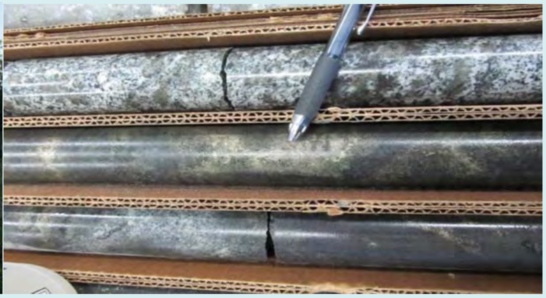
Duluth Metals Limited

Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects
Ely, Minnesota USA
NI 43-101 Technical Report



Prepared for:
Duluth Metals Limited

Prepared by:
Dr Harry Parker, RM SME
Dr Ted Eggleston, RM SME

Effective Date:
15 September 2012

Project Number:
171678

CERTIFICATE OF QUALIFIED PERSON

I, Harry Parker, Ph.D., RM SME., am employed as a Technical Director with AMEC E&C Services, Inc. (AMEC).

This certificate applies to the technical report titled "NI 43-101 Technical Report on the Maturi, Birch Lake, and Spruce Road Copper-Nickel-PGE Projects, Ely, Minnesota, USA" that has an effective date of September 15, 2012 (the "Technical Report").

I am a Fellow of the Australian Institute of Mining and Metallurgy (#113051), and a Registered Member of the Society for Mining, Metallurgy and Exploration (#2460450RM). I am licensed as a Professional Geologist in the State of Minnesota (#49606). I graduated from Stanford University with a Bachelor of Science (BSc) and doctoral (PhD) degrees in Geology in 1967 and 1975 respectively. I graduated from Harvard University in 1969 with a Master of Arts (AM) degree in Geology. I graduated from Stanford University with a Master of Science (MSc) degree in Statistics in 1974.

I have practiced my profession for 45 years during which time I have been involved in the estimation of mineral resources and mineral reserves for various mineral exploration projects and operating mines. I have either estimated or audited Ni, Cu and PGE resources for a number of mineral deposits, including the Platreef deposit (South Africa), Area 5 deposit (Maine), Stillwater (Montana); McCreedy East (Ontario), and Voiseys Bay (Labrador). From 1967 to 1970 while with The Hanna Mining Company I prepared outcrop maps covering portions of the South Kawishiwi Intrusion, including the Maturi deposit. I also logged several drill holes and conducted self potential surveys at South Filson Creek.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 Standards of Disclosure for Mineral Projects (NI 43–101).

I visited the Twin Metals Mining Project (the "Project") several times during preparation of this report, most recently from 19-20 June 2012.

I am responsible for Section 14 of the Technical Report.

I am independent of Duluth Metals Limited as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Twin Metals Mining Project since 2011 during which time I have prepared and supervised the preparation of mineral resource estimates on the Project.

I have read NI 43–101 and those portions of the Technical Report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the technical report not misleading.

Dated: 18 January 2013

"Signed and sealed"

Dr Harry Parker, RM SME.

AMEC E&C Services Inc.,
Mining and Metals Consulting Group
961 Matley Lane, Suite 110
Reno, NV, 89502
Tel: 775 331 2375
Fax: 775-331-4153

CERTIFICATE OF QUALIFIED PERSON

I, Ted Eggleston, Ph.D., RM SME., am employed as a Principal Geologist with AMEC E&C Services, Inc. (AMEC).

This certificate applies to the technical report titled "NI 43-101 Technical Report on the Maturi, Birch Lake, and Spruce Road Copper-Nickel-PGE Projects, Ely, Minnesota, USA" that has an effective date of September 15, 2012 (the "Technical Report").

I am a Registered Member of the Society for Mining, Metallurgy and Exploration (#4115851RM) and licensed as a Professional Geologist in the States of Wyoming (PG-1830) and Georgia (PG002016). I graduated from Western State College of Colorado with a BA degree in 1976 and from the New Mexico Institute of Mining and Technology with MSc and PhD degrees in Geology in 1982 and 1987 respectively.

I have practiced my profession for 36 years during which time I have been involved in the exploration for, and estimation of, mineral resources and mineral reserves, for various mineral exploration projects and operating mines. I have explored for, provided technical assistance for, or audited Ni, Cu and PGE resources for a number of mineral deposits, including Munali (Zambia); Niquelândia and Fortaleza (Brazil); Stillwater (Montana); McCreedy East, McCreedy West, Levack, Thunder Bay North (Ontario); Bucko Lake (Manitoba); and Kabanga (Tanzania).

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 Standards of Disclosure for Mineral Projects (NI 43–101).

I visited the Twin Metals Mining Project (the "Project") several times during preparation of this report, with the most recent visit being from 6–22 June 2012. These visits were made under the supervision of Dr Harry Parker.

I am responsible for Sections 1 through 13 and 15 through 27 of the Technical Report.

I am independent of Duluth Metals Limited as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Twin Metals Mining Project since 2011 during which time I have supervised data collection and geological modeling efforts leading to mineral resource estimates on the Project.

I have read NI 43–101 and those portions of the Technical Report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the technical report not misleading.

Dated: 18 January 2013

"Signed and sealed"

Dr Ted Eggleston, RM SME.

IMPORTANT NOTICE

This report was prepared as National Instrument 43-101 Technical Report for Duluth Metals Limited (Duluth) by AMEC E&C Services, Inc. (AMEC). The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC's services, based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by Duluth subject to terms and conditions of its contract with AMEC. Except for the purposed legislated under Canadian provincial and territorial securities law, any other uses of this report by any third party is at that party's sole risk.

CONTENTS

TABLES

FIGURES

1.0 SUMMARY

Duluth Metals Limited (Duluth) requested that AMEC E & C Services Inc. (AMEC) provide an independent Technical Report (the Report) summarizing the information supporting updated Mineral Resource estimates for the Maturi, Birch Lake, and Spruce Road deposits on the Twin Metals Minnesota Project (the Project) located near Ely Minnesota, USA.

Twin Metals Minnesota (TMM) is a limited liability company that, since 2010, has been operated as a joint venture between Antofagasta PLC (Antofagasta) and Duluth, under a Participation and Limited Liability Company Agreement ("Participation Agreement"). TMM is 35% owned by Duluth, 25% owned by Twin Metals (USA) LLC (which is indirectly owned by Duluth) and 40% owned by Northern Minerals Holding Co. (which is indirectly owned by Antofagasta). Accordingly, Duluth holds, directly or indirectly, a 60% controlling interest in TMM.

This Technical Report supports disclosure of an updated Mineral Resource estimate for the Project in the Duluth press release dated 4 December 2012, entitled "Duluth Metals Announces an Updated Mineral Resource Estimate Confirming Large Increases to Twin Metals Contained Metal, Grade and Indicated Tonnage".

1.1 Key Outcomes

The Mineral Resource estimates for the three deposits are as follows:

	Cutoff (% Cu)	Tons (Mt)	Cu (%)	Ni (%)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
Maturi (Indicated)	**0.3**	1,065	0.59	0.19	0.356	0.157	0.085	0.010	0.005	0.002
Maturi (Inferred)	**0.3**	542	0.51	0.17	0.32	0.14	0.072	0.009	0.004	0.002
Birch Lake (Indicated)	**0.3**	99.7	0.52	0.16	0.511	0.233	0.114	0.015	0.007	0.003
Birch Lake (Inferred)	**0.3**	239.2	0.46	0.15	0.370	0.180	0.087	0.011	0.005	0.003
Spruce Road (Inferred)	**0.3**	480	0.43	0.16						

Note: all tonnages are in million short tons (Mt)

Exploration of the deposits has been completed primarily with drilling because of the depth of the mineralization. Geophysical and geochemical exploration has met with limited success. Approximately 930 core holes have been drilled in the area of the deposits for a total of 1,939,914 feet (591,287 m) of drilling.

The Project database was audited and checked and found to be adequate to support resource estimation.

Metallurgical testwork is preliminary, but is adequate to demonstrate that the mineralization at all three deposits is amenable to concentration using conventional flotation concentration methods. Recoveries are adequate, but the best recoveries result in moderate concentrate grades. Those concentrates are believed to be saleable, but onsite processing using hydro-metallurgical technologies was investigated and found to be a possible alternative to conventional smelting for final extraction of metals. Metallurgical testwork is adequate to support resource estimation.

Geotechnical evaluation of the deposits is minimal but adequate to indicate that underground mining is possible. Conceptual mine and process design identified a number of scenarios that indicate reasonable prospects for economic extraction of the deposits.

AMEC recommends work that will enhance the results of the prefeasibility study that is currently in progress. Specifically, AMEC recommends that 75,000 feet of core be drilled at Maturi to investigate stratigraphic irregularities, close-range variability of the mineralization, and to support conversion of Inferred Mineral Resources to Indicated Mineral Resources. At Birch Lake, approximately 100,000 feet of drilling is necessary to investigate stratigraphic irregularities, close-range variability of the mineralization, and to support conversion of Inferred Mineral Resources to Indicated Mineral Resources.

1.1.1 Property Description and Ownership

Land in Minnesota is held by a combination of private, state, and federal owners, and land is subject to typical United States split-estate holdings, where the surface owner(s) may be different from the sub-surface owner(s).

Duluth, through its joint venture ownership in Twin Metals Minnesota LLC (TMM) has the benefit of various mineral interests including state leases, federal leases, private leases and federal prospecting permits, federal prospecting permit applications, a preference right lease application, and fee or option for fee interests, as summarized in Table 1-1. When not held in TMM’s own name, TMM’s mineral interests are held by its wholly owned subsidiary, Franconia Minerals (US) LLC or through the Birch Lake Joint Venture. The mineral interests of the Birch Lake Joint Venture are, in turn, held by

Lehmann Exploration Management, Inc., Beaver Bay, Inc., Lehmann Trust, or Beaver Bay Joint Venture Trust. For simplicity of reference, the mineral interests held by TMM in its own name as well as the mineral interests held by Franconia Minerals (US) LLC or through the Birch Lake Joint Venture are referred to in this report as TMM's mineral interests. TMM is 35% owned by Duluth, 25% owned by Twin Metals (USA) LLC (which is indirectly owned by Duluth) and 40% owned by Northern Minerals Holding Co. (which is indirectly owned by Antofagasta). Accordingly Duluth holds, directly or indirectly, a 60% controlling ownership interest in TMM.

Table 1-1: Summary of TMM Mineral Interests

Type	Number	Acres	Hectares
Federal Mineral Leases	2	4,944.78	2,001.09
Federal Prospecting Permits	3	1,818.46	735.91
Federal Prospecting Permit with Preference Rights Lease Application	1	13.75	5.56
Federal Prospecting Permit Applications	10	7,935.41	3,211.35
State Mineral Leases	27	6,012.84	2,433.31
Private Mineral Leases	13	5,562.93	2,251.24
Fee Minerals	N/A	1,047.75	424.01
Total	56	27,335.92	11,063.3

Subject to certain exceptions, TMM's mineral interests under state and federal leases and federal prospecting permits are insured pursuant to title insurance policies issued by First American Title Insurance Company on August 4, 2010 and August 31, 2011 as policy nos.; NCS-428640 (Nokomis; now Maturi) and NCS-471210 (Franconia) (note that TMM's mineral interests lying beneath the beds of reservoirs or other bodies of water are not insured by the above-referenced title polices).

TMM has filed applications for federal prospecting permits pending before the United States Bureau of Land Management ("BLM"), which are not insurable. TMM has the benefit of Federal Preference Rights Lease Application # 50264, which is pending with the BLM.

Expert reports provided to AMEC support Duluth's description of their mineral right ownership covering the areas of exploration and the mineral resource estimates.

1.1.2 Geology and Mineralization

Mineralization at Maturi, Birch Lake, and Spruce Road is hosted by the Duluth Complex, a composite intrusion comprising 12 sub-intrusions emplaced over a period of 10 to 12 million years. The basal portion of the South Kawishiwi intrusion (SKI) hosts all three deposits in what is locally known as the basal mineralized zone (BMZ) which is locally more than 1,000 ft thick. The BMZ is a complex zone comprising numerous small intrusive bodies ranging in composition from anorthosite to melatroctolite.

Mineralization comprises primarily chalcopyrite, cubanite, pentlandite, and talnakhite with numerous base and precious metals-bearing minerals in trace quantities.

The geological setting is adequately known to support resource estimation and preliminary mine planning.

1.1.3 Exploration

Exploration work completed to date is adequate to support the current resource estimation effort and to guide additional exploration.

Exploration procedures, including drilling, are adequate to support resource estimation. Sampling, sample preparation, and assaying have been done using industry-standard procedures. Analytical precision and accuracy are adequate to support resource estimation.

1.1.4 Mineral Resources

Mineral resources are summarized in the following sections. Mineral Resource estimation procedures for Maturi and Birch Lake are discussed in Section 14. These resources are estimated assuming underground mining as the preferred option. The mineral resource for Spruce Road is a re-tabulation of a 2007 resource estimate produced by Scott Wilson RPA using more current cost estimates and assuming an underground operation only. All tonnages are in million short tons (Mt).

Assumptions made were that mining, process and G+A costs would be approximately $16/t, $12/t and $2/t respectively for a total of $30/t. This indicates a breakeven NSR of approximately $30 per ton. Resources meeting an NSR cutoff of $30/t approximately equate to a copper cutoff of 0.3%. Above a global 0.6% Cu cutoff at Maturi or 0.55 Cu cutoff at Birch Lake/Spruce Road the mineralization outside the higher-grade units can break up into discontinuous bodies that may not support the mining method assumptions used to assess reasonable prospects for economic extraction.

The Qualified Person for the three resource estimates is Dr. Harry Parker, Registered Member, Society for Mining, Metallurgy and Exploration (RM SME). Mineral Resources have an effective date of 15 September 2012.

Maturi

Table 1-2 shows the base case Maturi Indicated Mineral Resource at a 0.3% copper cutoff grade, as well as sensitivity of the mineral resource to cutoff grade. Table 1-3 shows the Maturi Inferred Mineral Resources at the base case 0.3% copper cutoff grade, as well as the sensitivity of the mineral resource to cutoff grade.

Table 1-2: Maturi – Indicated Mineral Resources by Copper Cutoff Grade (base case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	1,137	0.57	0.18	0.343	0.151	0.081	0.010	0.004	0.002
0.3	1,065	0.59	0.19	0.356	0.157	0.085	0.010	0.005	0.002
0.4	936	0.63	0.20	0.379	0.167	0.090	0.011	0.005	0.003
0.5	739	0.67	0.21	0.419	0.185	0.099	0.012	0.005	0.003
0.6	538	0.72	0.23	0.454	0.200	0.107	0.013	0.006	0.003

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au.
The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 1-3: Maturi – Inferred Mineral Resources by Copper Cutoff Grade

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	782	0.43	0.14	0.266	0.118	0.06	0.008	0.003	0.002
0.3	542	0.51	0.17	0.320	0.140	0.072	0.009	0.004	0.002
0.4	383	0.57	0.19	0.375	0.164	0.083	0.011	0.005	0.002
0.5	256	0.63	0.20	0.443	0.197	0.098	0.013	0.006	0.003
0.6	141	0.70	0.22	0.531	0.237	0.116	0.015	0.007	0.003

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Birch Lake

Birch Lake Indicated Mineral Resources are summarized in Table 1-4 and Inferred Mineral Resources are summarized in Table 1-5.

Table 1-4: Birch Lake Indicated Mineral Resources by Copper Cutoff Grade

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	111.9	0.49	0.15	0.474	0.217	0.106	0.014	0.006	0.003
0.3	99.7	0.52	0.16	0.511	0.233	0.114	0.015	0.007	0.003
0.4	85.4	0.55	0.17	0.543	0.247	0.120	0.016	0.007	0.004
0.5	54.9	0.60	0.18	0.591	0.269	0.130	0.017	0.008	0.004

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 1-5: Birch Lake Inferred Mineral Resources by Copper Cutoff Grade

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	313.1	0.41	0.13	0.320	0.156	0.076	0.009	0.005	0.002
0.3	239.2	0.46	0.15	0.370	0.180	0.087	0.011	0.005	0.003
0.4	158.4	0.51	0.16	0.423	0.203	0.098	0.012	0.006	0.003
0.5	76.8	0.58	0.18	0.480	0.228	0.111	0.014	0.007	0.003

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Spruce Road Resources

Spruce Road resources are summarized in Table 1-6.

Table 1-6: Spruce Road Inferred Mineral Resources by Copper Cutoff

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)
0.2	674	0.38	0.14
0.3	480	**0.43**	**0.16**
0.4	254	0.50	0.18
0.5	101	0.57	0.21

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

1.2 Recommendations

AMEC recommends a two-phase work program that will support the Prefeasibility Study that is currently in progress.

Specifically, AMEC recommends that 75,000 feet of core be drilled at Maturi to investigate stratigraphic irregularities, close-range variability of the mineralization, and potentially support conversion of Inferred Mineral Resources to Indicated Mineral Resources. At Birch Lake, approximately 100,000 feet of drilling is necessary to investigate stratigraphic irregularities, close-range variability of the mineralization, and to potentially support conversion of Inferred Mineral Resources to Indicated Mineral Resources. As Duluth is focusing on the evaluation of the Maturi and Birch Lake deposits for the purposes of the Prefeasibility Study, no drill program is planned for Spruce Lake in the near term.

Once the drill data are available, a mineral resource estimate update should be completed for the two deposits.

Table 1-7: Estimated Cost of Recommendations

Budget Item	Amount	Units	Cost/unit (US$)	Estimated Cost (US$)
Exploration Drilling	175,000	ft	60	10,500,000
Drill Support				1,050,000
Assays	5,500	ea	55	302,500
Geology Support				250,000
Resource Update				500,000
Total				12,602,500

2.0 INTRODUCTION

2.1 Terms of Reference

On behalf of Duluth Metals Limited (Duluth), Twin Metals Minnesota (TMM) requested that AMEC E & C Services Inc. (AMEC) provide an independent Technical Report (the Report) summarizing the information supporting updated Mineral Resource estimates for the Maturi, Birch Lake, and Spruce Road deposits on the Twin Metals Minnesota Project (the Project) located near Ely Minnesota, USA.

The Technical Report supports disclosure of an updated Mineral Resource estimate for the Project contained in the Duluth press release dated 4 December 2012, entitled "Duluth Metals Announces an Updated Mineral Resource Estimate Confirming Large Increases to Twin Metals Contained Metal, Grade and Indicated Tonnage".

The Report was prepared to support updated mineral resource estimates on the Maturi and Birch Lake deposits and re-tabulation of mineral resource estimates for the Spruce Road deposit. The new estimates are considered by Duluth to represent a material change with respect to the affairs of Duluth. The Prefeasibility Study that is underway will review the scale, timing, and development of the Project appropriately for the latest resource estimate. The results of the January 8, 2009 PEA study were considered when assessing reasonable prospects of economic extraction of the Project's mineral resources, but those results are otherwise considered no longer relevant to the Project.

2.2 Qualified Persons

Dr. Harry Parker RM SME is the Qualified Person responsible for preparing or supervising the preparation of Section 14 Mineral Resources of the Technical Report. Dr. Parker is a licensed Professional Geologist in the State of Minnesota and supervised the overall project. Dr. Ted Eggleston RM SME is the Qualified Person responsible for preparing or supervising the preparation of all other sections of the Technical Report.

Other AMEC personnel have provided input to the QPs in their areas of relevant expertise.

2.3 Property Inspections by AMEC

Dr Parker visited the Project site and/or Project offices from 26 to 30 April, 2011, 6-16 September 2011, 5-7 April 2012, and 19-20 June 2012. Under the supervision of Dr

Parker, Dr Eggleston visited site and/or Project offices on 26 to 30 April, 2011, 6-18 June 2011, 6-16 September 2011, 10-22 March 2012, 4-7 April 2012, 7-23 May 2012, and 6-22 June 2012.

During the site visits, AMEC personnel reviewed the current and historical drill hole database, core handling, logging and cutting procedures, density measurements, preparation procedures, assaying quality assurance and quality control (QA/QC), collar surveys and down hole surveys. Discussions on geology and mineralization were held with Duluth and TMM personnel, and field site inspections were performed.

2.4 Effective Dates

The effective date of the mineral resource estimates presented herein is 15 September 2012, which represents the cutoff date in the database for the completed drill assays and completion of the geological models.

The authors of the technical report are not aware of any material change in the scientific and technical information between the effective date and date of signing of the technical report.

2.5 Previous Technical Reports

The following Technical Reports were previously prepared for the various projects and were used during preparation of this report.

Maturi

Carghill, D.G., 2005, Technical Report on the Maturi Extension Property, Minnesota, U.S.A.; 30 December 2005, NI 43-101 Technical Report Prepared by Roscoe Postle Associated, Inc. for Wallbridge Mining Company Limited, 90 p.

Clow, G.G. and Routledge, R.E., 2005, Preliminary Assessment of the Mineral Resources of the Birch Lake Property; 19 November 2005, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Mineral Corporation, 90 p.

Routledge, R.E., 2006, Technical Report on the Maturi Extension Property, Minnesota, U.S.A.; 31 May 2006, NI 43-101 Technical Report Prepared by Roscoe Postle Associated, Inc. for Duluth Metals Limited, 68 p.

Routledge, R.E. and Greenough, G.F., 2006, Technical Report on the Mineral Resource Estimate for the Maturi Property, Minnesota, U.S.A.; 30 June 2006, NI

43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Mineral Corporation, 96 p.

Routledge, R.E., 2007, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 8 August 2007, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 112 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 18 July 2008, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 107 p.

Clow, G.G., Hwozdyk, L.R., Routledge, R.E., McCombe D.A. and Scott, K.C., 2008, Technical Report on the Preliminary Assessment on the Nokomis Project, Minnesota, U.S.A.; NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 184 p.

Cox, J.J., Routledge, R.E., and Krutzlemann, H., 2009, Preliminary Assessment of the Nokomis Project, Minnesota, U.S.A.; 8 January, 2009, NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 182 p.

Moreton, C., and Routledge, R.E., 2009, Technical Report on the Mineral Resource Estimate for the Nokomis Deposit on the Nokomis Property, Minnesota, U.S.A.; 10 December 2009, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 115 p.

Parker, H.M. and Eggleston, T.L., 2012, Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects Ely, Minnesota USA; 27 July 2012, NI 43-101 Technical Report prepared by AMEC E&C Services Inc. for Duluth Metals Limited, 302 p.

Birch Lake

Routledge, R.E., 2004, Review of the Mineral Resources of the Birch Lake Property, Minnesota, U.S.A.; 22 January 2004, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 92 p.

Caracle Creek International Consulting Inc, (CCIC), 2004, Independent Technical Report: San Francisco Zinc (Utah), Mahoney Zinc (New Mexico), and Birch Lake PGE (Duluth Complex, Minnesota) Properties, United States of America; 16 April 2004, NI 43-101 Report Prepared by Caracle Creek International Consulting Inc. for Franconia Minerals Corp., 360 p.

Clow, G., and Routledge, R.E., 2005, Preliminary Assessment of Mineral Resources of the Birch Lake Property, Minnesota, U.S.A.; 19 November 2005, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 93 p.

Clow, G.G., Cox, J.J., Routledge, R.E., and Hayden, A.S., 2006, Technical Report on the Preliminary Assessment of the Birch Lake and Maturi Deposits, Minnesota, U.S.A.; 20 October 2006, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 175 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 22 August 2008, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 139 p.

Routledge, R.E., 2009, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 18 September 2009, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 164 p.

Routledge, R.E. and Galyen, R., 2010, Technical Report on the Resource Estimate Update for the Birch Lake Property, Minnesota, U.S.A.; NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 151 p.

Parker, H.M. and Eggleston, T.L., 2012, Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects Ely, Minnesota USA; 27 July 2012, NI 43-101 Technical Report prepared by AMEC E&C Services Inc. for Duluth Metals Limited, 302 p.

Spruce Road

Routledge, R.E. and Cox, J.J., 2007, Technical Report on the Resource Estimate for the Spruce Road Deposit, Minnesota, U.S.A.; 15 November 2007, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 130 p.

Parker, H.M. and Eggleston, T.L., 2012, Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects Ely, Minnesota USA; 27 July 2012, NI 43-101 Technical Report prepared by AMEC E&C Services Inc. for Duluth Metals Limited, 302 p.

Comment

The resource estimates in this report supersede resource estimates reported in the previous NI 43-101 reports. The Spruce Road resource model described in Routledge and Cox (2007) was accepted by AMEC as current, but the Mineral Resource estimate was re-tabulated by AMEC using cutoff grades based on current cost and metal value parameters.

Cox et al (2009) produced a preliminary economic assessment for the Nokomis (aka Maturi Extension) deposit. Since that report was issued, TMM acquired both the Maturi and Nokomis deposits which had previously been treated as separate deposits because of mineral tenure patterns. The preliminary economic assessment of the Nokomis deposit did not include the Maturi deposit and is not considered relevant by Duluth. The two areas have now been combined and are referred to as the Maturi deposit.

2.6 References

Previous Technical Reports and the reports and documents listed in Section 3.0 (Reliance on Other Experts) and Section 27.0 (References) of this Technical Report were used to support the preparation of the Technical Report.

3.0 RELIANCE ON OTHER EXPERTS

In sections of this Technical Report as noted below, the QPs have relied upon, and believe there is a reasonable basis for this reliance, the following reports that provided information regarding mineral tenure, surface rights, company incorporation and ownership details, inter-company agreements relating to the Project, royalties, environmental obligations, permitting requirements and applicable mining act data relevant to the Project.

3.1 Project Ownership and Agreements

The QPs have not independently reviewed ownership of the Project area and the underlying property agreements. The QPs have fully relied upon, and disclaim responsibility for, information derived from TMM and legal experts retained by TMM for this information through the following documents:

Morel, J.A., 2012: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on company structure prepared for Dr Ted Eggleston, AMEC, by Mr J.A. Morel, Chief Executive Officer, TMM, dated 26 July 2012.

The information is used in the introduction to Section 4 and in Section 4.5 of the Report.

Dorsey & Whitney LLP, 2012: Letter Re Certain Matters Relating To The Company's Existence And Ownership: opinion letter prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Dorsey & Whitney LLP, dated 26 July 2012.

The information is used in the introduction to Section 4 and in Section 4.5 of the Report.

3.2 Mineral Tenure and Surface Rights

The QPs have not independently reviewed the Project mineral tenure and the underlying surface rights. The QPs have fully relied upon, and disclaim responsibility for, information derived from legal experts retained by TMM for this information through the following documents:

Starnes B., 2012a: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on relevant federal legislation, surface rights and access, and exploration rights and permits prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Leonard, Street and Deinard, dated 26 July 2012.

Starnes, B., 2012b: Twin Metals Minnesota, LLC - 43-101 Report: authorization letter from Leonard, Street and Deinard to use opinion letter prepared for TMM, dated 26 July 2012.

Johnson, B., 2012, Federal Mineral Lease MNES 1352 ("Lease") dated June 1, 1966; 19 September 2012, Memorandum to Dan Colton (Twin Metals Minnesota), 2 p.

This information is used in Sections 4.2.1, 4.5 and 4.6 of the Report.

Loraas, P., 2012a: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: opinion letter on examination of title and acquisition of certain mineral rights held by TMM in the State of Minnesota prepared for Dr Ted Eggleston, AMEC, and Twin Metals Minnesota by Fryberger, Buchanan, Smith & Frederick, dated 26 July 2012.

Loraas, P., 2012b: Twin Metals Minnesota, LLC Mineral and Surface Interest Holdings: authorization letter from Fryberger, Buchanan, Smith & Frederick to use opinion letter prepared for TMM, dated 26 July 2012.

This information is used in Sections 4.2.2, 4.3 and 4.4 of the Report.

3.3 Environment

The QPs have not independently reviewed the environmental studies status or environmental liabilities status for the Project. The QPs have fully relied upon, and disclaim responsibility for, information derived from TMM for this information through the following document:

Williamson, A., 2012: Opinion on Environmental Items for Use in Duluth Metals Ltd NI 43-101 Report July 2012: opinion letter prepared for Dr Ted Eggleston, AMEC, by Ms A. Williamson, Vice President - Environment & Sustainability, TMM, dated 20 July 2012.

This information is used in Sections 4.8 and 4.9 of the Report.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Location

4.1.1 General Location

The Maturi, Birch Lake, and Spruce Road deposits are located east to southeast of Ely, Minnesota (Figure 4-1).

The Maturi deposit is located in Lake County, Townships 61N and 62N, Range 11W in the Kangas Bay and Bogberry Lake quadrangles (Figures 4-1 and 4-2). The properties are centered at approximately:

- North latitude 47^o 47′ 0″; west longitude 91^o 42′ 30″
- UTM coordinates Zone 15, 595,516E, 5,295,082N (NAD 27 CONUS)
- UTM coordinates Zone 15, 595,500E, 5,295,300N (NAD 83).

The Birch Lake deposit is in Lake and St. Louis counties approximately 125 km north-northeast of Duluth, Minnesota (Figures 4-1 and 4-2). The property is centered approximately at:

- North latitude 47^o 41’ 49”; west longitude 91^o 47’ 30”
- UTM coordinates Zone 15, 589,700E, 5,285,200N (NAD 27 CONUS)
- UTM coordinates Zone 15, 589,684E, 5,285,418N (NAD 83).

The Spruce Road deposit lies for the most part on Federal Lease US ES01353 located in northern Minnesota, Lake County, Townships 62N and Range 10W and 11W in the Bogberry Lake quadrangle (Figures 4-1 and 4-2). The property is centered approximately at:

- North latitude 47^o 50’ 09”; west longitude 91^o 40’ 00”
- UTM coordinates Zone 15, 599,800E, 5,298,700N (NAD 27 CONUS)
- UTM coordinates Zone 15, 599,784E, 5,298,918N (NAD 83).

Figure 4-1: General Location of the Properties (modified from Cox et al, 2009)

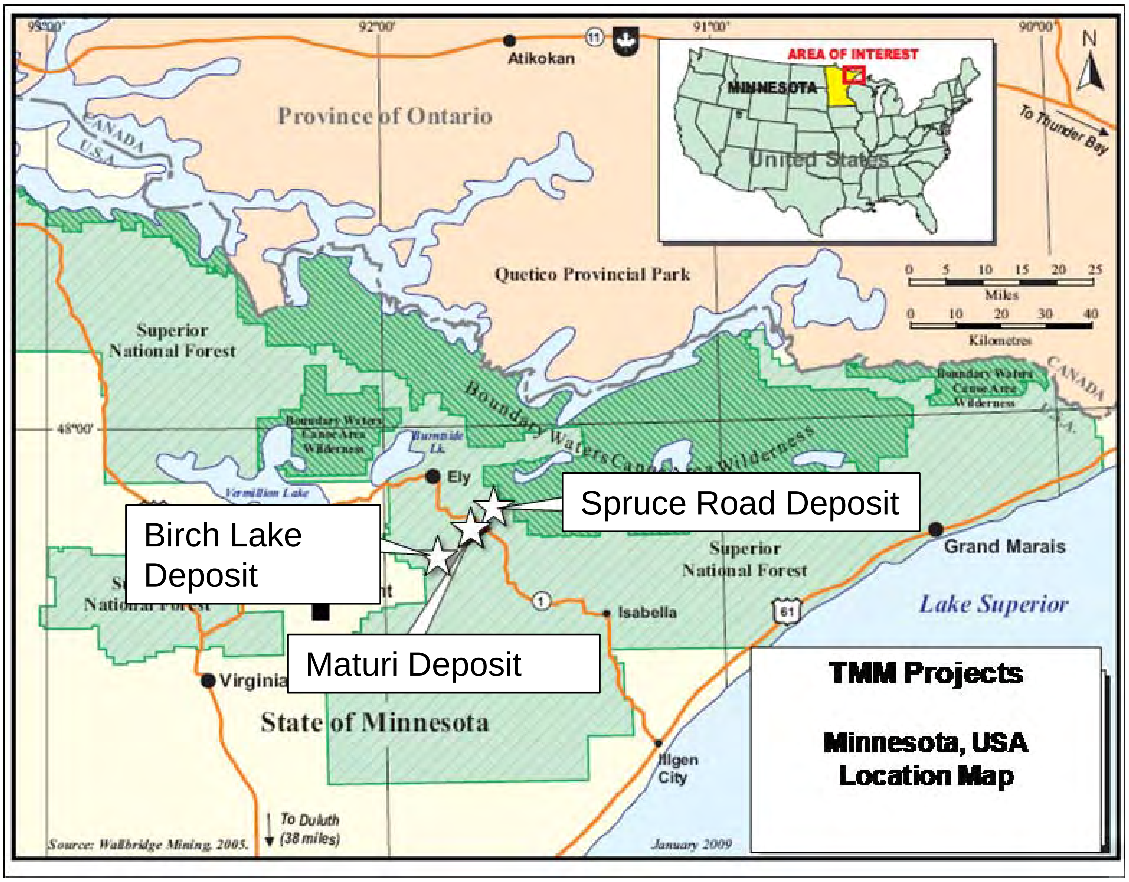
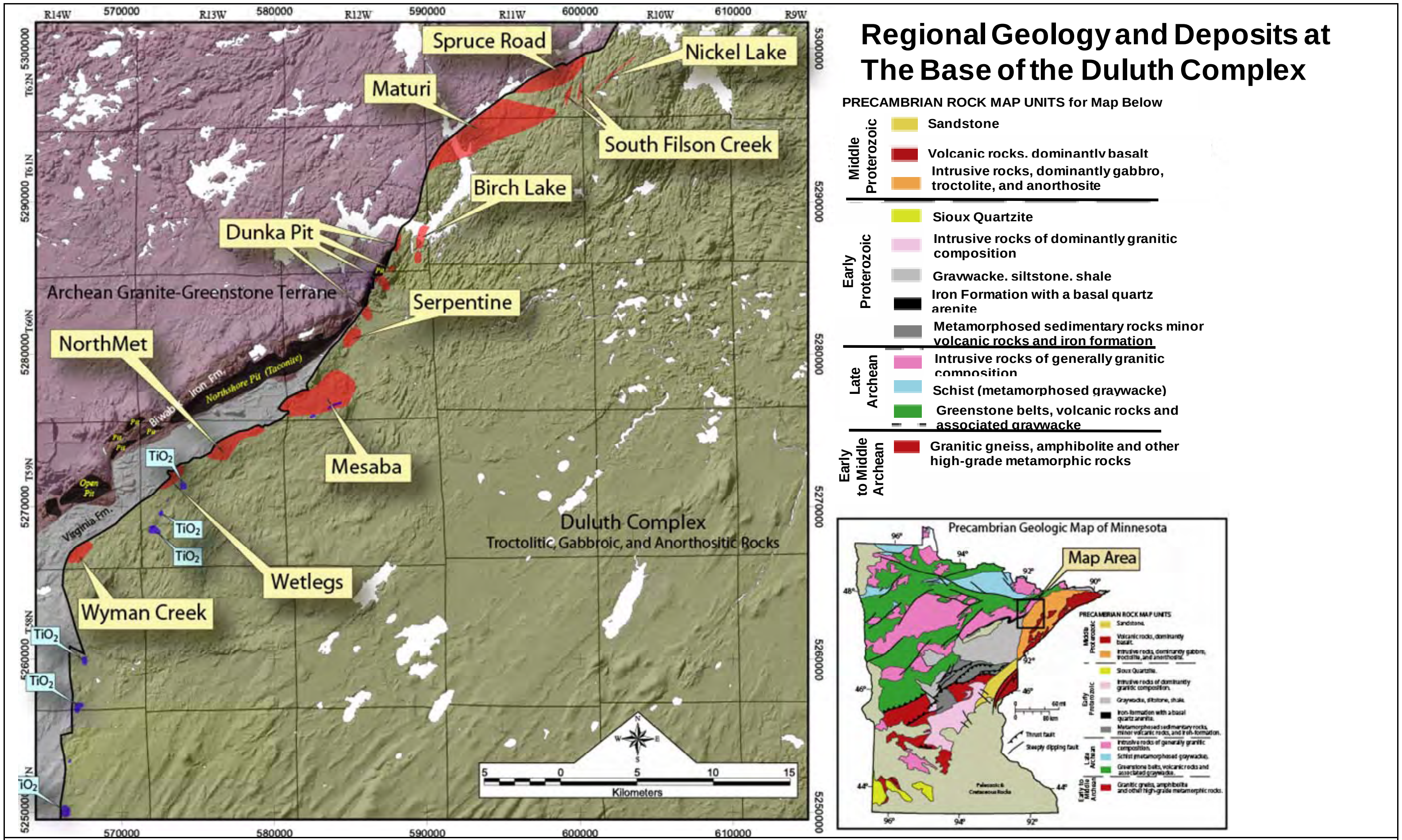


Figure 4-2: Sketch Regional Geological Map with Named Deposits at the Base of the Duluth Complex near Ely, MN (adapted from Peterson, 2010)



Only Spruce Road, Maturi, and Birch Lake are included in the TMM project. Other deposits are held by other operators.

4.1.2 Coordinate System and Topographic Data

Several coordinate systems have been employed for these projects. The most common are UTM Projection coordinates, but both NAD 83 and NAD 27 datums have been used. Inco used a local grid at Spruce Road and Maturi that was converted to UTM NAD 27. In order to avoid confusion, all coordinates in the database were converted to the Minnesota State Plane North, NAD 83, US Feet coordinate system.

4.2 Relevant Mining Law

4.2.1 Relevant Federal Legislation

Originally established from public domain lands, and minor mineral acreage “acquired” via other sources, the Superior National Forest was designated and approved by Presidential Proclamation No. 848 in 1909 by President Theodore Roosevelt. It encompasses more than three million acres of land in northeast Minnesota. Subject to applicable laws and regulations, the Superior National Forest is open to commercial development, including mining. The proclamation establishing the Superior National Forest “reserved” the public domain lands from the General Mining Law of 1872. While the General Mining Law of 1872 provides for a claim system for mineral tenure acquisition, the Superior National Forest is regulated under laws providing for a permitting and leasing system. Pursuant to 16 U.S.C. § 508b, section 402 of the Federal Reorganization Plan No. 3 of 1946 and the Weeks Act (36 Stat. 961), hardrock mineral leasing is available on both public domain and acquired lands in the Superior National Forest. The Bureau of Land Management is the agency primarily responsible for overseeing this permitting and leasing system and promulgated regulations (43 C.F.R. § 3500 et. seq.) to establish its regulatory guidelines.

Under the Bureau of Land Management regulations, a mining company may apply for prospecting permits, which have an initial two-year term and may be renewable for up to an additional four years (43 C.F.R. § 3505.10, .60, .61). These can be converted to Preference Rights Leases, a type of federal mineral lease, upon satisfying all regulatory requirements (43 CFR § 3507, et. seq.) The initial term for Preference Rights Leases is 20 years with the possibility of successive 10-year renewals. A Preference Rights Lease includes the right to develop and construct a mine under the terms thereof, but additional permits are required before work can commence.

4.2.2 Relevant State Legislation

State leases for nonferrous metallic mining are issued by the Minnesota Department of Natural Resources and may be held for up to fifty years (Minn. Stat. § 93.25.) These leases allow a mining company to engage in mineral exploration and mineral development located on the state-owned property, subject to compliance with all laws and issued permits. An operating mining company must pay a production royalty in addition to lease payments.

At the mineral development stage, a "Permit to Mine" is required for any new nonferrous metallic mineral mine in addition to the mining lease (Minn. Stat. § 93.481; Minn. R. 6132.0100-.5300.) This is required for mining of all nonferrous metallic mineral interests, irrespective of whether the ownership is state, federal, or private. A Permit to Mine may be issued for whatever term the Minnesota Department of Natural Resources deems necessary for the completion of the proposed mining operation, including reclamation or restoration.

4.3 Mineral Tenure

4.3.1 Introduction

Land in Minnesota is held by a combination of private, state and federal ownership, and land is subject to typical United States split-estate holdings, where the surface owner(s) may be different from the sub-surface owner(s).

TMM has the benefit of various mineral interests including state leases, federal leases, private leases and federal prospecting permits, federal prospecting permit applications, a preference right lease application, and fee or option for fee interests, as summarized in Table 4-1 and shown in Figure 4-3. When not held in TMM's own name, TMM's mineral interests are held by its wholly owned subsidiary, Franconia Minerals (US) LLC or through the Birch Lake Joint Venture. The mineral interests of the Birch Lake Joint Venture are, in turn, held by Lehmann Exploration Management, Inc., Beaver Bay, Inc., Lehmann Trust, or Beaver Bay Joint Venture Trust. For simplicity of reference, the mineral interests held by TMM in its own name as well as the mineral interests held by Franconia Minerals (US) LLC or through the Birch Lake Joint Venture are referred to in this report as TMM's mineral interests. (For a description of TMM's company structure, see Section 4.4.)

Subject to certain exceptions, TMM's mineral interests under state and federal leases and federal prospecting permits are insured pursuant to title insurance policies issued by First American Title Insurance Company on August 4, 2010 and August 31, 2011 as policy nos.: NCS-428640 (Nokomis; now Maturi) and NCS-471210 (Franconia) (note that TMM's mineral interests lying beneath the beds of reservoirs or other bodies of water are not insured by the above-referenced title polices).

Table 4-1: Summary of TMM Mineral Interests*

Type	Number	Acres	Hectares
Federal Mineral Leases	2	4,944.78	2,001.08
Federal Prospecting Permits	3	1,818.46	735.91
Federal Prospecting Permit with Preference Rights Lease Application	1	13.75	5.56
Federal Prospecting Permit Applications	10	7,935.41	3,211.35
State Mineral Leases	27	6,012.84	2,433.31
Private Mineral Leases	13	5,562.93	2,251.24
Fee Minerals	N/A	1,047.75	424.01
Total	56	27,335.92	11,063.3

*In some instances, TMM holds undivided fractional mineral interests. See Tables 4-6, 4-8, and 4-10.

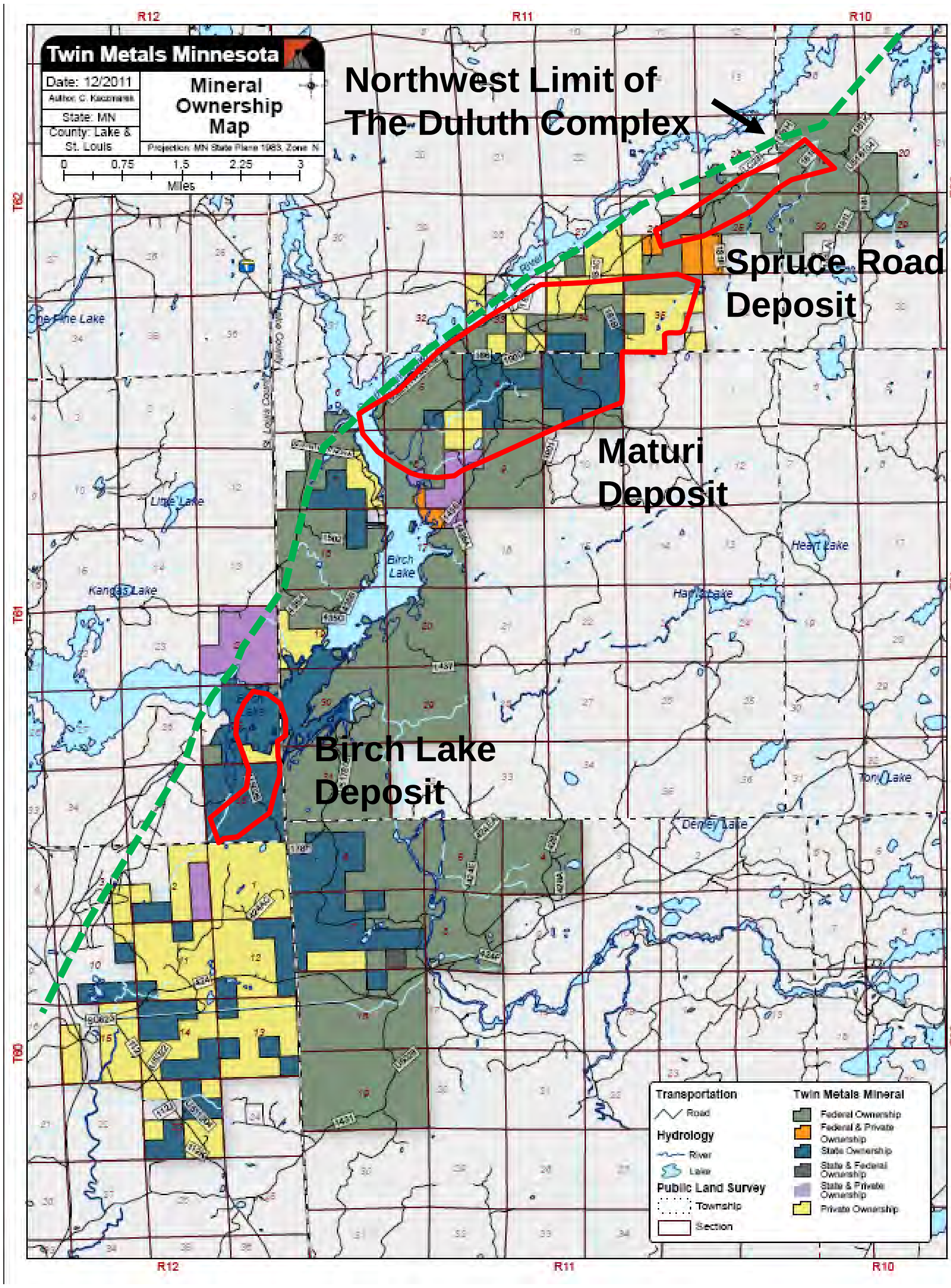
TMM has filed applications for federal prospecting permits pending before the United States Bureau of Land Management (BLM), which are not insurable. TMM has the benefit of Federal Preference Rights Lease Application # 50264, which is pending with the BLM.

Note that all of the locations for mineral leases and other property locations are described in the United States Public Land Survey System of Township, Range, Section, and Section subdivisions.

The following abbreviations are used in the accompanying tables:

ACNC	American Copper and Nickel Company Inc
BBJV	Beaver Bay Joint Venture
BLM	U.S. Bureau of Land Management
DNR	Minnesota Department of Natural Resources
FRA	Franconia Minerals Corporation Inc.
LEM	Lehmann Exploration Management
USFS	U.S. Forest Service

Figure 4-3: TMM Mineral Interest Map showing Mineral Ownership



4.3.2 Current Mineral Interests Status

Federal Mineral Leases

TMM holds rights to Federal Lease Nos. ES-01352 and ES- 01353, dated June 1, 1966, as part of the Birch Lake Joint Venture Agreement dated June 18, 2008. Figure 4-4 shows the location of these leases and Table 4-2 summarizes the locations of the two leases which total 4,944.78 acres (2,001.09 hectares). Table 4-3 summarizes the royalties and carrying costs. No annual work requirements exist, but periodic reporting (monthly) of results to the BLM is required.

The base royalty for the Federal Mineral Leases is 4.5% for Cu and Ni, paid on 1/3 of the market prices of a quantity of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill.

To compensate the lessor for associated products, there is an additional royalty of .3% of the gross value of a quantity of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill.

There is a further additional royalty of 1% of the gross value of "associated products" if the value of such products exceeds 20% of the aggregate market price as fully-refined metals of the quantity of copper and nickel contained in the minerals mined under the leases and shipped to the concentrating mill.

AMEC recommends that TMM should consider obtaining a formal legal opinion prior to any future production to determine the extent and applicability of any additional production royalties that may be due to third parties.

No annual work requirements exist, but periodic reporting (monthly) of results to the BLM is required.

Figure 4-4: Federal Mineral Interest Map

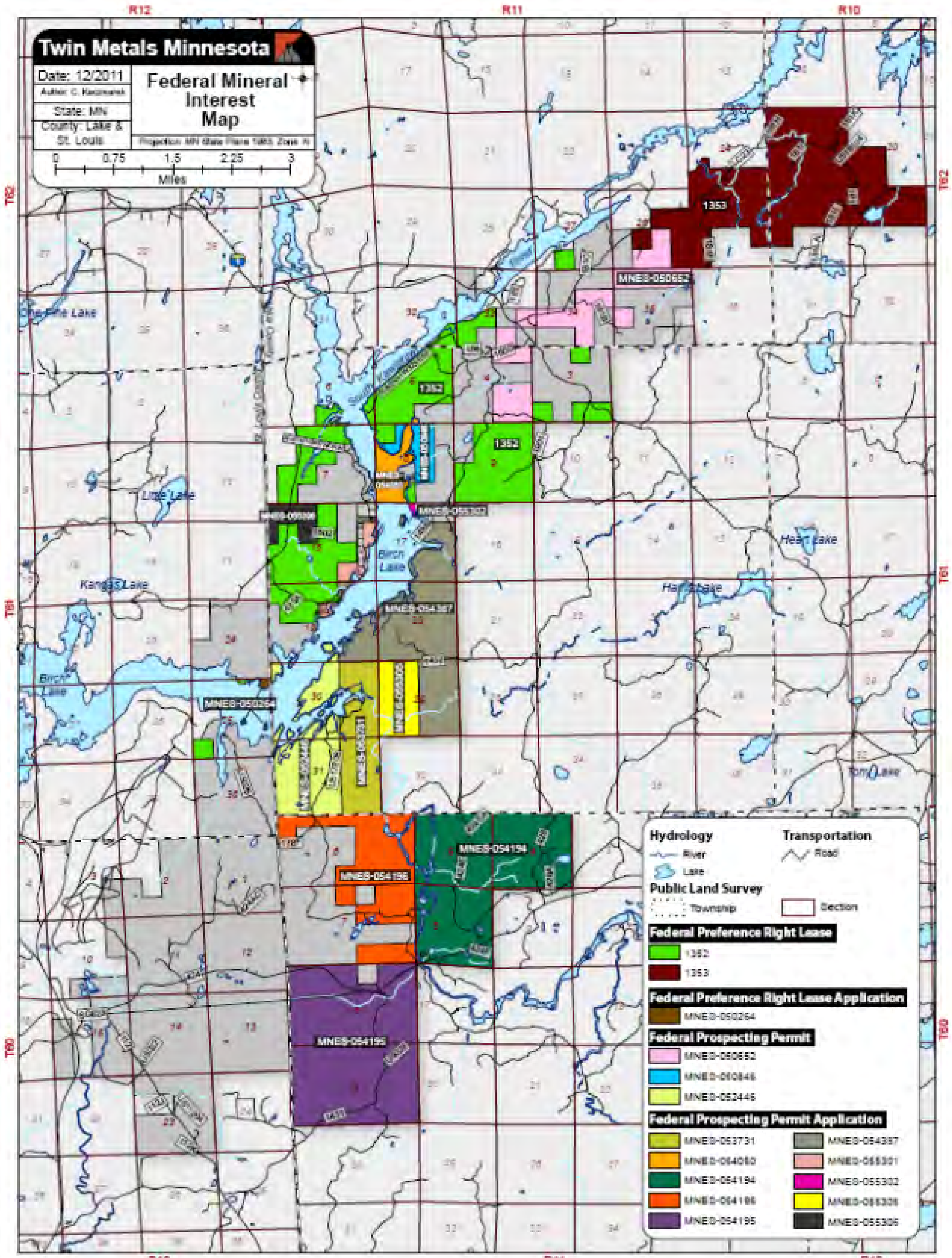


Table 4-2: Location of Federal Mining Leases

Lease Number	Permitting Or Leasing Authority	Surface Owner	Legal Description					Acres
			County	Section	TWP	Range	Section Subdivision	
MNES-01352	USA (BLM)	USA; South Kawishiwi Association LLC; Allete, Inc.	Lake	3	61	11	Lot 2	2,610.07 (Although MNES-01352 indicates a total of 2,610.07 acres, title searches indicate that the total acres held by USA under MNES-01352 are 2,444.12)
							SW-SW	
							S1/2-SE	
				5	61	11	Lots 1and 2	
							S1/2-NE	
							Lots 6-7	
							NE-SW	
							S1/2-SW	
							N1/2-SE	
				6	61	11	Lot 13	
							Lots 22-24	
				7	61	11	Lots 1-4	
							Lots 9-10	
							Lot 12	
							Lots 15-16	
							Lot 19	
				8	61	11	Lot 2	
							Lot 6	
				9	61	11	All EXCEPT W1/2-NW	
				18	61	11	Lot 2	
							Lot 7	
							Lot 9	
							Lots 12-20	
				19	61	11	Lots 2-5	
							Lots 7-8	
				27	62	11	SE-SW	
				32	62	11	Lot 4	
				33	62	11	Lots 6-7	
				34	62	11	NW 1/4	
			St. Louis	25	61	12	Lot 2	
							SW-SW	
MNES-01353	USA (BLM)	USA	Lake	19	62	10	All	2,334.71
				20	62	10	SW 1/4	
				29	62	10	N 1/2	
				30	62	10	N 1/2	
							Lot 3 (NW-SW)	
				24	62	11	Lot 7	

Lease Number	Permitting Or Leasing Authority	Surface Owner	Legal Description					Acres
			County	Section	TWP	Range	Section Subdivision	
							SE-SW	
							S1/2-SE	
				25	62	11	N 1/2	
							W1/2-SW (undiv 1/2)	
							NE-SE	
				26	62	11	S1/2-NE	
							NE-SW	
							E1/2-SE (undiv 1/2)	

Table 4-3: Terms of Federal Mining Leases

Lease Number	Expiry Date	Renewal	Initial Agreement Date	ROYALTIES			CURRENT ANNUAL CARRYING COSTS			
				Base Royalty (NSR)	Additional Royalty (NSR)	Rental or Advance Min. Royalty	Rental	Minimum Advanced Royalty	Total	
							2011-13	2011-13	2011-13	2014
MNES-01352	End of second renewal term 12/31/2013	Initial 20-year period followed by three 10-year renewal terms, with the possibility of additional 10-year renewal terms under BLM regulations	1-Jun-66	4.5% of Cu and Ni, paid on 1/3 of the market prices of a quantity of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill.	Additional royalty of .3% of the gross value of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill. Further additional royalty of 1% of gross value of "associated products" if value of such associated products exceeds 20% of aggregate market price as fully-refined metals of the quantity of copper and nickel contained in the minerals mined under the leases and shipped to the concentrating mill.	Rent of $1/acre/year until production; Min. Royalty of $10/acre/year	$2,610.07	$26,107.00	$28,717.07	Unknown

					Additional royalties may be due to third parties under existing agreements. See section 4.3.2 of this report.Additional royalty of .3% of the gross value of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill. Further additional royalty of 1% of gross value of "associated products" if value of such associated products exceeds 20% of aggregate market price as fully-refined metals of the quantity of copper and nickel contained in the minerals mined under the leases and shipped to the concentrating mill. Additional royalties may be due to third parties under existing agreements. See section 4.3.2 of this report.					

MNES-01353	End of second renewal term 12/31/2013	Initial 20-year period followed by three 10-year renewal terms, with the possibility of additional 10-year renewal terms under BLM regulations	1-Jun-66	4.5% of Cu and Ni, paid on 1/3 of the market prices of a quantity of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill.	Additional royalty of .3% of the gross value of fully-refined copper and of a quantity of fully-refined nickel equal to the respective quantities of unrefined copper and unrefined nickel contained in said minerals shipped to the concentrating mill. Further additional royalty of 1% of gross value of "associated products" if value of such associated products exceeds 20% of aggregate market price as fully-refined metals of the quantity of copper and nickel contained in the minerals mined under the leases and shipped to the concentrating mill. Additional royalties may be due to third parties under existing agreements. See section 4.3.2 of this report.	$1.00 per acre per year until production Minimum royalty $10.00/acre/year.	$2,254.71	$22,550.00	24,804.71	Unknown

Federal Prospecting Permits

TMM has the benefit of 13 prospecting permits and permit applications as well as one preference right lease application (Table 4-4) for a total of 9,767.62 acres (3,952.82 hectares). Figure 4-4 shows the location of these permits and permit applications. TMM's federal prospecting permits have been held for their initial period of two years and have been extended as described in Table 4-5.

Per the standard property advancement procedures for federal prospecting permits, TMM is required to convert its federal prospecting permits to a Preference Rights Lease in order to retain and further explore and develop the properties. According to federal regulations, in order to obtain a Preference Rights Lease, the applicant must hold a federal prospecting permit for the area it wants to lease, apply for a Preference Rights Lease, submit the first year annual lease payment, provide information required as stated in the U.S. Code of Federal Regulations (CFR) § 3507.17, including maps, a proposed mining and processing approach, a description of salable products and markets, utilities, and infrastructure in the area, and the applicant must demonstrate that it has discovered a valuable deposit covered by its prospecting permit. A valuable deposit is principally determined by the geologic assessment of the mineral deposit, detailing the type and extent of exploration, including drill log and other exploration results, that has occurred on the lands covered by the Federal Prospecting Permit as well as the exploration on adjacent lands both before and during the prospecting permit term.

As appropriate, Twin Metals will submit its applications for Preference Rights Leases on its federal prospecting permits in accordance with federal regulations and specific application dates.

Royalties on Federal Prospecting Permits are negotiated at the time the permits are advanced to Preference Rights Leases. The minimum royalty is anticipated to be 1.6% of copper and nickel with an "Additional Royalty" of at least 1% of gross value of "associated products" if value of such products exceeds 20% of aggregate value of copper and nickel.

Table 4-4: Location of Federal Prospecting Permits

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MNES 050652 (Permit)	Bureau of Land Management	Federal	Lake	4	61	11	SE 1/4 and N 1/2-NE (Lots 1 and 2)	865.78	12/1/2003
				26	62	11	SE-SW		
				26	62	11	W 1/2-SE		
				33	62	11	SW-SE		
				33	62	11	NE-SE		
				34	62	11	N 1/2-SW		
				34	62	11	W 1/2-SE		
				34	62	11	S 1/2-NE		
				35	62	11	N 1/4 (being the N 1/2-NW and the N 1/2-NE)		
				35	62	11	NW-SW		
MNES 050846 (Permit)	Bureau of Land Management	Federal	Lake	8	61	11	Lot 1 (includes NE-NW)	178.5	12/1/2003
				8	61	11	Lot 3		
				8	61	11	Lot 4		
				8	61	11	NW-NE		
				8	61	11	SW-NE		
				8	61	11	NW-SE		
MNES-53731 (Application)	Bureau of Land Management	Federal	Lake	30	61	11	N1/2 - NE1/2	596.23	Unknown
							SW1/4-NE1/4 (Lot 6)		
							SE1/4-NE1/4 (Lot 7)		
							NE1/4-SE1/4 (Lot 8)		
							NW1/4-SE1/4 (Lot 9)		
							S1/2-SE1/4		
				31	61	11	NE1/4		
							N1/2-SE1/4		
							SW1/4-SE1/4 (Lot 14)		
							SE1/4-SE1/4 (Lot 15)		
MNES-54387	Bureau of	Federal	Lake	17	61	11	Lot 3	1294.53	Unknown

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
(Application)	Land Management						Lot 6		
							Lot 7		
							Lot 8		
							Lot 9		
							Lot 10		
							SE - NE		
							SE - SE		
				19	61	11	Lot 1		
				20	61	11	SE - NW		
							NE		
							S2		
				29	61	11	E2		
MNES-52446 (Permit)	Bureau of Land Management	Federal	Lake	19	61	11	Lot 17	774.18	Unknown
							Lot 18		
				30	61	11	Lot 19		
							Lot 20		
							Lot 21		
							Lot 28		
							Lot 29		
							Lot 30		
							Lot 31		
							Lot 32		
							Lot 33		
							Lot 34		
							Lot 35		
							Lot 36		
							Lot 37		
							Lot 38		
							Lot 39		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							Lot 40		
							Lot 41		
							Lot 42		
							Lot 43		
				31	61	11	Lot 1		
							Lot 2		
							Lot 3		
							Lot 4		
							Lot 5		
							Lot 6		
							Lot 7		
							Lot 8		
							Lot 9		
							Lot 10		
							Lot 11		
							Lot 12		
							Lot 13		
MNES-50264 (Preference Application Filed)	Bureau of Land Management	USA	St. Louis	25	61	12	NE 1/4 - NE 1/4 (Lot 1), all unsurveyed islands	13.75	Original permit expired in 2006, Application for preference right lease filed.
MNES-55301 (Application)	Bureau of Land Management	USA	Lake	18	61	11	Lot 11	153.2	Unknown
							Lot 21		
							Lot 22		
				19	61	11	Lot 9		
MNES-55302 (Application)	Bureau of Land Management	USA	Lake	8	61	11	Lot 1	159.2	Unknown
							Lot 3		
							Lot 4		
							W1/2-NE1/4		
				17	61	11	Lot 2		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							Lot 4		
							Lot 5		
MNES-55305 (Application)	Bureau of Land Management	USA	Lake	29	61	11	W 1/2	320	Unknown
MNES-55306 (Application)	Bureau of Land Management	USA	Lake	18	61	11	Lot 3	165.05	Unknown
							Lot 4		
							Lot 5		
							Lot 6		
							Lot 8		
MNES-54050 (Application)	Bureau of Land Management	USA	Lake	5	61	11	All land under water in the S1/4	227	Unknown
							All land under water in Lot 5 (NE1/4 of SW1/4)		
				8			All land under water		
MNES 054194 (Application)	Bureau of Land Management	Federal	Lake	4	60	11	All	1,780.20	Unknown
				5	60	11	All		
				8	60	11	All		
MNES 054195 (Application)	Bureau of Land Management	USA	Lake	18-19	60N	11W	All of Sections 18 and 19	2,080 (includes 40 acres that are part of State Lease 10157)	Unknown
MNES 054196 (Application)	Bureau of Land Management	USA	Lake	6	60N	11W	1	1,160	Unknown
							2		
							3		
							4		
							5		

Permit Name	PERMITTING OR LEASING AUTHORITY	SURFACE OWNER	Legal Description					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							6		
							7		
							8		
							12		
							13		
							21		
							22		
							NE 1/4		
							SE 1/4		
							2		
							10		
							20		
							NE 1/4		
							SE 1/4		

Table 4-5: Terms of Federal Prospecting Permits and Permit Applications

Permit Name	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		ANNUAL CARRYING COSTS	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011-2016	
MNES 050652 (Permit)	BLM's 9/1/2011 Decision: 577 days remain	12/1/2001	N/A	To be Negotiated				No	Quarterly	$433.00	
MNES 050846 (Permit)	BLM's 9/1/2011 Decision: 577 days remain	12/1/2001	N/A	To be Negotiated				No	Quarterly	$89.50	
MNES-53731 (Application)	Unknown	Application 8/23/2005	N/A	To be Negotiated				No	Per CFR	$298.50	Pending until completion of USFS EIS on mineral exploration.
MNES-54387 (Application)	Unknown	4/10/2006	N/A	To be Negotiated				No	Per CFR	$647.50	Formerly #50163. Pending until completion of USFS EIS on mineral exploration.
MNES-52446 (Permit - See Remarks)	Unknown	11/1//2004	N/A	To Be Negotiated				No	Per CFR	$387.50	This permit is on hold until USFS EIS on mineral exploration is completed. Former Permit 49258.
MNES-50264 (Preference Application Filed)	Original permit expired in 2006, current application pending.	11/1/2000	N/A	To be Negotiated				No	Per CFR	$20.00	Preference Right Lease application filed 12/13/2006.
MNES-55301 (Application)	Unknown	Application 04/02/2008	N/A	To be Negotiated				No	Per CFR	$77.00	Pending until completion of USFS EIS on mineral exploration.
MNES-55302 (Application)	Unknown	Application 04/08/2008	N/A	To be Negotiated				No	Per CFR	$80.00	Pending until completion of USFS EIS on mineral exploration.

Permit Name	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		ANNUAL CARRYING COSTS	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011-2016	
MNES-55305 (Application)	Unknown	4/22/2008	N/A	To be Negotiated				No	Per CFR	$160.00	Pending until completion of USFS EIS on mineral exploration.
MNES-55306 (Application)	Unknown	Application 04/17/2008	N/A	To be Negotiated				No	Per CFR	$83.00	Pending until completion of USFS EIS on mineral exploration.
MNES-54050 (Application)	Unknown	Application 05/01/2006	N/A	To be Negotiated				No	Per CFR	$138.50	Pending until completion of USFS EIS on mineral exploration.
MNES 054194 (Application)	Unknown	Application 04/25/2006	N/A	To be Negotiated				Unknown	Unknown	$960	Pending until completion of USFS EIS on mineral exploration.
MNES 054195 (Application)	Unknown	Application: April 25, 2006		To be Negotiated					Quarterly	$1,040	Pending until completion of USFS EIS on mineral exploration.
MNES 054196 (Application)	Unknown	Application April 25, 2006		To be Negotiated					Quarterly		Pending until completion of USFS EIS on mineral exploration.

State Leases

State leases to explore for, mine and remove metallic minerals are held for a period of 50 years. Rights conveyed in these leases exclude the extraction of iron ore, taconite ores, coal, oil, gas, and other liquid or gaseous hydrocarbons, which are either reserved by the State of Minnesota or are covered under separate state leases involving third parties. Twin Metals has the benefit of 27 state leases (State Leases) for a total of 6,012.84 acres (2,433.31 hectares; Figure 4-5) as indicated in Table 4-6.

In Minnesota, an operating mining company pays a production royalty in addition to lease payments and applicable taxes. The base royalty consists of a base rate, and in some cases an additional bid rate, which are indicated in Table 4-6. State Leases also contain a royalty escalation clause that increases the base royalty as the net return value per ton of raw ore increases.

Table 4-7 summarizes the terms of the state leases. The State of Minnesota has an option to cancel a mineral lease after the end of the 20th year if, by that time, a lessee is not actively engaged in mining ore under the lease from the mining unit, a mine within the same government township as the mining unit or an adjacent government township and has not paid at least $100,000 to the State in earned royalty under a metallic mineral lease in any one calendar year. The State must exercise that option within the 21st year of the lease. If the State does not cancel within the 21st year, the lessee has until the end of the 35th calendar year to meet the conditions. If the lessee has not met the conditions by the end of the 35th year, the State has another window to cancel the lease during the 36th calendar year of the lease. Two state leases are beyond their 21st calendar year, but the State of Minnesota did not exercise its right to cancel and TMM now has until the end of the 35th calendar year to commence production and pay royalties.

Figure 4-5: TMM State of MN Mineral Lease Map

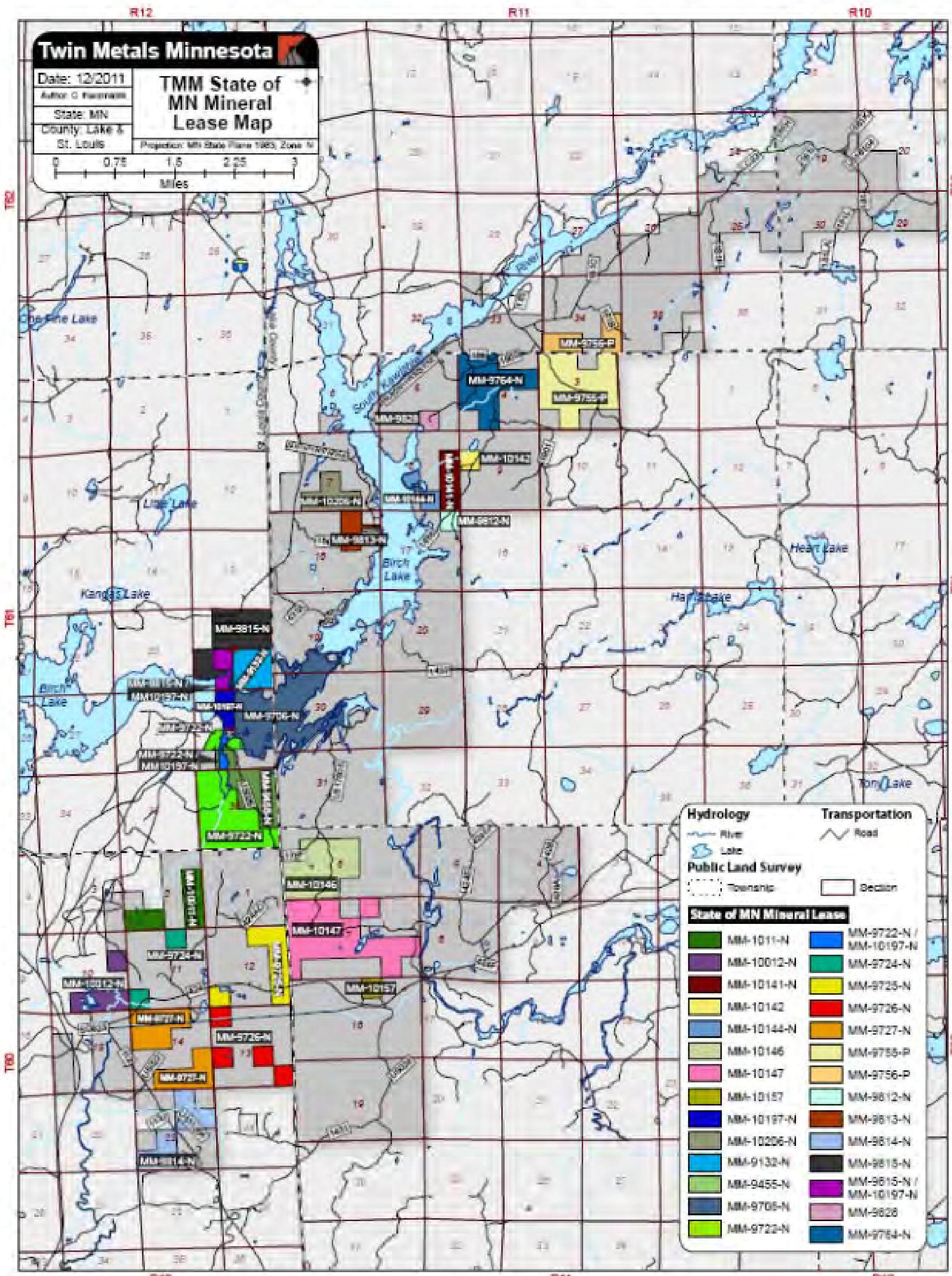


Table 4-6: Location of Minnesota State Mineral Leases

<table>
<tr><th rowspan="2">Lease Number</th><th rowspan="2">MINERAL LESSOR/OWNER</th><th rowspan="2">SURFACE OWNER</th><th colspan="5">LEGAL DESCRIPTION</th><th rowspan="2">ACRES</th><th rowspan="2">Expiry Date</th></tr>
<tr><th>County</th><th>Section</th><th>Twp</th><th>Range</th><th>Section Subdivision</th></tr>
<tr><td>MM-9132</td><td>State of Minnesota</td><td>USA</td><td>St. Louis</td><td>24</td><td>61</td><td>12</td><td>2/3 Interest in N 1/2 of SE 1/4
2/3 Interest in Lot 3
2/3 Interest in Lot 4</td><td>159.25</td><td>12/21/2038</td></tr>
<tr><td rowspan="2">MM-9455-N</td><td rowspan="2">State of Minnesota</td><td rowspan="2">Minnesota Power and Light & State</td><td rowspan="2">St. Louis</td><td>25</td><td>61</td><td>12</td><td><u>Mineral only</u>
SE1/4-SW1/4</td><td rowspan="2">242</td><td rowspan="2">6/7/2040</td></tr>
<tr><td>36</td><td>61</td><td>12</td><td><u>Surface and Mineral Rights</u>
NE1/4
NE1/4-SE1/4
<u>Mineral only</u>
That part of the NE1/4-NW1/4 lying east of the current natural ordinary high water mark of the Birch Lake Reservoir, more or less, but excepting and excluding the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark</td></tr>
<tr><td rowspan="5">MM-9706-N</td><td rowspan="5">State of Minnesota</td><td rowspan="5">USA and MN</td><td rowspan="3">Lake</td><td>19</td><td rowspan="3">61</td><td rowspan="3">11</td><td>S 1/2 of S 1/2 of W 1/2</td><td rowspan="5">614.96</td><td rowspan="5">10/4/2047</td></tr>
<tr><td>30</td><td>West 1/2</td></tr>
<tr><td>31</td><td>N 1/2 of N 1/2 of W 1/2</td></tr>
<tr><td rowspan="2">St. Louis</td><td>24</td><td>61</td><td>12</td><td>S 1/2 of SE 1/4</td></tr>
<tr><td>25</td><td>61</td><td>12</td><td>E 1/2</td></tr>
<tr><td>MM-9722-N</td><td>State of Minnesota</td><td>Rendfield Land Co. (Lots 3 and 4, SE 1/4 of SW 1/4, part of NW 1/4 of SW 1/4 and part of SW 1/4 of SW 1/4); USA (Lot 5); TMM (Part of NW 1/4 of SW 1/4 and part of</td><td>St. Louis</td><td>25</td><td>61</td><td>12</td><td><u>Mineral only</u>
Lot 4, including the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary water mark thereof, Section 25; and the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark thereof, in SE1/4-SW1/4, Section 25;</td><td>480.25</td><td>6/16/2049</td></tr>
</table>

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
		SW 1/4 of SW 1/4)							
		Rendfield Land Co. (NE 1/4 of NW 1/4 and part of NW 1/4 of NW 1/4); TMM (SW 1/4 of NW 1/4, SE 1/4 of NW 1/4, SW 1/4, and part of NW 1/4 of NW 1/4); MN (E/12)	St. Louis	36	61	12	<u>Surface and Mineral rights</u> NW1/4-SE1/4; and S 1/2- SE 1/4; <u>Mineral only</u> NE1/4-NW1/4, except that part lying east of the current natural ordinary high water mark of the Birch Lake Reservoir; and NW1/4-NW1/4; and S1/2-NW1/4; and SW1/4 each of which include the lands, minerals, and mineral rights lying in and directly under the bed of the Birch Lake Reservoir below the current natural ordinary high water mark.		
MM-9724	State of Minnesota	USA & Cliffs	St. Louis	11	60	12	<u>Mineral only</u> SW1/4-SW1/4 <u>Mineral and Surface</u> NW1/4-NE1/4	80	6/16/2049
MM-9725	State of Minnesota	MN	St. Louis	12	60	12	N1/2-NE1/4 SE1/4-NE1/4 SW1/4-SW1/4 E112-SE1/4	240	6/16/2049
MM-9726	State of Minnesota	USA and MN	St. Louis	13	60	12	NW1/4-NW1/4 NW1/4-SW1/4 SE1/4-SE1/4 NW1/4-SE1/4	160	6/16/2049
MM-9727	State of Minnesota	MN and Minnesota Power & Light	St. Louis	14	60	12	NW1/4-NE1/4 NE1/4-NW1/4 S1/2-NW1/4 SE1/4-SW1/4 NE1/4-SE1/4) S1/2-SE1/4 NW1/4-NW1/4	360	6/16/2049
MM-9755	State of Minnesota	MN	Lake	3	61	11	Lots 1, 3 and 4 SE 1/2 of NE 1/4 S 1/2 of NW 1/4 N 1/2 of SW 1/4 SE 1/4 of SW 1/4 N 1/2 of SE 1/4	457.58	6/8/2050

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MM-9756	State of Minnesota	MN	Lake	34	62	11	S 1/2 of SW 1/4 E 1/2 of SE 1/4	160	6/8/2050
MM-9764	State of Minnesota	MN	Lake	4	61	11	S 1/2 of NE 1/4 Lots 3 and 4 S 1/2 of NW 1/4 N 1/2 of SW 1/4 SE 1/4 of SW 1/4	348.2	9/7/2050
MM-9812	State of Minnesota	USA	Lake	17	61	11	Undivided 1/2 Interest in NE 1/4 - NE 1/4	40	12/14/2050
MM-9813	State of Minnesota	County & private	Lake	18	61	11	Lot One, except north 1.063 feet and except south 250 feet; W 1/2 - NE 1/4	80.3	12/14/2050
MM-9814	State of Minnesota	USA and MN	St. Louis	23	60	12	NW 1/4 - NE 1/4 (Mineral & Surface, if any) NE 1/4 - SW 1/4 (Mineral & Surface, if any) S 1/2 SW 1/4 (Mineral & Surface, if any) S 1/2 - NE 1/4 (Mineral only)	240	12/14/2050
MM-9815	State of Minnesota	USA	St. Louis	24	61	12	Mineral only: undivided interest, as follows: 8568/16128 in NE1/4-NE1/4; 106-5/16128 in NE1/4-NE1/4; 5210/16128 in NE1/4-NE1/4; 204120/435456 in NW1/4-NE1/4; 32589/435456 in NW1/4-NE1/4; 159426/435456 in NW1/4-NE1/4;204120/435456 in SW1/4-NE1/4; 32589/435456 in SW1/4-NE1/4; 159426/435456 in SW1/4-NE1/4; 1065/16128 in SE1/4-NE1/4; 5210/16128 in SE1/4-NE1/4; 32589/435456 in NE1/4-NW1/4;159426/435456 in NE1/4-NW1/4; 204120/435456 in SE1/4-NW1/4;32589/435456 in SE1/4-NW1/4; 159426/435456 in SE1/4 NW1/4; 9072/60480 in NE1/4-SW1/4, ex	377.25	12/14/2050

<table>
<tr><th rowspan="2">Lease Number</th><th rowspan="2">MINERAL LESSOR/OWNER</th><th rowspan="2">SURFACE OWNER</th><th colspan="5">LEGAL DESCRIPTION</th><th rowspan="2">ACRES</th><th rowspan="2">Expiry Date</th></tr>
<tr><th>County</th><th>Section</th><th>Twp</th><th>Range</th><th>Section Subdivision</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>easement 1.10 acres; 3291/60480 in NE1/4-S W1/4, ex easement 1.10 acres; 43458/60480 in NE1/4-SW1/4, ex easement 1.10 acres; 3291/60480 in NW1/4-SW1/4; 52530/60480 in NW1/4-SW1/4; 3291/60480 in Lot 1, ex easement 8.54 acres; 52530/60480 in Lot 1, ex easement 8.54 acres; 3291/60480 in Lot 2, ex easement 14.90 acres; 52530/60480 in Lot 2, ex easement 14.90 acres;
-Mineral and surface: undivided interest, as follows: 25/40 in NE1/4-SW1/4, ex easement, 25/40 in Lot 1, ex easement, 173/200 in Lot 2, ex easement.</td><td></td><td></td></tr>
<tr><td>MM-9828</td><td>State of Minnesota</td><td>MN</td><td>Lake</td><td>5</td><td>61</td><td>11</td><td>SW 1/4-SE 1/4</td><td>40</td><td>2050</td></tr>
<tr><td rowspan="3">MM-10011-N</td><td rowspan="3">State of Minnesota</td><td rowspan="3">TMM (SE 1/4 of SW 1/4 and SE 1/4 of NE 1/4); Erie Mining Company (SW 1/4 of SW 1/4); Allete, Inc. (SE 1/4 of NE 1/4); USA (NE 1/4 of SE 1/4)</td><td rowspan="3">St. Louis</td><td rowspan="3">2</td><td rowspan="3">60</td><td rowspan="3">12</td><td>S 1/2-SW 1/4</td><td rowspan="3">200</td><td rowspan="3">2054</td></tr>
<tr><td>undivided 19/1080 of SE 1/4-NE 1/4</td></tr>
<tr><td>undivided 19/1080 of NE 1/4-SE 1/4</td></tr>
<tr><td rowspan="3">MM-10012-N</td><td rowspan="3">State of Minnesota</td><td rowspan="3">Erie Mining Co. (SE 1/4 of NE 1/4); Northshore Mining Co. (SE 1/4 of SW 1/4 and SW 1/4 of SE 1/4); Allete, Inc. (SE 14 of SE 1/4)</td><td rowspan="3">St. Louis</td><td rowspan="3">10</td><td rowspan="3">60</td><td rowspan="3">12</td><td>SE 1/4-NE 1/4</td><td rowspan="3">160</td><td rowspan="3">2054</td></tr>
<tr><td>SE 1/4-SW 1/4</td></tr>
<tr><td>S 1/2-SE 1/4</td></tr>
</table>

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
MM-10141-N	State of Minnesota	TMM	St. Louis	8	61	11	Undivided 1/2 interest SE 1/4-NE 1/4 Undivided 1/2 interest NE 1/4-SE 1/4 Undivided 1/2 interest SE 1/4-SE 1/4	120	2057
MM-10142-N	State of Minnesota	TMM	Lake	9	61	11	Undivided 1/2 interest SW 1/4-NW 1/4	40	2057
MM-10144-N	State of Minnesota	Thomas Arendshorst and Sharon Arendshorst, husband and wife (Lot 5) and State of MN (SW 1/4 of SE 1/4)	Lake	8	61	11	Undivided 1/2 interest in Lot 5 and SW 1/4-SE 1/4	69	2057
MM-10146-N	State of Minnesota	USA and State of MN (Lots 17 & 18)	Lake	6	60	11	Lot 17 Lot 18 Lot 11 Lot 14 Lot 9 Lot 10 Lot 15 Lot 16 Lot 19 Lot 20	384.35	2057
MM-10147	State of Minnesota	MN	Lake	7	60	11	Lot 1 (surface and mineral) Lot 9 (surface and mineral) Lot 12 (surface and mineral) Lot 3 (surface and mineral) Lot 4 (surface and mineral) Lot 7 (surface and mineral) Lot 8 (surface and mineral)	619.3	12/6/2057

Lease Number	MINERAL LESSOR/OWNER	SURFACE OWNER	LEGAL DESCRIPTION					ACRES	Expiry Date
			County	Section	Twp	Range	Section Subdivision		
							Lot 5 (surface and mineral)		
							Lot 6 (surface and mineral)		
							Lot 13 (surface and mineral)		
							Lot 14 (surface and mineral)		
							Lot 15 (surface and mineral)		
							Lot 16 (surface and mineral)		
							Lot 11 (minerals only)		
							NE-SE (mineral Only)		
							NW-SE (minerals only)		
							Undivided 1/2 interest SW-SE (minerals only)		
MM-10157	State of Minnesota	USA	Lake	18	60	11	Lot 1	40	12/6/2057
MM-10197-N	State of Minnesota	USA (E 1/2 of S 1/2 of W 1/2); RendField Land Co. (E 1/2 of W 1/2)	Lake	24	61	12	E 1/2-S 1/2-W 1/2	91.65	6/21/2058
				25	61	12	E 1/2-W 1/2		
MM-10206-N	State of Minnesota	USA	Lake	7	61	11	Lot 14	160	9/11/2058
							Lot 20		
							Lot 21		
							SW-SE		
MM-10229	State of Minnesota		St. Louis	6	59	12	Lot 10	48.75	3/12/2059

Table 4-7: Terms of Minnesota State Leases

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9132	12/21/2038	12/21/1988	Lessee	3.50%	2.70%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum.	$2,654.25	$2,654.25	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 29). Subject to Minn. Stat. § 93.55, Subd. 2.
MM-9455-N	6/7/2040	6/7/1990	Lessee	3.50%	2.60%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$6,050.00	$6,050.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 29). Subject to special review of exploration plans by DNR.
MM-9706-N	0/4/2047	10/4/1997	Lessee	3.50%	2.60%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$18,448.8	$18,448.8	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Lake bottom lease.
MM-9722-N	6/16/2049	6/16/1999	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$14,407.50	$14,407.50	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20.
MM-9724	6/16/2049	6/16/1999	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum.	$2,400.00	$2,400.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 60-1288P and 69.51P.

