Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Grouting and Verification Plan for 'Yard' / Dudley Seam Workings

Newcastle City Art Gallery Expansion
1 Laman Street, Newcastle

Prepared for
Newcastle City Council

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

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1. Introduction

This report presents a grouting and verification plan for the abandoned mine workings in the 'Yard' / Dudley Seam, undertaken for the proposed Newcastle City Art Gallery Expansion at 1 Laman Street, Newcastle. This plan was developed for Newcastle City Council who are responsible for the project development. The work was undertaken with reference to Douglas Partners Pty Ltd (DP) proposal NCL200485.P.001 dated 20 August 2020.

The development will comprise the extension of the existing Art Gallery Building on the eastern side of the existing building, a basement is proposed along with a three storey building above ground level (total four storey).

A geotechnical investigation has previously been undertaken in 2012 by JK Geotechnics (JK) and the results are presented in JK (2012). DP has provided a brief summary of conditions encountered in this previous report by others, which is presented in Section 3 of this report. DP has undertaken several mine subsidence investigations in the Newcastle CBD and selected results are also summarised in Section 3 of this report for information purposes.

This grouting plan for the 'Yard' / Dudley Seam workings includes mass infill grouting which is required to achieve the following objectives:

- Locate workings;
- Reduce void space in bords beneath the proposed new buildings to prevent propagation of potholes; and
- Provide lateral support to existing pillars to increase pillar confinement and therefore strength and prevent future spalling.

The purpose of this plan is to provide a methodology for the following:

- Investigation of the 'Yard' / Dudley Seam workings to estimate the extent and locations of the seam at the site;
- The grout stabilisation of the workings (voids and rubble);
- Borehole and drilling requirements;
- Grout requirements; and
- Record keeping.

2. Roles and Responsibilities

For the purpose of this grout plan the following definitions apply:

- Principal – Newcastle City Council will be responsible for securing development approval and Subsidence Advisory NSW (SA NSW) approval for the works. They will also be responsible to engage suitable consultant(s) to perform the role(s) of grout designer and site verification engineers to prepare a Grout Verification Output Report to confirm that compliance with the accepted Grouting Plan has been achieved;
- Contractor – The grout and drill contractor employed by the Principal to undertake the works for the grouting of the mine workings beneath the site. The grouting contractor shall:
    - Be responsible to secure all other authority required permits and approvals to permit the execution and completion of the works to the satisfaction of relevant authorities;
    - Provide all required preliminaries and supervision required for the works;
    - Co-ordinate their works, with the works of others and the works as a whole;
    - Locate and protect all existing services and undertake all pedestrian and traffic control relating to the Works both inside and outside the site, all to the satisfaction of relevant authorities;
    - Provide all environmental protection and controls for the works;
    - The Grouting Contractor will undertake all monitoring, verification / validation testing and reporting to the satisfaction of the Principal and authorities and will demonstrate compliance with same;
- DP – Douglas Partners Pty Ltd who are the grout designer and site verification engineers who will prepare a Grout Verification Output Report to confirm that compliance with the accepted Grouting Plan has been achieved.

3. Background Data

3.1 Regional Geology

Reference to the Newcastle Coalfields Surface Geology Sheet, published by BHP, indicates that the site is underlain by the Lambton sub-group rocks of the Newcastle Coal Measures. The rocks are of Permian age and typically comprise sandstone, siltstone, claystone and multiple coal seams. The stratigraphy is presented in Table 1 below.

Table 1: Site Stratigraphy

Group	Sub Group	Formation	Description
Quaternary Aged Alluvial soils		Alluvial Soils	Clay, Silt, Sand and Gravel
Newcastle Coal Measures (Permian Age)	Lambton	Shepherds Hill Formation	Conglomerate, sandstone, siltstone and tuff
		Nobbys Seam	Coal
		Bar Beach Formation	Predominantly shales, but includes sandstone and tuffs and the Signal Hill Conglomerate Member
		Dudley Seam	Coal
		Bogey Hole	Lithic sandstone and Laminite
		Yard Seam	Coal
		Tighes Hill	Siltstone, sandstone and laminate
		Borehole Seam	Coal
		Waratah Sandstone	Sandstone, massive

Notes to Table 1:

Boreholes from the nearby area (undertaken by DP) confirm that geology represented by the shaded area underlies the site and includes the Dudley, Yard and Borehole Seams.

General:

- No detailed record of the mine layout is available, except for RT566 which shows the approximate probable extent of the 'Yard Seam' workings. RT566 is a copy of Exhibit 'Y' – Royal Commission on Earth Subsidence at Newcastle dated 1906, and is a Plan of the Workings of A, B and C Pits, of the A A Company's Colliery. Drawing 2 attached shows the inferred extent of the workings from the RT;
- The historic name of the workings is the 'Yard Seam', however, collation of deeper drilling records from the last decade indicate these workings most likely belong to the strata of the Dudley Seam. For the purpose of this report DP will refer to these workings as the Dudley Seam.

