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18th January 2004

JC03029A-L1

Mr Michael Gordon
John M Daly & Associates Pty Ltd
Fax (02) 4628 2013

Dear Sir

Re Preliminary Comments and Assessment on Contamination and Geotechnical Issues
Lots 1110, 1336, 1108, 1113, 80, 1111 and 20, Oxford Fall Road, Oxford Falls

Following our recent site investigation, this letter presents the following:

- A summary of subsurface condition across the site.
- A summary of laboratory test results.
- Preliminary comments on contamination issues.
- Preliminary comments on geotechnical issues.

This is not a final report.

1. Project Appreciation

The site is situated in the area bounded by Oxford Fall Road, Wearden Road and Barnes Road and comprises of 7 semi-rural residential block as follows;

Lot No	DP No	Owners
1108	752038	Helen & Joseph Earl
1110	752038	Kevin & Glenys Collins and Masanori Kuriyama
20	842523	Richard Smart, Susanna and Ian McKenzie
1111	752038	Richard Granger
80	846099	Stanley Harvey & Li Lin
1113	752038	Nereo & Anita Spaliviero
1336	752038	Erick & Cheryl Madsen

Total site area is about 40 acres. Refer to the attached Drawing No 1 for locality plan

We understand that the proposed development will include a retirement resort comprising of 600-800 units with 75-100 assisted care units and 50 bed nursing home, associated facilities and probably a small golf course. The proposed buildings may be up to 5 to 6 storeys high and the likely concentration of buildings will be on the south western corner of the site, being in Lot 80 and 1113 near Barnes Road.

2. Scope of Work

2.1 Desktop Study

The following information was used in to aid in the assessment;

- Aerial photographs.
- Orthophoto map prepared by JMD Development Consultants (Ref 03508 dated 12/11/03)
- Geological Series sheet 9030 (Edition 1) 1:100,000 sheet, 1991 prepared by Geological Survey of NSW Department of Minerals and Energy.
- Soil Landscape Series Sheet 9030, 1:100,000 sheet, prepared by Soil Conservation Service of NSW.
- Acid Sulfate Soil Risk Map – Edition Two, Department of Land and Water Conservation.

2.2 Site Inspection

A geotechnical and environmental engineer inspected the site on 26th October and 4th December 2003. The purpose of the site inspection was to inspect areas or potential areas of contamination, drainage depressions and other site features.

The site features are indicated on the attached Drawing No 1.

2.3 Subsurface Investigation

Fieldwork for the subsurface investigation consisted of excavation of a total of 35 test pits (TP 1 to 35) across the site using a rubber tyred backhoe. The investigation was carried out on 4th December 2003. The test pits locations which are shown on the attached Drawing No 2 were only approximate and obtained from pacing off existing site features, boundaries and fence lines.

The field investigation was monitored on a full time basis by an engineer from GeoEnviro Consultancy Pty Ltd.

The test pits were excavated to depths varying from 0.8m to 2.9m below existing ground surface. Hand penetrometer tests were carried out on the test pit walls where applicable.

Soil samples were taken from the site to our NATA accredited laboratory for analysis of soil to determine engineering properties. Selected soil samples were sent to Sydney Analytical Laboratories, an independent NATA accredited laboratory for soil chemistry analysis.

The test pits were observed for groundwater seepage, during and upon completion of the fieldwork. Long term groundwater was not carried out in this investigation. The field test results, together with details of the subsurface profile encountered are presented on the test pits on the attached Table A.

2.4 Laboratory Testing

The following laboratory tests were carried out on the soil samples;

- Atterberg Limits Test – To aid assessment of soil properties.
- Emerson Dispersion Test – To aid assessment of soil dispersiveness.
- Grading – To confirm visual soil classification.

Soil samples were sent to Sydney Analytical Laboratory for analysis for the following;

- pH – To aid assessment of soil acidity.
- Electrical Conductivity and Sulfate – To aid assessment of soil salinity and aggressiveness.
- Cation Exchange Capacity, Exchangeable Sodium and Total Phosphorus – To assess on-site effluent disposal capabilities.

3.0 SITE CONDITIONS

3.1 Topography and Vegetation

The site is situated on the upper catchment area of Middle Creek which flows to the Narrabeen Lakes.

The site topography may be divided into three areas as follows;

- Crest of the sandstone ridge on the south western portion of the site with ground surface reduced level (RL) typically ranging from about 92m to 114m.
- Toe of the sandstone hill with ground surface RL typically ranging from about 84 to 92m.
- Creek area which runs along the eastern site boundary with ground surface RL typically ranging from about 78 to 86m

The site has been predominantly cleared of trees and bushes and consists of open grassland. Forested areas and dense trees exist along the sandstone hillside on the south western portion of the site and along the creek on the eastern portion of the site.

3.2 Existing Site Features and History

Reference should be made to the attached Drawing No 1 for details of site features. The following is a summary of site features;

Lot 1108 in DP 752038

This lot consist of a large house with a few small buildings/sheds nearby and the remaining portion of the site consists of vacant land. This lot is currently being used for residential. Sandstone outcrops were noted on the ground surface along the south eastern portion of the lot.

The aerial photographs indicate this lot to have been cleared of vegetation since 1961. There were a number of buildings and small sheds and these structures were possibly associated with agricultural activities. By 1978, the majority of the structures were removed from the lot.

The 1994 photograph indicates the site conditions to be similar to current.

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Lot 1110 in DP 752038

This lot is currently being occupied by the Australian Tennis Academy and the Falls Function rooms. A channel transects the eastern portion of the site and the major portion of the lot on the western side of the channel is occupied by tennis courts. The function centre occupies the front portion of the site with a large bitumen car park.

The 1961 photograph indicate a large building existed on the western portion of the lot with a number of small buildings located close by. There was another small building at the front of the property is a track connecting the building. Thick vegetation canopied the creek.

The large building appeared to have been demolished in 1978 and the major portion of the lot was bare of vegetation.

The 1986 photograph indicates the academy and function rooms to have been established since then.

Lot 20 in DP 842523

There is a residential dwelling at the north western corner of the lot with a track leading to two sheds on the eastern side of the lot. There are a number of building material and miscellaneous items stored alongside the track including some piles of rubbish. The remaining portion of the site consists of undeveloped land with a lot of trees and bushes.

Based on the aerial photographs taken in 1961, 1970, 1978 and 1986, this lot consisted of bushland. The southern portion of the site was cleared and the track was formed by 1994.

Lot 111 in DP 752038

There is a large residential dwelling with a tennis court and pool on the western portion of the site. The remaining major portion of the lot consists of vacant cleared land covered with grass. Dense trees and bushes canopy the eastern portion of the lot including the creek.

Some minor orchard activities were noted on the western portion of the lot based on the 1951 aerial photograph. The track which currently exists providing access to the house was formed since 1951. At that time, there was a small house with two sheds at the end of the track. The lot appeared to have significantly been cleared of vegetation since 1951 with the exception of the front eastern portion.

The 1961 photograph indicates a long building with a possible dam in the vicinity of the current tennis court and pool locations. This building and dam appeared to have been removed by 1970 and there appeared to have a significant scarring of the ground surface in this area. Some excavation and filling works may have occurred. The remaining portion of the lot was regenerated with trees and bushes.

The scarring of the ground surface was still evident in the 1978 photo. The small house appeared to have been demolished after 1994.

Lot 80 in DP 846099

This lot is being occupied by a house on the southern portion. Thick trees and bushes canopied the sandstone hill slopes in the middle and the remaining portion of the site was cleared of trees.

