FINAL ACQUISITION AND PROCESSING REPORT
HELICOPTER BORNE MAGNETIC SURVEY
DIXIE VALLEY, NEVADA.
USGS Contract No. 02CRSA0165

for:
U.S. Geological Survey
Federal Center
Denver, Colorado

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I. INTRODUCTION

During the period January 20 through February 2, 2002, Pearson, deRidder and Johnson, Inc. of Lakewood, Colorado, in cooperation with El Aero Services Inc., of Carson City, Nevada, undertook the acquisition and processing of a helicopter borne magnetic data set over parts of Dixie Valley, Churchill County, in east central Nevada. The survey outline and location are shown in Fig. 1.

Data acquisition was undertaken from January 23 through January 31, 2002 and eighteen survey flights over 9 days were needed to complete the acquisition of 5740 line kilometers of airborne data. Weather and diurnal conditions were generally favorable during the field work and no stand down days were required. Final data processing was completed by the last week of February, 2002.

This report presents a discussion of the data acquisition specifications, the instrumentation used and the processing parameters applied to the survey data.

Digital data formats are listed in Appendix A and survey flight logs are contained in Appendix B.

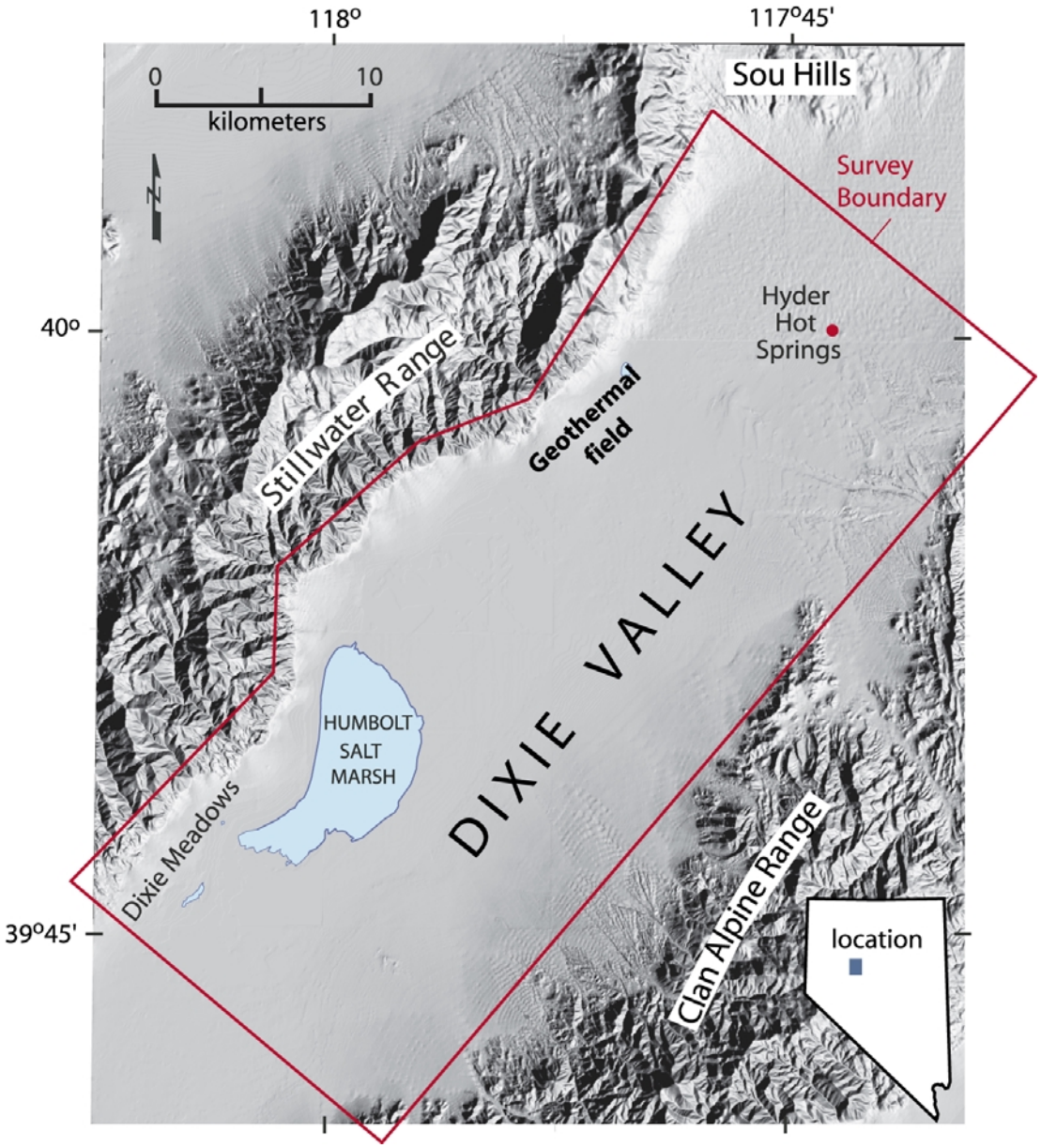

Fig 1. Survey location map

II. SURVEY SPECIFICATIONS

The data were acquired to the following specifications:

A. FLIGHT LINE SPECIFICATIONS.

Flight line spacing:	200 meters
Flight line direction:	N 30 W
Tie line spacing:	1000 meters
Tie line direction:	N 60 E

Flight lines and tie lines deviating more than 50 percent of the intended line spacing over distances of more than 3.2 linear kilometers were to be re-flown. Re-flights or fill-in flights were required to intersect at least two tie line or flight lines. No re-flights due to line separation errors were necessary, but 4 short lines on the south eastern side of the survey were acquired as line extensions when local windy conditions along the flanks of the Clan Alpine Mountains caused early termination of the flight lines due to safety considerations.

