



Douglas Partners
Geotechnics | Environment | Groundwater

Factual Report on
Additional Geotechnical Investigation

Proposed Rapid Creek Flood Mitigation
Corner of Henry Wrigley Drive and McMillans Road,
Marrara, NT

Prepared for
Jacobs Group (Australia) Pty Ltd

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Integrated Practical Solutions



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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

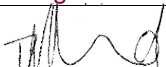
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Factual Report on Additional Geotechnical Investigation Proposed Rapid Creek Flood Mitigation Corner of Henry Wrigley Drive and McMillans Road, Marrara, NT

1. Introduction

This factual report presents the results of an additional geotechnical investigation undertaken for the proposed Rapid Creek Flood Mitigation at Corner of Henry Wrigley Drive and McMillans Road, Marrara, NT. The investigation was commissioned by Jacobs Group (Australia) Pty Ltd and was undertaken in accordance with Douglas Partners' proposal DWN170135 (Rev2) dated 24 August 2017.

It is understood that the proposed Rapid Creek Flood Mitigation project include is to include the construction of a retention pond at the site which will require significant bulk earthworks.

Previous geotechnical investigations have been undertaken by Douglas Partners Pty Ltd (DP), the results of which are detailed in the following reports:

-) *Factual Report on Geotechnical Investigation, Proposed Flood Mitigation Works* (Ref 1); and
-) *Report on Geotechnical Investigation, Proposed Water Main and Electrical Conduits* (Ref 2).

Since the previous investigations, Per- and Poly-Fluoroalkyl Substances (PFAS) have been confirmed (by others) to be present at the site and an assessment of the permeability of the subsurface soils was required to assist in determining the migration potential of the PFAS.

Hence, additional investigation was carried out to provide factual information on the following:

-) Subsurface conditions at test locations;
-) Presence of groundwater and/or bedrock;
-) Results of in-situ permeability tests; and
-) Results of laboratory testing (Atterberg limits and remoulded permeability).

The investigation included the excavation of forty-five (45) test pits, in-situ testing and laboratory testing of selected samples. The factual results are presented in this report.

2. Site Description and Regional Geology

The proposed development is located about 10 km north east of the Darwin CBD and immediately north of the Darwin International Airport on the corner of McMillans Road and Henry Wrigley Drive, Rapid Creek.

The main site is a triangular shaped area of about 9.5 ha. It is bounded by vacant land to the west, McMillans Road to the north and Henry Wrigley Drive to the east. To the south of the site is vacant land immediately adjoining Darwin International Airport.

The proposed works also extend across Henry Wrigley Drive, covering an additional 1 ha (approximately).

The extent of the works is shown on Drawing 1 in Appendix C.

Figures 1 to 4 below show the site conditions at the time of the investigation.



Figure 1 – North-eastern area of the site, looking north



Figure 2 – North-western area of the site, looking northwest



Figure 3 – Existing channel through centre of the site, looking east



Figure 4 – South-eastern area of the site (east of Henry Wrigley Drive), looking west

Reference to available geological information (Darwin 1:100,000 geological series map, Sheet 5073) indicates that soil conditions at the site are likely to comprise a typical lateritic profile of Cainozoic age that comprises either unconsolidated sand, clayey sand with limonite gravels (Czs) or variably cemented and mottled laterite (Czl).

These soils are shown to be underlain by Cretaceous age fine grained sediments belonging to the Darwin Member (Kld) of the Bathurst Island Formation, which overlies Proterozoic age metasediments of the Burrell Creek Formation (Pfb).

The Darwin Member typically comprises horizontally bedded, silicified, kaolinised and / or ferruginised siltstone or claystone with a thin basal unit of sandstone and / or quartz conglomerate. The silicified siltstone of the Darwin Member is typical in the upper metres of the formation and it is locally known as Porcellanite.

The Burrell Creek Formation typically consists of metamorphosed siltstones and phyllites that are steeply dipping to the east or west and strike in a north-south direction. Quartz veins of variable thickness are widespread within the Burrell Creek Formation. The contact between the Bathurst Island Formation and the Burrell Creek Formation (the Unconformity) is irregular, undulating and faulted in places, and usually identified by a marker bed of rounded quartz pebbles in clay matrix.

3. Field Work Methods

The field work was undertaken over the period between 5 September and 10 October 2017 and comprised the following;

-) Excavation of forty-five test pits (Pits 101 to 145) using either a 5.5 tonne excavator fitted with a 450 mm wide bucket or a 15 tonne excavator fitted with a 600 mm wide bucket. The test pits were excavated to depths ranging from 0.35 m to 4.0 m;
-) The subsurface conditions encountered in the test pits were logged by a geotechnical engineer, who also retrieved regular samples for strata identification and laboratory testing purposes;
-) Dynamic cone penetrometer (DCP) tests were carried out at selected test pit locations to provide an assessment of the penetrometer resistance of near surface soils; and
-) Constant head and falling head permeability testing was carried out at fifteen (15) test pits to provide in-situ permeability values for different soil horizons within the subsurface profile. At each selected test pit, constant head testing, using a permeameter, was carried out in accordance with AS1547 over the top 0.5 m. Given the strength of the underlying material (i.e. below 1 m depth), permeameter testing was unable to be effectively undertaken and hence simple falling head permeability testing was undertaken by introducing water in a 300 mm diameter hole and recording the rate at which the water level dropped within the hole.

The test pits were positioned on site at locations specified by the client. Their position was recorded using a Garmin handheld GPS which is accurate to within about 5 m. The test pit locations are shown on Drawing 1 in Appendix C.

4. Field Work Results

4.1 Test Pits

The conditions encountered in the test pits are presented on the logs in Appendix A, and they are preceded by notes explaining classification methods and descriptive terms. A summary of the conditions encountered in the test pits is given in Table 1, on the following pages.

Groundwater was encountered in Pit 125, at 1.5 m depth. No free groundwater was encountered in any of the remaining test pits. It should be noted that groundwater levels are dependent on factors such as climatic conditions and soil permeability and therefore can vary with time.

Based on the results of the current and previous investigations, the existing soils are generally considered suitable for use as 'General Fill', from a geotechnical perspective. Notwithstanding this, the filling encountered across the site comprised large fragments of concrete and other building waste which would be required to be removed in the event that the material was to be re-used.

Table 1: Summary of Sub-Surface Conditions in the Test Pits

| Test Location | | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 |
|---|-------------------------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| Unit | Material Description | Depth to Base of Material, Below Surface Level (m) | | | | | | | | | | | | |
| Uncemented overburden soils | Topsoil/Topsoil filling | - | 0.1 | 0.1 | 0.1 | 0.1 | 0.05 | 0.1 | 0.1 | 0.05 | 0.05 | 0.1 | 0.05 | - |
| | Filling | 1.3 | 1.65 | 0.9 | 1.1 | 0.9 | 0.75 | 0.5 | 0.9 | 0.4 | 0.85 | - | 1.0 | 1.1 |
| | Other Uncemented soils | - | - | 1.0 | - | - | 2.5 | 1.0 | 2.25 | 1.2 | 2.65 | 0.2 | 1.1 | 3.3 |
| Cemented lateritic soils (Typically weakly to strongly cemented) | | - | - | - | 1.5 | 1.0 | 3.5 | 2.2 | 2.8 | 1.9 | 3.8 | 0.35 | 2.4 | - |
| Bedrock | | - | 2.0 | 1.4 | 1.9 | 1.2 | 3.6 | 2.4 | 3.0 | 2.4 | - | - | 3.0 | - |
| Termination Depth (m) | | 1.3 | 2.0 | 1.4 | 1.9 | 1.2 | 3.6 | 2.4 | 3.0 | 2.4 | 3.8 | 0.35 | 3.0 | 3.3 |
| Reason for Test Termination | | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | limit |
| Depth to Free Groundwater | | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |

Table 1 (cont.): Summary of Sub-Surface Conditions in the Test Pits

| Test Location | | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 |
|---|-------------------------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Unit | Material Description | Material Depth Below Surface Level (m) | | | | | | | | | | | | |
| Uncemented overburden soils | Topsoil/Topsoil filling | 0.05 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 | 0.3 | 0.2 | 0.1 |
| | Filling | 2.2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Other Uncemented soils | 3.5 | 0.4 | 0.3 | 0.65 | 0.4 | 0.4 | 0.6 | 0.5 | 0.6 | 0.8 | 0.6 | - | 1.0 |
| Cemented lateritic soils (Typically weakly to strongly cemented) | | 4.0 | - | 0.9 | 1.0 | 0.8 | 0.8 | 0.8 | 1.0 | 1.1 | 1.7 | - | - | 1.1 |
| Bedrock | | - | 1.1 | 2.1 | - | 1.9 | 2.15 | 1.0 | 1.7 | 1.7 | 2.2 | 1.8 | 1.0 | - |
| Termination Depth (m) | | 4.0 | 1.1 | 2.1 | 1.0 | 1.9 | 2.15 | 1.0 | 1.7 | 1.7 | 2.2 | 1.8 | 1.0 | 1.1 |
| Reason for Test Termination | | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal |
| Depth to Free Groundwater | | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 1.5 | NE | NE |

Table 1 (cont.): Summary of Sub-Surface Conditions in the Test Pits

| Test Location | | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 |
|---|-------------------------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Unit | Material Description | Material Depth Below Surface Level (m) | | | | | | | | | | | | |
| Uncemented overburden soils | Topsoil/Topsoil filling | 0.35 | - | - | - | - | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Filling | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Other Uncemented soils | 1.5 | 0.9 | 0.2 | - | - | 1.2 | 1.0 | 0.8 | 0.8 | 0.9 | 0.5 | 0.3 | - |
| Cemented lateritic soils (Typically weakly to strongly cemented) | | 1.6 | - | 0.6 | - | - | 1.35 | 1.1 | 0.9 | 1.3 | 1.0 | 0.8 | 1.6 | 1.5 |
| Bedrock | | - | 1.1 | 0.8 | 0.8 | 1.2 | - | - | - | 1.4 | - | 0.9 | 2.4 | 2.4 |
| Termination Depth (m) | | 1.6 | 1.1 | 0.8 | 0.8 | 1.2 | 1.35 | 1.1 | 0.9 | 1.4 | 1.0 | 0.9 | 2.4 | 2.4 |
| Reason for Test Termination | | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal | refusal |
| Depth to Free Groundwater | | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |

Table 1 (cont.): Summary of Sub-Surface Conditions in the Test Pits

| Test Location | | 140 | 141 | 142 | 143 | 144 | 145 | | | | | | | |
|---|-------------------------|--|---------|---------|---------|---------|---------|--|--|--|--|--|--|--|
| Unit | Material Description | Material Depth Below Surface Level (m) | | | | | | | | | | | | |
| Uncemented overburden soils | Topsoil/Topsoil filling | 0.1 | 0.1 | 0.1 | 0.3 | 0.25 | 0.2 | | | | | | | |
| | Filling | - | - | - | - | - | - | | | | | | | |
| | Other Uncemented soils | 1.7 | - | 1.0 | 1.2 | - | 0.4 | | | | | | | |
| Cemented lateritic soils (Typically weakly to strongly cemented) | | - | 1.6 | 2.2 | 1.5 | 1.1 | 1.3 | | | | | | | |
| Bedrock | | 2.55 | 2.7 | 3.1 | 1.5 | 2.6 | 2.0 | | | | | | | |
| Termination Depth (m) | | 2.55 | 2.7 | 3.1 | 1.5 | 2.6 | 2.0 | | | | | | | |
| Reason for Test Termination | | refusal | refusal | refusal | refusal | refusal | refusal | | | | | | | |
| Depth to Free Groundwater | | NE | NE | NE | NE | NE | NE | | | | | | | |

4.2 In-Situ Permeability Testing

Permeability testing was carried out within selected test pits, targeting the various soil horizons encountered. The results of the testing are summarised in Table 2 and the detailed results are provided in Appendix A.

Where tests were completed within a short timeframe, say less than 20 mins, the test was repeated and annotated with an 'A' after the test pit number.

Table 2: Summary of In-situ Permeability Testing

| Pit | Depth (m) | Test Method | Soil Description | Permeability (m/sec) |
|------|------------|---------------|------------------------------|----------------------|
| 101 | 0.5 – 1.0 | Falling Head | Clayey Sandy Gravel Filling | 8×10^{-7} |
| 108 | 0 – 0.5 | Constant Head | Clayey Sandy Gravel Filling | 6×10^{-6} |
| 108 | 1.0 – 1.5 | Falling Head | Sandy Clay | 1×10^{-6} |
| 109 | 0.45 – 0.9 | Falling Head | Gravelly Clay | 1×10^{-6} |
| 114 | 0 – 0.5 | Constant Head | Clayey Silty Gravel Filling | 1×10^{-5} |
| 109 | 2.2 – 2.85 | Falling Head | Gravelly Clayey Sand | 1×10^{-6} |
| 115 | 0 – 0.5 | Constant Head | Slightly Clayey Sandy Gravel | 1×10^{-5} |
| 115A | 0 – 0.5 | Constant Head | Slightly Clayey Sandy Gravel | 1×10^{-5} |
| 115 | 0.4 – 0.9 | Falling Head | Siltstone Bedrock | 1×10^{-6} |
| 117 | 0 – 0.5 | Constant Head | Sandy Gravel | 1×10^{-5} |
| 117A | 0 – 0.5 | Constant Head | Sandy Gravel | 2×10^{-5} |
| 117 | 0.5 – 1.0 | Falling Head | Silty Sandy Gravel | 4×10^{-7} |
| 121 | 0 – 0.5 | Constant Head | Gravelly Sandy Silt | 4×10^{-6} |
| 121 | 0.5 – 1.0 | Falling Head | Clayey Sandy Gravel | 5×10^{-7} |
| 124 | 0 – 0.5 | Constant Head | Sandy Gravel | 8×10^{-5} |
| 124A | 0 – 0.5 | Constant Head | Sandy Gravel | 5×10^{-5} |
| 126 | 0 – 0.5 | Constant Head | Silty Sand | 1×10^{-4} |
| 126A | 0 – 0.5 | Constant Head | Silty Sand | 9×10^{-5} |
| 126 | 1.0 – 1.5 | Constant Head | Clayey Sandy Gravel | 4×10^{-6} |
| 130 | 0.4 – 0.8 | Falling Head | Siltstone Bedrock | 8×10^{-7} |
| 137 | 0 – 0.5 | Constant Head | Slightly Clayey Sandy Gravel | 1×10^{-4} |
| 137A | 0 – 0.5 | Constant Head | Slightly Clayey Sandy Gravel | 7×10^{-5} |
| 137 | 0.8 – 1.25 | Falling Head | Siltstone Bedrock | 3×10^{-7} |
| 138 | 0 – 0.5 | Constant Head | Silty Sandy Gravel | 2×10^{-5} |

Table 2 (cont.): Summary of In-situ Permeability Testing

| Pit | Depth (m) | Test Method | Soil Description | Permeability (mm/sec) |
|------|------------|---------------|---------------------|-----------------------|
| 138A | 0 – 0.5 | Constant Head | Silty Sandy Gravel | 3×10^{-5} |
| 138 | 0.8 – 1.2 | Falling Head | Clayey Sandy Gravel | 4×10^{-6} |
| 138A | 0.8 – 1.2 | Falling Head | Clayey Sandy Gravel | 6×10^{-6} |
| 142 | 0 – 0.5 | Constant Head | Sandy Silt | 2×10^{-5} |
| 142A | 0 – 0.5 | Constant Head | Sandy Silt | 2×10^{-5} |
| 142 | 0.6 – 1.25 | Falling Head | Clayey Sandy Gravel | 4×10^{-6} |
| 145 | 0 – 0.5 | Constant Head | Sandy Silt | 8×10^{-6} |
| 145 | 0.5 – 1.05 | Falling Head | Clayey Sandy Gravel | 3×10^{-6} |

5. Laboratory Testing

Selected samples of excavated soil recovered from the test pit locations were also tested for determination of Atterberg limits including linear shrinkage and remoulded permeability when typically compacted to 100% Modified compaction.

The results of laboratory testing are summarised in Table 3 on the following page with the detailed laboratory test reports presented in Appendix B.

The results of the testing carried out during the previous investigation have been included in Table 3.

Table 3: Summary of Laboratory Testing

| Pit (Lab ID) | Depth (m) | Soil Description | LL (%) | PI (%) | LS (%) | OMC (%) | MMDD (t/m ³) | Permeability (m/sec) |
|--|-----------|-----------------------------|--------|--------|--------|---------|--------------------------|-----------------------|
| Current Investigation | | | | | | | | |
| 101 (528I) | 0.0 – 0.5 | Clayey Sandy Gravel Filling | 30 | 13 | 5.5 | 12.0 | 1.98 | 2 x 10 ⁻¹⁰ |
| 103 (528J) | 0.1 – 0.4 | Clayey Sandy Gravel Filling | 40 | 23 | 7.5 | 17.5 | 1.89 | 2 x 10 ⁻¹⁰ |
| 103 (528K) | 0.4 – 0.9 | Sandy Clay Filling | 44 | 25 | 6.0 | 15.5 | 1.84 | 2 x 10 ⁻¹⁰ |
| 108 (528H) | 0.9 – 1.9 | Sandy Clay | 42 | 26 | 7.0 | 17.0 | 1.80 | 2 x 10 ⁻¹⁰ |
| 116 (528L) | 0.1 – 0.3 | Sandy Gravel | 15 | 3 | 1.0 | 9.0 | 2.25 | 3 x 10 ⁻⁸ |
| 118 (528B) | 0.1 – 0.4 | Sandy Clayey Gravel | 19 | 7 | 3.0 | 7.5 | 2.30 | 5 x 10 ⁻¹⁰ |
| 122 (528C) | 0.3 – 0.6 | Gravelly Sandy Clayey Silt | 48 | 23 | 10.5 | 15.0 | 1.87 | 3 x 10 ⁻¹⁰ |
| 123 (528A) | 0.8 – 1.4 | Clayey Sandy Gravel | 44 | 26 | 11.0 | 12.5 | 1.99 | 2 x 10 ⁻⁹ |
| 124 (528G) | 0.3 – 0.6 | Sandy Clayey Gravel | 25 | 10 | 4.5 | 9.5 | 2.20 | 1 x 10 ⁻⁹ |
| 140 (528D) | 0.1 – 0.8 | Gravelly Clay | 34 | 17 | 7.5 | 15.5 | 1.85 | 4 x 10 ⁻¹⁰ |
| 142 (528E) | 0.3 – 1.0 | Sandy Clay | 31 | 14 | 7.0 | 11.5 | 1.94 | 4 x 10 ⁻¹⁰ |
| 143 (528F/B) | 0.3 – 1.2 | Sandy Clayey Silt | 28 | 15 | 6.5 | 11.5 | 1.59 | 2 x 10 ⁻¹⁰ |
| Results from Previous Investigation (Ref 1) | | | | | | | | |
| TP4 | 0.8 – 1.2 | Gravelly Clayey Sand | 30 | 12 | 4.5 | 10.5 | 2.06 | 5 x 10 ⁻⁹ |
| TP5 | 0.3 – 0.5 | Gravelly Sandy Clay | 40 | 17 | 9.0 | 11.5 | 1.99 | 8 x 10 ⁻⁸ |

Notes:

Permeability results from previous investigation based on samples remoulded to 98% Standard compaction.

