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MURPHY URANIUM

GOBLIN PROSPECT: RESULTS OF

TRANSIENT ELECTROMAGNETIC SURVEY

JUNE 2012

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SUMMARY

The transient electromagnetic (TEM) survey carried out at Goblin in June 2012 was planned to detect any sizeable body of conductive sulphide mineralisation that might be associated with the prominent magnetic anomaly here. The anomaly is long and narrow and suspected of being caused by a feeder zone for mafic volcanic flows. Modelling suggested the source is steeply dipping with depth to top of 230-340 m.

The moving in-loop method was chosen for a survey consisting of nine traverses 1500 m long spaced 500 m apart, laid out across the strongest section of the magnetic anomaly.

Zonge Engineering and Research Organization Australia was contracted to carry out the survey, using a powerful Zonge transmitter and an EMIT Smartem receiver. A three-component fluxgate sensor and an RVR coil sensor were used at all stations.

Stacked profile plots for different sets of delay times show variations in response over the area, but no clear anomalies. Some weak, possibly anomalous, features in the RVR data are only partly supported by the fluxgate data, which are generally more noisy.

Conductivity quasi-sections and depth slices, made up from conductivities calculated from the RVR data using an approximate image method, provide a picture of the ground structure. This appears to consist of a thin conductive layer at the surface (black soil and weathered material), with resistive (ie much less conductive) rock beneath. Deep (100-400 m) conductivity patterns may relate broadly to the bedrock geology as indicated by magnetic anomalies, with the main magnetic zone appearing to be less conductive. The conductivity sections and plans do not reveal any anomalies indicative of conductive mineralisation.

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INTRODUCTION

A transient electromagnetic (TEM) survey was carried out at Goblin in order to discover any signs of conductive sulphide mineralisation that may be associated with the magnetic anomaly here. Modelling had suggested the magnetic source was likely to be steeply dipping with the depth to top between 230 m and 340 m. The anomaly is long and trends north-northwest – south-southeast so the survey was laid out on a local grid, with several traverses run across the anomaly and covering a strike extent of 4 km.

The moving in-loop method was chosen as suitable for the target and area to be surveyed. Zonge Engineering and Research Organization Australia was contracted to carry out the survey. Zonge provided a 30 kVA GGT-30 transmitter with generator, EMIT Smartem24 receiver, two induction coil sensors (RVR and TEM-3) and a 3-component fluxgate sensor.

This report presents the survey results and discusses indications of ground structure.

SURVEY

The TEM survey at Goblin consisted of nine 1500 m long traverses spaced 500 m apart, with a station interval of 100 m. The layout is shown together with the magnetic anomaly in Fig 1.

The weaker magnetic responses in the area are thought to come from Antrim Plateau basalts. These commonly exhibit what appear to be ‘holes’ or ‘windows’, such as the roughly ovoid magnetic low to the northeast of the survey grid. The strong narrow positive anomalies at Goblin form part of a long sinuous feature that may represent a feeder zone for the volcanics.

The central point of the local survey grid, at 1750E and 52000N, corresponds to 575750E, 8039950N MGA (GDA94) zone 53. Local north is 37^0 west of MGA north.

An earlier survey design was for 100 m loops, but this was changed to 200 m loops to increase the depth of exploration. However, the contractor began the work and read the first three traverses using the earlier design with 100 m loops. Progress was slow, due to rough ground and some areas of thick scrub, and although some tests were carried out with 200 m loops it was decided to continue with the 100 m loop size in order not to extend the time for the survey. The smaller loops should still be effective, as they used two turns with a high transmitter current of 25-30A.

The first part of the survey was also read using two induction coil sensors and a fluxgate sensor. A previous survey at UC19 had shown that the TEM-3 coil used there produced spurious late time ‘tails’, and interpretation etc had to be restricted to delay times up to about 7 ms. The same behaviour was observed at Goblin. An RVR coil brought up to be used at Goblin gave more acceptable late time data, however, consistent with the fluxgate measurements, and this coil and the fluxgate were used for the entire Goblin survey. As no anomalous indications were found, the survey was completed as designed, with no follow-up or fill-in work.

RESULTS

(a) Profile plots

The results from the survey are presented in the form of plans of stacked profiles in Plans 2-8. All but Plans 5 and 7 are for data from the RVR coil sensor. Plans 5 and 7 show signals from the fluxgate to provide a comparison.

In Plan 2 the RVR responses from channel 6 (0.3 ms delay time) to the last channel (35, at 156 ms) are plotted with arcsinh scaling (close to logarithmic for the larger signals, at early and mid times, and nearly linear for small signals, at late times). These results suggest only broad variations over the area of the survey.

Plans 3-8 are linear plots starting at progressively later delay times. In Plan 3 the first RVR profiles (top in each stack) are for 2.6 ms and these highlight the stronger early time response on the second and third traverses from the south. In Plan 4 the first RVR profiles are at 7.6 ms and there appears less variation across the area. Plan 5 depicts the fluxgate profiles also beginning at 7.6 ms. The same trends are evident as for the RVR but the measurements are noisier.

Plan 6 shows RVR profiles from 14.5 ms, when some sign of any good conductors displaying slower decays can be expected. Of possible interest is a double peak feature at the western end of the central traverse line, and an increasing response at the eastern end of the northernmost traverse. Fluxgate data for the same delay times are plotted in Plan 7. Again these are noisier than the RVR readings. They do not support a possible anomaly at the western end of the central line but there are signs of an increase at the eastern end of the northernmost line.

The latest times are shown in Plan 8, for signals from 22.3 ms and later. These are RVR measurements and show the signals are falling to the noise levels. The possible weak anomalies on the central and northernmost lines are still evident but only just above noise levels. Variations in noise are apparent over the area of the survey. These may be due to variations in ambient electrical noise (sferics) and to differences in the amount of wind causing sensor vibration.

(b) Conductivity-depth patterns

The voltage decays measured with the RVR coil have been converted to apparent conductivity versus depth by an approximate image method. This assumes a one-dimensional ground structure and uses a simple relation between the decay of the eddy current in the ground (as represented by a receding image of the transmitter) and the cumulative conductivity-thickness. Sections made up from the conductivity-depth values for each station along the traverses are shown in Plan 9.

The conductivity quasi-sections indicate that the ground consists of a thin conductive layer at the surface, overlying rocks of low conductivity (high resistivity). Elevated early time signals seen on the second and third traverses from the south (profiles in Plan 3) correspond to a more conductive surficial layer here. The conductive layer is thought to consist of black soil and the weathered zone beneath this.

In sections like those of Plan 9 good local conductors, such as semi-massive sulphide mineralisation, are expected to show up as deeper zones of anomalously high conductivity. Slightly elevated conductivities at depth are evident at the western end of the central traverse and at the eastern end of the northernmost line. These features are consistent with the possible anomalies seen in late time profile plots (Plans 6 and 8). However, they are very weak and poorly defined and are not considered to be significant. They also are not associated with the central magnetic anomaly.