Previous DP Reports:

- Several DP investigations within the Newcastle CBD region and south west toward Darby Street have encountered mine voids within the Dudley Seam, which are considered to be part of the 'Yard Seam' workings as identified by RT566;
- Previous projects where DP has undertaken investigations and grout verification works where the Dudley Seam workings were encountered comprise:
  - Newcastle East End Project ('Market Shaft');
  - New Court House Building (cnr of Burwood and Hunter Street, Newcastle);

- These workings were aligned in the north-east to south-west direction, boards were typically 5 m to 8 m in width and with long pillars, and the workings were generally regular in shape. The Dudley Seam thickness ranges from about 2 m to 2.5 m;
- Voids ranged from 0.8 m to 1.6 m in height with some limited areas which comprised rubble up to 1.3 m in height.

JK (2012) Report:
An investigation report (JK, 2012) was prepared for the project and indicates the following:

- Alluvial Soils;
  - Silty clay, overlying sand to 14 m to 21 m depth where rock was encountered;
  - Groundwater at 3.2 m to 3.5 m depth in 2012.
- 'Yard' / Dudley Seam:
  - Thickness in the range of 1.0 m to 1.2 m;
  - The voids were up to 1.6 m in height / thickness;
  - Depth of cover ranging from 24.4 m to 25.1 m.

Borehole logs from the JK (2012) report are presented in Appendix B.

4. Grout Plan Design Intent

Due to the uncertain nature of the workings (ie unknown condition, size and extent), this plan includes investigation and mapping requirements by DP during the grouting works to better understand the location of workings so they are identified and filled with grout below the site. The investigation requirements are further defined below.

5. Provision of Items

5.1 Items to be provided by the Grouting Contractor

The Grouting Contractor shall provide all items necessary to complete the grouting works unless those items are explicitly stated to be provided by the Principal or by DP on behalf of the Principal. The items and requirements listed in this section are provided to draw the Grouting Contractor's attention to the specific requirements in relation to some items. The list is not a complete list of all items and services to be provided by the Grouting Contractor. The Grouting Contractor should state in their tender any items which are explicitly excluded from their works.

The Grouting Contractor shall undertake all drilling and grouting for the works including the drilling of verification bores (if required). This shall include non-core drilling and HQ core drilling. Verification bores (if required) shall be drilled at locations as directed by DP on behalf of the Principal. This shall include the control, storage, treatment and disposal of soil and possible water displaced from the bores and the mine during grouting and drilling.

The Grouting Contractor shall undertake grout consistency testing and mould the grout test specimens (cubes or cylinders as appropriate) to specified consistency.

The Grouting Contractor shall arrange for UCS testing of the test specimens in a NATA accredited laboratory.

The Grouting Contractor shall set out and survey the as-drilled locations of all bores through which grout is placed. This shall include the borehole co-ordinates to MGA and the Collar RL to AHD to the nearest 0.1 m.

For each bore, the Grouting Contractor shall record:

- Bore number;
- Drilling method;
- Dates and duration of drilling;
- Depth of soil;
- Depth and diameter of casing;
- The depth and height of voids and if the voids are open or filled / partly filled with rubble;
- The depth and thickness of the rubble, if any;
- The depth and thickness of all intersected coal seams greater than 0.2 m thick;
- Loss of drilling water or water make from the bore; and
- Any difficulties or notable drilling observations.

Where a void is not encountered during drilling, the Grouting Contractor shall record following:

- Bore number;
- Co-ordinates to MGA and the Collar RL to AHD to the nearest 0.1 m drilling method;
- Dates and duration of drilling;
- Depth of soil;
- Depth and diameter of casing;
- The depth to top and base of any intersected coal seams;
- Loss of drilling water or water make from the bore; and
- Grout take to fill borehole.

The Grouting Contractor shall record details of the grouting method and grout takes. As a minimum this must include:

- Bore number;
- Type of grouting (eg permeation of rubble, infilling of open void, and sealing of borehole);
- Batch number, quantity and consistency measured by slump, flow cone or as otherwise specified;
- For each tremmie pipe level:
  - Depth to outlet of tremmie pipe and height of outlet above the floor of the void;
  - Grout takes;
  - Observations of water discharge from adjacent bores;
- Grout take volume for each bore as measured from flowmeter at the pump output location. These records should include the volume of grout installed in each bore for each particular date for which it was installed;
- Grout take based on back calculation from products delivered to site (by weight) and volume of water used as measured by flowmeter. This form of grout volume is an estimation only, and should be used as a check against actual volumes measured by the flowmeter at the grout pump output location; and
- Observation of the spread of grout into adjacent bores. Methods to undertake these observations include weighted tape, bailer and CCTV camera. CCTV Inspection shall be undertaken by the Grouting Contractor. The Grouting Contractor shall provide a suitable light source with the CCTV camera to assist with imaging of the voids. The CCTV camera shall be on site at all times. DP can assist the Grouting Contractor with observations by weighted tape and bailer if necessary.

Copies of the above records shall be provided to DP weekly as the work proceeds.

The Grouting Contractor shall provide assistance to DP in carrying out the items listed in Item 5.2 below. This may include the use of drill rigs to facilitate CCTV Inspection in addition to those required of the Grouting Contractor as described above.

5.2 Items to be provided by DP

On behalf of the Principal, DP will provide the following:

- Assist Grouting Contractor with determining the layout of the workings following initial drilling results;
- Core logging (verification bores – if required);
- Regularly observe and record grout takes;
- Observations of the consistency testing of grout and the moulding of test specimens which are to be undertaken by the Grouting Contractor;
- Review and collation of data collected by the Grouting Contractor; and
- Preparation of final Grout Verification Output Report suitable for submission to the (SA NSW).

