



**Technical Report
Firebag Property
Alberta, Canada**

Submitted to:
Athabasca Minerals Inc.

Report Date: Effective Date:
November 27, 2019 November 8, 2019

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Project No. 129500285

Important Notice

This notice is an integral component of the Firebag Property Technical Report (Technical Report or Report) and should be read in its entirety and must accompany every copy made of the Technical Report. The Technical Report has been prepared in accordance with the requirements of National Instrument 43-101 Standards of Disclosure for Mineral Projects.

The Technical Report has been prepared for Athabasca Minerals Inc. by Stantec Consulting Ltd (Stantec). The quality of information, conclusions, and estimates contained herein are consistent with the level of effort involved in the services of Stantec, based on: i) information available at the time of preparation of the Report, and ii) the assumptions, conditions, and qualifications set forth in this Report.

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CERTIFICATE OF QUALIFICATIONS

I, William A. Turner, P. Geol., do hereby certify that:

1. I am currently employed as Manager, Geology by Stantec Consulting Ltd., 200-325 25 Street S.E., Calgary, Alberta, Canada T2A 7H8.
2. I graduated with a Bachelor of Science degree from the University of Alberta in 1995, and a Master of Science degree from the University of Alberta in 2000.
3. I am a member in-good-standing of the Association of Professional Engineers, Geologists and Geophysicists of Alberta (Member 58136) and a member in-good-standing of the Association of Professional Engineers, Geologists and Geophysicists of Saskatchewan (Member 15364), and a member in-good-standing of the Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (Member L3656).
4. I have 24 years as a Geologist since graduating from my undergraduate degree in Geology. I have 13 years of project experience identifying and evaluating the physical properties and quantities of surficial materials that include aggregate (sand and gravel) assessment. I have completed several exploration and property assessment projects for sand that involved sample collection by test pit excavation and drilling, and the coordination and interpretation of laboratory analyses that conformed to International Organization for Standardization (ISO) 13503-2 standards. I have acted as the Qualified Person for several proppant Technical Reports.
5. I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101), and past relevant work experience, I meet the requirements to be a “Qualified Person” for the purposes of NI 43-101.
6. I am responsible for the preparation of portions of Sections 1 to 4, Section 5, portions of Section 6, Sections 7 to 9, portions of Sections 10 to 12, Section 13, Sections 15 through 24 and portions of Sections 25, 26, and 27 of the report titled “Technical Report Firebag Property, Alberta, Canada” dated November 27, 2019, Effective Date November 8, 2019.
7. I have read NI 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
8. I personally inspected the Property and collected samples on November 7, 2019.
9. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Report, the omission to disclose which makes the Report misleading.
11. I am independent of the issuer applying all of the tests in Section 1.5 of NI 43-101.

Dated this 27th day of November 2019.

“Original Signed and Sealed by Author”

William A. Turner, P.Geol.
Manager, Geology



CERTIFICATE OF QUALIFICATIONS

I, Andrew Christopher Hunter (Chris), P. Geol., do hereby certify that:

1. I am currently employed as Senior Resource Geologist by Stantec Consulting Limited (Stantec) 200-325 25 Street SE Calgary, Alberta, Canada T2A 7H8.
2. I graduated with a Bachelor of Science degree from Lakehead University Thunder Bay, Ontario in 1994.
3. I am a member in-good-standing of the Association of Professional Engineers and Geoscientists of Alberta, (Member 88635) and a member in-good-standing of the Association of Professional Geoscientists of Ontario (Member 2871).
4. I have 23 years of experience in mine geology and resource modelling for since my graduation from university. I have produced computer-based geological models for several different commodities, work which includes the estimation of resources. I have explored for and delineated multiple glacial sand deposits for use in aggregate and frac sand applications in Alberta and Saskatchewan. I have carried out sieve analysis and reviewed results of third-party laboratories analysis work.
5. I have read the definition of “qualified person” set out in National Instrument 43-101 (NI 43-101) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101), and past relevant work experience, I meet the requirements to be a “Qualified Person” for the purposes of NI 43-101.
6. I am responsible for the preparation of portions of Sections 1 to 4, portions of Section 6, portions of Sections 10 to 12, Section 14, and portions of Sections 25, 26, and 27 of the report titled “Technical Report Firebag Property, Alberta, Canada” dated November 27, 2019, Effective Date November 8, 2019.
7. I have read NI 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
8. I have not conducted an inspection of the Property.
9. At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Report, the omission to disclose which makes the Report misleading.
11. I am independent of the issuer applying all of the tests in Section 1.5 of NI 43-101.

Dated this 27th day of November 2019.

“Original Signed and Sealed by Author”

A.C. (Chris) Hunter, P.Geol.
Senior Resource Geologist



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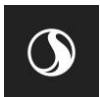
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Abbreviations

%	percent
~	approximate
°C	Degrees Celsius
°F	Degrees Fahrenheit
EPEA	Environmental Protection and Enhancement Act
ESRD	Alberta Environment and Sustainable Resource Development
AGAT	AGAT Laboratories Ltd.
Al ₂ O ₃	Aluminum Oxide
AMI	Athabasca Minerals Inc.
APEX	APEX Geoscience Ltd.
ASTM	American Society for Testing and Materials
ATV	All-Terrain Vehicle
Ba	Barium
C\$	Canadian dollars
CaO	Calcium Oxide (Quicklime)
CDEM	Canadian Digital Elevation Model
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CN	Canadian National Railway
Cr	Chromium
Dfb	Warm Summer Continental Climate
DLO	Department Lease of Occupation
DML	Department Miscellaneous Lease
Fe ₂ O ₃	Iron Oxide
g	gram
g/cm ³	grams per cubic centimetre
GPS	Global Positioning System
ha	hectares
ICP	Inductively Coupled Plasma
ISO	International Organization for Standardization
k	thousand
K ₂ O	Potassium Oxide
kg	kilogram(s)
km	kilometre(s)
K-Value	Proppant Crush Classification
LOI	Loss of Ignition
Loring	Loring Laboratories Ltd.
m	Metre(s)
masl	Metres above sea level
MgO	Magnesium Oxide
mm	Millimetre(s)
MnO	Manganese Oxide
Mt	Million tonnes
Na ₂ O	Sodium Oxide
Ni	Nickle
NI 43-101	National Instrument 43-101
NTU	Nephelometric Turbidity Units
P ₂ O ₅	Phosphorous Pentoxide
PEA	Preliminary Economic Assessment
Property	Firebag Property
psi	pounds per square inch



TECHNICAL REPORT – Firebag Property, Alberta, Canada

RMWB	Regional Municipality of Wood Buffalo
SiO ₂	Silicon Dioxide (Quartz)
SML	Surface Material Lease
SO ₃	Sulfur Trioxide
Sr	Strontium
SREM	Sustainable Resource Environmental Management
Stantec	Stantec Consulting Ltd.
Stim-Lab	Stim-Lab, Inc.
TiO ₂	Titanium Dioxide
V	Vanadium
WCSB	Western Canadian Sedimentary Basin



1 SUMMARY

On November 5, 2019, Athabasca Minerals Inc. (AMI) contracted Stantec Consulting Ltd. (Stantec) to prepare a Technical Report in accordance with the requirements of National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101). The purpose of this Technical Report is to constrain the physical characteristics, thickness, depth and continuity of the unconsolidated Quaternary sand on the Firebag Property (Property) to assess its suitability as a natural proppant. As part of this evaluation, the quality and volumes of the natural proppant and the reasonable prospects for eventual economic extraction were assessed.

The Property is located 95 km north of Fort McMurray and 130 km southwest of Fort Chipewyan in the Regional Municipality of Wood Buffalo, northeastern Alberta in map sheets 074E06, 074E11, and 074E12. The Property area spans from 57°34'11"N to 57°35'07"N, and 111°17'33"W to 111°16'48"W, with the Property centre being located at approximately 57°34'41"N, 111°16'49"W. Access to the Property is via the Chipewyan winter road or by helicopter from Fort McMurray. Figure 1-1 shows the general location of the Property.

The Property consists of Quaternary sediments, sand and silts.

A Stantec Qualified Person inspected the Property on November 7, 2019. During this property inspection, the Qualified Person collected 10 sand samples with a soil auger at specified depths that aligned with previously tested areas. The samples were directly transported by the Qualified Person to Calgary and were taken by the Qualified Person to AGAT Laboratories Ltd. (AGAT) on November 7, 2019.

The Firebag Property includes four Alberta Public Land Dispositions; three of which are active and one is pending (Alberta Government, 2019; Altalis, 2019). The SMLs that apply to the Property are registered to AMI. In addition to the approved and pending SMLs, AMI also is granted a Department License of Occupation (DLO), and a Department Miscellaneous Lease (DML). The DLO was obtained to secure road access into the Property from the Fort Chipewyan winter road. The DML is to serve as a laydown and is located to the northeast of the DLO road and the SMLs.

As of August 25, 2014, AMI was granted the right to extract surface material from SLM 130021 for 10 years. SML 120032 is still in the application stage as of the Effective Date of this Technical Report. Assignment of a 10-year term to SML 120032 is contingent on meeting the reclamation stipulations required for SML 130021. The details of the Firebag Property held land dispositions are shown in Table 1-1.



Table 1-1
Firebag Property Land Dispositions

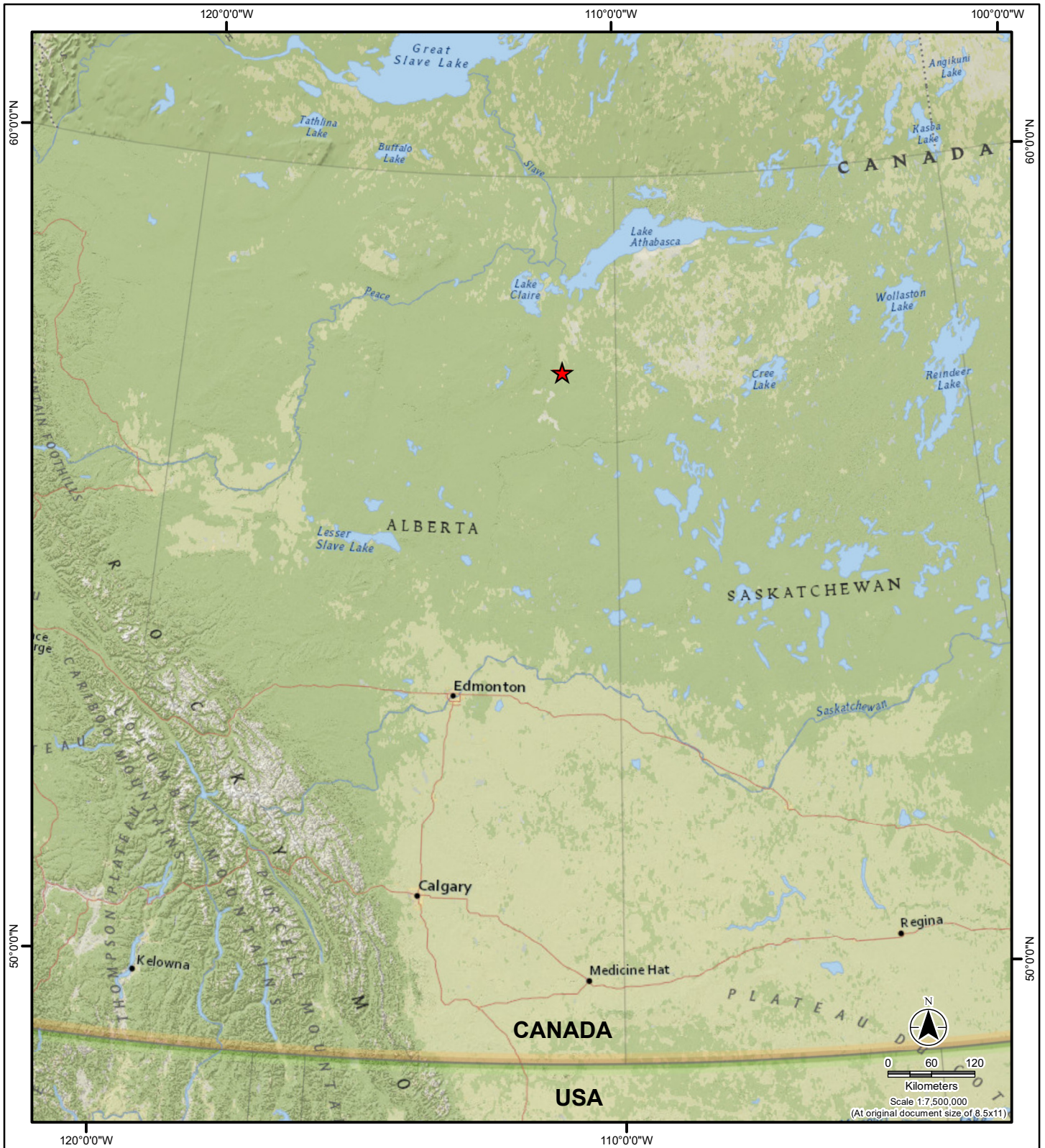
Agreement Number	Type	Status	Application Date	Effective Date	Amendment Date	Expiry Date	Area (ha)	Area (ac)
SML 130021	Surface Material Lease	Active / Disposed	2013-03-28	2014-08-25	2014-08-21	2024-08-24	32	80
SML 120032	Surface Material Lease	Approved Amendment For Surface Disposition	2012-04-30	-	2014-01-13	-	170	420
DLO 130748	Licence of Occupation	Active / Disposed	2013-03-28	2017-04-28	2014-09-18	2027-04-27	1	3
DML 130162	Miscellaneous Lease	Active / Disposed	2013-08-09	2017-04-28	2014-09-18	2027-04-27	10	25
Total							213	528

The Fort Chipewyan Winter Road runs along the western flank of the Property. This road is only accessible by truck during the winter months. Access to the Property may be possible year-round by all-terrain vehicles (ATV); however, winter is obviously the preferred time of the year to access the property and complete field work. The all-weather road gate at the north terminus of Highway 63 is seven kilometres south of the Property access. AMI's SMLs can also be accessed from an 860 m access road that is operated by AMI and intersects the Fort Chipewyan winter road.

In 2009, AMI commenced a regional exploration program to identify subsurface gypsum deposits as well as to examine dolomitized outcrops along the Firebag River. During this exploration program, AMI discovered sand that visually appeared to have high a silica purity. Samples were collected during this program, and geochemical and size distribution analyses were completed on the sand samples to assess its silica purity. The results of this preliminary study showed that the sand may have suitable physical properties to act as a proppant. Based on these results, the decision was made to conduct further exploration with test pit and auger testing in 2011.

Two auger drilling campaigns were completed in the vicinity of the Project to assess the extent and quality of the sand, and to constrain the optimal area to secure the surface material leases. Nineteen auger holes were drilled to approximately 14.3 m depth in January 2011. The location of auger hole TH6, which was drilled during this January 2011 campaign, was selected for further testing. In December 2011, a second field program was conducted in that area that involved the completion of 26 test pits and seven additional auger holes, which were drilled to 24.4 m depth. The results from this second testing campaign constrained the proposed SLM boundary.





Legend

★ Firebag Property



TECHNICAL REPORT FIREBAG PROPERTY

General Location Map

Figure 1-1

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Background Sources: National Geographic, Esri - ArcGIS Online basemap.

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Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Mineral Resource

The mineral resource shown in Table 1-2 is reported as in-place tonnages. The volumes calculated from the zone thickness were converted to tonnage by the application of representative average in-place bulk density of 1.5 g/cm³. The 20/40, 40/70, 70/140 and 140/170 fractions were assessed during the preparation of this report as each fraction has different applications during the hydraulic fracturing process.

Table 1-2
In-Place Mineral Resource Summary, Effective Date November 8, 2019

Category	Mineral Resources (Mt)				
	20/40 Mesh Fraction	40/70 Mesh Fraction	70/140 Mesh Fraction	140/170 Mesh Fraction	Total
MEASURED	-	-	-	-	-
INDICATED	4.45	19.34	13.40	0.98	38.18
MEASURED & INDICATED	4.45	19.34	13.40	0.98	38.18

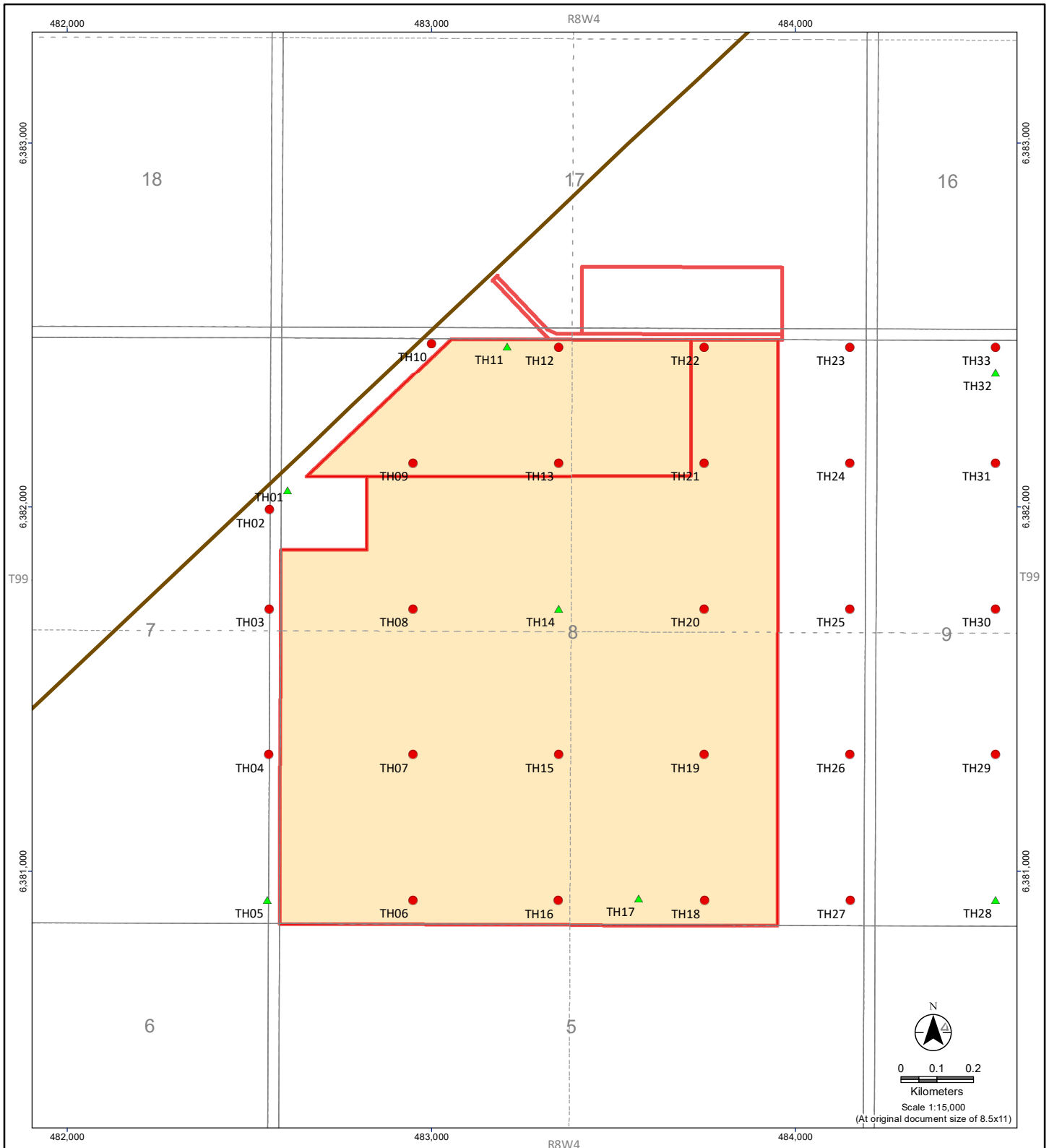
Mt = Million Tonnes

SML 130021 with 32.2 ha is calculated to have 6.02 Mt of saleable sand fractions and SML 120032 with 172.3 ha is calculated to have 32.16 Mt of saleable sand fractions.

A breakdown between the upper and lower zones, has the upper, Zone 1, with 37.4% of the resource based on 16 data inputs and the lower, Zone 2, contains 62.6% of the resource based on five data inputs analyses. The fractions outside of this reported range, the greater than 20 Mesh and less than 170 Mesh, sum to 1.50 Mt of non-saleable material.

The sand on the Property was classified as Indicated Resource based on the Qualified Person(s) experience with classifying flat lying stratified deposits. The resource is classified according to the confidence categories defined by *CIM Best Practice Guidelines for Industrial Minerals*, which was published by the CIM Estimation Best Practice Committee on November 23, 2003.





Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- ▭ Resource Distribution
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI

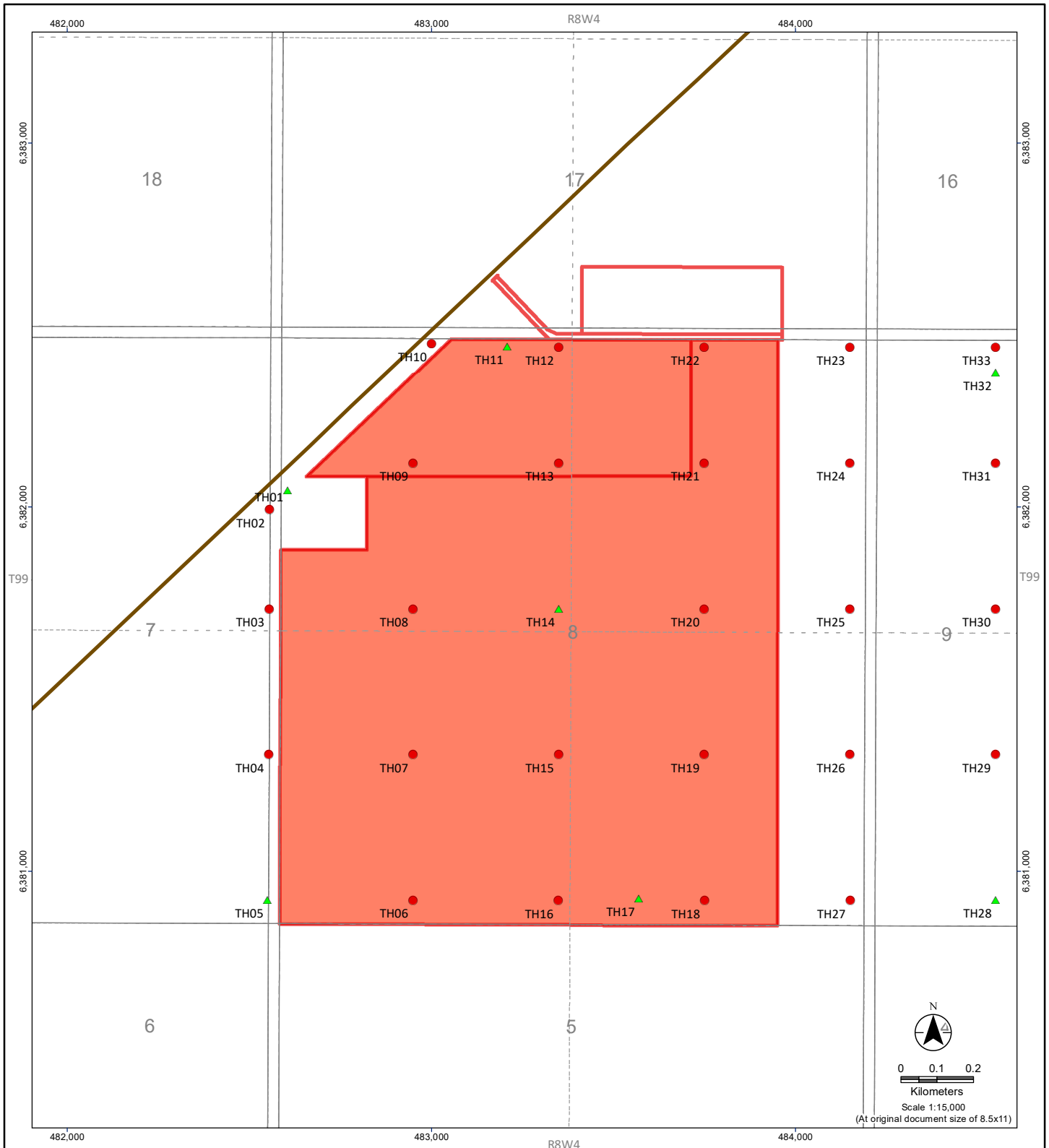


TECHNICAL REPORT FIREBAG PROPERTY

Resource Distribution Map

Figure 1-2

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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- ▭ Resource Classification - Indicated
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



TECHNICAL REPORT FIREBAG PROPERTY

Resource Classification Map

Figure 1-3

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Two follow-up phases are recommended to advance this Property.

