



Brickworks Plant 2 Upgrade

Soil and Water Management Plan & Civil Engineering Design Report

CLIENT/ BRICKWORKS LTD

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1. Introduction

1.1. Background

AT&L was commissioned by Brickworks Limited to prepare a Civil Servicing Report in support of an Environmental Impact Statement (EIS) associated with a State Significant Development Application for a proposed industrial development on their property at 780 Wallgrove Road, Horsley Park.

The site is situated within the Fairfield City Council local government area but the provisions of the State Environmental Planning Policy 2011 take precedence over local planning instruments due to the scale of the proposed development. This report has been prepared to address both Fairfield City Council's standard engineering requirements and the Secretary's Environmental Assessment Requirements as issued 16 November 2018.

1.2. Existing Site

The larger parent site on which the development is located covers an area of approximately 85 hectares in Horsley Park, Western Sydney. The site is bounded by Wallgrove Road to the west, Ferrers Road to the east, the WaterNSW bulk water supply pipelines to the north and a Veolia quarry and private rural properties to the south.

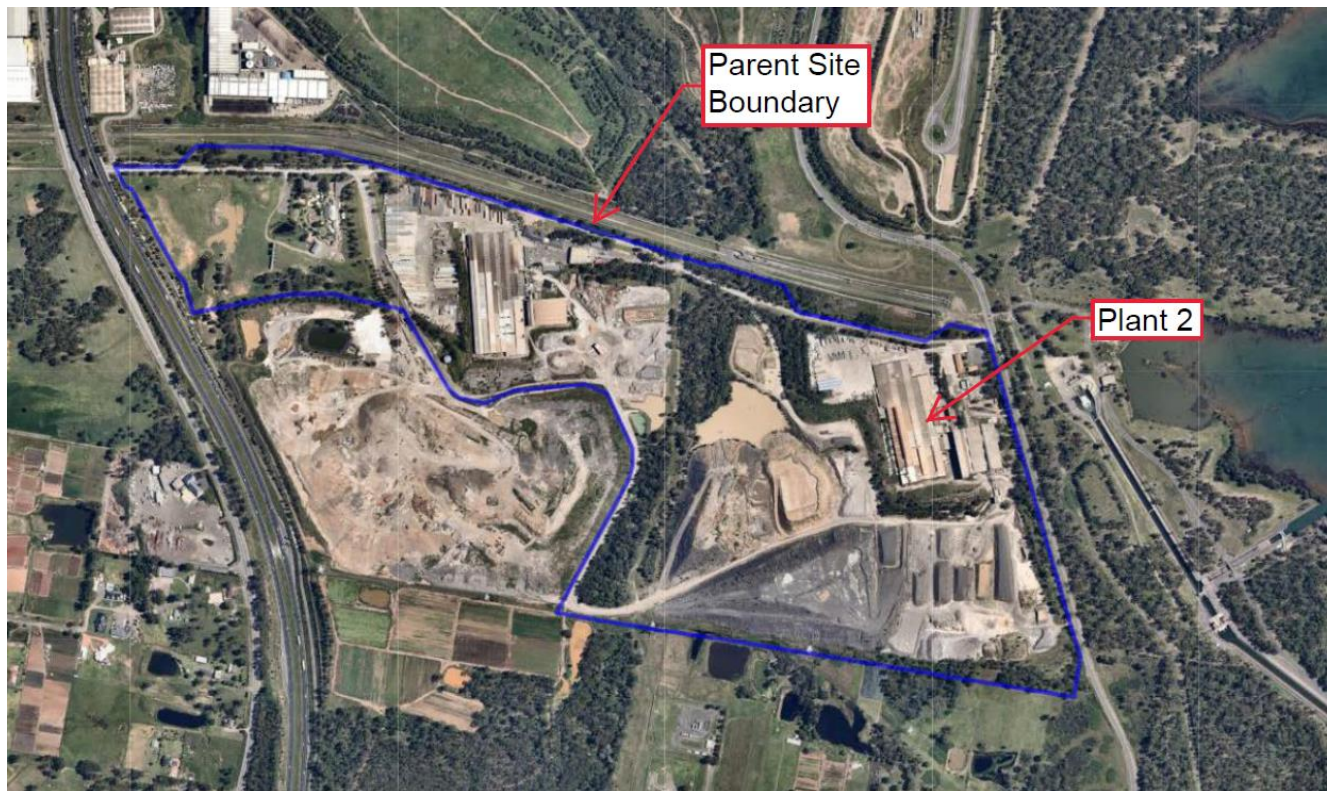
The site comprises an existing brick-making facility with associated factory buildings, access roads, carparks, material stockpiles, basins, offices and amenities. A 1.8km-long paved internal road runs along the northern edge of the site between Wallgrove Road and Ferrers Road.

Eastern Creek, classified as a fourth order or higher stream by the NSW Office of Water, runs through the centre of the parent site. It falls south to north through the site within a densely vegetated riparian corridor.

The topography of the site generally falls from Ferrers Road (RL68) and Wallgrove Road (RL62) towards Eastern Creek in the centre (RL55), although there are several other localised low-points around the site.

Refer to AT&L Drawing DAC003 enclosed under Appendix A which shows the proposed development area in the context of the wider parent site.

Figure 1 – Existing Site Aerial Photo

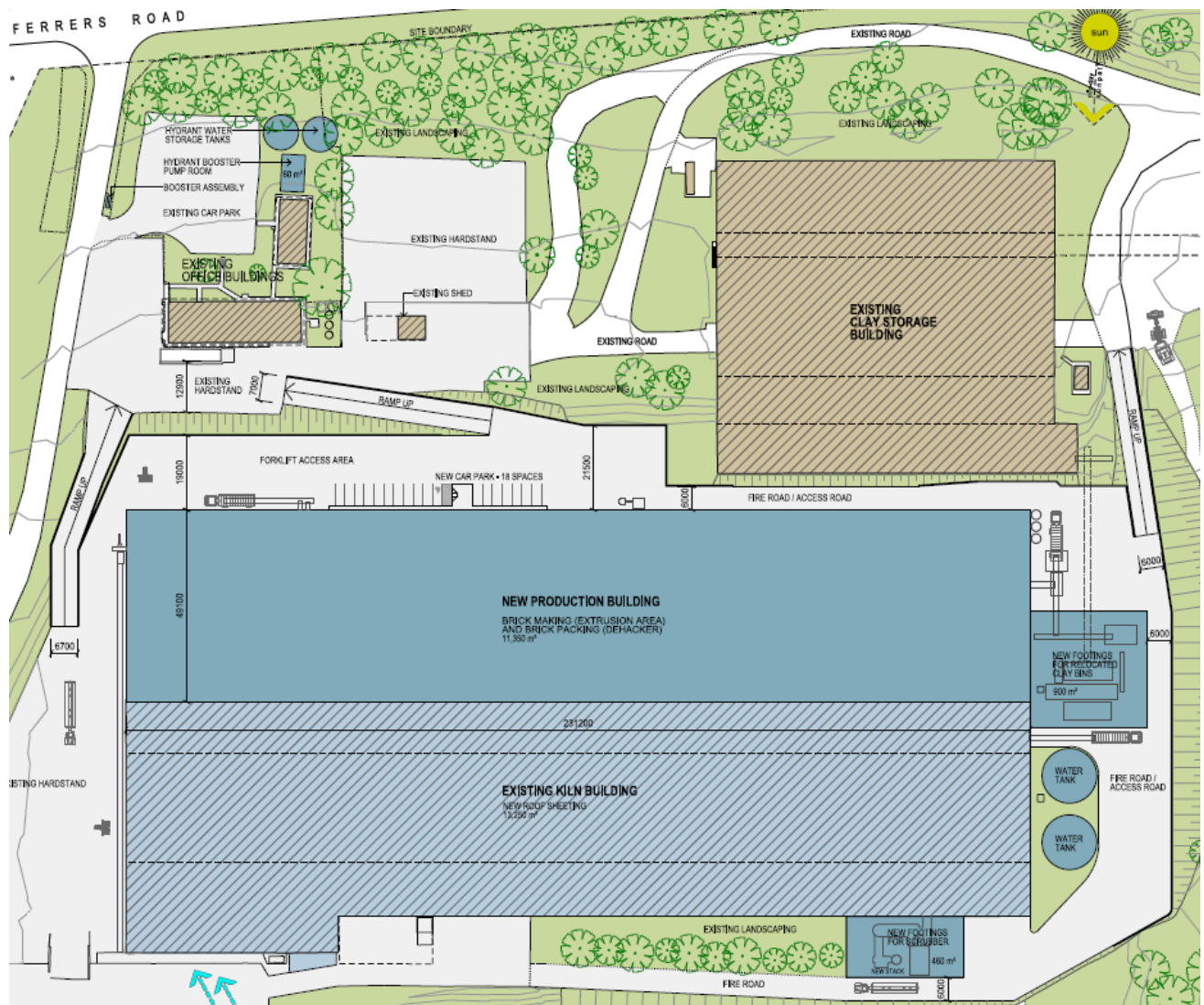


1.3. Proposed Development

The proposed development is an extension to the existing brick manufacturing facility known as Plant 2. New state-of-the-art industrial plant and machinery will be installed to modernise the facility, including kilns, crushers and conveyors. Associated works will include the construction of access ramps, storage hardstands and loading areas. As well as the building extension, the existing roof sheeting and guttering will be removed and replaced with new materials. Refer to Figure 2 below and also the SBA architectural drawings.

The extent of the redevelopment works will cover an area of approximately two hectares in the immediate vicinity of the Plant 2 complex.

Figure 2 – Proposed Plant 2 Development



2. Earthworks

2.1. SEARS

The Secretary's Environmental Assessment Requirements for the Development Application state that the Soil and Water Report must include:

- details of site history with regards to potential contamination; and
- description of the construction erosion and sediment controls.

2.2. Existing Geology

A geotechnical investigation of the subject site was undertaken by Douglas Partners in June 2015. A copy of their report (No.84821.00) is enclosed as Appendix B.

The investigation included the drilling of fifteen boreholes at various locations throughout the proposed development footprint in order to ascertain the existing subsoil conditions and strata. Lab testing of soil samples was subsequently undertaken by a NATA registered laboratory.

The investigation generally found that the site contains a layer of fill up to 8m thick (containing ripped shale, clay and crushed bricks) over residual stiff, high-plasticity silty clays. This is underlain by Bringelly shale typically of low to medium strength.

2.3. Proposed Bulk Earthworks

Bulk earthworks will be required in order to create suitable ground levels for the extension of the existing structure and construction of surrounding hardstand areas and access roads.

Refer to AT&L Drawing 18-577-C030 contained within Appendix A for the proposed bulk earthworks plan.

2.3.1. Excavation

The required total cut volume is estimated to be approximately 93,000m³ across the site.

Approximately 40,000m³ of this cut is related to the development works around Plant 2. This volume is primarily generated from excavation into existing berms around the perimeter of the existing facility.

The remaining 53,000m³ of cut is required in order to remove the existing clay stockpile at the proposed basin location and then excavate the basin itself below natural ground level.

The cut material will be relocated to a stockpile on the wider site in a suitable location to be confirmed closer to the time of construction (to suit quarry activities). It is noted that there are numerous existing stockpile areas spread across the wider Brickworks site.

The Douglas Partners geotechnical report states that excavation of the filling, clay and very low/low strength rock layers could be carried out using conventional earthmoving equipment up to a medium bulldozer/excavator. Should any deeper excavations be required into the higher strength shale or siltstone, specialist rock breaking equipment may be required.

2.3.2. Batters and Retaining Walls

As cut is removed from the existing berms, new batters and retaining walls will be introduced. The maximum permanent batter slope recommended by the Douglas Partners report is 1V:2H, subject to stabilisation measures which are likely to include planting with low-maintenance vegetation. The civil design has sought to limit retaining wall height to a maximum of 3.0m. It is likely that a segmental Austral product such as Magnumstone will be utilised, either in a gravity or earth-reinforced arrangement.

2.3.3. Filling

Filling is not required for the development.

2.4. Erosion and Sediment Controls

Appropriate erosion and sediment control measures will be installed and maintained for the duration of construction to ensure that sediment-laden runoff does not pollute the downstream environment, particularly the Eastern Creek riparian zone.

All erosion and sediment control plans will be prepared in accordance with the *NSW Government's Managing Urban Stormwater – Soils and Construction Blue Book Volume 1, 4th Edition, March 2007*.

A preliminary erosion and sediment control plan for the site is included under Appendix A. It is important to note that the measures identified on this plan are a conceptual approach to construction phase stormwater quality management. Erosion and sediment control is highly dependent on local site conditions and staging of the proposed earth disturbing activities. Therefore, further details of the erosion and sediment control systems and procedures will be provided at the detailed design stage when more information is available regarding in-situ soils and development staging.

Suitable erosion and sediment controls must be provided by the Contractor and maintained throughout all stages of works, including at completion of the bulk earthworks.

All design, documentation, installation and maintenance of sediment and erosion controls will be in accordance with the requirements of:

- Protection of the Environment Operations Act;
- Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2.

2.4.1. Sources of Pollution

The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and contamination of natural waters include:

- Earthworks undertaken immediately prior to rainfall periods
- Work areas that have not been stabilised
- Extraction of construction water from waterways during low rainfall periods
- Clearing of vegetation and the methods adopted, particularly in advance of construction works
- Stripping of topsoil, particularly in advance of construction works
- Bulk earthworks and construction of pavements
- Works within drainage paths, including depressions and waterways

- Stockpiling of excavated materials
- Storage and transfer of oils, fuels, fertilisers and chemicals
- Maintenance of plant and equipment
- Ineffective implementation of erosion and sediment control measures
- Inadequate maintenance of environmental control measures
- Time taken for the rehabilitation / revegetation of disturbed areas

2.4.2. Potential Impacts

The major potential impacts on the riparian environment relate to erosion of distributed areas or stockpiles and sediment transportation. Potential adverse impacts from erosion and sediment transportation can include:

- Loss of topsoil
- Increased water turbidity
- Decreased levels of dissolved oxygen
- Changed salinity levels
- Changed pH levels
- Smothering of stream beds and aquatic vegetation
- Reduction in aquatic habitat diversity
- Increased maintenance costs
- Decrease in waterway capacity leading to increased flood levels and durations

2.4.3. RUSLE Analysis

A Revised Universal Soil Loss Equation (RUSLE) has been undertaken in accordance with the “Blue Book”. This analysis has been undertaken to predict the long term, average and annual soil loss from sheet and rill flow from the site under specified management conditions.

Estimating soil loss for a proposed development has four important applications to soil and water management. These are to:

1. Assess the erosion risk at a site;
2. Identify suitable measures to overcome the erosion risk;
3. Estimate the required capacity of sediment retarding basins; and
4. Compare the effectiveness of various erosion control measures.

The parameters used in the RUSLE calculation are described below. The erosion hazard potential of the site is considered “low” in accordance with Table 4.2 of the Blue Book, due to the calculated soil loss lying in the range of 151 to 225 tonnes/ha/year.

Table 2.1 – RUSLE Calculation

| Parameter | Value |
|------------------------------------|---------|
| Rainfall Erosivity Factor, R | 2,329.3 |
| Soil Erodibility Factor, K | 0.05 |
| Slope Length/Gradient Factor, LS | 1.19 |
| Erosion Control Practice Factor, P | 1.20 |

| | |
|--|---------|
| Ground Cover and Management Factor, C | 1 |
| Computed Soil Loss (tonnes/ha/year), ($A = R \times K \times LS \times P \times C$) | 166.3 |
| Soil Loss Class | 2 (low) |

Notes:

- 1) Rainfall Erosivity Factor (R) calculated from Equation 2, Appendix A2 of Blue Book;
- 2) Soil Erodibility Factor (K) taken from Appendix C, Table C19 of Blue Book;
- 3) Slope Length (LS) is taken from Table A1 of Appendix A4 of the Blue Book. It is assumed to not exceed 80m immediately before forecast rainfall or during shutdown periods and is at a maximum gradient of 5%;
- 4) Erosion Control Factor (P) is the ratio of soil loss with a nominated surface condition ploughed up and down the slope. From Table A2 in Appendix A5, Blue Book, this factor is taken as 1.20 for “track-walked along the contour”.
- 5) Cover Factor (C): Is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. With the proposed ESC measures being installed as part of bulk earthworks operations, it is assumed that all soil is recently disturbed, thus a C factor of 1.0 is selected.

2.4.4. Construction Methodology

2.4.4.1. Pre-Construction

The following erosion control measures will be implemented prior to commencement of construction to minimise disturbance and ensure the performance criteria for water quality are met:

- Designation and marking of transport routes across undisturbed portions of the site to ensure minimal vegetation disturbance. Transport routes will be provided with stabilised construction entry/exits (e.g. Blue Book SD6-14) at the designated access points;
- Installation of the sediment basin described in Section 7.2 will occur before bulk earthworks across the site begin so that sediment-laden runoff from the works can be captured and treated;
- Diversions will be constructed to divert clean stormwater away from exposed soils and development areas;
- Existing vegetated buffer zones/bunds are to be fenced off;
- Filter rolls or geotextile inlet filters (e.g. Blue Book SD6-11 & 6-12) to be installed around all existing stormwater inlet gullies; and
- All site personnel to complete an environmental induction covering the erosion and sediment controls.

2.4.4.2. During Construction

Measures to mitigate water quality impacts during the construction phase will include:

- Sediment fences (e.g. Blue Book SD6-8) to be erected at the base of all batters and stockpiles to prevent sediment-laden stormwater from flowing into the Eastern Creek riparian zone;
- Regular dust suppression on exposed areas by water truck or use of chemical dust suppressant;
- Progressive stabilisation of filled and disturbed areas;
- Regular inspections as soon as practicable after storm events to check and maintain controls;
- Sediment to be removed from fences when controls are 40% full and at the completion of construction. All material to be re-used or stored on-site in a controlled manner or taken off-site for re-use or disposal at a licensed waste disposal facility;
- Filter rolls or geotextile inlet filters (e.g. Blue Book SD6-11&6-12) to be installed around all new stormwater inlet gullies;
- Monitoring of water quality to determine the effectiveness of the sediment and erosion control management practices; and
- The proposed on-site detention basin is to be utilised as a temporary sediment control basin during the construction phase. The basin shall not be converted into the final/ultimate basin until all building and construction works have been completed and at least 90% of the site is stabilised.

Erosion and sediment control measures will remain in place for the duration of construction works and following completion until the site is fully stabilised.

2.4.5. Sediment Basin Design

Since the proposed development works involve a disturbed area of greater than 2,500m², a sediment basin will be required to be installed during the construction phase. Sediment basin design shall be undertaken in accordance with Chapter 6.3 and Appendix L of the Blue Book.

For the anticipated Type F soils on the site, the required basin volume is calculated using the formulas below:

- $V_{\text{total}} = V_{\text{settling}} + V_{\text{storage}}$
- $V_{\text{settling}} = 10 \times C_v \times A \times R_{(85\%, 5\text{-day})}$

From Table 6.3a of the Blue Book, the 5-day rainfall depth and not exceeded in 85% of rainfall events is 35mm.

Table 2.2 – Sediment Basin Design Calculation

| Parameter | Item |
|---|--------------|
| Volumetric Runoff Coefficient, C_v (Appendix F3, Blue Book) | 0.50 |
| Contributing Area, A (ha) | 6.0 |
| $R_{(85\% \text{ ile, } 5 \text{ day})}$ | 35.00 |
| Settling Zone Volume (m ³) | 1,050 |
| Sediment Storage Zone Volume (m ³) | 525 |
| Total Sediment Basin Volume (m³) | 1,575 |

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It is proposed that the temporary sediment basin be installed in the same location as the ultimate detention/sediment basin. It is noted that the required volume is less than the proposed volume of the ultimate basin (refer Section 3.4).

2.4.5.1. Sediment Basin Maintenance (Construction Phase)

The anticipated 'Type F' soils contain a significant proportion of fine-grained particles (33% or finer than 0.02mm) which require a much longer residence time to settle.

Stormwater within the basin's settling zone should be drained or pumped out within 5 days (design time), if the nominated water quality targets are achieved. Flocculation should be employed where extended settling is likely to fail to meet the objectives within the 5-day time period. Flocculation involves applying chemical agents (e.g. polyaluminium chloride) to the sediment basins causing the colloidal particles to clump into larger units or 'floc' that can either settle in a reasonable time or be filtered out.

Refer to Appendix E4 of the Blue Book for further detail on flocculation methodologies and the product manufacturer's instructions for application rates.

2.4.5.2. Site Inspection and Maintenance

The inspection and maintenance requirements outlined in this section will need to be carried out as long as either earthworks are being conducted and/or the site subsoils are exposed. The Contractor's site representative will inspect the site after every rainfall event and at least weekly, and will:

- Inspect and assess the effectiveness of the SWMP and identify any inadequacies that may arise during normal work activities or from a revised construction methodology. Construct additional erosion and sediment control works as necessary to ensure the desired protection is given to downstream lands and waterways;
- Ensure that drains operate properly and make any repairs in a timely manner;
- Remove spilled sand or other materials from hazard areas, including lands closer than 5 metres from areas of likely concentrated or high velocity flows especially waterways and paved areas;
- Remove trapped sediment whenever less than design capacity remains within the structure;
- Ensure rehabilitated lands have affectively reduced the erosion hazard and to initiate upgrading or repair as appropriate;
- Maintain erosion and sediment control measures in a fully functioning condition until all construction activity is completed and the site has been rehabilitated;
- Remove temporary soil conservation structures as the last activity in the rehabilitation.

2.5. Eastern Creek Riparian Zone

No bulk earthworks are proposed within the Eastern Creek riparian zone. The creek alignment is located over 400m to the west of the proposed extent of Plant 2 redevelopment works. However the proposed detention/sediment basin is located within 100m of the creek in an existing quarry stockpile area. Locating the basin here is a necessity since it is at the low-point of the wider site. Care will need to be taken during construction of the basin to avoid any impacts on the adjacent riparian zone.

2.6. Groundwater

Douglas Partners recently undertook a geotechnical investigation of the subject site, the results of which are included in Report No.84821.00 dated June 2015. The investigation included installation of groundwater monitoring wells in boreholes to allow for measurement of groundwater levels and permeability testing.

Measured groundwater levels in the closest monitoring well to the subject site (Borehole No.7) ranged between RL59.3-59.6 over several days. Whilst finished surface levels of the proposed development are generally above this groundwater level, groundwater is expected to be encountered in some areas during excavation for service trenches. The contractor will need to employ a dewatering methodology during construction works where required.

Pervious subsoil drainage lines will be provided under all kerbs, behind retaining walls and around the perimeter of landscape areas to collect any groundwater seepage during the operational phase of the development.

It should also be noted that due to the largely impervious coverage of the proposed development (i.e. mostly buildings and pavements) there is expected to be minimal infiltration and therefore minimal interaction between surface water and groundwater on the site.

2.7. Contamination

No known contamination exists in the subsoils within the proposed extent of earthworks. Given the site's history of industrial use, it is possible that contaminated materials may be uncovered in localised areas during the excavation works. Should any contamination be uncovered during the course of the works, the Environment Protection Authority (EPA) will be notified and the contamination investigated and managed as prescribed by the Contaminated Land Management Act 1997.

3 Stormwater Drainage

3.1. SEARS

The Secretary's Environmental Assessment Requirements for the Development Application state that the Soil and Water Report must include:

- a description of the catchment and proximity of the site to waterways;
- an assessment of potential surface and groundwater impacts associated with the development, including potential impacts on watercourses and riparian areas, groundwater and groundwater dependent communities nearby;
- a description of the surface, stormwater and wastewater management systems, including on site detention, and measures to treat or reuse water;
- a detailed water balance including a description of the water demands and breakdown of water supplies and any water licensing requirements;
- description of the measures to minimise water use.

3.2. Hydrology

3.2.1. Existing Pre-Development Catchments

There are two main existing catchments located within the Plant 2 area of the site, as described below.

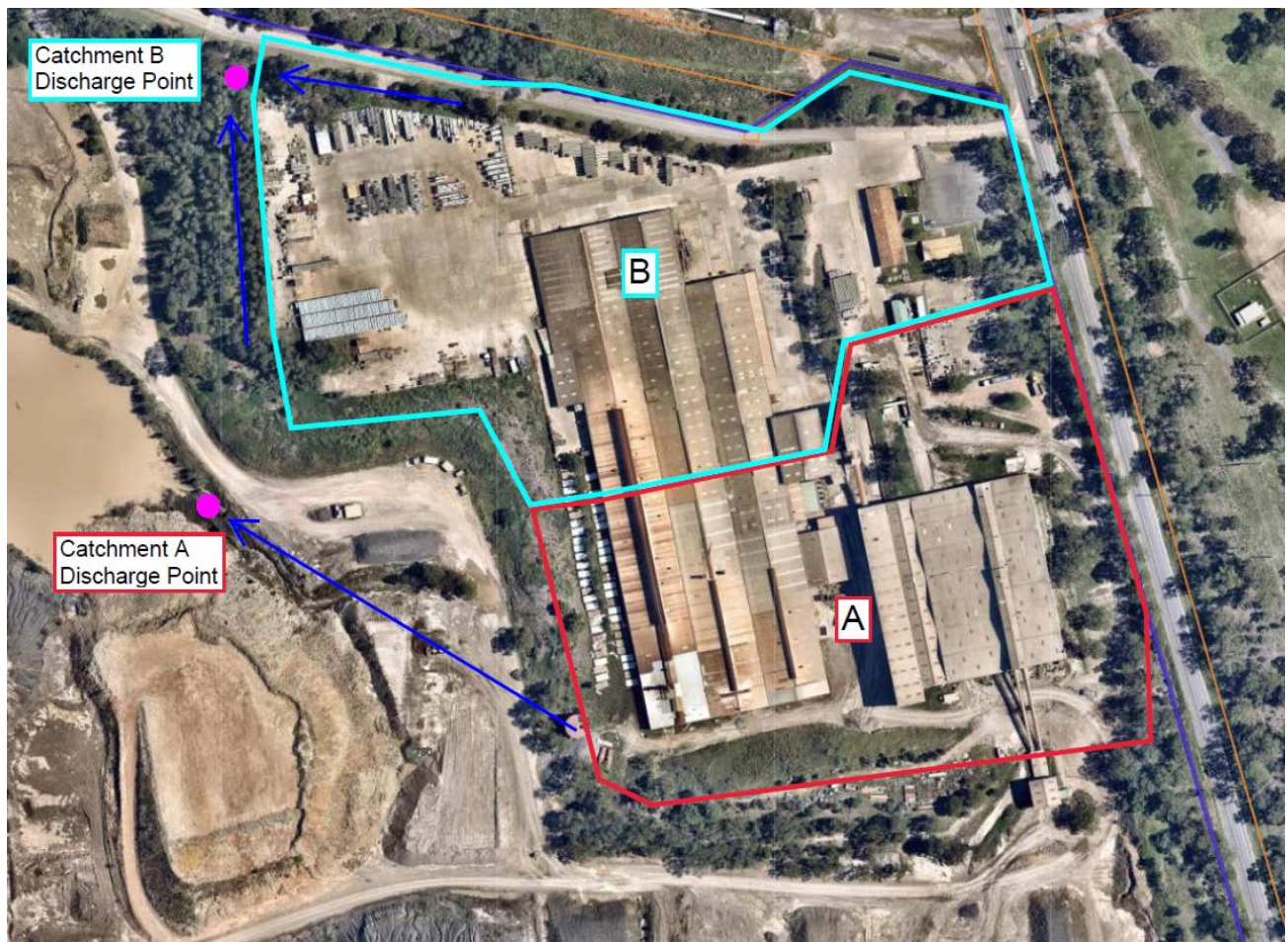
3.2.1.1. Existing Catchment A

This catchment covers an area of approximately 4.5ha focused on the southern half of Plant 2, the existing crusher building, surrounding unsealed storage/loading areas and some landscaped batters. The southern half of the existing factory roof drains into this catchment via internal box gutters dropping into pipes under the building slab. The catchment ultimately drains via an existing piped network which runs from the eastern side of the Plant 2 building, around the southern edge of the building and then west for approximately 200m before discharging into the existing dam via a headwall.

3.2.1.2. Existing Catchment B

This catchment covers approximately 5.5ha of area including the northern half of Plant 2, surrounding hardstands and landscaped bund areas. The northern half of the existing factory roof drains into this catchment via internal box gutters dropping into an existing piped network running under the northwest corner of the Plant 2 building slab towards an open vegetated drain at the western edge of the existing hardstand. The hardstand catchments discharge north to an open vegetated drain via sheet flow. These open drains connect and ultimately find their way west into Eastern Creek.

Figure 3 – Existing Stormwater Catchments



3.2.2. Proposed Post-Development Catchments

Refer to Figure 4 below which shows the indicative extents of the proposed stormwater catchments.

3.2.2.1. Proposed Catchment A

All proposed new development areas are included within Catchment A, which covers a total area of approximately 6.0ha with a composition as shown in Table 3.1.

There is a proposed increase of approximately 16,000m² impervious area within Catchment A as a result of the development works. For this reason, as well as the Council standards noted in Section 3.4 below, the proposed drainage network from this catchment will be routed through a new on-site detention basin to be constructed to the northwest of the site.

Catchment A will ultimately discharge to the Eastern Creek environs via a new discharge point as identified in Figure 4 below. This is an additional discharge point to the two existing approved Eastern Creek discharge points for the wider parent site designated under the current EPL, both of which are located further upstream and would not be feasible for re-use in this instance due to distance and level constraints. A submission will be made to the EPA, in tandem with the SSDA application, to amend the EPL to incorporate the new discharge point for the Plant 2 development.

Refer to AT&L Drawing DAC050 in Appendix A for individual catchment areas.

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3.2.2.2. Proposed Catchment B

There are no new development areas proposed within Catchment B and the existing discharge location and characteristics will be maintained. There is also a significant reduction in the catchment size from 5.5ha to 3.2ha due to the following:

- some upstream areas are to be diverted into the new Catchment A drainage network as part of the proposed upgrade works; and
- the majority of the factory roofwater will be diverted towards the new rainwater tanks at the southern end of the building in Catchment A, leaving only a smaller roof catchment draining north into Catchment B.

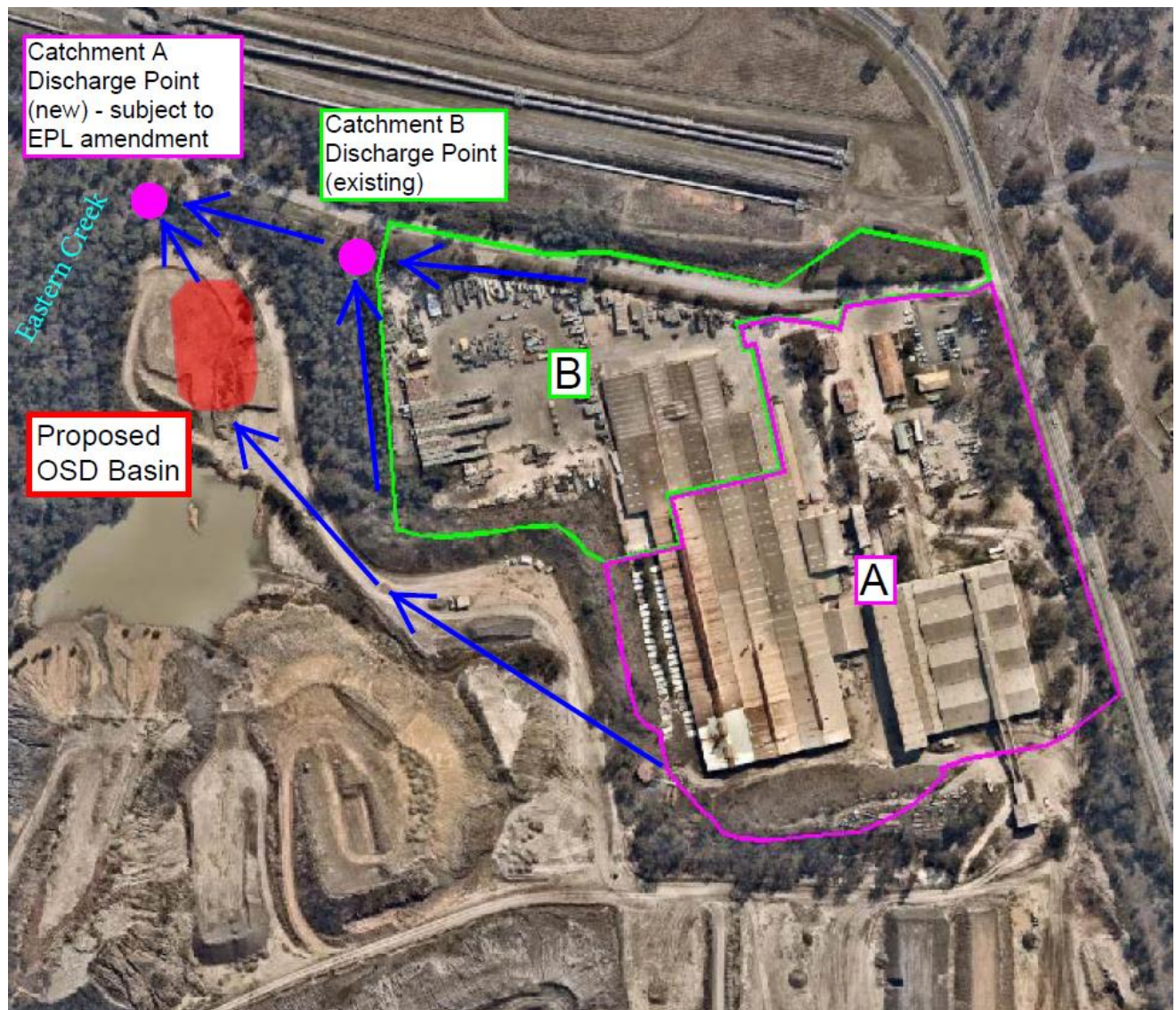
Based on the above factors, there is no intention to provide any OSD within this catchment. The existing discharge point will be maintained and will receive reduced peak flows due to the reduction in catchment area.

Some remediation works will also be undertaken to the existing roof sheeting materials and guttering on the northern side of the Plant 2 building. Associated stormwater drainage will be installed to collect the proposed siphonic roofwater downpipes on the northern edge of the building and connect back into the existing stormwater network.

Table 3.1 – Proposed Catchment Composition

| Catchment | Surface | Proposed Area | Discharge |
|-----------|--------------|---------------|---|
| A | Roof | 2.57ha | Discharge to OSD basin for attenuation of peak flows prior to release to existing dam |
| | Pavements | 2.18ha | |
| | Landscaping | 1.25ha | |
| | Total | 6.00ha | |
| B | Roof | 0.68ha | Existing piped discharge to vegetated open drain (to Eastern Creek) |
| | Pavements | 2.30ha | |
| | Landscaping | 0.82ha | |
| | Total | 3.80ha | |

Figure 4 – Proposed Stormwater Catchments



3.2.3. External Catchments

There are no external upstream catchments from outside of the Brickworks property draining through the proposed development site.

3.2.4. Existing Dam

The existing dam located adjacent to Eastern Creek has an approximate surface area of 1.5 hectares and a maximum depth of 3.0m. This dam is not a natural waterbody – it has been created as a result of historical quarrying operations and has filled up over time. It serves as a convenient low-point for impounding runoff from the existing catchments to the east.

Water to be discharged from the dam is currently pumped to existing sediment ponds on the opposite (western) side of Eastern Creek for treatment prior to release into Eastern Creek. Some water is also extracted from the dam for regular dust suppression activities across the site.

3.3. Concept Stormwater Drainage Design

An underground pit and pipe network will be installed through the new hardstand area to collect and convey stormwater to designated discharge points. The civil design includes suitable gradients applied to the surface of the new pavement areas to direct stormwater away from the building and towards grated gully inlets.

Refer to the concept civil design documentation provided within Appendix A for further details on the proposed stormwater drainage layout.

3.4. On-Site Detention

3.4.1. Planning Requirements

Fairfield City Council's *Stormwater Management Policy, September 2017* Section 4.3 identifies that on-site detention is required within the Rural Zone, within which the subject site is located, for all development greater than 30m² area.

As the proposed development involves an increase in impervious area a subsequent increase in peak stormwater flows would be expected from the site, in particular from Catchment A as described in Section 3.2.2 above. On-site detention will be provided in order to attenuate the increased flows from this catchment and therefore mitigate the risk of downstream flooding and erosion of unstable waterways.

3.4.2. Design Standards

Council's policy specifies that the proposed OSD system must satisfy the following requirements:

- Permissible Site Discharge (PSD) of 78L/s/ha for the 5, 15, 30, 60, 180, 360 and 540-minute duration storms for the 5 and 100 year ARI storm events for the developed site;
- Site Storage Requirements (SSR) of 4.09m³ per 100m² of developed site using the simplified method.

3.4.3. Analysis

A runoff routing analysis has been undertaken using DRAINS hydraulic modelling software. This software utilises the ILSAX method for comparing inflow and outflow hydrographs for multiple storm events. The proposed detention basin has been configured to mitigate peak flows for all designated storm durations for the 1 in 5 year ARI (20% AEP) and 1 in 100 year ARI (1% AEP) storm events in accordance with Council's required design parameters.

3.4.4. Results

The results of the hydraulic analysis indicated that the proposed OSD basin detailed on Drawing DAC015 has sufficient capacity to mitigate the peak flows off the new development area in accordance with Council requirements. The results are shown in the table below.

Table 3.2 - Peak Stormwater Flows for the 5 year and 100 year ARI events

| Storm Duration | Allowable PSD (78L/sec/Ha) | 5 YR ARI flow | 100 YR ARI flow |
|------------------|-------------------------------|---------------|-----------------|
| 5 min duration | 468 L/s | 0 L/s | 0 L/s |
| 15 min duration | | 0 L/s | 250 L/s |
| 30 min duration | | 163L/s | 349 L/s |
| 60 min duration | | 314L/s | 376 L/s |
| 180 min duration | | 315L/s | 383 L/s |
| 360 min duration | | 322L/s | 391 L/s |
| 540 min duration | | 326 L/s | 386 L/s |

3.4.5. OSD Basin Design

It is proposed that the necessary on-site detention capacity will be provided by the construction of a single detention basin to the northwest of the proposed development, immediately upstream of the location where stormwater flows are discharged from the primary development catchment ("A") into Eastern Creek.

The proposed basin analysed above has a total storage volume of approximately 4,500m³ below the proposed emergency overflow level (RL56.6). The lowest floor level of the basin is RL 54.7 resulting in a depth of 1.9m below the spillway level.

A 1200x1200mm grated inlet pit with a weir level of RL55.4 will be positioned in the corner of the basin and will act as the low-flow outlet, to be provided with a 525mm diameter RCP outlet pipe to the edge of Eastern Creek. It is recommended that the outlet pipe be constructed via a pipe-jacking methodology to avoid removal of any existing vegetation in the riparian zone. Suitable scour protection and energy dissipation should be provided around the outlet to prevent erosion.

In the event of a major storm event and/or pipe blockage the emergency weir and spillway (high-level outlet) will be activated and water will spill via a rock-lined overflow route (adjacent to the existing haul road) into the existing vegetated gully. Since this overflow level is set well below the Plant 2 floor and hardstand levels it will minimise the risks of local surcharge and flooding of the development.

Refer to AT&L Drawing DAC015 included in Appendix A.

3.5. Water Quality Treatment

3.5.1. Planning Requirements

Fairfield City Council's *Stormwater Management Policy September 2017* Section 6.3 identifies that water quality treatment is not required within the Rural Zone area, within which the subject site is located.

3.5.2. Existing Treatment

The subject site has an existing stormwater quality treatment regime which is undertaken by Austral staff in accordance with the terms of their Environmental Protection License (EPL) issued by the EPA. The overarching requirement is compliance with Section 120 of the Protection of the Environment Act 1997. It is understood that there are also particular license conditions relating to this site - the following is an extract from the EPL concerning water discharge concentration limits:

Table 3.3 – EPL Pollutant Concentration Limits

| Pollutant | Units of Measure | 50 percentile concentration limit | 90 percentile concentration limit | 3DGM concentration limit | 100 percentile concentration limit |
|------------------------|-------------------------------|-----------------------------------|-----------------------------------|--------------------------|------------------------------------|
| Oil and Grease | milligrams per litre | - | - | - | 10 |
| pH | pH | | | | 6.5-8.5 |
| Total suspended solids | milligrams per litre | - | - | - | 50 |
| Turbidity | nephelometric turbidity units | - | - | - | 150 |

The water quality requirements are consistent across all designated monitoring points on the site.

Runoff from Catchment A is currently discharged to the existing dam adjacent to Eastern Creek, where it is impounded and then pumped to another basin on the western side of Eastern Creek (beside Plant 1). The water in this basin is dosed with a chemical flocculant and once the sediment has dropped out and the water reaches the required target values for turbidity, total suspended solids, oil/grease and pH, it is pumped out into the Eastern Creek riparian corridor at a discharge point designated in the EPL. Test results are documented and filed by Austral's environmental staff.

The existing treatment scenario is not ideal because the relatively clean runoff from the factory roofs is mixed with runoff from the quarry surface which is heavily laden with sediment. This scenario would be even more pronounced post-development once the areas immediately surrounding Plant 2 are covered with new pavements (reducing sediment generation from Catchment A).

3.5.3. Proposed Treatment

The treatment methodology outlined above will be adapted and improved to provide better separation between the dirty quarry runoff (which will continue to drain to the existing quarry dam) and the relatively clean Plant 2 runoff.

The redevelopment of Plant 2 is focused on Catchment A (refer Section 3.2 above). Runoff from this catchment will be collected by downpipes and surface inlet pits and conveyed through an underground pipe network to a new basin to be constructed to the northwest of the site, adjacent to the quarry entry road.

The proposed basin will serve two functions: attenuation of peak flows (refer Section 3.4); and sediment removal. An automated rainfall-activated chemical dosing unit will be installed at the basin inlet to dose incoming flows from Plant 2 with a selected chemical flocculant such as polyaluminium chloride. The basin has been designed as a 2-stage system, with a pre-treatment inlet bay separated from the main pond by an inbuilt concrete weir/level spreader. This pre-treatment zone allows for mixing of the flocculant, improves hydraulic efficiency and provides a smaller area for more regular maintenance (reducing cost and frequency of de-silting of the main pond). Refer to AT&L Drawing DAC015 for basin general arrangement. This will be refined further at detailed design stage.

The basin will have both a low-flow and high-flow outlet configuration, ultimately discharging towards Eastern Creek. The low-flow outlet will be provided by a discharge pit with connecting 525mm diameter pipe

and the high-flow outlet will be provided by an overflow weir just below the basin crest connecting to a basin spillway.

Concrete access ramps will be provided to the floor of both zones of the basin to allow for maintenance activities to be undertaken once operational e.g. removal of sediment buildup.

3.6. Water Conservation

3.6.1. Planning Requirements

Fairfield City Council's Stormwater Management Policy September 2017 Section 5.4 identifies that water conservation is required for new industrial and commercial developments or additions of over 150m². When this is the case, at least 80% of the new development roof area must drain to a tank which has a capacity of 3,000L per 100m² of roof area. The tank is to be connected for non-potable uses such as toilet-flushing and irrigation.

3.6.2. Water Balance Overview

Potable water supplies in the Sydney area are in recognised short supply with projected population increases, potential climate change, periods of extended drought and development in water sources of the Sydney region accentuating the growing demand. As a result, authorities have encouraged sustainable development by the implementation of an integrated approach to water cycle management (potable water, sewage, stormwater and rainwater) to offset demands of potable water supplies.

Whilst opportunities for water reuse include such initiatives as regional stormwater harvesting, black water recycling and recycled water, this development is limited to rainwater collection and reuse. We have used MUSIC modelling to establish an estimated rainwater tank size and demonstrated the volume of water reuse possible in order to provide a more sustainable servicing solution.

3.6.3. Overall Site Runoff

On a site of this scale a large quantity of surface runoff is expected throughout the year. Whilst storage has been provided to capture and detain some of this water (for OSD requirements described above in Section 3.4), only a fraction of it will realistically be used to meet the development's water demand and the vast majority of the water will ultimately leave the site via the Eastern Creek watercourse per existing conditions.

Post-development site catchments are summarised in the following table along with their respective volumetric runoff coefficients. The volumetric runoff coefficient given in the table makes allowance for water loss through evaporation and infiltration from the respective surfaces.

Table 3.4 – Catchment Areas and Runoff Coefficients

| Catchment Type | Catchment Area | Volumetric Runoff Coefficient |
|----------------|----------------|-------------------------------|
| Building Roofs | 3.25ha | 0.95 |
| Paved Areas | 4.48ha | 0.85 |
| Landscaping | 2.07ha | 0.64 |

Potential runoff generated is therefore summarised in the following table, broken into dry, medium and wet years based on available climate statistics from the nearby Prospect Reservoir BOM station (Ref.067019):

Table 3.5 – Potential Runoff Generation

| | Potential Runoff (ML/year) | | |
|----------------|----------------------------|----------------|--------------|
| | Dry (575mm) | Medium (862mm) | Wet (1178mm) |
| Building Roofs | 17.8 | 26.6 | 36.4 |
| Paved Areas | 21.9 | 32.8 | 44.9 |
| Landscaping | 7.6 | 11.4 | 15.6 |
| Total | 47.3 | 70.8 | 96.9 |

3.6.4. Potential Non-Potable Water End Uses

We have identified the following potential water demand end uses which may be required across the development:

- toilet and urinal flushing, hand basin washing – approx. 20L/person/day;
- kitchen (food preparation, washing), drinking;
- air conditioning cooling;
- internal cleaning;
- truck wash;
- external cleaning;
- plant watering; and
- use in the brick manufacturing process.

3.6.5. Total Site Water Demands

In the absence of development-specific water demand information (e.g. proposed number of toilets), the following provide a reasonable approximation for an industrial site per Water NSW's current MUSIC guidelines:

- 1) 0.1kL/day/1000m² of roof area
- 2) 20kL/year/1000m² of external landscape area
- 3) 10kL/day of water use in brick manufacturing process

Table 3.6 – Total Site Water Re-Use Demand

| | Area (m ²) | Re-use Demand |
|-------------------------------|------------------------|---------------|
| Total Roof Area | 32,500 | 3.25 kL/day |
| Total External Landscape Area | 21,900 | 1.20 kL/day |

| | | |
|---------------------------------|-----|---------------------|
| Total Manufacturing Process Use | N/A | 10.0 kL/day |
| TOTAL | | 14.45 kL/day |

3.6.6. Rainwater Re-use

The use of rain water collected in rainwater tanks from roof runoff provides a valuable alternative to potable water for a variety of non-potable end uses. We have assumed for this development that irrigation and toilet flushing will be plumbed to the rainwater tanks. Other uses such as truck/forklift washdown facilities may be considered at the detailed design stage.

3.6.7. Rainwater Tank Modelling

A rainwater tank model was analysed in MUSIC to simulate the operation of the proposed rainwater tanks. As shown on the project drawings, two rainwater tanks of 14.0m diameter are proposed along the southern edge of the main factory building. These are each conservatively assumed to have a 330kL capacity based on a 2.2m height.

3.6.7.1. Assumptions

The assumptions built into the rainwater tank modelling scenarios include the following:

- 1) A total roof area of 10,336m² from the main factory building can be drained into the two rainwater tanks;
- 2) Local rainfall data from Fairfield MWSDB station No.067006 was used;
- 3) An allowance for 20% loss in rainwater tank size volume to allow for anaerobic sludge zones, mains water top up levels and overflow levels;
- 4) External re-use is modelled as an annual demand scaled by potential evapotranspiration (PET) whilst internal use is modelled as an average daily demand;
- 5) It is assumed that the initial 2mm of rainfall that falls on the roof is considered 'wetting', that is, potential rainfall runoff that is not captured by the rainwater tank, but is rather 'lost runoff' as evaporation or other;
- 6) The overflow pipes from individual tanks are modelled as 200mm diameter pipes;
- 7) To prevent sediment and other pollutants entering the rainwater tank, a portion of the initial runoff from the roof is transferred to stormwater, this is known as the 'first flush'. The portion of water diverted as part of the first flush differs for each facility depending on the amount of pollution each roof is susceptible to;
- 8) As the development is located in a predominantly light industrial area, where there may be potential for some roof pollution, a standard first flush volume of 1mm of runoff from across the roof area has been adopted; and
- 9) Any roof runoff that exceeds the rainwater tank capacity is 'overflow' and is directed to the stormwater drainage system.

3.6.7.2. Results

Modelling results suggest that the 2 x 330kL rainwater tanks proposed are sufficient to provide well over 80% of the development's re-use needs. The tanks could either be installed in an above-ground or below-ground installation with suitable plumbing, as long as they receive flows from gutters/downpipes draining the roof area stipulated.

Table 3.7 – MUSIC Rainwater Tank Water Balance Results

| Node Water Balance - Rainwater Tank | | | | | |
|-------------------------------------|--------------|-------------|------------|------------|------------|
| | Flow (ML/yr) | TSS (kg/yr) | TP (kg/yr) | TN (kg/yr) | GP (kg/yr) |
| Flow In | 7.42 | 191.80 | 1.13 | 16.24 | 215.27 |
| ET Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Infiltration Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Low Flow Bypass Out | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| High Flow Bypass Out | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pipe Out | 3.18 | 48.22 | 0.43 | 6.23 | 0.00 |
| Weir Out | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transfer Function Out | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Reuse Supplied | 4.20 | 51.35 | 0.55 | 6.70 | 0.00 |
| Reuse Requested | 4.84 | 0.00 | 0.00 | 0.00 | 0.00 |
| % Reuse Demand Met | 86.82 | 0.00 | 0.00 | 0.00 | 0.00 |
| % Load Reduction | 57.19 | 74.86 | 61.93 | 61.65 | 100.00 |

3.6.7.3. Comparison with Council Requirements

Further to the above, the minimum rainwater tank size required for the development has also been calculated based on Council's policy as described in Section 3.6.1 above.