An additional flight line, number 500, was completed at a lower elevation over an area of possible interest selected by the U.S. Geological Survey, and underlies flight line 82.

B. TERRAIN CLEARANCE SPECIFICATIONS.

Ground clearance requirements for the survey called for an average draped surface at a nominal 425 to 490 feet above ground level. The pilot's decision on factors influencing aircraft safety and final ground clearance obtained was binding on all parties. Average height of magnetometer above the ground was 390 feet (120 m).

C. DATA RECORDING SPECIFICATIONS.

The following specifications applied to the data acquired during the course of the survey.

The airborne magnetic field was recorded at 0.1 sec intervals to a resolution of 0.01 nT and with an acceptable noise level of +/- 0.125 nT.

The ground magnetic field data was recorded at 5 sec intervals to an accuracy of better than 1 nT

Terrain clearance as measured by the radar altimeter was recorded at 0.1 sec intervals to a resolution of 0.5 foot.

The airborne Differential GPS data was recorded at 1 sec intervals. Recorded positional traces included latitude and longitude, elevation, time and range data for the tracked satellites.

A continuously recording video system was operated during data acquisition with imprints of flight and line number, location, fiducial time and recorded magnetic value superimposed.

III. SURVEY EQUIPMENT AND CALIBRATION.

The following equipment was used on the project.

A. HELICOPTER AND CREW.

The aircraft used was a Bell 206BIII JetRanger, registration number N80526. The magnetometer sensor, in a towed bird configuration, was slung underneath the aircraft on a fifty foot cable. At the survey acquisition speeds, a sensor-helicopter height differential of forty feet is present.

The crew consisted of the following personnel:

Mr. J. Kelly, Pilot.	18,000 survey flight hours.
Mr. G. Tate.	Operator and electronics technician.
Mr. R. C. Johnson.	Field logistics.

B. AIRBORNE MAGNETOMETER.

The helicopter was equipped with a bird-mounted Geometrics G 823A Cesium vapor, optically-pumped magnetometer sampling at 10 Hz. The instrument has a sensitivity of 0.01 nT over a range of some 20,000 nT, with a sensor noise level of less than 0.02 nT. The airborne magnetic field was recorded at 0.1 sec intervals (less than 10 meters sample spacing) to a resolution of 0.01 nT.

C. AIRBORNE DGPS SYSTEM.

On-board real-time DGPS positioning was provided by an AGNAV 132 navigation system. Differential corrections are provided by a satellite-based subscription service and positioning information as cross-track position errors were provided as a real-time display to the pilot. The GPS antenna was mounted on the forward pitot tube of the helicopter.

D. ALTIMETERS.

A King KR3-A radar altimeter, with a range of 0 to 2,400 feet, recording at 10 Hz, was installed in a FAA approved mount on the helicopter skid frame. Terrain clearance as measured by the radar altimeter was recorded to a resolution of 0.5 foot. Aircraft altitude above sea level was provided by the full recording of the DGPS output from which the elevation values were extracted during post-flight processing.

E. ALTIMETER CALIBRATION.

A radar altimeter calibration was performed on 01-22-02 over flat terrain near the base camp. A series of hovering maneuvers were completed at hundred foot elevation intervals over the ground clearance ranges expected in the survey area. The results are presented hereunder and graphically shown in Fig. 2.

Time	Elevation in feet a.g.l.	Average radar	Number of samples
1535-1536	200	749.97	811
1537-1538	300	1321.03	480
1539-1540	400	2104.38	710
1541-1542	500	2789.38	420
1542-1543	600	3455.21	359

F. AIRBORNE DATA ACQUISITION SYSTEM.

Airborne data acquisition was accomplished on a lap top-based Data Acquisition system. Digital records at 10 Hz of the magnetometer, radar and the DGPS output (1.0 sec) were made. Time synchronization was provided for all data channels recorded based on the available GPS time signals.

G. LEAD-LAG TEST.

Prior to data acquisition, a final lead-lag test was completed 01-24-2002 over surficial magnetic targets consisting of two small automobile scrap heaps a few hundred yards west of the campsite. Two well-defined, sharp-peaked anomalies of some 8 nT in amplitude were observed and used in a series of flight lines flown in both directions across the targets to define an average lag of 0.42 seconds. This correction was applied to the acquired data traces during the compilation process.

H. VIDEO CAMERA AND RECORDER.

A JVC color video camera and associated recorder system were used. The video camera was mounted in an FAA approved mount on the helicopter skid frame and oriented for an alignment of less than 2 off vertical while in horizontal flight. Fiducial marking and positioning overlay information were incorporated in the video recording system.