Based on the aerial photographs taken in 1951, 1961, 1970 and 1978, this lot consisted of bushland. The 1986 photograph indicates the southern portion of the lot to be cleared of trees and bushes and was covered with grass.

The existing house was noted in the 1994 photograph.

Lot 1113 in DP 752038

The southern portion of the property is occupied by a large house with a tennis court and landscaped gardens. On the northern portion of the lot, at the toe of the sandstone hill slopes, there is a small dam with a house. A workshop building with an above ground fuel tank was erected to the south east of the house. We understand that this tank is still in used and hydrocarbon staining was evident around the tank. The remaining portion of the site consists of vacant land with grass cover.

The 1951 photograph indicates the northern portion of the lot to have been predominantly cleared of trees with a lot of small buildings scattered across the lot. There appeared to have significant amount activities including orchard activities on the northern portion of the lot. A shed was constructed in the vicinity of the current workshop building and a house further to the south.

Site activities appeared to have diminished in 1961. The house and a number of small sheds remained to the north east of the house. The northern portion of the site was predominantly cleared of vegetation and bare ground was exposed.

Ground surface disturbance was noted on the north eastern portion of the lot. Buried fill with building rubble encountered in the current investigation suggests previous excavation and landfilling activities had occurred.

The tennis court which currently exists on the southern portion of the lot was noted in the 1986 photograph. Some clearing of vegetation was noted in this area

Lot 1336 in DP 752038

There is a house at the north western portion of the lot with a dressage arena located to the east of the house. Two large sheds exist along the Oxford Falls Road frontage. The remaining portion of the site was fenced and used as horse paddocks.

The 1951 aerial photograph indicates this lot to be part of the adjoining southern property. Large buildings occupied the southern portion of the lot and these building were demolished and removed by 1961. This lot remained vacant with no specific landuse until 1978 where a horse track was formed.

The 1986 photograph indicates the site conditions to be similar to current.

Based on the 1:100,000 geological map of Sydney, the site is underlain by Hawkesbury Sandstone consisting of medium to coarse grained quartz sandstone with shale capping along the ridges.

Reference should be made to the test pit profile in Table A for details of the subsurface profile encountered and Drawing No 2 for a summary of subsurface profile encountered.

The following are our comments and observations:

- Fill with varying quantities of building material (eg bricks, concrete, steel, etc) was encountered at the north eastern portion of Lot 1113. Depths of fill as indicated in TPs 12, 13, 14 and 15 vary from 0.6m to 2.0m. TP 8 and 9 which were excavated on the northern portion of Lot 1113 also encountered fill but without building rubble. Depths of fill in TP 8 and 9 were found to be about 0.8m and 1.4m respectively.
- Fill with some building material was also encountered on the southern portion of Lot 1113 to depths of about 1.2m in TP 6 and 0.8m in TP 7.
- Fill containing building rubble was encountered in TP 31 and 33 which were located in Lot 20. Depths of fill in TP 31 and 33 were found to be about 1.8m and 0.6m respectively.
- Fill containing building rubble was encountered in TP 34 and 35 which were located on the southern portion of Lot 80. Depths of fill in TP 34 and 35 were found to be about 2.2m and 1.5m respectively.
- Relatively thick sandy and clayey soil profile was encountered along the creek on the eastern portion of the site as indicated in TP 1, 2, 19, 20 and 26. The soil profile was generally found to be moist to wet and relatively weak (ie very loose to loose for cohesionless soil and soft to stiff for cohesive soil). Sandstone bedrock was encountered in TP 1 and 2 at depths of about 2.3m and 2.8m respectively. TP 19, 20 and 26 which were excavated to depths varying from 2.2m to 2.9m did not encounter bedrock.
- Sandy soil overlying sandstone bedrock at relatively shallow depths of less than 1.5m generally occurs on the western and southern portion of the site, on the sandstone hill slopes and crests. Typical of sandstone hill slopes, there will be some localised deepening of sandstone bedrock caused by drops and benches of the sandstone formation. The sandy soil was generally found to be moist to wet and relatively weak.
- Groundwater was encountered in TP 1, 2, 20, 24, 28, 30, 34 and 35 at depths varying from 0.8m to 2.2m
- Information on subsurface profile in Lot 1110 is limited due to the built-up nature of the site with tennis courts, buildings and car parks.

5. LABORATORY TEST RESULTS

5.1 Soil Engineering Properties

Reference should be made to the laboratory test reports for particle distribution. The particle size distribution results confirm our visual soil classification.

The following is a summary of the laboratory test results:

Sample Location	Soil Class	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Emerson Crumb Class
TP 1 (0.6-1.5m)	SC					6
TP 4 (0.3-0.8m)	CL	26	15	11	4.5	6
TP 8 (0.8-1.0m)	CL	30	15	15	5	6
TP 24 (0.8-1.4m)	CL/SC					6
TP 26 (2.0-2.5m)	CL	26	13	13	4	6
TP 27 (0.5-1.0m)	CL					6
TP 29 (0.6-1.2m)	CL-CI	33	15	18	5	6
TP 34 (0-1.0)	SC					6

Soil samples with Liquid Limits in excess of 50% are considered highly plastic. Liquid Limit of between 35 to 45% is considered to be medium. The Linear Shrinkage of 4 to 5 % correlates to a low shrink-swell reactivity to moisture variation.

The Emerson Crumb tests indicate the soil to have a low dispersive characteristics with Emerson Class of 6.

5.2 Soil Chemistry

The following is a summary of the laboratory test results.

Sample	pH	EC	CEC	ESP	SO ₄
TP4(0.3-0.8m)	4.3	0.085	2.9	1.0	89
TP8(0.4-0.8m)	4.6	0.070	3.2	0.4	84
TP27(0.5-1.0m)	4.5	0.065	2.8	0.7	75
TP29(0.6-1.2m)	4.2	0.045	5.9	0.5	46

EC = Electrical Conductivity in dS/m
 CEC = Cation Exchange Capacity in cmol/kg
 ESP = Exchangeable Sodium in %
 SO₄ = Sulphate in mg/kg

6.0 PRELIMINARY ASSESSMENT AND RECOMMENDATIONS

6.1 Contamination Issues

Based on our desktop review of the site and site inspection, the following are our comments and preliminary assessment on contamination issues for the site:

- There is some potential for contamination in the workshop and above ground fuel tank location within Lot 1113. Types of contamination exist may include hydrocarbon and heavy metals.
- There is a significant amount of fill with buried building rubble at the northern portion of Lot 1113. Fill with buried rubble was also encountered in other parts of the site (eg in Lot 80 and 20). Types of contamination exists can be variable depending on the source of the fill material and it may include heavy metals, pesticides and asbestos.
- There was a significant amount site activities on Lot 1336 in 1951 where the major portion of the site was occupied with buildings. The exact nature of landuse could not be determined in this investigation, however previous site activities involving agricultural or manufacturing has the potential to cause contamination.
- There appeared to have previous agricultural activities on Lot 1108 and contamination associated with pesticides and heavy metals may occur.
- Contamination may exist in the vicinity of the existing building areas caused by human activities.

Based on the foregoing, we are of the opinion that the site has the potential for contamination as a result of current and previous landuse. Additional contamination investigation involving test pit soil sampling and laboratory analysis should be carried out.

6.2 Geotechnical Issues

6.2.1 Site Drainage

The site was found to be generally poorly drained particularly on the lower slopes of the sandstone hill and in the vicinity of the creek. The presence of groundwater in some test pits on site, soft soil and soft organic clays in various parts of the site as encountered in the test pit investigation would present major constraints in earthworks in respect of excavation and recompaction of insitu material for building pad and road construction.

