

# MAR 20120012: CROOKED RAPIDS

Crooked Rapids - a report on geological and geophysical exploration for magnetite in the Athabasca region, northeastern Alberta

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**ATHABASCA MINERALS INC.**  
**2010-2012 EXPLORATION**  
**CROOKED RAPIDS PROJECT, NORTHEAST ALBERTA**

**Mineral Assessment Report Part B**

**Metallic and industrial Minerals Permits**

9310060420

9310060421

9310060422

**Geographic Coordinates**

56° 27' 34.6"N to 56° 28' 57.4"N  
111° 48' 18.4"W to 111° 49' 34.6"W

NTS 74D05, 74D12, 84A08, 84A09

**August 2012**

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TABLE OF CONTENTS	PAGE
SUMMARY .....	i
1.0 INTRODUCTION .....	1
1.1 Purpose and Scope .....	1
1.2 Accessibility, Climate and Physiography .....	4
1.2.1 Topography, Elevation and Vegetation.....	4
1.2.2 Property Access.....	10
1.2.3 Proximity and Transport .....	10
1.2.4 Climate and Operating Season .....	12
1.3 Regional Bedrock Geology .....	12
2.0 MAGNETITE .....	19
2.1 Magnetite Uses.....	19
2.2 Permit Holdings .....	19
2.3 Local Geology.....	19
2.4 Previous Work.....	23
2.4.1 Pre-2010 Exploration .....	23
2.4.2 Initial Reconnaissance.....	26
2.5 Subsurface Mapping.....	26
2.5.1 Introduction .....	26
2.5.2 Data Control .....	29
2.5.3 Subsurface Stratigraphy .....	29
2.5.4 Structure Maps .....	33
2.6 Field Program.....	37
2.6.1 Introduction.....	37
2.6.2 Aerial Reconnaissance .....	37
2.6.3 Ground Investigation.....	39
2.6.4 Future Exploration .....	39
2.7 Conclusions and recommendations.....	43
2.8 References .....	44

FIGURE	PAGE
1	Alberta Road Map-Crooked Rapids Project .....2
2	ABM Metallic and Industrial Mineral Permits. ....3
3	Natural Regions and Subregions of Alberta .....5
4A	Surface Topography and Drainage.....6
4B	Topographic Relief-Crooked Rapids Area .....7
5	Soil Map of Northern Alberta and Saskatchewan.....9
6	Access to Crooked Rapids Project .....11
7	Frost –free Period.....13
8	Annual Total Precipitation .....14
9	January Daily Mean Temperature.....15
10	July Daily Mean Temperature.....16
11	Schematic Cross Section of Cretaceous Bedrock .....17
12	Bedrock Geology of the Fort McMurray Area .....18
13	Bedrock Geology of Northeast Alberta.....22
14A	Original Geolink Magnetic Map .....24
14B	Georeferenced Geolink Diagram Draped Over Surface Topography.....25
15	Oilsand Lease Holders .....27
16	Reference Well Locations.....28
17	Reference Well AB/08-33-86-12W4 .....30
18	Reference Well AA/10-22-86-12W4 .....31
19	Reference Well AA/10-16-86-12W4 .....32
20	Sub-Cretaceous Unconformity Structure .....34
21	Wabiskaw Member Structure.....35
22	Clearwater A Structure.....36
23	APEX Ground-based Magnetic Survey vs Geolink Magnetic Diagram.....40
24	Magnetic Anomaly Overview .....41
25	Proposed Permit Retention.....42

APPENDIX

1	Athabasca Minerals Inc. Metallic and Industrial Mineral Permits .....	45
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## SUMMARY

Athabasca Minerals Inc. (ABM), a mineral exploration company based in Edmonton, was formed in April of 2006. ABM has a 100% interest in more than 411,700 hectares of Metallic and Industrial Mineral Permits in the Athabasca region of northeast Alberta. The Crooked Rapids Property assessment report evaluates work completed on a contiguous three township block totaling 26, 275 hectares. The three mineral permits are located just south of the Athabasca River in northeast Alberta; about 40 km west-southwest of Fort McMurray.

Exploration activities on the three permits, during 2010 and 2011, focused on magnetite potential of the area. Metallic and Industrial Mineral permits were previously held by Ashton Mining of Canada and most recently by Geolink Exploration Ltd. A magnetic anomaly was identified from an airborne magnetic survey flown by Ashton in 1998. The results of follow-up work by Ashton are not known, but Geolink Exploration Ltd. acquired mineral permits over the anomaly in 2006 and retained the permits until the spring of 2010. An assessment report generally indicating inconclusive results was filed in 2008 allowing Geolink to retain the permits for an additional 2 years (2010).

ABM has conducted a preliminary review of the local and regional surface topography, an introductory structurally-based study of existing subsurface data and a small scale, ground-based magnetic survey over the anomaly discovered by Ashton. Surface ridges, similar in size and orientation, located near the anomaly do not appear to be related to the anomaly. Subsurface geophysical logs from oilsand exploratory wells in the area indicate a structural low, evident on several mappable stratigraphic surfaces, is aligned with the magnetic high. Further subsurface work is required to refine the structural interpretation and determine if the anomaly is deep seated or is a near surface feature. A preliminary ground-based magnetic survey confirmed the location and intensity of the magnetic feature. Based upon previous work by others and initial studies conducted by ABM future exploration is warranted.

An upcoming surface sampling is planned over the Property and will be likely followed up by a shallow drill program that will test strata to depths of up to 30 m. Based upon sample analysis results from the surface sampling and auger program exploration activities may continue with additional geophysical surveys and deeper drilling.

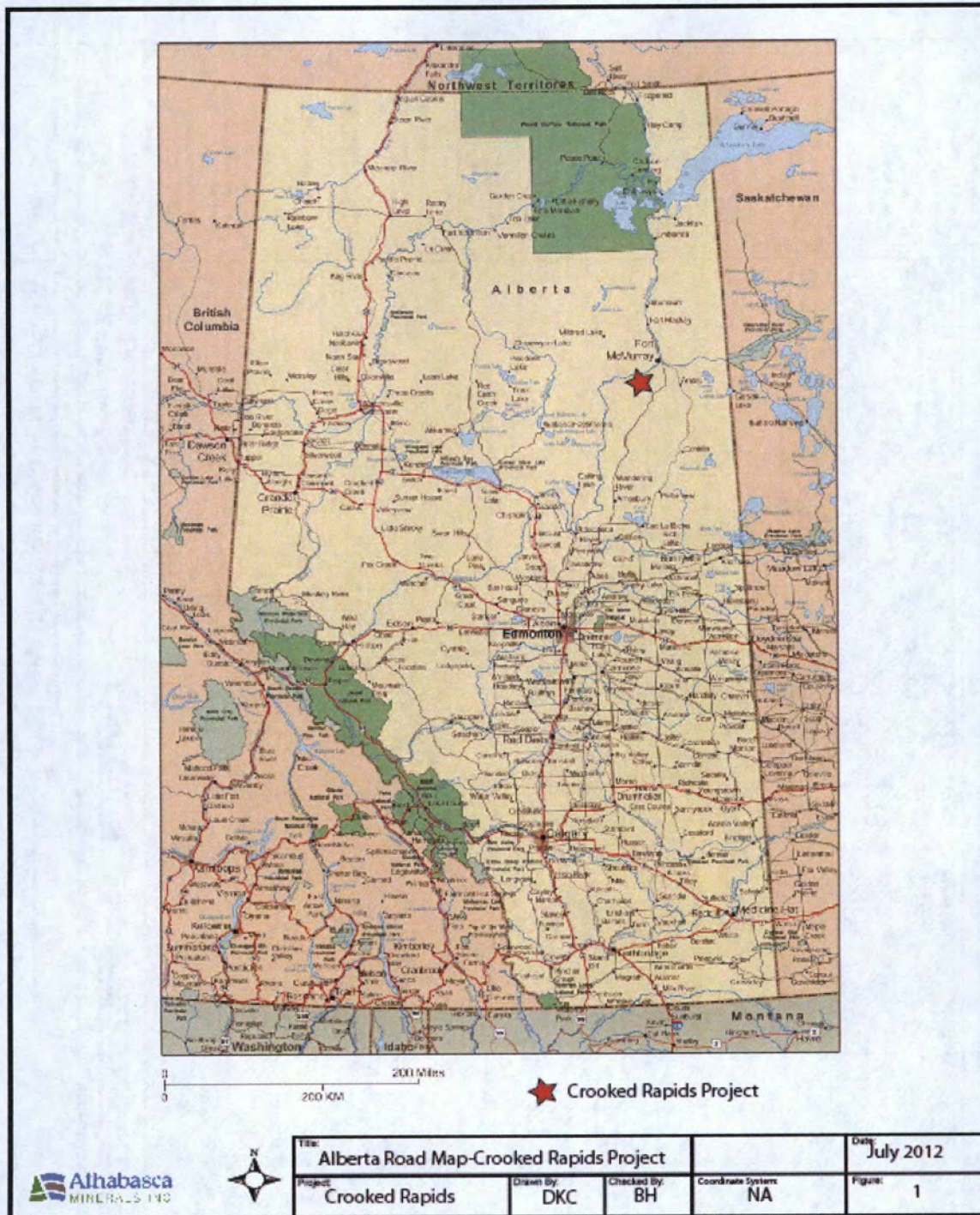
## 1.0 INTRODUCTION

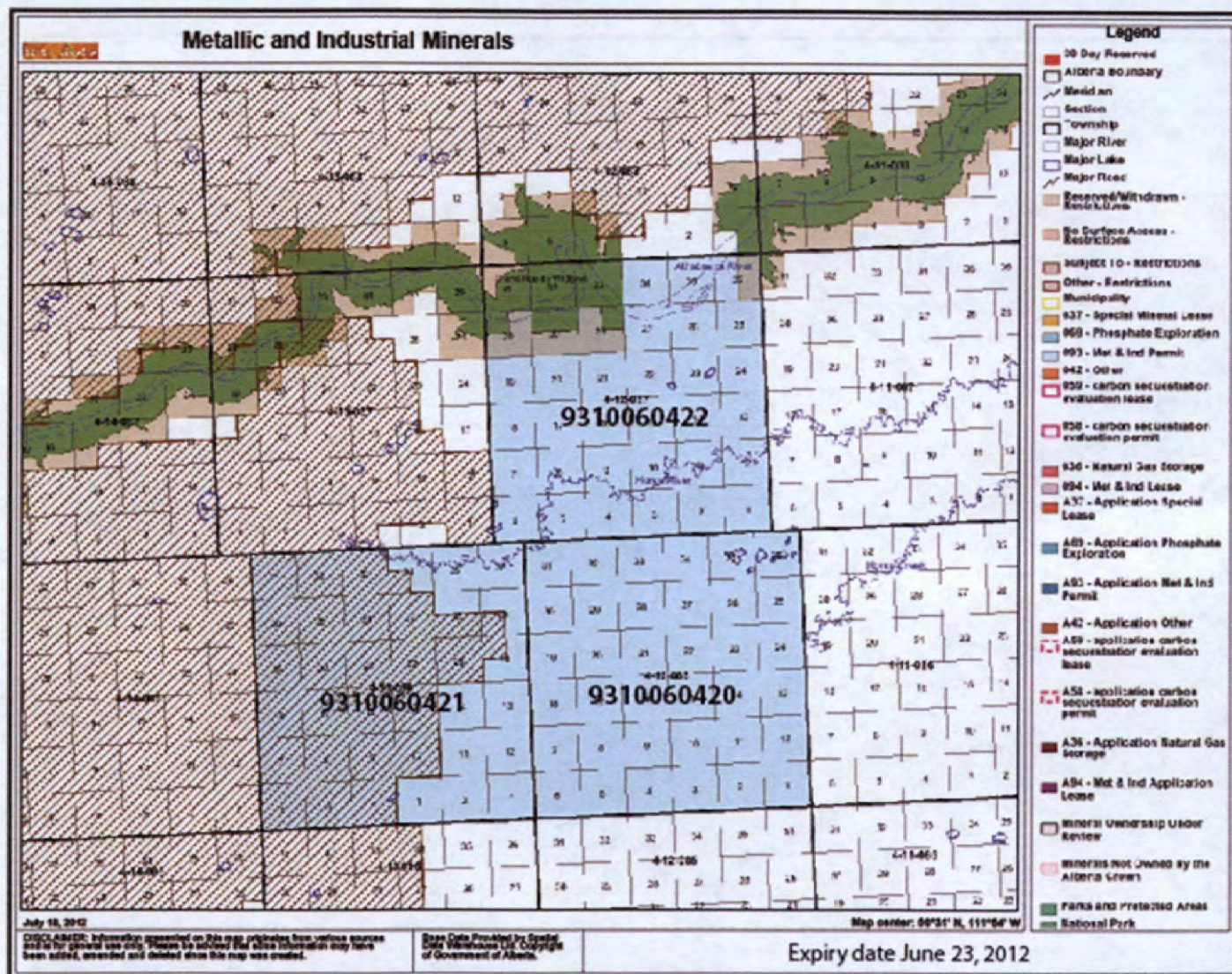
### 1.1 PURPOSE AND SCOPE

Athabasca Minerals Inc. (ABM) holds Metallic and Industrial Mineral Permits on more than 1 million acres (411,700 hectares) within the Athabasca region of northeast Alberta. These permits convey rights to all industrial and metallic minerals exclusive of coal, oil, gas and oil sands. The permits do not include rights to surface materials such as gravel. Regional studies conducted by the Alberta Geological Survey suggest the Athabasca region contains a rich variety of industrial minerals that include salt, silica sand, limestone and gypsum.

Permitted lands assessed within this report were acquired in June of 2010 (**Appendix 1**). The three permits are located within Township 86, ranges 12 and 13 and Township 87, Range 13 West of the Fourth Meridian (NTS map sheets 74D05, 74D12, 84A08 and 84A09). The Crooked Rapids Property is approximately 350 km northeast of Edmonton and 40 km southwest of the City of Fort McMurray (**Figure 1**). The northern permit (T87R12W4) borders the east flowing Athabasca River (**Figure 2**) and the Grand Rapids Wildland Conservation Area (follows the east-west course of the Athabasca River) thus decreasing size of the permit. One of the permits to the south (T86R13W4) has some restrictions in place, but exploration within the full township is allowable. The three adjoined permits total 26,275 ha.

The Crooked Rapids assessment report includes exploration activities dating back to the fall of 2010. The Property is currently in an early exploration phase due to higher priority targets within other Metallic and Industrial Permits held in region by ABM, thus the report covers preliminary subsurface and surface-based field exploration. Previous works by other exploration companies suggest the potential for economic quantities of near surface magnetite. Interest in the area was originally generated by a linear magnetic anomaly first identified by an airborne magnetic survey.





## 1.2 ACCESSIBILITY, CLIMATE AND PHYSIOGRAPHY

### 1.2.1 Topography, Elevation and Vegetation

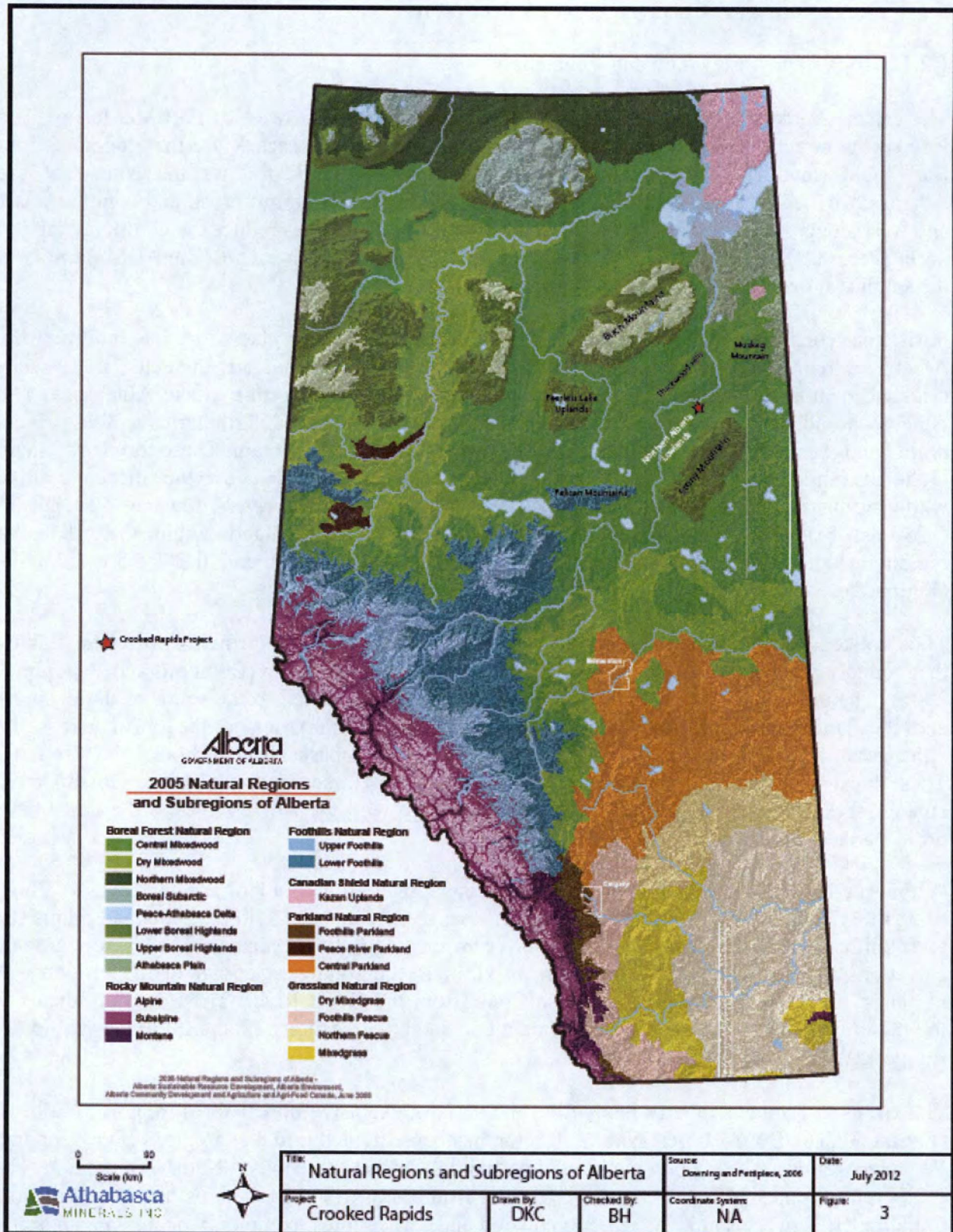
The center Crooked Rapids Property is located about 40 km southwest of Fort McMurray. The Property is bound to the north by the east-west leg of the Athabasca River that continues into Fort McMurray. The Grand Rapids Wildland Provincial Park follows the course of the Athabasca River, extending through the northern portion of the permit block and continues east and west along the river. The presence Grand Rapids Wildland does reduce the permit area in the north (Permit 9310060422) to 7842 ha rather than 9216 ha held in each of the ABM permits to the south (**Figure 2**).