6. Drilling

The bores required for the assessment of the workings, grouting and verification of grouting shall be drilled by the Grouting Contractor to achieve grouting of the target areas as presented in the attached drawing. The aim of the grouting is to grout areas at the site which are not occupied by the existing building. The 'area to be grouted' is shown on the drawing attached.

Some cored bores may be required to confirm grout has filled the voids and rubble and achieved satisfactory strength. If core is required for verification purposes, coring shall commence from the top of rock or at least 3 m above the grouted zone and continue to at least 1 m below the base of the workings. The core shall be HQ recovered with a suitable core barrel. Core drilling shall be undertaken by the Grouting Contractor at locations agreed with DP and the Principal. If it is considered that the drilling (or grouting) has not satisfied the above requirements, additional cored bores will be required.

The approximate location of the proposed grout target bores are presented in the drawing attached. These bore locations are indicative and should be confirmed by the Grouting Contractor following assessment of in-ground services, drilling accessibility, layout of the workings and any necessary permits from authorities or the Principal. Alternate drilling locations shall be submitted to DP for approval.

Bores drilled by the Grouting Contractor shall comply with the following requirements:

- All bores shall be cased through sand and clay soils and into rock to a sufficient depth to prevent the overlying sands and clays bypassing the casing and entering the bore. The casing shall be temporary and removed by the completion of the grouting contract. PVC casing shall not be used due to the risk of sand bypassing the casing and entering the underlying void. The casing shall not be removed until the borehole has been sealed with set grout to just below the rock-head, with the remaining borehole above the rock-head to be filled with grout as the casing is being removed. The casing shall have a minimum internal diameter (ID) of 115 mm. Alternate diameters of drill casing may be used but must be sufficient in diameter to allow assessment of the workings using down-hole tools (CCTV camera and Sonar equipment) without risk to equipment and will be subject to review by DP and the Principal;
- The contractor is to allow sufficient steel casings to undertake the works;
- Non cored bores shall have a minimum ID of 115 mm. Alternate borehole diameters may be used but must be sufficient in diameter to allow assessment of the workings using down-hole tools (CCTV camera and Sonar equipment) without risk to equipment. Alternate bore diameters will be subject to review by DP (or Others) and the Principal;
- Air percussion drilling methods shall not be used due to risks (albeit low) of release of methane gas within the coal seams, combustion and to minimise pressurising any mine voids with air which can potentially result in uncontrolled release of air and water from boreholes or interactions with subsurface elements including buried services or basements during drilling;
- In all cases the spacing between bores must achieve satisfactory grouting of the target zone which includes satisfactory permeation of the rubble. The proposed bore locations shall be provided to DP (or Others) prior to drilling for comment;
- If satisfactory grouting is not achieved, secondary bores are to be drilled and grouted to achieve satisfactory grouting of the voids and rubble;

- All bores shall be grouted to the ground surface. Bore plugs are not to be used. Bores not intersecting voids are to be grouted on completion via a tremmie line inserted to the base of the bore. Bores encountering open voids may remain open for use during grouting and verification but must be grouted prior to the Grouting Contractor leaving the site;
- Bore locations are nominated below; and
- All drilling spoil and excess waste or groundwater is to be disposed off-site by the Grouting Contractor in accordance with regulatory requirements.

7. Grouting

7.1 Objectives (Dudley Seam)

The objectives of remedial grouting in the Dudley Seam are as follows:

- Reduce void space in bords to prevent propagation of potholes beneath the proposed new buildings; and
- Provide lateral support to existing pillars to increase pillar confinement and therefore strength and prevent future spalling.

This requires filling of all voids under the site where the new building is proposed.

7.1.1 Grout Materials (Dudley Seam)

A minimum of two grout mixes are required:

- Low Mobility grout to form the barrier with the exception of bores immediately adjacent to the existing building which shall consist of high mobility grout;
- High Mobility grout to fill the area within the barrier.

The 7-day UCS of test specimens of the grout shall have not less than 50% of the test results less than 2 MPa and all test specimens shall have a 7-day UCS of not less than 1 MPa when cured in mine water. The 28-day UCS of test specimens shall not be less than 2 MPa cured in mine water.

For high mobility grout the grout flow cone value of about 25s to 35s and not less than 20s and not more than 45s, which is necessary to permeate the rubble and fill the void, resulting in a slurry with the consistency of a ‘thin milkshake’ or ‘creamy soup’.

Low mobility grout used in the barrier should have a flow cone value of typically 60 to 90, and not less than 50.

7.1.2 Submission of Grout Design (Dudley Seam)

Prior to the commencement of grouting operations the Grouting Contractor shall submit details of the proposed mix design for the low and high mobility grout and test results confirming a 2 MPa (7-day strength) for at least two specimens.

The mix design shall include field criteria for grout consistency monitoring during construction. Depending on the design consistency of the grout this may be a nominated range of slump or flow cone values or similar. This will be referred to as the 'grout consistency test' in this specification.

If previous records of proposed mix designs are held by the Grouting Contractor, these may be used to supplement grout trial data, subject to appraisal and approval by DP.