It is therefore considered that the proposed development should include some major upgrading of drainage works in order to improve site drainage.

6.2.2 Site Preparation and Earthworks

It is anticipated that bulk earthworks by excavation and filling will be required for the proposed development.

The limited laboratory analysis and scope of investigation indicate the insitu sandy and clayey material to be generally suitable for reuse as structural fill beneath buildings and pavements. A more rigorous laboratory analysis to further assess the soil properties and chemistry will be required to confirm the reuseability of this material for the proposed development. Depending on the outcome of the additional soil analysis, soil treatment may be required to remediate or improve the soil for development.

If the insitu fill material is found to have concentrations of contaminants of concern to be within the acceptable NSW EPA threshold, the fill material should be cleaned of building rubble and rubbish prior to reuse on the site and this would involve mechanical screening of the material.

Fill construction for building platforms and pavements typically include the following;

- Stripping and removal of all topsoil and organic material.
- Excavation of all uncontrolled fill if encountered to expose natural soil.
- Proof rolling of the exposed surface with a minimum 10 tonne vibrating roller to identify soft and heaving areas. If soft and heaving areas are encountered, excavation of soft material should be carried out and replaced with good quality granular fill such as ripped sandstone having a maximum particle size of 75mm.
- All fill should be place in layers not exceeding 250mm loose thickness and compacted to a minimum 95% of Standard Maximum Dry Density at $\pm 2\%$ of Optimum Moisture Content.
- The upper 300mm of fill forming the subgrade of pavements should be compacted to a minimum 100% of Standard Maximum Dry Density at $\pm 2\%$ of Optimum Moisture Content.

Earthworks should be closely monitored by a geotechnical consultant and must include field density testing at an appropriate frequency and level of supervision as detailed in AS 3798-1996.

6.2.3 Slope Modification and Stabilisation

The site inspection and mapping did not reveal signs of major natural earth movements apart from surficial soil erosion or slope instability. However, the nature of the site is such that instability problems could arise if the site earthworks do not properly take into account the various site geotechnical factors as follows;

Batter Slopes

Appropriate batter slopes for excavations depend not only on the material exposed in the excavation and the length of time for which the excavation will be unsupported, but also on the site specific factors such as drainage conditions, construction programming and proximity to adjacent structures or surcharges.

Under good drainage conditions, the following batter slopes or less may be adopted;

Material	Recommended Batter
Alluvial Soil	5 Horizontal : 1 Vertical
Compacted Fill	2.5 Horizontal : 1 Vertical
Residual clay	2 Horizontal : 1 Vertical
Weathered Bedrock	0.5 Horizontal : 1 Vertical

The above recommended batter slopes assume that surcharge loads will be kept well clear of the crest of the batters. Some localised sloughing of the fill batters could occur during wet weather, particularly where localised groundwater is encountered.

Retaining Walls

Excavation requiring retaining walls should be kept under 0.9m if possible. Deeper excavations in excess of 0.9m requiring retaining walls should be properly designed by a qualified engineer.

6.2.4 Roadworks

The site roadworks should be planned to reduce cutting and filling to the absolute minimum and the earthworks undertaken in stages to alleviate erosion and localised instability problem. To minimise the effects of erosion, all road batters, whether in cut or fill should be stabilised by planting (or the application of a sprayed-on mulch) with appropriate species of vegetation as soon as practical after construction

6.2.5 Foundation and Lots Classification

The current investigation indicates the majority of the test pit profile to comprise of "uncontrolled" fill and/or natural weak soil with high moisture content. On this basis, we assessed that the major portion of the site as it currently exist may be classified as Class 'P' in accordance with AS 2870 "Residential Slabs and Footings". Subject to implementation of drainage improvement and earthworks as described above, the site may be upgrade to Class 'M' or better.

We recommend that further investigation of the site should be carried out to assess the site classification once more specific details of development sites become available. Note that site classification applies to residential dwellings only.

For multi-storey residential units, it is anticipated that footings will be supported on sandstone bedrock. For preliminary design, an allowable bearing capacity of 800kPa may be adopted for footings founded on sandstone bedrock. Additional investigation by borehole drilling and bedrock sampling will be required if higher allowable bearing capacities are required.

6.3 Other Issues

6.3.1 Salinity

The limited analysis for Electrical Conductivity (EC) encountered values ranging from 0.045 to 0.085dS/m. EC values less than 4dS/m are considered to be low in salinity and therefore not expected to severely impact on plant growth.

6.3.2 Soil Aggressiveness

The samples analysed for pH encountered values ranging from 4.2 to 4.6. These pH values indicate a moderate to severe soil aggressiveness to concrete structures.

The samples analysed for sulphate encountered values ranging from 46 to 89mg/kg and therefore not considered aggressive to concrete structures

6.3.3 Acid Sulfate

Based on the Acid Sulfate Soil Risk Map, the site is situated within an area with No Known Occurrence of acid sulfate soils.

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Oxford Falls Road, Oxford Falls