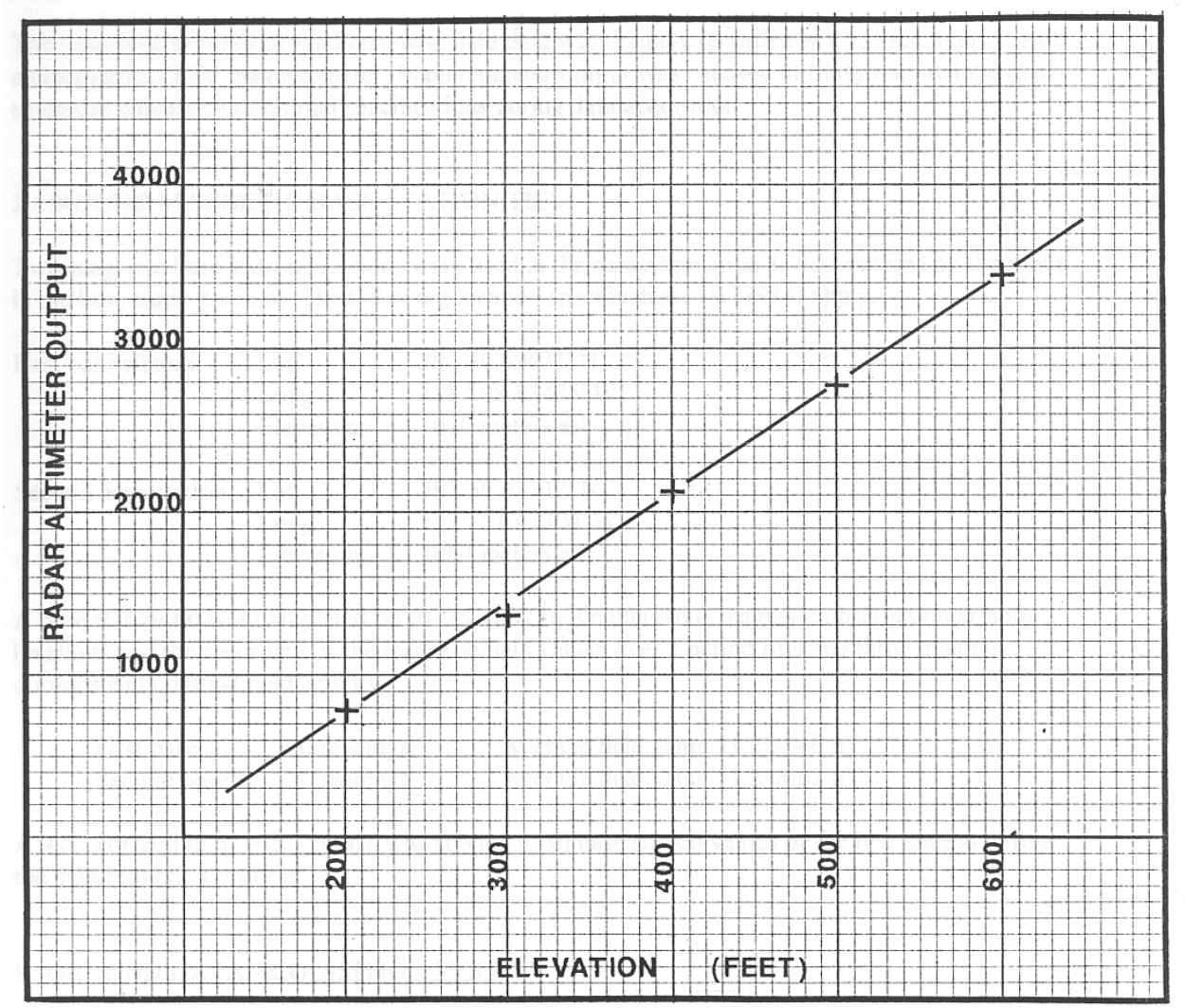

Fig. 2. Altimeter calibration plot.

I. GROUND MAGNETIC BASE STATION SYSTEM.

The time-synchronized ground magnetic field data was digitally recorded at a 5.0 sec interval with a Geometrics G856 magnetometer. Magnetometer output was checked at thirty minute intervals to ensure adherence to diurnal specifications during data acquisition.

J. GROUND MAGNETIC BASE STATION TIES.

Two magnetic base station locations were used in the data acquisition as necessitated by the move in the base camp position. The following location specifications (WGS84) apply:

First base station.	Lat.	39° 40.69631' N
	Long.	118° 08.83425' W
	Elevation	1070 meters asl
Second base station.	Lat.	39° 59.63312' N
	Long.	117° 51.43394' W
	Elevation.	1064 meters asl

A base station tie was completed on 01-26-2002 by simultaneous magnetic observation at both locations and the recording of the magnetic field values over a period of some three minutes during steady diurnal field activity

First base.	1760 readings	Average field value 51,290.46 nT
Second base.	36 readings	Average field value 51,518.02 nT

A level correction of +227.56 nT was applied to all base station values of the first station during the data reduction process.

K. GROUND DATA ACQUISITION SYSTEM.

The PC-based field data system allowed full use as a work station for profile data verification and display for editing and transcription purposes during survey operations. Processing software, available in-field, allowed the determination of flight line locations on a daily basis and the production of page-sized flight path location maps, as well as the full editing and verification of the acquired geophysical data traces.