In addition to the above the Grouting Contractor must demonstrate that the grout is suitable for placement and verify that the grout will not segregate after discharge and lateral flow from the tremmie pipe/drill string. The grout should not segregrate when placed into water and when pumped via a tremie into flooded mine workings. This could include a trial placement of grout in mine water filled tanks or trenches and the assessment of the hardened grout by DP. It should be noted that this trial is to be undertaken using the actual batching and grouting equipment to be used for the production grouting.

7.1.3 Grouting Methodology (Dudley Seam)

- The perimeter bores should be drilled at 3 m spacing's around the site northern, eastern, and southern boundary as per the attached Drawing 1, and Table A attached. Where the stage boundary is located adjacent to an existing neighbouring development or existing site development, the bores shall be drilled by the Grouting Contractor at a distance of 1.0 m from the neighbouring development. Any voids identified during such drilling shall be grouted in accordance with this specification;
- Perimeter grout should be undertaken in grout 'lifts' of up to 30 m^3 in each bore and allowed to 'set up' for at least 12 hours between additional lifts;
- Once the perimeter have been grouted and accepted by DP, internal primary bores located internal to the site should be drilled and grouted;
- The primary bores should be drilled at 10 m spacings, along bords (ie roadways) alignments , and bores drilled along 'lines' which are aligned in the north-east and south-west direction. The lines of bores should be a typical offset of 5 m from each other, and should be based on targeting boards from sonar readings. The primary bore locations need to be flexible and should be based on the results of 'mapping' from the bores as they progress. Refer to the attached Drawing 1 and Table A attached for a general guide;
- Secondary infill grout bores could be required between the primary bores depending on the results of grout volume monitoring from the primary bores. The secondary bores should be drilled at locations nominated by DP. For initial costing purposes, a quantity of 20% of primary bores should be allowed for;
- The grout in the primary and secondary bores shall be placed via tremmie tube or drill string which shall be initially placed at the bottom of the void and progressively raised during grouting. Grouting shall continue until the grout rises up the bore to the ground surface; and
- Bores should have casing installed to reduce the risk of bore collapse and re-drilling.

7.1.4 Verification (Dudley Seam)

Grout Placement Records

- Prior to the commencement of grouting, the grout design and the Grouting Contractor's ability to place the grout without segregation shall be demonstrated as discussed in Section 7.1.2 above;
- Prior to placing each batch of grout, the consistency shall be verified by slump or flow cone values or other method nominated as part of the mix design as per Section 7.1.1 above. Following initial grouting, it may be required to adjust the grouting consistency subject to agreement with DP;
- The grout takes shall be monitored together with the height of the tremmie outlet above the floor of the void. The grout take at each tremmie pipe / drill string level shall be recorded;
- During grouting, the height and lateral spread of the grout shall be monitored in adjacent bores by weighted tape, bailer and CCTV inspection. After setting, the height and the lateral spread of the grout shall be confirmed by these methods;
- The Grouting Contractor shall maintain schedules and plans recording the bores into which each batch was pumped and the inferred distribution of that batch within the voids; and
- The above documentation shall be provided to DP for review on behalf of the Principal.

Specific Verification Bores

DP will review the data and observations obtained by the Grouting Contractor as specified in Section 5. It is anticipated that this information will be sufficient to verify the infilling of the voids in the Dudley Seam Workings and hence no specific verification bores are anticipated. If, in the opinion of DP or the Principal the above information is not sufficient to verify filling of the voids then additional non cored verification bores will be drilled by the Grouting Contractor for CCTV inspection and / or additional grouting.

If any of the 7-day strength test results specified in this report fail to achieve a minimum strength of 1 MPa then the grout mix shall be adjusted to improve the strength of grout (ie increase the cement content) and assessment of potential strength gain at 28 days shall be made. Subject to these results, HQ core drilling shall be undertaken to recover samples of the hardened grout from the suspect area for testing.

Grout Strength Testing

- The strength of the grout shall be verified by the testing of concrete test cylinders or grout cubes as appropriate to the consistency of the grout:
  - If the grout consistency test is nominated by the Grouting Contractor as a slump or similar test then sampling and testing shall be based on concrete test cylinders tested in accordance with AS 1012.9:1999. The Grouting Contractor shall mould at least one pair of concrete test cylinders for each 200 m^3 of grout;
  - If the grout consistency test is nominated by the Grouting Contractor in terms of a flow cone rate or similar test, grout strength testing will be based on grout cubes in accordance with RMS Test Method T375. Testing shall be on the basis of at least one set of three cubes per 200 m^3 of grout;
  - The Grouting Contractor shall prepare the samples progressively as grouting proceeds. The Grouting Contractor shall report the batch time and date of the grout and the results of consistency tests. No water may be added to the grout mix after test specimens are moulded;

- The grout cubes or cylinders shall be tested in a NATA registered laboratory at 7-days and a second pair tested at 28 days.

7.2 Sealing Existing Bores

All previous investigation bores should be grouted to the surface during the remediation works.

7.3 Grout Volumes

The extent and layout of the workings in the 'Yard' / Dudley Seam has not been established and therefore the following estimated grout volumes to mass fill the workings has been based on the total area of the site and the estimated grout takes measured during grouting of the Dudley Seam at a limited number of other projects in the Newcastle CBD, and has back-calculated the typical grout takes per unit area for the Dudley Seam. In summary the grout takes associated with remedial works in the Dudley Seam was approximately 1 to 2 m^3/m^2. Grout takes in the Dudley Seam for are estimated as follows.