Permeability result for Sample 528F/B based on sample remoulded to 98% Modified compaction.

LL – Liquid Limit PI – Plasticity Index LS – Linear Shrinkage

MMDD – Modified Maximum Dry Density OMC – Optimum Moisture Content

6. References

1. Douglas Partners Pty Ltd, *Factual Report on Geotechnical Investigation, Proposed Flood Mitigation Works*, Project 78245.00 dated March 2016
2. Douglas Partners Pty Ltd, *Report on Geotechnical Investigation, Proposed Water Main and Electrical Conduits*, Project 78245.01 dated December 2016

7. Limitations

Douglas Partners (DP) has prepared this report for this project at Marrara, NT in accordance with DP's proposal DWN170135 (Rev 2) dated 24 August 2017 and acceptance received from Jacobs Group (Asutralia) Pty Ltd on 5 September 2017. The work was carried out under Jacobs Terms of Agreement for Subconsulting Services with DP amendments. This report is provided for the exclusive use of Jacobs Group (Australia) Pty Ltd and their agents for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Rock Descriptions
Test Pit Logs
In-Situ Permeability Results

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter in to the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:
4,6,7
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:
15, 30/40 mm

Sampling Methods

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.



Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

| Type | Particle size (mm) |
|---------|--------------------|
| Boulder | >200 |
| Cobble | 63 - 200 |
| Gravel | 2.36 - 63 |
| Sand | 0.075 - 2.36 |
| Silt | 0.002 - 0.075 |
| Clay | <0.002 |

The sand and gravel sizes can be further subdivided as follows:

| Type | Particle size (mm) |
|---------------|--------------------|
| Coarse gravel | 20 - 63 |
| Medium gravel | 6 - 20 |
| Fine gravel | 2.36 - 6 |
| Coarse sand | 0.6 - 2.36 |
| Medium sand | 0.2 - 0.6 |
| Fine sand | 0.075 - 0.2 |

The proportions of secondary constituents of soils are described as:

| Term | Proportion | Example |
|-----------------|------------|---------------------------|
| And | Specify | Clay (60%) and Sand (40%) |
| Adjective | 20 - 35% | Sandy Clay |
| Slightly | 12 - 20% | Slightly Sandy Clay |
| With some | 5 - 12% | Clay with some sand |
| With a trace of | 0 - 5% | Clay with a trace of sand |

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

| Description | Abbreviation | Undrained shear strength (kPa) |
|-------------|--------------|--------------------------------|
| Very soft | vs | <12 |
| Soft | s | 12 - 25 |
| Firm | f | 25 - 50 |
| Stiff | st | 50 - 100 |
| Very stiff | vst | 100 - 200 |
| Hard | h | >200 |

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

| Relative Density | Abbreviation | SPT N value | CPT qc value (MPa) |
|------------------|--------------|-------------|--------------------|
| Very loose | vl | <4 | <2 |
| Loose | l | 4 - 10 | 2 - 5 |
| Medium dense | md | 10 - 30 | 5 - 15 |
| Dense | d | 30 - 50 | 15 - 25 |
| Very dense | vd | >50 | >25 |

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

| Term | Abbreviation | Point Load Index $Is_{(50)}$ MPa | Approximate Unconfined Compressive Strength MPa* |
|----------------|--------------|-------------------------------------|---|
| Extremely low | EL | <0.03 | <0.6 |
| Very low | VL | 0.03 - 0.1 | 0.6 - 2 |
| Low | L | 0.1 - 0.3 | 2 - 6 |
| Medium | M | 0.3 - 1.0 | 6 - 20 |
| High | H | 1 - 3 | 20 - 60 |
| Very high | VH | 3 - 10 | 60 - 200 |
| Extremely high | EH | >10 | >200 |

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

| Term | Abbreviation | Description |
|----------------------|--------------|--|
| Extremely weathered | EW | Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident. |
| Highly weathered | HW | Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable |
| Moderately weathered | MW | Staining and discolouration of rock substance has taken place |
| Slightly weathered | SW | Rock substance is slightly discoloured but shows little or no change of strength from fresh rock |
| Fresh stained | Fs | Rock substance unaffected by weathering but staining visible along defects |
| Fresh | Fr | No signs of decomposition or staining |

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

| Term | Description |
|--------------------|---|
| Fragmented | Fragments of <20 mm |
| Highly Fractured | Core lengths of 20-40 mm with some fragments |
| Fractured | Core lengths of 40-200 mm with some shorter and longer sections |
| Slightly Fractured | Core lengths of 200-1000 mm with some shorter and longer sections |
| Unbroken | Core lengths mostly > 1000 mm |

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

| Term | Separation of Stratification Planes |
|---------------------|-------------------------------------|
| Thinly laminated | < 6 mm |
| Laminated | 6 mm to 20 mm |
| Very thinly bedded | 20 mm to 60 mm |
| Thinly bedded | 60 mm to 0.2 m |
| Medium bedded | 0.2 m to 0.6 m |
| Thickly bedded | 0.6 m to 2 m |
| Very thickly bedded | > 2 m |

Symbols & Abbreviations

Douglas Partners



Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

| | |
|------|--------------------------|
| C | Core drilling |
| R | Rotary drilling |
| SFA | Spiral flight augers |
| NMLC | Diamond core - 52 mm dia |
| NQ | Diamond core - 47 mm dia |
| HQ | Diamond core - 63 mm dia |
| PQ | Diamond core - 81 mm dia |

Water

| | |
|---|-------------|
| ▷ | Water seep |
| ▽ | Water level |

Sampling and Testing

| | |
|-----------------|--------------------------------|
| A | Auger sample |
| B | Bulk sample |
| D | Disturbed sample |
| E | Environmental sample |
| U ₅₀ | Undisturbed tube sample (50mm) |
| W | Water sample |
| pp | Pocket penetrometer (kPa) |
| PID | Photo ionisation detector |
| PL | Point load strength Is(50) MPa |
| S | Standard Penetration Test |
| V | Shear vane (kPa) |

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

| | |
|-----|-----------------|
| B | Bedding plane |
| Cs | Clay seam |
| Cv | Cleavage |
| Cz | Crushed zone |
| Ds | Decomposed seam |
| F | Fault |
| J | Joint |
| Lam | Lamination |
| Pt | Parting |
| Sz | Sheared Zone |
| V | Vein |

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

| | |
|----|----------------|
| h | horizontal |
| v | vertical |
| sh | sub-horizontal |
| sv | sub-vertical |

Coating or Infilling Term

| | |
|-----|----------|
| cln | clean |
| co | coating |
| he | healed |
| inf | infilled |
| stn | stained |
| ti | tight |
| vn | veneer |

Coating Descriptor

| | |
|-----|--------------|
| ca | calcite |
| cbs | carbonaceous |
| cly | clay |
| fe | iron oxide |
| mn | manganese |
| slt | silty |

Shape

| | |
|----|------------|
| cu | curved |
| ir | irregular |
| pl | planar |
| st | stepped |
| un | undulating |

Roughness

| | |
|----|--------------|
| po | polished |
| ro | rough |
| sl | slickensided |
| sm | smooth |
| vr | very rough |

Other

| | |
|-----|------------|
| fg | fragmented |
| bnd | band |
| qtz | quartz |

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

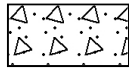
General



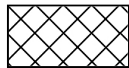
Asphalt



Road base



Concrete

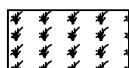


Filling

Soils



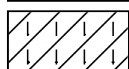
Topsoil



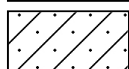
Peat



Clay



Silty clay



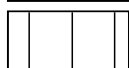
Sandy clay



Gravelly clay



Shaly clay



Silt



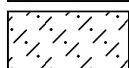
Clayey silt



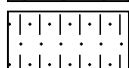
Sandy silt



Sand



Clayey sand



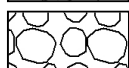
Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



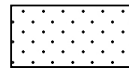
Boulder conglomerate



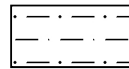
Conglomerate



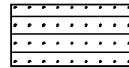
Conglomeratic sandstone



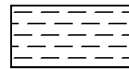
Sandstone



Siltstone



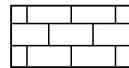
Laminite



Mudstone, claystone, shale

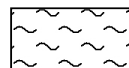


Coal

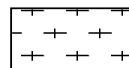


Limestone

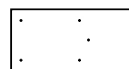
Metamorphic Rocks



Slate, phyllite, schist

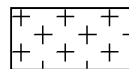


Gneiss

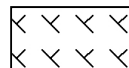


Quartzite

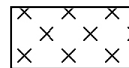
Igneous Rocks



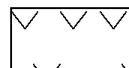
Granite



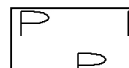
Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia





Porphyry

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704124
NORTHING: 8628928

PIT No: 101
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | | | |
|----|--------------|---|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|--|--|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 | | |
| | | FILLING: generally well compacted, brown, clayey sandy gravel, filling, fine to coarse porcellanite gravel, and fine to medium lateritic gravel, fine to coarse grained sand, cobbles (30%) to 200mm Ø, humid |  | B | 0.0 | | | | | | | | | |
| | | | | | 0.5 | | | | | | | | | |
| | 0.9 |concrete and asphaltic concrete at 0.8m | | | | | | | | | | | | |
| | 1 | FILLING: generally well compacted, red-brown, clayey sandy gravel filling, fine to medium lateritic gravel, fine to coarse grained sand, moist |  | | | | | | 1 | | | | | |
| | 1.3 | Pit discontinued at 1.3m- refusal | | | | | | | | | | | | |
| | 2 | | | | | | | | 2 | | | | | |
| | 3 | | | | | | | | 3 | | | | | |
| | 4 | | | | | | | | 4 | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | Δ | Water seep |
| E | Environmental sample | ∇ | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test ls(50) (MPa) |
| | | PL(D) | Point load diametral test ls(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |



Douglas Partners
Geotechnics | Environment | Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704097
NORTHING: 8628925

PIT No: 102
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | | | | | | | | |
|------|--|---|----------------|----------------------------|-------|--------|--------------------|-------|---|----|----|----|--|--|--|--|--|--|--|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 | | | | | | | |
| | 0.1 | TOPSOIL/FILLING: generally well compacted, brown, clayey sandy gravel, topsoil/filling, fine to coarse gravel, porcellanite, fine to coarse grained sand, rootlets, humid | | B | 0.5 | | | | 1 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | 1.2 | FILLING: generally well compacted, brown, clayey sandy gravel filling, fine to coarse grained sand, humid | | | | | | | | | | | | | | | | | |
| 1.65 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | | | | | | | | | | | | |
| 2.0 |becoming less fractured | | | | | | | | | | | | | | | | | | |
| 2 | 2.0 | Pit discontinued at 2.0m- refusal | | | | | | | 2 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | | Water seep |
| E | Environmental sample | | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test (s(50) (MPa) |
| | | PL(D) | Point load diametral test (s(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |



Douglas Partners
Geotechnics | Environment | Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704066
NORTHING: 8628925

PIT No: 103
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL/FILLING: generally well compacted, brown, clayey sandy gravel, topsoil/filling, fine to coarse gravel, porcellanite, fine to coarse grained sand, rootlets, humid | | B | 0.1 | | | | | | | |
| | 0.4 | FILLING: generally well compacted, red-brown, off-white, grey-brown, gravelly sandy clay filling, 1m Ø boulder, fine to coarse grained sand, fine to medium gravel, humid | | | 0.4 | | | | | | | |
| | 0.9 | FILLING: generally well compacted, red-brown, yellow-brown, reworked cemented soil, fine to medium gravel, fine to coarse grained sand, humid | | B | 0.9 | | | | | | | |
| 1 | 1.0 | SANDY SILT: stiff, grey-brown, sandy silt, fine to medium grained sand, humid | | | | | | | | | | |
| | 1.4 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstoneless fractured at 1.3m | | | | | | | | | | |
| | | Pit discontinued at 1.4m- refusal | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2




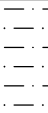
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|----|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | WL | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704127
NORTHING: 8628889

PIT No: 104
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, clayey sandy gravel, fine to medium gravel, fine to coarse grained sand, humid |  | | | | | | | | | |
| | | FILLING: generally well compacted, grey-brown, off-white, clayey sandy gravel, filling, fine to coarse gravel, fine to coarse grained sand, trace bricks, humid | | | | | | | | | | |
| | 0.7 | FILLING: generally well compacted, brown, clayey sandy gravel, filling, fine to coarse grained sand, humid |  | | | | | | | | | |
| | | | | | | | | | | | | |
| | 1.1 | CLAYEY SANDY GRAVEL: weakly cemented, red-brown, yellow-brown, clayey sandy gravel, cemented weathered/fragmented siltstone, fine to coarse porcellanite gravel, fine to coarse grained sand, damp |  | | | | | | | | | |
| | 1.5 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone |  | | | | | | | | | |
| | |becoming less fractured at 1.8m | | | | | | | | | | |
| | 1.9 | Pit discontinued at 1.9m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS: possible trench through centre of pit

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | = Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704095
NORTHING: 8628888

PIT No: 105
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL/FILLING: generally well compacted, brown, clayey sandy gravel, topsoil/filling, fine to coarse gravel, porcellanite, fine to coarse grained sand, rootlets, humid | | | | | | | | | | |
| | 0.5 | FILLING: generally well compacted, brown, clayey sandy gravel, filling, fine to coarse porcellanite gravel, and fine to medium lateritic gravel, fine to coarse grained sand, cobbles (30%) to 200mm Ø, (1m long concrete column, building debris) | | | | | | | | | | |
| | 0.9 | FILLING: generally well compacted, brown, clayey sandy gravel filling, fine to coarse grained sand, humid | | | | | | | | | | |
| 1 | 1.0 | CLAYEY SANDY GRAVEL: dense, weakly cemented, red-brown, yellow-brown, clayey sandy gravel, cemented weathered/fragmented siltstone, fine to coarse porcellanite gravel, fine to coarse grained sand, damp | | | | | | 1 | | | | |
| | 1.2 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstoneless fractured at 1.0m Pit discontinued at 1.2m- refusal | | | | | | | | | | |
| 2 | | | | | | | | 2 | | | | |
| 3 | | | | | | | | 3 | | | | |
| 4 | | | | | | | | 4 | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2




| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704123
NORTHING: 8628846

PIT No: 106
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.05 | TOPSOIL/FILLING: stiff, grey-brown, clayey sandy silt topsoil filling, fine to coarse grained sand, with rootlets, dry |  | B | 0.05 | | | | | | | |
| | 0.4 | SILTY SANDY GRAVEL/FILLING: generally well compacted, grey-brown, silty sandy gravel/filling, fine to coarse grained sand, humid | | | 0.4 | | | | | | | |
| | 0.75 | FILLING: generally well compacted, grey-brown, clayey sandy gravel, fine to medium angular gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1 | SANDY SILTY CLAY: very stiff, weakly cemented, red-white, white, sandy silty clay, fine to coarse grained sand, laterised gravel, moist |  | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 2.5 | SANDY CLAY: cemented, white, red, sandy clay, fine to coarse grained sand, laterised siltstone, humid to moist | | | | | | | | | | |
| | 3 | |  | | | | | | | | | |
| | 3.5 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | | | | |
| | 3.6 | Pit discontinued at 3.6m- refusal | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|----|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | WL | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
Marrara

SURFACE LEVEL: --
EASTING: 704095
NORTHING: 8628847

PIT No: 107
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

[illegible]

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | | Water seep |
| E | Environmental sample | | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test (s(50) (MPa) |
| | | PL(D) | Point load diametral test (s(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |



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Geotechnics | Environment | Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704070
NORTHING: 8628843

PIT No: 108
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water |
|----|--------------|--|-------------|----------------------------|-------|--------|-----------------------|-------|
| | | | | Type | Depth | Sample | Results & Comments | |
| | 0.1 | TOPSOIL/FILLING: generally well compacted, brown, clayey sandy gravel, topsoil/filling, fine to coarse gravel, <u>porcellanite, fine to coarse grained sand, rootlets, humid</u> FILLING: variably compacted, brown, clayey sandy gravel filling with some building waste (concrete slab and rubble), fine to coarse porcellanite gravel, and fine to medium lateritic gravel, fine to coarse grained sand, cobbles (30%) to 200mm ø | | | | | | |
| -1 | 0.9 | SANDY CLAY: stiff, red-brown, sandy clay, fine to coarse grained sand, M~WP | | D | 0.9 | | | 1 |
| -2 | 2.23 | CLAYEY SANDY GRAVEL: dense, weakly cemented, red-brown, yellow-brown, clayey sandy gravel, cemented weathered/fragmented siltstone, fine to coarse porcellanite gravel, fine to coarse grained sand, damp | | | 1.9 | | | 2 |
| -3 | 2.8 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, | | | | | | |
| | 3.0 |becoming less fractured at 2.9m Pit discontinued at 3.0m- refusal | | | | | | 3 |
| -4 | | | | | | | | 4 |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | W | Water seep |
| E | Environmental sample | W | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test ls(50) (MPa) |
| | | PL(D) | Point load diametral test ls(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |





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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704120
NORTHING: 8628802

