

# **NORTHERN TERRITORY DEPARTMENT OF MINES & ENERGY**



## **Operations and Processing Report**

### **Airborne Geophysical Survey WATERLOO Northern Territory**

June 2001 – August 2001

**FLOWN AND PROCESSED BY KEVRON GEOPHYSICS FOR AND ON BEHALF OF THE  
NORTHERN TERRITORY DEPARTMENT OF MINES & ENERGY**

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## **INTRODUCTION**

The Waterloo airborne geophysical survey lies on 1:250,000 maps Auvergne (SD52-15) and Waterloo (SE52-03). A total of 53,700 line kilometres of magnetic, radiometric and digital elevation data were acquired and processed. It is intended that the acquired geophysical data will constitute a major addition to the fundamental geological database of the Northern Territory and will stimulate mineral exploration activity with a view to possible discovery and development of economic mineral deposits.

The project was managed by the Northern Territory Department of Mines & Energy under the supervision of the Chief Geophysicist Mr. Richard Brecianini. The data acquisition, quality control, data processing and mapping were carried out by Kevron Geophysics Pty Ltd of 10 Compass Road, Jandakot Airport, Western Australia.

Kununurra was used as the base of operations for the duration of the Waterloo survey. Mobilisation of crew commenced on Tuesday 19th June 2001 and all crew members were on site on Thursday 21st June 2001. Production commenced on Friday 22nd June and was completed on 21st August 2001. A total of 67 sorties were flown.

Acquisition was undertaken using a twin engine Aero Commander 'Shrike' 500s aircraft, registration VH EXS. Several lines were reflown using VH KAV on the 5<sup>th</sup> November 2001. Periodic maintenance was performed by Kevron Aviation staff in Kununurra.

The fixed wing traverse lines were flown at an interline spacing of 400 m, and a tie line spacing of 4000m. Traverse lines and tie lines were oriented 360° and 090° respectively. An average ground clearance of 80m was specified for both magnetic and radiometric sensors.

In field data verification and quality control was undertaken on a post flight basis on-site using a combination of Kevron proprietary software and ChrisDBF. QC products produced in the field included magnetometer 4<sup>th</sup> difference noise plots, flight path deviation plots of cross-track and elevation and radiometric summed spectra plots. Diurnal plots of the Cs vapour base station magnetometer were plotted and assessed to ensure contract compliance. Some reflights were necessary due to excessive magnetic variation. Back-ups of all field data were written to compact disk and an additional copy sent to Kevron's data processing center in Perth where further QC products were produced and data processing undertaken.



## 1. SURVEY AREAS AND PARAMETERS

### 1.1 SURVEY AREA

Total line kilometres for the Waterloo Area was calculated to be 54,662 inclusive of tie lines and boundary overlap. A breakdown of the survey follows:

	Direction	Spacing	Shortest	Longest	Lines	Total
<b>Traverse Lines</b>	0 – 180°	400 m	7.3 km	167.6 km	603	49,721
<b>Tie Lines</b>	90 -270°	4000m	8.8 km	161.9 km	48	4,941
Total Line Kilometres						<b>54,662</b>

The Waterloo survey is located South West of Timber Creek between Longitude 129EE and 130E 30' E and Latitude 15E S and 17E S. The area is characterised by sand dunes, low scrub and spinifex with very little topographical relief. Mean daily maximum temperatures for Elliott (located on the North-East corner of the survey area) from June to August is 29.5E. Mean daily minimum temperatures for the same period is 12.6E.

The following geographic coordinates based on the GDA94 datum and spheroid define the survey boundary.

	Latitude	Longitude	Easting	Northing
1	16° 16' 48" S	130° 00' 00" E	498954	8287390
2	16° 00' 00" S	130° 00' 00" E	498739	8119553
3	15° 59' 57" S	129° 55' 56" E	661492	8118999
4	16° 02' 55" S	129° 55' 59" E	661547	8200778
5	16° 02' 56" S	129° 53' 50" E	607945	8200943
6	16° 08' 04" S	129° 53' 30" E	608275	8231927
7	16° 08' 04" S	129° 49' 50" E	598919	8231927
8	16° 12' 02" S	129° 49' 00" E	599029	8226589
9	16° 12' 04" S	129° 35' 50" E	593856	8226479
10	16° 03' 03" S	129° 35' 50" E	594021	8216848
11	16° 03' 05" S	129° 37' 59" E	586592	8216958
12	15° 59' 57" S	129° 38' 30" E	586757	8209749
13	16° 00' 00" S	129° 20' 16" E	564799	8209694
14	15° 56' 11" S	129° 20' 14" E	564854	8224552
15	15° 56' 10" S	129° 18' 10" E	569257	8224442
16	15° 49' 39" S	129° 18' 10" E	569477	8232092
17	15° 49' 40" S	129° 21' 19" E	537337	8232312
18	15° 43' 53" S	129° 21' 20" E	537392	8239576

19	15° 43' 52" S	129° 51' 00" E	533265	8239466
20	15° 41' 49" S	129° 51' 00" E	533375	8248932
21	15° 41' 50" S	129° 54' 00" E	539319	8249262
22	15° 40' 54" S	129° 54' 00" E	539209	8259939
23	15° 40' 55" S	130° 00' 30" E	592001	8259815
24	15° 30' 00" S	130° 00' 00" E	591985	8263075
25	15° 30' 00" S	129° 00' 00" E	597654	8263130
26	17° 00' 00" S	129° 00' 00" E	597654	8265002
27	17° 00' 00" S	130° 30' 00" E	608770	8264947
28	16° 16' 48" S	130° 30' 00" E	608639	8287114
29	16° 16' 48" S	130° 00' 00" E	498954	8287390

The survey areas cover portions of the following 1:250,000 map sheets.

1:250,000 Sheet Reference:

Auvergne	SD 52-15
Waterloo	SE 52-03

Refer to *Appendix 1* for survey area location diagram.

## 1.2 SURVEY PARAMETERS

Flight line direction	0° - 180°
Flight line spacing	400 metres
Tie line direction	90° - 270°
Tie line spacing	4000 metres
Mean Terrain Clearance	80 metres

Time Base and approximate sampling interval (in still air):

- Magnetics 0.1 second (7 metres approx.)
- Radar altimeter 0.1 second (7 metres approx.)
- Radiometrics 1.0 second (70 metres approx.)
- GPS system 1.0 second (70 metres approx.)

## 2. LOGISTICS

### 2.1 OPERATIONS BASE AND SURVEY DATES

Base Airfield	Latitude	Longitude	Elevation
Kununurra (YPKU)	15E 46.7' S	128E 42.4' E	145 ft

Kununurra was selected as the preferred operating base as it provided all the facilities required for the safe operation of an airborne geophysical survey.

The township of Kununurra offers comfortable accommodation and eating establishments, important for crew morale on large projects. A regular service by Commercial airlines allowed for the rapid dispatch of data to the DPC in Perth and the ability to rotate crews smoothly with little or no loss of production. Down time due to instrument failure was also minimised as replacement components could be despatched and delivered the following day.

Kununurra airport is located 2NM West of the township of Kununurra and has a single bitumen runway (12/30) 1829 m in length. Navigation aids include VOR (KU 116.6), NDB (KU 221) and DME (KU 116.5/112X). AVGAS was readily available from the Shell and AIR BP distributors in Kununurra.

Crew Accommodation:

Kununurra	Lake View Apartments 224 Victoria Hwy Kununurra WA
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Survey Dates and Production Summary

Refer to **APPENDIX 4** for detailed production summary.

Mobilisation	19 <sup>th</sup> June 2001
Production flying commenced	27 <sup>th</sup> June 2001
Production flying completed	21 <sup>st</sup> August 2001
Demobilisation	26 <sup>th</sup> August 2001
Total days on job	64
Total number of flights	68
Total production days	40
Total days lost due to weather	8
Total days lost due to aircraft maintenance	21
Total days lost due to Mag storms	0
Total days lost due to other causes	0
Total kilometres flown	56,369 km
Average acquisition rate - km per flight	829 km
km per production day	1,429 km

## 2.2 SURVEY AIRCRAFT AND FIELD CREW

*Aircraft*

Two twin engine Rockwell Aero Commander 500S  
'Shrike': Registration VH EXS and VH KAV



*Field Crew*

Pilots

Ivan Hussein  
Max Eichorn  
Alan Park

Operators

Ross Rackham  
Brett Archer  
Erron Gardner

*Crew Leader & Field QC*

Ross Rackham



### **3. SURVEY EQUIPMENT, OPERATION AND QUALITY CONTROL**

#### **3.1 MAJOR EQUIPMENT SUMMARY**

Aircraft Magnetometer	Geometrics G-822A Caesium vapour
Magnetic Compensator	RMS Instruments Automatic Aeromagnetic Digital Compensator (AADC)
Base station magnetometer	Geometrics G856 proton precession
Gamma-ray spectrometer	Exploranium GR820D, 256 channels
Gamma-ray detector	NaI(Tl) crystals; 33.6L down;
Altimeter	Sperry AA-210 radio altimeter
Barometer	Rosemount 1241m
Thermometer	Rosemount Model 22000 temperature sensor
Navigation system	Fugro Omnistar in VBS (Virtual Base Station) mode, Ashtech G12 GPS receiver
Flight Track Recording	VHS video tracking camera with wide-angle lens
Data acquisition system	RMS Instruments DAS-8 digital acquisition system

#### **3.2 MAGNETOMETER AND COMPENSATOR**

A Geometrics G-822A optically pumped caesium vapour magnetometer was used for the survey with the sensor mounted in a tail stinger of the aircraft. The magnetometer sensor was coupled to a RMS Instruments Automatic Aeromagnetic Digital Compensator (AADC) to produce real time compensation for the effects of the aircraft's motion, changes in attitude and heading. The AADC interference coefficients were calculated from compensation flights carried out before the survey commenced and after aircraft maintenance. The AADC output data, with a resolution and sensitivity of 0.001 nT at a sampling rate of ten (10) times per second, were recorded digitally. The noise envelope for compensated magnetometer readings was less than 0.1 nT

#### **3.3 BASE STATION MAGNETOMETER**

A GR823B caesium vapour base station magnetometer was used to measure the daily variations of the Earth's magnetic field. The base station was established in an area of low gradient, away from cultural influences. These data were displayed and recorded on a Libretto laptop computer. The base station was run continuously throughout the survey flying period with a sampling interval of 1 seconds and a sensitivity of 0.01 nT.

In addition to the caesium vapour base station, a Geometrics G856 proton precession magnetometer base station recording at 5 second intervals was established at Kununurra primarily as a storm monitor.



The base station data were closely examined after each days production flying to determine if any data had been acquired during periods of out-of-specification diurnal variation.

### 3.4 SPECTROMETER

An Exploranium GR-820, 256-channel gamma ray spectrometer with automatic crystal gain was used to record 256 channels of data in addition to the data from pre-set spectral windows. Total downward crystal array volume was 33.6 litres. System sample time and live time were also recorded. The digital were recorded once per second.

The pre-set spectral window limits were:

Window	Spectrometer channel number    Equivalent energy levels (keV)			
	Lower	Upper	Lower	Upper
Total Count	34	237	410	2.810
K-40	116	132	1 370	1 570
Bi-141	141	157	1 660	1 860
Tl-208	204	237	2 410	2 810
Cosmic	255	255	4 000	$\infty$ $\geq 4$ meV

### 3.5 ALTIMETERS

A Sperry AA-210 Radio Altimeter system was used to measure ground clearance. The radio altimeter indicator provides an absolute altitude display from 0 - 750 metres (0 - 2,500 feet) with a sensitivity of 4 mV/ft.

A Rosemount 1241m barometer, with an output sensitivity of 0.666 mV/ft, was used to measure barometric altitude of the aircraft.

The radar altimeter system was checked prior to commencement of production flying. This involved flying the aircraft at 30 metre height intervals, up to a height of 300 metres over the base of operations airstrip using the aircraft's barometric altimeter as the height reference. Radar altimeter and GPS height data were recorded for each flight interval flown. A comparison of these data with the aircraft's barometric altimeter verified that the system was operating satisfactorily.

Altimeter data (radar and barometric) were digitally recorded every 0.1 seconds.

### 3.6 NAVIGATION AND FLIGHT PATH RECOVERY

Aircraft navigation was controlled by real-time differential GPS using an Ashtech G12 receiver in the aircraft with pseudo range corrections obtained through the commercial FUGRO VBS system transmitting via the OPTUS B satellite.



The position of the aircraft was fixed and recorded once per second and the on-board pilot guidance steering signal updated once every half second.

The flight path data were inspected after each flight for any deviations of flight path from specifications and for any gaps caused by momentary loss of satellites. Flight path quality was confirmed at Kevron's processing centre by plotting flight path maps at an appropriate scale, highlighting any portions of lines which exceeded the specified horizontal and altitude tolerances.

### 3.7 FLIGHT TRACK RECORDING SYSTEM

The flight path of the aircraft was recorded with a National CCD colour video camera and a VHS video recorder. Line and fiducial numbers were recorded on the video image.

### 3.8 DATA ACQUISITION

A RMS Instruments DAS-8 Data Acquisition System was used to record all data in digital format onto a 10 gigabyte hard disk drive.

### 3.9 GENERAL QUALITY CONTROL

Rigorous in-field quality control was undertaken on-site and various QC products were produced in the field using a combination of Kevron proprietary software, ChrisDBF software and AGSO software. QC plots were produced for each flight and included:

- Flight path maps displaying cross track and height deviations.
- Magnetic 4<sup>th</sup> difference noise plots
- Radiometric Summed spectra plots
- Diurnal plots

Lines selected at random from each flight were subjected to further QC checks. Profiles were generated for all variables recorded and inspected for data quality. Any lines found to be outside the specified tolerances were identified and reflown.

A running log of each flight was maintained recording details of all lines flown. A complete flight line listing is included in *APPENDIX 3*. Equipment tests and calibrations are described in Section 4 and tabulations of the calibration and test flight data are in *APPENDIX 6*.

Field data were sent to Kevron's processing centre in Perth where they were further



inspected for data quality and conformance to specifications before commencing processing.

### 3.10 SAFETY MANAGEMENT

Kevron Geophysics Pty Ltd are an accredited active member of IAGSA and thus has a commitment, as far as practicable, to eliminate or control all risks and hazards to its staff that may arise in the work environment.

A revision of Kevron's Occupational Health, Safety and Environment was undertaken in January 2001 and a comprehensive Safety Management System was implemented in February 2001. The Safety Management System includes Risk Evaluation Processes and Procedures and Occupational Health Safety & Environment Policies for the entire Kevron Group of Companies.

Copies of Kevron's Occupational Health, Safety and Environment Policies are provided in **APPENDIX 8**

All aircraft operations, including pilot flying hours and aircraft maintenance, complied with the requirements of the Federal Civil Aviation Safety Authority (CASA) and the CASA-approved procedures set out in Kevron's Aircraft Operations Manual.

An integral part of the Safety Management System provides for the installation of a Flight Following System that transmits a position via satellite at pre determined intervals. The Fugro EagleStar Flight Following System is fitted to all Kevron aircraft and for the Waterloo survey, position information was transmitted every 4 minutes to FUGRO's premises in Perth. This information can be monitored by accessing the FUGRO web page where the updated flight path is displayed. In the event that positional information from the aircraft is lost for a period exceeding 12 minutes or three consecutive transmissions, an alarm is raised and a SMS text message sent to nominated contacts and the Emergency Response plan implemented.

## 4. CALIBRATIONS

### 4.1 MAGNETICS

Compensation coefficients for the AADC were established by flying a "compensation box" test (a series of pitch, roll and yaw manoeuvres in each of the four cardinal headings) before survey production commenced, and again after aircraft servicing where components were changed that may effect the magnetic field of the aircraft.

Compensation flights were flown in an area of low gradient approx. 35 nm North of Kununurra at an altitude of 8000 to 10000 feet above mean sea level.



The AADC calculates basic statistics, which reflect the degree of merit of the compensation. These include the standard deviation of the recorded data without corrections applied, the standard deviation with the correction applied, the improvement ratio (the ratio of the standard deviation of the data without and with corrections applied) and the vector norm (the degree of difficulty in calculating the corrections). The table below shows statistics recorded from compensation flights with the aircraft in survey configuration, ie Air conditioner on, Transponder off, DME off, HF on, ADF on, #1 COM on, #2 NAV/Com on .

Test Date	Aircraft	SDU	SDC	IR	VN
20 <sup>th</sup> June 2001	EXS	.7586	.03147	24.1	31.6
14 <sup>th</sup> July 2001	EXS	1.003	.04126	24.3	34.1

SDU, SDC= Respectively, the standard deviation of uncompensated and compensated data;  
IR (Improvement Ratio) = SDU/SDC;  
VN = Vector Norm, measure of degree of difficulty in calculating coefficients.

## 4.2 RADIOMETRICS

### 4.2.1. Background Correction Plots and Equations

The following procedure was used to determine the aircraft background radiation was determined following the procedures outlined in AGSO Record 1995/60. There were no changes to the system between the date of this test and the survey.

The measured 256 channel spectra are each the sum of the aircraft component (constant) and the cosmic component. The measured spectra are used to calculate the aircraft gamma energy spectrum and the normalised cosmic gamma energy spectrum.

Aircraft and Cosmic background spectra are estimated as follows:

$$N_i = a_i + b_i N_{cos}$$

Where:

$N_i$  = aircraft + cosmic background count rate in the (*i*)th channel

$N_{cos}$  = cosmic window count rate

$a_i$  = aircraft background in the (*i*)th channel

$b_i$  = cosmic background in the (*i*)th channel normalised top unit counts in the cosmic window.

A linear regression of the cosmic window count rate on any channel gives the cosmic sensitivity (slope of regression line) and aircraft background (zero intercept) for that channel.

The aircraft and cosmic background spectra are subtracted from the dead-time corrected and energy calibrated observed spectra, The conventional radiometric windows are extracted from the 256 channel data.

#### 4.2.2 Pre and Post Flight Checks

Hand sample checks, using thorium, uranium and caesium-137 samples, were carried out before and after flights.

#### 4.2.3 Test Line

A test line approximately 8 kilometres long was chosen NE of Tennant Creek along a cleared line. The start and end co-ordinates are as follows;

	<b>Latitude (°S)</b>	<b>Longitude (°E)</b>
South End	15E 34.9043'	128° 49.9366'
North End	15E 40.3951'	128E 45.2548'

#### 4.2.4 Compton Stripping Coefficients

The following Compton stripping coefficients, derived from calibrations over test pads in Perth were used in subsequent processing:

<b>VH EXS</b>	alpha (Tl-208 into Bi-214)	0.270648
	beta (Tl-208 into K-40)	0.455881
	gamma (Bi-214 into K-40)	0.855276

#### 4.2.5 Spectrometer Countrate Sensitivities

Broad source sensitivities for each of the radio-element windows were obtained from a flight line flown at a height of 80 m over the Carnamah Test Range and a corresponding line on the ground surveyed with a calibrated hand-held spectrometer supplied by Tesla Geoscience. The Carnamah Test Range is located approximately 10 kilometres east of Carnamah, 200 kilometres north of Perth, on the Carnamah-Belvoir Road. The Test Range follows the power line south for eight kilometres crossing undulating wheat crops and rocky scrub covered hills.

The aircraft acquisition system was not changed between the date of the calibration flight and the survey dates. The following values were obtained:

VH EXS 23<sup>rd</sup> June, 1999

Element	Corrected mean countrate (cps)	Average ground concentration	Countrate sensitivity
Potassium	357.1473589	2.71 %K	131.847 cps/%K
Uranium	36.86961332	3.93 ppm eU	9.375 cps/ppm eU
Thorium	204.0701113	32.39 ppm eTh	6.301 cps/ppm eTh
Total Count	4422.491351	143.95 nG/h (nGh <sup>-1</sup> )	30.72 cps/nGh

#### 4.3 PARALLAX

The parallax error was established immediately after completion of the survey by flying over a suitable anomaly in opposite directions. The parallax for each aircraft system was resolved to following:

**Magnetics** 7 fiducials (all flights)

**Radiometrics** No parallax correction was applied to the radiometrics

## **5. DATA PROCESSING**

### **5.1 DATA VERIFICATION AND EDITING**

The field data were sent regularly to Kevron's processing centre in Perth for verification and editing with in-house software installed on Sun Sparc 20 workstations.

The data were loaded into a database and a statistical report generated for each variable on a line by line basis. The data were then edited for scrubbed or duplicate lines and checked for spikes, steps or high noise levels. Lines with any out-of-specification data were flagged for reflight.

### **5.2 FLIGHT PATH RECOVERY**

The differentially corrected GPS data were converted to Universal Transverse Mercator coordinates using the Australian National Spheroid GDA94

The survey area is in grid UTM Zone 52 with a central meridian of 129° East.

Flight path maps were generated to verify the off-line tolerances and to ensure all necessary data had been loaded into the geophysical data base.

### **5.3 MAGNETIC PROCESSING**

After correcting the magnetic data for diurnal variations, the International Geomagnetic Reference Field (IGRF) was subtracted and the data were tie line levelled.

These processes are described more fully below.

#### **5.3.1 Diurnal Correction**

The diurnal data were edited to keep only those readings taken during flight time. The data were visually checked on the computer screen for spikes, noise and any apparent cultural magnetic events.

After editing, the data were low pass filtered using a twenty-term, spatial domain filter, which removed periods of less than thirty seconds. The data were again checked visually for integrity after the filtering process.

The filtered data were synchronised with the airborne data, interpolated and subtracted from the airborne data, one sample at a time. After subtraction, the mean diurnal value was added back to the airborne data for each line to produce diurnally corrected data.

#### **5.3.2 Subtraction of the IGRF**

The International Geomagnetic Reference Field (IGRF) was removed from the diurnally-corrected data by fitting a second order polynomial surface to thirteen coefficients computed from the IGRF model and then subtracting the IGRF values





on a sample by sample basis.

The IGRF 2000 model updated to the survey date was used with the following values:

IGRF updated to	2001.5
Magnetic Declination	3.8 °
Magnetic Inclination	-47.1 °
Total Field Strength	48512 nT

### 5.3.3 Tie Line Levelling

The diurnally corrected and IGRF-removed data were processed by a Kevron proprietary levelling program.

The program compares the magnetic differences at intersections of the flight lines and tie lines and calculates individual magnetic field biases for each flight line based on the tie line intersection. The miss-ties are minimised in a least-squares sense for all intersections. The biases are manually evaluated and selectively applied. Further reduction of the miss-ties can be removed by fitting a polynomial to produce levelled magnetic data.

The levelled data were then gridded on a 100 x 100 metre mesh using a minimum curvature algorithm based on Briggs (1974). The gridded data were displayed on an image processor to check data integrity and data levelling.

### 5.3.4 Micro Levelling

The data were microlevelled using Kevron in-house proprietary software. Kevron's micro-levelling process is line based rather than grid based. Pseudo lines are extracted perpendicular to the traverse line direction. These are low pass filtered and mis-tied to the traverse lines using the tie line levelling software.

The mis-tie values are bounded spatially by a series of polygons edited through ER Mapper.

## 5.4 RADIOMETRIC PROCESSING

### 5.4.1 System Deadtime and Energy Calibrations

Following correction for system deadtime, the 256 channel spectrometer data were energy calibrated using the following procedure:

For each line, the individual 256 channel data from each sample point were stacked to produce a single spectrum. The peak positions of the standard potassium and thorium windows were found by performing a gaussian fit to the spectral data for the energy range of each window after first removing the Compton continuum slope. If the measured peak positions were shifted by more than one channels for



the thorium peak or 0.5 channels for the potassium peak, an energy recalibration was performed to obtain the correct spectral channel positions for the lower and upper bounds of each of the required windows. Using these corrected channel limits, new window counts were then extracted from the 256 channel data for each 1 second data sample on the line.

#### 5.4.2 Noise Adjusted Singular Value Decomposition (NASVD)

The raw gamma-ray spectra was smoothed using the Noise Adjusted Singular Value Decomposition (NASVD – Hovgaard and Grasty, 1997) spectral smoothing technique. This technique is a spectral component analysis procedure for the removal of noise from gamma-ray spectra. The observed spectra were transformed into orthogonal spectral components in which lower order components represent the signal and higher order components represent noise. Noise was removed from the observed spectra by rejecting the noise components and reconstructing the spectra using the **first five** principal components.

#### 5.4.3 Aircraft and Cosmic Background Removal

Aircraft and cosmic background were removed from the data using the normalised 256 channel cosmic spectrum for the aircraft, and the aircraft 256 channel background spectrum.

<b>Aircraft Background Coefficients</b>	
Total Count	52.26
Potassium	7.4
Uranium	1.2
Thorium	0

<b>Aircraft Cosmic Coefficients</b>	
Total Count	0.718991
Potassium	0.039252
Uranium	0.033910
Thorium	0.035575

#### 5.4.4 Airborne radon removal

Data were corrected for airborne radon using Minty (1996 – Alt Method B) two component spectral ratio method. Calibration constants for Method B derived directly from observed radon and ground spectra at a height of 80m STP.  $C_1$ , and  $C_2$ , are the ratios between the 0.609 MeV peak count rate and the conventional U window count rate for a radon spectrum and a composite K, U and Th ground spectrum respectively.

Calibration Constants for Method B	
C1	1.944
C2	0.859

#### 5.4.5 Effective Altitude Calculations and Compton Scattering Corrections

At this point, the conventional radiometric windows are extracted from the 256 channel data and all further gamma-ray corrections are performed using three-window radiometric data processing.

Following reduction of the altitude data to effective altitude at standard temperature and pressure as described in Grasty and Minty (1995), Compton scattering stripping was carried out on the background corrected count rates in the potassium, uranium and thorium channel data using the appropriate coefficients listed in Section 4.2.4.

#### 5.4.6 Height attenuation corrections

A height attenuation factor was applied to reduce the data for each channel to a nominal datum of 80 m above ground level. The program used limits corrections to data at terrain clearances between 30m and 250m. Data recorded at terrain clearances outside these limits are corrected assuming they are at these limits.

The attenuation factors used are listed below and were determined from tests carried out over the Carnamah Test Range. (*APPENDIX 6*)

Total Count	Potassium	Uranium	Thorium
-0.0074	-0.0094	-0.0084	-0.0074

#### 5.4.7 Conversion to Ground Element Concentrations

Data were converted to equivalent ground concentrations using the method described in Grasty and Minty (1995) using, for each window, the equation:

$$C_i = N_i / S_i$$

where  $C_i$  = ground concentration of radio-element "i"  
 (%K, ppm eU or ppm eTh);

$N_i$  = corrected count rate for window "i"; and

$S_i$  = broad source sensitivity for window "i" as tabled in Section 4.2.5.

#### 5.4.8 Levelling

The corrected and reduced radiometric data were tie-line levelled and mirco-levelled using the procedure described above for the magnetic data.

## 5.5 DIGITAL ELEVATION MODEL

A digital elevation model (DEM) was computed by subtracting the terrain clearance measured by the radar altimeter from the GPS measured aircraft altitude to obtain a nominal ground elevation. The nominal ground elevation data were tie-line levelled and micro-levelled using the same technique described for the levelling of the magnetic data.

Allowance was made for the constant 3.9 m elevation difference between the radar altimeter and the GPS antenna.

A set of geoid-ellipsoid separation values were obtained from AUSLIG, gridded and values interpolated for each point along the survey lines. The interpolated separation values were subtracted from the nominal ground elevation to produce the final located DEM.

The DEM data were tie line levelled and micro-levelled using the procedure described above for the magnetic and radiometric data.



## 5.6 DELIVERABLE ITEMS

The following survey data items were produced and delivered:

1. Survey location diagram (APPENDIX 1)
2. Magnetometer Base station location diagram. (APPENDIX 2)
3. Flight Summary - list of flight lines and tie lines (APPENDIX 3)
4. Production summaries week by week for each aircraft. (APPENDIX 4)
5. Base Station Magnetometer plots (APPENDIX 5)
6. Tabulations of calibration and test flight data (APPENDIX 6)
7. Located digital records in the specified format (APPENDIX 7)
8. OHS and Environment Policies (APPENDIX 8)

## 5.7 FINAL PRODUCTS

The following files containing digital ASCII located data and grids were delivered on CD.

### CD#1

README - Text file describing contents of CD  
**DATA:**  
Waterloo\_256.DAT.zip (1.08GB uncompressed) - 1 sec 256 Channel Radiometric ASCII data  
Waterloo\_256.DES - Description file  
Waterloo\_256.DFN - Definition file

### CD#2

README - Text file describing content of CD  
**DATA:**  
Waterloo\_Mag.DAT.zip(1GB uncompressed) - Magnetics 0.1 second ASCII located data  
Waterloo\_Mag.DES - Description file  
Waterloo\_Mag.DFN - Definition file  
**GRIDS:**  
Waterloo\_1VD\_GDA94\_MGA52  
Waterloo\_1VD\_GDA94\_MGA52.ers - First Vertical Derivative Ermapper Grid  
Waterloo\_1VD\_RTP\_GDA94\_MGA52  
Waterloo\_1VD\_RTP\_GDA94\_MGA52.ers - First Vertical Derivative of RTP Ermapper Grid  
Waterloo\_AGC\_1VD\_GDA94\_MGA52  
Waterloo\_AGC\_1VD\_GDA94\_MGA52.ers - AGC of First Vertical Derivative Ermapper Grid  
Waterloo\_DTM\_GDA94\_MGA52  
Waterloo\_DTM\_GDA94\_MGA52.ers - DTM Ermapper Grid  
Waterloo\_RTP\_GDA94\_MGA52  
Waterloo\_RTP\_GDA94\_MGA52.ers - Reduced to Pole Ermapper Grid  
Waterloo\_TMI\_GDA94\_MGA52  
Waterloo\_TMI\_GDA94\_MGA52.ers - TMI Ermapper Grid

### CD#3

README - Text file describing content of CD



**DATA:**

Waterloo\_Spec.DAT - 1 second Radiometric ASCII Located Data  
Waterloo\_Spec.DES - Description file  
Waterloo\_Spec.DFN - Definition file

**GRIDS:**

Waterloo\_DTM\_GDA94\_MGA52  
Waterloo\_DTM\_GDA94\_MGA52.ers - DTM Ermapper Grid  
Waterloo\_K\_GDA94\_MGA52  
Waterloo\_K\_GDA94\_MGA52.ers - Potassium % Ermapper Grid  
Waterloo\_TC\_GDA94\_MGA52  
Waterloo\_TC\_GDA94\_MGA52.ers - Total Count nGy/hr Ermapper Grid  
Waterloo\_Th\_GDA94\_MGA52  
Waterloo\_Th\_GDA94\_MGA52.ers - Thorium ppm Ermapper Grid  
Waterloo\_U\_GDA94\_MGA52  
Waterloo\_U\_GDA94\_MGA52.ers - Uranium ppm Ermapper Grid  
Waterloo\_KThU\_RGB\_GDA94\_MGA52  
Waterloo\_KThU\_RGB\_GDA94\_MGA52.ers - Potassium Thorium Uranium (RGB) composite Ermapper Grid

Note : For each original CD delivered, 1 copy was also delivered.  
Total of 6 CDs were delivered for **Waterloo** (3 originals + 3 copies)

**REFERENCES**

Briggs, I.C., 1974. Machine Contouring Using Minimum Curvature. *Geophysics*, v.39: p. 39 - 48.

