# TECHNICAL REPORT ON THE

# Palisades Coal Property

## ALBERTA, CANADA

**Prepared for Altitude Resources Inc.**

**Report for NI 43-101**


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## List of Abbreviations

| Abbreviation | Definition | Abbreviation | Definition |
|---|---|---|---|
| **µ** | Micron | **kph** | kilometres per hour |
| **°C** | degrees Celsius | **km²** | square kilometre |
| **°F** | degree Fahrenheit | **kPa** | kilopascal |
| **µg** | Microgram | **kVA** | kilovolt-amperes |
| **A** | Ampere | **kW** | kilowatt |
| **A** | Annum | **kWh** | kilowatt-hour |
| **Bbl** | Barrels | **L** | Liter |
| **Bcm** | bank cubic metre | **L/s** | litres per second |
| **Bcy** | bank cubic yard | **LOM** | life of mine |
| **Btu** | British thermal units | **m** | metre |
| **C$** | Canadian dollars | **M** | mega (million) |
| **Cal** | Calorie | **m²** | square metre |
| **Cfm** | cubic feet per minute | **m³** | cubic metre |
| **Cm** | Centimetre | **Ma** | million years |
| **cm²** | square centimetre | **MASL** | metres above sea level |
| **Cps** | counts per second | **Mbcm** | million bank cubic metres |
| **D** | day | **min** | minute |
| **ddpm** | dial divisions per minute | **mm** | millimetre |
| **dia.** | diameter | **mph** | miles per hour |
| **Dlt** | dry long ton | **MVA** | megavolt-amperes |
| **Dmt** | dry metric tonne | **MW** | megawatt |
| **Dst** | dry short ton | **MWh** | megawatt-hour |
| **Dwt** | dead-weight ton | **m³/h** | cubic metres per hour |
| **FSI** | free swelling index | **opt, oz/st** | ounce per short ton |
| **Ft** | Foot | **oz** | Troy ounce (31.1035g) |
| **ft/s** | foot per second | **oz/dmt** | ounce per dry metric tonne |
| **ft²** | square foot | **pop** | population |
| **ft³** | cubic foot | **ppb** | part per billion |
| **G** | Gram | **ppm** | part per million |
| **G** | giga (billion) | **QA** | quality assurance |
| **Gal** | Imperial gallon | **QC** | quality control |
| **g/L** | gram per litre | **RL** | relative elevation |
| **g/t** | gram per tonne | **$Ro_{Max}$** | Maximum reflectance |
| **Gpm** | Imperial gallons per minute | **ROM** | run of mine |
| **gr/ft³** | grain per cubic foot | **s** | second |
| **gr/m³** | grain per cubic metre | **st** | short ton |
| **Hr** | Hour | **stpa** | short ton per year |
| **Ha** | Hectare | **t** | tonne |
| **Hp** | Horsepower | **tpa** | metric tonne per year |
| **In** | Inch | **tpd** | metric tonne per day |
| **in²** | square inch | **US$** | United States dollar |
| **J** | Joule | **USgpm** | US gallon per minute |
| **K** | kilo (thousand) | **V** | Volt |
| **Kcal** | Kilocalorie | **W** | Watt |
| **Kg** | Kilogram | **wmt** | wet metric tonne |
| **KJ/kg** | kilojoules per kilogram | **yd³** | cubic yard |
| **Km** | Kilometre | **yr** | year |

# 1 SUMMARY

This Technical Report summarizes coal exploration and drilling conducted on the Palisades Property in the central Alberta foothills, and presents a resource estimate based upon current 2016 and historic drill information and mapping.

## 1.1 PROPERTY DESCRIPTION

The centre of the Property is located at about 53°28'N, 118°0’W, approximately 35 km northwest of Hinton, AB, Canada (Figure 2-1). The Property can be accessed by road from Hinton via Highway 16, Highway 40 and either the Peppers Lake Road or Rock Lake Provincial Park Road. The Property is comprised of several coal leases in the Category 4 Land Use designation, and one coal lease application in the Category 2 Land Use Designation. A separate property owned by Altitude is located about 25 km northwest of the Palisades Property, spanning Moon Creek and Moberly Creek; this property is not included in the present report. Historical work in this area is reported as the “Hoff Property”, first by Rio Tinto (1969) and then Denison Mines (1982-83).

## 1.2 LAND TENURE

The Property is comprised of six contiguous Alberta Crown Coal leases and one coal lease application which are in Townships 51 and 52, Ranges 27 and 28, west of the 5$^{th}$ Meridian, and Range 01, west of the 6th Meridian. All the coal leases and the coal lease application are held by Altitude Resources Inc. The total area of the combined leases and lease application is 11,682.4 hectares. The leases are located approximately 12 km west of the Canadian National Railway (CN) that runs to ports on the west coast. In January of 2015, Altitude entered in to a joint exploration agreement with the Japan Oil, Gas and Metals National Corporation (JOGMEC) to further exploration on the Palisades Property. The terms of this agreement allowed a staged buy-in of up to 51% of the Property over three years, based upon three farm-in periods with total expenditure of $4,800,000.

## 1.3 GEOLOGY AND MINERALIZATION

The Property lies within the North-Central Alberta Foothills near the eastern edge of the Front Ranges of the Canadian Rocky Mountains. It is bounded by the north-trending, west-dipping, Collie Creek thrust sheet in the east, and the Folding Mountain thrust sheet in the west. The rocks underlying the Property are within the predominantly continental Lower Cretaceous Luscar Group (Langenberg and McMechan, 1985), which is equivalent to the Blairmore Group in Southern Alberta and Fort St. John Group in northeastern BC (Figure 7-1). The Luscar Group is overlain by dark gray marine shales of the Shaftesbury Formation. Strata of the Luscar Group are divided into four formations identified in ascending order as the Cadomin, Gladstone, Moosebar and the coal-bearing Gates Formation.

The Gates Formation consists primarily of sandstones, siltstones and coal cyclothems. The base of this Formation is characterized by a massive, medium-grained, 20 to 40 m thick sandstone unit known as the Torrens Member, which conformably overlies the marine shales of the Moosebar Formation. Overlying the Torrens Member is the coal bearing unit, referred to as the Grande Cache Member. The Grande Cache Member consists of fine-grained sandstones, siltstones and mudstones, and continuous coal seams. On the Property, this Member is 85 to 95 m thick and has three distinct identified coal zones. Overlying the Grande Cache Member is the Mountain Park Member, which consists predominantly of thick-bedded, fine- to medium-grained sandstone sequences with distinct siderite grains. This member ranges from 85 to 200 m in thickness and forms prominent ridges on the Property.

Stratigraphy in the Palisades area has been subjected to first and second order thrust faulting, as well as asymmetrical folding. The major faults, the Collie Creek Thrust in the northeast, and Folding Mountain Thrust in the southwest, trend northwest and dip to the southwest. Secondary local thrusts within each thrust sheet also trend northwest, resulting in local structure units or packages affecting the coal seam thickness and occurrence. Major folds include the Moosehorn and Coal Hill Synclines, and the Solomon Creek Anticline, which trend northwest and dip steeply to vertically to the southwest (Denison, 1984).

Three main coal seams, from top to bottom, Moosehorn, Hoff, and Solomon, have been correlated in the Palisades area. The coal is low–volatile bituminous to mid-volatile bituminous with variable but generally moderate ash content, good washability, and good coking properties, similar to that mined at Grande Cache.

## 1.4 EXPLORATION

This Technical Report presents the results of all exploration drilling and mapping conducted on the Property to date. In 2016, access construction and mapping of exposed road-cuts, drilling, and reclamation were conducted on the Property between June and early September. Twenty-five rotary-hammer drillholes and eight HQ (6.4 cm) core holes were completed in the Central Palisades (Icewater Creek) and Coal Hill areas. Where possible, existing access was rehabilitated, and new construction was minimized. Constructed drill pads were reclaimed, and access was reclaimed or deactivated at the end of the program under the terms of the coal exploration permit.

Altitude Resources Inc. conducted a limited mapping program in October 2012, and a significant mapping, trenching and drilling program (27 drillholes and three core holes) on the Property in 2013, as well as 22 drillholes and three core holes in 2015. Significant historical exploration programs on the Property, including drilling, trenching and mapping, were conducted by Rio Tinto Canadian Exploration Ltd., in 1969 (five rotary drillholes), and by Denison Mines Limited in 1982 to 1983 (twenty-three core holes).

## 1.5 COAL QUALITY

The change to HQ triple wireline coring in 2016 improved overall coal recoveries. The core samples collected in 2013, 2015, and 2016 confirm the coal rank on the Property as low- to medium-volatile bituminous coking coal. Petrographic analysis shows an overall reactive/inert ratio of 72/26 and a predicted ASTM Stability of 58 to 62. Ash analysis shows low total alkaline content (<10% average) which should contribute to a high CSR value. The phosphorous in coal is < 0.02% which is extremely low and highly desirable. Details are presented in Section 13.

## 1.6 MINERAL RESOURCE ESTIMATES

The in-place, surface-mineable resources for the Coal Hill/Central Palisades area and the South Palisades area are summarized in Table 1-1. These areas are outlined in Figure 14-1. Assumptions and methodology are provided in Section 14.

**Table 1-1. Palisades In-Place Surface-Mineable Coal Resources (Metric tonnes) Summary**

| Area | Seam | In-Place Coal Resources (TONNES) Stripping Ratio Cutoff 20:1 | | | |
|---|---|---|---|---|---|
| | | ASTM Group | Measured | Indicated | Inferred |
| Coal Hill/Central Palisades | Moosehorn | Mid-Volatile Bituminous | 910,000 | 540,000 | 530,000 |
| | Hoff | Low-Volatile Bituminous | 3,540,000 | 2,580,000 | 3,620,000 |
| | Solomon | Low-Volatile Bituminous | 5,110,000 | 3,300,000 | 4,060,000 |
| South Palisades | Moosehorn | Mid-Volatile Bituminous | 20,000 | 160,000 | 110,000 |
| | Hoff | Low-Volatile Bituminous | 70,000 | 160,000 | 190,000 |
| | Solomon | Low-Volatile Bituminous | 210,000 | 300,000 | 390,000 |
| | **Total Property** | | **9,860,000** | **7,040,000** | **8,900,000** |

(Note: partings removed, coal bed thickness >0.6 m, upper 8 m oxidised zone removed; rounded to nearest 10,000 tonnes)

The Property hosts a large exploration target of low- and mid- volatile bituminous coal that requires additional drilling to define a resource. Exploration targets are down-dip and along strike projections of the coal seams outside of the resource areas (Table 1-2). These targets are partly conceptual and based on current geological understanding; hence rounded tonnage range is presented. The target area is outlined in Figure 14-1.

**Table 1-2. Palisades In-Place Exploration Targets (Metric tonnes)**

| Area | Exploration Target* (TONNES) |
|---|---|
| Coal Hill/Central Palisades | 60,000,000 – 62,000,000 |
| South Palisades | 3,000,000 – 5,000,000 |
| **Total Property** | **63,000,000 to 67,000,000** |

*conceptual in-place coal with no stripping ratio cutoff; no depth of weathering; rounded to nearest 1,000,000 tonnes

## 1.7 Conclusions and Recommendations

The 2016 drilling resulted in an increase in the Measured, Indicated, and Inferred Resource categories, relative to the 2015 Resource Estimation. The defined Resources for the Moosehorn and Hoff Seams increased in all categories from 2015 to 2016. The 2016 Resource increased by:

- 800,000 tonnes of Total Measured Resource
- 240,000 tonnes of Indicated Resource
- 1,300,000 tonnes Inferred Resource

Resources for the Solomon Seam slightly decreased in all categories from 2015 to 2016. The reduction of Solomon Seam tonnage resulted from additional drill information that identified increased structural constraints and greater seam variability. The 2016 drilling identified greater variability in Solomon Seam thicknesses and increased parting thicknesses, relative to previous seam projections created from a smaller drillhole dataset. A portion of the previously defined Solomon Seams was re-identified as the Hoff Seam, contributing to the shift in the 2015 Solomon Resource. With the increased structural control and drill constraints there has been a significant increase in the exploration target from 2015 to 2016.

The results of the 2013 through 2016 exploration programs show that the three main coal seams on the Property contain low-to mid-volatile coal with excellent coking characteristics. Previous geological interpretation by Rio (Benkis, 1970) and Denison (1984) in the southern and eastern part of the property were found to be somewhat inaccurate. Some areas mapped as Grande Cache and Mountain Park members of the Gates Formation in the Central and South Palisades have been re-mapped as Shaftesbury Formation. The eastern flank of Coal Hill includes a further thrust-repetition of Mountain Park and Grande Cache members, which was previously mapped as Moosebar Formation. The area south of Coal Hill includes part of a previously un-mapped thrust-repeated eastern limb of the Coal Hill Anticline. The Coal Hill Syncline and Coal Hill Anticline are dissected by several splays from the Collie Creek Thrust, which increase the thickness of Grande Cache Member rocks and cause numerous seam repeats. Observations through mapping and drilling in 2015 and 2016 suggest that the coal bearing Grande Cache Member is thickened to the west of Coal Hill in a similar manner. The eastern flank of Coal Hill includes a further thrust-repetition of Mountain Park and Grande Cache members, which was previously mapped as Moosebar Formation which remains poorly constrained (Figure 7-4).

The conclusions drawn from the 2013 through 2016 exploration programs are that coal seams in the eastern part of the property, while thickened in places by folding, and repeated by thrust faulting, especially in the Coal Hill area, are generally thinner and contain more partings than was previously thought. Repetition of the Grande Cache Member coal seams by imbricate thrusting was confirmed in the western part of the Property. Areas of higher confidence Resources remain disconnected in places and potential unidentified subcrop extensions of the Grande Cache Member may exist south of Coal Hill, and in the central and southern parts of the Property (Figure 14-1). Further drilling is recommended to fill in these areas. A new Coal Exploration Permit would be required for a 2017 exploration and drilling program.

Based upon recommendations from the 2015 program, wireline coring was undertaken in 2016 with generally better core recoveries. The core samples collected in 2013 through 2016 confirm that the Solomon Seam and Hoff Seam are low-volatile hard coking coal. The Moosehorn Seam is medium-volatile coking coal. The Hoff and Moosehorn Seams appear to be of good quality, but more coring focused upon acquiring additional coal quality information should be undertaken. Efforts should, if possible include development of greater constraints on depth of weathering specific to the Property.

Further mapping in the central and southern parts of the Property is recommended to better define structures and support for targeting of potential unmapped, or subcropping coal zones. This area would benefit from future drilling, but currently lacks that constraint required for optimal drill targeting.

Drill targets have been proposed along the structurally controlled fault blocks that extend south of Coal Hill, along strike from 2016 drillholes AP16-018 and AP16-020, and along the east side of the Spine Line (Figure 26-1). Drill recommendations south of coal hill are designed to target near surface coal projections and provide more-complete structural cross-sections, P2017-001 Line through P2017-006 Lines that will better constrain structural and seam variability (Figure 26-1). Additional drilling has been recommended to connect and expand the Resource between the North and Central Areas, along newly developed logging access. These Central drill targets are represented along drill lines P2017-007 Line through P2017-009 Lines (Figure 26-1).

A 2,500 m drill campaign has been recommended and budgeted to evaluate and constrain the above drill and mapping targets. This work includes approximately 2,000 m of reverse circulation drilling and up to 500 m of wireline coring in target areas identified by the 2016 program is recommended. The estimated cost of this program would be about $ 1,100,000 (Figure 26-1; Table 26-1).

# 2 INTRODUCTION

Dahrouge Geological Consulting Ltd. ("Dahrouge") has been retained by Altitude Resources Inc. ("Altitude") to prepare an updated Technical Report on the Palisades Coal Property ("the Property"), located in Alberta, Canada (Figure 2-1). The report was commissioned by Altitude to comply with regulatory disclosure and reporting requirements outlined in Canadian National Instrument 43-101, Standards for Disclosure of Mineral Projects ("NI 43-101"), companion policy NI 43-101CP, and Form 43-101F ("Technical Reports").

Robert Engler, P. Geol., John Gorham, P. Geol., and William Miller, P. Geo., are the Qualified Persons responsible for preparing this Technical Report on the Property. Mr. Engler is responsible for Section 13 and jointly responsible for Sections 1, 12, 25 and 26. Mr. Gorham is responsible for all sections of this report except section 13. Mr. Miller is jointly responsible for Sections 1, 14, 25 and 26.

The purpose of this report is to review coal exploration on the Property carried out between 2012 and 2016, and to present a resource estimate based upon all drilling completed to date in 2016. Information, conclusions, and recommendations contained in this report are based on field observations as well as published and unpublished data (see Section 27: References).

Mr. Engler visited the Property on July 18-20, and July 29-30, 2016. Mr. Gorham visited the Property on June 4-16, 20-27, July 5-11, 18-30, and August 1-8, 2016. Mr. Miller did not visit the Property.

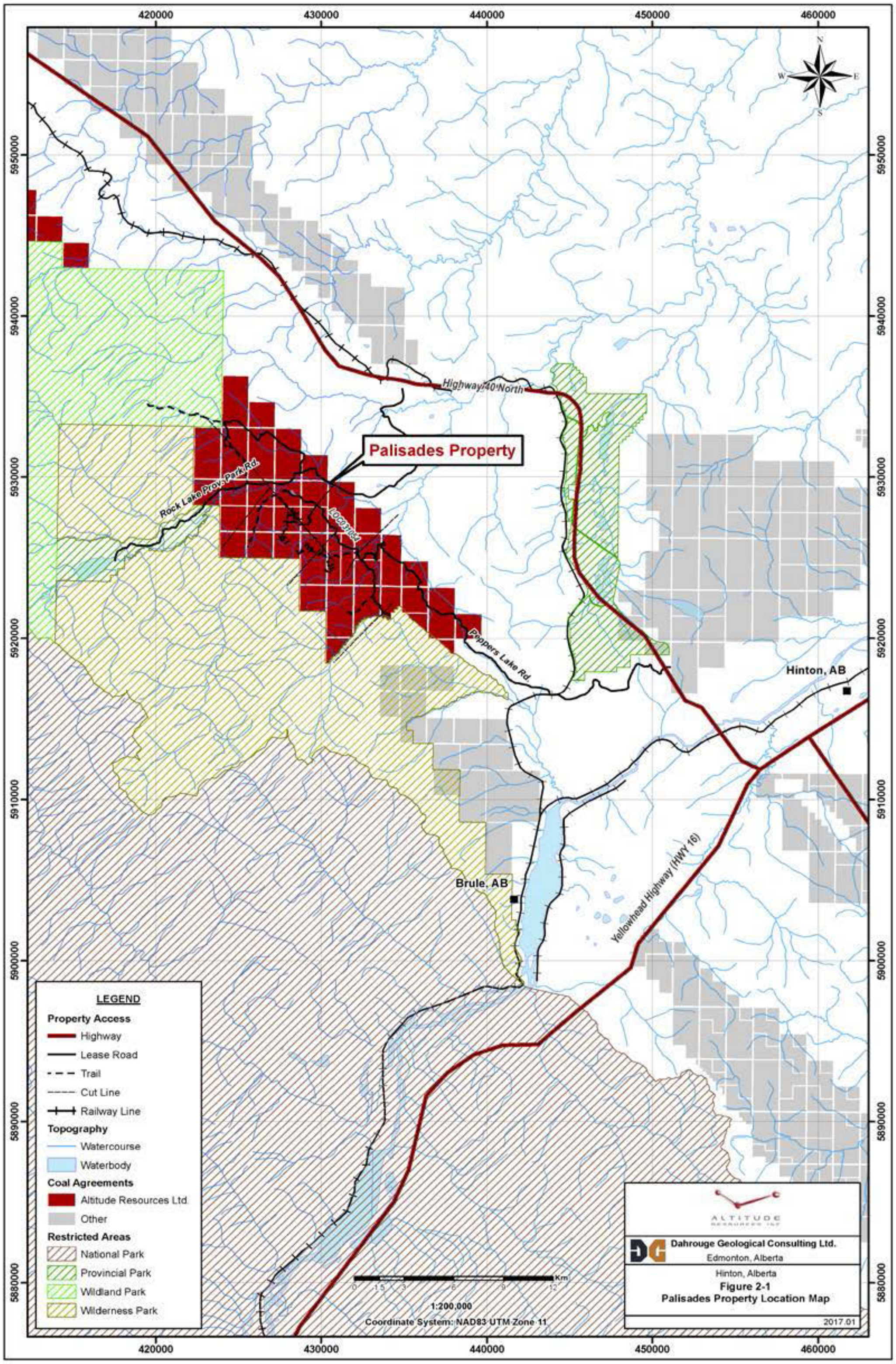


**Figure 2-1. Palisades Property Location Map**

# 3 RELIANCE ON OTHER EXPERTS

This report has been prepared by, Robert Engler, P. Geol., of Moose Mountain Technical Services, and John Gorham, P. Geol. and William Miller, P. Geo. of Dahrouge Geological Consulting Ltd. for Altitude Resources Inc. ("Altitude"). The information, conclusions, opinions, and estimates contained herein are based on:

- Information available to the authors at the time of preparation of this report,
- Assumptions, conditions, and qualifications as set forth in this report, and
- Data, reports, and other information supplied by Altitude Resources Inc. or available in the public domain.

The authors have relied upon the work of other consultants in the project areas in support of this Technical Report and have referenced this work throughout the report and in Section 27 of this report. The authors, where possible, verified data provided independently and completed site visits to review the physical evidence of these projects.

For the purpose of this report, the authors have relied on ownership information provided by Altitude and verified through the Alberta Government interactive coal tenure map system at:

https://gis.energy.gov.ab.ca/Geoview/Coal

While title documents were reviewed for this study, it does not constitute, nor is it intended to represent, a legal, or any other opinion as to title.

# 4 PROPERTY DESCRIPTION AND LOCATION

## 4.1 LOCATION

The centre of the Property is located at about 53°28'N, 118°0'W, approximately 35 km northwest of Hinton, AB, Canada (Figure 2-1) in the foothills of the Rocky Mountains. The Property extends north of the Wildhay River to the Solomon Creek and covers a distance greater than 12 km. Access to the Property is via the Yellowhead Highway (Highway 16), Highway 40 North and either Peppers Lake Road or Rock Lake Provincial Park Road. The Property is comprised of six coal leases and one coal lease application totalling 11,682.4 ha (Figure 4-1; Table 4-1). Altitude has four other contiguous coal lease applications (the Moberly Property) located about 28 km northwest of the Palisades Property, as well as five coal lease applications located about 100 km northwest near Grande Cache (the Altitude North Property), which are not the subject of this Technical Report.

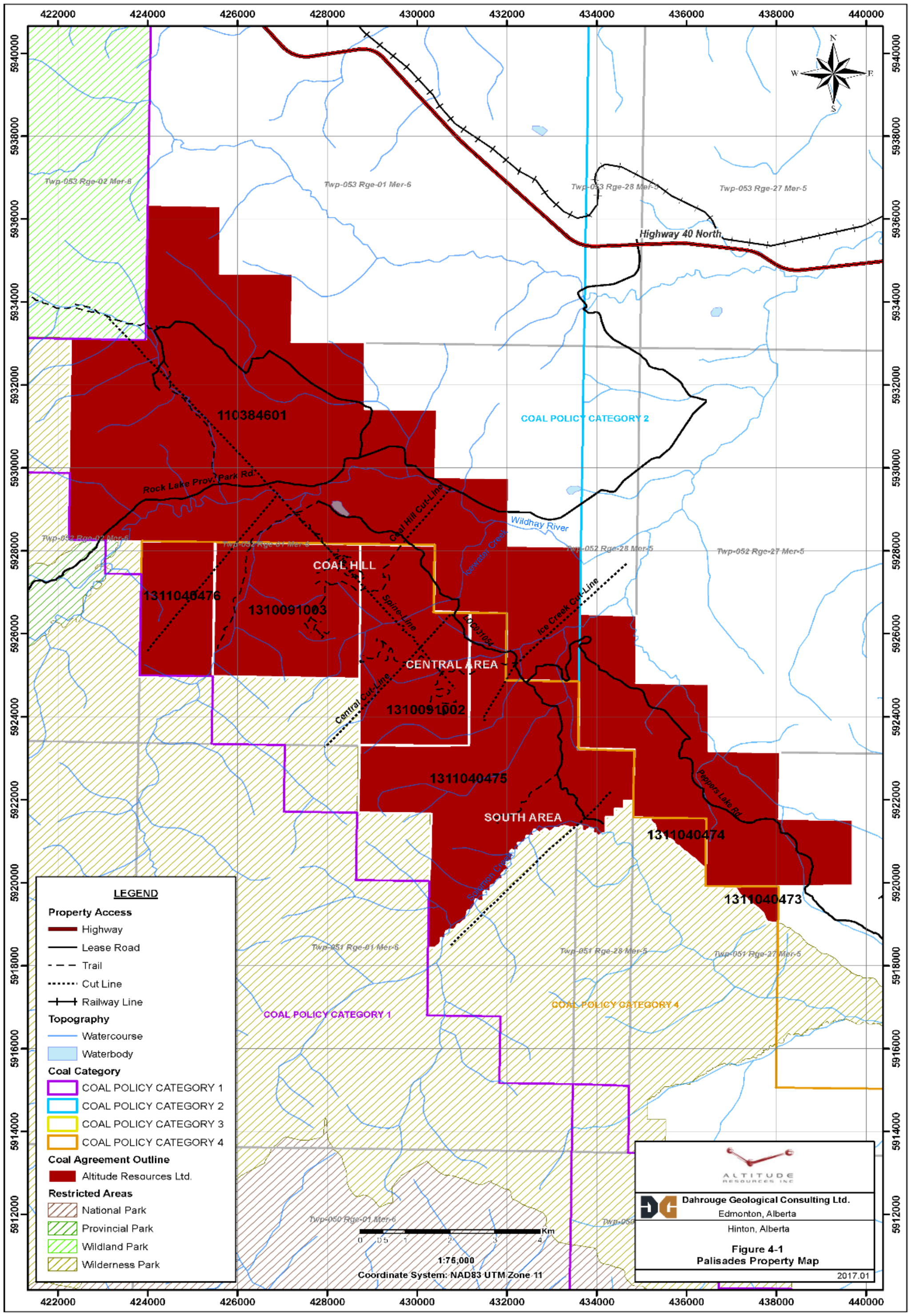


**Figure 4-1.** **Palisades Property Map.**

The Property consists of six contiguous coal leases which were acquired through open Public Tender of undisposed Coal Rights in September, 2010, and one coal lease application which was acquired October 17, 2011, encompassing an aggregate area of approximately 11,682.4 ha. Three tenures overlap WPP-0015-02, therefore agreement areas are reduced accordingly by approximately 303 ha. The land that comprises the Property is Crown Land. The six leases and the A13 coal lease application are held by Altitude Resources Inc. and are summarized in Table 4-1. They can be viewed on the Alberta Government Energy Website using the interactive coal map:

https://gis.energy.gov.ab.ca/Geoview/Coal

**Table 4-1. Details of the Palisades Coal Property Claims.**

| Lease Type | Lease Number | Agreement Area (hectares) | Date Recorded | Renewal Date |
|---|---|---|---|---|
| A13(application) | 110384601 | 7034 | 17-Oct-2011 | - |
| 013 | 1310091002 | 1024 | 02-Sept-2010 | 02-Sept-2025 |
| 013 | 1310091003 | 1024 | 02-Sept-2010 | 02-Sept-2025 |
| 013 | 1311040473 | 50.8 | 07-Apr-2011 | 07-Apr-2026 |
| 013 | 1311040474 | 82.9 | 07-Apr-2011 | 07-Apr-2026 |
| 013 | 1311040475 | 1954.7 | 07-Apr-2011 | 07-Apr-2026 |
| 013 | 1311040476 | 512 | 07-Apr-2011 | 07-Apr-2026 |
| **Total** | | 11,682.4 | | |

Alberta Crown Coal Leases are granted for a term of 15 years and are renewable for additional terms on application. There are no other obligations on the property other than annual lease rental requirements ($3.50 per hectare) to the Alberta Government and subsequent Coal Royalty payments after production.

Applications for coal lease agreements (A13) in Alberta must be accompanied by the $625.00 application fee, the first year's rent ($3.50 per hectare with a minimum of $50.00), plus GST as applicable. For a coal lease on a road allowance, the first year's rent is $50.00. Once received, an application is checked to confirm the requested mineral rights are available. The application is then reviewed with respect to development restrictions or policies, and the appropriate method of disposition. A successful coal lease application may, depending upon the circumstances, lead to an agreement being issued directly to the applicant, or may result in competitive bidding.

Altitude must pay an annual rent of $3.50/ha to the Alberta government to retain the Property, as well as royalties per the Coal Royalty Regulation if any production occurs. The current royalty rate for Crown-owned bituminous (Mountain/Foothills) coal is 1% of mine-mouth revenue before mine payout, and 1% of mine mouth revenue plus 13% of net revenue after mine payout.

A coal lease grants the right to explore the land within the boundaries of the lease. A coal lease does not grant surface rights; a surface lease or grant is required. Altitude has not applied for a surface lease on the Property.

The Property falls within the Rocky Mountain Forest Reserve, which is managed by the Alberta Government, and within the West Fraser Mills Forest Management Area. A road use agreement with West Fraser Mills is required for access to the Property.

The six Palisades Property coal leases are wholly within the Coal Development Policy Category 4 land zone, as designated by the 1976 Alberta Coal Policy. This land category allows for coal surface mine development by the lease holder. The application for a coal lease agreement (A13) is wholly within the Coal Development Policy Category 2 land zone. This category allows for limited exploration under strict controls. Approved development is generally restricted to in-situ or underground, as the area is considered to have moderate environmental sensitivity and minimal existing infrastructure.

There are two surface disposition types which may require consultation or restrict certain activities upon public lands. The activity types include Consultative Notation – Provincial Government (CNT) and Protective Notation (PNT). CNT does not impose any land use restriction but indicates that an agency wishes to be consulted prior to any commitment or disposition of the land. A CNT must not prevent the taking of applications or the cancellation of an application. All applications must be referred to the holding agency. The holding agency may request special conditions with respect to proposed disposition. If the holding agency wishes to restrict the proposed land use, the holding agency must apply for a Protective Notation (PNT) that will permit the appropriate level of restriction with respect to the surface disposition. The purpose of these restrictions is either managing natural hazards (erosion, flood risk, slope stability) or land management (wildlife, grazing, irrigation, watercourse protection). Currently, PNT8890245 (Grazing Lands) has been cancelled, so no notations appear on the Property.

