

at&l

# **Brickworks Plant 2 Yard Extension Soil and Water Management Plan & Civil Engineering Design Report**

**CLIENT/** BRICKWORKS LTD

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# 1. Introduction

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## 1.1. Background

AT&L was commissioned by Brickworks Limited to prepare a Soil and Water Management Plan and Civil Servicing Report in support of a Development Application for a proposed industrial development at 780 Wallgrove Road, Horsley Park. The site is situated within the Fairfield City Council local government area.

## 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. It is legally described as Lot 7 on DP1059698.

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 20-782-C002 enclosed under Appendix A which shows the proposed development area in the context of the wider parent site.

## 1.3. Current Plant 2 Upgrade Works

The Plant 2 factory building and surrounding infrastructure are currently being upgraded as part of an earlier separate Development Consent Ref. SSD-9601 approved in May 2020. Works under that approval included:

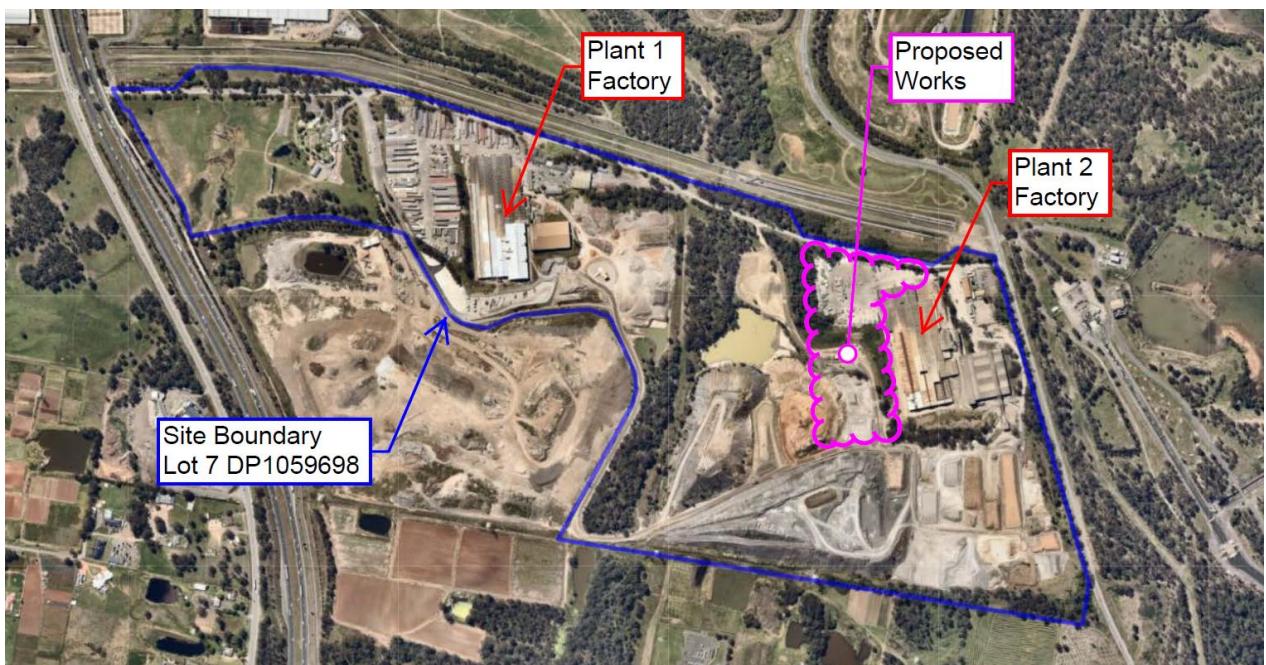
- Partial demolition of existing Plant 2 facility and existing kilns and installation of a new kiln
- Extension of the existing Plant 2 production building
- New hardstand areas around the Plant 2 building with associated pavements and retaining walls
- Stormwater drainage works and a new stormwater detention basin
- New retaining walls
- New internal fire access road

The works described in this report have been designed to augment these previously-approved works and will connect smoothly in all interface areas.

## 1.4. Existing Quarry Works

The manufacture of bricks and extraction of clay and shale on the wider site are covered by an existing Development Approval (Ref. DA 145/20/33). This includes stockpiles, visual bunds, dust control etc. which will continue to occur around the periphery of the proposed development area. The new works will be designed to tie in smoothly at the interface with surrounding quarry areas.

**Figure 1 – Existing Site Aerial Photo**



## 1.5. Proposed Development

The proposed development involves the construction of a new storage yard to the west of Plant 2 and redevelopment of an existing storage yard immediately to the north of Plant 2. These new yards will be provided with hardstand pavements and cover a total area of approximately 3.5 hectares. Associated works will include an extension to the existing stormwater basin, a new gatehouse building for incoming and outgoing vehicles and a new driveway and waiting area on the existing site access road.

Refer to Figure 1 above for the indicative location of the proposed development works and the architectural layout plans prepared by SBA included within Appendix F.

## 2. Bulk Earthworks

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### 2.1. 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. It is noted that this geotechnical report was compiled for a previous development proposal which is now obsolete, however the geotechnical results are still relevant.

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

In the area specific to this proposed development, the investigation generally found that the site contains a layer of fill from the surface up to 4m depth (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. In the absence of any historic Level 1 reporting, the existing fill layer must be considered uncontrolled.

CBR testing undertaken on the fill layer in the subject area revealed values ranging from 4% to 9%. Emerson Class testing also indicated Class 2 soils which equates to a moderate potential for dispersion.

### 2.2. Proposed Bulk Earthworks

Bulk earthworks will be required in order to create suitable ground levels for the construction of the new hardstand areas.

Refer to AT&L Drawings 20-782-C020 to C022 contained within Appendix A for the proposed bulk earthworks plans.

#### 2.2.1. Excavation

The required total cut volume is estimated to be approximately 64,000m<sup>3</sup> across the site. This volume is primarily generated from excavation into the existing ground under the proposed storage yard footprints to allow for new pavement construction.

Excavated 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 already numerous existing stockpile areas spread across the wider Brickworks site, which are managed under a separate approval (Ref. DA 145/20/33).

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. Deeper excavations into the higher strength shale or siltstone are unlikely to be required for the proposed but would demand the use of specialist rock breaking equipment.

Small batters will likely be required around the perimeter of the site to tie in with existing quarry surface levels. The maximum permanent batter slope has been adopted as 1V:2H, subject to further geotechnical advice and stabilisation measures which are likely to include planting with low-maintenance vegetation.

## 2.2.2. Filling

Bulk earthworks filling is not required for the development.

## 2.3. Eastern Creek Riparian Zone

No bulk earthworks are proposed within the Eastern Creek riparian zone. The creek alignment is located over 100m to the west of the proposed extent of the new hardstands. The proposed stormwater basin extension works are located within approximately 50m of the creek corridor.

Due care will be required during all civil construction works to ensure the downstream environment is adequately protected. Refer to Section 3.8 below for discussion on the proposed erosion and sediment control strategy for the site.

## 2.4. Groundwater

In June 2015 Douglas Partners undertook a geotechnical investigation of the subject site, the results of which are included in Report No.84821.00. 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 borehole to the proposed development area (Borehole No.4) was RL57.9 (approx. 4m deep) as observed during drilling and considered likely to be a perched water table in the fill. Whilst finished surface levels of the proposed development are generally well 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.

## 2.5. 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 Management

### 3.1. Existing Hydrology

There are four primary discharge points to Eastern Creek from the eastern part of the parent site (which includes the proposed development area):

- 1) via the existing drainage channel at the northern edge of the site (Catchment A)
- 2) via the recently-constructed Plant 2 stormwater basin (Catchments B and D)
- 3) via the existing quarry dam (Catchment C)

The corresponding catchments are described below and shown indicatively in Figure 2. The green circles represent the existing discharge points listed above.

#### 3.1.1. Existing Catchment A

This catchment covers approximately 5.1ha of area including the northern portion of the Plant 2 factory building, the adjacent northern hardstand, the internal access road/quarry entry and surrounding vegetated areas. Runoff from this catchment is captured by an existing open drainage channel which flows west into Eastern Creek.

Since the proposed development extents encompass some of this catchment area, some aspects of the catchment will be reconfigured to suit, refer Section 3.2 below.

#### 3.1.2. Existing Catchment B

This catchment covers an area of approximately 5.7ha focused on the southern half of the Plant 2 factory, the existing clay pan and crusher buildings, surrounding storage/loading pavements and some landscaped batters. Runoff from this catchment drains via an existing 1200mm diameter trunk pipe outlet (under Catchment C) to the recently-constructed stormwater basin in the northwest corner of the site. This basin provides treatment prior to release of flows to Eastern Creek.

No changes are proposed to this catchment as part of the proposed development.

#### 3.1.3. Existing Catchment C

This existing catchment contains all the quarry/stockpile areas on the eastern side of Eastern Creek as well as the existing quarry dam to which they drain. Total catchment area is approximately 30.6 hectares. All runoff from this catchment ultimately finds its way into the dam via two main drainage routes marked in Figure 2 below. The dam functions as a large sediment basin for primary treatment before water is pumped out to the Plant 1 sediment basin (which is controlled and flocculated to provide secondary treatment of sediment) prior to release into Eastern Creek.

No changes are proposed to this catchment as part of the proposed development.

### 3.1.4. Existing Catchment D

This catchment contains the recently-constructed stormwater detention and sediment treatment basin in the northwest corner of the site. The catchment covers approximately 0.84 hectares. The existing basin currently accepts piped flows from Catchment B and discharges directly to Eastern Creek via an outlet pipe.

The stormwater basin will be enlarged as part of the proposed development to allow for additional piped flows to enter from the new hardstand areas, refer Sections 3.2.4 and 3.4 below.

**Figure 2 – Existing Stormwater Catchments**



**Table 3.1 – Existing Catchment Composition**

Catchment	Type	Area	Discharge Point
<b>A</b>	Roof, Pavements & Landscaping	5.15 ha	Eastern Creek
<b>B</b>	Roof, Pavements & Landscaping	5.71 ha	Existing Stormwater Basin
<b>C</b>	Quarry/Stockpiles	30.6 ha	Existing Quarry Dam (then to Plant 1 Basin)
<b>D</b>	Basin	0.84 ha	Existing Stormwater Basin

## 3.2. Proposed Hydrology

The area containing the proposed development extents has been divided into logical sub-catchment areas based on proposed hardstand grading and proposed drainage infrastructure discharge points. Refer to Figure 3 below which shows the indicative extents of the proposed stormwater catchments.

The corresponding catchments are shown indicatively in Figure 3.

### 3.2.1. Proposed Catchment 1

Catchment 1 primarily contains the new storage yards which are proposed to be covered in impervious pavements.

There is a significant increase in impervious area within Catchment 1 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 collecting this catchment will be routed through the existing on-site detention basin in the northwest corner of the site, which will be enlarged to allow for the increase in contributing catchment.

Catchment 1 will ultimately discharge to the Eastern Creek corridor via the existing basin outlet arrangements i.e. low-level pipe and high-level spillway.

This catchment is split into 1A and 1B to account for the staged construction of Phases 1A and 1B of the hardstand works.

### 3.2.2. Proposed Catchment 2

Catchment 2 covers the existing concrete hardstand areas to the north and northwest of the Plant 2 factory building which are proposed to be replaced with new pavement during Phase 1C.

The catchment is divided into 2A (approx. 8,600m<sup>2</sup>) and 2B (approx. 14,100m<sup>2</sup>), since the piped networks collecting runoff from the surfaces will discharge into the existing drainage channel at two separate locations. Proprietary stormwater treatment devices are proposed to be installed prior to the outlet discharge points of these lines, refer to Section 3.5 below for further detail.

Since there is no increase in impervious area proposed in this catchment, it is not intended to provide any stormwater quantity/detention treatment. The existing drainage channel will be maintained as the discharge point and will actually receive reduced peak flows due to a slight reduction in the overall catchment area.

### 3.2.3. Proposed Catchment 3

Catchment 3 is a small impervious catchment (approximately 1,000m<sup>2</sup>) created by the new driveway and waiting bay to be constructed as part of Phase 3 of the development. As per existing conditions this catchment will continue to drain into the adjacent drainage channel as it is not feasible to collect it and convey it to any stormwater treatment devices.

### 3.2.4. Proposed Catchment 4

Catchment 4 contains the existing stormwater basin (i.e. Existing Catchment D) including the proposed extension at the southern end of the basin which creates a small increase in impervious percentage (but not total catchment area). Some modification works are required to the existing inlet headwall.

### 3.2.5. Existing Catchments A, B and C

Existing Catchment A is reduced in size as a result of the hardstand areas being split out as part of the new development.

Existing Catchment B remains unchanged and continues to drain to the stormwater basin. The trunk outlet pipe underneath Proposed Catchment 1 will be protected during works. Some minor works are required to the headwall location to allow for the proposed basin extension.

Existing Catchment C is reduced in size since the central quarry/stockpile area is converted into the proposed hardstand development (Catchment 1). This catchment continues to discharge to the quarry dam.

Ongoing changes to ground levels in these areas are subject to the existing quarry DA 145/20/33. The quarry operator will continue to ensure free drainage of stormwater runoff to the quarry dam from these areas.

**Table 3.2 – Proposed Catchment Composition**

Catchment	Surface	Proposed Area	Discharge
1A	Pavements	1.22 ha	Discharge to enlarged OSD/sediment basin for attenuation of peak flows prior to release to existing dam
1B	Pavements	0.91 ha	
	<b>Total</b>	<b>2.13 ha</b>	
2A	Pavements	0.86 ha	Piped discharge to existing northern drainage channel (to Eastern Creek)
2B	Roof	0.87 ha	
	Pavements	0.58 ha	
	<b>Total</b>	<b>2.31 ha</b>	
3	<b>Total</b>	<b>0.10 ha</b>	Sheet flow into existing northern drainage channel (to Eastern Creek)

<b>4</b>	<b>Total</b>	<b>0.84 ha</b>	Basin low-level (pipe) and high-level (spillway) outlets to Eastern Creek
<b>EX A</b>	<b>Total</b>	<b>2.17 ha</b>	Reduced area - continues to discharge to creek
<b>EX B</b>	<b>Total</b>	<b>5.71 ha</b>	Unchanged, continues to discharge to basin
<b>EX C</b>	<b>Total</b>	<b>29.05 ha</b>	Reduced area - continues to discharge to existing quarry dam

**Figure 3 – Proposed Stormwater Catchments**



### 3.2.6. External Catchments

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

### 3.2.7. 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. Total storage capacity is approximately 14,000m<sup>3</sup>. 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 quarry/stockpile catchments to the south and south 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

A new underground pit and pipe network will be installed through the new hardstand area to collect and convey stormwater efficiently to designated discharge points. The “minor” stormwater drainage system will generally be sized to convey the 10 year ARI (10% AEP) storm event. The civil design includes suitable gradients applied to the surface of the new pavement areas to direct stormwater away from the buildings and towards grated gully inlet pits located in localised sag points.

Existing stormwater drainage infrastructure to remain, such as the 1200mm diameter trunk outlet from the Plant 2 factory area (Existing Catchment B) to the stormwater detention basin, must also be protected during the construction of the works.

Refer to the concept civil design documentation provided within Appendix B for further details on the proposed stormwater drainage layout. This network will be further detailed at Construction Certificate stage, including longitudinal sections.

## 3.4. Stormwater Quantity

### 3.4.1. Planning Requirements

Fairfield City Council's *Stormwater Management Policy, September 2017* Section 4.3 identifies that on-site detention (OSD) is required within the Rural Zone, within which the subject site is located, for all development greater than 30m<sup>2</sup> 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 Proposed Catchment 1 since this includes the conversion of existing bare earth quarry areas into paved impervious surfaces. 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.

Since the WaterNSW regional bulk water supply pipelines are located immediately downstream (north) of the site along the Eastern Creek corridor, it is also a requirement of WaterNSW that post-development stormwater runoff flows into Eastern Creek must be equal to or less than current conditions.

### 3.4.2. Design Standards

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

- 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 4.09m<sup>3</sup> per 100m<sup>2</sup> 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. ARR2019 procedures, including the latest rainfall data from BOM and temporal patterns from ARR DataHub have been used in the analyses.

The proposed extension to the existing detention basin has been configured and sized to mitigate peak flows for all designated storm durations for the 1 year ARI (63% AEP) and 100 year ARI (1% AEP) storm events.

### 3.4.4. Results

The results of the hydraulic analysis indicated that the proposed OSD basin detailed on AT&L Drawings C021 and C031 has sufficient capacity to mitigate the peak flows from the new development area to less than or equal to pre-development levels.

Table 3.3 below shows the comparison of pre-development versus post-development peak flows into Eastern Creek from the designated discharge points. This is important due to the presence of the bulk water supply infrastructure corridor immediately downstream.

**Table 3.3 - Pre-Development vs Post-Development Peak Flow Comparison**

Storm Event (AEP)	Storm Event (ARI)	Pre-Development Flow (L/s)	Post-Development Flow (L/s)	Difference (L/s)	% Change	Peak Flow Reduction?
63%	1	634	496	-138	-21.8%	Yes
39%	2	902	708	-194	-21.5%	Yes
20%	4.48	1,191	1,060	-131	-11.0%	Yes
10%	10	1,497	1,353	-144	-9.6%	Yes
5%	20	1,807	1,509	-298	-16.5%	Yes
2%	50	2,193	1,749	-444	-20.2%	Yes
1%	100	2,493	2,016	-477	-19.1%	Yes

It is noted that pre and post-development flows identified in Table 3.3 are total flows off the development site, including both the detention basin and open channel discharge points in the northwest corner of the site. Existing Catchments C and D are excluded from the analysis since there is no development proposed or increase in impervious area there and they continue to discharge to the existing quarry dam and creek (under separate quarry approval).

A Permissible Site Discharge calculation has also been undertaken for the areas subject to new impervious development (i.e. Catchments 1, 3 and 4) in accordance with Council requirements. Catchment 2 is excluded from this analysis since this is an existing impervious area and no increase in impervious area is proposed within its extents as part of the development. The results are shown in Table 3.4 below.

**Table 3.4 - 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	685 L/s	18 L/s	21 L/s
10 min duration		20 L/s	24 L/s
20 min duration		22 L/s	26 L/s
30 min duration		23 L/s	29 L/s
60 min duration		25 L/s	491 L/s
180 min duration		27 L/s	566 L/s
360 min duration		251 L/s	617 L/s
540 min duration		322 L/s	509 L/s

\*Note: PSD calculated based on 8.78 hectares, which includes Existing Catchment B since it is also routed through the existing stormwater basin.

### 3.4.5. Detention Basin Design

It is proposed that the necessary on-site detention capacity will be provided by an extension to the existing detention basin at the northwest corner of the Plant 2 site. This will be achieved by excavating additional volume of soil at the southern end, lengthening the basin to increase storage capacity.

The proposed basin analysed above has a total storage volume of approximately 7,300m<sup>3</sup> below the proposed emergency overflow level. This is an increase of approximately 1,300m<sup>3</sup> over existing basin capacity. It is noted that for the purposes of hydraulic analysis, the volume of the basin below the internal weir level (RL55.45) has conservatively been removed from the capacity to make allowance for temporary storage of sediment and sediment-laden water during operation of the basin.

It is proposed that the existing basin outlet configuration (summarised below) is to be maintained in its current form since hydraulic modelling confirms that this is sufficient for the increased flows:

- **Low-level outlet** - a 1200x1200mm grated inlet pit with a surface level of RL56.5 will be positioned in the corner of the basin connecting to a 525mm diameter outlet pipe to Eastern Creek. Below this level there are also small diameter T-bar decants for sediment control, although these are of limited capacity.
- **High-level outlet** – emergency spillway at RL56.8 with reno mattress lining, 6.6m base width, 300mm depth

## 3.5. Stormwater Quality

### 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.

However, since the site is located within the Western Sydney Parklands, it is subject to the State Environmental Planning Policy (Western Sydney Parklands) 2009. Clause 13 of the SEPP states the following:

*"Development consent must not be granted to any development on land in the Western Parklands unless the consent authority is satisfied that the development will have a neutral or beneficial impact on the quality of the water in the bulk water supply infrastructure shown on the Bulk Water Supply Infrastructure Map".*

The SEPP Bulk Water Infrastructure Map (BWS-004) identifies the Warragamba to Prospect Pipelines corridor, located to the immediate north of the parent site as Bulk Water Supply Infrastructure. Refer Appendix C for a copy of the map which also shows the relative location of the proposed development.

