Douglas PARTNERS | GROUNDED EXPERTISE

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Project 227295.00
20 September 2024
R.003.Rev0
JCL:co

Report on Infiltration Testing
Proposed Residential Development
5-7 Church & 42 Donald Street, Nelson Bay NSW

1. Introduction

This report prepared by Douglas Partners Pty Ltd (Douglas) presents the results of infiltration testing undertaken for a proposed residential development at 5-7 Church & 42 Donald Street, Nelson Bay NSW (the site). The investigation was commissioned by email instructing to proceed dated 10 September 2024 from Roberto Giammaria of Fortezza Group Pty Ltd and was undertaken in line with Douglas' proposal 227295.00.P.002.Rev1 dated 10 September 2024.

It is understood that the proposed residential development, named "The Belvedere", will comprise of the construction of a ten-storey residential apartment building with up to 8 m of excavation anticipated in the western two thirds of the site for a two-level basement car park. The site is shown on Drawing 1, Appendix A.

The objective of this report is to present the results of infiltration testing to assist with design of stormwater management at the site.

The investigation included four double ring infiltration tests (DRI) completed at the surface and one DRI test in the base of the pit excavated at a depth of 0.5 m below the surface and analysis of the data. The results of the investigation are included in this report.

The investigation was conducted with reference to Port Stephens Council (PSC) *Soil Infiltration Technical Information Sheet* (PSC, 2019).

2. Site information

Site address	5-7 Church & 42 Donald Street, Nelson Bay NSW
Legal description	Lot A, B DP 417172 and 15 DP 5616
Approximate area	2200 m^2
Zoning	Medium density residential (R3) and Local centre (E1)
Local council area	Port Stephens Council (PSC)
Current use	Residential and commercial (hairdresser)
Surrounding uses	North – Residential (apartments) East – Commercial (clothing shop) South – Residential (house/apartments) West – School (Tomaree community college)
Geology	Reference to NSW Seamless Geology mapping indicates the site is underlain by Pleistocene to quaternary aged coastal deposits which typically comprise sand. Reference to the NSW NCCA Quaternary Geology mapping indicates the site is underlain by Pleistocene aged bedrock-mantling dune comprising marine sand and indurated sand which is indicated to have low pyrite, organic and carbonate content and low to moderate heavy mineral content, no shell.
Soil Landscape	Reference to NSW Soil Landscapes of Central NSW index indicates the site is underlain by soils typical of the Fingal Head soil landscape which typically comprises gently undulating rises to rolling low hills comprised of high-level dunes and sand sheets mantling bedrock. Typical limitations of this soil landscape include localised shallow soils, widespread poor moisture availability, widespread non-cohesive soils, localised steep slopes, localised mass movement hazard, localised foundation hazard, widespread recharge zone, widespread wind erosion hazard.
PSC Hydrologic Soil Group Mapping	Reference to PSC Hydrologic Soil Group Mapping (map HSG_005C) indicates the soils at the site are 'Group A' which is described as: soils having high infiltration rates, even when thoroughly wetted and consisting chiefly of deep, well to excessively-drained sands or gravels.

3. Site description

The north western area of the site (5 Church Street) is occupied by a single storey residential dwelling with a separate garage on the northern site boundary with grassed backyard. The southwestern area of the site (7 Church Street) is grassed. The southeastern area of the site is occupied by a commercial building.

The site slopes down to the south-east, with surface levels at the field test locations ranging from RL 19.9 (AHD) to RL 25.0.

4. Field Work

4.1 Methods

Field work was undertaken on 12 and 13 September 2024 and comprised the following:

- Four DRI tests at surface locations (DRI 101 to 104);
- Excavation of one test pit at DRI 102 using hand tools to a depth of 0.5 m;
- DRI at test pit location (DRI 102 / 0.5);
- Four boreholes (Bores 101 to 104) to depths of between 1.0 m and 1.5 m using hand tools following each DRI test;
- Logging and sampling by a geo-environmental engineer from Douglas.

The test locations were set out by geotechnical engineer taking into consideration the existing services on site and within accessible areas. The engineer also logged the subsurface profiles in the bores and collected representative samples for identification purposes.

The tested / drilled locations were recorded using a differential GPS, which is typically accurate to ±0.1 m, depending on satellite coverage and site condition. The approximate location (GDA2020 Zone 56) and elevation (AHD) of the tests are shown on the attached borehole logs. It is important to note that Douglas is not a registered surveyor, hence the locations and elevations are approximate only.

4.2 Results – Bores

The subsurface conditions encountered in the bores are shown in detail in the borehole logs attached. Subsurface conditions at the bore comprised:

FILL / silty SAND: at Bores101 to 103 only, generally comprising grey silty sand fill, trace rootlets to depths between 0.05 m and 0.20 m. Trace tile fragments were observed at Bore 101 and trace tile, plastic, PVC, metal and fibro fragments were observed at Bore 103.

FILL / sandy GRAVEL: at Bore 104 only, generally comprising brown sandy gravel trace rootlets and coal to a depth of 0.1 m.

Silty SAND: grey, fine to medium grained, to depths between 0.4 m to 0.5 m; underlain by

SAND: pale brown, fine to medium grained, to termination depths between 1.0 m to 1.5 m.

Groundwater was not encountered during drilling. It should be noted that groundwater levels are affected by factors such as climatic conditions and hydraulic conductivity and therefore vary with time.

Previous geotechnical investigation completed by Douglas included the five cone penetration tests and drilling of five bores (Douglas, 2024). This investigation indicated sand at the site extends to at least 14 m depth, with the absence of groundwater in CPTs to 10 m (limit of measurement) and in bores to 6 m (limit of investigation) (Douglas, 2024).

4.3 Results – Double Ring Infiltrometer (DRI) Tests

DRI testing was conducted with reference to ASTM D3385-18 *Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer* (ASTM D3385-18, 2018) as per PSC *Soil Infiltration Technical Information Sheet* (PSC, 2019).