In January of 2015, Altitude entered in to a joint exploration agreement with the Japan Oil, Gas and Metals National Corporation (JOGMEC) to further exploration on the Palisades Property. The terms of this agreement allowed a staged buy-in of up to 51% of the Property over three years with total expenditure of $4,800,000. The second stage of this agreement was undertaken in 2016. The joint exploration agreement is based on the three farm-in periods described below which are tied to specific funding milestones:

1. During the first farm-in period (2015), JOGMEC contributed C$1,500,000 towards exploration on the Palisades Project.
2. During the second farm-in period (2016), JOGMEC contributed C$1,500,000 towards exploration on the Palisades Project. This will earn JOGMEC an unencumbered right, title and benefit to 31.875% of the Palisades Property.
3. During the third farm-in period (2017) JOGMEC shall contribute a further C$1,800,000 towards exploration on the Palisades Project. If JOGMEC has contributed a total amount of C$4,800,000 by end of third farm-in period, property ownership interests will be Altitude: 49% and JOGMEC 51%.
4. The first and second farm-in periods have been completed in 2015 and 2016, respectively.

## 4.2 Environmental Liabilities

The authors are not aware of any environmental liabilities associated with the Property.

## 4.3 Required Permits

Exploration requires a Coal Exploration Permit from the Alberta Government. As of the effective date of this report, Altitude has applied for and been granted a Coal Exploration Permit (CEP 150001) for exploration drilling activity issued by the Alberta Government. This CEP covers two years of active exploration and a period of reclamation, expiring Aug 6, 2020. It was amended in 2016 to include 21 additional drill sites and up to 2.4 km of new access construction. Future work will require application for a new Coal Exploration Permit. The current or future operations of Altitude, including development and commencement of production activities on this property require other permits governed by laws and regulations pertaining to development, mining, production, taxes, labour standards, occupational health, waste disposal, toxic substances, land use, environmental protection, mine safety and other matters, may be required as the Project progresses.

### 4.4 OTHER SIGNIFICANT FACTORS AND RISKS

The Rock Lake –Solomon Creek Wildland Provincial Park (WPP-0015-02) established December 20, 2000, overlaps parts of coal leases 013-1311040473, 013-1311040474 and 013-1311040475 as well as the two quarter sections (SW29 and SW 31 TWP 51-R27W5 of lease application A13-110384601. This area is currently restricted for any off-highway vehicle access. Some surface access restrictions are in place on parts of the Property for biodiversity sensitivity, as well as grizzly bear, mountain sheep and mountain goat range. These have not affected exploration operations.

# 5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

## 5.1 TOPOGRAPHY, ELEVATION, AND VEGETATION

The Property is situated within the sub-alpine-montane sub-region of the larger Rocky Mountain Natural Region in Alberta. In general, the terrain is steep and mountainous, with highly variable elevations characterized by a series of steep rounded hills running northwest-southeast, parallel to the front range of the Rocky Mountains, which are incised by east flowing streams. The topographic elevation on the Property ranges from 1,350 to 2,000 m. The Wildhay River crosses the northern part of the Property about six kilometers south of the northernmost extent of the Property. It flows east from Rock Lake towards the Athabasca River drainage system. The southern boundary is formed by Solomon Creek. Vegetation on the Property is dominated by Engelmann spruce and subalpine fir at higher elevations, and lodgepole pine, balsam fir, alder, willow, black spruce and mixed grasslands at lower elevations.

## 5.2 INFRASTRUCTURE AND LOCAL RESOURCES

The Property is located approximately 20 km northwest of the town of Hinton, 76 km west of Edson and 300 km west of the city of Edmonton. The Property can be accessed by driving westwards from Hinton for 3.5 km on the Yellowhead Highway (Highway 16), then north on Highway 40 for about 11 km to the junction with Peppers Lake Road. The eastern boundary of the property is 28 km westward on the Peppers Lake Rd, which is a graveled all-weather, gated, forestry road owned by West Fraser Mills. Transport to and from the Property is by 4x4 truck, and on trails and cutlines, it is by ATV or on foot. Alternative road access to the north part of the Property is via the Rock Lake Provincial Park Road which leaves Highway 40 about 41 km from the junction with Highway 60 and runs west along the Wildhay River valley about 18 km to the eastern boundary of the Property.

The Canadian National Railway (CN) rail line runs 12 km parallel to the eastern boundary of the Property. The railway provides direct access for coal delivery to the Port of Vancouver and to the Ridley Island Terminal at Prince Rupert. Paved landing strips are available in both Hinton and Edson for light aircraft.

Hinton, the closest community, with a population of 9,640 (2011 census) is located about 20 km southeast of the Property. It hosts a full range of accommodations, food, fuel and other necessary services. Major employers are Teck Coal, Hinton Pulp, and Hinton Wood Products (West Fraser Mills Ltd.), as well as oil and gas operations. Other communities near to the Property include Grande Cache (pop. 4,319 (2011 census)), about 80 km to the northwest along Hwy 40, and Jasper (pop. 4,051 (2011 census)), about 70 km to the southwest.

Several coal mines are operating in the Hinton area. Teck Resources Limited operates the Cheviot (Cardinal River) mine about 40 km south of Hinton. This operation produces metallurgical coal from the Lower Cretaceous Gates Formation, as did the Grande Cache Coal mine at Grande Cache, about 140 km northwest of Hinton and 80 km northwest of the Property. Coalspur Mines Ltd has been developing its Vista project for thermal coal immediately southeast of Hinton in the Tertiary Coalspur Formation.

There is currently no existing mine infrastructure on the Property.

## 5.3 CLIMATE

The climate of the region is classified as boreal sub-alpine, characterized by long cold winters and short cool summers. Daily temperatures range from a mean maximum of 9°C to a mean minimum of minus 2.5°C, with a mean daily temperature of 3°C. Extreme temperatures range from a maximum of 30°C in August to a minimum of minus 42°C in January. The average annual number of days with frost is 280.

The mean total precipitation in the region is approximately 500 mm, which includes the rainfall equivalent of a mean snowfall of 119 cm. The average annual number of days with measurable precipitation is 133 (Environment Canada).

# 6 HISTORY

The first geological investigations of the region were undertaken by the Geological Survey of Canada. The coal deposits of the Foothills region surrounding the Athabasca River were first examined in 1910 and 1911 by D.B. Dowling (Dowling, 1914). In 1914, the Blue Diamond Coal Company commenced commercial underground production on deposits immediately north of Brule Lake, in what is now the Grande Cache member of the Gates Formation. A total of 1,677,500, tonnes were reportedly produced from 2 seams. The underground mines at Brule closed permanently in 1928, the closure attributed to complex structural conditions and faulting which affected production costs. The company also drove exploration tunnels on seams near Rock Lake along the Wildhay River in 1928/29. The Solomon Creek Coal Company produced about 700 tonnes from Sec 31-50-27W5 between 1919 and 1924 (ERCB ST-25, 2010). Several other mines were developed in the area, including Mt. Cavell Collieries Ltd. at Pocahontas, and those at the town of Coalspur which operated until the 1950's.

In 1916, the region northwest of Brule, including the Palisades area, was studied by J.M. MacVicar (MacVicar, 1919). In 1927, B.R. McKay made a detailed study of the Brule mining operations and coal deposits extending north to Solomon Creek (McKay, 1928). The purpose was to record in detail the stratigraphy and structure of coal seams at the active mine and assist in extending these deposits northwest towards the area of the Palisades Coal Property.

Between 1943 and 1945, A.H. Lang mapped the Brule and Entrance areas for the Geological Survey of Canada. His work concentrated on establishing nomenclature for the central and northern Foothills, and correlating this stratigraphy with that of the southern Foothills. The original stratigraphic work was done by MacKay (1929a and b; 1930), who established the original formational names for the Lower Cretaceous in the Athabasca Region. Later work was done by Lang (1947), Irish (1965), Thorsteinsson (1952) and J.R. McLean (1982). The stratigraphic nomenclature used in this report is that established by Langenberg and McMechan (1985) of the Alberta Geologic Survey and is based on detailed geological mapping of the region.

The increasing demand for coking coal in the 1960's led to renewed exploration in the Alberta foothills with focus on the Lower Cretaceous Luscar Group. This led to the opening of the Smoky River Mines at Grande Cache, the Cardinal River Mine southeast of Hinton in the early 1970's, and the Gregg River Mine adjacent to Cardinal River in 1983.

Prior to the acquisition of the Palisades coal leases by Altitude Resources, the only significant exploration in the immediate area was undertaken by Rio Tinto Canadian Exploration Ltd. ("Rio") which acquired the property in 1969 and Denison Mines Ltd. ("Denison") which subsequently acquired the property in 1974. Rio conducted basic mapping and trenching, and completed five rotary drillholes (Benkis, 1970). Denison undertook a small reconnaissance and trenching program shortly after the original leases were acquired in 1974. Then between 1982 and 1983, Denison conducted an extensive exploration program including helicopter-supported drilling (Denison, 1984).

The local geological mapping undertaken first by Rio and later expanded by Denison, provided good insight into the predictability of these coal seams within a fold and thrust belt environment. Trenching and drilling results reported by both Rio and Denison identified fold-related coal seam thickening when the seams were intersected within anticline or syncline closures. Both studies carried out laboratory analysis of the coal indicating a low volatile coking coal. During 1969, Rio spent a single season evaluating the continuity of these seams and at the time deemed them uneconomic, primarily due the inability to consistently trace them.

Altitude Resources acquired the coal leases in 2010 and 2011. In 2012, Altitude carried out a small reconnaissance program that involved mapping and trenching of known outcropping seams. In 2013, Altitude Resources conducted an extensive exploration program that included local geological mapping at 1:10,000 scale, trenching, and reverse circulation and core drilling. The mapping resulted in several significant changes to the original geological interpretation by Rio (Benkis, 1970) and Denison (1984). In the central and south Palisades, areas mapped as Grande Cache and Mountain Park Members of the Gates Formation were confirmed to be the Shaftsbury Formation. The overturned anticline crossed by the central drill access road appears to translate laterally into a thrust fault, truncating Grande Cache sediments against the younger Shaftsbury Formation. The Coal Hill Syncline and Coal Hill Anticline are dissected by several splays from the Collie Creek Thrust which increase the thickness of Grande Cache Member and cause numerous seam repeats.

## 6.1 PRIOR OWNERSHIP

In January of 1969, the Alberta Government announced that Coal Reservations to certain areas to the northwest of the town of Hinton would be sold by a public tender. These lands adjoined, and included, part of the Wilmore Wilderness area. Prior to this sale no coal exploration had been permitted in this area. Rio Tinto Canadian Exploration Ltd. entered bids on two blocks of ground in the designated area. On February 12, 1969, the Alberta Department of Mines and Minerals accepted Rio's tender to certain portions of the lands grouped into three separate blocks, known as the Moon Creek, Rock Lake and Hoff Range properties. The rights to explore for coal on these lands were granted for a period of twelve months. The Moon Creek block comprised part of what is now the Moberly Property. The Rock Lake block along the Moosehorn Range, is now covered by parts of the Rock Lake – Solomon Creek Wildland and Wilmore Wilderness Parks. The Hoff Range block had similar boundaries to the Palisades Property coal leases and comprised 9,324 ha. Rio did not explore after 1970 on the Hoff Range block (Benkis, 1970).

In October 1974 Denison Mines Ltd. acquired a total of 12 coal leases, 8 of which comprised the Hoff Range block, and 4 of which comprised the Moosehorn block. In 1978, 4 coal leases were added to the Hoff block. The 12 coal leases of the Hoff block totalled 7,429.5 ha and were all within land use Coal Development Policy Category 4 (1976 Alberta Coal Policy). These leases covered a similar area to the current Palisades Property. The Moosehorn block (3,303 ha) was approximately like Rio's Rock Lake block and was all within the 1976 Alberta Coal Development Policy Category 1 and 2 lands (Denison, 1984).

No additional work was carried out after 1983. Denison Mines focused their efforts on mine development in northeastern BC, and subsequently withdrew from the coal business with the sale of their Quintette Mine to Teck in 1991. The Palisades coal leases lapsed and reverted to the Alberta Government.

## 6.2 PREVIOUS EXPLORATION AND DEVELOPMENT

Exploration on the Property was conducted by Rio in 1969, by Denison in 1982 and 1983, and by Altitude in 2012, 2013 and 2015. These programs are summarized in Table 6-1 and Figure 6-1 and Figure 6-2.

Data compiled from the Rio Tinto and Denison reports displayed some uncertainties in the drillhole dataset. Historic drillhole locations were extracted from original exploration reports, geological logs, and geophysical logs when available. Local grid locations were converted to a UTM NAD 83 Zone 12N projection format and confirmed against exploration maps. If collar locations were not provided, approximate locations were georeferenced from exploration maps and validated against cross-sections and topography. Rotary and core hole collar information was generally well constrained for X-Y co-ordinates, but less reliable for Z co-ordinates. Down-hole directional information was limited to inclination and azimuth.

**Table 6-1. Historic Exploration Summary for the Palisades Property.**

| Operator | Campaign | Core Holes | Rotary Holes | Total Depth (m) | Trenches | Total Length | Mapping | Access Trails (km) |
|---|---|---|---|---|---|---|---|---|
| Rio Tinto | 1969 | - | 5 | 1160 | 11 | 4900 | 1:15,840 | 12.9 |
| Denison Mines | 1982 | 18 | - | 1782 | 9 | - | 1:10,000 | - |
| | 1983 | 5 | - | 1187 | 1 | - | 1:10,000 | - |
| Altitude Resources | 2012 | - | - | - | - | - | 1:10,000 | - |
| | 2013 | 3 | 27 | 4580 | 25 | 228.1 | 1:10,000 | 3.7 |
| | 2015 | 3 | 22 | 2797 | 24 | 390.8 | 1:5,000 | 3.6 |

## 6.2.1 RIO TINTO EXPLORATION

Rio Tinto conducted exploration on the Hoff Range block between May and November, 1969 (Benkis, 1970). The Hoff Range block covered approximately the same area as the Palisades Property. Initial prospecting and mapping was largely helicopter-supported, although some roads and cutlines, including the Rock Lake Road, Brule Lake-Rock Lake Road (part of Peppers Lake Road) and the major northwest-trending seismic line ("Spine Line") provided some four-wheel drive access. Access roads, trenches and drill pads were constructed using bulldozers in the Coal Hill area, and from the Brule Road southwest along the north side of the Solomon Creek valley (Figure 6-1 and Figure 6-2).

Rio's trenching was concentrated on Coal Hill, where several coal showings ("A" through "N") were found and exposed (Figure 6-1, Table 6-4). Trenches were also cut across strike along the central and southern roads, exposing two and three seams respectively. Mapping and trenching indicated repetition of coal seams in several thrust fault blocks interpreted as splays of the regional Collie Creek Thrust fault. Trench "M" on the north face of Coal Hill exposed a nearly flat-lying seam up to 5.3 m thick bounded by thrust faults. This thickening was interpreted as evidence of an anticlinal hinge.

Five vertical rotary drill holes (Table 6-2) were drilled on Coal Hill to test seam continuity from trenching. All holes were chip-logged and sampled. In HR-3 and HR-4, two intervals were cored at depth in each hole to clarify bedding attitude (Benkis, 1970). HR-1 was collared in the Mountain Park Formation at the top of Coal Hill and drilled to 435 m for stratigraphic control. It had been intended to reach the Cadomin conglomerate, yielding a complete section of the Gates Formation. The depth capacity of the drill was exceeded before the Cadomin was encountered, indicating substantial structural thickening of the Gates Formation.

**Table 6-2. Rio Tinto Drillholes – Coal Hill Area, Palisades Property.**

| Year | Drillhole | Easting | Northing | Elevation (m) | Azimuth (°) | Inclination (°) | Depth (m) |
|---|---|---|---|---|---|---|---|
| 1969 | **HR-1** | 428627 | 5927365 | 1662. | Vertical | -90 | 434.34 |
| 1969 | **HR-2** | 428292 | 5927585 | 1650 | Vertical | -90 | 213.36 |
| 1969 | **HR-3** | 428344 | 5927678 | 1619 | Vertical | -90 | 185.93 |
| 1969 | **HR-4** | 428398 | 5927711 | 1602 | Vertical | -90 | 235.00 |
| 1969 | **HR-5** | 428322 | 5927782 | 1588 | Vertical | -90 | 91.44 |

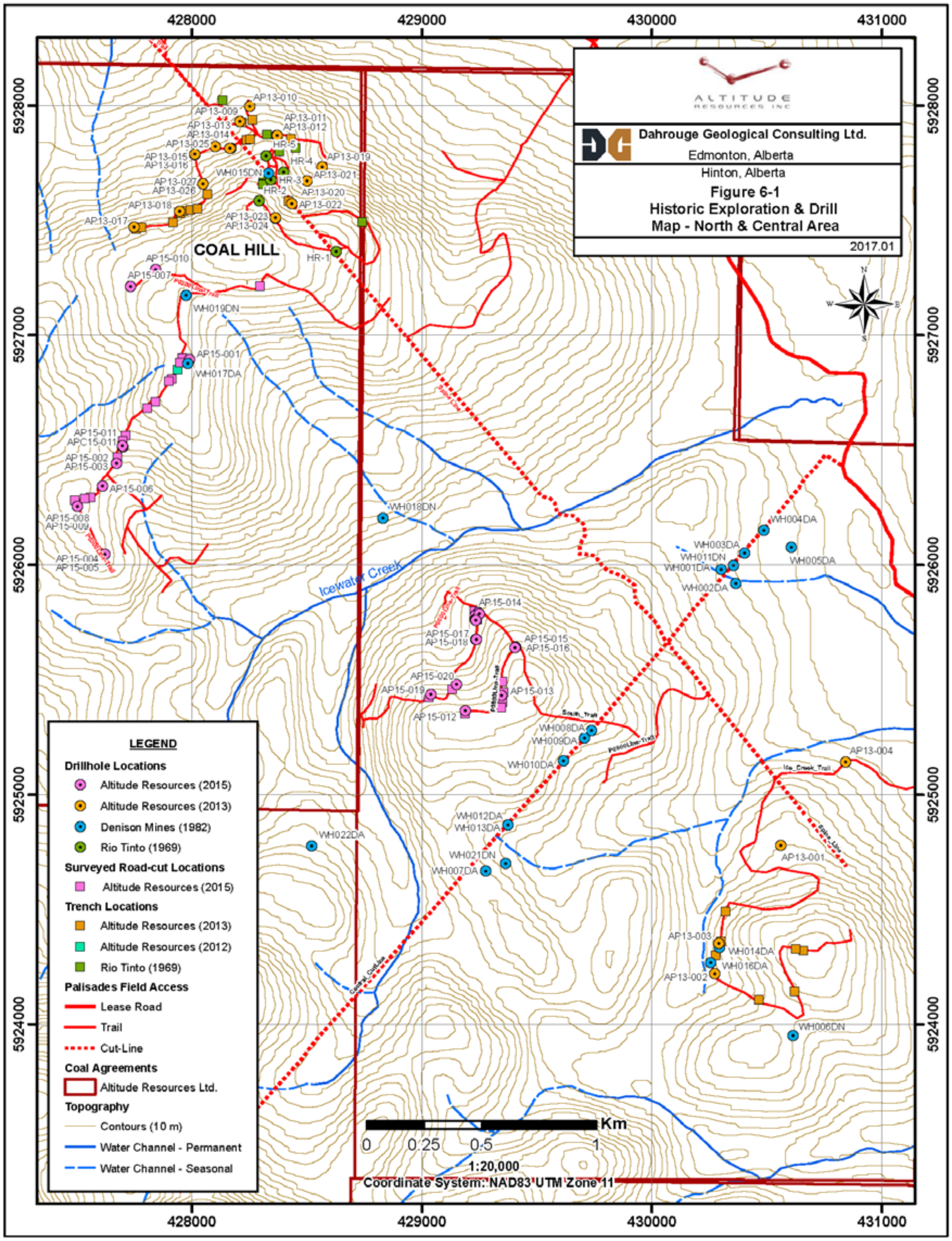


**Figure 6-1.** **North Area (Coal Hill) - Historic Exploration and Drilling**

Three major seams were identified in the Palisades area. Rio noted more seams in the Coal Hill area and interpreted thrust fault repetition of the Grande Cache member of the Gates Formation on splays of the Collie Creek Thrust. Rio did not attempt to assign seam identification at this stage of early exploration. As coal exposed in trenching was oxidized, cuttings from drillholes HR-1 to HR-4 were sent for proximate analysis to Cyclone Engineering Sales Ltd. of Edmonton, AB (Table 6-3). Samples were mainly low-volatile bituminous coal with variable F.S.I. due in part to contamination, wet seams and near-surface oxidation.

Historic drillhole intersection results were compiled using available geological logs, geophysical logs, and reported coal intersection summary logs. Historic coal intersections were reconciled to geophysical logs where available.

**Table 6-3. Proximate Analysis for Rio Tinto Historic 1969 Intersections (Benkis, 1970).**

| Drillhole | Interval | Width | Ash % | Volatile Matter % | Residual Moisture % | Fixed Carbon % | F.S.I. |
|---|---|---|---|---|---|---|---|
| **HR-1** | 425’-430’ | 5.0’ | 51.52 | 13.69 | 0.63 | 34.16 | 2, 2, 2½ |
| **HR-1** | 435’-441’ | 5.0’ | 20.04 | 17.67 | 0.57 | 61.72 | 5, 5½, 5½ |
| **HR-2** | 148'-151' | 3.0’ | 31.95 | 15.75 | 0.63 | 51.67 | 6, 5½, 5½ |
| **HR-2** | 556’-562.5’ | 6.5’ | 57.57 | 11.81 | 0.86 | 29.66 | 1, 1, 1 |
| **HR-3** | 18'-20' | 2.0’ | 50.66 | 13.74 | 1.15 | 35 .45 | N.A. |
| **HR-3** | 20 '-25' | 5.0’ | 22.49 | 17.16 | 0.72 | 59.63 | 1, 1, 1 |
| **HR-3** | 25'-30 ' | 5.0’ | 5.80 | 18.27 | 0.69 | 75.24 | 3, 3½, 3½ |
| **HR-3** | 30'-36' | 6.0’ | 11.55 | 18.59 | 0.54 | 69.32 | 6½, 6½, 6½ |
| **HR-3** | 46.9'-52' | 5.1’ | 22.56 | 17.56 | 0.54 | 59.34 | 5½, 5½, 5½ |
| **HR-3** | 72.5’-78.2’ | 5.7’ | 12.55 | 19.48 | 0.53 | 57.44 | 9, 9, 9 |
| **HR-4** | 8.7’-11’ | 2.3’ | 35.83 | 31.51 | 3.96 | 28.70 | N.A. |
| **HR-4** | 11’-15’ | 4.0’ | 12.86 | 20.41 | 2.15 | 64.58 | N.A. |
| **HR-4** | 15’-17.5’ | 2.5’ | 12.52 | 1.02 | 1.02 | 73.85 | ½, ½, ½ |

**Table 6-4. Rio Tinto and Denison Surface Coal Intersections from Trenches.**

| Name | Easting | Northing | Elevation (m) | Length (m) | Seam | Company | Year | Area |
|---|---|---|---|---|---|---|---|---|
| **TR-RIO-B** | 428134 | 5928024 | 1531 | 86.0 | Solomon | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-D** | 428452 | 5927816 | 1577 | 30.1 | Solomon | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-E** | 428380 | 5927802 | 1589 | 7.0 | Hoff | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-F** | 428741 | 5927493 | 1617 | 17.5 | Hoff | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-M** | 428311 | 5927699 | 1613 | 45.3 | Solomon | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-N** | 428307 | 5927659 | 1627 | 9.1 | Hoff | Rio Tinto | 1969 | Coal Hill |
| **TR-RIO-C** | 428327 | 5927875 | 1569 | 11.3 | Stray | Rio Tinto | 1969 | Coal Hill |
| **WT-02** | 427936 | 5926851 | 1700 | 2.0 | Moosehorn | Denison | 1984 | Coal Hill |
| **WT-03** | 427945 | 5926873 | 1697 | 1.5 | Solomon | Denison | 1984 | Coal Hill |
| **WT-04** | 427958 | 5926909 | 1702 | 2.5 | Solomon | Denison | 1984 | Coal Hill |

### 6.2.2 DENISON EXPLORATION

In 1974, Denison carried out a small reconnaissance and trenching program. A detailed assessment of the Palisades Coal lease area over a 24-month period was undertaken beginning in early 1982 (Denison, 1984) which included:

- Geologic mapping and air photo interpretation on a 1:10,000 scale
- Trenching and mapping ten coal subcrop locations
- Geophysics: ground magnetometer and ground resistivity profiles

- Diamond drilling: 23 helicopter supported core drilling sites.

The mapping and air photo interpretation identified the major formation boundaries and large scale structural configuration of the Palisades area. Significant differences from the Rio mapping were noted in some areas, but the scarcity of good exposures required some generalization of interpretation. Trenching by Denison included re-opening of some Rio trenches as well as new excavation. Nine resistivity test lines totalling 8,050 m were run both along and across structural grain. A single magnetic survey was run to map concealed lithology along resistivity line 3 (2,500 m) across the entire central part of the property. No contrast in magnetic response was noted. The resistivity test line over two exposed seams demonstrated a response and depth of penetration of about 7 to 10 m. An adjacent line about 100 m northwest yielded a similar, more muted response. The rest of the resistivity lines were not successful in identifying subsurface traces of the coal seams.

The helicopter-supported diamond drilling program included 18 holes drilled in 1982, many of which were shallow holes, and five holes drilled in 1983 (Table 6-5). Only 10 of the 23 holes intersected coal seams and samples from these were analyzed at General Testing Laboratories in Vancouver, BC to determine coal rank, quality, washability and rheological data.

**Table 6-5. Drillholes – Palisades Property**

| Year | Drillhole | Easting | Northing | Elevation (m) | Azimuth (°) | Inclination (°) | Depth (m) |
|---|---|---|---|---|---|---|---|
| 1982 | **WH001DA** | 430366 | 5925918 | 1420 | Vertical | -90 | 9.10 |
| 1982 | **WH002DA** | 430356 | 5925998 | 1427 | Vertical | -90 | 30.80 |
| 1982 | **WH003DA** | 430403 | 5926053 | 1430 | Vertical | -90 | 30.50 |
| 1982 | **WH004DA** | 430485 | 5926150 | 1406 | Vertical | -90 | 30.63 |
| 1982 | **WH005DA** | 430606 | 5926078 | 1397 | Vertical | -90 | 31.09 |
| 1982 | **WH006DN** | 430615 | 5923950 | 1544 | 041 | -60 | 355.70 |
| 1982 | **WH007DA** | 429278 | 5924667 | 1561 | Vertical | -90 | 30.48 |
| 1982 | **WH008DA** | 429737 | 5925281 | 1596 | Vertical | -90 | 27.43 |
| 1982 | **WH009DA** | 429707 | 5925246 | 1590 | Vertical | -90 | 15.24 |
| 1982 | **WH010DA** | 429615 | 5925147 | 1553 | Vertical | -90 | 30.17 |
| 1982 | **WH011DN** | 430301 | 5925980 | 1426 | 040 | -70 | 359.05 |
| 1982 | **WH012DA** | 429373 | 5924868 | 1563 | Vertical | -90 | 27.58 |
| 1982 | **WH013DA** | 429374 | 5924869 | 1564 | 040 | -60 | 29.41 |
| 1982 | **WH014DA** | 430293 | 5924334 | 1485 | Vertical | -90 | 28.50 |
| 1982 | **WH015DN** | 428331 | 5927705 | 1611 | Vertical | -90 | 303.00 |
| 1982 | **WH016DA** | 430255 | 5924270 | 1478 | Vertical | -90 | 24.23 |
| 1982 | **WH017DA** | 427983 | 5926878 | 1699 | 220 | -60 | 23.77 |
| 1982 | **WH018DN** | 428829 | 5926205 | 1480 | 220 | -70 | 398.35 |
| 1983 | **WH019DN** | 427974 | 5927175 | 1671 | Vertical | -90 | 271.95 |
| 1983 | **WH020DN** | 431520 | 5921750 | 1615 | Vertical | -90 | 298.78 |
| 1983 | **WH021DN** | 429362 | 5924700 | 1535 | Vertical | -90 | 296.03 |
| 1983 | **WH022DA** | 428521 | 5924775 | 1554 | Vertical | -90 | 138.11 |
| 1983 | **WH023DN** | 425750 | 5926242 | 1382 | Vertical | -90 | 182.01 |

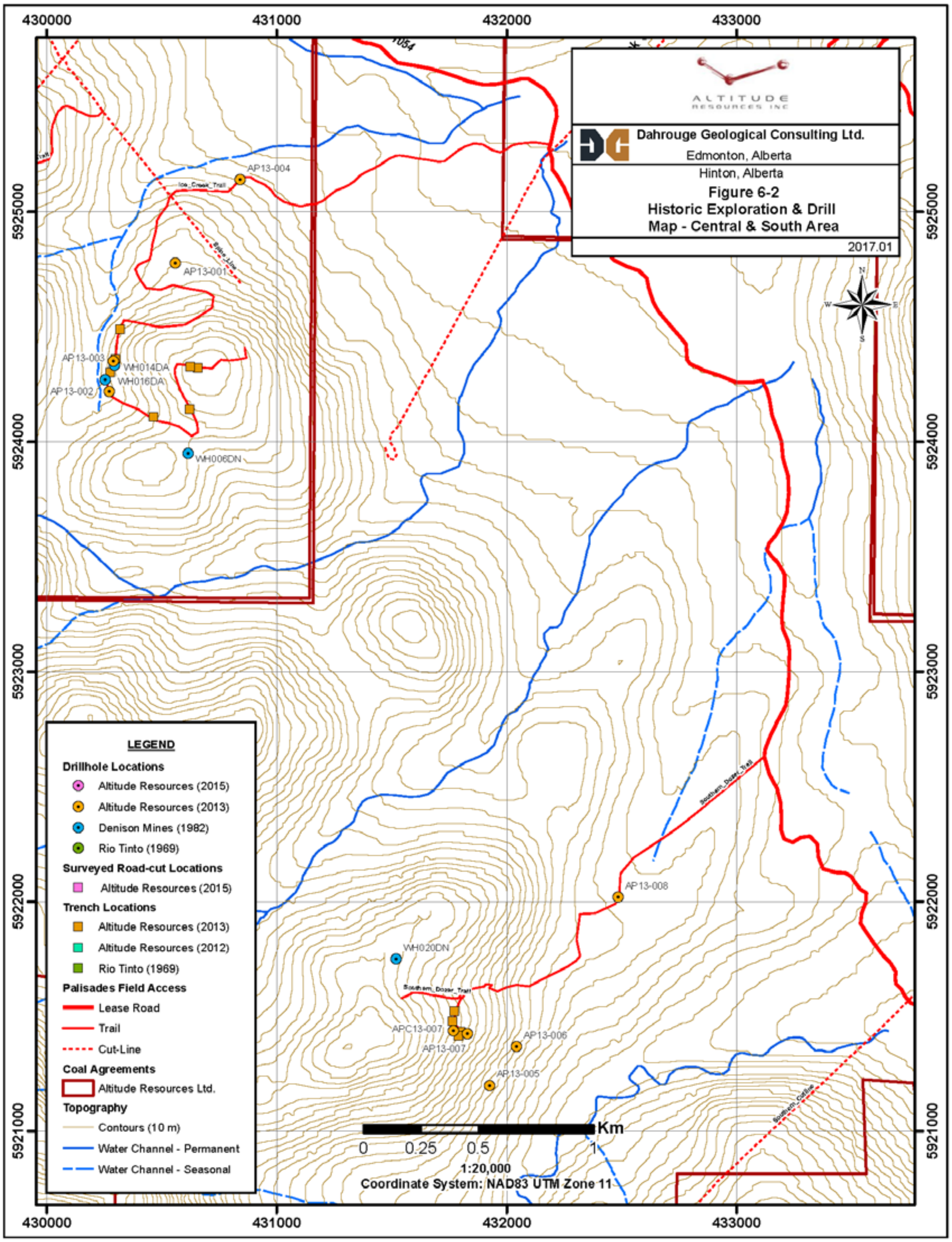


**Figure 6-2. Central and South Area - Historic Exploration and Drilling**

Denison identified three distinct coal seam horizons: Solomon, Hoff and Moosehorn (from lowest to highest in section). A resource estimate was made for the Hoff lease block using a cross-sectional method and an estimated specific gravity from laboratory determinations. Denison estimated that the total in-place coal to 500 m depth for the three coal seams on the property was 139,216,000 tonnes. This resource estimate must be regarded as historical.