Grasty, R.L., Wilkes, P.G.; and Kooyman, R., 1988. Background Measurements in Gamma-ray Surveys. Geological Survey of Canada Paper 88-11.

R.L. Grasty and B.R.S Minty, 1995: A Guide To The Technical Specifications For a Airborne Gamma-Ray Survey. AGSO Record 1995/60.

Hovgaard, J., (1997). A new processing technique for airborne gamma-ray spectrometer data (Noise Adjusted Singular Value Decomposition). Danish Emergency Management Agency.

Hovgaard, J. and Grasty, R.L, (1997). Reducing noise in airborne gamma-ray data through spectral component analysis. Exploration 97, Ontario Geological Survey.

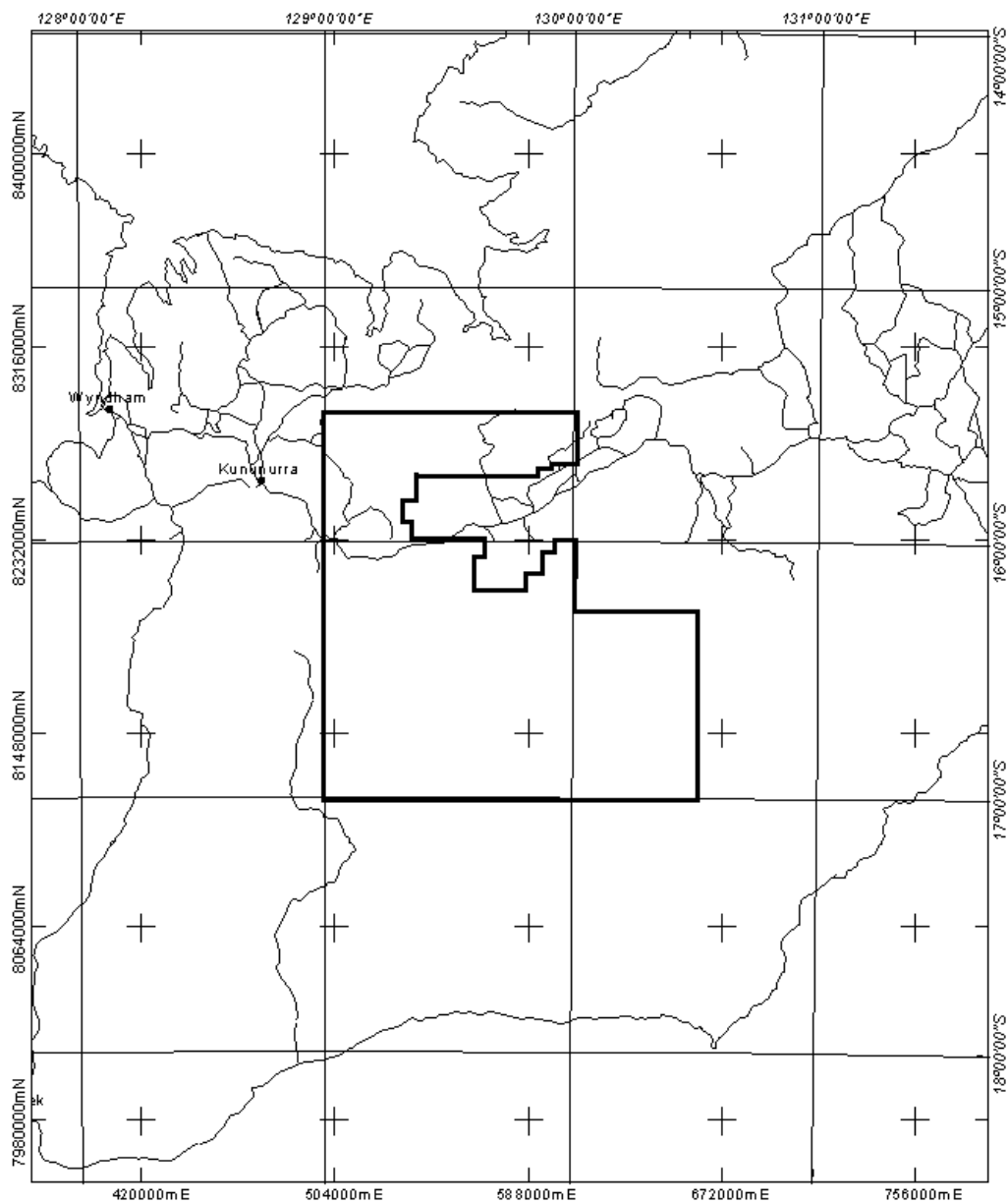
Minty, B.R.S., 1996. The analysis of multichannel airborne gamma-ray spectra. PhD Thesis, Australian National University.



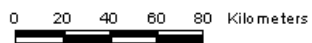
# APPENDIX 1

## Survey Area

# Waterloo Survey Area Location Diagram



Waterloo Magnetic and Radiometric Survey



Projection ; Transverse Mercator	Flight Line Heading ; 0
Spheroid ; WGS 84	Flight Line Spacing ; 10000
FalseEasting ; 500000	Cross Line Heading ; 90
FalseNorthing ; 10000000	Cross Line Spacing ; 10000
CentralMeridian ; 129	Total Line Km ; 3832



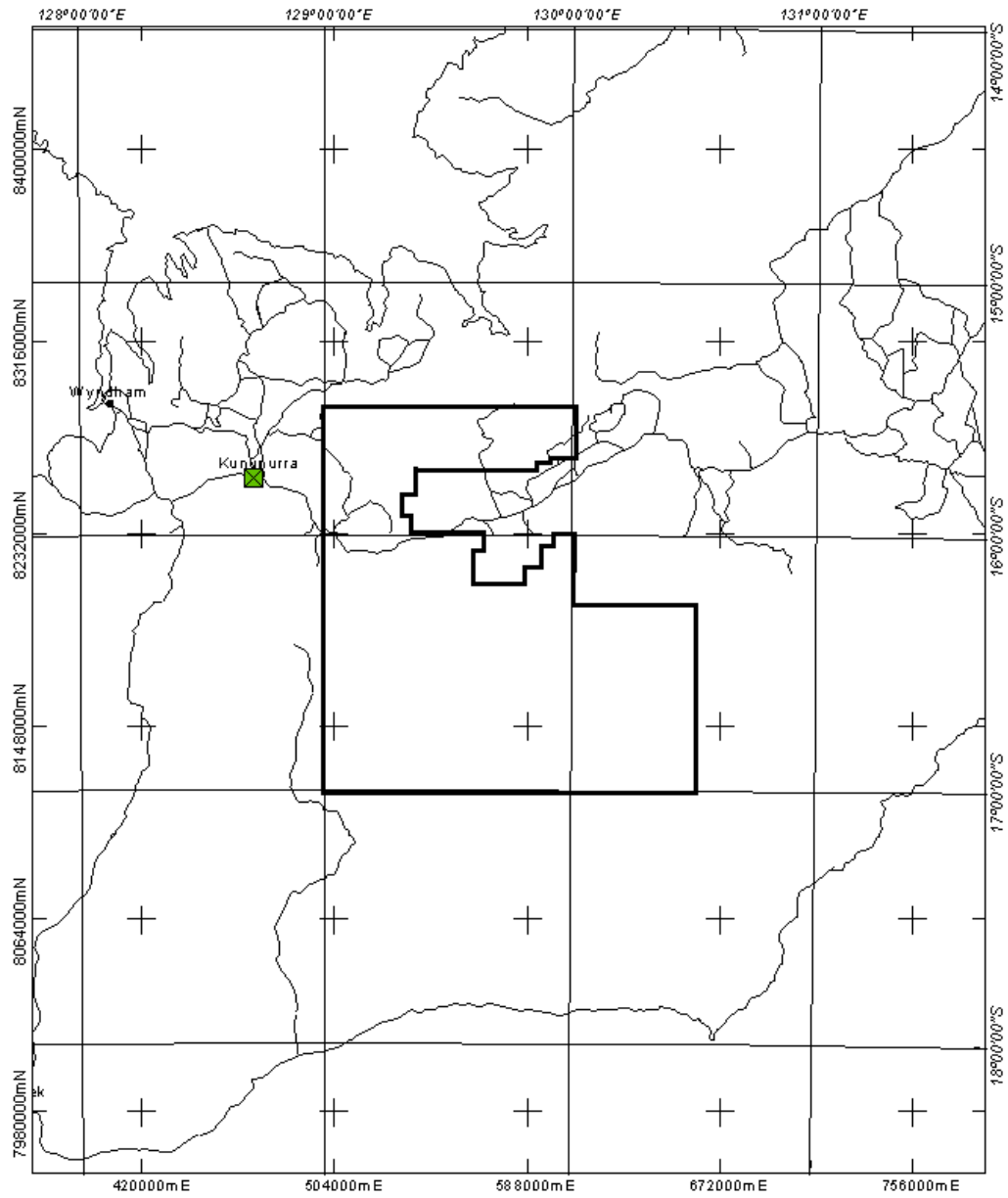


# APPENDIX 2

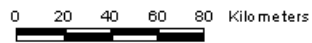
## Magnetometer Base Position



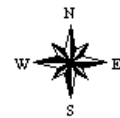
# Base Magnetometer Location Diagram



Waterloo Magnetic and Radiometric Survey  
diurnal basestation locations



Projection : Transverse Mercator	Flight Line Heading : 0
Spheroid : WGS 84	Flight Line Spacing : 10000
False Easting : 500000	Cross Line Heading : 90
False Northing : 10000000	Cross Line Spacing : 10000
Central Meridian : 129	Total Line Km : 3832



# APPENDIX 3

## Flight Summary Line Listing

Flight Line Listing Summary

Line	Flight	Date	Start Fid	End Fid	Line	Flight	Date	Start Fid	End Fid
10010	2	20010627	1940	25270	13300	53	20010813	2190	15180
10020	2	20010627	48350	71980	13311	22	20010707	12140	16170
10030	2	20010627	95120	118590	13320	52	20010812	112870	125260
10040	2	20010627	25290	48340	13330	22	20010707	20170	24080
10050	2	20010627	72000	95110	13340	52	20010812	87800	100150
10060	2	20010627	118600	141530	13350	22	20010707	28060	31970
10070	3	20010628	2040	25930	13360	52	20010812	100170	112860
10080	3	20010628	48690	72380	13370	22	20010707	16180	20150
10090	3	20010628	95370	118800	13380	52	20010812	75250	87780
10100	3	20010628	25940	48670	13390	22	20010707	24100	28050
10110	3	20010628	72390	95360	13400	52	20010812	50290	62780
10120	3	20010628	118820	141630	13410	22	20010707	31990	35880
10131	4	20010628	120	24830	13420	52	20010812	25300	37930
10140	4	20010628	24850	48780	13430	22	20010707	39660	43570
10150	4	20010628	48800	73190	13440	52	20010812	62790	75240
10160	4	20010628	73200	97150	13450	22	20010707	47420	51250
10170	4	20010628	97170	121300	13460	52	20010812	37940	50270
10180	4	20010628	121320	145190	13470	22	20010707	35890	39640
10190	5	20010629	1800	26510	13480	52	20010812	12750	25280
10200	5	20010629	26530	50780	13490	22	20010707	43590	47400
10210	5	20010629	50790	75260	13500	52	20010812	10	12740
10220	5	20010629	75280	99270	13510	22	20010707	51260	55130
10230	5	20010629	99290	123840	13520	51	20010812	120880	133150
10240	5	20010629	123860	147830	13530	22	20010707	59130	63120
10250	6	20010629	10	23730	13540	51	20010812	95560	107710
10260	6	20010629	46170	70060	13550	22	20010707	63140	67050
10270	6	20010629	92220	115970	13560	51	20010812	70130	82320
10280	6	20010629	23880	45960	13570	22	20010707	55150	59120
10290	6	20010629	70070	92200	13580	51	20010812	107720	120870
10300	6	20010629	115990	138280	13590	19	20010706	127790	131760
10310	7	20010630	1970	25280	13600	51	20010812	82330	95540
10320	7	20010630	47770	70920	13610	19	20010706	119570	123520
10330	7	20010630	93540	117210	13620	51	20010812	56990	70120
10340	7	20010630	25290	47760	13630	19	20010706	111340	115390
10350	7	20010630	70940	93530	13640	51	20010812	16240	29690
10360	7	20010630	117230	140180	13650	19	20010706	123530	127780
10370	8	20010630	10	23700	13660	51	20010812	43840	56970
10380	8	20010630	23710	46720	13670	19	20010706	115410	119560
10390	8	20010630	46730	70640	13680	51	20010812	29710	43820
10400	8	20010630	70650	93960	13690	19	20010706	107170	111320
10410	8	20010630	93980	117790	13700	51	20010812	1960	16230
10420	8	20010630	117800	140590	13710	19	20010706	98890	103160
10430	9	20010701	1800	25550	13720	50	20010809	82940	96070
10440	9	20010701	25570	49020	13730	19	20010706	90790	94940
10450	9	20010701	49030	72720	13740	50	20010809	96080	109310
10460	9	20010701	72730	95960	13750	19	20010706	103180	107150
10470	9	20010701	95970	119220	13760	50	20010809	69560	82930
10480	9	20010701	119230	142920	13770	19	20010706	94960	98870
10490	10	20010701	10	23020	13780	50	20010809	42750	56180
10500	10	20010701	45780	68810	13790	19	20010706	86810	90780
10510	10	20010701	91450	115180	13800	50	20010809	15620	29190
10520	10	20010701	23040	45770	13810	19	20010706	78650	82660
10530	10	20010701	68830	91440	13820	50	20010809	56200	69550
10540	10	20010701	115190	137680	13830	19	20010706	70460	74530



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<b>10550</b>	11	20010702	1910	25900	<b>13840</b>	50	20010809	29210	42740
<b>10560</b>	11	20010702	48670	72720	<b>13850</b>	19	20010706	82670	86800
<b>10570</b>	11	20010702	95430	119680	<b>13861</b>	58	20010816	15970	29260
<b>10580</b>	11	20010702	25910	48660	<b>13870</b>	19	20010706	74540	78630
<b>10590</b>	11	20010702	72740	95410	<b>13880</b>	49	20010808	96350	109280
<b>10600</b>	11	20010702	119690	143020	<b>13890</b>	19	20010706	66410	70440
<b>10610</b>	12	20010702	10	23650	<b>13900</b>	49	20010808	69660	82710
<b>10620</b>	12	20010702	23670	47280	<b>13910</b>	19	20010706	55640	59210
<b>10630</b>	12	20010702	47290	70980	<b>13920</b>	49	20010808	42630	55800
<b>10640</b>	12	20010702	70990	94340	<b>13930</b>	19	20010706	62820	66390
<b>10650</b>	12	20010702	94360	118070	<b>13940</b>	49	20010808	82720	96330
<b>10660</b>	12	20010702	118090	141220	<b>13950</b>	19	20010706	59220	62810
<b>10670</b>	13	20010703	33860	57950	<b>13960</b>	49	20010808	55820	69650
<b>10680</b>	13	20010703	57970	81260	<b>13970</b>	19	20010706	52030	55620
<b>10690</b>	13	20010703	81270	104880	<b>13980</b>	49	20010808	29240	42610
<b>10700</b>	13	20010703	104890	127920	<b>13990</b>	19	20010706	45090	48600
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<b>10730</b>	14	20010703	90680	113770	<b>14020</b>	49	20010808	10	14810
<b>10740</b>	14	20010703	23060	45630	<b>14030</b>	19	20010706	48610	52020
<b>10750</b>	14	20010703	68350	90660	<b>14040</b>	48	20010808	106830	121560
<b>10760</b>	14	20010703	113780	136370	<b>14050</b>	19	20010706	41640	45070
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<b>10800</b>	15	20010704	25780	48230	<b>14090</b>	19	20010706	27650	31080
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<b>10870</b>	15	20010704	139400	144730	<b>14160</b>	48	20010808	17360	32170
<b>10880</b>	24	20010714	46830	63460	<b>14170</b>	19	20010706	17370	20780
<b>10890</b>	16	20010704	10	5510	<b>14180</b>	48	20010808	2030	17340
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<b>10910</b>	16	20010704	11180	16730	<b>14200</b>	47	20010807	108790	123520
<b>10920</b>	24	20010714	81070	97600	<b>14210</b>	18	20010705	95940	99090
<b>10930</b>	16	20010704	22400	27950	<b>14220</b>	47	20010807	93540	108770
<b>10940</b>	24	20010714	97610	115500	<b>14230</b>	18	20010705	89630	92740
<b>10950</b>	16	20010704	5530	11160	<b>14240</b>	47	20010807	78820	93530
<b>10960</b>	67	20010821	137350	155700	<b>14250</b>	18	20010705	83260	86470
<b>10970</b>	16	20010704	16750	22380	<b>14260</b>	47	20010807	62700	78810
<b>10980</b>	67	20010821	101890	120160	<b>14270</b>	18	20010705	92760	95930
<b>10990</b>	16	20010704	27960	33630	<b>14280</b>	47	20010807	47330	62680
<b>11000</b>	67	20010821	155710	172660	<b>14290</b>	18	20010705	86480	89610
<b>11010</b>	16	20010704	39150	44940	<b>14300</b>	47	20010807	31340	47310
<b>11020</b>	67	20010821	120170	137340	<b>14310</b>	18	20010705	80110	83240
<b>11030</b>	16	20010704	50450	56240	<b>14320</b>	47	20010807	15860	31330
<b>11040</b>	67	20010821	84800	101870	<b>14330</b>	18	20010705	73820	76890
<b>11050</b>	16	20010704	33640	39130	<b>14340</b>	47	20010807	10	15840
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<b>11120</b>	67	20010821	33530	51060	<b>14410</b>	18	20010705	64350	67540



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11130	16	20010704	73410	79280	14420	46	20010807	48220	63290
11140	67	20010821	10	17520	14430	18	20010705	58070	61180
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11170	16	20010704	79290	83300	14460	46	20010807	63310	78720
11180	66	20010821	111180	126490	14470	18	20010705	61190	64340
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11210	16	20010704	95800	99810	14500	46	20010807	1930	17520
11220	66	20010821	48920	64230	14510	18	20010705	48510	51660
11230	16	20010704	83320	87550	14520	45	20010806	90940	106250
11240	66	20010821	17980	33150	14530	18	20010705	45300	48490
11250	16	20010704	91530	95780	14540	45	20010806	106260	121190
11260	66	20010821	64240	79770	14550	18	20010705	42120	45290
11270	16	20010704	99830	104040	14562	63	20010819	2080	17850
11280	66	20010821	33170	48900	14570	18	20010705	38890	42100
11290	16	20010704	108020	112250	14580	45	20010806	45810	60800
11300	66	20010821	1930	17960	14590	18	20010705	35550	38880
11310	16	20010704	116250	120480	14600	45	20010806	15280	30130
11320	65	20010820	94610	110760	14601	61	20010818	36220	41890
11330	16	20010704	104060	108010	14602	63	20010819	17870	22220
11340	65	20010820	110770	125900	14610	18	20010705	32400	35530
11350	16	20010704	112260	116230	14620	45	20010806	60820	76030
11360	65	20010820	79580	94590	14630	18	20010705	29090	32380
11370	16	20010704	120500	124510	14640	45	20010806	30150	45800
11380	65	20010820	48130	63300	14650	18	20010705	25860	29070
11390	17	20010705	1790	5820	14660	45	20010806	10	15260
11400	65	20010820	16330	31720	14661	61	20010818	41910	47820
11410	17	20010705	10180	14070	14670	18	20010705	22550	25840
11420	65	20010820	63320	79570	14680	44	20010806	94170	109880
11430	16	20010704	124530	128760	14690	18	20010705	19260	22530
11440	65	20010820	31740	48110	14700	44	20010806	71450	82700
11450	17	20010705	5830	10160	14710	18	20010705	15910	19240
11460	65	20010820	10	16320	14720	44	20010806	82710	94160
11470	17	20010705	14090	18320	14730	44	20010806	59950	71440
11480	64	20010820	99670	115900	14740	44	20010806	36800	48490
11490	17	20010705	22360	26650	14750	44	20010806	13670	25200
11500	64	20010820	67360	83510	14760	44	20010806	48510	59940
11510	17	20010705	30600	34910	14770	44	20010806	25220	36790
11520	64	20010820	115920	131850	14780	44	20010806	1990	13660
11530	17	20010705	18330	22340	14790	43	20010802	100240	110970
11540	64	20010820	83530	99660	14800	43	20010802	78430	89180
11550	17	20010705	26660	30590	14810	43	20010802	89190	100220
11561	64	20010820	51220	67350	14820	43	20010802	67260	78410
11570	17	20010705	34930	38980	14830	43	20010802	45490	56520
11580	62	20010818	94430	110440	14840	43	20010802	23780	34830
11590	17	20010705	43240	47310	14850	43	20010802	56540	67250
11600	62	20010818	110450	125520	14860	43	20010802	34850	45480
11610	17	20010705	51590	55740	14870	43	20010802	13060	23770
11622	64	20010820	34930	51200	14880	42	20010801	88540	99470
11630	17	20010705	38990	43220	14890	42	20010801	66580	77650
11640	62	20010818	47500	63070	14900	42	20010801	99480	110310
11650	17	20010705	47330	51580	14910	42	20010801	77660	88530
11660	62	20010818	15860	31290	14920	42	20010801	55750	66560
11670	17	20010705	55750	59900	14930	42	20010801	33730	44560
11681	63	20010819	37730	53560	14940	42	20010801	11580	22410
11690	17	20010705	63930	68040	14950	42	20010801	44580	55730
11702	64	20010820	18890	34920	14960	42	20010801	22430	33720



**Operations & Processing Report**  
**WATERLOO.**

11710	17	20010705	72030	76240	14970	42	20010801	450	11560
11722	64	20010820	2060	18870	14980	41	20010801	94950	106420
11730	17	20010705	59910	63920	14990	40	20010731	92820	104330
11740	61	20010818	98210	115420	15000	40	20010731	69810	81360
11750	17	20010705	68060	72010	15010	40	20010731	104350	115480
11760	61	20010818	64350	81580	15020	40	20010731	81380	92810
11770	17	20010705	76250	80240	15030	40	20010731	58380	69790
11780	61	20010818	115440	131930	15040	40	20010731	35120	46750
11790	17	20010705	84360	88310	15050	40	20010731	11730	23380
11800	61	20010818	81600	98190	15060	40	20010731	46770	58360
11810	17	20010705	92420	96350	15070	40	20010731	23390	35100
11820	61	20010818	47830	64340	15081	43	20010802	1970	13040
11830	17	20010705	80260	84350	15090	39	20010731	79890	90800
11840	60	20010817	98890	115460	15100	39	20010731	101670	112500
11850	17	20010705	88320	92410	15110	39	20010731	90820	101650
11860	60	20010817	115470	131500	15120	39	20010731	68930	79880
11870	17	20010705	96370	100420	15130	39	20010731	46790	57860
11880	60	20010817	82660	98870	15141	41	20010801	83550	94940
11890	17	20010705	104500	108670	15150	39	20010731	35640	46770
11900	60	20010817	49500	65850	15160	39	20010731	57880	68910
11910	17	20010705	112590	116700	15170	38	20010730	61260	67890
11920	60	20010817	16480	32890	15171	41	20010801	71830	83540
11930	17	20010705	100440	104490	15180	38	20010730	38170	49820
11940	60	20010817	65870	82640	15191	41	20010801	60330	71820
11950	17	20010705	108690	112580	15200	38	20010730	49830	61240
11960	60	20010817	32910	49480	15210	38	20010730	26680	38150
11970	17	20010705	116710	120680	15220	37	20010729	83000	94630
11980	60	20010817	10	16470	15230	37	20010729	60070	71760
11990	17	20010817	124840	128850	15240	37	20010729	37000	48690
12000	59	20010817	97720	113010	15250	37	20010729	71770	82980
12010	17	20010705	132950	136900	15260	37	20010729	48710	60060
12020	59	20010817	113020	129050	15270	37	20010729	25550	36980
12030	17	20010705	120700	124830	15280	36	20010727	36840	49050
12040	59	20010817	81690	97700	15290	36	20010727	60290	72320
12050	17	20010705	128860	132930	15300	36	20010727	49060	60270
12060	59	20010817	50210	66040	15310	36	20010727	25520	36830
12070	17	20010705	136920	141070	15320	35	20010723	83100	94670
12080	59	20010817	18360	34210	15330	35	20010723	60230	71780
12090	20	20010706	10	4170	15340	35	20010723	37120	48610
12100	59	20010817	66060	81670	15350	35	20010723	71800	83090
12110	20	20010706	8190	12200	15360	35	20010723	48630	60220
12120	59	20010817	34230	50200	15370	35	20010723	25600	37110
12130	20	20010706	16270	20340	15380	34	20010722	84880	96630
12140	59	20010817	2070	18340	15390	34	20010722	61340	73330
12150	20	20010706	4190	8180	15400	34	20010722	37890	49820
12160	58	20010816	108520	123890	15410	34	20010722	73340	84870
12170	20	20010706	12220	16250	15420	34	20010722	49840	61320
12180	58	20010816	77040	92530	15430	34	20010722	26470	37880
12190	20	20010706	20350	24340	15440	33	20010722	83390	94800
12200	58	20010816	45630	60980	15450	33	20010722	60340	71730
12210	20	20010706	28440	32470	15460	33	20010722	37280	48710
12220	58	20010816	92550	108500	15470	33	20010722	71750	83380
12230	20	20010706	36780	40970	15481	41	20010801	48630	60320
12240	58	20010816	61000	77030	15490	33	20010722	25680	37270
12250	20	20010706	24350	28420	15500	32	20010721	81710	93120
12260	58	20010816	29270	45620	15510	32	20010721	58470	69980
12270	20	20010706	32490	36760	15520	32	20010721	35150	46680
12280	57	20010816	121650	138640	15530	32	20010721	70000	81690



*Operations & Processing Report*  
**WATERLOO.**

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12290	20	20010706	40980	45170	15540	32	20010721	46700	58450
12300	57	20010816	87870	105120	15550	32	20010721	23370	35140
12310	20	20010706	49240	53410	15560	31	20010721	86060	97690
12320	57	20010816	53700	71310	15570	31	20010721	62600	74250
12330	20	20010706	57430	61560	15580	31	20010721	39020	50590
12340	57	20010816	105140	121630	15590	31	20010721	74270	86040
12350	20	20010706	45180	49230	15600	31	20010721	50600	62590
12360	57	20010816	19340	36470	15610	31	20010721	26920	39010
12370	20	20010706	53430	57420	15620	30	20010720	72920	84110
12380	57	20010816	71320	87850	15630	30	20010720	49650	61100
12390	20	20010706	61580	65610	15640	30	20010720	26430	37910
12400	57	20010816	36490	53680	15650	30	20010720	61110	72900
12410	20	20010706	69660	73690	15660	30	20010720	37930	49640
12420	57	20010816	2100	19330	15670	30	20010720	14830	26420
12430	20	20010706	77890	81900	15681	29	20010719	94280	105650
12440	56	20010815	110170	124160	15682	41	20010801	37130	48620
12450	56	20010815	139120	140490	15690	29	20010719	82780	94190
12460	20	20010706	65620	69650	15700	29	20010719	71400	82770
12470	56	20010815	82800	96710	15711	41	20010801	25270	37120
12480	56	20010815	140500	141830	15720	29	20010719	25070	36480
12490	20	20010706	73700	77870	15731	41	20010801	13840	25250
12500	56	20010815	124180	137770	15741	41	20010801	1950	13820
12510	56	20010815	137790	139100	15750	29	20010719	13250	25060
12520	20	20010706	81910	85920	15760	28	20010719	84620	96690
12530	56	20010815	96720	110150	15770	28	20010719	96700	108070
12540	55	20010815	10	1430	15780	28	20010719	73280	84610
12550	20	20010706	89920	94070	15790	28	20010719	49840	61170
12560	56	20010815	69420	82790	15800	28	20010719	26460	37830
12570	55	20010815	129260	130570	15810	28	20010719	61190	73260
12580	20	20010706	98020	102130	15820	28	20010719	37850	49820
12590	55	20010815	15080	28530	15830	28	20010719	14300	26450
12600	50	20010809	114330	115580	15840	27	20010718	38070	49480
12610	20	20010706	85930	89900	15850	27	20010718	61380	72870
12620	56	20010815	42260	55650	15860	27	20010718	49490	61360
12630	50	20010809	113100	114310	15870	27	20010718	26140	38050
12640	20	20010706	94090	98000	15880	26	20010717	37100	48450
12650	56	20010815	55660	69410	15890	26	20010717	25570	37080
12660	50	20010809	111830	113080	15900	25	20010714	59140	70710
12670	20	20010706	102150	106180	15910	25	20010714	82900	94270
12680	56	20010815	28550	42240	15920	25	20010714	70720	82890
12690	50	20010809	110580	111810	15930	25	20010714	47060	59130
12700	21	20010707	6100	10170	15940	23	20010708	102100	113230
12710	55	20010815	1440	15070	15950	23	20010708	80160	91130
12720	50	20010809	109320	110570	15960	23	20010708	113250	124420
12730	21	20010707	14290	18380	15970	23	20010708	91140	102090
12740	55	20010815	103980	116690	15980	23	20010708	69110	80140
12750	21	20010707	1860	6090	15990	23	20010708	46860	58030
12760	55	20010815	78740	91410	16000	23	20010708	24580	35870
12770	21	20010707	10180	14270	16010	23	20010708	58050	69100
12780	55	20010815	116710	129240	16020	23	20010708	35890	46840
12790	21	20010707	18400	22490	16030	23	20010708	13380	24570
12800	55	20010815	91420	103970	90010	1	20010726	10	15940
12810	21	20010707	26670	30740	90021	18	20010705	10	15900
12820	55	20010815	66210	78720	90030	13	20010703	1800	18210
12830	21	20010707	34880	38930	90040	13	20010703	18230	33840
12840	55	20010815	40800	53330	90050	18	20010705	102370	116840
12850	21	20010707	22500	26650	90060	19	20010706	2010	17360
12860	55	20010815	14970	27640	90070	19	20010706	131770	144420