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9725	6/16/2049	6/16/1999	Lessee	3.95%	0.16%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$7,200.00	$7,200.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 69-51P, 69-52P.
MM-9726	6/16/2049	6/16/1999	Lessee	3.95%	0.11%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum.	$4,800.00	$4,800.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake beds 69-51P, 69-52P.
MM-9727	6/16/2049	6/16/1999	Lessee	3.95%	0.11%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$10,800.00	$10,800	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Excludes lake bed 69-51P.
MM-9755	6/8/2050	6/8/2000	Lessee	3.95%	None	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$6,863.70	$13,727.40	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9756	6/8/2050	6/8/2000	Lessee	3.95%	None	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$4,800.00	$4,800.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9764	9/7/2050	9/7/2000	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$10,446.00	$10,446.61	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-9812	12/14/2050	12/14/2000	Lessee	3.95%	0.07%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$600.00	$600.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Subject to Minn. Stat. 93.55.
MM-9813	12/14/2050	12/14/2000	Lessee	3.95%	0.07%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$2,409.00	$2049.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9814	12/14/2050	12/14/2000	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$7,200.00	$7,200.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-9815	12/14/2050	12/14/2000	Lessee	3.95%	0.04%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$9,063.60	$9063.60	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Subj. to MN Statute 93.55, subd. 2
MM-9828	2050	12/14/2000	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$1,200.00	$1,200.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10011-N	2054	6/3/2004	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$1,231.65	$1,231.65	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10012-N	2054	6/3/2004	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$2,400.00	$2,400.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-10141-N	2057	3/21/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$300.00	$900.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10142-N	2057	3/21/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$100.00	$300.00	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10144-N	2057	10/16/2007	Lessee	3.95%	0.23%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$172.50	$517.50	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10146-N	2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$1,921.75	$5,765.25	Unknown	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31). Lease excepts and excludes the lands, minerals, and mineral rights lying in and directly under the bed of Stony River below the natural ordinary high water mark thereof
MM-10147	12/6/2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Rent.	No	Monthly production reports required, exploration reports are required annually as a minimum	$3,096.50	$9,289.50	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20

Lease Number	Expiry Date	Initial Agreement Date	Property Tax Paid By	ROYALTIES				WORK REQUIREMENTS		CURRENT ANNUAL CARRYING COSTS		Possible Land Use Restrictions	Comments
				Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Minimum Royalty	Yearly Work Commitment Required	Submission of Work Results	2011-12	2013-2016		
MM-10157	12/6/2057	12/6/2007	Lessee	3.95%	0.66%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$200.00	$600.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31)
MM-10197-N	6/21/2058	6/21/2008	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$458.25	$1,374.75	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-10206-N	9/11/2058	9/11/2008	Lessee	3.95%	0.50%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$800.00	$2400.00	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).
MM-10229	3/12/2059	3/12/2009	Lessee	3.95%	0.57%	Yes	Yes	No	Monthly production reports required, exploration reports are required annually as a minimum	$243.75	$731.25	Yes	Must pay royalties of $100,000 in any one year and be mining before year 20 (see Section 31).

Private Leased Lands

TMM currently has benefit of 13 mineral leases with private parties that cover 5,562.93 acres (2,251.24 hectares; Table 4-8; Figure 4-6). The provisions and terms of each lease are specific to the individual leases (Table 4-9). The terms, including initial and renewal terms, range from 40 to 50 years. The surface rights are owned either by TMM, its affiliates, the state or federal government, or private parties. The private leased lands are leased in an "as is" condition to TMM for the purposes of exploring, prospecting, drilling and test pitting the properties and grants TMM the sole and exclusive right to mine and extract and to carry on mining, milling and refining operations with respect to all mineral substances of a metalliferous nature.

Royalties are variable by lease and are summarized in Table 4-8. Some of these properties contain a royalty escalator that increases royalties as the net return value per ton of raw ore increases.

Figure 4-6: TMM Private Mineral Lease Map

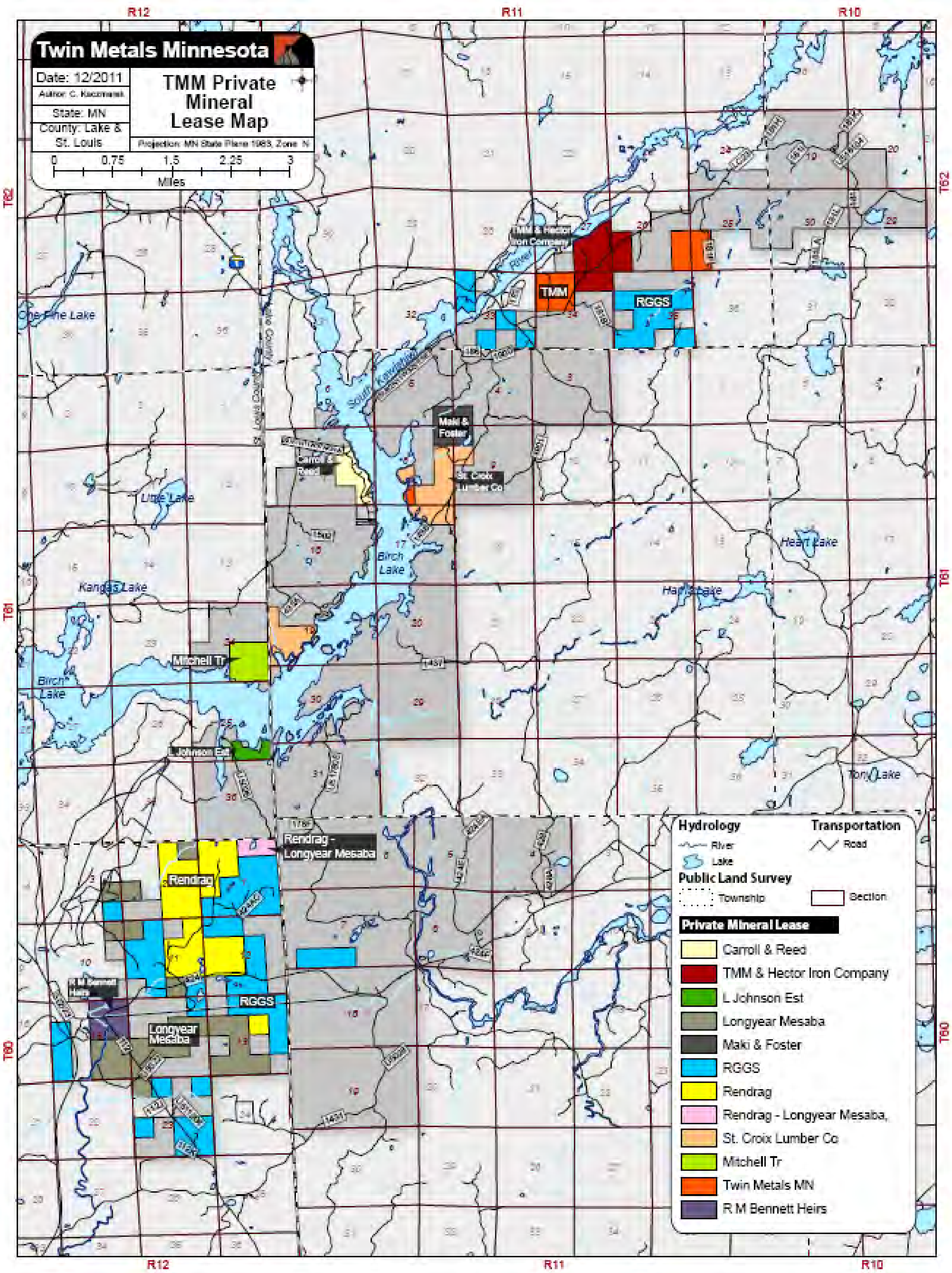


Table 4-8: TMM Private Leased Lands Locations

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
				Section	Twp	Range	Section Subdivision		
RGGS/Wallbridge 01/01/2006	RGGS Land & Minerals, Ltd.,		Lake	33	62	11	NW 1/4 - NW 1/4	40	1/1/2026
							SE 1/4 - SW 1/4	40	
							NW 1/4 - SE 1/4	40	
							SE 1/4 - SE 1/4	40	
							Government Lot 5	41.75	
				35	62	11	SW 1/4 NE 1/4	40	
							SE 1/4 - NE 1/4	40	
							SW 1/4 - NW 1/4	40	
							SE 1/4 - NW 1/4	40	
							NE 1/4 - SW 1/4	40	
							SW 1/4 - SW 1/4	40	
							SE 1/4 - SW 1/4	40	
							NW 1/4 - SE 1/4	40	
							SE 1/4 - SE 1/4	40	
Foster DMC Lease 02/12/08	Goldi I Foster and Walter B. Foster		Lake	4	61	11	Undivided 17/81 of SW 1/4 - SW 1/4	40	2/12/2028
				5	61	11	Undivided 17/81 of SE 1/4 - SE 1/4	40	
				8	61	11	Undivided 17/81 of NE 1/4 - NE 1/4	40	
				9	61	11	Undivided 17/81 of NW 1/4 - NW 1/4	40	
Maki DMC Lease 03/17/2007	Richard A. and Lavonne Maki; James K. and Linda Maki; Diane J. and Brian Manuszak; and Jean Maki		Lake	4	61	11	Undivided 4/9 in SW-SW	40	3/17/2027
				5	61	11	Undivided 4/9 in SE-SE	40	
				8	61	11	Undivided 4/9 in NE-NE	40	
				9	61	11	Undivided 4/9 in NW-NW	40	

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
St. Croix Lumber Co. DMC Lease 12/15/2006	St. Croix Lumber Company, Inc.		Lake	9	61	11	SW 1/4 - NW 1/4	40	12/15/2026
				8	61	11	SE 1/4 - NE 1/4	40	
				8	61	11	NE 1/4 - SE 1/4	40	
				8	61	11	SE 1/4 - SE 1/4	40	
				8	61	11	SW 1/4 - SE 1/4	40	
				8	61	11	NE 1/4 - SW 1/4	40	
St. Croix LEM Lease 04.09.1987	St. Croix Lumber Company, Inc	USA and Private	Lake	19	61	11	Lot 6	160.22	4/9/2012, 4/9/2037 or as long as commercial production (see remarks)
				19	61	11	Lot 12		
				19	61	11	Lot 13		
				19	61	11	Lot 14		
				19	61	11	Lot 15		
				19	61	11	Lot 16		
				30	61	11	Lot 2		
				17	61	11	NE 1/4 - NE 1/4	40	
				17	61	11	Lot 1	45.3	
				17	61	11	Lot 2		
WF Mitchell LEM 06.01.1987	Wells Fargo Bank, MN	USA	St. Louis	24	61	12	N 1/2 SE 1/4	159.25	6/1/2012; 6/1/2037 or as long as commercial production. See remarks.
							Lot 3 (SW 1/4 SE 1/4)		
							Lot 4 (SE 1/4 SE 1/4)		
Rendrag LEM 7/31/1999	Rendrag, Inc.	USA, MPL and Cliffs	St. Louis	1	60	12	Lot 1	39.8	8/1/2049
							Lot 3	39	
							Lot 4	38.6	
							NW/SW	40	
							SE/NW	40	
							SW/NW	40	
				2	60	12	Lot 2	39.7	
							NE/SE	40	
							NW/SE	40	
							SE/NE	40	
							SE/SE	40	

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
							SW/NE	40	
							SW/SE	40	
				11	60	12	NE/NE	40	
							NE/SE	40	
							NW/SE	40	
							SE/NE	40	
							SW/NE	40	
				12	60	12	NE/SW	40	
							NW/SW	40	
							SE/NW	40	
							SW/NW	40	
				13	60	12	SW/NE	40	
RM Bennett LEM Lease 1.1.2001	R.M. Bennett Heirs L.P.	Mesabi Trust	St. Louis	15	60	12	NE 1/4	160	12/31/2051
RGGS LEM Lease 08.30.2001	RGGS Lands & Minerals Ltd.	USA, MPL, Mesabi Trust, Cliffs, County	St. Louis	1	60	12	SW 1/4 NE 1/4	1,560.00	8/29/2021; continues indefinitely if minerals are produced (see Section 4).
							SE 1/4 NE 1/4		
							NE 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							SE 1/4 SW 1/4		
							NE 1/4 SE 1/4		
							NW 1/4 SE /14		
							SW 1/4 SE 1/4		
							SE 1/4 SE 1/4		
			St. Louis	3	60	12	SE 1/4 SE 1/4		
			St. Louis	11	60	12	NE 1/4 NW 1/4		
							SW 1/4 NW 1/4		
							SE 1/4 NW 1/4		
							NE 1/4 SW 1/4		
							NW 1/4 SW 1/4		

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
							SE 1/4 SW 1/4		
							SE 1/4 SE 1/4		
			St. Louis	12	60	12	SW 1/4 NE 1/4		
							NE1/4 NW 1/4		
							NW 1/4 NW 1/4		
							SE 1/4 SW 1/4		
							NW 1/4 SE 1/4		
							SW 1/4 SE 1/4		
			St. Louis	13	60	12	NE 1/4 NE 1/4		
							NW 1/4 NE 1/4		
							SE 1/4 NE 1/4		
							NE 1/4 NW 1/4		
							NE 1/4 SE 1/4		
			St. Louis	14	60	12	NE 1/4 NE 1/4		
			St. Louis	15	60	12	SW 1/4 NW 1/4		
							NW 1/4 SW 1/4		
							SW1/4 SW 1/4		
			St. Louis	23	60	12	NE 1/4 NE 1/4		
							NE 1/4 NW 1/4		
							NW 1/4 SW 1/4		
							NE 1/4 SE 1/4		
							NW 1/4 SE 1/4		
							SW 1/4 SE 1/4		
							SE 1/4 SE 1/4		
Johnson LEM Lease 06.10.1986	J. Thomas Johnson Mr. Darryl E. Coons, Lorrie Jams,	USA	St. Louis	25	61	12	Lot 5 (SW 1/4 SE 1/4)	62.75	6/09/2016; 06/09/2026 if merchantable ore discovered by 6/09/2016; indefinite if commercial production from the premises
							Lot 6 (SE 1/4 SE 1/4)		

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
	Mr. Harold A. Knutson								
Longyear Mesaba LEM Lease 10/01/2000	Longyear Mesaba Co., dba LMC Minerals	USA, Cliffs, Mesabi Trust Company	St. Louis	1	60	12	NW 1/4 NE 1/4	1000	9/30/2050 (9/30/2059 if min. earned royalty paid. Section 27)
			St. Louis	2	60	12	NE 1/4 NE 1/4		
							NW 1/4 SW 1/4		
			St. Louis	3	60	12	NE 1/4 SE 1/4		
			St. Louis	10	60	12	NE 1/4 NE 1/4		
			St. Louis	11	60	12	NW 1/4 NE 1/4		
							NW 1/4 NW 1/4		
							SW1/4 SE 1/4		
			St. Louis	13	60	12	SW 1/4 NW 1/4		
							SE 1/4 NW 1/4		
							NE 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							SE 1/4 SW 1/4		
							SW 1/4 SE 1/4		
			St. Louis	14	60	12	SW 1/4 NE 1/4		
							SE 1/4 NE 1/4		
							NE 1/4 SW 1/4		
							NW 1/4 SW 1/4		
							SW 1/4 SW 1/4		
							NW 1/4 SE 1/4		
			St. Louis	15	60	12	SE 1/4		
			St. Louis	23	60	12	NW 1/4 NW 1/4		
FMC Reed Lease 04/15/2010	Dayton Reed		Lake	7	61	11	NW 1/4 SE 1/4	168.28	4/15/2060
							Lot 11		
							Lot 13		
							Lot 22 (Conflict in legal description. See remarks.)		

Lease Name	Mineral Lessor/Owner	Surface Owner	County	Legal Description				ACRES	Expiration Date
				18	61	11	Lot 1		
FMC Carroll Lease 04/15/2011	Robert Carroll		Lake	7	61	11	NW 1/4 SE 1/4	168.28	4/15/2060
							Lot 11		
							Lot 13		
							Lot 22 (Conflict in legal description. See remarks.)		
				18	61	11	Lot 1		

Table 4-9: TMM Private Leased Lands Terms

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
RGGS / Wallbridge 01/01/2006	1/1/2026	7/5/2025 (180 days prior to expiration)	1/1/2006	5%	none	no	200,0000 after start of commercial production	$25,000 in years 1-2; $25,000/year after. Yearly report required, see Section 46.	Monthly: See Section 15.	Rent: Greater of $5/acre or $5,000	Only if commercial production starts	Rent: Greater of $5/acre or $5,000	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Rent: Greater of $10/acre or $7,500.00	Renewal terms for 5 years, max of four for a total extension to 01/01/2046. Rent ceases when commercial production begins.
Foster DMC Lease 02/12/08	2/12/2028	06/15/2028 (180 days prior to expiration)	2/12/2008	3%	none	No	Yearly minimum royalty (Section 13); no rent	No	Monthly. See Section 15.	None	$2,500.00	Adv. Royalty: $2500.00	Adv. Royalty: $2,500.00	Adv. Royalty: $2,500.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Renewal terms for 5 years, max of four for a total extension to 02/12/2048.
Maki DMC Lease 03/17/2007	3/17/2027	9/18/2026	3/17/2007	3%	none	No	Yearly minimum royalty (Section 13); no rent	No	Monthly. See Section 15.	None	$2,500.00	Adv. Royalty: $2500.00	Adv. Royalty: $2500.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Adv. Royalty: $5,000.00	Renewal terms for 5 years, max of four for a total extension to 03/17/2047.
St. Croix Lumber Co. DMC Lease 12/15/2006	12/15/2026	6/24/2026	12/15/2006	3%	none	No	Yearly minimum royalty (see 2007 amendment) ; no rent	No.	Monthly, See Section 15	None	$3,500	Adv. Royalty: $3,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Adv. Royalty: $7,500.00	Renewal terms for 5 years, max of 4 for a total extension to 12/15/2046.
St. Croix LEM Lease 04.09.1987	4/9/2012, 4/9/2037 or as long as commercial production (see remarks)	See remarks	4/9/1987	4% by underground; 5% by pit	none	Yes	Yes	No	Yearly reports. See Section 7.	0	$3,069.00	Adv. Royalty: $3,069.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	Adv. Royalty: $6,138.00 (before PPI Adjustment per section 5)	5% Royalty on open pit ores. Initial term automatically extends for an additional 25 years if merchantable ore is discovered, giving an expiration date of 2037. If there is commercial production on the premises by the expiration date in 2037, the lease extends as long as there is commercial production.
WF Mitchell LEM 06.01.1987	6/1/2012; 6/1/2037 or as long as commercial production. See remarks.	See remarks.	6/1/1987	4% by underground; 5% by pit	none	Yes	Yes	No	Yearly reports. See section 7.	0	$1,327.00 (before PPI adjustment per Section 5)	Adv. Royalty: $1,327.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	Adv. Royalty: $2,654.00 (before PPI adjustment per Section 5)	5% Royalty on open pit ores. Initial term automatically extends for an additional 25 years if merchantable ore is discovered, giving an expiration date of 2037. If there is commercial production on the premises by the expiration date in 2037, the lease extends as long as there is commercial production.

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
Rendrag LEM 7/31/1999	8/1/2049		7/31/1999	3.95% (Varies by Net Return Value, See Section 6)	0.1525% of Net Return Value (See Section 6 a)	Yes.	Rent	$100,000	Quarterly report of ore removed (Section 9); Detailed monthly report (Section 13); Additional monthly and annual reports with samples (Section 14)	25,713	0	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Rent: $25,713.00	Work commitment can be met on adjacent lands. Lessor has the right to cancel in years 26 and 36 if no development or production.
RM Bennett LEM Lease 1.1.2001	12/31/2051		1/1/2001	3.95% (varies by PPI, see Section 7)	0.23%	Yes	Yes (Section 5)	$50,000	Quarterly reports with royalty (section 11); Monthly reports (section 14); Additional annual and monthly reports (Section 15)		$1,600 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $1,600.00 (before adjustment per Section 5)	Adv. Royalty: $4,000.00 (before adjustment per Section 5)	Adv. Royalty: $4,000.00 (before adjustment per Section 5)	Lessor can terminate if minimum earned royalty payments not made by 2024, 2039, 2049 or 2059. Work commitment can be met on adjacent lands.
RGGS LEM Lease 08.30.2001	8/29/2021; continues indefinitely if minerals are produced (see Section 4).	N/A	8/30/2001	5.00%	none	No	Yes (section 7)	$25,000	Monthly (section 11); Annual report re exploration (Section 12); Annual minimum work commitment report (section 8).	15,600	0	Rent: $15,600.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	Rent: $39,000.00	20-yr term and so long thereafter as mining is occurring on a deposit wholly or partially leased lands. This lease is between United States Steel and LEM. United States Steel is now RGGS.
Johnson LEM Lease 06.10.1986	6/09/2016; 06/09/2026 if merchantable ore discovered by 6/09/2016; indefinite if commercial production from the premises	N/A	6/10/1986	Precious mineral royalty varies by depth of minerals; see remarks	none	No	Yes, Adjusted per PPI (Section 5 and 1998 Amendment)	No	Annual Reports (Section 7)	0	6,275	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $6,275.00 (Before PPI Adjustment)	Adv. Royalty: $12,550.00 (Before PPI Adjustment)	Precious minerals (gold, silver, platinum group) and uranium royalties vary by depth: 7% if within 1,000 feet of the surface; 6% if between 1,000 and 2,000 feet of the surface and 5% if greater than 2,000 feet. USFS ownership of surface restricts use without notification and approval. Commercial production" for purpose of lease duration requires production of at least 10,000 short tons per annum.

Lease Name	Expiry Date	Renewal Notice (if option exists)	Initial Agreement Date	Base Royalty	Additional Royalty	Royalty Escalator Applies	Rental or Advance Min. Royalty	Yearly Work Commitment Required	Submission of Work Results	Rental 2011	Minimum Advanced Royalty 2011	2011	2012	2013	2014	2015	2016	Comments
Longyear Mesaba LEM Lease 10/01/2000	9/30/2050 (9/30/2059 if min. earned royalty paid. Section 27)	N/A	10/1/2000	3.95% (adjusted. See section 7 and Exhibit A)	0.23%	Yes	Advanced Minimum Royalty	$100,000 per year	Quarterly statements (section 11); monthly reports (section 14) and additional monthly and annual reports (section 15)	0	10,000	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $10,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Adv. Royalty: $25,000.00 (Adjusted for CPI-U. See section 5)	Work commitment can be met by work on adjoining lands. Conflict as to ownership with state of NWNE Section 11-60-12. Lessor has right to cancel in years 26 and 36 if no development or production occurring.
FMC Reed Lease 04/15/2010	4/15/2060		4/15/2010	3.95% (adjusted per section 6)	0.25%	Yes	Rent: $750.00	No	Monthly reports (section 13); Quarterly reports with royalty (Section 10); Additional monthly and annual reports (section 14)	Rent: $750.00	N/A	Rent: $750.00	Rent: $750.00	Rent: $240.40	Rent: $240.40	Rent: $240.40	Rent: $360.60	
FMC Carroll Lease 04/15/2011	4/15/2060	N/A	4/15/2010	3.95% (adjusted per section 6)	0.25%	Yes	Rent: $750.00	No	Monthly reports (section 13); Quarterly reports with royalty (Section 10); Additional monthly and annual reports (section 14)	Rent: $750.00	N/A	Rent: $750.00	Rent: $750.00	Rent: $240.40	Rent: $240.40	Rent: $240.40	Rent: $360.60	Legal description of Lot 22 is unclear.

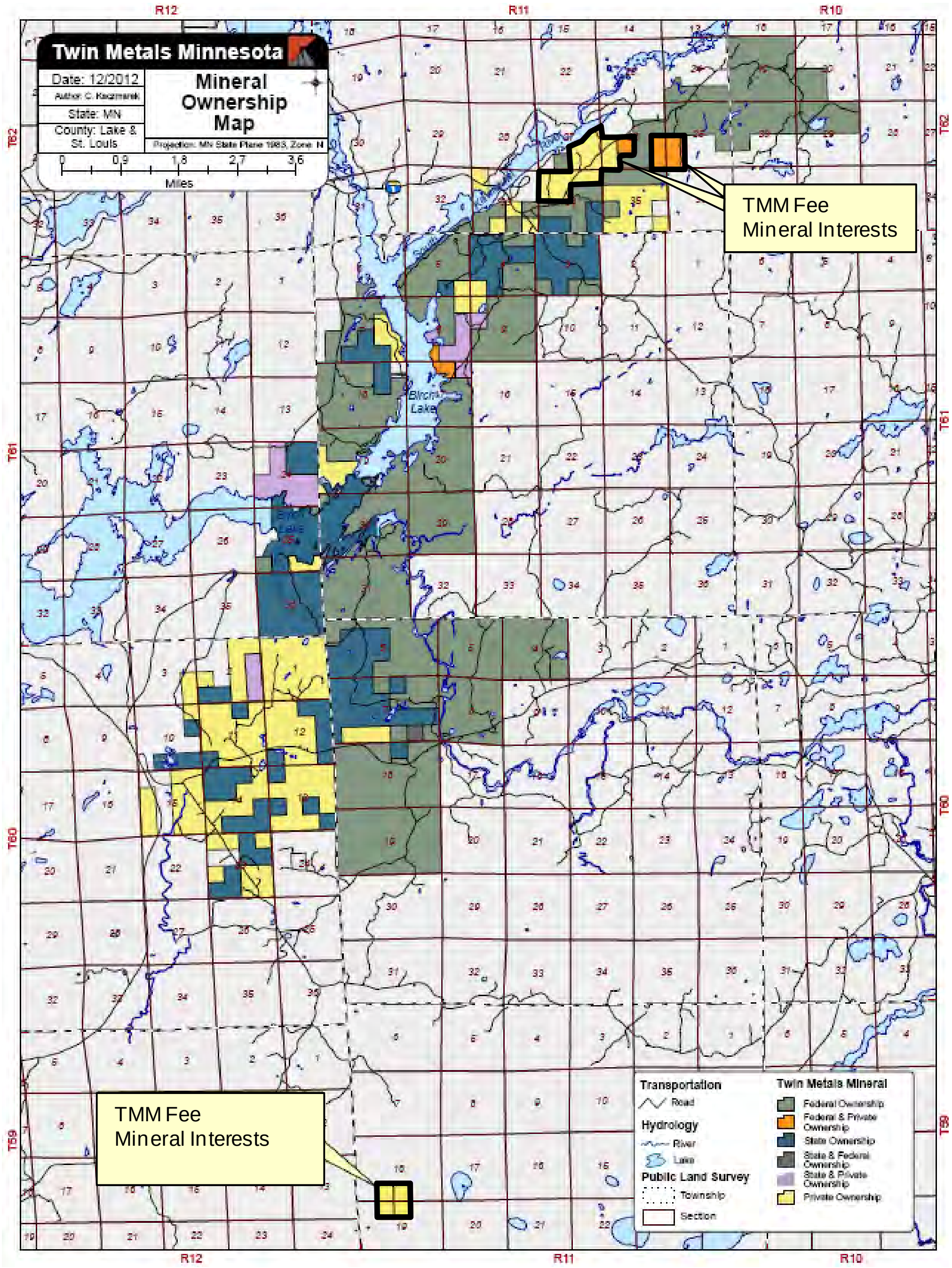
Fee Mineral Interests and Fee Surface Interests

TMM has the benefit of fee mineral ownership of approximately 400 acres (161.9 hectares) and an undivided one-half (1/2) interest in an additional 647.75 acres (262.1 hectares) (Table 4-10). Additionally, TMM has the benefit of fee ownership of, or an option to acquire, approximately 10,962.70 acres (4,436.4 hectares) of surface lands that do not include mineral rights though some surface lands overly mineral interests leased from different parties. Locations of fee mineral interests are shown in Figure 4-7.

Table 4-10: Summary of TMM Fee Mineral Interests

County	Section	Twp	Range	Surface Owner	Total Acres	Comments
Lake	18	59	11	Franconia Minerals (US) LLC	160	
	19	59	11	Franconia Minerals (US) LLC		
Lake	25	62	11	USA	160	Fee mineral interest indicated is an undivided ½ interest
	26	62	11	USA		
Lake	34	62	11	USA	160	Fee mineral interest indicated is an undivided ½ interest
Lake	26	62	11	USA	327.75	Fee mineral interest indicated is an undivided ½ interest
	27	62	11	USA/Private		
	34	62	11	USA		
Lake	7	60	11	Franconia Minerals (US) LLC	240	

Figure 4-7: TMM Fee Mineral Interests



4.4 Company Structure

4.4.1 TMM

Twin Metals Minnesota LLC (TMM) is a limited liability company that, since 2010, has been operated as a joint venture (JV) between Antofagasta PLC (Antofagasta) and Duluth Metals Limited (Duluth).

TMM is 35% owned by Duluth, 25% owned by Twin Metals (USA) LLC (which is indirectly owned by Duluth) and 40% owned by Northern Minerals Holding Co. (which is indirectly owned by Antofagasta). Accordingly Duluth holds, directly or indirectly, a 60% controlling ownership interest in TMM.

Antofagasta PLC is a Chilean copper mining company that owns and operates four copper mines in Chile. It is listed on the London Stock Exchange and has been a constituent of the FTSE-100 index since 2004.

Duluth is a Canadian exploration mining company searching for copper, nickel and platinum group metal deposits. Duluth is listed on the Toronto stock exchange (TSX).

Under the terms of the JV agreement, Antofagasta has the option to acquire an additional 25% of the joint venture from Duluth at an exercise price calculated on a pro rata share of 1.0x Net Asset Value, which will be determined by a bankable feasibility study. Antofagasta was required to provide US$130 million in direct funding to the project as its initial contribution to the joint venture. Upon making such contribution and completing a bankable feasibility study, and after certain other requirements are met, Antofagasta has the option to acquire an additional 25% equity interest in TMM based on an exercise price calculated in a pro-rata share of 1.0 times the Net Present Value of the project, which will be determined by the bankable feasibility study. Under the terms of the JV, Antofagasta also agreed to provide Duluth additional loan and financing facilities of up to US$30 million (of which US$20 million has already been advanced) to cover Duluth's share of subsequent project expenditures, which will ultimately be repayable in cash, Duluth shares, or offset against the 25% option exercise price. In addition, Antofagasta has undertaken to organize a common project financing for the large capital cost financing requirements of the project.

Duluth has retained approximately 31,000 acres of mineral interests on exploration properties adjacent to and near-by the joint venture holdings. In addition to actively participating in the joint venture on Nokomis (now Maturi), Duluth will undertake a large scale exploration program on its retained exploration properties. Because of the early stage of evaluation of these exploration properties, and the size of the properties covering the Project, these exploration properties were not considered a part of the Project.

4.4.2 Franconia Minerals (US) LLC and Birch Lake Joint Venture

Franconia Minerals (US) LLC (Franconia) is a wholly owned subsidiary of TMM. Franconia Minerals (US) LLC holds a 70% participating interest in the Birch Lake Joint Venture. The other 30% participating interest is held by Beaver Bay, Inc., an independent third-party entity. Under the terms of the Birch Lake Joint Venture agreement, Franconia may exercise an option to acquire a further 12% participating interest in the Birch Lake Joint Venture, which would result in Franconia holding an 82% participating interest and Beaver Bay, Inc. holding an 18% participating interest.

As described in Section 4.3.1, various mineral interests are held by Franconia and through the Birch Lake Joint Venture.

4.5 Surface Rights and Access

Use of the surface on federal land is provided for in the federal prospecting permits and Preference Rights Leases where the surface and mineral estates are held by the federal government. Surface rights on state land are provided for in the state leases where the surface and mineral estates are held by the state government. Use of the surface of federal or state lands is subject to approval by the applicable regulatory agencies. Surface access to federal prospecting permits and preference rights leases for drilling in certain areas is subject to seasonal restrictions (drilling from November 1 to April 30) and/or periods of frozen ground conditions. Additionally, use of the surface on many federal lands is subject to stipulations imposed by the U.S. Forest Service through the National Environmental Policy Act process to protect surface resources.

In the case of private mineral leases where there has been no severance of the surface and mineral estates, surface use is provided as part of the lease. Where the mineral and surface estates are severed and where surface rights are held privately, surface access is typically negotiated with the surface owner.

Use of fee lands owned by TMM is subject to regulatory approval by various federal, state, and local regulatory agencies.

Access to federal, state, and private lands may require additional agreements with other land owners if those lands are not accessible except by crossing other lands.

4.6 Exploration Permits & Approval

In addition to the mineral interests described above, prospecting and exploration programs may require permits and approvals from federal, state and/or local government agencies. Table 4-11 lists some of the most common permits and approvals that may be required, but Table 4-11 is not an exhaustive list. In particular, decision notices from the U.S. Forest Service may require additional approvals in certain circumstances. The ultimate scope of permits and approvals required will depend on the proposed scope of activities, the type(s) of activities, and/or the particular location of proposed activities and will be determined during more detailed studies in the future.

Table 4-11: Permits that May be Required for Exploration Activities

Federal Agency	Approval
Bureau of Land Management / US Forest Service	Plan of Operations
Bureau of Land Management / US Forest Service	National Environmental Policy Act Environmental Review
US Forest Service	Road/ Special Use Permit
Army Corps of Engineers	Clean Water Act § 404 Permit
US Fish & Wildlife Service	Threatened and Endangered Species Review
Advisory Council on Historic Preservation	Historic Preservation Review
State Agency	**Approval**
Department of Natural Resources	Operations/Exploration Plan and a company borers permit.
Department of Health	Explorer's License and boring notification
Department of Health	Temporary and Permanent Sealing Reports
Department of Natural Resources	Minnesota Environmental Policy Act Review
Pollution Control Agency	NPDES/SDS Construction Stormwater Permit (General Permit)
Pollution Control Agency	NPDES/SDS Industrial & Storm Water Discharge Permit (General Permit)
Pollution Control Agency	Storm Water Pollution Prevention Plan
Department of Natural Resources	Permit to Work in Public Waters, including Public Waters Wetlands
Department of Natural Resources	Water Appropriation Permit
Department of Natural Resources	Wetland Conservation Act approvals for activities on state land
Department of Natural Resources	Threatened and Endangered Species Review
Historic Preservation Office	Historic Preservation Review
Local Agency	**Approval**
County/Township	Grading, building and other land use permits and approvals
County/Township	Conditional use permit
County/Soil and Water Conservation District	Wetland Conservation Act approvals for activities on private land

4.7 Royalties and Encumbrances

Royalties and encumbrances are discussed in Section 4.3.2.

4.8 Environmental Studies

As part of the ongoing work, TMM has initiated baseline studies to support environmental review and permitting of the Project. Studies commenced to date include stream and lake water quality sampling, wild rice surveys, wetlands surveys, and sensitive species surveys.

Stream and water quality samples have been collected since 2008. Samples were collected during regularly scheduled events from Birch Lake, South Kawishiwi River, White Iron Lake, and a number of tributaries in the hydrologic system. Monitoring parameters include general chemistry, metals, and field parameters. The majority of the samples were collected in the spring and summer season with one season of winter sampling completed.

Wild rice studies have been conducted since 2009 in Birch Lake, White Iron Lake, South Kawishiwi River, and a number of tributaries. Because wild rice populations oscillate over an approximate 4- to 6-year period, ongoing studies are planned.

Surveys to document sensitive plants protected by State of Minnesota statutes have been conducted in various project locations. Thus far 14 sensitive species have been recorded, including two listed by the State of Minnesota as endangered. Lynx is listed as threatened under the Endangered Species Act (ESA). An existing lynx study within a portion of TMM properties identified lynx in the area.

Wetland studies have been conducted over approximately 5,400 acres of the project site to delineate wetland locations. Wetland boundaries were identified in the field, wetland descriptions were assigned, and functional assessments were conducted. Approximately 1,500 acres of wetlands have been delineated. Publicly available maps and aerial photographs have been used to make preliminary delineations throughout the entire project area.

TMM anticipates that the current studies will need to be expanded, and additional studies will be required prior to commencement of environmental review and permitting. The additional studies are expected to include material characterization, hydrogeology, air quality and meteorology, indicator species and forest health, cultural resources, socioeconomics, noise, light, and viewsheds.

4.9 Environmental Liabilities

Liabilities associated with the mineral exploration program are related to abandonment of boreholes and drill pad and road reclamation (Williamson, 2012). TMM has posted reclamation bonds with the US Bureau of Land Management and the Minnesota Department of Transportation.

Historical mine features on the project site include two former bulk sample sites; an underground shaft and workings developed in 1968 and a surface excavation developed in 1974. These were developed by the former lease-holder. The shaft is approximately 1,100 feet deep with approximately 700 feet of drifts. Reclamation work at the shaft site was done by the former lease holder after completion of the sampling, and included removal of all surface structures and installation of a concrete cap in the shaft. An uncapped development rock stockpile is present near the shaft collar. The stockpile is sparsely vegetated, and no indication of impacted surface runoff is present (Williamson, 2012). Excavations used for settling ponds during the bulk sample operations have not been backfilled.

The surface excavation bulk sample site is approximately 20 yards (20 m) in diameter and 10 feet (3 m) deep. The former lease holder reclaimed the site by capping it via backfilling and grading it to mimic the original topography. Several subsidence areas are present in the capped area. Seepage emanating from the site contains elevated concentrations of sulfate, copper, and nickel. In 2010 the U S. Forest Service studied water quality in the seep and surrounding surface waters. That study concluded that background loading of surface waters in the area is naturally high in sulfate, copper and nickel, and that the seep has no measurable negative impact on the watershed and that no additional management action or testing is needed.

TMM has reclamation responsibilities under applicable leases, and may be responsible for additional reclamation of the bulk samples sites if required; however, no specific reclamation has been requested by any agencies to TMM's knowledge and no reclamation plans have been developed by TMM. No bonding requirements are associated with the historical activities.

Ongoing liabilities at the adjacent Cliffs-Erie Dunka property, which are part of the TMM holdings, include permitted discharges from a sulfide-bearing rock stockpile and wetland treatment system, and permitted discharges of untreated mine pit water.

4.10 Social License

Although the project is in its early stages, TMM is actively pursuing local community involvement in the project. That work includes open house meetings at the office in Ely, MN as well as other community meetings in the area. Native American groups have been contacted and their involvement with the project sought.

4.11 Significant Risk Factors

Permitting is possibly the most significant risk factor for the project. Although there is a clear legal path forward for permitting a mine on the property, proximity to the Boundary Waters Canoe Wilderness Area (BWCWA) will certainly be cause for comment on the project and may generate significant opposition to the project. Comment and challenges based on proximity to the BWCWA will likely add significantly to the time required for permitting of a mining operation.

A Federal EIS on hardrock exploration drilling in the Superior National Forest was completed in the spring (2012). At the conclusion of the notification and appeals periods in September 2012, pending Federal Prospecting Permits began to be issued in the Superior National Forest.

4.12 Comments

Mineral tenure to the lands on which the resources reported here is secure; and TMM has the right to explore, develop, and mine valuable leased mineral resources located on those lands. Tenure arises from a combination of federal mineral leases and prospecting permits and state mineral leases.

Although there is a clear legal path forward, permitting may be challenging and poses a significant risk to the project.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Introduction

The Project is located at the east end of the Mesabi Iron Range, a major center for iron ore mining for over 100 years. Today the region has eight large operating taconite mines and associated process plants, and two additional operations in development. As a result of mining activity, an extensive network of railroads and paved roads has developed throughout the region that today provides excellent transport communications.

5.2 Physiography

Elevations on the Project leases range from 1,425 ft (435 m) to 1,550 ft (470 m). Topographic relief is generally low and controlled by bedrock exposures. The properties are poorly drained and are part of the Kawishiwi River/Birch Lake watershed.

Wisconsinan (110,000 to 10,000 years ago) continental glaciation scoured and shaped bedrock into low, north-northeast trending hills thinly mantled by till. Rock exposures are generally less than 5%.

Glacial drift is as thick as 65 ft (20 m) in low areas occupied by swamps, which are prominent in the north central and northeast portions of the main block of the Maturi are.

The upland areas of the Project leases are forested by second-growth mixed conifers and deciduous trees including white, red and jack pines, spruce, balsam, poplar and birch. Treed swamps and open marshes support reeds, sedges, and sphagnum mosses.

5.3 Climate

The northern Minnesota climate is mid-continental. The average annual temperature is 38°F (3°C), with local temperatures averaging 4°F (-16°C) in January and 66°F (19°C) in July. Annual rainfall averages approximately 28 in. (710 mm), with 30% occurring from November to April and 70% from May to October. Annual snowfall averages 60 in. (152 cm), with accumulation on the ground of 24 in. (60 cm) to 35 in. (90 cm). Exploration operations continue year-around with much of the drilling completed in the winter months to minimize surface disturbances. Future mining activities could be conducted on a year-round basis.

5.4 Accessibility

From the city of Duluth, the Project can be accessed by US Highway 53 north for 64 mi. (103 km) to its juncture with State Highway 169 north of the town of Virginia, thence 42 mi. (68 km) northeast on Highway 169 to the town of Ely. The Project is readily accessible by road from the town of Babbitt, a planned mining community of 1,200 inhabitants located approximately 10 mi. (16 km) to the southwest. From Babbitt, take route 70 west for 3 mi. (5 km) to the Ely-Babbitt Highway 21, north 7.5 mi. (12 km) to Highway 120, north and east on 120 for 5 mi. (8 km) to Highway 1, thence south and east to cross the South Kawishiwi River just north of the Project, a distance of 7 mi. (11 km).

From the town of Ely, the Project can be reached by taking Highway 1 south, which crosses the Kawishiwi River just north of the Property, a distance of 12 mi. (20 km).

Forest service roads provide access on the individual properties.

5.5 Local Resources

A major asset of the area is the engineering and technical resources supporting the iron mining operations that are accessible to TMM. Similarly, there is a large pool of skilled and unskilled labor in the region that is available to TMM.

5.6 Infrastructure

The local infrastructure related to mining is excellent. Low-cost electric power, railroad networks, paved state highways, mine equipment suppliers, mining professionals, and relatively low-cost labor are available locally to service the eight operating Mesabi Range iron ore mines to the west. The region has an extensive and reliable power supply network with two coal-fired thermal power stations located 8 and 85 miles (13 and 137 km) from the Project. Power is supplied to the area by 138 kV overhead transmission line linked to the regional power grid. The nearest rail access for the Project is at Babbitt and connects to the port of Duluth. The port of Duluth on Lake Superior is linked to the rail system and provides worldwide shipping access via the Great Lakes and St. Lawrence Seaway.

5.7 Sufficiency of Surface Rights

AMEC believes that the surface rights are sufficient to allow mining operations and supporting infrastructure. The Prefeasibility Study that is currently underway will determine the requirements and preferred location for mine openings, plant, waste dumps, and infrastructure to support mining operations. The large size of the property will allow flexibility in selecting the most suitable location and be sufficient to support future development of the deposits.

6.0 HISTORY

6.1 General

The region was opened to prospecting following the 1854 Treaty of LaPointe. Initial efforts focused on copper, and an 1865 gold rush led to discovery of iron ore. Iron ore mines opened in the Archean Soudan Iron Formation of the Vermilion Range in 1884. Mining of direct shipping iron ore from the Paleoproterozoic Biwabik Iron Formation commenced in 1892, and large scale production of iron ore pellets (taconite) from magnetite iron-formation began in 1955. Copper and nickel sulfides were discovered in the Duluth Complex in the 1890s; however, large scale exploration began in the 1950s. The Minnesota Department of Natural Resources (DNR) reports more than 1,900 diamond drill holes and 310 miles (500 km) of core have been drilled to explore the base of the Duluth Complex for copper and nickel (Cargill, 2005b). Starting in 1985, the DNR re-analyzed core from the copper-nickel exploration and found significant PGEs, which has prompted the re-evaluation of a number of known deposits in the western portion of the Duluth Complex.

Each of the three properties that comprise the Project has a somewhat different history and is discussed separately below.

6.2 Maturi

Until combined into the Maturi project, by TMM, the Nokomis (aka Maturi Extension) and Maturi projects were separate and had somewhat separate histories. The combined histories are summarized in Table 6-1. What was known as Nokomis was not well explored prior to about 2007 when Duluth began drilling the area. Maturi, on the other hand, was well explored by Inco with a combination of drilling and underground exploration.

Table 6-1: Summary of Maturi History (from Routledge and Greenough, 2006)

Year	Exploration
1954-1957	Surface exploration only. Exploration suspended when Federal Department of the Interior would not issue mining permits pending Congress enacting proposed wilderness legislation.
1966	ACNC granted two federal leases at Maturi and Spruce Road deposits.
1967	153 diamond drill holes for 81,699.23 ft (24,902 m) drilled at Maturi and Spruce Road. Exploration shaft sinking started at Maturi and Bechtel completed a scoping study for Maturi.
1968	Shaft sunk to 1,090 ft (332 m), a 634.9 ton (576 tonne) bulk sample taken and underground exploration carried out on the 1,000 ft (305 m) level at Maturi. 2,689.6 tons (2,440 tonnes) from the drift were stockpiled on surface and the shaft capped. Fifteen holes were drilled from surface (21,400.85 ft / 6,523 m).
1969	ACNC drilled 16 holes for 17,473.7 ft (5,326 m).
1973	Maturi buildings and head frame removed and site restored; exploration focused on Spruce Road.
1975-1979	All ACNC work suspended because of State moratorium on copper-nickel exploration and mining.
1985	DNR samples 1970-1975 Duval core from Birch Lake area and discovers 2 m of PGE mineralization associated with chromite rich oxides.
1986	Since earlier drilling had not assayed for PGM and Au, ACNC investigates Maturi drill core and assays for PGM and gold; only anomalous values found.
1988	ACNC Joint venture with Lehmann Exploration Management Inc. and BHP Utah to explore for PGM mineralization; one hole diamond drilled.
1989	Joint venture dissolved and a new ACNC joint venture with Lehmann Exploration Management Inc. (LEM) was formed.
1990	LEM drilled one hole on ACNC property; seven others in the area (14,150.22 ft / 4,313 m total).
1992	LEM unable to obtain financing, LEM joint venture with Inco (ACNC) dissolved.
2000	1,400 coarse reject samples from 26,247 ft (8,000 m) in 26 holes were assayed by Wallbridge for Cu, Ni, Co, Pt, Pd, Au and S. Wallbridge prepares a resource estimate under JORC code and assessment (scoping study) of the potential for economic mineralization. Hole 11526R (1166.7 ft/355.6 m) drilled to twin Inco hole 11526.
2005	In May, Franconia acquired from ACNC, through its Beaver Bay Joint Venture partner, an interest in 5,201 ac (2,105 hectares) covering the Spruce Road and Maturi deposits.
2006	Preliminary assessment of the Birch Lake and Maturi projects completed.
2006-2012	Duluth Metals and TMM drilled 435 exploration core holes with 154 wedge holes (1,316,766 ft/ 401,350 m)
2011	Franconia acquired by TMM.

6.3 Birch Lake

Birch Lake was explored by a series of operators between 1955 and now. Duval did a significant amount of work in the 1970-1975 period (Table 6-2). In 2000, the Beaver Bay Joint Venture began serious drill exploration of the area. In 2002, Franconia Minerals Corporation optioned the property and continued exploration drilling of the known mineralization. In 2010, TMM was formed and acquired the property with the acquisition of Franconia in 2011. TMM drilled 30 holes in 2011 and 2012 which were used (in part) in preparation of the resource estimate described in Section 14 of this Report.

Table 6-2: Summary of Birch Lake History

Year	Exploration
1970-1975	Duval Corporation diamond drilled a fence of wide spaced holes to the base of the Duluth Complex
1985	BBJV undertakes prospecting in vicinity of property and acquires initial mineral permits for property. Under an earn-in agreement with Utah International Inc. to explore for PGM in Duluth Complex, BBJV carries out data compilation and stream sediment survey extending to the shore of Lake Superior. MNDNR samples Duval core and discovers 2 m of PGE mineralization in DU-15 associated with chromite rich oxides. LEM leased ground for Cascade Joint Venture and drilled wedged offset hole to confirm PGEs.
1985-1987	Mapping and geophysical surveys; BBJV joint venture with Utah and ACNC (Inco) on land under option from ACNC (Inco) north of Birch Lake.
1988	Hole C88-1 drilled west of Duval hole DU-15 intersected copper mineralization but no PGEs. Utah and ACNC (Inco) terminated their earn-in agreements with the BBJV. Joint venture earn-in agreement signed with International Platinum Company Inc. (IPCO).
1989	Holes 89-1 and 2 drilled under IPCO agreement.
1990	BL90-1 and 2 drilled south of Birch Lake and 90-3 to north for assessment on lands sub-leased from ACNC (Inco). IPCO earn-in agreement terminated.
1995	BBJV reorganized with new partners; BL-95-1and BL95-1W drilled to test magnetic anomaly at the north edge of Birch Lake, no encouragement.
1997	MN Natural Resources Research Institute (NRRI) work suggests PGE's associated with Birch Lake fault zone; BBJV acquires State Lease for lake bottom, obtains funding from State and Amplats.
1998	BL98-1 and 1W from south shore west into Birch Lake and intersects PGE values. Preliminary metallurgical tests by Amplats. Earn-in joint venture agreement signed with Altoro Gold Corporation.
1999	BL99-1 and 2 and wedges drilled and property land package expanded. Altoro abandoned agreement with BBJV.
2000	Earn-in joint venture agreement signed with Impala Platinum Holding Ltd. Eleven holes and 25 wedges of BL00 series drilled (10,301 m) to delineate Cu-Ni-PGE mineralization.
2001	6,956 m in seven drill holes and 19 wedges drilled, five holes collared from barge in Birch Lake as step outs to further delineate mineralization. Drilled wedge hole off old Exxon hole D-5 south west of Birch Lake deposit.
2002	A wild cat hole drilled on boundary of property 600 ft. SW of old Exxon hole. Resource estimates by Snowden and LEM. Impala drops option late in year; property optioned to Franconia Minerals Corporation.
2004	Flotation and pilot plant PLATSOL™ hydrometallurgical testwork on Birch Lake core composites performed at SGS Lakefield Research.
2005	Four holes and four wedge offset holes (3,969 m) diamond drilled on the Birch Lake property. Agreement to use PLATSOL™ technology arranged by BBJV on behalf of Franconia.
2006	Preliminary assessment of the Birch Lake.
2010	Franconia drilled 11 exploration core holes
2011	Franconia acquired by TMM.
2011-2012	TMM drilled 30 exploration core holes (82,945 ft/25,281.6 m) and began metallurgical testwork, environmental baseline studies, and preliminary engineering.

6.4 Spruce Road

Disseminated sulfide mineralization was discovered at Spruce Road in 1951 (Table 6-3). Between 1954 and 1974 Inco performed intensive exploration and applied for a mining license in 1975 which was put on hold because of the moratorium on copper and nickel exploration. Since then, only two holes have been drilled.

Table 6-3: Summary of Spruce Road History

Year	Exploration
1951	Discovery of disseminated sulfide mineralization by Fred Childers and Roger Whiteside. Drilled one hole (188 ft).
1951-1954	ACNC (Inco) acquired the property and performed ground magnetometer and vertical loop electromagnetic surveys (VLEM), geological mapping and sampling.
1954-1957	ACNC (Inco) drilled a total of 17,930.2 ft (5,45.06 m) of AX core in 17 holes.
1957	Exploration suspended pending passage of wilderness legislation
1966-1968	ACNC (Inco) granted Federal Leases ES-01352 and ES-01353. 100,714 ft (30,900.29 m) of drilling completed in 166 holes and a 1,300 ton (1,180 tonne) bulk sample was collected. Geological mapping and geophysical surveys including Ronka EM 16 (VLF), ground magnetometer and induced polarization (IP) were completed.
1969	Additional private and Federal leases obtained by ACNC (Inco)
1972	Horizontal Loop electromagnetic surveys, IP surveys, and magnetometer surveys completed.
1973	ACNC (Inco) drilled a total of 769 ft (234.4 m) in 26 holes to test a bulk sample area.
1974	A 10,000 ton (9072 tonne) bulk sample was collected and processed at the Inco's Creighton Mill in Sudbury, Ontario.
1975	ACNC (Inco) submitted a formal mining proposal
1975	Minnesota declared a moratorium on copper-nickel exploration until 1979. The project was put on hold.
1988	ACNC (Inco) entered joint venture with Lehman Exploration Management (LEM) and BHP Utah to explore for PGE mineralization (the Beaver Bay Joint Venture - BBJV). The JV dissolved in 1989 after one hole was drilled.
1989	JV between ACNC (Inco) and LEM reformulated the BBJV.
1990	Eight holes drilled
1992	ACNC (Inco) and LEM JV dissolved
1997	Downhole Crone PEM Survey completed
1999	Wallbridge optioned the properties from Inco
1999-2000	Wallbridge drilled 4,054.04 ft (1,235.67 m) in two holes
2002	Franconia Minerals Corp. enters into agreement with Beaver Bay Joint Venture to acquire the Spruce Road deposit and other properties.
2010	Antofagasta Minerals and Duluth form Twin Metals Minnesota LLC, a joint venture company.
2011	Duluth and Antofagasta Minerals acquired all of the common shares of Franconia Minerals Corporation.

6.5 Historical Resource Estimates

All three properties have previous resource estimates that were superseded by resource estimates summarized in the various Technical Reports referenced in Section 2.4.

The current mineral resource estimates presented in this report, in Section 14, replace all previous estimates on the Project.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Introduction

Cu-Ni-PGE mineralization within the Duluth Complex is hosted by mafic to ultramafic intrusive rocks that are part of the overall complex. Table 7-1 summarizes the lithologies that typically host mineralization and Figure 7-1 shows the lithologies in the system olivine-plagioclase-clinopyroxene. Minerals (and their formulae) reported from the various deposits are summarized in Table 7-2.

Table 7-1: Lithologies Discussed in this Report

Lithology	Description
Anorthosite	An essentially monomineralic intrusive rock composed almost entirely of plagioclase feldspar, which is usually labradorite but may be as calcic as bytownite or as sodic as andesine or oligoclase. Accessory mafic minerals include olivine, augite, and oxide.
Dunite	An ultramafic intrusive rock consisting almost entirely olivine with accessory magnetite and/or ilmenite. Chromite is an important accessory at Birch Lake but rare at Maturi and Spruce Road.
Gabbro	A group of dark-colored, mafic intrusive rocks composed principally of basic plagioclase (commonly labradorite or bytownite) and clinopyroxene (augite), with or without olivine and orthopyroxene. It is the approximate intrusive equivalent of basalt.
Gabbronorite	A gabbroic rock containing both clinopyroxene and orthopyroxene as the mafic minerals. Generally occurs at the base of mafic intrusions as a result of contamination by footwall rocks.
Norite	A coarse-grained mafic intrusive rock containing basic plagioclase (labradorite) as the chief constituent and differing from gabbro by the presence of orthopyroxene (hypersthene) as the dominant mafic mineral.
Troctolite	A mafic intrusive rock composed of 50% to 80% calcic plagioclase (e.g. labradorite) and mafic minerals dominated by olivine.
Melatroctolite	A mafic troctolite with 50% to 80% olivine and 20% to 50% plagioclase.
Anorthositic Troctolite	A mafic intrusive rock composed of 70-80% plagioclase with 20-30% olivine and pyroxene. ol>px

ol – olivine; px – pyroxene

Figure 7-1: Mafic Intrusive Rock Ternary Classification Diagram (after Severson and Hauck, 1990)

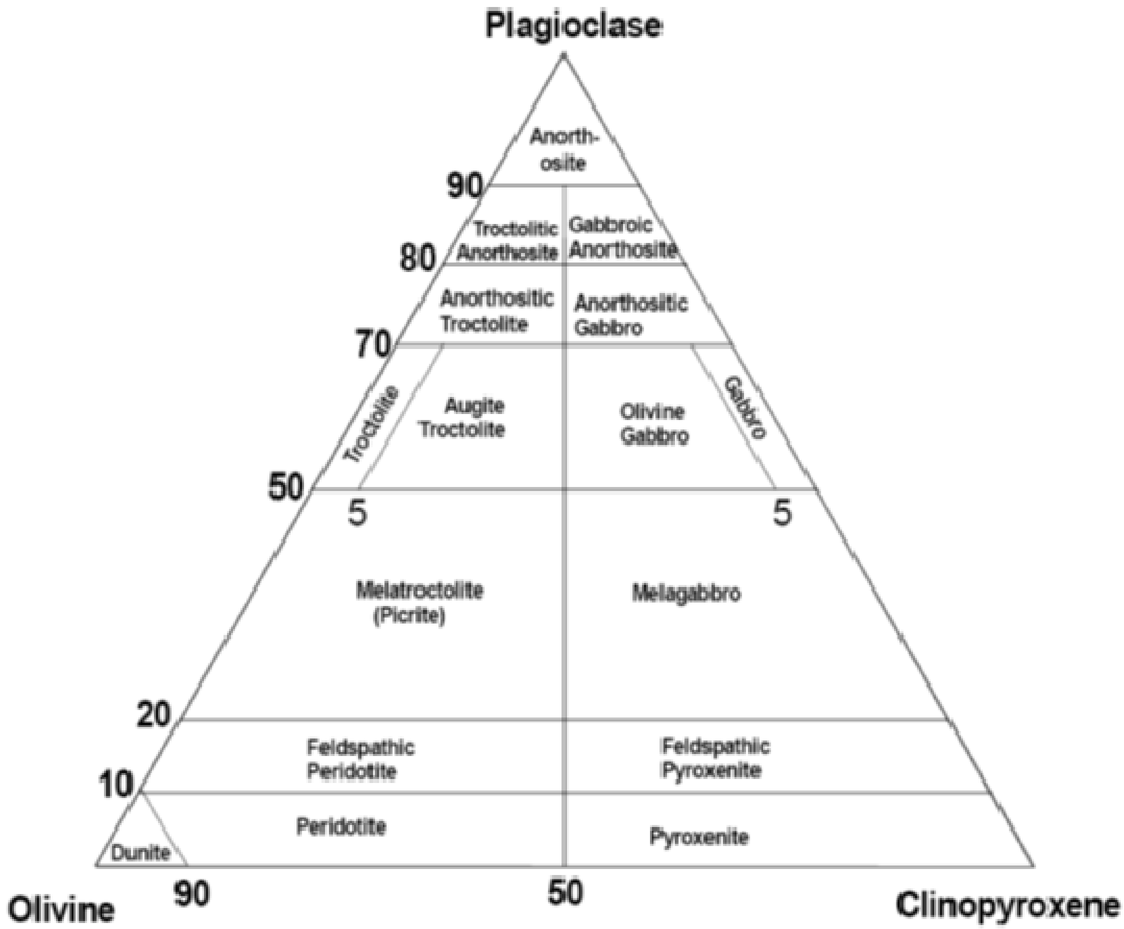


Table 7-2: Minerals Identified at Maturi, Birch Lake, or Spruce Road

Cu Minerals	Formula
native copper	Cu
bornite	Cu_5FeS_4
chalcocite	Cu_2S
chalcopyrite	$CuFeS_2$
covellite	CuS
cubanite	$CuFe_2S_3$
cuprite	Cu_2O
digenite	Cu_9S_5
haycockite	$Cu_4Fe_5S_8$
mooihoekite	$Cu_9Fe_9S_{16}$
neodigenite	Cu_9S_5
putoranite	$Cu_9Fe_9S_{16}$
talnakhite	$Cu_9(Fe,Ni)_8S_{16}$
tenorite	CuO

Ni Minerals	Formula
heazlewoodite	Ni_3S_2
mackinawite	$(Fe, Ni)_9S_8$
millerite	NiS
pentlandite	$(Fe,Ni)_9S_8$
violarite	Ni_2FeS_4

PM Minerals	Formula
native silver	Ag
electrum	$Au(Ag)$
froodite	$PdBi_2$
hessite	Ag_2Te
insizwaite	$Pt(Bi,Sb)_2$
irarsenite	$(Ir,Ru)As_2$
michenerite	$PdBiTe$
moncheite	$(Pt,Pd)(Te,Bi)_2$
paolovite	Pd_2Sn
polarite	$Pd(Bi,Pb)$
silver telluride	$AgTe$?
sobolivskite	$PdBi$
sperrylite	$PtAs_2$

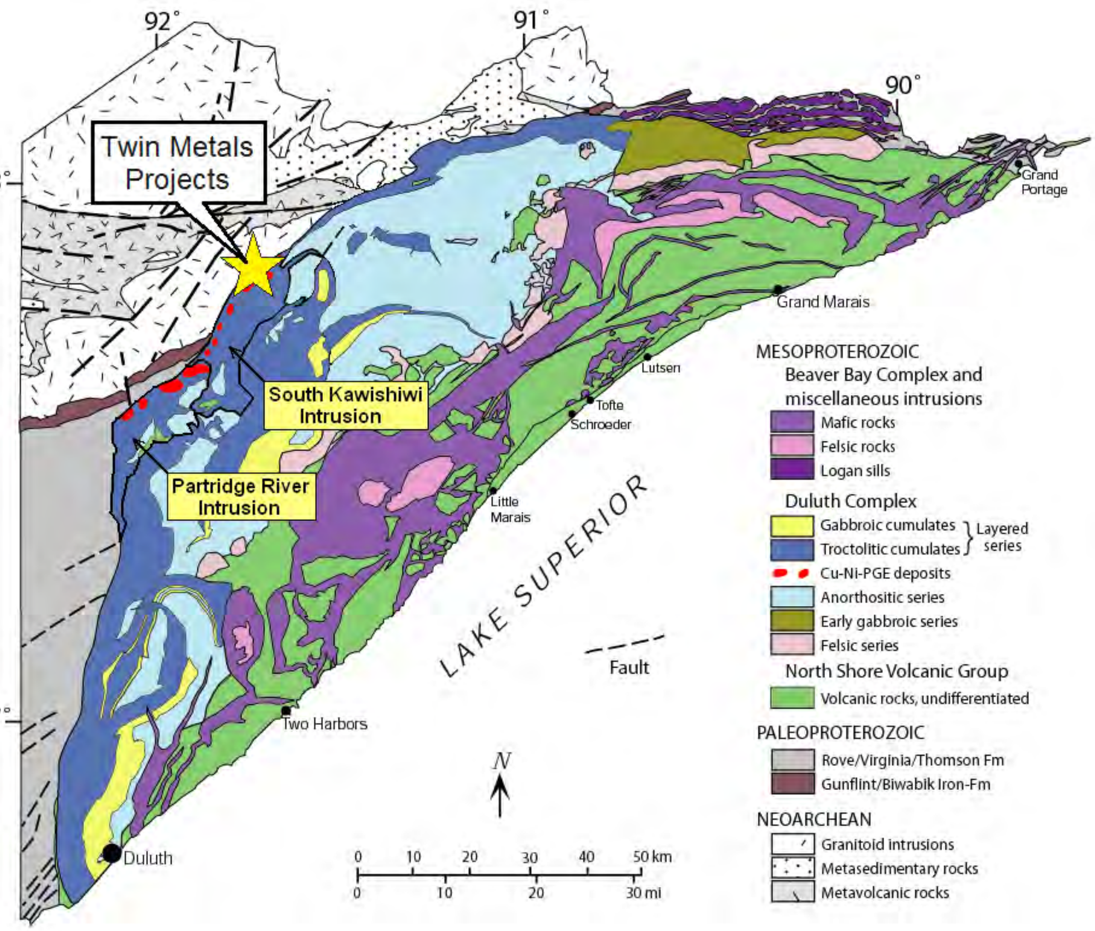
Gangue Minerals	Formula
altaite	$PbTe$
frobergite	$FeTe$
galena	PbS
pyrite	FeS_2
pyrrhotite	$Fe_{1-x}S$ (x= 0 to 0.2)
sphalerite	$(Zn,Fe)S$
troilite	FeS
chromian spinel	$Mg(Al,Cr)_2O_4$
chromite	$(Fe, Mg)(Cr, Al)_2O_4$
ilmenite	$FeTiO_3$
magnetite	Fe_3O_4

7.2 Regional Geology

The Maturi, Birch Lake, and Spruce Road properties lie within the Superior Province of the Canadian Shield that is exposed in central and northeastern Minnesota and extends north into Ontario (Routledge, 2004; Figure 7-2). The shield rocks include Archean (>2,600 Ma) mafic to felsic volcanic rocks, graywackes and granitic intrusives and ortho- and paragneisses; Paleoproterozoic (ca. 1,850 Ma) iron-formation, clastic, and carbonate sedimentary rocks; and Mesoproterozoic clastic sedimentary rocks, mafic pyroclastic volcanics and interbedded sedimentary rocks, and mafic intrusive rocks (ca. 1,100 Ma). The Algoman Orogeny circa 2,700 Ma and the Penokean Orogeny circa 1,850 Ma resulted in folding, faulting and weak metamorphism of the Archean and Paleoproterozoic rocks and the intrusion of granitic plutons.

In eastern Minnesota, the Midcontinent Rift System developed during crustal scale extension in the Mesoproterozoic. The rift system is traceable, as exposures of mantle-derived tholeiitic to subalkaline mafic lava flows, intrusives, and rift-filling fluvial sedimentary rocks, and in the subsurface as a gravity anomaly (high), from the eastern end of Lake Superior, arcing west across the lake basin, and extending south-southwest to northeastern Kansas. Intrusion of the Duluth Complex circa 1,108 - 1,099 Ma was related to rifting and is co-genetic with the North Shore Volcanic Group mafic volcanic rocks, forming its hanging wall to the east.

Figure 7-2: Regional Geological Map (after Soever, 2002)



7.3 District Geology

The Duluth Complex is defined as the more or less continuous mass of mafic to felsic plutonic rocks that extends for more than 170 miles (275 km) in an arcuate fashion from Duluth nearly to Grand Portage in Minnesota. It is bounded by a footwall of Paleoproterozoic sedimentary rocks and Archean granite-greenstone terranes (Peterson and Severson, 2002), and a hanging wall largely of comagmatic anorthosite, rift related flood basalts, and hypabyssal intrusions of the Beaver Bay Complex. In genetic terms, the Duluth Complex is composed of multiple discrete intrusions of mafic to felsic tholeiitic magmas that were episodically emplaced into the base of a comagmatic volcanic edifice between 1108 and 1099 Ma. Within the nearly continuous mass of intrusive igneous rock forming the Duluth Complex, four general rock series are distinguished on the basis of age, dominant lithology, internal structure, structural position, and geochronology within the complex (Fig. 7-2):

- Felsic series—Massive granophyric granite and smaller amounts of intermediate rock that occur as a semicontinuous mass of intrusions strung along the eastern and central roof zone of the complex, emplaced during an early stage magmatism (~1108 Ma).
- Early gabbro series—Layered sequences of dominantly gabbroic crocks that occur along the northeastern contact of the Duluth Complex, emplaced during early stage magmatism (~1108 Ma).
- Anorthositic series—A structurally complex suite of foliated, but rarely layered, plagioclase-rich anorthositic rocks emplaced throughout the complex during main stage magmatism (~1099 Ma).
- Layered series—A suite of stratiform troctolitic intrusions that comprises at least 12 variably differentiated mafic layered intrusions that occur mostly along the base of the Duluth Complex. These intrusions were emplaced shortly after the Anorthositic series (~1099 Ma).

Weiblen and Morey (1980) proposed a half-graben model for the emplacement of the Complex intrusives in which step-and-rise normal faults, with steep southeast dips, occurred in a northeasterly direction parallel to the trend of the Complex's basal contact.

Magma was subsequently intruded along these structures and coalesced to form the complex. A later series of northwesterly strike-slip faults offset the intrusive-controlling northeast faults.