The DRI test involves first saturating the proposed test surface with water prior to installation of test equipment. Then installing two open cylinders (300mm diameter and 600mm diameter with a length of 500mm), one inside the other and partially filling the rings with water. Water level within both the rings is kept constant and the volume of liquid consumed to maintain constant head within each ring is measured. The volume infiltrated during timed intervals is converted into an infiltration velocity by dividing by the area of the inner ring / outer annulus. The maximum steady state or average incremental infiltration velocity is equivalent to the steady state infiltration rate (ASTM D3385-18, 2018).

Infiltration rates were relatively consistent across each test indicating that adequate saturation of the subsurface had occurred prior to completing each test and therefore providing an estimated steady state infiltration rate.

Results of DRI testing are shown in detail in the result sheets attached and summarised below in Table 1, with test locations shown in Figure 1 to Figure 4.

Table 1: Summary of Double Ring Infiltrometer Testing

Location	Description	Soil Description	Depth (m)	Estimated steady state infiltration rate	
				cm/hour	mm/hour
101	Between garage and residential dwelling at 5 Church Street	Silty sand (grassed)	0.0	86	860
102	Backyard at 5 Church Street	Silty sand (grassed)	0.0	128	1280
102		Sand	0.5	151	1510
103	Centre of 7 Church Street	Silty sand (grassed)	0.0	95	950
104	Eastern side of building at 42 Donald Street	Sandy gravel (grassed)	0.0	106	1060

Figure 1: DRI 101 location, looking east.

Figure 2: DRI 102 location, looking west.

Figure 3: DRI 103 location, looking west.

Figure 4: DRI 104 location, looking north.

5. Comments

The ability of the subsurface profile on site to accept stormwater, and consequently, the estimated infiltration rates, is influenced by several factors including the following:

- The subsurface profile within the proposed infiltration area; and
- The presence of less permeable layers (e.g. silty sand or indurated sand) within the subsurface profile, such layers may lower the infiltration rate by several orders of magnitude. Comparison between results of DRI102/0.0 m (silty sand topsoil) and DRI102/0.5 m (sand) indicated an approximately 15% increase in infiltration rate between the silty sand topsoil and underlying sand.

The double ring infiltrometer tests conducted at the surface estimated steady state infiltration rates between 860 mm/hr (86 cm/hr) and 1280 mm/hr (128 cm/hr). The double ring infiltrometer conducted in at a depth of 0.5 m estimated a steady state infiltration rate of 1510 mm/hr (151 cm/hr). These levels of infiltration are considered typical the subsurface conditions encountered. The above rates do not take into account the long-term clogging and biofouling of the infiltration system that may occur, which may reduce the above-mentioned rates by an order of magnitude.

ASTM D3385-18 indicates that the DRI test is difficult to use and/or provides unreliable results in soils with a hydraulic conductivity greater than 1 x 10^{-2} cm/s (equivalent infiltration rate of 36 cm/hr) or in soils with a hydraulic conductivity less than 1 x 10^{-5} cm/s (equivalent infiltration rate of 0.04 cm/hr) (ASTM D3385-18, 2018). Whilst Douglas has taken care to make accurate measurements, infiltration rates estimated beyond this range should be treated as approximate only.

Reference to PSC Hydrologic Soil Group Mapping (map HSG_005C) indicates the soils at the site are 'Group A' which is described as "*soils having high infiltration rates, even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels*" which is consistent with subsurface investigation and testing completed to date. Table 3 of PSC *Soil Infiltration Technical Information Sheet* (PSC, 2019) indicates soils of 'Group A' require a minimum of 2 m clearance of infiltration systems from structures and property boundaries.

6. References

ASTM D3385-18. (2018). *Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer* . 1 March 2018: American Society for Testing and Materials.

Douglas. (2024). *Report on Preliminary Geotechnical Investigation, Proposed Residential Developmet, 5-7 Church Street & 42 Donald Street, Nelson Bay NSW.* Douglas Partners Pty Ltd: Document No. 227295.00.R.002.Rev0.

PSC. (2019). *Soil Infiltration, Technical Information Sheet.* Rev 3 dated May 2019: Port Stephens Council.

7. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for proposed residential development at 5-7 Church & 42 Donald Street, Nelson Bay NSW in line with Douglas' proposal 227295.00.P.002.Rev1 dated 10 September 2024 and acceptance received from Roberto Giammaria of Fortezza Group Pty Ltd dated 10 September 2024. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of Fortezza Group 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 Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas 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 Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas 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.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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. Douglas 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 Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

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

Yours faithfully
Douglas Partners Pty Ltd

Jason Lambert
Geotechnical Engineer

Reviewed by

Scott McFarlane
Principal

Attachments:

About this Report

Terminology, Symbols and Abbreviations

Soil Descriptions

Sampling, Testing and Excavation Methodology

Borehole Log (101 to 104)

Double Ring Infiltrometer Results

Drawing 1: Test Location Plan

About this Report

November 2023

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.

continued next page

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.

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Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style XW. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	KL
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	UK
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	ND
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	NA

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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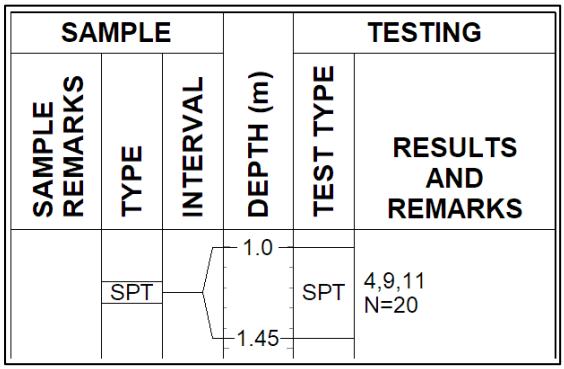
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

March 2024

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =x blows for y mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

Douglas PARTNERS

BOREHOLE LOG

CLIENT: Fortezza Group Pty Ltd
PROJECT: Proposed Development - The Belvedere
LOCATION: 5-7 Church & 42 Donald Street, Nelson Bay, NSW

SURFACE LEVEL: 25.0 AHD
COORDINATE: E:419555.9, N:6379291.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 101
PROJECT No: 227295.00
DATE: 12/09/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
12/09/24 No free groundwater observed		FILL / Silty SAND: grey; fine to medium; trace tile, rootlets .		FILL	NA	M						
	0.10	Silty SAND: grey; fine to medium.		AEO	NA	M						
	0.40	SAND: brown; fine to medium.		AEO	NA	M						
	24 1	Borehole discontinued at 1.00m depth. Limit of investigation.										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD: Hand Auger to 1.0m
REMARKS:

