MORRISON GEOTECHNIC

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Brisbane Office
Job No: DL17/286
Ref No: 12868
Author: L. McDowall

18th January 2017

Allroads Pty Ltd
PO Box 4698
Loganholme Qld 4101

ATTENTION: MR DARREN GILLESPIE
MR SAM PETERSON
Email: Darren.gillespie@allroads.com.au
Sam.petersen@allroads.com.au

Dear Sirs,

RE: LEVEL ONE COMPLIANCE REPORT FOR BULK EARTHWORKS FILLING OPERATIONS FLAGSTONE CITY STAGE 1G, FLAGSTONE

Table of Contents

1.0 INTRODUCTION

1.1 General

This report presents results of Level One Earthworks Inspections and associated Compaction Compliance testing carried out on Earthworks Fill constructed to form residential building platforms at the Flagstone City Stage 1G Development, Flagstone (The Site).

The work was commissioned by Mr. D. Gillespie representing Allroads Ltd Pty (The Client), using Purchase Order AR2210-SCA-001.

Earthworks were carried out by The Client.

Earthworks filling operations were carried out intermittently between 27th July 2017 and 23rd November 2017.

Picture 1: Aerial View of the Site (Image Source: Nearmap.com- dated 16th September 2017)

1.2 Previous Earthworks

As far as could be determined; no previous earthworks have been carried out at The Site.

1.3 The Project

The Purpose for filling at The Site is to construct a Residential Subdivision which included new pavements, residential building platforms and associated underground services.

Bradlees Pty Ltd Earthworks Cut/Fill Plan, Project Number 15-841, Drawing number C1-S1G-CIL-110, Revision B dated 02.02.2017, indicates the extents and thickness of fill to be constructed at The Site. This plan is a reasonable indication of the actual fill constructed at The Site.

The actual thickness of fill on an individual Lot can be obtained from the Developer as a Lot Disclosure Plan.

The Site is bounded by existing residential developments to the East, future residential developments to the West and South and undeveloped land to the North.

2.0 THE BRIEF

The Brief from the Client was limited to:

- Level One Inspection and Testing of the placement and compaction of fill materials in accordance with AS3798 2007 – "Guidelines on Earthworks for Commercial and Residential Developments",
- Logan City Council Project Specifications.
- Relative Density Control Testing in accordance with AS1289 – Testing of Soils for Engineering Purposes and at frequencies required in AS3798 Table 8.1.
- Notes on Bradlees Earthworks Drawings.

All other design requirements such as CBR and Quality of Materials, site classification, material, settlement assessments and existing filling were not included in the Brief and are therefore excluded from this Report.

3.0 METHODOLOGY

Earthworks Inspections and Testing was carried out on the stripped and exposed ground surfaces and during the placement and compaction of fill materials.

Field and laboratory testing included a walk over assessments of the existing ground conditions, observation of filling and compaction activities, field density testing using a nuclear soil moisture density gauge and Hilf compactions. All work was carried out in accordance with AS 3798 and AS 1289.

3.1 Stripped Surface Assessment

The areas to be filled at The Site were observed to be stripped and cleared of all visible organic matter, deleterious, loose and unsuitable materials to depths exposing a competent natural foundation.

The materials forming the natural fill foundation, exposed after the stripping and clearing can be broadly summarised as:

- Sandstone (SW) – slightly weathered, medium strength, fine to medium grained, orange with grey/brown streaks.
- Clayey Sand (SC) – at least very stiff, fine to course grained sand, low to medium plasticity, light orange – grey, moist

Following the stripped surface assessment of the fill areas, the natural fill foundation was approved for filling using the following process:

- Walk over assessments confirming that the competent ground was exposed.
- Proof roll testing using large sized and loaded truck confirming no movement of the foundation.
- Sloping areas to be filled were either benched prior to filling or fill was keyed into the slope during filling operations.

On this basis, the compliant assessments in accordance with above indicate that the exposed ground forming the fill foundation is capable of supporting new fill materials.

Picture 2: View of the Stripping Operations Prior to Fill Placement

3.2 Filling Operations

Fill material was sourced from onsite cuts areas, onsite stockpiles and trench excavations.

