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White Lake Geophysical Review

Prepared for

Battery Mineral Resources

by

Geoscience North

(Alan King, P.Geo., M.Sc.)

June 2020

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Acronyms

Mag	Magnetic/Magnetics
TMI	Total magnetic intensity
CVG	Calculated vertical gradient
1VD (may be used interchangeably with CVG)	First vertical derivative
AS	Analytic signal
OGS	Ontario Geologic Survey
EM	electromagnetic
AEM	Airborne electromagnetic

1 Introduction

(From SRK 2020)

The White Lake Project consists of purchased claims and staked claims. It is in the Browning, Dufferin, Leask, Stull and Unwin, Browning, Stull and Leask Townships of Northeastern Ontario, approximately 85 kilometres north of Sudbury, some 30 kilometres east southeast of Morin Village, at coordinates 492800 mE/ 5288700 mN (UTM NAD83, Zone 17).

The Project area comprises 538 mining claims totaling 21,533 hectares (215.3 square kilometres) in a contiguous block of mining claims.

The White Lake Property is underlain by the Huronian metasedimentary rocks of the Gowganda and Lorrain Formations. These are intruded by a large lobate or sigmoidal body of Nipissing diabase. The contact between the Lorrain and the Gowganda Formations appears to control the location of the diabase body which is coincident with the trace of a major north-northwest-south-southeast fault. The

Property is located only a few kilometres away from the surface trace of the sub-Huronian unconformity, or the edge of the Cobalt Embayment.

2 Coordinate system

NAD83 17N

3 Background

The following sections, shown in italics, are taken from SRK Battery Mineral Resources Ltd. 43-101- 2019 and 2020 reports, which are excellent introductions to and summary of the history, property geology and mineralization. These are considered critical to understanding the exploration targets and how geophysics can be used in regional and local targeting. Figures and tables have been renumbered for this report.

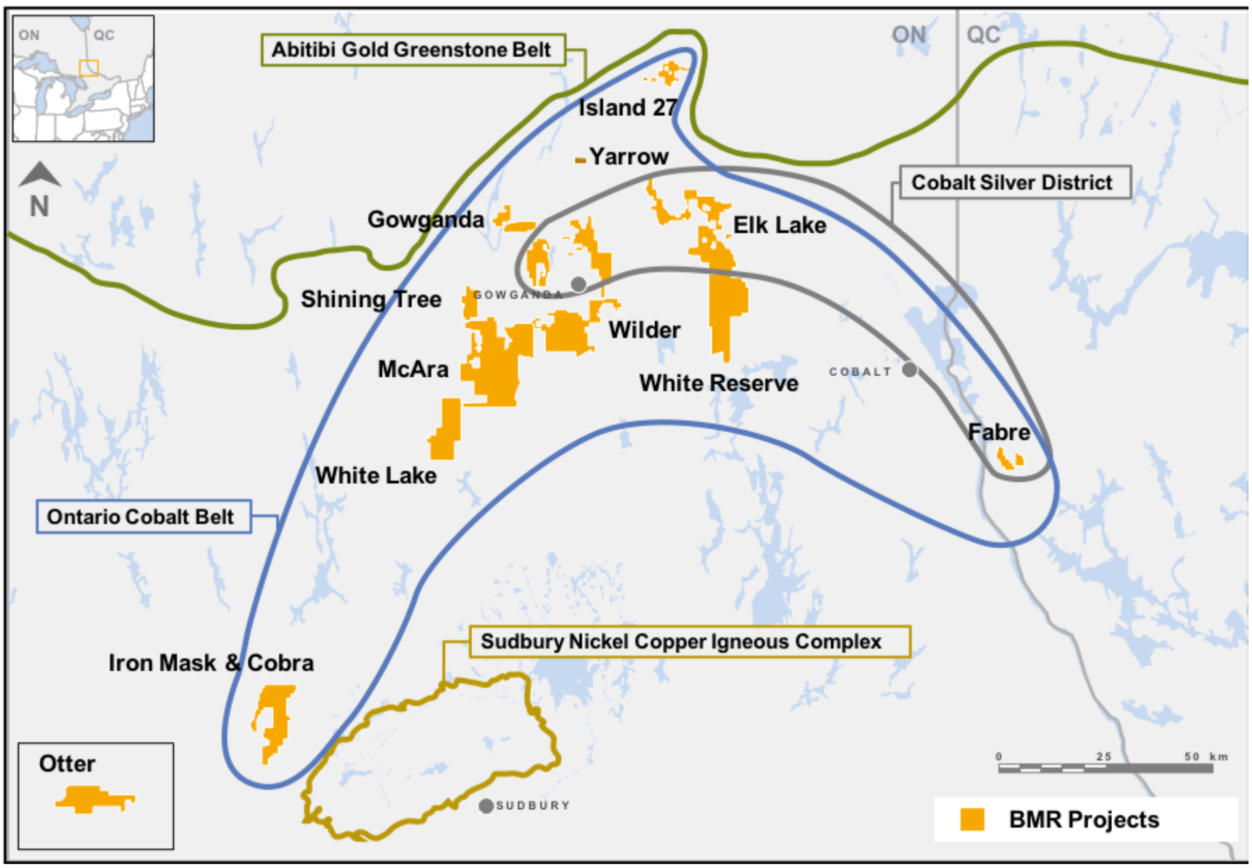

Figure 1. BMR projects, Cobalt and Co-Ag belts (https://www.batterymineralresources.com/projects/cobalt/canada-cobalt/other-ontario).

3.1 Historical Work

Four known cobalt occurrences and three abandoned mine sites are located on the property. The Annett/Salo Cobalt Prospect, located within BMR's claims, appears to lie along a strong east-

west structure. Cobalt mineralisation is hosted in quartz-calcite veins in diabase and occurs as smaltite and cobalt and nickel bloom.

A summary of all historical work documented in assessment reports is given in Table.1.

Table 1. White Lake Historical Assessment Reports

Year	Township	Assessment File Number (AFRI_FID)	Company	Work Description
1981	Browning	41P06SE0003	Patino Mines (Quebec) Ltd	Geological Survey / Mapping
1981	Unwin	41P06SE8465	Patino Mines (Quebec) Ltd	Electromagnetic Very Low Frequency, Geological Survey / Mapping, Magnetic / Magnetometer Survey
1981	Unwin	41P06SE0020	Patino Mines (Quebec) Ltd	Electromagnetic Very Low Frequency, Magnetic / Magnetometer Survey
1984	Browning	41P06SE0002	Golden Shield Res Ltd, McFinley Red L Gold Mines Ltd	Geochemical, Geological Survey / Mapping
1981	Browning	41P06SE0004	Patino Mines (Quebec) Ltd	Electromagnetic, Magnetic / Magnetometer Survey
1992	Knight	41P10NW0011	M J Perkins	Geochemical, Geological Survey / Mapping, Overburden Studies, Prospecting by Licence Holder
1984	Unwin	41P06SE0016	Onitap Resources Inc	Diamond Drilling
1996	Unwin	41P06SE0006	Unknown	Mechanical, Overburden Stripping
1982	Unwin	41P06SE8530	A. Elliott, M Dekeyser	Electromagnetic Very Low Frequency, Magnetic / Magnetometer Survey
1992	Knight	41P10NW0011	M J Perkins	Geochemical, Geological Survey / Mapping, Overburden Studies, Prospecting by Licence Holder
1981	Ogden	41P06SE0018	Amax Minerals Expl Ltd	Geological Survey / Mapping
1983	Unwin	41P06SE0017	A. Elliott Exploration	Magnetic / Magnetometer Survey, Self Potential
1984	Leask	41P03NE0011	A. Elliott Exploration	Magnetic / Magnetometer Survey, Self Potential
2009	Unwin	20000005174	Larry John Salo	Prospecting by Licence Holder

Pre-BMR Drilling

A location map showing known historical drilling on the White Lake Project drill collar positions is shown in Figure 2.

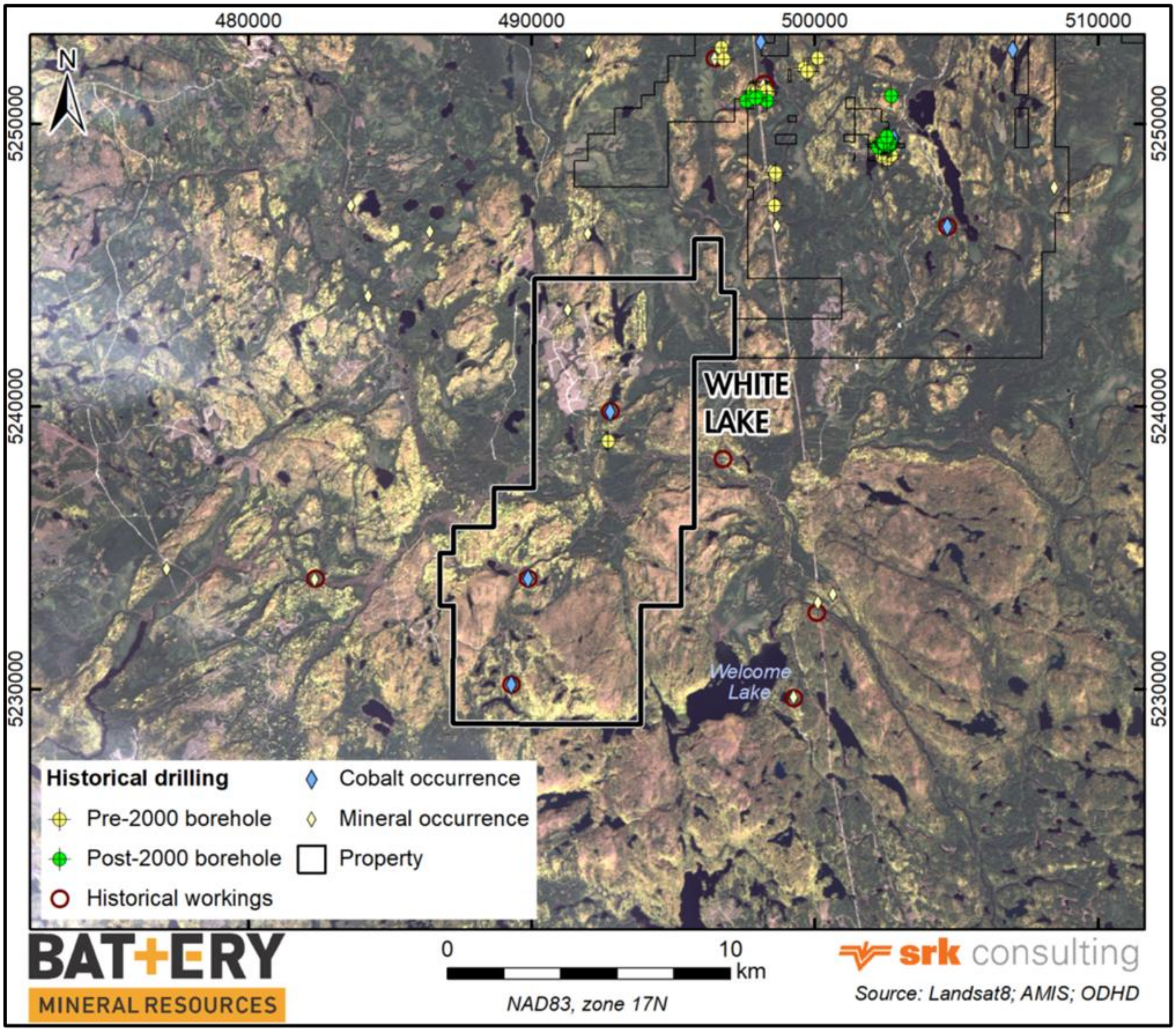

Figure 2. White Lake Project Drillhole Location Map.

3.2 Geologic Setting and Mineralization

3.2.1 Regional Geology

- *The project area is located in and on the margin of the Proterozoic Huronian basin that overlies the Archean Abitibi terrane of the Superior Province*

- *The Superior Craton or Superior Province is an Archean craton that forms the core of the Canadian Shield and of the North American continent. Comprised of assemblages of greenstone belts and sedimentary basins cored by granitic terranes, it represents the collision and amalgamation of microcontinents throughout the Archean. The Superior Province is subdivided into subprovinces that are generally defined by their igneous, sedimentary, or metamorphic nature. The project area lies in (and is located at the boundary of) the Southern Subprovince, a Proterozoic to Paleozoic (2500-2200 Ma) cover sequence of siliciclastic rocks that* *uncomformably overlies the Archean basement rocks of the Pontiac/Abitibi subprovinces. The Southern Subprovince corresponds in this area to the Huronian Supergroup, an extensive Early Proterozoic siliciclastic cover sequence that outlines an irregular paleobasin, also known as the Cobalt Embayment.*

- *The Shiningtree property is located in the central and eastern portion of the Southern Subprovince, near its southern contact with the Grenville Province.*
- *The geology of the target areas consists of Early Proterozoic (2450 Ma and 2220 Ma) sedimentary rocks of the Huronian Supergroup which rest unconformably on older Archean granitic, metavolcanic, and metasedimentary rocks of the Abitibi and/or Pontiac Subprovince(s). The Proterozoic Nipissing diabase intrudes all the other lithologies except the youngest mafic dykes or sills.*
- *A plan displaying the regional geological setting of the regional BMR properties in relation to the main mining areas in Ontario is provided in Figure 3 (Figures have been renumbered from the SRK 2019 report to fit in this report) , and the simplified stratigraphy of the Cobalt Embayment in shown in Figure 4.*

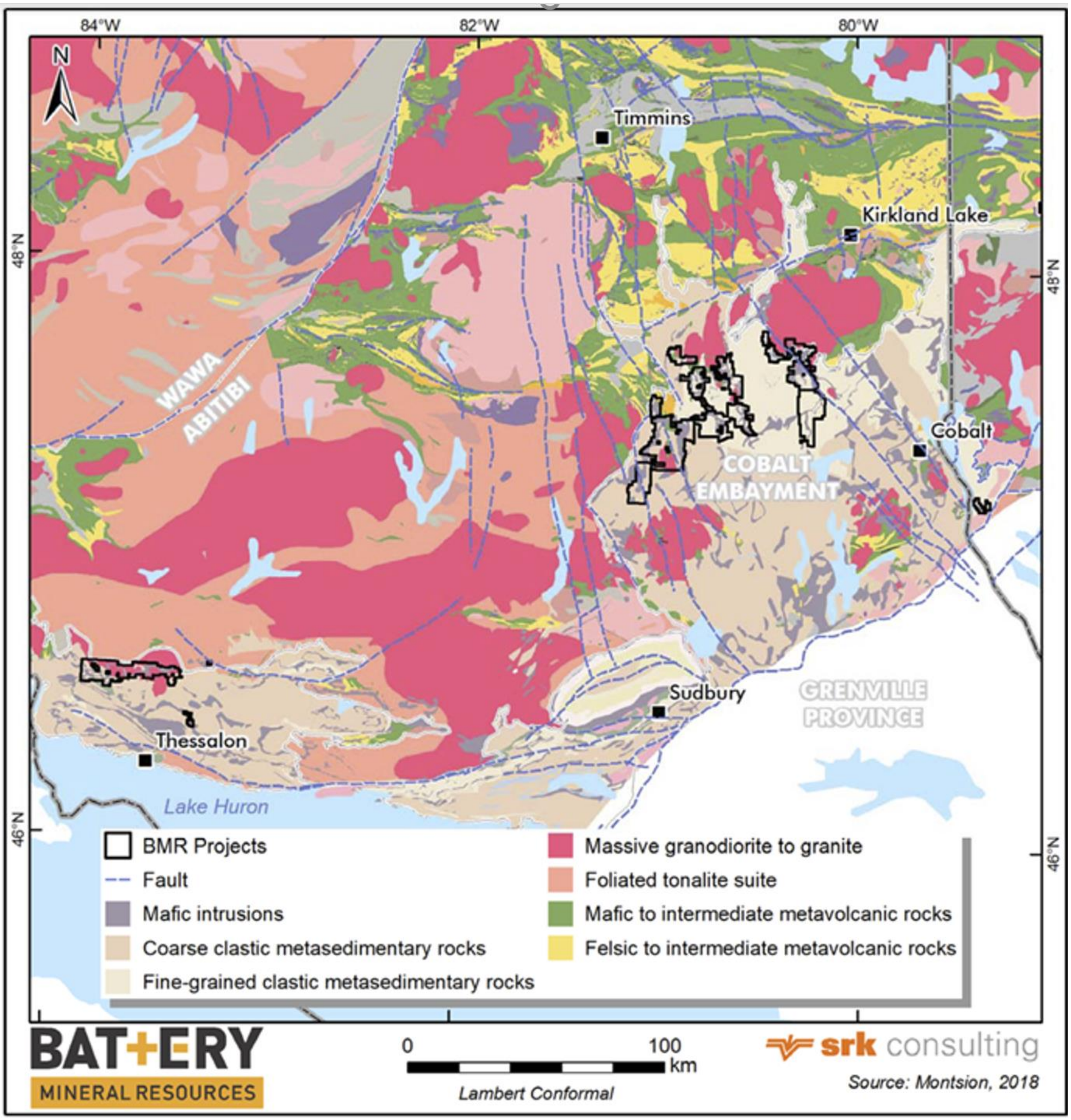

Figure 3. Regional Geologic Setting.

The lithologies are summarized as follows, from oldest to youngest below.

Archean Basement

The Archean basement rocks consist mainly of intermediate to mafic, massive and pillowed volcanic rocks intercalated with pyroclastic and sedimentary rocks. Locally, these rocks were intruded by Archean felsic dykes, quartz-feldspar porphyries, and granites, followed by minor mafic, ultramafic and lamprophyre dykes and sills. The rocks were isoclinally folded by Archean deformation, and are now steeply dipping and metamorphosed to greenschist facies.

Huronian Supergroup – Cobalt Group

The Huronian Supergroup consists of an assemblage of Proterozoic (middle Precambrian) metasedimentary sequences that lies unconformably above the Archean basement, forming a gently undulating cover to the steeply dipping basement rocks. The Huronian Supergroup, also known as the Cobalt Group or Cobalt Embayment, is distributed in a roughly circular pattern, thought to reflect the original configuration of the depositional basin, hence the description of these rocks as an "embayment" (Kerrich et al., 1986). Highly variable thicknesses suggest a highly irregular (Archean) basement topography (Andrews et al., 1996). Many of the deposits are spatially related to the Archean-Huronian unconformity.

The Huronian Supergroup consists of a variety of coarse- to fine-grained clastic sedimentary rocks that represent deposition in fluviatile, marine, and glacial paleoenvironments (Debicki, 1990). Metavolcanic sequences are also present. The Huronian Supergroup/ Cobalt group is subdivided as follows, from oldest to youngest:

- *Gowganda Formation, itself composed of two members:*
  -(lower) Coleman member: thick massive conglomerate, quartzite, arkose, argillite and greywacke; the main sedimentary host to the mineralization.
  (upper) Firstbrook member: argillite, siltstone, wacke.
- *Lorrain Formation: basal red wacke grading upwards into a fine-grained arkose.*

Nipissing Diabase

Regionally extensive sills and dikes of Nipissing diabase emplaced circa 2219 Ma, possibly along pre-Huronian faults, occur throughout the Embayment and preferentially host the silver sulpharsenide veins. With an overall composition of olivine tholeiite, the diabase intrudes both the Archean basement and the Huronian sequence and occurs both as extensive sills and steeply dipping dykes and plugs. Kerrich et al. (1986) propose that the sills were emplaced as part of basin development. They consist of hypersthene quartz diabase grading upward into a mesocratic varied textured diabase and a granophyre upper zone. The sills are horizontal to gently dipping with an average uniform thickness of 300 metres to 335 metres. All significant deposits are associated with the Nipissing diabase, either in the diabase itself or within 200 metres of its upper or lower contact (Andrews et al, 1986).

Late Diabase Dykes

Late Precambrian diabase occurs as narrow dykes cutting all older rock types (Sudbury Dykes).

Structure

Regional-scale faults crosscut all units of the Cobalt Embayment. Two sets are recognized: a strong NNW-trending set that extends for hundreds of kilometres across the embayment, crosscutting the Grenville Front to the south and Archean basement to the north, and a less pronounced NE-trending set recognized over a similar area. Post-diabase faulting has been proposed as a possible mechanism for the formation of structures now hosting the silver-sulpharsenide mineralization (Andrews et al, 1986), although other authors state that no relationship has been established between the mineralized veins and these regional-scale faults.

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Table 32: Simplified Stratigraphy of the Cobalt Mining District

Eon		Formation		Lithology
Quaternary				Till, sand, gravel, clay
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ unconformity				
Paleozoic (Silurian and Ordovician)		Wabi Group Liskeard Group		Dolomite, limestone, shale
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ unconformity				
Neoproterozoic	1145 Ma	Diabase dykes		Olivine and quartz diabase
	— — — — — — — — — — intrusive contact			
Paleoproterozoic	2219 Ma	Nipissing Diabase		Quartz diabase sills and dykes
	— — — — — — — — — — intrusive contact			
	2219.4 Ma	Huronian Supergroup Cobalt Group	Lorrain Fm	Basal red wacke to fine grained. arkose
			Gowganda Fm: Firstbrook Member	Argillite, siltstone, wacke
	2450 Ma		Gowganda Fm: Coleman Member	Conglomerate, quartzite, arkose, greywacke
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~unconformity				
Archean craton				Diabase and lamprophyre
	— — — — — — — — — — intrusive contact			
				Granite
	— — — — — — — — — — intrusive contact			
				Mafic rocks, lamprophyre, serpentinite
	— — — — — — — — — — intrusive contact			
				Greywacke and conglomerate
	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ unconformity			
	2720 Ma	Keewatin		Volcanic rocks, iron formations

Modified from Ruzicka and Thorpe (2016).

Figure 4. Simplified stratigraphy of the Cobalt Mining District.

3.2.2 Regional Mineralization

- *The silver sulpharsenide mineralization of the Cobalt - Gowganda Camp has been described in numerous publications. A comprehensive study is contained in a special volume of The Canadian Mineralogist entitled The Silver-Arsenide Deposits of the Cobalt-Gowganda Region, Ontario (Petruk and Jambor ,1971). The following characteristics of the Cobalt - Gowganda Camp mineralization is taken from more recent summaries: Ruzicka and Thorpe (1996), and Andrews et al. (1986).*
- *The Cobalt District was for a long time the largest silver producing area in Canada. The arsenide bearing veins were important sources of silver but also contained cobalt, copper, nickel, arsenic, and bismuth.*
- *The deposits are associated with the contact between the Nipissing diabase and the Coleman Member of the Gowganda Formation, or with its contact with the underlying Archean mafic to intermediate lavas, intercalated pyroclastic and sedimentary rocks. Mineralization is commonly hosted in steeply-dipping veins in the Nipissing diabase, or within 200 metres of its upper or lower contact (Andrews et al, 1986). Strong and continuous veins are observed where the*

Nipissing diabase intrudes the Huronian sediments slightly above the unconformity, leaving a thin layer of Coleman Member sediments sandwiched between the sill and the steeply dipping Archean basement. Veins are more discontinuous where the sill intrudes the Archean basement at or below the unconformity, but they are concentrated at the upper and lower contacts of the sill.

- *Most of the productive deposits occur near the Archean-Huronian unconformity. This unconformity and the lithologies that define it are exposed around the periphery of the embayment, yet the known deposits remain restricted to the northern and northeastern margin of the Cobalt Embayment.*
- *Mineralization is also spatially associated with regional-scale faults that cross-cut the contact with the Archean basement. Nipissing diabase sills located in well-developed sub-basins are targeted by BMR as these areas may represent favourable environments for paleo fluid flow and mineralization.*

The deposits of the Cobalt - Gowganda Camp contain three principal mineral assemblages:

- *· A base metal sulphide assemblage, confined to Archean metasedimentary and metavolcanics rocks*
- *· The arsenide silver-cobalt assemblage, occurring mainly near and at the contact between the Nipissing diabase and the sedimentary rocks of the Cobalt Group, and less so at the contact between the diabase and the Archean rocks and*
- *· A late-stage sulphide assemblage occupying the margins of arsenide-rich veins where they have reopened.*

- *The age of the arsenide mineralization is dated at between 2.22 and 1.45 Ga, between the age of emplacement of the diabase sills (2.22 Ga) but before the intrusion of the quartz diabase dykes and contemporaneous reverse faults that displace the mineralization.*

Veining

- *The arsenide veins generally occur in the Nipissing diabase and within 200 metres of its contact with the sedimentary rocks of the Cobalt Formation. The veins are steeply dipping, up to 1.2 metres wide, and can extend 1 kilometre horizontally and 120 metres vertically. A typical deposit consists of a few short anastomosing centimetre- to multi-decimetre-scale veins.*
- *The mineralization occurs in irregular high-grade lenses surrounded by aureoles of low-grade material and can also occur in masses, veinlets, and disseminations with or without associated gangue minerals. Mineralization consists of arsenides, sulpharsenides, and antimonides of nickel, cobalt, iron, and large amounts of native silver. Individual mineral species include: dyscrasite, acanthite, rammselbergite, skutterudite, arsenopyrite, gersdorffite, cobaltite, glaucodot, nickeline, breithauptite, chalcopyrite, tetrahedrite, and native bismuth.*
- *Ruzicka and Thorpe (1996) list the following mineral assemblages for the Cobalt -Gowganda Camp:*
  - *Nickel arsenide assemblage, at the periphery of major veins but also in small veins*
  - *Nickel-cobalt arsenide assemblage, associated with the best silver grades*
  - *Cobalt arsenide assemblage, occurring in the main parts of the veins*
  - *Cobalt-iron arsenide assemblage, less common than the previous ones, it occurs as intergrowths, disseminations, dendrites, rosettes and crystals.*
  - *· Iron arsenide assemblage, concentrated within veins and occurs with native bismuth, galena, and marcasite.*
  - *· Sulphide assemblage*

- · *Oxide assemblage*
- *The best silver grade is associated with the nickel-cobalt arsenide assemblage. Dolomite, calcite, quartz and chlorite are the principal gangue minerals; oxide minerals are commonly associated with the carbonate gangue.*
- *Most veins are related to shear zones, fault gouges, and breccia, with evidence of multiple veins generations and multiple faulting episodes.*
- *High-grade samples from historical occurrences grade up to 8% cobalt, several thousands of ppm silver, and multi-gram gold, along with bismuth, lead, zinc and copper in the percent range.*

Alteration

- *Alteration associated with the mineralized veins is prominent but limited in extent; it varies depending on the host rocks. Alteration haloes are developed in the wall rocks along the veins as zones, typically a few centimetres-wide, of calcite, chlorite, epidote, K-feldspar, muscovite and anatase. A characteristic spotted chlorite alteration occurs locally within the Cobalt - Gowganda Camp.*

3.2.3 Property Geology and Mineralization

The White Lake Property is underlain by the Huronian metasedimentary rocks of the Gowganda and Lorrain Formations. These are intruded by a large lobate or sigmoidal body of Nipissing diabase. The contact between the Lorrain and the Gowganda Formations appears to control the location of the diabase body which is coincident with the trace of a major north-northwest-south-southeast fault. The Property is located only a few kilometres away from the surface trace of the sub-Huronian unconformity, or the edge of the Cobalt Embayment (Figure 5).

Four cobalt occurrences and three abandoned mine sites are located on the property. The Annett/Salo Cobalt Prospect, located within BMR's claims, appears to lie along a strong east-west structure. Cobalt mineralisation is hosted in quartz-calcite veins in diabase and occurs as smaltite and cobalt and nickel bloom.

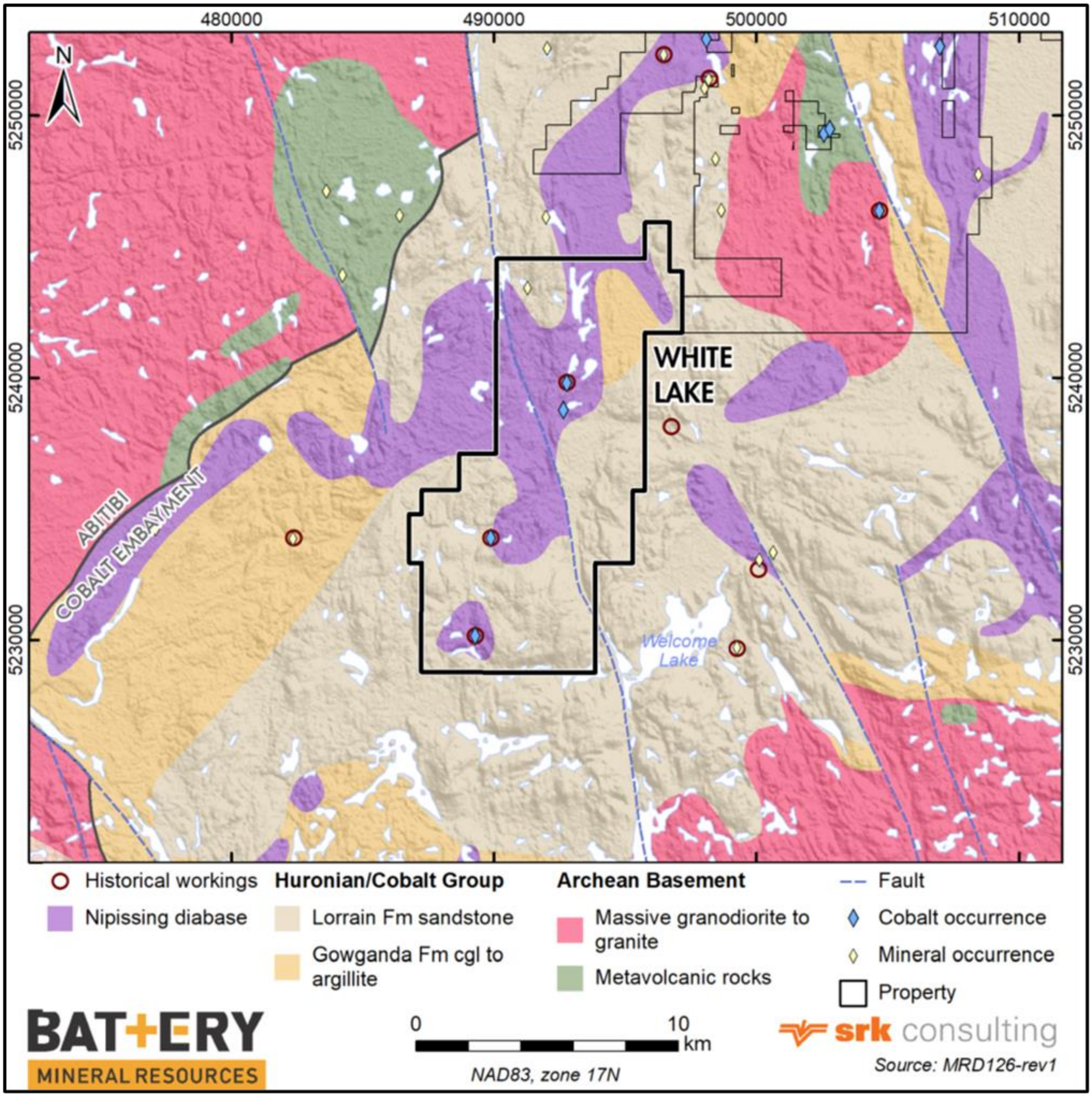

Figure 5. Geology of the White Lake project.