Table 2: Estimated Grout Volumes for Dudley Seam Workings

Grout Target Area	Approx. Plan Area# (m^2)	Assumed Extraction Ratio (%)	Typical Range of Grout Volume (m^3)*
Hatched Blue Area on attached Drawing 1	1930	40	2,000 to 4,000

Notes to Table 2:

* Range based on previous grout projects in CBD

\# Actual area should be confirmed by survey.

It is suggested that a contingency of ±30% of grout volume estimation should be allowed for and within tendering for such works. The actual volume of grout used to fill the Dudley Seam could be substantially less if the extent of workings does not occupy the entire site.

8. Reference

JK 2012, *Report on Geotechnical Investigation, Proposed Newcastle Regional Art Gallery Extensions, at the corner of Queen and Darby Streets, Newcastle*, Project 25978, dated 30 October 2012.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 1 Laman Street, Newcastle with reference to DP's proposal NCL200485 dated 20 August 2020, and acceptance from Newcastle City Council in the form of contract 2021 / 065Q dated 17 September 2020. This report is provided for the exclusive use of Newcastle City Council 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 based on previous investigations (JK 2012) and are therefore indicative of the subsurface 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. Subsurface 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 the previous investigations. 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. Given limitations with access due to the presence of buildings across the majority of the site it is recommended that additional investigation is conducted following demolition to confirm site conditions.

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.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

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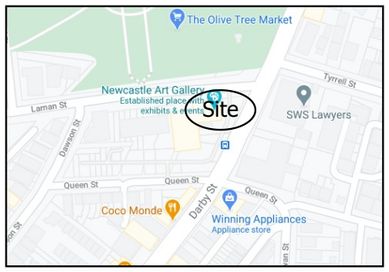
Appendix A

About This Report
Table A – Bore Quantities
Drawing 1 – Dudley Seam Workings – Grout Plan
Drawing 2 – Mapped Extent of Workings in Dudley Seam (RT654)

Table A - Bore Quantities		
Bore	Easting	Northing
A1	385258	6355844
A2	385258	6355841
A3	385258	6355838
A4	385258	6355835
A5	385258	6355832
A6	385258	6355829
A7	385260	6355828
A8	385263	6355828
A9	385266	6355828
A10	385269	6355828
A11	385272	6355828
A12	385275	6355829
A13	385278	6355829
A14	385281	6355829
A15	385284	6355829
A16	385287	6355829
A17	385290	6355829
A18	385292	6355831
A19	385294	6355834
A20	385295	6355836
A21	385296	6355839
A22	385297	6355842
A23	385298	6355845
A24	385299	6355848
A25	385300	6355850
A26	385302	6355853
A27	385303	6355856
A28	385304	6355859
A29	385305	6355861
A30	385306	6355864
A31	385307	6355867
A32	385309	6355870
A33	385310	6355872
A34	385311	6355875
A35	385312	6355878
A36	385313	6355881
A37	385314	6355884
A38	385315	6355886
A39	385317	6355889
A40	385318	6355892
A41	385319	6355895
A42	385320	6355897
A43	385317	6355897
A44	385314	6355897
A45	385311	6355897
A46	385308	6355896
A47	385305	6355896
A48	385302	6355895
B1	385313	6355893
B2	385302	6355893
B3	385304	6355889
B4	385306	6355884
B5	385309	6355880
B6	385302	6355871
B7	385304	6355867
B8	385290	6355871
B10	385295	6355862
B11	385297	6355858
B12	385299	6355853
B13	385281	6355867
B14	385284	6355863
B15	385286	6355858
B16	385288	6355854
B17	385290	6355849
B18	385292	6355845
B19	385294	6355840
B20	385281	6355845
B21	385283	6355840
B22	385285	6355836
B23	385270	6355845
B24	385272	6355841
B25	385274	6355836
B26	385276	6355832
B27	385259	6355845
B28	385261	6355841
B29	385263	6355836
B30	385265	6355832

Total Number of Perimeter 'A' Bores	48
Total Number of Primary 'B' Bores	30
Total Number of Bores	78



Site Location (image sourced from Google Maps)

Legend

- Site Boundary
- Area to be Grouted (~1924m²)
- Proposed Perimeter Bore Location (A1-A48)
- Proposed Primary Bore Locations (B1-B30)