IV. FIELD OPERATIONS.

The crew mobilized to Carson City, Nevada on the evening of 01-20-2002. Installation of all instrumentation was completed during the afternoon of 01-21-2002 and a series of system-check test flights near the Carson City airport were undertaken and satisfactorily completed. The crew mobilized to the southern end of the survey area in Dixie Valley on the morning of 01-22-2002.

01-22-2002. Diurnal K-factor = 2
A magnetic base station was established at 39 40.69631' N , 118 08.83425' W at an elevation of 1070 meters above sea level. Altimeter calibrations were completed over a level ground area near the camp site.

01-23-2002. Diurnal K-factor = 2
One survey flight completed.

01-24-2002. Diurnal K-factor = 0
Completed lead-lag tests over surface targets to the west of the base camp.
Two survey flights completed.

01-25-2002. Diurnal K-factor = 2
Two survey flights completed.

01-26-2002. Diurnal K-factor = 3
One survey flight completed.
Moved base camp to central part of survey area and established new magnetic base station location at 39 58.63312' N, 117 51.43394' W at an elevation of 1064 meters above sea level. Base stations were tied by simultaneous observation of the magnetic field at both locations.

01-27-2002. Diurnal K-factor = 2
Three survey flights completed.

01-28-2002. Diurnal K-factor = 2
Two survey flights completed.

01-29-2002. Diurnal K-factor = 1
Two survey flights completed.

01-30-2002. Diurnal K-factor = 1
Three survey flights completed.

01-31-2002. Diurnal K-factor = 2
Two survey flights completed.

02-01-2002.
Crew demobilized to the nearby town of Fallon with better communication facilities to await final demobilization approval.

Diurnal magnetic activity was low to very low during the survey period and weather was not a significant factor. Locally turbulent wind conditions along the along the western flank of the Clan Alpine Mountains caused early termination of four flight lines, which were subsequently re-flown as short segments. Field operations consisted of nine flying days and no standby days. The survey pilot logs are attached hereto as Appendix B.

Daily quality control measures consisted of the following procedures:

Daily monitoring of the magnetic base station activity.
Inspection of flight data traces for quality.
Inspection of all acquired digital data for completeness and for back up.
Inspection of ground magnetic data for diurnal activity and noise levels.
Check of the acquired GPS data for continuity of coverage and initial accuracy of positioning derived.
Comparison of the field flight path locations with the survey lay out.
Transmittal of all data to the processing center.

The field crew demobilized from the survey area on February 3, 2002.

V. DIGITAL DATA COMPILATION.

The magnetic and ancillary data were processed according to the following specifications:

A. FLIGHT PATH RECOVERY.

Aircraft position was recovered using the AGNAV 132 real-time DGPS data output. All DGPS horizontal positioning data acquired during acquisition were mapped and preliminary flight path maps produced.
The line locations with the derived aircraft speed information mapped for editing and comparison with the survey lay out maps. After this procedure, the positioning data was accepted for final flight path locations.

B. PRE-PROCESSING PROCEDURES.

1. Data editing.

A lag correction of 0.4 seconds (four fiducials), as derived from the lead-lag tests, was applied to the data. All merged data traces were screen-edited for completeness and no missing data or erroneous data values were found. A small number of drop-outs in the magnetic data trace were edited and the data interpolated over the drop-out interval of 2 to 3 data points. The origin of these data spikes is unknown, but they may have been associated with significant activity of a number of mobile military radar stations present in the survey area. No filtering of the data was undertaken and the raw field data were considered to be of good quality.

2. Cultural anomalies.

A minor amount of cultural noise, associated with the buildings of the geothermal power plant, was identified on the data set, but no de-culturing of the data was undertaken.

3. Radar altimeter data.

Radar altimeter output was converted to meters, using the altimeter calibration table constants and screen-edited to remove some obvious data spikes. No filtering of these data was undertaken.

4. GPS elevation.

DGPS-derived elevation values were extracted from the AGNAV records and merged with the profile data traces.

5. IGRF correction.

A regional correction, based on the International Geomagnetic Reference Field 2000 (reference: IAGA Division V Working Group 8, 2000: Geophysical Journal International, vol. 141, no. 1, pp. 259-262, April, 2000) was performed. This correction was applied to the magnetic data trace using the sensor elevation derived from the DGPS vertical elevation and location for each data point.

6. Diurnal correction.

The diurnal data from the first base station location were corrected with a level shift of + 227.56 nT relative to the values of the second base station location. The integrated diurnal data were then IGRF-corrected, based on magnetic base station location and elevation. A high-cut filter (< 6 min) was applied to the diurnal data, and the low pass diurnal applied to the IGRF-corrected magnetic profile data as a diurnal correction.

C. DATA LEVELING.

1. DC-leveling.

The profile data corrected for IGRF and diurnal effects were initially leveled using the determined values of the magnetic field at all the profile intersection during which mis ties at these intersections were minimized by the application of a DC-level shift to each of the profiles. A preliminary contour map after this step indicated that flight line oriented anomalies were still present in the data after this step.