OPERATOR:

LOGGED: Lambert
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: Fortezza Group Pty Ltd
PROJECT: Proposed Development - The Belvedere
LOCATION: 5-7 Church & 42 Donald Street, Nelson Bay, NSW

SURFACE LEVEL: 22.4 AHD
COORDINATE: E:419585.7, N:6379283.1
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 102
PROJECT No: 227295.00
DATE: 12/09/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		0.05	FILL / Silty SAND: grey; fine to medium; trace rootlets.		FILL	NA	M						
			Silty SAND: grey; fine to medium.		AEO	NA	M						
	22	0.40	SAND: brown; fine to medium.		AEO	NA	M				1		
		1											
	21		Borehole discontinued at 1.50m depth. Limit of investigation.										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD: Hand Auger to1.5m
REMARKS:

OPERATOR:

LOGGED: Lambert
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: Fortezza Group Pty Ltd
PROJECT: Proposed Development - The Belvedere
LOCATION: 5-7 Church & 42 Donald Street, Nelson Bay, NSW

SURFACE LEVEL: 24.4 AHD
COORDINATE: E:419552.5, N:6379266.9
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 103
PROJECT No: 227295.00
DATE: 13/09/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	24	FILL / Silty SAND: grey; fine to medium; trace rootlets, tile, PVC pipe, plastic, metal. 0.15m: fibro fragment		FILL	NA	M						
	0.20	Silty SAND: grey; fine to medium.		AEO	NA	M						
	0.50	SAND: brown; fine to medium.		AEO	NA	M						
	1 / 23	Borehole discontinued at 1.00m depth. Limit of investigation.										

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD: Hand Auger to 1.0m
REMARKS:

OPERATOR:

LOGGED: Lambert
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: Fortezza Group Pty Ltd
PROJECT: Proposed Development - The Belvedere
LOCATION: 5-7 Church & 42 Donald Street, Nelson Bay, NSW

SURFACE LEVEL: 19.9 AHD
COORDINATE: E:419593.3, N:6379260.8
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 104
PROJECT No: 227295.00
DATE: 13/09/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(^) / DENSITY.(^)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.10	FILL / Sandy GRAVEL, with silt: brown; fine to medium; fine to medium sand; trace coal, rootlets, gravel is crushed natural rock.		FILL	NA	M						
		Silty SAND: grey; fine - medium.		AEO	NA	M						
	0.50	SAND: brown; fine to medium.		AEO	NA	M						
	19											
	1	Borehole discontinued at 1.00m depth. Limit of investigation.										
	18											

NOTES: (#)Soil origin is "probable" unless otherwise stated. (^)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hand Tools
METHOD: Hand Auger to 1.0m
REMARKS:

OPERATOR:

LOGGED: Lambert
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Douglas PARTNERS | GROUNDED EXPERTISE

Test location: 101
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	12/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Test location information

Easting	419555.9	**Material type**	Silty sand (grassed)	**pH water (pH units)**	7.0
Northing	6379291	**Weather**	Overcast	**Soil temp (°C)**	17.0
Surface level (m AHD)	25.0	**Condition of ground surface before test**	Moist		

Preceding weather 0 days with >5mm daily rainfall in the preceding week (Williamtown RAAF station 61078)

Details of ring installation and saturation

Inner ring		**Outer ring**			
Diameter (cm)	30	**Diameter (cm)**	60	**Saturation prior to first reading (hrs)**	0.75
Embedment (cm)	15	**Embedment (cm)**	15	**Depth of liquid maintained (cm)**	15

Results of testing

Trial No.	Start/end	Time (hr:min)	Elapsed time Δtime (total) (mins)	Flow readings				Incremental infiltration rate		Water temp (°C)	Comment
				Inner		Annular		Inner (cm/hr)	Annular (cm/hr)		
				Reading (cm)	Flow (cm^3)	Reading (cm)	Flow (cm^3)				
1	S	08:59	5.0	0.0	2993	7.5	8232	51	47	18	-
	E	09:04	(5)	4.5		18.0					
2	S	09:09	5.0	13.0	3325	0.0	9016	56	51	18	-
	E	09:14	(15)	18.0		11.5					
3	S	09:14	5.0	18.0	5320	11.5	2744	90	16	18	-
	E	09:19	(20)	26.0		15.0					
4	S	09:25	4.0	2.0	7315	1.0	7840	155	55	18	-
	E	09:29	(30)	13.0		11.0					
5	S	09:29	5.0	13.0	4655	11.0	9408	79	53	18	-
	E	09:34	(35)	20.0		23.0					
6	S	09:40	3.0	0.0	3325	2.5	6664	94	63	18	-
	E	09:43	(44)	5.0		11.0					
7	S	09:43	2.0	5.0	1663	11.0	4312	71	61	18	-
	E	09:45	(46)	7.5		16.5					
8	S	09:45	1.5	7.5	1663	16.5	2744	94	52	18	-
	E	09:46	(47.5)	10.0		20.0					
-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-		-					
-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-		-					

Ring	Diameter (cm)	Area (cm^2)	Depth of liquid (cm)	Container (volume/ΔH) (cm^2)
Inner	30	707	15	665
Annulus	60	2121	15	784

Infiltration rate (I) (cm/hr)	**86**
Infiltration rate (I) (mm/hr)	**860**
Total saturation time (hrs)	**1.5**

