# ASSESSMENT OF IMPACTS ON
# SALTWATER INTAKE TUNNELS FOR SSDA6
# SYDNEY INTERNATIONAL, EXHIBITION AND ENTERTAINMENT PRECINCT - ICC HOTEL

**Prepared for Lend Lease**

**Report PSM1986-021R – Rev.4** **August 2013**

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**APPENDICES**

# 1. INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Application (referred to as SSDA6) seeks approval for construction of the International Convention Centre (ICC) Hotel component of the Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) at Darling Harbour.

This SSDA follows SSDA1, which seeks approval for the core convention, exhibition and entertainment facilities of the SICEEP Project; SSDA2, a staged application that sets out a Concept Proposal for a new mixed use neighbourhood at Darling Harbour known as 'The Haymarket'; and a number of detailed proposals (SSDA3, SSDA4, and SSDA5) for use of development plots within The Haymarket. SSDAs 1 and 2 were submitted to the Department of Planning and Infrastructure (DoPI) in March 2013, and the SSDAs 3-5 were submitted in May 2013.

The ICC Hotel forms part of the SICEEP Project, which will deliver Australia's global city with new world class convention, exhibition and entertainment facilities and support the NSW Government's goal to "make NSW number one again".

## 1.1. Overview of proposed development

The proposal relates to a SSDA for the ICC Hotel component of the SICEEP Project. The hotel is located at the northern end of the precinct and comprises a single building with 656 rooms. The hotel is being developed by Lend Lease and is consistent with Darling Harbour Live's Preferred Precinct Plan.

More specifically, this SSDA seeks approval for the following components of the development:

- Demolition of existing site improvements;
- Associated tree removal and replanting;
- Construction and use of a single hotel tower with 656 rooms and including guest facilities, restaurant and ballroom;
- Public domain improvements including integration with existing / proposed works; and
- Extension, realignment and augmentation of physical infrastructure / utilities as required.

## 1.2. Background

The NSW Government considers that a precinct-wide renewal and expansion of the existing convention, exhibition and entertainment centre facilities at Darling Harbour is required, and is committed to Sydney reclaiming its position on centre stage for hosting world-class events with the creation of the Sydney International Convention, Exhibition and Entertainment Precinct.

Following an extensive and rigorous Expressions of Interest and Request for Proposals process, a consortium comprising AEG Ogden, Lend Lease, Capella Capital and Spotless was announced by the NSW Government in December 2012 as the preferred proponent to transform Darling Harbour and create SICEEP.

Key features of the Preferred Precinct Plan include:

- Delivering world-class convention, exhibition and entertainment facilities, including:
  - Up to 40,000 $m^2$ exhibition space;
  - Over 8,000 $m^2$ of meeting rooms space, across 40 rooms;
  - Overall convention space capacity for more than 12,000 people;
  - A ballroom capable of accommodating 2,000 people; and
  - A premium, red-carpet entertainment facility with a capacity of 8,000 persons.
- Providing a hotel complex at the northern end of the precinct, immediately adjacent to the new International Convention Centre.
- A vibrant and authentic new neighbourhood at the southern end of the precinct, called 'The Haymarket', including apartments, student accommodation, community facilities, shops, cafes and restaurants.
- Renewed and upgraded public domain that has been increased by a hectare, including an outdoor event space for up to 27,000 people at an expanded Tumbalong Park.
- Improved pedestrian connections linking to the proposed Goods Line (formerly Ultimo Pedestrian Network) drawing people between Central, Chinatown and Cockle Bay Wharf as well as east-west between Ultimo/Pyrmont and the City.

### 1.3. <u>Site description</u>

The SICEEP Site is located within Darling Harbour. Darling Harbour is a 60 hectare waterfront precinct on the south-western edge of the Sydney Central Business District that provides a mix of functions including recreational, tourist, entertainment and business.

With an area of approximately 20 hectares, the SICEEP Site is generally bound by the Light Rail Line to the west, Harbourside shopping centre and Cockle Bay to the north, Darling Quarter, the Chinese Garden and Harbour Street to the east, and Hay Street to the south. The SICEEP Site has been divided into three redevelopment areas – Bayside, Darling Central and The Haymarket.

The ICC Hotel Site (refer to figure below):

- is located within the northern end of the Bayside precinct;
- is bound by Harbourside Shopping Centre to the north and east, the International Convention Centre to the south and Darling Drive to the west; and
- occupies an area of approximately 3,730 $m^2$.


SICEEP site and redevelopment areas

## 1.4. Planning approvals strategy

The SICEEP Project will result in the lodgement of numerous SSDAs for the various components of the redevelopment project. SSDAs have already been lodged for the PPP component of the SICEEP Project (comprising the convention centre, exhibition centre, entertainment facility and ancillary commercial premises and associated public domain upgrades), the Stage 1 Concept Proposal for The Haymarket, and the Stage 2 detailed proposals for three of the development plots within The Haymarket. Future applications will be lodged for the remaining development plots within The Haymarket Site.

This Application relates to a SSDA6 for the ICC Hotel component of the SICEEP Project and is consistent with Darling Harbour Live's Preferred Precinct Plan.

## 2. SCOPE OF WORK

This report presents a preliminary assessment of the impacts of the proposed hotel development on the existing historic saltwater intake tunnels which are located adjacent to the site.

This work was undertaken by Pells Sullivan Meynink (PSM) for Lend Lease Development Pty Ltd (Lend Lease).

It is noted that PSM has previously undertaken an initial assessment for a different proposed development of the site (Ref. PSM1986-011R). The current proposal differs in regards to the building size and footing layout.

Documents provided by Lend Lease and relied upon in undertaking this work are included in the appendices.

## 3. EXISTING SALTWATER INTAKE TUNNELS

The saltwater intake tunnels are located immediately to the north of the hotel site, as shown in Figure 1. The crown level (top) of the tunnel excavations are located approximately 6 m below the existing surface level.

These tunnels were completed by about 1928 and provided cooling water from Darling Harbour for the Ultimo Power House (now the Powerhouse Museum). The infrastructure is included in the Sydney Harbour Foreshore Authority's Heritage and Conservation Register.

It is noted that saltwater intakes considered in this report were a later addition to the Ultimo Power House, and that the original intake conduits had been completed by about 1899, though along a different alignment.

The intake tunnels comprise twin 1.8 m diameter pipes which run parallel to each other along most of their 850 m alignment. They run from the Powerhouse Museum northwards parallel to Darling Drive, and then turn east towards Darling Harbour. Approximately 50 m from the harbour the tunnels diverge, and each terminates in a substantial concrete intake structure located beneath Wharf 37 and Wharf 39.

Based on the historical records summarised in the Archaeological Assessment and Impact Statement prepared by Casey & Lowe Pty Ltd (Reference 1, extract of which is included in Appendix B), for the majority of their length the pipes were laid within a tunnel excavated in sandstone bedrock. Figure 2.45 in the report shows a dimensioned cross section of the tunnel which indicates an excavated height of 2.4 m and a span of 4.2 m. The historical photos in the report do not show any indications of structural support installed within the tunnel (e.g. timbering), which suggests that the rock conditions encountered were good enough to be self-supporting (at least in the locations shown in the photos). Some of the photos also suggest that the crown may have been excavated higher than indicated by the dimensioned drawing, possibly as a result of over-break along pre-existing defects in the rock.

Where the pipes enter the harbour they are understood to be supported by concrete piles. The location of the end of the tunnel and start of the underwater section is not known with any certainty, though is probably located near where the tunnels diverge (see Figure 1).

The intake pipes each comprise steel reinforced concrete pipes with an internal diameter of 1.8 m, and a wall thickness of 75 mm at the springline (sides) and 100 mm in the crown and invert (top and bottom). They were constructed off site in 7.6 m lengths, then manoeuvred into position within the tunnels and placed on a concrete footing. The weight of each length is approximately 30 tonnes.

The pipes are referred to as 'Monier' pipes, which is a trade name for an early reinforced concrete manufacturing technique. Gummow Forrest and Company imported a Monier pipe making machine from Europe in 1897 and set up a business near Darling Harbour (http://www.austehc.unimelb.edu.au/tia/848.html). The 22 June 1899 edition of the Sydney Morning Herald contains proceedings of the Engineering Section of the Royal Society, which included a précis of a paper by Mr Gummow entitled "Manufacture of Monier pipes". The article describes manual placement of cement grout and mortar on a form, followed by tensioned netting and a spiral wound wire. A second layer of grout and mortar is applied, and then a second spiral wire, and a third and final layer of mortar applied to achieve the required thickness. This may have been the process used in the construction of the original intake conduits (i.e. installed by about 1899).

Gummow Forrest and Company Ltd were purchased by the NSW Government in 1915 and became Monier State Pipe and Reinforced Concrete Works. A further refinement to the construction process was the introduction of 'vibra-spinning' which allowed simultaneous vibration while spinning of the pipe, which improved concrete quality.

The space in the tunnel between the pipes and rock was manually filled with rubble and poor quality concrete. Figure 2.47 from the archaeological assessment shows hand-packing of rubble around the pipes, which suggests that the rubble was not compacted, and used merely to ensure that the pipes remained on their footings.

Service drawings prepared by Lend Lease (Appendix C) indicate the approximate location of the tunnels. These drawings show two existing easements for the tunnel as shown in Figure 1. The easement dimensions are as follows:

- Easement on west side of Darling Drive is:
    - upper limit RL -3.00 m AHD
    - lower limit RL – 5.70 m AHD (i.e. easement height of 2.70 m)
    - width 4.0 m
- Easement on east side of Darling Drive is:
    - upper limit RL -2.33 m AHD
    - lower limit RL – 4.72 m AHD (i.e. easement height of 2.39 m)
    - width 4.7 m

Therefore the tunnel dimensions are larger than some of the dimensions of the existing easements, suggesting that the easement details provide only an approximate indication of the structure's size and location.

Note that there is currently no easement for the 65 m long section of the tunnel alignment which passes closest to the hotel.

For the purpose of this report it is assumed that the tunnels are centred within the existing easements and run in a straight line between them.

## 4. GEOTECHNICAL MODEL

### 4.1. Geotechnical units

A geotechnical model was prepared for the site based on a range of geotechnical data provided by Lend Lease, as well as from ten boreholes drilled for the hotel site by Coffey Geotechnics between May and June 2013 (Reference 2). The location of the boreholes is shown in Appendix D, and selected borehole logs are included in Appendix E.

The hotel is located on land reclaimed from Darling Harbour, as indicated by the location of the 1822 and 1854 shorelines shown on Figure 1.

The recent geotechnical investigation includes boreholes BH201 and BH202 drilled in the immediate vicinity of the saltwater intake tunnels. These indicate relatively good rock conditions, with bedrock occurring at about a metre depth.

Figure 2 and Figure 3 present two geotechnical sections extracted from the 2013 Coffey report, with the inferred location of the saltwater intake tunnels also shown.

Assessed geotechnical units, levels, and thicknesses for the site are shown in Table 1 below.

**TABLE 1**
**GEOTECHNICAL MODEL**

| GEOTECHNICAL UNIT | REDUCED LEVEL OF TOP OF UNIT RL (m) AHD | THICKNESS (m) |
|---|---|---|
| FILL, ALLUVIUM | 2.1 to 3.2 | 3 to 11 |
| CLASS III SANDSTONE | 2 to -8 | 1 to 3 |
| SHALE INTERBED (CLASS III) | -6 to -7 (absent in places) | 0.5 to 1 |
| CLASS II SANDSTONE | -3 to -10 | 3 |
| CLASS I SANDSTONE | -5 to -10 | > 20 |

Note: 1. Rock has been classified in accordance with Reference 3.

Inferred bedrock surface contours are also shown in Figure 1. These indicate that the rock levels drop from the west to the east by about 10 m over a distance of roughly 80 m.

### 4.2. Groundwater

Groundwater levels encountered in borehole investigations in the immediate vicinity of the shoreline have been measured at levels of between RL 1.25 m and RL -0.7 m.

It is noted that tide levels rarely exceed the range between RL -1.0 m and RL 1.2 m (Fort Denison), and therefore the intake tunnels would be permanently immersed.

## 5. ASSESSMENT OF IMPACTS ON SALTWATER INTAKE TUNNELS

### 5.1. Adverse mechanisms

Potential adverse effects on the saltwater intake tunnels have been considered in terms of those arising from the proposed hotel construction:

- Damage to the tunnel and pipes by physical impact from the drilling of pile holes.
- Damage to the tunnel and pipes by physical impact from the excavation of the trench for the diverted stormwater pipe.
- Damage to the tunnel and pipes caused by instability of the loaded pile (i.e. failure of the pile into the adjacent tunnel excavation).
- Damage to pipes from vibration caused by pile excavation.
- Deformation of the intake tunnel and pipes due to settlement of the hotel pile foundations.
- Vibration from excavation of trench for diverted stormwater pipe.

The following sections present an assessment of the above effects.

### 5.2. Physical impact

#### 5.2.1. General

The pile layout plan provided to PSM does not indicate pile lengths or founding levels. The closest pile to the intake tunnels is of 900 mm diameter and from the indicative basement plan included in Appendix A is shown to be located 4 m from the centreline of the saltwater tunnel easement.

As noted previously in Section 3, the location of the saltwater intake tunnel is only known approximately.

### 5.2.2. Drilling of pile holes

The actual distance between the closest proposed pile and the existing tunnel excavation is related to the following construction tolerances:

- pile location in plan,
- pile verticality, and
- excavated tunnel size (i.e. compared to the design drawing)

Based on previous piling experience, for a deep pile drilled with an auger and coring bucket, the out-of-plan deviation at 8 m depth may be in the order of 0.3 m.

Tunnels are frequently excavated larger than the design dimensions. For the purpose of this assessment an allowance for 0.5 m lateral over-excavation is considered appropriate, which corresponds to an overall tunnel span of 5.2 m.

In addition, because the location of the tunnel is only approximately known, the actual plan location could be different to that assumed at present. It is proposed that an allowance of 1 m be provided to account for this uncertainty.

For the anticipated rock conditions, a pillar width of at least 0.5 m is considered necessary between the side of the closest pile and the excavated tunnel wall. This width is to prevent excessive disturbance of the rock pillar located between the pile hole and the tunnel excavation.

Adding the above considerations results in a separation distance of 4.4 m between the centreline of the tunnel and the side of the closest pile (4.2/2 + 0.5 + 1.0 + 0.5 + 0.3). Note that this is in regards to physical impact only, and does not consider vibration effects or pile settlement, which are addressed in the following sections.

As noted above, the closest proposed pile is located closer to the tunnel than the proposed set-back distance. Therefore additional precautions are proposed to ensure that the pile hole does not strike or disturb the tunnel excavation:

- Drill a small diameter cored pilot hole (i.e. using a geotechnical investigation drilling rig) to check the location of the tunnel prior to the commencement of pile hole excavation. This would be located 0.5 m from the proposed side of the pile, and drilled vertically, to confirm the presence of at least 0.5 m rock between the pile and the tunnel.
- Undertake additional checks on the set-out position of the pile.
- Employ additional checks on the verticality of the pile.

### 5.2.3. Trench excavation for stormwater pipe diversion

A drawing showing the proposed stormwater pipe diversion is included in Appendix D, and shows that this involves:

- New 1500 mm diameter stormwater pipe
- Invert RL -0.4 m (Approx.)
- Clearance from top of intake tunnel to bottom of pipe 1.7 m (Approx.)

There is a potential for the trench excavation to intersect the tunnel excavation of the intake tunnel.

The base of the trench excavation is likely to be about 0.7 m below the invert level of the pipe (i.e. about RL -0.7 m where it passes over the existing tunnels).

The top of the tunnel easement on the east side of Darling Drive is at RL -2.33 m, and the easement height is 2.39 m. This compares to the dimensioned drawings which show a tunnel height of 2.4 m, and historic photos, some of which indicate the tunnel crown could be 0.5 m higher. Therefore the tunnel crown could be at RL -1.8 m, and possibly even higher.

Therefore the thickness of the rock between the tunnel crown and the base of the trench is likely to be 1.1 m or less. To manage to risk of intersecting the tunnel excavation, the following measures are proposed:

- Minimise the depth of trench excavation.
- Drill a small diameter cored pilot hole (as described above) to confirm the rock cover above the tunnel crown.

### 5.2.4. Pile instability

Where the pile toe level is located above the invert (floor) level of the adjacent tunnel, there is a potential for failure of the pile into the tunnel. Therefore it is recommended that the pile toe levels be such that they are located at least 1 m below a 45° 'line of influence' projecting upwards from the side of the tunnel.

This may result in the lengths of piles located near the tunnel being greater than would otherwise be required.

## 5.3. <u>Vibration limits</u>

The published literature provides some guidance in regards to the tolerable vibration limits for various types of structure:

- 4 mm/s for structurally unsound structures under heritage protection (West German vibration criterion for blasting, Reference 6).
- 12 mm/s for old residential structures in very poor condition (Chae, Reference 7)
- 2 mm/s up to 30 mm/s for historic buildings in other countries (Reference 6).
- 30 mm/s for well-braced structures with heavy elements, structurally sound (West German vibration criterion for blasting, Reference 6).

The pipes at the time of construction are likely to be fairly robust, such that they could readily tolerate vibration of 30 mm/s. As described in the previous section, the condition of the 85 year old reinforced concrete pipes is uncertain.

For the purposes of this assessment, an acceptable vibration limit in the order of 15 mm/s is proposed. This is about half of the value which would apply for the pipes at the time when they were constructed.

## 5.4. <u>Tolerable stress limits</u>

### 5.4.1. 'Reverse engineering' of pipe design

Details of the pipe reinforcing details are not shown in the available documents, though the basic pipe construction methodology is described above in Section 3. It is inferred from the pipe thickness that the prestressed reinforcing wires would be located about 50 mm from the inside face of the pipes so as to provide at least 20 mm cover to the outer wires. This implies that the inner 50 mm of concrete is maintained in compression by the tensioned wires.

In order to form some understanding of the likely structural capacity of the pipes, it is necessary to undertake 'reverse engineering' from the details that are known or inferred. This is to facilitate assessment of the forces and stresses for which the pipe was designed, and so permit a more realistic assessment of the capacity of the pipes when subjected to additional deformation or loads.

Several loading scenarios are considered below, with stresses in the pipe calculated for each. Note that the calculated stresses do not consider the effect of prestressing. The effect of prestressing forces (i.e. from the tensioned spiral wound wire) would result in the actual stresses being more compressive than the calculated stresses. This effect is considered in the assessment of acceptable limits.

It is frequently the case for precast concrete elements that the critical loading conditions they experience is during their handling and transporting between the factory and their final position. These conditions also include the case where the concrete is not fully cured and is thus relatively weak. There may also be dynamic loading conditions such as due to lifting and transportation.

Current precast concrete is regularly constructed with compressive strengths in excess of 60 MPa (http://www.cpaa.asn.au). In the 1920s, it is estimated that the 'vibra-spun' Monier pipes may have achieved a somewhat lower strength, say in the order of 25 MPa to 30 MPa. The working stress would probably be no greater than half this value, say 10 MPa (compression).

Based on the review of the various loads the original designers may have considered, and the proposed working stress of 10 MPa, it seems probable that the prestress would have been designed to achieve a hoop compressive stress in the order of 2 MPa. It is estimated that this would apply for the inner 50 mm wall thickness of the pipe. The implications of this in regards to steel quantity have been checked and appear realistic (i.e. 5 mm diameter wires spaced at about 20 mm, and stressed to 150 MPa).

Therefore to avoid cracking of the prestressed lining of the pipe (at the time of construction), tensile stresses on the inside face would need to be limited to less than about 4 MPa (i.e. 2 MPa prestress plus 2 MPa tensile strength of concrete). This assessment appears consistent with the various loading scenarios considered and other pipe details.

**TABLE 3**
**PIPE SERVICE LOADING CONDITIONS**
**AND ASSESSED WALL STRESSES**

| **LOADING CONDITION** | | **CALCULATED WALL STRESSES** [1.] | |
|---|---|---|---|
| | | **INSIDE FACE**<br>(MPa) | **OUTSIDE FACE**<br>(MPa) |
| Handling and transportation | Pipe placed on flat surface.<br>*Stresses calculated from Phase$^2$ analysis.* | +0.7<br>-0.8 | +0.7<br>-0.6 |
| | Pipe placed on timbers.<br>*Extrapolation based on Phase$^2$ analysis of continuously supported pipe.* | +1.4<br>-1.6 | +1.4<br>-1.2 |
| | Pipe section suspended from two slings (Ref. Figure 2.51 of heritage report).<br>*Hand calculation based on pipe geometry and weight.* | +0.5<br>-0.5<br>(longitudinal stresses) | +0.5<br>-0.5<br>(longitudinal stresses) |
| | Dynamic loading condition.<br>*Arbitrarily assumed to be about double the (static) loading conditions considered above.* | +2.8<br>-3.2 | +2.8<br>-2.4 |
| Service | Pipe installed in tunnel and buried by 0.5 m of rubble filling.<br>*Stresses calculated from Phase$^2$ analysis.* | +1.8<br>-1.6 | +1.6<br>-1.3 |
| | Pipe dewatered for inspection or maintenance (i.e. by operation of the valve at the inlet structure beneath the wharves). External water pressures correspond to a phreatic surface at RL 1.0 m.<br>*Hand calculation based on pipe geometry.* | +0.7<br>(hoop stress) | +0.7<br>(hoop stress) |

Notes: 1. +ve = compression, -ve = tension.
2. Calculated stresses ignore effect of prestressing.