7.4 BMZ Definition

Lithologic units within the TMM Project area include Mesoproterozoic rocks of the South Kawishiwi Intrusive (SKI) and the Anorthositic Series of the Duluth Complex, as well as basalt xenoliths of the North Shore Volcanic Group. At the TMM Project, SKI magmas intruded sub-horizontally between hangingwall Anorthositic Series rocks and footwall granitic rocks of the Neoarchean Giants Range batholith and locally the Paleoproterozoic Biwabik Iron Formation (at the Birch Lake deposit). Brief descriptions of the map units that Twin Metals recognizes on the project are given in Table 7-3.

Table 7-3: Geological Map Units in the Project Area

Duluth Complex and related rocks (~1.1 Ga.)	
SKI	Anorthositic troctolite to troctolite **(ATA Series)** - Medium to coarse-grained, homogeneous, well-foliated and locally layered anorthositic troctolite, troctolite, and ophitic troctolitic rocks.
SKI	Augite-bearing troctolite **(Main AGT)** - Homogeneous, coarse-grained, subophitic to ophitic, poorly foliated augite troctolite characterized by scattered augite-rich pegmatitic clots and patches. Commonly capped by hanging wall inclusions (HB & Ai) and interpreted to be equivalent to the solidified basaltic liquid that carried crystals and sulfides of the BMZ.
SKI	Sulfide-bearing troctolite **(BMZ)** - Heterogeneous, sulfide-bearing, variably textured troctolite, augite troctolite, anorthositic troctolite, and olivine gabbro with 0.5 - 5% disseminated chalcopyrite, cubanite, pentlandite and pyrrhotite.
Xenoliths in the SKI	Anorthosite **(AN-G & Ai)** - Undifferentiated Anorthositic Series inclusions. Includes well-foliated anorthosite, troctolitic-anorthosite, poikilitic troctolitic anorthosite, gabbroic anorthosite, and rarely gabbro and troctolite. Inclusions range from a few centimeters to elongate bodies measured in kilometers.
Xenoliths in the SKI	Anorthositic gabbro to gabbro **(Upper Gabbro)** - Mixed group of Anorthositic Series rocks that occur in the central portion of the map area. Includes well-foliated anorthositic gabbro, gabbro, anorthosite, hornfelsed basalt, and augite troctolite.
Xenoliths in the SKI	Basaltic hornfels **(Upper Basalt, HB)** - Fine-grained, granoblastic to poikiloblastic basaltic hornfels; consists of variable amounts of plagioclase, augite, olivine, hypersthene, and inverted pigeonite. Commonly associated with Anorthosite xenoliths (unit Ai).
Metamorphic Rocks	
Footwall	Biwabik Iron Formation **(BIF) (~1.90 Ga)** - Well-bedded, iron-bearing strata consisting of alternating granular (cherty) and banded (slaty) iron formation. The unit exhibits strong recrystallization and partial melting where in contact of the Duluth Complex.
Footwall	Virginia Formation (P-vf) - A well bedded sequence of argillaceous siltstone, carbonaceous shale, mudstone, fine-grained feldspathic graywacke, and minor carbonate and chert interbeds. Exhibits strong recrystallization and partial melting near the Duluth Complex and where it occurs as inclusions. Occurs in outcrop around the Dunka Pit in the southwestern portion of the map and as inclusions within the South Kawishiwi Intrusion.
Giants Range Batholith (~2.68 Ga.)	
Footwall	Porphyritic quartz monzonite **(GRB)** - Pink, coarse-grained, hornblende-phyric, quartz monzonite with large (1-2 cm) orthoclase phenocrysts. Contains irregular zones of aplite and supracrustal xenoliths. Strongly recrystallized and partially melted locally along the contact with the SKI.

The basal portion of the SKI is mineralized at Birch Lake, Maturi, and Spruce Road. In detail, the basal mineralized zone (BMZ) of the SKI consists of four regionally extensive units first identified by Severson (1994). These units are, from top to bottom, the PEG, U3, BH, and BAN, and are described below:

- Pegmatitic Unit **(PEG)** - Medium to very coarse-grained, locally sulfide-bearing, troctolitic to gabbroic rocks that grade into pegmatoidal (1-2 cm) and pegmatite (>2 cm) zones. The unit occurs immediately above the U3 unit and separates the sulfide-bearing lower units from the sulfide-free upper units of the South Kawishiwi intrusion.
- Ultramafic Three **(U3)** - Layered ultramafic (melatroctolite-peridotite) and troctolite horizons with lenses and pods of oxide-bearing (>5%) ultramafic rocks and/or massive oxide. The massive oxide horizons occur at the same stratigraphic level as the Biwabik Iron Formation (BIF) suggesting that assimilated BIF formed an oxide-rich "restite" within the intruding magma chamber (Severson, 1994). Disseminated sulfide occurs from trace amounts up to 5%, and typically include pyrrhotite, chalcopyrite, cubanite and pentlandite.
- Basal Heterogeneous Zone **(BH)** - The main sulfide-bearing unit characterized by variably textured and taxitic (a texture that results when wall rocks are softened and gradually invaded by hotter mafic or ultramafic intrusive material) troctolite, augite troctolite, anorthositic troctolite, and olivine gabbro with 0.5 - 5% disseminated pyrrhotite, chalcopyrite, cubanite and pentlandite.
- Bottom Augite Troctolite/Norite **(BAN)** – Variably textured and taxitic, sulfide-bearing gabbronorite, norite, and augite troctolite. The unit grades upward into the BH Unit - both are heterogeneous and are sulfide-bearing. In all likelihood the BAN Unit represents a footwall contamination zone of the BH Unit along the basal contact (Severson, 1994).

The base of the BMZ is invariably the unconformity between the Archean or Paleoproterozoic rocks that comprise the footwall rocks to the Mesoproterozoic SKI (1.1 Ga). The vast majority of the footwall to the SKI is composed of the Giants Range Batholith (GRB), a 2.68 Ga granitoid batholith dominated by silica-poor rocks ranging from diorite to quartz monzonite in composition. Locally, in the far southwestern part of the SKI, the footwall is composed of Paleoproterozoic metasedimentary rocks (~1.85 Ga.) of the Biwabik Iron Formation (banded iron formation) or the Virginia Formation (shales to greywacke clastics).

Commonly this lower contact is very abrupt and easily defined. Locally, a high degree of contact metamorphism and metasomatism by the SKI has created hybrid rocks at the contact which are commonly charnockite (orthopyroxene-bearing granite) resulting in a nebulous gradational contact. When the footwall is GRB in the Maturi area, the contact is easily picked geochemically by >750 ppm Ba and <0.4% Ti and an abrupt rise in Sr concentration.

The BMZ is characterized by the presence of three subunits initially defined by Severson (1994) and Hauck et al (1997) consisting of the U3, BH, and BAN units. These units have all been grouped together into the singular BMZ unit due to the obvious contemporaneous genetic relationships of the three and the difficulty in tracing each individual subunit from drill hole to drill hole although, in aggregate, the BMZ is extremely continuous.

The basal subunit of the BMZ is the BAN unit which is commonly present but not ubiquitous. BAN is composed mostly of finer-grained gabbroic to noritic rocks. It is interpreted to be a combination of a zone of contamination by the assimilation of the low-temperature footwall rocks and a broad chilled contact.

The main and ubiquitous subunit of the BMZ is the Basal Heterogeneous (BH) unit. It is, as the name implies, highly heterogeneous throughout. Dominantly a troctolite of various forms, it can range from a melatroctolite to a troctolitic anorthosite of various textures ranging from fine grained to pegmatoidal. Although mainly intergranular, it can locally become subpoikiolitic. Autolithic inclusions of troctolites are common ranging from several centimeters to tens of centimeters in size. Pegmatoidal aspects of the BH tend to be slightly more feldspathic with slightly higher clinopyroxene content than surrounding rocks and are interpreted to be networked veins in morphology, likely the caused by migrating late-stage fluids.

As with the BAN subunit, the U3 is commonly present but not ubiquitous. This subunit usually occupies the uppermost portion of the BMZ and comprises a package of dominantly ultramafic rocks ranging from olivine-rich troctolite to feldspathic peridotite intercalated with more leucocratic phases such as an anorthositic troctolite to troctolite. Autolithic inclusions identical to those seen in the BH are extremely common. When present, the upper contact of U3 is coincident with the top of the BMZ and there is usually a very sharp contact with the hanging wall rocks. If U3 is absent, the BH forms the upper contact of the BMZ. Although less apparent than the top of the U3, this contact is also usually quite easily discernible.

Hanging wall rocks to the BMZ fall into one of three main geologic units; PEG, Main AGT, or the An-Series. PEG is the most prevalent hanging wall unit consisting generally of a weakly to well-developed very coarse-grained to pegmatoidal anorthositic troctolite to anorthositic gabbro and is mostly barren of sulfides. Although broadly considered a layer, at a smaller-scale it is most likely a tightly anastomosing network of coarse-grained to pegmatoidal rock with a finer grained matrix and an indefinite upper contact.

Directly above PEG are the hanging wall rocks of the Main AGT. If PEG is not present, Main AGT directly overlies the top of the BMZ. Comprised of a homogenous augite troctolite to anorthositic troctolite, this unit is commonly very thick, sometimes exceeding 1,000 feet. Texturally and mineralogically, the Main AGT is distinct. Clinopyroxene oikiocrysts (dominantly 3-5 cm in length) with the presence of small amounts (1-2% each) of biotite and iron oxide are indicative and distinctive to this unit. The upper units of the BMZ very rarely contain more than trace amounts of biotite or iron oxide, and small amounts of interstitial clinopyroxene aiding in the definition of the upper contact of the BMZ.

Within the central and eastern portions of the Maturi Deposit, if the PEG or Main AGT units do not comprise the hanging wall to the BMZ, the AN-Series forms the hanging wall. This unit is an extremely large inclusion of an earlier phase of the Duluth Complex measuring thousands of feet laterally and locally several thousand feet thick. Dominantly anorthosite to anorthositic gabbro in composition, the lower portions of the inclusion that comprise the immediate hanging wall to the BMZ are usually a coarse to very coarse-grained anorthosite. Although largely barren of sulfides, locally disseminated pyrrhotite and chalcopyrite may be present up to 1-2%. These sulfides are distinct from those of the BMZ such that they are very low in precious metal tenor and are dominated by pyrrhotite whereas the sulfides of the underlying BMZ are usually present in larger quantities and contain significant amounts of cubanite and talnakhite with a very minor proportion of pyrrhotite. The sulfides present in the An-Series are interpreted to be unrelated to the mineralization event of the BMZ as there is strong evidence that limited sulfide mineralization occurred prior to the BMZ, likely related to the AN-Series.

The BMZ is defined as the mineralized basal portion of the SKI and is quite variable in its overall thickness ranging from tens of feet to hundreds of feet, but always occurs at the base of the SKI and is a continuous sheet-like body dipping to the southeast. The base of the BMZ is defined as the base of the SKI, and the top is defined as the uppermost U3, BH, or BAN occurrence coincident with the first occurrence of sulfide mineralization. Although pervasively containing sulfide mineralization, the BMZ may have low-grade to barren portions that may occur at the top, middle, or bottom of the unit. Despite the lack of sulfides in these rare instances, it is apparent by the distinctive rock types, textures, and stratigraphic position that these rocks are part and parcel of the BMZ even though the mechanism resulting in the dearth of sulfides is not understood. Thus, although generally the definition of the BMZ is based on the presence of sulfides, it is in fact the hosting package or rocks that should define this unit.

7.5 Local Geology

7.5.1 Maturi

Lithology

Mineralization at Maturi is in the lower South Kawishiwi Intrusion (SKI) in what is locally called the Basal Mineralized Zone (BMZ; BH, U3, and BAN Units of Severson, 1994; Cox et al, 2009). The SKI is bordered on the southwest by the Partridge River body and on the southeast by the Bald Eagle pluton. The SKI extends approximately 40 km northeast-southwest and is as wide as 4.3 miles (7 km). Exposed footwall consisting of Giants Range Granite lies approximately 1,600 ft (500 m) northwest of the Maturi deposit. The exposed SKI-granite contact trends northeast and generally dips 20° southeast but dips at depth range from 20 to 52° based on interpretation of the drill data. Figure 7-3 shows the property geology.

The SKI is composed of an upper sulfide-free troctolite with anorthosite layers and lower sulfide-enriched troctolite, picrite, dunite, anorthosite, oxide cumulates and hornfels. Rock units and mineralization at the base of the SKI are planar and sub-parallel to the lower contact. Rock units and mineralization at the base of the SKI are planar and sub-parallel to the lower contact. The contact strikes 60° and dips 35° to 52° southeast (Figure 7-4). The lower portion of the SKI (generally 200 to 300 ft (60 m to 100 m)) at Maturi is described as troctolite topped by a mafic troctolite or melatroctolite. The hangingwall to the BMZ is dominantly troctolite to anorthositic troctolite or augite troctolite. Olivine gabbros and anorthosite are mainly found within the AN-Series/Upper Gabbro.

The BMZ is a heterogeneous mixture of troctolite, augite troctolite, melatroctolite, olivine gabbro, anorthositic gabbro, norite, and gabbronorite as thick as 865 ft (260 m) at Maturi; averaging 215 ft (65 m) thick. Mafic intrusive rocks (troctolite and anorthosite) dominate with minor ultramafic rocks (melatroctolite, picrite). Textures range from very fine-grained to coarse pegmatite. All of the textural variations can be seen in a single outcrop which makes mapping of individual units within the BMZ difficult. The BMZ is commonly capped by a coarse pegmatitic unit (PEG) comprising all of the lithologies in the BMZ, but dominated by anorthositic troctolite. PEG occurs at the top of the BMZ in most of the holes drilled at Maturi and is used as a marker horizon for that reason. The thickness of PEG is extremely variable, but averages about 60 ft (20 m) thick with a maximum thickness of 216 ft (65 m).

The Duluth Complex has not been significantly deformed since magma consolidation, but it has been subjected to displacements along reactivated basement faults as well as cross faults. Structures are mostly subvertical north-northeasterly faults, and fault zones that have been interpreted from linear features on air photos and topographic maps. These faults have been active pre-, syn- and post-emplacement of the SKI. Where exposed in parts of the SKI and footwall rocks, movement on these faults ranges from 10 to 400 ft (3 m to 120 m). The Maturi deposit appears to occupy a gentle flexure in the contact that has formed a broad, easterly plunging embayment in the base of the SKI (Soever, 2000).

Figure 7-3: Local Geological Map of the Maturi and Spruce Road Deposits

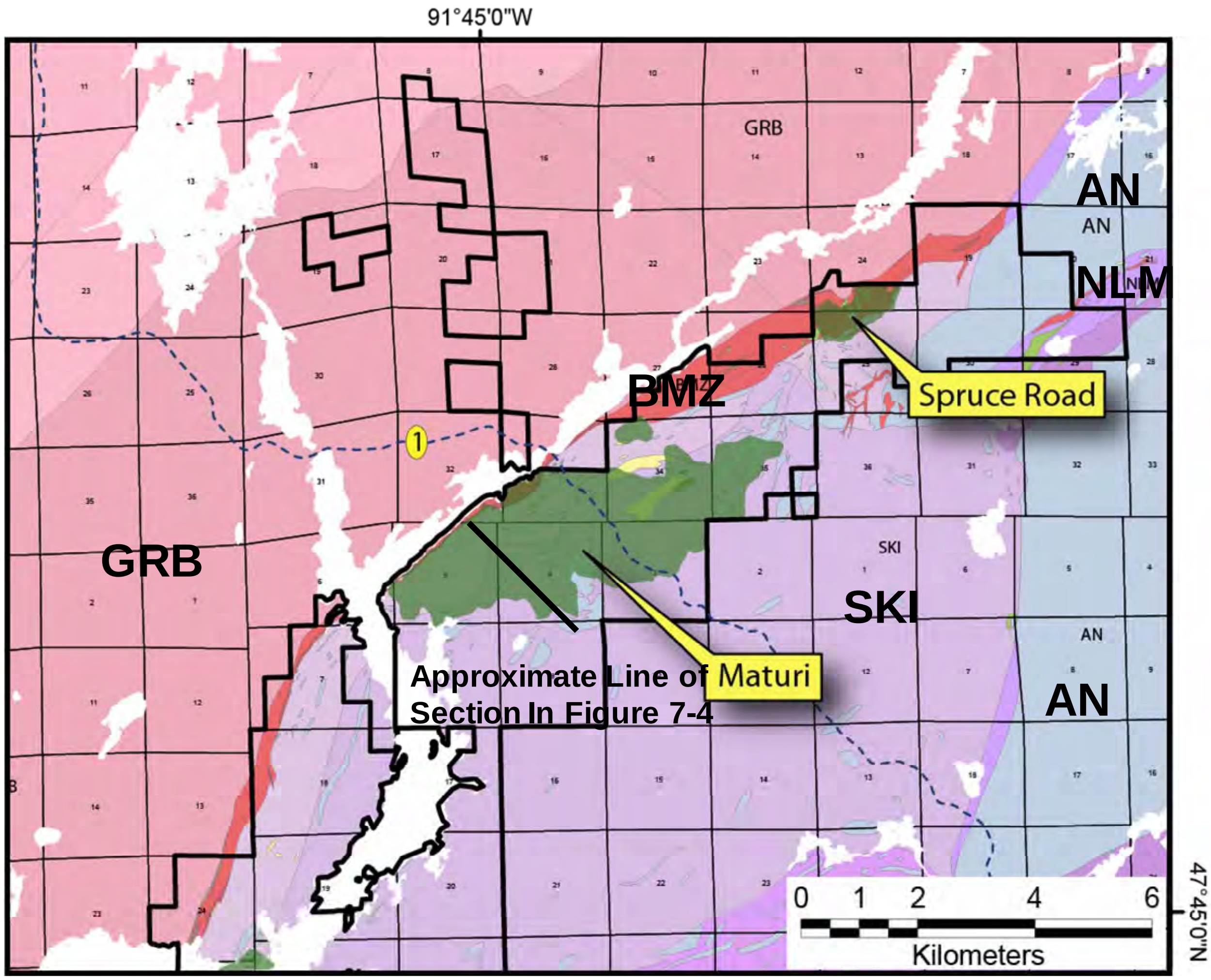
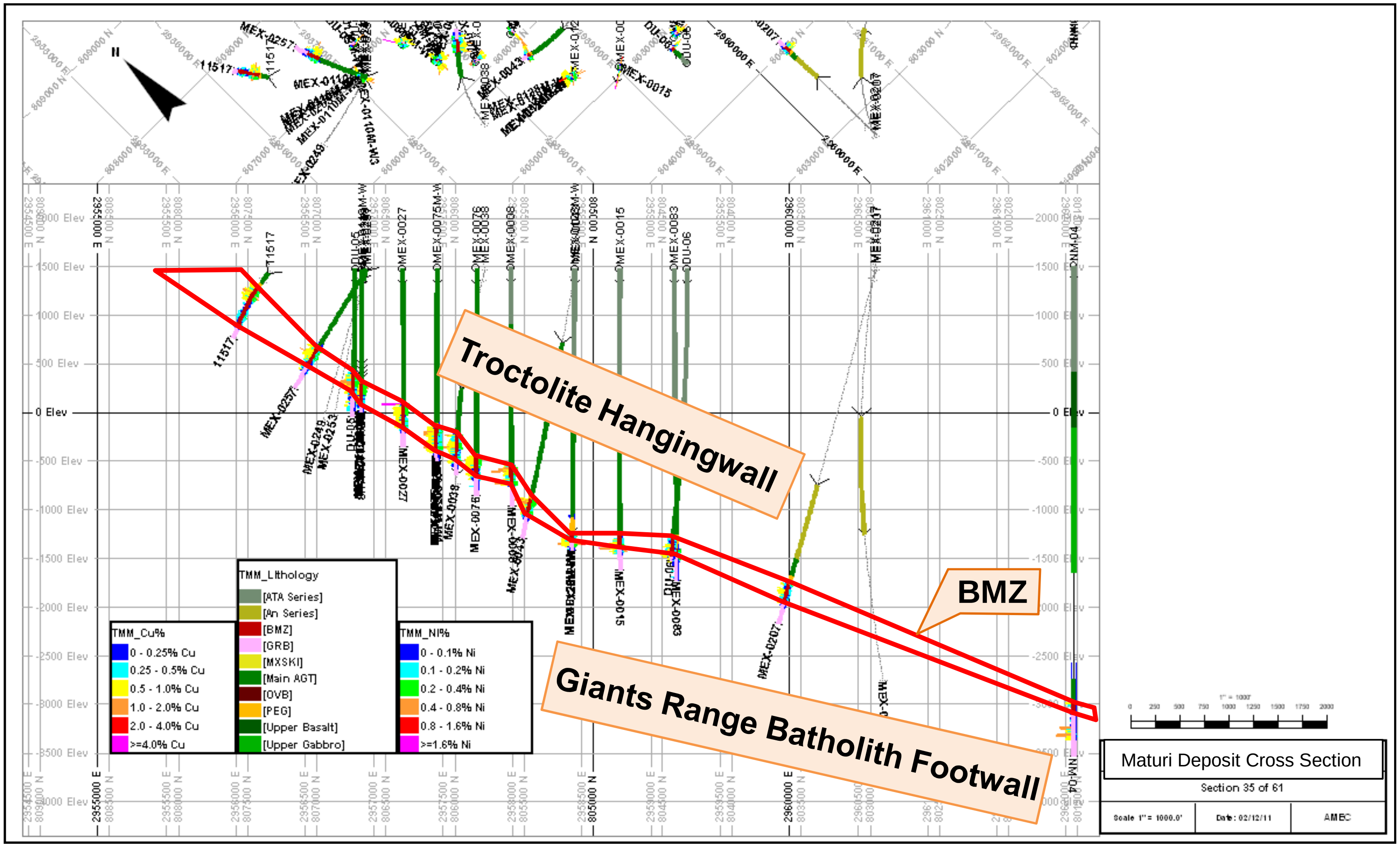


Figure 7-4: Typical Cross Section at Maturi



Alteration

Saussuritization (replacement of plagioclase by fined-grained aggregates of zoisite, epidote, albite, calcite, sericite, and zeolites) and serpentinization (replacement of olivine by serpentine) are logged. Serpentinization is common and is noted where present. Uralitization (the alteration of an igneous rock in which pyroxene is changed to amphibole) is commonly encountered and is also logged. These alterations exhibit no obvious relationship to mineralization but are logged so that those relationships can be identified if they are present.

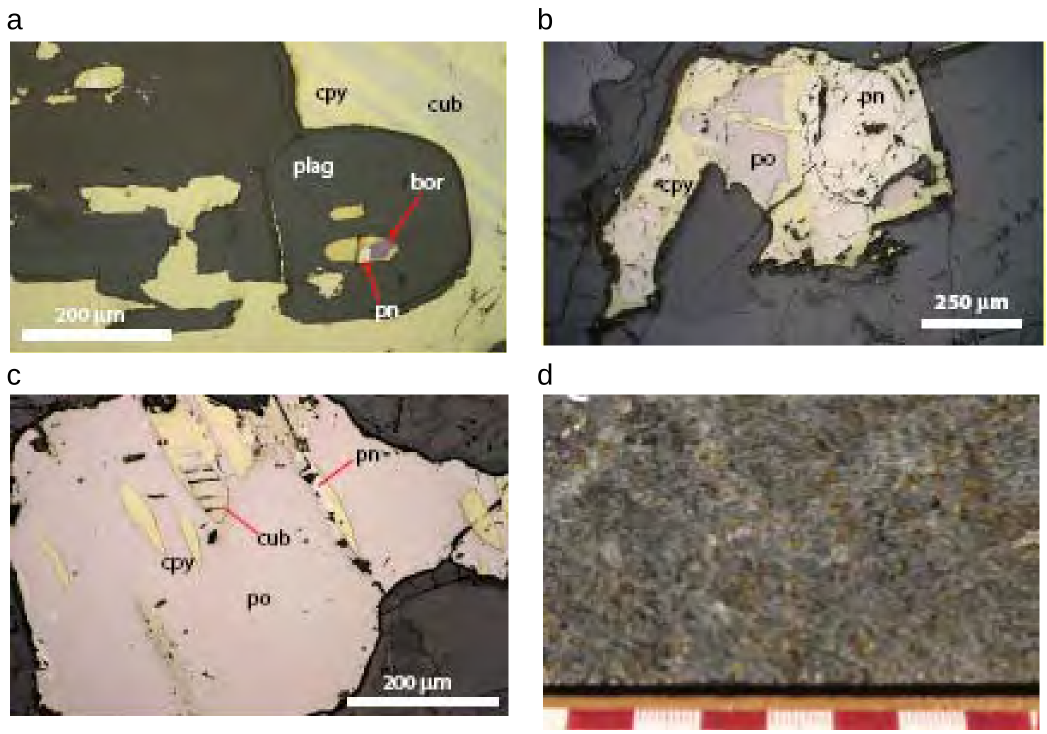
Mineralization

The Maturi deposit consists of a tabular sheet of disseminated copper-nickel-iron sulfide mineralization 5 ft (1.5 m) to 865 ft (260 m) thick (average 215 ft (65 m)) in the BMZ which rests on or close to the SKI-granite contact. The mineralized zone is in, and immediately above, the footwall contact of the SKI. It consists of 1% to 5% disseminated chalcopyrite, talnakhite, cubanite, pyrrhotite, and pentlandite in a tabular zone, parallel to the contact. Better grades of copper, nickel and PGEs are associated with more mafic units located near the top of the mineralized zone, and there is excellent continuity of widths and values from hole to hole and section to section.

The BMZ dips vary from 35° to 55° and the BMZ plunges approximately N60°E along the contact. Higher grades are concentrated in the upper 100 ft (30 m) of the zone that is approximately 4 mi (6.4 km) along strike. Mineralization has been traced by drilling laterally approximately 2.2 mi (3.5 km) and is open at depth.

Magmatic sulfide mineralization in the South Kawishiwi Intrusion is restricted to the BMZ but rarely can be found in the overlying PEG (including ultramafic) units and in the footwall granitoids as well (Gál et al, 2010). Sulfides are usually disseminated-patchy and interstitial to the host silicates (Figure 7-5). The most common sulfide minerals are chalcopyrite, pyrrhotite, pentlandite and cubanite which form irregular shaped patches consisting of multiple intergrown minerals (Figure 7-5a, b, c).

Figure 7-5: Photomicrographs (from Gál et al, 2010)



cpy – chalcopyrite; cub – cubanite; bor – bornite; plag – plagioclase; pn – pentlandite; po - pyrrhotite

Pyrrhotite forms anhedral grains often showing oriented lamellae of different Fe:S ratios (Gál et al, 2010; Figure 7-5c). Pyrrhotite is usually intergrown with rounded pentlandite grains.

Pentlandite is also abundant as flame-like exsolution lamellae in pyrrhotite (Gál et al, 2010).

Chalcopyrite occurs as interstitial patches between silicates, replacing pyrrhotite, pentlandite and silicates (pyroxene and plagioclase) as well (Gál et al, 2010; Figure 7-5d). Chalcopyrite also forms rounded primary inclusions in plagioclase and very rarely in clinopyroxene. Oriented star-shaped exsolution lamellae of sphalerite in chalcopyrite are abundant.

Cubanite is always present in the form of exsolution lamellae in chalcopyrite (Gál et al, 2010; Figure 7-5a).

Sulfide minerals often occur in micro-scale (1-5 µm thick) veinlets crosscutting all silicate phases and interconnecting interstitial sulfide patches (Gál et al, 2010). These veins are primarily filled with chalcopyrite and to lesser extent, cubanite as exsolution lamellae; however, some minor amount of pentlandite and pyrrhotite can also be found in such textural positions. The vein filling occurrences of sulfides implies that after the solidification of the silicate host rock, the immiscible sulfide melt, until a certain point, was still in liquid state and could migrate through micro-cracks in the rock.

Bornite, covellite, talnakhite, and millerite occur in subordinate amounts and are products of late-stage differentiation of the crystallizing sulfide melt. These minerals occur as replacing phases of chalcopyrite and along grain boundaries in sulfide patches and silicates (Gál et al, 2010).

Significant Cu-Ni mineralization occurs at the top of the footwall Giants Range Batholith. The mineralization is hosted within the contact thermal aureole to the Duluth Complex and is interpreted to be directly derived from the Duluth Complex. Mineralization in the footwall occurs in approximately one-quarter of the holes drilled to date, with about eighty percent of these holes showing mineralization in the BMZ and then continuing directly into the footwall with little or no breaks. The sulfide mineral assemblage in the footwall is the same as in the BMZ, being dominated by chalcopyrite and pyrrhotite with lesser cubanite, pentlandite, bornite and talnakhite. Pentlandite is the principal nickel mineral, although small amounts of nickel also occur in talnakhite and pyrrhotite. Chalcopyrite, cubanite, talnakhite and bornite are the principal copper-bearing minerals.

Platinum group minerals (PGMs) have been found in various textural positions (Gál et al, 2010) but most commonly occur as finely disseminated grains within sulfide patches. Pyrrhotite or pentlandite are the preferred hosts; however, chalcopyrite can host PGMs. Work by Gál et al, 2010 indicates that these grains are mostly Pt-Pd-bismuth-tellurides (michenerite, moncheite) or Pd-Sn-bearing phases (paolovite) in composition. Rare grains of Ir-arsenides (irarsenite) are enclosed in pyrrhotite.

The largest concentrations of PGMs occur along the grain boundaries of plagioclase and massive sulfide patches or in thin sulfide veinlets. In such places, Ca-alteration of plagioclase is almost always present with some amount of chlorite or serpentine. Grain boundaries of sulfides and biotite or apatite also host PGMs. Most of the Pt-Pd-bismuth-tellurides (michenerite, moncheite, polarite/sobolivskite) and sperrylite are located in such position.

In drillhole MEX-108, a possible zonation of PGMs was observed: in the lower sample (108-26) only Pt-rich grains were observed while in turn in the higher sample (108-25) only Pd-rich PGMs occur. This suggests differential mobilization of Pt and Pd; the latter perhaps more mobile under late-stage magmatic/hydrothermal conditions. However, a constant Pd:Pt ratio of 2.6:1 is evident in assays from the mineralized section of MEX-108, suggesting little differential late stage magnetic/hydrothermal mobility of Pt and Pd. These disparate conclusions indicate additional investigation into late stage PGE mobility is warranted.

PGMs not associated with sulfides are less abundant. Some of the grains were found along the boundary of K-feldspar and quartz in a granophyric segregation near to the footwall contact, others have been identified in sericitized plagioclase or in K-feldspar in a felsic mass close to abundant apatite inclusions.

PGMs also occur in semi-massive, net-textured sulfide patches associated with felsic inclusions or quartz-pegmatite, clearly showing evidence that during mixing of felsic material originating from the footwall and the intruding troctolitic magma these metals are mobile and may be concentrated in the felsic material.

A QEMSCAN mineralogical study was conducted by SGS Lakefield Research Limited (SGS Lakefield) in 2007 in conjunction with the bench-scale flotation test work on a composite sample of drill core from the Maturi deposit to determine the deportment of copper and nickel mineralization. A 4.4 lb (2 kg) sample was ground in a ball mill for 25 minutes and classified into four size fractions. A polished section from each fraction was prepared and submitted for QEMSCAN analysis. An important observation was that a significant portion of the nickel (about 22%) is non-sulfide and potentially non-recoverable. The distribution of chalcopyrite, cubanite, and pentlandite increases in the finer fractions. Pyrrhotite distribution remains almost constant in all fractions. About 80% of total copper in the ore is in chalcopyrite and 18% in cubanite. Pentlandite was the only nickel-bearing mineral detected in this study, but Ni also occurs in talnakhite.

7.5.2 Birch Lake

The Birch Lake property lies south of Maturi. The geology, while similar, is distinct because the SKI in this area includes numerous ultramafic and oxide (magnetite/ilmenite/chromite) layers that are not present at Maturi.

Lithology

The Birch Lake mineralization is hosted by the SKI (Routledge, 2004) (Figure 7-6), which extends approximately 25 mi (40 km) northeast-southwest and is as wide as seven kilometers. It is bordered on the southwest by the Partridge River body and on the southeast by the Bald Eagle pluton, both of which are mafic intrusive bodies similar in composition to the SKI. The footwall consists predominantly of Giants Range

Batholith with minor Middle Precambrian metasedimentary rocks that are exposed less than a kilometer west of the property boundary in the area of the Birch Lake deposit, and are exposed in the Dunka open pit area.

The SKI ranges from 1,150 ft (350 m) to 4,430 ft (1,347.5 m) thick over the deposit, as interpreted from drill intercepts of the footwall metasedimentary rocks or Giants Range monzonite.

Cu-Ni bearing sulfides and associated PGE mineralization at Birch Lake occur consistently in the BMZ below its contact with pegmatitic phases of sulfide-barren, hangingwall troctolites, gabbros, and anorthosites. The BMZ averages about 100 ft (30 m) thick, but is as thick as 515 ft (157 m). Figure 7-7 is a cross section across Birch Lake showing the BMZ.

Relative to Maturi, Birch Lake contains significantly more ultramafic intrusive rocks. PGE enrichment at Birch Lake is associated with late stage Cu-Ni sulfides, particularly with chalcopyrite, talnakhite, and bornite.

The Birch Lake area has not been significantly deformed since magma consolidation but it has been subjected to displacements along reactivated basement faults as well as cross faults. Mapped structures are mostly sub-vertical north-northeasterly faults and fault zones that are evident as linear features on air photos and topographic maps. Rowell (2002) believes that these faults have been active pre, syn and post emplacement of the SKI and offset the mineralized U3 unit. Where exposed in parts of the SKI and footwall rocks, movement on these faults ranges from 10 ft (3 m) to 400 ft (120 m).

West-northwest faults cut the northeasterly faults and show left lateral displacements in the south portion of the property and right lateral offsets under Birch Lake (Rowell, 2001; Pratt, 2010). These late faults have vertical displacements in the order of 30 ft (10 m) to 400 ft (122 m) and may be akin to transform faults that accompany rifting elsewhere.

The Bob Bay Fault zone trends north through Bob Bay, but northeasterly south and north of Bob Bay. This fault effectively cuts off the Birch Lake deposit on the west. Drill holes in this fault zone commonly intersect massive and disseminated sulfides in the footwall rocks and/or felsic dikes that cross-cut the intrusion. The sense of displacement between holes 88-1 and DU-15 is in the order of 200 ft (60 m) to 300 ft (90 m) down on the east side.

Figure 7-6: Birch Lake Property Geology

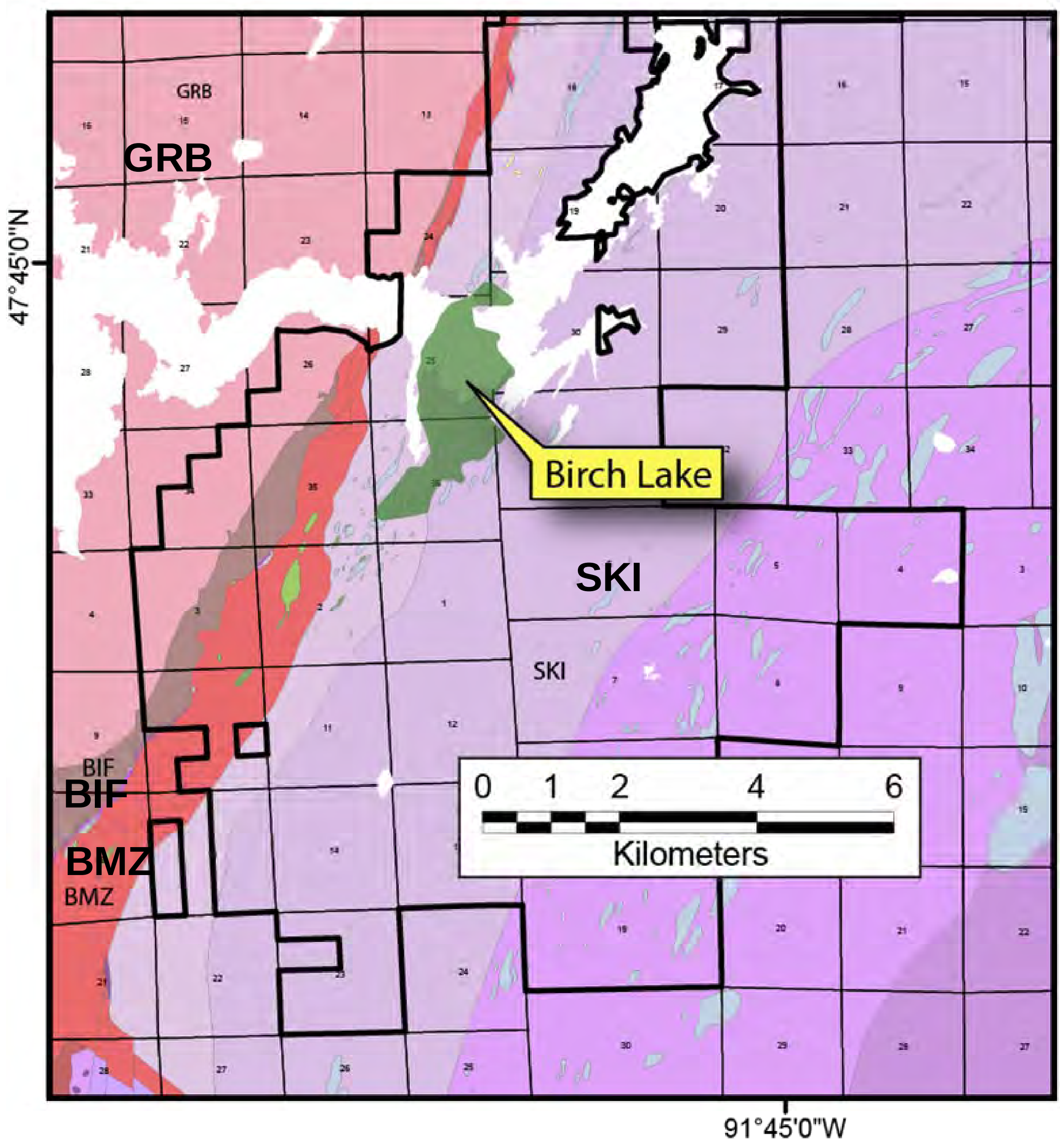
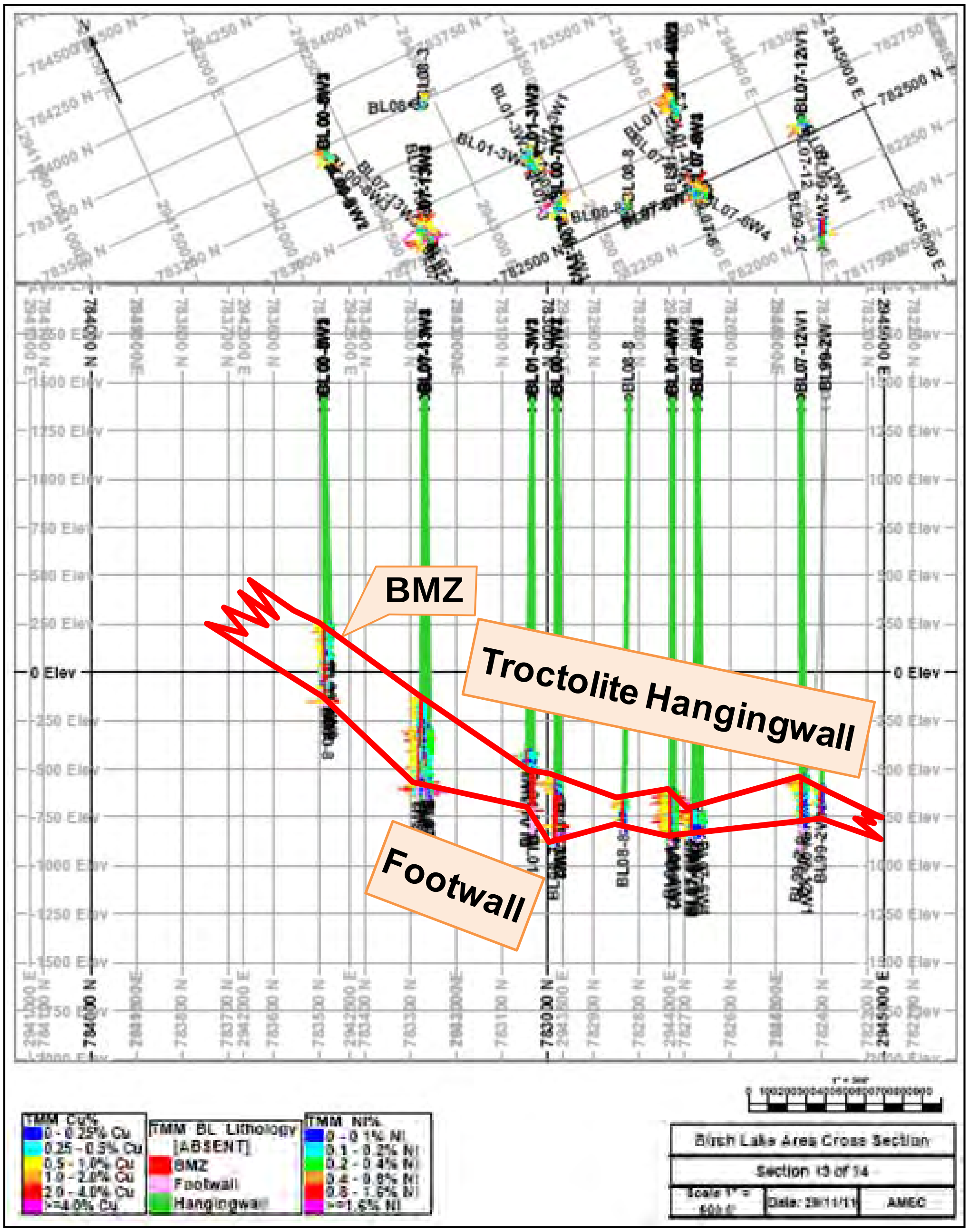


Figure 7-7: Birch Lake Cross Section



Alteration

Saussuritization (replacement of plagioclase by fine-grained aggregates of zoisite, epidote, albite, calcite, sericite, and zeolites) and serpentinization (replacement of olivine by serpentine) are common deuteric alteration styles in the U3 unit.

Mineralization

Information on mineralization has been obtained from core logging by personnel of the BBJV, its partners and State geologists, laboratory analysis and the detailed mineralogical investigation of five core samples from five drill holes (Routledge, 2004). Mineralogical investigations consisted of reflecting light microscope and scanning electron microscope study of polished thin sections prepared from heavy minerals concentrated by heavy liquid separation of crushed and ground core (Cabri, 2002). These samples had relatively high PGE grades. Detailed petrography and electron microprobe work on drill core from four holes has also been done by the University of Minnesota and the University of Minnesota Natural Resource Research Institute (NRRI) (Marma et al, 2002).

Sulfides are disseminated interstitially in the rock matrix and mirror the size of rock forming mineral grains: coarser sulfides with coarse grained to pegmatoid fabrics, finer sulfides with medium grained rocks. The sulfides occur:

- Intergrown as eutectic and replacement textures
- As triple point exsolution between rock mineral grains.
- Intergrown with silicates
- Rarely as sulfide seams or veinlets.

Microscopy by Cabri (2002) identified the major sulfide minerals as chalcopyrite and undefined members of the chalcopyrite family, possibly talnakhite, mooihoekite, putoranite, and/or haycockite. Oxide minerals include chromian spinel, ilmenite, magnetite, and chromite. Native copper and troilite occur locally. Other identified minerals include bornite, chalcocite, and cubanite as well as nickel sulfide minerals heazlewoodite and pentlandite. Trace amounts of altaite, digenite, frobergite, galena, mackinawite, millerite, sphalerite and unidentified PGE-bearing minerals, native silver, silver telluride and alloys of silver and gold have been identified. Pentlandite contains as much as 2.12% Co. Iron sulfide gangue is pyrrhotite and troilite.

Platinum group minerals (PGMs) occur as various fine grained Pd tellurides with other Pt, Os, Ru, Au, Ag, Te, and Bi bearing minerals. Ninety percent of the PGMs are associated with copper sulfides as discrete grains attached to sulfides, as sulfide inclusions and at the margins between sulfides and gangue silicates (Cabri, 2002). The PGMs may form halos around, or be included in, interstitial copper sulfides, pyroxenes, secondary amphiboles and biotite. PGMs are also remobilized in chlorite, serpentine, or secondary magnetite. Pd minerals occur at twice the frequency of Pt minerals.

Structural Geology

When the 2011-2012 drilling was complete, AMEC and TMM reviewed the data in the Birch Lake area in an attempt to identify major structural features. Data density was adequate to identify a total of eight possible faults (Figure 7-8). Offsets have been estimated for each fault and have been included in the geological model (Table 7-4). These faults have been modeled. The geological model suggests that all of the faults in the area have not been recognized and that there are errors in the estimates of displacements. Additional drilling is required to identify other faults and to improve the displacement estimates.

The displacement along Fault 2 and possibly Faults 3 and 4 diminishes northward. In the extreme south, Fault 2 has approximately 450 ft of displacement and where it intersects Fault 1 in the north, it has on the order of 80 ft of displacement. Some of the displacement may have been along unrecognized faults. Similarly, Fault 5 displacements are on the order of 350 ft where Fault 8 intersects, but only about 80 ft where Fault 5 intersects Fault 6. AMEC suspects that this discrepancy is due to an as yet unrecognized fault in the area.

Figure 7-8: Faults at Birch Lake

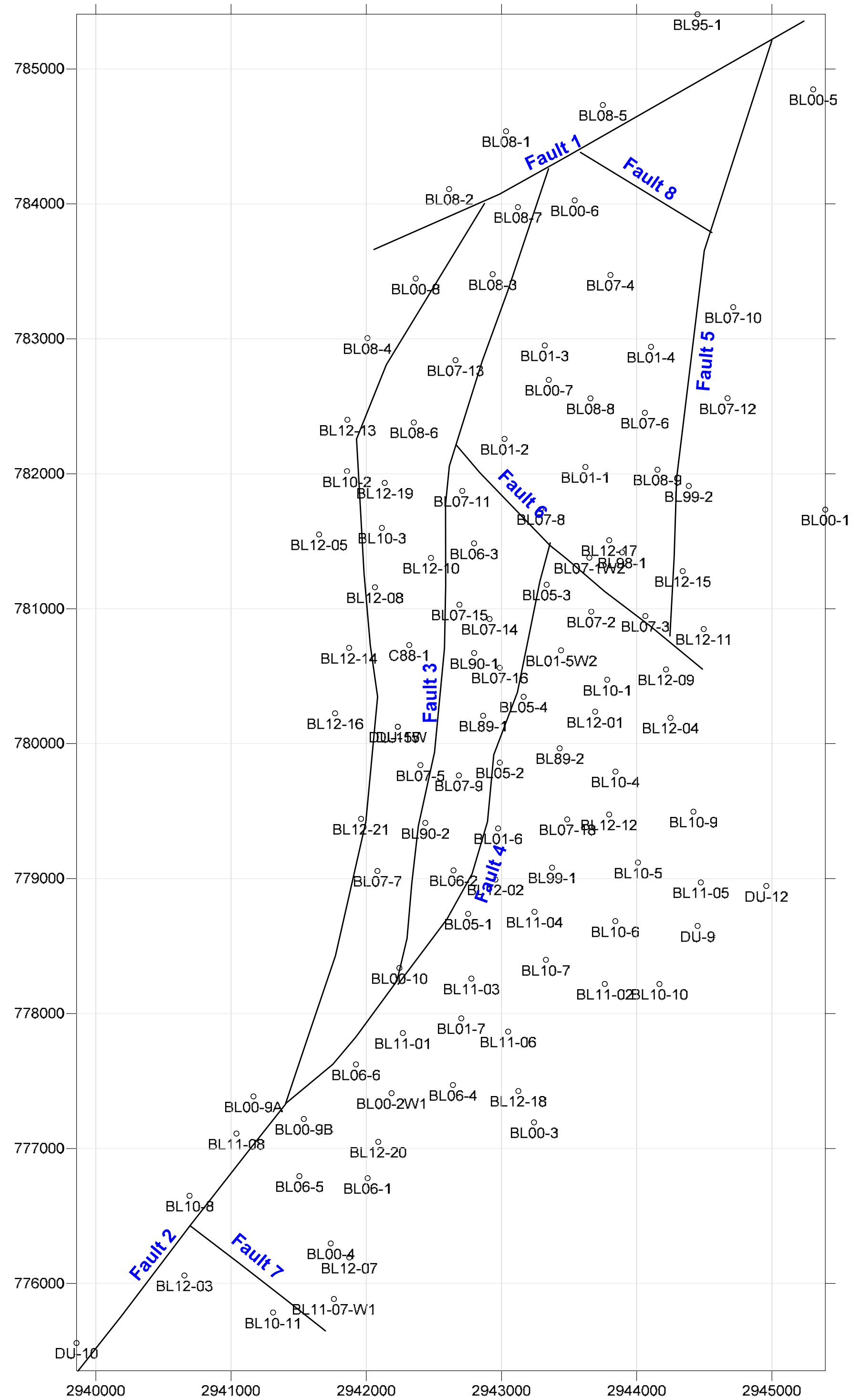


Table 7-4: Fault Offsets at Birch Lake

Fault	Offset	Mean Displacement
1	Down-to-the-south east	About 100 ft
2	Down-to-the-east	Variable, averages about 100 ft
3	Down-to-the-east	About 100 ft
4	Down-to-the-east	About 50-70 ft
5	Down-to-the-west	Variable, averages about 150 ft, less to south
6	Down-to-the-southwest	About 50 ft
7	Down-to-the-southwest	About 125 ft
8	Down-to-the-southwest	About 200 ft

7.5.3 Spruce Road

Lithology

Troctolitic rocks comprise much of the SKI at Spruce Road and carry abundant rafted basement inclusions of sedimentary hornfels, basaltic hornfels, anorthosite and iron formation (Routledge and Cox, 2007) (Figure 7-3). Inclusions are mostly barren, but locally are mineralized. At Spruce Road, in contrast to the Maturi and Birch Lake deposits, there does not appear be to any specific correlation of mineralization to lithology and there is no key unit or hanging wall marker horizon, such as the pegmatite, that overlies the mineralized unit at Maturi. Mineralization is considered to be consistent with the Basal Mineralized Zone (BMZ) and is very similar to the thick Cu-Ni mineralization in the northwestern part of Maturi (Figure 7-9). Typical features of the rocks are discontinuous layering, variable textures and common inclusions and erratic disseminated copper-nickel mineralization. There is some uncertainty as to the attitude and geometry of the mineralization at progressively higher grades at Spruce Road but, for the purpose of resource estimation, mineralization trends are assumed to parallel intrusive layering and conform to the overall geometry of the SKI.

Alteration

Alteration described at Spruce Road includes serpentinization, saussuritization and uralitization.

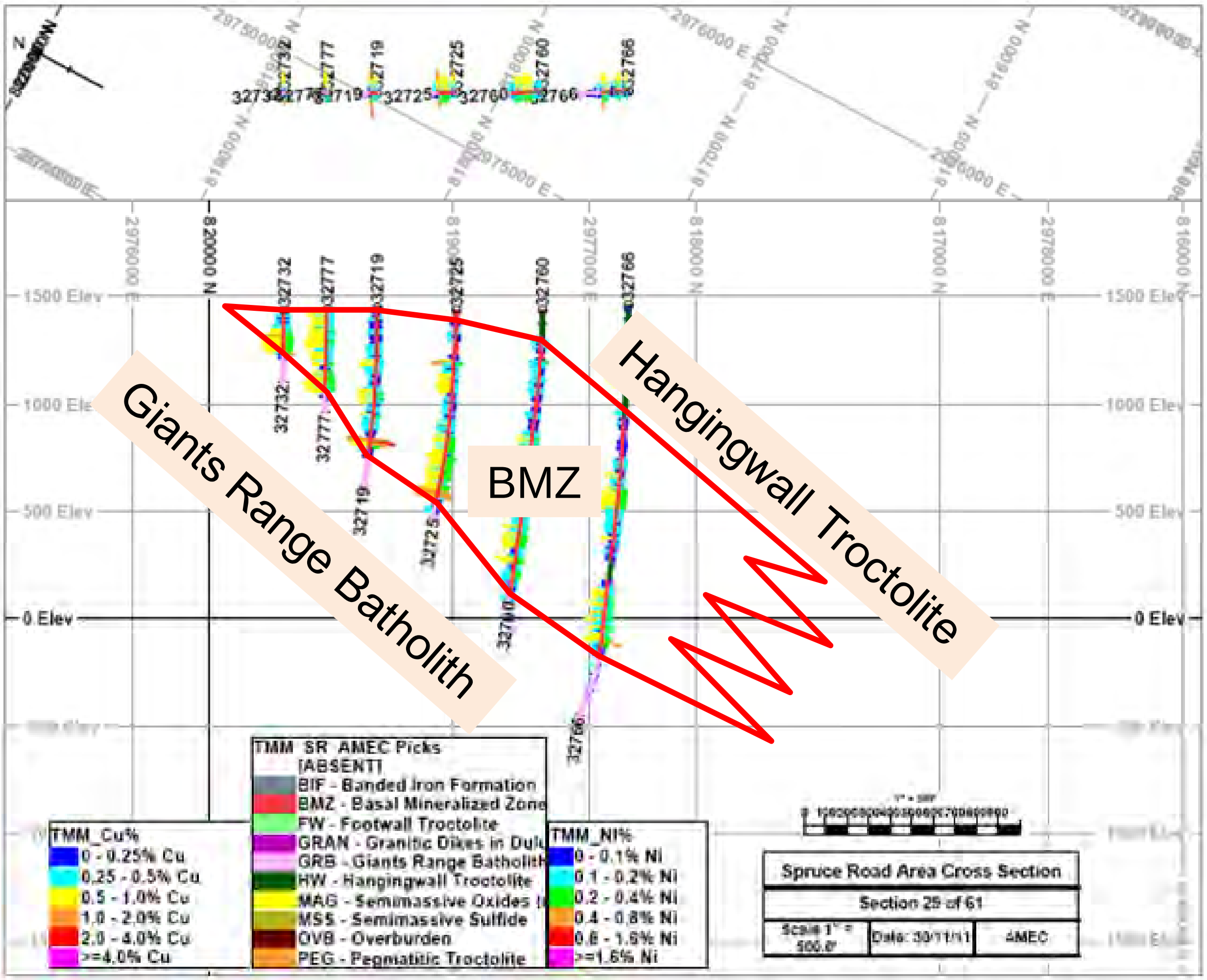
Mineralization

Sulfides occur as disseminated interstitial aggregates, irregular blebs, partially oriented inclusions in feldspar, biotite and amphibole and as thin stringers in fractures and cleavages in silicate minerals. Chalcopyrite, cubanite, pyrrhotite and pentlandite are the primary sulfide minerals. Inco identified minor to trace amounts of bornite, neodigenite (digenite), covellite, chalcocite, tenorite, cuprite, native copper, violarite, pyrite, mackinawite and sphalerite that occur locally in the deposit. Sulfides comprise 2% to 5% by volume and 3% to 4% by weight of the host rocks. Chalcopyrite is the primary copper sulfide with a >20:1 ratio with respect to cubanite.

Work by the University of Minnesota (Inco, 1966) on concentrates on behalf of Inco found that the "Minnesota ore" was a variety of gabbros carrying chalcopyrite, cubanite, pyrrhotite and pentlandite. About 70% of the chalcopyrite was present as individual grains or as compound grains with pyrrhotite. Compound grain size was 100 µm to 1,800 µm and averaged about 500 µm. The balance of the chalcopyrite occurs as minute inclusions in olivine corona structures or in pyrrhotite, magnetite, and olivine. Cubanite was not common but, when present, was always associated with chalcopyrite. Pyrrhotite was noted as having a similar mode of occurrence to chalcopyrite. Pentlandite was found as compound grains with pyrrhotite and chalcopyrite or included in pyrrhotite.

SGS Lakefield Research Limited (Lakefield) did a mineralogical study of core samples from Wallbridge America's drill hole WM-001 (Soever, 2000). Lakefield identified pentlandite, chalcopyrite, cubanite, bornite, mackinawite, violarite, pyrrhotite, pyrite, magnetite, and ilmenite. Soever (2007) notes that chalcopyrite and cubanite were identified as the main copper minerals with particle size ranges of 5 µm to 250 µm and 20 µm to 500 µm, respectively. Nickel was mainly present as pentlandite with grain sizes 2 µm to 250 µm and occurring as exsolution flames in pyrrhotite.

Figure 7-9: Spruce Road Cross Section



7.6 Geological Model Updates

The 2011-2012 drilling programs at Maturi and Birch Lake produced a significant volume of new, high-quality geochemical and geological data.

Mineralization in both the BMZ and footwall at Maturi were reclassified based on patterns in the physical distribution of mineralization as projected on down-hole plots. Sulfide mineralization is characterized by several distinct patterns, including 1) very low grade mineralized intervals showing low variability, 2) moderate grade mineralized intervals showing low variability, and 3) higher grade mineralized intervals showing higher variability and commonly bounded by very low grade selvages. Significantly, the contacts between different mineralized intervals are typically quite abrupt. A single drill hole might contain one or several distinct mineralized intervals within the BMZ. A single drill hole can contain more than one high-grade, high-variability interval, characterized by systematic variation in grades, with the highest grades occurring at the top, middle, or bottom of the section. Based on these criteria, four intrusive subunits, characterized by common grade profiles, were defined in the BMZ.

The classifications derived from this exercise were validated by multivariate statistical analysis of multi-element geochemical data, including principal component analysis and factor analysis. That investigation revealed a significant correlation of whole-rock geochemistry to mineralization within the BMZ as well as several possible subdivisions of the BMZ based on both physical distribution patterns of mineralization and geochemistry of the host rocks. The Maturi subunits so defined and validated by multiple discriminant analysis were determined to occur in a consistent stratigraphic order, and are correlative across the deposit. Details of that work are found in AMEC (2012c) and the results are summarized here.

Overall data quality problems prevented a similar study of all of the data at Birch Lake, but 2011-2012 data, which are equivalent to the Maturi data in terms of quality, were investigated and correlations similar to those at Maturi were discovered and applied.

The results of the studies follow.

7.6.1 Maturi

The BMZ at Maturi has been subdivided into four stratigraphic units; Stage 1 (S1), Stage 2 (S2), Stage 3 (S3), and the Upper Heterogeneous (UH) (Figure 7-10). Once defined across the deposit (Figure 7-11), those units were found to have an apparent time sequence and were named, in part, for their inferred time of intrusion. S1 and possibly the UH appear to have intruded first and were dissected and partially assimilated by S2 which was, in turn, dissected by S3 which appears to be the last intrusive to be emplaced. S3 is very well mineralized and S2 is contains significant mineralization. UH and S1 are poorly mineralized, but locally contain small volumes with significant base and precious metals grades. Although S1, S2 and S3 appear to be stratigraphically “layered”, each stratigraphic layer is interpreted to comprise multiple magma pulses of similar composition, and for example S3 may occur in contact with S1, or S3 can be bounded on the top by S2-like material in the UH and on the bottom by S2 proper.

ce of S3 material. These zones may represent xenoliths of older intrusive phases incorporated into younger phases, or they may represent small dikes or other apophyses of younger intrusive phases injected into older intrusive phases. In general, these bodies are on the order of 10-20 feet across and comprise about 5% of the volume of each subunit.

In addition to the stratigraphy within the BMZ, the footwall was subdivided into three stratigraphic units. The individual BMZ and footwall units are discussed below. Units are presented in apparent stratigraphic order, from top to bottom.

Figure 7-10: 2012 Maturi Stratigraphy

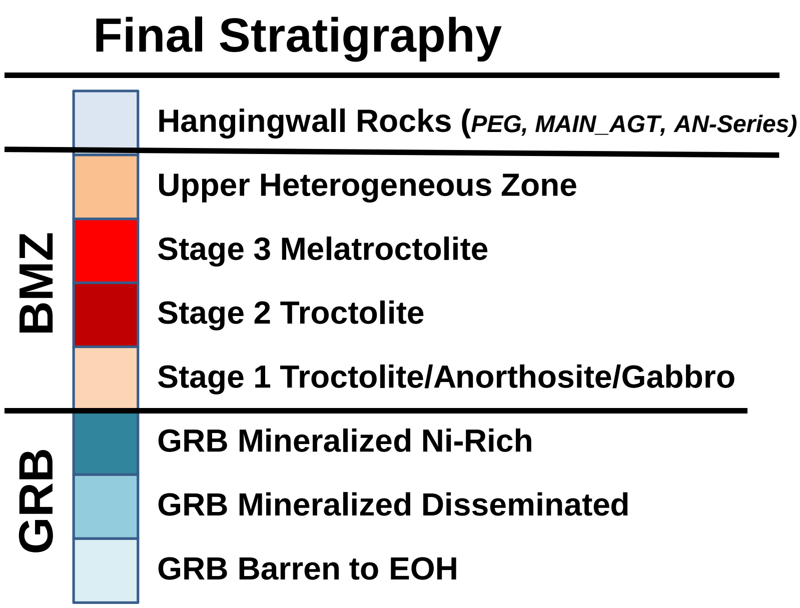
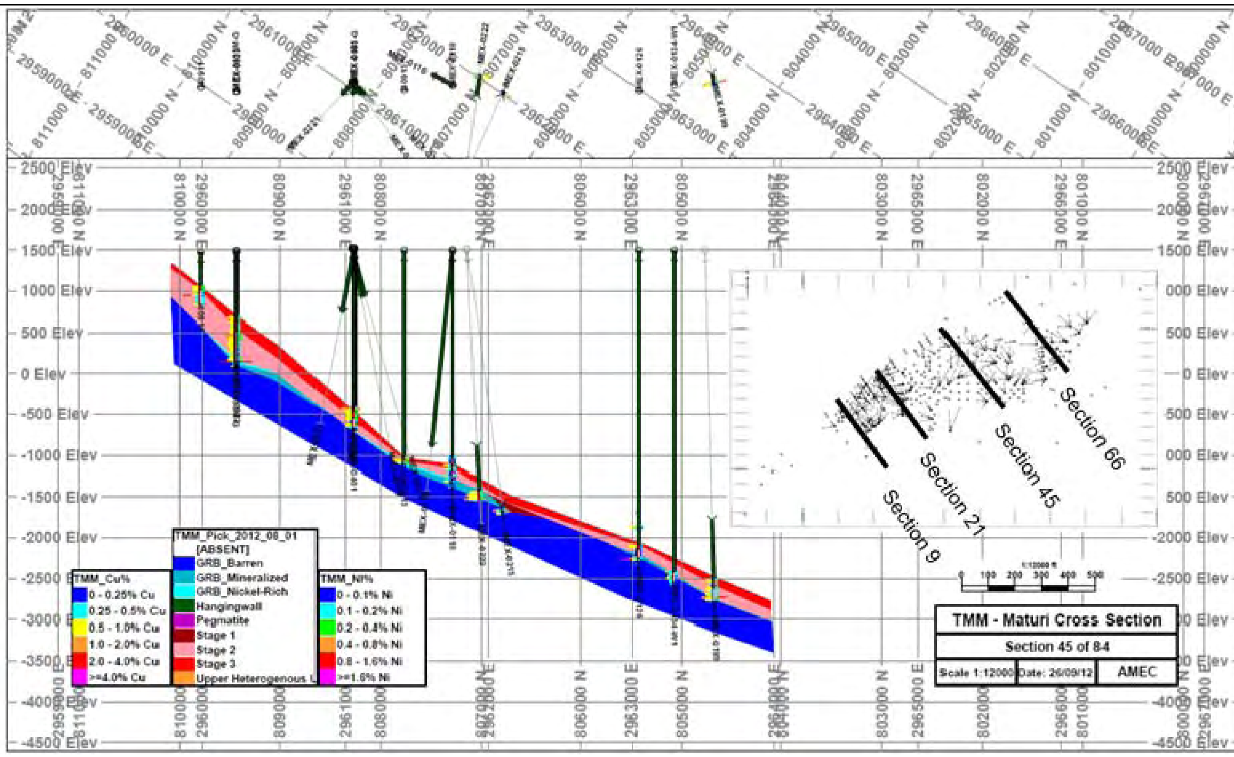


Figure 7-11: Maturi Section 45 Lithology



Columns are, from left to right, Cu, Lithology, Ni as indicated in the legends. The interpreted lithology is indicated on the section and corresponds to the central legend.

Upper Heterogeneous Unit (UH)

The UH intrusive subunit appears to be discontinuous remnants of an early intrusive along the top of the BMZ, likely intruded while in a suprasolidus (partially molten, but nearly solid) state by apophyses of later S2 and S3 magma. It is melatroctolitic in composition, and chemically and texturally quite similar to S3 rocks, but generally lacks sulfide minerals. In down-hole profiles, the top of UH is generally marked by a sharp increase in Mg from 2-4% to 6% or more. There is normally a modest decrease in P concentration as well as a decrease in Ti content. It is typically not possible to differentiate UH from S2 or S3 without consideration of base metal concentrations.

Base and precious metals grades in these early melatroctolitic rocks are uniformly low with few samples returning >0.2% Cu or any significant precious metals. That said, there are isolated zones within UH that contain significant Cu mineralization, hosted by pods of S2- or S3-like rock. That mineralization raises the overall mean Cu grade of UH to about 0.26%.

Stage 3 (S3)

The S3 intrusive subunit consists of a heterogeneous mix of melatroctolites to mafic troctolites (based on Mg composition) that is extensive throughout the deposit with some minor exceptions (Figure 7-11). Review of the data suggests that at least three major intrusive lobes are present, each with a unique petrochemistry. AMEC investigated these lobes separately and found no significant differences in base or precious metal composition; thus all lobes were treated as a single intrusive unit. The transition from UH to S3 is marked by a sharp increase in sulfide mineral content with little change in petrochemistry except for small changes in Mg, P, and Ti. Where UH is not present in the stratigraphy, the transition from hanging wall rocks is marked by a sharp increase in Mg from 2-4% to 6% or more in down-hole profile. There is normally a modest decrease in P concentration as well as a decrease in Ti content. A sharp increase in sulfide mineral content occurs within a few feet of the contact. In most cases, the increase in sulfide mineral content is correlative with the increase in Mg, but in a few cases, the increase in sulfide minerals is a few feet above or below the change in concentration of Mg/Ti/P.

Within S3, a number of troctolitic intercepts occur. Many of those units are well mineralized, but some contain low grades of base and precious metals. These are, interpreted to be either inclusions of pre-existing units (S1 and S2), or phenocryst-poor selvages to magmatic lobes within S3.

S3 hosts the highest and most consistent base and precious metals grades.

Stage 2 (S2)

The S2 intrusive subunit is troctolite to anorthositic troctolite in composition and thus, somewhat less mafic in composition than the S3. S2 is extensive throughout the deposit; however, it is somewhat less continuous that the S3 (Figure 7-11). The distribution of S2 is notably patchy in the central portion of Maturi, where it may have been thermally eroded by the later S3 intrusive subunit. The contact between S2 and S3 is marked in down-hole profiles by a gradual decrease of Mg from 6 to 5% to 2 to 5%, a small increase in P (450 to 700 ppm), and a sharp increase in Ti content. Base metal mineralization may or may not honor that contact, depending on location within the deposit.

Metal grades are significantly lower in S2 than in S3, especially TPMs.

Stage 1 (S1)

S1 is present in much of the area (Figure 7-11) and consists of two distinct intrusive phases - one with uniformly low Mg content; the other with high Mg.

The high Mg S1 occurs in a restricted area at the southwest part of the deposit. The high Mg S1 is melatroctolite or similar rock and appears to be a distinct intrusive that crosscuts the BMZ and has largely displaced mineralization in that area.

The majority of the S1 is anorthositic (low Mg) and may be the oldest intrusive phase in the BMZ. Low Mg S1 appears to have been dissected by both the S2 and S3 intrusive subunits. Along the southeast side of the deposit, this unit is quite thick and continuous and locally comprises 90% or more of the BMZ. This unit is much thinner under S2 and S3 rocks to the northwest where it has been thermally and/or mechanically eroded from the sequence. Under the main part of the deposit, only scattered remnants of S1 remain.

Base and precious metals grades are uniformly low with rare Cu grades above 0.1%. Total precious metals grades average about 0.1 ppm.

Giants Range Batholith (GRB)

The GRB forms the footwall to the Duluth Complex at Maturi and is locally mineralized. Mineralization was divided into three domains – nickel-rich (G_N), disseminated (G_M), and barren (G_B). The nickel-rich domain is taken to be all of the material below the BMZ and above the last appearance of approximately equal Cu and Ni concentrations. Grades may locally be very high, but typically run in the range of 0.2 to 0.5% Cu + Ni. Below the G_N is the disseminated mineralized GRB (G_M) which is typically more copper-rich with respect to nickel but lower grade. The bottom of this domain was placed at the base of significant disseminated mineralization, usually at cut-off of 0.1 to 0.2% Cu. Any GRB intervals below significant disseminated or Ni-rich mineralized GRB were considered to be barren (G_B) and designated as such.

Because of the methodology, both Ni-rich and disseminated GRB contain significant amounts of low-grade mineralization, or barren rock. These units are intended to delineate significant mineralization in the GRB footwall and to provide a framework for resource estimation, not to define high- versus low-grade zones.

Comment

This new interpretation of the geology of Maturi provides a logical and consistent framework for interpretation of the lithologies at Maturi. The initial delineation of each intrusive subunit relied on characteristics of the physical distribution of sulfide mineralization, as expressed in downhole plots. This delineation is supported by robust population and multivariate statistics, these statistics in turn provide a quick and reliable method for assigning intrusive subunit interpretations to uninterpreted data. All intrusive subunit assignments were individually checked for consistency and stratigraphic position. In a few cases, initial assignments were changed to make the assignment consistent with overall stratigraphic position; these reassignments likely represent larger apophyses of younger subunits, or large xenoliths of older subunits.

7.6.2 Birch Lake

TMM and AMEC geologists used some of the concepts developed by Duluth Metals for the Maturi deposit and investigated the petrochemistry of the Birch Lake area. AMEC delineated three intrusive subunits at Birch Lake – an upper melatroctolitic intrusive similar to S3 at Maturi (BL_MT), a lower troctolitic intrusive similar to S1 at Maturi (BL_T), and a basal hybrid rock sequence unique to Birch Lake (BL_HX) (Figure 7-12). The thickness of all three units is quite variable, but the stratigraphic succession does not vary across the deposit (Figure 7-13). Any of the three units can be missing from a specific drill hole.

At Birch Lake, multivariate statistical analysis was not used as an initial discriminator because there are two distinct geochemical data sets and combination of the two sets does not lend itself to multivariate statistical analysis. Assay data for the project prior to 2011 were obtained using a three-acid digestion with ICP finish. Data in 2011 and 2012 were obtained using a four-acid digestion with ICP finish. The three-acid digestion, while appropriate for sulfide minerals, is not adequate to dissolve some silicate minerals such as feldspar, especially K-feldspar; thus analyses of Sr, Ba, K, Na, and Mg for example, are not reliable and those elements will be under-reported with this method. Addition of HF to the acid (four-acid digestion) more efficiently attacks feldspars and produces more reliable analyses for Sr, Ba, K, Na and Mg. However, the lessons learned from the multivariate statistical analyses at Maturi were used to assist with definition of lithological units at Birch Lake.

The upper melatroctolitic sequence (BL_MT) hosts the highest grade mineralization and is correlative across the deposit. BL_MT is similar, but somewhat more mafic with a higher average Mg content than S3 at Maturi. Immediately below BL_MT is a lower grade troctolitic sequence (BL_T). BL_T is correlative over much of the deposit and is somewhat similar to S1 at Maturi. The lithology at the base of the BMZ is locally a hybrid rock (BL_HX) that shows similarities to both BL_T and the underlying GRB. Much of the BL_HX unit may indeed be metasomatized GRB, but local magmatic oxide layers consisting of magnetite and ilmenite in variable proportions indicate that some of the unit is troctolitic intrusive that has assimilated footwall rocks including

Biwabik Iron Formation, Virginia Formation and Giants Range Batholith. These lithologies are discussed more completely below.

Figure 7-12: 2012 Birch Lake Stratigraphy

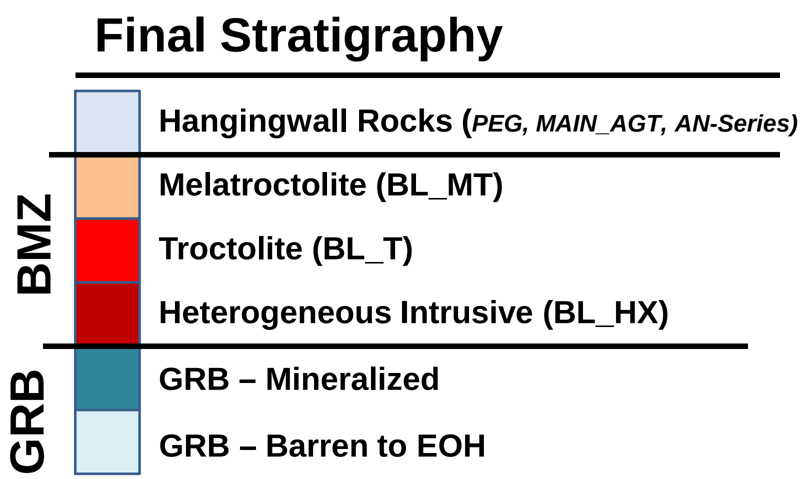
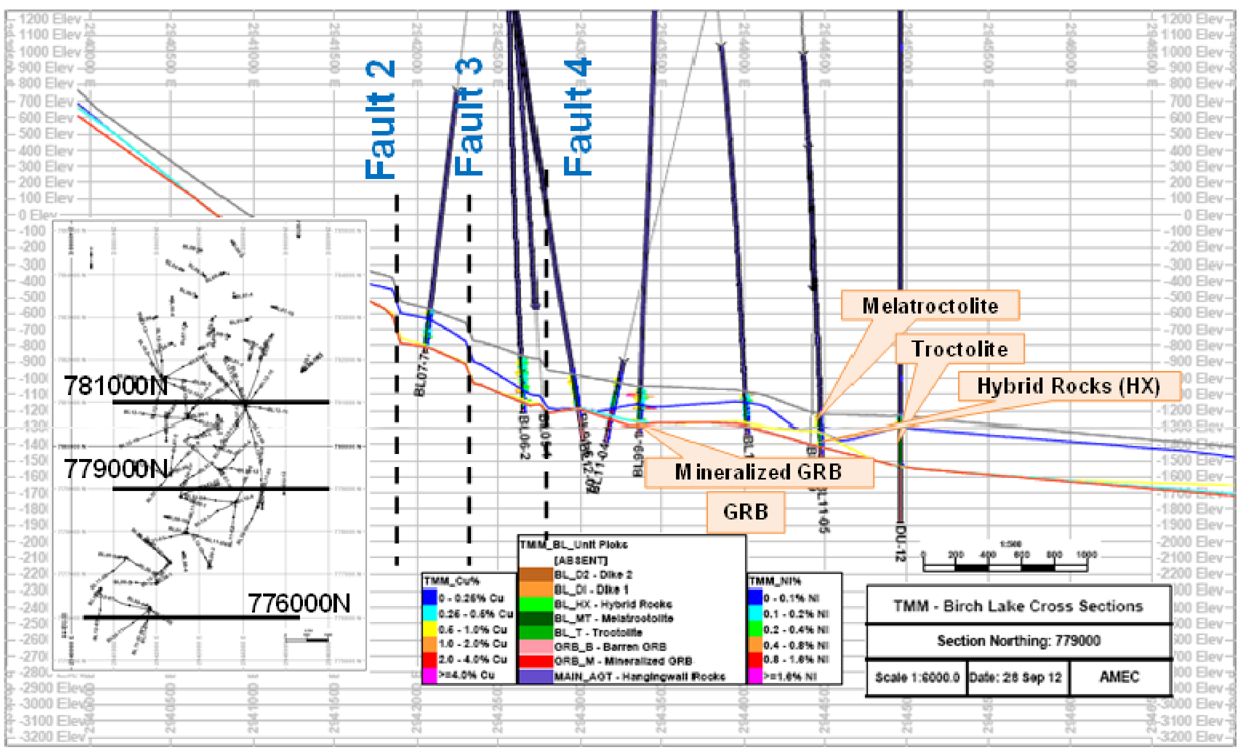


Figure 7-13: Section 779000N at Birch Lake



Melatroctolite (BL_MT)

The top of BL_MT is easily picked by the first appearance of 6% Mg in down hole plots. With the exception of two holes where mineralization was associated with troctolites (5% Mg) rather than melatroctolites, this method did not fail. BL_MT typically contains 8-9% Mg near the top and has an erratic Mg trace down hole, averaging about 6.4% Mg overall. Associated with this increase in Mg is a significant drop in Ti and P which persists through the BMZ to the Hybrid (BL_HX) zone, which is typically P-rich.