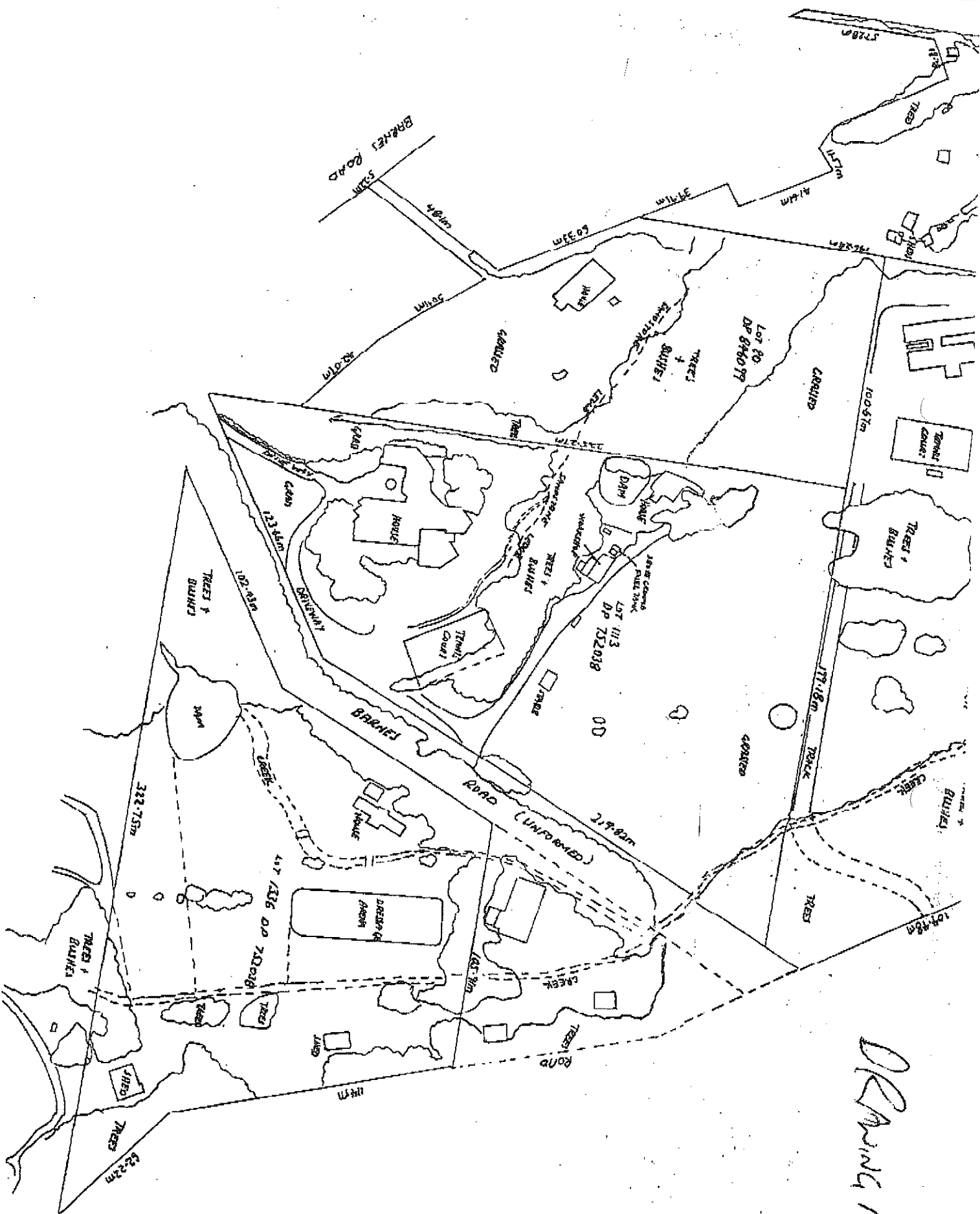
JC030294-L1
January 2004

A final report will be prepared shortly. In the mean time, please contact the undersigned if you have any queries.

Yours faithfully
Geoff Ingho Consultancy Pty Ltd
Solem Liew CPEng (NPER3)
Director

Attachement: Drawing No 1: Site Location and Features Plan
Drawing No 2: Test Pit Location Plan
Table A: Summary of Test Pit Profile

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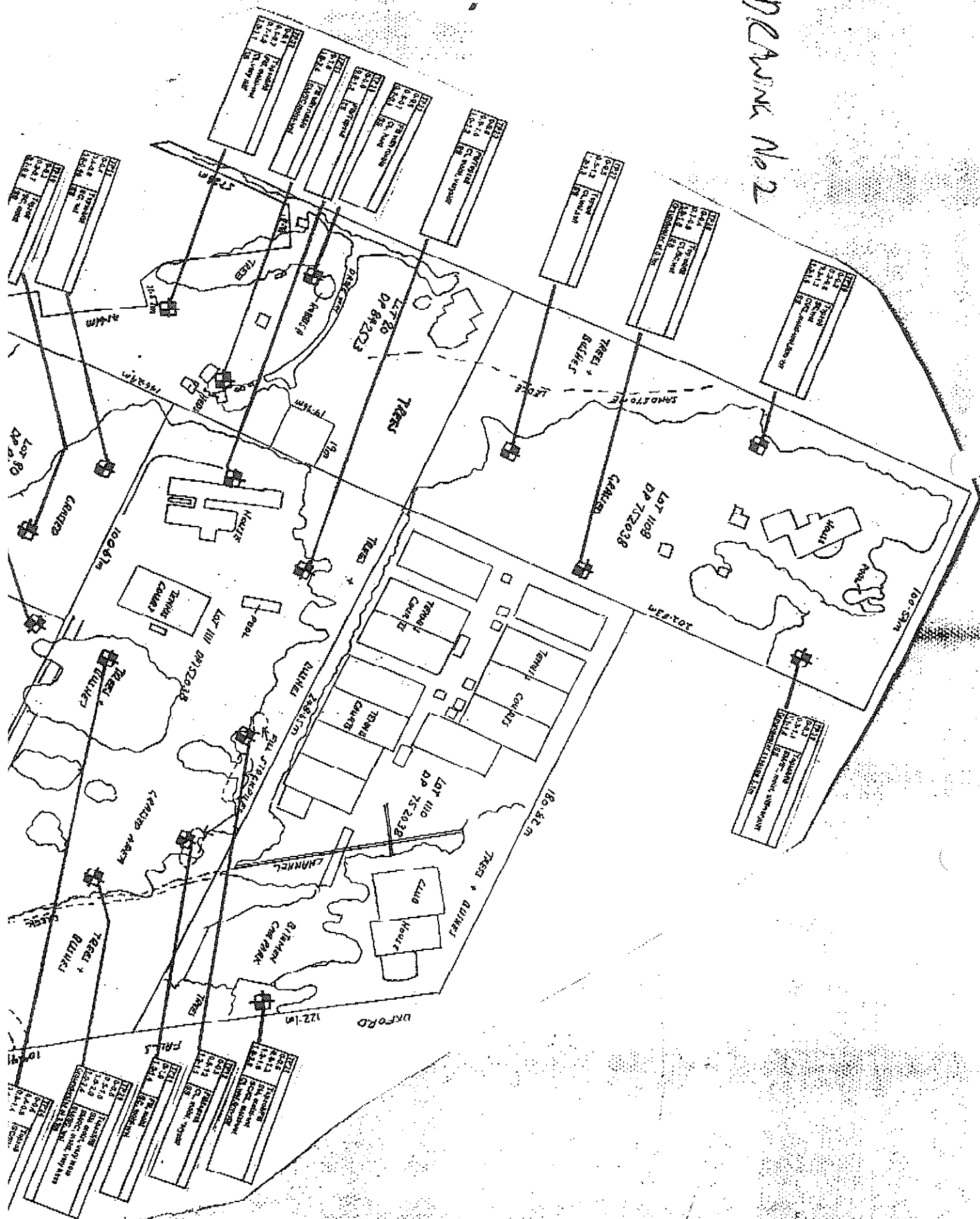


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DEATH NO 2

PLANK No 2



Plemons No 2

The site plan illustrates a complex of buildings and land parcels. Key features include:

- Buildings:** Multiple 'HOUSE' and 'BARN' structures are shown, along with a 'DRIVEWAY' and 'TRUCKS & BULLIES' area.
- Roads:** 'BREWER ROAD' and 'BREWER DRIVE' are labeled, along with various 'ROAD' and 'TRAIL' sections.
- Land Parcels:** Numerous tables are present, each containing data for land parcels, including area, dimensions, and other details. These tables are organized into several groups across the plan.
- Other Features:** 'TREES & BULLIES', 'DAM', 'LAKE', and 'CREEK' are also indicated.

The plan is oriented with a north arrow pointing towards the top right.

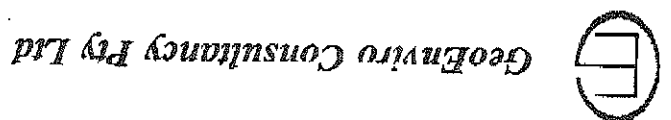


Table A : Summary of Test Pit Profile

CLIENT:	John Daly & Associates Pty
PROJECT:	Proposed Retirement Resort
LOCATION:	Lots 1110, 1336, 1108, 1113, 80, 1111 and 20 Oxford Fall Road, Oxford Fall
Job Number:	JC03029A
Logged By:	LM
Checked By:	SL
Date:	04-Dec-2003