### 5.4.2. Tolerable stresses

The above considerations are for the pipe at the time of construction, not after 85 years of service. The current condition of the pipes is unknown, other than they were used for training purposes by police divers in the 1990's. It is also understood that they are still used to supply cooling water to the Powerhouse Museum.

Present day suppliers of reinforced concrete pipes quote a service life of 100 years or more. It seems improbable that the intake pipes installed in a relatively aggressive environment (i.e. saltwater), would have survived 85 years without some degree of deterioration. The form of deterioration considered most likely to occur is corrosion of the steel wire and associated spalling of the layers of concrete between the wire and the outside surface of the pipe. This type of degradation would reduce the strength of the pipe, in particular the beneficial effect of prestressing.

For the purposes of this preliminary assessment, the following stresses have been adopted as acceptable limits:

- Compressive stress, $\sigma_c \leq 5$ MPa
- Tensile stress, $\sigma_t \leq 2$ MPa

These stresses are in the circumferential direction and are about half the values which would apply for the pipes at the start of their service life.

## 5.5. <u>Impact from hotel construction</u>

### 5.5.1. Vibration from bored pile construction

Vibration magnitude for various construction activities are described in Reference 7. For bored pile construction in rock, the resulting vibration characteristics are considered to be represented by the pseudo-steady-state conditions described in the reference.

Vibration data from pile excavation is not provided. This is likely to be because this type of vibration is typically negligible and does not result in adverse effects.

Vibration from other excavation activities, including “caisson drilling” and “jack hammers” are provided, and these are considered to be rough analogues for pile excavation using an auger fitted with tungsten points, as is often used in Sydney. For a distance of 2 m, vibration values (peak particle velocity) of between 6 mm/s and 15 mm/s are given for these plant types.

When a pile core barrel is employed for drilling rock it is often necessary to use the piling rig’s kelly bar to break off the cored rock from the bottom of the pile hole. Much larger vibration is expected to result from this practice compared to the values presented above.

Based on the above discussion of vibration limits and likely magnitude, it is considered that vibration from excavation of bored piles presents a moderate risk to the historic intake tunnels. Therefore a vibration trial would need to be undertaken to establish a ‘site law’ for vibrations from the proposed piling rig, construction method, and separation distance between the pile and tunnel. This trial would then allow an appropriate construction methodology to be developed.

### 5.5.2. Vibration from trench excavation for stormwater pipe diversion

Reference to the inferred top of rock level contours shown in Coffey’s Figure 2 (Appendix E), suggests a rock level at about RL 1.5 m at the location where the proposed stormwater pipe passes over the existing saltwater intake tunnels. Therefore the trench excavation for the diverted pipe is likely to involve about 2 m depth of excavation in bedrock.

Borehole BH202 is located about 15 m from this location. The engineering log for this borehole (included in Appendix F) shows that rock levels in the upper 2 m comprise slightly weathered to fresh sandstone, of medium to high strength.

Excavation of the rock could be undertaken by a variety of techniques, including:

- Excavator-mounted rock breaker,
- Excavator-mounted rotary grinding head, or
- Saw cutting and hydraulic splitting.

Reference 7 (Wiss, 1981) would indicate a peak particle velocity for rock breaker (assumed similar to pavement breaker) of about 70 mm/s for 2 m separation. Reference 8 (Hackney, 2002) provides specific data for a range of rock breaker sizes. For a 1000 kg to 1500 kg breaker, the extrapolated peak particle velocity is approximately 20 mm/s to 50 mm/s for 2 m separation. The monitoring data in Reference 8 also shows that smaller breakers result in less vibration.

Reference 8 also includes limited data for rotary rock grinders. This indicates peak particle velocities of approximately 2 mm/s to 50 mm/s for 2 m separation.

It is noted that actual vibration effects will be dependent on equipment details and how it is used, as well as geotechnical conditions.

Based on the above discussion of vibration limits and likely magnitude, it is considered that where the trench excavation approaches the saltwater intake tunnel, that vibration levels could potentially result in damage to the pipes, even for relatively delicate techniques such as rotary grinding. We are unaware of any data relating to vibration from the use of rock saws and hydraulic splitting, though expect that this technique would cause less vibration than the other methods considered.

Therefore, as per the previous discussion for pile construction, a vibration trial would need to be undertaken to establish a 'site law' for vibrations from the proposed excavation plant, construction method, and separation distance between to the tunnel. This trial would then allow an appropriate construction methodology to be developed.

### 5.5.3. Deformation due to hotel foundation settlement

A finite element analysis was previously undertaken for an earlier proposed hotel detail. This was done to calculate the stresses experienced by the intake tunnels due to deformation of the bedrock beneath the hotel piled foundations. Note that the currently proposed building applies a total vertical pile working load of only about 85% of the previous proposal.

It is considered appropriate that the results from the previous analysis be used to assess the current hotel detail.

The software package Phase$^2$, produce by Rocscience Inc was used for finite element analysis. The model included the saltwater intake tunnels, as well as the northern hotel foundation. Phase$^2$ is use to analyse two-dimensional problems, through the hotel footing only occurs over a relatively small area. To avoid an excessively conservative assessment, the pile loads were adjusted based on the pile geometry relative to the intake tunnel alignment.

The $Phase^2$ analysis included several construction stages, including:

1. Pre-development
2. Intake tunnel excavation
3. Placement if intake pipes
4. Backfilling around pipes
5. Installation of hotel piles
6. Loading of piles

The analysis indicated that excavation of the tunnel resulted in significant redistribution of stresses in the surrounding rock, with high compressive stresses in the invert and crown of the tunnel. Lateral convergence movement in the order of 3 mm was also calculated.

Once the hotel piles are installed and loaded, the calculated stresses in the pipes were:

- Compressive stress, $\sigma_c$ = 1.8 MPa (inside face)
  = 1.6 MPa (outside face)
- Tensile stress, $\sigma_t$ = 1.6 MPa (inside face)
  = 1.3 MPa (outside face)

These values are somewhat smaller than the adopted limits discussed previously, and are similar to the service loading conditions shown in Table 3.

The analysis indicates overall pipe movement in the order of 0.4 mm.

This assessment indicates that rock deformation due to the service loading of the proposed hotel piled foundation will have no adverse effect on the intake tunnels. This assessment is contingent on the application of the set-back distances noted in Section 5.2.

## 6. CONCLUSION AND RECOMMENDATIONS

The assessment described in this report demonstrates that the proposed hotel development can be constructed so as to achieve acceptable impacts on the existing saltwater intake tunnels.

The hotel building is to be supported on piled foundations which will be founded in Hawkesbury sandstone bedrock.

The saltwater intake tunnel is overlain by about 6 m thickness of sandstone bedrock and fill, and is located within a few metres of the closest proposed hotel pile. The intake tunnel was constructed in about 1928 and houses twin 1.8 m diameter reinforced concrete pipes.

To control physical impacts from the closest pile on the tunnel, a set-back distance is proposed. A restriction on the pile toe level is also proposed to avoid potential pile toe instability from the adjacent tunnel excavation, as summarised in Table 4 below.

**TABLE 4**
**SUMMARY OF RECOMMENDATIONS**

| POTENTIAL HAZARD | RECOMMENDATIONS | REPORT REFERENCE |
|---|---|---|
| Drilling of pile holes | Maintain a separation distance of 4.4 m between the edge of the pile holes and the assumed centreline of the tunnel (refer also to 5.5.1 relating to the impact of vibration)<br>Drill a small cored pilot hole at 0.5 m from the edge of the pile hole to confirm at least 0.5 m rock to the edge of the tunnel<br>Undertake additional checks on the set out of the pile location and the verticality of the pile | 5.2.2 |
| Excavation of trench for stormwater pipe diversion | The thickness of the rock between the bottom of the trench and the tunnel crown is likely to be less than 1.1 m, therefore:<br>• Minimise the depth of trench excavation<br>• Drill a small cored pilot hole to confirm the rock cover | 5.2.3 |
| Instability of piles | Pile toe levels should be located at least 1 m below a 45 degree 'line of influence' projecting upwards from the base of the side of the tunnel | 5.2.4 |
| Vibration from bored pile construction | Vibration from bored pile construction represents a moderate risk to the tunnel.<br>Therefore a vibration trial would need to be undertaken to establish a site law for vibrations from the proposed piling rig, construction method, and separation distance between the piles and the tunnel. | 5.5.1 |
| Vibration from trench excavation for stormwater pipe diversion | Excavation for the stormwater pipe diversion represents a moderate risk to the tunnel.<br>Therefore a vibration trial would need to be undertaken to establish a site law for vibrations from the proposed excavation plant, construction method, and separation distance to the tunnel. | 5.5.2 |

Where piles are to be installed near the proposed set-back distance, the drilling of a small diameter cored pilot hole is recommended to check the location of the tunnel prior to the commencement of pile hole excavation. Additional checks during construction are proposed in regards to pile installation tolerances (Ref. Table 4).

An assessment of vibrations caused by the excavation of pile holes was undertaken, and it was concluded that monitoring be undertaken to check vibration impacts prior to excavating piles close to the tunnel. This may lead to restrictions on the type of piling plant employed and construction methods.

An assessment of the structural capacity of the intake pipes has been performed. This was based on the available historical data, and from consideration of the manufacturing method and estimated design loads. The current condition of the pipes is not known, and hence an arbitrary 50% reduction in capacity has been adopted to account for possible deterioration of the 85 year old pipes. This analysis suggests that cracking of the lining would occur when the compressive stresses exceed 5 MPa, or the tensile stresses exceed 2 MPa. Assessment of the proposed hotel development and the tunnels indicates that the pipe stresses are not significantly affected by the hotel loads, and that the induced stresses are acceptable in comparison to the adopted limits.

The hotel development will also require diversion of an existing 900 mm diameter stormwater pipe. The relocated pipe will pass over the top of the existing tunnels, and is expected to require about 2 m of excavation in sandstone bedrock. To ensure that the trench excavation does not intersect the tunnel, probe drilling is proposed to check the thickness of rock above the crown of the existing tunnels, as summarised in Table 4 above.

Vibration from plant used to excavate the stormwater trench could potentially damage the intake tunnels. Monitoring is recommended to be undertaken to check vibration impacts prior to the trench excavation approaching the tunnel. This may lead to restrictions to the type of excavation plant employed and construction methods.

In summary, subject to the constraints and recommendations presented in this report, PSM is satisfied that the proposed hotel building can be developed adjacent to the existing saltwater intake tunnel without causing adverse structural impacts.

For and on behalf of
PELLS SULLIVAN MEYNINK

STRATH CLARKE

## REFERENCES


1. Casey & Lowe Pty Ltd report "Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP), Non-indigenous Archaeological Assessment and Impact Statement for SSDA1", March 2013.
2. Coffey Geotechnics Pty Ltd report, Ref. GEOTLCOV24303AH-AF, "SICEEP - International Convention Centre Hotel, Geotechnical Investigation Report, Darling Harbour, NSW", July 2013.
3. Pells, P.J.N., and Mostyn, G., and Walker, B.F., "Foundations on sandstone and shale in the Sydney Region", Australian Geomechanics Journal, 1998.
4. Pells, P.J.N, "EH Davis memorial lecture – Rock mechanics and engineering geology in the design of underground works", 1993.
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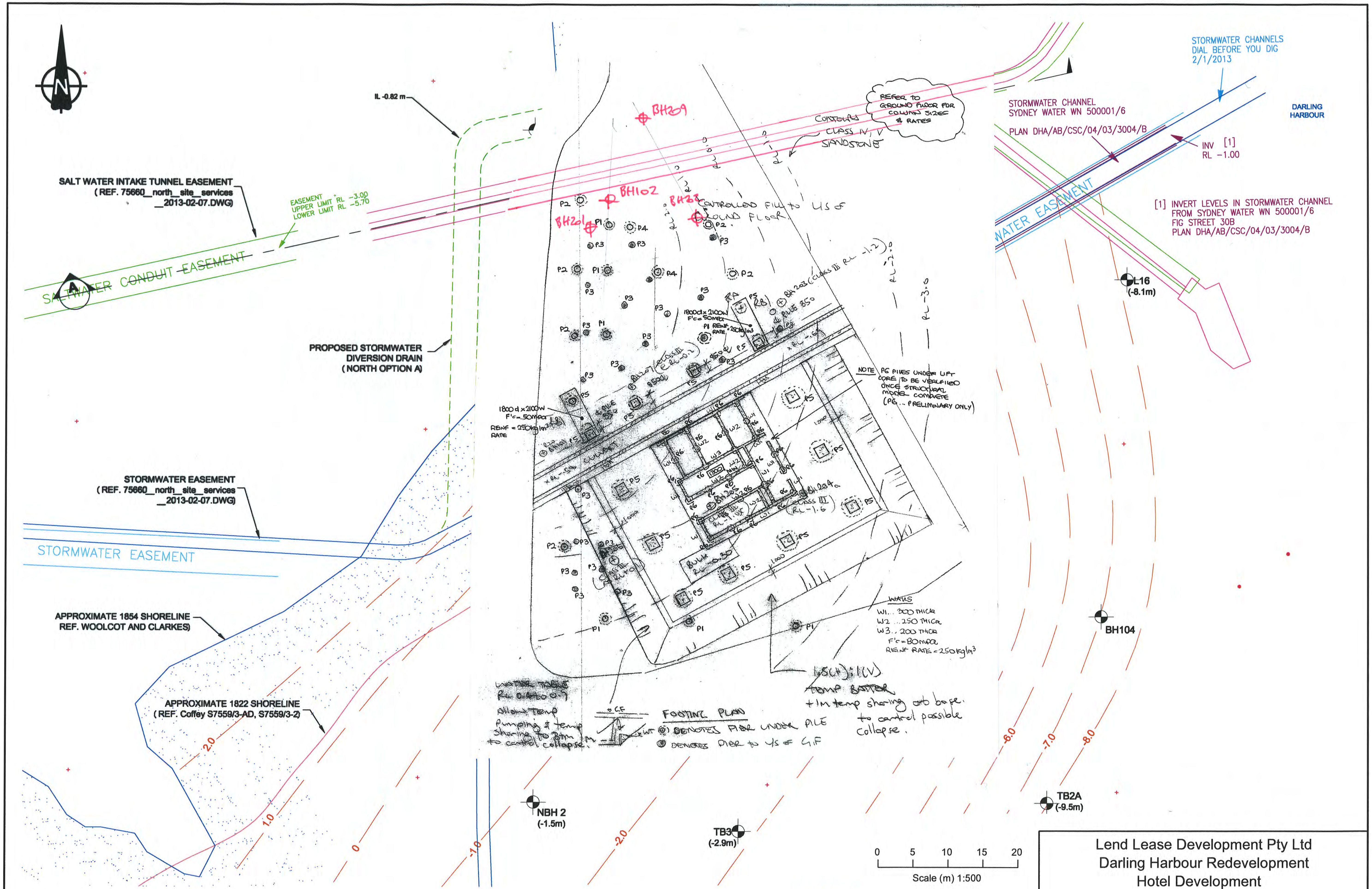
6. Rainer, J.H., "Effect of vibrations on historic buildings: An overview", Paper No. 1091, Division of Building Research, National Research Council, Canada, 1982.
7. Wiss, J.F., "Construction vibrations: State-of-the-art", Journal of the Geotechnical Engineering Division, February 1991.
8. Hackney, G.A., "Excavation induced vibration in Sydney sandstones", Proceedings of the 5th ANZ Young Geotechnical Professionals Conference, Rotorua, New Zealand, March 2002.
9. Australian Standard AS 2187.2-2006 "Explosives – Storage and use, Part 2: use of explosives".




Notes

1. (-2.9m) Reduced level of top of rock.
2. Surface survey and services; 75660 north_site_B-RBG.dwg, dated 13-02-2013.
3. BH101A and BH103 collar R.L. not specified,assumed as calculated from surface survey (2.)

PSM

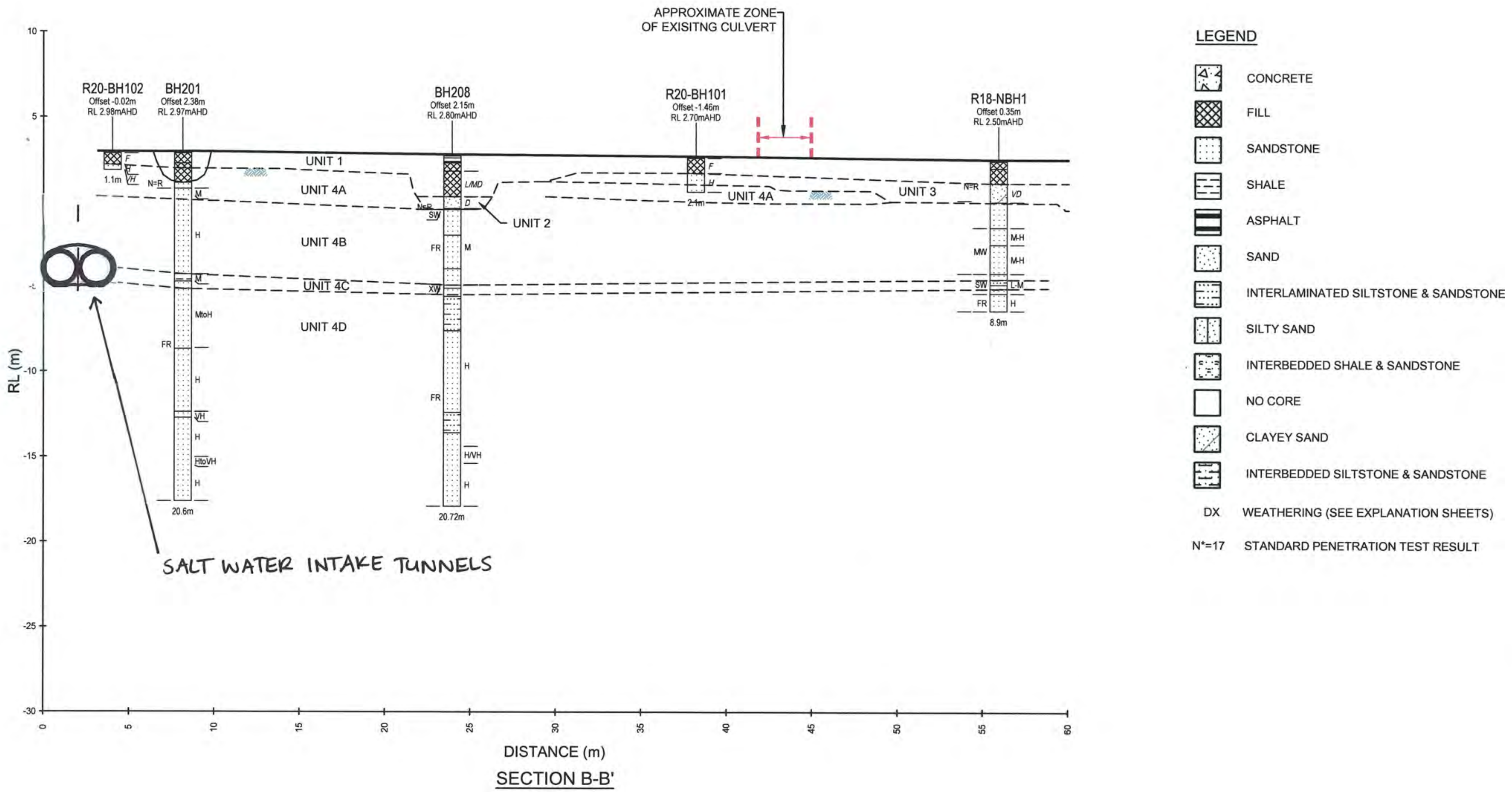
Pells Sullivan Meynink

Lend Lease Development Pty Ltd
Darling Harbour Redevelopment
Hotel Development

SITE PLAN

PSM1986-021R

FIGURE 1



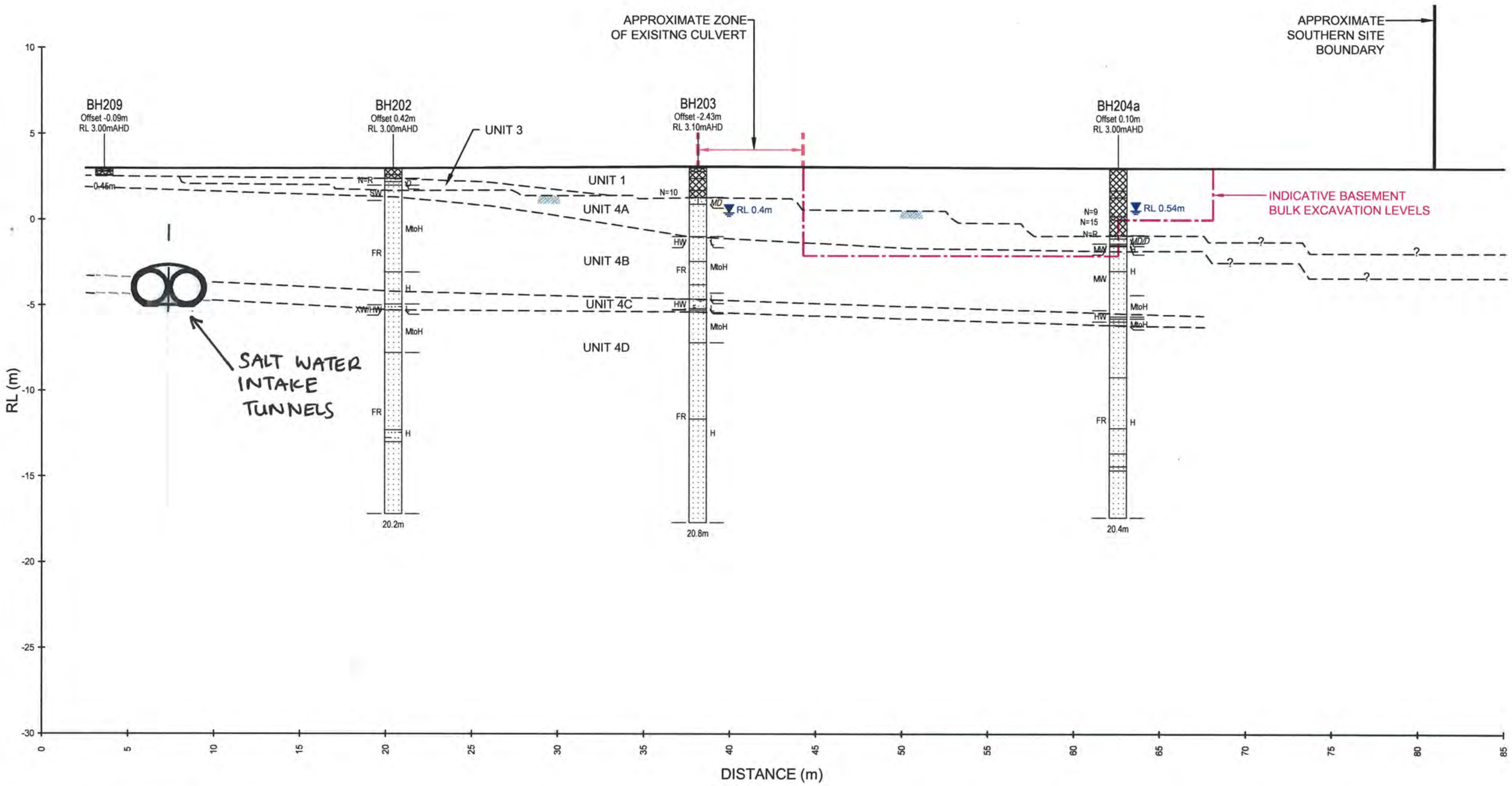

0 2 4 6 8 10

Scale (m)

