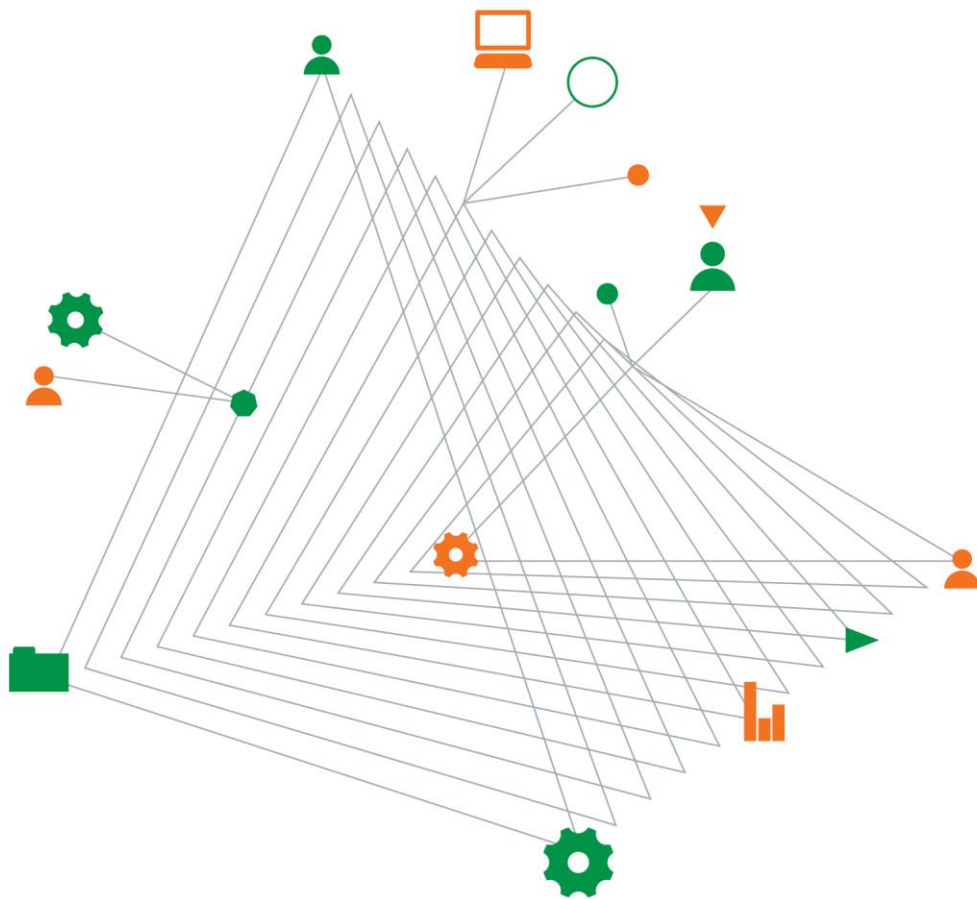


District Council of Robe

The Obelisk, Robe – Geotechnical Assessment

GEOTMEND07773AA-AC

19 October 2015



Experience
comes to life
when it is
powered by
expertise

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The Obelisk, Robe – Geotechnical Assessment

Prepared for
District Council of Robe

Prepared by
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Document authorisation

Our ref: GEOTMEND07773AA-AB

Please find enclosed our report on the geotechnical assessment undertaken for the above project.

Your attention is drawn to the enclosed sheet titled "*Important Information About Your Coffey Report*", which outlines the limitations of this report.

Should you require any further information or clarification regarding our report, please contact the undersigned.

For and on behalf of Coffey



John Slade

Geotechnics Team Leader, SA

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
AA-AB	For Comment	5/10/2015	J Slade		J Slade
AA-AC	Final	19/10/2015	J Slade		J Slade

Distribution

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Important information about your Coffey Report

Figures

Figure 1 - Site Plan

1. Introduction

Coffey Geotechnics Pty Ltd (Coffey) has undertaken a geotechnical assessment of the Obelisk situated at Cape Dombey, Robe.

The Obelisk requires repainting and “District Council of Robe” (Council) have requested the geotechnical assessment as part of an overall safety review for the task.

This report outlines the geotechnical assessment and summarises the subsurface conditions encountered. Recommendations relating to long term stability and the painting of the structure are provided in Section 4.

2. Scope of works

It is understood that Council intends to undertake some maintenance of the Obelisk. It is understood the maintenance work would require personnel accessing the Obelisk. In order to undertake the maintenance works and as a requirement of the Work Health Safety risk, the council would like to know about the integrity of the cliff face near the Obelisk.

The following report notes some of the site observations and recommendations.