Further, Water NSW's "Guideline for Development Adjacent to the Upper Canal and Warragamba Pipeline Corridor" is applicable and states the following:

*Development consent cannot be granted in the Western Sydney Parklands, in which part the Upper Canal is located, unless the development will have a neutral or beneficial impact on the quality of the water in the bulk water supply infrastructure (State Environmental Planning Policy (Western Sydney Parklands) 2009). The Upper Canal is bulk water supply infrastructure.*

The requirement for neutral or beneficial impact can be assessed using the principles of Water NSW's *NorBE Assessment Guidelines*. Under this guideline the development would be classified in the Module 5 development class and therefore require MUSIC modelling – refer Section 3.5.4 below for details.

### 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. This primarily involves treatment of sediment-laden water running off the quarry and stockpile areas (into existing quarry dam), prior to testing and controlled release of treated water to Eastern Creek at designated locations. A robust water quality monitoring regime is in place for Eastern Creek.

Additionally, as a result of the recent Plant 2 upgrade works, a stormwater detention and sediment treatment basin was constructed in the northwest corner of the site per the Conditions of the associated Development Consent. The requirement for this basin was targeted at treatment of the impervious surfaces in Catchment B i.e. the Plant 2 roof and surrounding pavements. Prior to discharge to the creek, the outlet pipe passes through a proprietary filter unit (Ocean Protect Jellyfish 3250-12-2) which contains filter media cartridges to remove dissolved nutrients.

### 3.5.3. Proposed Treatment

As part of the proposed development works, the new hardstand areas created will need to be provided with stormwater quality treatment measures to capture and remove the pollutants they are expected to generate.

In addition to the new yards located within Catchment 1 (Phases 1A & 1B), it is proposed that the existing hardstand to be replaced in Catchment 2 (Phase 1C) will also be provided with treatment measures to assist

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with improvement of water quality in Eastern Creek.

The impervious area in Catchment 3 (driveway and waiting bay) will bypass the proposed treatment train since it is relatively minor in size and it is not feasible to direct flows from this area to one of the treatment devices. Flows will in fact receive some ad hoc treatment from the grassed verge along the edge of the roadway before entering the drainage channel.

In order to achieve the required pollutant load reductions, a treatment train approach will be implemented, including the following:

- 1) **Primary treatment** - Gross pollutant trap to remove litter and larger particles etc.
- 2) **Secondary treatment** - Sediment basin focused on removing sediment, fine particles and attached pollutants
- 3) **Tertiary treatment** – Filtration device focused on removal of dissolved nutrients such as nitrogen, phosphorous and suspended solids

The extended basin will continue to serve two functions: attenuation of peak flows (refer Section 3.4); and sediment removal. The existing automated rainfall-activated chemical dosing unit is to be relocated to the new basin inlet location to dose incoming flows 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 secondary 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 remainder of basin).

No water quality treatment is proposed for Catchment 5 since there is no development proposed within this area (only reconfiguration of existing quarry access track and bund). There is an overall reduction in exposed quarry/stockpile catchment areas on the site and it is therefore noted that this will reduce the sediment load requiring treatment in the existing quarry dam.

### 3.5.4. Water Quality Modelling

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC, Version 6.3.0) was used to evaluate pollutant loads generated from the site for both pre-development and post-development conditions. MUSIC is water quality modelling software which offers the ability to simulate both quantity and quality of runoff from catchments. Modelling input parameters were based on the Sydney Catchment Authority document *Using MUSIC in Sydney's Drinking Water Catchment* (2012).

To demonstrate that NorBE is achieved, the pollutant loads and concentrations from the post-development scenario must be equal to or less than the pre-development scenario. However, given the uncertainty of MUSIC model outcomes, Water NSW requires a modelled improvement of 10% for total suspended solids, total phosphorus and total nitrogen loads to ensure NorBE is achieved. Also nutrient concentrations for the post-development case must be equal to or less than the predevelopment case.

#### 3.5.4.1. MUSIC Model Setup

##### 3.5.4.1.1. Rainfall Data

In accordance with Fairfield City Council recommendations, the nearby rainfall station 067035 Liverpool

(Whitlam Centre) has been used for 6-minute timestep rainfall data in the MUSIC model. For potential evapotranspiration (PET) data the average Sydney region PET data was used.

### 3.5.4.1.2. Catchment Source Nodes

Different MUSIC source nodes have been used to simulate various catchment characteristics i.e. roof, sealed pavements and pervious landscaped/revegetated areas. MUSIC model input parameters for these catchments including rainfall-runoff, base flow concentration and stormflow concentration parameters were selected as per those specified in *Using MUSIC in Sydney's Drinking Water Catchment*. The parameters used for the various catchment areas can be seen in the tables below.

**Table 3.5 – Rainfall-Runoff Parameters**

Parameter	Unit	Value
Rainfall Threshold Value - Roofs	mm	0.3
Rainfall Threshold Value – Sealed Roads/Carparks/Paving	mm	1.5
Rainfall Threshold Value - Unsealed Roads	mm	1.5
Soil Storage Capacity	mm	94
Field Capacity	mm	70
Initial Soil Storage	% of capacity	30
Infiltration Capacity Coefficient	a	135
Infiltration Capacity Coefficient	b	4.0
Initial Depth (Ground Water)	mm	10
Daily Recharge Rate	%	10
Daily Baseflow Rate	%	10
Daily Seepage Rate	%	0

Note that a root soil zone depth of 0.5m was assumed per the guidelines and a soil type of medium clay was assumed in the absence of detailed site-specific geotechnical information.

**Table 3.6 – Base Flow Pollutant Concentration Parameters**

Concentration (log mg/L)	Total Suspended Solids (TSS)		Total Phosphorous (TP)		Total Nitrogen (TN)	
Surface Type	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Roofs	-	-	-	-	-	-
Sealed Roads	1.20	0.17	-0.85	0.19	0.11	0.12
Unsealed Roads	1.20	0.17	-0.85	0.19	0.11	0.12
Revegetated Land	1.15	0.17	-1.22	0.19	-0.05	0.12
Quarries	1.20	0.17	-0.85	0.19	0.11	0.12

**Table 3.7 – Storm Flow Pollutant Concentration Parameters**

Concentration (log mg/L)	Total Suspended Solids (TSS)		Total Phosphorous (TP)		Total Nitrogen (TN)	
Surface Type	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Roofs	1.30	0.32	-0.89	0.25	0.30	0.19
Sealed Roads	2.43	0.32	-0.30	0.25	0.34	0.19
Unsealed Roads	3.00	0.32	-0.30	0.25	0.34	0.19

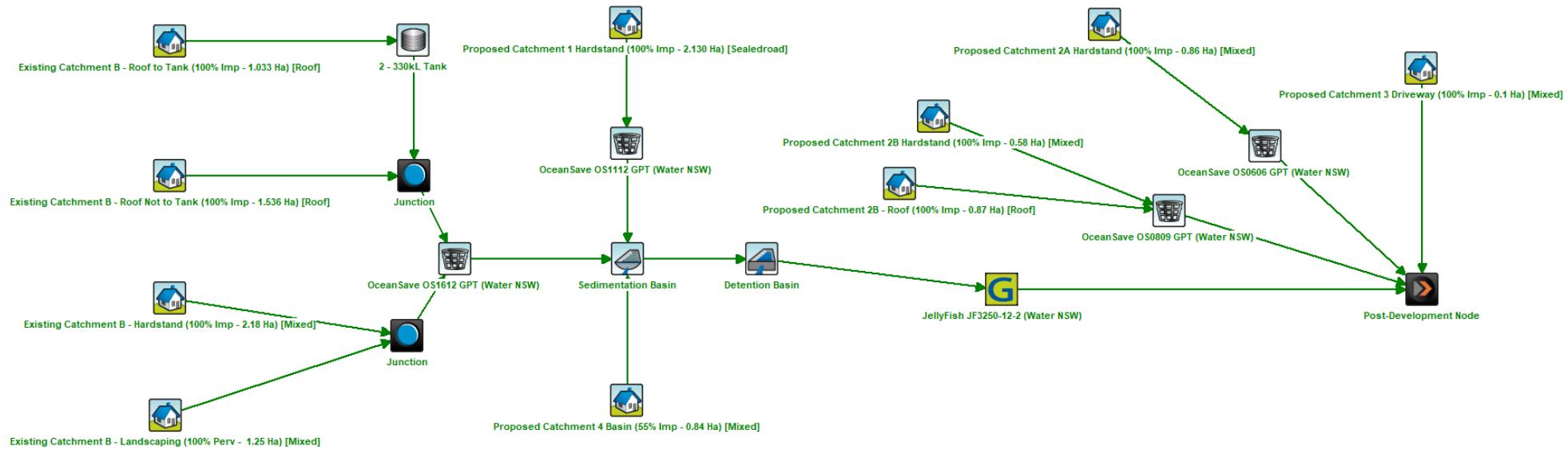
Revegetated Land	1.95	0.32	-0.66	0.25	0.30	0.19
Quarries	3.00	0.32	-0.30	0.25	0.34	0.19

### 3.5.4.1.3. Treatment Nodes

MUSIC treatment nodes for the proprietary stormwater quality improvement devices were supplied by Ocean Protect. Sediment basin, detention basin and rainwater tank nodes have been created based on the proposed design for each of these features. All treatment nodes have been configured based on WaterNSW's MUSIC modelling requirements as specified within Using MUSIC in Sydney's Drinking Water Catchment.

The treatment train has been developed on an iterative basis to find the optimal solution which meets the stormwater quality treatment requirements. A conceptual view of the MUSIC model used in this report is shown in Figure 4 below.

Figure 4 – MUSIC Model Configuration for Proposed Post-Development Treatment Train



### 3.5.4.2. Water Quality Modelling Results

#### 3.5.4.2.1. NorBE Comparison

According to WaterNSW's NorbE criteria the mean annual pollutant loads for the post-development case (including mitigation measures) must be 10% less than the pre-development case for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). For gross pollutants, the post-development load only needs to be equal to or less than pre-development load. The results listed in the table below confirms that this is achieved for the proposed development.

**Table 3.8 – NorBE Comparison of Pre-Development and Post-Development Pollutant Loads**

Scenario/Catchment	Annual Pollutant Loading (kg/year)			
	TSS	TP	TN	GP
Pre-Development <sup>[1]</sup>	24,000	22.4	135	973
Post-Development (with treatment)	2,910	11.9	97.3	81.1
Difference (Pre-Post)	-21,090	-10.5	-37.7	-891.9
% Improvement	87.9%	46.9%	27.9%	91.7%
<b>Neutral or Beneficial Effect? Y/N</b>	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>Y</b>

Notes:

- 1) For the purposes of comparison, the existing case includes the previously-approved and recently-constructed Plant 2 upgrade works since this catchment shares part of the same treatment train (i.e. sediment basin and filter unit) with some proposed catchments.

An additional WaterNSW NorBe criteria is that pollutant concentrations for TP and TN for the post-development case (including mitigation measures) must be equal to or better compared to the pre-development case for between the 50th and 98th percentiles over the five-year modelling period when runoff occurs. To demonstrate this, comparative cumulative frequency graphs, which use the Flow-Based Sub-Sample Threshold for both the pre-development and post-development cases are provided below in Figures 5 and 6.

#### 3.5.4.2.2. Treatment Train Effectiveness

The modelling results show substantial reductions in each pollutant category for the post-development mitigated scenario (based on implementation of the proposed treatment train) compared with the hypothetical unmitigated scenario.

**Table 3.9 – MUSIC Model Treatment Train Effectiveness Results**

Pollutant	Annual Pollutant Loads (kg/yr)		Reduction (%)	Council Target (%)
	Sources	Residual		
<b>Total Suspended Soils</b>	17,600	2,910	83.4	80.0
<b>Total Phosphorous</b>	32.2	11.9	63.0	55.0
<b>Total Nitrogen</b>	178	97.3	45.5	40.0
<b>Gross Pollutants</b>	2000	81.1	95.9	90.0

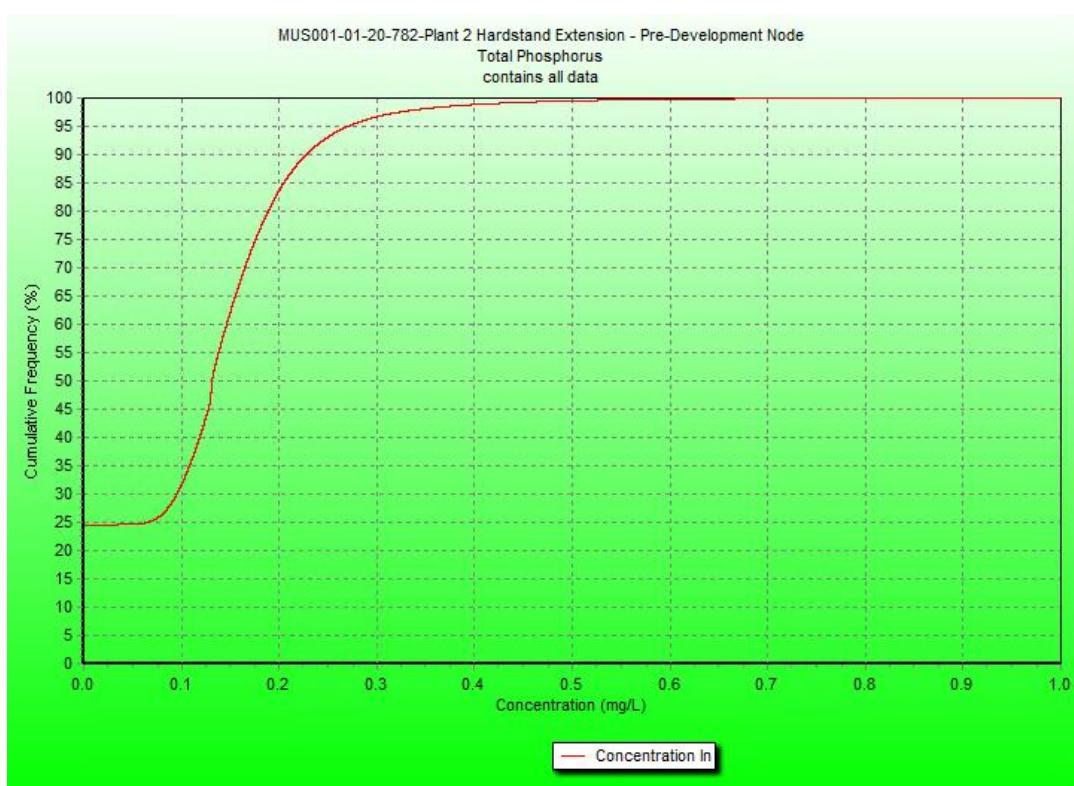
Notes:

- 1) The above table is for the complete treatment train which includes flows from the upstream Plant 2 factory catchment (Existing Catchment B) which also drains to the same basin and filter unit.
- 2) Council's Stormwater Management Policy does not require the designated targets to be achieved for sites in the Rural Zone.

**Figure 5 - TN Cumulative Frequency Pre-Development and Post-Development Comparison**



**Figure 6 - TP Cumulative Frequency Pre-Development and Post-Development Comparison**



### 3.6. Basin Operation & Maintenance

Following installation of stormwater management devices during the civil construction phase, the site owner will be responsible for the regular maintenance of these during the operational phase of the development. Since the basin is fully contained within an active manufacturing site, it will remain in private ownership by Brickworks Ltd.

Maintenance access to the basin must be provided to allow for cleaning of the basin floor and side batters. A 3.0m-wide berm has been provided around the top perimeter of the basin to allow maintenance vehicles to circulate. Two maintenance ramps constructed from concrete (maximum grade of 1V:6H) will be available along the eastern edge of the basin to allow direct access from the adjacent pavement onto the floor of the basin. The basin floor will be constructed from concrete to provide easy manoeuvrability for maintenance plant and this also clearly defines the bottom of the accumulated sediment layer.

Routine basin maintenance inspections will be undertaken on a 3 monthly-basis and also following significant storm events (over 30mm rainfall in a 24 hour period). A basin maintenance checklist shall be prepared, which will include the following:

- Litter and debris accumulation;
- Sediment accumulation;
- Condition of structures including inlet pipe outlet pit and pipe, spillway, ramps, weir. Check for debris blockage and sediment accumulation;
- Condition of vegetation – plant health, weed growth, density etc.;
- Condition of creek outlet including rock pad scour protection;
- Erosion or settlement of batters;
- Standing/stagnant water;
- Pest and mosquito control; and
- Damage or vandalism.

It is anticipated that sediment removal from the floor of the basin will occur at least once every two years. Austral's environmental staff may choose to undertake this more frequently should it be required for routine function of the basin. Maintenance will involve an excavator entering the basin via the concrete access ramps and loading out sediment. Any excavated sediment must be disposed of in an environmentally-sensitive manner so as not to cause contamination or downstream pollution.

The proprietary stormwater quality treatment units (gross pollutant trap and cartridge filter unit), located upstream and downstream of the basin respectively, will need to be serviced regularly in accordance with the manufacturer's recommendations. Usually this will involve 6-monthly maintenance inspections. Ocean Protect will provide a Maintenance Manual for the specific devices once supplied.

### 3.7. Water Conservation

Fairfield City Council's Stormwater Management Policy September 2017 Section 5.4 identifies that water conservation is required for new industrial and commercial buildings or additions of over 150m<sup>2</sup>. When this is the case, at least 80% of the new development roof area must drain to a rainwater tank which has a capacity of 3,000L per 100m<sup>2</sup> of roof area. The tank is to be connected for non-potable uses such as toilet-flushing and irrigation.

Since the proposed development only includes a small gatehouse building, with approximate roof area 99m<sup>2</sup>, it is not proposed to provide rainwater tanks.

## 3.8. Construction Phase Stormwater Management

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.

### 3.8.1. 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

### 3.8.2. 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

### 3.8.3. 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 measured.

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 0-150 tonnes/ha/year.

**Table 3.10 – RUSLE Calculation**

Parameter	Value
Rainfall Erosivity Factor, R	2,329.3
Soil Erodibility Factor, K	0.038
Slope Length/Gradient Factor, LS	1.19
Erosion Control Practice Factor, P	1.20
Ground Cover and Management Factor, C	1.0
Computed Soil Loss (tonnes/ha/year), ( $A = R \times K \times LS \times P \times C$ )	<b>126.4</b>
<b>Soil Loss Class</b>	<b>1 (very low)</b>

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.

### 3.8.4. Construction Methodology

#### 3.8.4.1. 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.

#### 3.8.4.2. 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

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

### 3.8.5. Sediment Basin Design

Since the proposed development works involve a disturbed area of greater than 2,500m<sup>2</sup>, 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.

#### 3.8.5.1. Minimum settling volume (Vs)

$$V_s = 10. R (_{85\%, 5\text{-day}}) \cdot C_v \cdot A$$

**V<sub>s</sub>** = Volume of the settling zone (m<sup>3</sup>)

**R (85%, 5-day)** = 5-day rainfall depth not exceeded in 85% of rainfall events. From the Blue Book Table 6.3a, using Blacktown as the closest data location = 32.2mm

**C<sub>v</sub>** = Volumetric runoff coefficient, the portion of rainfall that runs off as stormwater during a 5-day event. Class D/F soils are assumed. From Blue Book, Table F.2 = 0.64.

**A** = Effective catchment surface area connected to basin (ha). Refer Table 2.2 below.

#### 3.8.5.2. Minimum storage volume (Vss)

For a Type D basin, a minimum sediment storage zone volume equal to 50% of the settling volume is recommended.