Table 3.8 – Tank Size Calculation per Council standards

| | Area (m ²) |
|---|------------------------|
| Existing Plant 2 Roof Area | 21,100m ² |
| Proposed Plant 2 Roof Area | 25,400m ² |
| New Plant 2 Roof Area | 4,300m ² |
| Total Tank Volume (3,000L tank per 100m ² of <u>new</u> roof area) | 129kL |

It is noted that the volume capacity of the proposed tanks to be provided (total 660kL) easily exceeds this figure, hence the Council requirement is satisfied.

3.7. Flooding

3.7.1. Planning Requirements

Flooding within this catchment is subject to Chapter 11 – Flood Risk Management of the Fairfield Citywide Development Control Plan. Flood mapping helps to identify which areas of the city are flood prone and prescribes the applicable flood risk precinct (low, medium or high).

3.7.2. Existing Flooding

3.7.2.1. Rural Area Flood Study

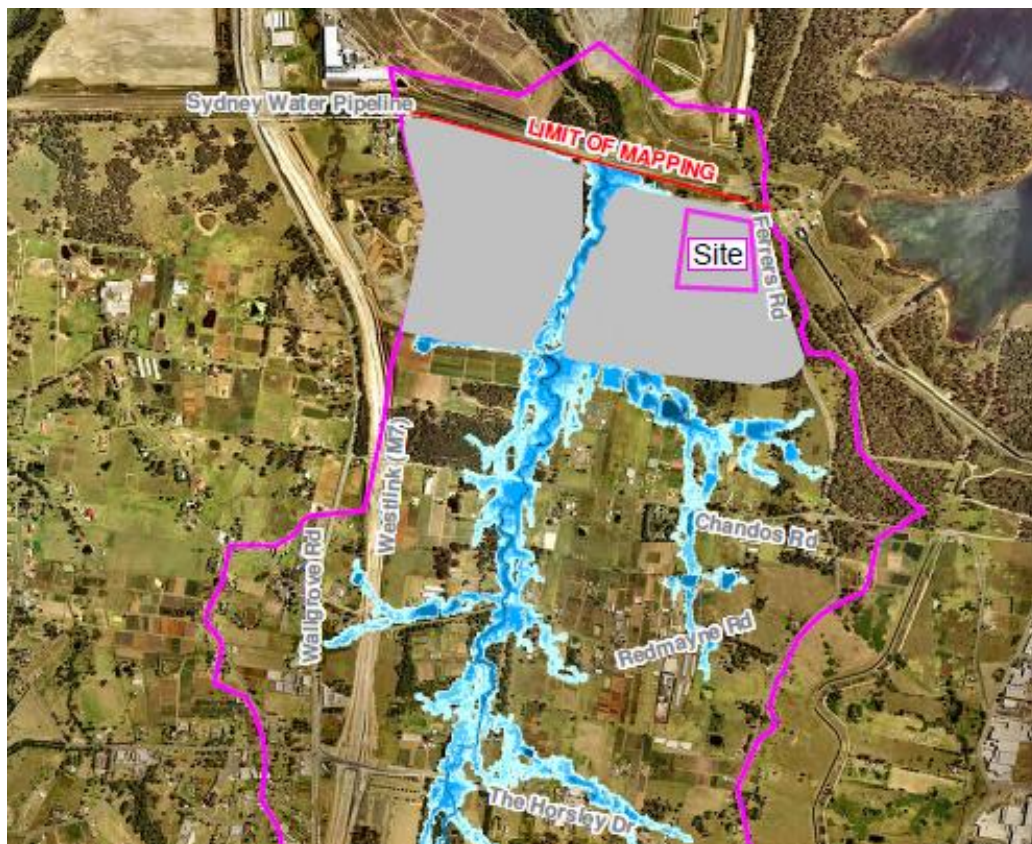
The site was included within the extents of the *Rural Area Flood Study for Ropes, Reedy and Eastern Creeks* prepared by BMT WBM for Fairfield City Council in 2013. The subject site is wholly located within the Eastern Creek catchment as shown in Figure 3 below. Council's associated flood mapping, specifically the *Eastern Creek Flood Planning Map 20 August 2014*, is available for download on their website and identifies low, medium and high flood hazard areas within the Eastern Creek catchment.

The subject site is not identified as being contained within any of the various flood hazard areas. However, due to the dynamic nature of quarries and the potential inaccuracy of flood storages within them, the subject site was modelled as "filled in" during the *Rural Area Flood Study*, hence the grey hatching on the flood hazard maps i.e. the subject site was essentially excluded from flood mapping.

Figure 5 – Excerpt from Rural Flood Study 2013: Eastern Creek Flood Model Extents



Figure 6 – Excerpt from Rural Flood Study 2013: Eastern Creek 100 year ARI Flooding



3.7.3. BMT WBM Flooding Assessment (2015)

Brickworks engaged BMT WBM in 2015 to conduct a further flood assessment of the site as part of a separate development application (SSD6820), which did not ultimately proceed. During this assessment BMT refined the Rural Flood Study modelling by using accurate 3d survey data for the subject site and incorporating it into their TUFLOW flood model as the 'existing' pre-development scenario. This replaced the Rural Flood Study as the base case model.

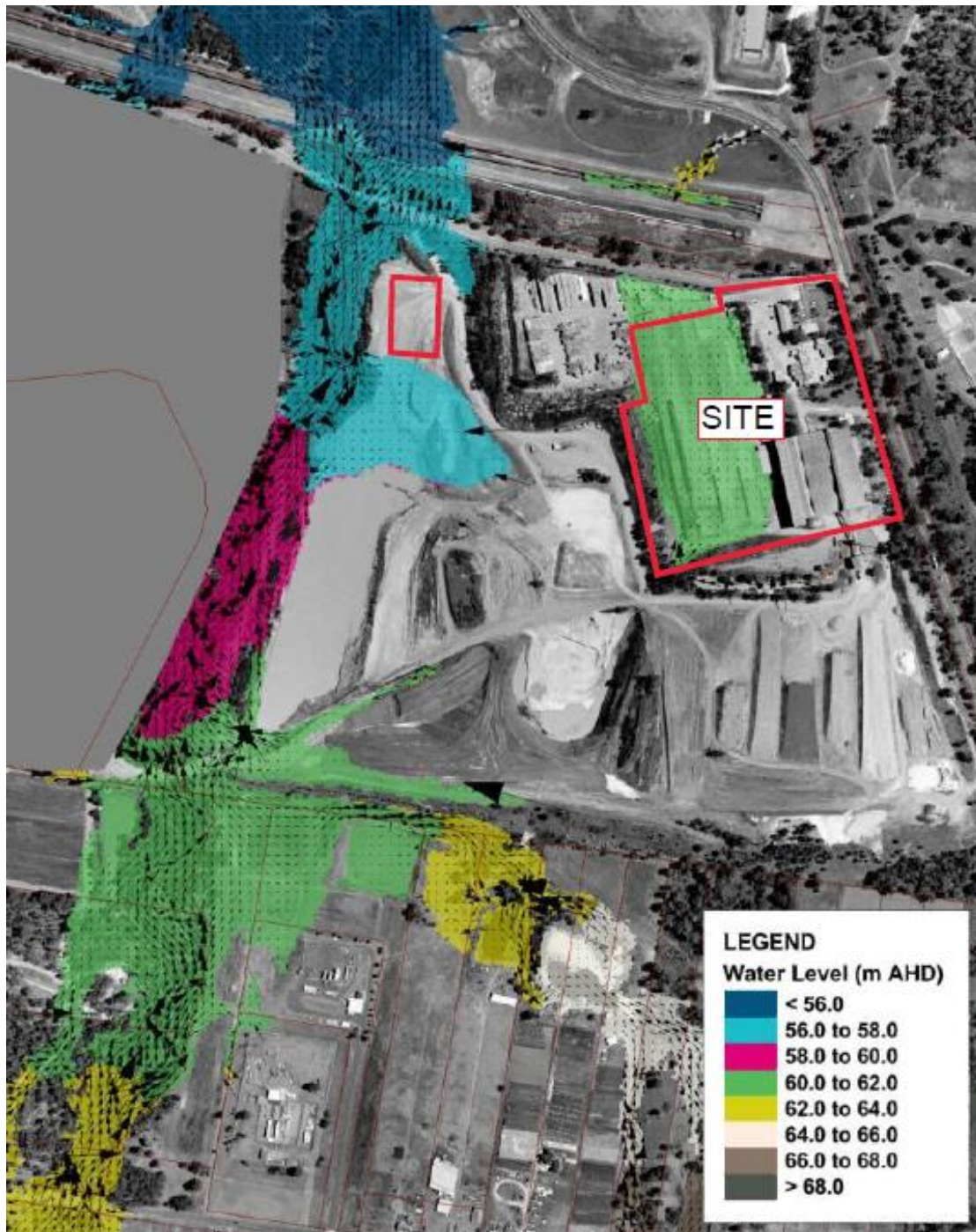
An excerpt showing the extents and levels of flooding in a 1% AEP (100 year ARI) is shown in Figure 4 below and the report is included under Appendix C. This shows that the proposed Plant 2 development area is not directly affected by existing flooding from Eastern Creek. It is noted that the green hatching shown surrounding the factory area is solely a result of local catchment runoff since the existing stormwater drainage network was not included in the modelling at the time.

No flood impacts are anticipated as a result of the proposed development for the following reasons:

- 1) No works are proposed within the designated 1% AEP/100 year ARI flood plain adjacent to Eastern Creek. There will not be any loss of flood storage or alterations to the flow paths of Eastern Creek;
- 2) There will be no increase in localised peak stormwater flows coming from the development due to the provision of an on-site detention basin. Refer Section 3.4 above.
- 3) All localised stormwater runoff will be captured and conveyed to discharge points by an underground piped network.

Civil Engineers & Project Managers

Figure 7 – Excerpt from BMT WBM Report (May 2015) showing 1% AEP Peak Flood Levels



4 Access & Pavements

4.1. SEARS

The Secretary's Environmental Assessment Requirements for the Development Application state that the Traffic and Transport assessment must include:

- plans of any road upgrades or new roads required for the development including the potential to create an east-west road connection through the site linking Wallgrove Road with Ferrers Road;
- detailed plans of the proposed layout of the internal road network and parking on site in accordance with the relevant Australian standards.

4.2. Existing

Access to the Plant 2 site is from the internal access road which runs east-west through the parent site, connecting Wallgrove Road with Ferrers Road. There are no plans to upgrade this internal access road.

Existing access ramps lead down to the Plant 2 building pad and hardstand area.

There are some existing reinforced concrete pavements located around the north eastern edge of the existing factory building. Other areas around the south eastern, south western and southern edges of the building consist of compacted bare earth or residual gravels, with no formal pavements.

4.3. Proposed

There are no plans to upgrade the internal access road between Wallgrove Rd and Ferrers Rd.

Three new access ramps will be built to the new hardstand area surrounding the Plant 2 building. A fire vehicle access track of minimum 6.0m width is also proposed around the full perimeter of the Plant 2 building.

All new hardstand areas will be comprised of a durable, hard-wearing and impervious surface. This is likely to take the form of Austral Masonry interlocking concrete block pavers placed over a cement-stabilised subbase material. The clay subgrade will be trimmed, compacted and proof rolled prior to paving works. The new access ramps will be constructed from reinforced concrete slabs instead due to the steeper gradients.

All internal roads, loading and manoeuvring areas have been designed in accordance with Australian Standards.

5 Servicing

5.1. Water Supply

The existing factory site is serviced with potable water from the 150mm diameter public main in the western verge of Ferrers Road.

A new connection is proposed onto the external main to supply a fire hydrant booster and tank suitable for feeding the development's firefighting system. Refer to the *Fire Engineering Strategy* (April 2019) prepared by Core Engineering Group for indicative locations of this infrastructure.

5.2. Sewerage

Due to the lack of nearby public sewerage infrastructure, wastewater flows from the development are currently collected in on-site holding tanks which are pumped out regularly by a contractor. It is anticipated that this wastewater regime will remain in place following the upgrade works since flows are expected to remain constant following the development works.

5.3. Utilities

The existing power supply and telecommunications services connect to the Plant 2 factory and surrounding buildings from an existing take-off point on the site-wide network which is aligned along the main internal access road. The existing connections are anticipated to have sufficient capacity to service the new facility.

Appendix A

AT&L Civil Engineering Drawings

780 WALLGROVE ROAD, HORSLEY PARK

BRICKWORKS PLANT 2 UPGRADE

CIVIL WORKS PACKAGE

DRAWING LIST

| DWG NO. | DRAWING TITLE |
|---------|--|
| DAC001 | COVER SHEET, DRAWING LIST AND LOCALITY PLAN |
| DAC002 | GENERAL NOTES AND LEGENDS |
| DAC003 | SITE CONTEXT PLAN |
| DAC004 | GENERAL ARRANGEMENT PLAN |
| DAC011 | SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 1 |
| DAC012 | SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 2 |
| DAC013 | SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 3 |
| DAC014 | SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 4 |
| DAC015 | SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 5 |
| DAC020 | TYPICAL SECTIONS SHEET 1 |
| DAC021 | TYPICAL SECTIONS SHEET 2 |
| DAC030 | BULK EARTHWORKS CUT/FILL PLAN |
| DAC031 | PAVEMENT PLAN |
| DAC035 | ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 1 |
| DAC036 | ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 2 |
| DAC041 | RETAINING WALL PLAN SHEET 1 |
| DAC042 | RETAINING WALL PLAN SHEET 2 |
| DAC043 | RETAINING WALL PROFILE SHEET 1 |
| DAC044 | RETAINING WALL PROFILE SHEET 2 |
| DAC050 | STORMWATER DRAINAGE CATCHMENT PLAN |
| DAC055 | STORMWATER DETAILS SHEET 1 |
| DAC056 | STORMWATER DETAILS SHEET 2 |
| DAC060 | EROSION AND SEDIMENT CONTROL PLAN |
| DAC061 | EROSION AND SEDIMENT CONTROL DETAILS |



LOCALITY PLAN
N.T.S

| | | | | | | | | | | | |
|-------|---------------------------------|------------|--|---|--------|--------------|-----|---|---|----------|----|
| | | Bar Scales | THIS DRAWING CANNOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY OTHER PURPOSE OTHER THAN THAT ORIGINALLY INTENDED WITHOUT THE WRITTEN PERMISSION OF AT&L | Client <div>BRICKWORKS LIMITED</div> | Scales | Drawn | QD | Project BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK | Civil Engineers and Project Managers <div>at&l</div> <div>Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1055 www.atl.net.au info@atl.net.au</div> | | |
| | | | | | | Designed | QD | | | | |
| | | | | | | Grid | MGA | | | Checked | SH |
| | | | | | | Height Datum | AHD | | | Approved | |
| | | | | | | | | | | | |
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 | | | | | | Title COVER SHEET, DRAWING LIST AND LOCALITY PLAN | Status FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 | |
| B | ISSUED FOR REVIEW | 09-04-19 | | | | | | | | | |
| A | ISSUED FOR INFORMATION | 03-11-18 | | | | | | | | | |
| Issue | Description | Date | | | | | | | | | |

CONCRETE NOTES

1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600 CURRENT EDITION WITH AMENDMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
2. CONCRETE QUALITY
ALL REQUIREMENTS OF THE CURRENT ACSE CONCRETE SPECIFICATION DOCUMENT 1 SHALL APPLY TO THE FORMWORK, REINFORCEMENT AND CONCRETE UNLESS NOTED OTHERWISE.

| ELEMENT | AS 3600 F _c MPa AT 28 DAYS | SPECIFIED SLUMP | NOMINAL AGG. SIZE |
|------------------------|---------------------------------------|-----------------|-------------------|
| VEHICULAR BASE | 32 | 60 | 20 |
| KERBS, PATHS, AND PITS | 25 | 80 | 20 |

- CEMENT TYPE SHALL BE (ACSE SPECIFICATION) TYPE SL
- PROJECT CONTROL TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS 1379.
3. NO ADMXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING BY AT & L.
4. CLEAR CONCRETE COVER TO ALL REINFORCEMENT FOR DURABILITY SHALL BE 40mm TOP AND 70mm FOR EXTERNAL EDGES UNLESS NOTED OTHERWISE.
5. ALL REINFORCEMENT SHALL BE FIRMLY SUPPORTED ON MILD STEEL PLASTIC TIPPED CHAIRS, PLASTIC CHAIRS OR CONCRETE CHAIRS AT NOT GREATER THAN 1m CENTRES BOTH WAYS. BARS SHALL BE TIED AT ALTERNATE INTERSECTIONS.
6. THE FINISHED CONCRETE SHALL BE A DENSE HOMOGENEOUS MASS, COMPLETELY FILLING THE FORMWORK, THOROUGHLY EMBEDDING THE REINFORCEMENT AND FREE OF STONE POCKETS. ALL CONCRETE INCLUDING SLABS ON GROUND AND FOOTINGS SHALL BE COMPACTED AND CURED IN ACCORDANCE WITH R.T.A. SPECIFICATION R83.
7. REINFORCEMENT SYMBOLS:
N DENOTES GRADE 450 N BARS TO AS 1302 GRADE N
R DENOTES 230 R HOT ROLLED PLAIN BARS TO AS 1302
SL DENOTES HARD-DRAWN WIRE REINFORCING FABRIC TO AS 1304
- NUMBER OF BARS IN GROUP — BAR GRADE AND TYPE
17 N 20 250
NOMINAL BAR SIZE IN mm — SPACING IN mm
- THE FIGURE FOLLOWING THE FABRIC SYMBOL SL IS THE REFERENCE NUMBER FOR FABRIC TO AS 1304.
8. FABRIC SHALL BE LAPPED IN ACCORDANCE WITH THE FOLLOWING DETAIL:



STORMWATER DRAINAGE NOTES

1. STORMWATER DESIGN CRITERIA:
(A) AVERAGE RECURRENCE INTERVAL:
1-100 YEARS ROOFED AREAS TO SURCHARGE PIT
1-20 YEARS EXTERNAL PAVEMENTS
(B) RAINFALL INTENSITIES:
TIME OF CONCENTRATION: 5 MINUTES
1-100 YEARS: 215 mm/hr
1-20 YEARS= 168 mm/hr
(C) RUNOFF COEFFICIENTS:
ROOF AREAS: C₁₀₀ = 1.0
EXTERNAL PAVEMENTS: C₂₀ = 0.95
2. PIPES 300 DIA. AND LARGER TO BE REINFORCED CONCRETE CLASS '3' APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS. U.N.O.
3. PIPES UP TO 300 DIA SHALL BE SEWER GRADE uPVC WITH SOLVENT WELDED JOINTS.
4. EQUIVALENT STRENGTH VCP OR FRC PIPES MAY BE USED.
5. ALL STORMWATER DRAINAGE LINES UNDER PROPOSED BUILDING SLABS TO BE uPVC PRESSURE PIPE GRADE 6. ENSURE ALL VERTICALS AND DOWNPIPES ARE uPVC PRESSURE PIPE, GRADE 6 FOR A MIN OF 3.0m IN HEIGHT.
6. PIPES TO BE INSTALLED TO TYPE HS1 SUPPORT IN ACCORDANCE WITH AS 3725 (1989) IN ALL CASES BACKFILL TRENCH WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL COMPACTED IN 150mm LAYERS TO MINIMUM 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. (OR A DENSITY INDEX OF NOT LESS THAN 75)
7. ALL INTERNAL WORKS WITHIN PROPERTY BOUNDARIES ARE TO COMPLY WITH THE REQUIREMENTS OF AS 3500 3.1 (2018) AND AS/NZS 3500 3.2 (2018).
8. PRECAST PITS MAY BE USED EXTERNAL TO THE BUILDING SUBJECT TO APPROVAL BY AT & L.
9. ENLARGERS, CONNECTIONS AND JUNCTIONS TO BE PREFABRICATED FITTINGS WHERE PIPES ARE LESS THAN 300 DIA.
10. WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS, UNSLOTTED uPVC SEWER GRADE PIPE IS TO BE USED.
11. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL.
12. GRATES AND COVERS SHALL CONFORM TO AS 3996.
13. ALL INTERNAL PIT DIMENSIONS TO CONFORM TO AS3500.3 TABLE 8.2.
14. AT ALL TIMES DURING CONSTRUCTION OF STORMWATER PITS, ADEQUATE SAFETY PROCEDURES SHALL BE TAKEN TO ENSURE AGAINST THE POSSIBILITY OF PERSONNEL FALLING DOWN PITS.
15. ALL EXISTING STORMWATER DRAINAGE LINES AND PITS THAT ARE TO REMAIN ARE TO BE INSPECTED AND CLEANED. DURING THIS PROCESS ANY PART OF THE STORMWATER DRAINAGE SYSTEM THAT WARRANTS REPAIR SHALL BE REPORTED TO THE SUPERINTENDENT/ENGINEER FOR FURTHER DIRECTIONS.

SITEWORKS NOTES

1. ORIGIN OF LEVELS:- REFER SURVEY NOTES.
2. CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK. ANY DISCREPANCIES TO BE REPORTED TO AT & L.
3. MAKE SMOOTH CONNECTION WITH EXISTING WORKS.
4. ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
5. ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL COMPACTED IN 150mm LAYERS TO MINIMUM 98% MODIFIED MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. (OR A DENSITY INDEX OF NOT LESS THAN 75)
6. PROVIDE 10mm WIDE EXPANSION JOINTS BETWEEN BUILDINGS AND ALL CONCRETE OR UNIT PAVEMENTS.
7. ASPHALTIC CONCRETE SHALL CONFORM TO RMS. SPECIFICATION R116.
8. ALL BASECOURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL TO COMPLY WITH RMS. FORM 3051 (UNBOUND), RMS. FORM 3052 (BOUND) COMPACTED TO MINIMUM 98% MODIFIED DENSITY IN ACCORDANCE WITH AS 1289 5.2.1
FREQUENCY OF COMPACTION TESTING SHALL NOT BE LESS THAN 1 TEST PER 50m OF BASECOURSE MATERIAL PLACED.
9. ALL SUB-BASE COURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL TO COMPLY WITH RMS. FORM 3051, 3051.1 AND COMPACTED TO MINIMUM 98% MODIFIED DENSITY IN ACCORDANCE WITH A.S 1289 5.2.1
FREQUENCY OF COMPACTION TESTING SHALL NOT BE LESS THAN 1 TEST PER 50m OF SUB-BASE COURSE MATERIAL PLACED.
10. AS AN ALTERNATIVE TO THE USE OF IGNEOUS ROCK AS A SUB-BASE MATERIAL IN (9) A CERTIFIED RECYCLED CONCRETE MATERIAL COMPLYING WITH RMS. FORM 3051 AND 3051.1 WILL BE CONSIDERED, SUBJECT TO MATERIAL SAMPLES AND APPROPRIATE CERTIFICATIONS BEING PROVIDED TO THE SATISFACTION OF AT & L.
11. SHOULD THE CONTRACTOR WISH TO USE A RECYCLED PRODUCT THIS SHALL BE CLEARLY INDICATED IN THEIR TENDER AND THE PRICE DIFFERENCE BETWEEN AN IGNEOUS PRODUCT AND A RECYCLED PRODUCT SHALL BE CLEARLY INDICATED.
12. WHERE NOTED ON THE DRAWINGS THAT WORKS ARE TO BE CARRIED BY OTHERS, (eg. ADJUSTMENT OF SERVICES), THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CO-ORDINATION OF THESE WORKS.

SURVEY NOTES

THE EXISTING SITE CONDITIONS SHOWN ON THE FOLLOWING DRAWINGS HAVE BEEN INVESTIGATED BY CARDNO , BEING REGISTERED SURVEYORS. THE INFORMATION IS SHOWN TO PROVIDE A BASIS FOR DESIGN. AT & L DOES NOT GUARANTEE THE ACCURACY OR COMPLETENESS OF THE SURVEY BASE OR ITS SUITABILITY AS A BASIS FOR CONSTRUCTION DRAWINGS.

SHOULD DISCREPANCIES BE ENCOUNTERED DURING CONSTRUCTION BETWEEN THE SURVEY DATA AND ACTUAL FIELD DATA, CONTACT AT & L.

THE FOLLOWING NOTES HAVE BEEN TAKEN DIRECTLY FROM THE ORIGINAL SURVEY DOCUMENTS.

- LIMITED SURVEY OF THE ROAD PAVEMENT HAS BEEN UNDERTAKEN SHOULD ANY DESIGN WORKS BE UNDERTAKEN AFFECTING THE ROADS HEREON THEN ADDITIONAL SURVEY MAY BE REQUIRED.
- HEIGHT OF FENCES WHERE SHOWN ARE APPROXIMATE ONLY.
- THE INFORMATION SHOWN IN GREYSCALE IS THE DRAWING PROVIDED TO CARDNO (130604-DETAIL.DWG)
- THE BLUE ARE BOUNDARIES WITHIN LAYER "APPROX BDYS-DCDB" COLOURED BLUE) ARE APPROXIMATE ONLY AND ARE NOT BE RELIED UPON FOR ANY DESIGN OR CONSTRUCTION.

SYMBOL LEGEND

| | |
|---|-----------------------------|
| ⊕ | TELSTRA PIT |
| Ⓢ | TELSTRA DISTRIBUTION PILLAR |
| ⊗ | BOLLARD |
| ⚡ | POWER POLE WITH LIGHT |
| ⊖ | LIGHT POLE |
| ⊗ | SEWER MANHOLE |
| ⊗ | SEWER LAMPHOLE |
| ⊗ | WATER AIR VALVE |
| ⊗ | WATER HYDRANT |
| Ⓜ | GAS BOX |
| ● | GAS MARKER POST |
| — | SIGN |
| ⚑ | FLAG POLE |
| ⚡ | BASEMENT/CARPARK LEVEL |

EROSION AND SEDIMENT CONTROL NOTES

GENERAL INSTRUCTIONS

- THE SITE SUPERINTENDENT/ENGINEER WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE LOCATED AS DOCUMENTED.
- ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH
 - LOCAL AUTHORITY REQUIREMENTS
 - EPA REQUIREMENTS
 - NSW DEPARTMENT OF HOUSING MANUAL "MANAGING URBANS STORMWATER, SOILS AND CONSTRUCTION", 4th EDITION, MARCH 2004.
- MAINTAIN THE EROSION CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.
- WHEN STORMWATER PITS ARE CONSTRUCTED, PREVENT SITE RUNOFF ENTERING UNLESS SEDIMENT FENCES ARE ERECTED AROUND PITS.
- CONTRACTOR IS TO ENSURE ALL EROSION & SEDIMENT CONTROL DEVICES ARE MAINTAINED IN GOOD WORKING ORDER AND OPERATE EFFECTIVELY. REPAIRS AND OR MAINTENANCE SHALL BE UNDERTAKEN AS REQUIRED, PARTICULARLY FOLLOWING STORM EVENTS.

LAND DISTURBANCE

- WHERE PRACTICAL, THE SOIL EROSION HAZARD ON THE SITE WILL BE KEPT AS LOW AS POSSIBLE. TO THIS END, WORKS SHOULD BE UNDERTAKEN IN THE FOLLOWING SEQUENCE:
 - INSTALL A SEDIMENT FENCE ALONG THE BOUNDARIES AS SHOWN ON PLAN. REFER DETAIL.
 - CONSTRUCT STABILISED CONSTRUCTION ENTRANCE TO LOCATION AS DETERMINED BY SUPERINTENDENT/ENGINEER. REFER DETAIL.
 - INSTALL SEDIMENT TRAPS AS SHOWN ON PLAN.
 - UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. WHERE POSSIBLE, PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.

EROSION CONTROL

- DURING WINDY WEATHER, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.
- FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 20 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

SEDIMENT CONTROL

- STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.
- ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.

- WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE, I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.

- TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

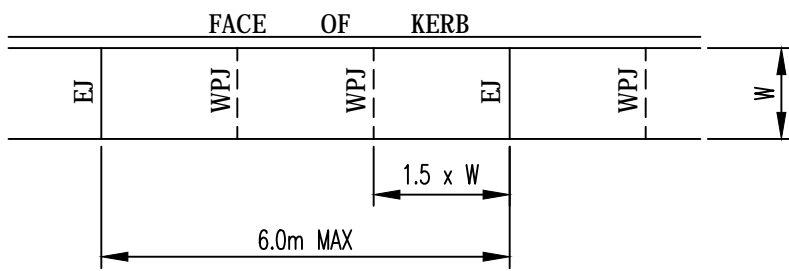
OTHER MATTERS

- ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.
- ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES BY:
 - PROTECTING THEM WITH BARRIER FENCING OR SIMILAR MATERIALS INSTALLED OUTSIDE THE DRIP LINE
 - ENSURING THAT NOTHING IS NAILED TO THEM
 - PROHIBITING PAVING, GRADING, SEDIMENT WASH OR PLACING OF STOCKPILES WITHIN THE DRIP LINE EXCEPT UNDER THE FOLLOWING CONDITIONS:
 - ENCROACHMENT ONLY OCCURS ON ONE SIDE AND NO CLOSER TO THE TRUNK THAN EITHER 1.5 METRES OR HALF THE DISTANCE BETWEEN THE OUTER EDGE OF THE DRIP LINE AND THE TRUNK, WHICH EVER IS THE GREATER
 - A DRAINAGE SYSTEM THAT ALLOWS AIR AND WATER TO CIRCULATE THROUGH THE ROOT ZONE (E.G. A GRAVEL BED) IS PLACED UNDER ALL FILL LAYERS OF MORE THAN 300 MILLIMETRES DEPTH
 - CARE IS TAKEN NOT TO CUT ROOTS UNNECESSARILY NOR TO COMPACT THE SOIL AROUND THEM.

JOINTING NOTES

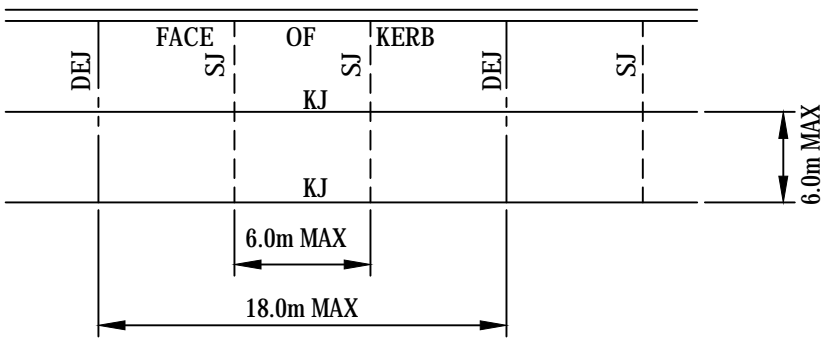
PEDESTRIAN PAVEMENT JOINTS

- ALL PEDESTRIAN PAVEMENTS ARE TO BE JOINTED AS FOLLOWS. (U.N.O)
- EXPANSION JOINTS ARE TO BE LOCATED WHERE POSSIBLE AT TANGENT POINTS OF CURVES AND ELSEWHERE AT MAX. 6.0m CENTRES.
- WEAKENED PLANE JOINTS ARE TO BE LOCATED AT A MAX. SPACING OF 1.5 x WIDTH OF THE PAVEMENT.
- WHERE POSSIBLE JOINTS SHOULD BE LOCATED TO MATCH KERBING AND OR ADJACENT PAVEMENT JOINTS.
- PEDESTRIAN PAVEMENT JOINT DETAIL.



VEHICULAR PAVEMENT JOINTS

- ALL VEHICULAR PAVEMENTS TO BE JOINTED AS FOLLOWS. (U.N.O)
- KEYED CONSTRUCTION JOINTS SHOULD GENERALLY BE LOCATED AT A MAX OF 6.0m CENTRES
- SAWN JOINTS SHOULD GENERALLY BE LOCATED AT A MAX OF 6.0m CENTRES WITH DOWELED EXPANSION JOINTS AT MAX 18.0m CENTRES
- VEHICULAR PAVEMENT JOINT DETAIL.



EXISTING UNDERGROUND SERVICES NOTES

THE LOCATIONS OF UNDERGROUND SERVICES SHOWN IN THIS SET OF DRAWINGS HAVE BEEN PLOTTED FROM SURVEY INFORMATION AND SERVICE AUTHORITY INFORMATION. THE SERVICE INFORMATION HAS BEEN PREPARED ONLY TO SHOW THE APPROXIMATE POSITIONS OF ANY KNOWN SERVICES AND MAY NOT BE AS CONSTRUCTED OR ACCURATE.

AT & L CAN NOT GUARANTEE THAT THE SERVICES INFORMATION SHOWN ON THESE DRAWINGS ACCURATELY INDICATES THE PRESENCE OR ABSENCE OF SERVICES OR THEIR LOCATION AND WILL ACCEPT NO LIABILITY FOR INACCURACIES IN THE SERVICES INFORMATION SHOWN FROM ANY CAUSE WHATSOEVER.

CONTRACTORS SHALL TAKE DUE CARE WHEN EXCAVATING ONSITE INCLUDING HAND EXCAVATION WHERE NECESSARY.

CONTRACTORS ARE TO CONTACT THE RELEVANT SERVICE AUTHORITY PRIOR TO COMMENCEMENT OF EXCAVATION WORKS.

CONTRACTORS ARE TO UNDERTAKE A SERVICES SEARCH, PRIOR TO COMMENCEMENT OF WORKS ON SITE. SEARCH RESULTS ARE TO BE KEPT ON SITE AT ALL TIMES.



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| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 | |
| B | ISSUED FOR REVIEW | 09-04-19 | |
| A | ISSUED FOR INFORMATION | 03-11-18 | |
| Issue | Description | Date | |

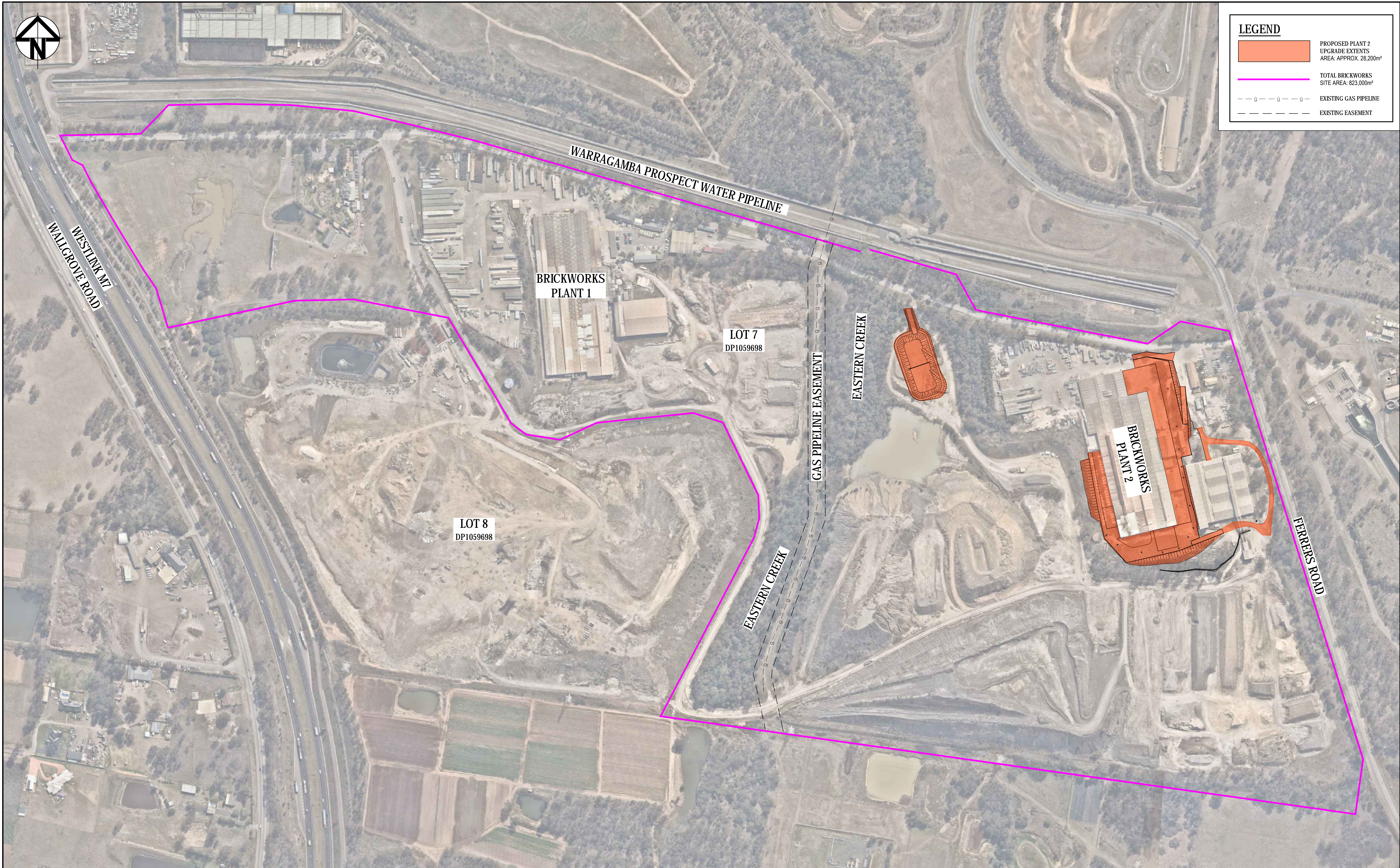
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| Scales | Drawn | QD |
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| | Checked | SH |
| Grid MGA | Approved | |
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| Height Datum | AHD | |
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| Project | BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK | |
| | | |
| Title | GENERAL NOTES AND LEDENDS | |
| | | |

| | | |
|---|---|-------|
| Civil Engineers and Project Managers | | |
| at&I Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1055 www.atl.net.au info@atl.net.au | | |
| Status | FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 |
| Drawing No. | Project No. | Issue |
| DAC002 | 18-577 | C |



LEGEND

PROPOSED PLANT 2
UPGRADE EXTENTS
AREA: APPROX. 28,200m²

TOTAL BRICKWORKS
SITE AREA: 823,000m²

EXISTING GAS PIPELINE

EXISTING EASEMENT

| | | |
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Bar Scales

050100150200m

1 : 2500 @ A1

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Client

BRICKWORKS

LIMITED

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| Scales | 1 : 2500 | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

SITE CONTEXT PLAN

Civil Engineers and Project Managers

at&l

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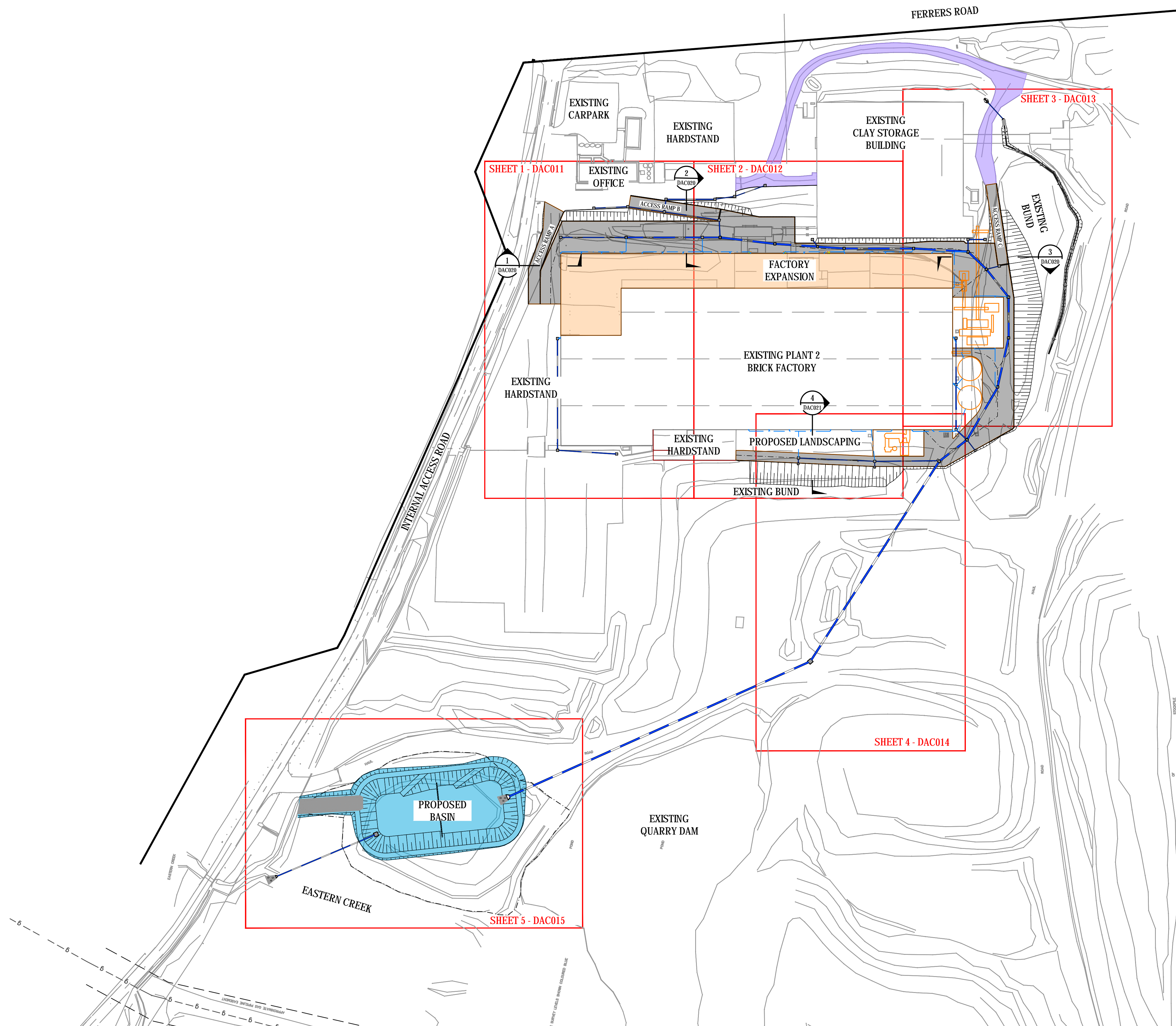
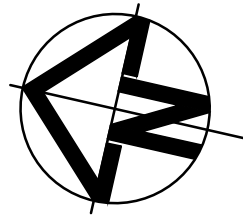
DAC003

Project No.

18-577

Issue

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| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |

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| Bar Scales |
| <div><div></div><div>0255075100125m</div></div> <div>1 : 1250 @ A1 1 : 2500 @ A3</div> |

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BRICKWORKS

LIMITED

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| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

GENERAL
ARRANGEMENT PLAN

Civil Engineers and Project Managers

at&l

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ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9423 1055
www.atl.net.au
info@atl.net.au

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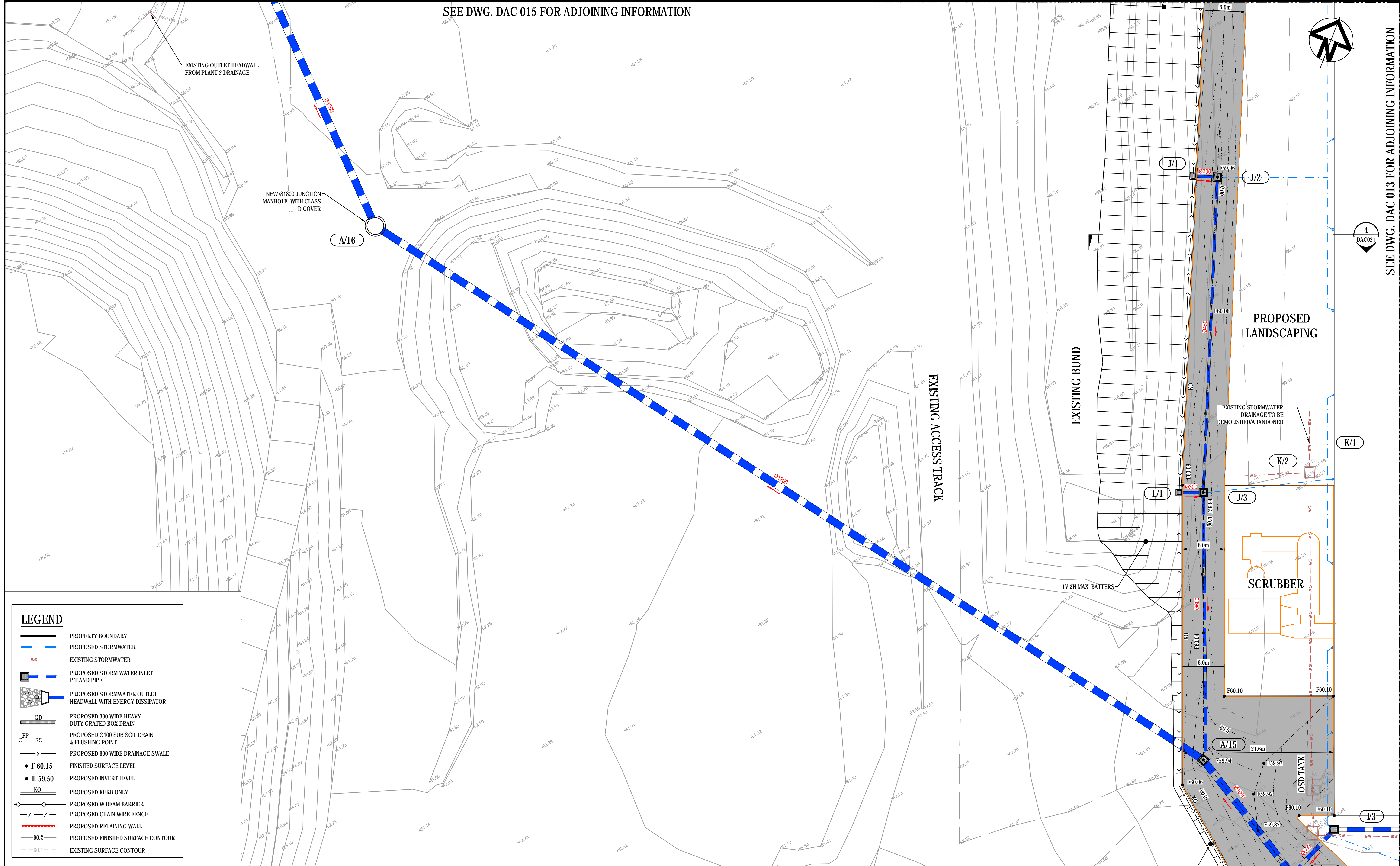
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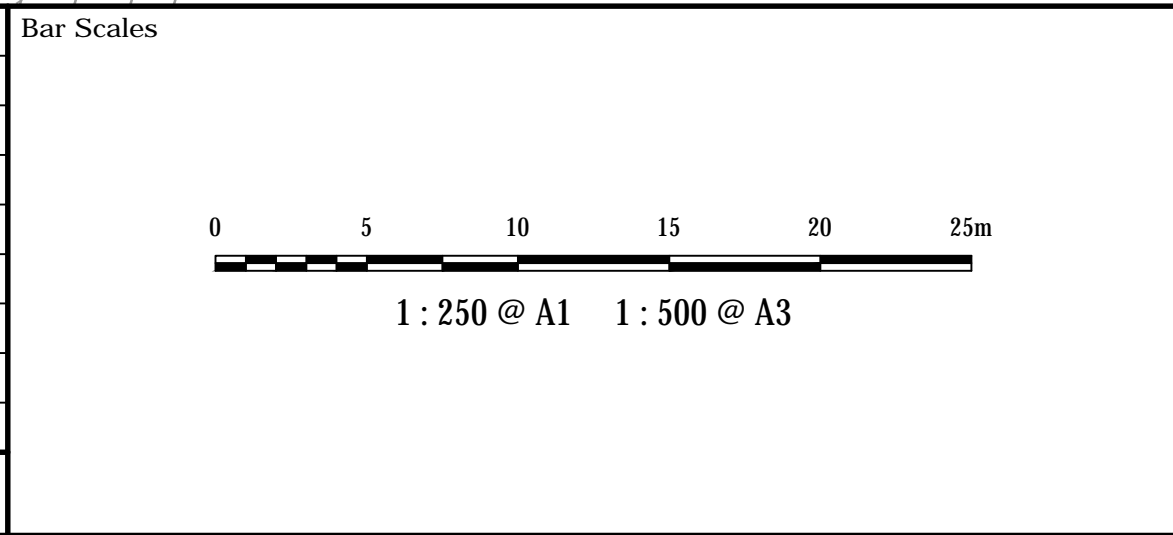
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Issue

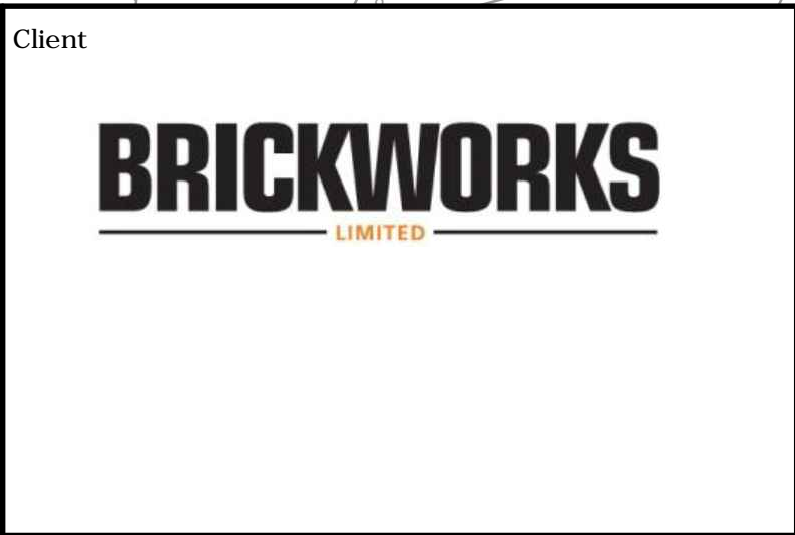
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| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |



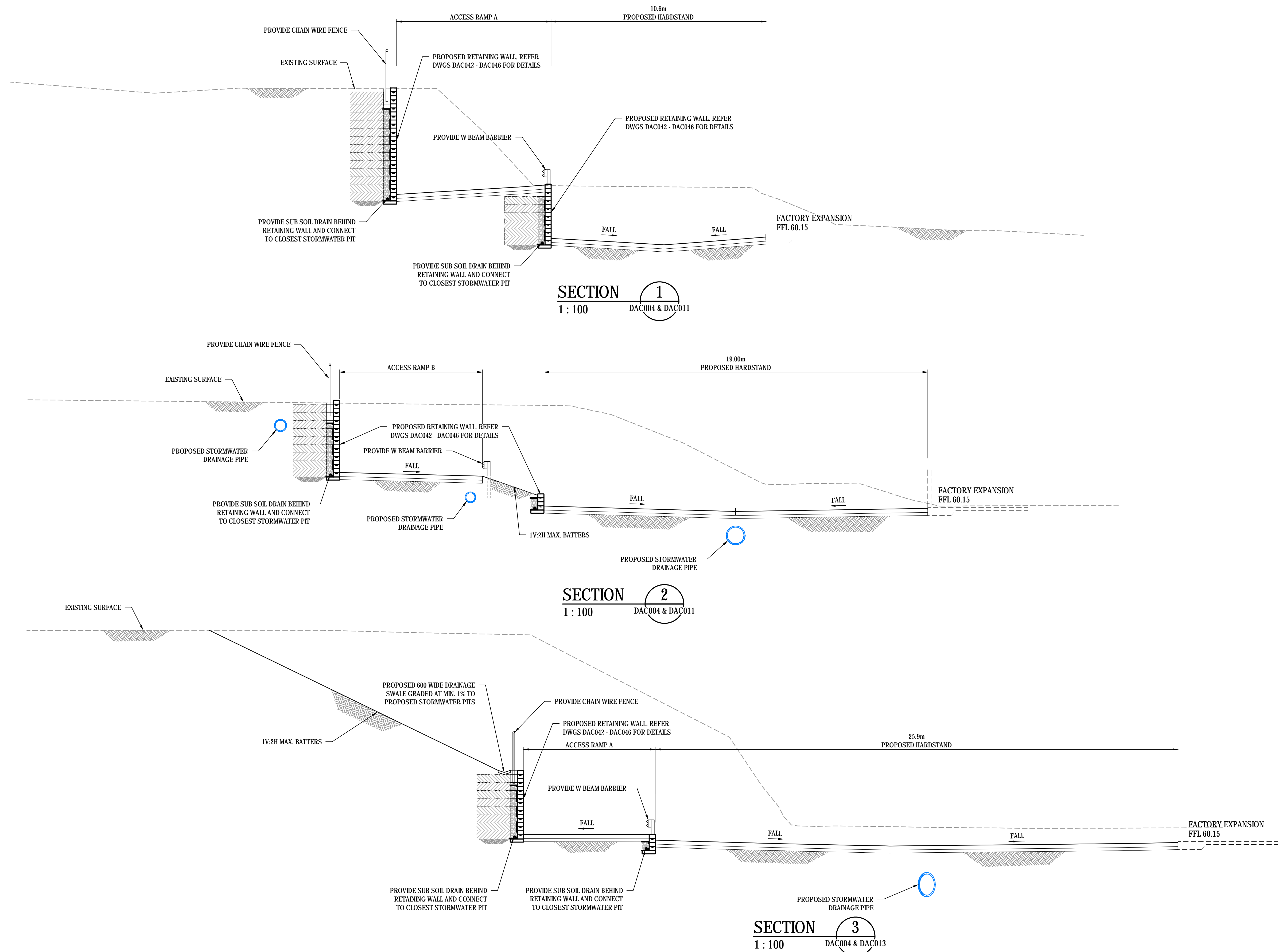
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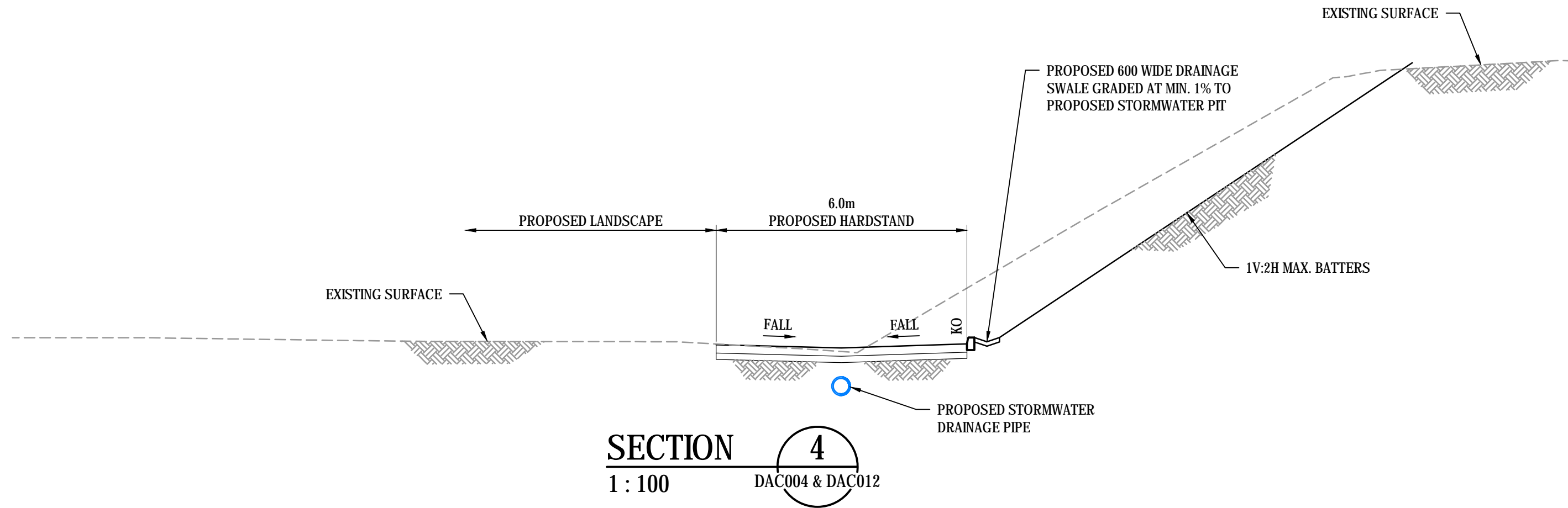
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| Height Datum | AHD | Approved | |




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| Project | BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK |
| Title | SITWORKS AND STORMWATER DRAINAGE PLAN SHEET 4 |

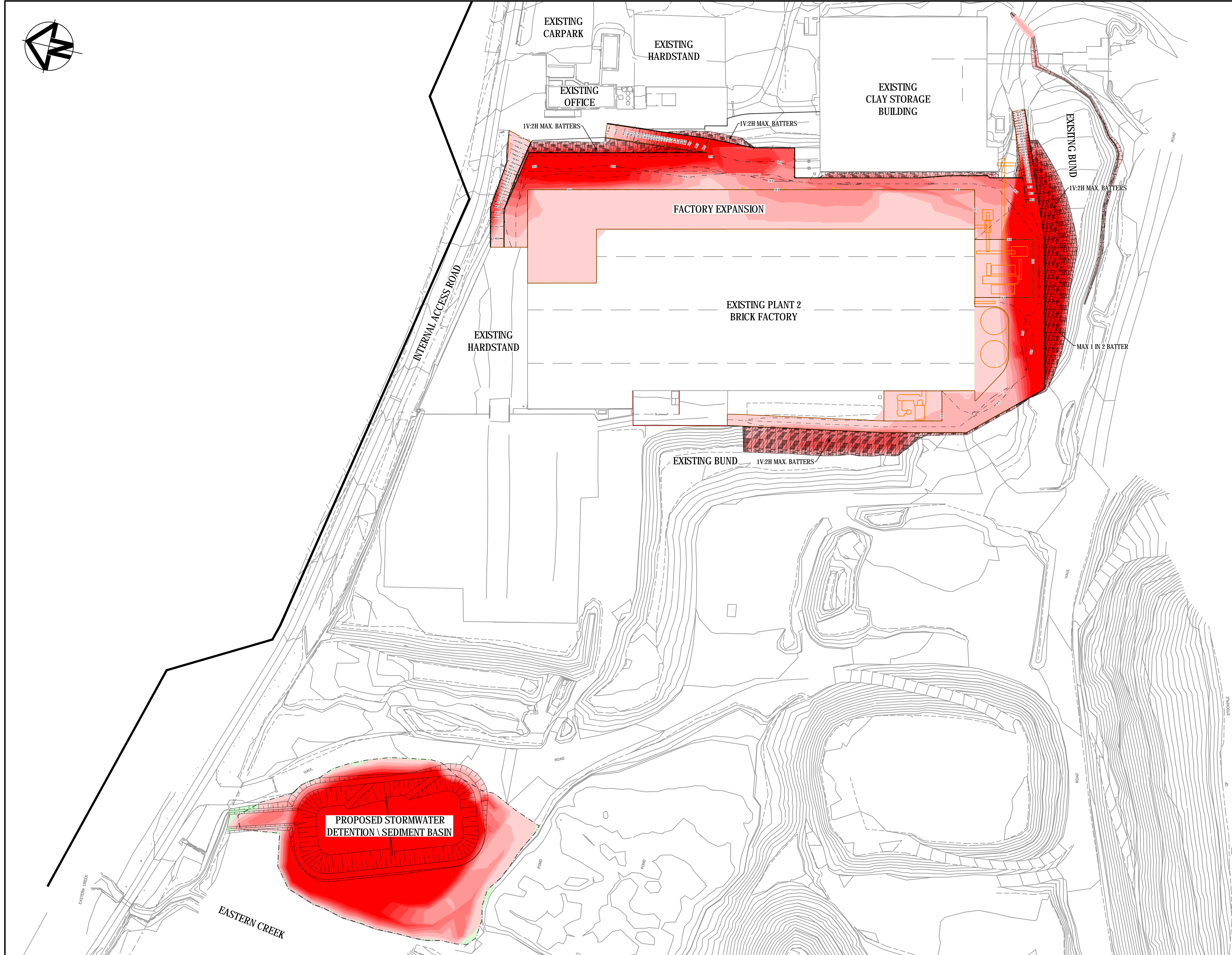
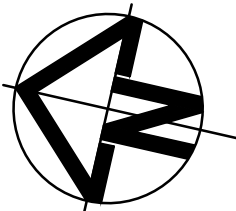
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| Civil Engineers and Project Managers | | |
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| Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1065 www.atl.net.au info@atl.net.au | | |
| Status | FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 |
| Drawing No. | DAC014 | Issue |
| Project No. | 18-577 | C |



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NOTES

1. EARTHWORKS VOLUMES ARE APPROXIMATE ONLY AND DO NOT TAKE INTO ACCOUNT THE FOLLOWING:
- TOPSOIL STRIPPING
 - BULKING FACTORS OF REMOVED CUT
 - SERVICES & UTILITIES TRENCH SPOIL
 - REMOVAL AND/OR REMEDIATION OF ANY EXISTING UNCONTROLLED FILL
 - PROPOSED LANDSCAPING
 - EXCAVATION OF RETAINING WALL FOOTING AND BACKFILL
2. PAVEMENT BOXING DEPTH HAS BEEN ASSUMED AS 300mm FOR PRELIMINARY DESIGN.

EARTHWORKS VOLUMES

| ITEM | NET CUT VOLUME (m3) | NET FILL VOLUME (m3) | BALANCE VOLUME (m3) |
|----------------------------|---------------------|----------------------|---------------------|
| PLANT 2 AREA | - 40,048 | - | - 40,048 |
| EXISTING STOCKPILE REMOVAL | - 46,968 | - | - 46,968 |
| DETENTION \ SEDIMENT BASIN | - 6,649 | 230 | - 6,879 |
| TOTALS | - 93,665 | 230 | - 93,895 |

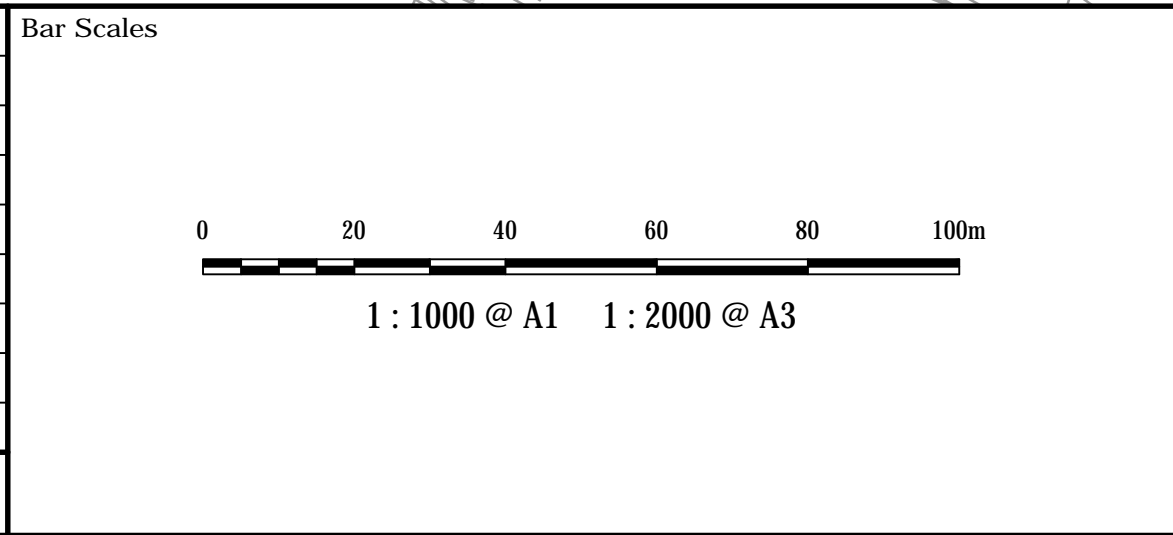
LEGEND

- PROPOSED RETAINING WALL
- 60.3 PROPOSED BULK EARTH WORKS CONTOUR
- 65.2 EXISTING SURFACE CONTOUR
- PROPERTY BOUNDARY

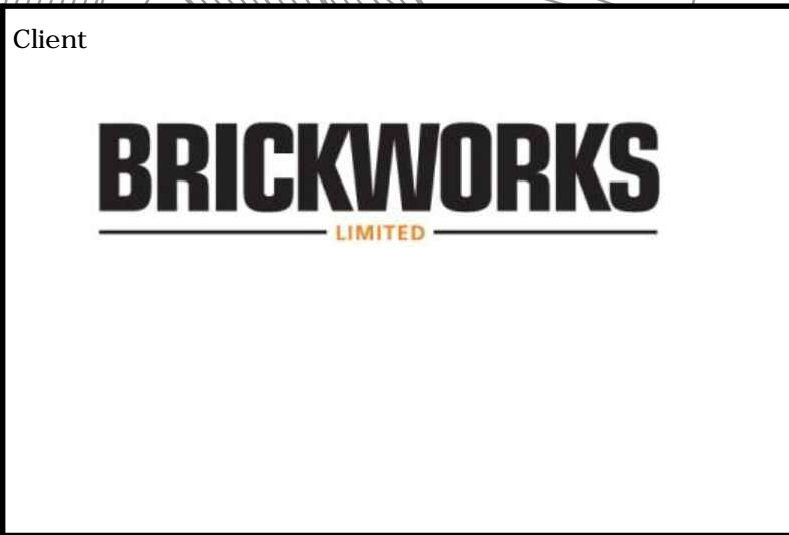
EARTHWORKS CUT/FILL LEGEND

| Lower_value | Upper_value | Colour |
|-------------|-------------|--|
| -99999 | to -3.5 | m ■ |
| -3.5 | to -3 | m ■ |
| -3 | to -2.5 | m ■ |
| -2.5 | to -2 | m ■ |
| -2 | to -1.5 | m ■ |
| -1.5 | to -1 | m ■ |
| -1 | to -0.5 | m ■ |
| -0.5 | to 0.00 | m ■ |
| 0.000 | to .5 | m ■ |
| .5 | to 1.0 | m ■ |
| 1.0 | to 1.5 | m ■ |
| 1.5 | to 2 | m ■ |
| 2 | to 2.5 | m ■ |
| 2.5 | to 3 | m ■ |
| 3 | to 3.5 | m ■ |
| 3.5 | to 9999 | m ■ |

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|-------|---------------------------------|----------|
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |



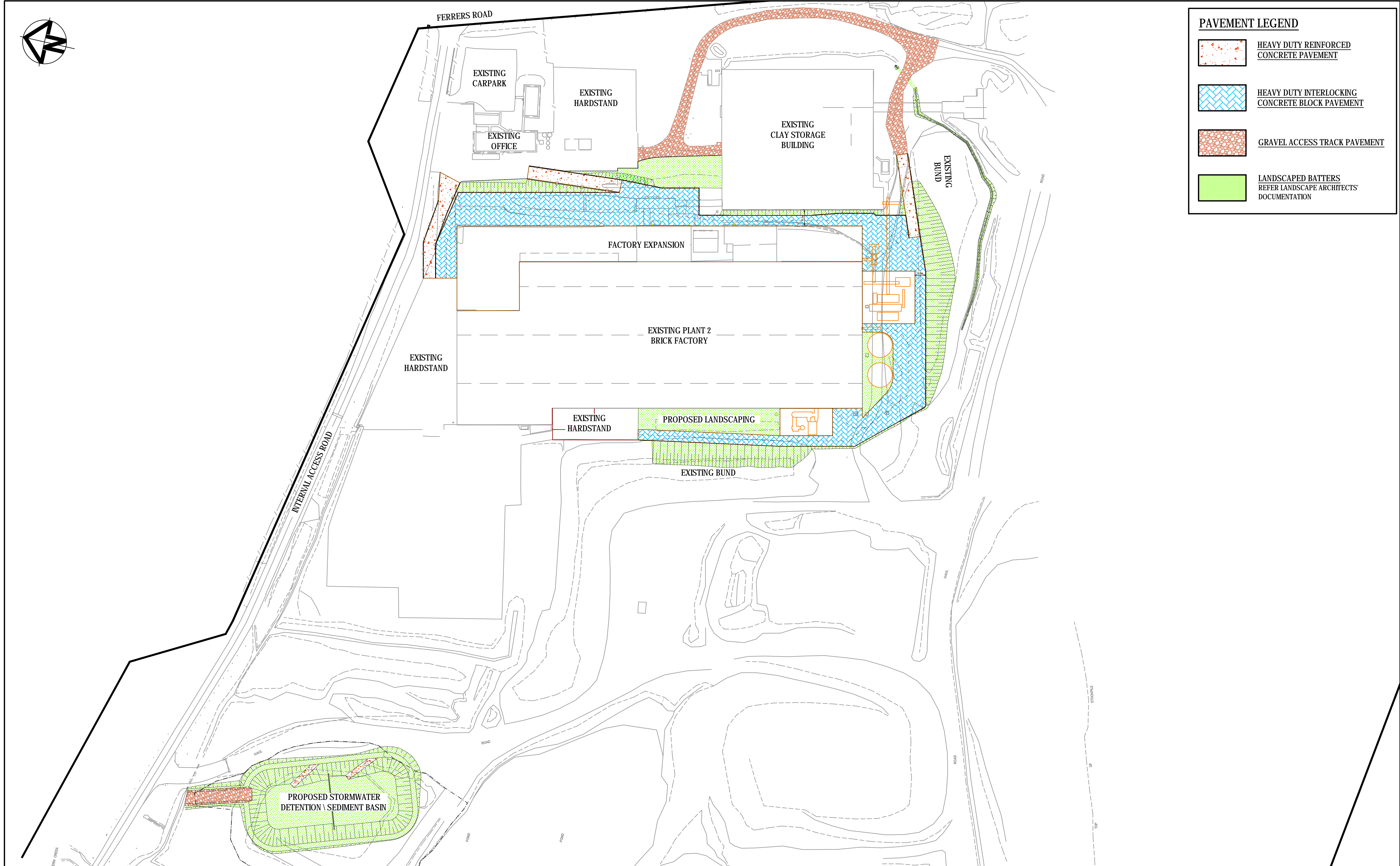
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| | | | |
|--------------|----------|----------|----|
| Scales | 1 : 1000 | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

| | |
|---------|---|
| Project | BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK |
| Title | BULK EARTHWORKS CUT/FILL PLAN |

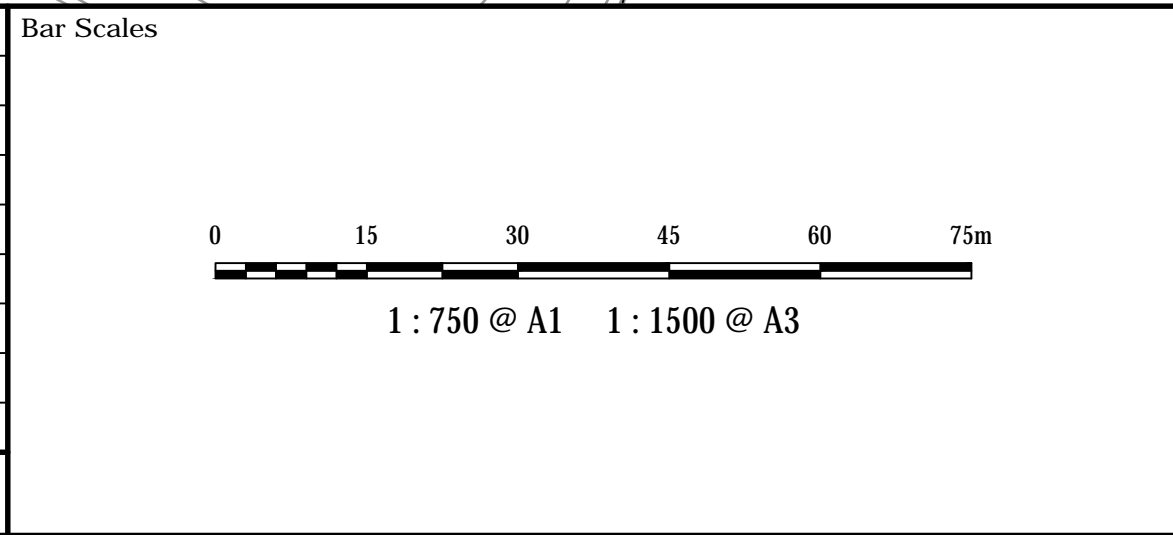
| | | |
|--|---|-------|
| Civil Engineers and Project Managers | | |
| at&I | | |
| Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1055 www.atl.net.au info@atl.net.au | | |
| Status | FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 |
| Drawing No. | Project No. | Issue |
| DAC030 | 18-577 | C |



PAVEMENT LEGEND

- HEAVY DUTY REINFORCED CONCRETE PAVEMENT
- HEAVY DUTY INTERLOCKING CONCRETE BLOCK PAVEMENT
- GRAVEL ACCESS TRACK PAVEMENT
- LANDSCAPED BATTERS REFER LANDSCAPE ARCHITECTS' DOCUMENTATION

| | | |
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| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |



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Client

BRICKWORKS
LIMITED

| | | | |
|--------------|----------|----------|----|
| Scales | 1 : 1000 | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

Project

**BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK**

Title

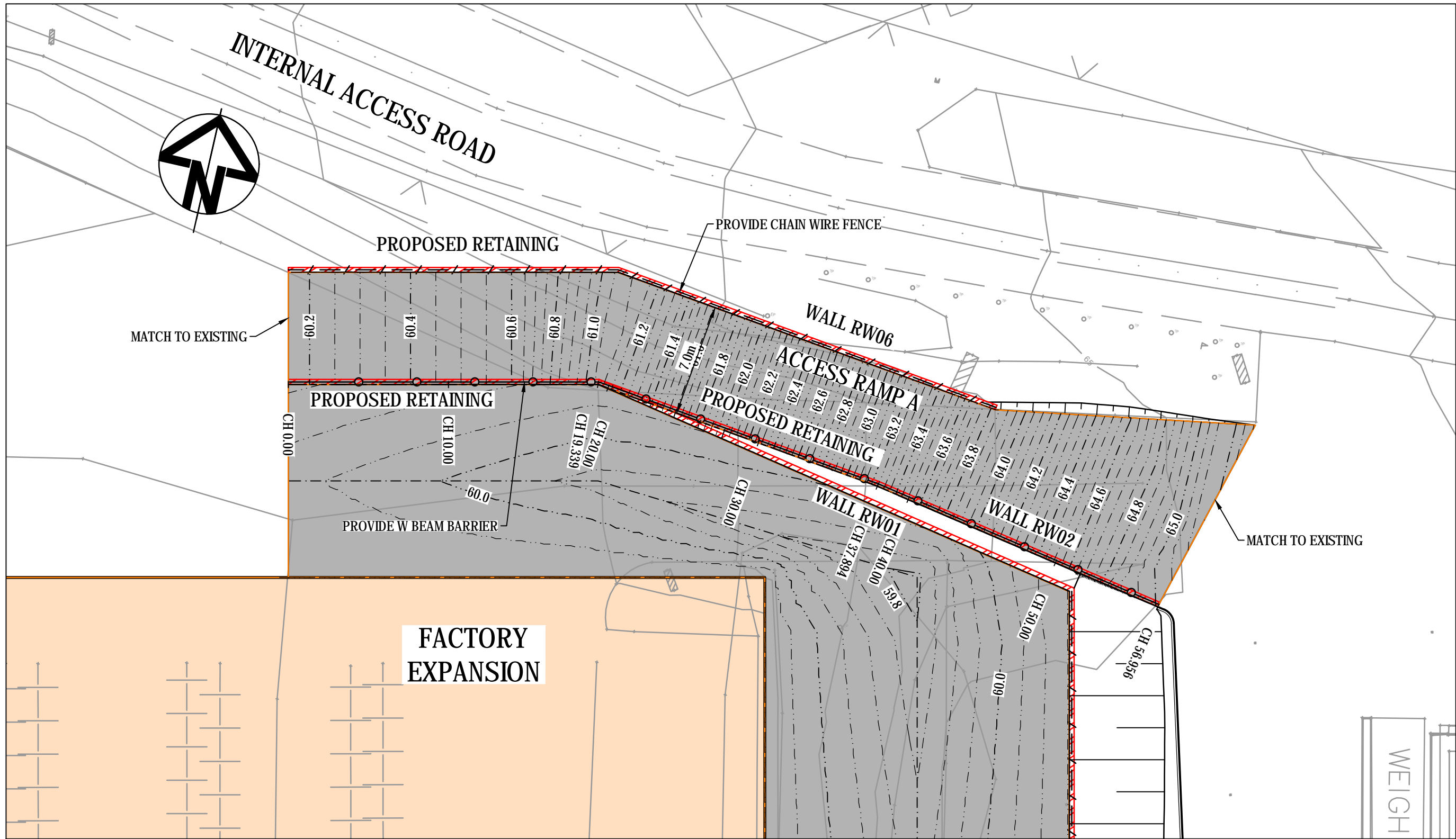
PAVEMENT PLAN

Civil Engineers and Project Managers

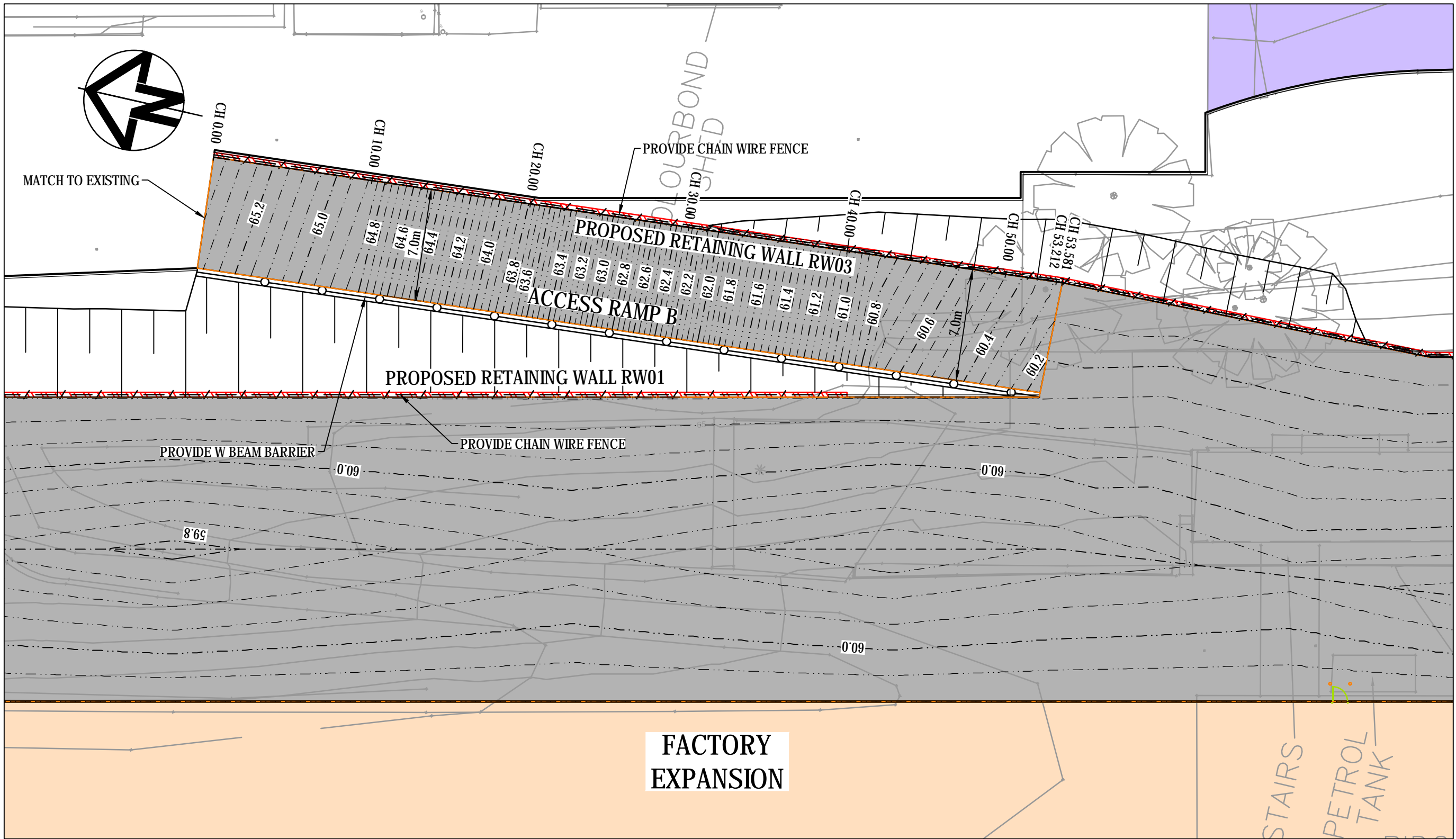
at&l

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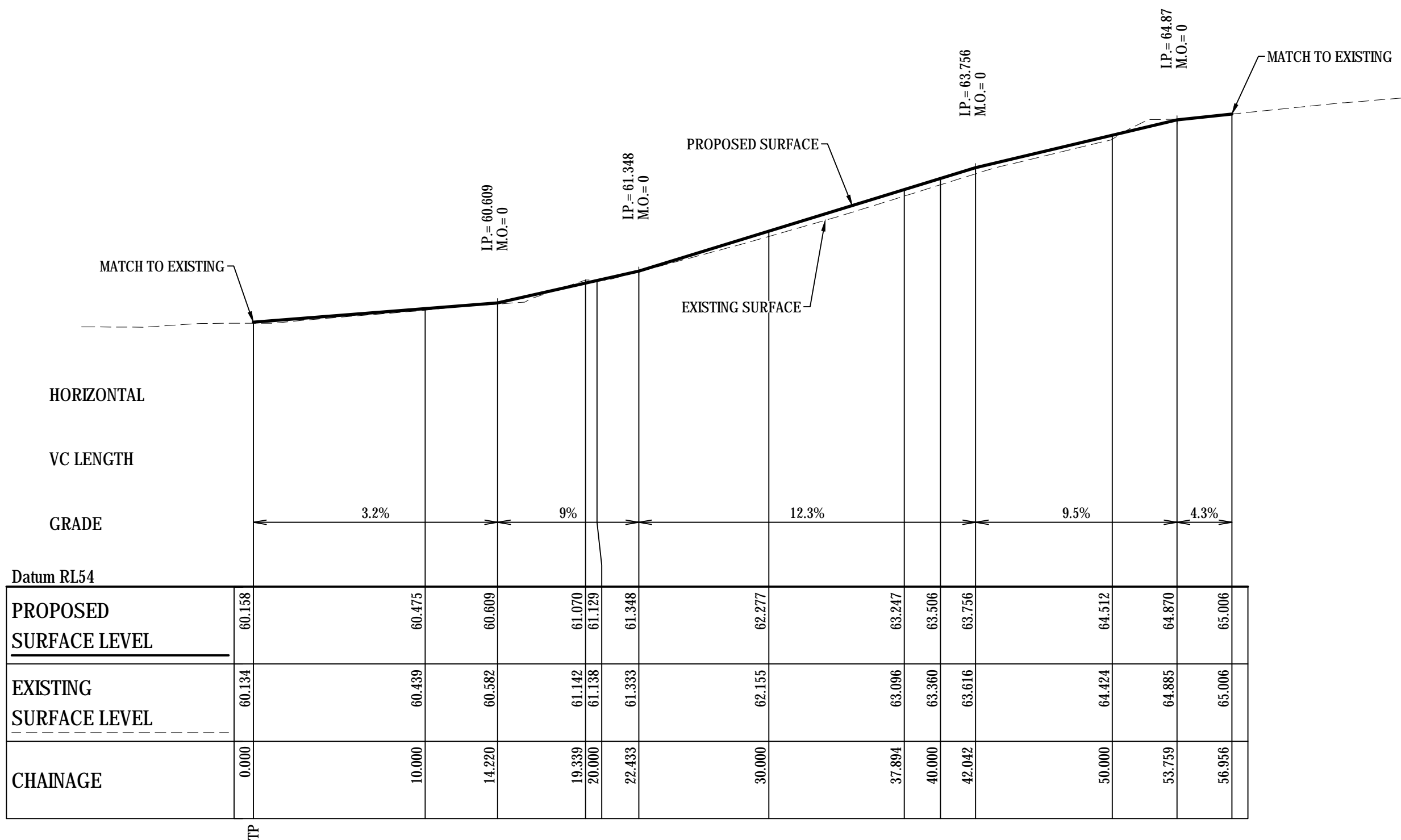
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| Status | FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 |
| Drawing No. | DAC031 | Issue |
| Project No. | 18-577 | C |



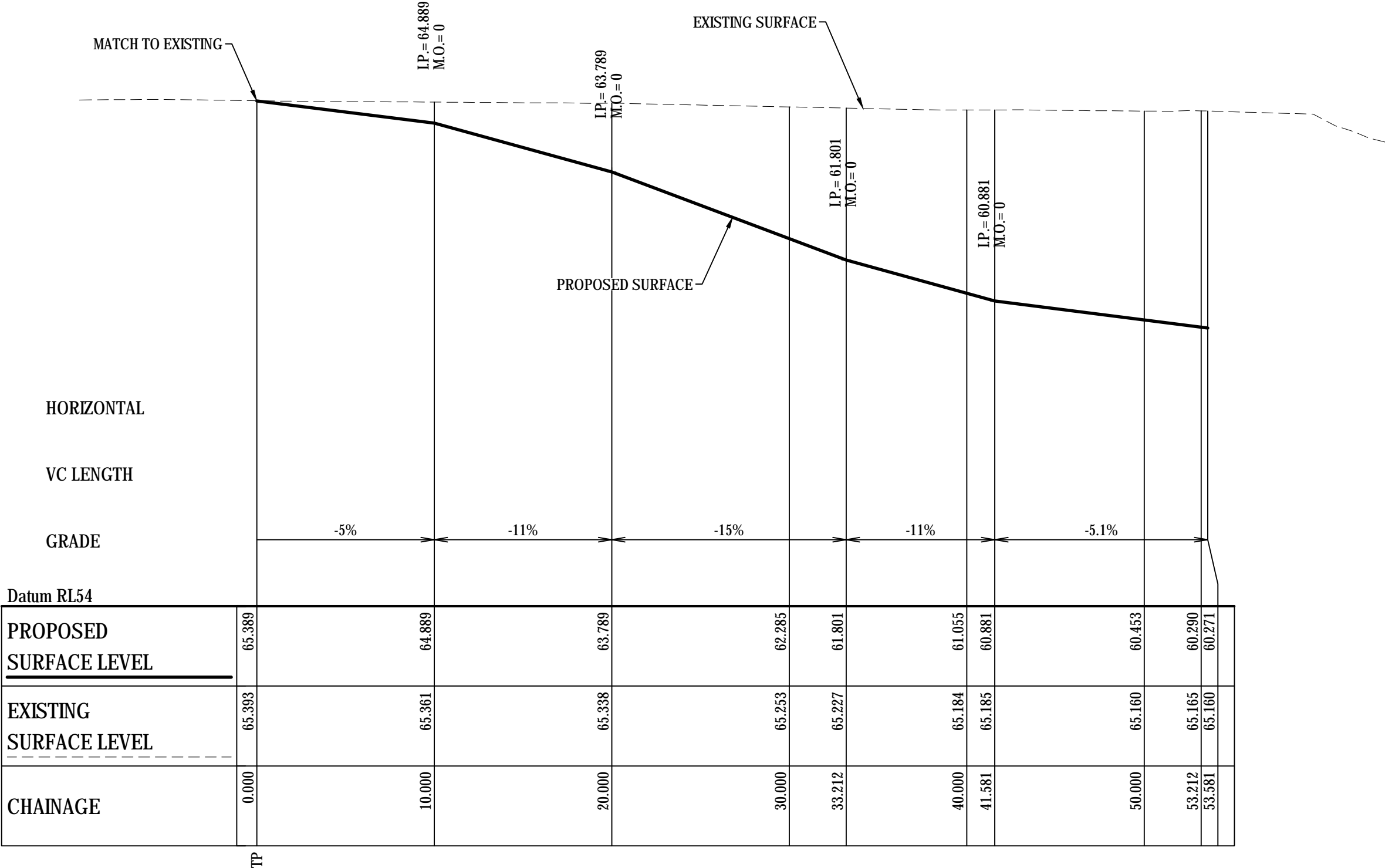
ACCESS RAMP A
1 : 250



ACCESS RAMP B
1 : 250

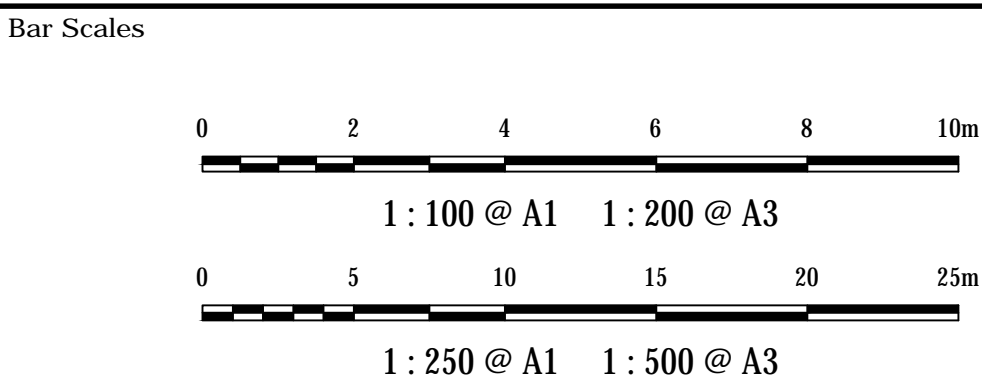


RAMP A LONGITUDINAL SECTION
SCALE 1:250 HORI
1:100 VERT.



RAMP B LONGITUDINAL SECTION
SCALE 1:250 HORI
1:100 VERT.

| | | |
|-------|---------------------------------|----------|
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |



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Scales
1 : 250H
1 : 100V

Grid
MGA

Height
Datum
AHD

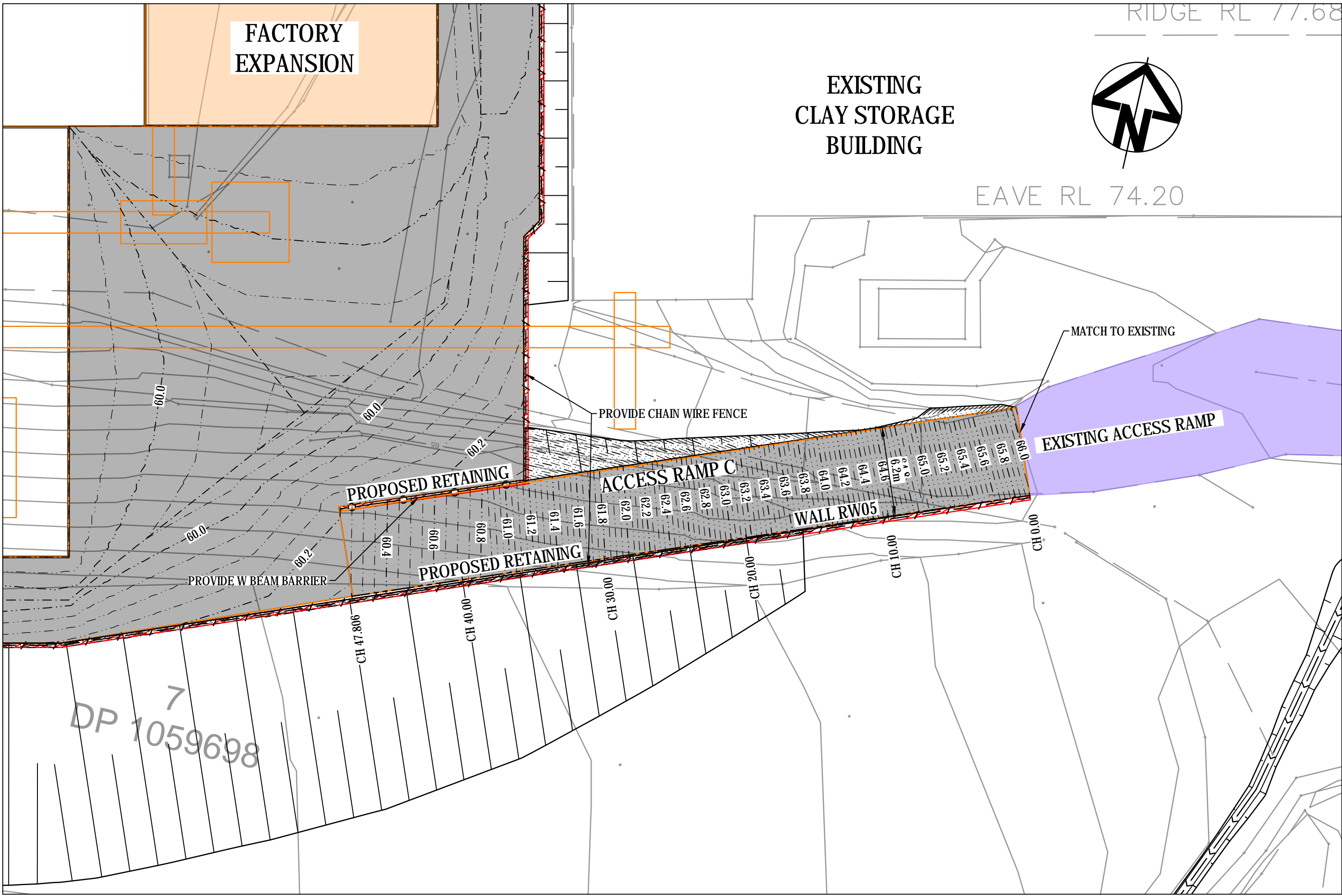
Drawn
Designed
Checked
Approved

Project
**BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK**

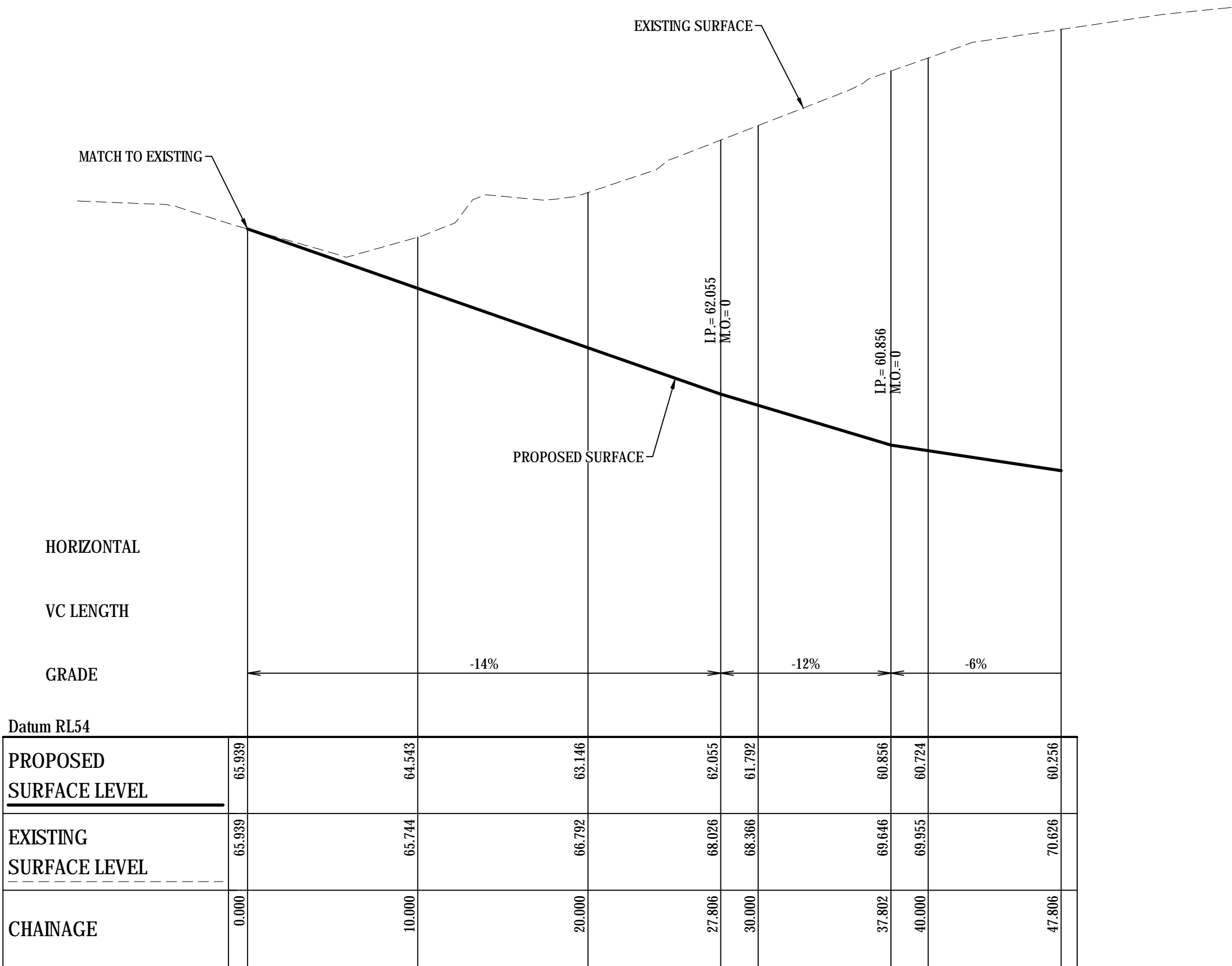
Title
**ACCESS RAMPS
LONGITUDINAL SECTIONS
SHEET 1**

Civil Engineers and Project Managers
at&L
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9423 1055
www.atl.net.au
info@atl.net.au

Status
FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION
Drawing No.
DAC035
Project No.
18-577
Issue
C

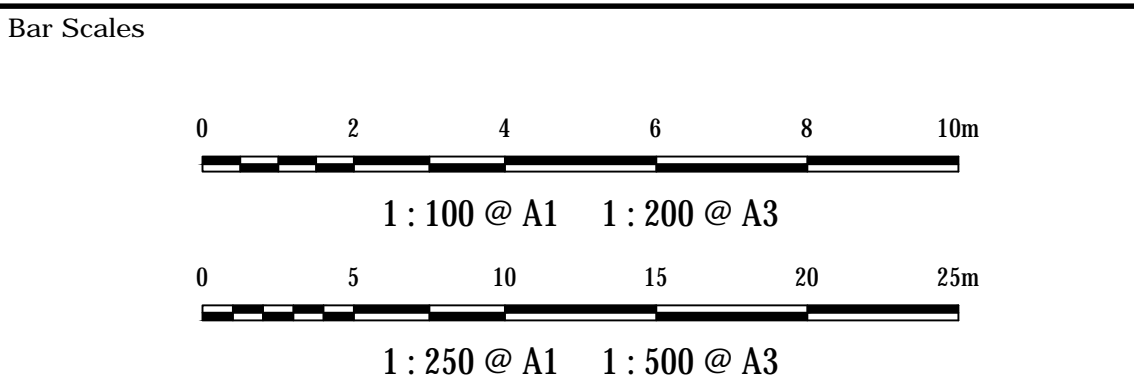


ACCESS RAMP C
1 : 250



RAMP C LONGITUDINAL SECTION
SCALE 1:250 HORI.
1:100 VERT.