Denison found that coal from the three seams was at the boundary of ASTM rank classification for low- and medium-volatile bituminous coal. Mean reflectance values ($R_o$) varied from 1.39% to 1.51%. Sulphur ranged from 0.40 to 0.65%. FSI values ranged from 6.5 to 9. Hardgrove grindability index exceeded 100. All seams exhibited good swelling properties. One sample from the Solomon Seam yielded a fluidity parameter of 111 ddpm and a dilation parameter of 48%. Other samples had poor dilation (Denison, 1984).

### 6.2.3 ALTITUDE RESOURCES EXPLORATION

In the fall of 2012, Altitude conducted a small reconnaissance program that included mapping of exposed coal seams, exposing and sampling of some historic trenches, and ground-truthing of historic work by Denison. The information from this program was used to plan the 2013 exploration program.

In 2013, Altitude carried out mapping, trenching, access rehabilitation and construction, and drilling on the Palisades property. Initially, a small property-wide mapping program was conducted. The mapping results, along with trenches were used to target drillhole locations and orientations. A total of 25 trenches intersecting coal, were excavated in 2013 (Table 6-6; Figure 6-1, Figure 6-2 and Figure 6-3). Some of the exposed seams were marked, measured and surveyed by a differential GPS to control surface expression for modelling. Selected trenches with clean coal intersections were sampled at 1.0 m maximum true thickness intervals and sent to Birtley Laboratories in Calgary for proximate analysis.

**Table 6-6. 2013 Trench Summary**

| Trench | Easting | Northing | Elevation (m) | Length (m) | Seam | Company | Year | Area |
|---|---|---|---|---|---|---|---|---|
| **TR-AP13-001** | 430658 | 5924322 | 1589 | 12.1 | Carb. Shale | Altitude | 2013 | Central |
| **TR-AP13-002** | 430625 | 5924328 | 1590 | 6.7 | Carb. Shale | Altitude | 2013 | Central |
| **TR-AP13-003** | 430621 | 5924142 | 1572 | 5.0 | Stray | Altitude | 2013 | Central |
| **TR-AP13-004** | 430465 | 5924109 | 1511 | 7.9 | Stray | Altitude | 2013 | Central |
| **TR-AP13-005** | 430277 | 5924301 | 1479 | 14.6 | Moosehorn | Altitude | 2013 | Central |
| **TR-AP13-006** | 430300 | 5924360 | 1479 | 11.9 | Hoff | Altitude | 2013 | Central |
| **TR-AP13-007** | 430319 | 5924492 | 1475 | 29.4 | Solomon | Altitude | 2013 | Central |
| **TR-AP13-008** | 431766 | 5921480 | 1553 | 19.2 | Solomon | Altitude | 2013 | South |
| **TR-AP13-009** | 431773 | 5921523 | 1548 | 11.4 | Solomon | Altitude | 2013 | South |
| **TR-AP13-010** | 427758 | 5927463 | 1613 | 11.1 | Moosehorn | Altitude | 2013 | Coal Hill |
| **TR-AP13-011** | 427781 | 5927471 | 1604 | 7.6 | Stray | Altitude | 2013 | Coal Hill |
| **TR-AP13-012** | 427918 | 5927492 | 1588 | 13.4 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-013** | 427950 | 5927531 | 1593 | 4.9 | Stray | Altitude | 2013 | Coal Hill |
| **TR-AP13-014** | 427962 | 5927543 | 1589 | 3.7 | Hoff | Altitude | 2013 | Coal Hill |
| **TR-AP13-015** | 427994 | 5927547 | 1584 | 3.3 | Stray | Altitude | 2013 | Coal Hill |
| **TR-AP13-016** | 428022 | 5927551 | 1582 | 12.5 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-017** | 428067 | 5927616 | 1573 | 4.9 | Hoff | Altitude | 2013 | Coal Hill |
| **TR-AP13-018** | 428238 | 5927853 | 1542 | 3.1 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-019** | 428252 | 5927855 | 1546 | 5.1 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-020** | 428263 | 5927937 | 1555 | 5.1 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-021** | 428218 | 5927929 | 1536 | 2.6 | Moosehorn | Altitude | 2013 | Coal Hill |
| **TR-AP13-022** | 428429 | 5927857 | 1583 | 6.4 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-023** | 428419 | 5927585 | 1609 | 6.7 | Solomon | Altitude | 2013 | Coal Hill |
| **TR-AP13-024** | 431799 | 5921433 | 1564 | 8.5 | Solomon | Altitude | 2013 | South |
| **TR-AP13-025** | 431790 | 5921417 | 1563 | 11.0 | Solomon | Altitude | 2013 | South |

A total of 27 rotary drillholes and 3 sonic core holes, were drilled during the 2013 exploration program (Table 6-7; Figure 6-1, Figure 6-2 and Figure 6-3). The RC drilling chips were collected and logged lithologically. Coal intersections greater than 0.5 m were sampled in cloth bags at 0.5 or 1.0 m intervals, and composited in the field. Composites were sent to Loring Laboratories of Calgary, AB for proximate analysis.

The sonic core holes were drilled to intersect coal as close to true thickness as possible. Expected coal intervals were drilled dry to reduce potential washout. Core was extruded into plastic liners and placed in wooden boxes. Lithologies were logged and photographed, and coal and coaly shale partings and transitional beds were sampled in their entirety, and placed in sealed plastic bags. Some coal intervals were dry, and others wet due to formational water. Partial washout of a seam in both APC13-007 and APC13-016 was suspected. Thrusting and adjacent drag folding displaced and removed part of the Solomon Seam in APC13-016, which was intersected in AP13-016.

Drill collars and access were surveyed by Foothills Surveys Ltd. of Hinton, AB using a differential GPS. Down-hole deviation surveys and borehole geophysics (density, guard resistivity and single-arm caliper) were conducted by DGI Geoscience Inc. of Toronto, ON, on all rotary holes. Several holes had either partial or no open-hole logs due to blockage or collapse. Seven-inch casing was set and removed following downhole logging. Each hole was cemented and collars were marked with treated 4x4" posts set into the concrete and marked with metal tags. Sonic core holes were surveyed by chain and compass from adjacent rotary pilot holes.

**Table 6-7. 2013 Drillhole Summary**

| Drillhole | Easting | Northing | Elevation (m) | Depth (m) | Azimuth | Inclination | Area | Type |
|---|---|---|---|---|---|---|---|---|
| **AP13-001** | 430560 | 5924778 | 1499.9 | 175 | 50 | -60 | Central | Rev. Circ. |
| **AP13-002** | 430272 | 5924221 | 1477.7 | 180.9 | 50 | -60 | Central | Rev. Circ. |
| **AP13-003** | 430291 | 5924353 | 1477.52 | 202.2 | 50 | -60 | Central | Rev. Circ. |
| **AP13-004** | 430842 | 5925141 | 1410.21 | 211.8 | 230 | -60 | Central | Rev. Circ. |
| **AP13-005** | 431925 | 5921199 | 1481.7 | 212 | 50 | -60 | South | Rev. Circ. |
| **AP13-006** | 432043 | 5921370 | 1501.87 | 185 | 50 | -60 | South | Rev. Circ. |
| **AP13-007** | 431828 | 5921425 | 1563.33 | 105 | 24 | -60 | South | Rev. Circ. |
| **AP13-008** | 432484 | 5922020 | 1433.26 | 157.5 | Vertical | -90 | South | Rev. Circ. |
| **AP13-009** | 428207 | 5927932 | 1533.54 | 230.7 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-010** | 428251 | 5927999 | 1563.14 | 212.4 | 50 | -55 | Coal Hill | Rev. Circ. |
| **AP13-011** | 428366 | 5927870 | 1574.9 | 185 | 50 | -60 | Coal Hill | Rev. Circ. |
| **AP13-012** | 428371 | 5927871 | 1574.93 | 160.5 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-013** | 428170 | 5927816 | 1534.7 | 166.5 | 50 | -60 | Coal Hill | Rev. Circ. |
| **AP13-014** | 428166 | 5927814 | 1534.66 | 218.5 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-015** | 428011 | 5927787 | 1550.14 | 233.8 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-016** | 428012 | 5927788 | 1550.3 | 178.6 | 50 | -60 | Coal Hill | Rev. Circ. |
| **AP13-017** | 427747 | 5927472 | 1609.61 | 153.5 | 50 | -60 | Coal Hill | Rev. Circ. |
| **AP13-018** | 427945 | 5927539 | 1588.63 | 120.9 | 40 | -60 | Coal Hill | Rev. Circ. |
| **AP13-019** | 428567 | 5927733 | 1531.1 | 102.6 | 50 | -70 | Coal Hill | Rev. Circ. |
| **AP13-020** | 428501 | 5927674 | 1556.35 | 96.5 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-021** | 428498 | 5927673 | 1556.35 | 111.75 | 240 | -70 | Coal Hill | Rev. Circ. |
| **AP13-022** | 428433 | 5927574 | 1598.04 | 160.5 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-023** | 428361 | 5927511 | 1663.33 | 163.8 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-024** | 428362 | 5927512 | 1663.39 | 148.5 | 50 | -60 | Coal Hill | Rev. Circ. |
| **AP13-025** | 428101 | 5927823 | 1530.29 | 151.4 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-026** | 428046 | 5927660 | 1564.3 | 148.3 | Vertical | -90 | Coal Hill | Rev. Circ. |
| **AP13-027** | 428046 | 5927660 | 1564.3 | 93.5 | 50 | -70 | Coal Hill | Rev. Circ. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **APC13-007** | 431767 | 5921438 | 1562 | 33.54 | Vertical | -90 | Coal Hill | Sonic Core |
| **APC13-016** | 428012 | 5927788 | 1550.3 | 50.31 | 50 | -60 | Coal Hill | Sonic Core |
| **APC13-020** | 428501 | 5927674 | 1556.35 | 32.01 | 50 | -50 | Coal Hill | Sonic Core |

In 2015, under the terms of its option agreement, Altitude carried out a further program of mapping, access rehabilitation and construction, and drilling on the Palisades Property. Field work consisted of three weeks of geological mapping at 1:10,000 scale in areas of natural exposure, and along constructed trails, to locate seams and refine drill targets. Exposures of coal in road cuts were measured and surveyed (Table 6-8; Figure 6-1; Figure 6-2). These intersections were incorporated in geological interpretation and modeling.

**Table 6-8. 2015 Surveyed Road Cut Summary.**

| Road Cut | Easting | Northing | Elevation (m) | Length (m) | Azimuth | Dip | Seam | Seam Interval (m) | Area |
|---|---|---|---|---|---|---|---|---|---|
| **TRAP15-001** | 427958 | 5926903 | 1688 | 8.24 | 13 | -11 | Moosehorn | 2.00 | P0300-LINE |
| **TRAP15-002** | 427958 | 5926903 | 1688 | 7.92 | 13 | -4 | Moosehorn | 4.52 | P0300-LINE |
| **TRAP15-003** | 427948 | 5926882 | 1686 | 11.00 | 210 | -23 | Hoff 1-2 | 3.84 | P0300-LINE |
| **TRAP15-004** | 427913 | 5926812 | 1670 | 27.00 | 14 | -4 | Solomon 1 | 1.66 | P0300-LINE |
| **TRAP15-005** | 427899 | 5926800 | 1666 | 69.00 | 208 | -10 | Solomon 2 | 3.00 | P0300-LINE |
| **TRAP15-006** | 427842 | 5926711 | 1651 | 4.90 | 230 | -37 | | - | P0300-LINE |
| **TRAP15-007** | 427806 | 5926682 | 1644 | 17.60 | 220 | -20 | | - | P0300-LINE |
| **TRAP15-008** | 427712 | 5926564 | 1624 | 14.48 | 220 | -11 | | - | P0300-LINE |
| **TRAP15-009** | 427700 | 5926541 | 1618 | 5.20 | 40 | -30 | Solomon | 2.00 | P0300-LINE |
| **TRAP15-010** | 427675 | 5926470 | 1604 | 10.70 | 40 | -5 | Hoff | 0.60 | P0300-LINE |
| **TRAP15-011** | 427560 | 5926294 | 1600 | 33.40 | 40 | -25 | Solomon | 3.30 | P0300-LINE |
| **TRAP15-012** | 427534 | 5926290 | 1605 | 15.67 | 80 | -28 | Hoff 1-2 | 1.17 | P0300-LINE |
| **TRAP15-013** | 427489 | 5926282 | 1619 | 18.80 | 80 | -15 | | - | P0300-LINE |
| **TRAP15-014** | 429351 | 5925491 | 1585 | 9.88 | 194 | -23 | Moosehorn | 1.49 | P0800-LINE |
| **TRAP15-015** | 429355 | 5925446 | 1586 | 22.94 | 190 | -12 | Hoff | 3.80 | P0800-LINE |
| **TRAP15-016** | 429350 | 5925404 | 1586 | 5.88 | 218 | -11 | Stray | 1.60 | P0800-LINE |
| **TRAP15-017** | 429343 | 5925379 | 1590 | 8.20 | 235 | -10 | Stray | 1.00 | P0800-LINE |
| **TRAP15-018** | 429343 | 5925379 | 1590 | 21.19 | 1 | -18 | Solomon | 0.60 | P0800-LINE |
| **TRAP15-019** | 429186 | 5925352 | 1619 | 31.00 | 56 | -9 | | - | P0800-LINE |
| **TRAP15-020** | 429131 | 5925457 | 1568 | 8.43 | 35 | -20 | Solomon 1-2 | 1.97 | P0700-LINE |
| **TRAP15-021** | 429031 | 5925423 | 1576 | 7.73 | 65 | -22 | Stray | 0.20 | P0700-LINE |
| **TRAP15-022** | 429242 | 5925765 | 1541 | 17.60 | 340 | -20 | Moosehorn | 9.10 | P0700-LINE |
| **TRAP15-023** | 429227 | 5925800 | 1538 | 6.40 | 330 | -15 | Moosehorn | 2.40 | P0700-LINE |
| **TRAP15-024** | 428295 | 5927214 | 1699 | 7.62 | 40 | -15 | Stray | 0.40 | West-Trail |

Conventional air hammer drilling of 22 holes totalling 2,735 m, and diamond core drilling of 3 holes totalling 62 m were completed during the 2015 program (Table 6-9, Figure 6-1, and Figure 6-2). Drill collars and access were surveyed using a Differential GPS unit, and down-hole deviation surveys and borehole geophysics were conducted on all rotary holes by Century Wireline Services, Red Deer Alberta.

The core and chip samples collected in 2013 and 2015, confirmed the coal rank as low- to medium-volatile bituminous coking coal (Ro 1.33 to 1.53). The clean coal core samples showed an average FSI (Free Swelling Index) of 7, Fluidity values of 4 to 47 ddpm, and positive dilatation. Petrographic analysis showed a Reactive/Inert ratio of 70/30 and a predicted ASTM Stability of 61. Ash analysis showed low total alkaline content (10% average) which should contribute to a high CSR value. The phosphorous in coal was 0.014% which is extremely low and highly desirable. Details are presented in Engler et al. (2015).

**Table 6-9.** **2015 Palisades Drilling Summary**

| Drillhole | Easting | Northing | Elevation (m) | Depth (m) | Azimuth | Incl. (degrees) | Area | Type |
|---|---|---|---|---|---|---|---|---|
| **AP15-001** | 427989.37 | 5926895.40 | 1692.79 | 165.00 | 249 | -49 | North | Conventional |
| **AP15-002** | 427671.74 | 5926442.50 | 1600.75 | 230.00 | 34 | -73 | North | Conventional |
| **AP15-003** | 427672.92 | 5926443.87 | 1600.82 | 165.00 | 30 | -49 | North | Conventional |
| **AP15-004** | 427619.99 | 5926046.36 | 1612.76 | 158.50 | 35 | -85 | North | Conventional |
| **AP15-005** | 427620.97 | 5926047.48 | 1612.69 | 195.00 | 34 | -61 | North | Conventional |
| **AP15-006** | 427609.41 | 5926343.16 | 1590.36 | 141.00 | 33 | -50 | North | Conventional |
| **AP15-007** | 427731.55 | 5927212.60 | 1671.00 | 98.00 | 28 | -49 | North | Conventional |
| **AP15-008** | 427501.12 | 5926254.05 | 1620.94 | 134.00 | 34 | -78 | North | Conventional |
| **AP15-009** | 427502.31 | 5926255.46 | 1620.82 | 98.00 | 30 | -46 | North | Conventional |
| **AP15-010** | 427842.78 | 5927287.01 | 1650.97 | 62.00 | 34 | -49 | North | Conventional |
| **AP15-011** | 427698.43 | 5926516.55 | 1614.78 | 33.50 | Vertical | -90 | North | Conventional |
| **APC15-011** | 427698.91 | 5926514.24 | 1614.67 | 18.80 | Vertical | -90 | North | 6" Core |
| **APC15-011a** | 427697.89 | 5926518.73 | 1614.60 | 16.80 | Vertical | -90 | North | 6" Core |
| **AP15-012** | 429187.68 | 5925364.20 | 1615.11 | 116.00 | 35 | -55 | Central | Conventional |
| **AP15-013** | 429345.70 | 5925431.73 | 1581.21 | 98.00 | 214 | -59 | Central | Conventional |
| **AP15-014** | 429244.45 | 5925792.68 | 1544.98 | 104.20 | Vertical | -90 | Central | Conventional |
| **AP15-014a** | 429230.69 | 5925780.54 | 1541.00 | 43 | Vertical | -90 | Central | Conventional |
| **AP15-014b** | 429233.04 | 5925761.64 | 1543.00 | 24 | Vertical | -90 | Central | Conventional |
| **APC15-014** | 429248.69 | 5925788.78 | 1545.05 | 34.75 | Vertical | -90 | Central | 6" Core |
| **APC15-014a** | 429233.59 | 5925759.24 | 1543.00 | 10 | Vertical | -90 | Central | 6" Core |
| **AP15-015** | 429406.63 | 5925642.92 | 1608.27 | 110.00 | 8 | -88 | Central | Conventional |
| **AP15-016** | 429404.74 | 5925640.97 | 1608.37 | 208.00 | 237 | -51 | Central | Conventional |
| **AP15-017** | 429234.73 | 5925674.96 | 1532.96 | 147.00 | Vertical | -90 | Central | Conventional |
| **AP15-018** | 429236.39 | 5925676.99 | 1532.89 | 140.00 | 33 | -49 | Central | Conventional |
| **AP15-019** | 429151.60 | 5925480.14 | 1566.16 | 159.00 | 31 | -48 | Central | Conventional |
| **AP15-020** | 429038.83 | 5925436.42 | 1572.82 | 104.00 | 39 | -48 | Central | Conventional |

The in-place, surface-mineable resources for the Coal Hill/Central Palisades area and South Palisades area were estimated in 2015 using drill and trench data from the 2013, and 2015 Altitude Palisades exploration programs as well as historic drill and trench data. These results are summarized in Table 6-10. These results were divided into the Coal Hill area, where most of the drilling was done in 2013 (Figure 6-1), and the Central-South Palisades area where most of the drilling was done in 2015 (Figure 6-1 and Figure 6-2).

Exploration targets determined in 2015 for the Palisades Property are summarized in Table 6-11. Coal was classified as an exploration target if it was between 400 and 1,000 m from data point intersections. These targets were conceptual in nature, as seam thickness and quality were not constrained. Seam thickness was not adjusted to remove partings and no stripping ratio limit was used in defining the exploration targets. The same area designations were used for exploration targets as for resource estimation. These targets were in part conceptual and based on current geological understanding; hence only rounded tonnages were calculated. Coal is present in the Grande Cache Member on the limbs of other folds on the Property, but was not included in the exploration targets due to lack of information on seam thickness and continuity.

**Table 6-10. 2015 Palisades In-Place Surface-Mineable Coal Resources Summary.**

| Area | Seam | In-Place Coal Resources (TONNES) Stripping Ratio Cutoff 20:1 | | | |
|---|---|---|---|---|---|
| | | **ASTM Group** | **Measured** | **Indicated** | **Inferred** |
| Coal Hill/Central Palisades | Moosehorn | Mid-Volatile Bituminous | 931,258 | 300,561 | 682,506 |
| | Hoff | Low-Volatile Bituminous | 2,552,051 | 1,454,636 | 2,194,868 |
| | Solomon | Low-Volatile Bituminous | 5,218,759 | 4,423,095 | 4,034,818 |
| South Palisades | Moosehorn | Mid-Volatile Bituminous | 22,316 | 164,080 | 114,323 |
| | Hoff | Low-Volatile Bituminous | 68,550 | 157,506 | 188,911 |
| | Solomon | Low-Volatile Bituminous | 211,368 | 301,693 | 390,951 |
| **Total Property** | | | **9,004,301** | **6,801,571** | **7,606,377** |

(* partings removed, coal bet thickness > 0.6m, average 8 m oxidised zone removed)

**Table 6-11. 2015 Palisades In-Place Exploration Targets.**

| Area | Exploration Target* (TONNES) *rounded-down* |
|---|---|
| Coal Hill/Central Palisades | 46,000,000 |
| South Palisades | 3,000,000 |
| **Total Property** | **49,000,000** (range 47,000,000 to 51,000,000) |

*conceptual in-place coal with no stripping ratio cutoff; no depth of weathering

## 6.3 PRODUCTION

To the knowledge of the authors, no production has taken place on the Palisades Property.

# 7 GEOLOGICAL SETTING AND MINERALIZATION

## 7.1 REGIONAL GEOLOGY

The Palisades Coal Property is located on the eastern margin of the inner foothills of the Rocky Mountain thrust belt in west central Alberta. The rocks underlying the property occur within the predominantly continental Lower Cretaceous Luscar Group (Langenberg and McMechan, 1985) which is equivalent to the Blairmore Group in Sothern Alberta and Fort St. John Group in northeast B.C. (Figure 7-1). The Group is overlain by dark gray marine shales of the Shaftesbury Formation.

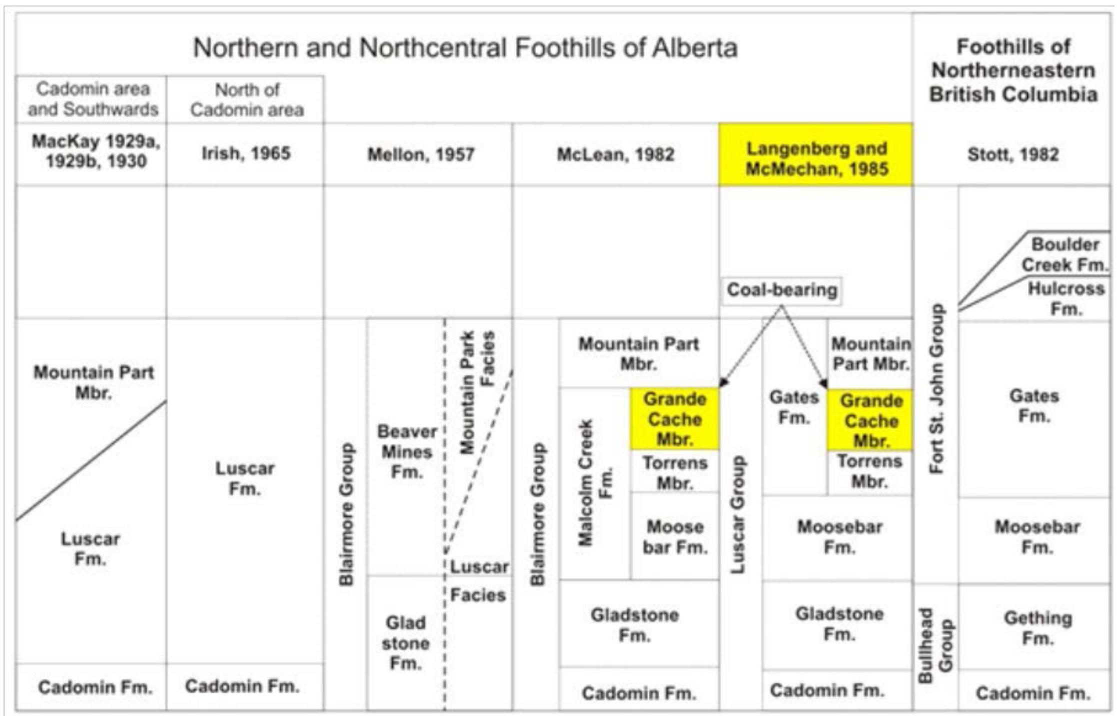


**Figure 7-1. Stratigraphic Correlation** (Modified from Langenberg et al, 1985).

Strata of the Luscar Group are divided into four Formations identified in ascending order as the Cadomin, Gladstone, Moosebar and Gates Formations. The Cadomin Formation consists of a very hard pebble conglomerate ranging from 5 to 10 m in thickness. It forms a resistant marker in the section but has only been identified in outcrop on the Property north of the Wildhay River. The Gladstone Formation consists of a fining upward sequence of fine-grained sandstone, shale and minor carbonaceous stringers. The lower part of the formation is interpreted to be braided stream deposits while the upper part appears to be of marine-estuarine origin. The formation ranges from 80 to 100 m in thickness on the Property. The Moosebar Formation consists predominantly of dark gray marine shales conformably overlying the Gladstone. The base of the formation is a distinctive glauconite-rich sandy or pebbly mudstone. The formation is 35 to 55 m thick, ranging to over 60 m in the Grande Cache area (Langenberg et al, 1987) and presents a distinct marker for mapping in the area.

The Gates Formation contains the coal-bearing sequence in the Luscar Group, and consists primarily of sandstones, siltstones and coal cyclothems. The base of the Gates Formation is characterized by a massive medium-grained sandstone unit known as the Torrens Member, which conformably overlies the marine shales of the Moosebar Formation. The Torrens Member ranges from 20 to 40 m in thickness. Overlying the Torrens Member is the coal-bearing unit referred to as the Grande Cache Member. This Member consists of fine sandstones, siltstones and mudstones, and continuous coal seams. The Grande Cache Member is 85 to 95 m thick on the property, and within it, three distinct coal seams have been identified. The Grande Cache Member is overlain by the Mountain Park Member which consists predominantly of thick-bedded, fine- to medium-grained sandstone sequences with distinct siderite grains. This Member ranges from 200 to 250 m in thickness, and forms prominent ridges on the property.

The three distinct coal seam horizons identified in the Grand Cache Member, are the Solomon, Hoff and Moosehorn Seams. The lowermost seam, the Solomon, is the most persistent and typically occurs directly above the Torrens Member sandstones. The Hoff Seam occurs approximately 45 to 60 m above the Solomon Seam and is consistently identified as two clean seams with a single parting throughout the Property. The uppermost Moosehorn Seam occurs approximately 25 m above the Hoff Seam, at or near, the top of the Grande Cache Member. The relative position of these coal seams is shown in Figure 7-2.