The top of BL_MT generally correlates with the top of the mineralized interval, but Cu-Ni mineralization may begin somewhat above or below this contact. Where BL_MT overlies BL_T, the base of BL_MT is somewhat more difficult to pick because BL_MT typically contains intervals of troctolite and the underlying BL_T contains short intervals of melatroctolite. The lower contact generally corresponds with a significant drop of Mg to below 6%, but the contact is generally easy to pick if base metal grades are considered because the drop in base metal grade normally correlates with a drop in Mg concentration.

Review of the logs indicates that the melatroctolite at the basal contact of BL_MT is locally fine-grained to pegmatoidal. The fine-grained portions may represent chilled margins at the base of individual intrusions.

Almost all of the significant Cu-Ni and precious metals mineralization in the Birch Lake deposit is hosted by the BL_MT.

Troctolite (BL_T)

BL_T contains about 3.7% Mg and uniformly low Cu-Ni grades. Mg remains in the 3.5-4.5% range throughout and is rather regular with few outliers. Texturally, this is a heterogeneous unit ranging from very fine-grained to pegmatoidal, but medium grained troctolites are most common. There are a few melatroctolitic intervals included in BL_T.

Base and precious metals grades in BL_T are uniformly lower than in BL_MT. Locally, the top of BL_T is mineralized, and there are small mineralized zones locally near the base of BL_T.

Basal Hybrid Zone (BL_HX)

BL_HX is a hybrid rock. It is marked by an abrupt increase in P in the lower portions of the BMZ and erratic Sr, Ba, Mg, Mn, and V concentrations, possibly because of assimilation of footwall rock, or metasomatism of GRB and other footwall rocks. Fe ranges from 2 to 45% largely because of assimilation of Biwabik Iron Formation, but there are local magmatic magnetite intervals. These rocks are present to some extent in most holes.

Other Mafic Intrusive Rocks

A large troctolite sill (BL_D2) in the footwall that appears to intrude into the base of the BMZ occurs in the extreme southern part of the deposit and largely truncates the mineralization. It is not clear from the limited data whether this sill is connected to a deeper magmatic source or whether it formed as a BL_T sill by injection into the footwall from the main intrusive. In any case, it has a distinctive chemistry and mineralogy that is easy to identify. Base and precious metals grades are uniformly low in this sill which appears to form the southern boundary of the Birch Lake deposit.

A second isolated troctolite intrusive into the footwall, possibly a dike (BL_DI) is known only from two widely-separated holes (BL11-08 and BL12-01). The orientation of this body is in question because of the limited number of intercepts. Chemically, it is somewhat similar to the troctolites in the main Duluth Complex, but BL_DI has a distinctive texture and color that sets it apart from the troctolites in the main Duluth Complex. Copper grades are significant (average of 0.43% Cu), as are PGM grades (0.37 g/t PGM); however, Ni grades are very low, on the order of 0.02% Ni.

GRB

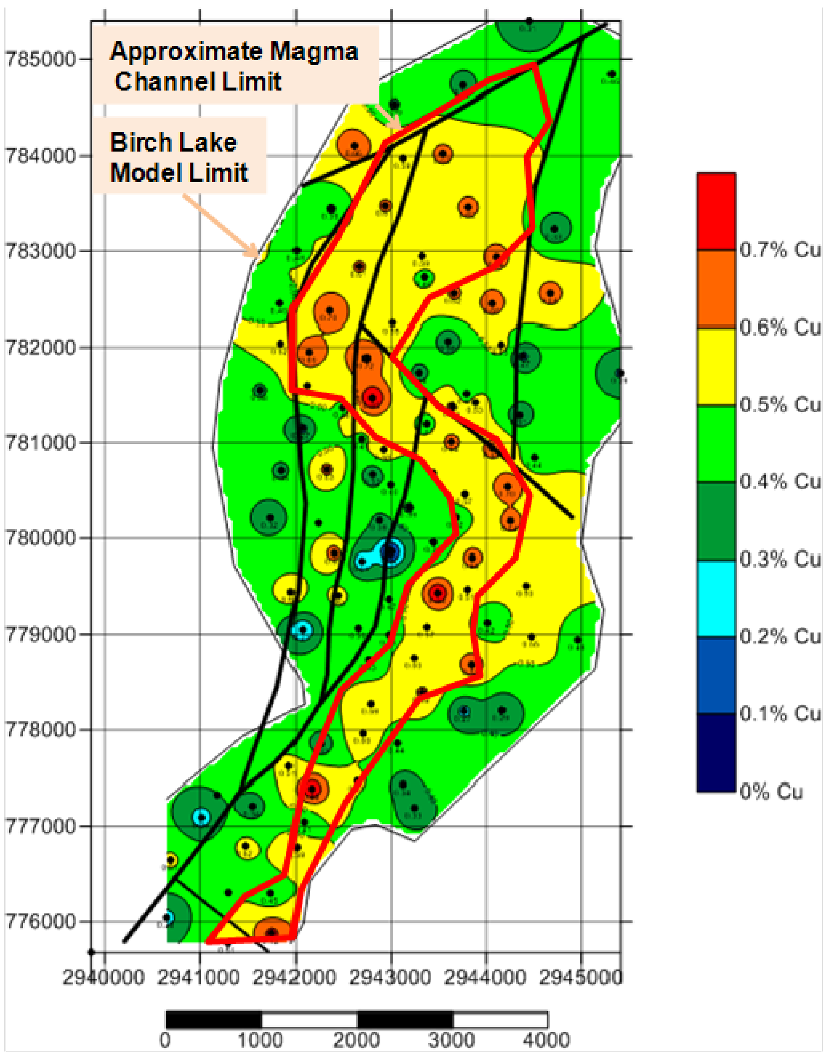
The GRB at Birch Lake consists of locally mineralized Giants Range Batholith, Biwabik Iron Formation, and Virginia Formation. That mineralization has been identified as GRB_M and is modeled separately. Mineralization generally consists of disseminated Cu-Ni sulfides with an average Cu grade of 0.28% and a Ni grade of 0.16%. Note that the Cu:Ni ratio here is about 2.3 which is significantly different than the Cu:Ni ratio in BL_MT which is about 3.3. PGM grades average 0.251 g/t. Local massive sulfide veins and bodies contribute significantly to the relatively high average Cu-Ni grade. Non-mineralized material is identified as GRB_B.

Magma Channel

During the geological modeling effort at Birch Lake, TMM and AMEC geologists noted a sinuous, channel-like body of persistent and higher Cu grades traversing the length of the Birch Lake deposit. In general, this “channel” follows the thickest portion of the BL_MT unit, but it obviously pinches out locally above an underlying melatroctolite unit that contains less persistent Cu grades. The origin of the channel is not well understood, but it appears to be some sort of a magma conduit (channel) with a somewhat different batch of magma filling it that contains somewhat higher grade, more continuous Cu mineralization. At this time, the more continuous Cu mineralization is the main difference but some possible petrochemical differences were noted and should be investigated when additional geochemical data are obtained.

Figure 7-14 shows the approximate location of the magma channel overlain on the average copper grade by drill hole. The trend of high-grade Cu is followed by the channel, which was modeled by following that trend and including the continuous mineralization in the channel while excluding discontinuous mineralization.

Figure 7-14: Birch Lake Magma Channel on Average Copper Base Map



Comment on Birch Lake Geological Model

This new interpretation of the geology of Birch Lake provides a logical and consistent framework for interpretation of the lithologies at Birch Lake. It has also pointed out some deficiencies in assaying at Birch Lake related to the use of three-acid digestions, which, while acceptable for base metals, are not adequate for elements more related to silicate minerals like Na, K, Ba, and Mg. If those elements are to be used for any purposes in future resource estimate or mine planning, they will need to be reassayed in pre-2011 samples.

7.6.3 Spruce Road

No new exploration has been performed at Spruce Road, and the geological model has not changed.

7.7 Comments on Geology

The geology of the TMM deposits, including the location of the mineralization and the associated rock types, is quite well known. Details of the relationship between mineralization and host rocks are well understood, and are adequate for resource estimation. AMEC considers the current geological models at Maturi and Birch Lake to be a significant improvement over the past models and that they are acceptable to support resource estimation and preliminary mine planning. Additional drilling will be required to precisely locate the faults at Birch Lake.

The geological model for Spruce Road has not been updated since the last resource estimated and while adequate for Inferred Mineral Resources, it is not adequate to support higher resource classifications.

Continuing exploration is providing insight into those relationships and will support significantly more detailed interpretations for future resource estimates. This is especially important at Maturi where the interrelationships of base metal mineralization and host rocks are complex.

Geotechnical and environmental work are adequate to support preliminary resource estimation.

8.0 DEPOSIT TYPES

The Maturi, Birch Lake, and Spruce Road deposits are classified as magmatic nickel-copper-platinum group element (PGE) deposits which are a broad group of deposits containing nickel, copper, and PGEs occurring as sulfide concentrations associated with a variety of mafic and ultramafic magmatic rocks (Eckstrand and Hulbert 2007). The magmas originate in the upper mantle and contain small amounts of nickel, copper, PGE, and variable but minor amounts of S. The magmas ascend through the crust and cool as they encounter cooler crustal rocks. If the original S content of the magma is sufficient, or if S is added by assimilation of crustal wall rocks, a separate sulfide liquid forms as droplets dispersed throughout the magma. Because the partition coefficients of nickel, copper, and PGE as well as iron favor sulfide liquid over silicate liquid, these elements preferentially transfer into the sulfide droplets from the surrounding magma. The sulfide droplets tend to sink toward the base of the magma because of their greater density, and form massive sulfide concentrations. Alternately, the sulfide droplets may adhere by surface tension to phenocrysts in the magma and be transported and emplaced as disseminated sulfide droplets as a rock-forming component of the intrusive body. On further cooling, the sulfide liquid crystallizes to form the ore deposits that contain these metals.

The mafic and ultramafic magmatic bodies that host the Ni-Cu sulfide ores are diverse in form and composition, and can be subdivided into the following four subtypes (Eckstrand and Hulbert 2007):

1. A meteorite-impact mafic melt sheet that contains basal sulfide ores (Sudbury, Ontario is the only known example).
2. Rift and continental flood basalt-associated mafic sills and dike-like bodies (Noril'sk-Talnakh, Russia; Duluth Complex, Minnesota; Muskox, Nunavut).
3. Komatiitic (magnesium-rich) volcanic flows and related sill-like intrusions (Thompson, Manitoba; Raglan and Marbridge, Quebec;).
4. Other mafic /ultramafic intrusions (Voisey's Bay, Labrador; Lynn Lake, Manitoba; Giant Mascot, British Columbia; Kotalahti, Finland; Råna, Norway; and Selebi-Phikwe, Botswana).

The Duluth Complex is associated with the Midcontinent Rift and continental flood basalt-associated mafic sills and dike-like bodies (Eckstrand and Hulbert 2007). Ni-Cu deposits of the rift and continental flood basalt associated subtype are the products of the magmatism that accompanies intracrustal rifting events. These deposits are associated with large magma systems, and that within these systems the Ni-Cu sulfide ores tend to be associated with conduits or feeders to the larger igneous masses (in this last respect, the Duluth Complex is an exception in which the low-grade Ni-Cu sulfides may not be associated with conduits or feeders but rather lobes of sulfide-enriched magmas). Much of the sulfide has been derived by contamination of the magma by incorporation of S from adjoining wall rocks.

Magmatic PGE deposits and Ni-Cu sulfide deposits are the source of essentially all of the world's platinum group elements (Eckstrand and Hulbert 2007).

9.0 EXPLORATION

9.1 Exploration

Exploration other than drilling from 1951 to about 1998 is not well documented. Records indicate that geological mapping and surface geochemical sampling were used to trace the exposed extent of mineralization. Various geophysical surveys were performed with the objective of defining down-dip extensions of known mineralization and discovery of new mineralization. Indications are that horizontal and vertical loop electromagnetic surveys, magnetometer surveys, induced polarization (IP), self-potential (SP), gravity surveys, magnetotellurics surveys, and various downhole methods have been used with limited success for near surface exploration. Self-potential (SP) was successfully used to locate oxidized sulfides (gossan) below thin veneers of glacial till at the South Filson Creek Occurrence.

Controlled source audio frequency magnetotellurics (CSAMT) was employed by Franconia at Birch Lake in 2008 to map major faults, depth and thickness of mineralization, and map subsurface structures (Routledge, 2008). The survey was conducted on the ice of Birch Lake in February 2008 with lines crossing the north portion of the deposit. Twenty-two soundings were recorded on two lines 1.7 mi (2.75 km) long oriented east-southeast. Ten soundings at 820 ft (250 m) stations were run on line one, and 12 on line 2 located 1.1 mi (1.8 km) to the north. Data inversion 2D modeling was performed to produce 2D Bostick transform resistivity profiles. The method reasonably well mapped the basement granites and low resistivity above the contact (mineralization) as well as discontinuities as probable faults and low resistivity areas as possible intrusive bodies.

For the most part; however, mineralization is too deep to be successfully explored using these methods. For that reason, drilling has been the preferred method of exploration in all areas since about 1955 and is summarized in Section 10.

9.2 Geotechnical Considerations

As part of the preparation for the prefeasibility study for TMM, Itasca Consulting Group, Inc. (ICG) has undertaken a geomechanical characterization of the Maturi and Birch Lake properties (DeGagné et al, 2012). The assessment is based principally on a combination of core logging, field and laboratory strength testing, empirical classifications, acoustic televiewer (ATV) logging, overcoring stress measurements and core photography. The main goal of the geomechanical assessment is to characterize the rock mechanical properties to differentiate between geotechnical units, to be used in geomechanical and mine hydrogeological modeling and to predict rock and rock mass behavior.

Approximately 13,000 ft of Maturi core and 10,000 ft of Birch Lake core has been logged in eight bore holes and samples have been collected for testing. Information collected included:

- Interval information, which includes:
  - Start/end depth along hole, natural feature type and rock unit;
  - *TCR* (total core recovered), fracture count and joint spacing;
  - Micro-defect intensity (if any);
  - *RQD, Jn, Jr and Ja* (Q' classification); and
  - Joint -separation, -roughness, -infill and -weathering ratings (RMR classification).
- Discrete feature information includes:
  - Start/end depth along hole, natural feature type/ID;
  - *Jr, Ja* and fracture mineral (if any);
  - Discontinuity mating and termination; and
  - Alpha and beta angles (for oriented core only).
- Point-load testing information includes:
  - Testing device, test type (axial or diametrical);
  - Sample start/end depth along hole;
  - Maximum pressure; and
  - Failure control (e.g., intact, vein, etc.).
- Laboratory sample information includes:
  - Sample start/end depth along hole and assigned ID; and
  - Rock unit, sample diameter and micro-defect intensity (if any).
- Laboratory testing includes the following:
  - Pre-loading elastic modulus (from P- and S-wave velocity);
  - Unloading and loading elastic modulus;
  - Poisson's ratio;
  - Peak uniaxial compressive strength; and
  - Triaxial strength (σ_3 = 1450, 2901, 5511 psi).

In addition, borehole televiewer logging tools were used to obtain oriented images of borehole cores when core recovery is difficult, costly or otherwise not available. Analysis of these data allows void and joint data to be presented in terms of depth, direction of dip (with respect to North), dip angle and strike.

Boreholes have been instrumented and are being monitored for hydrogeological purposes related to mine design.

Itasca has also completed a preliminary fault model for both the Maturi and Birch Lake deposits (Federowich, 2012).

9.3 Environmental Monitoring

AMEC is aware that TMM is actively monitoring environmental aspects of the project and is conducting base-line environmental studies in preparation for a pre-feasibility study to be conducted in 2012 and 2013. Williamson (2012) summarized the ongoing environmental work (refer to Sections 4.9 and 4.10) and indicates that the environmental work is adequate to support resource estimation.

10.0 DRILLING

10.1 Drilling Summary

Table 10-1 summarizes the drilling on the TMM properties. All drilling was completed with diamond tipped core tools. Drilling is considered legacy if it was completed before 2000 at Maturi and Birch Lake, and prior to 1999 at Spruce Road. Much of the legacy drilling reportedly utilized A-sized (1.067 in/27.1 mm) core tools. Current drilling utilized P-, H-, and N-sized core tools. Most current holes were collared with H-sized tools (2.4 in/ 61 mm) and reduced to N (2.155 in/54.7 mm), and locally B (1.655 in/42 mm) where drilling conditions did not permit larger core. P-sized tools (3.245 in/85 mm) were used to collect metallurgical samples during the current exploration programs. Note that the core diameters noted above are nominal. In some cases small variations in core diameter occurred because of the use of different tooling with the same hole diameter were used. An example is N-sized core – NTW (2.44 in/57 mm), NQ (1.875 in/47.5 mm), NX (2.155 in/54.7 mm), and NQ2 (1.99 in/50.5 mm) were all used during the course of the project. Most of the current drilling at Maturi was collared with NQ2 (1.99 in/50.5 mm) tools. At Birch Lake, most of the current holes were collared with PQ diameter tools.

Table 10-1: Summary of Drilling on the TMM Properties

Maturi			
	Holes	**Feet**	**Meters**
Current	349	1,087,511.9	331,474.63
Legacy	99	132,800.1	28,329.14
Total	448	1,220,312.0	371,952.22
Birch Lake			
	Holes	**Feet**	**Meters**
Current	213	501,735.7	152,929.50
Legacy	36	74,695.3	22,767.20
Total	250	578,118.0	176,210.90
Spruce Road			
	Holes	**Feet**	**Meters**
Current	2	4,054.1	1,235.68
Legacy	230	137,429.6	41,888.66
Total	232	141,483.6	43,124.34

During the time of the site visits, drills were active only on the Maturi property where AMEC observed drilling procedures. All procedures observed were found consistent with industry best practices.

Recent drilling at Maturi was completed by IDEA Drilling LLC, Virginia, MN, using a variety of different truck and skid mounted drill machines. Foraco (26 Plage de l'Estaque, 13016, Marseille, France) drilled a number of holes at Maturi in 2007-2008 using a variety of equipment. E.J. Longyear is reported to have drilled some of the Duval holes in the 1990s as well as some of the later Inco holes. E.J. Longyear equipment is not documented. There is no record of the contractor for most of the legacy holes, but the record indicates that E.J. Longyear was active in the area as early as 1955 and may have drilled most of the holes for Inco and the other contractors. Dr H. Parker, who worked in the area in the 1960s, noted a prevalence of Longyear 38 and 44 drills used by E.J. Longyear for exploration in 1967-1969. Hole K-8 was drilled by Odgers using Boyles Brothers equipment.

At both Birch Lake and Maturi, pilot holes and wedges from those holes were utilized to complete holes through the BMZ and/or to obtain sample for metallurgical testing.

10.2 Collar Surveying

10.2.1 Maturi

Inco collar surveys were originally in Inco's New Minnesota grid system and were converted by WMA to UTM NAD27 coordinates, which required a 20.4 m shift west and 42.0 m shift south, and a grid origin correction to 539,980.4E, 5,199,956.8N. Collars of legacy drill holes have been relocated in the field by the NRRI using GPS (Cox et al, 2009). Modern hole collars were initially located by hand-held GPS units and recorded in UTM coordinates (Cox et al, 2009). Completed drill hole collars were then surveyed using survey-grade GPS (Trimble Instruments).

10.2.2 Birch Lake

Duval early reconnaissance drilling along fences of widely-spaced holes relied on pace-and-compass collar locations (Routledge and Galyen, 2010). Later drilling to delineate Cu-Ni-PGE mineralization employed handheld Global Positioning System 12-channel instrumentation (GPS) for collar locations, accurate to ±5 m (Routledge and Galyen, 2010). In 2007, all pre-2006 drill collars that could be located in the field were surveyed by a registered land surveyor. All subsequent drill collars have been surveyed by a registered land surveyor to an accuracy of one meter (Routledge and Galyen, 2010).

10.2.3 Spruce Road

Inco collar surveys were originally in Inco's New Minnesota grid system and were converted to UTM NAD27 coordinates, which required a 20.4 m shift west and 42.0 m shift south, and a grid origin correction to 539,980.4E, 5,199,956.8N. Instruments used for these surveys are not recorded but were likely theodolites. TMM converted the UTM coordinates to Minnesota State Plane Coordinates.

10.3 Downhole Surveying

10.3.1 Maturi

Inco performed downhole surveys using acid-tube inclination tests (Cox et al, 2009; Routledge and Greenough, 2006). The acid-tube test only indicates the inclination and not the azimuth of the hole. As a result, the position of the toe and mineralized intervals is somewhat uncertain because of the lack of azimuth deviation data. Inclination tests were taken at intervals ranging from 15 m (50 ft) to 61 m (200 ft).

The Duval, Newmont, Kennecott, and US Steel holes were all vertical with no downhole azimuths recorded. The US Steel holes have acid-tube inclination tests and, of the others, only DU-03 and NM-03 have acid-tube inclination tests. The other historic holes have no downhole surveys.

Downhole surveys for the modern holes through MEX-045 were done using FLEXIT Smart Tool® Instrumentation by FLEXIT AB. Readings were generally taken at ±20 ft (6.1 m) intervals, coinciding with pulling drill rods in 20 ft. lengths at the end of drilling the hole when the survey is run. The tool is a magnetic field-based instrument that utilizes magnetometers and accelerometers to measure azimuth and dip. The tool records errors based on the fluctuation in magnetic field strength vectors that allows some internal correction by the tool itself and for the technician/geologist to review and do manual adjustments or omit spurious readings where appropriate. Spurious readings in the Duluth Complex rocks may be caused by their variability of magnetite content. After MEX-045, downhole surveys were performed by gyroscopic tools using the magnetic tools as quality control measures.

Review of the downhole survey data for the MEX series holes indicated that dips were generally reasonable, but azimuth readings tended to be noisy and some obvious spurious readings needed to be rejected and adjustment made to the survey data (Cox et al, 2009). These were corrected by TMM. For vertical holes, noisy azimuth readings have small impact on the accuracy of the hole position in 3D space since inclination is the critical reading and GEMS™ software smoothes the hole trace. For inclined holes, azimuth has a greater impact on spatial hole positioning despite the software smoothing.

For some inclined holes, the FLEXIT™ readings did not agree with the collar site orientation which was checked and confirmed in the field. For holes MEX-17, 22 and 23, the hole could not be or was not surveyed for various reasons, including drill rods lost down hole. Consequently, the downhole deviation for five inclined holes was modeled based on the collar azimuth and dip and the average deviation of other MEX series holes. The positioning of the hole toes and mineralized intervals in three dimensions is now reasonable for drill spacing greater than 200 ft.

In summary, all of the angle holes and most of the vertical holes have been surveyed using a FLEXIT™ gyroscopic tool. A few of the vertical holes drilled before MEX-45 were not surveyed due to blockages in the holes or bad hole conditions.

10.3.2 Birch Lake

Duval early reconnaissance drilling to explore to the base of the Duluth Complex in fences of wide spaced holes relied acid-tube inclination tests for downhole deviation except where wedging was performed (Routledge and Galyen, 2010).

Later drilling to delineate Cu-Ni-PGE mineralization employed Flexit™ SmartTool® surveys to track azimuth and inclination deviations downhole (Routledge and Galyen, 2010). The Flexit™ downhole survey system determines azimuth based on magnetometer readings and in areas of high magnetic susceptibility, readings are not reliable. Therefore, for magnetic pyrrhotite and magnetite enriched segments, readings are discarded. Where magnetic pyrrhotite and magnetite-enriched segments are thick, details on azimuth deviation are lost where tracking of such detail is important. Gyroscope-based downhole surveys are unaffected by magnetic rocks. Beginning in 2007 with drill hole BL07-5, all downhole surveys were performed with gyroscopic instruments.

Most of the pilot and wedge holes were surveyed from the bottom of the hole to the collar. In 2011, AMEC noted a number of discrepancies with survey azimuths while verifying data. The azimuths were as much as 180^{o} different between the various pilot holes and wedges in a single location. In 2012, the last wedge of all accessible holes was resurveyed as deeply as possible. In some cases, caving prevented complete resurveys. These new surveys were used to correct the problematical azimuth data.

10.3.3 Spruce Road

Inco holes were surveyed at the collar with only acid-tube inclination tests taken down hole (Routledge and Cox, 2007). Acid-tube inclination tests were taken at intervals ranging from 15 m (50 ft.) to 61 m (200 ft.) but generally at 30 m (100 ft.). The position of the hole toe and mineralized intervals is somewhat uncertain because of the lack of azimuth deviation data. In general acid-tube inclination deviation was plotted in the grid north direction (±331.6° azimuth) for the purpose of geologic interpretation and wireframing the resources.

10.4 Drilling Data and Results

Drilling results are summarized for each of the three properties individually below.

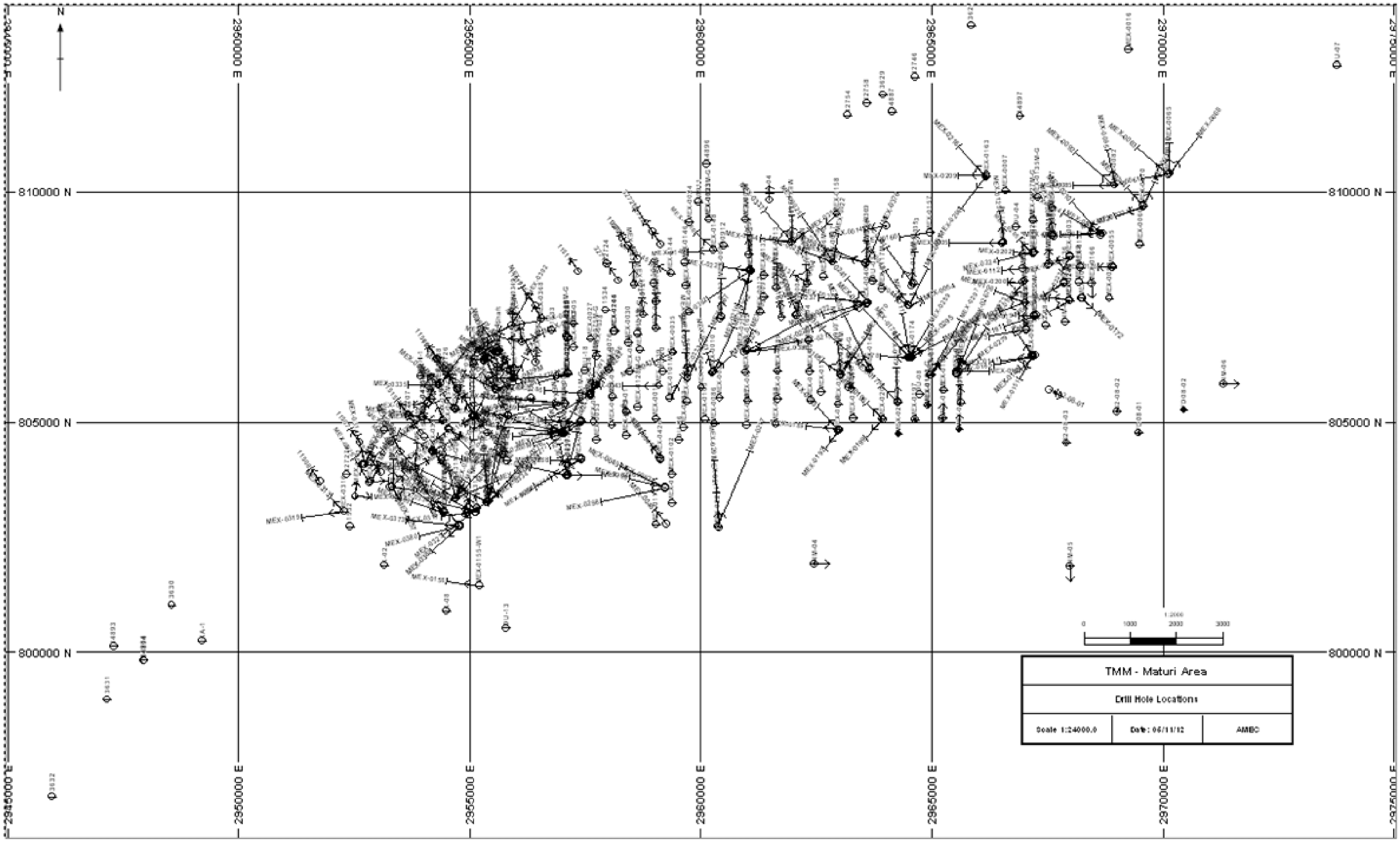
10.4.1 Maturi

Table 10-2 summarizes drilling at Maturi by year and operator. A total of 548 holes (1,421,796 ft; 433,363.4 m) have been drilled in the area. Collar locations are shown on Figure 10-1. Figure 7-4 shows a cross section across the main part of Maturi.

Table 10-2: Summary of Maturi Drilling by Year

Year	Company	Type	Holes	Feet	Meters
1950-60s	Inco	Core	65	61,603	18,221
1960s	Hanna	Core	3	7,357	2,176
1960s	Duvall	Core	11	31,931	9,445
1960s	Bear Creek	Core	1	1,635	484
1960s	Newmont	Core	4	19,465	5,757
2006	Wallbridge America	Core	10	30,922	9,146
2007	Duluth Metals	Core	73	221,980	65,658
2008	Duluth Metals	Core	73	228,147	67,483
2009	Duluth Metals	Core	2	4,725	1,398
2010	Duluth Metals/TMM	Core	50	198,265	58,644
2011	TMM	Core	129	369,963	109,430
2012	TMM	Core	101	201,390	59,568
Total			522	1,377,383	407,410

Figure 10-1: Maturi Drill Hole Locations



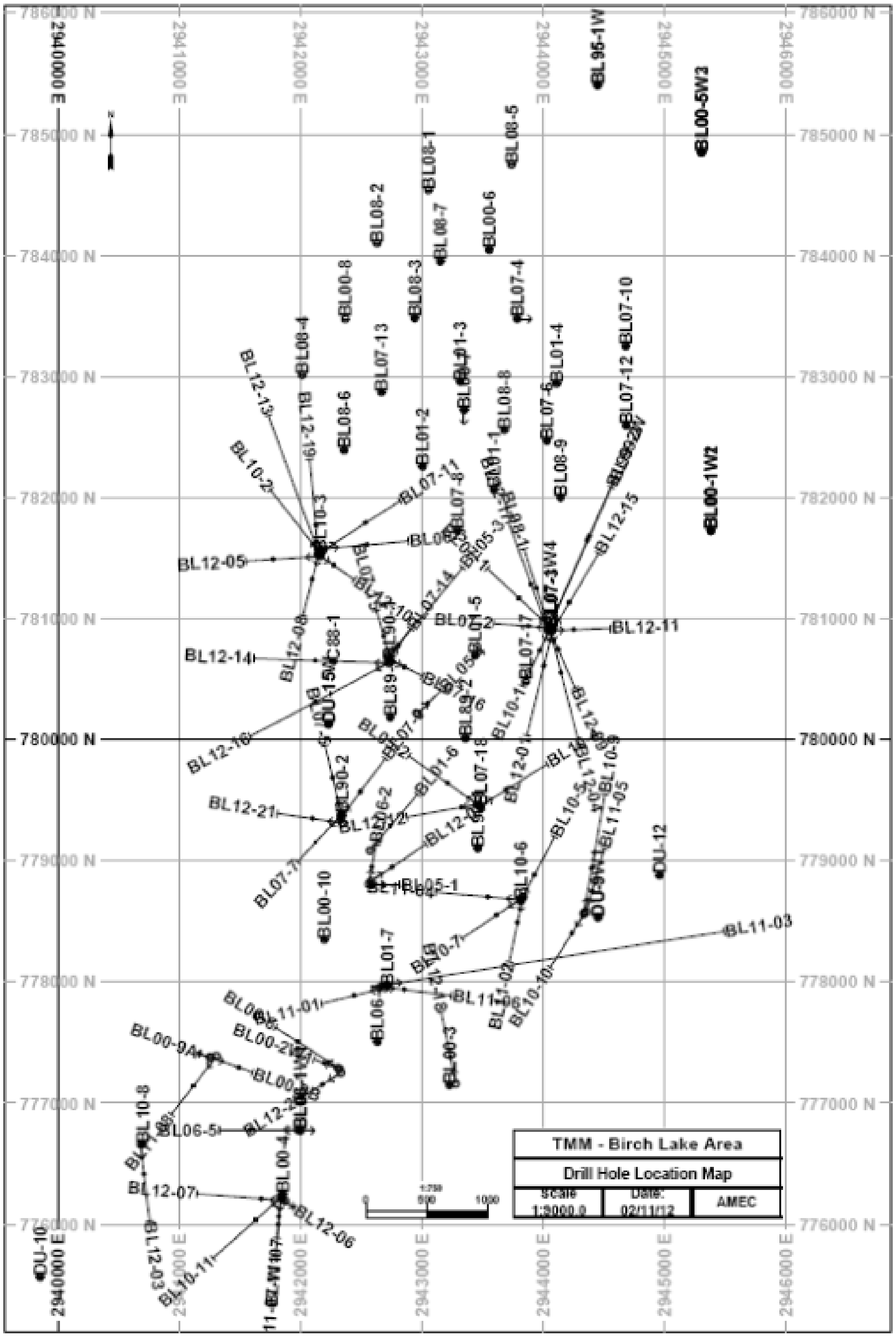
10.4.2 Birch Lake

At Birch Lake a total of 114 holes (287,160 ft; 87,527 m) have been completed, excluding wedge holes, to explore the property (see Table 10-3, Figure 10-2, Figure 7-7). 154 wedge holes (198, 360 ft; 58,022 m) were drilled to confirm the location and tenor of mineralization and to obtain sample for metallurgical testing.

Table 10-3: Summary of Drilling at Birch Lake by Year (excluding wedge holes)

Year	Company	Drill Type	No Drill Holes	Total Feet	Total Meters
1969-1976	Duval	Core	6	20,469	6,239
1967	Kennecott	Core	1	1,883	574
1988	Lehmann	Core	1	2,402	732
1989	Lehmann	Core	1	2,569	783
1990	Lehmann	Core	4	9,180	2,798
1995	Lehmann	Core	1	1,961	598
1998	Lehmann	Core	1	2,559	780
1999	Lehmann	Core	2	5,368	1,636
2000	Lehmann	Core	12	26,975	8,222
2001	Lehmann	Core	7	16,766	5,110
2005	Franconia	Core	4	10,973	3,345
2006	Franconia	Core	6	14,705	4,482
2007	Franconia	Core	16	39,115	11,922
2008	Franconia	Core	11	20,052	6,112
2010	Franconia	Core	11	29,238	8,912
2011	TMM	Core	9	25,248	7,696
2012	TMM	Core	21	57,697	17,586
Total			114	287,160	87,527

Figure 10-2: Birch Lake Drill Hole Locations



10.4.3 Spruce Road

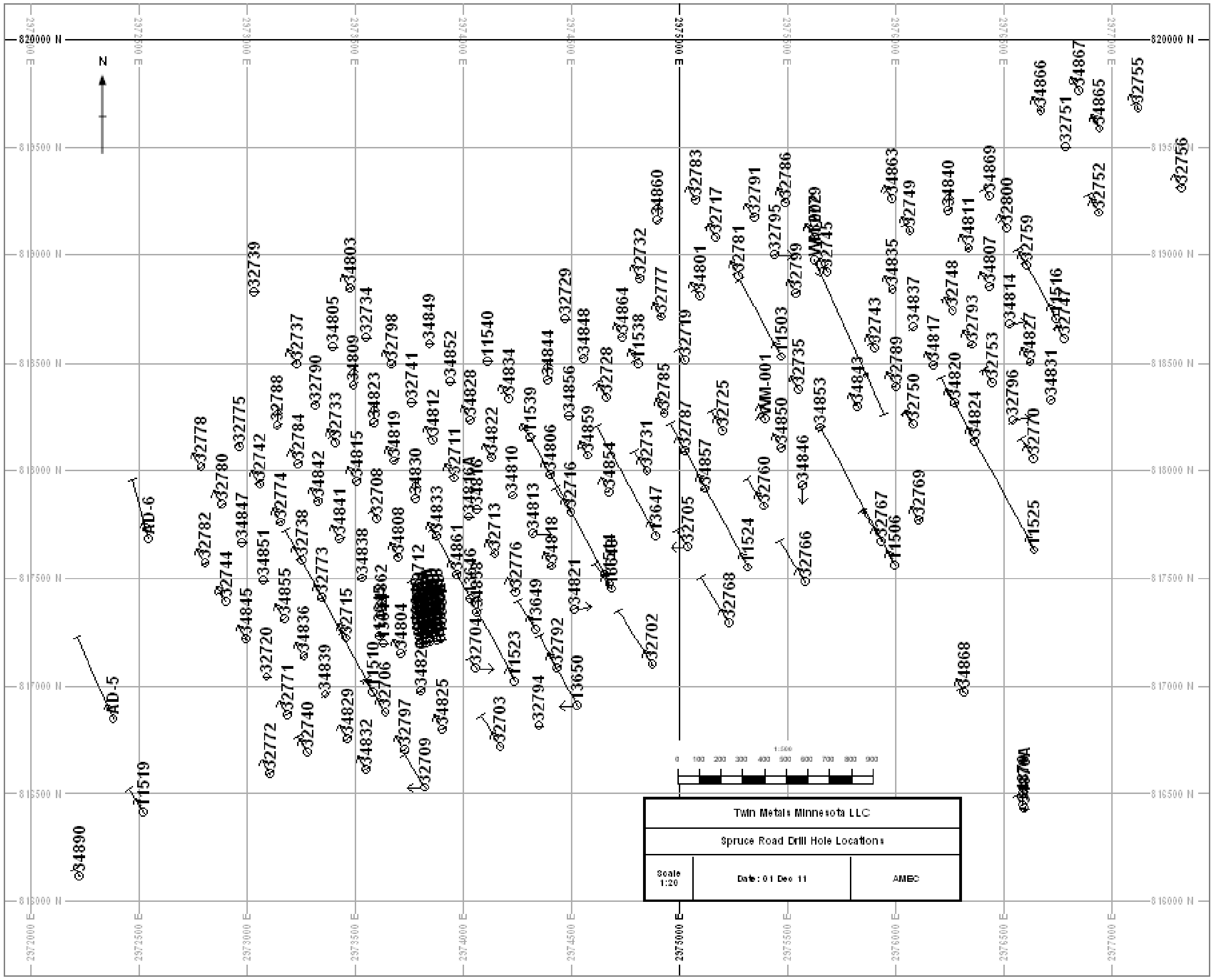
The Spruce Road database contains 232 holes (141,482.7 ft/ 43,124.06 m) (Table 10-4). The area included in the resource estimate contains 210 holes (118,303 ft, 36,058.68 m; Figure 10-3). Figure 7-9 is a representative cross section at Spruce Road.

Drill logs indicate most of the core was AX (27 mm diameter) and drilling was done by E. J. Longyear/Longyear Canada (Routledge and Cox, 2007). Two short PQ (85 mm diameter) holes were drilled in 1971.

Table 10-4: Summary of Drilling at Spruce Road by Year

Year	Number	Feet	Meters
1953	3	685.7	209.00
1954	14	16,261.0	4,956.37
1955	4	2,204.0	671.78
1957	9	6,334.0	1,930.61
1966	24	24,099.0	7,345.40
1967	135	68,292.0	20,815.46
1968	13	16,004.0	4,878.03
1969	2	2,780.0	847.35
1971	2	100.0	30.48
1973	24	669.0	203.91
1999	1	1,754.0	534.62
2000	1	2,300.0	701.04
Total	232	141,482.7	43,124.06

Figure 10-3: Spruce Road Drill Hole Locations



10.5 Core Logging

10.5.1 Maturi

Legacy logs from Inco, Duval, and others include a description of the lithology and mineralization. No specific logging procedures were discovered for these projects, but the companies were major mining companies at the time of the drilling that generally followed industry best practices for that period.

TMM core for the 2006-2012 programs was placed in 10 ft. capacity (5 ft. by 2 ft. rows) waxed cardboard core boxes at the drill and moved to Duluth Metals' Ely logging and sampling facility by Duluth geologists. The core was logged for lithology, texture, structure, alteration, ore mineralogy, and mineralization. Geotechnical logging includes recovery, rock quality designation, and fracture density. Core was digitally photographed. Samples were marked at the time the core was logged.

10.5.2 Birch Lake

Geological logging recorded major and minor lithology descriptions and RQD and recovery percentages. Sample intervals were marked by geologists at the time of logging. Owing to the number of drilling campaigns on the property since the 1970s, core logging has been done by various geologists. Available older core has been re-logged to standardized geologic descriptions.

10.5.3 Spruce Road

Over the course of 20 years of drilling (1954-1973), nine Inco geologists logged core. Two geologists accounted for 90% of the holes, suggesting reasonably consistent logging. The logs include a description of the lithology and mineralization. The logs are consistent with best practices for the time period. The logs have been re-interpreted in order to standardize nomenclature for the current resource estimate.

10.6 Core Recovery

Core recovery is about 100% at Maturi and 99.8% at Birch Lake. Recovery data were not recorded at Spruce Road, but rock conditions were similar and it is likely that core recovery was about 100% (H. Parker personal recollection).

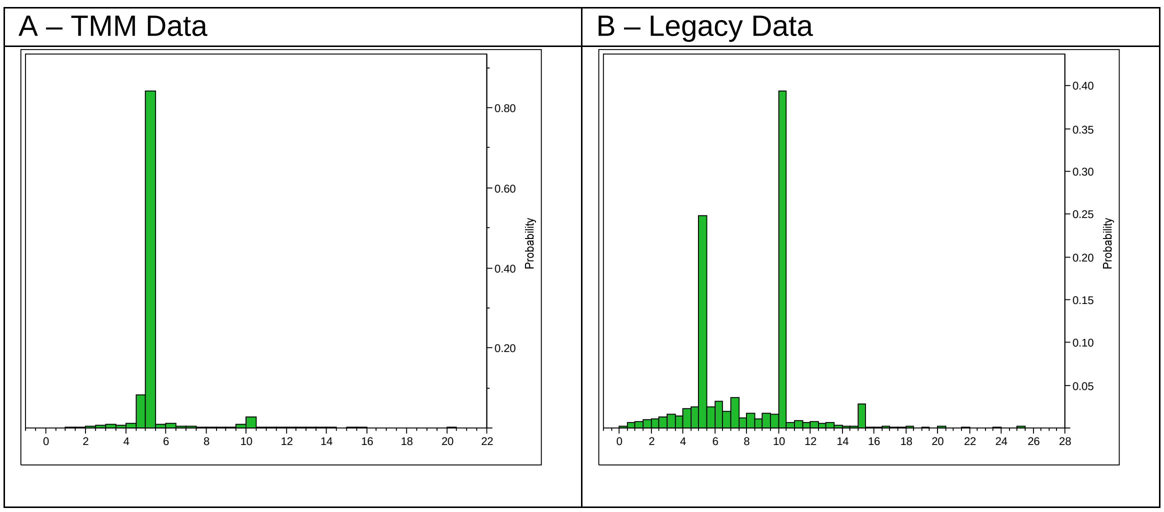
10.7 Core Sampling

10.7.1 Maturi

TMM samples were routinely taken (74%) at 5 ft. (1.52 m) lengths but some are as long as 10 ft. (3.05 m) (Figure 10-4A). Samples are marked by geologists logging the core and split with a diamond saw. One-half is bagged for transport to the sample preparation laboratory; the other half is returned to the box and archived.

Legacy samples range from 0.3 ft (0.09 m) to 25 ft (7.62 m) (Figure 10-4B). Core was split with a manual core splitter and one-half sent to the sample preparation laboratory and one-half was returned to the box and archived.

Figure 10-4: Summary of Maturi Sample Lengths (in feet)

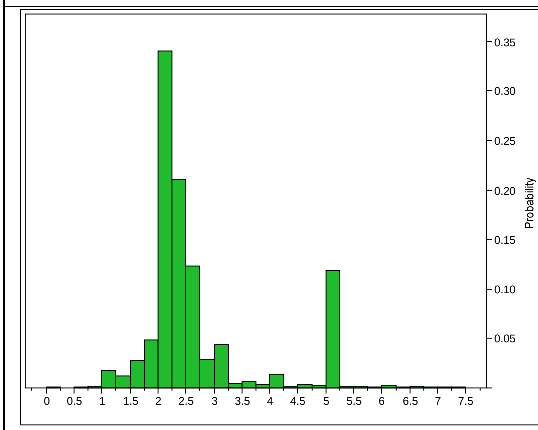
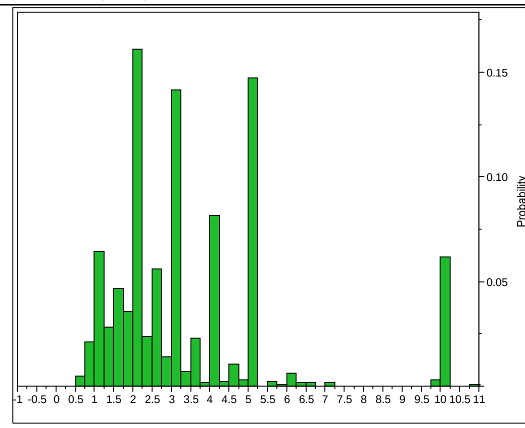


10.7.2 Birch Lake

TMM samples were routinely 2 – 3 ft. (0.61 – 0.91 m) lengths but are as short as 0.5 ft (0.15 m) or as long as 22 ft. (6.71 m) (Figure 10-5A). Samples are marked by geologists logging the core and split with a diamond saw. One-half is bagged for transport to the sample preparation laboratory; the other half is returned to the box and archived.

Legacy samples range from 0.5 ft (0.15 m) to 10 ft (7.62 m) (Figure 10-5B). A small number of intervals in the hanging wall in holes C88-1 and D3 have intervals as long as 101 ft (30.8 m). Core was split with a manual core splitter and one-half sent to the sample preparation laboratory and one-half was returned to the box and archived.

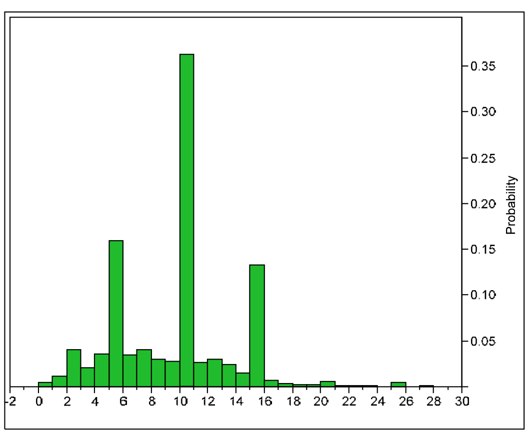
Figure 10-5: Summary of Birch Lake Sample Lengths (in feet)

A – TMM Data	B – Legacy Data
	

10.7.3 Spruce Road

All of the data at Spruce Road with the exception of the Wallbridge holes WM-001 and WM-002 are considered to be legacy data. Sample lengths of 5, 10, and 15 ft are the most common sample lengths (Figure 10-6). The minimum sample length is 0.20 ft (0.06 m) and the maximum sample length is 180 ft (54.8 m). Samples longer than 20 ft (6.1 m) (105 samples) were excluded from resource estimation. Core was split with a manual core splitter and one-half was sent to the sample preparation laboratory and one-half was returned to the box and archived.

Figure 10-6: Summary of Spruce Road Sample Lengths (in feet)



10.8 Comment on Drilling

10.8.1 Maturi

Collar Surveying

Legacy collar surveying is not documented, but is believed to have been done with theodolites and chains which were the standard tools at the time. Re-surveys of legacy collars have uncovered some minor discrepancies, but those are not believed to be significant. Legacy collar surveys are believed to be sufficiently accurate to be used for resource estimation.

Current collar surveying at Maturi utilizes industry-standard instrumentation and procedures and is adequate to support resource estimation.

Downhole Surveying

Legacy down-hole surveying was done primarily with acid-tubes. That method does not generally provide adequate control on the trajectory of drill holes, but in this case, drill hole azimuths are expected to vary very little because of the homogeneity of the rock. Those surveys are thus believed to be sufficient for estimation of Inferred Mineral Resources.

Modern drilling should confirm the trajectories of the legacy holes.

Current practice is to use gyroscopic tools that are unaffected by magnetic minerals in the rocks. These tools are widely used in the industry and provide orientation data that are adequate to support resource estimation.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation.

Core Sampling

Core sampling conforms to industry standard practices and is adequate to support resource estimation.

10.8.2 Birch Lake

Collar Surveying

Current collar surveying at Birch Lake utilizes industry-standard instrumentation and procedures and is adequate to support resource estimation.

Legacy collar surveying is not documented, but is believed to have been done with theodolites and chains which were the standard tools at the time. Re-surveys of legacy collars have uncovered some minor discrepancies, but those are not believed to be significant. Legacy collar surveys for the few legacy holes at Birch Lake are considered to be sufficiently accurate to be used for resource estimation.

Downhole Surveying

Legacy downhole surveys were largely acid-tube surveys that provide only inclination information. The locations of the ends of legacy holes are thus somewhat uncertain.

Modern holes have been downhole surveyed with gyroscopic and magnetic instruments that are widely used within the industry. TMM resurveyed the accessible holes at Birch Lake to eliminate problems with downhole surveys noted previously. The last wedge of all accessible holes was resurveyed and those surveys were used to properly orient all other wedges. AMEC concludes that the downhole survey data at Birch Lake are sufficiently accurate to support resource estimation at all resource classifications.

Down-hole deflections in legacy holes deserves additional study. Legacy holes were surveyed with acid-tubes. Because of the presence of magnetite, use of compasses(for example Tropari™, Eastman™ single-or multi-shot tools) to measure azimuthal variations was not reliable. A study of the amount of deflection versus hole depth with modern holes would provide an indication of the reliability of the legacy hole positions with depth.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation.

Core Sampling

Core sampling conforms to industry standard practices and is adequate to support resource estimation.

10.8.3 Spruce Road

Collar Surveying

Collar surveying is believed to have been performed with theodolites and chains, which was industry standard practice at the time the holes were drilled, but that has not been confirmed.

Downhole Surveying

Legacy down-hole surveying was done primarily with acid-tubes. That method does not generally provide adequate control on the trajectory of drill holes, but in this case, drill hole azimuths vary very little because of the homogeneity of the rock and most holes are less than1000 ft deep. Those surveys are thus believed to be adequate for estimation of Inferred Mineral Resources.

Modern drilling should confirm the trajectories of the legacy holes.

Drill Results

Drill results indicate the presence of mineralization with economically interesting grades over significant widths.

Core Logging

Core logging is adequate to support resource estimation. It is adequate to support resource estimation at an Inferred Mineral Resource level, but the knowledge of the rock hosting the mineralization has progressed significantly since the original logging, and many of the codes and descriptions may no longer be appropriate.

A program of twin hole drilling is needed to validate the location and tenor of the mineralization and to allow more direct comparison of current lithological nomenclature with the legacy nomenclature.

Core Sampling

Core sampling conforms to industry standard practices at the time the core was drilled and is believed to be adequate to support resource estimation.

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sample Preparation

11.1.1 Maturi

The Maturi area contains significant legacy data from ACNC (Inco). AMEC believes that ACNC (Inco) followed standard industry practices for sample preparation, but the sample preparation procedures are not documented. At the time that this exploration was being performed, ACNC's parent company, Inco, was an industry-leading Cu-Ni miner in Canada and had significant internal expertise in Cu and Ni sample preparation and assaying.

For the Duluth and subsequent TMM drilling campaigns of 2006-2012, core samples were crushed, split, and pulverized in ALS Chemex's preparation facility in Thunder Bay, Ontario. The standard procedure employed by ALS Chemex is to weigh and dry the sample followed by crushing of entire sample to better than 70% passing 2 mm (CRU-31). The sample was then split to 250 g (SPL-21) and pulverized to better than 85% passing 75 µm in a ring-and-puck pulverizer (PUL-31). Barren material is used to clean the mill between sample batches to prevent cross contamination.

11.1.2 Birch Lake

Prior to 2006, sample preparation at both ALS Chemex and Bondar Clegg consisted of crushing and splitting, with a split of the crushed material ring pulverized to -150 mesh (-106 µm).

For the 2006-2008 drilling campaigns, core samples were prepared by ALS Chemex in Thunder Bay, Ontario. Samples were crushed to 70% passing 6 mm and ring-and-puck pulverized to 75% passing 75 µm (-200 mesh).

For the 2010-2012 drilling campaign, core samples were prepared by ALS Chemex in Thunder Bay, Ontario. The samples were crushed to 70% passing 2 mm (CRU-31), riffle split to 250 g (SPL-21), and pulverized to 85% passing 75 µm in a ring-and-puck pulverizer (PUL-31).

11.1.3 Spruce Road

AMEC assumes that ACNC (Inco) followed standard industry practices for sample preparation, but the sample preparation procedures are not documented. At the time that this exploration was being performed, ACNC's parent company, Inco, was an industry leading Cu-Ni miner in Canada and had significant internal expertise in Cu and Ni sample preparation and assaying.

11.2 Assaying

11.2.1 Maturi

Assay data from Maturi is a mix of modern data with legacy data generated by ACNC (Inco) and a few other companies. Detailed information about analytical methods employed by ACNC is not available, but prior to 1965, Inco's Process Technology Laboratory in Sudbury determined copper and nickel colorimetrically (Routledge and Cox, 2007). By 1966 copper and nickel atomic absorption spectrometry was adopted. The cost of analysis for precious metals was significant prior to 1970 and assaying for those analytes was generally done on core composites (Routledge and Cox, 2007). Precious metals analysis was done by lead-collector fire assay followed by wet chemical extraction of the individual precious metals.

ALS Chemex performed most of the recent analyses at Maturi and is certified to standards of ISO 9001:2008 and has received accreditation to ISO/IEC 17025:2005 from the Standards Council of Canada (SCC) for the following methods:

- Fire Assay Au by Atomic Absorption (AA)
- Fire Assay Au and Ag by Gravimetric finish
- Fire Assay Au, Pt, and Pd by Inductively Coupled Plasma (ICP)
- Aqua Regia Ag, Cu, Pb, Zn and Mo by AA
- Four Acid Ag, Cu, Pb, Zn, Ni and Co by AA
- Aqua Regia Multi-element by ICP and MS
- Four Acid Multi-element by ICP and MS
- Peroxide Fusion Multi-element by ICP.

Analysis of copper, nickel, cobalt, silver, sulfur and 30 other elements was done by the ALS Chemex ME-ICP61 procedure which calls for digestion a 0.5 g pulp by $HF\text{-}HNO_3\text{-}HClO_4$, HCl leach with an ICP-AES finish. Table 11-1 summarizes the lower and upper detection limits for the elements analyzed by procedure ME-ICP61.

Precious metal analysis calls for a one assay ton (±30 g) aliquot of pulp that was fire assayed using a lead collector with an ICP-AES finish (procedure PGM-ICP23). Table 11-2 summarizes the lower and upper detection limits for the elements analyzed by procedure PGM-ICP23.

Table 11-1: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure ME-ICP61, values in ppm unless otherwise indicated)

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	0.5-100	Cr	1-10,000	Na	0.01%-10%	Ti	0.01%-10%
Al	0.01%-50%	Cu	1-10,000	Ni	1-10,000	Tl	10-10,000
As	5-10,000	Fe	0.01%-50%	P	10-10,000	U	10-10,000
Ba	10-10,000	Ga	10-10,000	Pb	2-10,000	V	1-10,000
Be	0.5-1,000	K	0.01%-10%	S	0.01%-10%	W	10-10,000
Bi	2-10,000	La	10-10,000	Sb	5-10,000	Zn	2-10,000
Ca	0.01%-50%	Mg	0.01%-50%	Sc	1-10,000		
Cd	0.5-1,000	Mn	5-100,000	Sr	1-10,000		
Co	1-10,000	Mo	1-10,000	Th	20-10,000		

Table 11-2: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure PGM-ICP23; values in ppm)

Analyte	Range (ppm)
Pt	0.005-10
Pd	0.001-10
Au	0.001-10

When Cu and Ni exceeded 10,000 ppm (1%) in a sample, the sample was re-assayed using a four acid digestion finished by atomic absorption spectrometry (AA; method AA62). Detection limits are given in Table 11-3.

Table 11-3: Lower and Upper Detection Limits for 2006-2011 Analyses at Maturi (ALS procedure AA62; values in %)

Analyte	Range (%)
Cu	0.001-40
Ni	0.001-30

11.2.2 Birch Lake

Sample assaying has been performed at the Ottawa, Ontario; Vancouver, British Columbia; and Sparks, Nevada laboratories of Bondar Clegg & Company (now ALS Chemex), Acme Analytical Laboratories Ltd. of Vancouver and ALS Chemex Labs Inc. in Vancouver. These companies are ISO 9000/9002 accredited mineral laboratories. ALS Chemex, which has performed most of the recent analyses, is certified to standards within ISO 9001:2008 and has received accreditation to ISO/IEC 17025:2005 from the Standards Council of Canada (SCC) for the methods detailed in Section 11.2.1.

Multi-element analyses were performed for core samples in 1999 and onward. Prior to this, only selected elements (Cu, Ni, Pt, Pd, Au, Ag, Cr, ±Co, and ±V) were analyzed.

A 32 element ICP-AES (inductively coupled plasma-atomic emission spectroscopy) geochemical package was used at ALS Chemex for 1998 and 1999 samples. Pt, Pd, and Au were analyzed by lead collector fire assay finished by ICP fluorescence spectroscopy (FAICP-AFS).

Bondar Clegg analyzed 35 elements by HCL:HNO_3 acid digestion and ICP including sulfur for 2000-2001 samples. Elevated copper was also analyzed by atomic absorption spectroscopy (AA). For some 1989 holes, only Au, Pt, Pd, Cu, Ni, and Cr were analyzed; in this case the precious metals were analyzed by the FA-DCP (direct coupled plasma emission method), Cu and Ni by hot acid extraction-AA, and Cr by X-ray fluorescence (XRF). Table 11-4 summarizes lower detection limits for pre-2006 analyses at Birch Lake.

Table 11-4: Lower Detection Limits for Pre-2006 Analyses at Birch Lake

Element	Detection Limit
Cu	1 ppm
Cu	0.01%
Ni	1 ppm
Pt	5 and 15 ppb
Pd	1 and 2 ppb
Au	1 and 2 ppb
Ag	0.2 and 0.5 ppm
Co	1 ppm

For the 2006-2012 drilling campaigns, core samples were analyzed by ALS Chemex in Vancouver, British Columbia. The ICP41 package was used for Cu, Ni, and Co and the ICP24 package was used for Pt, Pd, and Au. Table 11-5 summarizes detection limits for method ICP41, and Table 11-6 summarizes detection limits for method ICP24.

Table 11-5: Lower and Upper Detection Limits for ALS Method ICP41 (ppm unless otherwise indicated)

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	0.2-100	Co	1-10,000	Mn	5-50,000	Sr	1-10,000
Al	0.01%-25%	Cr	1-10,000	Mo	1-10,000	Th	20-10,000
As	2-10,000	Cu	1-10,000	Na	0.01%-10%	Ti	0.01%-10%
B	10-10,000	Fe	0.01%-50%	Ni	1-10,000	Tl	10-10,000
Ba	10-10,000	Ga	10-10,000	P	10-10,000	U	10-10,000
Be	0.5-1,000	Hg	1-10,000	Pb	2-10,000	V	1-10,000
Bi	2-10,000	K	0.01%-10%	S	0.01%-10%	W	10-10,000
Ca	0.01%-25%	La	10-10,000	Sb	2-10,000	Zn	2-10,000
Cd	0.5-1,000	Mg	0.01%-25%	Sc	1-10,000		

Table 11-6: Lower and Upper Detection Limits for ALS Method ICP24

Analyte	Range (ppm)
Pt	0.005-10
Pd	0.001-10
Au	0.001-10

Samples exceeding the 10,000 ppm limit for Cu or Ni were analyzed using the OG46 procedure. Upper and lower detection limits are summarized in Table 11-7.

Table 11-7: Lower and Upper Detection Limits for ALS Method OG46 (units are % except Ag which is ppm)

Analyte	Range	Analyte	Range	Analyte	Range	Analyte	Range
Ag	1-1,500	Co	0.001-20	Mn	0.01-50	Pb	0.001-20
As	0.01-60	Cu	0.001-40	Mo	0.001-10	S	0.01-10
Cd	0.0005-10	Fe	0.01-100	Ni	0.001-10	Zn	0.001-30

For the 2010 drilling campaign, core samples were prepared by ALS Chemex in Thunder Bay, Ontario, with assays at ALS Chemex in Vancouver, British Columbia. ALS Chemex protocols for 2010 included ALS procedure ICP41 for Cu, Ni, and 33 other elements (Table 11-5) and ICP24 for Pd, Pt, and Au (Table 11-6). Overlimit base metals were reanalyzed by OG46 (Table 11-7). Overlimit Pt, Pd, and Au were reanalyzed by ICP27 (Table 11-8).

Table 11-8: Precious Metals Analytical Ranges

Analyte	Range (ppm)
Pt	0.03-100
Pd	0.03-100
Au	0.03-100

Acme Analytical Laboratories (Vancouver) Ltd. protocols for the outside laboratory checks on pulps were:

- Fire assay fusion with lead collector for Au, Pt, and Pd finished by ICP-ES (procedures G606 (30 g sample) or G610 (50 g charge))
- Aqua Regia digestion ICP-ES analysis for Cu, Ni, Co (procedure 7AR).

11.2.3 Spruce Road

With the exception of two Wallbridge holes, data from Spruce Road are all legacy data generated by ACNC. Detailed information about analytical methods is not available. Prior to 1965, Inco's Process Technology Laboratory in Sudbury determined copper and nickel colorimetrically (Routledge and Cox, 2007). By 1966 copper and nickel atomic absorption spectrometry was adopted. The cost of analysis for precious metals and sulfur was significant prior to 1970 and assaying for those analytes was generally done on core composites (Routledge and Cox, 2007).

Samples from the 11500 series holes and most of the 13600 and 32700 series holes were analyzed for copper and nickel only. Gold, silver, platinum and palladium were determined by fire assay or spectrographically.

Analyses of Cu, Ni, Co, Pt, Pd, and Au for core samples from Wallbridge's drill hole WM-001 in 1999 and WM-002 in 2001 were performed by Lakefield as part of Wallbridge's metallurgical testing. Those procedures are not documented, but Lakefield generally employs pyrosulphate fusion for digestion and X-ray fluorescence (XRF) for Ni, Cu, Co and Fe analysis. Au, Pt and Pd are analyzed by fire assay (lead collector) with ICP finish. Lakefield is an independent, commercial mineral laboratory and has ISO/IEC Guide 25 accreditation (Routledge and Cox, 2007).

11.3 Density Measurements

11.3.1 Maturi

A total of 21,279 density determinations were made by TMM for samples from the Maturi deposit. Volume was determined by immersing the sample in a graduated cylinder and measuring the volume change. Mass was determined by balance in air. This is a standard technique for determination of density. Table 11-9 summarizes density by rock type where rock types were indicated (187 samples had no assigned rock type).

Table 11-9: Summary Density Data by Lithology at Maturi

Unit	N	Density (g/cm^3)
G_B	1,979	2.74
G_M	2,582	2.78
G_N	477	2.83
HW	2,843	2.89
PEG	893	2.96
S1	1,264	3.01
S2	4,294	3.05
S3	5,984	3.02
UH	779	3.02

11.3.2 Birch Lake

The density database for this report consists of 1,603 water immersion density determinations on drill core with an average density of 2.95. Table 11-10 summarizes the data by lithology. The method is a standard method.

Table 11-10: Summary Density Data by Lithology at Birch Lake

Unit	N	Density (g/cm^3)
BL_D2	71	3.038
BL_DI	16	3.088
BL_HX	164	3.002
BL_MT	484	2.995
BL_T	327	3.058
GRB_B	239	2.793
GRB_M	188	2.761
MAIN_AGT	114	2.933

11.3.3 Spruce Road

No density data are available for the Spruce Road deposit. A bulk density of 3.02 g/cm^3 was used for volume conversion to resource tonnage for the resource estimate. This bulk density is the same as the estimated average density for the Maturi mineralized material (dominantly S3 at 3.02 g/cm^3) deposit where density was determined by TMM. Waste bulk density at Spruce Road was assumed to be 3.00 g/cm^3.

11.4 Sample Security

11.4.1 Maturi

Sample security for the legacy samples generated by ACNC is not documented. Most ACNC core was lost in a fire in Canada during a labor action against Inco. Remaining core is stored at the DNR core library in Hibbing along with other legacy core.

Sample security for current samples consists of collecting core at the drill twice a day and storing it in a lockable core logging facility prior to sampling. Sampled core is stored in sturdy plastic bags in a locked room until it is shipped to the sample preparation laboratory by contract carrier.

11.4.2 Birch Lake

Samples were shipped to analytical laboratories in Nevada by courier services including UPS and FEDEX. Pre-2006 samples sent to Bondar Clegg and ALS Chemex in Canada were driven to the U.S. border for direct pick-up by laboratory personnel. The 2006-2012 core samples were placed on pallets in Franconia's secure facility at Babbitt and trucked via commercial freight to ALS Chemex sample preparation facility in Thunder Bay, Ontario.

11.4.3 Spruce Road

Sample security for the legacy samples generated by ACNC is not documented. Most ACNC core was lost in a fire in Canada during a labor action against Inco. Remaining core is stored at the DNR core library in Hibbing along with other legacy core.

11.5 Quality Assurance-Quality Control (QA/QC)

11.5.1 2011-2012 Maturi Quality Check Programs

TMM completed five assay evaluation programs in 2011, designed to test for potential issues with sample preparation and assaying. These included:

- Determining whether dust losses during sample preparation could be biasing metal grades,
- Testing whether more aggressive grinding during sample preparation could lead to higher grades of platinum group elements (PGEs),
- Determining whether cuttings lost during core sawing are biasing metal grades,
- Determining the proportion of unrecoverable nickel sequestered in silicate minerals using ammonium citrate peroxide leach assays, and
- Testing whether higher grades for PGEs can be expected using nickel sulfide fusion assays.

A discussion of each program is provided below.

Dust Loss

To measure dust loss during drill core sample preparation at the ALS Chemex sample preparation facility in Thunder Bay, Ontario, a batch of 46 mineralized Maturi samples from drill hole MEX-0247 were weighed before and after crushing to >70% passing 2 mm.

Dust losses due to crushing ranged between 0.01 and 0.09 kilograms or 0.2 to 2.6% of the sample mass, with an average loss of 0.04 kilograms or 0.9% of the sample. In AMEC's experience, this amount of loss to sample preparation is consistent with expected losses; dust loss at the ALS Chemex sample preparation facility in Thunder

Bay is not excessive. Dust losses are sufficiently low that a bias exceeding 5% is unlikely. Hence no further investigation of dust loss is warranted and the crushing method requires no improvement.

Successive Grinding

To determine whether the grinding protocol was adequate to attain total levels of platinum, palladium, and gold from the fire assay process TMM selected 30 coarse reject samples for test work on finer grinding. TMM had ALS Chemex prepare three splits for each coarse reject sample, one using the normal TMM protocol of 85% passing 75 µm, another using a finer grind of 95% passing 75 µm, and another using a further finer grind of 90% passing 53 µm.

The results of the test work showed that platinum and palladium values decreased slightly and gold values increased slightly with finer grinding, but not at statistically significant levels. Patterns were consistent by rock type. In AMEC's opinion, the current grind protocol is sufficient.

Core Saw Cuttings Loss

To test whether the core splitting process is selectively removing base metal-bearing minerals from the core and thus producing a systematic low bias, TMM compared the assays from half-core from an entire mineralized interval from one drill hole to the assays from the core saw sludge resulting from the sampling of the mineralized interval.

A total of 240 ft (73.1 m) were processed, including 175 ft (53.3 m) of mineralized, 35 ft (10.7 m) of barren hanging wall rock, and 30 ft (9.1 m) of barren footwall rock. The core saw cuttings filled four, 5-gallon (18.9 l) buckets. Grade biases between the core and the cuttings were shown to be less than 5% and are not considered significant, Therefore no significant bias occurs due to the cutting of the core. AMEC recommends no changes be made to the core cutting method in present use.

Silicate Nickel (2011)

To determine the proportion of unrecoverable nickel sequestered in silicate minerals in Maturi mineralized rocks, TMM assayed selected pulps for nickel using the ammonium citrate peroxide leach (ACPL) method. The ammonium citrate peroxide leach (ACPL) selective assay method for nickel does not dissolve nickel in silicate minerals, and assuming there are no nickel oxides present, it provides an estimate of the nickel present in sulfide minerals, and hence amenable to recovery by the sulfide flotation process.

A set of 96 pulps were submitted to Acme Laboratories (ACME) in Vancouver, B.C. for determination of ACPL nickel (Acme procedure code G810). A set of 10 blind CRMs were included in the submission and returned acceptable results.

Results of the ACPL assays show that recoverable nickel ranges between 68 and 81% and varies by rock type (Table 11-11). AMEC finds the amount of nickel sequestered in silicates to be sufficiently high and variable between BMZ subunits that it should be taken into consideration when evaluating metallurgical test results and possibly in establishing domains. Ni in silicates appears to be proportional to the total olivine content in the rocks.

Table 11-11: Summary of Ammonium Citrate Peroxide Leach Assays by Domain and BMZ Unit

Domain Code	Unit Code	N	Mean Total Ni ppm	Mean ACPL Ni ppm	Recoverable Ni pct
PEG	PEG	24	1589.6	1126.7	71
BMZ		72	1686.1	1237.8	73
	U3	23	1741.4	1180.4	68
	BH	24	1824.2	1318.3	72
	BAN	25	1502.8	1213.2	81

Nickel Sulfide Collector Fire Assays

In AMEC's experience, nickel sulfide fusion (NiS fire assay) typically gives results 5 to 10% higher on average for platinum and palladium compared to a traditional lead collector fire assay. Because the NiS fire assay is costly, projects typically do not use it in a production setting.

To test whether higher grades for platinum and palladium can be expected using nickel sulfide fusion assays, TMM selected 100 Maturi pulps from those intervals returning combined platinum and palladium assay values greater than 0.15 ppm and sent them to SGS in Lakefield, Ontario for NiS fire assay, with an ICP-MS finish. A set of 10 blind CRMs were included within the sample submission to monitor assay quality.

Evaluation of the CRMs inserted with the samples shows that the platinum and palladium assays are mostly biased low compared to the recommended values, with an average bias of 12% low for platinum and 16% low for palladium.

When evaluating the results by BMZ unit, the NiS assays show significantly more platinum for BH and PEG, and significantly more palladium for BH. Allowing for the probable low bias in the SGS results shown by the inserted CRMs, these results indicate that more platinum and palladium may be recovered from the BH unit than indicated in the resource estimate, and more platinum may be recovered from the PEG unit than indicated in the resource estimate.

AMEC concluded the results of this limited test were inconclusive and that additional NiS assays should be conducted to better define possible biases.

Silicate Ni Study (2012)

Eggleston (2012) demonstrated a strong correlation between Mg and Ni in the Maturi and Birch Lake Project drill core samples that were low in Cu and S. This suggested the possibility that the amount of Ni sequestered in silicates (silicate.Ni) such as olivine may be quantitatively estimated from the Mg concentration in rocks containing nickel sulfides (sulfide.Ni; Long, 2012c). If so, the amount the nickel contained in sulfide minerals (sulfide.Ni) can be estimated by the difference between the total nickel and estimate of Ni in silicates using the Mg concentration. As part of the check assay program on Maturi drill core samples conducted by AMEC (2012a; 2012b), Acme Laboratories (Vancouver) assayed 105 samples for Ni by the ammonium citrate-peroxide leach method (ACPL.Ni). This is a selective leach for nickel in sulfide minerals that does not extract the Ni in silicates.

Franconia metallurgical test work on Birch Lake drill core samples included ACPL.Ni assays and metallurgical recovery results on 30 samples. These two data sets allow an initial assessment of the use of Mg for estimating sulfide.Ni in rocks with economically important concentrations of Ni.

Long (2012c) concluded that Mg and total nickel can be used to predict sulfide nickel, but more robust ties between the ACPL.Ni results and metallurgical recovery data are required. This will necessitate additional ACPL.Ni results on metallurgical samples where actual flotation recoveries are determined.

Accuracy of Mg results must become a focus of all analytical work. Mg has not been a focus of quality control previously and Mg coverage is not complete for all samples. At Birch Lake, demonstrated biases (Long, 2012b) limit the predictive ability of this method. Areas where Mg is absent or significantly biased and where economically important levels of Ni occur should be identified so that consideration can be given to remedial assaying for Mg.

Ni Reassay Program

Due to a significant negative bias in Ni assays from the pre-Mex-112 drill holes at Maturi discovered during the QA-QC review in 2011, 8,748 samples were selected for reassay to provide more confidence in the data and to remove the bias. Those samples were reassayed at ALS Laboratories using method ME-ICP61 described in Section 11.2.1. When compared to the original assays, the overall improvement in Ni grade was 4.1% relative to the average of the original data. TMM replaced the prior data with the new data in the database and the new data were used for resource estimation.

11.5.2 Assay QA/QC

Maturi

Legacy Drilling

Legacy drilling campaigns at Maturi likely did not employ a modern QA/QC protocol and no data are known to exist for the legacy drilling campaigns.

Duluth/TMM Drilling

Duluth and TMM have consistently applied an assay QA/QC protocol consisting of the following control samples inserted into batches of mineralized samples:

- Two CRMs randomly placed
- Two blanks placed typically after strong visual mineralization
- Two ¼ core duplicates selected from average visual mineralization.

A drill hole submittal typically consists of the BMZ plus 30 ft (9.1 m) of hanging wall and 30 ft (9.1 m) of footwall, ranges in total length between 150 and 650 ft (45.7 and 198.1 m), and includes 30 to 130 samples. Control sample insertion rates therefore range between 20% (6/30) to 5% (6/130).