PIT No: 109
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.05 | TOPSOIL/FILLING: stiff, grey-brown, clayey sandy silt topsoil filling, fine to coarse grained sand, with rootlets, humid |  | | | | | | | | | |
| | 0.4 | FILLING: generally well compacted, grey-brown, clayey sandy gravel, cobbles & concrete to 500mm Ø and other building debris, dry | | | | | | | | | | |
| | | GRAVELLY CLAY: very stiff, red, gravelly clay with some sand, fine to coarse gravel, M<Wp | | | | | | | | | | |
| | 1.2 | GRAVELLY SILTY CLAY: strongly cemented, orange-brown, gravelly silty clay, fine to coarse lateritic gravel, M<Wp |  | | | | | | | | | |
| | 1.9 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | | | | |
| | 2.4 | Pit discontinued at 2.4m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2



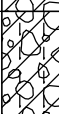

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704092
NORTHING: 8628799

PIT No: 110
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.05 | TOPSOIL/FILLING: loose, light pink-brown, clayey silty gravel topsoil/filling, fine to coarse gravel, rootlets, dry FILLING: light pink-brown, clayey silty gravel, fine to coarse gravel, cobbles to 200mm Ø, fragmented porcellanite |  | | | | | | | | | |
| | 0.85 | GRAVELLY CLAY: very stiff, red, gravelly clay with some sand, fine to coarse gravel, M<Wp |  | | | | | | | | | |
| | 2.65 | CLAYEY SILTY GRAVEL: dense, strongly cemented, red with some orange & white, clayey silty gravel, fine to coarse grained gravel, humid |  | | | | | | | | | |
| | 3.0 | GRAVELLY CLAYEY SILT: dense, strongly cemented, white, orange, gravelly clayey silt, fine to medium lateritic gravel, humid |  | | | | | | | | | |
| | 3.8 | Pit discontinued at 3.8m- refusal | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

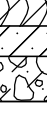
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704120
NORTHING: 8628759

PIT No: 111
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sand, topsoil, fine to coarse grained sand, some rootlets, humid |  | | | | | | | | | |
| | 0.2 | SANDY CLAY: stiff, brown and red brown, sandy clay, with some gravel, M<Wp | | | | | | | | | | |
| | 0.35 | CLAYEY SANDY GRAVEL: moderately cemented, red-brown, clayey sandy gravel, humid Pit discontinued at 0.35m- refusal | | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2




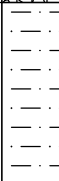

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|----|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | WL | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704096
NORTHING: 8628761

PIT No: 112
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.05 | TOPSOIL/FILLING: stiff, grey-brown, clayey sandy silt topsoil filling, fine to coarse grained sand, with rootlets, humid FILLING: generally well compacted, grey-brown, clayey sandy gravel with some cobbles to 300mm Ø, building debris (Steel, metal, plastic), humid |  | | | | | | | | | |
| | 1.0 | GRAVELLY CLAY: very stiff, red, gravelly clay with some sand, fine to coarse gravel, M<Wp |  | | | | | | | | | |
| | 1.1 | GRAVELLY CLAYEY SILT: strongly cemented, orange, white and red, gravelly clayey silt, fine to coarse lateritic gravel, M<PL |  | | | | | | | | | |
| | 2.4 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone |  | | | | | | | | | |
| | 3.0 |becoming less fractured at 2.9m Pit discontinued at 3.0m- refusal |  | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704064
NORTHING: 8628758

PIT No: 113
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|-----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | | FILLING: generally well compacted, red and yellow-brown, clayey sandy gravel, humid | | | | | | | | | | |
| | | - layer of sandy silt from 0.6 m to 0.8 m depth | | | | | | | | | | |
| 1 | 1.1 | SANDY CLAY: stiff, red-brown, sandy clay with some gravel, M<Wp | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 3.3 | | - mottled yellow-brown and red-brown from 3.2m depth Pit discontinued at 3.3m- limit of investigation | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2






| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704028
NORTHING: 8628768

PIT No: 114
PROJECT No: 78245.02
DATE: 6/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.05 | TOPSOIL/FILLING: loose, light pink-brown, clayey silty gravel topsoil/filling, fine to coarse gravel, rootlets, dry FILLING: brown, clayey silty gravel, fine to coarse gravel, cobbles to 200mm Ø, fragmented porcellanite |  | | | | | | | | | |
| | 1.3 | FILLING: orange and brown clayey gravelly silt filling, M<Wp |  | | | | | | | | | |
| | 2.2 | GRAVELLY CLAYEY SAND: medium dense, brown, gravelly clayey sand, fine to coarse gravel, fine sand, damp |  | | | | | | | | | |
| | 2.5 | SANDY CLAY: strong, red-brown, sandy clay, fine to coarse grained sand, M~WP |  | | | | | | | | | |
| | 3.5 | SANDY CLAY: weakly cemented, red-brown, yellow-brown |  | | | | | | | | | |
| | 4.0 | Pit discontinued at 4.0m- refusal | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon & V. Harrington **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

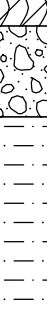
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703929
NORTHING: 8628930

PIT No: 115
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid |  | | | | | | | | | |
| | 0.4 | SANDY GRAVEL: dense, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | | PORCELLANITE: medium strength, highly weathered, off-white, yellow-brown, highly fractured/fragmented | | | | | | | | | | |
| | 1 |becoming less fractured | | | | | | | | | | |
| | 1.1 | Pit discontinued at 1.1m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703870
NORTHING: 8628944

PIT No: 116
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid | | B | 0.1 | | | | | | | |
| | 0.3 | SANDY GRAVEL: dense, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | 0.3 | | | | | | | |
| | 0.9 | SANDY GRAVEL: weakly to moderately cemented, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1.8 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | |becoming less laterised | | | | | | | | | | |
| | 2.1 | KAOLONISED SILTSTONE: low strength, off-white, yellow-brown, kaolonised siltstone | | | | | | | | | | |
| | 2.1 | Pit discontinued at 2.1m- refusal | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | W | Water seep |
| E | Environmental sample | W | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test Is(50) (MPa) |
| | | PL(D) | Point load diametral test Is(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703787
NORTHING: 8628939

PIT No: 117
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid SANDY GRAVEL: very dense, yellow-brown, sandy gravel, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.65 | CLAYEY SANDY GRAVEL: weakly to moderately cemented, off-white, clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| 1 | 1.0 | becoming very low strength, moderately cemented, off-white and red-brown kaolinised siltstone from 0.9m depth Pit discontinued at 1.0m- refusal | | | | | | 1 | | | | |
| | 2 | | | | | | | 2 | | | | |
| | 3 | | | | | | | 3 | | | | |
| | 4 | | | | | | | 4 | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

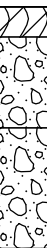
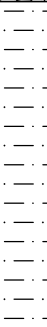
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703822
NORTHING: 8617823

PIT No: 118
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid |  | B | 0.1 | | | | | | | |
| | 0.4 | SANDY GRAVEL: dense, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | 0.4 | | | | | | | |
| | 0.8 | SANDY GRAVEL: weakly to moderately cemented, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | | | | | |
| | 1.9 | Pit discontinued at 1.9m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

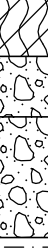
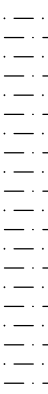
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | W | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703834
NORTHING: 8628878

PIT No: 119
PROJECT No: 78245.02
DATE: 5/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|--|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.2 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid |  | | | | | | | | | |
| | 0.4 | SANDY GRAVEL: dense, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.8 | SANDY GRAVEL: weakly to moderately cemented, grey-brown, slightly clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 2.15 | Pit discontinued at 2.15m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 703893
NORTHING: 8628871

PIT No: 120
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 **OF** 1

[illegible]

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test ls(50) (MPa) |
| BLK | Block sample | T | Tube sample (x mm dia.) | PL(D) | Point load diametral test ls(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | W | Water level | V | Shear vane (kPa) |



Douglas Partners
Geotechnics | Environment | Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703873
NORTHING: 8628841

PIT No: 121
PROJECT No: 78245.02
DATE: 7/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.2 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid | | | | | | | | | | |
| | 0.5 | GRAVELLY SANDY SILT: very stiff, yellow-brown, sandy gravelly silt, fine to medium lateritic gravel, fine to coarse grained sand, lightly cemented, humid | | | | | | | | | | |
| | 1.0 | CLAYEY SANDY GRAVEL: weakly cemented, red-brown, yellow-brown, clayey sandy gravel, humid | | | | | | | | | | |
| | 1.7 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1.7 | Pit discontinued at 1.7m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

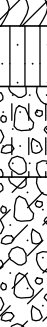

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | W | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703930
NORTHING: 8628823

PIT No: 122
PROJECT No: 78245.02
DATE: 7/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: stiff, grey-brown, sandy silty topsoil, fine to medium grained sand, trace gravel, roots & rootlets, M<WP |  | | | | | | | | | |
| | 0.3 | SANDY SILT: stiff, grey-brown, sandy silt, fine to medium grained sand, trace gravel, sandy silt, M<WP | | | 0.3 | | | | | | | |
| | 0.6 | GRAVELLY SANDY SILT: very stiff, (lightly cemented), yellow-brown mottled orange-brown, sandy gravelly silt, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | 0.6 | | | | | | | |
| | 1.1 | CLAYEY SANDY GRAVEL: weakly to moderately cemented, red-brown, yellow-brown, clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1.7 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | | | | | |
| | 1.7 | Pit discontinued at 1.7m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

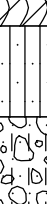
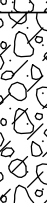
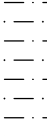
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|----|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | WL | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703931
NORTHING: 8614940

PIT No: 123
PROJECT No: 78245.02
DATE: 7/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|-----|-----------|--|--|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: stiff, grey-brown, sandy silty topsoil, fine to medium grained sand, trace gravel, roots & rootlets, M<WP |  | | | | | | | | | |
| | 0.4 | SANDY SILT: stiff, grey-brown, sandy silt, fine to medium grained sand, trace gravel, sandy silt, M<WP | | | | | | | | | | |
| | 0.8 | GRAVELLY SANDY SILT: very stiff, yellow-brown, sandy gravelly silt, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| 1 | 0.8 | CLAYEY SANDY GRAVEL: weakly cemented, yellow-brown, orange-brown, clayey sandy gravel, fine to medium gravel, fine to coarse grained sand, humid |  | | 0.8 | | | | | | | |
| | 1.4 | | | | 1.4 | | | | | | | |
| 1.7 | 1.7 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | | | | | |
| 2.2 | 2.2 | Pit discontinued at 2.2m- refusal | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

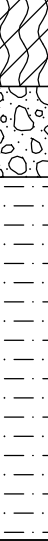
| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | = Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703874
NORTHING: 8628673

PIT No: 124
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.3 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP |  | B | 0.3 | | | | | | | |
| | 0.6 | SANDY GRAVEL: medium dense, brown, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | 0.6 | | | | | | | |
| | 1.8 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1.8 | Pit discontinued at 1.8m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed at 1.5m depth

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |
| | | V | | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 703912
NORTHING: 8628681

PIT No: 125
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

[illegible]

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | W | Water seep |
| E | Environmental sample | W | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test (s(50) (MPa) |
| | | PL(D) | Point load diametral test (s(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |



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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 703976
NORTHING: 8628713

PIT No: 126
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, roots & rootlets, humid | | | | | | | | | | |
| | | SILTY SAND: dense, yellow-brown, silty, fine to coarse grained sand, with some gravel, humid | | | | | | | | | | |
| | 0.55 | CLAYEY SANDY GRAVEL: dense, yellow-brown, clayey sandy gravel, humid | | | | | | | | | | |
| | 1 | - weakly cemented from 1.0m depth | | | | | | | | | | |
| | 1.1 | Pit discontinued at 1.1m- refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |
| | | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2




| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | Sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |
| | | V | | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704066
NORTHING: 8628690

PIT No: 127
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | | FILLING: generally well compacted. red-brown and grey-brown, clayey sandy gravel filling, fine to medium gravel, fine to coarse grained sand, humid |  | | | | | | | | | |
| | 0.35 | SANDY CLAY: very stiff, red-brown, sandy clay, with some gravel, M<Wp |  | | | | | | | | | |
| | 0.8 | CLAYEY SANDY GRAVEL: very dense, red-brown, clayey sandy gravel, humid |  | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 1.6 | - weakly to moderately cemented from 1.5m depth Pit discontinued at 1.6m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2



| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704066
NORTHING: 8628731

PIT No: 128
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|--------------|---|---|----------------------------|-------|--------|--------------------|-------|---|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| 1 | | SANDY CLAY: very dense, red-brown, sandy clay, fine to coarse grained sand, M<WP |  | | | | | | | | | |
| | 0.9 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | 1 | | | | |
| | 1.1 | Pit discontinued at 1.1m- refusal | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| | | | | | | | | 2 | | | | |
| | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| | | | | | | | | 3 | | | | |
| | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| | | | | | | | | 4 | | | | |
| | | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | T | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | W | Water seep |
| E | Environmental sample | W | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test (s(50) (MPa) |
| | | PL(D) | Point load diametral test (s(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |




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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704095
NORTHING: 8628732

PIT No: 129
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.2 | CLAYEY SANDY GRAVEL: medium dense, red-brown, fine to medium lateritic gravel, fine to coarse grained sand, humid |  | | | | | | | | | |
| | | CLAYEY SANDY GRAVEL: medium dense, weakly cemented, red-brown, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.6 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 0.8 | Pit discontinued at 0.8m- refusal | | | | | | | | | | |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | Sp | Standard penetration test |
| E | Environmental sample | W | Water level | S | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704125
NORTHING: 8628731

PIT No: 130
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.8 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1 | Pit discontinued at 0.8m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704150
NORTHING: 8628731

PIT No: 131
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

[illegible]

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test ls(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test ls(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | W | Water level | V | Shear vane (kPa) |





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Geotechnics | Environment | Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704866
NORTHING: 8628690

PIT No: 132
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP SANDY CLAY: stiff, red brown sandy clay, W<Wp |  | | | | | | | | | |
| | 0.8 | CLAYEY SANDY GRAVEL: dense to very dense, red brown, fine to medium gravel, fine to coarse grained sand, humid - weakly to moderately cemented from 1.2m depth |  | | | | | | | | | |
| | 1.35 | Pit discontinued at 1.35m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

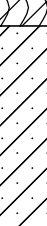

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704080
NORTHING: 8628651

PIT No: 133
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP SANDY CLAY: very stiff, red brown slightly gravelly sandy clay, W<Wp |  | | | | | | | | | |
| | 0.8 | CLAYEY SANDY GRAVEL: dense to very dense, red brown, fine to medium gravel, fine to coarse grained sand, humid |  | | | | | | | | | |
| | 1 | - weakly to moderately cemented from 1.0m depth | | | | | | | | | | |
| | 1.1 | Pit discontinued at 1.1m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |
| | | V | | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704150
NORTHING: 8628675

PIT No: 134
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP | | | | | | | | | | |
| | 0.3 | GRAVELLY SANDY SILT: dense to very dense, grey brown, gravelly sandy silt, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.8 | SANDY GRAVEL: dense to very dense, dark brown, slightly clayey sandy gravel, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.9 | CLAYEY SANDY GRAVEL: weakly to moderately cemented, red and yellow brown, clayey sandy gravel, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| 1 | | Pit discontinued at 0.9m- refusal | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|----|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | WL | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704060
NORTHING: 8628642

PIT No: 135
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP SANDY CLAY: very stiff, red and yellow brown slightly gravelly sandy clay, W<Wp | | | | | | | | | | |
| | 0.8 | CLAYEY SANDY GRAVEL: very dense to weakly cemented, red and yellow brown, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1 | - weakly cemented from 1.2m depth | | | | | | | | | | |
| | 1.3 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1.4 | Pit discontinued at 1.4m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |
| | | V | | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road,
 Marrara

SURFACE LEVEL: --
EASTING: 704101
NORTHING: 8628610

PIT No: 136
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

[illegible]

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|----------------------|-------|--|
| A | Auger sample | G | Gas sample |
| B | Bulk sample | P | Piston sample |
| BLK | Block sample | U | Tube sample (x mm dia.) |
| C | Core drilling | W | Water sample |
| D | Disturbed sample | W | Water seep |
| E | Environmental sample | W | Water level |
| | | PID | Photo ionisation detector (ppm) |
| | | PL(A) | Point load axial test (s(50) (MPa) |
| | | PL(D) | Point load diametral test (s(50) (MPa) |
| | | pp | Pocket penetrometer (kPa) |
| | | S | Standard penetration test |
| | | V | Shear vane (kPa) |




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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704114
NORTHING: 8628611

PIT No: 137
PROJECT No: 78245.02
DATE: 20/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|---|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, gravelly sandy silt, fine to medium gravel, fine to medium grained sand, M<WP |  | | | | | | | | | |
| | 0.8 | SANDY GRAVEL: dense to very dense, grey and yellow brown, slightly clayey sandy gravel, fine to medium gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 0.9 | - weakly to moderately cemented, red and yellow brown from 0.5m depth | | | | | | | | | | |
| | 0.9 | KAOLONISED SILTSTONE: extremely low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1 | Pit discontinued at 0.9m- refusal | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 5.5 tonne excavator with 450mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | S | Standard penetration test |
| E | Environmental sample | ≡ | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704248
NORTHING: 8628472

PIT No: 138
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: stiff, grey-brown, sandy silty topsoil, fine to medium grained sand, trace gravel, decicated, roots & rootlets, M<WP | | | | | | | | | | |
| | 0.3 | SILTY SANDY GRAVEL: dense, grey-brown, silty sandy gravel, fine to coarse grained sand, fine to medium gravel, humid | | | | | | | | | | |
| | | CLAYEY SANDY GRAVEL: weakly to moderately cemented, red-brown, yellow-brown, fine to coarse grained sand, fine to medium gravel, humid | | | | | | | | | | |
| | 1 |fragmented porcellanite void infill at 1.2m | | | | | | | | | | |
| | 1.6 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 2.0 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | | | | |
| | 2.4 | Pit discontinued at 2.4m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704246
NORTHING: 8628418

PIT No: 139
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: strong, grey-brown, sandy silty topsoil, fine to medium grained sand, roots & rootlets, M<WP CLAYEY SANDY GRAVEL: moderately cemented, red-brown, yellow-brown, clayey sandy gravel, fine to medium sub-rounded lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 1.5 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 2.4 | Pit discontinued at 2.4m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | = Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704246
NORTHING: 8628418