Notes:
1) Section extracted from Coffey Geotechnics Report, 11 July 2013
2) Saltwater Intake Tunnel location is approximate

PSM
Pells Sullivan Meynink

| | |
|---|---|
| Lend Lease Development Pty Ltd<br>Darling Harbour Redevelopment<br>Hotel Development | |
| MODIFIED CROSS SECTION<br>COFFEY SECTION B-B' 2013 | |
| PSM1986-021R | FIGURE 2 |




SECTION C-C'

LEGEND

| | | | |
|---|---|---|---|
| | CONCRETE | | INTERLAMINATED SILTSTONE & SANDSTONE |
| | FILL | | SILTY SAND |
| | SANDSTONE | | INTERBEDDED SHALE & SANDSTONE |
| | SHALE | | NO CORE |
| | ASPHALT | | CLAYEY SAND |
| | SAND | | INTERBEDDED SILTSTONE & SANDSTONE |

DX WEATHERING (SEE EXPLANATION SHEETS)

N*=17 STANDARD PENETRATION TEST RESULT

WATER LEVEL RECORDED DURING GROUNDWATER SAMPLING

0 2 4 6 8 10
Scale (m)

Notes:
1) Section extracted from Coffey Geotechnics Report, 11 July 2013
2) Saltwater Intake Tunnel location is approximate

PSM
Pells Sullivan Meynink

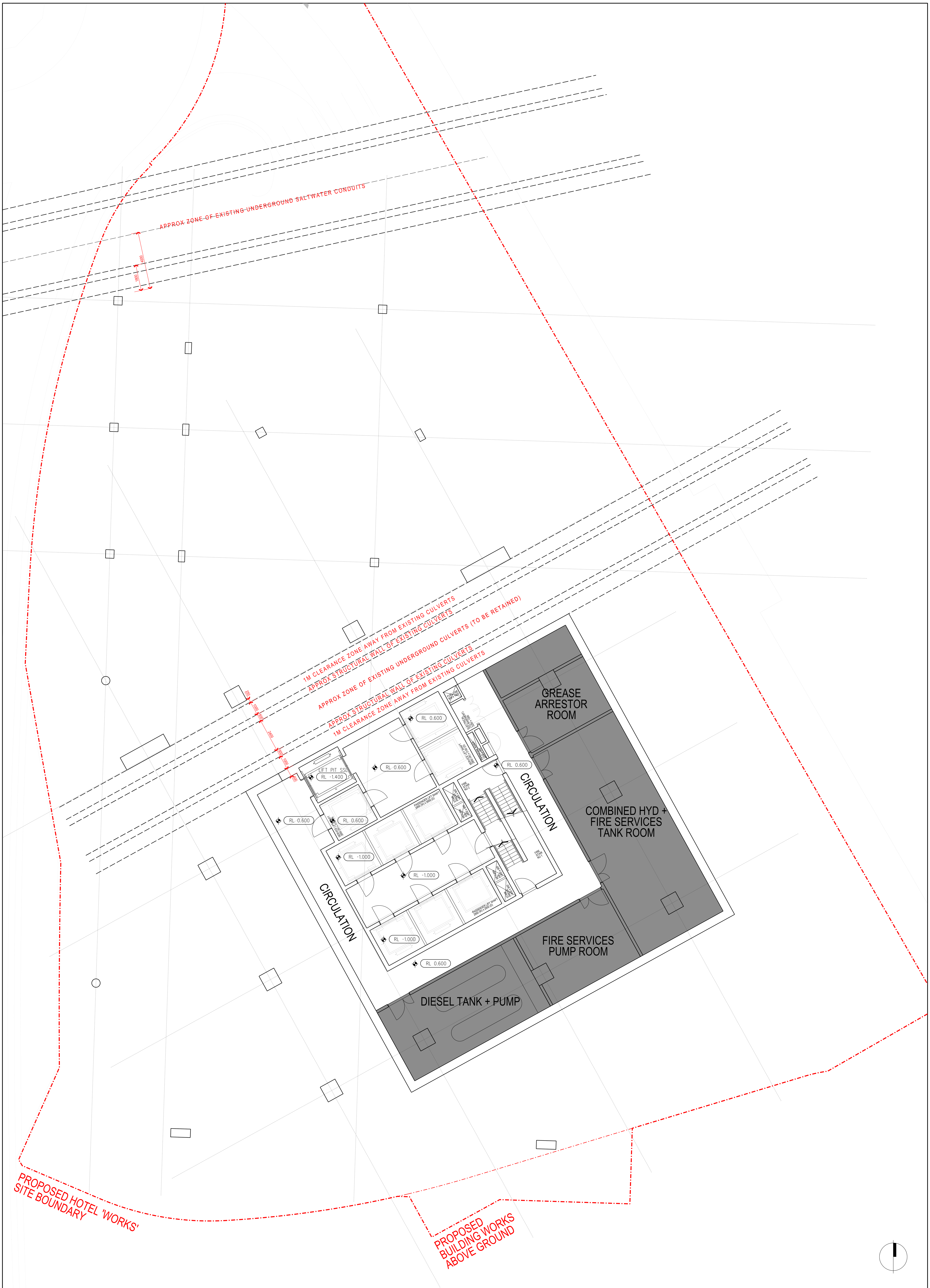
Lend Lease Development Pty Ltd
Darling Harbour Redevelopment
Hotel Development

MODIFIED CROSS SECTION
COFFEY SECTION C-C' 2013

| PSM1986-021R | FIGURE 3 |
|---|---|

**APPENDIX A**

**PROPOSED BUILDING LAYOUT AND PILE LOADS**



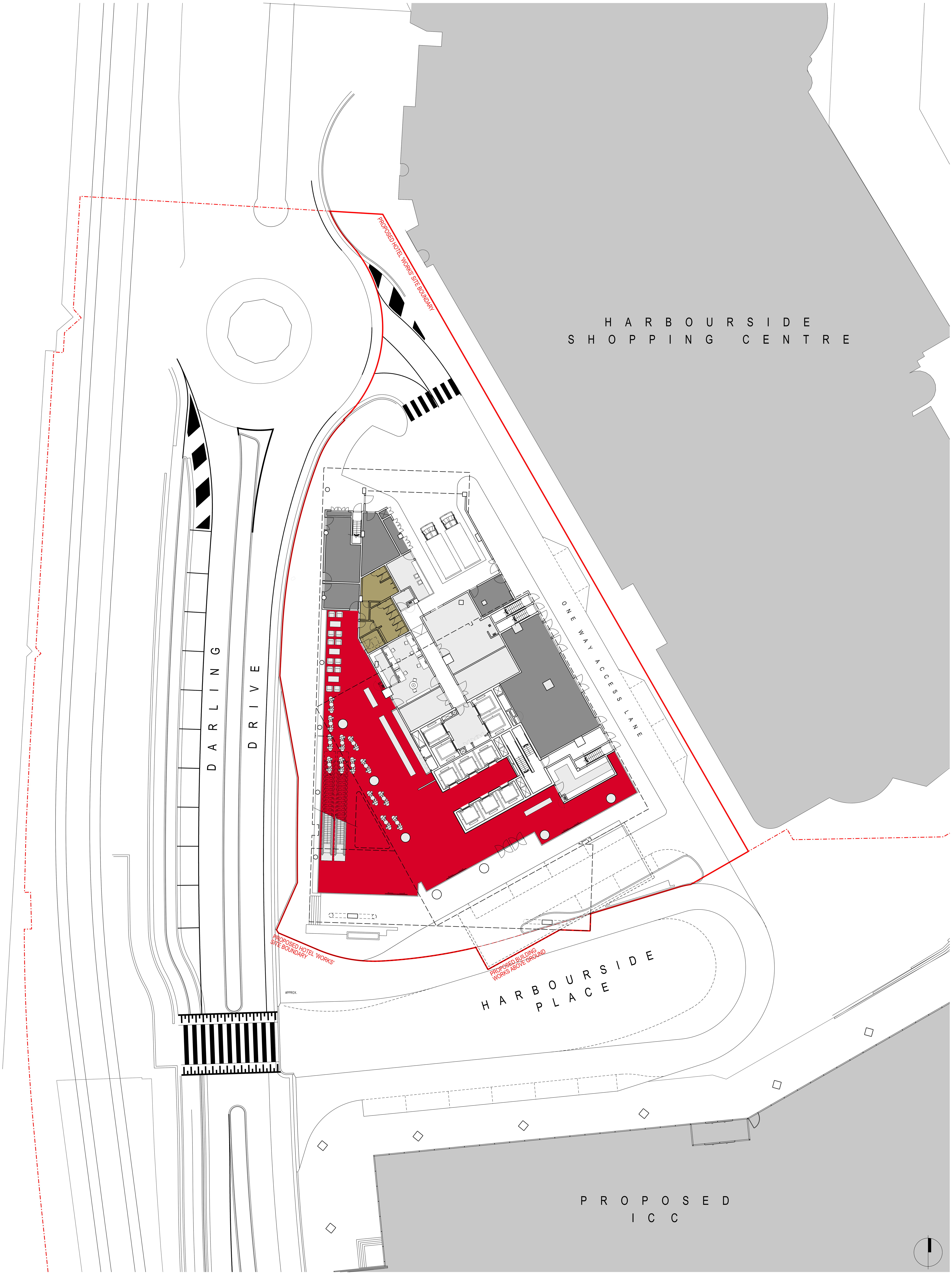

note: all planning configuration + figures noted are indicative only - subject to review + design development

jea344 29/08/2013 10:46:33 AM$FILE$

Lend Lease

| Project | Drawing | Drawing Number | Date | Issue | Scale |
|---|---|---|---|---|---|
| PROPOSED ICC HOTEL - SKETCH PLANNING STUDY | INDICATIVE BASEMENT PLAN | ASK090 | 13/08/13 | P | 0 5 10M<br>1:100 @ B1 1:250 @ A3 |

NOTE: ISSUED FOR DEVELOPMENT APPLICATION ONLY




Lend Lease

Architects

LEND LEASE DESIGN

Darren Kindrachuk
Principal Architect | ARB NSW 7240

fjmt
francis-jones morehen thorp
Richard Francis-Jones
Design Director | ARB NSW 5301

Landscape Architect

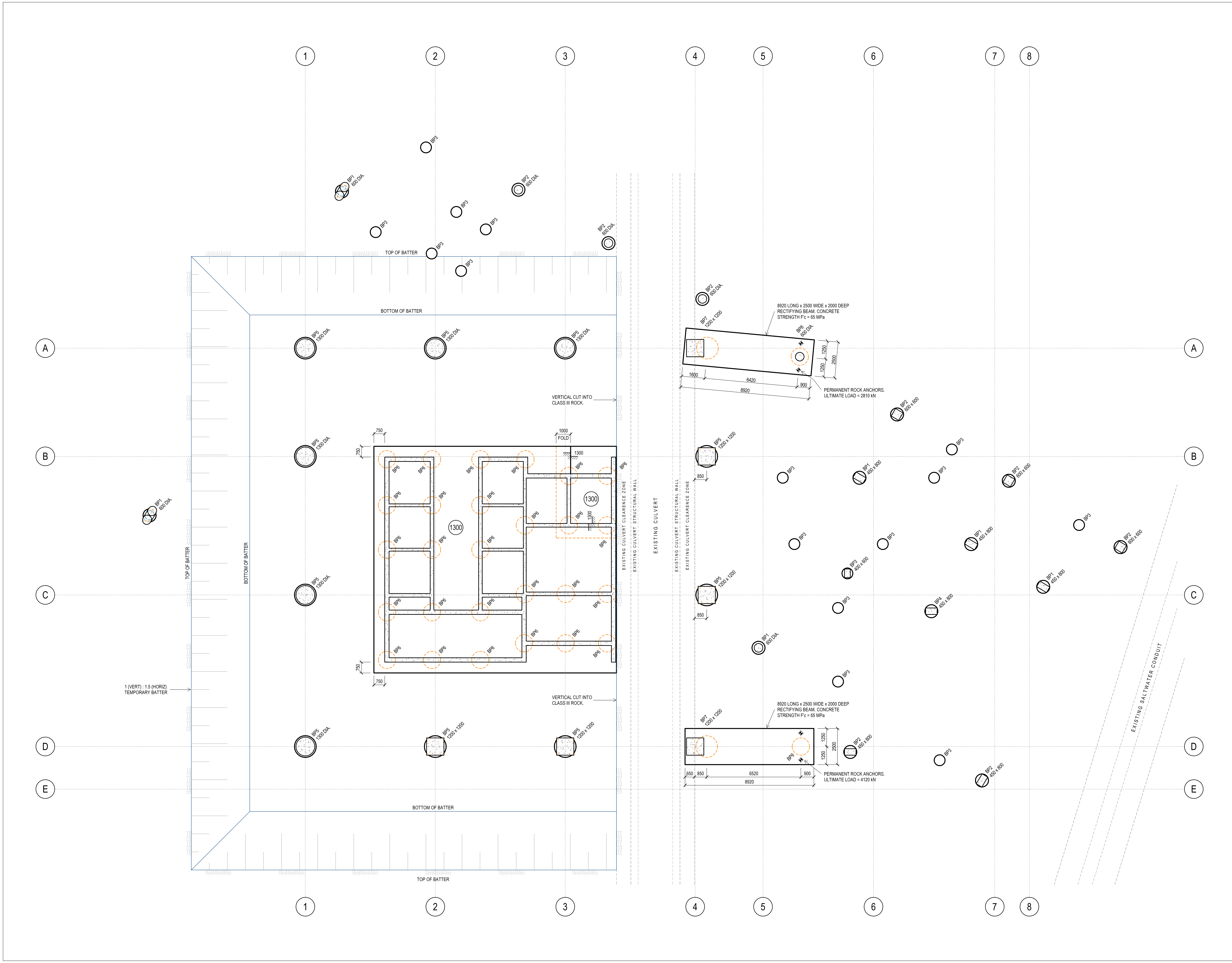
HASSELL

Ken Maher
Chairman International Executive | ARB NSW 3156

| | |
|---|---|
| Project Number 162661 | Drawing Number DA004 |
| Scale 1:200 | Revision A |

SSDA6 SICEEP - ICC HOTEL

Drawing Title
GROUND PLANE
WITH IMMEDIATE CONTEXT

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Key Plan

## GENERAL NOTES

REFER TO DRAWINGS:
: SD1000020 FOR BORED PILE SCHEDULE

FOR ROCK CONTOUR LOCATIONS REFER TO 'COFFEY GEOTECHNICS' DRAWING FIGURE 2, PROJECT No. GEOTLCOV24303AH-AF

## ROCK ANCHOR NOTES

PERMANENT ROCK ANCHORS ARE TO HAVE A DESIGN LIFE OF 50 YEARS.

| Rev | Revision Description | Date |
|---|---|---|
| | | |

Lend Lease

| | |
|---|---|
| Developer | Lend Lease |
| Project Management & Construction | Lend Lease |
| Design | Lend Lease |

Architect
Name I Principal Architect I Reg No.

Structural Engineer

Mechanical, Electrical, Hydraulic, Fire Services Engineering

Sustainability

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ABN 97 000 098 162
30 The Bond, 30 Hickson Road
Millers Point, NSW, 2000
www.lendlease.com

Client
LEND LEASE

Project
ICC HOTEL DEVELOPMENT

Title
# FOOTING PLAN

Scale: 0 — 5M
As indicated @ B1 1:100

| Drawn | Checked | Approved | Drawing Status |
|---|---|---|---|
| T.Bosman | P.Siewert | R.Bressi | PRELIMINARY |

| Project Number | Drawing Number | Revision |
|---|---|---|
| 162661 | SD1000010 | |

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T.Bosman

| BORED PILE SCHEDULE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PILE MARK | PILE DIAMETER (mm) | DESCRIPTION | CONCRETE STRENGHT (MPa) | REINFORCEMENT RATE (Kg/m) | WORKING LOAD (kN) | SHORT TERM SERVICE LOAD (kN) | | LONG TERM SERVICE LOAD (kN) | ULTIMATE LOAD (kN) | | ULTIMATE LATERAL LOAD (kN) |
| | | | | | | COMPRESSION | TENSION | | COMPRESSION | TENSION | |
| BP1 | 900 | BORED PILE | 40 MPa | | 6000 | 5700 | | 5400 | 7500 | | 187.5 |
| BP2 | 900 | BORED PILE | 40 MPa | | 4250 | 3900 | | 3560 | 5400 | | 135 |
| BP3 | 750 | BORED PILE | 40 MPa | | 700 | 630 | | 570 | 900 | | 22.5 |
| BP4 | 900 | BORED PILE | 40 MPa | | 2600 | 2380 | | 2170 | 3350 | | 83.75 |
| BP5 | 1500 | BORED PILE | 65 MPa | | 34000 | 32250 | | 30700 | 42100 | | 1053 |
| BP6 | 1200 | BORED PILE | 50 MPa | | 9970 | 18370 | 2300 | 8820 | 23130 | 2550 | 450 |
| BP7 | 1500 | BORED PILE | 65 MPa | | 32890 | 31960 | | 31030 | 40400 | | 5040 |
| BP8 | 1200 | BORED PILE | 65 MPa | | | | | | | 5624 | 4970 |
| BP9 | 1200 | BORED PILE | 65 MPa | | | | | | | 8240 | 4970 |
| Grand total: 72 | | | | | | | | | | | |

NOTES: PILE 'P7' TO BE DESIGNED FOR ULTIMATE MOMENT OF M* = 8200 kNm (INCLUDING 75mm OUT OF POSITION PILE TOLERENCE).
PILES 'P8 & P9' TO BE DESIGNED FOR AN ULTIMATE MOMENT OF M* = 4545 kNm (INCLUDING 75mm OUT OF POSITION PILE TOLERENCE).
PILES TO BE SOCKETED INTO UNIT 4B & 4D MATERIAL (TBA), REFER TO "COFFEY GEOTECHNICS" REPORT
MAXIMUM LONG TERM SETTLEMENT AT THE PILE HEAD = 10mm



Key Plan

| Rev | Revision Description | Date |
|---|---|---|

Lend Lease

Developer — Lend Lease

Project Management & Construction — Lend Lease

Design — Lend Lease

Architect
Name I Principal Architect I Reg No.

