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Jacobs Group (Australia) Pty Ltd
PO Box 2145
PARAP NT 0820

Project 78245.00
26 April 2016
R.001
JMP:pc

Attention: Mr Christopher Pick

Email: chris.pick@jacobs.com

Dear Sirs

Limited Soil Testing
Flood Mitigation Works
Cnr McMillans Rd and Henry Wrigley Dr, Rapid Creek, NT

1. Introduction

This data report by Douglas Partners Pty Ltd (DP) summarises the results of limited soil testing for flood mitigation works at a site on the corner of McMillians Road and Henry Wrigley Drive, Rapid Creek, NT. The work was requested by Mr Christopher Pick of Jacobs Group Pty Ltd.

DP prepared *Factual Report on Geotechnical Investigation, Proposed Flood Mitigation Works, Rapid Creek, NT* for Jacobs Group (Australia) Pty Ltd dated 29 March 2016.

The objective of the investigation was to comment on the presence of asbestos at the test locations which were specified by the client. The current investigation comprised the excavation and logging of four test pits followed by the collection and analysis of soil samples for asbestos. Details of the field work are given in this report, together with results of laboratory testing. This scope of work was completed following completion of the geotechnical investigation.

2. Scope of Works

The scope of work by DP was as follows:

- Excavation and logging of four test pits to depths of between 1.8 m and 2.4 m below ground level (bgl).
- Collection and analysis of eight soil samples for asbestos identification.

3. Site Location and Description

The proposed development is located about 10 km north east of Darwin and immediately north of the Darwin International Airport on the corner of McMillians Road and Henry Wrigley Drive, Rapid Creek as shown in attached Drawings 1 and 2.

The site is a triangular shaped area of about 9.5 ha. It is bounded by vacant land to the west, McMillians 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.

At the time of the investigation, the site generally sloped to the north at about 2° - 3° and was covered in vegetation comprising thick tall grasses, some shrubs, semi to matured trees and varieties of palm trees.

Reference to a survey plan with spot heights and site contour levels supplied by the client indicates that the site surface levels are typically in the order of RL 9 m AHD to RL 14 m AHD (metres above Australian Height Datum).

The south east corner of the site appeared to be terraced and comprised up to 1 m – 2 m of filling.

4. Field Work and Analysis Rationale

As stated above, four test pits (TP01C to TP04C) were excavated in the central eastern portion of the site. The test locations were specified by the client. The samples which were considered to have the greatest potential of asbestos were selected for analysis.

5. Field Work Results

Test pit logs are attached along with notes on descriptive terms.

Filling was encountered in all of the test pits to depths of between 1.5 m and 1.8 m bgl. No building rubble or anthropogenic materials were encountered in the filling with the exception of an abandoned asbestos pipe which was located in the filling at a depth of 1.0 m bgl in TP03C. The filing was underlain by gravelly clayey sand, sandy silt or clayey sand to depths of between 1.8 m and 2.4 m bgl (test pit termination depths).

6. Analytical Results

The laboratory reports are attached. The laboratory reported that asbestos was not detected at the reporting limit of 0.1 g/kg in any of the samples tested.

Given that building rubble and anthropogenic materials were not encountered in the filling apart from one abandoned asbestos pipe which was encountered in the filling in one of the test pits and that asbestos was not detected at the reporting limit in any of the soil samples tested, the contamination risk at the test locations, in terms of asbestos is considered to be low.

It is noted that the scope of work conducted including the number, location, frequency and testing etc. is considered to be preliminary.

7. Limitations

Douglas Partners (DP) has prepared this report for this project at the corner of McMillans Road and Henry Wrigley Drive, Rapid Creek, NT in accordance with DP's proposal dated 18 November 2015 and acceptance received from Ms Erika Crowley of Jacobs Group (Australia) Pty Ltd dated 18 November 2015. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Jacobs Group (Australia) Pty Ltd 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.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

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 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 environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Reviewed by

Jessica Paulsen
Environmental Scientist

Paul Gorman
Senior Associate

Attachments:
About this Report
Drawings 1 and 2
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Test Pit Logs
Laboratory Test 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.