Table 2. **Mineral occurrences on the White Lake property.**

Township	MDI Number	Name	UTM_E	UTM_N	Commodity
Browning	MDI41P06SE00009	Rosie Creek	491281	5243426	Ag
Leask	MDI41P03NE00004	Major Leckie's Shaft	489289	5230166	Co (Ag)
Unwin	MDI41P06SE00004	Chicault Au-Cobalt	489870	5233902	Au, Co (Ag)
Unwin	MDI41P06SE00013	Annett Option	492644	5238779	Ni, Co (Ag, Au)
Unwin	MDI41P06SE00014	Patino Sample 9738	492774	5239817	Co, Ag (Ni)

Deposit Types Detail

- *The Cobalt and Gowganda Districts of northern Ontario define the Canadian type-locality for silver cobalt vein deposits, which are also known as arsenide silver-cobalt veins, nickel-cobalt-native silver veins, five-element vein deposit or Ag-Ni-Co-As-Bi vein deposits, even though not all five elements are always present, and even though some of these deposits can also be associated with uranium.*
- *The following description of the five-element vein deposit is summarized from the BCGS Mineral Deposit Profile no. I14 (Lefebure, 1996), Kissin (1993), and USGS Open File 2017-1155 (Hitzman et al., 2017).*

Typical Deposit Geology

Mineralization

- *The deposits typically consist of native silver hosted in carbonate and quartz veins associated with a variety of mineral assemblages that are rare in other settings, such as nickel-cobalt-iron (Ni-Co-Fe) arsenides, nickel-cobalt-iron-antimony (Ni-Co-Fe-Sb) sulpharsenides and bismuth minerals. In many cases, only some of these minerals are present, although the best examples of this deposit type typically contain significant silver-nickel-cobalt (Ag-Ni-Co) open-space-filling veins up to several metres in width that pinch and swell.*
- *Ore minerals can include native silver associated with nickel-cobalt arsenide minerals (rammelsbergite, safflorite, niccolite, cloanthite, maucherite), sulpharsenides of cobalt, nickel, iron and antimony, native bismuth, bismuthinite, argentite, ruby silver, pyrite and uraninite (pitchblende). Chalcopyrite, bornite and chalcocite are common, but minor constituents. Minor to trace galena, tetrahedrite, jamesonite, cosalite, sphalerite, arsenopyrite and rare pyrrhotite can be present. In many deposits only a partial mineral assemblage occurs containing a subset of the many elements which may occur in these veins. These veins are usually characterized by the absence of gold, but gold grades are reported in the Cobalt – Gowganda Camp.*
- *Native silver is usually associated with calcite and dolomite, which are common in the core of some veins. Quartz, jasper, barite and fluorite are less common.*
-

Five sequential stages of mineral deposition are generally recognized:

1. Early quartz with minor amounts of pyrite, sphalerite, galena.
2. Uraninite-quartz (this stage may be absent)
3. Native silver with nickel-cobalt arsenide minerals and sometimes native bismuth with calcite or dolomite.
4. Pyrite, sphalerite, galena, chalcopyrite with native silver and argentite and calcite, and minor amounts of quartz, fluorite, and barite
5. Late-stage calcite, sometimes with barite or fluorite

- *Repeated cycles are documented. Thickness can vary from centimetre- to decimetre-scale within distances of less than tens of metres. Veins occur as single veins or as vein sets ranging widely in size and grade, sometimes extending up to 500 metres deep. In some districts, the veins are barren at depth.*

Alteration

- *Wallrock alteration is not very conspicuous, and where present, consists of a 2 to 5 centimetres halo of calcite and chlorite alteration. The low sulphide content doesn't produce gossans at surface, but weathering can locally produce the distinctive pink erythrite coating (cobalt bloom). In the Cobalt District, chlorite alteration is evident in a distinctively spotted texture.*

Depositional/Tectonic Environment

- *These deposits occur in areas underlain by continental crust and, in some cases, appear related to basinal subsidence and continental rifting. Deposits are associated mafic and post-orogenic environments. Veins are believed to be emplaced at shallow depths in a continental setting along high-angle fault systems.*
- *Vein deposition was initially high temperature (450° C) from highly saline solutions which decreased in temperature and became more reducing through the depositional sequence. Intermittent boiling is thought to have occurred at shallow depths.*

Summary

In the Cobalt district, the distribution of the silver-cobalt veins is controlled by the contact between the Nipissing diabase sill and the metasedimentary rocks of the Cobalt Group (Gowganda Formation). The veins occur in the sill, at its contact, or in the host metasedimentary rocks within a few hundred metres from the contact. Mineralization postdates the intrusion and cooling of the diabase sills. According to Andrews et al. (1986), the sills are interpreted to provide a favourable structural host as fractures resulting from regional faulting would localize mineralizing fluids associated with deformation. Figure 6 shows a simplified geological model taken from Andrews et al. (1986).

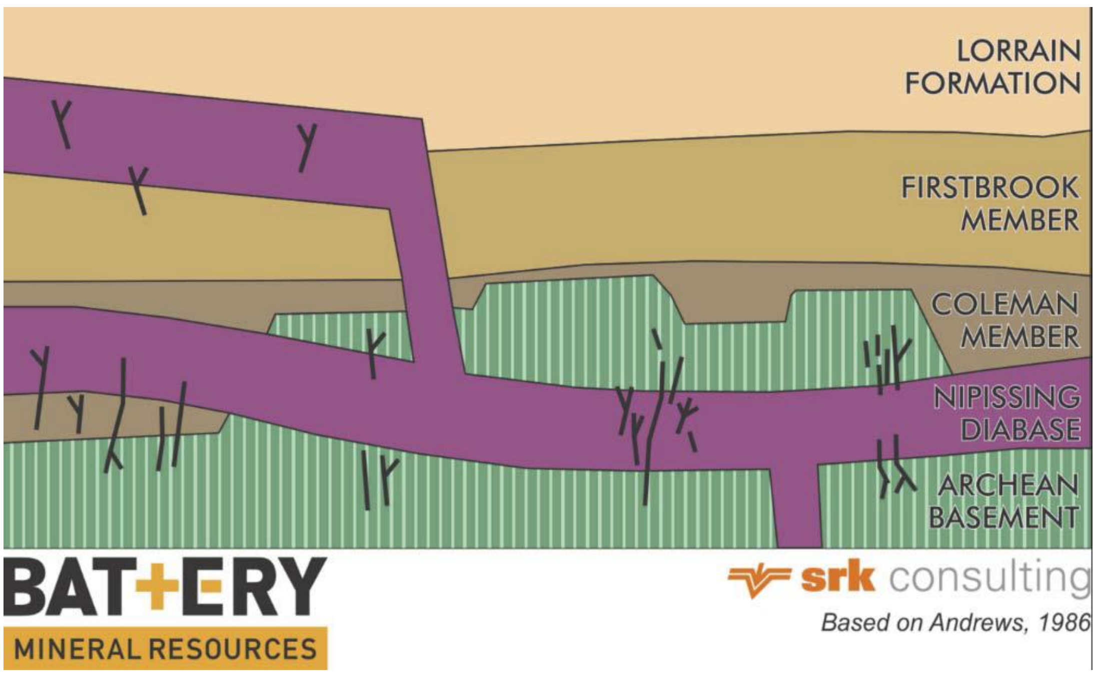

Figure 6. Simplified geological setting of silver-cobalt vein deposits. Black lines denote silver-sulpharsenide veins. The Firstbrook and Coleman members comprise the Gowganda Formation.

4 Regional Geophysics

The regional geology, magnetics and gravity for the White Lake Property area are shown in Figures 7, 8 and 9, respectively.

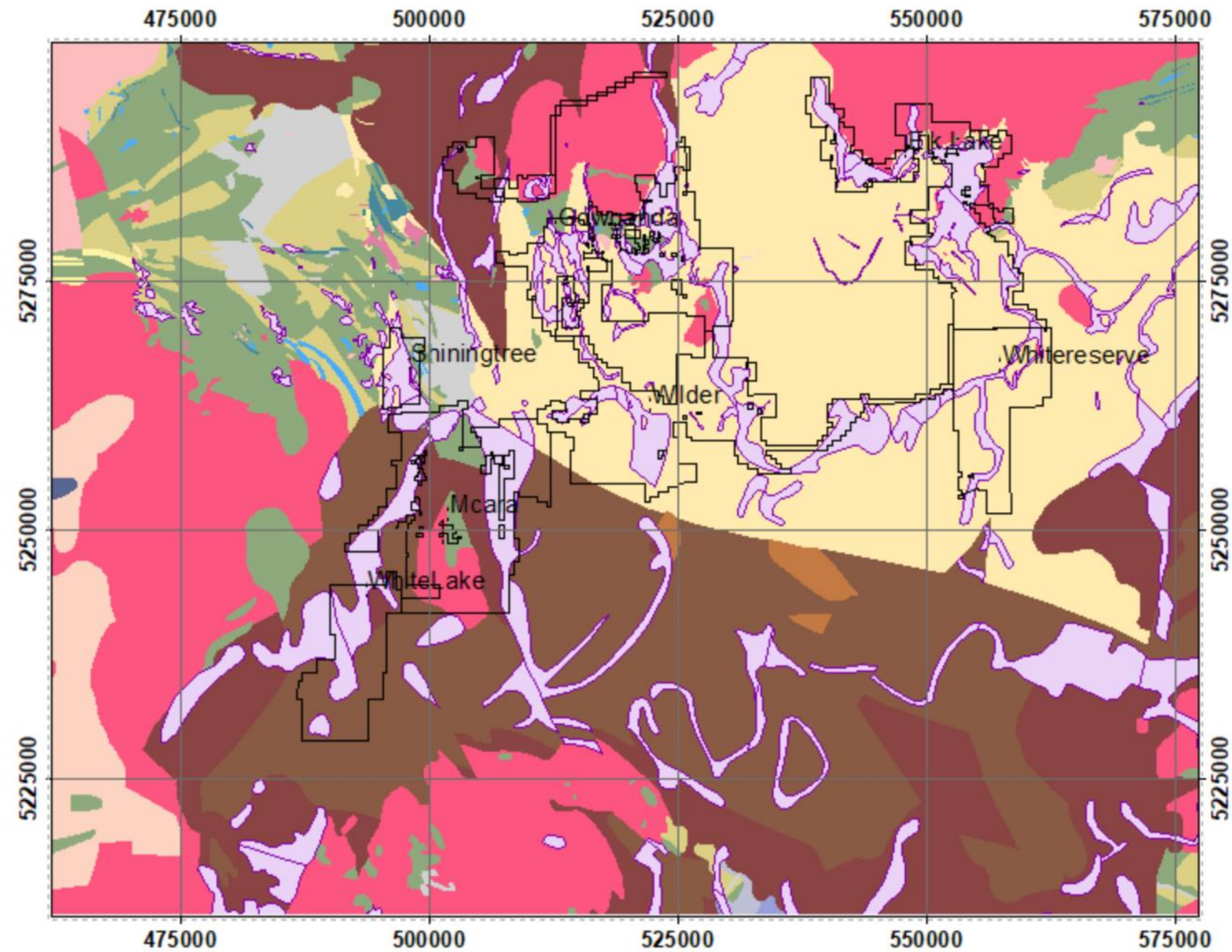

Figure 7. BMR Property Areas over OGS regional Geology with Nippissing Diabase (ND) outlined in pink.

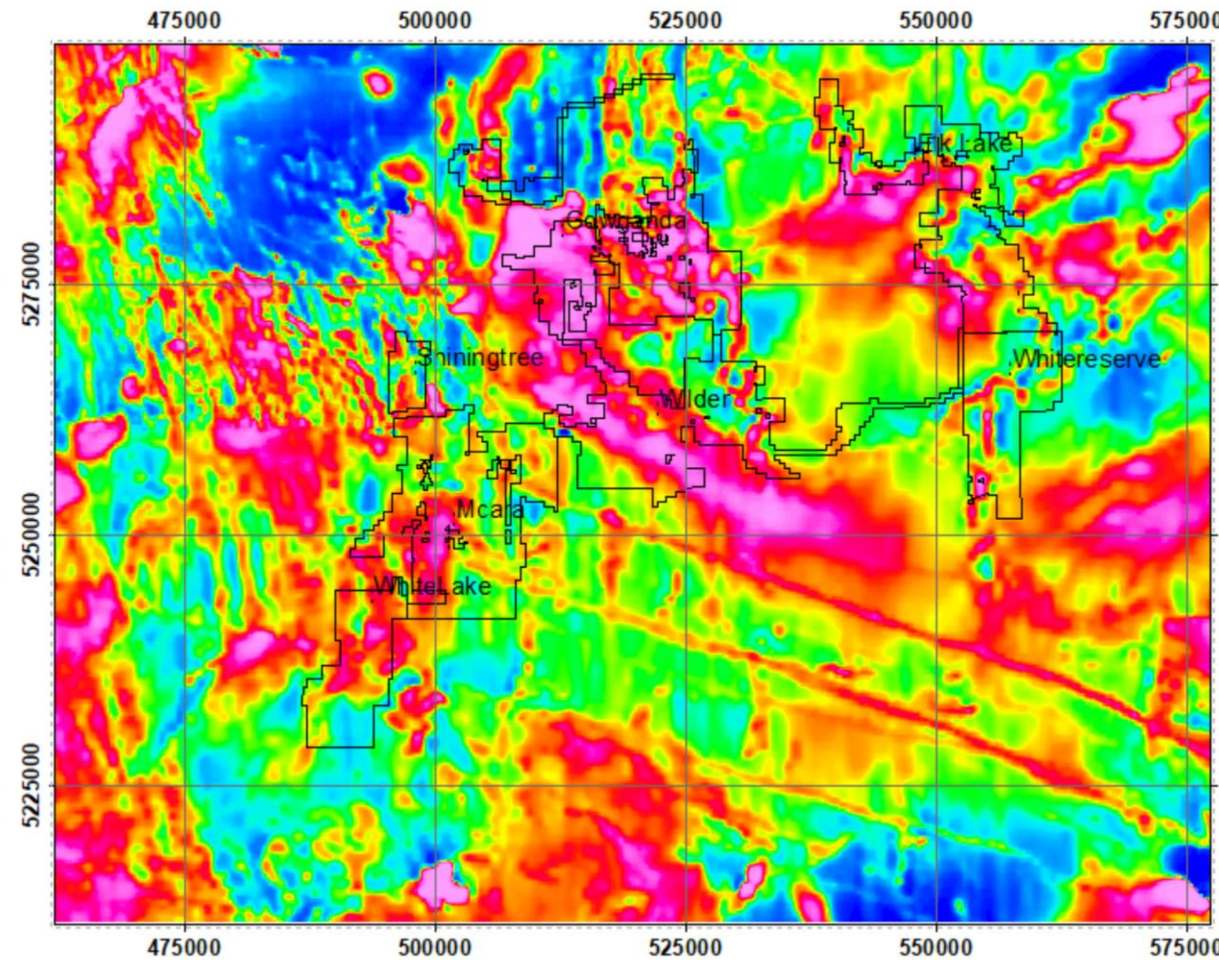

Figure 8. BMR Property Areas over OGS regional Magnetic TMI (Total Magnetic Intensity) colour grid.

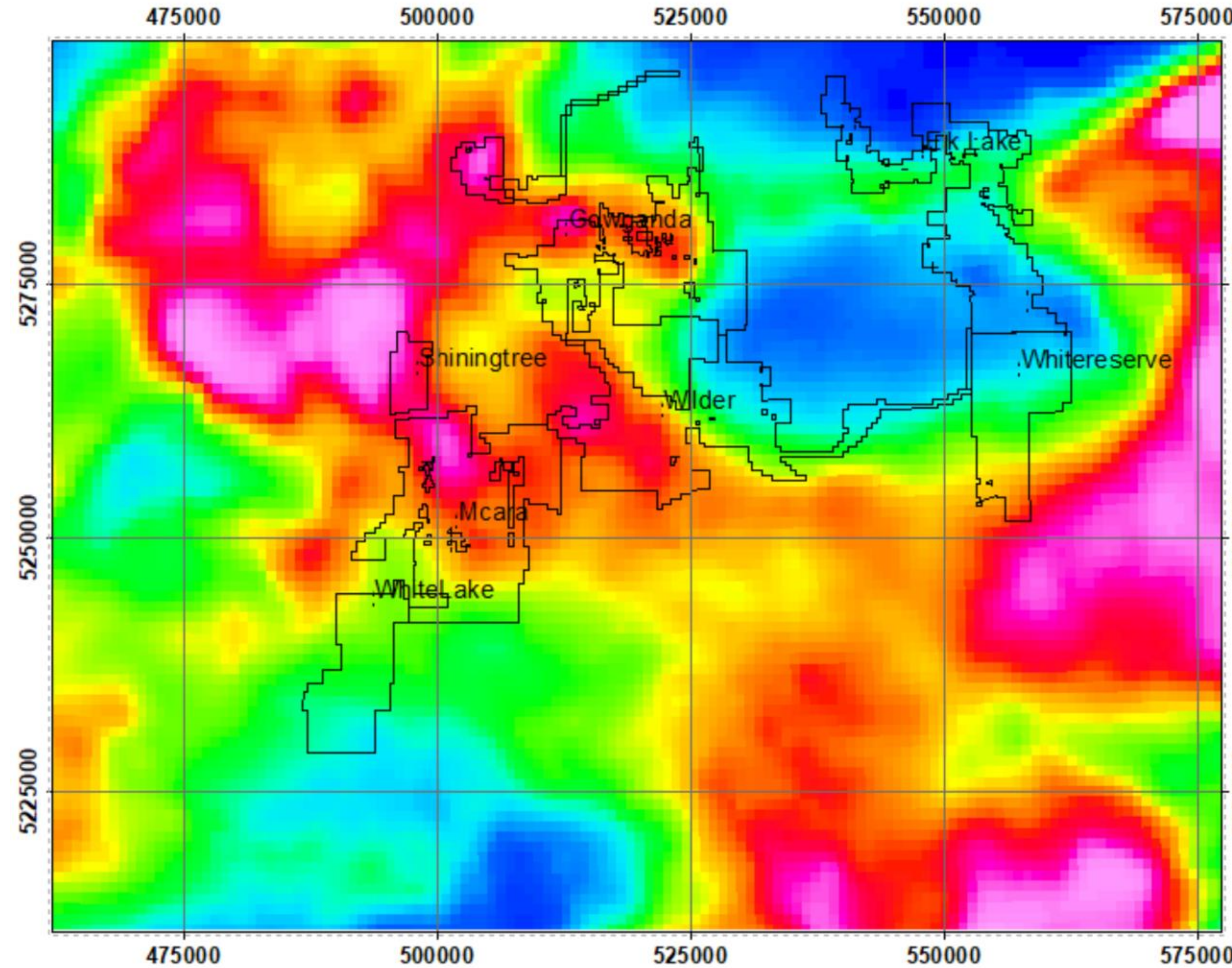

Figure 9. BMR Property Areas over OGS regional Bouger Gravity colour grid.

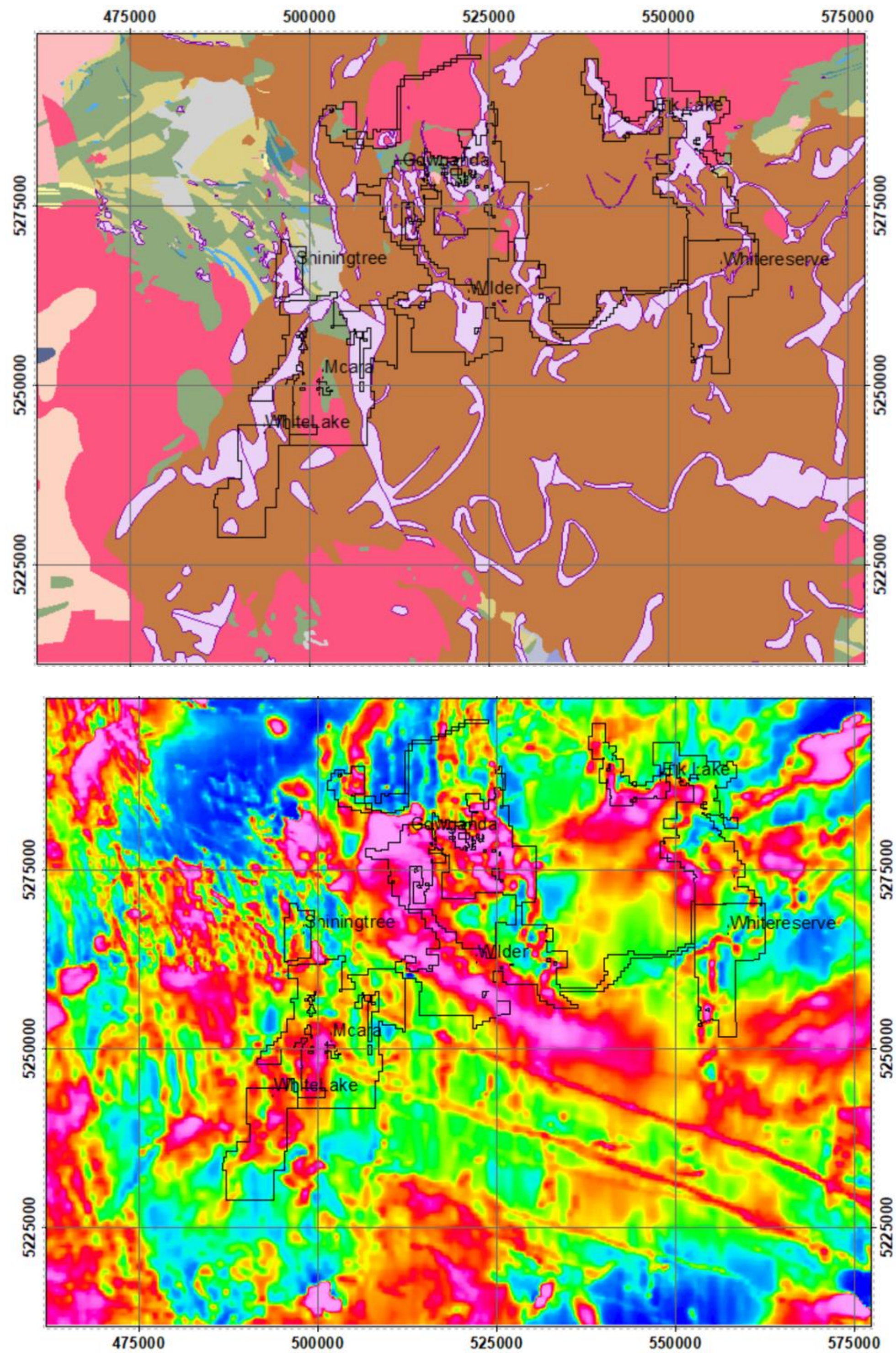

Figure 10. Top: Property Areas with OGS regional Geology (ND outlined in purple) and the Southern Province/Cobalt Embayment (brown in top figure) compared to regional TMI Magnetics (bottom).

Figure 10 shows strong magnetic responses over some parts of the Cobalt Embayment. Since the sedimentary rocks of the embayment are generally non- magnetic the magnetics responses are likely from some combination of mafic dykes, Nippissing sills and dykes, and/or magnetic Archean basement rocks.

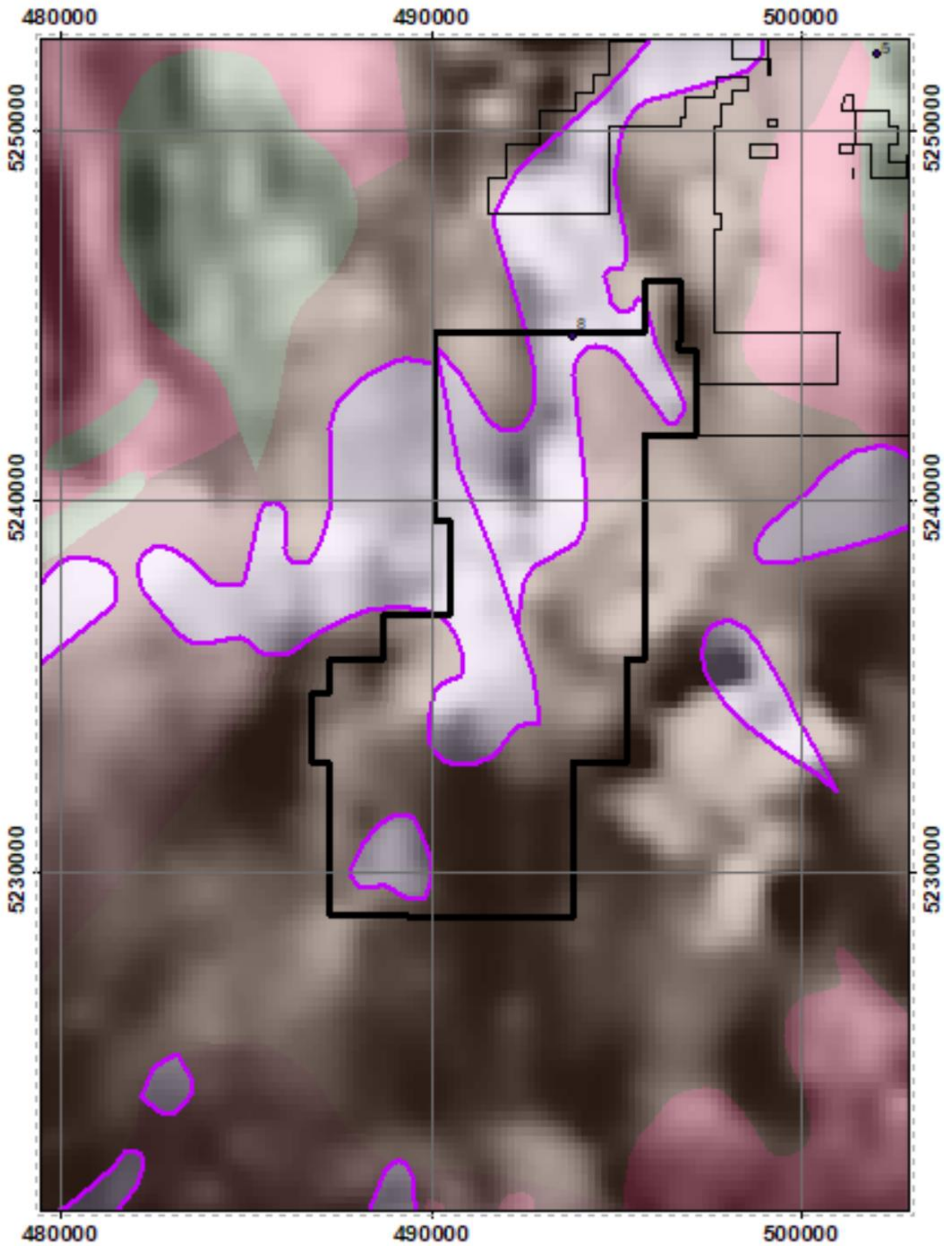

Figure 11. White Lake area OGS regional Geology with ND shown overlying OGS TMI Mag greyscale. Higher mag values = lighter coloured areas.

As shown in more detail in the combined geology/magnetics image above, the ND sills and dykes generally show up as more magnetic areas in the regional magnetic data. However, in detail the magnetic response are complex. There are no Archean basement rocks mapped on this property and so most of the shallow high frequency magnetic response is attributed to ND sills and dykes.

