Dynamic Satellite Surveys

06031

Final Operations Report
on the

2006 Tasmania Basin 2D Seismic Survey

for

Terrex Seismic Pty Ltd and Great South Land Minerals Ltd

April to May 2006

The Director
Dynamic Satellite Surveys Pty Ltd
PO Box 713, Yeppoon QLD 4703
Telephone: 07 4939 2866
International: +61 7 4939 2866
Facsimile: 07 4939 2867
E-mail: yeppoon@dss.com.au

Dynamic Satellite Surveys Pty Ltd is a Quality Assured Company, externally certified to AS/NZS ISO 9001:2000 standards - Licence# QEC10046

Table of Contents

1

INTRODUCTION

The following report covers the **2006 Tasmania Basin 2D Seismic Survey** operation, performed by **Dynamic Satellite Surveys Pty Ltd** (DSS) whilst contracted to **Terrex Seismic Pty Ltd** (Terrex) for **Great South Land Minerals Ltd** (GSLM).

The survey was conducted within SEL 13/98, located in the centre of Tasmania near Ouse.

The prospect consisted of eight (8) seismic lines, which DSS pegged and surveyed. The total length of the survey was **401.60 kilometres**.
Due to operational constraints, Terrex Seismic did not record the total 401.60 km.

DSS commenced survey operations on the 4th of April, 2006 and completed survey operations on the 26th of May, 2006.

2

INSTRUMENTATION AND PERSONNEL

2.1 Personnel

DSS personnel involved in the survey were as follows:

Ben Allsopp	-	Bachelor of Surveying - Curtin University of Technology
	-	Surveying/Report
Dave Nielsen	-	Associate Diploma - University of Southern Qld
	-	Surveying
Denis Williams	-	Bachelor of App Sc (Surveying) / Bachelor of Information Technology
	-	Report
Noel Croswell	-	Survey Offsider

2.2 Logistics

Personnel and equipment logistics were supported by the DSS Yeppoon office.

Survey operations were based from the Ouse Motel, Tasmania.

2.3 Equipment

Equipment provided by DSS and used on this project:

	Description	**Qty**
Vehicles	Toyota 4WD Trayback - DSS	1
GPS receivers	NovAtel G2 c/w VHF Telemetry	3
Computers	Dell Inspiron 5100	1
	Fujitsu Tablets	1
	iPAQ PCs	2
Software	GravNav / GravNet GPS post-processing - Waypoint Consultancy	Ver 7.60
	Nav05 field software - DSS	Ver 3.42
	MIB for Windows - DSS	Ver 6.1.2
	TransIt 5.0 - DSS	Ver 5.2
	MapInfo Professional	Ver 7.8
Printers	Canon i6100	1
Survey Instruments	Rapid Elevation Meter - DSS	2
	Electronic Compass	1
	Survey Master 3	1
Miscellaneous	Kodak Digital camera	1
	Necessary standard surveying equipment	
	Sundry office and transport equipment	
	Field and Office Consumables	

3

SURVEY REFERENCE SYSTEMS

3.1 Geodetic Datum

GPS data is acquired on the World Geodetic System 1984 (WGS84) datum, described by the following parameters:

Datum:	WGS84 (World Geodetic System 1984)
Spheroid:	WGS84
Semi-Major Axis Length:	6 378 137.0
Inverse Flattening:	298.257223563
Unit of Measure:	International Metre

Coordinates were transformed directly to the Australian Map Grid (AMG66), based on the Australian Geodetic Datum (AGD66):

Datum:	AGD66 (Australia Geodetic Datum 1966)
Spheroid:	Australian National Spheriod
Semi-Major Axis Length:	6 378 160.0
Inverse Flattening:	298.25
Unit of Measure:	International Metre

3.2 Map Projection

Rectangular coordinates provided to the client are based on the Australian Map Grid (AMG66).

Parameters for AMG66 are described below:

Projection:	Universal Transverse Mercator (UTM) Zone 55
Latitude of Origin:	0°
Central Meridian (CM):	147° E
Scale Factor at CM:	0.9996
False Easting:	500 000
False Northing:	10 000 000
Unit of Measure:	International Metre

3.3 Height Datum

All elevations obtained relative to WGS84 have been reduced to the Australian Height Datum (AHD71) using the AUSGEOID98 Geoid - Spheroid separation model to determine the geoid-ellipsoid separation (N) for the particular area.

GPS observations are made on the WGS84 datum. The height associated with this datum is an ellipsoidal height (h). The Australian Height Datum (the height datum usually associated with AMG), is an orthometric height which is measured as the height above mean sea level, or the geoid (H).

The function that defines the relationship between the ellipsoid and orthometric heights is:

$$\mathbf{H = h - N}$$

Or

AHD = Ellipsoidal height - Geoid-Spheroid Separation.

AUSGEOID98 is the third in a series of national geoid models produced for Australia by the Australian Surveying and Land Information Group (AUSLIG). The geoid-ellipsoid data is prepared for the Australian region from:

- EGM96 Global Geopotential Model;
- 1996 Australian Gravity DataBase, from the Australian Geological Survey Organisation (AGSO);
- AUSLIG / AGSO GEODATA nine-second digital elevation model;
- Satellite altimeter - derived free air gravity anomalies offshore;
- Theories, techniques and software developed by Associate Professor Will Featherstone, Curtin University of Technology[1].

AUSGEOID98 N values were obtained using the GrafNet Version 7.60 software, distributed by Waypoint Consulting Inc.

[1] Johnston, G.M., Featherstone, W.E. (1998) AUSGEOID98: A New Gravimetric Model for Australia

4

SURVEY CONTROL

The survey was base on the following Permanent Markers (AMG66):

Station	Easting (AMG66)	Northing (AMG66)	Height (AHD)
SPM718	476013.612	5296427.231	89.579
SPM724	476295.667	5298034.428	92.212
SPM8689	526083.806	5317695.531	443.114
SPM8847	452443.279	5330716.089	646.733
SPM9000	471961.105	5301103.356	230.184
SPM10213	500599.396	5307730.902	353.703
SPM10215	499147.490	5307415.304	348.344
SPM10586	473819.844	5352814.581	1040.880

Two new base stations were installed throughout the prospect. These coordinates are located in **Appendix A - Survey Control**.

5

MONUMENTATION

All lines were pegged at a 20 metre station interval. Wooden pegs were placed at every fifth station, numbered front and back. Pink pin flags for even and blue for odd numbered stations were installed between the pegs.