Structural Engineer

Mechanical, Electrical, Hydraulic, Fire Services Engineering

Sustainability

Lend Lease Design
ABN 97 000 098 162
30 The Bond, 30 Hickson Road
Millers Point, NSW, 2000
www.lendlease.com

Client
LEND LEASE

Project
ICC HOTEL DEVELOPMENT

Title
FOOTING DETAILS - SHEET 1

Scale
0 1M
1 : 1 @ B1 1:20

| Drawn | Checked | Approved | Drawing Status |
|---|---|---|---|
| T.Bosman | P.Siewert | R.Bressi | PRELIMINARY |

| Project Number | Drawing Number | Revision |
|---|---|---|
| 162661 | SD1000020 | |

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**APPENDIX B**

**EXTRACT FROM ARCHAEOLOGICAL ASSESSMENT REPORT**

## 2.8 Ultimo Power House Cooling System

The Ultimo Power House is considered one of the oldest and most important industrial buildings in Sydney. It is historically significant as the original generating station for the supply of electricity for the Sydney electric tramway network and for the general reticulation of electrical power. It opened in 1899 and for many years was the largest and most important power generating station in NSW. Now housing the Powerhouse Museum, these buildings lie to the southwest, outside the SICEEP study area. Water conduits associated with water cooling system run between the power house and Darling Harbour, once supplying salt water for the condensers, and are within the study area. Water inlet and outlet conduits dating from 1899 to the 1920s follow different routes through the study area. The main focus here is the cooling system and its infrastructure in the vicinity of the study area. A brief timeline for the Ultimo Power House is provided in Appendix D.

The location selected for the Ultimo Power House in 1896 was based on multiple factors including the distribution of electrical current, coal supply and disposal of ashes, water supply, room for future expansion, cost of land, the foundations, and availability of a labour force. The Ultimo site near Darling Harbour met these criteria, with close proximity to a supply of salt water for the condensers.[102]

An Act of Parliament on 8 May 1896 allowed for the construction of a power house for the George Street and Harris Street Electric Tramway. By June 1897 many of the tenders had been let and a short time later Contract No 18, for the conduit from the boiler house to Darling Harbour supplying seawater for condensing, was awarded to Justin McSweeny. By mid-1898 good progress had been made in the sinking of the shafts and by mid 1899 the water conduits were complete. The inlet conduit was estimated at 950 feet (289.5m) long although a later report describes it as 1,000 feet (304.8m) in length and 3 feet 3 inches (1.01m) in diameter.[103] The heated condenser water was discharged back into the Harbour not far from the intake.[104] The 1899 outlet and inlet conduits are shown in a diagram produced in 1933 (Figure 2.44). The material used for the conduits is not known and plans and specifications for this work have not been located. Precast concrete pipes were used in Public Works Department projects in the 1890s and it is possible that they were specified for this project.

The water cooling system consisted of three electrically driven centrifugal circulating pumps for the Wheeler-type surface condensers, each capable of delivering 2,000 gallons per minute (150 litres/sec) against a head of 36 feet (11m). Each pump was directly coupled to 50 horse power motor with two pumps run in parallel, the third being a reserve. Water was discharged from the pumps through a Reeves filter before passing into the boilers.[105]

Extensions to the Ultimo Power House by the Railway Department, including new equipment, were carried out from 1902 to 1905.[106] In 1907-8 a new conduit was constructed, and additional pumps installed in anticipation of the installation of new generating units taking the rated capacity of the Ultimo Power House to 19,400 kW. Details of the construction of the new length of conduit are not known. The Railway Commissioners documentation of post-1898 alterations and additions to the Ultimo Power House was less detailed than work documented by the 1890s Public Works

[102] DM Godden et al, *History and Technology of the Ultimo Power House, Sydney*, NSW PWD, nd [1982]: 27.
[103] *Department of Public Works Report,* y.e 30 Jun 1897, 1898: 26; *Department of Public Works Report,* y.e. 30 Jun 1898, 1899: 23-24; *Department of Public Works Report,* y.e. 30 Jun 1899, 1900: 21; *Department of Public Works Report,* y.e. 30 Jun 1900, 1901: 22, 23.
[104] JW Thomson, L Glendenning & W Upton, *The Power House Ultimo: The Tram Depot Ultimo History*, report to Public Works Department of New South Wales, Sydney, 1982: 22.
[105] *Public Works Report,* y.e. 30 Jun 1900, 1901: 23.
[106] Godden et al [1982]: 59.

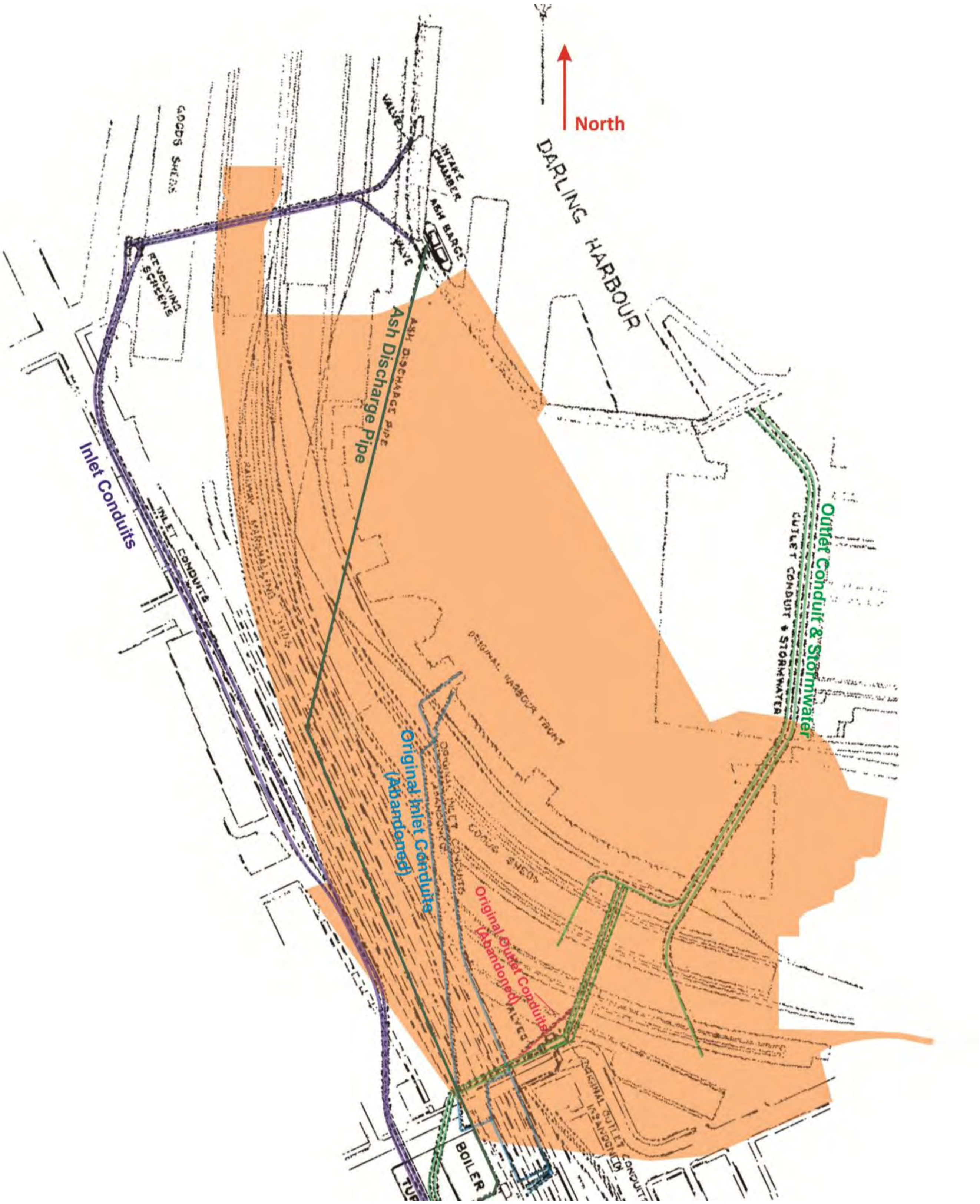


**Figure 2.44: Plan showing the shoreline in relation to circulating water ducts and conduits inlets and outlet used in 1899 and those constructed in the mid 1920s. The location of intake sumps, valves and screens is also shown. Myers 1933: 255.**

Department. Scientific and engineering journals provide many of the accounts of the site under Railway Department management.[107]

Plans for the reclamation of Darling Harbour commencing in the 1920s resulted in the installation of new and considerably longer intake and outlet conduits for the Ultimo Power House. The Railway Commissioners started the project in c1923-24, running the conduit to the point where the parallel pipelines diverged. The Sydney Harbour Trust completed the lines from this point into the harbour. This work was of considerable magnitude, requiring the Harbour Trust to sink a shaft down to the lengths of conduit already installed by the Railway Department and extending it by means of two lines of precast Monier concrete pipes with screening chambers at the end. The lines extended beyond the reclamation and out into the deep water of Darling Harbour. Each 25 ft (7.62m) long section of pipe was 6 ft (1.83m) in diameter weighing approximately 30 tons (30.481 tonnes). The conduits were laid on concrete piers at a maximum depth of 47 feet (14.33m) underwater. The 'faulty' nature of the foundations for the pipes resulted in extensive underwater concrete work done by divers, who also constructed the timberwork of the coffer dam. Wharf No. 39 was later constructed above the conduit.[108]

The construction work for the conduits was described in a later engineering journal as:

> tunnelled through solid sandstone rock, a single tunnel being formed, and the Monier pipes laid side by side with the spaces around and between filled in with rubble.[109]

Photographs showing the installation of the intake conduits are reproduced below (Figure 2.45, Figure 2.46, Figure 2.47, Figure 2.48, Figure 2.49, Figure 2.50, Figure 2.51 and Figure 2.52).

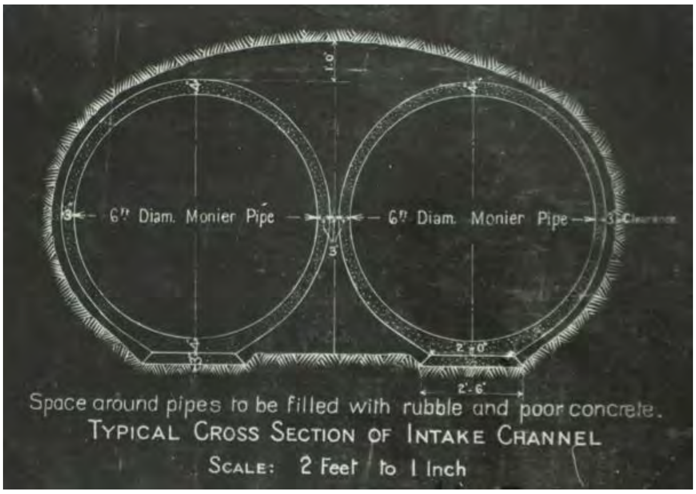


**Figure 2.45: Typical cross section of Intake channels for Ultimo Power House. State Rail Photos Series: 17420 Item: 364/49 SRNSW.**

---

[107] Godden *et al* [1982]: 54, 62.

[108] *Sydney Harbour Commissioners Report*, NSW Legislative Assembly, Sydney, 1927: 3 & 1928: 3; WH Myers, 'Reconstruction of Ultimo Power Station, Sydney, *Journal of the Institution of Engineers Australia*, Sydney, 1933: 262.

[109] Myers 1933: 262.

**Figure 2.46: Excavation under Darling Harbour for the installation of water conduits for Ultimo Power House. State Rail Photos Series: 17420 Item: 364/44 SRNSW.**

**Figure 2.47: Pair of RC Monier conduits being installed in the sandstone tunnel under Darling Harbour. Rubble is stacked ready for packing around the 6 ft diameter pipes. State Rail Photos Series: 17420 Item: 364/45 SRNSW.**

**Figure 2.48: Rails in the foreground were used to cart rubble fill to the pipes. State Rail Photos Series: 17420 Item: 364/46 SRNSW.**

**Figure 2.49: Joints between the sections of conduit are visible along the length of the water supply pipe. State Rail Photos Series: 17420 Item: 364/47 SRNSW.**

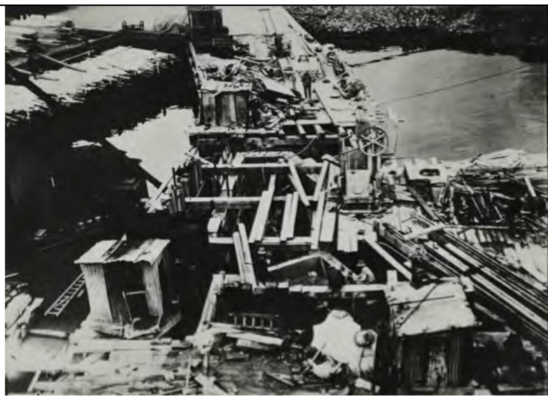

**Figure 2.50: Coffer dam and formwork for the installation of conduits. State Rail Photos Series: 17420 Item: 364/48A SRNSW.**

| | |
|---|---|
|  **Figure 2.51: Reinforced concrete Monier pipe being lowered into position. State Rail Photo Series: 17420 Item: 364/48B SRNSW.** |  **Figure 2.52: Work undertaken at the water's edge for installation of the inlet conduits for the Ultimo Power House. State Rail Photo Series: 17420 Item: 364/48C SRNSW.** |

Work on the outlet conduit for the power house is poorly documented. A newspaper report in May 1924 reveals that it was to be constructed in a 34 ft (10.36m) wide open-cut trench but that work had not yet commenced.[110] Figure 2.42 above shows the outlet conduit running parallel with a stormwater line and might have been laid in conjunction with work done by the Metropolitan Sewerage and Drainage Board. The reclamation of Darling Harbour resulted in extensions to the sewerage and stormwater lines in the area and it would have been economical to run the lines in a single trench.

The new inlet conduits, and presumably the outlets also, were completed in 1928.[111] As shown in Figure 42 above, two inlet conduits drew water from the west side of Darling Harbour under Wharf No 37, converging at a point west of the jetty in the vicinity of the former shoreline. They then ran in parallel to the screening chambers on the east side of Murray Street, Pyrmont. From this point the conduits followed a line along Pyrmont Street to the power house. The outlet conduit followed a similar route to the 1899 outlet conduit up to the former shoreline. It then followed a new line to the east side of the harbour where it was paired with a stormwater line.

The power house upgrade work resulted in a sufficient condensing capacity for the new 20,000 kW turbines. Although the construction of new water supply conduits were partly influenced by the Darling Harbour reclamation work, the replacement of much of the power house equipment in the 1920s was timely, resulting in substantial improvements in efficiency and economy.[112]

The new circulating water system was far more extensive than the original ones, with the new inlet conduits measuring 2770 feet (845m). The conduits were constructed with bypasses so that either inlet conduit could be used temporarily, and for the purposes of scouring after heating, as a discharge conduit.[113]

New equipment installed in conjunction with the water supply system included 'trash racks', a water jet cleaning system, revolving screens capable of being raised for maintenance, and a dewatering system. The revolving screens and screening well or cistern for the new circulating water system were located to the east of Murray Street, Pyrmont outside of the study area. Fouling of the conduits by marine growth was a constant problem and methods of killing the growth or

[110] *SMH* 22 May 1924: 10.
[111] *Sydney Harbour Commissioners Report*, NSW Legislative Assembly, Sydney, 1928: 3.
[112] Myers 1933: 262; Godden *et al* [1982]: 35.
[113] Myers 1933: 262.

scouring it out were tried. If left uncleaned for 12 months the conduit head loss increased from 24 kpa (3.5 ft) to 50 kpa (7.2 ft). The fouling problem was compounded by low tide when the head loss increased and air was drawn into the circulating water pump suction. Air intake contributed to corrosion of the condenser and a major failure of the second large turbo-alternator (installed 1931). Curved cones ('hydraucones') fitted to the pump suction pipe to reduce velocity losses solved the air intake problem. Further technical details about the makers and functions of the water circulating system equipment are detailed in Walter Myers' 1933 report, 'The Construction of Ultimo Power Station, Sydney'.[114]

The 'Water Cooling System and Manifold' of the former Ultimo Power House are included in the Sydney Harbour Foreshore Authority's Heritage and Conservation Register. It is described as:

> Underground conduits possibly built of sandstone taking cool water to the Powerhouse from Darling Harbour waters edge and hot water from the Powerhouse to the waters edge. The remains of the engineering equipment/manifold of this cooling system are located in the carpark of the Novotel accessed from Murray Street.

The Police utilised the water-cooling system conduits between the disused power station and Darling Harbour in Police Rescue Squad training until c1991.

[114] Myers 1933: 262-3.

## APPENDIX C

## COMBINED SERVICES PLAN


SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

DARLING HARBOUR LIVE

REFERENCE MAP

## NOTES:

1. DO NOT SCALE FROM DRAWINGS. WORK TO WRITTEN DIMENSIONS ONLY.
2. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
3. ALL COORDINATES TO MGA. ALL LEVELS TO AHD.
4. ALL DIMENSIONS, COORDINATES AND LEVELS TO BE VERIFIED ON SITE BEFORE PROCEEDING WITH WORK. HYDER SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.
5. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.

0 5 10 15 20 25m

1 : 250

| REV | DESCRIPTION | DATE |
|---|---|---|
| 09 | ARCHITECTURAL BASE UPDATED | 21/08/2013 |
| | AMENDED AS PER CLIENT REQUEST | 19/08/2013 |
| 07 | AMENDED AS PER CLIENT REQUEST | 15/08/2013 |
| 06 | ISSUE FOR DEVELOPMENT APPLICATION | 09/08/2013 |
| 05 | ISSUE FOR INFORMATION | 01/08/2013 |
| 04 | ISSUE FOR INFORMATION | 26/07/2013 |
| 03 | ELECT AND COMMS AMENDED (PER PROJ WEB COR 1453) | 18/07/2013 |
| 02 | STORMWATER ADDED | 18/07/2013 |
| 01 | ISSUE FOR REVIEW | 17/07/2013 |

CLIENT

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www.hyderconsulting.com



Hyder

PROJECT
SICEEP
DARLING HARBOUR
ICC HOTEL

DRAWING TITLE
# COMBINED SERVICES PLAN

STATUS
DEVELOPMENT APPLICATION

| SCALE @ A1 | DRAWN | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|
| 1 : 250 | JJB | - | - | - |

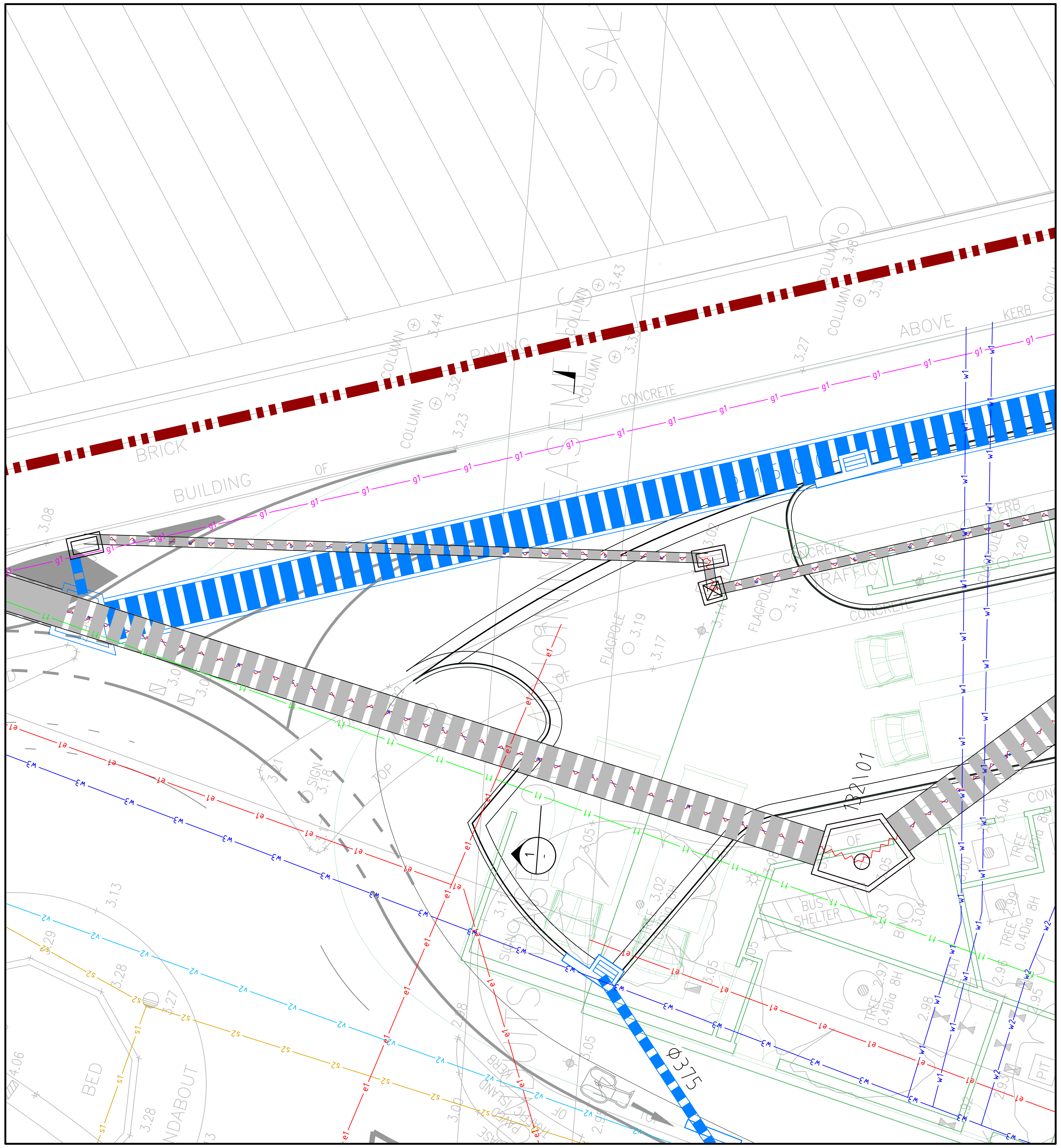
| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| AA004399 | HO-CI-0701 | 09 |