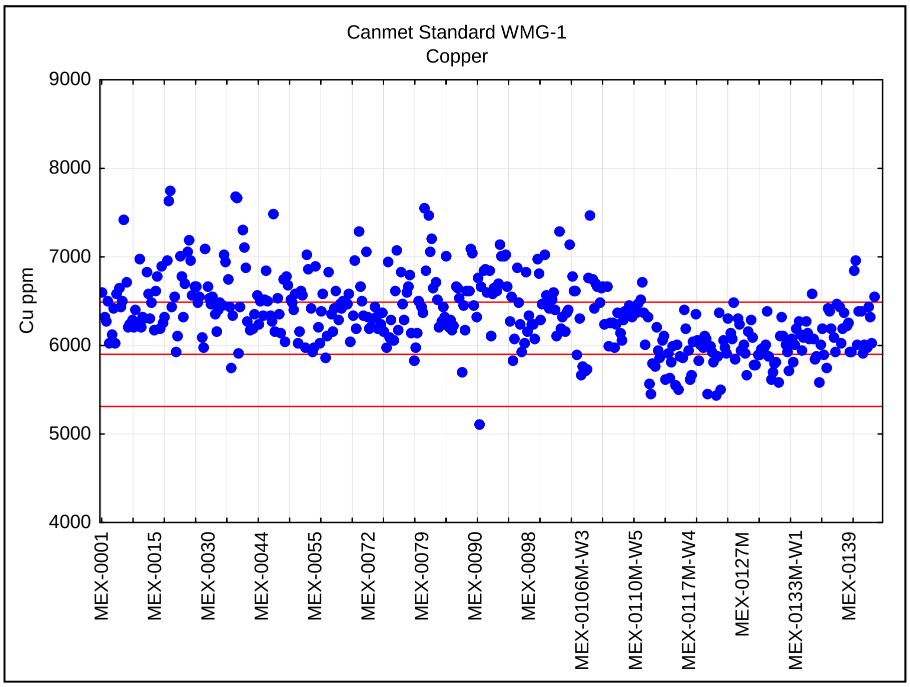
A number of CRMs have been used through the project history, including CANMET standard WMG-1 (2006 through March 2008), CANMET standard WPR-1 (March 2008 through May 2011), and more recently AMIS standards 73 and 93, and OREAS standard 13b.

The project's initial monitoring of assay accuracy used a single CANMET standard: WMG-1. This CRM has certified values for 15 elements including gold, platinum, and palladium. The recommended values for copper and nickel are not certified values;

they are "provisional" values. Results for an element are classified as provisional if the laboratories participating in the round robin do not agree adequately.

AMEC documented variation in copper results over time from TMM's external CRM WMG-1 assayed by ALS Chemex (Figure 11-1). The middle horizontal red line represents the recommended value for the CRM, and the upper and lower red lines represent 10% above and below the recommended value.

Figure 11-1: WMG-1 Results for Copper



The copper assays from CRM WMG-1 indicate that the original copper assays for drill holes MEX-0001 to MEX-0112 are biased high 10% relative to the best value and 8% high relative to the average SRM results for drill holes MEX-0113 to MEX-0149. An additional check assay program conducted by Antofagasta Minerals and duplicate assays conducted by TMM suggest that the bias is real, with the high bias ranging between 4 and 6%.

Based on the evidence, AMEC initially recommended that copper assays for drill holes MEX-0001 to MEX-0112 be reduced by 6%, the value consistent with the preponderance of evidence. To account for this bias TMM and AMEC agreed to reduce the copper grade for these holes by 6% (Wakefield, 2011b). This reduction was applied only to the ICP results (ALS Chemex method ME-ICP61); the copper results re-assayed with method AA62 were not reduced.

When the supply of CRM WMG-1 was exhausted, TMM acquired CRM WPR-1 material from CANMET to control assay accuracy. TMM then had SGS package the material into 100 g envelopes, and this CRM was used from March 2008 through early 2011. This CRM has certified values for 11 elements including gold, copper, platinum, and palladium. No significant biases are shown for any of the elements over the period that the WPR-1 was used. Results for platinum and palladium are generally tightly clustered within the acceptable limits. Results for the CRM samples indicate the accuracy of gold for these batches to be good, but the spread of the results indicates poor precision at these low concentration levels.

In early 2011 TMM began using CRM AMIS-0093 to control assay accuracy. This CRM is provided by African Mineral Standards (AMIS) in South Africa, and has certified values for copper, nickel, platinum, and palladium and a more uncertain 'provisional' value for gold. In mid-2011, TMM purchased additional CRMs for use in the assay test programs that are currently being used in TMM routine submittals, AMIS CRM AMIS-0073 and the Ore Research CRM OREAS 13b.

Copper and nickel results for AMIS-0093 indicate that assay accuracy for these elements in the batches tested is acceptable. Platinum and palladium results show no significant bias. Gold results are biased low on average and the high degree of scatter in the results indicates poor precision at these very low grade levels.

An insufficient number of results for AMIS-0073 and OREAS 13b have been received to date to provide meaningful analysis.

Blank samples have been inserted into TMM/Duluth batches consistently throughout the project history. In AMEC's opinion, there is no significant carryover contamination in the sample preparation process at ALS Chemex for copper, nickel, platinum, palladium, and gold.

TMM has consistently employed a program of ¼ core duplicates, consisting of two intervals selected in visual mineralization. Results for copper and nickel show acceptable precision with 90% of the duplicate pairs yielding absolute relative difference (ARD) values of less than 30%. Platinum, palladium, and gold show poor precision, yielding ARD values of 62, 41, and 79% respectively at the 90% population level.

2012 QA-QC Results

For the 2011-2012 Maturi drill program, TMM inserted crusher duplicate, pulp duplicate, blank, and standard samples. TMM and AMEC monitored QC results throughout the drill program and concluded that:

- Accuracy for Cu, Pd, Pt, and Au analyses are adequate to support resource estimation.
- Ni accuracy below 2,000 ppm is adequate to support resource estimation, but above 2,000 ppm, there appears to be a small negative bias relative to standard samples. The bias is on the order of 4-6%.
- Blank samples indicate no significant contamination for Pd, Pd, and Au. The material used for blanks is not truly blank for Cu (averages 60 ppm excluding outliers) and Ni (averages 12 ppm excluding outliers). The data set (362 results) contains 11 outliers that may be due to contamination. The maximum values (627 ppm Cu and 204 ppm Ni) are significantly elevated relative to the mean of the data, but AMEC believes that the impact on the resource estimate is negligible.
- Precision estimates for all elements in coarse duplicate samples (crusher samples at -2 mm) are in the range anticipated by AMEC and are adequate to support resource estimation.
- Precision estimates for all elements except Pt and Au in pulp duplicate samples are in the range anticipated by AMEC and are adequate to support resource estimation. Au precision (±49%) is outside the anticipated range (±25%), but the overall low Au grade makes improvements to precision very difficult without significant changes to the sample preparation protocol. Similarly, Pt precision (±28%) is somewhat outside the anticipated range but is not a significant concern.

Comments on Maturi QA/QC Program

AMEC recommends that resource blocks influenced by Maturi legacy drill holes be classified as Inferred Resources and the influence of Maturi legacy drill holes was taken into account in resource classification (see Section 14.2.13).

CRM, check assay, and duplicate results indicate that the original copper assays for drill holes MEX-0001 to MEX-0112 are biased high between 4 and 10%. AMEC recommends that copper assays for drill holes MEX-0001 to MEX-0112 be reduced by 6%, an amount revision consistent with three independent estimates of the bias. This revision was made prior to resource estimation.

Maturi assay accuracy is acceptable for nickel, platinum, palladium, and gold.

In AMEC's opinion, there is no significant carryover contamination in the sample preparation process at ALS Chemex for copper, nickel, platinum, palladium, and gold.

Duplicate results for copper and nickel show acceptable precision. Platinum, palladium, and gold show poor precision. AMEC recommends that TMM conduct a heterogeneity study to determine whether the sample preparation scheme can practically bring the platinum, palladium, and gold assays into acceptable precision levels.

Legacy drilling campaigns at Maturi likely did not employ a modern QA/QC protocol and no QA/QC data are known to exist for the legacy drilling campaigns. However, one legacy ACNC (Inco) drill hole was twinned by Lehmann Exploration in 1989, and TMM drilled a series of twin drill holes at Maturi in 2011 to validate the legacy assays. The tenor and location of the legacy data were validated.

Birch Lake

The drilling campaigns at Birch Lake can be logically divided into four major phases: pre-Franconia (Duval and Lehmann), early Franconia (1989 to 2005), recent Franconia (2006 to 2010), and TMM. A discussion of the QA/QC programs of each phase is provided below.

Legacy (pre-Franconia) Drilling

Legacy campaigns at Birch Lake are not known to have included assay QA/QC programs and no QA/QC data are available to TMM for any of these drill holes. Legacy drill holes consist of six Duval drill holes and one Lehman Exploration drill hole. Together, these account for 3.0% of the drill holes and 3.4% of the drill footage at Birch Lake.

Early Franconia Drilling (1989 to 2005)

Control samples (standards, blanks, and duplicates) were not inserted into the project sample batches for any of the early Franconia drilling campaigns. However, in 2001, Franconia carried out a check assay program on drill holes completed from 1989 to 2000 to confirm mineralized intercepts. Original mineralized assay intervals were selected and composited into lengths ranging from 9 to 14 feet to approximate minimum mining widths. Composite samples were compiled from rejects retrieved at the Minnesota Department of Natural Resources (DNR) core facility in Hibbing, Minnesota or from pulps from the Franconia core storage facility in Babbitt, Minnesota. Insufficient checks were performed for campaigns 1990, 1995, 2001, and 2005 to make conclusions regarding the assay accuracy of the original results.

A total of 692 individual samples were combined into 102 composite samples for check assay. Samples were assayed at Bondar Clegg in Vancouver, Canada for Cu and Ni by aqua regia acid digestion and ICP finish and Pt, Pd, Rh, Ir, Os, Ru, and Au primarily by neutron activation and less frequently by fire assay and AA finish. Splits of the composites were also sent to Genalysis (Maddington, Western Australia), where Cu and Ni were determined by three-acid digestion and AA finish and Pt, Pd, Rh, Ir, Os, Ru, and Au were assayed by NiS fire assay and ICP-MS finish There is no evidence that external quality control samples were inserted in the check assay batches.

In addition, 33 individual samples from drill hole BL00-7 were sent to Genalysis to directly compare with the original Bondar Clegg individual assays.

Composite check assays for copper and nickel, when all campaigns are plotted together, agree reasonably well with the original assays, and no significant bias is evident. Certain campaigns show a bias for either copper or nickel, but the number of check assays for all campaigns except for 2000 is too few to draw any conclusions. No significant bias was noted in the 2000 data. The individual check assays show a potentially significant constant low bias in copper and a very significant low bias in nickel.

Composite check assays for platinum and palladium show significant scatter and possible significant low bias in the original platinum assays above 1,000 ppb. Certain campaigns show a bias for either platinum or palladium, but the number of check assays for all campaigns except for 2000 is too few to draw any conclusions. The individual assays support the conclusions from the composite assays, where platinum assays are biased about 16% low, and palladium assays are biased low, but not significantly so.

Composite check assays for gold show some evidence of high bias in the original results for values below 400 ppb, and some evidence of low bias above 400 ppb. The individual gold check assays show that gold is biased high, but marginally so.

Recent Franconia Drilling (2006 to 2010)

Beginning in 2006, Franconia instructed their primary laboratory, ALS Chemex, to generate a second pulp of every 10th sample and to periodically send these samples to ACME Laboratories in Vancouver, Canada for check assays. ACME is an independent ISO 9001:2000 registered assay laboratory.

Copper check assays agree with the 2006 to 2010 Birch Lake original assays from ALS Chemex, with between-lab biases acceptably small, between 1 and 6%. Nickel check assays are consistently high, between 4 and 13%, relative to the original ALS nickel assays. The lack of inserted reference materials in the check assay submissions makes it impossible to determine the sources of the observed relative biases.

Platinum and palladium check assays agree with the original assays for years 2006, 2007, and 2010. Platinum and palladium check assays for the 2008 drilling campaign are significantly higher than the original assays, between 15 and 18%, on average. Gold check assays agree with the original assays for years 2007, 2008, and 2010, but are significantly higher for year 2006, 30% on average. It should be noted that there is a high degree of scatter, or imprecision, in some of the platinum, palladium, and gold check assays.

In 2007, Franconia initiated the insertion of blank samples consisting of cement core-shaped intervals in every batch of 20 samples submitted to ALS Chemex. Several very high concentrations are observed in the blank assays for all elements likely indicating sample switches, where the blank and an adjacent sample were switched. Ignoring the likely sample switches, there appears to be carryover of about 50 to 200 ppm copper, 30 to 60 ppm nickel, and 0.005 to 0.010 ppm palladium in the sample preparation process. Platinum and gold consistently report at or below five times the lower detection limit for the assay. These levels of copper, nickel, and palladium are relatively small and carryover contamination at these levels is not likely to significantly bias grades in the resource estimate.

2012 Check Assay Program

In 2012, TMM performed two check assay programs to investigate the accuracy of the analyses performed by Franconia from 1998 through 2010. The first program covered 1998-2001 and 2005 (Long 2012a). The second program covered 2006-2008 and 2010 (Long 2012b).

Samples for the reassay program were submitted to Acme (Vancouver) in late April 2012 (Long, 2012a; 2012b). These submissions include sample pulps and coarse rejects from drill holes and included approximately 1,912 samples. Coarse reject samples were submitted instead of pulps if sample pulps could not be located in storage. The submission included blind certified reference materials (CRMs).

All samples were fire assayed (30 g, Acme method 3B) for Au, Pt and Pd and underwent a four-acid digestion with a multi-element ICP determinations of base metals and many major elements (Acme method 7TD).

TMM had Acme re-assay selected samples using an aqua regia digestion (Acme method 7AR) for comparison purposes and a sub-set of these underwent ammonium citrate peroxide leach for nickel (Acme method 8NiS) that selectively dissolves nickel in sulfide minerals, leaving silicate minerals largely intact.

A few samples in the coarse reject submissions were screen tested to determine the quality of the original sample preparation by ALS Thunder Bay, prior to being pulverized by Acme. Similarly, a few pulp samples were checked for grind quality prior to Acme re-blending samples in a pulverizer in order to check the original grind quality produced by ALS Thunder Bay. The original preparation met specification with a few minor exceptions.

The most important conclusions from the work are (Long, 2012a; 2012b):

- PGM results for the 1998-2001 and 2005 Franconia work are acceptably accurate.
- Copper results for BL98 and BL99 should be adjusted downward by multiplying by 0.9 for use in the resource model. Copper results from BL05 time period average 9% high. There may be a time period within this year (2005) that warrants a downward adjustment. In order to do this, the job numbers of the original assay results would need to be compiled in order to get the results correctly ordered. Because of the small number of samples involved this recommendation was not implemented.
- Nickel results have a probable low bias of nine to fourteen percent for drill holes with prefixes BL98, BL99, BL00, and BL01; these can probably best be dealt with in future resource models by developing a sulfide-Nickel model based upon Mg data and ammonium citrate peroxide Ni assays (ACPL.Ni), by using different linear equations for the different time periods which will remove the biases from the sulfide-Ni model.
- Mg results show marked biases in the 1998-2001 and 2005 Franconia work; hence both the original Mg and original Ni results from the same time period should be used to fit with new ACPL.Ni assays for creating these linear equations for each assay time period.
- There are insufficient checks on the Cu-AA method for Cu results greater than 1 % Cu to judge the accuracy of these results for the 1998-2001 and 2005 Franconia work.
- PGM results for the 2006-2008 and 2010 Franconia work are acceptably accurate.
- ALS ICP copper results have a high bias of approximately 5%, possibly closer to 10% for 2006. A 5% downward correction to the 2006 ICP Cu results may be warranted. Additional investigation of this possible bias was recommended prior to implementing the adjustment.
- The ALS ICP nickel results have a low bias, which occurs in all years checked. Total nickel is likely to be underestimated between 6 and 10%. This could be compensated for in a sulfide nickel model, because an empirical estimate of sulfide

nickel, based upon empirically derived formulas using Mg, ammonium citrate peroxide leach Ni (ACPL.Ni), and total Ni results, would, because it is an empirical fit of the existing data plus new ACPL.Ni data, compensate for any biases, provided that ACPL.Ni assays are consistently accurate and precise, and the obtained correlations are sufficiently robust. However, any total nickel model will suffer from this low nickel bias. AMEC recommended that all samples be reassayed for Ni in order to remove this bias. No adjustments were made to the data for the current resource estimate.

- Mg shows a marked low bias in the Franconia data relative to the Acme data. Use of the existing Mg data may be problematical because the less expensive aqua regia digestion method was apparently used in 2006, and a three-acid digestion was used in other years. This provides a low bias in the Mg data which may make it much less effective for use in an empirical formula for estimating sulfide nickel. This must be determined by studies that determine how well the existing Mg results correlate with the difference between the existing Ni results and new ACPL.Ni results.

2012 QA-QC Results

For the 2011-2012 Birch Lake drill program, TMM inserted crusher duplicate, pulp duplicate, blank, and standard samples. TMM and AMEC monitored QC results throughout the drill program and concluded that:

- Accuracy for Cu, Pd, Pt, and Au analyses are adequate to support resource estimation. Au bias for some standards is outside the ±5% window that AMEC normally uses, but is with ±10% which is adequate for resource estimation.
- Ni accuracy below 2,000 ppm is adequate to support resource estimation, but above 2,000 ppm, there appears to be a small negative bias relative to standard samples. The bias is on the order of 4-6%. No adjustments were made to the data for the current resource estimate.
- Blank samples indicate no significant contamination for Pd, Pd, and Au. The material used for blanks is not truly blank for Cu (averages 54 ppm excluding outliers) and Ni (averages 14 ppm excluding outliers). The data set (56 results) contains two outliers that may be due to contamination. The maximum values (184 ppm Cu and 131 ppm Ni) are elevated relative to the mean of the data and may be either contamination, normal variation in the blank sample, or mislabeled samples. AMEC believes that the impact on the resource estimate is negligible.
- Precision estimates for all elements in coarse duplicate samples (crusher samples at -2 mm) are in the range anticipated by AMEC and are adequate to support resource estimation.

Precision estimates for all elements except Pt and Au in pulp duplicate samples are in the range anticipated by AMEC and are adequate to support resource estimation. Au precision (±32%) is outside the anticipated range (±25%), but the overall low Au grade makes improvements to precision very difficult without significant changes to the sample preparation protocol. Similarly, Pt precision (±37%) is somewhat outside the anticipated range but is not a significant concern.

Comments on Birch Lake QA/QC Program

Based on evaluation of the QA-QC data, AMEC concludes that the TMM and Franconia base and precious metals data are sufficiently accurate and precise to support resource estimation at all levels of classification. Ni accuracy below 2,000 ppm is adequate to support resource estimation, but above 2,000 ppm, there appears to be a small negative bias relative to standard samples. The bias is on the order of 4-6%. Assay data were not adjusted for this bias which represents an opportunity to modestly improve Ni grades.

Precision estimates for all base and precious metals except Pt and Au in pulp duplicate samples are within the range anticipated by AMEC and are adequate to support resource estimation. The low grades of Pt and Au make significant improvements in precision very difficult. AMEC has accepted the precision for those elements as adequate to support resource estimation, but cautions that the precision is somewhat outside the limits normally used by AMEC. The data appear to be unbiased which means The overall estimated Pt and Au grades will likely be accurate but that Pt and Au grades will be underestimated or overestimated locally.

TMM Mg data are sufficiently accurate and precise to support resource estimation. Franconia Mg data exhibit significant biases, largely because of the three-acid digestion used for much of those data. Those data should not be used for resource estimation. Much of the Franconia Mg data is now covered by Acme check assays that can be used for silicate Ni estimation. If a geometallurgical model is to be based on Mg data, many of the Franconia samples will need to be reassayed for Mg.

Pre-Franconia base metal data are adequate to support resource estimation but AMEC notes that approximately three holes drilled in 1998-1999 may have a 5-9% high Cu bias. This bias will not significantly affect the resource estimate and should be confirmed by additional sampling and assay data were not adjusted for this bias.

Spruce Road

No QA/QC data are available for Spruce Road assays.

11.6 Comment

Sample Preparation

Legacy sample preparation by ACNC (Inco) is not documented, but it is the QP's opinion that it is reasonable to consider sample preparation procedures as adequate, largely because ACNC's parent company, Inco, was an industry leader in Cu-Ni mining at the time the samples were collected and analyzed.

Sample preparation for recent exploration programs completed by Franconia, Duluth, and TMM has been performed using standard procedures and is adequate to support resource estimation.

Sample Analysis

Analytical procedures used for legacy ACNC (Inco) samples is not documented, but is believed to be adequate.

Analytical procedures employed by Franconia, Duluth, and TMM are industry-standard procedures and are adequate to support resource estimation.

Density Analysis

Density determinations at Maturi and Birch Lake were performed using standard procedures and are adequate to support resource estimation.

No density determinations have been performed at Spruce Road.

Sample Security

Sample security for legacy samples is not documented. Sample security for modern samples is considered to be sufficient to support resource estimation.

QA/QC

QA/QC for legacy samples is not documented.

QA/QC for current samples is considered by AMEC to be adequate to support resource estimation. Some problems were noted by AMEC and have been remedied by TMM. Minor adjustments to the TMM procedures have been implemented.

12.0 DATA VERIFICATION

12.1 Database Compilation and Validation

12.1.1 Introduction

TMM is now maintaining the database in an acQuire™ database after migration from an Access™-based database in 2011-2012. On 15 May 2012, AMEC received a database export from TMM to verify that the migration of the TMM database from Access™ to acQuire™ was successful. AMEC noted a number of discrepancies that were subsequently corrected prior to the final database audit in June and July of 2012.

In order to validate the data for Maturi and Birch Lake, AMEC performed two audits of the databases for those two properties (Wakefield, 2011; 2012). AMEC's audits consisted of checking the database records against the original documentation for the data that are material to the resource estimation process. This includes the drill collar location information, the down-hole surveys, the core lithological logging data, and the assays.

AMEC also performed a number of database integrity checks which included:

- Checking that all drill holes have collar, assay, survey, and lithology records
- Checking ranges of collar location coordinates
- Checking ranges of assay fields
- Checking ranges of down-hole survey readings
- Check for unusually small or large intervals that have assays
- Check for gaps in sampling/assaying.

12.1.2 Maturi Database Audit

AMEC selected approximately 10% of the TMM, Duluth and legacy drill holes for the purposes of the database audit (Wakefield, 2011; 2012). Audit drill holes were selected to be spatially (equally spaced throughout the Maturi deposit), and temporally (equally spaced throughout the drilling campaign period) representative.

Results of the Maturi audit are:

- Collar Locations
  - Collar Locations for the MEX series holes drilled by Duluth and TMM are considered adequately accurate. No errors were noted in the database.

AMEC located 16 collars in the field with a hand-held GPS unit and found that the coordinates agreed well with those in the database.

- Legacy collars were surveyed using a variety of coordinate systems. Several legacy collars were located by TMM staff and resurveyed.

- Downhole Surveys
  - Downhole surveys for MEX drill holes were completed using two methods: FlexIT Gyro® and FlexIT Multismart®. AMEC checked the depth, azimuth, and inclination (dip) values for a total of 8,597 downhole surveys against the original paper survey files found in the drill hole folders in the TMM offices in Ely. No errors were found.
  - Downhole surveys for legacy drill holes consist of acid-tube tests that provide only inclination (dip) information. AMEC checked the depth and inclination values for a total of 97 acid-tube surveys from nine drill holes that had been surveyed down hole.
- Lithology Logs
  - Lithology logs from the TMM and Duluth drill campaign have been logged in a consistent manner. AMEC checked the From, To, and RockType values for a total of 783 logged intervals from 36 drill holes. A total of 9 errors were found out of the 2,118 values checked for an error rate of 0.4% in 2011. In 2012, Maturi and Birch Lake were audited as a unit. A total of 1,122 records were audited and an error rate of 0.1% was discovered (one error).
  - Legacy lithology data in the database is a product of the original drill logs or re-logs conducted by the NRRI. AMEC did not audit original lithology logs, and will instead rely upon the Unit code picks by TMM staff.
  - AMEC compared lithological logs from Maturi to core from ten holes and found no significant discrepancies.

- Assays
  - MEX drill core has been consistently submitted to ALS Chemex for assay, and assay methodology has also remained consistent through the years. ALS Chemex provided AMEC with digital copies of original assay certificates for the audit drill holes through secure login to their website. AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au and found an error rate of 0.01%, which is acceptable.
  - Assay data for the Maturi legacy drill holes typically consist of hand-written or typed Cu and Ni values entered into the margins of the lithology log for the drill hole. In most cases, the assay method, laboratory, and even units are not known for certain. AMEC checked From, To, Cu, and Ni values for 744 assay

intervals from 13 legacy audit drill holes. AMEC also checked From, To, Au, Pt, Pd, Cu, Ni, and S values from 88 assay intervals from four legacy drill holes from the NRRI re-sampling/re-assaying program. AMEC found a total of five errors in 2011 for an acceptable error rate of 0.6%.

12.1.3 Birch Lake Database Audit

In 2011, AMEC selected approximately 6% of the Franconia drill holes and 71% of the legacy drill holes for the purposes of the database audit. Collar locations, downhole surveys, lithology logs and assays were checked against the original documentation for all these drill holes. The audit drill holes were selected to be spatially (equally spaced throughout the Birch Lake deposit), and temporally (equally spaced throughout the drilling campaign period) representative.

Results of the Birch Lake audit are:

- Collar Locations
  - Collar locations for BL drill holes were surveyed by Livgard Surveying, Inc. of Superior, Wisconsin. In 2011 AMEC checked easting, northing, and elevation values for the 14 audit drill holes and found one discrepancy in the elevation values that is likely due to truncation of the original value. AMEC located 24 collars in the field with a hand-held GPS unit and found that the coordinates agreed well with those in the database.
  - Legacy drill collars at Birch Lake were surveyed by Livgard Surveying, Inc. of Superior, Wisconsin where they could be located in the field. AMEC checked easting, northing, and elevation values for the five legacy audit drill holes and found one small discrepancy in the elevation values of the three drill holes.
  - In 2012, AMEC checked easting, northing, and elevation values for 31 drill holes in the master database and found one error.

- Downhole Surveys
  - Downhole surveys for BL holes were completed using two separate methods: FlexIT Gyro™ and FlexIT Multismart™. In 2011, AMEC checked the depth, azimuth, and inclination (dip) values for a total of 772 downhole surveys against the original paper survey files. Significant issues were found with six of the 14 audited drill holes. AMEC also found significant issues with some pilot and wedge hole surveys. As a result, AMEC picked holes that were the most consistent with the geology and used those surveys. AMEC recommended that all BL holes that can be re-entered be resurveyed.

  - In 2012, the Birch Lake drill holes with identified downhole survey problems were re-entered and the last wedge hole was resurveyed. These data were used to correct the problem data.
  - Downhole surveys for legacy drill holes generally consist of acid-tube tests whose results are typed into the margin or at the end of the lithology log. AMEC checked the depth, azimuth, and inclination (dip) values for downhole surveys from the two legacy audit drill holes that have downhole surveys against the surveys recorded on the original drill logs and found them to accurately represent the original records.
  - In 2012, TMM re-entered 31 holes and resurveyed the last wedge hole to the bottom of the hole or as deep as possible given hole conditions. Some holes had caved preventing complete resurvey of the holes. Those data were used to adjust the other wedges in each hole set. The 2012 resurvey program included a number of QC measures including down-the-hole and up-the-hole surveys on most holes and duplicate surveys on some holes.
  - AMEC compared downhole surveys to original documents and found no errors in 2012.

- Lithology Logs
  - In 2011, AMEC checked the From, To, and RockType values for a total of 428 logged intervals from 14 Franconia (BL) drill holes. A total of six errors were found out of the 1,284 values checked for an error rate of 0.5%.
  - The lithology codes for the seven material legacy drill holes at Birch Lake were not audited.
  - In 2012, Maturi and Birch Lake were audited as a unit. A total of 1,122 records were audited and one error was discovered for an acceptable error rate of 0.1%.
  - Lithology logs were compared to core from four holes and no discrepancies were noted.

- Assays
  - In 2011, the four drill holes assayed at Bondar Clegg were audited against paper copies of the assay certificates. ALS Chemex provided AMEC with digital copies of original assay certificates for the remaining 10 audit drill holes through secure login to their website. AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for 412 assay intervals from the four audit drill holes assayed by Bondar Clegg and found nine errors, for an error rate of 0.3%. AMEC then checked the From, To, Cu, Ni, Pt, Pd, and Au for 1,065 assay intervals from the 10 audit drill holes assayed by ALS Chemex and found no errors.

- In 2012, AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for 2,381 assay intervals from 31 drill holes and found two errors, for an error rate of 0.01%. AMEC checked the sample interval database records against the sample sheets found in the TMM drill hole folders, and checked the assay values against digital assays downloaded from the ALS Webtrieve™ website.
- AMEC checked the From, To, Cu, Ni, Pt, Pd, and Au for assay intervals from four legacy audit drill holes. Database values matched all original assays, but AMEC found that the Pt, Pd, and Au original assays for two drill holes are not in the database.

12.1.4 Spruce Road Data Checks

The Spruce Road database consists of legacy data with the exception of two holes. The legacy data are from ACNC who explored the area. The assay and lithology data have not been verified by twin holes or other methods. None of the core from that exploration remains. Comparison of a limited number of assay data for ACNC exploration during that time period at Maturi suggests that there are no significant biases at Spruce Road. AMEC believes that the data are adequate to support Inferred Mineral Resources, but additional verification by twin holes is required to support higher resource classification.

12.2 Comment

The combined Maturi and Birch Lake database is adequate to support estimation of mineral resources without restriction. AMEC believes that the Spruce Road database is adequate to support estimation of only Inferred Mineral Resources because it is largely unverifiable.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

As part of the ongoing PFS, TMM is evaluating various process alternatives for metal recovery. A small number of samples have been tested at Maturi and Birch Lake. The primary objective was to establish general amenability to flotation recovery of base and precious metals and to produce concentrate for testing of final metal recovery by hydrometallurgical (pressure leaching) means and other methods.

13.1 Historical Metallurgical Testing

13.1.1 Historical Test Samples

Samples for metallurgical testing at Maturi were composite drill core samples from various parts of the deposit. The composite sample is marginally higher grade than the average of the overall deposit, but represents what is likely to be the first several years of production but does not account for local metallurgical variability.

Samples for metallurgical testing at Birch Lake were also composite drill core. This sample is considered to be representative of the overall deposit, but may not account for local metallurgical variability.

Spruce Road metallurgical testing was based on a bulk sample taken from a small open pit on the deposit. That sample is not likely representative of the overall deposit, but represented the first few years of production based on the plans at the time.

13.1.2 Metallurgical Domains

A number of mineralogical domains have been identified at Maturi. Those domains are based on mineralogy, grade, and metal ratios. The QPs believe that the metallurgical response may vary from domain to domain. Mineralization within those domains should be tested to determine if there is indeed significant variability in metallurgical response.

No domains have been identified at Birch Lake or Spruce Road as of the effective date of this report; however, different styles of mineralization have been identified at Birch Lake. Those styles include; disseminated, semi-massive sulfide, and massive sulfide mineralization as well as mineralization associated with Fe/Ti oxides. At the present time, metallurgical response of those material types is unknown. The QPs believe that the metallurgical response may vary by material type and that those material types should be tested.

13.1.3 Historical Flotation Testwork

Flotation is used to concentrate base and precious metals bearing minerals so that the metals can more efficiently be extracted. Flotation is a standard process and is well understood. In general, the process is as follows:

- Crushing of the mill feed
- Grinding of the crushed mill feed
- Flotation of minerals of interest using a variety of reagents that cause minerals to float to the top of an aqueous slurry.
- Separation of flotation concentrate and barren process material.

Flotation produces a mineral concentrate and barren processed material. Metals are extracted from the concentrate, and the barren processed materials are typically stored in tailings storage facilities.

Various flotation testwork campaigns have been conducted on Maturi, Birch Lake, and Spruce Road mineralization or core samples.

Maturi

Bench scale flotation test work on a composite sample of drill core from the Maturi Deposit was undertaken at SGS Lakefield for Duluth (Cox et al, 2009). The composite graded 0.75% Cu, 0.24% Ni, 0.19 g/t Pt, 0.43 g/t Pd and 0.12 g/t Au. The key findings of the SGS Lakefield test work are summarized below (Cox et al, 2009):

- Ni recovery to concentrate is limited by the amount of silicate-hosted Ni, which appears to be about 25% of total nickel in the sample
- The production of various concentrates was investigated, including a low grade bulk concentrate (6.3% Cu, 4.5% Ni) and a reasonably high grade Cu concentrate (28% Cu, 1.0% Ni). Flotation recoveries were 95% for copper in the copper concentrate and the bulk concentrate and 61% for nickel in the bulk concentrate. Flotation recoveries of precious metals were as follows: Pd (87%); Pt (86%), and Au (73%). Overall recoveries, including pressure leaching, were about: Cu (95%); Ni (60%); Pd (85%); Pt (84%); Au (61%).

Birch Lake

Bench scale flotation testwork on a composite sample of drill core from the Birch Lake deposit was undertaken at SGS Lakefield Research (Lakefield) in 2005. Additional flotation testwork was initiated in late 2006 and crushing and milling work index and grindability testing was done in late 2008.

Flotation recoveries were as follows: Cu (97%); Ni (68%); Pd (91%); Pt (91%); Au (90%). Overall recoveries, including pressure leaching, were about: Cu (93%); Ni (66%); Pd (78%); Pt (82%); Au (40%).

Spruce Road

In 1973 a 10,000 ton bulk sample from surface pits at Spruce Road was processed at Inco's Creighton mill in Sudbury, Ontario. Inco performed extensive testwork that defined and demonstrated a workable flotation process that gave an average recovery of 89% for copper and 63% for nickel for a bulk flotation concentrate grade of 13.4% Cu and 2.8% Ni.

In 2000, Wallbridge submitted 90 core samples metallurgical test work in 2000. A single composite was prepared from the samples and a series of scoping froth flotation tests. Results indicated that a bulk concentrate with a combined Cu+Ni grade of 15% can be produced at recoveries of 90% for copper and 66% for nickel.

13.2 Current Bulk Flotation Testwork

Bulk flotation test work has generally been directed at developing an understanding of the quality of concentrate that could potentially be utilized within any hydrometallurgical processing system that might be incorporated into the project. Testwork indicates that the most effective grinding size for ore is P80=150 micron, with regrinding of concentrates in the cleaner/scavenger circuit. The testwork has shown the energy input for comminution will range from 12-14 Kwhr per ton. Results on specific resource areas are summarized in the following sections. Table 13-1 provides a graphic of the current conceptual flowsheet to produce a bulk concentrate for hydrometallurgical processing.

13.2.1 Maturi

A metallurgical test program was completed at the SGS Lakefield laboratory between January and July 2011 on a composite sample originating from the Maturi deposit. The composite graded 0.72% Cu, 0.23% Ni, 0.25 g/t Pt, 0.49 g/t Pd and 0.13 g/t Au. Also, a selection of variability samples grading 0.3 to 1.1% Cu was analyzed. Key findings of that test work are summarized below. The results obtained in laboratory scale locked cycle tests are:

- Cu recovery to bulk concentrate varies from 92 to 96% depending on grinding size and Cu feed grade;
- Ni recovery to bulk concentrate varies from 60 to 80%, and it is limited by the amount of silicate-hosted Ni, which appears to be about 15% to 25% of total nickel in the sample; and
- Au, Pt and Pd recovery varies from 80% to 93%.

Production of medium-grade bulk concentrate with 16% S content and 12% Cu plus Ni was evaluated in a simple rougher and regrinding-cleaner circuit for Hydromet testing.

13.2.2 Birch Lake

Bench scale flotation testwork on a composite sample of drill core from the Birch Lake Deposit was undertaken at SGS Lakefield Research (Lakefield) in 2005. Additional flotation testwork was initiated in late 2006 and crushing and milling work index and grindability testing was done in late 2008. In 2012, a selection of variability samples were processed through laboratory-scale locked cycle tests. The results obtained were:

- Cu recovery to bulk concentrate varies from 90 to 95% depending on grinding size and Cu feed grade;
- Ni recovery to bulk concentrate varies from 60 to 76%, and it is limited by the amount of silicate-hosted Ni, which is greater than for Maturi, comprising 25% to 30% of total nickel in the sample; and
- Au, Pt and Pd recovery varies from 82% to 93%, depending on head grade, grind size, and final concentrate grade.

Production of medium-grade bulk concentrate for Hydromet testing with 14%-16% S content and 11%-12% Cu plus Ni was evaluated at pilot plant scale (450 kg/h) in a simple rougher and regrinding-cleaner circuit.

13.3 Conceptual Flotation Flowsheet

Based on the testwork results, flotation can be used to concentrate base and precious metals bearing minerals so that the metals can more efficiently be extracted. Flotation is a standard process and is well understood. In general, the process is as follows:

- Crushing
- Grinding of the crushed material
- Flotation of minerals of interest using a variety of reagents that cause minerals to float to the top of an aqueous slurry.
- Separation of flotation concentrate and barren process material.

Flotation produces a mineral concentrate and barren processed material. Metals are extracted from the concentrate and the barren processed materials are typically stored in large ponds where the excess water is extracted.

13.3.1 Conceptual Bulk Flotation Description

The conceptual bulk concentrate process flowsheet (Figure 13-1) is designed to produce a Cu-Ni-PGM bulk concentrate with high metallurgical recoveries of the valuable metals, low sulfide content in the tailings and specified Cu, Ni and S concentrations amenable for downstream hydrometallurgical (Hydromet) processing.

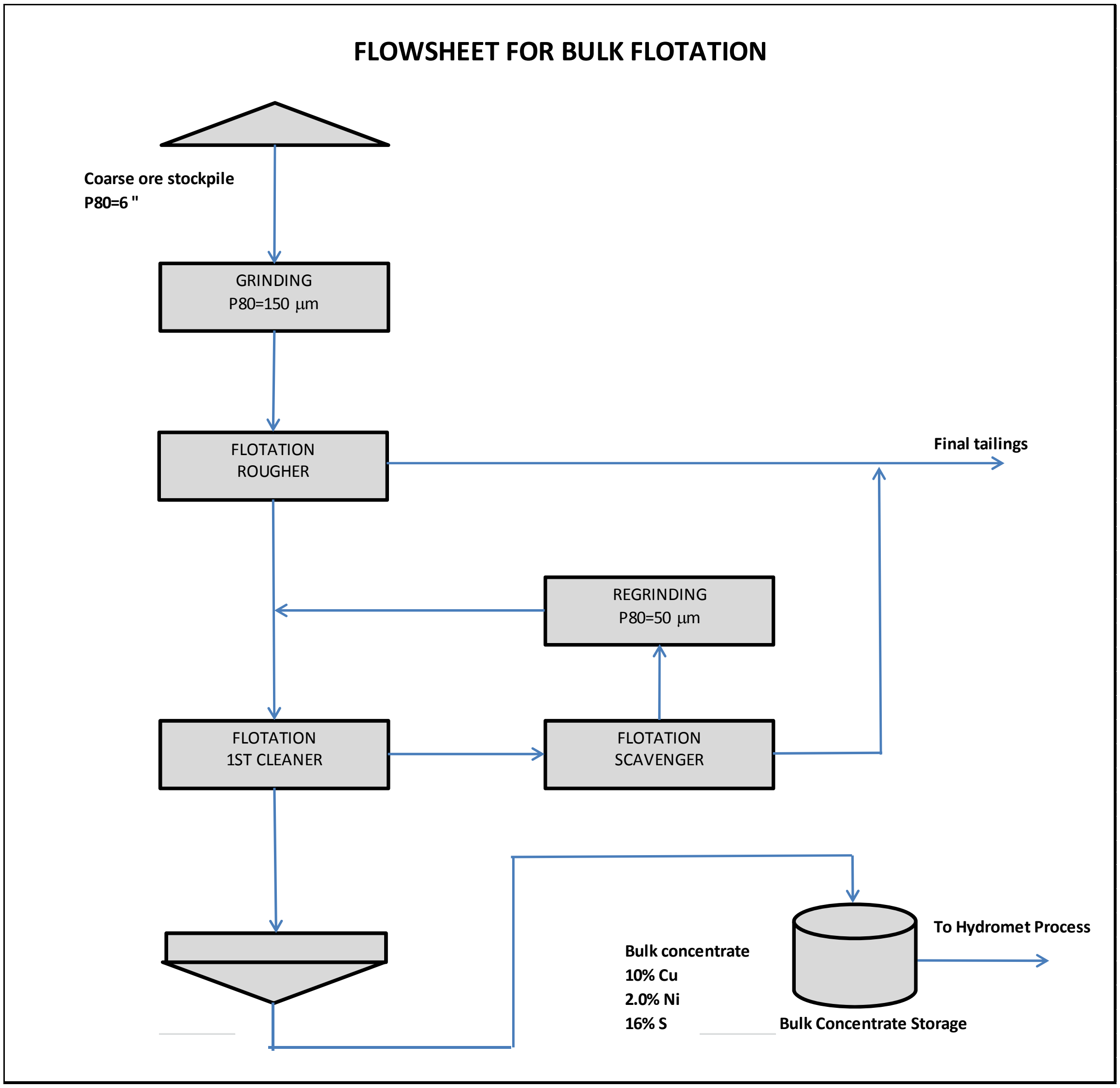
Under the current conceptual scenario, crushed run-of-mine material (80% less than 6”) is to be fed to the grinding circuit at a rate of 40,000 tons per day. The conceptual grinding circuit consists of one SAG mill plus one ball mill, and a size classification system of hydrocyclones. The mill feed is wet milled to achieve a product size of 150 µm to be fed to the flotation plant.

Ground mill feed with a slurry consistency of 30% solids is to be fed to rougher flotation. Rougher concentrate representing 10%-12% of total ore mass would then be sent to cleaner flotation, while rougher tailings would be filtered and dry-stacked in the tailings storage facility.

Cleaner flotation product concentrate is sent to the concentrate thickener where it is thickened to 60% solids to be pumped to the concentrate storage holding tanks. From this tank the concentrate slurry is sent to the Hydromet plant.

First cleaner tails are processed in the scavenger flotation circuit. Scavenger concentrate is sent to a regrind mill to be ground to 50 µm to improve liberation of metal sulfides from the gangue and then is returned to the first cleaner stage. Scavenger tailings are combined with the rougher tailings and report to the tailings storage facility.

Figure 13-1: Preliminary Conceptual Bulk Flotation Flowsheet



13.4 Hydromet Testwork and Flowsheet

Onsite processing of a bulk concentrate has significant advantages in terms of total value recovery from the deposit. Several Hydromet technologies, including Teck Resources Limited's (Teck) CESL™ Technology (CESL™) which is described below, have been considered to process the bulk Cu/Ni concentrate produced from Maturi, Birch Lake, and other deposits. For various theoretical and practical reasons based on preliminary testwork, CESL™ technology was chosen for this project. Additional testwork is needed to perfect the process, but preliminary testwork indicates that CESL™ technology will produce reasonable recoveries of the metals of interest.

13.4.1 CESL™ Process Description

CESL™ technology utilizes a medium temperature (150^{o} C) oxidative leach technology for processing base metal concentrates. Application of CESL™ Technology to most base metal concentrates results in high copper, nickel, cobalt, and precious metal (PM including Au, Pd, and Pt) recoveries through selective, partial oxidation of the concentrate. Base metals are leached from the concentrate and report to the leach solution, with copper being recovered by standard solvent extraction/electrowin (SX/EW) methods and nickel and cobalt reporting to an intermediate, high grade product, which can then undergo further refining to produce refined metal products. PMs remain in the leach residue, and are recovered through physical separation techniques.

13.4.2 CESL™ Testwork

By the end of 2012, 37 individual bench CESL™ tests had been completed on a 50 kg sample of Maturi copper-nickel concentrate. The focus of the bench program was the development of the base case conditions for optimal leaching of base metals in the pressure autoclave. Optimum results were obtained under CESL™ Process 4 Flowsheet conditions (see Figure 13-2 in Section 13.6.3) and achieved the results shown in Table 13-1.

Table 13-1: Base Metal Extraction Results

	Extraction (%)	Recovery (%)
Nickel	96.2	95.6
Copper	97.1	96.3

Along with a bench testwork program a mini-pilot campaign was operated with the objective of producing residue for PGM testwork. Roughly 600 kg of Maturi concentrate was processed through Teck's CESL™ pilot plant over a five-day period. Proprietary technology was used to selectively upgrade the PGM metals contained within the residue. Promising PGM recoveries were achieved when the residue underwent sulfur flotation. Table 13-2 gives the results for the CESL™ PM sulfur flotation concentrate.

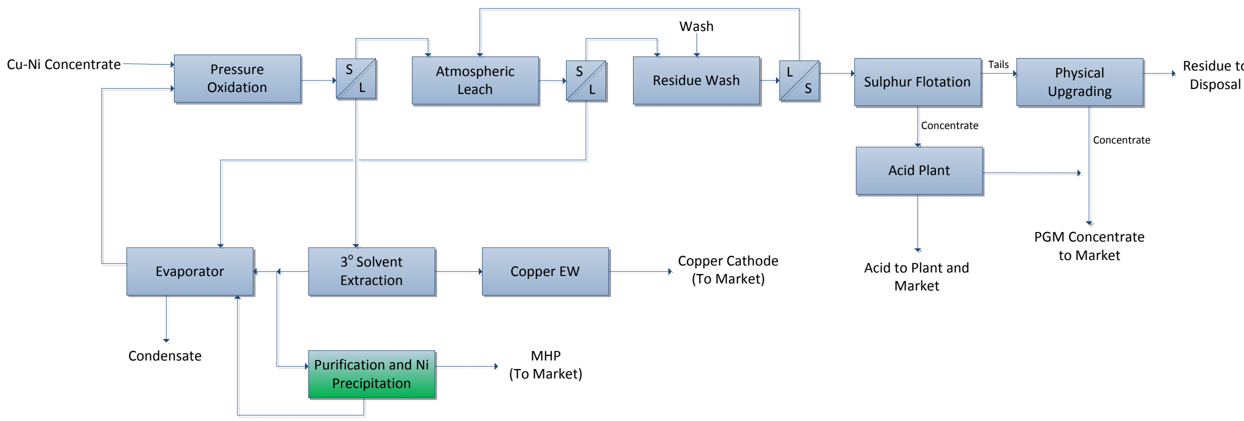
Table 13-2: Precious Metal Sulfur Flotation Results

Product	Recovery to Concentrate (%)					
	S	Mg	Ag	Au	Pt	Pd
Bulk Concentrate	79.0	10.2	40.1	74.5	59.4	70.7

13.4.3 Conceptual CESL™ Flowsheet

The conceptual CESL™ flowsheet based on current testwork is shown in Figure 13-2.

Figure 13-2: Overall CESL™ Block Flowsheet for Maturi Concentrate



Maturi copper-nickel concentrate is processed in pressure oxidation followed by atmospheric leach where the copper and nickel are leached into solution. The residue produced in these circuits is washed before reporting to flotation and physical upgrading to produce a high-grade PGM concentrate that may be sold to the market. The copper is separated and purified in solution by solvent extraction before being electrowon into LME grade A copper cathodes. The nickel and cobalt undergo purification stages before being co-precipitated into a mixed hydroxide product (MHP) which can then be re-leached for the production of nickel metal and cobalt hydroxide or sold to the market.

13.5 Products

Three major value products that are envisioned to be produced from the Maturi concentrate in the CESL™ refinery are as follows:

- LME Grade A Copper Cathode
- Mixed Hydroxide Product (MHP) Cake

- PGM Concentrate.

LME Grade A copper cathode will meet the specification of 99.99% copper. Table 13-3 summarizes the approximate composition of the mixed hydroxide precipitation cake produced from application of the CESL™ process.

Table 13-3: CESL™ Mixed Hydroxide Precipitate Composition

Mixed Hydroxide Precipitation					
Ni %	**Co** %	**S** %	**Mn** %	**Mg** %	**Cl** %
46.2	1.4	4.7	0.2	0.9	0.1

The PGM concentrate produced during sulfur flotation had the composition in Table 13-4.

Table 13-4: Sulfur Flotation PGM Concentrate

Sulfur Flotation PGM Concentrate				
Pt **g/t**	**Pd** **g/t**	**Au** **g/t**	**Ag** **g/t**	**S** **%**
8.08	28.6	5.65	76	85

The sulfur flotation PGM concentrate is expected to have an overall PGM grade of about 42.3 g/t and will require additional downstream upgrading before being sold to the market. Upgrading of the PGM concentrate can be done in an acid plant where the sulfur is converted to acid and the upgraded PGM containing dust can be collected and sold. Several other possibilities such as sulfur melting and burning are being investigated to identify the best opportunity for this project.

13.6 Deleterious Elements

Preliminary metallurgical testing has not identified any significant deleterious elements reporting to the concentrates. Routine assays include typical deleterious elements such as As, Bi, and Sb. Those elements are present in small quantities in all of the deposits. Additional testwork is required to determine if they will pose significant problems or not.

13.7 Process Site

Process facility sites (including Hydromet) have not been selected at this time; the selected site is expected to be within 25 miles of the Project. Surface disturbance at the process facility is expected to be approximately 200 acres. Those facilities are not expected to be on the Federal permits discussed in this report.

13.8 Comment

Final recoveries are summarized in Table 13-5. AMEC considers the metallurgical testwork and recoveries to be adequate to support resource estimation. Additional work may be required to support reserve declarations.

Table 13-5: Summary of Metal Recoveries at Maturi and Birch Lake

Metal	Recovery - Concentrate		Recovery – CESL™	Recovery - Global	
	Birch Lake	Nokomis/Maturi		Birch Lake	Nokomis/Maturi
Copper	94.3%	94.3%	96.3%	90.8%	90.8%
Nickel	60.0%	72.0%	95.6%	57.4%	68.8%
Gold	85.0%	85.0%	74.5%	63.3%	63.3%
Palladium	90.0%	90.0%	70.7%	63.6%	63.6%
Platinum	93.0%	93.0%	59.4%	55.2%	55.2%

Samples tested to date adequately represent the bulk deposit, but there may be metallurgical domains within the deposits that will require additional testwork. Work is in progress that will help with definition of possible metallurgical domains. Testwork to date indicates that there are no processing factors or deleterious elements that will adversely impact the project; however, additional work is in progress.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Overview

Mineral resources have been estimated for Maturi, Birch Lake and Spruce Road. New estimates are summarized for Maturi and Birch Lake and a previous estimate for Spruce Road has been re-tabulated using more current concepts assuming only underground mining. This section is a summary of AMEC (2012c) which provides details of the resource estimates reported here.

14.2 Maturi

14.2.1 Introduction

This section summarizes the 2012 resource estimate for the Maturi deposit completed in November 2012. The resource model was completed by Douglas Reid, AMEC Principal Geological Engineer under the supervision of Dr. Harry Parker, AMEC Technical Director. Todd Wakefield, AMEC Principal Geologist, completed audits of the Maturi drill hole database. Scott Long, AMEC Chief Geochemist, and Dr. Ted Eggleston, AMEC Principal Geologist, completed the QA/QC analysis.

The 2012 Maturi geological model was constructed using 554 holes (1,435,990 ft; 437,689.8 m) that were drilled between 1960 and 2012. A database review for the September 2012 update was completed in June and July 2012, and additional verification of the data was completed in September 2012.

The 2012 resource model was completed using Vulcan™ software and ordinary kriging (OK) interpolation. Model validation consisted of box plots and swath plots. Nearest-neighbor and inverse distance to the second power (ID2) models were constructed for validation purposes.

14.2.2 Database Adjustments

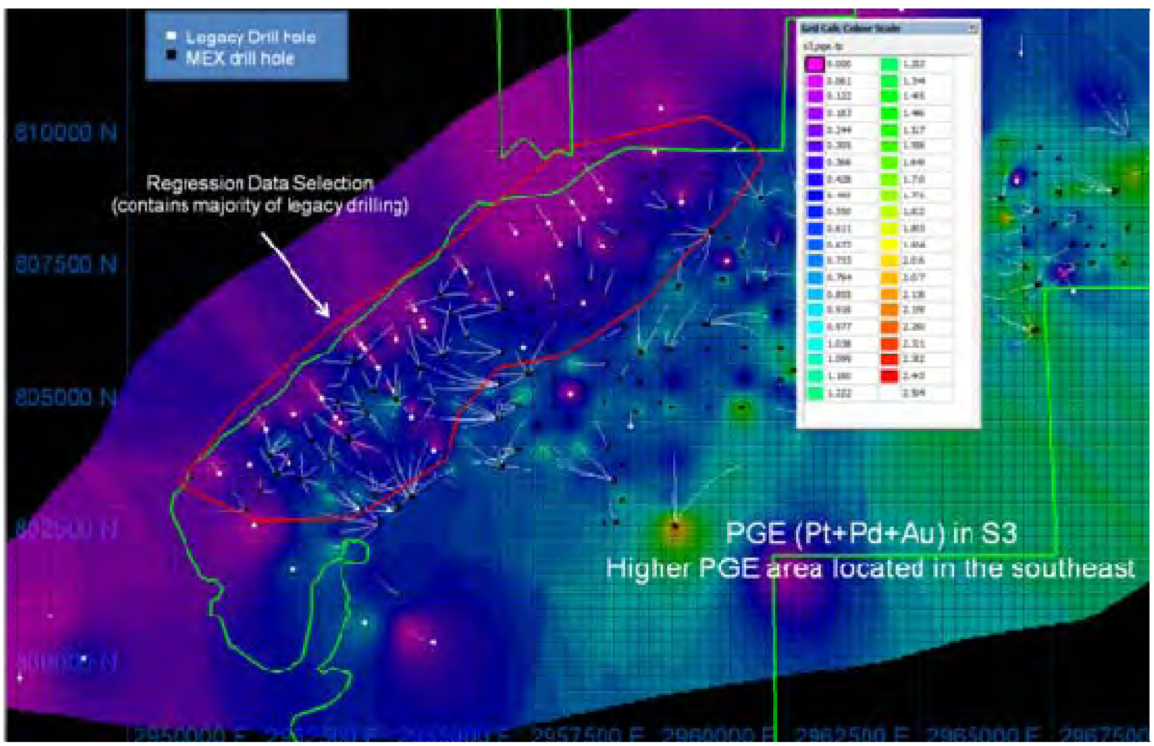
Un-sampled Intervals

Un-sampled intervals were assigned lower detection limit values for all elements. In cases where core was not recovered in a mineralized interval, missing intervals were purposely left blank. This allows the estimation algorithm to estimate across the intervals with no core recovery with no detriment to the grades because of the missing data.

Regressions for Missing Data (Assays)

Legacy drill holes were only assayed for copper and nickel. NRRI submitted selected intervals of the legacy drill holes for PM analysis; thus PM and minor element data were largely missing for those drill holes. To aid in grade estimation in areas populated by the legacy drilling, AMEC developed regression formulas for Pt, Pd, Au, Co, Ag, S, Cr, and Mg using either copper or nickel grades, depending on which pairing of the dependent variable had the highest correlation with copper or nickel. This is an accepted practice used in similar deposits located in the Sudbury Basin of Canada. AMEC restricted the data used to generate the regression formulae to the area containing the majority of the legacy drilling. This restriction removed influence of the higher PGE grades encountered to the southeast. This restricted area is shown in Figure 14-1.

Figure 14-1: Selected Area for PGE Regression Data



To help smooth the data, AMEC grouped the data pairs into bins. Regression formulae for individual units were developed for each metal. An example plot is shown in Figure 14-2. Data represented by the blue points are not considered representative (lack of sufficient data in each bin) and were not included when developing the regression equation. Insufficient data for the UH unit were located within the selected area. AMEC decided to apply the S1 regressions to the UH unit as the two units are similar (discussed in the following lithology section). The formulae were applied and the resulting regressed values were added to the assay database in Vulcan. To validate the regression, AMEC calculated a residual value by calculating a regressed value on MEX drilling. The residual value should be near zero if the regression is representative of the relationship between copper or nickel and the missing data. The residual value was determined by:

Residual = Assayed Value – Regressed Value

Histograms were calculated for the residual value for each of the regressed elements. An example is shown in Figure 14-3; the mean value for the residual is 0.00. In AMEC's opinion the applied regression adequately represents the relationships between copper, nickel and the regressed elements. The regression equations applied are presented in Table 14-1.

Figure 14-2: Grade Regression – Pt versus Ni

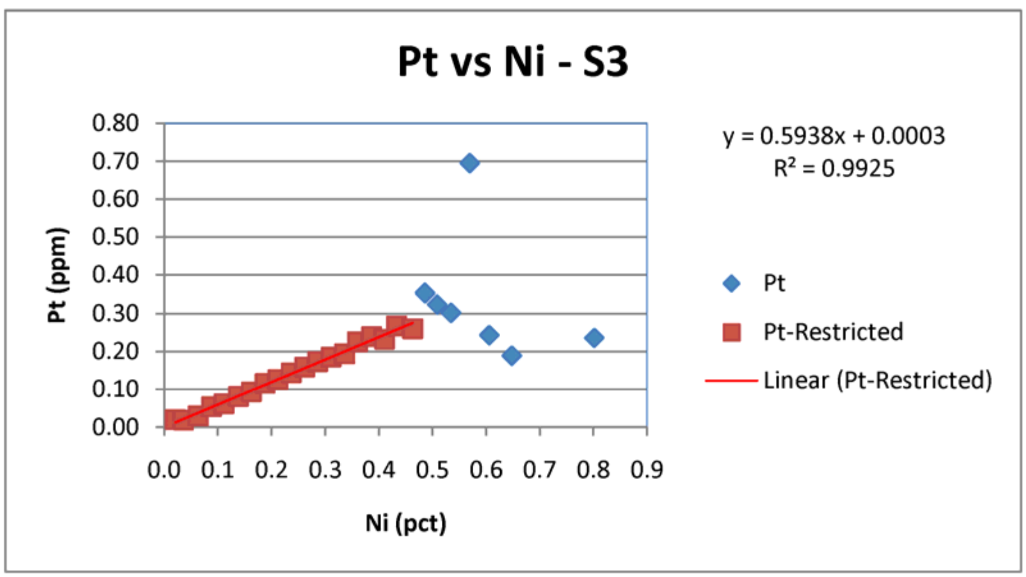


Figure 14-3: Grade Regression – Residual Analysis

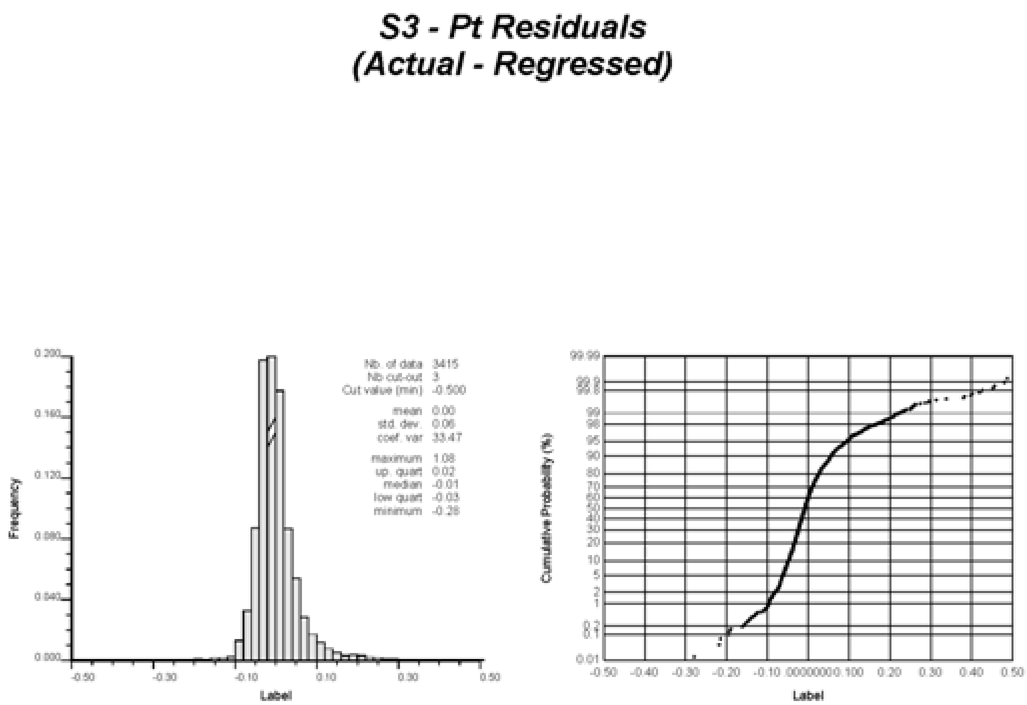


Table 14-1: Regression Equations

Major Elements			
Domain	**Pt**	**Pd**	**Au**
UH	Pt = 0.1977*Cu	Pd = 1.0714*Ni	Au = 0.2554*Ni
S3	Pt = 0.1943*Cu	Pd = 1.4273*Ni	Au = 0.1185*Cu
S2	Pt = 0.1623*Cu	Pd = 1.2134*Ni	Au = 0.1023*Cu
S1	Pt = 0.1977*Cu	Pd = 1.0714*Ni	Au = 0.2554*Ni
G_N	Pt = 0.1792*Cu	Pd = 0.9953*Ni	Au = 0.0884*Cu
G_M	Pt = 0.1861*Cu	Pd = 1.4042*Ni	Au = 0.107*Cu

UH based on S1 regression

Minor Elements					
Domain	**Ag**	**Co**	**Cr**	**S**	**Mg**
UH	Ag = 3.4219Cu + 0.1364	Co = $148.02Ni^{0.2848}$	Cr = $429.32Ni^{0.1436}$	S = 1.6997Cu	Mg = $8.6704Ni^{0.1479}$
S3	Ag = 3.6951Cu	Co = $225.48Ni^{0.4453}$	Above 0.30 Ni, Cr = 350, Cr = $631.66Ni^{0.4634}$	S = 1.4603Cu + 0.0969	Mg = $10.021Ni^{0.2698}$
S2	Ag = 3.4523Cu	Co = $202.06Ni^{0.3851}$	Above 0.35 Ni, Cr = 275, else Cr = $369.6Ni^{0.2288}$	S = 1.6141Cu + 0.1323	Mg = $7.4556Ni^{0.1672}$
S1	Ag = 3.4219Cu + 0.1364	Co = $148.02Ni^{0.2848}$	Cr = $429.32Ni^{0.1436}$	S = 1.6997Cu	Mg = $8.6704Ni^{0.1479}$
G_N	Ag = 2.4154Cu + 0.2535	Co = 263.22Ni + 20.556	Cr = 320	S = 5.0923Ni + 0.1461	Mg = 4.15
G_M	Ag = 3.4105Cu + 0.2064	Co = 227.44Ni + 21.143	Above 0.2 Ni, Cr = 400, else Cr = $789.84Ni^{0.4161}$	S = 6.2879Ni	Mg = $8.324Ni^{0.2823}$

UH based on S1 regression

Wedge Group Drill Hole Construction

Due to declustering difficulties and geological surface modeling issues, each pilot and associated wedge holes were combined into “group” holes. The assays and downhole locations from the pilot and included wedge holes were then averaged to generate assays and location data for the “group” hole. Geologic unit intervals were assigned to the “group” hole. If an individual wedge hole was greater than 25 feet from the pilot or other wedge holes it was excluded from the grouping. There were 34 “group” holes created (Table 14-2).

Figure 14-4 shows the location of the “group” holes for reference, and Figure 14-5 shows a comparison of a “group” hole (MEX-0433M-G) to the pilot and wedge holes. Table 14-2 contains a list of the “group” holes.

Figure 14-4: Location of "Group" Drill holes

Figure 14-5: Comparison of Group to Pilot and Wedges (MEX-0433M-G)

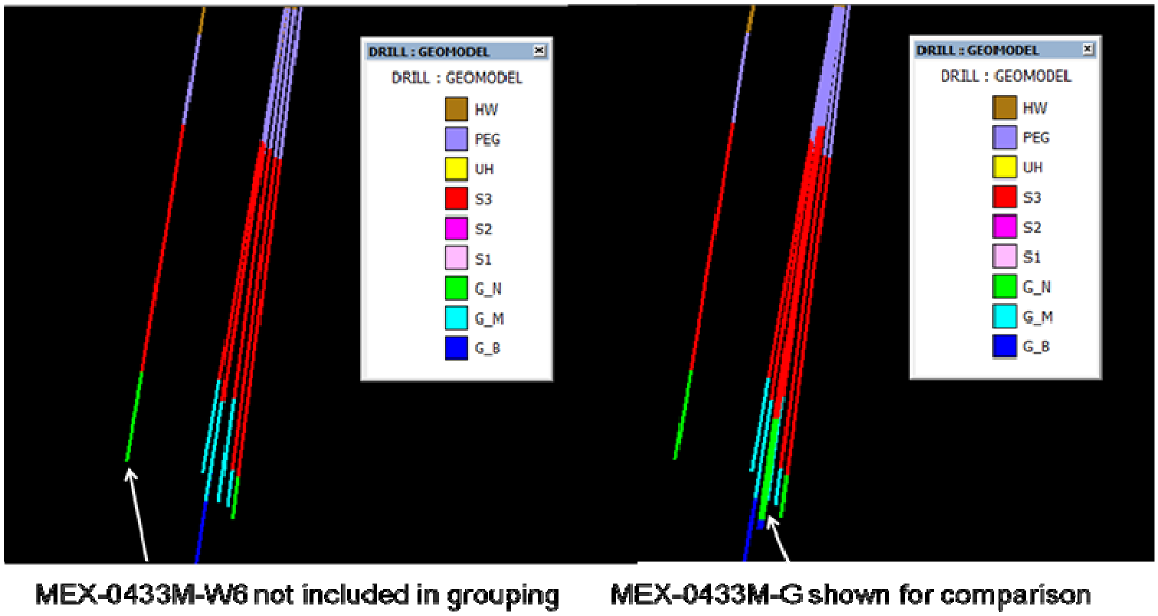


Table 14-2: Listing of "Group" Drill holes

MEX-0075M-G	MEX-0122M-G	MEX-0270M-G	MEX-0431M-G
MEX-0077-G	MEX-0127M-G	MEX-0271-G	MEX-0433M-G
MEX-0081M-G	MEX-0128M-G	MEX-0278M-G	MEX-0434M-G
MEX-0091M-G	MEX-0133M-G	MEX-0291M-G	MEX-0435M-G
MEX-0096M-G	MEX-0135M-G	MEX-0363-G	
MEX-0101M-G	MEX-0137M-G	MEX-0417M-G	
MEX-0106M-G	MEX-0139-G	MEX-0422M-G	
MEX-0110M-G	MEX-0142-G	MEX-0425M-G	
MEX-0115M-G	MEX-0183-G	MEX-0428M-G	
MEX-0117M-G	MEX-0251M-G	MEX-0430M-G	

Unit Codes

TMM compiled a set of unit codes for each drill hole at Maturi. These unit codes, which are based on geochemistry and lithology codes were the basis for the 2012 lithology model that was used to control grade estimation. For the current model, the BMZ was subdivided into four subunits and the GRB was subdivided into three subunits. Those units are discussed in Section 7.6.1.

Domains

In this model, AMEC believed that the estimation could be improved by domaining the deposit based on generalized dip and dip direction of the units.

AMEC found it useful to subdivide S3 into five stratigraphic intervals and S2 into two stratigraphic intervals of equal length in each hole. These domains were produced because mineralization appears to be stratiform in the holes and AMEC is of the opinion that this procedure adequately controls the estimation without the need for more advanced estimation procedures (unfolding).

14.2.3 Geological Model

Holes Excluded

A three-dimensional model of the geological units was constructed using grouped TMM drill holes as well as selected legacy drill holes drilled by various companies in the 1960s. There were 17 holes excluded from construction of the geological model. The holes and rationale for exclusion are presented in Table 14-3.

Table 14-3: Drill holes Excluded from Geological Model

Hole	Comment
11505	removed, doesn't fit with surrounding holes
11530	removed, conflicts with MEX-0356
32730	removed, conflicts with MEX-0324
32736	remove conflicts with MEX-0385
11526R	removed, GRB disagrees with 11526
34881	Maturi UG, location uncertain, geology disagrees as a group
34882	Maturi UG, location uncertain, geology disagrees as a group
34883	Maturi UG, location uncertain, geology disagrees as a group
34884	Maturi UG, location uncertain, geology disagrees as a group
34874	Maturi UG, location uncertain, geology disagrees as a group
34875	Maturi UG, location uncertain, geology disagrees as a group
34876	Maturi UG, location uncertain, geology disagrees as a group
34877	Maturi UG, location uncertain, geology disagrees as a group
34879	Maturi UG, location uncertain, geology disagrees as a group
34880	Maturi UG, location uncertain, geology disagrees as a group
34885	Maturi UG, location uncertain, geology disagrees as a group
34878	Maturi UG, location uncertain, geology disagrees as a group

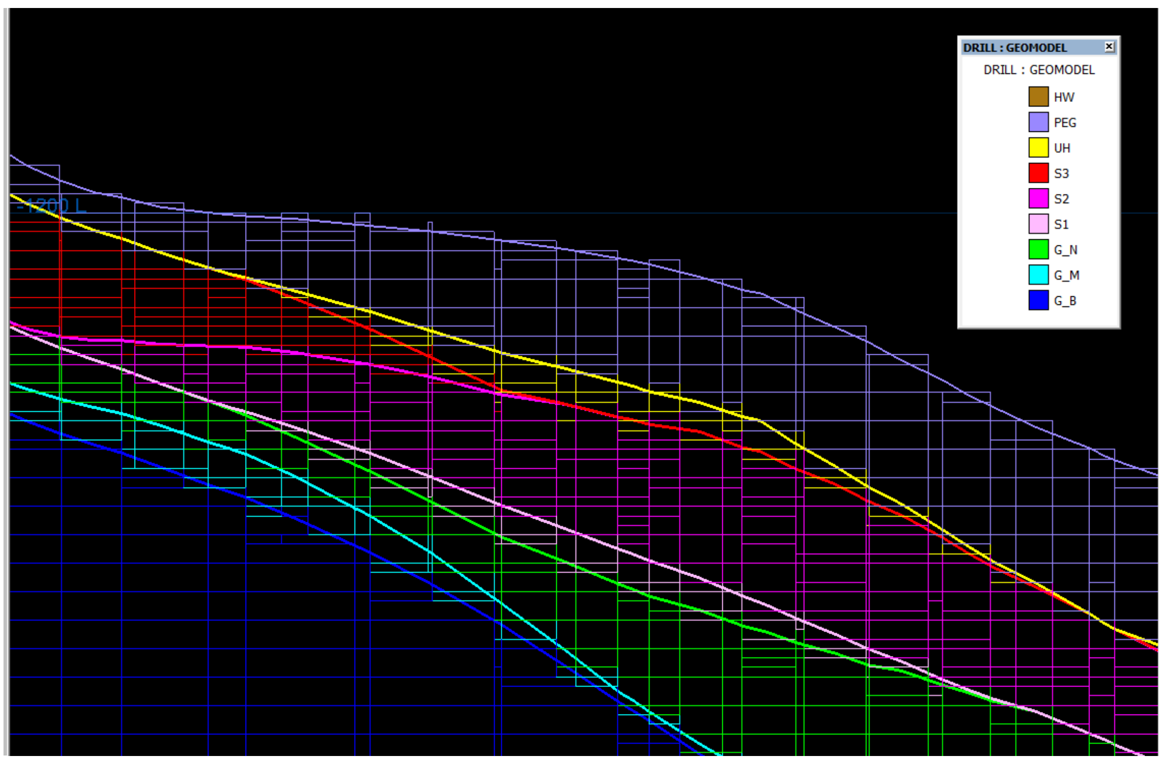
Using selected drill holes, AMEC constructed gridded surfaces models with the aid of Vulcan Grid Calc™ routines. A 50 x 50 ft cell size was used to create upper surfaces for the PEG, UH, S3, S2, S1, GN, GM and GB units. Triangulations were constructed, including spot elevations from the drill holes, of the gridded surfaces. These triangulations were used to control compositing and the construction of the block model.

Unit Codes

A typical section showing these modeled units is shown in Figure 14-6. The unit codes and digital equivalents for compositing and blocks are:

HW – 10
PEG – 100
UH - 200
S3 – Stratigraphic layers 301 - 305
S2 – Stratigraphic layers 321 - 323
S1 - 330
GN - 410
GM - 420
GB – 500

Figure 14-6: Typical Modeled Unit Geology



S3 and S2 Unit Stratigraphic Layers

AMEC separated the S3 Unit into five stratigraphic layers and the S2 Unit into 3 stratigraphic layers in an effort to maintain the stratigraphic location of mineralization within the units, i.e. mineralization located along the upper contact of the S3 Unit would be constrained to the upper stratigraphic levels rather than be smeared vertically within the unit. Figure 14-7 shows the stratigraphic layers within the S3 and S2 Units as defined by AMEC. Figure 14-8 shows an example the variation in location of copper mineralization within the S3 Unit.