PIT No: 140
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: medium dense, grey-brown, silty sandy gravel, topsoil, fine to medium sub-rounded lateritic gravel, fine to medium grained sand, humid GRAVELLY CLAY: stiff, red-brown, gravelly clay with some sand, fine to medium lateritic gravel, M<WP | | B | 0.1 | | | | | | | |
| | | | | | 0.8 | | | | | | | |
| 1 | | | | | | | | | | | | |
| | 1.7 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1.9 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| | 2.25 |becoming less fractured at 2.2m Pit discontinued at 2.25m- refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2


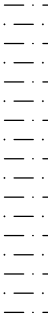
| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704272
NORTHING: 8628381

PIT No: 141
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|--|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.1 | TOPSOIL: stiff, grey-brown, sandy silty topsoil, fine to medium grained sand, trace gravel, roots & rootlets, M<WP CLAYEY SANDY GRAVEL: very dense, weakly cemented, red-brown, mottled yellow-brown, clayey sandy gravel, fine to coarse grained sand, fine to medium lateritic gravel, humidbecoming moderately cemented at 0.5m |  | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 1.6 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone |  | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 2.7 | Pit discontinued at 2.7m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704333
NORTHING: 8628321

PIT No: 142
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per 150mm) |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|---|
| | | | | Type | Depth | Sample | Results & Comments | | |
| | 0.1 | TOPSOIL: stiff, grey-brown, sandy silty topsoil, fine to medium grained sand, trace gravel, decicated, roots & rootlets, M<WP | | | | | | | |
| | 0.3 | SANDY SILT: medium dense, grey-brown, sandy silt, fine to medium grained sand, trace rootlets and roots, humid SANDY CLAY: stiff, red-brown, sandy clay with some gravel, fine to coarse grained sand, fine to medium gravel, M<WP | | | 0.3 | | | | |
| | 1.0 | CLAYEY SANDY GRAVEL: weakly cemented, red-brown, yellow-brown, fine to medium gravel, fine to coarse grained sand, humid moderately compacted at 1.6m | | | 1.0 | | | | |
| | 2.2 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | |
| | 2.8 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone | | | | | | | |
| | 3.1 | Pit discontinued at 3.1m- refusal | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | |
|-----------------------------------|---------------------------|--|--|
| A Auger sample | G Gas sample | PID Photo ionisation detector (ppm) | |
| B Bulk sample | P Piston sample | PL(A) Point load axial test Is(50) (MPa) | |
| BLK Block sample | U Tube sample (x mm dia.) | PL(D) Point load diametral test Is(50) (MPa) | |
| C Core drilling | W Water sample | pp Pocket penetrometer (kPa) | |
| D Disturbed sample | > Water seep | S Standard penetration test | |
| E Environmental sample | ≡ Water level | V Shear vane (kPa) | |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704372
NORTHING: 8628257

PIT No: 143
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.3 | TOPSOIL: grey-brown, sandy silty topsoil, fine to medium grained sand, M<WP | | | 0.3 | | | | | | | |
| | 1.2 | SANDY SILT, stiff, yellow-brown, grey-brown, sandy silt, fine to medium sand, M<WP | | B | | | | | | | | |
| | 1.2 | CLAYEY SANDY GRAVEL: weakly to moderately cemented, red-brown, yellow-brown, clayey sandy gravel, humid | | | 1.2 | | | | | | | |
| | 1.5 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 2.7 | Pit discontinued at 2.7m- refusal | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | > | Water seep | sp | Standard penetration test |
| E | Environmental sample | ≡ | Water level | S | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704418
NORTHING: 8628221

PIT No: 144
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.25 | TOPSOIL: medium dense, grey-brown, silty sandy gravel, topsoil, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 1.1 | CLAYEY SANDY GRAVEL: weakly to moderately cemented, red-brown, yellow-brown, clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand, humid | | | | | | | | | | |
| | 2.6 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 2.6 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone Pit discontinued at 2.6m- refusal | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | W | Water seep | S | Standard penetration test |
| E | Environmental sample | W | Water level | V | Shear vane (kPa) |

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Proposed Rapid Creek Flood Mitigation
LOCATION: Cnr Henry Wrigley Drive & McMillans Road, Marrara

SURFACE LEVEL: --
EASTING: 704484
NORTHING: 8628219

PIT No: 145
PROJECT No: 78245.02
DATE: 8/9/2017
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Dynamic Penetrometer Test (blows per mm) | | | |
|----|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|--|----|----|----|
| | | | | Type | Depth | Sample | Results & Comments | | 5 | 10 | 15 | 20 |
| | 0.2 | TOPSOIL: medium dense, grey-brown, sandy silty gravel, topsoil, fine to medium gravel, fine to medium grained sand, rootlets & roots, decicated | | | | | | | | | | |
| | 0.4 | SANDY SILT: stiff, grey-brown, sandy silt, fine to medium grained sand, trace gravel, decicated | | | | | | | | | | |
| | | CLAYEY SANDY GRAVEL: weakly cemented, red-brown, yellow-brown, clayey sandy gravel, fine to medium lateritic gravel, fine to coarse grained sand | | | | | | | | | | |
| | 1 | | | | | | | | | | | |
| | 1.3 | KAOLONISED SILTSTONE: very low strength, moderately cemented, off-white, red-brown, siltstone | | | | | | | | | | |
| | 1.9 | | | | | | | | | | | |
| 2 | 2.0 | PORCELLANITE (DARWIN MEMBER): medium to high strength, moderately weathered, off-white, yellow-brown, highly fractured, silicified siltstone Pit discontinued at 2.0m- refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | |

RIG: 15 tonne excavator with 600mm wide rock tooth bucket

LOGGED: R. Arbon

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater encountered

REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

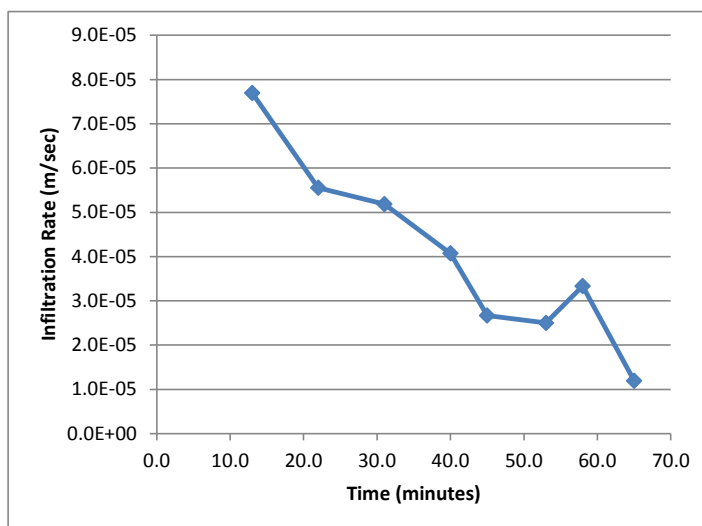
| SAMPLING & IN SITU TESTING LEGEND | | | | | |
|-----------------------------------|----------------------|---|-------------------------|-------|--|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | U | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ≻ | Water seep | S | Standard penetration test |
| E | Environmental sample | ≻ | Water level | V | Shear vane (kPa) |

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 101, 0.5 m below surface | 101 |
| Material type: Clayey Sandy Gravel Filling | Easting: 704124 m |
| Condition of ground surface before test: Humid | Northing 8628928 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 630 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 13.0 | | 60 | 7.69E-05 |
| 22 | | 90 | 5.56E-05 |
| 31 | | 118 | 5.19E-05 |
| 40 | | 140 | 4.07E-05 |
| 45 | | 148 | 2.67E-05 |
| 53 | | 160 | 2.50E-05 |
| 58 | | 170 | 3.33E-05 |
| 65 | | 175 | 1.19E-05 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 65 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 175 | 4.49E-05 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 65 min | 3900 sec |
| H2 = | 383 cm | 3.83 m |

| | | | | |
|----------|----------|-----------------|--------|--|
| k | = | 5.06E-03 | cm/min | where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$ |
| | = | 8.44E-07 | m/sec | (Kessler & Oosterban 1974) |
| | = | 0.07 | m/day | |

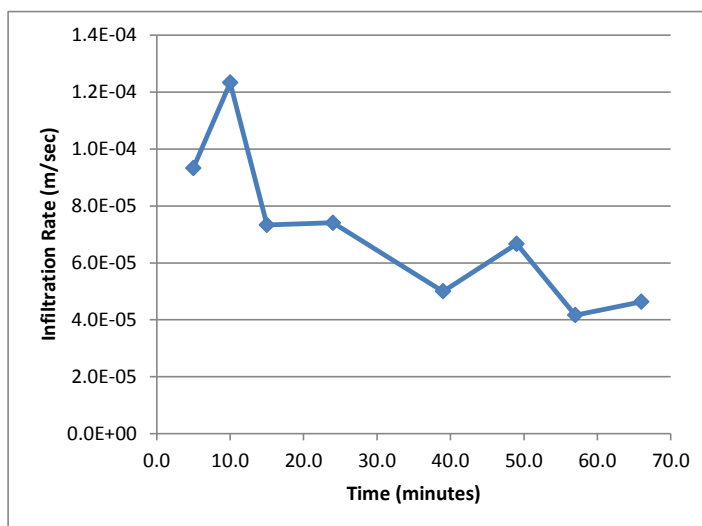
| | | | | |
|----------|----------|-----------------|--------|--|
| k | = | 6.17E-03 | cm/min | where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$ |
| | = | 1.03E-06 | m/sec | (Kessler & Oosterban 1974) |
| | = | 0.09 | m/day | |

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 109, 0.45 m below surface | 109 |
| Material type: Red brown Gravelly Clay | Easting: 704120 m |
| Condition of ground surface before test: Humid | Northing 8628802 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 450 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 28 | 9.33E-05 |
| 10 | | 65 | 1.23E-04 |
| 15 | | 87 | 7.33E-05 |
| 24 | | 127 | 7.41E-05 |
| 39 | | 172 | 5.00E-05 |
| 49 | | 212 | 6.67E-05 |
| 57 | | 232 | 4.17E-05 |
| 66 | | 257 | 4.63E-05 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 66 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 257 | 6.49E-05 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 66 min | 3960 sec |
| H2 = | 374 cm | 3.74 m |

k = **7.40E-03** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **1.23E-06** m/sec (Kessler & Oosterban 1974)
= **0.11** m/day

[illegible]

Permeability Testing - Simple Falling Head Test Report

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 21-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

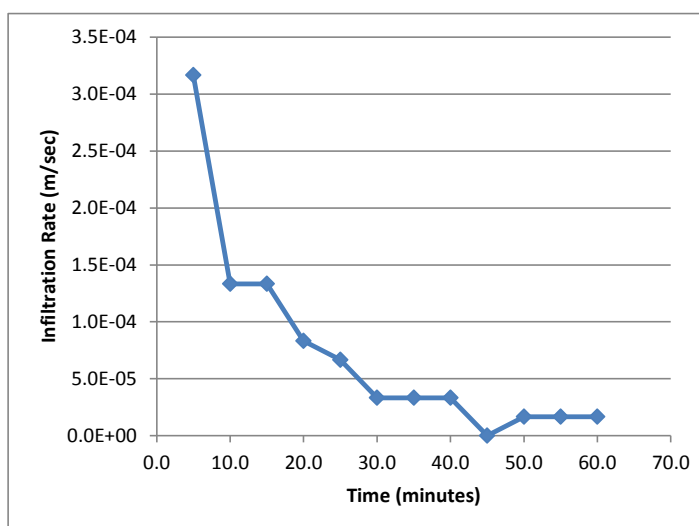
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 115, 0.4 m below surface | 115 |
| Material type: Siltstone Bedrock | Easting: 703929 m |
| Condition of ground surface before test: Humid | Northing: 8628930 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

Details of Bore (open uncased)

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 520 mm | | |
| Depth to water at initial filling | 0 mm | | |

Test Results

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 95 | 3.17E-04 |
| 10 | | 135 | 1.33E-04 |
| 15 | | 175 | 1.33E-04 |
| 20 | | 200 | 8.33E-05 |
| 25 | | 220 | 6.67E-05 |
| 30 | | 230 | 3.33E-05 |
| 35 | | 240 | 3.33E-05 |
| 40 | | 250 | 3.33E-05 |
| 45 | | 250 | 0.00E+00 |
| 50 | | 255 | 1.67E-05 |
| 55 | | 260 | 1.67E-05 |
| 60 | | 265 | 1.67E-05 |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 265 | 7.36E-05 |
|--------|---|-----|----------|

Calculations :

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 60 min | 3600 sec |
| H2 = | 374 cm | 3.74 m |

Hydraulic Conductivity - Over total duration of test

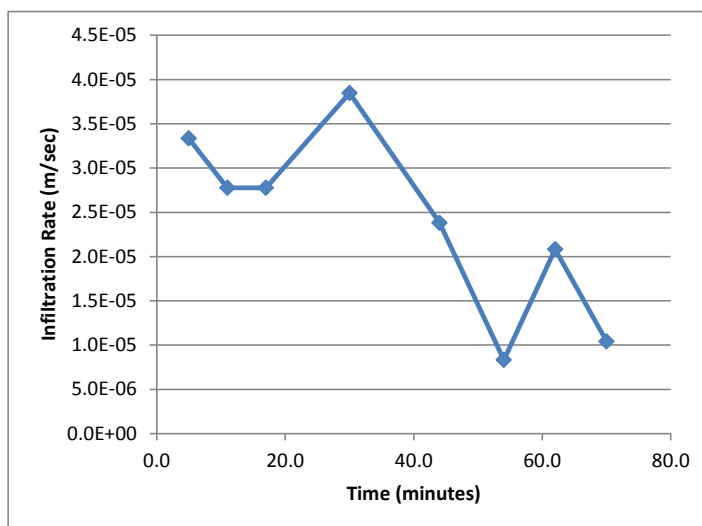
| | | | | |
|---|---|----------|--------|--|
| k | = | 8.41E-03 | cm/min | where k = $r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$ |
| | = | 1.40E-06 | m/sec | (Kessler & Oosterban 1974) |
| | = | 0.12 | m/day | |

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 117, 0.5 m below surface | 117 |
| Material type: Yellow brown silty sandy gravel | Easting: 703787 m |
| Condition of ground surface before test: Humid | Northing 8628939 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 500 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 10 | 3.33E-05 |
| 11 | | 20 | 2.78E-05 |
| 17 | | 30 | 2.78E-05 |
| 30 | | 60 | 3.85E-05 |
| 44 | | 80 | 2.38E-05 |
| 54 | | 85 | 8.33E-06 |
| 62 | | 95 | 2.08E-05 |
| 70 | | 100 | 1.04E-05 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 70 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 100 | 2.38E-05 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 70 min | 4200 sec |
| H2 = | 390 cm | 3.90 m |

k = **2.66E-03** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **4.44E-07** m/sec (Kessler & Oosterban 1974)
= **0.04** m/day

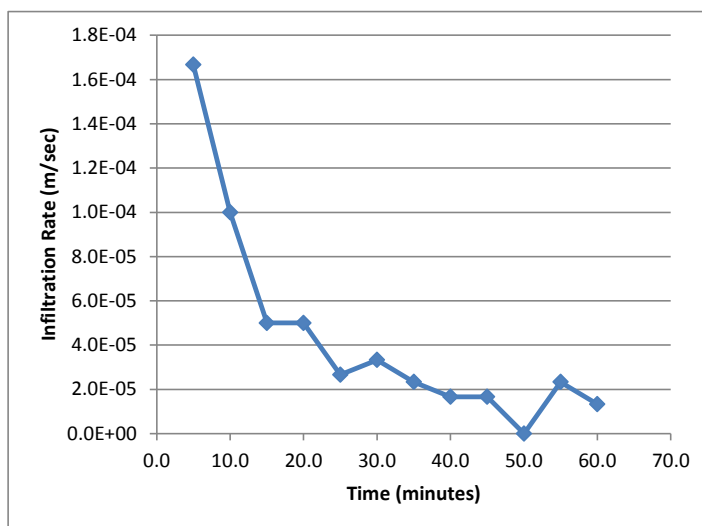
| | | | | |
|----------|----------|-----------------|--------|--|
| k | = | 3.29E-03 | cm/min | where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$ |
| | = | 5.48E-07 | m/sec | (Kessler & Oosterban 1974) |
| | = | 0.05 | m/day | |

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 130, 0.4 m below surface | 130 |
| Material type: Siltstone Bedrock | Easting: 704125 m |
| Condition of ground surface before test: Humid | Northing 8628731 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 400 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 50 | 1.67E-04 |
| 10 | | 80 | 1.00E-04 |
| 15 | | 95 | 5.00E-05 |
| 20 | | 110 | 5.00E-05 |
| 25 | | 118 | 2.67E-05 |
| 30 | | 128 | 3.33E-05 |
| 35 | | 135 | 2.33E-05 |
| 40 | | 140 | 1.67E-05 |
| 45 | | 145 | 1.67E-05 |
| 50 | | 145 | 0.00E+00 |
| 55 | | 152 | 2.33E-05 |
| 60 | | 156 | 1.33E-05 |
| | | | |
| | | | |
| | | | |
| 60 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 156 | 4.33E-05 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 60 min | 3600 sec |
| H2 = | 384 cm | 3.84 m |

k = **4.88E-03** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **8.13E-07** m/sec (Kessler & Oosterban 1974)
= **0.07** m/day

Permeability Testing - Simple Falling Head Test Report

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 21-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