Water penetration below ground surface after test & rings removed (m) >1.0

Douglas PARTNERS | GROUNDED EXPERTISE

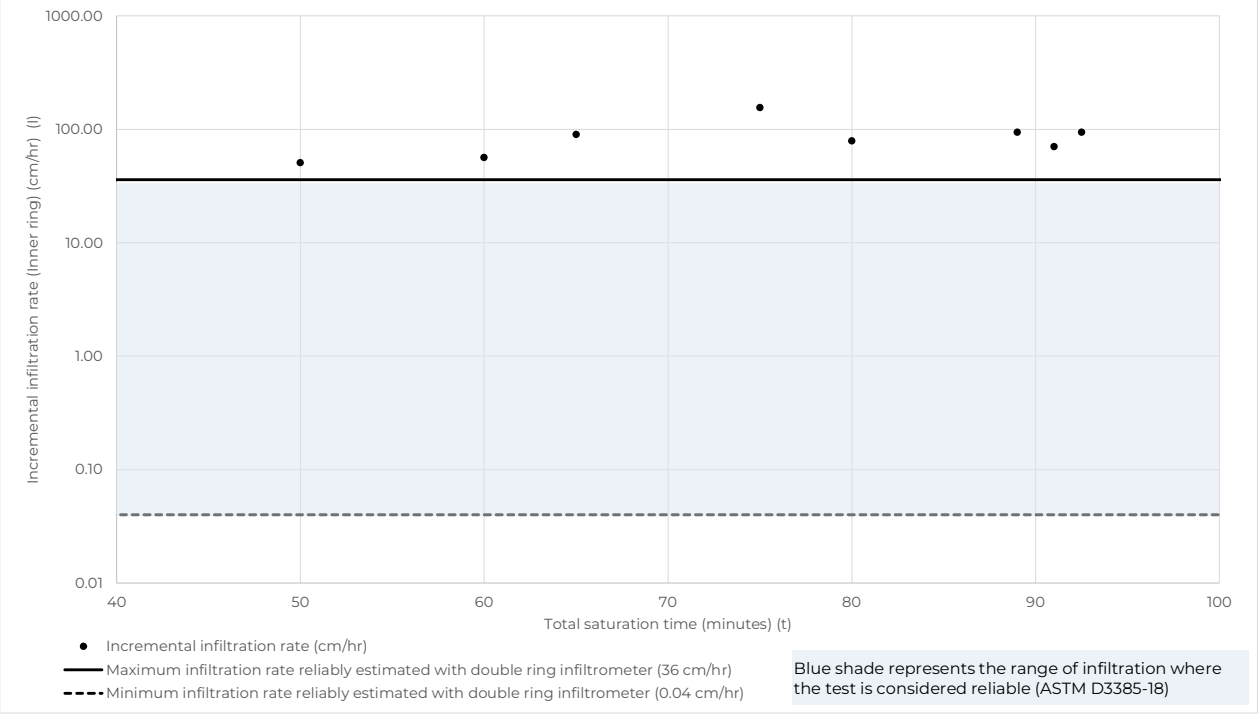
Test location: 101
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	12/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Incremental infiltration rate (inner ring) vs total saturation time



Results are plotted against total saturation time which includes saturation time prior to taking readings

Estimated in-situ hydraulic conductivity

Estimated hydraulic conductivity (I **2.1E-04** m/second

Water penetration below surface >1.0 m

where: $k = \frac{I}{\frac{H + L_f + \Psi f}{L_f}}$ (JGE 1989)

Wetting front suction head Ψf conservatively assumed to be = 0

References:

ASTM D3385-18 - Infiltration Rate of Soils in Field Uisng Double Ring Infiltrometer; and

Journal of Geotechnical Engineering (JGE), Volume 115, No.9, 1989, pp1216

Douglas PARTNERS GROUNDED EXPERTISE

Douglas PARTNERS GROUNDED EXPERTISE

Test location: 102
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	12/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Test location information

Easting	419585.7	**Material type**	Silty sand (grassed)	**pH water (pH units)**	7.0
Northing	6379283.1	**Weather**	Overcast	**Soil temp (°C)**	18.0
Surface level (m AHD)	22.4	**Condition of ground surface before test**	Moist		

Preceding weather 0 days with >5mm daily rainfall in the preceding week (Williamtown RAAF station 61078)

Details of ring installation and saturation

Inner ring		**Outer ring**			
Diameter (cm)	30	**Diameter (cm)**	60	**Saturation prior to first reading (hrs)**	1.25
Embedment (cm)	15	**Embedment (cm)**	15	**Depth of liquid maintained (cm)**	15

Results of testing

Trial No.	Start/end	Time (hr:min)	Elapsed time Δtime (total) (mins)	Flow readings				Incremental infiltration rate		Water temp (°C)	Comment
				Inner		Annular		Inner (cm/hr)	Annular (cm/hr)		
				Reading (cm)	Flow (cm^3)	Reading (cm)	Flow (cm^3)				
1	S	12:10	2.0	5.0	1663	-1.0	6272	71	89	19	-
	E	12:12	(2)	7.5		7.0					
2	S	12:10	4.0	7.5	998	7.0	7448	21	53	19	-
	E	12:14	(4)	9.0		16.5					
3	S	12:14	3.0	9.0	3325	-	-	94	-	19	Outer bottle empty
	E	12:17	(7)	14.0		-					
4	S	12:17	3.0	14.0	5320	1.0	5880	151	55	19	-
	E	12:20	(10)	22.0		8.5					
5	S	12:20	2.5	22.0	3658	8.5	5880	124	67	19	-
	E	12:22	(12.5)	27.5		16.0					
6	S	12:30	2.0	0.0	3990	-1.0	3136	169	44	19	-
	E	12:32	(22)	6.0		3.0					
7	S	12:32	2.5	6.0	3325	3.0	6272	113	71	19	-
	E	12:34	(24.5)	11.0		11.0					
8	S	12:34	2.5	11.0	3990	11.0	6272	135	71	19	-
	E	12:37	(27)	17.0		19.0					
9	S	12:55	2.0	7.5	3325	-5.0	6664	141	94	19	-
	E	12:57	(47)	12.5		3.5					
10	S	12:57	4.5	12.5	5653	3.5	12936	107	81	19	-
	E	13:01	(51.5)	21.0		20.0					

Ring	Diameter (cm)	Area (cm^2)	Depth of liquid (cm)	Container (volume/ΔH) (cm^2)
Inner	30	707	15	665
Annulus	60	2121	15	784

Infiltration rate (I) (cm/hr)	**128**
Infiltration rate (I) (mm/hr)	**1280**
Total saturation time (hrs)	**2.1**