**Table 3.11 – Construction-Phase Sediment Basin Design Calculations**

Parameter	Catchment 1	Catchment 2
Contributing Area, A (ha)	2.42	2.27
Settling Zone Volume (m <sup>3</sup> )	499	468
Sediment Storage Zone Volume (m <sup>3</sup> )	250	234
<b>Total Sediment Basin Volume (m<sup>3</sup>)</b>	<b>749</b>	<b>702</b>

It is noted that the existing quarry dam (capacity approx. 14,000m<sup>3</sup>) will provide the required volume quoted above for Catchment 1 whereas for Catchment 2 it is proposed that a temporary sediment basin satisfying the above capacity requirement will be installed at the edge of the proposed hardstand area.

### 3.8.6. Sediment Basin Maintenance

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.

### 3.8.7. 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 effectively 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.

## 4. Flooding

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### 4.1.1. 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).

The Secretary's Environmental Assessment Requirements (SEARS) provided by the NSW Department of Planning for the development state that the Soil and Water Report must include:

- *Consideration of potential local and mainstream flooding impacts*

Since the site is located within the Western Sydney Parklands, it is subject to the State Environmental Planning Policy (Western Sydney Parklands) 2009. Clause 13 of the SEPP includes the following requirement:

*(b) the development will not impact on the integrity or security of the bulk water supply infrastructure*

To ensure this requirement is achieved, any flooding impacts on WaterNSW's bulk water supply pipelines (located immediately north of the site) as a result of the proposed development must be analysed and assessed.

### 4.1.2. Rural Area Flood Study

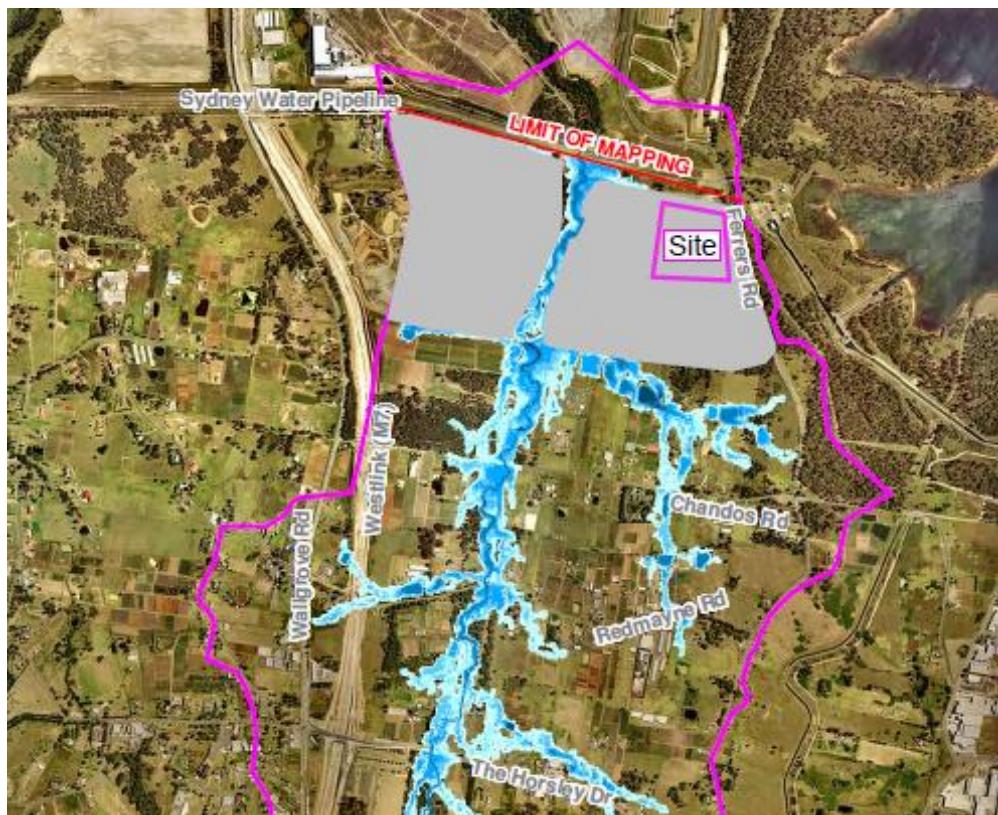
The site was included within the extents of the *Rural Area Flood Study for Ropes, Reedy and Eastern Creeks* prepared by BMT for Fairfield City Council in 2013. The subject site is wholly located within the Eastern Creek catchment as shown in Figure 8 below. Council's associated flood mapping, specifically 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 (refer Figure 9) i.e. the subject site was essentially excluded from flood mapping.

**Figure 7 – Excerpt from Rural Flood Study 2013: Eastern Creek Flood Model Extents**



**Figure 8 – Excerpt from Rural Flood Study 2013: Eastern Creek 100 year ARI Flooding**



#### 4.1.3. BMT Flood Impact Assessment

A new flood impact assessment has been undertaken by BMT in February 2021 using Fairfield City Council's current hydraulic model and the proposed development's civil design surface prepared by AT&L.

Since the original Rural Flood Study hydraulic model was based on the assumption that quarry areas were filled in, it was not suitable for use as a base case model for the impact assessment. Therefore BMT were required to "patch in" accurate 3d survey data for the subject site to the wider model in order to create the refined pre-development/ existing conditions model. The quarry dam was also assumed to be full prior to the design storm event.

The results of the TUFLOW flood modelling exercise undertaken by BMT for the post-development scenario, using AT&L's supplied design surface, show that at the critical Reporting Point P08 (immediately downstream of the site and upstream of the WaterNSW bulk water pipelines) the afflux in the 5% AEP, 1% AEP and PMF storm events is nil or negative, indicating that there is no increase in flood levels at these locations. Figure 9 below also shows this graphically for the 1% AEP. Similarly, upstream of the parent site at Reporting Point P02 there is also nil increase in any of the design storm events.

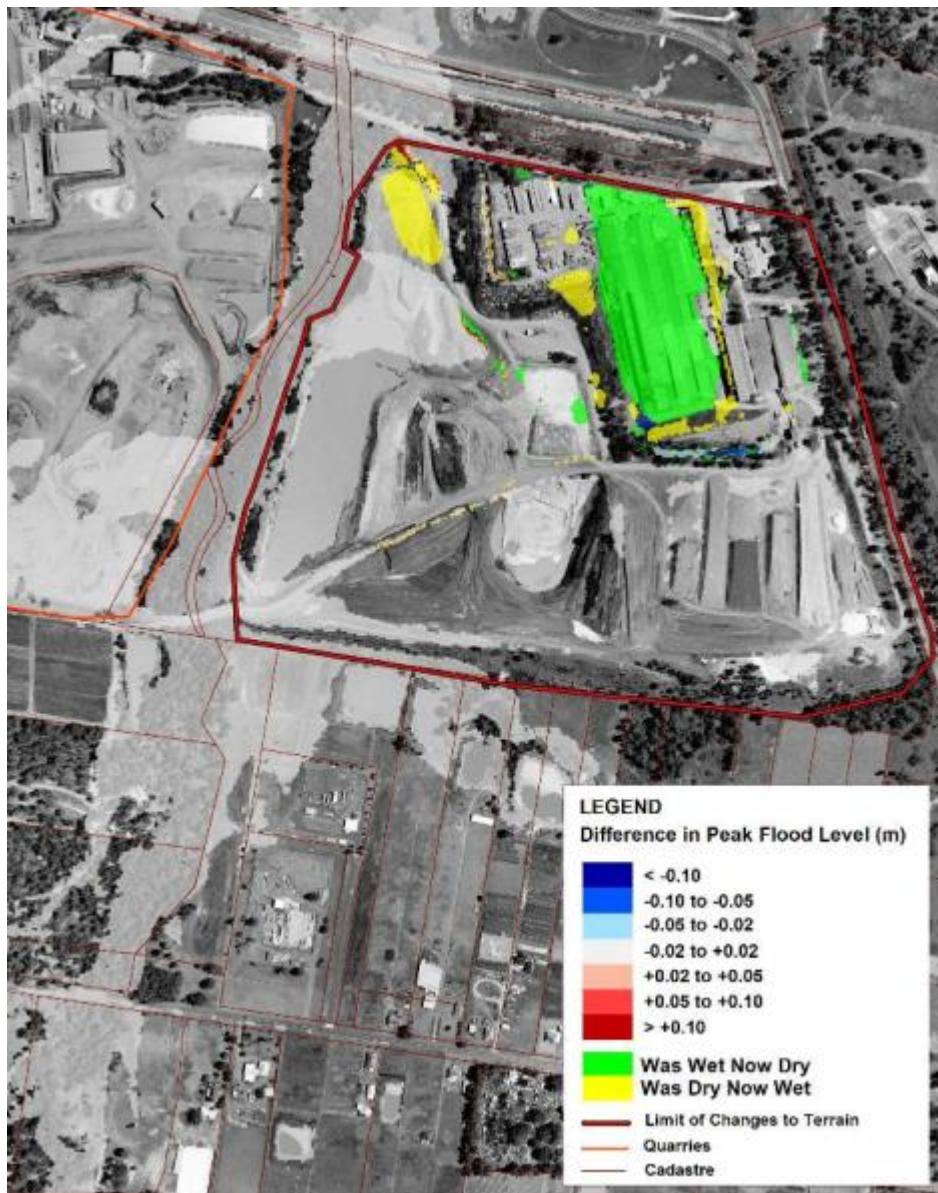
The proposed Plant 2 storage yard development area is also not directly affected by flooding from Eastern Creek as shown in Figure 10 below.

Please refer to the BMT letter report (Ref. L.S20149.04) enclosed under Appendix E for further information.

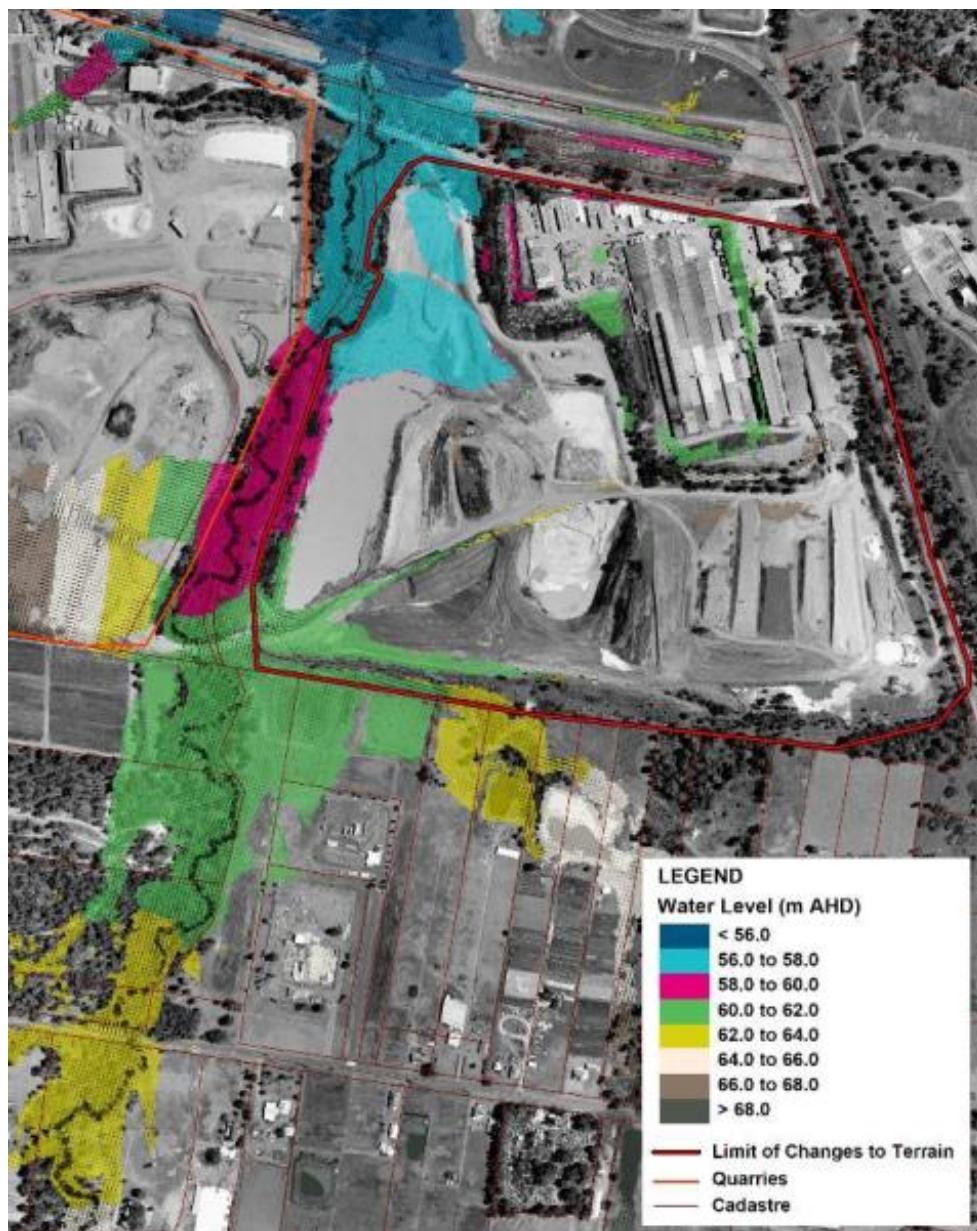
No adverse flooding impacts are anticipated as a result of the proposed development for the following reasons:

- 1) No works are proposed within the designated 1% AEP 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 (actually a reduction) in localised peak stormwater flows coming from the development due to the provision of an on-site detention basin. Refer Section 3.4 above; and
- 3) All local stormwater runoff from new hardstands will be captured and conveyed to discharge points by an underground piped network.

**Figure 9 – Excerpt from BMT Report showing 1% AEP Peak Flood Level Comparison for Pre-Development vs Post-Development Cases**



**Figure 10 – Excerpt from BMT Report showing 1% AEP Peak Flood Levels for Post-Development Case**



## 5. Access & Pavements

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### 5.1. Existing

Access to the Plant 2 site is from a sealed internal access road which runs east-west through the parent site, connecting Wallgrove Road with Ferrers Road. From this road an existing access track leads into the quarry area and a separate existing concrete driveway leads onto the existing storage yard at the northern end of the Plant 2 factory building.

The existing storage yard has a reinforced concrete pavement of unknown depth and composition. The quarry areas generally consist of compacted bare earth with scattered stockpiles.

### 5.2. Proposed

As part of Phase 3 of the proposed development a new heavy vehicle waiting bay will be constructed on the northern edge of the internal access road and a new concrete driveway will be constructed to provide access into the northwest corner of the upgraded storage yard. This driveway will direct incoming and outgoing vehicles to the new gatehouse and weighbridges prior to entering/exiting the yard areas.

All new hardstand areas will be comprised of a durable, hard-wearing and impervious surface. This is likely to take the form of jointed reinforced concrete slabs. The clay subgrade will be trimmed, compacted and proof rolled prior to paving works.

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

## 6. Servicing

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### 6.1. Water Supply

The existing Plant 2 site is serviced with potable water from the 150mm diameter public main in the western verge of Ferrers Road. The internal water reticulation will be augmented to supply the new gatehouse building with domestic and fire-fighting water supply.

### 6.2. Sewerage

Due to the lack of nearby public sewerage infrastructure, wastewater flows from the wider site are currently collected in on-site holding tanks which are pumped out regularly by a contractor. It is anticipated that this regime will also be applied to the wastewater generated by amenities in the new gatehouse.

### 6.3. Utilities

The existing power supply and telecommunications services connected to the Plant 2 factory and surrounding buildings will be augmented to supply the new gatehouse. The existing connections are anticipated to have sufficient capacity to service the new facility.

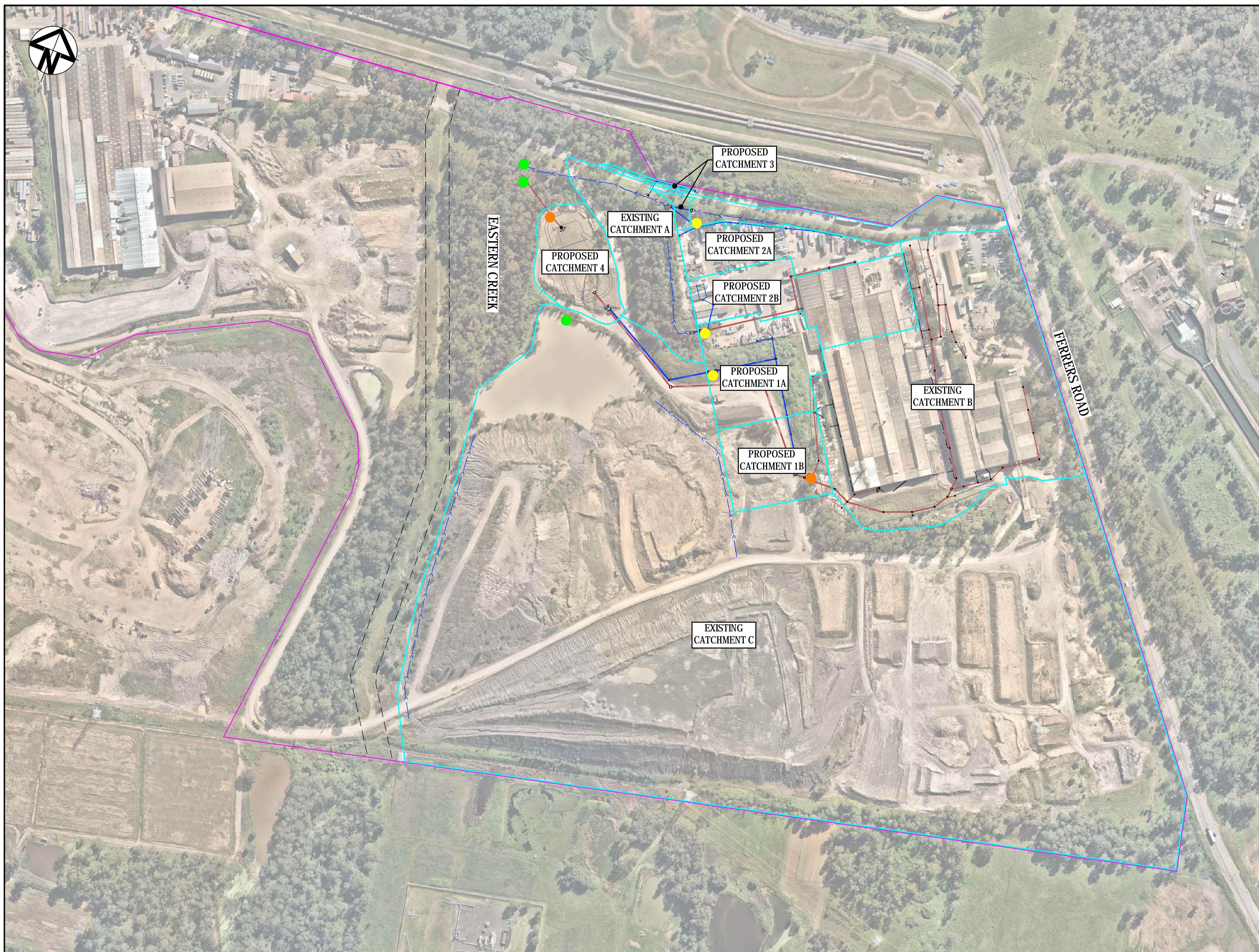
# Appendix A

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## Stormwater Catchment Plans



		Bar Scales	0 50 100 150 200m 1 : 2000	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 <b>BRICKWORKS</b> LIMITED	Scales 1 : 2000 @ A1 Designed Grid MGA Height Datum AHD	Drawn SH Checked Approved	Project <b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b>	Civil Engineers and Project Managers <b>at&amp;l</b> Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au									
B	ISSUE FOR INFORMATION																	
A	ISSUED FOR INFORMATION	06-01-21																
Issue	Description	Date																
Status <b>FOR INFORMATION</b> NOT TO BE USED FOR CONSTRUCTION									A1									
Project - Drawing No. 20-782-SK-006									Issue B									