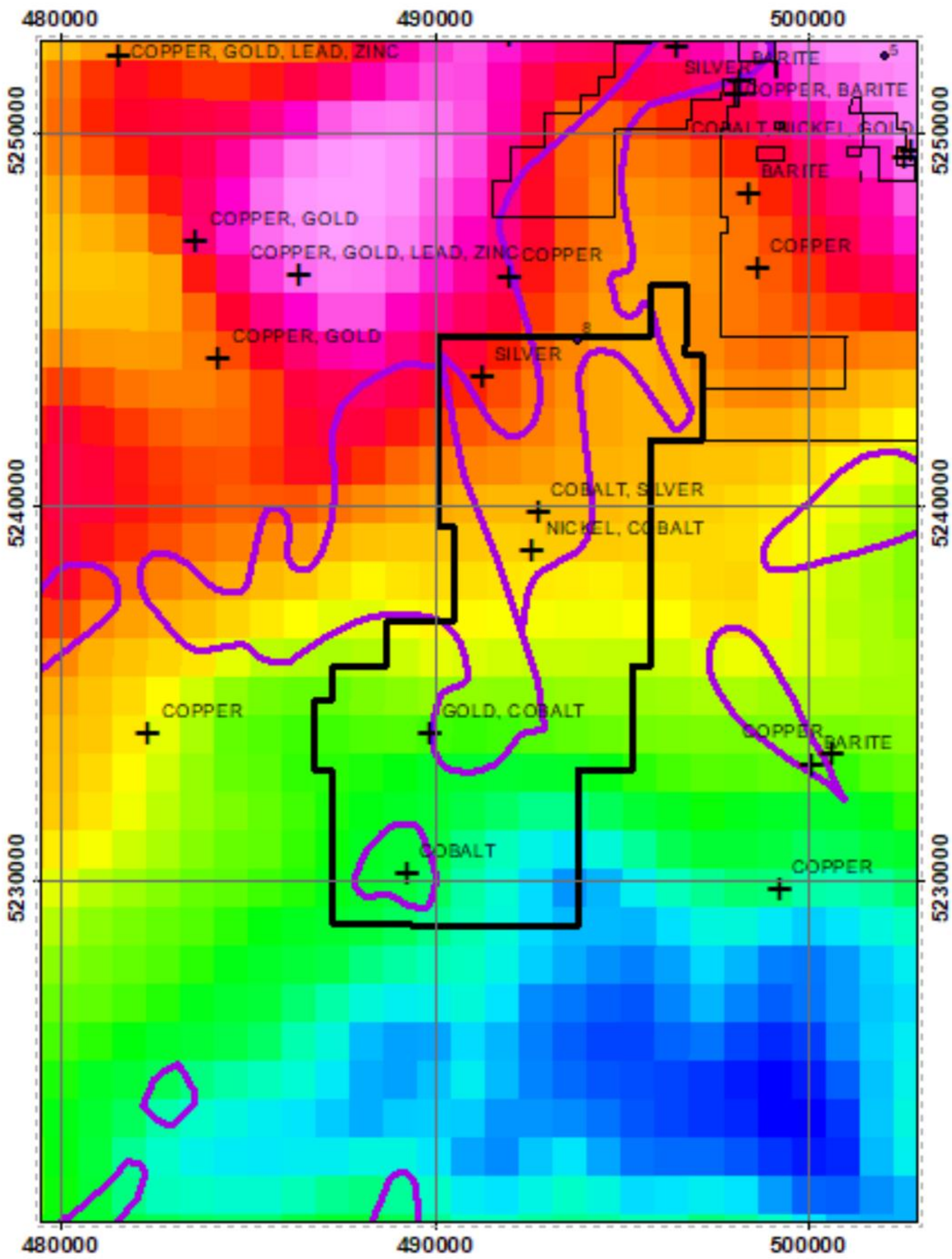

Figure 12. White Lake Property scale OGS regional Gravity colour grid with OGS 2011 MDI mineral occurrences (symbolized by +) and ND outline (purple).

Figure 12 shows the OGS regional Gravity with OGS mineral occurrences. In this case, the southern part of the property is located over a large regional gravity low which is associated with a large underlying granitic batholith which comes to surface outside the property area. A general relationship that has been noted throughout the Cobalt embayment is that there is an association between higher densities of Cobalt -Silver 0currences and areas of higher gravity. As can be seen by comparing the larger scale gravity map with the regional geology, higher regional gravity values generally appear to be associated with greenstone belts in Archean basement and this allows the greenstone belts to be interpreted under the Huronian metasediments. There may also be some higher gravity effects from possible deep feeders to the ND, or from variations in depth to denser Archean basement.

The association of higher densities of mapped five element Co-Ag veins with the regional gravity anomalies and the underlying interpreted greenstone belts, suggests that the presence of five element Co-Ag veins in the Huronian is somehow associated with underlying Archean greenstone belts. This makes the regional gravity a valuable regional exploration guide and may also contribute to a better understanding of the genesis of this poorly understood deposit type.

On this property there are Cobalt occurrences and historical workings on the center and south parts of the White Lake block on the flank of the gravity low, but none over the very low gravity area to the south of the property. Cobalt occurrences are closely related to areas of mapped ND intrusives and it is likely that these are structurally controlled which may allow some “leakage” of metal bearing fluids out from the greenstone belts in the basement.

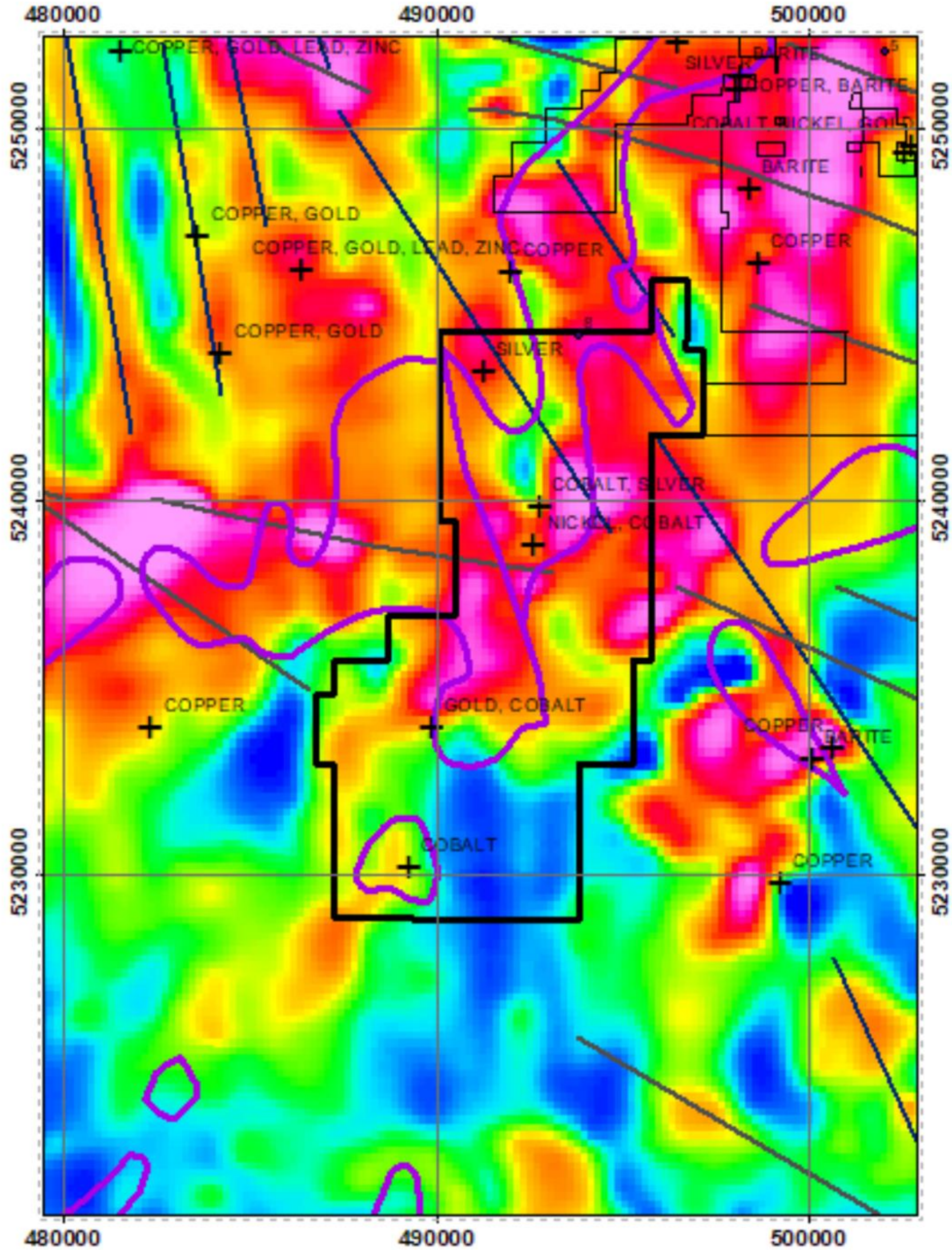

Figure 13. White Lake Property OGS regional Magnetic colour grid with OGS 2011 MDI mineral occurrences (symbolized by +), ND outline (purple) and OGS dykes (dark grey lines).

In the regional magnetic data at the property scale, shown in Figure 13, there are broader areas of higher magnetic values outside of the property boundary to the NW and SE but most of the magnetic response over the property is directly related to ND intrusives and younger NW trending mafic dykes. Some of the large NE, and NNE to N trending structures, are more apparent in this colour image.

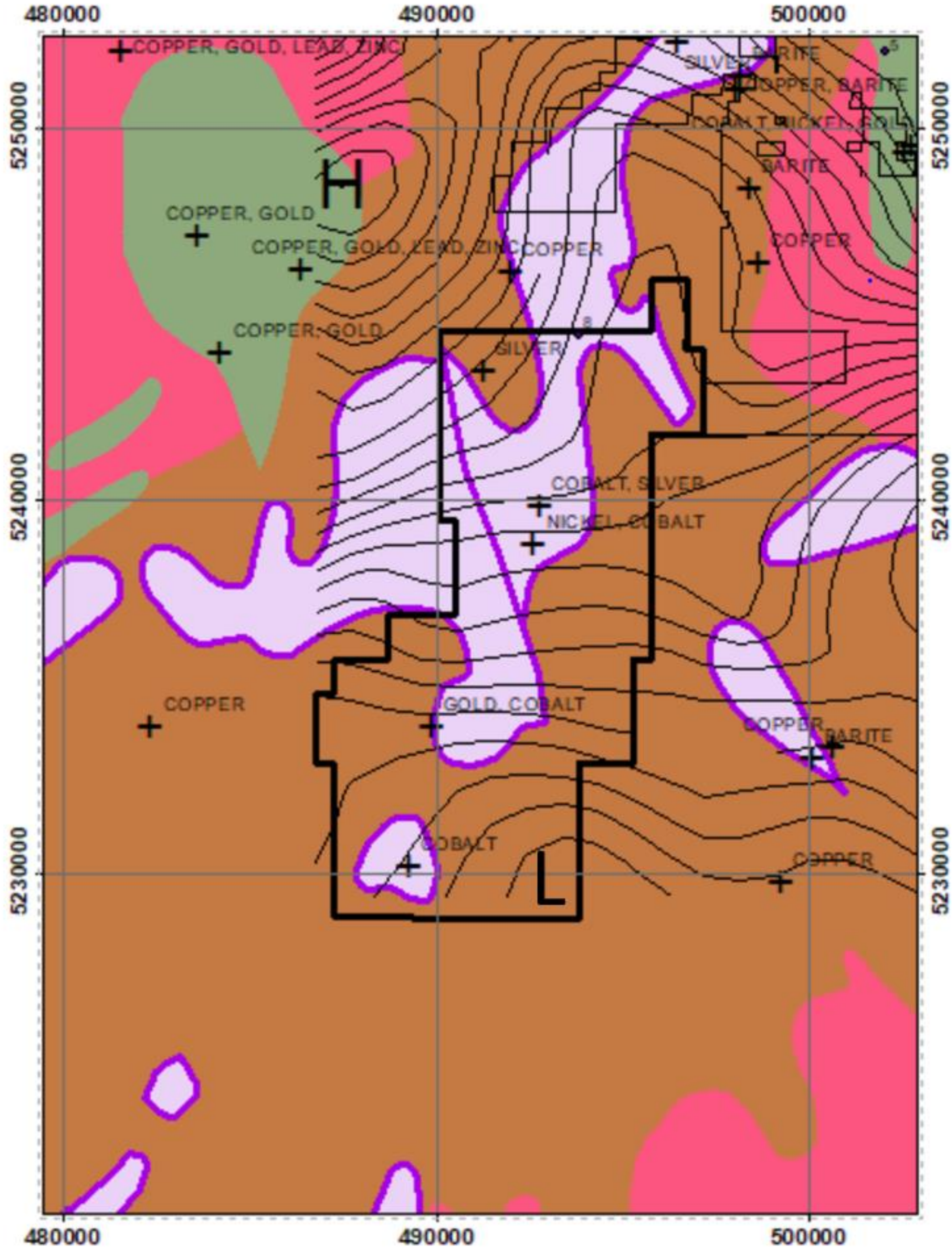

Figure 14. White Lake Area Gravity contours, over OGS geology.

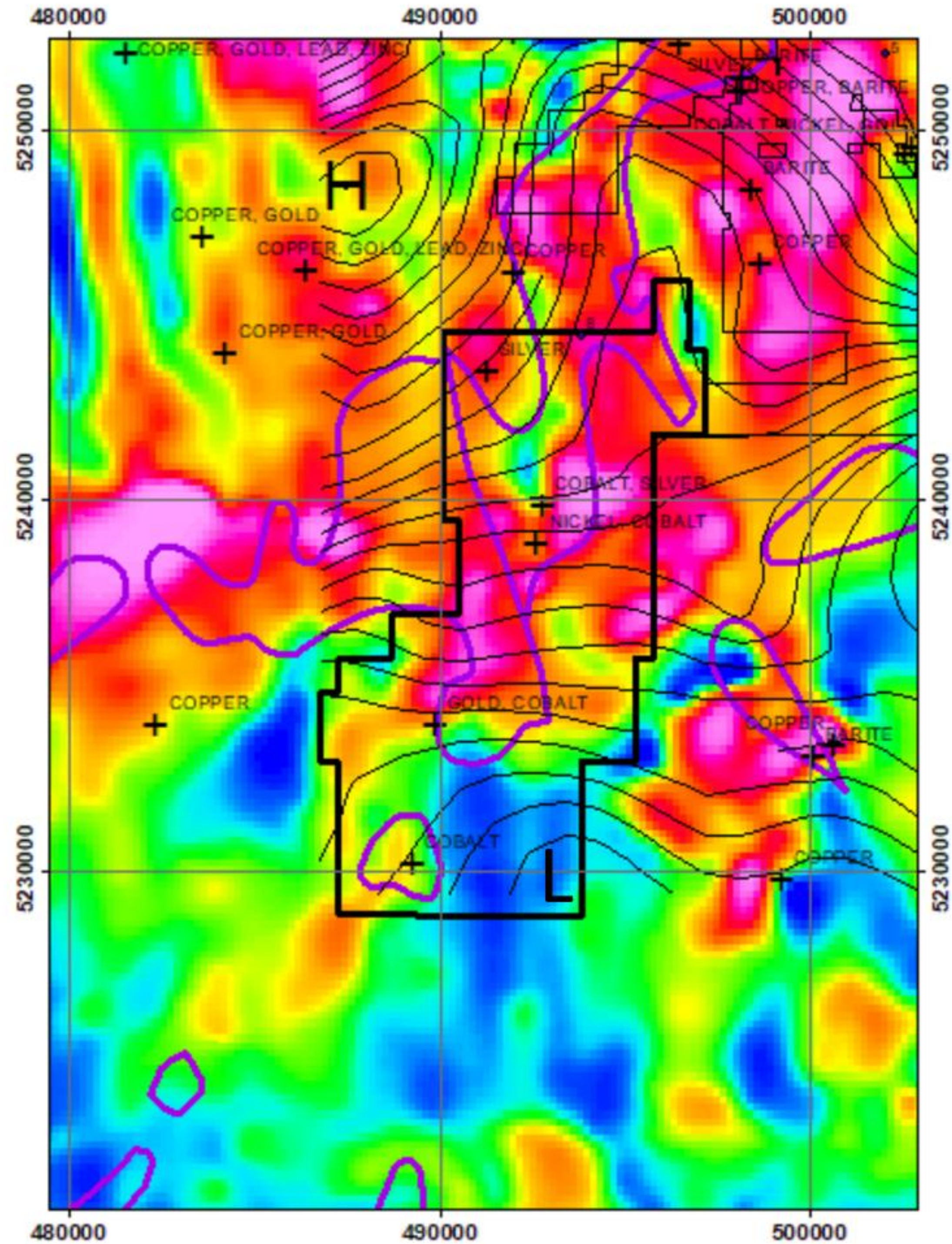

Figure 15. White Lake Area Gravity contours over Mag TMI.

As shown in Figures 14 and 15 the gravity contours over regional geology and regional magnetics show that the property is located on the flank of a major regional gravity low located to the south of the property. The gravity low is due a very large Archean granitic batholith in the basement rocks and more

Co-Ag deposits are associated with the gravity high to the north and along ND intrusive/structural trends that extend to the South. The higher magnetic values on the property are generally associated with the mapped ND sills/dykes but the association is not 100%, which suggests that the distribution of ND intrusives at shallow depth may differ from the ND as mapped in the regional geology and/or there may be variations in mineralogy in the ND intrusives. It is known that some of the larger ND intrusive bodies can differentiated to some extent (Lightfoot, 1993). This possible variation in the magnetic response of the ND is discussed in more detail in the section on the property scale magnetics.

There are no recent AEM surveys over the property.

4.1 Regional Geophysical Work by BMR (from SRK 2019)

- *BMR has conducted exploration work since 2017 on properties located in the Cobalt district of eastern Ontario and western Quebec. A general summary of the regional work done was given in Table 42 in the* SRK 2019 report which is shown in in this report in Table 3.
- *In late 2016, BMR contracted Precision GeoSurvey Inc. of Langley, BC, to conduct a detailed airborne magnetic and radiometrics survey of all the BMR properties, including Shining Tree. The overall survey comprised 10 separate blocks. Magnetic data was collected using a cesium vapour magnetometer and radiometrics data was collected using a 21-litre crystal gamma ray spectrometer. All survey blocks were flown at 100-metre spacing, with tie lines at 1000-metre spacing flown perpendicular to the survey lines. Line orientation varied by project. In general, lines were flown at approximately 40 metres elevation, unless cultural features did not allow. (Precision GeoSurvey, 2016).*
- *In 2018, a LiDAR survey of all claim blocks was contracted to Airborne Imaging of Calgary, Alberta.*

Table 3. BMR Geophysical surveys from Battery Mineral Resources Ltd. Technical Report (SRK 2019).

Property	Survey Year	Survey Type	Contractor	Coverage	Specifications
McAra, Gowganda, Fabre, Shining Tree, Elk Lake, Wilder, White Reserve, White Lake	2016	Airborne Mag & radiometrics	Precision GeoSurveys	For claims blocks included in this report: 10,242 line-km	MAG: Scintrex CS-3 Cesium magnetometer; Configuration Stringer with 3 axis compensation; Sample Rate 10 Hz; Sensitivity: 0.0006 nT vHz rms. SPECTROMETER: Pico Envirotec GRS-10 Gamma Spectrometer. Downward-Looking Crystals: 16.8 litres of NaI(TI) crystals; Upward-Looking Crystals: 4.2 litres of NaI(TL) crystals; Sample Rate: 1 Hz. Line spacing: 100m. Tie line spacing: 1000 m. Survey height: ~40 m (except 166 m for the Fabre).
McAra, Gowganda, Elk Lake, Otter, Wilder, White Reserve, White Lake	2018	Airborne Mag and radiometrics	Precision GeoSurveys	13,893 line-km	MAG: Scintrex CS-3 Cesium magnetometer Configuration Stringer with 3 axis compensation; Sample Rate 20 Hz; Sensitivity: 0.0006 nT vHz rms; SPECTROMETER: Pico Envirotec GRS-10 Gamma Spectrometer. Line spacing: 100m. Tie line spacing: 1000 m.
All Properties	2018	LiDAR	Airborne Imaging	1,266.54 sq km	LiDAR System: Leica ALS70; Flight Height: 1200 m; Flying Speed: 150 Knots; Pulse Rate Rep: 400 kHz; Scan Frequency: 47 Hz; Scan Angle: 50 degree; Side Lap: 50%; Point Density: 8.3 pts/m2; Number of Returns Recorded: Max 4.

BMR Exploration

Exploration activities on the White Lake Project are shown in Figure 16 and are tabulated in Tables 4 and 5. . New geophysical surveys by BMR on the property consisted of airborne geophysical mag/spec surveys only. No new ground geophysical data were conducted. BMR made several property visits to the Annett/Salo Cobalt Prospect.

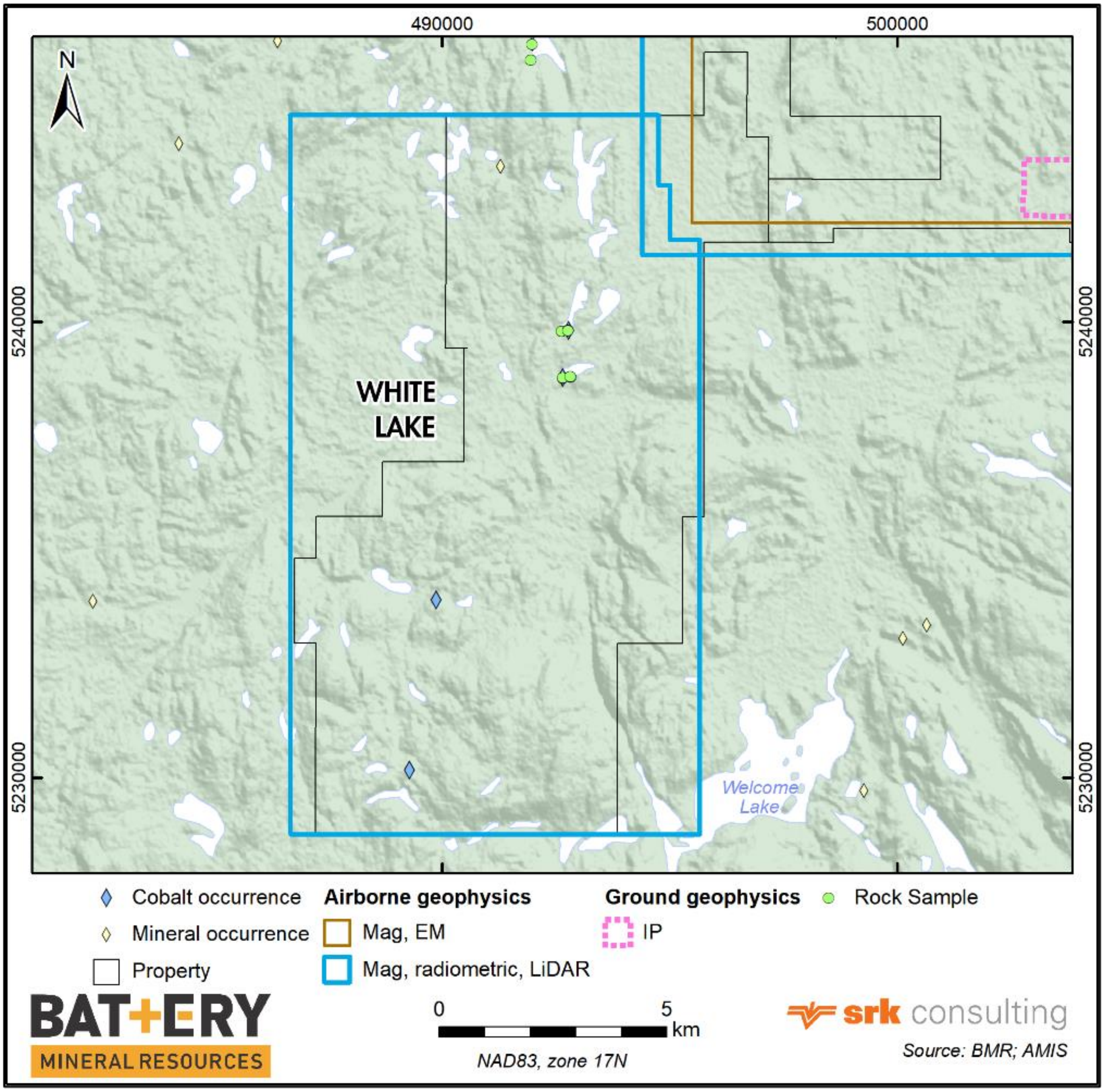

Figure 16. BMR Exploration Activities on the White Lake Project.

Table 4. White Lake Exploration Activities.

Survey Type	Total	Significant Results
Prospecting and mapping	14 traverses for 79.8 line-km	
Rock sampling	13 rock samples	max 5.82% Co (R0405)

BMR Geophysics and LIDAR

The following surveys were contracted by BMR on the White Lake claim block.

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Table 5. BMR Geophysical Surveys on White Lake Project.

Property/ Zone	Survey Date	Survey Type	Contractor	Coverage	Survey-specific Parameters
White Lake	2016 & 2018	Airborne Mag & radiometrics	Precision GeoServices	1616 line-km	2016: Mean Flight Height: 37.97 m; Survey Line Direction 090°/270°; Tie-Line Direction: 000°/180°. 2018: BLOCK A: Mean Flight Height: 40.10 m; Survey Line Direction 090°/270°; Tie-Line Direction: 000°/180°. BLOCK B: Mean Flight Height: 39.20 m; Survey Line Direction 000°/180°; Tie-Line Direction: 090°/270°.
White Lake	2018	LiDAR	Airborne Imaging Inc.	101.59 sq. km	2016: Mean Flight Height: 37.97 m; Survey Line Direction 090°/270°; Tie-Line Direction: 000°/180°. 2018: BLOCK A: Mean Flight Height: 40.10 m; Survey Line Direction 090°/270°; Tie-Line Direction: 000°/180°. BLOCK B: Mean Flight Height: 39.20 m; Survey Line Direction 000°/180°; Tie-Line Direction: 090°/270°.

5 White Lake Project Drilling

(From SRK 2020)

Pre-BMR Drilling

Only two holes by Onitap Resources are recorded and located in the centre of the claim block. No assays are included in the filed assessment report.

BMR Drilling

There has been no drilling by BMR on the White Lake Property to date.

6 Property Area BMR Airborne Geophysical surveys

6.1 Magnetic surveys

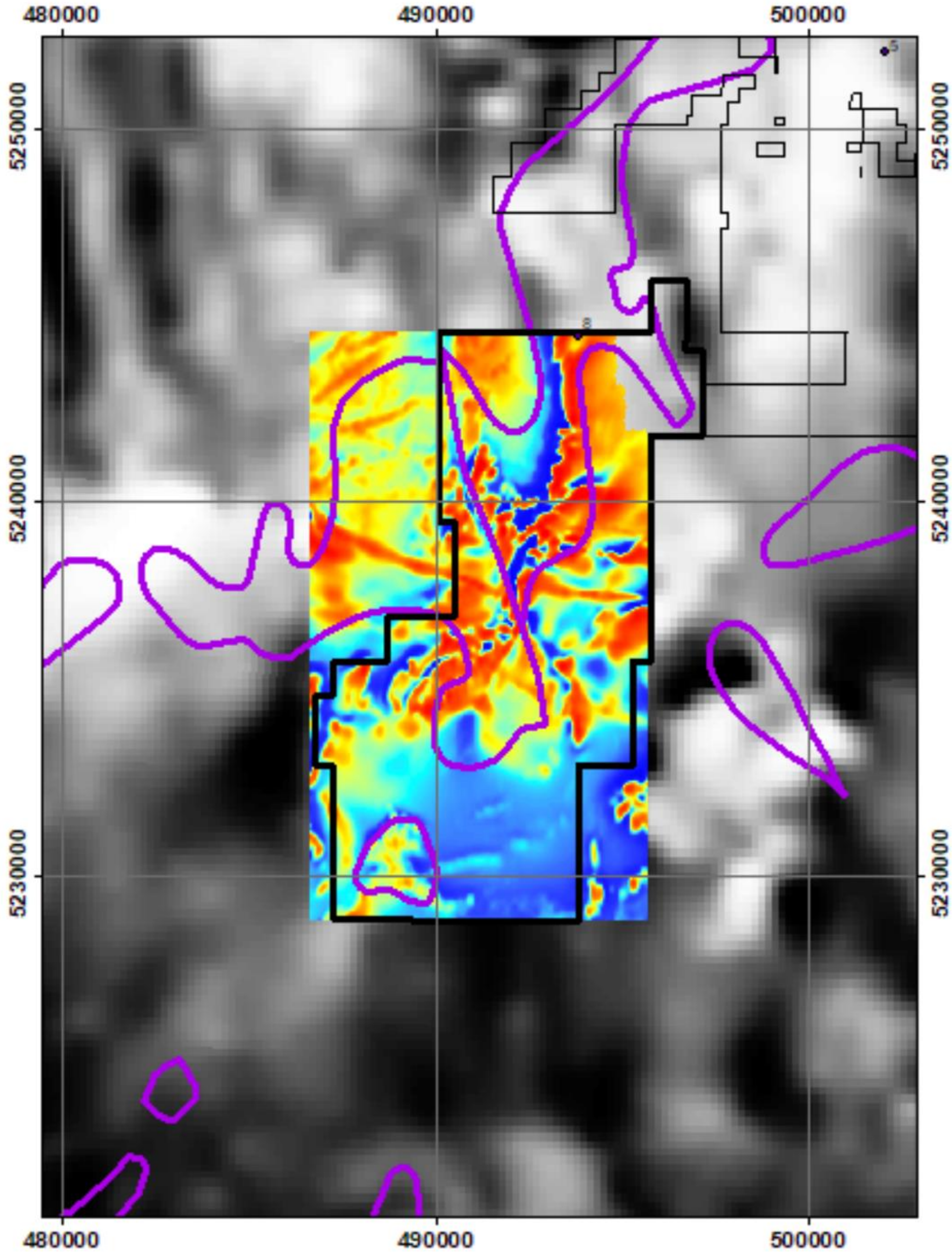

Figure 17. White Lake Property (black outline) Area Mag surveys with TMI Mag by Precision (colour image), ND dykes (purple), and OGS regional TMI Mag (greyscale in the background).

As shown in Figure 17 and 19, there are strong and relatively isolated magnetic responses from the Nippissing sills/dykes in the detailed aeromag data over this property. This is due in part to the absence of outcropping or subcropping Archean rocks on the property. However, the correlation of magnetic responses with the mapped ND is not 100%. There are also several non-ND dykes trending west north-westerly across the property.

The discrepancy between the magnetic responses and the mapped ND on the northeast and central parts of the property are largely due to lack of clear exposure at the edges of the ND intrusives as the edge effects in the magnetic data are very clear. However there are large mapped sheets of ND in the NW and central south parts of the property that show only moderately higher magnetic values in the Mag TMI in Figure 17, and lack the characteristic strong mottled textures in the vertical or horizontal gradient data images shown in Figure 19. Assuming the geological mapping is largely correct it is possible that some of the larger ND sills are somewhat differentiated, as per Lightfoot 1993 and the more subdued “wavy” textures in these areas is a characteristic of the larger sills. This texture has also been observed in ND sills further to the south and this appearance suggests relationships to differentiation, and possibly also flow, at the time of emplacement.

In any case full mapping of the location of the ND Intrusives, which have a strong correlation with Co-Ag veins, will require carefully integrated geological and geophysical information:

1) Geological outline of shallow ND intrusives may be partially inaccurate due to lack of clear exposure at the edges of some the ND intrusives
2) the magnetic signature of the sills may vary.

In order to do additional advanced processing and modeling of the property scale aeromagnetic data, it is necessary to determine if there is any strong remanent magnetization in the survey area. This is done by comparing the Total Magnetic Intensity (TMI) mag and the Mag Analytic Signal (Mag AS) results, as shown in Figure 18.