This initial leveling process was further refined to the application of a low pass filter to the grid derived above. Statistical differences between the mean profile magnetic values and the mean value of the low-passed grid, interpolated onto the profile locations, were determined for the magnetically quiet areas of the survey block. These differences were than applied as a second DC-level shift to both the flight line and tie line magnetic values.

Strong magnetic gradients are associated with the high frequency, large amplitude anomalies along the flanks of the survey area. The profile data were subsequently subjected to an additional,

third round of DC-leveling adjustments by the deletion in the leveling process of those intersections associated with numerically large horizontal gradient values, and the application of a final level shift to manually selected lines.

All DC-leveled profile data, including flight lines and tie lines, resulting from the above process are included in the digital profile data set as the DC-leveled magnetics.

2. Refined leveling.

A series of non-DC leveling adjustments were applied to the profile data of the flight lines only using the following process:

A strike filter, aligned along the flight line directions, was applied to the high frequency component of the gridded data set derived from the DC-leveled profile data. The strike filter results were interpolated onto the profile locations, edited and selectively applied to the profile data as a non-linear correction to the DC-level adjusted data. The flight line profile data set reflecting this process is included in the digital data set as the Final Magnetics.

D. FINAL GRIDDING AND MAPPING.

The final leveled, profile-oriented magnetic flight line, data derived above, was gridded and mapped using a minimum curvature routine with a grid spacing of 100 meters, approximately one-half of the line spacing of the survey. The gridding routine applied uses a minimum curvature approach (Ref: Program Minc USGS OFR 81-1224). The grid is included in the digital data set as the Total Magnetic Intensity Grid (tmi2.gxf).

E. RADAR ALTIMETER AND PSEUDO-TOPOGRAPHY GRIDS.

Edited radar altimeter data were gridded at a 100 meter grid interval and this grid is included in the digital data set provided with the report as the radar2.gxf grid.

A pseudo-topography trace was derived for each of the flight lines and tie lines acquired by the subtraction of the radar altimeter values from the GPS-derived elevation values above sea level. A high-cut filter, 100-200 meter roll-off, was applied to the radar altimeter data trace prior to the subtraction. No further edits or leveling procedures were applied to this data trace and the profile-oriented, pseudo-topography profile values so determined were directly gridded. This data set therefore contains all errors inherent in the vertical GPS determinations, as well as any remaining noise in the radar altimeter trace and the resulting grid is provided with the digital data sets accompanying this report as the topo2.gxf grid.

VI. DELIVERABLES.

A. MAPS.

Two copies of the following map, in two sheets and at a scale 1 : 50,000, are presented with this report.

Total Magnetic Intensity, black line contour map on mylar.

Map projection information:

Projection	UTM
UTM Zone	11
Central Meridian:	117^{o} W.
Spheroid:	WGS84
Datum:	1983 NAD

B. DIGITAL DATA.

Two copies of the digital data are enclosed with this report on CD-ROM and include the following data sets:

1. Grids of the following in Gxf Format:
    a. Total Magnetic Intensity
    b. Radar Altimeter Ground clearance.
    c. Pseudo-topography

2. Archive profile data set in ASCII profile format.

Digital data formats and file names are contained in Appendix A hereto.

APPENDIX A

DIGITAL DATA FORMAT

PROJECT NAME: Dixie Valley, Nevada

DATA PROVIDED:

TMI2.GXF TMI Grid in GXF Grid Format of the Dixie Valley Survey, Nevada.

RADAR2.GXF Radar Altimeter Grid in GXF Grid Format of the Dixie Valley Survey, Nevada.

TOPO2.GXF Topography Grid in GXF Grid Format of the Dixie Valley Survey, Nevada.

DIXIE.XYZ Profile Data in ASCII XYZ Format of the Dixie Valley Survey, Nevada.

DIXIE.I0 Montaj XYZ Import Template.

PROJECTION INFORMATION:

Projection:	UTM, Zone 11
Base Lat.:	0
Central Meridian:	117 West
False Easting:	500,000 Meters
False Northing:	0 Meters
Grid Origin X:	401000.0
Grid Origin Y:	4389000.0
Grid Spacing X:	100 Meters
Grid Spacing Y:	100 Meters
Grid Cell Value:	Centered
Spheroid:	WGS 84(NAD-83)
	Clark 1866(NAD-27), profile data only.

MISCELLANEOUS:

Tow Cable Length:	50 Feet
Sensor/Altimeter height Difference:	40 feet

PROFILE FORMAT:

Format	Description	Units	Columns
I4	Line Number		1-4
F12.5	Longitude NAD-83	(Decimal Degrees)	5-16
F10.5	Latitude NAD-83	(Decimal Degrees)	17-26
F12.5	Longitude NAD-27	(Decimal Degrees)	27-38
F10.5	Latitude NAD-27	(Decimal Degrees)	39-48
F10.1	UTM X WGS-84	(Meters)	49-58
F10.1	UTM Y WGS-84	(Meters)	59-68
F10.1	UTM X Clarke 1866	(Meters)	69-78
F10.1	UTM Y Clarke 1866	(Meters)	79-88
I5	Fiducial		89-93
A11	Date	(YYYY/MM/DD)	94-104
A12	Time	(HH:MM:SS:SS)	105-116
F8.1	Radar Altimeter	(Meters)	117-124
F8.1	GPS Vertical	(Meters)	125-132
F8.1	Topography	(Meters)	133-140
F10.3	Diurnal Magnetics	(nT)	141-150
F10.3	Raw Magnetics	(nT)	151-160
F10.3	Diurnally Corrected Mag.	(nT)	161-170
F10.3	Residual Magnetics	(nT)	171-180
F10.3	DC Leveled Magnetics	(nT)	181-190
F10.3	Final Magnetics	(nT)	191-200
F10.3	IGRF Corrected Magnetics	(nT)	201-210

*NOTE: (99999.9 is a null value for the radar, GPS vertical, and topography.)
(99999.999 is a null value for the magnetics.)