0 10 20 30 m

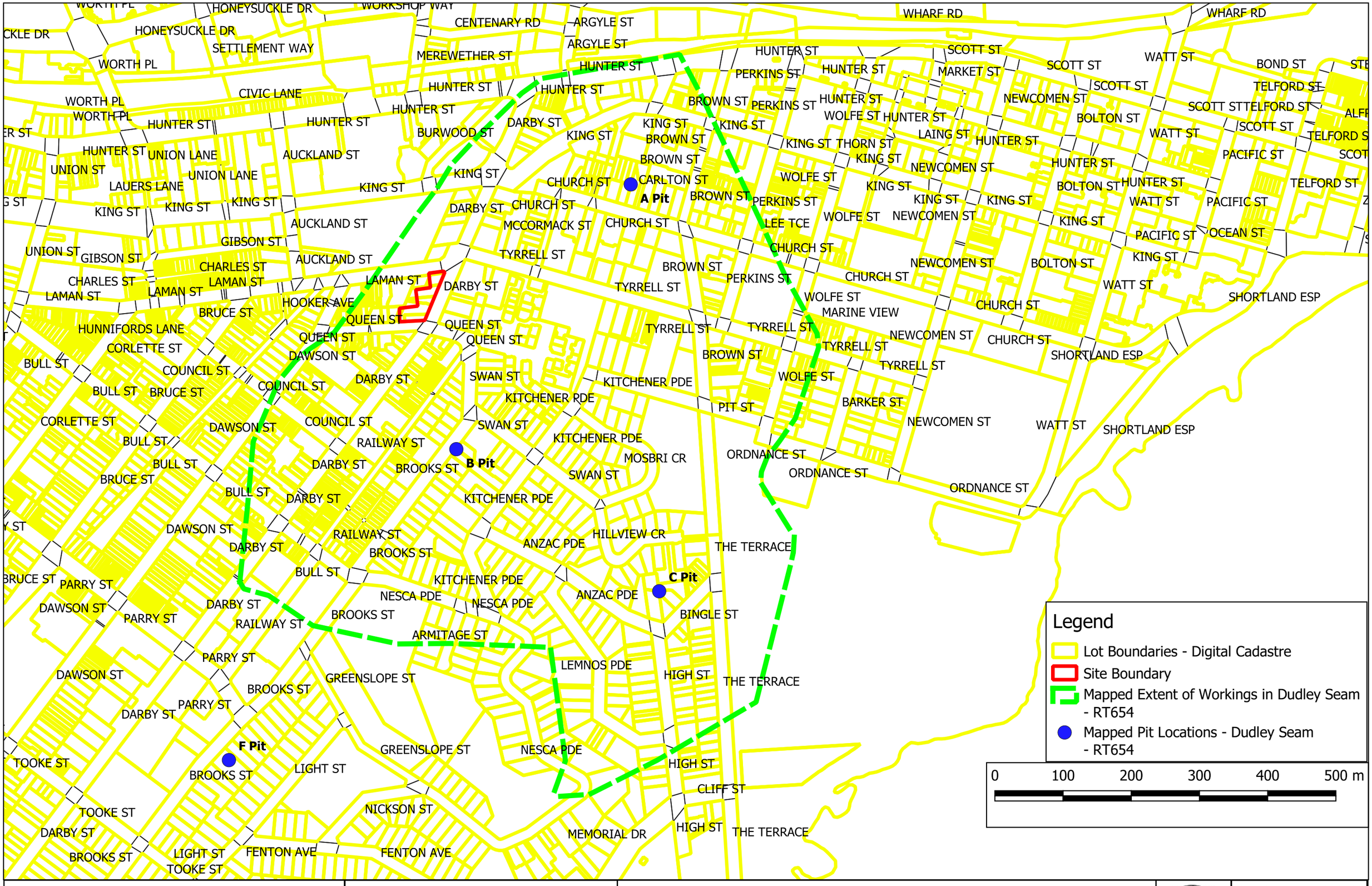
Drawing adapted from Nearmap image dated 02 September 2020

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Newcastle City Council		
OFFICE:	Newcastle	DRAWN BY:	PLH
SCALE:	1:500 @ A3	DATE:	04.November.2020

TITLE: **Dudley Seam workings - Grout Plan**
Newcastle Art Gallery Proposed Alterations and Additions
1 Laman St, Newcastle

Project:	49737.03
DRAWING No:	1
REVISION:	0



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Newcastle City Council	
OFFICE: Newcastle	DRAWN BY: DJH
SCALE: 1:5000 @ A3	DATE: 20.October.2020

TITLE: **Mapped Extent of Mine Workings in Dudley Seam (RT 654)**
Newcastle Art Gallery Proposed Alterations and Additions
1 Laman St, Newcastle

Project:	49737.03
DRAWING No:	1
REVISION:	0

Appendix B

JK Bores (Borehole Logs 1 to 4)

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **1** 1/4

BOREHOLE LOG

Client: THE CITY OF NEWCASTLE

Project: NEWCASTLE REGION ART GALLERY

Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 8.3m

Date: 18-12-06 **Datum:** AHD

Logged/Checked by: T.M./[illegible]

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	ASPHALTIC CONCRETE: 30mm.t	M	-	-	
									FILL: Sandy gravel, fine to coarse grained rounded igneous, brown, with fine to medium grained sand.	M			
					N = 21 6,9,12	1			FILL: Sand, fine to medium grained, light grey to brown, with brick fragments.				
									FILL: Silty sand, fine to medium grained, brown to dark brown, with brick fragments.				
					N = 6 3,3,3			SM	SILTY SAND: fine to medium grained, brown to yellow brown, with clay bands.	M	L		
					N = 6 5,5,1	3							
▶						4			SILTY SAND: fine to medium grained, light grey to light yellow brown, with dark brown bands.	W			NO RECOVERY FROM SPT SPLIT SPOON SAMPLER
					N = 4 1,2,2	5							
ON COMPLETION					N = 18 8,9,9	6					MD		
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1 2/4

BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 8.3m
Date: 18-12-06 **Datum:** AHD
Logged/Checked by: T.M./RW