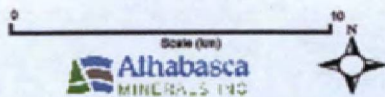
Post-Cretaceous erosional events, the last significant event being glaciation, has modified the Athabasca region into a series of highlands and high plains that are dissected by a well-established drainage network that collects and transports water north to Lake Athabasca. The Athabasca and the Clearwater are the two major rivers in the area. Tributaries to these rivers drain from the Birch Mountains, Stony Mountain and Muskeg Mountain. These three prominent highlands range between 550 and 800 m above sea level (up to 450 m above the adjacent plains), while the broad, incised valleys of the Athabasca and Clearwater rivers downcut 60 to 90 m (~250 asl) below the plains (Carrigy, 1973). Other prominent highlands within the Athabasca region include the Peerless Lake Uplands, the Pelican Mountains and the Thickwood Hills (**Figure 3**).

The Crooked Rapids Property is located within a regional lowland (Northern Alberta Lowlands) that roughly follows the course of the present day Athabasca River (Downing and Pettapiece, 2006). The northeast trending Stony Mountain highland is situated to the south of the Property and the Thickwood Hills (a more subdued topographic high) lies to the north across the Athabasca River (**Figure 3**). Local tributaries, to the Athabasca River, dissect the Property. These local drainage networks include the Horse River, Horse Creek and Little Horse Creek. Horse Creek and Little Horse Creek eventually merge with the Horse River to the east of the project area (**Figure 4A**).

Within the Property surface topographic elevations ranges from a low of around 275m to a high of 515m (**Figure 4B**). The Athabasca River incises deeply into the adjoining lowland plains (up to 180m below the elevation of the plains). From the edge of the Athabasca River, topographic elevations rise gradually to a maximum of 515m in the southwest corner of the Property. A northeast plunging ridge separates Horse Creek from the Horse River. The ridge terminates in the region (**Figures 4A and 4B**) of the magnetic anomaly (sections 28 and 29 of Township 86, Range 12W4).

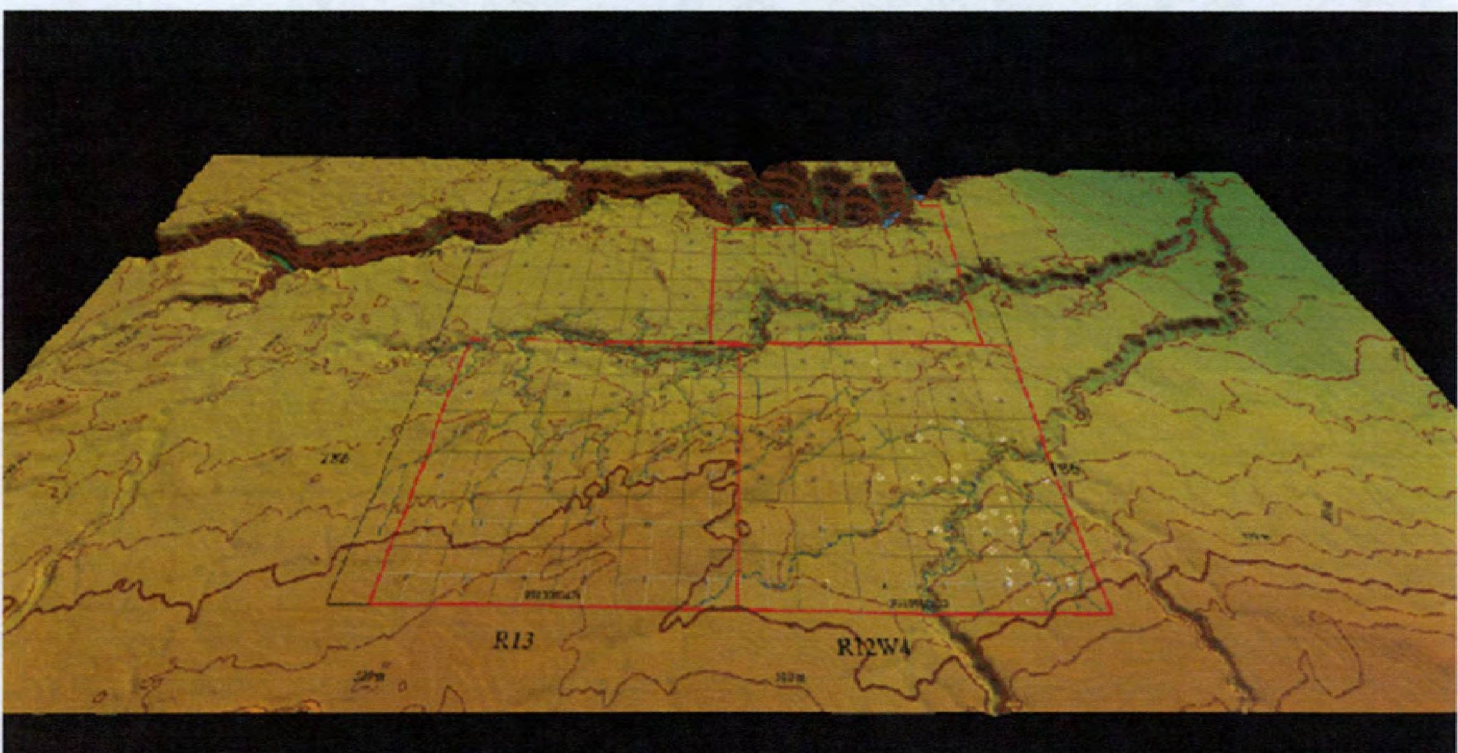
The Crooked Rapids Property lies within the aerially extensive boreal forest region of Alberta (**Figure 3**). The Boreal Forest Natural Region has been divided into 8 subregions (Downing and Pettapiece, 2006). The Property is located within the Central Mixedwood Natural Subregion. The subregion occupies 25% of Alberta, extending from the Caribou Mountains in the north to the Cameron Hills in the south. Aspen, mixedwood and spruce forest commonly occupy uplands and these elevated areas are commonly surrounded by treed fens. Stands of Jack Pine commonly inhabit areas where coarser grained surface material is present. In the specific area of interest





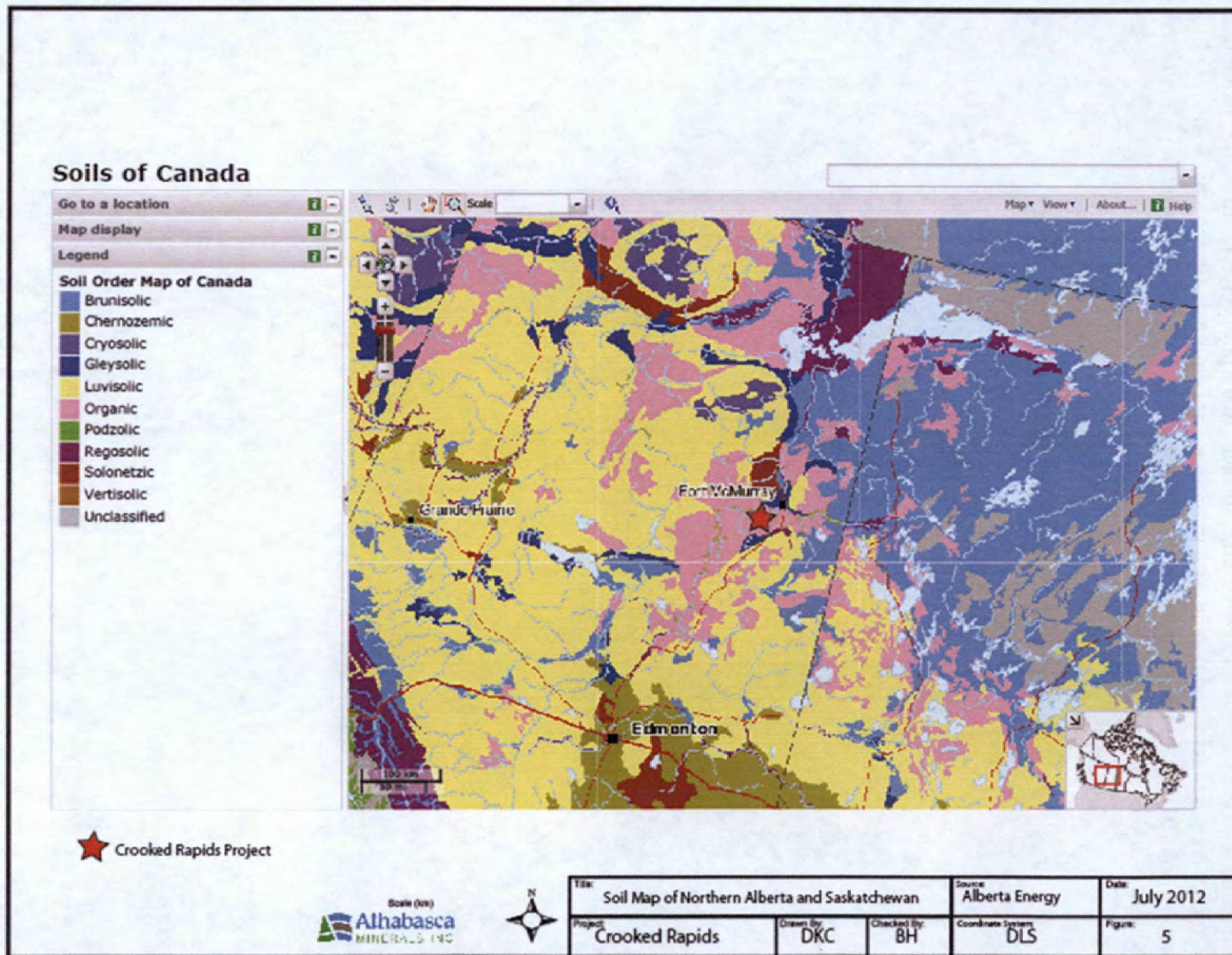
**Alhabasca**  
MINERALS LTD

Title: Surface Topography and Drainage			Source: Alberta Energy	Date: July 2012
Project: Crooked Rapids	Drawn By: DKC	Checked By: BH	Coordinate System: DLS	Figure: 4A



Title: Topographic Relief Crooked Rapids Area			Contour Interval: 10m	Date: July 2012
Project: Crooked Rapids	Drawn By: DKC	Checked By: BH	Coordinate System: DLS	Figure: 4B

(identified magnetic anomaly) elevated areas contain merchantable timber consisting of spruce and poplar. Wetlands are a dominant component of the Central Mixedwood Subregion and are common in the project area. The wetlands are typically comprised of black spruce fens and bogs. Luvisolic soils are common in the upland areas and organic soils dominate the wet, poorly drained areas (**Downing and Pettapiece, 2006**). A soils map of Canada indicates the Property is dominated by organic soil (**Figure 5**). Surface material typically includes glaciolacustrine sediment, coarse glaciofluvial sand and gravel, eolian sand and fine to coarse textured till. The composition of the surface sediment significantly influences the type and distribution of vegetation in the area.



### 1.2.2 Property Access

The Crooked Rapids Property is located about 40 km southwest of Fort McMurray. The northern boundary of the Property borders an east-west leg of the Athabasca River. Although relatively close to the City of Fort McMurray, access to the property is limited. Thus far visits to the permits have been via helicopter only. Recent oilsand drilling (2008-2011) has opened the area to some extent by way of a number of intersecting cutlines. The closest well, to the area of interest was drilled in 2010 and is less than 2 km from the north end of the magnetic anomaly.

Oil and gas exploration activities are typically limited to the winter drilling season, as it is elsewhere in the Athabasca Oil Sands region (mid-December to mid-March). Surface access during the spring, summer and fall is believed possible by use of a tracked Argo or Nodwell.

Thermal bitumen recovery operations south of the Property (Japan Canada Oilsands and Grizzly Oilsands) utilize all-weather roads to access their respective facilities. Grizzly Oilsand has recently constructed an all-weather road into the companies Algar SAGD operation (built spring 2012).

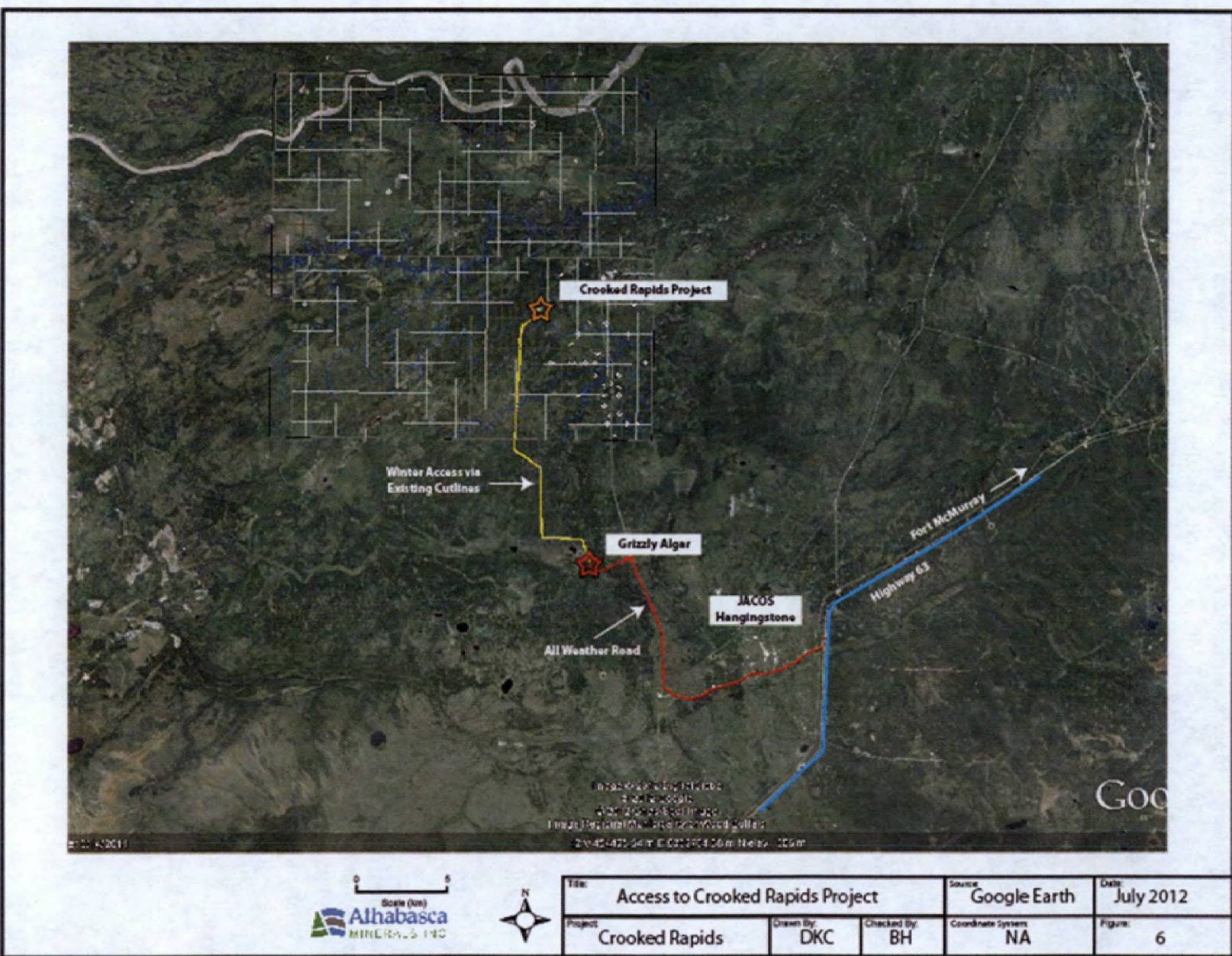
Due to new road construction in the area, the best access to the Property is by way of the all-weather JACOS road that heads west off Highway 63 at kilometer 192. Continue west on the JACOS all-weather road to the Grizzly Oilsands turn-off. The Grizzly all-weather road turns to the north, crosses the Little Horse Creek and ends at the Algar SAGD site (a total of 20 km from Highway 63). From the Algar site continue north for an additional 17 km on a series of cutlines (winter access only with the exception of tracked vehicles, **Figure 6**).