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| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |



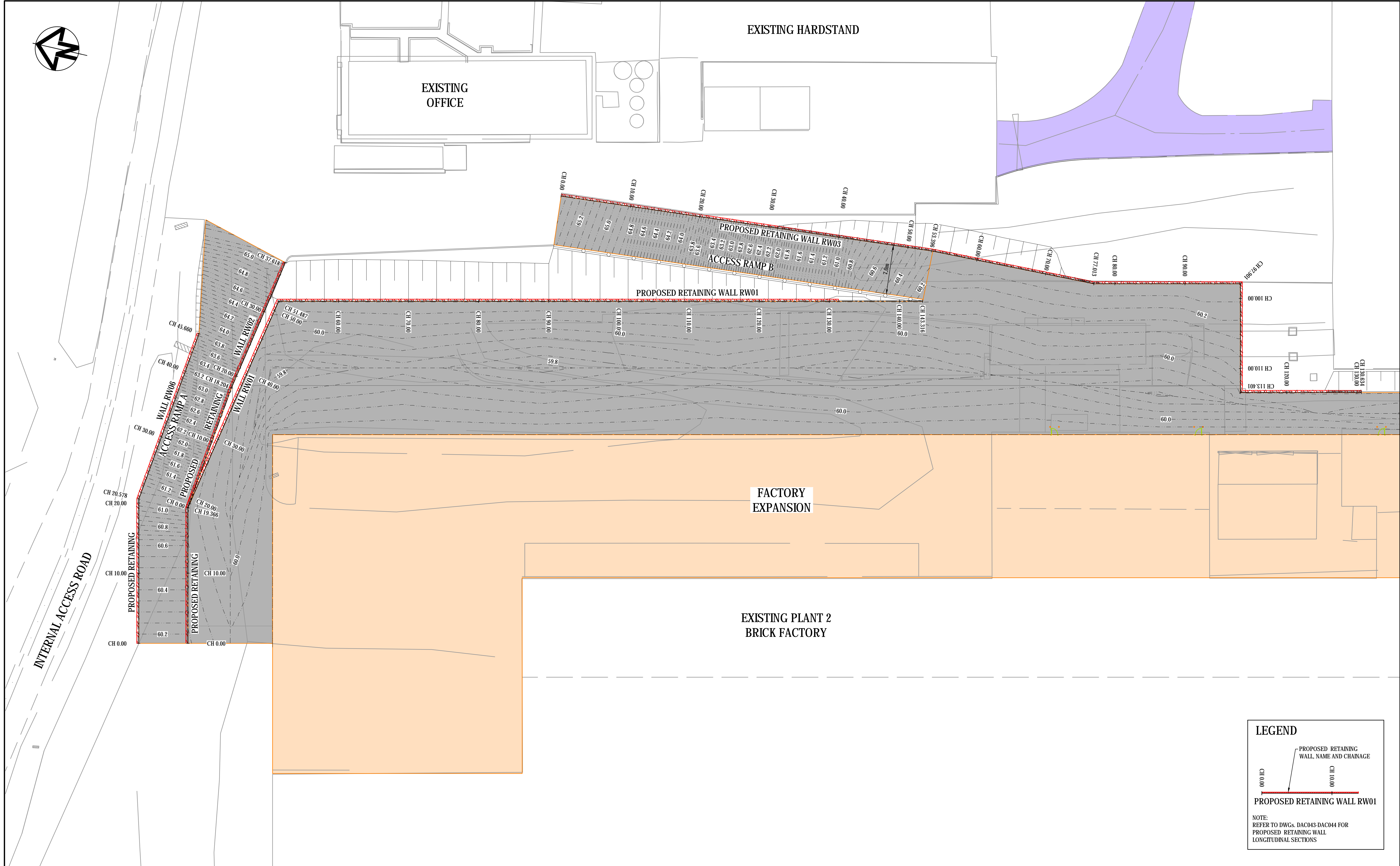
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|--------------------------------|----------|----|
| Scales 1 : 250H 1 : 100V | Drawn | QD |
| | Designed | QD |
| | Checked | SH |
| Grid MGA | Approved | |
| Height Datum AHD | | |

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|---|
| Project BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK |
| Title ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 2 |

| | | |
|---|-----------------------|------------|
| Civil Engineers and Project Managers at&L Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1055 www.atl.net.au info@atl.net.au | | |
| Status FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 | |
| Drawing No. DAC036 | Project No. 18-577 | Issue C |



LEGEND

PROPOSED RETAINING WALL, NAME AND CHAINAGE

CH 0.00 CH 10.00

PROPOSED RETAINING WALL RW01

NOTE:
REFER TO DWGS. DAC043-DAC044 FOR
PROPOSED RETAINING WALL
LONGITUDINAL SECTIONS

| | | |
|-------|---------------------------------|----------|
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

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LIMITED

| | | | |
|--------------|---------|----------|----|
| Scales | 1 : 250 | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| | | Approved | |
| Height Datum | AHD | | |

Project

**BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK**

Title

**RETAINING WALL PLAN
SHEET 1**

Civil Engineers and Project Managers

at&l

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North Sydney NSW 2060
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Tel: 02 9439 1777
Fax: 02 9423 1055
www.atl.net.au
info@atl.net.au

Status

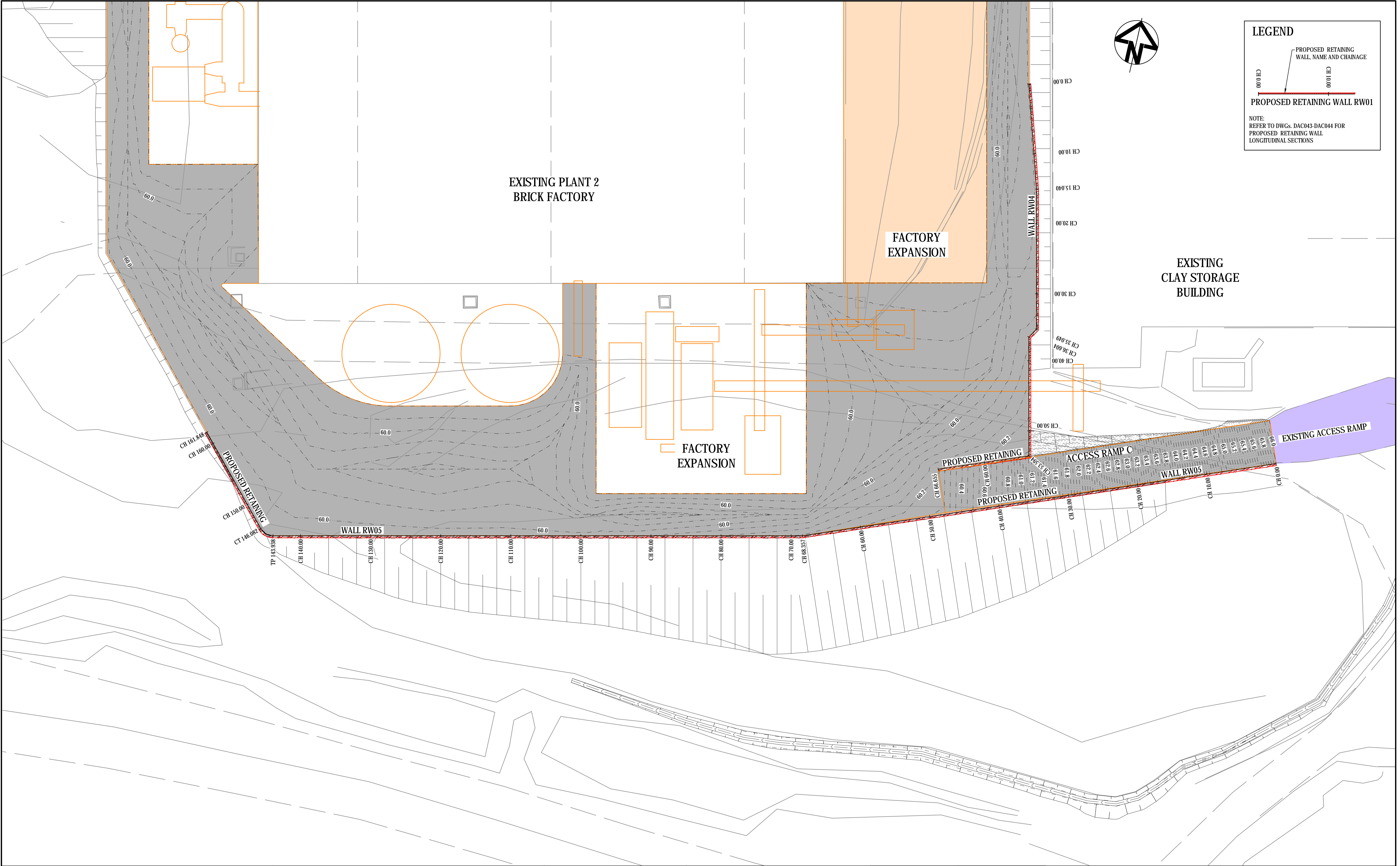
**FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION**

Drawing No.
DAC041

Project No.
18-577

Issue
C

A1



LEGEND

PROPOSED RETAINING WALL, NAME AND CHAINAGE

CH 0.00CH 0.00

PROPOSED RETAINING WALL RW01

NOTE:
REFER TO DWGS. DAC043-DAC044 FOR
PROPOSED RETAINING WALL
LONGITUDINAL SECTIONS

| | | |
|-------|---------------------------------|----------|
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |
| Issue | Description | Date |

Bar Scales

0510152025m

1 : 250 @ A11 : 500 @ A3

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Client

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| | | | |
|--------------|---------|----------|----|
| Scales | 1 : 250 | Drawn | QD |
| | | Designed | QD |
| | | Checked | SH |
| Grid | MGA | Approved | |
| Height Datum | AHD | | |

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

RETAINING WALL PLAN
SHEET 2

Civil Engineers and Project Managers

at&l

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Fax: 02 9423 1055
www.atl.net.au
info@atl.net.au

Status

FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.

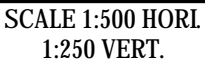
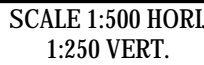
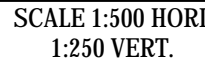
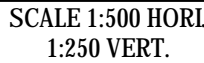
DAC042

Project No.

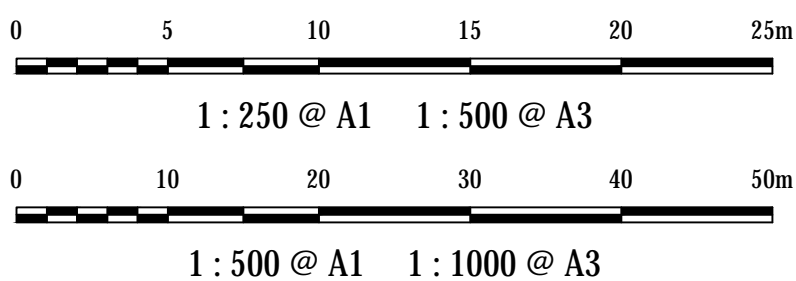
18-577

Issue

C



Bar Scales



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| | | | |
|-----------------|----------------------|----------|----|
| Scales | 1 : 500H 1 : 250V | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

[illegible]

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

RETAINING WALL PROFILE
SHEET 1

Civil Engineers and Project Managers

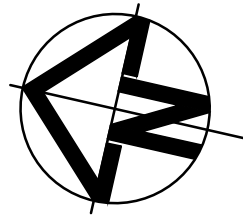


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| | | |
|--|-----------------------|------------|
| Status FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | | A1 |
| Drawing No. DAC043 | Project No. 18-577 | Issue C |



Date Plotted: 9 May 2019 - 06:45PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC044.dwg



STORMWATER CATCHMENT LEGEND

PROPOSED CATCHMENT BOUNDARIES

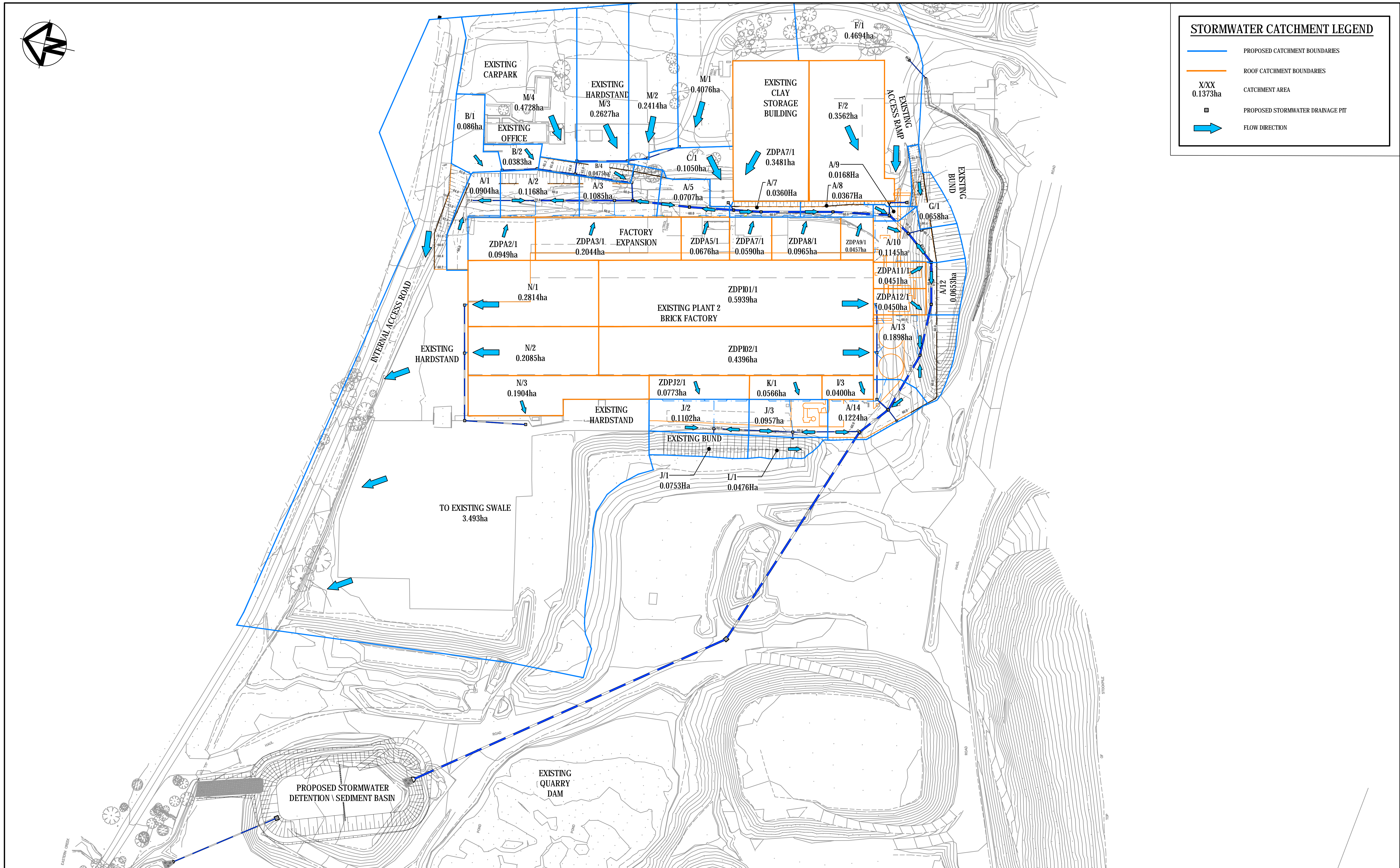
ROOF CATCHMENT BOUNDARIES

X/XX
0.1373ha

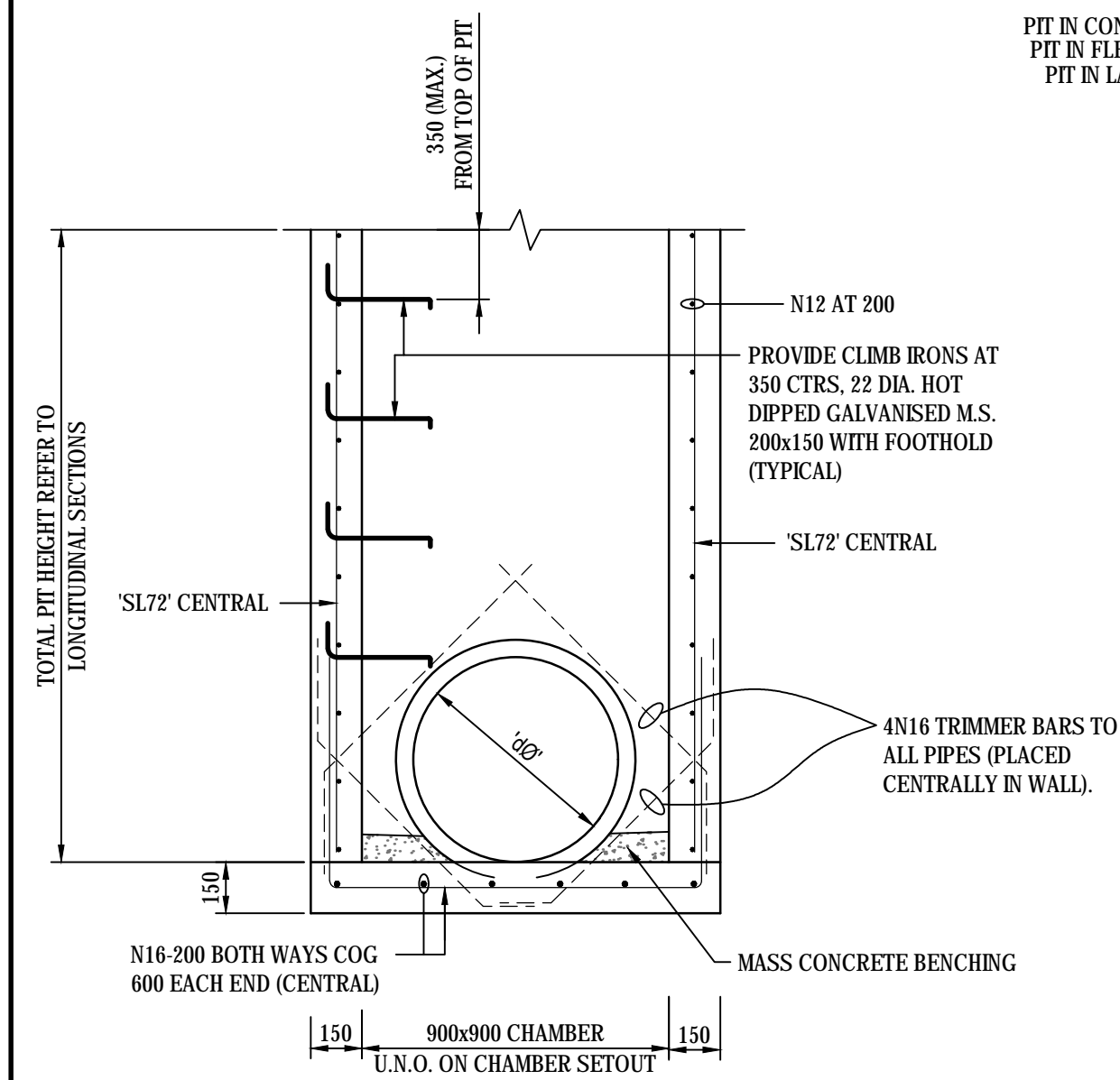
CATCHMENT AREA

PROPOSED STORMWATER DRAINAGE PIT

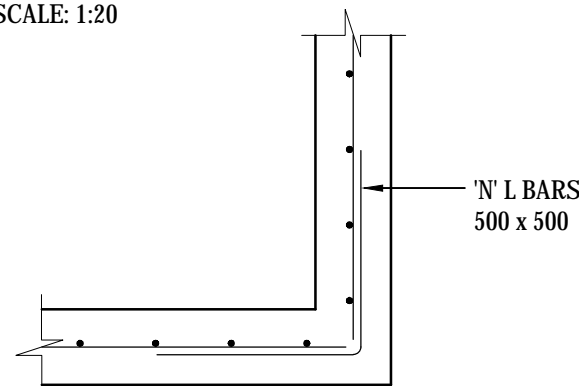
FLOW DIRECTION



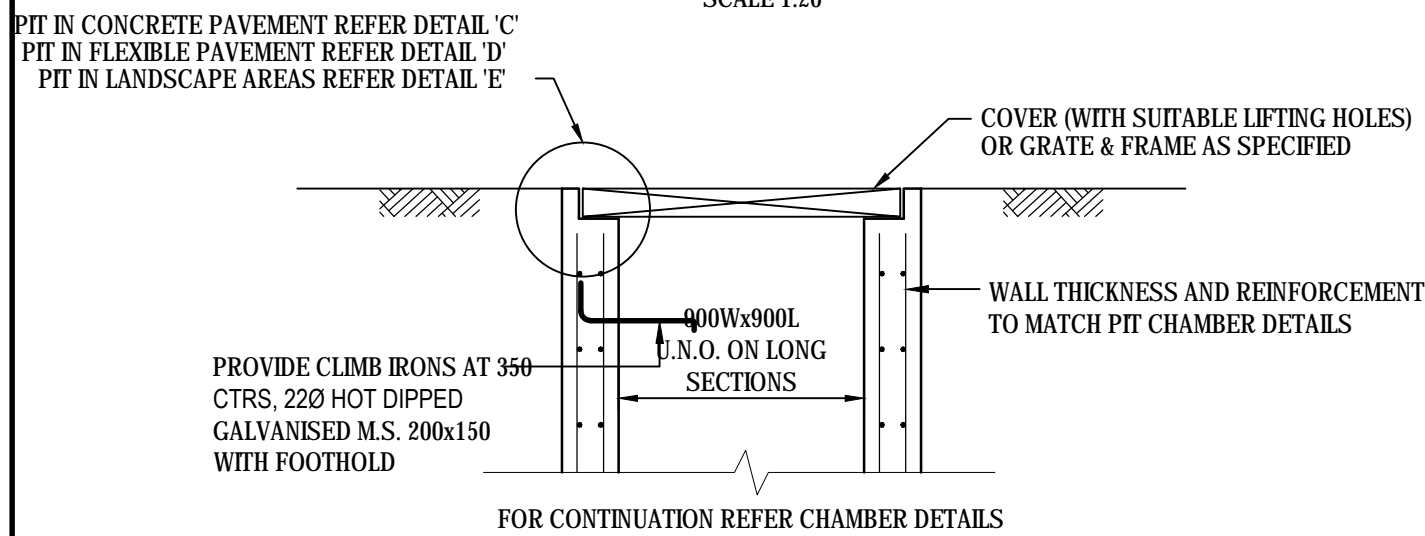
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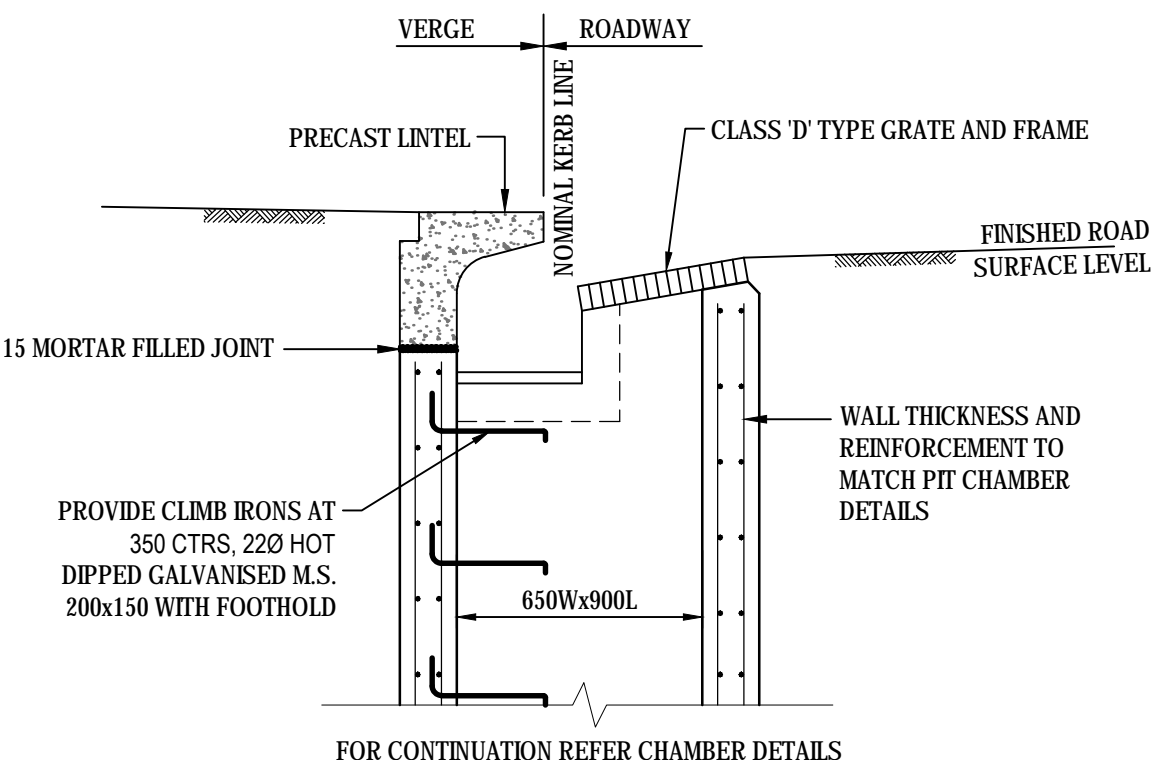
PIT CHAMBER DETAIL
FOR PIPES UP TO 525Ø
SCALE: 1:20



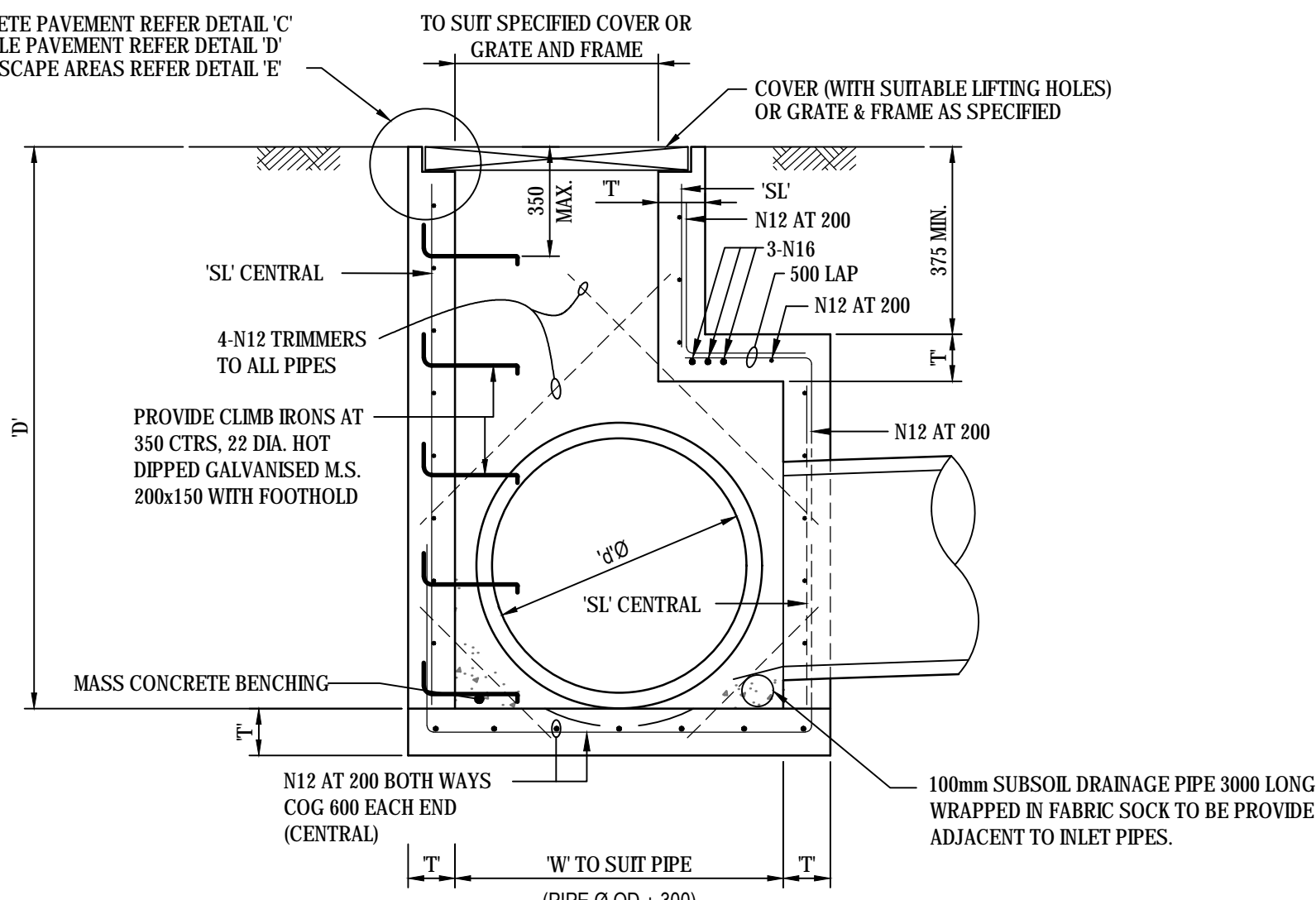
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STANDARD SURFACE INLET OR SEALED JUNCTION PIT
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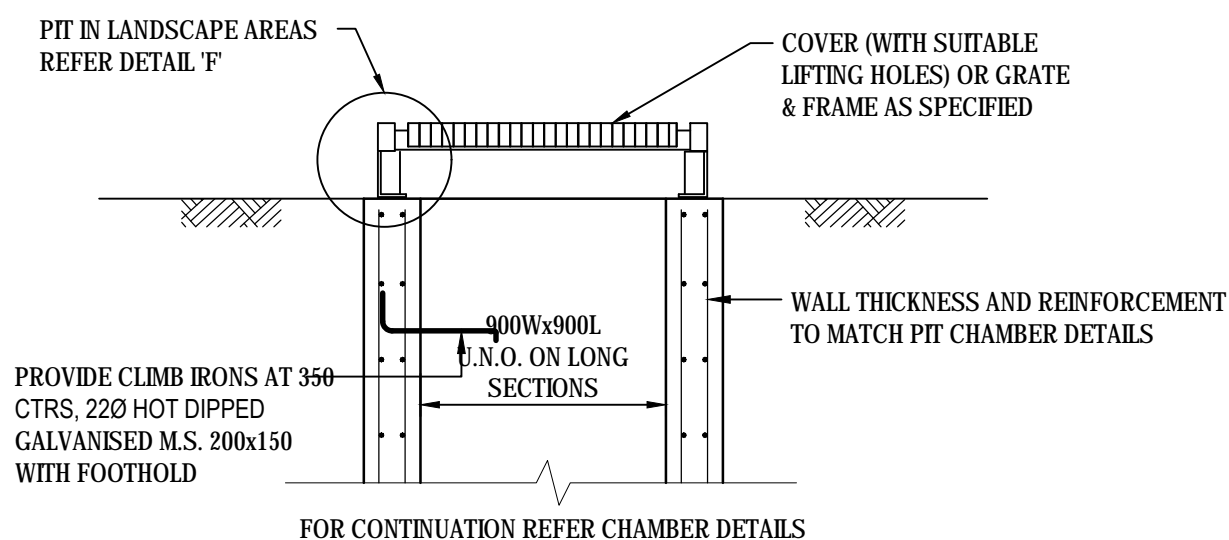
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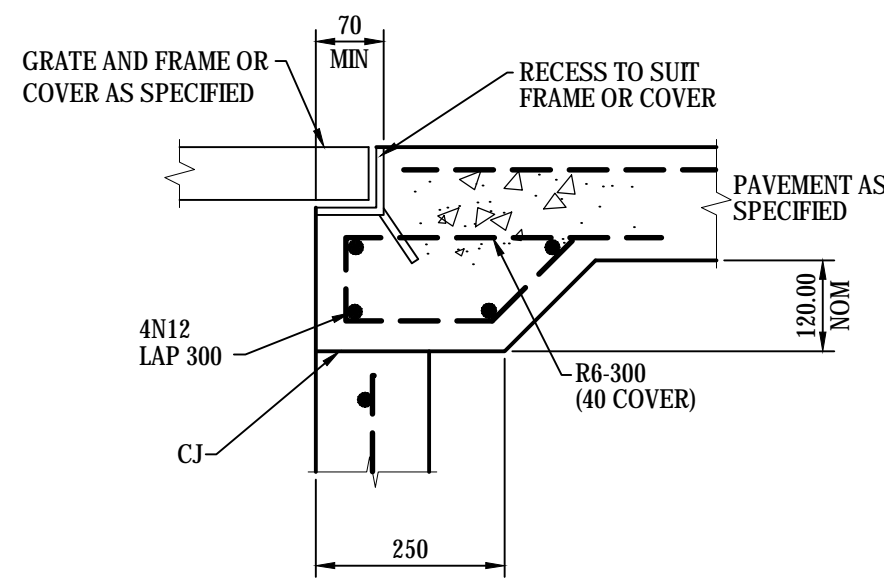
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FOR PIPES FROM 600Ø TO 1200Ø
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SCALE: 1:20

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| 750 | 1000 | 1200-2400 | SL72 |
| 825 | 1150 | 1200-2400 | SL72 |
| 900 | 1200 | 1200-2400 | SL82 |
| 1050 | 1350 | 1300-2400 | SL92 |
| 1200 | 1500 | 1500-2800 | SL102 |

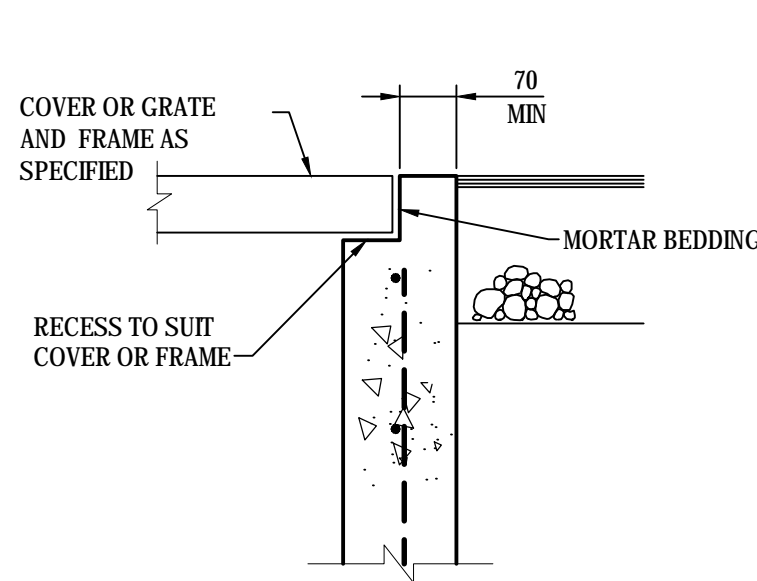
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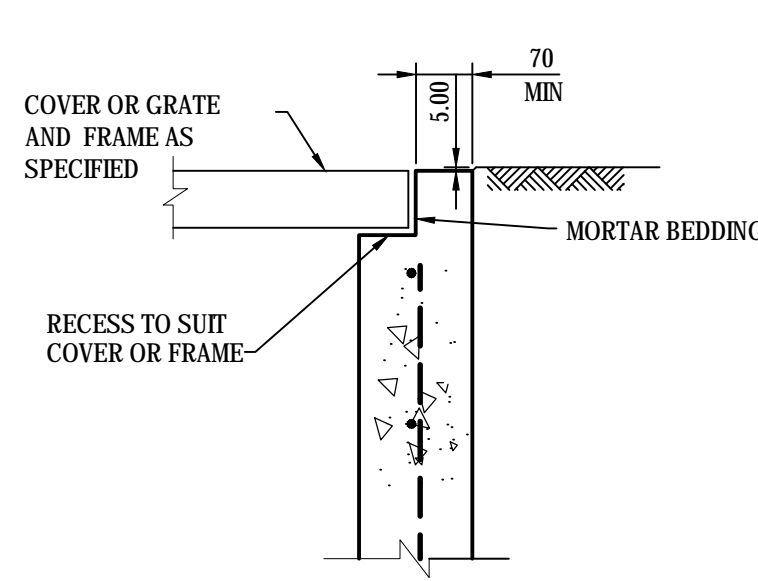
STANDARD SURCHARGE SURFACE INLET PIT
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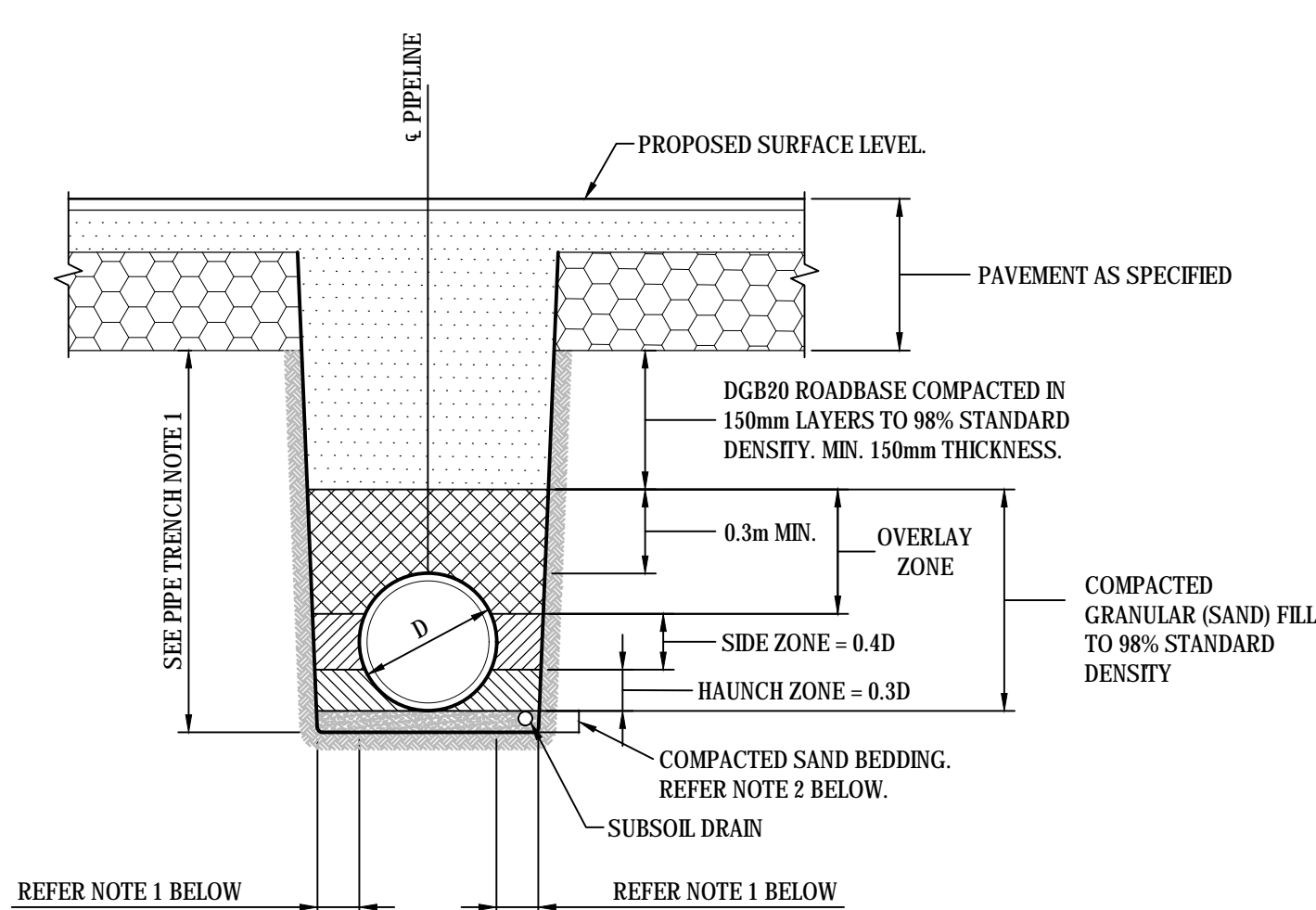
DETAIL "C"
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DETAIL "D"
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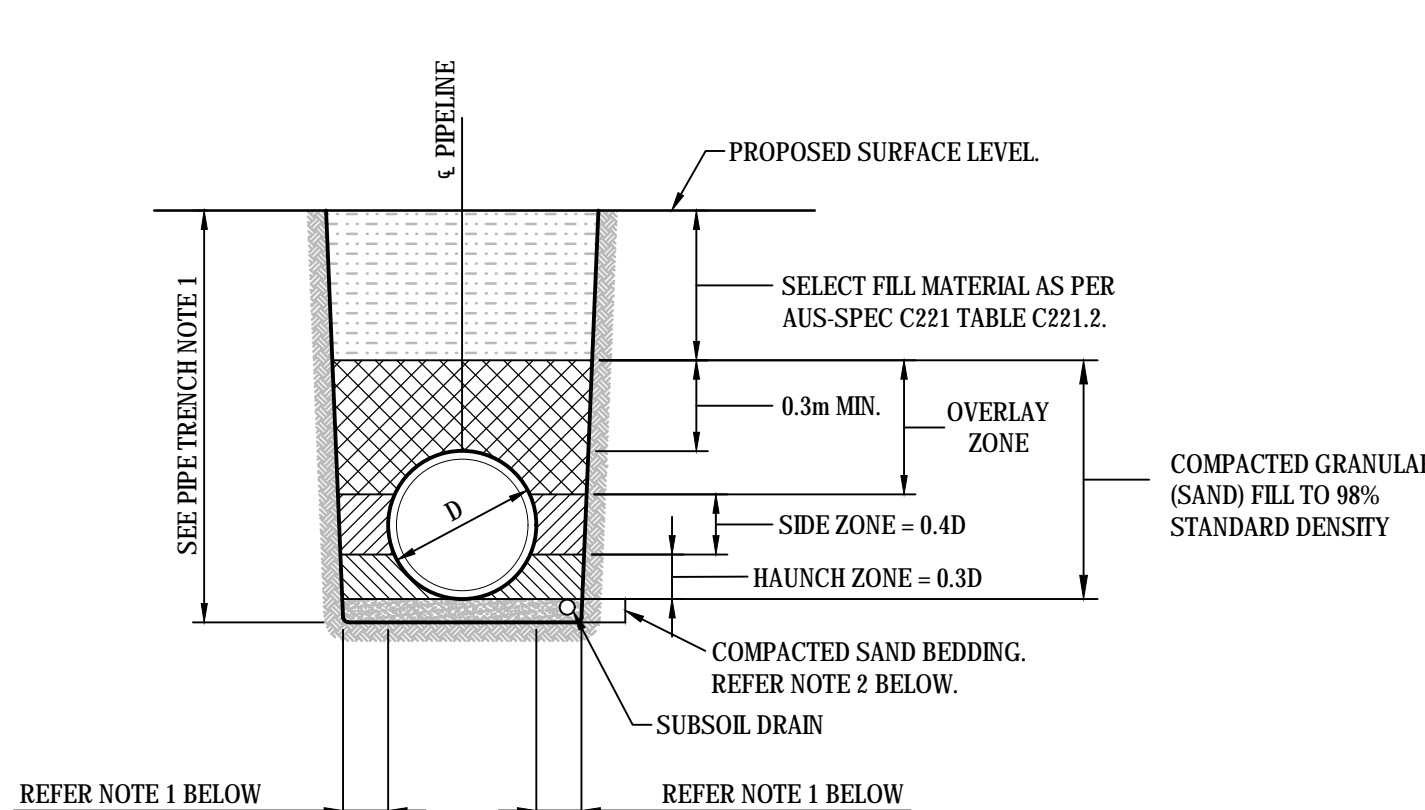


DETAIL "E"
SCALE 1:10



PIPE TRENCH BELOW PAVEMENT
N.T.S.

NOTE
1. ≥0.2D OR 0.3m (WHICHEVER IS GREATER)
2. 100mm FOR PIPE DIA. ≤1500



PIPE TRENCH BELOW LANDSCAPING (HS3)
N.T.S.

NOTE
1. ≥0.2D OR 0.3m (WHICHEVER IS GREATER)
2. 100mm FOR PIPE DIA. ≤1500

PIPE TRENCH NOTES

- IN UNDERTAKING TRENCH EXCAVATION, THE CONTRACTOR SHALL PROVIDE ANY SHORING, SHEET PILING OR OTHER STABILISATION OF THE TRENCH NECESSARY TO COMPLY WITH OH&S REGULATION REQUIREMENTS. THE SIDES ARE NOT TO BE LOADED & SHALL BE KEPT CLEAR OF LOOSE MATERIAL ETC. SAFE ACCESS & EGRESS SHALL BE PROVIDED AT ALL TIMES.
- THE TRENCH SHALL BE EXCAVATED TO A WIDTH 1.4 TIMES THE EXTERNAL DIAMETER OF THE PIPE, OR TO THE EXTERNAL DIAMETER OF THE PIPE PLUS 300mm ON EACH SIDE, WHICHEVER IS THE GREATER.