DIXIE.XYZ:

1170 -117.76166 40.09035 -117.76070 40.09043 435070.5 4438062.9 435150.3 4437861.6
1 2002/01/26 9:59:32.07 102.2 1287.1 1186.5 51523.037 51796.331 52145.319 199.005
197.830 0.000 -149.983
1170 -117.76167 40.09032 -117.76072 40.09041 435069.1 4438060.3 435149.0 4437859.0
2 2002/01/26 9:59:32.18 102.4 1287.0 1186.2 51523.035 51796.098 52145.086 198.785
197.610 0.000 -150.203
1170 -117.76169 40.09030 -117.76073 40.09039 435067.8 4438057.8 435147.7 4437856.4
3 2002/01/26 9:59:32.29 102.4 1286.9 1186.1 51523.033 51795.886 52144.874 198.587
197.412 0.000 -150.401

APPENDIX B

SURVEY FLIGHT LOGS.

Survey flight 1 January 23 2002

Take off 12:28 - Land 15:44

Recorded Line	Actual Line	Start	Stop	
18	11W	12:37	12:46	
19	12E	12:46	12:54	
20	13W	12:54	13:02	
21	14E	13:02	13:11	
22	15W	13:11	13:19	
23	16E	13:19	13:27	
24	17W	13:28	13:35	
25	18E	13:36	13:44	
26	19W	13:44	13:45	Scrub for bad start (logging computer)
27	19W	13:47	13:55	
28	20E	13:55	14:03	
29	21W	14:04	14:11	
30	22E	14:11	14:19	Stopped short on E side of line
31	22.1E	14:19	14:20	Scrub Short, Remainder of 22E
32	23W	14:20	14:28	
33	24E	14:29	14:37	
34	25W	14:38	14:45	
35	26E	14:46	14:54	
36	27W	14:55	15:02	
37	28E	15:03	15:11	
38	29W	15:11	15:19	
39	30E	15:20	15:28	
40	31W	15:29	15:29	Scrub for bad start (navigation)
41	31W	15:29	15:37	

Survey flight 2 January 24 2002

Take off 07:37 - Land 10:55

Recorded Line	Actual Line	Start	Stop	
42	1E	07:43	07:52	
43	2W	07:52	08:01	
44	3E	08:01	08:10	
45	4W	08:10	08:18	
46	5E	08:18	08:27	
47	6W	08:27	08:36	
48	7E	08:36	08:45	
49	8W	08:45	08:53	
50	9E	08:54	09:02	
51	10W	09:02	09:11	
52	32E	09:14	09:22	
53	33W	09:22	09:30	
54	34E	09:31	09:39	
55	35W	09:40	09:47	
56	36E	09:48	09:56	
57	37W	09:56	10:04	
58	38E	10:05	10:13	
59	39W	10:14	10:22	
60	40E	10:22	10:30	
61	41W	10:30	10:38	
62	300E	10:41	10:46	Re-flew valley floor to East end of line 22.

Survey flight 2a January 24 2002

Take off 12:38 - Land 15:59

Recorded Line	Actual Line	Start	Stop	
63	42E	12:47	12:56	
64	43W	12:56	13:05	
65	44E	13:05	13:13	
66	45W	13:14	13:22	Spike in mag data
67	46E	13:22	13:30	
68	47W	13:31	13:39	Spike in mag data
69	48E	13:39	13:47	Stopped to fix computer
70	49W	13:56	14:05	
71	50E	14:05	14:13	
72	51W	14:13	14:21	
73	52E	14:22	14:29	
74	53W	14:30	14:37	
75	54E	14:38	14:46	
76	55W	14:46	14:54	
77	56E	14:54	15:02	
78	57W	15:03	15:11	
79	58E	15:11	15:20	
80	59W	15:20	15:28	
81	60E	15:28	15:36	
61	61W	15:36	15:44	

Survey flight 3 January 25, 2002

Take off 07:39 - Land 10:52

Recorded Line	Actual Line	Start	Stop	
83	62E	07:48	07:57	
84	63W	07:58	08:05	
85	64E	08:06	08:14	
86	65W	08:15	08:23	
87	66E	08:23	08:32	
88	67W	08:32	08:40	
89	68E	08:41	08:49	
90	69W	08:50	08:57	
91	70E	08:58	09:06	
92	71W	09:06	09:14	
93	72E	09:15	09:23	
94	73W	09:24	09:32	
95	74E	09:32	09:41	
96	75W	09:41	09:49	
97	76E	09:50	09:58	
98	77W	09:59	10:06	
99	78E	10:07	10:15	Mine on West End
100	79W	10:16	10:24	
101	80E	10:25	10:33	
102	81W	10:33	10:41	