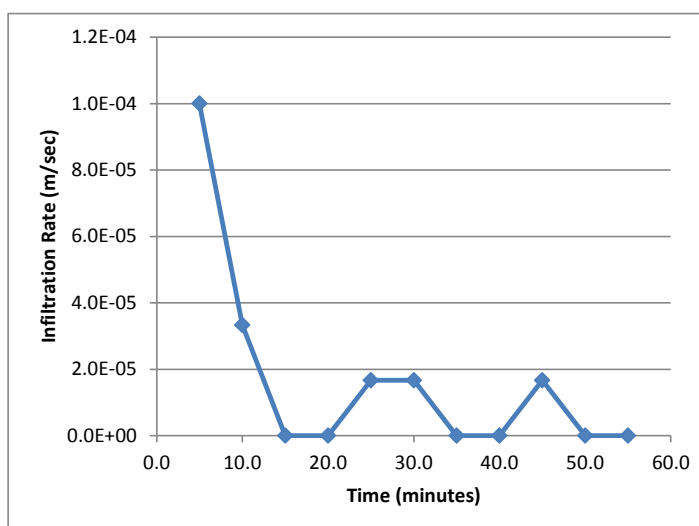
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 137, 0.8 m below surface | 137 |
| Material type: Siltstone Bedrock | Easting: 704114 m |
| Condition of ground surface before test: Humid | Northing: 8628611 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

Details of Bore (open uncased)

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 450 mm | | |
| Depth to water at initial filling | 0 mm | | |

Test Results

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|------------|-------------------|------------|---------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 30 | 1.00E-04 |
| 10 | | 40 | 3.33E-05 |
| 15 | | 40 | 0.00E+00 |
| 20 | | 40 | 0.00E+00 |
| 25 | | 45 | 1.67E-05 |
| 30 | | 50 | 1.67E-05 |
| 35 | | 50 | 0.00E+00 |
| 40 | | 50 | 0.00E+00 |
| 45 | | 55 | 1.67E-05 |
| 50 | | 55 | 0.00E+00 |
| 55 | | 55 | 0.00E+00 |



Totals 0 55 1.67E-05

Calculations :

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 55 min | 3300 sec |
| H2 = | 395 cm | 3.95 m |

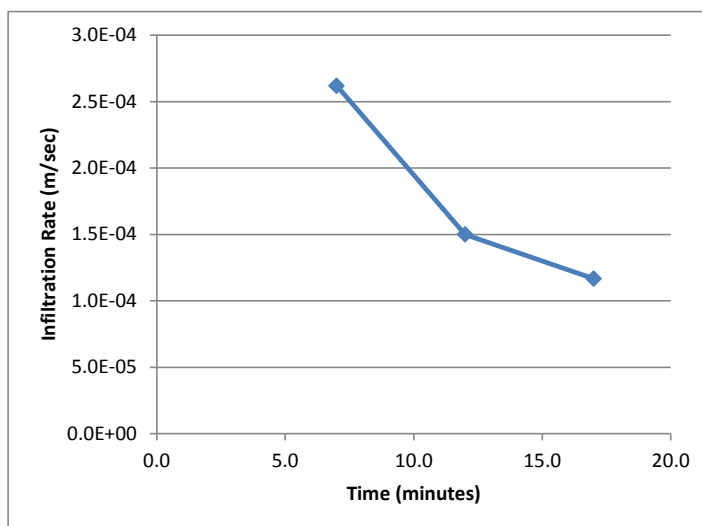
Hydraulic Conductivity - Over total duration of test

| | | | | |
|---|---|----------|--------|--|
| k | = | 1.85E-03 | cm/min | where k = $r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$ |
| | = | 3.09E-07 | m/sec | (Kessler & Oosterban 1974) |
| | = | 0.03 | m/day | |

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 21-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 138, 0.8 m below surface | 138 |
| Material type: Red and yellow brown Clayey Sandy Gravel | Easting: 704248 m |
| Condition of ground surface before test: Humid | Northing 8628472 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 400 mm | | |
| Depth to water at initial filling | 0 mm | | |

[illegible]

| | | | |
|--------|---|-----|----------|
| Totals | 0 | 190 | 1.86E-04 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 17 min | 1020 sec |
| H2 = | 381 cm | 3.81 m |

k = **2.11E-02** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **3.51E-06** m/sec (Kessler & Oosterban 1974)
= **0.30** m/day

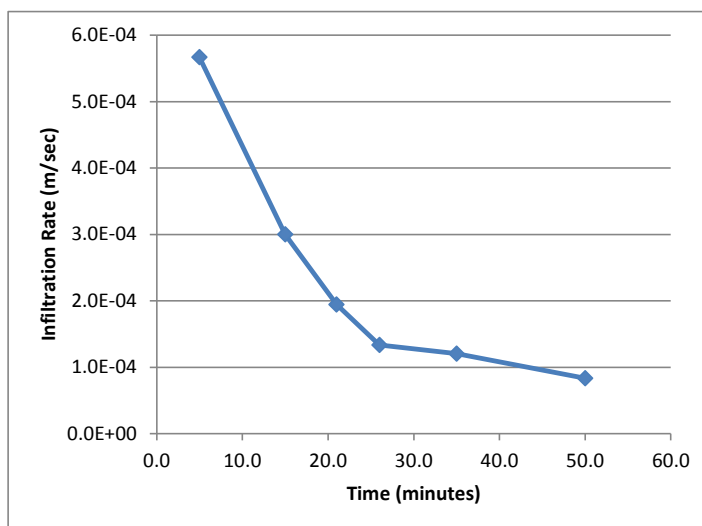
k = **3.70E-02** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **6.16E-06** m/sec (Kessler & Oosterban 1974)
= **0.53** m/day

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 21-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 142, 0.6 m below surface | 142 |
| Material type: Red and yellow brown Clayey Sandy Gravel | Easting: 704333 m |
| Condition of ground surface before test: Humid | Northing 8628321 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 650 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|----------------------|---------------|------------------------------------|
| 0 | 0 | 0 | |
| 5.0 | | 170 | 5.67E-04 |
| 15 | | 350 | 3.00E-04 |
| 21 | | 420 | 1.94E-04 |
| 26 | | 460 | 1.33E-04 |
| 35 | | 525 | 1.20E-04 |
| 50 | | 600 | 8.33E-05 |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 50 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 600 | 2.00E-04 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 50 min | 3000 sec |
| H2 = | 340 cm | 3.40 m |

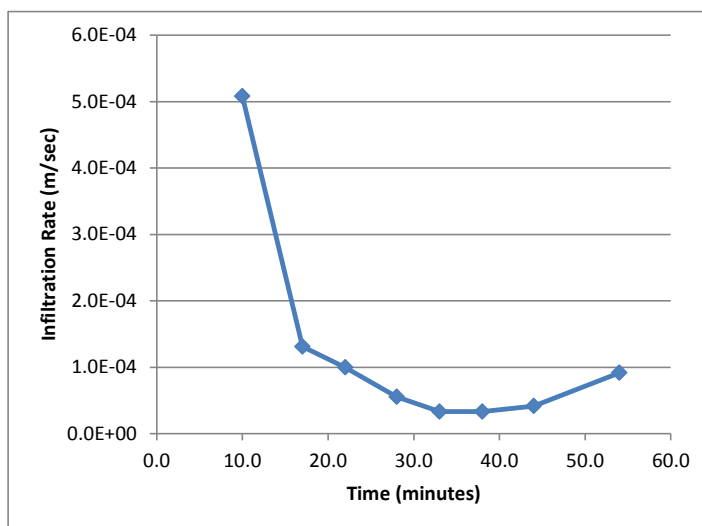
k = **2.39E-02** cm/min where $k = r/2[\ln(r/2+H_1)-\ln(r/2+H_2)]/(t_2-t_1)$
= **3.98E-06** m/sec (Kessler & Oosterban 1974)
= **0.34** m/day

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 21-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 145, 0.5 m below surface | 145 |
| Material type: Red and yellow brown Clayey Sandy Gravel | Easting: 704484 m |
| Condition of ground surface before test: Humid | Northing 8628219 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | | |
|-----------------------------------|--------|----------------------|---------|
| Hole diameter | 300 mm | Depth to water table | 4000 mm |
| Depth of hole at time of test | 550 mm | | |
| Depth to water at initial filling | 0 mm | | |

| Time (min) | Volume added (ml) | Depth (mm) | Infiltration Rate [F/t] (m/sec) |
|---------------|-------------------------|---------------|---------------------------------------|
| 0 | 0 | 0 | |
| 10.0 | | 305 | 5.08E-04 |
| 17 | | 360 | 1.31E-04 |
| 22 | | 390 | 1.00E-04 |
| 28 | | 410 | 5.56E-05 |
| 33 | | 420 | 3.33E-05 |
| 38 | | 430 | 3.33E-05 |
| 44 | | 445 | 4.17E-05 |
| 54 | | 500 | 9.17E-05 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 54 | | | |



| | | | |
|--------|---|-----|----------|
| Totals | 0 | 500 | 1.54E-04 |
|--------|---|-----|----------|

| | | |
|---------|--------|----------|
| r/2 = | 7.5 cm | 0.075 m |
| H1 = | 400 cm | 4 m |
| t2-t1 = | 54 min | 3240 sec |
| H2 = | 350 cm | 3.50 m |

k = **1.82E-02** cm/min where $k = r/2[\ln(r/2+H1)-\ln(r/2+H2)]/(t2-t1)$
= **3.03E-06** m/sec (Kessler & Oosterban 1974)
= **0.26** m/day

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

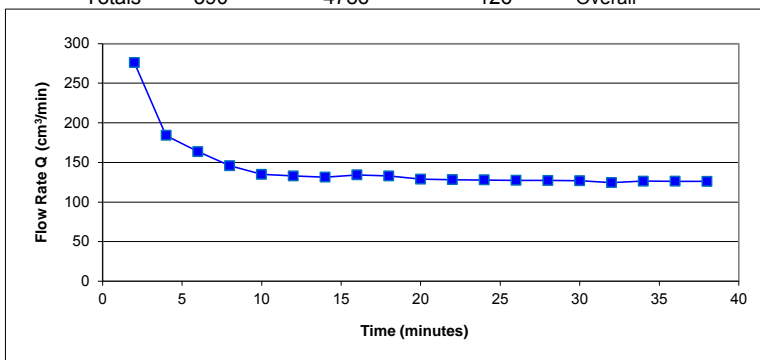
| | | |
|--|-------------------|-------|
| Test Location | Test No. | |
| Description: Test Pit 108, at surface | Easting: 704070 | m |
| Material type: Brown Clayey Sandy Gravel Filling | Northing: 8628843 | m |
| Condition of ground surface before test: Humid | Surface Level: - | m AHD |
| Weather during test: Fine and sunny | | |

| Details of Bore Installation | | | | |
|---|-----|----|----------------------------|-----------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 350 | mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 | mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 45 | 552 | 276 |
| 4 | 60 | 736 | 184 |
| 6 | 80 | 982 | 164 |
| 8 | 95 | 1166 | 146 |
| 10 | 110 | 1350 | 135 |
| 12 | 130 | 1595 | 133 |
| 14 | 150 | 1841 | 131 |
| 16 | 175 | 2148 | 134 |
| 18 | 195 | 2393 | 133 |
| 20 | 210 | 2577 | 129 |
| 22 | 230 | 2823 | 128 |
| 24 | 250 | 3068 | 128 |
| 26 | 270 | 3313 | 127 |
| 28 | 290 | 3559 | 127 |
| 30 | 310 | 3804 | 127 |
| 32 | 325 | 3988 | 125 |
| 34 | 350 | 4295 | 126 |
| 36 | 370 | 4541 | 126 |
| 38 | 390 | 4786 | 126 |

Totals 390 4786 126 Overall


Saturated Hydraulic Conductivity - Over total duration of test

$k = 3.77E-02$ cm/min where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$
 $= 6.29E-06$ m/sec ref. AS1547-2012 App G
 $= 0.54$ m/day

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 114, at surface | 114 |
| Material type: Brown, Clayey Silty Gravel Filling | Easting: 704028 m |
| Condition of ground surface before test: Humid | Northing: 8628768 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

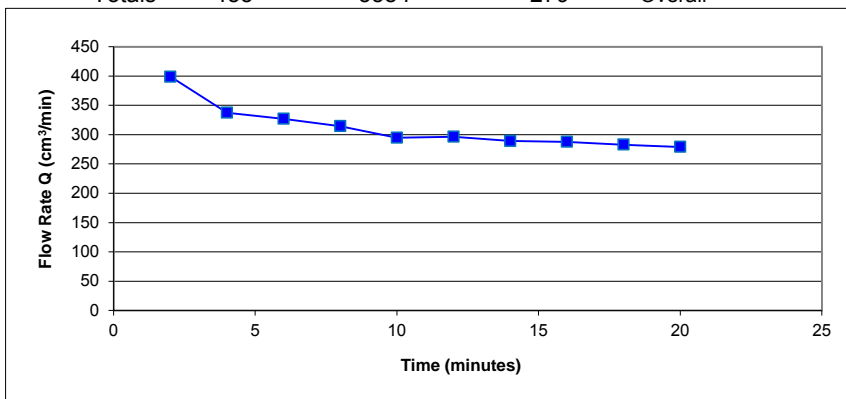
Details of Bore Installation

| | | | |
|---|--------|----------------------------|-----------|
| Depth of augered hole | 520 mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 390 mm | Time from filling to start | 1 minutes |
| Diameter of hole | 125 mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 65 | 798 | 399 |
| 4 | 110 | 1350 | 337 |
| 6 | 160 | 1963 | 327 |
| 8 | 205 | 2516 | 314 |
| 10 | 240 | 2945 | 295 |
| 12 | 290 | 3559 | 297 |
| 14 | 330 | 4050 | 289 |
| 16 | 375 | 4602 | 288 |
| 18 | 415 | 5093 | 283 |
| 20 | 455 | 5584 | 279 |
| | | | |
| | | | |

Totals 455 5584 279 Overall



Saturated Hydraulic Conductivity - Over total duration of test

| | | | |
|------------|-----------------|--------|---|
| k = | 7.24E-02 | cm/min | where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$ |
| = | 1.21E-05 | m/sec | ref. AS1547-2012 App G |
| = | 1.04 | m/day | |

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | | |
|---|-------------------|-------|
| Test Location | Test No. | |
| Description: Test Pit 115, at surface | 115 | |
| Material type: Grey brown slightly Clayey, Sandy Gravel | Easting: 703929 | m |
| Condition of ground surface before test: Humid | Northing: 8628930 | m |
| Weather during test: Fine and sunny | Surface Level: - | m AHD |

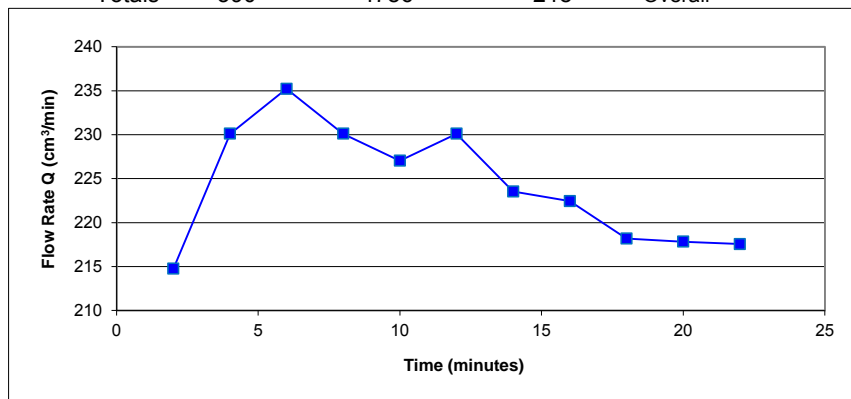
Details of Bore Installation

| | | | |
|---|--------|----------------------------|-----------|
| Depth of augered hole | 500 mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 350 mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 35 | 430 | 215 |
| 4 | 75 | 920 | 230 |
| 6 | 115 | 1411 | 235 |
| 8 | 150 | 1841 | 230 |
| 10 | 185 | 2270 | 227 |
| 12 | 225 | 2761 | 230 |
| 14 | 255 | 3129 | 224 |
| 16 | 290 | 3559 | 222 |
| 18 | 320 | 3927 | 218 |
| 20 | 355 | 4357 | 218 |
| 22 | 390 | 4786 | 218 |

Totals 390 4786 218 Overall



Saturated Hydraulic Conductivity - Over total duration of test

| | | |
|---------------------|--------|---|
| k = 6.52E-02 | cm/min | where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$ |
| = 1.09E-05 | m/sec | ref. AS1547-2012 App G |
| = 0.94 | m/day | |

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | | |
|---|-----------------|-----------|
| Test Location | Test No. | 115A |
| Description: Test Pit 115, at surface | Easting: | 703929 m |
| Material type: Grey brown slightly Clayey, Sandy Gravel | Northing | 8628930 m |
| Condition of ground surface before test: Humid | Surface Level: | - m AHD |
| Weather during test: Fine and sunny | | |

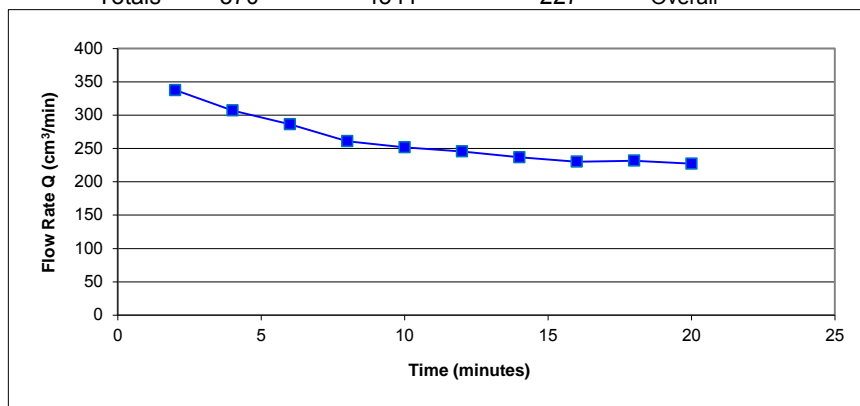
Details of Bore Installation

| | | | |
|---|--------|----------------------------|-----------|
| Depth of augered hole | 500 mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 350 mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 55 | 675 | 337 |
| 4 | 100 | 1227 | 307 |
| 6 | 140 | 1718 | 286 |
| 8 | 170 | 2086 | 261 |
| 10 | 205 | 2516 | 252 |
| 12 | 240 | 2945 | 245 |
| 14 | 270 | 3313 | 237 |
| 16 | 300 | 3682 | 230 |
| 18 | 340 | 4172 | 232 |
| 20 | 370 | 4541 | 227 |

Totals 370 4541 227 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 6.80\text{E-}02 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{(r/H)^2 + 0.25}] + r/H / 2\pi H^2 \\
 &= 1.13\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 0.98 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

