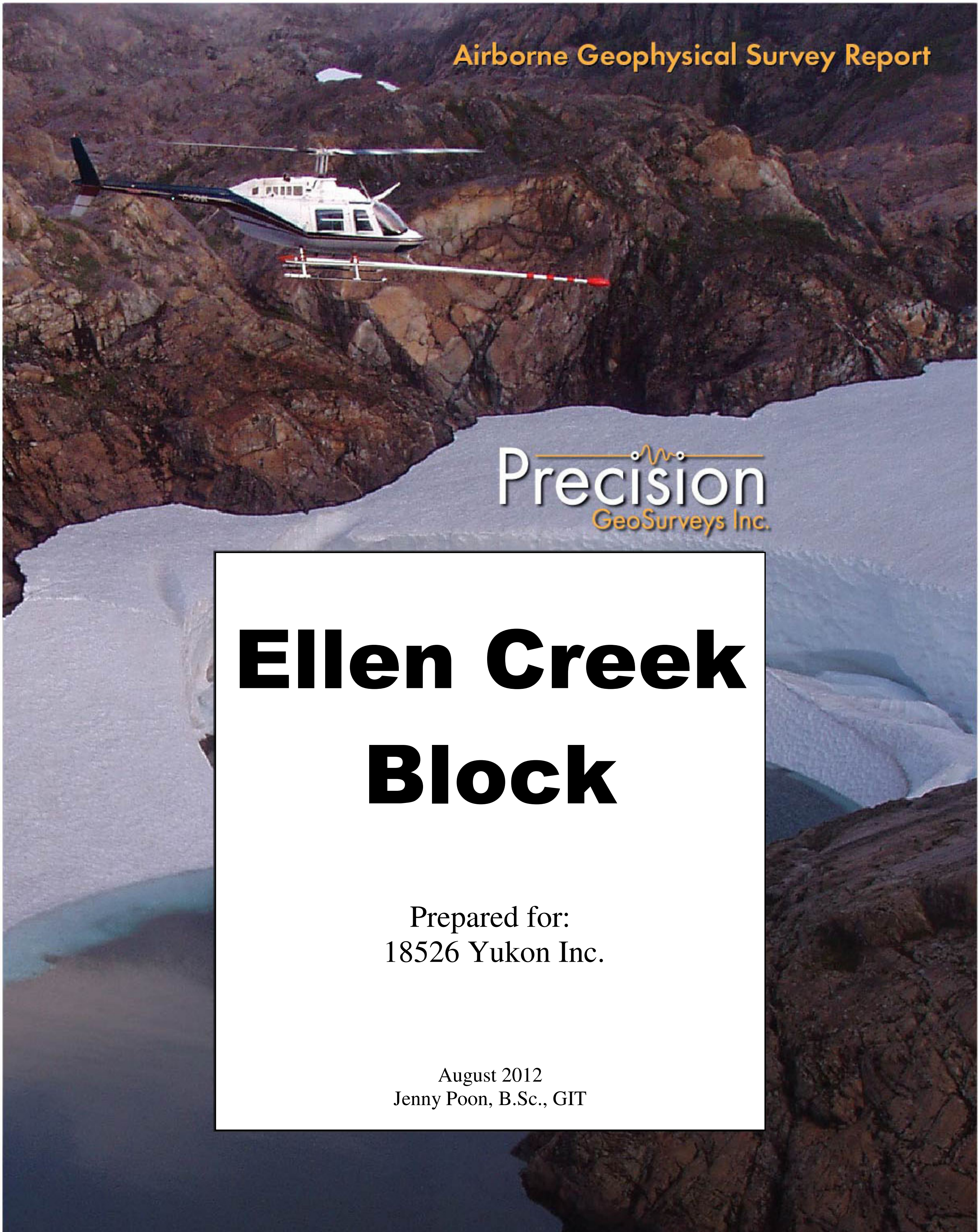

Airborne Geophysical Survey Report

Precision GeoSurveys Inc.

Ellen Creek Block

Prepared for:
18526 Yukon Inc.

August 2012

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1.0 Introduction:

This report outlines the survey operations and data processing actions taken during the airborne geophysical survey flown at the Ellen Creek block. The survey area is located south east of Ross River, Yukon Territory, Canada and south west of Fire Lake in the Finlayson VMS (Volcanogenic Massive Sulphide) district (Figure 1). The airborne geophysical survey was flown by Precision GeoSurveys Inc. for 18526 Yukon Inc. The geophysical survey, carried out on August 11, 2012 saw the acquisition of high resolution magnetic and radiometric data.

Figure 1: Block location map.

1.1 Survey Area

The Ellen Creek block is located south east of Finlayson Lake. The survey block is approximately 150 km south east of Ross River, Yukon Territory, Canada (Figure 2).

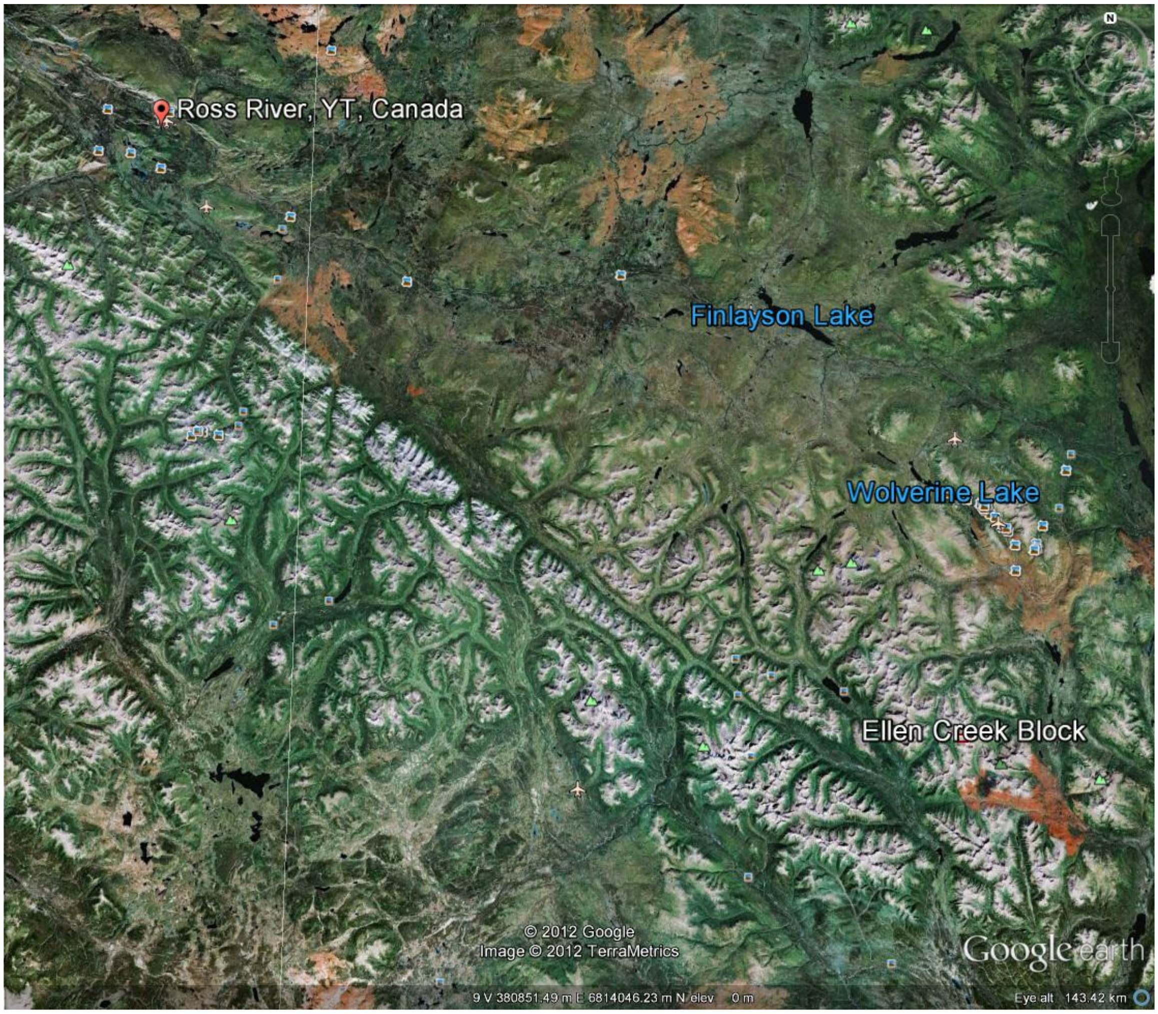

Figure 2: Ellen Creek block location relative Ross River, Yukon Territory on Google Earth.

The Ellen Creek block is approximately 2 km by 1 km (Figure 3). A total of 25 line kilometers of magnetic and radiometric data were flown for this survey; this total includes tie lines and survey lines.

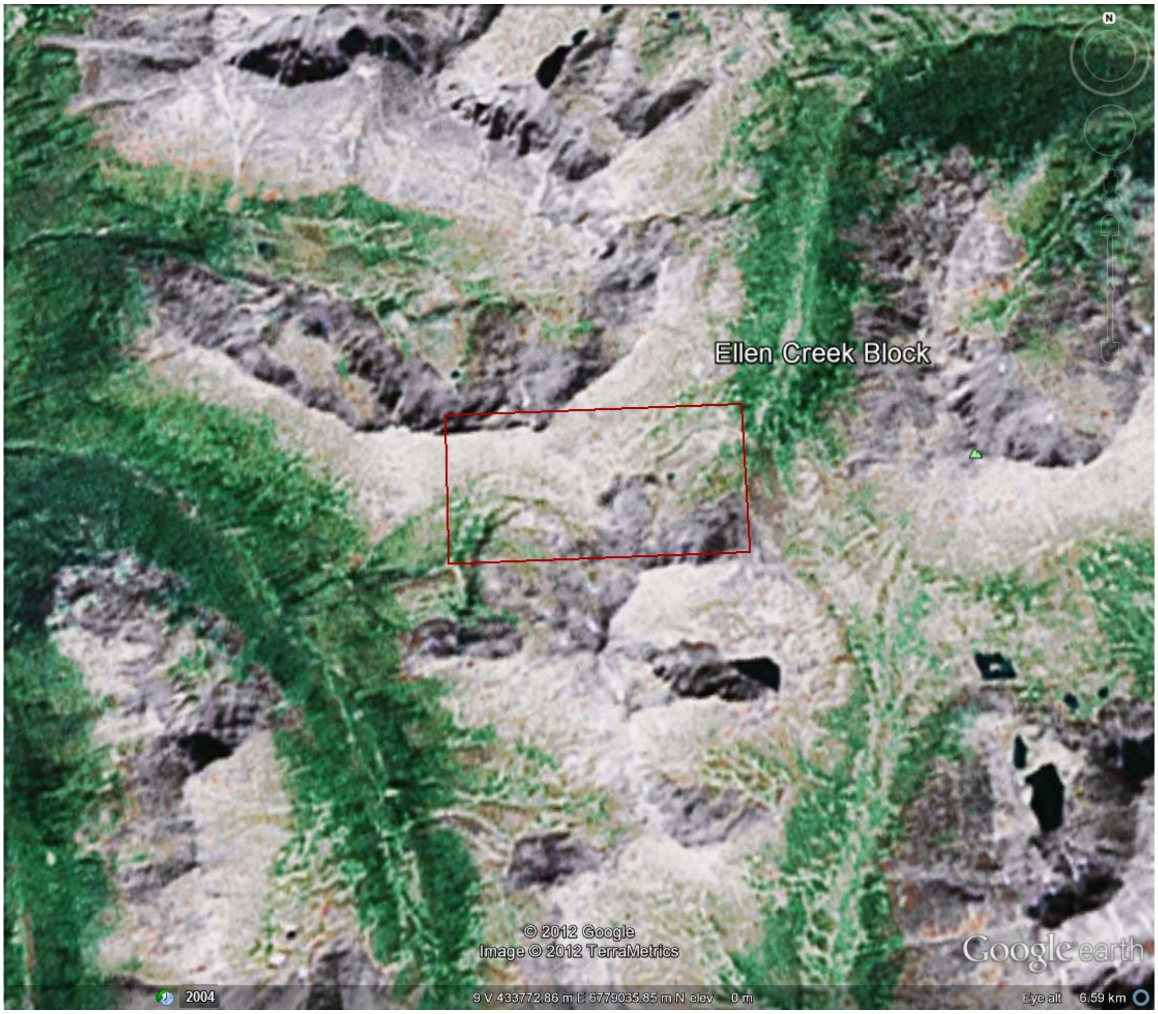

Figure 3: Ellen Creek block survey boundary in red.