Date Plotted: 21 Aug 2013 - 12:44PM File Name: F:\AA004399\E-CAD\C-Civil\D-Final\C-Hotel\HO-CI-0701-CombinedServicesPlan.dwg

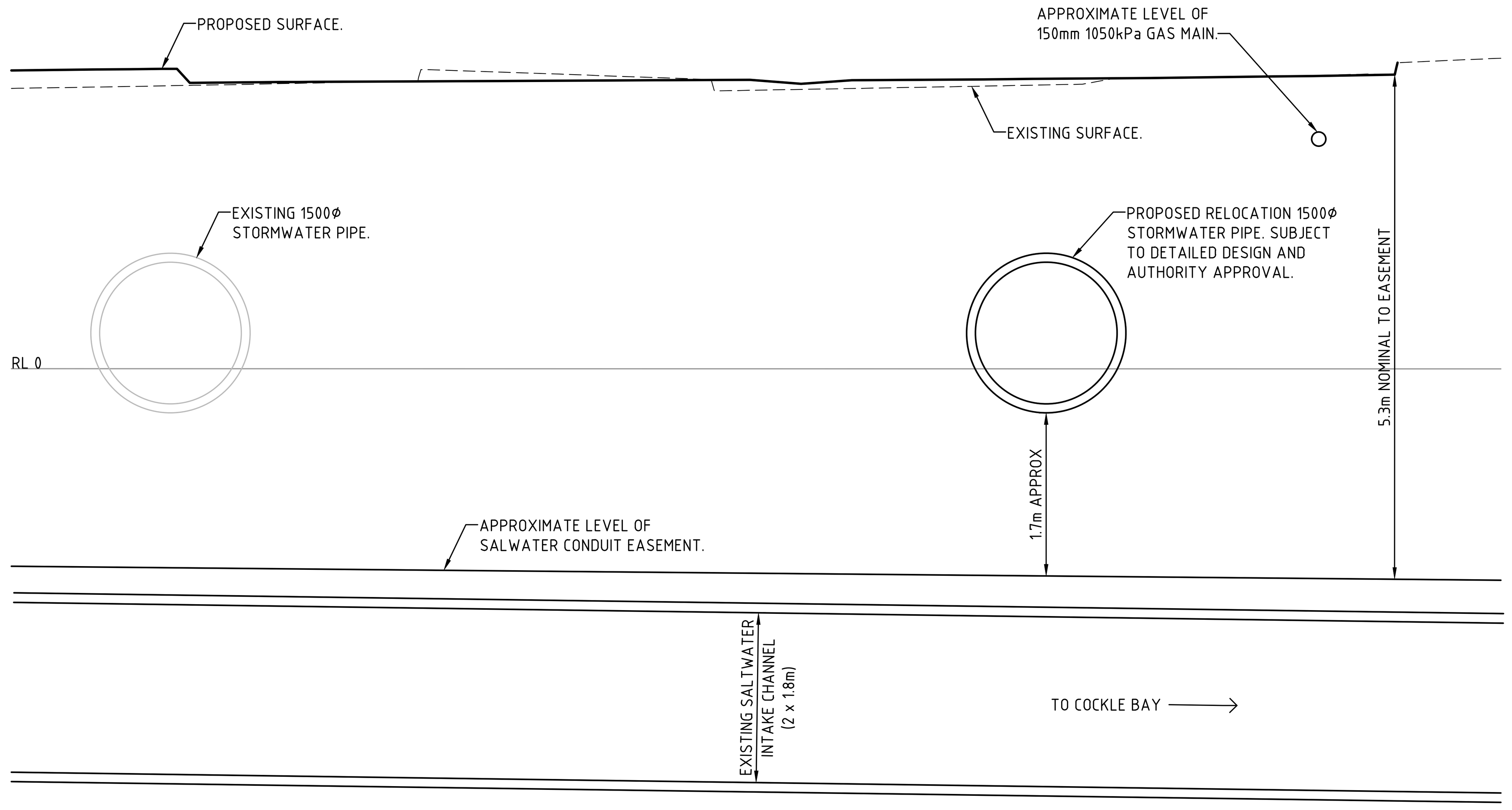
Original Sheet Size A1 - 841 x 594mm

# APPENDIX D

# STORMWATER DIVERSION DRAWING



PLAN
1 : 250




SECTION 1
1 : 50

**NOTE:**
SALTWATER INTAKE LEVELS HAVE BEEN ESTIMATED BASED ON AVAILABLE INFORMATION.

DARLING HARBOUR LIVE

REFERENCE MAP

P.D.A.

NOTES:
1. DO NOT SCALE FROM DRAWINGS. WORK TO WRITTEN DIMENSIONS ONLY.
2. ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE.
3. ALL COORDINATES TO MGA. ALL LEVELS TO AHD.
4. ALL DIMENSIONS, COORDINATES AND LEVELS TO BE VERIFIED ON SITE BEFORE PROCEEDING WITH WORK. HYDER SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.
5. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.

0 5 10 15 20 25m
1 : 250
0 1 2 3 4 5m
1 : 50

DRAFT

| REV | DESCRIPTION | DATE |
|---|---|---|
| 01 | ISSUE FOR REVIEW | 31/07/2013 |

CLIENT
Lend Lease
**PROJECT MANAGEMENT & CONSTRUCTION**
LEVEL 4, THE BOND, 30 HICKSON RD
MILLERS POINT, NSW 2000

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AUSTRALIA

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www.hyderconsulting.com


Hyder

PROJECT
SICEEP
DARLING HARBOUR
HOTEL

DRAWING TITLE
SALTWATER INTAKE CHANNEL SECTION

STATUS
PRELIMINARY ONLY

| SCALE @ A1 | DRAWN | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|
| AS SHOWN | KM | - | CM | - |

| PROJECT NUMBER | DRAWING NUMBER | REV |
|---|---|---|
| AA004399 | SKCHO017 | 01 |

# APPENDIX E

# COFFEY BOREHOLE PLAN AND SECTIONS
# 2013 INVESTIGATION


| revision | description | drawn | approved | date |
|---|---|---|---|---|
| | A - APPROXIMATE SITE BOUNDARY AMMENDED | AW | MG | 26/07/13 |
| | | | | |
| | | | | |
| | | | | |

N

5 0 5 15 25

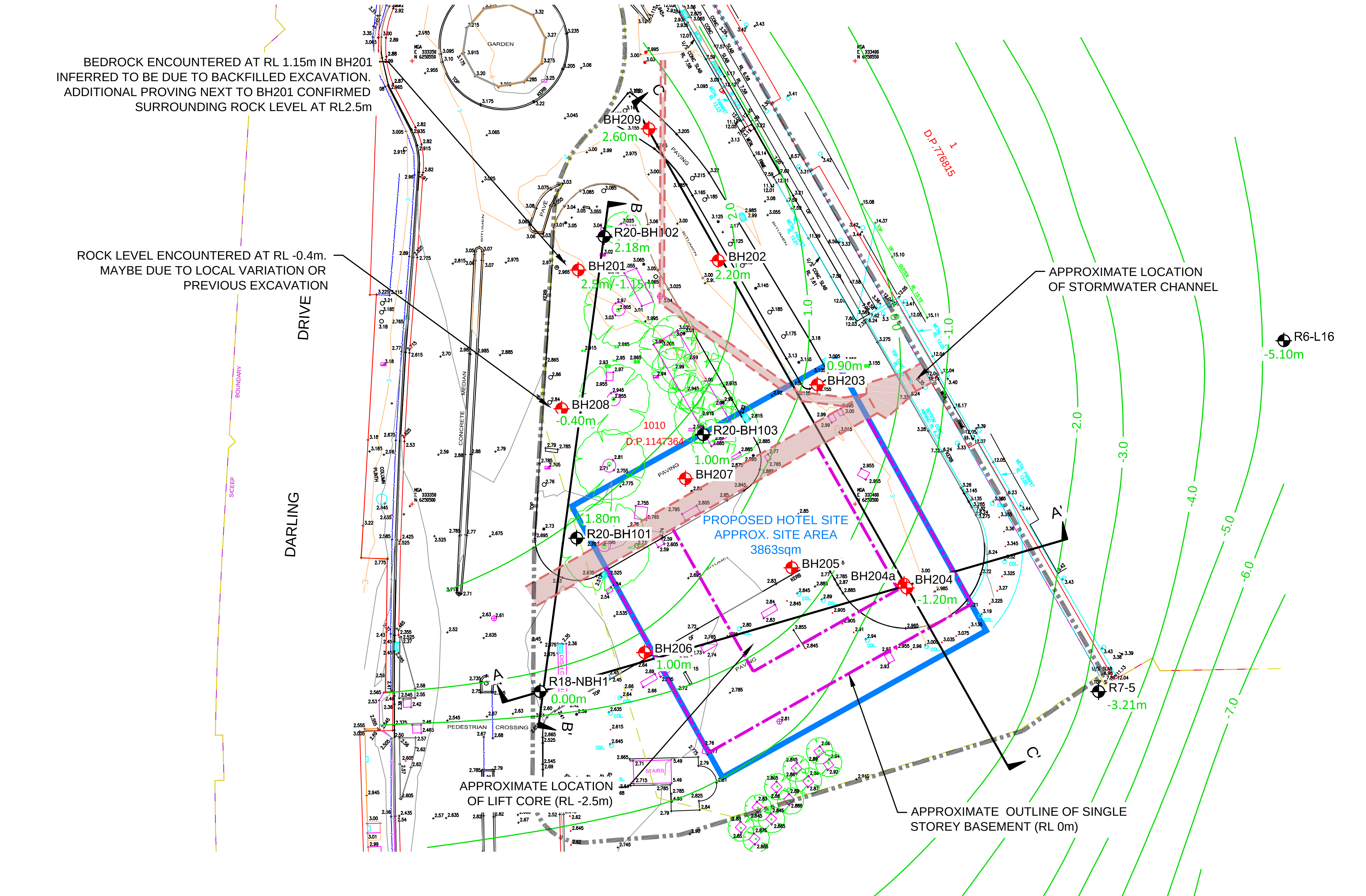
Scale (metres) 1:500

| | |
|---|---|
| drawn | MG / LH |
| approved | MG |
| date | 29 / 07 / 13 |
| scale | 1:500 |
| original size | A3 |

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

| | |
|---|---|
| client: | LEND LEASE DEVELOPMENT PTY LTD |
| project: | GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL |
| title: | BOREHOLE LOCATION PLAN |
| project no: GEOTLCOV24303AH-AF | figure no: FIGURE 1 |

PLOT DATE: 29/07/2013 11:33:45 AM DWG FILE: F:\GEOTECHNICS\1.PROJECTS\GEOTLCOV243\GEOTLCOV24303AH LEND LEASE - ICC HOTEL\8. FIGURES\GEOTLCOV24303AH-AF.DWG




NOTES:

1. INFERRED ROCK LEVEL CONTOURS ARE APPROXIMATE ONLY. VARIATIONS MAY OCCUR DUE TO GEOLOGICAL FEATURES AND MAN-MADE EXCAVATIONS.
2. ACTUAL ROCK LEVELS ARE LIKELY TO OCCUR AS A SERIES OF STEPS AND BENCHES RATHER THAN GRADUAL SLOPE CHANGE

LEGEND

- PREVIOUS BOREHOLE LOCATIONS
- BOREHOLE LOCATIONS OF CURRENT INVESTIGATION
- APPROXIMATE SITE FOOTPRINT
- 2.0 INFERRED TOP OF ROCK LEVEL (mAHD)
- SECTION LINE

| revision | description | drawn | approved | date |
|---|---|---|---|---|
| | A - APPROXIMATE SITE BOUNDARY AMMENDED | AW | MG | 26/07/13 |
| | | | | |
| | | | | |
| | | | | |

5 0 5 15 25

Scale (metres) 1:500

| | |
|---|---|
| drawn | MG / LH |
| approved | MG |
| date | 29 / 07 / 13 |
| scale | 1:500 |
| original size | A3 |

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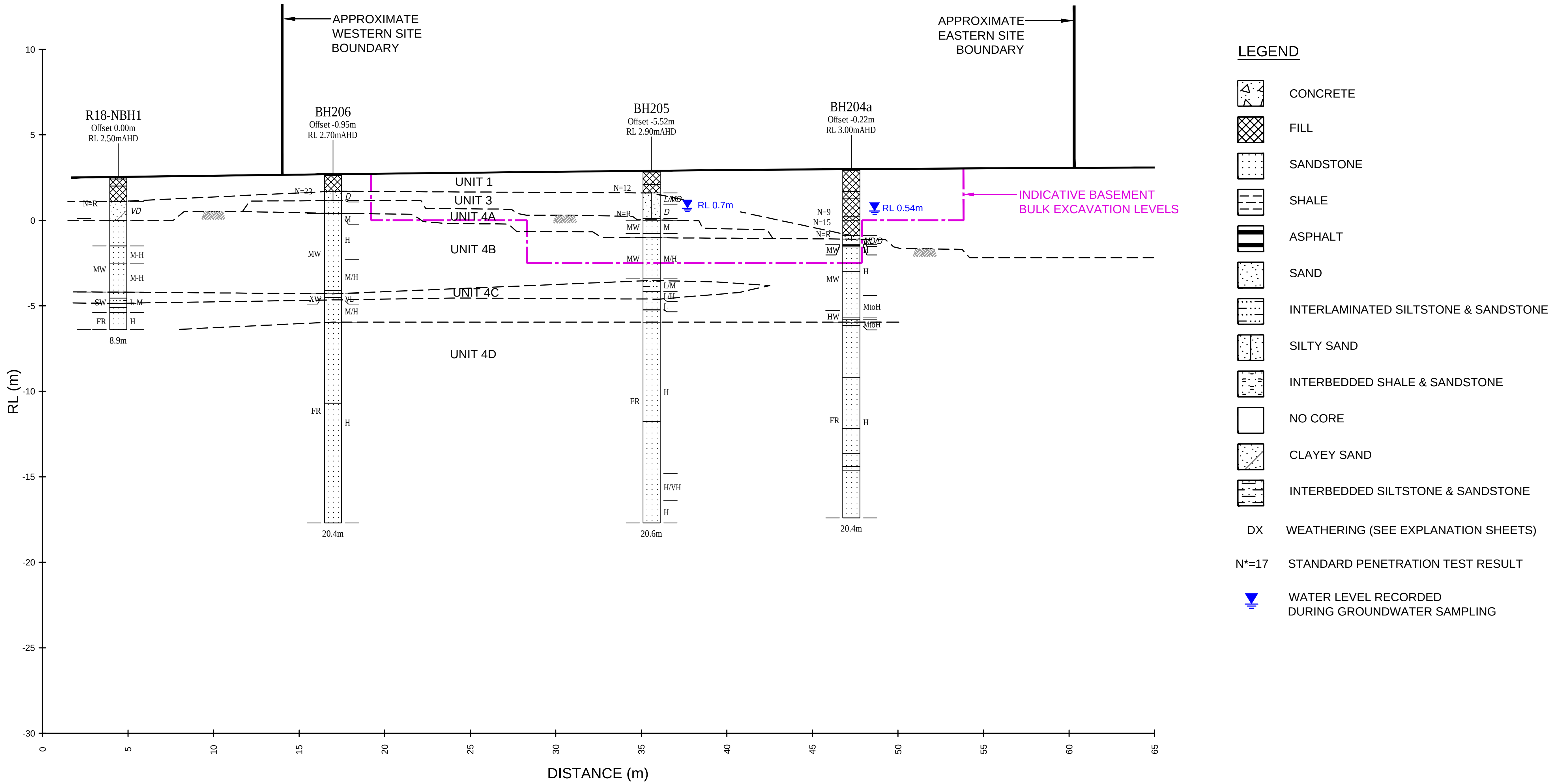
SPECIALISTS MANAGING THE EARTH

| | |
|---|---|
| client: | LEND LEASE DEVELOPMENT PTY LTD |
| project: | GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL |
| title: | INTERPOLATED ROCK CONTOUR PLAN |
| project no: | GEOTLCOV24303AH-AF |
| figure no: | FIGURE 2 |

PLOT DATE: 29/07/2013 11:32:33 AM DWG FILE: F:\GEOTECHNICS\1 PROJECTS\GEOTLCOV24303AH LEND LEASE - ICC HOTEL\8. FIGURES\GEOTLCOV24303AH-AF.DWG




## SECTION A-A'

| revision | description | drawn | approved | date |
|---|---|---|---|---|
| | A - APPROXIMATE SITE BOUNDARY AMMENDED | AW | MG | 26/07/13 |

Scale (metres) 1:250

| | |
|---|---|
| drawn | MG / LH |
| approved | MG |
| date | 26 / 07 / 13 |
| scale | 1:250 |
| original size | A3 |

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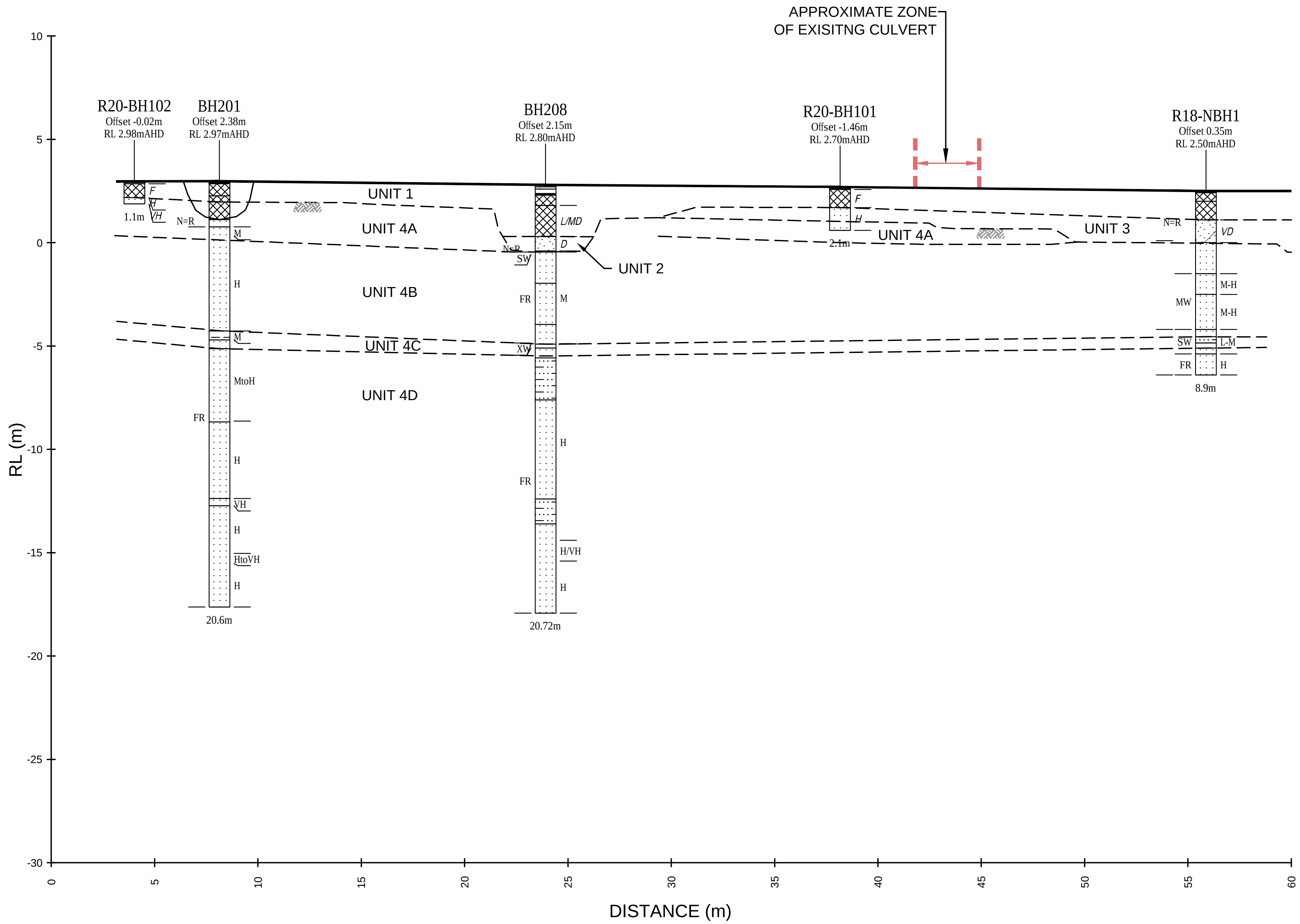
SPECIALISTS MANAGING THE EARTH

| | |
|---|---|
| client: | LEND LEASE DEVELOPMENT PTY LTD |
| project: | GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL |
| title: | SECTION A-A' |
| project no: | GEOTLCOV24303AH-AF |
| figure no: | FIGURE 3 |