Copyright

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

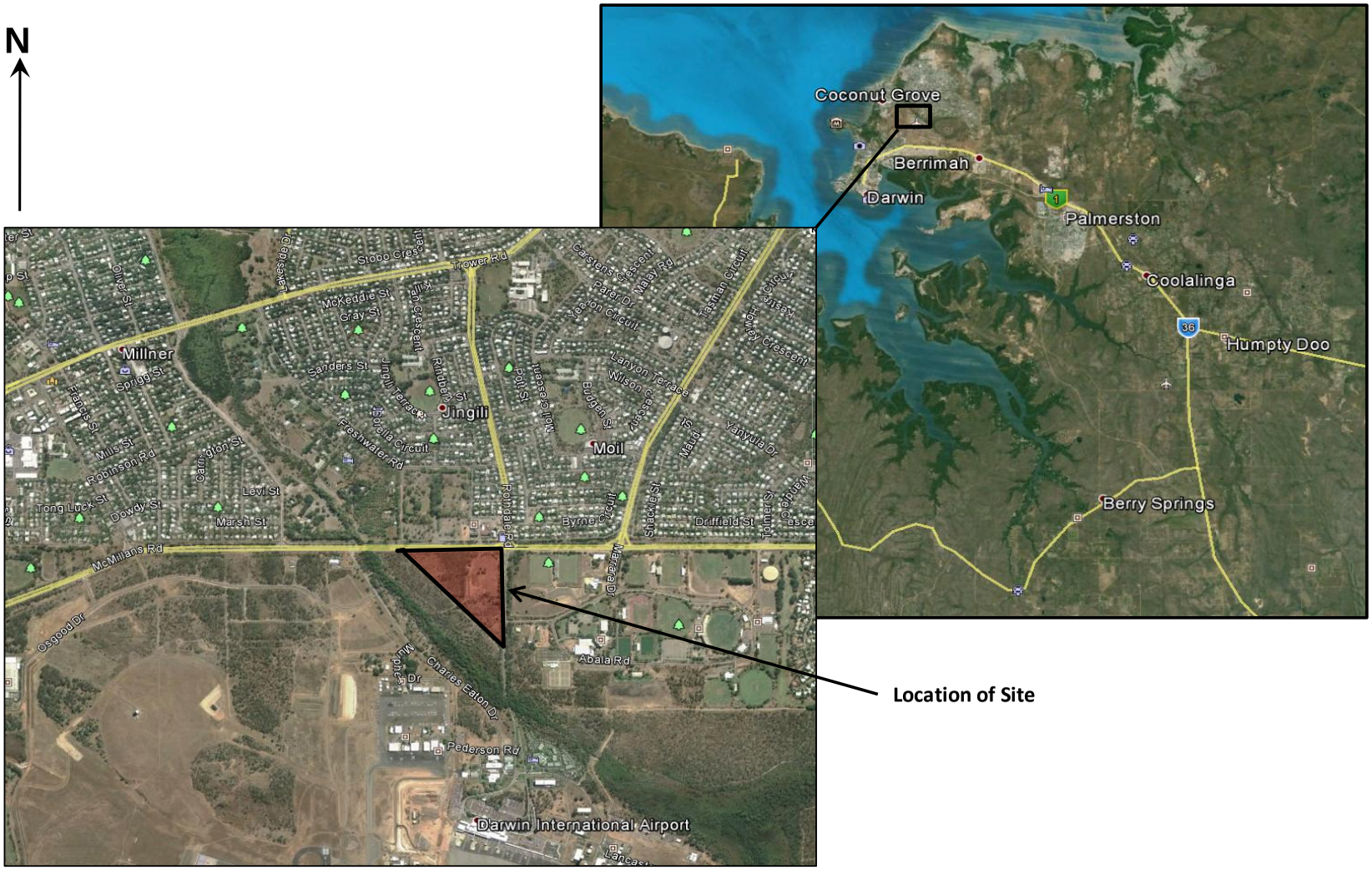
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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



Douglas Partners Geotechnics / Environment / Groundwater	Project No. 78245.00	Site Location Plan	Drawing No. 1
	Date: 27 Jan 2016	Flood Mitigation Works Client: Jacobs Group (Australia) Pty Ltd	