3. Site conditions

3.1. Regional geology

The Geological Survey of South Australia (1 to 1 inch Robe Sheet) indicates that the site is likely to be underlain by Aeolianite (Qpe) which comprises consolidated beach sands with travertine (cemented) horizons.

The site may also be expected to be underlain by back shore, beach ridged calcareous and siliceous dune sands (Qrb) which is shown to be present immediately to the north of the site

3.2. Local geology

The Obelisk landform is composed of a calcrete capping (typically sheet calcrete) that is of low to medium rock strength but irregular with depth lateral extent. The surface is typically pitted from 0.1 to 0.5m width and depth.

To an unknown extent below the calcrete is cross bedded variably cement beachsands. The dune beds are thick up to 3m in depth and are bound by distinct layers. In the local area these distinct layers

3.3. Notes and observations

The Obelisk is a 5mW x 5mD x 12.2mH pyramid shaped monument built in 1855 as a landmark to be seen from sea for ships entering Guichen Bay. There is a fence restricting public access to the structure, due to the following conditions:

- The Obelisk is located upon a narrow pointed extension of the coast bound by cliffs of 5m to 8m height (Photographs 1, 2 and 3). The ocean surrounding the cliffs has deep currents with wave action impacting on the base of the cliffs. Refer to Figure 1 for a plan of the site;
- Access to the structure is via a narrow 2m wide segment of land bound by cliffs that extend into deep water (Photograph 4);
- The Obelisk is a simple unreinforced hollow structure, assumed to be built from local rocks (less than 200mm in diameter) bound by a cement matrix (Photograph 5). The pyramidal shape is strong but has not been built to take any additional surface loading.
- The structure is relatively light with the load spread over a large area and thus the force upon the ground surface is assumed to be low and well supported by the subgrade rock. However, where there are cracks in the surface rock, it is unknown how deep these cracks extend into the rock mass. If the rock is broken into fragments, the bearing capacity of the rock is reduced substantially;
- Wave action at the base of the cliff is eroding the base of the cliff to a greater extent than the crest of the cliffs (Photograph 1). The long-term stability of the Obelisk will be most influenced by wave action, undercutting of the cliff and then the rock mass cracking from the bottom of the cliff to the upper surface and individual blocks tilting/toppling to the base of the slope;
- Unfortunately, the door to the Obelisk was not in place. It is unknown whether this door will assist in the stability of the Obelisk, especially given the weakness of the inner surface noted above;
- The boundary of the Obelisk landform is composed of steeply sided cliffs. In many areas, the upper crest of the cliff is undercut to variable extents. Typically, the landform is:
 - To the East – a narrow access to the Obelisk;
 - To the South – the shortest distance the cliff crest is 1.8m adjacent to the Obelisk;
 - To the West – the landform is significantly undercut (almost to the edge of the Obelisk, see Photograph 1);
 - To the North – the shortest distance the cliff crest is 3.8m adjacent to the Obelisk;
- The surface of the Obelisk landform is uneven and irregular. Within many of the depressions, water is ponded. This water is both from rainfall and from seaspray. When the ground surface is wet, it is slippery underfoot;

Overall, the landform surrounding the Obelisk is difficult to access and continuous care is needed to traverse the landform. The author considers that when carrying items that may obscure vision of the ground surface, access across the landform would be very difficult and leading to very dangerous activities.

4. Assessment and recommendations

The following assessment is subjective and based on a likelihood and consequence assessment method. Extreme risks are assessed as leading to fatal risks or the destruction of the Obelisk structure, which may impact on the structure used to paint the Obelisk.

Should access to the structure be required, fall arrest equipment would be required from adjacent the fence to the Obelisk and is assumed in the following assessment.

Personnel

The landform from the fence to the Obelisk is assessed to have an extreme potential / likelihood for a person to fall off from the upper surface of the landform and the consequence of the resulting injury being ranked as high to extreme.

Due to the undercutting of the landform crest, trafficking the landform is recommended to be undertaken at a minimum of 1m from the edge of the landform. Where cracks are present the cracks should be marked with paint and monitored for the duration of the project by the person responsible for staff entering the work area.

If material is to be stored on the landform the location of storage should be defined following a survey via the water and land (at the same time) to assist in the definition of where overhangs are located, also further advice should be sought from the author.

Obelisk Landform Stability

With respect to the stability of the landform immediately surrounding the Obelisk, the consequence of any landform instability is ranked as high to extreme, due to the assumed unravelling nature of the stone and mortar Obelisk structure and the resulting injury to staff adjacent to the structure or damage to the structure.

A high likelihood of landform stability is evident by:

- Less than 4m width to the landform to the north and south of the structure.
- The uneven surface of the landform.

It is assumed should a framework/scaffolding be suggested for the project, such items would result in point loads to the ground surface, locating load points where there is not cracks or depressions would require careful planning. Creating a level surface is expected to be problematic and result in multiple traverses across the narrow access. Also Width is required to gain access and egress to the scaffolding and to put items onto the scaffolding.