**Operations & Processing Report**  
**WATERLOO.**

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<b>12870</b>	21	20010707	30750	34860	<b>90080</b>	4	20010628	145210	151300
<b>12880</b>	55	20010815	53340	66190	<b>90090</b>	4	20010628	151310	157120
<b>12890</b>	21	20010707	38940	42950	<b>90100</b>	3	20010628	141640	147590
<b>12900</b>	56	20010815	27660	40790	<b>90110</b>	3	20010628	147600	152410
<b>12911</b>	22	20010707	10	4120	<b>90120</b>	8	20010630	140600	145410
<b>12920</b>	55	20010815	1990	14960	<b>90130</b>	8	20010630	145420	150210
<b>12930</b>	21	20010707	55010	59040	<b>90140</b>	13	20010703	127940	133350
<b>12940</b>	54	20010814	97580	110730	<b>90150</b>	23	20010708	2180	11990
<b>12951</b>	22	20010707	4130	8060	<b>90160</b>	23	20010708	12000	13370
<b>12960</b>	54	20010814	124830	137940	<b>90170</b>	23	20010708	125820	135270
<b>12971</b>	22	20010707	8080	12130	<b>90180</b>	23	20010708	124430	125800
<b>12980</b>	54	20010814	110740	124810	<b>90190</b>	28	20010719	2010	11760
<b>12990</b>	21	20010707	59060	62970	<b>90200</b>	28	20010719	11770	14280
<b>13000</b>	54	20010814	83490	97560	<b>90210</b>	28	20010719	110330	119590
<b>13010</b>	21	20010707	66930	70960	<b>90220</b>	28	20010719	108080	110310
<b>13020</b>	54	20010814	56200	70090	<b>90230</b>	29	20010719	10	9810
<b>13030</b>	21	20010707	74920	78870	<b>90240</b>	29	20010719	9830	13240
<b>13040</b>	54	20010814	29220	43110	<b>90250</b>	30	20010720	1910	11400
<b>13050</b>	21	20010707	62980	66910	<b>90260</b>	30	20010720	11410	14820
<b>13060</b>	54	20010814	70100	83470	<b>90270</b>	29	20010719	105670	120600
<b>13070</b>	21	20010707	70970	74900	<b>90280</b>	30	20010720	84120	99010
<b>13080</b>	54	20010814	43120	56190	<b>90290</b>	26	20010717	2130	25560
<b>13090</b>	21	20010707	78890	82800	<b>90300</b>	26	20010717	48460	70330
<b>13100</b>	54	20010814	16020	29210	<b>90310</b>	27	20010718	1950	26120
<b>13110</b>	21	20010707	86820	90750	<b>90320</b>	27	20010718	72880	94950
<b>13120</b>	53	20010813	104010	117040	<b>90330</b>	31	20010721	2060	26910
<b>13130</b>	21	20010707	94790	98740	<b>90340</b>	31	20010721	97700	120130
<b>13140</b>	53	20010813	78690	91780	<b>90350</b>	32	20010721	10	23360
<b>13150</b>	21	20010707	82810	86800	<b>90360</b>	32	20010721	93130	115240
<b>13161</b>	54	20010814	2010	16000	<b>90370</b>	33	20010722	1920	25670
<b>13170</b>	21	20010707	90760	94770	<b>90380</b>	33	20010722	94810	116800
<b>13180</b>	53	20010813	91800	103990	<b>90390</b>	34	20010722	20	26460
<b>13190</b>	21	20010707	98760	102710	<b>90400</b>	34	20010722	96640	118770
<b>13200</b>	53	20010813	66270	78680	<b>90410</b>	35	20010723	1900	25590
<b>13210</b>	21	20010707	106660	110730	<b>90420</b>	35	20010723	94680	116830
<b>13220</b>	53	20010813	40650	53080	<b>90430</b>	36	20010727	1920	25510
<b>13230</b>	21	20010707	114820	118790	<b>90440</b>	37	20010729	1980	25530
<b>13240</b>	53	20010813	15200	27570	<b>90450</b>	38	20010730	2020	26670
<b>13250</b>	21	20010707	102720	106650	<b>90460</b>	37	20010729	94640	94790
<b>13260</b>	53	20010813	53100	66250	<b>90461</b>	37	20010729	94810	117020
<b>13270</b>	21	20010707	110750	114800	<b>90470</b>	25	20010714	94280	116990
<b>13280</b>	53	20010813	27590	40640	<b>90480</b>	25	20010714	23170	47040
<b>13290</b>	21	20010707	118810	122780					



# APPENDIX 4

## Weekly Production Reports

# KEVRON GEOPHYSICS PTY LTD: Production Summary

**Job No:** 1592A

**Company Name:** NT DEPARTMENT OF MINES AND ENERGY

**Company Address:** CENTREPOINT TOWER BUILDING

Contact Name RICHARD BRESCIANINI

SMITH STREET MALL

DARWIN NT 0828

(08) 8999 5511

**Project Name:** WATERLOO SURVEY

**Date Awarded:**

**Demobilisation Date:**

26/08/01

**DIRECT PHONE:** (08) 8999 5389

**Total Estimated Value:**

\$284,503

**Budgeted Line Kms:**

53,700.0

**Mobilisation Date:**

19/06/01

**Budgeted Flying Hours:**

0

**Date Completed:**

21/08/01

Aircraft	On Line Hours	Other Flying Hours	Total Flying Hours	Total Line Kms	Total Reflown Km	Total Kms Flown	Total Fuel	Start Date	Last Date	Last Flt No	Tot. Standby Time	Total Lost Days
EXS	233.1	76.3	309.4	53,817.2	2,436.2	56,253.4	31949	19/06/01	21/08/01	67	8	20.5
KAV	0.5	5.6	6.1	0.0	115.2	115.2	581	04/11/01	04/11/01	0	0	0.5
<b>Total:</b>	<b>233.6</b>	<b>81.9</b>	<b>315.5</b>	<b>53,817.2</b>	<b>2,551.4</b>	<b>56,368.6</b>	<b>32530</b>	<b>19/06/01</b>	<b>04/11/01</b>	<b>67</b>	<b>8</b>	<b>21</b>

**Average Production Rate Kms/On Line Hours** 230.4 **Average Daily Production (production days only)** 460.0 **Litres per Hour** 103.1

**Average Production Rate (Kms/Total Hours)** 170.6 **OFFLINE Hours as % of Total Hours** 26.0% **Total Days On Job** 138.0

**Average Daily Production over survey period** 390.0 **Reflight as % of Km Flown** 4.5% **Total Production Days** 117.0

**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 18/06/2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Alan Park, Max Eichorn

**OPERATORS:**

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON.	-	1594	-	-	-	-	-	-	-	-	-	-	INGHAM FOR 100 HOURLY
18/06	-	1594	-	-	-	-	-	-	-	-	-	-	INGHAM FOR 100 HOURLY
TUE.	-	1592A	06.55	-	2.8	-	-	-	-	-	AP	ME	Ferry Ingham – Mt Isa
19/06	-	1592A	11.00	-	2.7	-	-	-	-	-	ME	AP	Ferry Mt Isa-Tennant Creek
	-	1592A	14.50	-	2.8	-	-	-	-	-	ME	AP	Ferry Tennant Creek - Kunanurra
WED.	-	1592A	-	-	1.0	-	-	-	-	-	AP	ME	Compensation Box
20/06	-	1592A	-	-	-	-	-	-	-	-	-	-	-
THU.	-	1592A	-	-	-	-	-	-	-	-	-	-	-
21/06	-	-	-	-	-	-	-	-	-	-	-	-	-
FRI.	1	1592A	10.20	-	1.2	345	1	1	-	-	AP	ME	High winds / Testline
22/06	1	1592A	13.30	0.5	0.6	-	-	-	260.0	-	AP	ME	High winds
SAT.	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due Highwinds
23/06	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due Highwinds
SUN.	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due Highwinds
24/06	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due Highwinds
<b>TOTALS</b>				0.5	11.1				260.0	-	-	-	

**SUMMARY**

FUEL USAGE	119.8	Ltrs/Hr
OIL USAGE L:	0.17	Ltrs/Hr
R:	0.11	Ltrs/Hr
PRODUCTION RATE		Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	<b>TOTALS</b>	
			HOURS	LINE KM
ALAN PARK				
MAX EICHORN				
<b>GRAND TOTALS</b>				

HOURS TO 120 HOURLY: **88.4**

TOTAL A/C HOURS: **26,561.0**

**Operations & Processing Report  
WATERLOO.**

WEEK COMMENCING MONDAY 25/ 06/ 2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Alan Park, Max Eichorn

**OPERATORS:** Ross Rackham, Brett Archer

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 25/06	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft U/S Mechanical
	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft U/S Mechanical
TUE. 26/06	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft U/S Mechanical
	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft U/S Mechanical
WED. 27/06	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft U/S Mechanical
	2	1592A	10.02	4.0	0.6	465	-	-	1009.8	-	ME	BA	Strong Winds & Turbulent
THU. 28/06	3	1592A	06.15	4.5	0.3	542	1	1	1083.0	-	AP	RR	Flight OK
	4	1592A	11.44	4.7	0.5	545	-	-	1089.0	-	ME	BA	Flight OK
FRI. 29/06	5	1592A	05.59	4.2	0.5	470	1	1	1009.7	-	ME	BA	Very Turbulent
	6	1592A	11.40	4.1	0.6	485	-	1	1009.7	-	AP	RR	Very Turbulent
SAT. 30/06	7	1592A	06.00	4.1	0.6	478	1	-	1009.7	-	AP	RR	Very Turbulent & Strong Easterly
	8	1592A	1.40	4.5	0.6	556	-	1	1077.2	-	ME	BA	Strong Easterly
SUN. 01/07	9	1592A	05.13	4.0	0.6	503	1	1	1009.8	-	ME	BA	Flight OK
	10	1592A	1.45	4.0	0.2	490	1	-	1009.8	-	AP	RR	Flight OK
<b>TOTALS</b>				38.2	4.9	4545	5	5	9307.7	-	-	-	

**SUMMARY**

FUEL USAGE	105.5	Ltrs/Hr
OIL USAGE L:	0.11	Ltrs/Hr
R:	0.11	Ltrs/Hr
PRODUCTION RATE	218.5	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
ALAN PARK	16.7	1.7	18.4	4112.2
MAX EICHORN	21.4	2.8	24.2	5195.5
<b>GRAND TOTALS</b>			42.6	9307.7

HOURS TO 120 HOURLY: **45.3**

TOTAL A/C HOURS: **26,604.1**



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**Operations & Processing Report  
WATERLOO.**

WEEK COMMENCING MONDAY 02/07/2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Alan Park, Max Eichorn

**OPERATORS:** Ross Rackham, Brett Archer

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 02/07	11	1592A	05.30	4.0	0.7	460	1	1	1009.8	-	AP	RR	OK
	12	1592A	01.18	4.0	0.7	500	-	-	1009.8	-	ME	BA	OK
TUE. 03/07	13	1592A	05.14	4.2	0.4	500	-	-	928.2	-	ME	BA	OK
	14	1592A	11.53	3.9	0.6	478	2	1	1010	-	AP	RR	OK, DELAY T/OFF DUE REFUEL
WED. 04/07	15	1592A	05.54	4.1	0.6	500	1	-	1047.8	-	AP	RR	OK
	16	1592A	11.55	4.2	0.6	573	1	1	858.7	-	ME	BA	OK
THU. 05/07	17	1592A	6.07	4.5	0.8	551	-	1	926.6	-	ME	BA	OK
	18	1592A	12.41	3.7	0.4	492	1	-	697.2	108.7	AP	RR	DELAY DUE SPAR INSPECTION
FRI. 06/07	19	1592A	05.57	4.5	0.4	493	1	1	966.0	-	AP	RR	SHORT LINES OK
	20	1592A	11.55	3.4	1.0	530	1	2	709.8	-	ME	BA	SHORT LINES OK
SAT. 07/07	21	1592A	06.09	3.9	1.0	530	1	1	819	-	ME	BA	SHORT LINES OK
	22	1592A	11.39	2.1	1.6	389	1	1	381.5	71.9	AP	RR	ABORT DUE ANALOG DATA
SUN. 08/07	23	1592A	09.10	4.5	0.7	-	-	-	972.3	-	AP	RR	LONG FERRY, FINISH NORTH
	-	1592A	-	-	-	-	-	-	0	-	-	-	NO FLIGHT/ PILOT DUTY TIME
<b>TOTALS</b>									11336.7	190.6	-	-	

**SUMMARY**

FUEL USAGE	92.26	Ltrs/Hr
OIL USAGE L:	0.16	Ltrs/Hr
R:	0.14	Ltrs/Hr
PRODUCTION RATE		Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
ALAN PARK				
MAX EICHORN				
<b>GRAND TOTALS</b>				

HOURS TO 120 HOURLY **4.8**

TOTAL A/C HOURS: **26,663.6**



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**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 09/ 07/ 2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Ivan Hussein, Max Eichorn

**OPERATORS:** Ross Rackham, Brett Archer

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 09/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
TUE. 10/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
WED. 11/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
THU. 12/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Engine Change & 100 hourly Maint.
	-	1592A	13.00	-	0.6	468	1	1	-	-	ME	LG	Test Flight
FRI. 13/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Aircraft Maintenance.
	-	1592A	15.00	-	2.0	-	-	-	-	-	IH	LG	Test Flight
SAT. 14/07	24	1592A	06.50	3.2	1.3	570	1	1	767.8	-	ME	BA	Early Fog & Comp Box, OK, 6 Ties
	25	1592A	11.55	4.4	0.7	512	1	1	985.2	-	IH	RR	Survey OK, 2 Ties & 6 Travs
SUN. 15/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Damage to Nose Wheel Gear Door
	-	1592A	-	-	-	-	-	-	-	-	-	-	Damage to Nose Wheel Gear Door
<b>TOTALS</b>				7.6	4.6	1550	3	3	1753.0	0	-	-	

**SUMMARY**

FUEL USAGE	127.0	Ltrs/Hr
OIL USAGE L:	0.24	Ltrs/Hr
R:	0.24	Ltrs/Hr
PRODUCTION RATE	143.7	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
IVAN HUSSEIN	4.4	2.7	7.1	985.2
MAX EICHORN	3.2	1.9	5.1	767.8
<b>GRAND TOTALS</b>			12.2	1753.0

HOURS TO 120 HOURLY **107.8**

TOTAL A/C HOURS: **26,675.8**



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**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 16/07/2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Ivan Hussein, Max Eichorn

**OPERATORS:** Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 16/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Repair to A/c Gear Door
	-	1592A	-	-	-	-	-	-	-	-	-	-	Repair to A/c Gear Door
TUE. 17/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Repair to A/c Gear Door
	26	1592A	14.23	2.0	1.0	151	-	-	486.4	-	IH	RR	Test Flight & Survey, 2 Ties, 2 Travs
WED. 18/07	27	1592A	6.00	2.8	1.2	511	1	1	649.4	-	ME	EG	2 Ties, 4 Travs, Short flight training
	-	1592A	-	-	-	-	-	-	0	-			No flight due HD Failure
THU. 19/07	28	1592A	6.28	4.0	0.7	463	1	1	811.4	-	IH	RR	Flight OK , 4 Ties, 8 Travs
	29	1592A	11.47	3.9	0.7	488	-	1	847.8	-	ME	EG	Flight OK , 3 Ties, 8 Travs
FRI. 20/07	-	1592A	11.17	3.3	0.7	-	1	1	684.7	-	ME	EG	Late due to Mag probs
	30	1592A	-	-	-	-	-	-	-	-			No flight due aircraft repairs.
SAT. 21/07	31	1592A	6.16	3.5	1.1	450	1	1	812.8	-	IH	RR	Flight OK, 2 Ties, 6 Travs
	32	1592A	11.35	3.6	1.2	490	-	1	813	-	ME	EG	Flight OK, 2 Ties, 6 Travs
SUN. 22/07	33	1592A	6.06	3.6	1.1	500	1	1	812.6	-	ME	EG	Flight OK, 2 Ties, 6 Travs
	34	1592A	11.30	3.8	1.2	510	-	-	812.6	-	IH	RR	Flight OK, 2 Ties, 6 Travs
<b>TOTALS</b>				30.5	8.9	3563	5	7	6730.7	-	-	-	

**SUMMARY**

FUEL USAGE	90.4	Ltrs/Hr
OIL USAGE L:	0.13	Ltrs/Hr
R:	0.18	Ltrs/Hr
PRODUCTION RATE	170.8	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
IVAN HUSSEIN	13.3	4.0	17.3	2,923.2
MAX EICHORN	17.2	4.9	22.1	3,807.5
<b>GRAND TOTALS</b>			39.4	6,730.7

HOURS TO 120 HOURLY **68.3**

TOTAL A/C HOURS: **26,716.3**



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**Operations & Processing Report  
WATERLOO.**

WEEK COMMENCING MONDAY 23/ 07/ 2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Max Eichorn

**OPERATORS:** Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON.	35	1592A	9.32	3.7	1.3	582	-	1	812.5		ME	EG	Flight OK
23/07	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due High Winds
TUE.	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due High Winds
24/07	-	1592A	-	-	-	-	-	-	-	-	-	-	No flight due High Winds
WED.	-	1592A	-	-	1.0	145	-	-	-	-	-	-	No flight due High Winds
25/07	-	1592A	-	-	-	-	-	-	-	-	-	-	High Winds & Turb
THU.	-	1592A	-	-	1.3	-	-	-	-	-	-	-	Dust Storm in Survey Area
26/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Dust Storm in Survey Area
FRI.	-	1592A	-	-	-	-	-	-	-	-	-	-	Dust Storm in Survey Area
27/07	36	1592A	12.50	1.9	2.0	464	-	-	488	-	ME	EG	High Winds Turbulent
SAT.	-	1592A	-	-	1.0	-	-	-	-	-	-	-	Dust Storm in Survey Area
28/07	-	1592A	-	-	-	-	-	-	-	-	-	-	Low Visibility
SUN.	37	1592A	11.12	3.7	1.3	133	1	-	812.3	-	ME	EG	Flight OK
29/07	-	1592A	-	-	-	556	-	-	-	-	-	-	
<b>TOTALS</b>				9.3	7.9	1880	1	1	2112.8	-	-	-	

**SUMMARY**

FUEL USAGE	109.3	Ltrs/Hr
OIL USAGE L:	0.06	Ltrs/Hr
R:	0.06	Ltrs/Hr
PRODUCTION RATE	122.8	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
Max Eichorn	9.3	7.9	17.2	2112.8
<b>GRAND TOTALS</b>			17.2	2112.8

HOURS TO 120 HOURLY **52.4**

TOTAL A/C HOURS: **26,732.2**



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**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 30/ 07/ 2001

AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Alan Park, Max Eichorn  
**OPERATORS:** Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 30/07	38	1592A	7.40	2.5	1.5	425	-	1	406.2	-	ME	EG	DAS 8 FAILURE
	-	1592A	-	-	-	-	1	2	-	-	-	-	-
TUE. 31/07	39	1592A	6.22	3.2	1.5	500	-	1	817.0	-	AP	RR	OK LONG FERRY
	40	1592A	12.07	3.3	1.5	510	-	1	817.0	-	ME	EG	OK
WED. 01/08	41	1592A	6.37	3.1	1.8	500	1	2	81.7	653.6	ME	EG	OK LATE TAKE OFF DUE DAS8
	42	1592A	12.15	3.2	1.3	500	1	1	817.2	-	AP	RR	OK, (SMOKE & LONG FERRY)
THU. 02/08	43	1592A	06.45	3.3	1.4	365	-	-	735.6	81.7	AP	RR	SMOKE
	-	1592A	-	-	2.0	-	-	-	-	-	AP	-	FERRY TO DERBY FOR 100 HR
FRI. 03/08	-	1592A	-	-	-	283	-	-	-	-	-	-	100 HOURLY
	-	1592A	-	-	-	-	-	-	-	-	-	-	100 HOURLY
SAT. 04/08	-	1592A	-	-	-	-	-	-	-	-	-	-	100 HOURLY
	-	1592A	-	-	-	-	-	-	-	-	-	-	100 HOURLY
SUN. 05/08	-	1592A	-	-	-	320	-	-	-	-	-	-	FERRY TO KUNUNURRA
	-	1592A	-	-	-	-	-	-	-	-	-	-	-
<b>TOTALS</b>				18.6	11	3403	3	8	3674.7	735.3	-	-	

**SUMMARY**

FUEL USAGE	115	Ltrs/Hr
OIL USAGE L:	0.10	Ltrs/Hr
R:	0.27	Ltrs/Hr
PRODUCTION RATE	148.9	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
ALAN PARK	9.7	6.2	15.9	2,451.5
MAX EICHORN	8.9	4.8	13.7	1,958.5
<b>GRAND TOTALS</b>			29.6	4,410.0

HOURS TO 120 HOURLY

TOTAL A/C HOURS:



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**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 06/08/2001 AIRCRAFT: **VH-EXS** CREW: PILOTS: Alan Park, Max Eichorn, Rod Jamieson, David Chappell  
OPERATORS: Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 06/08	44	1592A	6.15	3.1	1.7	370	-	-	766.8		ME	EG	OK
	45	1592A	11.40	3.5	1.2	500	-	1	903.2		AP	RR	OK
TUE. 07/08	46	1592A	5.53	3.5	1.2	572	2	2	903.4		AP	RR	OK
	47	1592A	11.05	3.5	1.2	496	1	1	887.0		ME	EG	OK
WED. 08/08	48	1592A	5.33	3.5	1.4	541	1	1	859.6		ME	EG	OK
	49	1592A	11.35	3.2	1.2	462	1	1	802.4		AP	RR	OK
THU. 09/08	50	1592A	06.59	3.5	1.1	499	1	2	820.5		AP	RR	OK, Short lines
	-	1592A	-	-	-	-	-	-	-	-	-	-	-
FRI. 10/08	-	1592A	-	-	-	-	-	-	-	-	-	-	-
	-	1592A	-	-	-	-	-	-	-	-	-	-	-
SAT. 11/08	-	1592A	-	-	-	-	-	-	-	-	-	-	-
	-	1592A	-	-	-	-	-	-	-	-	-	-	-
SUN. 12/08	51	1592A	6.02	3.8	1.1	522		1	935.1	-	RJ	RR	OK
	52	1592A	11.30	3.5	0.9	511	1	1	905.7	-	DC	EG	OK
<b>TOTALS</b>				31.1	11.0	4473	7	10	7783.7	-	-	-	

**SUMMARY**

FUEL USAGE	106.2	Ltrs/Hr
OIL USAGE L:	0.16	Ltrs/Hr
R:	0.24	Ltrs/Hr
PRODUCTION RATE	184.9	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	<b>TOTALS</b>	
			HOURS	LINE KM
ALAN PARK	13.7	4.7	18.4	3429.5
MAX EICHORN	10.1	4.3	14.4	2513.4
DAVE CHAPPELL	3.5	0.9	4.4	905.7
ROD JAMIESON	3.8	1.1	4.9	935.1
<b>GRAND TOTALS</b>			42.1	7783.7

HOURS TO 120 HOURLY **70.8**

TOTAL A/C HOURS: **26,811.1**

**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 13/ 08/ 2001 AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Rod Jamieson, Ivan Hussein  
**OPERATORS:** Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 13/08	53	1592A	9.20	3.7	1.1	510	2	2	905.5	-	RJ	RR	OK, Very Windy
	-	1592A	-	-	-	-	-	-	-	-	-	-	
TUE. 14/08	54	1592A	7.42	3.9	1.3	510	Oil Change		814.5	90.5	IH	EG	Very Turbulent
	-	1592A	-	-	-	-	-	-	-	-	-	-	
WED. 15/08	55	1592A	5.58	3.9	0.9	510	-	-	912.7	-	RJ	RR	OK, Turbulent
	56	1592A	11.50	4.2	0.9	530	1	1	934.7	-	IH	EG	Flight OK
THU. 16/08	57	1592A	6.00	4.0	1.0	520	1	2	903.4	-	IH	EG	Flight OK
	58	1592A	11.50	3.8	1.0	482	-	1	677.6	210.8	RJ	RR	Flight OK
FRI. 17/08	59	1592A	5.52	3.6	0.9	475	-	1	903.2	-	RJ	RR	Flight OK
	60	1592A	11.04	3.7	0.9	475	2	2	903.2	-	IH	EG	Flight OK
SAT. 18/08	61	1592A	6.10	3.3	1.2	460	1	1	564.4	172.9	IH	EG	Very Windy
	62	1592A	11.42	3.6	0.8	460	-	1	903	-	RJ	RR	Flight OK
SUN. 19/08	-	1592A	10.00	-	0.5	100	-	-	-	-	RJ	RR	Test Flight
	63	1592A	11.50	3.0	1.2	440	1	2	112.9	594.5	RJ	EG	Short Flight, Check data QC
<b>TOTALS</b>				40.7	11.7	4962	8	13	8535.1	1068.7	-	-	-

**SUMMARY**

FUEL USAGE	94.7	Ltrs/Hr
OIL USAGE L:	0.15	Ltrs/Hr
R:	0.25	Ltrs/Hr
PRODUCTION RATE	183.3	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
IVAN HUSSEIN	19.1	5.3	24.4	4383.6
ROD JAMIESON	21.6	6.4	28.0	5220.2
<b>GRAND TOTALS</b>			52.4	9603.8

HOURS TO 120 HOURLY **18.4**

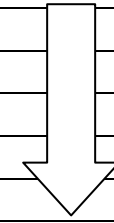
TOTAL A/C HOURS: **26,863.5**

**Operations & Processing Report**  
**WATERLOO.**

WEEK COMMENCING MONDAY 20/ 08/ 2001 AIRCRAFT: **VH-EXS**

**CREW: PILOTS:** Rod Jamieson, Ivan Hussein  
**OPERATORS:** Ross Rackham, Erron Gardner

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servicability etc)
							L	R			PLT	OR	
MON. 20/08	64	1592A	06.15	3.7	0.9	760	-	-	451.6	451.6	IH	EG	Flight OK
	65	1592A	12.10	3.6	0.8	500	-	1	902.7	-	RJ	RR	Flight OK
TUE. 21/08	66	1592A	5.54	3.1	1.0	488	1	2	902.6	-	RJ	RR	Flight OK
	67	1592A	10.55	4.9	0.9	437	-	-	1163.6	-	IH	EG	Flight OK. Job Completed
WED. 22/08	-	-	-	-	-	-	-	-	-	-	-	-	100 Hourly in Kununurra
	-	-	-	-	-	-	-	-	-	-	-	-	
THU. 23/08	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
FRI. 24/08	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
SAT. 25/08	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
SUN. 26/08	-	1593	7.30	-	3.9	496	-	-	-	-	RJ	-	Ferry Kununurra to Urandangi
	-	1593	14.30	-	1.8	342	1	1	-	-	RJ	-	Urandangie – Alice - Urandangi
<b>TOTALS</b>				15.3	10.9	2723	2	4	3420.5	451.6	-	-	



**SUMMARY**

FUEL USAGE	111	Ltrs/Hr
OIL USAGE L:	0.1	Ltrs/Hr
R:	0.2	Ltrs/Hr
PRODUCTION RATE	205	Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	TOTALS	
			HOURS	LINE KM
IVAN HUSSEIN	8.6	1.8	10.4	2066.8
ROD JAMIESON	6.7	9.1	15.8	1805.3
<b>GRAND TOTALS</b>			26.2	2871.1

HOURS TO 120 HOURLY **112.5**

TOTAL A/C HOURS: **26,885**



Flown and Processed for  
Northern Territory Department Of Mines & Energy

Job No. 1592A  
Page 11

**Operations & Processing Report  
WATERLOO.**

WEEK COMMENCING MONDAY 5/11/2001

**CREW: PILOTS:** Rod Jamieson

AIRCRAFT: **VH-KAV**

**OPERATORS:** Rob Deopel

DAY/ DATE	FLIGHT No.	JOB No.	TAKE OFF TIME	"ON LINE" FLIGHT HOURS	ALL OTHER FLIGHT HOURS	FUEL	OIL		KM FLOWN	KM REFLOWN	CREW		COMMENTS  (Routes Flown, Wx, Equipment & A/C Servcability etc)
							L	R			PLT	OR	
MON. 5/11	-	1592A	12.15	0.9	1.2		-	-	-	210.8	RJ	RD	WATERLOO REFLYS
TUE. 6/11													
WED. 7/11													
THU. 8/11													
FRI. 9/11													
SAT. 10/11													
SUN. 11/11													
<b>TOTALS</b>													

**SUMMARY**

FUEL USAGE		Ltrs/Hr
OIL USAGE L:		Ltrs/Hr
R:		Ltrs/Hr
PRODUCTION RATE		Km/Hr

**PILOT SUMMARY:**

NAME	'ON LINE'	OTHER HRS	HOURS	LINE KM
<b>GRAND TOTALS</b>				

HOURS TO ENGINE CHANGE? **18**

TOTAL A/C HOURS: **10.797.5**



**Kevron**  
Geophysics Pty Ltd

Flown and Processed for  
Northern Territory Department Of Mines & Energy

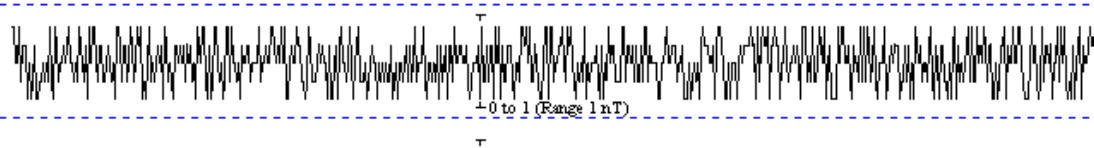
Job No. 1592A  
Page 12

# APPENDIX 5

## Base Station Magnetometer Plots

DIURNAL June 22, 2001 Waterloo Survey Julian Day 173

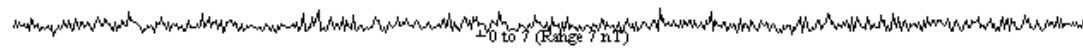
Difference (5.0-sec samples)