Phase One: Sonic Drill Program (C\$101K)

Much of the testing on the Property has been completed through excavation of test pits; there are only five auger drill holes completed directly within the model. It is recommended that a subsequent mini sonic drill program be completed that penetrates through the base of the sand in all holes so that a comprehensive understanding of the sand thickness be obtained. Use of a mini sonic drill is recommended over the use of an auger drill at greater depths, such as depths greater than 25 m. Also, due to the advancement of continuous casing during drilling, the sonic core is not contaminated through dragging against the sidewall of the drill hole. It is recommended that approximately six sonic holes be completed in this phase.

Systematic continuous sampling is required to characterize potential variations in the sand that may occur spatially across the Property. Table 1-3 lists the required tasks and the estimated associated cost.

**Table 1-3
Phase 1: Sonic Exploration Program**

Task	Estimated Cost (C\$)
Personnel (Office, Field, Travel Expenses)	14,000
Six-Hole Drill Program (Rig and crew)	30,000
Laboratory (Sieve Analyses)	17,000
Laboratory (Proppant Testing & Shipment)	40,000
Estimate Total	101,000

Phase Two: Revised Preliminary Economic Assessment (C\$350K)

Depending on the results of the drilling, it is advised that a new geological model be developed, and the resource tonnage be reassessed and reclassified. A reevaluation of the economics is recommended as a Preliminary Economic Assessment (PEA) was last completed on the project in 2015. Stantec recommends an independent market assessment be completed to support a PEA. Table 1-4 shows the list of tasks that require revision following completion of Phase One.



Table 1-4
Phase 2: Preliminary Economic Assessment

Project Task	Fees (Cdn\$)
Project Management	\$10,000
Geology, Resource Evaluation, Reclassification	\$30,000
Water Management Plan	\$65,000
Extraction and Development Plan	\$90,000
Infrastructure / Transport / Process	\$80,000
Environmental / Regulatory / Permitting	\$5,000
Project Cost & Economic Analyses	\$40,000
Project Review and Reporting	\$30,000
Total	\$350,000



2 INTRODUCTION

On November 5, 2019, Athabasca Minerals Inc. (AMI) contracted Stantec Consulting Ltd. (Stantec) to prepare a Technical Report in accordance with the requirements of National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101). The purpose of this Technical Report is to constrain the physical characteristics, thickness, depth, and continuity of the unconsolidated Quaternary sand on the Firebag Property (Property) to assess its suitability as a natural proppant. If the quality and continuity of the sand is deemed prospective, then a resource estimate is to be completed and a resource classification assigned. As part of this evaluation, the quality and volumes of the natural proppant and the reasonable prospects for eventual economic extraction were assessed.

A Stantec Qualified Person inspected the Property on November 7, 2019. During this property inspection, the Qualified Person collected 10 sand samples with a soil auger at specified depths that aligned with previously tested areas. The samples were directly transported by the Qualified Person to Calgary and were taken by the Qualified Person to AGAT Laboratories Ltd. (AGAT) on November 7, 2019.

The “Effective Date” means, with reference to a Technical Report, the date of the most recent scientific or technical information included in the Technical Report.

The accuracy of resource estimates is, in part, a function of the quality and quantity of available data, and of engineering and geological interpretation and judgment. Given the data available at the time this report was prepared, the estimates presented herein are considered reasonable. They should, however, be accepted with the understanding that additional data and analysis available subsequent to the date of the estimates may necessitate revision. These revisions may be material. There is no guarantee that all or any part of the estimated resources will be recoverable.



3 RELIANCE ON OTHER EXPERTS

The Qualified Person(s) did not rely on a report, opinion or statement of another expert who is not a Qualified Person, or on information provided by the issuer, concerning legal, political, environmental, or tax matters.



4 PROPERTY DESCRIPTION AND LOCATION

4.1 Description and Location

The Property is located 95 km north of Fort McMurray and 130 km southwest of Fort Chipewyan in the Regional Municipality of Wood Buffalo, northeastern Alberta in map sheets 074E06, 074E11, and 074E12, as shown on Figure 4-1. The Property area spans from 57°34'11"N to 57°35'07"N, and 111°17'33"W to 111°16'48"W, with the Property centre being located at approximately 57°34'41"N, 111°16'49"W. Access to the Property is via the Chipewyan winter road or by helicopter from Fort McMurray. Figure 4-2 shows the location of the Property.

4.2 Licences and Leases

Surface Material Lease Applications

On April 30, 2012, AMI applied to Alberta Environment and Sustainable Resource Development (ESRD) for a SML that proposed a coverage of 500 acres. AMI received a response from the director of ESRD on May 30, 2012, that no decision to accept, reject, or require additional information regarding the application for the SML would be made until a decision was arrived at regarding the proposed project was to be considered under the provincial approval process.

On November 16, 2012, AMI received a letter stating that, as the sand was intended for use in industrial projects such as frac sand for drilling rather than standard commercial uses in buildings and roads, the *Alberta Aggregate Allocation Policy for Commercial Use on Public Lands* did not apply and therefore this SML application was outside of the bonus bid process described in the policy. This letter provided the additional explanation as quoted below.

“Under the *Public Lands Act Section 15(1)*, the director may prescribe terms and conditions for applications. In this case, the department accepts the application in principle and will consider the SML application subject to AMI satisfying the following additional terms and conditions:

- AMI is required to complete First Nations Consultation for the proposed project. AMI is required to prepare a consultation plan to be approved by the SREM Aboriginal Affairs Branch. The document will list the First Nations required to be consulted and bi-monthly reports of consultation activities will be submitted. These bi-monthly reports will be used to determine adequacy of consultation upon review of the completed application as an integral part of the merit decision for the approvals.
- AMI is required to undertake a voluntary Environmental Impact Assessment Report for the project area under the Environmental Protection and Enhancement Act (EPEA)
- AMI is required to participate in the Natural Resource Conservation Board Public Interest Decision Process.”



TECHNICAL REPORT – Firebag Property, Alberta, Canada

Further to this tentative project approval, a decision was made to amend the application of SML 120032 by requesting a change in size from 500 acres to 420 acres. The removed 80-acre package was to be separated out as an independent SML. In a letter dated January 13, 2014, AMI was approved by ESRD to change the SML land package size. The reason for creating two SMLs was that the ESRD wanted to monitor reclamation for a smaller 80-acre disposition, which subsequently became SML 130021, due to sensitive soil conditions as the topsoil and subsoil layers are very thin. AMI was granted the right to extract surface material from SLM 130021 for 10 years on August 25, 2014. Assignment of a 10-year term to SML 120032 is contingent on meeting the reclamation stipulations required for SML 130021.

AMI Land Dispositions

The Firebag Property includes four Alberta Public Land Dispositions; three of which are active and one is pending (Alberta Government, 2019; Altalis, 2019). The SMLs that apply to the Property are registered to AMI. In addition to the approved and pending SMLs, AMI also is granted a Department License of Occupation (DLO), and a Department Miscellaneous Lease (DML). The DLO was obtained to secure road access into the Property from the Fort Chipewyan winter road. The DML is to serve as a laydown and is located to the northeast of the DLO road and the SMLs (Figure 4-3). The details of the Firebag Property land dispositions are listed in Table 4-1.

Table 4-1
Firebag Property Land Dispositions

Agreement Number	Purpose	Status	Application Date	Effective Date	Amendment Date	Expiry Date	Area (ha)	Area (ac)
SML 130021	Surface Material Lease	Active / Disposed	2013-03-28	2014-08-25	2014-08-21	2024-08-24	32	80
SML 120032	Surface Material Lease	Approved Amendment For Surface Disposition	2012-04-30	-	2014-01-13	-	170	420
DLO 130748	Licence of Occupation	Active / Disposed	2013-03-28	2017-04-28	2014-09-18	2027-04-27	1	3
DML 130162	Storage - Stockpile	Active / Disposed	2013-08-09	2017-04-28	2014-09-18	2027-04-27	10	25
Total							213	528





Legend

★ Firebag Property



TECHNICAL REPORT FIREBAG PROPERTY

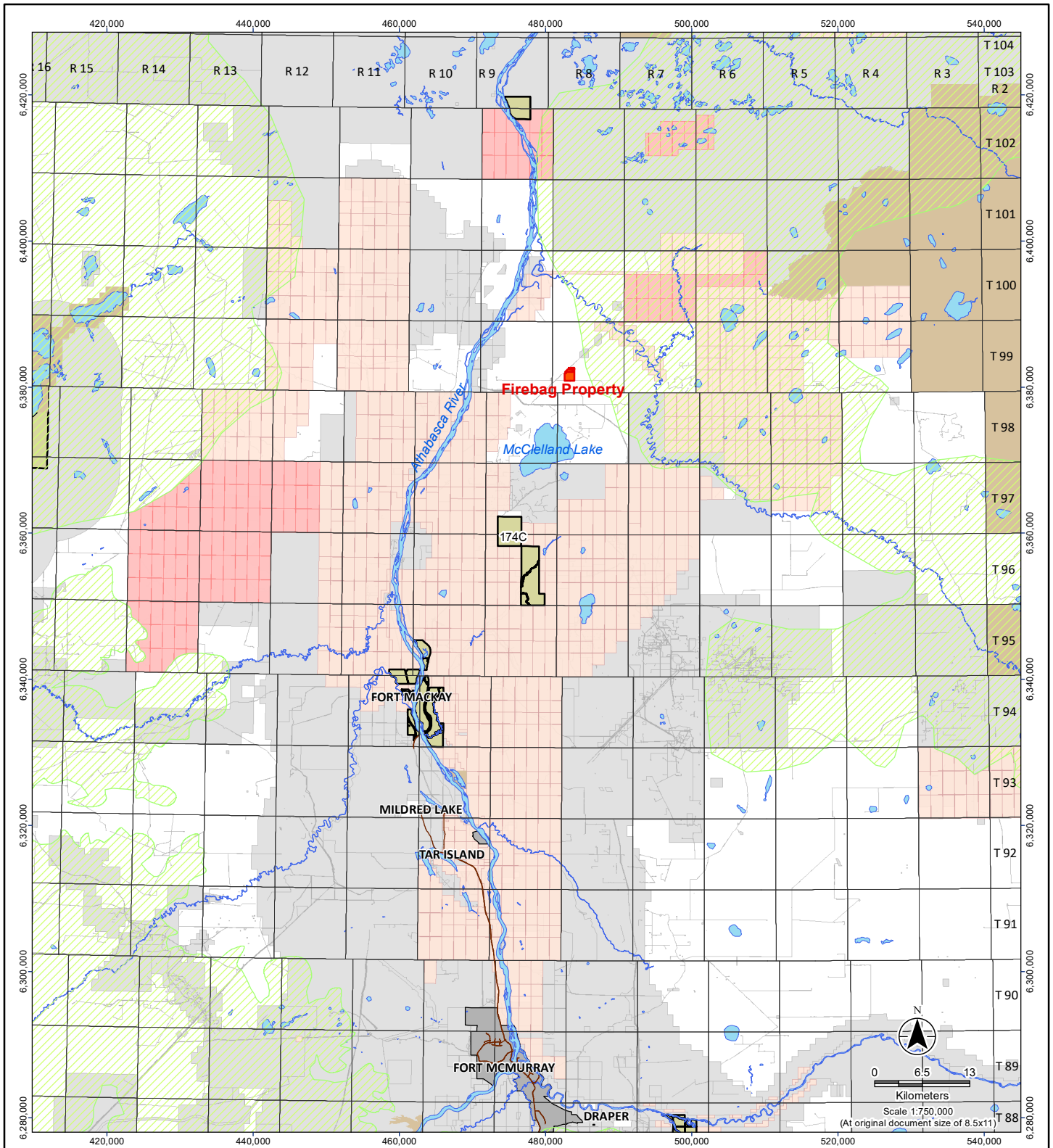
General Location Map

Figure 4-1

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Background Sources: National Geographic, Esri - ArcGIS Online basemap.

DRAWN BY: M.B. FILE: Fig_4_1_General_Location
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 DATE: 19/ 11/ 12

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Legend

- | | |
|--------------------|--|
| Caribou Range | Firebag Property |
| Lake / River | Other Land Dispositions |
| Protected Area | Metallic and Industrial Mineral Agreements |
| First Nations Area | Athabasca Minerals Inc. |
| City / Town | Other Owners |

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: base features - Altalis; Metallic and Industrial Mineral Agreements, 2017. <https://open.alberta.ca/opendata/>



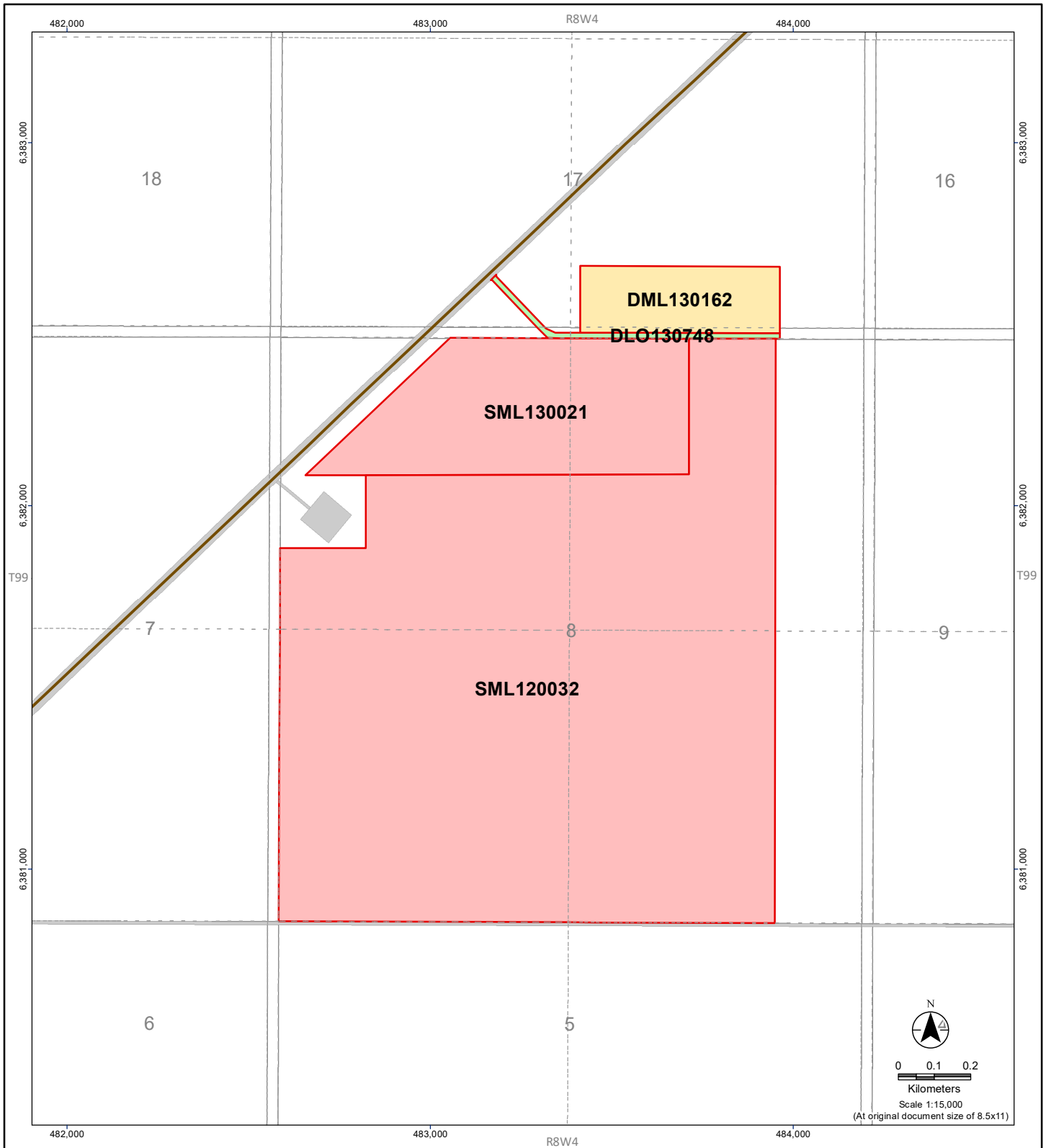
TECHNICAL REPORT FIREBAG PROPERTY

Property Location Map

Figure 4-2

DRAWN BY: M.B. FILE: Fig_4_2_Property_Location
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Legend

- License of Occupation (DLO)
- Miscellaneous Lease (DML)
- Surface Material Lease (SML)
- Other Land Dispositions
- 8 ATS Section
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Source: Altalis



TECHNICAL REPORT FIREBAG PROPERTY

Property Dispositions

Figure 4-3

DRAWN BY: M.B. FILE: Fig_4_3_Property_Dispositions
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 DATE: 19/ 11/ 26

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4.3 Underlying Agreements, Royalties and Encumbrances

Alberta Energy assigns commodity specific royalty rates on Alberta-owned metallic and industrial minerals. The lease holder is assigned a royalty rate of \$0.37/tonne of silica sand removed from a property (Government of Alberta, 2019).

4.4 Environmental Liabilities

AMI submitted the “Conservation and Reclamation Business Plan of SML 130021 in N ½ Section 8-99-08-4 (32.36 ha)” to ESRD in April 2014. This plan was approved by ESRD in August 2014.

The Author(s) is not aware of any environmental liabilities that may affect access, title or the right or ability to perform work on the Property.

4.5 Other Significant Factors and Risks

The Author(s) understands that SML 120032 is in the application stage, contingent on the operational outcome of SML 130021. If SML 120032 is not approved for development, then the sand resource estimate presented in Section 14.6 of this Technical Report would need to be reduced by approximately 84%.



5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Topography, Elevation, and Vegetation

The topography of the area varies from flat to gently sloped, with elevations ranging from approximately 304 m to 312 m above sea level (masl). In the western part of the SML, there is a subtle ridge that trends northward.

The SML area was partially burned by wildfires in 2011. In areas that were not burned, jack pine stands occur with average tree heights of 3.5 m, with diameters ranging from 3 cm to 8 cm.

5.2 Property Access and Proximity to Population Centers

The Fort Chipewyan Winter Road runs along the western flank of the Property. This road is only accessible by truck during the winter months. Access to the Property may be possible year-round by all-terrain vehicles (ATV); however, winter is the preferred time of the year to access the property and complete field work. The all-weather road gate at the north terminus of Highway 63 is seven kilometres south of the Property access. AMI's SMLs can also be accessed from an 860 m access road that is operated by AMI and intersects the Fort Chipewyan winter road; both are shown on Figure 5-1.

In addition to obtaining access by the Chipewyan Winter Road, access is also possible by air via fixed wing and helicopter from Fort McMurray, which is located approximately 95 km south of the Property. Fort McMurray is approximately 450 km north of Edmonton, Alberta, and is accessible by road or by regular daily commercial flights from both the Calgary International Airport and the Edmonton International Airport, as well as other regional and international airports throughout Alberta and Canada.

5.3 Climate

According to the Köppen-Geiger Climate Classification system, the Fort McMurray area falls under the warm summer continental climate subtype (“Dfb”) (Cantymedia, 2019, para. 2).

The average temperature in the Fort McMurray area ranges from highs of 17.1°C in July to lows of 17.3°C in January, although highs can reach up to 37°C in the summer, and lows as cold as -50°C in the winter (paras. 3 and 4).

Fort McMurray experiences precipitation in both rain and snow forms, totally 419.1 mm. July experiences the most rain on average, with 81.3 mm. February is the driest month on average, with 12.7 mm of precipitation, which could be either rain or snow. On average, the Fort McMurray area receives 1,338.58 mm of snow, most of which comes in January (paras. 5-7).



5.4 Infrastructure

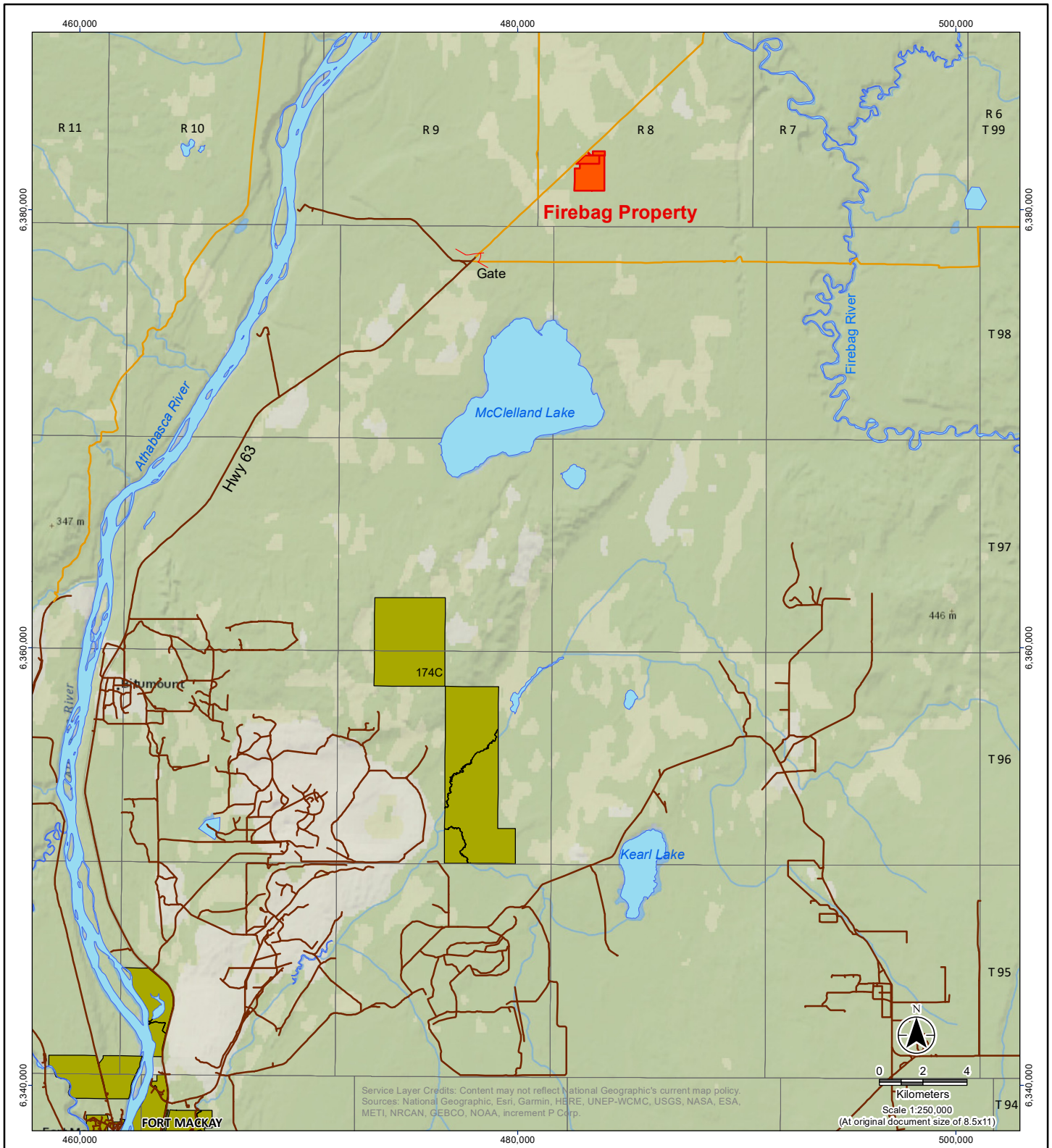
Rail shipping services to Fort McMurray are provided by the Canadian National Railway (CN). CN operates a rail line that runs from the rail terminus south of Fort McMurray to Edmonton.

The Kearl Mine is located approximately 18 km to the SE of the Property and has advanced power infrastructure.

Fort McMurray, Fort McKay, and Edmonton are population centres in Northern Alberta that can provide a skilled work force to assist with each stage of Property development.

Airstrips located within 50 km the Property west of the Athabasca River include the Albian Aerodrome, east of the Muskeg River Mine, and the Suncor Firebag Airport, south of the Kearl Mine.





Legend

- Firebag Property
- Lake / River
- First Nations Area
- Road
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: ESRI ArcGIS online basemap; Altalis.



TECHNICAL REPORT FIREBAG PROPERTY

Infrastructure Map

Figure 5-1

DRAWN BY: M.B. FILE: Fig_5_1_Access_Road
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6 HISTORY

6.1 Prior Ownership and Exploration Activities on the Property

AMI is the first documented company to have explored for, and subsequently leased, the Property for natural proppant. There are no records of exploration activities on the Property prior to AMI's exploration campaign commenced in 2009. Since the discovery of proppant sand in 2009 on the Property, there have not been changes in ownership. The results of the initial exploration campaign completed by AMI are documented in Cotterill, 2011.