Other access routes into the Property have been identified and mapped, but all involve winter road and cutline paths that are longer and less predictable than the above mentioned.

### 1.2.3 Proximity and Transport

Although reasonably close to Fort McMurray, the Property is considered somewhat remote as there is no direct access via an all-weather road. An all-weather road services two SAGD bitumen recovery operations in the area (JACOS Hangingstone and Grizzly Algar). The all-weather road is 20km in length and ends south the Crooked Rapids magnetic anomaly. A series of winter cutlines, totaling 17 km in length, continue north to the Property. Should an economic mineral deposit be discovered and developed an all-weather road would be required to service an extraction facility and transport the mineral commodity to market.

Alternatively, the mineral commodity could be extracted and transported during the winter months from late-December to mid-March.



### 1.2.4 Climate and Operating Season

Northern Alberta is occupied by an extensive Boreal Forest and is classified as a subarctic climate. The Property is frost free for approximately 105 to 115 days (days above 0 degrees C, **Figure 7**) and the annual total precipitation ranges from 450 to 500 mm (**Figure 8**). The January daily mean temperature ranges from -20 to -18 degrees C (**Figure 9**) and the July daily mean temperature ranges from 15 to 16 degrees C (**Figure 10**).

The lengthy frozen season allows for the mobilization of drilling rigs into areas that are otherwise impassable due to expansive regions of poorly drained muskeg. Typically, oil and gas exploration drill programs in the Athabasca region operate between late-December and mid-March. Access to the Property with heavy equipment is currently limited to the winter months (December to March), but other surface-based field activities are possible during the remainder of the year. Access to the project area by land is possible by Argo, snowmobile and Nodwell.

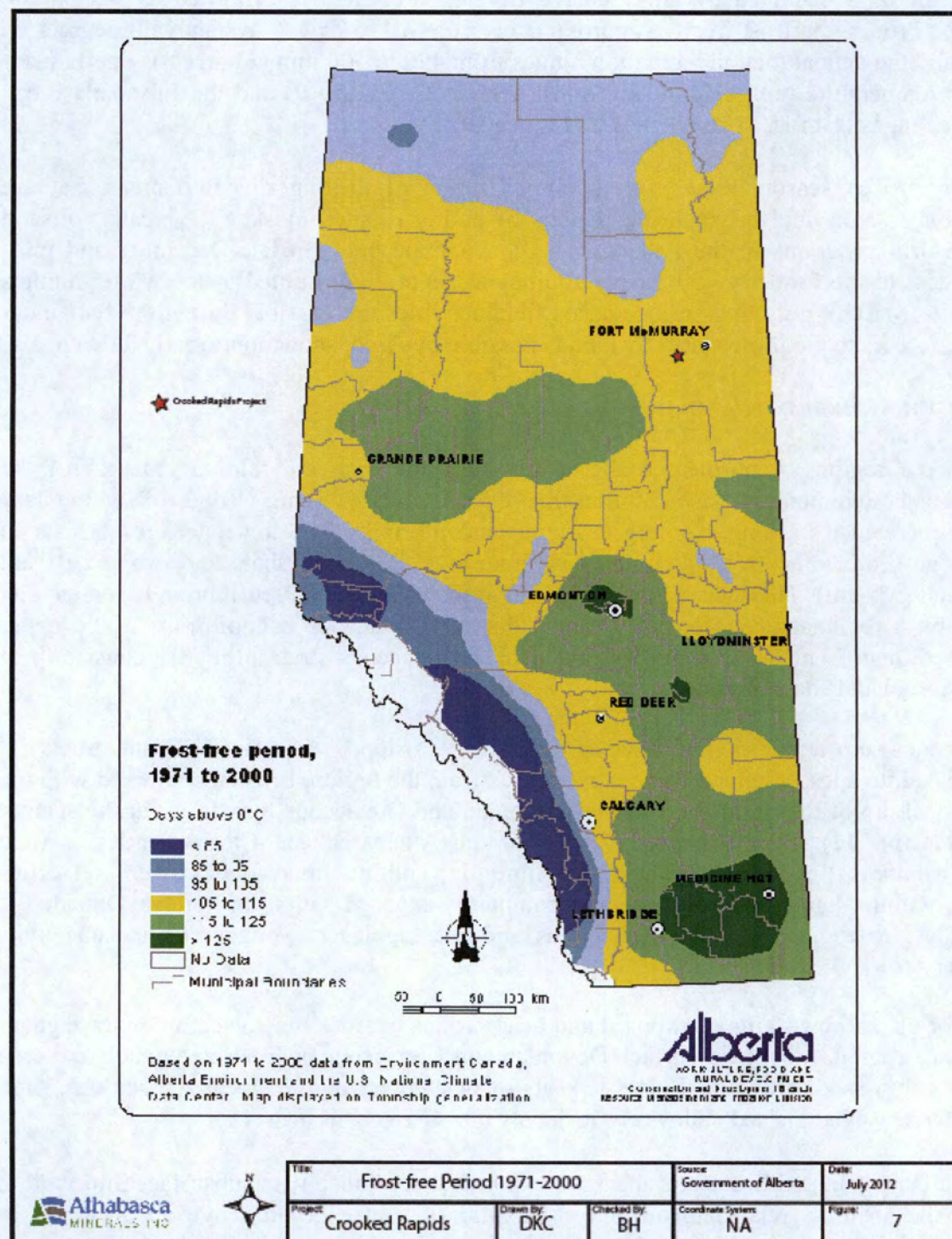
### 1.3 REGIONAL BEDROCK GEOLOGY

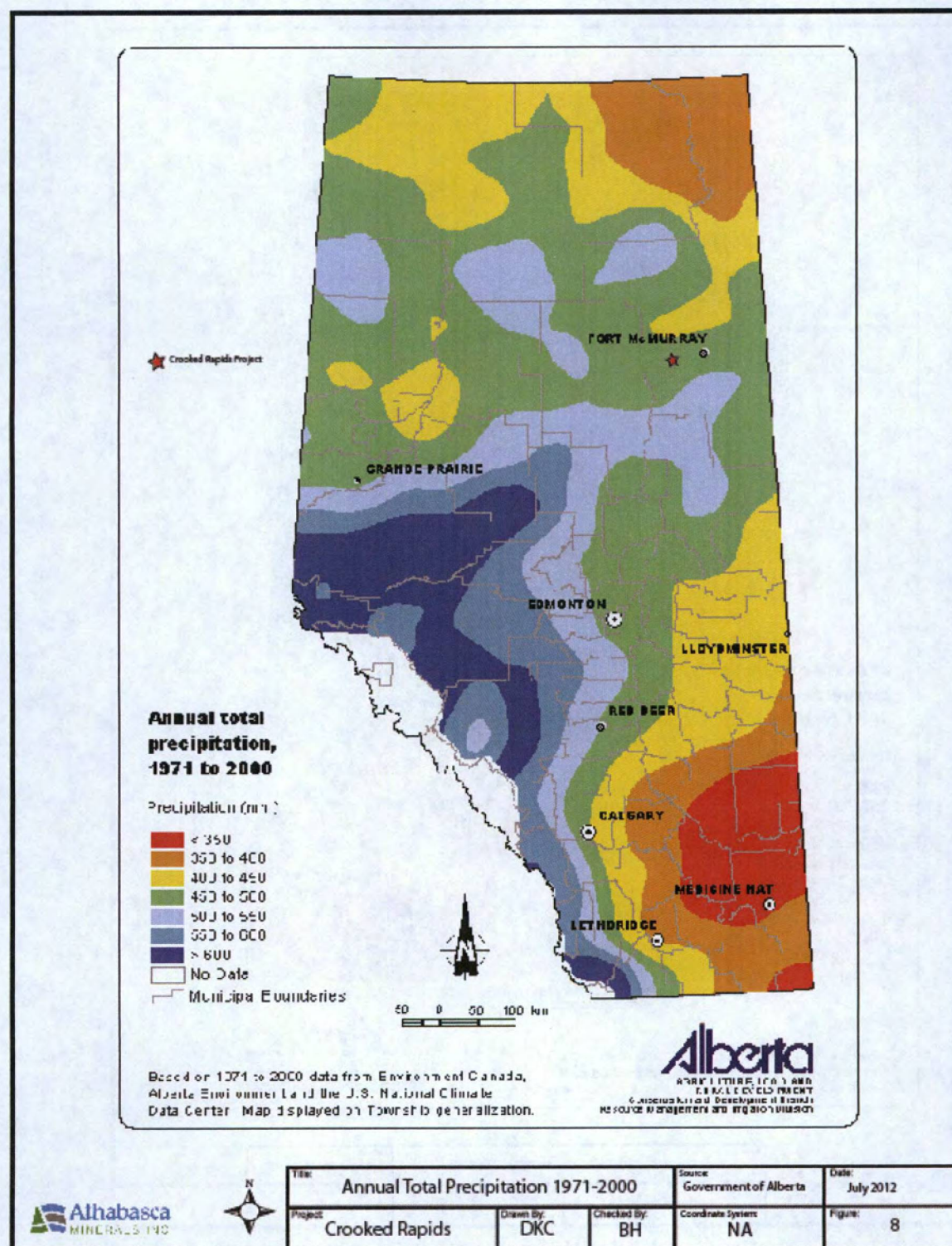
The Athabasca region, of northeast Alberta, lies near the eastward thinning margin of the Western Canada Sedimentary Basin. Within this setting two converging wedges of sedimentary strata are separated by a long standing erosional unconformity. The lower wedge consists of Devonian age sedimentary rock dominated by limestone, dolomite, shale and evaporite (salt, anhydrite and gypsum). The succession is bounded at the base by the Precambrian basement and at the top by a regional unconformity (termed the sub-Cretaceous unconformity). The upper wedge of sediment is made up of Lower and Upper Cretaceous strata primarily consisting of interbedded sand and shale intervals.

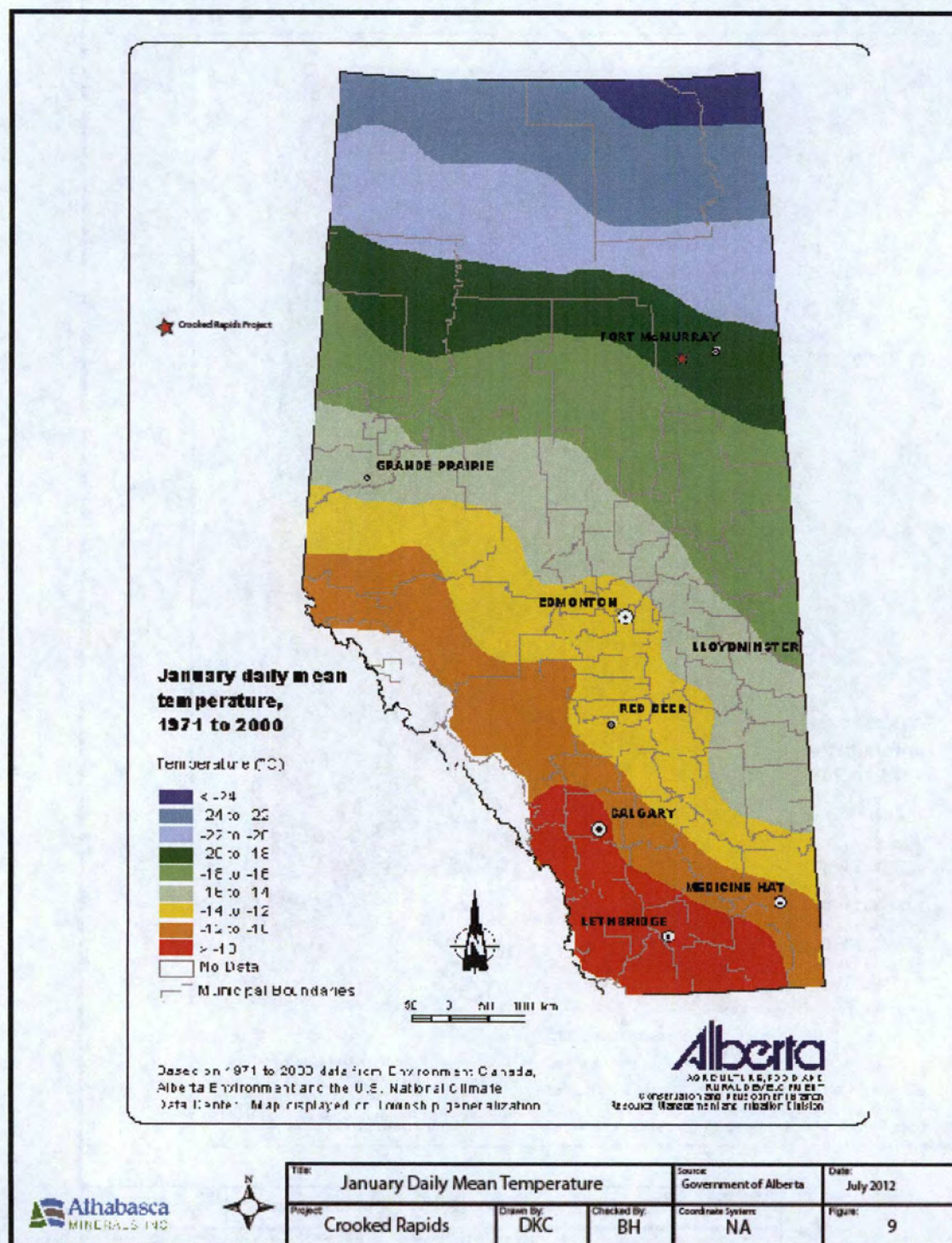
Post-Cretaceous erosional events have progressively stripped away significant tracts of Cretaceous and, to a lesser extent, Devonian bedrock from the region. Erosion combined with the gentle regional dip of the basin has exposed Devonian and Cretaceous formations at the surface (**Figures 11 and 12**). Deeply incised valleys of the Athabasca and Clearwater rivers (and associated tributaries) expose Upper Devonian limestone and lime mudstone. Lower Cretaceous formations, within Mannville Group, are also commonly exposed within the valleys. Outside the major valleys, extending into the high plains and the highlands, younger Cretaceous units progressively crop out at the surface.

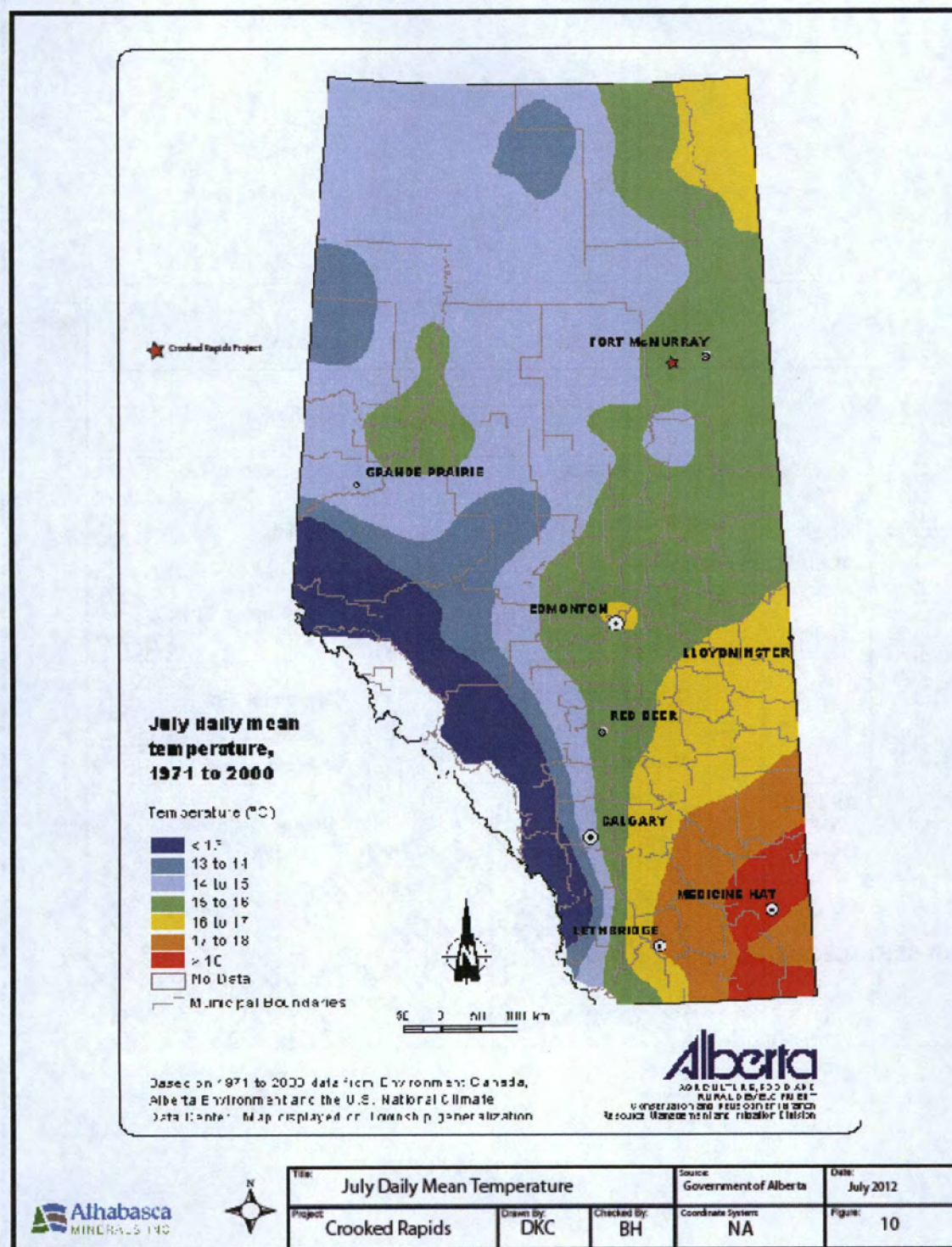
Evidence for glacial reworking of exposed and near-surface bedrock units is common throughout the Athabasca region. Most near-surface Devonian and Cretaceous bedrock is typically covered by relatively thin sand, gravel and clay deposits of Quaternary age. In localized settings, sand filled, Quaternary aged incised valleys erode deeply into Cretaceous bedrock.