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 22 10,11,11	8		SM	SILTY SAND: fine to medium grained, light grey to light yellow brown, with dark brown seams.	W	MD		
									SILTY SAND: fine to medium grained, dark brown.				
					Nc = 12 17 26	9		SP	SAND: fine to medium grained, light grey to light brown.		D		
						10							
						11							
						12							
						13							
						14							

Jeffery and Katauskas Pty Ltd
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BOREHOLE LOG

Borehole No. 1 3/4

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP
Date: 18-12-06
Method: SPIRAL AUGER JK550
Logged/Checked by: T.M./PW
R.L. Surface: ≈ 8.3m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						15		SP	SAND: fine to medium grained, light grey to light brown.	W	MD		
						16							
						17			SAND: fine to medium grained, light yellow brown.				
						18							
						19							
						20			REFER TO CORED BOREHOLE LOG				

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JOB NO. 20829S BH1 START CORING AT 19.45m

20 CORE LOSS 0.35m

21 CORE LOSS 0.31m

22 EOBH AT 22.39m

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Borehole No. 1 4/4

CORED BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Core Size:** NMLC **R.L. Surface:** ≈ 8.3m
Date: 18-12-06 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** T.M./PW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		19		START CORING AT 19.45m					
		20		SANDSTONE: fine grained, light grey, with orange brown laminae, cross bedded at 0-30°.	DW	L VL	×		- Be, 0-5°, P, S, IS - Be, 0-5°, P, S, IS
				CORE LOSS 0.35m					
		21		SANDSTONE: fine grained, light grey, with orange brown stained bands.	XW DW	EL L	×		- HIGHLY FRACTURED ZONE, 240mm.t - J, 70-90°, 90mm LONG, UN, R
				SANDSTONE: fine grained, grey.		M	×		
				CORE LOSS 0.31m	XW	EL			
		22		SANDSTONE: fine grained, grey, with shale bands.	XW DW	EL M-H	×		- Be, 0-2°, 10mm.t, UN, R
				END OF BOREHOLE AT 22.39m					
		23							
		24							
		25							

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Borehole No. 2 1/5

BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP
Date: 19-12-06
Method: SPIRAL AUGER JK550
R.L. Surface: ≈ 9.5m
Datum: AHD
Logged/Checked by: T.M./PW

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			ASPHALTIC CONCRETE: 100mm.t				
								-	FILL: Sandy gravel, medium to coarse grained angular igneous gravel, brown, with fine to medium grained sand.	M	-	-	
					N = 6 2,3,3				FILL: Silty sand, fine to medium grained, brown to yellow brown.				
						1		SM	SILTY SAND: fine to medium grained, light yellow brown to light grey.	M	L	-	
					N = 7 2,3,4	2							
					N = 12 4,6,6	3		SP	SAND: fine to medium grained, light grey.		MD		
▶						4							
					N = 10 5,5,5	5							
					N = 16 5,7,9	6							
						7							

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BOREHOLE LOG

Borehole No. 2
2/5

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP
Date: 19-12-06
Method: SPIRAL AUGER JK550
Logged/Checked by: T.M./RW
R.L. Surface: ≈ 9.5m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SP	SAND: fine to medium grained, light yellow brown, with a trace of roots.	W	MD		
					N = 10 4,4,6	8							
						9			SAND: fine to medium grained, light grey, with bands of silty clay; high plasticity, pale grey and pale red brown.				
						10					D		
					SPT 21/150mm END	11							
						12							
						13							
					N > 29 6,11, 18/100mm	14							

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BOREHOLE LOG

Borehole No. 2 3/5

Client: THE CITY OF NEWCASTLE

Project: NEWCASTLE REGION ART GALLERY

Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 9.5m

Date: 19-12-06 **Datum:** AHD

Logged/Checked by: T.M./ [illegible]

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					REFUSAL			SP	SAND: fine to medium grained, light grey, with bands of silty clay; high plasticity, pale grey and pale red brown.	W	D		
				■	SPT 22/100mm REFUSAL	15							
						16							
						17							
						18							
						19							
						20							
									REFER TO CORED BOREHOLE LOG				


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JOB NO. 208295 BH2 START CORING AT 20.45m
21
22
23
24
25
26
27
28
29

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Borehole No. **2** 4/5

CORED BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Core Size:** NMLC **R.L. Surface:** ≈ 9.5m
Date: 19-12-06 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** T.M.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		20		START CORING AT 20.45m					
		21		SANDY CLAY: medium plasticity, brown mottled pale grey and orange brown, with bands of XW, EL strength sandstone.	MC≈PL	H			
		22							
		23		SANDSTONE: fine grained, light grey.	DW	VL	×		
				SILTSTONE: grey.		L-M	×		
		24					×		- COAL SEAMS. 0-20°, 70mm.t
		25		COAL		L			- 25.13-25.29m J, 90°, P, S - 25.33-25.95m J, 70-90°, P, S
		26		SHALE: grey.	XW	VL	×		
				SANDSTONE: fine grained, light grey, with some VL-L strength shale bands.	XW	L			


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30
31
32
EOBH AT 31.47m

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Borehole No. **2** 5/5

CORED BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP | **Core Size:** NMLC | **R.L. Surface:** ≈ 9.5m
Date: 19-12-06 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK550 | **Bearing:** - | **Logged/Checked by:** T.M./PW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL VL L M H VH EH)	DEFECT DETAILS: DEFECT SPACING (mm) (600 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		28		SANDSTONE: fine grained, light grey, with some VL-L strength shale bands.		H	×		
				SANDSTONE: fine to medium grained, light grey.		H-VH	×		
		29		SANDSTONE: fine grained, light grey, with dark grey laminae, bedded	SW		×		
		30					×		
		31					×		
				END OF BOREHOLE AT 31.47m					
		32							
		33							