6.2 Significant Historical Mineral Resource Estimates

The following present the historical sand resource estimates that were completed on the Property by third party consulting entities.

6.2.1 2014 Technical Report Mineral Resource

APEX Geoscience Ltd. (APEX), based in Edmonton, Alberta, issued a resource estimate and Technical Report for the Property that is dated September 19, 2014 (Eccles, Zdunczyk, and Nicholls, 2014). The title of this Technical Report is "*National Instrument 43-101 Technical Report, inferred frac sand resource estimate for the Firebag Property, Northeastern Alberta, Canada*".

Key Assumptions, Parameters, and Methods

APEX used all sieve data from samples analysed from the six auger holes and 21 test pit holes that were within the Property boundary. Multiple laboratories were used to complete sieve analyses, including DK Engineering (DK), an in-house testing facility that was based at the AMI Edmonton office. The DK testing facility was not ISO certified. Many of the sand intervals that DK analysed were further tested by other laboratories, with exception of the last interval in the holes that was between 13.72 m and 15.25 m.

The resulting geological model that was generated within the Property boundary was at 400 m by 400 m spacing; this hole drill density was deemed to be acceptable to determine a resource estimate. The main inputs used to develop the model included a collar file of the auger and test pits, sieve sample information from the holes and test pits including sand fraction laboratory analyses, and a one metre resolution LiDar topographic survey.

As part of the data validation process, the drill hole database was checked for overlapping sample and geological intervals, and survey, collar, and auger hole length data. Once the data was deemed acceptable, the data was uploaded to MICROMINE, which is a three-dimensional block modeling software.

The sieve data was composited into 3.05 m intervals to match horizontal horizons that were interpreted by the geologists during this program. By using this methodology, five vertically



defined sand groupings that included sieve and proppant quality data were modelled to a depth of 15.25 m. The ultimate block size that was applied to the model build was 150 m by 150 m by 3.05 m, with sub-blocking to 15 m by 15 m by 0.305 m. Multiple passes were completed using Nearest Neighbour modelling methodology.

2014 Mineral Resource

The following is a direct except from this Technical Report:

“The Firebag Inferred mineral resource estimate has been classified as ‘inferred’ according to the CIM definition standards. The classification of the Firebag Inferred Resource mineral resource was based on geological confidence, data quality and grade continuity. In addition, mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of the inferred mineral resource will be converted into a mineral reserve.

Using no base cut-off for the silica sand, this Firebag Inferred Resource estimate predicts that a 45.323 million tonnes of silica sand is present within the Firebag Property resource area (bounded by Surface Material Leases: SML130021 and SML120032), which includes: 38.027 million tonnes in SML120032 and 7.296 million tonnes in SML130021. The Firebag Inferred Resource is also reported by sieve size fraction, and the estimated tonnages of the individual fractions include:

- +20 mesh fraction: 419,000 tonnes (0.9%);
- 20/40 mesh fraction: 4,402,000 tonnes (9.7%);
- 40/70 mesh fraction: 21,231,000 tonnes (46.8%);
- 70/140 mesh fraction: 16,244,000 tonnes (35.8%); and
- -140 mesh fraction: 3,027,000 tonnes (6.7%).

The bulk of the total silica sand resource resides in the 40/70 mesh size fraction (47%; 21.231 million tonnes) followed by the 70/140 (36%; 16.244 million tonnes) and then the 20/40 (10%; 4.402 million tonnes).

The classification of the Firebag Inferred Frac Sand Resource was based on geological confidence, data quality and stratigraphic continuity. That is, the criteria and rationale for the classification of inferred resource is based upon the wide-spaced nature of the drilling to date and the fact that the Firebag frac sand project is classified as an early stage project with little ‘operational’, or bulk mineral processing test work completed to date. As this is the inferred resource, no mining studies have been employed to constrain the resource within an optimal pit shell.” (pp. 11-13.)



Mineral Classification

The 2014 APEX Technical Report categorized resources in accordance with guidelines established by the CIM “Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines” dated November 23rd, 2003 and CIM “Definition Standards for Mineral Resources and Mineral Reserves” dated November 14, 2004.

Superseding Resource Estimates

In 2015, Norwest Corporation (Norwest) published a resource estimate, which is reviewed later in Section 6.2. No additional data was available to the issuers in 2014 or 2015.

Relevance and Reliability of Resource Estimate

The analytical data that APEX used to build their geological model was compiled from independent laboratories as well as DK Engineering. The Nearest Neighbour modelling methodology that was used by APEX to create the geological model is widely used in resource modelling. The modelling methodology that APEX used represents the sand resource across the Property in an unbiased fashion.

The resource volumes calculated by APEX are higher than those calculated by either Norwest or the Author(s) of this Technical Report. This difference in the resource volumes is largely attributed to Norwest and the Author(s) of this report not using the DK sieve data. Although the decision by Norwest and the Author(s) of this report was to not use the DK sieve data, the DK sieve data is consistent with the other samples analysed from this Property. As such, the resource estimation and classification assigned by APEX to the Property is acceptable to the Author(s) of this report.

Requirements to upgrade Historical Estimate to a Current Resource Estimate

The Author(s) advise that intervals that do not contain sieve analyses from certified or industry acceptable laboratories be reanalysed by a certified laboratory. If AMI has not retained these samples, then redrilling the original hole locations is recommended to collect samples to the bottom of the holes.

In addition, the resource that was generated by APEX does not include the 140 to 170 sieve size sand fraction. In 2019, this sand fraction was identified to have commercial application and therefore it is recommended that the model be regenerated with this additional fraction.

Cautionary Statement regarding 2014 Resource Estimation

A Qualified Person has not done sufficient work to classify the 2014 historical estimate by APEX as a current mineral resource or reserve.



The Author(s) of this Technical Report are not treating the 2014 historical resource estimate by APEX as a current mineral resource or mineral reserve.

6.2.2 2015 Preliminary Economic Assessment

In late 2014, Norwest was commissioned by AMI to undertake a Preliminary Economic Assessment (PEA) for the Property (Hannah and Lavender, 2015). The resultant Technical Report was titled “*Preliminary Economic Assessment Firebag River Sand Property*”, which is dated March 3, 2015.

Key Assumptions, Parameters, and Methods

Norwest compiled the sieve data from independent laboratories into a database. As DK was an in-house testing facility for AMI, Norwest chose to not use the DK data when compiling the analytical database for the model. Prior to development of a geological model, Norwest reviewed the viability of the proposed drill collar and test pit locations, assessed cross over intervals between sampled intervals, and where cross over between intervals occurred, Norwest selected the laboratory analyses with the most current results. Norwest used Mintec’s MineSight® software to develop and validate a deterministic 3D block model. After reviewing the sieve data within the sample intervals, Norwest chose to create horizontal block model zones to constrain the population of model blocks using Inverse Distance Squared methodology.

Resource estimates that were completed by Norwest were initially calculated without application of a base cut off for the silica sand, and then as an estimated recoverable sand resource tonnage following implementation of preliminary mine plans, production schedules, and processing plant and materials handling. The resource estimates for these two parameters are reviewed in the following subsections.

2015 Mineral Resource

Mineral Resource without Base Cut Off

The following subsection is an excerpt from pages 14-1 and 14-2 from the 2015 PEA:

“Using no base cut-off for the silica sand, this Firebag Inferred Resource estimate predicts that 39.244 million tonnes of in-situ silica sand is present within the Firebag Property resource area (bounded by SML 130021 and SML 120032), which includes the following:

- 33.120 million tonnes in SML 120032; and
- 6.123 million tonnes in SML 130021.

The Firebag Inferred Resource is also reported by sieve size fraction, and the estimated tonnages of the individual fractions include the following:



- +20 mesh fraction: oversize;
- 20/40 mesh fraction: 4,340,530 tonnes (11.1%);
- 40/70 mesh fraction: 18,547,530 tonnes (47.3%);
- 70/140 mesh fraction: 12,894,430 tonnes (32.9%); and
- -140 mesh fraction: undersize.

The geological model created by Norwest did not separate the oversize and undersize material, +20 mesh and -140 mesh respectively. These two combined made up 3,461,510 tonnes of material or 8.8% of the total product.

The bulk of the total silica sand resource resides in the 40/70 mesh fraction (47%; 18.548 million tonnes), followed by the 70/140 mesh fraction (33%; 12.894 million tonnes) and then the 20/40 mesh fraction (11%; 4.341 million tonnes).”

Mineral Resource with Mining Criteria

The following subsection is an excerpt from pages 15-1 and 15-2 from the 2015 PEA:

“Mining criteria and recovery of select material at the processing plant were used to estimate the Firebag Inferred resource, effective November 26, 2014. The resource estimate predicts that 24,642,450 ROM tonnes, or 22,727,650 clean metric tonnes, of silica sand are present within the Firebag Property resource area (bounded by SML 130021 and SML 120032), which includes the following:

- 19,257,610 million clean tonnes in SML 120032; and
- 3,470,040 million clean tonnes in SML 130021.

The Firebag Inferred Resource is also reported by sieve size fraction, and the estimated tonnages of the individual fractions include the following:

- +20 mesh fraction: oversize material;
- 20/40 mesh fraction: 2,919,730 clean metric tonnes (11.8%);
- 40/70 mesh fraction: 12,273,330 clean metric tonnes (49.8%);
- 70/140 mesh fraction: 7,534,590 clean metric tonnes (30.6%); and
- -140 mesh fraction: undersize.

The geological model created by Norwest did not separate the oversize and undersize material, +20 mesh and -140 mesh respectively. These two combined made up 1,914,800 tonnes of material or 7.8% of the total product.”



Mineral Classification

The 2015 Norwest PEA referred to Geological Survey of Canada Paper 88-21 for the classification, estimation and reporting of reserves for the Project. The resource classification system in this paper defined Speculative, Inferred, Indicated, and Measured. This classification was used by Norwest as it assisted with defining resource confidence for stratigraphic mineral deposits. Although the CIM publication “Standards for Mineral Resources and Mineral Reserves” was not referenced in this Technical Report, the resource classification of Inferred, Indicated and Measured does align with those outlined in this CIM publication.

Superseding Resource Estimates

There are no other Technical Reports that were completed from 2015 until present day. No additional data was available to the issuers of the 2015 Technical Report.

Relevance and Reliability of Resource Estimate

Norwest did not use the DK sieve data in the 2015 model and resource estimate. As such, the difference in the resource volumes is largely attributed to Norwest and the Author(s) of this report not using the DK sieve data. Although the decision by Norwest and the Author(s) of this report were to not use the DK dataset, which typically eliminated this last interval from the data, the DK sieve data is consistent with the other samples analysed from this Property. It is anticipated that if the DK sieve data was incorporated into the 2015 model, the resultant resource would align with that assigned by APEX to the Property.

Requirements to upgrade Historical Estimate to a Current Resource Estimate

The Author(s) advise that intervals that do not contain sieve analyses from certified or industry acceptable laboratories be reanalysed by a certified laboratory. If AMI has not retained these samples, then redrilling the original hole locations is recommended to collect samples to the bottom of the holes.

In addition, the resource that was generated by Norwest does not include the 140 to 170 sieve size sand fraction. In 2019, this sand fraction was identified to have commercial application and therefore it is recommended that the model be regenerated with this additional fraction.

Cautionary Statement regarding 2015 Resource Estimation

A Qualified Person has not done sufficient work to classify the 2015 Norwest historical estimate as a current mineral resource or reserve.

The Author(s) of this Technical Report are not treating the 2015 Norwest historical resource estimate as a current mineral resource or mineral reserve.



6.3 Historical Production on the Property

There are no records of production activities on the Property. Also, as of the Effective date of this Technical Report, AMI has also not conducted any production from the Property.



7 GEOLOGIC SETTING AND MINERALIZATION

7.1 Regional Geology

The Western Canada Sedimentary Basin (WCSB) is the dominant depositional environment in Alberta. It comprises a Phanerozoic wedge of strata overlying the crystalline Precambrian basement. This wedge measures up to 7,000 m thick. It is adjacent to the foothills and diminishes to its zero edge along the Canadian Shield to the northeast (Mossop and Shetsen, 1994).

The Athabasca Region is along the inactive, eastward thinning margin of the WCSB where sediments overlap the southwest-dipping Precambrian Shield. Quaternary surficial deposits that are dominated by glaciofluvial and glaciolacustrine sediments cover the sedimentary rocks of the WCSB as shown on Figure 7-1. The sources of frac sand at the Property might originate from the following processes:

- reworked deposits resulting from glacial and eolian processes;
- within a Quaternary glacial outwash; and
deposited on the Cretaceous unconformity.

These frac sands are made up of rounded and sorted quartz-rich grains with few impurities. The potential sand-producing formations include McMurray, Grand Rapids and Pelican.

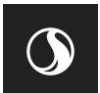
7.2 Property Geology

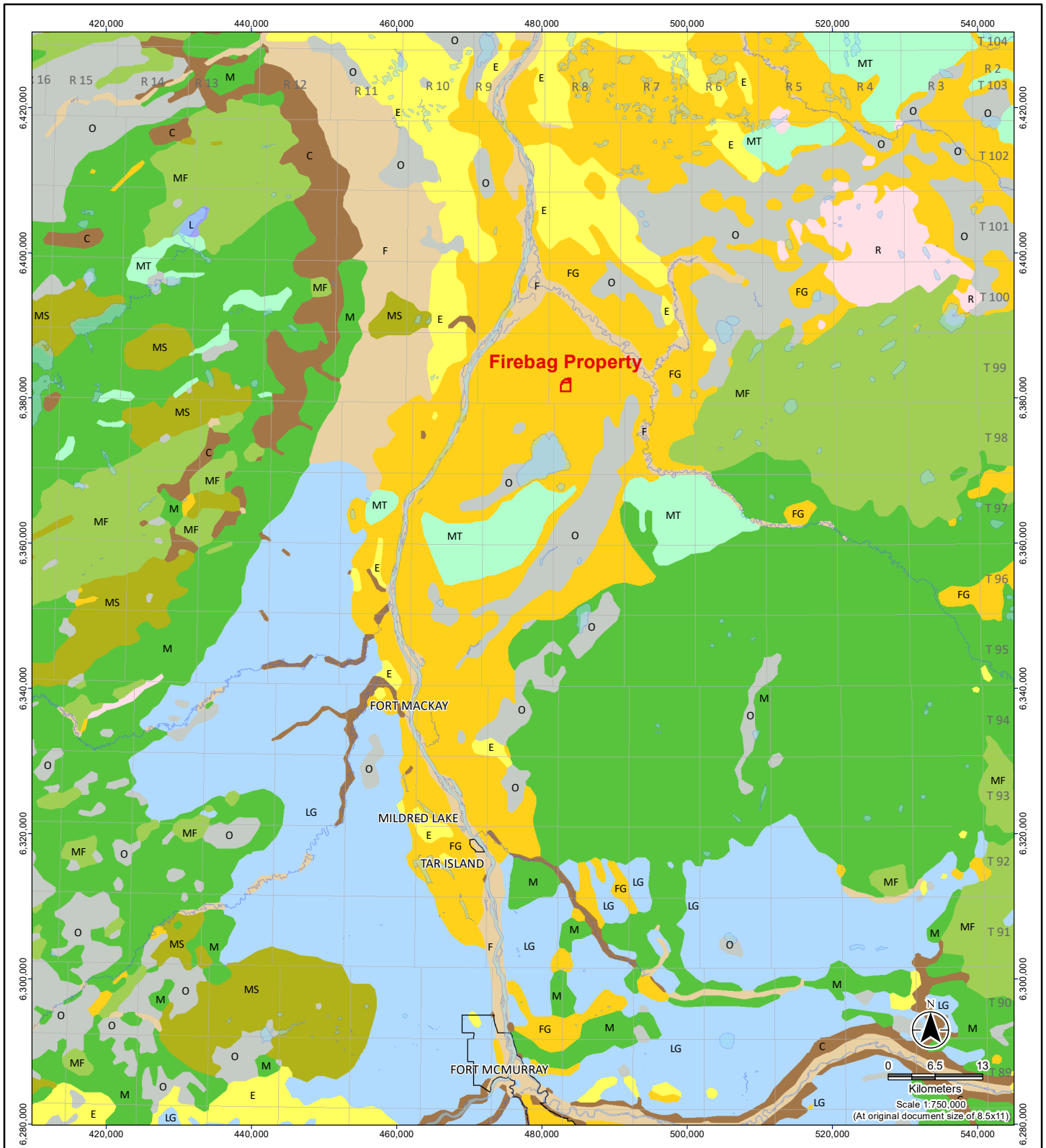
A deep Quaternary channel, up to 40 m thick, exists on the Property. It trends southwest northeast. The Quaternary sediments mostly overlie the Cretaceous McMurray Formation, but in some places on the Property, the sediments are in direct contact with the Devonian Formation. The Devonian is made up of limestone and dolomite. The Quaternary unit is dominantly composed of the following material:

- moderately clean fine to coarse-grained sand; and
basal clay and sand till.

AMI conducted a geological review of the 2011 exploration program using auger information. Results showed that the 2011 program intersected five distinct sand units over a depth of approximately 14.5 m, as interpreted by the sand colour and grain size (Cotterill, 2011 p. 28).

The 2011 backhoe test pit program and the 2011 auger drilling program showed that the Quaternary sand thicknesses exceed the auger depth of 24 m, and that the Quaternary sand extends laterally beyond the boundaries of the SMLs.





Legend

- Firebag Property
- City / Town
- Lake / River

Surficial Geology

- Organic Deposits (O)
- Colluvial Deposits (C)
- Fluvial Deposits (F)
- Lacustrine Deposits (L)
- Eolian Deposits (E)
- Glaciolacustrine Deposits (LG)
- Glaciofluvial Deposits (FG)
- Moraine (M)
- Fluted moraine (MF)
- Stagnant Ice Moraine (MS)
- Ice-thrust moraine (MT)
- Bedrock (R)

Notes

Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Surficial Geology 1M (Map 601) - Alberta Energy Regulator / Alberta Geological Survey



TECHNICAL REPORT FIREBAG PROPERTY

Regional Surficial Geology Map

Figure 7-1

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 DATE: 19/ 11/ 13

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The 2011 backhoe test pit program indicated the following:

- Fine to medium-quartz sand that is clean and moderate to well-sorted exists in the 3 m to 5 m deep backhoe test pits.
- Visually, the sand is generally 40/70 mesh material.
- As the depth increases, there are subtle changes to the sand relative to its colour, level of impurity, and grain size.
- The sand is dominated by well-sorted, fine to medium-grained quartz that is sub-rounded to rounded and spherical in shape.

The 2011 auger drilling program indicated the following:

- The depth of the upper layer of clean sand extends to approximately 10 m deep, although this varied depending on topography.
- The sand becomes slightly darker in colour between 10 m to 15 m deep, but it is still consistently clean and well-sorted.
- Between approximately 15 m and 24 m, the sand becomes darker brown, coarser grained, and increases in argillaceous content. At the bottom of the hole, the sand is interpreted as glacial outwash sediment.

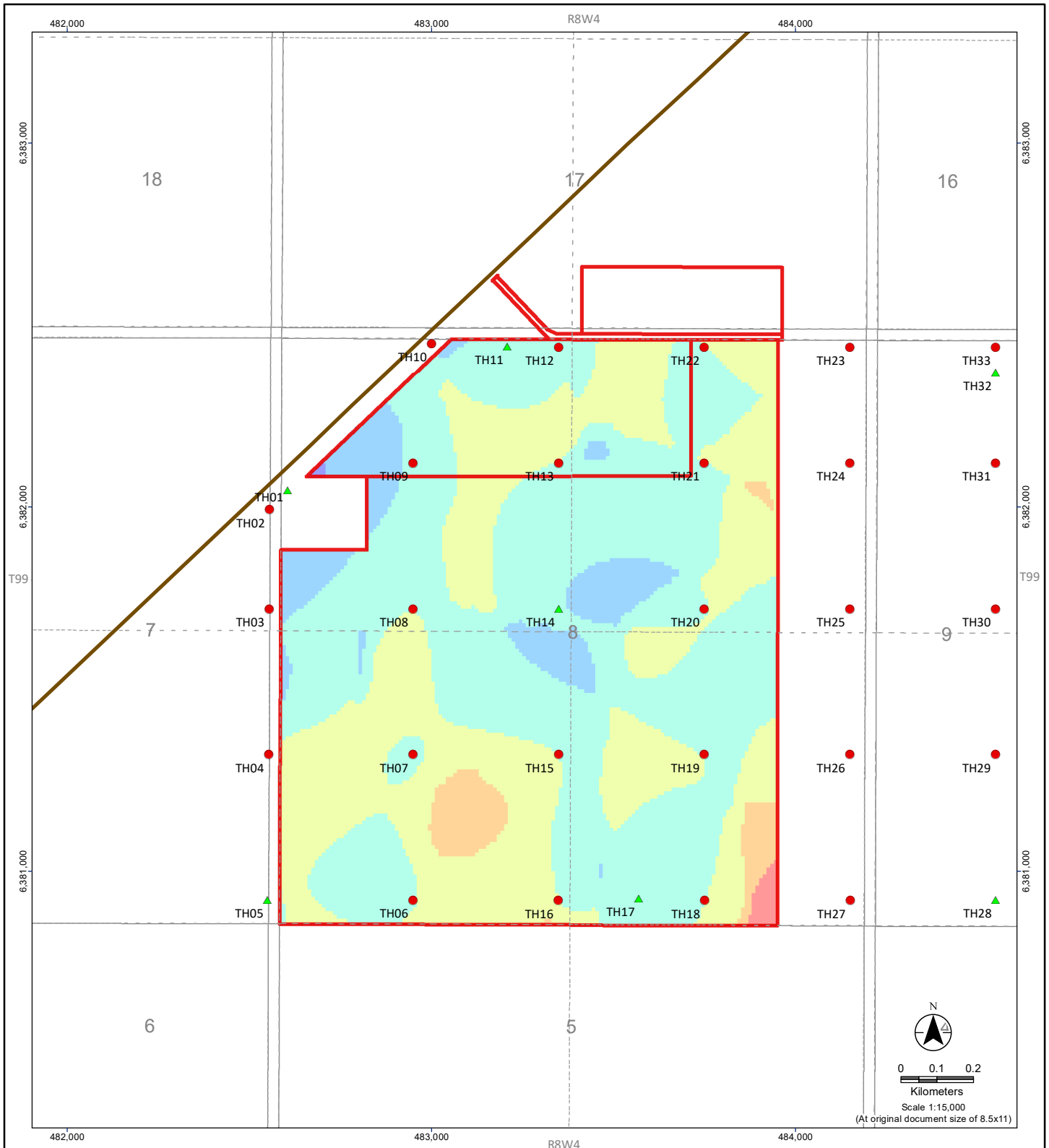
7.3 Mineralization

The overall Quaternary sand deposit is characterized as follows:

- laterally extensive;
- high in silica content; and
indicative of frac sand quality as evidenced by grain size and roundness.

The target unit on the Property is unconsolidated sand. The primary objective of the program was to delineate the quality and quantity of the unconsolidated sand, to assess if the quality of the sand is viable to perform as a natural proppant for hydraulic fracturing. Figures 7-2 to 7-4 show the sand thickness for Zone 1, Zone 2 and total. The drilled and laboratory tested sand has a thickness of 14.4 m on the Property. There are drill holes that report sand depths to 24.3 m; however, no sieve or proppant data support this additional depth interval. Figures 7-5 and 7-6 show cross section views of the sand deposit.





Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

Sand Thickness (m)

- | | |
|---------|---------|
| 2.1 - 3 | 5.1 - 6 |
| 3.1 - 4 | 6.1 - 7 |
| 4.1 - 5 | 7.1 - 8 |



TECHNICAL REPORT FIREBAG PROPERTY

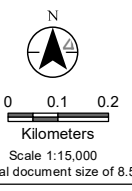
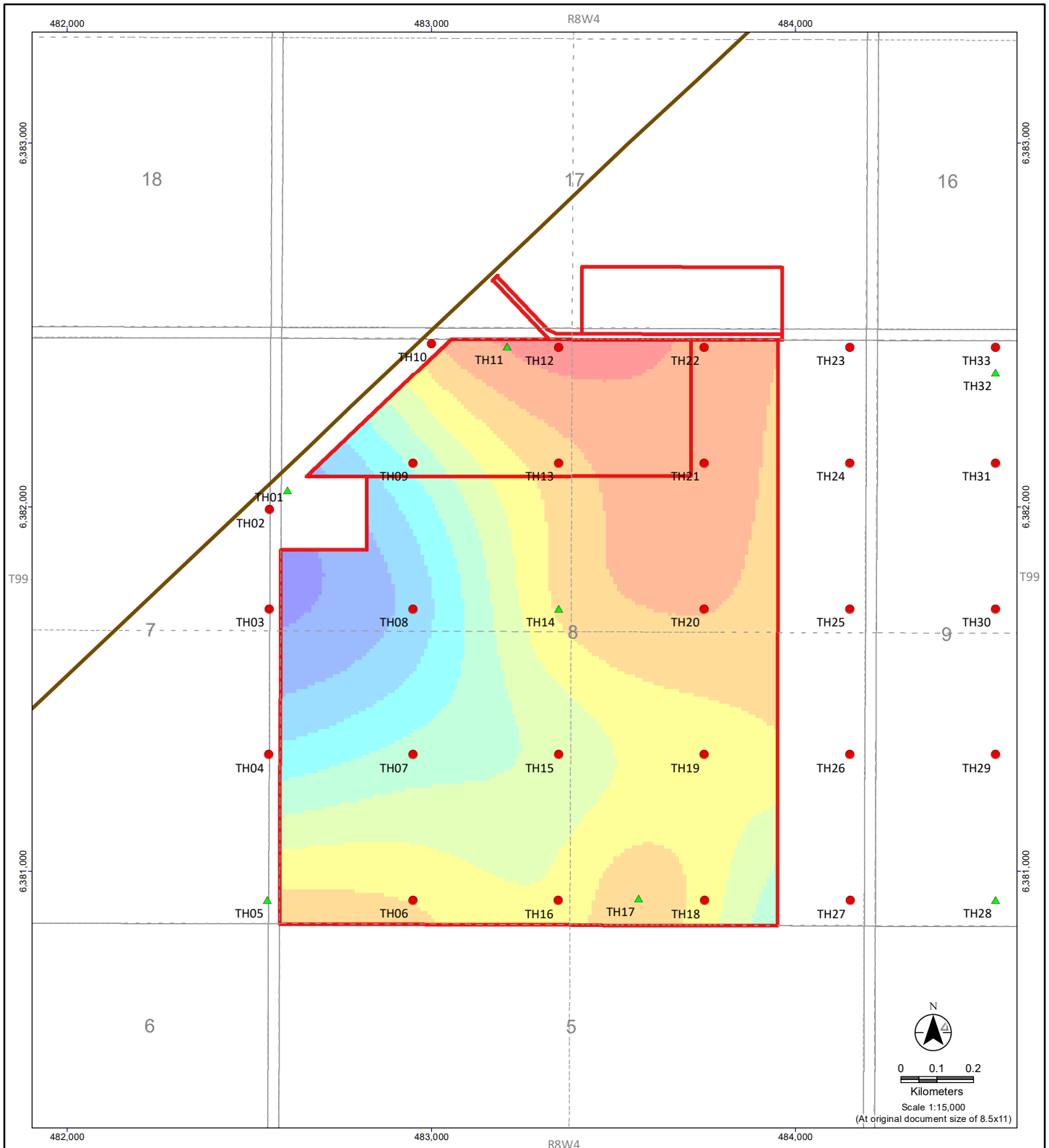
**Test Pit - Zone 1
Sand Thickness Map**

Figure 7-2

Notes
Coordinate System: NAD 1983 UTM Zone 12N
Data Sources: Altalis; AMI

DRAWN BY: M.B.
CHK'D BY: A.T.
DATE: 19/ 11/ 13
FILE: Fig_7_2_TestPit_Sand_Thickness
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

Sand Thickness (m)

2.1 - 3	7.1 - 8
3.1 - 4	8.1 - 9
4.1 - 5	9.1 - 10
5.1 - 6	10.1 - 11
6.1 - 7	11.1 - 12



TECHNICAL REPORT FIREBAG PROPERTY

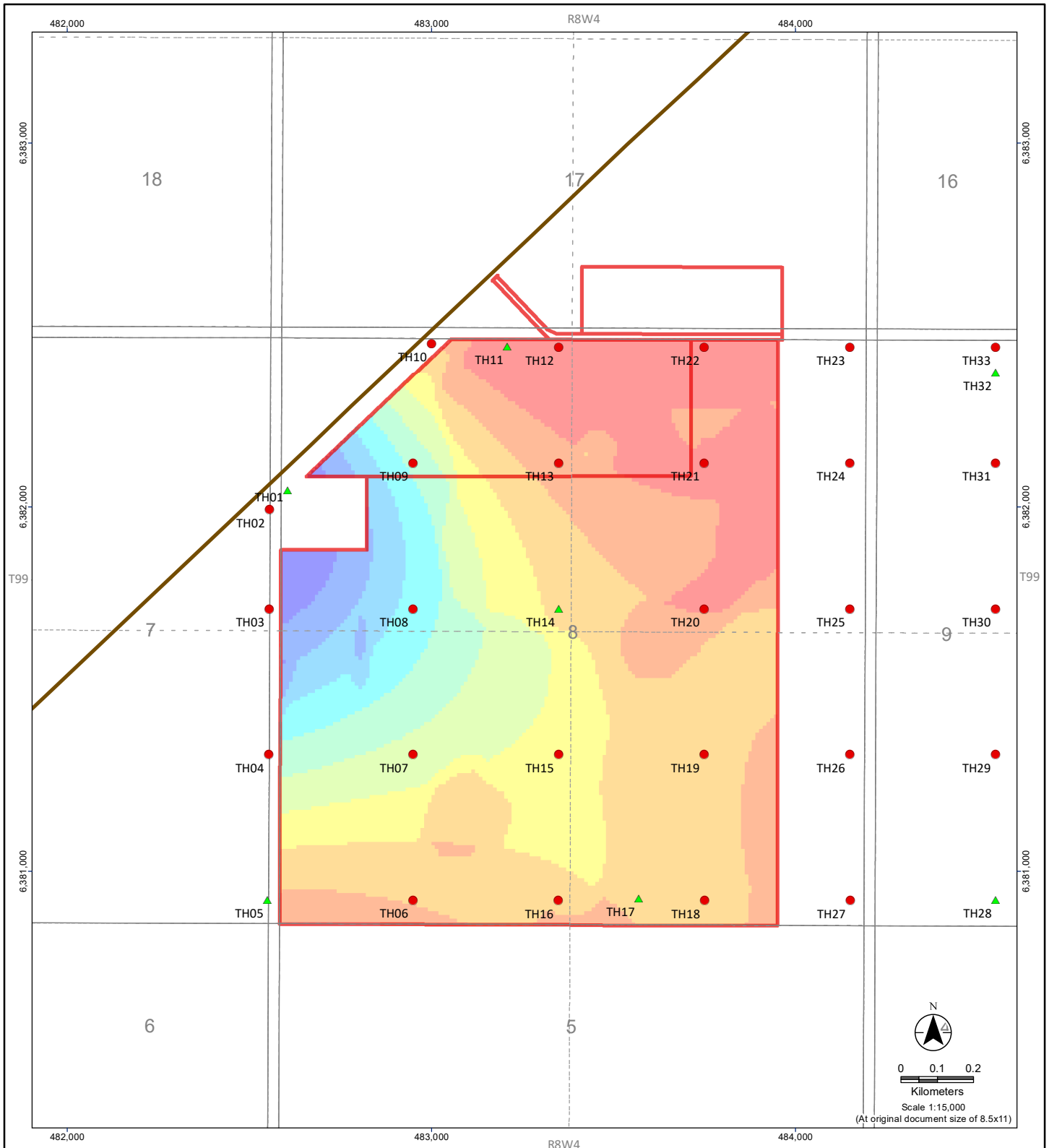
**Auger - Zone 2
Sand Thickness Map**

Figure 7-3

Notes
Coordinate System: NAD 1983 UTM Zone 12N
Data Sources: Altalis; AMI

DRAWN BY: M.B.
CHK'D BY: A.T.
DATE: 19/ 11/ 11
FILE: Fig_7_3_Auger_Sand Thickness
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

Total Sand Thickness (m)

<ul style="list-style-type: none"> ■ ≤7 ■ 7.1 - 8 ■ 8.1 - 9 ■ 9.1 - 10 ■ 10.1 - 11 	<ul style="list-style-type: none"> ■ 11.1 - 12 ■ 12.1 - 13 ■ 13.1 - 14 ■ 14.1 - 15 ■ > 15
---	---

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



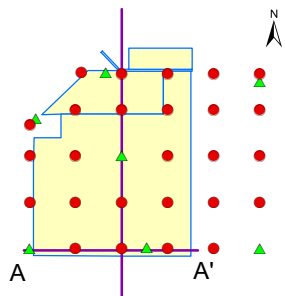
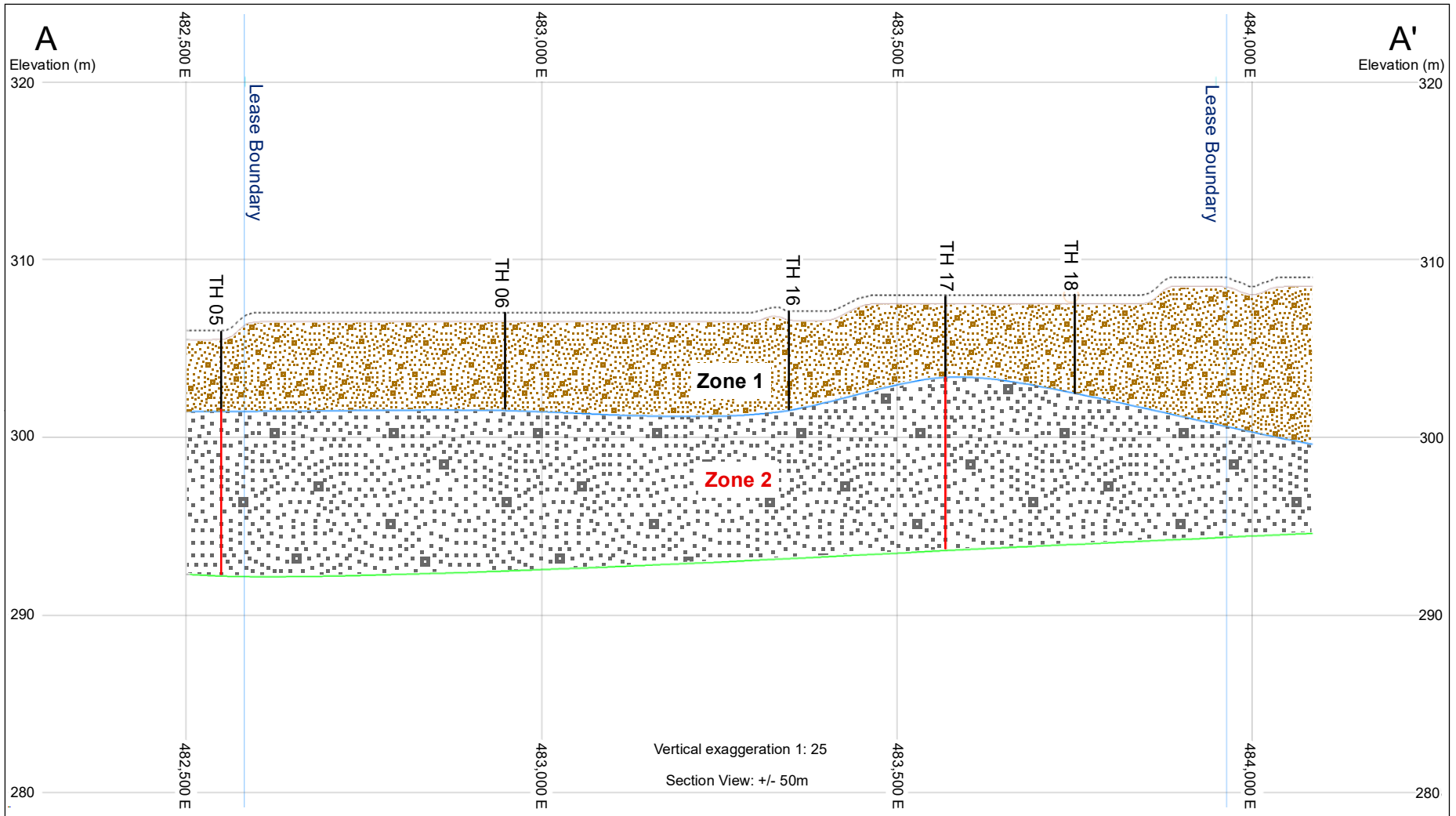
TECHNICAL REPORT FIREBAG PROPERTY

**Total Sand Thickness Map
(Zone 1 + Zone 2)**

Figure 7-4

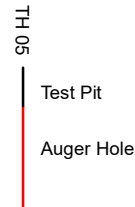
DRAWN BY: M.B. FILE: Fig_7_4_Sand Thickness
 CHK'D BY: A.T.
 DATE: 19/ 11/ 13 V:\1295\active\129500285\Reports\Draft\Figures\MXD

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Legend

- Topography
- Offset 0.5m from Topography
- Base of Zone 1
- Base of Zone 2
- Sand - Zone 1
- Sand - Zone 2



TECHNICAL REPORT FIREBAG PROPERTY

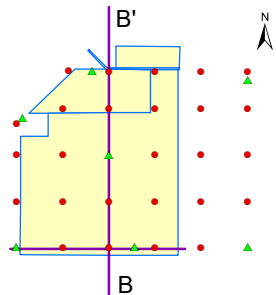
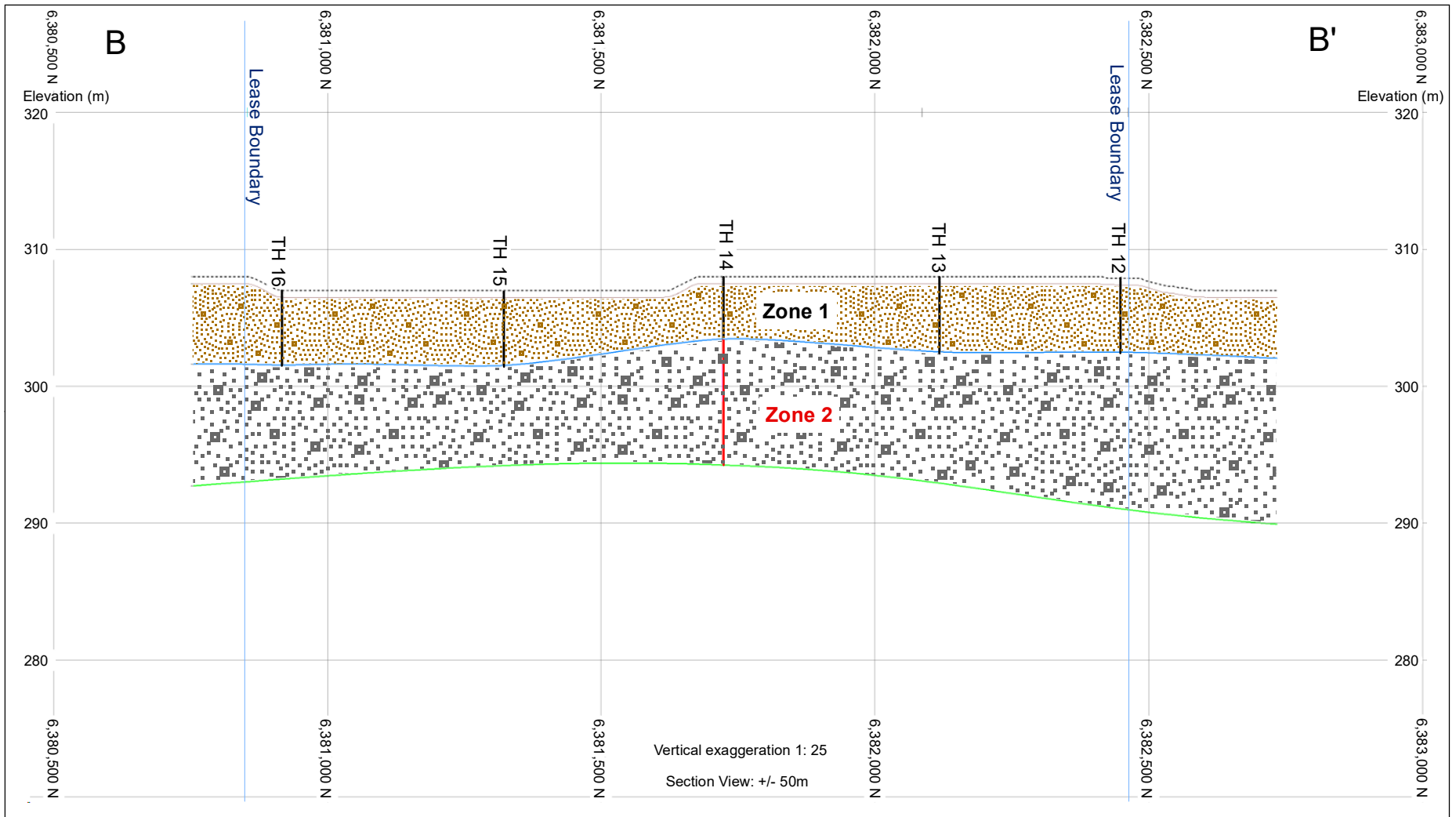
**Structural Cross Section
N 6,380,905 m**

Looking North

Figure 7-5

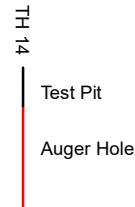
DRAWN BY: M.B.
CHK'D BY: C.H.
DATE: 19/ 11/ 13

FILE: Fig_7_5_xSection6380905
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Legend

- Topography
- Offset 0.5m from Topography
- Base of Zone 1
- Base of Zone 2
- Sand - Zone 1
- Sand - Zone 2



TECHNICAL REPORT FIREBAG PROPERTY

**Structural Cross Section
E 483,350 m**

Looking West

Figure 7-6

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CHK'D BY: C.H.
DATE: 19/ 11/ 13

FILE: Fig_7_6_NS_Section 483350
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8 DEPOSIT TYPES

The Property contains an accumulation of sand deposited by glacial processes. Glacially derived sedimentation is common in Alberta. This style of deposit is complex, as several events were responsible for the deposition of the surficial materials, commonly including several events of glacial advancement and retreat, which develop moraines (terminal and lateral) and glacial outwash sand deposits. In periods of quiescence, fine sediments accumulate in depressions forming fine-dominant lacustrine sediments. Sand accumulations in this style of deposit require systematic drilling, sampling, and comprehensive analyses to assess vertical and lateral variation in particle size abundance and suitability to meet ISO 13503-2 to qualify as a hydraulic fracturing natural proppant.



9 EXPLORATION

9.1 Pre-2011 Exploration

In 2009, AMI commenced a regional exploration program to identify subsurface gypsum deposits as well as to examine dolomitized outcrops along the Firebag River. During this exploration program, AMI discovered sand that visually appeared to have a high silica purity. Samples were collected during this program, and geochemical and size distribution analyses were completed on the sand samples to assess its silica purity. The results of this preliminary study showed that the sand may have suitable physical properties to act as a proppant. Based on these results, the decision was made to conduct further exploration with test pit and auger testing in 2011. The test pit program is reviewed in the following subsection.

9.2 Test Pit Program – December 2011

The purpose of the December 2011 test pit program was primarily to constrain a road accessible area with thick consistent sand that meets the specification to be suitable as a natural proppant. The ultimate area that the test pit program covered was 2,000 m x 1,600 m. The test pits were excavated in a grid that consisted of six north-south orientated lines that were spaced 400 m apart. Five test pits were excavated at 400 m spacing along each of the lines (Eccles, Zdunczyk, and Nicholls, 2014, p. 66).

During this program, 26 test pits were completed, ranging in depths from 3 m to 5 m and exposed the upper depositional sequence. These test pits were originally prefixed with MZ; however, the pits were relabeled and are hereafter referred to as the TH-series. Table 9-1 lists the test pit locations and Figure 9-1 shows the TH-series hole locations.

Sand was encountered in all the test pits. The sand was fine to medium-grained, was moderately to well-sorted, and was relatively clean of deleterious material. Subtle lithological changes were observed in the test pits that include occasional variations in colour, impurities, and grain size. None of these variations are deemed significant.

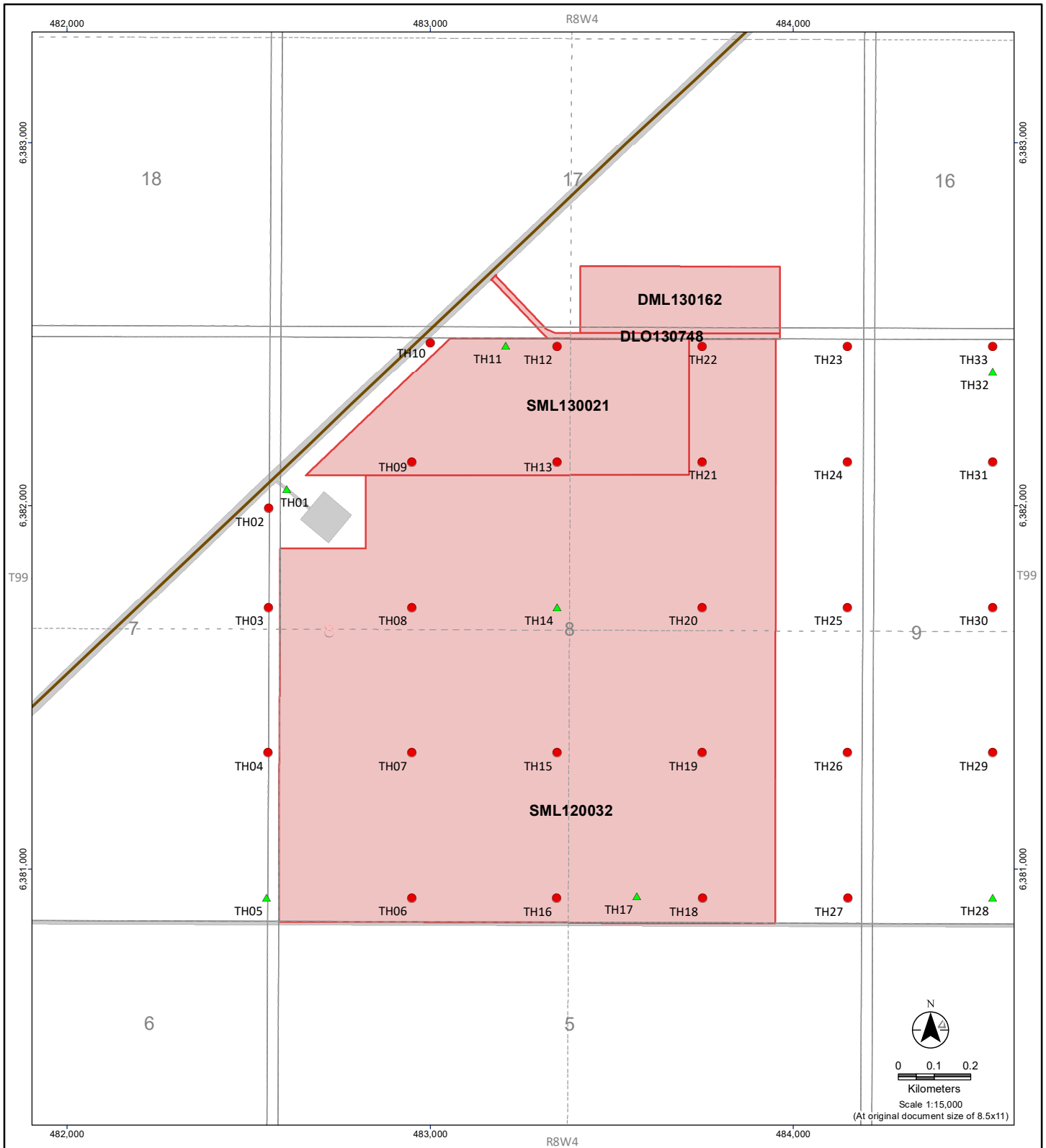
The test pit sample method was as follows. During excavation of each test pit, the sand was piled adjacent to its respective pit. A homogenous sample across the entire depth of the test pit was collected for analyses by taking a shoveled sample from the top to the bottom of the pile and putting the material into a sample bag. All sample bags were labelled, and the material was described. The samples were transported at the end of the program by truck to AMI's office in Edmonton, Alberta. Upon arrival, samples were inspected to verify that the sample bags were not compromised during transport and subsequently locked in a storage bin only accessible by AMI staff (Eccles, Zdunczyk, and Nicholls, 2014).