Fill materials can be broadly summarised as:

- Sandy Clay (CI) – medium plasticity, fine to coarse grained sand, orange – grey - brown, moist.
- Clayey Sand (SC) – fine to course grained sand, low to medium plasticity, light orange – grey, moist

Placement and compaction of the fill materials was carried out using the following plant:

- 825 Compactor
- Dozer
- Scraper
- Articulated Dump Truck
- Water Truck
- Excavator
- Surface Miner

The fill materials were moisture conditioned at the source and during placement to moisture contents suitable for compaction. Deleterious materials such as organics, sticks, roots and over size particles were sorted and removed during placement or were rejected for use. Occasional cobble sized particles may remain in the fill however are not considered to affect the fill as a mass.

Placement of the fill materials was carried layers appropriate for the above plant and compacted using the above plant carrying out multiple passes.

Our representative observed the filling process as described above and it was assessed to be consistent for the entire thickness of fill.

Field density tests and laboratory compactions were carried out on the compacted fill materials in accordance with Table 5.1 and 8.1 of AS3798 2007 (Guidelines on Earthworks for Commercial and Residential Developments) and tested to AS1289 test methods (Testing of Soils for Engineering Purposes). Testing achieved the required specification of 95% of the Hilf Density.

Fill placed and compacted at measured density ratios less than 95% were tyned, moisture conditioned and re-compacted until the required specification was achieved. Retesting was carried out using Random Stratified Location methods.

The Location of the field density tests are shown on the Site Plan contained in Appendix A. These test locations and levels were not obtained by survey and therefore should only be considered as approximate.

Picture 3: View of the Site During Construction

Picture 4: View of the Site During Construction

4.0 STATEMENT OF COMPLIANCE

Our representative observed all the relevant earthworks operations including the stripped surface, filling operations and carried out field density tests in accordance with the required standards (AS3798, AS1289) and specifications.

It is confirmed that Level One Inspection and Testing has been carried out on the earthworks fill to form the residential Lots and embankments below subgrade. Based on the observations made by our Geotechnicians and the results of the field and laboratory tests, the placed and compacted fill at the above project has, as far as we have been able to assess, been constructed in general accordance with the intent of AS3798 and the Specifications.

The fill can be deemed as “controlled” as defined in AS2870 (Residential Slabs and Footings).

5.0 EXCLUSIONS

This statement does not include any top soil, which may be placed for use as dressing or any other subsequent earthworks after 23rd November 2017.

Assessments of material quality such as soaked CBR and site classifications are excluded from this commission.

Our on-site attendance specifically excludes assessments of fill material quality and engineering properties that are outside the requirements of AS3798 - 2007, including soil or fill reactivity and soaked CBR values. We note that the fill materials used may result in unfavourable site classifications and low subgrade design strengths.

Footings and ground slabs for any structures constructed over natural soils or controlled fill should be designed to accommodate the characteristic ground surface movements and settlement potential. Assessments of these design parameters are beyond the scope of this Report.

This report is not to be relied upon for settlement analysis engineering advice. This is beyond the scope of this report and outside our engagement.

6.0 LIMITATIONS

This Report has been prepared by Morrison Geotechnic Pty Ltd (**Morrison Geotechnic**), and may include contributions from Morrison Geotechnic's officers and employees, sub-contractors, sub-consultants or agents (**Contributors**).

This Report is for the sole benefit and use of Allroads Pty Ltd (**Client**), its designers, clients and relevant statutory authorities for the sole purpose of providing geotechnical advice and recommendations in respect of the Flagstone City Stage 1G Development, Flagstone **(Project)**. The Report is only intended to address those issues expressly described in the Brief/ Work Instructions in this Report.

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(b) used or relied upon by any other party.

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(a) have relied upon and presumed the accuracy of this information;
(b) have not verified the accuracy or reliability of this information (other than as expressly stated in this Report);
(c) have not made any independent investigations or enquiries in respect of those matters of which it has no actual knowledge at the time of giving this Report to the Client; and
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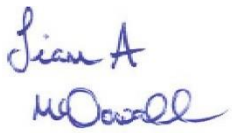
(a) is not an environmental, contamination or hazardous materials assessment; may be invalid, incomplete or inaccurate (including errors in the scope of work, investigation methodology, observations, opinions and advice) where the information provided to Morrison Geotechnic was invalid, incomplete or inaccurate;
(b) is limited to observations of those parts of the site described in Section 1.0.