Sheet 1 of 6

Test Pit Number	Test Location	Depth (m)		Material Description
		From	To	
1	Refer to Drawing No 2	0.0	0.60	Fill/Topsoil: Clayey Silty Sand and Sandy Clay with some gravel, grey brown, moist to wet
		0.60	1.50	(SC) Sandy Clay/Clayey Sand: medium plasticity, fine to medium grained, brown and yellow brown with some gravel, moist to wet
		1.50	2.30	(SM/SC) Silty Sand/Clayey Sand: fine to medium grained, dark grey and brown with organic odour, wet
		2.30	2.40	Sandstone: distinctly weathered, low strength, brown
		2.40	2.80	Backhoe Refusal at 2.4m. Groundwater seepage at 2.0m
2		0.0	0.40	Topsoil/Fill: Clayey Silty Sand with some gravel, brown, wet
		0.40	1.80	(SC) Clayey Sand: fine to medium grained with some silt and gravel, yellow brown and grey, moist to wet, loose
		1.80	2.80	(SM/SC) Silty Sand/Clayey Sand: fine to medium grained, dark grey and brown with organic odour, wet
		2.80	2.90	Sandstone: distinctly weathered, low strength, brown
		2.90	3.00	Backhoe Refusal at 2.9m. Groundwater seepage at 2.2m. Test pit collapsed
3		0.0	0.50	Topsoil/Fill: Clayey Silty Sand, with some gravel
		0.50	1.60	(SC/CI) Sandy Clay/Clayey Sand: fine to medium grained, medium plasticity yellow brown, wet, loose
		1.60	1.65	Sandstone: distinctly weathered, very low strength
		1.65	1.65	Backhoe Refusal at 1.65m
4		0.0	0.30	Topsoil: Clayey Silty Sand, fine to medium grained, dark brown, wet
		0.30	0.60	(CL) Sandy Clay: medium plasticity, yellow brown, with some gravel, MC>PL firm, PP 40 to 100kPa
		0.60	0.90	Sandstone: distinctly weathered, very low strength
		0.90	1.65	Backhoe Refusal at 1.65m
5		0.0	0.40	Topsoil: Clayey Silty Sand, fine to medium grained, dark brown, moist
		0.40	0.60	(SC/CL) Sandy Clay/Clayey Sand, fine to medium grained, low plasticity, yellow brown moist with some gravel, PP 40 to 100kPa, soft to firm
		0.60	0.85	Sandstone: distinctly weathered, very low strength
		0.85	0.85	Backhoe Refusal at 0.85m, dry
6		0.0	0.20	Topsoil/Fill: Clayey Silty Sand with some gravel, brown
		0.20	1.20	Fill: Silty Sand mixed with some sandy clay, some brick and concrete fragments
		1.20	1.60	: some rusty steel pipes, grey brown, moist to wet
		1.60	1.60	(CL) Sandy Clay: medium plasticity, yellow brown, moist to wet, firm, PP 40 to 60kPa
		1.60	1.65	Sandstone: distinctly weathered, very low strength
		1.65	1.65	Backhoe Refusal at 1.65m, dry



Table A : Summary of Test Pit Profile

Test Pit	Number	Location	Depth (m)		Material Description
			From	To	
7	Refer to Drawing No. 2	Oxford Fall Road, Oxford Fall	0.0	0.20	Topsoil/Fill: Clayey Silty Sand, brown
			0.20	0.80	Fill: Silty Sand/Clayey Sand, with some sandstone gravel, brick and concrete fragments, a trace of glass pieces, dark grey and brown, moist to wet
			0.80	1.20	(Cl) Gravely Silty Sand, low plasticity, yellow brown, MC>PL, stiff
			1.20	1.30	Sandstone, distinctly weathered, low strength, grey
			1.30	1.40	Bucket Refusal at 1.3m
			0.40	0.80	Topsoil/Fill: Clayey Silty Sand, brown
			0.80	0.80	Fill: Silty Sand with sandstone gravel, brown, wet
			0.80	1.40	(CL) Sandy Clay/Gravely Silty Sand, low plasticity, grey and yellow brown
			1.40	1.50	MC>PL, firm to stiff with some sandstone cobbles
			1.50	1.50	Sandstone, distinctly weathered, low strength, grey
8	Refer to Drawing No. 2	Oxford Fall Road, Oxford Fall	0.0	0.40	Topsoil/Fill: Clayey Silty Sand, brown
			0.40	0.80	Fill: Silty Sand with sandstone gravel, brown, wet
			0.80	1.40	(CL) Sandy Clay/Gravely Silty Sand, low plasticity, grey and yellow brown
			1.40	1.50	MC>PL, firm to stiff with some sandstone cobbles
			1.50	1.50	Sandstone, distinctly weathered, low strength, grey
			0.20	0.20	Topsoil/Fill: Clayey Silty Sand, brown, wet
			0.20	0.70	(SC) Clayey Sand, fine to medium grained, brown, moist
			0.70	0.80	Sandstone, distinctly weathered, low strength, brown
			0.80	0.80	Bucket Refusal at 0.8m
			0.40	0.40	Topsoil/Fill: Clayey Silty Sand, brown
11	Refer to Drawing No. 2	Oxford Fall Road, Oxford Fall	0.0	0.40	Topsoil/Fill: Clayey Silty Sand, brown
			0.40	0.80	Fill: Silty Sand with sandstone gravel, brown, wet
			0.80	1.40	(CL) Sandy Clay/Gravely Silty Sand, low plasticity, grey and yellow brown
			1.40	1.50	MC>PL, firm to stiff with some sandstone cobbles
			1.50	1.50	Sandstone, distinctly weathered, low strength, grey
			0.20	0.20	Topsoil: Clayey Silty Sand, fine to medium grained, brown, wet
			0.20	0.70	(SC) Clayey Sand, fine to medium grained with some sandstone bands, grey
			0.70	0.80	Sandstone, distinctly weathered, low strength, brown
			0.80	0.80	Bucket Refusal at 0.8m
			0.40	0.40	Topsoil/Fill: Clayey Silty Sand, brown
12	Refer to Drawing No. 2	Oxford Fall Road, Oxford Fall	0.0	0.20	Topsoil/Fill: Clayey Silty Sand, dark brown, moist
			0.20	1.30	Fill: Mixture of Silty Sand with some bricks, concrete up to about 0.8m in size, ash and sandstone gravel, dark grey and brown, Moist
			1.30	2.00	(SC/CL) Sandy Clay/Clayey Sand, fine to medium grained, brown, moist to wet
			2.00	2.90	(CL) Sandy Clay: medium plasticity, yellow brown, MC>PL, stiff to very stiff
			2.90	2.90	Bucket Refusal at 2.9m
			0.20	0.20	Topsoil/Fill: Clayey Silty Sand, with some gravel, brown
			0.20	1.80	Fill: Mixture of Silty Sand and building rubble such as bricks, concrete, ash moist to wet
			1.80	2.50	(CL) Sandy Clay: medium plasticity, orange brown, MC>PL, PP 90 to 150kPa firm to stiff
			2.50	2.50	Bucket Refusal at 2.5m
			0.20	0.20	Topsoil/Fill: Clayey Silty Sand, dark brown, moist