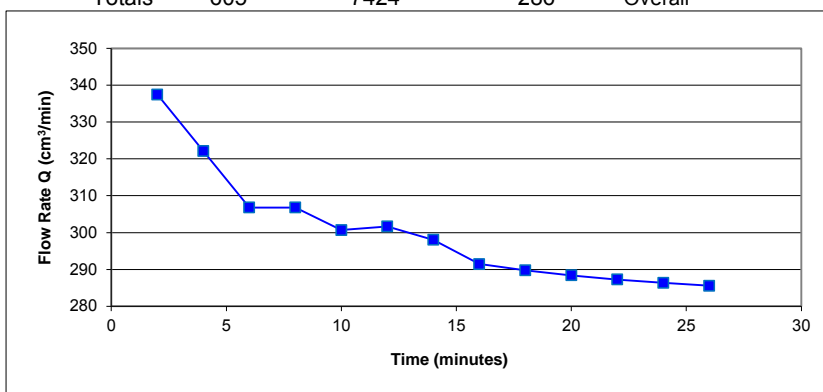
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 117, at surface | 117 |
| Material type: Yellow brown Sandy Gravel | Easting: 703787 m |
| Condition of ground surface before test: Humid | Northing: 8628939 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| Details of Bore Installation | | | | |
|---|-----|----|----------------------------|-----------|
| Depth of augered hole | 520 | mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 370 | mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 | mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 55 | 675 | 337 |
| 4 | 105 | 1289 | 322 |
| 6 | 150 | 1841 | 307 |
| 8 | 200 | 2454 | 307 |
| 10 | 245 | 3007 | 301 |
| 12 | 295 | 3620 | 302 |
| 14 | 340 | 4172 | 298 |
| 16 | 380 | 4663 | 291 |
| 18 | 425 | 5216 | 290 |
| 20 | 470 | 5768 | 288 |
| 22 | 515 | 6320 | 287 |
| 24 | 560 | 6872 | 286 |
| 26 | 605 | 7424 | 286 |

Totals 605 7424 286 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 7.95\text{E-}02 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{(r/H)^2 + 0.25}] + r/H / 2\pi H^2 \\
 &= 1.32\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 1.14 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

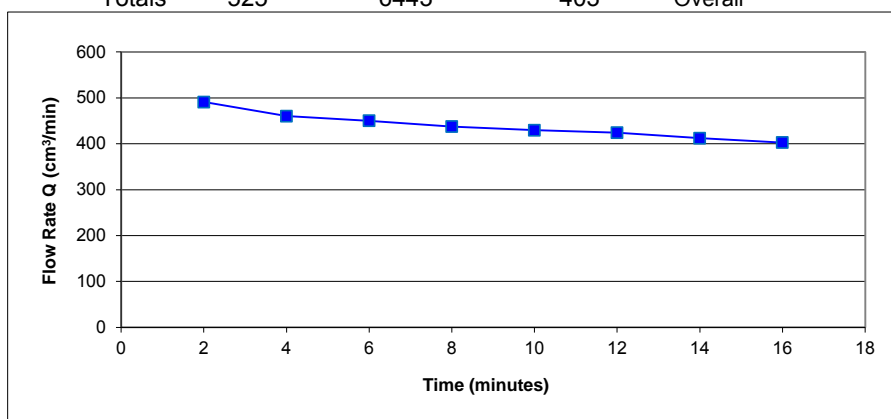
| | | |
|--|-----------------|-----------|
| Test Location | Test No. | 117A |
| Description: Test Pit 117, at surface | Easting: | 703787 m |
| Material type: Yellow brown Sandy Gravel | Northing | 8628939 m |
| Condition of ground surface before test: Humid | Surface Level: | - m AHD |
| Weather during test: Fine and sunny | | |

| Details of Bore Installation | | | | |
|---|-----|----|----------------------------|-----------|
| Depth of augered hole | 520 | mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 370 | mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 | mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 80 | 982 | 491 |
| 4 | 150 | 1841 | 460 |
| 6 | 220 | 2700 | 450 |
| 8 | 285 | 3497 | 437 |
| 10 | 350 | 4295 | 430 |
| 12 | 415 | 5093 | 424 |
| 14 | 470 | 5768 | 412 |
| 16 | 525 | 6443 | 403 |

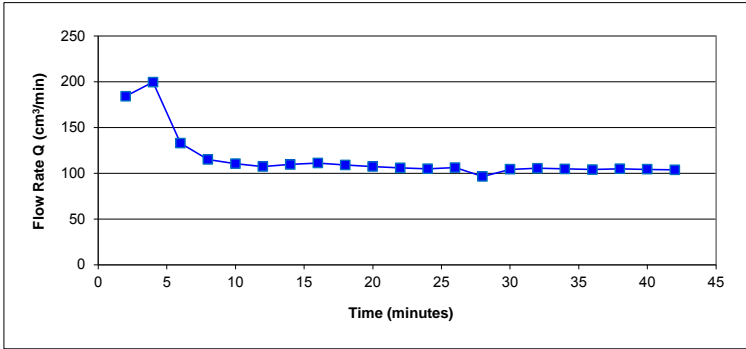
Totals 525 6443 403 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 1.12\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 1.87\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 1.61 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| Client: Jacobs Group (Australia) Pty Ltd Project: Proposed Rapid Creek Flood Mitigation Location: Marrara, NT | Project No: 78245.02 Date: 8-Sep-17 Tested by: VH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--------------------------------------|---|--------------------------------------|---|---|---|---|--|---|----|-----|-----|---|----|-----|-----|---|----|-----|-----|---|----|-----|-----|----|----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|----|-----|------|-----|--------|-----|------|-------------|
| Test Location Description: Test Pit 121, at surface Material type: Yellow brown Gravelly Sandy Silt Condition of ground surface before test: Humid Weather during test: Fine and sunny | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Test No. 121 Easting: 703873 m Northing: 8628841 m Surface Level: - m AHD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Details of Bore Installation Depth of augered hole: 580 mm Depth of constant water below permeameter: 430 mm Diameter of hole: 125 mm Depth to impermeable layer: - m Time from filling to start: 2 minutes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Test Results <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Time (minutes)</th> <th>Level below top (mm)</th> <th>Flow Volume (cm³)</th> <th>Rate of Loss [Q] (cm³/min)</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td></td></tr> <tr><td>2</td><td>30</td><td>368</td><td>184</td></tr> <tr><td>4</td><td>65</td><td>798</td><td>199</td></tr> <tr><td>6</td><td>65</td><td>798</td><td>133</td></tr> <tr><td>8</td><td>75</td><td>920</td><td>115</td></tr> <tr><td>10</td><td>90</td><td>1104</td><td>110</td></tr> <tr><td>12</td><td>105</td><td>1289</td><td>107</td></tr> <tr><td>14</td><td>125</td><td>1534</td><td>110</td></tr> <tr><td>16</td><td>145</td><td>1779</td><td>111</td></tr> <tr><td>18</td><td>160</td><td>1963</td><td>109</td></tr> <tr><td>20</td><td>175</td><td>2148</td><td>107</td></tr> <tr><td>22</td><td>190</td><td>2332</td><td>106</td></tr> <tr><td>24</td><td>205</td><td>2516</td><td>105</td></tr> <tr><td>26</td><td>225</td><td>2761</td><td>106</td></tr> <tr><td>28</td><td>220</td><td>2700</td><td>96</td></tr> <tr><td>30</td><td>255</td><td>3129</td><td>104</td></tr> <tr><td>32</td><td>275</td><td>3375</td><td>105</td></tr> <tr><td>34</td><td>290</td><td>3559</td><td>105</td></tr> <tr><td>36</td><td>305</td><td>3743</td><td>104</td></tr> <tr><td>38</td><td>325</td><td>3988</td><td>105</td></tr> <tr><td>40</td><td>340</td><td>4172</td><td>104</td></tr> <tr><td>42</td><td>355</td><td>4357</td><td>104</td></tr> <tr> <td>Totals</td> <td>355</td> <td>4357</td> <td>104 Overall</td> </tr> </tbody> </table> <div style="text-align: center;">  </div> | | Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) | 0 | 0 | 0 | | 2 | 30 | 368 | 184 | 4 | 65 | 798 | 199 | 6 | 65 | 798 | 133 | 8 | 75 | 920 | 115 | 10 | 90 | 1104 | 110 | 12 | 105 | 1289 | 107 | 14 | 125 | 1534 | 110 | 16 | 145 | 1779 | 111 | 18 | 160 | 1963 | 109 | 20 | 175 | 2148 | 107 | 22 | 190 | 2332 | 106 | 24 | 205 | 2516 | 105 | 26 | 225 | 2761 | 106 | 28 | 220 | 2700 | 96 | 30 | 255 | 3129 | 104 | 32 | 275 | 3375 | 105 | 34 | 290 | 3559 | 105 | 36 | 305 | 3743 | 104 | 38 | 325 | 3988 | 105 | 40 | 340 | 4172 | 104 | 42 | 355 | 4357 | 104 | Totals | 355 | 4357 | 104 Overall |
| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 30 | 368 | 184 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 65 | 798 | 199 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 65 | 798 | 133 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 75 | 920 | 115 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 90 | 1104 | 110 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | 105 | 1289 | 107 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | 125 | 1534 | 110 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | 145 | 1779 | 111 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | 160 | 1963 | 109 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | 175 | 2148 | 107 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 | 190 | 2332 | 106 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 24 | 205 | 2516 | 105 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26 | 225 | 2761 | 106 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 | 220 | 2700 | 96 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | 255 | 3129 | 104 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32 | 275 | 3375 | 105 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 34 | 290 | 3559 | 105 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 36 | 305 | 3743 | 104 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 38 | 325 | 3988 | 105 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 40 | 340 | 4172 | 104 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 42 | 355 | 4357 | 104 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Totals | 355 | 4357 | 104 Overall | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Saturated Hydraulic Conductivity - Over total duration of test $k = 2.35E-02 \text{ cm/min}$ where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$ $= 3.92E-06 \text{ m/sec}$ ref. AS1547-2012 App G $= 0.34 \text{ m/day}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

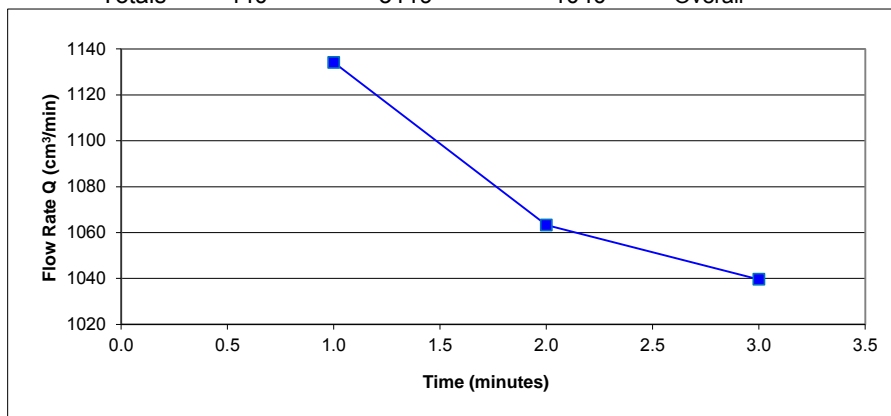
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 124, at surface | 124 |
| Material type: Brown, Sandy Gravel | Easting: 703874 m |
| Condition of ground surface before test: Humid | Northing: 8628673 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | |
|---|--------|----------------------------|
| Details of Bore Installation | | |
| Depth of augered hole | 500 mm | Depth to impermeable layer |
| Depth of constant water below permeameter | 300 mm | Time from filling to start |
| Diameter of hole | 95 mm | 0.5 minutes |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 1.0 | 160 | 1134 | 1134 |
| 2.0 | 300 | 2126 | 1063 |
| 3.0 | 440 | 3119 | 1040 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Totals 440 3119 1040 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 4.59\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 7.65\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 6.61 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

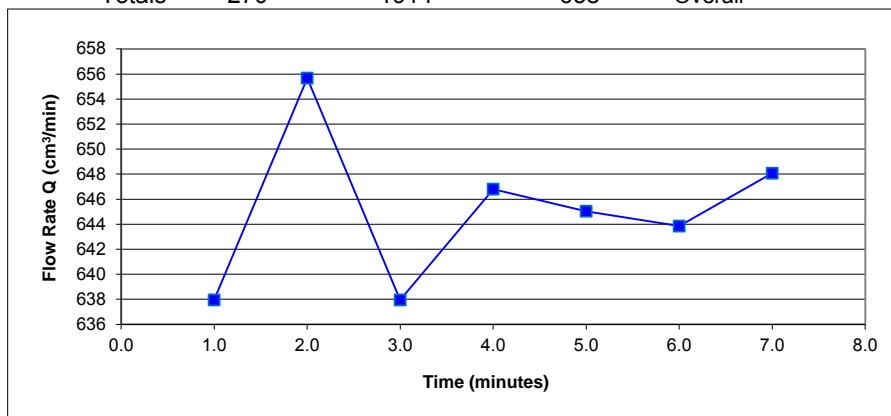
| | | |
|--|-------------------|-------|
| Test Location | Test No. | |
| Description: Test Pit 124, at surface | Easting: 703874 | m |
| Material type: Brown, Sandy Gravel | Northing: 8628673 | m |
| Condition of ground surface before test: Humid | Surface Level: - | m AHD |
| Weather during test: Fine and sunny | | |

| Details of Bore Installation | | | | | |
|---|-----|----|----------------------------|-----|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 300 | mm | Time from filling to start | 0.5 | minutes |
| Diameter of hole | 95 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 1.0 | 90 | 638 | 638 |
| 2.0 | 185 | 1311 | 656 |
| 3.0 | 270 | 1914 | 638 |
| 4.0 | 365 | 2587 | 647 |
| 5.0 | 455 | 3225 | 645 |
| 6.0 | 545 | 3863 | 644 |
| 7.0 | 640 | 4536 | 648 |

Totals 270 1914 638 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 2.82\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 4.69\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 4.06 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

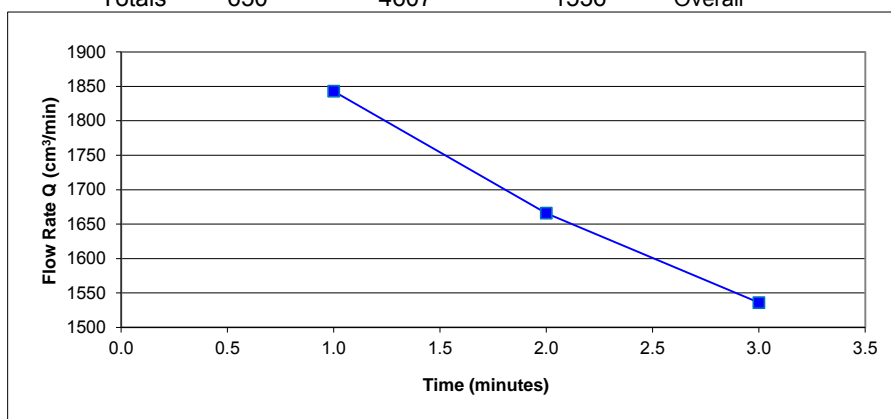
| | |
|---|------------------------|
| Test Location | Test No. |
| Description: Test Pit 126, at surface | 126 |
| Material type: Brown and yellow brown, Silty Sand | Easting: 703976 m |
| Condition of ground surface before test: Humid | Northing: 8628713 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | |
|---|--------|----------------------------|
| Details of Bore Installation | | |
| Depth of augered hole | 500 mm | Depth to impermeable layer |
| Depth of constant water below permeameter | 320 mm | Time from filling to start |
| Diameter of hole | 95 mm | 0.5 minutes |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 1.0 | 260 | 1843 | 1843 |
| 2.0 | 470 | 3331 | 1666 |
| 3.0 | 650 | 4607 | 1536 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

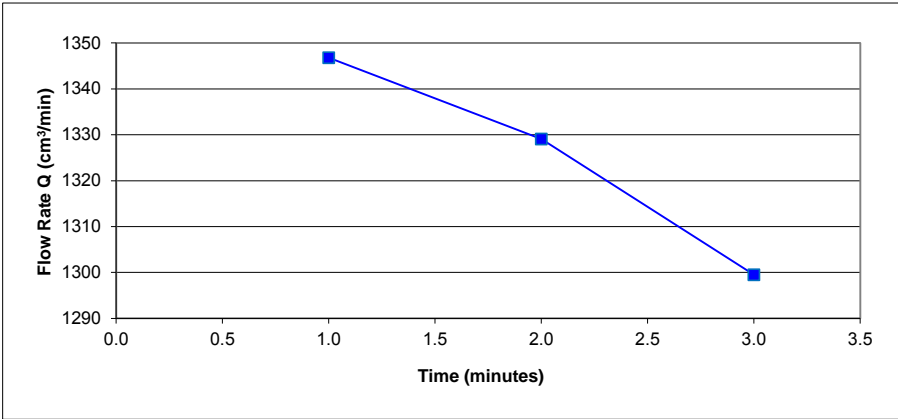
Totals 650 4607 1536 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 6.21\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 1.04\text{E-}04 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 8.94 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| Client: Jacobs Group (Australia) Pty Ltd Project: Proposed Rapid Creek Flood Mitigation Location: Marrara, NT | Project No: 78245.02 Date: 10-Oct-17 Tested by: BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--------------------------------|---|--------------------------------|---|---|---|---|--|-----|-----|------|------|-----|-----|------|------|-----|-----|------|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|-----|------|------|---------|--|--|--|----------------|------------------------------------|-----|------|-----|------|-----|------|
| Test Location Description: Test Pit 126, at surface Material type: Brown and yellow brown, Silty Sand Condition of ground surface before test: Humid Weather during test: Fine and sunny | Test No. 126A Easting: 703976 m Northing: 8628713 m Surface Level: - m AHD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Details of Bore Installation Depth of augered hole: 500 mm Depth of constant water below permeameter: 320 mm Diameter of hole: 95 mm Depth to impermeable layer: - m Time from filling to start: 0.5 minutes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Test Results <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th>Time (minutes)</th> <th>Level below top (mm)</th> <th>Flow Volume (cm³)</th> <th>Rate of Loss [Q] (cm³/min)</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td></td></tr> <tr><td>1.0</td><td>190</td><td>1347</td><td>1347</td></tr> <tr><td>2.0</td><td>375</td><td>2658</td><td>1329</td></tr> <tr><td>3.0</td><td>550</td><td>3899</td><td>1300</td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr> <td>Totals</td> <td>550</td> <td>3899</td> <td>1300</td> </tr> <tr> <td colspan="4" style="text-align: right;">Overall</td> </tr> </tbody> </table> <div style="margin-top: 10px;">  <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <caption>Graph Data Points</caption> <thead> <tr> <th>Time (minutes)</th> <th>Flow Rate Q (cm³/min)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>1347</td></tr> <tr><td>2.0</td><td>1329</td></tr> <tr><td>3.0</td><td>1300</td></tr> </tbody> </table> </div> | | Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) | 0 | 0 | 0 | | 1.0 | 190 | 1347 | 1347 | 2.0 | 375 | 2658 | 1329 | 3.0 | 550 | 3899 | 1300 | | | | | | | | | | | | | | | | | | | | | Totals | 550 | 3899 | 1300 | Overall | | | | Time (minutes) | Flow Rate Q (cm ³ /min) | 1.0 | 1347 | 2.0 | 1329 | 3.0 | 1300 |
| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0 | 190 | 1347 | 1347 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.0 | 375 | 2658 | 1329 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.0 | 550 | 3899 | 1300 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Totals | 550 | 3899 | 1300 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Overall | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Time (minutes) | Flow Rate Q (cm ³ /min) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0 | 1347 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.0 | 1329 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.0 | 1300 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Saturated Hydraulic Conductivity - Over total duration of test <div style="display: flex; justify-content: space-between; align-items: flex-start; margin-top: 10px;"> <div> k = 5.26E-01 cm/min = 8.76E-05 m/sec = 7.57 m/day </div> <div> where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$ ref. AS1547-2012 App G </div> </div> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