Water penetration below ground surface after test & rings removed (m) >1.0

Douglas PARTNERS | GROUNDED EXPERTISE

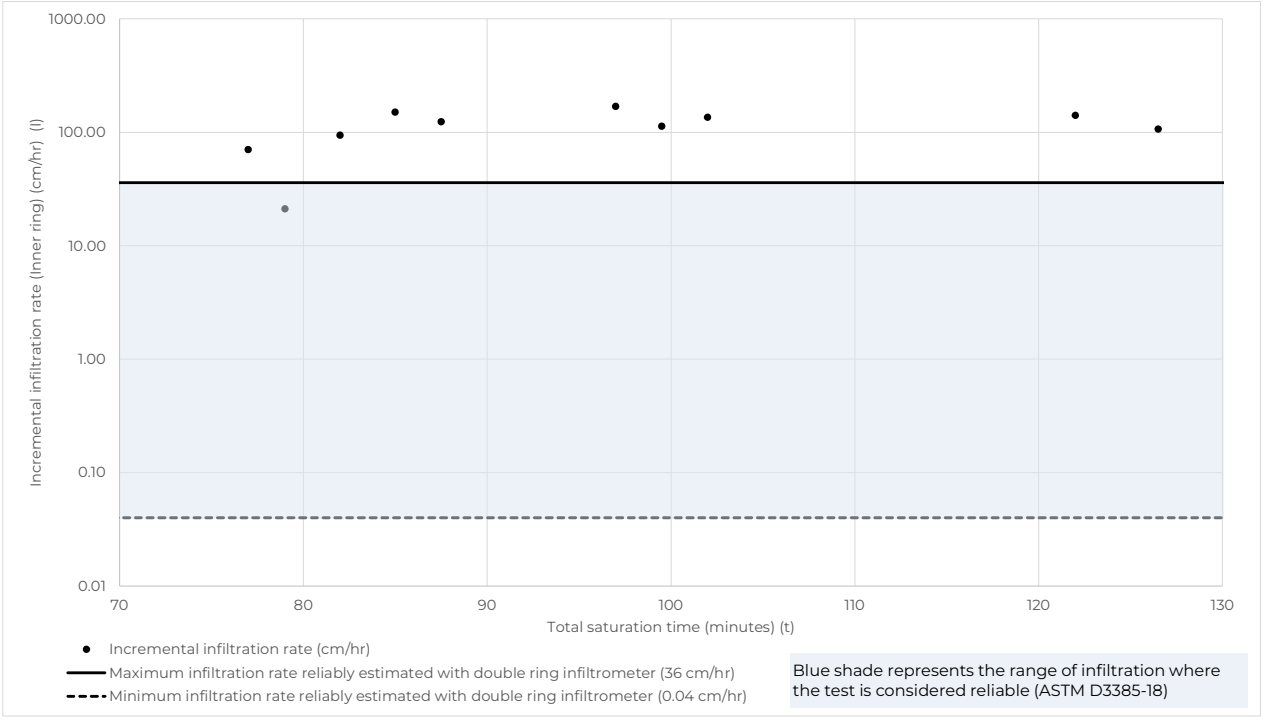
Test location: 102
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	12/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Incremental infiltration rate (inner ring) vs total saturation time



Results are plotted against total saturation time which includes saturation time prior to taking readings

Estimated in-situ hydraulic conductivity

Estimated hydraulic conductivity (I **3.1E-04** m/second

Water penetration below surface >1.0 m

where: $k = \frac{I}{\frac{H + L_f + \Psi f}{L_f}}$ (JGE 1989)

Wetting front suction head Ψf conservatively assumed to be = 0

References:

ASTM D3385-18 - Infiltration Rate of Soils in Field Uisng Double Ring Infiltrometer; and

Journal of Geotechnical Engineering (JGE), Volume 115, No.9, 1989, pp1216

Test location: 102
Depth: 0.5 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00		
Project	Proposed residential development	**Date**	12/09/2024		
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert		
Test location information					
Easting	419585.7	**Material type**	Sand	**pH water (pH units)**	7.0
Northing	6379283.1	**Weather**	Overcast	**Soil temp (°C)**	18.0
Surface level (m AHD)	22.4	**Condition of ground surface before test**	Moist		

Preceding weather 0 days with >5mm daily rainfall in the preceding week (Williamtown RAAF station 61078)

Details of ring installation and saturation

Inner ring		**Outer ring**			
Diameter (cm)	30	**Diameter (cm)**	60	**Saturation prior to first reading (hrs)**	2.50
Embedment (cm)	15	**Embedment (cm)**	15	**Depth of liquid maintained (cm)**	15

Results of testing

Trial No.	Start/end	Time (hr:min)	Elapsed time Δtime (total) (mins)	Flow readings				Incremental infiltration rate		Water temp (°C)	Comment
				Inner		Annular		Inner (cm/hr)	Annular (cm/hr)		
				Reading (cm)	Flow (cm^3)	Reading (cm)	Flow (cm^3)				
1	S	14:00	1.0	5.0	1663	-40.0	15680	141	444	19	-
	E	14:01	(1)	7.5		-20.0					
2	S	14:01	3.0	7.5	5985	-20.0	25088	169	237	19	-
	E	14:04	(4)	16.5		12.0					
3	S	14:04	2.0	16.5	3325	12.0	8232	141	116	19	-
	E	14:06	(6)	21.5		22.5					
4	S	14:10	1.5	7.5	2993	-2.5	7840	169	148	19	-
	E	14:11	(11.5)	12.0		7.5					
5	S	14:11	2.5	12.0	3990	7.5	13720	135	155	19	-
	E	14:14	(14)	18.0		25.0					
6	S	14:14	7.0	6.5	1663	0.0	4704	20	19	19	-
	E	14:21	(21)	9.0		6.0					
7	S	14:21	2.0	9.0	3990	6.0	9408	169	133	19	-
	E	14:23	(23)	15.0		18.0					
8	S	14:23	2.0	15.0	3325	-	-	141	-	19	Constant head in outer ring maintained with hose
	E	14:25	(25)	20.0		-					
9	S	14:25	3.0	20.0	4988	-	-	141	-	19	
	E	14:28	(28)	27.5		-					
-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-		-					

Ring	Diameter (cm)	Area (cm^2)	Depth of liquid (cm)	Container (volume/ΔH) (cm^2)
Inner	30	707	15	665
Annulus	60	2121	15	784