NOTE

- STANDARD GULLY PITS REFER TO STRATHFIELD COUNCIL STANDARD DRAWING FOR DETAILS
- FOR INLET SIZE, PIT CHAMBER SIZE AND SETOUT REFER TO STORMWATER LONGITUDINAL SECTIONS ON DRAWING C851 - C854
- REINFORCING MESH IS TO BE BENT TO LAP 300 AROUND ALL CORNERS. VERTICAL BARS ARE NOT TO BE CUT. ALTERNATELY PROVIDE N12 'L' BARS (500x500) AT 400 VERTICAL CTS.
- COMPRESSIVE STRENGTH (F_c) FOR CAST IN SITU CONCRETE SHALL BE A MINIMUM 32 MPa AT 28 DAYS.
- TOP OF BENCHING SHALL BE 1/2 OF OUTLET PIPE DIAMETER.
- 100mm SUBSOIL DRAINAGE PIPE 3000 LONG WRAPPED IN FABRIC SOCK TO BE PROVIDE ADJACENT TO INLET PIPES.
- ALL PITS SHALL BE PROVIDED WITH A LOCKING CLIP.
- PIT GRATE TO BE 'WELDLÖK' GULLY GRATE GG 78-50 OR APPROVED EQUIVALENT.
- DURING INSTALLATION OF GRATE AND FRAME CONTRACTOR IS TO ENSURE CLEARANCE BETWEEN LINTEL AND OPENED GRATE (REFER TO INSTALLATION TOLERANCE).
- PROVIDE STEP IRONS AS INDICATED FOR PITS DEEPER THAN 1200.
- N12 AT 200 CENTRALLY PLACED MAY BE USED IN LIEU OF MESH. LAP 500 AT CORNERS
- MINIMUM REINFORCEMENT COVER TO BE 45mm UNLESS NOTED OTHERWISE
- CHAMBER DEPTH EXCEEDING 2m IN HEIGHT WILL BE DESIGNED AND APPROVED BY STRUCTURAL ENGINEER
- CONCRETE STRENGTH: - UNLESS NOTED OTHERWISE

| ELEMENT | f _c MPa (28 DAYS) | SLUMP | MAX AGG SIZE | CEMENT TYPE |
|---------|------------------------------|-------|--------------|-------------|
| PITS | 32 | 80mm | 20mm | GP |

| Issue | Description | Date |
|-------|---------------------------------|----------|
| C | ISSUED FOR DEVELOPMENT APPROVAL | 10-05-19 |
| B | ISSUED FOR REVIEW | 09-04-19 |
| A | ISSUED FOR INFORMATION | 03-11-18 |

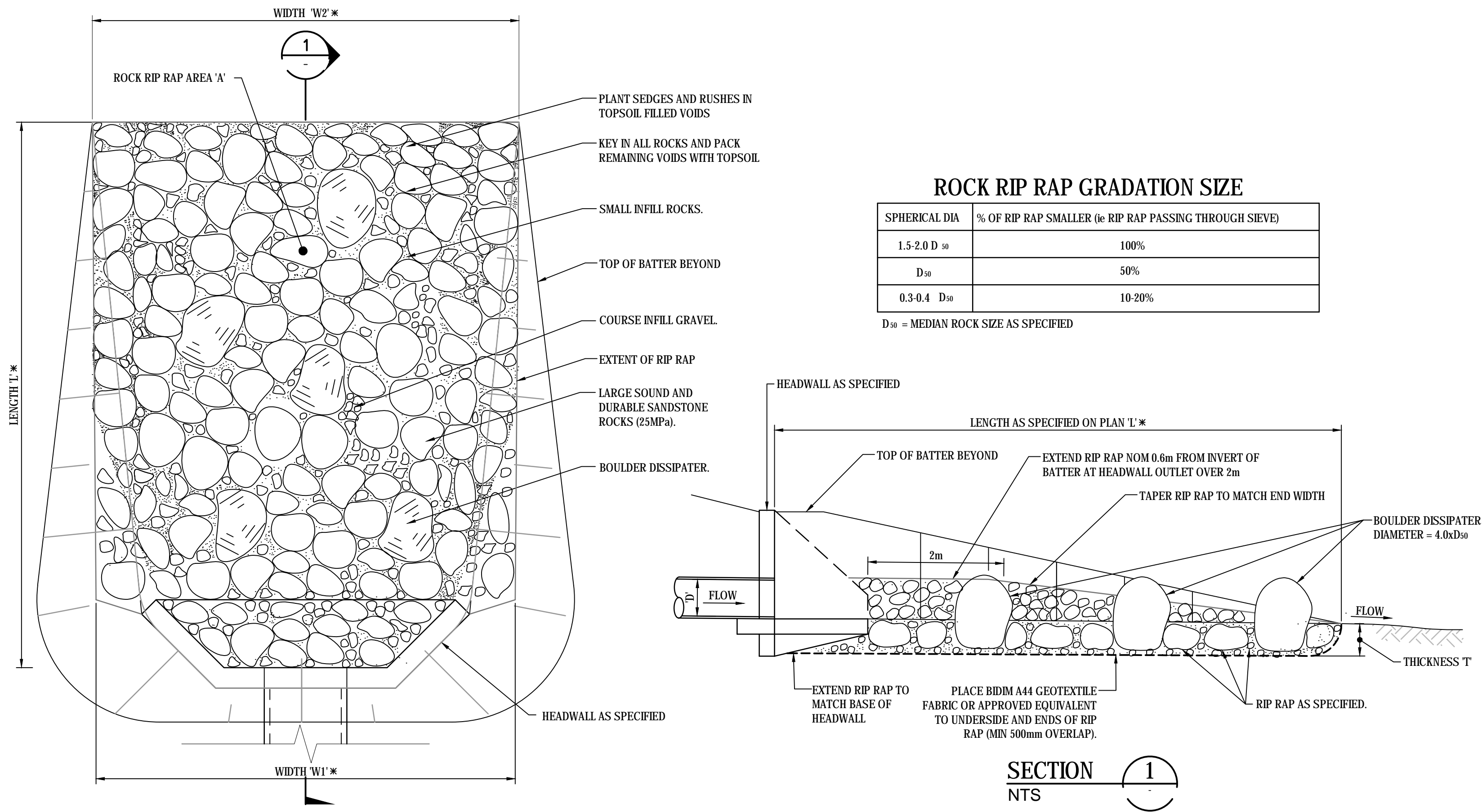
| Bar Scales |
|------------------------------|
| 0 100 200 400 600 800 1000mm |
| 1 : 10 @ A1 1 : 20 @ A3 |
| 0 500 1000 1500 2000mm |
| 1 : 20 @ A1 1 : 40 @ A3 |

| |
|--|
| THIS DRAWING CANNOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY OTHER PURPOSE OTHER THAN THAT ORIGINALLY INTENDED WITHOUT THE WRITTEN PERMISSION OF AT&L |
| Client |
| BRICKWORKS LIMITED |

| | | | |
|--------------|------------------|----------|----|
| Scales | 1 : 10 1 : 20 | Drawn | QD |
| | | Designed | QD |
| Grid | MGA | Checked | SH |
| Height Datum | AHD | Approved | |

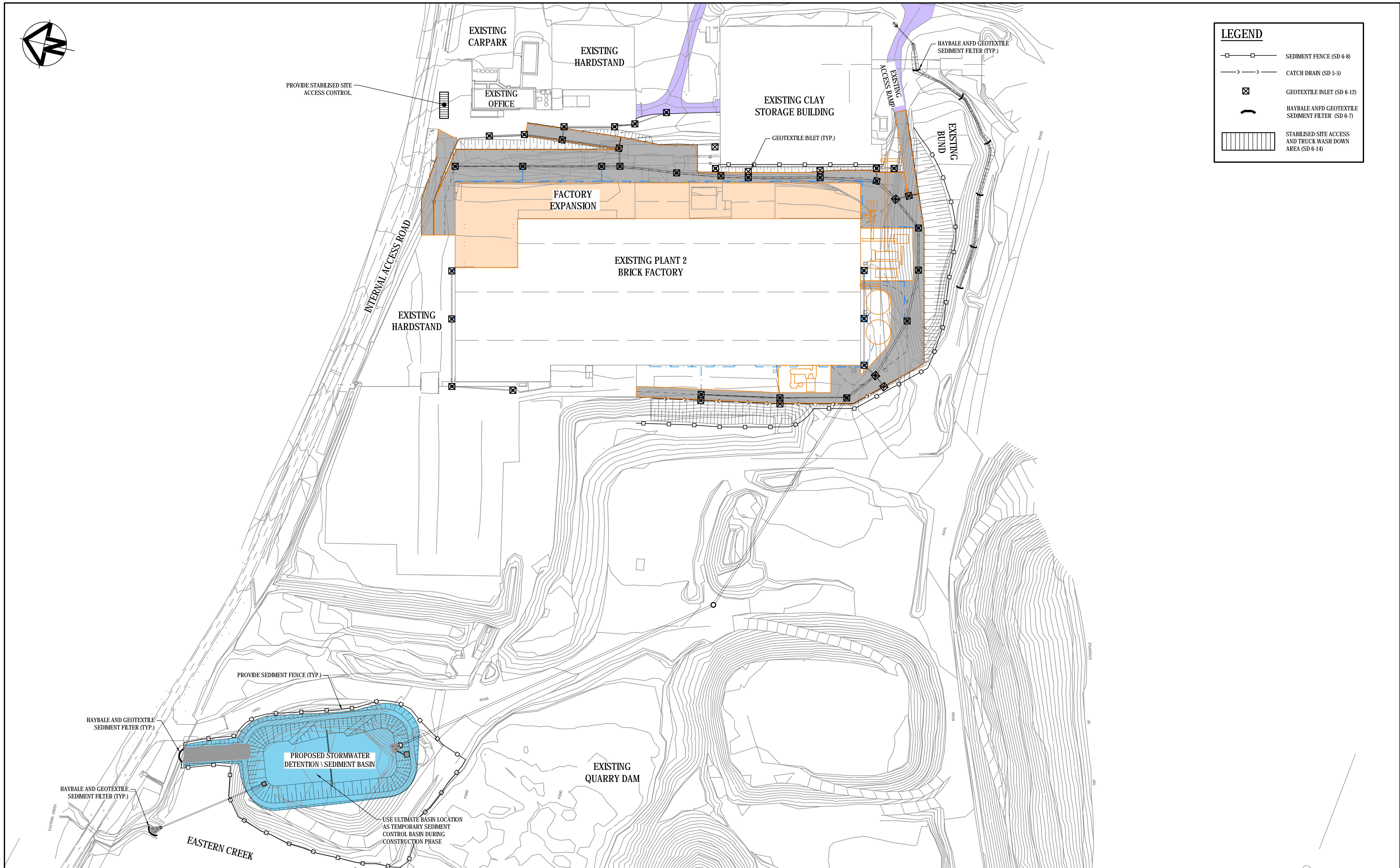
| | |
|---------|--|
| Project | BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK |
| Title | STORMWATER DETAILS SHEET 1 |

| | | |
|--------------------------------------|---|--|
| Civil Engineers and Project Managers | at&l | Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9423 1055 www.atl.net.au info@atl.net.au |
| Status | FOR REVIEW NOT TO BE USED FOR CONSTRUCTION | A1 |
| Drawing No. | DAC055 | Issue |
| Project No. | 18-577 | C |



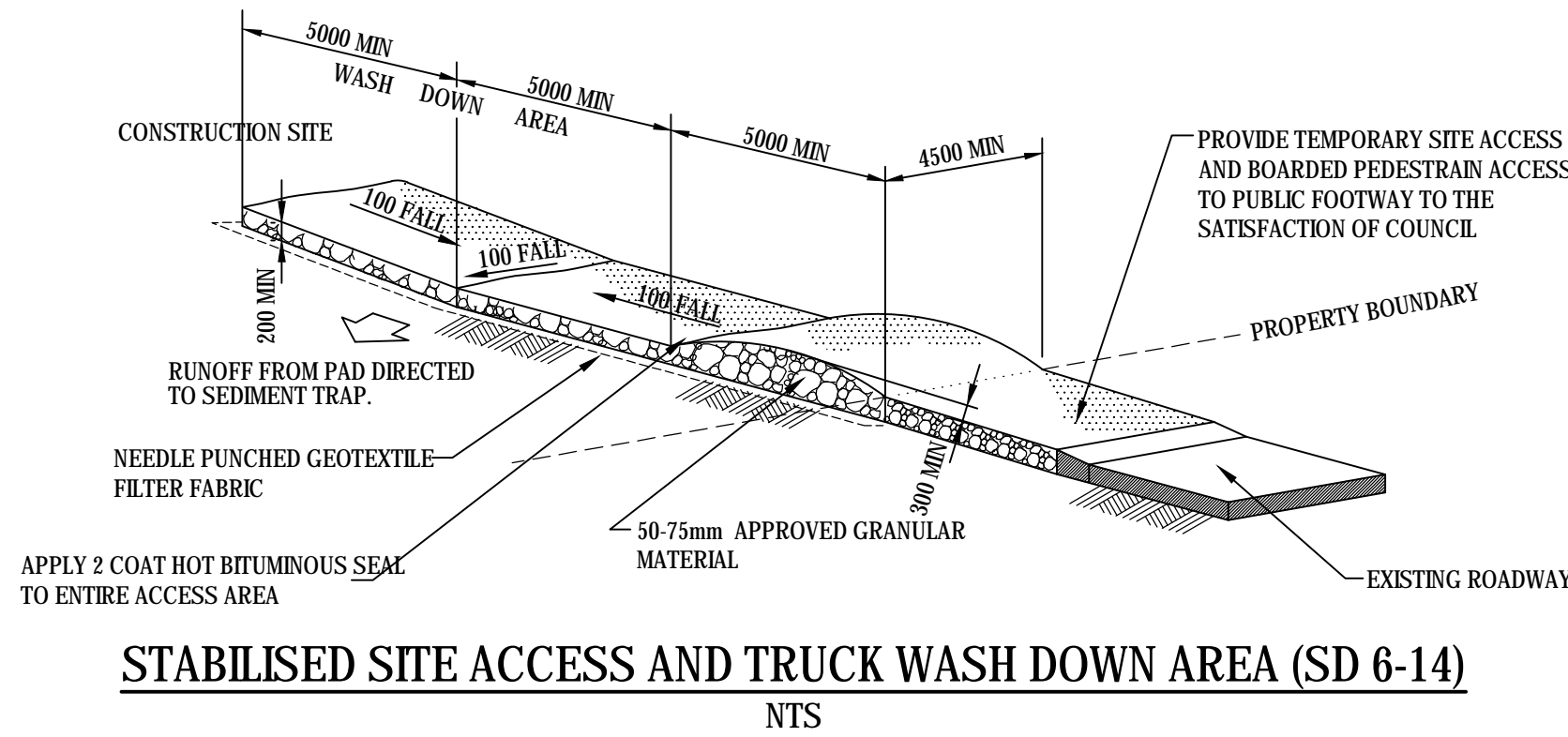
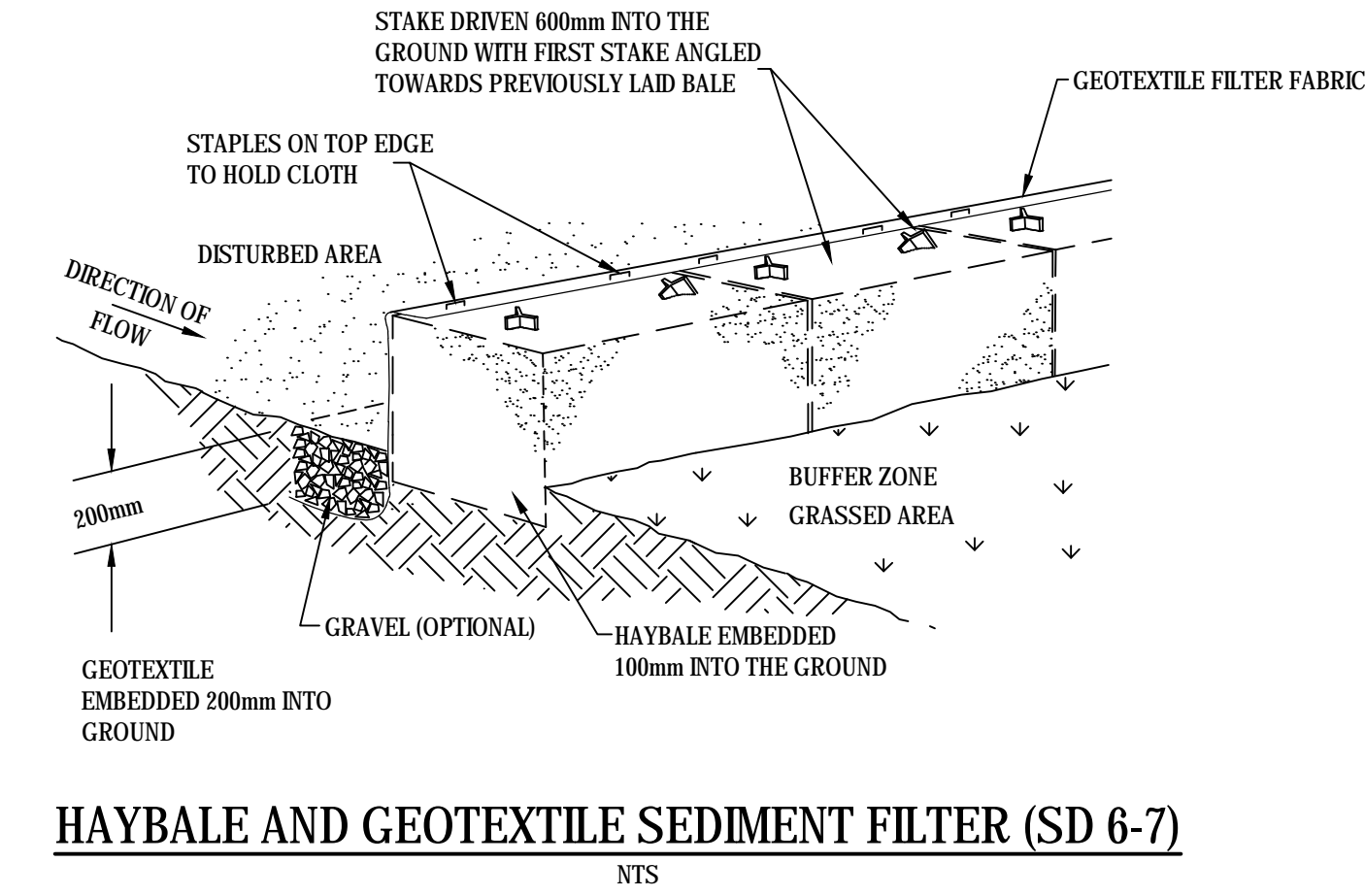
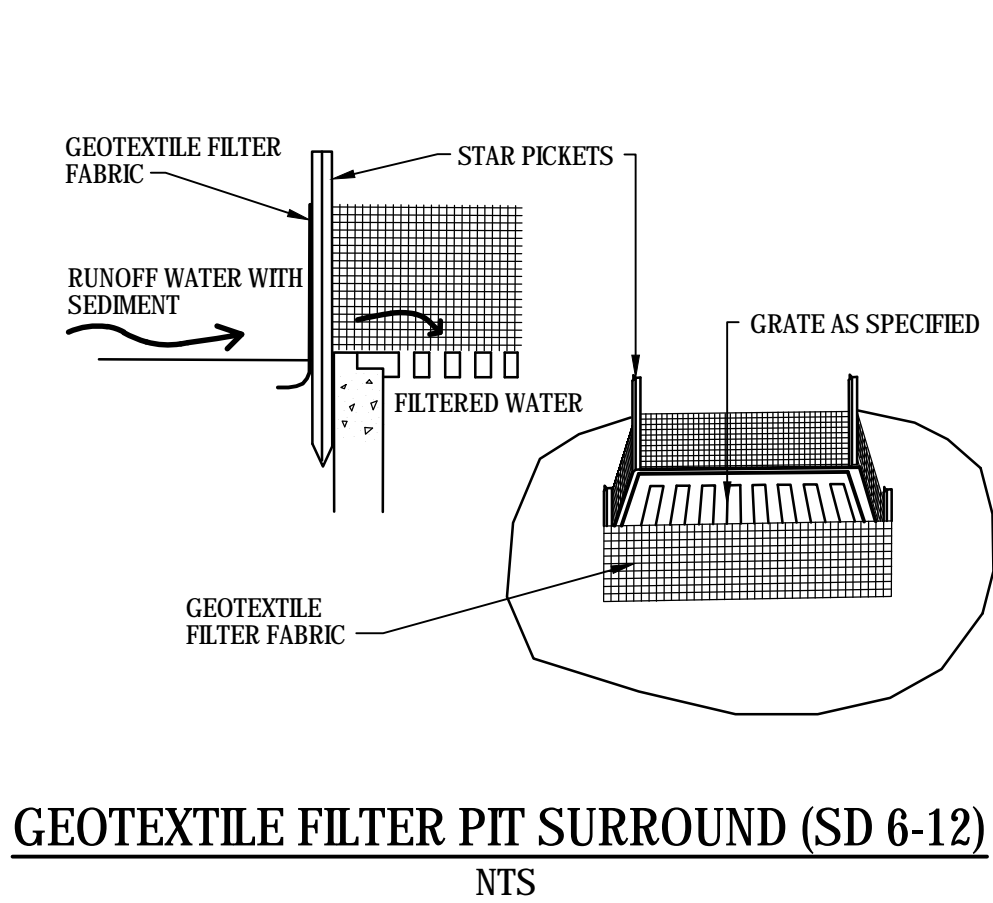
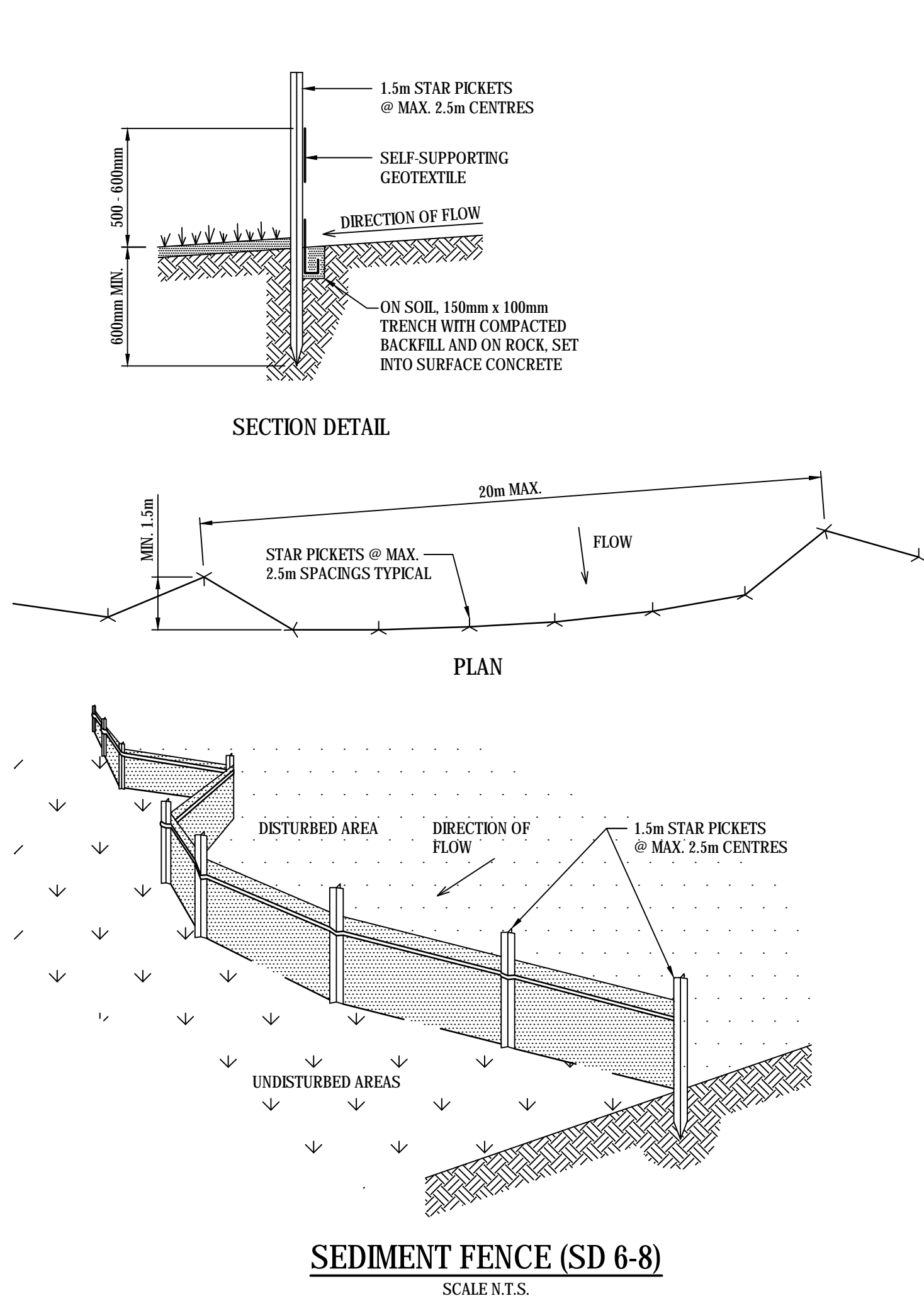
PLAN
SCALE NTS
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* - REFER SCOUR PROTECTION SCHEDULE ON THIS DRAWING

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Report on Geotechnical Investigation
Lightweight Aggregate Project
Plant 2, Austral Brick Site
720 Wallgrove Road, Horsley Park

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed lightweight aggregate facility at Plant 2 in the Austral Brick Site at 720 Wallgrove Road, Horsley Park. The work was commissioned by Ms Megan Kublins of Brickworks Limited on 22 April 2015 and was undertaken generally in accordance with a proposal by DP dated 14 April 2015.

The proposed lightweight aggregate project comprises the installation of new plant and equipment on the southern and western sides of the existing brick factory and existing mill building. The investigation was carried out to provide information on the soil, rock and groundwater characteristics for design and planning purposes.

The investigation included drilling of five rock cored bores, five deep auger bores and five shallow auger bores for pavement design purposes. Laboratory testing was carried out on selected samples to assess the engineering properties of the soil and rock and to enable recommendations to be made on suitable design parameters. Details are provided in the report, together with comments relating to the following:

- Subsurface conditions including groundwater;
- Excavatability of in situ materials and suitability for reuse as structural fill elsewhere on the site;
- Advice on footing design;
- Estimated settlements;
- Maximum slopes for temporary and permanent batters;
- Pavement design parameters; and
- Foundation treatment within the existing dam to enable embankment construction.

2. Site Description

The site is located at the eastern end of the Austral Bricks site at Horsley Park in an area of gently undulating terrain where natural surface slopes are generally less than about 5%. The area, however, has been extensively altered by quarrying for brick making purposes and by the creation of level areas for construction of large industrial buildings.

The site measures about 400 m in an east-west direction and approximately 300 m in a north-south direction with a fall in the overall surface levels in a northerly direction of approximately 10 m. Within the site, however, there are many significant changes in level due to the presence of large stockpiles, an existing dam, and vegetated bunds.

The site location and the position of the bores is given on Drawing 1 in Appendix B.

3. Geology

Reference to the Penrith 100,000 Geological Series Sheet shows Quaternary alluvium has been deposited along the line of the major creeks in the region, including Eastern Creek. It is possible that some alluvial deposits occur over the northern portion of the site where the western Sydney Pipeline crosses through low lying terrain adjacent to Eastern Creek.

The site is mostly located on the lower slopes of a small north-south trending ridge. At the bottom of the slope there are flatter areas near Eastern Creek which probably represent areas of alluvial soil deposits. The remainder of the site is underlain by residual clay and silty clay derived from the weathering of the underlying Bringelly Shale.

The geological sheet indicates that the region is underlain at shallow depth by Bringelly Shale which is part of the Wianamatta Group of Triassic age. The Wianamatta Group consists of three formations of which the Bringelly Shale is stratigraphically the highest. In areas west of Sydney the sedimentary rocks have been gently folded to form a basin like structure with the Bringelly Shale generally occupying the centre.

The Bringelly Shale typically comprises claystone, siltstone, laminite (thinly interbedded siltstone and sandstone) and sandstone units with minor occurrences of coal, carbonaceous claystone and tuff. The various units are typically dark grey and black but also include light grey claystone units.

The Austral Brick Site is located just west of the Prospect intrusion which is a large volcanic intrusion consisting of a basin-shaped, geological feature estimated to be several hundred metres in diameter. Several small volcanic breccia pipes are mapped in the area around Erskine Park, Minchinbury and Marsden Park and have been extensively quarried for road and concrete aggregates. These intrusions are often associated with smaller igneous features such as dykes. During investigations for the adjoining Eastern Creek Waste Management Centre an igneous dyke was mapped on the southern boundary trending in a south westerly direction beneath the easement for the water pipeline onto the Austral Brick site.

An extract from the geological map is shown on Drawing 2 in Appendix B.

4. Field Work Methods

The field work for the current investigation included five deep auger bores (BH1 – BH5), five deep cored bores (BH6 – BH10) and five shallow pavement bores (BH11 – BH15). The bores were all drilled using a truck-mounted auger/rotary drilling rig. The locations of the bores are shown on Drawing 1 in Appendix B.

The bores were drilled through soil and extremely weathered rock using solid flight augers. The deep cored bores were then continued using rotary drilling techniques to obtain continuous core samples of the bedrock. Standard penetration tests were carried out within the soils at 1.5 m depth intervals to assess the soil strength and to obtain samples for laboratory testing. In addition, disturbed bulk samples were collected from the shallow pavement bores to enable testing to be undertaken in the laboratory for compaction characteristics and California bearing ratio.

The bores were logged and sampled by an experienced geotechnical engineer. The rock cores recovered from the bores were photographed, followed by point load strength index tests (Is50) on selected samples.

Groundwater monitoring wells were installed in three boreholes (BH7, BH9 and BH10) to allow for measurement of groundwater levels and permeability testing. The wells comprised Class 18 machine slotted PVC with gravel backfill, a bentonite plug below the surface and a steel protective cap installed flush with the existing surface. Groundwater levels were measured in the wells and in the remaining bores where auger methods were employed. Further groundwater level measurements would be possible in the monitoring wells to provide an indication of long-term fluctuations of the groundwater levels, particularly after periods of heavy rainfall.

Rising head permeability tests were carried out within the wells whereby the water within the wells was pumped out and the rate of inflow or recharge was measured.

The locations of the bores were measured using differential GPS equipment which is normally accurate to within ± 1 m in plan location. Ground surface levels were estimated using the GPS equipment and checked against surface levels provided on drawings supplied by the client.

5. Field Work Results

Details of the subsurface conditions encountered are given on the borehole logs in Appendix C, together with colour photographs of the rock core and notes defining classification methods and descriptive terms.

5.1 Bores

The subsurface materials and layer thicknesses recorded in the bores varied across the site due to the presence of large stockpiles and filling placed during previous construction on the site. The results can be divided into three groups, as indicated in Tables 1, 2 and 3, below:

- Table 1: Deep auger bores in the north-western and western sections of the site (BH 1 to BH5) for the proposed office and the proposed crushing and screening plant. The strata comprised variably compacted ripped shale or siltstone filling with some brick inclusions to depths of 2.8-4.2 m, overlying 1-3 m thick layer of stiff to hard natural clays, and then extremely low or very low strength shale to depths of 5.6–6.0 m where the bores were discontinued;
- Table 2: Deep cored bores in the south-eastern section of the site (BH6 to BH10) for the proposed Kiln Pad No. 1. Some of these bores were drilled from the top of a large spoil heap and intersected 5.7–8.2 m of variably compacted filling over 1-3 m thick layer of residual clay and some extremely low to very low strength shale/siltstone then low to medium strength shale/siltstone; and
- Table 3: Shallow pavement bores along the proposed access roads (BH 11 to BH 15) across the site. These bores all intersected clay and crushed shale filling to the maximum drilled depths of 2.0 m.

The strata intersected by the bores is summarised in the following tables.

Table 1: Summary of Deep Auger Bores in north-western and western sections

| | Depths to Strata Boundaries (m) (Levels in brackets) | | | | |
|---|---|---------------|---------------|---------------|---------------|
| Strata Description | BH1 | BH2 | BH3 | BH4 | BH5 |
| FILLING – Ripped shale clay and crushed bricks | 0.0 (57.9) | 0.0 (60.2) | 0.0 (61.6) | 0.0 (61.7) | 0.0 (60.7) |
| ----- SILTY CLAY – Stiff to very stiff silty clay, shaly clay and extremely low strength shale | 3.2 (54.7) | 2.8 (57.4) | 3.5 (58.1) | 4.2 (57.5) | 2.0 BD |
| ----- SHALE – Very low to low strength shale | 5.7 (52.2) | 5.3 (54.7) | 5.1 (56.5) | 5.0 (56.7) | |
| | 6.0 BD | 5.7 BD | 5.7 BD | 5.6 BD | |

Note: BD: Bore discontinued

NE: Not encountered

Table 2: Summary of Cored Test Bores in south-eastern section

| | Depths to Strata Boundaries (m) (Levels in brackets) | | | | |
|--|---|----------------|----------------|---------------|---------------|
| Strata Description | BH6 | BH7 | BH8 | BH9 | BH10 |
| FILLING – Ripped shale, clay and crushed bricks | 0.0 (65.8) | 0.0 (71.4) | 0.0 (71.3) | 0.0 (69.6) | 0.0 (67.1) |
| ----- SILTY CLAY – Stiff to hard silty clay and shaly clay | 2.2 (63.2) | 8.2 (63.2) | 8.0 (63.6) | 5.7 (63.3) | 2.6 (64.5) |
| ----- SHALE/SILTSTONE – Variably weathered, extremely low and very low strength with bands of low and medium strength | 3.8 (62.0) | 9.3 (62.1) | 11.1 (60.2) | 6.8 (62.8) | NE |
| ----- SHALE/SILTSTONE – Consistently medium strength | 6.9 (58.9) | 12.5 (58.9) | 11.5 (59.8) | 9.3 (60.3) | 5.8 (61.3) |
| | 7.4 BD | 13.0 BD | 13.0 BD | 10.3 BD | 0.4 BD |

Note: BD: Bore discontinued

NE: Not encountered

An interpreted section through some of these bores is shown on Drawing 3 in Appendix B.

Table 3: Summary of Pavement Bores along proposed access roads

| | Depths to Strata Boundaries (m) | | | | |
|--|--|-------------|-------------|-------------|-------------|
| Strata Description | BH11 | BH12 | BH13 | BH14 | BH15 |
| FILLING – Red and grey shaly clay or silty sandy clay with some crushed shale gravel | | | | | |
| | 1.5 BD | 2.0 BD | 1.5 BD | 1.5 BD | 1.5 BD |

Note: BD: Bore discontinued

5.2 Groundwater and Depths

The results of groundwater measurements within the monitoring wells installed in BH7, BH9 and BH10 and observations made in two of the auger bores during drilling are shown in Table 4, below.

Table 4: Measured Groundwater Depths

| | | Depth to Groundwater (m) (Levels in brackets) | | | | |
|---------|-----------------|--|---------------|-----------------|----------------|----------------|
| Date | Time | BH1 | BH4 | BH7 | BH9 | BH10 |
| 26/5/15 | During drilling | 3.9 (54.0) | 3.8 (57.9) | | | |
| 12/6/15 | 2:27pm | | | 12.08 (59.3) | | |
| 12/6/15 | 2:15pm | | | | 9.57 (60.0) | |
| 12/6/15 | 12:50pm | | | | | 6.8 (60.3) |
| 15/6/15 | 9:57am | | | 11.80 (59.6) | | |
| 15/6/15 | 10:00am | | | | 9.50 (60.1) | |
| 15/6/15 | 10:05am | | | | | 6.55 (60.6) |

In BH1 and BH4 the water levels were recorded during drilling and it is considered that this water is probably seepage stored within the filling, referred to as perched water. In the three bores where monitoring wells had been installed, the wells were purged of water and then data loggers installed to measure recovery. In each case the overall recovery was less than 0.3 m over more than 3 days so there was insufficient drawdown and recovery for meaningful analysis of strata permeability.

6. Laboratory Testing

The results of the laboratory testing on selected soil samples are given on the detailed results sheets in Appendix D. The results of the Point Load Strength testing on the rock cores are given on the detailed borehole logs.

Typical samples from the bores were submitted for testing for Atterberg Limits and linear shrinkage, compaction properties, California Bearing Ratio, natural moisture content and Emerson dispersion tests. The results are summarised in Tables 5, 6 and 7 below.

Table 5: Results of Atterberg Limits, Linear Shrinkage and Emerson Class tests

| Bore No. | Depth (m) | Strata Description | w (%) | w _L (%) | w _p (%) | PI (%) | LS (%) | Emerson Class |
|----------|-----------|--|-------|--------------------|--------------------|--------|--------|---------------|
| BH7 | 7.0-7.45 | FILLING – grey silty clay & crushed shale | 14.9 | 39 | 20 | 19 | 10 | 2 |
| BH8 | 4.0-4.45 | FILLING – light grey clay and crushed shale | 12.6 | 38 | 18 | 20 | 12.5 | 2 |
| BH9 | 5.5-5.95 | FILLING and CLAY – light grey mottled brown silty clay | 22.4 | 65 | 22 | 43 | 18 | 2 |
| BH10 | 2.5-2.8 | SILTSTONE – light grey-brown siltstone | 12.9 | 49 | 19 | 30 | 14.5 | 2 |

Note: w = Natural moisture content w_L = Liquid limit w_p = Plastic limit PI = Plasticity index
 LS = Linear shrinkage

The results indicate that the soils and weathered rock on the site contains moderate to high plasticity clays with liquid limits ranging from about 40% to 65%. The clayey soils would therefore have a moderate to high potential for shrinking and swelling with varying moisture contents.

The results of the Emerson Class tests indicated a consistent Class 2, which means the clayey soils have a moderate potential for dispersion and hence could be susceptible to erosion or dispersion if used in a location which is permanently saturated.

Table 6: Results of Compaction and CBR tests

| Bore No. | Depth (m) | Strata Description | w (%) | MDD (t/m ³) | OMC (%) | CBR (%) |
|----------|-----------|--|-------|-------------------------|---------|---------|
| BH11 | 0.0-0.5 | FILLING – orange brown sandy clay with some gravel | 6.3 | 2.02 | 8.7 | 25 |
| BH12 | 0.0-0.5 | FILLING – grey shaly and silty clay | 8.1 | 1.97 | 11.5 | 4.0 |
| BH12 | 1.5-2.0 | FILLING – grey shaly silty clay | 11.2 | 1.93 | 12.1 | 4.5 |
| BH13 | 0.5-1.0 | FILLING – yellow brown clay with some gravel | 5.6 | 1.99 | 11.1 | 9.0 |
| BH14 | 0.5-1.0 | FILLING – dark grey shaly clay | 11.4 | 2.01 | 11.1 | 5.0 |
| BH15 | 0.5-1.0 | FILLING – grey silty clay and crushed shale | 9.8 | 2.01 | 10.8 | 9.0 |

Note: w = Natural moisture content MDD = Maximum dry density OMC = Optimum moisture content
 CBR = California bearing ratio

The testing indicates that the filling material on site generally has a low CBR with the exception of one sample from BH11 which provided a higher CBR result of 25%, probably due to the gravel included in the sample tested. as opposed to an expected CBR of 4-6%.

Table 7: Results of Laboratory Testing

| Bore No. | Depth (m) | Strata Description | w (%) |
|----------|-----------|---|-------|
| BH1 | 1.0 | FILLING – Grey and light grey-brown silty clay & crushed shale | 6.2 |
| BH2 | 1.0 | FILLING – Light grey-brown silty sand, crushed sandstone, shale & brick fragments | 15.2 |
| BH3 | 1.0 | FILLING – Grey brown and red brown silty sandy clay with some crushed shale & brick fragments | 9.3 |
| BH4 | 1.0 | FILLING – Grey crushed shale | 6.4 |
| BH7 | 2.5 | FILLING – Grey silty clay with crushed shale & brick fragments | 10.8 |
| BH7 | 4.0 | FILLING – Grey silty clay with crushed shale & brick fragments | 17.3 |
| BH8 | 1.0 | FILLING - Grey silty clay and crushed shale with some brick fragments | 13.8 |
| BH8 | 5.5 | FILLING - Light grey crushed shale & brick gravel | 17.6 |
| BH9 | 4.0 | FILLING –Light brown silty sandy clay with some crushed shale fragments | 21.6 |
| BH9 | 7.0 | FILLING –Light brown silty sandy clay with some crushed shale fragments | 17.9 |
| BH10 | 1.0 | FILLING – Grey and brown silty clay and crushed shale with some brick fragments | 6.8 |

Note: w = Natural moisture content

Selected samples of the rock core were tested in the laboratory to determine the Point Load Strength Index (Is_{50}) values to assist with the rock strength classification. The results of the testing are shown on the detailed borehole logs at the appropriate depths. The Is_{50} values for the rock typically ranged from 0.2 MPa to 0.7 MPa, with an average of 0.45 MPa, indicating that the rock samples tested range from low strength to medium strength.

7. Proposed Development

It is understood that the proposed Lightweight Aggregate project involves the construction of a large kiln and conveyors within the Plant 2 area of the Austral Bricks site. The proposed development will include new plant buildings, associated amenities, access roads and services. The bores were located at the client's request to target the following features:

- BH1 Office building
- BH2-3 Crusher/Screening building
- BH4 Underground conveyor system requiring up to 5m excavation below existing
- BH5-10 Kiln pad area requiring excavation of existing bund/stockpile of up to 10 m
- BH11-15 Future access roads

The kiln structures will have chimney stacks up to 25-30 m high and are expected to have relatively high foundation loads. For this reason it is unlikely that shallow footings founded in either existing or reworked filling would be adequate for these structures.

The development will include the construction of an access road across an existing stormwater detention basin. This would require the basin to be dewatered and any sludge or softened material to be removed below the embankment footprint. Once a firm base has been prepared in this area, earthworks can be carried out using conventional techniques.

The preliminary plans indicate that the level of the proposed kiln pad in the south-eastern section of the site will be at about RL 61.0 m which will require removal of about 5-10 m of an existing stockpile before excavating into the natural soils and weathered rock.

The following sections provide engineering advice and design parameters for the various elements of the proposed construction.

8. Engineering Advice

8.1 Excavation

Excavation to depths of up to 10 m, mainly removing an existing stockpile or bund, will be required to construct Kiln Pad No. 1 to a finished level of RL 61 m AHD. It is expected that most of the excavation will be through filling comprising clay, ripped shale and brick fragments. As indicated in Table 2 the approximate levels of the strata in this area are:

- Filling down to RL 63-64 m; over
- Clay down to RL 62-63 m; over
- Variably weathered shale; with
- Medium strength shale below RL 59-61 m.

The excavation through the filling and the stiff to hard natural clays below the filling should be readily carried out using conventional earthmoving equipment. The variably weathered shale bedrock which includes bands of very low, low and medium strength rock should be rippable with a medium sized bulldozer. If excavation is required into the underlying consistent medium strength shale or siltstone, which is expected below about RL 59-61 m, then this will require heavy ripping or possibly some assistance with rock breaking equipment.

Drawing 3 in Appendix C provides an indication of the possible strata levels on a cross-section through this section of the site.

Excavation of up to 5 m is also required for the proposed underground conveyor system which is to be located in the area adjacent to bore BH4. This bore intersected filling (crushed shale and ripped sandstone) to a depth of 4.2 m, then stiff silty clay to 5.0 m and then very low to low strength shale. It is expected that this material should be readily excavated using conventional equipment, although there could be local higher knobs of harder shale along the line of the conveyor which may require the use of rock hammers.

8.2 Material Re-use

The material excavated from the area of the kiln pads and from the underground conveyor line will be predominantly clay and crushed shale filling. It is considered that this material would be suitable for re-use in engineered filling provided precautions are taken to ensure that the material is adequately compacted and that fill embankments are not allowed to dry once the earthworks is completed.

The materials have a relatively high shrink/swell potential and allowing them to dry out significantly below the optimum moisture content or the equilibrium moisture content for clays will mean that the clays will shrink and then when they become covered by either foundations or buildings, they will have a tendency to swell significantly. Measurement of the swell potential in buildings in the Eastern Creek area recently showed floor slabs in major warehouses had moved upwards by as much as 65 mm due to swelling of clay which had dried out.

The best ways to reduce the risk of shrinkage and swelling movements are to either replace the clay with low plasticity material or to cover the completed earthworks with a granular material to limit evaporation of the moisture from within the compacted clay.

8.3 Embankment over Dam

In order to construct a new road embankment over the existing dam area, it will be necessary to dewater the dam and remove any sludge or softened soils prior to carrying out earthworks in a conventional manner.

Where filling is required to be placed over existing cut slopes then these slopes should be trimmed to form a series of small horizontal steps so that the new filling can be placed and compacted in horizontal layers and keyed into the slope.

The filling should be placed in layers not exceeding 300 mm loose thickness and compacted to a density within 98%-102% of the standard maximum dry density and at a moisture content within 2% of the optimum moisture content. For reasons outlined above, the moisture content should then be maintained within the embankment filling until road pavements are constructed on the embankment or the fills are covered by industrial buildings.

Further comments on embankment slopes are given in Section 8.5.

8.4 Site Preparation and Earthworks

It is suggested that site preparation and placement of engineered fills should incorporate the following:

- Strip to design subgrade level and remove any sludge or softened soils from areas to be constructed over the existing dam;
- Scarify and moisture condition the exposed surface. Where a considerable depth of old filling is located immediately below the subgrade level, further testing should be carried out within the filling to verify whether it is properly compacted before earthworks commence. If the filling is

poorly compacted, it should be excavated down to natural soils and replaced in layers and compacted to form a platform which can provide adequate support for engineering structures;

- Compact the conditioned surface with at least six passes of a minimum 10 tonne dead weight roller. The final pass of the subgrade should be inspected by a geotechnical engineer to detect any soft, wet or highly compressible areas that require further treatment. Any unsatisfactory areas detected during the proof rolling would need to be rectified which would generally include stripping to a stiff base and replacement with engineering fill;
- Place engineering filling in layers of 300 mm maximum loose thickness and compact to a minimum dry density ratio of 98-102% of the standard maximum dry density. The filling should be maintained within 2% of the standard optimum moisture content and, as indicated above, should be protected to prevent drying out after earthworks are completed; and
- Carry out density testing of each layer of compacted filling in accordance with Level 1 standard as defined in Australian Standard AS3798:2007 *Guidelines for Earthworks for Commercial and Residential Developments* to verify that the specified density ratio have been achieved.

Due to the clayey composition of the existing filling on site, some problems may be experienced with trafficability during wet weather, particularly in low-lying areas. For general construction machinery, it is suggested that tracked vehicles should be used where possible in order to avoid such problems.

8.5 Engineering Slopes

8.5.1 Cut Slopes

Where space permits unsupported slopes to be used, the following maximum temporary and permanent batter slopes are recommended for excavations.

Table 8: Maximum Recommended Cut Batter Slopes

| Material | Maximum Temporary Slope | Maximum Permanent Slope |
|-------------------------------------|--------------------------------|--------------------------------|
| Existing variably compacted filling | 1.5H : 1V | 3H : 1V |
| Stiff to hard residual clays | 1.5H : 1V | 2H : 1V |
| Variably weathered shale | 1H : 1V | 1.5H : 1V |
| Consistent medium strength shale | 1H : 1V | 1H : 1V |

Notes: H = horizontal, V = vertical

These recommended maximum slopes are for excavations less than 3 m deep and where there are no surcharges from stockpiled materials, adjacent buildings, vehicles or other loads to a setback distance of at least the excavation depths behind the crest of the excavation. For permanent slopes protection against surface erosion either in the form of vegetation or shotcrete cover is recommended.

For deeper unsupported excavations then additional stability analysis should be undertaken to assess the stability of the proposed cut batters. In general terms, however, either the slopes would need to be flattened or a horizontal bench (berm) should be included in the cut slope which would result in a

flatter overall slope. The horizontal bench should typically be at least 2 m wide to allow for access during slope maintenance.

Where the recommended batter slopes are not feasible the excavation will require both temporary and permanent lateral support during excavation or as part of the final structure. This support may be provided by retaining walls. Earth pressures acting on these walls may be calculated using the parameters given in Table 9 below.

Table 9: Design Parameters for Excavation Support Structures

| Material | Bulk Unit Weight (kN/m³) | Coefficient of Active Earth Pressure (K_a) | Coefficient of Passive Earth Pressure (K_p) | Coefficient of Earth Pressure at Rest (K_o) |
|-------------------------------------|--|---|--|--|
| Existing variably compacted filling | 20 | 0.4 | 2.5 | 0.6 |
| Stiff to hard residual clays | 20 | 0.3 | 3.3 | 0.45 |
| Variably weathered shale | 22 | 0.2 | 4.0 | 0.3 |
| Consistent medium strength shale | 22 | 0.1 | 5.0 | 0.2 |

Additional pressure should be allowed for where the ground surface behind the wall is sloping upwards from the rear of the wall, or where surcharging occurs from stockpiled materials, vehicular traffic or other loads. Provided positive drainage measures can be incorporated to prevent water pressure build up behind the retaining walls, water pressure need not be included in the design.

The drilling indicates that the weathered shale and siltstone contains many joints, dipping at 30-60 degrees below the horizontal. These joints could form unstable wedges if unsupported and they may result in pressures in excess of those calculated using earth pressure coefficients as indicated in Table 9. For this reason it is suggested that retaining walls be checked to ensure that they can also support a rock wedge formed by a joint dipping at 45 degrees below horizontal intersecting the cut face near the base of the excavation. For this load case it is suggested that a lower factor of safety can be adopted as the probability of such wedges running continuously over a significant length of a retaining wall or are oriented directly into the excavation is relatively low. There have, however, been some significant slope failures on nearby sites where excavations have been cut at slopes steeper than 45 degrees (1H:1V).

8.5.2 Fill Slopes

For new compacted filling embankments less than 5 m high, the recommended maximum permanent slope is 2H:1V, provided the surface of these slopes are protected against erosion. Consideration should be given to using flatter slopes to allow for establishment of vegetation and long term maintenance of the slopes.

Higher fill slopes should include horizontal benches generally at not more than 5 m vertical spacing. These horizontal benches should typically be not less than 2 m wide to allow for access, and are required to control down slope surface water flows and to catch any minor slippages or surface erosion.

Where new fill embankments are required around the edge of the existing dam or other new ponds the fill embankment will be subjected to permanent saturation, possible drawdown as the water levels rise and fall, and possible erosion due to wind generated waves. For these reasons it is suggested that generally the fill slopes below the water should be constructed at a maximum slope of 3H:1V and protected against erosion and drawdown by a 0.6 m thick rock protection layer or a concrete filled geofabric mattress. Further analysis is recommended when the total height of the dam embankments and the water storage depth are better defined.

8.6 Foundations

For design of foundations for the proposed new structures the following general recommendations are provided.

Table 10: Recommended Foundation Design Parameters

| Material | Ultimate | | Allowable (Serviceability) | |
|-------------------------------------|-------------------|----------------------|----------------------------|----------------------|
| | End bearing (kPa) | Shaft Adhesion (kPa) | End bearing (kPa) | Shaft Adhesion (kPa) |
| Existing variably compacted filling | NA | NA | NA | NA |
| New controlled compacted filling | 400 | 20 | 150 | 15 |
| Stiff to hard residual clays | 500 | 30 | 200 | 20 |
| Variably weathered shale | 3000 | 150 | 1000 | 100 |
| Consistent medium strength shale | 30,000 | 600 | 3,500 | 350 |

Notes: NA = not applicable – do not found structures on this material

For the proposed kiln structures (BH5-10), reference to Table 2 and the detailed borehole logs indicates that at the proposed pad level of RL 61 m the exposed materials are likely to be the variably weathered shale profile, with consistently medium strength shale expected to be within 0-2 m below the proposed pad level. For the relatively high loads of the kiln structures it is recommended that all the footings be founded on the medium strength shale layer to ensure that differential settlement between footings is minimised. These footings could comprise shallow pad or strip footings where the medium strength rock is at or close to the pad level, or short bored piles where the depth to rock is greater. Footings designed using the allowable bearing pressures given in Table 10 would be expected to have total settlements of less than 1% of the minimum footing width or pile diameter. Differential settlements between adjacent footings are expected to be less than 0.5% of the minimum footing width.

For the proposed office building (BH1) the subsurface conditions comprised 3.2 m of variably compacted filling, then stiff silty clay down to 5.7 m, and then extremely low strength shale. It is not recommended that the office building be founded on the existing variably compacted filling, therefore the options are either to remove and replace the existing filling with controlled compacted filling, or to use bored piles taken down to at least the top of the variably weathered shale of at least extremely low strength.

Whilst drilling BH1, water was encountered at a depth of 3.9 m below existing surface level. Provision should therefore be made to either use temporary casing to support the bores until the reinforcement cage is inserted and the concrete poured to surface level. In addition to using temporary casing, it may also be necessary to either pump the bores immediately before pouring the concrete to remove any seepage water or to use tremie techniques to pour the concrete below water. If there are any delays between the end of drilling and pouring of the concrete then softening of the clays at the base of the pile will occur and therefore it may be necessary to either redrill the bores to remove any softened material or to downgrade the working bearing pressures to allow for potential additional settlement.

For the proposed crusher and screening building (BH2-3), the subsurface conditions comprised variably compacted filling to depths of 2.8-3.5 m, over stiff to very stiff silty clay, with variably weathered shale below depths of 5.1-5.5 m. Again it is not recommended that the new buildings be founded on the existing variably compacted filling. The options are to remove and replace the existing filling with new controlled filling, or to use piles taken down into the stiff residual clays and variably weathered shale. Depending on the structural loads it may be more economical to design the piles to be taken down onto the medium strength shale so that higher bearing pressures can be used, but if this is the case then additional cored boreholes would be required to confirm the depth and quality of the bedrock.

For the proposed underground conveyor system (BH4) it is understood that excavation of up to 5 m will be required. At this depth BH4 intersected very low to low strength shale (below 4.2 m of filling and stiff silty clay) which suggests that the conveyor system may be supported on pad or strip footings founded on the variably weathered shale layer. Seepage was noted at a depth of 3.8 m when drilling this bore. This seepage is expected to be from a perched water table within the filling, but it could cause wet conditions at the base of the proposed excavation and local dewatering in the form of sumps and pumps may be required.

The bores drilled for the future access roads (BH11-15) all intersected variably compacted filling to depths in excess of 2 m. Prior to constructing the new pavements it is recommended that the upper 0.5 m of existing filling below the proposed subgrade level be removed and replaced in compacted layers in order to provide a uniform platform for support of the new pavements. During this process, when the 0.5 m upper layer has been removed and before the new filling is placed, it is recommended that the exposed subgrade is rolled with at least six passes of a minimum 10 tonne dead weight roller. The final pass of the roller should be inspected by a geotechnical engineer to detect any soft, wet or highly compressible areas that require further treatment. Any unsatisfactory areas detected during the proof rolling would need to be rectified which would generally include removing the soft material and replacing with compacted filling.

8.7 Pavement Design

Laboratory testing for CBR and compaction was carried out on six bulk samples recovered from the subgrade soils along the general alignment of the proposed access roads. The samples were all from within the filling which includes clays and crushed shale with some brick fragments. The CBR values ranged from 4% to 25% with the higher values being attributed to the presence of gravel or crushed brick within the predominantly clay filling. It is suggested that a CBR value of 9% is probably not achievable at all locations and therefore a design CBR of 4.5% is suggested for pavements

constructed on the existing filling or natural silty clay. An elastic modulus value of 45 MPa may be adopted for the sub-grade for pavement design.