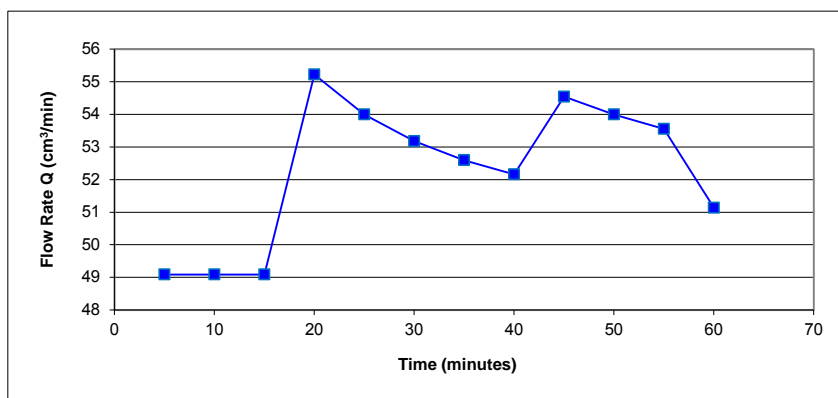
| Test Location | | Test No. | 126 |
|--|-----------------------------------|----------------|-----------|
| Description: | Test Pit 126, 1.0 m below surface | Easting: | 703976 m |
| Material type: | Yellow brown, Clayey Sandy Gravel | Northing | 8628713 m |
| Condition of ground surface before test: | Humid | Surface Level: | - m AHD |
| Weather during test: | Fine and sunny | | |

| Details of Bore Installation | | | | | |
|---|-----|----|----------------------------|---|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 250 | mm | Time from filling to start | 2 | minutes |
| Diameter of hole | 125 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 5 | 20 | 245 | 49 |
| 10 | 40 | 491 | 49 |
| 15 | 60 | 736 | 49 |
| 20 | 90 | 1104 | 55 |
| 25 | 110 | 1350 | 54 |
| 30 | 130 | 1595 | 53 |
| 35 | 150 | 1841 | 53 |
| 40 | 170 | 2086 | 52 |
| 45 | 200 | 2454 | 55 |
| 50 | 220 | 2700 | 54 |
| 55 | 240 | 2945 | 54 |
| 60 | 250 | 3068 | 51 |

Totals 250 3068 51 Overall


Saturated Hydraulic Conductivity - Over total duration of test

$$k = 2.37E-02 \text{ cm/min} \quad \text{where } K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25]} + r/H]/2\pi H^2$$

$$= 3.94E-06 \text{ m/sec} \quad \text{ref. AS1547-2012 App G}$$

$$= 0.34 \text{ m/day}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

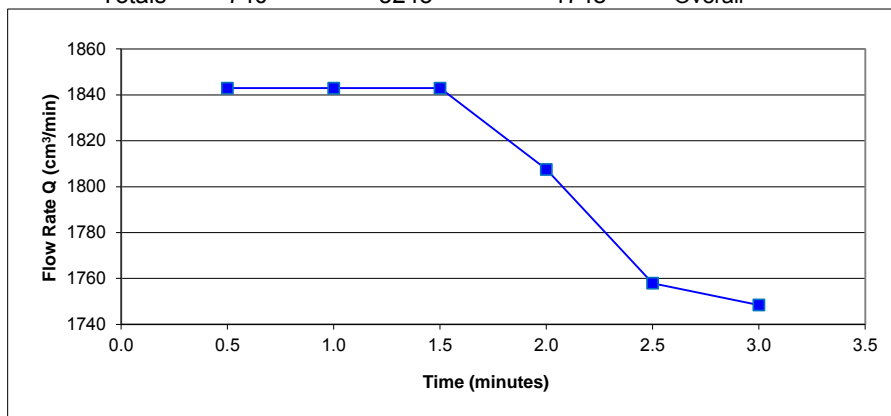
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 137, at surface | 137 |
| Material type: Grey and yellow brown, slightly clayey Sandy Gravel | Easting: 704114 m |
| Condition of ground surface before test: Humid | Northing: 8628611 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| | | |
|---|--------|----------------------------|
| Details of Bore Installation | | |
| Depth of augered hole | 500 mm | Depth to impermeable layer |
| Depth of constant water below permeameter | 360 mm | Time from filling to start |
| Diameter of hole | 95 mm | 0.5 minutes |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 0.5 | 130 | 921 | 1843 |
| 1.0 | 260 | 1843 | 1843 |
| 1.5 | 390 | 2764 | 1843 |
| 2.0 | 510 | 3615 | 1807 |
| 2.5 | 620 | 4395 | 1758 |
| 3.0 | 740 | 5245 | 1748 |
| | | | |
| | | | |

Totals 740 5245 1748 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 6.01\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 1.00\text{E-}04 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 8.65 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|-----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 10-Oct-17 |
| Location: | Marrara, NT | Tested by: | BS |

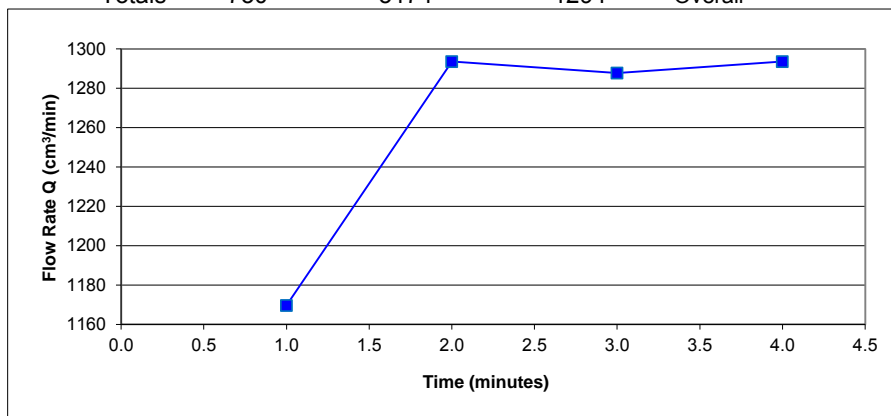
| | |
|--|------------------------|
| Test Location | Test No. |
| Description: Test Pit 137, at surface | 137A |
| Material type: Grey and yellow brown, slightly clayey Sandy Gravel | Easting: 704114 m |
| Condition of ground surface before test: Humid | Northing: 8628611 m |
| Weather during test: Fine and sunny | Surface Level: - m AHD |

| Details of Bore Installation | | | | | |
|---|-----|----|----------------------------|-----|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 360 | mm | Time from filling to start | 0.5 | minutes |
| Diameter of hole | 95 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 1.0 | 165 | 1170 | 1170 |
| 2.0 | 365 | 2587 | 1294 |
| 3.0 | 545 | 3863 | 1288 |
| 4.0 | 730 | 5174 | 1294 |
| | | | |
| | | | |
| | | | |
| | | | |

Totals 730 5174 1294 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 4.45\text{E-}01 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25]} + r/H]/2\pi H^2 \\
 &= 7.41\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 6.40 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

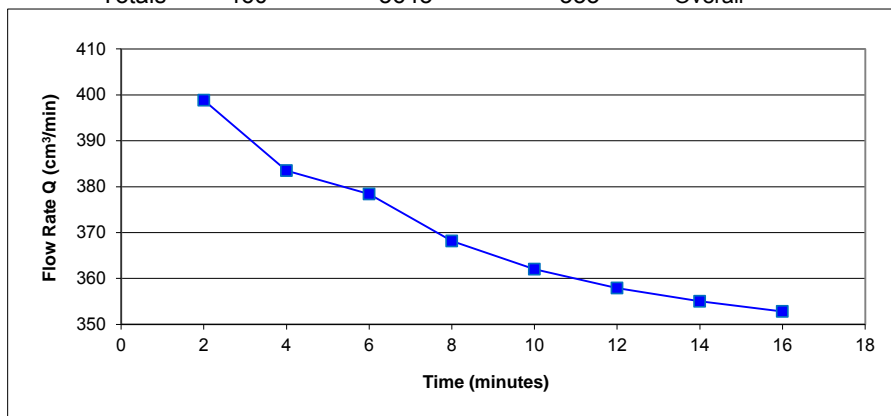
| | | | | |
|--|-------------------------------|-----------------|---------|-------|
| Test Location | | Test No. | 138 | |
| Description: | Test Pit 138, at surface | Easting: | 704248 | m |
| Material type: | Grey brown Silty Sandy Gravel | Northing | 8628472 | m |
| Condition of ground surface before test: | Humid | Surface Level: | - | m AHD |
| Weather during test: | Fine and sunny | | | |

| Details of Bore Installation | | | | | |
|---|-----|----|----------------------------|---|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 350 | mm | Time from filling to start | 2 | minutes |
| Diameter of hole | 125 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 65 | 798 | 399 |
| 4 | 125 | 1534 | 383 |
| 6 | 185 | 2270 | 378 |
| 8 | 240 | 2945 | 368 |
| 10 | 295 | 3620 | 362 |
| 12 | 350 | 4295 | 358 |
| 14 | 405 | 4970 | 355 |
| 16 | 460 | 5645 | 353 |

Totals 460 5645 353 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 1.06\text{E-}01 \quad \text{cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 1.76\text{E-}05 \quad \text{m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 1.52 \quad \text{m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

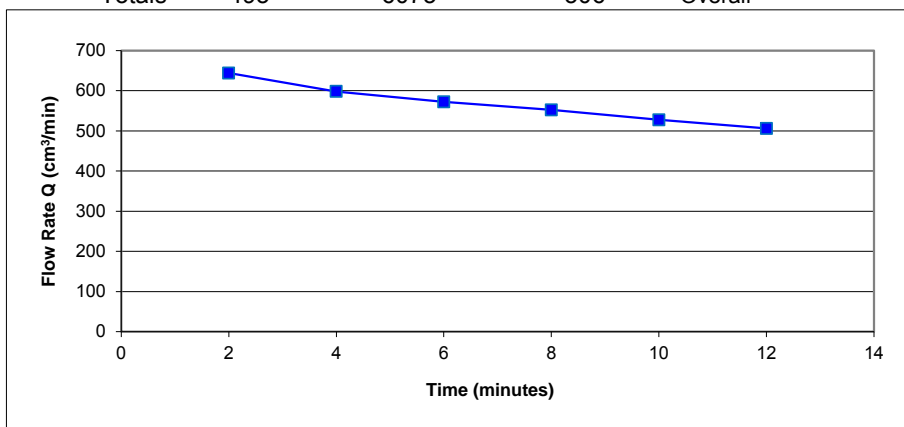
| | | |
|--|-------------------|-------|
| Test Location | Test No. | |
| Description: Test Pit 138, at surface | Easting: 704248 | m |
| Material type: Grey brown Silty Sandy Gravel | Northing: 8628472 | m |
| Condition of ground surface before test: Humid | Surface Level: - | m AHD |
| Weather during test: Fine and sunny | | |

| | | | |
|---|--------|----------------------------|-----------|
| Details of Bore Installation | | | |
| Depth of augered hole | 500 mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 350 mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 105 | 1289 | 644 |
| 4 | 195 | 2393 | 598 |
| 6 | 280 | 3436 | 573 |
| 8 | 360 | 4418 | 552 |
| 10 | 430 | 5277 | 528 |
| 12 | 495 | 6075 | 506 |

Totals 495 6075 506 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$k = 1.52E-01 \text{ cm/min} \quad \text{where } K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$$

$$= 2.53E-05 \text{ m/sec} \quad \text{ref. AS1547-2012 App G}$$

$$= 2.18 \text{ m/day}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

| | | | | |
|--|--------------------------|-----------------|---------|-------|
| Test Location | | Test No. | 142 | |
| Description: | Test Pit 142, at surface | Easting: | 704333 | m |
| Material type: | Grey brown Sandy Silt | Northing | 8628321 | m |
| Condition of ground surface before test: | | Surface Level: | - | m AHD |
| Weather during test: | Fine and sunny | | | |

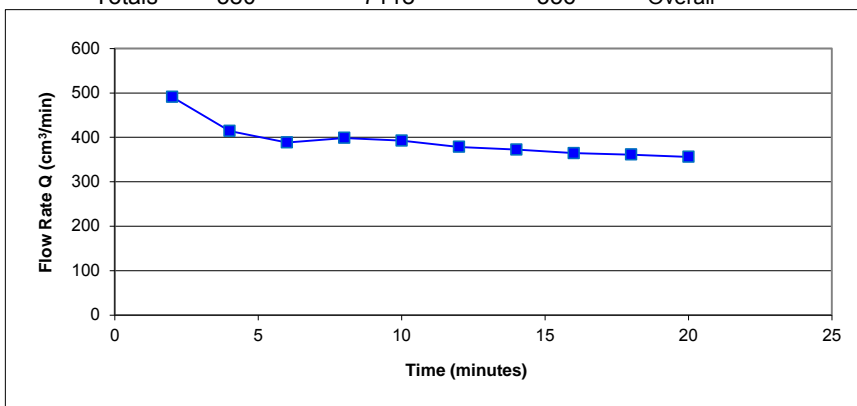
Details of Bore Installation

| | | | | | |
|---|-----|----|----------------------------|---|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 350 | mm | Time from filling to start | 2 | minutes |
| Diameter of hole | 125 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 80 | 982 | 491 |
| 4 | 135 | 1657 | 414 |
| 6 | 190 | 2332 | 389 |
| 8 | 260 | 3191 | 399 |
| 10 | 320 | 3927 | 393 |
| 12 | 370 | 4541 | 378 |
| 14 | 425 | 5216 | 373 |
| 16 | 475 | 5829 | 364 |
| 18 | 530 | 6504 | 361 |
| 20 | 580 | 7118 | 356 |

Totals 580 7118 356 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 1.07\text{E-}01 \quad \text{cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{(r/H)^2 + 0.25}] + r/H / 2\pi H^2 \\
 &= 1.78\text{E-}05 \quad \text{m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 1.54 \quad \text{m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

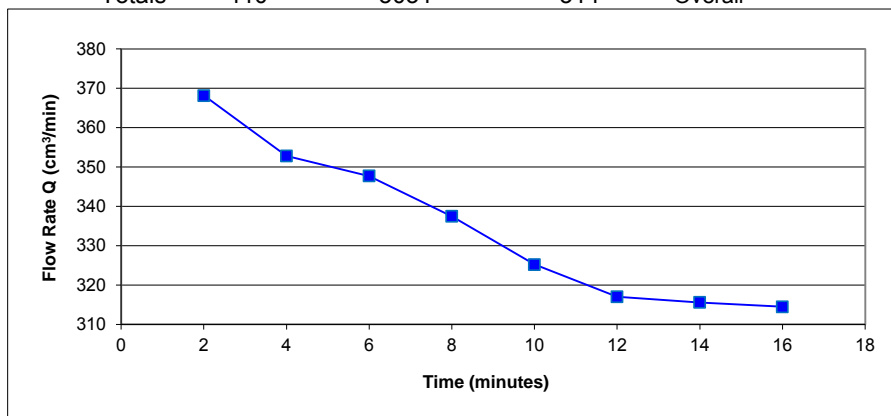
| | | |
|--|-----------------|-----------|
| Test Location | Test No. | 142A |
| Description: Test Pit 142, at surface | Easting: | 704333 m |
| Material type: Grey brown Sandy Silt | Northing | 8628321 m |
| Condition of ground surface before test: Humid | Surface Level: | - m AHD |
| Weather during test: Fine and sunny | | |

| Details of Bore Installation | | | | | |
|---|-----|----|----------------------------|---|---------|
| Depth of augered hole | 500 | mm | Depth to impermeable layer | - | m |
| Depth of constant water below permeameter | 350 | mm | Time from filling to start | 2 | minutes |
| Diameter of hole | 125 | mm | | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 60 | 736 | 368 |
| 4 | 115 | 1411 | 353 |
| 6 | 170 | 2086 | 348 |
| 8 | 220 | 2700 | 337 |
| 10 | 265 | 3252 | 325 |
| 12 | 310 | 3804 | 317 |
| 14 | 360 | 4418 | 316 |
| 16 | 410 | 5031 | 314 |

Totals 410 5031 314 Overall



Saturated Hydraulic Conductivity - Over total duration of test

$$\begin{aligned}
 k &= 9.42\text{E-}02 \text{ cm/min} & \text{where } K &= 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2 \\
 &= 1.57\text{E-}05 \text{ m/sec} & & \text{ref. AS1547-2012 App G} \\
 &= 1.36 \text{ m/day}
 \end{aligned}$$