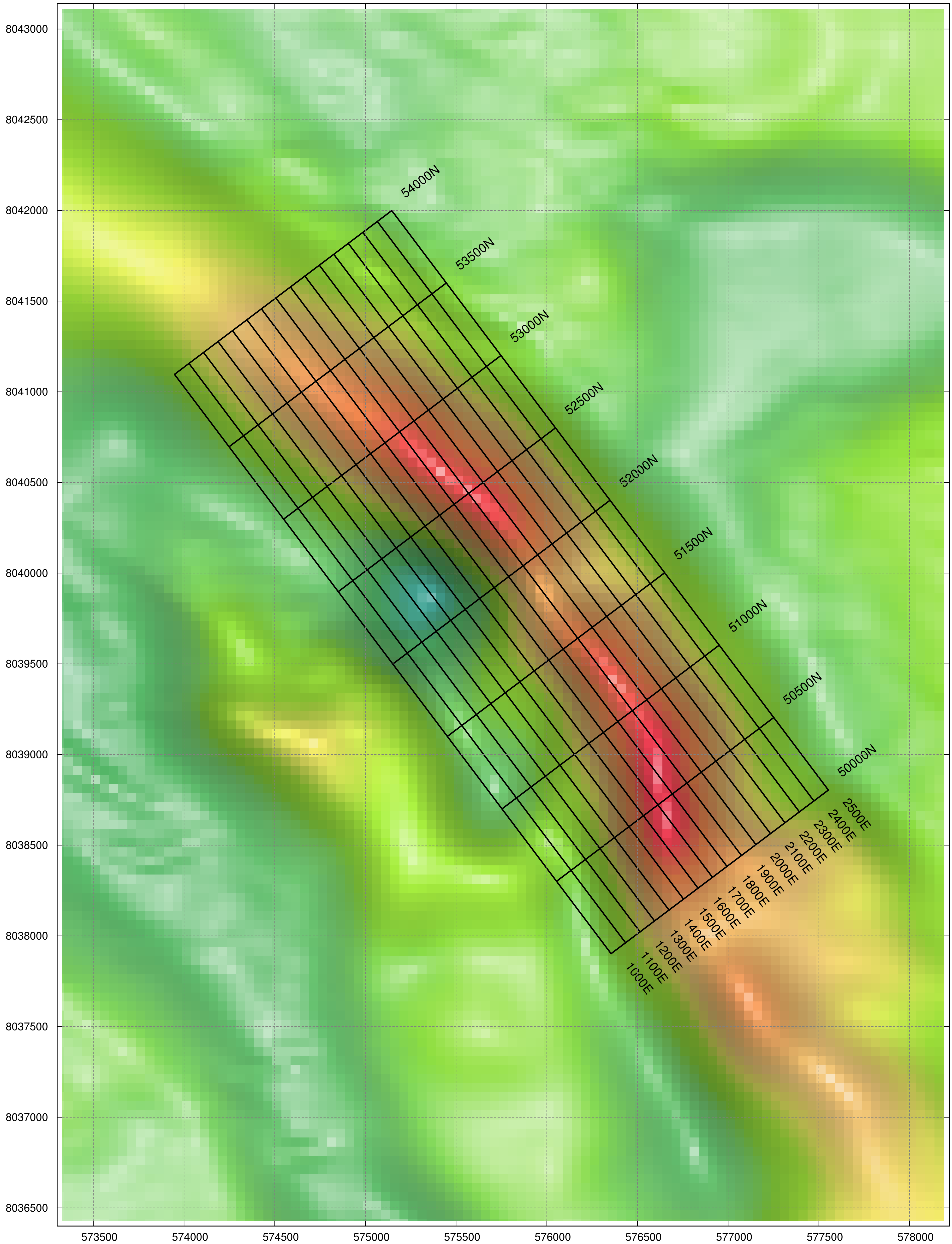
Two conductivity depth slices have been derived from the conductivity-depth data. Plan 10 shows the average estimated conductivity for 0-50 m below the surface and Plan 11 shows the averaged conductivity for 100-400 m below the surface. Colours for the conductivities are like those used in the sections. The shallow slice illustrates variations in the cover. These bear little relation to geological features as indicated by the magnetic responses. The deep slice shows some tendency to reflect in reverse the shallow slice (for example in the south there are unusually low conductivities beneath an area of higher shallow conductivity values). There is also a rather vague correspondence with the magnetic anomalies. The main magnetic zone appears to be characterised by low conductivity while the magnetic low in the western central area is associated with slightly elevated conductivities. However, as expected from the sections, there are no high conductivity anomalies evident in the deep slice.

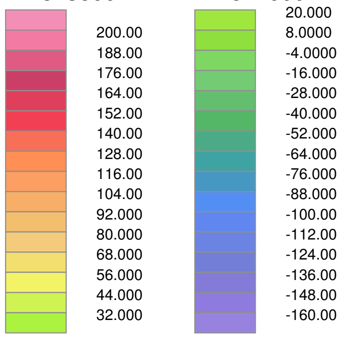
CONCLUSION

The TEM survey at Goblin provided a test for the presence of conductive sulphide mineralisation, based on a target zone over 200 m deep and several hundred metres long. Use of the high power Zonge 30 kVA transmitter and an RVR induction coil sensor provided good sensitivity for the weak late time signals expected from such a target. Although 200 m loops would have been preferable to maximise the depth of exploration, the 100 m loops used should have been effective and were significantly faster to lay out.

Profile plots show moderate variations over the survey but no obviously anomalous zones. In a couple of areas there are weak late time ‘highs’ that are not much above the noise levels.