8.8 Disposal of Excavated Material

Any excavated materials requiring off site disposal will need to be handled in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). This includes filling and natural materials that may be removed from the site. Accordingly, environmental testing will need to be carried out to classify any spoil prior to transport from the site.

8.9 Design for Earthquake Loading

In accordance with AS1170-2007 “*Structural Design Actions, Part 4: Earthquake Actions in Australia*” a hazard factor (Z) of 0.08 and a site subsoil Class C_e is considered to be appropriate for the site.

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at Wallgrove Road, Horsley Park in accordance with DP's proposal dated 15 April 2015 and acceptance received on 24 April 2015. This report is provided for the exclusive use of Brickworks Ltd for this project only and for the purposes as described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

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

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners



Introduction

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

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

Copyright

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

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

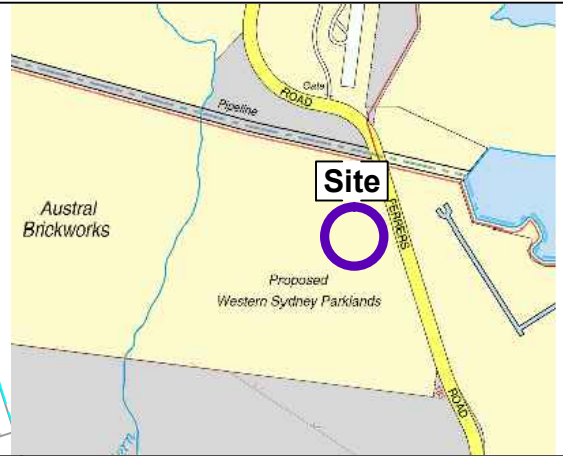
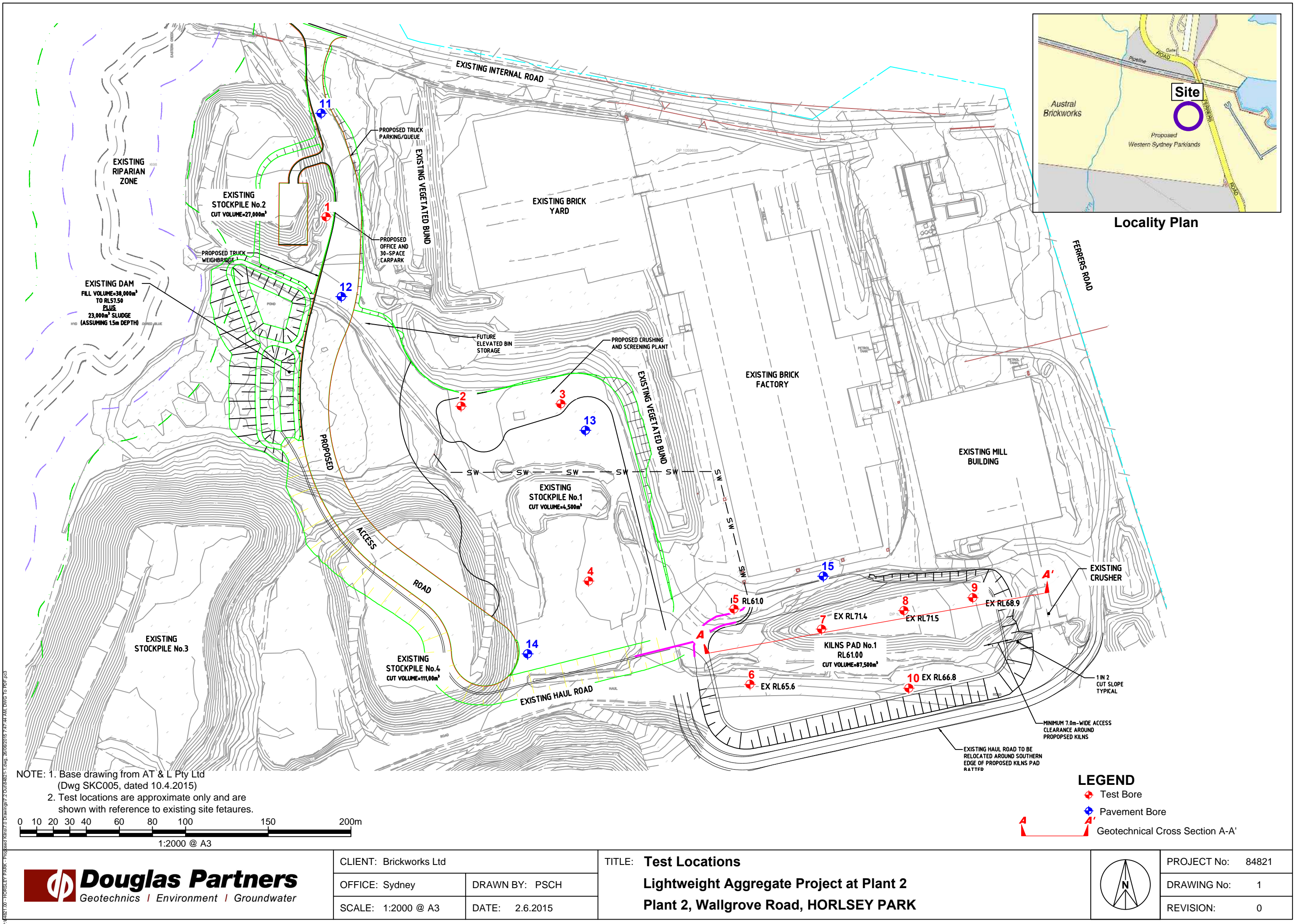
The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawing 1 – Test :Locations

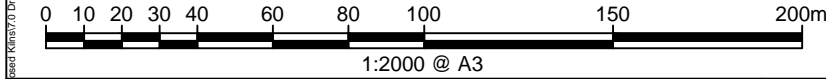
Drawing 2 – Extract from Geological Map

Drawing 3 –Cross-Section A-A'



Locality Plan

NOTE: 1. Base drawing from AT & L Pty Ltd (Dwg SKC005, dated 10.4.2015)
2. Test locations are approximate only and are shown with reference to existing site features.



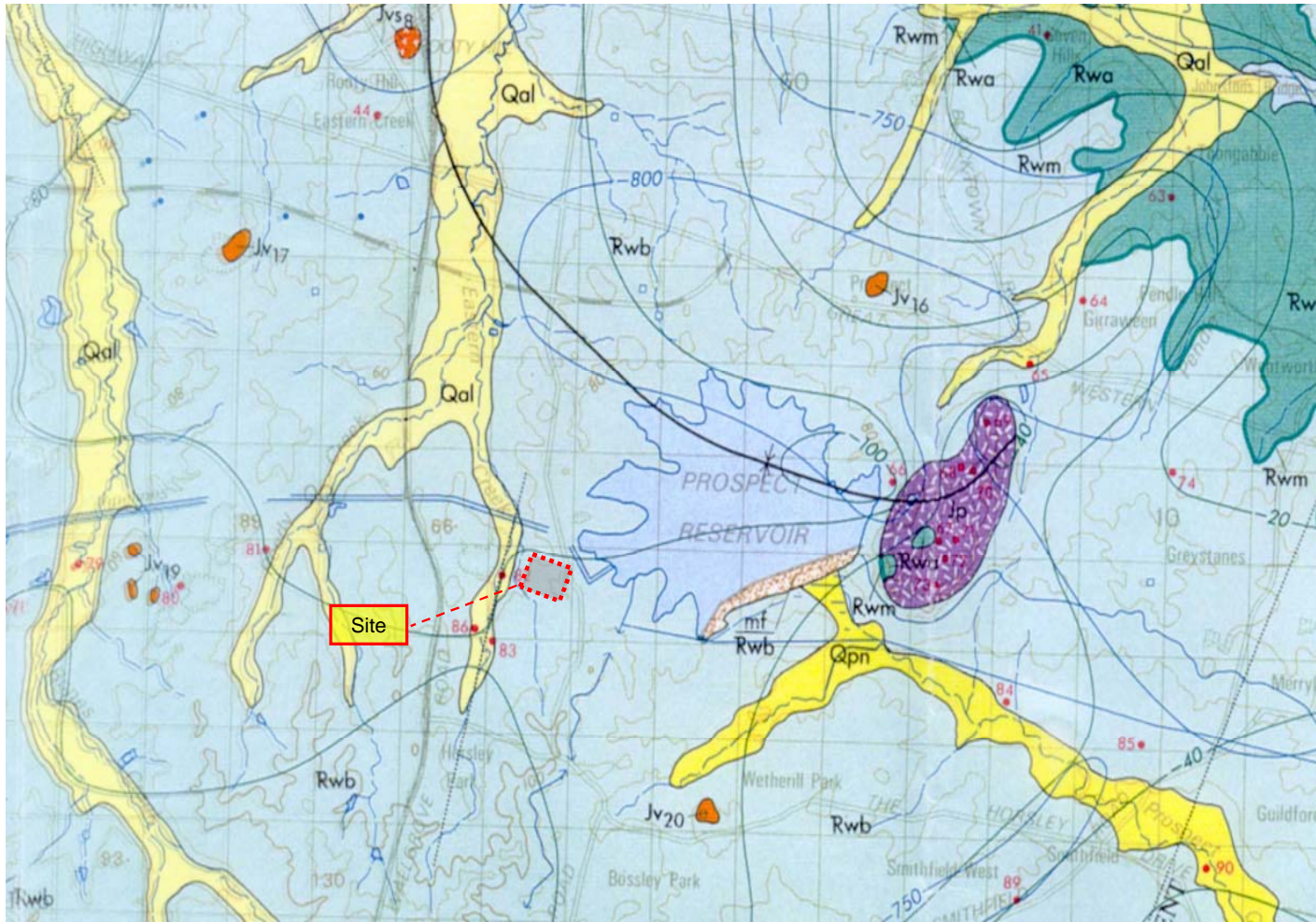
LEGEND

- Test Bore
- Pavement Bore
- Geotechnical Cross Section A-A'

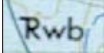



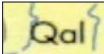



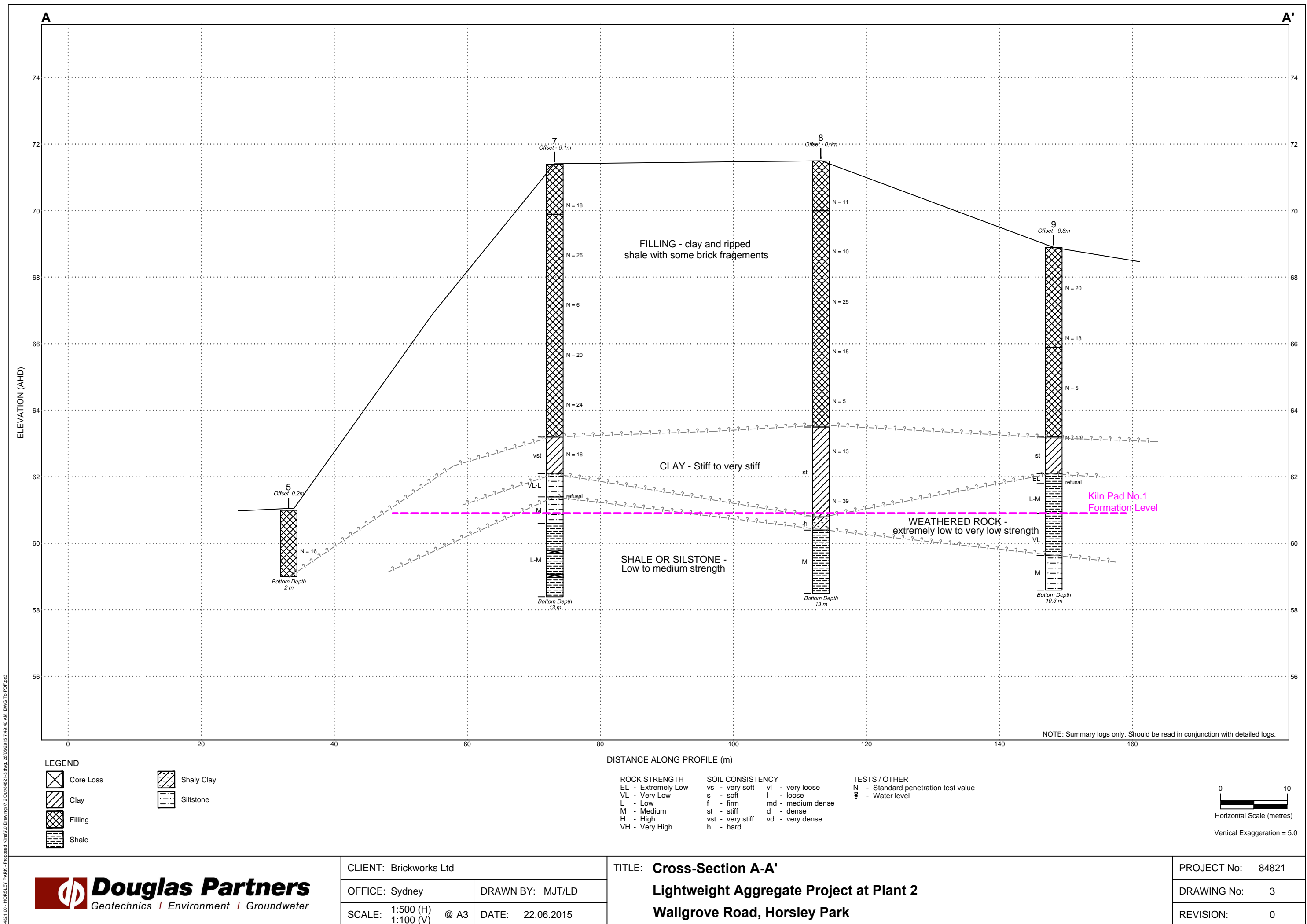
| | | | | |
|------------------------|----------------|---|-------------------|--|
| CLIENT: Brickworks Ltd | | TITLE: Test Locations Lightweight Aggregate Project at Plant 2 Plant 2, Wallgrove Road, HORLSEY PARK | PROJECT No: 84821 | |
| OFFICE: Sydney | DRAWN BY: PSCH | | DRAWING No: 1 | |
| SCALE: 1:2000 @ A3 | DATE: 2.6.2015 | | REVISION: 0 | |





LEGEND

-  Bringelly Shale
-  Ashfield Shale
-  Prospect Picrite intrusion
-  Quaternary Alluvium
-  Quaternary Alluvium
-  Volcanic Diatremes



P:\84821_00 - HORSLEY PARK - Proposed Kiln\7.0 Drawings\7.2 Out\84821-3.dwg, 26/06/2015 7:49:40 AM, DWG to PDF.pd3

Appendix C



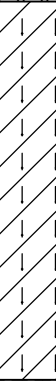

Field Work Results

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 57.9 AHD
EASTING: 302548
NORTHING: 6255229
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 84821
DATE: 26/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Well Construction Details | |
|--|-----------|---|---|----------------------------|-------|-----------------|--------------------|---|---------------------------|--|
| | | | | Type | Depth | Sample | Results & Comments | | | |
| 57 56 55 54 53 52 51 50 49 48 | 1 | FILLING - variably compacted, grey and light grey-brown, silty clay and crushed shale filling, damp |  | A | 0.1 | | 12,20,23 N = 43 |  | | |
| | A | | | 0.5 | | | | | | |
| | A | | | 1.0 | | | | | | |
| | S | | | 1.45 | | | | | | |
| | | | | | | | | | | |
| | 2 | SILTY CLAY - stiff, light grey mottled brown, silty clay, moist to wet |  | | 2.5 | | 3,3,4 N = 7 | | | |
| | S | | | 2.95 | | | | | | |
| | | | | | | | | | | |
| | | | | 4.0 | | 5,6,9 N = 15 | | | | |
| | | | | 4.45 | | | | | | |
| | 3 | SHALE - extremely low strength, light grey to grey-brown shale |  | | 5.5 | | 8,10,20 N = 30 | | | |
| | S | | | 5.95 | | | | | | |
| | | | | | | | | | | |
| | 5.95 | Bore discontinued at 5.95m | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

RIG: Scout 4

DRILLER: RKE

LOGGED: SI

CASING: Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

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

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 60.2 AHD
EASTING: 302629
NORTHING: 6255115
DIP/AZIMUTH: 90°/-

BORE No: 2
PROJECT No: 84821
DATE: 26/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Well Construction Details | |
|------|-----------|--|-------------|----------------------------|-------|--------|--------------------|-------|---------------------------|--|
| | | | | Type | Depth | Sample | Results & Comments | | | |
| 60.0 | | FILLING - variably compacted, light grey-brown, silty sand, crushed sandstone, shale and brick fragments filling, damp | | A | 0.1 | | | | | |
| | | | | A | 0.5 | | | | | |
| 1 | | | | A | 1.0 | | | | | |
| 59.0 | | | | S | 1.45 | | 8,6,6 N = 12 | | | |
| 2 | | 2.5m: becoming moist | | | 2.5 | | | | | |
| 2.8 | | | | S | 2.95 | | 5,6,8 N = 14 | | | |
| 3 | | SILTY CLAY - very stiff, light grey and mottled brown, silty clay with a trace of fine sand, wet | | | | | | | | |
| 4 | | | | S | 4.0 | | | | | |
| 5 | | 5.0m: becoming shaly clay | | | 4.45 | | 5,8,12 N = 20 | | | |
| 5.5 | | | | S | 5.5 | | | | | |
| 5.7 | | SHALE - low strength, light grey-brown shale | | S | 5.7 | | 10,20/50mm refusal | | | |
| | | Bore discontinued at 5.7m | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |

RIG: Scout 4

DRILLER: RKE

LOGGED: SI

CASING: Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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



Douglas Partners
 Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 61.6 AHD
EASTING: 302690
NORTHING: 6255116
DIP/AZIMUTH: 90°/-

BORE No: 3
PROJECT No: 84821
DATE: 26/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Well Construction Details | |
|--|-----------|---|-------------|----------------------------|-------|--------|--------------------|-------|---------------------------|--|
| | | | | Type | Depth | Sample | Results & Comments | | | |
| 61 1 1.3 2 3 3.5 4 5 5.1 5.65 6 7 8 9 | | FILLING - grey-brown and red-brown, silty sand and crushed brick fragment filling, damp | | A | 0.1 | | | | | |
| | | | | A | 0.5 | | | | | |
| | | | | A | 1.0 | | | | | |
| | | | | S | 1.45 | | 12,14,14 N = 28 | | | |
| | | FILLING - variably compacted, light grey-brown, sandy silty clay filling with some shale and brick fragments, moist | | | | | | | | |
| | | | | | | | | | | |
| | | | | S | 2.5 | | 2,3,8 N = 11 | | | |
| | | | | | 2.95 | | | | | |
| | | SILTY CLAY - stiff, light grey mottled brown, silty clay with a trace of ironstone gravel, moist | | | | | | | | |
| | | | | S | 4.0 | | 3,5,5 N = 10 | | | |
| | | | | | 4.45 | | | | | |
| | | SHALE - very low then low strength, light grey-brown shale | | | | | | | | |
| | | | | S | 5.5 | | 30/150mm refusal | | | |
| | 5.65 | Bore discontinued at 5.65m | | | 5.65 | | | | | |
| | 6 | | | | | | | | | |
| | 7 | | | | | | | | | |
| | 8 | | | | | | | | | |
| | 9 | | | | | | | | | |

RIG: Scout 4

DRILLER: RKE

LOGGED: SI

CASING: Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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








Douglas Partners
 Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 61.7 AHD
EASTING: 302707
NORTHING: 6255009
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 84821
DATE: 27/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | Water | Well Construction Details | |
|----|--------------|---|---|----------------------------|-------|--------|--------------------|---------------------------------|--|
| | | | | Type | Depth | Sample | | | |
| 61 | 1 | FILLING - variably compacted, grey, crushed shale filling, damp |  | A | 0.1 | | 6,7,9 N = 16 | | |
| | | | | A | 0.5 | | | | |
| | | | | A | 1.0 | | | | |
| | | | | S | 1.45 | | | | |
| 60 | 2 | | | | 2.5 | | | | |
| 59 | 2.6 | FILLING - light grey-brown, crushed/rippled sandstone filling, damp |  | S | 2.95 | | 3,23,20 N = 43 | | |
| 58 | 3 | FILLING - apparently poorly compacted, light grey-brown, clay and crushed shale fragments filling, moist to wet |  | | | | | | |
| | 4 | 3.8m: becoming wet | | | 4.0 | | | | |
| 57 | 4.2 | SILTY CLAY - stiff, brown, silty clay, wet |  | S | 4.45 | | 3,4,6 N = 10 | | |
| 56 | 5 | SHALE - very low then low strength, light grey to grey shale |  | | | | | | |
| 55 | 5.55 | Bore discontinued at 5.55m | | S | 5.55 | | 30/50mm refusal | | |
| 54 | 6 | | | | | | | | |
| 53 | 7 | | | | | | | | |
| 52 | 8 | | | | | | | | |
| 51 | 9 | | | | | | | | |

RIG: Scout 4

DRILLER: RKE

LOGGED: SI

CASING: Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 3.8m whilst augering

REMARKS:

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




Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 60.7 AHD
EASTING: 302794
NORTHING: 6254992
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 84821
DATE: 27/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Well Construction Details | |
|--|--------------|---|---|----------------------------|-------|--------|-----------------------|-------|---------------------------------|--|
| | | | | Type | Depth | Sample | Results & Comments | | | |
| 60 1 59 | 2.0 | FILLING - variably compacted, light grey and grey, silty clay and crushed shale filling, damp |  | A | 0.1 | | 8,7,9 N = 16 | | | |
| | | A | | 0.5 | | | | | | |
| | | A | | 1.0 | | | | | | |
| | | S | | 1.45 | | | | | | |
| | | | | | | | | | | |
| 58 2 57 3 56 4 55 5 54 6 53 7 52 8 51 9 | | Bore discontinued at 2.0m | | A | 2.0 | | | | | |

RIG: Scout 1

DRILLER: RKE

LOGGED: SI

CASING: Uncased

TYPE OF BORING: Solid flight auger to 2.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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



Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 65.8 AHD
EASTING: 302804
NORTHING: 6254946
DIP/AZIMUTH: 90°/-

BORE No: 6
PROJECT No: 84821
DATE: 27/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Degree of Weathering EW HW MW SW FS FR | Graphic Log | Rock Strength Ex Low Very Low Low Medium High Very High Ex High | Water | Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00 | Discontinuities B - Bedding J - Joint S - Shear F - Fault | | Sampling & In Situ Testing | | | |
|------|-----------|---|---|-------------|--|-------|--|---|--|----------------------------|-------------|-------|---|
| | | | | | | | | | | Type | Core Rec. % | RQD % | Test Results & Comments |
| 65.0 | 1 | FILLING - variably compacted, light grey and brown, crushed shale, sandstone and brick fragments filling, humid | | | | | | | | A | | | 30/150mm refusal |
| 64.5 | | | | | | | | | | A | | | |
| 64.0 | | | | | | | | | | A | | | |
| 63.5 | 2.2 | SILTY CLAY - very stiff to hard, light grey and mottled red-brown, silty clay with some ironstone gravel, most | | | | | | | | S | | | 10,14,15 N = 29 |
| 63.0 | | | | | | | | | | | | | |
| 62.5 | | | | | | | | | | | | | |
| 62.0 | 3.8 | SILTSTONE - very low strength, light grey-brown siltstone | | | | | | | | | | | 35/100mm refusal |
| 61.5 | 4.1 | SILTSTONE - medium strength, highly to moderately weathered, slightly fractured, grey-brown siltstone with some very low strength bands | | | | | | | | S | | | |
| 61.0 | | | | | | | | | | | | | PL(A) = 0.4 PL(A) = 0.5 PL(A) = 0.4 |
| 60.5 | | | | | | | | | | | | | |
| 60.0 | | | | | | | | | | | | | |
| 59.5 | | | | | | | | | | | | | |
| 59.0 | | | | | | | | | | | | | |
| 58.5 | 6.15 | SHALE - very low strength, highly weathered, slightly fractured, grey-brown shale | | | | | | | | | | | PL(A) = 0.4 |
| 58.0 | | | | | | | | | | | | | |
| 57.5 | | | | | | | | | | | | | |
| 57.0 | 6.85 | SHALE - medium strength, slightly weathered, slightly fractured, grey shale | | | | | | | | | | | PL(A) = 0.4 |
| 56.5 | | | | | | | | | | | | | |
| 56.0 | 7.35 | Bore discontinued at 7.35m | | | | | | | | | | | |
| 55.5 | | | | | | | | | | | | | |
| 55.0 | | | | | | | | | | | | | |
| 54.5 | | | | | | | | | | | | | |
| 54.0 | | | | | | | | | | | | | |
| 53.5 | | | | | | | | | | | | | |
| 53.0 | | | | | | | | | | | | | |
| 52.5 | | | | | | | | | | | | | |
| 52.0 | | | | | | | | | | | | | |
| 51.5 | | | | | | | | | | | | | |
| 51.0 | | | | | | | | | | | | | |
| 50.5 | | | | | | | | | | | | | |
| 50.0 | | | | | | | | | | | | | |
| 49.5 | | | | | | | | | | | | | |
| 49.0 | | | | | | | | | | | | | |
| 48.5 | | | | | | | | | | | | | |
| 48.0 | | | | | | | | | | | | | |
| 47.5 | | | | | | | | | | | | | |
| 47.0 | | | | | | | | | | | | | |
| 46.5 | | | | | | | | | | | | | |
| 46.0 | | | | | | | | | | | | | |
| 45.5 | | | | | | | | | | | | | |
| 45.0 | | | | | | | | | | | | | |
| 44.5 | | | | | | | | | | | | | |
| 44.0 | | | | | | | | | | | | | |
| 43.5 | | | | | | | | | | | | | |
| 43.0 | | | | | | | | | | | | | |
| 42.5 | | | | | | | | | | | | | |
| 42.0 | | | | | | | | | | | | | |
| 41.5 | | | | | | | | | | | | | |
| 41.0 | | | | | | | | | | | | | |
| 40.5 | | | | | | | | | | | | | |
| 40.0 | | | | | | | | | | | | | |
| 39.5 | | | | | | | | | | | | | |
| 39.0 | | | | | | | | | | | | | |
| 38.5 | | | | | | | | | | | | | |
| 38.0 | | | | | | | | | | | | | |
| 37.5 | | | | | | | | | | | | | |
| 37.0 | | | | | | | | | | | | | |
| 36.5 | | | | | | | | | | | | | |
| 36.0 | | | | | | | | | | | | | |
| 35.5 | | | | | | | | | | | | | |
| 35.0 | | | | | | | | | | | | | |
| 34.5 | | | | | | | | | | | | | |
| 34.0 | | | | | | | | | | | | | |
| 33.5 | | | | | | | | | | | | | |
| 33.0 | | | | | | | | | | | | | |
| 32.5 | | | | | | | | | | | | | |
| 32.0 | | | | | | | | | | | | | |
| 31.5 | | | | | | | | | | | | | |
| 31.0 | | | | | | | | | | | | | |
| 30.5 | | | | | | | | | | | | | |
| 30.0 | | | | | | | | | | | | | |
| 29.5 | | | | | | | | | | | | | |
| 29.0 | | | | | | | | | | | | | |
| 28.5 | | | | | | | | | | | | | |
| 28.0 | | | | | | | | | | | | | |
| 27.5 | | | | | | | | | | | | | |
| 27.0 | | | | | | | | | | | | | |
| 26.5 | | | | | | | | | | | | | |
| 26.0 | | | | | | | | | | | | | |
| 25.5 | | | | | | | | | | | | | |
| 25.0 | | | | | | | | | | | | | |
| 24.5 | | | | | | | | | | | | | |
| 24.0 | | | | | | | | | | | | | |
| 23.5 | | | | | | | | | | | | | |
| 23.0 | | | | | | | | | | | | | |
| 22.5 | | | | | | | | | | | | | |
| 22.0 | | | | | | | | | | | | | |
| 21.5 | | | | | | | | | | | | | |
| 21.0 | | | | | | | | | | | | | |
| 20.5 | | | | | | | | | | | | | |
| 20.0 | | | | | | | | | | | | | |
| 19.5 | | | | | | | | | | | | | |
| 19.0 | | | | | | | | | | | | | |
| 18.5 | | | | | | | | | | | | | |
| 18.0 | | | | | | | | | | | | | |
| 17.5 | | | | | | | | | | | | | |
| 17.0 | | | | | | | | | | | | | |
| 16.5 | | | | | | | | | | | | | |
| 16.0 | | | | | | | | | | | | | |
| 15.5 | | | | | | | | | | | | | |
| 15.0 | | | | | | | | | | | | | |
| 14.5 | | | | | | | | | | | | | |
| 14.0 | | | | | | | | | | | | | |
| 13.5 | | | | | | | | | | | | | |
| 13.0 | | | | | | | | | | | | | |
| 12.5 | | | | | | | | | | | | | |
| 12.0 | | | | | | | | | | | | | |
| 11.5 | | | | | | | | | | | | | |
| 11.0 | | | | | | | | | | | | | |
| 10.5 | | | | | | | | | | | | | |
| 10.0 | | | | | | | | | | | | | |
| 9.5 | | | | | | | | | | | | | |
| 9.0 | | | | | | | | | | | | | |
| 8.5 | | | | | | | | | | | | | |
| 8.0 | | | | | | | | | | | | | |
| 7.5 | | | | | | | | | | | | | |
| 7.0 | | | | | | | | | | | | | |
| 6.5 | | | | | | | | | | | | | |
| 6.0 | | | | | | | | | | | | | |
| 5.5 | | | | | | | | | | | | | |
| 5.0 | | | | | | | | | | | | | |
| 4.5 | | | | | | | | | | | | | |
| 4.0 | | | | | | | | | | | | | |
| 3.5 | | | | | | | | | | | | | |
| 3.0 | | | | | | | | | | | | | |
| 2.5 | | | | | | | | | | | | | |
| 2.0 | | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | |
| 1.0 | | | | | | | | | | | | | |
| 0.5 | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | |

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 4.0m
TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 4.1m; NMLC-Coring to 7.35m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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

DOUGLAS PARTNERS PTY LTD
PROPOSED AGGREGATE FACILITY – HORSLEY PARK
BORE 6 PROJECT 84821 MAY 2015



BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 71.4 AHD
EASTING: 302848
NORTHING: 6254980
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 84821
DATE: 29/5/2015
SHEET 1 OF 2

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | | | | Discontinuities | | Sampling & In Situ Testing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | EW | HW | MW | SW | FS | | FR | Ex Low | Very Low | Low | Medium | | High | Very High | Ex High | 0.01 | 0.05 | 0.10 | 0.50 | 1.00 | B - Bedding S - Shear | J - Joint F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 71 | 1.5 | FILLING - apparently variably compacted, grey to grey-brown, silty clay and crushed shale filling, damp | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 10.0m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.0m; NMLC-Coring to 13.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Borehole moved 3.0m. Standpipe installed to 13.0m (screen 11.0-13.0m; gravel 10.0-13.0m; bentonite 9.0-10.0m; backfill to GL; 0.5m stick-up)

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

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 71.4 AHD
EASTING: 302848
NORTHING: 6254980
DIP/AZIMUTH: 90°/-

BORE No: 7
PROJECT No: 84821
DATE: 29/5/2015
SHEET 2 OF 2

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | Discontinuities | Sampling & In Situ Testing | | | | | |
|------|--------------|---|----------------------|----|----|----|----------------|------------------|----|--------|----------|-----|-------|----------------------------|---|---|-----------|---------|--------------------------|--------------------------------|-------------|
| | | | EW | HW | MW | SW | | FS | FR | Ex Low | Very Low | Low | | | Medium | High | Very High | Ex High | B - Bedding S - Shear | J - Joint F - Fault | Type |
| 61 | 10.8 | SILTSTONE - medium strength, highly to moderately weathered, fractured and slightly fractured, grey-brown siltstone | | | | | | | | | | | | | 10.2m: B0°, cly co, 2mm 10.25m: B0°, cly 10.46m: J30°, un, ro, cly 10.56m: J30° & 35°, st, ro, fe 10.72m: J30°, pl, sm, fe 10.8-10.85m: Cs 11.15m: J, sv, pl, sm, cln | | S | | | refusal PL(A) = 0.5 | |
| 11 | 60 | SHALE - low to medium strength, highly to moderately weathered, fractured and slightly fractured, grey-brown shale with some extremely low and very low strength bands | | | | | | | | | | | | | 11.6m: CORE LOSS: 100mm | | C | 94 | 51 | PL(A) = 0.5 PL(A) = 0.3 | |
| 11.7 | 12 | | | | | | | | | | | | | | | 12.32m: CORE LOSS: 100mm 12.55m: J45°, pl, ro, cln 12.72m: J65°- 85°, cu, ro, cln | | C | 92 | 58 | PL(A) = 0.3 |
| 59 | 12.42 | | | | | | | | | | | | | | | | | | | | |
| 13 | 13.0 | Bore discontinued at 13.0m | | | | | | | | | | | | | | | | | | | |
| 58 | 14 | | | | | | | | | | | | | | | | | | | | |
| 57 | 15 | | | | | | | | | | | | | | | | | | | | |
| 56 | 16 | | | | | | | | | | | | | | | | | | | | |
| 55 | 17 | | | | | | | | | | | | | | | | | | | | |
| 54 | 18 | | | | | | | | | | | | | | | | | | | | |
| 53 | 19 | | | | | | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | | | | | | | |

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 10.0m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.0m; NMLC-Coring to 13.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Borehole moved 3.0m. Standpipe installed to 13.0m (screen 11.0-13.0m; gravel 10.0-13.0m; bentonite 9.0-10.0m; backfill to GL; 0.5m stick-up)

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

DOUGLAS PARTNERS PTY LTD
PROPOSED AGGREGATE FACILITY – HORSLEY PARK
BORE 7 PROJECT 84821 MAY 2015



BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 71.3 AHD
EASTING: 302897
NORTHING: 6254991
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 84821
DATE: 29/5/2015
SHEET 1 OF 2

[illegible]

RIG: Scout 4

DRILLER: RKE

LOGGED: SI

CASING: HW to 2.5m: HQ to 11.1m

TYPE OF BORING: Solid flight auger to 2.5m: Rotary to 11.1m: NMLC-Coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

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



Douglas Partners
Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 71.3 AHD
EASTING: 302897
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BORE No: 8
PROJECT No: 84821
DATE: 29/5/2015
SHEET 2 OF 2

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | Discontinuities | Sampling & In Situ Testing | | | | |
|------|--------------|--|----------------------|----|----|----|----------------|------------------|----|--------|----------|-----|-------|----------------------------|--|----------------------------|-----------|---------|--------------------------|--------------------------------|
| | | | EW | HW | MW | SW | | FS | FR | Ex Low | Very Low | Low | | | Medium | High | Very High | Ex High | B - Bedding S - Shear | J - Joint F - Fault |
| 61 | | CLAY - stiff, light grey and brown clay, moist to wet (<i>continued</i>) | | | | | | | | | | | | | Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10° | S | | | 8,14,25 N = 39 | |
| 10.7 | | SHALY CLAY - hard, light grey mottled brown, shaly clay, damp | | | | | | | | | | | | | | | | | | |
| 11 | 11.1 | SHALE - medium strength, highly to moderately weathered, fractured then slightly fractured, grey-brown shale with some very low strength bands | | | | | | | | | | | | | | | C | 100 | 75 | PL(A) = 0.4 PL(A) = 0.5 |
| 12 | | | | | | | | | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | | | | | | | | | |
| 13 | 13.0 | Bore discontinued at 13.0m | | | | | | | | | | | | | 12.9m: J80°, pl, sm, cln | | | | | |
| 58 | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | |
| 57 | | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | | |
| 56 | | | | | | | | | | | | | | | | | | | | |
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| 55 | | | | | | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | | | | | | | | | |

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 11.1m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 11.1m; NMLC-Coring to 13.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

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

DOUGLAS PARTNERS PTY LTD
PROPOSED AGGREGATE FACILITY – HORSLEY PARK
BORE 8 PROJECT 84821 MAY 2015



BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 69.0 AHD
EASTING: 302939
NORTHING: 6254999
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 84821
DATE: 28/5/2015
SHEET 1 OF 2

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | | | | Discontinuities | | Sampling & In Situ Testing | | | | | | |
|----|-----------|--|----------------------|----|----|----|----|----|-------------|---------------|----------|-----|--------|------|-------|----------------------|---------|------|------|-----------------|------|----------------------------|--------------------------|------------------------|------|-------------|-------|-------------------------|
| | | | EW | HW | MW | SW | FS | FR | | Ex Low | Very Low | Low | Medium | High | | Very High | Ex High | 0.01 | 0.05 | 0.10 | 0.50 | 1.00 | B - Bedding S - Shear | J - Joint F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments |
| 68 | | FILLING - variably compacted, grey and red-brown, silty clay and crushed shale filling with some brick fragments, damp | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 68 | 1 | | | | | | | | | | | | | | | | | | | | | A | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | S | | | | | | |
| | 3 | FILLING - poorly compacted, light brown, silty sandy clay filling with some crushed shale fragments, wet | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5.7 | CLAY - stiff, light grey mottled brown, slightly silty clay, wet | | | | | | | | | | | | | | | | | | | | S | | | | | | |
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| | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 6.8 | SHALE - extremely low strength, grey-brown shale with low strength bands | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 7.1 | | | | | | | | | | | | | | | | | | | | | S | | | | | | |
| | | SHALE - low to medium strength, highly to moderately weathered, slightly fractured, grey-brown shale | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 8 | SHALE - very low strength, highly to moderately weathered, slightly fractured, grey-brown shale with some low strength bands | | | | | | | | | | | | | | | | | | | | C | 100 | 64 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 9.26 | SILTSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown siltstone | | | | | | | | | | | | | | | | | | | | C | 100 | 80 | | | | |
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BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 69.0 AHD
EASTING: 302939
NORTHING: 6254999
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 84821
DATE: 28/5/2015
SHEET 2 OF 2

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | | | | Discontinuities | | Sampling & In Situ Testing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | EW | HW | MW | SW | FS | | FR | Ex Low | Very Low | Low | Medium | | High | Very High | Ex High | 0.01 | 0.05 | 0.10 | 0.50 | 1.00 | B - Bedding S - Shear | J - Joint F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 98 | 10.3 | SILTSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown siltstone <i>(continued)</i> Bore discontinued at 10.3m | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 1.5m; HQ to 7.1m
TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 7.1m; NMLC-Coring to 10.3m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Standpipe installed to 10.3m (screen 8.3-10.3m; gravel 7.3-10.3m; bentonite 6.0-7.3m; backfill to GL with gatic cover)

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

DOUGLAS PARTNERS PTY LTD
PROPOSED AGGREGATE FACILITY – HORSLEY PARK
BORE 9 PROJECT 84821 MAY 2015



BOREHOLE LOG

CLIENT: Brickworks Ltd
PROJECT: Lightweight Aggregate Project at Plant 2
LOCATION: 720 Wallgrove Road, Horsley Park

SURFACE LEVEL: 67.1 AHD
EASTING: 302900
NORTHING: 6254945
DIP/AZIMUTH: 90°/-

BORE No: 10
PROJECT No: 84821
DATE: 28/5/2015
SHEET 1 OF 1

| RL | Depth (m) | Description of Strata | Degree of Weathering | | | | Graphic Log | Rock Strength | | | | | Water | Fracture Spacing (m) | | | | Discontinuities | | Sampling & In Situ Testing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | EW | HW | MW | SW | | FS | FR | Ex Low | Very Low | Low | | Medium | High | Very High | Ex High | 0.01 | 0.05 | 0.10 | 0.50 | 1.00 | B - Bedding S - Shear | J - Joint F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 67 | | FILLING - variably compacted, grey and brown, silty clay and crushed shale filling with some brick fragments | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | </ |

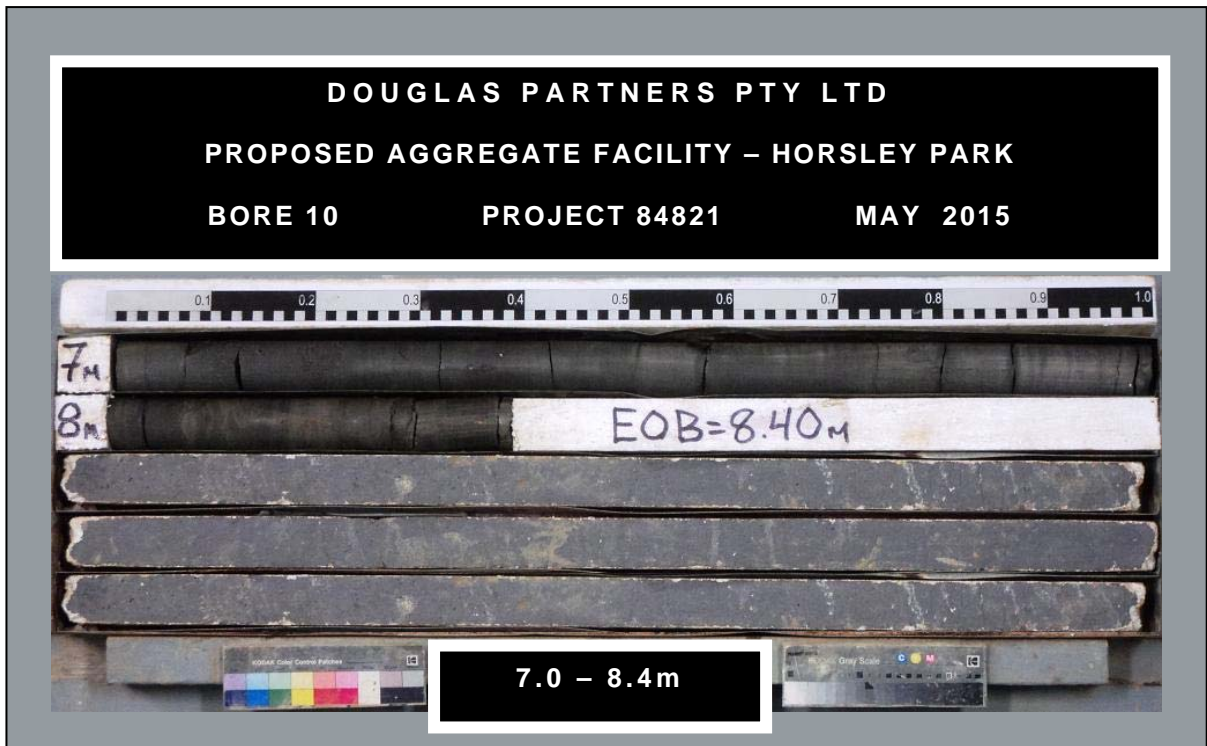
RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.8m
TYPE OF BORING: Solid flight auger to 2.8m; NMLC-Coring to 8.4m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Standpipe installed to 8.4m (screen 5.4-8.4m; gravel 5.0-8.4m; bentonite 4.0-5.0m; backfill to GL with 0.6m stick-up)

SAMPLING & IN SITU TESTING LEGEND

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



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Sampling

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

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

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

Test Pits

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

Large Diameter Augers

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

Continuous Spiral Flight Augers

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

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

Non-core Rotary Drilling

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

Continuous Core Drilling

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

Standard Penetration Tests

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

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

The test results are reported in the following form.