Table 9-1
Test Pit Locations

TH-Series Test Pit Name	Original Test Pit Name	UTM, Zone 12, NAD83		Elevation (masl)	Total Depth (m)	Sampled Interval for Analyses (m)	Material Type
		Easting (m)	Northing (N)				
TH02	MZ04	482,556	6,381,992	307	4.3	0 – 4.3	Sand
TH03	MZ03-AP	482,555	6,381,720	307	4.3	0 – 4.3	Sand
TH04	MZ02	482,554	6,381,320	307	5.5	0 – 5.5	Sand
TH06	MZ09	482,950	6,380,920	307	5.5	0 – 5.5	Sand
TH07	MZ08	482,950	6,381,320	307	5.5	0 – 5.5	Sand
TH08	MZ07	482,950	6,381,720	307	5.5	0 – 5.5	Sand
TH09	MZ06	482,950	6,382,120	307	4.6	0 – 4.6	Sand
TH10	MZ14	483,000	6,382,449	307	4.3	0 – 4.3	Sand
TH12	MZ15-AP	483,350	6,382,439	308	4.3	0 – 4.3	Sand
TH13	MZ13	483,350	6,382,120	308	5.5	0 – 5.5	Sand
TH15	MZ11	483,350	6,381,320	307	5.5	0 – 5.5	Sand
TH16	MZ10-AP	483,349	6,380,919	307	5.5	0 – 5.5	Sand
TH18	MZ20	483,751	6,380,919	308	5.5	0 – 5.5	Sand
TH19	MZ19-CA	483,750	6,381,319	308	5.5	0 – 5.5	Sand
TH20	MZ18-AP	483,750	6,381,720	309	5.5	0 – 5.5	Sand
TH21	MZ17-A	483,750	6,382,120	308	5.5	0 – 5.5	Sand
TH22	MZ16	483,750	6,382,439	307	5.5	0 – 5.5	Sand
TH23	MZ25	484,150	6,382,439	No Data; outside of SML boundary			
TH24	MZ24	484,150	6,382,120	No Data; outside of SML boundary			
TH25	MZ23	484,150	6,381,720	No Data; outside of SML boundary			
TH26	MZ22-A	484,150	6,381,319	No Data; outside of SML boundary			
TH27	MZ21	484,151	6,380,919	No Data; outside of SML boundary			
TH29	MZ29	484,550	6,381,319	No Data; outside of SML boundary			
TH30	MZ28	484,550	6,381,720	No Data; outside of SML boundary			
TH31	MZ27	484,550	6,382,120	No Data; outside of SML boundary			
TH33	MZ26AP	484,550	6,382,439	No Data; outside of SML boundary			





Legend

- Firebag Property
- Other Land Dispositions
- 8 ATS - Section
- Winter Road

Hole Type

- Auger Hole
- Test Pit

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: AMI; Altalis



TECHNICAL REPORT FIREBAG PROPERTY

TH-Series Hole Location Map

Figure 9-1

DRAWN BY: M.B. FILE: Fig_9_1_DrillHole_Locations
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10 DRILLING

10.1 Type and Extent of Drilling, and Material Recovery Factors

Two auger drilling campaigns were completed in the vicinity of the Project to assess the extent and quality of the sand, and to constrain the optimal area to secure the surface material leases. Nineteen auger holes were drilled in January 2011, with an additional seven holes being completed in December 2011 (Cotterill, 2011).

The drilling campaigns were completed by a two-man drill crew that used an auger rig that was mounted on a tracked argo. The diameter of the auger stems was 7", which enabled the auger flights to collect more sand during drilling. A geologist was present for the drilling of all holes (Cotterill, 2011; Eccles, Zdunczyk, and Nicholls, 2014).

Once the rig was brought to each proposed drill location, a hand-held Global Positioning System (GPS) unit was used to verify the accuracy of the hole location prior to breaking ground with the drill. As these holes were not professionally surveyed, it is understood that there is an associated error in the hole locations.

During drilling, the auger drill string was extracted from the hole after drilling of each five-foot stem so that the geologist could describe the returned cuttings of the auger flights and collect samples that were recorded by depth. To obtain an accurate representation of sample depth, the top of soil that was encountered on the first auger stem was assigned zero depth, and subsequent stems were added in five-foot increments. The geologist at the rig had to be diligent during drilling to distinguish the actual collected in situ sand sample from contamination sand that was scrapped onto the flights of the auger stems as the auger string was extracted from the hole following the drilling of each run. As such, sand recovery from the target intervals decreased with increased hole depth due to sidewall contamination.

10.2 2011 Auger Drill Program – January 2011

Nineteen solid stem auger holes, named F1 to F19, were drilled by AMI in January 2011 to collect sand samples and to determine the sand continuity in the area, and to constrain the optimal areas to focus subsequent exploration programs. The hole locations are listed in Table 10-1 and shown on Figure 10-1. Fourteen drill holes were evenly spaced at one km intervals along the north-south township boundary road. The remaining five holes were spaced at two km intervals along the southwest-northeast trending Fort Chipewyan Winter Road. Holes were typically drilled to a depth of 14.3 m. With exception of auger hole F01, all holes drilled in January 2011 were collared north of the Property. In total, 135 samples were collected during this drilling campaign. (Cotterill, 2011).



10.3 Auger Drill Program – December 2011

In December 2011, a second field program was completed to define the depth and continuity of the sand in the vicinity of auger hole F01. In addition to completing the 26 test pits that were addressed in Section 9, seven auger holes were drilled on the Property to an approximate depth of 24.4 m. The hole locations are listed in Table 10-1 and shown in Figure 9-1. The holes were drilled along the perimetry of the Property to verify that the continuity and thickness of sand. Piezometers were installed in select auger holes that supported a water table depth of approximately 17 to 20 m below ground level for holes with elevations that range in elevations between 306 and 308 masl.

Table 10-1
Drill Holes in Vicinity of Property

Final Hole Name	Original Hole Name	Hole Azimuth (°)	Hole Dip (°)	UTM, Zone 12, NAD83		Elevation (masl)	Total Depth (m)	Sample Intervals (m)	Material Type
				Easting (m)	Northing (m)				
F01	F01	0	90	480,904	6,380,689	303	14.3	0 – 14.3	Sand
F02	F02	0	90	480,913	6,381,717	304	14.3	0 – 14.3	Sand
F03	F03	0	90	480,927	6,382,913	302	14.3	0 – 14.3	Sand
F04	F04	0	90	480,933	6,383,796	301	14.3	0 – 14.3	Sand
F05	F05	0	90	480,932	6,384,806	300	14.3	0 – 14.3	Sand
F06	F06	0	90	480,944	6,385,880	298	14.3	0 – 14.3	Sand
F07	F07	0	90	480,946	6,386,839	297	14.3	0 – 14.3	Sand
F08	F08	0	90	480,940	6,387,882	296	14.3	0 – 14.3	Sand
F09	F09	0	90	480,942	6,388,834	295	14.3	0 – 14.3	Sand
F10	F10	0	90	480,960	6,389,839	294	14.3	0 – 14.3	Sand
F11	F11	0	90	480,963	6,390,921	288	14.3	0 – 14.3	Sand
F12	F12	0	90	480,962	6,391,802	281	14.3	0 – 14.3	Sand
F13	F13	0	90	480,961	6,392,783	276	14.3	0 – 14.3	Sand
F14	F14	0	90	480,978	6,393,584	274	14.3	0 – 14.3	Sand
F15	F15	0	90	481,245	6,380,858	304	14.3	0 – 14.3	Sand
F17	F17	0	90	484,222	6,383,587	300	14.3	0 – 14.3	Sand
F18	F18	0	90	485,496	6,384,893	293	14.3	0 – 14.3	Sand
F19	F19	0	90	487,217	6,386,434	289	14.3	0 – 14.3	Sand
TH01	F16	0	90	482,605	6,382,045	307	14.3	0 – 14.3	Sand
TH05	MZ1-A	0	90	482,550	6,380,920	306	24.4	0 - 13.72	Sand
TH11	MZ14A	0	90	483,209	6,382,440	308	24.4	0 - 13.72	Sand
TH14	MZ12A	0	90	483,350	6,381,720	308	24.4	0 - 13.72	Sand
TH17	MZ10-AP2	0	90	483,570	6,380,924	308	24.4	0 - 14.33	Sand
TH28	MZ30-AP	0	90	484,550	6,380,920	No Data	24.4	No Data	Sand
TH32	MZ26AP	0	90	484,550	6,382,369	No Data	24.4	No Data	Sand



10.4 Drill Program Summary and Significant Results

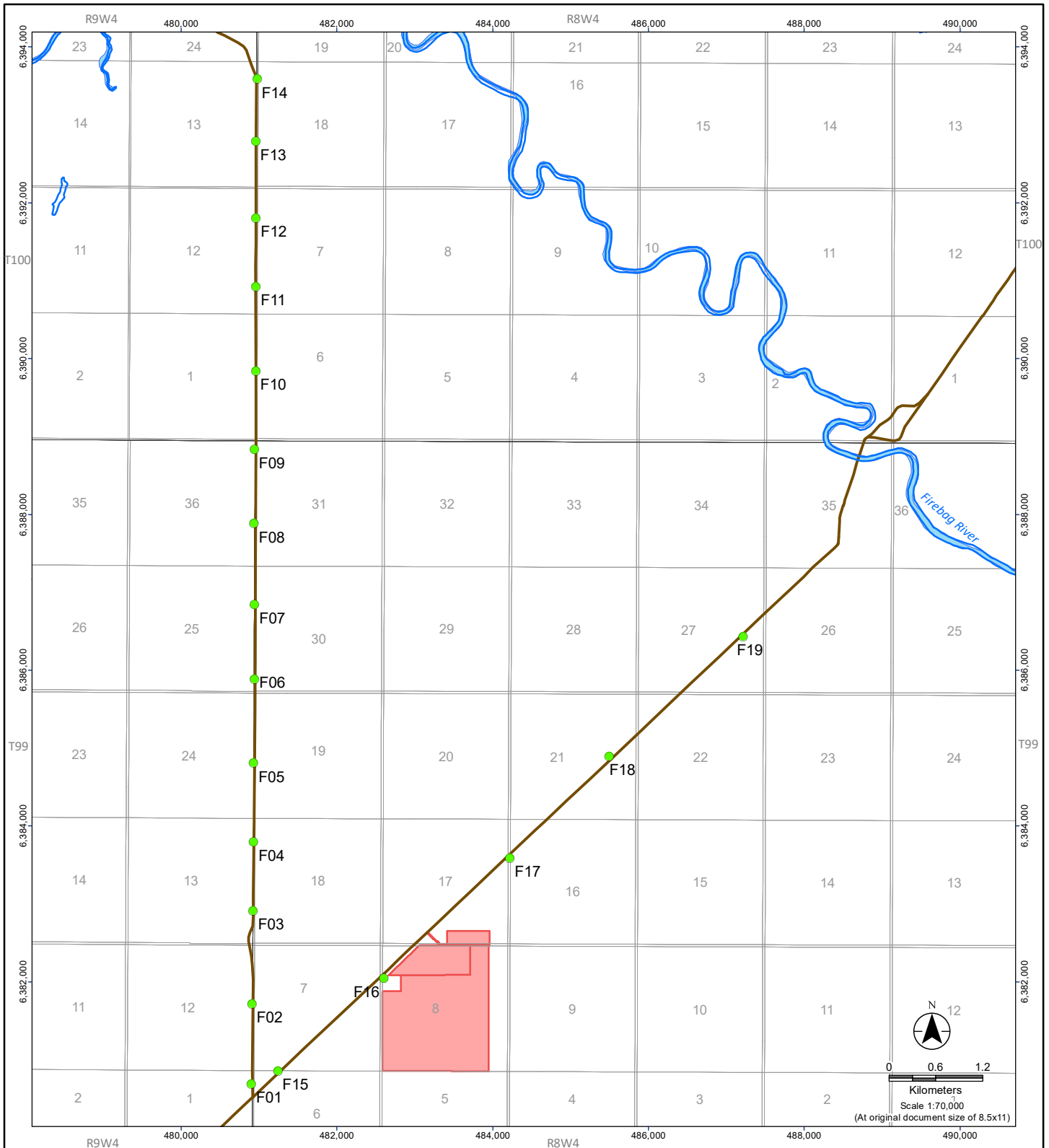
Overall the sand the testing programs showed that the sand on the Property has relatively consistent attributes, which are:

- Quartz dominant
- well-sorted;
- fine to medium grained;
- sub-rounded to rounded; and spherical in shape.

At a depth of approximately 10 m, the quartz sand becomes slightly darker, but it is still relatively clean and well-sorted. At a depth of about 15 m, the sand is slightly coarser and remains this way until a total depth of 24 m. Visually, the sand did not appear to meet the 20/40 mesh size; however, the 30/50 mesh size is visually apparent.

It is important to note that the transition between the fine to medium-grained sand and the coarse sand provides a contact between the upper dune deposit and the lower glacial outwash at a depth of approximately 15 m.





Legend

- F-Series Hole
- Firebag Property
- Winter Road
- 8 ATS - Section
- Lake / River

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: AMI; Altalis



TECHNICAL REPORT FIREBAG PROPERTY

**F-Series
 Hole Location Map**

Figure 10-1

DRAWN BY: M.B. FILE: Fig_10_1_DrillHole_Jan11_F_Series
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11 SAMPLE PREPARATION, ANALYSES AND SECURITY

11.1 Field Sample Preparation Methods and Quality Control Measures

The geologist typically collected samples from each five-foot stem; each sample typically weighted between 1.0 and 1.5 kg. The total number of samples collected from each hole was determined by the final hole depth. Following the collection of the samples from the prescribed depths, in order to ensure sample security, all sample bags were labelled with the drill hole and the depth interval from which they were collected.

Once the auger sampling drill program was completed, all the samples were transported by truck to AMI's office in Edmonton, Alberta. Upon arrival, samples were inspected to verify that the sample bags were not compromised during transport, and subsequently locked in a storage bin only accessible by AMI staff. All samples were submitted by AMI to Loring Laboratories Ltd. (Loring) for whole rock Inductively Coupled Plasma (ICP) analyses to assess the geochemistry of the sample, and for sieve analysis to understand the particle size distribution of the sand within each sample (Cotterill, 2011; Eccles, Zdunczyk, and Nicholls, 2014).

Samples collected during the 2019 site visit were placed in plastic sample bags. The outside of each bag and a label tag were labelled with the drill hole name, sample number, and date. The label tags were put inside the bags, which were sealed by zip-tie and placed in a large zip tied rice bag for transport to the laboratory. The samples were transported directly from the Property to AGAT Laboratories in Calgary, Alberta by the Stantec Qualified Person.

The following subsections present the results of the laboratory studies.

11.2 Laboratory Analyses

Whole rock geochemical evaluation was conducted at Loring, using ICP analysis to evaluate the geochemical oxide properties of each sample. Sieve fraction analyses was conducted by Loring, DK Engineering Services Ltd. (DK Engineering), Stim-Lab Inc. (Stim-Lab), and AGAT Laboratories Inc (AGAT). Proppant testing was conducted by Tetra Tech EBA, Stim-Lab, and PropTester Inc. (PropTester).

AGAT is also an independent laboratory with ISO 9001:2015 (Certificate No. 0100019). Stim-Lab, PropTester, and Tetra Tech EBA are independent laboratories; however, do not hold ISO certification.

Table 11-1 summarizes the number and type of analyses completed by each laboratory.



Table 11-1
Laboratory Analyses Testing Summary

Testing Facility	Number of Analyses	Location	Year Analysed	Analytical Method
Tetra Tech EBA	14	Calgary, Alberta	2011	Proppant Testing
Loring	153	Calgary, Alberta	2011 - 2012	Sieve
	135		2011	Whole Rock ICP Geochemical Testing
DK Engineering	47	Edmonton, Alberta	2012	Sieve
Stim-Lab	30	Duncan, Oklahoma	2012	Sieve
	5		2014	X-ray Diffraction
	8		2014	Proppant Testing
PropTester	6	Houston, Texas	2014	Sieve
	6		2014	Proppant Testing
	6		2014	X-ray Diffraction
AGAT	10	Calgary, Alberta	2019	Sieve

11.3 Tetra Tech EBA

Tetra Tech EBA is an independent laboratory; however, does not hold ISO certification. Tetra Tech EBA completed roundness, sphericity and crush resistance testing. The results from the roundness and sphericity testing support that the sand from the Property met the roundness and sphericity criteria of a natural proppant. Positive results were also obtained by the crush resistance testing; however, there was significant analytical spread in the crush resistance testing within each of the fraction bins.

It is the opinion of the Author(s) that inconsistencies in the sample preparation or testing procedure may have resulted in variations identified in the crush resistant testing. As such, the Author(s) do not have confidence in these results, and therefore the crush resistant test results are not presented in this section or used in this study.

11.4 Loring

Loring is an ISO 9001:2008 accredited laboratory for analyzing mining and mineral exploration samples (CERT-0063770).

Loring completed 135 major oxide geochemical analyses during an exploration study in 2011, of which seven samples were on the Property. Of these seven samples, the silica content varied from 88% to 93.1%, with an average of 91.3%. The SiO₂ content does not directly correlate to total quartz content as silica is also present in other minerals. The average Al₂O₃ was 2.5%,



which supports that the sand contains a minor component of feldspar and other aluminum-bearing minerals. The results of the whole rock geochemical study are shown in Table 11-2.

Loring completed wet sieve analysis on 153 samples of which 25 samples were from the Property. The sieve mesh sizes were -14 to -200M, +20M and bins 20/40M, 40/70M, 70/100M.

A list of the 11 samples that were validated and used in the 2019 model are shown in Table 11-3.

It is the opinion of the Author(s) that the sample preparation, security, and analytical procedures are adequate.



Table 11-2
Drill Hole TH01 Whole Rock Analyses

Sample Name	From (m)	To (m)	Al ₂ O ₃ (%)	Ba (ppm)	CaO (%)	Cr (ppm)	Fe ₂ O ₃ (%)	K ₂ O (%)	MgO (%)	MnO (%)	Na ₂ O (%)	Ni (ppm)	P ₂ O ₅ (%)	SO ₃ (%)	SiO ₂ (%)	Sr (ppm)	TiO ₂ (%)	V (ppm)	LOI @ 1000 (%)	Sum (%)
F06-1	0	1	1.95	139	0.19	3	0.38	0.2	0.07	0.01	0.19	1	0.02	0.03	93.09	42	0.05	4	0.91	97.08
F06-2	1	3.5	2.69	259	0.31	6	1.46	0.41	0.17	0.02	0.35	4	0.03	0.03	91.11	62	0.06	9	0.48	97.1
F06-3	3.5	6	3.23	325	1.62	6	1.22	0.51	0.31	0.02	0.44	3	0.03	0.07	88	81	0.06	9	1.57	97.06
F06-4	6	8	2.6	269	1.49	6	0.99	0.44	0.33	0.01	0.31	4	0.03	0.09	89.94	68	0.07	9	1.61	97.89
F06-5	8	12	2.42	269	1.07	6	0.87	0.44	0.24	0.01	0.28	4	0.02	0.07	91.68	62	0.07	9	1.15	98.32
F06-6	12	14	2.11	266	0.76	5	0.72	0.37	0.16	0.01	0.25	3	0.02	0.06	92.16	55	0.06	8	0.92	97.59
F06-7	14	14.5	2.17	236	1.03	5	0.74	0.74	0.19	0.01	0.25	3	0.02	0.08	92.78	58	0.07	8	1.06	98.78



Table 11-3
PSD Data for Verified Samples used in 2019 Model

Laboratory	Drill Hole Name	From (m)	To (m)	Sample Name	Fraction Range					
					>20	20/40	40/70	70/140	140/170	< 200
Loring	TH06	0.00	5.49	MZ9	0.56	8.38	53.44	33.75	1.63	98.99
Loring	TH07	0.00	5.49	MZ8-CA	0.37	7.76	59.31	28.51	1.79	98.92
Loring	TH08	0.00	5.49	MZ7	0.69	12.13	45.83	37.09	1.94	98.78
Loring	TH09	0.00	4.57	MZ6-CA	1.05	10.96	49.63	34.54	1.66	99.01
Loring	TH12	0.00	5.49	MZ15-AP	2.39	11.81	53.43	28.74	1.46	99.08
Loring	TH13	0.00	5.49	MZ13	3.14	15.32	51.93	26.15	1.37	98.90
Loring	TH18	0.00	5.49	MZ20	2.55	14.48	48.95	30.55	1.40	98.89
Loring	TH19	0.00	5.49	MZ19-CA	1.42	11.62	53.18	30.57	1.32	99.08
Loring	TH20	0.00	5.49	MZ18-AP	4.13	14.32	48.69	28.93	1.55	98.76
Loring	TH21	0.00	5.49	MZ17-A	1.59	13.53	51.63	29.65	1.48	98.93
Loring	TH22	0.00	5.49	MZ16	2.15	10.94	52.53	31.10	1.30	99.02
PropTester	TH16	0.00	5.49	MZ10AP (0-18')	1.10	13.60	48.60	32.60	0.00	96.6
Stim-Lab	TH14	0.00	4.57	MZ12(0-18')	0.70	9.50	42.90	42.10	3.30	99.5
Stim-Lab	TH14	4.57	6.40	MZ12A (15'-21')	3.60	14.40	46.20	31.00	2.70	99.4
Stim-Lab	TH14	9.14	12.19	MZ12A (30'-40')	0.60	12.20	44.50	36.40	3.50	99.1
Stim-Lab	TH14	12.19	13.72	MZ12A (40'-45')	0.20	3.20	48.10	46.10	1.40	99.7
Stim-Lab	TH17	0.00	4.57	MZ10AP (0-18')	0.90	12.60	48.50	34.00	2.50	99.9
Stim-Lab	TH17	4.57	6.10	MZ10AP-2(15'-21')	0.50	12.40	46.40	36.10	2.80	99.5
Stim-Lab	TH17	6.10	9.14	MZ10AP-2(20'-30')	0.40	12.40	47.80	33.40	3.50	99.2
Stim-Lab	TH17	9.75	12.80	MZ10AP-2(32'-42')	1.20	10.60	61.90	23.50	1.40	99.5
Stim-Lab	TH17	12.80	14.32	MZ10AP-2(42'-47')	0.10	8.40	66.10	24.00	0.80	99.8
Stim-Lab	TH15	0.00	5.49	MZ11	0.30	10.60	47.70	36.30	2.50	99.0



11.5 DK Engineering

DK Engineering was a testing facility based at the AMI office in Edmonton that completed in-house sieve analyses. DK Engineering was not ISO certified.

The Author(s) accept the qualitative value of the test results from the 39 samples; however, these results are not used in the 2019 geological model and resource estimate.

11.6 Stim-Lab

Stim-Lab is an independent laboratory but does not have external accreditation. Stim-Lab is, however, recognized as an industry leader and does comply with API STD19C:2018. At the time that the analyses that is presented in this report was completed, Stim-Lab aligned with ISO 13503-2.

Stim-Lab conducted sieve analyses on 28 samples that were analysed in two phases; November 2012 and June 2014. From the 28 samples, six samples consisted of a combination of sand fractions from various holes. These data were verified and used in the 2019 model. Stim-Lab then performed proppant specific testing on 12 samples, which included such tests as Krumbein Shape Factor assessment, acid solubility, turbidity, bulk density, crush resistance, K-Value assessment as well as conductivity and permeability closure tests. From the 12 samples, four consisted of the combined fraction samples.

The 14 samples that were selected for proppant analyses during the testing program are summarized in Table 11-5. The composite samples shown in Table 11-4 are weight averaged. Since six samples consisted of four sand fractions and depth intervals from multiple drill holes, an average of those results was used in the 2019 model, which are reviewed further in Section 14. The results from the proppant analyses on composite samples are shown in Table 11.4 and reviewed in the following subsections.