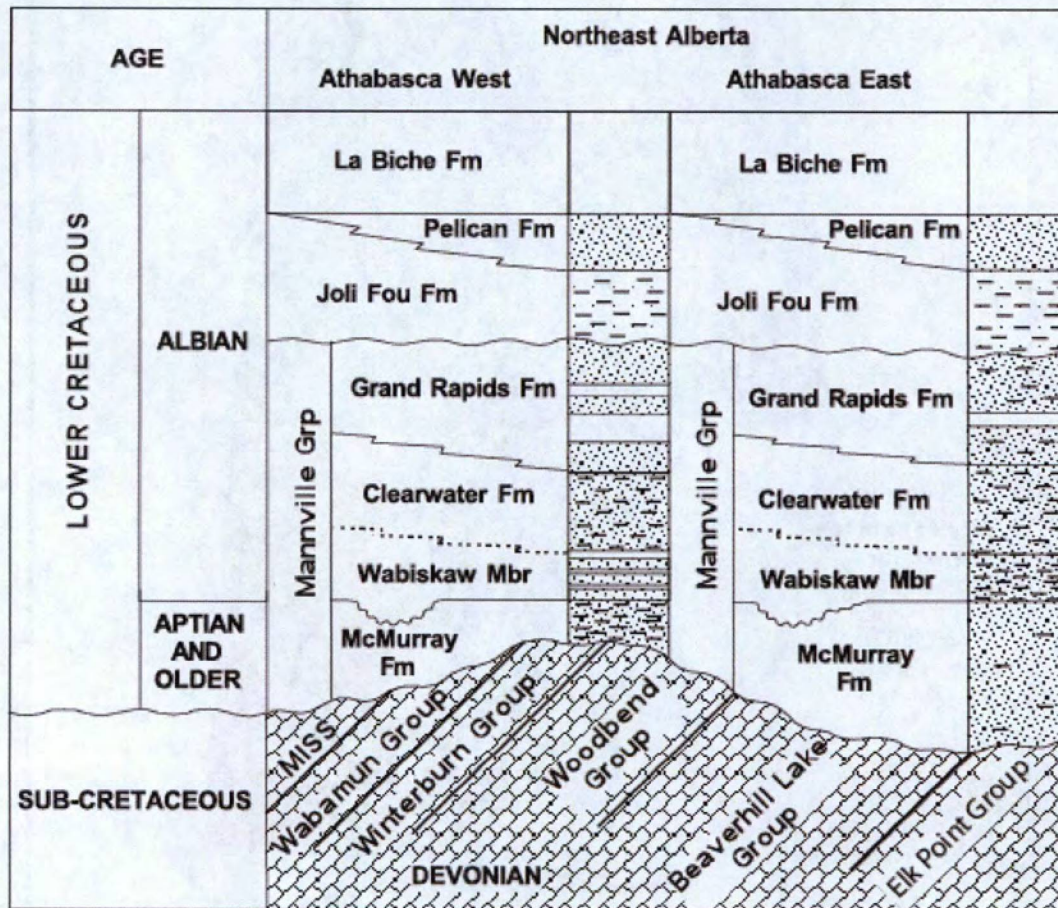
Widespread Devonian and Cretaceous bedrock exposures, combined with subsurface information from extensive drilling, related to oil and gas exploration, provide attractive opportunities to identify potential metallic and industrial mineral deposits within the Athabasca region. Studies combining surface and subsurface data enable the characterization of not only the physical properties of targeted commodities, but also the thickness and lateral distribution of prospective, near-surface mineral deposits.



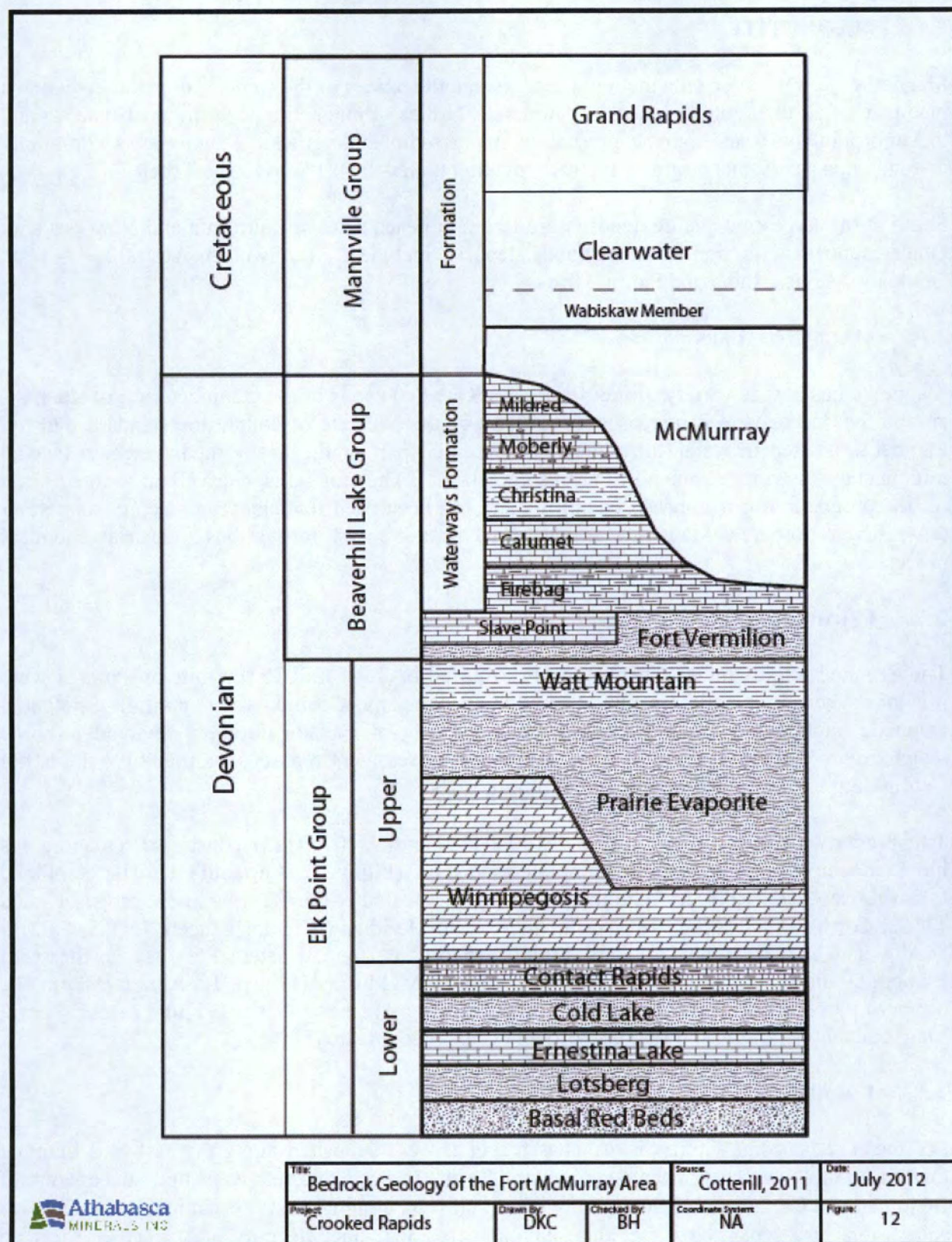








Title: Schematic Cross Section of Cretaceous Bedrock			Source: Wightman et al 1995	Date: July 2012
Project: Crooked Rapids	Drawn By: DKC	Checked By: BH	Coordinate System: NA	Figure: 11



## 2.0 MAGNETITE

Magnetite ( $\text{Fe}_3\text{O}_4$ ), a ferromagnetic mineral, is one the oxides of the spinel group and is the most magnetic of all the naturally occurring minerals. Grains of magnetite occur in most igneous and metamorphic rocks and can be present in many sedimentary rocks. Magnetite is commonly disseminated as crystals or grains typically making up less than 1% of the host rock.

Some of the largest magnetite deposits are found in beach sand in California and New Zealand. Other countries with significant magnetic deposits include Chile, Sweden, Australia, Norway, Germany, Mexico, India and South Africa.

### 2.1 MAGNETITE USES

Magnetite has a wide variety of industrial uses. One key use is in the manufacturing of steel. As an additive to concrete it increases the density of the concrete to double the standard density. Magnetite is used in water filtration, is an essential part of the heavy media process in coal mining and is used in as mineral filler in some plastics. The mineral is an excellent source of iron for the production of iron-based chemicals and has been used for removing arsenic from water (an efficient sorbent). Magnetite is also used as a catalyst for various industrial chemical processes.

### 2.2 PERMIT HOLDINGS

The Crooked Rapids mineral permits were acquired in June of 2010. Permits in the area were previously held by Geolink, a junior exploration company. Geolink was exploiting a potential magnetic anomaly first identified by Ashton Mining of Canada during a regional airborne magnetic survey. ABM is not aware of any mineral assessment reports submitted by Ashton, but Geolink Exploration filed an assessment report in 2008.

The Property permits (9310060420, 9310060421, and 9310060422) consist of a contiguous block encompassing nearly three complete townships (**Figure 2, Appendix 1**). The combined townships exceed 26,000 ha. The three permits are located within Township 86, ranges 12 and 13 and Township 87, Range 13 West of the Fourth Meridian (NTS map sheets 74D05, 74D12, 84A08 and 84A09). The Crooked Rapids Property is approximately 350 km northeast of Edmonton and 40 km southwest of the City of Fort McMurray (**Figure 1—Alberta Map**). The northern permit (T87R12W4) borders the east flowing Athabasca River (**Figure 2—AE Permit Map**) and adjoins the Grand Rapids Wildland Conservation Area.

### 2.3 LOCAL GEOLOGY

Sedimentary deposits within the Athabasca region were deposited along the eastward thinning margin of the Western Canada Sedimentary Basin. In this area, relatively thin successions of Devonian and Cretaceous sediment onlap the southwest dipping Precambrian basement. The two successions are separated by a long standing erosional unconformity and together form an eastward converging wedge of sediment that progressively terminates unconformably along granitic basement. The Devonian succession is dominated by carbonates and evaporites and the Cretaceous succession consists of repetitive siliciclastic sand and shale intervals (**Figures 11 and 12**). Post-Cretaceous (Tertiary and Quaternary) erosional events have progressively stripped

away much of the Cretaceous sediment and to a lesser degree the underlying Devonian strata. Regional erosion is most prominent within the eastern half of the Athabasca Oil Sands area (east of Fort McMurray).

The current drainage network in the Athabasca region consists of two major rivers. The Athabasca and Clearwater rivers combined with associated tributaries drain an extensive area of northeast Alberta. Prominent tributaries to the Athabasca River include the Horse, Hangingstone, Steepbank, MacKay, Ells and Firebag rivers. The Horse River and lower order streams dissect the Crooked Rapids Property. Tributaries to the Clearwater River include the Christina and High Hill rivers. Some rivers expose both Cretaceous and Devonian bedrock along the valley walls and valley bottoms, but all rivers mentioned expose Cretaceous age sedimentary deposits. Devonian exposures include units of the Waterways and Winnipegosis formations: exposed Cretaceous formations exposed at surface include intervals from within the McMurray, Wabiskaw, Clearwater and Grand Rapids, Joli Fou, Pelican, and Base Fish Scales and Second White Speckled Shale (**Figures 11 and 12**).

Within the subsurface of the Crooked Rapids Property and surrounding area Devonian sedimentary deposits unconformably overlie the crystalline Precambrian basement. Preserved Devonian strata within northeast Alberta has been subdivided into the Elk Point Group and the Beaverhill Lake Group (**Figure 12**). Stratigraphic units present within the Elk Point Group include, from oldest to youngest, the Basal Red Beds, Cold Lake, Contact Rapids, Winnipegosis, Prairie Evaporite and Watt Mountain formations. The Cold Lake salt was not deposited in the immediate area. Formations within the overlying Beaverhill Lake Group include the Fort Vermilion, Slave Point and Waterways (**Figure 12**). Eroded members within the Waterways Formation subcrop at the sub-Cretaceous unconformity, forming a series of subcrop belts oriented roughly northwest-southeast.

Local Devonian strata are comprised of relatively thick intervals of carbonate and evaporite. Carbonate rocks include limestone, shale and dolomite; evaporitic units are comprised of salt, anhydrite and minor gypsum (Cotterill and Hamilton, 1995). Gypsum deposits are unlikely within the project area as the transformation from anhydrite to gypsum generally occurs at shallower depths than present in the study area. Gypsum has been identified due east of the Property and is present on ABM's Firebag Property.

Devonian age units of the Waterways Formation (Moberly Member) do crop out at the surface along the Athabasca River from Crooked Rapids (just north of the Property), and extend east to the City of Fort McMurray. A number of low relief rapids, formed from resistive limestone, are present along the River. Lower Cretaceous, bitumen saturated sediment within the McMurray Formation is evident unconformably overlying the Devonian carbonates at Crooked Rapids and exposed sections continue along the Athabasca River into Fort McMurray.

Topographic highlands within the Athabasca area expose Cretaceous age bedrock and younger, unconsolidated Quaternary sediment. Major highlands include Stony Mountain, Muskeg Mountain, the Pelican Mountains and the Thickwood Hills (**Figure 3**). The top of the highlands are typically heavily treed so bedrock exposures are limited. Most topographic highs are covered by a thin veneer of Quaternary sediment, and commonly show evidence of recent glaciation. Subsurface and surficial mapping indicates the major highlands are comprised of Lower and

Upper Cretaceous bedrock (**Figure 13**). The Northern Alberta Lowlands, an extensive topographic low, dissects the Thickwood Hills to the north from Stony Mountain to the south.

Regionally, the WCSB basin dips gradually to the southwest. The structural dip of the basin combined with the deeply incised course of the Athabasca River results in extensive, exposed tracts of Cretaceous bedrock that become progressively younger to the west (**Figure 13**; McMurray, Clearwater, Grand Rapids, Joli Fou and Viking). Near surface, Cretaceous bedrock preserved within the Crooked Rapids Property include the Clearwater, Grand Rapids, Joli Fou and Viking formations (Hamilton et al 1999). Subtle, post-Cretaceous erosional topography influences the degree of exposure of near surface Cretaceous sediment. Unconsolidated sand, gravel and clay (till) of Quaternary age unconformably cap the Cretaceous stratigraphy within and around the Property.

Athabasca Minerals Inc. holds Metallic and Industrial Minerals permits over the Property, but the rights to the oilsands are held by three companies (Southern Pacific, Athabasca Oil Sands and



Grizzly Oilsands). The companies have the rights to potential oilsand deposits that extend from the top of the Woodbend Group (eroded, not present within project area) to the top of the Viking Formation. Within the Property bitumen saturated sands are present within the McMurray Formation and the Wabiskaw Member. The presence oilsand deposits on the Property are not expected to affect future exploration activities planned by ABM.

There has been a total of 31 oilsand exploration wells drilled on the Property and surrounding area, dating from the late 1950's to as recent as 2011. The majority of wells were been drilled between 2008 and 2011 and most coreholes are located in Township 86, Range 12W4. Subsurface well data (primarily geophysical well logs and well cuttings) provided by the oilsand exploration drilling is a critical component to evaluating the mineral potential on the Property.

