher lineament density are related to clusters of tight-spaced northeast- and northwest-trending surficial lineaments, as well as discrete areas with higher number of short lineaments. Areas of highest surficial lineament density are located centrally throughout Block B, and include zones located on the northwestern side of the Black River and in the southeastern portion of Block B. Areas of lower lineament density are distributed throughout Block B. Locally, low lineament density zones correspond to areas of thicker overburden deposits (5 km east of Agonzon Lake) and larger river valleys, including the northeast-trending Black River along the central-southern boundary of the block. In other cases, areas of bedrock exposure also show lower surficial lineament density, including the areas surrounding Barehead Lake, within the Fourbay Pluton, and around Morley Lake.

Block C is characterized by a higher surficial lineament density compared to Block A and B, with relatively few small pockets of lower surficial lineament density (Figure 19c). The majority of the higher lineament density zones correspond to tight-spaced corridors of northeast-trending lineaments and the intersection of these lineaments with north- and northwest-trending lineaments. Notable higher density areas include an area of tight northeast-trending surficial lineaments located in the northern portion of Block C, which is consistent with the location of the northeast-trending metavolcanic and gabbroic units. This northeast trend is also consistent with the interpretation of several northeast-trending unclassified lineaments from the geophysical data set. A significant area of lower surficial lineament density occurs along the southern boundary of Block C, however this area is also coincident with extensive glacial outwash and esker deposits, suggesting that the surficial expression of bedrock structures in these areas is masked by the presence of overburden.

Final Integrated Lineament Density

The final integrated lineaments result from the integration of the geophysical and surficial lineaments. Therefore, these lineaments can be classified into brittle, dyke, and unclassified

lineaments. Similar to the geophysical lineament density analyses, density analyses for the final integrated lineaments were conducted with and without the unclassified lineaments. Figure 20 shows the lineament density of the brittle and dyke lineaments from the final integrated lineament data set, and Figure 21 includes the unclassified lineaments in the calculation of lineament density.

Lineament density analyses of the final integrated brittle and dyke lineaments reveal a variable distribution of lower lineament density with multiple zones of elevated lineament density (Figure 20). Similar to the other data sets, zones of higher lineament density correspond to tight-spaced northeast-, north-, and northwest-trending brittle and dyke lineaments, and the intersection of these lineament orientations. The addition of unclassified lineaments to the lineament density analyses reveal isolated zones of elevated lineament density (Figure 21c)

The density of brittle and dyke lineaments in Block A is relatively variable (Figure 20a), and include minor zones of elevated lineament density along tight-spaced northeast-trending lineaments, and at the intersection of northwest- and north-trending lineaments, in addition to isolated zones of low lineament density. When including unclassified lineaments in the final lineament density calculation, broad zones of high lineament density occur in the areas surrounding the pervasive east-west trending unclassified lineaments (Figure 21a).

Brittle and dyke lineaments within Block B exhibit a variable lineament density, including several well-defined zones of higher density (Figure 20b), such as areas in the central and eastern portion of Block B. The higher density zones are either isolated or form linear northwest, north, and northeast trends, and typically result from tightly spaced clusters of brittle and dyke lineaments, and the intersection of these lineaments. Similar to the geophysical lineament density, zones of lower brittle and dyke lineament density are locally coincident with areas of elevated unclassified lineament density (Figures 20b, 21b). When also considering the unclassified lineaments, additional areas of high lineament density are present adjacent to the Fourbay Lake pluton, along the northern boundary of Block B, and in the southeast corner of the block (Figure 21b).

Brittle and dyke lineament density within Block C (Figure 20c) shows a similar distribution as the geophysical density plots, including areas of higher lineament density occurring along zones of closely spaced brittle and dyke lineaments, and at the intersection of these lineament clusters. In particular, an elevated zone of brittle and dyke lineament density occurs along the south-western boundary of Block C. Similar to the geophysical lineament density, a low-density area is located in the northern portion of Block C (Figure 20c). When also considering the unclassified lineaments, this northern portion of Block C displays a relatively high lineament density, due to the network of pervasive east-northeast trending unclassified lineaments (Figure 21c). This high-density area is larger than observed in the geophysical lineament density due to the integration and coincidence with multiple surficial lineaments along the same east-northeast trend.

5.4.2 Lineament Intersection Density

An analysis of lineament intersection density for each data set and block is presented below and in Figures 22 to 26.

Geophysical Lineament Intersection Density

As the character of the unclassified lineaments is unknown at this stage, two separate lineament intersection density analyses were conducted. Figure 22 shows lineament intersection density of only brittle and dyke lineaments interpreted in the geophysical data. Figure 23 incorporates the distribution of unclassified lineaments into this lineament intersection density analyses. Elevated lineament intersection densities are typically due to the intersection of tightly spaced clusters of lineaments (Figure 22).

In Block A, zones of minor elevated brittle and dyke lineament intersection density occur at the intersections of northeast- and northwest-trending brittle lineaments with dyke lineament clusters (Figure 22a). When also considering the distribution of the unclassified lineaments (Figure 23a), additional zones of elevated intersection density are present, particularly in the southeastern portion of Block A. These areas of elevated density are the result of the intersection of northwest- and northeast-trending brittle and dyke lineaments with east-west trending unclassified lineaments.

Brittle and dyke lineament intersection density is relatively low and variable throughout Block B (Figure 22b). Minor zones of elevated intersection density are present in the central western portion of Block B. In particular, multiple minor zones of elevated lineament intersection density occur in the central western portion of Block B, and within the Fourbay Lake pluton. These zones correspond to the intersection of a set of northwest-trending brittle and dyke lineaments with multiple north- and northeast-trending brittle and dyke lineaments. When also considering unclassified lineaments, the distribution of lineament intersection densities is similar (Figure 23b), with the exception of two additional zones of elevated intersection density, along the southeastern and northern boundaries of Block B.

Brittle and dyke lineament intersection density within Block C is elevated in the central-western portion of the block (Figure 22c), and is relatively low elsewhere. The higher density areas are the result of the intersection of a tight cluster of northwest-trending dykes and subparallel brittle lineaments with several northeast-trending dykes and subparallel brittle lineaments. When also considering unclassified lineaments, the northern portion of Block C displays an elevated lineament intersection density (Figure 23c). This is the result of multiple northeast-, north-, and northwest-trending brittle and dyke lineaments intersecting the pervasive network of east-northeast trending unclassified lineaments in this area.

Surficial Lineament Intersection Density

Lineament intersection density for the integrated surficial lineaments shown in Figure 24 displays a very similar pattern as the surficial lineament density shown in Figure 19. Similar to the surficial lineament density, the surficial lineament intersection density is in part influenced by the distribution of overburden deposits. In order to properly assess the surficial lineament intersection density it is necessary to take into account the location of surficial features that may have limited the lineament interpretation (e.g., river valleys, glacial till cover, etc.).

The intersection density of surficial lineaments in Block A is relatively low, and exhibits local zones of increased lineament density (Figure 24a). Block A has been mapped as containing a significant amount of overburden deposits (i.e., moraine) relative to the other blocks in the Manitouwadge area. Therefore, it is plausible that these overburden units may mask additional surficial lineaments within the area. Areas of high surficial lineament density correspond to the intersection of northwest- and north-trending lineaments with lineaments of other orientations, including north- and northwest-trending zones of elevated lineament density located in the southwest portion of Block A. In addition, the area around Lauri Lake also shows a high surficial lineament intersection density, similar to the surficial lineament density (Figure 19).

Zones of elevated surficial lineament intersection in Block B occur in linear northwest and northeast orientations, due to the intersections between tightly spaced northeast- and northwest-trending lineaments. Northeast- and northwest-trending surficial lineaments are the most prominent orientations interpreted within Block B. These areas include a zone on the northwestern side of Black River, and a broad zone in the southeastern part of Block B. In addition, areas north of Agonzon Lake and east of Morley Lake show minor elevated density of surficial lineament intersections. Overall, areas of high intersection densities are also coincident with areas of high

surficial lineament density (Figure 19). Areas of relatively low surficial lineament intersection density include the northeast-trending zone along the Black River in the south-central portion of Block B, and the area adjacent to and including the Fourbay Lake pluton. The area including the Black River valley is covered by significant glaciolacustrine sediments (Figure 2), resulting in the interpretation of relatively few surficial lineaments.

The intersection density of surficial lineaments in Block C is relatively high compared to Blocks A and B, and exhibits multiple zones of elevated intersection density (Figure 24c). Areas of higher surficial lineament intersection densities occur in the central and northern portions of Block C and tend to be distributed along northeast-trending and northwest-trending orientations (Figure 24c). The northernmost zone of high surficial lineament intersection density results from the intersection of northwest-trending lineaments with tightly spaced east-northeast trending lineaments. The majority of the east-northeast trending surficial lineaments are coincident with the dominant orientation of the unclassified lineaments interpreted from the geophysical data in this area, as well as the east-northeast trending metavolcanic and gabbroic unit. The higher density zone in the central portion of Block C results from the intersection of tightly spaced northwest- and northeast-trending lineaments. Areas of relatively low lineament intersection density are located along the southern and eastern boundary of Block C. Lower lineament intersection densities along the southeastern boundary of Block C are likely due to the presence of significant glacial outwash sediments (Figure 2), possibly masking the interpretation of surficial lineaments.

Final Integrated Lineament Intersection Density

The following section describes the final integrated lineament intersection density based on lineaments that are interpreted as brittle, dyke, and unclassified from the geophysical and surficial data sets (DEM and FRI). As the character of the unclassified lineaments is unknown at this stage, two separate lineament intersection density analyses were conducted. Figure 25 shows lineament intersection density of all final brittle and dyke lineaments, and Figure 26 incorporates the unclassified lineaments, and shows the final integrated lineament intersection density for all interpreted lineaments.

Block A exhibits three zones of elevated brittle and dyke lineament intersection density, located at the intersections of northeast- and northwest-trending brittle lineament and dyke lineament clusters (Figure 25a), with the largest area located near Lauri Lake. When also considering the dominant east-trending unclassified lineaments (Figure 26a), areas of elevated intersection density broaden to include the majority of Block A. Exceptions to this include a zone of lower intersection density area in the southwestern corner of Block A.

Brittle and dyke lineament intersection density is variable throughout Block B, and includes several discrete areas of high intersection density, typically oriented along northeast and northeast trends (Figure 25b). Elevated zones of intersection density scattered throughout Block B result from the intersection of dyke and brittle lineaments of the three dominant orientations (northwest, north and northeast). Large lower intersection density areas are also apparent throughout Block B, in particular near Morley Lake, to the west and east of Agonzon Lake, and the area adjacent to the Fourbay pluton. When also considering the unclassified lineaments, the overall density of lineament intersections locally increases (Figure 26b). In particular, intersection density increases in the northern portion of the block, where east-trending unclassified lineaments that form a broad zone along the northern boundary of Block B. Despite the presence of significant unclassified lineaments adjacent to the Fourbay Lake pluton, the intersection density remains relatively low, as these lineaments are typically sub-parallel and do not form intersections with other lineaments.

Within Block C the brittle and dyke lineament intersection density is elevated in the central-western portion of the block (Figure 25c). The higher density areas are the result of the intersection of a tight

cluster of northwest-trending Matachewan dykes and subparallel brittle lineaments with several northeast-trending Biscotasing dykes and subparallel brittle lineaments. Areas of low intersection density area present along the northern and eastern boundary of Block C. In this case, the area along the northern boundary of the Block C shows a lowest intersection density within the east-northeast trending bedrock units mapped as metavolcanic and gabbroic. When also considering unclassified lineaments, this northern portion of Block C displays an elevated lineament intersection density resulting from multiple northeast-, north-, and northwest-trending brittle and dyke lineaments intersecting the pervasive network of east-northeast trending unclassified lineaments (Figure 26c).

5.5 Lineament Truncation and Relative Age Relationships

The structural history of the Manitouwadge area, outlined in Section 2.3, provides a framework that may aid in constraining the relative age relationships of the interpreted bedrock lineaments. Previous work in and around the Manitouwadge area identified six regionally distinguishable deformation episodes ($D_1 – D_6$) that are inferred to have overprinted the bedrock geological units of the area. The lineament interpretation is roughly consistent with regional observations, however, certain deformation events described in the literature could not be distinguished in the interpreted lineaments (D_1), and other deformation events could not be separated and were therefore grouped together (i.e., D_2 to D_4, and D_5 and D_6).

As summarized in Section 2.3, D_1 is characterized by a lack of penetrative fabric and rarely preserved isoclinal folds between ca. 2.719 and ca. 2.691 Ga, and D_2-D_4 includes all unclassified lineaments, and is characterized by steeply-dipping foliations, isoclinal folds, and thrust faults, primarily observed within the greenstone belts, and dated between ca. 2.691 and ca. 2.673 Ga.

Details of structural features associated with the D_5 and D_6 deformation events are limited in the literature to brittle and brittle-ductile faults of various scales and orientations (Lin 2001; Muir 2003). Within the Hemlo greenstone belt, certain D_5 and D_6 faults offset the Marathon, and Biscotasing dyke swarms (all ca. 2.2 Ga; Muir, 2003), and as such, D_5 and D_6 faults in the Hemlo region may have developed after ca. 2.2 Ga. However, since there are no absolute age constraints on specific events, the entire D_5-D_6 interval of brittle deformation can only be constrained to a post-2.673 Ga timeframe that may include many periods of re-activation attributable to any of several post-Archean tectonic events. In addition, while no evidence was observed for dyke emplacement postdating brittle deformation, the lack of constraint on the age of fault development does not preclude this possibility.

Of the 1763 final integrated lineaments, 263 were attributed as unclassified lineaments, 1282 as brittle lineaments, and 218 were classified as dyke lineaments (Figure 27). Based on the character of the unclassified lineaments, they are interpreted to represent structures formed during D_2-D_4 deformation. The unclassified lineaments were recognized predominantly from the geophysical data by their curvi-linear geometry and their low-angle truncation of form lines. As discussed in Section 3.2, these lineaments may locally represent the internal fabric of the rock units rather than brittle-ductile or ductile shear zones. These lineaments define a semi-continuous approximately east-west pattern in the Quetico metasedimentary rocks of Block A, and the northern portion of the Black Pic batholith in Block B. Adjacent to the Fourbay Lake pluton the unclassified lineaments define a curvi-linear pattern that traces the eastern boundary of the pluton. In Block C the unclassified lineaments clearly define a pervasive network of east-northeast trending fabric that may represent potential shear zones or internal fabric within and adjacent to the metavolcanic and gabbroic rocks.

The D_2-D_4 unclassified lineaments are interpreted to represent the oldest generation of structure (likely Archean) and locally show evidence of offset and/or truncation by younger brittle lineaments (Figure 27, a, b, c). In a few cases the interpretation suggests that the D_2-D_4 unclassified lineaments may have been reactivated such that they truncate and (or) offset D_5-D_6 brittle lineaments. In these

cases, the D_2-D_4 unclassified lineaments were reclassified as D_5-D_6 brittle lineaments as they reactivated under a younger regime of brittle deformation. Structures associated with D_1 deformation were not identified in the lineament interpretation.

Brittle lineaments in the final integrated data set are observed in three dominant orientations: northwest, north, and northeast. Each of the brittle lineament orientations is parallel to subparallel to the three dominant dyke orientations. Despite the geometric relationship between dyke and brittle lineaments, the relative ages of the brittle lineaments does not appear to correlate with the age of emplacement of the dykes (i.e., brittle lineaments subparallel to youngest dyke generation do not consistently offset or truncated brittle lineaments subparallel to older dyke generations). Rather, brittle lineaments of all orientations tend to offset and truncate, and are offset and truncated by all other brittle and dyke lineaments. As a result, brittle lineaments could not systematically be differentiated into different generations of brittle deformation, and were therefore classified into the same broad generation of brittle deformation, D_5-D_6. The complexity and inconsistency of the structural relationships observed between all brittle and dyke lineaments suggest a protracted history of deformation that may include multiple generations of brittle reactivation.

Of the 218 final integrated dyke lineaments, three distinct dyke populations can be identified, including: 88 dyke lineaments corresponding to the 2.473 Ga northwest-trending Matachewan dyke swarm (Buchan and Ernst 2004), 36 dyke lineaments corresponding to the 2.167 Ga. northeast-trending Biscotasing dyke swarm (Hamilton et al., 2002), and 94 dyke lineaments corresponding to the 2.121 Ga. north-trending Marathon dyke swarm (Buchan et al., 1996; Hamilton et al., 2002). As discussed, dyke lineaments may locally truncate and offset, and may be truncated and offset by all possible orientations of brittle lineaments. Considering these possible relationships, one or several of the following scenarios are possible:

- Dyke emplacement preceded the interpreted brittle faulting, and brittle faults subsequently exploited weaknesses developed in subparallel orientations
- Dyke swarms exploited and were emplaced along pre-existing faults
- Dykes and faults were generated coevally in subparallel orientations
- Brittle faults were reactivated syn- or post-dyke emplacement

Apart from these timing constraints, there are no additional absolute age constraints for aforementioned phases of deformation.

5.5.1 Mapped Structures and Lineament Relationships

Relatively few faults have been previously mapped in the three Manitouwadge Phase 2 lineament assessment blocks compared to the rest of the Manitouwadge area (Figure 2). All mapped faults were also reproduced in the lineament interpretation. The relationship of mapped faults relative to the final integrated lineaments can be seen in Figure 27.

Although no faults were previously mapped within Block A, the east-west oriented unclassified lineaments roughly correspond to the orientation of the Wawa-Quetico subprovince boundary approximately 20 kilometres to the south (Figure 27). In the area around Block A, two northwest-trending and two north-trending faults have been mapped. Trends of these mapped faults are consistent with the dominant trends of brittle and dyke lineaments interpreted within Block A.

Five mapped faults have been previously mapped within Block B (Figure 2 and 27b). Two named north-trending faults are located along the northern boundary of the block (the Cadawaja fault to the west that offsets the southern boundary of the Manitouwadge greenstone belt, and the Fox Creek fault to the east). Both faults extend less than 1 kilometre into the northern boundary of Block B.

Despite the termination of the mapped faults near the southern margin of the Manitouwadge greenstone belt, based on the lineament interpretation, both faults have the potential to extend further into Block B. In particular, the Cadawaja fault is interpreted to extend approximately 20 km further to the south than previously mapped, crossing the entire length of Block B. This fault produces a fairly broad expression in both the geophysical and surficial data sets. In addition, a series of north-trending dyke lineaments and occasional north-trending brittle lineaments occur adjacent to this interpreted extension of the Cadawaja fault, potentially indicating a relatively broad zone of deformation and dyke emplacement. South of the Fox Creek fault two north-trending brittle lineaments and a subparallel dyke lineament were interpreted. The brittle lineaments extend south approximately 4.5 kilometres.

Two unnamed northwest-trending faults intersecting the Fourbay Lake pluton in Block B and are coincident with two brittle lineaments that were interpreted with high certainty and reproducibility (Figure 2 and 27b). The northern most mapped fault only extends into the Fourbay Lake pluton roughly 2 km, however, the interpreted brittle lineament extents further to the southeast throughout the entire Fourbay Lake pluton, and was not identified beyond the southern boundary of Block B.

An additional short (approximately 3 kilometre) northeast-trending mapped fault is located within the southeast quadrant of Block B (Figure 27b). This fault is coincident with a northeast-trending brittle lineament that was interpreted to extend significantly beyond the trace of this mapped fault. This lineament was interpreted as a moderate certainty, and is expressed in both the geophysical and surficial data sets.

Four unnamed faults are mapped within Block C, including two northwest-trending faults and two north-trending faults (Figure 2 and 27c). Both northwest-trending faults mapped in the northern portion of Block C are coincident with interpreted northwest-trending lineaments. The north-trending mapped fault located in the northeastern portion of Block C, is coincident with a geophysical brittle and surficial lineament that are interpreted to extend south through the majority of the study area. The north-trending lineament, parallel to the western boundary of Block C, is coincident with a short brittle lineament interpreted in the FRI data. This lineament is coincident with an approximately 1 km long segment at the northern-most portion of the mapped fault. As the remainder of the mapped fault is positioned very near, or outside the boundary of Block C, identifying this fault in the lineament data sets is difficult.

Multiple dykes have been previously interpreted throughout all Manitouwadge blocks from regional-scale geophysical data (Figure 2; Ontario Geological Survey, 2011). These dykes are generally coincident with interpreted dyke lineaments, however certain discrepancies exist due to the higher resolution of the geophysical data set used in this assessment. The most noticeable discrepancy is that a single previously interpreted dyke from the regional-scale data is often recognized as a series of tightly spaced dyke lineaments within the higher resolution geophysical data (Figure 27). This was most evident for northwest-trending Matachewan dykes that often manifested in the high resolution geophysical data as a series of tightly spaced dyke lineaments. Only a single northwest trending dyke, previously interpreted to cross through the northern portion of the Fourbay Lake pluton, shows no evidence that it exists within the higher resolution geophysical data.

6 Summary of Results

This report documents the source data, workflow, and results from a lineament interpretation of geophysical (magnetic) and surficial (DEM and FRI digital aerial imagery) data sets acquired as part of Phase 2 Preliminary Assessments for the Manitouwadge area. The lineament analysis provides an interpretation of the location and orientation of possible individual brittle, dyke, and unclassified lineaments on the basis of remotely sensed data, and helps to evaluate their relative timing relationships within the context of the regional geological setting. The workflow involves a three-step process that was designed to address the issues of subjectivity and reproducibility. The distribution of lineaments in the area of Manitouwadge reflects the bedrock structure, resolution of the data sets used, and surficial cover.

Within the Manitouwadge Phase 2 assessment area, a total of 755 geophysical lineaments, 524 DEM lineaments, and 1123 FRI lineaments were interpreted by the two interpreters (RA_1) from their respective data sets. Merging the lineaments derived from the DEM and FRI data resulted in a total of 1218 surficial lineaments (RA_2). Merging the surficial lineaments with those derived from the geophysical data resulted in a total of 1763 final integrated lineaments (RA_2).

The reproducibility assessment (RA_1) revealed a moderate to high coincidence between interpreters for all three data sets (i.e., 61% for the geophysical lineaments, 58% for the DEM lineaments, and 48% for the FRI lineaments). The variability between interpreters could be attributed to the resolution of the data sets and the judgement of the expert carrying out the interpretation. In general, longer and higher certainty lineaments were identified more often by both interpreters, as well as dyke lineaments (RA_1 = 82%; which are more easily interpreted due to their distinct geophysical signature).