Table 11-4
Stim-Lab Composite Samples

Composite Sample ID	Drill Hole Name	Sample ID
to depth of 6m	CMBO1	Random selection of MZ
Approximately 10'	Group 1 (0-10')	F16+MZ1+MZ14+MZ12+MZ10
Approximately 20'	Group 2 (10-20')	F16+MZ1+MZ14+MZ12+MZ10
Approximately 30'	Group 3 (20'-30')	F16+MZ1+MZ14+MZ12+MZ10
Approximately 40'	Group 4 (30'-40')	F16+MZ1+MZ14+MZ12+MZ10
Approximately 50'	Group 5 (40'-50')	F16+MZ1+MZ14+MZ12+MZ10
Note: composite samples are weight averaged		



Table 11-5
Propellant Analyses Results

Sample ID	Lab	Drill Hole Name	From (m)	To (m)	Fraction	Stress Tested (3000 psi)	Stress Tested (4000 psi)	Stress Tested (5000 psi)	Stress Tested (6000 psi)	Stress Tested (7000 psi)	Stress Tested (8000 psi)	Stress Tested (9000 psi)	K-Value (K)	Roundness	Sphericity	Acid Solubility %	Bulk Density (g/cm ³)	Turbidity (NTU)
MZ12	PropTester	TH14	0.00	5.49	40/70			8.7%	13.0%				5	0.8	0.7	4.6	1.5	26.0
MZ10AP	PropTester	TH16	0.00	5.49	40/70					8.0%	10.2%		7	0.8	0.7	4.0	1.5	31.0
F16	PropTester	TH01	0.00	2.99	40/70					9.8%	12.7%		7	0.8	0.7	3.8	1.5	28.0
MZ14A	PropTester	TH11	0.00	4.11	40/70					7.8%	13.4%		7	0.9	0.8	4.5	1.5	12.0
MZ1	PropTester	TH05	0.00	5.49	40/70					7.8%	10.7%		7	0.8	0.8	3.6	1.5	12.0
MZ1	PropTester	TH05	0.00	5.49	20/40			9.8%	14.4%				5	0.9	0.8	4.3	1.5	16.0
MZ1	StimLab	TH05	0.00	5.49	20/40		8%	15.0%					4	0.6	0.7	3.0	1.5	12.0
MZ1	StimLab	TH05	0.00	5.49	40/70			4.9%		8.5%	11.3%		7	0.6	0.7	2.7	1.5	12.0
MZ1A	StimLab	TH05	4.57	6.40	20/40		7.5%	12.4%					4	0.7	0.7	2.7	1.5	10.0
MZ1A	StimLab	TH05	4.57	6.40	40/70			4.1%		7.7%	11.6%		7	0.6	0.6	2.2	1.5	9.0
MZ1A	StimLab	TH05	6.40	9.14	40/70			5.9%	8.2%	11.9%			6	0.6	0.7	3.0	1.4	6.0
MZ1A	StimLab	TH05	9.45	12.19	40/70			5.7%	8.2%	11.9%			6	0.6	0.6	3.7	1.4	7.0
MZ1A	StimLab	TH05	12.19	13.72	40/70			7.4%	11.1%				5	0.6	0.7	3.9	1.4	9.0
MZ1A	StimLab	TH05	6.40	9.14	20/40	7.9%	12.5%						3	0.6	0.7	3.3	1.5	10.0
MZ1,10,12,14,F16	StimLab	Comp**	0.00	15.24	20/40		4.6%	9.6%	15.5%				5	0.7	0.8	3.2	1.5	5.0
MZ1,10,12,14,F16	StimLab	Comp**	0.00	15.24	30/50		3.5%		8.2%	13.7%			6	0.6	0.7	2.9	1.5	5.0
MZ1,10,12,14,F16	StimLab	Comp**	0.00	15.24	40/70			3.6%		7.8%	10.9%		7	0.6	0.7	2.8	1.5	6.0
MZ1,10,12,14,F16	StimLab	Comp**	0.00	15.24	70/140			2.2%				8.7%	9	0.5	0.7	3.8	1.4	11.0

** Composite of multiple blended samples (TH01,05,10,11,14,16,17) across 4 depth intervals



Bulk Density

Bulk density was determined for all selected samples. The bulk density was consistent, ranging from 1.41 to 1.51 g/cm³.

Shape Factor Assessment

Sphericity and roundness were evaluated microscopically for 20 grains in each sample, and the mean value calculated. Sphericity for all samples ranged from 0.6 to 0.8. Roundness was determined for the selected samples and ranged between 0.5 and 0.9. All the samples meet or exceed the recommended 0.6 for roundness and sphericity.

Acid Solubility Test

The recommended maximum acid solubility for proppants is 3.0%. Of the 14 samples tested, the average acid solubility was 3.4%, and the minimum and maximum values were 2.2% and 4.6%. The elevated acid solubility values may be due to a minor amount of carbonate minerals in the samples.

Turbidity

Turbidity in the tested samples reached a minimum of 5 NTU and a maximum of 12 NTU, which is well below the limit of 250 NTU.

Crush Resistance (K-Value) Test

Crush resistance tests were completed through a range of stresses to determine a K-Value for each sample. The K-Value is given as the highest stress level at which the sand sample generates no more than 10% crushed material (fines), rounded down to the nearest 1,000 (psi) stress. An upper limit of six was obtained for the 40/70 fraction and 9 for the 70/140 fraction.

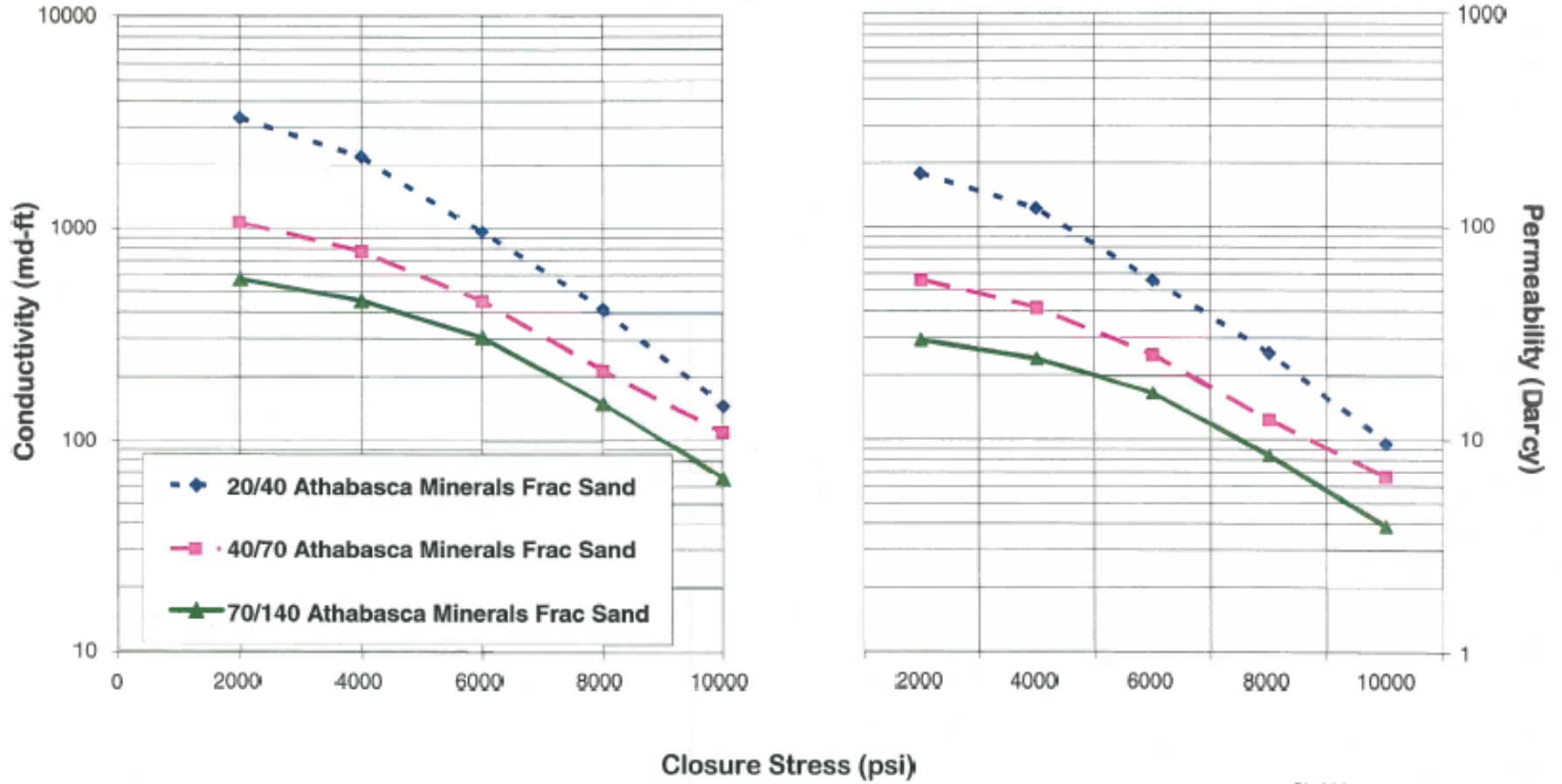
Conductivity and Permeability Closure Tests

Long term conductivity and permeability measurements of the proppant were collected at 1,000, 2,000, 4,000, 6,000, 8,000, and 10,000 psi at 150 °F for the 20/40, 40/70, and 70/140 fractions. Each psi level was assessed at 150 °F for 50 hours. The results from this study are shown on Figure 11-1.

It is the opinion of the Author(s) that the sample preparation, security, and analytical procedures used by Stim-Lab were adequate.



2 lb/ft² 20/40, 40/70, and 70/140 Frac Sands



SL 9385
June 30 - July 12, 2011

Submitted by Athabasca Minerals, Inc. at SL May 16, 2011 in 2% KCl between Ohio Sandstone at 150 °F



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Long Term Conductivity and Permeability

Figure 11-1

Notes
Data Source: Stim Lab, 2011

DRAWN BY: M.B.
CHK'D BY: C.H.
DATE: 19/ 11/ 13
FILE: Fig_11_1_Long_Term_Conductivity_Permeability
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11.7 PropTester

PropTester is an independent laboratory based in Houston Texas. PropTester is, however, well respected in the industry and did, at the time that the time of completion of the analyses that are presented in this report, align with ISO 13503-2.

In June 2014, PropTester performed sieve analyses on six samples from the 20/40 and 40/70 fractions between February and June 2014. The sieve analyses were completed on mesh sizes that ranged from -16 to -200.

PropTester then performed proppant specific testing on six samples, which included Krumbein Shape Factor assessment, acid solubility, turbidity, bulk density, crush resistance and K-Value assessment. Results are shown in Table 11-5.

It is the opinion of the Author(s) that the sample preparation, security, and analytical procedures used by PropTester were adequate.

11.8 AGAT

AGAT started the sieve analyses testing on November 8, 2019. AGAT is an independent laboratory with ISO 9001:2015 (Certificate No. 0100019).

A Stantec Professional Geologist inspected the AGAT laboratory in Calgary, Alberta on April 5, 2019, to observe the laboratory procedure for sieve analysis. It was confirmed that AGAT follows API STD19C:2018 for sieve analysis testing. A summary of the analytical procedures included sample drying and weighing, pre-screening the coarse fraction via the 10-mesh sieve, sample splitting, washing of the sample through the 200-mesh sieve to separate the fines, riffle splitting the sample to an ~100-gram (g) sample, and completion of a sieve analyses to obtain weights for each size fraction. AGAT completed sieve analyses on 10 samples.

It is the opinion of the Author(s) that the sample preparation, security, and analytical procedures used by AGAT were adequate.



12 DATA VERIFICATION

The following subsections review the verification processes that the independent Qualified Person(s) was able to complete on the Property, as well as the limitations that the independent Qualified Person(s) encountered during this review. The following subsection include; an overall Property investigation and an assessment of the particle size distribution bins from the 2011 datasets relative to the samples collected on November 7, 2019 by the Qualified Person, a review of the elevations of the auger holes relative to publicly available digital elevation information, and an evaluation of the limitations that the Qualified Person(s) encountered during the data verification process.

12.1 Property Investigation, Material Sampling and Validation

On November 7, 2019 an independent Stantec Qualified Person inspected the Property. The Property investigation was done by helicopter and therefore an areal view of the Property was completed to assess the overall topography and vegetation of the area, the location of roads that provide access to the Property relative to what was documented in previous reports, and areas of exposed sand on surface on the Property. As previously documented, the area has undergone at least one wildfire burn, which allowed for more of the Property to be seen from the air. This investigation also included material collection, which is addressed in the following subsection.

The independent Qualified Person completed hand soil auger testing at five locations on the Property. The purpose of this testing was three-fold; to validate the thickness of topsoil that AMI had presented on the drill logs, to collect two samples from each hand soil auger hole to assess differences in the material type with increased depth so that samples could be provided to a certified laboratory for particle size distribution analyses, and so that the independent Qualified Person could complete an independent assessment of the roundness and sphericity from each sample. These holes locations are shown in Table 12-1.



Table 12-1
Property Investigation Hole Locations

Hole ID	Sample ID	Sample Depth relative to Ground Level (m)	Northing NAD 83, Zone 12	Easting NAD 83, Zone 12	Collar Elevation (masl)
184	6000	0.55 – 0.70	6380908	0483731	288
184	6001	1.00 – 1.15	6380908	0483731	288
185	6002	0.55 – 0.70	6380921	0482648	297
185	6003	1.00 – 1.15	6380921	0482648	297
186	6004	0.55 – 0.70	6381426	0483743	305
186	6005	1.00 – 1.15	6381426	0483743	305
187	6006	0.55 – 0.70	6382451	0483444	306
187	6007	1.00 – 1.15	6382451	0483444	306
188	6008	0.55 – 0.70	6381925	0482734	307
188	6009	1.00 – 1.15	6381925	0482734	307

Transport of the 10 samples from the field on November 7, 2019 were under the custody of the independent Qualified Person, who hand delivered the samples on the same day to AGAT laboratory. A chain-of-custody document was signed off by AGAT Laboratories to document the sample custody transfer. AGAT commenced sample preparation the same day and provided analytical results to the independent Qualified Person on November 8, 2019. Table 12-2 shows the PSD from the 2019 validation samples relative to that of the 2011 datasets, along with the number of samples analysed and the sample depth intervals.

Table 12-2
Property Investigation Hole Locations

Dataset	Number of Samples	Sample Interval Depth (m)	20/40 Bin (%)	40/70 Bin (%)	70/140 Bin (%)	20/140 Bin (%)
2019 Samples	10	0.55 – 1.15	14	44	32	90
2011 Samples	35	0 – 5.49	12	50	33	95

Although some variation is observed between the fraction bins of the 2011 and 2019 datasets, the overall relative distribution abundance spread within the 2011 data and 2019 data is similar. It is the opinion of the independent Qualified Person(s) that when considering the practical limit of error for the types of sample collection methods, that the analytical results obtained from the 10 samples analysed on November 8, 2019 validates the particle size distribution results obtained from the 2011 samples.



12.2 Validity of Drill Hole Elevations

Drill hole source type and collar locations were supplied by AMI. Stantec compared the elevations of the auger drill collar sites relative to publicly sourced topographic elevation. Due to elevation discrepancies, as shown in Table 12-3, the topographic elevation was used instead of the supplied collar elevation.

Table 12-3
Collar Elevations vs. Topographic Elevations

Hole No.	Collar Elevation	Topographic Elevation	Delta
TH04	306.98	306.96	0.02
TH05	306.00	306.03	-0.03
TH11	308.00	306.75	1.25
TH14	335.00	308.00	27.00

12.3 Limitation to Data Validation by Qualified Person

Limitations to the validation that the Qualified Person was able to complete are listed below:

- The Stantec Qualified Person was not involved in the project during 2011 and therefore cannot validate the field procedures used during drilling and sample collection.
- No evidence of the 2011 drill collar locations that were drilled on the Property were observed during the site investigation that was completed on November 7, 2019.
- Chain-of-custody documents for sample shipments, with exception of those delivered to AGAT on November 7, 2019, were not available to the Qualified Person.
- Geological descriptions for the test pits completed outside of the two SML locations were not available for the Qualified Person(s) to review.
- Laboratory quality control inspections were not completed by the Qualified Person at the time of testing to verify that ISO 13503-2:2006/Amd.1:2009E standards were being followed.
- Some of the original laboratory documents certifying the sieve and proppant testing results were not available for review by independent Qualified Persons during the preparation of this Technical Report; therefore, not all aspects of the sample datasets could be validated prior to completing the geological model and resource estimation.



12.4 Opinion of the Independent Qualified Person

It is the opinion of the independent Qualified Person(s) that the field procedures and sampling protocols that were implemented in 2011 by AMI personnel are reasonable. Also, the quality of the laboratory testing completed by Loring, AGAT, PropTester, and Stim-Lab are reasonable. The independent Qualified Person(s) is confident that the samples and associated laboratory datasets that are used in this Technical Report are accurate.



13 MINERAL PROCESSING AND METALLURGICAL TESTING

Beyond the proppant evaluation testing that was reviewed in Section 11 that was completed by PropTester and Stim-Lab, no additional processing has been completed on material collected from the Property.



14 MINERAL RESOURCE ESTIMATES

In accordance with the requirements of NI 43-101 and the Canadian Institute of Mining, Metallurgy and Petroleum Definition Standards, the independent Qualified Person(s) reviewed the available drill hole and sample dataset and created geologic models for the purposes of generating resource estimates within the Property. As noted in Section 12, not all original geological logs or laboratory assay sheets were available for review to validate the datasets prior to modelling.

The geologic model construction, resource estimation approach, criteria and assumptions used during this resource estimation are outlined in the following sections.

14.1 Computer Model Construction

The geologic resource model was developed using Hexagon Mining’s geological modelling and mine planning software, MineSight® version 15.60. MineSight® is widely used throughout the mining industry for digital resource model development. Hexagon Mining’s suite of interpretive and modelling tools is well-suited to meet the resource estimation requirements for the Property.

A two dimensional (2D) gridded-surface deterministic modelling approach was used to evaluate and calculate in-place resource estimates for the glacial-fluvial silica sands located within the Property. The 2D gridded-surface model consists of laterally contiguous cells (commonly called *grids*). The selected grid size of 10 m x 10 m (x, y) was determined by the density of the test pit and drill hole data, required resolution on the gridded surfaces and extent of the Property boundaries. Each grid has a fixed position of easting and northing within the model limits and contains a list of variables or numeric identifiers, such as the unit thickness, percent of each sand fraction, and other pertinent information. Resource estimates are calculated without application of a base cut off for the silica.

Table 14-1 details the model limits on the Property.

Table 14-1
Model Limits

Block Dimensions	Easting (NAD83_Z12)	Northing (NAD83_Z12)	Elevation (masl)	Grid Cell Size (m)
Minimum	482,500	6,380,750	292	10
Maximum	484,090	6,382,740	310	10



Topographic and Model Horizons

Surface topography data utilized was publicly available 1 m resolution Lidar. This dataset was converted into a gridded-surface file within MineSight®. All drill hole collar elevations were made equivalent to the gridded surface topography.

The Base of Soils surface, referred to in the model as SO, is an estimated bottom of soil horizon A and B. This surface was created by copying and offsetting the Lidar topography surface by 0.5 m below topography across the Property. This layer when observed in test pits and auger drilling was not consistently captured in field notes and in many cases may not exist. The SO surface is used as a top of sand contact for resource volumes and provides a more conservative view of those volumes.

The Base of Test Pits surface, referred to in the model as TP, was created from a point set extracted from the total depth of each test pit within the Property and modeled in Minesight utilizing the Implicit Modeler tool.

The Base of Auger surface, referred to in the model as AU, was created from a point set extracted from the bottom sampling depth of each auger drill hole within the Property and modeled in Minesight utilizing the Implicit Modeller Tool. The AU surface is the bottom boundary of the resource that has been sampled and analyzed. Some auger holes were drilled deeper and found more sand than what was sampled. No additional resource volume has been credited below the AU modelled surface. The deposit remains open at depth.

Within the model boundary, there are 16 test pits locations and the five auger drill locations, resulting in a large variation in sample density by depth across the Property. It was decided to create a boundary in the model between the upper test pit data and lower auger data denoted as the TP surface. This technique is supported by the sieve analysis for the auger holes which shows generally coarser material in the lower surface referred to as Zone 2 area. Resource volumes are calculated separately by each zone.

The thickness of each interval was calculated based on the SO, TP and AU surfaces in MineSight®. These calculated vertical interval thicknesses grids were used to create isopach's of each interval as discussed in Section 7.3 and demonstrate the variability of thickness across the Property. Verification of the input surface datapoints and the representation of the data by the Implicit Modeller surfaces was verified through cross sections and review of field description logs.

Assay Data Compositing and Interpolation

Sieve-derived laboratory grain size data from the sand samples, as described in detail in Section 11, were composited into length weighted sand composites for two zones; Zone 1: SO surface to base of TP surface and Zone 2: base of TP surface to base of AU surface, encompassing all sampled intervals.



The composited values in each zone for the common proppant sand fractions were modelled using Inverse Distance Weighting cubed interpolation to calculate the percentage breakdown for each range at every grid node. The tonnage of sand for both Zone 1 and Zone 2 was calculated from the grid volume, multiplied by an average bulk density value of 1.5 g/cm³, then factored by the percentage of each sand fraction. The modelled sieve results are reported by Zone for each of the four common tonnages for 20/40, 40/70, 70/140 and 140/170. Figure 14-1 through Figure 14-8 show the PSD maps.

Table 14-2 demonstrates the model estimation settings used for interpolating the PSD data into the grid file.

**Table 14-2
Model Estimation Settings**

XY Search	IDW Power	Minimum Composites	Maximum Composite	Zones
2000	3	1	8	2

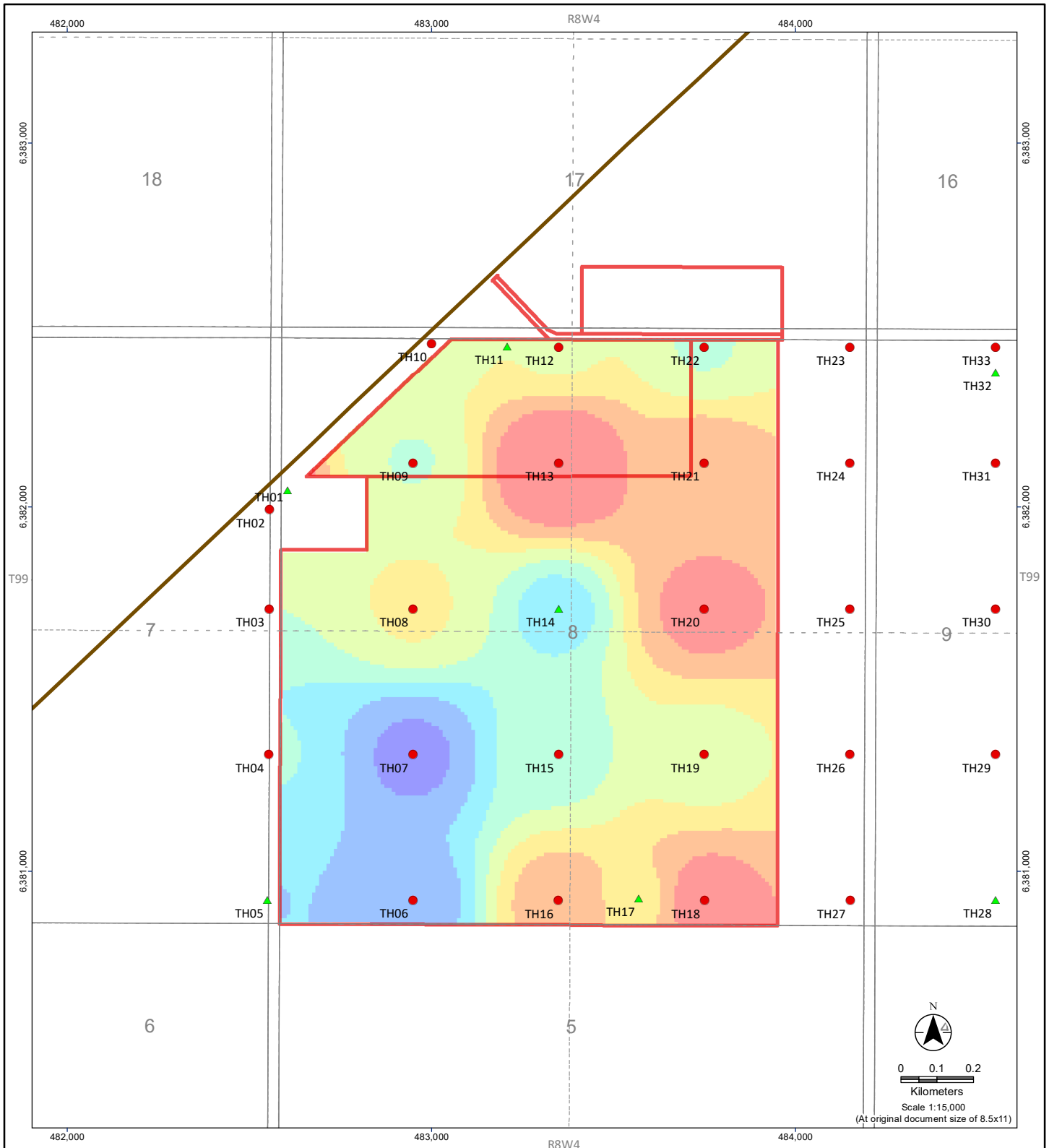
Frac Sand Proppant Variable Modelling

With 18 samples having natural proppant physical and chemical characteristics tested at varying depth intervals over a range of proppant size fractions, the data density of any one sand fraction does not support modelling individual proppant variables at each size, across the Property. Average proppant values for each size fraction are included in Table 14-3.