On private property with livestock, wooden pegs were used at every station. Additional pink and black striped flagging was applied to the station marks to indicate zones of threatened species. Additional flagging colours were applied to pegs in areas of line overlap and were noted on the trace maps accordingly.

Several permanent markers placed throughout the project area and were used as GPS base stations and control. These consisted of a 1.65m steel star picket driven to give 1.2m above ground and tagged with an aluminium plate stating the line number and station number or control number details.

The new and existing GPS base stations are listed in **Appendix A - Survey Control and Ties**.

6

METHOD OF SURVEY

6.1 Line Ranging

All lines followed existing tracks or roads. Line trace diagrams were completed in the field for each line. Later these were digitally edited, creating trace maps in mapinfo for use by the crew.

6.2 Manual Chaining

Manual chaining was used for the first few weeks until the Navtrack system, developed specifically for this project, was implemented (See 6.5 Navtrack). All manual chaining was completed by DSS, using a Surveyor and a Survey Assistant.

Manual chaining required a graduated chain (at 20m intervals) to be dragged behind the work vehicle. Once the end of the chain at the last entered station, the survey assistant works towards the vehicle installing the intermediate stations.

6.3 Rapid Elevation Metre (REM)

This instrument consists of a digital-quartz barometer, which models atmospheric conditions during a certain time period of survey observations.

Setting the known Australian Height Datum (mean sea level) height into the REM at a known location allows the surveyor to progress along the seismic line, observing intermediate stations, before closing to another known elevation station. These sections are completed a second time, such that a standard deviation of the data can be computed.

Any points which lie outside a standard deviation of 0.3m are flagged, and a third observation is completed as necessary.

Typically, each run lasts only fifteen minutes, thus allowing for minimal change in atmospheric conditions over a short period of time.

With the introduction of the DSS' Navtrack system, we further improved heights by using the REM in differential mode. This involves a base station REM setup for the purpose of monitoring atmospheric changes and corrections applied to the REM in the vehicle. This system further improves the accuracy of heights in unstable weather conditions, and allows a single pass on all stations.

6.4 GPS Surveying

There are three modes of use in GPS surveying; static, kinematic and real-time kinematic. On assessment, it was decided a real-time kinematic survey utilising OmniSTAR would best enable position and elevation co-ordinates to be acquired in real-time and on the appropriate datum.

The OmniSTAR real-time GPS correction system, used with the Novatel dual frequency receiver, enables the surveyor to operate independently of any existing ground control being of great advantage in hilly, heavily wooded terrain. Utilising phase data received from US Navy NAVSTAR Satellites, the system provides three-dimensional positioning. Corrections for the GPS satellite positions are received from a privately operated source, which transmits them from another satellite. These corrections are applied in real-time to improve position accuracy.

Using this method of positioning, calculation the NovAtel dual frequency real-time kinematic method can achieve accuracies of better than +/-0.3m in position and elevation, depending on satellite constellation geometry.

Using the DSS' in-house developed Nav05 software, checks and ties were examined in real-time operation to assess coordinate integrity.

6.5 Navtrack

Navtrack is a software package developed in-house by DSS for use in areas that GPS satellite coverage is poor, or lost, due to environmental conditions. Navtrack enables traversing between known GPS points, as well as monitoring of data quality while GPS satellite coverage is lost by utilising an electronic compass, survey master and differential REM.

Navtrack allows the surveyor to continue surveying at a much higher production rate in conditions that would normal require manually chaining.

6.6 Processing and Quality Control

After computing horizontal and vertical data, the data is downloaded to the office computer each evening.

The survey data is checked using DSS' MIB Windows software. Any position which falls outside a specified distance or azimuth tolerance is flagged for further investigation and re-recorded if necessary.

Numerous checks on pre-recorded marks were observed during each day's survey. These observations confirm the integrity of the GPS base receiver and the placed markers.

Profile plots are examined to identify any height anomalies.

7

DATA PRESENTATION

All line files were checked and finalised before the survey crew demobilised from the project area.

All final data was in UTM grid coordinate format on the AMG66 datum on the ANS reference spheroid. All elevations were on the Australian Height Datum (AHD71).

Final data was presented in the following file formats:

TB02-XXX.uka	Line data in UKOOA format.
TB02-XXX.seg	Line data in SEGP1 format.
TB02-XXX Map.jpg	Digital mud maps for all lines.

All information is retained in the Yeppoon office for future reference.

8

OPERATIONAL ASPECTS

Working in Tasmania provided some difficult challenges for surveying. The nature of this survey required a lot of zig-zagging back and forth, which was difficult given we were working on public roads.

Logging tracks and poor visibility meant constant use of traffic control was required. This involved everyone being very vigilant of safety at all times. The traffic crew was also required to develop a knowledge of surveying for the operation to run smoothly.

Without detailed field-scouting being carried out, survey was dealing with obstacles as we progressed which, at times, slowed progress significantly. There was difficulty foreseeing problems such as locked gates and bridges with low load limits.

Tasmania, being very hilly and covered with tall thick timber, greatly slowed survey progress using GPS. Decent production was only possible by developing and using surveying innovations such as the Navtrack system.

9

CONCLUSIONS AND RECOMMENDATIONS

Besides the trying conditions for surveying in Tasmania, the greatest challenge was the combination of survey and traffic management crews. DSS, being greatly experienced with completing seismic surveys, was slowed by the inexperienced traffic crews that weren't initially setup correctly for the job. There were a lot of problems with the traffic crews' radio communications, signage and vehicles.

Basic training of the traffic crew in seismic survey procedures was also required. There was conflict between the two crews, as several tasks required were activities not normally faced on the usual static road jobs.

Once the tasks were addressed, it was a matter of the traffic crews adapting their setup so these tasks could be performed safely. The job flowed smoothly after the initial problems were corrected.

Performing this work in central Tasmania during the winter provided poor weather conditions and increased safety risks. A great deal of time was lost from weather conditions not allowing work on the road, and increased above-normal travel times.

Significant savings could be made by better planning and scouting of lines. For future surveys of this nature, a DSS surveyor should scout the lines, and give recommendations before pegging the lines, thus only one person is used, rather than having the survey team and traffic management held up waiting for decisions on difficult lines.

The project would have been achieved with far less down time if operations could have been undertaken in more favourable weather, however this may not always be possible when financial and legals requirements are considered.

Unfortunately, an extensive lead that was left un-recorded by the crew because of the unforseen changes in to the main crews schedule.

Overall, given the very difficult and trying conditions, the survey crew managed to successfully maintain a lead, overcome the obstacles faced, and complete the work in a timely and safe manner.

The new DSS NAVTRACK system proved to be outstanding by more than doubling effective survey production, with not extra personnel required.

Ben Allsopp

Senior Surveyor

10

APPENDICES

Survey Control

Survey Control

Coordinates are AMG66, Zone 55

Elevations are AHD71 using AusGeoid98 N Values

CONTROL STATIONS USED

Station	Easting (AMG66)	Northing (AMG66)	Height (AHD)
SPM718	476013.612	5296427.231	89.579
SPM724	476295.667	5298034.428	92.212
SPM8689	526083.806	5317695.531	443.114
SPM8799	475623.75	5297364.034	116.074
SPM8847	452443.279	5330716.089	646.733
SPM9000	471961.105	5301103.356	230.184
SPM10213	500599.396	5307730.902	353.703
SPM10215	499147.49	5307415.304	348.344
SPM10586	473819.844	5352814.581	1040.88

NEW STATIONS INSTALLED

Station	Easting (AMG66)	Northing (AMG66)	Height (AHD)
BB1715	466949.84	5289094.92	733.77
BBTP01	470526.94	5291796.29	258.87

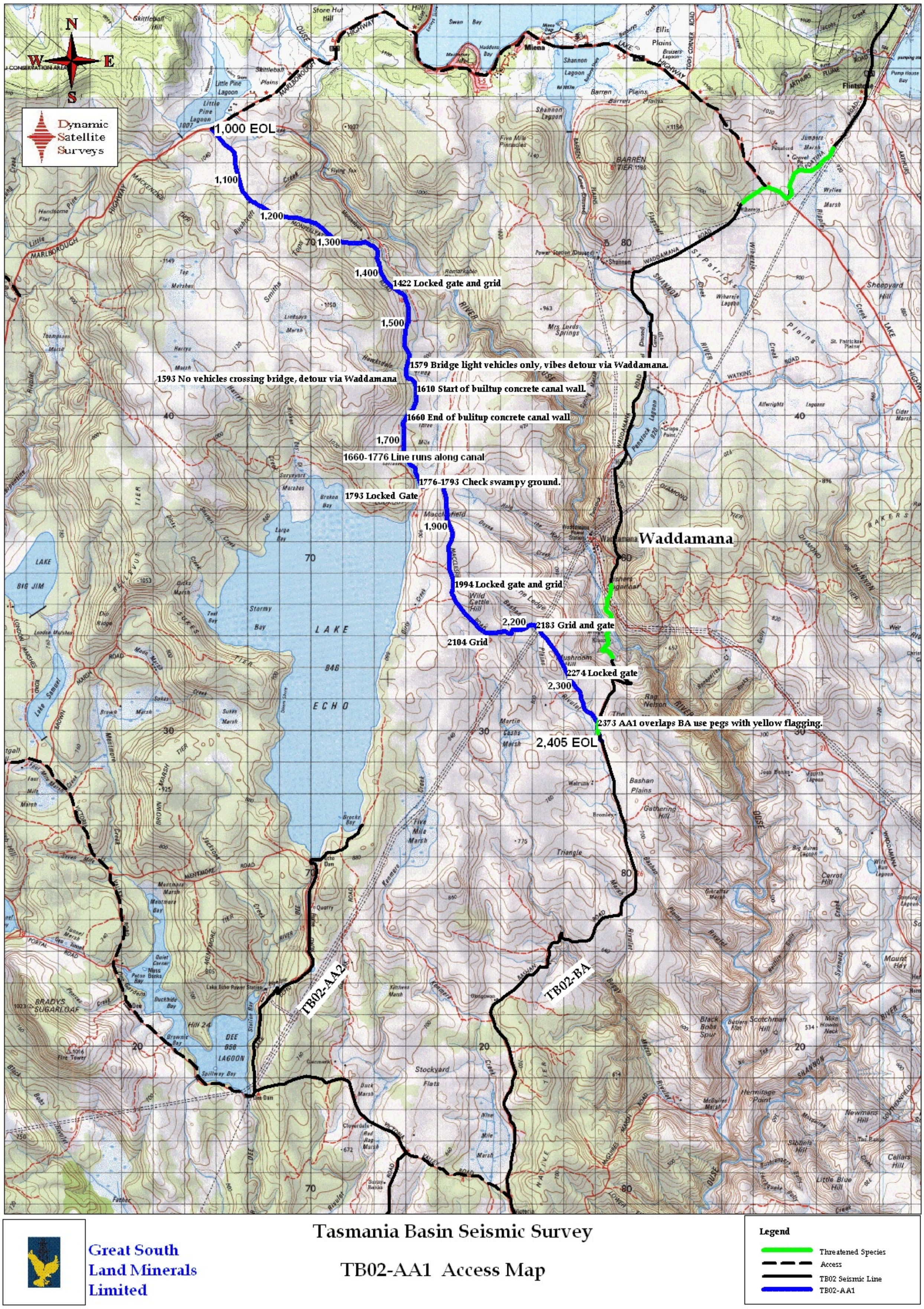
Line Length Summary

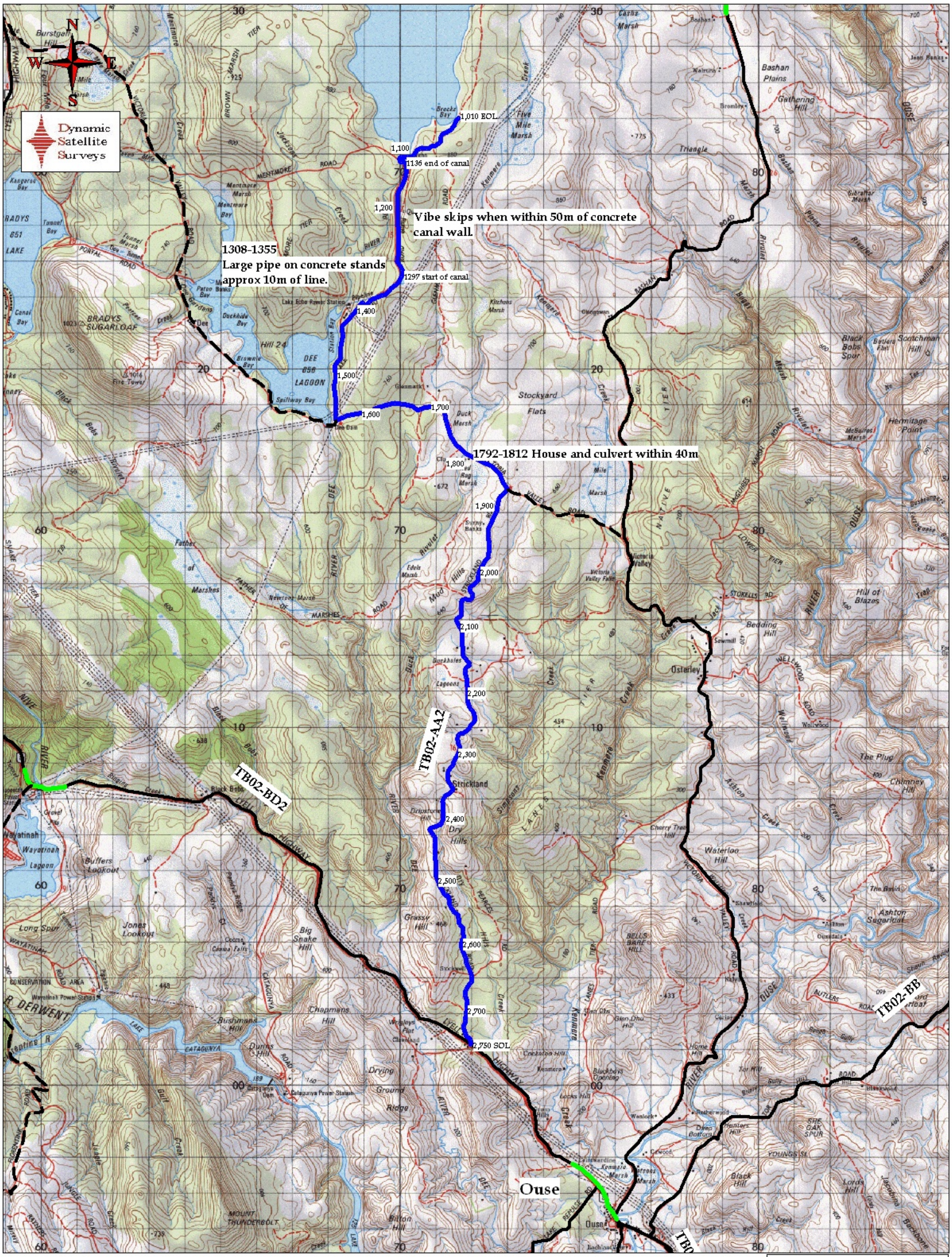
Line Length Summary

Station Interval = 20.0 metres

Line Name	Start	End	Distance
TB02-AA1	1000	2405	28.10
TB02-AA2	1010	2750	34.80
TB02-BA	131	5467	106.72
TB02-BB	149	6019	117.40
TB02-BD1	1000	1711	14.22
TB02-BD2	1000	2906	38.12
TB02-BG1	1000	2257	25.14
TB02-BH	1000	2855	37.10
		TOTAL	**401.60**

Trace Maps


N
S
W
E
Dynamic
Satellite
Surveys
1,000 EOL
1,100
1,200
1,300
1,400
1422 Locked gate and grid
1,500
1579 Bridge light vehicles only, vibes detour via Waddamana.
1593 No vehicles crossing bridge, detour via Waddamana
1610 Start of builtup concrete canal wall.
1660 End of bulitup concrete canal wall
1,700
1660-1776 Line runs along canal
1776-1793 Check swampy ground.
1793 Locked Gate
1,900
Waddamana
1994 Locked gate and grid
2,200
2183 Grid and gate
2104 Grid
2274 Locked gate
2,300
2373 AA1 overlaps BA use pegs with yellow flagging.
2,405 EOL
LAKE
ECHO
TB02-AA2
TB02-BA
Great South
Land Minerals
Limited
Tasmania Basin Seismic Survey
TB02-AA1 Access Map
Legend
Threatened Species
Access
TB02 Seismic Line
TB02-AA1



Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-AA2 Access Map

Legend

- Threatened Species
- Access
- TB02 Seismic Line
- TB02-AA2

Tasmania Basin Seismic Survey

TB02-BA Access Map A

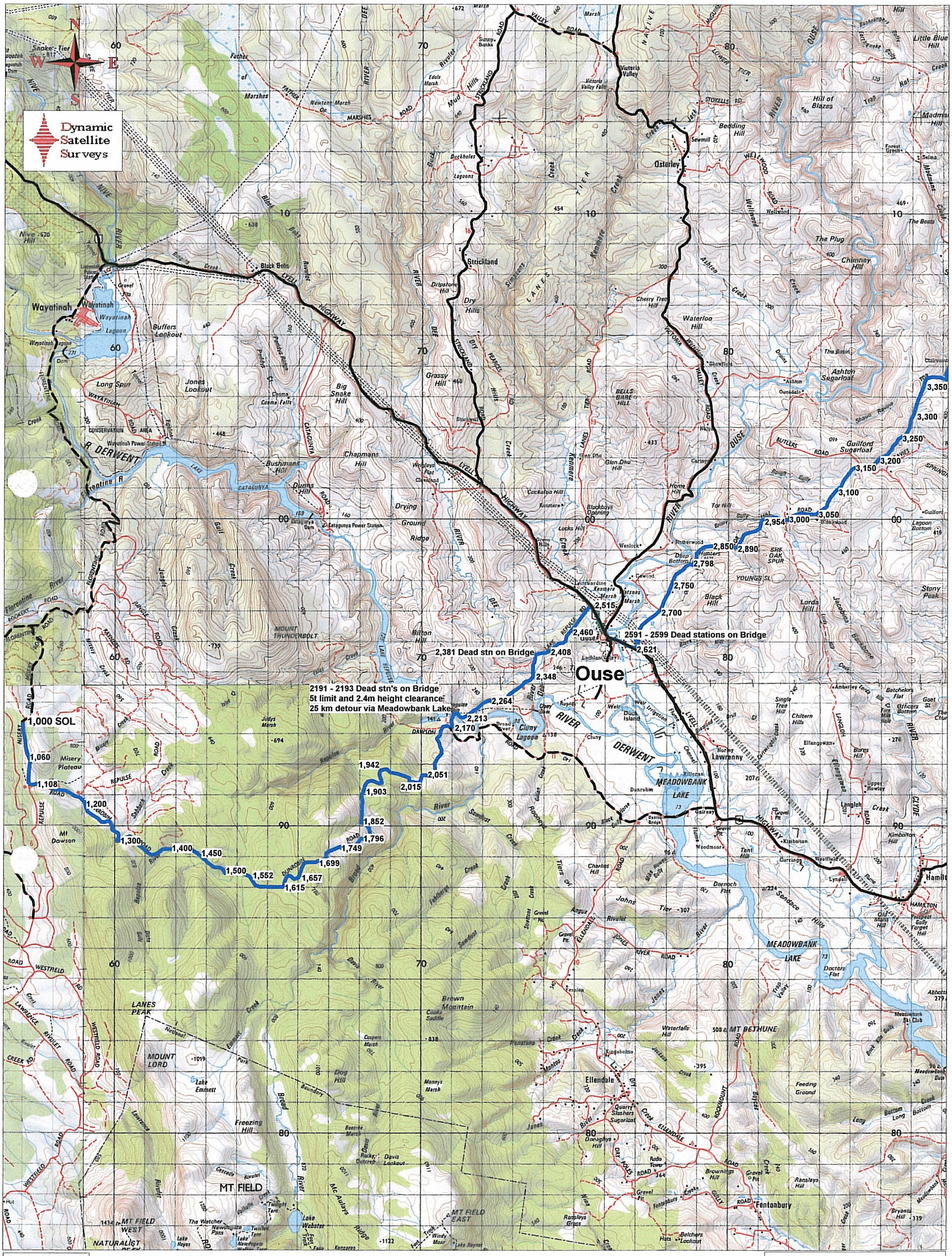
Great South Land Minerals Limited

Legend

- Threatened Species
- Access
- TB02-BA

Tasmania Basin Seismic Survey

TB02-BA Access Map B



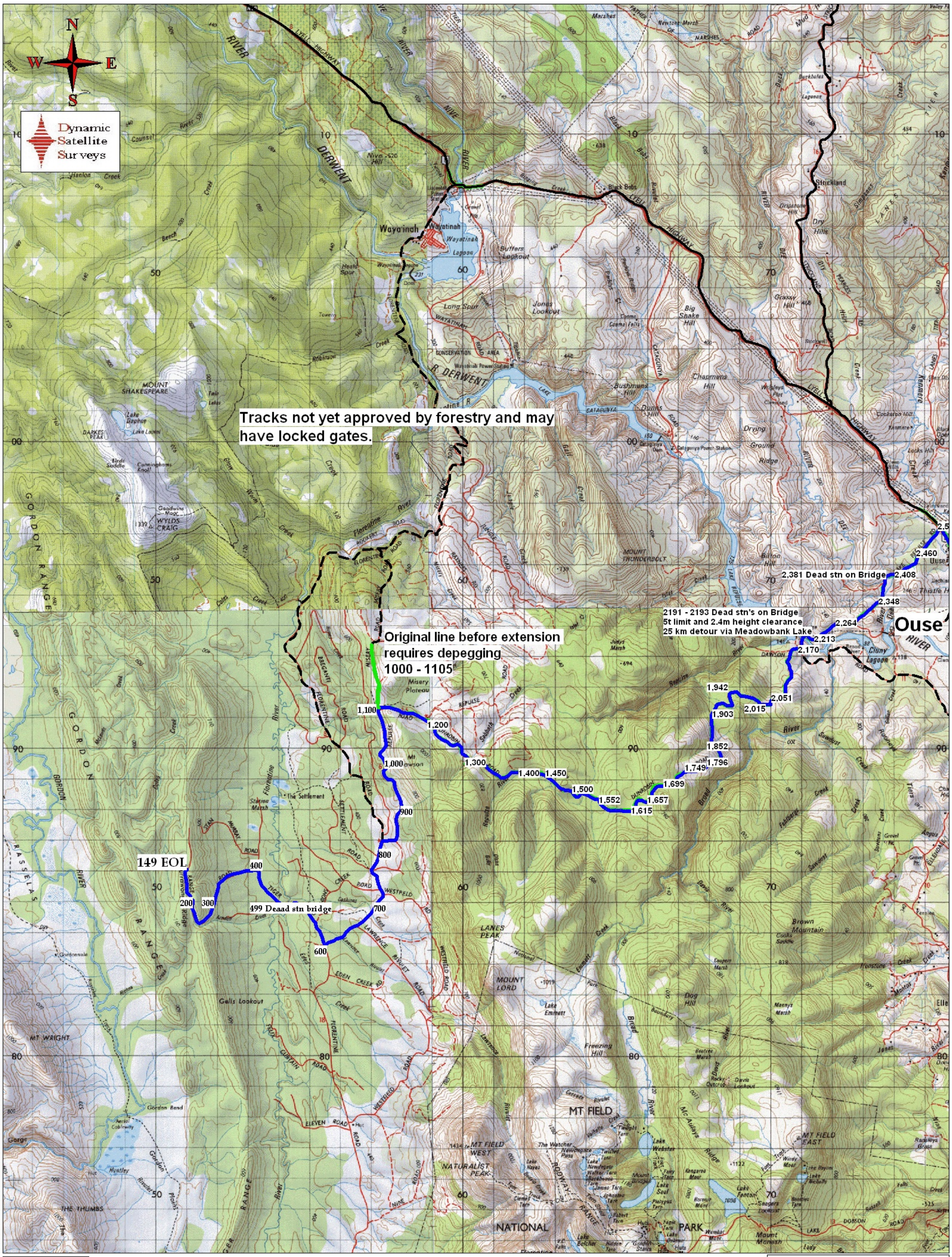
Tasmania Basin Seismic Survey

TB02-BB Access Map A

Great South Land Minerals Limited

Legend

- Threatened Species
- Access
- TB02-BB
- TB02 Seismic Lines



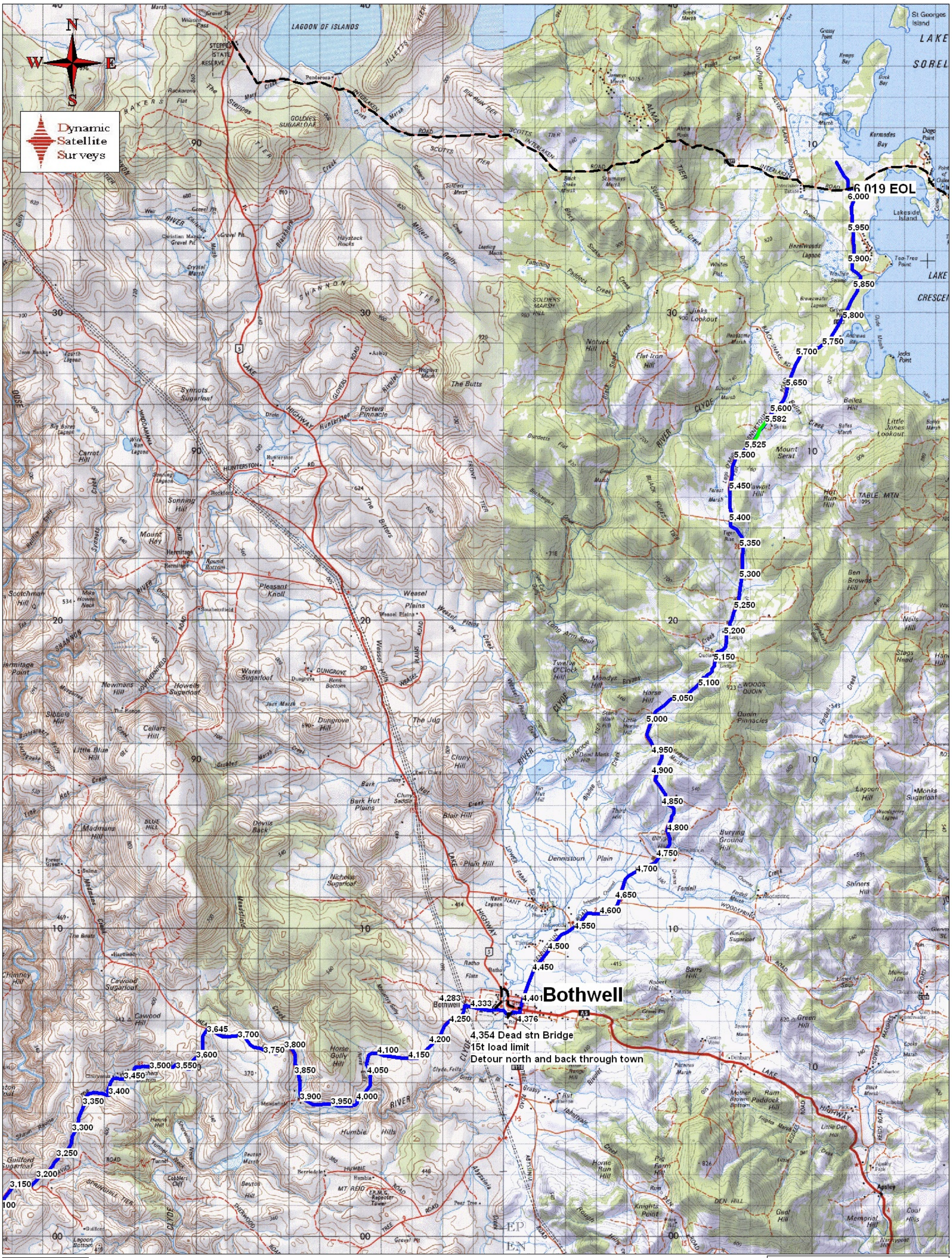
Tasmania Basin Seismic Survey

TB02-BB Access Map A (Extension)

Great South Land Minerals Limited

Legend

- Threatened Species
- Access TB02-BB
- TB02 Seismic Lines



Great South
Land Minerals
Limited

Tasmania Basin Seismic Survey

TB02-BB Access Map B

Legend

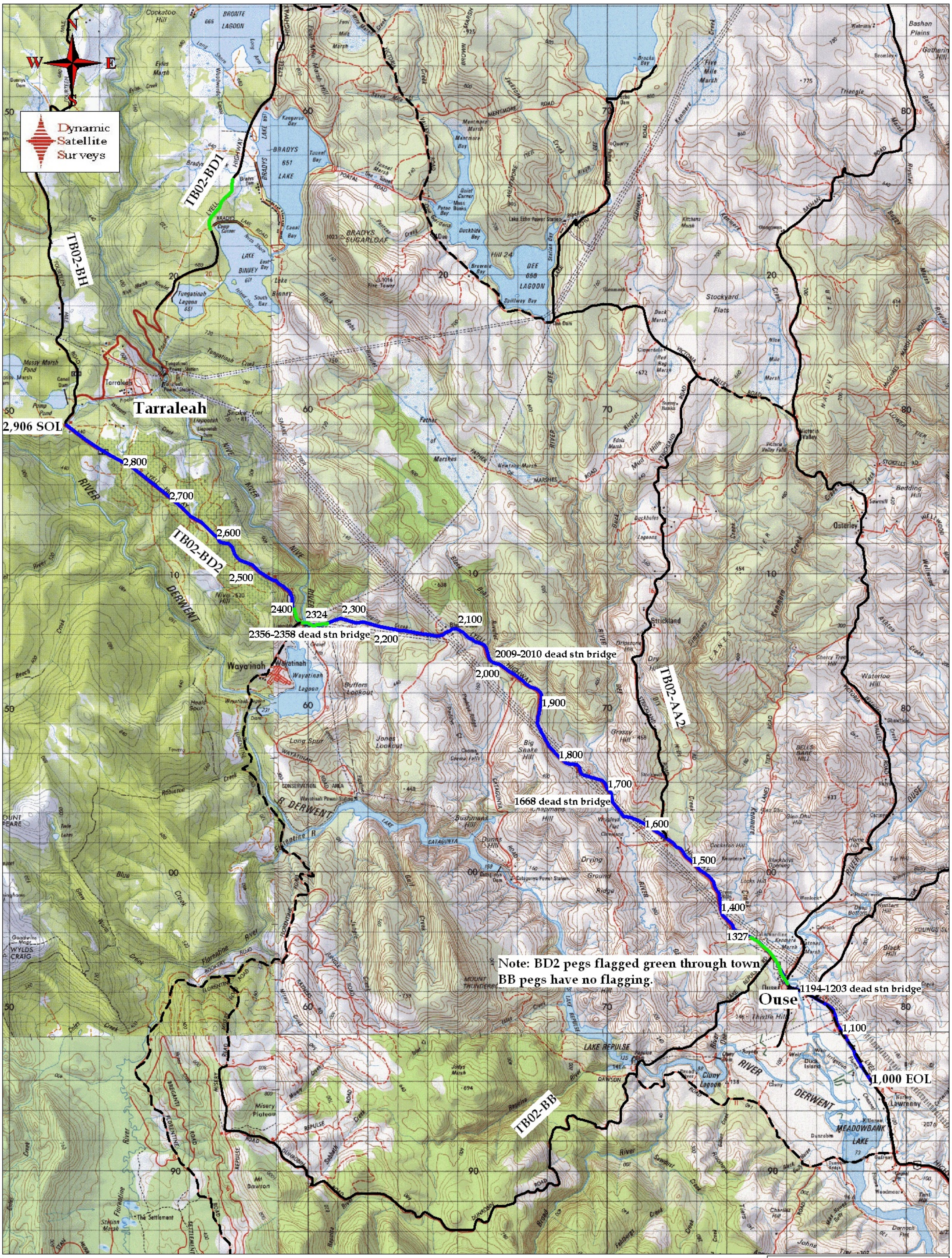
- Threatened Species
- Access
- TB02-BB
- TB02 Seismic Lines

Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-BD1 Access Map

Legend
- Threatened Species
- Access
- TB02 Seismic Line
- TB02-BD1



Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-BD2 Access Map

Legend	
(green line)	Threatened Species
(dashed line)	Access
(black line)	TB02 Seismic Line
(blue line)	TB02-BD2

Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-BG1 Access Map

Legend

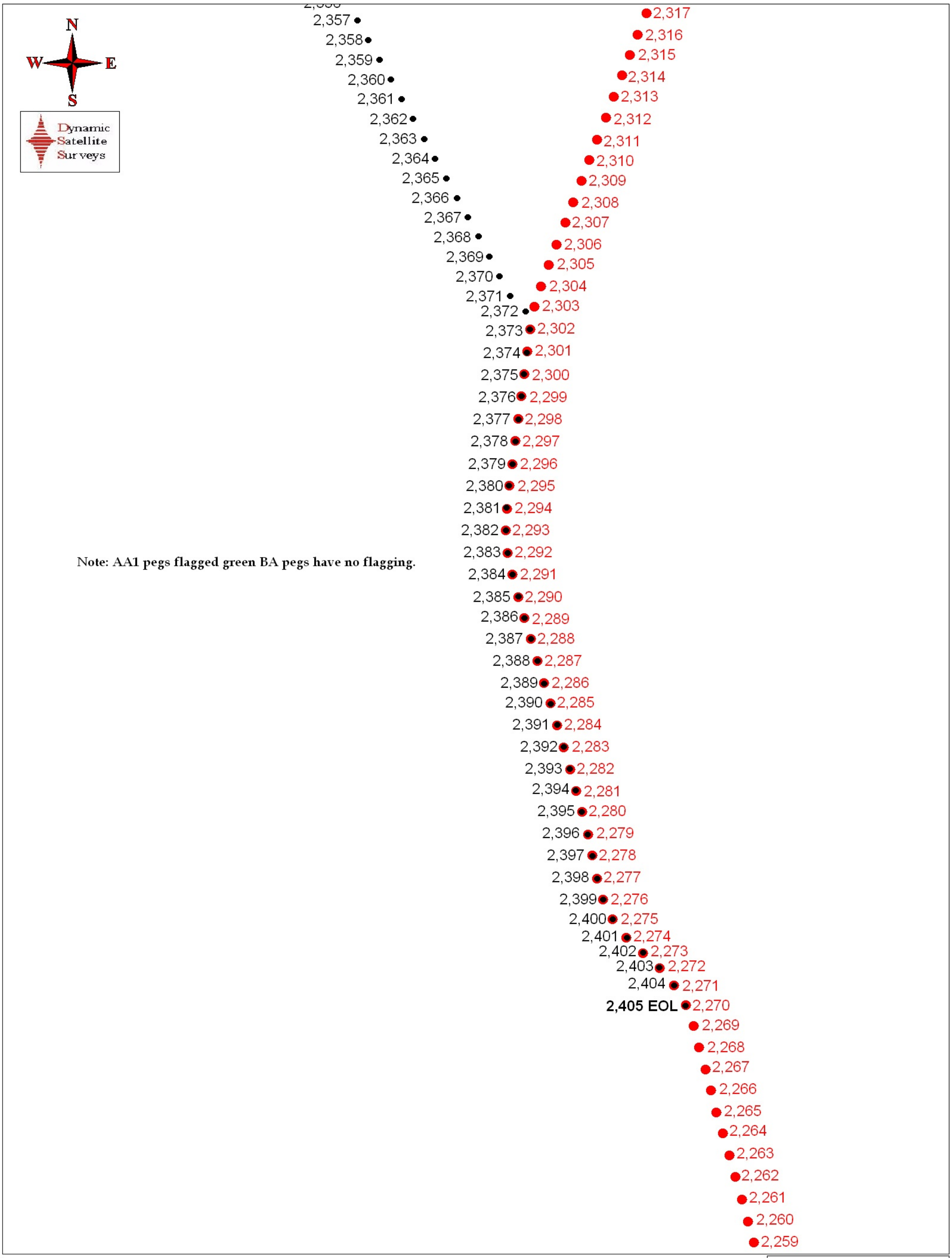
- Threatened Species
- Access
- TB02 Seismic Line
- TB02-BG1

Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-BH Access Map

Legend
- Threatened Species
- Access
- TB02 Seismic Line
- TB02-BH

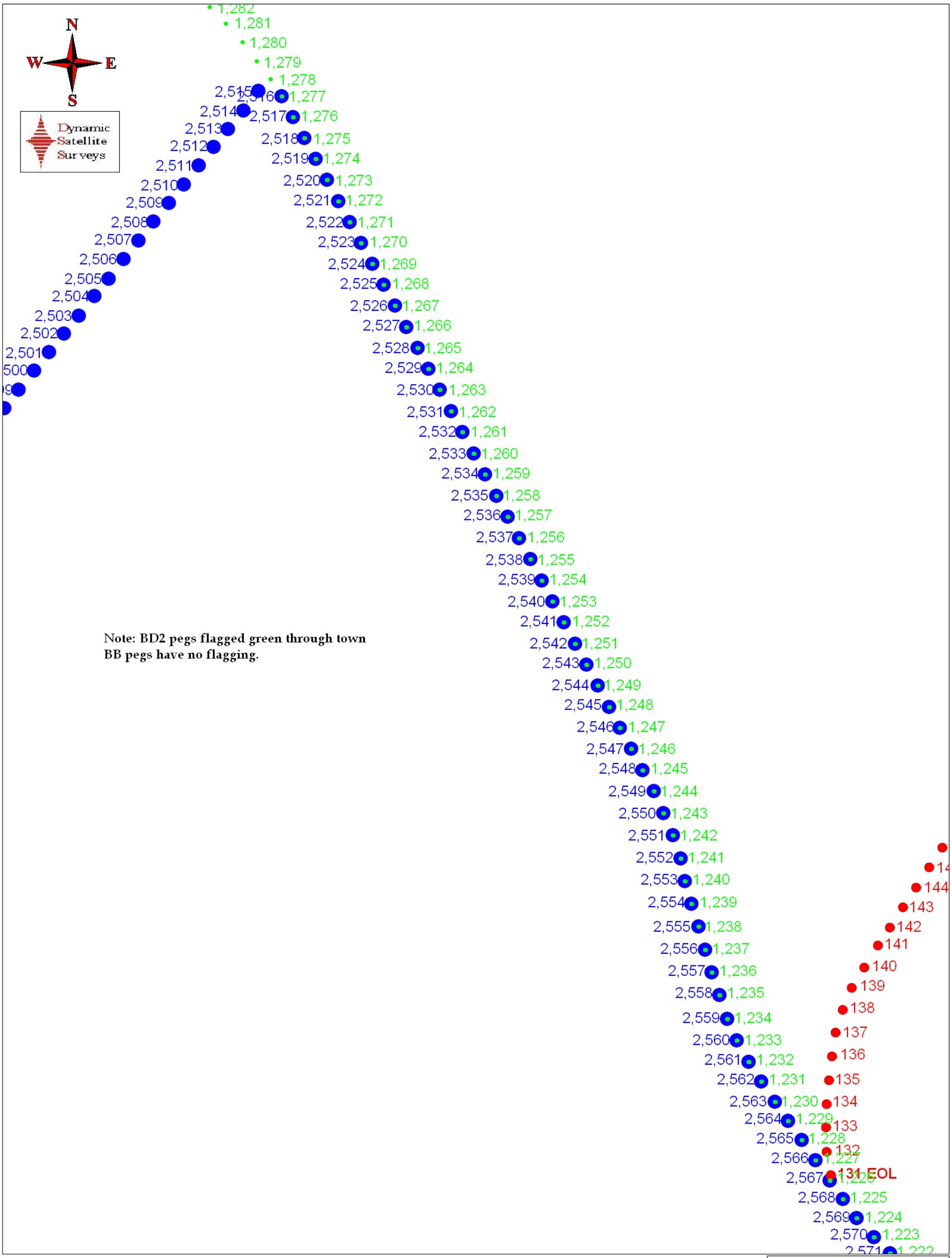


Great South Land Minerals Limited

Tasmania Basin Seismic Survey

TB02-AA1 overlap on TB02-BA

Legend
- TB02-BA
- TB02-AA1

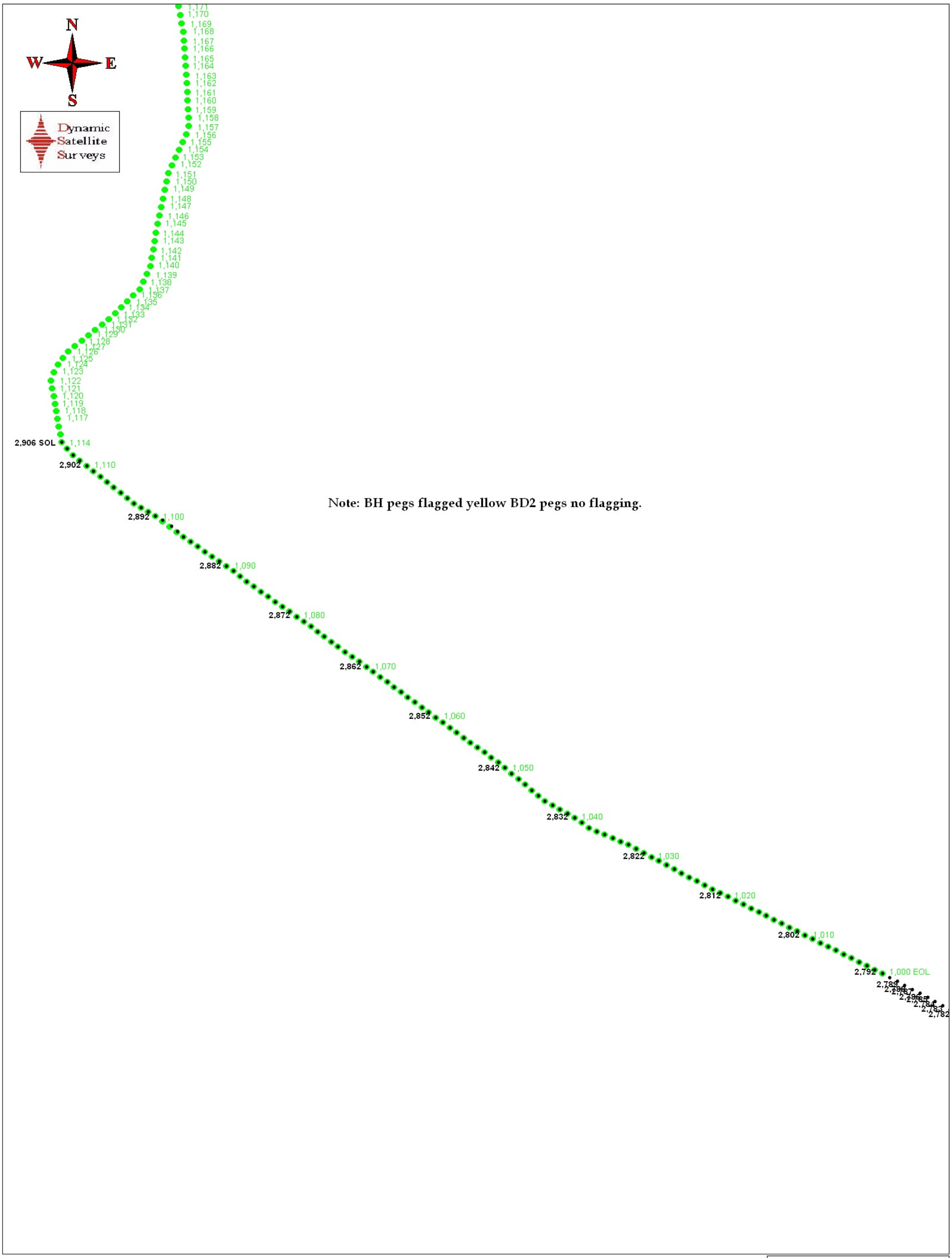


Tasmania Basin Seismic Survey

Ouse Line Crossings Map

Legend

- TB02-BD2
- TB02-BA
- TB02-BB



Great South Land Minerals Limited

Tasmania Basin Seismic Survey

BH/BD2 Line Overlap Map

Legend

- TB02-BD2
- TB02-BH

Photographs


062 IOH


SURVEY


SURVEY
PREPARE TO STOP
SURVEY