Attachment E Geophysical Data

EBA File: V33101016.400.009
January 2010

Subject: AREVA Resources Road & Mine Infrastructure Mill Site Survey

1.0 INTRODUCTION

Areva Resources Canada Inc. is in the preliminary stage of development of a uranium mine in the vicinity of Baker Lake, Nunavut. As a part of the mine development, subsurface investigations were performed on two separate occasions by EBA Engineering Consultants Ltd. (EBA) in order to delineate soil stratigraphy and/or bedrock contacts, bedrock surface condition, and permafrost conditions up to depths of approximately 15 m. The first investigation was conducted between September 16 and September 20, 2008, and covered the proposed Power House, Mill Site, Ore Pad, Accommodations Complex and Tank Farm areas, as well as the proposed location of a dam south of Sik Sik Lake. A second survey, performed on April 27, 2009, covered additional portions of the proposed processing facility area, as well as the two major extraction pit locations.

2.0 THEORY OF GROUND PENETRATING RADAR

GPR is a non-destructive geophysical technique capable of delineating materials that have contrasting bulk electrical properties. The GPR technique images shallow soil and rock structure at a relatively high resolution. The resolution and depth of penetration are a combined function of the soil electrical properties, the antenna frequency and the transmitted power. Higher antenna frequencies provide better resolution at the cost of lower depths of penetration.

The GPR system transmits a short duration electromagnetic (EM) pulse into the ground, and a downward-propagating wave front is generated. The velocity at which the wave front travels is controlled by the dielectric constant (or charge capacity) of the material in which it is travelling. Changes in the bulk electrical properties typically correspond to changes in stratigraphy within the ground profile. Different dielectric constants between two material layers will create a reflection at the material boundary which can be seen within the GPR trace. An abrupt change in dielectric properties will tend to be more detectable than a gradual change. This also leads to the problem of having different radar wave velocities through different materials, and the resulting impact this has on a reflection's depth interpretation.

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The second controlling electrical property is the material's electrical conductivity. In conductive materials, such as wet and/or clayey soils, the radar signals are attenuated more easily by the medium, as the radar energy is converted into electrical currents. This will decrease the ability of the GPR signal to penetrate the material.

3.0 METHODOLOGY

The first GPR survey was conducted by Mr. James Mickle, Geoph. I.T., of EBA's Calgary office and Mr. Drew Davidge, E.I.T., of EBA's Vancouver office, using a Sensors & Software pulseEKKO IV system with a 400 V transmitter with 50 MHz, 100 MHz and 200 MHz antennas. All GPR data was collected in step mode. When data is collected in step mode, the antennas are placed in a stationary location and a reading or trace is recorded. The antennas are then "stepped" a known distance to the next reading along the line and the process is repeated, making a profile of multiple traces. A step size of 10 cm with an antenna separation of 1 m and a time window of 600 ns were used to collect the data. The average depth of penetration was approximately 15 m. Six survey lines were collected, varying in length from 78 m to 663 m and totalling 1779 m. Data positioning and elevation information are based on surveyed coordinates of two or more control points along the lines. The coordinates of the intermediate traces were then interpolated to provide positioning and elevation data along the entire length of the profiles.

The second GPR survey was performed during winter, by Mr. James Mickle with the aid of a local helper from Baker Lake. A Mala Geosciences' Ramac CUII with 50MHz rough-terrain antenna was pulled behind a snowmobile at approximately 5 to 10 km/h. In this survey, the data was collected in "free-run" mode, where the system is set to collect data as fast as it can, while simultaneously logging differential GPS positions. Traces were acquired at a rate of 9 Hz, with a time window of 520 ns. The depth of penetration varied substantially from one location to the next, depending on the subsurface constituents, but the maximum depth of penetration is approximately 32 m. Five major survey lines totalling approximately 6.5 km were acquired, with smaller additional profiles collected while travelling from the endpoint of one line to the beginning of the next. A NovAtel SMART-V1 GPS unit with L2 band capability using CDGPS differential corrections output positions once per second. Given suitable satellite constellations, this unit has a horizontal positional accuracy of approximately 20 cm.

After the GPR profiles were collected, the data was imported into custom processing routines running in a data analysis package (Matlab, The Mathworks). Each profile was filtered and gained to try to remove as much background noise as possible and to amplify the significant information. Once the data had been processed in this manner, the profiles were examined, and the relevant features were outlined.

4.0 FINDINGS AND DISCUSSION

Figures 1 and 2 provide an overview of the two survey regions, highlighting the locations of all GPR profiles collected to date. Figures 3 through 17 illustrate the results of the GPR survey.

Radar wave velocity values, required to calculate 'true' depths to reflectors in the ground, were obtained by performing a velocity analysis on strong point diffractions identified in the data. It is important to note that this value is influenced by all media through which the radar pulse passes before hitting the point diffractor. For the 2008 survey, a single average value of 0.088 m/ns was obtained from Profile 5 using this method. This value is relatively low for solid bedrock, and is more indicative of wetter environments. This is likely due to the low-lying, lake drainage type of environment through which Line 5 was collected. The second survey yielded an average value of approximately 0.14 m/ns. This value was consistently obtained from numerous point diffractions in the various profiles, and is consistent with significantly frozen soils and solid bedrock.