**Table 14-3
Proppant Results by Size Fraction
(Includes Four Blended Samples)**

Size Fraction	K-Value (K)	Roundness	Sphericity	Acid Solubility %	Bulk Density (g/cm ³)	Turbidity (NTU)
20/40	4	0.7	0.7	3.3	1.5	10.6
30/50	6	0.6	0.7	2.9	1.5	5.0
40/70	6	0.7	0.7	3.5	1.5	14.4
70/140	9	0.5	0.7	3.8	1.4	11.0





Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

20 /40 Fraction (%)

<ul style="list-style-type: none"> 7.1 - 8 8.1 - 9 9.1 - 10 10.1 - 11 	<ul style="list-style-type: none"> 11.1 - 12 12.1 - 13 13.1 - 14 14.1 - 15.3
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Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



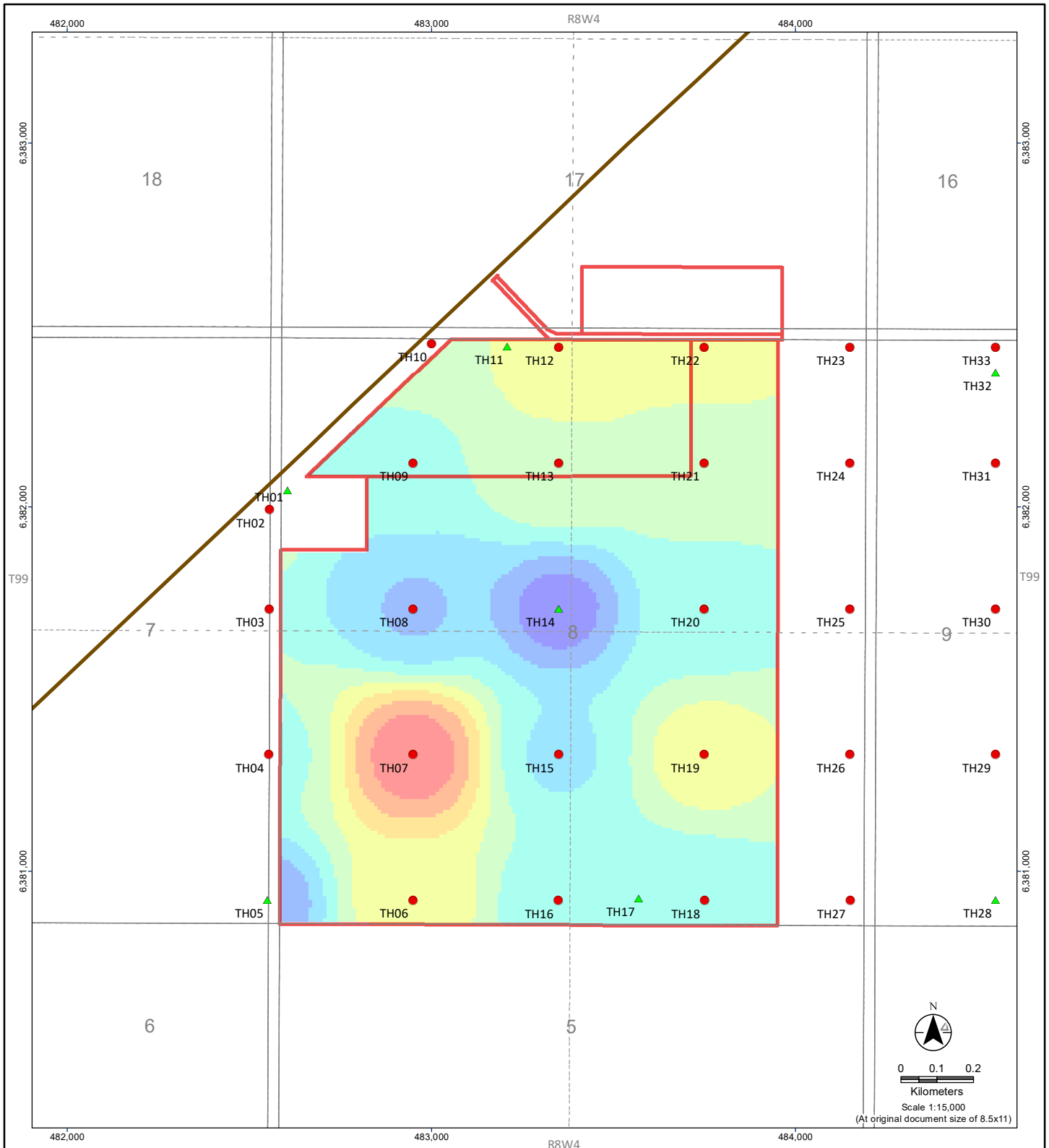
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**Test Pit - Zone 1
 20/40 Fraction Distribution Map**

Figure 14-1

DRAWN BY: M.B. FILE: Fig_14_1_U_PSD_20_40
 CHK'D BY: C.H. V:\1295\active\129500285\Reports\Draft\Figures\MXD
 DATE: 19/ 11/ 12

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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

40 /70 Fraction (%)

<ul style="list-style-type: none"> ■ 42.0 - 44 ■ 44.1 - 46 ■ 46.1 - 48 ■ 48.1 - 50 ■ 50.1 - 52 	<ul style="list-style-type: none"> ■ 52.1 - 54 ■ 54.1 - 56 ■ 56.1 - 58 ■ 58.1 - 60
---	--

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



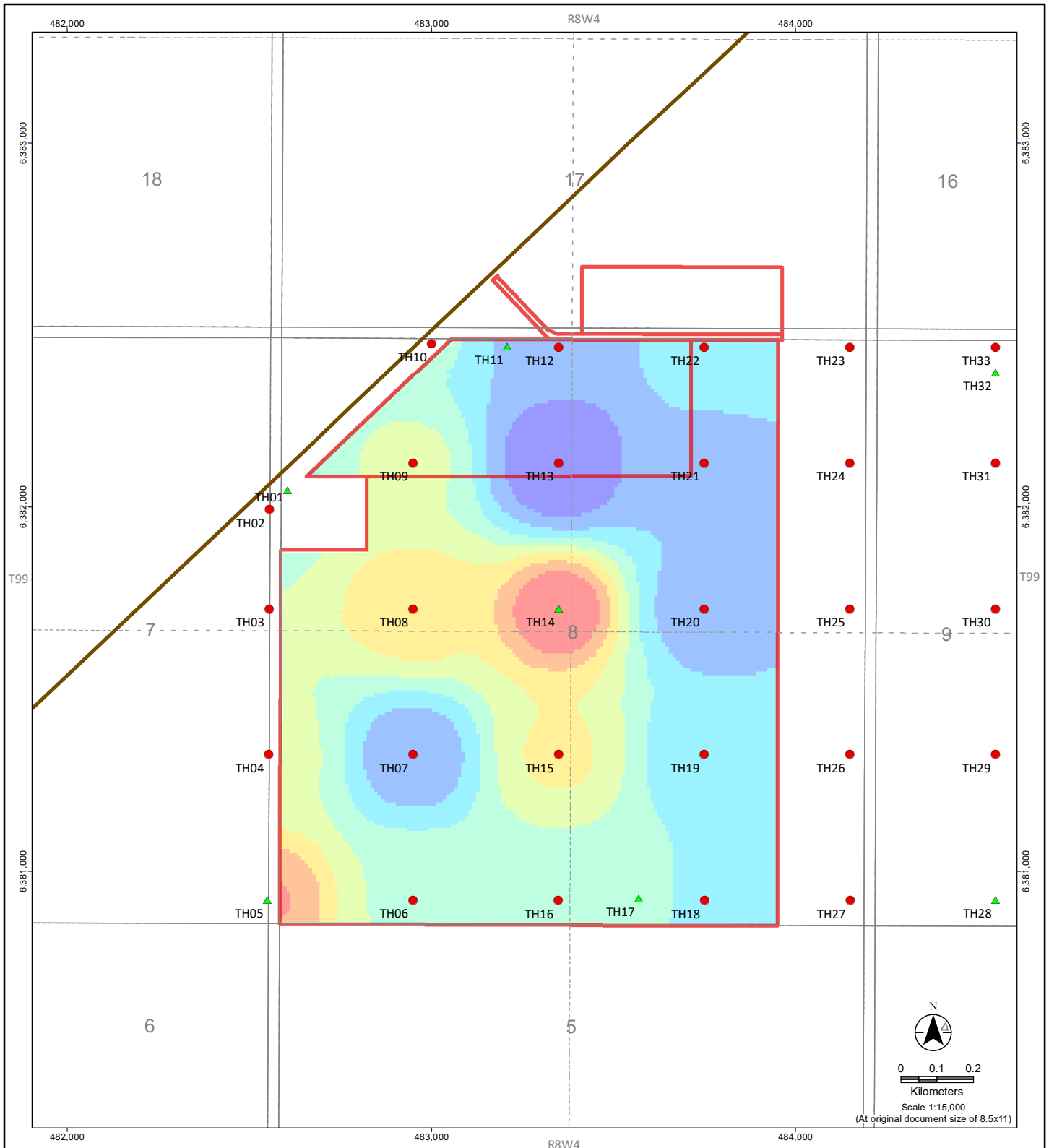
TECHNICAL REPORT FIREBAG PROPERTY

**Test Pit - Zone 1
 40/70 Fraction Distribution Map**

Figure 14-2

DRAWN BY: M.B. FILE: Fig_14_2_U_PSD_40_70
 CHK'D BY: C.H. V:\1295\active\129500285\Reports\Draft\Figures\MXD
 DATE: 19/ 11/ 12

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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

70 / 140 Fraction (%)

26.1 - 28	34.1 - 36
28.1 - 30	36.1 - 38
30.1 - 32	38.1 - 40
32.1 - 34	40.1 - 42



TECHNICAL REPORT FIREBAG PROPERTY

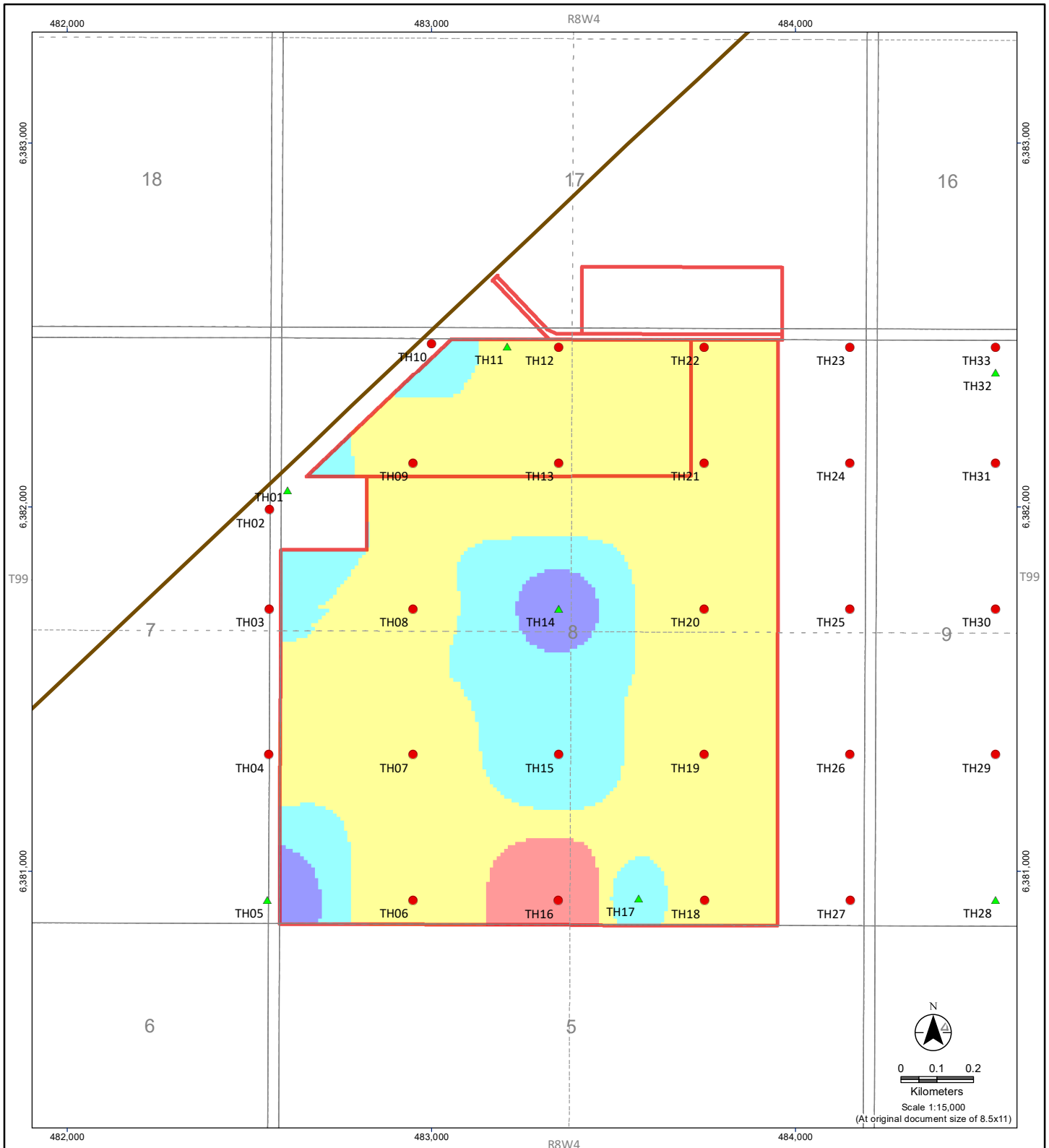
**Test Pit - Zone 1
70/140 Fraction Distribution Map**

Figure 14-3

Notes
Coordinate System: NAD 1983 UTM Zone 12N
Data Sources: Altalis; AMI

DRAWN BY: M.B. FILE: Fig_14_3_U_PSD_70_140
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

140 / 170 Fraction (%)

- 0 - 1
- 1.1 - 2
- 2.1 - 3
- 3.1 - 4

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



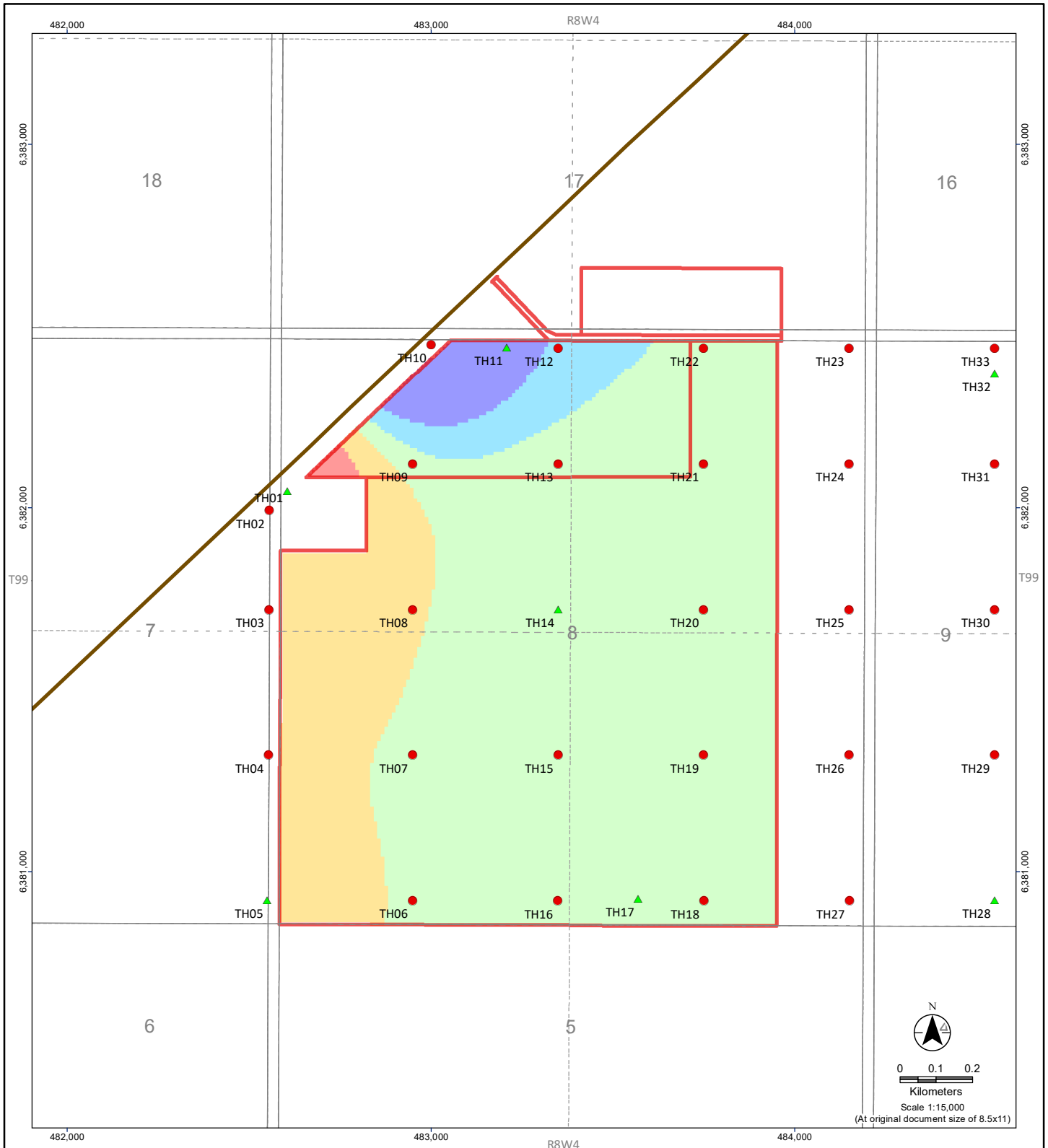
TECHNICAL REPORT FIREBAG PROPERTY

**Test Pit - Zone 1
 140/170 Fraction Distribution Map**

Figure 14-4

DRAWN BY: M.B. FILE: Fig_14_4_PSD_140_170
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

20 /40 Fraction (%)

- 5.9 - 8
- 8.1 - 10
- 10.1 - 12
- 12.1 - 14
- 14.1 - 16

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



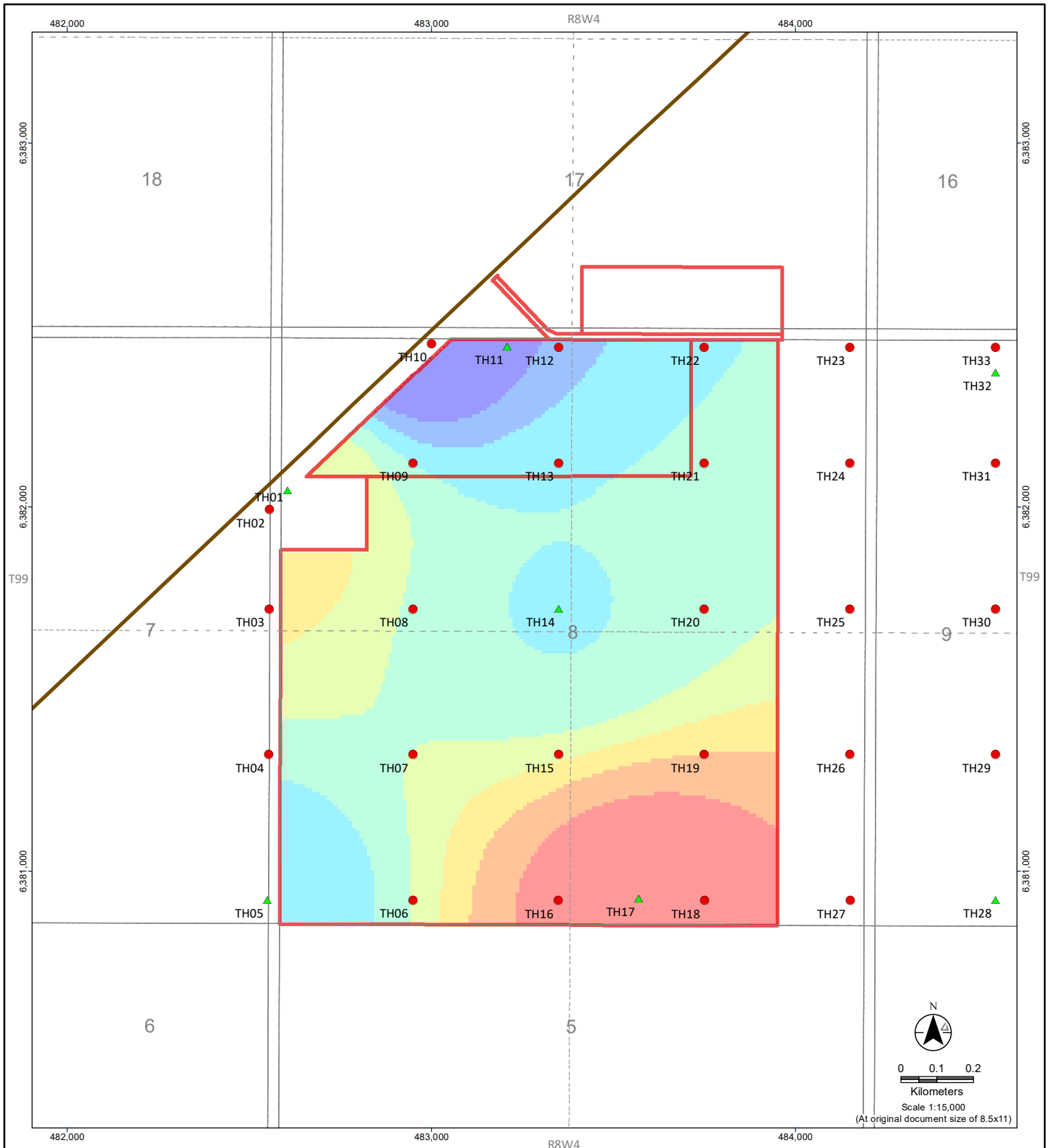
TECHNICAL REPORT FIREBAG PROPERTY

**Auger - Zone 2
 20/40 Fraction Distribution Map**

Figure 14-5

DRAWN BY: M.B. FILE: Fig_14_5_L_PSD_20_40
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

40 /70 Fraction (%)