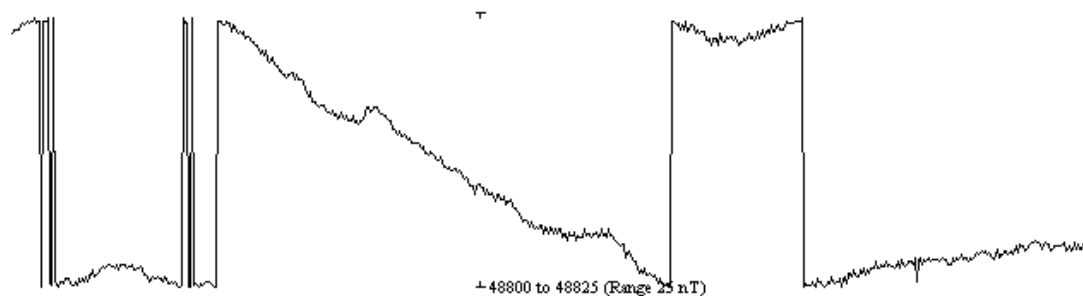
Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity (5.0-sec samples)

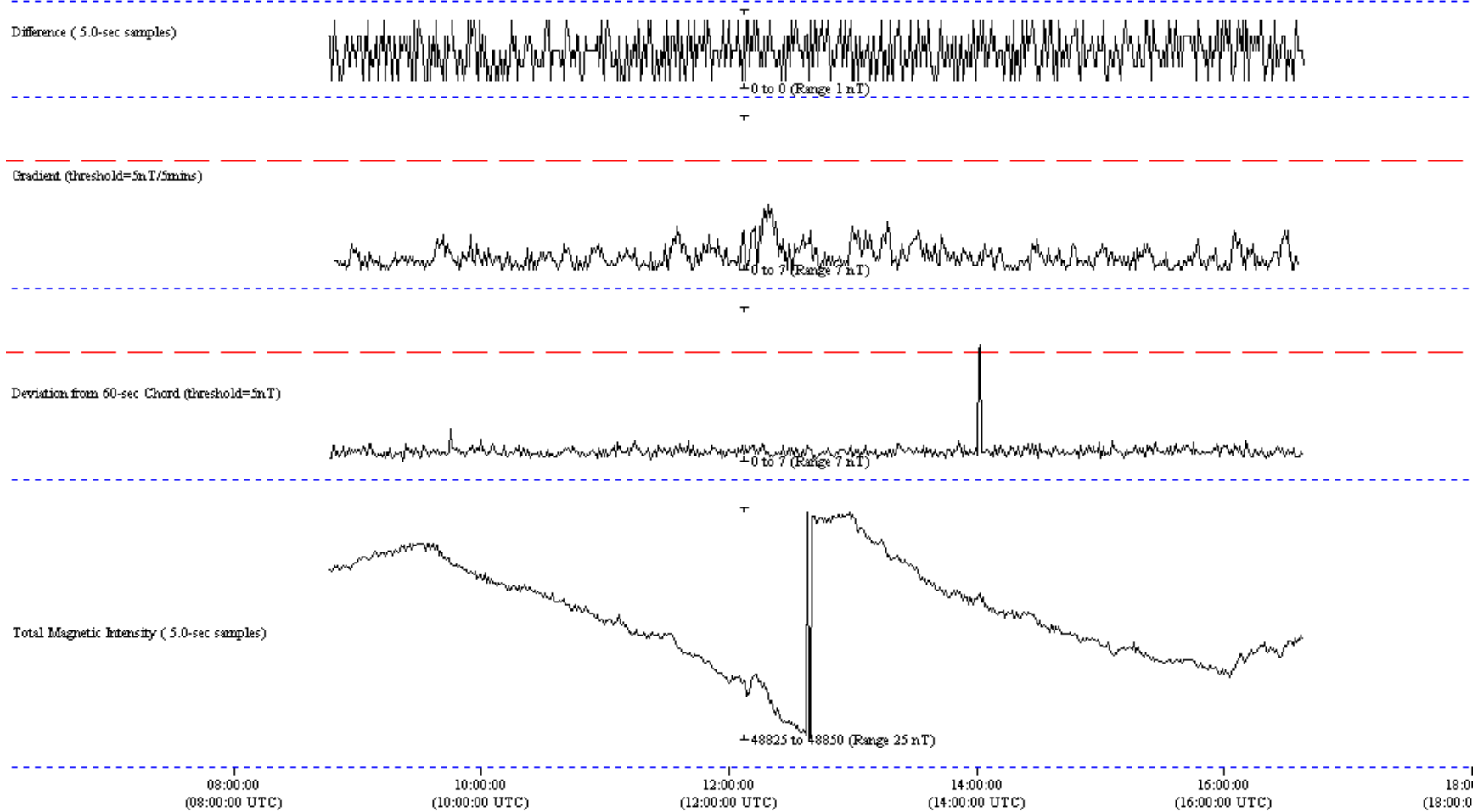


0:00 08:00:00 10:00:00 12:00:00 14:00:00 16:00:00 18:00:00  
(08:00:00 UTC) (10:00:00 UTC) (12:00:00 UTC) (14:00:00 UTC) (16:00:00 UTC) (18:00:00 UTC)



**Operations & Processing Report**  
**WATERLOO.**

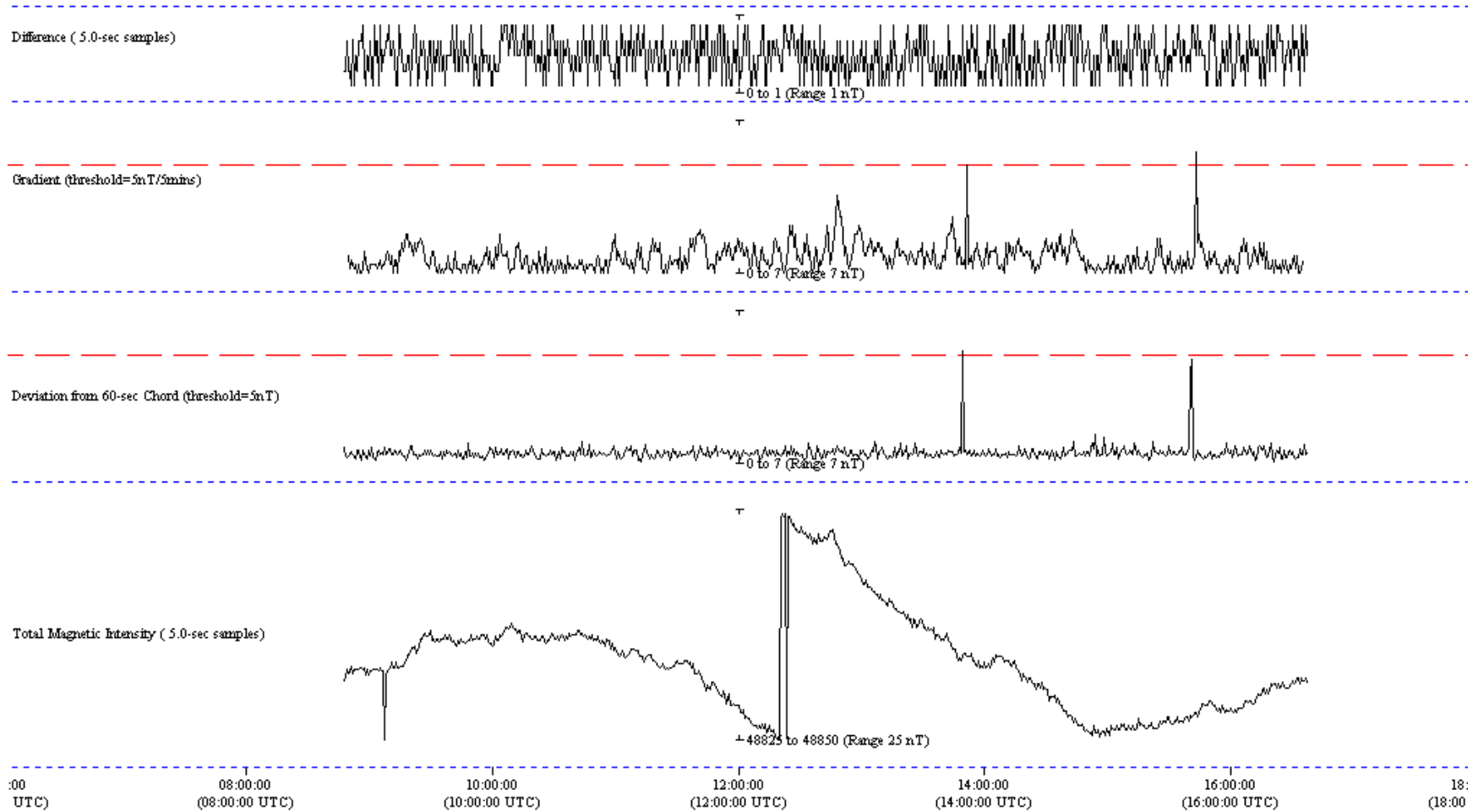
**DIURNAL June 23, 2001 Waterloo Survey Julian Day 174**



**Operations & Processing Report**  
**WATERLOO.**

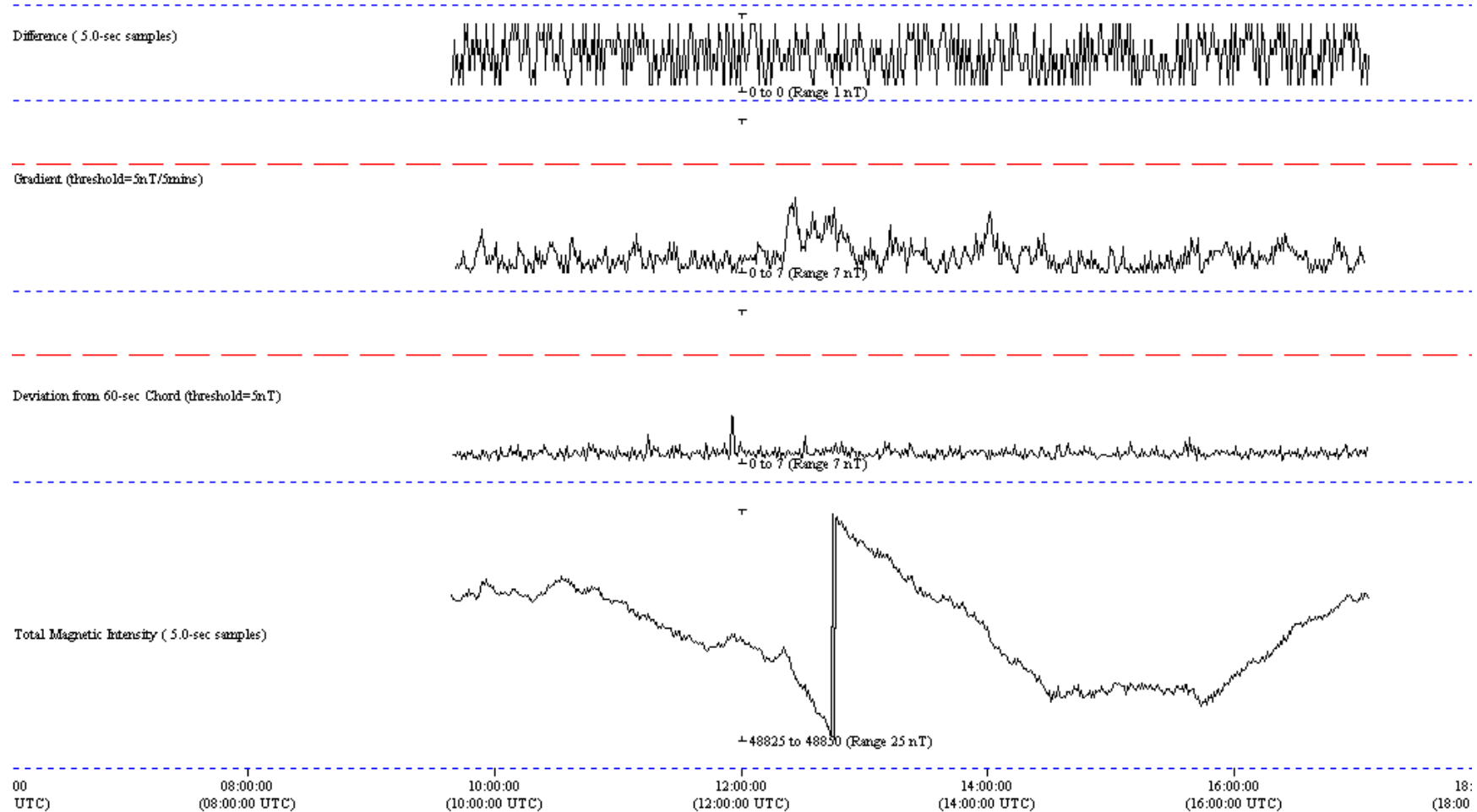
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**DIURNAL June 24, 2001 Waterloo Survey Julian Day 175**

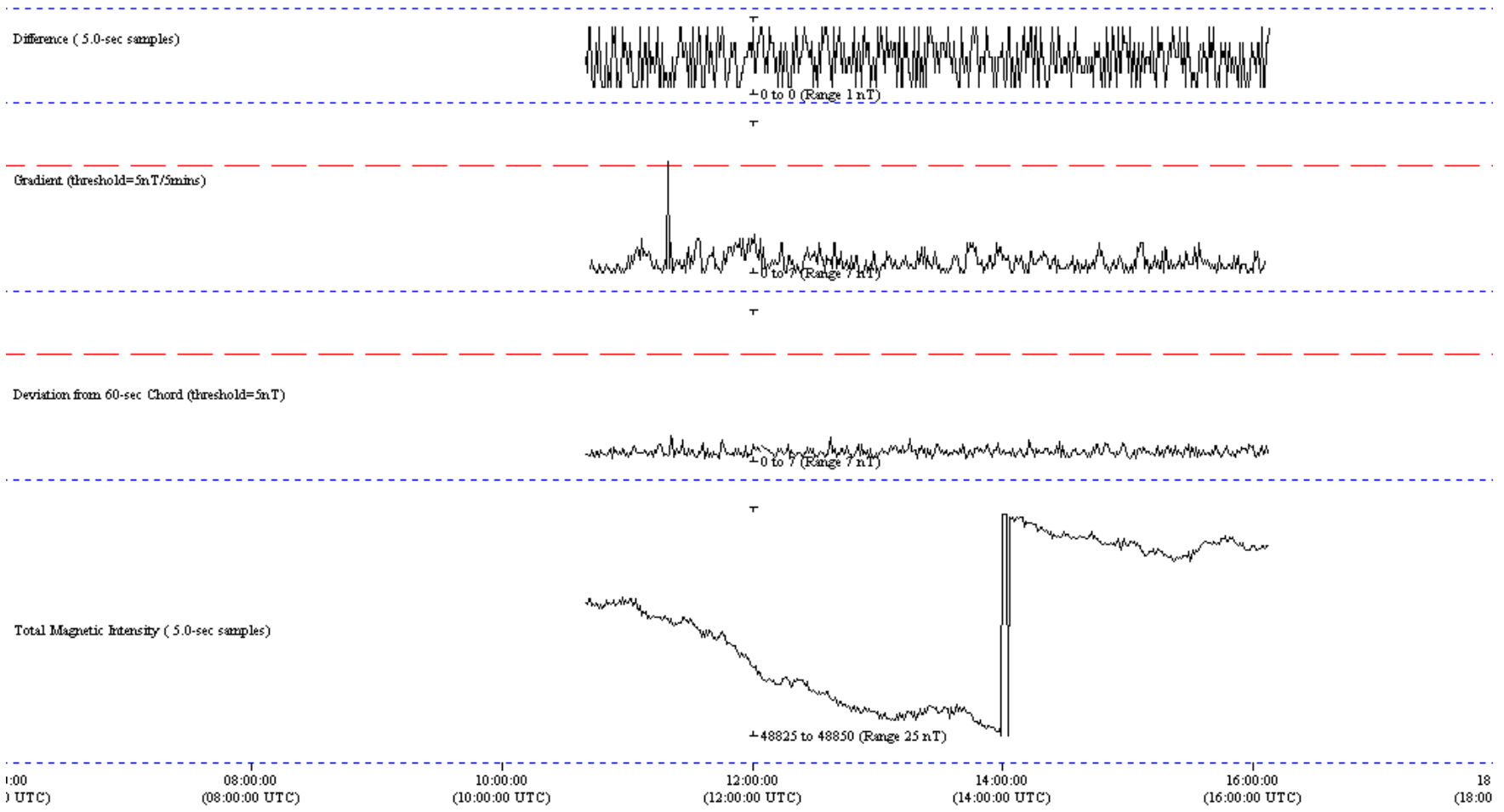


**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL June 25, 2001 Waterloo Survey Julian Day 176**

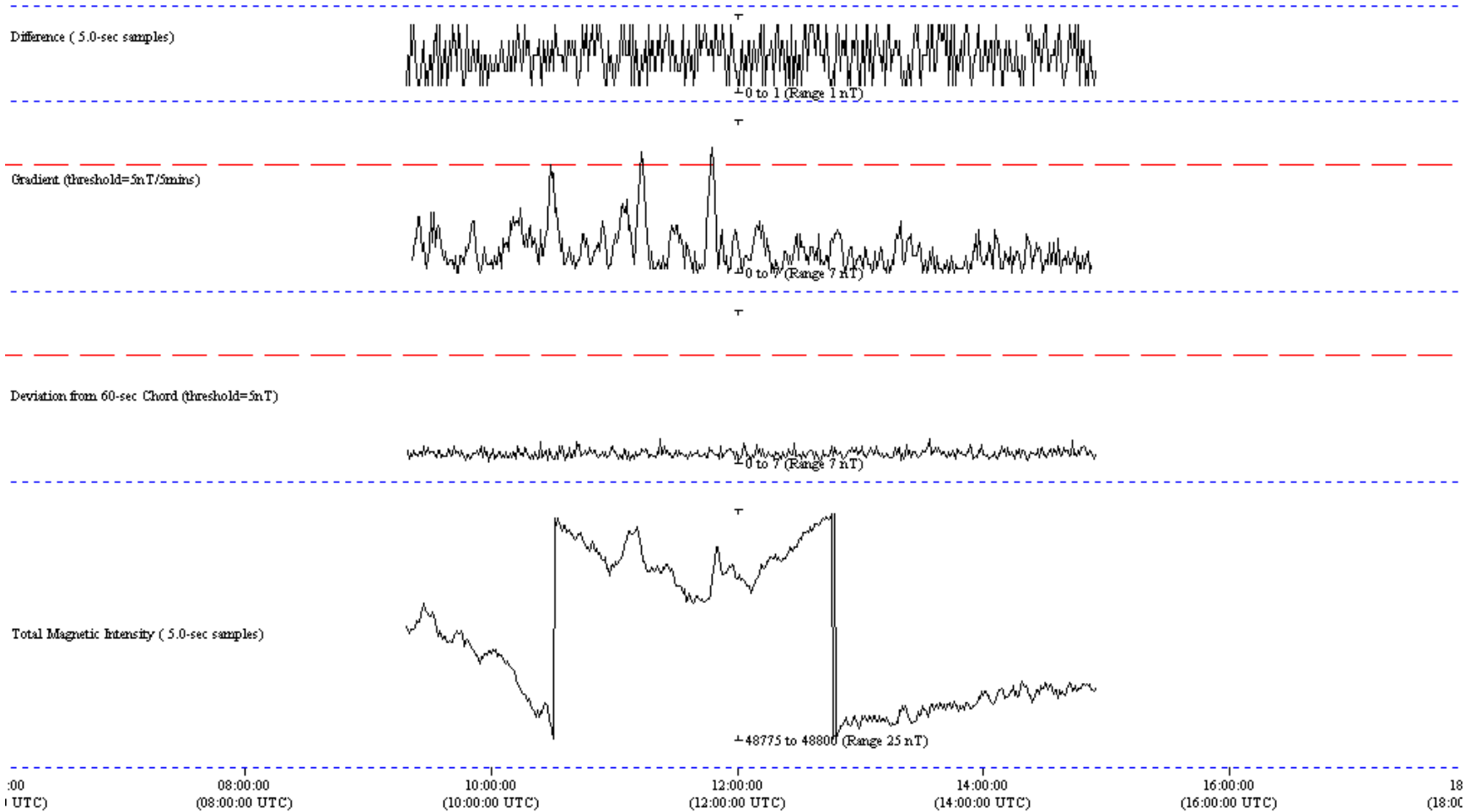


**Operations & Processing Report**  
**WATERLOO**  
**DIURNAL June 26, 2001 Waterloo Survey Julian Day 177**



**Operations & Processing Report**  
**WATERLOO.**

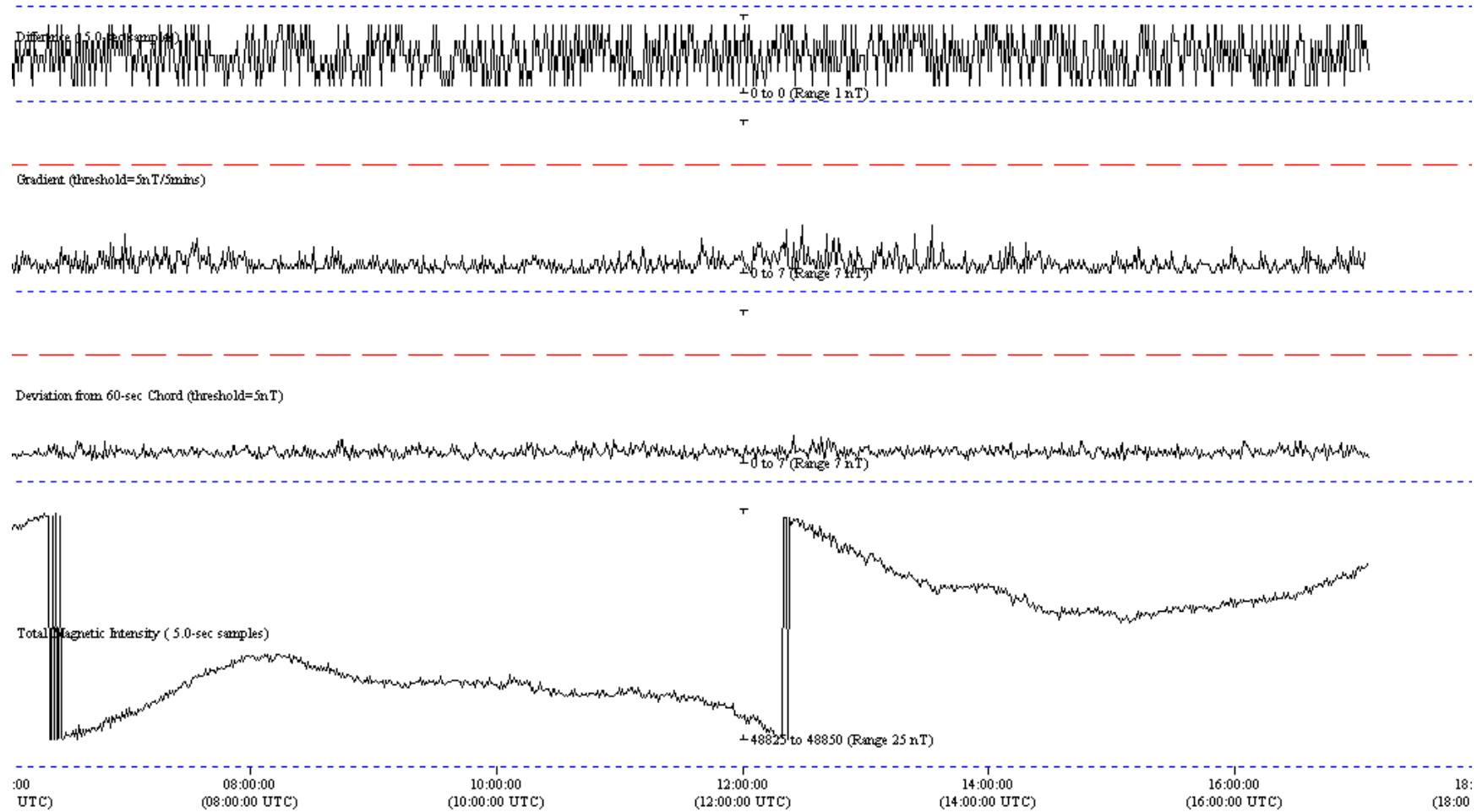
**DIURNAL June 27, 2001 Waterloo Survey Julian Day 178**



**Operations & Processing Report**  
**WATERLOO.**

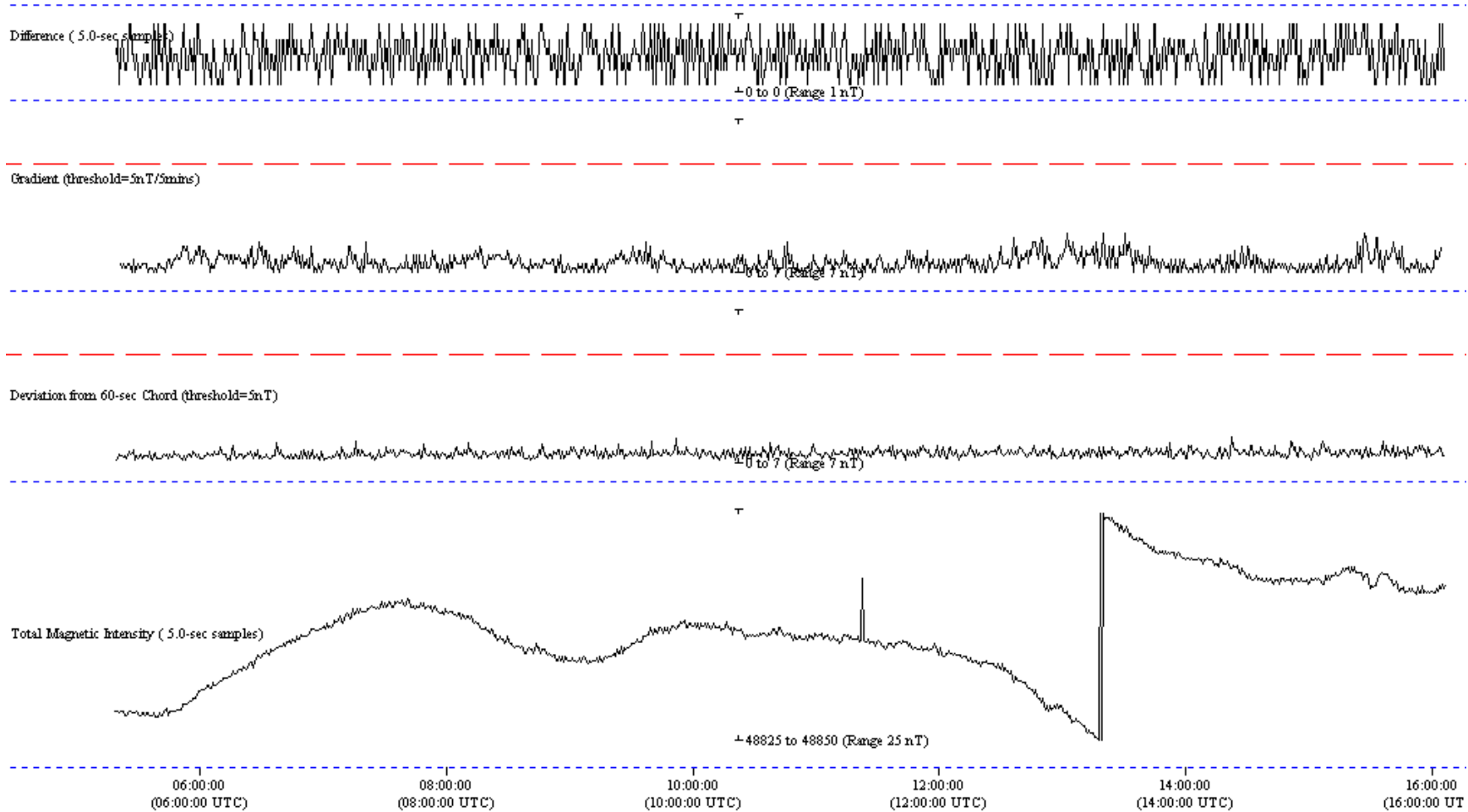
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**DIURNAL June 28, 2001 Waterloo Survey Julian Day 179**



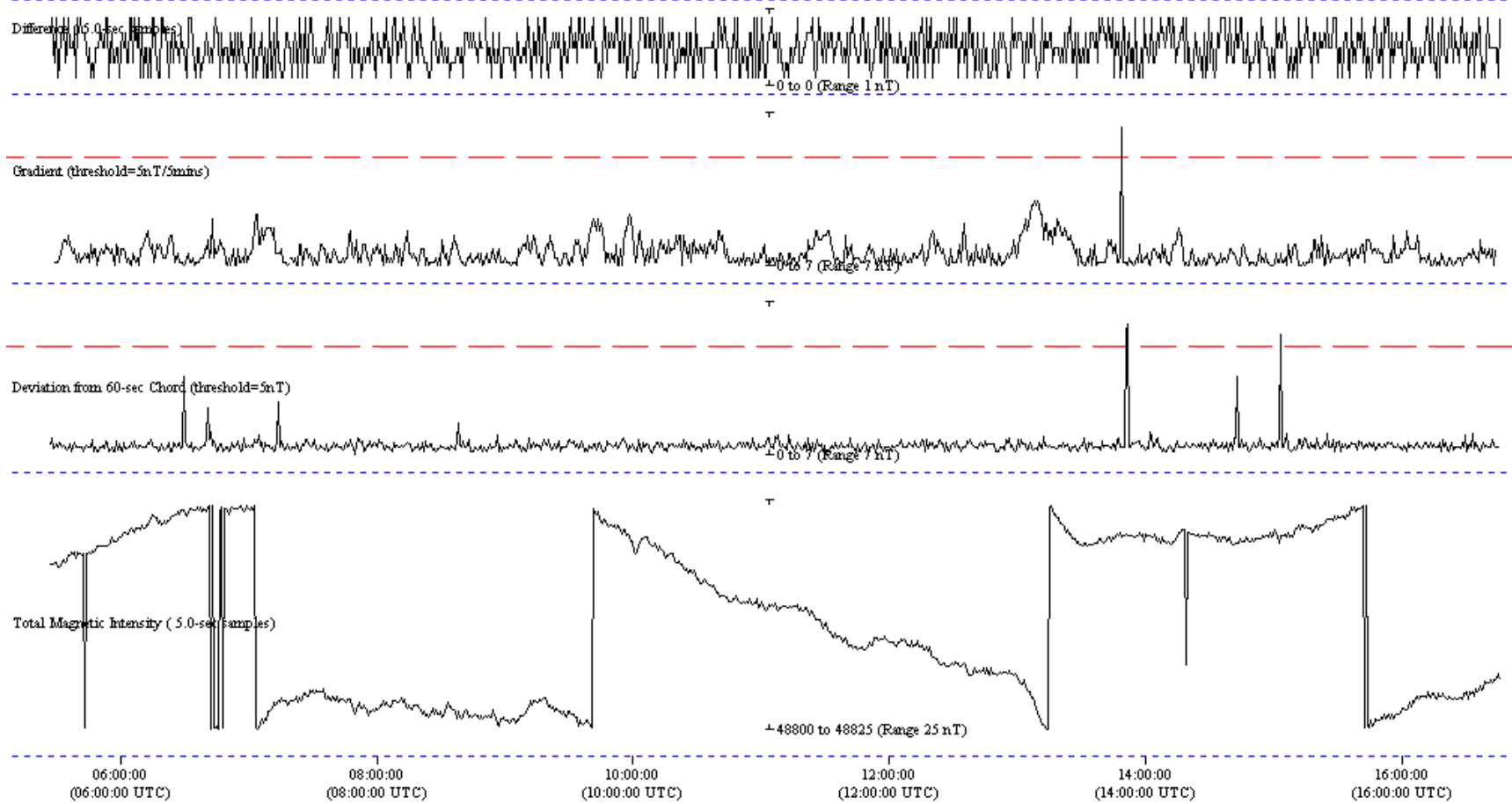
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL June 29, 2001 Waterloo Survey Julian Day 180**