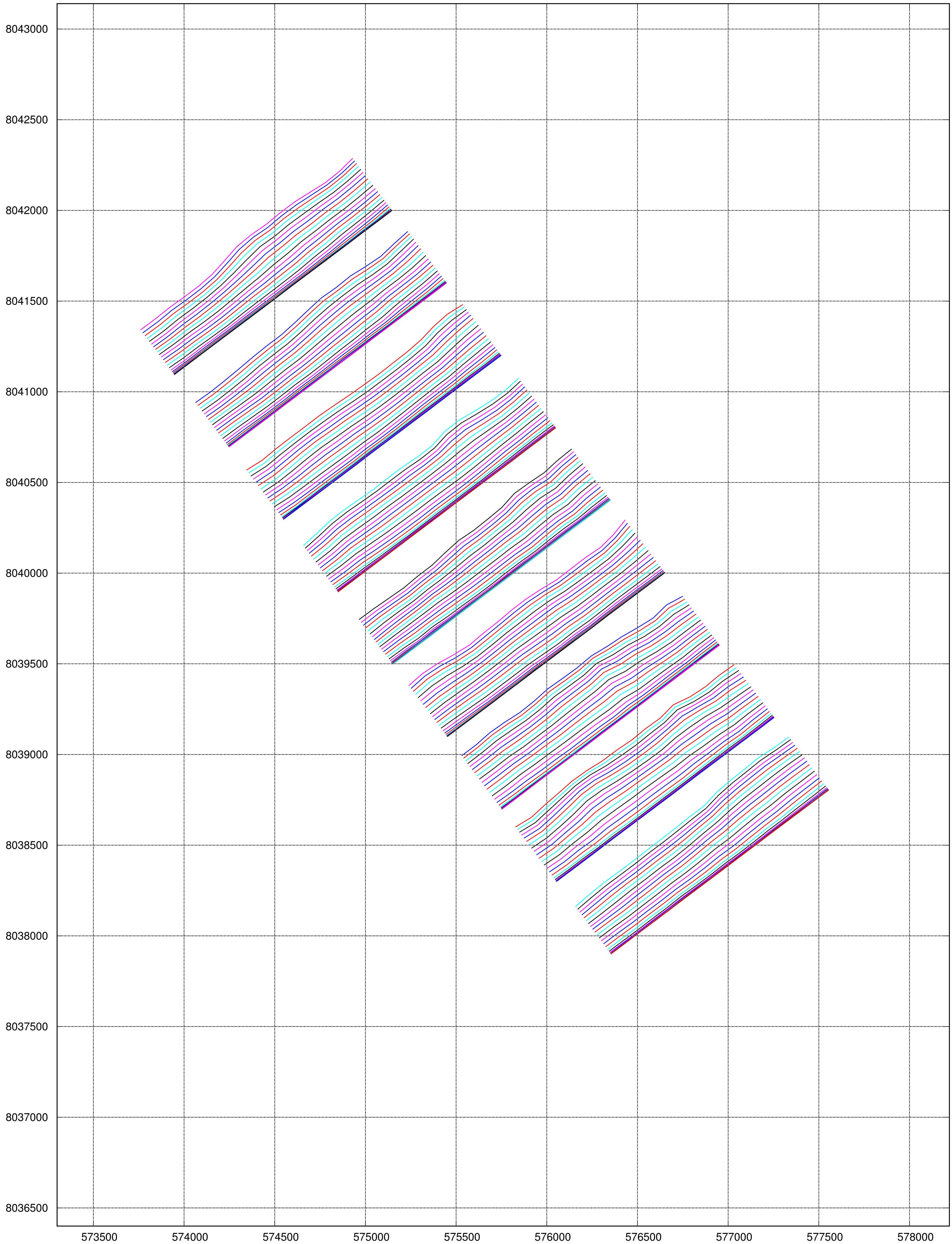
Transformation of the voltage-time measurements to conductivity-depth, using an approximate image method, is useful for gaining an idea of ground structure and highlighting any buried zones of high conductivity. At Goblin conductivity quasi-sections show that the TEM responses come mainly from a thin conductive surficial layer. Both the sections and depth slices of averaged conductivity show variations in the cover and in the rocks beneath. The deeper patterns show some relation to the magnetic anomalies but no clear evidence of any body of conductive mineralisation.





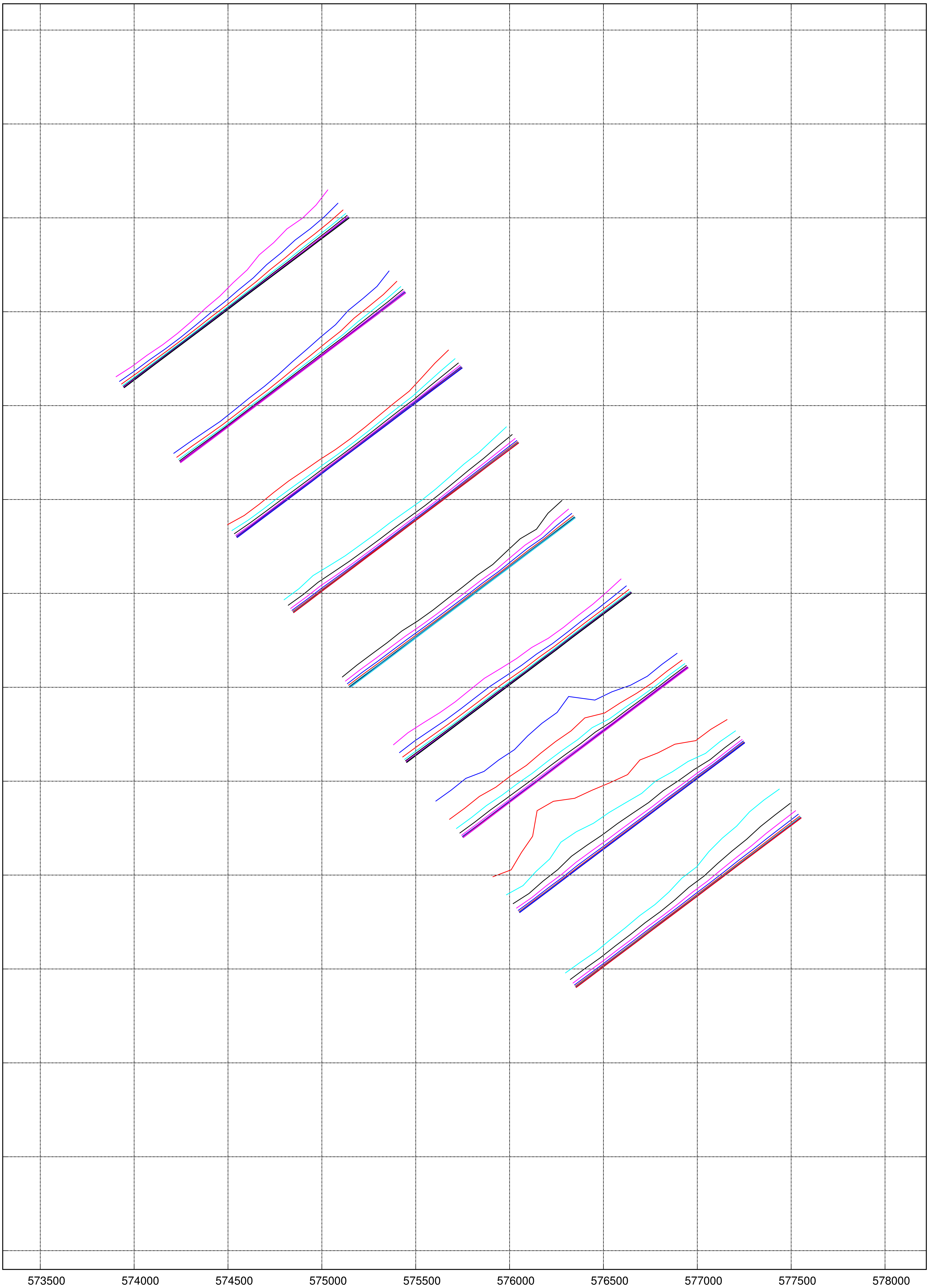
This plan shows the layout for a transient electromagnetic [TEM] survey on a local skew grid. Local north is 37 degrees west of MGA north. The TEM survey consists of traverses on 50000N, 50500N, etc. to 54000N, with stations on each traverse at 1000E, 1100E, etc. to 2500E.
The background image shows magnetic responses from an airborne survey. Colours indicate values in nT of the difference between the total intensity reduced to the pole at survey level and continued upward 5000 m.
Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT LAYOUT FOR TRANSIENT ELECTROMAGNETIC SURVEY	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	1
DRAWN JHC	



These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 0.3 - 156 ms.
Scale: arcsinh, 3 units to 100 m.
Sensor: RVR coil.
Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: RVR PROFILES FOR DELAY TIMES 0.3 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	2
DRAWN JHC	



These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 2.6 - 156 ms.
Scale: 25 microvolts/amp to 100 m.
Sensor: RVR coil.
Coordinates: MGA [GDA94] zone 53.

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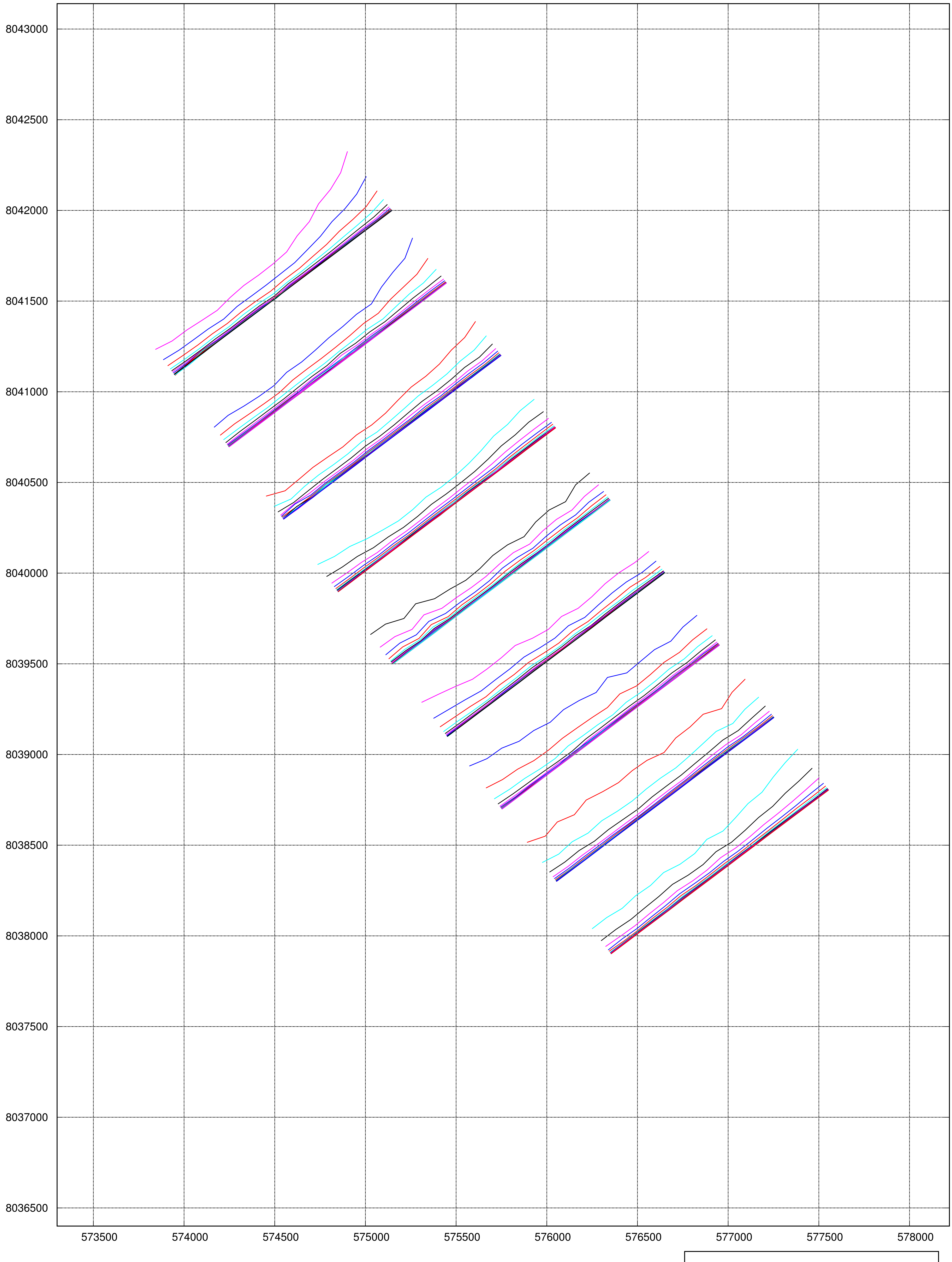
GOBLIN PROSPECT TEM SURVEY: RVR PROFILES FOR DELAY TIMES 2.6 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	3
DRAWN JHC	



These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 7.6 - 156 ms.
Scale: 0.6 microvolt/amp to 100 m.
Sensor: RVR coil.
Coordinates: MGA [GDA94] zone 53.

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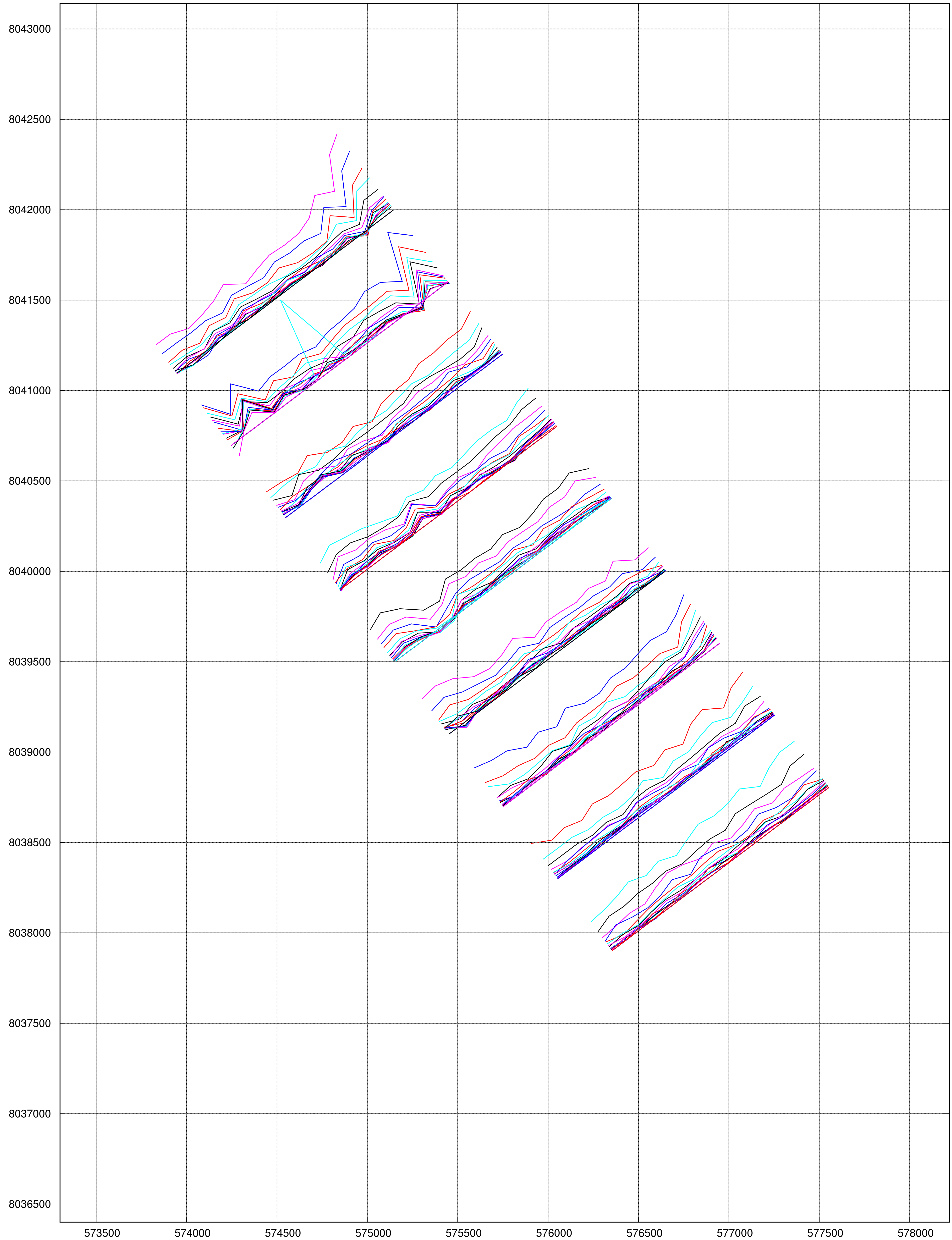
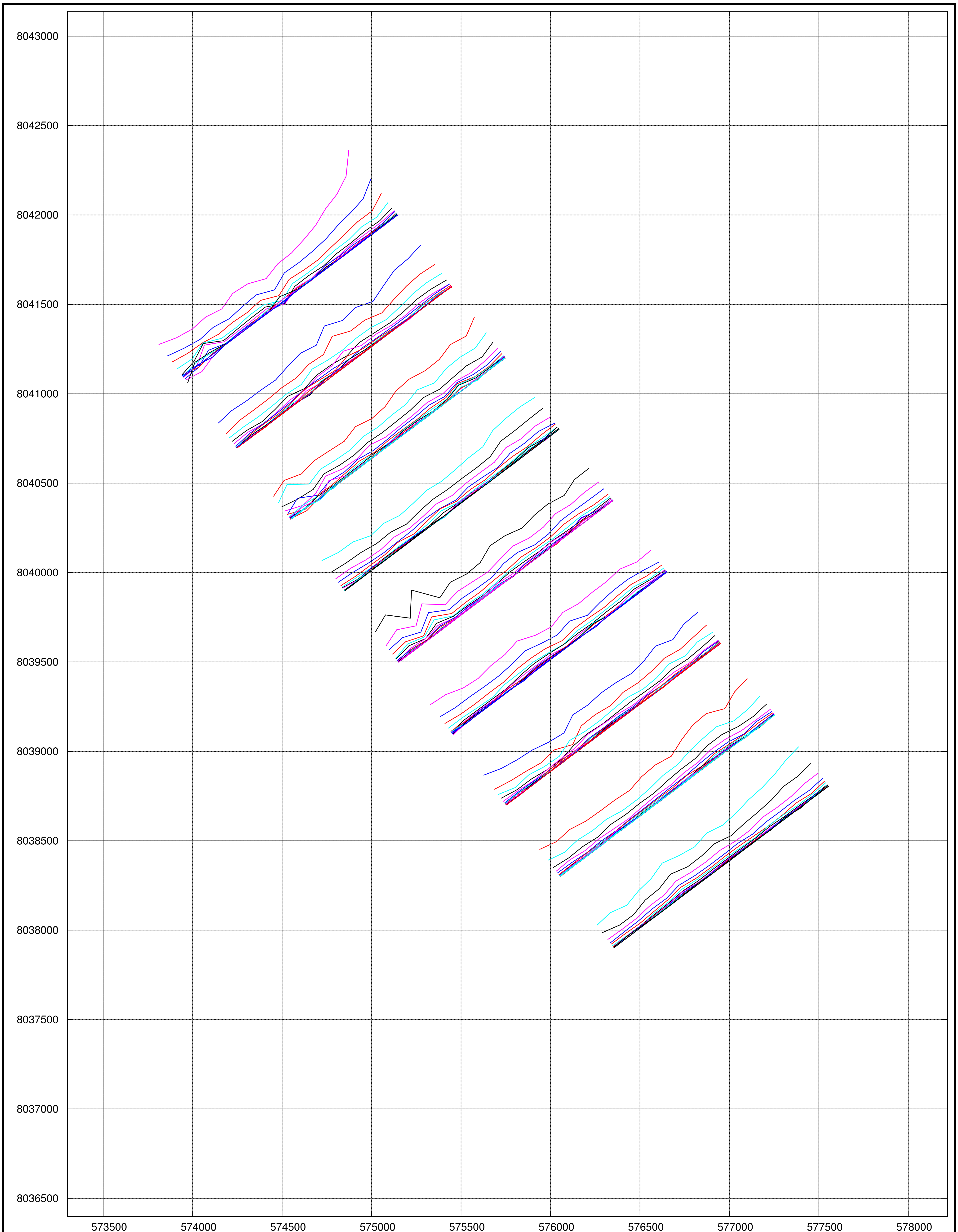
GOBLIN PROSPECT TEM SURVEY: RVR PROFILES FOR DELAY TIMES 7.6 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	4
DRAWN JHC	



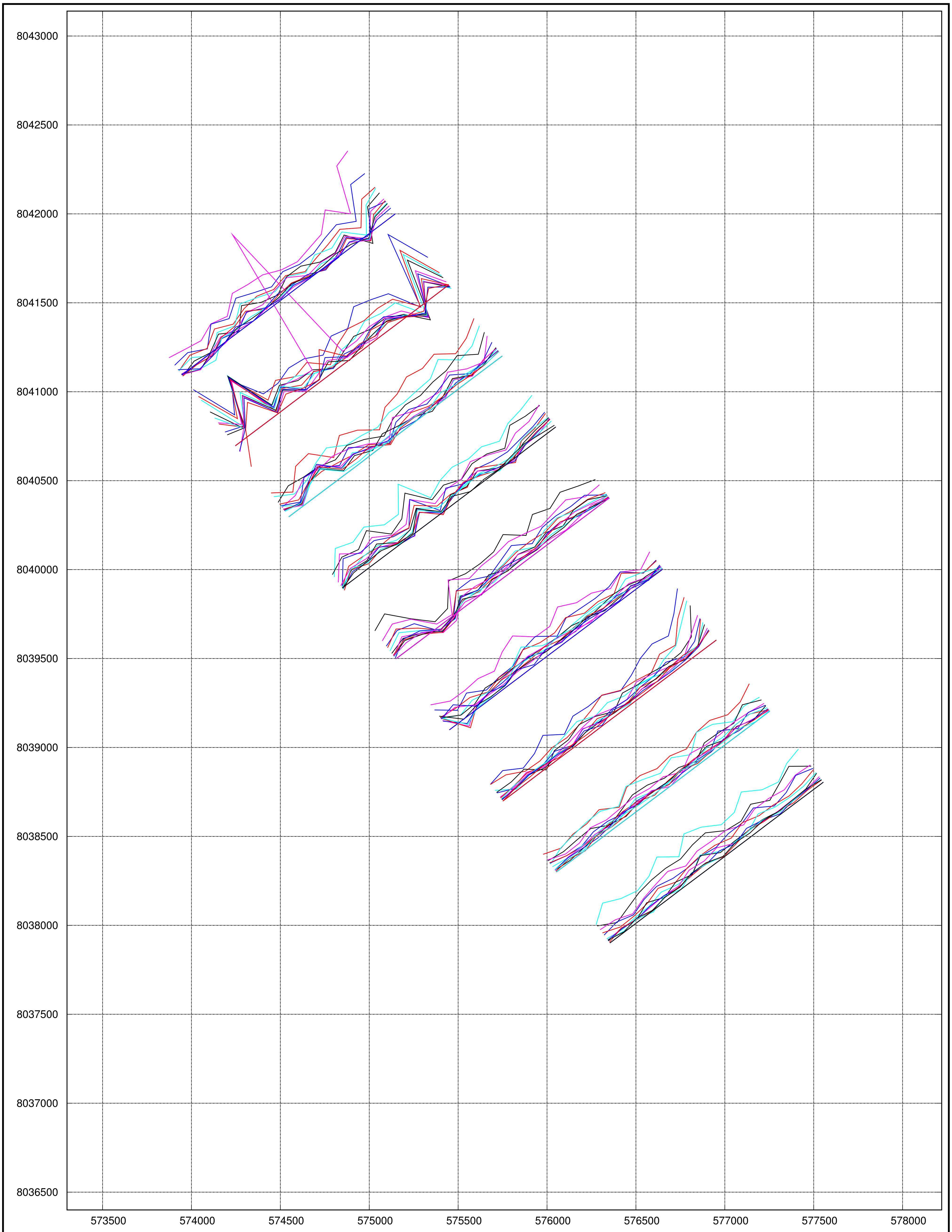
These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 7.6 - 156 ms.
Scale: 10 pT to 100 m.
Sensor: fluxgate magnetometer.
Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: MAG PROFILES FOR DELAY TIMES 7.6 - 156 ms	
SCALE 1 : 20000 DATE JUNE 2012 DRAWN JHC	PLAN NUMBER 5



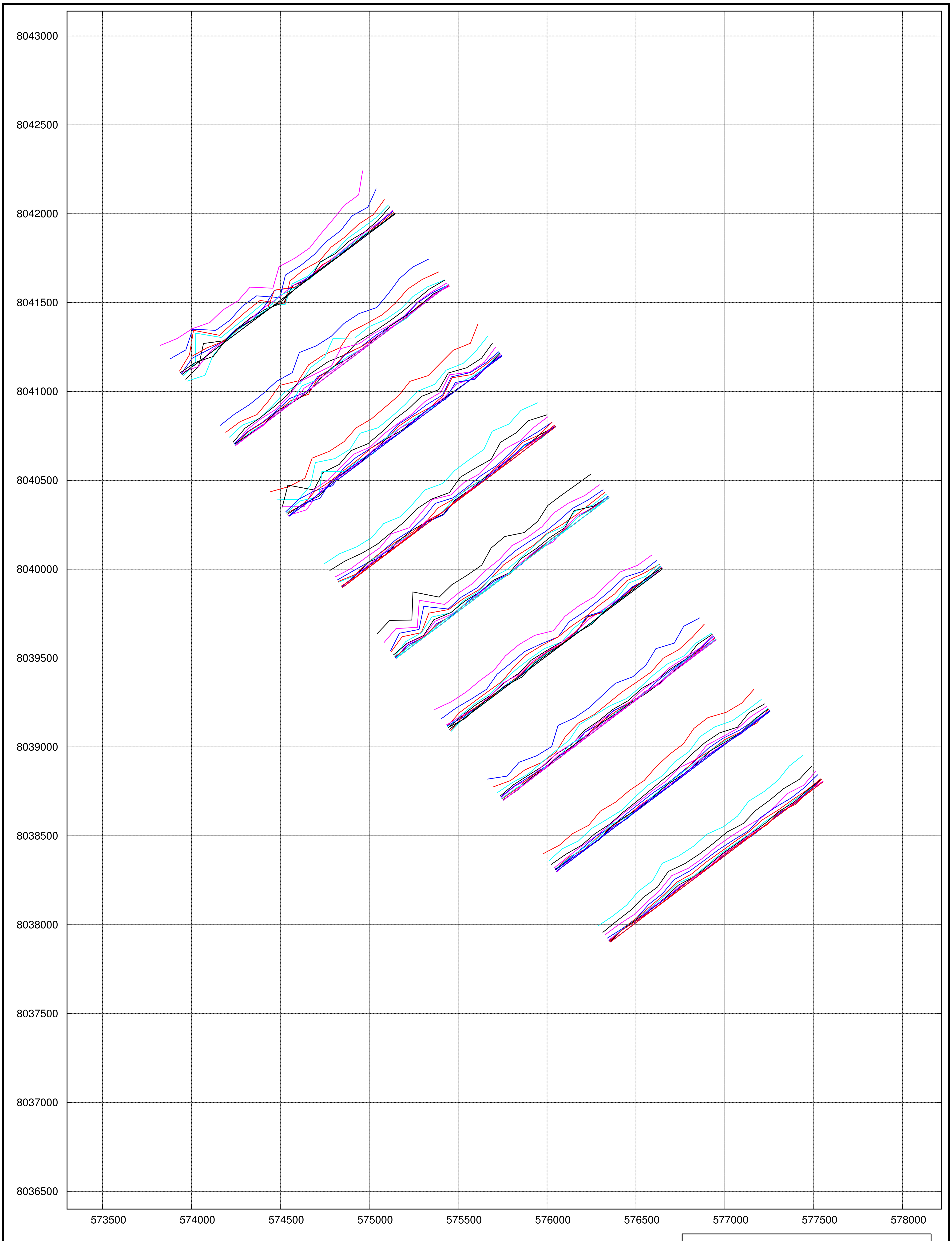
These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 14.5 - 156 ms.
Scale: 0.1 microvolt/amp to 100 m.
Sensor: RVR coil.
Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: RVR PROFILES FOR DELAY TIMES 14.5 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	6
DRAWN JHC	



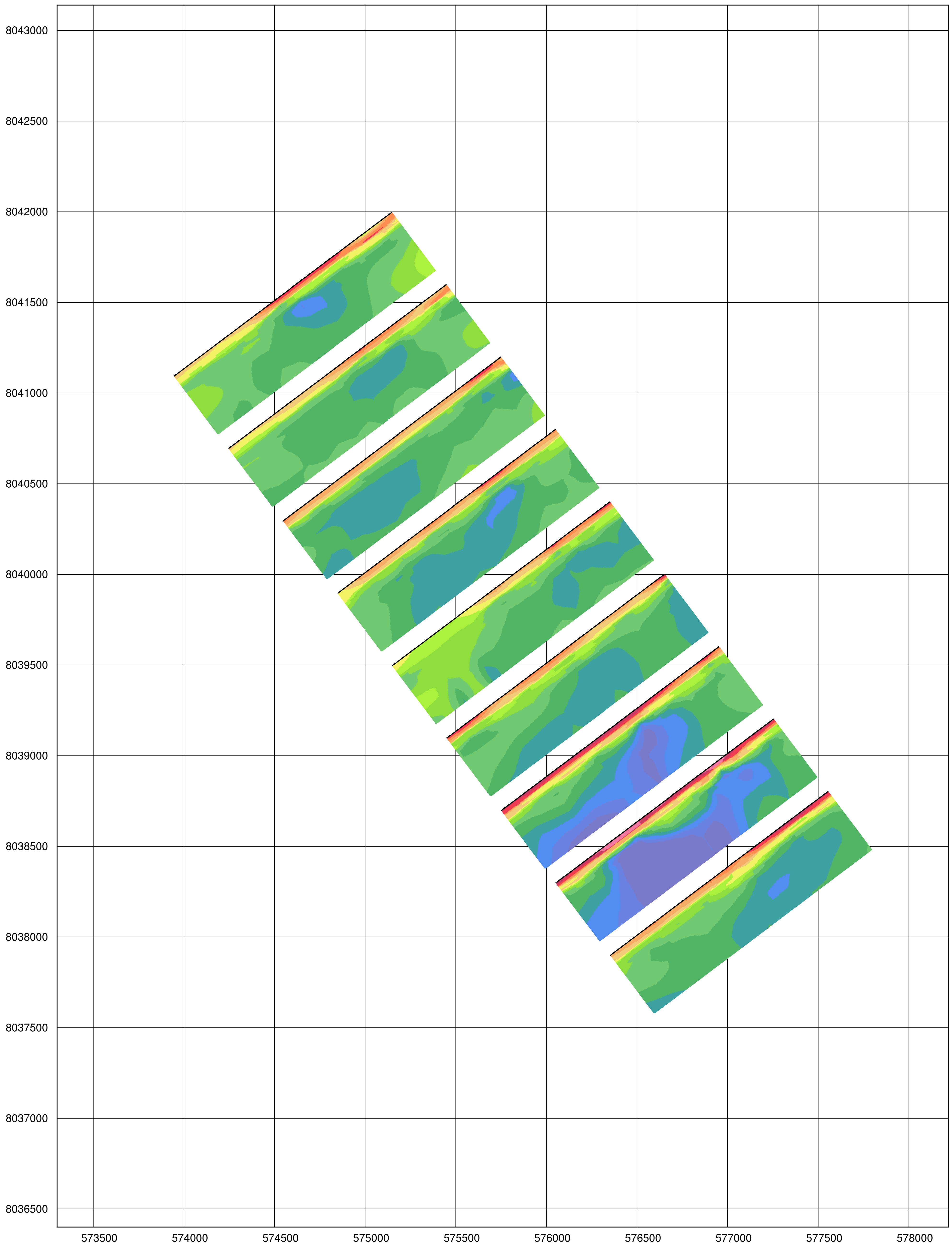
These profiles show the vertical component responses from a 100 m moving in-loop transient electromagnetic [TEM] survey, for delay times 14.5 - 156 ms.
Scale: 5 pT to 100 m.
Sensor: fluxgate magnetometer.
Coordinates: MGA [GDA94] zone 53.

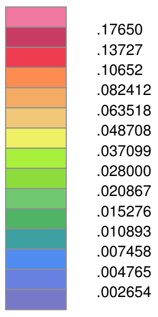
MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: MAG PROFILES FOR DELAY TIMES 14.5 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	7
DRAWN JHC	



These profiles show the
vertical component responses
from a 100 m moving in-loop
transient electromagnetic
[TEM] survey, for delay times
22.3 - 156 ms.
Scale: 0.05 microvolt/amp to 100 m.
Sensor: RVR coil.
Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: RVR PROFILES FOR 22.3 - 156 ms	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	8
DRAWN JHC	





These sections show conductivity in S/m, calculated by an approximate image method from 100 m moving in-loop TEM measurements. Each section is 400 m deep, with its top [black line] at the traverse location. Coordinates: MGA [GDA94] zone 53.

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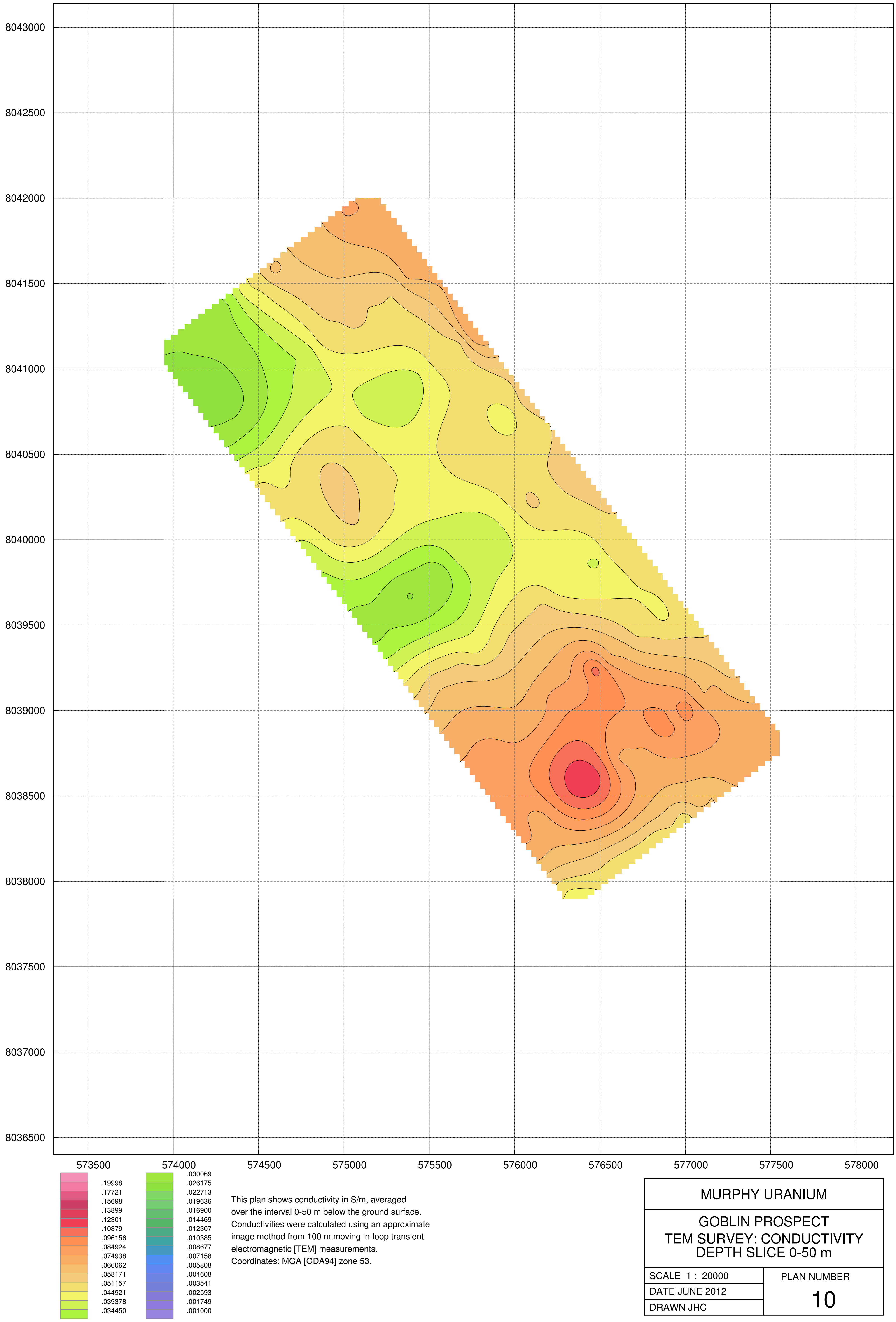
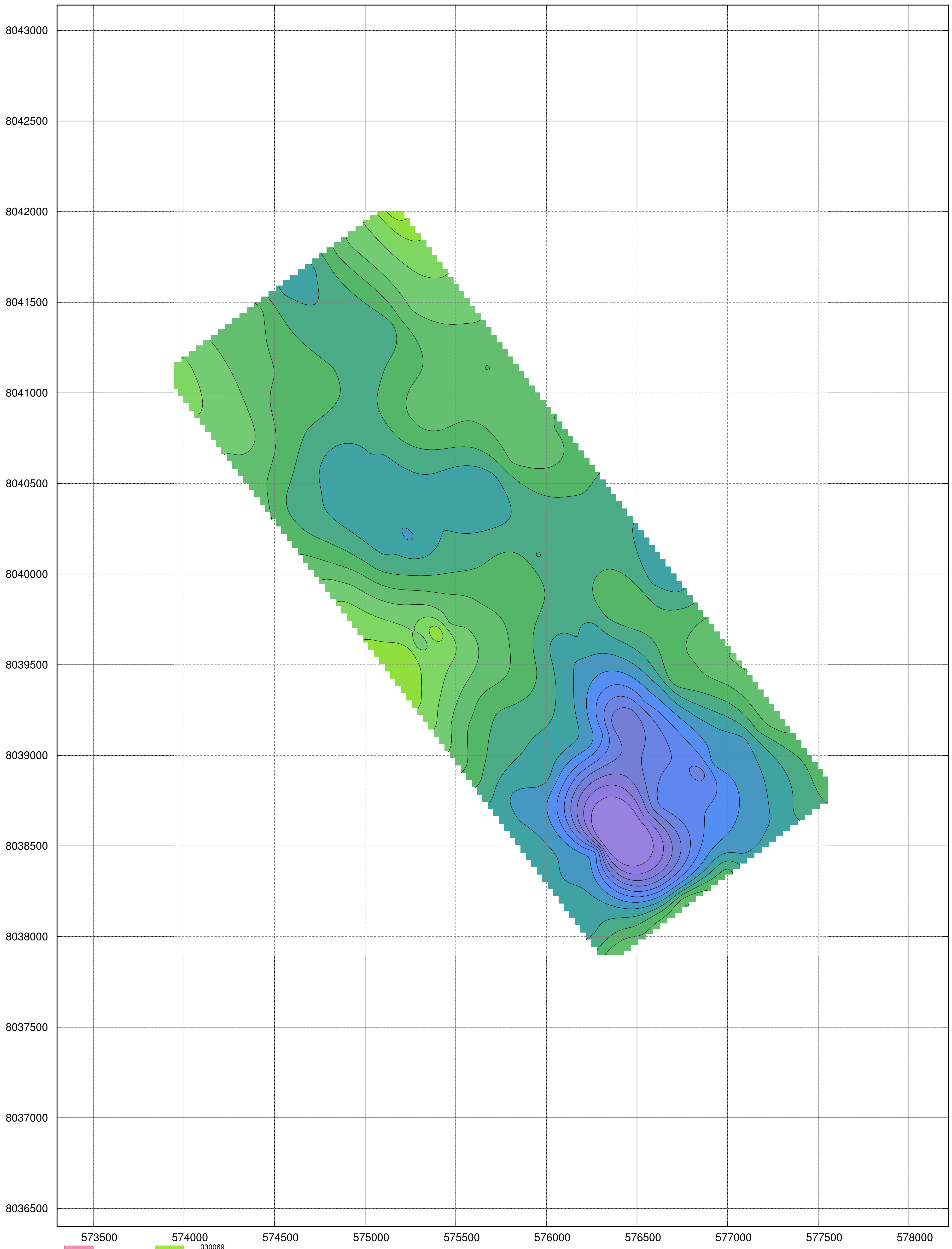
GOBLIN PROSPECT
TEM SURVEY: CONDUCTIVITY QUASI-SECTIONS

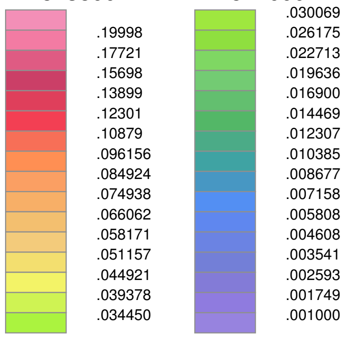
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	9
DRAWN JHC	



This plan shows conductivity in S/m, averaged over the interval 0-50 m below the ground surface. Conductivities were calculated using an approximate image method from 100 m moving in-loop transient electromagnetic [TEM] measurements. Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: CONDUCTIVITY DEPTH SLICE 0-50 m	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	10
DRAWN JHC	





This plan shows conductivity in S/m, averaged over the interval 100-400 m below the ground surface. Conductivities were calculated using an approximate image method from 100 m moving in-loop transient electromagnetic [TEM] measurements. Coordinates: MGA [GDA94] zone 53.

MURPHY URANIUM	
GOBLIN PROSPECT TEM SURVEY: CONDUCTIVITY DEPTH SLICE 100-400 m	
SCALE 1 : 20000	PLAN NUMBER
DATE JUNE 2012	11
DRAWN JHC	