39.6 - 42	48.1 - 50
42.1 - 44	50.1 - 52
44.1 - 46	52.1 - 54
46.1 - 48	54.1 - 56

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI

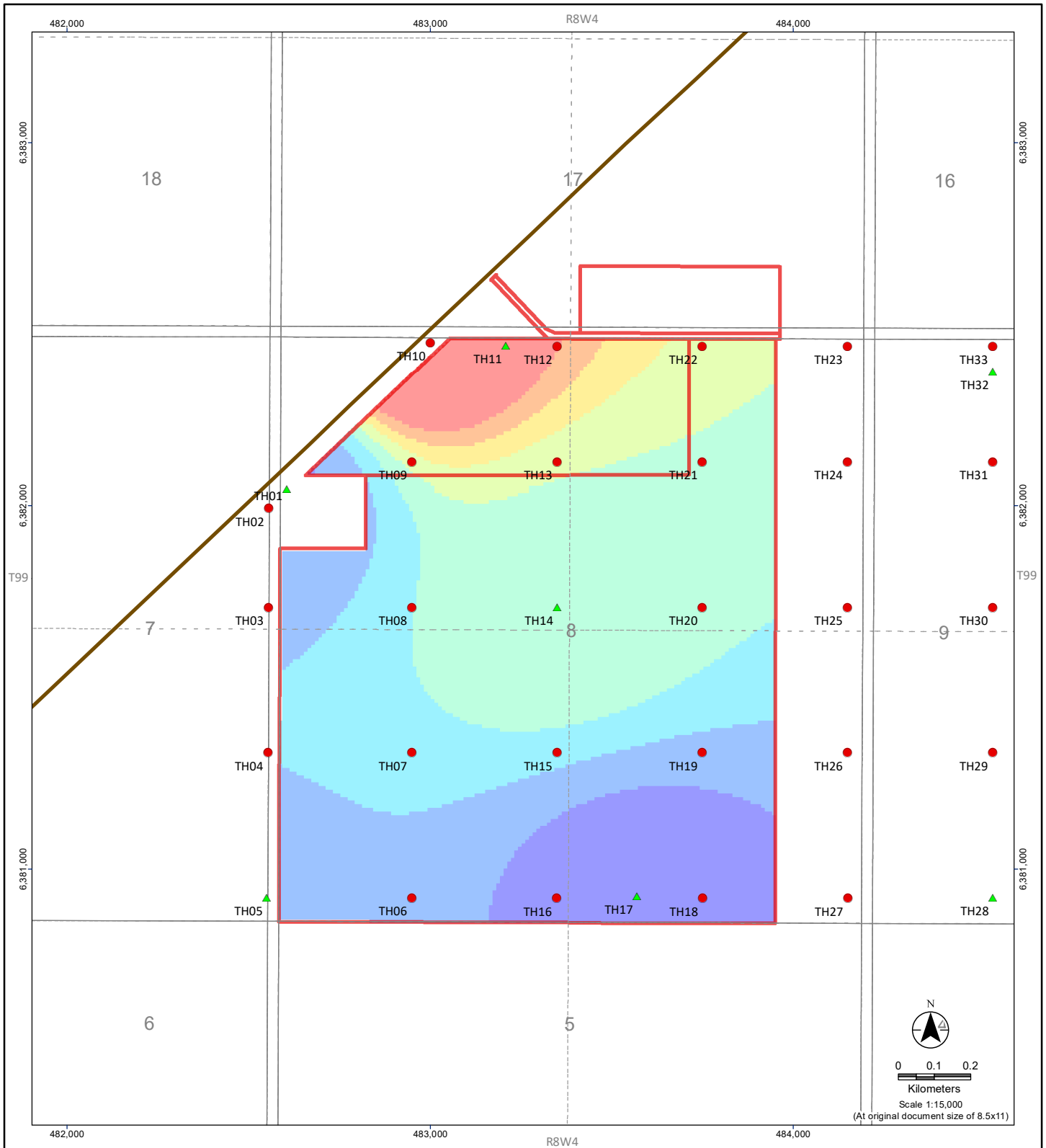


TECHNICAL REPORT FIREBAG PROPERTY

Auger - Zone 2 40/70 Fraction Distribution Map

Figure 14-6

DRAWN BY: M.B. CHK'D BY: C.H. DATE: 19/ 11/ 12	FILE: Fig_14_6_L_PSD_40_70 V:\1295\active\129500285\Reports\Draft\Figures\MXD
--	--



Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

70 / 140 Fraction (%)

■ 28.1 - 30	■ 36.1 - 38
■ 30.1 - 32	■ 38.1 - 40
■ 32.1 - 34	■ 40.1 - 42
■ 34.1 - 36	■ 42.1 - 47.3

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



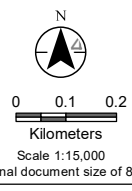
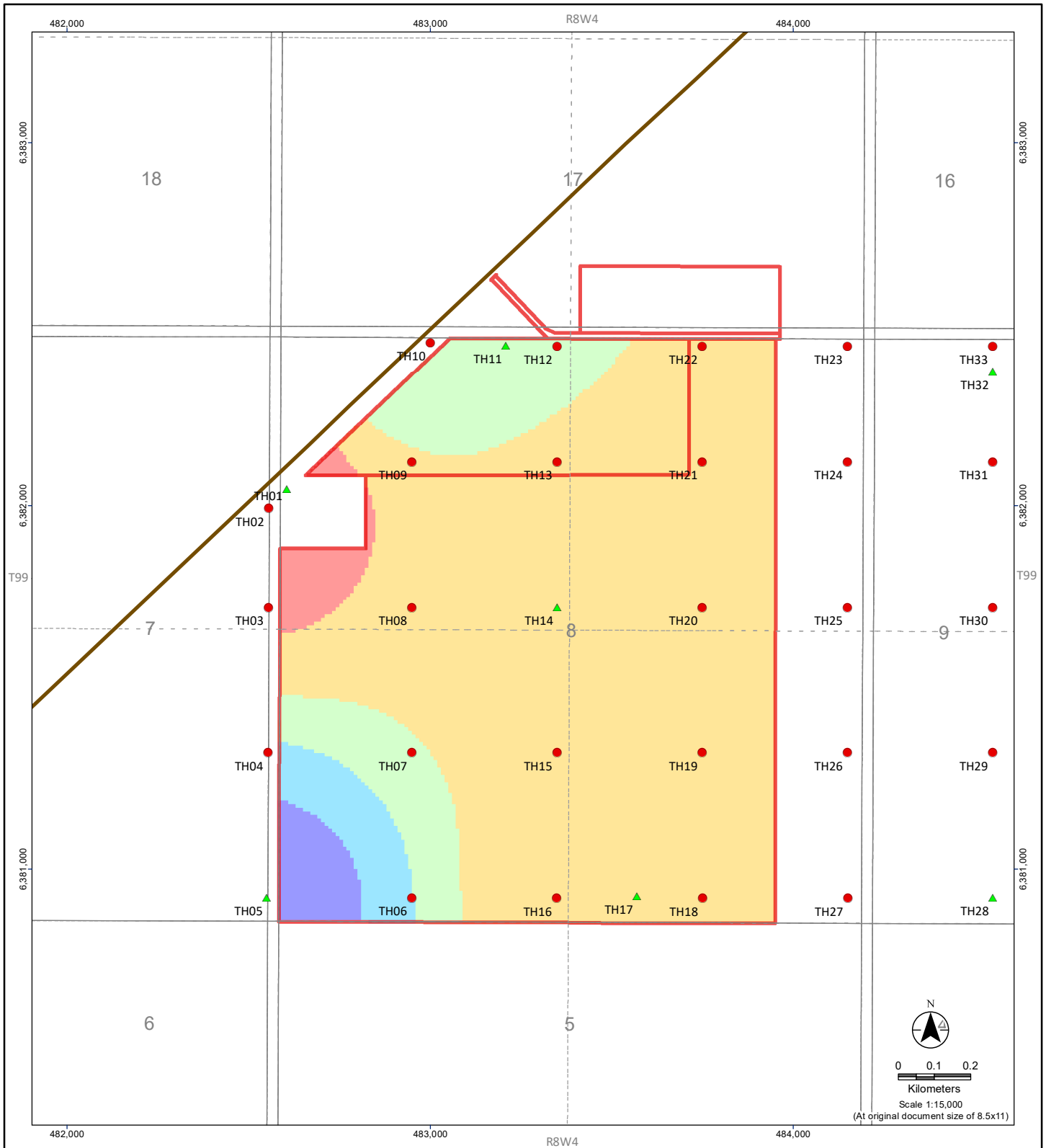
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**Auger - Zone 2
 70/140 Fraction Distribution Map**

Figure 14-7

DRAWN BY: M.B. FILE: Fig_14_7_L_PSD_70_140
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Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Winter Road

140 / 170 Fraction (%)

- 1.1 - 2
- 2.1 - 3
- 3.1 - 4
- 4.1 - 5
- 5.1 - 6

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



TECHNICAL REPORT FIREBAG PROPERTY

**Auger - Zone 2
 140/170 Fraction Distribution Map**

Figure 14-8

DRAWN BY: M.B. FILE: Fig_14_8_L_PSD_140_170
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14.2 Resource Estimation Approach

Stantec used the following approach to facilitate the estimation of resources:

- Zone 1 and Zone 2 thicknesses were calculated from test pits and auger holes completed by AMI during the 2011 programs.
- Cumulative percentages of the different fractions were used as provided from the laboratory.
- MineSight® version 15.60 software was used to construct a 3D geological computer model of the Property, to estimate in-place resource volumes by gridding thickness for Zone 1 and Zone 2.
- Volumes were converted to tonnage by the application of a representative average bulk density value of 1.5 g/cm³ based on the proppant analyses.
- The geological interpretations and their relationship to the raw data were confirmed through the model building process.
- The estimation only includes those resources that are within the boundaries of SML 120032 and SML 130021, as shown on the Resource Distribution Map of Figure 14-9.
- Unsampled intervals at the bottom of the holes were not included in the resource estimate.
- Review of the test pits, drill hole spacing, the available assay data, and resource distribution were used to classify the resources.

14.3 Basis for Resource Classification

NI 43-101 specifies that the definitions of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Guidelines be used for the identification of resources. The CIM Resource and Reserve Definition Committee have produced the following statements which are restated here in the format originally provided in the CIM Reserve Resource Definition document:

“Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.”

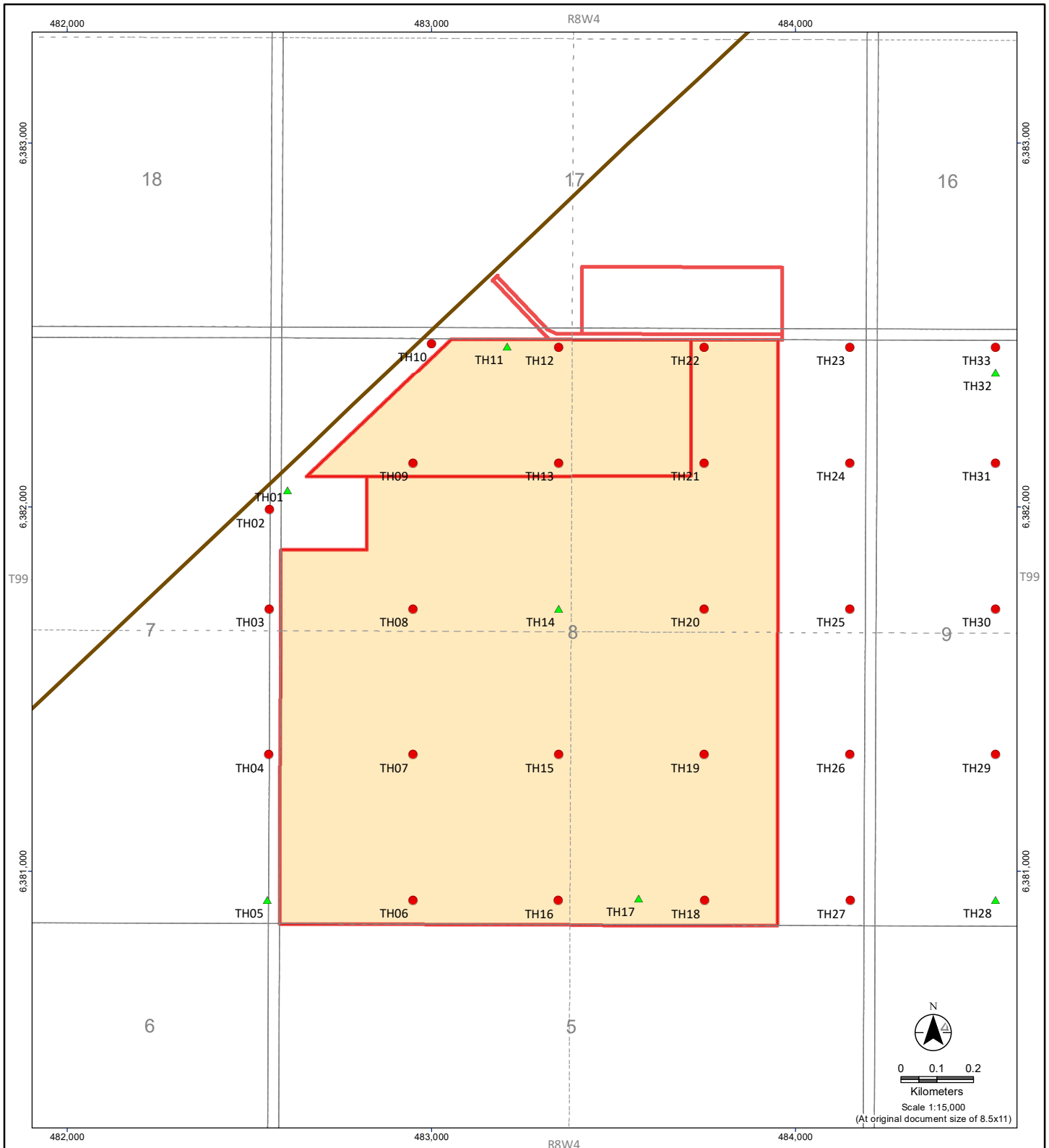
The Definition of Resources is as follows:

“A Mineral Resource is a concentration or occurrence of material of economic interest in or on the Earth’s crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.”



“Material of economic interest refers to diamonds, natural inorganic material, or natural fossilized organic material including base and precious metals, coal, and industrial minerals.”





Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- Resource Distribution
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



TECHNICAL REPORT FIREBAG PROPERTY

Resource Distribution Map

Figure 14-9

DRAWN BY: M.B. FILE: Fig_14_9_Resource_Distribution
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The committee went on to state that:

“The term Mineral Resource covers mineralization and natural material of intrinsic economic interest which has been identified and estimated through exploration and sampling and within which Mineral Reserves may subsequently be defined by the consideration and application of technical, economic, legal, environmental, socio-economic and governmental factors. The phrase ‘reasonable prospects for eventual economic extraction’ implies a judgment by the Qualified Person in respect of the technical and economic factors likely to influence the prospect of economic extraction. Interpretation of the word ‘eventual’ in this context may vary depending on the commodity or mineral involved. For example, for some coal, iron, potash deposits and other bulk minerals or commodities, it may be reasonable to envisage ‘eventual economic extraction’ as covering time periods in excess of 50 years. However, for many gold deposits, application of the concept would normally be restricted to perhaps 10 to 15 years, and frequently to much shorter periods of time.”

These definitions and statements clearly show that natural material is considered a resource if there is clear identification of the economic potential of the deposit. For sand deposits this means that the nature of the deposit, technology for mining and mine planning, some degree of practical recovery constraints and the economic potential in current markets must be considered in order to identify a sand resource.

14.4 Property Resource Classification

Resources are classified according to the confidence categories defined by *CIM Best Practice Guidelines for Industrial Minerals*, which was published by the CIM Estimation Best Practice Committee on November 23, 2003. The assigned resource classification is currently constrained to the depth of the auger holes that contain sieve and proppant quality data from independent laboratories. The sand on the Property was classified as Indicated Resource based on the Qualified Person(s) experience with classifying flat lying stratified deposits. Figure 14-10 shows the resource classification map.

The sand on the Property is intended for use as a natural proppant. There is a demand for natural proppant in the WCSB. The volume of sales and anticipated margins for natural proppants from this Property are anticipated to be reasonable, as discussed in Section 14.5.





Legend

- Test Pit
- ▲ Auger Hole
- ▭ Firebag Property
- ▭ Resource Classification - Indicated
- Winter Road

Notes
 Coordinate System: NAD 1983 UTM Zone 12N
 Data Sources: Altalis; AMI



TECHNICAL REPORT FIREBAG PROPERTY

Resource Classification Map

Figure 14-10

DRAWN BY: M.B. FILE: Fig_14_10_Resource_Classification
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 DATE: 19/ 11/ 14

14.5 Assessment of Reasonable Prospect for Eventual Economic Extraction

In coming to a determination regarding the assessment of reasonable prospects for the eventual economic extraction of the Property sand deposit, the Author(s) considered the following:

- The proximity of the unconsolidated sand resource at or near surface.
- The consistency and predictability of the sand units.
- The topographic features of the area, which consist of flat to gently rolling forest.
- The proximity of the sand deposit relative to the terminus of Highway 63; approximately 7 km.
- Fort McMurray is 95 km south of the Property. This city is the location for many suppliers of mining equipment, materials handling equipment, process equipment, and other infrastructure suppliers.
- The technology for the processing and beneficiation of sand deposits to support the oil and gas industry with natural proppant is well established.
- Current estimates show that the Firebag Property sand deposit could potentially be developed and operated for an average unit product cost (including both unit operating costs and unit capital costs) in the range of \$110 to \$120 per tonne of product delivered to the Montney Basin area. This estimate utilizes Stantec's knowledge of development, mining, and processing costs of projects with similar scale and complexity.
- The use of natural sand proppant in the Western Canadian oil and gas industry and the product pricing is highly dependent on the specific properties of the resource, the location of the resource in relation to the oil and gas producing basins, the specific properties and requirements of individual oil and gas wells, and the current oil and gas market. Upon review of the information available to Stantec regarding product pricing, it appears reasonable to conclude that the Firebag Property sand deposit could attract pricing in the range of \$120 to \$140 per tonne of product in the Montney Basin.

These factors lead the Author(s) to conclude that the Firebag Property could be developed in a manner that would make the project competitive in the Western Canada natural proppant market, depending on market conditions. On the basis of the information provided above, the Author(s) believe that the Property is a reasonable prospect for eventual economic extraction.

14.6 Mineral Resource Estimation

Table 14-4 shows the estimate of the mineral resource for the Property as of November 8, 2019.

The mineral resource shown in Table 14-4 is reported as in-place tonnages. The volumes calculated from the zone thickness were converted to tonnage by the application of representative average in-place bulk densities of 1.5 g/cm³. The 20/40, 40/70, 70/140 and



140/170 fractions were assessed during the preparation of this report as each fraction has different applications during the hydraulic fracturing process.

Table 14-4
In-Place Mineral Resource Summary, Effective Date November 8, 2019

Category	Mineral Resources (Mt)				
	20/40 Mesh Fraction	40/70 Mesh Fraction	70/140 Mesh Fraction	140/170 Mesh Fraction	Total
MEASURED	-	-	-	-	-
INDICATED	4.45	19.34	13.40	0.98	38.18
MEASURED & INDICATED	4.45	19.34	13.40	0.98	38.18

Mt = Million Tonnes

SML 130021 with 32.2 ha is calculated to have 6.02 Mt of saleable sand fractions and SML 120032 with 172.3 ha is calculated to have 32.16 Mt of saleable sand fractions.

A breakdown between the upper and lower zones, has the upper, Zone 1, with 37.4% of the resource based on 16 data inputs and the lower, Zone 2, contains 62.6% of the resource based on 5 data inputs analysis. The fractions outside of this reported range, the greater than 20-Mesh and less than 170-Mesh, sum to 1.50 Mt of non-saleable material.

The accuracy of resource estimates is, in part, a function of the quality and quantity of available data and of engineering and geological interpretation and judgment. Given the data available at the time that this Technical Report was prepared, the estimates presented herein are considered reasonable. However, this estimate should be accepted with the understanding that additional data and analysis available after the date of the estimates, may necessitate revision. These revisions may be material. There is no guarantee that all or any part of the estimated resources will be recoverable.



15 MINERAL RESERVE ESTIMATES

This Technical Report does not include an estimate of reserves.



16 MINING METHODS

This Technical Report does not include discussions regarding mining methods.



17 RECOVERY METHODS

There is no information for this section of the Technical Report as the Property is not presently producing and is not yet under development.



18 PROJECT INFRASTRUCTURE

There is no information for this section of the Technical Report as the Property is not presently producing and is not yet under development.



19 MARKETS AND CONTRACTS

There is no information for this section of the Technical Report as the Property is not presently producing and is not yet under development.



20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

Environmental studies, permitting and social or community impact was not included in this Technical Report.



21 CAPITAL AND OPERATING COSTS

There is no information for this section of the Technical Report as the Property is not presently producing and is not yet under development.



22 ECONOMIC ANALYSIS

There is no information for this section of the Technical Report as the Property is not presently producing and is not yet under development.



23 ADJACENT PROPERTIES

There are no adjacent properties exploiting natural proppant adjacent to the Property.

Along the northwestern corner of the Property at 57°34.73143'N and 111°17.26960'W, which is just outside of SML 120032, there is an abandoned well (Licence Number 0375291) that was owned by Silverbirch Energy Corp (Alberta Government, 2019).



24 OTHER RELEVANT DATA AND INFORMATION

All relevant information is included in this Technical Report.



25 INTERPRETATION AND CONCLUSIONS

Two auger drilling campaigns were completed in the vicinity of the Project to assess the extent and quality of the sand, and to constrain the optimal area to secure the surface material leases. Nineteen auger holes were drilled to approximately 14.3 m depth in January 2011. The location of auger hole TH6, which was drilled during this January 2011 campaign, was selected for further testing. In December 2011, a second field program was conducted in that area that involved the completion of 26 test pits and seven additional auger holes, which were drilled to 24.4 m depth. The results from this second testing campaign constrained the proposed SLM boundary.

Table 25-1 shows the estimate of the mineral resource for the Property as of November 8, 2019. The mineral resource shown in Table 14-4 is reported as in-place tonnages. The volumes calculated from the zone thickness were converted to tonnage by the application of representative average in-place bulk densities of 1.5 g/cm³. The 20/40, 40/70, 70/140 and 140/170 fractions were assessed during the preparation of this report as each fraction has different applications during the hydraulic fracturing process.

Table 25-1
In-Place Mineral Resource Summary
Effective Date November 8, 2019

Category	Mineral Resources (Mt)				
	20/40 Mesh Fraction	40/70 Mesh Fraction	70/140 Mesh Fraction	140/170 Mesh Fraction	Total
MEASURED	-	-	-	-	-
INDICATED	4.45	19.34	13.40	0.98	38.18
MEASURED & INDICATED	4.45	19.34	13.40	0.98	38.18

Mt = Million Tonnes

SML 130021 with 32.2 ha is calculated to have 6.02 Mt of saleable sand fractions and SML 120032 with 172.3 ha is calculated to have 32.16 Mt of saleable sand fractions.

A breakdown between the upper and lower zones, has the upper, Zone 1, with 37.4% of the resource based on 16 data inputs and the lower, Zone 2, contains 62.6% of the resource based on 5 data inputs analysis. The fractions outside of this reported range, the greater than 20 Mesh and less than 170 Mesh, sum to 1.50 Mt of non-saleable material.

The sand on the Property was classified as Indicated Resource based on the Qualified Person(s) experience with classifying flat lying stratified deposits. The resource is classified according to the confidence categories defined by *CIM Best Practice Guidelines for Industrial Minerals*, which was published by the CIM Estimation Best Practice Committee on November 23, 2003.



TECHNICAL REPORT – Firebag Property, Alberta, Canada

The accuracy of resource estimates is, in part, a function of the quality and quantity of available data and of engineering and geological interpretation and judgment. Given the data available at the time that this Technical Report was prepared, the estimates presented herein are considered reasonable. However, this estimate should be accepted with the understanding that additional data and analysis available after the date of the estimates, may necessitate revision. These revisions may be material. There is no guarantee that all or any part of the estimated resources will be recoverable.

No significant risks or uncertainties are expected to affect the reliability or confidence in the exploration information or mineral resource. This report does not address mineral reserve estimates or projected economic outcomes.

It is the Author(s) opinion that the distribution, density, and associated laboratory analyses from the Property are sufficient to indicate reasonable potential for economic extraction. Based on all available data, the mineral resource is classified as Indicated.



26 RECOMMENDATIONS

It is recommended that AMI advance the Property through the following two phases, as detailed below.

26.1 Phase One: Sonic Drill Program (C\$101K)

Much of the testing on the Property has been completed through excavation of test pits; there are only five auger drill holes completed directly within the model. It is recommended that a subsequent mini sonic drill program be completed that penetrates through the base of the sand in all holes so that a comprehensive understanding of the sand thickness be obtained. Use of a mini sonic drill is recommended over the use of an auger drill at greater depths, such as depths greater than 25 m. Also, due to the advancement of continuous casing during drilling, the sonic core is not contaminated through dragging against the sidewall of the drill hole. It is recommended that approximately six sonic holes be completed in this phase.

Systematic continuous sampling is required to characterize potential variations in the sand that may occur spatially across the Property. Table 26-1 lists the required tasks and the estimated associated cost.

Table 26-1
Phase 1: Sonic Exploration Program

Task	Estimated Cost (C\$)
Personnel (Office, Field, Travel Expenses)	14,000
Six-Hole Drill Program (Rig and crew)	30,000
Laboratory (Sieve Analyses)	17,000
Laboratory (Proppant Testing & Shipment)	40,000
Estimate Total	101,000

26.2 Phase Two: Revised Preliminary Economic Assessment (C\$350K)

Depending on the results of the drilling, it is advised that a new geological model be developed, and the resource tonnage be reassessed and reclassified. A reevaluation of the economics is recommended as a Preliminary Economic Assessment (PEA) was last completed on the project in 2015. Stantec recommends an independent market assessment be completed to support a PEA. Table 26-2 shows the list of tasks that require revision following completion of Phase One.



Table 26-2
Phase 2: Preliminary Economic Assessment

Project Task	Fees (Cdn\$)
Project Management	\$10,000
Geology, Resource Evaluation, Reclassification	\$30,000
Water Management Plan	\$65,000
Extraction and Development Plan	\$90,000
Infrastructure / Transport / Process	\$80,000
Environmental / Regulatory / Permitting	\$5,000
Project Cost & Economic Analyses	\$40,000
Project Review and Reporting	\$30,000
Total	\$350,000



27 REFERENCES

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