**LEGEND**

- PROPERTY BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- EXISTING STORMWATER PIPE
- PROPOSED STORMWATER PIPE
- EXISTING DRAINAGE CHANNEL
- EXISTING DISCHARGE LOCATION
- EXISTING STORMWATER QUALITY TREATMENT DEVICE
- PROPOSED STORMWATER QUALITY TREATMENT DEVICE

		Bar Scales	0 50 100 150 200m	1 : 2000	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	<b>BRICKWORKS</b> LIMITED	Scales	1 : 2000 @ A1	Drawn	SH	Project	<b>BRICKWORKS</b> HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	Civil Engineers and Project Managers			
C	ISSUED FOR INFORMATION																
B	ISSUED FOR INFORMATION	12-04-21						Grid	MGA	Checked							
A	ISSUED FOR INFORMATION	06-01-21						Height Datum	AHD	Approved							
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Status <b>FOR INFORMATION</b> NOT TO BE USED FOR CONSTRUCTION A1																	
Project - Drawing No. 20-782-SK-007												Issue	C				

# Appendix B

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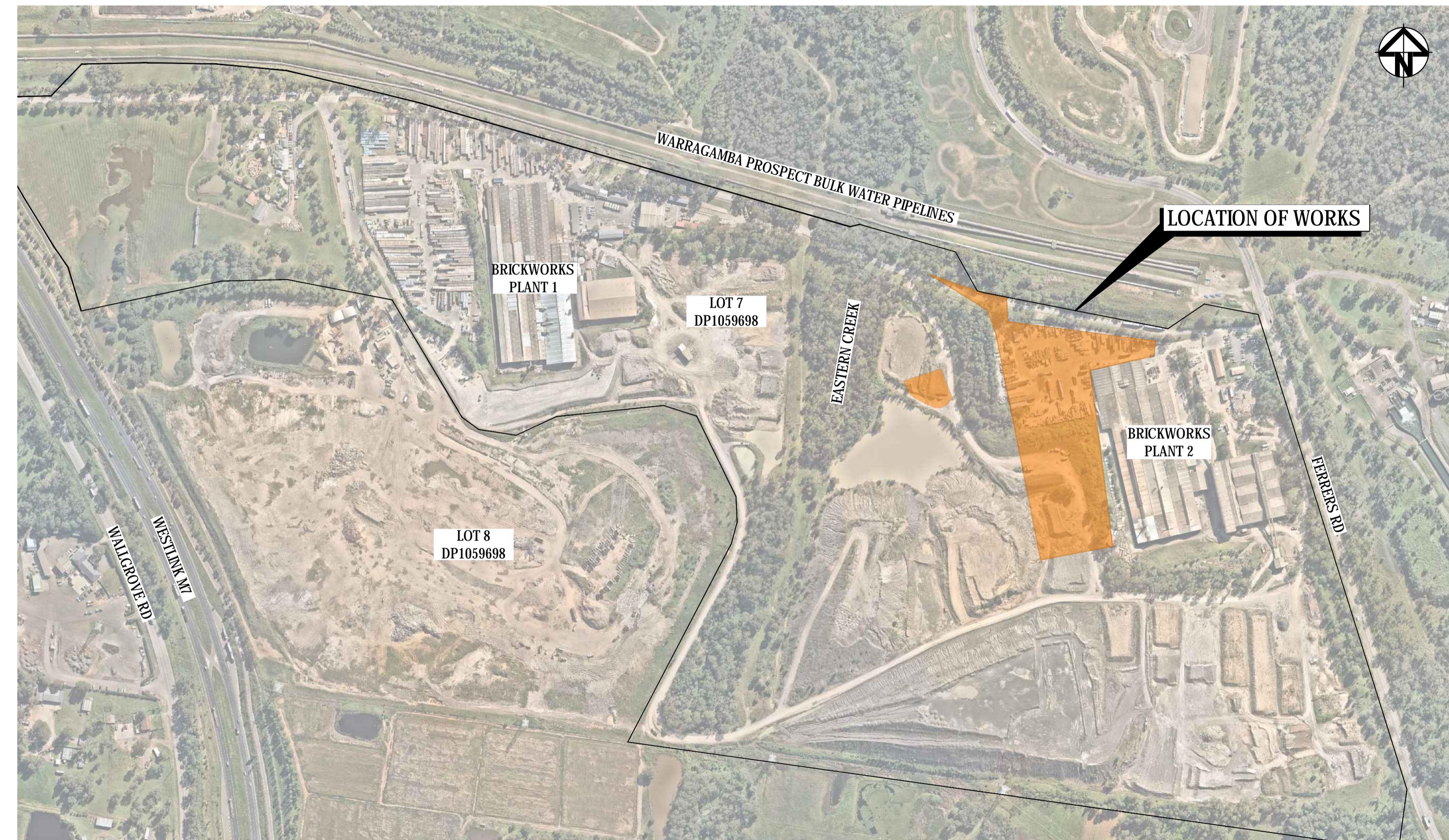
## Concept Civil Engineering Drawings

# BRICKWORKS PLANT 2 - HARDSTAND EXTENSION

## 780 WALLGROVE ROAD, HORSLEY PARK

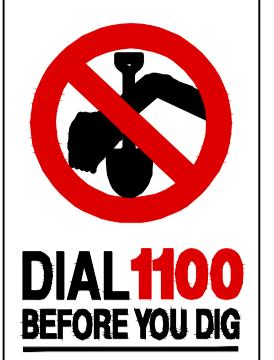
### CIVIL WORKS DA PACKAGE

DRAWING LIST - AT&L	
DRAWING NUMBER	DRAWING DESCRIPTION
C000	COVERSHEET, LOCALITY PLAN AND DRAWING LIST
C001	GENERAL NOTES
C002	GENERAL ARRANGEMENT PLAN
C010	SITE SECTIONS PHASE 1A SHEET 1
C011	SITE SECTIONS PHASE 1A SHEET 2
C012	SITE SECTIONS PHASE 1B
C013	SITE SECTIONS PHASE 1C SHEET 1
C014	SITE SECTIONS PHASE 1C SHEET 2
C015	SITE SECTIONS PHASE 3
C020	BULK EARTHWORKS PLAN PHASE 1A & 1B SHEET 1
C021	BULK EARTHWORKS PLAN PHASE 1A & 1B SHEET 2
C022	BULK EARTHWORKS PLAN PHASE 1C & PHASE 3
C030	SITEWORKS AND STORMWATER PLAN PHASE 1A SHEET 1
C031	SITEWORKS AND STORMWATER PLAN PHASE 1A SHEET 2
C032	SITEWORKS AND STORMWATER PLAN PHASE 1B
C033	SITEWORKS AND STORMWATER PLAN PHASE 1C
C034	SITEWORKS AND STORMWATER PLAN PHASE 3
C041	PAVEMENT PLAN PHASE 1A
C042	PAVEMENT PLAN PHASE 1B
C043	PAVEMENT PLAN PHASE 1C
C044	PAVEMENT PLAN PHASE 3
C060	EROSION AND SEDIMENT CONTROL PLAN PHASE 1A & 1B SHEET 1
C061	EROSION AND SEDIMENT CONTROL PLAN PHASE 1A & 1B SHEET 2
C062	EROSION AND SEDIMENT CONTROL PLAN PHASE 1C
C063	EROSION AND SEDIMENT CONTROL PLAN PHASE 3
C065	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 <b>BRICKWORKS</b> LIMITED	Scales	NA	Drawn	ALS	Project	BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	Civil Engineers and Project Managers
A	ISSUED FOR COORDINATION										
Issue	Description	Date			Grid	MGA	Checked	SH			at&l
					Height Datum	AHD	Approved	SH			Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
									Title	FOR INFORMATION NOT FOR CONSTRUCTION	A1
										Project - Drawing No.	
										C000	20-782
										Issue	A



## CONCRETE NOTES

- ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600:2018 CURRENT EDITION WITH AMENDMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
- CONCRETE QUALITY ALL REQUIREMENTS OF THE CURRENT ACSE CONCRETE SPECIFICATION DOCUMENT 1 SHALL APPLY TO THE FORMWORK, REINFORCEMENT AND CONCRETE UNLESS NOTED OTHERWISE.
- CEMENT TYPE SHALL BE (ACSE SPECIFICATION) TYPE SL
- PROJECT CONTROL TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS 1379.
- NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING AT & L
- CLEAR CONCRETE COVER TO ALL REINFORCEMENT FOR DURABILITY SHALL BE 40mm TOP AND 70mm FOR EXTERNAL EDGES UNLESS NOTED OTHERWISE.
- 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.
- 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 COMPAKTED AND CURED IN ACCORDANCE WITH RMC SPECIFICATION R83.
- REINFORCEMENT SYMBOLS:
  - N DENOTES GRADE 450 N BARS TO AS/NZS 4671 GRADE N
  - R DENOTES 23x R HOT ROLLED PLAIN BARS TO AS/NZS 4671
  - SL DENOTES HARD-DRAWN WIRE REINFORCING FABRIC TO AS/NZS 4671

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/NZS 4671.

- FABRIC SHALL BE LAPPED IN ACCORDANCE WITH THE FOLLOWING DETAIL:



## STORMWATER DRAINAGE NOTES

- ALL STORMWATER DRAINAGE WORKS TO BE CARRIED OUT IN ACCORDANCE WITH CONTRACT SPECIFICATION, FAIRFIELD CITY COUNCIL POLICY NO. 4-515 AND AS/NZS3500.3:2018.
- STORMWATER DESIGN CRITERIA:
  - (A) AEP/ARI:
 

1% AEP/1:100 YEAR ARI	MAJOR STORM
5% AEP/1:20 YEAR ARI	EXTERNAL PAVEMENTS
  - (B) RAINFALL INTENSITIES:
 

TIME OF CONCENTRATION: 5 MINUTES
1% AEP/1:100 YEAR ARI = 218 mm/hr
5% AEP/1:20 YEAR ARI = 168 mm/hr
  - (C) RUNOFF COEFFICIENTS:
 

INDUSTRIAL PAVED AREAS AND ROOFS
$C_{100} = 1.00$
$C_{50} = 0.95$
- PIPES EQUAL TO OR SMALLER THAN 300mm ARE TO BE uPVC CLASS SN8 TO AS1254.
- PIPES 375 DIA AND LARGER ARE TO BE RUBBER RING JOINTED SPIGOT AND SOCKET EITHER FRC/RCP OR APPROVED EQUIVALENT IN ACCORDANCE WITH AS 5065 AND AS 2566. PIPE CLASS AS SHOWN ON DRAWINGS.
- ALL PIPES TO BE PROVIDED WITH HS2 SUPPORT IN ACCORDANCE WITH AS/NZS3725-2007. REFER DRAWINGS FOR TRENCH BACKFILL REQUIREMENTS.
- PRECAST PITS MAY BE USED SUBJECT TO APPROVAL BY AT & L.
- ENLARGERS CONNECTIONS AND JUNCTIONS TO BE PREFABRICATED FITTINGS WHERE PIPES ARE LESS THAN 300 DIA.
- WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS, UNSLOTTED uPVC SN8 PIPE IS TO BE USED.
- CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL. DUE TO THE FLAT GRADIENT OF PIPES, LEVEL CONTROL DURING CONSTRUCTION IS CRITICAL. PIPES LAID FLATTER THAN THE DESIGN WILL NOT BE ACCEPTED. DETAILED INVERT LEVEL SURVEY IS TO BE PROVIDED TO AT&L FOR REVIEW PRIOR TO CERTIFICATION.
- GRATES AND COVERS SHALL CONFORM TO AS 3996.
- ALL INLET GRATES TO BE CLASS 'D' U.N.O. ALL MANHOLE COVERS TO BE ROADWAY STRENGTH.
- ALL INTERNAL PIT DIMENSIONS TO CONFORM TO AS3500.3 TABLE 8.2.
- AT ALL TIMES DURING CONSTRUCTION OF STORMWATER PITS, ADEQUATE SAFETY PROCEDURES SHALL BE TAKEN TO ENSURE AGAINST THE POSSIBILITY OF PERSONNEL FALLING DOWN PITS.
- 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.
- ALL GULLY PITS/MANHOLES DEEPER THAN 1200 MM MUST HAVE STEP IRONS INSTALLED IN ACCORDANCE WITH AS 1657.

## SITEWORKS NOTES

- ORIGIN OF LEVELS- REFER SURVEY NOTES.
- CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK. ANY DISCREPANCIES TO BE REPORTED TO AT&L IMMEDIATELY.
- MAKE SMOOTH CONNECTION WITH EXISTING WORKS.
- ALL TRENCH BACKFILL MATERIAL SHALL BE COMPAKTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
- ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENT BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL. COMPAKTED 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).
- PROVIDE 10mm WIDE ABLFLEX ISOLATION JOINTS BETWEEN BUILDINGS AND ALL EXTERNAL PAVEMENTS.
- ASPHALTIC CONCRETE SHALL CONFORM TO RMS SPECIFICATION R116.
- ALL BASECOURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL COMPACTED TO MINIMUM 98% MODIFIED DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. FREQUENCY OF COMPAKCTION TESTING SHALL NOT BE LESS THAN 1 TEST PER 50m<sup>3</sup> OF BASE COURSE MATERIAL PLACED. MATERIAL TO COMPLY WITH RMS FORM 3051.
- ALL SUB-BASE COURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL COMPACTED TO MINIMUM 95% MODIFIED DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. FREQUENCY OF COMPAKCTION TESTING SHALL NOT BE LESS THAN 1 TEST PER 50m<sup>3</sup> OF SUB-BASE COURSE MATERIAL PLACED. MATERIAL TO COMPLY WITH RMS FORM 3051.
- 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.

## KERBING NOTES

- ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 25MPa UNLESS NOTED OTHERWISE ON DRAWINGS.
- ALL KERBS, GUTTERS, DISH DRAINS AND CROSSINGS TO BE CONSTRUCTED ON 100mm GRANULAR BASECOURSE COMPACTED TO MINIMUM 98% MODIFIED DRY DENSITY (AS 1289 5.2.1).
- EXPANSION JOINTS (E.J) TO BE FORMED FROM 10mm COMPRESSIBLE CORK FILLER BOARD FOR THE FULL DEPTH OF THE SECTION AND CUT TO PROFILE. EXPANSION JOINTS TO BE LOCATED AT DRAINAGE PITS, ON TANGENT POINTS OF CURVES AND ELSEWHERE AT MAX 12m CENTRES EXCEPT FOR INTEGRAL KERBS WHERE THE EXPANSION JOINTS ARE TO MATCH THE JOINT LOCATIONS IN THE SLABS.
- WEAKENED PLANE JOINTS TO BE MIN 3mm WIDE AND LOCATED AT 3m CENTRES EXCEPT FOR INTEGRAL KERBS WHERE THE WEAKENED PLANE JOINTS ARE TO MATCH THE JOINT LOCATIONS IN THE SLABS.
- BROOMED FINISH TO ALL RAMPED AND VEHICULAR CROSSINGS. ALL OTHER KERBING OR DISH DRAINS TO BE STEEL FLOAT FINISHED.
- IN THE REPLACEMENT OF KERB AND GUTTER :-  
EXISTING ROAD PAVEMENT IS TO BE SAWCUT 900mm U.N.O FROM THE LIP OF GUTTER. UPON COMPLETION OF THE NEW KERB AND GUTTER NEW BASECOURSE AND SURFACE TO BE LAID 600mm WIDE U.N.O.
- EXISTING KERB AND GUTTER IS TO BE COMPLETELY REMOVED WHERE NEW KERB AND GUTTER IS SHOWN.

## 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.

1. 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.

2. HEIGHT OF FENCES WHERE SHOWN ARE APPROXIMATE ONLY.

3. THE INFORMATION SHOWN IN GREYSCALE IS THE DRAWING PROVIDED TO CARDNO (130604-DETAIL.DWG)

4. THE BLUE ARE BOUNDARIES WITHIN LAYER "APPROX BDYS-DCDB" COLOURED BLUE) ARE APPROXIMATE ONLY AND ARE NOT TO 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

## 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 ON SITE 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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Issue	Description	Date						

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**BRICKWORKS**  
LIMITED

Client

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Designed ALS

Grid MGA Checked SH

Height Datum AHD Approved SH

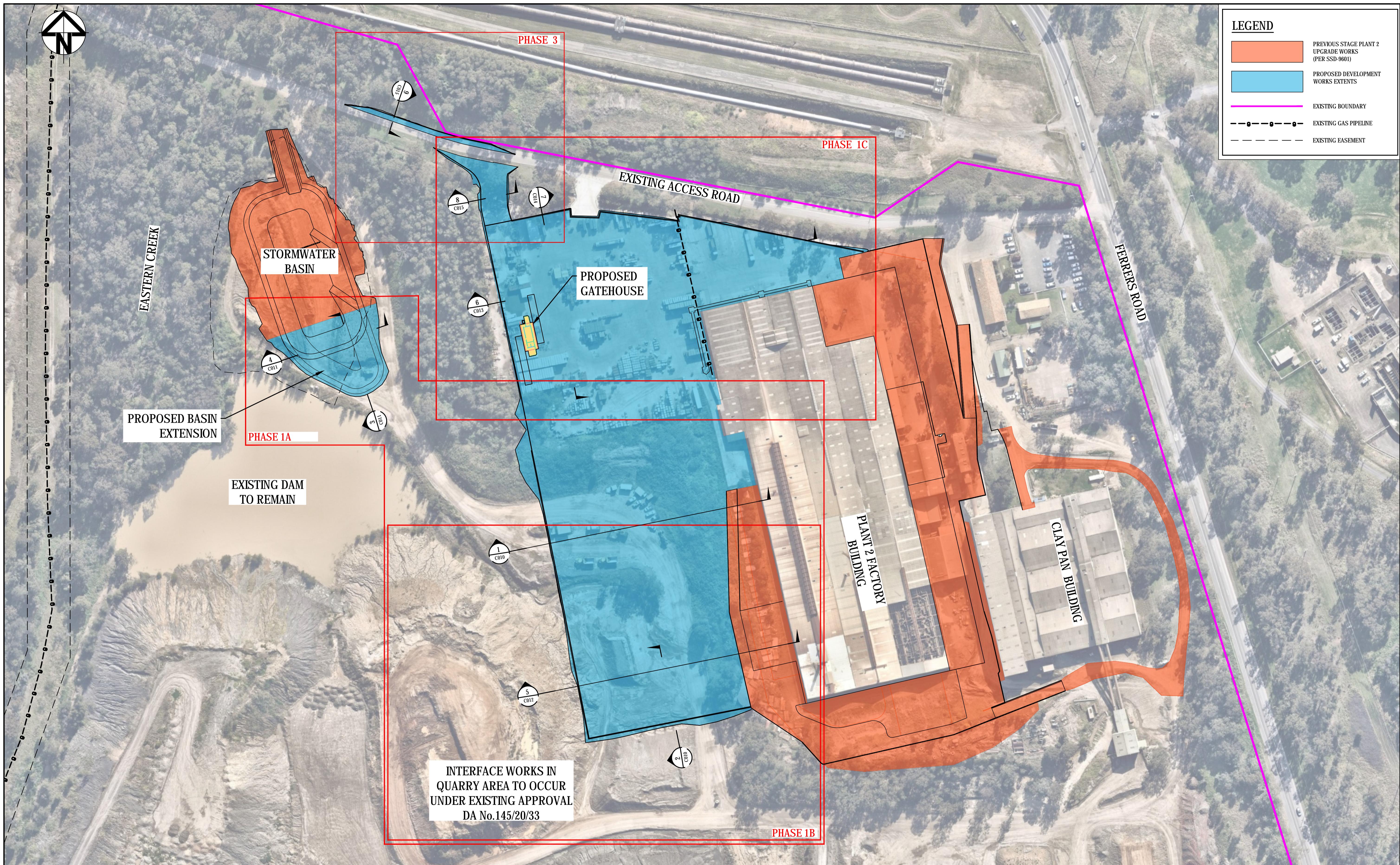
**BRICKWORKS**  
HORSLEY PARK  
PLANT 2 HARDSTAND  
EXTENSION

GENERAL NOTES

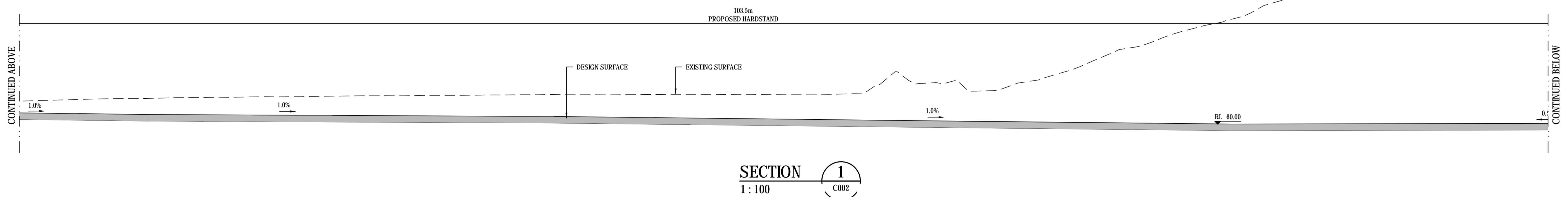
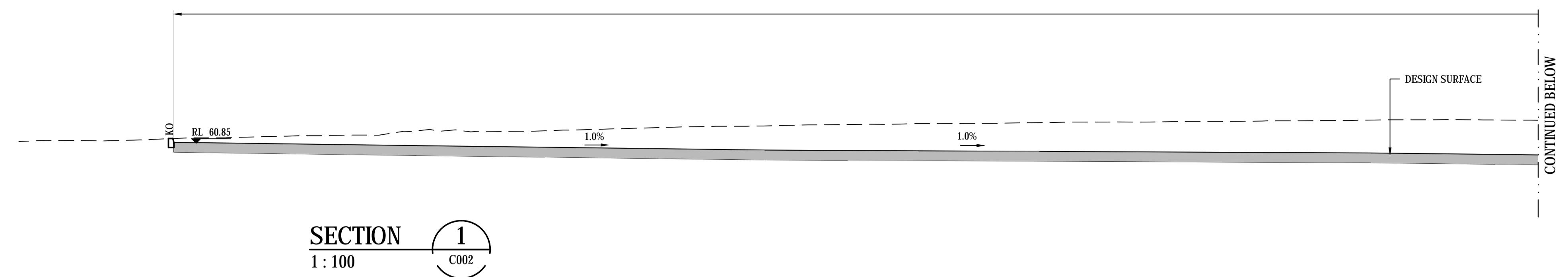
Civil Engineers and Project Managers  
**at&l**  
Level 1, 153 Walker Street  
North Sydney NSW 2060  
ABN 96 130 882 405  
Tel: 02 9439 1777  
Fax: 02 9923 1055  
www.atl.net.au  
info@atl.net.au