Table A : Summary of Test Pit Profile

Test Pit	Number	Location	Test	Depth (m)		Material Description
				From	To	
CLIENT:	John Daly & Associates Pty	PROJECT:	Proposed Retirement Resort	LOCATION:	Lots 1110, 1336, 1108, 1113, 80, 1111 and 20	Job Number: J03029A Logged By: LM Checked By: SL Date: 04-Dec-2003
14	Refer to Drawing No 2	0.0	0.10	2.00	0.10	Topsoil/Fill: Clayey Silty Sand, brown, moist to wet Fill: Mixture of Silty Sand and Clayey Sand with some concrete footings up to about 1.6m long, steel bars up to about 1.2m long, some bricks and brick fragments, some ash and timber pieces and sandstone gravel/cobbles, dark grey brown, moist (CL) Sandy Clay: medium plasticity, brown and grey, MC>PL, stiff to very stiff PP 160 to 210kPa
15		0.0	0.10	0.60	0.10	Topsoil/Fill: Clayey Silty Sand, brown, moist Fill: Clayey Silty Sand and Sandy Clay mixed with some bricks and concrete pieces, dark grey, moist (CL) Gravely Sandy Clay: medium plasticity, orange brown, MC>PL, very stiff Sandstone: extremely weathered, extremely low strength, dark brown and red
16		0.0	0.40	0.40	0.40	Topsoil: Clayey Silty Sand, fine to medium grained, grey brown, moist (CL) Gravely Sandy Clay/Sandy Clay: medium plasticity, orange brown MC>PL, very stiff, moist
17		0.0	0.40	0.40	0.40	Topsoil/Fill: Clayey Silty Sand, fine to medium grained, grey brown, moist (CL) Gravely Sandy Clay: medium plasticity, orange brown, MC>PL, PP 190 to 250 kPa (CL) Sandy Clay: medium plasticity, orange brown, MC>PL, PP 190 to 250 kPa (CI) Gravely Sandy Clay: medium plasticity with sandstone bands, brown, moist
18		0.0	0.50	0.50	0.50	Topsoil/Fill: Clayey Sand with some gravel Sandstone: distinctly weathered, low strength, grey brown Backhoe Refusal at 0.6m
19		0.0	0.20	0.70	0.20	Topsoil/Fill: Clayey Silty Sand, brown, moist Fill: Silty Sand and Clayey Sand with some sandstone gravel, one brick, dark grey brown, moist, loose (SM/SC) Silty Sand/Clayey Sand: fine to medium grained, yellow brown, MC>PL, loose (CL/SC) Clayey Sand/Sandy Clay: medium plasticity, fine to medium grained MC>PL, loose
20		0.0	0.50	1.00	0.50	Topsoil/Fill: Clayey Silty Sand, fine to medium grained, with some gravel brown, moist (SM) Silty Sand, fine to medium grained, moist, very loose (SM/SC) Silty Sand/Clayey Sand: fine to medium grained, yellow brown, moist, very loose As above but wet and loose. Groundwater seepage at 2.0m
Notes: MC = Moisture Content PL = Plastic Limit PP = Pocket Penetrometer						



Table A : Summary of Test Pit Profile

CLIENT: John Daly & Associates Pty	PROJECT: Proposed Retirement Resort	LOCATION: Lots 1110, 1336, 1108, 1113, 80, 1111 and 20 Oxford Fall Road, Oxford Fall	Job Number: JC03029A	Logged By: TM	Checked By: SL	Date: 04-Dec-2003	Material Description	Test Pit	Number	Refer to Drawing No. 2	0.0	1.00	1.40	0.50	1.20	1.50	0.80	1.00	1.20	0.40	0.80	1.40	1.60	0.80	1.20	0.60	1.20	1.80	2.90	Notes: MC = Moisture Content PL = Plastic Limit PP = Pocket Penetrometer		
								Test	Location																						From	To
								Depth (m)																								