**Operations & Processing Report**  
**WATERLOO.**

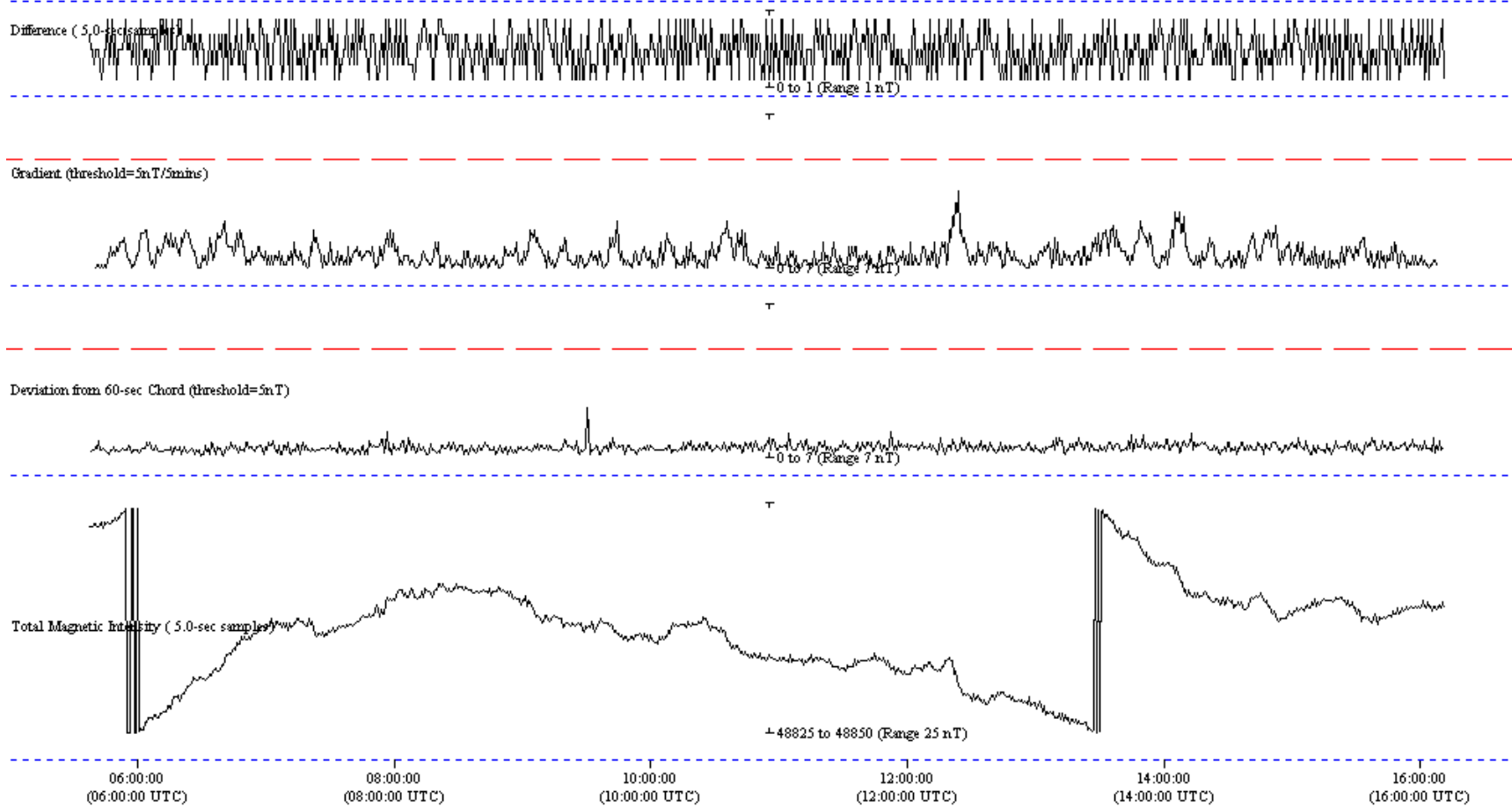
**DIURNAL July 6, 2001 Waterloo Survey Julian Day 187**





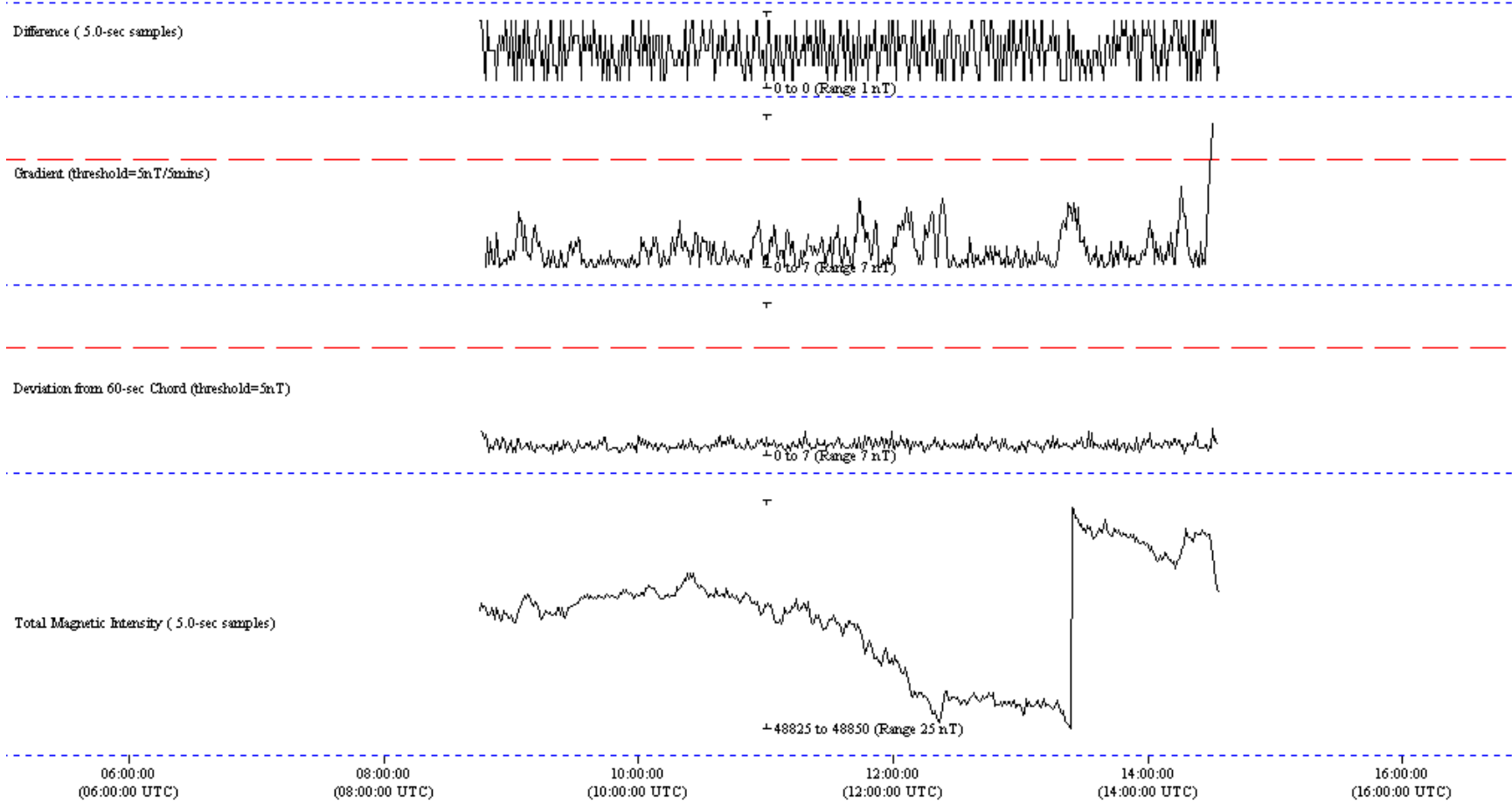
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 7, 2001 Waterloo Survey Julian Day 188**



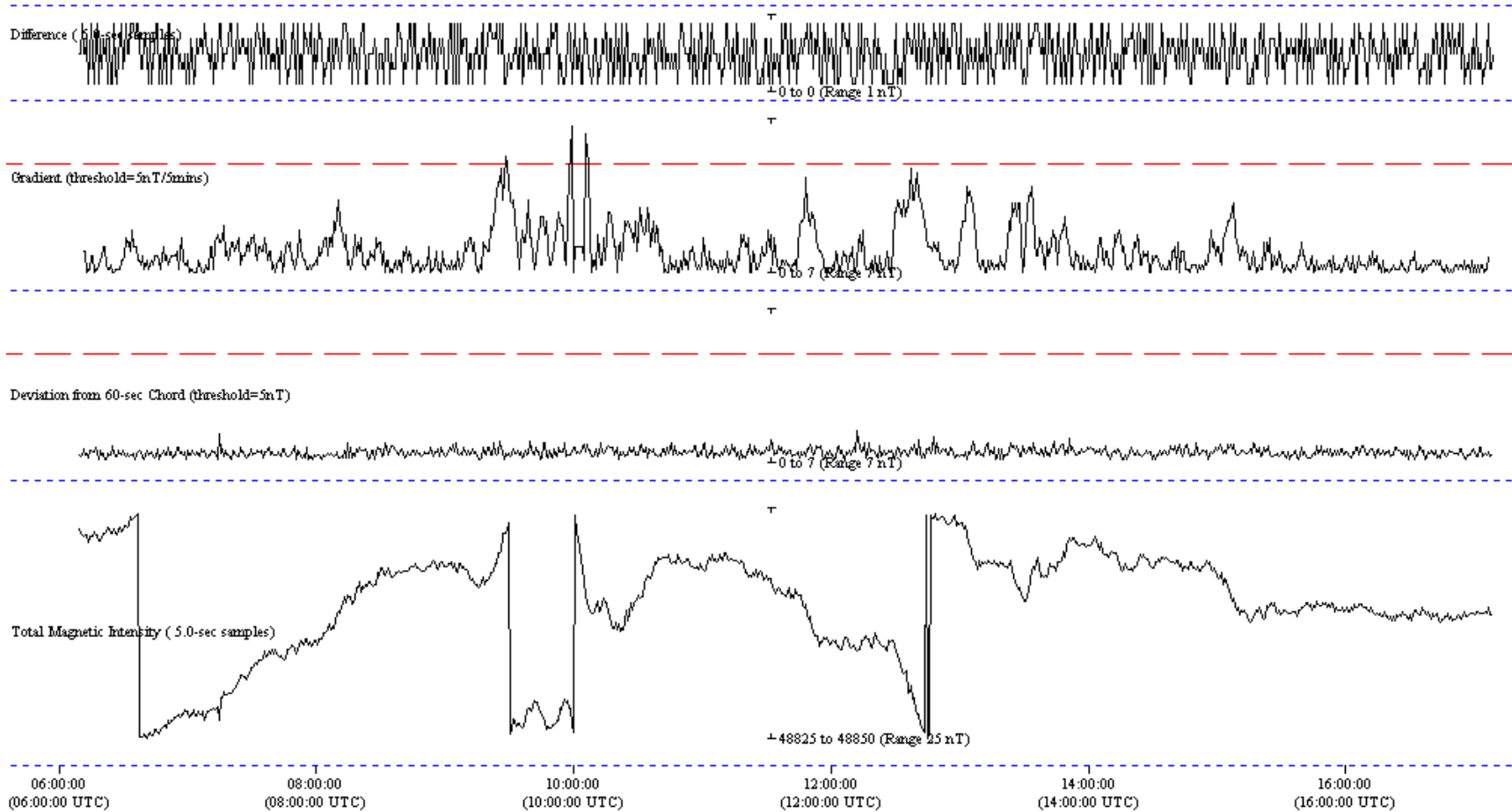
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 8, 2001 Waterloo Survey Julian Day 189**



**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 14, 2001 Waterloo Survey Julian Day 195**



**Operations & Processing Report**  
**WATERLOO.**

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**DIURNAL July 17, 2001 Waterloo Survey Julian Day 198**

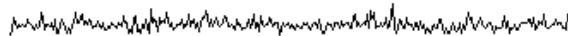
Difference ( 5.0-sec samples)



Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity ( 5.0-sec samples)

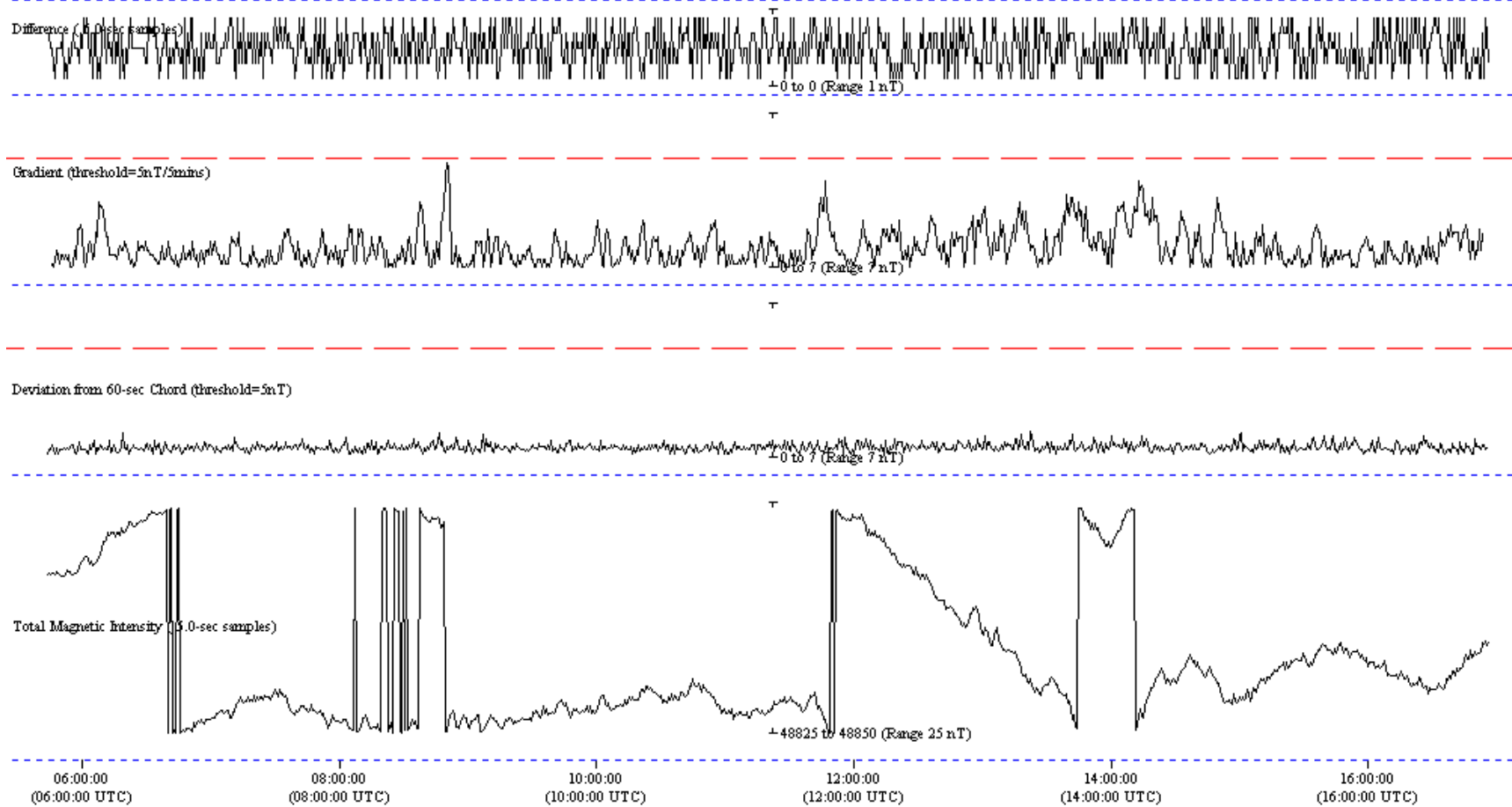


:00  
UTC)      14:00:00      16:00:00      18:00:00      20:00:00      22:00:00      00  
(14:00:00 UTC)      (16:00:00 UTC)      (18:00:00 UTC)      (20:00:00 UTC)      (22:00:00 UTC)      (00:00:00 UTC)



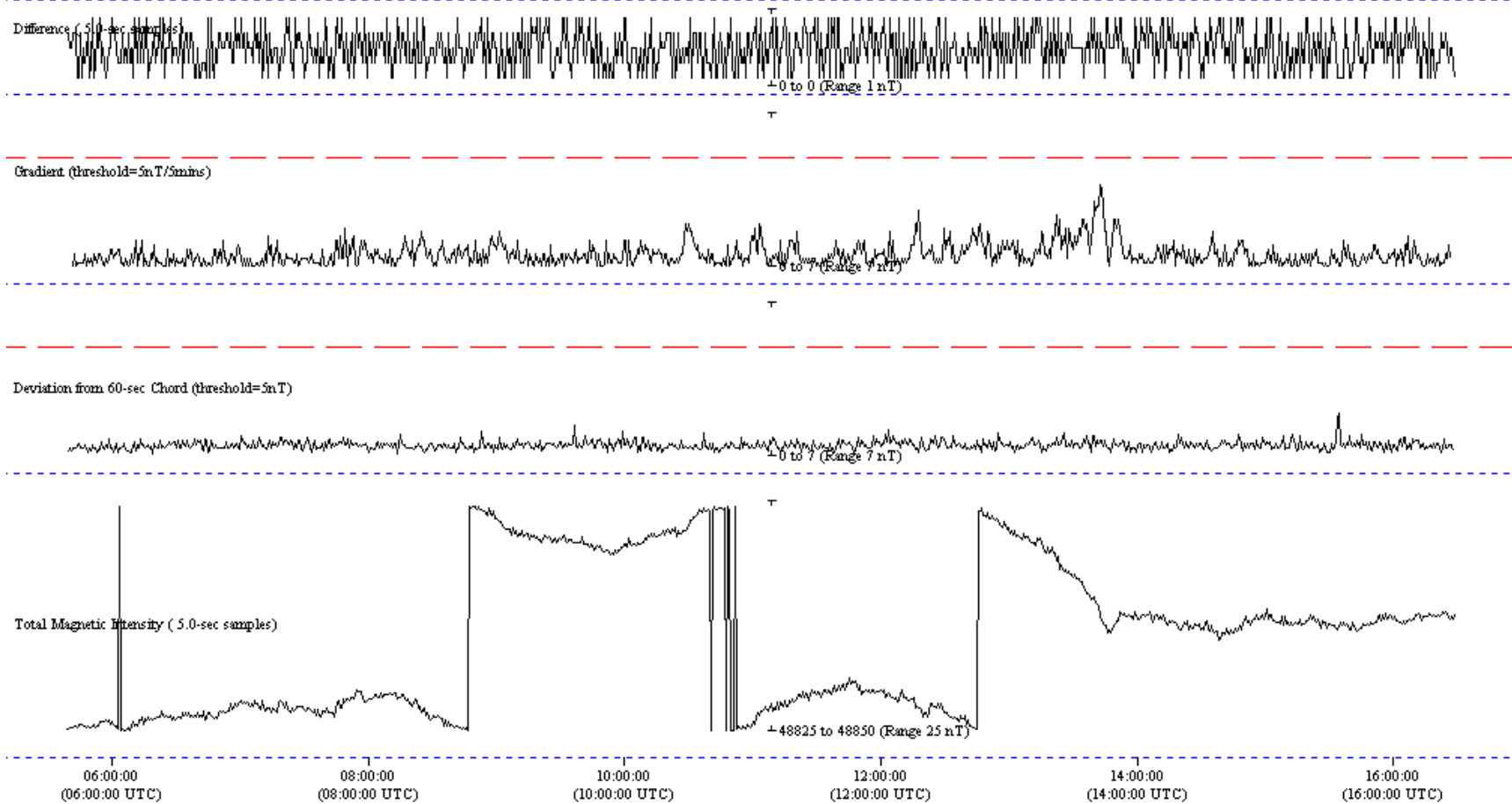
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 18, 2001 Waterloo Survey Julian Day 199**



**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 19, 2001 Waterloo Survey Julian Day 200**

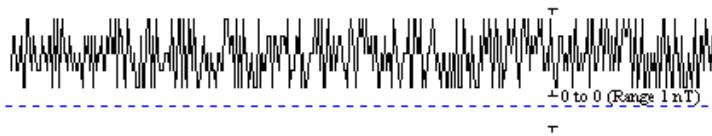


**Operations & Processing Report**  
**WATERLOO.**

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**DIURNAL July 20, 2001 Waterloo Survey Julian Day 201**

Difference (5.0-sec samples)



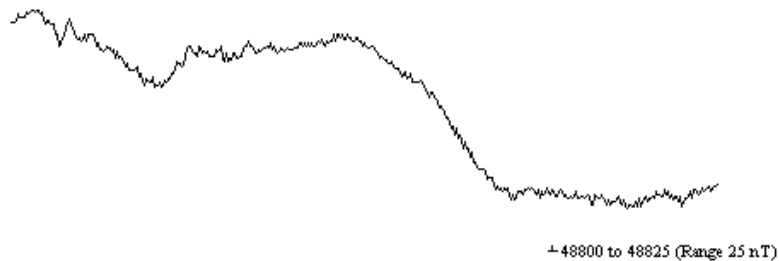
Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity (5.0-sec samples)



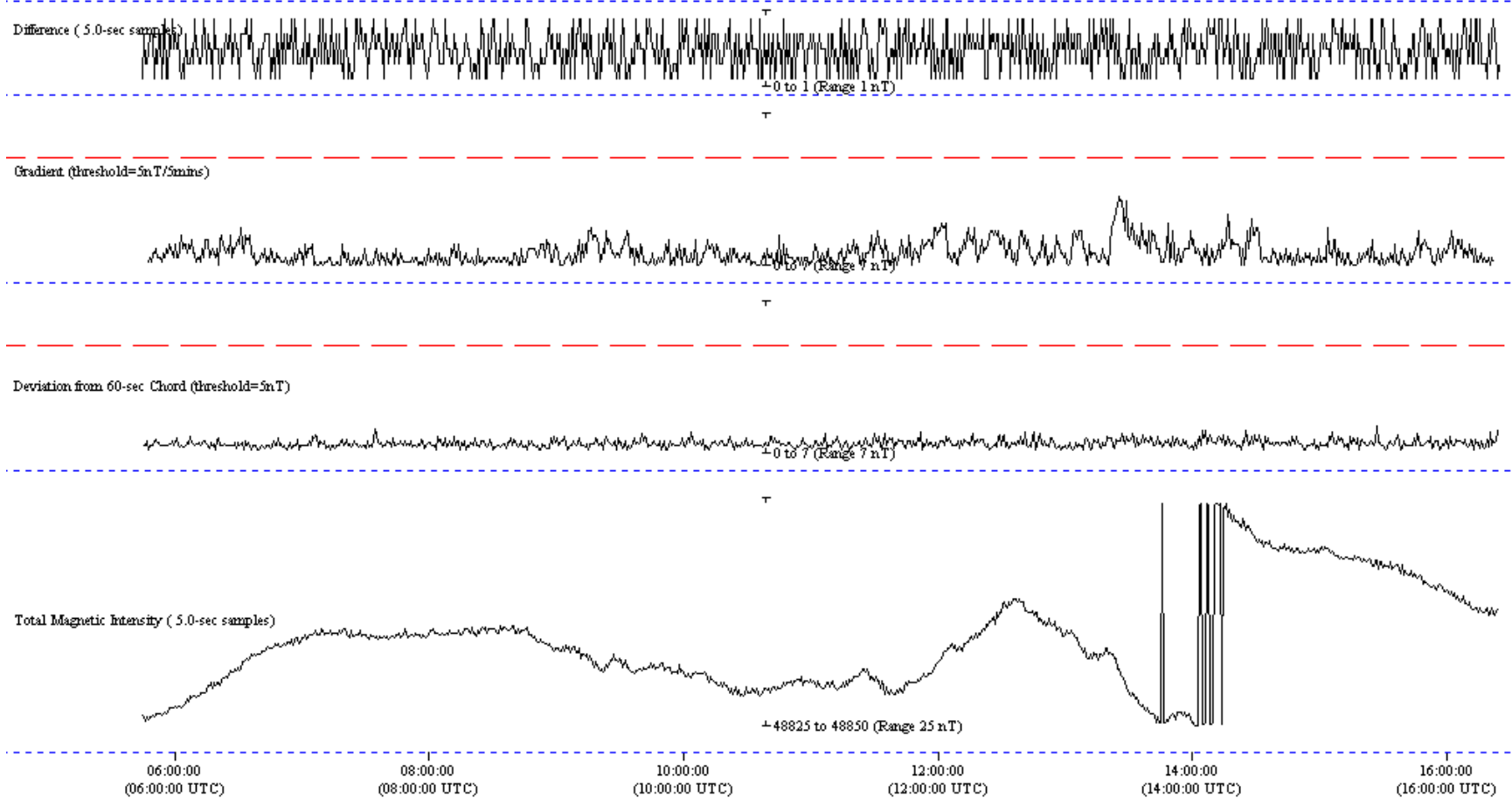
10:00:00 (10:00:00 UTC) 12:00:00 (12:00:00 UTC) 14:00:00 (14:00:00 UTC) 16:00:00 (16:00:00 UTC) 18:00:00 (18:00:00 UTC) 20:00:00 (20:00:00 UT)



**Operations & Processing Report**  
**WATERLOO.**

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**DIURNAL July 21, 2001 Waterloo Survey Julian Day 202**

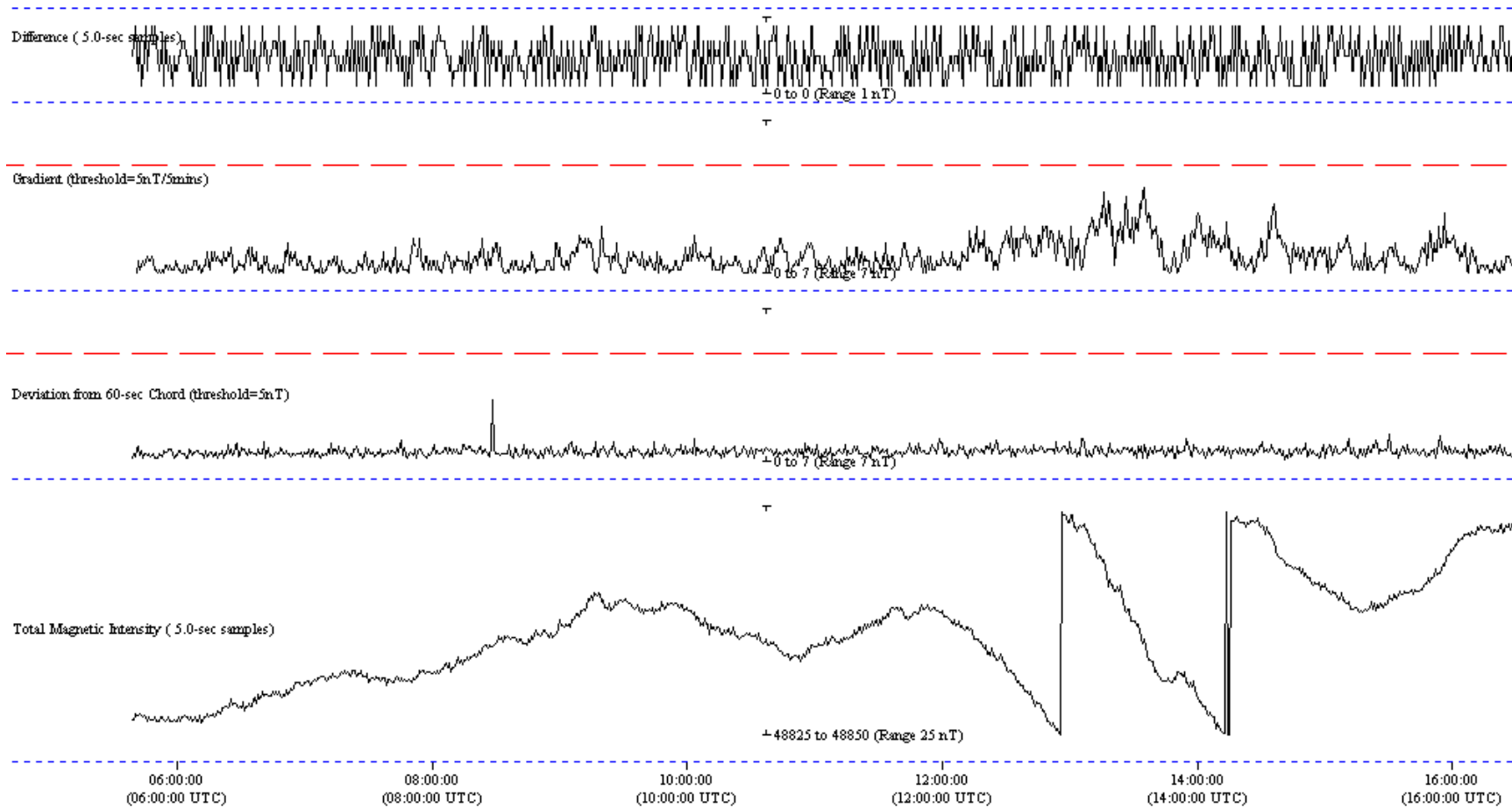




**Operations & Processing Report**  
**WATERLOO.**

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**DIURNAL July 22, 2001 Waterloo Survey Julian Day 203**