Given a scaffolding option will results in increased frequency of access across the narrow entrance to the landform. The scaffolding option increases the likelihood of an incident.

Structure Stability

Obelisk footing is considered to be large enough to be able to support and spread the vertical loads from the structure, however it is assumed there is no reinforcement in the structure and therefore the structure is unable to be distorted. Given this lack of flexibility should any of movement occur in the foundation the Obelisk may become unstable.

Should the Obelisk come unstable it may impact on any scaffolding surrounding the Obelisk and also limit access to fix the Obelisk.

Recommendation

Coffey have not been specifically told how the Obelisk will be maintained but given the nature of the cliff retreat acknowledged by Council and the proactive fencing of the Obelisk landform from the public, it has been assumed maintenance could involve:

- Painting the structure, replacing the door and repairing the inside of structure.

However, how can this be undertaken? Noting it is assumed that the risks must be reduced:

- By using a large crane to move select skilled personnel to and from the site. The narrow access to the Obelisk allows for no errors in footing during trafficking the access. The access is long and therefore the risks are extreme;
- The staff must be skilled in high rope access and be able to set up a system to restrain and maintained a fall arrest system throughout;
- All work to be undertaken when the landform surface is dry.
- If there is large enough crane to do the work, or a combination of crane, platform and crane. The option should be assessed.

Coffey are open to discuss the options further and provide further advice is required.

5. Limitations

It is recommended that an experienced Geotechnical Engineer review plans and specifications that affect or are affected by geotechnical issues to assure the geotechnical findings and recommendations contained herein have been correctly interpreted.

We are pleased to offer our services to discuss this project when an approach is agreed upon by Council.

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

Important information about your Coffey Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples.