## 2.4 PREVIOUS WORK

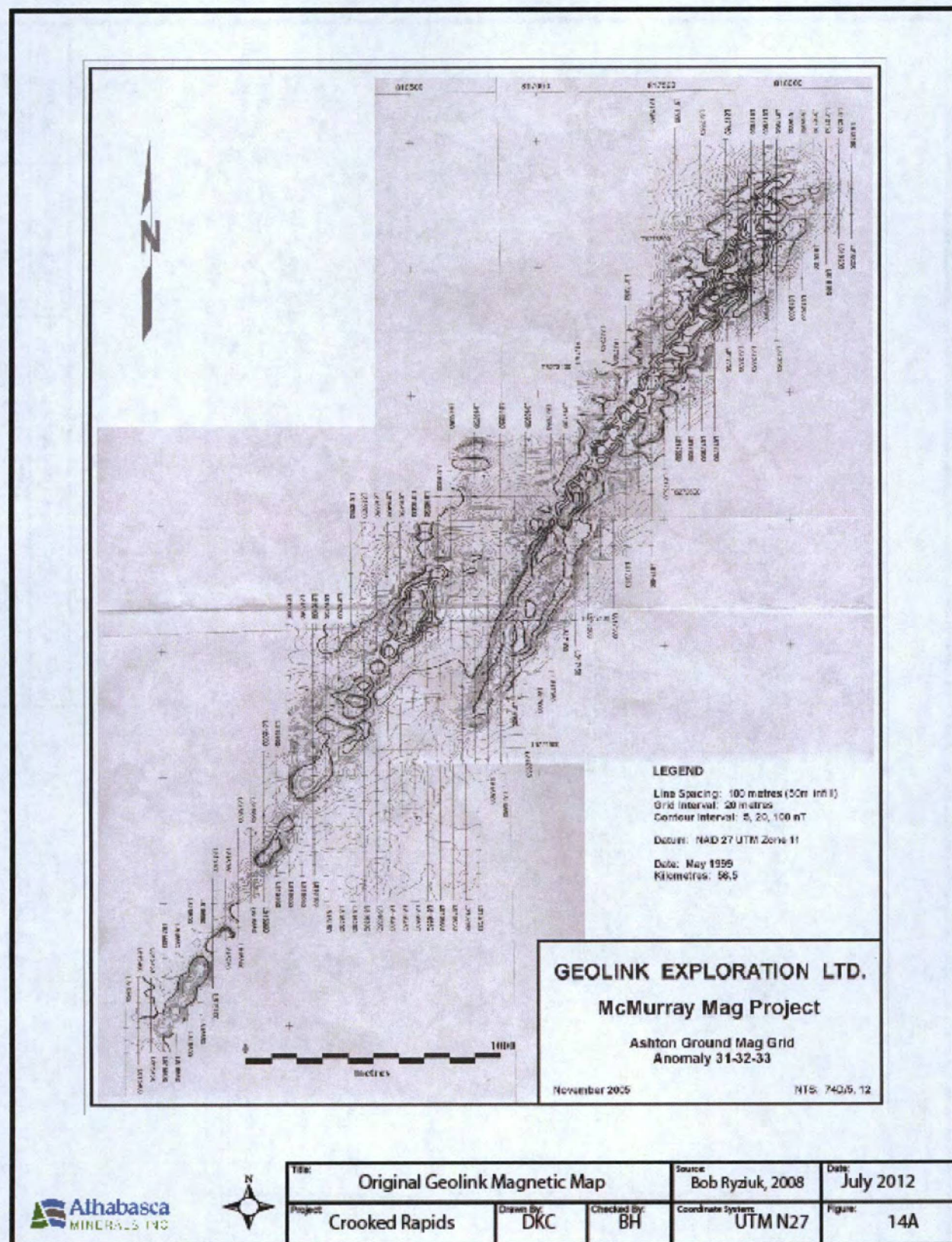
### 2.4.1 Pre-2010 Exploration

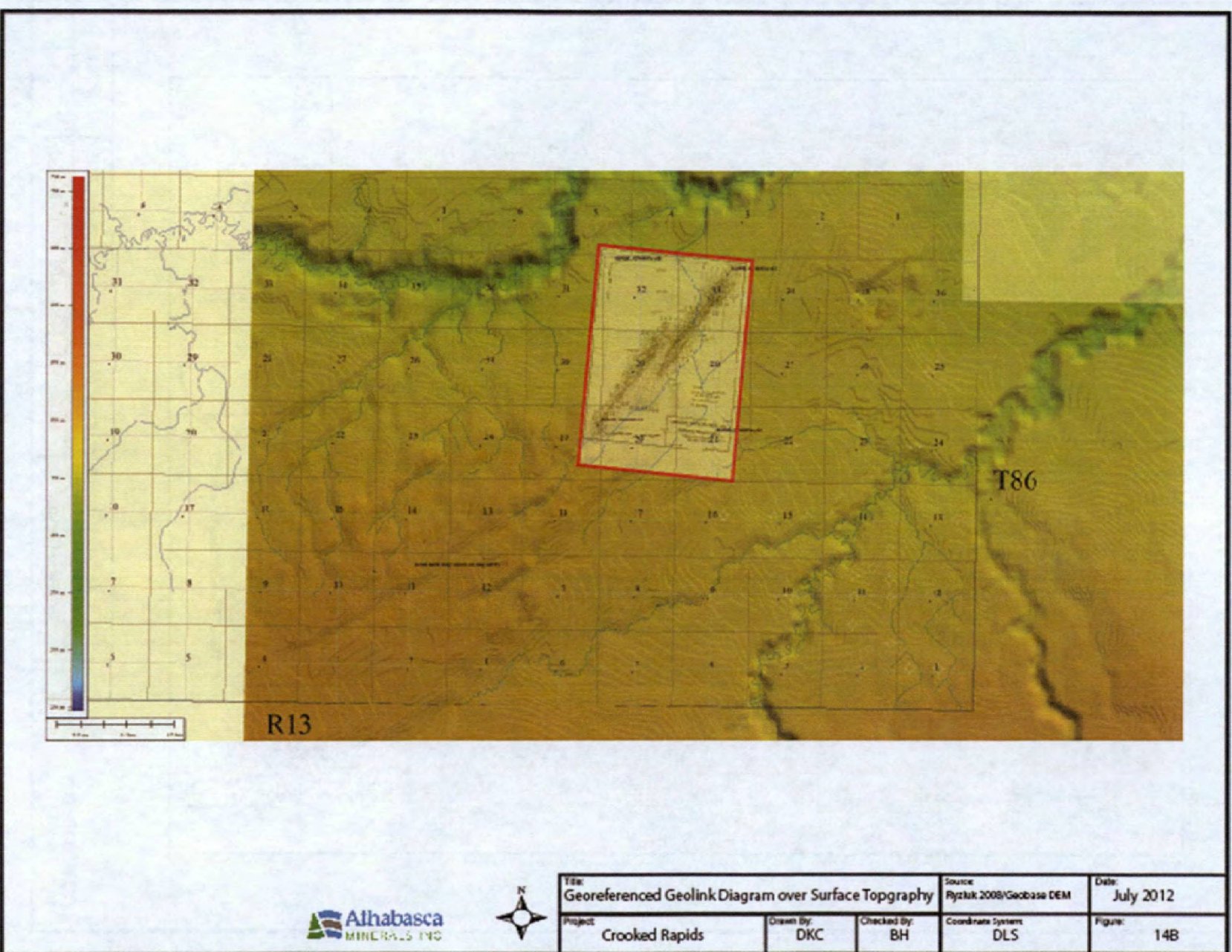
The Crooked Rapids Property has been previously permitted for Metallic and Industrial Minerals prior to the acquisition by ABM in June of 2010. Geolink Exploration Ltd. held a mineral permit on Township 86, Range 12W4 from at 2006 to 2010 (permit number 093 9306011205). Bob Ryziuk, president of Geolink Exploration, filed a mineral assessment report in April of 2008 (McMag Project) which enabled Geolink to retain the mineral permit until the spring of 2010.

The magnetic anomaly was discovered by Ashton Mining of Canada in 1998 while flying an airborne magnetic survey in the region (Ryziuk, 2008). In 1999 the anomaly was confirmed by Ashton via a tightly spaced, ground-based magnetic survey totaling 56 line km (**Figures 14A and 14B**). It has been stated that Ashton apparently drilled two diamond drill holes on the anomaly, but the drilling results were not filed in an assessment report and the core was not relinquished to the Province of Alberta (Ryziuk, 2008). Geolink could not find evidence in the field that could verify any drilling activities. At this time ABM cannot confirm the drilling was actually completed.

In 2005 Geolink visited the area to verify the location and magnetic signature of the anomaly. A ground-based magnetic survey, 1.8 km in length, was conducted and a magnetic profile was generated over the previously identified anomaly. In addition, nine surface samples were collected and analyzed using Mobile Ion Geochemistry (Ryziuk, 2008). Surface samples collected varied from wet sand to organic material. The samples were analyzed by SGS Mineral Services in Ontario.

Mark Fedikow (Manitoba Geological Survey) assumed the anomalous magnetic trend was probably related to magnetite. Geochemical analysis indicated base metal enrichment in Cu, Pb, ZN, Ni and Co. The assessment report recommended additional geochemical sampling, EM geophysics and drilling if warranted by sampling and EM results (Ryziuk, 2008).





### 2.4.2 Initial Reconnaissance

Shortly after acquisition of the Crooked Rapids permits digital elevation data was reviewed over the area and the Ashton magnetic anomaly (ground-based survey) was georeferenced and imported into the digital elevation model (DEM). The DEM indicated two linear ridges with a slightly different orientation located just southwest of the imported magnetic image. It was initially assumed that the location of the magnetic anomaly may have been misinterpreted during the survey. Athabasca Minerals Inc. decided to conduct a ground-based magnetic survey to confirm the location and intensity if the magnetic response.

In addition to planning a small scale magnetic survey a subsurface study was initiated which evaluated all geophysical well logs from oilsand exploration drill programs within and around the Property.

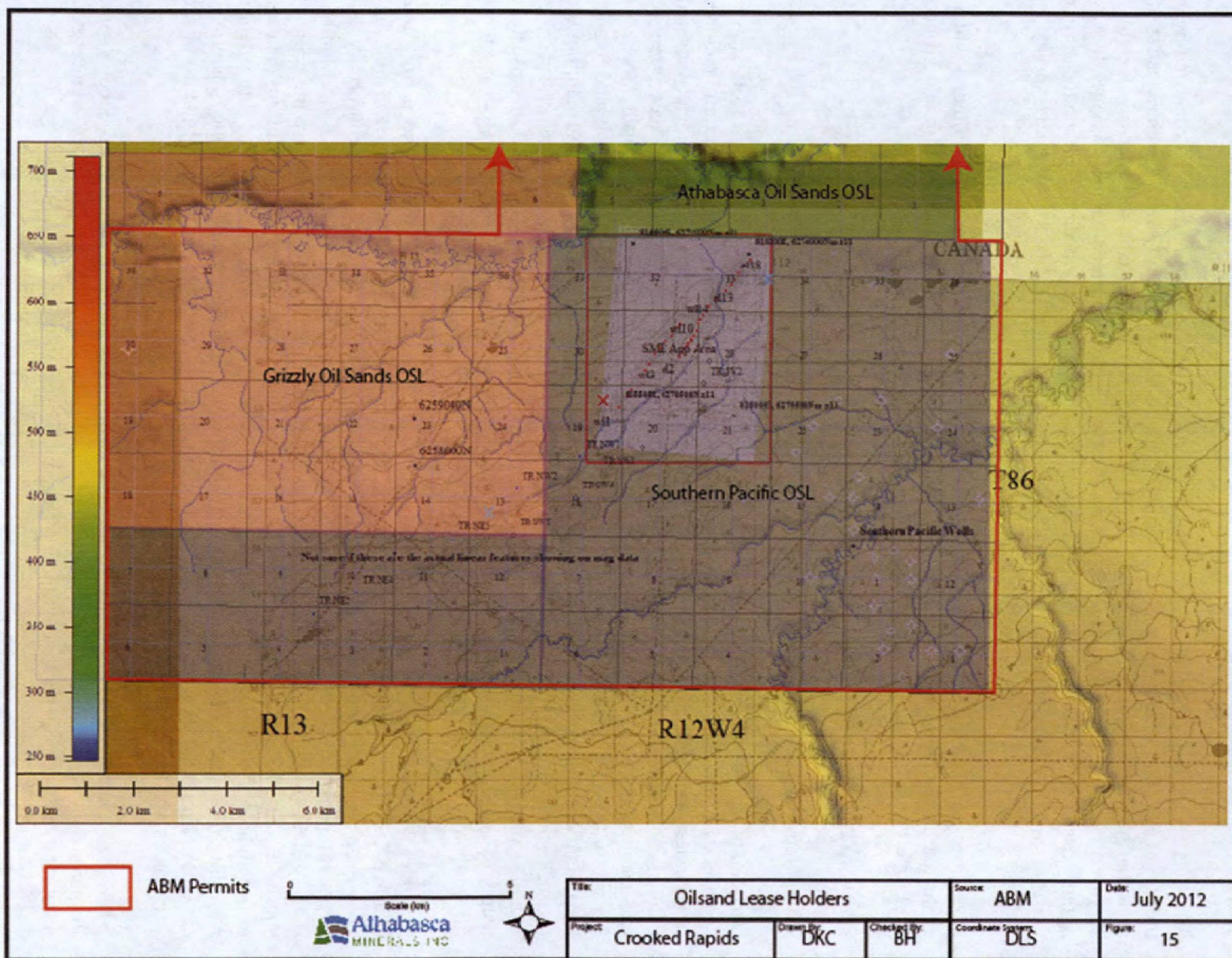
## 2.5 SUBSURFACE MAPPING

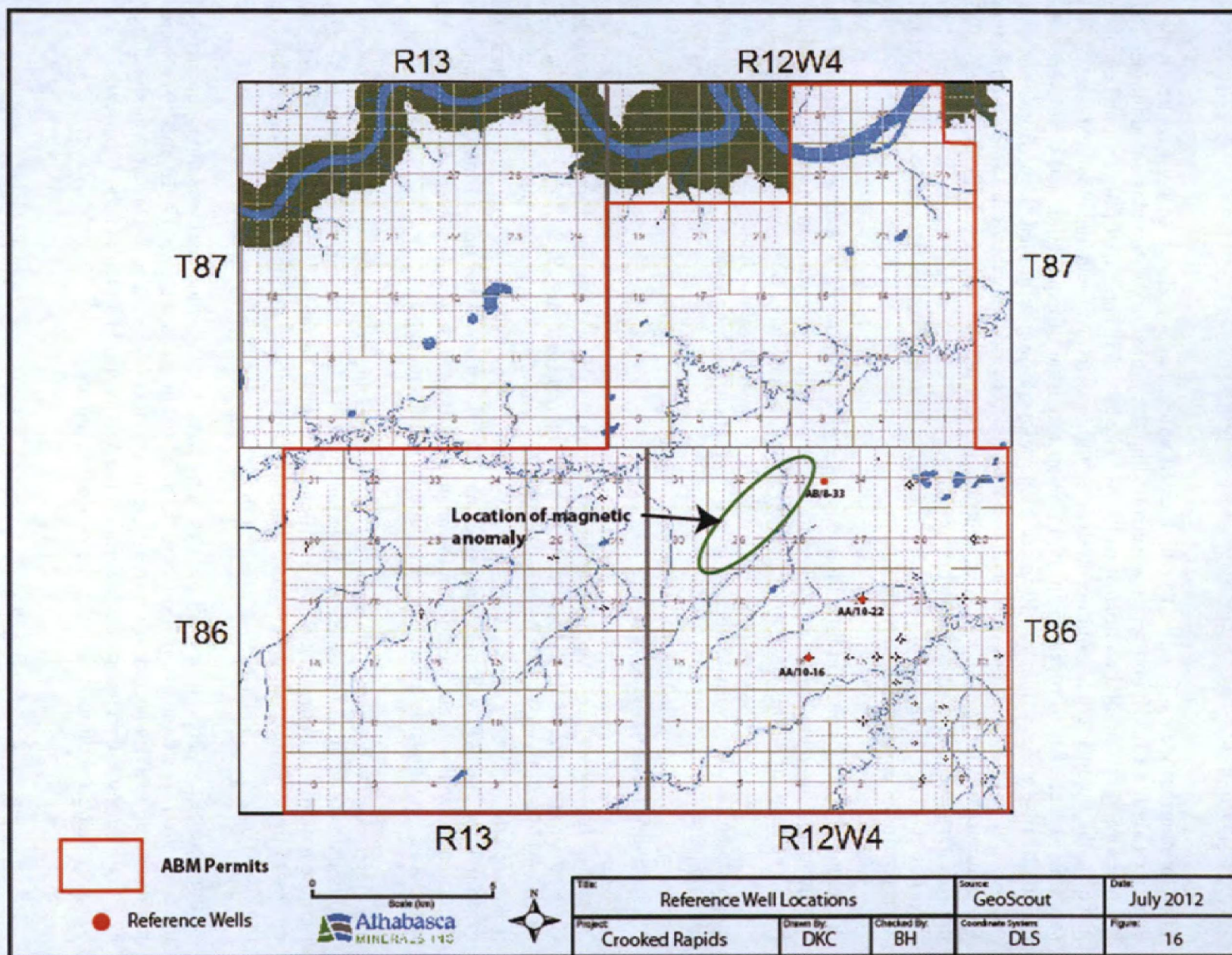
### 2.5.1 Introduction

Surficial mapping within and surrounding the Crooked Rapids Property indicates that four Lower Cretaceous formations are present near surface (**Figures 11 and 13**). The formations include, from oldest to youngest, the Clearwater, Grand Rapids, Joli Fou and Viking (locally termed Pelican). These stratigraphic bedrock units are covered by a variably thick succession of unconsolidated sand, gravel and potentially semi-consolidated till. The deeply incised Athabasca River, to the north, also exposes the Lower Cretaceous McMurray Formation and Upper Devonian Waterways Formation. In addition to understanding the surficial geology, mapping the bedrock succession in the subsurface is crucial to evaluating the Crooked Rapids prospect. In fact, a significant portion of the work in determining the surficial geology is rooted in subsurface mapping. ABM currently holds the Metallica and Industrial Mineral permits in the area and three oil companies own the rights to the oilsands on the Property (**Figure 15**).