The coincidence assessment (RA_2) revealed a moderate to low coincidence between surficial lineaments interpreted from the DEM and FRI data sets (i.e., 33% of lineaments were coincident in both surficial data sets). Similarly, the final integrated lineaments revealed a low coincidence between lineaments interpreted from the three data sets (i.e., 12.5% of lineaments were coincident with all three data sets, 22.5% of lineaments were coincident in at least one other data set, and 65% of lineaments lacked coincidence with other data sets). The variability between lineaments derived from the different data sets could be attributed to multiple factors, including deeper structures identified in the magnetic data that may not have a surface expression, surficial features that may not extend to depth, features identified in the surficial data that may not possess sufficient magnetic susceptibility contrast to be recognized in the magnetic data, the masking of surface expressions of geophysical lineaments by the presence of overburden, and the differing resolution of the various data sets. Similar to RA_1, longer and higher certainty lineaments were more often coincident in the various data sets.

An analysis of lineament orientations revealed an overall consistency between the orientations of lineaments identified in the various data sets, which suggests that lineaments interpreted from all three data sets are identifying the same sets of structures. Lineament orientations within the Manitouwadge area reveal five dominant orientations: southeast, north-south, northeast, north-northeast, and east to east-northeast. Of these lineament orientations, the southeast-, northeast-, north-northeast, and north-trending lineaments are well defined in all data sets. The east to east-northeast lineament orientation is only observed in the geophysical and final integrated unclassified lineaments. The southeast, north to north-northeast, and northeast lineament orientations are distributed throughout the Manitouwadge Phase 2 assessment areas, and correspond to dyke

lineaments of the Matachewan, Marathon, and Biscotasing dyke swarms, respectively, and subparallel brittle lineaments. Brittle and dyke lineaments occur both as clusters of tight-spaced lineaments and in isolation.

Evaluation of lineament length data for the geophysical brittle and dyke, surficial, and final integrated lineaments reveals roughly the same distribution, where the majority of lineaments are less than 5 kilometres in length. In general, the geophysical brittle and dyke, and final integrated lineament sets contain more long lineaments relative to the integrated surficial lineaments due to the style in which bedrock structures are manifested within these data sets. Lineaments that were reproduced in all three data sets (RA_2=3), and lineaments with the highest certainty value (3) typically represent the longest lineaments (i.e. greater than 5 kilometres). Long surficial, brittle, and dyke lineaments trend predominantly northwest, north, and northeast, corresponding to the major dyke sets and subparallel brittle structures. Long surficial lineaments trend dominantly towards the northeast, which is also coincident with the orientation of glaciation flow.

The geophysical lineament density of surficial, brittle and dyke lineaments throughout all blocks reveal a relatively low and uniform background lineament density and multiple zones of elevated lineament density, particularly in Block C. Zones of elevated lineament density occur within most geological units and are typically the result of clusters of tight-spaced brittle and (or) dyke lineaments, and the intersection of different orientations of lineament clusters. Unclassified lineament density plots reveal several distinct domains of unclassified lineaments, including a strong northeast-trending domain coincident with metavolcanic and gabbroic rocks in the north of Block C, and a curvi-linear domain subparallel and adjacent to the Fourbay Lake pluton in Block B.

The surficial lineament density throughout all blocks also reveals a somewhat variable lineament density with several well-defined zones of elevated lineament density. Similar to the geophysical data, zones of elevated lineament densities typically occur along or at the intersection of tight-spaced northwest-, north-, and northeast-trending surficial lineaments. The density of surficial lineaments is in part influenced by the presence of overburden that may obscure the interpretation of surficial lineaments related to bedrock structures. For example, limited surficial lineaments were interpreted along the central-southern boundary of Block B where abundant glaciolacustrine sediments are present along the Black River.

The final integrated lineament density throughout all blocks is variable, similar to geophysical and surficial lineament density analyses. Lineament density analyses of the final integrated brittle and dyke lineaments reveal a variable background lineament density with multiple zones of elevated lineament density. This includes two northeast- and northwest-trending corridors in the central portion of Block B. Similar to the other data sets, zones of high lineament density correspond to tight-spaced northeast-, north-, and northwest-trending brittle and dyke lineaments, and the intersection of these lineament clusters. For unclassified lineaments, multiple isolated domains of elevated lineament density are present, including a strong northeast-trending domain coincident with metavolcanic and gabbroic rocks in the north of Block C, and a curvi-linear domain subparallel and adjacent to the Fourbay Lake pluton in Block B.

Six main regionally distinguishable deformation episodes (D_1-D_6) are recognized in the Manitouwadge Phase 2 assessment areas, and can be used to constraint the relative age relationships of the interpreted lineaments. The final interpreted lineaments can be classified within the structural history into successive stages of ductile, brittle-ductile and brittle deformation, including: 263 D_2-D_4 (unclassified) lineaments and 1282 D_5-D_6 (brittle) lineaments. A total of 218 dyke lineaments were also interpreted throughout the assessment areas.

D_2-D_4 unclassified lineaments were recognized predominantly from the geophysical data by their curvi-linear character and the truncation of form lines. These lineaments may represent the internal fabric of the rock units including the more intense fabric along ductile or brittle-ductile shear zones. Unclassified lineaments define distinct zones within the three blocks. As the unclassified lineaments are the oldest generation of interpreted structure, they are often offset and or truncated by younger brittle lineaments. Locally the unclassified lineaments were also reactivated, in which case they were reclassified as D_5-D_6 brittle lineaments.

D_5-D_6 brittle lineaments were observed in three dominant orientations: northwest, north, and northeast, subparallel to the dominant dyke orientations. Brittle lineaments of all orientations are observed to offset and truncate, and be offset and truncated by all other brittle and dyke lineament orientations. As a result, brittle lineaments cannot systematically be differentiated into different generations. Therefore, all brittle lineaments were classified into the same broad D_5-D_6 generation of brittle deformation.

Interpreted brittle faults are coincident with all mapped faults within and intersecting the Manitouwadge Phase 2 assessment areas. In particular, interpreted brittle lineaments appear to define the southern continuation of the Cadawaja and Fox Creek faults that offset the Manitouwadge greenstone belt north of Block B.

Of the 218 final integrated dyke lineaments, three distinct dyke populations can be identified, including 88 dyke lineaments corresponding to the 2.473 Ga northwest-trending Matachewan dyke swarm, 36 dyke lineaments corresponding to the 2.167 Ga. northeast-trending Biscotasing dyke swarm, and 94 dyke lineaments corresponding to the 2.121 Ga. north-trending Marathon dyke swarm. Dyke lineaments locally truncate and offset, and are truncated and offset by all orientations of brittle lineaments.

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APPENDIX A – Additional Supporting Figures

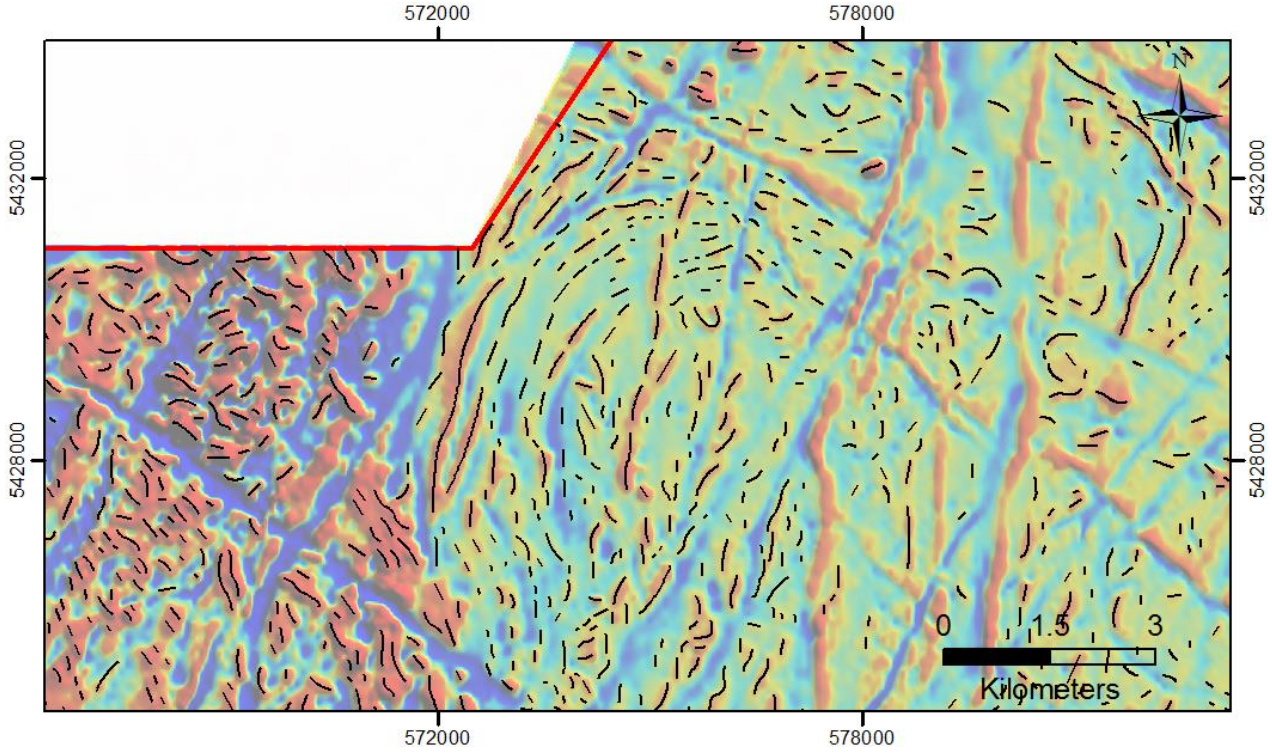


Figure A1: Example of Form Lines from the Manitouwadge Area

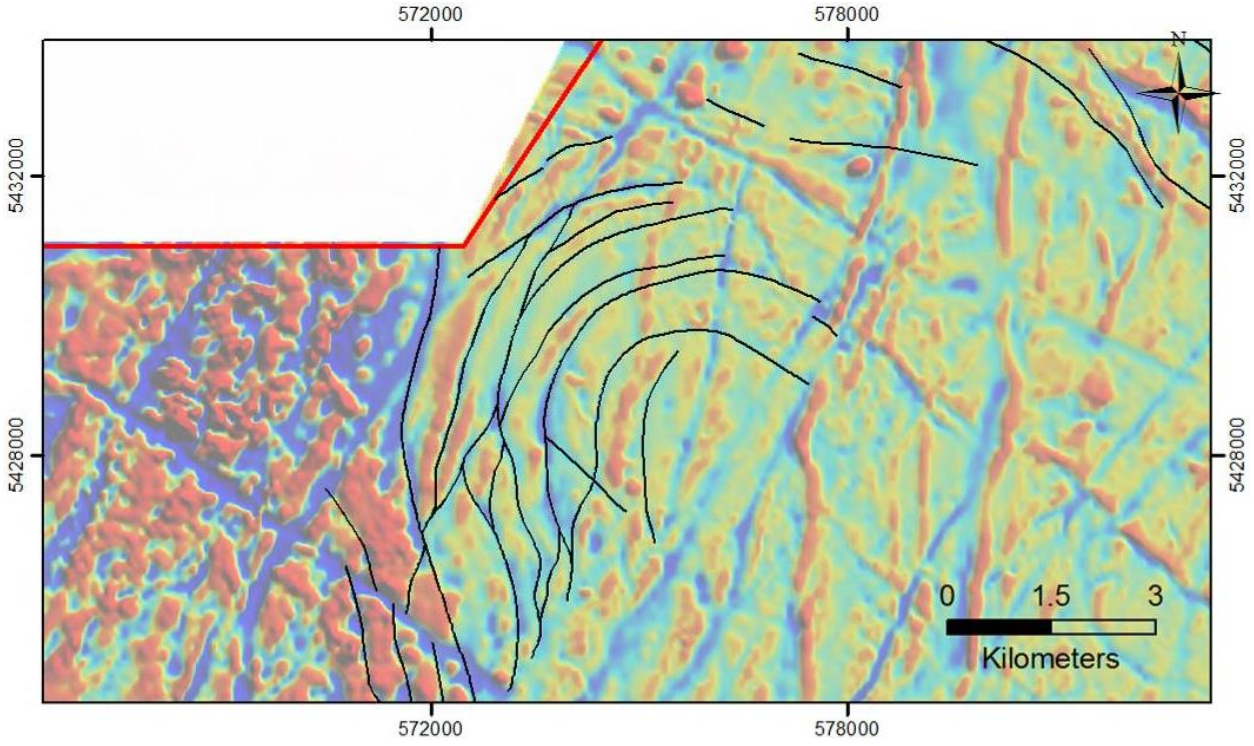


Figure A2: Example of Unclassified Lineaments from the Manitouwadge Area

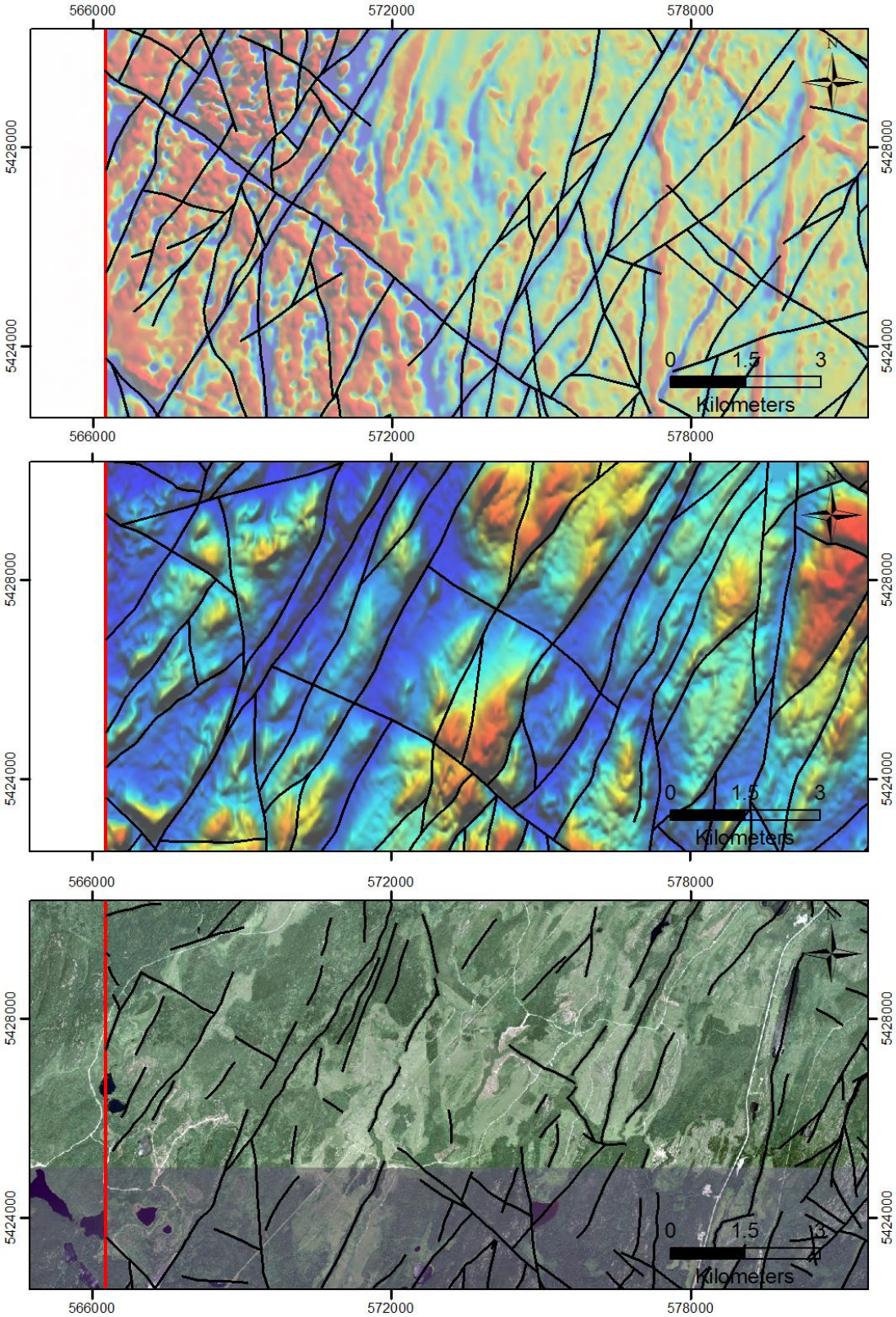


Figure A3: Example of Brittle Lineaments from the Same Location in the Manitouwadge Area

Top, middle and bottom show brittle lineaments manifested in magnetic, DEM and FRI data sets, respectively.

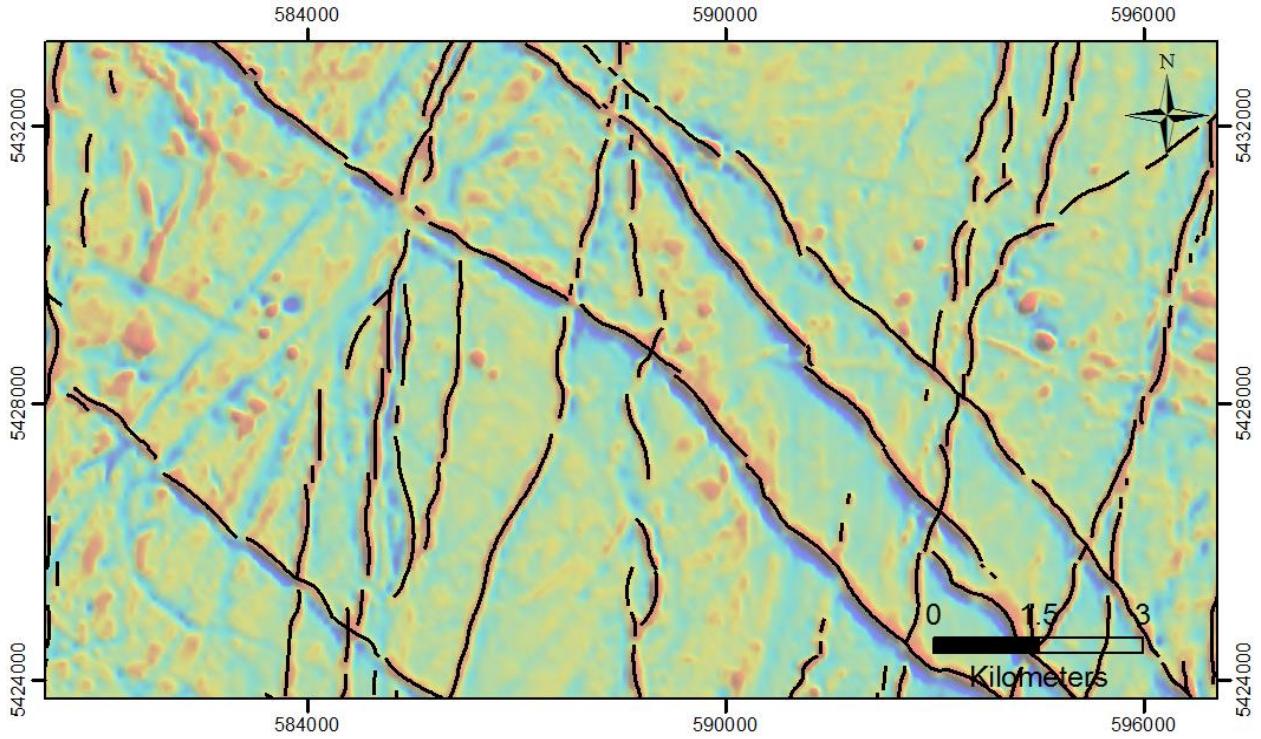


Figure A4: Example of Dyke Lineaments from the Manitouwadge Area

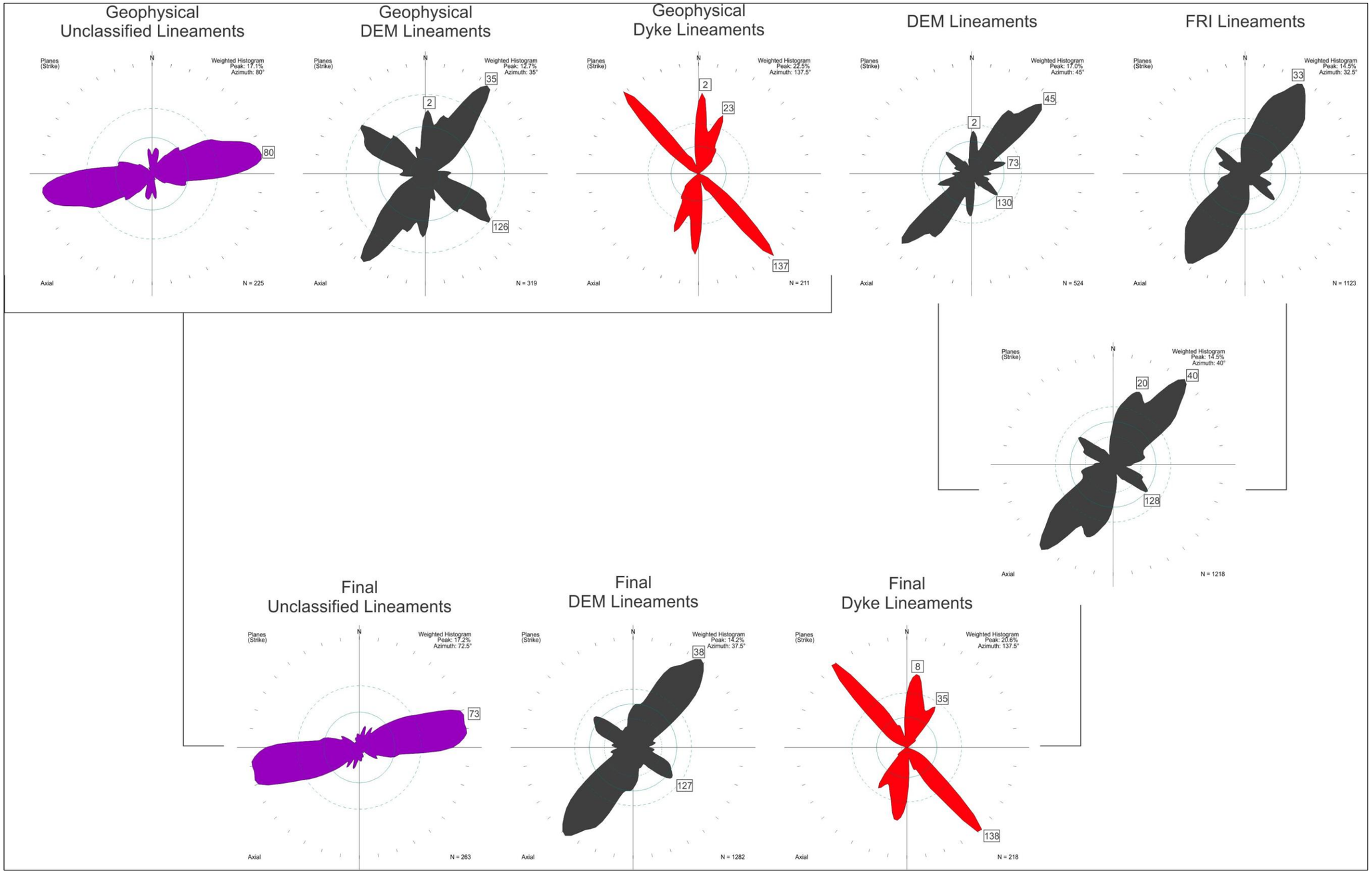


Figure A5: Summary of Lineament Orientations for all Blocks of the Manitouwadge Phase 2 Assessment Area