**Operations & Processing Report**  
**WATERLOO.**

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**DIURNAL July 23, 2001 Waterloo Survey Julian Day 204**

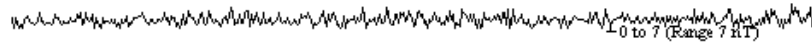
Difference (5.0-sec samples)



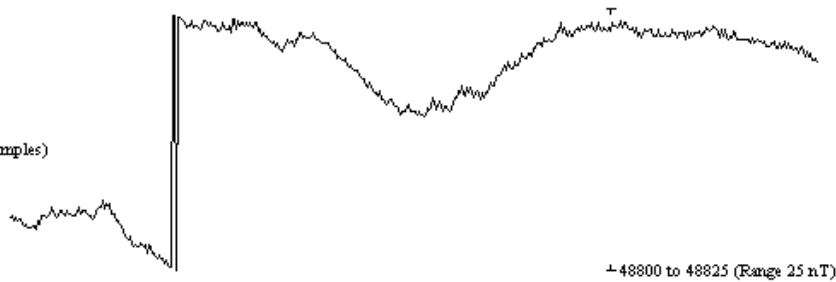
Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity (5.0-sec samples)



08:00:00  
(08:00:00 UTC)

10:00:00  
(10:00:00 UTC)

12:00:00  
(12:00:00 UTC)

14:00:00  
(14:00:00 UTC)

16:00:00  
(16:00:00 UTC)

18:00:00  
(18:00:00 UTC)

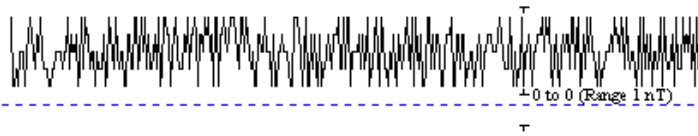


**Operations & Processing Report**  
**WATERLOO.**

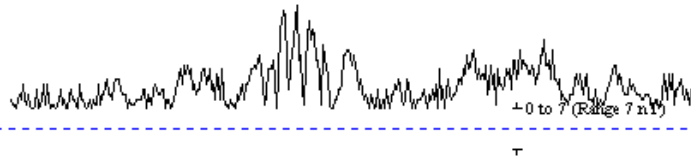
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**DIURNAL July 27, 2001 Waterloo Survey Julian Day 208**

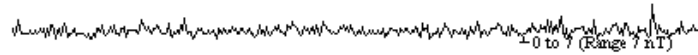
Difference ( 5.0-sec samples)



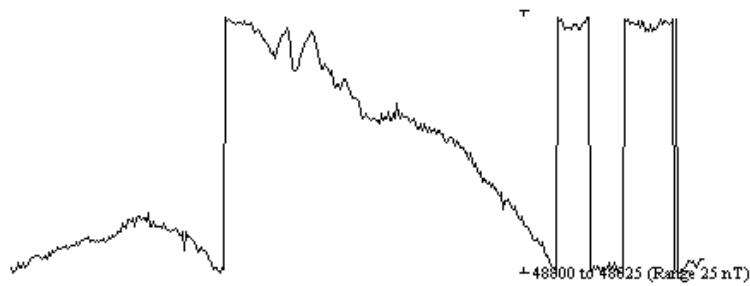
Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity ( 5.0-sec samples)



10:00:00  
0:00:00 UTC)

12:00:00  
(12:00:00 UTC)

14:00:00  
(14:00:00 UTC)

16:00:00  
(16:00:00 UTC)

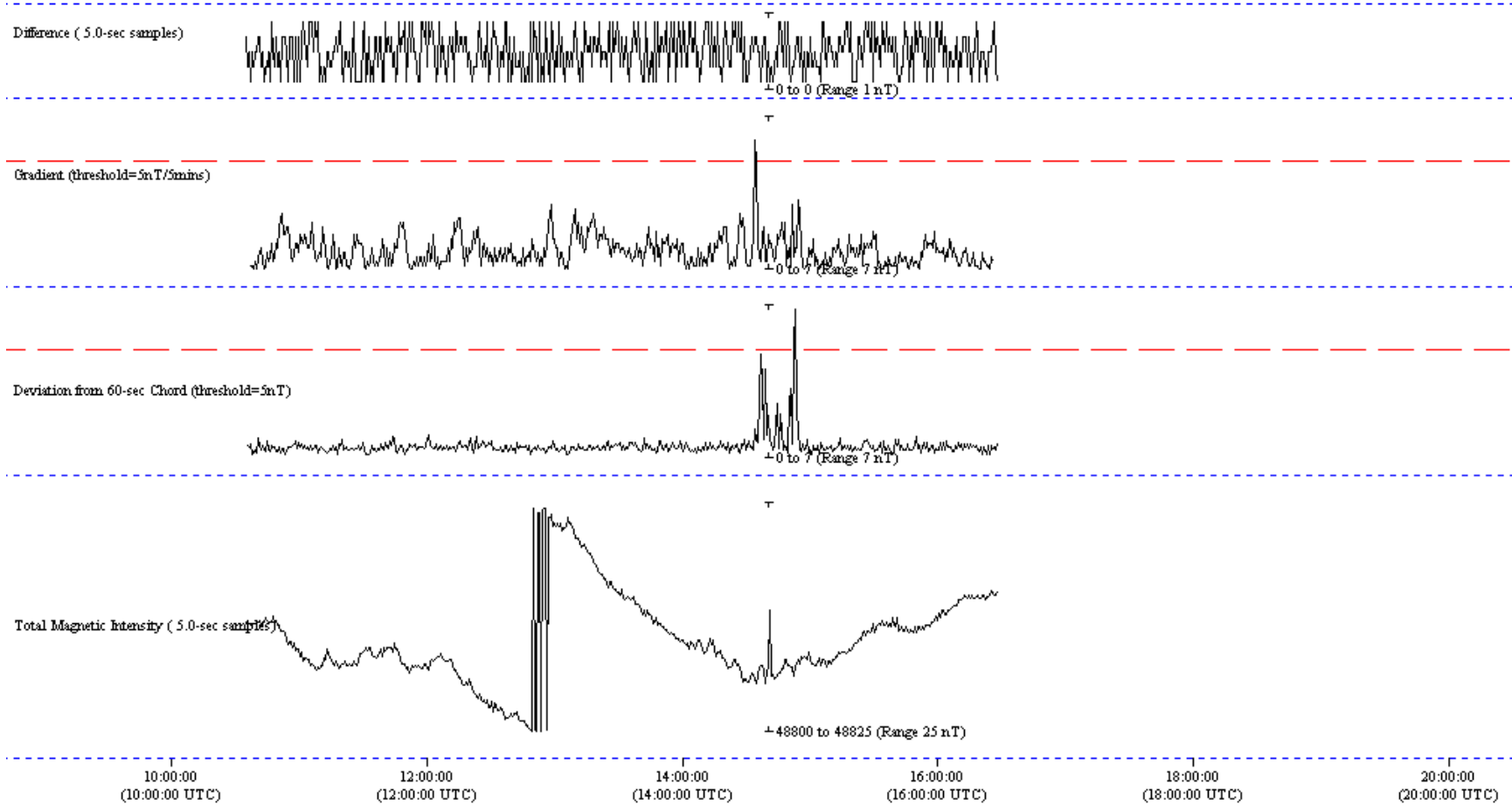
18:00:00  
(18:00:00 UTC)

20:00:00  
(20:00:00 UTC)



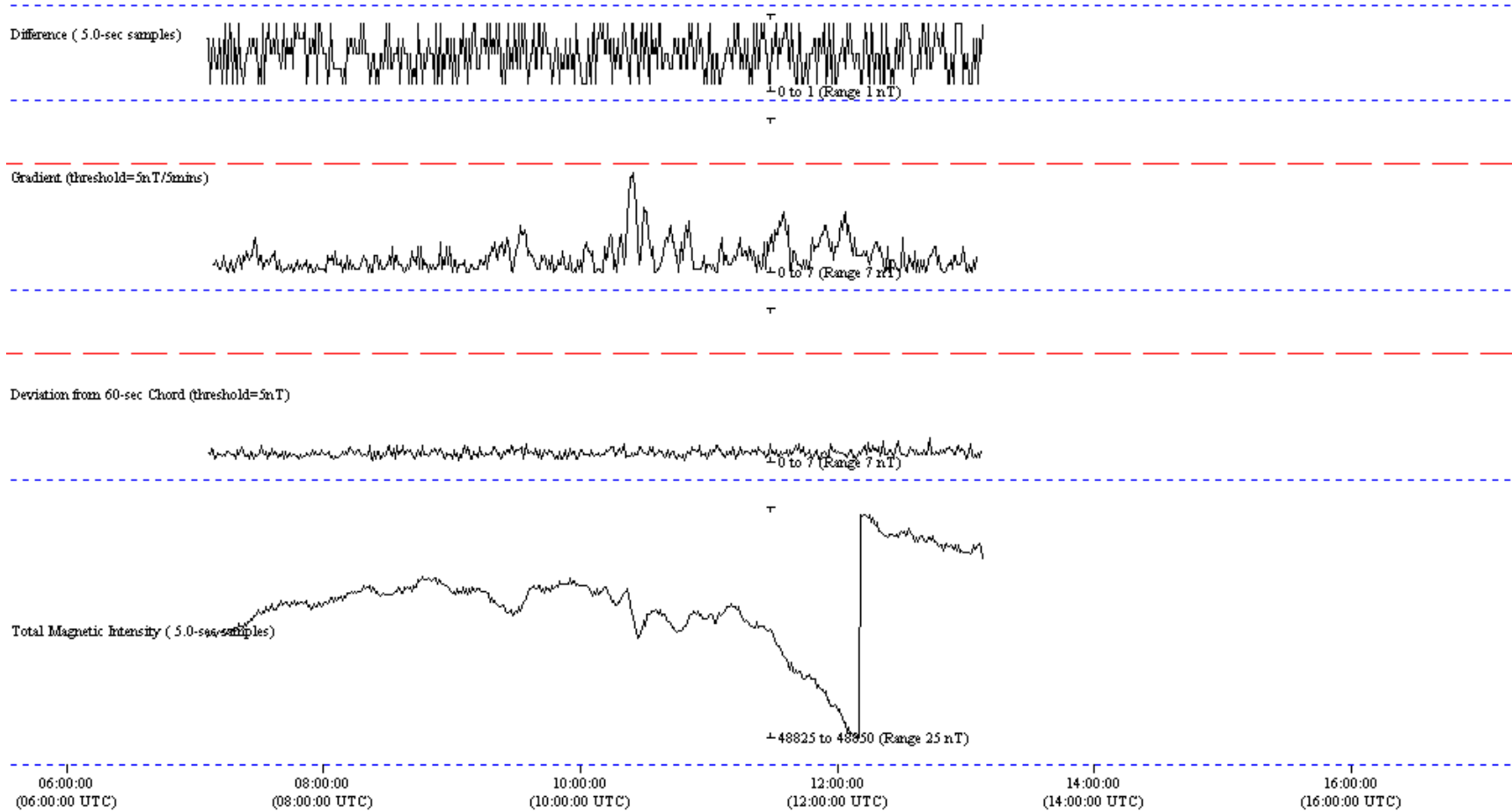
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 29, 2001 Waterloo Survey Julian Day 210**



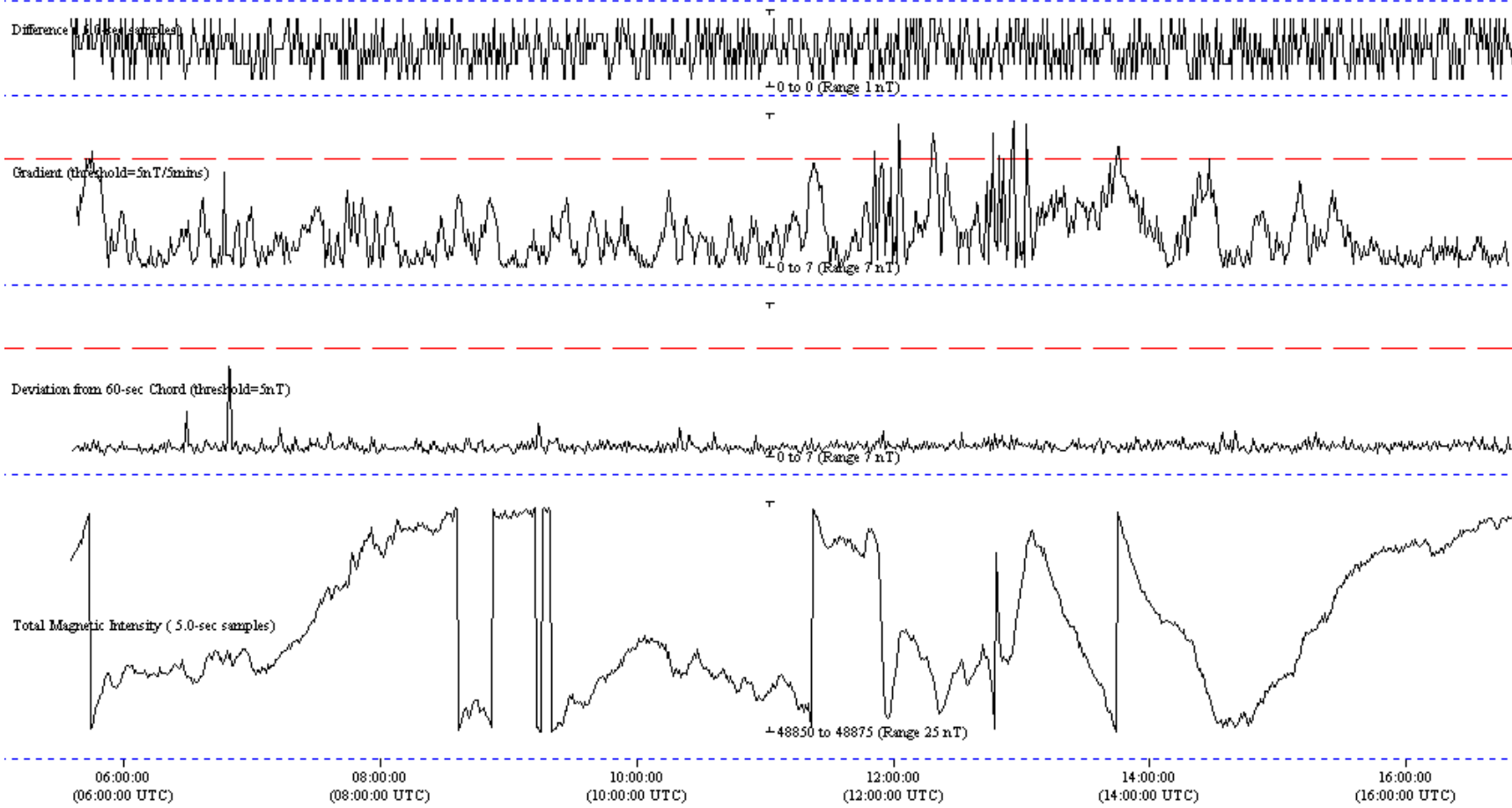
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 30, 2001 Waterloo Survey Julian Day 211**



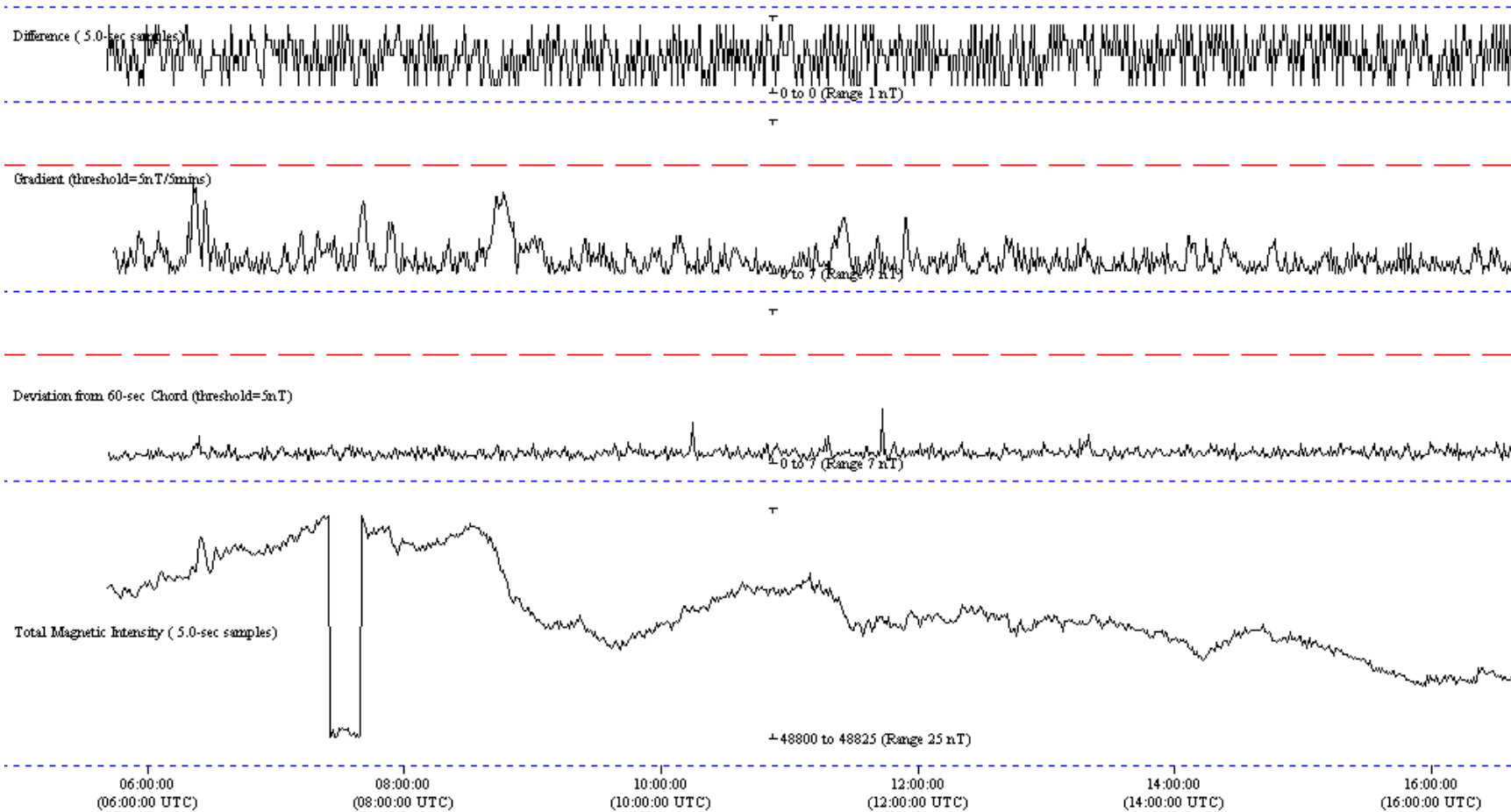
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL July 31, 2001 Waterloo Survey Julian Day 212**



**Operations & Processing Report**  
**WATERLOO.**

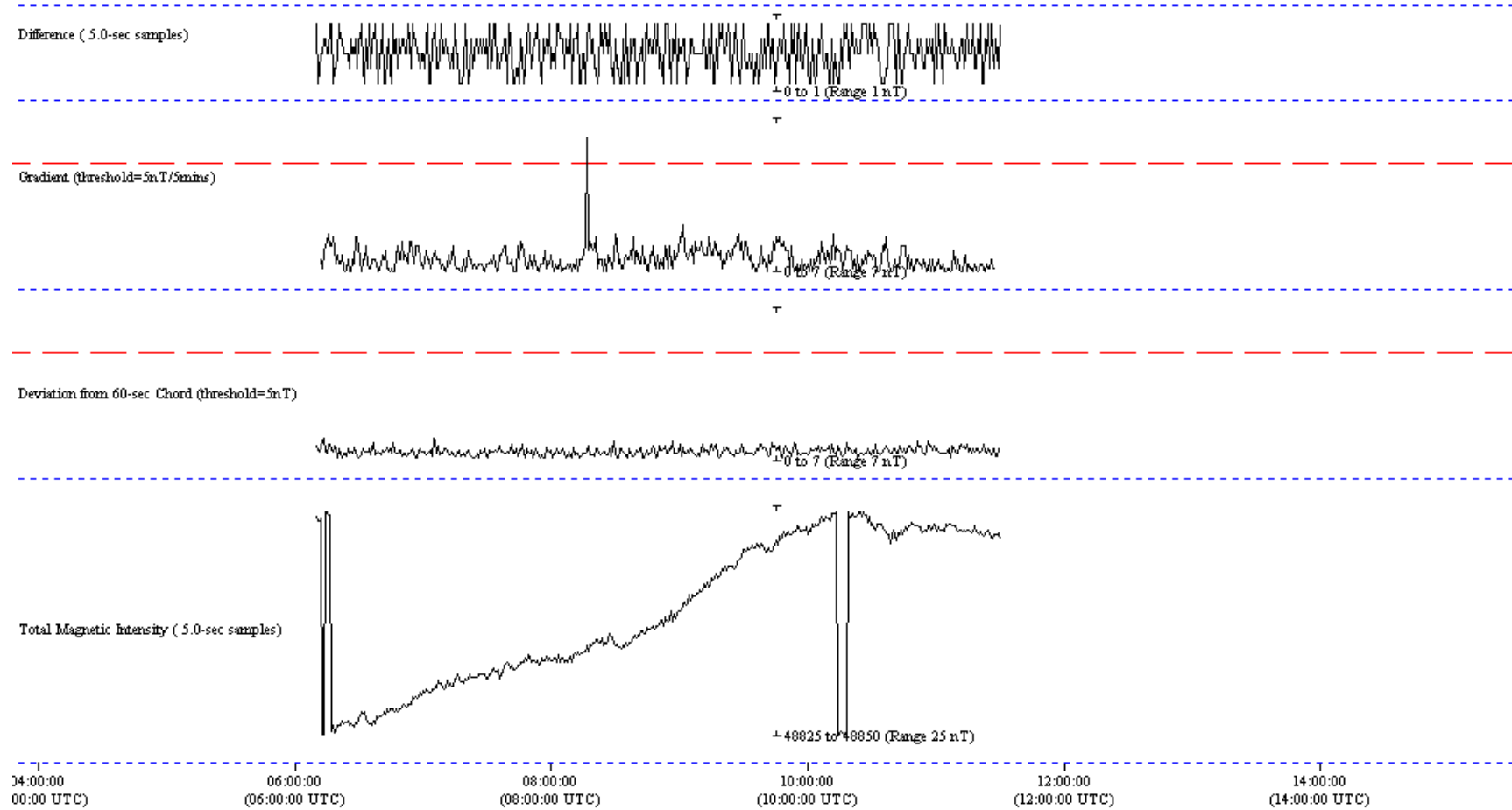
**DIURNAL August 1, 2001 Waterloo Survey Julian Day 213**



**Operations & Processing Report**  
**WATERLOO.**

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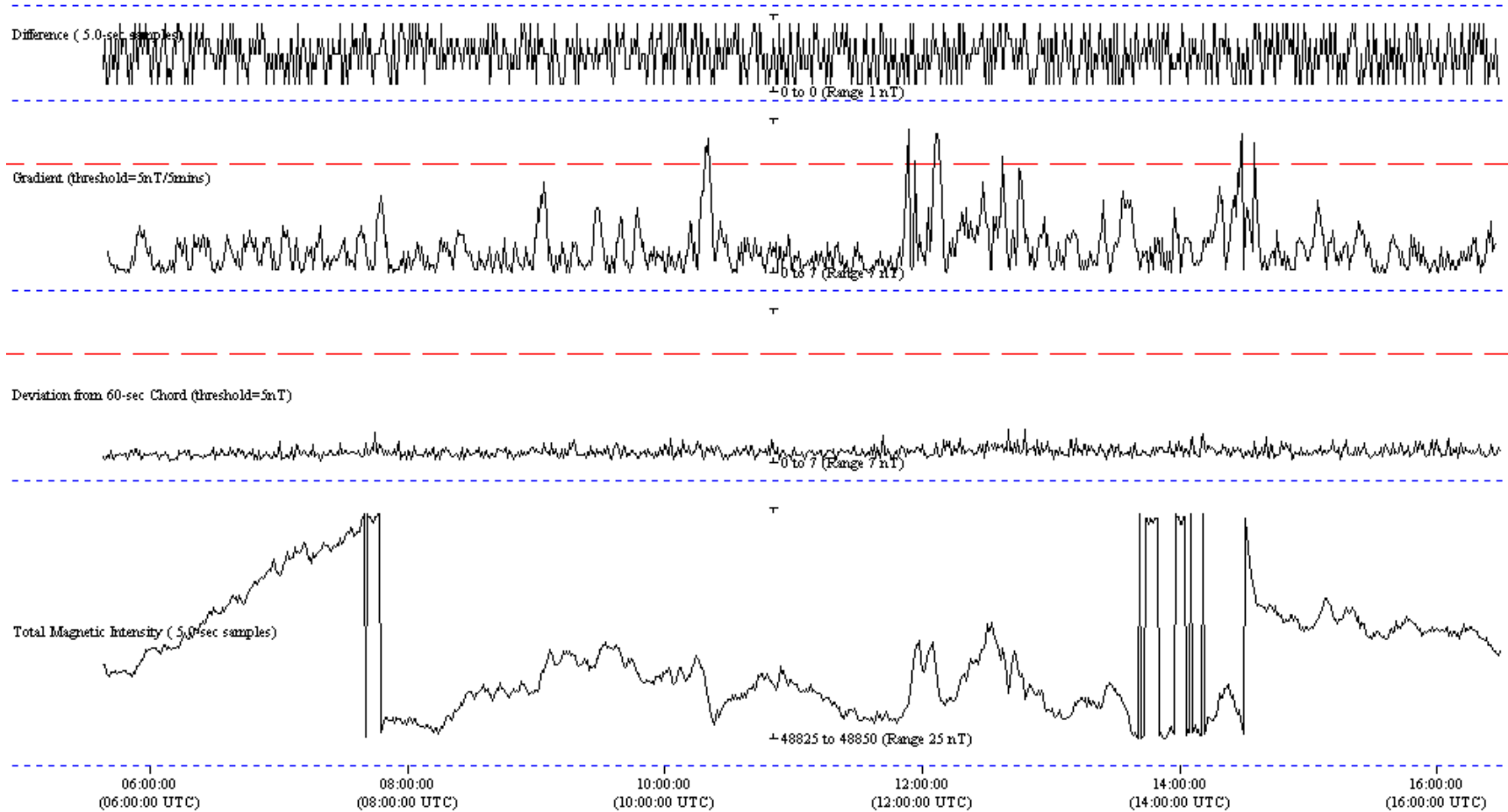
DIURNAL August 2, 2001 Waterloo Survey Julian Day 214





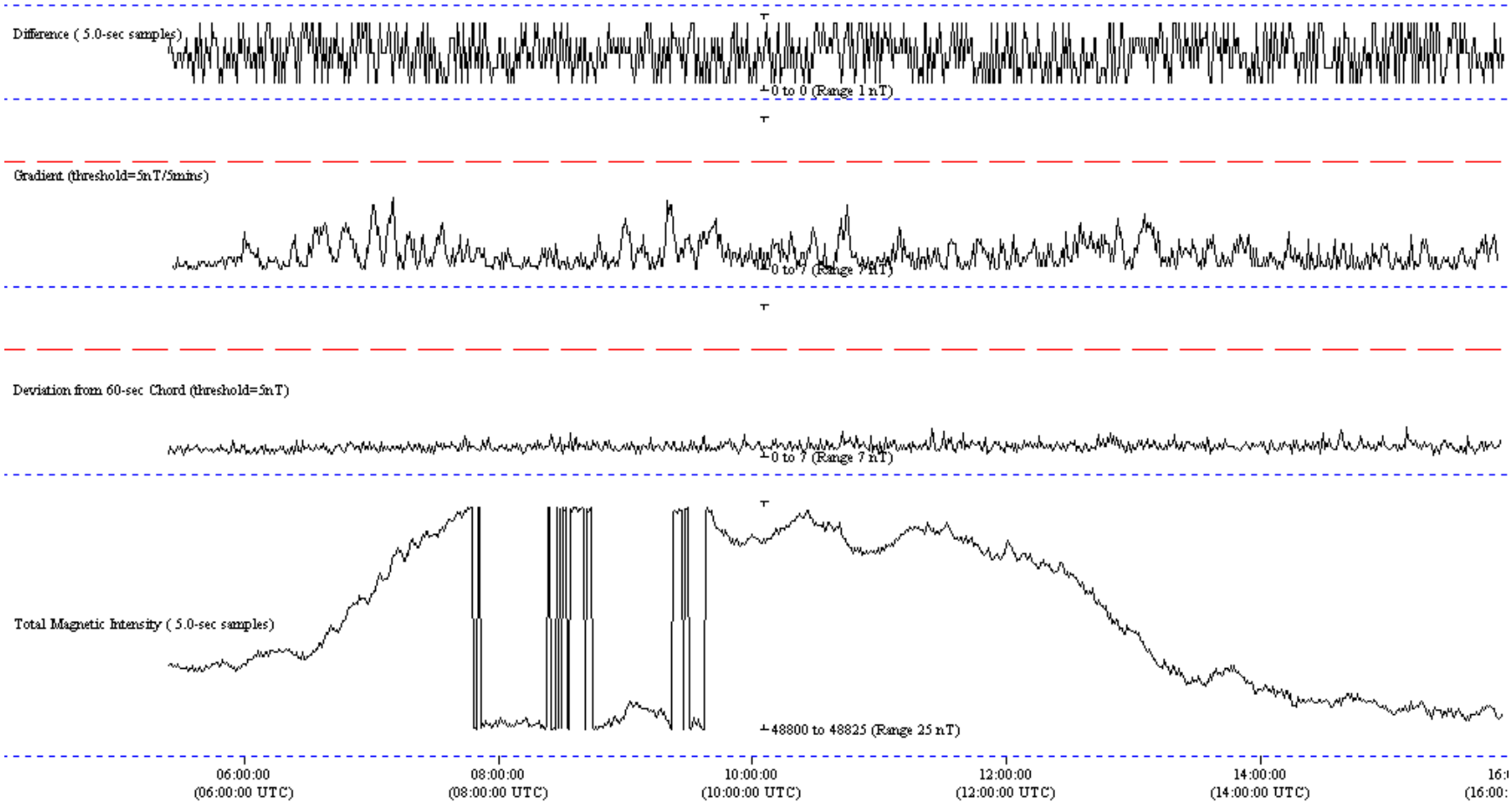
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 6, 2001 Waterloo Survey Julian Day 218**