PLOT DATE: 25/07/2013 5:15:39 PM DWG FILE: F:\GEOTECHNICS\11 PROJECTS\GEOTLCOV24303\GEOTLCOV24303AH LEND LEASE - ICC HOTEL\6 FIGURES\GEOTLCOV24303AH-AF.DWG




## SECTION B-B'

## LEGEND

- CONCRETE
- FILL
- SANDSTONE
- SHALE
- ASPHALT
- SAND
- INTERLAMINATED SILTSTONE & SANDSTONE
- SILTY SAND
- INTERBEDDED SHALE & SANDSTONE
- NO CORE
- CLAYEY SAND
- INTERBEDDED SILTSTONE & SANDSTONE
- DX WEATHERING (SEE EXPLANATION SHEETS)
- N*=17 STANDARD PENETRATION TEST RESULT

| revision | description | drawn | approved | date |
|---|---|---|---|---|
| | A - APPROXIMATE SITE BOUNDARY AMMENDED | AW | MG | 26/07/13 |
| | | | | |
| | | | | |
| | | | | |

2.5 0 5 10

Scale (metres) 1:250

| | |
|---|---|
| drawn | MG / LH |
| approved | MG |
| date | 26 / 07 / 13 |
| scale | 1:250 |
| original size | A3 |

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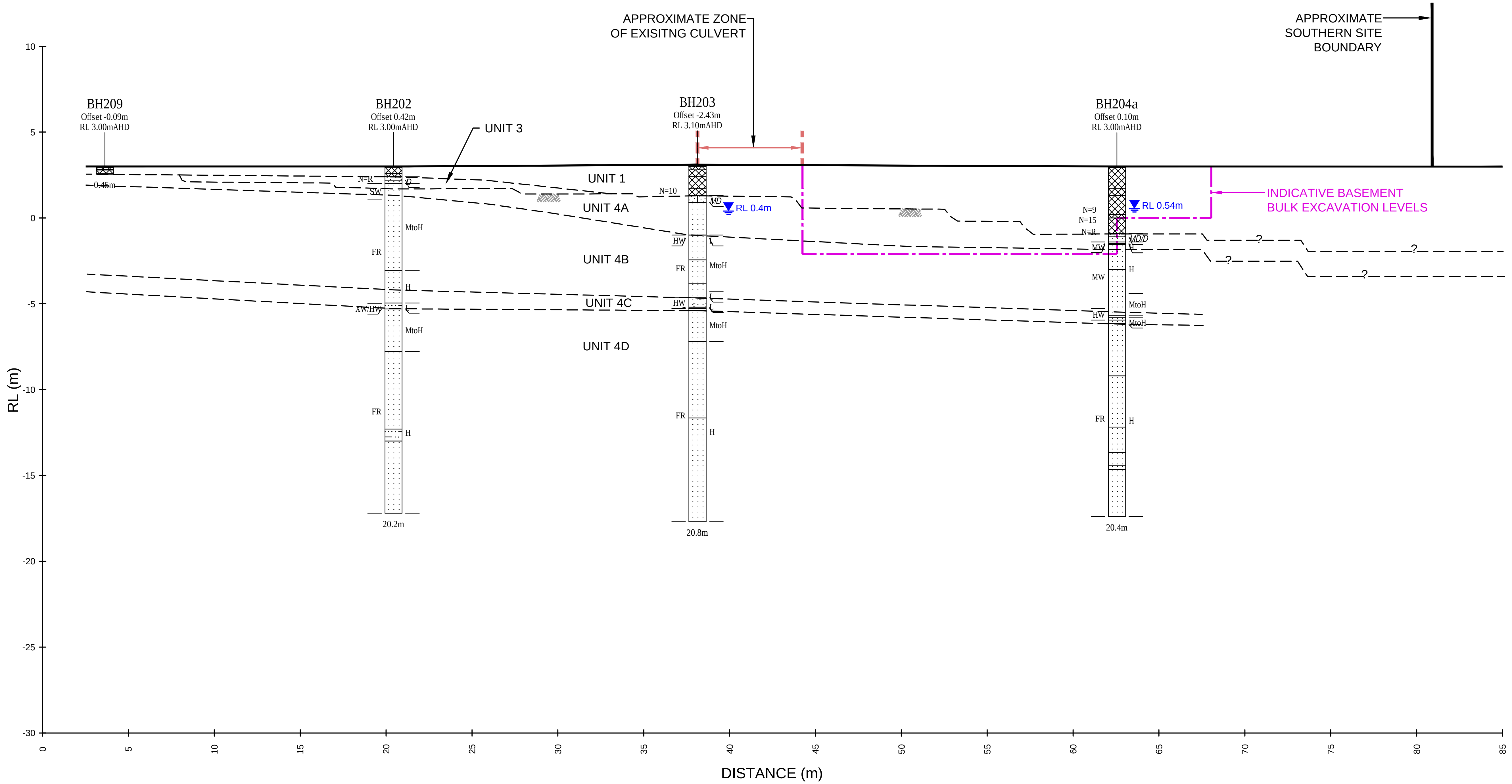
SPECIALISTS MANAGING THE EARTH

| | |
|---|---|
| client: | LEND LEASE DEVELOPMENT PTY LTD |
| project: | GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL |
| title: | SECTION B-B' |
| project no: GEOTLCOV24303AH-AF | figure no: FIGURE 4 |




## SECTION C-C'

## LEGEND

- CONCRETE
- FILL
- SANDSTONE
- SHALE
- ASPHALT
- SAND
- INTERLAMINATED SILTSTONE & SANDSTONE
- SILTY SAND
- INTERBEDDED SHALE & SANDSTONE
- NO CORE
- CLAYEY SAND
- INTERBEDDED SILTSTONE & SANDSTONE
- DX — WEATHERING (SEE EXPLANATION SHEETS)
- N*=17 — STANDARD PENETRATION TEST RESULT
- WATER LEVEL RECORDED DURING GROUNDWATER SAMPLING

| revision | description | drawn | approved | date |
|---|---|---|---|---|
| | A - APPROXIMATE SITE BOUNDARY AMMENDED | AW | MG | 26/07/13 |

2.5 0 5 10
Scale (metres) 1:250

| | |
|---|---|
| drawn | MG / LH |
| approved | MG |
| date | 26 / 07 / 13 |
| scale | 1:250 |
| original size | A3 |

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

| | |
|---|---|
| client: | LEND LEASE DEVELOPMENT PTY LTD |
| project: | GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL |
| title: | SECTION C-C' |
| project no: GEOTLCOV24303AH-AF | figure no: FIGURE 5 |

PLOT DATE: 25/07/2013 5:15:44 PM DWG FILE: F:\GEOTECHNICS\1.PROJECTS\GEOTLCOV243\GEOTLCOV24303AH LEND LEASE - ICC HOTEL\8. FIGURES\GEOTLCOV24303AH-AF.DWG

## APPENDIX F

## COMPILATION OF BOREHOLE LOGS

# coffey geotechnics

## Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH201** |
| sheet: | 1 of 4 |
| project no. | **GEOTLCOV24303AH** |
| client: | *Lend Lease Development Pty Ltd* |
| principal: | |
| project: | *SICEEP - International Convention Centre (ICC) Hotel* |
| location: | *Darling Harbour, Sydney* |
| date started: | *28 May 2013* |
| date completed: | *28 May 2013* |
| logged by: | *DB* |
| checked by: | *DS* |

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

**drilling information** / **material substance**

| method & support | penetration 1 2 3 | water | samples & field tests | RL (m) | depth (m) | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | hand penetrometer (kPa) 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|
| DT | | | | | | **BRICK PAVERS**: 0.08m. | D | | | **PAVEMENT** |
| HA | | | | | | **CONCRETE**: 0.04m. | M | | | **STABILISED ROADBASE** |
| | | | E | | | **FILL: Sandy GRAVEL**: fine to medium, subangular to angular, dark grey to pale brown, sand is medium to coarse grained, with some lime. | | | | PID = 0ppm at 0.6m, no odour or staining |
| AD/T | | | E | 2 | 1.0 | **FILL: Gravelly SAND**: medium to coarse, pale-grey to dark brown, sub-angular, sandstone gravel, trace clay. | | | | **FILL** |
| | | | E | | | **FILL: SAND**: fine to medium, pale-brown to pale-grey, trace fine to medium grained, dark grey to pale-grey sandstone and shale gravel. | | | | PID = 0ppm at 1.0m, no odour or staining |
| | | | | | | trace fine metal chicken wire and rubber fragments, observed at base of auger | | | | PID = 0ppm at 1.6m, no odour or staining |
| | | | SPT 1/50mm HB N*=R | 1 | 2.0 | **SANDSTONE**: fine to medium, pale-grey, slightly weathered, medium to high strength. | | | | **BEDROCK** SPT bouncing at 1.95m |
| | | | | | | Borehole BH201 continued as cored hole | | | | |
| | | | | 0 | 3.0 | | | | | |
| | | | | -1 | 4.0 | | | | | |
| | | | | -2 | 5.0 | | | | | |
| | | | | -3 | 6.0 | | | | | |
| | | | | -4 | 7.0 | | | | | |

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH201** |
| sheet: | 2 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **28 May 2013** |
| date completed: | **28 May 2013** |
| logged by: | **DB** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|
| 2 | 1.0 | | | | | |
| 1 | 2.0 | start coring at 2.20m | | | | |
| | | **SANDSTONE**: medium grained, pale-grey to orange-white, indistinctly cross bedded at 0-10°, with some dark grey laminae at 0-10° | FR | | | SM, 0°, PL, 25mm, HP Clay |
| | | | | | | PT, 0°, PL, Clay CO |
| | | | | a=0.66 d=0.54 | | PT, 0°, PL, RO, Clay CO |
| 0 | 3.0 | | | | | PT, 5°, PL, RO, CO, Carbon |
| | | | | | 90% | PT, 5°, CU, RO, Clay CO |
| | | | | | | JT, 10°, PL, RO, CN |
| -1 | 4.0 | | | a=2.25 d=2.13 | | |
| | | | | | | PT, 5°, PL, RO, Clay CO |
| -2 | 5.0 | | | a=1.38 d=2.01 a=2.20 d=1.77 | | |
| | | 5.2 - 6.2m: massive | | | | |
| -3 | 6.0 | | | a=1.74 d=1.67 | | |
| | | | | | | PT, 0 - 5°, PL, RO, Clay CO |
| | | | | | 96% | PT, 5°, PL, RO, CO, Carbon |
| -4 | 7.0 | | | a=1.53 d=1.64 | | |
| | | | | | | PT, 0°, PL, RO, Clay CO |
| | | **SHALE**: dark grey, indistinctly bedded at 0-5° | | | | SM, 0°, PL, 20mm, HP Clay |
| | | | | | | SM, 0 - 20°, IR, 15mm, HP Clay |
| | | **SANDSTONE**: medium to coarse grained, pale grey, pebbly | | | | SM, 0°, PL, 25mm, HP Clay |

method & support: NMLC

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | BH201 |
| sheet: | 3 of 4 |
| project no. | GEOTLCOV24303AH |

| | | | |
|---|---|---|---|
| client: | Lend Lease Development Pty Ltd | date started: | 28 May 2013 |
| principal: | | date completed: | 28 May 2013 |
| project: | SICEEP - International Convention Centre (ICC) Hotel | logged by: | DB |
| location: | Darling Harbour, Sydney | checked by: | DS |

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| method & support | RL (m) | depth (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | additional observations and defect descriptions |
|---|---|---|---|---|---|---|---|
| NMLC | | | SANDSTONE: medium grained, pale-grey to orange-white, indistinctly cross bedded at 0-10°, with some dark grey laminae | FR | a=0.84 d=1.35 | 96% | PT, 5°, PL, VR, CO, Carbon |
| | -6 | 9.0 | | | | | |
| | -7 | 10.0 | | | a=0.93 d=0.60 | 100% | |
| | -8 | 11.0 | | | a=1.21 d=0.85 a=1.49 d=1.00 | | PT, 0 - 10°, PL, RO, Sandy clay CO |
| | -9 | 12.0 | SANDSTONE: medium grained, pale-grey to orange-white, massive, with some carbonaceous flecks < 25mm diameter | | a=1.45 d=1.48 | | |
| | -10 | 13.0 | | | a=1.54 d=1.64 | 100% | |
| | -11 | 14.0 | | | | | JT, 35°, IR, VR, CN |
| | -12 | 15.0 | shale breccia - 25mm thickness<br>shale breccia - 50mm thickness | | a=1.31 d=1.64 | | JT, 25°, PL, RO, CN<br>JT, 35°, PL, RO, CN |
| | | | SANDSTONE: fine grained, pale-grey to grey, indistinctly bedded at 0°, with some dark grey laminations | | | 94% | PT, 0°, PL, RO, Clay CO |

**method & support**
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; W washbore; NMLC NMLC core (51.9 mm); NQ wireline core (47.6mm); HQ wireline core (63.5mm); PQ wireline core (85.0mm); SPT standard penetration test

**water**
10/10/12, water level on date shown; water inflow; complete drilling fluid loss; partial drilling fluid loss; 25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material); no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil; XW extremely weathered; HW highly weathered; DW distinctly weathered; MW moderately weathered; SW slightly weathered; FR fresh
*W replaced with A for alteration

**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
PT parting; JT joint; SZ shear zone; SS shear surface; CS crushed seam; SM seam; DB drilling break

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR Irregular

**roughness**
SL slickensided; POL polished; SO smooth; RO rough; VR very rough

**coating**
CN clean; SN stain; VN veneer; CO coating

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:09

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH201** |
| sheet: | 4 of 4 |
| project no. | **GEOTLCOV24303AH** |

| | | | |
|---|---|---|---|
| client: | ***Lend Lease Development Pty Ltd*** | date started: | ***28 May 2013*** |
| principal: | | date completed: | ***28 May 2013*** |
| project: | ***SICEEP - International Convention Centre (ICC) Hotel*** | logged by: | ***DB*** |
| location: | ***Darling Harbour, Sydney*** | checked by: | ***DS*** |

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| method & support | water | RL (m) | depth (m) | graphic log | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | estimated strength & Is50 | samples, field tests & Is(50) (MPa) | core run & RQD | defect spacing (mm) | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | | | | **SANDSTONE**: medium to coarse grained, pale-grey, indistinctly bedded at 0-15°, with some dark grey laminae *(continued)* | FR | | a=1.41 d=1.53 | | | |
| | | | | | | | | a=1.78 d=2.24 | | | JT, 55°, CU, VR, CN |
| | | | | | | | | | | | PT, 10°, PL, RO, Clay CO |
| | | | | | | | | | 94% | | |
| | | -14 | 17.0 | | | | | | | | |
| | | | | | | | | a=1.70 d=2.39 | | | |
| | | -15 | 18.0 | | | | | a=2.70 d=3.18 | | | |
| | | | | | | | | | | | PT, 0°, PL, RO, Clay CO |
| | | -16 | 19.0 | | | | | a=2.38 d=2.22 | 100% | | |
| | | | | | | | | | | | PT, 0°, PL, RO, Clay CO |
| | | -17 | 20.0 | | | | | a=2.70 d=1.82 | | | |
| | | | | | Borehole BH201 terminated at 20.60 m | | | | | | |
| | | -18 | 21.0 | | | | | | | | |
| | | -19 | 22.0 | | | | | | | | |
| | | -20 | 23.0 | | | | | | | | |

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH202** |
| sheet: | 1 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **23 May 2013** |
| date completed: | **23 May 2013** |
| logged by: | **CL** |
| checked by: | **DS** |

client: **Lend Lease Development Pty Ltd**

principal:

project: **SICEEP - International Convention Centre (ICC) Hotel**

location: **Darling Harbour, Sydney**

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

**drilling information** / **material substance**

| method & support | penetration | water | samples & field tests | RL (m) | depth (m) | graphic log | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | hand penetrometer (kPa) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD/T, HA, HQ Casing | | | E | 3 | | | | **ASPHALT**: 0.05m. | D | | | **PAVEMENT** |
| | | | | | | | | **Gravelly SAND**: fine coarse, dark grey, fine to medium grained igneous gravel. | | | | **ROADBASE** PID = 0.4ppm at 0.2m |
| AD/T | | | E, E | | | | | **Gravelly SAND**: fine coarse, grey mottled brown, fine to medium grained gravel. | | | | **FILL** PID = 0ppm at 0.5m |
| | | | SPT 15/100mm N*=R | | | | SP | **SAND**: fine, orange brown, with a trace of sandstone gravel. | | D | | **RESIDUAL SOIL** |
| | | | | 2 | 1.0 | | | **SANDSTONE**: pale grey mottled orange brown, moderately weathered to slightly weathered, medium strength. | | | | PID = 0ppm at 0.6m **BEDROCK** |
| | | | | | | | | Borehole BH202 continued as cored hole | | | | |
| | | | | 1 | 2.0 | | | | | | | |
| | | | | 0 | 3.0 | | | | | | | |
| | | | | -1 | 4.0 | | | | | | | |
| | | | | -2 | 5.0 | | | | | | | |
| | | | | -3 | 6.0 | | | | | | | |
| | | | | -4 | 7.0 | | | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:12

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 — no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH202** |
| sheet: | 2 of 4 |
| project no. | **GEOTLCOV24303AH** |

client: ***Lend Lease Development Pty Ltd***
principal:
project: ***SICEEP - International Convention Centre (ICC) Hotel***
location: ***Darling Harbour, Sydney***

date started: ***23 May 2013***
date completed: ***23 May 2013***
logged by: ***CL***
checked by: ***DS***

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°
drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | RL (m) | depth (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | defect descriptions |
|---|---|---|---|---|---|---|---|
| | 3 | | | | | | |
| | 2 | 1.0 | start coring at 1.00m | | | | |
| NMLC | | | **SANDSTONE**: fine to medium grained, pale grey, with dark grey laminae, distinctly cross bedded at 0-15°<br>1.30m to 1.70m: some iron staining | SW | | | 180 mm, XW zone<br>JT, 45°, ST, RO, CO<br>PT, 0°, PL, RO, SN |
| | | | | | a=0.96 d=0.76 | 90% | |
| | 1 | 2.0 | | FR | | | PT, 0°, PL, RO, CO |
| | | | | | a=0.83 d=1.24 | | PT, 0°, PL, RO, CN<br>SM XW, 10 mm<br>PT, 0°, PL, RO, CN |
| | 0 | 3.0 | | | a=1.34 d=1.04 | 100% | PT, IR, RO, CO |
| | -1 | 4.0 | | | a=0.84 d=1.25 | | PT, 0°, PL, RO, CN<br>PT, 5°, PL, RO, CO |
| | -2 | 5.0 | | | a=1.35 d=1.24 | 99% | |
| | -3 | 6.0 | | | | | SM, 40 mm |
| | | | **SANDSTONE**: medium to coarse grained, pale grey, with some dark grey shale lentices, iron stained from 6.07m to 6.28m, some iron staining from 7.3m to 7.65m | | a=1.15 d=1.32 | | |
| | -4 | 7.0 | | | a=1.27 d=2.29 | 70% | PT, 0°, PL, RO, CO<br>PT, 0°, PL, RO, CO<br>PT, 0°, PL, RO, CN |

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:09

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH202** |
| sheet: | 3 of 4 |
| project no. | **GEOTLCOV24303AH** |
| client: | **Lend Lease Development Pty Ltd** |
| date started: | **23 May 2013** |
| principal: | |
| date completed: | **23 May 2013** |
| project: | **SICEEP - International Convention Centre (ICC) Hotel** |
| logged by: | **CL** |
| location: | **Darling Harbour, Sydney** |
| checked by: | **DS** |

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

**drilling information** | **material substance** | **rock mass defects**

| method & support | water | RL (m) | depth (m) | graphic log | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | defect spacing (mm) 30 100 300 1000 3000 | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | | | | **INTERLAMINATED SHALE (80%) & SANDSTONE (20%)**: shale dark grey, sandstone fine grained, grey *(continued)* | XW / HW | | | 70% | | SM XW/HW, 350 mm |
| | | | | | | | | | | | PT, 0°, PL, RO, CO |
| | | | | | **SANDSTONE**: fine grained, pale grey, with dark grey laminae, distinctly cross bedded at 0-15° | FR | | a=1.49 d=1.46 | | | |
| | | -6 | 9.0 | | | | | | | | |
| | | | | | | | | | 94% | | |
| | | -7 | 10.0 | | | | | a=0.80 d=0.88 | | | |
| | | | | | **SANDSTONE**: fine to medium grained, pale grey, with some carbonaceous flecks, massive | | | a=1.47 d=1.65 | | | PT, 5°, PL, RO, CO |
| | | | | | | | | | | | SM XW, 30 mm |
| | | -8 | 11.0 | | | | | a=1.38 d=1.50 | | | |
| | | -9 | 12.0 | | | | | a=1.36 d=1.56 | 100% | | |
| | | -10 | 13.0 | | | | | | | | |
| | | | | | | | | a=2.08 d=2.14 | | | |
| | | -11 | 14.0 | | | | | | 99% | | |
| | | | | | | | | a=1.85 d=1.89 | | | |
| | | -12 | 15.0 | | | | | | | | |
| | | | | | 15.21m to 15.24m: shale band | | | | | | PT, 0°, PL, RO, CN |
| | | | | | **INTERLAMINATED SHALE (30%) & SANDSTONE (70%)**: fine grained, pale grey, shale is dark grey | | | a=2.85 d=1.51 | 96% | | PT, 0°, PL, RO, CN |