6.1.1 Remnant Magnetization

Remanent magnetization is magnetization that is “frozen” into the rock when it cools below the Curie point and is fixed in strength and direction with respect to the rock. The more common induced magnetization is caused by the current earth’s magnetic field, inducing a magnetic response in magnetically susceptible rocks. Induced magnetization is in the direction of the current earth’s magnetic field and is proportional to the magnetic susceptibility of the rock. Strong remanent magnetization is more common in younger rocks but can occur in older mafic intrusive rocks as well and requires special processing to produce advanced products such as Reduced to the Pole (RTP) maps and 2D or 3D models. We know from the paleomagnetic literature that we can expect some remanent magnetization in the ND area.

The Mag AS processing compensates for all variations in magnetization direction, such as variations due to latitude and remanent magnetization. However, it also emphasizes shallow magnetic features at the expense of deeper features. The Mag AS data was generated mainly to check if there were any strong remanent magnetic effects in any of the rocks.

Since the Mag AS values are +ve (red-pink) for any area with stronger magnetization no matter what the direction, any areas where there are strong mag lows (blue) in the TMI mag and highs in the Mag AS are indicators of possible strong reversed mag remanence. There can be strong +ve mag remanence as well but this will mostly just add to the induced magnetic signal and show up as a higher magnetic susceptibly. Remanent magnetism can be a useful indicator of particular rock units, but strong remanence can also make some mag processing, such as reduction to the pole and the usual mag susceptibility inversion methods, problematic unless the remanent magnetism is taken into account explicitly.

The Mag AS product is relatively independent of changes in direction of the magnetic field due to remanent magnetism or latitude. Hence all areas of strong magnetization show up as positive (red) anomalies in the Mag AS image. Comparing the TMI mag and the Mag AS in Figure 18, there are no obvious large areas of strong +ve AS and -ve Mag MTI which would indicate strong remanent magnetization. Since most areas appear to exhibit a normal magnetization direction, we can try the usual mag susceptibility inversion methods for 3D modeling as it provides more detail than the MVI (Magnetic Vector Inversion) method that takes magnetic remanence into account. However, since the ND intrusives are known to have some remanence, an MVI inversion was run as well.

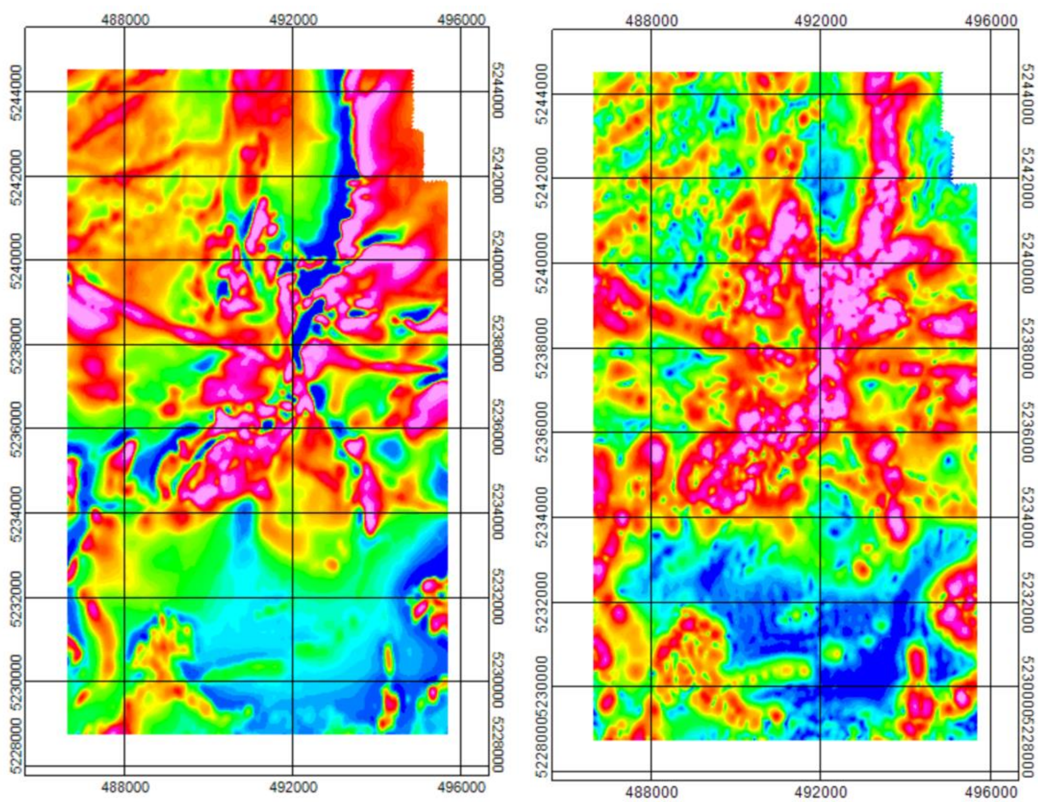

Figure 18. BMR Precision Mag TMI (left) and Mag AS (right) products that are used to locate areas of strong remanent magnetism.

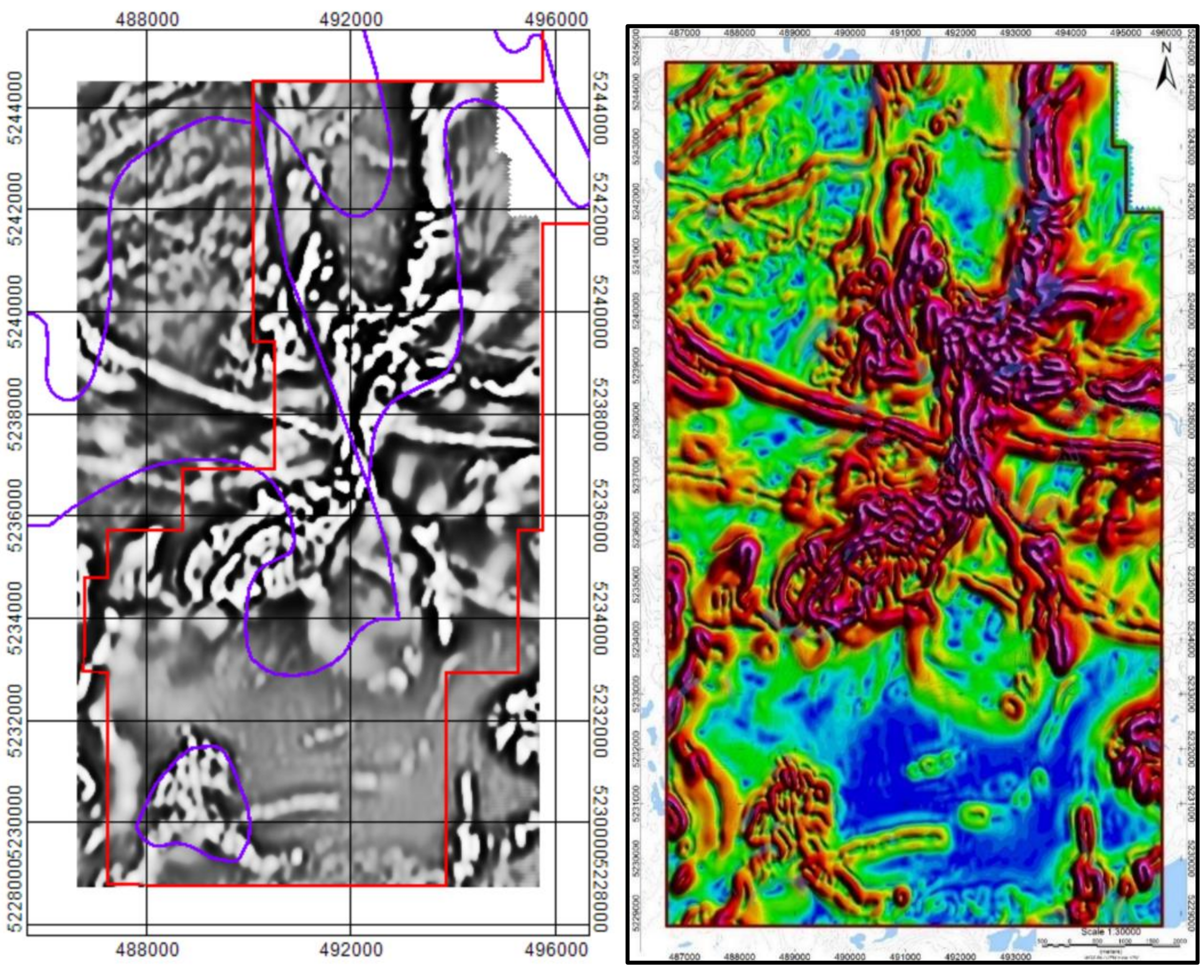

Figure 19. Left - Precision Mag, First Vertical Gradient (1VG) greyscale. Right - Horizontal Gradient (HG) colour image.

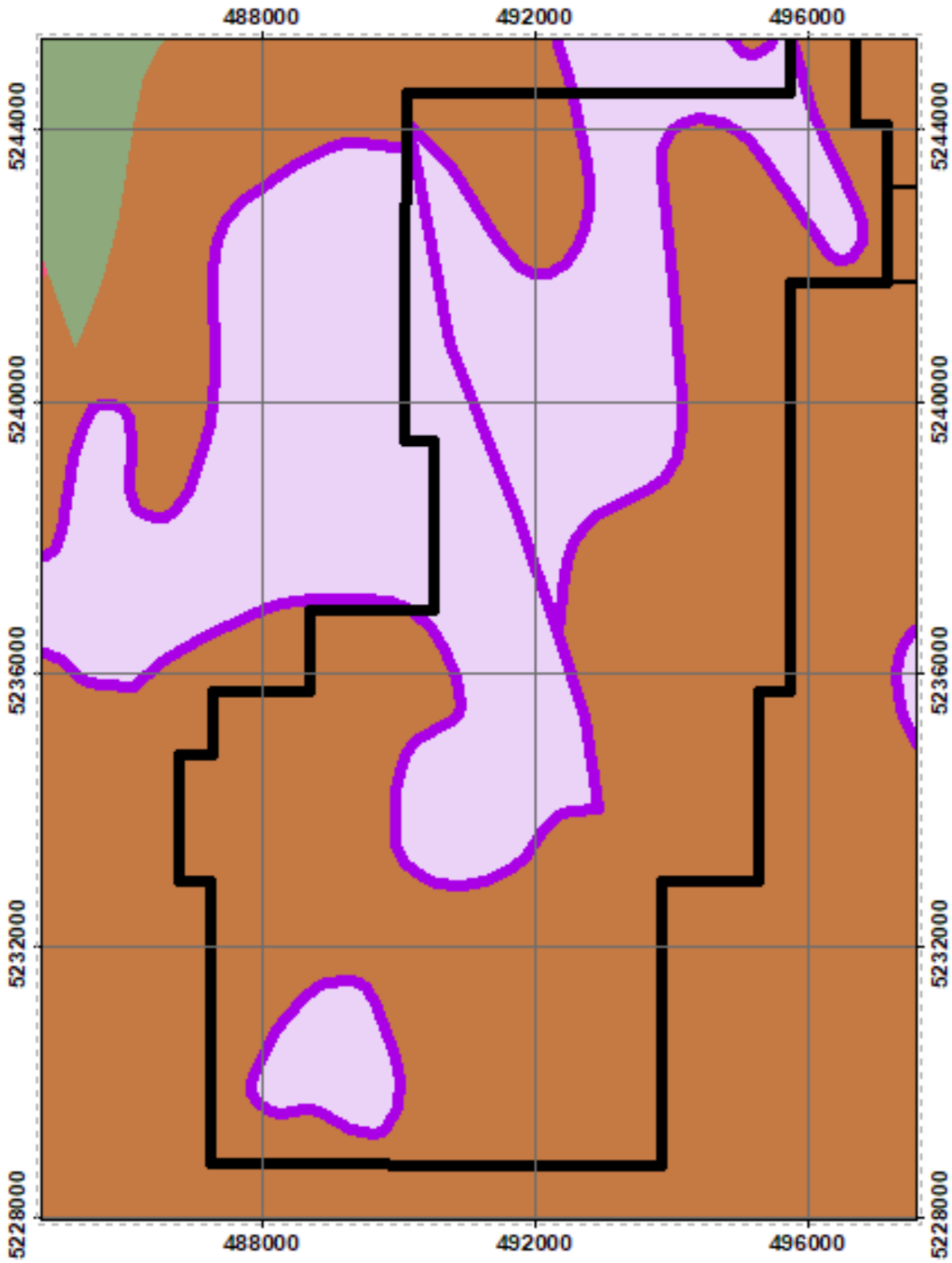

Figure 20. OGS Regional Geology over the White Lake Property for reference.

On this property the magnetic derivative image products in Figure 19 most directly map the distribution of the ND geophysically, however as mentioned above there may be some variations in the magnetic properties and magnetic signature of the ND intrusives that could complicate mapping of them with a single simple magnetics signature.

6.1.2 Magnetic Inversions

3D magnetic inversions were done using the usual mag susceptibility inversion method, to get the best resolution for the majority of the background lithologies, as well as an MVI inversion that accounts for remanent magnetism. The results are shown in Figure 21.

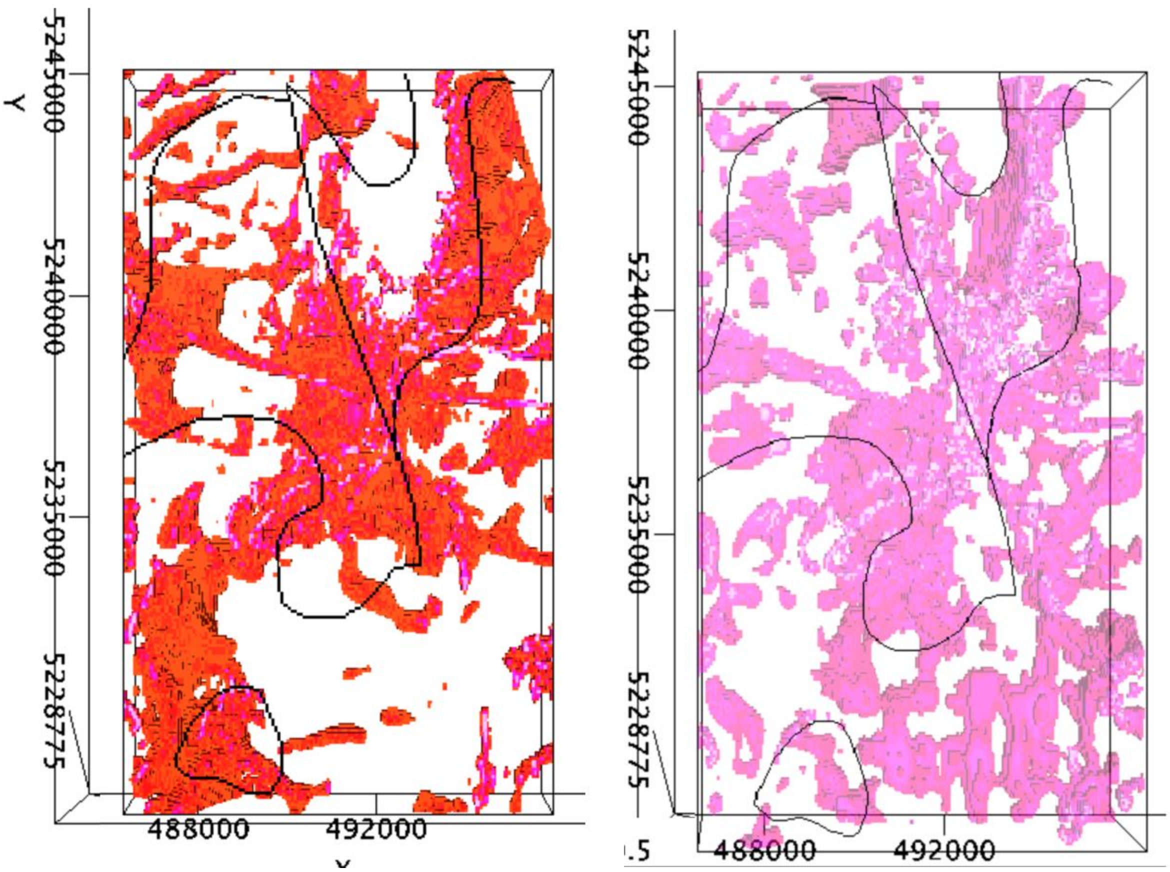

Figure 21. Plan view of White Lake Voxi 3D Mag Susc. (left) and MVI (right) inversion of the new Precision Mag survey, with low cutoff at 0.001 SI and 0.005 magnetization units, respectively. Outline of the mapped ND dykes and sills are shown as black lines.

The 3D Mag MVI inversions seems to outline the edges of the ND sills and dykes better, and both inversion models draw attention to some deeper magnetic anomalies around the edges of the mapped ND outcrop. The MVI image appears less noisy and seems to pick out the sills more clearly. Where there is no response over mapped sills, the sills may be thin, absent, or differentiated to a less magnetic phase.

6.2 Radiometric surveys

As shown in Figures 22 to 25, the radiometric response correlates with large scale geological units but is strongly affected by topography and lakes. Gamma radiation from the earth only penetrates about 0.5 to one meter of material and hence is strongly affected by near surface conditions. In particular, lakes and swamps will block most gamma radiation and the gamma response of transported overburden will often dominate over that of the underlying bedrock.

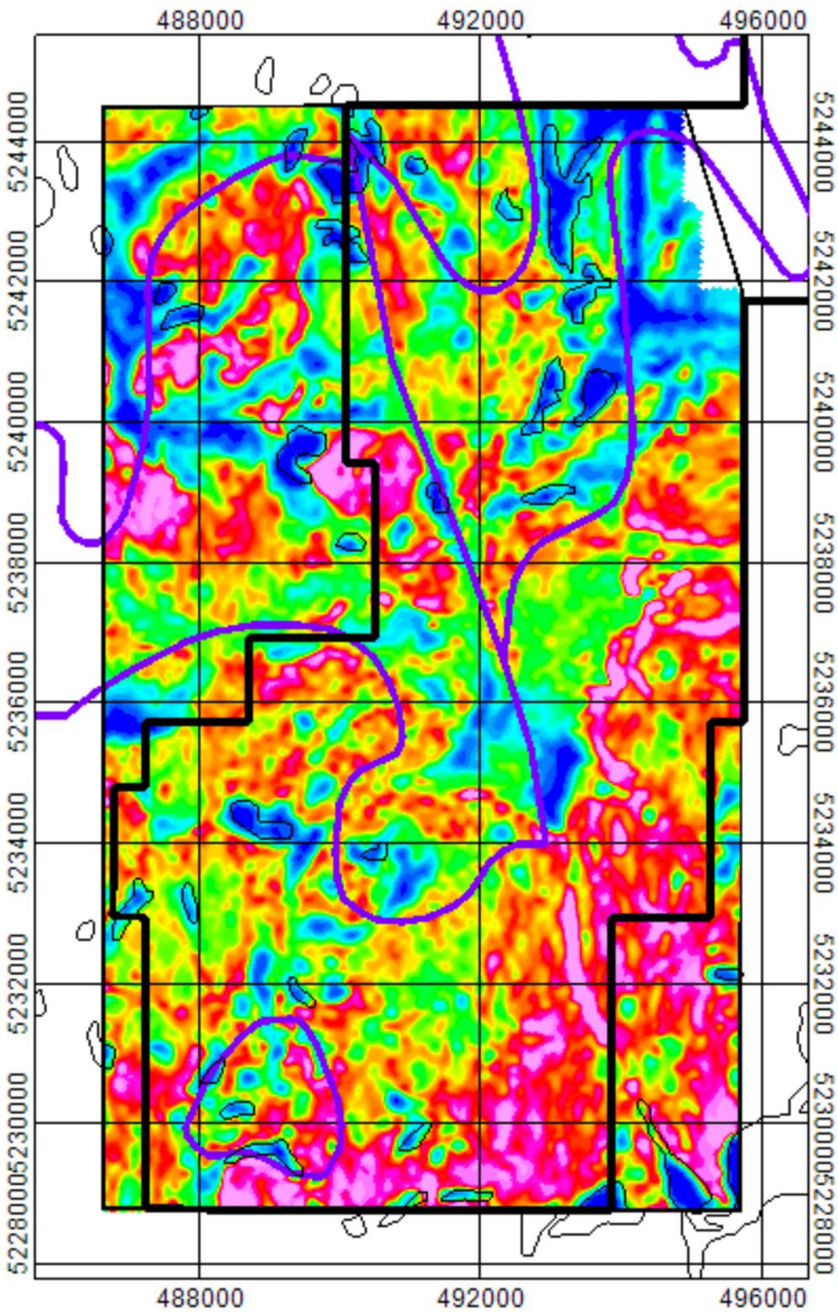

Figure 22. 2016 BMR White LakeProperty Area Radiometrics – Total Count (TC) TCcor_25m with lakes (thin black outlines) and ND (purple outlines).

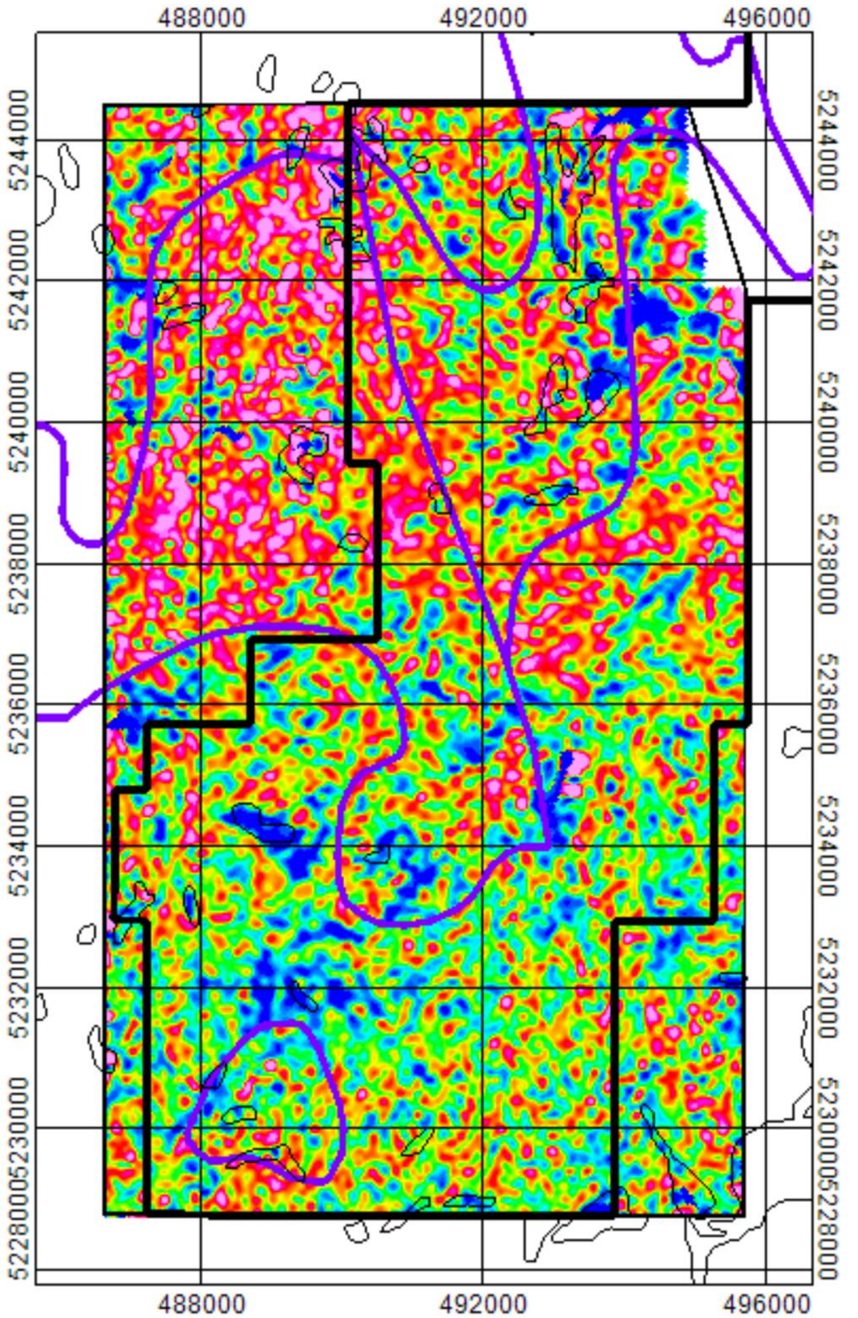

Figure 23. BMR White Lake Property Area Radiometrics - K/Th ratio

Taking ratios of the different radiometric data channels can reduce some of the topographic effects and higher K/Th ratios (red areas in the figure) can be an indicator of areas hydrothermal activity/alteration (K enrichment). Areas of stronger K/Th in the vicinity of ND intrusives may be of interest. Higher K/Th values in the NW part of the survey area occur over a large area mapped as an ND sill. As these are intermediated to mafic rocks, this is unusual, but this is also the are where the magnetic response is subdued. This supports the possibility that this part of the ND sill complex may have differentiated to a more felsic, less magnetic and potassium rich unit. Other areas of higher K/Th along the margins of the ND intrusives, or along structures within the ND, may be of interest for exploration.

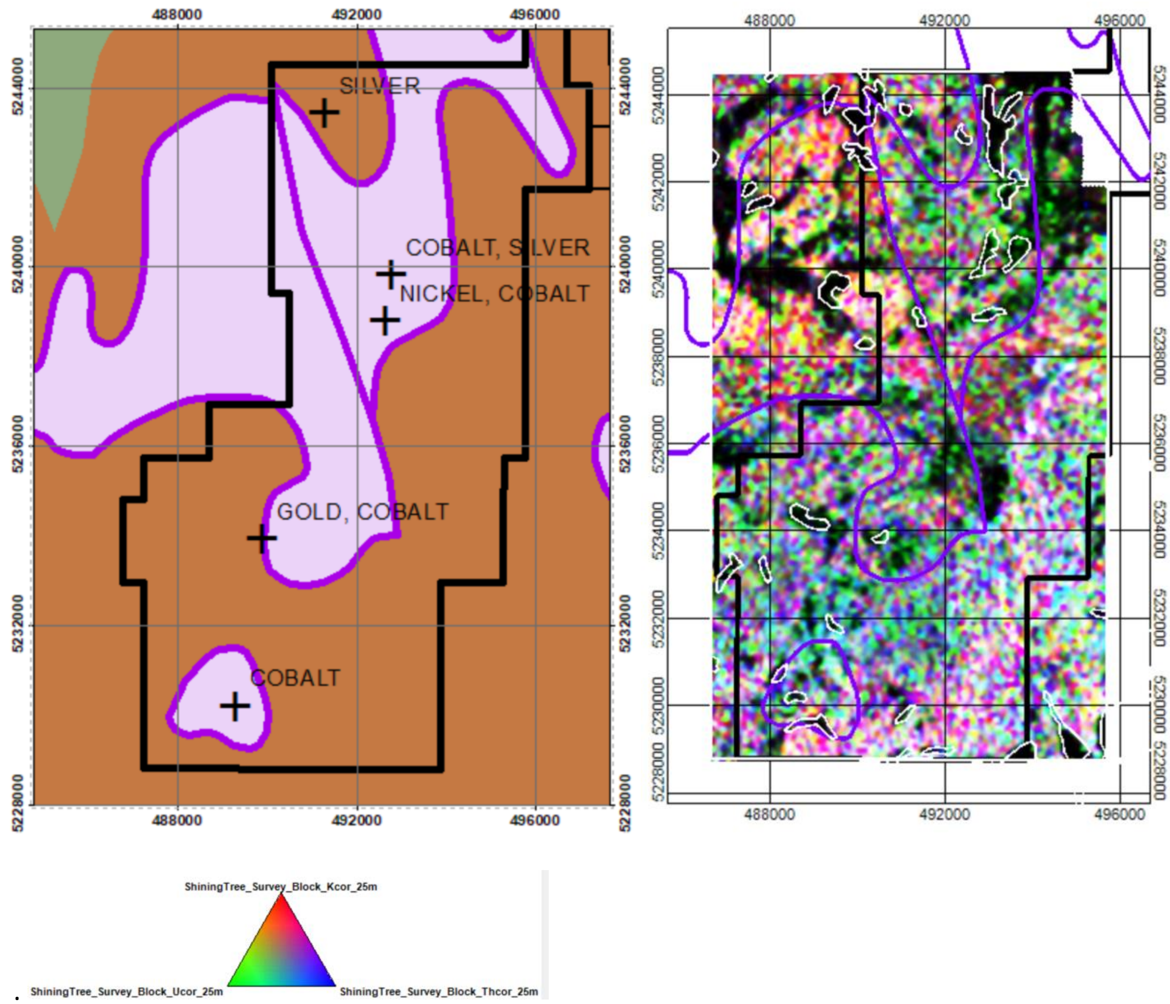

Figure 24. OGS Geology (left) and Nippissing sills (purple outlines) with Ternary Radiometrics RGB= K-U-Th (right) with lakes (thin white lines) and Ternary plot legend.

As shown in Figures 24 and 25, full ternary plots of K, U and Th are usually the best radiometric product for mapping geology. In the ternary plots, white and pink are likely to be granites and higher K granites respectively. Green is likely to be sediments with higher U content. Higher K (red) can be an indicator of hydrothermal activity/alteration with K enrichment. Wet areas and M/UM rocks are black (little to no spectrometer response). Ternary plots, like all radiometric data, are strongly affected by overburden and wet areas.