Status FOR INFORMATION NOT FOR CONSTRUCTION A1  
Project - Drawing No. C001 Issue  
20-782 A

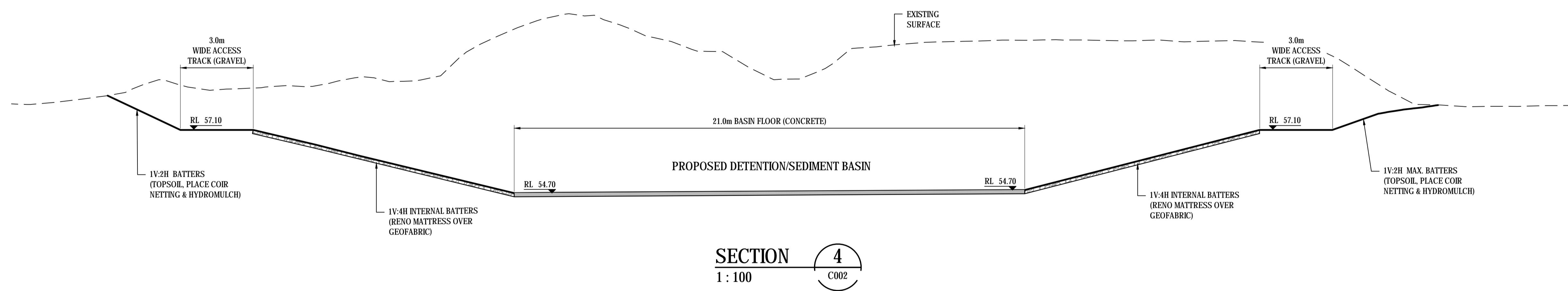
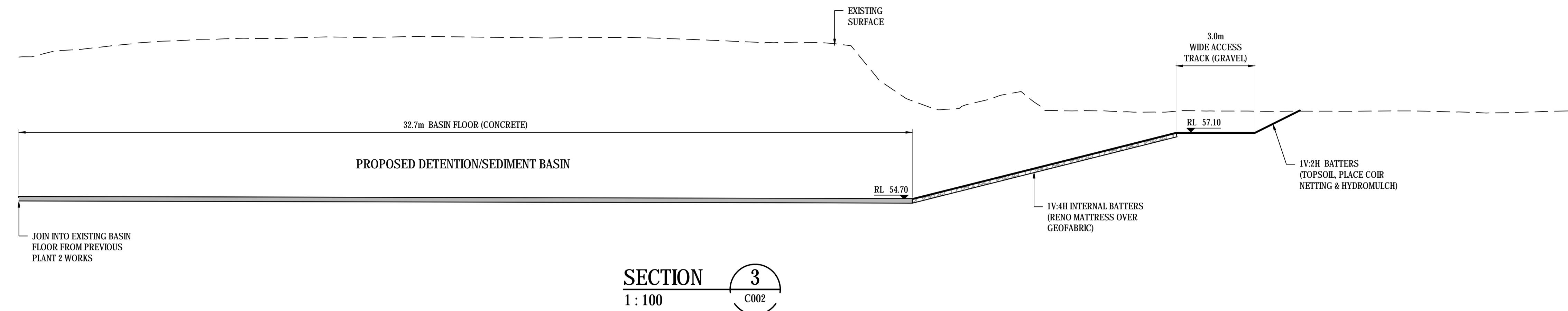
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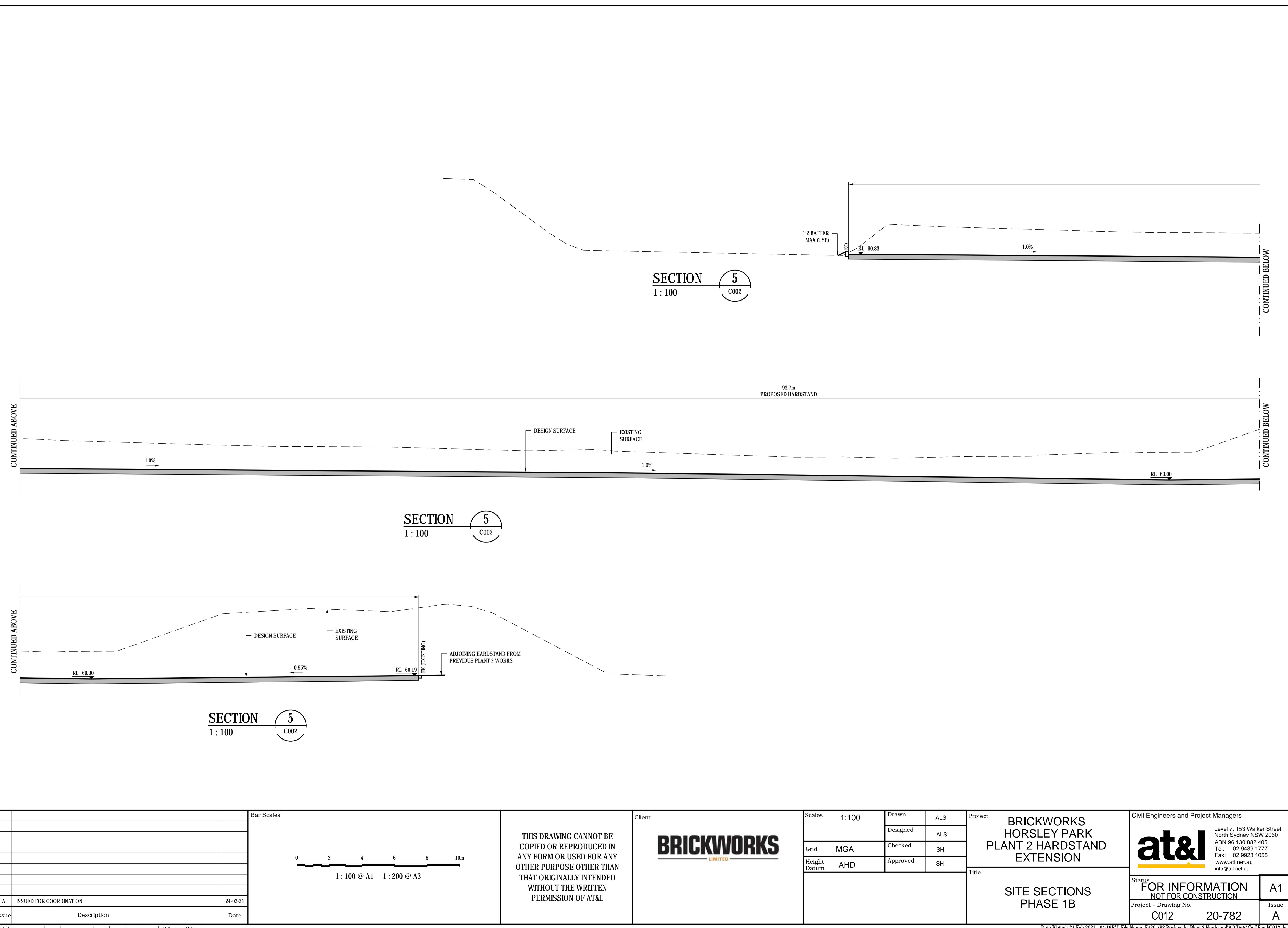


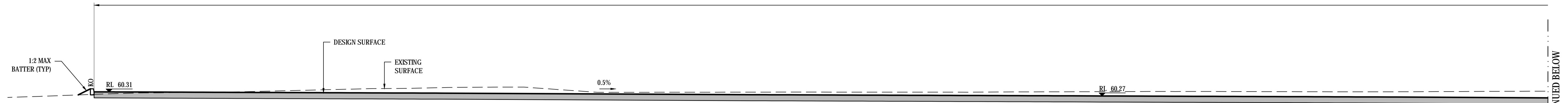
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A	ISSUED FOR COORDINATION	1:1000 @ A1 1:2000 @ A3	Grid MGA	Designed	ALS	Checked	SH	at&l
			Height Datum AHD	Approved	SH			Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
Issue	Description	Date	Title		GENERAL ARRANGEMENT PLAN		Status	
			FOR INFORMATION NOT FOR CONSTRUCTION		A1		Project - Drawing No.	Issue
			C002		20-782		C002	B



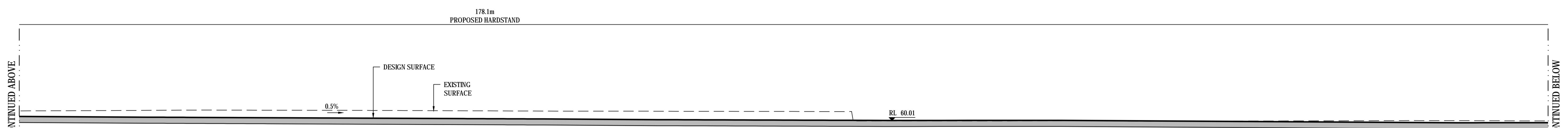
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Issue	Description	Date	100mm on Original						
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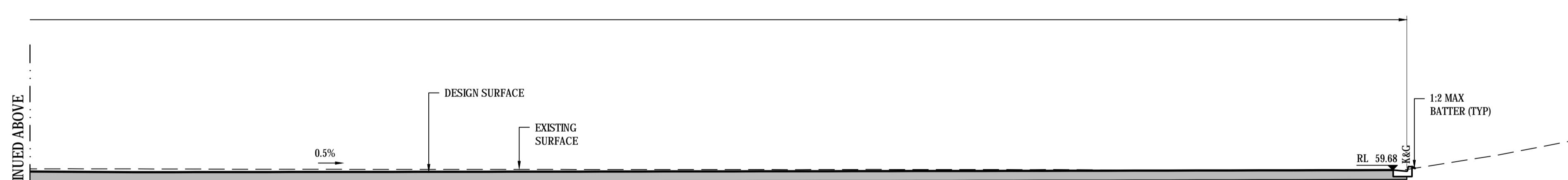




SECTION 6  
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C002

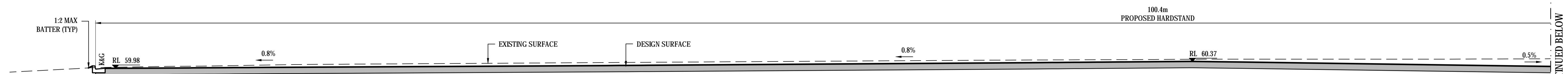


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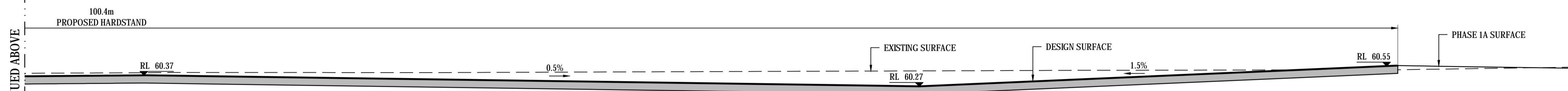
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Designed	ALS																			
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A	ISSUED FOR COORDINATION																			
Issue	Description	Date					<p>Status</p> <p><b>FOR INFORMATION NOT FOR CONSTRUCTION</b></p> <p>Project - Drawing No. C013</p>	<p>A1</p> <p>Issue</p> <p>A</p>												



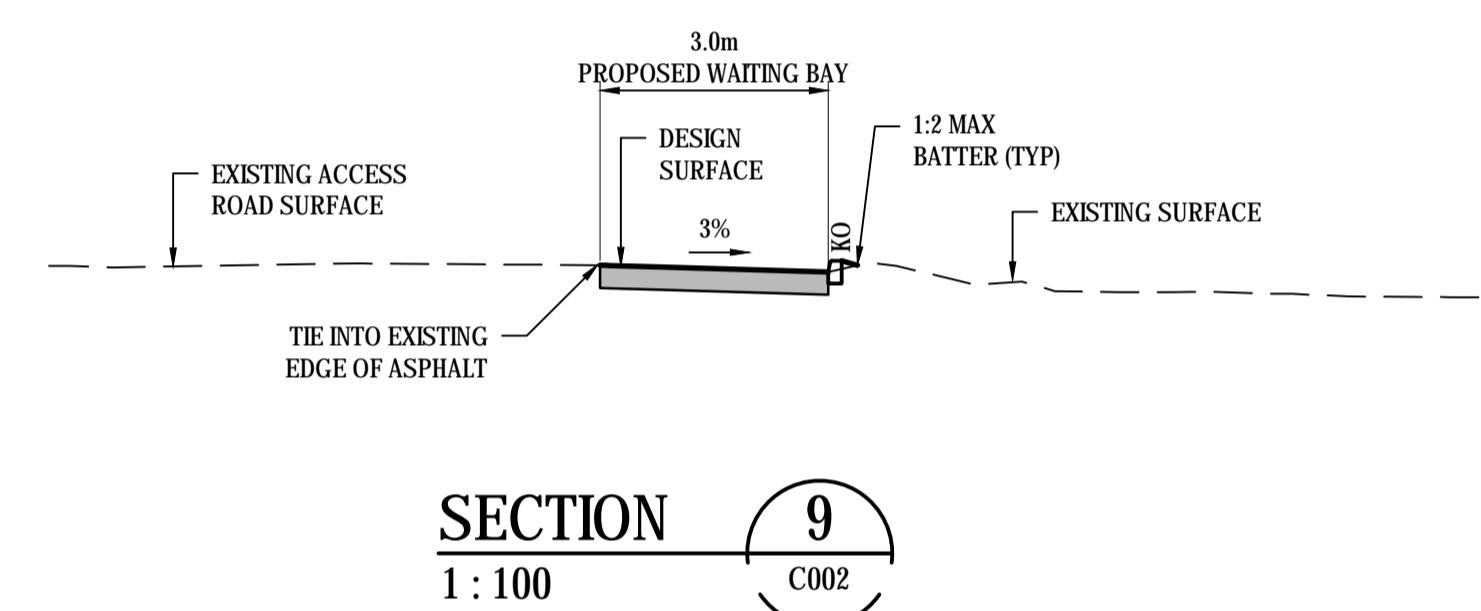
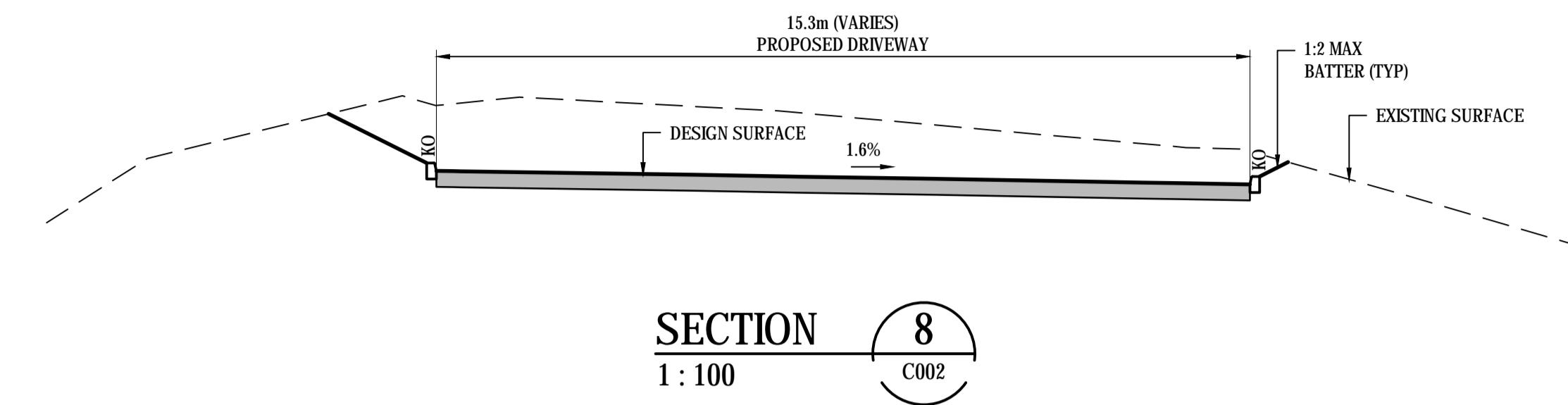
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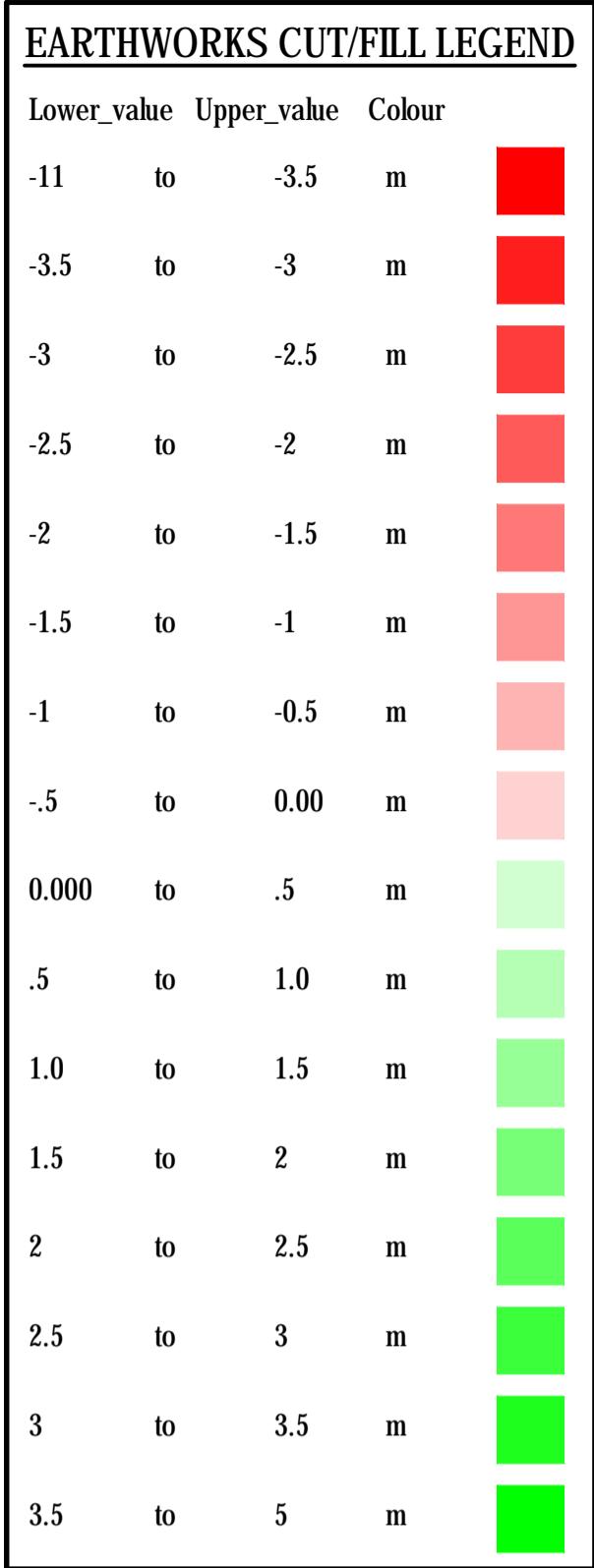
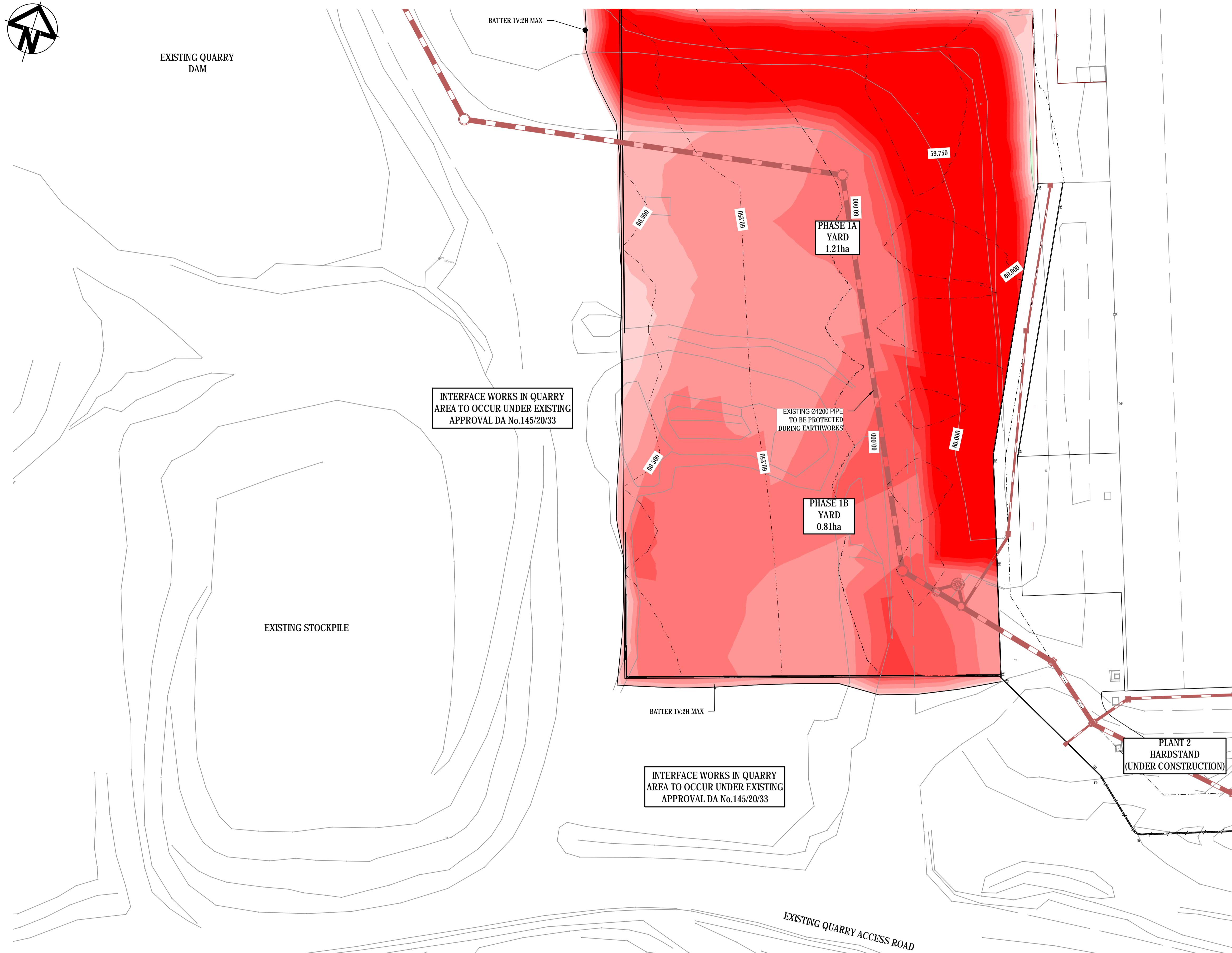