Figure 14-7: Typical Modeled Unit Geology Showing S3 and S2 Stratigraphic Layers

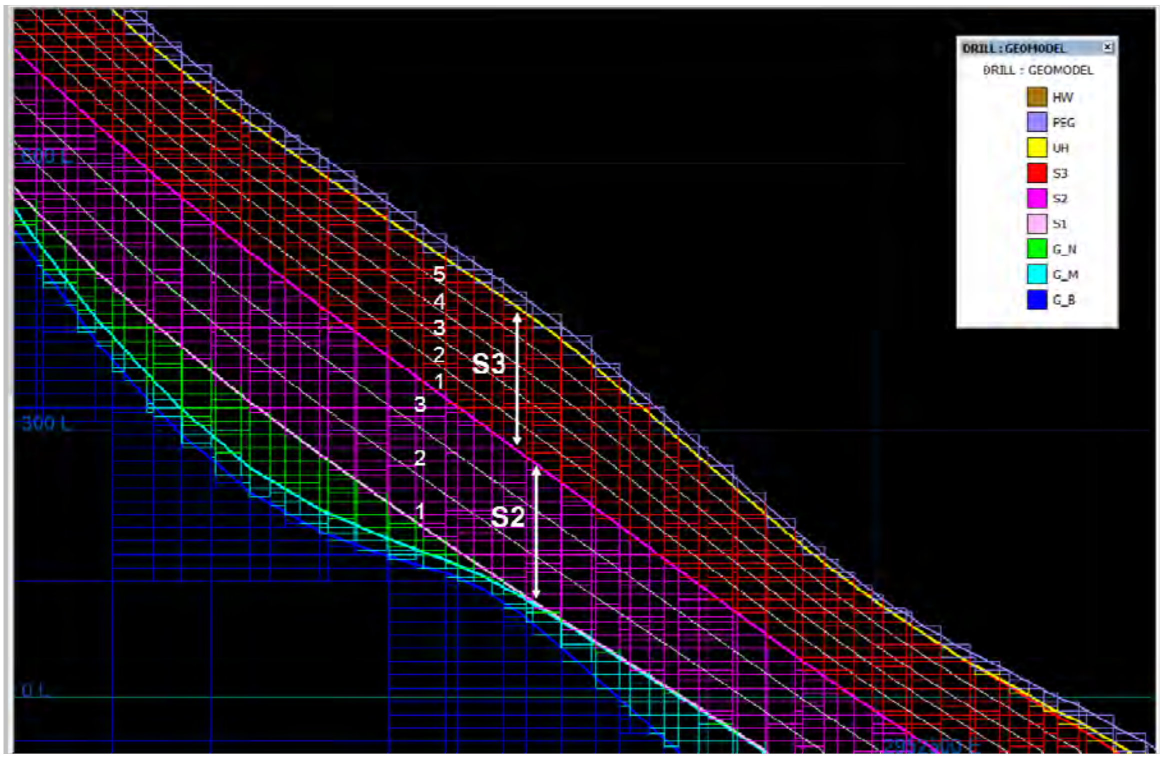
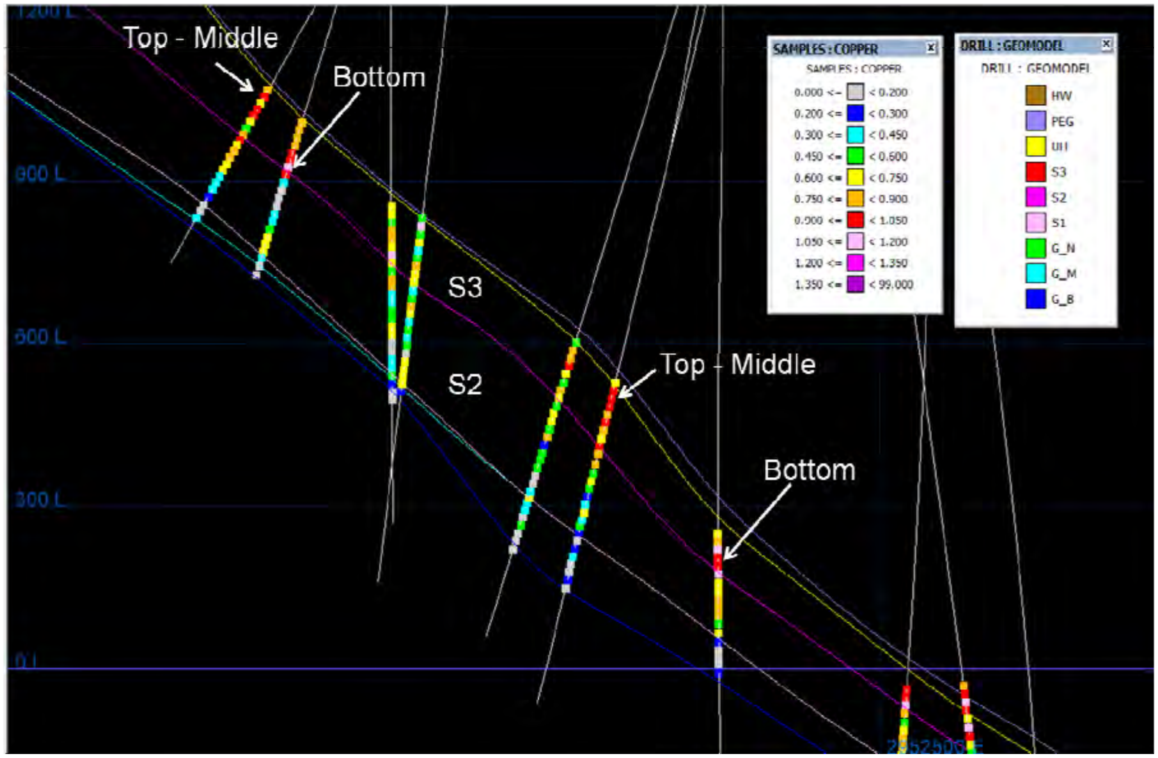


Figure 14-8: Example of Location of Copper Mineralization



14.2.4 Composites

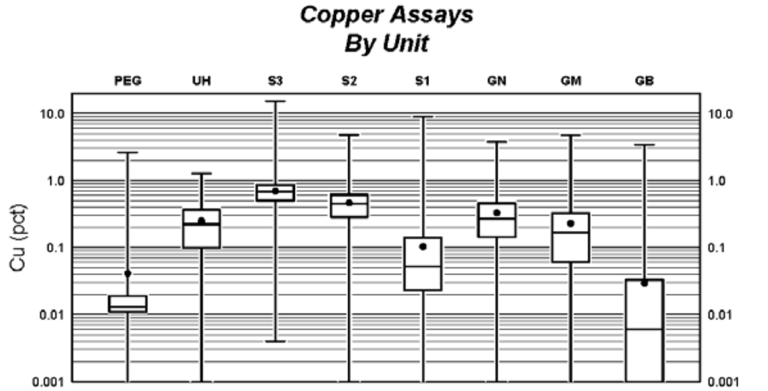
AMEC generated 15 foot composites for Cu, Ni, Pt, Pd, Au, Ag, Co, Cr, S and Mg. The composites were broken by the geological units: UH, S3, S2, S1, GN and GB. Composites with lengths less than 7.5 feet were merged with adjacent composites within the same geological unit where possible. Codes for the stratigraphic layers in S3 and S2 were added to the composite file by flagging the samples using the stratigraphic triangulations.

14.2.5 Exploratory Data Analysis

Assays

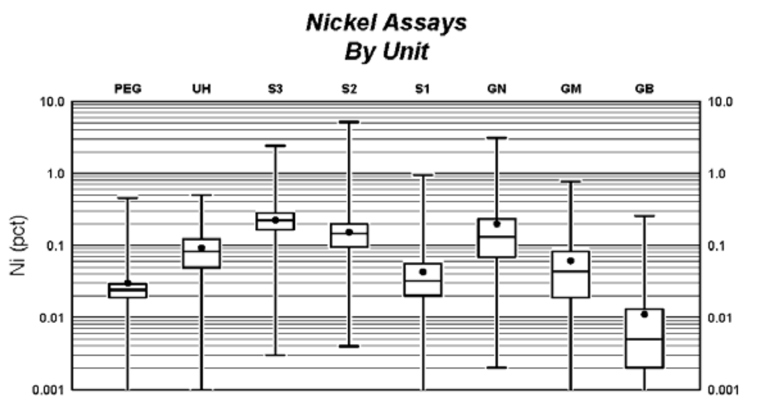
AMEC created boxplots of assay data to examine the behavior of each metal separated by unit. Assay intervals were tagged with unit geology codes from the drill hole. Figure 14-9 shows a boxplot of copper assays by unit geology while Figure 14-10 shows nickel assays by unit geology.

Figure 14-9: Boxplot of Copper Assays by Unit Geology



	PEG	UH	S3	S2	S1	GN	GM	GB	
No. of data	1754	1442	12712	9520	2729	1087	5350	3791	No. of data
Mean	0.041	0.249	0.690	0.461	0.103	0.327	0.228	0.029	Mean
Maximum	2.620	1.260	15.150	4.780	8.980	3.770	4.730	3.440	Maximum
Quartile	0.019	0.363	0.860	0.611	0.139	0.455	0.326	0.033	Quartile
Median	0.013	0.222	0.681	0.447	0.052	0.267	0.167	0.006	Median
Quartile	0.011	0.099	0.500	0.284	0.023	0.144	0.060	0.001	Quartile
Minimum	0.000	0.001	0.004	0.001	0.000	0.001	0.000	0.000	Minimum
Variance	0.017	0.035	0.109	0.063	0.033	0.079	0.061	0.007	Variance
CV	3.143	0.753	0.477	0.543	1.771	0.858	1.082	2.786	CV
Skewness	10.280	1.070	8.221	1.048	26.419	3.128	4.334	22.714	Skewness

Figure 14-10: Boxplot of Nickel Assays by Unit Geology



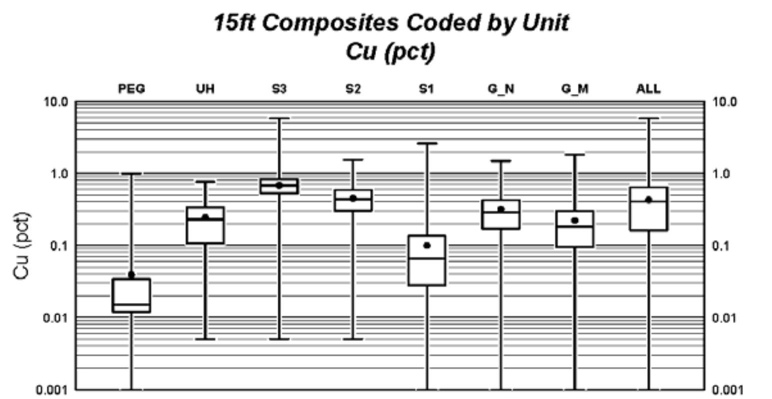
	PEG	UH	S3	S2	S1	GN	GM	GB	
No. of data	1754	1442	12712	9519	2729	1087	5348	3791	No. of data
Mean	0.030	0.092	0.225	0.152	0.043	0.199	0.061	0.011	Mean
Maximum	0.457	0.500	2.400	5.130	0.955	3.100	0.771	0.257	Maximum
Quartile	0.029	0.123	0.278	0.196	0.056	0.233	0.083	0.013	Quartile
Median	0.024	0.083	0.220	0.147	0.032	0.130	0.043	0.005	Median
Quartile	0.019	0.049	0.165	0.095	0.020	0.069	0.019	0.002	Quartile
Minimum	0.000	0.001	0.003	0.004	0.000	0.002	0.000	0.000	Minimum
Variance	0.001	0.003	0.010	0.015	0.002	0.055	0.004	0.000	Variance
CV	1.201	0.633	0.439	0.802	1.008	1.178	1.005	1.398	CV
Skewness	6.548	1.657	2.571	23.367	6.807	3.527	2.467	4.612	Skewness

Composites

AMEC then created boxplots for the 15 foot composites. These were used to evaluate characteristics of the geological units and stratigraphic layers with in S3 and S2 units. This assisted in identifying possible grouping of units and stratigraphic layers for each metal. Proposed groupings were then refined using contact plots. Figure 14-11 shows

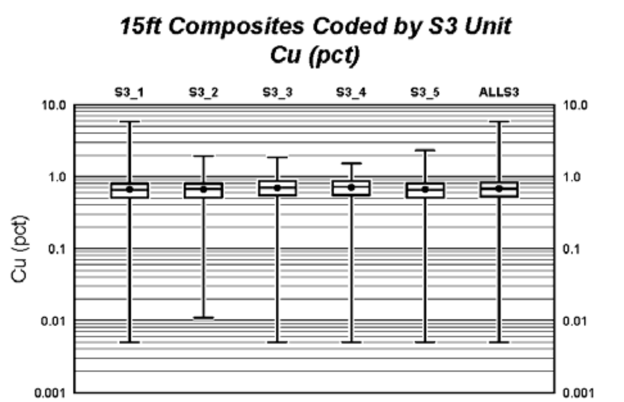
BMZ copper composites separated by domain. An example for copper composites separated by the stratigraphic layers within the S3 unit is shown in Figure 14-12.

Figure 14-11: Boxplot Copper Composites by Geological Unit



	PEG	UH	S3	S2	S1	G_N	G_M	ALL	
No. of data	711	341	3373	2713	931	296	1603	9968	No. of data
Mean	0.039	0.243	0.680	0.448	0.099	0.314	0.222	0.426	Mean
Maximum	1.000	0.761	5.800	1.544	2.576	1.481	1.814	5.800	Maximum
Quartile	0.034	0.335	0.823	0.585	0.135	0.423	0.302	0.644	Quartile
Median	0.015	0.230	0.679	0.437	0.066	0.288	0.179	0.405	Median
Quartile	0.012	0.107	0.525	0.302	0.028	0.170	0.095	0.162	Quartile
Minimum	0.001	0.005	0.005	0.005	0.001	0.001	0.001	0.001	Minimum
Variance	0.005	0.026	0.065	0.044	0.015	0.044	0.035	0.093	Variance
CV	1.726	0.663	0.375	0.466	1.230	0.668	0.846	0.716	CV
Skewness	4.477	0.669	2.816	0.439	8.280	1.375	2.352	1.105	Skewness

Figure 14-12: Boxplot Copper Composites – Stratigraphic Layers in S3

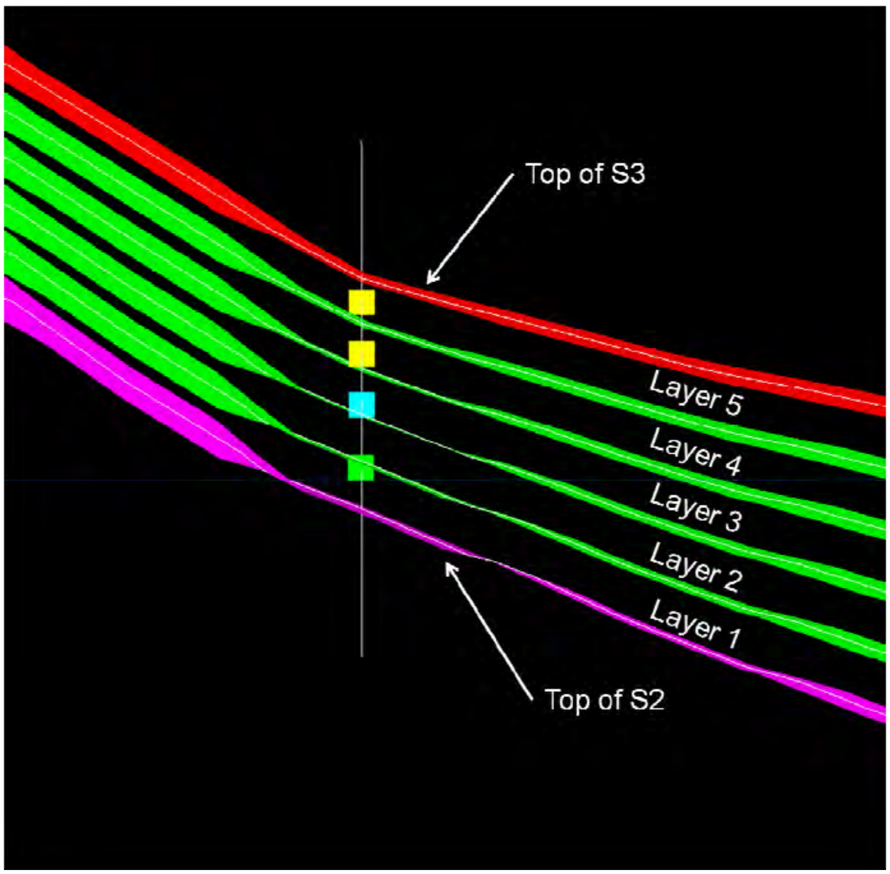


	S3_1	S3_2	S3_3	S3_4	S3_5	ALLS3	
No. of data	646	670	684	671	682	3373	No. of data
Mean	0.662	0.663	0.700	0.711	0.665	0.680	Mean
Maximum	5.800	1.946	1.843	1.517	2.312	5.800	Maximum
Quartile	0.796	0.797	0.861	0.859	0.807	0.823	Quartile
Median	0.653	0.672	0.707	0.712	0.651	0.679	Median
Quartile	0.507	0.511	0.544	0.552	0.510	0.525	Quartile
Minimum	0.005	0.011	0.005	0.005	0.005	0.005	Minimum
Variance	0.102	0.054	0.061	0.056	0.051	0.065	Variance
CV	0.483	0.349	0.354	0.334	0.341	0.375	CV
Skewness	7.096	0.310	0.016	0.111	0.735	2.816	Skewness

Contact Profiles

Contact profiles were completed on 15 ft composites to evaluate the nature of the contacts between the various geological units. The contacts between the stratigraphic layers in S3 and S2 were considered “hard”, unless a particular layer was missing in the composite file. This tended to occur where the S3 or S2 unit would thin. An example is shown in Figure 14-13 where a composite coded for layer 2 is missing. In this case the composite from adjacent layers (1 and 3) would be selected for estimation. For the final estimation pass there was no stratigraphic restriction applied, all composites within S3 or S2 units could be selected for estimation.

Figure 14-13:Example of Missing Stratigraphic Composite in Layer 2



This approach was refined to consider the contact as soft, firm or hard (SFH) for each element. A soft contact would allow composites to be selected on either side of a contact; a firm contact would allow composites within a specified distance of the contact to be selected, while a hard contact would not allow composite selection across the contact. A SFH matrix for copper is shown in Table 14-4. A code of “0” indicates a soft contact, a "1" indicates a hard contact and a code of 2 indicates a "soft" contact, the second digit indicates the number of composites that can be selected for sharing across the contact (i.e. a code of 23 means that 3 composites across the contact may be selected) as indicated for both sides of the contact between GN and S1. The corresponding contact plot for GN and S1 is shown in Figure 14-14. An example of a contact plot showing a hard boundary for copper between S3 and S2 is shown in Figure 14-15.

Table 14-4: Copper SFH Matrix

COPPER - CONTACT MATRIX FOR ESTIMATION													
sfh_cu	**PEG**	**UH**	**S3_5**	**S3_4**	**S3_3**	**S3_2**	**S3_1**	**S2_3**	**S2_2**	**S2_1**	**S1**	**G_N**	**G_M**
PEG	0	1	1	1	1	1	1	1	1	1	1	1	1
UH	1	0	1	1	1	1	1	1	1	1	1	1	1
S3_5	1	1	0	1	1	1	1	1	1	1	1	1	1
S3_4	1	1	1	0	1	1	1	1	1	1	1	1	1
S3_3	1	1	1	1	0	1	1	1	1	1	1	1	1
S3_2	1	1	1	1	1	0	1	1	1	1	1	1	1
S3_1	1	1	1	1	1	1	0	1	1	1	1	1	1
S2_3	1	1	1	1	1	1	1	0	1	1	1	1	1
S2_2	1	1	1	1	1	1	1	1	0	1	1	1	1
S2_1	1	1	1	1	1	1	1	1	1	0	1	22	1
S1	1	1	1	1	1	1	1	1	1	1	0	23	21
G_N	1	1	1	1	1	1	1	1	1	22	23	0	1
G_M	1	1	1	1	1	1	1	1	1	21	21	1	0

Figure 14-14:Contact Plots – Firm Boundary (3 bins) for Copper – GN and S1

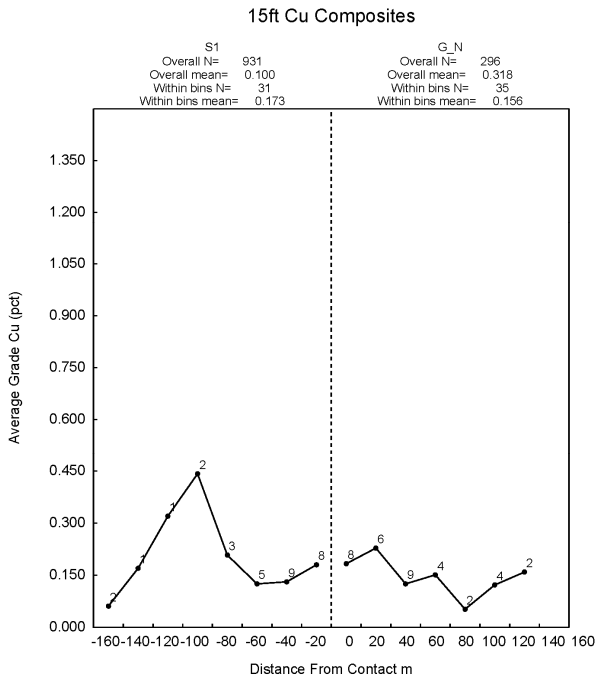
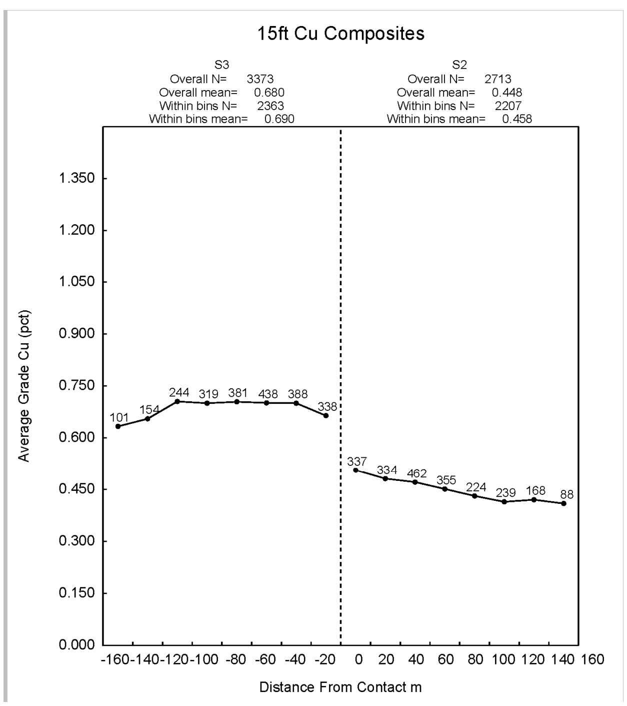


Figure 14-15:Contact Plots – Hard Boundary for Copper – S3 and S2



Variography

AMEC performed variography for each element (Cu, Ni, Pt, Pd, Au, Ag, Co, Cr, S and Mg), and for each unit to be interpolated (UH, S3, S2, S1, G_N, and G_M). Calculations were performed on uncapped grades due to generally low CV values. Values derived from regression equations were not included. Unfolding was not applied; instead, the deposit was broken into four domains, (Figure 14-16). Using the S3 upper surface as a reference, it was re-gridded to a 500 x 500 foot cell size and the strike, dip and dip direction was calculated for two triangles in each of these cells. Separate plots of dip and dip direction were made to assess the possibility of creating sub-domains. Examination of these plots revealed the deposit could be separated into four domains of fairly consistent strike and dip, based on the orientation of the modeled top of the S3 unit for variography and estimation purposes. The search ellipse and variograms were oriented to match the domain orientation. These domains were considered soft; thus composites were shared across domain boundaries. Insufficient data are contained in Domain 1 and 4 to generate reasonable variograms; the variogram from Domain 2 was rotated and applied to Domain 1. The variogram for Domain 3 was rotated and applied to Domain 4. The domains and orientations are shown in Figure 14-16. Figure 14-16 is a perspective view of the Maturi domains looking northeast. As an additional alternative to unfolding, AMEC subdivided S3 and S2 into “stratigraphic subunits”, as described in section 14.2.3.

AMEC used SAGE2001™ software to calculate correlograms. Directional correlograms were calculated in the along-strike and down-dip directions. For all units, AMEC assumed the orientation to be equivalent to the top of the S3 unit. In addition to the strike and down-dip correlograms, two “off-directions” were calculated, being rotated 45 degrees within the plane of the top of the S3 unit. Table 14-5 summarizes the variogram parameters for copper domains 2 and 4. Details of the variography are presented in AMEC (2012c).

Figure 14-16: Variography Domains showing Ellipse Orientations (blue ellipses; surface represents the top of the S3 unit; view looking northeast)

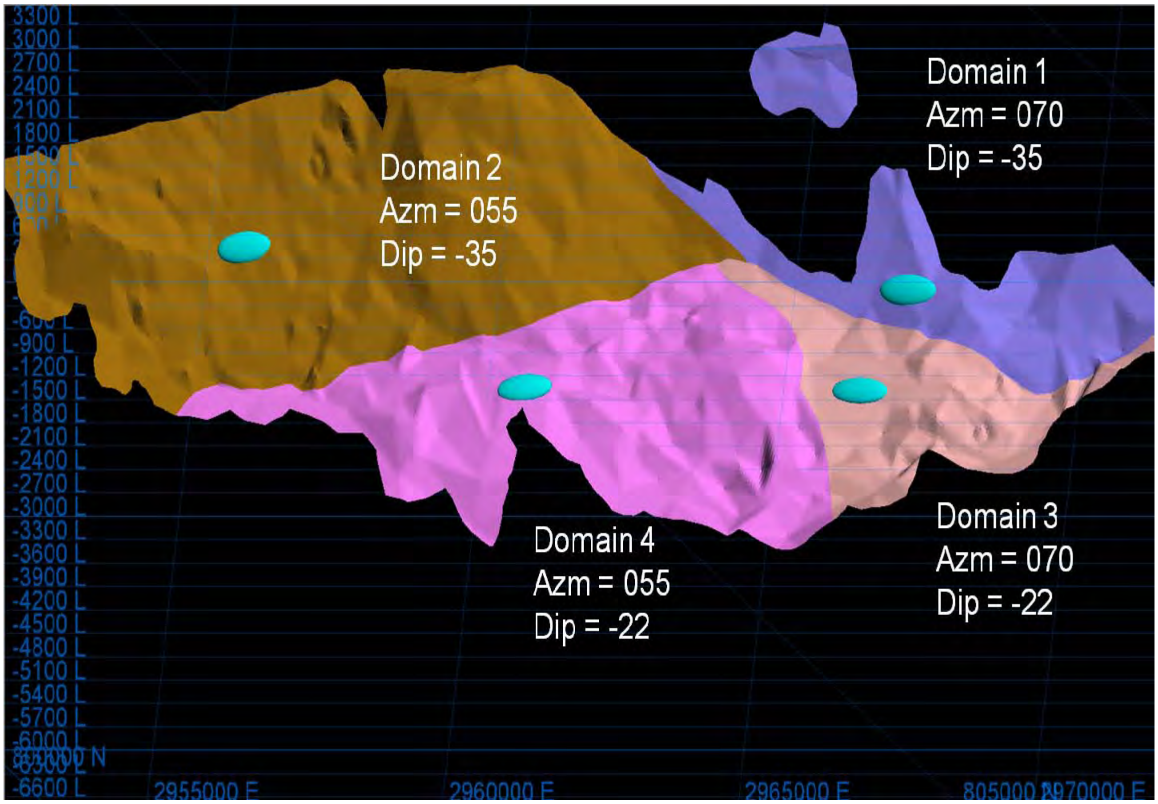


Table 14-5: Variogram Parameters for Copper Domains 2 and 4 (see Section 14.2.7 for a discussion of domains)

Domain/ unit	C0	C1	C2	Bearing	Plunge (RotY)	Dip (RotX)	1st Struc. Range			2nd Struc. Range		
							X	Y	Z	X	Y	Z
D2 UH	0.25	0.4	0.35	55	0	-39	150	150	50.0	1500	1000	160.0
D2 S3	0.4	0.3	0.3	55	0	-39	200	80	76.5	1700	900	293.4
D2 S2	0.25	0.35	0.4	55	0	-39	120	60	69.9	2800	1200	281.5
D2 S1	0.25	0.45	0.3	55	0	-39	100	200	28.3	1500	1000	1600.0
D2 G_N	0.35	0.35	0.3	55	0	-39	100	80	197.9	1200	800	198.4
D2 G_M	0.35	0.35	0.3	55	0	-39	70	70	55.7	450	450	93.5
D4 UH	0.25	0.4	0.35	55	0	-22	60	90	50.0	900	1700	160.0
D4 S3	0.3	0.35	0.35	55	0	-22	100	200	43.5	1000	700	43.5
D4 S2	0.25	0.4	0.35	55	0	-22	120	150	31.2	1200	1500	376.8
D4 S1	0.25	0.45	0.3	55	0	-22	150	150	28.3	800	800	800.0
D4 G_N	0.35	0.35	0.3	55	0	-22	90	90	197.9	1000	1000	198.4
D4 G_M	0.35	0.35	0.3	55	0	-22	60	100	37.9	1300	3000	303.6

14.2.6 Density

A total of 20,999 density measurements were recorded. Density data for the S3 and S2 units were refined by the stratigraphic layer. The density for the geological units and stratigraphic subdivisions is shown in Table 14-6. AMEC used the mean density value calculated for each of these groups to derive a tonnage factor used in the block model.

Table 14-6: Mean Density Values by Unit and Stratigraphic Layer

UNIT	Count	Density (g/cm^3)	Tonnage Factor (lbs/ft^3)
PEG	885	2.95	0.09208
UH	777	3.02	0.09427
S3	5882	3.02	0.09427
S3_5	1220	3	0.09364
S3_4	1206	3.01	0.09395
S3_3	1165	3.02	0.09427
S3_2	1170	3.03	0.09458
S3_1	1121	3.05	0.09520
S2	4241	3.05	0.09520
S2_3	1475	3.07	0.09583
S2_2	1383	3.06	0.09551
S2_1	1383	3.04	0.09489
S1	1261	3.01	0.09395
G_N	474	2.82	0.08802
G_M	2574	2.78	0.08677
G_B	1931	2.74	0.08553

14.2.7 Block Model

Geological Model

The geological model was generated using the Unit Geology intervals supplied by TMM. A topographic surface was generated using newly acquired LIDAR data with a 2 foot contour interval supplied by TMM. The upper surface for each of the PEG, UH, S3, S2, S1, GN, GM and GB units was generated using X, Y and Z of drill hole intercepts using Vulcan Grid Calc modeling functions. A grid cell size of 50 ft x 50 ft was used over the model area. A stratigraphic model of the S3 and S2 units was developed by dividing the calculated S3 unit thickness into 5 equal units and the S2 unit thickness into 3 equal parts. Grade estimation was carried out within the UH, S3, S2, S1, GN and GM units. Typical cross sections showing the geological model are shown in Figure 14-6 and Figure 14-7.

Estimation Domains

Estimation domains are the same as the domains defined for variography in Section 14.2.5.

14.2.8 Estimation

The grade estimation for the 2012 resource model update used ordinary kriging (OK) within Vulcan. The grade estimations were completed for copper, nickel, palladium, platinum, gold, silver, cobalt, chromium, magnesium and sulfur. The estimations were completed for each element independently. The geological units were each estimated independently. Grade estimates were not completed for the HW, PEG and GB units (below the GM unit).

Each element was estimated independently in multiple passes with expanding searches for each pass within the unit. Estimation passes are shown in Table 14-7. A restrictive pass (Pass 0) was used for estimation of PGE elements to reduce the smearing of higher grades. This pass used a smaller number of composites within a reduced search ellipse to eliminate contribution of distant drill holes. The large number of passes shown in Table 14-7 was required to accommodate the various combinations of search ellipses, geological units, and stratigraphic layers. At the completion of grade estimation, a Vulcan™ script was run to fill any unestimated blocks with the average grade for the particular domain, unit, and stratigraphic level. There were no unestimated blocks within the Indicated and Inferred classifications.

Table 14-7: Estimation Search Strategy

Pass	Unit	Strat	Search (ft)			Composites		
			X	Y	Z	Min	Max	Max per Hole
0*	UH	-	500	500	200	5	9	3
1	UH	-	1000	1000	200	5	12	3
2	UH	-	2500	2500	200	5	12	3
3	UH	-	5000	5000	500	5	12	3
0*	S3	5	500	500	200	5	9	3
1	S3	5	1000	1000	200	5	12	3
2	S3	5	2500	2500	200	5	12	3
3	S3	5	5000	5000	500	5	12	3
0*	S3	4	500	500	200	5	9	3
1	S3	4	1000	1000	200	5	12	3
2	S3	4	2500	2500	200	5	12	3
3	S3	4	5000	5000	500	5	12	3
0*	S3	3	500	500	200	5	9	3
1	S3	3	1000	1000	200	5	12	3
2	S3	3	2500	2500	200	5	12	3
3	S3	3	5000	5000	500	5	12	3
0*	S3	2	500	500	200	5	9	3
1	S3	2	1000	1000	200	5	12	3
2	S3	2	2500	2500	200	5	12	3
3	S3	2	5000	5000	500	5	12	3
0*	S3	1	500	500	200	5	9	3
1	S3	1	1000	1000	200	5	12	3
2	S3	1	2500	2500	200	5	12	3
3	S3	1	5000	5000	500	5	12	3
0*	S2	3	500	500	200	5	9	3
1	S2	3	1000	1000	200	5	12	3
2	S2	3	2500	2500	200	5	12	3
3	S2	3	5000	5000	500	5	12	3
0*	S2	2	500	500	200	5	9	3
1	S2	2	1000	1000	200	5	12	3
2	S2	2	2500	2500	200	5	12	3
3	S2	2	5000	5000	500	5	12	3
0*	S2	1	500	500	200	5	9	3
1	S2	1	1000	1000	200	5	12	3
2	S2	1	2500	2500	200	5	12	3
3	S2	1	5000	5000	500	5	12	3
0*	S1	1	500	500	200	5	9	3
1	S1	1	1000	1000	200	5	12	3
2	S1	1	2500	2500	200	5	12	3
3	S1	1	5000	5000	500	5	12	3
0*	GN	1	500	500	200	5	9	3
1	GN	1	1000	1000	200	5	12	3
2	GN	1	2500	2500	200	5	12	3
3	GN	1	5000	5000	500	5	12	3
0*	GM	1	500	500	200	5	9	3
1	GM	1	1000	1000	200	5	12	3
2	GM	1	2500	2500	200	5	12	3
3	GM	1	5000	5000	500	5	12	3

** Pass 0 was applied to Pt, Pd and Au only.*

14.2.9 Metal at Risk

AMEC examined probability plots and histograms (logarithmic and arithmetic) of 15 foot composites for each element separated by geological unit. Due to the low coefficient of variation (CV), a very light or no cap grade was selected. Table 14-8 summarizes the grade capping that was applied.

Table 14-8: Grade Capping Levels

Unit	Grade Capping				
	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)
UH	-	0.25	0.30	0.60	0.15
S3	2.00	0.60	-	2.00	2.00
S2	-	0.50	0.40	-	0.30
S1	0.80	0.25	0.25	0.40	0.10
GN	1.00	0.80	0.30	0.60	0.15
GM	1.00	-	-	0.90	0.25

Metal removed from the BMZ units is summarized in Table 14-9. The metal removed was determined by comparing grades between the unrestricted kriged model and the final kriged model where the grade capping was applied. Overall the relative metal removed for copper and nickel is 0.1% and 0.7% respectively. Overall the relative metal removed for platinum, palladium and gold is 0.8%, 0.2% and 0.0% respectively.

AMEC considers the level of metal removed from the resource to be reasonable for the Indicated and Inferred Resource classifications. Differences in metal removed between this and the previous model are largely due to the improved geological model.

Table 14-9: Metal Removed by Capping

Indicated			
Metal	**OK Uncapped**	**OK Capped**	**Relative Metal Removed (OK Uncapped versus OK Capped)**
Copper (%)	0.525	0.524	0.2%
Nickel (%)	0.170	0.169	0.6%
Platinum (ppm)	0.139	0.138	0.7%
Palladium (ppm)	0.314	0.314	0.0%
Gold (ppm)	0.075	0.075	0.0%
Inferred			
Metal	**OK Uncapped**	**OK Capped**	**Relative Metal Removed (OK Uncapped versus OK Capped)**
Copper (%)	0.352	0.352	0.0%
Nickel (%)	0.114	0.113	0.9%
Platinum (ppm)	0.098	0.097	1.0%
Palladium (ppm)	0.220	0.219	0.5%
Gold (ppm)	0.050	0.050	0.0%
Indicated + Inferred			
Metal	**OK Uncapped**	**OK Capped**	**Relative Metal Removed (OK Uncapped versus OK Capped)**
Copper (%)	0.447	0.446	0.1%
Nickel (%)	0.145	0.144	0.7%
Platinum (ppm)	0.120	0.119	0.8%
Palladium (ppm)	0.271	0.271	0.2%
Gold (ppm)	0.064	0.064	0.0%

14.2.10 Model Validation

Model validation consisted of visual inspection of cross-sections and plan-sections comparing estimated grades to the 15 foot composites. Box plots and swath plots were used to compare grade estimates to nearest-neighbor (NN) grades and 15 foot composite grades. A series of contact plots were also generated comparing the block estimates and composite grades across the geological contacts.

Nearest-Neighbor Model

A NN model was completed for model validation. The NN model provides a declustered distribution of grades, wherein a block is assigned the grade of the closest composite. Kriged models use multiple composites to interpolate grades into blocks.

While this theoretically provides more accurate local estimates, sometimes artifacts are introduced related to selection of composites from areas with different mean grades or assigning too much weight to some composites and too little to others. The NN model is a benchmark used to check for problems in the kriging process. The NN model utilized the same search criteria as the OK estimate and was used for comparison of summary statistics in box plots and swath plots. Model validation was completed using blocks classified as Indicated for the BMZ units and blocks within 250 feet of a drill hole for the GN and GM units, as these were classified as Inferred.

Visual Inspection

Visual inspection on sections and plans comparing estimated block grades to the 15 foot composites was completed for all elements. Figure 14-18 and 14-19 (plan view) show block grades for copper. (Figure 14-17 shows the section location for Figure 14-18.)

AMEC noted good correlation between composite data and block grades. In general AMEC observed good grade and thickness continuity between drill holes; however, in some areas, additional drilling is required to reduce the distance between existing drill holes. This additional drilling is required to increase the confidence in the resource model and to reduce the reliance on legacy drill holes.

Figure 14-17:Section Location

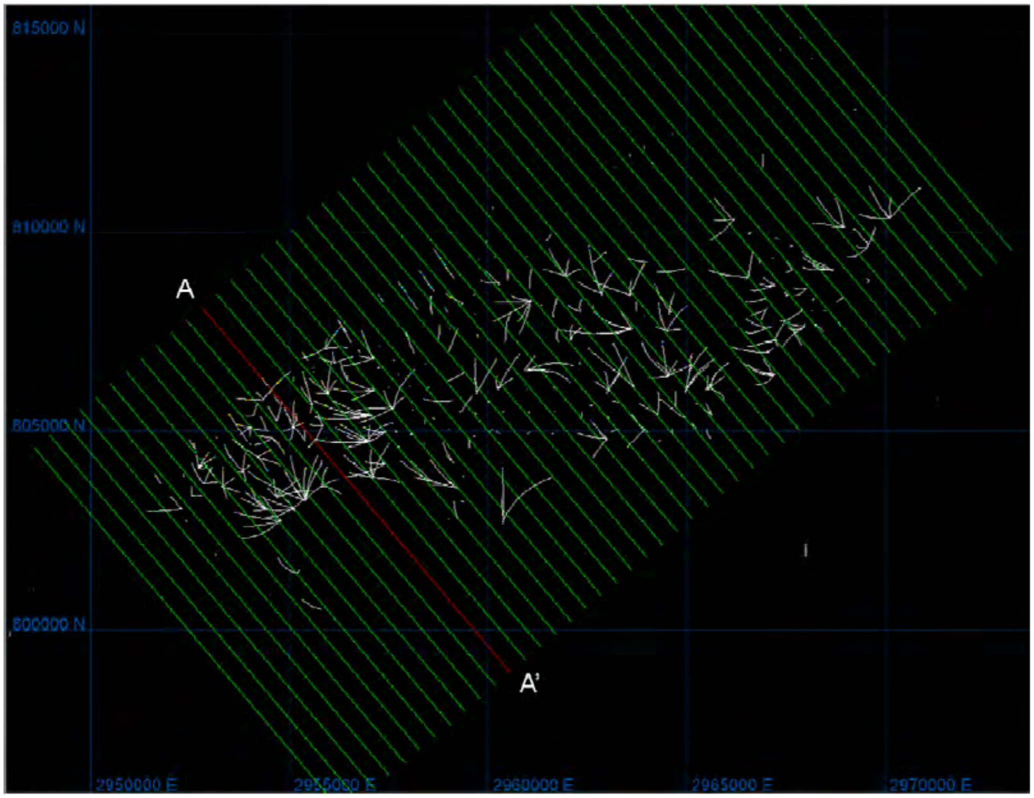
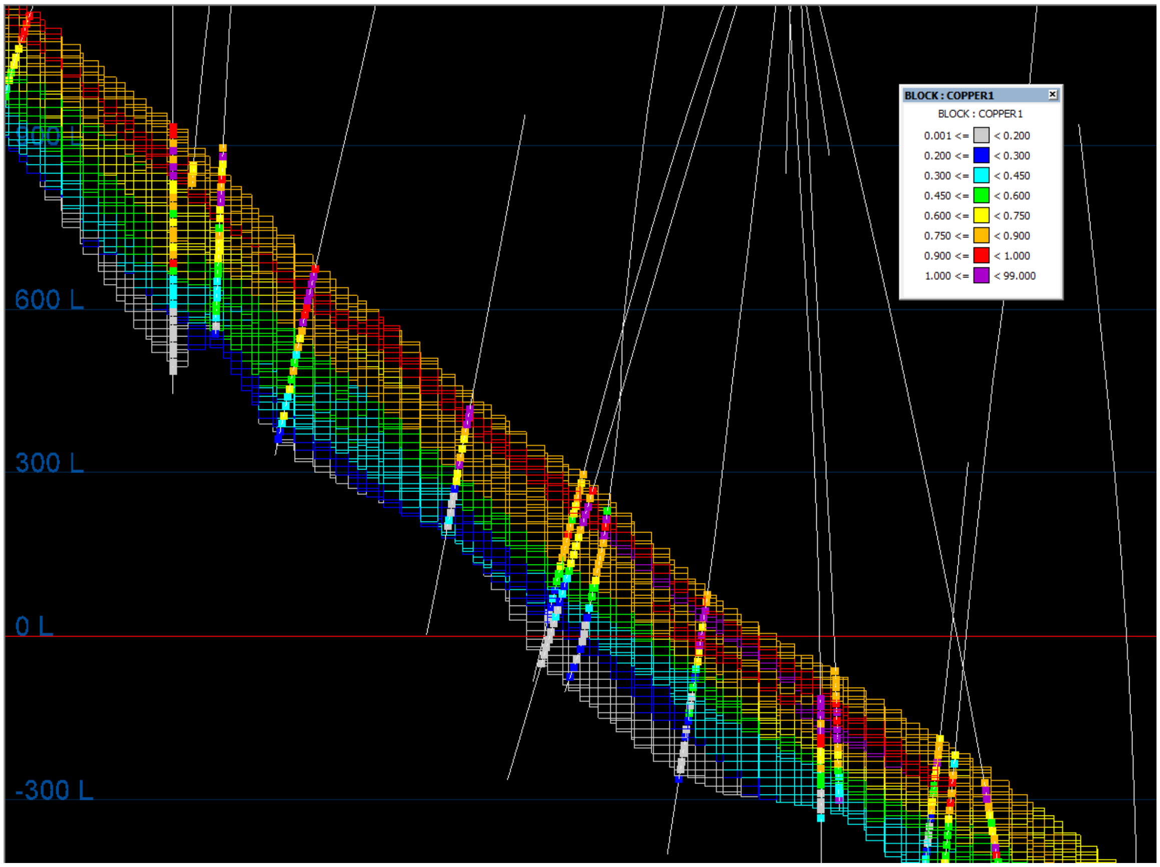
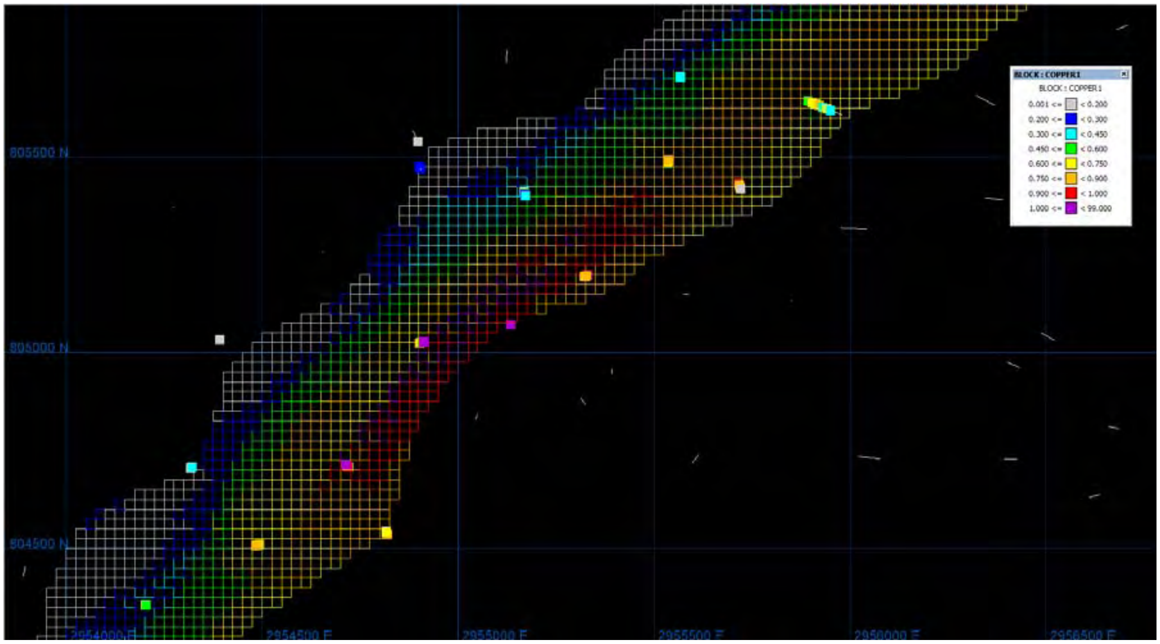


Figure 14-18:Copper Grades for Blocks and Composites – Section A-A' (Looking Northeast)-Detail View



Note: Composites are projected 250 ft each side of the section

Figure 14-19:Copper Grades For Blocks and Composites – Elevation -100 ft

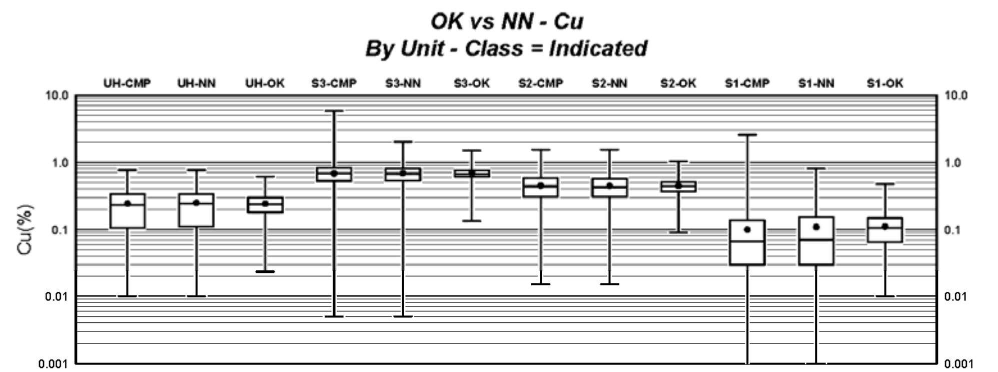


Note: Composites are projected 50 ft each side of the plan

Boxplots

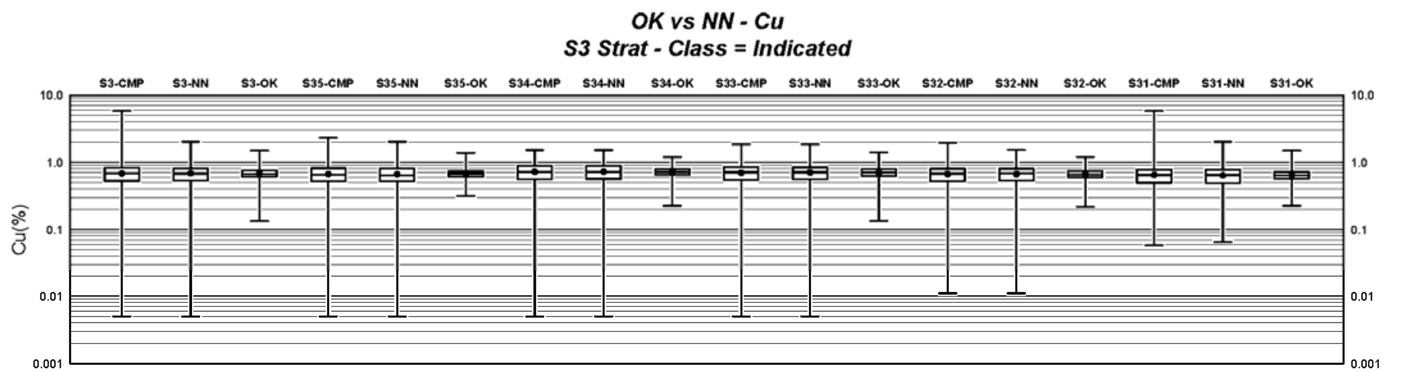
Boxplots were completed for each element comparing the 15 foot composites, nearest neighbor, and kriged estimates by unit and by stratigraphic group for each metal. Figures 14-20 through 14-22 are box plots for copper validation by unit, S3 stratigraphic level and S2 stratigraphic level. The boxplots generally show very good agreement of average grades of composites with NN and kriged estimates indicating that globally, the kriging process gives the same results as the NN (declustered) model.

Figure 14-20:Boxplots of Copper Grades by Unit



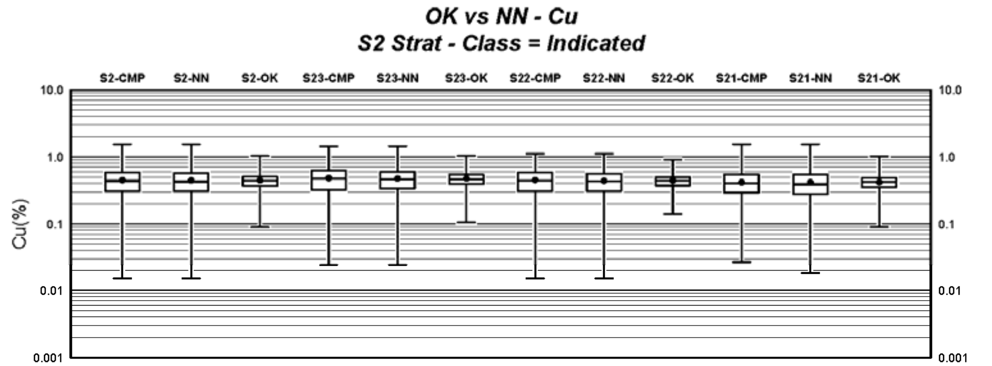
	UH-CMP	UH-NN	UH-OK	S3-CMP	S3-NN	S3-OK	S2-CMP	S2-NN	S2-OK	S1-CMP	S1-NN	S1-OK	
No. of data	339	110678	110678	3340	1265064	1265064	2655	769148	769148	912	170768	170768	No. of data
Mean	0.244	0.250	0.243	0.681	0.687	0.689	0.450	0.445	0.445	0.100	0.109	0.111	Mean
Maximum	0.761	0.761	0.612	5.800	2.000	1.487	1.544	1.544	1.034	2.576	0.800	0.475	Maximum
Quartile	0.336	0.334	0.300	0.823	0.809	0.746	0.585	0.569	0.504	0.137	0.154	0.148	Quartile
Median	0.231	0.244	0.237	0.680	0.677	0.675	0.438	0.427	0.442	0.067	0.071	0.106	Median
Quartile	0.107	0.111	0.180	0.525	0.532	0.608	0.305	0.307	0.370	0.030	0.030	0.065	Quartile
Minimum	0.010	0.010	0.023	0.005	0.005	0.133	0.015	0.015	0.090	0.000	0.001	0.010	Minimum
Variance	0.026	0.026	0.007	0.065	0.054	0.012	0.043	0.038	0.012	0.015	0.013	0.003	Variance
CV	0.658	0.644	0.348	0.375	0.339	0.158	0.458	0.439	0.250	1.233	1.033	0.530	CV
Skewness	0.672	0.601	0.209	2.847	0.316	0.101	0.469	0.507	0.385	8.085	2.165	0.767	Skewness

Figure 14-21:Boxplots of Copper Grades by Unit, by S3 Stratigraphic Level



No. of data	3340	1265064	1265064	671	250135	250135	655	251597	251597	672	253088	253088	653	254487	254487	680	255757	255757	No. of data
Mean	0.681	0.687	0.689	0.668	0.664	0.666	0.722	0.726	0.726	0.699	0.703	0.704	0.667	0.666	0.666	0.653	0.642	0.647	Mean
Maximum	5.800	2.000	1.487	2.312	2.000	1.380	1.517	1.517	1.190	1.843	1.843	1.389	1.946	1.525	1.201	5.800	2.000	1.487	Maximum
Quartile	0.823	0.809	0.746	0.813	0.803	0.726	0.880	0.882	0.793	0.851	0.835	0.784	0.797	0.796	0.730	0.776	0.769	0.715	Quartile
Median	0.680	0.677	0.675	0.659	0.644	0.665	0.713	0.718	0.721	0.710	0.708	0.698	0.679	0.686	0.660	0.647	0.648	0.645	Median
Quartile	0.525	0.532	0.608	0.516	0.518	0.606	0.557	0.565	0.653	0.542	0.557	0.623	0.522	0.532	0.598	0.490	0.488	0.572	Quartile
Minimum	0.005	0.005	0.133	0.005	0.005	0.316	0.005	0.005	0.225	0.005	0.005	0.133	0.011	0.011	0.218	0.058	0.066	0.224	Minimum
Variance	0.065	0.054	0.012	0.052	0.047	0.007	0.056	0.056	0.010	0.059	0.061	0.015	0.052	0.045	0.010	0.103	0.056	0.012	Variance
CV	0.375	0.339	0.158	0.342	0.327	0.129	0.327	0.325	0.140	0.348	0.350	0.173	0.341	0.319	0.148	0.492	0.367	0.166	CV
Skewness	2.847	0.316	0.101	0.740	0.826	0.126	0.128	0.128	0.212	-0.007	0.161	0.229	0.306	0.042	0.220	6.800	0.853	0.425	Skewness

Figure 14-22:Boxplots of Copper Grades by S2 Stratigraphic Level

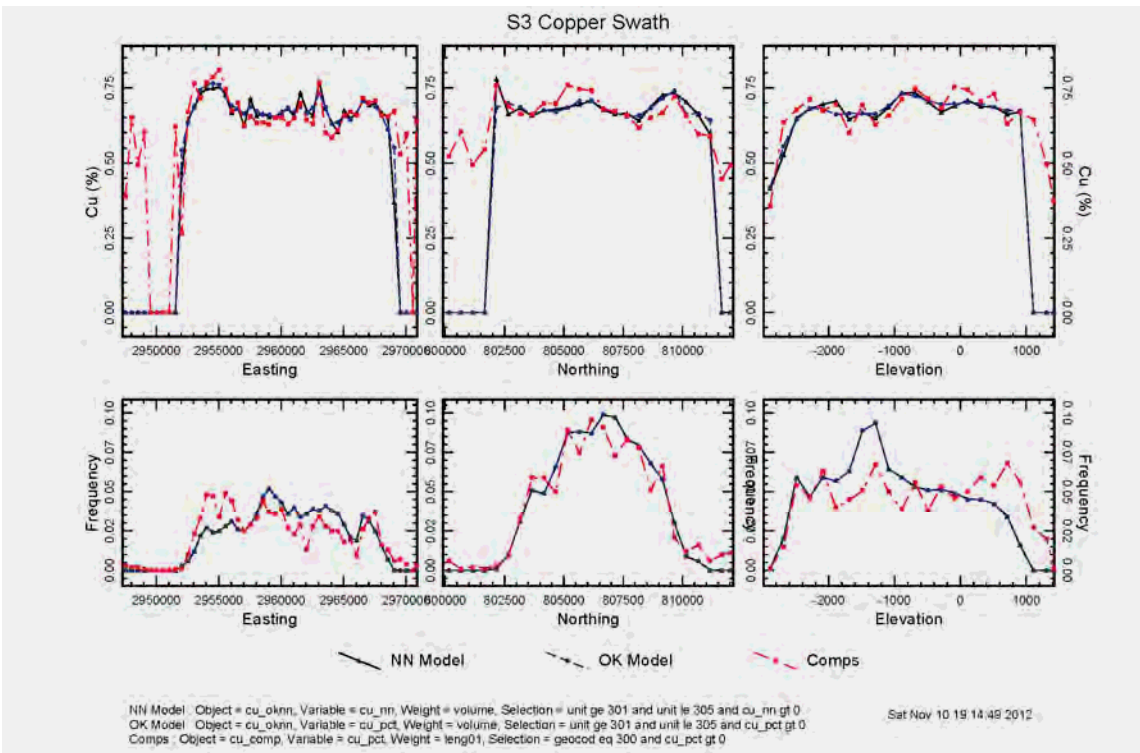


No. of data	2655	769148	769148	877	253807	253807	871	256581	256581	895	258760	258760	No. of data
Mean	0.450	0.445	0.445	0.482	0.475	0.474	0.452	0.440	0.441	0.419	0.417	0.419	Mean
Maximum	1.544	1.544	1.034	1.443	1.443	1.034	1.112	1.112	0.909	1.544	1.544	1.010	Maximum
Quartile	0.585	0.569	0.504	0.629	0.601	0.540	0.588	0.561	0.499	0.543	0.548	0.485	Quartile
Median	0.438	0.427	0.442	0.476	0.462	0.461	0.442	0.430	0.439	0.404	0.391	0.426	Median
Quartile	0.305	0.307	0.370	0.321	0.335	0.394	0.307	0.308	0.373	0.292	0.281	0.353	Quartile
Minimum	0.015	0.015	0.090	0.024	0.024	0.106	0.015	0.015	0.139	0.027	0.018	0.090	Minimum
Variance	0.043	0.038	0.012	0.051	0.043	0.016	0.039	0.033	0.010	0.035	0.037	0.010	Variance
CV	0.458	0.439	0.250	0.470	0.436	0.264	0.436	0.410	0.227	0.448	0.461	0.236	CV
Skewness	0.469	0.507	0.385	0.415	0.570	0.564	0.214	0.319	0.288	0.664	0.565	-0.231	Skewness

Swath Plots

Swath plots were constructed for a combination of units and stratigraphic levels within the S3 and S2. The swath plots compare the OK grade estimates to the NN grades and the grades of the 15 ft composites in swaths across the model. Swath intervals were 500 ft in the easterly and northerly directions and 100 ft in the vertical direction. Swaths generally show good agreement with the exception of areas where data become sparse. Swath plots for copper S3 are shown in Figure 14-23.

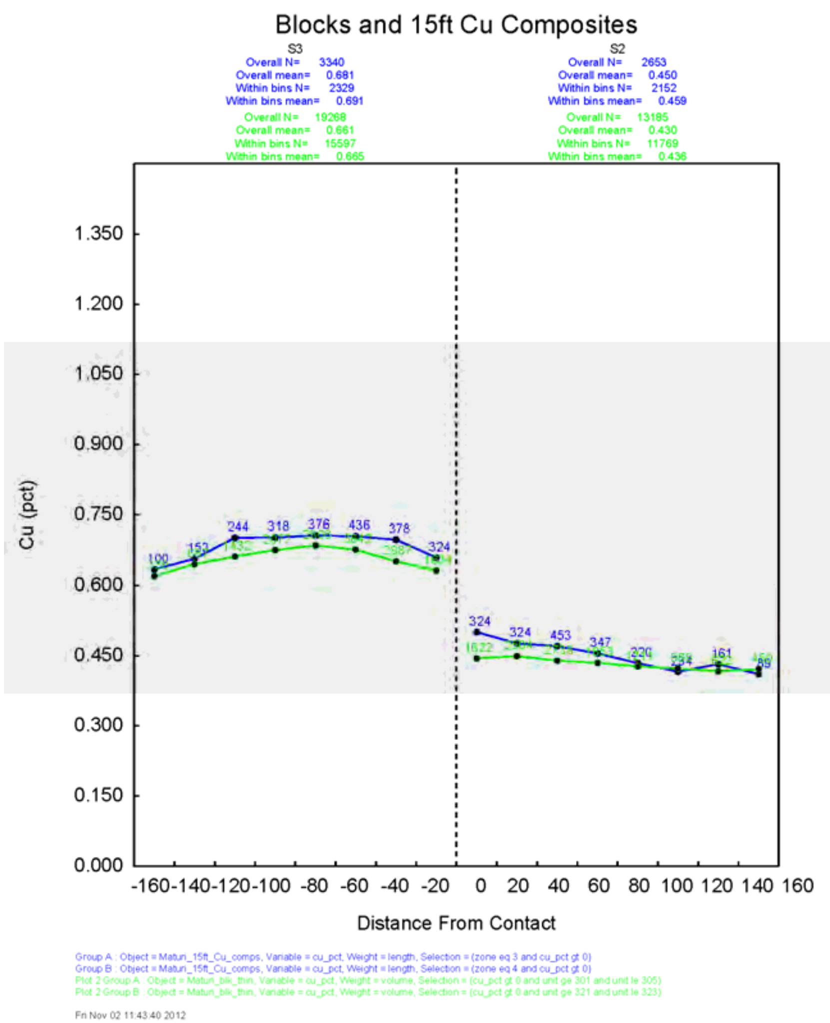
Figure 14-23:Copper Swath Plots – Unit S3



Block Contact Profiles

Contact profiles were constructed across the contacts between the various units and across the stratigraphic levels within the S3 and S2 units. These contact profiles compare the OK grade estimates and the grades of the 15 ft composites as they approach geologic contacts. Figure 14-24 shows the contact profile between the S3 and S2 units for Cu. The composites tend to be slightly higher grade than the block estimates near the contact, but this is not seen in the swath plots. Likely there was some clustering in the composites in higher grade areas; the block values are declustered.

Figure 14-24:Copper Contact Profiles – Blocks and Composites S3 – S2



14.2.11 NSR Calculation

A net smelter return (NSR) was calculated for each block using a Vulcan script. Criteria for the NSR calculation are summarized in Table 14-10. The metal prices used in the NSR calculation were mutually agreed upon by TMM, Antofagasta and AMEC on December 7, 2011 and have not changed for this estimate. The prices used are based on industry-consensus surveys of long-term metal prices used for cash flows and reserves with an approximate 15% uplift for evaluation of reasonable prospects for extraction of the resources in the foreseeable future. In general the prices used for copper, nickel, and gold are less than the past three-year moving average prices. Prices for palladium and platinum are somewhat higher than the three-year moving average prices.

Table 14-10: Maturi NSR Parameters

Metal	Price (US$)	Recovery Concentrate	Recovery CESL	Recovery Global	Payable	Refining Charge
Copper	$3.00/lb	94.3%	96.3%	90.8%	100.0%	
Nickel	$9.38/lb	72.0%	95.6%	68.8%	80.0%	
Gold	$1050/troy oz	85.0%	74.5%	63.3%	80.0%	
Palladium	$805/troy oz	90.0%	70.7%	63.6%	80.0%	
Platinum	$1840/troy oz	93.0%	59.4%	55.2%	80.0%	

AMEC reviewed the calculations used to assign a value to mining blocks and found the calculations to be done properly with reasonable assumptions (AMEC, 2012a).

14.2.12 Reasonable Prospects for Economic Extraction

During 2012, TMM evaluated a number of conceptual mining scenarios using the 2007 SWRPA PEA and recent process testwork as a basis for a conceptual analysis of likely mining and processing options and costs (Berenguela, 2013). These studies indicated that a number of throughput rates could be economically attractive, ranging from 40 kptd to 80 kptd, and that a hydrometallurgical process is viable. Based on these scenarios and the latest metallurgical testwork, TMM evaluated various NSR and cutoff grade calculations to determine a likely break-even NSR cutoff. This work clearly shows that the project has reasonable prospects for economic extraction and was the basis for the NSR parameters presented in Section 14.2.11. Assuming a mining cost of $16/t, a process cost of $12/t and general and administrative (G&A) charges of $2/t, the breakeven NSR required is $30/t. This indicates a breakeven NSR of approximately $30 per ton. Resources meeting an NSR cutoff of $30/t approximately equate to a copper cutoff of 0.3%. Therefore, AMEC has used the same cut-off grade of 0.3% Cu for all three deposits when determining which portions of the classified material meet reasonable prospects of economic extraction. A 0.2% Cu cut-off grade will meet reasonable prospects of economic extraction when spot metal prices are considered. Above a global 0.6% Cu cutoff, the mineralization outside the higher-grade units can break up into discontinuous bodies that may not support the mining method assumptions used to assess reasonable prospects of economic extraction.

AMEC believes that, based on the Berenguela (2013) work, that all three deposits on the project have reasonable prospects for economic extraction and that similar cutoff parameters apply to all three deposits. AMEC concludes that the deposits have reasonable prospects for economic extraction based on the assumptions detailed in this report; however, continuing work on the deposits may not confirm that all or part of the deposits are actually economic.

14.2.13 Resource Classification

The Maturi mineral resource is a combination of Indicated and Inferred Mineral Resources. The Indicated Resource boundary generally extends 250 feet from well drilled areas showing continuity in NSR values and geological geometry. The Inferred Resource boundary typically extends 500 feet from well drilled areas showing continuity in NSR values and geological geometry. The drill hole spacing averages 500 foot (excluding wedges). The GN and GM units were entirely classified as Inferred.

Areas defined primarily by legacy drilling are not included in the Indicated Resource outline, and were downgraded to an Inferred Resource Classification. This downgrade was due to uncertainty in collar location, downhole location, lack of QA-QC to support assays, and the use of regressed data for Pt, Pd, Au, and the minor elements. To identify regions where the estimates were largely influenced by legacy drilling, AMEC created an indicator model using legacy composites flagged as 1 and MEX (current) composites flagged as 0. These indicators were kriged into blocks, and blocks with an estimated indicator of over 0.50 were used to refine the Inferred Classification outline. A plan view is shown in Figure 14-25, and an example section (location shown in Figure 14-18) restricted to S3 blocks is shown in Figure 14-26. The classification outlines are shown in Figure 14-27. Drill hole collars used in the resource estimation are shown for reference.

A final refinement was made to the classification. Material above 1000 foot elevation was removed from classification and represents an estimate by AMEC of the amount of material required for a safety zone that separates the contemplated underground mine workings from significant ground and surface water. This material will be left in place, thus cannot be included in the resource estimate as it would not be mined.

AMEC notes that the elevation and thickness is on experience with other deposits and the final safety zone definition will require engineering design studies which are in progress.

Figure 14-25:Plan View of Classification Indicator Model

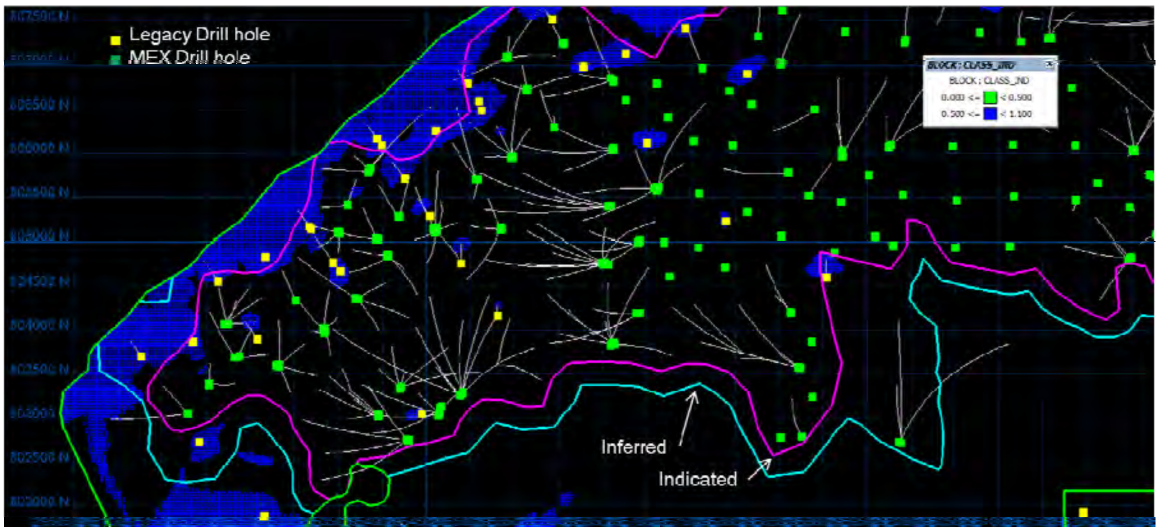


Figure 14-26:Section A-A' showing S3 Blocks in Blue Where Indicator Model had Values over 50%

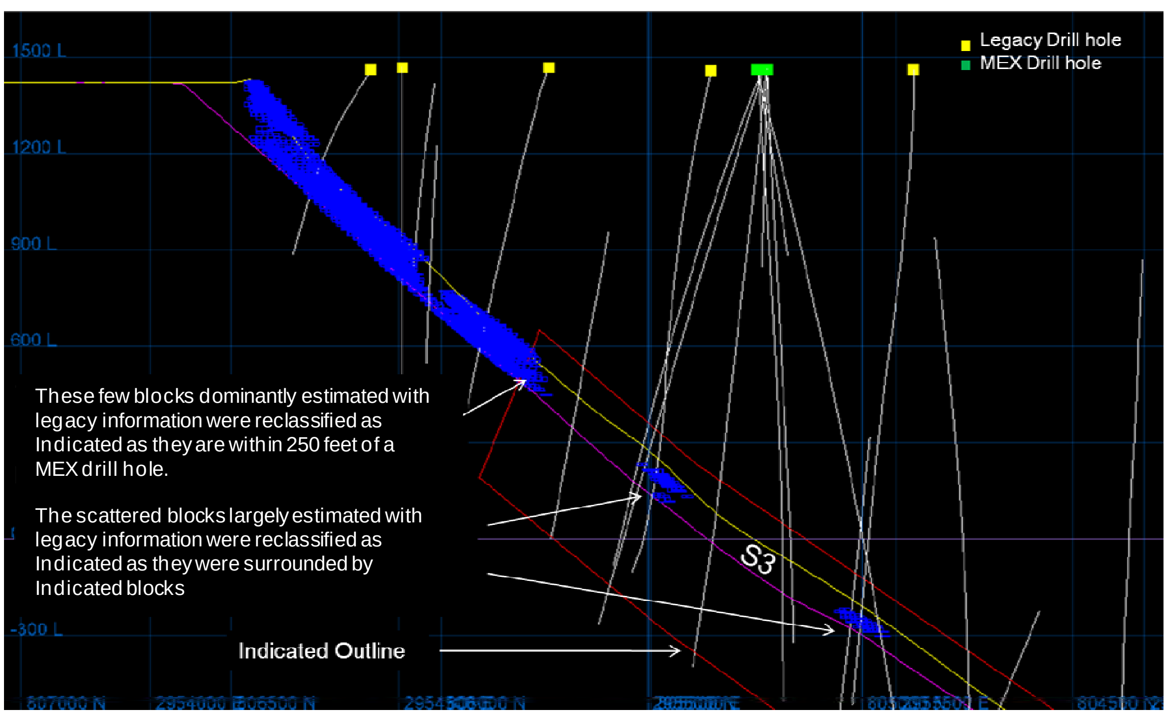
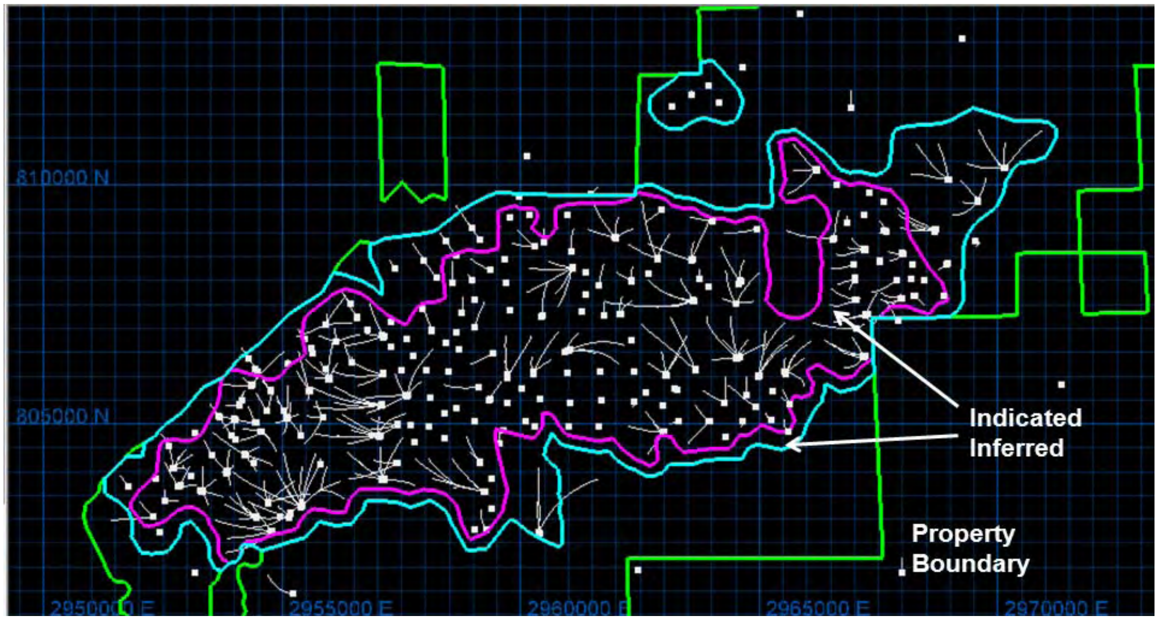


Figure 14-27:Maturi Resource Classification



14.2.14 Resource Tabulation

The Maturi Indicated and Inferred Mineral Resources are tabulated using cumulative copper cutoff grades. Tables 14-11 and 14-12 tabulate the Indicated and Inferred Mineral Resources for the BMZ and GRB Units by cumulative copper cutoffs. The base case for 0.30% copper is gray-shaded; the remaining cases are sensitivity cases to show the sensitivity of the Mineral Resource estimates to changes in cut-off grade. The Indicated and Inferred Resources are stated in Million Short Tons, (Mt).

Table 14-13 and Table 14-14 tabulate Maturi S3 Indicated and Inferred Mineral Resources by cumulative copper cutoffs. Table 14-15 and Table 14-16 tabulate Maturi S2 Indicated and Inferred Mineral Resources by cumulative copper cutoffs. For all tables, the base case for 0.30% copper is gray-shaded; the remaining cases are sensitivity cases to show the sensitivity of the Mineral Resource estimates to changes in cut-off grade. The individual units are reported separately because S3 is more continuous and higher grade than S2 and will likely be where mining starts.

Table 14-11: Maturi Indicated Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	1,137	0.57	0.18	0.151	0.343	0.081	0.004	0.010	0.002
0.3	1,065	0.59	0.19	0.157	0.356	0.085	0.005	0.010	0.002
0.4	936	0.63	0.20	0.167	0.379	0.090	0.005	0.011	0.003
0.5	739	0.67	0.21	0.185	0.419	0.099	0.005	0.012	0.003
0.6	538	0.72	0.23	0.200	0.454	0.107	0.006	0.013	0.003

Notes:
Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons.