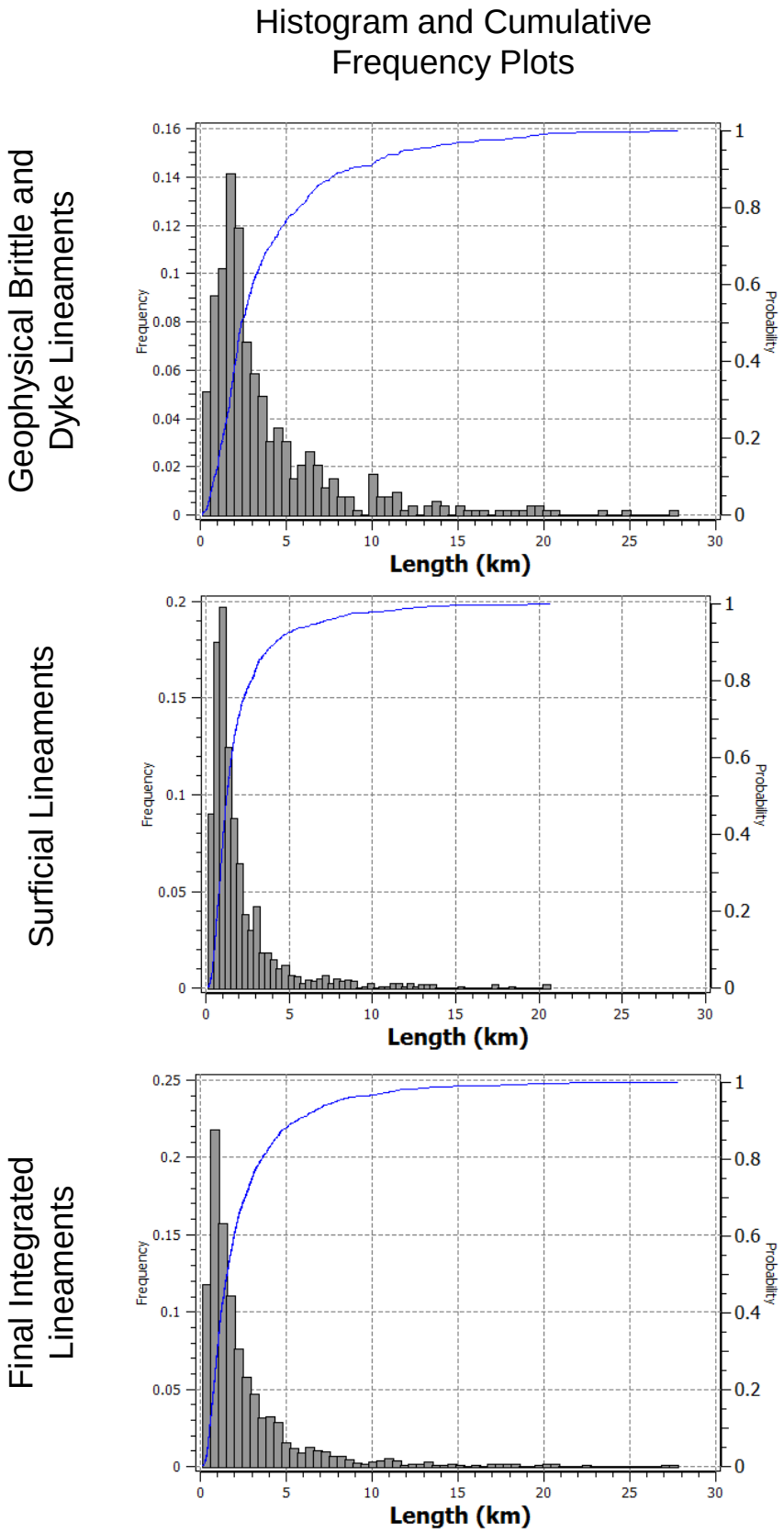


Figure A6: Summary of Length Statistics for all blocks of the Manitouwadge Phase 2 Assessment Area

APPENDIX B - Summary of Lineament Statistics

Table B1: Summary of Geophysical Lineament Statistics

	All Blocks	All Blocks - Unclassified	All Blocks - Brittle	All Blocks - Dyke	Block A - All	Block A - Unclassified	Block A - Brittle	Block A - Dyke	Block B - All	Block B - Unclassified	Block B - Brittle	Block B - Dyke	Block C - All	Block C - Unclassified	Block C - Brittle	Block C - Dyke
Total Number of Lineaments	755	225	319	211	129	71	20	38	384	100	190	94	242	54	109	79
Max Length (kilometres)	27.77	13.05	19.65	27.77	14.4	6.73	11.59	14.4	27.77	12.25	18.35	27.77	19.65	13.05	19.65	19.31
Minimum Length (kilometres)	0.14	0.46	0.44	0.14	0.14	0.52	0.62	0.14	0.16	0.46	0.44	0.16	0.14	0.72	0.58	0.14
Median Length (kilometres)	2.37	2.29	2.38	2.45	2.19	1.78	1.78	4.23	2.7	2.59	2.74	2.77	2.25	2.78	2.26	1.96
Mean Length (kilometres)	3.69	3.15	3.51	4.55	3.2	2.35	2.67	5.06	3.96	3.45	3.71	5.02	3.53	3.64	3.32	3.75
Certainty 1 (number)	203	70	127	6	16	9	7	0	132	40	87	5	55	21	33	1
Certainty 1 (percent)	27%	31%	40%	3%	12%	13%	35%	0%	34%	40%	46%	5%	23%	39%	30%	1%
Certainty 2 (number)	280	94	140	46	50	31	12	7	132	46	65	21	98	17	63	18
Certainty 2 (percent)	37%	42%	44%	22%	39%	44%	60%	18%	34%	46%	34%	22%	40%	31%	58%	23%
Certainty 3 (number)	272	61	52	159	63	31	1	31	120	14	38	68	89	16	13	60
Certainty 3 (percent)	36%	27%	16%	75%	49%	44%	5%	82%	31%	14%	20%	72%	37%	30%	12%	76%
RA1 = 2 (number)	463	120	170	173	83	36	13	34	153	54	102	75	149	30	55	64
RA1 = 2 (percent)	61%	53%	53%	82%	64%	51%	65%	89%	40%	54%	54%	80%	62%	56%	50%	81%
RA1 = 1 (number)	292	105	149	38	46	35	7	4	231	46	88	19	93	24	54	15
RA1 = 1 (percent)	39%	47%	47%	18%	36%	49%	35%	11%	60%	46%	46%	20%	38%	44%	50%	19%

Table B2: Summary of DEM Lineament Statistics

	All Blocks	Block A	Block B	Block C
Total Number of Lineaments	524	86	237	201
Max Length (kilometres)	28.46	11.29	28.46	19.73
Minimum Length (kilometres)	0.27	0.27	0.55	0.44
Median Length (kilometres)	2.35	1.68	2.95	2.28
Mean Length (kilometres)	3.38	2.45	4.12	2.9
Certainty 1 (number)	187	33	87	67
Certainty 1 (percent)	36%	38%	37%	33%
Certainty 2 (number)	193	32	89	72
Certainty 2 (percent)	37%	37%	38%	36%
Certainty 3 (number)	144	21	61	62
Certainty 3 (percent)	27%	24%	26%	31%
RA1 = 2 (number)	326	61	149	116
RA1 = 2 (percent)	62%	71%	63%	58%
RA1 = 1 (number)	198	25	88	85
RA1 = 1 (percent)	38%	29%	37%	42%

Table B3: Summary of FRI Lineament Statistics

	All Blocks	Block A	Block B	Block C
Total Number of Lineaments	1123	175	612	336
Max Length (kilometres)	16.99	12.37	16.99	11.85
Minimum Length (kilometres)	0.11	0.23	0.11	0.19
Median Length (kilometres)	1	0.85	0.97	1.11
Mean Length (kilometres)	1.44	1.13	1.42	1.65
Certainty 1 (number)	511	84	273	154
Certainty 1 (percent)	46%	48%	45%	46%
Certainty 2 (number)	470	79	254	137
Certainty 2 (percent)	42%	45%	42%	41%
Certainty 3 (number)	142	12	85	45
Certainty 3 (percent)	13%	7%	14%	13%
RA1 = 2 (number)	538	82	294	162
RA1 = 2 (percent)	48%	47%	48%	48%
RA1 = 1 (number)	585	93	318	174
RA1 = 1 (percent)	52%	53%	52%	52%

Table B4: Summary of Integrated Surficial Lineament Statistics

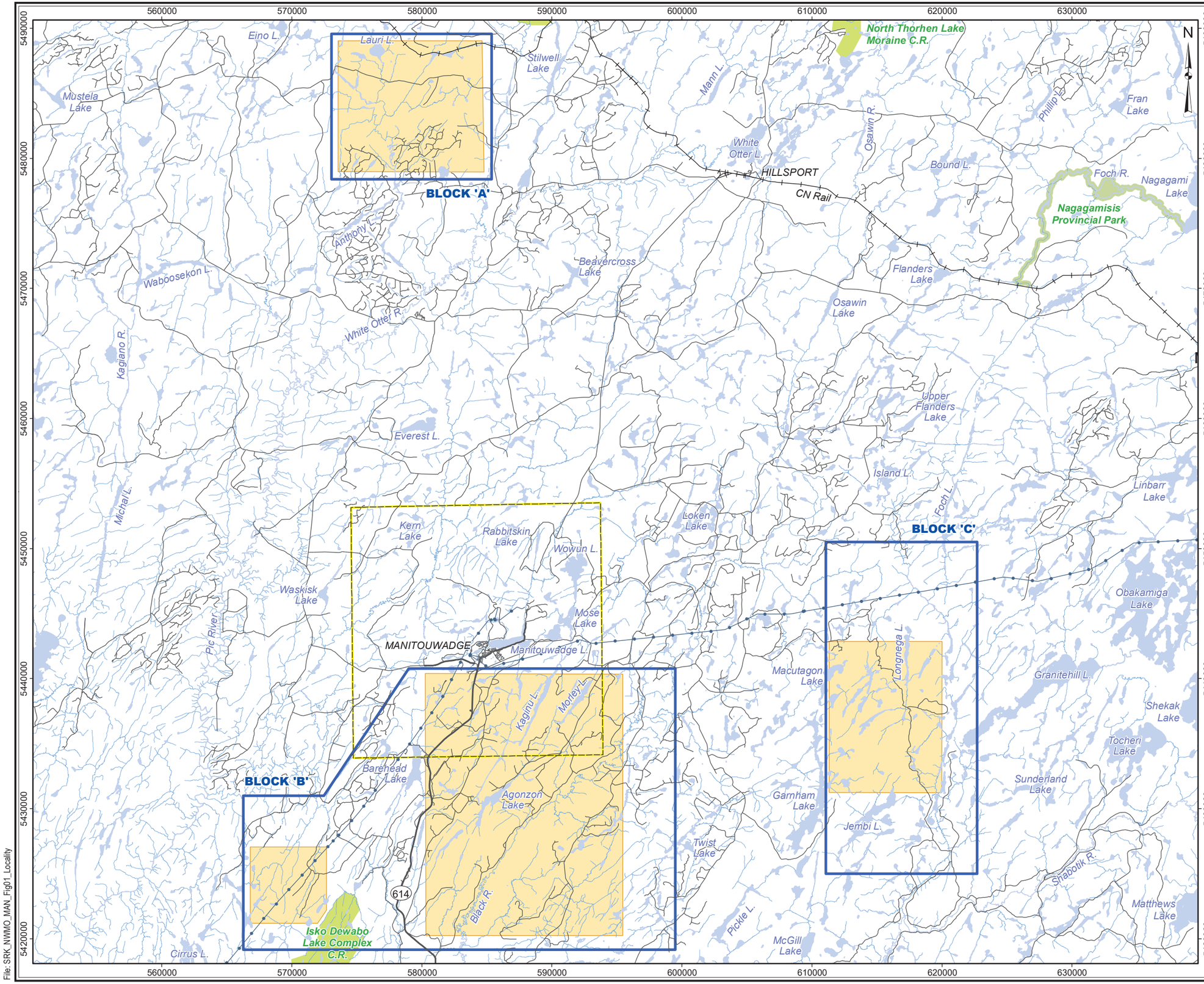
	All Blocks	Block A	Block B	Block C
Total Number of Lineaments	1218	211	615	392
Max Length (kilometres)	20.6	13.76	20.6	13.66
Minimum Length (kilometres)	0.15	0.21	0.16	0.15
Median Length (kilometres)	1.26	1.04	1.29	1.39
Mean Length (kilometres)	2.03	1.56	2.2	2.03
Certainty 1 (number)	483	88	252	143
Certainty 1 (percent)	40%	42%	41%	36%
Certainty 2 (number)	489	94	237	158
Certainty 2 (percent)	40%	45%	39%	40%
Certainty 3 (number)	246	29	126	91
Certainty 3 (percent)	20%	14%	20%	23%
RA2 = 2 (number)	396	42	197	157
RA2 = 2 (percent)	33%	20%	32%	40%
RA2 = 1 (number)	822	169	418	235
RA2 = 1 (percent)	67%	80%	68%	60%

Table B5: Summary of Final Integrated Lineament Statistics

	All Blocks	All Blocks - Unclassified	All Blocks - Brittle	All Blocks - Dyke	Block A	Block A - Unclassified	Block A - Brittle	Block A - Dyke	Block B	Block B - Unclassified	Block B - Brittle	Block B - Dyke	Block C	Block C - Unclassified	Block C - Brittle	Block C - Dyke
Total Number of Lineaments	1763	263	1282	218	297	79	178	40	909	106	707	96	557	78	397	82
Max Length (kilometres)	27.75	13.13	20.6	27.75	14.57	9.77	11.13	14.57	27.75	10.99	20.3	27.75	17.62	13.13	16.74	17.62
Minimum Length (kilometres)	0.14	0.37	0.23	0.38	0.35	0.36	0.35	0.93	0.23	0.42	0.23	0.32	0.24	0.82	0.24	0.4
Median Length (kilometres)	1.54	2.24	1.35	2.27	1.24	1.64	1.01	3.91	1.64	2.52	1.46	2.66	1.53	2.35	1.37	1.9
Mean Length (kilometres)	2.53	2.92	2.15	4.32	2.18	2.37	1.5	4.84	2.68	3.16	2.33	4.76	2.46	3.14	2.11	3.55
Certainty 1 (number)	546	61	479	6	78	10	67	1	318	31	282	5	150	20	130	0
Certainty 1 (percent)	31%	23%	37%	3%	26%	13%	38%	3%	35%	29%	40%	5%	27%	26%	33%	0%
Certainty 2 (number)	676	105	523	48	128	34	86	8	330	50	259	21	218	21	178	19
Certainty 2 (percent)	38%	40%	41%	22%	43%	43%	48%	20%	36%	47%	37%	22%	39%	27%	45%	23%
Certainty 3 (number)	541	97	280	164	91	35	25	31	261	25	166	70	189	37	89	63
Certainty 3 (percent)	31%	37%	22%	75%	31%	44%	14%	78%	29%	24%	23%	73%	34%	47%	22%	77%
RA2 = 3 (number)	220	40	146	34	20	9	4	7	111	8	88	15	89	23	54	12
RA2 = 3 (percent)	12%	15%	11%	16%	7%	11%	2%	18%	12%	8%	12%	16%	16%	29%	14%	15%
RA2 = 2 (number)	394	46	315	33	59	16	34	9	203	17	173	13	132	13	108	11
RA2 = 2 (percent)	22%	17%	25%	15%	20%	20%	19%	23%	22%	16%	24%	14%	24%	17%	27%	13%
RA2 = 1 (number)	1149	177	821	151	218	54	140	24	595	81	446	68	336	42	235	59
RA2 = 1 (percent)	65%	67%	64%	69%	73%	68%	79%	60%	65%	76%	63%	71%	60%	54%	59%	72%

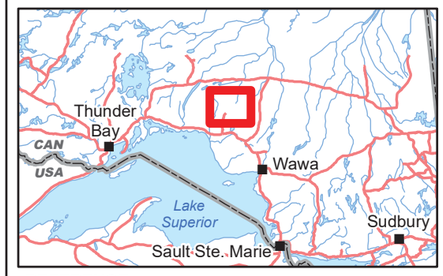
Table B6: Summary of Final Integrated Brittle and Dyke Lineament Length Statistics

	All Subareas		Block A		Block B		Block C	
	Mean length (kilometres)	Median length (kilometres)	Mean length (kilometres)	Median length (kilometres)	Mean length (kilometres)	Median length (kilometres)	Mean length (kilometres)	Median length (kilometres)
Certainty 1	1.23	0.98	0.91	0.70	1.34	1.04	1.15	0.97
Certainty 2	1.87	1.49	1.41	1.07	2.01	1.59	1.91	1.51
Certainty 3	4.58	3.15	4.79	3.81	4.92	3.70	3.97	2.55
RA2 = 3	6.96	5.53	8.02	7.65	7.48	5.85	5.97	4.02
RA2 = 2	2.80	1.96	3.10	2.33	2.99	2.09	2.40	1.69
RA2 = 1	1.51	1.09	1.47	0.97	1.52	1.13	1.53	1.10



LEGEND

- Phase 2 Assessment Area
- Manitouwadge Municipal Boundary
- Major Road
- Minor Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Provincial Park
- Conservation Reserve
- Withdrawal Area



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

0 10 km

srk consulting

PROJECT

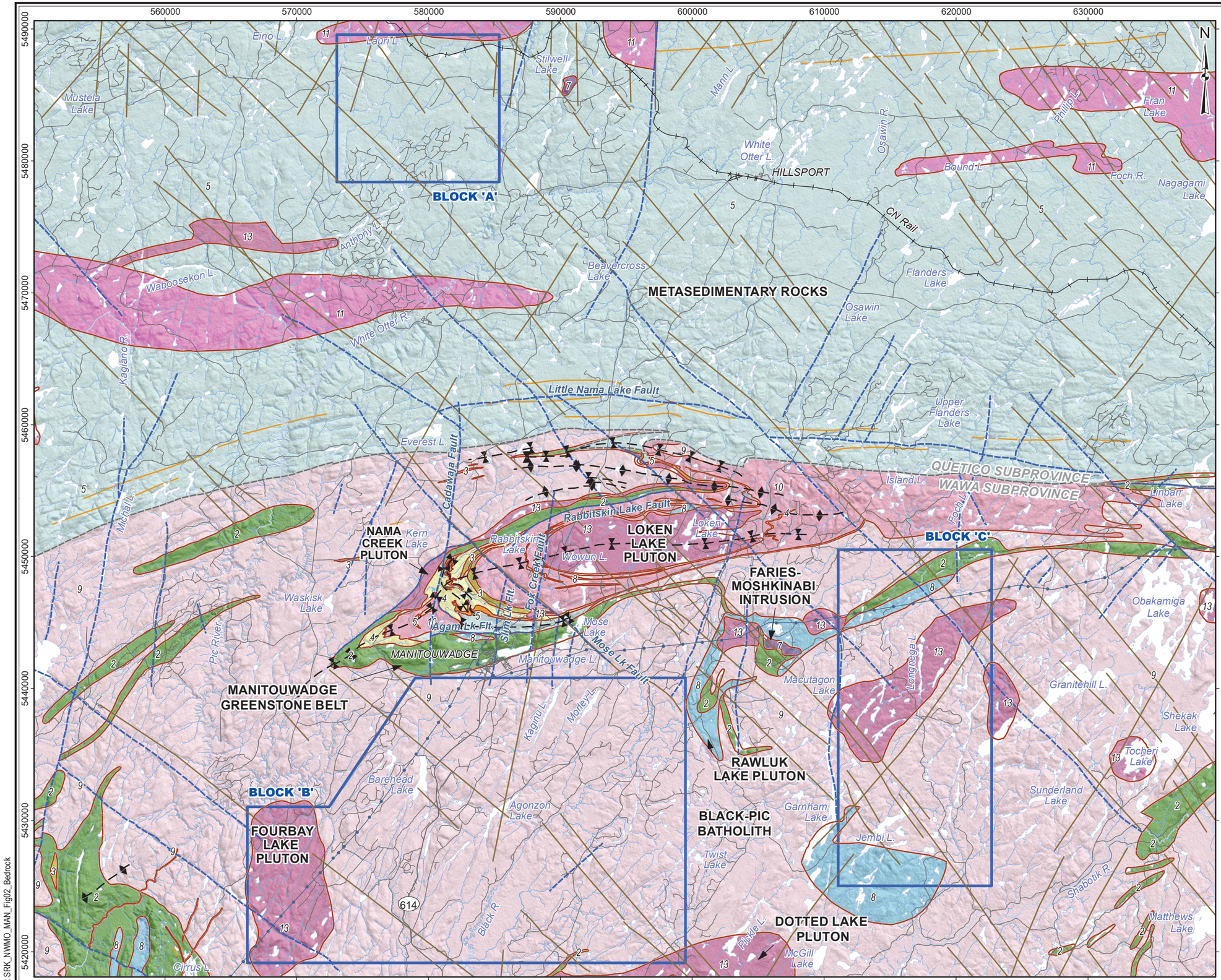
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Location and Overview of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 1**	REVISION 2
GIS	JA	25 MAY 2016		UTM ZONE 16N
CHECK	CN	25 MAY 2016		NAD 1983
REVIEW	JPS	25 MAY 2016		1:280,000

File: SRK_NWMO_MAN_Fig01_Locality



LEGEND

- Phase 2 Assessment Area
- Major Road
- Minor Road
- Railway
- Transmission Line
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Fault
- Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Bedrock Geology of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 2**	REVISION 3
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig02_Bedrock

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

Eino L.
Lauri L.
Stilwell Lake
Mustela Lake
Wann L.
Osawin R.
Phillip L.
Fran Lake
White Otter L.
HILLSPORT
CN Rail
Bound L.
Foch R.
Nagagami Lake
BLOCK 'A'
Anthony L.
Waboosekon L.
Beavercross Lake
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Upper Flanders Lake
Everest L.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Linbarr Lake
Foch L.
Michal L.
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake
Wowun L.
LOKEN LAKE PLUTON
Loken Lake
BLOCK 'C'
FARIES-MOSHKINABI INTRUSION
Waskisk Lake
Pic River
Mose Lake
Obakamiga Lake
MANITOUWADGE
Manitouwadge L.
Longnega L.
MANITOUWADGE GREENSTONE BELT
Macutagon Lake
Granitehill L.
Kagiju L.
Motley L.
Shekak Lake
Tocheri Lake
RAWLUK LAKE PLUTON
BLOCK 'B'
Barehead Lake
Sunderland Lake
Agonzon Lake
Garnham Lake
BLACK-PIC BATHOLITH
FOURBAY LAKE PLUTON
Jembi L.
Twist Lake
Shabotik R.
614
Black R.
Pickle L.
DOTTED LAKE PLUTON
Matthews Lake
McGill Lake
Cirrus L.