703600 703800 704000 704200 704400 704600

8629000 8628800 8628600

TP01 TP02 TP03 TP04 TP05 TP06 TP07 TP08 TP09 TP01C TP02C TP03C TP04C

50 0 50 100 150 200 m

Background Imagery from NEARMAPS

Legend

- Approximate Test Location
- Soakaway Test Location
- Lot Boundary

Douglas Partners
Geotechnics · Environment · Groundwater

CLIENT: Jacobs Group (Australia) Pty Ltd	
OFFICE: Darwin	DRAWN BY: PO
SCALE: 1 : 3000 @ A3	DATE: 29/03/2016

TITLE: TEST LOCATION PLAN
Proposed Flood Mitigation Works
Corner of McMillans Road & Henry Wrigley Drive
Northern Territory

N

PROJECT: 78245.00
DRAWING No: 2
REVISION: Rev0

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 into 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

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.

Soil Descriptions

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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, 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.

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

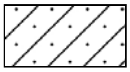
Soils


Topsoil

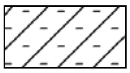

Peat


Clay

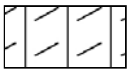

Silty clay

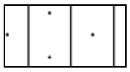

Sandy clay

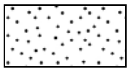

Gravelly clay

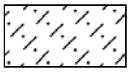

Shaly clay

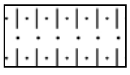

Silt


Clayey silt


Sandy silt

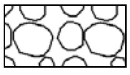

Sand

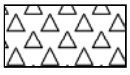

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

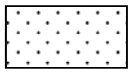

Talus

Sedimentary Rocks

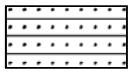

Boulder conglomerate

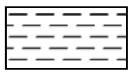

Conglomerate


Conglomeratic sandstone

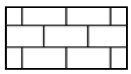

Sandstone


Siltstone


Laminite

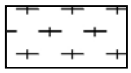

Mudstone, claystone, shale

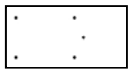

Coal


Limestone

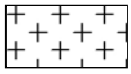
Metamorphic Rocks

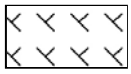

Slate, phyllite, schist

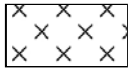

Gneiss

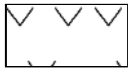

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: Jacobs Group Pty Ltd
PROJECT: Flood Mitigation Works
LOCATION: Corner of McMillans Road and Henry Wrigley Drive, Rapid Creek, NT

SURFACE LEVEL: 13.75 AHD
EASTING: 704034
NORTHING: 8628815

PIT No: TP01C
PROJECT No: 78245.00
DATE: 17/3/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
13	0.2	FILLING: variably compacted, grey brown and brown, slightly silty sandy gravel filling, fine to coarse angular to sub-angular gravel, fine to coarse grained sand, some cobbles to 100 mm, damp							
		FILLING: variably compacted, brown and orange brown with grey brown, off-white and red brown streaks, clayey gravelly sand filling, fine to coarse sub-rounded to sub-angular gravel, fine to coarse grained sand, damp		E	0.3				
				E	0.6				
		...clayey sand zones at 0.8 m							
	1			E	1.0				1
12	1.6	GRAVELLY CLAYEY SAND: weakly cemented, red brown and orange brown, gravelly clayey sand, fine sub-rounded to rounded gravel, fine to medium grained sand, damp							
	2 2.0	Pit discontinued at 2.0m , near refusal							2
11	3								3
10									

RIG: Hitachi 5 tonne excavator with 450 mm rock toothed bucket

LOGGED: B.S

SURVEY DATUM: WGS84 Zone 52

WATER OBSERVATIONS: Groundwater not 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_x	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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group Pty Ltd
PROJECT: Flood Mitigation Works
LOCATION: Corner of McMillans Road and Henry Wrigley Drive, Rapid Creek, NT