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Borehole No. **4** 1/5

BOREHOLE LOG

Client: THE CITY OF NEWCASTLE

Project: NEWCASTLE REGION ART GALLERY

Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 8.2m

Date: 21-12-06 **Datum:** AHD

Logged/Checked by: T.M./pw

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	ASPHALTIC CONCRETE: 30mm.t FILL: Sandy gravel, fine to coarse grained rounded igneous gravel, yellow brown, with fine to medium grained sand.	D	-	-	
					SPT 12/50mm REFUSAL				FILL: Silty sand, fine to medium grained, dark grey to black, with concrete fragments.				
						1		CL	SILTY CLAY: medium plasticity, grey brown mottled orange brown.	MC>PL	H	-	
					N = 21 6,9,12							>600 >600 >600	
						2			as above, but dark grey brown.				
					N = 25 4,12,13	3						>600 >600 >600	
▶						4							
								SM	SILTY SAND: fine to medium grained, light grey to grey, with a trace of clay.	W	MD		
					N = 26 11,13,13	5							
						6					L		
					N = 8 3,4,4								
						7							

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BOREHOLE LOG

Borehole No. 4
2/5

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP
Date: 21-12-06
Method: SPIRAL AUGER JK550
Logged/Checked by: T.M./PW
R.L. Surface: ≈ 8.2m
Datum: AHD

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N = 6 3,4,2	8		SM	SILTY SAND: fine to medium grained, light grey to grey, with a trace of clay.	W	L		
					N = 21 6,8,13	9		SC	CLAYEY SAND: fine to coarse grained, light grey, with fine grained sub rounded ironstone gravel and sandy clay bands and bands of silty sand; fine to medium grained with a trace of clay.		MD		
					N = 37 12,16,21	10 11 12					D		
						13 14							

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Borehole No. 4 3/5

BOREHOLE LOG

Client: THE CITY OF NEWCASTLE

Project: NEWCASTLE REGION ART GALLERY

Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 8.2m

Date: 21-12-06 **Datum:** AHD

Logged/Checked by: T.M./RW

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SC	CLAYEY SAND: fine to coarse grained, light grey, with fine grained sub rounded ironstone gravel and sandy clay bands.	W	D		
				■	N = 24 8,10,14	15		CH	SANDY CLAY: high plasticity, light grey, fine to coarse grained sand, with a trace of fine to medium grained sub rounded ironstone gravel.	MC>PL	VSt	320 280 300	
						16							
						17							
						18							
									REFER TO CORED BOREHOLE LOG				
						19							
						20							


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JOB NO. 20829S BOREHOLE 4 START CORING AT 18.17m
18
19
C.L. 0.1m
20
21
22
23
24
25
26

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Borehole No. **4** 4/5

CORED BOREHOLE LOG

Client: THE CITY OF NEWCASTLE

Project: NEWCASTLE REGION ART GALLERY

Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Core Size:** NMLC **R.L. Surface:** ≈ 8.2m

Date: 21-12-06 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK550 **Bearing:** - **Logged/Checked by:** T.M./RW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL VL L M H VH EH)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 60 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		18		START CORING AT 18.17m					
				SILTSTONE: light grey stained orange brown.	DW	H			- CS, 0-60°, 50mm.t
				SANDSTONE: fine to medium grained, grey, with occasional orange brown stained bands.		VL			- CS, 0-45°, 40mm.t - J, 0-90°, Un, R
		19			XW	EL			
				CORE LOSS 0.1m					
				SANDSTONE: fine to medium grained, light grey.	SW	H			
		20							- J, 0-45°, Un, R
									- HEAVILY FRACTURED ZONE, 120mm.t
		21							- HIGHLY FRACTURED ZONE, 30mm.t
		22							
		23		SANDSTONE: fine grained, light grey.					- Cr 0°, 25mm.t - Cr, 70mm.t
		24		SHALE: grey.		M			- Be, 0°, Un, R - Cr, 35mm.t - J, 70-90°, Un, S
					XW	EL			


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27
28
29
30
EOBH AT 30.17m
31

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Borehole No. **4** 5/5

CORED BOREHOLE LOG

Client: THE CITY OF NEWCASTLE
Project: NEWCASTLE REGION ART GALLERY
Location: 1 LAMAN STREET, COOKS HILL, NSW

Job No. 20829SP **Core Size:** NMLC **R.L. Surface:** ≈ 8.2m
Date: 21-12-06 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** T.M./fw.

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL VL L M H VH EH)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				SHALE: grey.	DW	M-H			
				COAL	DW	L			
		26		SHALE: grey.	DW	L-M			- XWS, 0°, 30mm.t - Cr, 40mm.t - XWS, 0°, 30mm.t
				SANDSTONE: fine grained, grey.	SW	H-VH			- XWS, 0-2°, 30mm.t
		27							- J, 0-10°, Un, R
		28							- XWS, 0-2°, 20mm.t
		29							
		30							
				END OF BOREHOLE AT 30.17m					
		31							