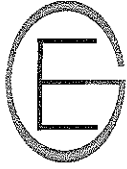
Table A : Summary of Test Pit Profile

CLIENT:	John Daly & Associates Pty	PROJECT:	Proposed Retirement Resort	LOCATION:	Lots 1110, 1136, 1108, 1113, 80, 1111 and 20 Oxford Fall Road, Oxford Fall	Job Number: JC03029A	Loaded By: LM	Checked By: SL	Date: 04-Dec-2003																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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27	0.0	0.50	1.20	1.30	Topsoil: Clayey Silty Sand, fine to medium grained, brown with some gravel, wet (CL) Sandy Clay, low plasticity, orange brown with red mottling, some ironstone gravel, MC>PL, wet, soft, PP <50kPa	Sandstone: fine to medium grained, extremely to distinctly weathered, very low to low strength, grey brown	to low strength, grey brown	Bucket Refusal at 1.3m	Topsoil/Fill: Clayey Sand with some gravel, brown	(CL/SC) Gravely Sandy Clay/Clayey Sand: low plasticity, orange brown	MC>PL	Sandstone: extremely weathered, very low strength, orange brown	Groundwater seepage at 0.8m	Topsoil: Clayey Silty Sand, fine to medium grained, grey brown, wet (SC) Clayey Sand/Sandy Clay: medium plasticity, fine to medium grained, dark brown, wet	(CL-Cl) Sandy Clay: low to medium plasticity, grey with some ironstone gravel	MC>PL, firm to stiff, PP 50 to 150kPa	Sandstone: extremely to distinctly weathered, very low strength, grey brown	Bucket Refusal at 1.6m	Topsoil/Fill: Clayey Silty Sand, fine to medium grained, dark brown, wet (SM/SC) Gravely Sandy Clay/Clayey Sand, fine to medium grained, medium plasticity, orange brown and grey, MC=PL, stiff to very stiff, PP 140 to 220kPa	Sandstone: extremely to distinctly weathered, very low strength, grey brown	Bucket Refusal at 1.4m, Slight seepage at 1.1m	Fill: Mixture of Silty Sand, Sandy Clay, crushed concrete, bricks, tiles and sandstone cobbles/boulders, dark brown and grey, moist (SM/SC) Silty Sand/Clayey Sand: fine to medium grained, dark brown, moist to wet	Topsoil/Fill: Clayey Sand with some gravel, brown	Fill: Silty Sand mixed with sandstone and sandy clay, brown and grey, moist to wet	(CL) Gravely Sandy Clay: medium plasticity, grey brown, very stiff, PP 320 to 410kPa	Sandstone: fine to medium plasticity, low strength, grey	Bucket Refusal at 1.1m	Notes: MC = Moisture Content PL = Plastic Limit PP = Pocket Penetrometer																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
	0.10	0.70	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00	4.10	4.20	4.30	4.40	4.50	4.60	4.70	4.80	4.90	5.00	5.10	5.20	5.30	5.40	5.50	5.60	5.70	5.80	5.90	6.00	6.10	6.20	6.30	6.40	6.50	6.60	6.70	6.80	6.90	7.00	7.10	7.20	7.30	7.40	7.50	7.60	7.70	7.80	7.90	8.00	8.10	8.20	8.30	8.40	8.50	8.60	8.70	8.80	8.90	9.00	9.10	9.20	9.30	9.40	9.50	9.60	9.70	9.80	9.90	10.00	10.10	10.20	10.30	10.40	10.50	10.60	10.70	10.80	10.90	11.00	11.10	11.20	11.30	11.40	11.50	11.60	11.70	11.80	11.90	12.00	12.10	12.20	12.30	12.40	12.50	12.60	12.70	12.80	12.90	13.00	13.10	13.20	13.30	13.40	13.50	13.60	13.70	13.80	13.90	14.00	14.10	14.20	14.30	14.40	14.50	14.60	14.70	14.80	14.90	15.00	15.10	15.20	15.30	15.40	15.50	15.60	15.70	15.80	15.90	16.00	16.10	16.20	16.30	16.40	16.50	16.60	16.70	16.80	16.90	17.00	17.10	17.20	17.30	17.40	17.50	17.60	17.70	17.80	17.90	18.00	18.10	18.20	18.30	18.40	18.50	18.60	18.70	18.80	18.90	19.00	19.10	19.20	19.30	19.40	19.50	19.60	19.70	19.80	19.90	20.00	20.10	20.20	20.30	20.40	20.50	20.60	20.70	20.80	20.90	21.00	21.10	21.20	21.30	21.40	21.50	21.60	21.70	21.80	21.90	22.00	22.10	22.20	22.30	22.40	22.50	22.60	22.70	22.80	22.90	23.00	23.10	23.20	23.30	23.40	23.50	23.60	23.70	23.80	23.90	24.00	24.10	24.20	24.30	24.40	24.50	24.60	24.70	24.80	24.90	25.00	25.10	25.20	25.30	25.40	25.50	25.60	25.70	25.80	25.90	26.00	26.10	26.20	26.30	26.40	26.50	26.60	26.70	26.80	26.90	27.00	27.10	27.20	27.30	27.40	27.50	27.60	27.70	27.80	27.90	28.00	28.10	28.20	28.30	28.40	28.50	28.60	28.70	28.80	28.90	29.00	29.10	29.20	29.30	29.40	29.50	29.60	29.70	29.80	29.90	30.00	30.10	30.20	30.30	30.40	30.50	30.60	30.70	30.80	30.90	31.00	31.10	31.20	31.30	31.40	31.50	31.60	31.70	31.80	31.90	32.00	32.10	32.20	32.30	32.40	32.50	32.60	32.70	32.80	32.90	33.00	33.10	33.20	33.30	33.40	33.50	33.60	33.70	33.80	33.90	34.00	34.10	34.20	34.30	34.40	34.50	34.60	34.70	34.80	34.90	35.00	35.10	35.20	35.30	35.40	35.50	35.60	35.70	35.80	35.90	36.00	36.10	36.20	36.30	36.40	36.50	36.60	36.70	36.80	36.90	37.00	37.10	37.20	37.30	37.40	37.50	37.60	37.70	37.80	37.90	38.00	38.10	38.20	38.30	38.40	38.50	38.60	38.70	38.80	38.90	39.00	39.10	39.20	39.30	39.40	39.50	39.60	39.70	39.80	39.90	40.00	40.10	40.20	40.30	40.40	40.50	40.60	40.70	40.80	40.90	41.00	41.10	41.20	41.30	41.40	41.50	41.60	41.70	41.80	41.90	42.00	42.10	42.20	42.30	42.40	42.50	42.60	42.70	42.80	42.90	43.00	43.10	43.20	43.30	43.40	43.50	43.60	43.70	43.80	43.90	44.00	44.10	44.20	44.30	44.40	44.50	44.60	44.70	44.80	44.90	45.00	45.10	45.20	45.30	45.40	45.50	45.60	45.70	45.80	45.90	46.00	46.10	46.20	46.30	46.40	46.50	46.60	46.70	46.80	46.90	47.00	47.10	47.20	47.30	47.40	47.50	47.60	47.70	47.80	47.90	48.00	48.10	48.20	48.30	48.40	48.50	48.60	48.70	48.80	48.90	49.00	49.10	49.20	49.30	49.40	49.50	49.60	49.70	49.80	49.90	50.00	50.10	50.20	50.30	50.40	50.50	50.60	50.70	50.80	50.90	51.00	51.10	51.20	51.30	51.40	51.50	51.60	51.70	51.80	51.90	52.00	52.10	52.20	52.30	52.40	52.50	52.60	52.70	52.80	52.90	53.00	53.10	53.20	53.30	53.40	53.50	53.60	53.70	53.80	53.90	54.00	54.10	54.20	54.30	54.40	54.50	54.60	54.70	54.80	54.90	55.00	55.10	55.20	55.30	55.40	55.50	55.60	55.70	55.80	55.90	56.00	56.10	56.20	56.30	56.40	56.50	56.60	56.70	56.80	56.90	57.00	57.10	57.20	57.30	57.40	57.50	57.60	57.70	57.80	57.90	58.00	58.10	58.20	58.30	58.40	58.50	58.60	58.70	58.80	58.90	59.00	59.10	59.20	59.30	59.40	59.50	59.60	59.70	59.80	59.90	60.00	60.10	60.20	60.30	60.40	60.50	60.60	60.70	60.80	60.90	61.00	61.10	61.20	61.30	61.40	61.50	61.60	61.70	61.80	61.90	62.00	62.10	62.20	62.30	62.40	62.50	62.60	62.70	62.80	62.90	63.00	63.10	63.20	63.30	63.40	63.50	63.60	63.70	63.80	63.90	64.00	64.10	64.20	64.30	64.40	64.50	64.60	64.70	64.80	64.90	65.00	65.10	65.20	65.30	65.40	65.50	65.60	65.70	65.80	65.90	66.00	66.10	66.20	66.30	66.40	66.50	66.60	66.70	66.80	66.90	67.00	67.10	67.20	67.30	67.40	67.50	67.60	67.70	67.80	67.90	68.00	68.10	68.20	68.30	68.40	68.50	68.60	68.70	68.80	68.90	69.00	69.10	69.20	69.30	69.40	69.50	69.60	69.70	69.80	69.90	70.00	70.10	70.20	70.30	70.40	70.50	70.60	70.70	70.80	70.90	71.00	71.10	71.20	71.30	71.40	71.50	71.60	71.70	71.80	71.90	72.00	72.10	72.20	72.30	72.40	72.50	72.60	72.70	72.80	72.90	73.00	73.10	73.20	73.30	73.40	73.50	73.60	73.70	73.80	73.90	74.00	74.10	74.20	74.30	74.40	74.50	74.60	74.70	74.80	74.90	75.00	75.10	75.20	75.30	75.40	75.50	75.60	75.70	75.80	75.90	76.00	76.10	76.20	76.30	76.40	76.50	76.60	76.70	76.80	76.90	77.00	77.10	77.20	77.30	77.40	77.50	77.60	77.70	77.80	77.90	78.00	78.10	78.20	78.30	78.40	78.50	78.60	78.70	78.80	78.90	79.00	79.10	79.20	79.30	79.40	79.50	79.60	79.70	79.80	79.90	80.00	80.10	80.20	80.30	80.40	80.50	80.60	80.70	80.80	80.90	81.00	81.10	81.20	81.30	81.40	81.50	81.60	81.70	81.80	81.90	82.00	82.10	82.20	82.30	82.40	82.50	82.60	82.70	82.80	82.90	83.00	83.10	83.20	83.30	83.40	83.50	83.60	83.70	83.80	83.90	84.00	84.10	84.20	84.30	84.40	84.50	84.60	84.70	84.80	84.90	85.00	85.10	85.20	85.30	85.40	85.50	85.60	85.70	85.80	85.90	86.00	86.10	86.20	86.30	86.40	86.50	86.60	86.70	86.80	86.90	87.00	87.10	87.20	87.30	87.40	87.50	87.60	87.70	87.80	87.90	88.00	88.10	88.20	88.30	88.40	88.50	88.60	88.70	88.80	88.90	89.00	89.10	89.20	89.30	89.40	89.50	89.60	89.70	89.80	89.90	90.00	90.10	90.20	90.30	90.40	90.50	90.60	90.70	90.80	90.90	91.00	91.10	91.20	91.30	91.40	91.50	91.60	91.70	91.80	91.90	92.00	92.10	92.20	92.30	92.40	92.50	92.60	92.70	92.80	92.90	93.00	93.10	93.20	93.30	93.40	93.50	93.60	93.70	93.80	93.90	94.00	94.10	94.20	94.30	94.40	94.50	94.60	94.70	94.80	94.90	95.00	95.10	95.20	95.30	95.40	95.50	95.60	95.70	95.80	95.90	96.00	96.10	96.20	96.30	96.40	96.50	96.60	96.70	96.80	96.90	97.00	97.10	97.20	97.30	97.40	97.50	97.60	97.70	97.80	97.90	98.00	98.10	98.20	98.30	98.40	98.50	98.60	98.70	98.80	98.90	99.00	99.10	99.20	99.30	99.40	99.50	99.60