No warranty or guarantee, whether express or implied, is made in respect of the geotechnical data, information, advice, opinions and recommendations present in this Report.

If further information becomes available, or additional assumptions need to be made, Morrison Geotechnic reserves its right to amend this Report.

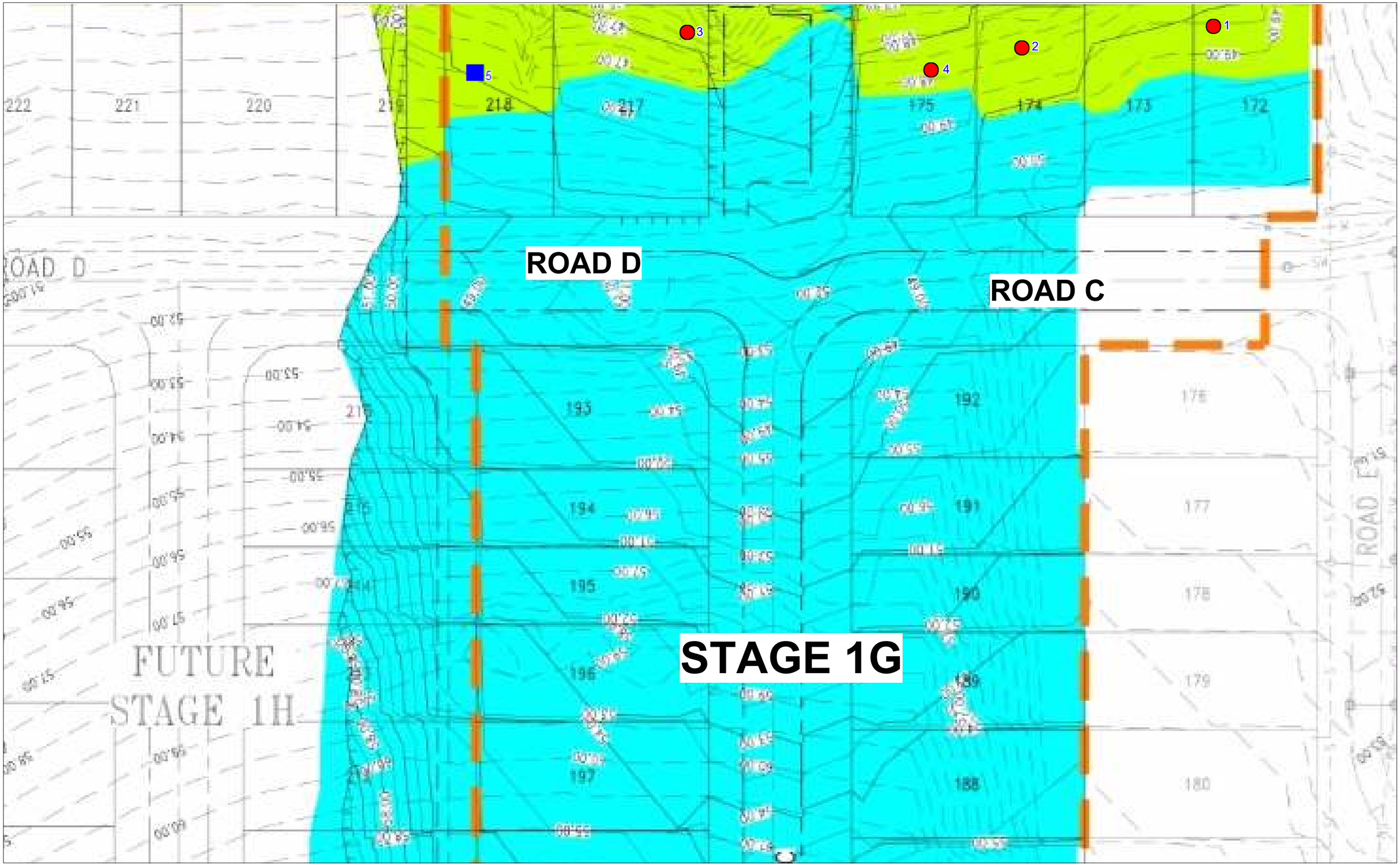
If you have any queries regarding the above, please contact our Brisbane office.