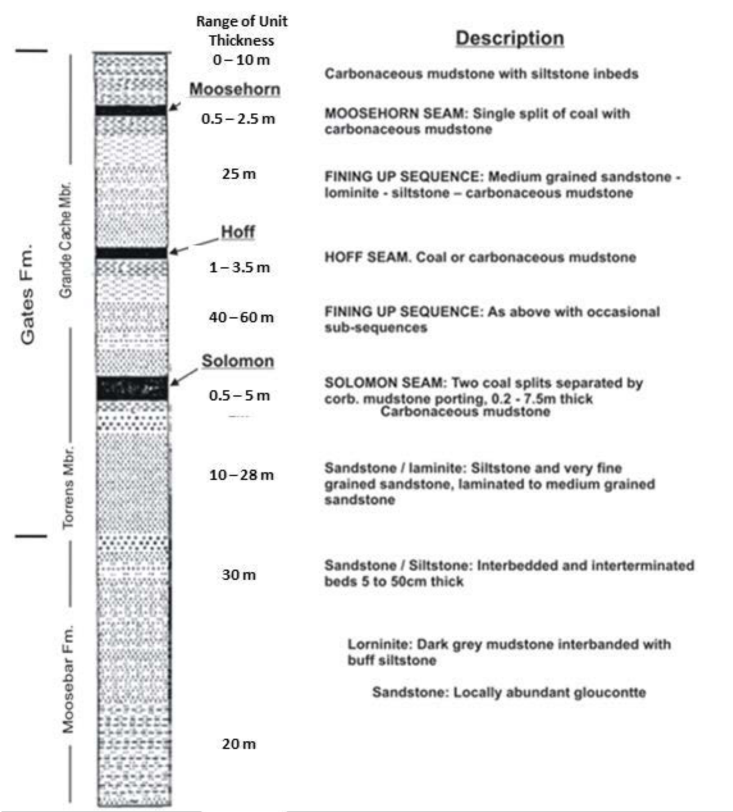


**Figure 7-2. Generalized Stratigraphic Column in Palisades Area** **(modified after Denison, 1984)**

Structural geology in the Foothills area of the Rocky Mountain Thrust Belt is characterized by west-dipping sub-parallel thrust faults of varying displacement, with generally northwest-southeast traces (Figure 7-3). These are accompanied by asymmetrical to overturned folds often with steep west to southwest-dipping axial planes which also trend northwest-southeast. Coal-bearing sediments of the Luscar Group are exposed in a northwest-trending belt bounded by over-thrust Paleozoic or Jurassic Fernie Group sediments to the southwest, and younger mid to upper Cretaceous marine sediments of the Shaftsbury, Dunvegan and Kaskapau Formations to the northeast (Langenberg et al, 1987).

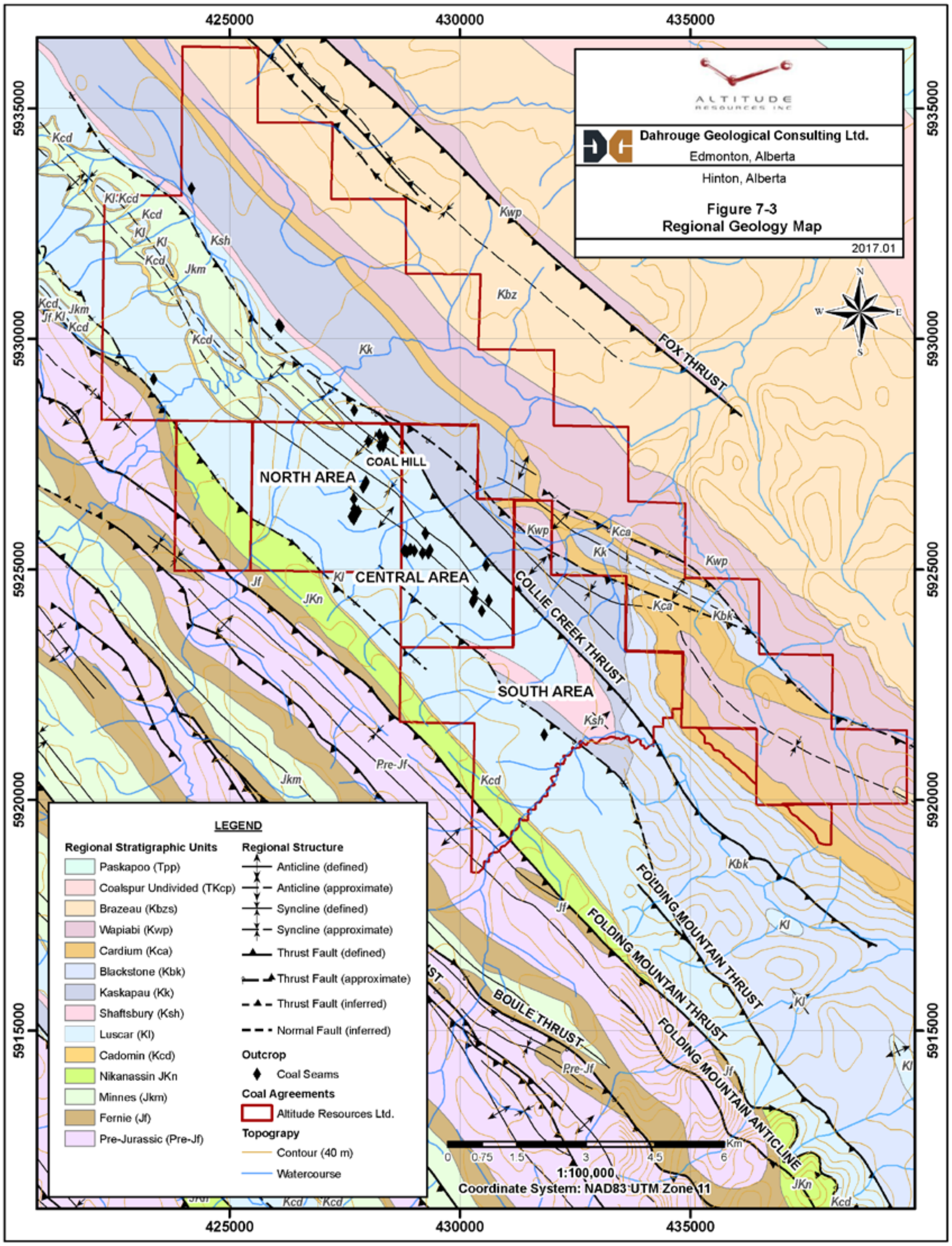


**Figure 7-3. Regional Geology Map**

## 7.2 PROPERTY GEOLOGY

Detailed property geology is presented in Figure 7-4. Exposure on the Property is generally limited to road cuts and along creeks, due to the recessive nature of much of the stratigraphic section, although more resistant sandstones of the Mountain Park and Torrens Members, as well as the chert-pebble conglomerate of the Cadomin Formation do outcrop locally on hillsides.

## 7.3 STRATIGRAPHY

The lowest observed strata on the property are quartzitic sandstones of the Late Jurassic to Early Cretaceous Nikanassin Formation which underlie the Cadomin Formation. The Cadomin conglomerate is composed of abundant well-cemented rounded chert pebbles and interbedded sandstone. It forms a distinctive marker unit. Nikanassin and Cadomin strata are exposed along the Rock Lake and Collie Creek roads, as well as along the southwest edge of the Property.

The Gladstone Formation consists of grey-brown weathered, interbedded sandstones and mudstones with minor thin coal seams. These sediments are bioturbated and contain pelecypod shells and fragments. Its upper contact with the Moosebar Member is placed at a thin layer of glauconite-rich pebble conglomerate. Exposures of the Gladstone Formation are found along Moosehorn Creek northwest of Coal Hill, the P-0300 Line trail and southeastwards along the ridge to Icewater Creek.

The Moosebar Formation is about 60 m thick. It consists of a lower laminated dark-grey siltstone or very fine-grained sandstone unit, overlain by interbedded siltstone and very fine-grained sandstone. The upper part of the formation is sandstone-dominant and grades into the Torrens Member above. Bioturbation and slump features are common. Due to its recessive nature, outcrop is poor. Moosebar is exposed along the P-0300 Line trail, P-0700 Line trail and Central Drill access trail.

The Torrens Member of the Gates Formation is 25 to 28 m thick in the Palisades area. It is dominantly fine- to coarse-grained, grey to grey-green, well-cemented sandstone. The sandstone beds are up to 2 m thick and can be cross-bedded, with subordinate interbedded or interlaminated siltstone and mudstone. Generally, the upper contact is picked at the base of the lowest coal seam (Solomon) of the Grande Cache Member; however, in the Coal Hill-Icewater Creek area of the Property, 8 to 10 m of interbedded siltstone, shale and thin sandstone characteristic of Grande Cache were noted between the Torrens sandstones and the lowest coal seam. This occurred both in an exposure along the Central Drill access road and in drill intersections. Torrens is exposed along the P-0300 Line trail, P-0700 Line trail, P-0800 Line trail and Central Drill access trail.

The Grande Cache Member of the Gates Formation ranges from 74 to 92 m thick (based on drilling by Denison) on the Palisades Property. Substantial thickening through folding and thrusting, particularly in the Coal Hill area, has increased this to as much as 450 m. In other studies, the base of the Grande Cache is placed at the base of the Solomon Seam, or the carbonaceous mudstone below it. The transition from Torrens Member to Grande Cache Member on the Property appears gradational. The upper contact of the Grande Cache is placed at the base of the first massive sandstone above the upper Moosehorn Seam.

In the central part of the Property about 22 m of sandstones interbedded with siltstone and coaly shale characteristic of the Grande Cache overlie the Moosehorn Seam, although it is roofed by about three metres of massive to cross-bedded sandstone. A similar section is exposed on the P-0800 Line. In the Coal Hill area at drillhole AP13-017, about 5 m of interbedded siltstone, shale and minor sandstone, overlie the Moosehorn Seam. Up to 5 m of resistant massive to cross-bedded sandstone overly the Hoff Seam in the Central palisades area and are exposed near AP16-013 and TR-AP16-002. Denison (1984) observed fining-upwards cycles between the Solomon, Hoff and Moosehorn Seams north of WH-006 in the central Palisades area. These cycles grade from clean, light-grey medium- to coarse-grained sandstone exhibiting a sharp contact with the underlying coal seam, through siltstone to carbonaceous mudstone and finally coal.

The Mountain Park Member of the Gates Formation is defined by a distinct grey-green, fine- to medium-grained, thick-bedded to massive sandstone that is often cross-bedded and resistant. Consistently across the property, it shows three main fining-upwards sandstone sequences separated by mudstone. Each sandstone unit contains laminations of siltstone and sandstone near the top, and can contain thin, discontinuous coal seams and pieces of plant remnants. The base of Mountain Park is generally taken at the first major sandstone unit above the Moosehorn Seam and the top placed at a thin (~½ m to 3 m) chert-pebble conglomerate at the base of the Shaftsbury Formation. This unit is well exposed in the South Palisades area on the ridge west of WH020DN (Figure 7-6). The Mountain Park Member ranges from 87 to 165 m in thickness on the Palisades Property, but is thicker regionally.

The Shaftsbury Formation is at least 175 m thick in the Palisades area. It subcrops extensively on the southern and eastern parts of the Property. It is mainly a recessive dark-grey mudstone, with subordinate interbedded siltstone and sandstone. The basal chert-pebble conglomerate is a distinctive marker observed along the most southerly branch of Icewater Creek, and above Collie Creek along the 'Spine Line' on the North Palisades extension. It is well exposed along the eastern limb of the Moosehorn Syncline to the west of AP13-007.

The Upper Cretaceous Dunvegan and Kaskapau Formations, which overlie the Shaftsbury Formation subcrop on the Property to the east of the trace of the Collie Creek thrust fault. They were intersected in AP16-024. The Dunvegan formation in the area is at least 50m thick, and is dominantly marine. It consists of brown to reddish weathering quartzitic sandstone with interbedded shale and thin coal seams. Lithic arenites with predominantly detrital quartz and chert grains and quartz cement. The Kaskapau formation, which overlies the Shaftsbury Formation, consists of dark grey marine shales of Cenomanian age. Only the lowest portion of the unit is present in the study area. Because of internal folding, a thickness cannot be determined (Langenberg et al, 1987).

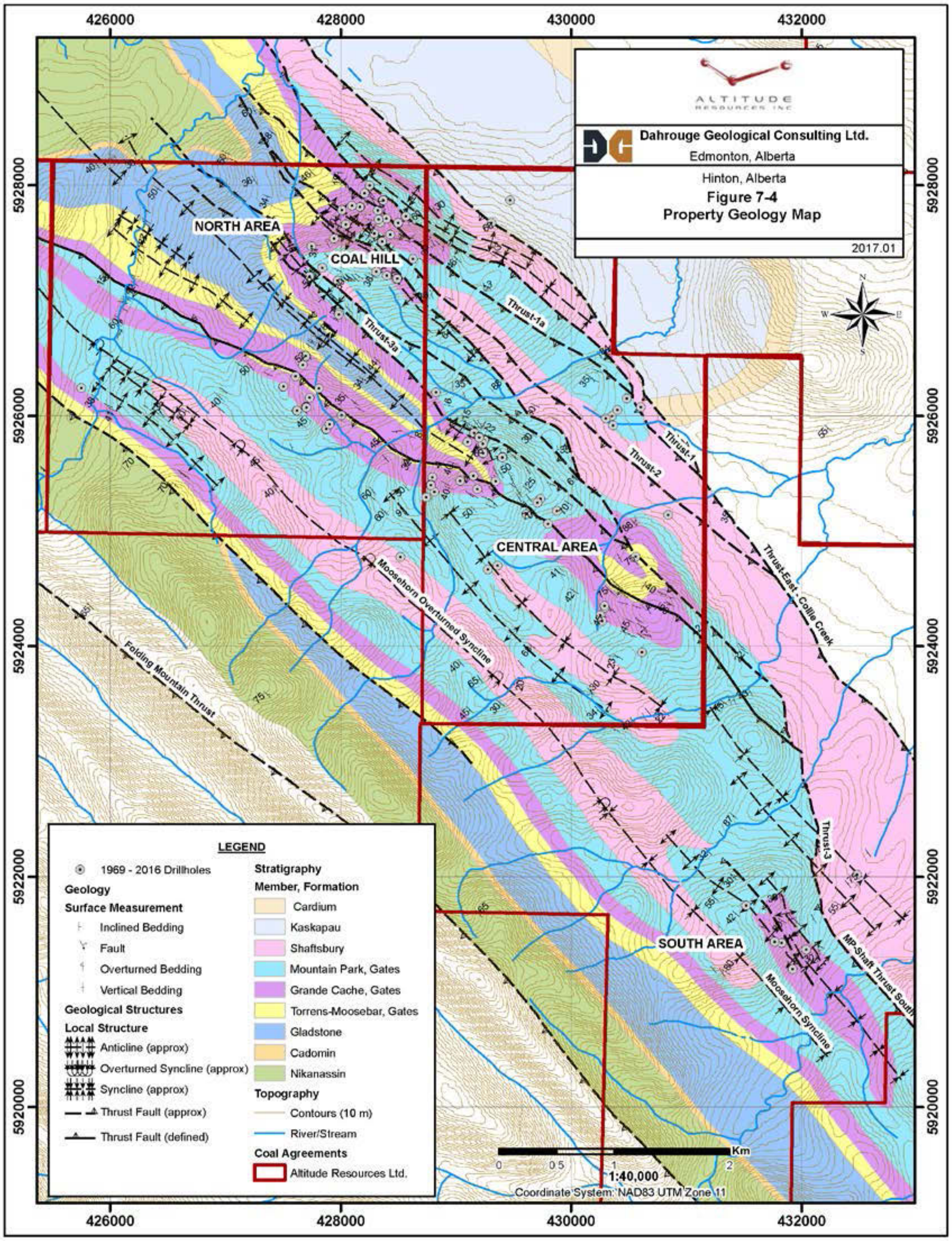


**Figure 7-4. Property Geology – Coal Hill Area**

## 7.4 STRUCTURAL GEOLOGY

The Luscar Group sediments on the Palisades Coal Property are exposed in a northwest to southeast trending fold belt bounded on both margins by major thrust faults (Figure 7-3). The southwest boundary is marked by the Folding Mountain Thrust Fault which over-thrusts carbonate rocks of the Jurassic Period onto much younger Cretaceous strata. The northeast boundary is marked by the Collie Creek Thrust Fault which over-thrusts the Luscar Group strata onto younger Upper Cretaceous formations.

Bounded by these two thrusts are several large-scale structures including, from west to east, the Moosehorn Syncline, Solomon Creek Anticline and Coal Hill Syncline/Anticline. The south west limb of the Moosehorn Syncline is nearly vertical, to slightly overturned towards the northeast. The axial hinge of this fold runs parallel to the Folding Mountain Thrust, suggesting deformation took place at the time this thrust fault was active. The Solomon Creek Anticline appears to be asymmetric as well, with the northeast dipping limb inclined at higher angles than the southwest dipping limb. There is also some evidence that this fold is faulted locally along the axial hinge line by a steeply southwest-dipping thrust fault (Figure 7-4). The adjacent Coal Hill Syncline is also asymmetric, dipping more steeply on the southwest limb. This asymmetry is mirrored in smaller folds and reflects the northeastward regional compression (Figure 7-7).

The Collie Creek Thrust marks the north-eastern boundary of the Property and is sub-parallel to the axial hinges of the fold structures, suggesting this major dislocation was after and not contemporaneous with initial deformation events. Smaller splays above the Collie Creek Thrust dissect the folding and stack the Gates Formation, particularly in the area of Coal Hill. One of these splays brings the Grande Cache Member over the Mountain Park Member on the east side of Coal Hill. Trenching and road-cuts exposed tight drag folding adjacent to faults in several locations on Coal Hill. Repetition of coal seams some in drillholes (e.g. AP13-007, AP13-016) appears to be the result of tight folding.

Mapping and drilling in 2015 and 2016 focussed on the area west and south of Coal Hill where the northern extension of the Solomon Creek anticline was cut by three drill sections (P-0300, P-0700, and P-0800). The anticline is asymmetrical, and is cut by several west-dipping thrusts which repeat parts of the Gates Formation as at Coal Hill. On the southwest limb of the anticline, the entire Grand Cache section, sitting on the Torrens Member, is thrust over two partial repeat sections along the P-0300 line. This repeat section is consistent southeastward to the P-0700 and P-0800 lines (Figure 7-4). These thrust faults are associated with smaller scale drag folds. Structures on the east and south sides of Coal Hill have been more clearly defined and indicate a doubling of the Grande Cache Member on the east limb of the anticline (Figure 7-4; Figure 7-7).

There is apparent over-thickening, local thinning, and repetition of the coal section which supports a model of severe deformation and faulting in high compression zones at or near the axial hinges of these folds (see Figure 7-7 and Figure 14-2 to Figure 14-6).

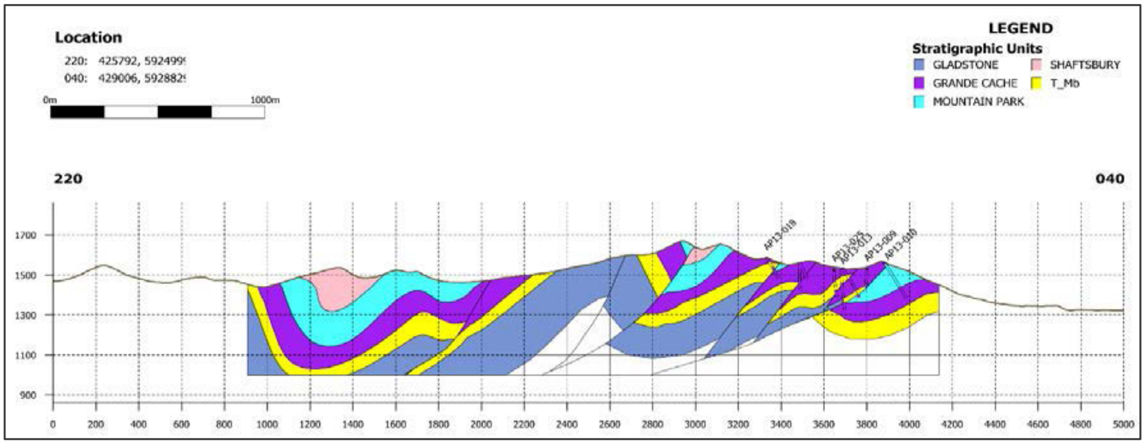


**Figure 7-5. Stratigraphic Cross-section Correlating to Section 1 (Figure 14-2)**

Mapping of the workings of the old underground mines at Brule adjacent to the southeast (McKay, 1927) shows plastic deformation and over-thickening of the coal seams in anticline crowns and syncline hinges (Figure 7-8). A similar thickening of the Moosehorn Seam was observed in the road cut near drillhole AP15-014 and AP16-019. This style of deformation is related to the mechanical nature of the Gates Formation rocks. Effectively, the relatively weak coal-bearing Grande Cache Member is sandwiched between the Torrens Member sandstone and the massive Mountain Park Member sandstone. During severe folding events, weaker shale and coal units will detach and compress along bedding planes and flow towards hinge axes. This type of deformation, along with moderate displacement along accommodating thrusts, appears to be dominant on the Property.

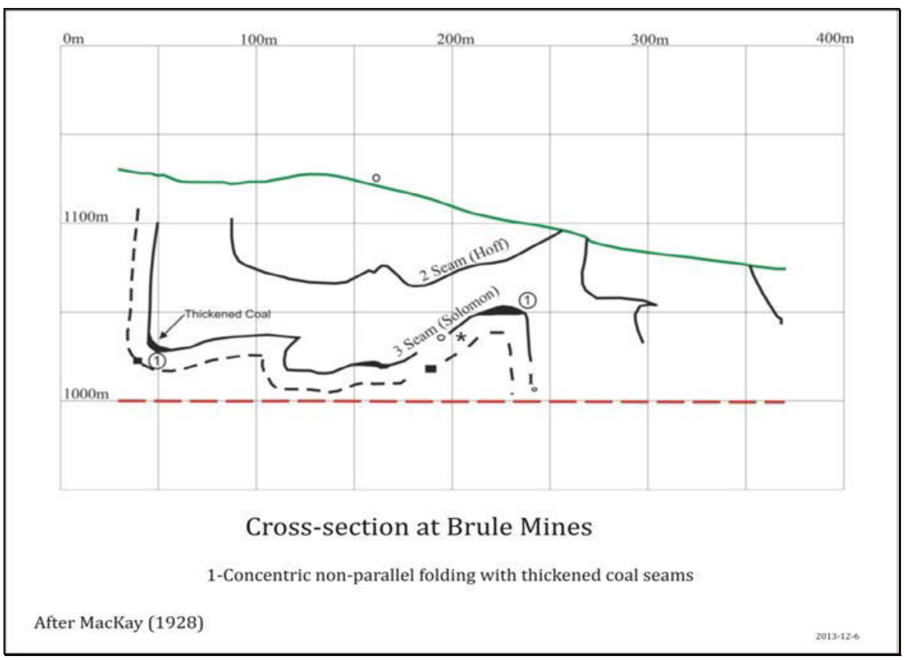


**Figure 7-6. Cross-Section (Brule Mines) Showing Coal Thickening at Fold Hinges**

## 7.5 MINERALIZED ZONES

The terminology used for identifying coal zones and individual seam plies has been adopted from Denison. Figure 7-2 shows a composite section of the Grande Cache Member including the main coal zones on the Property.

There are three coal zones recognized within the Grande Cache Member, identified in ascending order as the Solomon, Hoff, and Moosehorn. While these individual zones maintain relative stratigraphic position in the Palisades area, the thickness of individual seams and proportion of coal plies to rock partings in each zone is variable. The variation is both depositional and in some cases caused by structural distortion. Coal zones are often sheared and appear to be preferred loci for thrust faulting. It should be noted that observations regarding the continuity and character of these zones is based on very limited drill data spaced over a wide area, except in the Coal Hill and Central Palisades area.

The Hoff and Solomon Zone are the best developed coal zone on the property, however there is variability in the Solomon Seam partings and seam thickness. The Solomon Seam was intersected in four 2016 drillholes, twelve 2015 drillholes, twenty 2013 drillholes, and ten historic drillholes. Typically, it lies directly above the Torrens Member sandstone and consists of two major sub-seams separated by a carbonaceous mudstone parting. In the central and northern parts of the Property, there appears to be 8 to 10 m of interbedded siltstone, shale and sandstone below the seam. Seam thickness varies from hole to hole. In the southeast, (drillhole WH020DN), the zone contains 1.07 m of coal. In AP13-007, intersections of 2.7 and 4.4 m on opposite limbs of an anticline were oblique and not representative of true thickness. In trench TR-AP13-024, coal splits of 0.7 and 2.9 m were observed but are affected by thickening in the hinge of the anticline. In TR-AP13-025 the splits are 0.8 and 0.9 m which are likely close to true thickness. In the central area (drillhole WH021DN) the seam thins to 0.53 m. Drillholes AP13-002 and AP13-003 cut split seams of about 1.1 and 0.3 m true thickness. In the northwest (drillhole WH023DN) the seam is 0.65 m thick. The maximum development occurs in the Coal Hill area along the hinge of the Solomon Creek Anticline where seam thickness averages over 3 m (drillhole AP15-005, WH019DN, WH015DN and WH018DN and HR-3, HR-4). The thickest intersection is in WH015DN, at 4.6 m; this is likely showing the effect of structural thickening. In 2013 drilling, aggregate thicknesses for the Solomon Seam of up to 4 m were intersected in AP13-009, AP13-014, AP13- 015, AP13-016, AP13-026, AP13-027, but these included many shaley partings. In 2015 drilling, similar thicknesses were intersected in AP15-005, AP15-011 and AP15-019. In 2016 drilling, aggregate thicknesses in nine intersections varied from 1.8 to 2.9 m. A thick Solomon Seam is also recorded in drillholes WH006DN and WH014DA where the seam averages over 2 m in thickness. Again, this follows the crown of the Solomon Creek Anticline.

An unnamed stray seam, approximately 1 m thick, was intersected about 10 m below the Hoff Seam in AP13-002 and AP13-003. This may correlate with the banded coal and coaly shale units intersected below the Hoff Seam at Coal Hill (TR-AP13-013, TR-AP13-015 and AP13-017). A similar unit below the Moosehorn Seam (TR-AP13-011, AP13-017) is also observed at Coal Hill.

The Hoff Zone occurs approximately 50 m above the Solomon Zone where no structural thickening is observed. The zone consists of a single seam which was only intersected in two historic drillholes in the central part of the Property: WH006DN (1.5 m thick) and WH019DN (0.9 m thick). The Hoff Zone was also intersected in AP13-002 (4.6 m thick, probably over-thickened) and AP 13-003 (2.3 m thick). In the Coal Hill area and to the west, the Hoff Seam was intersected in several drillholes in 2013, 2015 and 2016, and appears to split into two seams (estimated true thicknesses of <1.5 m and <2.2 m) separated by about 1-3 m of siltstone and shale parting. The Hoff Seam was well exposed in the P-0300 line access road in 2015, and along the P700 to P600 access road in 2016.

The upper most coal zone, the Moosehorn Zone, is approximately 25 m above the Hoff Zone. It is typically a single coal seam ranging from 0.9 to 1.2 m in thickness. It thickens to over 4 m at the crest of an anticline near AP15-014 and AP16-019 (Figure 7-4). In the Coal Hill area where there is significant fault repetition of the Grand Cache Member, the upper part containing the Moosehorn Zone is missing in some sequences.

# 8 DEPOSIT TYPES

A coal deposit, unlike most mineral deposits, is a distinct sedimentary entity. As such, its characteristics are not defined by mineralization type, distribution and grade. Key characteristics contributing to the classification of a coal seam, or multiple seams, as a coal deposit, include seam thickness, seam continuity and correlation as well as coal quality. Deposit type will also refer to the probable extraction method (i.e. surface or underground) and to the ultimate use for the coal (i.e. metallurgical or thermal), since physical coal properties, such as the potential (or lack) to coke, will restrict end use.

Coal deposit types are defined in Geological Survey of Canada (GSC) Paper 88-21, a core reference for coal deposits as specified in NI 43-101. Four categories are proposed:

1) 'surface mineable' - extracted by removing overburden from surface using dragline, truck and shovel, or other techniques;
2) 'underground mineable' - extracted using room-and-pillar, longwall, shortwall, hydraulic or other techniques from surface drivages;
3) 'non-conventional' - deposits too deep or inaccessible by first two methods, requiring in situ gasification or other techniques;
4) 'sterilized' - unavailable for mining due to legislative, environmental or other restrictions. Section 2.2 of the NI 43-101 requires the disclosure of coal resources or reserves to follow the categories set out in CIM Definition Standards (2010), although the framework of GSC Paper 88-21 can be used for development and characterization of estimates which must then be converted to equivalent CIM Definition categories.

GSC Paper 88-21 also refers to geology types, which define the amount of geological complexity, usually imposed by the structural complexity of the area. This classification helps determine the approach to be used for resource estimation methodology, as well as limits to be applied to certain key estimation criteria. Four classes are provided:

1) 'low' - essentially flat-lying deposits of the Alberta plains type with low tectonic disturbance (deposits of Ravenscrag and Judith River Formations);
2) 'moderate' - characterized by broad folds and homoclines (wavelength >15 km, dips <30°) typical of outer foothills (Obed, Marsh, McLeod River, Ram River, Bullmoose deposits);
3) 'complex' - high tectonic disturbance, tight, steep, sometimes overturned folds, fault offsets present but individual fault-bounded plates (Harmer, Fording River, Grassy Mountain, Smokey River deposits);
4) 'severe' - extreme tectonic disturbance, tight, overturned folds, large-displacement faults, stratigraphic discontinuities, structurally thickened or thinned coal seams (Byron Creek Deposit, parts of Grassy Mountain Deposit).

The Property contains low- to medium- volatile bituminous coal suitable for metallurgical uses. Potential for both surface and underground-mineable resources exist. Resources are considered to be in the 'complex' category for purposes of this report. Section 14 of this report provides the details of current resource estimation criteria.

Defining resources in a 'complex' coal deposit requires close-spaced drilling. Typically, Measured Resources require cross-sectional drilling lines 150 m apart; Indicated Resources require lines 300 m apart; and Inferred Resources require lines 600 m apart. Drillhole data along these lines should be at a mean spacing of 100 m, 200 m and 400 m, respectively. In this report, radial distances from known data points are used (Table 14-1). Pit design requires measured and indicated resources at a minimum, in order to estimate tonnage and potential recovery.

# 9 EXPLORATION

This technical report presents results of Altitude's 2016 exploration program on the Property (Figure 9-1). Site visits by the authors are described in Section 12. Details of the historic exploration programs on the Palisades Property are presented in Sections 6.