The Ellen Creek block survey lines were flown at 100 meter spacing at a 090°/270° heading; the tie lines were flown at 1 km spacing at a heading of 000°/180° (Figures 4 and 5).

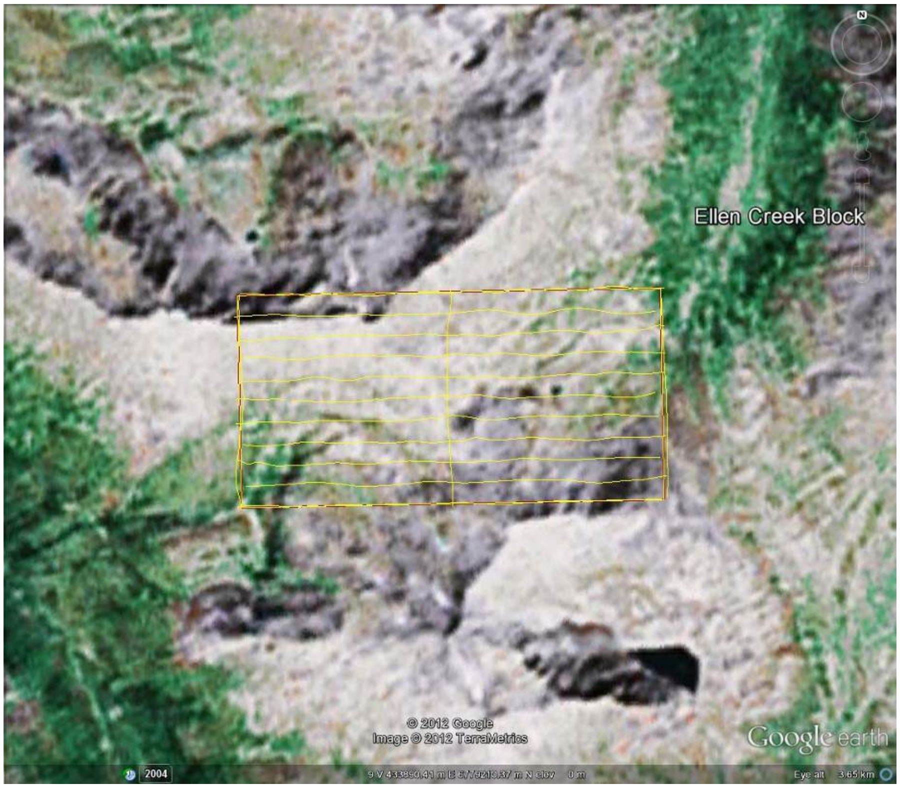

Figure 4: Plan View - Ellen Creek block with survey and tie lines outlined in yellow and the boundary in red.

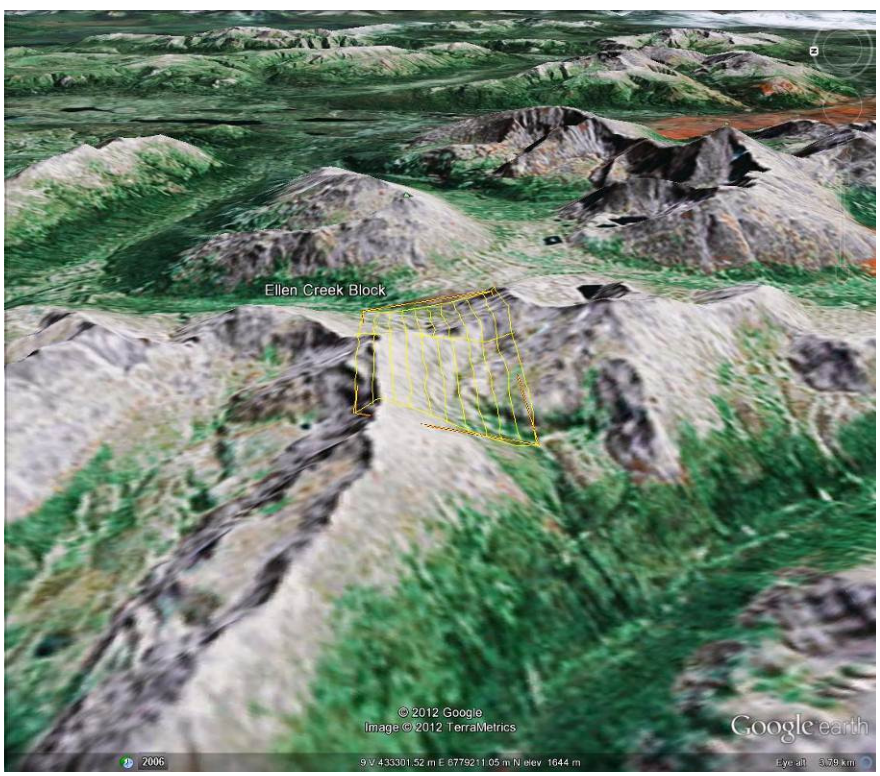

Figure 5: Terrain View - Ellen Creek block with survey and tie lines outlined in yellow and the boundary in red.

1.2 Survey Specifications:

The geodetic system used for this survey is WGS 84 and the area is contained in zone 9N (Figure 6). The survey data acquisition specifications and coordinates for Ellen Creek block survey are specified as followed (Tables 1 to 2).

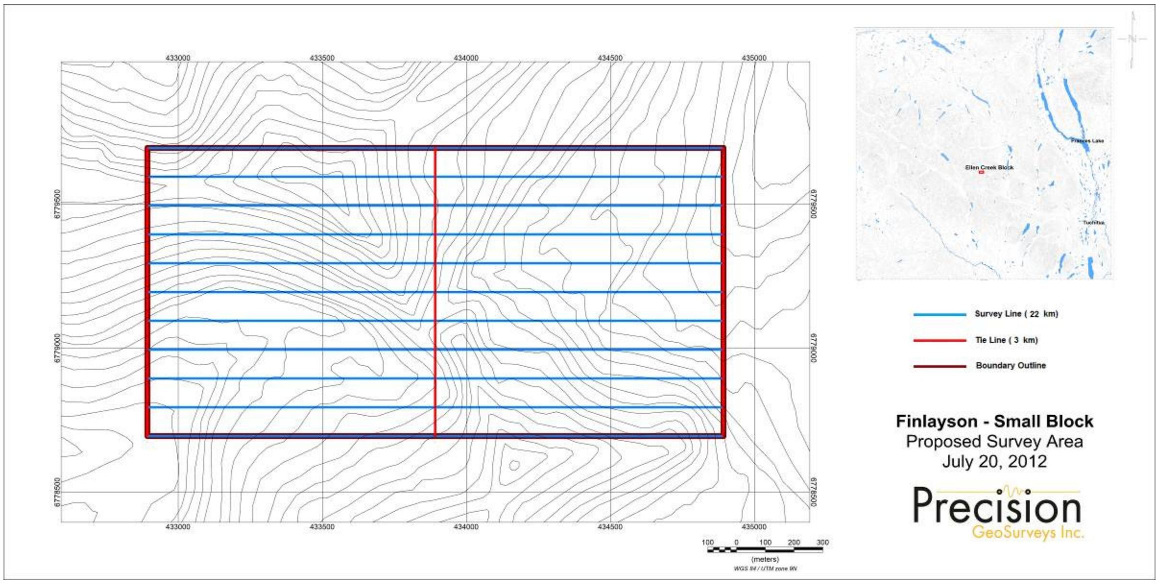

Figure 6: Proposed survey map of Ellen Creek block showing survey lines, tie lines and the block boundary.

Survey block	Line Spacing m	Planned Survey Line km	Planned Tie Line km	Total Planned Line km	Total Actual Flown km	Survey Line Orientation	Nominal Survey Height m
Ellen Creek	100	22	3	25	25	090°/270°	35
Total				25	25		

Table 1: Ellen Creek block survey acquisition specifications.

Longitude	Latitude	Easting	Northing
130.24652973	61.14605322	432892.78	6779694.68
130.20938912	61.14639024	434892.78	6779694.68
130.20904586	61.13741452	434892.78	6778694.68
130.24617594	61.13707763	432892.78	6778694.68

Table 2: Ellen Creek block survey polygon coordinates using WGS 84 in zone 9N.

2.0 Geophysical Data:

Geophysical data are collected in a variety of ways and are used to aid in the exploration and determination of geology, mineral deposits, oil and gas deposits, contaminated land sites and UXO detection.

For the purposes of this survey, airborne magnetic and radiometric data were collected to serve in the exploration of the Ellen Creek block which contains rocks that are prospective for zinc, silver, copper, barium, and lead.

2.1 Magnetic Data:

Magnetic surveying is probably the most common airborne survey type to be conducted for both mineral and hydrocarbon exploration. The type of survey specifications, instrumentation, and interpretation procedures, depend on the objectives of the survey. Typically magnetic surveys are performed for:

1. Geological Mapping to aid in mapping lithology, structure and alteration in both hard rock environments and for mapping basement lithology, structure and alteration in sedimentary basins or for regional tectonic studies.
2. Depth to Basement mapping for exploration in sedimentary basins or mineralization associated with the basement surface.

2.2 Radiometric Data:

Radiometric surveys detect and map natural radioactive emanations, called gamma rays, from rocks and soils. All detectable gamma radiation from earth materials come from the natural decay products of three primary elements; uranium (U), thorium (Th), and potassium (K). The purpose of radiometric surveys is to determine either the absolute and relative amounts of U, Th, and K in surface rocks and soils.

3.0 Survey Operations:

Precision GeoSurveys will be operating out of Inconnu Lodge, YT. The crew will have the base station set up prior to the start of the survey. The experience of the pilot helped to ensure that the data quality objectives were met and that the safety of the flight crew was never compromised given the potential risks involved in airborne surveying. Field processing and quality control checks are done daily.

3.1 Operations Base and Crew:

The base of operations for this survey was at the Inconnu Lodge, Yukon Territory, Canada. The Precision crew consisted of three members:

Harmen Keyser– Pilot
Erik Keyser - Operator
Jenny Poon - Geophysicist

The survey was started and completed on August 11, 2012. It encountered no delays due to weather.

3.2 Base Station Specifications:

Two magnetic base stations were set up before every flight to ensure that diurnal activity was recorded during the survey flights. In this case, two GEM GSM 19T base stations were plotted in the bushes. GEM 3 (Serial # 5081669) and GEM 5 (Serial # 1094678) were located adjacent to the fueling station at the south end of Finlayson Lake (Table 3).