SECTION 7  
1 : 100 C002

		Bar Scales	<p>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&amp;L</p> <p>0 2 4 6 8 10m</p> <p>1 : 100 @ A1 1 : 200 @ A3</p>	<p>Client</p> <p><b>BRICKWORKS</b> LIMITED</p>	Scales	1:100	Drawn	ALS	<p>Project</p> <p><b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b></p>	<p>Civil Engineers and Project Managers</p> <p><b>at&amp;l</b></p> <p>Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au</p>
A	ISSUED FOR COORDINATION	24.02.21			Grid	MGA	Checked	SH		
Issue	Description	Date	Height Datum	AHD	Approved	SH				
							Title	<p><b>SITE SECTIONS</b> <b>PHASE 1C</b> <b>SHEET 2</b></p>		
							Status	<b>FOR INFORMATION</b> NOT FOR CONSTRUCTION	A1	
							Project - Drawing No.	C014	Issue	
								20-782	A	



		Bar Scales		<p>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&amp;L</p>	<p>Client</p> <p><b>BRICKWORKS</b> LIMITED</p>	<p>Scales 1:100 Grid MGA Height Datum AHD</p>	<p>Drawn Designed Checked Approved</p>	<p>ALS ALS SH SH</p>	<p>Project</p> <p><b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b></p>	<p>Civil Engineers and Project Managers</p> <p><b>at&amp;l</b></p> <p>Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au</p>
A	ISSUED FOR COORDINATION									
Issue	Description		Date							
<p><b>FOR INFORMATION NOT FOR CONSTRUCTION</b></p> <p>Project - Drawing No. C015 Issue A</p> <p>20-782</p>										
<p>100mm on Original</p>										



#### 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
2. FOR THE PURPOSES OF EARTHWORKS ANALYSIS A 300mm DEPTH HAS BEEN ASSUMED FOR ALL PAVEMENT AREAS.

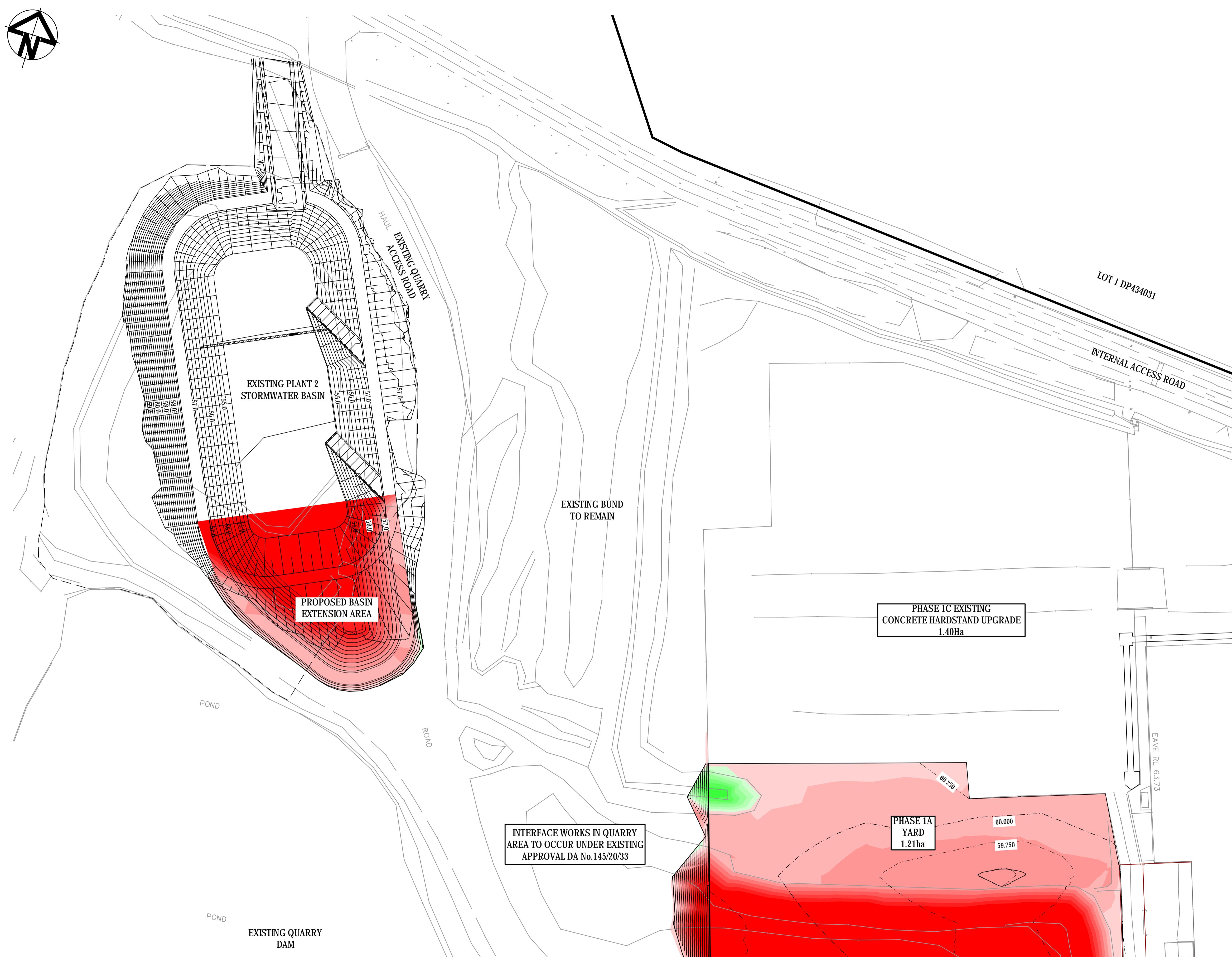
#### EARTHWORKS VOLUMES

ITEM	NET CUT VOLUME (m <sup>3</sup> )	NET FILL VOLUME (m <sup>3</sup> )	BALANCE VOLUME (m <sup>3</sup> )
PHASE 1A & 1B AREA	-53,324	226	-53,098
PHASE 1C AREA	-7,754	8	-7,746
PHASE 3 AREA	-258	1	-257
DETENTION \ SEDIMENT BASIN	-2,443	74	-2,369
<b>TOTALS</b>	<b>-63,779</b>	<b>309</b>	<b>-63,470</b>

#### LEGEND

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

		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 <b>BRICKWORKS</b> <small>LIMITED</small>	Scales 1:500 Grid MGA Height Datum AHD	Drawn Designed Checked Approved	ALS ALS SH SH	Project <b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b> Title <b>BULK EARTHWORKS PLAN PHASE 1A &amp; 1B SHEET 1</b>	Civil Engineers and Project Managers <b>at&amp;l</b> Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 <a href="http://www.atl.net.au">www.atl.net.au</a> <a href="mailto:info@atl.net.au">info@atl.net.au</a>
A	ISSUED FOR COORDINATION	24.02.21							
Issue	Description	Date							



EARTHWORKS CUT/FILL LEGEND		
Lower_value	Upper_value	Colour
-11	to	-3.5
-3.5	to	-3
-3	to	-2.5
-2.5	to	-2
-2	to	-1.5
-1.5	to	-1
-1	to	-0.5
-0.5	to	0.00
0.000	to	.5
.5	to	1.0
1.0	to	1.5
1.5	to	2
2	to	2.5
2.5	to	3
3	to	3.5
3.5	to	5

#### NOTES

- 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
- FOR THE PURPOSES OF EARTHWORKS ANALYSIS A 300mm DEPTH HAS BEEN ASSUMED FOR ALL PAVEMENT AREAS.

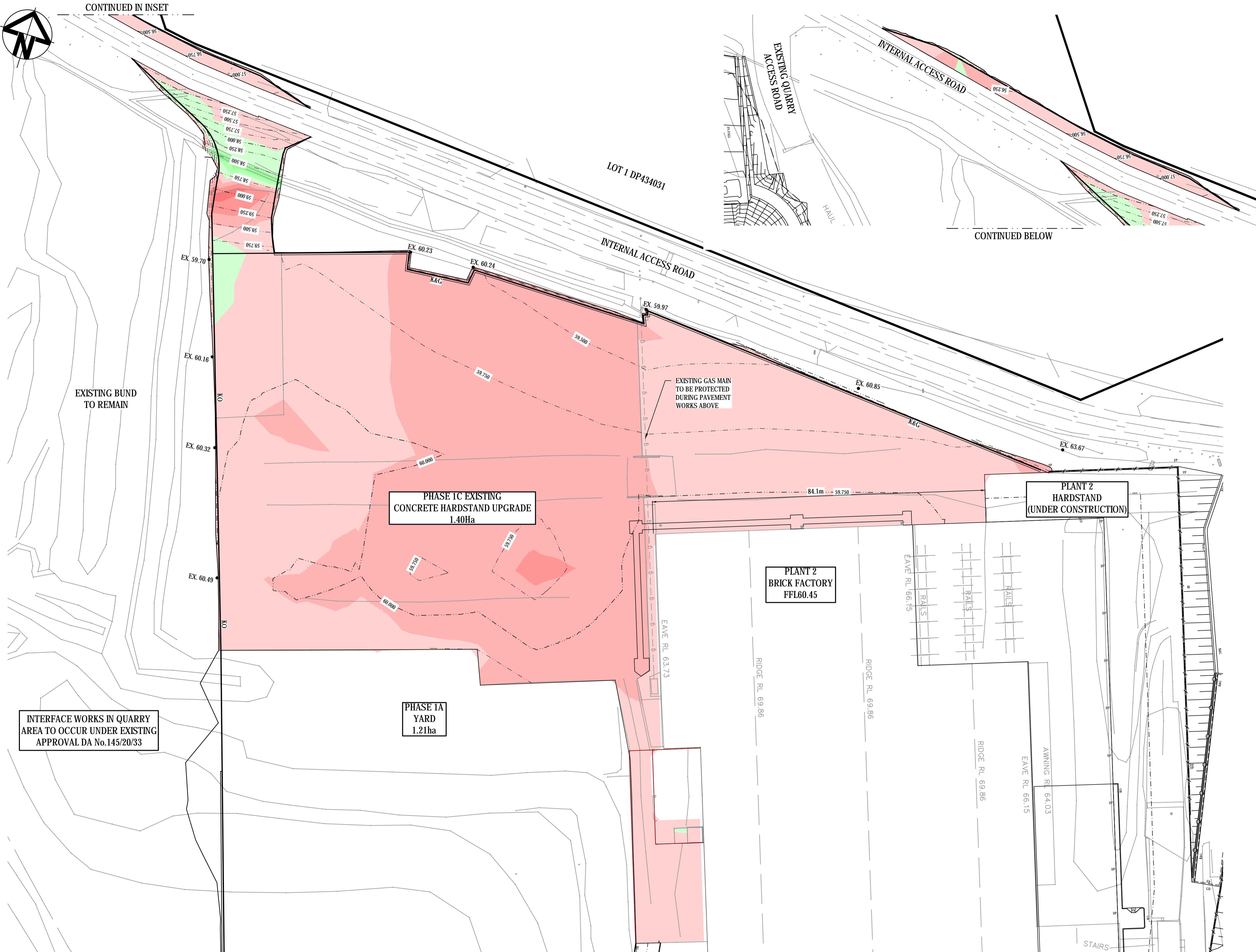
#### EARTHWORKS VOLUMES

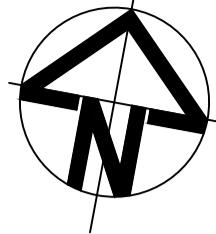
ITEM	NET CUT VOLUME (m <sup>3</sup> )	NET FILL VOLUME (m <sup>3</sup> )	BALANCE VOLUME (m <sup>3</sup> )
PHASE 1A & 1B AREA	-53,324	226	-53,098
PHASE 1C AREA	-7,754	8	-7,746
PHASE 3 AREA	-258	1	-257
DETENTION \ SEDIMENT BASIN	-2,443	74	-2,369
TOTALS	-63,779	309	-63,470

#### LEGEND

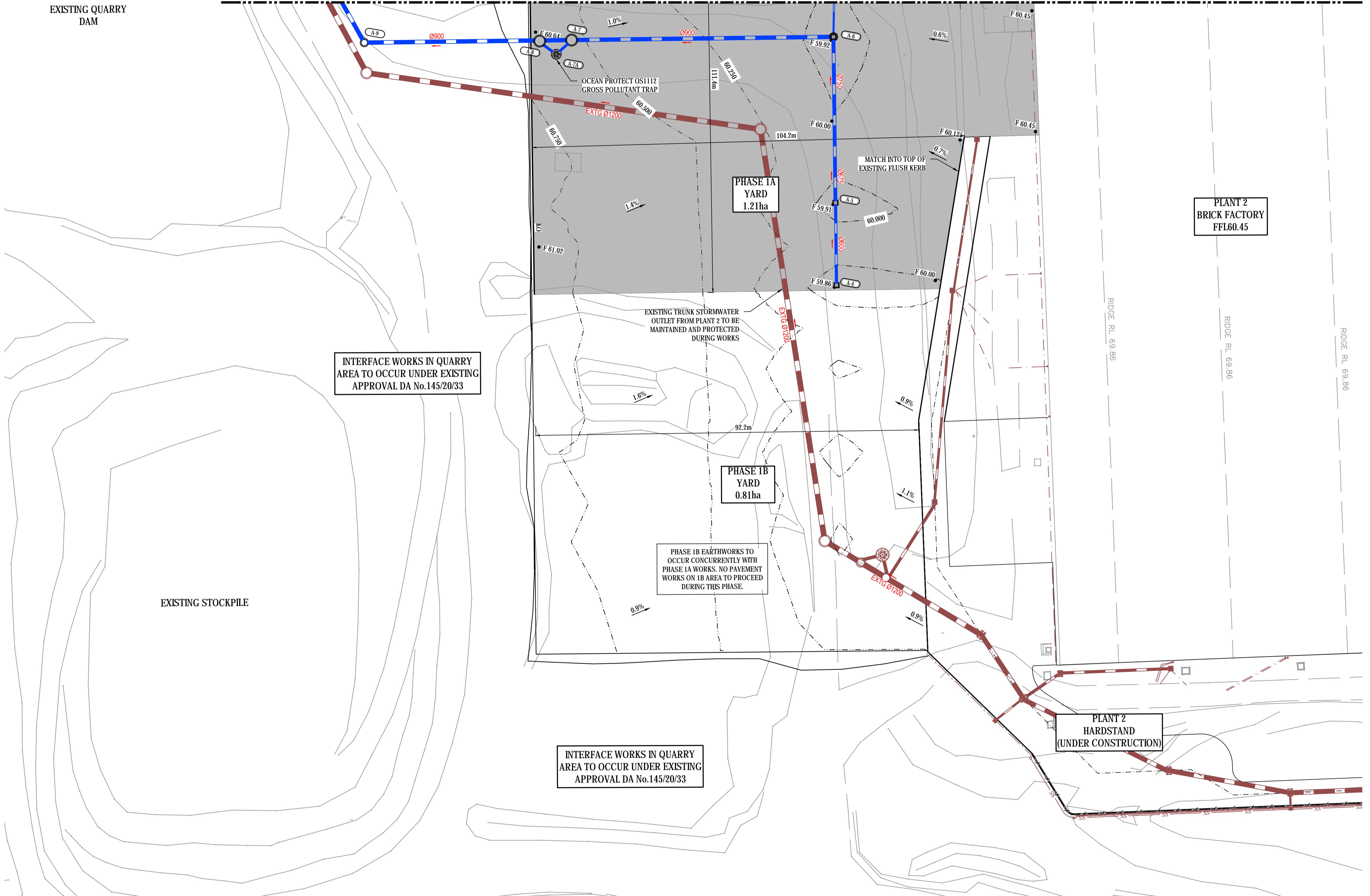
- 60.3 — PROPOSED BULK EARTH WORKS CONTOUR
- - 65.2 - - EXISTING SURFACE CONTOUR
- PROPERTY BOUNDARY