Yours faithfully



LIAM McDOWALL
For and on behalf of
MORRISON GEOTECHNIC PTY LIMITED

ATTACHMENTS:
Appendix A – Site Plan Showing Test Locations
Appendix B – Laboratory Test Results Reports
Brochure – 'Important Information About Your Geotechnical Report'



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Engineers: D.Riley, J. Daly
D.Dragun, & S.Wynne
Geologists: L.Bexley & R.Howchin
Laboratory: M.Morrison

LEGEND

- RL 40.00 TO 50.00
- FINAL LEVEL

Map Description :	**EARTHWORKS FIELD DENSITY TESTING - Level 1 Inspection**				
Client :	ALLROADS PTY LTD				
Project :	**FLAGSTONE CITY, STAGE 1G**				
Project No :	DL17/286	Drawing No :	DL17/286 - 01	Scale :	Not to Scale

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Hilf Density Ratio Report

Client :	ALLROADS PTY LTD	Report Number:	DL17/286 - 1
Address :	P O BOX 4698, LOGANHOLME, QLD, 4129	Report Date :	11/08/2017
Project Name :	EARTHWORKS SUPERVISION	Order Number :	AR2210-SCA-001
Project Number :	DL17/286	Test Method :	AS1289.5.8.1 & 5.7.1
Location:	FLAGSTONE CITY , STAGE 1G		

Sample Number :	232494			
Test Number :	1			
Sampling Method :	-			
Date Sampled :	28/07/2017			
Date Tested :	28/07/2017			
Material Type :	General Fill			
Material Source :	On Site			
Lot Number :	-			
Sample Location :	E 34099.600 N 73577.000 RL 48.962			
Test Depth (mm) :	150			
Layer Depth (mm) :	-			
Maximum Size (mm) :	19			
Oversize Wet (%) :	-			
Oversize Dry (%) :	-			
Oversize Density (t/m³) :	-			
Field Moisture Content (%) :	7.4			
Hilf MDR Number :	232494			
Hilf MDR Method :	AS1289.5.1.1 & 5.7.1			
Compactive Effort :	Standard			
Field Density Method :	AS1289.5.8.1 & 5.7.1			
Moisture Method :	AS1289.2.1.1			
Moisture Ratio (%) :	63.5			
Field Wet Density (t/m³) :	2.092			
Optimum Moisture Content (%) :	11.7			
Moisture Variation :	4.3			
Peak Converted Wet Density (t/m³) :	2.146			
Hilf Density Ratio (%) :	97.5			
Minimum Specification :	95			
Moisture Specification :	-			
Site Selection :	-			
Soil Description :	-			
Remarks :	-			

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ACCREDITATION

Accredited for compliance with ISO/IEC 17025.

APPROVED SIGNATORY

Sam Woodley (Brisbane) - Laboratory Manager
NATA Accreditation Number
1162 / 1169

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Hilf Density Ratio Report

Client :	ALLROADS PTY LTD	Report Number:	DL17/286 - 2
Address :	P O BOX 4698, LOGANHOLME, QLD, 4129	Report Date :	15/08/2017
Project Name :	EARTHWORKS SUPERVISION	Order Number :	AR2210-SCA-001
Project Number :	DL17/286	Test Method :	AS1289.5.8.1 & 5.7.1
Location:	FLAGSTONE CITY , STAGE 1G		

Sample Number :	232596	232597		
Test Number :	2	3		
Sampling Method :	-	-		
Date Sampled :	31/07/2017	31/07/2017		
Date Tested :	31/07/2017	31/07/2017		
Material Type :	General Fill	General Fill		
Material Source :	On Site	On Site		
Lot Number :	-	-		
Sample Location :	E 34073.800 N 73579.800 RL 46.900	E 34031.500 N 73586.200 RL 46.300		
Test Depth (mm) :	150	150		
Layer Depth (mm) :	-	-		
Maximum Size (mm) :	19	19		
Oversize Wet (%) :	-	-		
Oversize Dry (%) :	-	-		
Oversize Density (t/m³) :	-	-		
Field Moisture Content (%) :	7.5	8.7		
Hilf MDR Number :	232596	232597		
Hilf MDR Method :	AS1289.5.1.1 & 5.7.1	AS1289.5.1.1 & 5.7.1		
Compactive Effort :	Standard	Standard		
Field Density Method :	AS1289.5.8.1 & 5.7.1	AS1289.5.8.1 & 5.7.1		
Moisture Method :	AS1289.2.1.1	AS1289.2.1.1		
Moisture Ratio (%) :	77.5	82		
Field Wet Density (t/m³) :	2.136	2.112		
Optimum Moisture Content (%) :	9.6	10.6		
Moisture Variation :	2.2	2.0		
Peak Converted Wet Density (t/m³) :	2.141	2.155		
Hilf Density Ratio (%) :	100.0	98.0		
Minimum Specification :	95	95		
Moisture Specification :	-	-		
Site Selection :	-	-		
Soil Description :	-	-		
Remarks :	-			