LEGEND

- Phase 2 Assessment Area
- Major Road
- Minor Road
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Geological Boundary
- Subprovince Boundary

Surficial Geology

- Escarpment
- Esker
- Drumlin
- Steep-walled valley
- Local Dune Area
- Moraine
- Glacial outwash, esker
- Glaciolacustrine plain, beach
- Alluvial
- Sand dunes
- Organics
- Bedrock



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Surficial Geology: MRD-160 (Digital Northern Ontario Engineering Geology Terrain Study, 2005)

0 10 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Terrain Features of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 3**	REVISION 3
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig03_Terrain

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

BLOCK 'A'

HILLSPORT

CN Rail

METASEDIMENTARY ROCKS

QUETICO SUBPROVINCE

WAWA SUBPROVINCE

NAMA CREEK PLUTON

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

BLOCK 'C'

MANITOUWADGE

MANITOUWADGE GREENSTONE BELT

RAWLUK LAKE PLUTON

BLOCK 'B'

FOURBAY LAKE PLUTON

BLACK-PIC BATHOLITH

614

DOTTED LAKE PLUTON

LEGEND

- Phase 2 Assessment Area
- Major Road
- Minor Road
- Railway
- Transmission Line
- Geological Boundary
- Subprovince Boundary

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 10 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Pole Reduced Magnetic Data (First Vertical Detivative) of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 4**	REVISION 3
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig04_MAG

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5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

Eino L.
Laurel L.
Stilwell Lake
Mustela Lake
Manni L.
Phillip L.
Fran Lake
White Otter L.
Osawin R.
HILLSPORT
Bound L.
Foch R.
Nagagami Lake
CN Rail
BLOCK 'A'
Anthony L.
Beavercross Lake
Waboosekon L.
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Upper Flanders Lake
Everest L.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Linbarr Lake
Michal L.
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake
Wowun L.
LOKEN LAKE PLUTON
Loken Lake
Foch L.
BLOCK 'C'
FARIES-MOSHKINABI INTRUSION
Waskisk Lake
Obakamiga Lake
Mose Lake
Pic River
MANITOUWADGE
Manitouwadge L.
MANITOUWADGE GREENSTONE BELT
Longnegger L.
Macutagon Lake
Granitehill L.
Shekak Lake
Keghin L.
Morey L.
RAWLUK LAKE PLUTON
Barehead Lake
BLOCK 'B'
Agonzon Lake
Tocheri Lake
Sunderland Lake
FOURBAY LAKE PLUTON
Garnham Lake
BLACK-PIC BATHOLITH
Jembi L.
Twist Lake
614
Black R.
Shabotik R.
Pickle L.
DOTTED LAKE PLUTON
Matthews Lake
McGill Lake
Cirrus L.

LEGEND

- Phase 2 Assessment Area
- Major Road
- Minor Road
- Railway
- Watercourse
- Waterbody
- Geological Boundary
- Subprovince Boundary

Elevation (masl)

487m

213



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)

Detailed Relief: Digital Elevation Model (SGL, 2015)

0 10 km

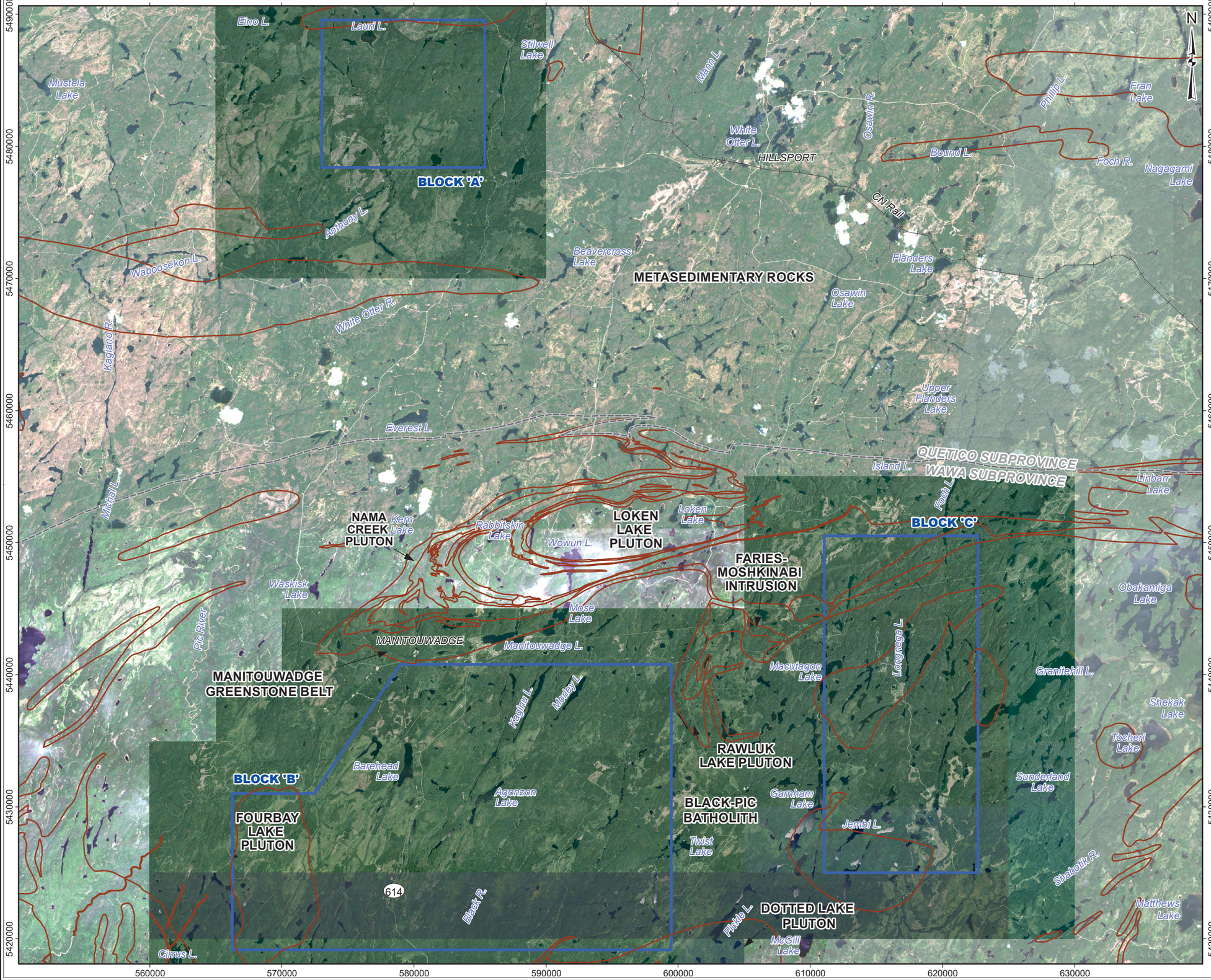
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PROJECT: Phase 2 Structural Lineament Interpretation Manitouwadge Area, Ontario

TITLE: **Digital Elevation Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 5**	REVISION 2
GIS	JA	15 APR 2016		UTM ZONE 16N
CHECK	CN	15 APR 2016		NAD 1983
REVIEW	JPS	15 APR 2016		1:280,000

File: SRK_NWMO_MAN_Fig05_DEM



LEGEND

- Phase 2 Assessment Area
- Railway
- Geological Boundary
- Subprovince Boundary



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 10 km

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PROJECT

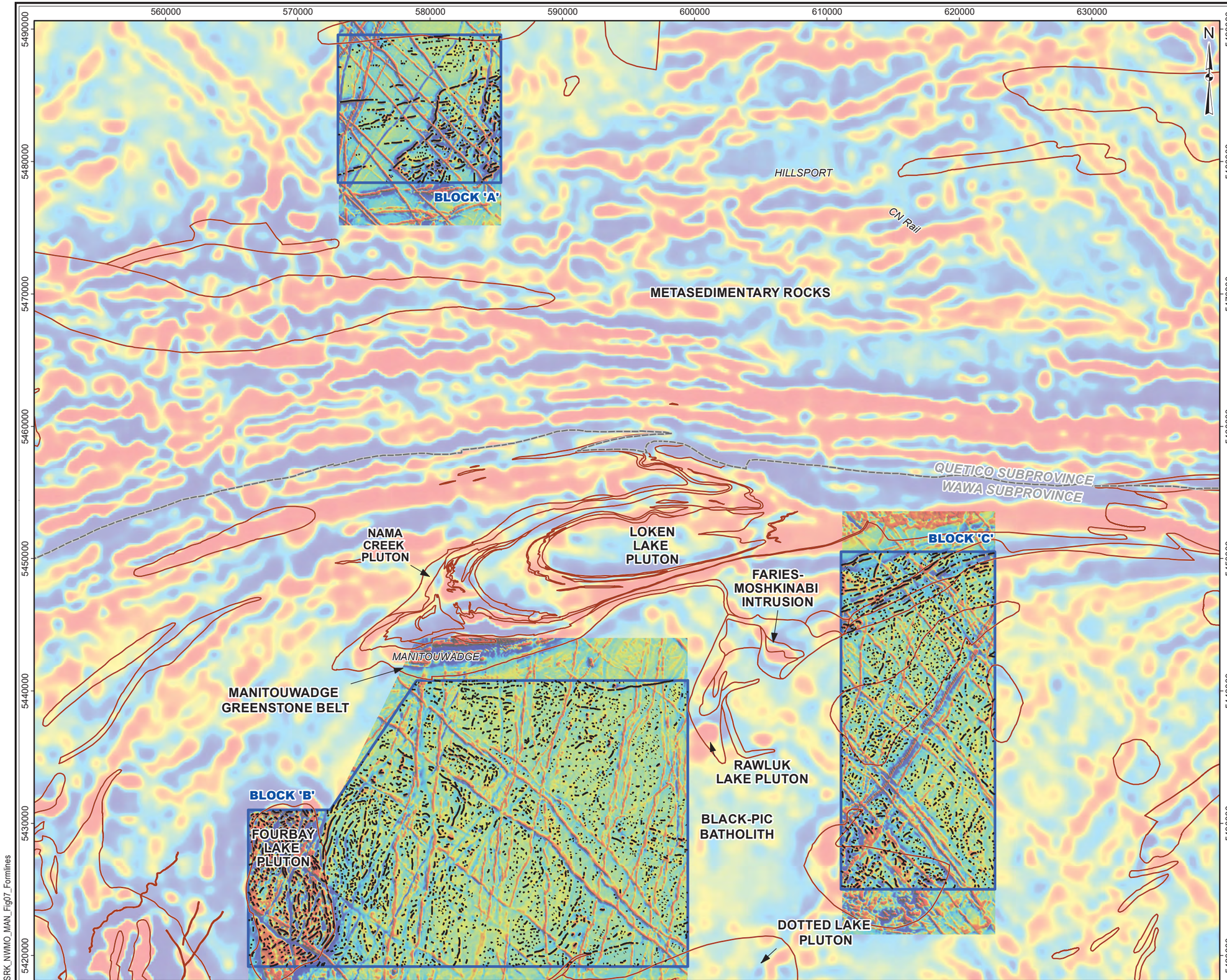
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Forest Resource Inventory Digital Aerial Imagery of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 6**	REVISION 2
GIS	JA	15 APR 2016		UTM ZONE 16N
CHECK	CN	15 APR 2016		NAD 1983
REVIEW	JPS	15 APR 2016		1:280,000

File: SRK_NWMO_MAN_Fig06_SAT



LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary
- Form Line

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Form Lines from Pole Reduced Magnetic Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 7**	REVISION 4
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig07_Formlines

570000
580000
590000
5490000
5480000
5470000

CARAMAT

BLOCK 'A'

METASEDIMENTARY ROCKS

N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Form Line

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Form Lines from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 7a**	REVISION 4
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig07a_Formlines

570000
580000
590000
600000
5440000
5430000
5420000
N
MANITOUWADGE
MANITOUWADGE GREENSTONE BELT
BLOCK 'B'
FOURBAY LAKE PLUTON
DOTTED LAKE PLUTON

LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Form Line

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Form Lines from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 7b**	REVISION 4
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig07b_Formlines

600000
610000
620000
630000
5450000
5440000
5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLOCK 'C'

BLACK-PIC BATHOLITH

N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Form Line

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT

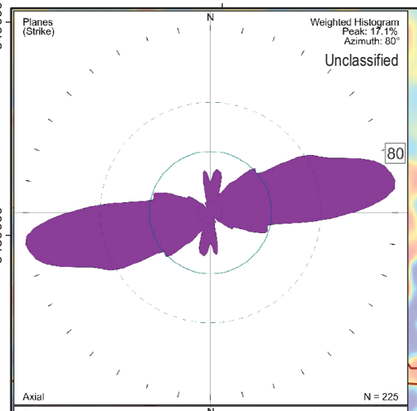
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

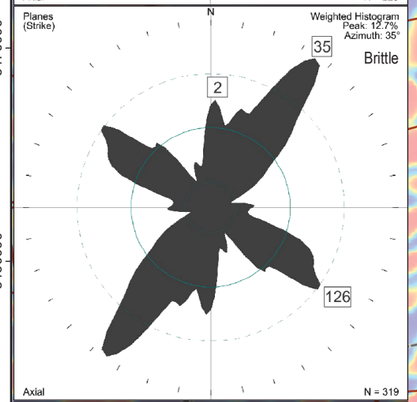
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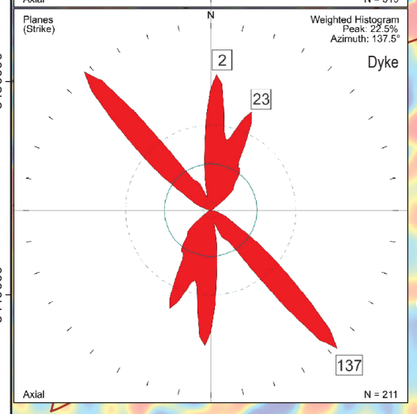
Form Lines from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

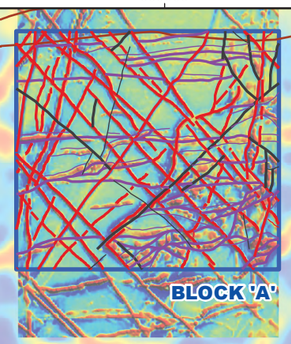
DESIGN	KR	02 SEP 2014	**Figure 7c**	REVISION 4
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig07c_Formlines









LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary

Unclassified Lineament (RA1)
- 1
- 2

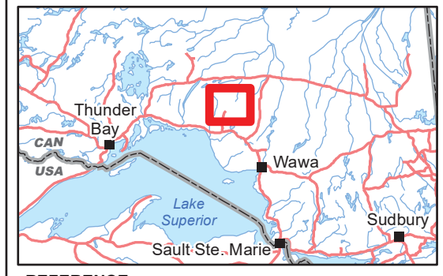
Brittle Lineament (RA1)
- 1
- 2

Dyke Lineament (RA1)
- 1
- 2

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 10 km

srk consulting

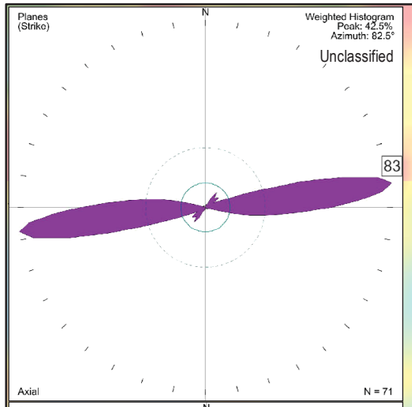
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

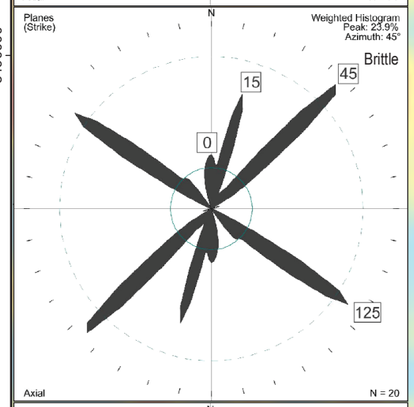
TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area

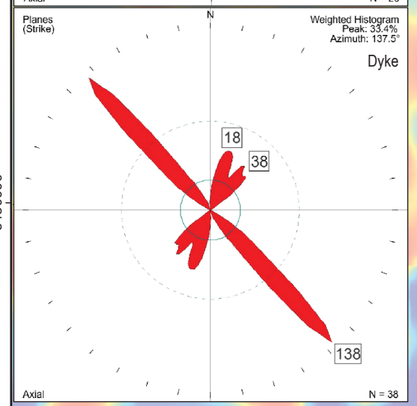
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GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

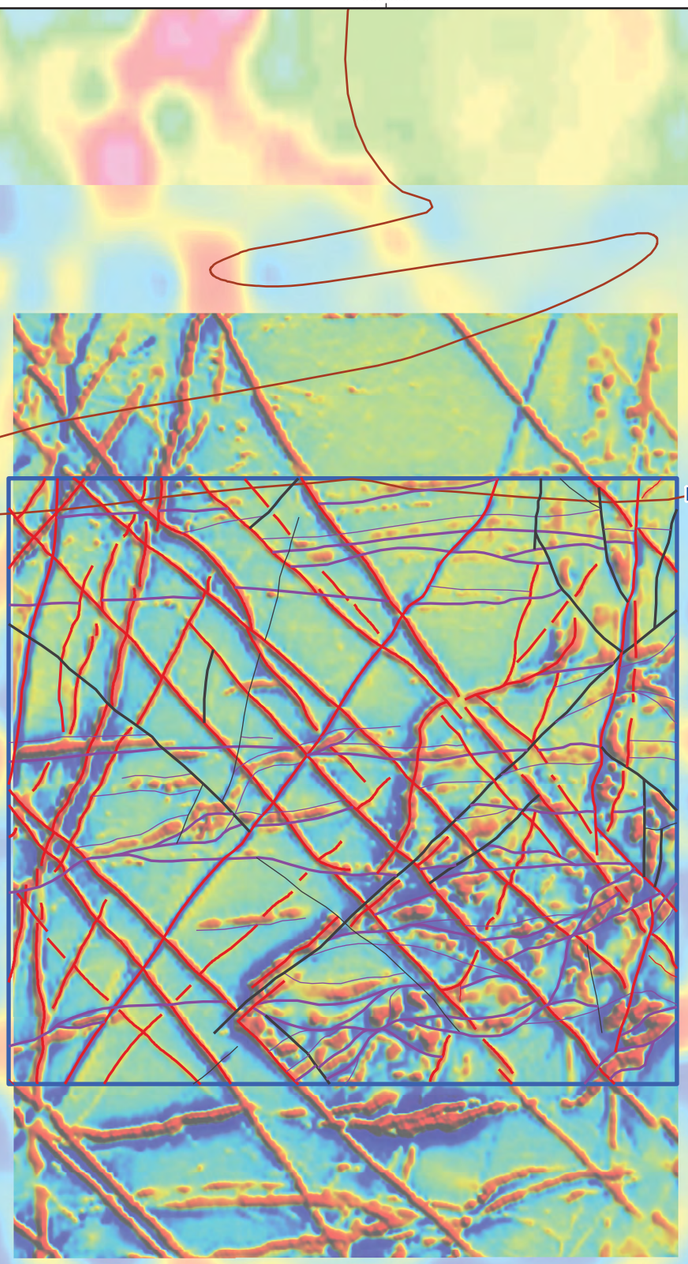
File: SRK_NWMO_MAN_Fig08_MagRA1

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METASEDIMENTARY ROCKS

N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary

Unclassified Lineament (RA1)
- 1
- 2

Brittle Lineament (RA1)
- 1
- 2

Dyke Lineament (RA1)
- 1
- 2

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data
(First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

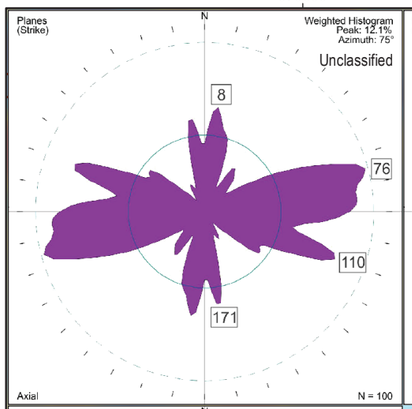
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

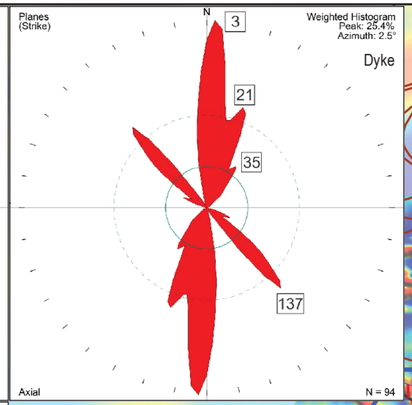
TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