Work completed in 2016 on the Property included:

- Geological mapping at 1:10,000 scale was completed along new road-cuts, including new logging access trails, and in some areas of natural exposure, including rock outcroppings and some coal seams (Figure 7-4 to Figure 7-7)
- Conventional air hammer drilling: 25 holes totalling 2,931 m (Details in Section 10)
- Diamond core drilling: 8 holes totalling 210 m (Details in Section 10)

## 9.1 MAPPING

A program of access layout and geological mapping of new logging trails and natural outcrops was undertaken by two geologists beginning in the second week of June 2016. Additional mapping was carried out as new exposures were created by access construction. The focus of this effort was to verify and expand upon previous mapping, with attention to areas of proposed drilling. The mapping included collecting detailed descriptions (structural measurements; rock types and stratigraphic units) of select road-cuts and surveying them with an RTK-GPS to assist with interpretation and subsurface geological modelling.

Observations of bedding attitudes and such structural information as cleavage, lineation and fault traces were made using a Brunton compass and hand-held Garmin 64s GPS units. Outcrop is generally sparse on the Property except along creeks or where resistant sandstone units' outcrop along ridge-tops. Coal-bearing units are recessive and seldom exposed except during access construction. A total of 47 stations were taken, primarily in the north (Coal Hill) and central areas of the property (Figure 7-4 to Figure 7-6).

## 9.2 TRENCHING

No trenching was conducted in 2016. As in 2015, exposures of coal in road cuts were measured and surveyed (Figure 9-1, Table 9-1 ). These intersections were incorporated in geological interpretation and modeling. Good exposure of the Hoff Seam along the P-0700 to P-0600 access were mapped in TRAP16-002 and TRAP16 -006/007 on the P-0600 access road.

**Table 9-1. 2016 Palisades Surveyed Road Cut Exposures**

| Road Cut | Easting | Northing | Elevation (m) | Length (m) | Azimuth | Dip | Rock Type | Seam | Seam Interval (m) |
|---|---|---|---|---|---|---|---|---|---|
| **TRAP16-001** | 427689 | 5926092 | 1560 | 9.4 | 40 | -34 | Coal | Hoff | 2.62 |
| **TRAP16-002** | 428868 | 5925381 | 1513 | 5.6 | 150 | -35 | Coal | Hoff | 2.2 |
| **TRAP16-003** | 427695 | 5926136 | 1548 | 4.04 | 50 | -35 | Coal. Coaly Shale | Stray | 1.19 |
| **TRAP16-004** | 427715 | 5926327 | 1565 | 5.12 | 124 | -46 | Coaly Shale, Coal | Stray | 1.14 |
| **TRAP16-005** | 427701 | 5926335 | 1568 | 2.92 | 125 | -28 | Coal, Coaly Shale | Stray | 0.55 |
| **TRAP16-006** | 428798 | 5925411 | 1499 | 6.49 | 353 | -38 | Coal | Hoff | 0.95 |
| **TRAP16-007** | 428802 | 5925423 | 1499 | 7.6 | 352 | -44 | Coal | Hoff | 1.51 |
| **TRAP16-008** | 428804 | 5925445 | 1494 | 7.55 | 353 | -27 | Coal, Coaly Shale | Stray | 1.68 |
| **TRAP16-009** | 427659 | 5926430 | 1598 | 3.22 | 354 | -41 | Coal | Stray | 0.9 |

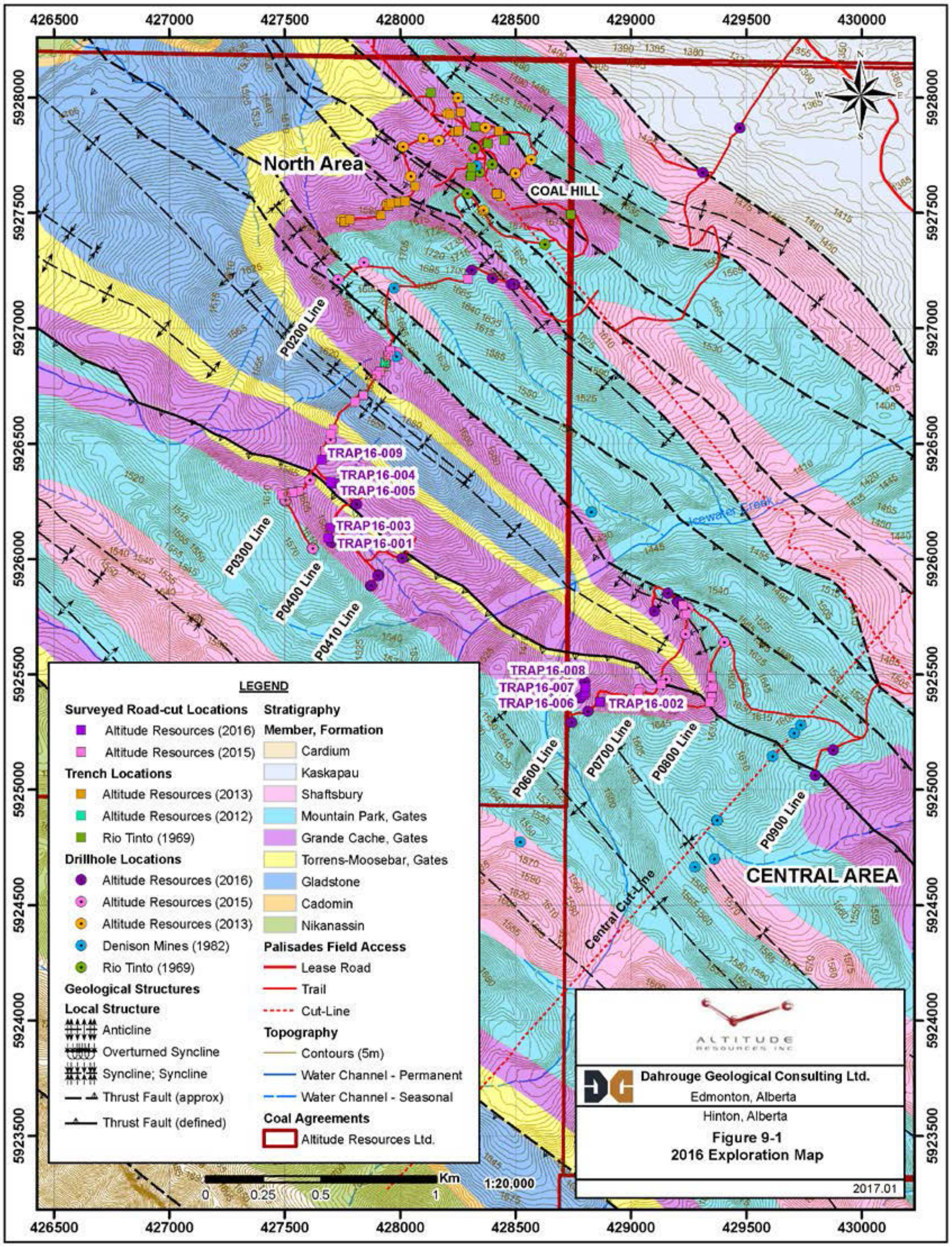


**Figure 9-1. 2016 Palisades Exploration**

# 10 DRILLING

A total of 25 conventional rotary air hammer drillholes and eight 3½" core holes were drilled during the 2016 exploration program (Table 10-1; Figure 10-1). In addition, 22 drill holes and 24 roadcuts from the 2015 Palisades program; 30 drillholes and 25 trenches from the 2013 program; and 28 historic drillholes and 10 historic trenches (Table 6-1 to Table 6-7) were used for geologic interpretation and modelling. Drill collars and access were surveyed using a Differential GPS (DGPS) unit, and down-hole deviation surveys and borehole geophysics were conducted on all rotary holes. Data from the 2013 program was collected using similar methods.

**Table 10-1. 2016 Palisades Drilling Summary**

| Name | Easting | Northing | Elevation (m) | Depth (m) | Azimuth | Inclination | Area | Type |
|---|---|---|---|---|---|---|---|---|
| **AP16-001** | 427872.11 | 5925884.97 | 1516.12 | 189 | 40 | -80 | P410-LINE | Conventional |
| **AP16-002** | 427874.62 | 5925886.84 | 1516.10 | 98 | 40 | -60 | P410-LINE | Conventional |
| **AP16-003** | 429102.00 | 5925775.15 | 1485.10 | 158 | 40 | -60 | P600-LINE | Conventional |
| **AP16-004** | 429100.903 | 5925773.873 | 1485.01 | 201 | 40 | -90 | P600-LINE | Conventional |
| **AP16-005** | 429160.474 | 5925852.499 | 1524.997 | 146 | 220 | -70 | P600-LINE | Conventional |
| **AP16-006** | 428744.456 | 5925293.089 | 1499.228 | 189 | 40 | -55 | P600-LINE | Conventional |
| **AP16-007** | 427906.039 | 5925932.353 | 1504.948 | 37 | 40 | -60 | P410-LINE | Conventional |
| **AP16-008** | 427903.233 | 5925929.092 | 1505.349 | 12 | 40 | -80 | P410-LINE | Conventional |
| **AP16-009** | 428008.289 | 5926003.957 | 1505.231 | 98 | 40 | -60 | P410-LINE | Conventional |
| **AP16-010** | 428799.125 | 5925468.206 | 1489.931 | 93 | 40 | -55 | P600-LINE | Conventional |
| **AP16-011** | 428782.21 | 5925399.687 | 1497.968 | 37 | 0 | -90 | P600-LINE | Conventional |
| **AP16-012** | 428783.633 | 5925401.275 | 1498.092 | 158 | 40 | -55 | P600-LINE | Conventional |
| **AP16-013** | 427699.553 | 5926080.632 | 1557.806 | 140 | 15 | -55 | P400-LINE | Conventional |
| **AP16-014** | 427731.953 | 5926156.587 | 1535.888 | 24 | 40 | -55 | P400-LINE | Conventional |
| **AP16-015** | 427811.369 | 5926238.352 | 1540.993 | 73 | 40 | -60 | P400-LINE | Conventional |
| **AP16-016** | 428310.284 | 5927252.091 | 1696.092 | 225 | 40 | -90 | COAL HILL | Conventional |
| **AP16-017** | 428814.087 | 5925340.53 | 1518.499 | 110 | 0 | -90 | P300-LINE | Conventional |
| **AP16-018** | 428311.258 | 5927253.418 | 1696.002 | 110 | 40 | -60 | COAL HILL | Conventional |
| **AP16-019** | 429203.88 | 5925819.03 | 1535.616 | 110 | 220 | -70 | P700-LINE | Conventional |
| **AP16-020** | 428495.234 | 5927189.396 | 1684.205 | 134 | 0 | -90 | COAL HILL | Conventional |
| **AP16-020-Pilot** | 428485.57 | 5927193.76 | 1684.205 | 43 | 0 | -90 | COAL HILL | Conventional |
| **AP16-021** | 428401.044 | 5927216.835 | 1689.53 | 125 | 0 | -90 | COAL HILL | Conventional |
| **AP16-022** | 429798.418 | 5925063.538 | 1531.919 | 128 | 220 | -55 | P900-LINE | Conventional |
| **AP16-023** | 429876.734 | 5925174.037 | 1550.165 | 146 | 220 | -65 | P900-LINE | Conventional |
| **AP16-024** | 429473.012 | 5927869.986 | 1390.047 | 25 | 0 | -90 | COAL HILL | Conventional |
| **AP16-025** | 429310.5 | 5927676.62 | 1442.441 | 122 | 40 | -90 | COAL HILL | Conventional |
| **APC16-011** | 428780.014 | 5925398.779 | 1497.924 | 30 | 0 | -90 | P600-LINE | 3½" core |
| **APC16-011A** | 428783.786 | 5925400.276 | 1497.861 | 28 | 0 | -90 | P600-LINE | 3½" core |
| **APC16-019** | 429201 | 5925817 | 1535.616 | 37 | 220 | -70 | P400-LINE | 3½" core |
| **APC16-019A** | 429205.411 | 5925813.805 | 1532.164 | 15 | 220 | -60 | P400-LINE | 3½" core |
| **APC16-013** | 427701.1 | 5926076.96 | 1557.806 | 24 | 0 | -90 | P700-LINE | 3½" core |
| **APC16-013a** | 427702.6 | 5926073.529 | 1558 | 16.5 | 0 | -90 | P700-LINE | 3½" core |
| **APC16-020** | 428482 | 5927192.255 | 1684 | 43 | 0 | -90 | COAL HILL | 3½" core |
| **APC16-020a** | 428494.16 | 5927191.3 | 1683.83 | 16.5 | 0 | -90 | COAL HILL | 3½" core |

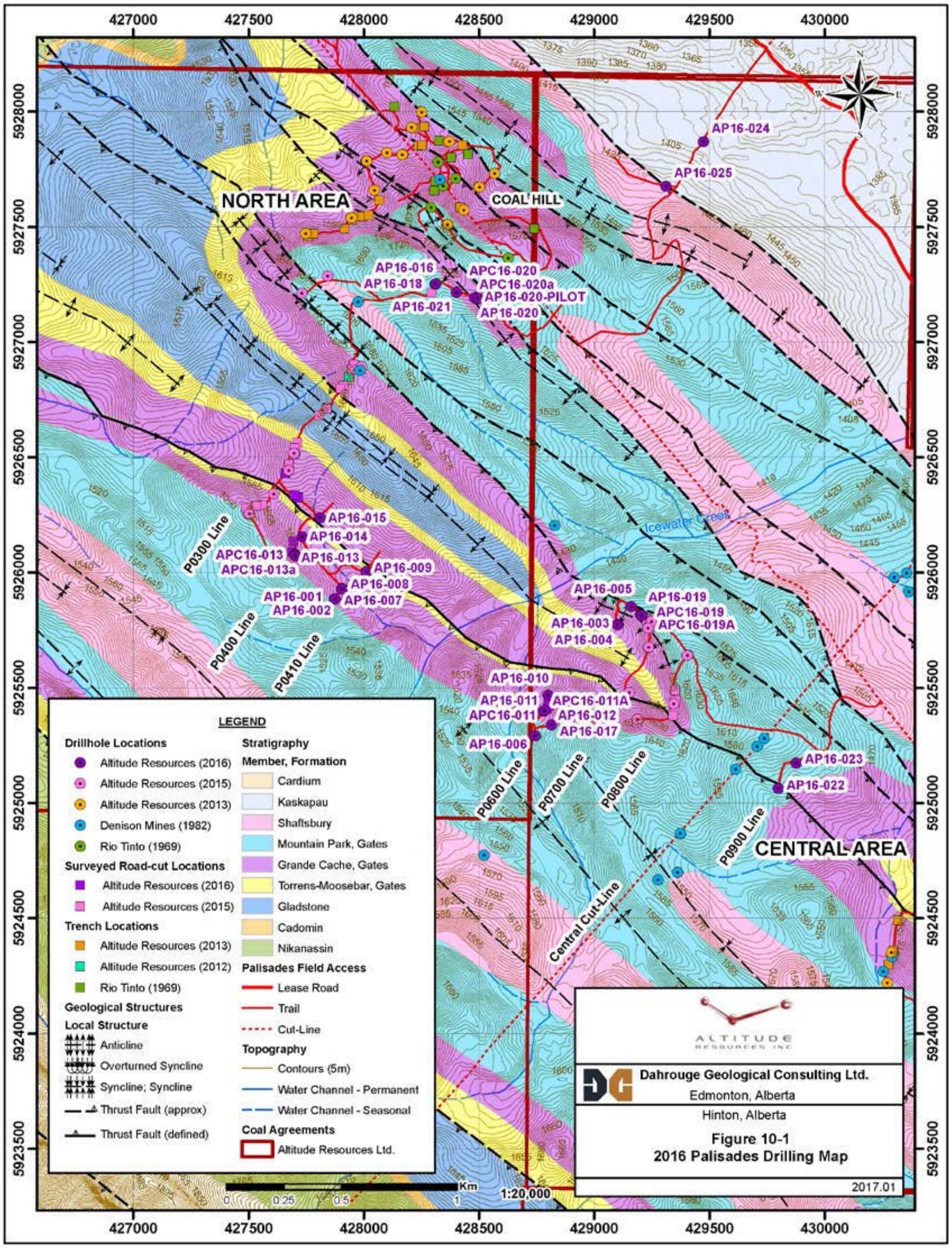


**Figure 10-1. 2016 Palisades Drilling**

## 10.1 Conventional Rotary Drilling

Rocky Mountain Drilling Inc, Hinton, AB were contracted to provide two truck-mounted Atlas Copco TH60 conventional air hammer rotary drill rigs for the 2016 program. Drilling began July 21st, and ended August 11th, 2016. Twenty-five 4¾" (120 mm) diameter holes totalling 2,931 m were drilled. Depths ranged from 12 to 225 m. Seven-inch (178 mm) casing was set and removed following downhole logging. Each hole was cemented. Collars were marked with squared wooden posts set into the concrete and marked with metal tags.

Drillhole collar locations were surveyed by using Differential GPS methods. Downhole azimuth and deviation surveys using a Reflex multishot system were run in rods, by Century Wireline Services of Red Deer, AB. Borehole geophysical logging tools for density and natural gamma were initially run in rods, and density, natural gamma, resistivity and caliper were also run in the open hole. Several holes had partial open-hole logs due to blockage or collapse.

Drilling chips were collected from the collar splitter and were logged lithologically. Coal intersections are presented in Table 10-2. Not all were true thickness, owing to practical limitations upon drillhole inclination and variation in dips. Coal intersections greater than 0.5 m were sampled in cloth bags at 1.0 m intervals, and later composited. Four composites were sent to Birtley Coal and Minerals Testing Division in Calgary, AB, for proximate analysis, and to David Pearson and Associates in Victoria, BC for petrographic analysis (Table 10-3).

**Table 10-2. 2016 Rotary Drillhole Coal Intersections**

| Drillhole | From (m) | To (m) | Seam Length* | Rock Type | Seam |
|---|---|---|---|---|---|
| AP16-001 | 32.50 | 34.75 | 2.25 | Coal | Moosehorn |
| AP16-001 | 55.50 | 56.20 | 0.70 | Coal | Hoff 1 |
| AP16-001 | 57.91 | 59.70 | 1.79 | Coal | Hoff 2 |
| AP16-001 | 163.90 | 164.70 | 0.80 | Coal | Solomon 1 |
| AP16-001 | 166.50 | 167.60 | 1.10 | Coal | Solomon 2 |
| AP16-002 | 10.00 | 11.50 | 1.50 | Coal | Moosehorn |
| AP16-002 | 37.00 | 38.70 | 1.70 | Coal | Hoff 1 |
| AP16-002 | 45.90 | 47.00 | 1.10 | Coal | Hoff 2 |
| AP16-002 | 76.40 | 77.80 | 1.40 | Coal | Solomon 1 |
| AP16-002 | 80.60 | 81.50 | 0.90 | Coal | Solomon 2 |
| AP16-003 | 4.00 | 5.00 | 1.00 | Coal | Moosehorn |
| AP16-003 | 21.64 | 23.40 | 1.76 | Coal | Hoff 1 |
| AP16-003 | 29.60 | 30.00 | 0.40 | Coal | Hoff 2 |
| AP16-003 | 129.80 | 131.30 | 1.50 | Coal | Hoff 1 |
| AP16-003 | 139.50 | 140.20 | 0.70 | Coal | Hoff 2 |
| AP16-004 | 14.70 | 15.20 | 0.50 | Coal | Moosehorn |
| AP16-004 | 29.00 | 31.10 | 2.10 | Coal | Hoff 1 |
| AP16-004 | 38.10 | 39.00 | 0.90 | Coal | Hoff 2 |
| AP16-004 | 69.80 | 70.90 | 1.10 | Coal | Solomon 1 |
| AP16-004 | 80.00 | 83.00 | 3.00 | Coal | Solomon 2 |
| AP16-004 | 167.30 | 169.90 | 2.60 | Coal | Solomon 1 |
| AP16-004 | 173.74 | 175.50 | 1.76 | Shaley Coal | Solomon 2 |
| AP16-005 | 71.90 | 73.70 | 1.80 | Coal | Moosehorn |
| AP16-005 | 117.35 | 119.40 | 2.05 | Shaley Coal + Coal | Hoff 1 |
| AP16-005 | 120.50 | 121.60 | 1.10 | Coal | Hoff 2 |
| AP16-006 | 58.80 | 59.70 | 0.90 | Coal | Moosehorn |
| AP16-006 | 81.50 | 82.70 | 1.20 | Coal | Hoff 1 |
| AP16-006 | 87.90 | 88.70 | 0.80 | Coal | Hoff 2 |
| AP16-006 | 168.30 | 169.80 | 1.50 | Coal + Coaly Shale | Solomon 1 |
| AP16-006 | 171.40 | 172.82 | 1.42 | Coal | Solomon 2 |
| AP16-009 | 60.40 | 61.70 | 1.30 | Shaley Coal | Solomon 1 |

| | | | | | |
|---|---|---|---|---|---|
| AP16-009 | 63.40 | 63.70 | 0.30 | Coal | Solomon 2 |
| AP16-010 | 41.90 | 42.50 | 0.60 | Coal | Solomon |
| AP16-011 | 17.70 | 19.70 | 2.00 | Coal | Hoff 1 |
| AP16-011 | 25.00 | 26.90 | 1.90 | Coal | Hoff 2 |
| AP16-012 | 13.20 | 14.70 | 1.50 | Coal | Hoff 1 |
| AP16-012 | 19.00 | 19.70 | 0.70 | Coal | Hoff 2 |
| AP16-012 | 85.50 | 86.40 | 0.90 | Coal | Solomon 1 |
| AP16-012 | 88.20 | 88.80 | 0.60 | Coal | Solomon 2 |
| AP16-013 | 3.05 | 4.88 | 1.83 | Coal | Hoff 1 |
| AP16-013 | 8.70 | 9.40 | 0.70 | Coal | Hoff 2 |
| AP16-013 | 85.20 | 87.00 | 1.80 | Coal | Solomon 1 |
| AP16-013 | 94.60 | 95.50 | 0.90 | Coal | Solomon 2 |
| AP16-015 | 29.50 | 30.70 | 1.20 | Shaley Coal | Solomon 1 |
| AP16-015 | 32.20 | 32.80 | 0.60 | Shaley Coal | Solomon 2 |
| AP16-016 | 56.90 | 59.70 | 2.80 | Shaley Coal | Moosehorn |
| AP16-016 | 94.00 | 95.60 | 1.60 | Coal | Hoff 1 |
| AP16-016 | 101.90 | 102.90 | 1.00 | Coal | Hoff 2 |
| AP16-016 | 149.20 | 150.40 | 1.20 | Coal + Coaly Shale | Solomon 1 |
| AP16-016 | 151.00 | 151.90 | 0.90 | Shaley Coal | Solomon 2 |
| AP16-016 | 152.80 | 153.30 | 0.50 | Shaley Coal | Solomon 2 |
| AP16-017 | 22.00 | 23.10 | 1.10 | Coal | Moosehorn |
| AP16-017 | 51.30 | 53.40 | 2.10 | Shaley Coal | Hoff 1 |
| AP16-017 | 58.70 | 59.60 | 0.90 | Coal | Hoff 2 |
| AP16-017 | 106.30 | 106.68 | 0.38 | Shaley Coal | STRAY |
| AP16-018 | 43.70 | 44.60 | 0.90 | Coal | Moosehorn |
| AP16-018 | 71.70 | 72.00 | 0.30 | Coal | Hoff 1 |
| AP16-018 | 75.50 | 76.00 | 0.50 | Shaley Coal | Hoff 2 |
| AP16-019 | 22.10 | 24.60 | 2.50 | Coal + Coaly Shale | Hoff 1 |
| AP16-019 | 25.00 | 28.10 | 3.10 | Coal | Hoff 2 |
| AP16-019 | 89.80 | 91.30 | 1.50 | Coal + Coaly Shale | Moosehorn |
| AP16-020 | 31.30 | 36.10 | 4.80 | Coal | Moosehorn |
| AP16-020 | 48.50 | 52.90 | 4.40 | Coal + Coaly Shale | Hoff 1 |
| AP16-020 | 53.40 | 55.00 | 1.60 | Coal | Hoff 2 |
| AP16-020-PILOT | 31.30 | 35.30 | 4.00 | Coal | Moosehorn |
| AP16-021 | 27.30 | 28.10 | 0.80 | Coal | Moosehorn 1 |
| AP16-021 | 29.50 | 30.00 | 0.50 | Shaley Coal | MH2 |
| AP16-021 | 61.10 | 62.00 | 0.90 | Coal | Hoff 1 |
| AP16-021 | 66.10 | 67.00 | 0.90 | Coal | Hoff 2 |
| AP16-022 | 100.10 | 103.00 | 2.90 | Coal + Coaly Shale | Solomon |
| AP16-023 | 129.50 | 132.00 | 2.50 | Coal + Coaly Shale | Moosehorn |

* Coal intersections are not necessarily true thickness due to drillhole inclination and dip angles

**Table 10-3. 2016 Rotary Drilling Composite Coal Samples**

| Sample | From (m) | To (m) | Length (m) | Seam | Ro Max | Moist % | Ash % | Vol% | F.C.% | S% | FSI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AP16-020-01 | 31.30 | 35.30 | 4.00 | Moosehorn | 1.33 | 0.87 | 8.65 | 20 | 70.48 | 0.54 | 8.5 |
| AP16-020-02 | 53.60 | 54.80 | 1.20 | Moosehorn | 1.32 | 1.23 | 8.99 | 19.83 | 69.95 | 0.54 | 8 |
| AP16-021-01 | 61.00 | 62.00 | 1.00 | Hoff | 1.37 | 1.43 | 9.36 | 19.93 | 69.28 | 0.57 | 8.5 |
| AP16-021-02 | 66.00 | 67.00 | 1.00 | Hoff | 1.42 | 1.26 | 8.33 | 19.58 | 70.83 | 0.55 | 9 |

Drilling in 2016 on the north area of the property along lines P-0300, P-0400, and P-410 was planned to further test seams within the Grande Cache Member on both limbs of the major anticline west of Coal Hill (Figure 7-4) and to extend previous resources. Drilling in 2015, and mapping of several seams originally exposed by previous road construction, defined thrust fault repetition on the western limb of the anticline. At several sites, both a vertical or near-vertical, and an inclined hole were drilled to constrain dips and true thickness of coal seams (Figure 10-1, Table 10-1). Drillholes AP16-001, AP16-002, AP16-007 to -009, and AP16-013 to -015 were located on the moderately-dipping west limb. On the north-central part of the Property, south of Icewater Creek, holes AP16-006, -010 to -012 and -017 were also drilled on the west limb on the P-0600, P-0700 and P-0900 lines (Figure 7-4) to confirm structure and extend resources. AP16-003 to -005 and AP16-019 were drilled on the east limb of the anticline in the same area. Drillholes AP16-022 and -023 were drilled on the P-0900 line to the south to constrain subcrop of the Grande Cache Member. Drillholes AP16-016, -018 and -020, -021 were drilled on the south side of Coal Hill to test an anticline hinge where Grande Cache Member rocks were suspected to be close to surface. AP16-024 and -025 were drilled on the east side of Coal Hill to test a possible repetition of the Grande Cache Member, but intersected the Upper Cretaceous Dunvegan and Kaskapau Formations, helping to define the trace of the Collie Creek thrust fault.

The three major seams were each cut in several holes (Table 10-2), the aim in part being to identify suitable locations and depths for coring to gain further controls on coal quality. Seam chip samples were taken for most intersections, and four samples were sent for proximal and petrographic analysis (Table 10-3).

## 10.2 CORE DRILLING

Coring was carried out by Rocky Mountain Drilling with one of the truck-mounted Atlas Copco TH60 air hammer rotary drill rigs used in the conventional drilling program. Holes were drilled with a 6" (15 cm) rotary bit to core point, and coring through designated seams was done with a ten-foot wireline core barrel lined with plastic tubing, producing HQ (6.3 cm) diameter core.

Eight core holes were drilled totalling 210 m (Figure 10-1) and samples were recovered from seven of them (Table 10-4). APC16-011 and APC16-011a were drilled adjacent to AP16-011 on the P0-600 road to test the exposed Hoff Seam which had two splits in the road cut. APC16-011a was drilled with about a 2 m offset to attempt better recovery and gain some additional depth. Core-hole APC16-013 and APC16-013a were drilled with about a 4 m and 10m offset, respectively from AP16-013 to target the Hoff Seam. APC16-019 and APC16-019a were drilled adjacent to AP16-019 which was located about 50 m northwest of APC15-014 and -014a. Its purpose was to obtain unoxidized samples of the seam sampled in 2015. Core-hole APC16-020 was drilled adjacent to rotary hole AP16-020 to test the Solomon Seam. A second core-hole (APC-020a) was drilled as no coal core was recovered from the initial attempt. Details of coal quality from these samples are presented in Section 13 (Table 13-1 to Table 13-5).

**Table 10-4. 2016 Core Coal Samples**

| Sample | From (m) | To (m) | Length (m) | Seam | Ro Max | Moist % | Ash % | Vol% | F.C.% | S% | FSI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **APC16-011-01** | 19.66 | 21.58 | 1.92 | Hoff | 1.45 | 0.75 | 9.04 | 18.56 | 65.51 | 0.72 | 7.50 |
| **APC16-011a-01** | 17.07 | 18.87 | 1.80 | Hoff | 1.44 | 0.7 | 9.83 | 18.21 | 68.38 | 0.59 | 5.00 |
| **APC16-011a-02** | 25.14 | 26.11 | 0.97 | Hoff | | 0.71 | 8.71 | 18.12 | 57.84 | 0.53 | 6.00 |
| **APC16-019-01** | 34.44 | 36.48 | 2.04 | Hoff | 1.36 | 1.5 | 13.01 | 19.19 | 35.92 | 0.75 | 1.50 |
| **APC16-019a-01** | 12.51 | 14.33 | 1.82 | Hoff | 1.44 | 2.55 | 7.21 | 19.76 | 30.27 | 0.62 | 1.00 |
| **APC16-013-01** | 11.27 | 12.79 | 1.52 | Hoff | - | 1.54 | 7.41 | 17.53 | 73.9 | 0.47 | 0.00 |
| **APC16-013a-01** | 14.98 | 16.02 | 1.04 | Hoff | 1.46 | 1.56 | 8.78 | 16.97 | 64.47 | 0.47 | 0.00 |
| **APC16-020-01** | No sample recovered | | | Moosehorn | - | - | - | - | - | - | - |
| **APC16-020a-01** | 14.48 | 15.93 | 1.45 | Moosehorn | 1.31 | 1.16 | 12.21 | 19.64 | 48.04 | 0.53 | 7.00 |

# 11 Sample Preparation, Analyses, and Security

Coal samples were collected during the 2016 exploration program from conventional drilling and core drilling. Different protocols were used for sampling and analysis. They are described below.