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH202** |
| sheet: | 4 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **23 May 2013** |
| date completed: | **23 May 2013** |
| logged by: | **CL** |
| checked by: | **DS** |

client: **Lend Lease Development Pty Ltd**

principal:

project: **SICEEP - International Convention Centre (ICC) Hotel**

location: **Darling Harbour, Sydney**

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | water | RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|---|---|
| NMLC | | -13 | | **SANDSTONE**: fine to medium grained, pale grey, with pale grey laminae, distinctly cross bedded at 0-10° | FR | | | SM, 10 mm |
| | | | | | | | | PT, 0°, PL, RO, CN |
| | | | | | | | 96% | PT, 0°, PL, RO, CN |
| | | | | | | a=2.66 d=1.90 | | |
| | | -14 | 17.0 | | | a=1.70 d=1.96 | | JT, 35°, PL, RO, CN |
| | | | | | | | | PT, 0°, PL, RO, CN |
| | | | | | | | | PT, 0°, PL, RO, CN |
| | | -15 | 18.0 | | | | | |
| | | | | | | | 95% | |
| | | | | | | a=2.08 d=2.39 | | |
| | | -16 | 19.0 | | | a=2.40 d=2.23 | | PT, 0°, PL, RO, CO |
| | | | | | | | | PT, 0°, PL, RO, CO |
| | | | | | | | | JT, 10°, PL, RO, CO |
| | | -17 | 20.0 | | | | | |
| | | | | Borehole BH202 terminated at 20.20 m | | | | |
| | | -18 | 21.0 | | | | | |
| | | -19 | 22.0 | | | | | |
| | | -20 | 23.0 | | | | | |

estimated strength & Is50: × = axial; ○ = diametral; VL L M H VH EH

defect spacing (mm): 30 100 300 1000 3000

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | ***BH203*** |
| sheet: | 1 of 4 |
| project no. | ***GEOTLCOV24303AH*** |
| date started: | ***24 May 2013*** |
| date completed: | ***24 May 2013*** |
| logged by: | ***CL*** |
| checked by: | ***DS*** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 125 mm

**drilling information** | **material substance**

| method & support | water | samples & field tests | RL (m) | depth (m) | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|
| HA | | E | 3 | | | **BRICK PAVERS**: 0.1m. | M | | **PAVEMENT** |
| HA | | | | | | **FILL: Gravelly SAND**: fine to coarse, black, fine to coarse gravel. | | | **FILL**<br>PID = 0ppm at 0.1m, no odour or staining |
| HA | | E | | | | **FILL: Gravelly SAND**: fine to coarse, grey black, fine to coarse gravel. | | | PID = 0ppm at 0.3m, no odour or staining |
| AD/T | | E | 2 | 1.0 | | **FILL: Gravelly SAND**: fine to coarse, dark brown, fine to coarse gravel. | | | PID = 0ppm at 0.9m, no odour or staining |
| AD/T | | E<br>SPT<br>1, 1, 9<br>N=10<br>E | | | | **FILL: Gravelly Clayey SAND**: fine, yellow brown mottled pale grey, orange brown and red brown, fine to medium grained gravel, high plasticity clay. | | | PID = 0ppm at 1.4m, no odour or staining |
| AD/T | | | 1 | 2.0 | SM | **Silty SAND**: fine to medium, mottled orange brown and grey, with a trace of fine to medium grained sandstone gravel. | | MD | **RESIDUAL SOIL** |
| AD/T | | | | | | **SANDSTONE**: fine to medium, pale grey, highly weathered, low strength. | | | **BEDROCK** |
| AD/T | ▶ (water inflow) | | 0 | 3.0 | | | | | |
| | | | -1 | 4.0 | | Borehole BH203 continued as cored hole | | | |
| | | | -2 | 5.0 | | | | | |
| | | | -3 | 6.0 | | | | | |
| | | | -4 | 7.0 | | | | | |

penetration: 1 2 3 — hand penetrometer (kPa): 100 200 300 400

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 — no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**

| | |
|---|---|
| U## | undisturbed sample ##mm diameter |
| D | disturbed sample |
| B | bulk disturbed sample |
| E | environmental sample |
| HP | hand penetrometer (kPa) |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| VS | vane shear; peak/remouded (uncorrected kPa) |
| R | refusal |

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**

| | |
|---|---|
| VS | very soft |
| S | soft |
| F | firm |
| St | stiff |
| VSt | very stiff |
| H | hard |
| Fb | friable |
| VL | very loose |
| L | loose |
| MD | medium dense |
| D | dense |
| VD | very dense |

# coffey geotechnics

## Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | ***BH203*** |
| sheet: | 2 of 4 |
| project no. | ***GEOTLCOV24303AH*** |
| date started: | ***24 May 2013*** |
| date completed: | ***24 May 2013*** |
| logged by: | ***CL*** |
| checked by: | ***DS*** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 125 mm

| RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|
| 3 | | | | | | |
| 2 | 1.0 | | | | | |
| 1 | 2.0 | | | | | |
| 0 | 3.0 | | | | | |
| -1 | 4.0 | start coring at 4.10m | | | | |
| | | **SANDSTONE**: fine to medium grained, pale grey, with some grey laminae distinctly cross bedded at 0-5° | HW | | | PT, 0°, PL, RO, CN |
| | | | FR | a=0.90 d=0.41 | 100% | PT, 0°, PL, RO, CN |
| -2 | 5.0 | | | | | XW SM, 10mm |
| | | | | a=1.12 d=0.67 | | PT, 0°, PL, RO, CN |
| | | **SANDSTONE**: fine to medium grained, pale grey, with a trace of sideritic flecks, massive | | | | |
| -3 | 6.0 | | | | 99% | |
| | | | | a=0.86 d=0.90 | | |
| -4 | 7.0 | **SANDSTONE**: medium to coarse grained, pale grey, with some orange brown laminae, distinctly across bedded at 0-5° | | | | PT, 0°, PL, RO, CN |
| | | becoming with dark grey shale lenticles | | d=0.22 | | PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, CN |
| | | | HW | | 64% | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:09

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH203** |
| sheet: | 3 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **24 May 2013** |
| date completed: | **24 May 2013** |
| logged by: | **CL** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 125 mm

| RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|
| -5 | | **INTERLAMINATED SHALE (80%) & SANDSTONE (20%)**: shale is dark grey, sandstone is fine grained, pale grey, distinctly laminated at 0° *(continued)* | HW | | | XW SM, 40mm; PT, 0°, PL, RO, CN; XW SM, 150mm |
| | | **NO CORE:** 0.08 m | | | | |
| | | **SANDSTONE**: fine grained, pale grey, pebbly | FR | a=1.15 d=1.50 | 64% | |
| -6 | 9.0 | **SANDSTONE**: fine grained, pale grey, with grey laminations, distinctly cross bedded at 0-5° | | a=0.66 d=0.51 | | XW SM, 10mm; PT, 0°, PL, RO, CN; JT, 10°, PL, RO, CN |
| -7 | 10.0 | | | a=1.50 d=1.34 | | |
| | | **SANDSTONE**: fine to medium grained, pale grey, with some carbonaceous flecks, massive | | | 94% | |
| -8 | 11.0 | | | a=1.38 d=1.30 | | JT, 45°, PL, RO, CN; JT, 25°, PL, RO, CN |
| -9 | 12.0 | | | a=1.45 d=1.35 | 100% | PT, 0°, PL, RO, CN |
| -10 | 13.0 | | | d=1.40 | | |
| -11 | 14.0 | | | | 98% | |
| -12 | 15.0 | **SANDSTONE**: fine to medium grained, pale grey, with grey laminae, distinctly across bedded at 0-5° | | a=1.36 d=1.16 | | |
| | | | | a=2.36 d=1.46 | | JT, 10°, PL, RO, CN; XW SM, 10mm |
| | | with some dark grey shale | | | | |
| | | shale band | | | | PT, 0°, PL, RO, CN |

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | ***BH203*** |
| sheet: | 4 of 4 |
| project no. | ***GEOTLCOV24303AH*** |
| date started: | ***24 May 2013*** |
| date completed: | ***24 May 2013*** |
| logged by: | ***CL*** |
| checked by: | ***DS*** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 125 mm

**drilling information** | **material substance** | **rock mass defects**

| method & support | water | RL (m) | depth (m) | graphic log | material description<br>**ROCK TYPE**: grain characterisics, colour, structure, minor components | weathering & alteration | estimated strength & Is50 (× = axial; ○ = diametral) VL L M H VH EH | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | defect spacing (mm) 30 100 300 1000 3000 | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -13 | | | **SANDSTONE**: fine to medium grained, pale grey, with grey laminae, distinctly across bedded at 0-5° *(continued)* | FR | | | 100% | | PT, 0°, PL, RO, CN |
| | | | | | | | | | 100% | | |
| | | | | | | | | a=1.39<br>d=0.96 | | | PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, CN |
| | | -14 | 17.0 | | | | | | | | |
| | | | | | | | | a=2.23<br>d=2.07 | | | |
| | | | | | | | | | 96% | | |
| | | -15 | 18.0 | | | | | | | | XW SM, Clay, 20mm |
| | | | | | | | | a=1.95<br>d=1.42 | | | |
| | | -16 | 19.0 | | | | | | | | |
| | | | | | | | | | | | JT, 45°, PL, RO, CN<br>PT, 0°, PL, RO, CN |
| | | -17 | 20.0 | | | | | d=1.30 | 97% | | |
| | | | | | with dark grey sideritic laminae and patches of siderite | | | a=2.02<br>d=2.10 | | | |
| | | -18 | 21.0 | | Borehole BH203 terminated at 20.80 m | | | | | | |
| | | -19 | 22.0 | | | | | | | | |
| | | -20 | 23.0 | | | | | | | | |



**method & support**

DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**

10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss

25uL — water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**

core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**

barrel withdrawn

RQD = Rock Quality Designation (%)

**weathering & alteration***

RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**

VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**

PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**

PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**

SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**

CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH204** |
| sheet: | 1 of 1 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **14 May 2013** |
| date completed: | **14 May 2013** |
| logged by: | **JW** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,405.80; N: 6,250,490.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

**drilling information** | **material substance**

| method & support | samples & field tests | water | RL (m) | depth (m) | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|
| DT | | | 3 | | | **CONCRETE**: 0.15m. | | | **PAVEMENT** |
| HA | E, E, E | | | | | **FILL: SAND**: fine, grey, with some fine to medium sandstone gravel. | D | | **FILL** PID = 0.1ppm at 0.3m, no odour or staining; PID = 0ppm at 0.6m, no odour or staining |
| | | | 2 | 1.0 | | **FILL: SAND**: fine, dark grey, trace of fine gravel. | | | PID = 0ppm at 0.8m, no odour or staining |
| AD/T | SPT 6, 5, 4 N*=9 | | | | | **FILL: SAND**: fine, orange brown, trace of high plasticity clay. | M | | PID = 0ppm at 1.3m, no odour or staining |
| | E | | 1 | 2.0 | | **FILL: Clayey SAND**: fine to medium, pale grey, orange pink, clay is high plasticity. | | | |
| | E, E | | | | | **FILL: CLAY**: high plasticity, mottled dark grey, orange and red brown, trace of shale gravel. | | | PID = 0.1ppm at 2.5m, no odour or staining |
| | SPT 3, 4, 3 N*=7 | ► | 0 | 3.0 | SP | **SAND**: medium to coarse, dark grey, black, trace of clay and with some plant roots. | M | MD | **ALLUVIUM** PID = 0ppm at 3.2m, no odour or staining |
| | | | | | SP | **Clayey SAND**: medium to coarse, mottled pale grey, brown and dark red, trace of fine to medium sandstone gravel. | | MD / D | **RESIDUAL SOIL** |
| | | | -1 | 4.0 | | | | | |
| | | | | | | Borehole BH204 terminated at 4.25 m | | | |
| | | | -2 | 5.0 | | | | | |
| | | | -3 | 6.0 | | | | | |
| | | | -4 | 7.0 | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:12

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 — no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH204a** |
| sheet: | 1 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **07 Jun 2013** |
| date completed: | **07 Jun 2013** |
| logged by: | **RC** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

**drilling information** / **material substance**

| method & support | penetration 1 2 3 | water | samples & field tests | RL (m) | depth (m) | graphic log | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | hand penetrometer (kPa) 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD/T | | | | 3 | | | | **ASPHALT**: 0.07m. | D | | | **PAVEMENT** |
| | | | | | | | | **FILL: Gravelly SAND**: fine to medium, dark grey, cement stabilised. | | | | **FILL** |
| | | | | | | | | becoming black | | | | |
| | | | | 2 | 1.0 | | | | | | | |
| | | | | | | | | **FILL: SAND**: medium, pale brown, trace of white shell fragments. | | | | |
| | | | | 1 | 2.0 | | | **FILL: Sandy CLAY**: low plasticity, white and pale brown, medium grained sand with some ironstone gravel. | <Wp | | | |
| | | ▶ (water inflow) | | | | | | | >Wp | | | |
| | | | SPT 1, 4, 5 N*=9 | | | | | with some dark grey shale rock fragments within the fill | W | | | |
| | | | SPT 4, 10, 5 N*=15 | 0 | 3.0 | | | **FILL: Silty SAND**: medium, dark grey, trace of shells. | W / >Wp | | | |
| | | | | | | | | **FILL: MIXTURE OF SAND AND CLAY**: fine to medium, low plasticity, brown and grey. | | | | |
| | | | SPT 5, 10, 16/30mm N*=R | -1 | 4.0 | | SM | **Silty SAND**: medium, dark grey, with some shells. | W | MD / D | | **ALLUVIUM** |
| | | | | | | | | **SANDSTONE**: medium grained, red brown, highly weathered, low strength | | | | **BEDROCK** |
| | | | | | | | | Borehole BH204a continued as cored hole | | | | |
| | | | | -2 | 5.0 | | | | | | | |
| | | | | -3 | 6.0 | | | | | | | |
| | | | | -4 | 7.0 | | | | | | | |



**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 — no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH204a** |
| sheet: | 2 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **07 Jun 2013** |
| date completed: | **07 Jun 2013** |
| logged by: | **RC** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| method & support | water | RL (m) | depth (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | defect descriptions (particular) |
|---|---|---|---|---|---|---|---|---|
| | | 3 | | | | | | |
| | | 2 | 1.0 | | | | | |
| | | 1 | 2.0 | | | | | |
| | | 0 | 3.0 | | | | | |
| | | -1 | 4.0 | start coring at 4.40m | | | | |
| NMLC | | | | **SANDSTONE**: medium to coarse grained, brown, iron stained, indistinctly cross bedded | MW | | | |
| | | | | **NO CORE:** 0.07 m | MW | a=1.67 d=1.52 | 74% | PT, 0°, PL, RO, SN |
| | | -2 | 5.0 | **SANDSTONE**: medium to coarse grained, brown and grey, iron stained, indistinctly cross bedded | | | | PT, 0°, PL, RO, SN |
| | | | | | | | | PT, 20°, PL, RO, SN |
| | partial drilling fluid loss | -3 | 6.0 | | | a=1.73 d=1.53 | | |
| | | | | **SANDSTONE**: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions | | | 97% | |
| | | -4 | 7.0 | | | a=1.34 d=1.03 | | |
| | | | | | | a=0.94 d=1.05 | | SM, 5°, PL, RO, Clay, 5 mm |
| | | | | | | | | PT, 20°, PL, RO, SN |

general: Defects are: PT, 5 - 15°, PL, RO, SN, unless otherwise described

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

# Engineering Log - Cored Borehole

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| | |
|---|---|
| Borehole ID. | **BH204a** |
| sheet: | 3 of 4 |
| project no. | **GEOTLCOV24303AH** |

| | | | |
|---|---|---|---|
| client: | *Lend Lease Development Pty Ltd* | date started: | *07 Jun 2013* |
| principal: | | date completed: | *07 Jun 2013* |
| project: | *SICEEP - International Convention Centre (ICC) Hotel* | logged by: | *RC* |
| location: | *Darling Harbour, Sydney* | checked by: | *DS* |

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| method & support | RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | additional observations and defect descriptions |
|---|---|---|---|---|---|---|---|
| NMLC | | | **SANDSTONE**: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions *(continued)* | MW / HW | a=0.52 d=1.27 | 97% | PT, 30°, PL, RO, Clay VN |
| | | | **NO CORE:** 0.12 m | | | | SM, 5°, PL, RO, Clay, 35 mm |
| | -6 | 9.0 | **SANDSTONE**: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions | FR | a=1.07 d=0.85 | | PT, 10°, PL, RO, Clay CO, 2 mm |
| | | | **SANDSTONE**: medium grained, pale grey, distinctly cross bedded at 10° -15° | | | | |
| | -7 | 10.0 | **SANDSTONE**: medium grained, pale grey, massive, with carbonaceous flecks | | a=1.45 d=1.63 | 85% | |
| | -8 | 11.0 | | | a=1.58 d=1.49 | | |
| | -9 | 12.0 | **SANDSTONE**: medium to coarse grained, pale grey and grey, distinctly cross bedded at 15°-20° | | | | PT, 20°, PL, RO, CN |
| | -10 | 13.0 | | | a=1.72 d=1.76 | 100% | PT, 20°, PL, RO, CN |
| | | | | | | | PT, 15°, PL, RO, CN |
| | -11 | 14.0 | | | a=1.64 d=1.49 | | PT, 15°, PL, RO, Clay VN |
| | -12 | 15.0 | | | a=1.87 d=1.42 | 97% | PT, 10°, PL, RO, Clay VN |
| | | | **SANDSTONE**: medium to coarse grained, grey and pale grey, distinctly cross bedded at 25° with some fine siltstone gravel clasts | | | | PT, 10°, UN, SO, Coal CO; PT, 5°, UN, SO, Coal CO; PT, 30°, UN, SO, Coal CO |

**method & support**
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; W washbore; NMLC NMLC core (51.9 mm); NQ wireline core (47.6mm); HQ wireline core (63.5mm); PQ wireline core (85.0mm); SPT standard penetration test

**water**
10/10/12, water level on date shown; water inflow; complete drilling fluid loss; partial drilling fluid loss; 25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material); no core recovered

**core run & RQD**
barrel withdrawn; RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil; XW extremely weathered; HW highly weathered; DW distinctly weathered; MW moderately weathered; SW slightly weathered; FR fresh
*W replaced with A for alteration

**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
PT parting; JT joint; SZ shear zone; SS shear surface; CS crushed seam; SM seam; DB drilling break

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR Irregular

**roughness**
SL slickensided; POL polished; SO smooth; RO rough; VR very rough

**coating**
CN clean; SN stain; VN veneer; CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH204a** |
| sheet: | 4 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **07 Jun 2013** |
| date completed: | **07 Jun 2013** |
| logged by: | **RC** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

| method & support | water | RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | estimated strength & Is50 | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | defect spacing (mm) | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | -13 | | **SANDSTONE**: medium to coarse grained, grey and pale grey, distinctly cross bedded at 25° with some fine siltstone gravel clasts *(continued)* | FR | H | a=2.20 d=1.60 | 97% | | PT, 30°, PL, RO, CN |
| | | | | with siltstone clasts, 5mm to 50mm | | | | | | PT, 20°, UN, SO, CN, siltstone clast |
| | | -14 | 17.0 | **SANDSTONE**: coarse grained, pale grey, massive | | H | a=1.80 d=1.83 | | | |
| | partial drilling fluid loss | | | with some laminations at 20° | | | | | | |
| | | | | **SANDSTONE**: fine to medium grained, grey, closely spaced distinct laminations at 10° | | H | a=1.42 d=1.57 | 100% | | PT, 10°, PL, RO, CN |
| | | | | | | | | | | PT, 15°, PL, RO, CN |
| | | -15 | 18.0 | **SANDSTONE**: medium grained, pale grey, distinctly cross bedded at 15° with some siltstone gravel clasts, 10mm to 40mm diameter | | | | | | |
| | | -16 | 19.0 | | | H | a=2.02 d=1.80 | | | |
| | | | | | | H | a=2.78 d=2.11 | | | |
| | | -17 | 20.0 | | | | | | | PT, 15°, PL, RO, Clay VN |
| | | | | Borehole BH204a terminated at 20.40 m | | | | | | |
| | | -18 | 21.0 | | | | | | | |
| | | -19 | 22.0 | | | | | | | |
| | | -20 | 23.0 | | | | | | | |