To date, 31 oilsand exploratory wells have been drilled within and around the permit area (**Figure 16**). The wells were drilled between 1959 and 2011, but the majority of drilling has taken place between 2008 and 2011. Most wells intersect the sub-Cretaceous unconformity and target bitumen saturated sands within the McMurray Formation and the Wabiskaw Member (Clearwater Formation). Geophysical well logs from the various drill programs are the primary source of data for evaluating the subsurface stratigraphy, but core and drilling cutting data are also valuable for evaluating the Property. Geophysical well logs provide key information regarding the lithologies intersected through the Cretaceous bedrock and overlying Quaternary cover. As important as mapping subsurface lithologies, is mapping the structural nature of the Cretaceous and Devonian bedrock.

ABM has conducted a preliminary subsurface stratigraphic study within Crooked Rapids Property. Due to the lack of well control in some areas and in order to reduce edge effects inherent in computer generated mapping a large buffer region was also evaluated.





### 2.5.2 Data Control

There are currently 31 oilsand test wells located within the boundaries of the Crooked Rapids Property (**Figure 13**). The buffer area, surrounding the project area, contains an additional 167 test holes bringing the total number of wells evaluated to 198. The bulk of the drilling has taken place in the southeast and south-central area within active oilsand development areas. The southeast corner of the Property appears to be an extension of exploration and development to the south. Elsewhere within the Property exploration drilling is limited. Data from four new wells has been removed from confidential status and provided valuable subsurface information for continued evaluation of the area. Outside the densely drilled areas, in the south, well information is generally scarce so when producing computer-generated maps it is important to keep in mind the limitations of the data which, in the end, affect the accuracy of the structural interpretation in parts of the study area.

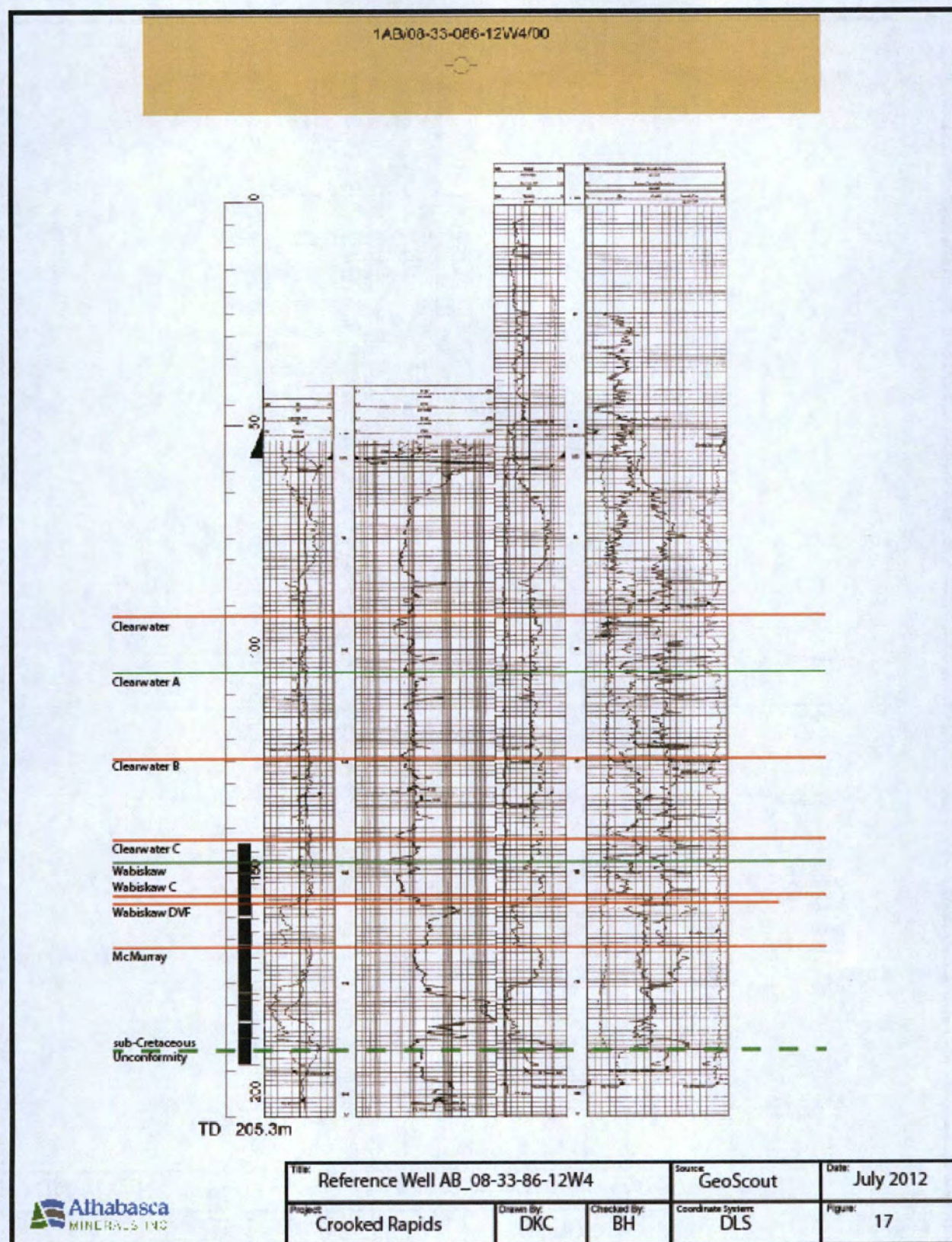
A preliminary set of common formation tops were picked within the available well dataset. The stratigraphic tops include the interval from the sub-Cretaceous unconformity to the top of the Viking Formation. At this stage of evaluation structure maps have been generated for the top of the sub-Cretaceous unconformity, the Wabiskaw Member, and the Clearwater A. Future mapping tasks will evaluate the structural formation tops considered to be of secondary importance.

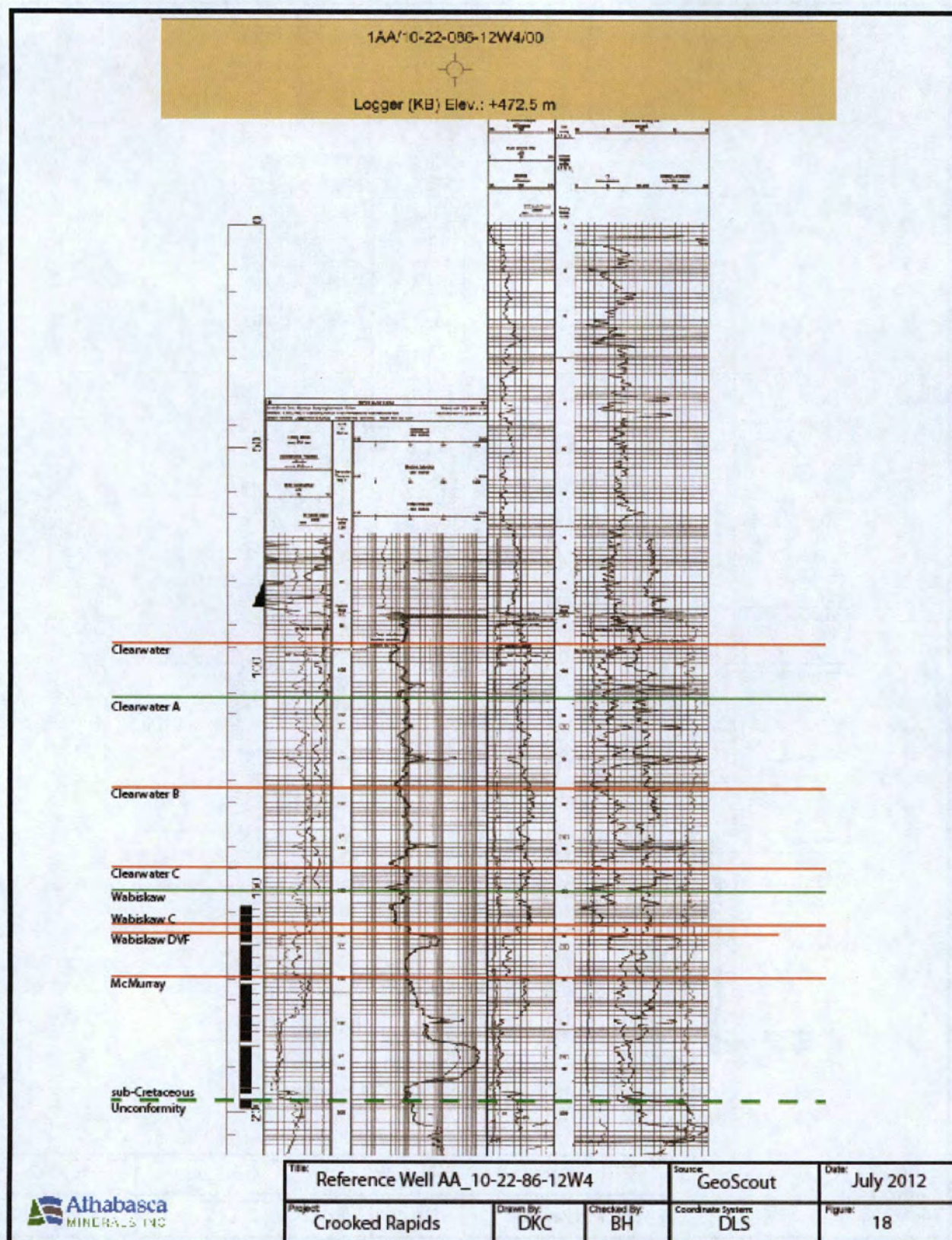
### 2.5.3 Subsurface Stratigraphy

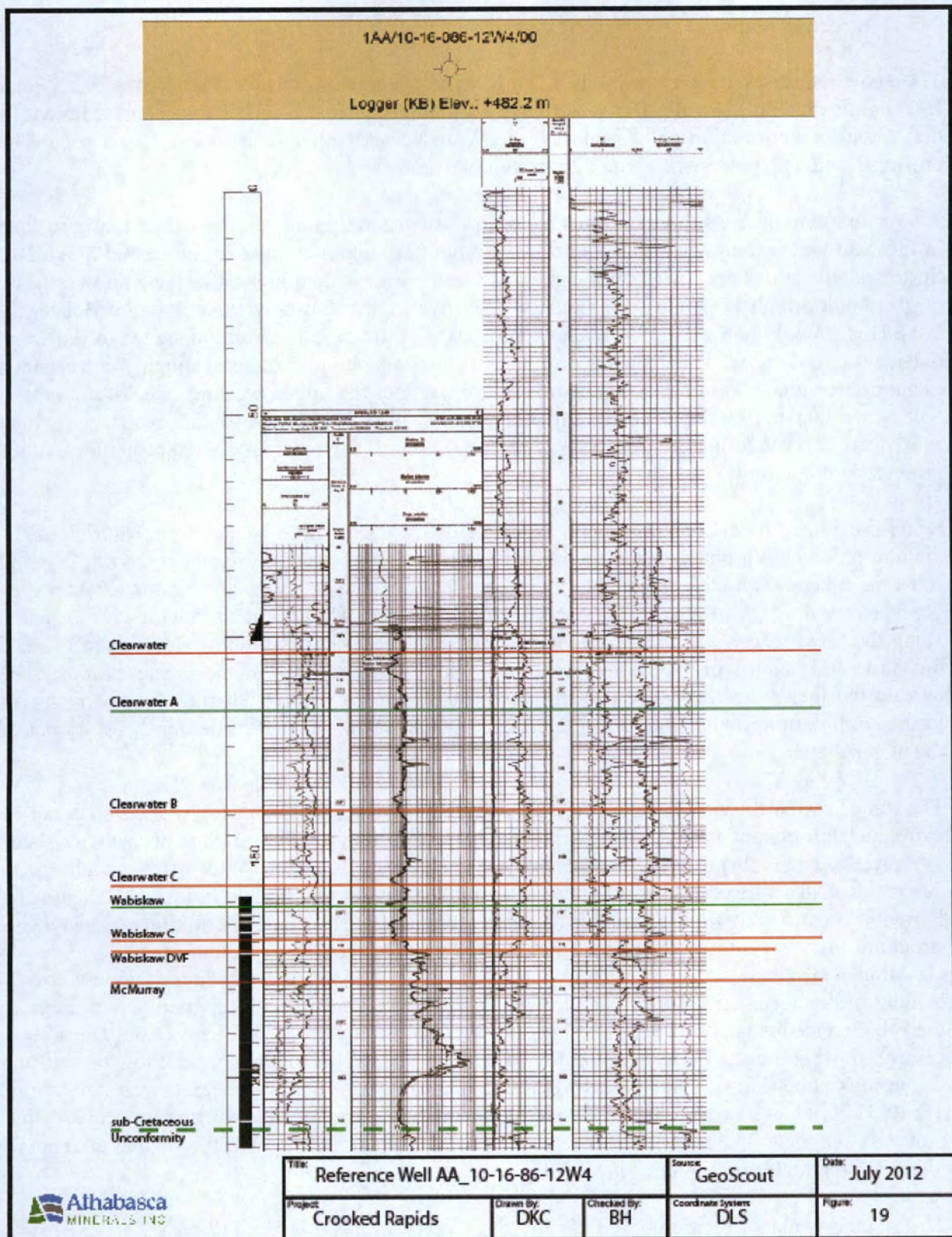
As part of the subsurface investigation three reference wells were selected, primarily due to the close proximity of the wells to the specific area of interest (sections 19, 20, 28, 29, 30, 32 and 33 in Township 86, Range 12W4) and secondly, the quality of the geophysical logs. Reference wells include 8-33-86-12W4, 10-22-86-12W4 and 10-16-86-12W4 (**Figures 17, 18 and 19**, respectively). The 8-33 well was designated as ``Confidential`` at the time of map generation so data from the well was not included in the mapping dataset. The well, however has been included in this assessment as it is located closest to the magnetic anomaly.

The reference wells highlight most of the stratigraphic top picks within the study area. Additional stratigraphic tops were compiled above the Clearwater. Some of the supplementary tops are not present in the area or were difficult to identify so the tops have not been included in this assessment. Future subsurface work will focus on further defining younger bedrock units on the Property.

At the time of the subsurface work the structural nature of the study area was the main focus of the evaluation. The three mapped surfaces (highlighted in green; **Figures 17, 18 and 19**) selected for structural analysis are known to be laterally continuous and have consistent log signatures. The top of the sub-Cretaceous unconformity, the Wabiskaw Member and the Clearwater A can be easily identified throughout much the Athabasca region.