Station name	Easting/ Northing	Longitude/ Latitude	Datum/ Projection
GEM 3 (Serial # 5081669)	0418852E, 6836560N	130° 31' 55.341" W 61° 39' 13.376" N	WGS84, Zone 9N
GEM 5 (Serial # 1094678)	0418847E, 6836566N	130° 31' 55.690" W 61° 39' 13.566" N	WGS84, Zone 9N

Table 3: Base station specifications.

Base station readings were reviewed at regular intervals to ensure that no data were collected during periods with high diurnal activity (greater than 5 nT per minute). The base stations were installed at a magnetically noise-free area, away from metallic items such as steel objects, vehicles, or power lines (Figure 7) that could affect the survey data.

Figure 7: GEM 3 (left) and GEM 5 (right) base station locations.

The diurnal magnetic variations recorded from the stationary base stations are removed from the magnetic data recorded in flight to ensure that the anomalies seen are real and not due to solar activity.

3.3 Field Processing and Quality Control:

On a flight-by-flight basis, the survey data were transferred onto a USB flash drive and copied onto a field data processing laptop. The raw data files are in PEI binary data format and are converted into Geosoft GDB database format. Using Geosoft Oasis Montaj 7.5, the quality of the data is inspected to see if it meets the contract specifications (see Table 4). If survey and tie lines exhibit excessive deviation from (left/right or up/down) the contract specifications, or were considered to be inferior quality, were reflown. Any suspicious anomalies, especially those found on a single flight line, were reflown. All re-flights will be a minimum of 2000 m long and survey line re-flights crosses at least two tie lines, and tie line re-flights will cross at least 7 survey lines where applicable. For this survey project, no re-flights were required due to diurnal or equipment malfunctions.

Specification	Technology	Details
Line Spacing	Position	Flight lines deviate from flight path by more than +/- 15 m left/ right for 1 km or more.
Height		Flight lines deviate from height by more than +/- 10 up/down (with a nominal flight height of 35 m above ground) for 1 km or more.
Diurnal Variations	Magnetics	Non-linear magnetic diurnal variations exceed 10nT from a linear chord of length one (1) minute
Normalized 4th Difference		Magnetic data exceeding 0.30 nT peak to peak for distances greater than 1 km or more (provided noise is not due to geological or cultural features).
Test Line Data	Radiometrics	If signals from the four spectrometer windows (K, Th, U, and TC) over the test line exceed by more than 12%, the flights shall be re-flown or suspended.

Table 4: Contract re-flight specifications.

4.0 Aircraft and Equipment:

All geophysical and subsidiary equipment are carefully installed on Precision GeoSurvey's aircraft. For this survey, a magnetometer, spectrometer, a data acquisition system, base stations, laser altimeter, pilot guidance unit (PGU), and a GPS navigation system were required to carry out the survey and collect quality, high resolution data. The survey magnetometer was carried in an approved "stinger" configuration to enhance flight safety and improve data quality in this mountainous terrain.

4.1 Aircraft:

Precision GeoSurveys flew the blocks using a Eurocopter AS350 helicopter (Figure 8), registration CGOHK. The survey lines were flown at a nominal line spacing of one hundred (100) meters and the tie lines were flown at 1 km spacing for both the magnetometer and spectrometer. The average survey elevation was 35 meters vertically above ground for both blocks.

Figure 8: Eurocopter AS350 equipped with mag stinger for magnetic data acquisition, and internal spectrometer crystals for radiometric data acquisition.

4.2 Equipment:

4.2.1 AGIS:

The Airborne Geophysical Information System, AGIS, (Figure 9), is the main computer used in data recording, data synchronizing, displaying real-time QC data for the geophysical operator, and the generation of navigation information for the pilot and operator display system.

Figure 9: AGIS installed in the Eurocopter AS350.

The AGIS was manufactured by Pico Envirotec; therefore the system uses standardized Pico software and external sensors are connected to the system via RS-232 serial communication cables. The AGIS data format is easily converted into Geosoft or ASCII file formats by a supplied conversion program called PEIView. Additional Pico software allows for post real time magnetic compensation and survey quality control procedures.

4.2.2 Magnetometer:

The magnetometer used by Precision GeoSurveys is a Scintrex cesium vapor CS-3 magnetometer. The system was housed in a front mounted “stinger” (Figure 10). The CS-3 is a high sensitivity/low noise magnetometer with automatic hemisphere switching and a wide voltage range, the static noise rating for the unit is +/- 0.01 nT. On the AGIS screen the operator can view the raw magnetic response, the magnetic fourth difference, aircraft position, and the survey altitude for immediate QC of the magnetic data. The magnetic data are recorded at 10 Hz. A magnetic compensator is also used to remove noise created by the movement of the helicopter as it pitches, rolls and yaws within the Earth’s geomagnetic field.

Figure 10: View of the mag stinger.

4.2.3 Spectrometer:

The IRIS, or Integrated Radiometric Information System is a fully integrated, gamma radiation detection system containing 16.8 litres of NaI (T1) downward looking crystals and 4.2 litres NaI (T1) upward looking crystals (Figure 11). The IRIS is equipped with upward-shielding high density RayShield® gamma-attenuating material to minimize cosmic and solar gamma noise. Real time data acquisition, navigation and communication tasks are integrated into a single unit that is installed in the rear of the aircraft as indicated below. Information such as total count, counts of various radioelements (K, U, Th, etc.), temperature, cosmic radiation, barometric pressure, atmospheric humidity and survey altitude can all be monitored on the AGIS screen for immediate QC. All the radiometric data are recorded at 1 Hz.

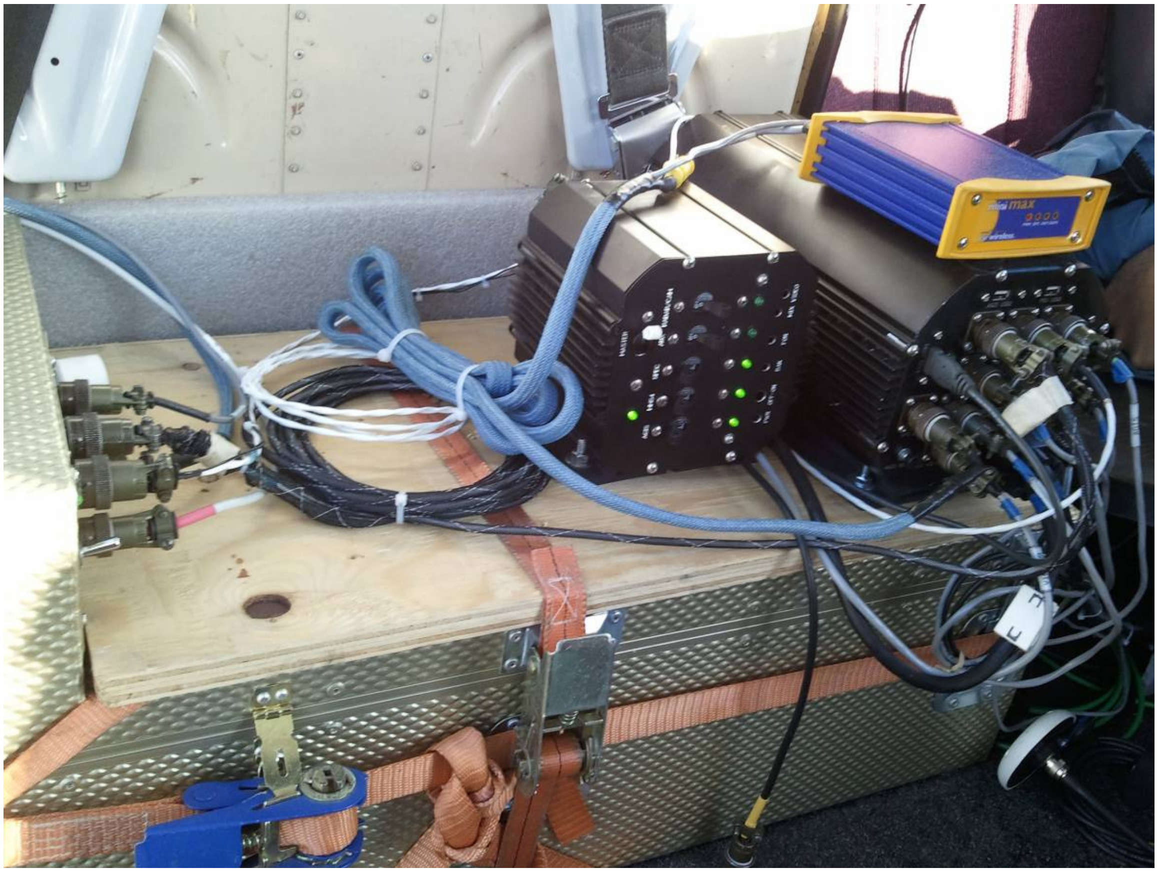

Figure 11: One of the IRIS strapped in the back seat of the Eurocopter AS350.

4.2.4 Base Station:

For monitoring and recording of the Earth's diurnal magnetic field variation, Precision GeoSurveys operates two magnetometer base stations continuously throughout the airborne data acquisition survey. Precision GeoSurveys operates two GEM GSM-19T magnetometer base stations. The base stations are installed mounted close to the survey blocks, and in an area with low magnetic gradient, as possible to give accurate magnetic field data. It is located in an area away from electric transmission power lines and moving ferrous objects, such as aircraft and motor vehicles that could affect the survey data integrity.

The GEM GSM-19T magnetometer with GPS (Figure 12) uses the proton precession technology sampling at a rate of 0.5 Hz. The GSM-19T has an accuracy of +/- 0.2 nT at 1 Hz. Base station data recorded in the solid-state memory of the base station, are downloaded onto a field laptop using GEMLink 5.0 software. Profile plots of the base station readings are generated and updated at the end of each survey day

Figure 12: GEM GSM-19T proton precession magnetometer.

4.2.5 Laser Altimeter:

The pilot is provided with terrain guidance and clearance information from an Acuity AccuRange AR3000 laser altimeter (Figure 13). This is attached at the aft end of the magnetometer boom. The AR3000 sensor is a time-of-flight sensor that measures distance by a rapidly-modulated and collimated laser beam that creates a dot on the target surface. The maximum range of the laser altimeter is 300 m off of natural surfaces with 90% reflectance and 3 km off special reflectors. Within the sensor unit, reflected signal light is collected by the lens and focused onto a photodiode. Through serial communications and analog outputs, the distance data are transmitted and collected by the AGIS at 10 Hz.

Figure 13: Acuity AccuRange AR3000 laser altimeter.

4.2.6 Pilot Guidance Unit:

The PGU (Pilot Guidance Unit) is a graphical display type unit that provides continuous steering and elevation information to the pilot (Figure 14). It is mounted remotely from the data system on top of the instrument panel. The PGU assists the pilot to keep the helicopter on the flight path and at the desired ground clearance.

Figure14: Pilot Guidance Unit.

The LCD monitor measures 7 inches, with a full VGA 800 x 600 pixel display. The CPU for the PGU is housed in the PC-104 console and uses Windows XP Embedded operating system control, with input from the GPS antenna, laser altimeter, and AGIS.

4.2.7 GPS Navigation System:

A Garmin GPS 16x-HVS navigation system integrated with the pilot display (PGU) and AGIS provided navigational information and control. The GPS 16x are complete GPS sensor with embedded receiver and antenna. It's capable of tracking multiple satellites at a time while providing fast time-to-first-fix, one-second navigation updates, and at low power consumption. This GPS sensor includes the capability of FAA Wide Area Augmentation System (WAAS) differential GPS.