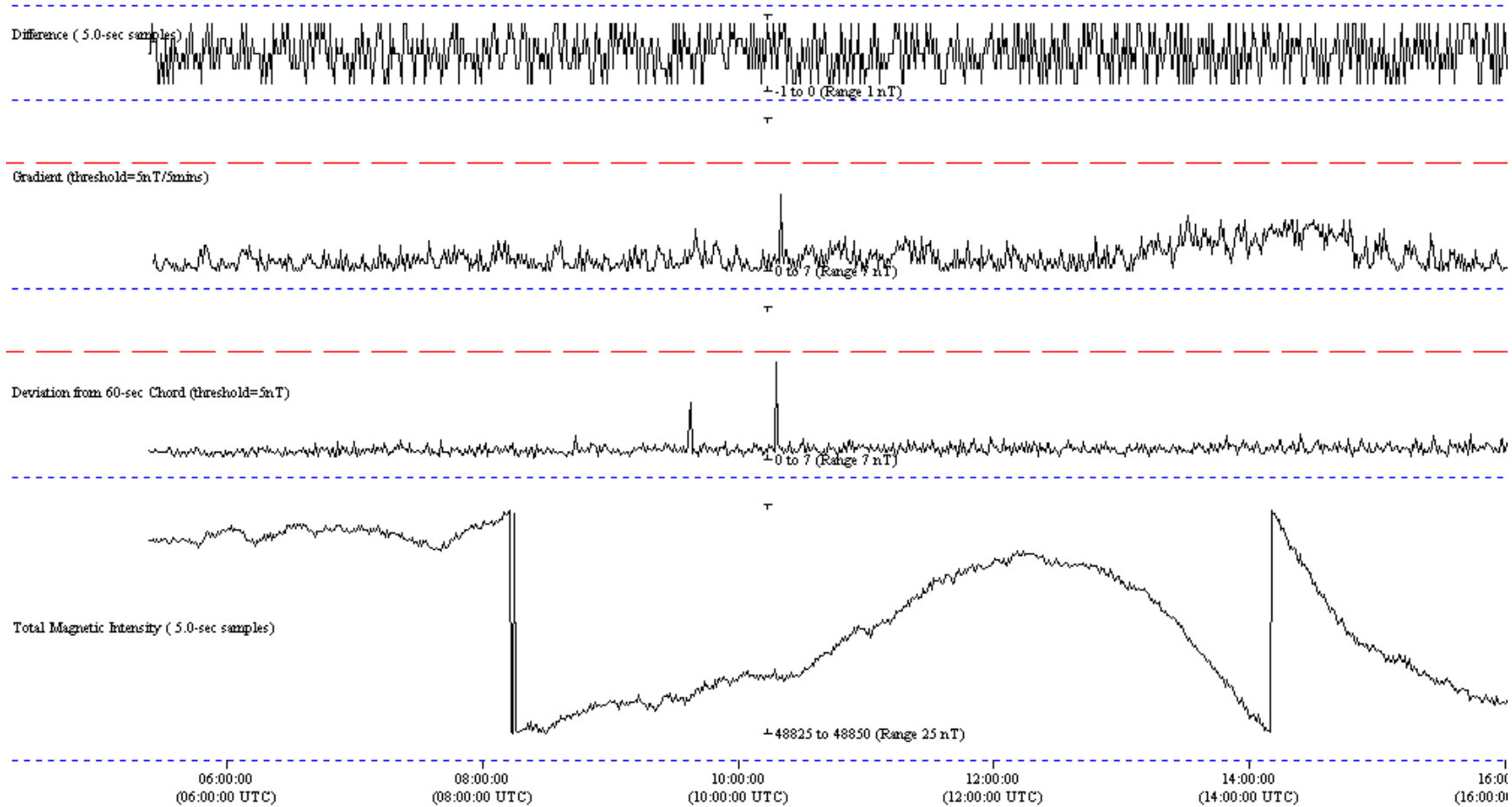
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 7, 2001 Waterloo Survey Julian Day 219**



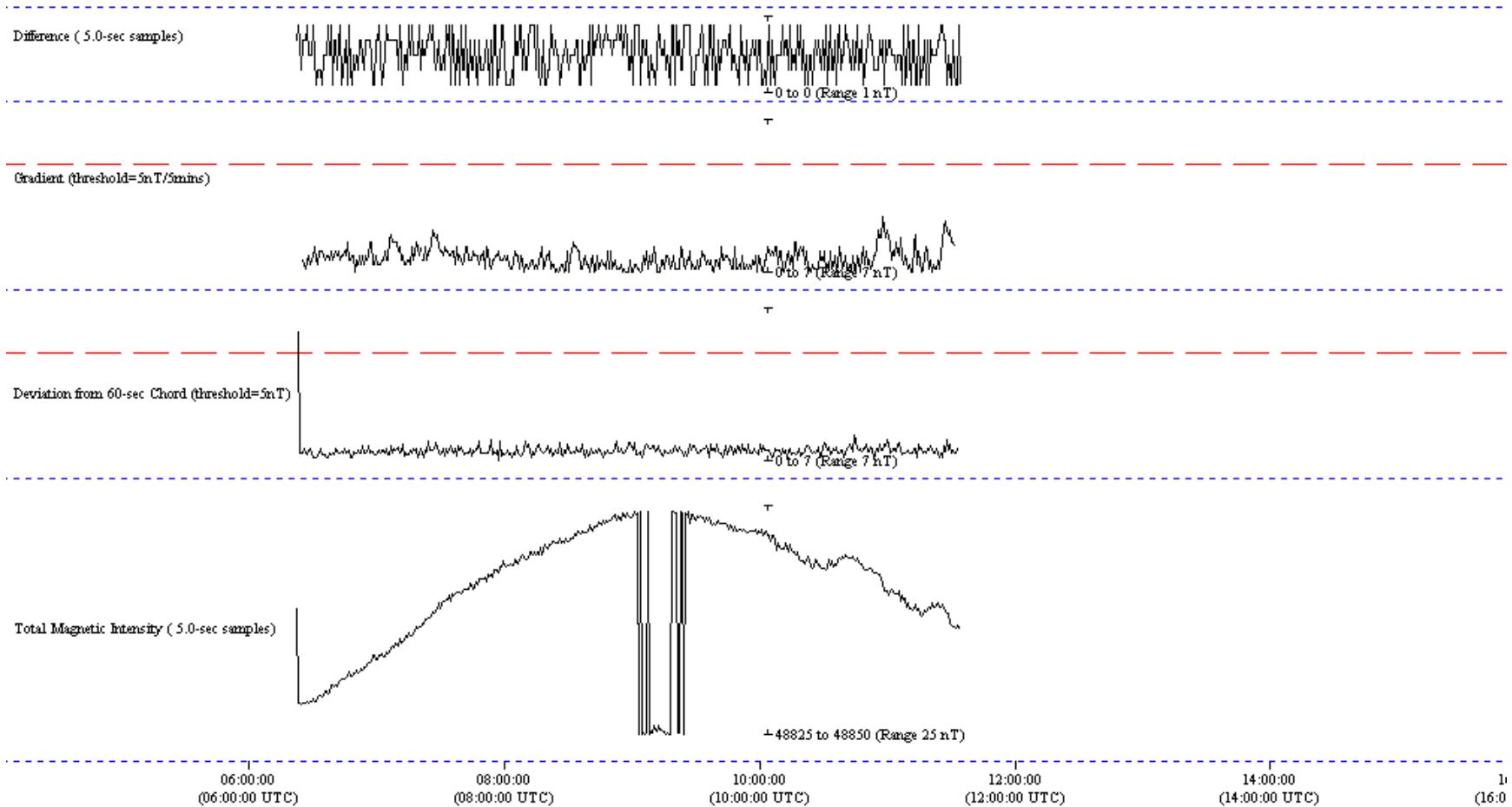
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 8, 2001 Waterloo Survey Julian Day 220**



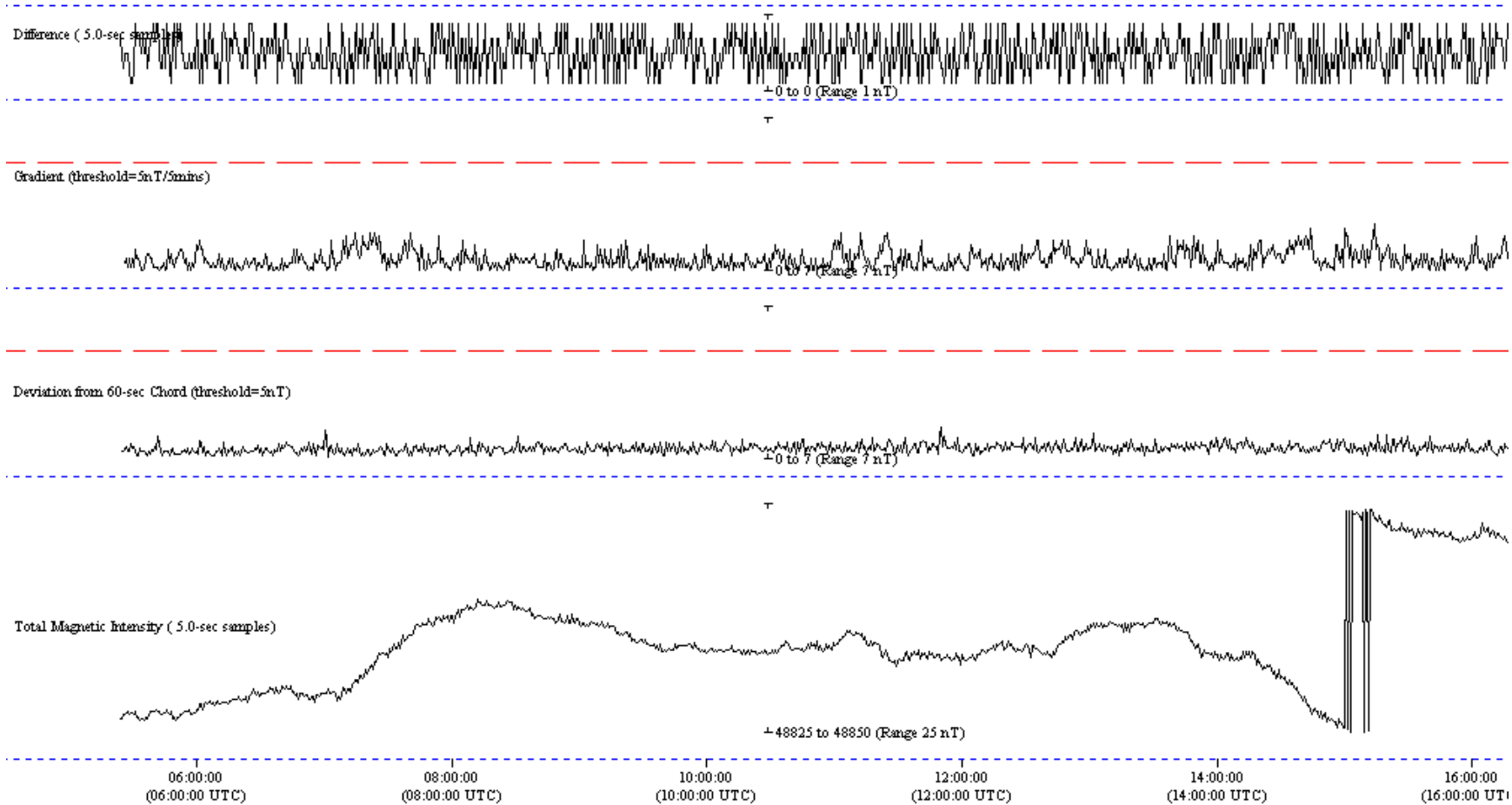
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 9, 2001 Waterloo Survey Julian Day 221**



**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 12, 2001 Waterloo Survey Julian Day 224**

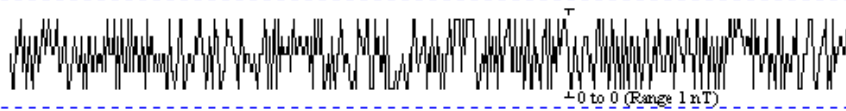


**Operations & Processing Report**  
**WATERLOO.**

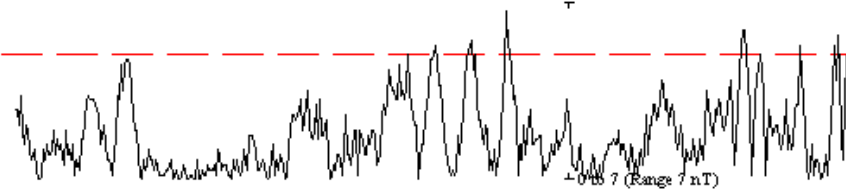
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**DIURNAL August 13, 2001 Waterloo Survey Julian Day 225**

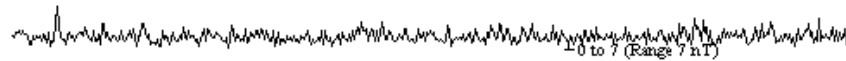
Difference ( 5.0-sec samples)



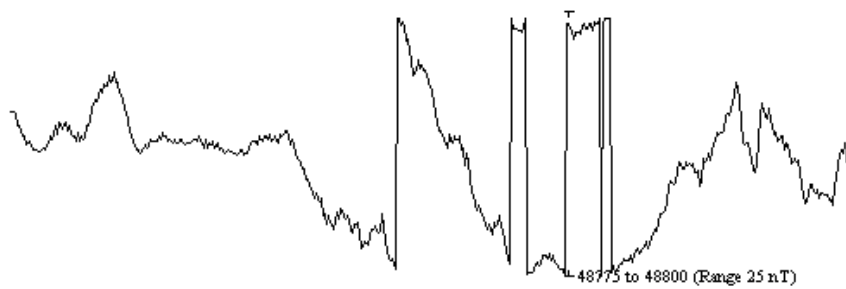
Gradient (threshold=5nT/5mins)



Deviation from 60-sec Chord (threshold=5nT)



Total Magnetic Intensity ( 5.0-sec samples)



08:00:00  
(08:00:00 UTC)

10:00:00  
(10:00:00 UTC)

12:00:00  
(12:00:00 UTC)

14:00:00  
(14:00:00 UTC)

16:00:00  
(16:00:00 UTC)

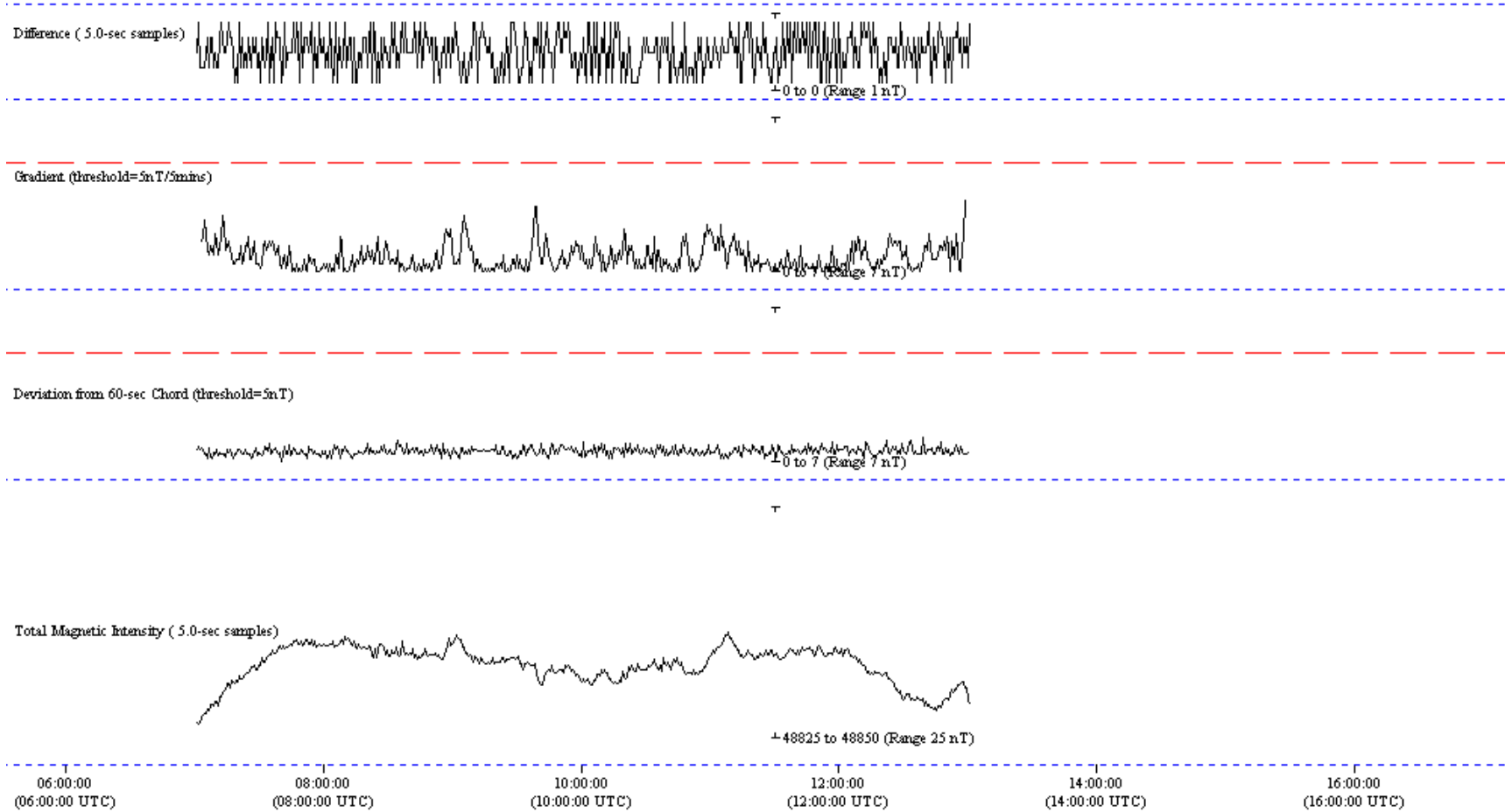
18:00:00  
(18:00:00 UTC)



**Operations & Processing Report**  
**WATERLOO.**

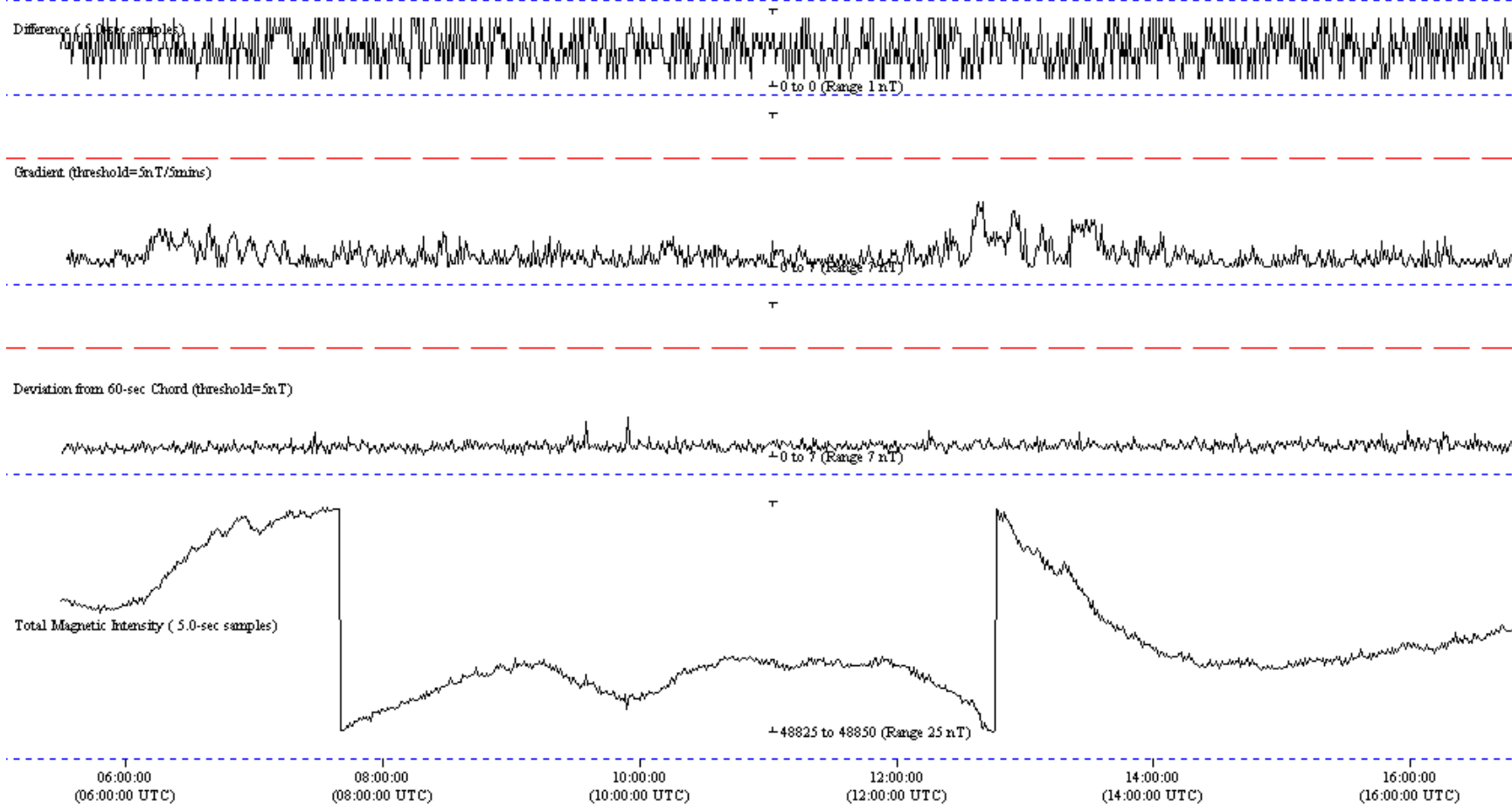
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**DIURNAL August 14, 2001 Waterloo Survey Julian Day 226**



**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 15, 2001 Waterloo Survey Julian Day 227**

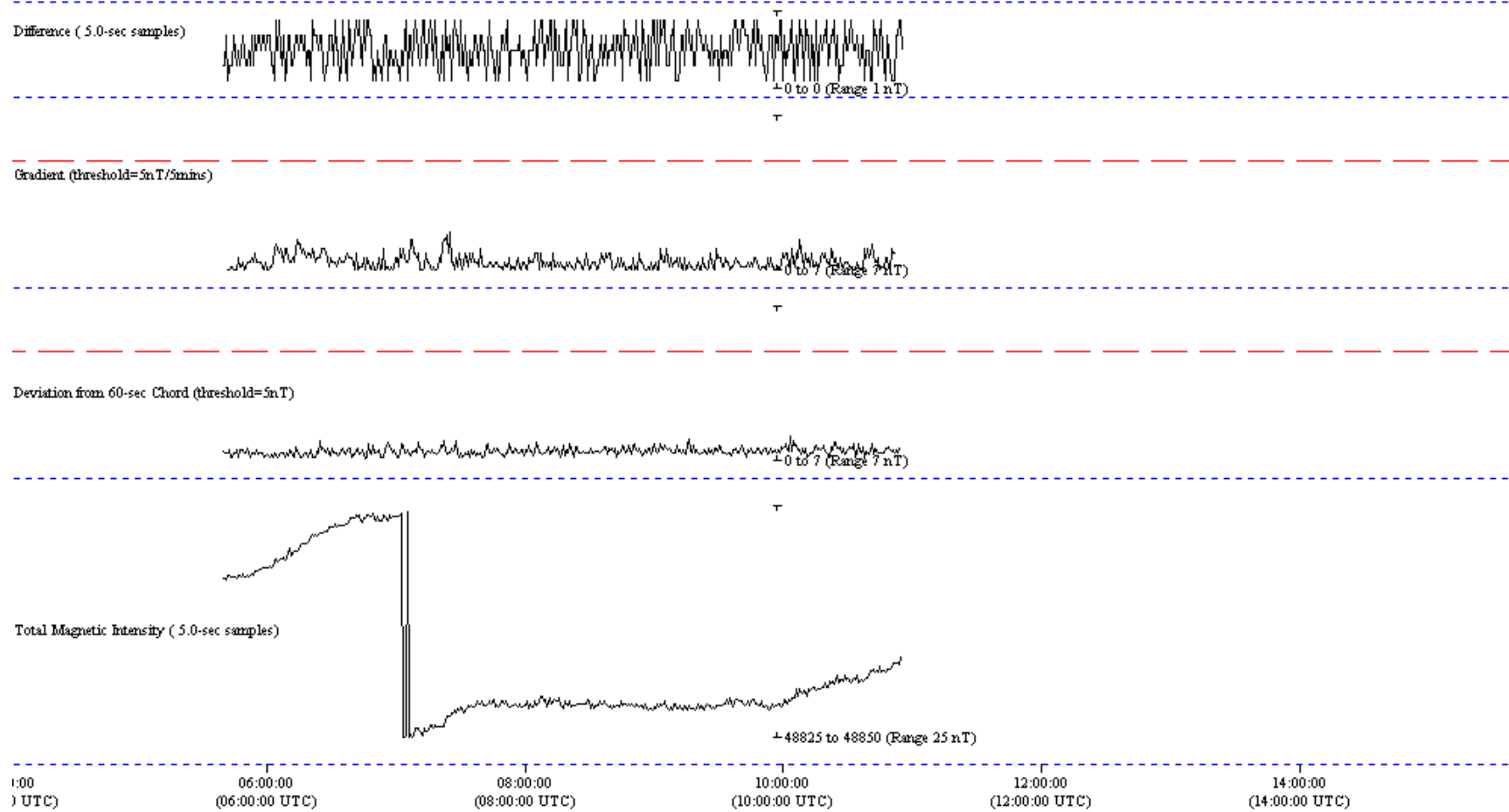




**Operations & Processing Report**  
**WATERLOO.**

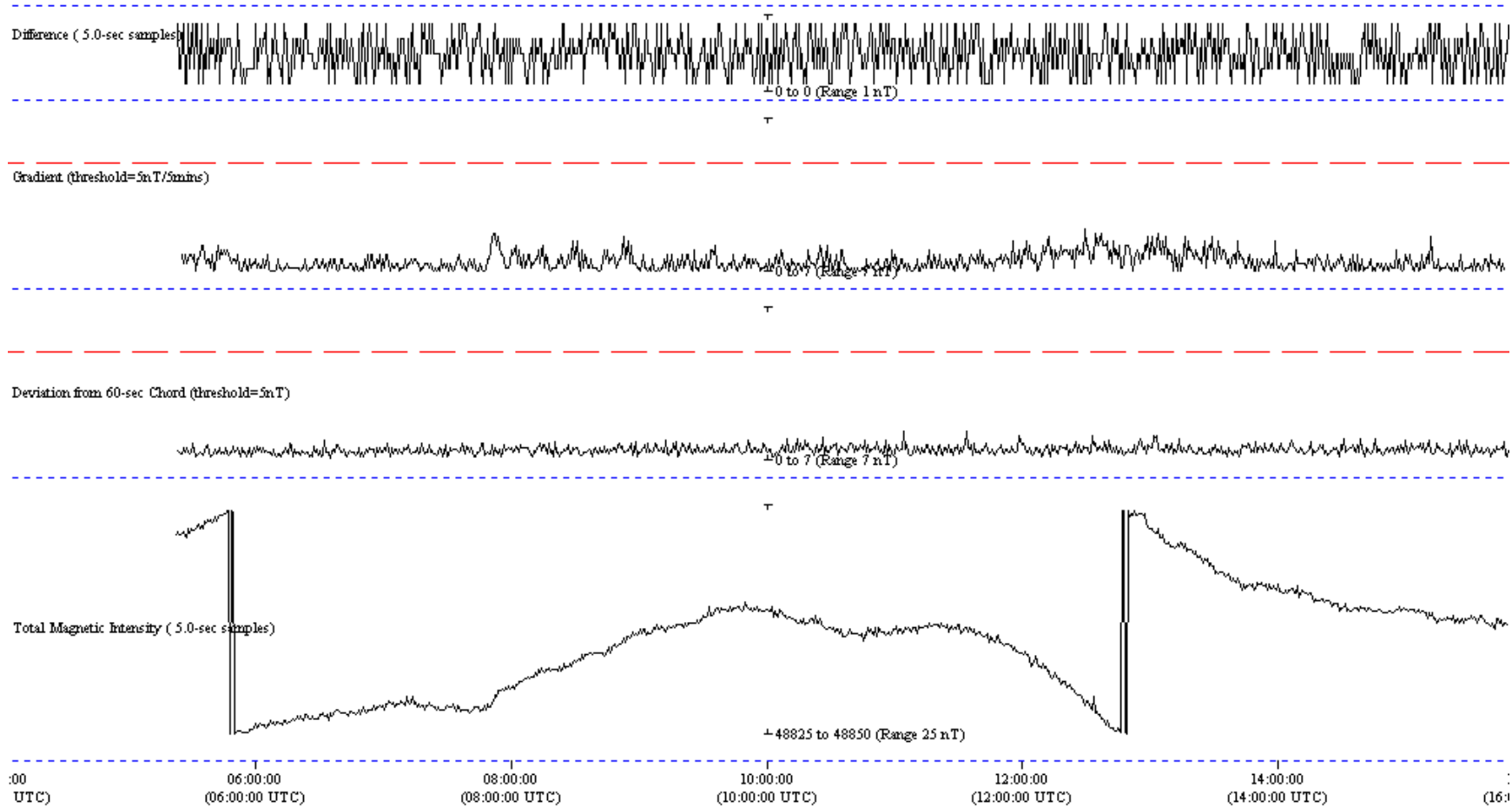
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**DIURNAL August 16, 2001 Waterloo Survey Julian Day 228**