Many locations have been identified where faults and point anomalies appear to exist within the bedrock. Suspected bedrock reflections and areas of poor bedrock surface quality have also been assessed where possible. The composition of the subsurface in this region is extremely complex, from a geologic and geophysical perspective. Bedrock and overburden topography undulates rapidly, and many areas exhibit varying degrees of bedrock fracturing, complex overburden and surface water flowpaths. These factors all combine to make a conclusive assessment of the subsurface conditions nearly impossible without significant ground-truthing. A series of shallow holes were drilled in 1988, the locations of which are shown on Figures 1 and 2. However, only one of these boreholes (BH88-2WD1) lies close to a GPR line (2009-5), and was only drilled to a depth of 1.2 m before auger refusal short of bedrock. Two deep holes were more recently drilled along profile 2008-1, and are shown in the corresponding figure, though data quality along profile 2008-1 is somewhat poor, relative to all other profiles.

It is EBA's understanding that a drilling program is being strongly considered for the winter of 2009–2010. For this reason, a list of candidate drill targets has been identified from the GPR results, based on various criteria. These locations are illustrated in Figures 1 and 2 and listed in Appendix A. It is anticipated that information from the drilling program will permit more accurate depth estimates of GPR anomalies, as well as better characterise the various responses, so that similar bedrock conditions can be better assessed throughout the surveyed areas.

5.0 CONCLUSION

This report summarizes the geophysical surveys performed by EBA during the September 2008 and April 2009 field investigations. The objective was to complete a geophysical investigation to assess the soil stratigraphy and/or bedrock contacts, and permafrost conditions up to depths of 15 m. Fifteen GPR profiles were acquired, covering the proposed Power House, Mill Site, Ore Pad, Accommodations Complex, Tank Farm and Extraction Pit locations, as well as other locations in the processing plant area and the proposed location of a dam immediately south of Sik Sik Lake. Radar velocities of 0.088 m/ns and 0.14 m/ns were obtained from distinct reflections in the data; these are consistent with the suspected soil conditions at the times the surveys were performed. Numerous locations have been identified as candidate targets for drilling and further investigation, tentatively scheduled for winter 2009–2010. The results of that program can then be applied to the existing processed GPR data to further refine its interpretation.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of AREVA Resources Canada Inc. and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than AREVA Resources Canada Inc. or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in the General Conditions provided in Appendix A of this report.

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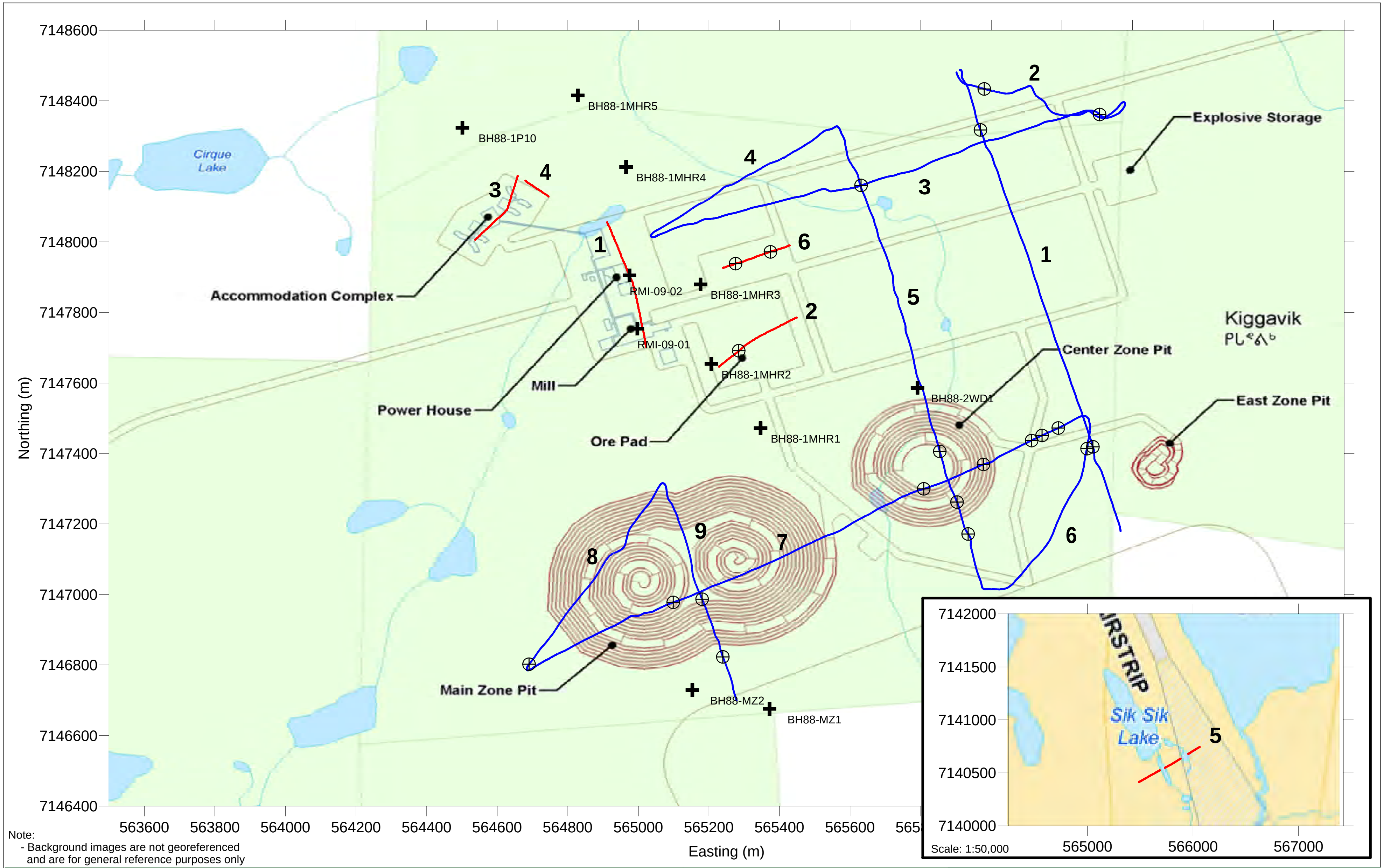
CONSULTANTS LTD.