Figure 15: Garmin GPS 16x navigation system.

The survey flight lines (coordinates) were programmed onto AGIS prior to the start of the survey and information will be displayed onto the pilot guidance unit (PGU) to provide airborne navigation.

5.0 Data Acquisition Equipment Checks and Calibration:

At the start of the survey, airborne equipment tests were conducted. There are three tests conducted for the airborne magnetometer: compensation flight, lag test, and the heading error test (clover leaf test). Gamma ray spectrometer checks and calibrations are also conducted prior to the start of the survey. The three tests conducted were the calibration pad test, cosmic flight test, and the Brekenridge test range.

5.1 Magnetometer Checks:

5.1.1 Compensation Flight Test:

During aeromagnetic surveying noise is introduced to the magnetic data by the aircraft itself. Movement in the aircraft (roll, pitch and yaw) and the permanent magnetization of the aircraft parts (engine and other ferric objects) are large contributing factors to this noise. To remove this noise a process called magnetic compensation is implemented. The magnetic compensation process starts with a test flight at the beginning of the survey where the aircraft flies in the four orthogonal headings required for the survey ($000^o/180^o$ and $090^o/270^o$ in the case of this survey) at an altitude (typically > 1,500 m AGL) where there is no ground effect in the magnetic data. In each heading, three specified roll, pitch, and yaw maneuvers are performed by the pilot; these maneuvers provide the data that are required to calculate the necessary parameters for compensating the magnetic data.

5.1.2 Lag Test:

A lag test was performed to determine the relationship between the time the digital reading was recorded by the instrument and the time for the position fix that the fiducial of the reading was obtained by the GPS system.

The test was flown in the four orthogonal headings over an identifiable magnetic anomaly (ie.Truck, Trailer, etc.) at survey speed and height. A lag of 10 fiducials (1.0 seconds) was determined from the lag test.

5.1.3 Heading Error Test:

To determine the magnetic heading effect a cloverleaf pattern flight test was conducted. The cloverleaf test was flown in the same heading as the survey and tie lines at 300 m AGL in area with low magnetic gradient. For each direction, it must fly over a recognizable feature on the ground in order to calculate the heading error. For all four directions it must pass over the same mid-point all four times.

5.2 Gamma-ray Spectrometer Checks and Calibrations:

Pre-survey calibrations and testing of the GRS-10 airborne gamma-ray spectrometry system were carried out prior the start of the survey. The calibration of the spectrometer system involved three tests which enabled the conversion of airborne data to ground concentration of natural radioactive elements. These tests were the calibration pad test, cosmic flight test, and the Breckenridge test range. The measurements were made in accordance with IAEA technical report series No. 323, “Airborne Gamma Ray Spectrometer Surveying”, and AGSO Record 1995/60, “A Guide to the Technical Specification for Airborne Gamma-Ray Surveys”.

5.2.1 Calibration Pad Test:

The calibration pad test was conducted by Pico Envirotec at the GSC (Geological Survey of Canada) testing facility in Ottawa, Ontario over the approved GSC calibration pad. It is a slab of concrete containing known concentrations of the radioelements (K, Th, and U) and is ideally used to stimulate a geological source of radiation. The measurements collected from the calibration pad test are used to determine the Compton scattering and Grasty Backscatter (spectral overlap between element windows) coefficients.

5.2.2 Cosmic Flight Test:

As the height of the aircraft increases, radiation in each spectral window increases Ellen Creeknentially due to the radiation of cosmic origin. Also, the background source of radiation from the aircraft itself is constant. The cosmic flight test is conducted to determine the aircraft background attenuation coefficients for the detector crystal packs and the cosmic coefficients.

The pilot is required to fly over the same location repeatedly in opposite directions starting from 1,500 m to 3,000 m at every 500 m interval for approximately 2 minutes each. Due to extremely high elevation in the survey area and low cloud cover, the test was not carried out within the survey area for safety reasons. Therefore, the standard values recommended for a single crystal pack were obtained from the IAEA Technical report.

5.2.3 Brekenridge Test Range:

The Brekenridge test range is very similar to the cosmic flight test but is conducted at lower elevations (from ground level). The pilot is required to fly over the same location at the following elevations in meters above ground; 30, 50, 100, 150, 200, 250, and 300. As the distance of the aircraft increases away from the radioactive source, the source signature Ellen Creeknentially degrades. As a result, this test is used to determine the altitude attenuation coefficients and the radio-element sensitivity of the airborne spectrometer system.

6.0 Data Processing:

After all the data are collected from a survey flight several procedures are undertaken to ensure that the data meet a high standard of quality. All data were processed using Pico Envirotec software and Geosoft Oasis Montaj geophysical processing software.

6.1 Magnetic Processing:

Before any processing and editing of the raw magnetic data, the data obtained from the compensation flight test must be applied to the raw magnetic data. A computer program called PEIComp is used to create a model from the compensation flight test for each survey to remove the noise induced by aircraft movement; this model is applied to each survey flight so the data can be further processed.

Filtering is applied to the laser altimeter data to remove vegetation clutter and to show the actual ground clearance. To remove vegetation clutter a Rolling Statistic filter is applied to the laser altimeter data and a low pass filter is used to smooth out the laser altimeter profile to remove isolated noise. As a result, filtering the data will yield a more uniform surface in close conformance with the actual terrain.

The processing of the magnetic data involved the correction for diurnal variations. The base station data is edited, plotted and merged into a Geosoft (.gdb) database daily. The airborne magnetic data are corrected for diurnal variations by subtracting the observed magnetic base station deviations. Following the diurnal correction, a lag correction is applied. A lag correction of 1.0 seconds was applied to the total magnetic field data to compensate for the lag in the recording system as the magnetometer sensor flies 5.70 m ahead of the GPS antenna. Lastly, a heading correction was applied to the data.

Some filtering of the magnetic data is also required. A Non Linear filter was used for spike removal. The 1D Non-Linear Filter is ideal for removing very short wavelength, but high amplitude features from data. It is often thought of as a noise spike-rejection filter, but it can also be effective for removing short wavelength geological features, such as signals from surficial features. The 1D Non-Linear Filter is used to locate and remove data that is recognized as noise. The algorithm is 'non- linear' because it looks at each data point and decides if that datum is noise or a valid signal. If the point is noise, it is simply removed and replaced by an estimate based on surrounding data points. Parts of the data that are not considered noise are not modified. The combination of a Non-Linear filter for noise removal and a low pass trend enhancement filter resulted in level data as indicated in the results section of this report. The low pass filter smooths out the magnetic profile to remove isolated noise.

The corrected magnetic data from the survey and tie lines were used to level the entire survey dataset. Two forms of leveling are applied to the corrected data: conventional leveling and micro-leveling. There are two components to conventional leveling; the first involves statistical leveling of magnetic data to correct miss ties (intersection errors) followed by specific patterns or trends. For the second component, tie lines are brought to a common regional base value using the mean value of the cross-level error. To obtain the best possible leveled data, individual corrections are edited at selected intersections. Lastly, micro-leveling is applied to the corrected conventional leveled data. This will remove any residual noise related to flight line direction, and any low amplitude component of flight line noise, that still remains in the data after tie line leveling.

6.2 Radiometric Processing:

Calibrating the spectrometer system in the helicopter is the first and vital step before the airborne radiometric data can be processed. Once calibration of the system has been complete, the radiometric data are processed by windowing the full spectrum to create channels for U, K, Th and total count. A 5-point Hanning filter was applied to the Cosmic window before going any further with processing the radiometric data.

Aircraft background and cosmic stripping corrections were applied to all three elements, and total count using the following formula:

$$C_{ac} = C_{lt} - (a_c + b_c * \mathrm{Cos}_f)$$

Precision GeoSurveys Inc.

where: C_{ac} is the background and cosmic corrected channel
C_{lt} is the live time corrected channel
a_c is the aircraft background for this channel
b_c is the cosmic stripping coefficient for this channel
Cos_f is the filtered cosmic channel

The radon backgrounds are first removed followed by Compton stripping. Spectral overlap corrections are applied on to potassium, uranium, and thorium as part of the Compton stripping process. This is done by using the striping ratios that have been calculated for the spectrometer by prior calibration, this breaks the corrected elemental values down into the apparent radioelement concentrations. Lastly, attenuation corrections are applied to the data which involves nominal survey altitude corrections, in this case 35 metres is applied to total count, potassium, uranium, and thorium data.

With all corrections applied to the radiometric data, the final step is to convert the corrected potassium, uranium, and thorium to apparent radioelement concentrations using the following formula:

$$eE = C_{cor} / s$$

where: eE is the element concentration K(%) and equivalent element concentration of U(ppm) & Th(ppm)
s is the experimentally determined sensitivity
Ccor is the fully corrected channel

Finally, the natural air absorption dose rate is determined using the following formula:

$$E = 13.08 * K + 5.43 * eU + 2.69 * eTh$$

where: E is the absorption dose rate in nG/h
K is the concentration of potassium (%)
eU is the equivalent concentration of uranium (ppm)
eTh is the equivalent concentration of thorium (ppm)

To calculate for radiometric ratios it follows the guidelines in the IAEA report. Due to statistical uncertainties in the individual radioelement measurements, some care was taken in the calculation of the ratio in order to obtain statistically significant values. Following IAEA guidelines, the method of determining ratios of the eU/eTh, eU/K and eTh/K was as follows:

1. Any data points where the potassium concentration was less than 0.25 were neglected.
2. The element with the lowest corrected count rate was determined.

3. The element concentrations of adjacent points on either side of each data point were summed until they exceeded a certain threshold value. This threshold was set to be equivalent to 100 counts of the element with the lowest count rate. Additional minimum thresholds of 1.6% for Potassium, 20 ppm for thorium, and 30 ppm for uranium were set up to insure meaningful ratios.
4. The ratios were calculated using the accumulated sums.

With this method, the errors associated with the calculated ratios will be similar for all data points.

7.0 Deliverables:

All digital data will be presented on a compact disc (CD) and a copy of the logistic report and maps will be printed out. The survey data are presented as digital databases, maps, and report.

7.1 Digital Data:

The file format will be provided in two (2) formats, the first will be a .GDB file for use in Geosoft Oasis Montaj, the second format will be a .XYZ file, this is text file. A complete file provided in each format will contain both magnetic and radiometric data. Full description of the digital data and contents are included into the report (Appendix B).

The digital data are represented into grids. The following grids prepared for the Ellen Creek block are listed below:

- Digital terrain model (DTM)
- Leveled total magnetic intensity (TMI)
- Calculated vertical gradient (CVG) - first vertical derivative
- Potassium (Kcor) - radiometric data in concentrations
- Thorium (Thcor) - radiometric data in concentrations
- Uranium (Ucor) - radiometric data in concentrations
- Total count (TCcor) – radiometric data in concentrations
- Total count (TCexp) – radiometric data in exposure rate
- Thorium over Potassium ratio (eTh/%K ratio) – radiometric ratios
- Uranium over Potassium ratio (eU/%K ratio) – radiometric ratios
- Uranium over Thorium ratio (eU/%Th ratio) – radiometric ratios

7.2 KMZ Grids:

The digital data represented into grids are exported into kmz files which can be displayed using Google Earth. The grids are laid overtop topography and rendered to give a 3D view.

7.3 Maps:

Maps were created for the Ellen Creek block at a scale of 1:7000. The following map products prepared are listed below:

Magnetic Maps (colour images with elevation contour lines):

- Digital terrain model
- Flight lines
- Total magnetic intensity
- Total magnetic intensity with plotted flight lines
- Calculated vertical gradient

Gamma-ray Spectrometry Maps (colour images with elevation contour lines):

- Potassium – equivalent concentration
- Thorium – equivalent concentration
- Uranium – equivalent concentration
- Total Count – equivalent dose rate
- Total Count (exposure) – exposure rate of SUM(%k, eU, eTh) * determined factors
- Thorium over Potassium ratio
- Uranium over Potassium ratio
- Uranium over Thorium ratio

All maps created were in prepared in World Geodetic System 84 (WGS 84) datum, and UTM zone 9N.

7.4 Report:

The report provides information about the acquisition, procedures, magnetic and radiometric processing, and presentation of the Ellen Creek block survey data. A pdf copy of the report is included along with the digital data and maps that are provided on the CD report.

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Appendix A

Equipment Specifications

- GEM GSM-19T Proton Precession Magnetometer (Base Station)
- Garmin GPS 16x-HVS
- Scintrex CS-3 Survey Magnetometer
- Bartington Mag-03 three-axis fluxgate magnetic field sensor
- Pico Envirotec GRS-10 Gamma Spectrometer
- Pico Envirotec AGIS data recorder system (for Navigation, Gamma spectrometer, VLF-EM and Magnetometer Data Acquisition)

GEM GSM-19T Proton Precession Magnetometer (Base Station)

Configuration Options	15
Cycle Time	999 to 0.5 sec
Environmental	-40 to 60 ° Celsius
Gradient Tolerance	7,000 nT/m
Magnetic Readings	299,593
Operating Range	10, 000 to 120,000 nT
Power	12 V @ 0.62 A
Sensitivity	0.1 nT @ 1 sec
Weight (Console/ Sensor)	3.2 Kg
Integrated GPS	Yes

Garmin GPS 16x-HVS

Receiver	WAAS enabled GPS receiver continuously tracks and uses multiple satellites to compute and update position	
Acquisition Times	Reacquisition: Less than 2 secs Hot: Approx. 1 sec (all data known) Warm: Approx. 38 secs (initial position, time, and almanac known; ephemeris unknown Cold: Approx 45 secs	
Sentence Rate	1 sec default; NMEA 0183 output interval configurable from 1 to 900 secs in 1-sec increment	
Interfaces	True RS-232 output, asynchronous serial input compatible with RS-232 or TTL voltage levels, RS-232 polartiy. User selectable baud rate: 4800, 9600, 19200, or 38400	
Accuracy	GPS Standard Positioning Service (SPS)	Position: <15 meters, 95% typical Velocity: 0.1 knot RMS steady state
	DGPS (USCG/RTCM)	Position: 3-5 meters, 95% typical Velocity: 0.1 knot RMS steady state
	DGPS (WAAS)	Position: <3 meters, 95% typical Velocity: 0.1 knot RMS steady state
	PPS Time	± Microsecond at rising edge of PPS pulse
	Dynamic	999 knots velocity (only limited at altitude greater than 60,000 feet, 3g dynamics

Scintrex CS-3 Survey Magnetometer

Operating Principal	Self-oscillation split-beam Cesium Vapor (non-radioactive Cs-133)
Operating Rage	15,000 to 105,000 nT
Gradient Tolerance	40,000 nT/metre
Operating Zones	10° to 85° and 95° to 170°
Hemisphere Switching	a) Automatic b) Electronic control actuated by the control voltage levels (TTL/CMOS) c) Manual
Sensitivity	0.0006 nT √Hz rms.
Noise Envelope	Typically 0.002 nT P-P, 0.1 to 1 Hz bandwidth
Heading Error	+/- 0.25 nT (inside the optical axis to the field direction angle range 15° to 75° and 105° to 165°)
Absolute Accuracy	<2.5 nT throughout range
Output	a) continuous signal at the Larmor frequency which is proportional to the magnetic field (proportionality constant 3.49857 Hz/nT) sine wave signal amplitude modulated on the power supply voltage b) square wave signal at the I/O connector, TTL/CMOS compatible
Information Bandwidth	Only limited by the magnetometer processor used
Sensor Head	Diameter: 63 mm (2.5") Length: 160 mm (6.3") Weight: 1.15 kg (2.6 lb)
Sensor Electronics	Diameter: 63 mm (2.5") Length: 350 mm (13.8") Weight: 1.5 kg (3.3 lb)
Cable, Sensor to Sensor Electronics	3m (9' 8"), lengths up to 5m (16' 4") available
Operating Temperature	-40°C to +50°C
Humidity	Up to 100%, splash proof
Supply Power	24 to 35 Volts DC
Supply Current	Approx. 1.5A at start up, decreasing to 0.5A at 20°C
Power Up Time	Less than 15 minutes at -30°C

Bartington Mag-03 three-axis fluxgate magnetic field sensor

Number of axes	3
Bandwidth	0 to 3kHz at 50µT peak
Internal Noise: **Basic version** **Standard version** **Low Noise version**	>10 to 20pTrms/√Hz at 1Hz 6 to ≤10pTrms/√Hz at 1Hz <6pTrms/√Hz at 1Hz
Scaling error (DC)	<±0.5%
Orthogonality error	<0.1°
Alignment error (Z axis to reference face)	<0.1°
Linearity error	<0.0015%
Frequency response	0 to 1kHz maximally flat, ±5% maximum at 1kHz
Input voltage	±12V to ±17V
Supply current	+30mA, -10mA (+1.4mA per 100µT for each axis)
Power supply rejection ratio	5µV/V (-106dB)
Analog output	±10V (±12V supply) swings to within 0.5V of supply voltage
Output impedance	10 Ω
Operating temperature range	-40°C to +70°C
Environmental protection	IP51
Dimensions (W x H x L)	32 x 32 x 152mm
Weight	160g
Enclosure material	Reinforced epoxy
Connector	ITT Cannon DEM-9P-NMB
Mating connector	ITT Cannon DEM-9S-NMB
Mounting	2 x M5 fixing holes

Pico Envirotec GRS-10 Gamma Spectrometer

Crystal volume	16.8 liters downward plus 4.2 liters upward
Resolution	256/512 channels
Tuning	Automatic using peak determination algorithm
Detector	Digital Peak
Calibration	Fully automated detector
Real Time	Linearization and gain stabilization
Communication	RS232
Detectors	Expandable to 10 detectors and digital peak
Count Rate	Up to 60,000 cps per detector
Count Capacity per channel	65545
Energy detection range:	36 KeV to 3 MeV
Cosmic channel	Above 3 MeV
Upward Shielding	RayShield® non-radioactive shielding on downward looking crystals
Downward Shielding	6mm lead plate on upward looking crystals
Spectra	Collected spectra of 256/512 channels, internal spectrum resolution 1024
Software	**Calibration:** High voltage adjustment, linearity correction coefficients calculation, and communication test support **Real Time Data Collection:** Automatic Gain real time control on natural isotopes, and PC based test and calibration software suite
Sensor	Each box containing two (2) gamma detection NaI(Tl) crystals – each 4.2 liters. (256 cu in.) (approx. 100 x 100 x 650 mm) Total volume of approx 8.4 litres or 512 cu in with detector electronics
Spectra Stabilization	Real time automatic corrections on radio nuclei: Th, Ur, K. No implanted sources.

Pico Envirotec AGIS data recorder system
(for Navigation, Gamma spectrometer, VLF-EM and Magnetometer Data Acquisition)

Functions	Airborne Geophysical Information System (AGIS) with integrated Global Positioning System Receiver (GPS) and all necessary navigation guidance software. Inputs for geophysical sensors - portable gamma ray spectrometer GRS-10, MMS4 Magnetometer, Totem 2A EM, A/D converter, temperature probe, humidity probe, barometric pressure probe, and laser altimeter. Output for the 2 line Pilot Indicator
Display	Touch screen with display of 800 x 600 pixels; customized keypad and operator keyboard. Multi-screen options for real-time viewing of all data inputs, fiducial points, flight line tracking, and GPS channels by operator.
GPS Navigation	Garmin 12-channel, WAAS-enabled
Data Sampling	Sensor dependent
Data Synchronization	Synchronized to GPS position
Data File	PEI Binary data format
Storage	80 GB
Supplied Software	**PEIView:** Allows fast data Quality Control (QC) **Data Format:** Geosoft GBN and ASCII output **PEIConv**: For survey preparation and survey plot after data acquisition
Software	**Calibration:** High voltage adjustment, linearity correction coefficients calculation, and communication test support **Real Time Data Collection:** Automatic Gain real time control on natural isotopes and PC based test and calibration software suite
Power Requirements	24 to 32 VDC
Temperature	Operating:-10 to +55 deg C; storage:-20 to +70 deg C

Appendix B

Digital File Descriptions

- Magnetic database description
- Radiometric database description
- Grids
- Maps

Magnetic Database:

Abbreviations used in the GDB files listed below:

Channel	Units	Description
X	m	UTM Easting - WGS84 Zone 9 North
Y	m	UTM Northing - WGS84 Zone 9 North
Galt	m	GPS height - WGS84 Zone 9 North
Lalt	m	Laser Altimeter readings
DTM	m	Digital Terrain Model
GPStime	Hours:min:secs	GPS time (UTC)
basemag	nT	Base station diurnal data
Mag	nT	Total Magnetic Intensity

Radiometric Database:

Abbreviations used in the GDB files listed below:

Channel	Units	Description
X	m	UTM Easting - WGS84 Zone 9 North
Y	m	UTM Northing - WGS84 Zone 9 North
Galt	m	GPS height - WGS84 Zone 9 North
Lalt	m	Laser Altimeter readings
DTM	m	Digital Terrain Model
BaroSTP_Kp	KiloPascal	Barometric Altitude (Pressure and Temp Corrected)
Press_kP	KiloPascal	Atmospheric Pressure
Temp_degC	Degrees C	Air Temperature
COSFILT	counts/sec	Spectrometer - Filtered Cosmic
UPUFILT	counts/sec	Spectrometer - Filtered Upward Uranium
TCcor	µR	Dose Rate Equivalent
TCexp	µR/hour	Exposure Rate - SUM(%k, eU, eTh) * determined factors
Kcor	%	Equivalent Concentration - Potassium
Ucor	ppm	Equivalent Concentration - Uranium
Thcor	ppm	Equivalent Concentration - Thorium
THKratio		Spectrometer - eTh/%K ratio
UKratio		Spectrometer - eU/%K ratio
UTHratio		Spectrometer - eU/eTh ratio
Date	yyyy/mm/dd	Dates of the survey flight(s)
FLT		Flight numbers

Grids: WGS84 Datum, Zone 9N

File Name	Description
EllenCreek_ DTM	Ellen Creek block digital terrain model
EllenCreek_ TMI.grd	Ellen Creek block total magnetic intensity
EllenCreek_CVG_dz.grd	Ellen Creek block calculated vertical gradient
EllenCreek_Block_Kcor.grd	Ellen Creek block potassium (Kcor) equivalent concentration
EllenCreek_Block_Thcor.grd	Ellen Creek block Thorium (Thcor) equivalent concentration
EllenCreek_Block_Ucor.grd	Ellen Creek block Uranium (Ucor) equivalent concentration
EllenCreek_Block_TCcor.grd	Ellen Creek block Total Count (TCcor) equivalent dose rate
EllenCreek_Block_TCexp.grd	Ellen Creek block Total Count (TCexp) exposure rate
EllenCreek_Block_THKratio.grd	Ellen Creek block thorium over potassium ratio (eTh/%K)
EllenCreek_Block_UKratio.grd	Ellen Creek block uranium over potassium ratio (eU/%K)
EllenCreek_Block_UThratio.grd	Ellen Creek block uranium over thorium ratio (eU/eTh)

Maps: WGS84 Datum, Zone 9N

File Name	Description
EllenCreek_Block_DTM.pdf	Ellen Creek block digital terrain model
EllenCreek_Block_FlightLines.pdf	Ellen Creek block flight lines flown
EllenCreek_Block_TMI.pdf	Ellen Creek block total magnetic intensity
EllenCreek_Block_TMI_with_Flightlines.pdf	Ellen Creek block total magnetic intensity with flight lines flown
EllenCreek_Block_CVG.pdf	Ellen Creek block calculated vertical gradient
EllenCreek_Block_Kcor_EquivalentConcentration_Radiometrics.pdf	Ellen Creek block potassium (Kcor) equivalent concentration
EllenCreek_Block_Thcor_EquivalentConcentration_Radiometrics.pdf	Ellen Creek block Thorium (Thcor) equivalent concentration
EllenCreek_Block_Ucor_EquivalentConcentration_Radiometrics.pdf	Ellen Creek block Uranium (Ucor) equivalent concentration
EllenCreek_Block_TCcor_EquivalentDoseRate_Radiometrics.pdf	Ellen Creek block Total Count (TCcor) equivalent dose rate
EllenCreek_Block_TCexp_ExposureRate_Radiometrics.pdf	Ellen Creek block Total Count (TCexp) exposure rate
EllenCreek_Block_eTh%Kratio_Radiometrics.pdf	Ellen Creek block thorium over potassium ratio
EllenCreek_Block_ eU%Kratio_Radiometrics. pdf	Ellen Creek block uranium over potassium ratio
EllenCreek_CVG_ eUeThratio_Radiometrics. pdf	Ellen Creek block uranium over thorium ratio

Appendix C

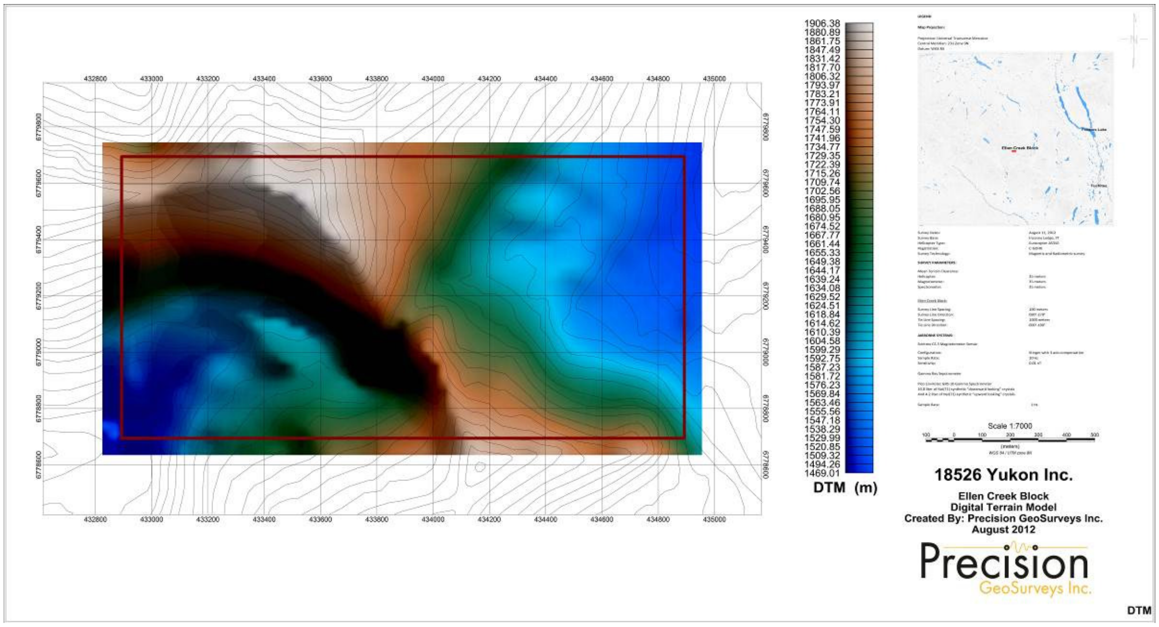
Ellen Creek Block Maps

Magnetic Maps (colour image with elevation contour lines):

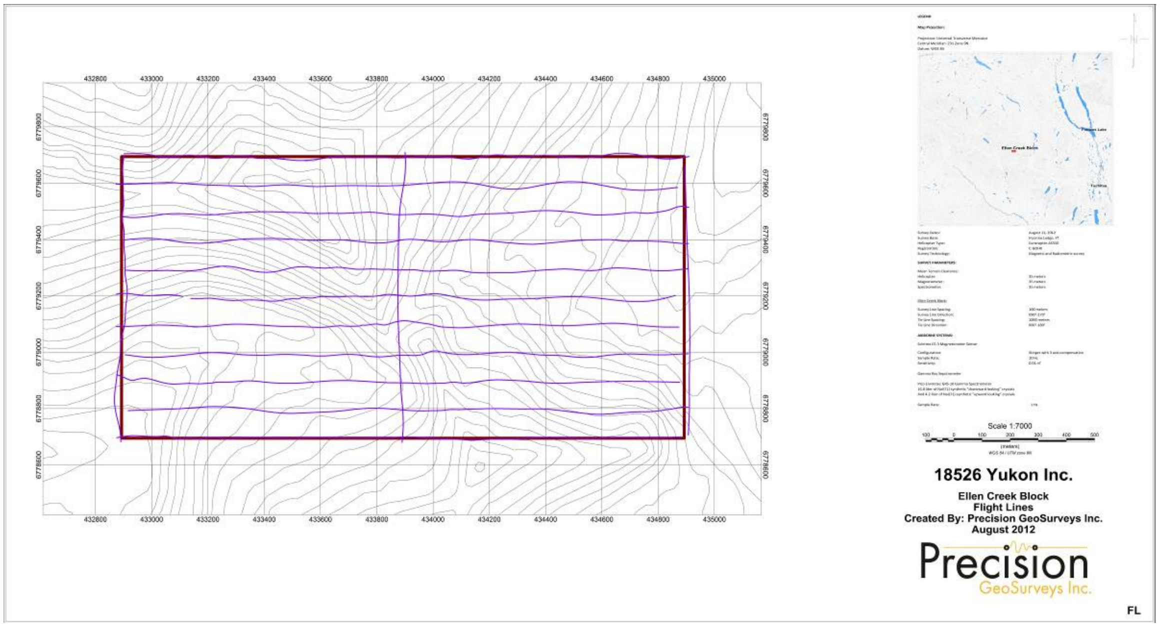
- Digital Terrain Model (DTM)
- Flight lines map
- Total Magnetic Intensity (TMI)
- Total Magnetic Intensity (TMI) with flight lines
- Calculated Vertical Gradient (CVG)

Gamma-Ray Spectrometry Maps (colour image with elevation contour lines):

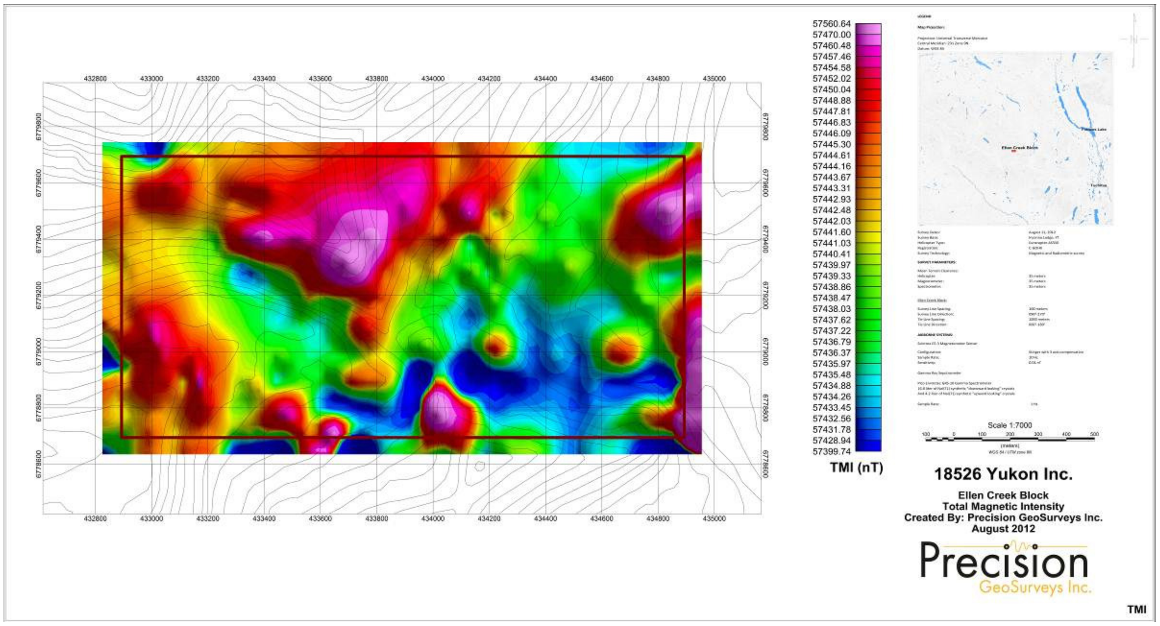
- Potassium – Equivalent Concentration (% K)
- Thorium – Equivalent Concentration (eTh)
- Uranium – Equivalent Concentration (eU)
- Total Count – Dose Rate Equivalent (TC)
- Total Count - Exposure Rate SUM(%k, eU, eTh) * determined factors
- Thorium over Potassium Ratio - Spectrometer - eTh/%K ratio
- Uranium over Potassium Ratio - Spectrometer - eU/%K ratio
- Uranium over Thorium Ratio - Spectrometer - eU/eTh ratio



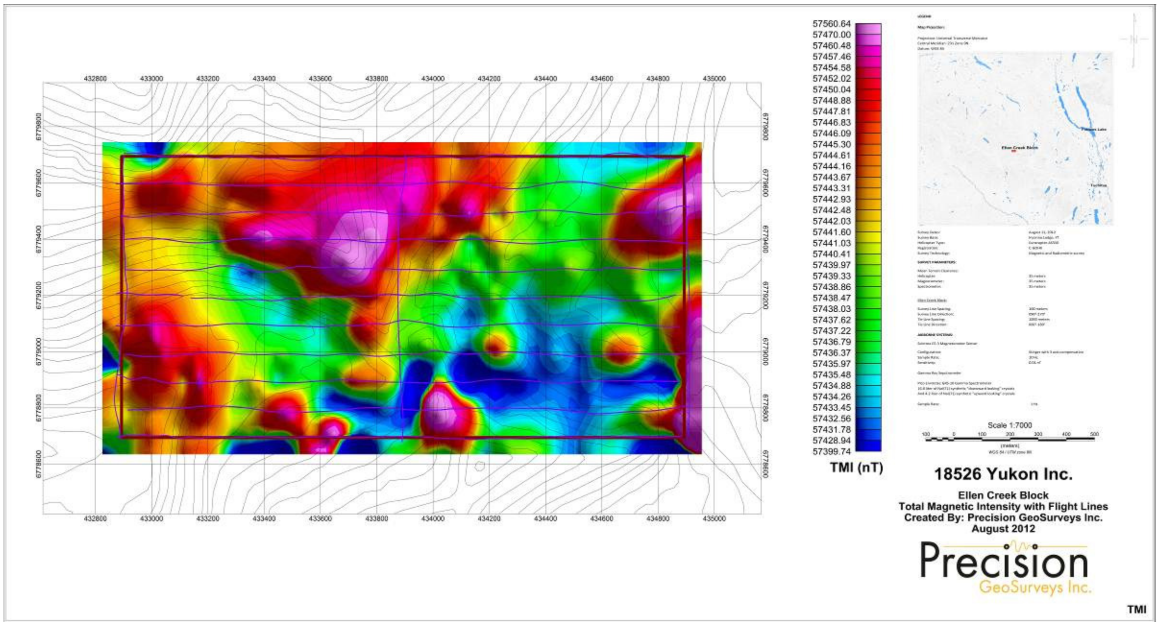
Map 1: Ellen Creek block digital terrain model.



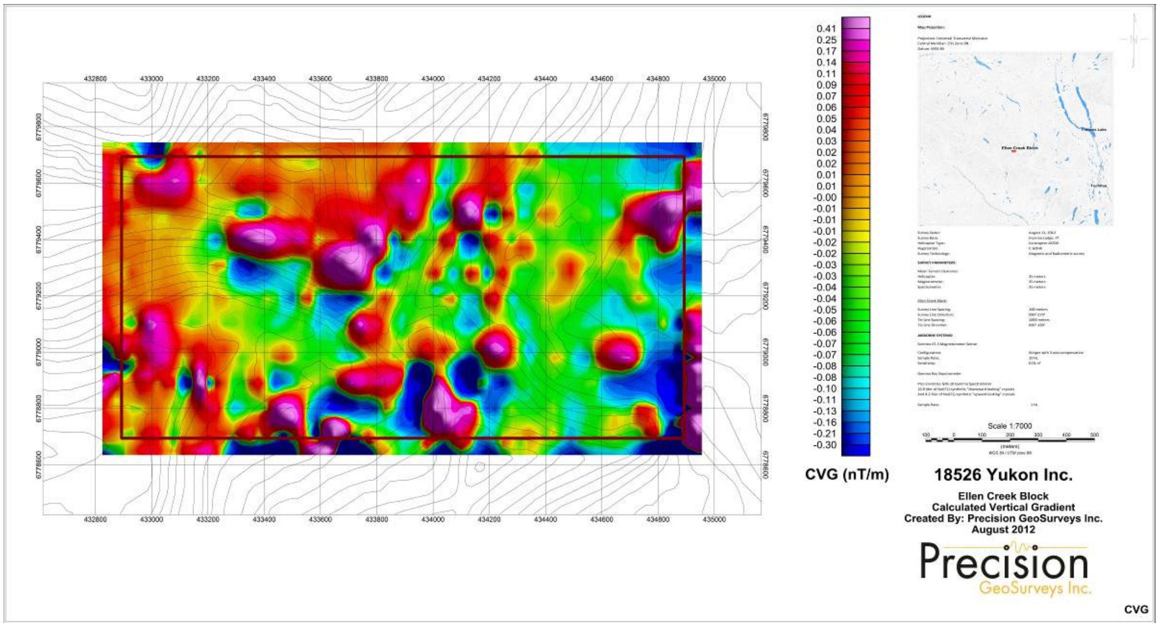
Map 2: Ellen Creek block flight lines.



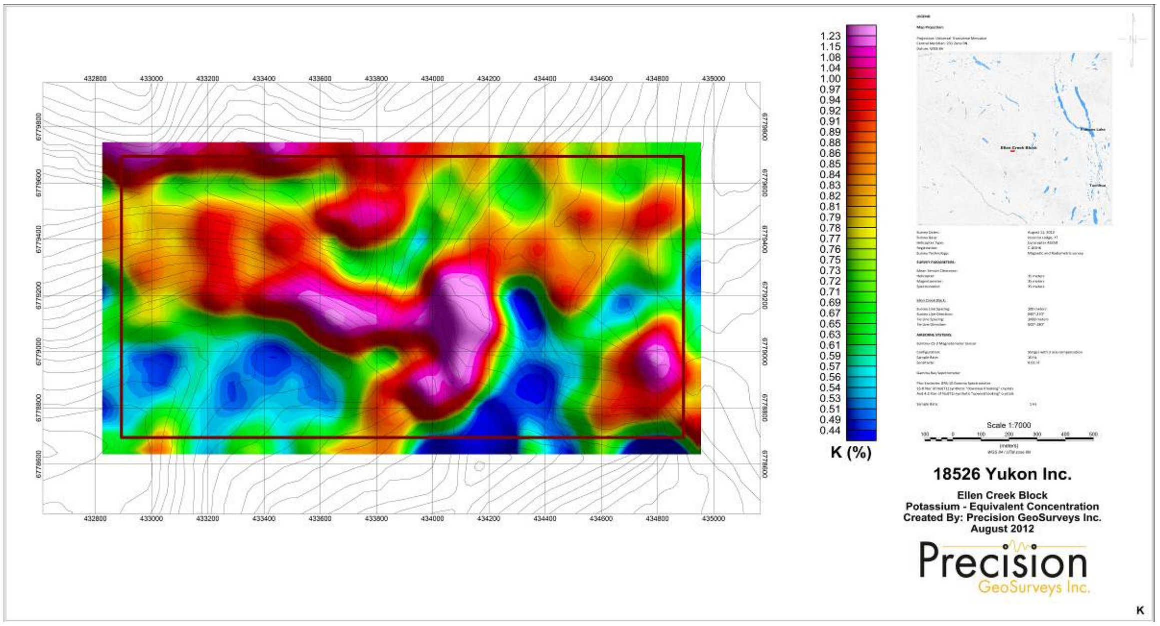
Map 3: Ellen Creek block total magnetic intensity.



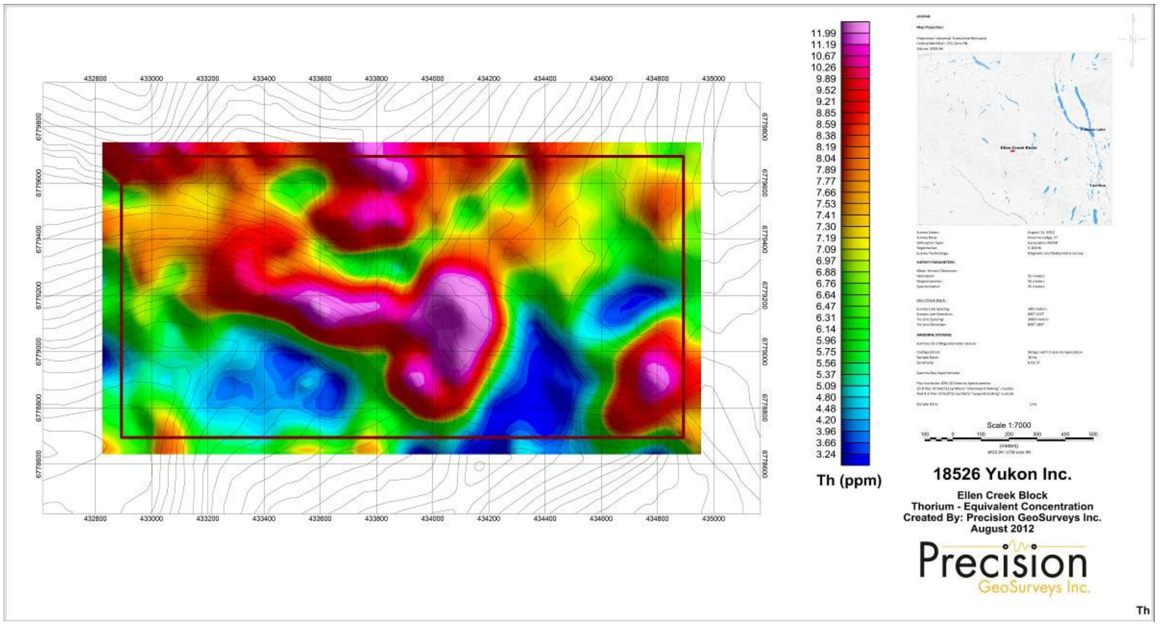
Map 4: Ellen Creek block total magnetic intensity with plotted flight lines.



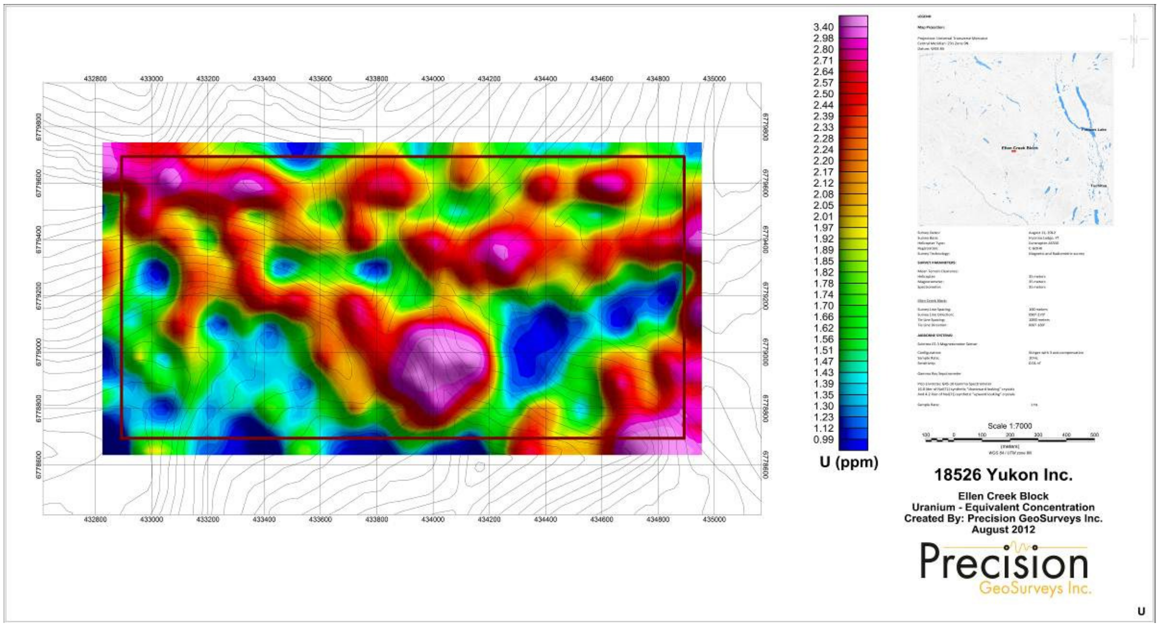
Map 5: Ellen Creek block calculated vertical gradient.