Table 14-12: Maturi Inferred Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	782	0.43	0.14	0.118	0.266	0.060	0.003	0.008	0.002
0.3	542	0.51	0.17	0.140	0.320	0.072	0.004	0.009	0.002
0.4	383	0.57	0.19	0.164	0.375	0.083	0.005	0.011	0.002
0.5	256	0.63	0.20	0.197	0.443	0.098	0.006	0.013	0.003
0.6	141	0.70	0.22	0.237	0.531	0.116	0.007	0.015	0.003

Notes
Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 14-13: Maturi S3 Indicated Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	643	0.68	0.22	0.198	0.449	0.105	0.006	0.013	0.003
0.3	643	0.68	0.22	0.198	0.449	0.105	0.006	0.013	0.003
0.4	641	0.68	0.22	0.198	0.449	0.105	0.006	0.013	0.003
0.5	622	0.69	0.22	0.199	0.451	0.106	0.006	0.013	0.003
0.6	500	0.72	0.23	0.206	0.468	0.109	0.006	0.014	0.003

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 14-14: Maturi S3 Inferred Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	234	0.62	0.20	0.206	0.464	0.100	0.006	0.014	0.003
0.3	232	0.62	0.20	0.208	0.466	0.101	0.006	0.014	0.003
0.4	225	0.63	0.20	0.210	0.472	0.102	0.006	0.014	0.003
0.5	198	0.65	0.21	0.222	0.495	0.107	0.006	0.014	0.003
0.6	129	0.70	0.22	0.248	0.554	0.120	0.007	0.016	0.004

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 14-15 Maturi S2 Indicated Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	440	0.45	0.14	0.092	0.210	0.053	0.003	0.006	0.002
0.3	405	0.46	0.15	0.094	0.215	0.054	0.003	0.006	0.002
0.4	292	0.50	0.16	0.100	0.228	0.058	0.003	0.007	0.002
0.5	117	0.58	0.18	0.111	0.253	0.065	0.003	0.007	0.002
0.6	38	0.67	0.20	0.119	0.276	0.071	0.003	0.008	0.002

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

Table 14-16: Maturi S2 Inferred Mineral Resources by Copper Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (pct)	Ni (pct)	Pt (ppm)	Pd (ppm)	Au (ppm)	Pt (oz/t)	Pd (oz/t)	Au (oz/t)
0.2	240	0.41	0.14	0.084	0.200	0.049	0.002	0.006	0.001
0.3	199	0.44	0.15	0.087	0.210	0.052	0.003	0.006	0.002
0.4	127	0.49	0.16	0.095	0.228	0.057	0.003	0.007	0.002
0.5	50	0.56	0.18	0.105	0.252	0.064	0.003	0.007	0.002
0.6	11	0.64	0.20	0.115	0.277	0.070	0.003	0.008	0.002

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

14.2.15 Exploration Targets

Canadian disclosure standards under NI 43-101 allow the estimated quantities of an Exploration Target to be disclosed as a range of tonnages and grade. AMEC cautions that the potential quantity and grade are conceptual in nature, and that there has been insufficient exploration to define the Exploration Targets as a Mineral Resource. It is uncertain if additional exploration will result in the target(s) being delineated as a Mineral Resource.

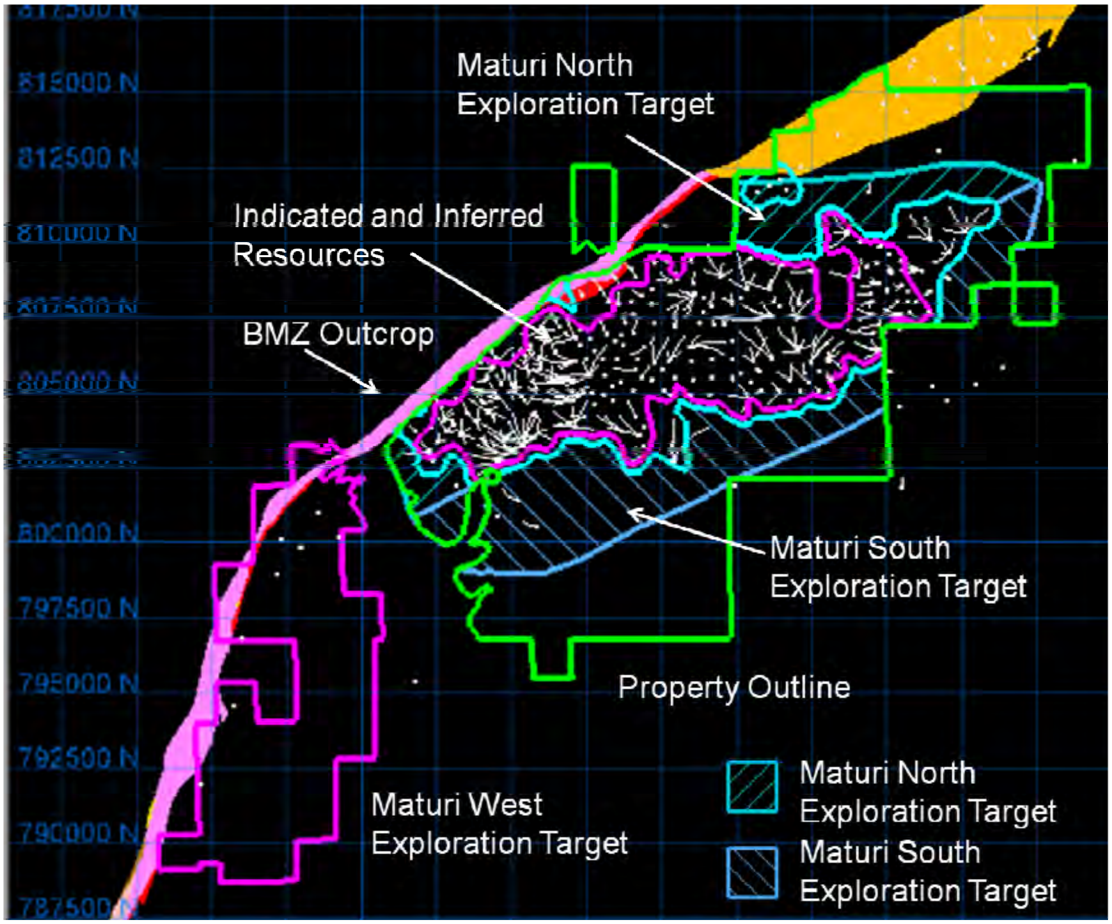
The area inside the Maturi model perimeter surrounding the Indicated and Inferred Mineral Resources was divided into two exploration targets, Maturi North and Maturi South (Figure 14-28). For the Maturi North and South targets the target grade ranges and tonnage ranges were based on estimated blocks within the model that were not classified as either Indicated or Inferred. Exploration Target grade and tonnage ranges for Maturi North and Maturi South were determined by applying 0.8 and 1.2 factors to the estimated base case grades and tonnage of unclassified blocks within the modeled area. An additional exploration target, Maturi West, lies outside and to the west of the current model area. Ranges for Maturi West were determined using variance of the grades and thickness of the BMZ intercepts obtained from the available drill holes in this area. Exploration Target tons have not been adjusted to reflect TMM's current mineral interest.

Tonnage and grades of the Maturi North exploration target could range from 290 to 435 Mt grading 0.41 to 0.61 %Cu, 0.14 to 0.21 %Ni, 0.10 to 0.14 ppm Pt, 0.24 to 0.34 ppm Pd and 0.06 to 0.08 ppm Au.

Tonnage and grades of the Maturi South exploration target could range from 330 to 500 Mt grading 0.42 to 0.62 %Cu, 0.13 to 0.19 %Ni, 0.14 to 0.21 ppm Pt, 0.31 to 0.45 ppm Pd and 0.07 to 0.10 ppm Au.

Tonnage and grades of the Maturi West exploration target could range from 600 to 980 Mt grading 0.41 to 0.52 %Cu, 0.15 to 0.18 %Ni, 0.10 to 0.14 ppm Pt, 0.27 to 0.31 ppm Pd and 0.06 to 0.08 ppm Au. Ranges of PGE values stated for Maturi West are based on regression formulae as discussed in Section 14.2.2.

Figure 14-28:Maturi Exploration Targets



14.3 Birch Lake Resources

14.3.1 Introduction

The Birch Lake deposit resource model update was completed with 115 drill holes (288,781.5 ft; excluding wedges) that were drilled between the 1970s and 2012. A database audit was completed in July 2011 (Wakefield, 2011) and in June 2012 (Wakefield, 2012). QA-QC data were reviewed in the fall of 2011 (Wakefield, 2012) and in 2012 by Scott Long and Ted Eggleston. AMEC completed field checks of drill hole collars, reviewed the deviation surveys in September 2011. The 2012 checks are summarized in this report and the 2011 results are summarized in AMEC (2012).

The 2012 resource model was completed using Vulcan™ software and ordinary kriging (OK) interpolation. Model validation consisted of visual inspection, box plots, and swath plots.

14.3.2 Birch Lake Database Adjustments

Un-sampled Intervals

Early campaigns in the Birch Lake area did not sample the full extent of the BMZ. In 2011, AMEC recommended that, where possible, those non-sampled intervals be recovered and properly sampled. In 2012, TMM recovered 733 samples in previously non-sampled intervals and had those samples analyzed at ALS Chemex.

Remaining missing values were assigned lower detection limit values.

Regressions for Missing Data (Assays)

All drill holes in the Birch Lake drill hole database include Cu and Ni analyses. Analyses for platinum, palladium, gold, silver, cobalt, chromium, magnesium and sulfur were completed for some drill campaigns and are missing in other campaigns. AMEC developed regression formulas for BL_MT, BL_T, BL_HX and GRB_M in Excel™ based on copper and nickel. Copper regressions were chosen to estimate missing analysis for Au, Pt, Pd, Ag, Co and sulfur. Nickel regressions were chosen to estimate the missing analysis for Cr and Mg. Where an insufficient correlation was observed, the element was not regressed, and the grade was estimated using the available data.

Regression plots for Au, Pt, Pd and Ag are presented in Figure 14-29. A Vulcan™ *fcl* script (*set_smp_regressions.fcl*) was used to apply the regression formulas to the Vulcan Isis™ drill hole database. Regression values that resulted in negative values were given the detection value for the element (Table 11-5). The regression formulae are provided in Table 14-17.

AMEC validated the regression formulae using the samples intervals with analytical results. The differences (residuals) between the actual and the regressed values were calculated. The residuals were also inspected in Vulcan™ to ensure local anomalies do not exist, and histograms and scatter plots of the residuals were also constructed. Figure 14-30 shows the scatter plot and histogram of the residuals for the BL_Mt Pt regression.

Figure 14-29:Regressions Based on Copper Grades (data points shown in blue were not used to fit regression lines)

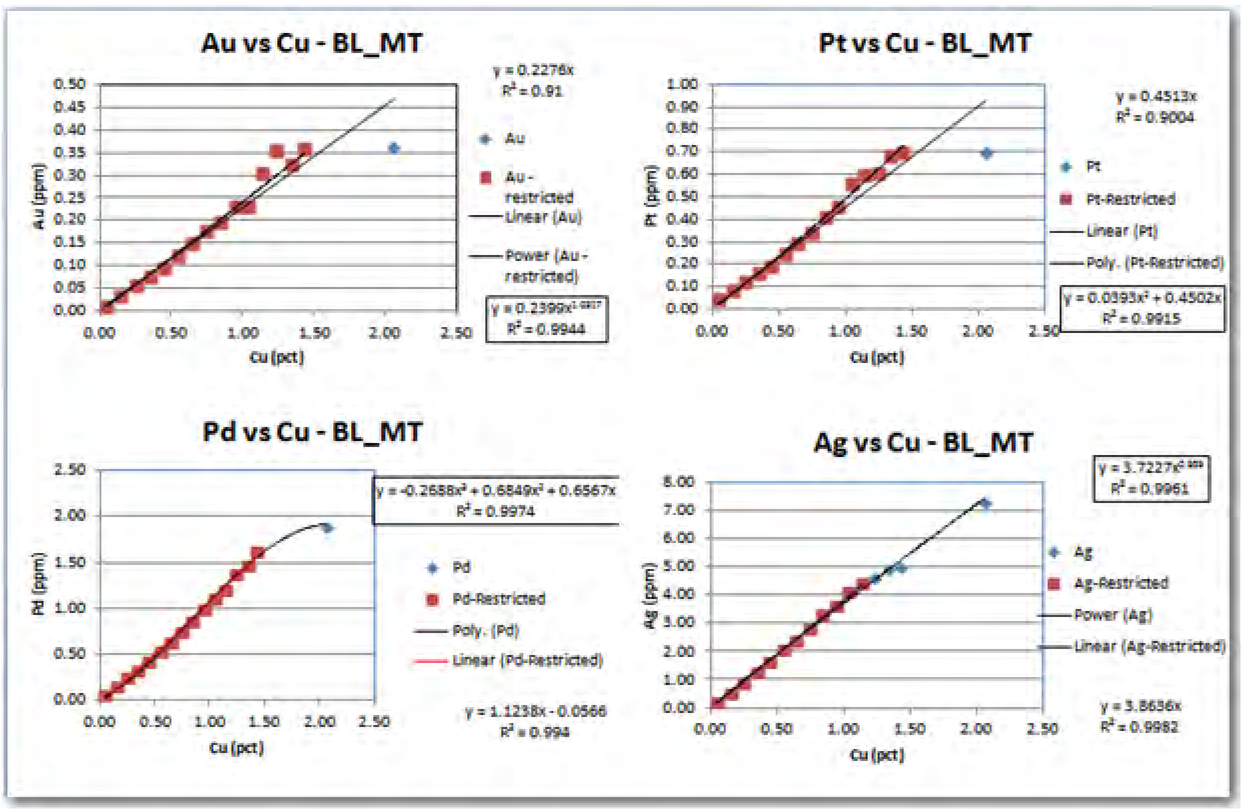
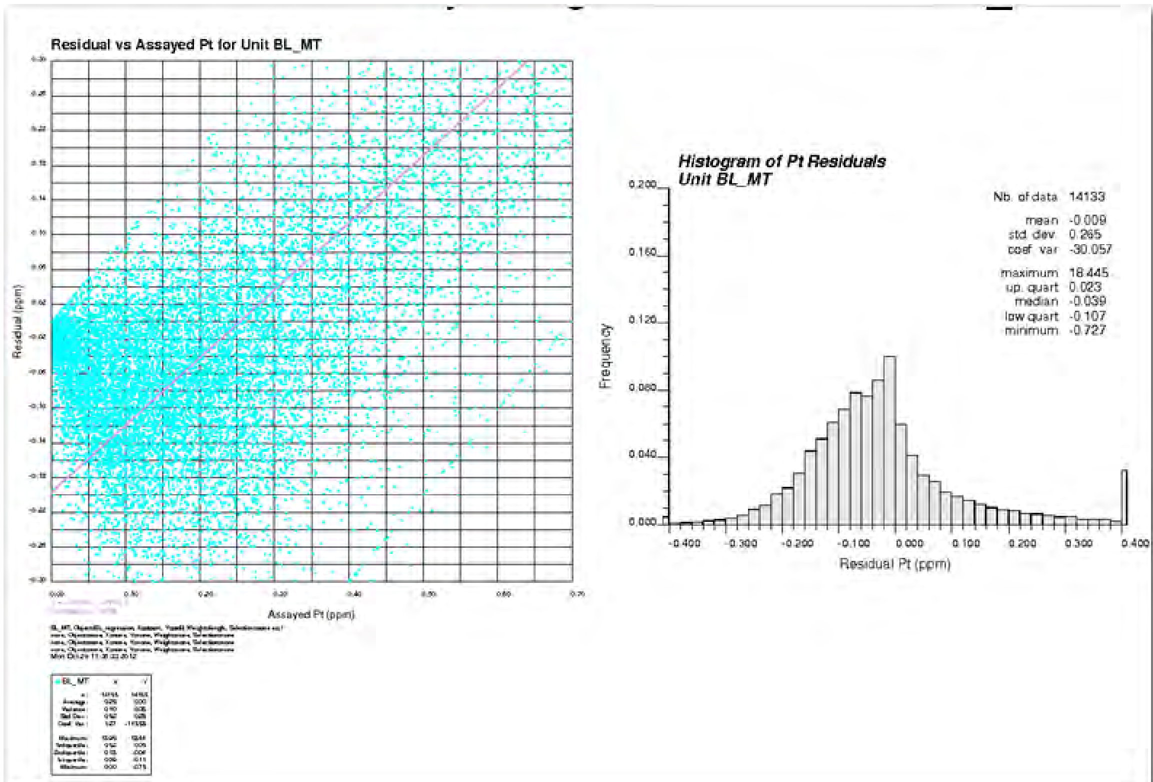


Table 14-17: Birch Lake Regression Equations

Element	Unit	Regression Equations
Au	BL_MT	If Cu >2.06%, then Au = 0.36ppm; Else Au = $0.2399Cu^{1.0317}$
	BL_T	If Cu >2.06%, then Au = 0.14ppm; Else Au = $-0.168Cu^3 + 0.2599Cu^2 + 0.0969Cu$
	BL_HX	If Cu >1.13%, then Au = 0.15ppm; Else Au = 0.1327Cu
	GRB_M	If Cu >1.18%, then Au = 0.14ppm; Else Au = 0.1188Cu
Pd	BL_MT	If Cu >2.06%, then Pd = 1.9ppm; Else Pd = $-0.2688Cu^3 + 0.6849Cu^2 + 0.6567Cu$
	BL_T	If Cu >1.14%, then Pd = 0.88ppm; Else Pd = $-0.291Cu^3 + 0.5382Cu^2 + 0.5636Cu$
	BL_HX	If Cu >1.5%, then Pd = 0.86ppm; Else Pd = 0.5873Cu
	GRB_M	If Cu >1.4%, then Pd = 0.85ppm; Else Pd = 0.5949Cu
Pt	BL_MT	If Cu >1.5%, then Pt = 0.7ppm; Else Pt = $0.0393Cu^2 + 0.4502Cu$
	BL_T	If Cu >1.1%, then Pt = 0.39ppm; Else Pt = $-0.1803Cu^3 + 0.3506Cu^2 + 0.1971Cu$
	BL_HX	If Cu >1.1%, then Pt = 0.32ppm; Else Pt = 0.2887Cu
	GRB_M	If Cu >1.31%, then Pt = 0.31ppm; Else Pt = 0.2378Cu
Ag	BL_MT	Ag = $3.7227Cu^{0.959}$
	BL_T	If Cu >2.06%, then Ag = 6.5ppm; Else Ag = $-0.3532Cu^2 + 3.8441Cu$
	BL_HX	If Cu >1.0%, then Ag = 2.8ppm; Else Ag = $-0.8275Cu^3 - 0.2506Cu^2 + 3.8413Cu$
	GRB_M	If Cu >1.0%, then Ag = 2.8ppm; Else Ag = $-1.3007Cu^2 + 3.8107Cu$
Co	BL_MT	If Ni >0.44%, then Co = 156ppm; Else Co = $4486.4Ni^3 - 3914.9Ni^2 + 1209.2Ni$
	BL_T	If Ni >0.6%, then Co = 220ppm; Else Co = 298Ni + 41.397
	BL_HX	If Ni >1.16%, then Co = 564ppm; Else Co = $-78.124Ni^3 + 120.87Ni^2 + 453.31Ni$
	GRB_M	If Ni >1.16%, then Co = 585ppm; Else Co = $-369.96Ni^3 + 606.76Ni^2 + 289.04Ni + 11.878$
Cr	BL_MT	If Ni >0.5%, then Cr = 154ppm; Else Cr = $8856.1Ni^3 - 11574Ni^2 + 3844.2Ni$
	BL_T	Insufficient correlation
	BL_HX	Insufficient correlation
	GRB_M	Insufficient correlation
Mg	BL_MT	If Ni >0.4%, then Mg = 6.4%; Else Mg = $-139.78Ni^3 + 26.31Ni^2 + 19.016Ni + 3.5577$
	BL_T	Insufficient correlation
	BL_HX	Insufficient correlation
	GRB_M	If Cu >1.2%, then Mg = 0.56%; Else Mg = $0.3515Cu^3 - 0.9041Cu^2 + 0.0239Cu + 1.2043$
S	BL_MT	If Cu >2.06%, then S = 2.67%; Else S = $0.0837Cu^3 - 0.3811Cu^2 + 1.7338Cu$
	BL_T	S = 7.3199Ni
	BL_HX	If Ni >1.16%, then S = 6.73%; Else S = $-0.6226Ni^3 - 3.1148Ni^2 + 10.259Ni$
	GRB_M	If Ni >1.16%, then S = 7.6%; Else S = $-1.4974Ni^3 - 1.7905Ni^2 + 10.654Ni$

Figure 14-30:Scatter Plot and Histogram of Regression Residuals



Wedge Group Holes

The Birch Lake drill hole database includes numerous wedge holes that were drilled for the purpose of confirming grades and collecting material for metallurgical testing. The nominal drill spacing at Birch Lake is 500 ft. Generally the wedge holes have a separation distance from the pilot hole of <10 ft. To reduce the effects of clustering, AMEC combined the wedge holes that were within 25 ft of the pilot holes (in the BMZ) into a single virtual hole.

The procedure for constructing the wedge group holes is:

1. Construct 5 ft composites for each pilot and wedge hole.

2. Calculate the length-weighted average for each 5 ft composite for the elements (Cu, Ni, Pt, Pd, Au, Ag, Co, Cr, Mg, S, P, Te, Sr, Fe, Ba, K)

3. Calculate the average mid-point for each 5-foot composite

4. Calculate a down-hole survey for each WG hole using the mid-points.

5. Remove significant kinks from each WG down-hole survey which occur as the number of holes increase (at the wedge points) and decrease at the end of hole.

6. The averaged data for each 5 ft interval were then provided to AMEC and a TMM geologist to determine unit picks of the WG holes based on the averaged analytical data.

7. Import the WG assay data, calculated surveys and WG Unit picks into the BL drill hole database.

8. A Vulcan selection file was used to select the appropriate data from the database for compositing.

Discussion of Wedge Group Holes

Due to survey issues observed in the wedge drill holes in 2011, only the pilot drill holes were used for grade estimation in the 2011 resource model. To investigate the grade changes when the pilot holes and wedge holes were averaged into the Wedge Group hole (WG Hole), AMEC compared the mean grades of the WG holes to the Pilot drill holes for each element to be estimated in the 2012 resource model. These mean grades are summarized in Table 14-18. For the BL_MT unit, the mean grades of the WG holes and the pilot holes are within 2%. For the BL_T, BL_HX and GRB_M units, the mean grades are within 5%.

AMEC also compared the drill intersection between the pilot holes and the WG holes. The average drill intersections for the primary units (BL_MT, BL_T, BL_HX and GRB_M) are summarized in Table 14-19. The average thickness of the BL_MT increased approximately 10% over the pilot holes.

Table 14-18: Summary Grade Statistics of WG holes and Pilot Holes

UNIT	Pilot	BL_MT	BL_T	BL_HX	GRB_M
Cu(%)	Pilot	0.498	0.169	0.226	0.269
	WG	0.495	0.175	0.221	0.276
Ni(%)	Pilot	0.158	0.061	0.097	0.115
	WG	0.157	0.062	0.094	0.114
Pt(ppm)	Pilot	0.233	0.055	0.055	0.070
	WG	0.236	0.052	0.055	0.068
Pd(ppm)	Pilot	0.496	0.121	0.126	0.169
	WG	0.500	0.119	0.123	0.156
Au(ppm)	Pilot	0.116	0.027	0.028	0.035
	WG	0.115	0.027	0.027	0.033
Ag(ppm)	Pilot	1.905	0.640	0.774	0.823
	WG	1.870	0.662	0.756	0.815
Co(ppm)	Pilot	101	68	59	60
	WG	100	69	58	59
Cr(ppm)	Pilot	304	181	76	69
	WG	305	182	81	62
Mg(%)	Pilot	6.452	4.252	2.005	1.122
	WG	6.445	4.264	2.082	1.249
S(%)	Pilot	0.743	0.413	0.956	1.108
	WG	0.739	0.425	0.885	1.112

Table 14-19: Summary Thickness Statistics of WG holes and Pilot Holes

Pilot	BL_MT (ft)	BL_T (ft)	BL_HX (ft)	GRB_M (ft)
Pilot	135.0	109.9	60.3	31.9
WG	141.9	100.9	60.6	28.8

Birch Lake Unit Codes

In addition to the data provided in the master database, TMM provided AMEC with unit picks for the Main_AGT, BL_MT, BL_T, BL_HX, GRB_M and GRB_B (*BL Geological Units.xls*). This file included HoleID, From and To drill depths and the Unit Picks (Main_AGT, BL_MT, BL_T, BL_HX, Dikes, GRB_M and GRB_B). The Unit code data were imported into Vulcan™. Table 14-20 summarizes the Unit Coding for drill hole data, composite codes and the resource model block codes. Note the BL picks do not include PEG unit for 2012.

BL_MT was subdivided into five equal-length "Strat" horizons and BL_T was divided into three equal-length Strat horizons to help control vertical estimation of grades which exhibit vertical gradients.

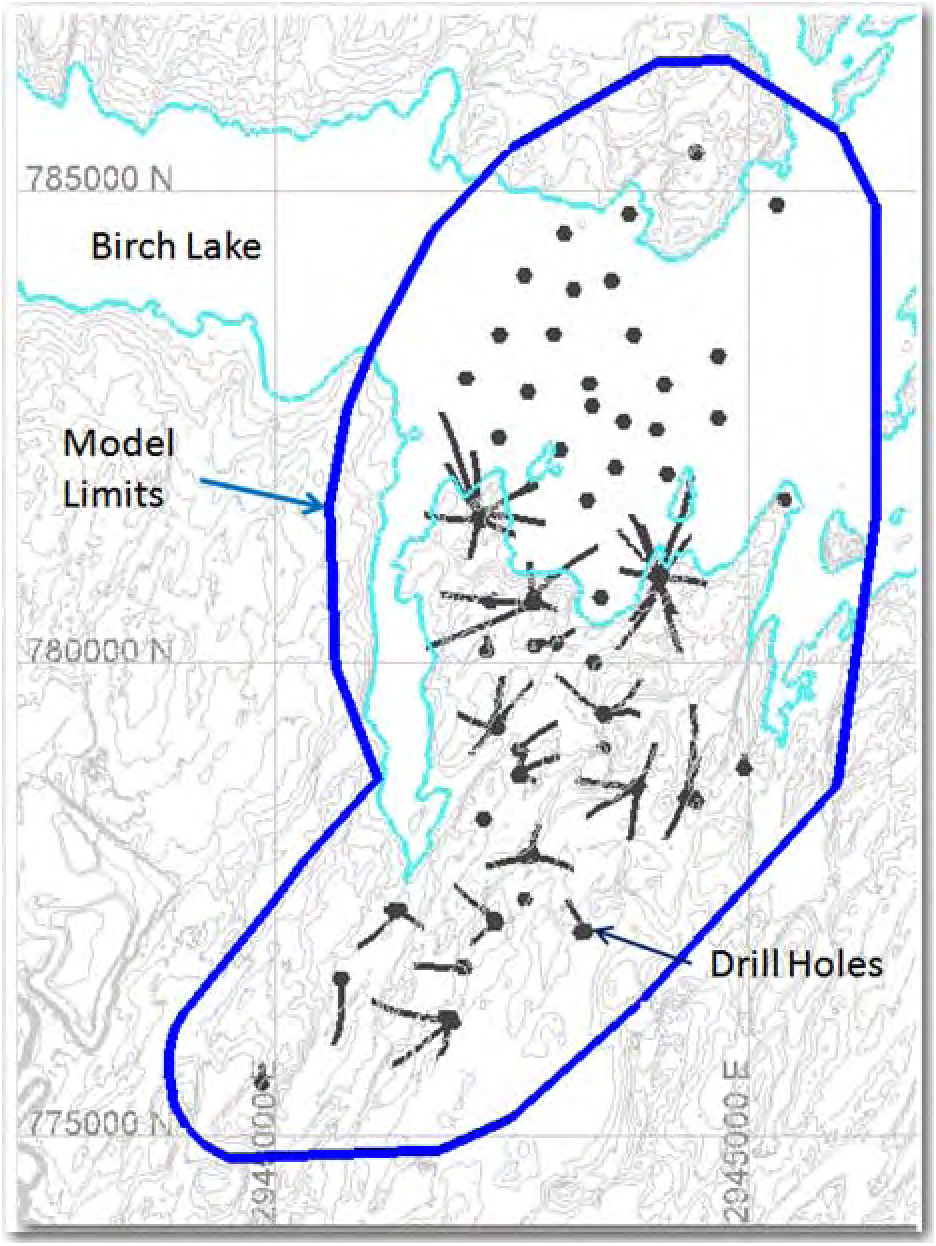
Table 14-20:Lithology Codes for Assays, Composites, Block Model

Rock Type	Assays	Assay Code	Composites Code	Model Code
Main AGT	AGT	100	100	100
			305 (top)	305 (top)
			304	304
MT	MT	300	303	303
			302	302
			301 (bot)	301 (bot)
			405 (top)	405 (top)
			404	404
T	T	400	403	403
			402	402
			401 (bot)	401 (bot)
HX	HX	500	500	500
GRB_M	GRBM	600	600	600
GRB_B	GRBB	700	700	700
Dikes	DI	800	800	800

The Unit intervals picks are based on total chemistry and the methodology is discussed in Section 7.6.2.

The Birch Lake Deposit area defined for the 2012 resource model update is presented in Figure 14-31. The extent of the block model was determined by extending nominally 1,000 ft beyond the drill hole data.

Figure 14-31:Birch Lake Deposit Model Areas



Domains

Domains were identified to control variography; these domains are discussed in section 14.3.5.

14.3.3 Geological Model

The Birch Lake geological model was defined using seven unit codes, Main_AGT, BL_MT, BL_T, BL_HX, GRB_M, GRB_B and dikes.

Gridded surfaces models (25 m x 25 m) were created for the Top of BL_MT, Top of BL_T Top of BL_HX, Top of GRB_M and Top of GRB_B. Wireframes were constructed for dikes in the southern part of the Birch Lake model area. Surfaces were constructed using the Vulcan grid-modeling functions.

Eight faults were also interpreted at the Birch Lake area. The traces of the faults are shown in Figure 7-8. Generally the faults are considered to show consistent displacement through the magmatic units and extend into the GRB. However, locally it was interpreted the fault displacement could differ between the magmatic units. The fault displacement was accommodated within the Vulcan GridCalc™ methodology by tagging fault displacement values at nodes along the fault trace.

To address apparent stratigraphic control of mineralization in the BL_MT and BL_T magmatic units, each unit was divided into five stratigraphic horizons.

The grid modeling functions were captured in a Vulcan GridCalc™ Macro (*Build01_BL_Surfaces.gdc_cmnd*). The grid surfaces were converted to surface triangulations using spot elevations from the drill holes. These triangulations were used to back tag composites and for the construction of the block model.

14.3.4 Composites

The Birch Lake assay data were composited to 15 ft equal length composites. The final composite in each drill hole was stitched into the previous composite if its length was < 7.5 ft.

The composites were coded with the majority code from the lithology table and were also coded from the geological surfaces and wireframes (AGT, BL_MT, BL_T, BL_HX, GRB_M, GRB_B and dikes). The composite breakdown by geological unit is summarized in Table 14-21.

Table 14-21:Number of 15 ft Composites by Unit

Pilot	BL_MT	BL_T	BL_HX	GRB_M
	2788	850	614	305

14.3.5 Exploratory Data Analysis

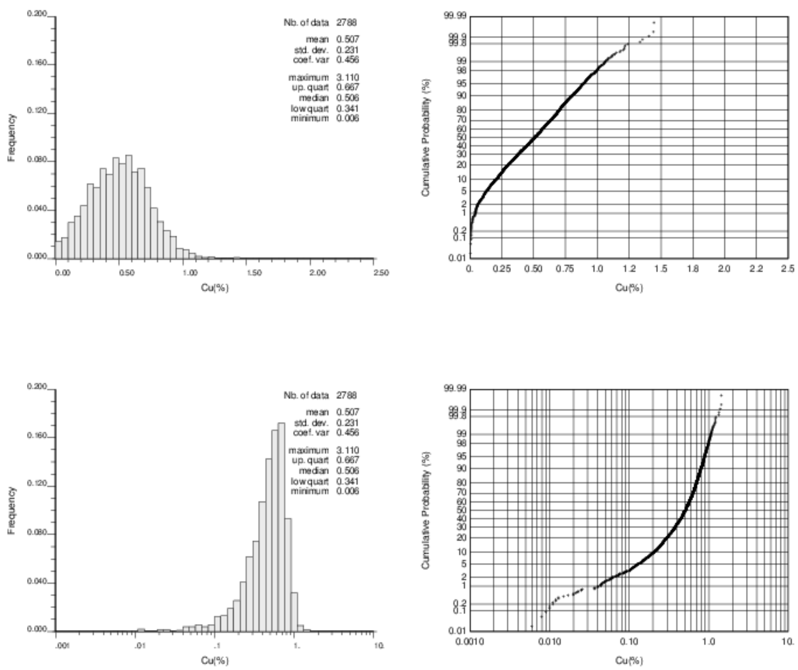
Exploratory Data Analysis (EDA) was completed on 15 ft composites and consisted of Histogram, probability plots, box plots and contact profiles.

Histograms and Probability Plots

Histograms and Probability Plots were constructed on non-WG composites using AMEC proprietary plugins to SGeMS©. Histograms and probability plots were constructed of the 15 ft composites for BL_MT, BL_T, BL_HX, GRB_M for each of the elements to be estimated (copper, nickel, platinum, palladium, gold, silver, cobalt, chromium, magnesium and sulfur). Histograms and probability plots were also constructed for the stratified horizons of the BL_MT and BL_T. Figure 14-32 shows the histogram and probability plot for copper for the BL_MT unit.

Histograms and probability plots were completed for copper, nickel, platinum, palladium, gold, silver, cobalt, chromium, magnesium and sulfur. The probability plots generally display a curvilinear profile suggesting multiple populations; however, the probability plots display a lognormal population.

Figure 14-32: Histogram and Probability Plot for Copper in BL_MT (15ft Composites)

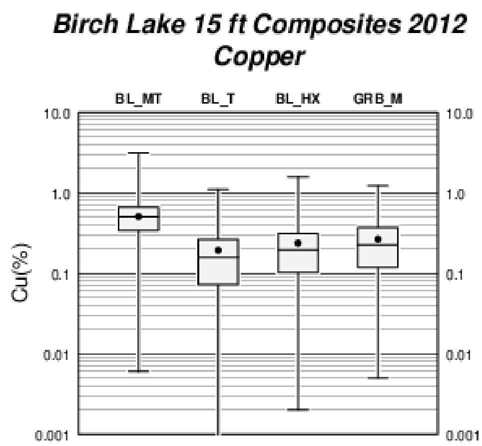


Boxplots

Box plots of 15 ft composites were completed for BL_MT, BL_T, BL_HX, and GRB_M for each of the 10 elements to be estimated. Figure 14-33 displays the copper box plot for BL_MT, BL_T, BL_HX and GRB_M. The box plots consistently display higher grades of the primary elements (Cu, Ni, Pt, Pd, Au) for the BL_MT unit which is identified as the predominant host to mineralization at Birch Lake.

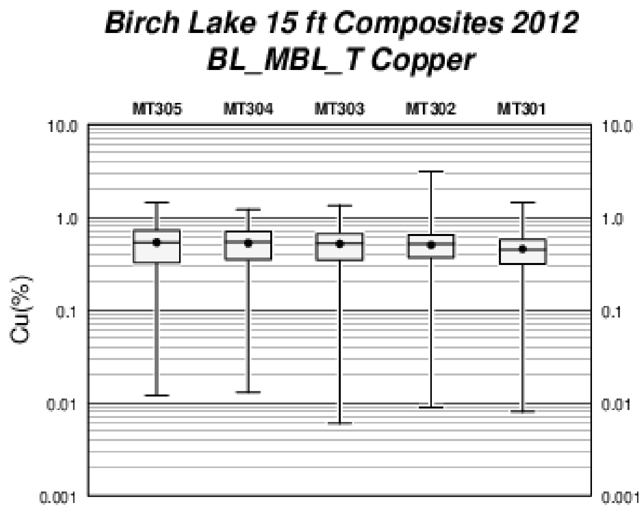
Box plots were also constructed by Strat horizon within the BL_MT and BL_T for all 10 elements to be estimated. Figure 14-34 displays the copper box plot for the five stratigraphic horizons of BL_MT. It is noted that the grade generally decrease from the top of the BL_MT to the bottom of the BL_MT.

Figure 14-33: Copper Box Plot by Unit (15ft Composites)



	BL_MT	BL_T	BL_HX	GRB_M	
No. of data	2788	850	614	305	No. of data
Mean	0.507	0.193	0.237	0.266	Mean
Maximum	3.110	1.095	1.579	1.220	Maximum
Quartile	0.667	0.262	0.313	0.369	Quartile
Median	0.506	0.157	0.195	0.225	Median
Quartile	0.341	0.072	0.102	0.118	Quartile
Minimum	0.006	0.000	0.002	0.005	Minimum
Variance	0.053	0.024	0.037	0.037	Variance
CV	0.456	0.809	0.807	0.721	CV
Skewness	0.237	1.414	2.004	1.220	Skewness

Figure 14-34: Copper Box Plot by MT Stratigraphic Horizons (15ft Composites)

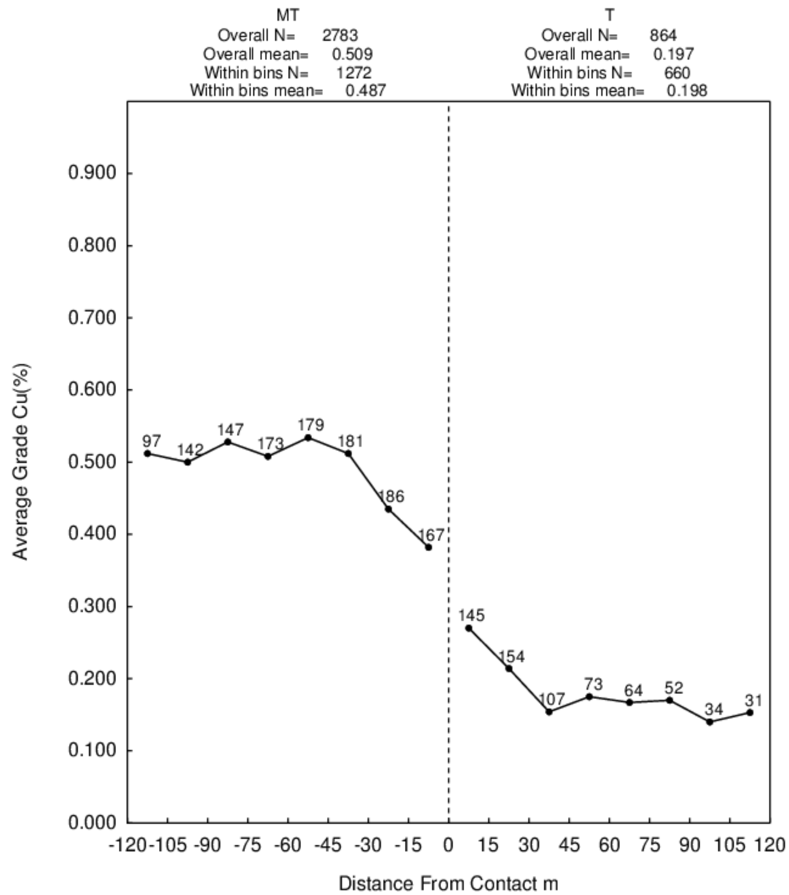


	MT305	MT304	MT303	MT302	MT301	
No. of data	551	558	572	546	561	No. of data
Mean	0.535	0.526	0.517	0.502	0.455	Mean
Maximum	1.445	1.205	1.337	3.110	1.441	Maximum
Quartile	0.719	0.701	0.666	0.642	0.576	Quartile
Median	0.537	0.540	0.525	0.515	0.445	Median
Quartile	0.322	0.350	0.348	0.370	0.313	Quartile
Minimum	0.012	0.013	0.006	0.009	0.008	Minimum
Variance	0.070	0.055	0.053	0.045	0.040	Variance
CV	0.495	0.448	0.446	0.420	0.438	CV
Skewness	0.202	-0.063	0.130	0.245	0.532	Skewness

Contact Profiles

Contact profiles of 15 ft composites were completed to analyze the grade profiles near the contacts between BL_MT, BL_T, BL_HX, GRB_M for each of the 10 elements. Contact profiles were also constructed between the stratigraphic horizons to analyze grade profiles within the BL_MT and BL_T. Figure 14-35 displays the copper contact profile between BL_MT and BL_T. Any contact that generally displays some degree of sharing may be incorporated into the sample selection criteria.

Figure 14-35: Contact Profile of Copper across BL_MT - BL_T Contact



Variography

Variography was completed for each of the 10 elements to be estimated using Sage 2001™. Variograms were modeled for BL_MT and BL_T. Because of the paucity of data in the BL_HX and GRB_B, these units were combined for variography.

The Birch Lake deposit generally strikes northeasterly and dips 15^o to the east. However, in the central portion of the deposit, the strike direction is north. Variogram domains were identified to accommodate the change in strike. Variogram domain 1 includes the northern and southern portions of the deposit where the strike is northeasterly. Variogram domain 2 is in the central portion of the deposit where the strike is generally north (Figure 14-36).

Variogram models were completed with correlograms by variogram domain for the BL_MT and BL_T. Due to the paucity of data, the BL_HX and GRB_M were combined and were not divided into variogram domains.

The nominal drill spacing at Birch Lake is 500 ft, but locally the high number of wedge holes permit analysis a closer drill spacing. Therefore variograms were modeled using all the wedge data (the WG holes were not included in variography).

The final variogram parameters are summarized in Tables 14-22 and 14-23.

Figure 14-36: Variogram Domains

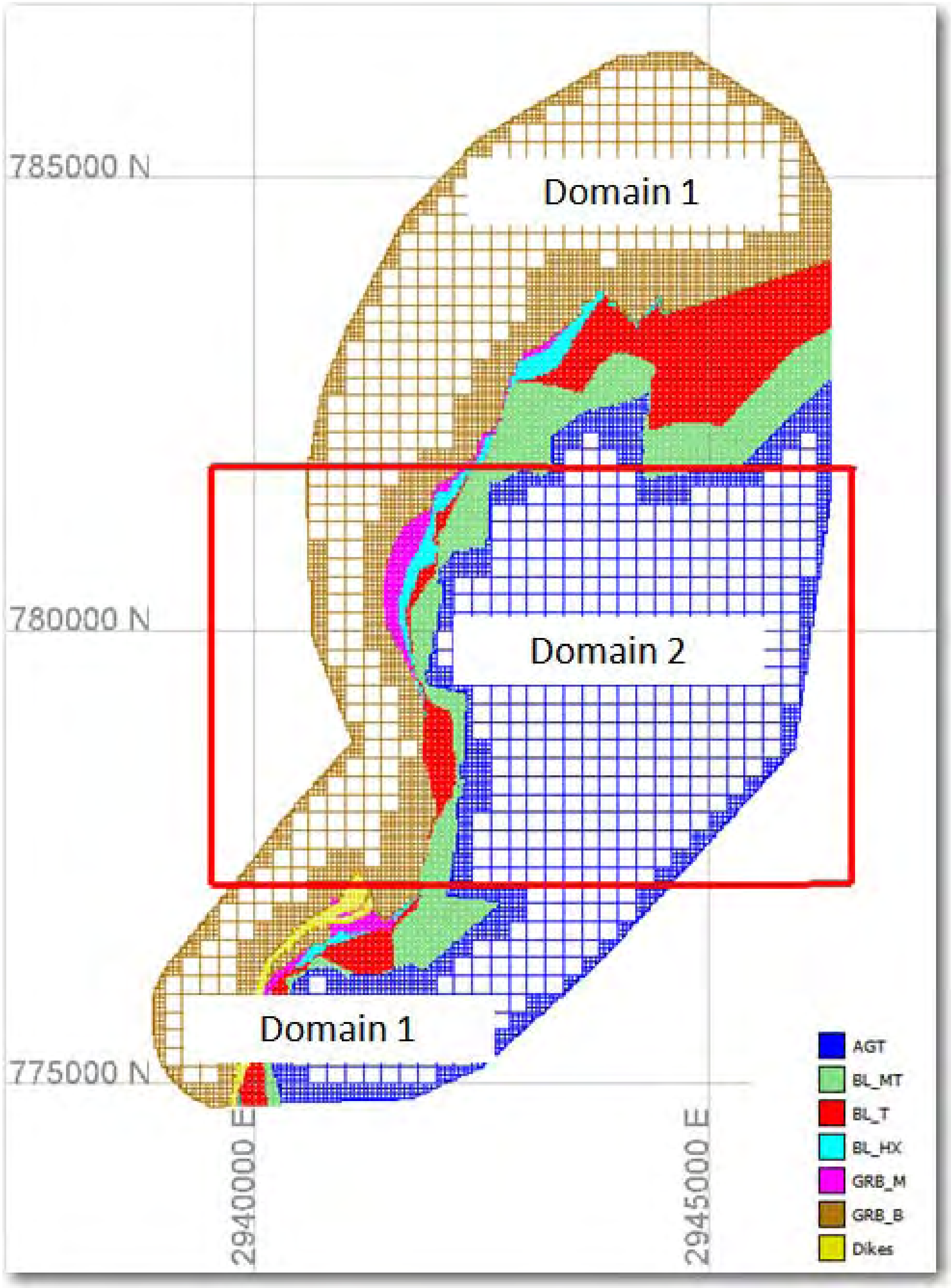


Table 14-22: Summary of Variogram Parameters for Cu, Ni, Pd, Pt and Au

Element	Unit	Domain	Azim	Dip	C0	C1	C2	Range X1	Range Y1	Range Z1	Range X2	Range Y2	Range Z2
Cu	MT	D1	30	-15	0.16	0.38	0.46	400.0	150.0	38.8	1000.0	500.0	140.0
	T	D1	30	-15	0.28	0.16	0.56	40.0	40.0	33.6	900.0	800.0	140.0
	MT	D2	0	-15	0.14	0.30	0.56	150.0	100.0	29.0	700.0	400.0	288.0
	T	D2	0	-15	0.14	0.21	0.65	150.0	150.0	126.0	700.0	700.0	126.3
	HXGRBM		30	-15	0.12	0.22	0.66	30.0	30.0	18.0	300.0	300.0	71.0
Ni	MT	D1	30	-15	0.19	0.42	0.39	70.0	70.0	123.4	2200.0	1500.0	123.6
	T	D1	30	-15	0.12	0.28	0.60	100.0	100.0	200.0	1000.0	2200.0	240.0
	MT	D2	0	-15	0.14	0.16	0.70	50.0	50.0	50.0	850.0	750.0	70.0
	T	D2	0	-15	0.40	0.35	0.25	40.0	40.0	118.0	850.0	1300.0	118.0
	HXG		30	-15	0.30	0.58	0.12	500.0	120.0	40.0	1000.0	600.0	126.0
Pd	MT	D1	30	-15	0.20	0.12	0.68	40.0	125.0	36.0	2500.0	1600.0	158.0
	T	D1	30	-15	0.12	0.45	0.43	100.0	200.0	215.0	1500.0	1500.0	215.0
	MT	D2	0	-15	0.16	0.46	0.38	150.0	60.0	51.0	1900.0	1200.0	120.0
	T	D2	0	-15	0.20	0.49	0.31	50.0	50.0	110.0	600.0	600.0	110.0
	HXGRMP		30	-15	0.05	0.55	0.40	200.0	300.0	68.0	900.0	430.0	68.0
Pt	MT	D1	30	-15	0.14	0.18	0.68	50.0	20.0	25.5	2000.0	1500.0	150.9
	T	D1	30	-15	0.15	0.54	0.31	140.0	140.0	200.0	800.0	800.0	200.0
	MT	D2	0	-15	0.25	0.45	0.30	50.0	50.0	30.0	500.0	400.0	112.0
	T	D2	0	-15	0.10	0.53	0.37	20.0	20.0	150.0	800.0	600.0	150.0
	HXGRM		30	-15	0.05	0.33	0.62	50.0	50.0	70.0	700.0	400.0	70.0
Au	MT	D1	30	-15	0.40	0.39	0.21	50.0	50.0	27.0	2500.0	1750.0	156.6
	T	D1	30	-15	0.10	0.50	0.40	100.0	100.0	207.8	750.0	750.0	208.0
	MT	D2	0	-15	0.29	0.46	0.25	75.0	75.0	45.6	675.0	350.0	130.1
	T	D2	0	-15	0.10	0.41	0.49	50.0	50.0	14.5	900.0	500.0	145.7
	HXGRM		30	-15	0.05	0.71	0.24	350.0	300.0	61.2	800.0	400.0	61.2

Table 14-23: Summary of Variogram Parameters for Ag, Co, Cr, Mg and S

Element	Unit	Domain	Azm	Dip	C0	C1	C2	Range X1	Range Y1	Range Z1	Range X2	Range Y2	Range Z2
Ag	MT	D1	30	-15	0.47	0.15	0.38	40.0	50.0	135.0	2200.0	1100.0	137.0
	T	D1	30	-15	0.27	0.32	0.41	100.0	100.0	245.1	1100.0	975.0	245.1
	MT	D2	0	-15	0.55	0.23	0.19	60.0	80.0	124.4	1350.0	340.0	126.9
	T	D2	0	-15	0.05	0.67	0.28	28.6	38.6	64.1	1000.0	800.0	65.0
	HXGRM		30	-15	0.19	0.38	0.44	45.0	50.0	115.0	500.0	475.0	140.0
Co	MT	D1	30	-15	0.19	0.54	0.27	44.0	68.0	60.0	5050.0	5900.0	76.0
	T	D1	30	-15	0.74	0.08	0.18	40.0	40.0	10.3	1000.0	500.0	174.9
	MT	D2	0	-15	0.23	0.54	0.23	45.0	35.0	81.0	1000.0	1500.0	157.0
	T	D2	0	-15	0.82	0.12	0.06	25.0	27.0	135.8	750.0	632.1	150.0
	HXGRM		30	-15	0.20	0.51	0.29	45.0	28.0	43.0	815.0	425.0	43.0
Cr	MT	D1	30	-15	0.18	0.35	0.47	55.0	90.0	97.0	505.0	558.0	97.0
	T	D1	30	-15	0.31	0.49	0.21	27.0	17.0	62.0	75.0	1000.0	62.0
	MT	D2	0	-15	0.20	0.69	0.11	60.0	35.0	60.0	1100.0	800.0	177.0
	T	D2	0	-15	0.31	0.25	0.44	40.0	30.0	30.0	1300.0	700.0	135.0
	HXGRM		30	-15	0.22	0.27	0.41	28.0	30.0	77.0	1290.0	425.0	298.0
Mg	MT	D1	30	-15	0.19	0.51	0.30	200.0	200.0	57.8	1500.0	1500.0	106.7
	T	D1	30	-15	0.03	0.49	0.48	40.0	75.0	59.6	1500.0	1500.0	383.4
	MT	D2	0	-15	0.17	0.44	0.39	37.3	25.0	54.5	1500.0	620.0	190.3
	T	D2	0	-15	0.02	0.46	0.53	30.0	52.1	157.6	2000.0	1500.0	157.4
	HXGRM		30	-15	0.07	0.48	0.45	55.0	60.0	167.0	1950.0	1000.0	168.1
S	MT	D1	30	-15	0.26	0.31	0.43	22.0	54.3	39.0	2000.0	1034.5	94.5
	T	D1	30	-15	0.12	0.46	0.42	60.0	60.0	232.2	2000.0	1050.0	232.2
	MT	D2	0	-15	0.21	0.28	0.51	40.0	40.0	39.1	1750.0	1000.0	134.2
	T	D2	0	-15	0.18	0.25	0.58	35.8	50.8	89.2	2500.0	2000.0	327.7
	HXGRM		30	-15	0.08	0.81	0.11	40.5	59.8	40.9	1250.0	1500.0	180.6

14.3.6 Density

Density data were coded with the unit code and the mean of the density values for each unit was used for the Unit density. The results are summarized in Table 14-24.

Table 14-24: Density Determinations

Rock Type	No. Determinations	Mean Density (g/cm^3)	Mean TF (t/ft^3)
AGT	1582	2.921	0.09117
BL_MT	1167	3.042	0.09496
BL_T	569	3.036	0.09476
BL_HX	412	3.004	0.09377
GRB_M	234	2.775	0.08661
GRB_B	271	2.783	0.08686
BL_DI	109	3.033	0.09467

14.3.7 Block Model

The geological model was coded for the main units (AGT, BL_MT, BL_T, BL_HX, GRB_M and GRB_B and dikes) using the topographic and geological surfaces constructed in Vulcan™. The dikes in the southern portion of Birch Lake were identified by a wireframe. The BL_MT and BL_T were each partitioned into five stratigraphic horizons.

14.3.8 Estimation

Grade estimation for the 2012 resource model update was completed using Ordinary Kriging (OK). Grade estimations were completed for copper, nickel, palladium, platinum, gold, silver, cobalt, chromium, magnesium and sulfur. Elements in each of the main units (BL_MT, BL_T, BL_HX, GRB_M) were estimated independently. Grade estimation was not completed for the AGT and GRB_B units.

Each element was estimated independently in four passes with expanding searches for each pass. The search and sample selection is summarized in Table 14-25.

Table 14-25: Search Strategy for Grade Estimation

Pass	Search (x,y,z; in feet)	Samples max-min-max/DH
Pass 1	750, 750, 200	12 - 5 - 3
Pass 2	1500, 1500, 500	12 - 5 - 3
Pass 3	2500, 2500, 500	12 - 5 - 3
Pass 4	15000, 15000, 1500	12 - 3 - 3

Note: Pass 4 was a fill pass to populate unestimated blocks located near the periphery of the model area.

14.3.9 Metal at Risk

AMEC addressed metal at risk using by capping 15 ft composites. Grade capping levels are summarized in Table 14-26. Metal removed is based on a 0.0% Cu cutoff.

Metal removed from the BL_MT is summarized in Table 14-27. Metal removed from the BL_T is summarized in Table 14-28. AMEC considers the level of metal removed from the resource to be reasonable.

Table 14-26:Capping Levels (ppm unless otherwise specified)

	Capping Level by Unit			
Element	BL_MT	BL_T	BL_HX	GRB_M
Cu	1.10%	0.75%	0.70%	0.80%
Ni	0.50%	0.30%	0.45%	0.80%
Pd	2.00	0.75	0.90	0.60
Pt	1.20	0.40	0.45	0.25
Au	0.40	0.20	0.20	0.17
Ag	6.50	2.80	2.70	2.80
Co	200	150	250	300
Cr	2000	1000	400	200
Mg	None	11.0%	11.0%	6.0%
S	2.0%	2.0%	4.0%	4.0%

Note: Values are in ppm unless noted (%). Capping levels were applied to 15 ft composites

Table 14-27: Relative Metal Removed by Capping – BL_MT

Metal	Units	Uncapped Mean	Capped Mean	Relative Metal Removed
Copper	%	0.42974	0.42943	0.1%
Nickel	%	0.13894	0.13894	0.0%
Palladium	ppm	0.33843	0.33842	<0.1%
Platinum	ppm	0.16467	0.16463	<0.1%
Gold	ppm	0.08027	0.07982	0.6%
Silver	ppm	1.59172	1.59172	0.0%
Cobalt	ppm	97.60	97.60	0.0%
Chromium	ppm	300.74	296.56	1.4%
Magnesium	%	6.56	6.56	0.0%
Sulfur	%	0.69744	0.69675	0.1%

Table 14-28: Relative Metal Removed by Capping – BL_T

Metal	Units	Uncapped Mean	Capped Mean	Relative Metal Removed
Copper	%	0.17154	0.17154	0.0%
Nickel	%	0.06154	0.06126	0.5%
Palladium	ppm	0.08810	0.08672	1.6%
Platinum	ppm	0.04324	0.04314	0.2%
Gold	ppm	0.02285	0.02282	0.1%
Silver	ppm	0.64934	0.64632	0.5%
Cobalt	ppm	68.74	68.55	0.3%
Chromium	ppm	175.36	173.49	1.1%
Magnesium	%	4.18	4.18	0.0%
Sulfur	%	0.42094	0.41298	1.9%

14.3.10 Model Validation

Model validation consisted of visual Inspection of cross-sections and plan-sections. Box plots, swath plots and contact profiles were used to compare grade estimates to grades from a NN model. Model validation was limited to blocks classified as Indicated.

Nearest-Neighbor Model

A NN model was completed for model validation. The NN model utilized the same search criteria as the OK estimate and was used for comparison of summary statistics in box plots and swath plots.

Visual Inspection

Inspection of cross sections and plan sections was completed for all elements. Figures 14-37 and 14-38 show block grades for copper and platinum respectively.

AMEC noted good correlation between composite and block grades. AMEC observed weak general grade continuity between drill holes, indicating in-fill drilling is required to improve the confidence in the resource model.

Figure 14-37: Copper Cross Section 777400 N (Drill Hole Projection 200 ft; units % Cu)

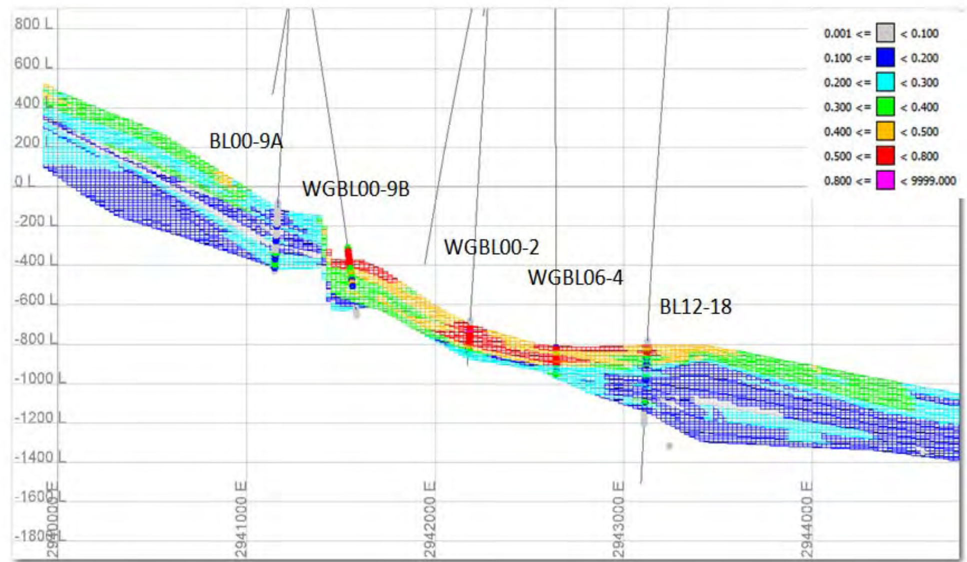
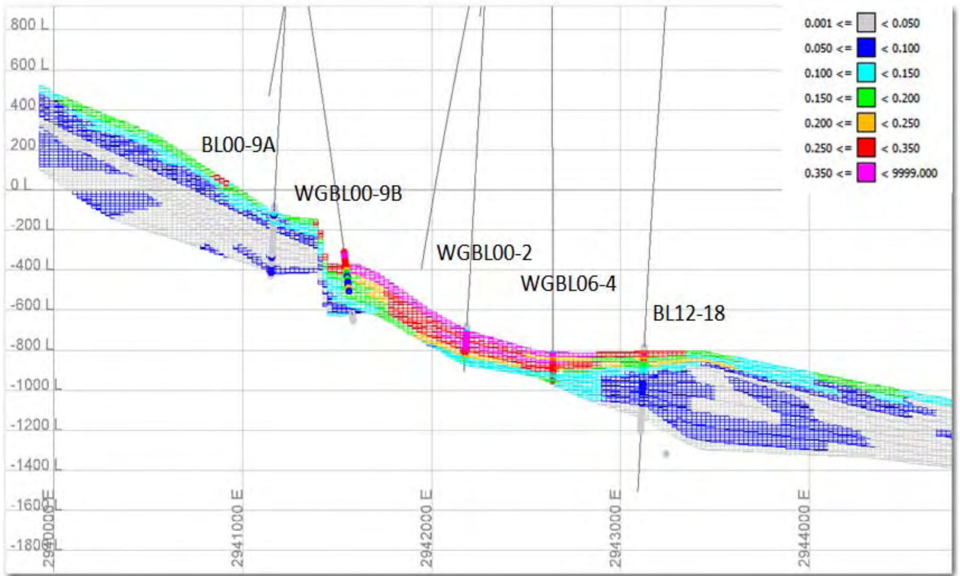


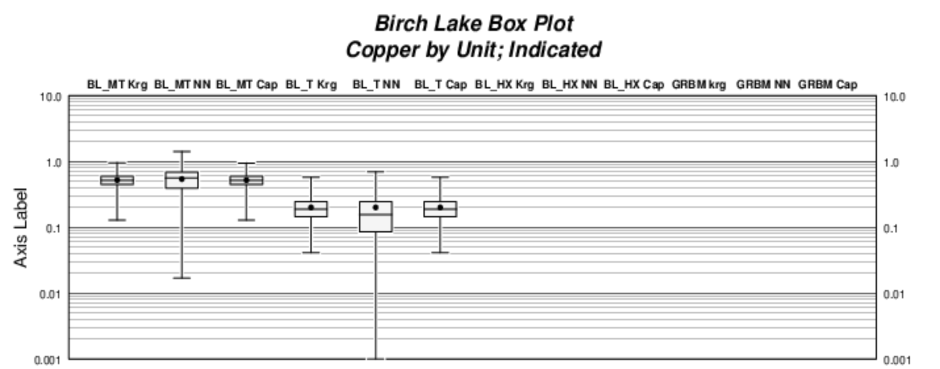
Figure 14-38: Platinum Cross Section 777400 N (Drill Hole Projection 200 ft; units ppm)



Boxplots

Boxplots were completed for each element comparing the OK estimate to the NN grades. Figure 14-39 displays a box plot of copper grades for BL_MT. The boxplots includes capped, NN, and uncapped grade estimates. There is good correspondence between mean grades by geological unit. There are no blocks classified as Indicated for BL_HX and GRB_M.

Figure 14-39:Copper Box Plot of Indicated Blocks



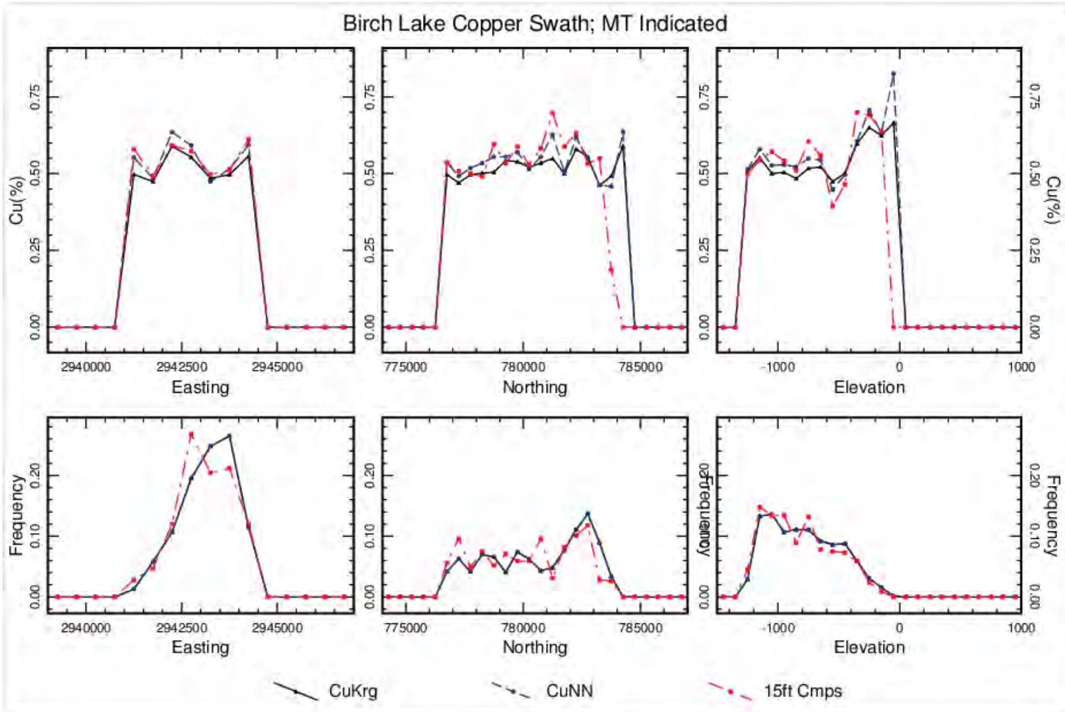
	BL_MT Krg	BL_MT NN	BL_MT Cap	BL_T Krg	BL_T NN	BL_T Cap	BL_HX Krg	BL_HX NN	BL_HX Cap	GRBM krg	GRBM NN	GRBM Cap	
No. of data	177898	177898	177898	69501	69501	69501	0	0	0	0	0	0	No. of data
Mean	0.521	0.540	0.520	0.200	0.200	0.200	0.000	0.000	0.000	0.000	0.000	0.000	Mean
Maximum	0.955	1.406	0.945	0.572	0.694	0.572	0.000	0.000	0.000	0.000	0.000	0.000	Maximum
Quartile	0.594	0.684	0.593	0.244	0.245	0.244	0.000	0.000	0.000	0.000	0.000	0.000	Quartile
Median	0.515	0.558	0.515	0.189	0.156	0.189	0.000	0.000	0.000	0.000	0.000	0.000	Median
Quartile	0.446	0.392	0.446	0.144	0.085	0.144	0.000	0.000	0.000	0.000	0.000	0.000	Quartile
Minimum	0.129	0.017	0.129	0.041	0.001	0.041	0.000	0.000	0.000	0.000	0.000	0.000	Minimum
Variance	0.013	0.050	0.013	0.006	0.026	0.006	0.000	0.000	0.000	0.000	0.000	0.000	Variance
CV	0.222	0.412	0.220	0.377	0.810	0.377	0.000	0.000	0.000	0.000	0.000	0.000	CV
Skewness	0.249	0.236	0.210	0.770	1.395	0.770	0.000	0.000	0.000	0.000	0.000	0.000	Skewness

Note: There are no blocks classified as Indicated in BL_HX and GRB_M.

Swath Plots

Swath plots were constructed using the blocks classified as Indicated for BL_MT and BL_T. The swath plots compare the OK grade estimates to the NN grades and the grades of the 15 ft composites in swaths across the model. Swath intervals were 500 ft in the easterly and northerly directions and 200 ft m in the vertical direction. Swaths generally show good agreement with the exception of areas where data become sparse. The swath plots for copper in BL_MT are shown in Figure 14-40.

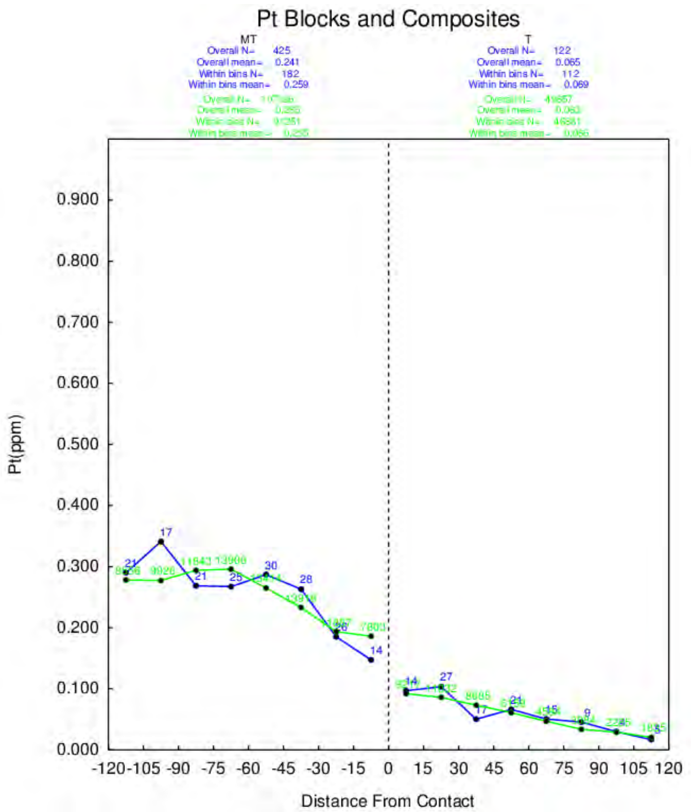
Figure 14-40: Copper Swath Plot



Contact Profiles

Contact Profiles of model block grades and composite grades were completed to compare the grade profiles across each of the geological units. Contact profiles generally show good comparisons between the 15 ft composites and the block grades (Figure 14-41).

Figure 14-41:Platinum Contact Profile of BL_MT to BL_T (composites are shown in blue, blocks in green)



14.3.11 NSR Calculation

An NSR was calculated for each block using a Vulcan™ script. Criteria for the NSR calculation are summarized in Table 14-29.

Table 14-29: NSR Parameters for Birch Lake (Source TMM)

Metal	Price (US$)	Recovery Concentrate	Recovery CESL™	Recovery Global	Payable
Copper	$3.00/lb	94.3%	96.3%	90.8%	100.0%
Nickel	$9.38/lb	60.0%	95.6%	57.4%	80.0%
Platinum	$1,840/troy oz	93.0%	59.4%	55.2%	80.0%
Palladium	$805/troy oz	90.0%	70.7%	63.6%	80.0%
Gold	$1,050/troy oz	85.0%	74.5%	63.3%	80.0%

14.3.12 Prospects for Economic Extraction

See Section 14.2.12 for a discussion of reasonable prospects for economic extraction.

14.3.13 Resource Classification

To determine the mineral resource classification, AMEC reviewed the continuity of grade and the continuity of thickness between drill holes. The process included constructing 247 cross-sections between paired drill holes. Each section was given a continuity letter grade based on the continuity of grade and thickness between drill hole pairs. The grading classification was as follows:

A. Continuity of grade and thickness observed.

B. Continuity of thickness observed

C. Poor continuity of grade and thickness

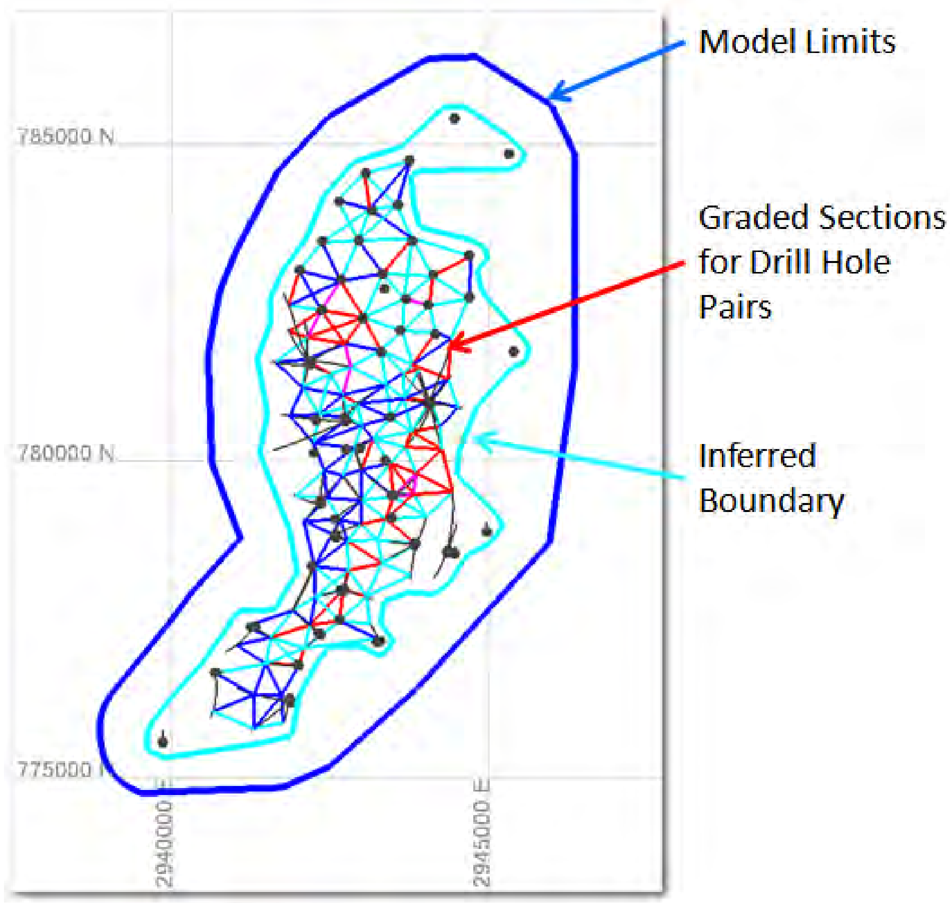
D. No continuity

Note: If a fault separated the drill holes on the paired section the classification was down-graded one confidence level.

Figure 14-42 shows the final grading of each of the paired drill holes. The final resource classification boundaries are presented in Figure 14-43. Figure 14-44 displays the magma channel discussed in Section 7.6.2 with the resource classification boundaries.

The Inferred classification was determined by a polyline 250 ft beyond the drilling envelope. The Indicated classification was determined by reviewing the paired sections.

Figure 14-42:Graded Paired Drill Hole Sections



Grading Scheme
A = Continuity of Thickness and Grade
B: Continuity of Thickness, Not Grade
C: No continuity of Thickness
D: No Continuity
Downgrade 1 category for crossing fault.