Table A : Summary of Test Pit Profile

CLIENT: John Daly & Associates Pty				Job Number: JC03029A	
PROJECT: Proposed Retirement Resort				Logged By: LM	
LOCATION: Lots 1110, 1236, 1108, 1113, 80, 1111 and 20				Checked By: SL	
Oxford Fall Road, Oxford Fall				Date: 04-Dec-2003	
Test Pit Number	Test Location	Depth (m)		Material Description	
		From	To		
33	Refer to Drawing No 1	0.0	0.50	Fill: Sandy Clay and Clayey Sand with some sandstone, brick and concrete pieces, grey brown, moist	Notes: MC = Moisture Content PL = Plastic Limit PP = Pocket Penetrometer
		0.60	0.70	(CL) Gravelly Sandy Clay: medium plasticity, grey, hard, moist	
		0.70	0.80	Sandstone: fine to medium grained, distinctly weathered, low strength grey	
		0.80	0.80	Backhoe Refusal at 0.8m	
34		0.0	0.10	Topsoil/Fill: Clayey Silt	
		0.10	2.20	Fill: Mixture of Sandy Clay and Clayey Sand with some bricks and brick fragments some concrete pieces up to about 0.8m in size, some crushed sandstone, grey	
		2.20	2.50	(CL) Gravelly Sandy Clay: medium plasticity, grey brown	
		2.50	2.60	Sandstone: fine to medium grained, distinctly weathered, low strength, grey	
		2.60	2.60	Groundwater seepage at 1.6 to 1.8m	
		2.60	2.60	Groundwater seepage at 1.6 to 1.8m	
35		0.0	1.50	Fill: Mixture of Sandy Clay and Clayey Sand with a trace of building material such as concrete and bricks	
		1.50	1.60	Sandstone: fine to medium grained, distinctly weathered, low strength, grey	
				Slight Groundwater seepage at 1.5m	



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23rd September 2004

JG03029A-L6

Tiffany Developments
C/- John M Daly & Associates
PO Box 25
CAMPBELLTOWN NSW 2560

Attention: Mr Terry Hams

Dear Sir,

**Re Stability Assessment
 Oxford Fall Retirement Resort
 Lots 1110, 1336, 1108, 1113, 80, 1111 and 20, Oxford Falls Road, Oxford Falls**

1. Introduction

Further to our Preliminary Contamination and Geotechnical Assessment report (Ref JC03029A dated January 2004), this letter provides our comments and assessment of the present and likely long-term stability of this site following development.

This assessment is based on information obtained from our previous site investigation and observation of surface indicators of the site and the immediately adjoining land. Reference should be made to our previous reports for details.

2. Site Description

The site is situated on the upper catchment area of Middle Creek which flows to the Narrabeen Lakes. As mentioned in our previous report, the site topography may be divided into three regions as follows;

Region 1: Crest of the sandstone ridge on the south western portion of the site with ground surface reduced level (RL) typically ranging from about 92m to 114m. Based on the Soil Landscape Series Sheet 9030, 1:100,000 sheet, prepared by Soil Conservation Service of NSW, this area is underlain by Hawkesbury Soil Landscape of the colluvial origin with typical soil consisting of earthy sand, yellow earths and some yellow podzolic soil. The colluvial slopes within several areas throughout the Sydney Basin region are very similar in that they were formed by either the collection of fallen rock which has since weathered to form a cohesive mass of rock debris (cobbles and boulders) in a clayey matrix, or through the build up of material washed down the slopes, often as flat as 10° over horizontal. Instability is mostly confined to the talus or colluvium material and, in some cases, the residual insitu clayey soil overburden. The underlying bedrock or parent rock, even in highly weathered form is generally being considered to be stable

Region 2: Toe of the sandstone hill with ground surface RL typically ranging from about 84 to 92m. Based on the Soil Landscape Series Sheet, this area is underlain by the Lambert Soil Landscape of erosional origin. Typical soil consists of earthy sand and yellow earths on the crest and leached sands, grey earths and gleyed podzolic soil. This region has gentle to moderate slopes and slope instability is confined to surface erosion.

Region 3: Creek area which runs along the eastern site boundary with ground surface RL typically ranging from about 78 to 86m. Based on the Soil Landscape Series Sheet, this area is underlain by the Oxford Falls Soil Landscape of fluvial origin with typical soil consisting of earthy sand, yellow earths and siliceous sands. This region has very gentle slopes and there is no obvious signs of previously slope instability.

Based on the Geological Series sheet 9030 (Edition 1) 1:100,000 sheet 1991, the underlying bedrock belongs to the Hawkesbury Sandstone group consisting of medium to coarse grained quartz sandstone with shale capping along the ridges to the south of the site.

2.0 Proposed Development

We understand that at this stage, specific details of the proposed development are not yet available. Based on the Master Plan drawing prepared by MDA Building Design (Drawing No CF 09), the proposed development will include construction of two to three storeys building blocks, some with basement car parks. The building blocks are grouped into 3 areas, Areas A and B will be located within Region 2 and Area C will be located within Region C

3.0 Stability Assessment

The stability of an apparently stable existing block of land may be adversely affected by many activities on or nearby the site as follows;

- The diversion of surface water onto the block by new roadways, houses or other activities involving landscaping.
- The addition of large volumes of filling either above or beside the block.
- The excavation of soil from the area below (downhill) of the block.
- The development of septic tile beds or other drainage systems whereby liquids are introduced into the soil/rock mass.

Good drainage is almost always the key to a stable block. Where a new structure, modifications to an existing structure or even landscaping is proposed, it is highly unlikely that some form or other of surface or subsurface drainage will not be required to enhance the stability of the site.

The risk of slope instability is affected by three main factors;

- Slope angle
- Strength of the subsurface materials
- Concentration of water

The risk of slope instability may be generally classified into three categories;

Class	Implication
Low	A landslide is very unlikely
Moderate	A landslide is unlikely
High	Some risk of landslide

Our previous site inspection and mapping did not reveal signs of major natural earth movements or landslip apart from surficial soil erosion and scouring on the upper steeper portion of the sandstone hill within Region 1. Regions 2 and 3 which are located on the lower slopes with relatively gentle ground surface slopes have no obvious signs of previous slope instability.

Based on the foregoing, our slope stability assessment for the various Regions is as follows;

Region 1	Moderate Risk
Region 2	Low to moderate Risk
Region 3	Low Risk

Proposed development in Region 1 should incorporate good hillside construction practices which will include the following;

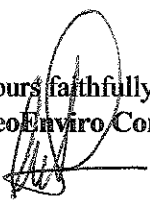
- All footings for the proposed building should be supported on footings founded on stable sandstone bedrock. Footing inspection should be carried out by a suitably qualified engineer prior to concreting to ensure adequacy of bearing material for the proposed structure. Care should be taken to ensure footings are not founded on potential unstable sandstone wedge blocks or overhanging rocks.
- The proposed building structure should include adequate articulation joints along the walls to accommodate some movements.
- All excavation in excess of 1.2m high should be adequately retained by engineered designed retaining wall.
- All unretained cut and fill should be adequately battered. As a general rule, the following batter slopes may be adopted.

Material	Recommended Batter
Compacted Fill	2.5 Horizontal : 1 Vertical
Residual clay	2 Horizontal : 1 Vertical
Weathered Bedrock	0.5 Horizontal : 1 Vertical

Steeper sandstone excavation may be adopted subject to approval by a qualified engineer.

- All stormwater run-off from uphill should be diverted away from pool and tank footings.
- A suitably qualified and experienced engineer should supervise all works.

Should you have any queries regarding the above, please contact the undersigned.


Yours faithfully
GeoEnviro Consultancy Pty Ltd

**Solern Liew CPEng
Director**

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