		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 <b>BRICKWORKS</b> LIMITED	Scales 1:500 Grid MGA Height Datum AHD	Drawn Designed Checked Approved	ALS ALS SH SH	Project BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION Title BULK EARTHWORKS PLAN PHASE 1A & 1B SHEET 2	Civil Engineers and Project Managers <b>at&amp;l</b> Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
A	ISSUED FOR COORDINATION	24.02.21							
Issue	Description		Date						

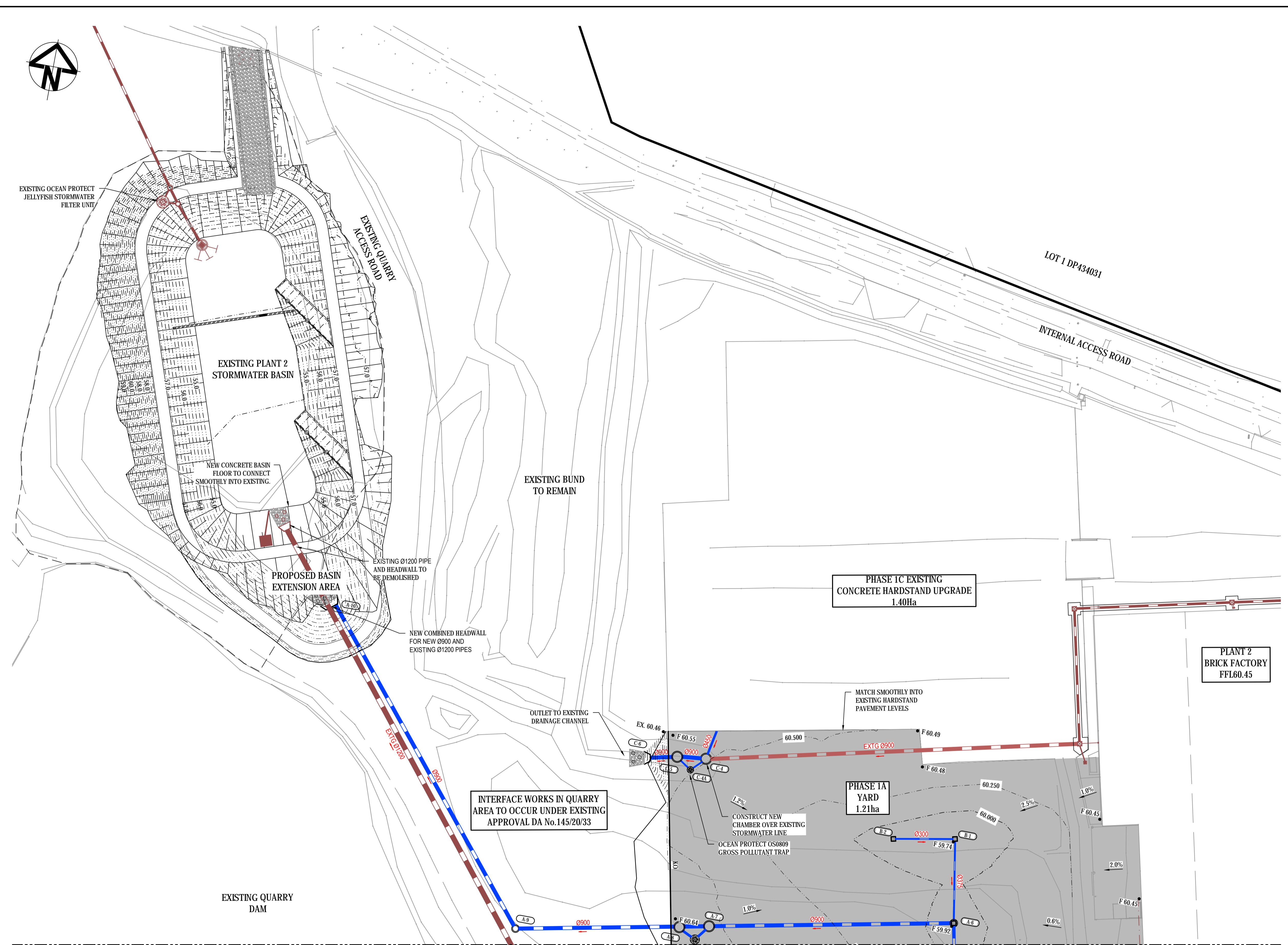


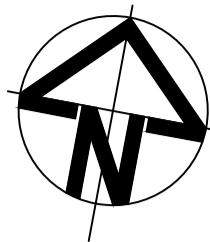


SEE DWG C031 FOR CONTINUATION



		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	Scales	1:500	Drawn	ALS	Project	BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	Civil Engineers and Project Managers
A	ISSUED FOR COORDINATION										
Issue	Description	Date		BRICKWORKS LIMITED	Grid	MGA	Checked	SH			at&l
					Height	AHD	Approved	SH			Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
					Datum				Title	PAVEMENT GRADING & STORMWATER DRAINAGE PLAN	FOR INFORMATION NOT FOR CONSTRUCTION
									PHASE 1A SHEET 1	C030	A1
									Project - Drawing No.	20-782	Issue



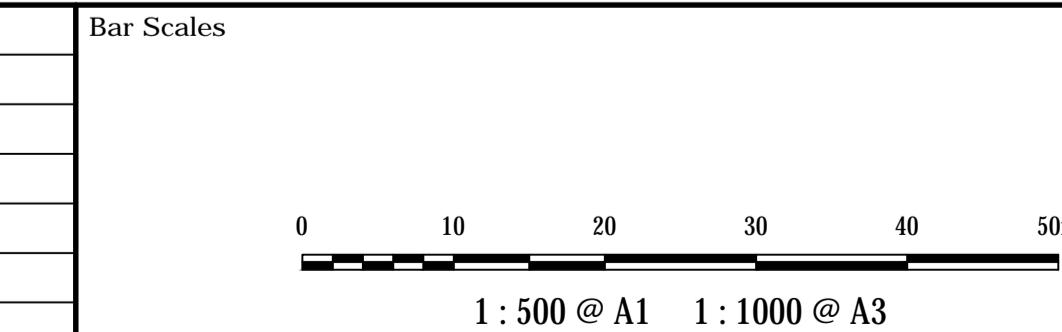


## EXISTING QUARRY DAM

INTERFACE WORKS IN QUARR  
AREA TO OCCUR UNDER EXISTING  
APPROVAL DA No.145/20/33

## EXISTING STOCKPILE

INTERFACE WORKS IN QUARRY  
AREA TO OCCUR UNDER EXISTING  
APPROVAL DA No.145/20/33



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# **BRICKWORKS** LIMITED

**KS**

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Scales 1:500

---

Grid MGA

---

Height Datum AHD

---

	ALS	Project  <b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b>
ed	ALS	
ed	SH	
ved	SH	
Title		<b>PAVEMENT GRADING &amp; STORMWATER DRAINAGE PLAN PHASE 1B</b>

<h1>Civil Engineers and Project Managers</h1> 		<p>Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 <a href="http://www.atl.net.au">www.atl.net.au</a> <a href="mailto:info@atl.net.au">info@atl.net.au</a></p>
Status	<h2>FOR INFORMATION NOT FOR CONSTRUCTION</h2>	
Project - Drawing No.	C032	A1
	20-782	Issue A

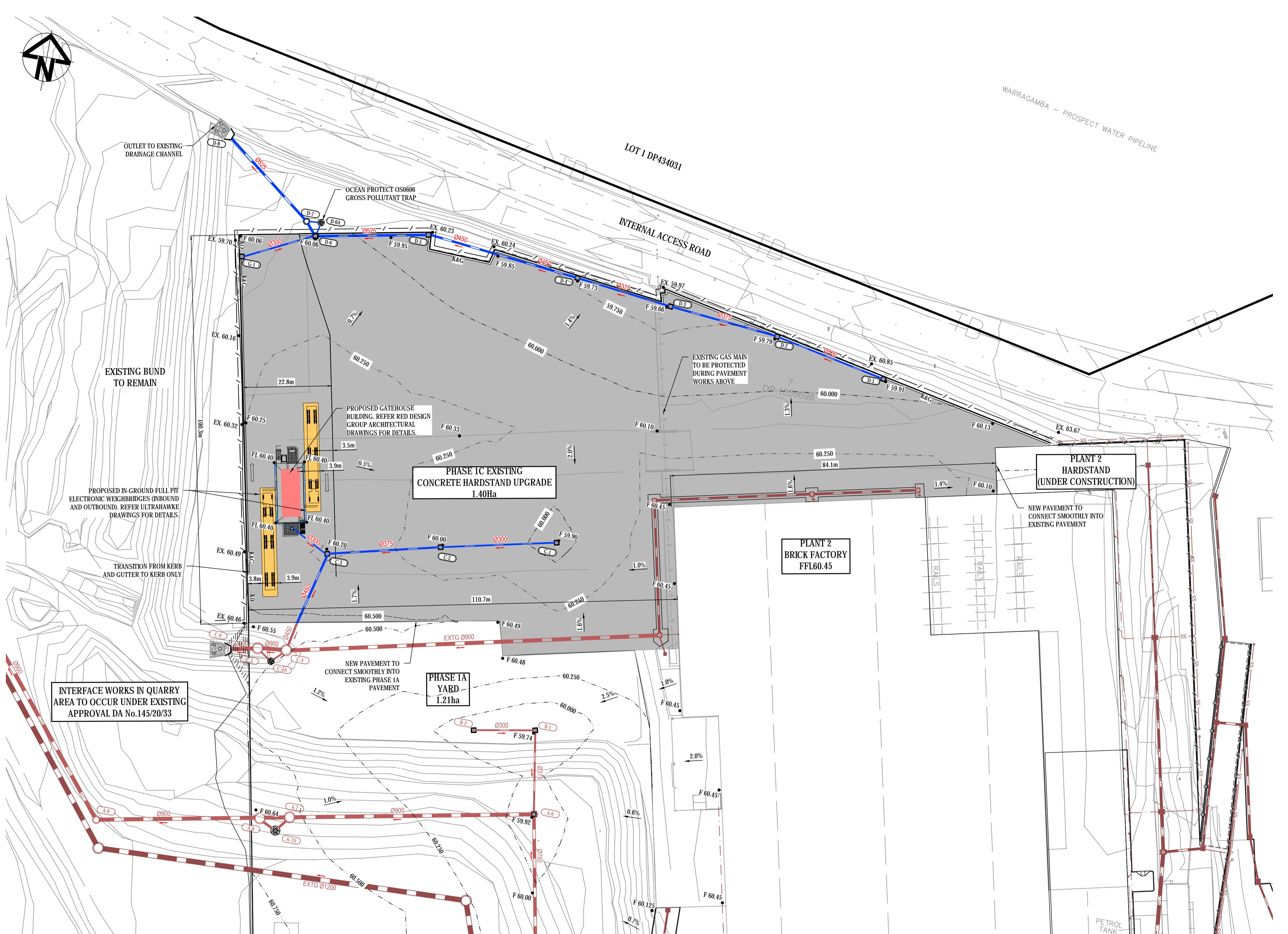
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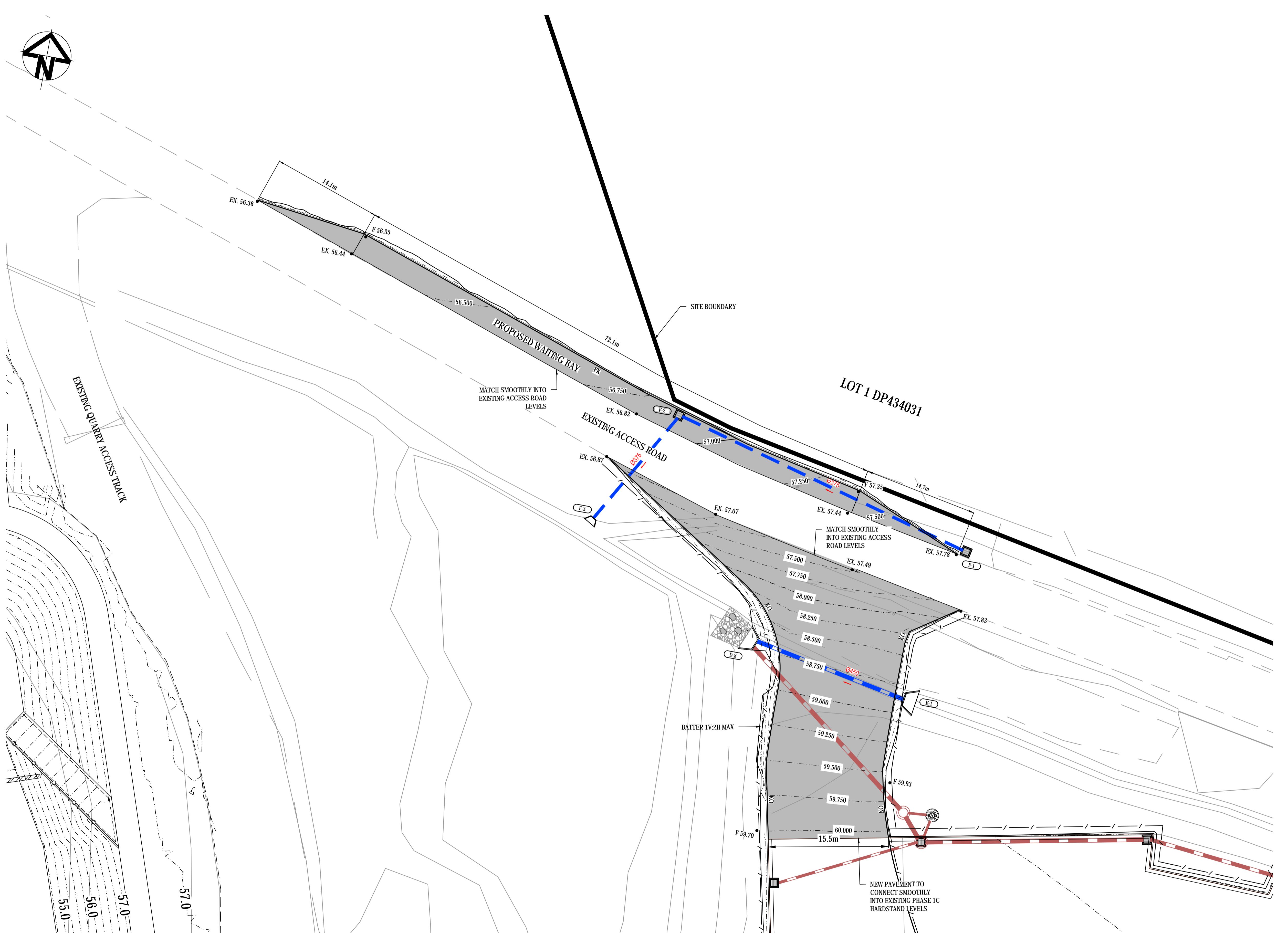
na\NC032.dwg

	EXTENT OF PHASE PAVEMENT WORKS
	PROPERTY BOUNDARY
	PROPOSED STORMWATER PIPE
	EXISTING STORMWATER PIPE
	EXISTING STORMWATER TO BE REMOVED
	PROPOSED STORMWATER SURFACE INLET PIT
	PROPOSED STORMWATER JUNCTION PIT
	PROPOSED STORMWATER ACCESS MANHOLE
	PROPOSED STORMWATER QUALITY TREATMENT DEVICE
	PROPOSED STORMWATER OUTLET HEADWALL WITH SCOUR PROTECTION
	PROPOSED 300 WIDE HEAVY DUTY GRATED TRENCH DRAIN
• F 60.15	FINISHED SURFACE LEVEL
• EX 59.50	EXISTING SURFACE LEVEL
• IL 59.50	PROPOSED INVERT LEVEL
	PROPOSED GRADE
KO	PROPOSED KERB ONLY
K&G	PROPOSED KERB & GUTTER
FK	PROPOSED FLUSH KERB
	PROPOSED BOLLARDS (140mm DIA)
	PROPOSED GUARDRAIL BARRIER
	PROPOSED CHAIN WIRE FENCE (1.8m HIGH)
— 60.2 —	PROPOSED FINISHED SURFACE CONTOUR
— 60.1 —	EXISTING SURFACE CONTOUR

Date Plotted: 24 Feb 2021 - 08:16PM File Name: F:\20-782 Brickworks Plant 2 Hardstand\6.0 Drgs\Civil\Final\C032.dwg

Date Plotted: 24 Feb 2021 - 08:16PM File Name: F:\20-782 Brickworks Plant 2 Hardstand\6.0 Drgs\Civil\Final\C032.dwg







## EXISTING QUARRY DAM

INTERFACE WORKS IN QUARRY  
AREA TO OCCUR UNDER EXISTING  
APPROVAL DA No.145/20/33

## EXISTING BUND TO REMAIN



## PAVEMENT LEGEND

## **NEW HEAVY DUTY REINFORCED CONCRETE PAVEMENT**

## CONCRETE PAVEMENT

- 200mm THICK N40 CONCRETE SLAB REINFORCED WITH SL92 MESH ON
- 100mm DGS40 GRANULAR SUBBASE

## EXISTING REINFORCED CONCRETE PAVEMENT

## CONCRETE BASIN FLOOR

- 150mm THICK REINFORCED N32 CONCRETE WITH SL72 MESH (TOP) 40mm COVER ON
- 100mm DGS40 SUBBASE

## BASIN BATTERS & SPILLWAY

**BASIN BATTERS & SPILLWAY**  
230mm THICK RENO MATTRESS FILLED WITH WELL-GRADED  
75-150mm SIZE QUARRIED ROCK PLACED OVER BIDIM A49

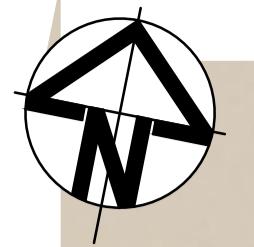
## BASIN BERM ACCESS TRACK

**BASIN DERM ACCESS TRACK**

## LANDSCAPED BATTERS

**LANDSCAPED BATTERS**  
REFER LANDSCAPE ARCHITECTS' DOCUMENTATION.  
ALL BATTERS TO BE STABILISED AT COMPLETION OF  
EARTHWORKS WITH TOPSOIL, COIR NETTING AND  
HYDROMULCH

## EXISTING PLANT 2 INTERLOCKING CONCRETE BLOCK PAVEMENT



EXISTING QUARRY  
DAM

INTERFACE WORKS IN QUARRY  
AREA TO OCCUR UNDER EXISTING  
APPROVAL DA No.145/20/33

EXISTING STOCKPILE

INTERFACE WORKS IN QUARRY  
AREA TO OCCUR UNDER EXISTING  
APPROVAL DA No.145/20/33

EXISTING QUARRY ACCESS ROAD

PHASE 1A  
YARD  
1.21ha

PHASE 1B  
YARD  
0.81ha

NEW PHASE 1B CONCRETE PAVEMENT  
TO TIE IN SMOOTHLY WITH EXISTING  
PHASE 1A CONCRETE HARDSTAND AT  
INTERFACE

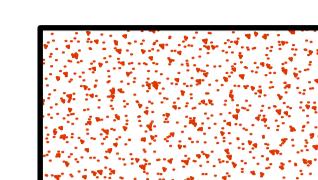
NEW PHASE 1B CONCRETE PAVEMENT  
TO TIE IN SMOOTHLY WITH EXISTING  
PLANT 2 KERB

