# TENDER

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## Introduction and Description of the Problem

The following proposal aims to create and interpret a magnetic profile in the survey area situated to the north west of Golden Colorado. Such anomalies will be used to infer the bedrock configuration prior to the construction of an elementary school on the site. The results of the report would then be made available for consideration in terms of building regulations and associated cost factors.

A recent gravity survey carried out by *Adducent* detected the presence of a sub-surface tunnel and a positive gravity anomaly trending approximately north-west at coordinates (-150,0). The exact nature of this second anomaly is currently unknown.

A series of east-west oriented magnetic profiles will be established within the survey area to clarify the nature of the gravity anomaly. Other variations in the bedrock, not recognised on a gravity profile may also be identified in addition to the primary purpose of the survey. The great variability in magnetic susceptibility (See appendix 1) of the known rock types in the area would suggest that a magnetic survey is the best approach to examine the cause of the gravity anomaly, and its relationship to the local geology.

## Survey Design Considerations

Important considerations in the design of this survey include…

- The contrast in magnetic susceptibility between different lithologies in the survey area.
- The use of geological and gravity data in conjunction with new magnetics data to further develop an accurate model of the region.
- Minimisation of the impact of background noise, standard deviation and operator error on the quality of the data obtained. Corrections will need to be made in the data for diurnal variation and the regional magnetic field.
- The variation of parameters such as line spacing, station spacing, number of readings and position of base line to maximise the quality of data while minimising cost.
- The monitoring and effect of magnetic storms on the cost and quality of data collection.

## Survey Plan

### Summary of Process

Computer models were created to identify the shape of the body most likely to produce the observed gravity anomaly. A cylinder produced the best fit to the gravity data previously obtained (appendix 2). Slabs and spheres were also modelled. After determining the parameters of the cylindrical model (position, width and depth) experimental design commenced with the aims to produce data which best describes the anomaly given the model parameters and cost consideration. These conditions are outlined below.

### Assumptions and Limitations

- The variability in magnetic susceptibility is great enough to provide meaningful information about the nature of the gravity anomaly.
- The effects of diurnal, regional, and interference can be reduced (or accounted for) effectively enough to allow interpretation of results.
- The shape of the gravity anomaly is best modelled with a cylindrical body. This shape is most likely a dyke structure which is likely to have markedly different magnetic susceptibility to the country rock.

### Survey Parameters

Modelling seems to suggest that given marked differences in magnetic susceptibility, the key factor in the effective modelling of the anomaly is that survey lines are chosen as close to perpendicular to the strike of the body as possible. Further description of why parameters were chosen is available in appendix 3. Data for diurnal corrections will be collected continuously by a second magnetometer located at the base station coordinates (0,0).

| | |
|---|---|
| Line Spacing: 150m | Station Spacing: 3m |
| Measurements per station: 4 | Base Station Coordinates: (0,0) |

### Cost Breakdown

| | |
|---|---|
| Field | $1295 |
| Office | $ 180 |
| Subsistence | $1295 |
| Salary oncosts | $ 360 |
| Overhead | $3130 |
| Magnetometer | $ 486 |
| Vehicle | $ 162 |
| Total: | $6910 |

## Conclusion

Given the quality of the gravity data, and the validity of the survey assumptions, we feel confident that a magnetics survey will effectively quantify the anomaly. The survey can be completed over a 3 day period. Should you have any questions relating to the tender please contact me immediately