#### 2.5.4 Structure Maps

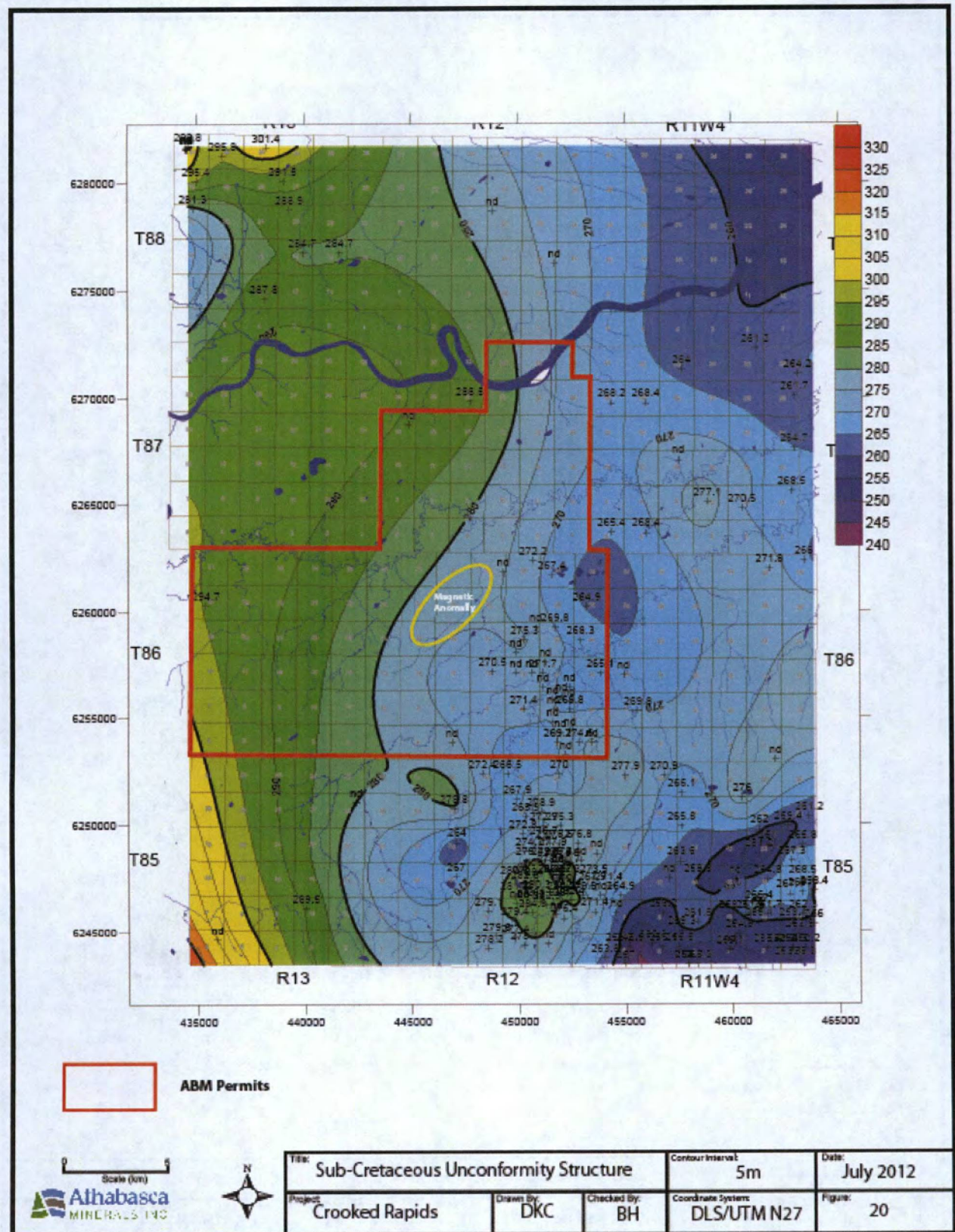
The sub-Cretaceous unconformity is a long standing erosion surface that juxtaposes Upper Devonian carbonates (locally the Waterways Formation) against Lower Cretaceous sediment of the McMurray Formation and, in places, the Wabiskaw Member (Clearwater Formation). The erosional time gap represents about 225 million years.

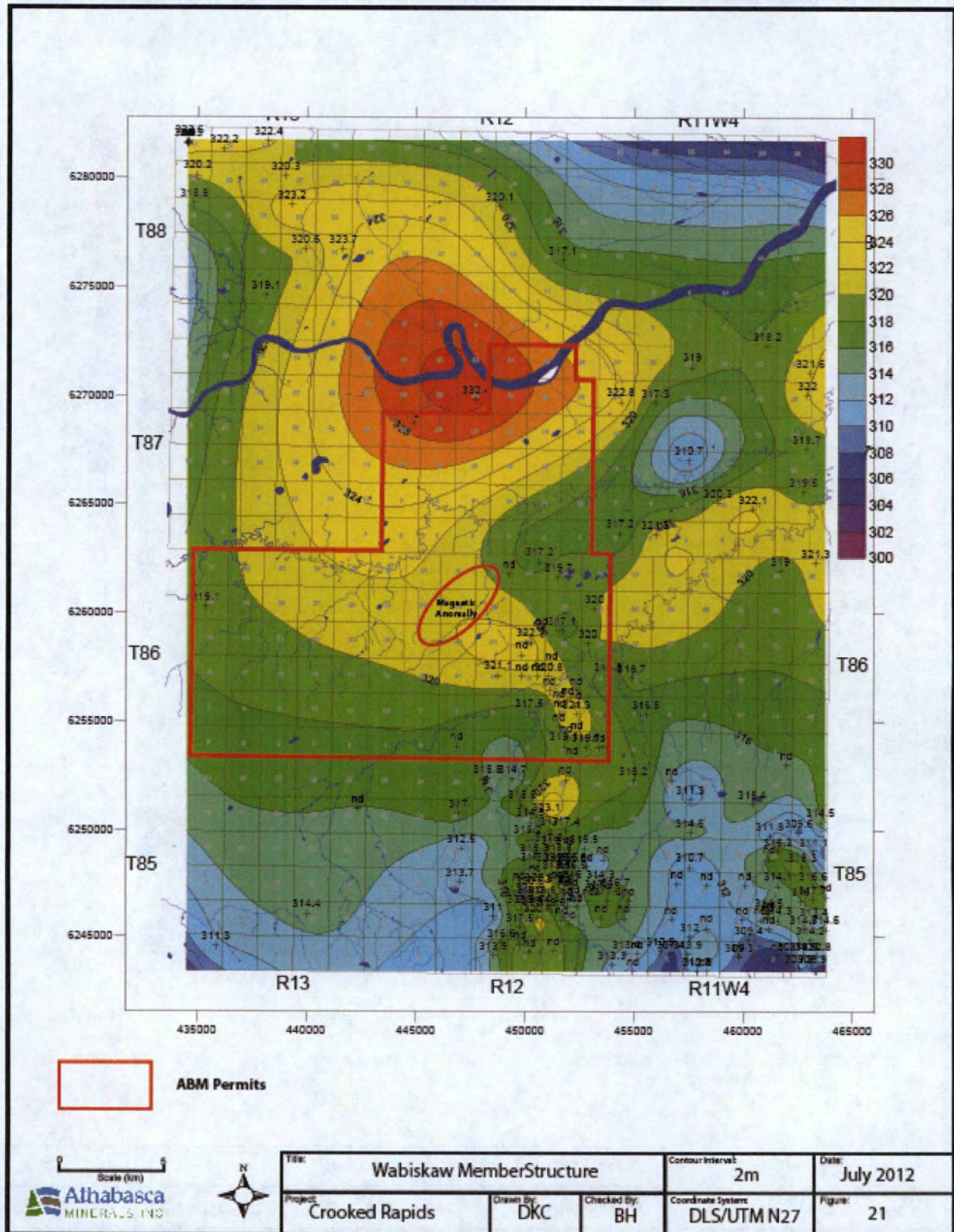
A structure map on the sub-Cretaceous unconformity generally indicates a gradual rising surface in the west and a somewhat linear, northeast trending topographic low in the east (**Figure 20**). Structural elevations are lowest in the southeast and northeast and highest in the southwest. The north trending high is part of a regionally extensive high informally known as the Beaverhill Lake High (Wightman et al 1995). The central axis of the high lies some distance to the west, outside the study area. The irregular drop in structural elevation to the east roughly corresponds to a more regionally significant structural low that defines the upper, western edge of the Prairie Salt Scarp that marks the edge of salt dissolution within Middle Devonian evaporites which subsequently resulted in the structural collapse of younger Devonian and Cretaceous formations through geologic time.

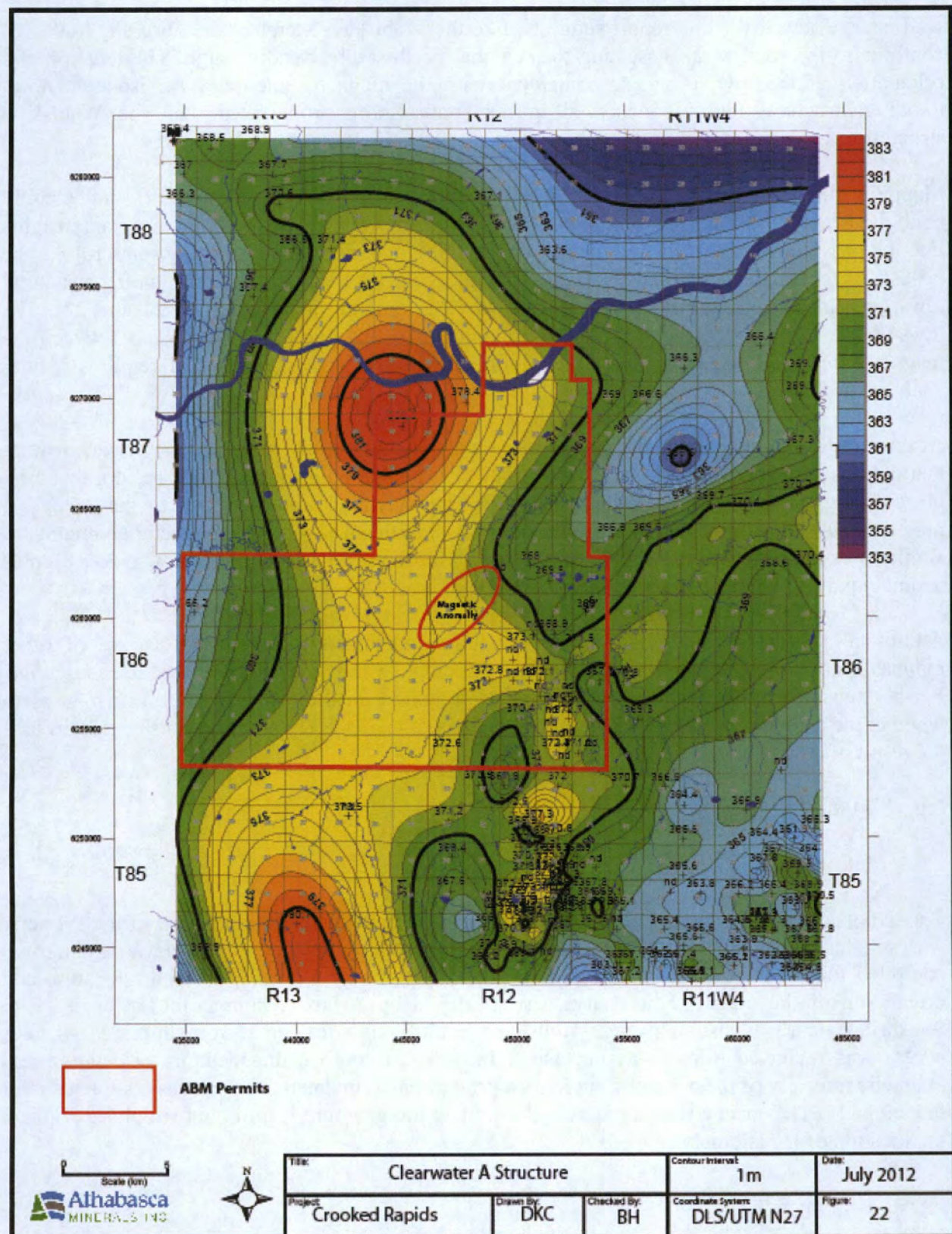
Some previous publications depict the Prairie Salt Scarp as being a near linear feature, but the dissolution edge is probably irregular in nature and was likely active in some areas while being static in others. Salt dissolution has been active since the Jurassic and continues today as observed by a series of sinkholes observed at the surface. The sinkholes features are oriented along the present day position of the Salt Scarp. In places, salt dissolution has high influenced the structural nature of overlying Devonian and Cretaceous sedimentary successions. The narrow, northeast trending low present on the structure in **Figure 20** may be the result of localized dissolution emanating from the more extensive low situated in the northeast corner of the mapped area.

The top of the Wabiskaw Member is a laterally continuous, consistent log marker that can be correlated throughout much of the Athabasca Oilsands region. The marker horizon has been interpreted to have been initially deposited as a relatively flat, deep water marine shale. Post-depositional structure on the marker bed (and similar younger marker beds within the Clearwater Formation) can result from a number of causes, one of which is salt dissolution. An extensive structural high is centered over the Athabasca River (**Figure 21**). The high gradually drops in elevation and narrows to the southeast and northwest. A northeast trending structural low is evident in the north-central area. The low is somewhat coincident with the paleolow present on the sub-Cretaceous unconformity and may be the result of localized salt dissolution. Dense well control in the southeast indicates a similar low in the same relative position as a low on the sub-Cretaceous unconformity, but is less definitive (**Figure 20**). Recently released well data within T86R13W4 suggests the northeast-southwest trending low extends further southwest than presently mapped. The extension of this low is roughly coincident with the magnetic anomaly identified on the Geolink map (**Figure 14**).

The structure map illustrating the top of the Clearwater A marker (**Figure 22**) suggests a regional, north-south trending high in the west and a structurally low in the northeast and southeast corners of the study area. The same, localized, northeast-southwest trending low recognized on the Wabiskaw Member is also present on the Clearwater A structure map. New







well data reviewed for this report suggests, like the Wabiskaw Member structure, the low does continue to the southwest, dissecting the regional north-south trending high. The location and orientation of the low, is again, coincident with the magnetic anomaly. An isolated, north trending structural high, is observed in the south (more pronounced than the Wabiskaw structure).

Mapping the structural nature of the sub-Cretaceous unconformity (**Figure 20**) and laterally continuous marker horizons within the Cretaceous bedrock does provide some important insights into the possible source of the magnetic anomaly. Structure does appear to play some role in the genesis of the magnetic anomaly as demonstrated by the northeast-southwest trending structural lows, present on both, the Wabiskaw and Clearwater structure maps (**Figures 21 and 22**). The lows appear to be aligned with the Ashton anomaly. At this point the relationship between the magnetic high and the coincident, well-defined structural is interesting and requires further analysis.

At this time it is probable that the magnetic anomaly is geologically recent, a near surface feature that may have developed in the area as a result of structural adjustments in the region, that took place during Cretaceous and Tertiary time. ABM has flown an airborne magnetic survey over a nine township block northwest of the Property. A significant number of magnetic anomalies of similar size and orientation have been observed. Resolving the genesis of the Crooked Rapids anomaly may be key to evaluating the other anomalies.

Additional subsurface study is required to fully understand the structural nature of other mappable horizons and the lateral change in lithology within the individual Cretaceous units. Further subsurface and surficial evaluations are required on the Property to gain insight as to whether the anomaly is a surface feature associated with recent Quaternary events or it is, in fact, the result of an undiscovered, deep seated structure.

## **2.6 FIELD PROGRAM**

### **2.6.1 Introduction**

The Crooked Rapids mineral permits were acquired in June of 2010. Evaluation of the Property was initiated in August of 2010. Prior to visiting the Property detailed digital elevation data was compiled for the region and reviewed for surface topography with respect to the location and orientation of the magnetic anomaly, first identified by Ashton Mining of Canada in 1998. Subsurface data was also analyzed within the permit boundaries and surrounding area. Surface access was reviewed prior to a site visit. . In order to confirm the location, orientation and magnetic intensity of the magnetic anomaly a ground-based magnetic survey was completed over the anomaly. The survey was not intended to remap the geologic feature, but simply to confirm the location of the anomaly.

### **2.6.2 Aerial Reconnaissance**

Shortly after the Metallic and Industrial Mineral permits were acquired over the Property a regional surface evaluation was initiated. Satellite images from Google Earth (**Figure 10**) were reviewed for general surface topography, vegetation (forested areas and wetlands), commercial

logging and potential access to the Crooked Rapids Property. Regional bedrock maps were reviewed (**Figure 13**; Hamilton et al 1999).

Digital elevation data (DEM) was acquired from Geobase and processed using Global Mapper (**Figures 4A and 4B**). The ground-based magnetic survey image generated by Ashton (**Figures 14A and 14B**) was georeferenced and imported into Global Mapper. The DEM was utilized to analyze the general surface topography in the area to ascertain if any surface expressions were matched the location of the magnetic anomaly. A set of linear topographic ridges with a slightly different orientation are situated just southwest of the magnetic anomaly. Because the linear surface ridges and the magnetic anomaly are situated in close proximity and display similar geometries a decision was made to conduct a small scale ground-based magnetic over anomaly and surrounding area indicated by the Ashton magnetic survey.

### 2.6.3 Ground Investigation

Following insights identified during the aerial reconnaissance a small scale, ground-based magnetic survey was proposed and executed in September of 2010. The survey simply involved running a series of transects perpendicular to the length of the two linear magnetic anomalies discovered by Ashton Mining of Canada in 1998 (**Figures 14A and 14B**). The primary purpose of the survey was to merely confirm the location and intensity of the magnetic high.

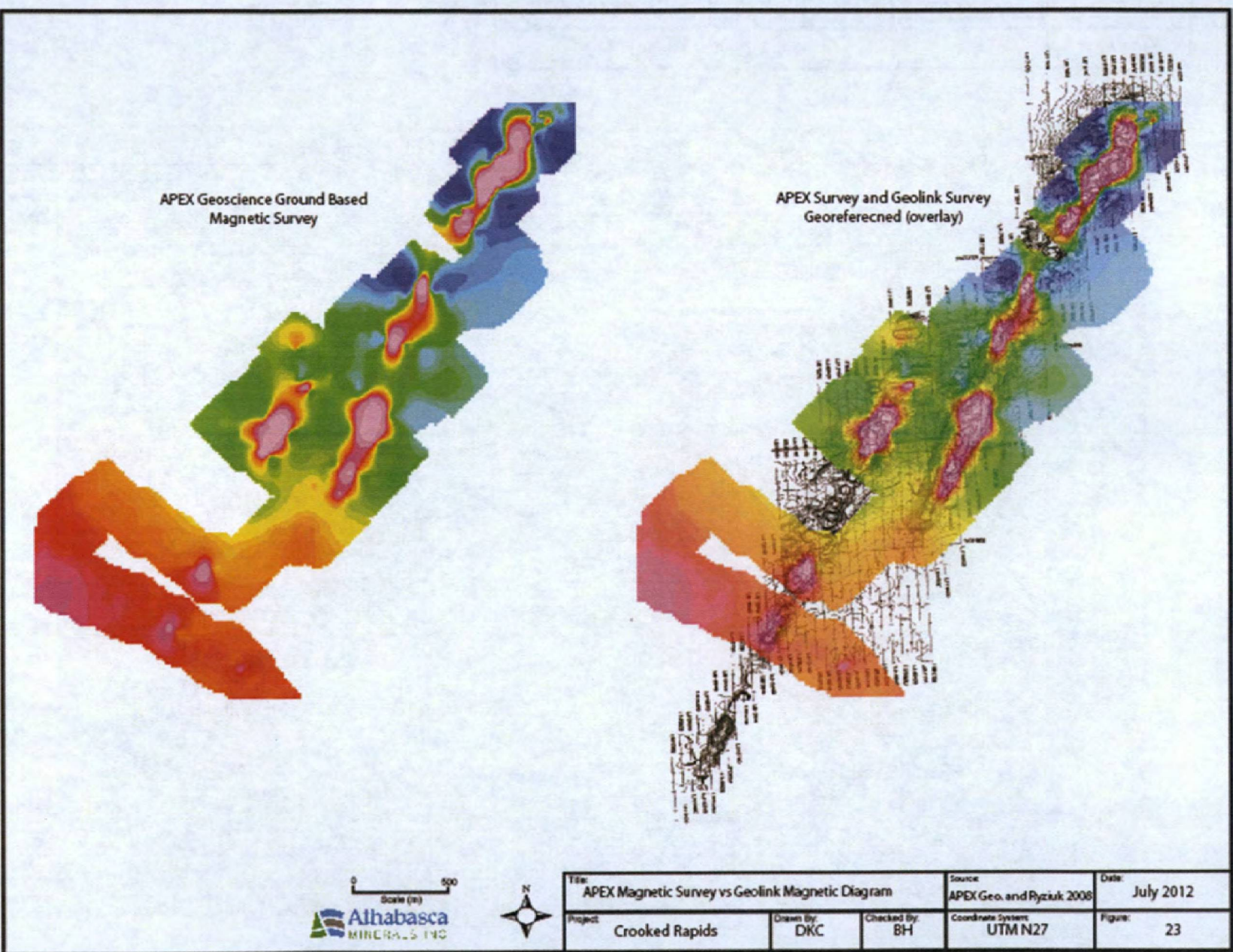
Access to the area was via helicopter. The magnetic survey was contracted to APEX Geoscience located in Edmonton Alberta. The field program included a geologist from Athabasca Minerals and two geophysicists from APEX. The survey was completed in a single day. The crew was dropped off at the south end of the Ashton anomaly and the survey proceeded to the northwest via a number of perpendicular transects that crossed the assumed location of the magnetic feature (**Figure 23**).

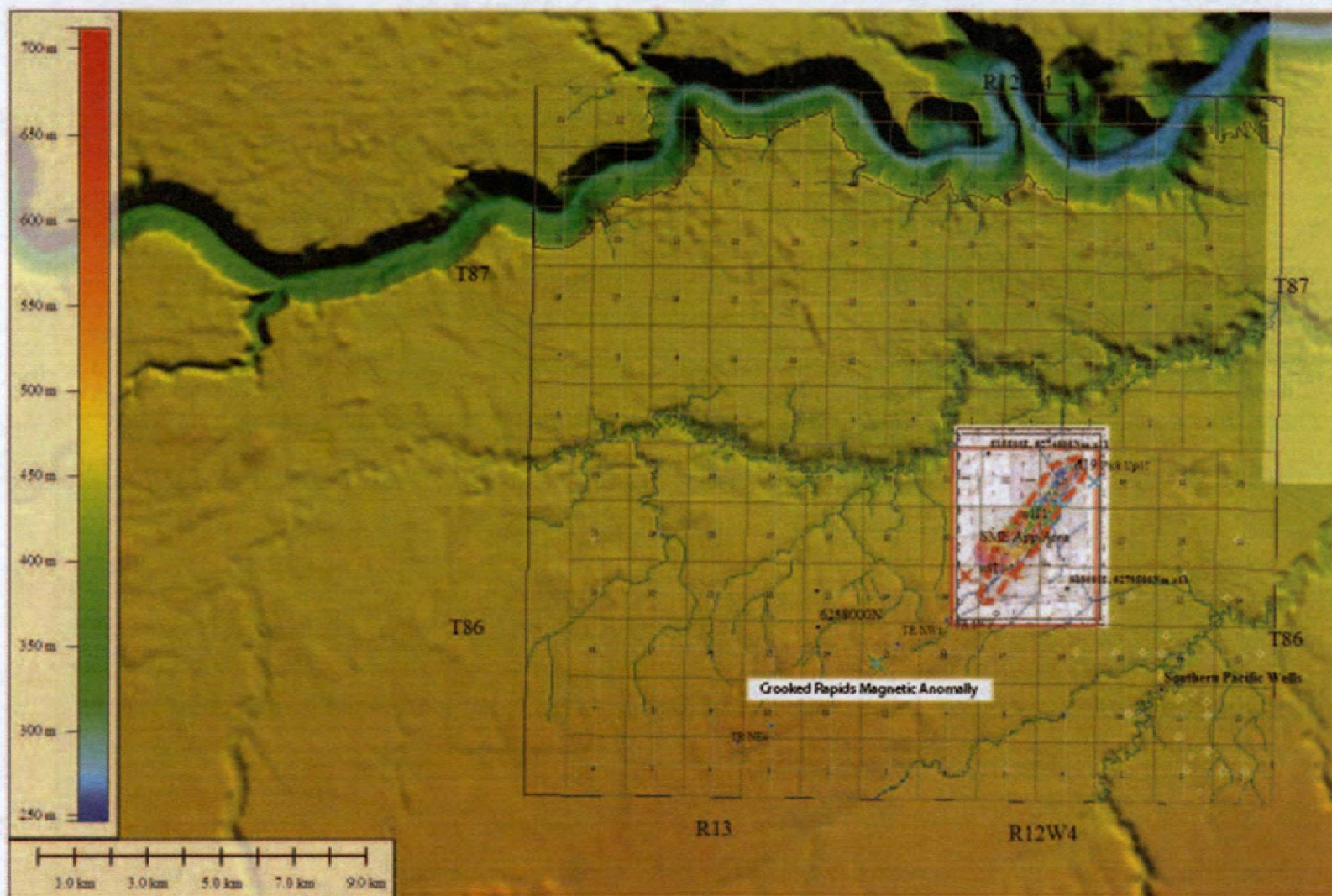
The total length of the survey was around 11 km. The Ashton magnetic high was intersected with the ground-based geophysical survey at 16 different locations. The survey confirmed the magnetic intensity and location of the anomaly with the notable exception that the anomaly appeared to be shifted by about 150 m from the original Ashton ground-based survey. Survey transects identified sharp, well-defined boundaries across the feature and readings along the length of the feature appeared consistent with the original reporting from Geolink exploration (**Figure 23**).

Based upon the preliminary evaluation of the Crooked Rapids Property by ABM and past exploration activities conducted by Ashton and Geolink, Athabasca Minerals intends to retain Metallic and Industrial Mineral permits over the confirmed magnetic anomaly and will include a small buffer region around the geologic feature (**Figures 24 and 25**; sections 20, 21, 28, 29, 32 and 33 of Township 86, Range 12W4).

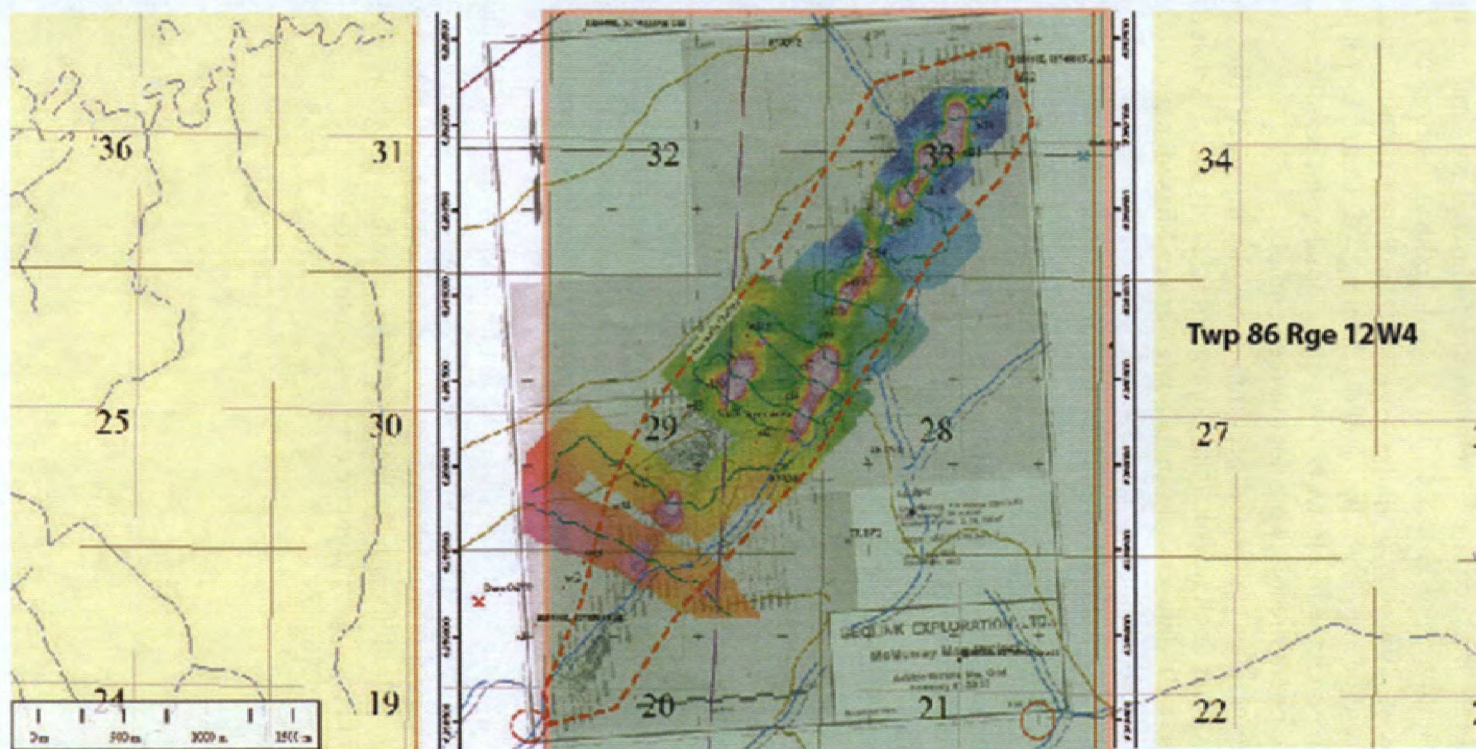
### 2.6.4 Future Exploration

- Athabasca Minerals Inc. will retain the permits covering the confirmed magnetic anomaly first identified by an airborne magnetic survey in 1998.
- A surface sampling program will be conducted over retained permit area (over the magnetic high and adjacent areas)
- The samples will be analyzed using whole rock geochemistry and visually inspected for heavy mineral concentration.
- Results from sample analysis will guide additional exploration activity. If surface sampling does not resolve the probable source of the magnetic response a shallow auger drill program may be warranted.
- Results from a potential auger drilling program will determine if deeper testing is warranted (eg: bedrock coring program) or possible abandonment of the Property.





Title: Magnetic Anomaly Overview			Source: NA	Date: July 2012
Project: Crooked Rapids	Drawn By: DKC	Checked By: BH	Coordinate System: DLS	Figure: 24



**Retain 6 sections within Twp 86 Rge 12W4  
(20, 21, 28, 29, 32 and 33)**

 **Retained  
Permits**

Scale (km)  
 **Altabasca  
MINERALS INC.**



Title: <b>Proposed Permit Retention</b>			Source: <b>NA</b>	Date: <b>July 2012</b>
Project: <b>Crooked Rapids</b>	Drawn By: <b>DKC</b>	Checked By: <b>BH</b>	Coordinate System: <b>DLS</b>	Figure: <b>25</b>

## 2.7 CONCLUSIONS AND RECOMMENDATIONS

- Athabasca Minerals Inc. acquired Metallic and Industrial Mineral permits over an area located 40 km southwest of Fort McMurray (Crooked Rapids Project). The permits were acquired in June of 2012 based upon two linear, northeast trending magnetic anomalies that were discovered in 1998 by Ashton Mining of Canada. Ashton and Geolink Exploration Ltd. conducted field work over the anomaly, but results were inconclusive as to what geologic phenomenon is producing the anomaly.
- Athabasca Minerals has completed preliminary exploration activities over the Crooked Rapids Property that include surficial topographic analysis, a subsurface study using existing oilsand well data and a small scale, ground-based magnetic survey over the previously discovered anomaly.
- The subsurface study indicates significant structural variability on the sub-Cretaceous unconformity and on several correlatable surfaces within the overlying Cretaceous formations. A structural paleohigh, present on several subsurface marker horizons, is aligned with the magnetic anomaly. Preliminary stratigraphic analysis of Cretaceous units does not indicate anomalous lithologic variations that may reflect the magnetic high.
- The primary goal of the magnetic survey was to confirm the location and intensity of the parallel, linear anomalies. Topographic ridges proximal to the anomaly, with similar orientations, were observed so it was deemed necessary to prove or disprove any geologic relationship between the ridge sets and the anomaly of similar size and trend.
- The ground-based survey confirmed the location and intensity of the anomaly, but registered the feature with a slight off-set of about 150 m.
- Based on data reviewed thus far it seems probable that the magnetic anomaly is sourced from near surface material. A large airborne magnetic survey, flown by ABM to the northwest, has identified a number of similar anomalies with roughly the same regional orientation (Cotterill and Hodder, 2007). To date, the potential source of these anomalies has not been explained.
- Additional detailed subsurface is planned for the area within the Cretaceous formations and particularly the younger Quaternary succession, which has not been reviewed.
- A surface sample program is planned over and around the magnetic high. Results from sample analysis will determine whether a deeper auger program will be required to determine the source of the magnetic response in the area.

## 2.8 REFERENCES

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## **Appendix 1**

Athabasca Minerals Inc.

Metallic and Industrial Mineral Permits

Crooked Rapids Project

1-1	9310060420
1-2	9310060421
1-3	9310060422

Appendix 1-1

Form Agreement

**MINERAL AGREEMENT DETAIL REPORT**

Report Date: July 20, 2012 9:40:38 AM

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Agreement Number: 093 9310060420

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Status: ACTIVE  
Agreement Area: 9216.0000Term Date: 2010/06/23  
Continuation Date:

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**DESIGNATED REPRESENTATIVE**Client Id: 8082863  
Client Name: ATHABASCA MINERALS INC.

Address: 9524 27 AVE NW

EDMONTON, AB  
CANADA T6N 1B2

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**LAND / ZONE DESCRIPTION**

4-12-086: 01-36

METALLIC AND INDUSTRIAL MINERALS

## Appendix 1-2

Form Agreement

**MINERAL AGREEMENT DETAIL REPORT**

Report Date: July 20, 2012 9:39:41 AM

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**Agreement Number:** 093 9310060421

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Status: ACTIVE  
Agreement Area: 9216.0000Term Date: 2010/06/23  
Continuation Date:

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**DESIGNATED REPRESENTATIVE**Client Id: 8082863  
Client Name: ATHABASCA MINERALS INC.

Address: 9524 27 AVE NW

EDMONTON, AB  
CANADA T6N 1B2

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**LAND / ZONE DESCRIPTION**

4-13-086: 01-36

METALLIC AND INDUSTRIAL MINERALS

## Appendix 1-3

Form Agreement

**MINERAL AGREEMENT DETAIL REPORT**

Report Date: July 20, 2012 9:37:29 AM

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**Agreement Number:** 093 9310060422

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**Status:** ACTIVE  
**Agreement Area:** 7843.0000**Term Date:** 2010/06/23  
**Continuation Date:**

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**DESIGNATED REPRESENTATIVE****Client Id:** 8082863  
**Client Name:** ATHABASCA MINERALS INC.**Address:** 9524 27 AVE NWEDMONTON, AB  
CANADA T6N 1B2

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**LAND / ZONE DESCRIPTION**

4-12-087: 01-27; 28SEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 28SWP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 28NWP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 29SEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 29SWP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 30SEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 30SWP  
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4-12-087: 30NEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 34-35; 36SEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 36NEP  
PORTION(S) LYING OUTSIDE GRAND RAPIDS WILDLAND PROVINCIAL PARK.

4-12-087: 36SW, NW

METALLIC AND INDUSTRIAL MINERALS