FIGURES



Note:
- Background images are not georeferenced and are for general reference purposes only

N

Scale (1:15,000)
NAD83
UTM Zone 14

LEGEND

3 — Sep. 2008 GPR Track (w Line #)

5 — Apr. 2009 GPR Track (w Line #)

⊕ Proposed Drill Target

✚ RMI-09-01 Drilled Borehole

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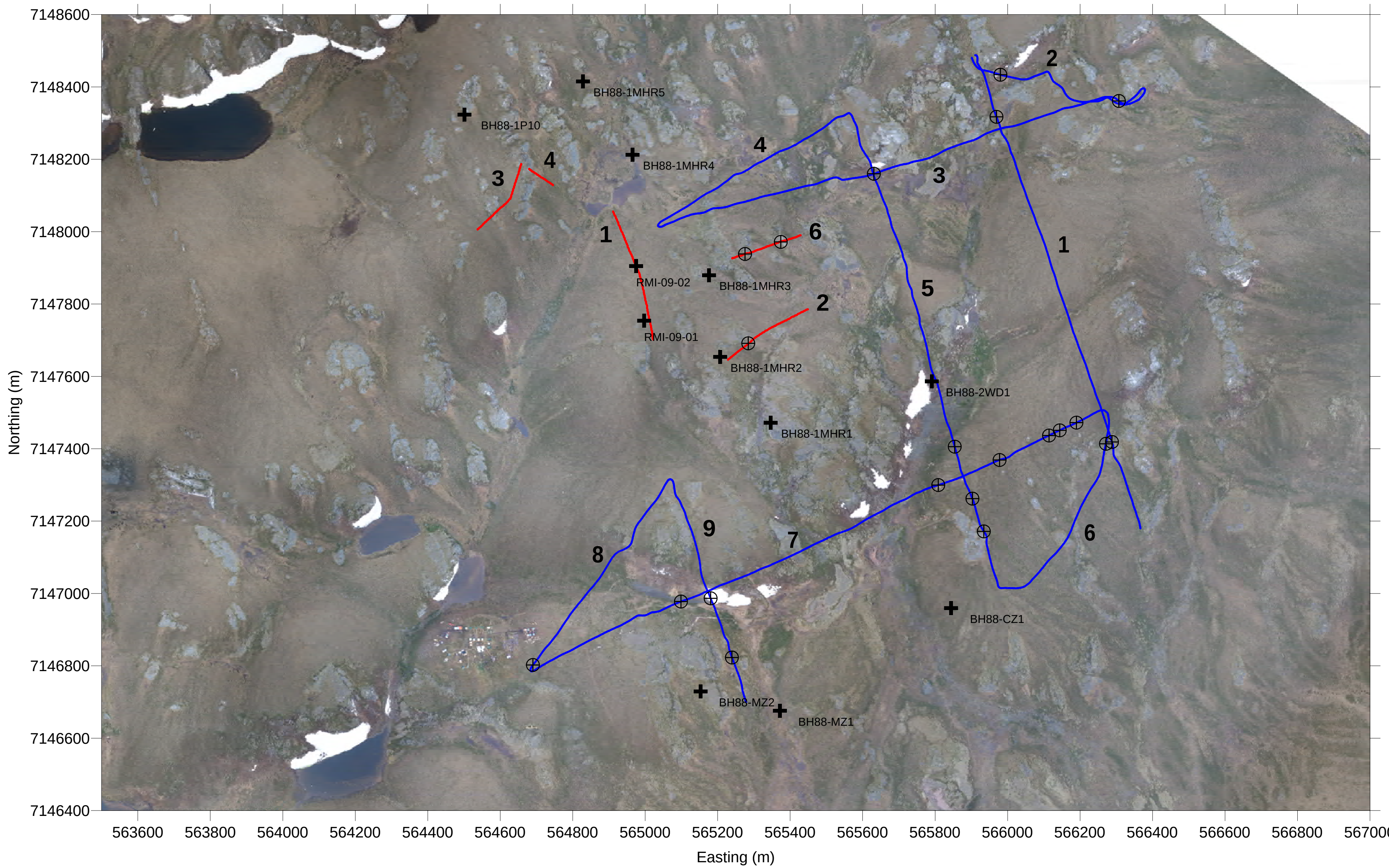
Areva Kiggavik Project
2008-2009 Subsurface GPR Survey

Mill Site GPR Survey Coverage
and Confirmatory Drill Target Locations
(Mill Site Sketch Underlay)

PROJECT NO.	DWN	CKD	REV
V33101016	RJM	NSP	0
OFFICE	DATE		
Calgary	January 14, 2010		

Figure A1



N

Scale (1:15,000)
NAD83
UTM Zone 14

LEGEND

3 (red line)	**Sep. 2008 GPR Track (w Line #)**
5 (blue line)	**Apr. 2009 GPR Track (w Line #)**
⊕	**Proposed Drill Target**
✚ RMI-09-01	**Drilled Borehole**

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Areva Kiggavik Project
2008-2009 Subsurface GPR Survey

Mill Site GPR Survey Coverage
and Confirmatory Drill Target Locations
(Orthophoto Underlay)