SURFACE LEVEL: 14.25 AHD
EASTING: 704033
NORTHING: 8628853

PIT No: TP02C
PROJECT No: 78245.00
DATE: 17/3/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
14	0	FILLING: variably compacted, orange brown and brown with off-white and grey brown streaks, clayey gravelly sand filling, fine to coarse sub-rounded to sub-angular gravel, fine to coarse grained sand, some cobbles to 100 mm, damp to moist		E	0.3				
				E	0.7				
13	1	....silty clay zones at 1.0 m		E	1.2				
	1.5	SANDY SILT: firm, grey brown, slightly gravelly sandy silt, fine to medium sub-rounded gravel, fine to medium grained sand, moist, possible filling ....becoming stiff from 1.6 m		E	2.0				
12	2								
	2.4	Pit discontinued at 2.4m , limit of invesigation							
11	3								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Hitachi 5 tonne excavator with 450 mm rock toothed bucket

LOGGED: B.S

SURVEY DATUM: WGS84 Zone 52

WATER OBSERVATIONS: Groundwater not 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_x	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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group Pty Ltd
PROJECT: Flood Mitigation Works
LOCATION: Corner of McMillans Road and Henry Wrigley Drive, Rapid Creek, NT

SURFACE LEVEL: 13.5 AHD
EASTING: 704144
NORTHING: 8628821

PIT No: TP03C
PROJECT No: 78245.00
DATE: 17/3/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
13	0.0	FILLING: variably compacted, brown, clayey gravelly sand filling, fine to medium sub-rounded to sub-angular gravel, fine to coarse grained sand, moist		E	0.3				
	0.6	FILLING: variably compacted, yellow brown, gravelly sandy clay filling, fine to medium sub-rounded to sub-angular gravel, moist		E	0.7				
12	1.0	FILLING: variably compacted, brown and orange brown, clayey gravelly sand filling, fine to coarse sub-rounded to sub-angular gravel, fine to coarse grained sand, damp		E	1.0		Pipe encountered at 1.0 m		
				E	1.3				
	1.7	CLAYEY SAND: weakly cemented, orange brown, red brown and yellow brown, slightly gravelly clayey sand, fine to medium grained sand, damp							
11	1.8	Pit discontinued at 1.8m , refusal							
10									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: Hitachi 5 tonne excavator with 450 mm rock toothed bucket

LOGGED: B.S

SURVEY DATUM: WGS84 Zone 52

WATER OBSERVATIONS: Groundwater not 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_x	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)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group Pty Ltd
PROJECT: Flood Mitigation Works
LOCATION: Corner of McMillans Road and Henry Wrigley Drive, Rapid Creek, NT

SURFACE LEVEL: 13.5 AHD
EASTING: 704143
NORTHING: 8628853

PIT No: TP04C
PROJECT No: 78245.00
DATE: 17/3/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
13	0.0	FILLING: variably compacted, grey brown and brown, gravelly clayey sand filling, fine to coarse sub-rounded to sub-angular gravel, fine to coarse grained sand, damp		E	0.3				
	0.6	FILLING: variably compacted, yellow brown, slightly gravelly clayey sand filling, fine to medium sub-rounded gravel, fine to medium grained sand, damp		E	0.8				
12	1.2	FILLING: variably compacted, brown, clayey gravelly sand filling, fine to coarse sub-rounded to sub-angular gravel, fine to coarse grained, cobbles to 100 mm, damp		E	1.5				
	1.8	CLAYEY SAND: weakly cemented, orange brown, red brown and yellow brown, slightly gravelly clayey sand, fine to medium grained sand, damp							
11	1.9	Pit discontinued at 1.9m , near refusal							
10									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: Hitachi 5 tonne excavator with 450 mm rock toothed bucket

LOGGED: B.S

SURVEY DATUM: WGS84 Zone 52

WATER OBSERVATIONS: Groundwater not 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_x	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)

Douglas Partners
Geotechnics / Environment / Groundwater

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 144385

Client:
Douglas Partners NT
PO Box 36858
Winnellie
NT 0821

Attention: Michael Harris, Ben Sipos

Sample log in details:

Your Reference:	**78245.00, Rapid Creek Flood MItigation Works**
No. of samples:	8 Sample
Date samples received / completed instructions received	07/04/16 / 07/04/16

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	14/04/16 / 12/04/16
Date of Preliminary Report:	Not Issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

Asbestos ID - soils						
Our Reference:	UNITS	144385-1	144385-2	144385-3	144385-4	144385-5
Your Reference	---------- -	TP01C	TP01C	TP02C	TP02C	TP03C
Depth	----------	0.3	1.0	0.3	0.7	0.3
Date Sampled		17/03/2016	17/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	12/04/2016	12/04/2016	12/04/2016	12/04/2016	12/04/2016
Sample mass tested	g	Approx. 45g	Approx. 60g	Approx. 50g	Approx. 55g	Approx. 65g
Sample Description	-	Brown clayey soils	Brown clayey soils	Brown clayey soils	Brown clayey soils	Brown clayey soils
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils				
Our Reference:	UNITS	144385-6	144385-7	144385-8
Your Reference	---------- -	TP03C	TP04C	TP04C
Depth	----------	1.3	0.8	1.5
Date Sampled		17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil
Date analysed	-	12/04/2016	12/04/2016	12/04/2016
Sample mass tested	g	Approx. 45g	Approx. 70g	Approx. 55g
Sample Description	-	Brown clayey soils	Brown clayey soils	Brown clayey soils
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

Report Comments:

Asbestos ID was analysed by Approved Identifier: Paul Ching
Asbestos ID was authorised by Approved Signatory: Lulu Scott

INS: Insufficient sample for this test
NR: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 42 43 44

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph 02 9910 6200 / sydney@envirolab.com.au
Perth Lab - MPL Laboratories
16-18 Hayden Crt Myaree, WA 6154
Ph 08 9317 2505 / lab@mpl.com.au
Melbourne Lab - Envirolab Services
1A Dalmore Drive Scoresby VIC 3179
Ph 03 9763 2500 / melbourne@envirolab.com.au
Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
Ph 07 3266 9532 / brisbane@envirolab.com.au
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7a The Parade, Norwood, SA 5067
Ph 0406 350 706 / adelaide@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT, 0820
Ph 0477 012 027 / darwin@envirolab.com.au

Client: Douglas Partners - Darwin
Contact Person: Ben Sipos
Project Mgr: Michael Harris
Sampler: Ben Sipos
Address: Unit 2, 14 Caryota Ct, Coconut Grove, 0810
Phone: 08 8948 6800 **Mob:** 0428986577
Email: Ben.Sipos@douglaspartners.com.au
sharsnell@envirolab.com.au

Client Project Name / Number / Site etc (ie report title): 78245.00 Rapid Creek Flood Mitigation Works
PO No.:
Envirolab Quote No. : C5 National
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
Note: Inform lab in advance if urgent turnaround is required - surcharges apply
Report format: esdat / equis /
Lab Comments:

Sample information					Tests Required														Comments
Envirolab Sample ID	Client Sample ID or information	Depth (m)	Date sampled	Type of sample	Asbestos in Soil														Provide as much information about the sample as you can
143705	TP03C D=1.0 m	1	17-3-16	Bag	1	- Sample already at lab. Previously tested for asbestos													
144385-1	TP01C D=0.3 m	0.3	17-3-16	Bag	1														Refer to 143705
2	TP01C D=1.0 m	1	17-3-16	Bag	1														
3	TP02C D=0.3 m	0.3	17-3-16	Bag	1														
4	TP02C D=0.7 m	0.7	17-3-16	Bag	1														
5	TP03C D=0.3 m	0.3	17-3-16	Bag	1														
6	TP03C D=1.3 m	1.3	17-3-16	Bag	1														
7	TP04C D=0.8 m	0.8	17-3-16	Bag	1														
8	TP04C D=1.5 m	1.5	17-3-16	Bag	1														

Envirolab Services
12 Ashley St, Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 144385
Date Received: 07042016
Time Received: 1100
Received by: CB
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Broken/None

Relinquished by (Company): Douglas Partners
Print Name: Ben sipos
Date & Time: ~~31-3-2016~~ 5/4/16.
Signature:

Received by (Company): ELS.
Print Name: Calum Bonser.
Date & Time: 07042016 1100
Signature: CB.

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book