Infiltration rate (I) (cm/hr)	**151**
Infiltration rate (I) (mm/hr)	**1510**
Total saturation time (hrs)	**3.0**

Water penetration below ground surface after test & rings removed (m) >1.0

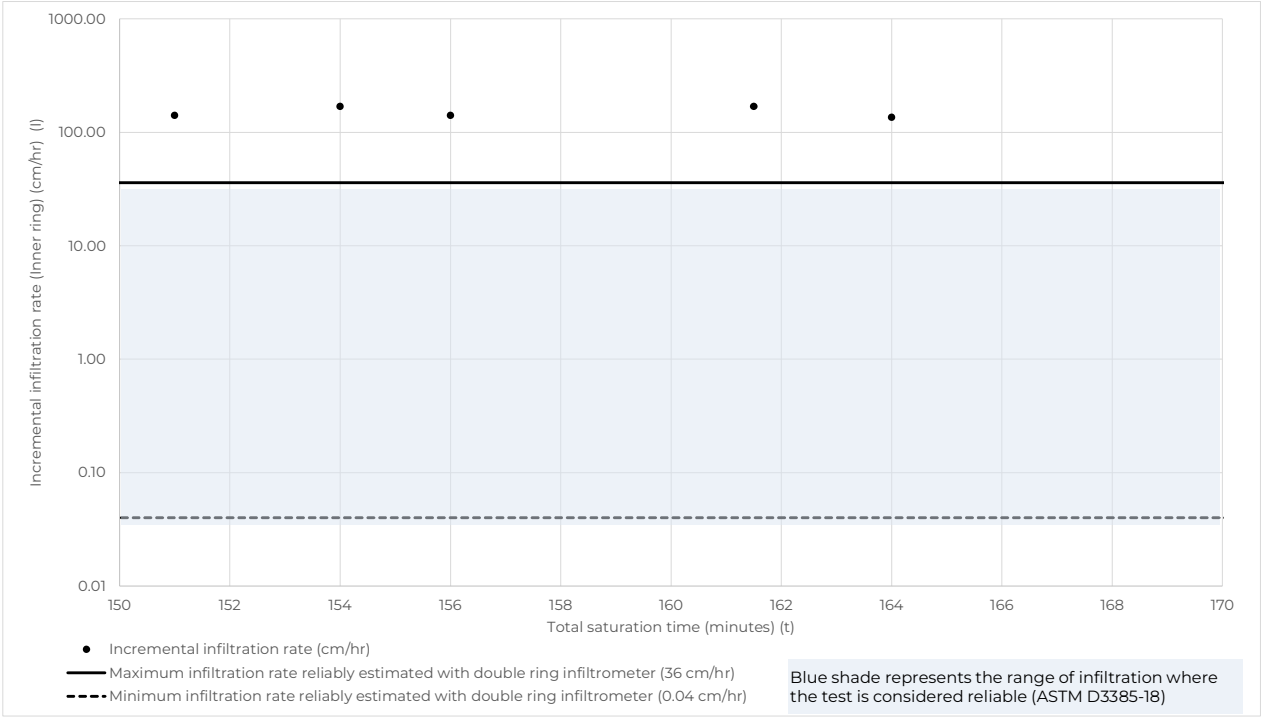
Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Test location: 102
Depth: 0.5 m

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	12/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Incremental infiltration rate (inner ring) vs total saturation time



Results are plotted against total saturation time which includes saturation time prior to taking readings

Estimated in-situ hydraulic conductivity

Estimated hydraulic conductivity (I **3.6E-04** m/second

Water penetration below surface >1.0 m

where: $k = \frac{I}{\frac{H + L_f + \Psi f}{L_f}}$ (JGE 1989)

Wetting front suction head Ψf conservatively assumed to be = 0

References:

ASTM D3385-18 - Infiltration Rate of Soils in Field Uisng Double Ring Infiltrometer; and

Journal of Geotechnical Engineering (JGE), Volume 115, No.9, 1989, pp1216

Test location: 103
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	13/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Test location information

Easting	419552.5	**Material type**	Silty sand (grassed)	**pH water (pH units)**	7.0
Northing	6379266.9	**Weather**	Overcast	**Soil temp (°C)**	18.0
Surface level (m AHD)	24.4	**Condition of ground surface before test**	Moist		

Preceding weather 0 days with >5mm daily rainfall in the preceding week (Williamtown RAAF station 61078)

Details of ring installation and saturation

Inner ring		**Outer ring**			
Diameter (cm)	30	**Diameter (cm)**	60	**Saturation prior to first reading (hrs)**	1.00
Embedment (cm)	15	**Embedment (cm)**	15	**Depth of liquid maintained (cm)**	15

Results of testing

Trial No.	Start/end	Time (hr:min)	Elapsed time Δtime (total) (mins)	Flow readings				Incremental infiltration rate		Water temp (°C)	Comment
				Inner		Annular		Inner (cm/hr)	Annular (cm/hr)		
				Reading (cm)	Flow (cm^3)	Reading (cm)	Flow (cm^3)				
1	S	11:50	8.0	0.0	8645	-	-	92	-	19	
	E	11:58	(8)	13.0		-					
2	S	11:58	4.0	13.0	3990	-	-	85	-	19	
	E	12:02	(12)	19.0		-					
3	S	12:02	4.0	19.0	3990	-	-	85	-	19	Outer bottle seal broken, erroneous readings.
	E	12:06	(16)	25.0		-					
4	S	12:06	1.7	25.0	1663	-	-	81	-	19	Constant head in outer ring maintained with hose
	E	12:07	(17.7)	27.5		-					
5	S	12:07	2.0	27.5	1663	-	-	71	-	19	
	E	12:09	(19.7)	30.0		-					
6	S	12:20	2.5	5.0	3325	-	-	113	-	19	
	E	12:22	(32.5)	10.0		-					
7	S	12:22	2.5	10.0	3325	4.0	6272	113	71	19	-
	E	12:25	(35)	15.0		12.0					
8	S	12:25	2.7	15.0	3325	12.0	4704	103	48	19	-
	E	12:27	(37.8)	20.0		18.0					
9	S	12:27	2.7	20.0	3325	-	-	103	-	19	
	E	12:30	(40.5)	25.0		-					Constant head in outer ring maintained with hose
10	S	12:30	3.5	25.0	3325	-	-	81	-	19	
	E	12:34	(44)	30.0		-					