PROJECT NO.	DWN	CKD	REV	
V33101016	RJM	NSP	0	**Figure A2**
OFFICE	DATE			
CGY-EBA	Oct 20, 2009			

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UTMz14
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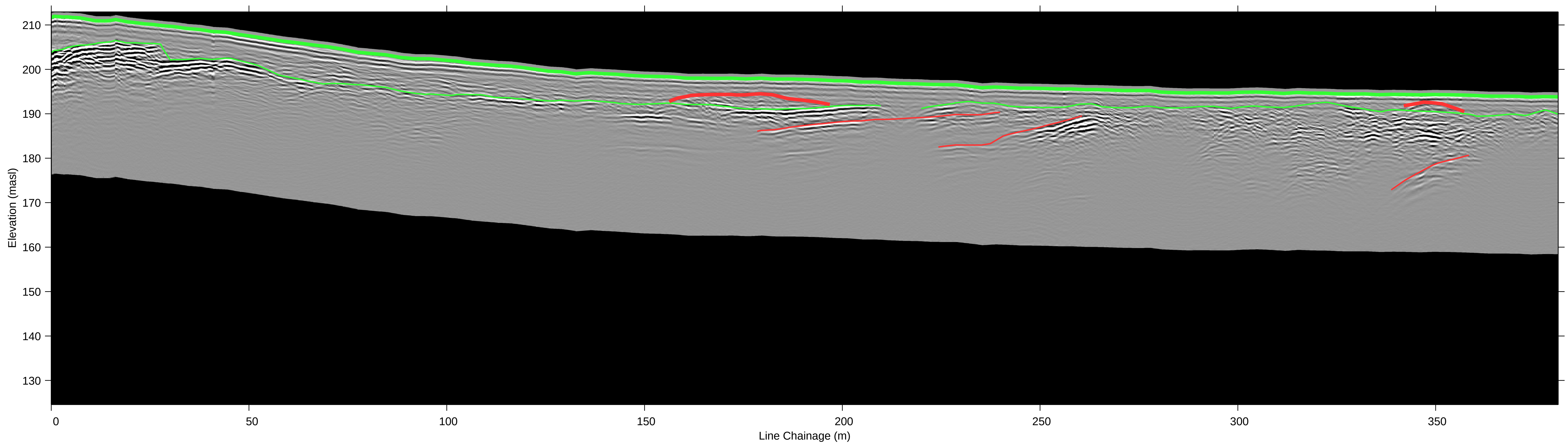

LEGEND

- Ground Surface
- Unfrozen Surface
- Weathered Bedrock
- Bedrock Surface
- Bedrock Surface (Inferred)
- Bedrock Fault
- Bedrock Anomaly

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Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

Mill Site
Profile 2009–1

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A3.1
OFFICE: Calgary	DATE: Oct. 15, 2009			

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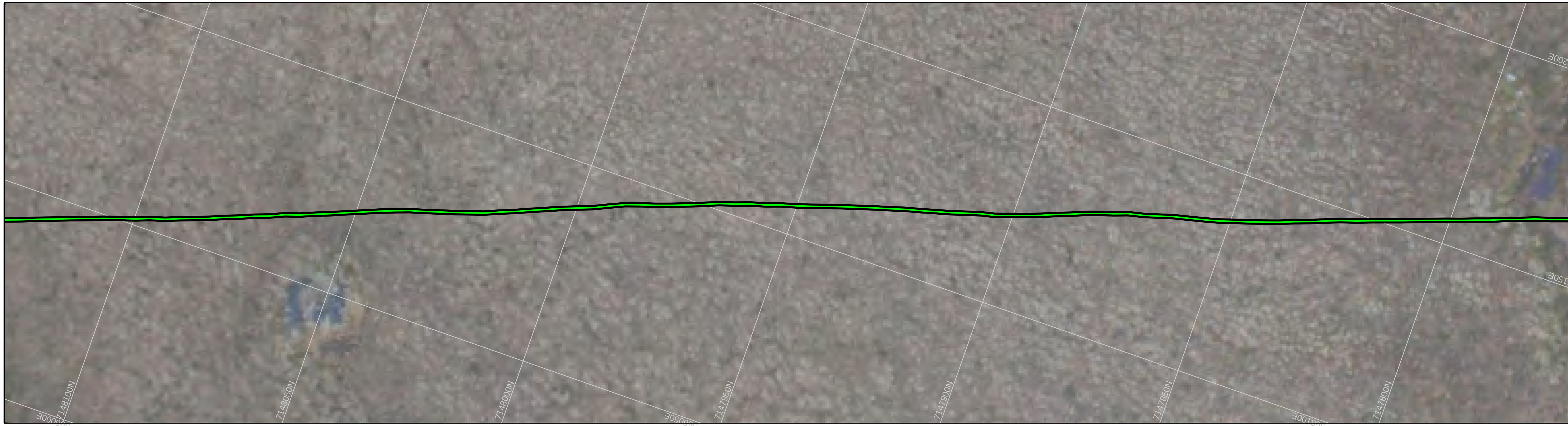

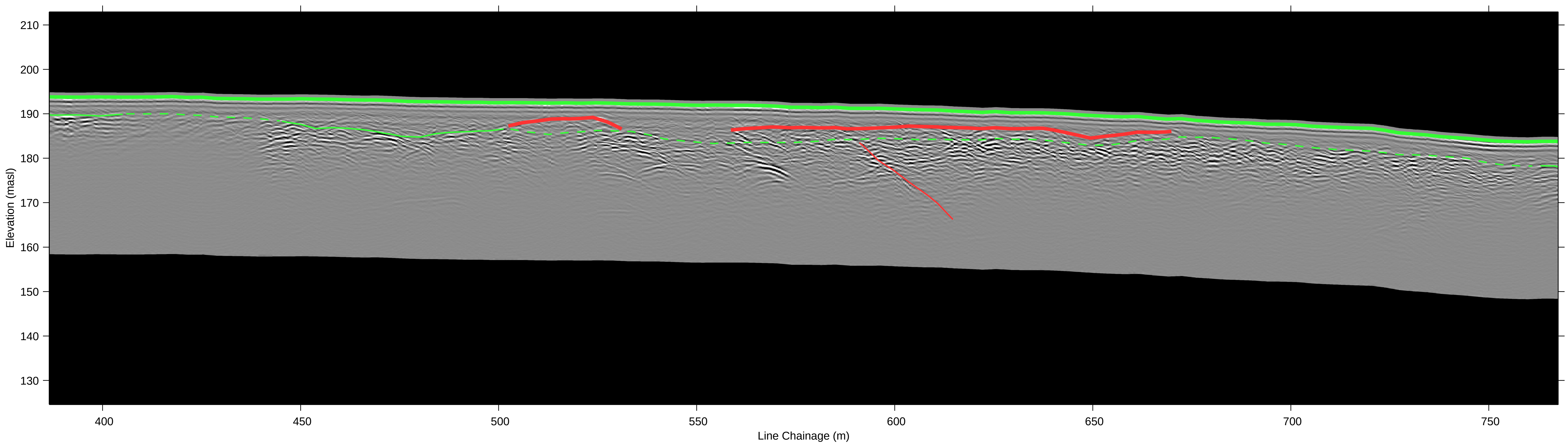

LEGEND

- Ground Surface
- Unfrozen Surface
- Weathered Bedrock
- Bedrock Surface
- Bedrock Surface (Inferred)
- Bedrock Fault
- Bedrock Anomaly

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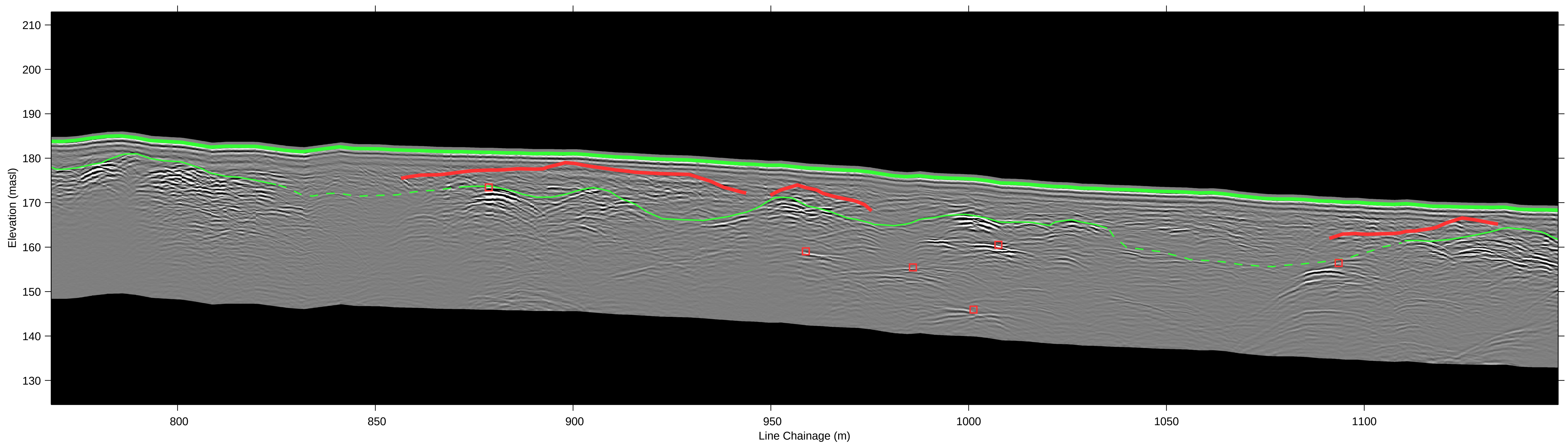
Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

Mill Site
Profile 2009–1

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A3.2
OFFICE	DATE			
Calgary	Oct. 15, 2009			



LEGEND

- Ground Surface
- Unfrozen Surface
- Weathered Bedrock
- Bedrock Surface
- Bedrock Surface (Inferred)
- Bedrock Fault
- Bedrock Anomaly

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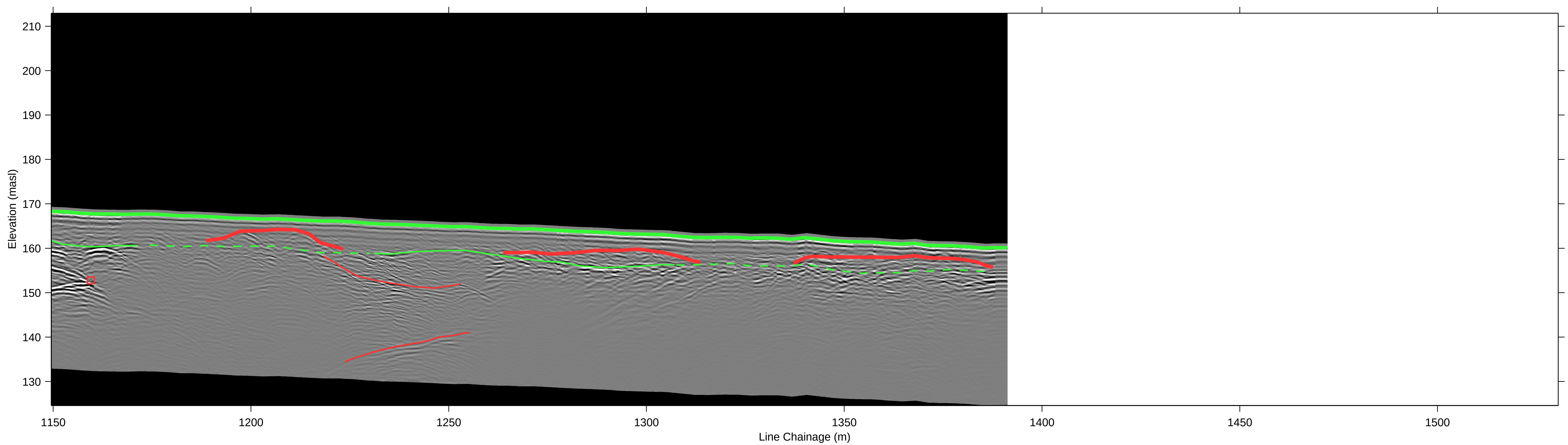
Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

Mill Site
Profile 2009–1

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A3.3
OFFICE: Calgary	DATE: Oct. 15, 2009			



LEGEND

- Ground Surface
- Unfrozen Surface
- Weathered Bedrock
- Bedrock Surface
- Bedrock Surface (Inferred)
- Bedrock Fault
- Bedrock Anomaly

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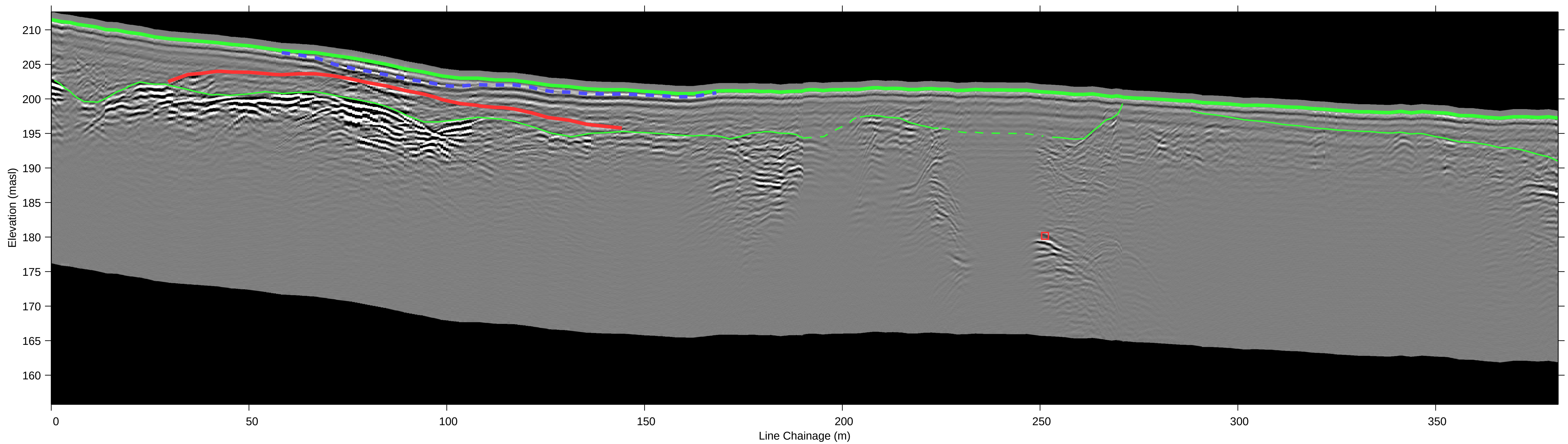
Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

Mill Site
Profile 2009–1

Project No.	DWN	CHKD	REV
V33101016	RJM	NSP	0

OFFICE	DATE
Calgary	Oct. 15, 2009

Figure A3.4



LEGEND

- Ground Surface
- Unfrozen Surface
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- Bedrock Surface
- Bedrock Surface (Inferred)
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- Bedrock Anomaly

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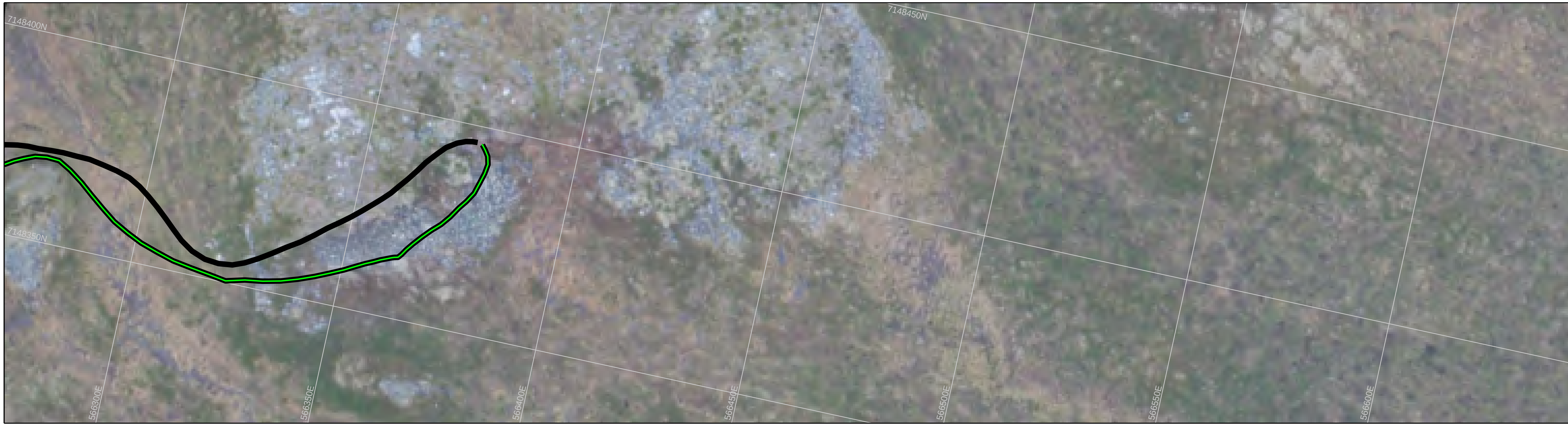
Areva Kiggavik Project
2008−2009 Subsurface GPR Survey

Mill Site
Profile 2009−2

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A4.1
OFFICE	DATE			
Calgary	Oct. 15, 2009			



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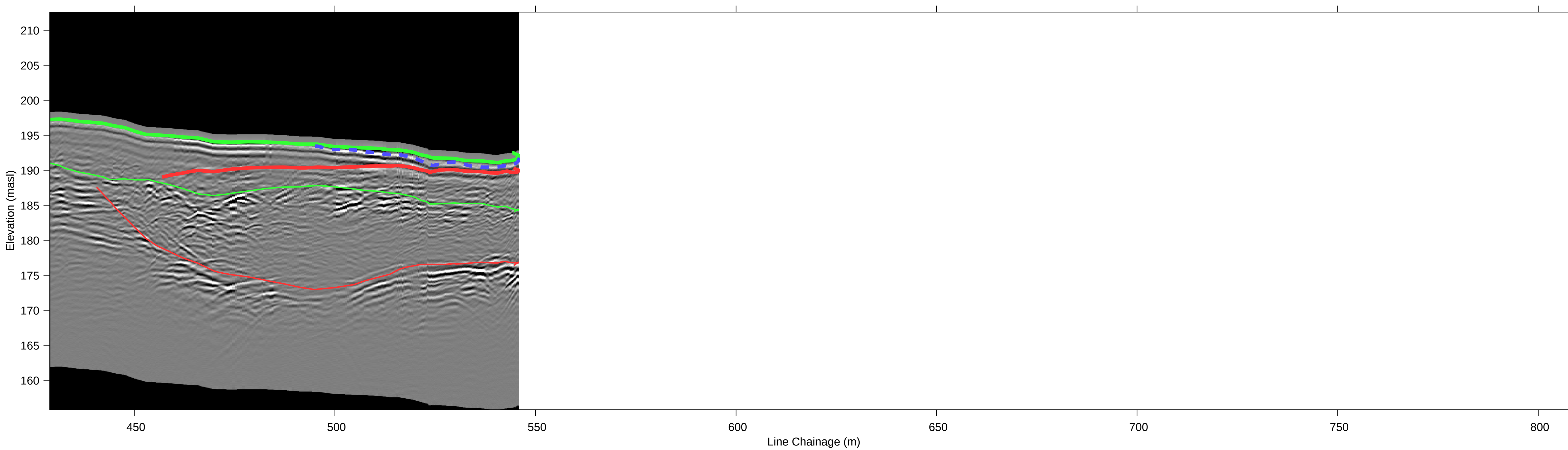

LEGEND

- Ground Surface
- Unfrozen Surface
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- Bedrock Surface
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- Bedrock Fault
- Bedrock Anomaly

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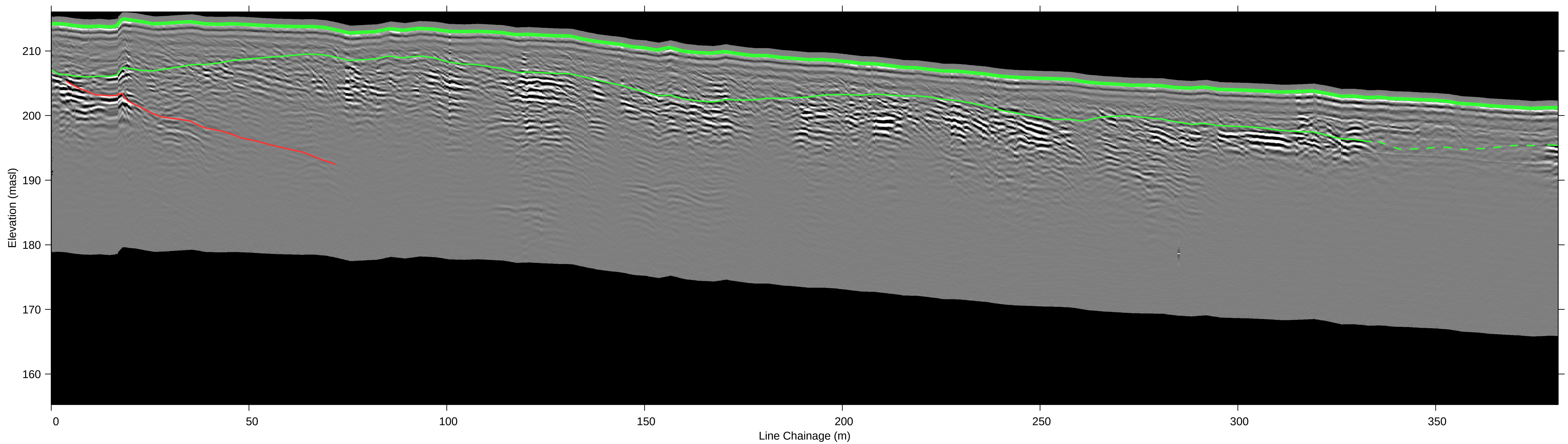
Areva Kiggavik Project
2008−2009 Subsurface GPR Survey