## 11.1 Conventional Drill Sampling

For each drillhole, lithologic chip samples were collected by the driller's helper, from the sample stream several times for each 3 m run. They were rinsed and placed in a chip tray with the drillhole number and interval marked. Trays were collected by the site geologist, fully cleaned and logged and placed in sample vials. Coal chip samples were collected by members of the drill crew from the cyclone sampling output stream under supervision of a site geologist. The driller was instructed to stop drilling at first signs of coal, circulate and drill at 1.0 m intervals. Each interval was bagged separately in a cloth bag to allow wet samples to drain. Each bag was marked and tagged with the appropriate interval at the drill. Samples were collected by the site geologist from the drill, taken to camp, allowed to drain and inspected. Seam samples under 0.5 m were rejected, as they were dominantly shale samples. Samples were sorted and composited for each seam and packed in sealed labeled plastic bags. The bags were placed in sealed plastic pails and shipped via commercial courier to the Birtley Coal and Mineral Testing Division of GWIL Industries Inc. in Calgary, AB (Table 13-6). Subsamples of selected intervals were forwarded to David E. Pearson and Associates Ltd., in Victoria, BC, for petrographic analysis (Table 13-7).

## 11.2 Core Sampling

Core was removed from the core barrel in 3½" (9 cm) plastic liners in nominal 10 ft. (3.04 m) lengths for logging and photographing by the site geologist. Coal intervals were sampled separately and placed immediately into sealed plastic bags with sample number and interval marked. The site geologist transported the samples to camp, where they were sealed in plastic pails. Samples were transported by the site geologist back to the Dahrouge office in Edmonton, AB, and shipped via commercial courier to the Birtley Coal and Mineral Testing Division of GWIL Industries Inc. in Calgary, AB (Table 13-1 to Table 13-4). Subsamples were forwarded to David E. Pearson and Associates Ltd., in Victoria, BC, for petrographic analysis.

## 11.3 Petrographic Samples

Petrographic analysis was conducted on four composite washed rotary chip samples and eight washed core samples to ascertain coal rank and composition. The samples were prepared and analyzed by David Pearson and Associates (Pearson) in Victoria, BC (Table 13-5).

## 11.4 Laboratory Sample Preparation and Analysis

Composited conventional drilling chip samples were sent to Birtley Coal and Mineral Testing Division of GWIL Industries Inc. in Calgary, AB. Upon receipt, samples were weighed and air-dried. Samples were crushed to minus 9.5 mm if required, and a representative split of about 500 g was selected for float/sink analysis. The clean float samples were subjected to full proximate analysis, as well as sulphur, and FSI (Free Swelling Index). HGI (Hardgrove Grindability Index) was not determined as samples were too fine (Table 13-3). These results are discussed in Section 13.

Core samples were sent via courier to Birtley Coal and Mineral Testing in Calgary, AB (Birtley). Samples were weighed and air-dried. Prior to crushing, an apparent relative density determination was made to aid in determining recovery and composite choices. Samples were then crushed to pass minus 12.5 mm if required, and screened to ±0.25 mm. Subsamples of ¼ or less, depending upon mass, were taken and a raw coal head sample was assayed for proximate analysis, sulphur, FSI (free swelling index) and LT% (light transmittance) to determine level of oxidation (Table 13-1). The retained split for unoxidized samples was screened to ± 0.25 mm. On the plus 0.25 mm fraction, a float sink test was conducted at 1.50 and 1.60 SG and the fractions assayed for proximate analysis, sulphur, and FSI. The clean coal composite was run for full proximate analysis, sulphur, FSI, fluidity, dilatation, phosphorus in coal and mineral analysis of the ash. A split of the clean coal was sent directly to David E. Pearson and Associates Ltd., in Victoria, BC, for petrographic analysis.

These results are discussed in Section 13.

## 11.5 QUALITY CONTROL AND QUALITY ASSURANCE

Laboratories used for coal analysis during the Palisades program have established industry experience. 2016 Palisades coal samples were analyzed by Birtley using ASTM D2013, D 3302, D3173, D3174, D3175, D4239, D720, D5263, D5515, D2639, D3682, D2795, and D4371 procedures. Birtley adhere to ASTM and ISO preparation and testing specifications and have quality control processes in place. They have participated in the International Canadian Coal Laboratories Round Robin Series (CANSPEX) since its inception. They are also part of the ISO Technical Committee for Canada for TC27 and its associated subcommittees for coal preparation and coal testing. Pearson Coal Petrography has provided services in Victoria since 1981. They operate to ISO standards, undertake routine calibration of photometers and potentiometers, and employ two methods of vitrinite reflectance as a means of quality assurance. They also perform a monthly internal round robin check between their four labs worldwide. Vitrinite reflectance was employed in part to provide an independent valuation of coal rank.

Both Birtley and Pearson are commercial laboratories and are independent of the issuer.

Conventional drilling and core intervals containing coal were sampled in 2016 using project-defined procedures, processed as raw and clean coal samples, and analysed as described. The major issues affecting coal quality analyses during the 2015 program were:

The imprecise nature of conventional drilling sampling (thin coal intersections were in some cases poorly recovered or over-contaminated with out-of-seam rock in the open hole) as reflected by the high ash content (typically greater than 50%) and the fine size of the material which cannot be qualified as truly representative of the in-situ coal seam. As such the value of this sample information is primarily limited to the determination of coal rank only (expressed as $R_0$ Max).

The coring program in 2015 was somewhat limited by recovery problems due to the extremely sheared nature of the coal seams. Overall coal seam recoveries in 2016 using smaller diameter HQ (6.3 cm)) core rather than 6-inch (15 cm) were good, and ranged between 82.8% and 93.3%, except for sample APC16-019-01 and 01a (Table 11-1).

**Table 11-1. 2016 Core Coal Sample Recovery**

| Sample | Drill Hole | From (m) | To (m) | Length (m) | Recovery (m) | % Recovery | Seam |
|---|---|---|---|---|---|---|---|
| **APC16-011-01** | APC16-011 | 19.66 | 21.58 | 1.92 | 1.59 | 82.8% | Hoff |
| **APC16-011a-01** | APC16-011a | 17.07 | 18.87 | 1.80 | 1.68 | 93.3% | Hoff |
| **APC16-011a-02** | APC16-011a | 25.14 | 26.11 | 0.97 | 0.81 | 83.5% | Hoff |
| **APC16-019-01** | APC16-019 | 34.44 | 36.48 | 2.04 | 0.77 | 37.7% | Hoff |
| **APC16-019a-01** | APC16-019a | 12.51 | 14.33 | 1.82 | 0.46 | 25.3% | Hoff |
| **APC16-013-01** | APC16-013 | 11.27 | 12.79 | 1.52 | 1.3 | 85.5% | Hoff |
| **APC16-013a-01** | APC16-013a | 14.98 | 16.02 | 1.04 | 0.97 | 93.3% | Hoff |
| **APC16-020-01** | APC16-020 | No sample recovered | | | 0 | 0.0% | Moosehorn |
| **APC16-020a-01** | APC16-020a | 14.48 | 15.93 | 1.45 | 1.23 | 84.8% | Moosehorn |

The results are discussed in Section 13.

# 12 DATA VERIFICATION

Author Robert Engler visited the Property on July 18-20, and July 29-30, 2015. He reviewed geology and stratigraphy, drilling and sampling methodology, as well as core sampling and methodology. Mr. Gorham visited the Property on June 4-16, June 20-27, July 5-11, July 18-30 and August 1-8, 2015. He reviewed geology and mapping, and drill site location, as well as sampling. Mr. Miller did not visit the Property.

Historical data including mapping, geophysical logs, location data and coal intersections were reviewed and verified for consistency in 2013, and re-evaluated in conjunction with new mapping and drilling in 2015 and 2016. As mentioned in Section 10, original logs and analytical data were not always available. The authors have relied on the professional quality of the historic work. The authors have concluded that work completed by Rio Tinto and Denison was completed in a professional manner that was consistent with the data collection and reporting standards of the time, and can therefore be incorporated in interpretation for modelling purposes.

Some limitations to the data set generated during the program were noted. The regularity with which chips were retrieved, sieved, and washed was generally consistent. A 1.0 m sample interval for coal seams was chosen to minimize contamination while being practical for drilling rates. It must be assumed that some part of the top of a seam would be lost, as the driller must react quickly to an increase in penetration rates and stop drilling, circulate to observe cuttings for coal and initiate coal sampling. Similarly, the last sample of a given seam has potential to include some of the floor rock before the driller can react and stop cutting. As the sample interval approaches the actual seam thickness, under-reporting and rock contamination increase. It must be assumed that this was a factor in the Palisades program.

Lithologic chip sampling during rotary drilling is by its nature imprecise, as circulation return time varies with depth. Some depth correction, especially for sharp lithologic changes such as coal seams, can be achieved with downhole geophysical logs, which provide more accurate depth picks and thicknesses for seams. Of the 25 conventional rotary holes drilled in the 2016 program, three holes had no downhole logs as they did not reach bedrock and caved in (AP16-008, AP16-014 and AP16-024). AP16-001 had only through-pipe density due to blocking. AP16-002 and AP16-007 had only a partial open-hole electrologs due to collapse when rods were pulled. Seam and lithologic picks for these holes were therefore incomplete. Two holes (AP116-006, and AP16-021) had only partial open-hole logs due to sloughing after rods were pulled, but in each case, were logged to within 15 m of drilled depth.

Selected historic drillhole and trench information from programs by Rio Tinto and Denison was used to support geologic interpretation from the 2013, 2015 and 2016 drilling information. This integrated interpretation was used in the current resource estimation. Altitude and Dahrouge were not involved in the historic coal quality sampling programs. Original logs and analytical information for the historic drilling and trenching were not available. Although the Rio Tinto program employed conventional theodolite surveying of collars and trenches in the Coal Hill area, details for Denison program were unavailable, therefore collar locations were georeferenced. The authors acknowledge some uncertainty, especially in elevations for this information. Reliance on historic seam picks and thickness was confirmed, when possible, and modified in accordance with new information. It has been determined that geological professionals from both companies employed best practices, of the time.

The authors note that air blast drilling techniques in open holes may contribute to some relatively high ash contents observed in some reverse coal chip samples. The lack of open-hole geophysical logs in three drillholes, and the partial blockage of other holes reduced the ability to interpret subsurface geology and seam correlation, reducing somewhat the robustness of the geological model upon which resource estimation is based. The lack of outcrop in many areas of the Property also hampers geological and structural interpretation.

# 13 MINERAL PROCESSING AND METALLURGICAL TESTING

## 13.1 COAL QUALITY ASSESSMENT

This section deals with an assessment of coal quality for the Palisades Property based on drilling in 2016. Previous work reported by Rio Tinto Exploration in 1970 and Denison Mines Ltd in 1983 and the results of coring and sampling undertaken by Altitude during the 2013, and 2015 exploration campaigns are summarized in Engler and Morris, (2011) and Engler et al. (2015).

### 13.1.1 Coking Coal Quality Assessment Parameters

The main analytical criteria for coking coal evaluation are:

***Coal Rank and Petrographic Composition***

Coking coals only occur within a certain coal rank window as measured by vitrinite reflectance ($R_o$ Max). The range is from $R_0$ 1.0 to 1.6 (high-volatile to low-volatile bituminous). Palisades coking coals are typically in low- to mid-volatile ranges ($R_0$ 1.33 to 1.55).

As a general statement, the value of a coking coal is related its ability to form a hard coke product during carbonization. The mechanical strength of produced coke is measured by its resistance to abrasion. The ASTM coke stability test places 3-inch lump coke in a tumbler drum and screens the coal on a 1 inch screen after 1,400 revolutions. The amount remaining on the screen (expressed as a percent of total sample) is the Stability Index. In general, results over 55% are good, 60 to 65% are excellent. The Japanese run a similar test: the JIS drum Index D1 30/15, where 50 mm top size coke is rotated for 30 revolutions and the percentage of -15 mm is measured. Both tests do essentially the same thing and the results from one can be "translated" into the other format.

The strength of coke produced can be determined by the petrographic composition of the organic elements of the coal, called macerals. These are divided into reactive macerals (those that melt during coke making) and inert macerals (those that don't). It is important to have the right ratio of reactives to inerts to produce a strong coke.

Research conducted by US Steel proved that the ASTM coke stability index could be predicted with a high degree of accuracy using petrographic (microscopic) analysis to determine two key criteria:

- Coal rank as determined by the reflectance of vitrinite in a coal sample ($R_0$ Max)
- The amount of inert (non-melting) macerals within a coal sample.

The advantage to this technique is that it allows for a very accurate, cost effective test without the expense of having to physically produce a coke sample.

The following chart produced by David Pearson and Associates shows this fundamental relationship between rank, inerts and coke stability:

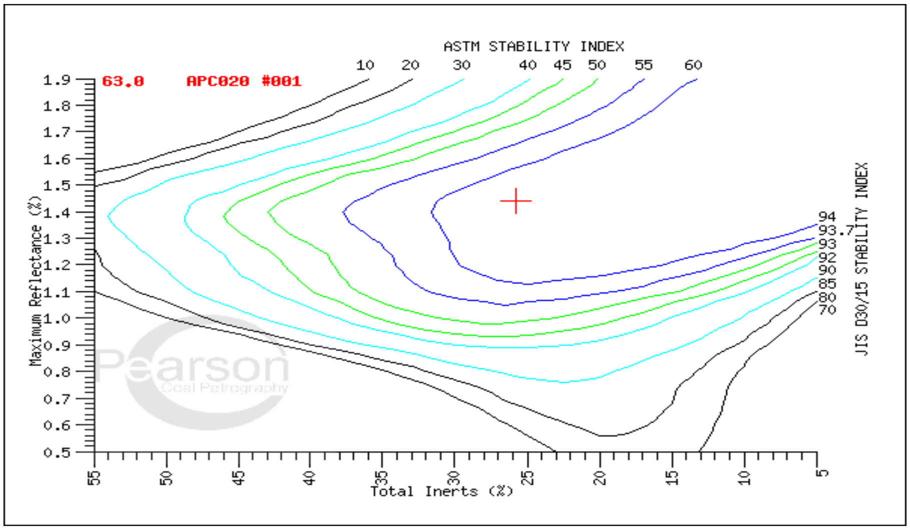


**Figure 13-1. Relationship between Rank ($R_0$ Max), percent Inerts, and Coke Stability**

The diagram shows that plotting the petrographic indices for rank ($R_0$ Max) and total inerts for any coal sample will allow a prediction of coke stability. In this example the plotted red cross is a sample from the Solomon Seam (Sonic core APC13-020); with a stability of 63, which is excellent. One may also observe that if the level of inerts increases or the $R_0$ value starts to go up, the stability decreases.

The breakdown of coal macerals into reactives and inerts is based on whether they melt during the carbonization process. The reactives melt; the inerts as the name implies do not. Reactive macerals are typically vitrinite, half of the semifusinite, and exinite. Inert macerals are half of the semifusinite, fusinite (which is charcoal), micrinite and mineral matter. The relative proportion of these maceral types is determined by the composition of the original source materials.

### *Free Swelling Index (FSI)*

This test measures the caking/swelling property of a coal sample when heated in a crucible in the absence of air. The resulting coke button is measured for expansion on a scale of 1 to 9. A good coking coal will have an FSI greater than 5. This is an easy test to perform and is used as an initial screening tool.

### *Rheology*

The Gieseler Fluidity and Arnu Dilatation tests measure the plastic properties of coking coal through the heating cycle from initial melting temperature through to final solidification temperature. The fluidity test measures the viscosity of the coal when melted in a fluid state (measured in ddpm) and the dilatometer measures expansion and contraction during devolatization. Coals with higher fluidity properties are good for blending, and low-pressure expansion and contraction on final coking are desirable in coke ovens.

### *Ash Chemistry*

In addition to the stability index, coke stability after reaction (CSR) is an important evaluation parameter for evaluating a coking coal type.

When coke descends in the blast furnace, it is subjected to reaction with countercurrent carbon dioxide ($CO_2$), and abrasion. These concurrent processes weaken the coke and chemically react with it to produce excess fines that can decrease the permeability of the blast furnace burden.

The CRI/CSR test measures coke reactively in carbon dioxide at elevated temperatures and its strength after reaction by tumbling. In the test, 200g of $^{+}19 \times ^{-}22$ mm sized coke is reacted in a vessel with $CO_2$ gas for 2 hours at 1,100°C. The weight loss after the reaction equals the CRI. The reacted coke is then tumbled in an I-shaped tumbler for 600 revolutions at 20 rpm and then weighed. The weight percent of the $^{+}$10mm coke equals the CSR. Most blast furnaces will require a coke with a CSR greater than 60 and CRI less than 25.

Research has shown that ash chemistry is a key factor in determining CSR values. The presence of alkaline elements such as Fe, Ca, Na and K has a catalytic effect on the reaction of $CO_2$ with coke, resulting in an accelerated breakdown in the blast furnace. Consequently, coals with low alkaline content will have the highest, most desirable CSR characteristics.

Nippon Steel and Kobe Steel have developed formulas to predict CSR and CRI values. The input parameters are coal rank ($R_0$), fluidity and ash chemistry.

The other evaluation aspect that warrants consideration is the phosphorous content of the coke. The acceptable maximum limit is 0.27% $P_2O_5$ in coke; which means the coal should have less than 2.5% $P_2O_5$ in the ash.

## 13.2 2016 Coal Quality Results (Altitude Drilling)

The 2016 program was designed to continue and extend the 2015 quality information from the northern Coal Hill area to the southwest along the southwest limb of a major anticlinal structure. The plan was to initially drill using conventional air-blast techniques, and then follow up with coring in confirmed areas where good coal intersections had been discovered at suitable depths.

The coal core recovery problems experienced during the 2015 program were caused primarily by the inability to retain the highly fractured coal material in the large diameter 15 cm barrel. It was decided to try triple tube HQ continuous wireline coring for the 2016 program to avoid any potential downhole sample loss or caving contamination.

The initial core target was hole APC16-011, which contains two Hoff Seams splits separated by 6 m of rock parting (Figure 10-1, Table 11-1). The initial attempt recovered the upper seam only (83%). A second attempt (APC16-011a) intersected both seams with good recovery (93% and 83% respectively).

The second target was hole APC16-019, in which a single 2.04 m seam, identified as the Hoff Seam was intersected. Two attempts were made with poor recovery of 37.8% and 25.3% (APC16-019a) respectively. The recovered samples showed highly sheared and fractured coal, indicating a faulted zone. No further attempts were made at this location.

The third target hole was APC16-013, a single 1.52 m Hoff Seam. The first attempt recovered this seam at a depth of 11.3 m. Recovery was good at 85.5%. A second attempt (APC16-013a) was completed at a depth of 15 m and excellent recovery of 93%.

The final target was hole APC16-020, which intersected two thick 5 m seams that appear to be a structural repeat of the Moosehorn Seam. The initial attempt was a failure, so the drill rig moved 8 m up dip and intersected a 1.45 m seam at 14.5 m (APC16-020a). The recovery was good at 85%.

The coring program was concluded after this hole as the allotted budget was consumed. Overall, the triple tube continuous wireline method was considered successful. The challenge at Palisades' project continues to be the faulted and friable nature of the coal seams.

Chip samples were also collected from AP16-020 and AP16-021 to provide further samples for rank determination. It was assumed these would be most useful in identifying individual seams in this structurally complex area.

### 13.2.1 2016 - HQ Core Samples

The core intervals were logged on site and immediately sealed in plastic bags for transhipment to Birtley Labs in Calgary, Alberta. The samples were weighed and analyzed for raw proximate analysis, light transmittance (LT) and free-swelling index (FSI) (Table 13-1). LT tests are used to determine oxidation; values below 92 indicate the onset of oxidation.

**Table 13-1. 2016 - HQ Core Composite Head Raw Proximate Analysis**

| Seam | Sample | Moisture % | Ash % | Volatiles % | F.C.% | LT % | FSI* |
|---|---|---|---|---|---|---|---|
| **Hoff** | **APC16-011-01** | 0.75 | *16.63 | *17.11 | *65.51 | 99.2 | 6 |
| | | | +16.76 | +17.24 | +66.01 | | |
| **Hoff** | **APC16-011a-01** | 0.70 | *13.78 | *17.14 | *68.38 | 99.0 | 5.5 |
| | | | +13.88 | +17.26 | +68.86 | | |
| **Hoff** | **APC16-011a-02** | 0.71 | *22.13 | *19.32 | *57.84 | | 4 |
| | | | +22.29 | +19.46 | +58.25 | | |
| **Hoff** | **APC16-019-01** | 1.50 | *49.96 | *12.62 | *35.92 | 95.1 | 0 |
| | | | +50.72 | +12.81 | +36.47 | | |
| **Hoff** | **APC16-019a-01** | 2.55 | *54.89 | *12.62 | *27.08 | 62.7 | 05 |
| | | | +56.33 | +12.61 | +31.06 | | |
| **Hoff** | **APC16-013-01** | 1.54 | *7.30 | *17.26 | *73.90 | 92.3 | 0 |
| | | | +7.41 | +17.53 | +75.06 | | |
| **Hoff** | **APC16-013a-01** | 1.56 | *17.52 | *16.45 | *65.49 | 95.1 | 0 |
| | | | +17.80 | +16.71 | +46.62 | | |
| **Moosehorn** | **APC16-020a-01** | 1.16 | *35.94 | *14.86 | *48.04 | 98.8 | 1 |
| | | | +36.36 | +15.03 | +48.60 | | |

*adb: air dried basis
+ db: dry basis

A washability test program was undertaken to assess the characteristic of a clean coal product. The raw samples were crushed to 12.5 mm and the 12.5 mm x 0.25 mm fraction was washed at two specific gravities (1.50 and 1.60 sg). The minus 0.25 millimetre fraction was treated by froth floatation. The objective was to produce a clean coal product in the 10% ash range. The test work showed an optimum yield was achieved at 1.60 sg for the majority Hoff samples. The high ash samples in drillhole APC16-019 and APC16-019a were cut at 1.50 sg to produce a reasonable clean coal proxy. The clean coal samples were analyzed for proximate analysis, sulphur, FSI, fluidity, dilatation, and mineral analysis of ash (Table 13-1to Table 13-4). A representative split of each sample was sent for petrographic analysis (Table 13-5).

**Table 13-2. 2016 - HQ Core Washability Analysis**

| Sample | Seam | Thickness (m) | Raw Ash% *db | Float SG | Clean Coal Proximate Analysis | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Yield % | Ash % *db | VM % *db | S % *db | FSI |
| **APC16-011-01** | **Hoff** | 1.92 | 16.76 | 1.6 | 84.48 | 9.04 | 18.56 | 0.72 | 7.5 |
| **APC16-011a-01** | **Hoff** | 1.8 | 13.88 | 1.6 | 88.12 | 9.83 | 18.21 | 0.59 | 5 |
| **APC16-011a-02** | **Hoff** | 0.97 | 22.29 | 1.6 | 70.72 | 8.79 | 18.12 | 0.53 | 6 |
| **APC16-019-01** | **Hoff** | 2.04 | 50.72 | 1.5 | 20.97 | 13.01 | 19.19 | 0.74 | 1.5 |
| **APC16-019a-01** | **Hoff** | 1.82 | 56.33 | 1.5 | 8.75 | 7.21 | 19.76 | 0.62 | 1 |
| **APC16-013a-01** | **Hoff** | 1.04 | 17.80 | 1.6 | 76.81 | 8.78 | 16.97 | 0.47 | 0 |
| **APC16-020a-01** | **Moosehorn** | 1.45 | 35.94 | 1.5 | 36.45 | 12.21 | 19.64 | 0.53 | 7 |

* db: dry basis

The washability results show poor yields from both APC16-019-01 and APC16-019a-01 samples due to the high ash content of the raw coal. The low LT value in APC16-019a-01 show the coal is oxidized at this location. Similarly, the zero FSI values recorded for the APC16-013 sample indicate partial oxidation of the coal

The unoxidized clean coal samples were analyzed for fluidity and dilatation to get some understanding for the plastic properties of this coal (Table 13-3).

The results show low fluidity values ranging from 0.7 to over 16 for the Hoff Seam samples. The dilatation test shows this coal is contracting (-22%) and has positive dilatation, both of which are good for coke-making. The oxidized samples exhibit no plastic properties at all. These results are consistent with the 2013 and 2015 data.

The single Moosehorn Seam sample shows a considerably higher fluidity value of 271 ddpm and similar contracting behavior.

**Table 13-3. 2016 - HQ Core Sample Rheology**

| Sample | Seam | Gieseler Fluidity | | | | | Dilatation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial Soft (°C) | Max. Fluidity (°C ) | Solidification (°C) | Range (°C) | Max. Ddpm* | Soft Temp °C | Max. Contr. Temp °C | Max. Dil. Temp °C | Contrac-tion % | % Dil |
| | | | | | | | T1 | T2 | T3 | | |
| **APC16-011-01** | **Hoff** | 455 | 476 | 497 | 42 | 3.6 | 417 | 468 | 492 | 25 | -16 |
| **APC16-011a-01** | **Hoff** | -- | 471 | | | 0.9 | 418 | 478 | | 20 | |
| **APC16-011a-02** | **Hoff** | 464 | 475 | 499 | 35 | 1.4 | 421 | 490 | | 20 | |
| **APC16-020a-01** | **Moose-horn** | 427 | 470 | 500 | 73 | 271 | 397 | 448 | 473 | 20 | 2 |

* Ddpm = dial divisions per minute

The last phase of lab testing was for the determination of coal ash chemistry. The results for the twelve-element ash analysis conducted on the clean HQ (6.5 cm) core samples are shown in Table 13-4. They are representative of the 2013 and 2015 samples, with very low alkaline element content.

**Table 13-4. 2016 - HQ Core Ash Chemistry**

| Sample | Seam | $SiO_2$ | $Al_2O_3$ | $TiO_2$ | CaO | BaO | SrO | $Fe_2O_3$ | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | SO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APC 16-011-01 | Hoff | 69.45 | 16.25 | 0.85 | 0.60 | 0.58 | 0.03 | 7.33 | 1.38 | 0.28 | 1.07 | 0.09 | 0.50 |
| APC 16-011a-01 | Hoff | 72.56 | 15.76 | 0.96 | 0.50 | 0.52 | 0.03 | 4.62 | 1.18 | 0.27 | 1.18 | 0.08 | 0.42 |
| APC 16-011a-02 | Hoff | 62.83 | 15.57 | 1.14 | 0.94 | 0.51 | 0.04 | 15.23 | 1.29 | 0.31 | 0.64 | 0.32 | 0.95 |
| APC16-019-01 | Hoff | 64.63 | 23.24 | 2.13 | 0.55 | 0.60 | 0.03 | 4.42 | 0.99 | 0.28 | 1.49 | 0.24 | 0.62 |
| APC16-019a-01 | Hoff | 59.81 | 25.26 | 1.99 | 0.69 | 0.66 | 0.06 | 6.93 | 1.77 | 0.19 | 1.28 | 0.21 | 0.62 |
| APC16-013a-01 | Hoff | 64.35 | 24.51 | 1.03 | 0.38 | 0.60 | 0.02 | 4.60 | 0.90 | 0.34 | 1.42 | 0.10 | 0.27 |
| APC16-020a-01 | Moose-horn | 63.28 | 23.20 | 0.85 | 0.59 | 0.58 | 0.04 | 6.78 | 1.77 | 0.13 | 1.59 | 0.14 | 0.45 |

These same samples were analysed for petrographic composition (Table 13-5). The results show a good compositional balance of reactive to inert macerals in the Hoff Seam samples and apart from APC019 - 01, a consistent rank of $R_0$Max 1.44 to 1.46. These results are consistent with the Hoff Seam's low volatile bituminous rank values determined in the 2015 drill sampling program. The lower $R_0$Max 1.36 value in sample APC16-019-01 is thought to be caused by severe fault shearing at this location.

The Moosehorn Seam sample showed a lower mid volatile $R_o$Max 1.31 rank which is again consistent with rank values in previous programs.

**Table 13-5. 2016– HQ Core Petrographic Analysis**

| Sample | Seam | $R_0$ Max | Reactive Macerals | | | Inert Macerals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Vitrinite | Semi-Fusinite | Total Reactives | Semi-Fusinite | Fusinite | Inerto | Macrinite | M.M.* | Total Inerts |
| APC 16-011-01 | Hoff | 1.45 | 64.9 | 12.3 | 77.2 | 12.5 | 1.3 | 3.4 | 0.4 | 5.2 | 22.8 |
| APC 16-011a-01 | Hoff | 1.44 | 64.1 | 11.2 | 75.3 | 11.2 | 1.7 | 6.2 | 0.2 | 5.4 | 24.7 |
| APC 16-011a-02 | Hoff | 1.46 | 50 | 18.6 | 68.6 | 18.6 | 4 | 3.6 | 0.2 | 5 | 31.4 |
| APC 6-019-01 | Hoff | 1.36 | 69.4 | 8.2 | 77.6 | 8.2 | 3.5 | 3.3 | 0.2 | 7.2 | 22.4 |
| APC 16-019a-01 | Hoff | 1.44 | 58.6 | 11.7 | 70.3 | 11.9 | 10.8 | 3.1 | | 3.9 | 29.7 |
| APC 16-013a-01 | Hoff | 1.46 | 49.8 | 18.8 | 68.6 | 18.8 | 3.2 | 4 | 0.4 | 5 | 31.4 |
| APC 16-020a-01 | Moose-horn | 1.31 | 46.4 | 13.4 | 59.8 | 13.4 | 14.2 | 4.8 | 0.9 | 6.9 | 40.2 |

*M.M. = Mineral Matter

### 13.2.2 2016 Drill Chip Samples

Drill chip samples were collected from four holes (APC16-020-01, APC16-020-02, APC16-021-01, and APC16-021-02) to obtain samples for petrographic rank determination. The purpose was to identify specific seams in a structurally complex area. The chip samples were washed at Birtley labs at 1.50 SG to produce a clean coal proxy for further analysis. The first step was proximate analysis (Table 13-6). The LT results showed that samples are all unoxidized and have very good FSI values. Sample splits were then sent to Pearson Petrographics for analysis (Table 13-7).

**Table 13-6. 2016 Chip sample Proximate Analyses dry.**

| Sample | Seam | LT | %Yield | 1.50 float Ash | 1.50 float Volatiles | % DAF Volatiles | % Sulphur | FSI |
|---|---|---|---|---|---|---|---|---|
| **APC16-020-01** | **Moosehorn** | 97.5 | 64.45 | 8.65 | 20.00 | 21.89 | 0.54 | 8.5 |
| **APC16-020-02** | **Moosehorn** | 98.8 | 55.89 | 8.99 | 19.83 | 21.79 | 0.54 | 8 |
| **APC16-021-01** | **Hoff** | 98.9 | 44.48 | 9.36 | 19.93 | 21.99 | 0.57 | 8.5 |
| **APC16-021-02** | **Hoff** | 97.4 | 54.99 | 8.33 | 19.58 | 21.36 | 0.55 | 9 |

The $R_0$Max results for chip samples were compared to the known rank range for the three coal seams from the 2013 and 2015 programs.

The lower rank 1.33 Ro in the APC16-020 holes confirms this is a Moosehorn Seam. The higher rank of 1.40 $R_0$Max (average) confirms that the Hoff Seam was sampled in the APC16-021 holes

**Table 13-7. 2016 Chip Sample Petrographic Analysis**

| | | | Reactive Macerals | | | Inert Macerals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample** | **Seam** | **$R_0$ Max** | **Vitrinite** | **Semi-Fusinite** | **Total Reactives** | **Semi-Fusinite** | **Fusinite** | **Inerts** | **Macrinite** | **M.M.*** | **Total Inerts** |
| **APC16-020-01** | **Moose-horn** | 1.33 | 51.6 | 17.9 | 69.5 | 17.9 | 5.5 | 1.7 | 0.6 | 4.8 | 30.5 |
| **APC16-020-02** | **Moose-horn** | 1.32 | 51.1 | 17.5 | 68.6 | 17.5 | 6.6 | 1.7 | 0.6 | 5.0 | 31.4 |
| **APC16-021-01** | **Hoff** | 1.37 | 67.2 | 9.3 | 76.5 | 9.3 | 4.7 | 3.6 | 0.6 | 5.3 | 23.5 |
| **APC16-021-02** | **Hoff** | 1.42 | 68.0 | 10.7 | 78.7 | 10.7 | 2.9 | 2.9 | 0.2 | 4.6 | 22.3 |

*M.M. = Mineral Matter

## 13.3 2016 RESULTS

Coal sampling on the Palisades Project has been difficult due to the complex structure and friable nature of the seams encountered. Core sampling in 2013 using sonic coring equipment was not satisfactory due to the incompetent strength of the coal material. Large diameter 15 cm coring in 2015 had less than optimal recovery. The HQ triple wireline coring method used in 2016 has achieved the best results to date in terms of coal recovery and appears to be the best method going forward.

From the analytical information collected over the past three years, the following observations are made regarding the three main coal seams underlying the property.

- **Solomon Seam**

  This seam was sampled in the 2013 and 2015 campaign. Due to poor core recovery techniques, the raw coal ash content was typically high and as such no realistic washability recovery values can be determined. The washed clean coal proxy samples (1.50 to 1.60 SG) indicate a clean product in the 10% ash content range could be produced, with a volatile matter content of 18.5% and sulphur content 0.60%. The FSI averages 8 and the coal shows low fluidity, averaging 7 ddpm which is typical for this rank of coal in western Canada.

  Petrographic analysis shows an $R_0$Max value of 1.48 +/- 0.02 which confirms the rank of low volatile bituminous. Petrographic composition shows an average Reactives/Inerts ratio of 76/24 which results in a predicted stability of 62.

  Ash chemistry analysis shows a very low alkaline content and a base/acid ratio of 0.11 +/- 0.04. The phosphorous level is very low at 0. 020% P in coal.

- **Hoff Seam**

  This seam was sampled in the 2015 and 2016 campaign. The 2016 core recoveries were good so the data here is much more reliable. The averaged raw ash content was 26.5%. Washing at 1.50 and 1.60 SG produced a clean product at 9.14% Ash, 18.33% volatile matter, 0.59% sulphur and an FSI of 6.5. The washing yield was 64%.

  Fluidity values are low at 2 ddpm.

  Petrographic analysis shows an $R_0$Max value of 1.44 +/- 0.04 which confirms the rank of low volatile bituminous. Petrographic composition shows an average reactives/inerts ratio of 73/27 which results in a predicted stability of 63.

  Ash chemistry analysis shows a very low alkaline content and a base/acid ratio of 0.14 +/- 0.02. The phosphorous level is very low at 0. 010% P in coal.

- **Moosehorn Seam**

  This seam was sampled in a single core in the 2015 and 2016 programs so the data set is limited. The averaged raw ash content was 35.6%. Washing at 1.50 and 1.60 SG produced a clean product at 10.29% ash, 20.11% volatile matter, 0.53% sulphur and an FSI of 7. The washing yield wash was low at 34%. Fluidity values are much higher at 271 ddpm.

  Petrographic Analysis shows an $R_0$Max value of 1.33+/- 0.02 which confirms the rank of mid volatile bituminous. Petrographic composition shows an average reactives/inerts ratio of 66/34 which results in a predicted stability of 58.

  Ash chemistry analysis shows a very low alkaline content and a base/acid ratio of 0.13 +/- 0.03. Most of the alkaline content is $Fe_2O_3$ which averages 5 % on a whole ash basis. The phosphorous level is very low at 0. 014% P in coal.

# 14 MINERAL RESOURCE ESTIMATES

Mineral Resource Estimates for the Palisades Property in this report are based on historical drill and trench information and the 2013 through 2016 Altitude programs. Parameters in the current resource estimates remain the same as those presented for the 2015 program (Engler et al, 2014). The grouping of resource areas in this report was modified from Coal Hill and Regional (Central and South areas combined) in 2013, to Coal Hill/Central Palisades, where drilling was done in 2015 and 2016, and South Palisades where no further drilling has been undertaken since 2013.

Geological Classification

As the stratigraphic and structural complexity of a coal deposit increases, a greater number of data points are required to assign the coal to measured, indicated, or inferred resource categories. Data points are defined as locations where a coal seam, or a marker horizon indicating the proximity to a coal seam, is exposed. Valid data points were obtained from drillhole intersections, trenches, and surface outcrop. Table 14-1 outlines the resource classification criteria for different geology types. Figure 14-2 through Figure 14-6 present cross-sections through various parts of the property.

**Table 14-1. Resource Classification Categories** (Hughes et al., 1989)

| Geology Type | Resource Classification (Distance from Point) | | |
|---|---|---|---|
| | **Measured** | **Indicated** | **Inferred** |
| Moderate | 0-450 m | 450-900 m | 900-2,400 m |
| Complex | 0-100 m | 100-200 m | 200-400 m |
| Severe | 0-50 m | 50-100 m | 100-200 m |

A **moderate geology** type occurs where the deposit has only been subjected to limited tectonic deformation. This may include faults with displacements of less than 10 m, although these should be uncommon. Homoclines and broad open folds with wavelengths less than 1.5 km may also be present and bedding should not exceed 30°.

A **complex geology** type occurs where a deposit has been subjected to relatively high levels of tectonic deformation. Fault bounded blocks within this deposit type generally retain their normal stratigraphic sequence and seams will have only rarely been modified from their pre-deformational thickness. Tight folds with steeply dipping or overturned limbs can be present and offsets by faults are common.

A **severe geology** type occurs where extreme tectonic deformation has occurred. The stratigraphic sequence is commonly disturbed and difficult to ascertain, whereas coal seams are often structurally thickened and thinned from their pre-deformational state. Tight folds, steeply inclined and overturned beds, and large displacement faults are common.

**Density**

Rotary drilling and core samples taken in the 2013 through 2016 were too fine for meaningful density determinations. Historic density information for deposits on the Property is limited to determinations from whole core made by Denison. The bulk density values compare reasonably to estimates suggested in GSC Paper 88-21, which shows low volatile bituminous coal with bulk densities ranging from 1.52 $g/cm^3$ to 1.66 $g/cm^3$ having ash contents of 25% to 35%.

A lower bulk density value of 1.52 g/cm$^3$ was used as a conservative estimate, although ash contents determined from coal samples taken in 2013, 2015 and 2016 drill campaigns suggest that higher densities for some seam intersections could be supported. Sink/float determinations for both rotary and core samples show an average float yield of 54% at 1.60 g/cm$^3$.

**Geological Interpretation and Block Modelling**

The modelling methodology used for the resource estimation for all areas of the Property consisted of the following steps:

- Import data into the mining software package (Maptek Vulcan 10™).
- Database validation and error checking.
- Import fault surface triangulations from Leapfrog.
- Create area data subsets and blank fault block triangulations.
- Correlate drillholes, trenches, and surface exposures on or directly adjacent to the Property.
- Create final fault blocks by applying a Boolean Test to a blank fault block solid using the fault surface triangulations.
- Grid the topography and base of weathering triangulation surfaces (10 m). Base of weathering was created at a depth of 8 m below topography.
- Run FixDHD on each sub area to create Mapfile Databases.
- Create seam grids (20 m in Coal Hill/Central Palisades and 25 m in South Palisades) and triangulations in Model Stratigraphy using the FixDHD Mapfile Databases, topography grid, and base of weathering grid. Seam grids were cropped against the base of weathering grid to remove oxidized coal. Fault blocks were modelled using a hybrid method and a variety of trending types.
- Create HARP (Horizon Adaptive Rectangular Prism) block models for each sub area using the parting and thickness grids as qualities. Blocks were 40 x 40 m with a sub-blocking of 2 (x and y directions) in the Coal Hill/Central Palisades area, and 50 x 50 m with a sub-blocking of 2 in the South Palisades area.
- Classify block confidence using the distance of the block centroid to the nearest data point based on the criteria in Table 14-1.
- Determine the cumulative stripping ratio for each block of coal within the model (total volume of waste/total tonnage of product).
- Apply a parting factor (coal thickness/aggregate seam thickness).
- Calculate the coal resources for each sub area based on the criteria in Table 14-2.
- Constrain resource estimation by the current Altitude lease boundaries.
- Constrain resource estimation to coal bed thickness greater than 0.6 m for measured, indicated, and inferred classification.

**Table 14-2. Resource Reporting Criteria for Surface-Mineable Resources**

| Area | Resource Criteria | | | |
|---|---|---|---|---|
| | Coal Bed Thickness | Partings | Stripping Ratio | Geology Type |
| Coal Hill/Central Palisades | > 0.6 m | Not Included | < 1:20 | Complex |
| South Palisades | > 0.6 m | Not Included | < 1:20 | Complex |

**Probable Method of Extraction**

For resource classification in this report, only surface minable resources were considered. Surface resources were those with a cumulative stripping ratio of less than 1:20 (tonne coal to cubic metre of waste) and coal bed thicknesses greater than 0.6 m.

## 14.1 RESOURCE SUMMARY

The in-place resources for the Coal Hill and regional areas of the Palisades Property are summarized in Table 14-3. These areas are outlined in Figure 14-1. Seam thickness was adjusted to exclude partings.

**Depth of Weathering**

Some information has been gathered through drilling on actual depth of weathering, but it remains unsystematic as seam intersections have been targeted to try to avoid oxidized coal. Actual oxidised coal intersections provide only a minimum depth of weathering for a given seam at a given place. The deepest oxidized coal intersected was in core hole APC13-007, at 31.3 m, which appears to have resulted from oxidizing fluids through a fault conduit. Sample APC15-014-01 at 7.2-8.2 m was the shallowest oxidized intersection. The two samples of the Hoff Seam in APC16-013 and APC16-013a, at 11.3 and 15.0 m were also oxidized, but this may be due to comparatively steep dips. The shallowest depth at which un-oxidized coal was intersected was in APC15-011, at 14.1m (FSI 9.0).

An average estimated depth of oxidization of 8 m was used for resource estimation as this is the depth of weathering determined at the nearby and structurally similar Grande Cache Coal mine (van Eendenburg et al, 2011). The effect of depth of weathering on these estimates is significant, reducing the resource by 5 to 20% depending upon geometry. Future drilling and quality evaluation should continue efforts to constrain depth of weathering for the Property.

**Table 14-3. In-Place Surface-Mineable Coal Resources (Metric tonnes) Summary**

| Area | Seam | In-Place Coal Resources (TONNES) Stripping Ratio Cutoff 20:1 | | | |
|---|---|---|---|---|---|
| | | ASTM Group | Measured | Indicated | Inferred |
| Coal Hill/Central Palisades | Moosehorn | Mid-Volatile Bituminous | 910,000 | 540,000 | 530,000 |
| | Hoff | Low-Volatile Bituminous | 3,540,000 | 2,580,000 | 3,620,000 |
| | Solomon | Low-Volatile Bituminous | 5,110,000 | 3,300,000 | 4,060,000 |
| South Palisades | Moosehorn | Mid-Volatile Bituminous | 20,000 | 160,000 | 110,000 |
| | Hoff | Low-Volatile Bituminous | 70,000 | 160,000 | 190,000 |
| | Solomon | Low-Volatile Bituminous | 210,000 | 300,000 | 390,000 |
| | **Total Property** | | **9,860,000** | **7,040,000** | **8,900,000** |

(Note: partings removed, coal bed thickness >0.6 m, average 8 m oxidised surface zone removed; rounded to nearest 10,000 TONNES)

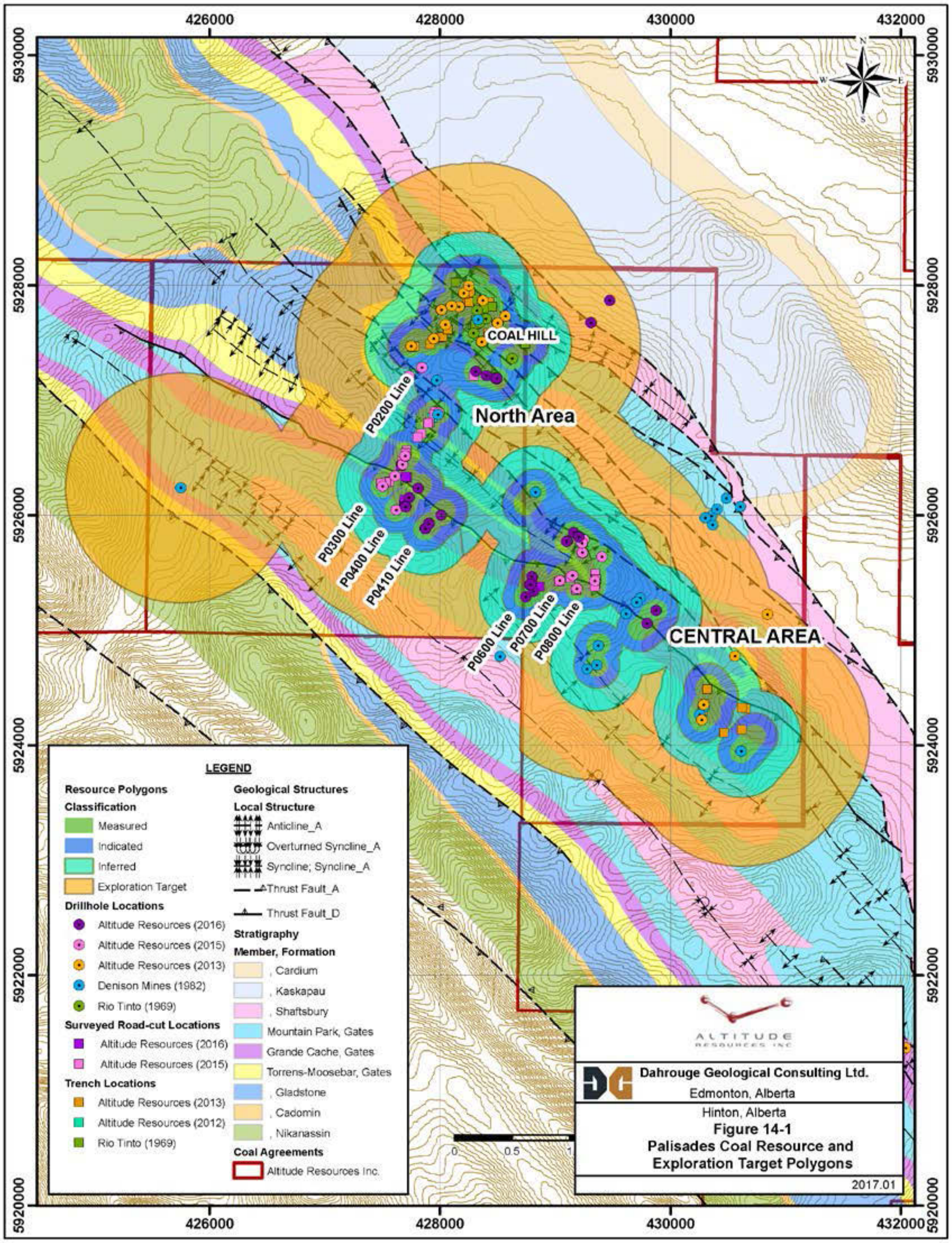


**Figure 14-1. Palisades Coal Resource Projections and Exploration Targets.**

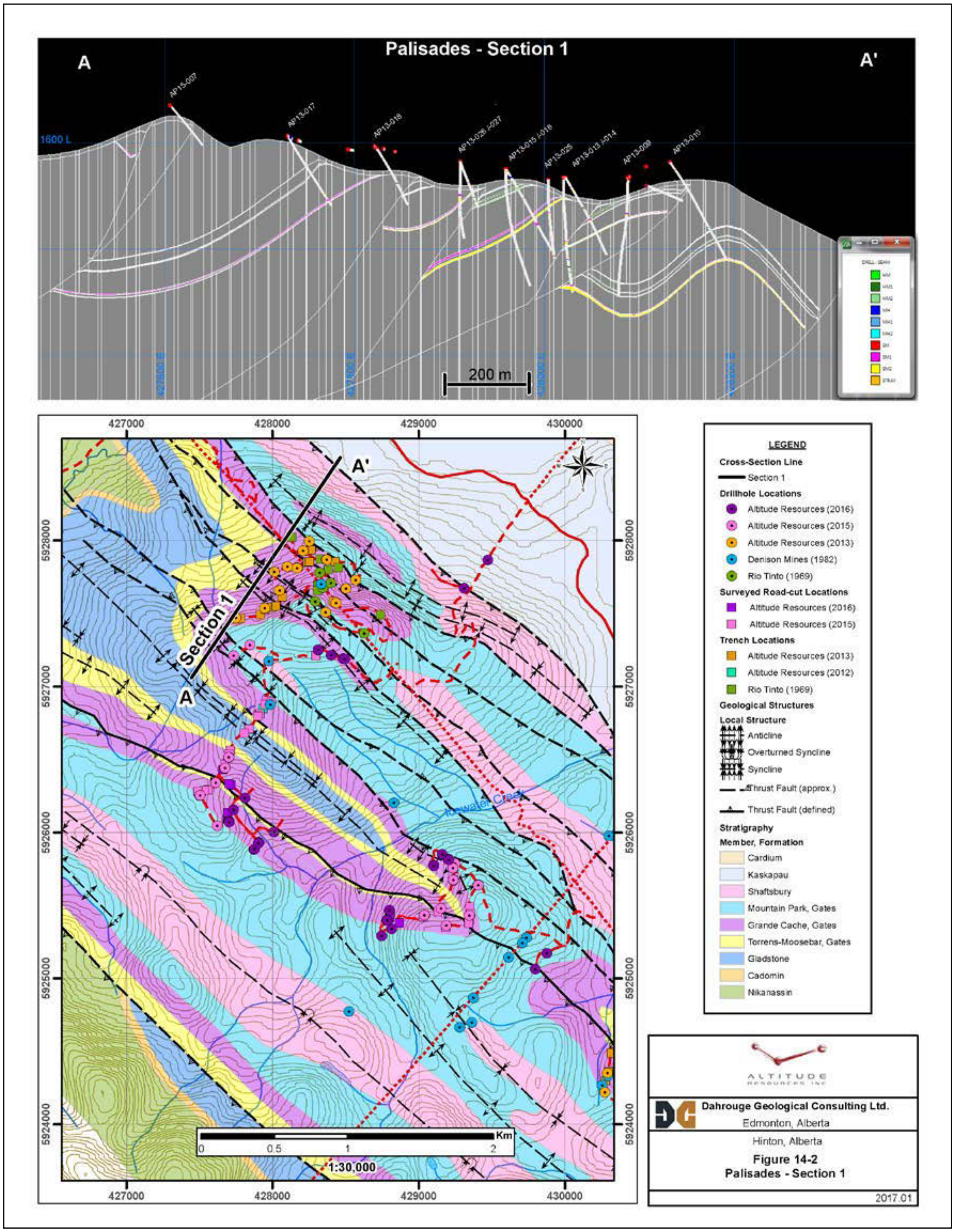


**Figure 14-2. Palisades Cross-Section 1 (A-A') Coal Hill Area**

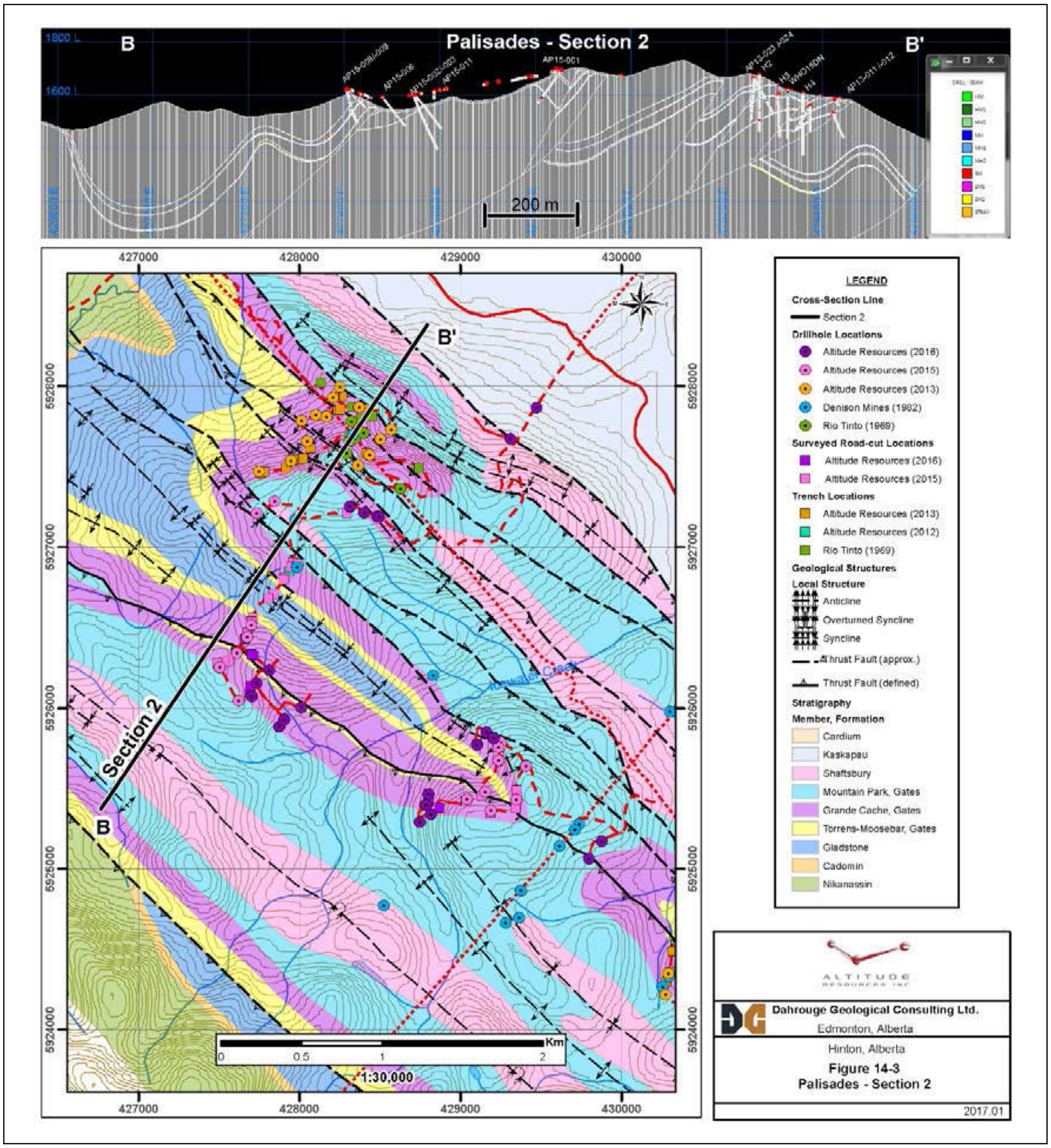


**Figure 14-3.      Palisades Cross-Section 2 (B-B') North Area and Coal Hill**

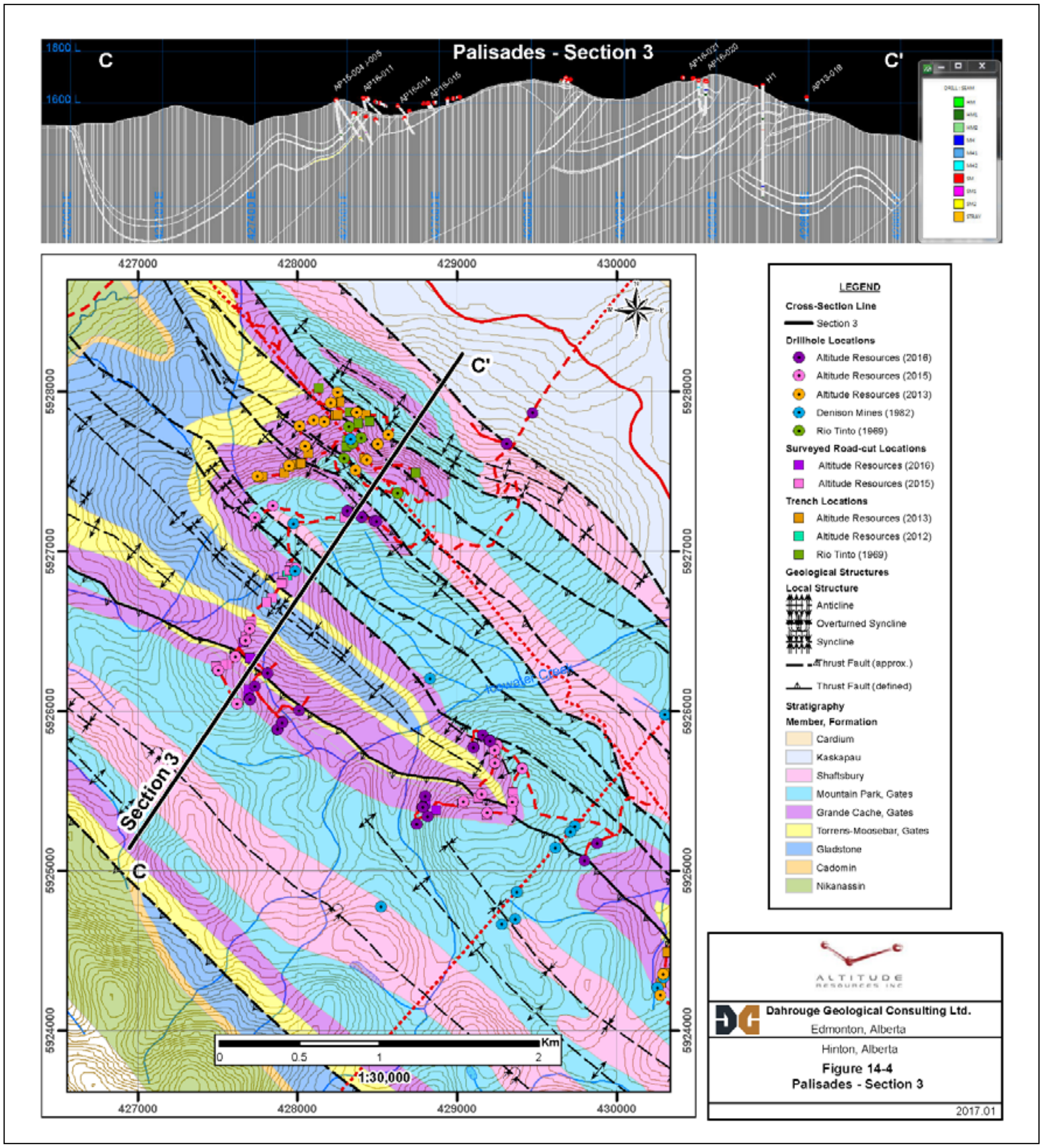


**Figure 14-4. Palisades Cross-Section 3 (C-C') North Area and Coal Hill**

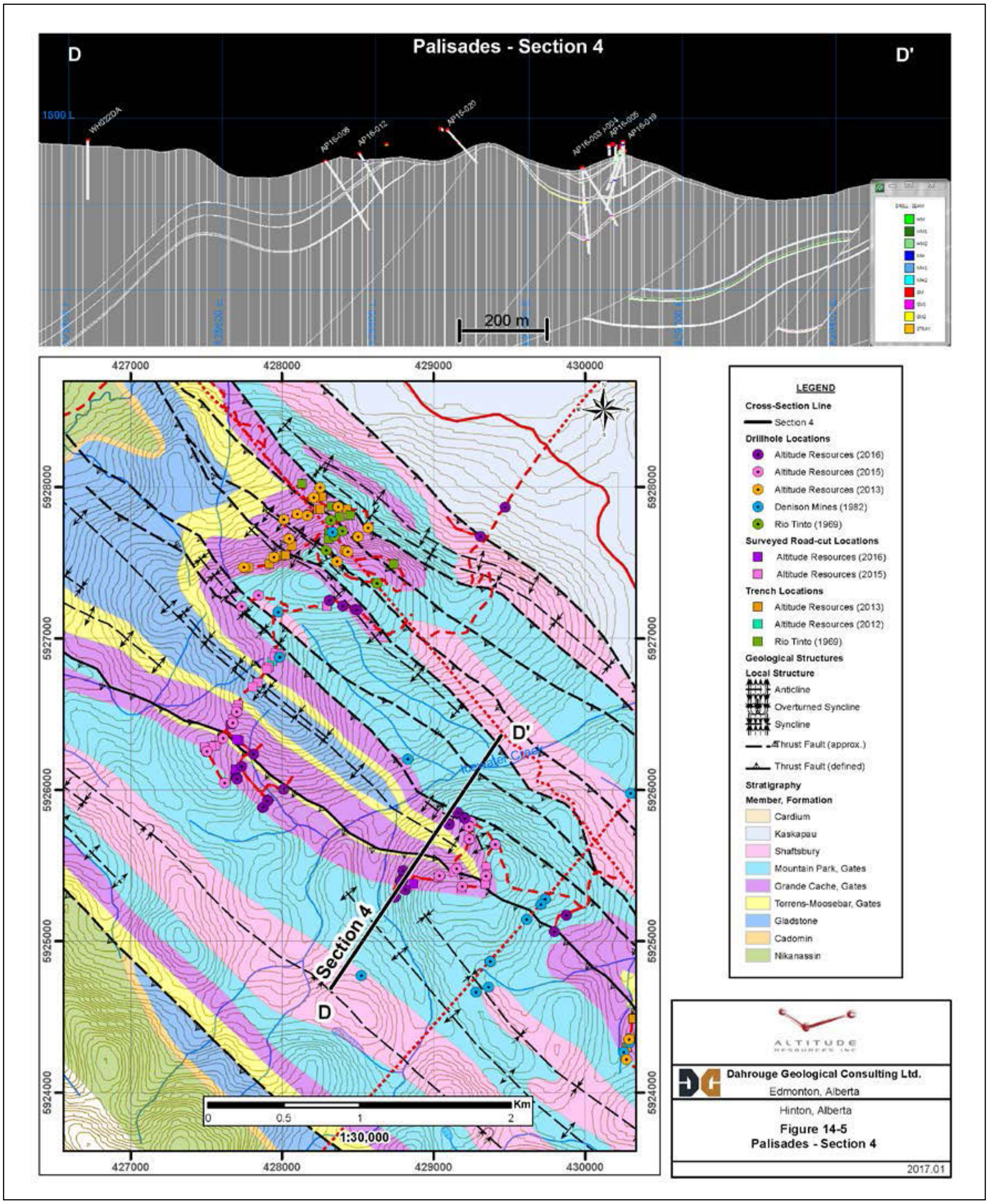


**Figure 14-5. Palisades Cross-Section 4 (D-D') North-Central Palisades**

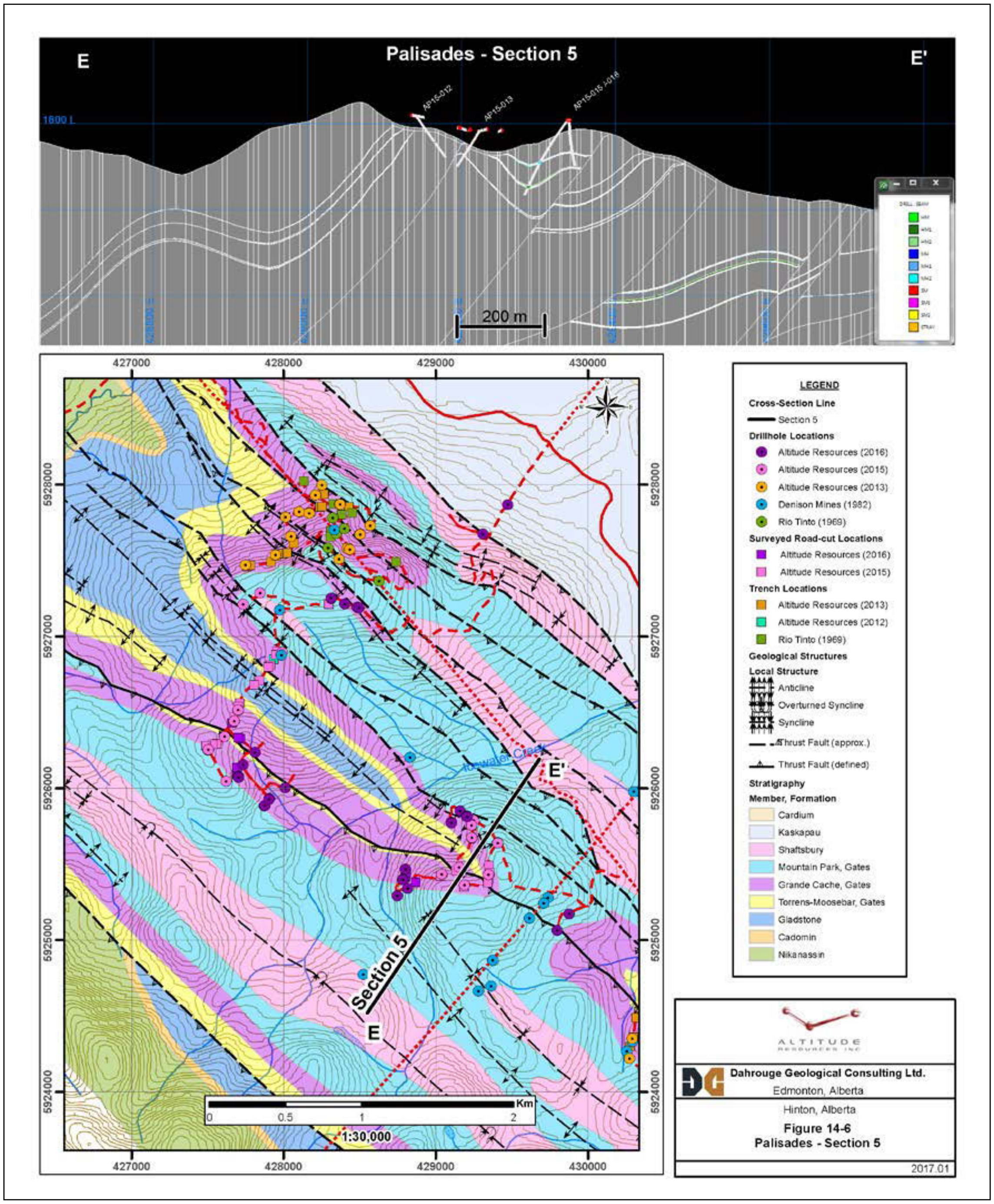


**Figure 14-6. Palisades Cross-Section 5 (E-E') North-Central Palisades**

## 14.2 EXPLORATION TARGET SUMMARY

The Exploration Targets for the Palisades Property are summarized in Table 14-4 and Figure 14-1. Coal was classified as exploration target if it was between 400 and 1,000 m from coal data point intersections. These targets remain conceptual in nature as they are not constrained by surveyed coal seams, trenches, or drillholes that fall within the above Resource classification criteria. The Exploration Target is modelled using coal seam projections constrained by stratigraphic modelling, surface mapping, distant seam orientations and thickness. Consequently, seam thickness was not adjusted to remove partings and no stripping ratio limit was used in defining the exploration targets. It is uncertain whether further exploration would delineate a resource. As noted for the resource estimates, the division of target areas has changed from 2013 to reflect 2016 exploration.

**Table 14-4. Palisades In-Place Exploration Targets (Metric tonnes)**

| Area | Exploration Target* (TONNES) |
|---|---|
| Coal Hill/Central Palisades | 60,000,000 – 62,000,000 |
| South Palisades | 3,000,000 – 5,000,000 |
| **Total Property** | 63,000,000 to 67,000,000 |

*conceptual in-place coal with no stripping ratio cutoff; no depth of weathering; rounded to nearest 1,000,000 tonnes

# 15 MINERAL RESERVE ESTIMATES

There are no mineral reserves, as defined by NI 43-101 criteria, on the Property at this time.

# 16 Mining Methods

Given the stage of exploration on the Property, mining methods have not yet been considered.

# 17 Recovery Methods

Given the stage of exploration on the Property, recovery methods have not yet been considered.

# 18 PROJECT INFRASTRUCTURE

Given the stage of exploration on the Property, project infrastructure requirements have not yet been considered.

# 19 MARKETING STUDIES AND CONTRACTS

Given the stage of exploration on the Property, marketing studies and contracts have not yet been considered.

# 20 Environmental Studies, Permitting and Social or Community Impact

Given the stage of exploration on the property, environmental studies, permitting and social or community impact have not yet been considered.

# 21 CAPITAL AND OPERATING COST

Given the stage of exploration on the Property, capital and operating cost have not yet been considered.

# 22 ECONOMIC ANALYSIS

Given the stage of exploration on the Property, an economic analysis has not been performed.

# 23 ADJACENT PROPERTIES

The Palisades Coal Property is directly adjacent to the north of Teck Corporation's Brule Property. The Brule Property was developed by the Blue Diamond Coal Company as an underground mine and operated continuously over the period 1914 through 1928, producing a total of 1.8 million tonnes. The Geologic Survey of Canada conducted a detailed survey of the Brule Property in 1927 during active operations and established the stratigraphy and seam nomenclature which extends north into the Palisades Coal Property.

There are currently two nearby active mining operations which are collectively the Cardinal River Operations of Teck Resources Limited. These are the Luscar Mine 62 km to the southeast, and the Cheviot Mine 78 km to the southeast of the Palisades Property. Both produce metallurgical coal from the same Grande Cache Member of the Gates Formation. The Grande Cache Mine, 90 km to the northwest of the Property also has produced metallurgical coal from the Grande Cache Member. It was placed on care and maintenance on December 24th, 2015, citing current market conditions. Other than an estimate for depth of weathering, information from these properties has not been used to complete the resource estimate for the Palisades Property.

# 24 OTHER RELEVANT DATA AND INFORMATION

The authors are unaware of any other relevant information.

# 25 INTERPRETATION AND CONCLUSIONS

The 2016 drilling resulted in an increase in the Measured, Indicated, and Inferred Resource categories, relative to the 2015 Resource Estimation. The defined Resources for the Moosehorn and Hoff Seams increased in all categories from 2015 to 2016. The 2016 Resource increased by:

- 800,000 tonnes of Total Measured Resource
- 240,000 tonnes of Indicated Resource
- 1,300,000 tonnes Inferred Resource

Resources for the Solomon Seam slightly decreased in all categories from 2015 to 2016. The reduction of Solomon Seam tonnage resulted from additional drill information that identified increased structural constraints and greater seam variability. The 2016 drilling identified greater variability in Solomon Seam thicknesses and increased parting thicknesses, relative to previous seam projections created from a smaller drillhole dataset. A portion of the previously defined Solomon Seams was re-identified as the Hoff Seam, contributing to the shift in the 2015 Solomon Resource. With the increased structural control and drill constraints there has been a significant increase in the exploration target from 2015 to 2016. Structures on the anticline west of Coal Hill were confirmed by new road exposures and drilling. The potential repeat of Gates Member east of Coal Hill was found to be truncated against the Collie Creek Thrust Fault, however, seam thickening on the south side of Coal Hill (AP16-020 and AP16-021) indicates potential to substantially increase resources with further drilling in this area. Logging by West Frazer Mills Ltd. in the Central area of the Property will provide access to drilling to convert more of the southern extension of the Exploration Target to Resources.

The conclusions drawn from the 2015 exploration program were borne out in the 2016 program. Coal seams in the northern and central part of the Property, while substantially thickened in places by folding, and repeated by thrust faulting, especially in the area of Coal Hill, are generally thinner and contain more partings than was previously thought. Areas of higher confidence resources are better connected than for the end of the 2015 program (Figure 14-1). Drill sections recommended along the P2017-001 Line through P2017-009 Lines would close these gaps and significantly increase the resources along strike (Figure 26-1). As the two-year Coal Exploration Permit (CEP 150001) was completed in 2016, a new permit application is required prior to the initiation of future exploration work.

The core samples collected in 2013 through 2016 confirm that the three major seams (Solomon, Hoff and Moosehorn) are high quality, low-volatile to medium-volatile hard coking coal, justifying further work. Wireline HQ diameter coring proved effective in 2016, and is recommended going forward to increase the number of intersections and depth of feasible seam intersections.

# 26 RECOMMENDATIONS

Further drilling and some additional mapping is recommended for 2017. This program would use some existing access constructed in 2015 and 2016, as well as some new access constructed as part of logging operations by West Fraser Mills Ltd. Some additional new construction would be required. The recommended goal would be to minimize new construction. The program should focus upon acquiring additional coal quality information, using wireline core drilling. A portion of conventional drilling should follow up on exploration targets if budget allows.

Further mapping in the central and southern parts of the Property is recommended to better define structures and support for targeting of potential unmapped, or subcropping coal zones. This area would benefit from future drilling, but currently lacks that constraint required for optimal drill targeting.

Drill targets have been proposed along the structurally controlled fault blocks that extend south of Coal Hill, along strike from 2016 drillholes AP16-018 and AP16-020, and along the east side of the Spine Line (Figure 26-1). Drill recommendations south of coal hill are designed to target near surface coal projections and provide more-complete structural cross-sections, P2017-001 Line through P2017-006 Lines that will better constrain structural and seam variability (Figure 26-1). Additional drilling has been recommended to connect and expand the Resource between the North and Central Areas, along newly developed logging access. These Central drill targets are represented along drill lines P2017-007 Line through P2017-009 Lines (Figure 26-1). Three to six additional holes north of the Rock Lake Road to test the Grande Cache Member on the North Palisades Extension are also recommended. Not all recommended drill sites may be required, and are subject to ground validation, access construction and drilling success.

A 2,500 m drill campaign has been recommended and budgeted to evaluate and constrain the above drill and mapping targets. This work includes approximately 2,000 m of reverse circulation drilling and up to 500 m of wireline coring in target areas identified by the 2016 program is recommended. The estimated cost of this program would be about $ 1,100,000 (Figure 26-1; Table 26-1).

**Table 26-1. Proposed 2017 Budget.**

| Item | Estimated Cost |
|---|---|
| Planning and new Access Layout | $50,000 |
| Access Constructions and Reclamation | $250,000 |
| Mapping | $40,000 |
| RC Drilling | $160,000 |
| Coring | $160,000 |
| Geological Supervision | $240,000 |
| Geophysical Logging | $70,000 |
| Drill Site Survey | $10,000 |
| Laboratory, Coal Testing | $40,000 |
| Geological 3-D Modelling | $40,000 |
| Data Compilation / Final Reports | $30,000 |
| **Total Estimate** | **$1,100,000** |

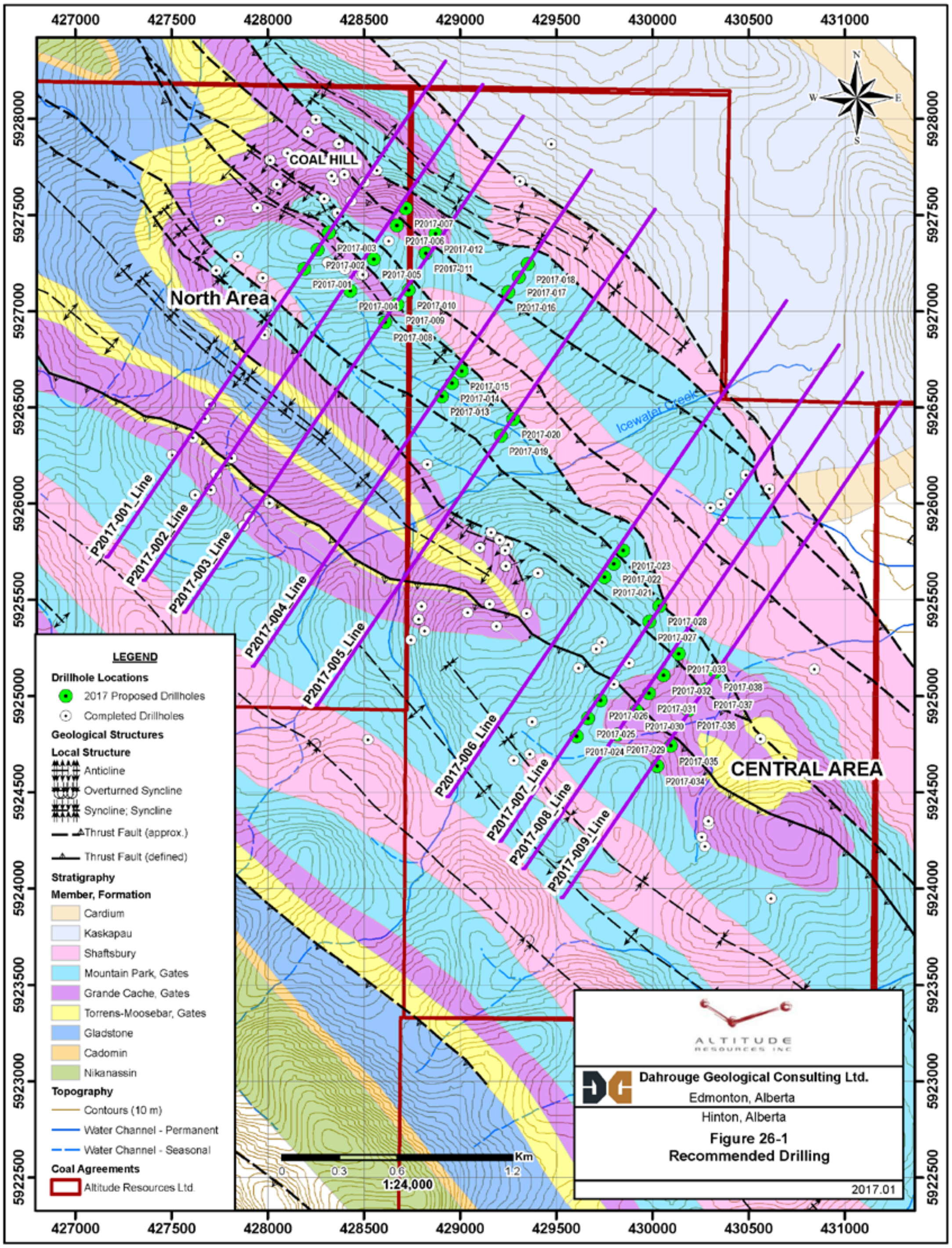


**Figure 26-1. Recommended Drilling**

## 27 REFERENCES


Benkis, R., 1970. **Report on Coal Exploration 1969 Rocky Mountain Foothills Alberta**: *Volume I of II.* Toronto: Rio Tinto Canada, 41p, 15 plates, maps.

Carmichael, S.M.M., 1983. **Sedimentology of the Lower Cretaceous Gates and Moosebar Formations, Northeast Coalfields, British Columbia**: PhD thesis, Department of Geological Sciences, University of British Columbia, 317p.

Denison Mines Limited, 1984. **Wildhay Project Geological Report**: Denison Mines Ltd, 86p, maps, 2 appendices.

Dowling, D.B., 1914. **Coal fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia**: Geological Survey of Canada Memoir 53, 142p.

Engler, R., and Morris, R., 2011. **Resource Estimate for the Palisades Coal Property**, **West Central Alberta**: Moose Mountain Technical Services, NI-43-101 Technical Report, SEDAR, 60p.

Engler, R.F., Gorham, J.H. and Miller, W.S., 2014. **Technical Report on the Palisades Coal Property, Alberta, Canada:** Dahrouge Geological Consulting Ltd., NI-43-101 Technical Report, SEDAR, 83p.

Engler, R.F., Gorham, J.H., and Miller, W.S., 2015. **Technical Report on the Palisades Coal Property, Alberta, Canada:** Dahrouge Geological Consulting Ltd., NI-43-101 Technical Report, SEDAR, 95p.

Environment Canada, **Canadian Climate Normals,** http://climate.weather.gc.ca/climate_normals/results.

ERCB Serial Publication ST 45 Coal Mine Atlas Operating and Abandoned Coal Mines in Alberta, 2010.

Hughes, J.D., Klatzel-Mudry, L., and Nikols, D.J., 1989. **A Standardized Coal Resource/Reserve Reporting System for Canada**: Geological Survey of Canada 88-21, 18p.

Irish E.J.W, 1945. **Pedley Map Area, Alberta:** Geol. Surv. Can. Paper 45-13, 9p, Map 838A.

Irish E.J.W, 1965. **Geology of the Rocky Mountain foothills, Alberta between latitudes 53 15' and 54 15'**; GSC Memoir 334, with maps 1139A and 1140A, 241p.

Lang, A.H. 1945. **Entrance Map Area, Alberta**: Geol. Surv. Can. Paper 45-11, 8p, map.

Lang, A.H. 1947. **Brule and Entrance Map Area, Alberta**: Geol. Surv. Can. Memoir 224, 65p.

Langenberg, W., Kalkreuth, W., & Wrightson, C., 1987. **Deformed Lower Cretaceous Coal-Bearing Strata of the Grande Cache Area, Alberta**: AGS Bulletin 056, Geological Survey Dept., Alberta Research Council, 1-54.

Langenberg, C.W. and McMechan, M.E., 1985. **Lower Cretaceous Luscar Group (revised) of the northern and north-central Foothills of Alberta**: Bulletin of Canadian Petroleum Geology, v. 33, p. 1-11.

MacDonald, D.E., Langenberg, C.W., and Gentzis, T. 1989. **A Regional Evaluation of Coal Quality in Northern Foothills/Mountain, Region of Alberta**: Alberta Geological Survey Earth Sciences Report 89-2, 76p.

MacKay B.R., 1928. **Brule Mines Area Alberta**: *in* Summary Report 1928, Part B, Canada. Department of Mines, Ottawa, 131pp

Mackay, B.R., 1929a. **Mountain Park Sheet, West of Fifth Meridian, AB**: Geological Survey of Canada, "A" Series Map 208A, Scale: 1:63,360 (1 Inch to 1 Mile).

Mackay, B.R., 1929b. **Cadomin Sheet, West of Fifth Meridian, AB**: Geological Survey of Canada, "A" Series Map 209A, Scale: 1:63,360 (1 Inch to 1 Mile).

Mackay, B.R., 1930. **Stratigraphy and Structure of the Bituminous Coalfields in the vicinity of Jasper Park, AB**: Transactions of the Canadian Institute of Mining and Metallurgy, v 33, pp473-504.

MacVicar, J., 1919. **Coal areas northwest of Brule Lake, AB**: GSC Sum Report 1919, pt. C, pp 8-13.

McLean, J.R., 1982. **Lithostratigraphy of the Lower Cretaceous coal-bearing sequence, Foot hills of AB**: Geological Survey of Canada, Paper 80-29, 46.

Richardson, R.J.H., Langenberg, C.W., Chao, D. K., and Fietz, D., 1990. **Coal Compilation Project, Entrance NTS 83F/5**: Alberta Geological Survey Open File Report 1990-2, 68p.

Smith, G.C., Cameron, A.R., Bustin, R.M., 1994. **Coal Resources of the Western Canada Sedimentary Basin**: Atlas of the Western Canada Sedimentary Basin, Chapter 33; Alberta Geological Survey.

Thorsteinsson, R., 1952. **Grande Cache map-area, AB**: Geological Survey of Canada, paper no. 52-56, 44p.

Ulry, B., 2012. **Palisades & Moberly Property2012 Exploration Report:** unpublished internal report for Altitude Resources Ltd., 33p.

Van Eendenburg, C.H., Parent, R., Erasmus, P., 2011. **2011 NI 43-101 Technical Report on the Grande Cache Coal Operation:** SEDAR, 110p.

Wadsworth, J., Boyd, R., Diessel, C., and Leckie, D., 2003. **Stratigraphic Style and Non-marine Strata in a High-Accommodation Setting: Fahler Member and Gates Formation (Lower Cretaceous), Western Alberta**: Bulletin of Canadian Petroleum Geology Vol. 51, No. 3, pp 275-303.

## Date and Signature Page

This report entitled "**Technical Report on the Palisades Coal Property, Alberta Canada**" with an effective date of March 3rd, 2017, was prepared on behalf of Altitude Resources Inc. and is signed by the authors Robert Engler, John Gorham, and William Miller.

PROFESSIONAL GEOLOGIST ALBERTA R. F. ENGLER

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**Robert F. Engler, P. Geol.**

**28 Hummingbird Road**

**Sherwood Park, Alberta**

March 7th, 2017

PROFESSIONAL GEOLOGIST ALBERTA JOHN H. GORHAM

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**John H Gorham, P. Geol.**

**Suite 18 – 10509 81st Avenue**

**Edmonton, Alberta**

**T6E 1X7**

March 7th, 2017

PROFESSIONAL GEOSCIENTIST ALBERTA WILLIAM MILLER

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**William S Miller, P. Geo.**

**Suite 18 – 10509 81st Avenue**

**Edmonton, Alberta**

**T6E 1X7**

March 7th, 2017

## CERTIFICATE OF QUALIFIED PERSONS

I, Robert F. Engler, of 28 Hummingbird Road, Sherwood Park, Alberta do hereby certify that:

- I, Robert F. Engler, P. Geol. am a Principal of Moose Mountain Technical Services.

This certificate applies to the Technical Report titled "Technical Report on the Palisades Coal Property, Alberta Canada" with an effective date of March 3rd, 2017 (the "Technical Report").

- I graduated with a B.Sc. from the University of Alberta in 1974.
- I am a member of the Association of Professional Engineers, Geologists and Geophysicists of Alberta. (#M24009).
- I have worked as a geologist for a total of forty-two years since my graduation from university. My experience includes work with all the coal mines in Alberta, Saskatchewan and British Columbia as well as exploration projects in western Canada, and western US, Mexico, Mongolia, and China. I also held senior marketing positions for fifteen years with Luscar Ltd, a major Canadian coal producer.
- I have read the definition of "qualified person" set out in NI 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfill the requirements to be a "qualified person". I am independent of Altitude Resources Ltd in accordance with section 1.5 of NI 43-101.
- I inspected the Property on July 18-20, and July 29-30, 2016. I have worked extensively on nearby Sherritt-owned mining operations. I work as a geological consultant to the mining industry.
- I am responsible for Section 13 and jointly responsible for Sections 1, 12, 25 and 26 of this Technical Report.
- I am independent of the issuer of this report, Altitude Resources Inc. as defined by Section 1.5 of NI 43-101.
- I have read NI 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.
- As of the effective date of this 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.

"Signed and sealed"

Robert F. Engler, B.Sc., P.Geol.
Dated: March 7th, 2017

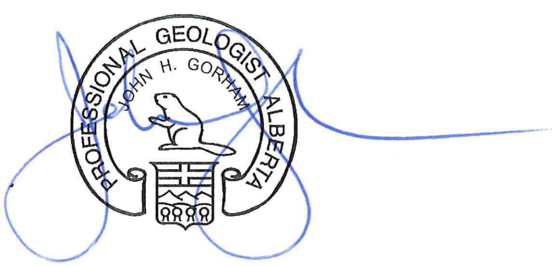
I, John Gorham, of #18- 10509 81$^{st}$ Avenue, Edmonton, Alberta, hereby certify that

- I, John Gorham, P.Geol, am employed as a Senior Geologist with Dahrouge Geological Consulting Ltd.

This certificate applies to the Technical Report titled "Technical Report on the Palisades Coal Property, Alberta Canada" with an effective date of March 3$^{rd}$, 2017 (the "Technical Report").

- I graduated from the University of Calgary, Canada with a B.Sc. degree in Geology in 1976.
- I am a Professional Geoscientist in the Provinces of Alberta, British Columbia and the Northwest Territories, Canada.
- I have practiced my profession for 40 years since graduation. I have been directly involved in green fields and brown fields exploration, and consulting, with experience in gold, base metals, precious and rare metals and rare earth deposits, coal, industrial and precious gem minerals.
- As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101).
- I inspected the Property on June 4-16, June 20-27, July 5-11, July 18-30 and August 1-8, 2016.
- I am jointly responsible for Sections 1 to 13, and 15 to 27 of this Technical Report.
- I am independent of the issuer of this report, Altitude Resources Inc. as defined by Section 1.5 of NI 43-101.
- I have read NI-43-101 and this report has been prepared in compliance with this Instrument.
- As of the effective date of this 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.

'Signed and Sealed"




John Gorham, P. Geol

Dated: March 7$^{th}$, 2017



DAHROUGE GEOLOGICAL CONSULTING LTD.

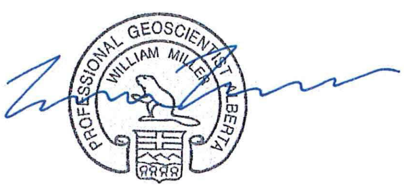
I, William Miller, of #18- 10509 81$^{st}$ Avenue, Edmonton, Alberta, hereby certify that

- I, William Miller, P.Geo, am employed as a Project Geologist with Dahrouge Geological Consulting Ltd.

This certificate applies to the Technical Report titled "Technical Report on the Palisades Coal Property, Alberta Canada" with an effective date of March 3$^{rd}$, 2017 (the "Technical Report").

- I graduated from the University of Alberta, Canada with a B.Sc. degree in Geology in 2009.
- I am a Professional Geoscientist in the Province of Alberta, Canada.
- I have practiced my profession for 7 years since graduation. I have been directly involved in green fields and brown fields exploration, and consulting, with experience including industrial minerals, phosphate, gold, nickel-PGEs, rare earths and coal.
- As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 Standards of Disclosure for Mineral Projects (NI 43–101).
- I have not visited the Palisades Coal Property.
- I am jointly responsible for Sections 1, 14, 25 and 26 of this Technical Report.
- I am independent of the issuer of this report, Altitude Resources Inc. as defined by Section 1.5 of NI 43-101.
- I have read NI-43-101 and this report has been prepared in compliance with this Instrument.
- As of the effective date of this 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.

'Signed and Sealed"




William Miller, P. Geo

Dated: March 3$^{rd}$, 2017