Ring	Diameter (cm)	Area (cm^2)	Depth of liquid (cm)	Container (volume/ΔH) (cm^2)
Inner	30	707	15	665
Annulus	60	2121	15	784

Infiltration rate (I) (cm/hr)	**95**
Infiltration rate (I) (mm/hr)	**950**
Total saturation time (hrs)	**1.7**

Water penetration below ground surface after test & rings removed (m) >1.0

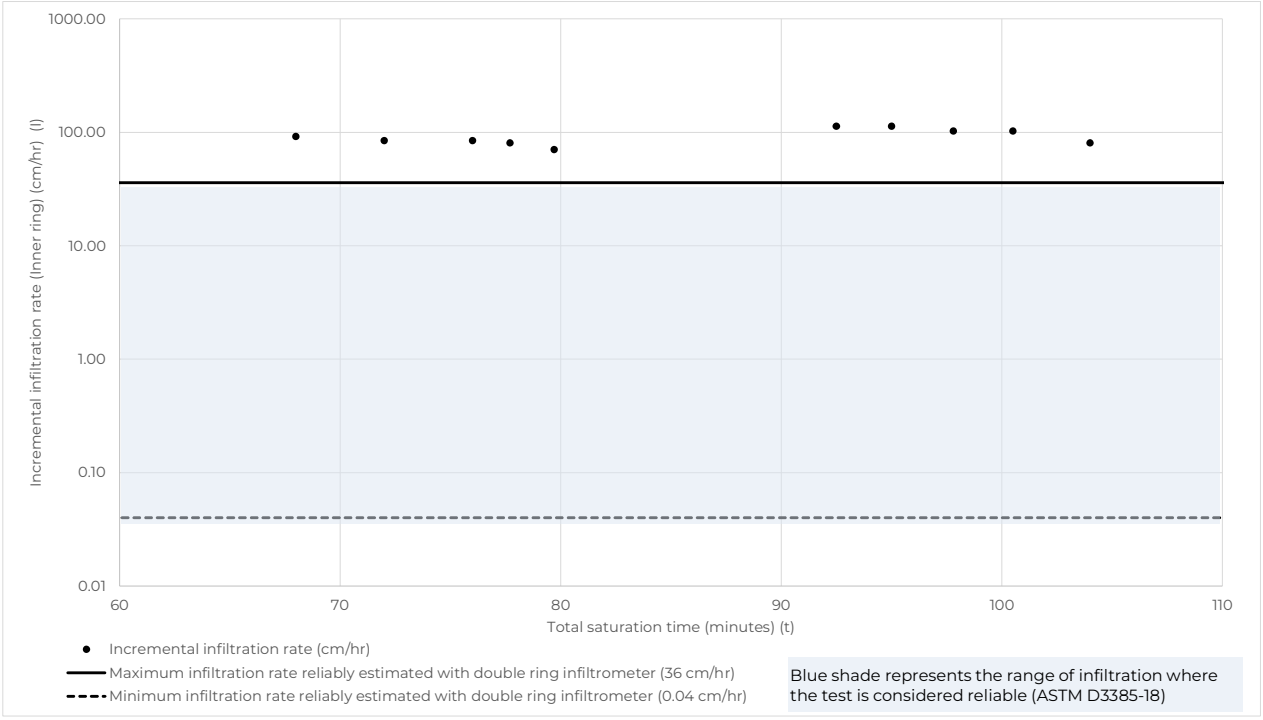
Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Test location: 103
Depth: 0.0 m

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	13/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Incremental infiltration rate (inner ring) vs total saturation time



Results are plotted against total saturation time which includes saturation time prior to taking readings

Estimated in-situ hydraulic conductivity

Estimated hydraulic conductivity (I **2.3E-04** m/second

Water penetration below surface >1.0 m

where: $k = \frac{I}{\frac{H + L_f + \Psi f}{L_f}}$ (JGE 1989)

Wetting front suction head Ψf conservatively assumed to be = 0

References:

ASTM D3385-18 - Infiltration Rate of Soils in Field Uisng Double Ring Infiltrometer; and

Journal of Geotechnical Engineering (JGE), Volume 115, No.9, 1989, pp1216

Test location: 104
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00		
Project	Proposed residential development	**Date**	13/09/2024		
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert		

Test location information

Easting	419593.3	**Material type**	Silty sand (grassed)	**pH water (pH units)**	7.0
Northing	6379260.8	**Weather**	Overcast	**Soil temp (°C)**	16.0
Surface level (m AHD)	19.9	**Condition of ground surface before test**	Moist		

Preceding weather 0 days with >5mm daily rainfall in the preceding week (Williamtown RAAF station 61078)

Details of ring installation and saturation

Inner ring		**Outer ring**			
Diameter (cm)	30	**Diameter (cm)**	60	**Saturation prior to first reading (hrs)**	1.00
Embedment (cm)	15	**Embedment (cm)**	15	**Depth of liquid maintained (cm)**	15

Results of testing

Trial No.	Start/end	Time (hr:min)	Elapsed time Δtime (total) (mins)	Flow readings				Incremental infiltration rate		Water temp (°C)	Comment
				Inner		Annular		Inner (cm/hr)	Annular (cm/hr)		
				Reading (cm)	Flow (cm^3)	Reading (cm)	Flow (cm^3)				
1	S	09:25	5.0	4.0	5653	-1.5	9016	96	51	17	-
	E	09:30	(5)	12.5		10.0					
2	S	09:30	10.0	12.5	5320	10.0	10192	45	29	17	-
	E	09:40	(15)	20.5		23.0					
3	S	09:50	2.0	2.5	2660	0.0	5096	113	72	17	-
	E	09:52	(27)	6.5		6.5					
4	S	09:52	2.0	6.5	1663	6.5	5096	71	72	17	-
	E	09:54	(29)	9.0		13.0					
5	S	09:54	2.0	9.0	2328	13.0	4704	99	67	17	-
	E	09:56	(31)	12.5		19.0					
6	S	09:56	3.0	12.5	3325	-	-	94	-	17	Constant head in outer ring maintained with hose
	E	09:59	(34)	17.5		-					
7	S	09:59	1.0	17.5	1663	-	-	141	-	17	
	E	10:00	(35)	20.0		-					
8	S	10:00	1.3	20.0	1663	-	-	106	-	17	
	E	10:01	(36.3)	22.5		-					
9	S	10:01	1.3	22.5	1663	-	-	106	-	17	
	E	10:02	(37.7)	25.0		-					
10	S	10:02	1.3	25.0	1663	-	-	106	-	17	
	E	10:04	(39)	27.5		-					