Survey flight 3a January 25, 2002

Take off 12:34 - Land 15:57

Recorded Line	Actual Line	Start	Stop	
103	82E	12:46	12:55	
104	83W	12:55	13:04	
105	84E	13:04	13:13	
106	85W	13:14	13:23	
107	86E	13:23	13:31	
108	87W	13:32	13:40	
109	88E	13:41	13:49	Short on E end
110	89W	13:49	13:57	Short on E end
111	90E	13:58	14:06	
112	91W	14:07	14:15	
113	92E	14:16	14:24	
114	93W	14:25	14:33	
115	94E	14:33	14:42	
116	95W	14:42	14:50	Maintenance Break
117	96E	14:56	15:05	
118	97W	15:06	15:14	
119	98E	15:15	15:24	Scrub:Missing Diurnal
120	99W	15:24	15:32	Scrub:Missing Diurnal
121	100E	15:33	15:41	Scrub:Missing Diurnal
121	101W	15:42	15:51	Scrub:Missing Diurnal

Survey flight 4 January 26, 2002

Take off 09:51 - Land 13:29

Recorded Line	Actual Line	Start	Stop	
123	1170S	09:59	10:21	Break to do Transfer Survey
124	1210N	11:13	11:17	
125	1200S	11:20	11:28	
126	1190N	11:36	11:40	Broke up into three lines(1190,1191,1192).
126	1191N	11:43	11:50	
126	1192N	11:56	11:59	
127	1180S	12:00	12:25	
128	1160N	12:26	12:44	Noticed well head SW of plant
129	1150S	12:45	13:03	
130	1140N	13:03	13:22	Noticed well head NE of plant

Survey flight 5 January 27, 2002

Take off 07:37 - Land 11:09

Recorded Line	Actual Line	Start	Stop	
131	1130S	07:45	08:02	Break to correct noisy mag
132	1120N	08:34	08:57	Break to correct video display
133	1110S	09:02	09:03	SCRUB LINE Radar recording incorrect
134	1110N	09:05	09:20	
135	1100S	09:21	09:43	
136	1090N	09:44	09:59	
137	1080S	10:00	10:22	
138	1070N	10:22	10:38	
139	1060N	10:38	10:59	

Winds from the North at 10 to 25 Kts

Base Station Location recorded at landing

Survey flight 5a January 27, 2002

Take off 12:41 - Land (15:57, At end flight 5b)

Recorded Line	Actual Line	Start	Stop	
140	1050S	12:50	13:07	
141	1040N	13:07	13:28	Maintenance Break
142	1030S	13:32	13:49	
143	1020N	13:50	14:10	
144	1010S	14:10	14:28	
145	1000N	14:28	14:49	

Winds from the North at 10 Kts

Survey flight 5b January 27, 2002

Take off 12:41 (At begin flight 5a) - Land 15:57

Recorded Line	Actual Line	Start	Stop
146	237W	14:52	15:01
147	236E	15:01	15:10
148	235W	15:10	15:18
149	234E	15:18	15:26
150	233W	15:26	15:35
151	232E	15:35	15:43
152	231W	15:43	15:51

Winds from the North at 10 Kts

Survey flight 6 January 28, 2002

Take off 07:56 - Land 11:18

Recorded Line	Actual Line	Start	Stop	
153	238E	08:05	08:13	
154	102W	08:25	08:34	
155	103E	08:34	08:44	
156	104W	08:44	08:53	
157	105E	08:53	09:03	Navigation system failed E of mud flats
158	303E	09:05	09:09	Stopped in center of mud flats of line 105E.
159	106W	09:14	09:23	
160	107E	09:23	09:33	
161	108W	09:33	09:42	
162	109E	09:42	09:51	
163	110W	09:51	10:00	
164	111E	10:01	10:09	
165	112W	10:10	10:18	
166	113E	10:19	10:28	
167	114W	10:28	10:36	
168	115E	10:37	10:45	
169	116W	10:45	10:54	
170	117E	10:54	11:03	
171	118W	11:04	11:12	

Winds from the North at 5 to 10 Kts

Occasional spikes on mag possibly due to low temperature

Spikes were observed mostly on the West end of lines at the base of the hills.

Survey flight 6a January 28, 2002

Take off 13:02 - Land 16:14

Recorded Line	Actual Line	Start	Stop	
172	160E	13:05	13:13	
173	161W	13:13	13:21	
174	162E	13:21	13:29	
175	163W	13:29	13:37	
176	164E	13:37	13:45	
177	165W	13:45	13:54	
178	166E	13:54	14:02	
179	167E	14:02	14:10	
180	168E	14:10	14:18	Spike at beginning of line. Break
181	169W	14:22	14:30	
182	170E	14:30	14:38	
183	171W	14:38	14:46	
184	172E	14:47	14:55	
185	173W	14:55	15:03	
186	174E	15:03	15:11	
187	175W	15:12	15:20	Spike at beginning of line.
188	176E	15:20	15:28	
189	177W	15:29	15:37	
190	178E	15:37	15:45	
191	179W	15:46	15:53	
192	180E	15:54	16:01	
193	181W	16:02	16:10	

Winds light and variable.