Figure 14-43:Birch Lake Resource Classification

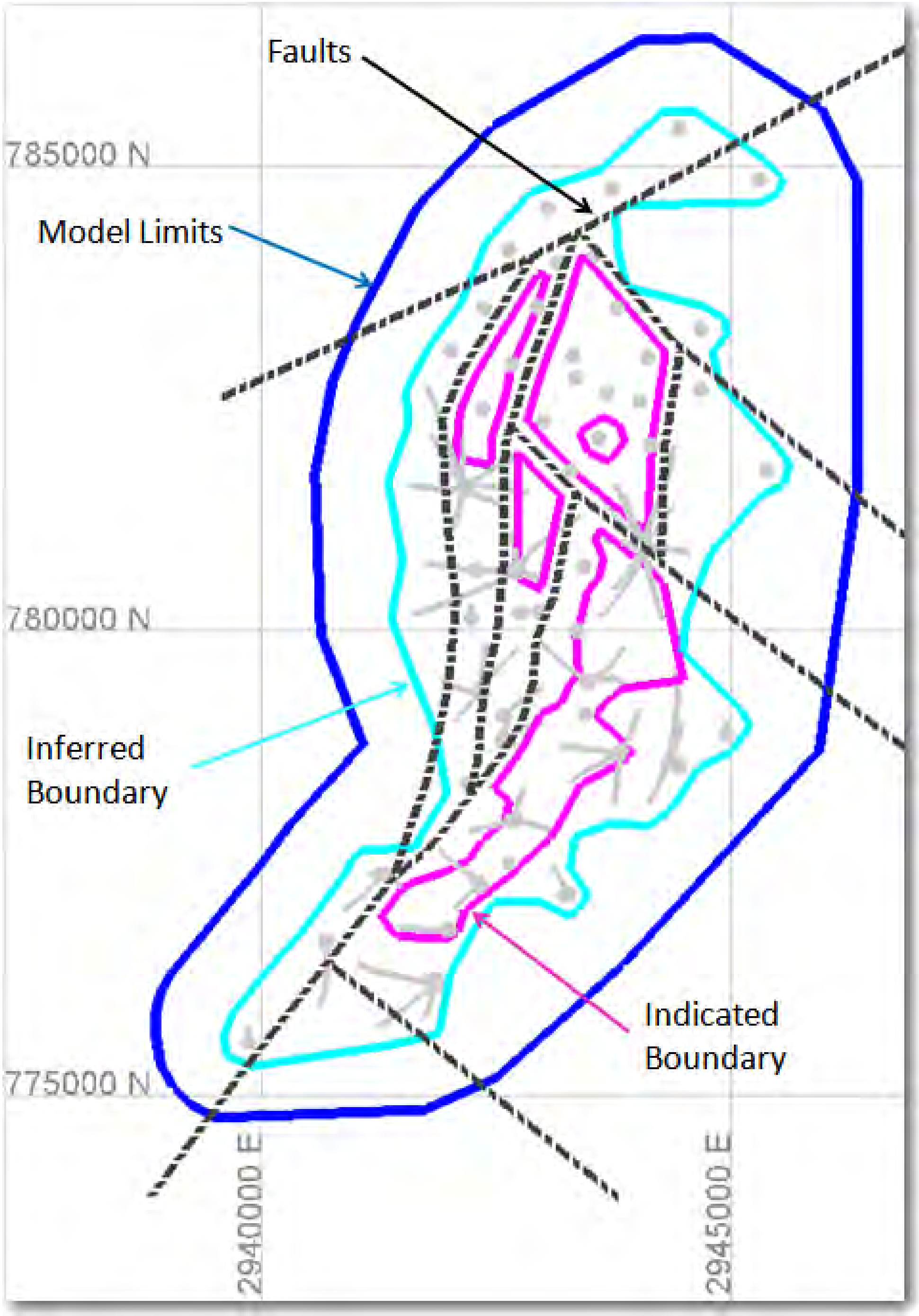
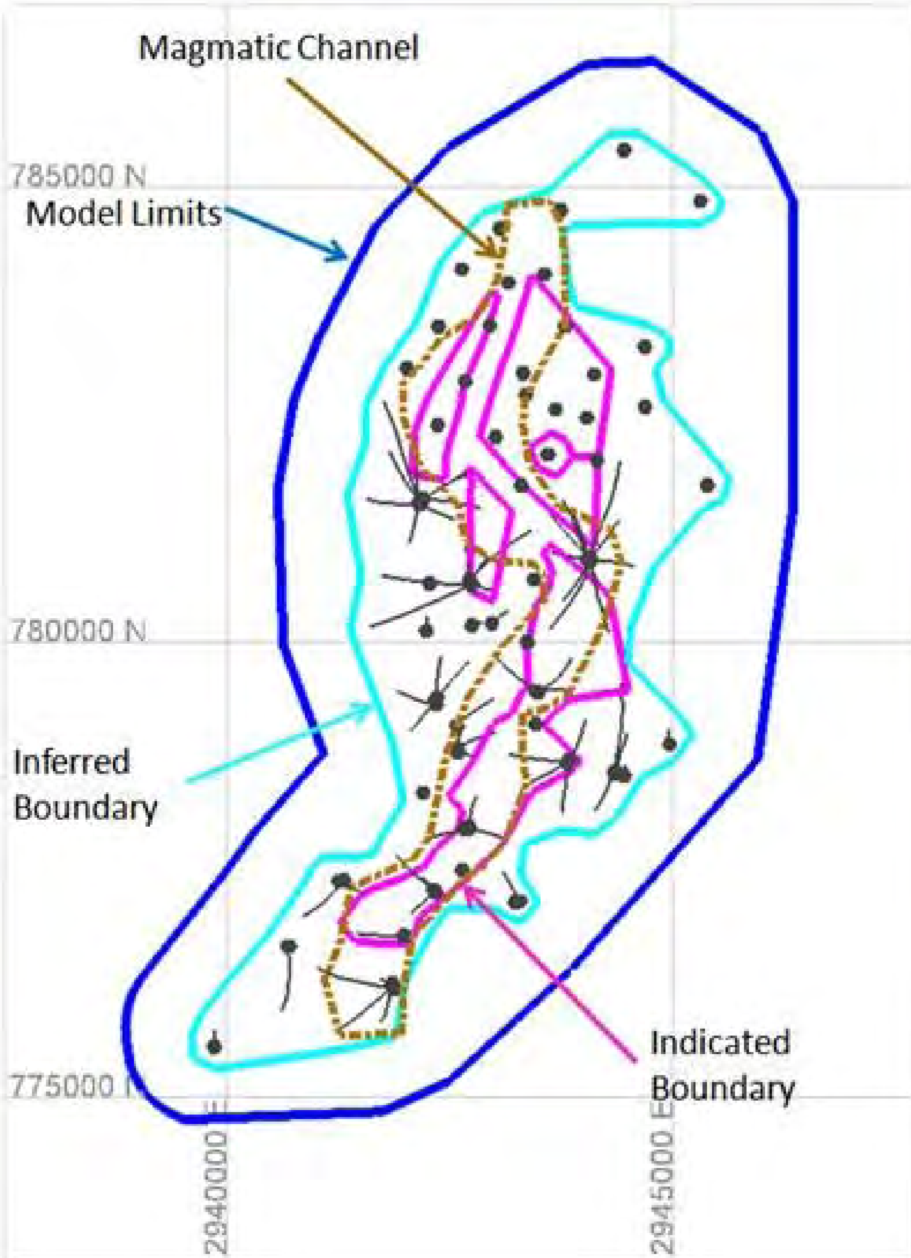


Figure 14-44: Resource Classification Boundaries and Magmatic Channel



14.3.14 Resource Tabulation

Table 14-30 tabulates the Indicated and Inferred Mineral Resources for Birch Lake by cumulative copper cutoffs to show sensitivity of the estimate to variations in cut-off grade. The base case, 0.30% Cu, is gray-shaded. The Indicated and Inferred Resources are stated in Million Short Tons (Mt).

At Birch Lake, the mineral resources are located at least 600 ft below the surface. Engineering judgment is that at that depth, it is not necessary to make allowances for a safety pillar.

Table 14-30: Birch Lake Resource Tabulation by Cu Cutoff (base-case is highlighted)

Birch Lake Indicated Mineral Resources

Cutoff (Cu %)	Tons (Mt)	Cu (pct)	Ni (pct)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	111.9	0.49	0.15	0.474	0.217	0.106	0.014	0.006	0.003
0.3	99.7	0.52	0.16	0.511	0.233	0.114	0.015	0.007	0.003
0.4	85.4	0.55	0.17	0.543	0.247	0.120	0.016	0.007	0.004
0.5	54.9	0.60	0.18	0.591	0.269	0.130	0.017	0.008	0.004
0.6	22.8	0.67	0.21	0.630	0.285	0.140	0.018	0.008	0.004

Birch Lake Inferred Mineral Resources

Cutoff (Cu %)	Tons (Mt)	Cu (pct)	Ni (pct)	Pd (ppm)	Pt (ppm)	Au (ppm)	Pd (oz/t)	Pt (oz/t)	Au (oz/t)
0.2	313.1	0.41	0.13	0.320	0.156	0.076	0.009	0.005	0.002
0.3	239.2	0.46	0.15	0.370	0.180	0.087	0.011	0.005	0.003
0.4	158.4	0.51	0.16	0.423	0.203	0.098	0.012	0.006	0.003
0.5	76.8	0.58	0.18	0.480	0.228	0.111	0.014	0.007	0.003
0.6	23.5	0.66	0.20	0.569	0.274	0.131	0.017	0.008	0.004

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au.
The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

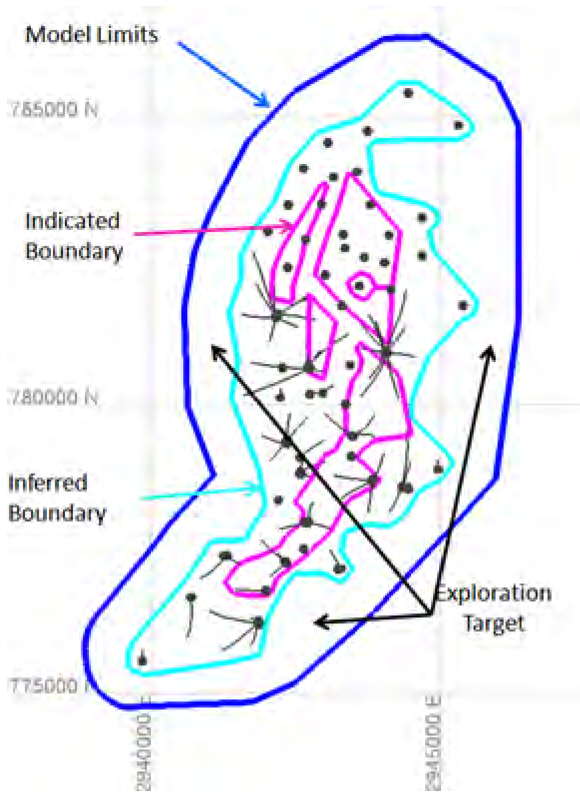
14.3.15 Comparison with Previous Estimate

A significant change in the Birch Lake mineral resource compared to June 2012 was due to the resolution of the deviation surveys which permitted an Indicated classification for a portion of the resource. Other factors included the modification of the geological model into magma units by the TMM geological staff and additional drilling.

14.3.16 Exploration Targets

At Birch Lake, blocks with extrapolated grades outside the area classified as Inferred are considered to be Exploration Target material. Figure 14-45 shows the location of the Indicated and Inferred Mineral Resources and the Exploration Target material. Exploration Target material is in the range of 222 to 334 Mt and contains 0.33 to 0.50% Cu, 0.11 to 0.16% Ni, 0.11 to 0.16 ppm Pt, 0.22 to 0.33 ppm Pd, and 0.05 to 0.8 ppm Au. The range of tonnage and grade is based on application of a 0.30% Cu cutoff to material outside of the Inferred classification boundary but within the model boundary. The range of grade and tonnage is determined as ±20% of those values. AMEC cautions that the potential tons and grade of the exploration target are conceptual in nature, and that there has been insufficient exploration to define the exploration targets as a Mineral Resource. It is uncertain if additional exploration will result in the target(s) being delineated as a Mineral Resource.

Figure 14-45: Birch Lake Exploration Target Area



14.4 Spruce Road

14.4.1 Introduction

Scott Wilson Roscoe Postle Associates Inc. (SWRPA) produced a resource estimate for the Spruce Road deposit in 2007 (Routledge and Cox, 2007). That work was done for Franconia Minerals Corporation TMM asked that an underground-only mining option be considered, which required that AMEC review the SWRPA model and recast the resource estimate based on underground mining assumptions.

The Spruce Road resource estimate is based almost entirely on legacy Inco data that are largely unverified. Wallbridge Mining drilled a single hole (WM_001) in 1999 and that hole is included in the model. The Inco core shed and offices were destroyed by fire and all physical records of the Spruce Road deposit were in those facilities; thus the data used for the resource estimate are largely unverified. Recent drilling at Maturi has largely verified legacy Inco data from the same era. Based on this work, AMEC believes that it is reasonable that the data at Spruce Road will be verified when twin holes are completed and thus that the Inco data are currently appropriate to use for resource estimation at an Inferred Mineral Resource level.

Troctolitic rocks comprise much of the SKI at Spruce Road and carry abundant rafted basement inclusions of sedimentary hornfels and iron formation (Routledge and Cox, 2007). Inclusions are mostly barren, but locally are mineralized. At Spruce Road, in contrast to the Maturi and Birch Lake deposits, there does not appear be to any specific correlation of mineralization to lithology and there is no key unit or hanging wall marker horizon, such as the pegmatite, that overlies the mineralized unit at Maturi. Mineralization is considered to be consistent with the Basal Mineralized Zone (BMZ) and is very similar to the thick Cu-Ni mineralization in the northwestern part of Maturi. Typical features of the rocks are discontinuous layering, variable textures and common inclusions and erratic disseminated copper-nickel mineralization. There is some uncertainty as to the attitude and geometry of the mineralization at progressively higher grades at Spruce Road but, for the purpose of resource estimation, mineralization trends are assumed to parallel intrusive layering and conform to the overall geometry of the SKI.

The BMZ at Spruce Road is very thick, locally as thick as 1,200 ft (365 m) locally, although there will be poorly mineralized zones within the total thickness, and the average thickness is on the order of 300 ft (91 m). This is much thicker than the average BMZ thickness at Maturi and Birch Lake.

Mineralization tends to be very uniform where it occurs. Grades are somewhat lower than grades at Maturi and Birch Lake.

14.4.2 SWRPA Model

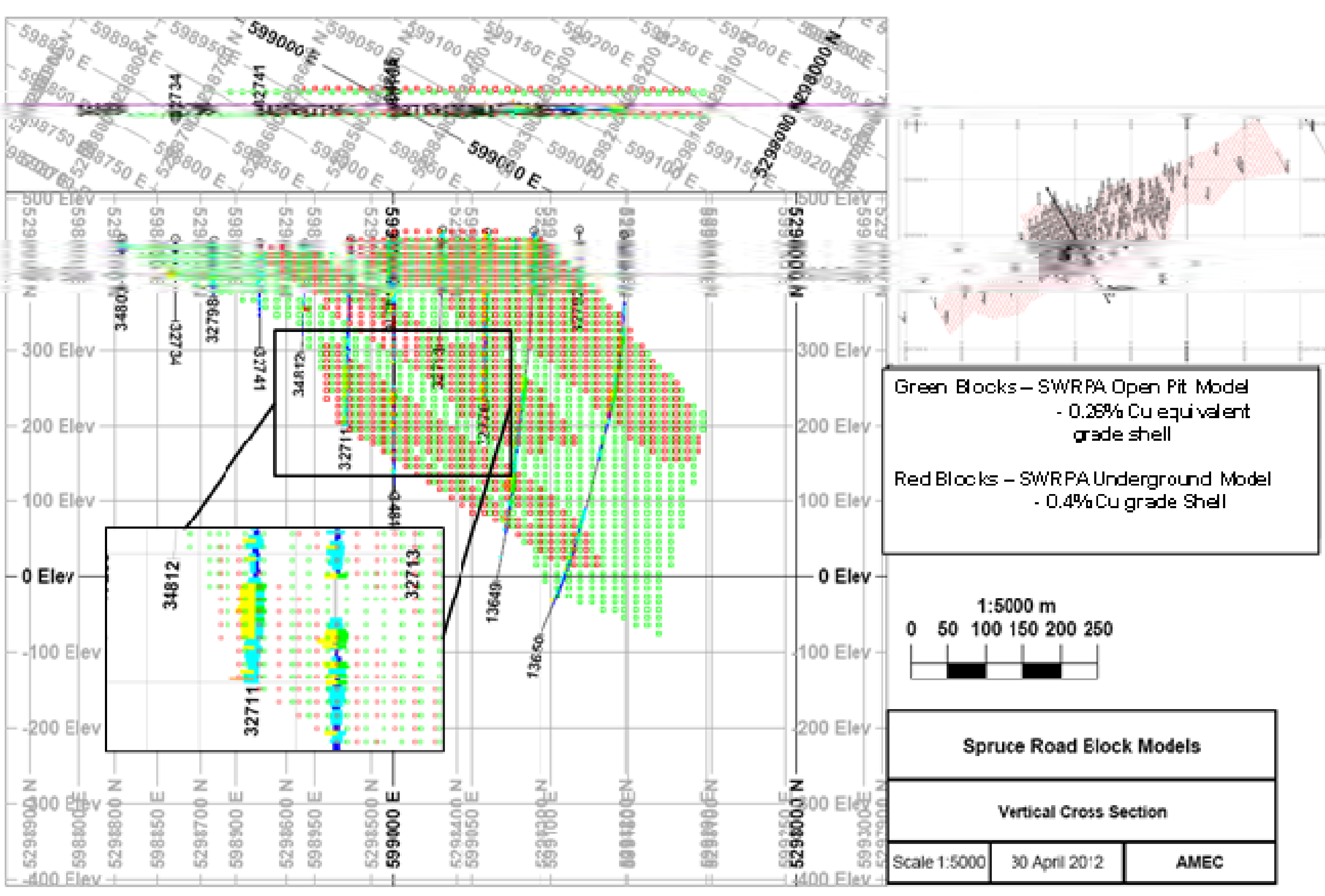
Scott Wilson RPA estimated Mineral Resources at cutoff grades appropriate for underground mining (0.4% Cu) and for open pit mining (0.26% Cu equivalent) in accordance with the requirements of NI 43-101 and the definitions set out by the CIM Definition Standards for Mineral Resources and Mineral Reserves adopted by the CIM Council on December 11, 2005 (2005 CIM definitions). The resource estimate is based on core sampling data and employs 3D computer block modeling with inverse distance squared (ID2) interpolation for the underground resource and ordinary kriging (OK) for the open pit resource. Block dimensions were 30 x 15 x 10 m and rotated 28^o to be parallel with regional strike and inclined to be parallel with the base of the BMZ.

Mineral Resources on the property have been estimated from the northwest boundary of the Spruce Road property from surface to approximately 1,683.1 ft (513 m) depth. The drill hole information was obtained from Inco and consists of results of core drilling from 1954 to 1973. Cobalt results are incomplete and PGE and Au assays are mostly lacking on an individual assay basis for the Inco holes. Consequently resources for these metals are not estimated. AMEC is not aware of any density data from Spruce Road so an average density of 3.02 g/cm^3 was used. That value is consistent with the average density data from Maturi.

The resources in the Spruce Road deposit extend off the property and have been reported by "clipping" the underground resource block model at the property boundary and by constraining the open pit shell to the property.

SWRPA utilized grade shells for control of estimation at Spruce Road. One grade shell was at 0.26% Cu equivalent, the other was at 0.4% Cu. Separate block models were produced for each of the grade shell models. SWRPA called the block model utilizing the 0.26% Cu equivalent grade shell the "Open Pit Model" and the block model utilizing the 0.4% Cu grade shell the "Underground Model". It is not clear from Routledge and Cox (2007) why independent block models were used but the blocks are somewhat offset. Figure 14-46 shows the locations of blocks on a section across the center of the deposit. This clearly shows the offset of the block centers. For this work, AMEC has used the "Open Pit Model" shown in green squares in Figure 14-46.

Figure 14-46: Spruce Road Block Model Cross Section showing Block Centers



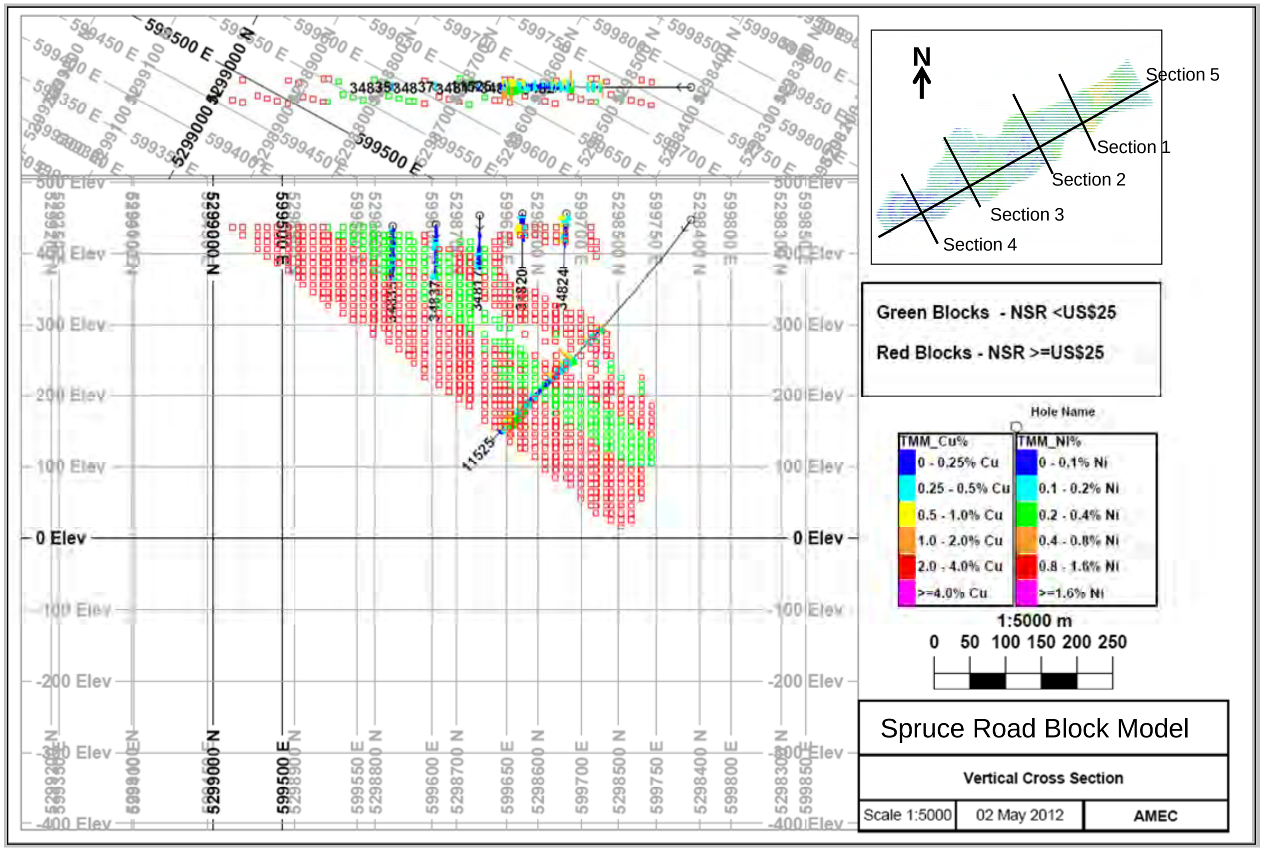
14.4.3 AMEC Methodology

Resource Definition

AMEC calculated an NSR value for each block in the "Open Pit Model" using the same equations as were used at Maturi but excluded the terms for PGEs which were not analyzed in the original data and are thus lacking in the SWRPA model, and converted the tonnage factors to metric tonnes because the original model was done in metric tonnes. Figure 14-47 is a typical cross section showing the NSR for blocks across the deposit.

A set of sections prepared using the NSR values show remarkable consistency in the US$20-40 NSR range, but the sections demonstrate that continuity breaks up rapidly in the higher NSR ranges. This led AMEC to consider that additional work such as stope block definition was not necessary to support estimation of these resources at this stage of the project.

Figure 14-47: Spruce Road Section 2



Checks for Extrapolated Blocks

Spruce Road was estimated within grade shells at 0.26% Cu equivalent and 0.4% Cu. This method normally significantly restricts extrapolation of grades because the grade shell is normally carefully matched to data in drill holes and does not extend beyond the limits of data. In order to confirm that few, if any blocks, were extrapolated, AMEC calculated the distance between block centers and the nearest sample from drilling. The longest distance is 248.9 m with the mean distance of 62.9 m. Given these values, AMEC concludes, that for the purposes of this report, all of the block data are interpolated.

In order to confirm that blocks in the 0.4% grade shell are all interpolated, AMEC calculated the distances from block centers to the nearest drill data. NN distances for all of the 0.4% Cu grade shell model are <120 m which indicates that that all of the block grades were interpolated.

14.4.4 Spruce Road Mineral Resources

SWRPA classified the resources at Spruce Road as a mix of Indicated and Inferred Mineral Resources. While the drill spacing generally supports the Indicated Mineral Resource classification, the estimate is based largely on unverified legacy data. A single hole was drilled by Wallbridge Mining in 1999 (WM-001). That hole was drilled to obtain material for metallurgical testing and to test the off-hole conductor in BH13648. The hole was assayed for PGEs which suggests grade, mineralogy, and mineralization style similarities to parts of Maturi. TPGEs are on the order of 0.5 g/t. The legacy (Inco) data are not directly verifiable because core and hard copies of the data were destroyed in a fire that consumed the Inco core storage facility and offices.

AMEC believes that the data will be validated by additional drilling. Current work at Maturi with similar vintage Inco legacy data suggests that no significant problems will be encountered, but the work has not been done at Spruce Road.

Table 14-31 summarizes the mineral resources at Spruce Road. AMEC used a 0.3% Cu cutoff for the tabulation and assumed a 164 ft (50 m) safety pillar. All material above the minimum NSR value of $30/t was tabulated as an Inferred Mineral Resource. Tonnages are in million short tons (Mt). An average density of 3.02 g/cm^3 was used for Spruce Road which is consistent with the average density data from Maturi. The base case for 0.30% copper is gray-shaded; the remaining cases are sensitivity cases to show the sensitivity of the Mineral Resource estimates to changes in cut-off grade.

AMEC classified the resource as Inferred Mineral Resources recognizing that the underlying data will likely be validated with additional exploration at Spruce Road. AMEC is of the opinion that the data are not adequate to support Indicated Mineral Resources until those data are verified by twin hole drilling.

Table 14-31: Spruce Road Inferred Mineral Resources by Cu Cutoff (base-case is highlighted)

Cutoff Cu (%)	Tons (Mt)	Cu (%)	Ni (%)
0.2	674	0.38	0.14
0.3	480	**0.43**	**0.16**
0.4	254	0.5	0.18
0.5	101	0.57	0.21
0.6	24	0.66	0.24

Notes: Effective Date is 15 September 2012.
Dr Harry Parker, RM SME, is the QP for the estimate and is a Professional Geologist licensed in Minnesota.
The resources are based on a US$30/t NSR that in turn assumes a mining cost of $16/t, a process cost of $12/t and general and administrative charges of $2/t; global metallurgical recoveries of 90.8% (Cu), 68.8% (Ni), 63.3% (Au), 63.6% (Pd) and 55.2% (Pt); and long-term consensus metal prices of $3.00/lb Cu, $9.38/lb Ni, $1,050/troy oz Au, $805/troy oz Pd and $1,840/troy oz Au. The NSR equates to a 0.3% Cu cut-off grade.
Figures have been rounded and may not sum.
Mt = million short tons

14.5 Conclusions and Recommendations

14.5.1 Maturi

The Maturi deposit contains a significant resource currently classified as Inferred. It is possible the classification of this resource could be upgraded with additional drilling. AMEC has reviewed TMM's proposed drill program and recommended additional drill holes in areas to reduce the current drill hole spacing. AMEC's recommendation also includes a cross of closely-spaced holes to help assess the local scale variability within the deposit. Drilling in the Maturi West Exploration target is planned for the upcoming winter (2012-2013) subject to USFS and the state of Minnesota granting the permits.

14.5.2 Birch Lake

Significant issues that affect the Mineral Resource classification at Birch Lake are the faults which potentially will affect underground mining operations and the location of the magma channel that controls the higher grades and greater thicknesses of mineralization.

AMEC recommends that:

1. Drill fences be completed normal to the interpreted strike of the faults in order to determine the fault locations and the characteristics of the faults.

2. Drill fences be completed across the axis of the magmatic channel to identify the channel margins and the characteristics of the channel margins.

14.5.3 Spruce Road

AMEC believes that the SWRPA estimate is adequate for a preliminary resource estimate. Re-tabulation of the results of the estimate was utilized for this report.

This estimate is based on largely unverified data. SWRPA verified the data as well as those data can be verified, but the lack of original collar and down-hole surveys, assay certificates, and drill logs is detrimental to the project and can only be resolved by drilling at least 10% twin holes to verify the data.

As Duluth is focusing on the evaluation of the better explored Maturi and Birch Lake deposits, no drill program is planned for Spruce Lake in the near term.

15.0 MINERAL RESERVE ESTIMATES

Not applicable to this report at this time.

16.0 MINING METHODS

Not applicable to this report at this time.

17.0 RECOVERY METHODS

Not applicable to this report at this time.

18.0 INFRASTRUCTURE

Not applicable to this report at this time.

19.0 MARKET STUDIES AND CONTRACTS

Not applicable to this report at this time.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

Not applicable to this report at this time.

21.0 CAPITAL AND OPERATING COSTS

Not applicable to this report at this time.

22.0 ECONOMIC ANALYSIS

Not applicable to this report at this time.

23.0 ADJACENT PROPERTIES

There are no adjacent properties.

24.0 OTHER RELEVANT DATA AND INFORMATION

TMM is currently conducting work on a Prefeasibility Study for the Twin Metals Project. The resource estimate detailed in this report is expected to form the geologic basis for the study. TMM has engaged numerous consultants to work with its team to complete the PFS. Along with ongoing geologic effort, work is being advanced on metallurgical testing, detailed mine planning, geotechnical and hydro-geologic investigations, base line environmental work, infrastructure needs, and other aspects of a Prefeasibility Study. TMM advised AMEC that the company has budgeted adequate expenditures to complete the study.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Tenure

TMM's mineral tenure, while secure, is located in close proximity to the federally designated Boundary Waters Canoe Area Wilderness. Permitting a mining project in this region will be subject to close regulatory, environmental, and political scrutiny, which may pose a significant risk to the project.

25.2 Geological Setting

Mineralization at Maturi, Birch Lake, and Spruce Road are hosted by the Duluth Complex which is a composite intrusion, comprising 12 sub-intrusions emplaced over a period of 10 to 12 million years. The basal portion of the South Kawishiwi intrusion (SKI) hosts all three deposits in what is locally known as the basal mineralized zone (BMZ) which is as much as 1,000 ft thick locally. The BMZ is a complex zone comprising numerous small intrusive bodies ranging in composition from anorthosite to melatroctolite.

The current geological models at Maturi and Birch Lake are significant improvements over previous models and are adequate to support resource estimation and mine planning. Faults, recognized and unrecognized, pose little risk to the resource estimate but are a risk to mine planning. Additional drilling is required at both Maturi and Birch Lake to better define faults.

Mineralization comprises primarily chalcopyrite, cubanite, pentlandite, and talnakhite with numerous base and precious metals bearing minerals in trace quantities.

The geological setting is adequately known to support resource estimation and preliminary mine planning for a prefeasibility study (in progress).

25.3 Deposit Types

The Maturi, Birch Lake, and Spruce Road deposits are classified as magmatic nickel-copper-platinum group element (PGE) deposits which are a broad group of deposits containing nickel, copper, and PGEs occurring as sulfide concentrations associated with a variety of mafic and ultramafic magmatic rocks (Eckstrand and Hulbert 2007).

The deposit type is well known and understood.

25.4 Drilling

Drill procedures including collar and downhole surveying at Maturi are consistent with industry best practices and are adequate to support resource estimation and mine planning.

Drill procedures including collar and downhole surveying at Birch Lake are consistent with industry best practices and are adequate to support resource estimation at an Indicated Mineral Resource level. Downhole survey problems discovered in 2011 were largely resolved by resurveying of holes in 2012.

Drill procedures at Spruce Road are largely unknown. The operator of the exploration effort, ACNC (Inco), was an established mining house with a very good track record of finding and developing copper-nickel deposits. While the procedures are not verified, AMEC concludes that they would meet typical standards today and that they are adequate to support resource estimation.

25.5 Sample Preparation, Analyses, and Security

Sample Preparation

Sample preparation of current samples at both Maturi and Birch Lake has been done using industry-standard procedures and is adequate to support resource estimation.

Sample preparation of legacy samples from Maturi and Birch Lake and at Spruce Road is unknown, but is believed to have been done at Inco's internal laboratory which would have used industry-standard procedures at the time.

Sample Analysis

Sample analysis for the current samples at both Maturi and Birch Lake is done using standard procedures and is adequate to support resource estimation. Sample analysis of legacy samples at Maturi and Birch Lake and at Spruce Road is unknown, but is believed to have been done by acid digestion followed by AA spectrometry which is a standard procedure today. These analyses have been largely validated by work at Maturi which has a large number of legacy drill holes and is believed by AMEC to be adequate to support resource estimation.

Density Analysis

Density data at Maturi and Birch Lake have been collected using standard procedures and is adequate to support resource estimation. There are no density data for Spruce

Road which is a small risk, but the uniformity of the rocks and the small density range shown by Maturi and Birch Lake tend to mitigate that risk.

Sample Security

Sample security is adequate.

QA/QC

Accuracy and precision for current Maturi and Birch Lake sample results is adequate to support resource estimation. Although a small number of problems were noted during the course of the project, those problems have been largely resolved and will not pose a risk to the project. NiS collector fire assays at Maturi show significantly more platinum for BH and PEG, and significantly more palladium for BH. Allowing for the probable low bias in the SGS results shown by the inserted CRMs, these results suggest that more platinum and palladium could be recovered from Maturi than indicated in the resource estimate.

25.6 Data Verification

Extensive audits and other checks of the database indicate that the error rate is quite small. The Maturi and Birch Lake databases are adequate to support estimation of Indicated Mineral Resources. The Spruce Road database is adequate to support estimation of Inferred Mineral Resources because it is comprises largely unverified legacy data. While unverified at Spruce Road, similar vintage data from Maturi have been largely verified, and thus AMEC believes that Spruce Road will be similarly verified when twin holes are drilled in the area.

25.7 Metallurgical Testwork

Metallurgical testwork is preliminary at this point but shows that copper, nickel, and precious metals can be concentrated using conventional flotation procedures. Estimated recoveries, based on testwork to date, are summarized in Table 25-1. In order to recover the maximum amount of metals, a pressure oxidation procedure is required. The forecast recoveries must be confirmed by additional testwork.

Table 25-1: Estimated Metallurgical Recoveries for Maturi and Birch Lake

Maturi

Metal	Recovery Concentrate	Recovery CESL™	Recovery Global
Copper	94.3	96.3	90.8
Nickel	72.0	95.6	68.8
Platinum	93.0	59.4	55.2
Palladium	90.0	70.7	63.6
Gold	85.0	74.5	63.3

Birch Lake

Metal	Recovery Concentrate	Recovery CESL™	Recovery Global
Copper	94.3	96.3	90.8
Nickel	60.0	95.6	57.4
Platinum	93.0	59.4	55.2
Palladium	90.0	70.7	63.6
Gold	85.0	74.5	63.3

25.8 Mineral Resources

Indicated and Inferred Mineral Resources carry an inherent risk that they may not be converted to Mineral Reserves because of modifying factors and economic considerations. AMEC believes that the resources, as stated, have reasonable prospects for economic extraction but there is no guarantee that any of the resources will convert to reserves. The primary sources of this risk are economic and social. Preliminary estimated capital and operating cost estimates may not be confirmed by more detailed studies. Permitting may require significant time and expenditures which will also pose an economic risk to the project. Proximity to the Boundary Waters Canoe Wilderness Area will likely increase the time required for permitting and is both a social and economic risk.

The basis for the mineral resource estimate was a digital database received from TMM that included drill hole collar orientations, down-hole surveys, geological logging information for the trenches and drillholes completed by TMM and others as well as assay results for those samples. Following review and validation of the digital database AMEC concluded that the database was suitable to support estimation of Mineral Resources for all three deposits.

Estimation procedures for all three deposits are consistent with the style of mineralization and should accurately estimate the grade and tonnage of in situ mineralization.

Specific concerns and recommendations for each deposit are presented below.

25.8.1 Maturi

The Maturi deposit contains a significant resource currently classified as Inferred. It is possible the classification for some or all of this resource could be upgraded with additional drilling. AMEC has reviewed TMM's proposed drill program and has recommended additional drill holes in areas to reduce the current drill hole spacing. AMEC's recommendation also includes a cross of closely-spaced holes to help assess the local scale variability within the deposit once a starting point for mining is decided from mine planning.

Drilling in Maturi West Exploration target is planned for the upcoming winter (2012-2013) subject to USFS and the State of Minnesota granting the necessary permits.

25.8.2 Birch Lake

Significant issues that affect the Mineral Resource classification at Birch Lake are the faults which potentially affect underground mining operations and the location of the magma channel that controls the higher grades and greater thicknesses of mineralization.

AMEC recommends that:

- Drill fences be completed normal to the interpreted strike of the faults to determine the fault locations and the characteristics of the faults.
- Drill fences be completed across the axis of the magmatic channel to identify the channel margins and the characteristics of the channel margins.

25.8.3 Spruce Road

No current exploration has been performed at Spruce Road; thus, mineral resources have been estimated using unverified legacy data. When exploration continues at Spruce Road, verification of the legacy data by twin hole drilling should be a priority. Exploration drilling outside the current drill pattern is expected to identify additional resources because the current resource estimate extends to the limit of drilling.

26.0 RECOMMENDATIONS

AMEC has proposed a two-stage work program for the Project, which consists of an initial drill program, followed by a resource estimate update.

AMEC recommends that 75,000 feet of core be drilled at Maturi to investigate stratigraphic irregularities, close-range variability of the mineralization, and to potentially support conversion of Inferred Mineral Resources to Indicated Mineral Resources. The proposed drill program and AMEC's recommendations are shown in Figure 26-1 with details of the closely-spaced drilling in Figure 26-2.

At Birch Lake, approximately 100,000 feet of drilling is expected to be necessary to investigate stratigraphic irregularities, close-range variability of the mineralization, and to potentially support conversion of Inferred Mineral Resources to Indicated Mineral Resources. The optimum locations for the drill hole collars are still under evaluation.

Once the drill data are available, mineral resource estimates should be updated.

A summary of the estimated budget for the recommendations is shown in Table 26-1.

Table 26-1: Estimated Cost of Recommendations

Budget Item	Amount	Units	Cost/unit	Estimated Cost (US$)
Exploration Drilling	175,000	ft	60	10,500,000
Drill Support				1,050,000
Assays	5,500	ea	55	302,500
Geology Support				250,000
Resource Update				500,000
Total				12,602,500

Duluth is focusing on the current evaluation of the Maturi and Birch Lake deposits for the purposes of the Prefeasibility Study, so no additional exploration is planned for Spruce Road in the near term. The number of drill holes and optimal collar locations should be evaluated when Duluth is ready to recommence work on the deposit. AMEC has suggested that about 15–20 core holes may be required to twin existing legacy drilling and verify the legacy data.

Figure 26-1: Maturi Proposed Drill Program and Recommendations

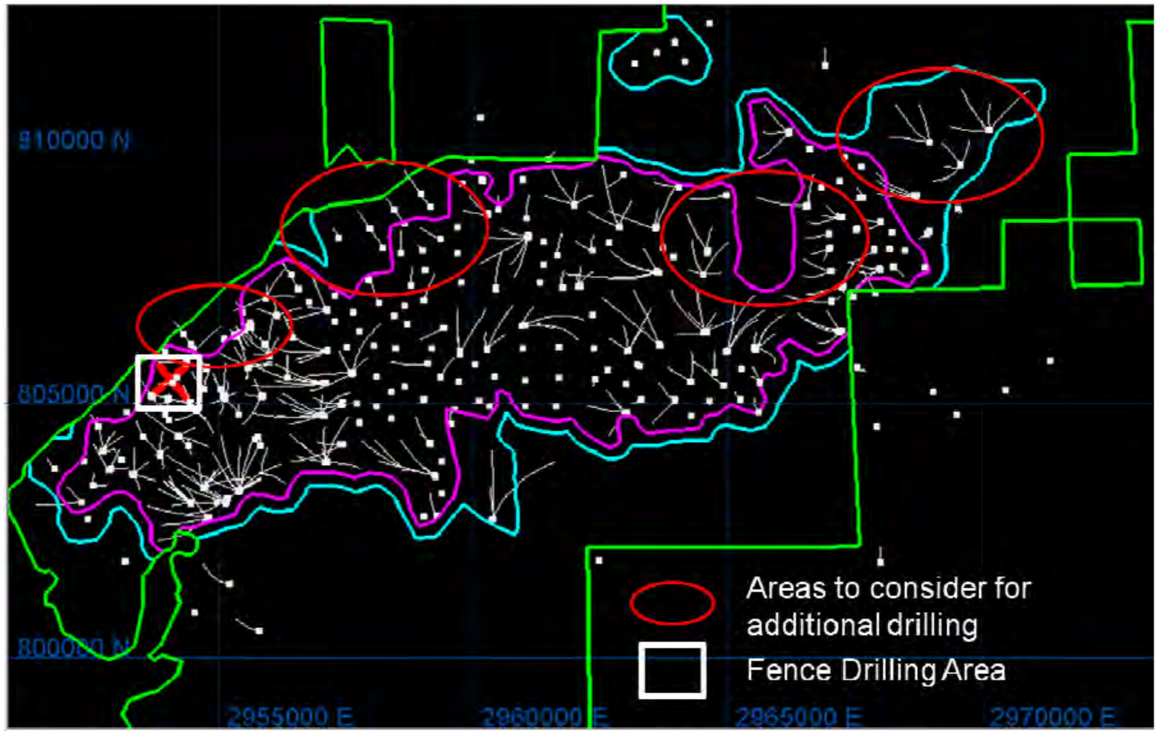
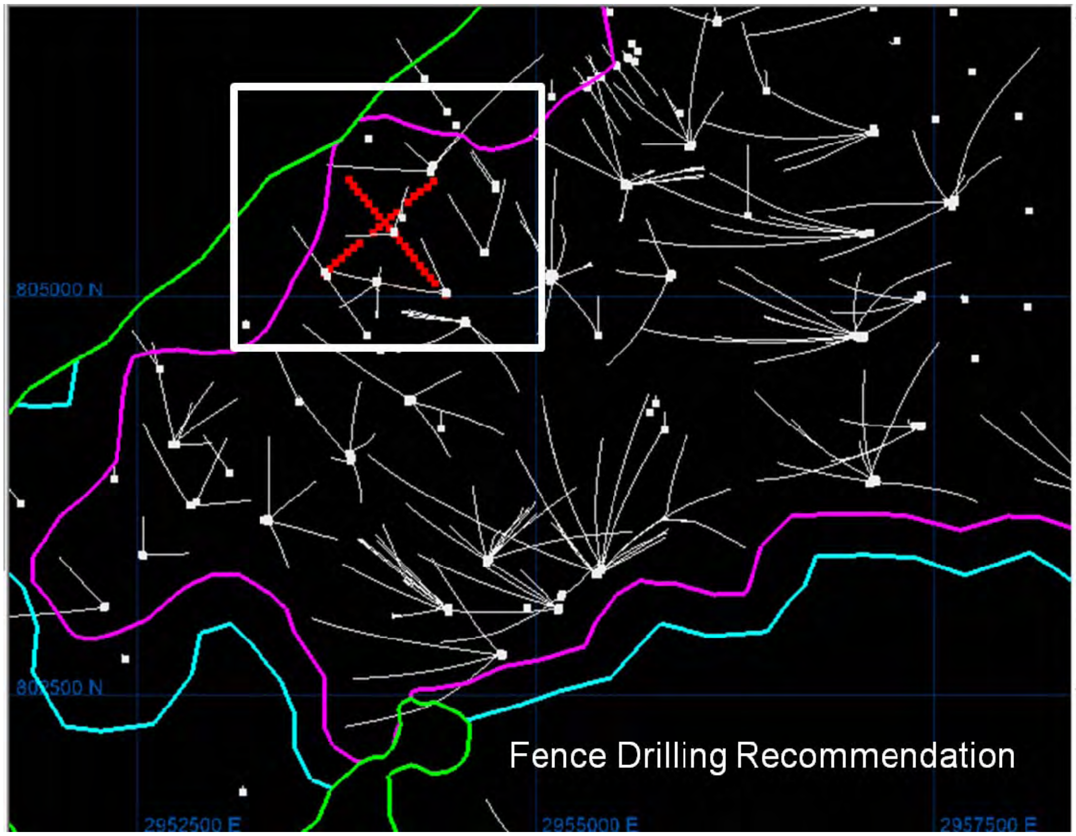


Figure 26-2: Maturi Proposed Close Spaced Drilling



27.0 REFERENCES

Alminas, H.V., 1975, Soil Anomalies Associated with a Cu-Ni Mineralization in the South Kawishiwi Area, Northern Lake County, Minnesota; U.S. Geological Survey Open File Report 75-158.

Alminas, H.V., Tompkins, M.L., and Domenico, J., 1986, Analytical Results for Rock and B-horizon Soil Samples Collected from the Northwestern Portion of the Duluth Complex, Northeastern Minnesota; NTIS tape USGS-GD-86-006.

AMEC, 2012a, Preliminary Mineral Resource Estimate for the Maturi, Birch Lake, and Spruce Road Deposits Ely Minnesota; 11 May 2012, Consultant Report to Twin Metals Minnesota, Inc., 185 p.

AMEC, 2012b, Nokomis/Maturi and Birch Lake Projects QA-QC Report; 5 January 2012, AMEC Report to Twin Metals Minnesota, 94 p.

AMEC, 2012c, Mineral Resource Estimate for the Maturi, Birch Lake, and Spruce Road Deposits Ely, Minnesota: 29 November 2012, Consultant Report to Twin Metals Minnesota, Inc., 316 p.

Amplats, 1998, The Mineralogy and Metallurgical Response of Boreholes BL98-1 and BL98-1W from Birch Lake, Duluth Complex, Minnesota; Unpublished report, August 26, 1998, 9 p.

Bechtel Corporation, 1967, Preliminary Engineering and Cost Study, Inco, Ely, Minnesota; 17 July 1967, Report by Bechtel Corporation for Inco, 274 p. (In NRRI Files)

Boerboom, T.J., 1994, Archean Crustal Xenoliths in a Keweenawan Hypabyssal Sill, Northeastern Minnesota. White was right!; Abstract, 40th Annual Institute on Lake Superior Geology, Part1 – Program and Abstracts, Houghton, Mi, v. 40, p. 5-6.

Boerst, K., 2011, Geological and Grade Domains of the Maturi-Nokomis Deposit; 2 May 2012, Twin Metals Minnesota Internal Memorandum, 16 p.

Bonnichsen, B., 1972, Southern Part of the Duluth Complex; *in* Sims, P. K. and Morey, G. B. *eds* Geology of Minnesota: A Centennial Volume, Minnesota Geological Survey, 1972, p. 361-387.

Bonnichsen, B., 1972, Sulfide Minerals in the Duluth Complex; *in* Sims, P. K. and Morey, G. B. *eds.* Geology of Minnesota: A Centennial Volume, Minnesota Geological Survey, 1972, p. 388-393.

Cabri, L.J., 2002, A Mineralogical Study of Samples from the Birch Lake PGE-Cu-Ni Prospect in the Duluth Complex, Northeastern Minnesota; Unpublished report, April 20, 2002, 49 p.

Car, D., 1992, An Overview of Inco Activities within the Duluth Complex; April 1992, Inco Exploration and Technical Services Inc. Report, 19 p.

Caracle Creek International Consulting Inc, (CCIC), 2004, Independent Technical Report: San Francisco Zinc (Utah), Mahoney Zinc (New Mexico), and Birch Lake PGE (Duluth Complex, Minnesota) Properties, United States of America; 16 April 2004, NI 43-101 Report Prepared by Caracle Creek International Consulting Inc. for Franconia Minerals Corp., 360 p.

Cargill, D.G., 2005a, Maturi Extension Property, Minnesota U.S.A. Valuation Report; 20 June 2005, Unpublished Report Prepared by Roscoe Postle Associates Inc. for Wallbridge Mining Company, 38 p.

Cargill, D.G., 2005b, Technical Report on the Maturi Extension Property, Minnesota, U.S.A.; 30 December 2005, NI 43-101 Technical Report by Roscoe Postle Associates Inc. prepared for Wallbridge Mining Company, 90 p.

Chandler, V.W., and Lively, R.S., 2000, Preliminary Gravity and Magnetic Grids for the Duluth Complex of Northeastern Minnesota and Adjacent Areas; Minnesota Geological Survey Open-File Report 00-1, 6 grids and 1 data file.

Chase, C.G., and Gilmer, T.H., 1973, Precambrian Plate Tectonics; the Midcontinent Gravity High; Earth and Planetary Science Letters, v. 21, p. 70-78.

Clow, G.G. and Routledge, R.E., 2005, Preliminary Assessment of the Mineral Resources of the Birch Lake Property; 19 November 2005, NI 43-101 Technical Report by Roscoe Postle Associates Inc. prepared for Franconia Mineral Corporation, 90 p.

Clow, G.G., Cox, J.J., Routledge, R.E., and Hayden, A.S., 2006, Technical Report on the Preliminary Assessment of the Birch Lake and Maturi Deposits, Minnesota, U.S.A.; 20 October 2006, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 175 p.

Clow, G.G., Hwozdyk, L.R., Routledge, R.E., McCombe D.A. and Scott, K.C., 2008, Technical Report on the Preliminary Assessment on the Nokomis Project, Minnesota, U.S.A.; NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 184 p.

Cole, S., et al., 2000, An investigation of the recovery of copper and nickel from Duluth Complex ore samples: Unpublished Report by Lakefield Research for Wallbridge Mining Company Ltd.

Cole, Steve (2002): Scoping flotation program. Unpublished Lakefield Research Limited letter report, 10 p.

Cox, J.J., Routledge, R.E., and Krutzelmann, H., 2009, Preliminary Assessment of the Nokomis Project, Minnesota, U.S.A.; 8 January 2009, NI 43-101 Technical Report prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 182 p.

Dahlberg, E.H., 1987, Drill Core Evaluation for Platinum Group Mineral Potential of the Basal Zone of the Duluth Complex; Minnesota Department of Natural Resources Report 255, 41 p.

Dahlberg, E.H. and Alminas, H.V., 1994, Platinum, Palladium and Gold Distribution in B-horizon Soils in the Northwestern Part of the Duluth Complex Minnesota; Minnesota Department of Natural Resources Report 308, 15 p.

Dahlberg, E.H., Peterson, D., and Frey, B.A., 1989, 1988-1989 Drill Core Repository Sampling Projects, Minnesota Department of Natural Resources Reports 255-1, 265 and 266, 368 p.

DeGagné, D.O., Petersen, L., Pierce, M., 2012, Summary of Geomechanical Data Collection; 13 June 2012, Memorandum Report by Itasca Consulting Group, Inc to Tim Jefferson (TMM) and Ted Eggleston (AMEC), 8 p.

Downey, P.G., 2006, Independent Technical Report on the NorthMet Project (located in N-E Minnesota, USA, near the town of Babbitt); September 2006, NI 43-101 Technical Report Prepared by P. Downy and Associates for Polymet Mining Inc., 63 p.

Eckstrand, R.O. and Hulbert, L.J., 2007, Magmatic Nickel-Copper-Platinum Group Element Deposits; in Goodfellow, W.D., ed., Mineral Deposits of Canada: a Synthesis of Major Deposit Types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods; Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p. 205-222.

Eggleston, T.L., 2012, Silicate Nickel Study; 9 April 2012, AMEC Memorandum to Twin Metals Minnesota, 11p.

Fedorowich, J., 2012, Fault Model for Nokomis-Maturi and Birch Lake Ni-Cu-PGE Deposits, NE Minnesota – Draft; May 2012, Itasca Consulting Canada Inc. Report to Twin Metals Minnesota, 36 p.

Ferron, C.J., Flemming, C.A., O'Kane, P.T. and Dreisinger, D., 2002, Pilot Plant Demonstration of the PLATSOL Process for the Treatment of the NorthMet Copper-Nickel-PGM deposit; December 2002, Mining Engineering, Vol. 54, No. 12, p.33-39.

Gál, B., Molnár, F., Mogessie, A., and Peterson, D.M., 2010, Fluid-segregation in the South Kawishiwi Intrusion, Duluth Complex and its Role in Metal Distribution - Implications from Field Evidences, Petrography and Mineral Chemistry: Poster at 2010 Society of Economic Geologists Conference.

Gavin, B., 2005, Drilling reveals higher grade copper-nickel-PGM results at Birch Lake project, Minnesota. Public Release (SEDAR), November 3, 2005, 3 p.

Geerts, S.D., 1991, Geology, Stratigraphy, and Mineralization of the Dunka Road Cu-Ni Prospect, Northeastern Minnesota; June 1991, NRRI, University of Minnesota, Technical Report NRRI/GMIN/TR-91/14, 74 p.

Geerts, S.D., R.J., Barnes, and Hauck, S.A., 1990, Geology and Mineralization in the Dunka Road Copper-Nickel Mineral Deposit, St. Louis County, Minnesota; March 1990, Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/GMIN-TR-89-16, 80 p.

Grammatikopoulos, T., 2000, Mineralogical examination of one head sample; Report by Lakefield Research for Wallbridge Mining Company Ltd.

Green, J.C., Phinney W.C., and Weiblen P.W., 1966, Gabbro Lake Quadrangle, Lake County, Minnesota; Minnesota Geological Survey Miscellaneous Map M-2.

Guiry, J.D., 1974, Minnesota Project Spruce Mine and Concentrator, Ely, MN;19 December 1974, Inco draft report, 206 p. (In NRRI files)

Hauck, S.A., 2003, Facsimile letter listing drill holes surveyed in the Birch Lake area by the Natural Resources Research Institute, Center for Applied Research and Technology Development, University of Minnesota, November 21, 2003, 1 p.

Hauck, S.A. and Severson, M.J., 2000, Platinum-Group Element-Gold-Silver-Copper-Nickel-Cobalt Assays Primarily from the Local Boy Ore Zone, Babbitt Deposit, Duluth Complex, Northeastern Minnesota: an Update; August 2000, Natural

Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/RI-2000/01, 49 p.

Hauck, S.A., Severson, M.J., Ripley, E., Goldberg, S., and Alapieti, T., 1997, Geology and Cr-PGE Mineralization of the Birch Lake Area, South Kawishiwi Intrusion, Duluth Complex; December 1997, Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/TR-97/13, 32 p.

Hauck, S.A., Severson, M.J., Zanko, L., Barnes, S-J, Morton P., Alminas, H.V., Foord, E.E., Dahlberg, E.H., 1995, An Overview of the Geology and Oxide, Sulfide, and Platinum Group Element Mineralization Along the Western and Northern Contacts of the Duluth Complex; GSA Special Paper.

Hayden, A.S., 2005, Franconia Minerals Corporation Birch Lake Project Review of Bench Scale Pressure Leaching Testwork and Preliminary Estimates of Capital and Operating Costs; April 2005, EHA Engineering Ltd. Report to Franconia Minerals Corporation Inc., 12 p.

Hayden, A. S., 2005, Birch Lake Project Review of Bench Scale Flotation Testwork; April 2005, EHA Engineering Ltd. Report to Franconia Minerals Corporation Inc, 11 p.

Impala Platinum Holdings Limited, 2002, Birch Lake Project geology report; Unpublished Impala Platinum Holdings Ltd. Company Report, July 2002.

Inco, 1975, Description of Operating Concepts Required to Establish Pre-Operational Monitoring for Inco's Spruce Road Project; July 1975, Inco Internal Report, 29 p.

Inco, 1966, Quantitative Mineralogical Examination of Samples from the Maturi and Spruce Ore Zones, Minnesota; 22 December 1966, J. Roy Gorden Research Laboratory report to Inco, 9 p. (In NRRI files)

Independent Mining Consultants, Inc., 2001, NorthMet Project, Minnesota Prefeasibility Study Volume 1 Project Summary; April 2001, NI 43-101 Technical Report prepared by Independent Mining Consultants Inc. report for PolyMet Mining Corporation, 222 p.

Jones, D. and Moore, R., 2002, CESL Process: Application to a Bulk Copper Nickel Concentrate; May 2002, Paper published at ALTA 202 COPPER-7 Technical Proceedings, Perth, Australia, 15 p.

Komppa, U.E., 1998, Oxide, Sulphide, and Platinum Mineralogy of the South Kawishiwi and Partridge River Intrusions of the Duluth Layered Intrusion Complex, Minnesota, U.S.A.; Unpublished Dissertation for the degree of Master of Science in Geology and Mineralogy (no. 77266S), presented to the Department of Geosciences, University of Oulu, 128 p. (English Translation by Malcolm Hicks. Natural Resources Research Institute (NRRI), University of Minnesota Technical Report, NRRI/RI-2002/01.)

Kuhns, M.J.P., Hauck, S.A., and Barnes, R.J., 1990, Origin and Occurrence of Platinum Group Elements, Gold and Silver in the South Filson Creek Copper-Nickel Mineral Deposit, Lake County, Minnesota; Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report, NRRI/TR-89-15, 67 p.

Lakefield Research Limited, 2000, An Investigation of the Recovery of Copper and Nickel from Duluth Complex Ore Samples Submitted by Wallbridge Mining Company; 24 January 2000, Lakefield Research Limited Report LR5558 to Wallbridge Mining Company, 53 p.

Lehmann E.K., 2002a, The Birch Lake Project Lake and St. Louis Counties, Minnesota supplement to 2002 Resource Estimate Prepared for Beaver Bay Joint Venture; 28 October 2002, Lehmann Exploration Management Inc. Report prepared for Beaver Bay Joint Venture, 13 p.

Lehmann Ernest K., 2002b, Comments on Birch Lake Project Review Reports; Unpublished memorandum, July 30, 2002, 8 p.

Lehmann, E.K., 2002c, The Birch Lake Project, Lake and St. Louis Counties, Minnesota, 2002 Resource Estimate Prepared for Impala Platinum Holdings Ltd. and Beaver Bay Joint Venture; 20 March 2002, revised 20 March 2002, Lehmann Exploration Management Inc. Report for Impala Platinum Holdings Ltd. and Beaver Bay Joint Venture February, 23 p.

Lehmann, E.K., 2003, The Birch Lake Project; a Plan for Development of a Major Platinum-Palladium-Copper-Nickel Resource in Northern Minnesota; 17 June 2003. Lehmann Exploration Management Inc. Report, 44 p.

Lehmann, E.K., 2005, The Birch Lake Project Lake and St. Louis Counties, Minnesota Resource Estimate Prepared for Franconia Minerals Corporation (US) Inc.; July 2005, Lehmann Exploration Management Inc. Report Prepared for Franconia Minerals Corporation and Beaver Bay Joint Venture, 26 p.

Lehmann Exploration Management Inc., 2001, The Birch Lake Project Review and Summary of Mining Environmental Review and Permitting in Minnesota; 20

February 2001, Lehmann Exploration Management Inc. Report prepared for Impala Platinum Holdings Ltd. and Beaver Bay Joint Venture, 88 p.

LeMaitre, R.W., 1989, A classification of igneous rocks and glossary of terms: Recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks: Oxford, Blackwell Scientific, 193 p.

Li, C. and Naldrett, A.J., 1999, Geology and Petrology of the Voisey's Bay Intrusion: Reaction of Olivine with Sulfide and Silicate Liquids; Lithos, v. 47, p. 1-31.

Long, S., 2012a, Acme Check Assays for Birch Project Years 1998-2001, 2005; 31 May 2012, AMEC Memorandum Report to Twin Metals Minnesota, 11p.

Long, S., 2012b, Acme Check Assays for Birch Project Years 2006-2008, 2010; 31 May 2012, AMEC Memorandum Report to Twin Metals Minnesota, 27p.

Long, S., 2012c, Estimating Nickel in Sulfide Minerals; 21 May 2012, AMEC Memorandum Report to Twin Metals Minnesota, 10 p.

Marma, J.C., Brown, P.E. and Hauck, S.A., 2002, Magmatic and Hydrothermal PGE Mineralization of the Birch Lake Cu-Ni-PGE Deposit in the South Kawishiwi Intrusion, Duluth Complex, Northeast Minnesota; Paper No.52-2 presented at the 2002 Denver Annual GSA meeting, October 27-30, 2002.

Milbourne, J., Tomlinson, M., and Gormely, L., 2003, Use of Hydrometallurgy in Direct Processing of Base Metal/PGM Concentrates; *in* Young, C.A., Alfantazi, A.M., Anderson, C.G., Dreisinger, D.B., Harris, B. and James, A. *eds.* Hydrometallurgy 2003-Fifth International Conference in Honor of Professor Ian Ritchie, Volume 1: Leaching and Solution Purification, The Minerals, Metals & Materials Society, 2003, p. 617-630.

Miller, J.D., 1999, Geochemical Evaluation of Platinum-Group Element (PGE) Mineralization in the Sonju Lake Intrusion, Finland, Minnesota; in press.

Miller, J.D. and Chandler V.W., 1997, Geology, Petrology and Tectonic Significance of the Beaver Bay Complex, Northeastern Minnesota; Geological Society of America Special Paper 312, pp. 73-97.

Miller, J. D., Green, J. C., Severson, M.J., Chandler, V.W., and Peterson, D.M., 2001, Geologic Map or the Duluth Complex and Related Rocks, Northeastern Minnesota; Minnesota Geological Survey, Map M-119 (two sheets).

Miller, J. D., Severson, M.J., and Hauck, S. A., 2002, History of Geologic Mapping and Mineral Exploration in the Duluth Complex; *in* Geology and Mineral Potential of the Duluth Complex and Related Rocks of Northeastern Minnesota; Report of Investigations 58, Minnesota Geological Survey, University of Minnesota, pp. 21-51.

Mogessie, A., and Stumpfl, E., 1991, The Role of Fluids in the Formation of Platinum-Group Minerals, Duluth Complex, Minnesota: Mineralogic, Textural, and Chemical Evidence; Economic Geology, v. 86, pp. 1506-1518.

Moreton, C., and Routledge, R.E., 2009, Technical Report on the Mineral Resource Estimate for the Nokomis Deposit on the Nokomis Property, Minnesota, U.S.A.; 10 December 2009, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 115 p.

Parker, H.M. and Eggleston, T.L., 2012, Maturi, Birch Lake, and Spruce Road Cu-Ni-PGE Projects Ely, Minnesota USA; 27 July 2012, NI 43-101 Technical Report prepared by AMEC E&C Services Inc. for Duluth Metals Limited, 302 p.

Parker, J., 2000, Mineability of the Birch Lake Cu-Ni-PGE deposit, Northeastern Minnesota; Unpublished letter report (rock mechanics) prepared by Jack Parker and Associates, 19 July 2000, 4 p.

Patelke, R.L., 1994, The Babbitt Copper-Nickel Deposit Part A: Digital Drill Hole Data Files for the Babbitt and Serpentine Copper-Nickel Deposits; September 1994, Natural Resources Research Institute (NRRI), University of Minnesota, Duluth, Minnesota, Technical Report NRRI/TR-94/21a, 48 p.

Patelke, R.L., 2002, Digital Drill Logs for the Duluth Complex; Natural Resources Research Institute (NRRI), University of Minnesota, Duluth, Minnesota, 3 p.

Patelke, R., 2003, Exploration Drill Hole Lithology, Geologic Unit, Copper-Nickel Assay and Location Database for the Keweenawan Duluth Complex, Northeastern Minnesota; Natural Resources Research Institute (NRRI), University of Minnesota Duluth Technical Report NRRI/TR-2003/21; 107 p. and digital database files.

Percy, G. R. and Sauerbrei, J. A., 1972, Evaluation of Inco's Ely Project, Minnesota; 10 March 1972, Inco Internal Report, 47 p. (on file with NRRI)

Peterson, D. M., 1997, Ore Deposit Modeling and Mineral Exploration Criteria for Footwall Copper-Platinum Group Element Mineralization in the Duluth Complex;

Project 317, Minnesota Department of Natural Resources, Division of Minerals, 55 p., 46 plates, 8 diskettes.

Peterson, D. M., 2001a, Copper-Nickel-PGE Mineral Potential of the Eastward Extension of the Maturi Cu-Ni Deposit, Duluth Complex; March 2001, Natural Resource Research Institute (NRRI), University of Minnesota, Report NRRI/RI-20001/02, 29 p.

Peterson, D. M., 2001b, Development of a Conceptual Model of Cu-Ni-PGE Mineralization in a Portion of the South Kawishiwi Intrusion, Duluth Complex, Minnesota; SEG, Second Annual PGE Workshop, Sudbury Ontario. (NRRI Paper, 3 p.)

Peterson, D. M., 2002a, Three Dimensional Views of the Basal Surface of the Partridge River intrusion.

Peterson, D.M., 2002b, 3D View through a Mineralized System, the S. Kawishiwi Intrusion, Duluth Complex; NRRI, U of Minnesota, Duluth.

Peterson, D.M., 2002c, Shaded Relief Map of the Basal Contact Surface of the South Kawishiwi Intrusion, Duluth Complex, Northeastern Minnesota; March 2002, Natural Resources Research Institute (NRRI), University of Minnesota, Map NRRI/Map-2002/01, 1 plate.

Peterson, D.M., 2002d, Copper-Nickel Grade Maps for the Spruce Road Deposit, South Kawishiwi Intrusion, Duluth Complex; Natural Resources Research Institute (NRRI), University of Minnesota Report NRRI/RI-2002/03, 96 p.

Peterson, D.M., 2004, Development of a Conceptual Model of Cu-Ni-PGE Mineralization in a Portion of the South Kawishiwi Intrusion; Unpublished Power Point presentation.

Peterson, D.M., 2009a, The Nokomis Deposit: Geology, Origin, Models, and some Geochemical Attributes, 11 September 2009, Duluth Metals Internal Report, 46 p.

Peterson, D.M., 2009b, The Geology, Origin, and Ore Deposit Model for the Nokomis Deposit, Duluth Complex, Northeastern Minnesota; 22 September 2009, Duluth Metals Internal Report, 37 p.

Peterson, D.M., 2010, The Nokomis Cu-Ni-PGE Deposit, Duluth Complex, Minnesota: A Sulfide-Bearing Crystal Laden Magmatic Slurry; 7 April 2010, PowerPoint™ Presentation at 2010 IAGOD Conference, 42 p.

Peterson, D.M., Marma, J. and Brown, P., 2002, Bedrock Geology, Sample Location, Property Position Maps of the West Birch Lake Area, Lake and St Louis Co.; NRRI/MAP-2002/02.

Peterson, D.M., Patelke, R.L., and Severson, M.J., 2004, Bedrock Geology Map and Cu-Ni Mineralization Data for the Basal Contact of the Duluth Complex West of Birch Lake; NRRI/MAP 2004-02.

Phinney, W.C., 1969, The Duluth Complex in the Gabbro Lake Quadrangle, Minnesota: Minnesota Geological Survey Report of Investigations 9, 20 p.

Phinney, W.C., 1972, Duluth Complex, History and Nomenclature, *in* Sims, P.K., and Morey G.B., *eds.*, The Geology of Minnesota: A Centennial Volume, Minnesota Geological Survey, p. 333-334.

Phinney, W.C., 1972, Northwestern Part of Duluth Complex; *in* Sims, P.K., and Morey, G.B., *eds.*, The Geology of Minnesota: A Centennial Volume, Minnesota Geological Survey, p. 335-345.

Potter, S. and Haren, E., 2002, Impala Platinum Limited Birch Lake Project Review; Unpublished Snowden Mining Industry Consultants (Pty) Ltd. report, June 2002, 48 p.

Pratt, W., 2010, Site Visit: Birch Lake Cu-Ni-PGE-Au Project, Minnesota; 8 August 2010, Specialized Geological Mapping Report to Franconia Minerals Corporation, 23 p.

Routledge, R.E., 2004, Review of the Mineral Resources of the Birch Lake Property, Minnesota, U.S.A.; 22 January 2004, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 92 p.

Routledge, R.E., 2006, Technical Report on the Maturi Extension Property, Minnesota, USA; 31 May 2006, NI 43-101 Technical Report Prepared by Roscoe Postle Associates Inc. for Duluth Metals Limited, 69 p.

Routledge, R.E., 2007, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 8 August 2007, NI 43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 112 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Nokomis Deposit on the Maturi Extension Properties, Minnesota, U.S.A.; 18 July 2008, NI

43-101 Technical Report Prepared by Scott Wilson Roscoe Postle Associates Inc. for Duluth Metals Limited, 107 p.

Routledge, R.E., 2008, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 22 August 2008, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 139 p.

Routledge, R.E., 2009, Technical Report on the Resource Estimate for the Birch Lake Property, Minnesota, U.S.A.; 18 September 2009, NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 164 p.

Routledge, R.E. and Galyen, R., 2010, Technical Report on the Resource Estimate Update for the Birch Lake Property, Minnesota, U.S.A.; NI 43-101 Technical Report by Scott Wilson Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 151 p.

Routledge, R.E. and Greenough, G., 2006, Technical Report on the mineral resource estimate for the Maturi Property, Minnesota, U.S.A.; 30 June 2006, NI 43-101 technical report prepared by Roscoe Postle Associates Inc. for Franconia Minerals Corporation, 96 p.

Rowell, W.F., 2001a, Birch Lake PGE-Cu-Ni prospect Northeastern Minnesota summary of program to check analytical results and determine specific gravity; Unpublished Lehmann Exploration Management Inc. report, June 2001, 53 p.

Rowell, W.F., 2001b, Summary of 2000 drilling program on the Birch Lake platinum-group element-Cu-Ni prospect Northeastern Minnesota, USA March-December 2000 Part 1 summary of drill holes for Impala Platinum Holding Ltd. and Beaver Bay Joint Venture; Unpublished Lehmann Exploration Management Inc. report, February 2001, 119 p.

Rowell, W.F., 2001c, Summary of 2000 drilling program on the Birch Lake platinum-group element-Cu-Ni prospect Northeastern Minnesota, USA March-December 2000 Part 2 geology and geochemistry for Impala Platinum Holding Ltd. and Beaver Bay Joint Venture; Unpublished Lehmann Exploration Management Inc. report, February 2001, 15 p.

Rowell, W.F., 2002a, Summary of 2001 drilling program on the Birch Lake platinum-group element–Cu-Ni prospect Northeastern Minnesota, USA June-November 2001 Part 1 geology and geochemistry for Impala Platinum Holding Ltd. and the

Beaver Bay Joint Venture; Unpublished Lehmann Exploration Management Inc. report, February 2002, 119 p.

Rowell, W.F., 2002b, Summary of 2001 drilling program on the Birch Lake platinum-group element-Cu-Ni prospect Northeastern Minnesota, USA June-November 2001 Part 2 geology and geochemistry for Impala Platinum Holding Ltd. and the Beaver Bay Joint Venture; Unpublished Lehmann Exploration Management Inc. report, March 2002, 26 p.

Sawyer, E.W., 2002, Report on Thin Sections From DDH WM-1, Spruce Road Cu-Ni Deposit, South Kawishiwi Intrusion, Duluth Complex; Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/RI-2002/13, 21 p.

Schulz. K. and Cannon, W., 1998, Potential for new Nickel-Copper sulfide deposits in the Lake Superior Region: internet address <http://minerals.er.usgs.gov/emrst/pub/mwni_cu/index.html, 6 p.

Severson, M.J., 1991, Geology, Mineralization, and Geostatistics of the Minnamax/Babbitt Cu-Ni Deposit (Local Boy Area), Minnesota Part I: Geology; June 1991, NRRI, University of Minnesota, Technical Report NRRI/GMIN/TR-91/13a, 38 p.

Severson, M.J., 1994, Igneous Stratigraphy of the South Kawishiwi Intrusion, Duluth Complex, Northeastern Minnesota; Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/TR-93/34.

Severson, M.J., 1995, Geology of the Southern Portion of the Duluth Complex; December 1995, Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/TR-95/26, 185 p.

Severson, M.J., 1997, Water Hen Cu-Ni-PGE Footwall Mineralization; October 1997, Natural Resources Research Institute (NRRI), University of Minnesota, Technical Report NRRI/TR-97/18, 176 p.

Severson, M.J. and Barnes, R.J., 1991, Geology, Mineralization, Geostatistics of the Minnamax/Babbitt Cu-Ni Deposit (Local Boy Area), Minnesota, Part II: Mineralization and Geostatistics; Natural Resource Research Institute (NRRI), University of Minnesota, Technical Report, NRRI/TR-91/13b, 221 p.

Severson, M.J., and Hauck, S.A., 1990, Geology, geochemistry, and stratigraphy of a portion of the Partridge River Intrusion, Duluth Complex, Allen Quadrangle, Minnesota: Natural Resources Research Institute, Technical Report, NRRI/GMIN-TR-89-11, 236 p, 4 pls.

Severson, M.J. and Hauck, S.A., 1997, Igneous Stratigraphy and Mineralization in the Basal Portion of the Partridge River Intrusion, Duluth Complex, Allen Quadrangle, Minnesota; December 1997, Natural Resource Research Institute (NRRI), University of Minnesota, Technical Report, NRRI/TR-97/19, 102 p.

Severson, M.J., Miller, J. D., Peterson, D. M., Green, J.C., and Hauck, S. A., 2002, Mineral Potential of the Duluth Complex and Related Intrusions; *in* Geology and Mineral Potential of the Duluth Complex and Related Rocks of Northeastern Minnesota, Report of Investigations 58, Minnesota Geological Survey, University of Minnesota, pp. 21-51.

Severson, M.J., Patelke, R.L., Hauck, S.A., and Zanko, L.M., 1994, The Babbitt Copper-Nickel Deposit Part B: Structural Datums; September 1994, Natural Resource Research Institute (NRRI), University of Minnesota, Technical Report, NRRI/TR-94/21b, 48 p.

Severson, M.J., Patelke, R.L., Hauck, S.A., and Zanko, L.M., 1994, The Babbitt Copper-Nickel Deposit Part C: Igneous Geology, Footwall Lithologies, and Cross-Sections; March 1996, Natural Resource Research Institute (NRRI), University of Minnesota, Technical Report, NRRI/TR-94/21c, 77 p.

SGS Lakefield Research Limited, 2005a, The Recovery of Cu, Ni, Au and PGM's from a Birch Lake Flotation Concentrate; 27 July 2005, Unpublished Report LR 10854-003-Report 1 Prepared for Franconia Minerals Corporation (US) Inc., 8 p. and appendices.

SGS Lakefield Research Limited, 2005b, Copper/Nickel PGE Flotation on Birch Lake Samples; 6 April 2005, Unpublished report LR 10854-002-Final Report Prepared for Franconia Minerals Corporation (US) Inc. and Beaver Bay Joint Venture, 23 p. and appendices.

SGS Lakefield Research Limited, 2007, A Scoping Level Investigation into the Recovery of Copper, Nickel and PGMs from Ore of the Nokomis Deposit; 16 November 2007, Report prepared for Duluth Metals Corp.

Soever, A.T., 2000, Mineral Resource Estimate and Assessment of the Potential for Economic Mineralization within the Existing Resource at the Maturi and Spruce Road Deposits, Lake County, Minnesota; 26 April 2000, Report by Watts, Griffis and McOuat Limited for Wallbridge Mining Company Limited, 98 p.

Soever, A., 2001, Mineral Resource Estimate and Assessment of the Potential for Economic Mineralization Within the Existing Resource at the Maturi and Spruce Road Deposits, Lake County, Minnesota; Report by Watts, Griffis and McOuat Limited, Consulting Geologists and Engineers for Wallbridge Mining Company Ltd, 97 p.

Soever, A., 2002, Overview of the Maturi Extension Project; Unpublished report by Watts, Griffis and McOuat Limited, Consulting Geologists and Engineers for Wallbridge, Mining Company Ltd., 37 p.

Strommer, J., Morton, P., and Hauck, S.A., 1990, Geology and Mineralization of a Cyclic Layered Series, Water Hen Intrusion, St. Louis County, Minnesota; March 1990, NRRI, University of Minnesota, Technical Report NRRI/GMIN-TR-89-17, 38 p.

Thériault, R.D., Barnes, S.J., and Severson, M.J., 2000, Origin of Cu-Ni-PGE Sulfide Mineralization in the Partridge River Intrusion, Duluth Complex, Minnesota; Economic Geology, v. 95, p. 929-944.

Wakefield, T., 2011, Database Audit and Assay Testwork Progress Report; 29 July 2011, AMEC Report to David Oliver and others, 18 p.

Weiblen, P.W., 1965, A Funnel Shaped Intrusion in the Duluth Complex, Lake County, Minnesota; Ph.D. Dissertation, Univ. of Minn.

Weiblen, P.W. and Morey, G.B., 1975, The Duluth Complex – A Petrologic and Tectonic Summary: Minnesota Geological Survey Reprint Series 28, 48th. Annual Meeting, Minnesota Section, AIME, 1975.

Weiblen, P.W. and Morey, G.B., 1980, A Summary of the Stratigraphy, Petrology and Structure of the Duluth Complex; American Journal of Science, v. 280-A, p. 88-133.

Williamson, A.L., 2012, Opinion on Environmental Items for Use in Duluth Metals Ltd NI 43-101 Report July 2012; 20 July 2012, Letter from Anne Williamson, TMM Vice President of Environment and Sustainability to Ted Eggleston, 3 p.

Zanko, L.M., 1996, The Babbitt Copper-Nickel Deposit, Part C; Igneous Geology, Footwall Lithologies, and Cross-Sections; Natural Resources Research Institute, University of Minnesota, Duluth, Technical Report NRRI/TR-94/21c, 79 p.

Zanko, L.M., Severson, M.J., and Ripley, E.M., 1994, Geology and Mineralization of the Serpentine Copper-Nickel Deposit; December 1994, Natural Resources

Research Institute (NRRI), University of Minnesota, Duluth, Technical Report NRRI/TR-93/52, 99 p.