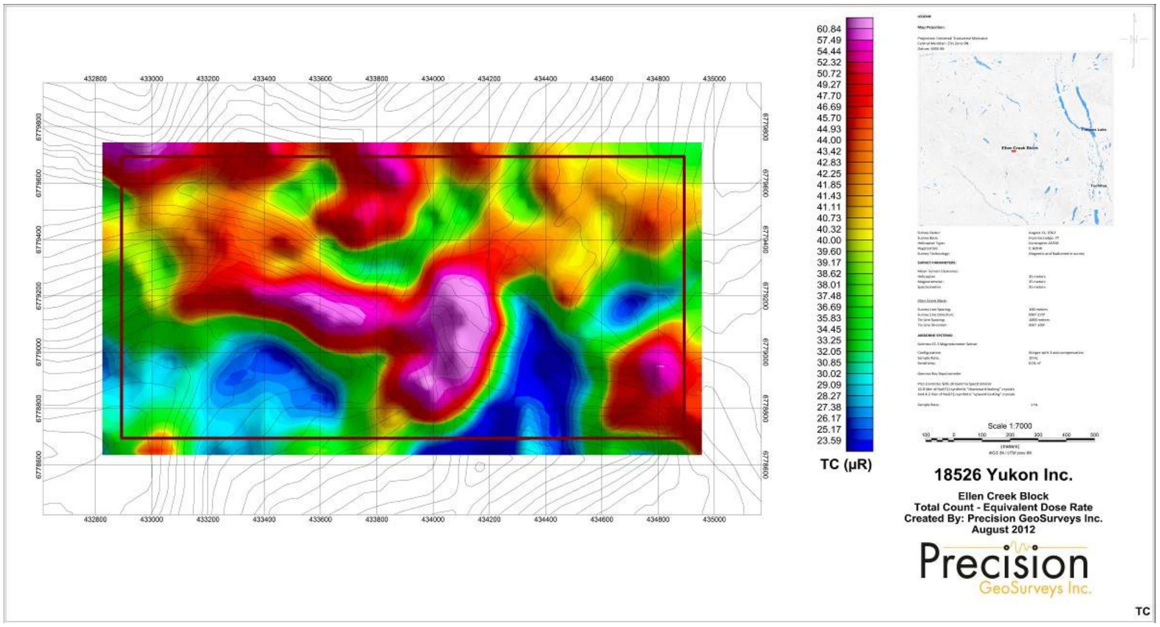
Map 6: Ellen Creek block potassium – equivalent concentration.



Map 7: Ellen Creek block thorium – equivalent concentration.



Map 8: Ellen Creek block uranium – equivalent concentration.



Map 9: Ellen Creek block total count – equivalent dose rate.

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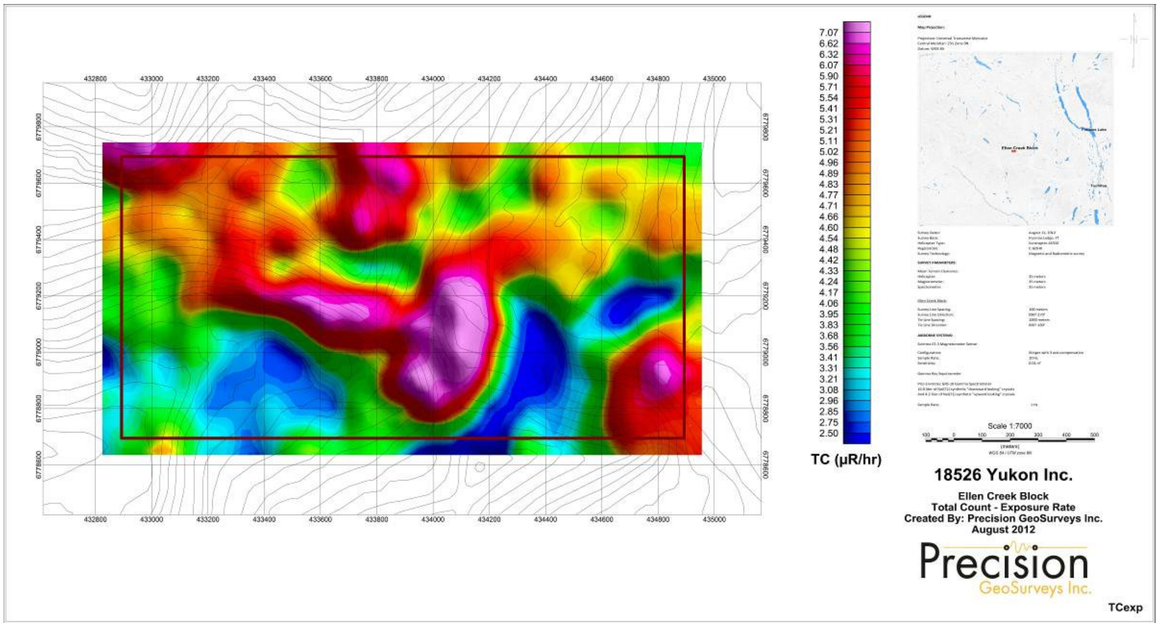

Map 10: Ellen Creek block total count – exposure rate.

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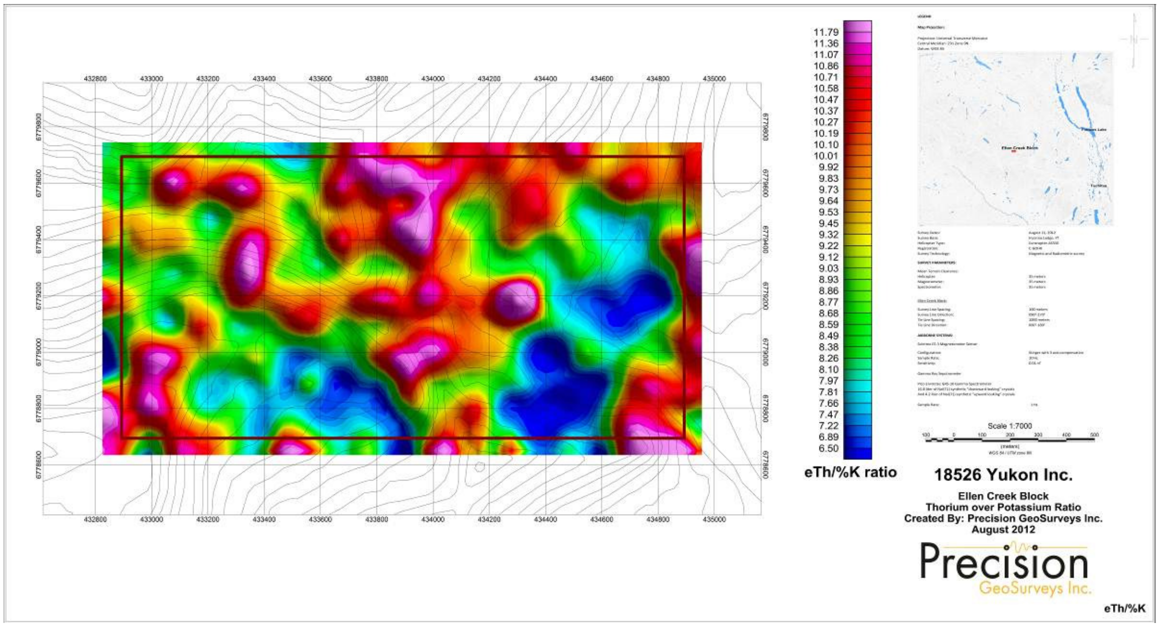

Map 11: Ellen Creek block thorium over potassium ratio.

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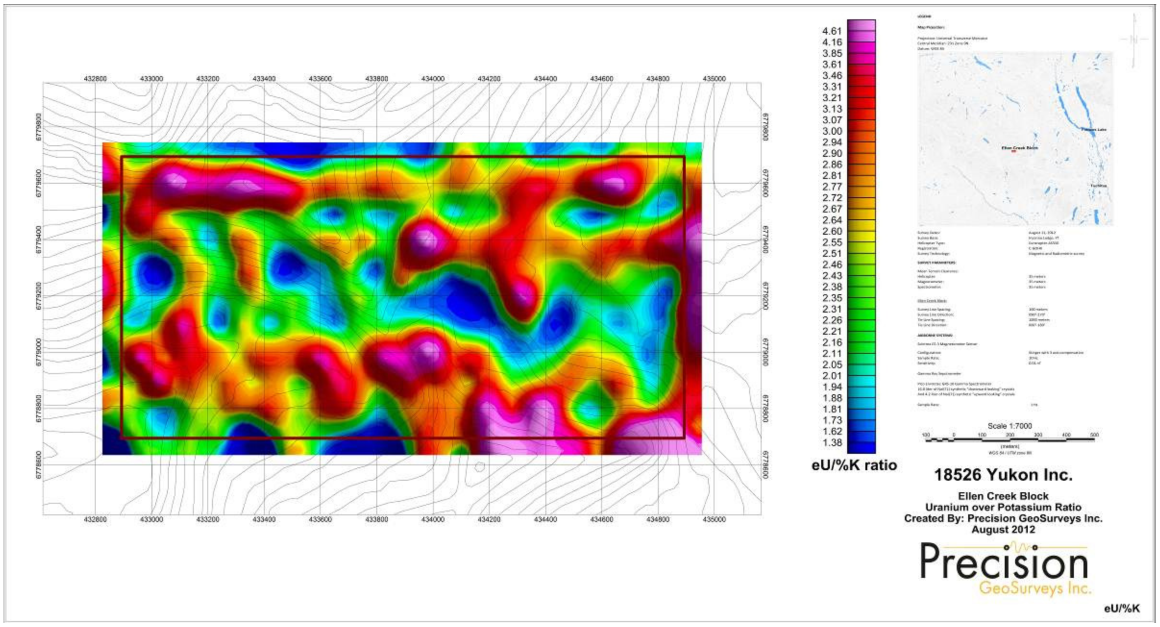
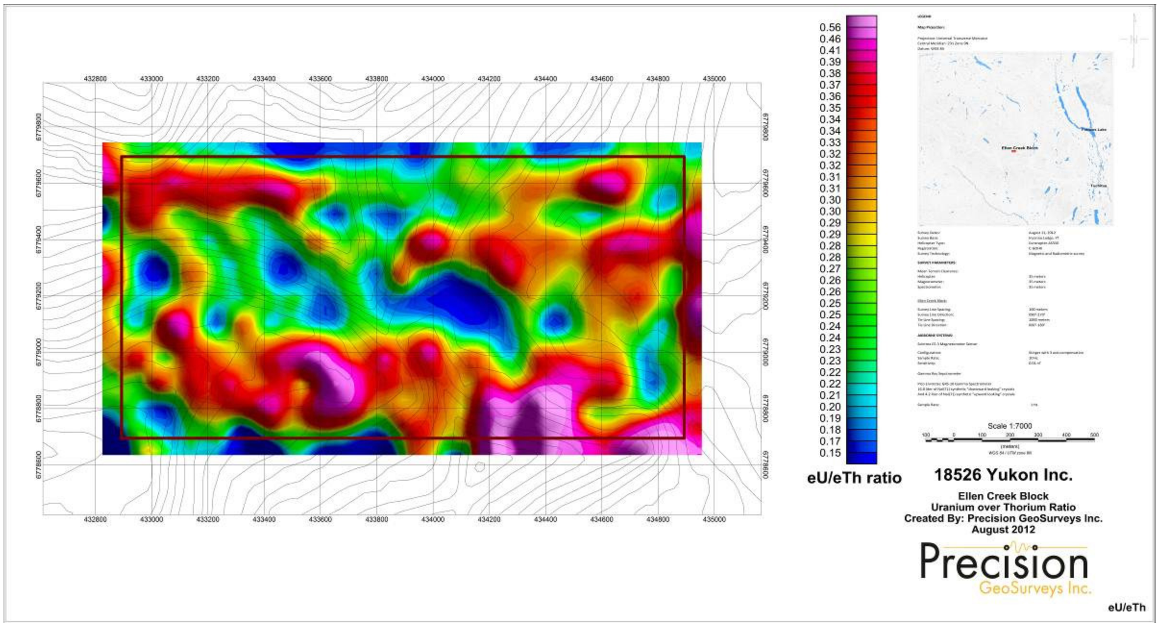


Map 12: Ellen Creek block uranium over potassium ratio.



Map 13: Ellen Creek block uranium over thorium ratio.

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