Kind Regards

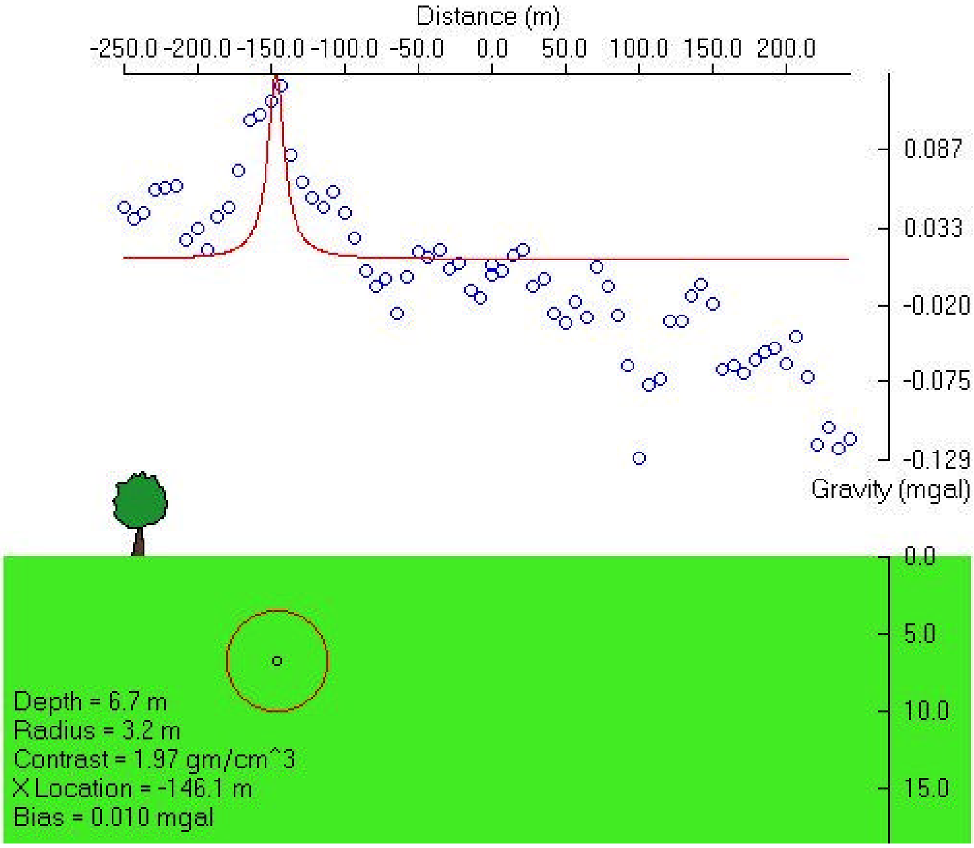
Luke Rankin

## Appendix One: Magnetic Susceptibility

| MATERIAL | SUSCEPTIBILITY X 10^3 (SI)* |
|---|---|
| Air | ~0 |
| Quartz | -0.01 |
| Rock Salt | -0.01 |
| Calcite | -0.001 - 0.01 |
| Sphalerite | 0.4 |
| Pyrite | 0.05 - 5 |
| Haematite | 0.5 - 35 |
| Ilmenite | 300 - 3500 |
| Magnetite | 1200 - 19,200 |
| Limestones | 0 - 3 |
| Sandstones | 0 - 20 |
| Shales | 0.01 - 15 |
| Schist | 0.3 - 3 |
| Gneiss | 0.1 - 25 |
| Slate | 0 - 35 |
| Granite | 0 - 50 |
| Gabbro | 1 - 90 |
| Basalt | 0.2 - 175 |
| Peridotite | 90 - 200 |

Source:
http://www.met.unimelb.edu.au/ES304/MODULES/MAG/NOTES/rocksus.html

# Appendix Two: Cylindrical Model for Gravity Anomaly



## Appendix 3: Choice of Survey Parameters

The following provides a brief summary of the reasons for choosing the survey parameters.

**Line Spacing: 150m** This spacing should optimise the resolution of the magnetics survey in the study area. Placing survey lines on the perimeter of the survey area may produce data that lies outside the survey area and is not relevant to the request for bid.

**Trend of Lines: (E-W)** The client has requested that one of the survey lines correspond to the location of the gravity profile collected previously (-250,0 to 250,0). It is expected that all lines parallel to this base line will cut across the strike of the body under investigation. This should allow for accurate determination of trend of the body and changes in depth and dip (if any) along strike.

**Station Spacing: (3m)** If the body being modelled is narrow or has low contrast between the magnetic susceptibilities of the country rock, a station spacing greater than 3 metres would reduce the resolution to unacceptable levels. Given the expected size of the body from gravity modelling, sufficient resolution should be attained with a station spacing of 3 metres.

**Measurements per station: (4)** After the other minimum parameters have been chosen, this represents the smallest number of measurements that can be taken and still provide a high resolution data while attempting to minimise the standard deviation.

All of the parameters are chosen to produce enough quality data to model the sub-surface structure while minimising cost effects.

## Appedix 4: If Then Statements

- If the width of the body decreases then the amplitude of the signal produced decreases.
- If the depth of the body increases then the amplitude of the signal produced decreases, and the width of the anomaly increases.
- If the magnetic susceptibility of the body increases the amplitude of the signal produced increases.
- If the contrast between magnetic susceptibilities is small then the anomaly will be more difficult to detect.
- If the tilt of the magnetometer is varied in the same position then the observed field will vary as a result of effect of the earths main magnetic field.
- If the body detected is dipping then the magnetic anomaly occurs over a greater area and the signal will be asymmetric.
- If the trend of the body is not perpendicular to the survey line, then an asymmetric signal will be produced, and the peak of the field will not represent the centre of the body.
- As distance from the dyke increases, the size of the anomaly decays rapidly.
- If base station reoccupation technique is used to monitor diurnal effects, then the standard deviation is much too high.