Constant Head Permeameter Test Report [AS1547:2012 App G]

| | | | |
|-----------|---------------------------------------|-------------|----------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | Proposed Rapid Creek Flood Mitigation | Date: | 8-Sep-17 |
| Location: | Marrara, NT | Tested by: | VH |

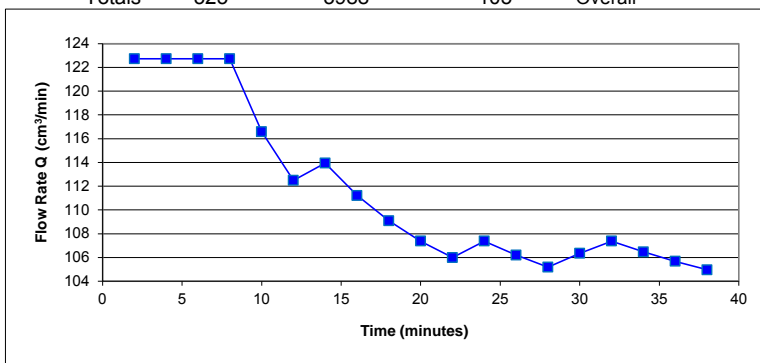
| | | |
|--|-------------------|-------|
| Test Location | Test No. | |
| Description: Test Pit 145, at surface | Easting: 704484 | m |
| Material type: Grey brown Sandy Silt | Northing: 8628219 | m |
| Condition of ground surface before test: Humid | Surface Level: - | m AHD |
| Weather during test: Fine and sunny | | |

| Details of Bore Installation | | | | |
|---|-----|----|----------------------------|-----------|
| Depth of augered hole | 400 | mm | Depth to impermeable layer | - m |
| Depth of constant water below permeameter | 250 | mm | Time from filling to start | 2 minutes |
| Diameter of hole | 125 | mm | | |

Test Results

| Time (minutes) | Level below top (mm) | Flow Volume (cm ³) | Rate of Loss [Q] (cm ³ /min) |
|-------------------|----------------------------|--------------------------------------|---|
| 0 | 0 | 0 | |
| 2 | 20 | 245 | 123 |
| 4 | 40 | 491 | 123 |
| 6 | 60 | 736 | 123 |
| 8 | 80 | 982 | 123 |
| 10 | 95 | 1166 | 117 |
| 12 | 110 | 1350 | 112 |
| 14 | 130 | 1595 | 114 |
| 16 | 145 | 1779 | 111 |
| 18 | 160 | 1963 | 109 |
| 20 | 175 | 2148 | 107 |
| 22 | 190 | 2332 | 106 |
| 24 | 210 | 2577 | 107 |
| 26 | 225 | 2761 | 106 |
| 28 | 240 | 2945 | 105 |
| 30 | 260 | 3191 | 106 |
| 32 | 280 | 3436 | 107 |
| 34 | 295 | 3620 | 106 |
| 36 | 310 | 3804 | 106 |
| 38 | 325 | 3988 | 105 |

Totals 325 3988 105 Overall


Saturated Hydraulic Conductivity - Over total duration of test

$k = 4.85E-02$ cm/min where $K = 4.4Q[0.5 \sinh^{-1}(H/2r) - \sqrt{[(r/H)^2 + 0.25] + r/H}] / 2\pi H^2$
 $= 8.09E-06$ m/sec ref. AS1547-2012 App G
 $= 0.70$ m/day

Appendix B

Laboratory Test Results

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270010 |
| | | Report Date: | 16-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 08-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|---|
| Location: | WR17-528I |
| Depth | 0-0.5(m) |
| Sample Description: | Clayey sandy GRAVEL |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 99% Optimum Moisture Content |
| Placement Dry Density: | 1.98 t/m ³ |
| Placement Moisture Content: | 11.9 % |
| Final Moisture Content: | 14.4 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 7 |
| Coefficient of Permeability: | 2x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Peter Chan
Associate



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

| |
|-------------|
| Tested: CP |
| Checked: AG |

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270011 |
| | | Report Date: | 16-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 08-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528J |
| Depth | 0.4-0.9(m) |
| Sample Description: | Clayey sandy GRAVEL |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 100% Optimum Moisture Content |
| Placement Dry Density: | 1.89 t/m ³ |
| Placement Moisture Content: | 15.4 % |
| Final Moisture Content: | 16.4 % |
| Maximum Hydraulic Gradient: | 8 |
| Minimum Hydraulic Gradient: | 8 |
| Coefficient of Permeability: | 2x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Peter Chan
Associate



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

| |
|-------------|
| Tested: CP |
| Checked: AG |

Results of Falling Head Permeability Test

| | | | |
|------------------|--|----------------------|--------------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270012 |
| | | Report Date: | 16-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 08-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|---|
| Location: | WR17-528K |
| Depth | 0.1-0.4(m) |
| Sample Description: | Sandy CLAY |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 1.84 t/m ³ |
| Placement Moisture Content: | 17.7 % |
| Final Moisture Content: | 18.9 % |
| Maximum Hydraulic Gradient: | 7 |
| Minimum Hydraulic Gradient: | 6 |
| Coefficient of Permeability: | 2x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Peter Chan
Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|--|----------------------|--------------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270009 |
| | | Report Date: | 09-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 03-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528H |
| Depth | 0.9-1.9(m) |
| Sample Description: | Sandy CLAY |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 1.80 t/m ³ |
| Placement Moisture Content: | 17.1 % |
| Final Moisture Content: | 20.1 % |
| Maximum Hydraulic Gradient: | 8 |
| Minimum Hydraulic Gradient: | 7 |
| Coefficient of Permeability: | 2x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Samp[led by Engineering Department

Remarks:

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270013 |
| | | Report Date: | 16-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 08-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|-------------------------------------|--|
| Location: | WR17-528L |
| Depth | 0.1-0.3(m) |
| Sample Description: | Sandy GRAVEL |
| Sample Preparation: | Remoulded to 100% Standard Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 2.25 t/m ³ |
| Placement Moisture Content: | 9.1 % |
| Final Moisture Content: | 12.1 % |
| Maximum Hydraulic Gradient: | 8 |
| Minimum Hydraulic Gradient: | 2 |
| Coefficient of Permeability: | 3x10⁻⁸ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Peter Chan
Associate



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

| |
|-------------|
| Tested: CP |
| Checked: AG |

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270003 |
| | | Report Date: | 08-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 31-Oct-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528B |
| Depth | 0.1-0.4 |
| Sample Description: | Sandy clayey GRAVEL |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 99% Optimum Moisture Content |
| Placement Dry Density: | 2.30 t/m ³ |
| Placement Moisture Content: | 7.5 % |
| Final Moisture Content: | 8.8 % |
| Maximum Hydraulic Gradient: | 8 |
| Minimum Hydraulic Gradient: | 6 |
| Coefficient of Permeability: | 5x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Andrew Murphy
Senior Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270004 |
| | | Report Date: | 08-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 31-Oct-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528C |
| Depth | 0.3-0.6 |
| Sample Description: | Gravelly sandy calyey SILT |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 100% Optimum Moisture Content |
| Placement Dry Density: | 1.87 t/m ³ |
| Placement Moisture Content: | 15.0 % |
| Final Moisture Content: | 17.8 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 8 |
| Coefficient of Permeability: | 3x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Andrew Murphy
Senior Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270002 |
| | | Report Date: | 08-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 31-Oct-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528A |
| Depth | 0.8-1.4(m) |
| Sample Description: | Clayey sandy GRAVEL |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 1.99 t/m ³ |
| Placement Moisture Content: | 12.6 % |
| Final Moisture Content: | 16.1 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 4 |
| Coefficient of Permeability: | 2x10 ⁻⁹ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Andrew Murphy
Senior Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|--|----------------------|--------------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270008 |
| | | Report Date: | 09-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 03-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528G |
| Depth | 0.3-0.6(m) |
| Sample Description: | Sandy clayey GRAVEL |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 2.20 t/m ³ |
| Placement Moisture Content: | 9.6 % |
| Final Moisture Content: | 11.2 % |
| Maximum Hydraulic Gradient: | 8 |
| Minimum Hydraulic Gradient: | 3 |
| Coefficient of Permeability: | 1x10 ⁻⁹ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:

Results of Falling Head Permeability Test

| | | | |
|------------------|--|----------------------|--------------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270005 |
| | | Report Date: | 08-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 31-Oct-0217 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|---|
| Location: | WR17-528D |
| Depth | 0.1-0.8 |
| Sample Description: | Gravelly CLAY |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 99% Optimum Moisture Content |
| Placement Dry Density: | 1.85 t/m ³ |
| Placement Moisture Content: | 15.4 % |
| Final Moisture Content: | 16.8 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 5 |
| Coefficient of Permeability: | 4x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:

A. R. Murphy
 Andrew Murphy
 Senior Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|---|----------------------|-------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270006 |
| | | Report Date: | 08-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 31-Oct-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|---|
| Location: | WR17-528E |
| Depth | 0.3-1.0 |
| Sample Description: | Sandy CLAY |
| Sample Preparation: | Remoulded to 100% Modified Maximum Dry Density @ 99% Optimum Moisture Content |
| Placement Dry Density: | 1.94 t/m ³ |
| Placement Moisture Content: | 11.4 % |
| Final Moisture Content: | 14.9 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 5 |
| Coefficient of Permeability: | 4x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, AS 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:

A. A. Murphy
 Andrew Murphy
 Senior Associate

Results of Falling Head Permeability Test

| | | | |
|------------------|--|----------------------|--------------------|
| Client: | Jacobs Group (Australia) Pty Ltd | Project No: | 78245.02 |
| Project: | MARRARA Flood Mitigation Additional Geo | Report No: | M17270007 |
| | | Report Date: | 16-Nov-2017 |
| Location: | Cnr Henry Wrigley DrV & McMillans Rd, MARRARA | Date Sampled: | - |
| | | Date of Test: | 03-Nov-2017 |
| | | Page: | 1 of 1 |

| | |
|------------------------------|--|
| Location: | WR17-528F/B |
| Depth | 0.3-1.2(m) |
| Sample Description: | Sandy clayey SILT |
| Sample Preparation: | Remoulded to 98% Modified Maximum Dry Density @ 101% Optimum Moisture Content |
| Placement Dry Density: | 1.55 t/m ³ |
| Placement Moisture Content: | 11.6 % |
| Final Moisture Content: | 13.2 % |
| Maximum Hydraulic Gradient: | 9 |
| Minimum Hydraulic Gradient: | 6 |
| Coefficient of Permeability: | 2x10 ⁻¹⁰ m/sec |

Test Method(s): AS 1289.6.7.2, as 1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



Peter Chan
Associate

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528A
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 123 (0.8 - 1.4m)
Material: Clayey Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 44 | | |
| Plastic Limit (%) | 18 | | |
| Plasticity Index (%) | 26 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 11.0 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.99 |
| Optimum Moisture Content (%) | 12.5 |
| Oversize Sieve (mm) | 19 |
| Oversize Material (%) | 0 |

Material Test Report



(Signature)

Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528B
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 118 (0.1 - 0.4m)
Material: Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 19 | | |
| Plastic Limit (%) | 12 | | |
| Plasticity Index (%) | 7 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 3.0 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 2.31 |
| Optimum Moisture Content (%) | 7.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan
Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528C
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 122 (0.3 - 0.6m)
Material: Gravelly Sandy Silt

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 48 | | |
| Plastic Limit (%) | 25 | | |
| Plasticity Index (%) | 23 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 10.5 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.87 |
| Optimum Moisture Content (%) | 15.0 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528D
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 140 (0.1 - 0.8m)
Material: Gravelly Clay

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 34 | | |
| Plastic Limit (%) | 17 | | |
| Plasticity Index (%) | 17 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 7.5 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.85 |
| Optimum Moisture Content (%) | 15.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528E
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 142 (0.3 - 1.0m)
Material: Sandy Clay

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 31 | | |
| Plastic Limit (%) | 17 | | |
| Plasticity Index (%) | 14 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 7.0 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.94 |
| Optimum Moisture Content (%) | 11.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



(Signature)

Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528F
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 143 (0.3 - 1.2m)
Material: Sandy Silt

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 28 | | |
| Plastic Limit (%) | 13 | | |
| Plasticity Index (%) | 15 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 6.5 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.59 |
| Optimum Moisture Content (%) | 11.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



(Signature)

Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528G
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 124 (0.3 - 0.6m)
Material: Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 25 | | |
| Plastic Limit (%) | 15 | | |
| Plasticity Index (%) | 10 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 4.5 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 2.20 |
| Optimum Moisture Content (%) | 9.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528H
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 108 (0.9 - 1.9m)
Material: Sandy Clay

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 42 | | |
| Plastic Limit (%) | 16 | | |
| Plasticity Index (%) | 26 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|------|-----|-----|
| Linear Shrinkage (%) | 7.0 | | |
| Cracking Crumbling Curling | None | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.80 |
| Optimum Moisture Content (%) | 17.0 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528I
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 101 (0 - 0.5m)
Material: Filling - Clayey Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 30 | | |
| Plastic Limit (%) | 17 | | |
| Plasticity Index (%) | 13 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|------|-----|-----|
| Linear Shrinkage (%) | 5.5 | | |
| Cracking Crumbling Curling | None | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.98 |
| Optimum Moisture Content (%) | 12.0 |
| Oversize Sieve (mm) | 19 |
| Oversize Material (%) | 0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528J
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 103 (0.4 - 0.9m)
Material: Filling - Clayey Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 44 | | |
| Plastic Limit (%) | 19 | | |
| Plasticity Index (%) | 25 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 6.0 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.89 |
| Optimum Moisture Content (%) | 15.5 |
| Oversize Sieve (mm) | 19.0 |
| Oversize Material (%) | 0.0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528K
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 103 (0.1 -0.4m)
Material: Filling - Sandy Clay

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 40 | | |
| Plastic Limit (%) | 17 | | |
| Plasticity Index (%) | 23 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|------|-----|-----|
| Linear Shrinkage (%) | 7.5 | | |
| Cracking Crumbling Curling | None | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 1.84 |
| Optimum Moisture Content (%) | 17.5 |
| Oversize Sieve (mm) | 19 |
| Oversize Material (%) | 0 |

Material Test Report



Approved Signatory: Clare Whelan

Lab Manager

NATA Accredited Laboratory Number: 828

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Sample Number: 17-528L
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Sample Location: 116 (0.1 - 0.3m)
Material: Sandy Gravel

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|--|-----------|-----|-----|
| Preparation Method | Dry Sieve | | |
| Sample History | Air Dried | | |
| Liquid Limit (%) | 15 | | |
| Plastic Limit (%) | 12 | | |
| Plasticity Index (%) | 3 | | |

| Linear Shrinkage (AS1289 3.4.1) | | Min | Max |
|---------------------------------|----------|-----|-----|
| Linear Shrinkage (%) | 1.0 | | |
| Cracking Crumbling Curling | Cracking | | |

| Dry Density - Moisture Relationship (AS 1289 5.2.1 & 2.1.1) | |
|---|-----------------|
| Mould Type | 1 LITRE MOULD A |
| Compaction | Modified |
| No. Layers | 5 |
| No. Blows / Layer | 25 |
| Maximum Dry Density (t/m ³) | 2.25 |
| Optimum Moisture Content (%) | 9.0 |
| Oversize Sieve (mm) | 19 |
| Oversize Material (%) | 0 |

Material Test Report

Report Number: 78245.02-1
Issue Number: 1
Date Issued: 09/11/2017
Client: Jacobs Group (Australia) Pty Ltd
452 Flinders Street, Melbourne VIC 3000
Project Number: 78245.02
Project Name: Proposed Rapid Creek Flood Mitigation Additional Geotechnical Investigation
Project Location: Cnr Henry Wrigley Drive & McMillans Road, MARRARA
Work Request: 528
Date Sampled: 05/09/2017
Sampling Method: Sampled by Engineering Department
Material: Various Update



Approved Signatory: Clare Whelan
Lab Manager

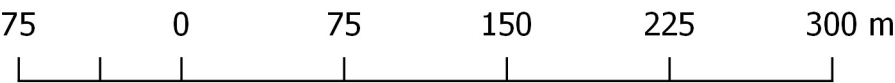
NATA Accredited Laboratory Number: 828

Moisture Content AS 1289 2.1.1

| Sample Number | Sample Location | Moisture Content | Material |
|---------------|------------------|------------------|-------------------------------|
| 17-528A | 123 (0.8 - 1.4m) | 12.1 % | Clayey Sandy Gravel |
| 17-528B | 118 (0.1 - 0.4m) | 4.9 % | Sandy Gravel |
| 17-528C | 122 (0.3 - 0.6m) | 12.0 % | Gravelly Sandy Silt |
| 17-528D | 140 (0.1 - 0.8m) | 10.8 % | Gravelly Clay |
| 17-528E | 142 (0.3 - 1.0m) | 12.5 % | Sandy Clay |
| 17-528F | 143 (0.3 - 1.2m) | 9.7 % | Sandy Silt |
| 17-528G | 124 (0.3 - 0.6m) | 5.7 % | Sandy Gravel |
| 17-528H | 108 (0.9 - 1.9m) | 19.7 % | Sandy Clay |
| 17-528I | 101 (0 - 0.5m) | 8.0 % | Filling - Clayey Sandy Gravel |
| 17-528J | 103 (0.4 - 0.9m) | 12.1 % | Filling - Clayey Sandy Gravel |
| 17-528K | 103 (0.1 - 0.4m) | -7.2 % | Filling - Sandy Clay |
| 17-528L | 116 (0.1 - 0.3m) | 4.7 % | Sandy Gravel |

Appendix C

Drawing 1 – Test Location Plan



Legend

 Approximate Test Pit Locations

| | | | | | |
|--|--|------------------|---|-------------------|---|
|  Douglas Partners <i>Geotechnics • Environment • Groundwater</i> | CLIENT: Jacobs Group (Australia) Pty Ltd | | TITLE: Test Location Plan Proposed Retention Basin Cnr Henry Wrigley Drive & McMillans Road Marrara, NT | PROJECT: 78245.02 |  |
| | OFFICE: Darwin | DRAWN BY: RA | | DRAWING No: 1 | |
| | SCALE: 1 : 3.5k@ A3 | DATE: 10/10/2017 | | REVISION: Rev 0 | |