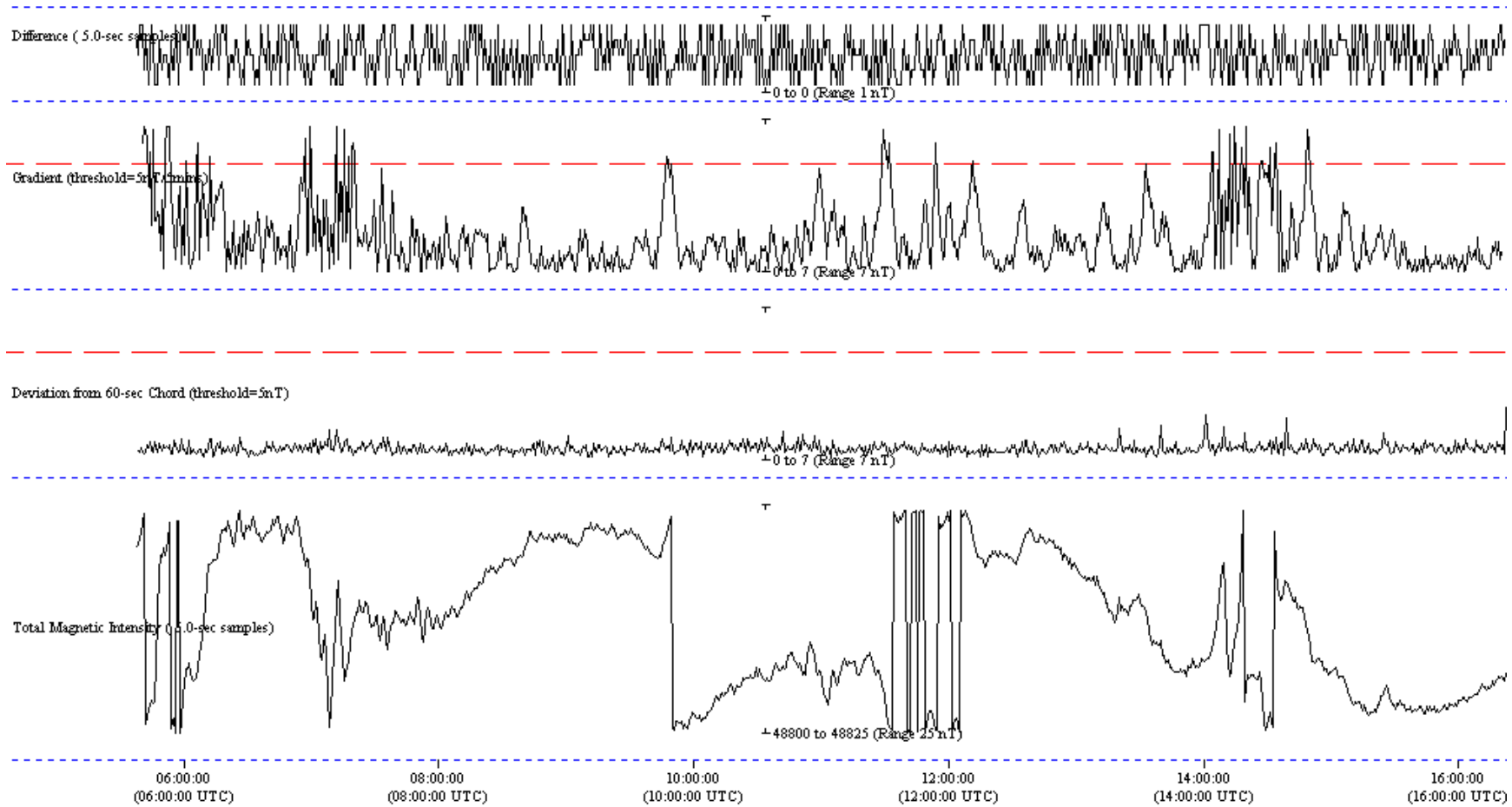
**Operations & Processing Report**  
**WATERLOO.**

**DIURNAL August 17, 2001 Waterloo Survey Julian Day 229**



**Operations & Processing Report**  
**WATERLOO.**

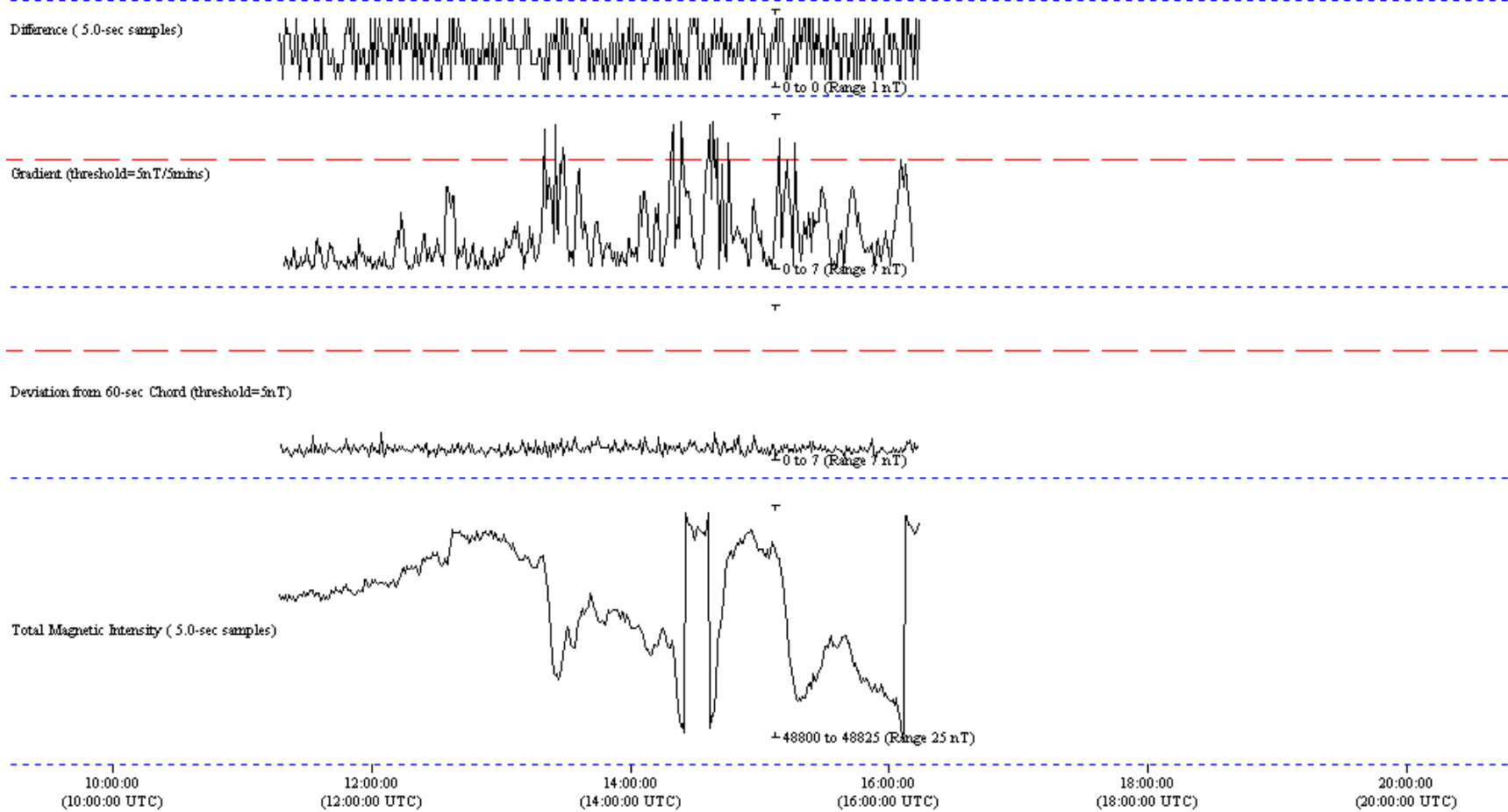
**DIURNAL August 18, 2001 Waterloo Survey Julian Day 230**



**Operations & Processing Report**  
**WATERLOO.**

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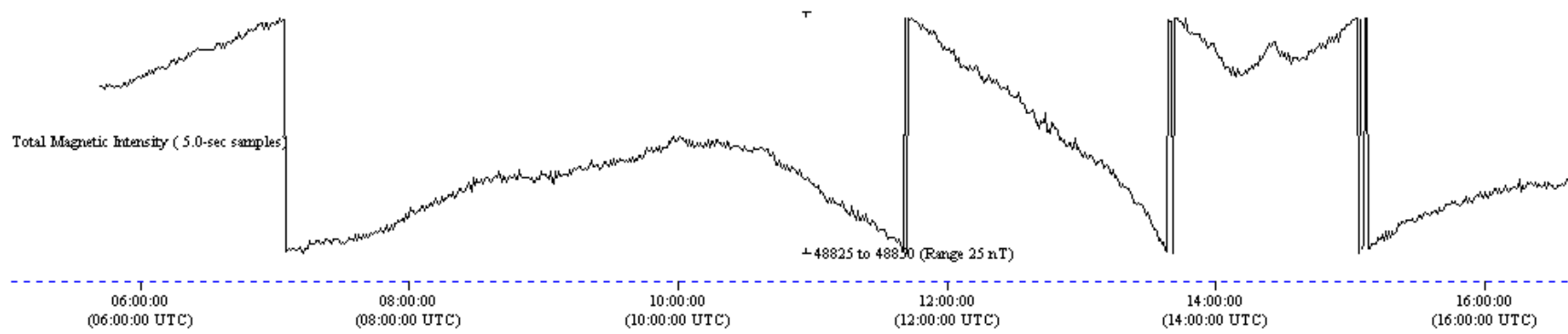
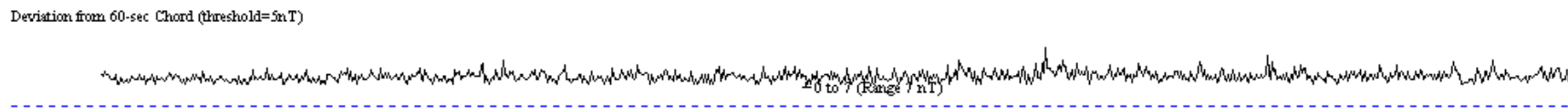
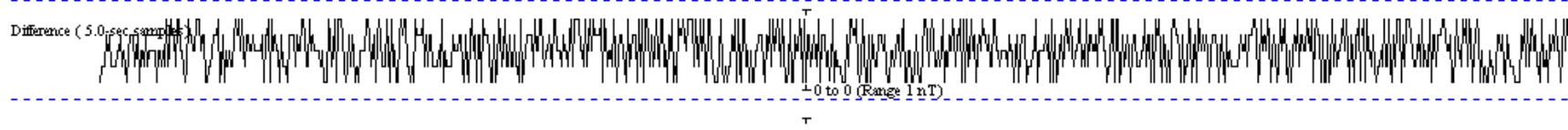
**DIURNAL August 19, 2001 Waterloo Survey Julian Day 231**



**Operations & Processing Report**  
**WATERLOO.**

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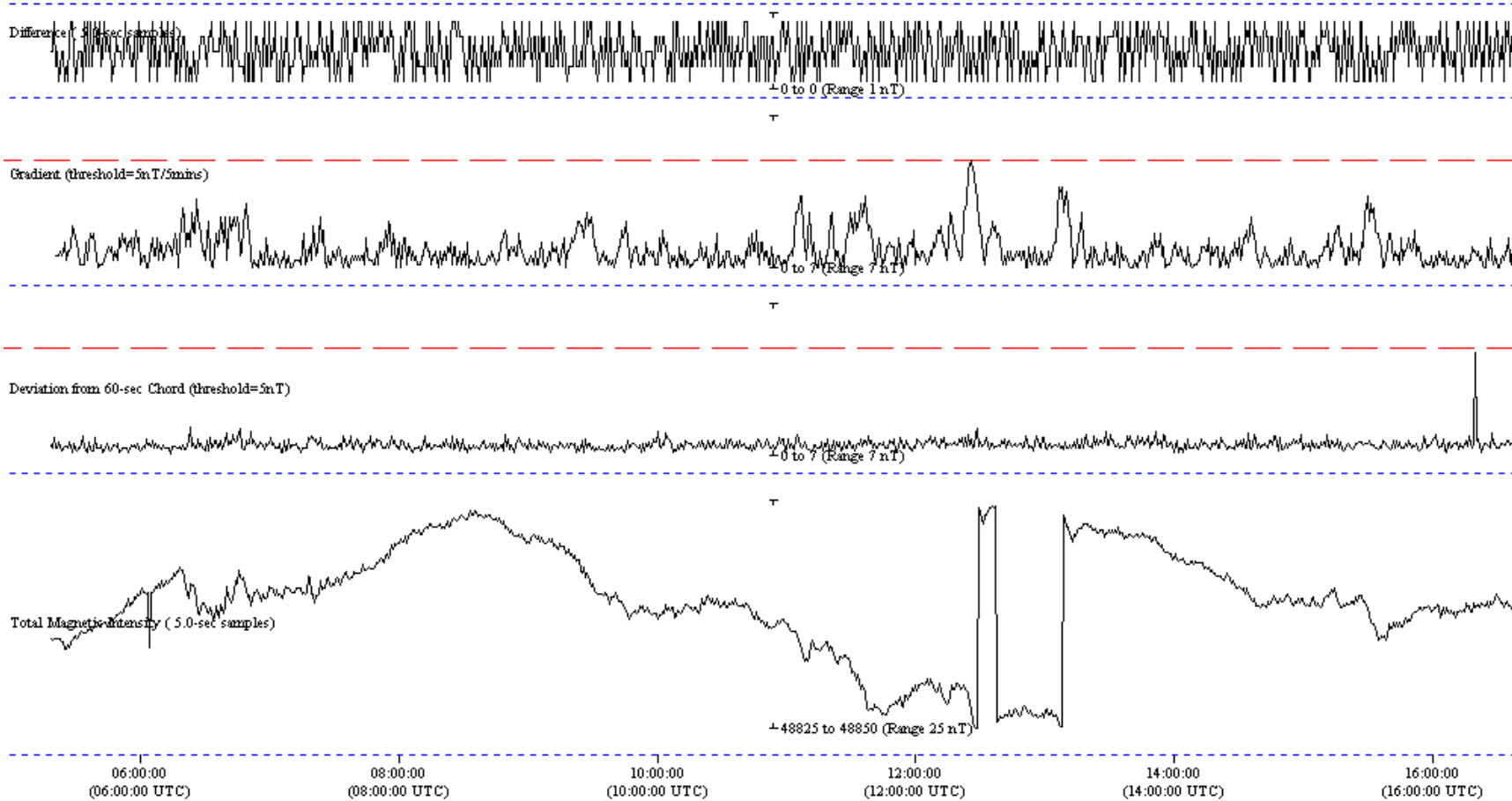
**DIURNAL August 20, 2001 Waterloo Survey Julian Day 232**



**Operations & Processing Report**  
**WATERLOO.**

---

DIURNAL August 21, 2001 Waterloo Survey Julian Day 233



# APPENDIX 6

## Radiometric Calibrations

# APPENDIX 7

## Digital Data Formats



**WATERLOO MAGNETICS DATA DESCRIPTION FILE**

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Survey Name: Waterloo  
Survey Date: July 2001  
Airborne Contractor: Kevron Geophysics  
Contractor Job Number: 1592  
Processing Contractor: Kevron Geophysics  
Client: Department of Mines and Energy Northern Territory

1:250 000 sheets flown in Located Data File:

Waterloo SE52-3  
Auvergne SD52-15

1:100 000 sheets flown in Located Data File:

Keep 4766  
Pinkerton 4866  
Newry 4765  
Kildurk 4865  
Baines 4965  
Waterloo 4764  
Kimon 4864  
Wickham River 4964

Flight Line Number Range of Located Data File: 10010 - 16030  
Tie Line Number Range of Located Data File: 90010 - 90480

**SURVEY SPECIFICATIONS:**

Flight Line Direction: North-South  
Flight Line Separation (m): 400 metres  
Tie Line Direction: East-West  
Tie Line Separation (m): 4000 metres  
Nominal Terrain Clearance (m AGL): 80 metres  
Average Terrain Clearance (m ASL): 80 metres  
Total Line km: 54,662  
Projection: MGA  
Datum: GDA94  
Zone: 52

**SURVEY EQUIPMENT:**

Aircraft: Rockwell Aerocommander 500S VH-EXS  
Magnetometer: Geometrics G-822A Cesium Vapour  
Magnetometer Resolution (nT): 0.001  
Magnetometer Compensation: RMS AADCII operating in real time  
Magnetometer Sample Rate (s): 0.1  
Magnetometer Sample Interval (m): approx 7.0 metres  
Base Station Magnetometer: Geometrics G856  
Base Station Magnetometer Resolution: .1 nT  
Base Station Magnetometer Sample Rate: 5 sec  
Base Station Magnetometer Location(s): Kununurra Airport  
Aprox: -15 46.7 128 42.4  
Data Acquisition System: RMS DAS8  
Flight Path Navigation System: GPS  
Navigation Equipment: Fugro Omnistar and Ashtech G12 GPS  
GPS Base Station Location(s): Differential corrections via Fugro Omnistar VB(Virtual Base Station)  
Radar Altimeter: Sperry AA200



**DATA PROCESSING:**

**MAGNETIC DATA:**

Data are corrected for diurnal variation, and International Geometric Reference Field IGRF 2000 updated to 2001.5 secular variation removed. Tie line and micro levelling has been performed.

The Reduced To Pole (RTP) grid was calculated using a magnetic inclination of -47.1 deg and magnetic declination of 3.8 deg. These values correspond to the following location: latitude -16.22490 deg S, longitude 129.83275 deg E, elevation 500 metres.

**ELEVATION DATA:**

Elevation was calculated by subtraction of the radar altimetre from the gps height.

Tie line and micro levelling has been performed.

AUSGEOID 98 nval geoid ellipsoid separation values subtracted to achieve AHD.

**LOCATED DATA FORMAT:**

Variable	Units	Col number	Width	Format	Null
LineName		[ 1]	12	%12.12s	'-'
LineDate		[ 2]	8	%8.8s	'-'
Flight number		[ 3]	4	%3.0f	'-99'
Time (CST)	hours	[ 4]	9	%8.5f	'-9999999'
Fiducial		[ 5]	10	%9.0f	'-9999999'
Easting	metres	[ 6]	11	%10.2f	'-9999999.0'
Northing	metres	[ 7]	11	%10.2f	'-9999999.0'
Raw Magnetics	nT	[ 8]	10	%9.2f	'-9999999.'
Diurnal	nT	[ 9]	10	%9.2f	'-9999999.'
Final Magnetics	nT	[ 10]	10	%9.2f	'-9999999.'
1VD	nT	[ 11]	11	%10.6f	'-9999999.0'
Radio Alt	meters	[ 12]	7	%6.1f	'-99999'
Baro Alt	metres	[ 13]	7	%6.1f	'-99999'
Gps Height	metres	[ 14]	7	%6.1f	'-99999'
Elevation	metres	[ 15]	7	%6.1f	'-99999'

**WATERLOO RADIOMETRICS DATA DESCRIPTION FILE**

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Survey Name: Waterloo  
Survey Date: July 2001  
Airborne Contractor: Kevron Geophysics  
Contractor Job Number: 1592  
Processing Contractor: Kevron Geophysics  
Client: Department of Mines and Energy Northern Territory

1:250 000 sheets flown in Located Data File:  
Waterloo SE52-3  
Auvergne SD52-15

1:100 000 sheets flown in Located Data File:  
Keep 4766  
Pinkerton 4866  
Newry 4765  
Kildurk 4865  
Baines 4965  
Waterloo 4764  
Kimon 4864  
Wickham River 4964

Flight Line Number Range of Located Data File: 10010 - 16030  
Tie Line Number Range of Located Data File: 90010 - 90480

**SURVEY SPECIFICATIONS:**

Flight Line Direction: North-South  
Flight Line Separation (m): 400 metres  
Tie Line Direction: East-West  
Tie Line Separation (m): 4000 metres  
Nominal Terrain Clearance (m AGL): 80 metres  
Average Terrain Clearance (m ASL): 80 metres  
Total Line km: 54,662  
Projection: MGA  
Datum: GDA94  
Zone: 52

**SURVEY EQUIPMENT:**

Aircraft: Rockwell Aerocommander 500S VH-EXS  
Magnetometer: Geometrics G-822A Cesium Vapour  
Magnetometer Resolution (nT): 0.001  
Magnetometer Compensation: RMS AADCII operating in real time  
Magnetometer Sample Rate (s): 0.1  
Magnetometer Sample Interval (m): approx 7.0 metres  
Base Station Magnetometer: Geometrics G856  
Base Station Magnetometer Resolution (nT): .1  
Base Station Magnetometer Sample Rate (s): 5  
Base Station Magnetometer Location(s): Kununurra Airport Aprox: -15 46.7 128 42.4  
Spectrometer: Exploranium GR820  
Crystal Size: 33lt downward array  
Spectrometer Sample Rate (s): .5  
Spectrometer Sample Interval (m): 70  
Spectral Windows: Potassium 1370 - 1570 keV



Uranium 1660 - 1860 keV  
 Thorium 2410 - 2810 keV  
 Cosmic 4000 keV

Date aircraft last calibrated: March 2001  
 Calibration range: Carnamah

Data Acquisition System: RMS DAS8  
 Flight Path Navigation System: GPS  
 Navigation Equipment: Fugro Omnistar and Ashtech G12 GPS  
 GPS Base Station Location(s): Differential corrections via Fugro Omnistar VBS  
 (Virtual Base Station)  
 Radar Altimeter: Sperry AA200

**RADIOMETRICS DATA PROCESSING:**

Data has been corrected for aircraft and cosmic backgrounds.  
 Height corrected to a constant datum of 80 metres,  
 minimum height of 30 and a maximum of 300 metres.  
 Data has also been corrected for radon using  
 Minty (1996 - Alt Method B) and corrected for channel interaction.

Noise Adjusted Singular Value Deconvolution (NASVD) has been applied.  
 Five components used to reconstruct spectra.

**ELEVATION DATA:**

Elevation was calculated by subtraction of the radar altimeter from the gps height.  
 Tie line and micro levelling has been performed.  
 AUSGEOID 98 nval geoid ellipsoid separation values subtracted to achieve AHD.

**LOCATED DATA FORMAT:**

Variable	Units	Col number	Width	Format	Null
LineName		[ 1]	12	%12.12s	'-'
LineDate		[ 2]	8	%8.8s	'-'
Flight number		[ 3]	4	%3.0f	'-99'
Time (CST)	hours	[ 4]	9	%8.5f	'-9999999'
Fiducial		[ 5]	10	%9.0f	'-9999999'
Easting	metres	[ 6]	11	%10.2f	'-9999999.0'
Northing	metres	[ 7]	11	%10.2f	'-9999999.0'
Raw Potassium	cps [ 8]	9	%8.2f	'-9999999'	
Raw Uranium	cps	[ 9]	9	%8.2f	'-9999999'
Raw Thorium	cps	[ 10]	9	%8.2f	'-9999999'
Raw Total Count	cps	[ 11]	9	%8.2f	'-9999999'
Corrected Potassium	cps	[ 12]	9	%8.2f	'-9999999'
Corrected Uranium	cps	[ 13]	9	%8.2f	'-9999999'
Corrected Thorium	cps	[ 14]	9	%8.2f	'-9999999'
Corrected Total Count	cps	[ 15]	9	%8.2f	'-9999999'
Corrected Potassium	%	[ 16]	9	%8.3f	'-9999999'
Corrected Uranium	ppm	[ 17]	9	%8.3f	'-9999999'
Corrected Thorium	ppm	[ 18]	9	%8.3f	'-9999999'
Corrected Total Count	nGy/hr	[ 19]	9	%8.3f	'-9999999'
Radio Alt	meters	[ 20]	7	%6.1f	'-99999'
Baro Alt	metres	[ 21]	7	%6.1f	'-99999'
Gps Height	metres	[ 22]	7	%6.1f	'-99999'
Elevation	metres	[ 23]	7	%6.1f	'-99999'



Stripping Coefficients

ALPHA	0.265020
BETA	0.433140
GAMMA	0.805216
A	0.081903

Height Attenuation Coefficients

TOTAL_COUNT	-0.0074
POTASSIUM	-0.0094
URANIUM	-0.0084
THORIUM	-0.0074

Cosmic & Aircraft background

Cosmic

TOTAL_COUNT	0.718991
POTASSIUM	0.039252
URANIUM	0.033910
THORIUM	0.035575

Background

TOTAL_COUNT	52.26
POTASSIUM	7.4
URANIUM	1.2
THORIUM	0.0

Sensitivity Coefficients

Potassium	98.60
Uranium	7.9
Thorium	6.1
Total Count	27.5



**WATERLOO 256 CHANNEL RADIOMETRIC DATA DESCRIPTION FILE**

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Survey Name: Waterloo  
Survey Date: July 2001  
Airborne Contractor: Kevron Geophysics  
Contractor Job Number: 1592  
Processing Contractor: Kevron Geophysics  
Client: Department of Mines and Energy Northern Territory

1:250 000 sheets flown in Located Data File:

Waterloo SE52-3  
Auvergne SD52-15

1:100 000 sheets flown in Located Data File:

Keep 4766  
Pinkerton 4866  
Newry 4765  
Kildurk 4865  
Baines 4965  
Waterloo 4764  
Kimon 4864  
Wickham River 4964

Flight Line Number Range of Located Data File: 10010 - 16030  
Tie Line Number Range of Located Data File: 90010 - 90480

**SURVEY SPECIFICATIONS:**

Flight Line Direction: North-South  
Flight Line Separation (m): 400 metres  
Tie Line Direction: East-West  
Tie Line Separation (m): 4000 metres  
Nominal Terrain Clearance (m AGL): 80 metres  
Average Terrain Clearance (m ASL): 80 metres  
Total Line km: 54,662  
Projection: MGA  
Datum: GDA94  
Zone: 52

**SURVEY EQUIPMENT:**

Aircraft: Rockwell Aerocommander 500S VH-EXS  
Magnetometer: Geometrics G-822A Cesium Vapour  
Magnetometer Resolution (nT): 0.001  
Magnetometer Compensation: RMS AADCII operating in real time  
Magnetometer Sample Rate (s): 0.1  
Magnetometer Sample Interval (m): approx 7.0 metres  
Base Station Magnetometer: Geometrics G856  
Base Station Magnetometer Resolution (nT): .1  
Base Station Magnetometer Sample Rate (s): 5  
Base Station Magnetometer Location(s): Kununurra Airport Aprox: -15 46.7 128 42.4  
Spectrometer: Exploranium GR820  
Crystal Size: 33lt downward array  
Spectrometer Sample Rate (s): .5  
Spectrometer Sample Interval (m): 70  
Spectral Windows: Potassium 1370 - 1570 keV



Uranium 1660 - 1860 keV  
 Thorium 2410 - 2810 keV  
 Cosmic 4000 keV

Date aircraft last calibrated: March 2001  
 Calibration range: Carnamah

Data Acquisition System: RMS DAS8  
 Flight Path Navigation System: GPS  
 Navigation Equipment: Fugro Omnistar and Ashtech G12 GPS  
 GPS Base Station Location(s): Differential corrections via Fugro Omnistar VBS  
 (Virtual Base Station)  
 Radar Altimeter: Sperry AA200

Data Acquisition System: RMS DAS8  
 Flight Path Navigation System: GPS

**RADIOMETRICS DATA PROCESSING:**

Data has been corrected for aircraft and cosmic backgrounds.  
 Height corrected to a constant datum of 80 metres,  
 minimum height of 30 and a maximum of 300 metres.  
 Data has also been corrected for radon using  
 Minty (1996 - Alt Method B) and corrected for channel interaction.

Noise Adjusted Singular Value Deconvolution (NASVD) has been applied.  
 Five components used to reconstruct spectra.

**LOCATED DATA FORMAT:**

Variable	Units	Col number	Width	Format	Null
LineName		[ 1]	12	%12.12s	' '
LineDate		[ 2]	8	%8.8s	' '
Flight number		[ 3]	4	%3.0f	' -99'
Time (CST)	hours	[ 4]	9	%8.5f	' -9999999'
Fiducial		[ 5]	10	%9.0f	' -9999999'
Easting	metres	[ 6]	11	%10.2f	' -9999999.0'
Northing	metres	[ 7]	11	%10.2f	' -9999999.0'
Raw Potassium	cps	[ 8]	9	%8.2f	' -9999999'
Raw Uranium	cps	[ 9]	9	%8.2f	' -9999999'
Raw Thorium	cps	[ 10]	9	%8.2f	' -9999999'
Raw Total Count	cps	[ 11]	9	%8.2f	' -9999999'
Corrected Potassium	cps	[ 12]	9	%8.2f	' -9999999'
Corrected Uranium	cps	[ 13]	9	%8.2f	' -9999999'
Corrected Thorium	cps	[ 14]	9	%8.2f	' -9999999'
Corrected Total Count	cps	[ 15]	9	%8.2f	' -9999999'
Corrected Potassium	%	[ 16]	9	%8.3f	' -9999999'
Corrected Uranium	ppm	[ 17]	9	%8.3f	' -9999999'
Corrected Thorium	ppm	[ 18]	9	%8.3f	' -9999999'
Corrected Total Count	nGy/hr	[ 19]	9	%8.3f	' -9999999'
Temperature	deg	[ 20]	9	%8.3f	' -9999999'
Humidity	%	[ 21]	9	%8.3f	' -9999999'
Air Pressure	hPa	[ 22]	9	%8.3f	' -9999999'
Radio Alt	meters	[ 23]	7	%6.1f	' -99999'
Gps Height	metres	[ 24]	7	%6.1f	' -99999'
Live Time	msec	[ 25]	5	%5d	' '
256 channel counts	cps	[ 26-279]	5	%5d	' '
Cosmic	cps	[ 280]	5	%5d	' '



Stripping Coefficients

ALPHA	0.265020
BETA	0.433140
GAMMA	0.805216
A	0.081903

Height Attenuation Coefficients

TOTAL_COUNT	-0.0074
POTASSIUM	-0.0094
URANIUM	-0.0084
THORIUM	-0.0074

Cosmic & Aircraft background

Cosmic

TOTAL_COUNT	0.718991
POTASSIUM	0.039252
URANIUM	0.033910
THORIUM	0.035575

Background

TOTAL_COUNT	52.26
POTASSIUM	7.4
URANIUM	1.2
THORIUM	0.0

Sensitivity Coefficients

Potassium	98.60
Uranium	7.9
Thorium	6.1
Total Count	27.5





# APPENDIX 10

## Occupational Health and Safety and Environment Policies