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH207** |
| sheet: | 1 of 4 |
| project no. | **GEOTLCOV24303AH** |

| | | | |
|---|---|---|---|
| client: | **Lend Lease Development Pty Ltd** | date started: | **14 May 2013** |
| principal: | | date completed: | **15 May 2013** |
| project: | **SICEEP - International Convention Centre (ICC) Hotel** | logged by: | **JW** |
| location: | **Darling Harbour, Sydney** | checked by: | **DS** |

position: E: 333,380.80; N: 6,250,502.90 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°
drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | penetration | water | samples & field tests | RL (m) | depth (m) | graphic log | classification symbol | material description | moisture condition | consistency / relative density | hand penetrometer (kPa) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | | | | | | | **BRICK PAVER**: 0.1m. | | | | **PAVEMENT** |
| AD/V, HQ Casing | | | E | | | | | **FILL: SAND**: fine to medium, brown and orange brown. | M | | | **FILL** PID = 0.0ppm at 0.2m, no odour or staining |
| | | | E | | | | | becoming dark brown | | | | PID = 0.0ppm at 0.5m, no odour or staining |
| | | | | 2 | | | | **FILL: SAND**: fine to medium, mottled grey, pale grey and brown, with a trace of clay and fine gravel. | | | | |
| | | | E | | 1.0 | | | **FILL: SAND**: fine to medium, pale orange and brown. | | | | PID = 0.0ppm at 1.1m, no odour or staining |
| | | | | | | | | with a trace of shell | | | | |
| | | | SPT 6, 14, 33/120mm N*=R | 1 | | | SC | **Clayey SAND**: medium to coarse, mottled grey, brown, dark red purple. | | MD / D | | **RESIDUAL SOIL** |
| AD/T | | | | | 2.0 | | | **SANDSTONE**: medium to coarse grained, grey with carbonaceous laminae, highly weathered, low strength | | | | **BEDROCK** |
| | | | | 0 | 3.0 | | | Borehole BH207 continued as cored hole | | | | |
| | | | | -1 | 4.0 | | | | | | | |
| | | | | -2 | 5.0 | | | | | | | |
| | | | | -3 | 6.0 | | | | | | | |
| | | | | -4 | 7.0 | | | | | | | |
| | | | | -5 | | | | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:13

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH207** |
| sheet: | 2 of 4 |
| project no. | **GEOTLCOV24303AH** |

| | | | |
|---|---|---|---|
| client: | **Lend Lease Development Pty Ltd** | date started: | **14 May 2013** |
| principal: | | date completed: | **15 May 2013** |
| project: | **SICEEP - International Convention Centre (ICC) Hotel** | logged by: | **JW** |
| location: | **Darling Harbour, Sydney** | checked by: | **DS** |

position: E: 333,380.80; N: 6,250,502.90 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

**drilling information** | **material substance** | **rock mass defects**

| depth (m) | RL (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | defect descriptions |
|---|---|---|---|---|---|---|
| 0.0–2.70 | 2 to 0 | start coring at 2.70m | | | | |
| 2.70 | 0 | **SANDSTONE**: medium to coarse grained, grey with dark grey laminate, indistinctly laminated at 0-20° | SW / XW / SW | a=0.13<br>a=1.07<br>d=0.77 | 0% | Highly fractured zone, 120mm<br>SM, 100 mm, XW<br>PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, Clay CO<br>PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, Fe SN |
| 3.2 | | **SANDSTONE**: medium to coarse grained, pale grey brown with some shale breccia, iron oxide bedding, indistinctly laminated at 10-20° | | | 72% | PT, 0°, PL, RO, Fe SN<br>JT, 20°, PL, RO, CN |
| 4.0 | | **SANDSTONE**: medium to coarse grained, pale grey, yellow brown and red brown, indistinctly laminated at 0-20°, heavily iron stained | MW / SW / MW | a=0.32<br>d=1.12<br>a=2.18<br>d=1.48<br>a=1.25<br>d=1.35 | 63%<br>97% | PT, 10°, PL, RO, CN<br>JT, 20°, PL, RO, CN<br>PT, 10°, PL, RO, CN<br>CS, 10 mm<br>PT, 0 - 10°, IR, RO, Fe SN<br>PT, 0°, PL, RO, Fe SN<br>PT, 0°, IR, RO, Fe SN |
| 6.7 | -4 | **SANDSTONE**: medium to coarse grained, grey, with carbonaceous laminae, and shale clast, indistinctly bedded | FR | d=0.51 | | PT, 10°, IR, RO, X VN<br>PT, 5°, IR, VR, CN<br>SM, 50 mm, XW |
| 7.2 | | **INTERBEDDED SHALE AND SANDSTONE**: shanle is dark grey, sandstone is medium grained, pale grey | HW | | 45% | SM, Clay, 480 mm<br>PT, 0 - 5°, IR - PL, SO, CN |

method & support: NMLC

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:10

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

# coffey geotechnics

## Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH207** |
| sheet: | 3 of 4 |
| project no. | **GEOTLCOV24303AH** |
| client: | *Lend Lease Development Pty Ltd* |
| principal: | |
| project: | *SICEEP - International Convention Centre (ICC) Hotel* |
| location: | *Darling Harbour, Sydney* |
| date started: | *14 May 2013* |
| date completed: | *15 May 2013* |
| logged by: | *JW* |
| checked by: | *DS* |

position: E: 333,380.80; N: 6,250,502.90 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

Method & support: NMLC

| depth (m) | RL (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | defects (type, inclination, planarity, roughness, coating) |
|---|---|---|---|---|---|---|
| | | **SANDSTONE**: medium to coarse grained, carbonaceous laminae, rooted | HW | a=0.77 d=1.20 | 45% | SM, Clay, 100 mm; SM, Clay, 60 mm |
| | | 8.35m - 9.45m: sandstone is medium to coarse grained, pale grey, with carbonaceous laminaes, indistinctly bedded at 0-15° | FR | | | |
| 9.0 | -6 | | | | 100% | PT, 0°, PL, RO, CN |
| | | **SANDSTONE**: fine to medium grained, pale grey, with carbonaceous flecks, massive | | a=1.50 d=1.80 | | PT, 0°, PL, RO, CN |
| 10.0 | -7 | | | | | PT, 0°, IR, RO, CN |
| 11.0 | -8 | | | a=1.37 d=1.93 | | |
| | -9 | | | a=1.92 d=1.95 | 100% | |
| 12.0 | | | | | | |
| | -10 | | | a=1.86 d=1.92 | | PT, 0°, PL, RO, CN |
| 13.0 | | | | a=1.59 d=2.06 | | |
| 14.0 | -11 | | | | 100% | |
| | -12 | | | a=1.34 d=1.57 | | |
| 15.0 | | with shale clasts | | | 100% | PT, 0 - 5°, PL - CU, RO, CN |
| | -13 | **SANDSTONE**: medium to coarse grained, pale grey, with dark grey laminae, indistinctly cross bedded at 0-10° | | a=1.76 | | PT, 5°, PL, RO, CN |

**method & support**
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; W washbore; NMLC NMLC core (51.9 mm); NQ wireline core (47.6mm); HQ wireline core (63.5mm); PQ wireline core (85.0mm); SPT standard penetration test

**water**
10/10/12, water level on date shown; water inflow; complete drilling fluid loss; partial drilling fluid loss; 25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material); no core recovered

**core run & RQD**
barrel withdrawn; RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil; XW extremely weathered; HW highly weathered; DW distinctly weathered; MW moderately weathered; SW slightly weathered; FR fresh
*W replaced with A for alteration

**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
PT parting; JT joint; SZ shear zone; SS shear surface; CS crushed seam; SM seam; DB drilling break

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR Irregular

**roughness**
SL slickensided; POL polished; SO smooth; RO rough; VR very rough

**coating**
CN clean; SN stain; VN veneer; CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | ***BH207*** |
| sheet: | 4 of 4 |
| project no. | ***GEOTLCOV24303AH*** |

| | | | |
|---|---|---|---|
| client: | ***Lend Lease Development Pty Ltd*** | date started: | ***14 May 2013*** |
| principal: | | date completed: | ***15 May 2013*** |
| project: | ***SICEEP - International Convention Centre (ICC) Hotel*** | logged by: | ***JW*** |
| location: | ***Darling Harbour, Sydney*** | checked by: | ***DS*** |

position: E: 333,380.80; N: 6,250,502.90 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | water | RL (m) | depth (m) | graphic log | material description ROCK TYPE: grain characterisics, colour, structure, minor components | weathering & alteration | estimated strength & Is50 (× = axial; ○ = diametral) VL L M H VH EH | samples, field tests & Is(50) (MPa) a = axial; d = diametral | core run & RQD | defect spacing (mm) 30 100 300 1000 3000 | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | | | | **SANDSTONE**: medium to coarse grained, pale grey, with dark grey laminae, indistinctly cross bedded at 0-10° *(continued)* | FR | | d=2.04 | 100% | | |
| | | -14 | 17.0 | | | | | a=1.77 d=1.20 | 100% | | |
| | | -15 | 18.0 | | | | | a=2.54 d=3.00 | | | PT, 0°, PL, RO, CN, x3 |
| | | | | | | | | a=2.41 d=2.41 | 98% | | PT, 0°, PL, RO, Clay CO |
| | | -16 | 19.0 | | | | | a=3.23 d=2.33 | | | |
| | | -17 | 20.0 | | | | | a=2.68 d=1.61 | 100% | | |
| | | | | | Borehole BH207 terminated at 20.30 m | | | | | | |
| | | -18 | 21.0 | | | | | | | | |
| | | -19 | 22.0 | | | | | | | | |
| | | -20 | 23.0 | | | | | | | | |
| | | -21 | | | | | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:10

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH208** |
| sheet: | 1 of 4 |
| project no. | **GEOTLCOV24303AH** |

| | | | |
|---|---|---|---|
| client: | *Lend Lease Development Pty Ltd* | date started: | *21 May 2013* |
| principal: | | date completed: | *22 May 2013* |
| project: | *SICEEP - International Convention Centre (ICC) Hotel* | logged by: | *CL* |
| location: | *Darling Harbour, Sydney* | checked by: | *DS* |

position: E: 333,366.90; N: 6,250,510.70 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

**drilling information** | **material substance**

| method & support | penetration 1 2 3 | water | samples & field tests | RL (m) | depth (m) | graphic log | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | hand penetrometer (kPa) 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DT | | | E | | | | | **BRICK PAVER**: 0.1m. | | | | **PAVEMENT** |
| | | | | | | | | **CONCRETE**: 0.1m. | | | | PID = 0 ppm at 0.2m, no staining or odour |
| | | | | | | | | **ASPHALT**: 0.3m. | | | | |
| AD/T, HQ Casing | | | E | 2 | | | | **FILL: Gravelly SAND**: fine to coarse, brown, fine to coarse sandstone and igneous rock gravel. from 0.8m - becoming orange brown | D | | | **ROADBASE** PID = 0 ppm at 0.5m, no staining or odour |
| | | | E | | 1.0 | | | **FILL: SAND**: fine, yellow brown. | | L / MD | | **FILL** PID = 0 ppm at 1m, no staining or odour |
| | | | | 1 | | | | | | | | |
| | | | E | | 2.0 | | | | M | | | PID = 0 ppm at 2m, no staining or odour |
| | | ▶ (water inflow) | | 0 | | | SP | **SAND**: fine to medium, brown, trace of fine grained shell fragments. | W | D | | **ALLUVIUM** |
| | | | E | | 3.0 | | | | | | | PID = 0 ppm at 3m, no staining or odour |
| | | | SPT 30 N*=R | | | | | **SANDSTONE**: fine to medium grained, orange brown mottled grey and brown, extremely to highly weathered, low strength | | | | **BEDROCK** |
| | | | | -1 | 4.0 | | | Borehole BH208 continued as cored hole | | | | |
| | | | | -2 | 5.0 | | | | | | | |
| | | | | -3 | 6.0 | | | | | | | |
| | | | | -4 | 7.0 | | | | | | | |
| | | | | -5 | | | | | | | | |



**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 — no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH208** |
| sheet: | 2 of 4 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **21 May 2013** |
| date completed: | **22 May 2013** |
| logged by: | **CL** |
| checked by: | **DS** |

client: **Lend Lease Development Pty Ltd**

principal:

project: **SICEEP - International Convention Centre (ICC) Hotel**

location: **Darling Harbour, Sydney**

position: E: 333,366.90; N: 6,250,510.70 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | additional observations and defect descriptions |
|---|---|---|---|---|---|---|---|
| | 2 | 1.0 | | | | | |
| | 1 | 2.0 | | | | | |
| | 0 | 3.0 | start coring at 3.25m | | | | |
| NMLC | | | **SANDSTONE**: medium to coarse grained, pale grey with dark grey laminae, distinctly cross bedded at 0-15°, iron stained at surface | SW / FR | | | PT, 0°, PL, RO, Fe SN |
| | -1 | 4.0 | | FR | a=2.59 d=1.20 a=1.83 d=1.78 | 97% | PT, 5°, PL, RO, Fe SN; PT, 10°, PL, RO, CN; PT, 10°, PL, RO, CN |
| | -2 | 5.0 | **SANDSTONE**: fine to medium grained, pale grey with carbonaceous flects, massive to indistinctly bedded | FR | | | SM, Clay, 10 mm; PT, 5°, PL, RO, CN |
| | -3 | 6.0 | | FR | a=2.56 d=1.59 | 87% | |
| | -4 | 7.0 | **SANDSTONE**: medium to coarse grained, grey with some dark grey shale lenticles, distinctly cross bedded at 0-5° | FR | a=1.39 d=1.22 a=1.86 d=2.05 | 87% | PT, 5°, PL, RO, Clay CO; PT, 5°, PL, RO, Clay CO; PT, 0°, PL, RO, Clay CO |
| | -5 | | **NO CORE:** 0.19 m | XW | | | XW SM, Clay, 60mm; PT, 0°, PL, RO, Clay CO |

**method & support**
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; W washbore; NMLC NMLC core (51.9 mm); NQ wireline core (47.6mm); HQ wireline core (63.5mm); PQ wireline core (85.0mm); SPT standard penetration test

**water**
10/10/12, water level on date shown; water inflow; complete drilling fluid loss; partial drilling fluid loss; 25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material); no core recovered

**core run & RQD**
barrel withdrawn; RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil; XW extremely weathered; HW highly weathered; DW distinctly weathered; MW moderately weathered; SW slightly weathered; FR fresh
*W replaced with A for alteration

**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
PT parting; JT joint; SZ shear zone; SS shear surface; CS crushed seam; SM seam; DB drilling break

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR Irregular

**roughness**
SL slickensided; POL polished; SO smooth; RO rough; VR very rough

**coating**
CN clean; SN stain; VN veneer; CO coating

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH208** |
| sheet: | 3 of 4 |
| project no. | **GEOTLCOV24303AH** |
| client: | **Lend Lease Development Pty Ltd** |
| principal: | |
| project: | **SICEEP - International Convention Centre (ICC) Hotel** |
| location: | **Darling Harbour, Sydney** |
| date started: | **21 May 2013** |
| date completed: | **22 May 2013** |
| logged by: | **CL** |
| checked by: | **DS** |

position: E: 333,366.90; N: 6,250,510.70 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | RL (m) | depth (m) | material description | weathering & alteration | samples, field tests & Is(50) (MPa) | core run & RQD | additional observations and defect descriptions |
|---|---|---|---|---|---|---|---|
| NMLC | | | **SANDSTONE**: medium to coarse grained, grey with some dark grey shale lenticles and clasts, distinctly cross bedded at 0-5° *(continued)* | FR | | 87% | |
| | | | **SANDSTONE**: fine grained, grey with grey laminae, distinctly cross bedded at 0-5° | | | | PT, 0°, PL, RO, CN |
| | -6 | 9.0 | | | a=1.78 d=0.91 | | |
| | | | | | a=1.48 d=1.30 | 100% | |
| | -7 | 10.0 | | | | | PT, 0°, PL, RO, CO, Siderite |
| | | | **SANDSTONE**: fine to medium grained, pale grey with some carbonaceous flecks, massive | | | | PT, 0°, PL, RO, Clay CO |
| | | | | | | | SM, Clay, 20 mm |
| | -8 | 11.0 | | | a=1.40 d=1.35 | 100% | JT, 15°, PL, RO, CN |
| | | | | | d=1.46 | | |
| | -9 | 12.0 | | | | 100% | |
| | -10 | 13.0 | | | a=1.72 d=2.15 | | |
| | -11 | 14.0 | 14.2m: some shale clasts up to 50mm | | | 100% | |
| | -12 | 15.0 | | | a=1.58 d=2.09 | | PT, 0°, PL, RO, CN |
| | | | **SANDSTONE**: fine grained, pale grey, with grey laminae, distinctly bedded at 0-5°, with some silty sandstone beds | | | | SM, Clay, 10 mm |
| | -13 | | | | a=2.04 d=1.94 | | |

**method & support**
DT diatube; AS auger screwing; AD auger drilling; RR roller/tricone; CB claw or blade bit; W washbore; NMLC NMLC core (51.9 mm); NQ wireline core (47.6mm); HQ wireline core (63.5mm); PQ wireline core (85.0mm); SPT standard penetration test

**water**
10/10/12, water level on date shown; water inflow; complete drilling fluid loss; partial drilling fluid loss; 25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material); no core recovered

**core run & RQD**
barrel withdrawn; RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil; XW extremely weathered; HW highly weathered; DW distinctly weathered; MW moderately weathered; SW slightly weathered; FR fresh
*W replaced with A for alteration

**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
PT parting; JT joint; SZ shear zone; SS shear surface; CS crushed seam; SM seam; DB drilling break

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR Irregular

**roughness**
SL slickensided; POL polished; SO smooth; RO rough; VR very rough

**coating**
CN clean; SN stain; VN veneer; CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole ID. | **BH208** |
| sheet: | 4 of 4 |
| project no. | **GEOTLCOV24303AH** |
| client: | **Lend Lease Development Pty Ltd** |
| date started: | **21 May 2013** |
| principal: | |
| date completed: | **22 May 2013** |
| project: | **SICEEP - International Convention Centre (ICC) Hotel** |
| logged by: | **CL** |
| location: | **Darling Harbour, Sydney** |
| checked by: | **DS** |

position: E: 333,366.90; N: 6,250,510.70 (Datum Not Specified) surface elevation : 2.80m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

| method & support | water | RL (m) | depth (m) | material description (ROCK TYPE: grain characterisics, colour, structure, minor components) | weathering & alteration | samples, field tests & Is(50) (MPa) (a = axial; d = diametral) | core run & RQD | additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) |
|---|---|---|---|---|---|---|---|---|
| NMLC | | | | | FR | a=1.82 d=2.72 | | |
| | | | | **SANDSTONE**: fine to medium grained, pale grey with a trace of dark grey laminae and shale lenticles, distinctly cross bedded at 0-10° | | | | JT, 85°, ST, RO, CN; Highly fractured zone, 30mm |
| | | -14 | 17.0 | | | | 97% | |
| | | | | | | a=2.36 d=3.10 | | PT, 0°, PL, RO, CO, Siderite |
| | | -15 | 18.0 | | | a=2.92 d=3.21 | | |
| | | -16 | 19.0 | | | a=2.64 d=2.53 | 100% | |
| | | -17 | 20.0 | | | a=2.74 d=2.34 | | |
| | | -18 | | Borehole BH208 terminated at 20.72 m | | | | |
| | | | 21.0 | | | | | |
| | | -19 | 22.0 | | | | | |
| | | -20 | 23.0 | | | | | |
| | | -21 | | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:10

**method & support**
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

**water**
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

**graphic log / core recovery**
core recovered (graphic symbols indicate material)
no core recovered

**core run & RQD**
barrel withdrawn
RQD = Rock Quality Designation (%)

**weathering & alteration***
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

**strength**
VL very low
L low
M medium
H high
VH very high
EH extremely high

**defect type**
PT parting
JT joint
SZ shear zone
SS shear surface
CS crushed seam
SM seam
DB drilling break

**roughness**
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

**coating**
CN clean
SN stain
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole ID. | **BH209** |
| sheet: | 1 of 1 |
| project no. | **GEOTLCOV24303AH** |
| date started: | **28 May 2013** |
| date completed: | **28 May 2013** |
| logged by: | **DB** |
| checked by: | **DS** |

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,376.70; N: 6,250,542.30 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: Hand Auger mounting: hole diameter : 100 mm

**drilling information** / **material substance**

| method & support | penetration 1 2 3 | water | samples & field tests | RL (m) | depth (m) | graphic log | classification symbol | material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components) | moisture condition | consistency / relative density | hand penetrometer (kPa) 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | | | 3 | | | | **BRICK PAVER**: 0.08m. | D | | | **PAVEMENT** |
| | | | E | | | | | **FILL: SAND**: medium - coarse, pale brown to orange brown. | M | | | **FILL** |
| | | | | | | | | **FILL: BITUMEN** | | | | **STABILISED ROADBASE** |
| | | | | | | | | **FILL: Gravelly SAND**: medium - coarse, dark grey, fine to medium grained subangular gravel with some lime. | | | | **BEDROCK** |
| | | | | 2 | 1.0 | | | **SANDSTONE**: medium, orange brown to pale grey, moderately weathered, medium strength. | | | | |
| | | | | | | | | Borehole BH209 terminated at 0.45 m | | | | |
| | | | | 1 | 2.0 | | | | | | | |
| | | | | 0 | 3.0 | | | | | | | |
| | | | | -1 | 4.0 | | | | | | | |
| | | | | -2 | 5.0 | | | | | | | |
| | | | | -3 | 6.0 | | | | | | | |
| | | | | -4 | 7.0 | | | | | | | |

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:13

**method**
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

**support**
M mud N nil
C casing

**penetration**
1 2 3 no resistance ranging to refusal

**water**
10-Oct-12 water level on date shown
water inflow
water outflow

**samples & field tests**
U## undisturbed sample ##mm diameter
D disturbed sample
B bulk disturbed sample
E environmental sample
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (uncorrected kPa)
R refusal

**classification symbol & soil description**
based on Unified Classification System

**moisture**
D dry
M moist
W wet

**consistency / relative density**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense