REQUEST FOR BIDS

ON

HIGH RESOLUTION AIRBORNE MAGNETONETER SURVEYING

IN THE

TIMMINS - KIRKLAND LAKE REGION OF NORTHERN ONTARIO

A project of innovation, cooperation and revitalization
in the Abitibi region of Northern Ontario

Preliminary Notes

- The contract for the airborne survey will be with the City of Timmins and will be directed by personnel from the Discover Abitibi Initiative.
- The survey is the first of three to be completed in 2008
- The technical authority and QA/QC function shall be directed by the Geological Survey of Canada
- Annex "A" statement of work outlines the survey and the technical specification and along with the Annex "C" and the project outline map forms the entire Request for Proposal
- Annex "C" **MANDATORY REQUIREMENTS, EVALUATION CRITERIA AND SELECTION METHOD** shall form part of the selection process under the direction of DAI personnel
- Correspondence can be directed to the project manager as follows:

Robert Calhoun, P.Geo.
Project Manager
Discover Abitibi Initiative
54 Spruce St, South
Timmins, Ontario P4N 2M5
Tel 705-360-2600 ext 7085, Fax 705-360-2679
email rcalhoun@timmins.ca
website www.discoverabitibi.com

- **The proposals shall be directed to Robert Calhoun and consist of three bound copies and one cd containing the complete proposal in Microsoft word format. Figures should be in universally readable format.**
- **Proposals are due by 4:00pm, January 11, 2008**

Special Note

The awarding of the final contract shall be at the sole discretion of the Corporation of the City of Timmins under the advise of the Timmins Economic Development Corporation and Discover Abitibi. The Corporation of the City of Timmins reserves the right to reject any or all proposals or to accept any proposal should it be deemed in the interest of the Corporation to do so and, in particular, if only one proposal is received, the Corporation reserves the right to reject it.

ANNEX "A"

STATEMENT OF WORK

TITLE: Aeromagnetic Survey – Burntbush, Ontario

SECTION 1. SURVEY PARTICULARS

To conduct a digitally-recorded high sensitivity fixed-wing airborne total magnetic field and transverse gradient survey of the **Burntbush, Ontario** area consisting of approximately 34 202 lkm and to compile the acquired data in accordance with the technical specifications given in Section 3.

1.1 Delineation of Survey Areas:

The following geographic coordinates define the survey area:

Burntbush Area Survey Boundaries	
EASTING UTM Zone 17	**NORTHING UTM Zone 17**
607225	**5496113**
608376	**5427414**
588585	**5435908**
571808	**5451617**
566649	**5459964**
541085	**5468014**
540648	**5490849**
569953	**5488881**
585850	**5495890**
605403	**5496091**

In the event that the survey boundary does not reach the Ontario Quebec border the contractor to insure complete coverage of the Ontario portion should adjust the survey.

The location map (Figure A-1) shows the survey boundaries.

Figure A-1 and Figures C-1, C-2, and C-3 referenced in Annex "A" and the theoretical flight lines: TIE.XYZ and LINES.XYZ are available for download on the GSC FTP site at:
ftp://ftp.agg.NRCan.gc.ca/docs/RFPspecs/Burntbush/

1.2 Flying Specifications:

The data quality control must be done in the field on a daily basis.
Parts of traverse lines reflown to complete a traverse line must cross control lines at either end and join the original traverse line at a low angle at a point where the data conforms to the technical specifications. All segments of a traverse line must begin and end by crossing control lines. Conversely, segments of a control line must start and end by crossing a common traverse line. All traverse lines must intersect a minimum of two (2) control lines. One (1) traverse line must be flown outside of the survey area where the

boundary is parallel to the traverse line direction to provide valid information beyond the map boundaries. Otherwise, outside survey boundaries, all traverse lines must start or end by intersecting a control line. No perimeter lines are to be flown. No gaps will be accepted in the final products. The contractor must refly lines or portions of lines where the following specifications are not met.

For each survey flight, adjacent lines must be flown consecutively and in opposite directions, racetrack flying pattern will not be permitted.

1.2.1 Height: 80 m NTC (nominal terrain clearance) except in areas where Transport Canada regulations prevent flying at this height. In areas where obstacles or topography conflict with the drape surface, the pilot's judgment shall prevail within reason. The survey height must be controlled according to the pre-defined smooth drape surface.

Traverse lines and control lines must be flown at the same altitude at points of intersection. In addition, the altitude tolerances are limited to no more than 30m difference between traverse lines and control lines.

1.2.2 Traverse line and Control line bearing and spacing:

Traverse line:
- bearing N-S
- spacing 100 m
- allowed min. separation: 70 m
- allowed max. separation: 130 m

Control line:
- bearing: E-W
- spacing: 500 m

Upon notification of the award of the contract, the Technical Authority will provide the Contractor with a smooth drape surface of the Digital Elevation Model (DEM) to be flown. Alternatively, the contractor may calculate the smooth drape surface of the DEM. In areas of steep terrain, the smooth drape surface is to be calculated using a grade (rate of climb and descent) of 5%. The Contractor's smooth drape surface must be submitted to the Technical Authority for approval prior to mobilization to the field. The gridded smooth drape surface data must be accompanied by information specifying the source of the data, method of generation and any relevant information that can be used to evaluate the data.

1.2.3 Diurnal Specifications: A maximum tolerance of **3.0 nT** (peak to peak) deviation from a long chord equivalent to a period of **one minute** for each base station. In order to limit ULF waves (micropulsations) an additional maximum tolerance of **0.5 nT** (peak to peak) deviation from a long chord equivalent to a period of **15 seconds** for each base station. This specification must be verified in the field prior to demobilization.

1.3 Specific Equipment Requirements:

Aircraft:
Contractor must provide suitable aircraft capable of following the drape surface of the DEM at a sustained rate of climb/descent specified above in paragraph 1.2.2.

Magnetometers:
The transverse sensors must be rigidly attached to the aircraft. They must also be oriented orthogonally to the direction of flight with a minimum separation of 10m . A third sensor is required and must be mounted in a stinger attached to the aircraft.

Radar Altimeter:
Minimum range: 0 - 1 500 m
Accuracy (minimal): 2%

Barometric Altimeter:
Accuracy (minimal): 2%

GPS:
Real time differential system must be used for navigation.
GPS ground base station
Raw dual-frequency positional GPS data must be supplied.*

*Post-flight differential correction of the raw GPS data is **mandatory** using ground GPS base station data for all flights.

Video Camera:
Recording speed must be set to Standard Play (SP) mode, with image overlay showing time to tenths of seconds, position and image centre cross-hair.

Ground Magnetometer Stations:
Two magnetic ground stations are required. At least one ground station is required **within the boundaries of the survey area**. The base stations must record data at a rate of 1 sample per second and record GPS time with each magnetic base station reading.

1.4 Compilation Specifics:

Map Scale, projection: 1:20 000 (NAD83, Universal Transverse Mercator)
Digital bases available: 1:50 000 (NAD83, Universal Transverse Mercator)
Grid size: 20 metres

For the use in the preparation of bases for each map, the contractor will be provided with digital base maps in DXF format for each NTS map sheet relevant to the survey area, at 1:50 000 scale.

1.5 Final Products:

- Processed Variables:

  Number of processed parameters: **6**
  a) Total Field Magnetic data
  b) Horizontal measured gradient
  c) Residual Total Field Magnetic data
  d) Magnetic First Vertical Derivative data
  e) Magnetic Second Vertical Derivative data
  f) Digital Elevation Model data

- Residual Total Field Magnetic grid enhanced using measured horizontal gradient.
  The method used to produce the horizontal-gradient enhanced grid must be approved by the Technical Authority

- Maps:

  Seven (7) final plotted copies of all map products are required. All final map products must also be delivered in both PostScript and PDF formats at resolution suitable to accurately reproduce the plotted products. If Geosoft is used to generate the final maps the Geosoft .map files will be substituted for the Postscript format.

  Map scales of 1:20 000

  Residual Magnetic Total Field-Gradient Enhanced (colour and contour interval)

  First Vertical Derivative of the gradient enhanced Total Magnetic Field (colour interval)

  Archive media can be either CD-ROM or DVD

- For each area, one Geosoft format digital archive of the final line data.

- For each area, one Geosoft format grid file for each of the processed parameters for the entire survey in NAD83, UTM projection.

- Final Technical report (**7 paper copies)** accompanied by one digital file in WordPerfect or MS Word.

- All other final products, video cassettes, logs, levelling documents.

SECTION 2. DELIVERABLES AND PAYMENT SCHEDULE

2.1 Deliverables

2.1.1 Weekly Progress Report (Acquisition):

During the data acquisition phase, production figures must be communicated to the GSC Project Leader on a weekly basis, each Monday morning by fax (613) 952-8987 or e-mail to Project Leader.

2.1.2 Weekly Progress Report (Compilation):

The Contractor's Project Manager shall submit weekly reports each Monday morning describing the state of progress of the various aspects of the work as well as projections as to the completion of the work. These reports will be faxed and addressed to the Technical Inspector or other designated persons authorized by the Technical Authority.

Included in the reports will be:

- Base of operations utilized; the number of survey flying hours and the line-kilometres flown and accepted on a daily basis during the report period and their total to report date; a sketch map (letter size) showing the area of data acquisition to date; visits by the Technical Inspector or other authorized persons.

- A statement of diurnal and weather conditions as well as any major operational, logistical or other problems which may have hindered production; downtime due to unserviceability.

- The altimeter calibration (see Part 3, Technical Specifications),

- Lag tests are required (see Part 3, Technical Specifications),

- The results of any other tests carried out during the report week including FOM, Heading, GPS Base Position and **Sensor Comparison**

Supporting documents, such as chart records or digital listings, must be supplied with any documented test results.

- Compilation of data. Flight path recovery and detailed processing stages. Maps inspected. Delivery schedule for each block.

- A sketch map (letter size) showing data compilation, drafting and reproduction progress at the different stages.

2.1.3 Digital Data

The digital data are to be delivered in line and gridded archive format as itemized in section 1.5 and described in detail in section 3.5.2. These digital data include survey acquisition data, calibration data, geophysical and navigational processed data. The digital data must be accompanied by supporting preliminary paper plots at each processing step and by proof plots for the final products, as requited.

2.1.4 Other Deliverables

1) Final Maps:
Final digital and paper copies of the maps as itemized in Section 1.5 (above) and described in detail in section 3.4 of Part 3, Technical Specifications.

2) Video cassettes or DVD's:
Video cassettes or DVD's will be labelled showing area name, date, flight number, line number, time ranges.

3) Equipment Log Book:
As described under "Airborne and Ground Instrumentation", Section 3.1

4) Levelling Documents:
The final levelling network and final flight path data (compilation listings or digital files and plots) must be submitted. All flight logs and quality control sheets must be properly labelled and submitted for data evaluation.

5) Technical Report:
A technical report must be prepared by the Contractor which presents (i) a reasonably comprehensive account of the field operations, (ii) a description of compilation of the data and (iii) an inventory of the resultant end products which will be useful to users of the data. The specifics to be included in the project report are described in further detail in section 3.6.3.

2.1.5 Handling and Storage of Digital Data

Copies of all digital data must be stored by the Contractor for 1 year after the safe delivery of the same data to the GSC Technical Authority. During this time the data may not be erased except by explicit written authorization of the Technical Authority.

After delivery of all final maps, any related materials used to produce the final products will be delivered to the GSC Technical Authority in acceptable containers which have labels identifying their contents. The Contractor must prepare a catalogue (as part of the Technical Report) for all of these data and will submit it to the GSC Technical Authority.

2.2 Schedule of Products Required

The Contractor's Project Manager shall be responsible for signing off all reports and all products being delivered, thereby certifying that the work was carried out in accordance with the Technical Specifications in Section 3.

The Contractor must make available to the Technical Inspector any digital data requested for checking purposes, to facilitate timely approval of map products.

For each awarded survey area:

2.2.1 **Milestone 1**

Not later than **March 1, 2008**, and following completion and submission of:

- documented results of all required calibration and test flights,
- mobilization and positioning of the survey aircraft, personnel, equipment and supplies at the base of operations,
- completion and acceptance by the Technical Authority of an initial 4,000 line-kms of digitally-recorded survey data,
- delivery and acceptance by the Technical Inspector of an initial 4000 line kilometres of raw GPS digitally recorded fight path data prepared in RINEX2 (ASCII) format, archived by flight, together with the GPS base station data archived by day,
- delivery and acceptance by the Technical Authority of raw magnetics base station data archived by day

2.2.2 **Milestone 2**

By **March 31, 2008** and after completion of the following:

- completion and acceptance by the Technical Authority of an initial 14,000 line-kms of digitally-recorded survey data,
- delivery and acceptance by the Technical Inspector of an initial 14,000 line kilometres of raw GPS digitally recorded fight path data prepared in RINEX2 (ASCII) format, archived by flight, together with the GPS base station data archived by day,
- delivery and acceptance by the Technical Authority of raw magnetics base station data archived by day

2.2.3 **Milestone 3**

By **April 30, 2008** and after completion of the following:

- delivery and acceptance of the edited acquisition data (including electronic navigation), Geosoft *.gdb format and FP verification by the Technical Authority,
- delivery and acceptance of all raw GPS digitally recorded fight path data prepared in RINEX2 (ASCII) format, archived by flight,
- delivery and acceptance of all raw magnetic base station diurnal data from both stations prepared in Geosoft *.gdb format, archived by day,
- a copy of the preliminary flight path map,

2.2.4 **Milestone 4**

By **May 30, 2008** and following completion, delivery and acceptance by the Technical Authority of:

- Digital files for each map sheet as described in Section 1.5 for the following:
    a) Residual Total Magnetic Field
    b) First Vertical Derivative of the Magnetic Field

- Seven (7) paper copies for each sheet as described in Section 1.5 for the following:
    a) Residual Total Magnetic Field
    b) First Vertical Derivative of the Magnetic Field

- Final digital archive of line data

- Final digital archives of the following grid data:
    a) Total Magnetic Field
    b) Residual Total Magnetic Field
    c) First Vertical Derivative of the Magnetic Field
    d) Second Vertical Derivative of the Magnetic Field
    e) Digital Elevation Model
    f) Horizontal measured gradient
    g) Total magnetic field (measured gradient enhanced)

- Final Technical report (7 paper copies) signed by the Project Manager according to the GSC Technical Specifications, Section 3, accompanied by digital file in WordPerfect or MS Word format.

- All other final products, (refer to section 3.6 of the Statement of Work).

SECTION 3. GSC TECHNICAL SPECIFICATIONS

A copy of the Technical Specifications must be in the possession of each of the Contractor's personnel who have a responsibility in the execution of the contract. The Contractor must obtain and have available in the field and office all relevant charts, maps, etc. pertaining to navigation and flight path recovery.

3.1 Airborne and Ground Instrumentation:

The instrument operator shall maintain and update an equipment log book noting all equipment replacement and repairs throughout the survey and the results of calibration tests carried out on the equipment.

3.1.1 Systems Timing Synchronization:

All data acquisition systems' timing in the aircraft and on ground base stations **must be synchronized** by the GPS time pulses**, in real time**.

3.1.2 Airborne Magnetometers:

The airborne magnetometer must be a commercially manufactured optical type, with a resolution of 0.01 nT or better and must be approved by the Technical Authority.

The recording of the magnetic field values shall be essentially without filtering except that imposed by the sampling interval itself.

The following define what are minimally acceptable:

	Total Field
Sensitivity	0.01 nT
Absolute accuracy	± 10 nT
Noise envelope	0.10 nT
Ambient range	20,000 to 100,000 nT
Sampling interval	0.1 second
Heading effect	< 2.0 nT

3.1.3 Altimeters:

Radar altimeter and barometric altimeters with digital output and a precise radar display, must form part of the ancillary equipment for the survey aircraft.

	Radar Altimeter
Minimum range:	0-1500 m
Accuracy (minimal)	2%

3.1.4 Electronic navigation:

The use of real time differential GPS is required for the accurate navigation of the survey aircraft (see Section 1, Survey Particulars). Complete GPS coverage must be obtained. The positional outputs are to be digitally recorded to 0.00001 degree to provide a final and minimal positional error. Twelve channel dual frequency receiver(s) are minimally acceptable.

3.1.5 GPS positioning system:

A **dual-frequency** 12-channel GPS acquisition system with adequate memory to record aircraft position at **10 Hz**. **Two (2) additional** dual-frequency 12 channel GPS antennas sampling at 10Hz are required to record the attitude of the aircraft . A dual-frequency GPS base station set up near the base of operations is required.

Note: Any GPS system utilized in this survey must have the capability to record and store all parameters to permit post flight differential correction of the GPS navigational data.

3.1.6 Flight Path Video Camera:

A vertically-mounted, continuous-recording video camera, with a wide angle lens to maximize ground coverage at survey altitude, must be operating at all times while the aircraft is surveying. Clearly visible time stamp updates (seconds after midnight, with

tenths of seconds) are to be displayed on the video image along with real time GPS positional information. The combined navigation system (electronic and video imaging) must be capable of providing the required accuracy over the entire survey area. Video recording must be set to SP mode.

3.1.7 Ground Monitoring Station:

A digitally-recording total field magnetometer ground station must be calibrated and operated continuously throughout the survey operation. It shall be set up at the base of operations or within the survey area, at a magnetically noise-free location, away from moving steel objects, vehicles and DC electrical power lines, which could interfere with the recording of the magnetic field diurnal variation. For each new installation of the ground station, the Contractor shall make simultaneous records with the airborne and ground station magnetometers while the aircraft is motionless on the ground and in the vicinity of the ground station. These records must be annotated for comparison and submitted to the Technical Inspector. There shall be no gaps in the recording of base station data during actual survey flying.

GPS clock time must be used to record the time of the ground magnetometer readings for **all** the base stations. The time readings of the base station(s) must be synchronized with the time reading on board the aircraft. The ground monitoring magnetometer(s) must be approved by the Technical Authority.

Ground	**Magnetometer base stn**
Sensitivity	0.01 nT
Recording	1 sec. or better
int. Noise level	0.10 nT or better

3.1.8 Field Data Verification System:

The digital data must be verified on a daily basis with an in-field verification system to ensure the recorded parameters meet the contract specifications.

The field verification system must consist of microcomputers, printer, plotter and a video player plus software to apply differential GPS corrections and to evaluate the flight path data quality. The system is to be capable of plotting a paper copy of the data at the compilation scale, to ensure all data are within specifications. Preliminary levelled grids of the magnetic total field data will be required and must be produced in the field during the survey.

3.2 Calibration Flights

3.2.1 Magnetometer:

Calibration of the aircraft magnetometer system must be carried out using the G.S.C. calibration range at Bourget, Ontario (see Figure C-1) or Meanook, Alberta (see Figure C-2), at the start and end of survey operations. The Technical Inspector must be notified of the scheduling of these test flights prior to their execution. This calibration must include a measurement of the heading error. Two (2) passes in each of the north, south,

east and west directions must be flown to obtain sufficient statistical data to complete the form C-3 referenced in Annex "A", section 1.

The results of these tests must be presented in the chart format which will be used during survey production and saved in the digital format that will be used for archiving the data. The same decimal accuracy is required. Test results plus video coverage of flight path, must be submitted to the Technical Authority for approval **before the Contractor proceeds to the survey area**.

Ground station total field values covering the duration of these calibration flights, at Bourget, Ontario or Meanook, Alberta must be obtained from the Ottawa Magnetic Observatory, Geological Survey of Canada. The procedure for obtaining these total field values using a data terminal with a modem will be described upon request. See attachment Figure C-3.: Aeromagnetic Survey System Calibration Test Ranges Form, which is to be used to tabulate the Test Range results.

3.2.2 Compensation test: FOM less than **1.5 nT**

The Contractor must determine the effects of aircraft manoeuvres: roll, pitch and yaw and to submit the results of these tests to the Technical Inspector. These tests must be performed over a magnetically quiet zone, at a high altitude. They consist of flying +/-10 degree rolls, +/-5 degree pitches and +/-5 degree yaws peak to peak along North, South, East and West headings over periods of 4 to 5 seconds. A compensation Figure of Merit (FOM) for the aircraft will be calculated by the Contractor, by summing up the peak-to-peak amplitudes of the 12 magnetic signatures.
The FOM must be determined once per month during the flying period and the results must be included in the weekly progress reports. A FOM in excess of that specified will require corrective action plus approval by the Technical Authority, before survey operations can continue.

3.2.3 Lag tests:

Prior to the initial commencement of survey production and with any major survey equipment alteration or replacement on the aircraft, the Contractor must perform a lag test to ascertain the time difference between the magnetometer readings and the operation of the positioning devices. The results of these test flights, which must be flown in opposite directions at the normal survey height across a distinct anomaly, must submitted to the Technical Inspector with the next weekly report. Lag tests must also be performed in the survey area by flying over a known point in opposite directions. This will determine lag in the digitally-recorded navigational data. Lag tests may be carried out while performing the calibration flights. To ascertain that the calculated lag remains constant within a flight and from flight to flight the contractor will conduct regular lag tests.

3.2.4 Radar Altimeter:

Pre- and post-survey calibrations must be performed by flying a range of altitudes, representative of the survey area conditions, above and below the designated survey altitude. These altitudes must cover the minimum and maximum range at 5 altitudes of equal increments. Typically, these levels must be determined by the real time GPSZ and barometric altimeter above the elevation of the base air strip. An additional line is to be

flown at survey height crossing over a lake (preferably 1 km in width) to ascertain the radar unit's sensitivity to the reflectivity difference of dry land and water.

A re-calibration must be performed if equipment is changed. All calibration results must be submitted to the Technical Inspector in tabulated form as a Microsoft Excel file accompanied by a graph, showing GPS altitude versus the radar altitude and barometric altitude.

3.2.5 Electronic navigation:

A calibration check on the accuracy of the electronic navigation system must be carried out, plotted at 1:5,000 scale and made available to the Technical Inspector prior to the commencement of survey operations (the Bourget or Meanook calibration range is suitable for this test).

3.2.6 Daily calibration:

The data recorded during these calibrations are considered to be part of the raw data and must be properly labelled and given to the GSC Project Leader at the end of the survey flying. The barometric altimeter pressure readings must be noted pre- and post flight on flight logs in order to determine any barometric drift. Drift corrections must be applied in the processing stage. The corrected barometric altimeter data must be verified against the differentially corrected GPS altitude data which must also be corrected to the orthometric height.

3.2.7 Aircraft systems comparison:

When more than one aircraft is used for a survey block, each aircraft must fly the same line and the data must be compared to ensure that all systems produce similar results. The test can be done on more than one line providing that at least 50 km of data have been collected in survey mode. This comparative line must be performed at least once during the survey and repeated at any time equipment is changed on an aircraft.

3.2.8 Stationary Aircraft GPS position test:

A GPS position test is to be performed at the end of a survey flight. The aircraft GPS system and ground GPS base station are to be kept in continuous and recording operation from the end of data acquisition until the aircraft is stationary on the airport tarmac for at least 5 minutes.

3.3 Data Records:

3.3.1 Digital:

Isolated errors or spikes and short non-sequential gaps which can be edited out are acceptable with the approval of the Technical Inspector.

3.3.1.1 Airborne:

All digital data, video, and map products must be referenced to time of day as seconds after midnight, Coordinated Universal Time, (UTC) rather than fiducials.

Recording Specifications:

	Recording Interval	**Accuracy**
Time	0.1 second	0.1 sec
Magnetic total field	0.1 second	0.01 nT
Radar altimeter	0.2 second	5 m
GPS height	1.0 second	4 m
Barometric altimeter	0.2 second	5 m
GPS Geographical Coord.	1 .0 second	4 m

3.3.1.2 Ground:

Recording Specifications:

	Recording Interval	**Accuracy**
Time	1.0 second	0.01 sec
Magnetic total field	1.0 second	0.01 nT
GPS base station	1.0 second	1 m

3.3.2 Chart Records:

The production of paper charts for airborne data is not required

3.4 Compilation of the Survey:

3.4.1 Base Maps:

The Contractor will be responsible for acquiring the necessary navigational charts and maps at its own expense.

3.4.2 Field data verification procedure:

After each day's flying, the field data quality controller must maintain an up-to-date log of the survey progress and production. A list of planned reflights must be prepared with annotations of flight data quality with specific details on any problems which would potentially have adverse effects on data quality.

The field quality controller must demonstrate that all survey calibrations have been completed as required according to specifications. All digital flight data and magnetic base station data, video recordings, flight analogue charts, must be systematically annotated and verified to be complete.

The field quality controller must demonstrate that all airborne magnetic data and ground magnetic diurnal data, collected since the start of the survey, have been evaluated; that all data which do not meet specifications have been identified, noted and available for review by the GSC technical inspector.

The field quality controller must demonstrate that all digital flight path data has been processed, differentially corrected and plotted at the compilation scale on a regular basis. Further verification of the positioning must be completed by calculating a digital elevation model (DEM) using the differentially corrected GPS altitude (corrected to the orthometric height) and radar data. The difference, producing the DEM, must be gridded and plotted at a convenient scale.

3.4.3 Flight Path:

GPS data must be utilized to position the flight lines throughout the entire survey area. It is the primary positional system. A plot of the flight path shall be made from the digital electronic flight path data with appropriate latitude and longitude labeled registration markers to permit verification relative to NTS map coordinates.

All of the raw GPS acquisition data which provides a position fix for the aircraft during survey flight must be recorded and archived. This data is to be archived as separate flights. This data in its raw form must be converted into RINEX2 format (see www page at: http://igscb.jpl.nasa.gov/igscb/data/format/rinex2.txt for format definition) and delivered to the Technical Inspector together with the raw GPS base station data as part of the required deliverables (refer to Section 2, Deliverables and Payment Schedule).

3.4.4 Magnetic Data:

All magnetic data recorded in flight must be checked for noise by an inspection of the fourth difference trace.

Base station data will be reviewed to identify any diurnal variations beyond specifications stated in Section 1.

Any lines or section of lines not meeting the specifications must be noted and reflown.

3.4.5 Altitude data:

Proper altitude control is necessary throughout the survey to optimize the quality of the magnetic levelling.

All radar altimeter data must be checked to ensure that the full height range is being recorded.

The survey must be flown at the correct altitude with respect to the conditions stated in the Section 1.

Line segments that exceed maximum altitude difference tolerance at intersections will be identified and the location plotted on a flight path map to be used in determining reflights.

3.4.6 Format:

Each traverse/control line must have a unique line number with the segment number incorporated as the last digit of the line number. Control line numbers must have a different range than the traverse lines.