Ring	Diameter (cm)	Area (cm^2)	Depth of liquid (cm)	Container (volume/ΔH) (cm^2)
Inner	30	707	15	665
Annulus	60	2121	15	784

Infiltration rate (I) (cm/hr)	**106**
Infiltration rate (I) (mm/hr)	**1060**
Total saturation time (hrs)	**1.7**

Water penetration below ground surface after test & rings removed (m) >1.0

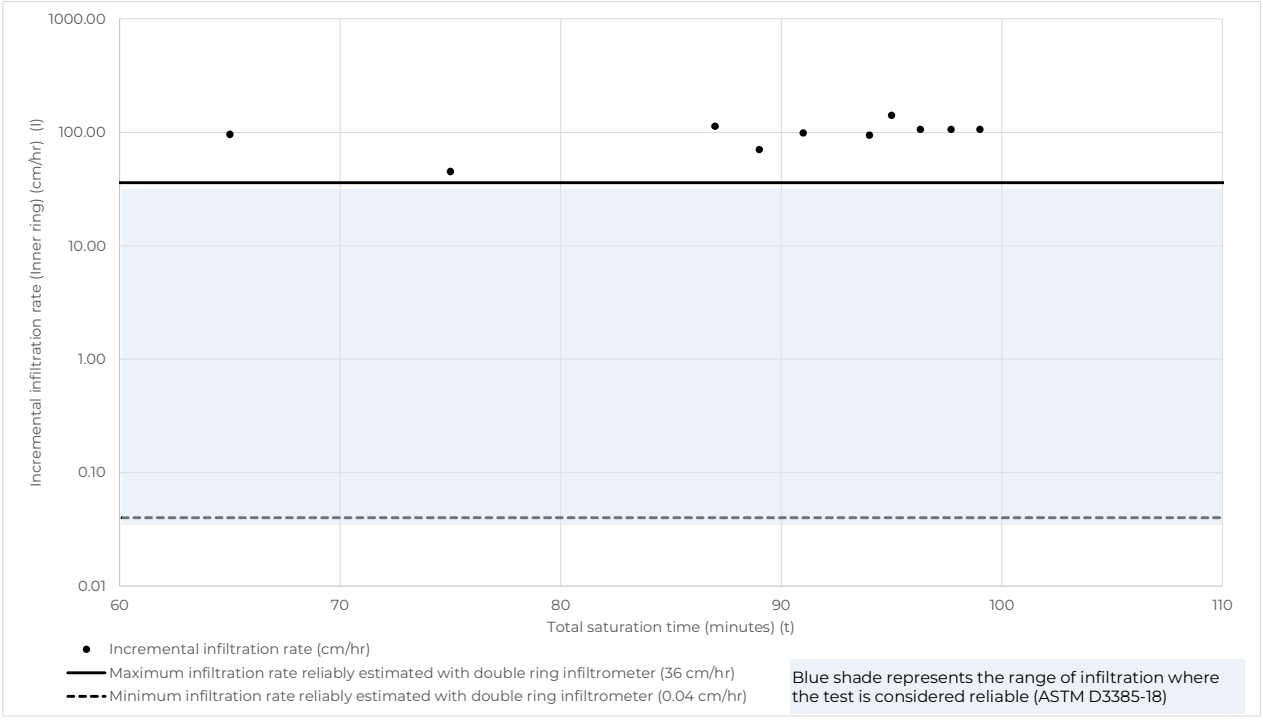
Test location: 104
Depth: 0.0 m

Double Ring Infiltrometer Test Report Sheet [ASTM D3385-18]

Project information

Client	Fortezza Group Pty Ltd	**Project No**	227295.00
Project	Proposed residential development	**Date**	13/09/2024
Location	5-7 Church & 42 Donald Street, Nelson Bay	**Tested by**	Lambert

Incremental infiltration rate (inner ring) vs total saturation time



Results are plotted against total saturation time which includes saturation time prior to taking readings

Estimated in-situ hydraulic conductivity

Estimated hydraulic conductivity (I **2.6E-04** m/second

Water penetration below surface >1.0 m

where: $k = \frac{I}{\frac{H + L_f + \Psi f}{L_f}}$ (JGE 1989)

Wetting front suction head Ψf conservatively assumed to be = 0

References:

ASTM D3385-18 - Infiltration Rate of Soils in Field Uisng Double Ring Infiltrometer; and

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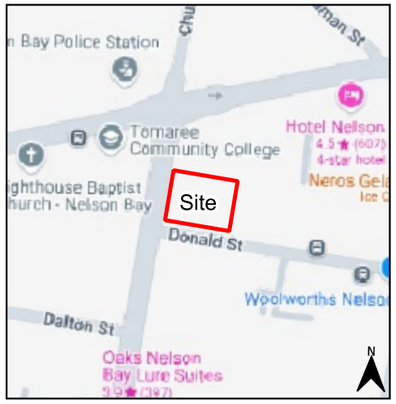

Site Location

Legend

- Approximate site boundary
- Approximate borehole location (previous investigation)
- Approximate CPT location (previous investigation)
- Approximate DRI location

0 10 20 30 m

NOTE:
1. Drawing adapted from aerial imagery from Metromap dated 30 May 2024.
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.1 m depending on satellite coverage.

Douglas PARTNERS

CLIENT:	Fortezza Group Pty Ltd	TITLE:	**Test location plan**
OFFICE:	Newcastle	DRAWN BY:	JCL		**Proposed residential development**
SCALE:	1:400 @A3	DATE:	16.September.2024		**5-7 Church & 42 Donald Street, Nelson Bay NSW**

N

Project:	227295.00
DRAWING No:	R.003.D.001
REVISION:	0