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Hilf Density Ratio Report

Client :	ALLROADS PTY LTD	Report Number:	DL17/286 - 3
Address :	P O BOX 4698, LOGANHOLME, QLD, 4129	Report Date :	18/08/2017
Project Name :	EARTHWORKS SUPERVISION	Order Number :	AR2210-SCA-001
Project Number :	DL17/286	Test Method :	AS1289.5.8.1 & 5.7.1
Location:	FLAGSTONE CITY , STAGE 1G		

Sample Number :	232805			
Test Number :	4			
Sampling Method :	-			
Date Sampled :	02/08/2017			
Date Tested :	02/08/2017			
Material Type :	General Fill			
Material Source :	On Site			
Lot Number :	-			
Sample Location :	E 34077.000 N 73578.300 RL 48.500			
Test Depth (mm) :	150			
Layer Depth (mm) :	-			
Maximum Size (mm) :	19			
Oversize Wet (%) :	-			
Oversize Dry (%) :	-			
Oversize Density (t/m³) :	-			
Field Moisture Content (%) :	8.2			
Hilf MDR Number :	232805			
Hilf MDR Method :	AS1289.5.1.1 & 5.7.1			
Compactive Effort :	Standard			
Field Density Method :	AS1289.5.8.1 & 5.7.1			
Moisture Method :	AS1289.2.1.1			
Moisture Ratio (%) :	68.5			
Field Wet Density (t/m³) :	2.113			
Optimum Moisture Content (%) :	12.0			
Moisture Variation :	3.8			
Peak Converted Wet Density (t/m³) :	2.102			
Hilf Density Ratio (%) :	100.5			
Minimum Specification :	95			
Moisture Specification :	-			
Site Selection :	-			
Soil Description :	-			
Remarks :	-			

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Hilf Density Ratio Report

Client :	**ALLROADS PTY LTD**	Report Number:	**DL17/286 - 4**
Address :	**P O BOX 318, BROWNS PLAINS, QLD, 4118**	Report Date :	**30/11/2017**
Project Name :	**EARTHWORKS SUPERVISION**	Order Number :	**AR2210-SCA-001**
Project Number :	**DL17/286**	Test Method :	**AS1289.5.8.1 & 5.7.1**
Location:	**FLAGSTONE CITY , STAGE 1G**	**Page 1 of 1**	

Sample Number :	238338			
Test Number :	5			
Sampling Method :	-			
Date Sampled :	23/11/2017			
Date Tested :	23/11/2017			
Material Type :	**Allotment Fill**			
Material Source :	**On Site**			
Lot Number :	**218**			
Sample Location :	Lot 218 4m From North Boundary 5m From West Boundary Final Level			
Test Depth (mm) :	150			
Layer Depth (mm) :	-			
Maximum Size (mm) :	19			
Oversize Wet (%) :	-			
Oversize Dry (%) :	-			
Oversize Density (t/m³) :	-			
Field Moisture Content (%) :	7.1			
Hilf MDR Number :	238338			
Hilf MDR Method :	AS1289.5.1.1 & 5.7.1			
Compactive Effort :	Standard			
Field Density Method :	AS1289.5.8.1 & 5.7.1			
Moisture Method :	AS1289.2.1.1			
Moisture Ratio (%) :	71			
Field Wet Density (t/m³) :	2.223			
Optimum Moisture Content (%) :	10.0			
Moisture Variation :	2.9			
Peak Converted Wet Density (t/m³) :	2.215			
Hilf Density Ratio (%) :	**100.5**			
Minimum Specification :	95			
Moisture Specification :	-			
Site Selection :	-			
Soil Description :	-			
Remarks :	-			

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Liam Mcdowall (Brisbane) - Branch Manager
NATA Accreditation Number
1162 / 1169

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

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