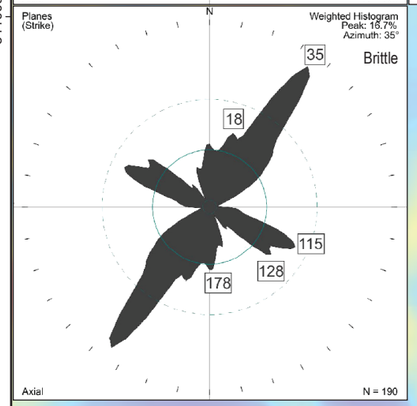
DESIGN	KR	02 SEP 2014	**Figure 8a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig08a_MagRA1

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5440000
5430000
5420000







MANITOUWADGE

BLOCK 'B'

FOURBAY
LAKE
PLUTON

N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary

Unclassified Lineament (RA1)

- 1
- 2

Brittle Lineament (RA1)

- 1
- 2

Dyke Lineament (RA1)

- 1
- 2

Magnetic Intensity (nT/km)

6,668

-2,332



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 8b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig08b_MagRA1

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5430000

LOKEN LAKE PLUTON

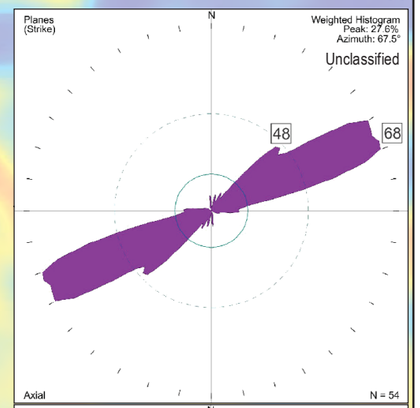
FARIES-MOSHKINABI INTRUSION

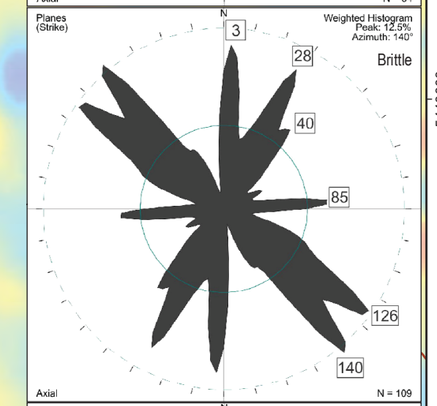
RAWLUK LAKE PLUTON

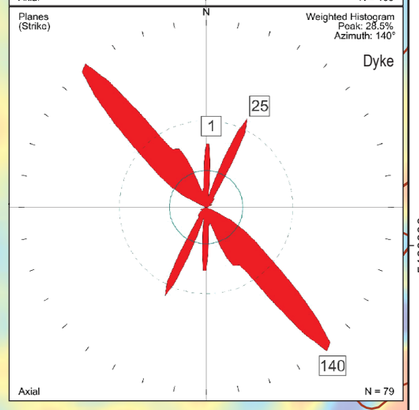
BLACK-PIC BATHOLITH

BLOCK 'C'

N







LEGEND

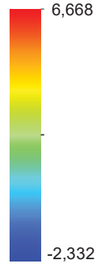
- Phase 2 Assessment Area
- Geological Boundary

Unclassified Lineament (RA1)
- 1
- 2

Brittle Lineament (RA1)
- 1
- 2

Dyke Lineament (RA1)
- 1
- 2

Magnetic Intensity (nT/km)





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Regional Geophysics: Single Master Gravity and Aeromagnetic Data for Ontario (Ontario Geological Survey, 1999)

Detailed Geophysics: Pole Reduced Magnetic Data (First Vertical Derivative) (SGL, 2017)

0 5 km

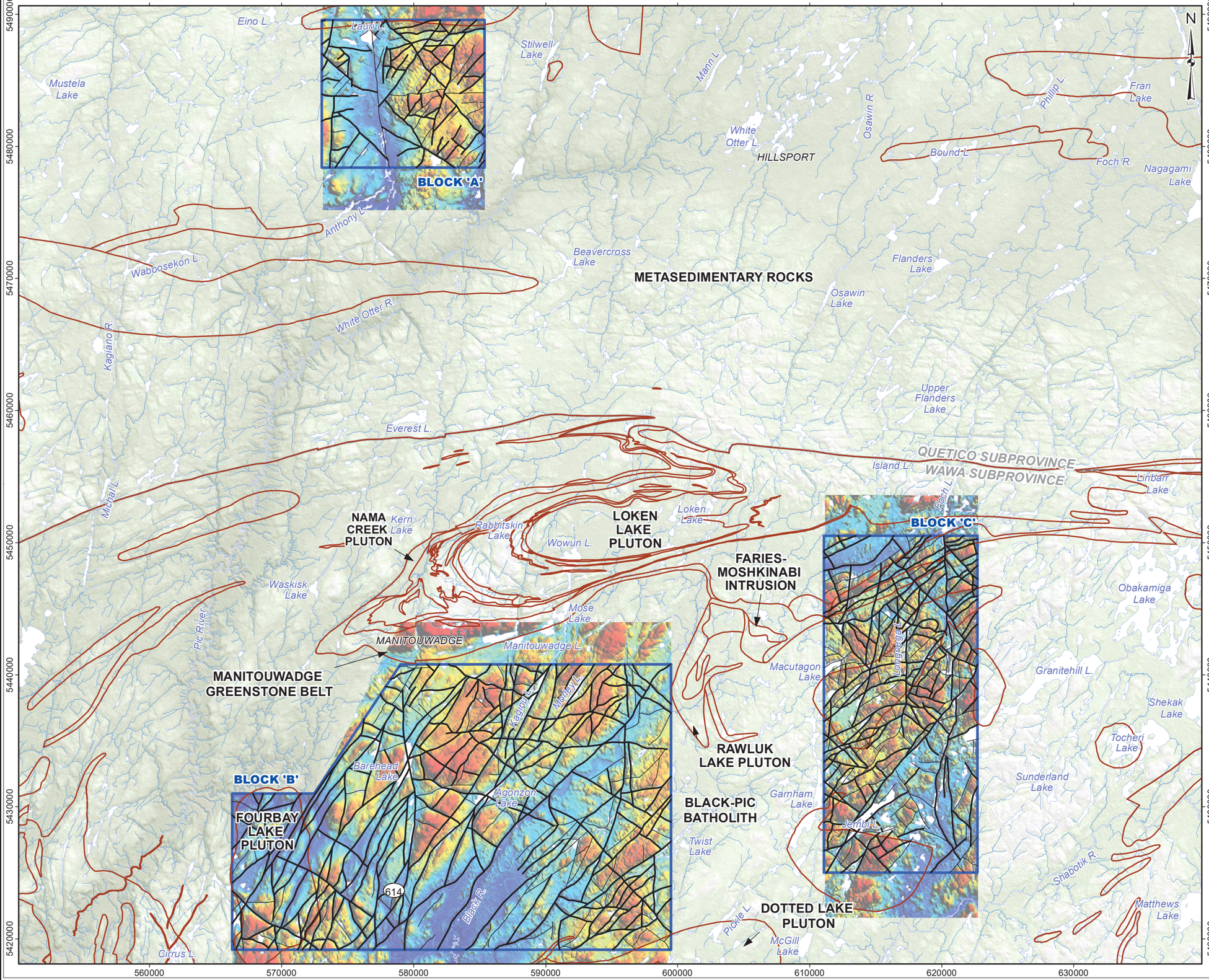
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 8c**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig08c_MagRA1



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody
- Geological Boundary
- Subprovince Boundary

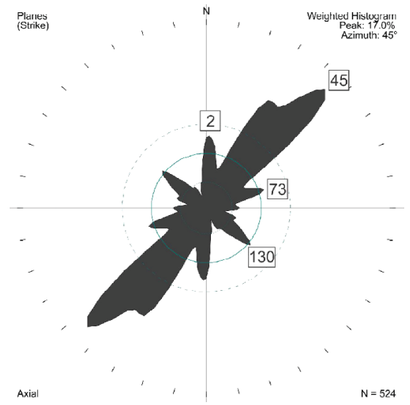
DEM Lineament (RA1)

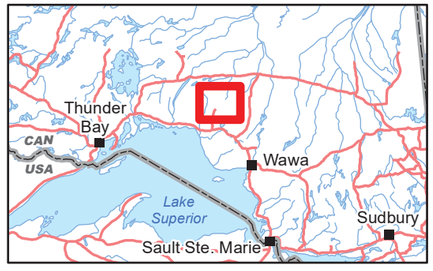
- 1
- 2

Elevation (masl)

487m

213





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)

Detailed Relief: Digital Elevation Model (SGL, 2017)

0 10 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments from Digital Elevation Data of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 9**	REVISION 5
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

File: SRK_NWMO_MAN_Fig09_DemRA1

570000
580000
590000
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5470000
N
Charon L.
Eino L.
Lauri L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS

LEGEND

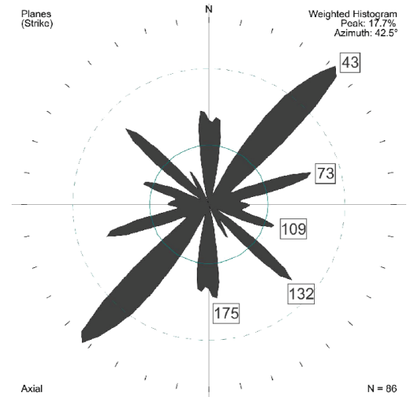
- Phase 2 Assessment Area
- Watercourse
- Waterbody
- Geological Boundary

DEM Lineament (RA1)

- 1
- 2

Elevation (masl)

487m
213





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)

Detailed Relief: Digital Elevation Model (SGL, 2017)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Digital Elevation Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 9a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig09a_DemRA1

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

Manitouwadge L.

Mose L.

BLOCK 'B'

FOURBAY LAKE PLUTON

Barrelhead

Kagimu L.

Morley L.

Agonzon Lake

Fourbay Lake

Black R.

DOTTED LAKE PLUTON

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody
- Geological Boundary

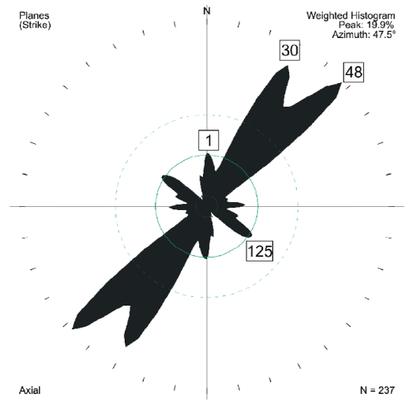
DEM Lineament (RA1)

- 1
- 2

Elevation (masl)

487m

213





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)

Detailed Relief: Digital Elevation Model (SGL, 2017)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments from Digital Elevation Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 9b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig09b_DemRA1

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnegal L.

Garnham Lake

Twist Lake

Dembi L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody
- Geological Boundary

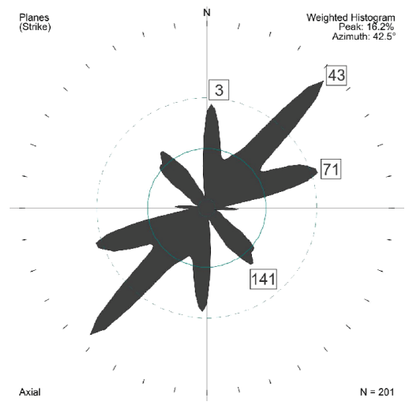
DEM Lineament (RA1)

- 1
- 2

Elevation (masl)

487m

213





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Relief: 1 Arc-Second Digital Elevation Model (SRTM, 2000)

Detailed Relief: Digital Elevation Model (SGL, 2017)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments from Digital Elevation Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 9c**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig09c_DemRA1

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5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

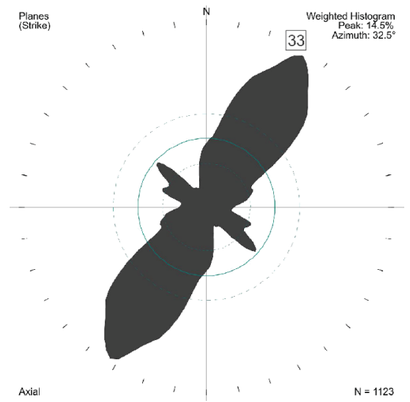
Eino L.
Lauri L.
Stilwell Lake
Mann L.
Mustela Lake
White Otter L.
HILLSPORT
Osawin R.
Phillip L.
Fran Lake
Bound L.
Foch R.
Nagagami Lake
CN Rail
BLOCK 'A'
Anthony L.
Waboosekon L.
Beavercross Lake
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Upper Flanders Lake
Everest L.
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Linbarr Lake
Foch L.
Michal L.
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake
Wowun L.
LOKEN LAKE PLUTON
Loken Lake
BLOCK 'C'
FARIES-MOSHKINABI INTRUSION
Waskisk Lake
Obakamiga Lake
Mose Lake
Pic River
MANITOUWADGE
Manitouwadge L.
MANITOUWADGE GREENSTONE BELT
Macutagon Lake
Longnegal L.
Granitehill L.
Shekak Lake
Tocheri Lake
RAWLUK LAKE PLUTON
Barehead Lake
Keginu L.
Marlay L.
BLOCK 'B'
Agonzon Lake
Garnham Lake
Sunderland Lake
FOURBAY LAKE PLUTON
BLACK-PIC BATHOLITH
Jembi L.
Twist Lake
Shabotik R.
614
Black R.
Pickle L.
DOTTED LAKE PLUTON
Matthews Lake
McGill Lake
Cirrus L.

LEGEND

- Phase 2 Assessment Area
- Geological Boundary
- Subprovince Boundary

FRI Lineament (RA1)

- 1
- 2





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 10 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 10**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

File: SRK_NWMO_MAN_Fig10_SATra1

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CARAMAT
Charon L.
Eino L.
Lauri L.
BLOCK 'A'
CN Rail
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
METASEDIMENTARY ROCKS
Beavercross Lake

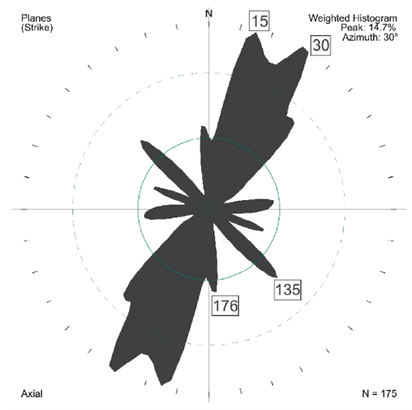
N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary

FRI Lineament (RA1)

- 1
- 2





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 10a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig10a_SATra1

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE

MANITOUWADGE GREENSTONE BELT

Mose L.

Manitouwadge L.

BLOCK 'B'

Kagiput L.

Motley L.

Barrhead L.

Agonzon Lake

FOURBAY LAKE PLUTON

Fourbay Lake

Black R.

DOTTED LAKE PLUTON

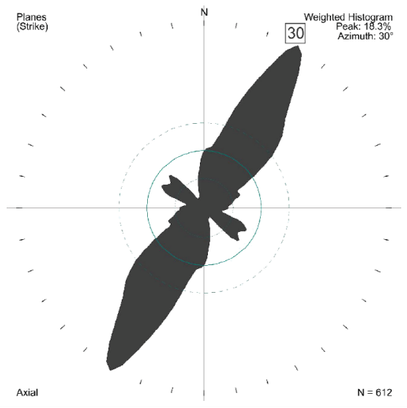
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LEGEND

- Phase 2 Assessment Area
- Geological Boundary

FRI Lineament (RA1)

- 1
- 2





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 10b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig10b_SATra1

600000
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630000
5450000
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5430000

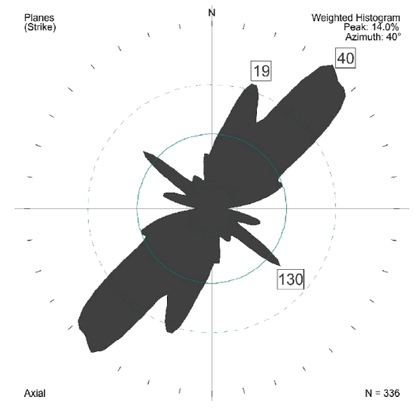
Loken Lake
LOKEN LAKE PLUTON
FARIES-MOSHKINABI INTRUSION
RAWLUK LAKE PLUTON
BLACK-PIC BATHOLITH
BLOCK 'C'
Macutagon Lake
Longnose L.
Garnham Lake
Jembi L.
Twist Lake
Obakamiga Lake
Granitehill L.
Tocheri Lake
Sunderland Lake
Shabotik R.
N

LEGEND

- Phase 2 Assessment Area
- Geological Boundary

FRI Lineament (RA1)

- 1
- 2





REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Background Imagery: Pan-sharpened LandSAT-8 (LP DAAC, 2015)

Detailed Imagery: Forest Resource Inventory Digital Aerial Imagery (Land Information Ontario, 2007-2011)

0 5 km

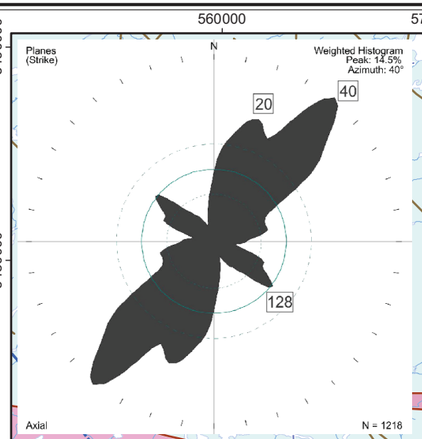
srk consulting

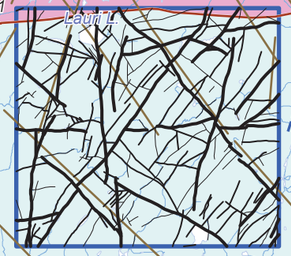
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

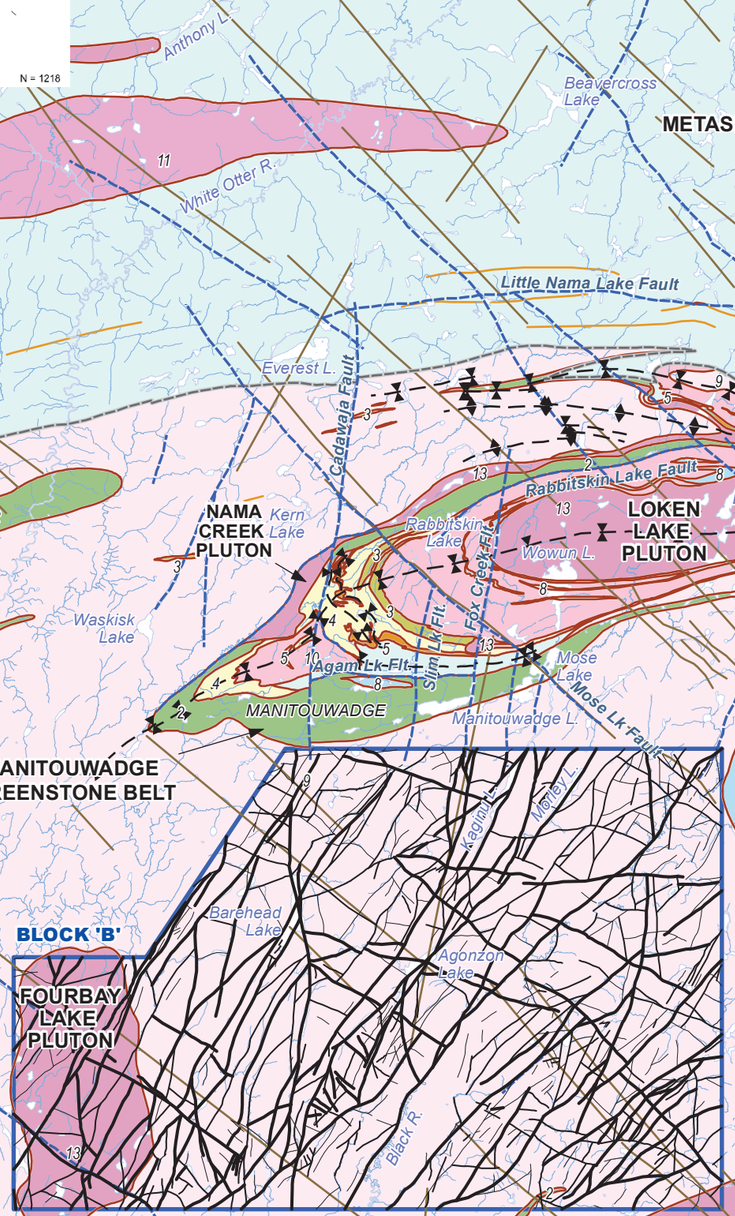
TITLE
Interpreted Lineaments from Forest Resource Inventory (FRI) Imagery of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 10c**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig10c_SATra1







560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

Laun L.
Stilwell Lake
Mann L.
Phillip L.
Fran Lake
White Otter L.
HILLSPORT
Osawin R.
Bound L.
Foch R.
Nagagami Lake
Anthony L.
Beavercross Lake
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
Waboosekon L.
White Otter R.
Kagiano R.
Little Nama Lake Fault
Upper Flanders Lake
Everest L.
Cadawaja Fault
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Foch L.
Linbarr Lake
Michal L.
Rabbitskin Lake Fault
Loken Lake
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake
Wowun L.
LOKEN LAKE PLUTON
FARIES-MOSHKINABI INTRUSION
Waskisk Lake
Slim Lk Flt.
Fox Creek Flt.
Agami Lk Flt.
Mose Lake
Mose Lk Fault
Pic River
MANITOUWADGE
Manitouwadge L.
Obakamiga Lake
Macutagon Lake
Longheg Lk Flt.
Granitehill L.
MANITOUWADGE GREENSTONE BELT
Kagiano L.
Mariet L.
Shekak Lake
Tocheri Lake
RAWLUK LAKE PLUTON
Barehead Lake
Agonzon Lake
Sunderland Lake
BLACK-PIC BATHOLITH
Garnham Lake
Jembaji L.
FOURBAY LAKE PLUTON
Twist Lake
Black R.
Shabotik R.
Matthews Lake
Pickle L.
DOTTED LAKE PLUTON
McGill Lake
Cirrus L.



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 10 km

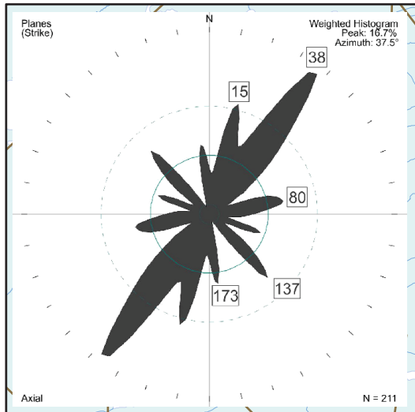
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Surficial Data of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 11**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

File: SRK_NWMO_MAN_Fig11_SurfCert



570000
580000
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Charon L.
Eino L.
Lauri L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake

BLOCK 'A'

METASEDIMENTARY ROCKS

5
7
11
13

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Surficial Lineament

- Certainty 1
- Certainty 2
- Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

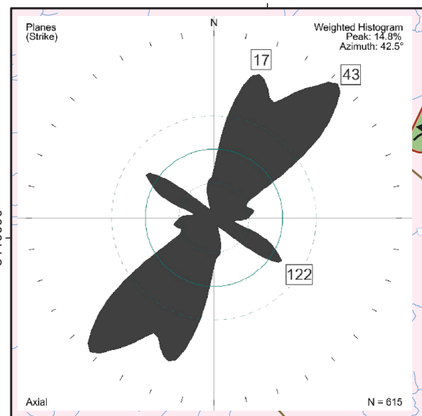
srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 11a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig11a_SurfCert



570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

BLOCK 'B'

FOURBAY LAKE PLUTON

DOTTED LAKE PLUTON

MANITOUWADGE

Cadawaja Fault

Slim Lake Fault

Manitouwadge L.

Fox Creek Fit

Mose L.

Mose Lake Fault

Kagimu L.

Money L.

Barlee Creek

Agonzon Lake

Little Joe Lake Fault

Fourbay Lake

Black R.

2 4 8 9 13

N

LEGEND

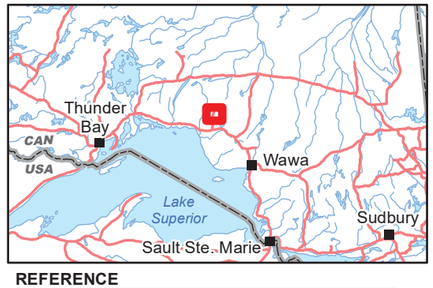
- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Surficial Lineament

- Certainty 1
- Certainty 2
- Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

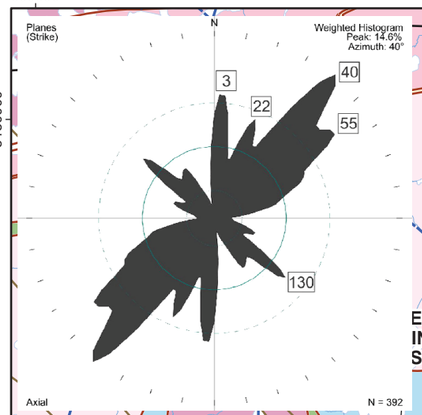
Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 11b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig11b_SurfCert

600000 610000 620000 630000

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BLOCK 'C'

ES-
INABI
SION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

Macutagon Lake

Longnega L.

Obakamiga Lake

Granitehill L.

Garnham Lake

Sunderland Lake

Tocheri Lake

Twist Lake

Jembi

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Surficial Lineament

- Certainty 1
- Certainty 2
- Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

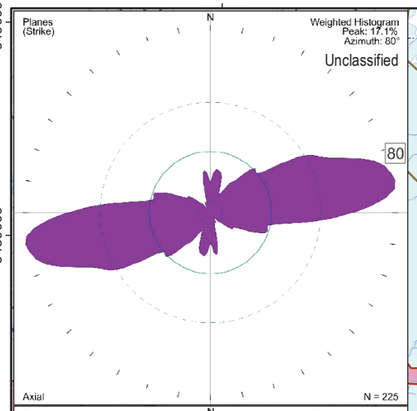
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

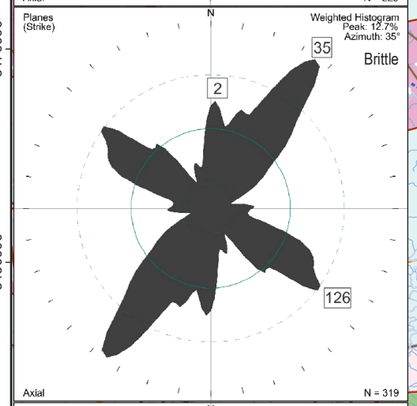
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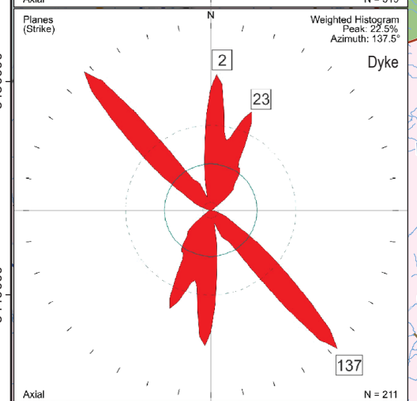
Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block C

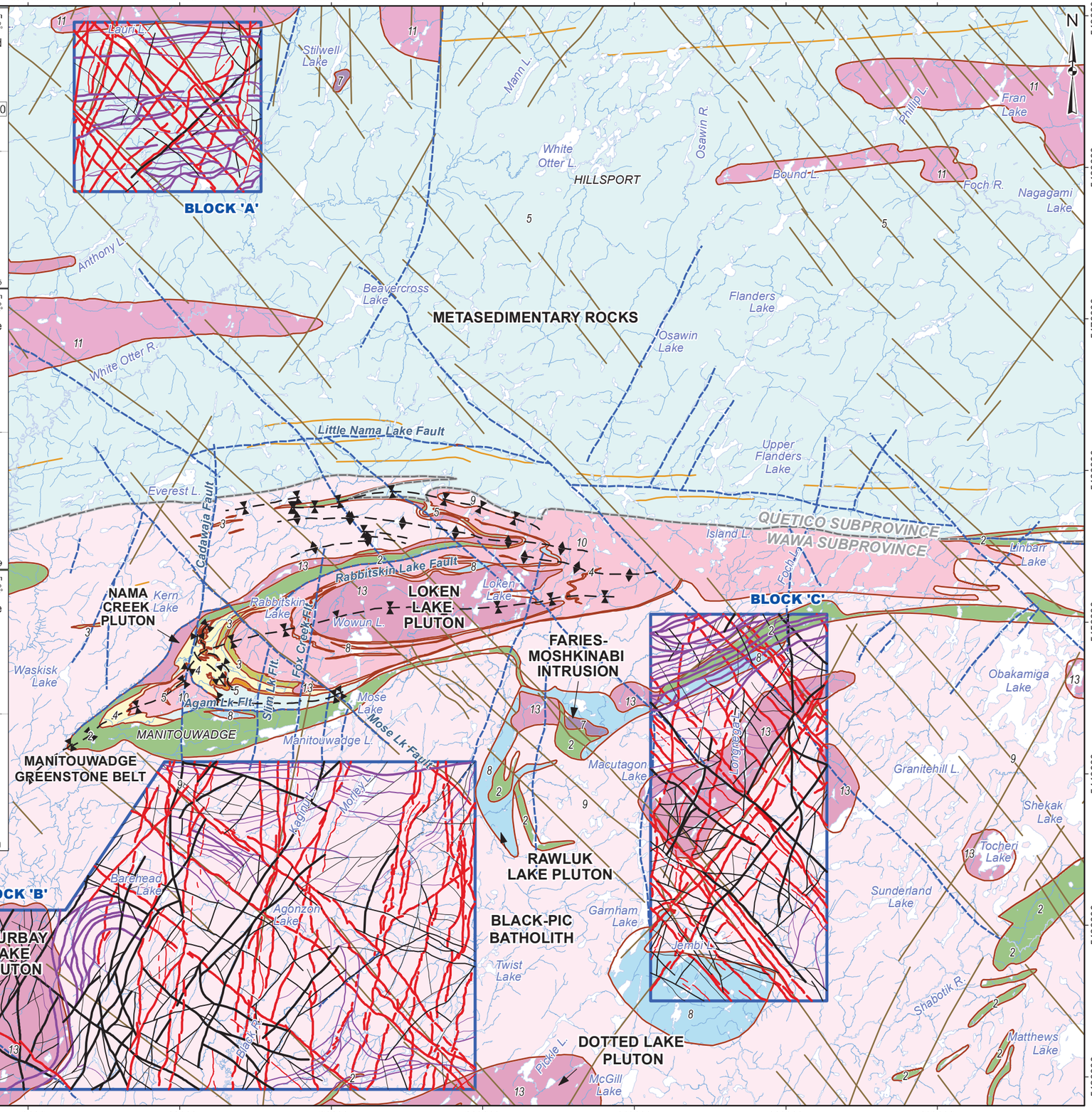
DESIGN	KR	02 SEP 2014	**Figure 11c**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig11c_SurfCert









LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineament (Certainty)

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

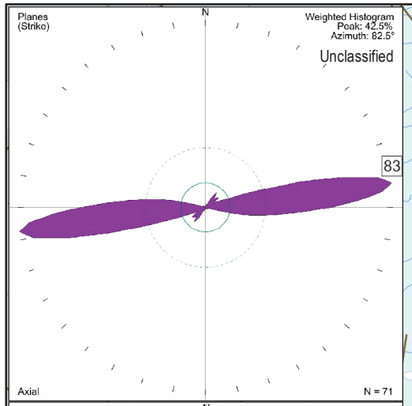
srk consulting

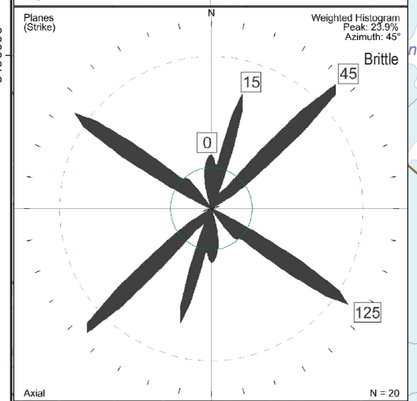
PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

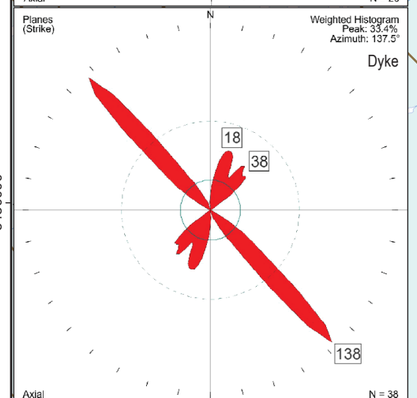
TITLE: **Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 12**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

File: SRK_NWMO_MAN_Fig12_MagCert







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Charon L.
Lauri L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS
13
11
7
5
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Lineament (Certainty)

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

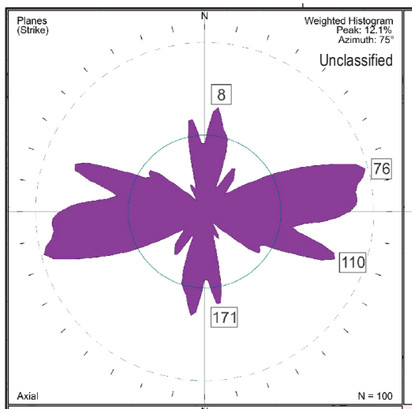
srk consulting

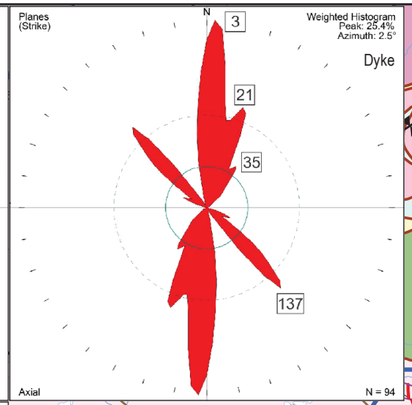
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

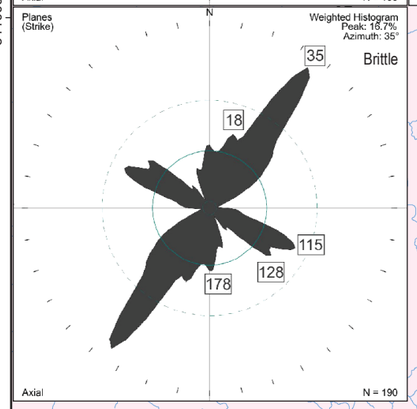
TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 12a**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig12a_MagCert







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5420000
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BLOCK 'B'
MANITOUWADGE
Manitouwadge L.
Agam Lake Fault
Slim Lake Fault
Cadawaja Fault
Fox Creek Fault
Mose Lake Fault
Mose L.
Morley L.
Kaginu L.
Barrehead L.
Agonzon Lake
FOURBAY LAKE PLUTON
Little Jos Lake Fault
Fourbay Lake

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineament (Certainty)

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 12b**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig12b_MagCert

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnegal L.

Garnham Lake

Jembi L.

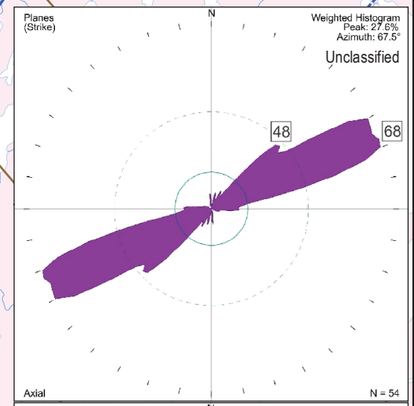
Twist Lake

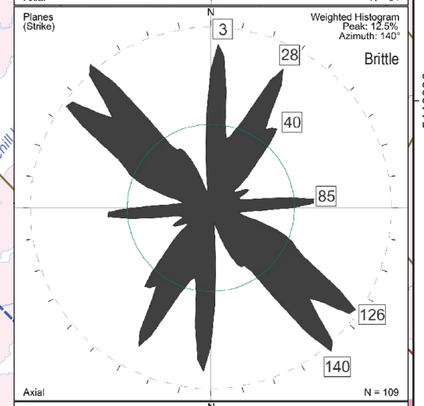
Granitehill L.

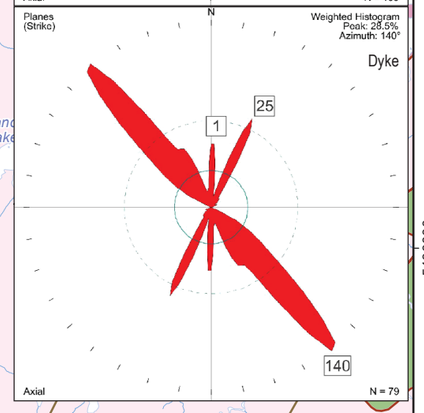
Sunderland Lake

Shabotik R.

N







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Lineament (Certainty)

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

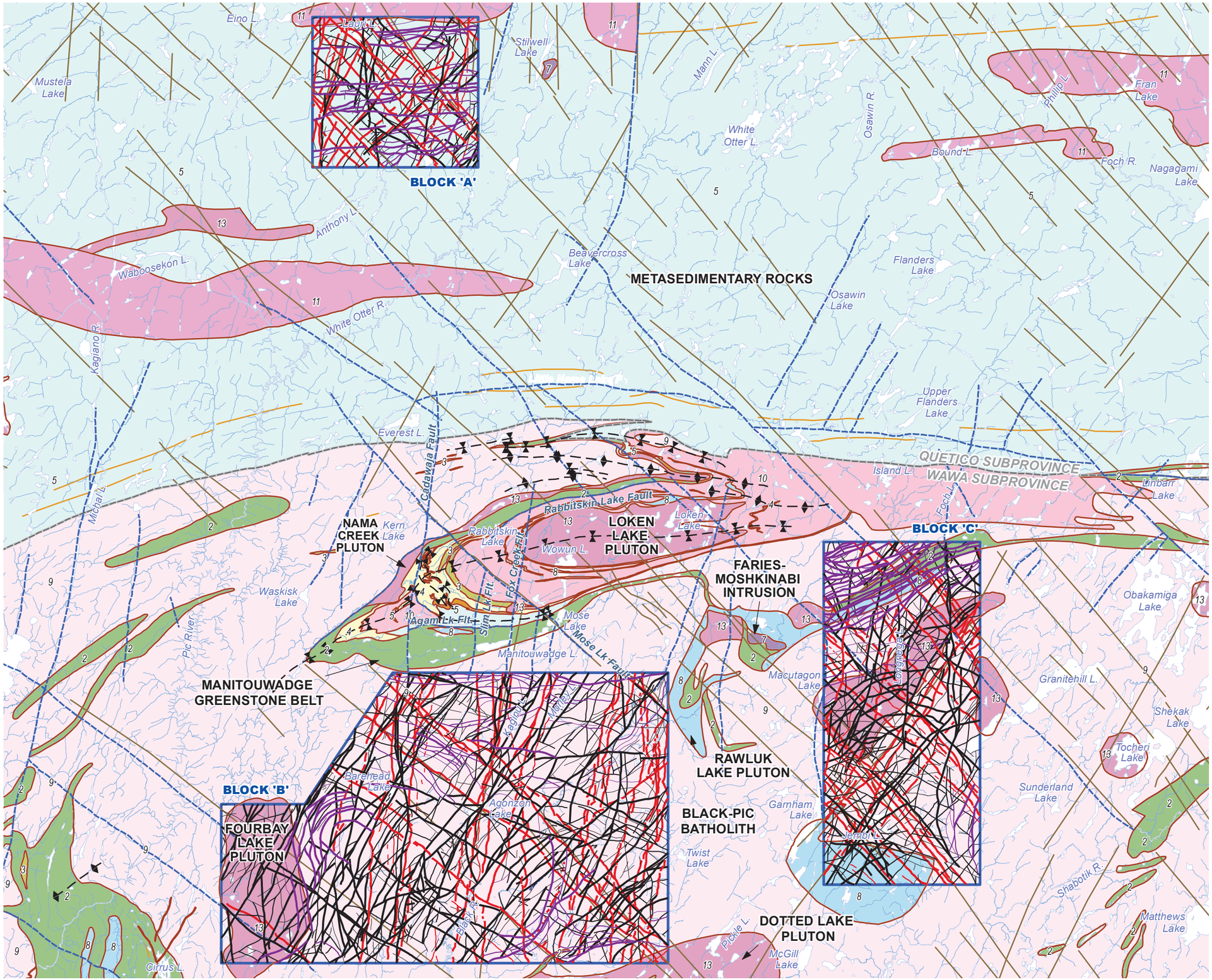
srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C**

DESIGN	KR	02 SEP 2014	**Figure 12c**	REVISION 5
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig12c_MagCert



REFERENCE

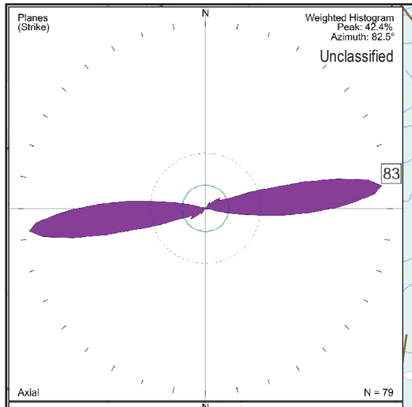
Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

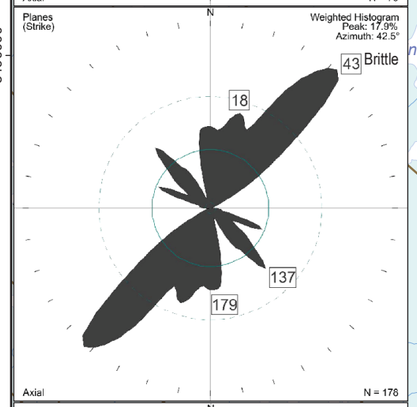
Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

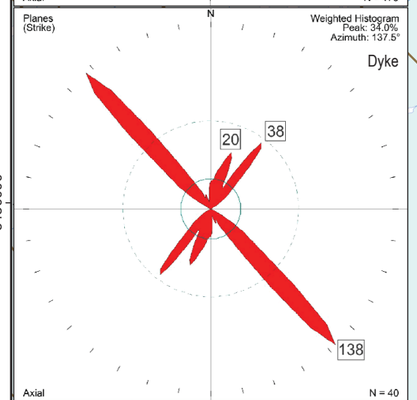
srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	**Figure 13**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000







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Charon L.
Laurin L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Lineament

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

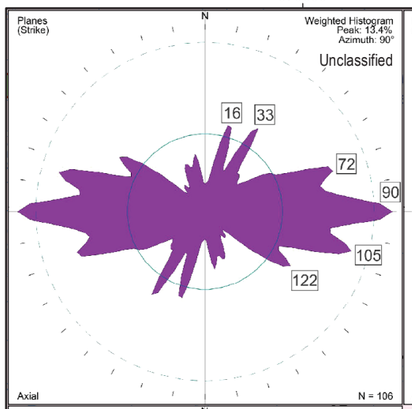
srk consulting

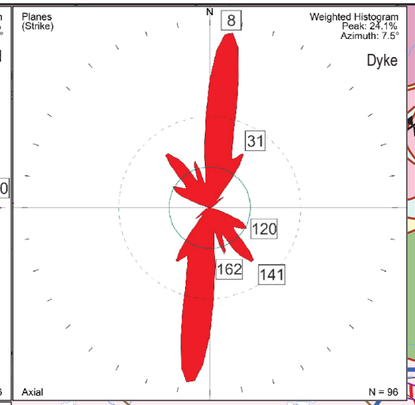
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

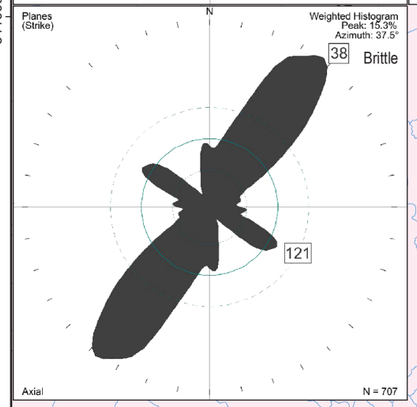
TITLE
Final Integrated Lineaments of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 13a**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig13a_FinalCert







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineaments

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 1
Certainty 2	Certainty 2	Certainty 2
Certainty 3	Certainty 3	Certainty 3



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Final Integrated Lineaments of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 13b**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig13b_FinalCert

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnega L.

Granitehill

Sunderland Lake

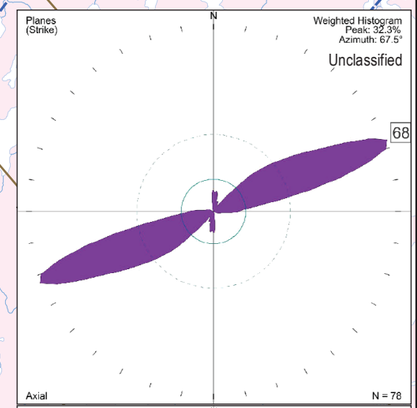
Garnham Lake

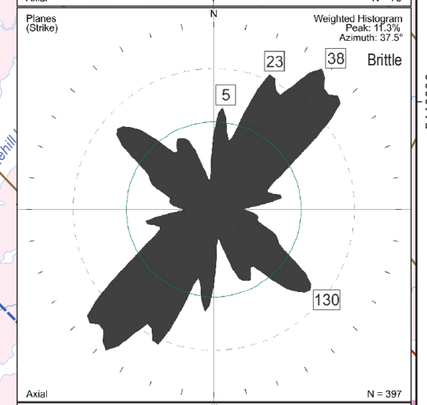
Twist Lake

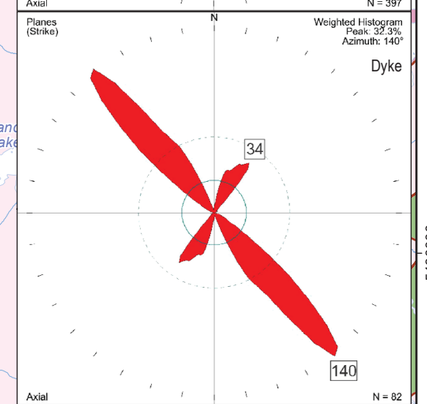
Jempi

Shabotik R.

N







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Lineament

Unclassified	Brittle	Dyke
Certainty 1	Certainty 1	Certainty 2
Certainty 2	Certainty 2	Certainty 3
Certainty 3	Certainty 3	



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Final Integrated Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 13c**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig13c_FinalCert

Eino L.
Laurin L.
Stilwell Lake
Mustela Lake
White Otter L.
Osawin R.
Phillip L.
Fran Lake
Bound L.
Foch R.
Nagagami Lake
Anthony L.
Waboosekon L.
Beavercross Lake
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Upper Flanders Lake
Everest L.
Island L.
Foch L.
Linbarr Lake
Michal L.
Kern Lake
Rabbitskin Lake
Wowun L.
Loken Lake
Waskisk Lake
Mose Lake
Obakamiga Lake
Pic River
Manitouwadge L.
Macutagon Lake
Longnecker L.
Granitehill L.
Shekak Lake
Tocheri Lake
Sagimo L.
Morley L.
Barrenhead Lake
Agonzon Lake
Sunderland Lake
Garnham Lake
Jembi L.
Twist Lake
Shabotik R.
Matthews Lake
Pickle L.
McGill Lake
Cirrus L.

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

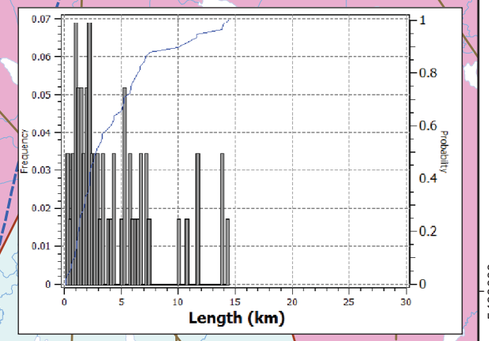
srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	Figure 14	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

570000
580000
590000
5490000
5480000
5470000

CARAMAT
Charon L.
Eino L.
Lauri L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13



N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Brittle Lineament	Dyke Lineament
<1 km	<1 km
1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5
>5 km	>5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 14a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig14a_MagLen

570000
580000
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5440000
5430000
5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

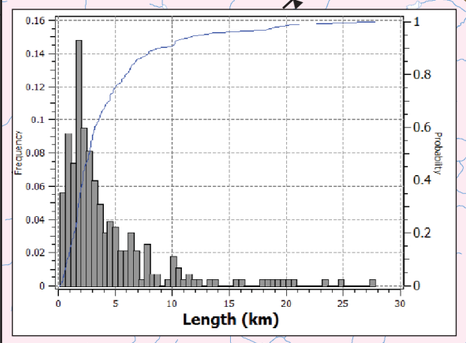
BLOCK 'B'

FOURBAY LAKE PLUTON

DOTTED LAKE PLUTON

Cadawaja Fault
Slim Lake Fault
Fox Creek Fault
Mose Lake Fault
Little Jackfish Fault

Manitouwadge L.
Mose L.
Morley L.
Kagimu L.
Barrehead L.
Agonzon Lake
Fourbay Lake
Black R.



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Brittle Lineament	Dyke Lineament
<1 km	<1 km
1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5
>5 km	>5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Manitouwadge Area - Block B**

DESIGN	KR	02 SEP 2014	**Figure 14b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig14b_MagLen

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnegan L.

Granitehill L.

Tocheri Lake

Sunderland Lake

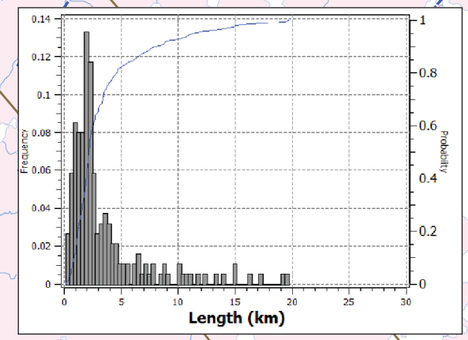
Shabotik R.

Garnham Lake

Jembi L.

Twist Lake

N



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Brittle Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km

Dyke Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Brittle and Dyke Lineaments from Pole Reduced Magnetic Data (by Length) of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 14c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig14c_MagLen

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

Eino L.
Lauri L.
Stilwell Lake
Mani L.
Phillip L.
Eran Lake
Mustela Lake
White Otter L.
Osawin R.
HILLSPORT
Bound L.
Foch R.
Nagagami Lake
BLOCK 'A'
Anthony L.
Waboosekon L.
Beavercross Lake
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Little Nama Lake Fault
Upper Flanders Lake
Everest L.
Cadawaja Fault
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Foch L.
Linbarr Lake
Michal L.
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake Fault
LOKEN LAKE PLUTON
Loken Lake
BLOCK 'C'
Rabbitskin Lake
Wowun L.
Fox Creek Fault
Waskisk Lake
Sim Lk Flt.
Agami Lk Flt.
Mose Lake
Mose Lk Fault
FARIES-MOSHKINABI INTRUSION
Obakamiga Lake
Pic River
MANITOUWADGE
Manitouwadge L.
Longnegar L.
Granitehill L.
MANITOUWADGE GREENSTONE BELT
Macutagon Lake
Shekak Lake
Kagimut L.
Mercer L.
Barehead Lake
RAWLUK LAKE PLUTON
Tocheri Lake
BLOCK 'B'
Agonzon Lake
Sunderland Lake
FOURBAY LAKE PLUTON
BLACK-PIC BATHOLITH
Garnham Lake
Jemmat L.
Twist Lake
Shabotik R.
Black R.
Pickle L.
DOTTED LAKE PLUTON
Matthews Lake
McGill Lake
Cirrus L.

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Interpreted Lineaments (by Length) from Surficial Data of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 15**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

570000
580000
590000
5490000
5480000
5470000
N
CARAMAT
Charon L.
Eino L.
Lauri L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS
5
11
13
7
Length (km)
Frequency
Probability
0
5
10
15
20
25
30
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.2
0.4
0.6
0.8
1

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Surficial Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Interpreted Lineaments (by Length) from Surficial Data of the Manitouwadge Area - Block A**

DESIGN	KR	02 SEP 2014	**Figure 15a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig15a_SurfLen

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

BLOCK 'B'

Cadawaja Fault

Slim Lake Fault

Fox Creek Fault

Manitouwadge L.

Mose L.

Mose Lake Fault

Kagimu L.

Manley L.

Barrhead L.

Agonzon Lake

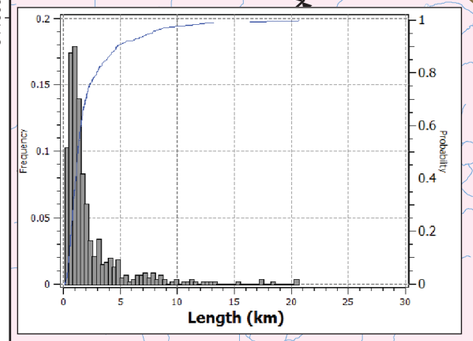
Little Ice Lake Fault

FOURBAY LAKE PLUTON

Fourbay Lake

Black R.

DOTTED LAKE PLUTON



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Surficial Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation Manitouwadge Area, Ontario

TITLE: **Interpreted Lineaments (by Length) from Surficial Data of the Manitouwadge Area - Block B**

DESIGN	KR	02 SEP 2014	**Figure 15b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig15b_SurfLen

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnegal L.

Granitehill L.

Garnham Lake

Jembi

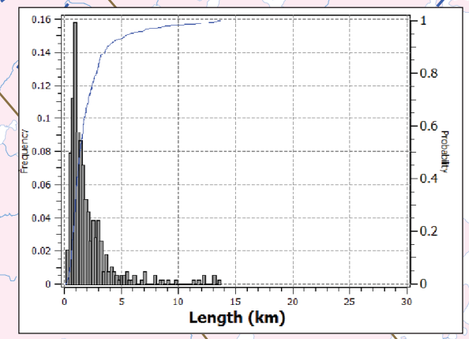
Twist Lake

Sunderland Lake

Tocheri Lake

Shabotik R.

N



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Surficial Lineament

- <1 km
- 1 - 2.5
- 2.5 - 5
- >5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Interpreted Lineaments (by Length) from Surficial Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 15c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig15c_SurfLen

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

Eino L.
Leaunit L.
Stilwell Lake
Mani L.
Phillip L.
Eran Lake
Mustela Lake
White Otter L.
HILLSPORT
Osawin R.
Bound L.
Foch R.
Nagagami Lake
BLOCK 'A'
Anthony L.
Waboosekon L.
Beavercross Lake
METASEDIMENTARY ROCKS
Flanders Lake
Osawin Lake
White Otter R.
Kagiano R.
Little Nama Lake Fault
Upper Flanders Lake
Everest L.
Cadawaja Fault
QUETICO SUBPROVINCE
WAWA SUBPROVINCE
Island L.
Foch L.
Linbarr Lake
Michal L.
NAMA CREEK PLUTON
Kern Lake
Rabbitskin Lake Fault
LOKEN LAKE PLUTON
Loken Lake
BLOCK 'C'
Rabbitskin Lake
Wowun L.
Fox Creek Fault
Waskisk Lake
Sim Lk Flt.
Agami Lk Flt.
Mose Lake
Mose Lk Fault
FARIES-MOSHKINABI INTRUSION
Obakamiga Lake
Pic River
MANITOUWADGE
Manitouwadge L.
Lodge Creek Fault
Macutagon Lake
Granitehill L.
MANITOUWADGE GREENSTONE BELT
Jackfish L.
Violet L.
Shekak Lake
Barehead Lake
Agonzon Lake
RAWLUK LAKE PLUTON
Tocheri Lake
BLOCK 'B'
FOURBAY LAKE PLUTON
Garnham Lake
Sunderland Lake
BLACK-PIC BATHOLITH
Twist Lake
Jemmett L.
Shabotik R.
Matthews Lake
Pickle L.
DOTTED LAKE PLUTON
McGill Lake
Cirrus L.

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

DESIGN	KR	02 SEP 2014	Figure 16	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

570000
580000
590000
5490000
5480000
5470000
N
CARAMAT
Charon L.
Eino L.
Laum L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13
Frequency
Probability
Length (km)
0
5
10
15
20
25
30
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.2
0.4
0.6
0.8
1

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Lineament

Unclassified	Brittle	Dyke
<1 km	<1 km	<1 km
1 - 2.5	1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5	2.5 - 5
>5 km	>5 km	>5 km

Thunder Bay
CAN
USA
Wawa
Lake Superior
Sudbury
Sault Ste. Marie

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Final Integrated Lineaments (by Length) of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 16a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig16a_FinalLEN

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

BLOCK 'B'

FOURBAY LAKE PLUTON

DOTTED LAKE PLUTON

Cadawaja Fault

Slim Lake Fault

Fox Creek Fault

Manitouwadge L.

Mose L.

Mose Lake Fault

Kagiano L.

Moiler L.

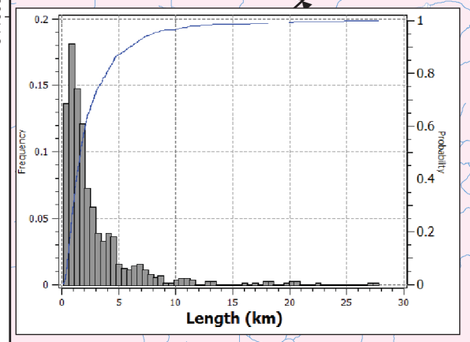
Gareheard L.

Agonzon Lake

Little Ice Lake Fault

Fourbay Lake

Black R.



N

LEGEND

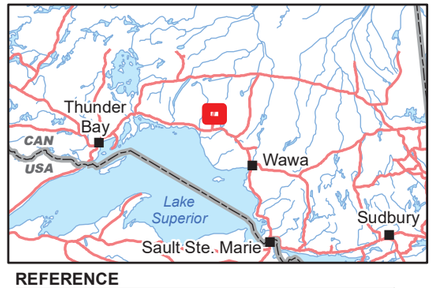
- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Lineament

Unclassified	Brittle	Dyke
<1 km	<1 km	<1 km
1 - 2.5	1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5	2.5 - 5
>5 km	>5 km	>5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Final Integrated Lineaments (by Length) of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 16b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig16b_FinalLEN

600000 610000 620000 630000

5450000 5440000 5430000

Loken Lake

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Macutagon Lake

Longnegal L.

Granitehill L.

Garnham Lake

Jembi

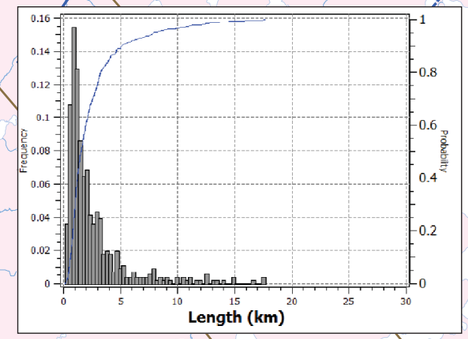
Twist Lake

Tocheri Lake

Sunderland Lake

Shabotik R.

N



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Lineament

Unclassified	Brittle	Dyke
<1 km	<1 km	<1 km
1 - 2.5	1 - 2.5	1 - 2.5
2.5 - 5	2.5 - 5	2.5 - 5
>5 km	>5 km	>5 km



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Final Integrated Lineaments (by Length) of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 16c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig16c_FinalLEN

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

BLOCK 'A'

BLOCK 'B'

BLOCK 'C'

METASEDIMENTARY ROCKS

HILLSPORT

MANITOUWADGE GREENSTONE BELT

NAMA CREEK PLUTON

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

DOTTED LAKE PLUTON

FOURBAY LAKE PLUTON

QUETICO SUBPROVINCE

WAWA SUBPROVINCE

Little Nama Lake Fault

Rabbitskin Lake Fault

Agami Lk Flt.

Sym Lk Flt.

Mose Lk Fault

Black Fault

Fox Creek Fault

Cadawaja Fault

Eino L.

Lauri L.

Stilwell Lake

Mustela Lake

Mann L.

White Otter L.

Osawin R.

Phillip L.

Fran Lake

Bound L.

Foch R.

Nagagami Lake

Anthony L.

Waboosekon L.

White Otter R.

Kagiano R.

Beavercross Lake

Flanders Lake

Osawin Lake

Upper Flanders Lake

Everest L.

Michal L.

Island L.

Foch L.

Linbarr Lake

Kern Lake

Rabbitskin Lake

Wowun L.

Loken Lake

Waskisk Lake

Pic River

Agami L.

Mose Lake

Manitouwadge L.

Obakamiga Lake

Granitehill L.

Macutagon Lake

Longnecker L.

Shekak Lake

Tocheri Lake

Sunderland Lake

Garnham Lake

Jemb L.

Twist Lake

Shabotik R.

Matthews Lake

Pickle L.

McGill Lake

Cirrus L.

Barehead Lake

Agonzon Lake

Magill L.

Motey L.

Thunder Bay

CAN

USA

Wawa

Lake Superior

Sudbury

Sault Ste. Marie

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineament Density

6 (km/km²)

0

- Brittle Lineament
- Dyke Lineament

REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 17**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig17_mBDLinDens

570000
580000
590000
5490000
5480000
5470000
N
CARAMAT
Charon L.
Eino L.
Lauri L.
Bishop Lake
Anthony L.
White Otter R.
Stilwell Lake
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)
0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A**

DESIGN	KR	02 SEP 2014	**Figure 17a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig17a_mBDLinDens

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

Cadawaja Fault

Slim Lake Fault

Manitouwadge L.

Fox Creek Fault

Mose L.

Mose Lake Fault

BLOCK 'B'

Gareau L.

Kagimut L.

Morley L.

Agonzon Lake

Little Pic River

FOURBAY LAKE PLUTON

Fourbay Lake

Black R.

DOTTED LAKE PLUTON

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 17b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig17b_mBDLinDens

600000 610000 620000 630000

5450000 5440000 5430000

BLOCK 'C'

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

Loken Lake

Macutagon Lake

Longnegal L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi L.

Twist Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 17c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig17c_mBDLinDens

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	**Figure 18**	REVISION 4
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

570000
580000
590000
5490000
5480000
5470000
CARAMAT
Charon L.
Eino L.
Lauri L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS
5
11
13
7
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 18a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig18a_mUBDLinDens

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

Cadawaja Fault

Slim Lake Fault

Manitouwadge L.

Fox Creek Fault

Mose L.

Mose Lake Fault

BLOCK 'B'

Carlshead L.

Kagimu L.

Morley L.

Agonzon Lake

Little Pic River Fault

FOURBAY LAKE PLUTON

Fourbay Lake

Black R.

DOTTED LAKE PLUTON

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B**

DESIGN	KR	02 SEP 2014	**Figure 18b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig18b_mUBDLinDens

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake
Macutagon Lake
Longnegal L.
Obakamiga Lake
Granitehill L.
Garnham Lake
Jembi L.
Twist Lake
Tocheri Lake
Sunderland Lake
Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 18c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig18c_mUBDLinDens

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

BLOCK 'A'

BLOCK 'B'

BLOCK 'C'

METASEDIMENTARY ROCKS

HILLSPORT

MANITOUWADGE GREENSTONE BELT

NAMA CREEK PLUTON

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

DOTTED LAKE PLUTON

FOURBAY LAKE PLUTON

QUETICO SUBPROVINCE

WAWA SUBPROVINCE

Little Nama Lake Fault

Rabbitskin Lake Fault

Mose Lk Fault

Sym Lk Flt.

Agami Lk Flt.

Fox Creek Fault

Cadawaja Fault

Eino L.

Laurl L.

Stilwell Lake

Mustela Lake

Mann L.

White Otter L.

Osawin R.

Phillip L.

Fran Lake

Bound L.

Foch R.

Nagagami Lake

Anthony L.

Waboosekon L.

White Otter R.

Kagiano R.

Beavercross Lake

Flanders Lake

Osawin Lake

Upper Flanders Lake

Everest L.

Michal L.

Island L.

Foch L.

Linbarr Lake

Kern Lake

Rabbitskin Lake

Wowun L.

Loken Lake

Waskisk Lake

Pic River

Mose Lake

Manitouwadge L.

Macutagon Lake

Longnegg L.

Obakamiga Lake

Granitehill L.

Shekak Lake

Tocheri Lake

Sunderland Lake

Shabotik R.

Matthews Lake

Barehead Lake

Agonzon Lake

Kagimu L.

Morley L.

Black R.

Garnham Lake

Jemmi L.

Twist Lake

Pickle L.

McGill Lake

Cirrus L.

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

- Surficial Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for Interpreted Lineaments from Surficial Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 19**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig19_sLinDens

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N
CARAMAT
Charon L.
Eino L.
Lauri L.
Bishop Lake
Stilwell Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Surficial Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block A**

DESIGN	KR	02 SEP 2014	**Figure 19a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig19a_sLinDens

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MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
Cadawaja Fault
Slim Lake Fault
Manitouwadge L.
Fox Creek Fault
Mose L.
Mose Lake Fault
BLOCK 'B'
Kagimi L.
Mondey L.
Barrenland L.
Agonzon Lake
Little Jackfish Lake Fault
FOURBAY LAKE PLUTON
Fourbay Lake
Black R.
DOTTED LAKE PLUTON

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Surficial Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 19b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig19b_sLinDens

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5450000 5440000 5430000

N

BLOCK 'C'

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

Loken Lake

Macutagon Lake

Longnegal L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi

Twist Lake

Shabotik R.

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

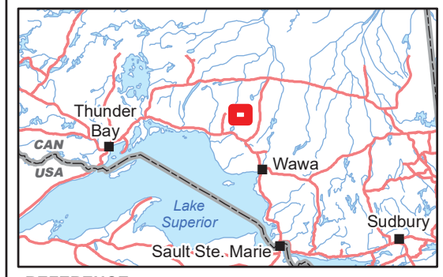
- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Surficial Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Density for Interpreted Lineaments from Surficial Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 19c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig19c_sLinDens

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	**Figure 20**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

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CARAMAT
Charon L.
Eino L.
Laun L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

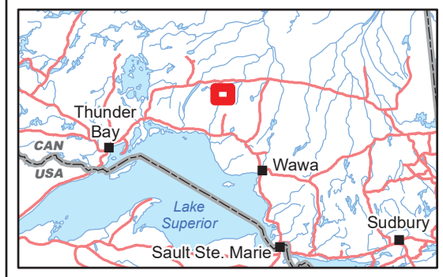
- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 20a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig20a_fBDLinDens

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MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
BLOCK 'B'
FOURBAY LAKE PLUTON
DOTTED LAKE PLUTON
Cadawaja Fault
Slim Lake Fault
Fox Creek Fault
Manitouwadge L.
Mose L.
Mose Lake Fault
Kagimi L.
Marley L.
Barrhead L.
Agonzon Lake
Little Ice Lake Fault
Fourbay Lake
Black R.
2
4
8
9
13

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 20b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig20b_fBDLinDens

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5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Longnegal L.

Granitehill L.

Obakamiga Lake

Garnham Lake

Jembi L.

Twist Lake

Sunderland Lake

Tocheri Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 20c**	REVISION 2
GIS	JA	05 SEP 2016		UTM ZONE 16N
CHECK	CN	05 SEP 2016		NAD 1983
REVIEW	JPS	05 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig20c_fBDLinDens

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	**Figure 21**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

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CARAMAT
Charon L.
Eino L.
Laun L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS

5
7
11
13

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)
0



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for All Final Integrated Lineaments of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 21a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig21a_fUBDLinDens

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5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

MANITOUWADGE

BLOCK 'B'

Cadawaja Fault

Slim Lake Fault

Fox Creek Fault

Manitouwadge L.

Mose L.

Mose Lake Fault

Kagami L.

Marter L.

Gareneau L.

Agonzon Lake

Little Jackfish Fault

FOURBAY LAKE PLUTON

Fourbay Lake

Black R.

DOTTED LAKE PLUTON

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Density for All Final Integrated Lineaments of the Manitouwadge Area - Block B**

DESIGN	KR	02 SEP 2014	**Figure 21b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig21b_fUBDLinDens

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5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake
Macutagon Lake
Garnham Lake
Twist Lake
Lorignegal L.
Jembi
Obakamiga Lake
Granitehill L.
Tocheri Lake
Sunderland Lake
Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke

Lineament Density

6 (km/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Density for All Final Integrated Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 21c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig21c_fUBDLinDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Intersection Density

10 (/km²) — 0

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 22**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig22_mB_IntDens

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CARAMAT
Charon L.
Eino L.
Lauri L.
Bishop Lake
Stilwell Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
11
13
7

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)
0



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 22a**	REVISION 2
GIS	JA	02 SEP 2014		UTM ZONE 16N
CHECK	CN	02 SEP 2014		NAD 1983
REVIEW	JPS	02 SEP 2014		1:110,000

File: SRK_NWMO_MAN_Fig22a_mB_IntDens

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MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
Cadawaja Fault
Slim Lake Fault
Fox Creek Fault
Manitouwadge L.
Mose L.
Mose Lake Fault
BLOCK 'B'
Morley L.
Kaginul L.
Bareilead L.
Agonzon Lake
FOURBAY LAKE PLUTON
Fourbay Lake
Little Jackfish River
Black R.
DOTTED LAKE PLUTON
2
4
8
9
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks
- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 22b**	REVISION 2
GIS	JA	02 SEP 2014		UTM ZONE 16N
CHECK	CN	02 SEP 2014		NAD 1983
REVIEW	JPS	02 SEP 2014		1:110,000

File: SRK_NWMO_MAN_Fig22b_mB_IntDens

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5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Longnegg L.

Granitehill L.

Obakamiga Lake

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi L.

Twist Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Intersection Density for Interpreted Brittle & Dyke Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 22c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig22c_mB_IntDens



LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Intersection Density

10 (/km²)

0

Geophysical Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 23**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig23_mALL_IntDens

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N
CARAMAT
Charon L.
Eino L.
Lauri L.
Anthony L.
White Otter R.
Stilwell Lake
Bishop Lake
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 23a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig23a_mALL_IntDens

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N
MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
Cadawaja Fault
Slim Lake Fault
Manitouwadge L.
Fox Creek Fault
Mose L.
Mose Lake Fault
BLOCK 'B'
Kagimut L.
Morley L.
Eareshead L.
Agonzon Lake
Little Pic River
FOURBAY LAKE PLUTON
Fourbay Lake
Black R.
DOTTED LAKE PLUTON
9
2
4
8
13
5

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 23b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig23b_mALL_IntDens

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Longbeg L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi L.

Twist Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Geophysical Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Intersection Density for All Interpreted Lineaments from Pole Reduced Magnetic Data of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 23c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig23c_mALL_IntDens

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

BLOCK 'A'

BLOCK 'B'

BLOCK 'C'

METASEDIMENTARY ROCKS

HILLSPORT

MANITOUWADGE GREENSTONE BELT

NAMA CREEK PLUTON

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

DOTTED LAKE PLUTON

FOURBAY LAKE PLUTON

QUETICO SUBPROVINCE

WAWA SUBPROVINCE

Little Nama Lake Fault

Rabbitskin Lake Fault

Mose Lk Fault

Agami Lk Flt.

Sym Lk Flt.

Fox Creek Flt.

Caduwaja Fault

Eino L. Laun L. Stilwell Lake Mustela Lake Mann L. Phillip L. Fran Lake Nagagami Lake White Otter L. Osawin R. Bound L. Foch R. Anthony L. Waboosekon L. White Otter R. Kagiano R. Beavercross Lake Flanders Lake Osawin Lake Upper Flanders Lake Everest L. Michal L. Island L. Foch L. Linbarr Lake Kern Lake Rabbitskin Lake Wowun L. Loken Lake Waskisk Lake Pic River Mose Lake Manitouwadge L. Longnegger L. Macutagon Lake Granitehill L. Obakamiga Lake Shekak Lake Tocheri Lake Sunderland Lake Garnham Lake Jembi L. Twist Lake Shabotik R. Matthews Lake Pickle L. McGill Lake Cirrus L. Barehead Lake Agonzon Lake Keagmi L. Motley L. Black R.

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Intersection Density

10 (/km²)

0

- Surficial Lineament
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for Interpreted Surficial Lineaments of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 24**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig24_sALL_IntDens

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580000
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CARAMAT
Charon L.
Eino L.
Lauri L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS
5
11
13
7
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Surficial Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Interpreted Surficial Lineaments of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 24a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig24a_sALL_IntDens

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MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
Cadawaja Fault
Slim Lake Fault
Manitouwadge L.
Fox Creek Fault
Mose L.
Mose Lake Fault
BLOCK 'B'
Barrenland L.
Kagina L.
Morley L.
Agonzon Lake
Little Jackfish River
FOURBAY LAKE PLUTON
Fourbay Lake
Black R.
DOTTED LAKE PLUTON
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Surficial Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Intersection Density for Interpreted Surficial Lineaments of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 24b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig24b_sALL_IntDens

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake
Macutagon Lake
Longnegal L.
Obakamiga Lake
Granitehill L.
Tocheri Lake
Garnham Lake
Jembi
Sunderland Lake
Twist Lake
Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Surficial Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Interpreted Surficial Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 24c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig24c_sALL_IntDens

REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

srk consulting

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

DESIGN	KR	02 SEP 2014	**Figure 25**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

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580000
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CARAMAT
Charon L.
Eino L.
Laun L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
11
13
7
N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)
0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 25a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig25a_fB_IntDens

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N

MANITOUWADGE GREENSTONE BELT
MANITOUWADGE
Cadawaja Fault
Slim Lake Fault
Fox Creek Fault
Manitouwadge L.
Mose L.
Mose Lake Fault
BLOCK 'B'
Kagimu L.
Mondey L.
Fareheads L.
Agonzon Lake
Little Otter Lake
FOURBAY LAKE PLUTON
Fourbay Lake
Black R.
DOTTED LAKE PLUTON

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)
0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Intersection Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 25b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig25b_fB_IntDens

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Lofgnegas L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi

Twist Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

- Brittle Lineament
- Dyke Lineament
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE

Lineament Intersection Density for Final Integrated Brittle & Dyke Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 25c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig25c_fB_IntDens

560000 570000 580000 590000 600000 610000 620000 630000

5490000 5480000 5470000 5460000 5450000 5440000 5430000 5420000

N

BLOCK 'A'

BLOCK 'B'

BLOCK 'C'

METASEDIMENTARY ROCKS

MANITOUWADGE GREENSTONE BELT

NAMA CREEK PLUTON

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

DOTTED LAKE PLUTON

FOURBAY LAKE PLUTON

QUETICO SUBPROVINCE

WAWA SUBPROVINCE

HILLSPORT

MANITOUWADGE

Little Nama Lake Fault

Rabbitskin Lake Fault

Fox Creek Flt.

Agami Lk Flt.

Mose Lk Fault

Eino L., Laurl L., Stilwell Lake, Mustela Lake, Mann L., White Otter L., Osawin R., Phillip L., Fran Lake, Bound L., Foch R., Nagagami Lake, Anthony L., Waboosekon L., White Otter R., Kagiano R., Beavercross Lake, CN Rail, Flanders Lake, Osawin Lake, Upper Flanders Lake, Everest L., Caduwaja Lake, Michal L., Island L., Foch L., Linbarr Lake, Kern Lake, Rabbitskin Lake, Wowun L., Loken Lake, Waskisk Lake, Pic River, Agami L., Mose Lake, Manitouwadge L., Macutagon Lake, Longvegg L., Obakamiga Lake, Granitehill L., Shekak Lake, Tocheri Lake, Sunderland Lake, Garnham Lake, Jembi L., Twist Lake, Barehead Lake, Agonzon Lake, Black R., Shabotik R., Matthews Lake, Pickle L., McGill Lake, Cirrus L.

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Intersection Density

10 (/km²)

0

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 10 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for All Final Integrated Lineaments of the Manitouwadge Area**

DESIGN	KR	02 SEP 2014	**Figure 26**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:280,000

File: SRK_NWMO_MAN_Fig26_fALL_lnDens

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N
CARAMAT
Charon L.
Eino L.
Laun L.
BLOCK 'A'
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for All Final Integrated Lineaments of the Manitouwadge Area - Block A**

DESIGN	KR	02 SEP 2014	**Figure 26a**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig26a_fALL_IntDens

570000 580000 590000 600000

5440000 5430000 5420000

MANITOUWADGE GREENSTONE BELT

BLOCK 'B'

FOURBAY LAKE PLUTON

DOTTED LAKE PLUTON

MANITOUWADGE

Cadawaja Fault

Slim Lake Fault

Fox Creek Fault

Manitouwadge L.

Mose L.

Mose Lake Fault

Kagami L.

Margaret L.

Gareau L.

Agonzon Lake

Little Otter Lake

Fourbay Lake

Black R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Intersection Density for All Final Integrated Lineaments of the Manitouwadge Area - Block B**

DESIGN	KR	02 SEP 2014	**Figure 26b**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig26b_fALL_IntDens

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Longnegal L.

Obakamiga Lake

Granitehill L.

Tocheri Lake

Sunderland Lake

Garnham Lake

Jembi

Twist Lake

Shabotik R.

N

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

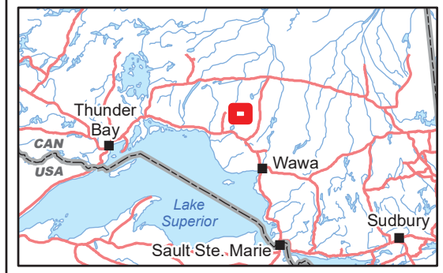
Final Inegrated Lineament

- Unclassified
- Brittle
- Dyke
- Lineament Intersection

Intersection Density

10 (/km²)

0



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT

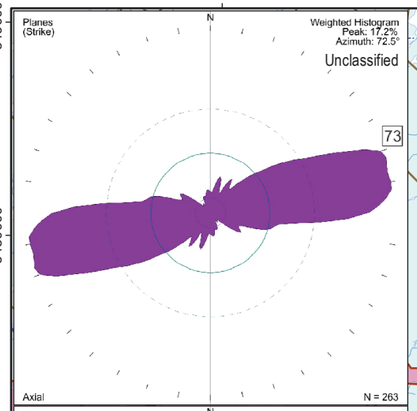
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

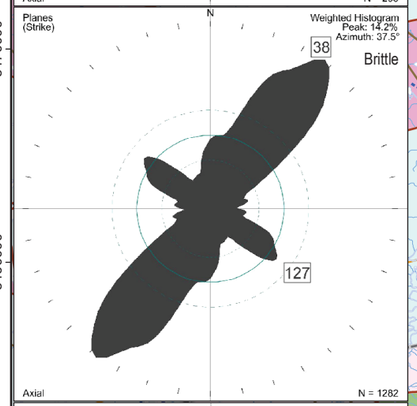
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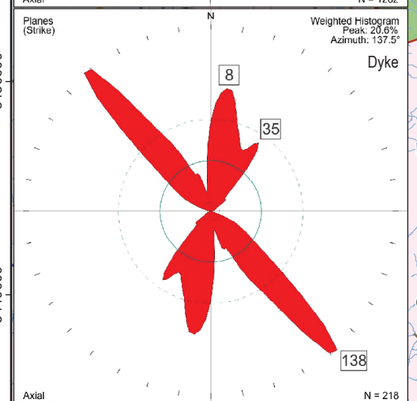
Lineament Intersection Density for All Final Integrated Lineaments of the Manitouwadge Area - Block C

DESIGN	KR	02 SEP 2014	**Figure 26c**	REVISION 2
GIS	JA	02 SEP 2016		UTM ZONE 16N
CHECK	CN	02 SEP 2016		NAD 1983
REVIEW	JPS	02 SEP 2016		1:110,000

File: SRK_NWMO_MAN_Fig26c_fALL_intDens







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Subprovince Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- Fold (anticline)
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineament

- D2-D4 (Unclassified)
- D5-D6 (Brittle)
- Dyke



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 10 km

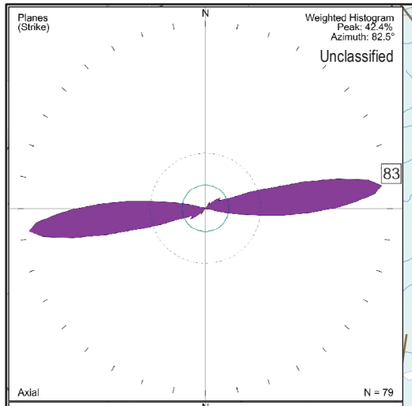
srk consulting

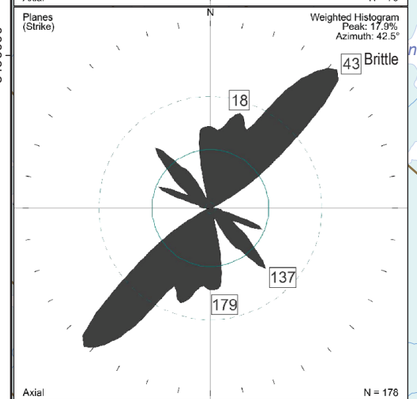
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

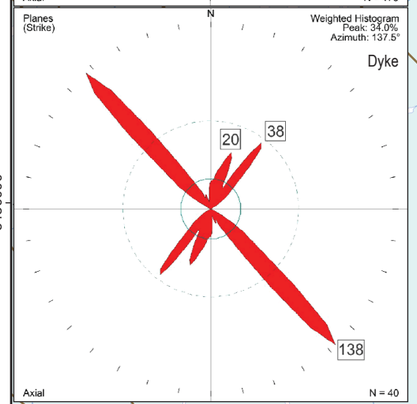
TITLE
Lineament Relative Age Relationships of the Manitouwadge Area

DESIGN	KR	02 SEP 2014	**Figure 27**	REVISION 3
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:280,000

File: SRK_NWMO_MAN_Fig27_fAge







570000
580000
590000
5490000
5480000
5470000
Charon L.
Laurn L.
Stilwell Lake
Bishop Lake
Anthony L.
White Otter R.
Beavercross Lake
BLOCK 'A'
METASEDIMENTARY ROCKS
5
7
11
13

LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- 13: Granite-granodiorite
- 11: Granite-granodiorite
- 7: Ultramafic plutonic rocks
- 5: Metasedimentary rocks

Lineament

- D2-D4 (Unclassified)
- D5-D6 (Brittle)
- Dyke



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

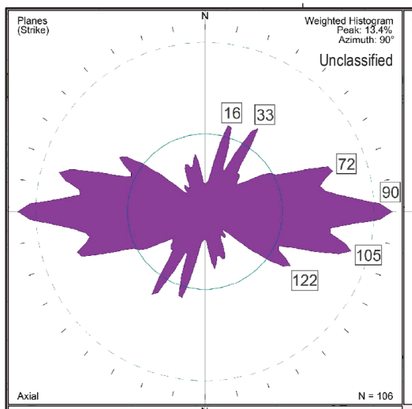
srk consulting

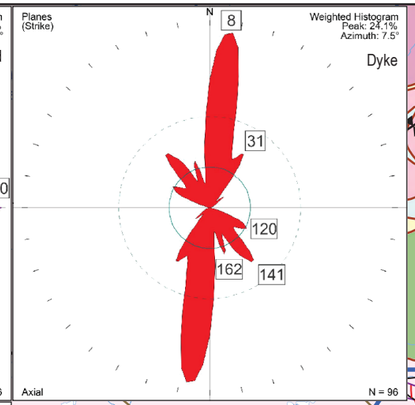
PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

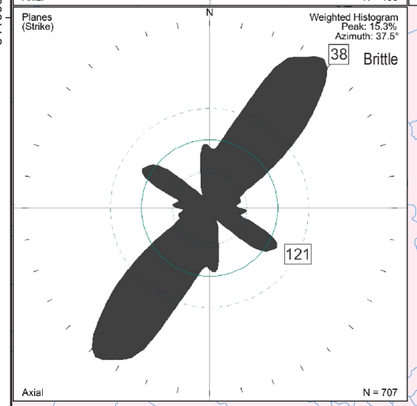
TITLE
Lineament Relative Age Relationships of the Manitouwadge Area - Block A

DESIGN	KR	02 SEP 2014	**Figure 27a**	REVISION 3
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig27a_fAge







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 5: Metasedimentary rocks
- 4: Felsic volcanic rocks
- 3: Felsic and intermediate metavolcanic rocks
- 2: Mafic metavolcanic Rocks
- Iron Formation

Lineaments

- D2-D4 (Unclassified)
- D5-D6 (Brittle)
- Dyke



REFERENCE

Base Data: Land Information Ontario (obtained 2015);
CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011);
Ontario Geological Survey Map 2665 (Santaguida, 2001);
Map 2666 (Santaguida, 2001);
Map 2667 (Johns, McIlraith and Stott, 2003);
Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT
Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE
Lineament Relative Age Relationships of the Manitouwadge Area - Block B

DESIGN	KR	02 SEP 2014	**Figure 27b**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig27b_fAge

600000 610000 620000 630000

5450000 5440000 5430000

LOKEN LAKE PLUTON

FARIES-MOSHKINABI INTRUSION

RAWLUK LAKE PLUTON

BLACK-PIC BATHOLITH

BLOCK 'C'

Loken Lake

Macutagon Lake

Garnham Lake

Twist Lake

Jembi L.

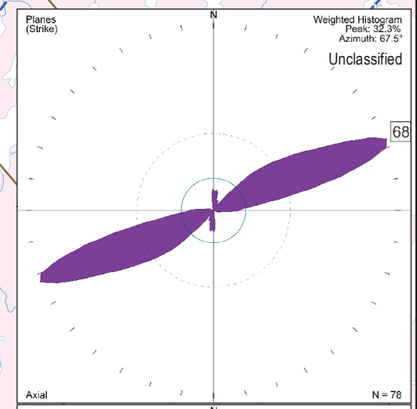
Longnegg L.

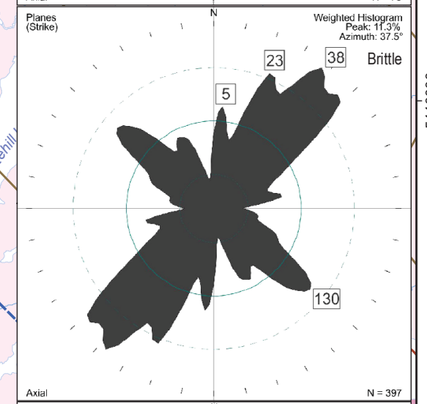
Granitehill L.

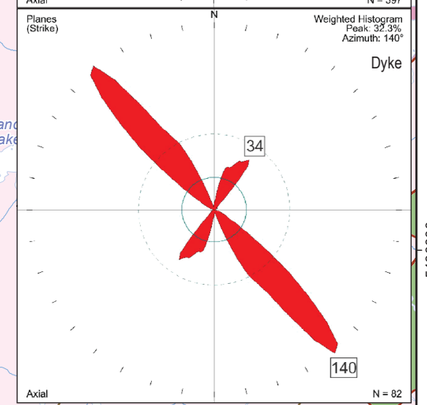
Sunderland Lake

Shabotik R.

N







LEGEND

- Phase 2 Assessment Area
- Watercourse
- Waterbody

Bedrock Geology

- Geological Boundary
- Mapped Fault
- Mapped Dyke
- Fold (syncline)
- 13: Granite-granodiorite
- 10: Foliated tonalite suite
- 9: Gneissic tonalite suite
- 8: Gabbro
- 7: Ultramafic plutonic rocks
- 4: Felsic volcanic rocks
- 2: Mafic metavolcanic Rocks

Lineament

- D2-D4 (Unclassified)
- D5-D6 (Brittle)
- Dyke



REFERENCE

Base Data: Land Information Ontario (obtained 2015); CanVec Topography (obtained 2015)

Bedrock Geology: MRD 126-REV1 (Ontario Geological Survey, 2011); Ontario Geological Survey Map 2665 (Santaguida, 2001); Map 2666 (Santaguida, 2001); Map 2667 (Johns, McIlraith and Stott, 2003); Map 2668 (Johns and McIlraith, 2003)

0 5 km

srk consulting

PROJECT: Phase 2 Structural Lineament Interpretation
Manitouwadge Area, Ontario

TITLE: **Lineament Relative Age Relationships of the Manitouwadge Area - Block C**

DESIGN	KR	02 SEP 2014	**Figure 27c**	REVISION 6
GIS	JA	11 APR 2017		UTM ZONE 16N
CHECK	CN	11 APR 2017		NAD 1983
REVIEW	JPS	11 APR 2017		1:110,000

File: SRK_NWMO_MAN_Fig27c_fAge