System wiring checked before flight. Tightened loose connections in junction box. Magnetometer behavior improved compared to previous two flights.

Survey flight 7 January 29, 2002

Take off 07:58 - Land 11:06

Recorded Line	Actual Line	Start	Stop	
194	182E	08:03	08:12	
195	183W	08:12	08:20	
196	184E	08:20	08:29	
197	185W	08:30	08:38	
198	186E	08:38	08:47	
199	187W	08:47	08:55	
200	188E	08:55	09:04	
201	189E	09:04	09:12	
202	190E	09:13	09:21	
203	191W	09:22	09:30	
204	192E	09:30	09:39	
205	193W	09:39	09:47	
206	194E	09:47	09:56	
207	195W	09:56	10:04	
208	196E	10:04	10:13	
209	197W	10:13	10:21	
210	198E	10:21	10:30	Maintenance break
211	199W	10:34	10:42	
212	200E	10:42	10:52	
213	201W	10:52	11:01	

Winds light from N at take off.
Winds 10 kts from N at land.

System wiring checked before flight. Tightened loose connections in junction box. Magnetometer behavior improved compared to previous two flights.

Survey flight 7a January 29, 2002

Take off 12:57 - Land 16:13

Recorded Line	Actual Line	Start	Stop	
214	202E	13:03	13:13	
215	203W	13:13	13:22	
216	204E	13:23	13:33	
217	205W	13:33	13:42	Spike
218	206E	13:43	13:53	
219	207W	13:53	14:01	
220	208E	14:02	14:11	
221	209E	14:12	14:20	
222	210E	14:20	14:30	
223	211W	14:30	14:38	
224	212E	14:38	14:48	
225	213W	14:48	14:56	
226	214E	14:57	15:07	
227	215W	15:07	15:14	
228	216E	15:15	15:24	Spike
229	217W	15:24	15:32	
230	218E	15:32	15:42	
231	219W	15:42	15:49	Spike
232	220E	15:50	15:59	
233	221W	15:59	16:07	

Winds light from N at take off.
Winds 10 kts from E at land.

Survey flight 8 January 30, 2002

Take off 08:18 - Land 11:20

Recorded Line	Actual Line	Start	Stop
234	222E	08:25	08:33
235	223W	08:34	08:42
236	224E	08:42	08:50
237	225W	08:51	08:59
238	226E	08:59	09:07
239	227W	09:08	09:16
240	228E	09:16	09:24
241	229E	09:25	09:33
242	230E	09:33	09:41
243	159W	09:47	09:54
244	158E	09:55	10:02
245	157W	10:03	10:10
246	156E	10:11	10:18
247	155W	10:18	10:26
248	154E	10:26	10:34
249	153W	10:34	10:42
250	152E	10:42	10:51
251	151W	10:51	10:59
252	150E	10:59	11:08
253	149W	11:08	11:16

Winds light and variable.

Survey flight 8a(030P), January 30, 2002

Take off 12:28 - Land 15:43

Recorded Line	Actual Line	Start	Stop
254	148E	12:32	12:40
255	147W	12:40	12:49
256	146E	12:49	12:57

Flight 8a terminated to correct computer problems. Flight 8b is continuation of 8a.

Survey flight 8b January 30, 2002

Recorded Line	Actual Line	Start	Stop	
257	145W	13:09	13:10	Scrub
258	145W	13:11	13:19	
259	144E	13:20	13:28	
260	143W	13:28	13:36	
261	142E	13:37	13:45	
262	141E	13:45	13:53	
263	140E	13:54	14:02	
264	139W	14:02	14:11	
265	138E	14:11	14:20	
266	137W	14:20	14:28	
267	136E	14:28	14:37	
268	135W	14:37	14:46	
269	134E	14:46	14:55	
270	133W	14:55	15:04	
271	132E	15:04	15:13	
272	131W	15:13	15:21	
273	130E	15:21	15:30	
274	129W	15:30	15:38	

Winds light and variable.

Occasional mag spikes

Survey flight 9 January 31, 2002

Take off 07:35 - Land 10:20

Recorded Line	Actual Line	Start	Stop	
275	88W	07:43	07:44	Scrub
276	88.1W	07:44	07:49	Scrub Reflew Wrong End.
277	89.1E	07:49	07:53	Scrub Reflew Wrong End.
278	98W	07:59	08:08	
279	99E	08:08	08:10	Scrub
280	99E	08:16	08:25	
281	100W	08:26	08:35	
282	101E	08:35	08:44	
283	119W	08:46	08:54	
284	120E	08:54	09:03	
285	121W	09:03	09:12	
286	122E	09:12	09:21	
287	123W	09:21	09:29	
288	124E	09:29	09:38	
289	125W	09:38	09:46	
290	126E	09:47	09:55	
291	127W	09:55	10:03	
292	128E	10:03	10:11	

Survey flight 031P(9a) January 31, 2002

Take off 11:41 - Land 12:20

Recorded Line	Actual Line	Start	Stop
293	302E	13:09	13:10 East end of line 89W.
294	301W	13:11	13:19 East end of line 88E.
295	500E	13:20	13:28 Low Level Line

Winds light and variable.