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

Sampling Methods

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

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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



Description and Classification Methods

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

Soil Types

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

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

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

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

The proportions of secondary constituents of soils are described as:

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

Definitions of grading terms used are:

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

Cohesive Soils

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

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

Cohesionless Soils

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

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

Soil Descriptions

Soil Origin

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

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

Transported soils may be further subdivided into:

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



Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

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

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

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

Degree of Fracturing

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

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

Rock Descriptions

Rock Quality Designation

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

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners



Introduction

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

Drilling or Excavation Methods

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

Water

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

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

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

Roughness

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

Other

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

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General



Asphalt



Road base



Concrete

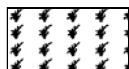


Filling

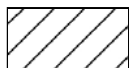
Soils



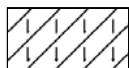
Topsoil



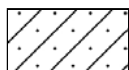
Peat



Clay



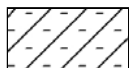
Silty clay



Sandy clay



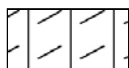
Gravelly clay



Shaly clay



Silt



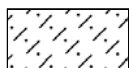
Clayey silt



Sandy silt



Sand



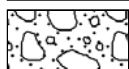
Clayey sand



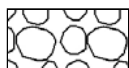
Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



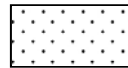
Boulder conglomerate



Conglomerate



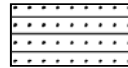
Conglomeratic sandstone



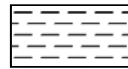
Sandstone



Siltstone



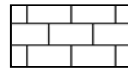
Laminite



Mudstone, claystone, shale

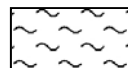


Coal

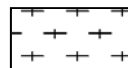


Limestone

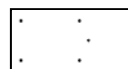
Metamorphic Rocks



Slate, phyllite, schist

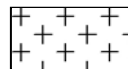


Gneiss

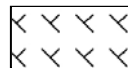


Quartzite

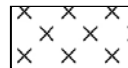
Igneous Rocks



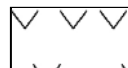
Granite



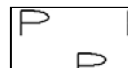
Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

Appendix D

Laboratory Test Results

Results of Moisture Content, Plasticity and Linear Shrinkage Tests

| | | | |
|------------------|--------------------------------|----------------------|------------|
| Client: | Brickworks Ltd | Project No: | 84821 |
| Project: | Geotechnical Investigation | Report No: | 1 |
| Location: | 780 Wallgrove Rd, Horsley Park | Report Date: | 09/06/2015 |
| | | Date Sampled: | |
| | | Date of Test: | - |
| | | Page: | 04/06/2015 |
| 1 of 1 | | | |

| Test Location | Depth (m) | Description | Code | W _F % | W _L % | W _P % | PI % | *LS % |
|---------------|------------|---|------|------------------|------------------|------------------|------|---------|
| BH7 | 7 - 7.45 | FILLING - grey, silty clay, crushed shale and brick fragments filling | 2,5 | 14.9 | 39 | 20 | 19 | 10 |
| BH8 | 4 - 4.45 | FILLING - light grey, clay and crushed shale and brick gravel filling | 2,5 | 12.6 | 38 | 18 | 20 | 12.5 |
| BH9 | 5.5 - 5.95 | CLAY - light grey mottled brown, slightly silty clay | 2,5 | 22.4 | 65 | 22 | 43 | 18 CU |
| BH10 | 2.5 - 2.8 | SILTSTONE - light grey-brown siltstone | 2,5 | 12.9 | 49 | 19 | 30 | 14.5 CU |

Legend:

W_F Field Moisture Content
 W_L Liquid limit
 W_P Plastic limit
 PI Plasticity index
 LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:

Moisture Content: AS 1289 2.1.1
 Liquid Limit: AS 1289 3.1.2
 Plastic Limit: AS 1289 3.2.1
 Plasticity Index: AS 1289 3.3.1
 Linear Shrinkage: AS 1289 3.4.1

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Methods: Sampled by Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

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

Tested: LW
 Checked: MM


 Mark Matthews
 Laboratory Manager

Determination of Emerson Class Number of Soil

| | | | |
|-------------------|--------------------------------|----------------------|-----------|
| Client : | Brickworks Ltd | Project No. : | 84821 |
| Project : | Geotechnical Investigation | Report No. : | 2 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 9/06/2015 |
| | | Page: | 1 of 1 |

| Sample No. | Depth (m) | Date of Test | Description | Water Type | Water Temp | Class No. |
|------------|-----------|--------------|---|------------|------------|-----------|
| BH10 | 2.5 | 5/06/2015 | SILTSTONE - light grey-brown siltstone | Distilled | 23 | 2 |
| BH7 | 7.0 | 5/06/2015 | FILLING - grey, silty clay, crushed shale and brick fragments filling | Distilled | 23 | 2 |
| BH8 | 4.0 | 5/06/2015 | FILLING - light grey, clay and crushed shale and brick gravel filling | Distilled | 23 | 2 |
| BH9 | 5.5 | 5/06/2015 | CLAY - light grey mottled brown, slightly silty clay | Distilled | 23 | 2 |

Test Methods: AS 1289 3.8.1

Sampling Methods: Sampled by Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

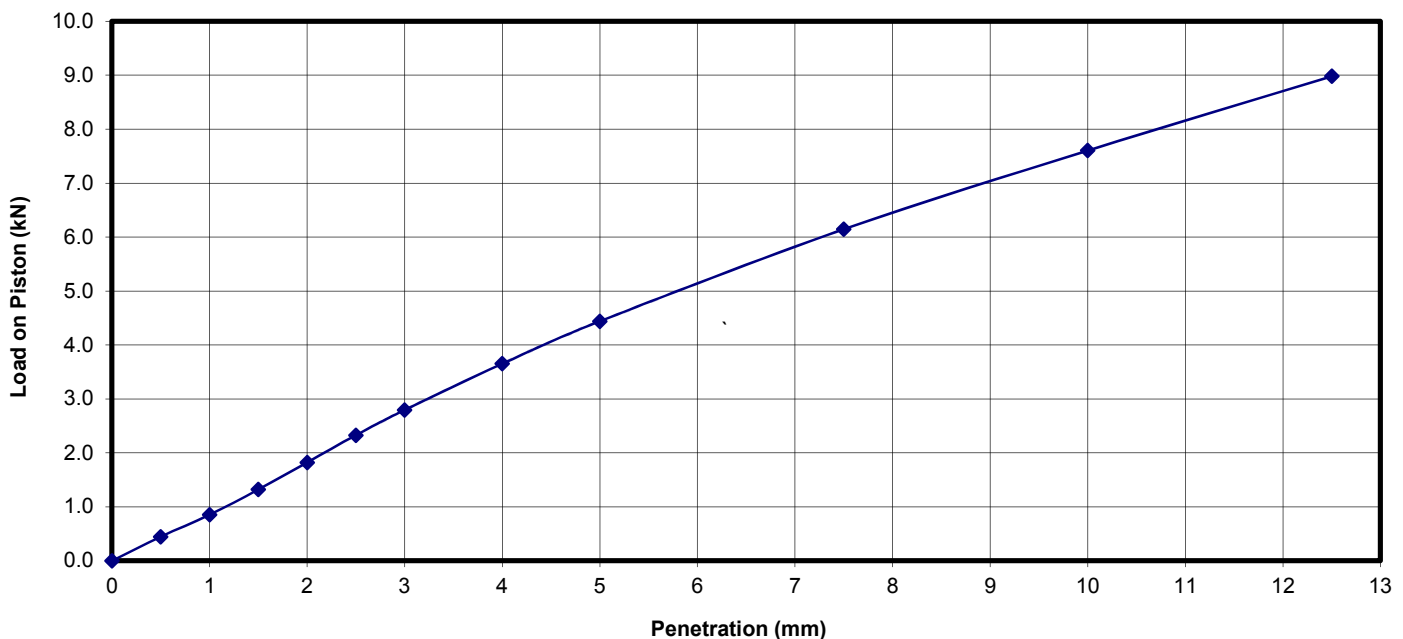
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025



Mark Matthews
Laboratory Manager

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 3 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 11/06/2015 |
| Test Location : | BH11 | Date Sampled : | 29/05/2015 |
| Depth / Layer : | 0.0 - 0.5m | Date of Test: | 9/06/2015 |
| | | Page: | 1 of 1 |



Description: Orange brown sandy clay with some gravel (5-day soak)

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 5% Excluded

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 0.4%

MOISTURE RATIO: 96% of STD OMC

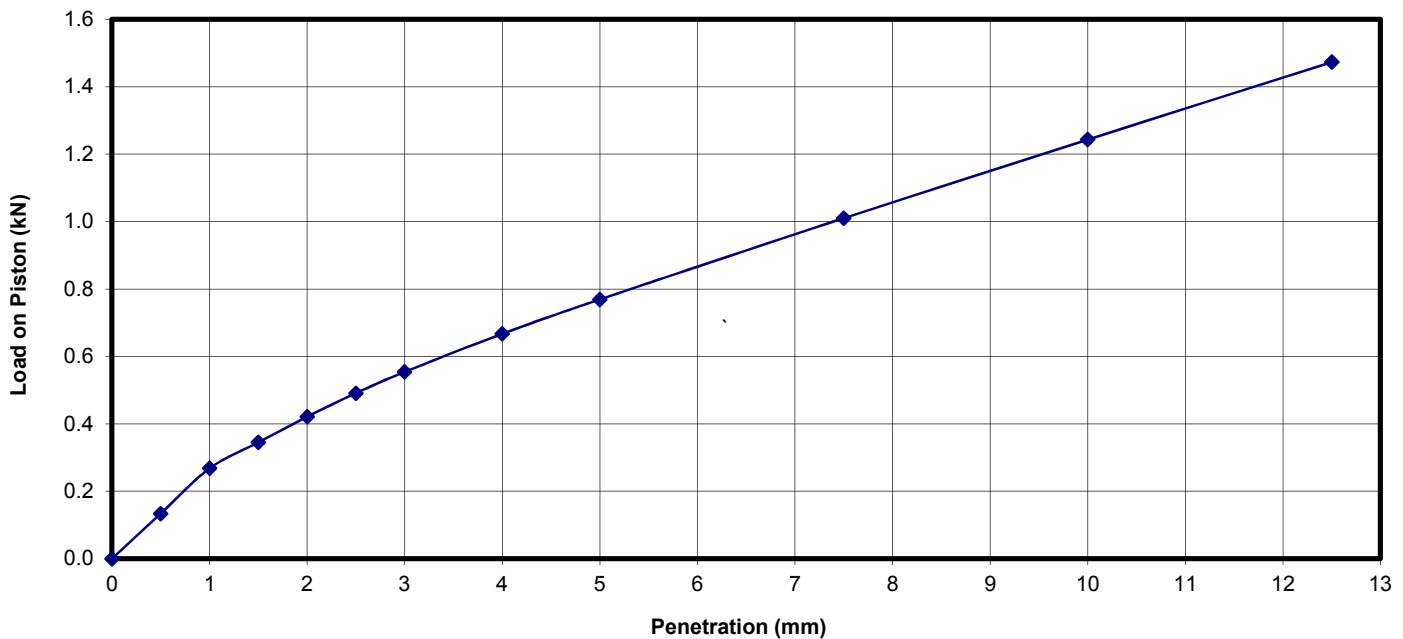
SOAKING PERIOD: 5 days

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 8.3 | 2.02 |
| After soaking | 10.6 | 2.02 |
| After test | | |
| Top 30mm of sample | 9.8 | - |
| Remainder of sample | 9.8 | - |
| Field values | 6.3 | - |
| Standard Compaction (OMC/MDD) | 8.7 | 2.01 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 25 |

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 4 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 11/06/2015 |
| Test Location : | BH12 | Date Sampled : | 29/05/2015 |
| Depth / Layer : | 0.0 - 0.5m | Date of Test: | 9/06/2015 |
| | | Page: | 1 of 1 |



Description: Grey shaly silty clay (24 hrs curing)

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 2% Excluded

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 1.9%

MOISTURE RATIO: 100% of STD OMC

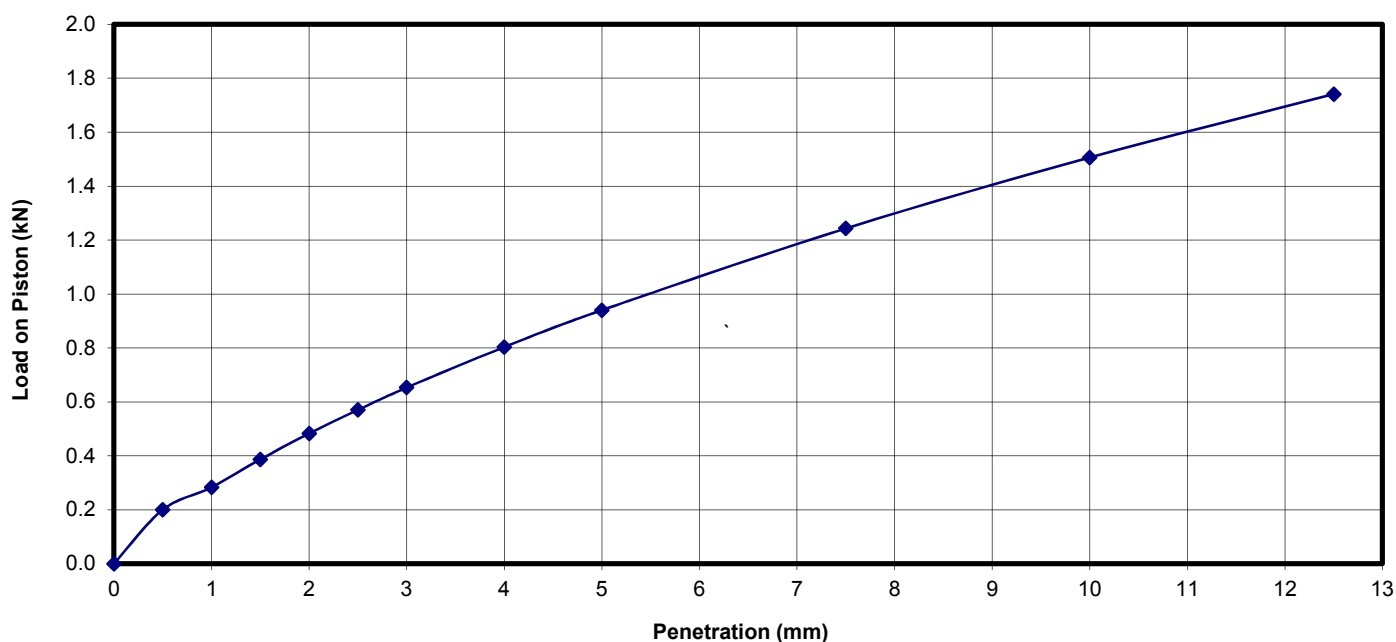
SOAKING PERIOD: 4 days

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 11.5 | 1.97 |
| After soaking | 14.0 | 1.97 |
| After test | | |
| Top 30mm of sample | 15.3 | - |
| Remainder of sample | 12.8 | - |
| Field values | 8.1 | - |
| Standard Compaction (OMC/MDD) | 11.5 | 1.97 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 4 |

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 5 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 11/06/2015 |
| Test Location : | BH12 | Date Sampled : | 29/05/2015 |
| Depth / Layer : | 1.5 - 2.0m | Date of Test: | 9/06/2015 |
| | | Page: | 1 of 1 |



Description: Grey shaly silty clay (5-day soak)
Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1
Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 99% of STD OMC

SURCHARGE: 4.5 kg
SOAKING PERIOD: 5 days

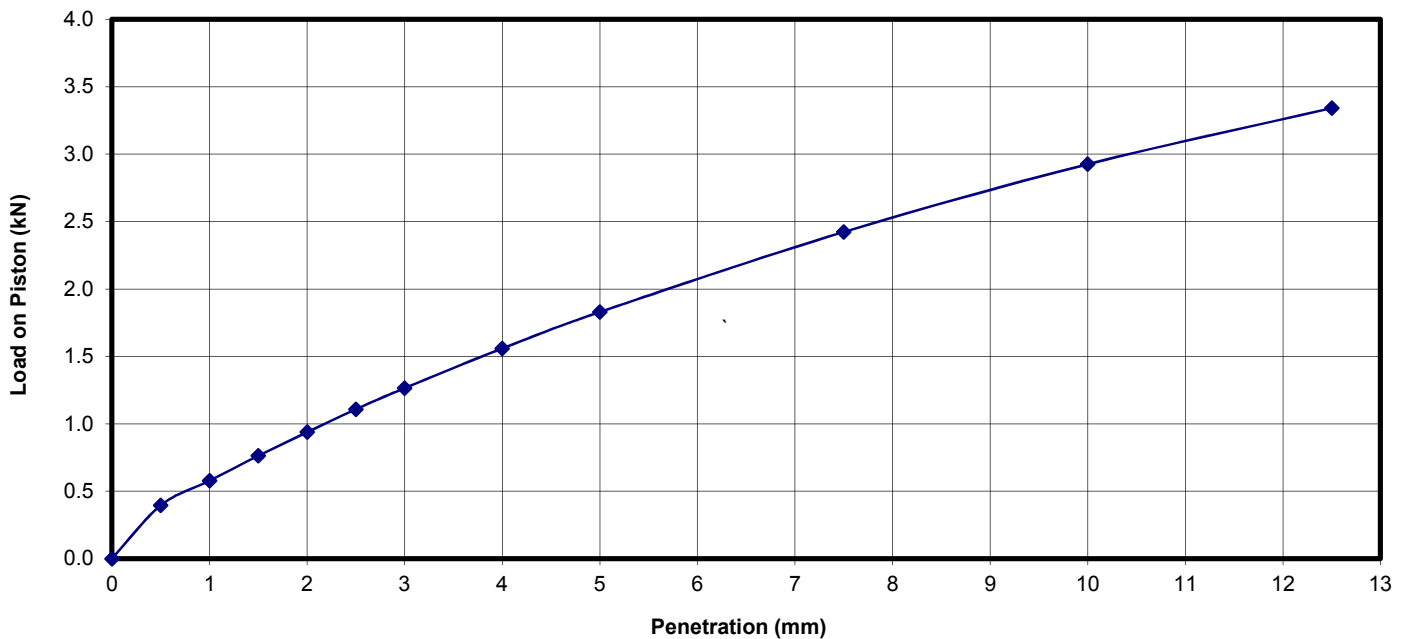
SWELL: 2.6%

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 12.0 | 1.93 |
| After soaking | 15.4 | 1.93 |
| After test | | |
| Top 30mm of sample | 16.7 | - |
| Remainder of sample | 14.6 | - |
| Field values | 11.2 | - |
| Standard Compaction (OMC/MDD) | 12.1 | 1.93 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 4.5 |

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 6 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 11/06/2015 |
| Test Location : | BH13 | Date Sampled : | 29/05/2015 |
| Depth / Layer : | 0.5 - 1.0m | Date of Test: | 9/06/2015 |
| | | Page: | 1 of 1 |



Description: Yellow brown clay with some gravel

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 2% Excluded

LEVEL OF COMPACTION: 99% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 0.5%

MOISTURE RATIO: 102% of STD OMC

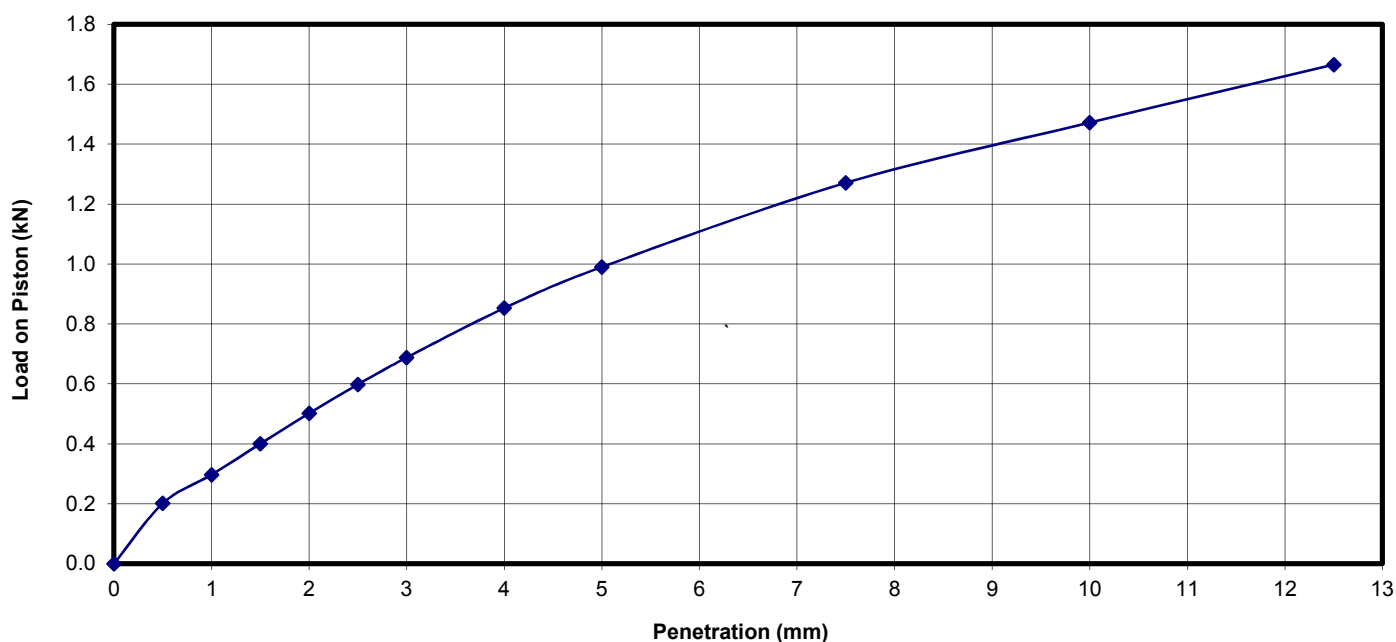
SOAKING PERIOD: 4 days

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 11.3 | 1.97 |
| After soaking | 12.8 | 1.97 |
| After test | | |
| Top 30mm of sample | 12.9 | - |
| Remainder of sample | 12.2 | - |
| Field values | 5.6 | - |
| Standard Compaction (OMC/MDD) | 11.1 | 1.99 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 9 |

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 7 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 11/06/2015 |
| Test Location : | BH14 | Date Sampled : | 29/05/2015 |
| Depth / Layer : | 0.5 - 1.0m | Date of Test: | 9/06/2015 |
| | | Page: | 1 of 1 |



Description: Dark grey shaly clay (5-day soak)

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 3% Included

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 0.4%

MOISTURE RATIO: 104% of STD OMC

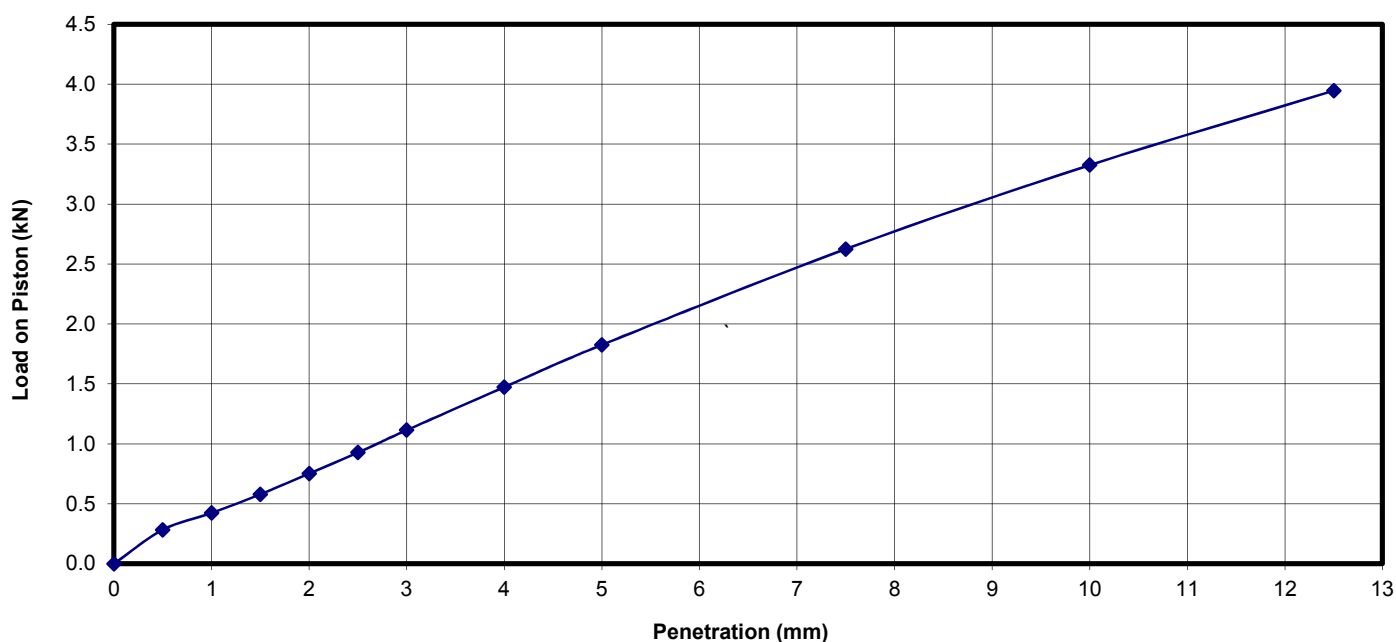
SOAKING PERIOD: 5 days

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 11.5 | 2.00 |
| After soaking | 12.8 | 2.00 |
| After test | | |
| Top 30mm of sample | 12.2 | - |
| Remainder of sample | 11.8 | - |
| Field values | 11.4 | - |
| Standard Compaction (OMC/MDD) | 11.1 | 2.01 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 5 |

Results of California Bearing Ratio Test

| | | | |
|------------------------|--------------------------------|-----------------------|------------|
| Client : | Brickworks Ltd | Project No. : | 84821.00 |
| Project : | Geotechnical Investigation | Report No. : | 9 |
| Location : | 780 Wallgrove Rd, Horsley Park | Report Date : | 16/06/2015 |
| Test Location : | BH15 | Date Sampled : | 2/06/2015 |
| Depth / Layer : | 0.5 - 1.0m | Date of Test: | 15/06/2015 |
| | | Page: | 1 of 1 |



Description: Filling - light grey to grey, silty clay and crushed shale fragments filling

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 4% Excluded

LEVEL OF COMPACTION: 100% of STD MDD

SURCHARGE: 4.5 kg

SWELL: 0.2%

MOISTURE RATIO: 105% of STD OMC

SOAKING PERIOD: 4 days

| CONDITION | MOISTURE CONTENT % | DRY DENSITY t/m ³ |
|-------------------------------|--------------------|------------------------------|
| At compaction | 11.3 | 2.01 |
| After soaking | 13.1 | 2.01 |
| After test | | |
| Top 30mm of sample | 13.3 | - |
| Remainder of sample | 11.9 | - |
| Field values | 9.8 | - |
| Standard Compaction (OMC/MDD) | 10.8 | 2.02 |

| RESULTS | | |
|---------|-------------|---------|
| TYPE | PENETRATION | CBR (%) |
| TOP | 5.0 mm | 9 |



Results of Moisture Content Test

| Client : Brickworks Ltd | | | | Project No. : 84821 | |
|--|-----------|--------------|-------------|---|----------------------|
| Project : Geotechnical Investigation | | | | Report No. : 8 | |
| Location : 780 Wallgrove Rd, Horsley Park | | | | Report Date : 15/06/2015 | |
| Test Location | Depth (m) | Date Sampled | Date Tested | Description | Moisture Content (%) |
| BH1 | 1.0 | 29/05/2015 | 11/06/2015 | Grey and light grey-brown silty clay and crushed shale filling | 6.2 |
| BH10 | 1.0 | 29/05/2015 | 11/06/2015 | Grey and brown silty clay and crushed shale filling with some brick fragments | 6.8 |
| BH2 | 1.0 | 29/05/2015 | 11/06/2015 | Light grey-brown silty sand crushed sandstone, shale and brick fragments filling | 15.2 |
| BH3 | 1.0 | 29/05/2015 | 11/06/2015 | Grey-brown and red-brown, silty sandy clay with some shale and crushed brick fragment filling | 9.3 |
| BH4 | 1.0 | 29/05/2015 | 11/06/2015 | Grey crushed shale filling | 6.4 |
| BH7 | 2.5 | 29/05/2015 | 11/06/2015 | Grey silty clay, crushed shale and brick fragments filling | 10.8 |
| BH7 | 4.0 | 29/05/2015 | 11/06/2015 | Grey silty clay, crushed shale and brick fragments filling | 17.3 |
| BH8 | 1.0 | 29/05/2015 | 11/06/2015 | Grey silty clay and crushed shale fragments filling with some gravel (brick fragments) | 13.8 |
| BH8 | 5.5 | 29/05/2015 | 11/06/2015 | Light grey and crushed shale and brick gravel filling | 17.6 |
| BH9 | 4.0 | 29/05/2015 | 11/06/2015 | Light brown silty sandy clay filling with some crushed shale fragments | 21.6 |
| BH9 | 7.0 | 29/05/2015 | 11/06/2015 | Light brown silty sandy clay filling with some crushed shale fragments | 17.9 |

Test Methods: AS 1289.2.1.1

Sampling Methods: AS 1289.1.2.1, AS 1289.1.1

Remarks:



NATA Accredited Laboratory Number: 828

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



Mark Matthews
Laboratory Manager

Appendix C

BMT WBM Flood Report

Our Ref: L.S20149.01_BrickworksQuarry_FIA.docx

26 May 2015

Suite 702, 154 Pacific Highway,
St Leonards NSW 2065

Attention: Simon Haycock

Dear Simon

RE: Brickworks Quarry Site at Horsley Park – Flood Impact Assessment

The following letter report outlines the flood impact assessment undertaken for the proposed development at the above address.

The flood impact assessment was undertaken using Fairfield Council's current hydraulic model of the Eastern Creek catchment developed as part of the Rural Area Flood Study, Ropes, Reedy and Eastern Creeks – Final Draft (2013).

Proposed Development and Description of Existing Flood Risk

The proposed works will involve bulk earthworks to form platform levels for a new manufacturing plant and associated amenities. This will include some filling of the existing dam. This assessment focuses on determining the risk of flooding and flooding impacts from Eastern Creek which is immediately west of the site (Figure 1).

Hydraulic Modelling Overview

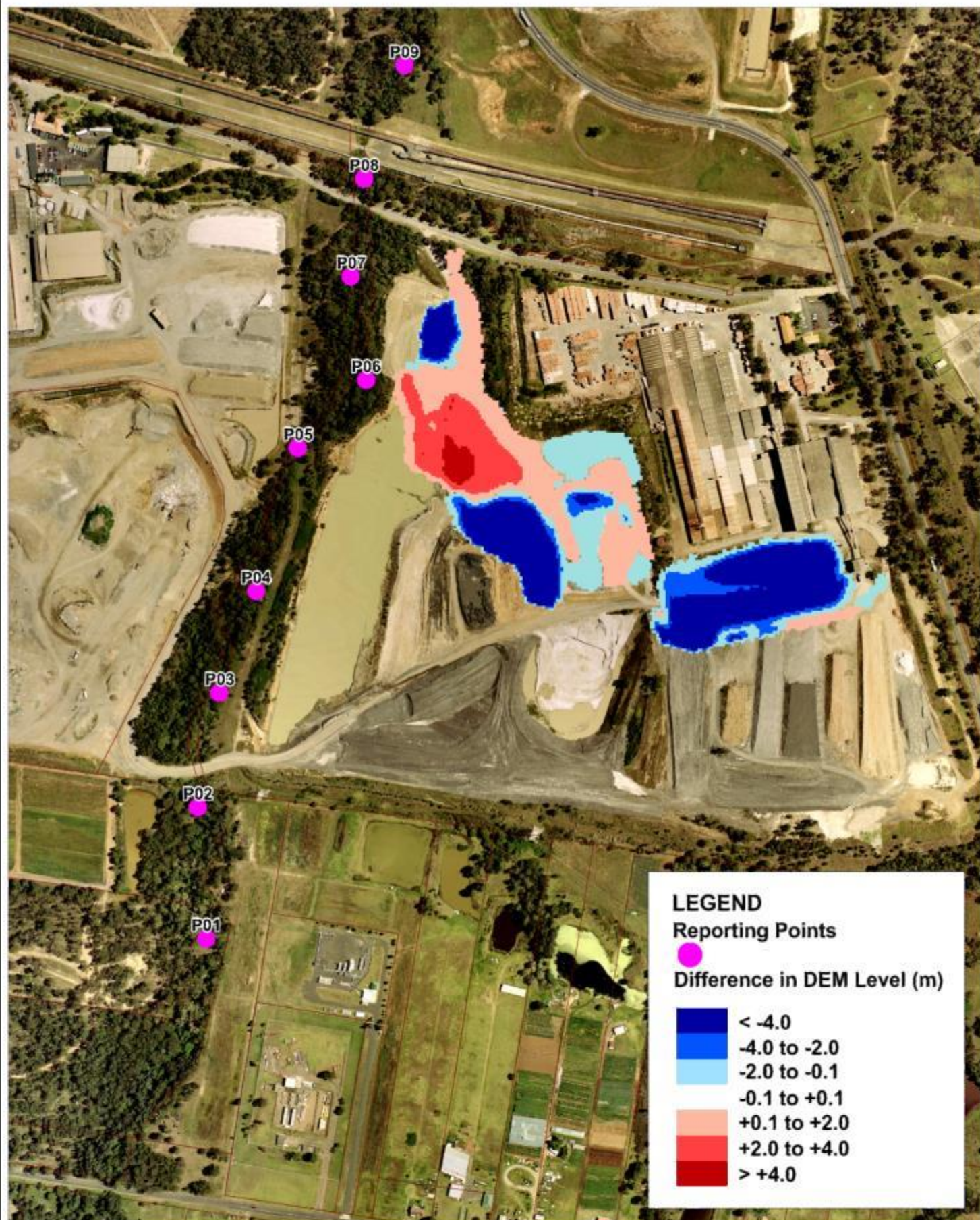
The Eastern Creek catchment hydraulic model is a two-dimensional (2D) TUFLOW model utilising a 5m grid resolution. Major stream paths such as Eastern Creek are modelled as nested 1D features. In order to assess the existing overland flood risk and flood impacts of the proposed development, refinement to the Draft model was required. The following modifications were made to the TUFLOW model.

- Existing Case Model (Pre-development conditions)

Modelling undertaken for the flood study assumed that the quarries were filled (topographic changes). For the purposes of this flood impact assessment, the flood study model is therefore not a suitable base case model. Local site survey was provided as a 12da file for the Pre Developed conditions. This terrain was "patched" on the flood study model. The dam adjacent to the Creek was assumed full prior to the design storm. Aerial imagery supports this starting water level. Quarry land-use layers developed for the flood study were applied on the site for the assessment.

- Proposed Case Model

Two proposed development models were developed when preparing the flood impact assessment in order to mitigate flood impacts in Eastern Creek from the development (only the final scenario is reported). Proposed development site topography was provided as 12da files. This terrain data was similarly patched over the pre-development model. Figure 1 shows the change in topography for the Proposed Case versus Existing Case model.



Title:
Study Area and Reporting Locations

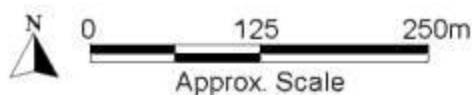
Figure:

1

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Flood Mapping and Peak Result Tables

The TUFLOW hydraulic model has been used to derive “Flood Study Condition”, “Pre Developed” and “Proposed Development” flood levels for the 5% AEP (20 year ARI), 1% AEP (100 year ARI) and the PMF (Probable Maximum Flood) design storms.

Flooding characteristics for all design events have been determined by assessing a range of design storm durations. The resulting peak water level is determined by considering all storm durations and extracting the highest water level in each model cell.

Figure 2 shows the Flood Study 1% AEP maximum water level surface while Figure 3 shows the difference in flood levels (1% AEP) from the Flood Study model versus the pre-developed model. The Flood Study adopted topographic changes to remove the quarry in conjunction with a revised land-use layer assuming the quarry site had been restored. This resulted in higher conveyance within Eastern Creek at the western site boundary for the Flood Study compared to that modelled for the pre-developed scenario. Note red sections in Figure 3 indicate areas where the pre-developed scenario produces higher flood levels than the flood study.

A range of flood mapping has been provided as follows:

Appendix A – Flood Level Impact Mapping

- A1 5% AEP (20 Year ARI) Maximum Water Level Differences
- A2 1% AEP (100 Year ARI) Maximum Water Level Differences
- A3 PMF Maximum Water Level Differences

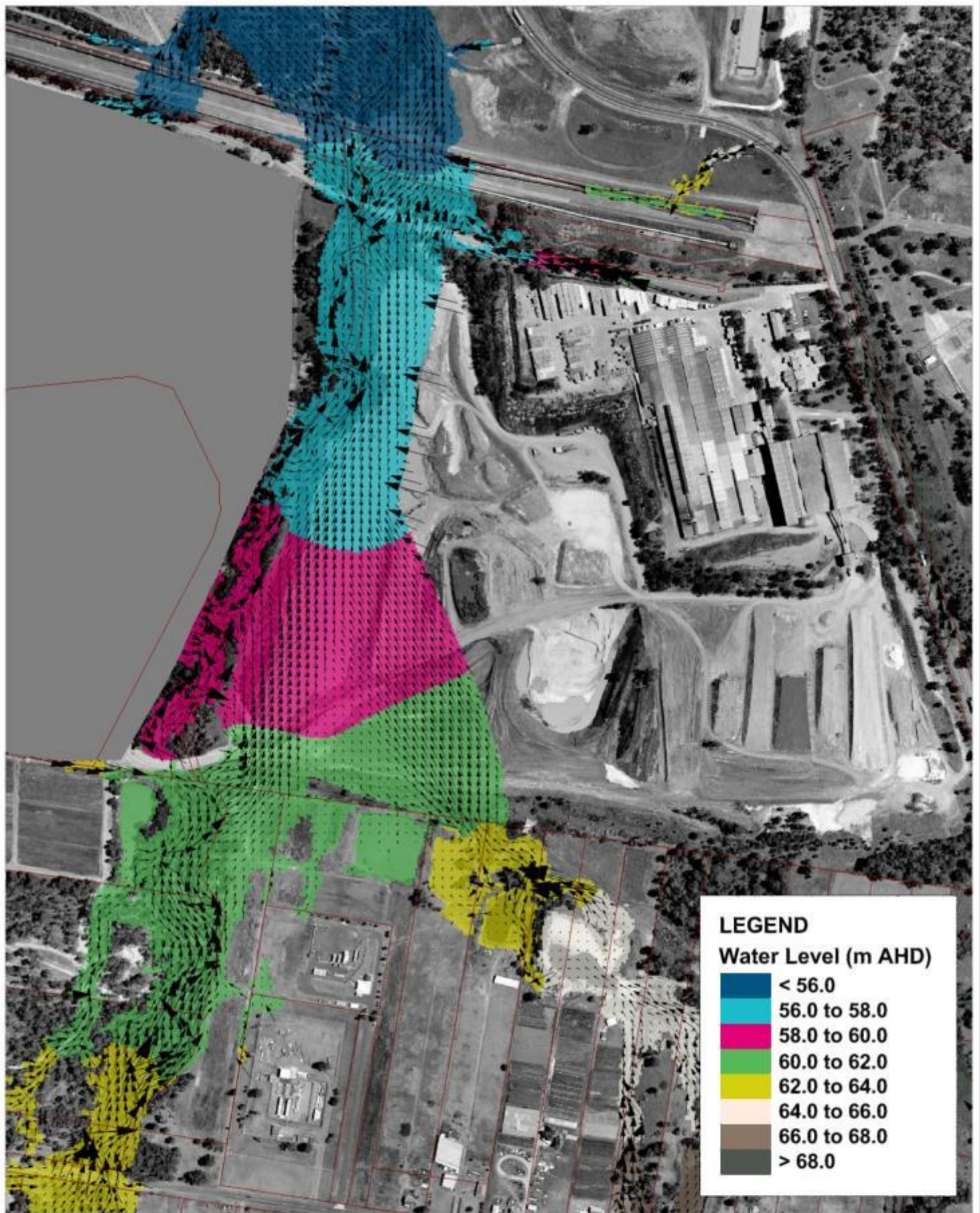
Appendix B – Velocity-Depth Product Mapping

- B1 5% AEP (20 Year ARI) Velocity-Depth Product - Pre Developed
- B2 1% AEP (100 Year ARI) Velocity-Depth Product - Pre Developed
- B3 PMF Velocity-Depth Product - Pre Developed
- B4 5% AEP (20 Year ARI) Velocity-Depth Product - Developed
- B5 1% AEP (100 Year ARI) Velocity-Depth Product - Developed
- B6 PMF Velocity-Depth Product - Developed

Appendix C – Peak Water Level Mapping (include velocity vectors)

- C1 5% AEP (20 Year ARI) Maximum Water Levels – Pre Developed
- C2 1% AEP (100 Year ARI) Maximum Water Levels – Pre Developed
- C3 PMF Maximum Water Levels - Pre Developed
- C4 5% AEP (20 Year ARI) Maximum Water Levels - Developed
- C5 1% AEP (100 Year ARI) Maximum Water Levels - Developed
- C6 PMF Maximum Water Levels - Developed

Impact mapping provided in Appendix-A contrasts the revised pre-developed scenario with the developed scenario. Flood levels determined in the Flood Study model are however different to the pre-developed scenario.



Title:

Flood Study -Peak Flood Level 1% AEP (100 yr ARI)

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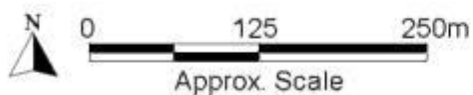
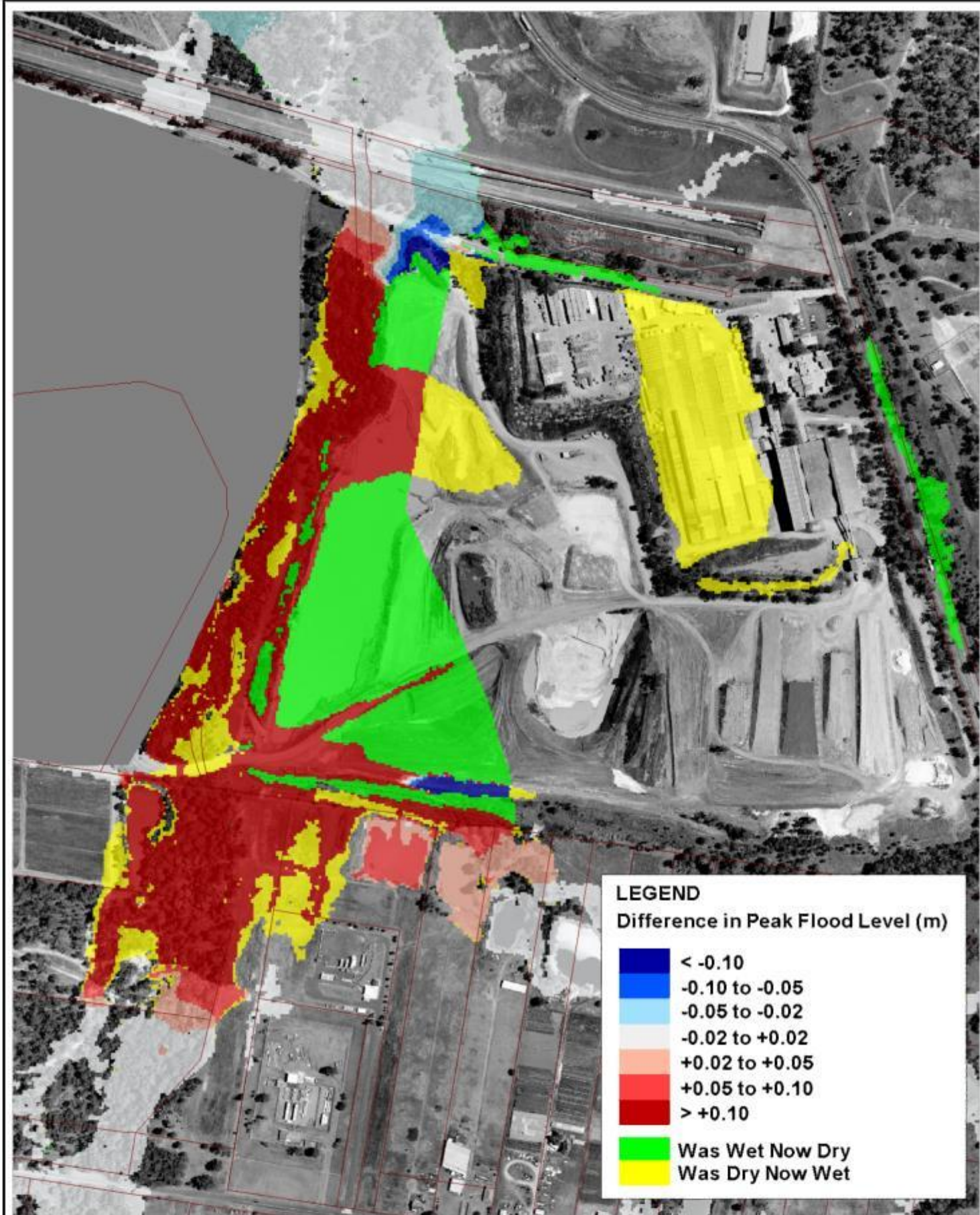


Figure:

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Title:

Flood Level Impacts - Flood Study versus Pre Developed 1% AEP (100 yr ARI)

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0 125 250m
Approx. Scale

Figure:

03

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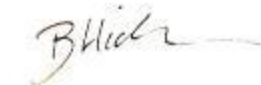
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Peak water levels have been extracted along the site for the “pre-developed case” and “developed case” (Table 1). Figure 1 shows the locations reported.

Table 1 Peak Water Levels Results on site (mAHD)

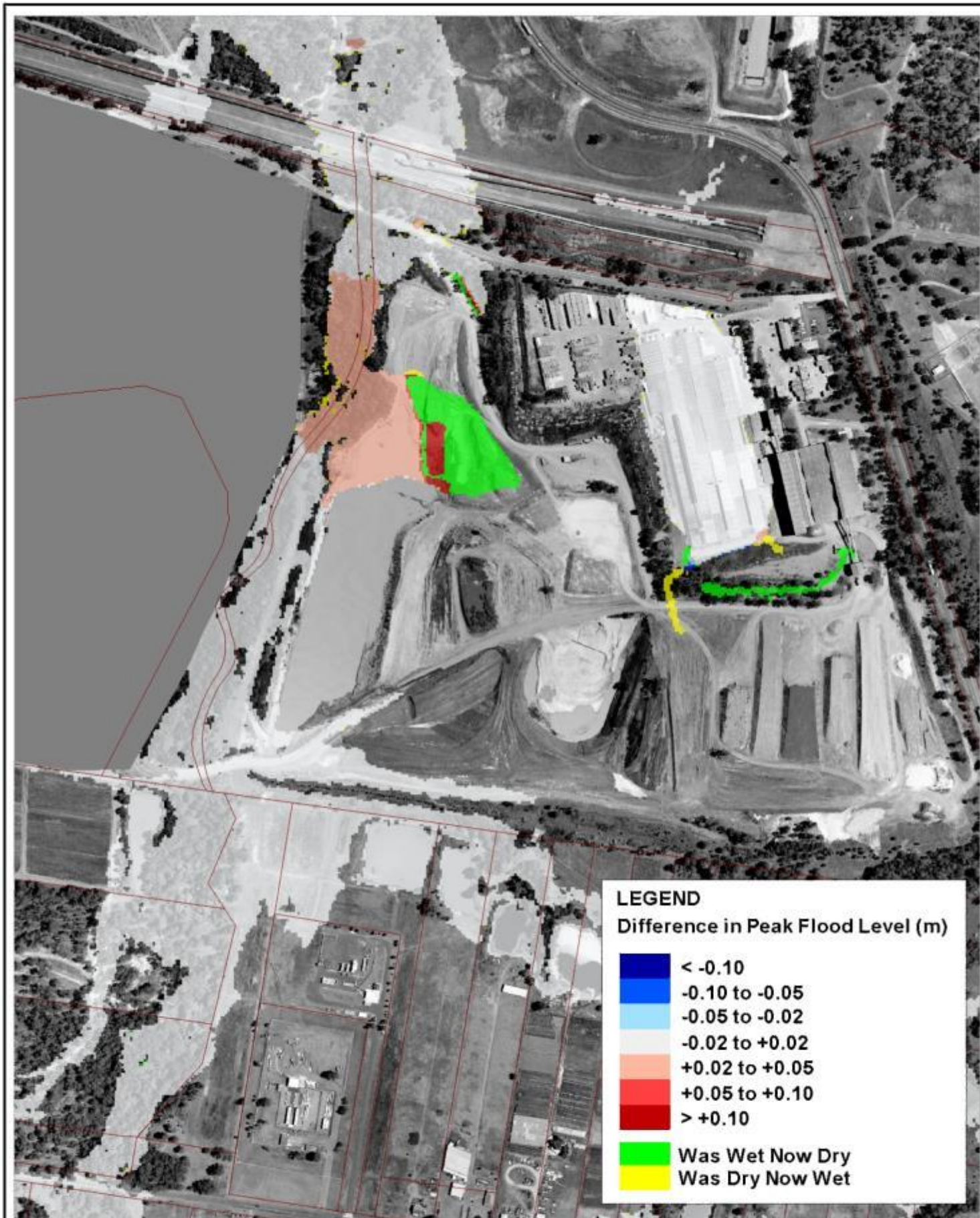
| Location | Pre Developed | | | Post Developed (It 2) | | | Impacts | | |
|----------|---------------|--------|-------|-----------------------|--------|-------|---------|--------|------|
| | 5% AEP | 1% AEP | PMF | 5% AEP | 1% AEP | PMF | 5% AEP | 1% AEP | PMF |
| P01 | 61.18 | 61.33 | 62.84 | 61.18 | 61.33 | 62.84 | 0.00 | 0.00 | 0.00 |
| P02 | 61.10 | 61.24 | 62.75 | 61.10 | 61.24 | 62.75 | 0.00 | 0.00 | 0.00 |
| P03 | 59.28 | 59.56 | 61.85 | 59.28 | 59.56 | 61.85 | 0.00 | 0.00 | 0.00 |
| P04 | 58.84 | 59.09 | 61.27 | 58.84 | 59.09 | 61.27 | 0.00 | 0.00 | 0.01 |
| P05 | 57.83 | 58.11 | 59.95 | 57.84 | 58.11 | 59.99 | 0.02 | 0.01 | 0.04 |
| P06 | 57.31 | 57.63 | 59.66 | 57.33 | 57.64 | 59.72 | 0.03 | 0.01 | 0.05 |
| P07 | 56.86 | 57.11 | 58.75 | 56.88 | 57.12 | 58.79 | 0.02 | 0.01 | 0.04 |
| P08 | 56.17 | 56.29 | 57.43 | 56.18 | 56.30 | 57.44 | 0.01 | 0.00 | 0.01 |
| P09 | 55.42 | 55.57 | 56.95 | 55.43 | 55.58 | 56.95 | 0.01 | 0.00 | 0.00 |

Yours Faithfully
BMT WBM



Bowen Hicks

Appendix A Flood Level Impact Mapping



Title:
**Flood Level Impacts - Development versus Pre Developed
5% AEP (20 yr ARI)**

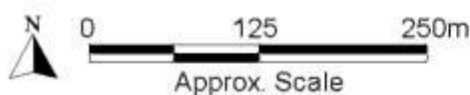
Figure:

A-1

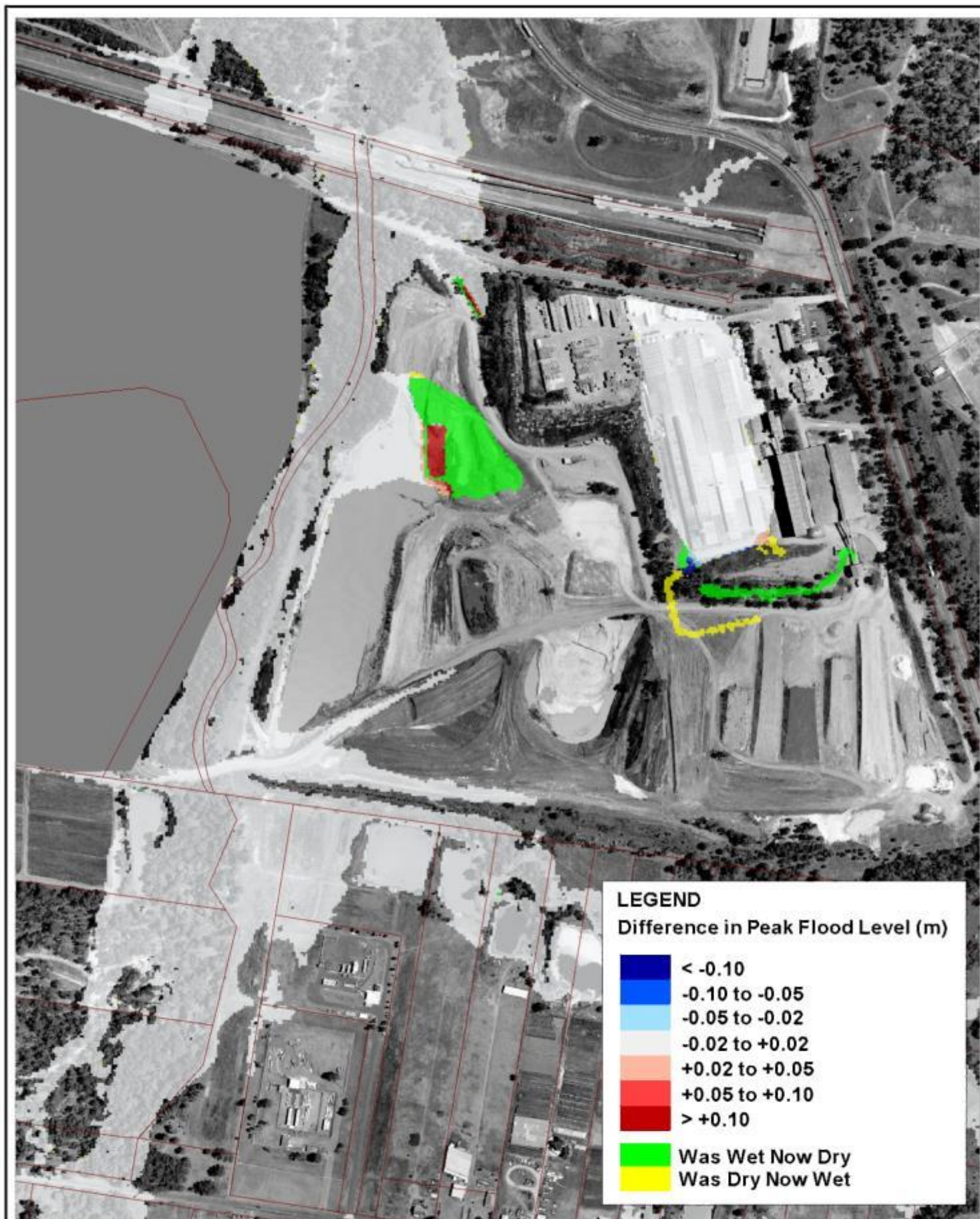
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Title:
**Flood Level Impacts - Development versus Pre Developed
1% AEP (100 yr ARI)**

Figure:

A-2

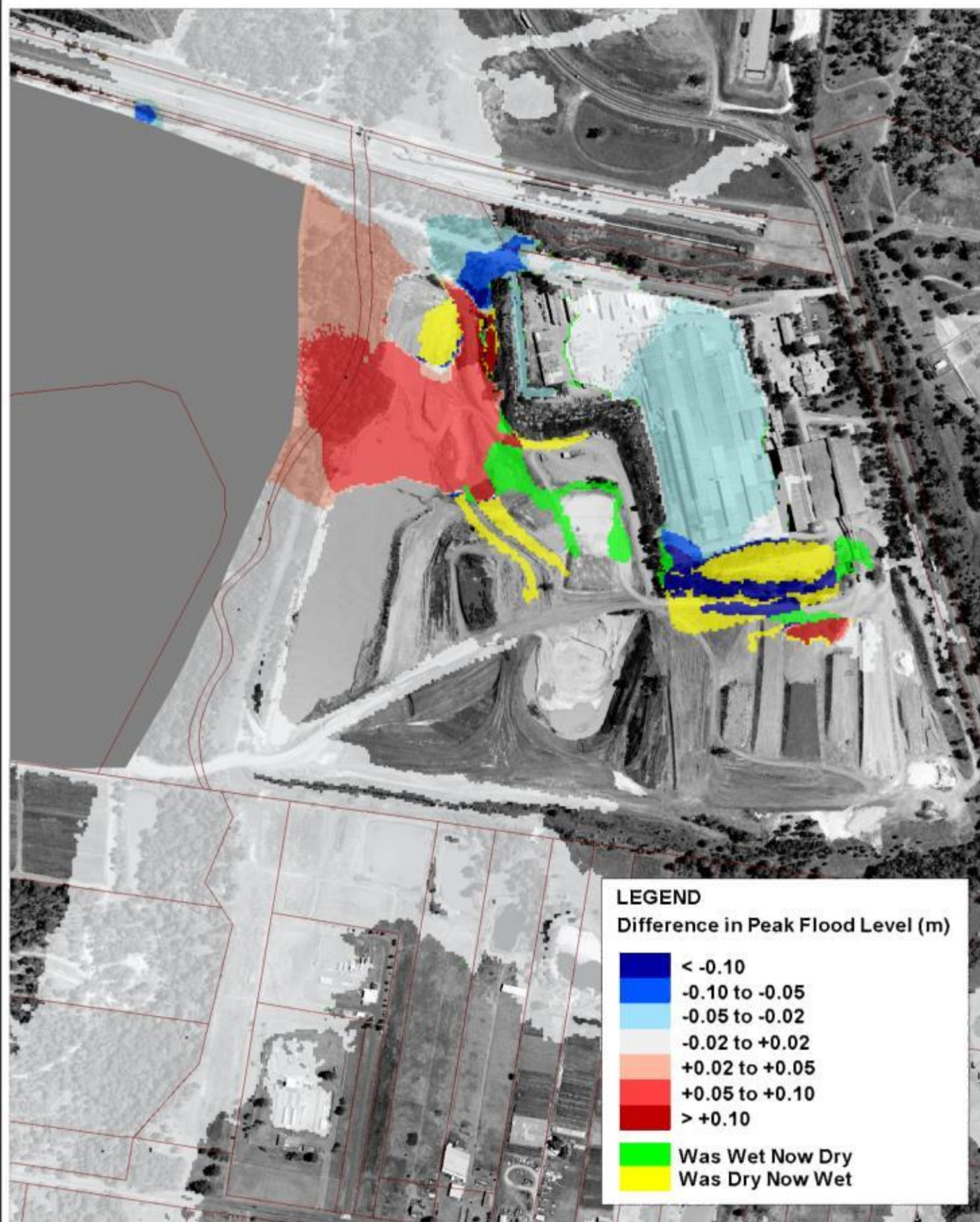
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Title:
**Flood Level Impacts - Development versus Pre Developed
Probable Maximum Flood (PMF)**

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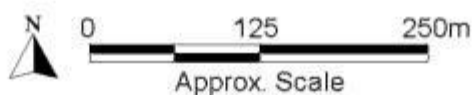


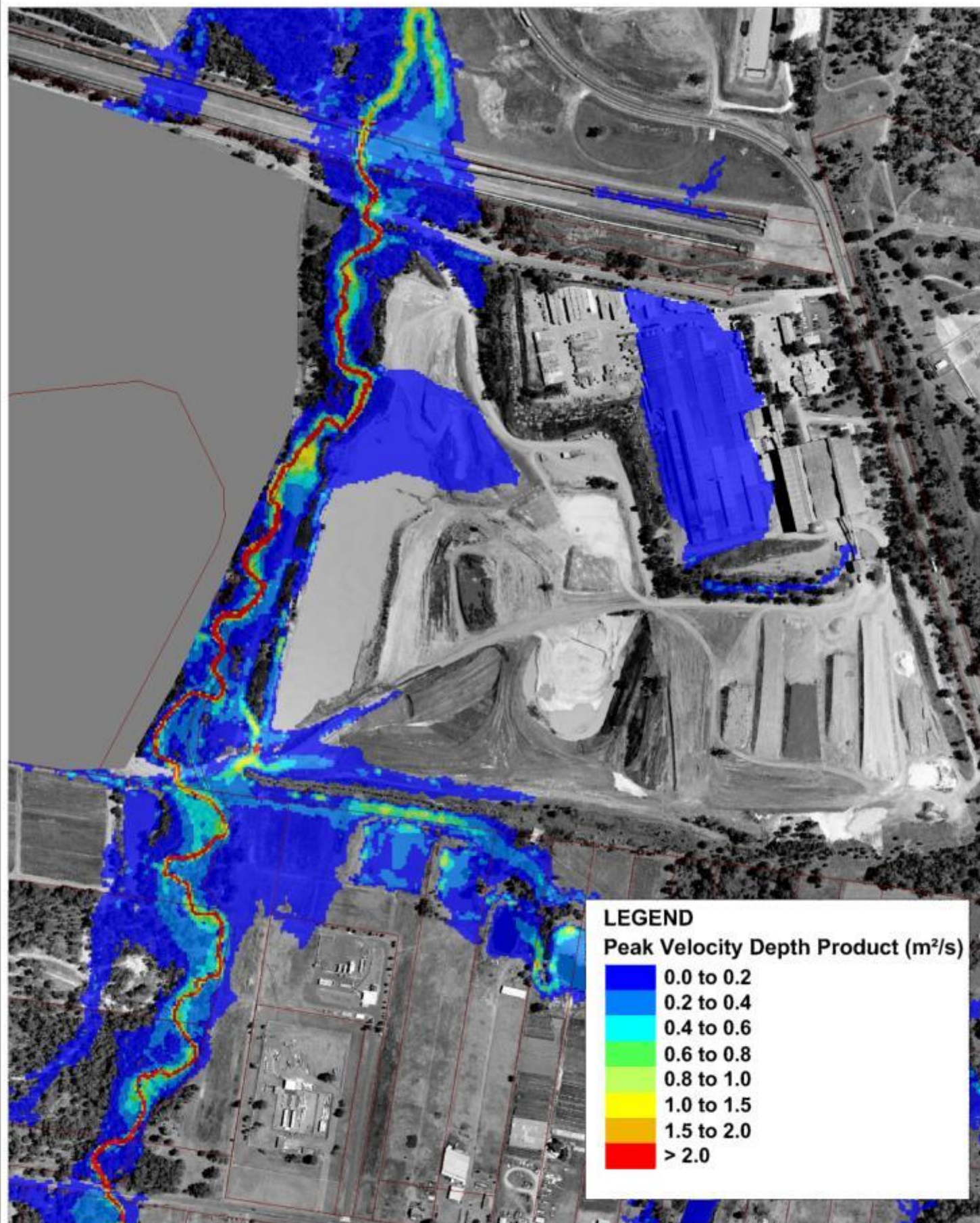
Figure:

A-3

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Appendix B Velocity-Depth Product Mapping



Title:
**Pre Development -Velocity Depth Product
5% AEP (20 yr ARI)**

Figure:

B-1

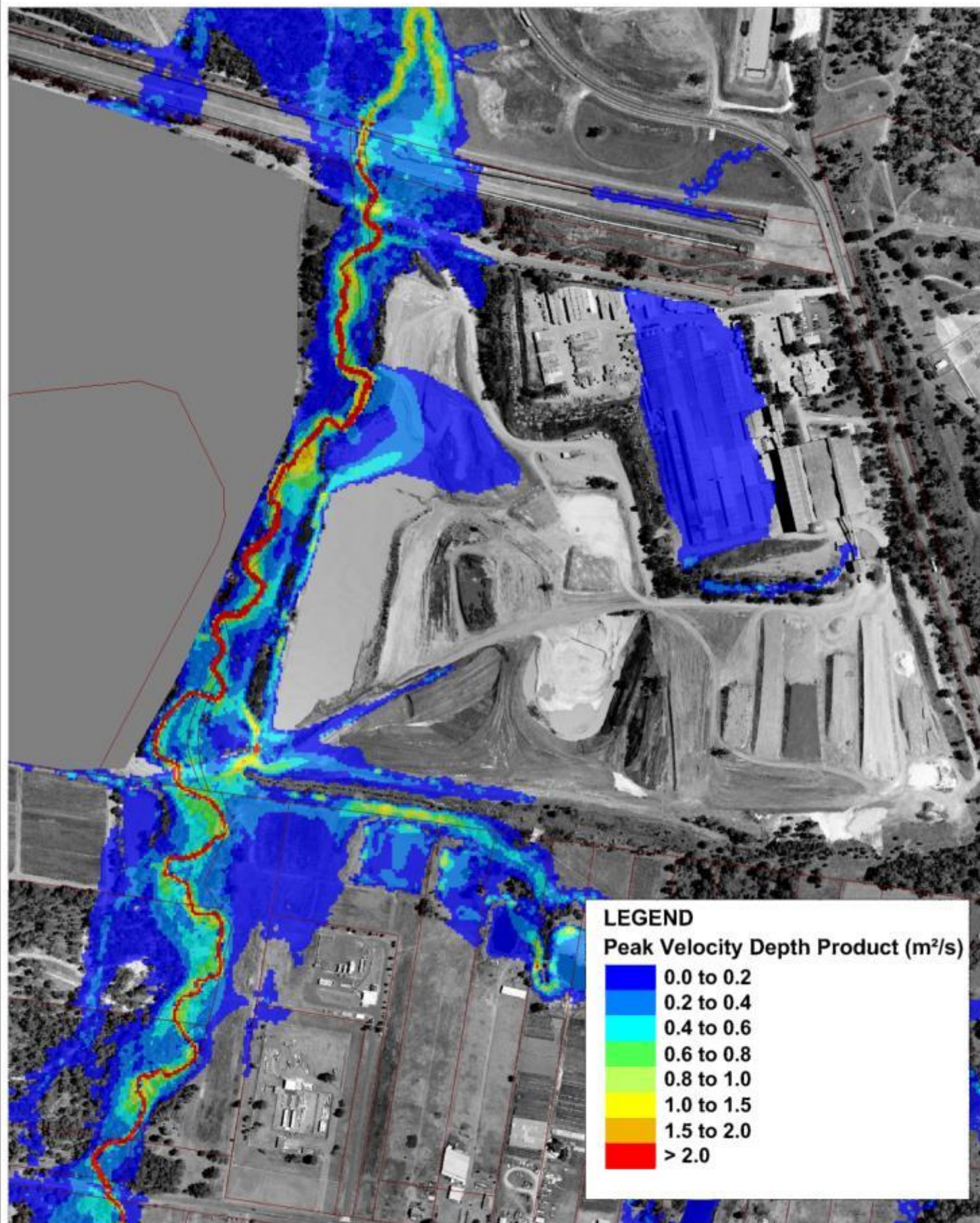
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Title:
**Pre Development -Velocity Depth Product
1% AEP (100 yr ARI)**

Figure:

B-2

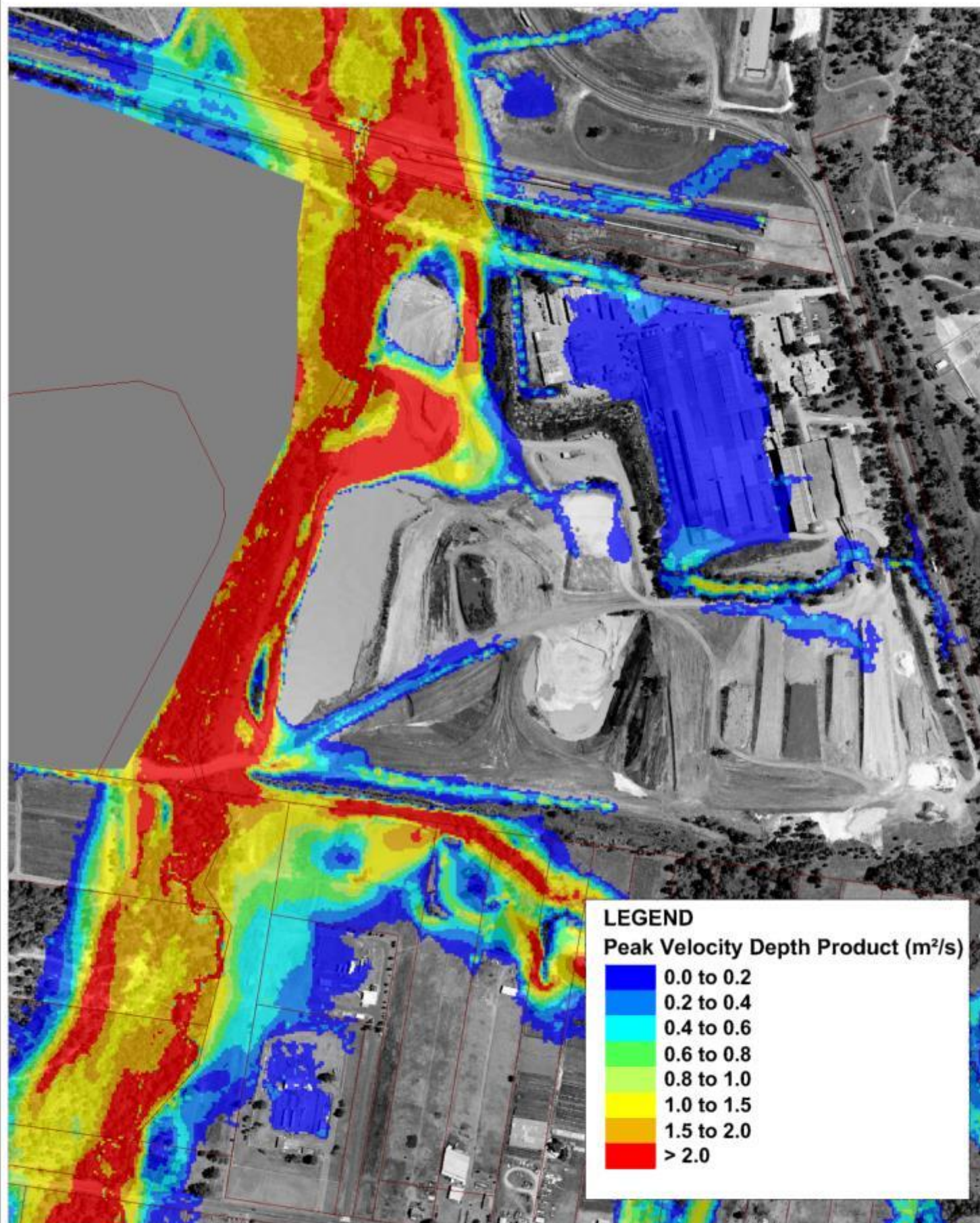
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Title:
**Pre Development -Velocity Depth Product
Probable Maximum Flood (PMF)**

Figure:

B-3

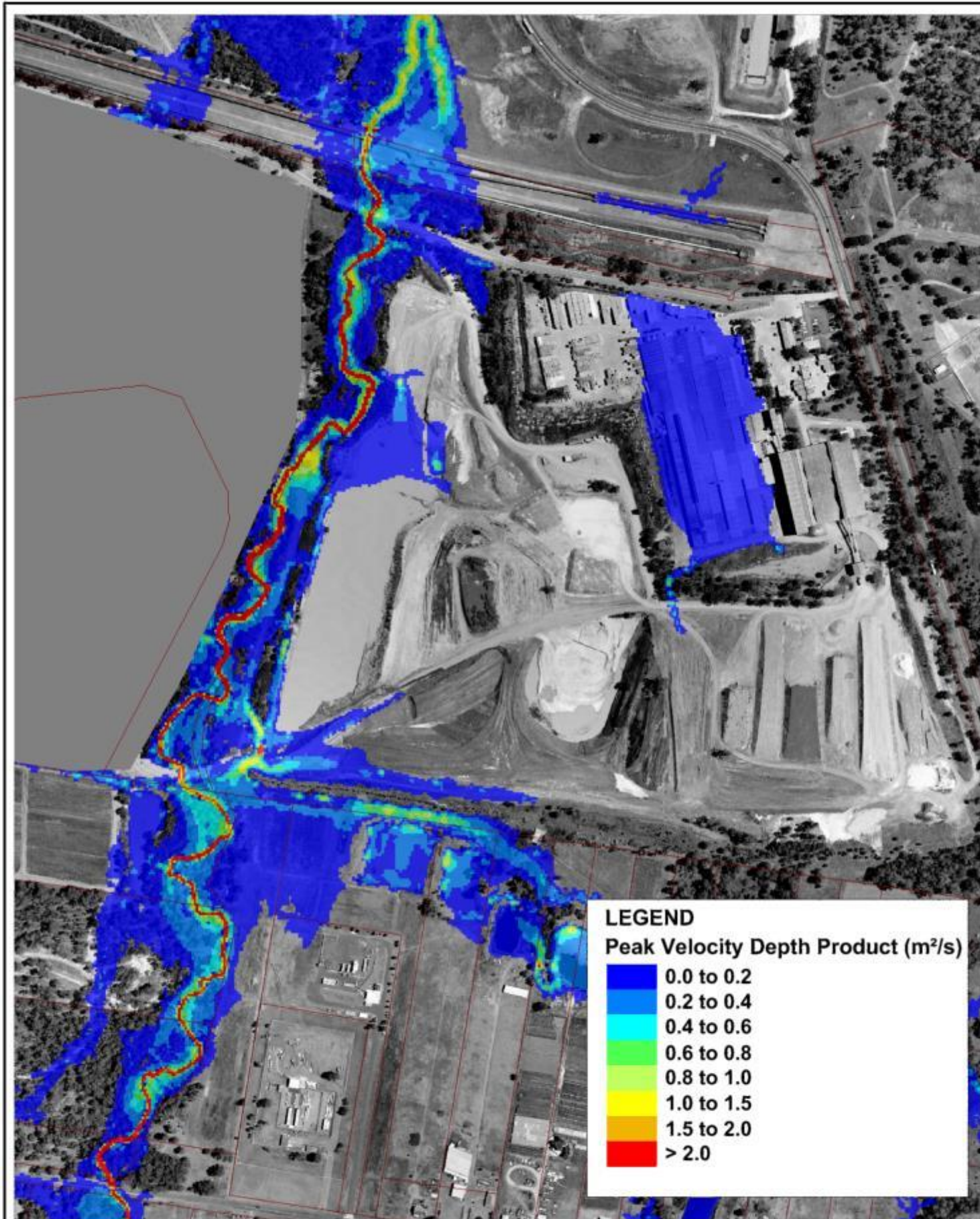
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Title:
**Post Development It2 -Velocity Depth Product
5% AEP (20 yr ARI)**

Figure:

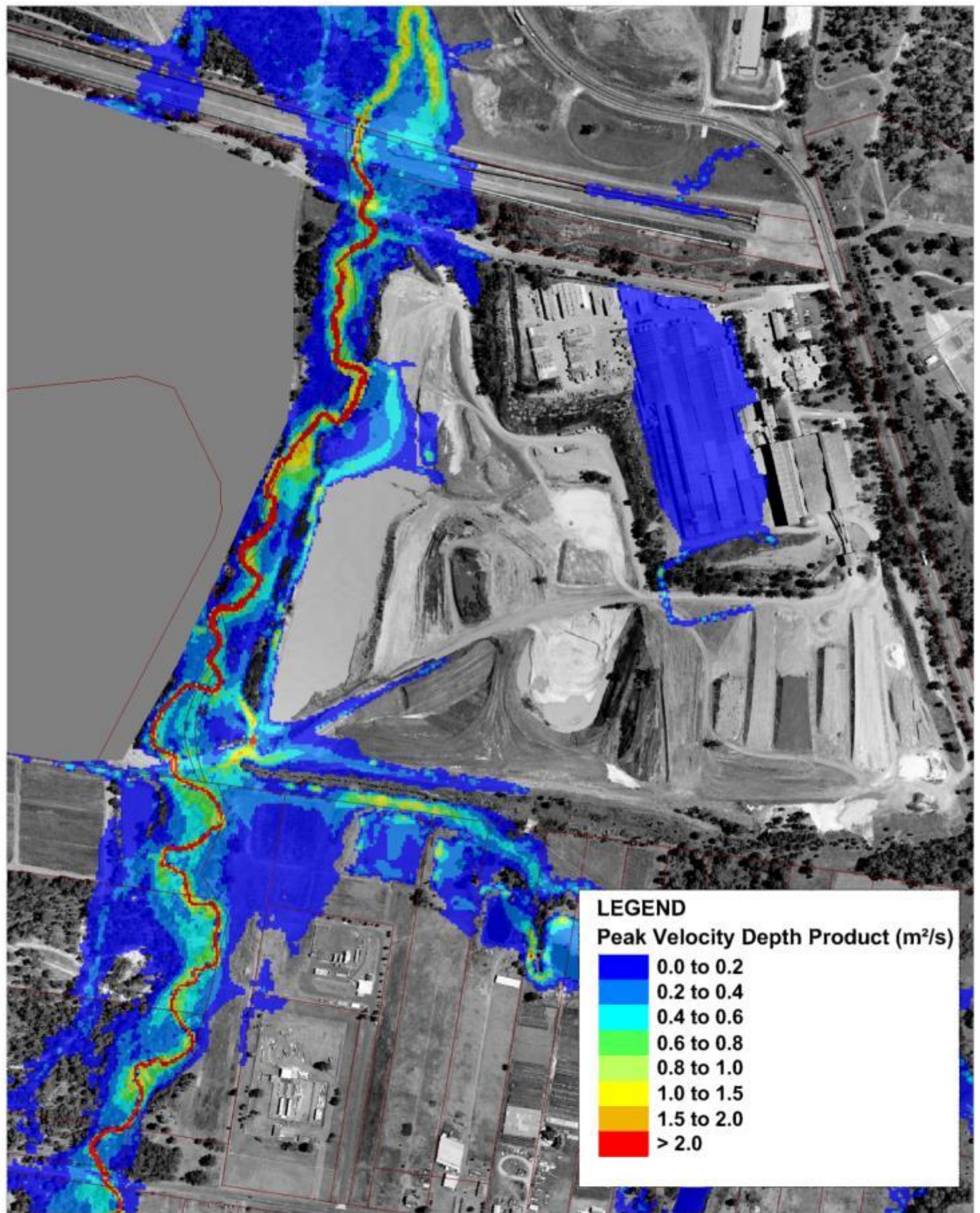
B-4

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Title:
**Post Development It2 -Velocity Depth Product
1% AEP (100 yr ARI)**

Figure:

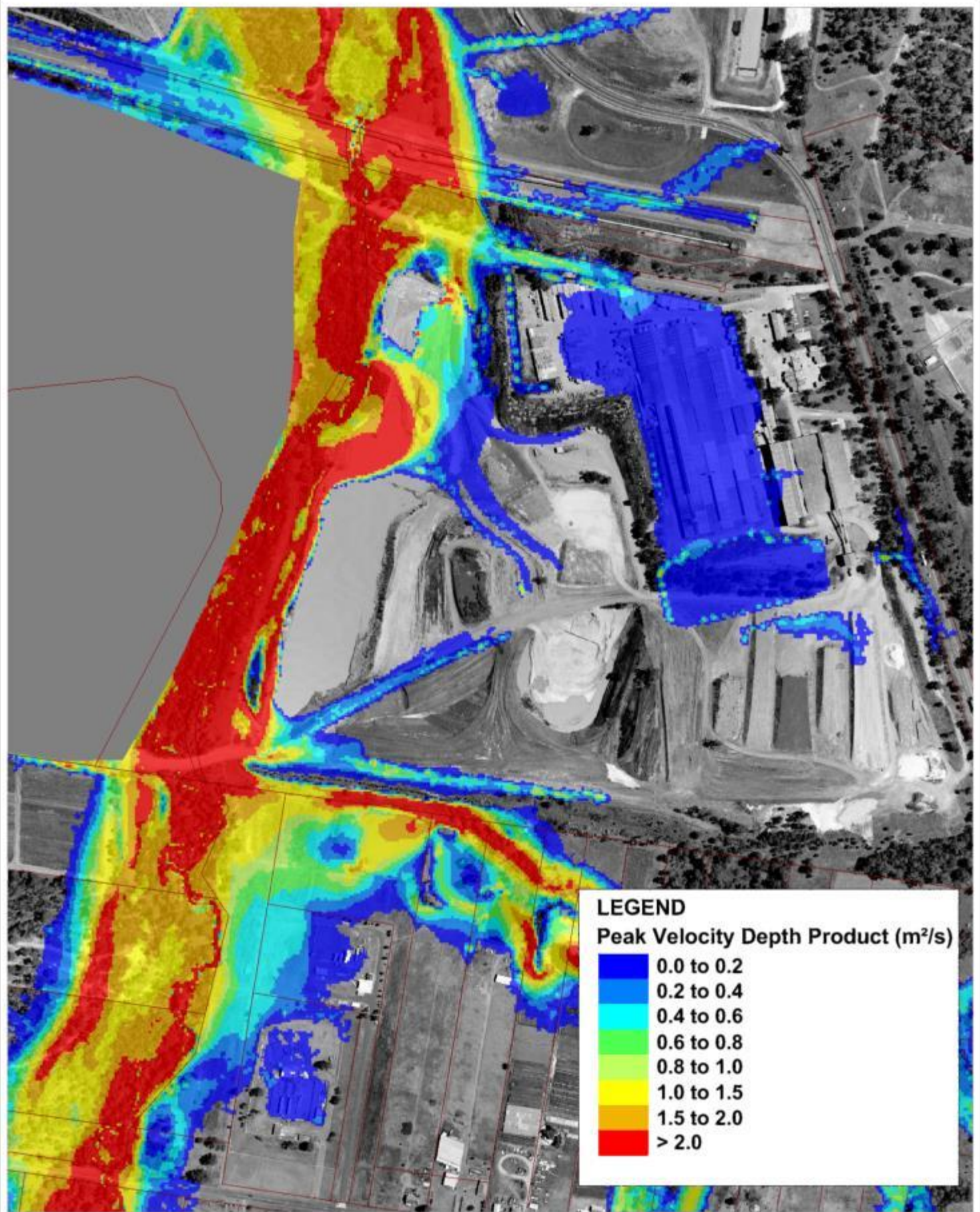
B-5

Rev:

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Title:
**Post Development It2 -Velocity Depth Product
Probable Maximum Flood (PMF)**

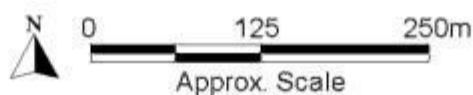
Figure:

B-6

Rev:

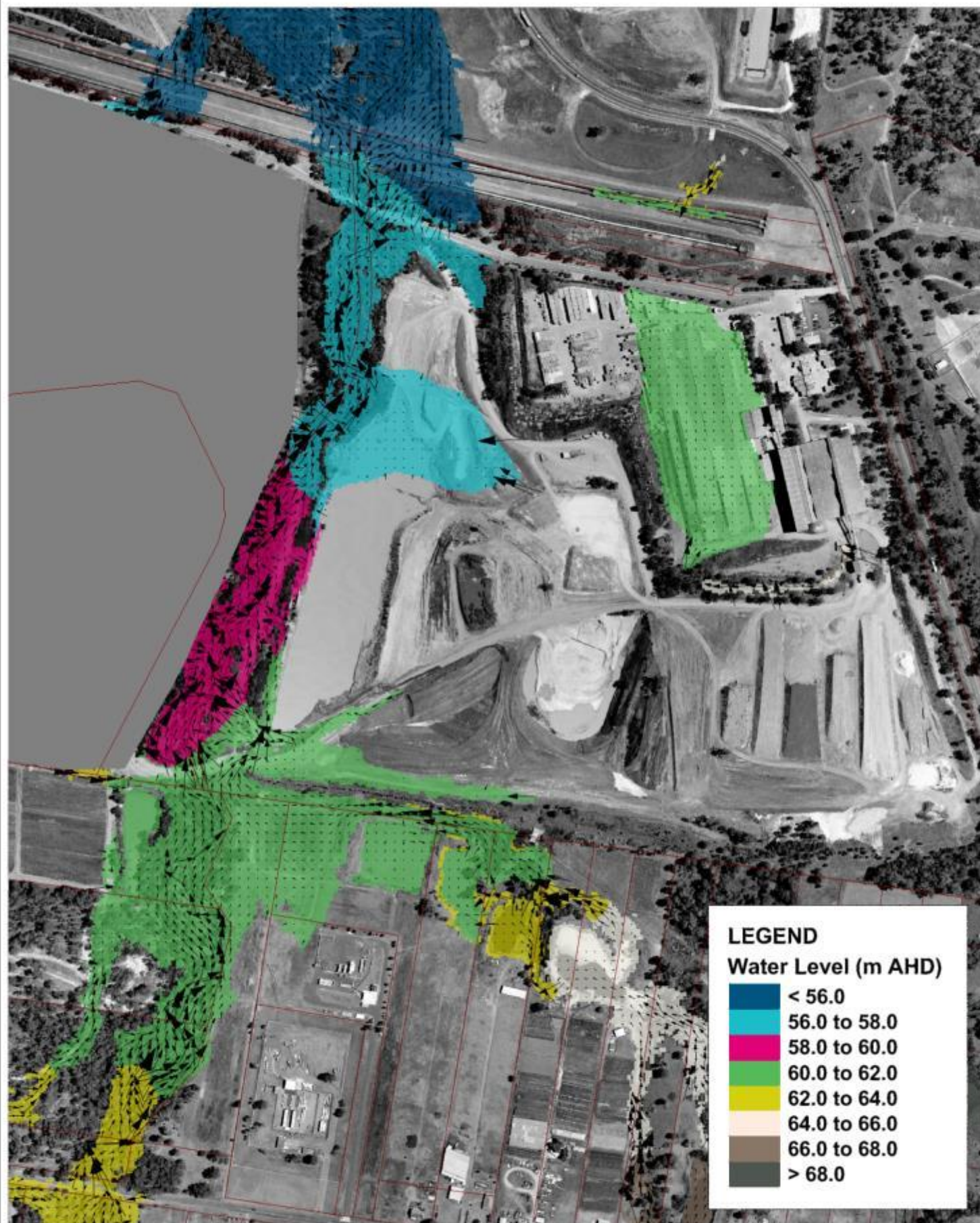
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Appendix C Peak Water Level Mapping



LEGEND

Water Level (m AHD)

| |
|--------------|
| < 56.0 |
| 56.0 to 58.0 |
| 58.0 to 60.0 |
| 60.0 to 62.0 |
| 62.0 to 64.0 |
| 64.0 to 66.0 |
| 66.0 to 68.0 |
| > 68.0 |

Title:

**Pre Development -Peak Flood Level
5% AEP (20 yr ARI)**

Figure:

C-1

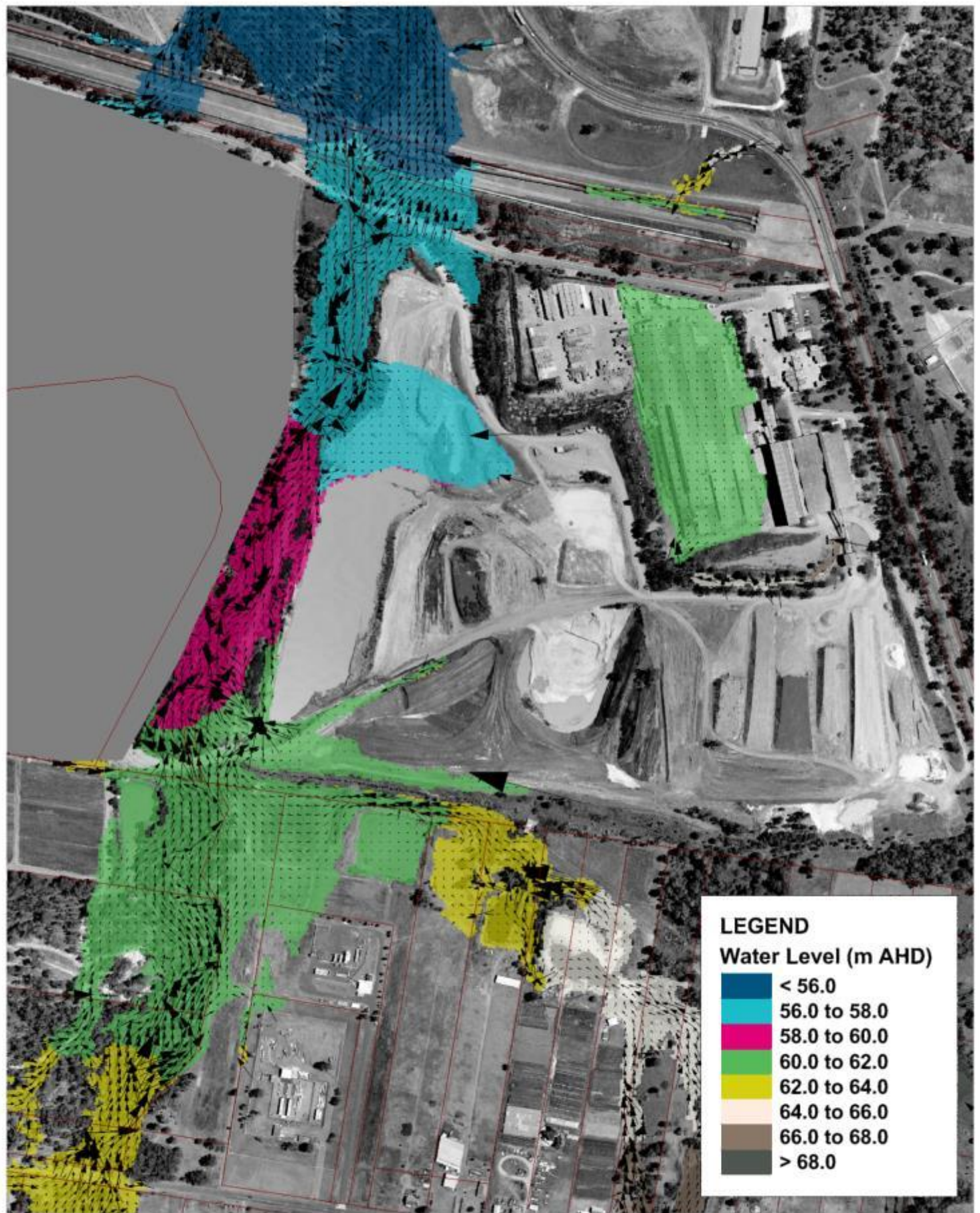
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Title:
**Pre Development -Peak Flood Level
 1% AEP (100 yr ARI)**

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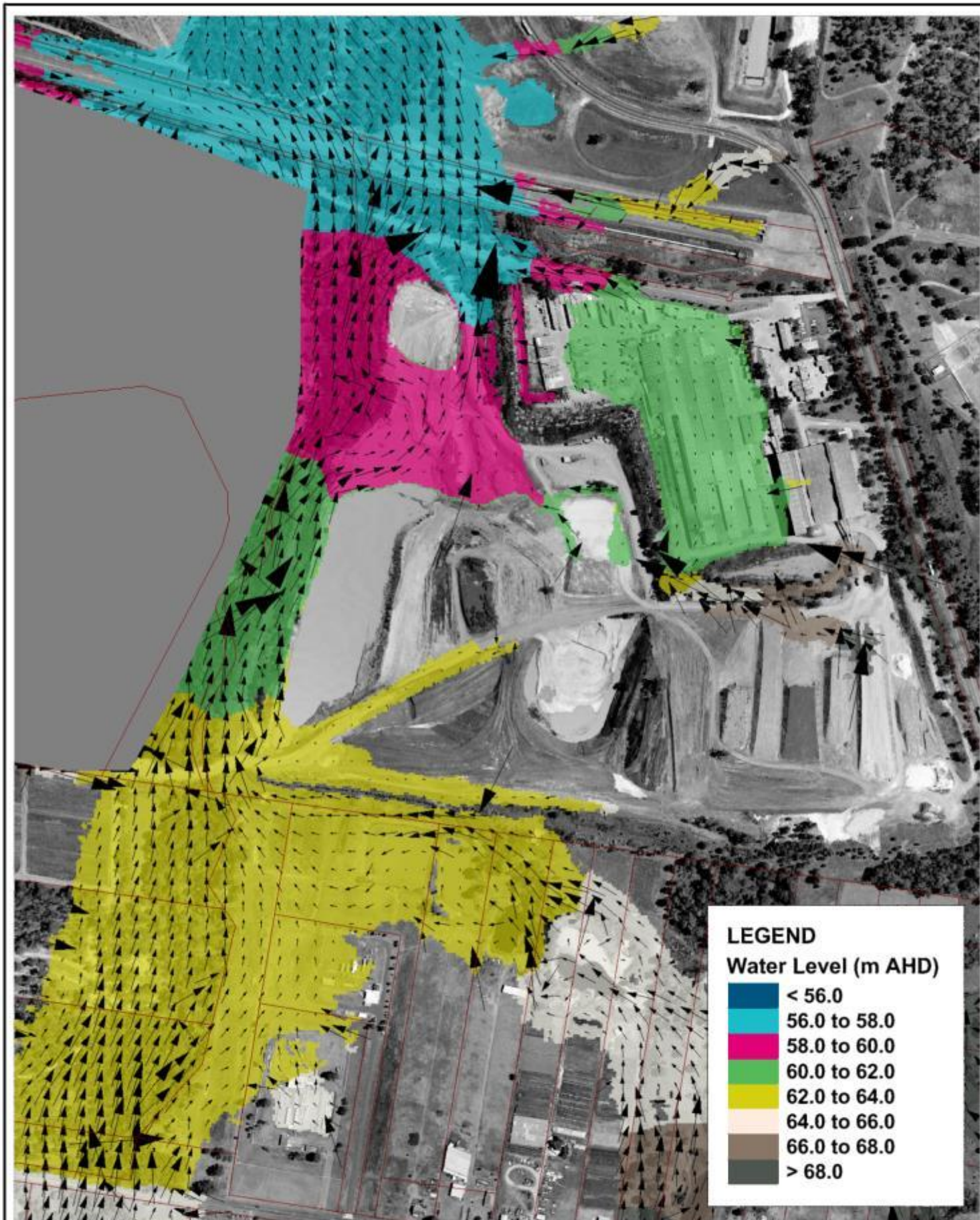


Figure:

C-2

Rev:

-



Title:
**Pre Development -Peak Flood Level
 Probable Maximum Flood (PMF)**

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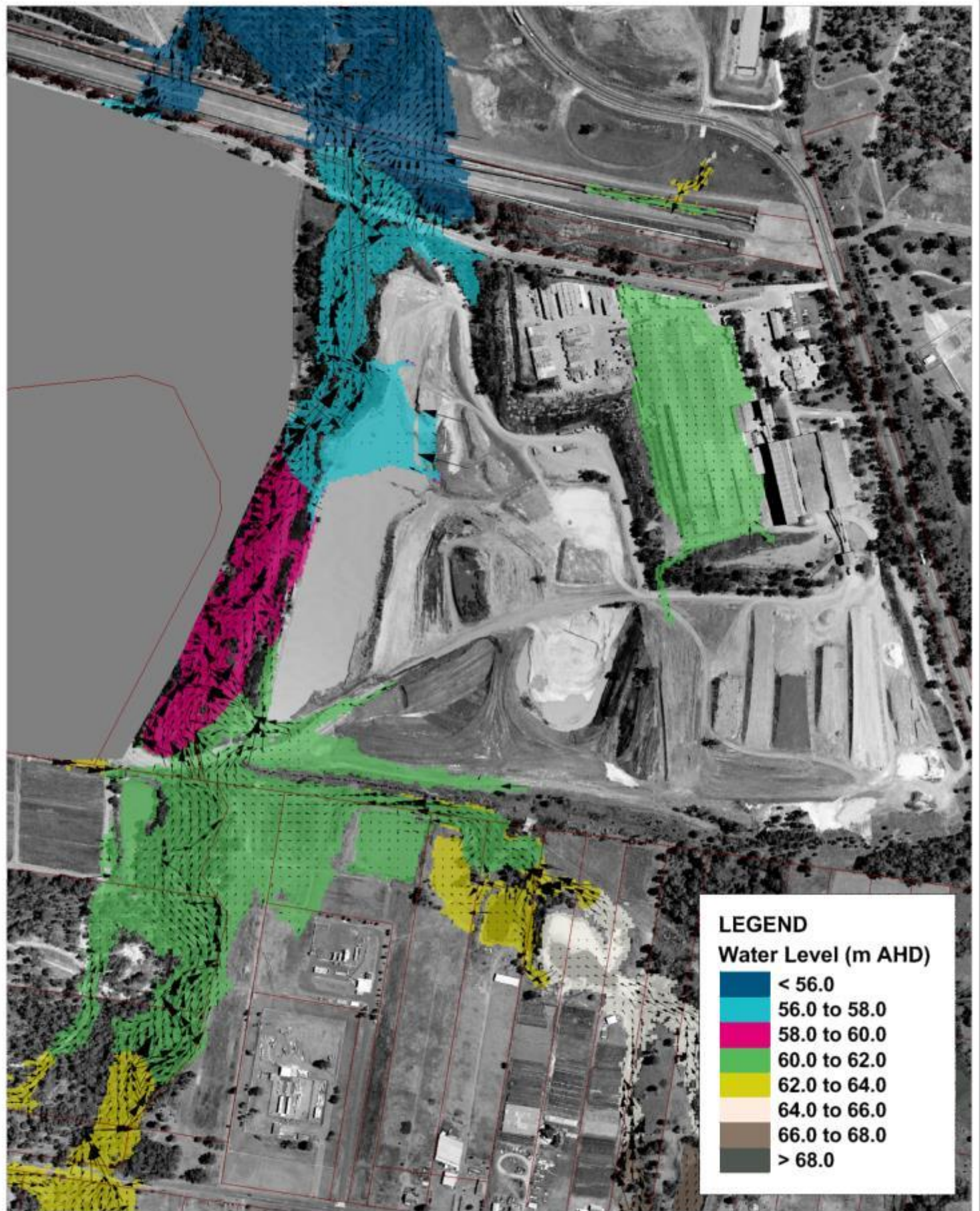


Figure:

C-3

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Title:
**Post Development It2 -Peak Flood Level
5% AEP (20 yr ARI)**

Figure:

C-4

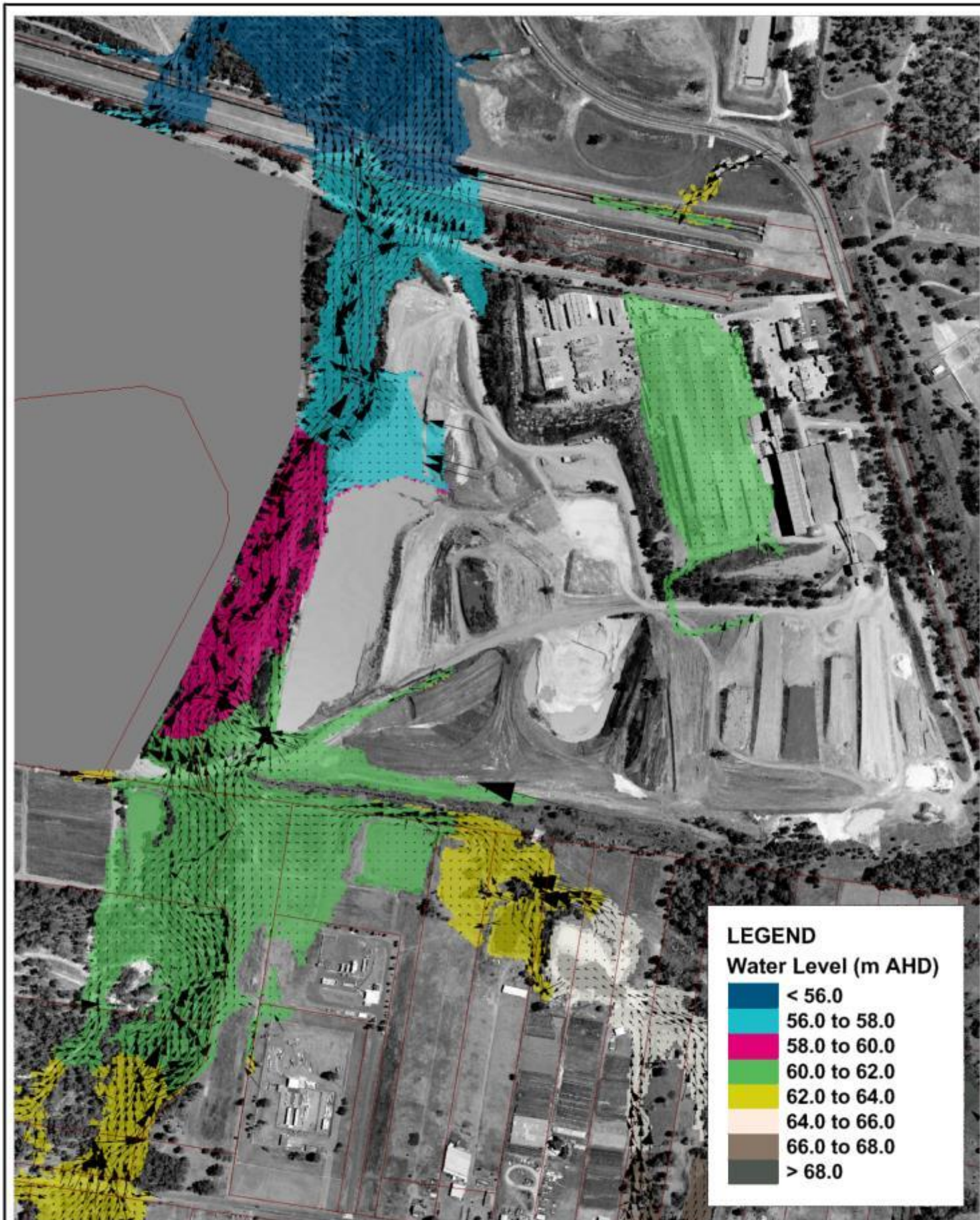
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Title:
**Post Development It2 -Peak Flood Level
1% AEP (100 yr ARI)**

Figure:

C-5

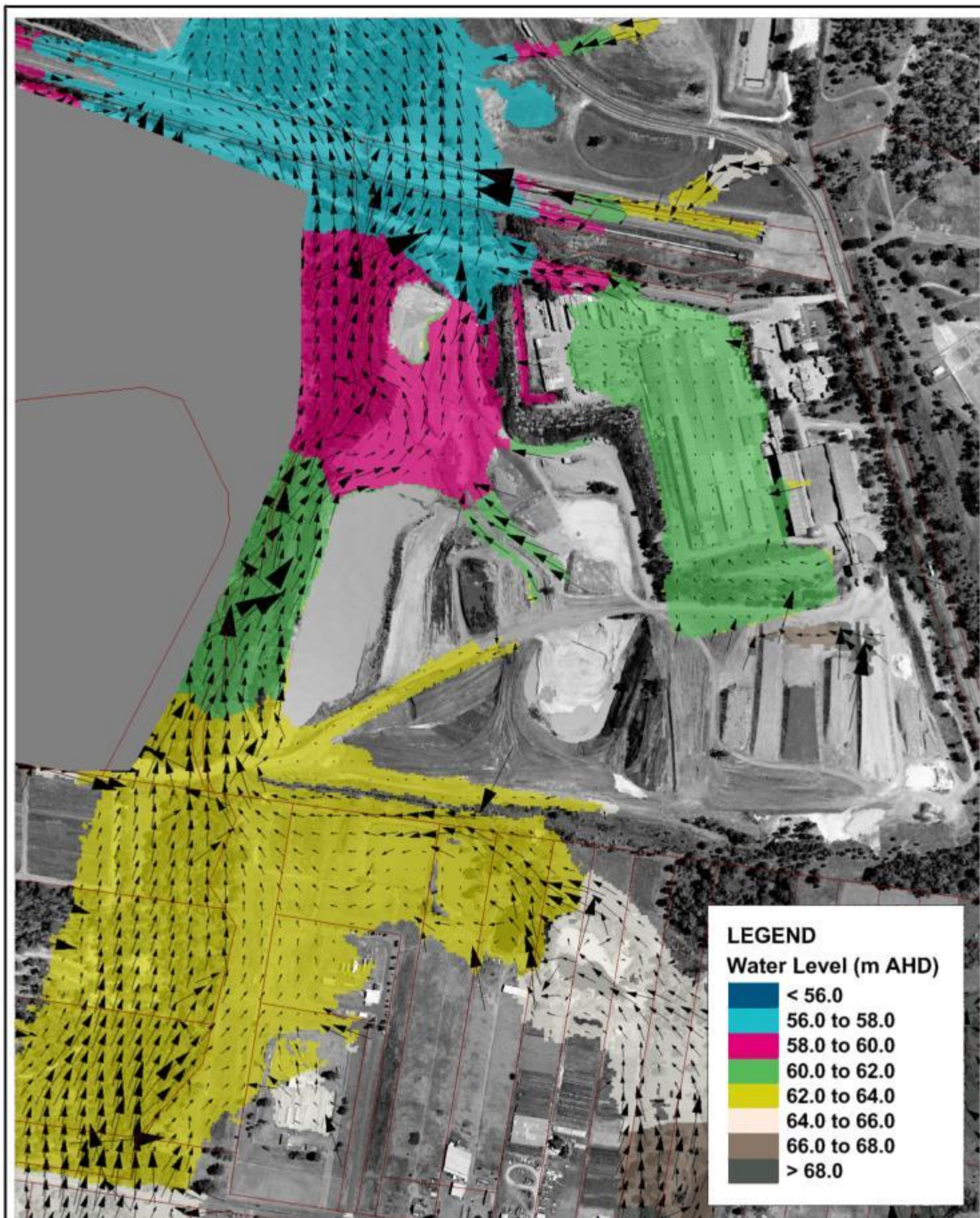
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Title:
**Post Development It2 -Peak Flood Level
 Probable Maximum Flood (PMF)**

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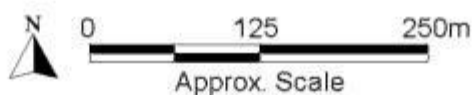


Figure:

C-6

Rev:

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