These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Figure

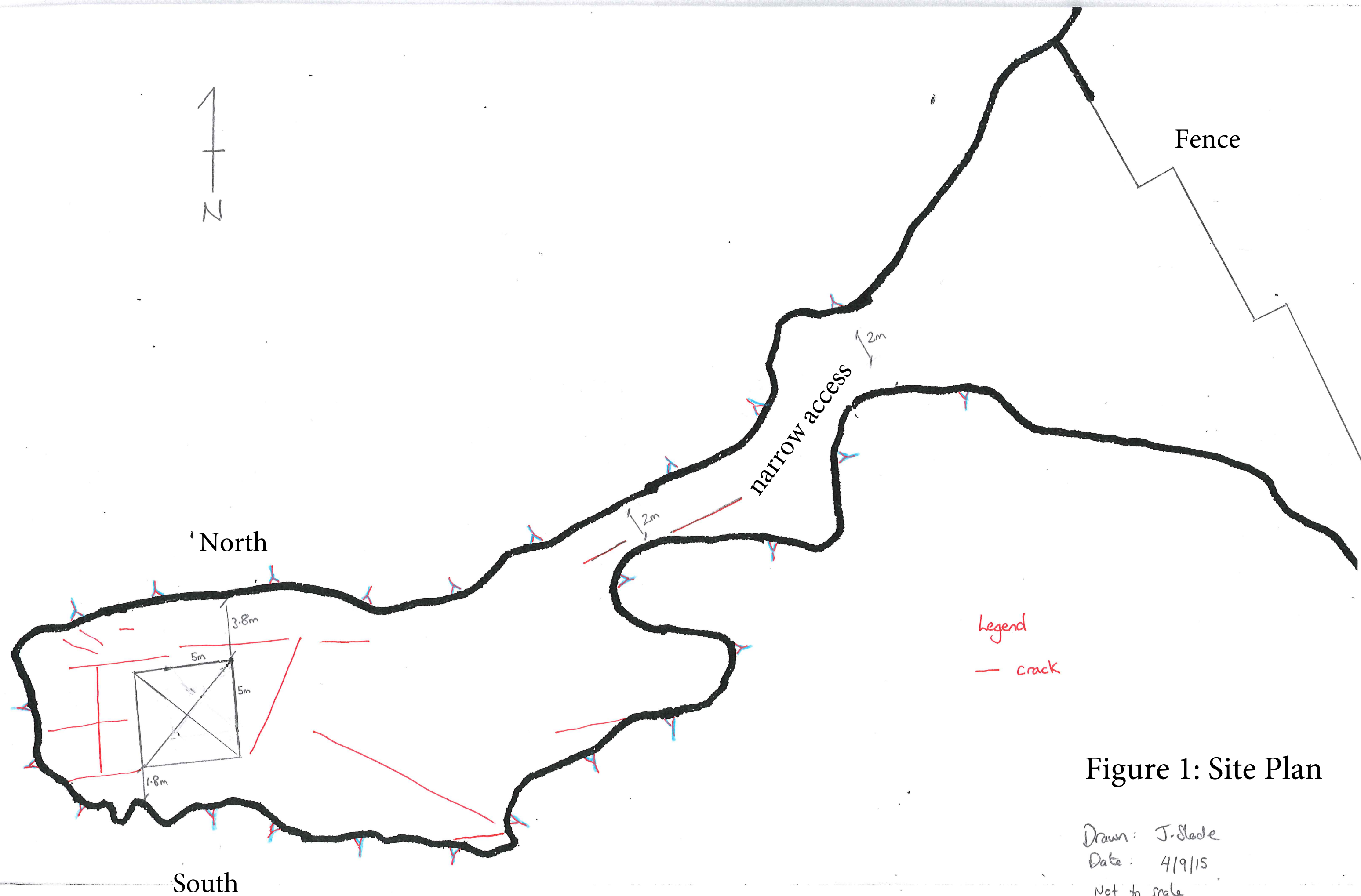


Figure 1: Site Plan

Drawn: J. Sledde

Date: 4/9/15

Not to scale

Photographs



Photo 1: View looking South. Note width of western footing is 6m.



Photo 2: View looking West. Note width of north eastern footing of the Obelisk is approximately 3.8m. (yellow arrow denotes distance). Also the ledge is undercut by atleast 0.5m.

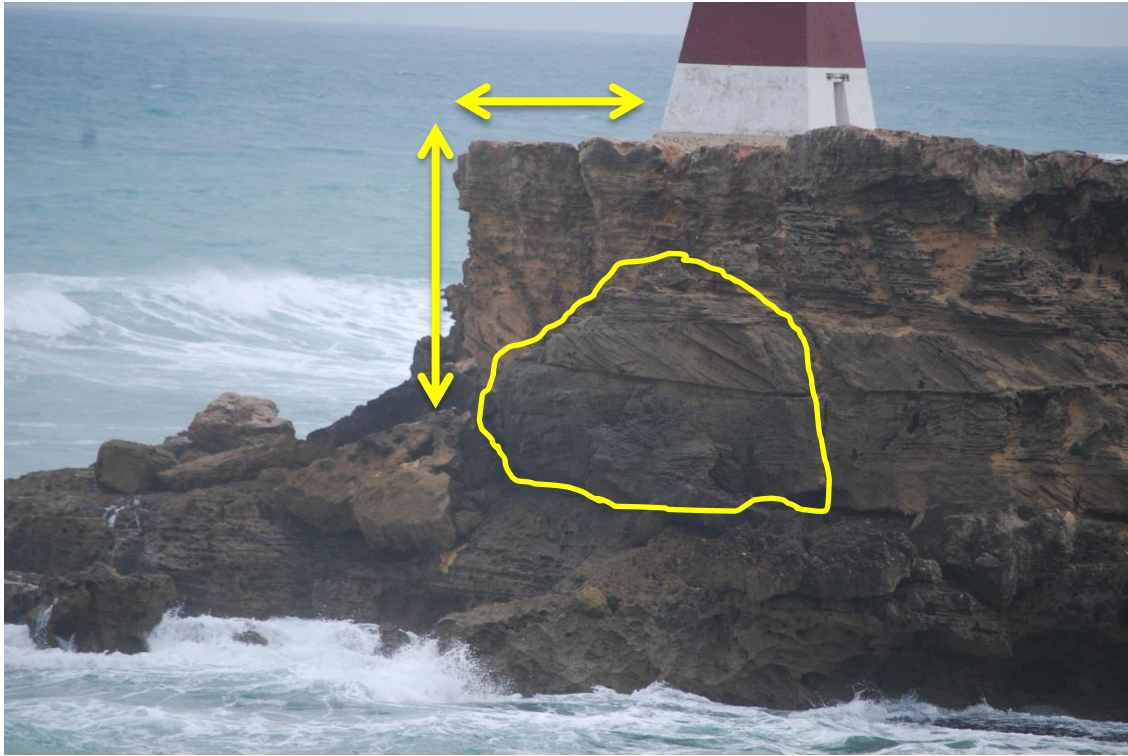


Photo 3: View looking West. Arrows highlight horizontal length is less than vertical height. Irregular yellow shape outlines a loose large block that will detach from the rock substrate in the near future.



Photo 4: Access to the Obelisk is via a narrow uneven landmass. Note the cracks in the surface rock.



Photo 5: photograph of internal northern wall where a segment (approx. 1m^2) has a significant weakening. Location is approximately at the location of the 1st Red line on the outside of the Obelisk.



Photo 6: View looking west at the northern boundary to the Obelisk, noting uneven ground and a long crack between the Obelisk and the white 2m length tape.