Example: Traverse lines: 10000 to 79001; Control lines: 80000 to 99000. The last digit of these line numbers being the segment number. Traverse line 79001 is indicating a line segment.

3.4.7 Plotting flight path:

Labeled traverse lines and control lines must be plotted on a layer separate from the contour information. Each line must be labelled with a minimum of 2 time labels per map sheet, or a minimum of 1 label if the line direction is noted in the line label.

Line weights and labelling will be discussed with the Contractor. Sample maps shall be provided upon request. Traverse line numbers and control line numbers must be positioned inside the west and south boundaries of each map. Final labelling of flight line data must have a unique line number for each segment presented on the flight line map as well as in the corresponding digital archive data.

3.4.8 Geophysical Data:

Digital data are to be provided in Geosoft binary (GDB) line data format. The Contractor must establish a system for providing such data expeditiously when requested.

3.4.9 Levelling:

3.4.9.1 Magnetic Total Field:

Levelling of magnetic total field will be essentially based on control and traverse line intersections. The subtraction of base stations data from the airborne magnetic total field will only be authorized in special cases (subject to the review of the diurnal conditions) by the Technical Authority.

Intersection total field values, altitudes and gradients must be determined for both line and control line and will be made available digitally for verification purpose. Any modifications to these specifications must be approved by the Technical Authority.

Differences at intersections must be carefully analyzed and distributed along the control lines and/or the traverse lines to yield an identical final total field value for both lines at a given intersection. Corrections must be made to reconcile differences due to altitude. The contractor should utilize electronic positional information (GPS) to ensure that these differences are minimal.

Final values must then be assigned to the traverse profiles at the appropriate intersections and used as corrections to the digitally-recorded values along the traverse lines. In areas of steep magnetic gradient and/or of rugged topographic relief, the intersection adjustments may be deleted or an appropriate adjustment assigned to the traverse line.

Control line data must be levelled and used in the gridding process (unless instructed otherwise by the Technical Authority).

The Contractor may employ a manual, computer or combined method for determining the levelling adjustments. Whatever method is used, the Contractor must provide a detailed description of the methodology applied to the Technical Inspector.

A graphical plot of the final total field level adjustments along the traverse lines and control lines, must be plotted at the compilation scale to determine any levelling problems. This map must be submitted along with the preliminary contour maps to the Technical Inspector.

3.4.9.2 Gridding:

A square grid will be calculated from the levelled traverse and control line data. Contour maps must be produced from this grid by a contouring program. The grid used for the compilation maps must be used for the final maps.

3.4.10 Colour Interval Maps:

The Contractor is required to assemble and produce final maps consisting of the descriptive notes, map headings, logos, map coordinates and adjoining map references, neat line, the topographic base within and all layers of data pertaining to the survey, with appropriate line weights and colours as described in 3.4.5, 3.4.10.1 and 3.4.11 within the window defined by the neatline.

The base map with surround for each map sheet must be prepared and submitted for approval. The maps must conform to generic GSC Open File standards as modified for aeromagnetic maps. The contractor shall be made aware of the necessary modifications to the following generic specifications.

http://www.nrcan-rncan.gc.ca/ess/carto/pdfs/toolbox/design_specs.pdf

The colour intervals for the Residual Total Magnetic Field must conform to a histogram equalized distribution of the data range. The colour intervals for the First Vertical Derivative of the Magnetic Field must conform to either a histogram equalized distribution of the data range or to a standardized distribution supplied by the Technical Inspector. Specific colour tables for each parameter will be provided by the GSC. Colour interval maps that incorporate contours must have their intervals adjusted so that they correspond to the major contour intervals.

The contour interval for the Residual Total Magnetic Field must be 2nT. Contour intervals 10 ,50 and 250 nT must be shown using different line weights. If the data warrants changing these intervals, this may be modified in consultation with the Technical Inspector. Magnetic depressions must be indicated by "tick-marks" placed around the inside of the contours expressing the locally low areas in the magnetic total field. Highs will not require any special identification. Sample maps illustrating proper line weights and contour labelling shall be provided upon request. The direction of the contour labelling must face up gradient.

Flight path and relevant line and fiducial (time) labelling must be included as described in 3.4.7.

3.4.11 Technical inspection of final compilation:

The Contractor must prepare a set of working scale (1:50 000) preliminary maps for the entire survey area for the approval of the Technical Authority before preparing final data set consisting of:

(i) isomagnetic contours and flight path maps overlain on the colour grid of the levelled magnetic data,
(ii) colour calculated 1st vertical derivative of the magnetic field maps,
(iii) colour calculated 2nd vertical derivative of the magnetic field maps,
(iv) profile of the total magnetic field level adjustments and flight path,
(v) colour maps of the DEM calculated from the difference of the GPSZ minus radar.

Each plot submitted for approval must be accompanied by all the pertinent analog records, videos, flight logs, computer listings, levelling information, etc. necessary to verify the compilation. The digital line and gridded data and a preliminary step-by-step compilation report must also be submitted at this time.

On completion of the inspection by the Technical Inspector, one copy of each plot must be returned to the Contractor indicating corrections, if any, to be carried out. When these corrections have been completed by the Contractor, the Technical Authority must approve the compilation by signature on the accepted copy.

Each manuscript submitted for approval must be properly identified as to survey area, map number and the proper geographic coordinates.

3.5 Preparation of Digital Archives:

In specific circumstances, digital line data must be nulled by adding the appropriate null value where the data is not used in the gridding. These circumstances are:

1. unused control line data at intersections in magnetic levelling;
2. overlapping line data where flight lines have been broken;
3. flight path ending outside of the survey boundaries within a map sheet.

3.5.1 General specifications:

The digital data set is the principal end product to be delivered and it must be of the highest possible quality, essentially error-free. It is recommended that the contractor provide a statistical summary for each field in the line data set and also for the complete gridded data sets being submitted as final archives (not from the contractor's database).

Acceptable media are CD ROM or DVD. The contractor must consult with the Project Leader to ensure compatibility.

3.5.2 Detail specifications:

3.5.2.1 Line archive:

The line archive data must be submitted in **Geosoft** binary (*.gdb) format.
Line data sample rate: **10** samples per second **for all fields**

The structure and format line archive:

Channel	Description	NULL	Unit	Format
line	line number			I10
time	time (seconds after midnight)		sec	f10.2
fiducial	fiducial		sec	f10.2
X	Easting UTMX, NAD83 - projection in appropriate zone		m	f10.2
Y	Northing UTMY, NAD83 - projection in appropriate zone		m	f10.2
drape	drape surface used for height navigation	50,000	m	f10.2
gpsz_rrl	raw GPS elevation (realtime)	50,000	m	f10.2
gpsz_pp	raw GPS elevation (post processed)	50,000	m	f10.2
gpsz_fin	GPS elevation- FINAL(orthometric MSL)	50,000	m	f10.2
Lat	longitude, NAD83		degrees	f13.6
Long	latitude, NAD83		degrees	f13.6
raltraw1	raw radar altimeter, de-spiked	50,000	m	f10.2
ralt	radar altimeter - FINAL	50,000	m	f10.2
balt	barometric altimeter (corrected) - FINAL	50,000	m	f10.2
rot_term1 1	rotation matrix – term 1,1			f10.5
rot_term12	rotation matrix – term 1,2			f10.5
rot_term13	rotation matrix – term 1,3			f10.5
rot_term21	rotation matrix – term 2,1			f10.5
rot_term22	rotation matrix – term 2,2			f10.5
rot_term23	rotation matrix – term 2,3			f10.5
rot_term31	rotation matrix – term 3,1			f10.5
rot_term32	rotation matrix – term 3,2			f10.5
rot_term33	rotation matrix – term 3,3			f10.5
Azmth	Azimuth- Final GPS calculated aircraft heading	5000	deg	f10.3

Roll	Roll- Final GPS calculated	5000	deg	f10.3
Pitch	Pitch- Final GPS calculated	5000	deg	f10.3
Fluxgate_x	X Fluxgate	500,000	nT	f10.2
Fluxgate_y	Y Fluxgate	500,000	nT	f10.2
Fluxgate_z	Z Fluxgate	500,000	nT	f10.2
demraw	DEM - prior to levelling adjustment	50,000	m	f10.2
demcorr	DEM - corrections, tie line leveling adjustment	50,000	m	f10.2
dem	DEM FINAL - levelled digital elevation model	50,000	m	f10.2
maguncom_r	right-raw uncompensated mag	500,000	nT	f10.2
magraw_r	right-raw compensated mag	500,000	nT	f10.2
magrawed_r	right-raw compensated mag (edited lagged and de-spiked)	500,000	nT	f10.2
maguncom_l	left-raw uncompensated mag	500,000	nT	f10.2
magraw_l	left-raw compensated mag	500,000	nT	f10.2
magrawed_l	left-raw compensated mag (edited lagged and de-spiked)	500,000	nT	f10.2
maguncom	tail-raw uncompensated mag	500,000	nT	f10.2
magraw	tail-raw compensated mag	500,000	nT	f10.2
magrawed	tail-raw compensated mag (edited lagged de-spiked)	500,000	nT	f10.2
diuraw1	base mag #1, raw diurnal magnetic	500,000	nT	f10.2
diuraw2	base mag #2, raw diurnal magnetic	500,000	nT	f10.2
diuraw3	base mag X, raw diurnal magnetic, (if applicable)	500,000	nT	f10.2
diurnal	edited, or filtered base mag , (if applicable)	500,000	nT	f10.2
diurcorr	diurnal adjustment of magnetic field , (if applicable)	500,000	nT	f10.2
magbase	magnetic field, post diurnal adjustment, (if applicable)	500,000	nT	f10.2
tlcorr	tie line mag levelling adjustment (mag)	500,000	nT	f10.2
addcorr	additional levelling correction, (if applicable)	500,000	nT	f10.2
maglev	levelled mag - FINAL	500,000	nT	f10.2
grad_raw	measured transverse gradient	500,000	nT/m	f10.5
grad	measured transverse gradient-rotationally corrected	500,000	nT/m	f10.5
gradl_raw	measured longitudinal gradient	500,000	nT/m	f10.5
gradl	measured longitudinal gradient-rotationally corrected	500,000	nT/m	f10.5
date_gsc	date, (example : 24062001)	ddmmyyyy		I10
flight	flight number			I10

Prior to line archive generation the Contractor must consult with the Technical Inspector on the final format.

3.5.2.2 Grid archive:

See Section 1 for grid cell size.

One Geosoft *.grd format grid file for each one of the processed variable for the entire survey.
The Universal Transverse Mercator projection with the appropriate central meridian must be used for creating the gridded data sets. All longitudes west of Greenwich should be represented as negative degrees. Each survey grid origin must be a multiple of the grid interval for both easting and northing coordinates.

3.6 Final Products:

See Section 1, for list of Final Products

3.6.1 Aeromagnetic Maps: (See Annex "A" Survey Particulars)

The Contractor is required to assemble and produce final maps consisting of:

Paper maps as described under Section 1.5.
All digital final map products (see section 1.5) must also be delivered at resolution suitable to accurately reproduce the plotted products, two (2) copies on CD-R or DVD media.

3.6.2 Digital Archive Data:

Archives of final line data in binary Geosoft *.gdb format and archives of grid data as *.grd (FLOAT) format files, two (2) copies on CD-ROM or DVD media.

3.6.3 Technical Report:

A technical report must be prepared by the Contractor which presents (i) a reasonably comprehensive account of the field operations, (ii) a description of compilation of the data and (iii) an inventory of the resultant end products which will be useful to users of the data. The project report shall include the following:

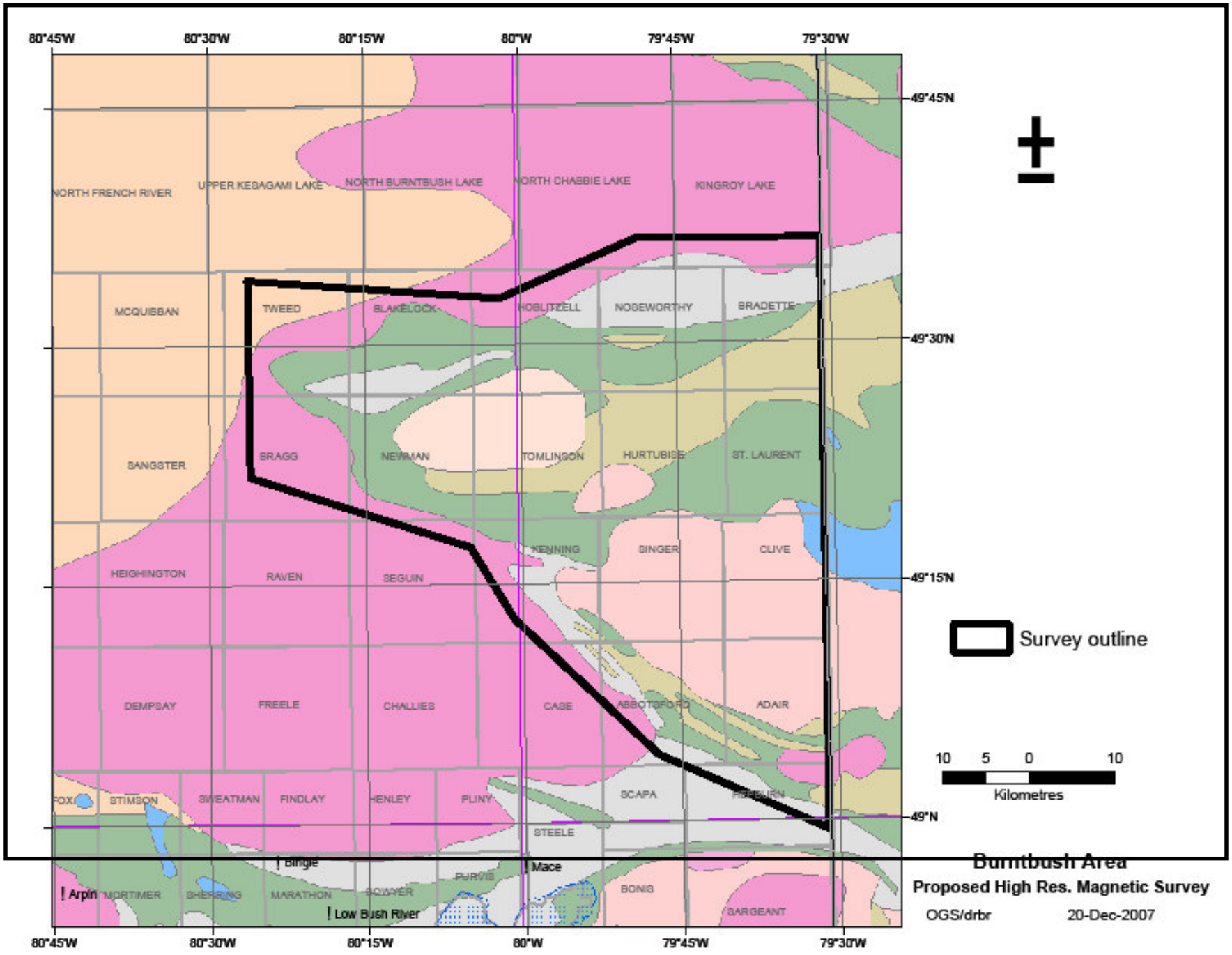
(i) Description of the field operations with statistics including a list of:
- bases of operations with pertinent dates and personnel involved
- description of the survey aircraft and instrumentation used.

(ii) Technical specifications of the survey including a description of the problems encountered during the survey. A discussion of the effectiveness of the survey techniques and instrumentation utilized with suggestions to improve the effectiveness of aeromagnetic surveys.

(iii) Description of the compilation procedure including a general flow chart of complete data compilation technique from correction and editing of raw data to contour map production; a list of all criteria employed in rejection/acceptance of data; a general explanation of the mathematical basis of the levelling and gridding algorithm used; personnel involved.

(iv) Index maps and a list of all the end products of the survey. In addition, for every file:
- a detailed documentation of the file formats.
- a list of all constants, datum levels, and conversion factors required for subsequent use of the data.

A draft copy of the Project Report must be submitted to the Project Leader and approved by the Technical Authority prior to its finalization. The final version must be accompanied by a digital version in either MSWord or WordPerfect. Seven (7) copies are required.


80°45'W
80°30'W
80°15'W
80°W
79°45'W
79°30'W
49°45'N
49°30'N
49°15'N
49°N
NORTH FRENCH RIVER
UPPER KESAGAMI LAKE
NORTH BURNTBUSH LAKE
NORTH CHABBIE LAKE
KINGROY LAKE
MCQUIBBAN
TWEED
BLAKELOCK
HOBLITZELL
NOSEWORTHY
BRADETTE
SANGSTER
BRAGG
NEWMAN
TOMLINSON
HURTUBISE
ST. LAURENT
KENNING
SINGER
CLIVE
HEIGHINGTON
RAVEN
SEGUIN
DEMPSAY
FREELE
CHALLIES
CASE
ABBOTSFORD
ADAIR
FOX
STIMSON
SWEATMAN
FINDLAY
HENLEY
PLINY
SCAPA
STEELE
! Bingle
! Mace
! Arpin
MORTIMER
SHEPPARD
MARATHON
SQUAPER
PURVIS
BONIS
SARGEANT
! Low Bush River
Survey outline
10 5 0 10
Kilometres
Burntbush Area
Proposed High Res. Magnetic Survey
OGS/drbr
20-Dec-2007

ANNEX "C"

MANDATORY REQUIREMENTS, EVALUATION CRITERIA AND SELECTION METHOD

A. MANDATORY REQUIREMENTS - 88 POINTS

At bid closing time, the Bidder must :

- comply with the following Mandatory Requirements; and
- provide the necessary documentation to support compliance.

Any proposal which fails to meet the following Mandatory Requirements will be deemed non-compliant and will not be given further consideration. **Each requirement should be addressed separately.** A proposal meeting the mandatory criteria will automatically be awarded 88 points out of a total of 100 points allocated to the proposal. The point rated criteria have been allocated a total of 12 points.

1. The Bidder must submit a signed proposal as per the Acceptance of Terms and Conditions clause of the Request for Proposal.

2. The Bidder must **submit a letter** from an Insurance Broker or Insurance Company licensed to operate in Canada **that certifies** that the Bidder, if successful in being awarded a Contract, will or can be insured in accordance with ALL the insurance coverage requirements.

3. Aeromagnetic Survey Accreditation and Experience:

The bidder must be accredited to fly aeromagnetic surveys.

The bidder and its subcontractors combined must have experience and demonstrated capability to carry out the required work and to compile the resultant data into aeromagnetic and airborne gamma-ray spectrometric map form. This will require that the bidder has suitable survey aircraft, equipment, instrumentation and compilation facilities. The bidder will be deemed to have demonstrated its capability and experience if it has flown and compiled at least one regional total field aeromagnetic survey of at least 10,000 line kilometres **using GPS navigation aids to fly a pre-planned drape surface**.

4. Qualified Personnel:

Personnel qualifications will be evaluated only on the basis of information shown on resumés provided. Personnel will be evaluated on educational qualifications, experience and track record.

The bidder must propose personnel with the following level of education and experience:

(a) Project Manager:
Geophysicist, with a degree in earth sciences from a recognised university or geoscientist with applied experience in aeromagnetic surveys; and 3 years experience in airborne

geophysical survey projects that were comparable in scope, instrumentation and survey parameters to that required for the contract.

(b) Field Manager:
Two (2) years of related experience in this type of geophysical survey projects.

(c) Pilots:
Must hold a valid commercial pilot licence, applicable to the type of aircraft to be flown, issued by Transport Canada and must be able to provide proof on demand of the Contracting Authority.

In addition, pilots must have at least 300 hours of flying on low level airborne geophysical surveys of this type and must be able to provide proof on demand of the Contracting Authority.

(d) Field Quality Controller:
Must have related experience on at least two (2) geophysical airborne survey projects of this type within the last 3 years and must be able to provide proof, on demand of the Contracting Authority.

(e) Instrument Operator or Co-pilot:
Must have at least one (1) year of operational experience on this type of geophysical survey and must be able to provide proof, on demand of the Contracting Authority.

(f) Maintenance Engineer:
Must hold a valid Category M licence and be able to provide proof on demand by the Contracting Authority. This position may be subcontracted.

The Bidder must provide an organization chart for this project (with names and functions), showing the actual reporting responsibilities of personnel.

Personnel list and **resumes for each of proposed personnel**. Resumes should contain full name, citizenship, education and professional qualifications - degrees or licenses, years and granting institution, languages spoken, employment record including employers, years and places of employment with type of work performed and the extent of experience in the function delegated on this project. Resumes are not required for individual mechanics who may be provided under a sub-contract.

5. Systems

Evaluation of Systems will be in accordance with the requirements stated in the Technical Specifications, attached hereto as **Annex "A", Section 3**.

(a) aircraft - provide the following information:
Type, registration, number of engine hours remaining after mobilization, before overhaul, range, cruising speed in knots, climb/descent gradient performance, aviation fuel used, hourly consumption for aviation fuel and oil.

(b) airborne magnetic system and base station magnetometers plus digital acquisition systems - provide the following information:
Manufacturer, type and model number, number of units, serial number, range in nT, sensitivity in nT, sampling rate, GPS and acquisition system timing interface mechanism.

(c) navigation system - provide the following information:
Positioning cameras, navigation and flight path recovery systems: manufacturers, model numbers, radar altimeter, temperature and barometric pressure recording, electronic positioning system(s) including serial number, displays, resolution, accuracy, number of GPS channels. Describe the video camera lens and the image (ground distance) at survey altitude.

(d) field data plotting and verification system - provide the following information:
Manufacturer and model number of all components including hardware and software.

EVALUATION CRITERIA - POINT RATED REQUIREMENTS

Each technical and management proposal which meet all the Mandatory Requirements specified above, will be evaluated and scored in accordance with the following evaluation criteria:

B. POINT RATED CRITERIA - 12 POINTS

- Proposals are point rated on the following criteria:

(a) Recent Past Performance of the Bidder, as described in **B.1** below **(6 points maximum)**
(b) Current Work Plan and Capacity as described in **B.2** below **(6 points maximum)**

- Criteria (a) and (b) above are evaluated, classified and awarded or deducted points on each of the three sub-criteria contained therein as follows:

Surpasses requirements	2 points (2 points added)
Satisfactory	0 points (no points added)
Substandard and inadequate	-2 points (2 points deducted)

To be considered compliant, a proposal must NOT obtain a substandard rating in any category under B.1 of the point rated criterion; and must NOT obtain more than one substandard rating under B.2 of the point rated criterion.

B.1 Recent Past Performance - 6 Points

Past performance will be evaluated on the following sub-categories:

	Maximum Points
(a) quality of data acquisition with respect to specifications	**2 Points**
• completeness of data set and gaps in coverage	
• noise levels on magnetic and electromagnetic data	
• altimeter data	
• navigational data	
• diurnal monitoring	
(b) timing	**2 Points**
• start of data acquisition	
• conduct and efficiency of operations	

- delivery of acquisition data
- delivery of final products

(c) compilation and final products **2 Points**

- number of re-submissions
- quality of final products

In order to support the evaluation of the above sub-categories, provide the following:
Similar projects recently undertaken, including:

- *Location, size, client, date, contact name & telephone number*
- *Description and details of drape surface used (maximum slope)*

B.2 **<u>Current Work Plan and Capacity</u>** - **6 Points**

Current capabilities and plans will be evaluated on:

(a) current workload **2 Points**

- ability to undertake this contract and deliver products in a timely manner, given existing workloads

In order to support the evaluation of the above sub-category, provide the following:
Details of work in progress including:
- Size, work remaining, expected completion date

Capacity, particularly in terms of current work:
- Flexibility in terms of being able to cope with workload variations,

(b) reconnaissance of project **2 Points**

- demonstrated understanding of survey area, operational constraints

In order to suport hte evaluation of the above sub-category, provide a description of operational details specific to project, including:

(i) regional facts:
-weather, terrain, protected areas, mileages, specific operating licences, etc.

(ii) base of operations:
- airport plus alternatives, fuel availability, flight planning, base station locations, data transfer and frequency of transfer between remote and field office, field office location

(iii) drape flying:
- procedure that will be used to ensure that altitude difference at traverse – control line intersections will be minimised.

(iv) timing:
- time required by the Bidder between date of notification of contract award and date of commencement of survey operations in weeks or calendar days
- Bar chart showing detailed scheduling which demonstrates how all activities will be co-ordinated to ensure achievement of required delivery date

(v) Bidders are required to calculate and provide the total number of line kilometres for survey area from the coordinates provided in Annex "A" and the index maps Figure A-1 and Figure A-2 with separate traverse and control line totals, including the overfly. A flight line and control line map for the entire survey area should be submitted as part of the proposal:

Traverse Line Kilometres = _____ ***lkm***
Control Line Kilometres = _____ ***lkm***
Total Line Kilometres = _____ ***lkm***

(c) quality control **2 Points**

- field procedures to ensure data integrity
- office procedures to validate the data at each processing step including steps for flight path finalization.

Provide a plan of action outlining the detailed approach and technique to be followed in carrying out the work involved in completing all aspects of this project. Measures to be taken and the quality control procedures to be implemented and followed to ensure a consistent quality of work. A detailed description for:

- the field
- the office

Digital compilation procedure including flight path recovery, editing with speed checks, levelling, gridding, contouring, detailed procedure to produce final digital archives and maps, and checking of final products.

- description
- Annex & Page of Data Reduction Flow Chart

SELECTION METHOD - LOWEST COST-PER-POINT

To be considered compliant, a proposal must:

(a) meet all the mandatory criteria;
(b) must not obtain a substandard rating in any category under B.1 in the point rated criteria; and
(c) must not obtain more than one substandard rating in B.2 in the point rated criteria.

Proposals not meeting (a) or (b) or (c) above will be given no further consideration.
Neither the compliant proposal that scores the highest number of rated points nor the one that contains the lowest price will necessarily be accepted. Selection will be based on the compliant proposal with the lowest cost per rated point, as calculated as follows:

$$\textbf{Cost Per Rated Point} = \frac{\textbf{Total All Inclusive Survey Cost*}}{\textbf{Total Points Achieved}}$$

Once the cost per rated points have been calculated for the compliant proposals, selection will follow the process detailed below:

The awarding of the final contract shall be at the sole discretion of the Corporation of the City of Timmins under the advise of the Timmins Economic Development Corporation and Discover Abitibi. The Corporation of the City of Timmins reserves the right to reject any or all proposals or to accept any proposal should it be deemed in the interest of the Corporation to do so and, in particular, if only one proposal is received, the Corporation reserves the right to reject it.