Mill Site
Profile 2009−2

Project No.	DWN	CHKD	REV
V33101016	RJM	NSP	0

OFFICE	DATE
Calgary	Oct. 15, 2009

Figure A4.2



LEGEND

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- Bedrock Surface (Inferred)
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Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

2009 Mill Site Data
Profile 2009–3

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A5.1
OFFICE	DATE			
Calgary	Oct. 15, 2009			

NAD83
UTMz14
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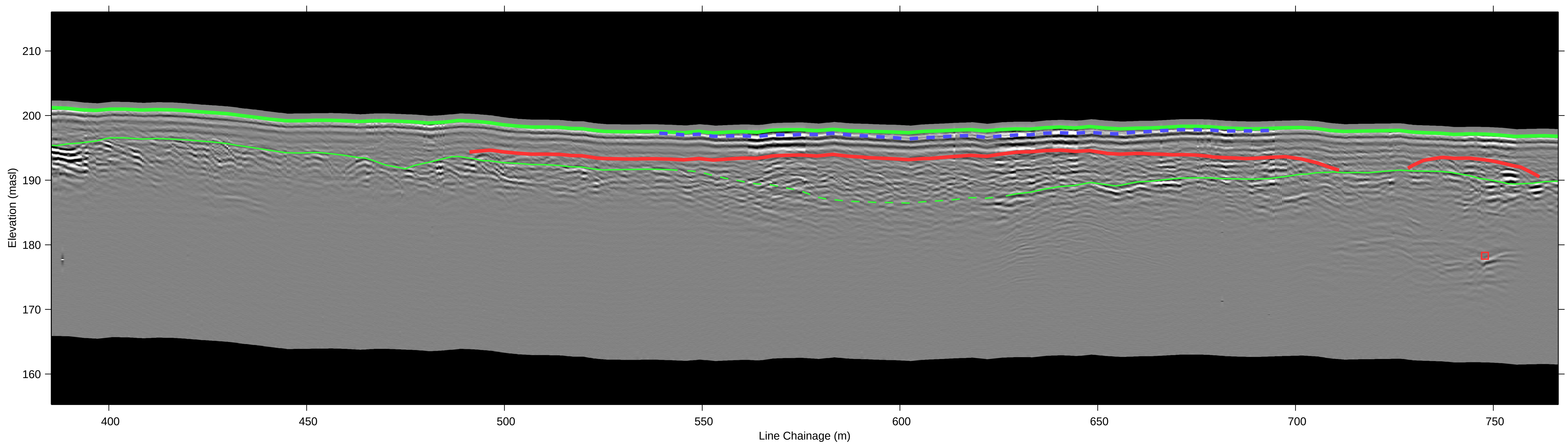

LEGEND

- Ground Surface
- Unfrozen Surface
- Weathered Bedrock
- Bedrock Surface
- Bedrock Surface (Inferred)
- Bedrock Fault
- Bedrock Anomaly

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Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

2009 Mill Site Data
Profile 2009–3

Project No.	DWN	CHKD	REV	
V33101016	RJM	NSP	0	Figure A5.2
OFFICE	DATE			
Calgary	Oct. 15, 2009			

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UTMz14
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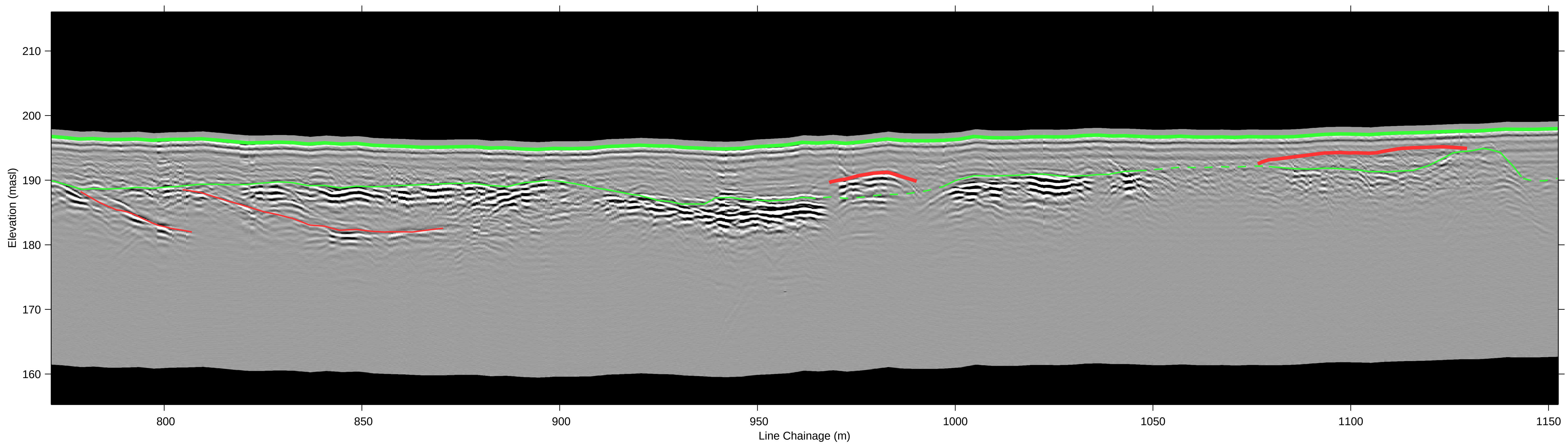

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Areva Kiggavik Project
2008–2009 Subsurface GPR Survey

2009 Mill Site Data
Profile 2009–3

Project No.	DWN	CHKD	REV
V33101016	RJM	NSP	0

OFFICE	DATE
Calgary	Oct. 15, 2009

Figure A5.3