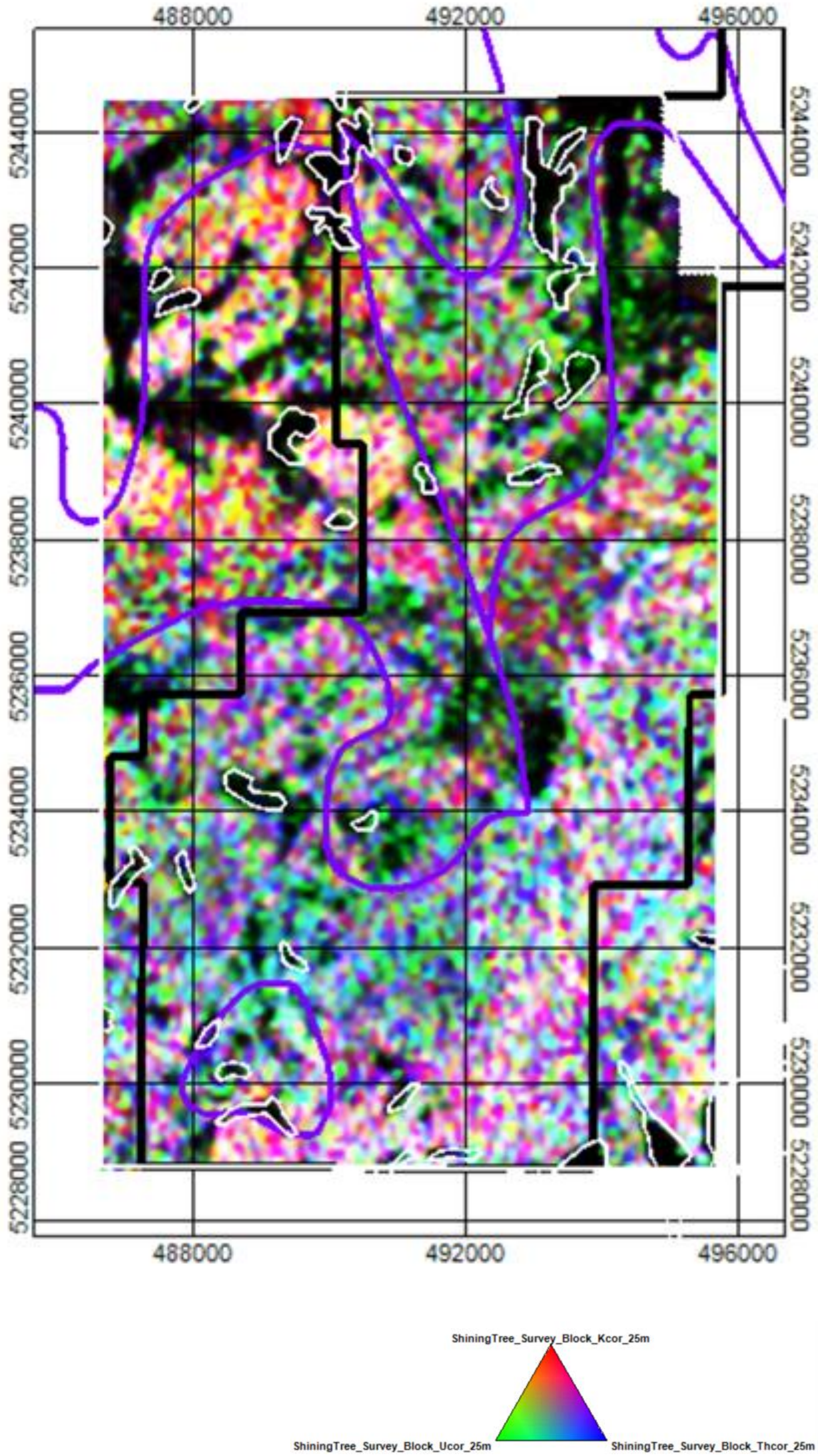

Figure 25. Ternary Radiometrics with Nippissing sills (purple) and lakes (black outline) with legend.

7 BMR Ground Geophysics

No new ground geophysical surveys were done by BMR on this property.

8 Property Scale Targets

Due to a lack of direct detection geophysical surveys such as AEM and ground IP surveys, there aren't the usual well-defined targets on this property. The individual data sets that are available or could be used for property scale targeting are summarized in Sections 8.1 to 8.3. In section 8.4 the available new high quality Mag and radiometric surveys, geology, topography and known occurrences are merged in an integrated targeting exercise to provide some possible target areaa for further ground follow up.

8.1 AEM

There was no available AEM data over this property

8.2 New Aeromagnetic data

Detailed structural/lineament interpretation of the new Precision and VTEM aeromag data can assist in mapping significant structures that may be associated with mineralization.

8.3 Precision radiometric data

The areas of higher K/Th ratios in the radiometric data could be used as an indicator of possible hydrothermal alteration, to upgrade the potential of certain areas.

Neither magnetic or spectrometric data are definitive for targeting on their own, but when used with all other data in a 2D or 3D GIS can be valuable in confirming or upgrading areas of interest.

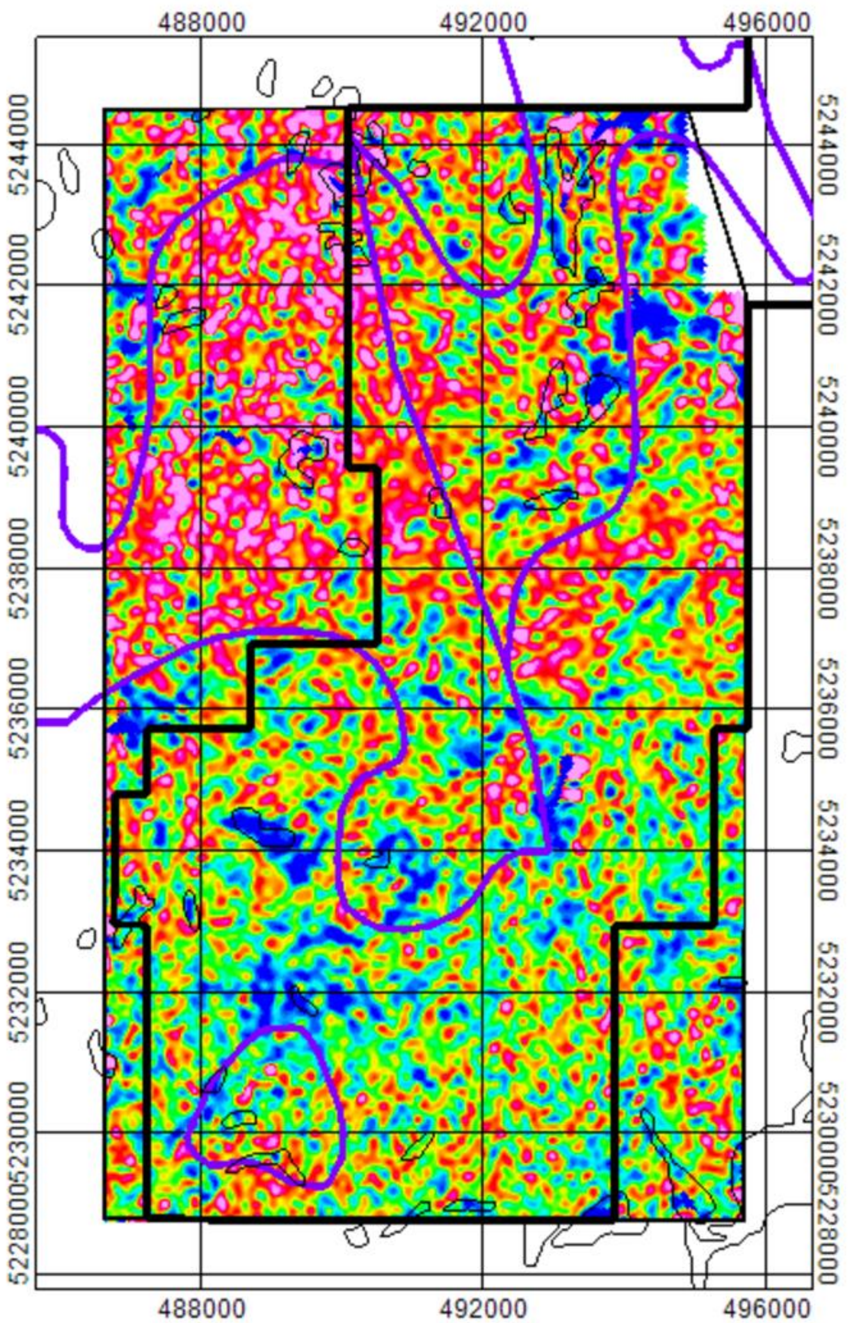

Figure 26. BMR White Lake Property Area Radiometrics - K/Th ratio.

Areas of stronger K/Th in the vicinity of ND intrusives or along stuctures with the ND may be of interest.

8.4 Integrated Targeting

New high quality Mag and radiometric surveys, geology, topography and known occurrences are merged in 2D in ARCGIS and Geosoft Oasis Montaj and in 3D in Geoscience Analyst (GA).

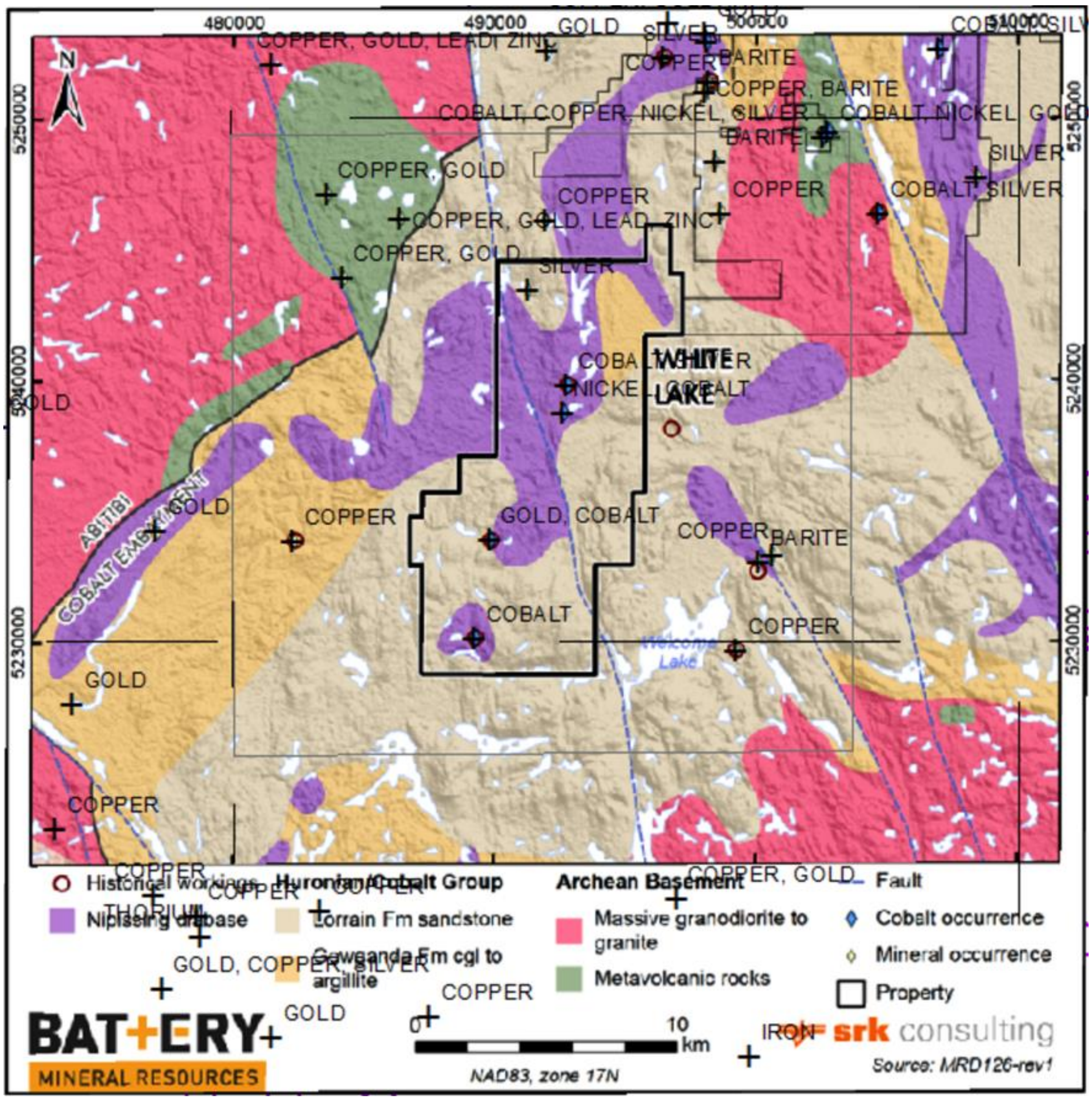

Figure 27 Geology of the White Lake project with OGS MDI 2011 Mineral Occurrences

In Figure 27 shows 4 known Co occurrences on the property and Co-Ag occurrences in the area in association with Nippissing Diabase (ND) . There are also gold and base metal occurrences in the nearby Archean greenstone basement and some Cu and Au occurrences in the Huronian rocks. The association (and first order control) of Co-Ag deposits with ND is well known but more local controls on Co mineralization are not clear from the regional geology alone.

The next figure shows the Tilt Derivative image as processed from the new Precision Mag TMI data with MDI 2011 Mineral Occurrences and interpreted key lineaments/structures.

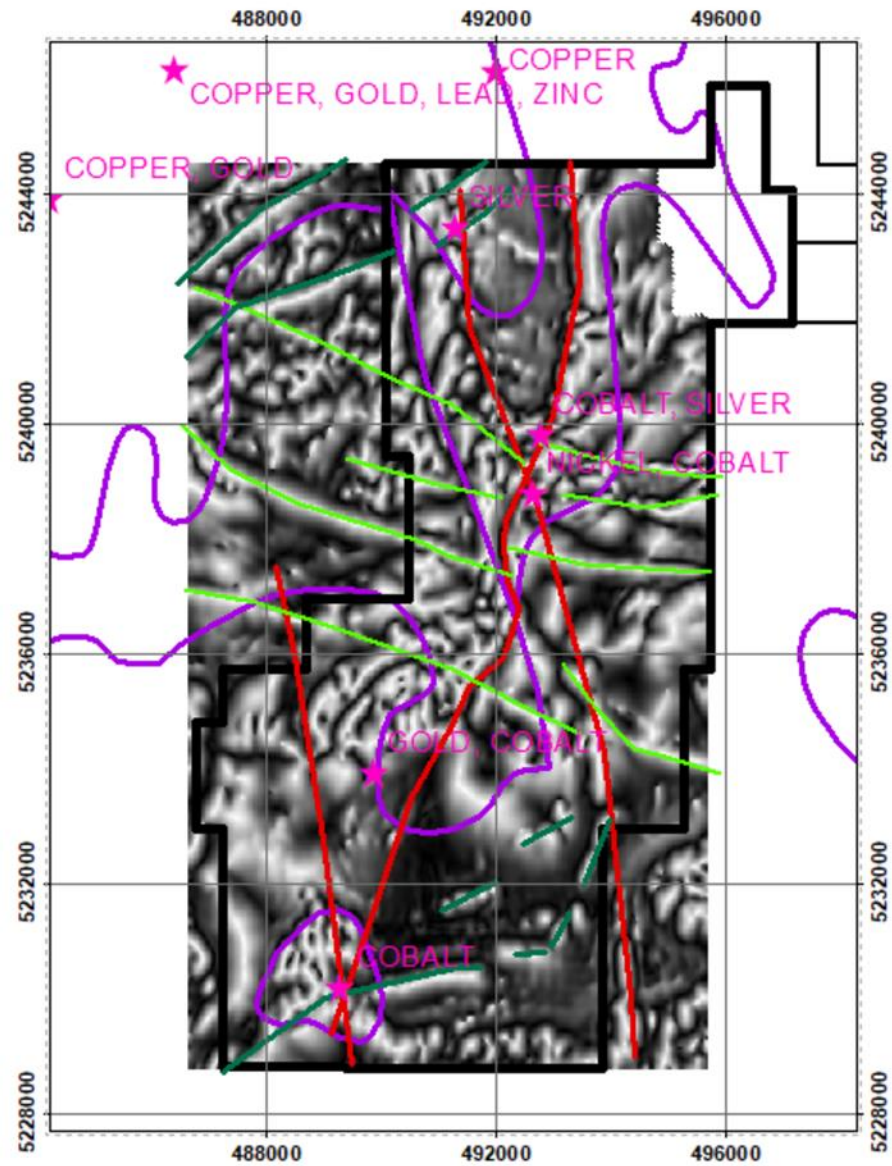

Figure 28 White Lake Precision Mag TDR with MDI 2011 Mineral Occurrences and interpreted key lineaments/structures. - Major Structures, - 1235-1238 Ma Sudbury dike, - Unknown dykes with ND outline in purple.

The known Co occurrences seem to fall along a few generally north trending key structures shown in red. These features are probably related to the regional scale north trending Onaping-Temiskaming fault system that is apparent throughout the Cobalt embayment. This large scale fault system was active before and during the deposition of the Cobalt embayment as it is a controlling influence on the boundaries and internal large structures of the embayment (including ND intrusives) and also controls the very large Matachewan dyke system which just predates the Huronian. The Matachewan dykes in turn are though to be related to a rift that controlled overall Huronian development on the South flank of the developing Superior craton.

These key structures are considered a key second order control on Co-Ag mineralizing targeting can be focussed on areas where they are near to or intersect the ND.

Further targeting focus can be provided by looking for areas of intersecting/cross cutting features or structural complexity along the major structures that could have provided local dilatant zones that would be favorable for mineralization.   In the figure significant WNW and ESW dykes are interpreted. These likely occupy zones of ongoing weakness and can provide the desired local dilatant /complex zones along the key structures. The known Co occurrences seem to be associated with intersecting/cross cutting features and areas with similar features are considered to be favorable target areas and are highlighted in the next figure.

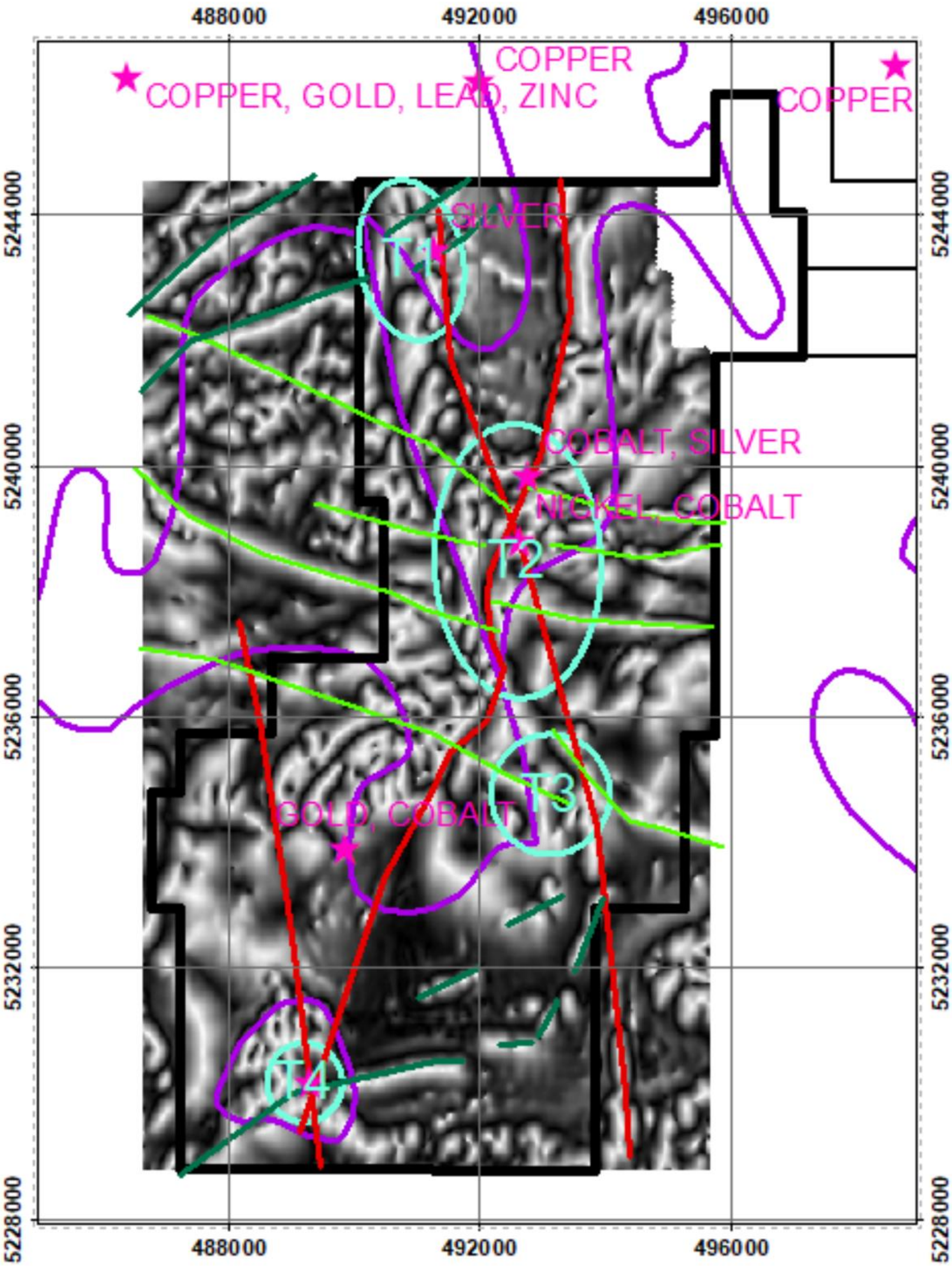
488000
492000
496000
COPPER
COPPER, GOLD, LEAD, ZINC
COPPER
SILVER
T1
COBALT, SILVER
NICKEL, COBALT
T2
T3
GOLD, COBALT
T4
5244000
5240000
5236000
5232000
5228000

Figure 29 White Lake Precision Mag TDR with MDI 2011 Mineral Occurrences and interpreted key lineaments/structures with suggested target areas T1 to T4

Of the four suggested target areas, 3 already contain Co occurrences but the identification of the key structures in the target areas can provide focus for further ground follow-up.

Area T2 was previously identified by BMR geophysical consultant Tom Weiss as a probable dilatant zone and favourable target area. (Weiss 2018 and 2020).

As previously mentioned, areas of higher K/Th ratios in the radiometric data can be used as an indicator of possible hydrothermal alteration, to upgrade the potential of certain areas. Figure 30 shows key structures and target area over a K/Th ratio Grey scale image. The K/Th can used as a background image in any targeting exercise as another component to upgrade or downgrade areas.

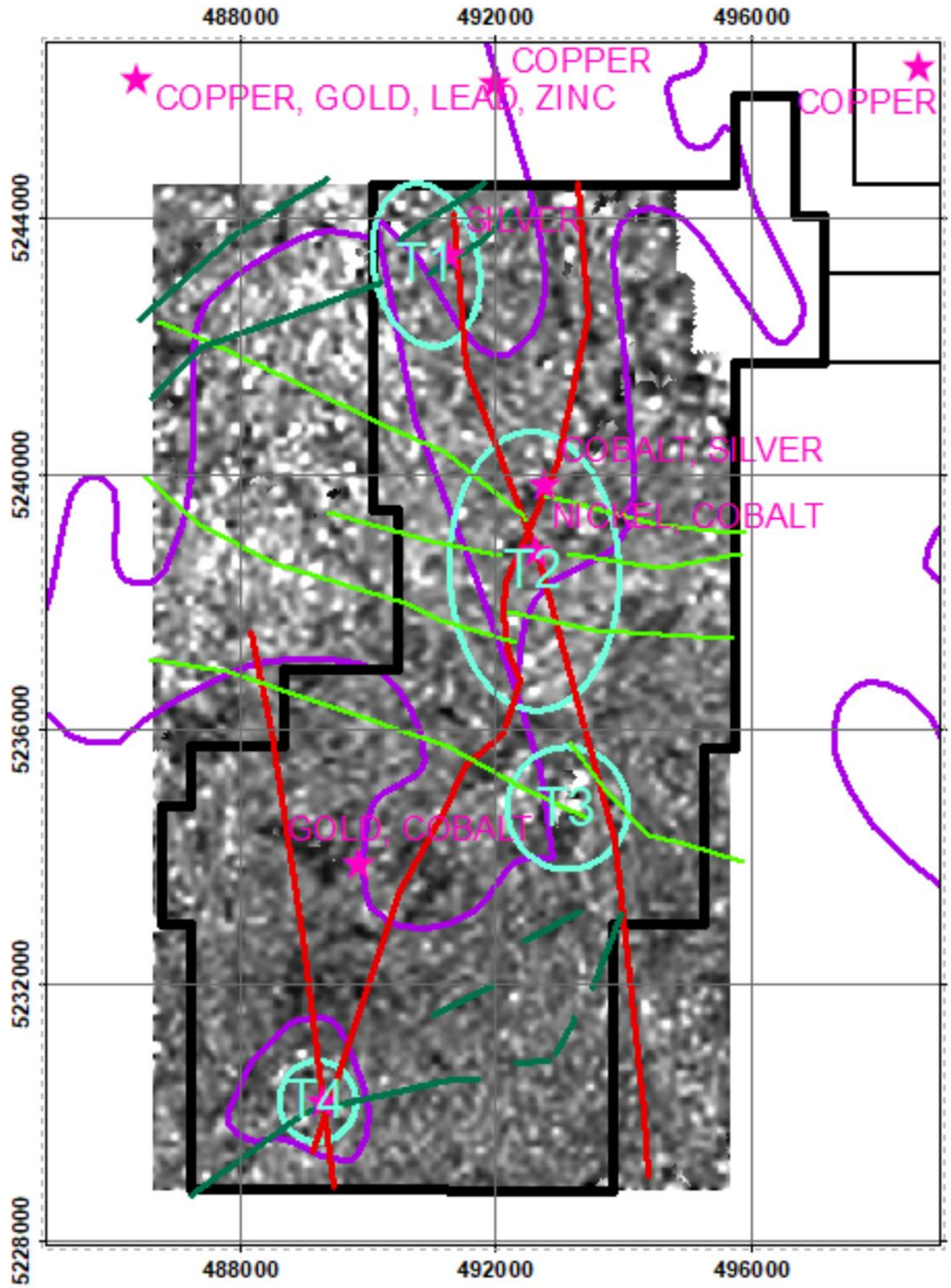

Figure 30 Key structures and target area over a K/Th ratio Grey scale image. White is High K/Th

The inherent noise in the K/Th ratio is apparent as spottiness throughout the image There are also large scale variations which are mainly geological as well as local anomalies due to lakes/topo etc. but there are also a few local coherent areas of higher K/Th values. The one bright spot within the T3 target is of particular interest.

3D Integrated Model

All 2D data and 3D products such as magnetic inversions and topography were merged in a 3D Geoscience Analyst model. A View of the 3D model with the Mag MVI 3D inversion. Mineral Occurrences, key structures, and target areas is shown in Figure 31.

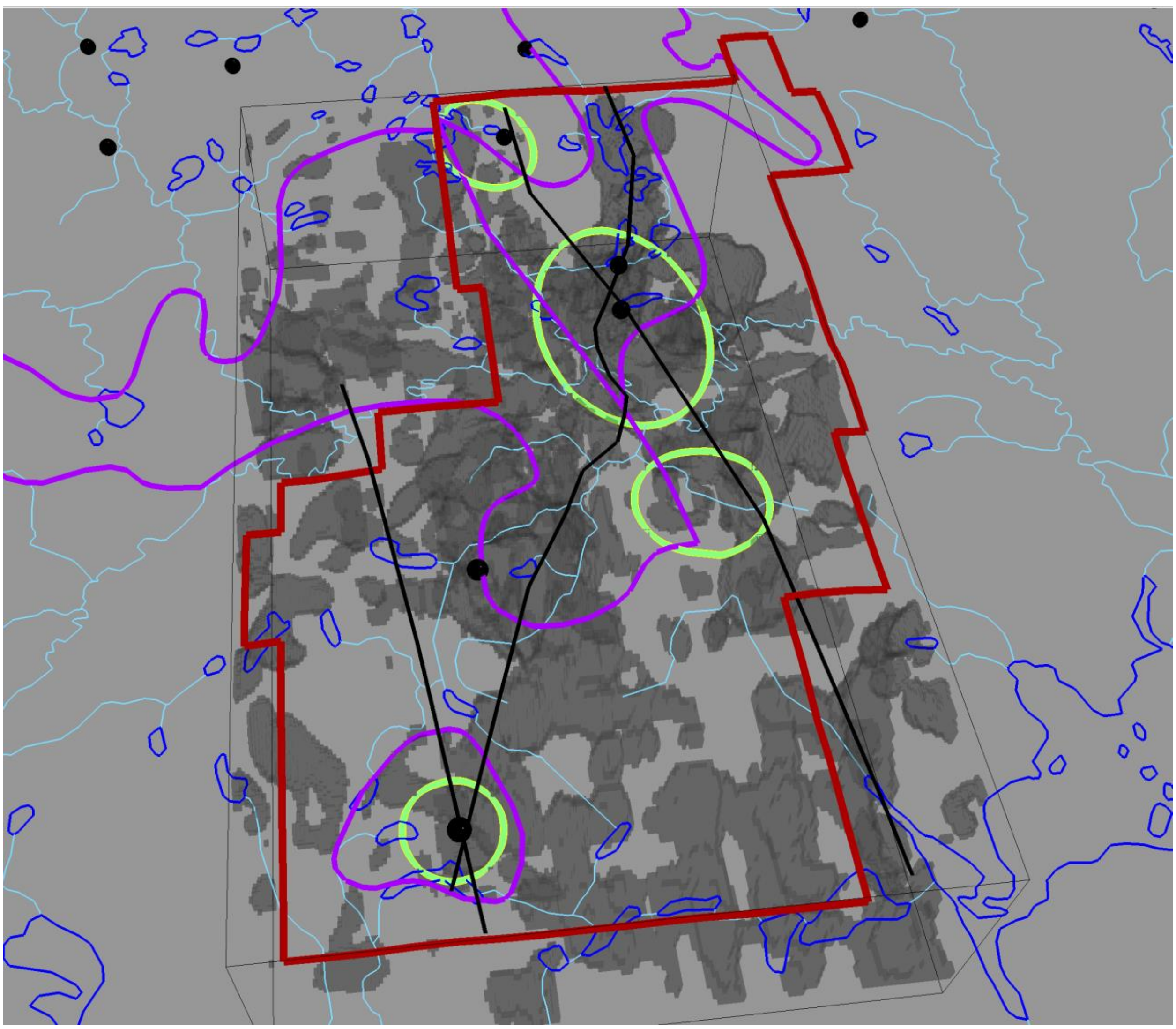

Figure 31 3D model with Mag MVI 3D inversion with MDI 2011 Mineral Occurrences, key structures, and target areas. View from SSW and above. Volumes of higher magnetization (> 0.005 Magnetization units) shown in grey.

The 3D magnetization volume shows the large scale 3D shape of the ND and other magnetic bodies (the more E-W younger dykes) and shows the extensions at depth and continuity along the major structures. The 3D model is a deliverable with this report and it is recommended that it be used in targeting as an additional resource.

The last figure shows another view of the 3D model with the K/Th grid draped on topo with MDI 2011 Mineral Occurrences and key Structures. The whole view has 5 times vertical exaggeration to highlight topo effects.

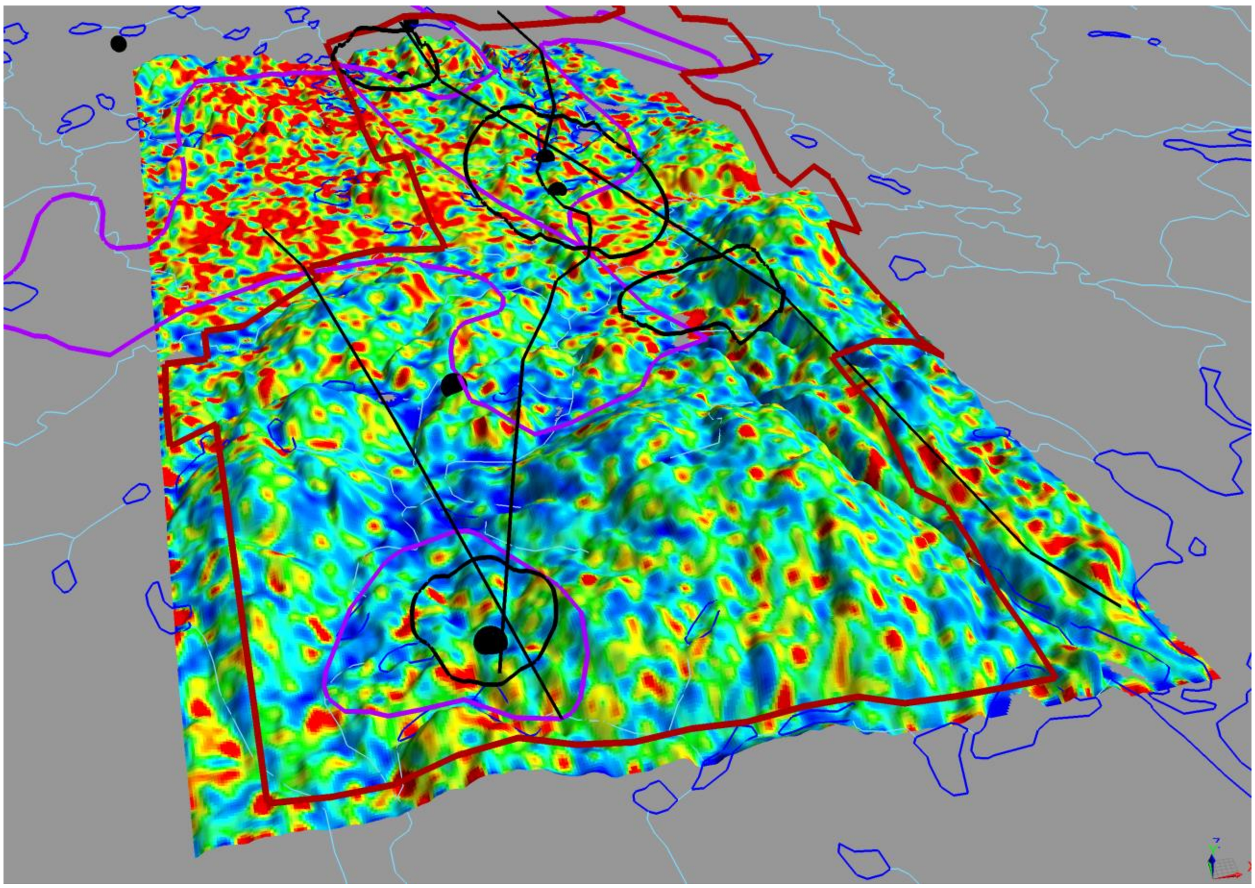

Figure 32 3D model with K/Th draped on topo x 5, MDI 2011 Mineral Occurrences (black balls), key Structures and target areas (black outline)

Including the topo in the 3D model is valuable as the K/Th ratio can be strongly affected by lakes and topo but it also shows that the key structures go through low lying areas in many places. These are expected to be largely overburden covered and this would have conceal subcropping deposits from any previous surface prospecting which was the main tool in historic exploration for the Co vein style deposits. This suggests that there is likely considerable potential for more deposits under cover.

Exploration for buried deposits could be carried out efficiently by doing reconnaissance style IP lines along favourable structural corridors instead of on more traditional grid lines.

.

9 Conclusions

- The ND sills and dykes on this property show up relatively well in the new high-resolution magnetic data. This partly due to the lack of strong magnetic signatures in the surrounding rocks which are mainly Huronian sediments. However, there are some variations in magnetic response in areas mapped as ND. These may be due to variations in the ND due to differentiation during emplacement and cooling.
- The new High-resolution magnetic data provides considerably better information on the location of the Nipissing intrusives and also highlights key North trending and cross cutting structures that may localize mineralization. A total of four target areas were selected based on this data.
- A observation made from the regional data is that the mapped five element Co-Ag veins appear to be associated with regional gravity highs which appear to be due mainly to Archean greenstone belts, both exposed at surface and buried under the Huronian. This suggests that a higher density of Co veins, in particular, in the Huronian is somehow associated with underlying Archean greenstone belts. This makes the regional gravity a valuable regional exploration guide and may also contribute to a better understanding of the genesis of this poorly understood deposit type.
- As seen at other BMR properties in the area. AEM anomalies are likely the best direct indicator of mineralization at the property and regional scale. Correlation of weak AEM anomalies with ground resistivity lows on other BMR properties shows that even the weakest discrete AEM anomalies, where they are not obviously due to conductive overburden or barren conductive material, may be of interest. The White Lake property has not been covered by AEM surveys and modern AEM surveys are recommended.
- Due the often-discontinuous nature of five element vein type mineralization, ground IP/Resistivity surveys may be the best direct local indicator of mineralization.
- K/Th anomalies could assist in highlighting areas where hydrothermal alteration has resulted in increased K. Two areas of anomalous K/Th were noted.

10 Recommendations

- More detailed ground follow up is recommended over the 4 target areas picked from the magnetic structural interpretations
- VLF surveys (ground or airborne) and/or older style higher frequency FDEM (such as the high frequency DIGHEM AEM channels) together with detailed aeromagnetic products may be a good indicator of the local structures that may host mineralization. These data could be used, together with all other data to map significant structures over the whole property
- There are no modern AEM surveys over the property. It is recommended that new AEM surveys be flown over areas of geological interest as AEM is likely the best tool for regional to property scale targeting for larger deposits.

- Reconnaissance IP/Res could be run along structures of interest and anomalies at structural intersections could be drill tested.
- BHIP +/- BHEM is suggested in all drill holes into target areas to expand the radius of exploration away from the drillhole at depth.
- Compile in more detail any historical geophysical work such as magnetics, IP/Res, VLF and small footprint ground EM surveys. These may provide more detail in areas of historical exploration.
- More physical property measurements for five element vein style mineralization and associated alteration would be useful. These could be done on core, or in-situ downhole logs. Some of this may be available in the historical or current literature.
- Follow-up research work on the unconformity and oxidation/reduction mineralization models. The Northern Saskatchewan U deposits are similar in many ways and in some cases contain significant Ni and Co.

References

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11 Statement of Qualifications

I, Alan R. King, B.Sc, M.Sc, P.Geo, declare that:

1) I am a Consulting Geophysicist with residence in Sudbury, Ontario and am presently employed in this capacity with Geoscience North Ltd., Sudbury, Ontario;

2) I obtained a Bachelor of Science Degree (B.Sc.), in Geology from the University of Toronto in 1976, and a Master of Science Degree (M.Sc.), in Geophysics from Macquarie University in 1989;

3) I am a registered geophysicist with a license to practice in the Province of Ontario (APGO member # 1178);

4) I have practiced my profession continuously since 1976 in North and South America, Australasia;

5) I am a member of the Society of Exploration Geophysicists, and the Australian Society of Exploration Geophysicists;

6) I have no interest, nor do I expect to receive any interest in the properties or securities of the company, its subsidiaries or its joint-venture partners;

7) I am the Professional Geologist/(Geophysicist) and a member in good standing of APGO who has coauthored this Report;

8) The statements made in this report represent my professional opinion in consideration of the information available to me at the time of reviewing this report.

Dated this 13 th Day of June, 2020.

Signature

Alan King

Geophysicist

Geoscience North Ltd.

1. 1. When existing data is reprocessed, provide details of the processing software, methods and input parameters

Additional processing was done on magnetic data. This included one or both of the following processing on the various projects:

- Tilt Derivative (TDR) of the Total Magnetic Intensity (TMI)
  Reference - Miller, H. G., and V. Singh, 1994, Potential field tilt —A new concept for location of potential field sources: Journal of Applied Geophysics, 32,

- Analytic Signal (AS) of the Total Magnetic Intensity (TMI)
  Reference - The Analytic Signal Of Two-Dimensional Magnetic Bodies With Polygonal Cross-Section: Its Properties And Use For Automated Anomaly Interpretation, Misac N. Nabighian, Geophysics 1972

The processing was done in the Geosoft Oasis Montaj software. Input to the processing was the TMI grids provided by the contractor and new grids were created from the process data using Geosoft Oasis Montaj using the minimum curvature method with appropriate grid cell sizes.

2. When a computer generated model was created as part of the interpretation, provide details of the modelling software, method and input parameters

3D Modeling was done on the magnetic data using the Geosoft VOXI inversion facility in Oasis Montaj. Input to the processing was the TMI data in the grids or the binary databases provided by the contractor. In all the cases the models were created using unconstrained inversion of the TMI data based on the methods developed at the UBC-GIF facility and adapted by Geosoft in to their VOXI software.
Reference - https://gif.eos.ubc.ca/about

Oasis montaj How-To Guide

VOXI Earth Modelling - Running an Inversion

Manual release date: November-18-13.

Please send comments or questions to info@geosoft.com

Data used in this document:
Ontario Geological Survey 2000. Reid-Mahaffy airborne geophysical test site survey; Ontario Geological Survey, Miscellaneous Release – Data 55. © Queen's Printer for Ontario, 2000. Reproduced with permission.

Geosoft Incorporated
Queen's Quay Terminal
207 Queen's Quay West
Suite 810, PO Box 131
Toronto, Ontario
M5J 1A7
Canada
Tel: (416) 369-0111
Fax: (416) 369-9599

Website: www.geosoft.com
E-mail: info@geosoft.com

Support
For obtaining technical support, email support@geosoft.com

If you wish to speak to a technical support representative in your region, please visit the Geosoft Support page at: www.geosoft.com/about-geosoft/contact-us/world-offices for contact information.

Running an Inversion

Overview

This document describes how to run a simple inversion in VOXI Earth Modelling. It focuses solely on the functionality in the VOXI Earth Modelling interface and assumes that you are familiar with the Oasis montaj environment.

We strongly recommend that you properly prepare your data prior to inversion. Please refer to the Best Practice Guide - Preparing Data for Inversion document, which describes the files required for an inversion and guidelines on how to create them.

In this example, you will:

- Create a new VOXI session from a polygon
- Add data to the model
- Run an inversion
- Export the VOXI model

The data used in this example is airborne magnetic data, sourced from the Ontario Geological Survey (OGS). It was acquired over the Reid-Mahaffy property at a nominal 200 m line spacing and 60 m terrain clearance.

The Reid-Mahaffy property in Ontario, Canada, has been designated by the OGS as a test site and was flown by a number of airborne companies. The airborne Reid-Mahaffy magnetic data was flown in 1999 by Dighem as part of an airborne EM survey, commissioned by the OGS, under the project number MRD-55. The coinciding SRTM elevation grid was downloaded from the Oasis montaj DAP server using Seeker.

⚠ *The outcome of this document should not be interpreted as the actual sub-surface structure.*

The data used in this guide can be downloaded here. Please refer to the *README.txt* file for a description of the files and where to save them to.

The folder includes the following:

- An outline of the area to be modelled.
- A database containing potential field measurements. The data has a projected coordinate system defined.
- A Digital Elevation Model grid covering the area of interest.

You will begin by creating a new project and loading the VOXI menu.

To load the VOXI menu:

1. Start Oasis montaj and create a new project in the **VOXI Run Inversion Data** folder named **VOXI.gpf**.
2. From the **GX** menu, select **Load Menu**.

   The Load Menu window opens.
3. Select **voxi.omn** and click **Open**.

   The VOXI menu is added to your menu bar.

New VOXI from Polygon

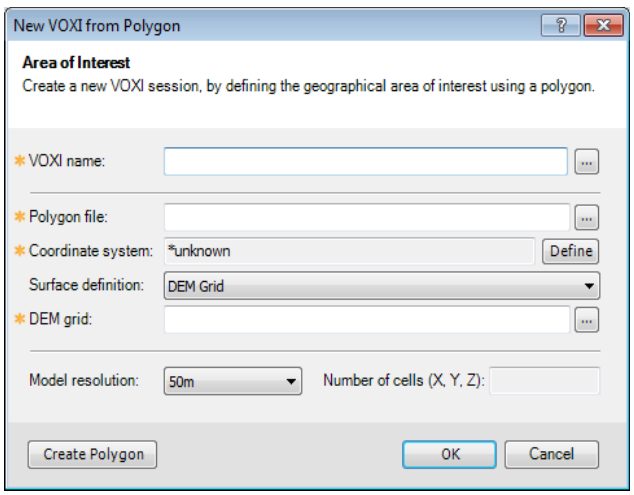
VOXI offers two approaches for defining the area of interest (AOI): you can either use a polygon file that defines the outline of your area, or you can supply a georeferenced voxel model compiled from other sources, the outline of which will be automatically calculated. In this example, you will use a supplied polygon file.

To create a new VOXI session from a polygon:

1. From the **VOXI** menu, select **New VOXI from Polygon**.

   The New VOXI from Polygon dialog box opens.

   Figure 1.1 New VOXI from Polygon dialog box



2. For **VOXI name**, enter **Mahaffy**.
3. For the **Polygon file**, click the **Browse** button ... .
4. From the **VOXI Run Inversion Data** folder, select **Mahaffy.ply** and click **Open**.

   This is the polygon file that defines your area of interest (AOI). By default, the coordinate system information for this VOXI document is based on the defined coordinate system of the selected file. If the selected polygon file does not have a coordinate system defined, then the **Define** button becomes active and can be used to define the coordinate system for the VOXI document.

*You can click the **Create Polygon** button to interactively create a new polygon to define your area of interest from an existing map. If the existing map is not already in your project, you will be prompted to load it.*

If you are working with data located on a geographic (longitude, latitude) coordinate system, use Geosoft tools to create a projected coordinate system map from which to define a polygon.

5. For the **DEM grid**, click the **Browse** button [...].
6. From the **VOXI Run Inversion Data** folder, select **DEM.grd** and click **Open**.

   This is the grid of the Earth's surface elevation (DEM) that covers the area defined by the supplied polygon. You can also choose to define the surface using a constant elevation value.
7. For **Model resolution**, use the default value of **50m**.

   By default, VOXI calculates the model resolution to generate the smallest appropriate model based upon the input data resolution. Generally, this will be less than 100 cells in the x and y directions.

   The Reid-Mahaffy data used in this example was flown at 200 metre nominal line spacing and 60 metre terrain clearance. The default model resolution of 50 metres is appropriate because it is roughly equivalent to the flying altitude and a quarter of the line spacing.

   It is good practice to use the default voxel resolution when running the first inversion for a project area. To begin with, you may even want to define a coarser mesh than the default. As your knowledge of the area increases, you can refine the voxel resolution as required.
8. Click **OK**.

   The VOXI Viewer opens and displays the voxel mesh to be inverted, the area-defining polygon, and the DEM; at this point, the Add Data to VOXI message window opens asking if you would like to run the Add Data wizard.

Figure 1.2 VOXI Viewer

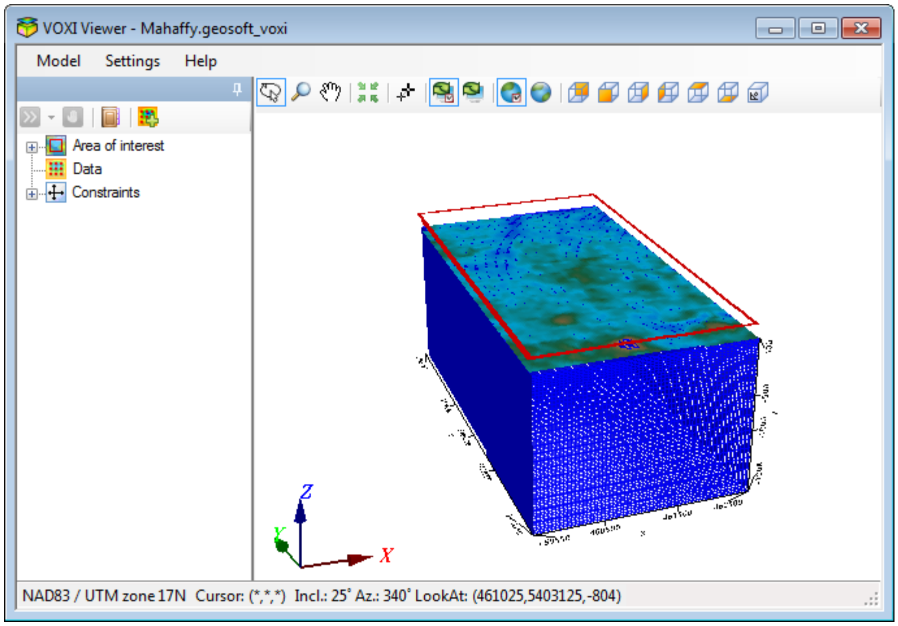
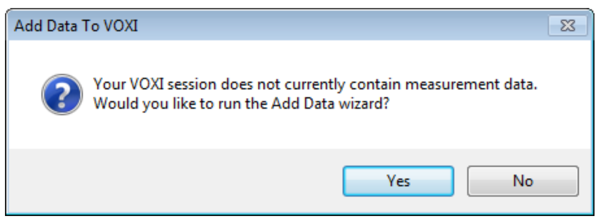


Figure 1.3 Add Data To VOXI window



9. For this example, click **No**.

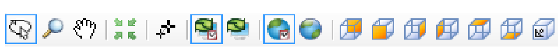
   You will add data after you visually inspect your model.

   *If you are satisfied with the model you have defined, you can click **Yes** to directly run the Add Data wizard.*

The 3D view of the constructed model provides the opportunity to visually inspect the model. If it is not properly defined, for example if the mesh is too coarse or too fine, if the terrain does not register correctly or if the AOI polygon is not the correct one, you can modify the model prior to adding data and proceeding with inversion.

The standard Oasis montaj 3D visualisation tools are available in the VOXI Viewer.

Figure 1.4 3D visualisation tools



You may notice an "interference" between the mesh and the terrain colour image. This is an expected effect that will occur if your DEM is of a higher resolution than the voxel mesh. In such a case, the program will average the elevation measurements over the horizontal extent of each voxel element.

*To modify the Area of interest settings, right-click the Area of interest item in the tree list and select **Modify**.*

Adding Data

Now that you have created the voxel mesh defining your area of interest, you will add data by selecting a measurements database containing the data to be modelled.

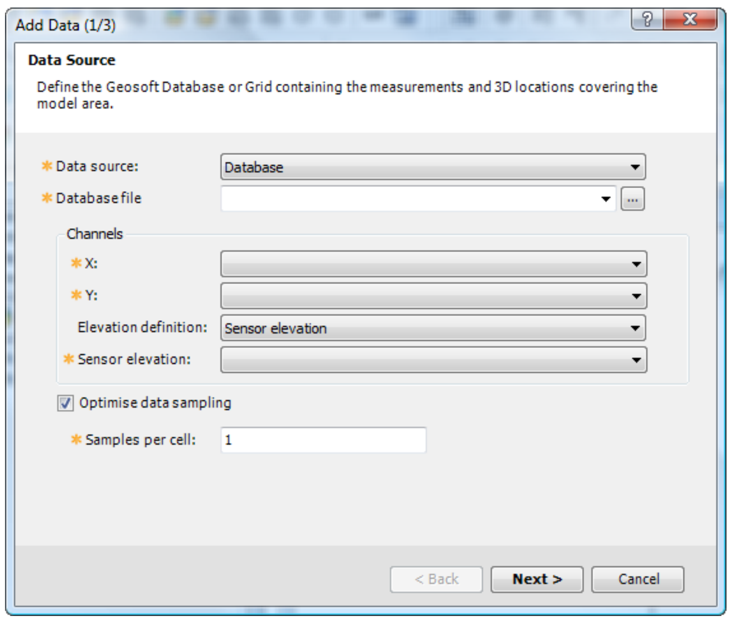
Note that you can also use gridded data (Geosoft Grid format) as an input for inversion.

To add data:

1. In the VOXI Viewer tree list, right-click **Data** and click **Add Data** or click the **Add Data** button on the VOXI toolbar.

   The Add Data (1/3) dialog box opens.

   Figure 1.5 Add Data (1/3) dialog box



2. From the **Data Source** list, select **Database**. For the **Database file**, click the **Browse** button.
3. From the **VOXI Run Inversion Data** folder, select **ReidMahaffy_DIG.gdb** and click **Open**.

   Because the coordinate channels in this database are already defined, the X and Y channels are automatically set. If you have an alternate pair of X and Y channels, you can select them as long as they have a defined projected coordinate system.
4. From the **Elevation definition** list, select **Sensor elevation**. From the **Sensor elevation** list, select **gps_z_final**.

   The sensor elevation should be in the same units as the coordinate system of the DEM.
5. Ensure the **Optimise data sampling** option is selected.

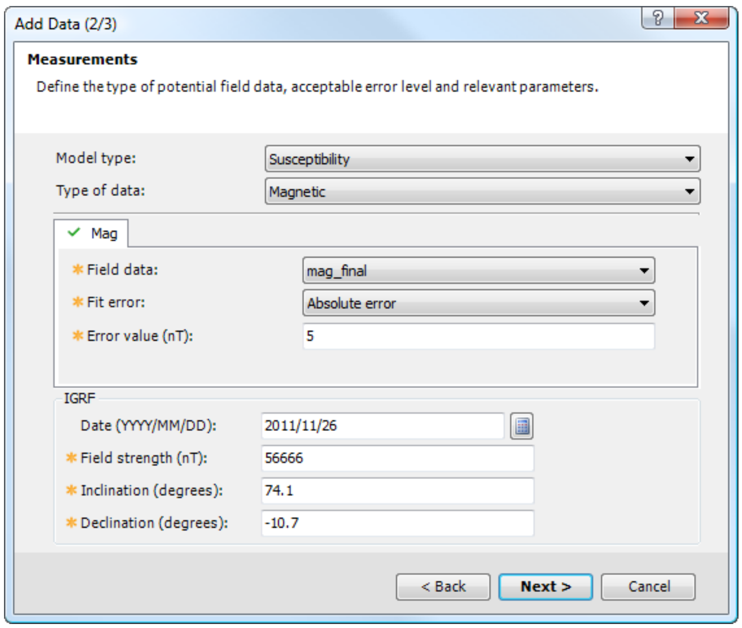
With this option, you can decimate the data if it is too highly sampled relative to the size of the voxel model element. By default, a decimation factor is chosen that will provide roughly one sample per surface voxel element.

It is highly recommended that you decimate the observed data to one sample per cell. All observed measurements that fall within the same element are appropriately averaged. Not decimating the data increases the computation time without any corresponding gain in the resolution of the output model.

6. Click **Next**.

   The Add Data (2/3) dialog box opens. Here you will select the type of model you want. You have the choice of Susceptibility, Density or Vector magnetization model. When you select the **Model type**, the **Type of data** field will update according to your choice.

   Figure 1.6 Add Data (2/3) dialog box



7. From the **Model type** list, select **Susceptibility**.

   The Type of data automatically changes to **Magnetic** and additional options are now available in the dialog box.

8. From the **Field data** list, select **mag_final**.

9. For the Absolute **Error value (nT)**, enter **5**.

   By default, an Absolute error value is calculated to 5% of the standard deviation of the data, which in this example is a calculated Error value of approximately 6 nT. A VOXI Inversion will attempt to fit your data until the difference between the model prediction (the fit) and the measured data is on average less than the Fit error. In general, this default error calculation allows for a reasonable fit; however, you may opt to modify it to better suit your dataset. If you wish, you can specify an alternative means by which to calculate the fit error. The other options are: Relative Error, Fraction of Standard Deviation or Data Error Channel

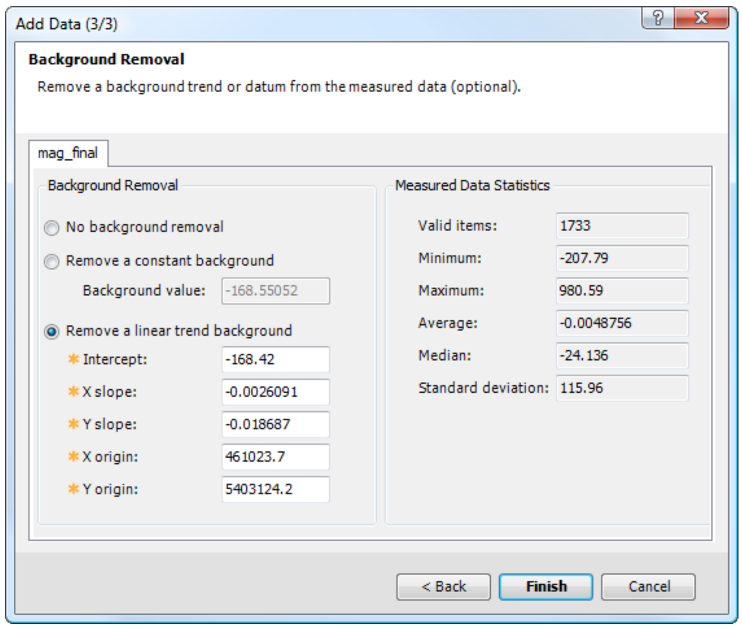
Click the Help button to learn more about alternate approaches to setting the error level.

In the case of a susceptibility model, you can specify or modify the IGRF parameters. If the survey date is stored as a property of the lines in the database, then the IGRF parameters are calculated automatically. Otherwise, you have to supply the survey date in order for the IGRF parameters to be calculated.

10. Click **Next**.

    The Add Data (3/3) dialog box opens.

Figure 1.7 Add Data (3/3) dialog box



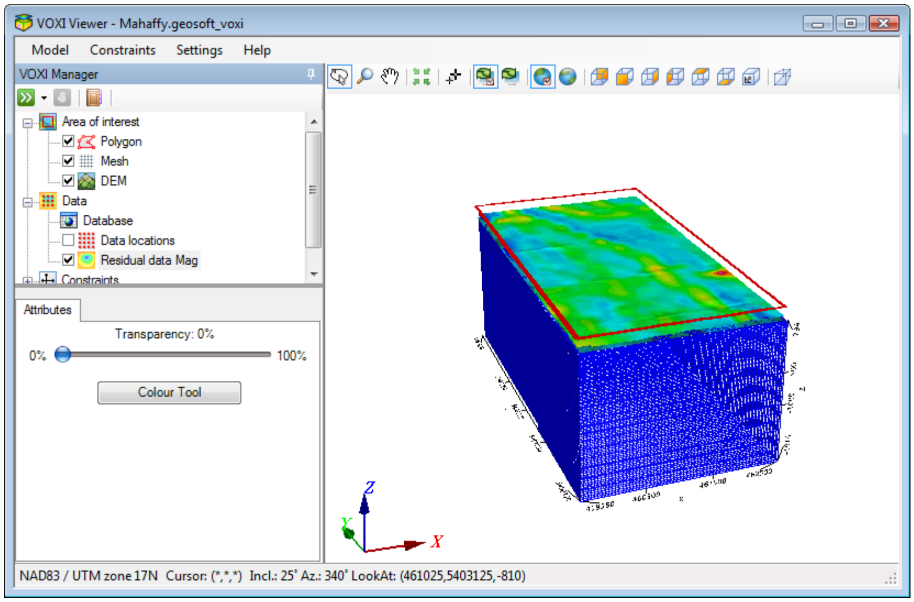
This dialog gives you options by which to remove the regional component of the potential field data, so that the inversion can focus on localised anomalies. The default option, **Remove a linear trend background**, will remove the linear trend plane from the observed data in an attempt to eliminate the long wavelength (regional) component of the field. The best-fit linear trend parameters of the observed data are automatically calculated.

The Measured Data Statistics are dynamically updated to reflect the statistics of the observed data after the removal of the suggested linear trend background. You would expect that the Average of the data would be around zero. If you have removed the background in the data preparation stage and are confident in the method applied, you are encouraged not to remove it again here.

11. For this example, select **Remove a linear trend background** and click **Finish**.

The selected data is added to the VOXI document and displayed in the VOXI Viewer. This data is placed at the observation elevation. Note that the Run Inversion button on the VOXI toolbar is now active.

Figure 1.8 VOXI Viewer with data added to model



The Database, Data locations and Residual data items are now listed under Data in the VOXI Manager. You can turn the Residual data item on and off to display the input field data. All data displays are coloured based on a linear colour scheme.

Running the Inversion

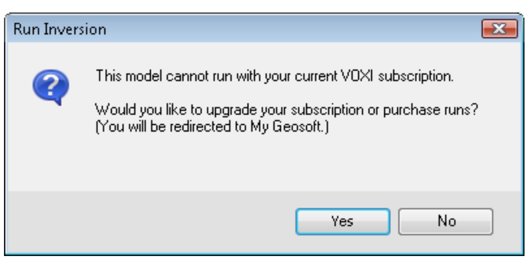
At this point, you have defined your area of interest, created a voxel mesh, and have added the data to be modelled. You will now run the inversion.

To run the inversion:

1. From the **Model** menu, select **Run Inversion** or click the **Run Inversion** button on the VOXI toolbar.

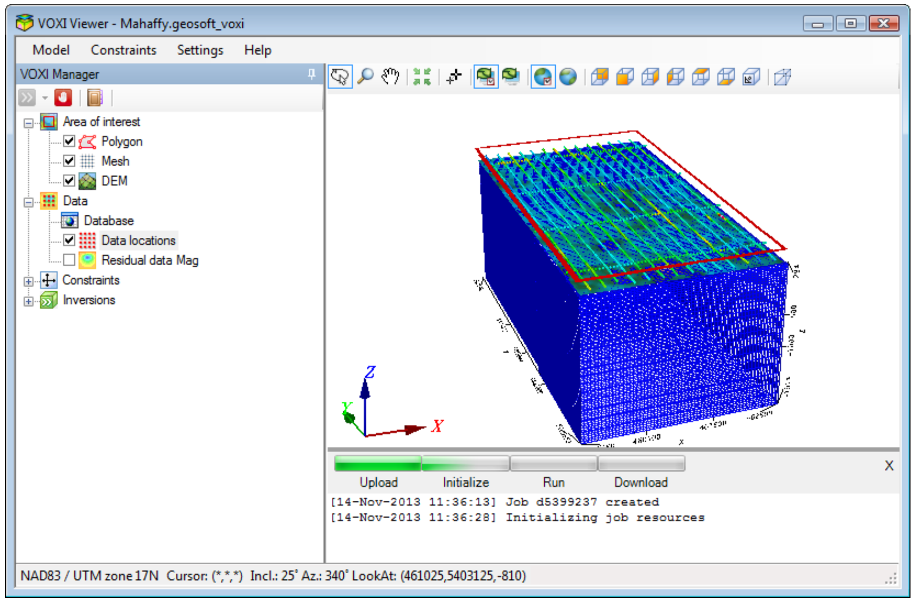
   If your subscription does not support running a forward model or your number of runs have expired, a warning dialog prompts you to upgrade or purchase new runs from My Geosoft.

Figure 1.9 VOXI Subscription warning



After you start the inversion process, the Inversion item is added to the VOXI Manager and the progress of the inversion is reported in the Progress log pane in the lower-right of the VOXI Viewer.

Figure 1.10 VOXI Viewer with inversion in progress



After the data has been uploaded, you can safely close the window without stopping the inversion. You can revisit the session at a later time, check the progress and ultimately the results of the inversion.

If you decide to edit your input data further while the inversion is running, you can stop the process by clicking the Stop Process button . The inversion will terminate immediately.

2. In the VOXI Manager, expand **Inversions** to see the item representing the model you are inverting.

   The name of the item is composed of the type of model, and suffixed by the current date and time stamp. All subsequent trials will appear under Inversions with their unique date and time stamp.

   The Input data item contains a copy of the input data used for this inversion process. In subsequent trials you may modify some of the model parameters; the snapshot of the input parameters together with the output modelled voxel allows you to review your settings for each inversion.

   Using the VOXI Journal on the VOXI toolbar, you can enter comments to describe the specifics of individual inversion sessions and notes on the differences between different inversion results.

   At the successful completion of the inversion, a check box is added in front of the session name and the inversion results are displayed. This check box can be used to turn the display of the resulting voxel model off and on in the VOXI Viewer. The Process log is also saved in the tree list and can be viewed and saved at any time.

For more descriptive clarity in the 3D Viewer pane, you may want to turn off some elements. You can try the following:

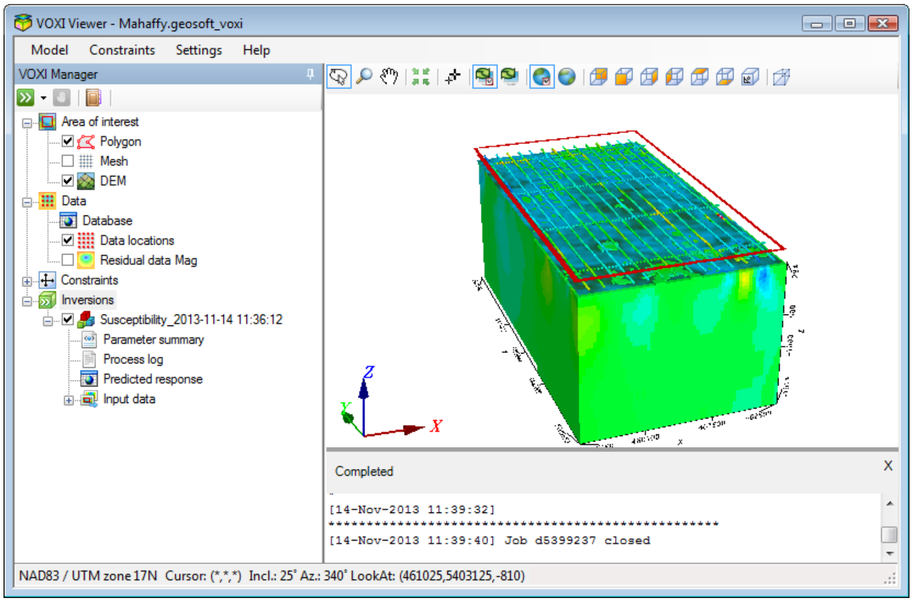
- You may wish to turn off the display of the model mesh.

  In the VOXI Manager, expand **Area of interest** and clear the check box beside **Mesh**.

- You may also wish to turn off the display of the data locations.

  Within the **Data** item list in the VOXI Manager, clear the check box beside **Data locations**.

Figure 1.11 VOXI Viewer with completed inversion model



As in the Oasis montaj 3D Viewer, you can select an item in the tree list and adjust its Attributes, Clipping and Colours. For example, you can clip the extents of the output voxel model by selecting it and adjusting the Clipping parameters.

Exporting a VOXI Model

Once you have created your VOXI model, you can export it as a Geosoft Voxel file to share with others or to integrate with other data in the 3D Viewer. Alternatively, you can also display the results in a 3D map.

To export a VOXI model:

1. Under Inversions in the VOXI Viewer tree list, right-click the **Susceptibility** modelling session item and select **Export**.

   The Save As window opens.

2. Use the default File name or enter a new name and click **Save**.

   The VOXI model is saved as a Geosoft Voxel file (*.geosoft_voxel) and can be further analysed using the 3D tools in Oasis montaj.

To see a comparison of inversion results with and without constraints, please refer to the Best Practice Guide - Comparing Upper Bound Constrained and Unconstrained Inversion Results document.

To display results in a 3D map

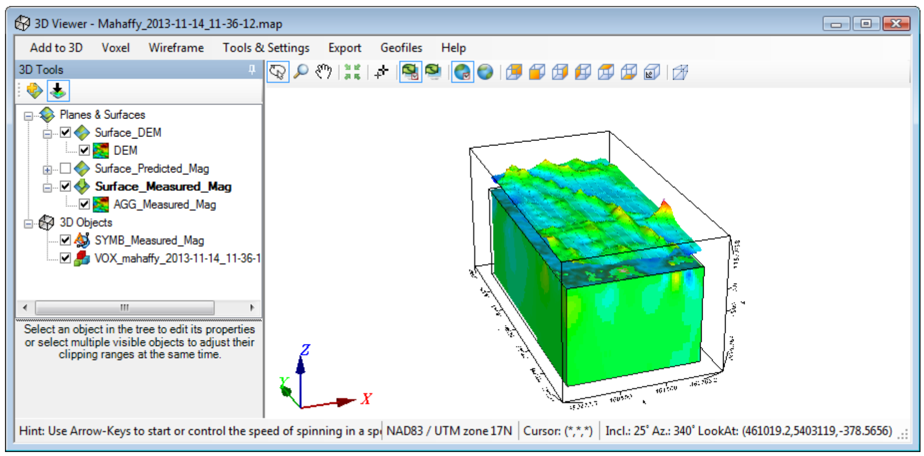
1. Under Inversions in the VOXI Viewer tree list, right-click the **Susceptibility** modelling session item and select **Display Results in 3D Map**.

   The Display Results in 3D Map window opens.

2. A unique default file name will be generated, however you can specify a more descriptive name. Click **OK**.

   The VOXI model is saved as a Geosoft Map file (*.map). The observed and modelled data are gridded displayed along with the DEM grid.

Figure 1.12 VOXI model displayed in 3D Viewer



Exporting the Predicted Response (Forward Calculation) Database

At the completion of the inversion calculation, the input as well as the predicted data are saved in the predicted database, under the current inversion model. You can export this content to a Geosoft Database file (*.gdb).

To export the predicted response (forward calculation) database:

1. Under Inversions in the VOXI Viewer tree list, expand the **Susceptibility** modelling session item.

2. Right-click **Predicted response** and select **Export**.

   The Save As window opens.

3. A unique default file name will be generated, however you can specify a more descriptive name. Click **Save**.

   The predicted response (forward calculation) database opens and is saved as a Geosoft Database file (*.gdb). This data can be further analysed in Oasis montaj or used to grid the predicted response. The predicted channel is named

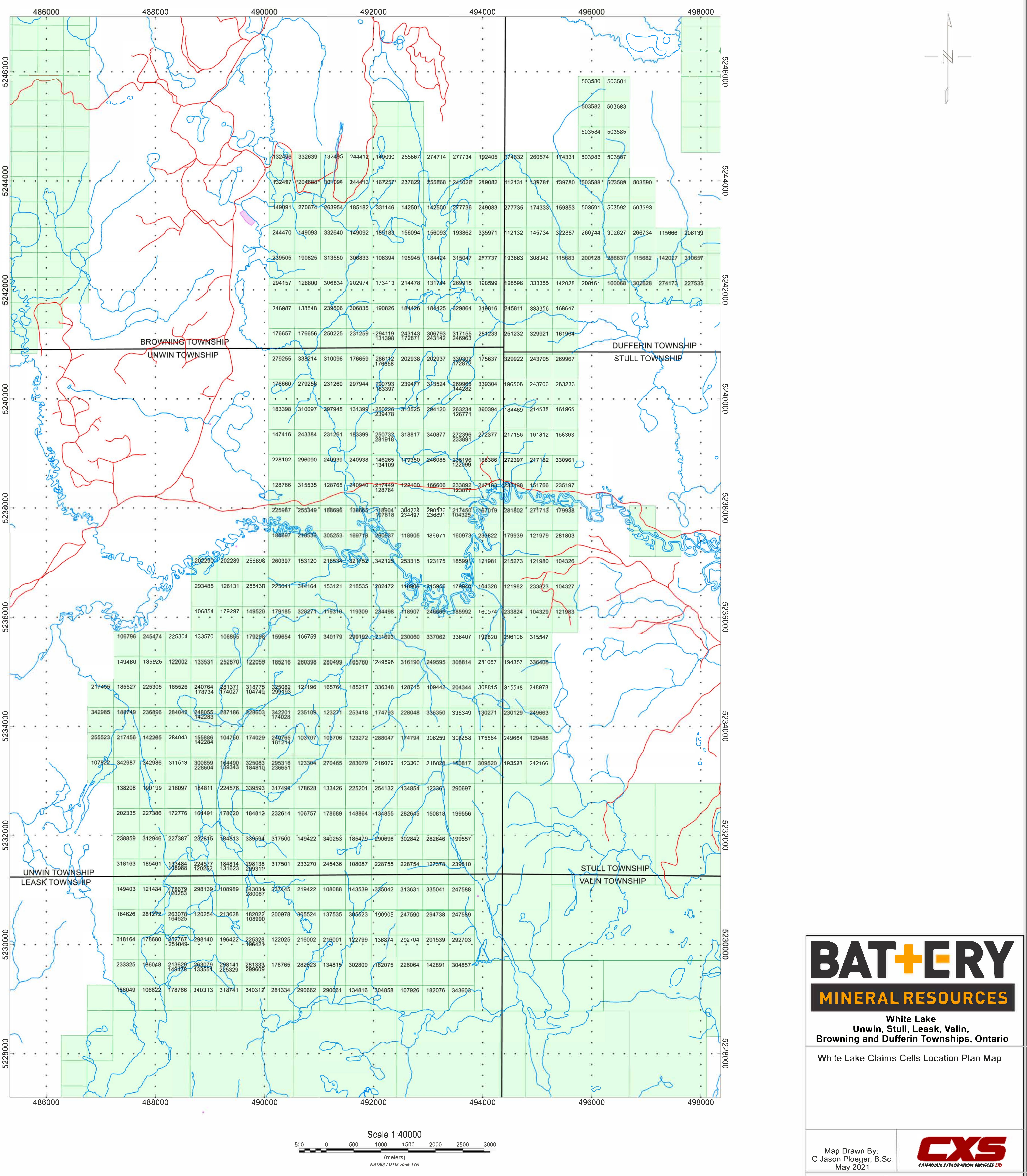
PREDICTED_###, where ### indicates the number of iterations conducted to obtain the inversion result.

Figure 1.13 Predicted response (forward calculation) database

Mahaffy_2013-11-14_11-36-12_Measurement.gdb

L10021:0	X_NAD83 x	Y_NAD83 y	z_f z	_fi	nal_VOXI_Re	nal_VOXI_Back	INTERNAL_	DE	PREDICTED_00
3120.9	459714.1	5400386.3	344.2	**	287.08300	-113.84016	5.00000	**	284.08840
3121.0	459713.1	5400424.2	343.3	**	277.00717	-114.54503	5.00000	**	277.00448
3121.1	459712.4	5400475.7	342.9	**	264.09103	-115.50569	5.00000	**	265.21917
3121.2	459712.2	5400527.1	344.0	**	248.64160	-116.46551	5.00000	**	251.11566
3121.3	459712.9	5400576.2	344.6	**	227.31150	-117.38539	5.00000	**	216.43371
3121.4	459714.1	5400625.2	344.4	**	149.49502	-118.30451	5.00000	**	148.18024
3121.5	459715.0	5400675.9	344.1	**	64.32807	-119.25441	5.00000	**	74.79462
3121.6	459714.7	5400725.8	343.9	**	40.23891	-120.18605	5.00000	**	40.17436
3121.7	459714.1	5400776.1	344.9	**	37.63511	-121.12339	5.00000	**	36.68718
3121.8	459714.2	5400825.6	346.6	**	39.99459	-122.05018	5.00000	**	40.51404
3121.9	459715.1	5400874.8	347.2	**	42.18577	-122.97033	5.00000	**	42.51964
3122.0	459720.9	5400927.8	348.1	**	47.77689	-123.97698	5.00000	**	46.16876
3122.1	459716.0	5400975.5	347.8	**	50.96593	-124.85516	5.00000	**	50.28934
3122.2	459716.0	5401026.4	347.0	**	54.71452	-125.80587	5.00000	**	54.85645
3122.3	459715.9	5401075.4	346.3	**	59.03443	-126.72193	5.00000	**	61.04504
3122.4	459715.6	5401124.9	345.5	**	68.03877	-127.64694	5.00000	**	69.25755
3122.5	459715.4	5401174.5	343.9	**	80.55247	-128.57230	5.00000	**	80.27425
3122.6	459715.4	5401224.1	341.6	**	94.11695	-129.49856	5.00000	**	93.90630
3122.7	459715.7	5401273.4	340.0	**	110.14671	-130.42075	5.00000	**	109.94840
3122.8	459716.4	5401323.8	338.3	**	128.77363	-131.36558	5.00000	**	127.82916

Line L10021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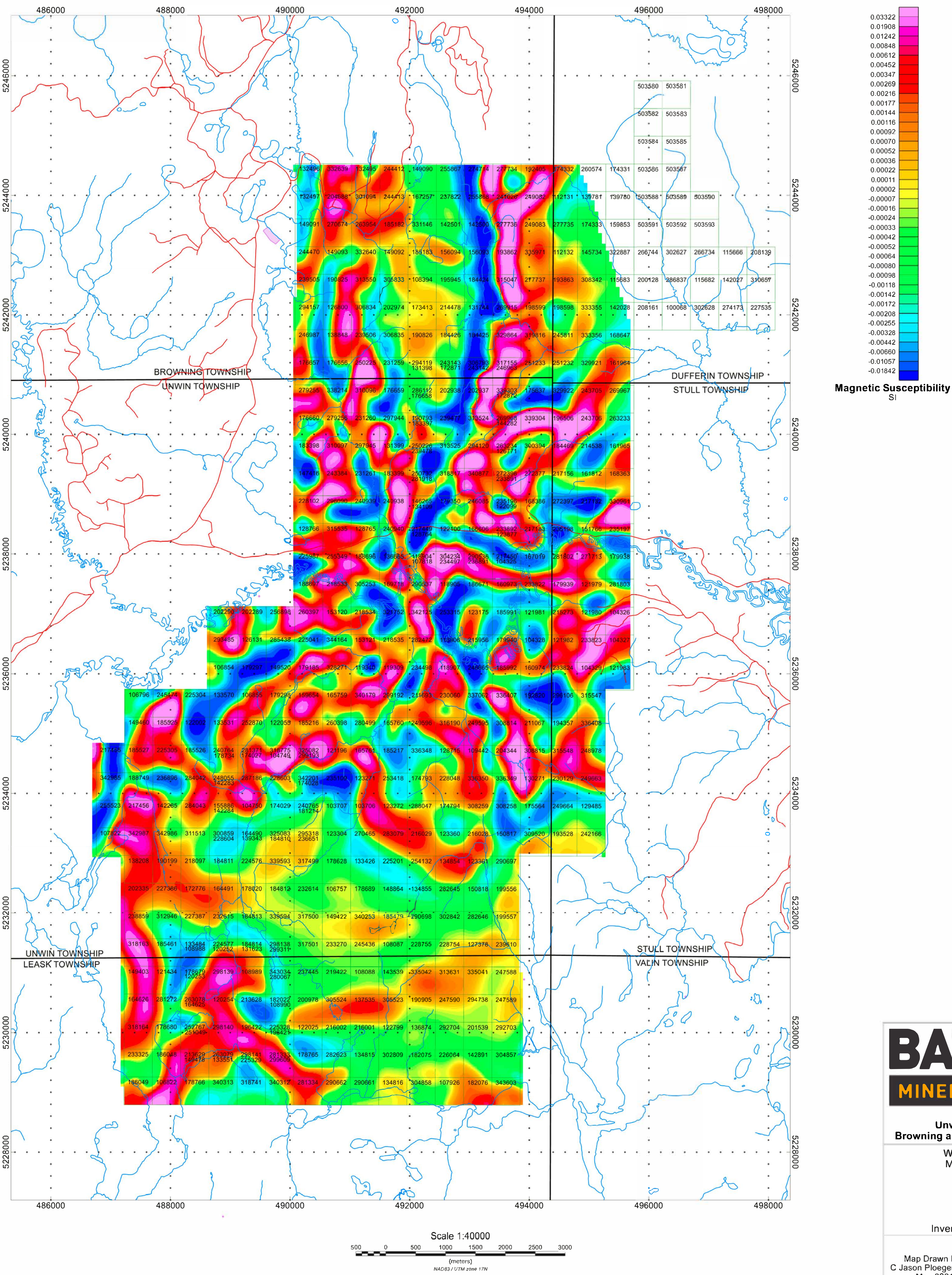
5230000
5228000
BROWNING TOWNSHIP
UNWIN TOWNSHIP
DUFFERIN TOWNSHIP
STULL TOWNSHIP
UNWIN TOWNSHIP
LEASK TOWNSHIP
STULL TOWNSHIP
VALIN TOWNSHIP
Scale 1:40000
500 0 500 1000 1500 2000 2500 3000
(meters)
NAD83 / UTM zone 17N
BATTERY
MINERAL RESOURCES
White Lake
Unwin, Stull, Leask, Valin,
Browning and Dufferin Townships, Ontario
White Lake Claims Cells Location Plan Map
Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021
CXS
CANADIAN EXPLORATION SERVICES LTD
Drawing: BMR-WhiteLake-Cells



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

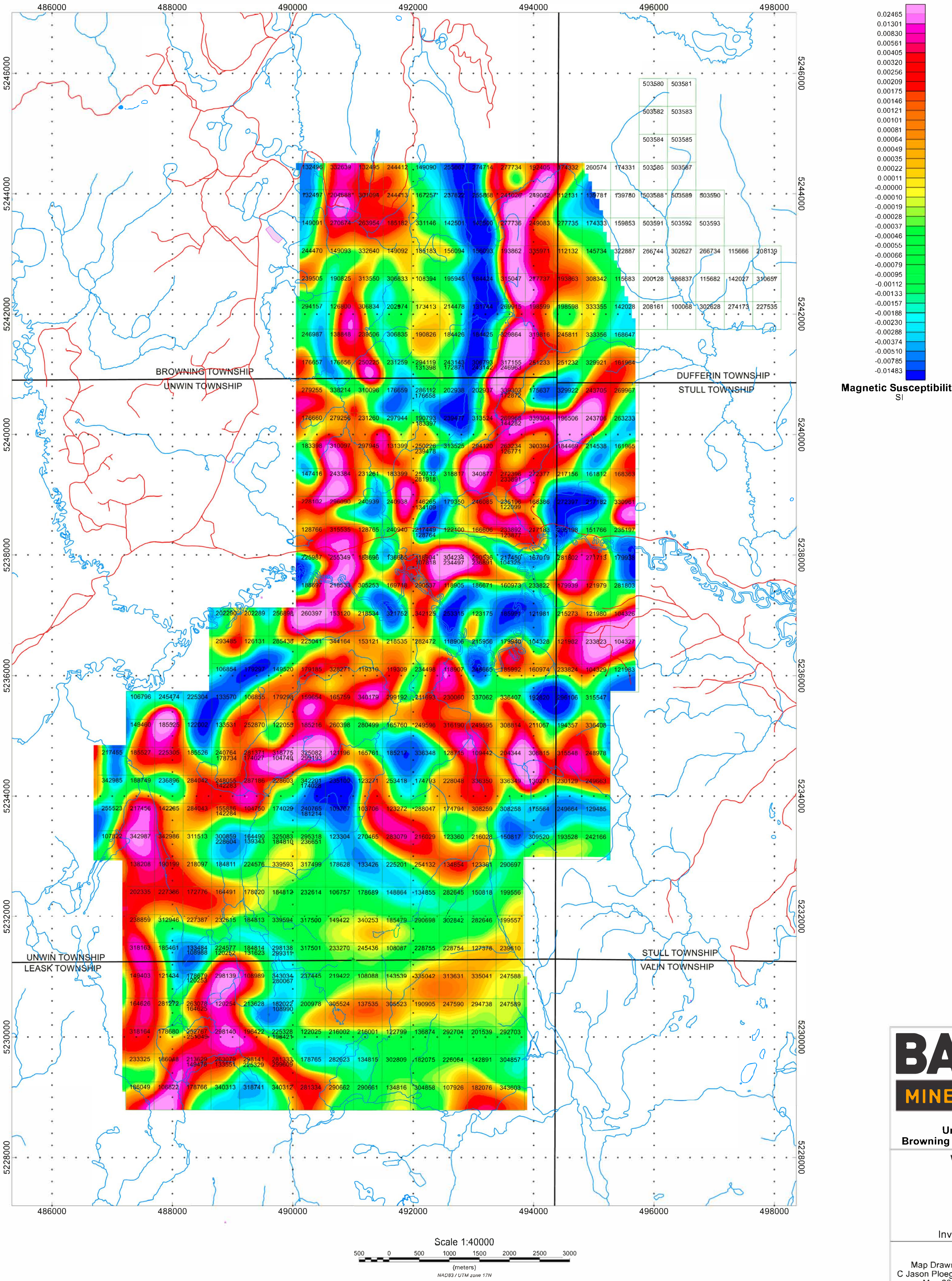
White Lake Claims Cells
Magnetic Susceptibility
100 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-100MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

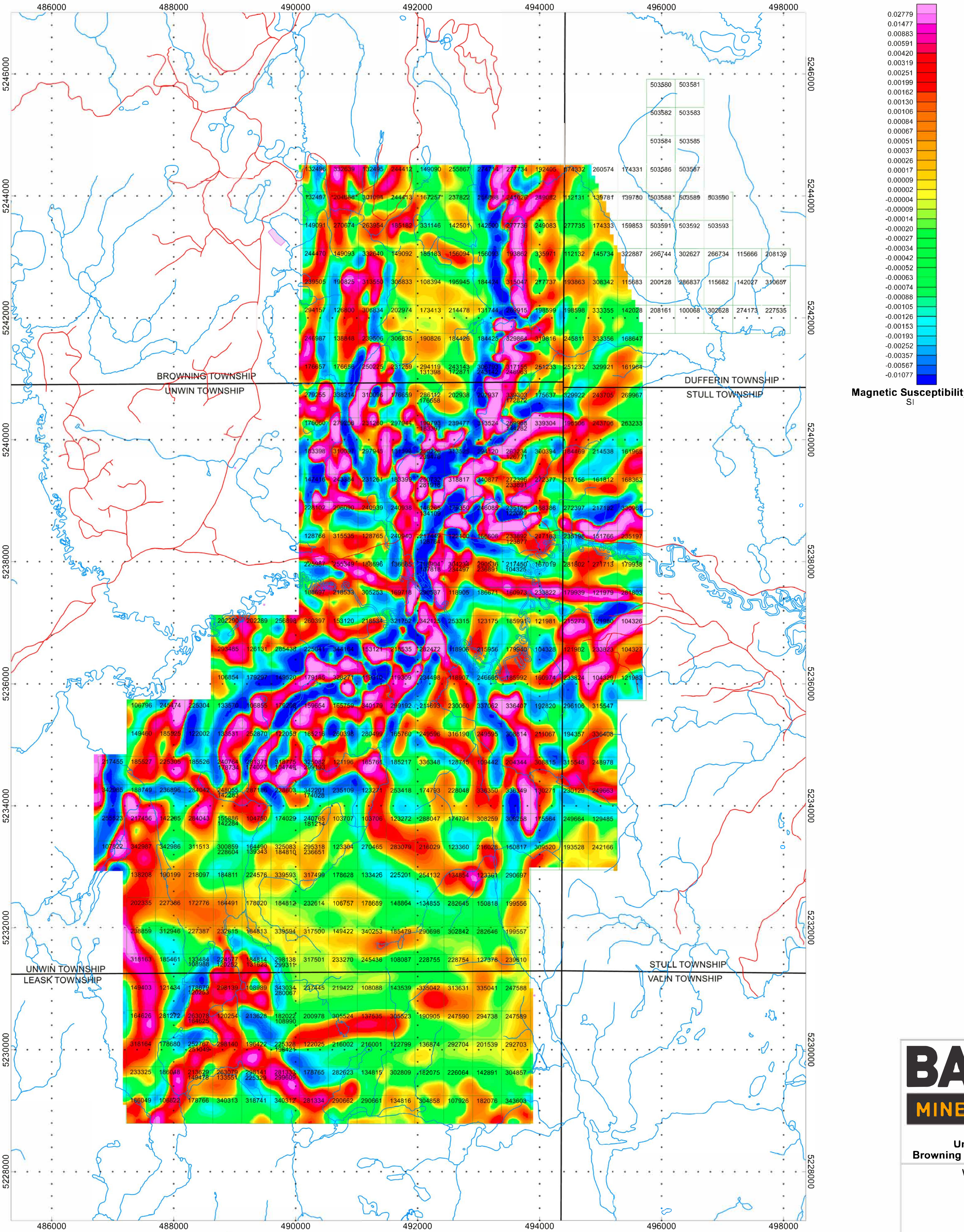
White Lake Claims Cells
Magnetic Susceptibility
-100 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-100MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin,
Browning and Dufferin Townships, Ontario

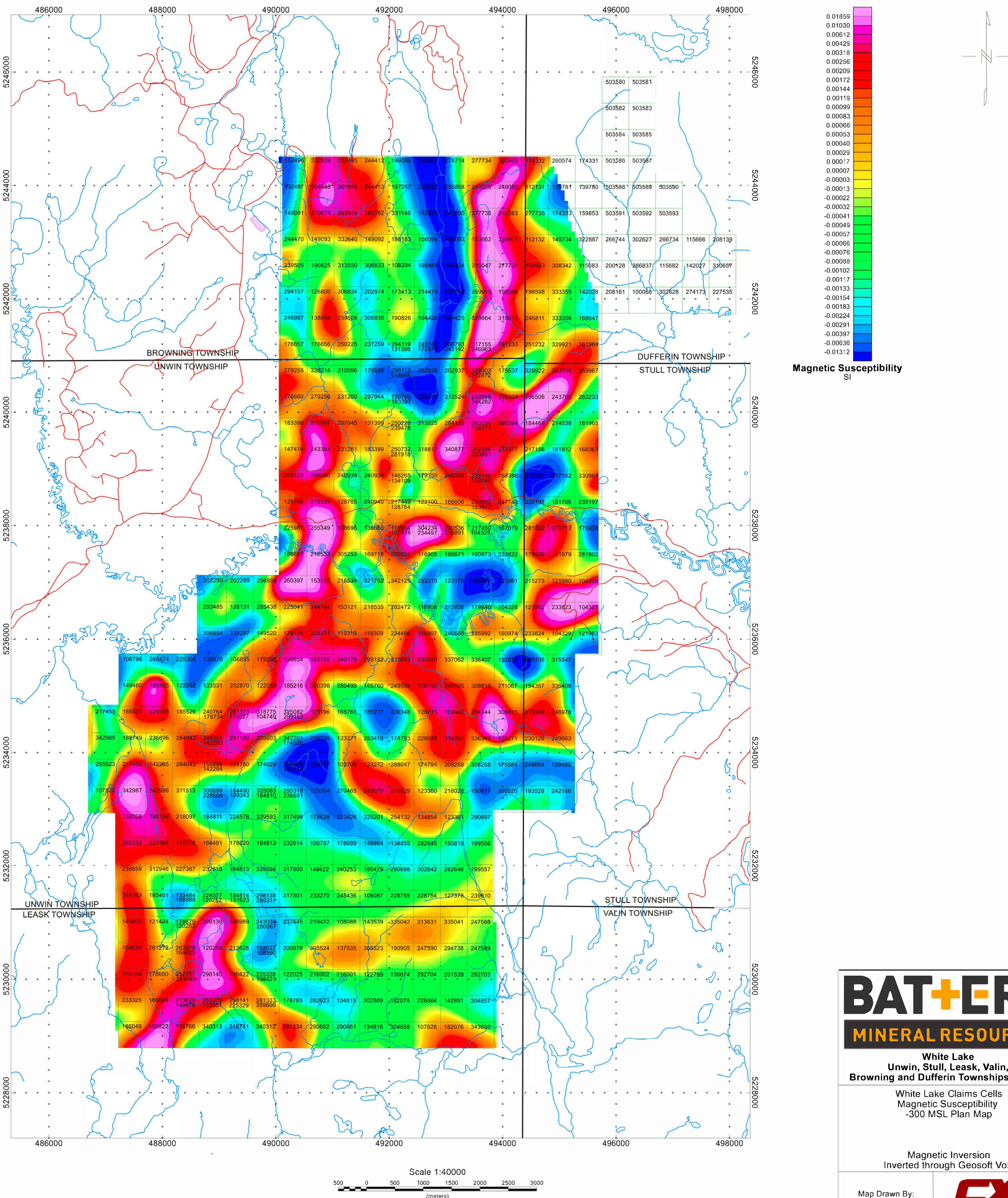
White Lake Claims Cells
Magnetic Susceptibility
300 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-300MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

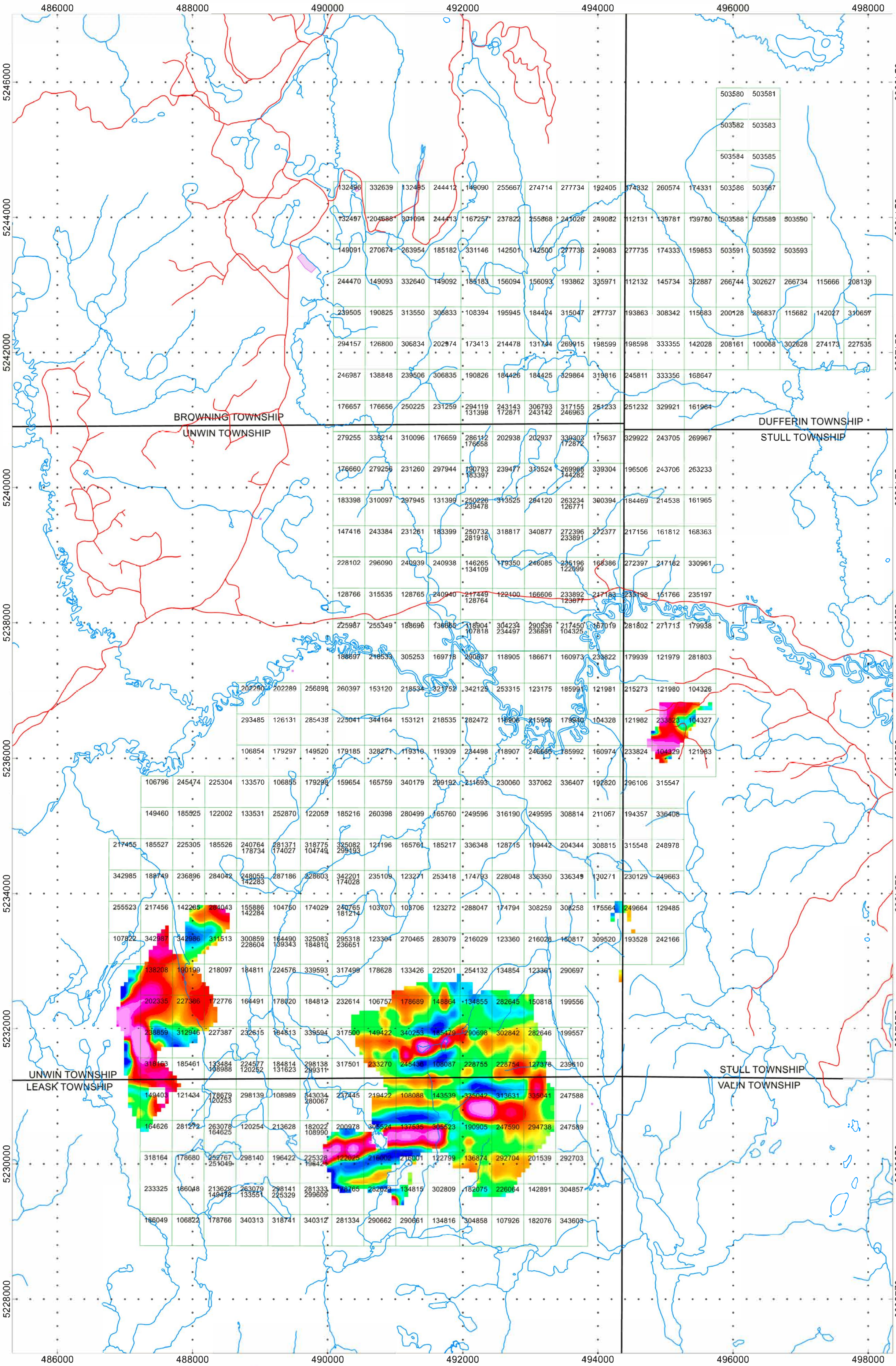
White Lake Claims Cells
Magnetic Susceptibility
-300 MSL Plan Map

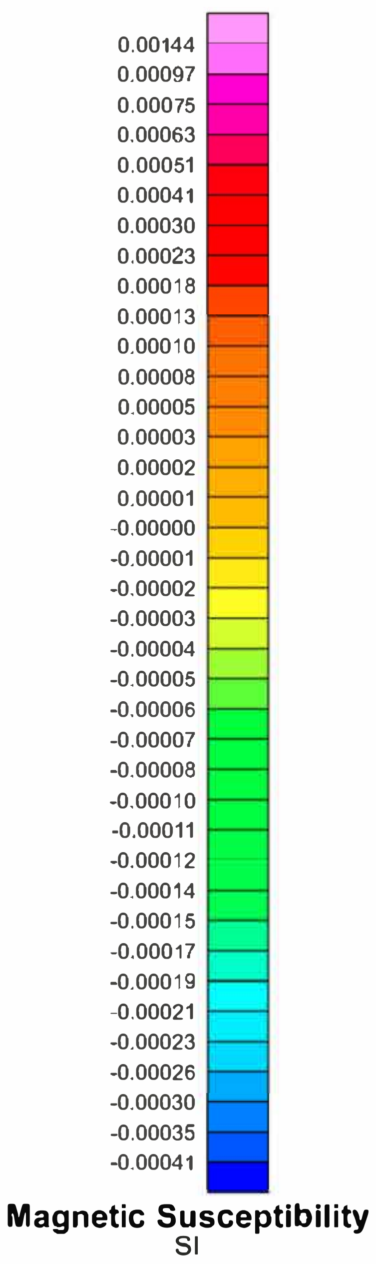
Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-300MSL





Scale 1:40000

500 0 500 1000 1500 2000 2500 3000

(meters)

NAD83 / UTM zone 17N

BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

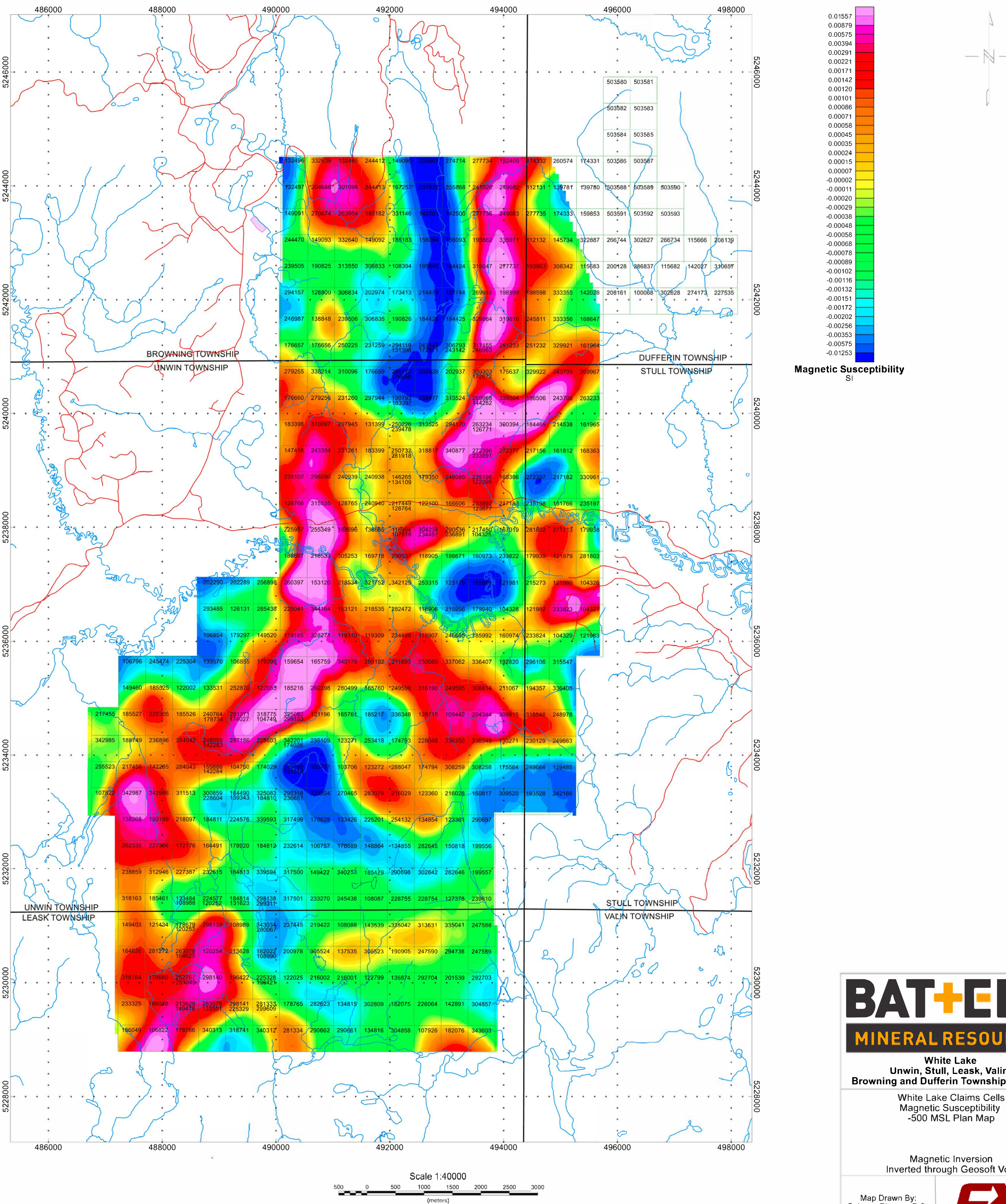
White Lake Claims Cells
Magnetic Susceptibility
500 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS
CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-500MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

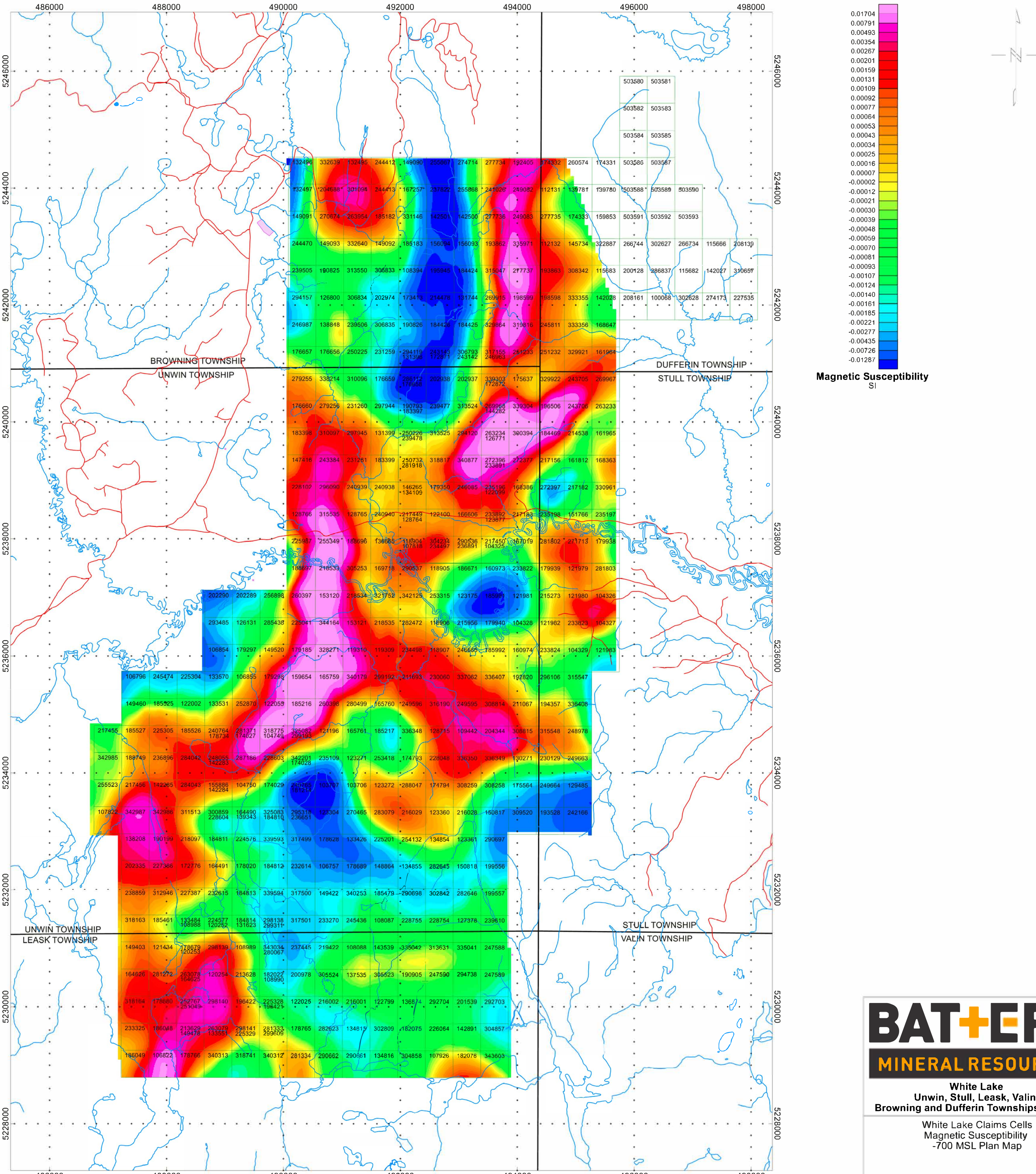
White Lake Claims Cells
Magnetic Susceptibility
-500 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv--500MSL



Scale 1:40000

500 0 500 1000 1500 2000 2500 3000

(meters)

NAD83 / UTM zone 17N

BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

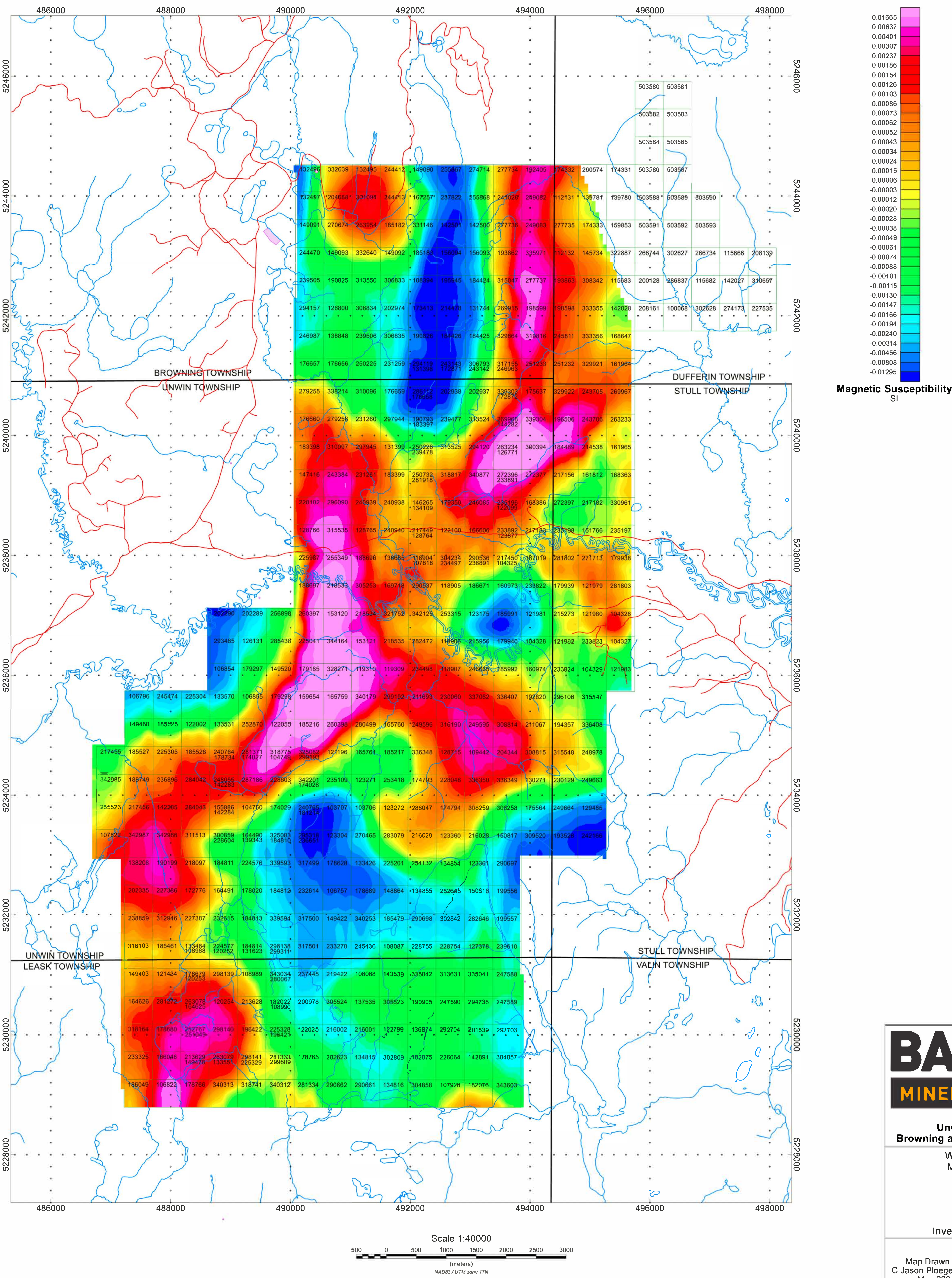
White Lake Claims Cells
Magnetic Susceptibility
-700 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv-700MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

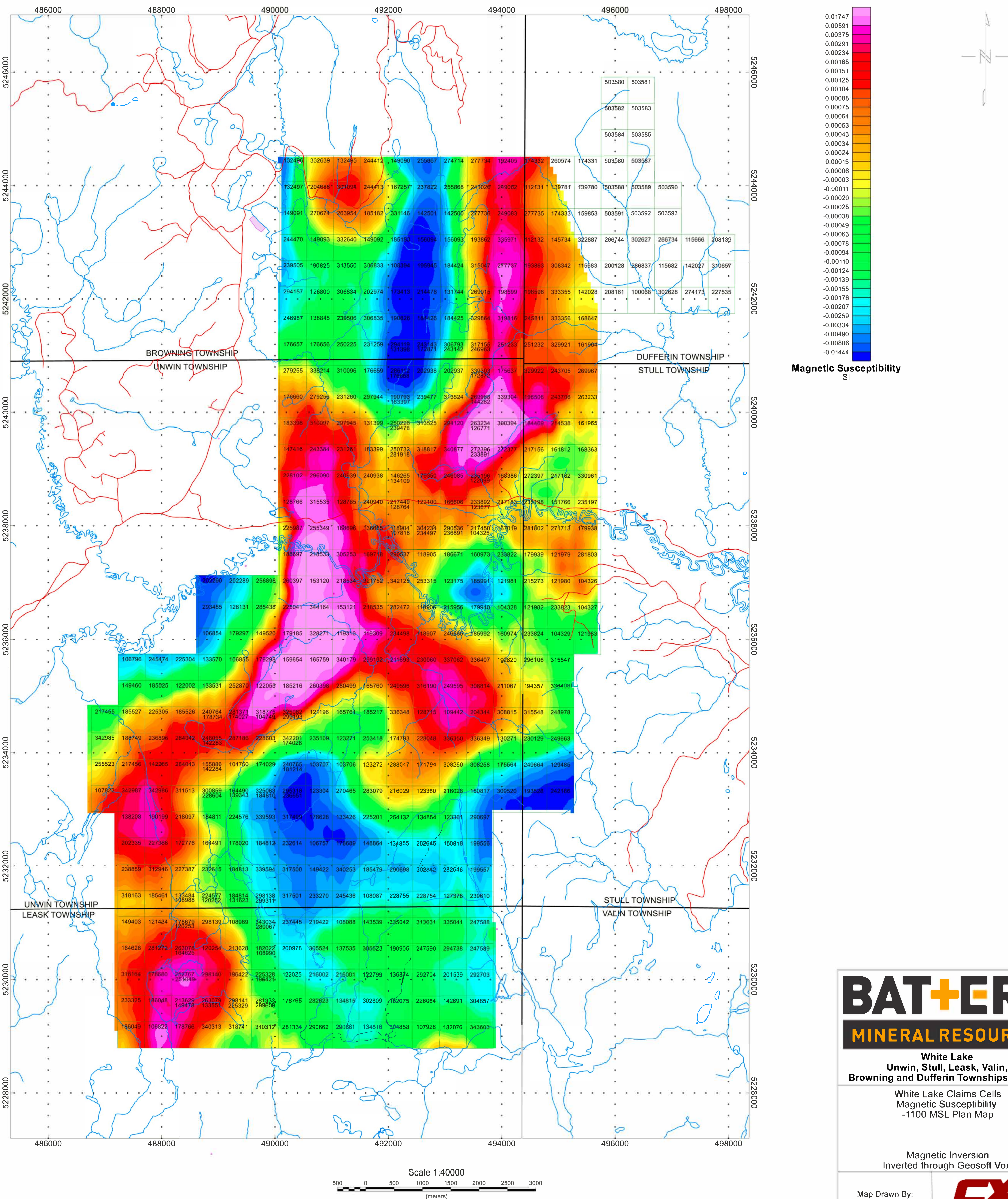
White Lake Claims Cells
Magnetic Susceptibility
-900 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv--900MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin, Browning and Dufferin Townships, Ontario

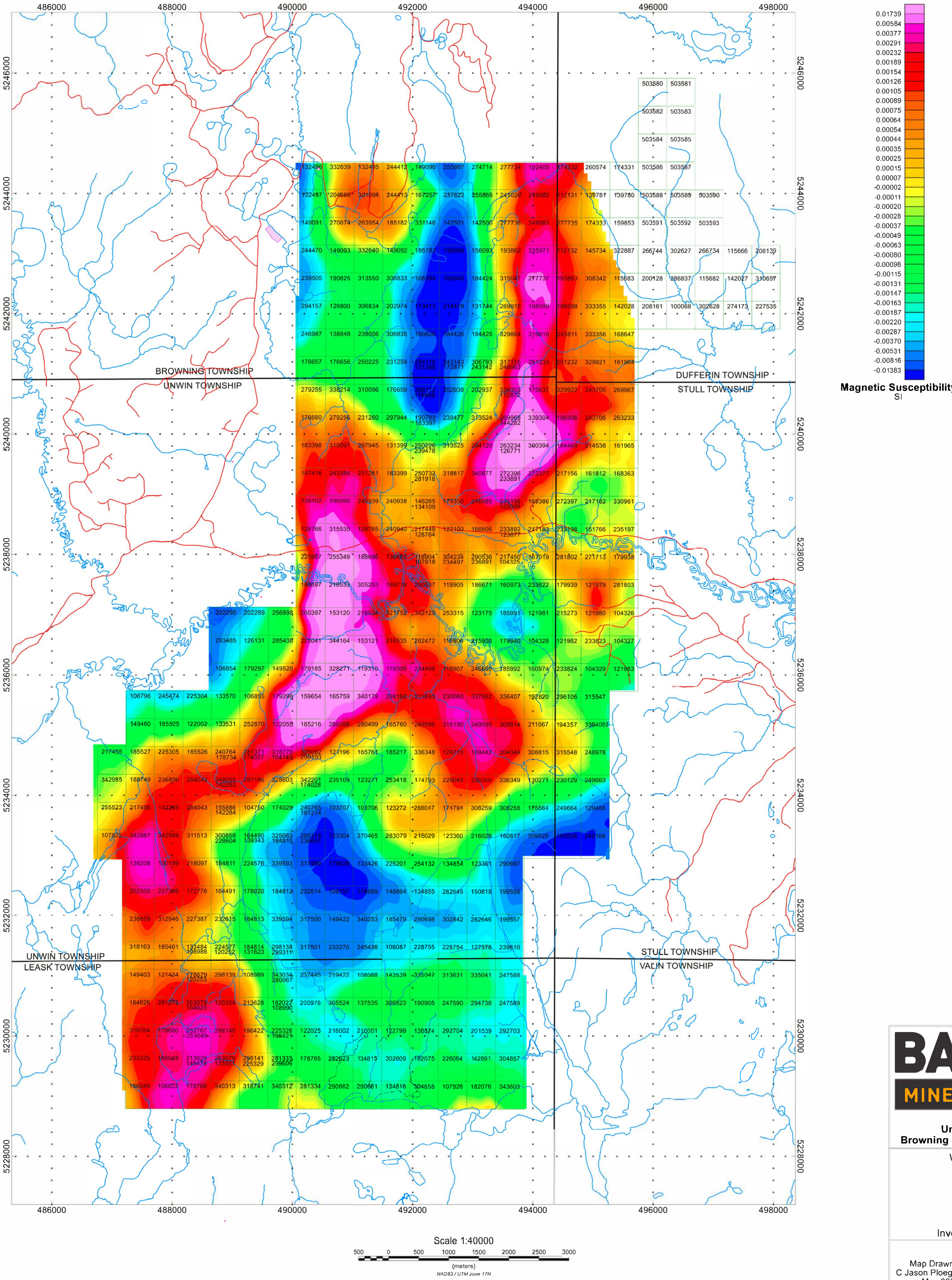
White Lake Claims Cells
Magnetic Susceptibility
-1100 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS
CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv--1100MSL



BATTERY MINERAL RESOURCES

White Lake
Unwin, Stull, Leask, Valin,
Browning and Dufferin Townships, Ontario

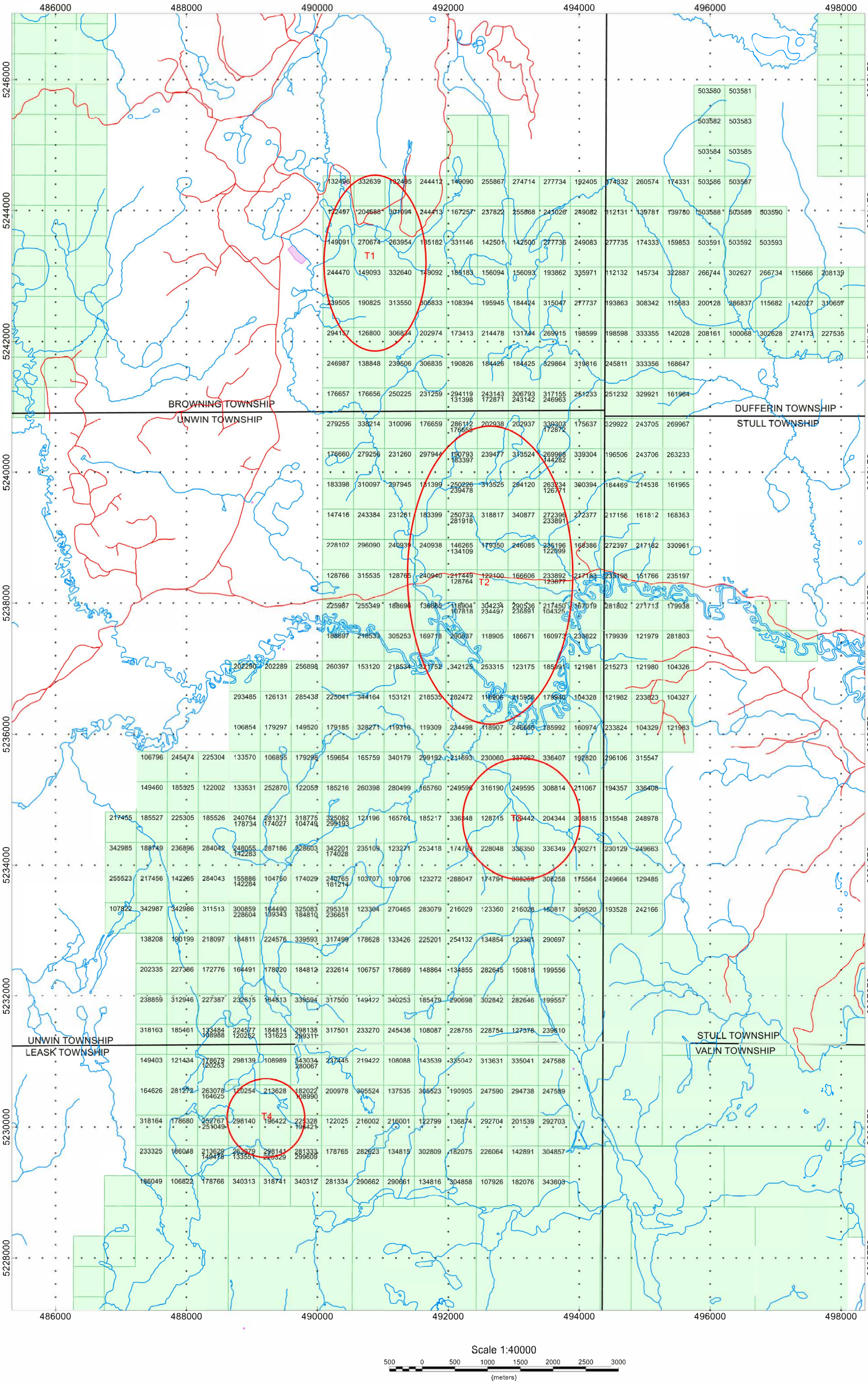
White Lake Claims Cells
Magnetic Susceptibility
-1300 MSL Plan Map

Magnetic Inversion
Inverted through Geosoft Voxi

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

CXS CANADIAN EXPLORATION SERVICES LTD

Drawing: BMR-WhiteLake-Mag-Inv--1300MSL



White Lake
Unwin, Stull, Leask, Valin,
Browning and Dufferin Townships, Ontario

White Lake Claims Cells
with Targets Plan Map

Map Drawn By:
C Jason Ploeger, B.Sc.
May 2021

Drawing: BMR-WhiteLake-Targets