PLANT 2  
BRICK FACTORY  
FFL60.45

ridge RL 69.86  
ridge RL 69.86

PLANT 2  
HARDSTAND  
(UNDER CONSTRUCTION)

#### PAVEMENT LEGEND



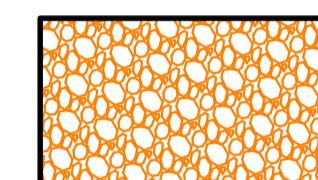
NEW HEAVY DUTY REINFORCED  
CONCRETE PAVEMENT  
• 200mm THICK N40 CONCRETE SLAB REINFORCED WITH  
SL92 MESH ON  
• 100mm DGS40 GRANULAR SUBBASE



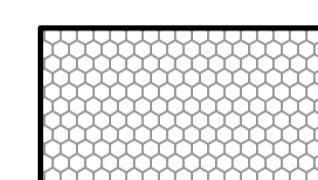
EXISTING REINFORCED  
CONCRETE PAVEMENT



CONCRETE BASIN FLOOR  
• 150mm THICK REINFORCED N32 CONCRETE WITH SL72  
MESH (TOP) 40mm COVER ON  
• 100mm DGS40 SUBBASE



BASIN BATTERS & SPILLWAY  
230mm THICK RENO MATTRESS FILLED WITH WELL-GRADED  
75-150mm SIZE QUARRIED ROCK PLACED OVER BIDIM A49  
NON-WOVEN GEOTEXTILE



BASIN BERM ACCESS TRACK  
150mm DGS40 GRAVEL OVER BIDIM A49 GEOFABRIC  
OVER COMPAKTED SUBGRADE



LANDSCAPED BATTERS  
REFER LANDSCAPE ARCHITECTS DOCUMENTATION.  
ALL BATTERS TO BE STABILISED AT COMPLETION OF  
EARTHWORKS WITH TOPSOIL, COIR NETTING AND  
HYDROMULCH



EXISTING PLANT 2 INTERLOCKING  
CONCRETE BLOCK PAVEMENT

		Bar Scales	1:500	Drawn	ALS	Project	BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	Civil Engineers and Project Managers
			Designed	ALS				
		Grid MGA	Checked	SH				
		Height Datum AHD	Approved	SH				
A	ISSUED FOR COORDINATION	24.02.21				Title	PAVEMENT PLAN PHASE 1B	Status
Issue	Description	Date						FOR INFORMATION NOT FOR CONSTRUCTION
								Project - Drawing No. C042
								Issue A

0 10 20 30 40 50m  
1 : 500 @ A1 1 : 1000 @ A3

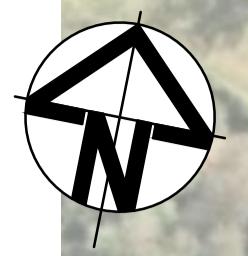
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LIMITED

**at&l**

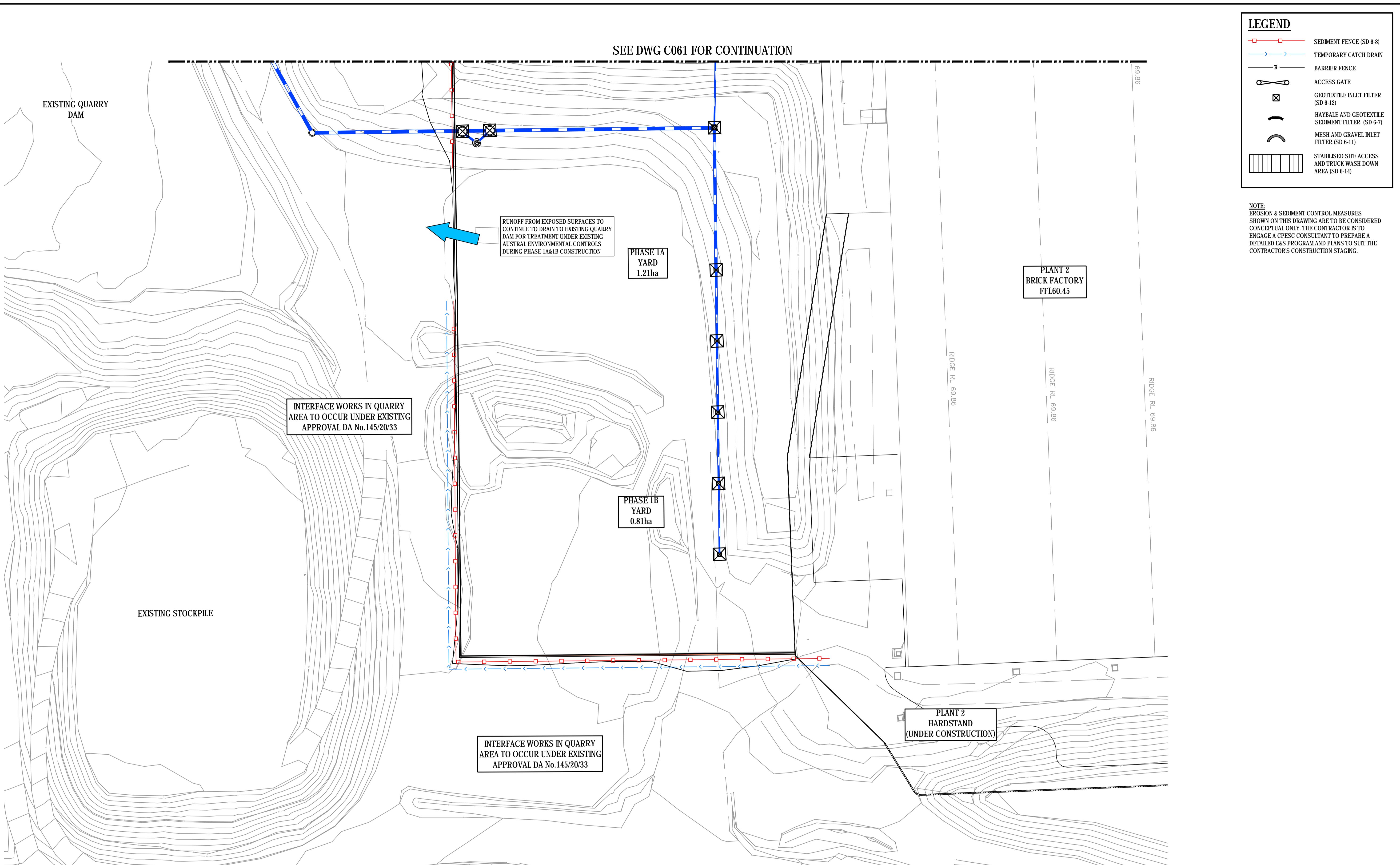
Level 7, 153 Walker Street  
North Sydney NSW 2060  
ABN 96 130 882 405  
Tel: 02 9439 1777  
Fax: 02 9923 1055  
www.atl.net.au  
info@atl.net.au

Status FOR INFORMATION  
NOT FOR CONSTRUCTION A1  
Project - Drawing No. C042  
Issue 20-782 A

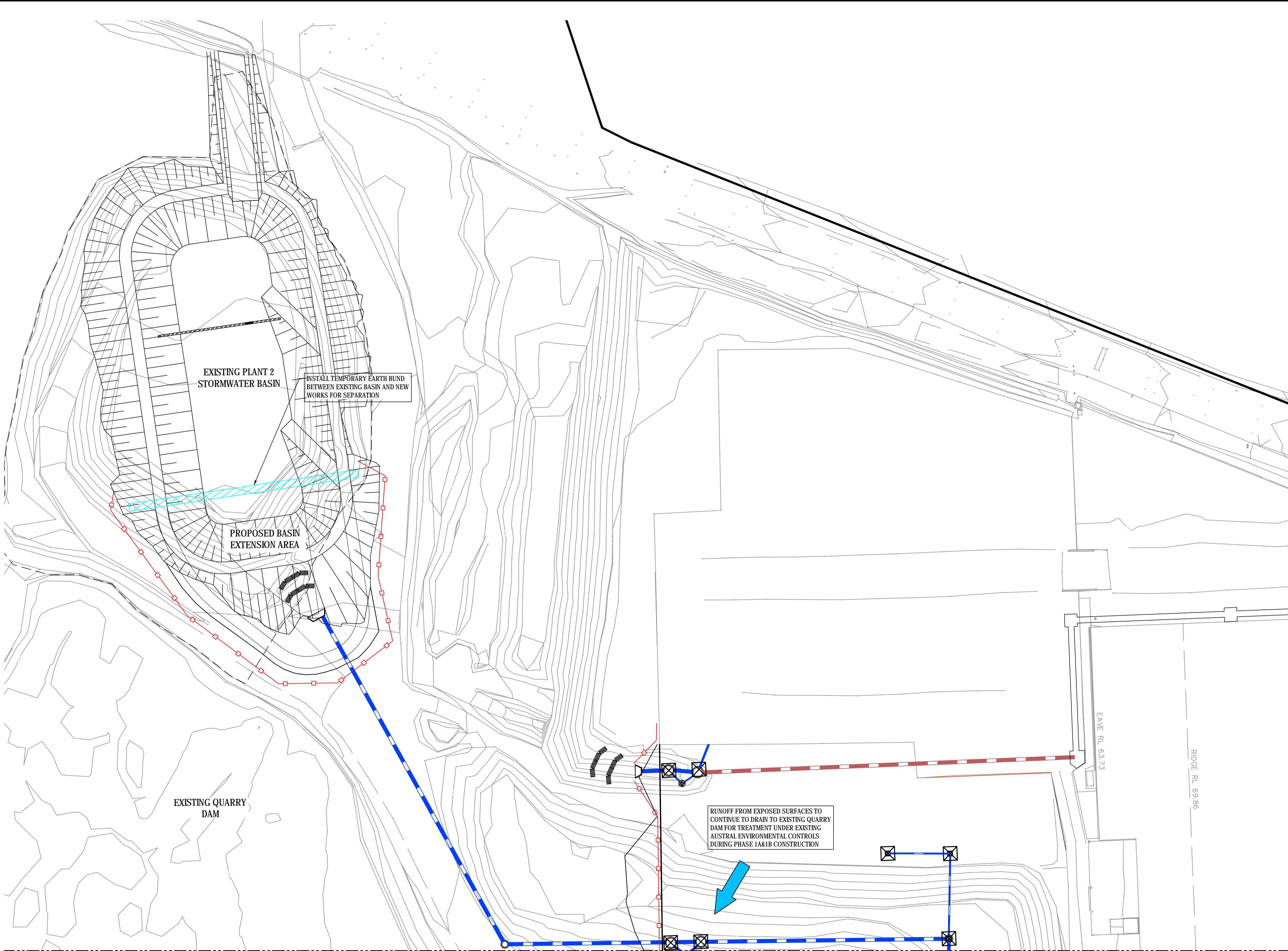


		Bar Scales	0 5 10 15 20 25m 1 : 250 @ A1 1 : 500 @ A3	THIS DRAWING CANNOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY OTHER PURPOSE OTHER THAN THAT ORIGINALLY INTENDED WITHOUT THE WRITTEN PERMISSION OF AT&L	Client <b>BRICKWORKS</b> LIMITED	Scales 1:500 Designed Grid MGA Height Datum AHD	Drawn ALS Checked SH Approved SH	Project <b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b>	Civil Engineers and Project Managers <b>at&amp;l</b> Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
A	ISSUED FOR COORDINATION								
Issue	Description	Date						<b>PAVEMENT PLAN PHASE 1C</b>	Status <b>FOR INFORMATION NOT FOR CONSTRUCTION</b>
								Project - Drawing No. C043	A1 Issue 20-782 A



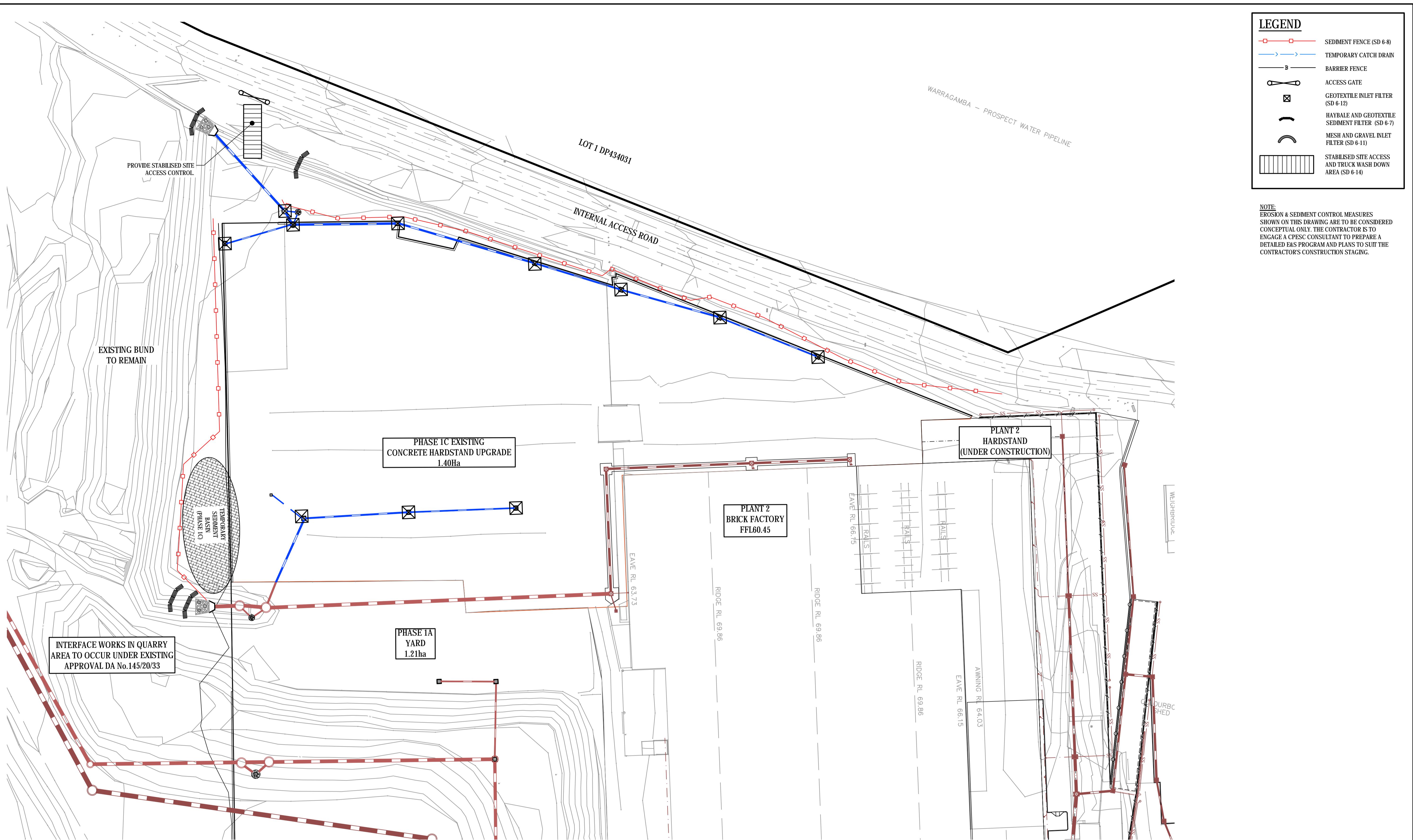


		Bar Scales	Client	Scales	Project	Civil Engineers and Project Managers
		0 10 20 30 40 50m	<b>BRICKWORKS</b> LIMITED	1:500 Designed MGA Checked AHD Approved	BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	at&l Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
A ISSUED FOR COORDINATION		24.02.21		ALS ALS SH SH	Title EROSION AND SEDIMENT CONTROL PLAN PHASE 1A & 1B - SHEET 1	Status FOR INFORMATION NOT FOR CONSTRUCTION
Issue	Description	Date				

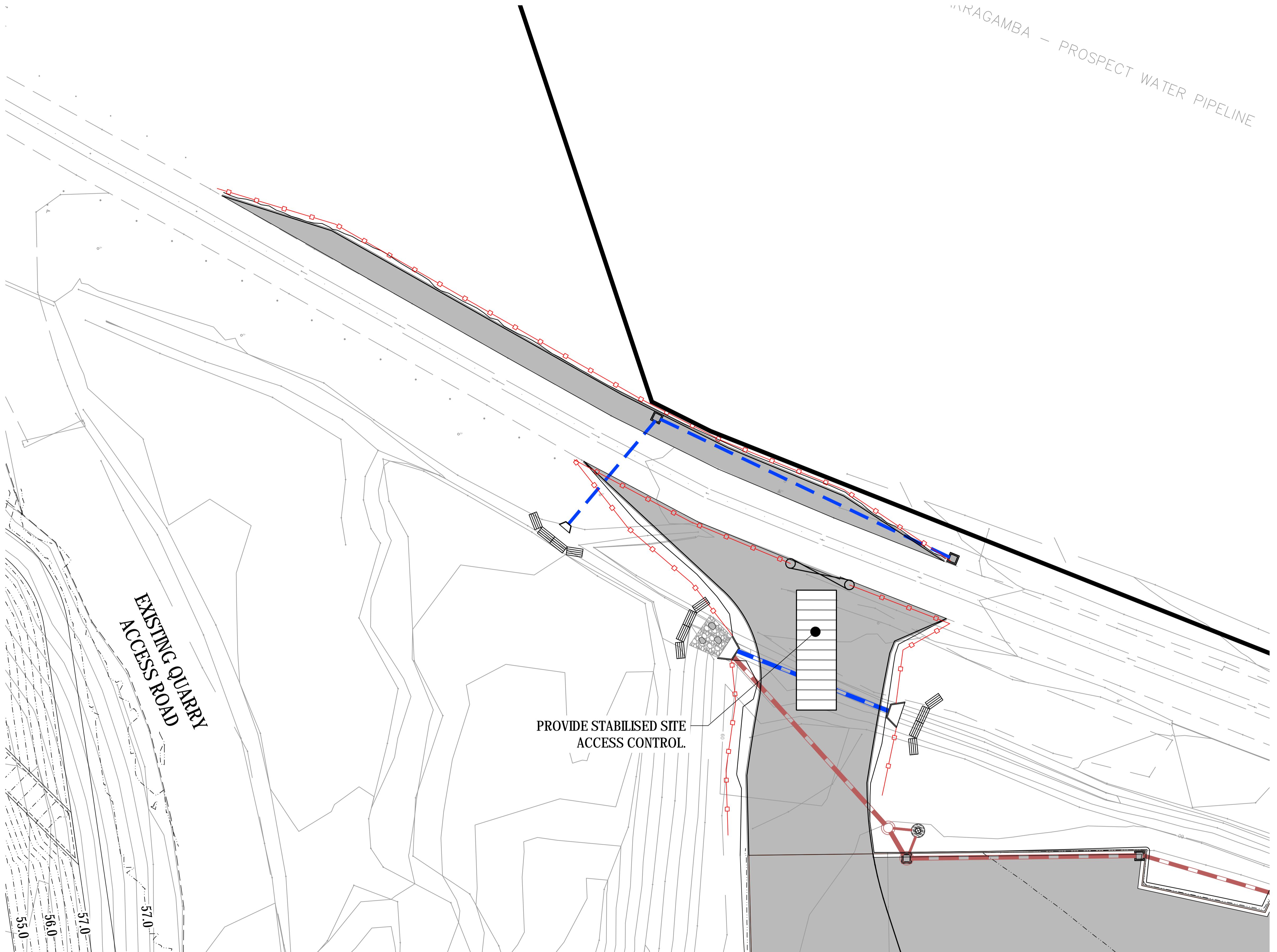


SEE DWG C060 FOR CONTINUATION

		Bar Scales	Client	Scales	Drawn	ALS	Project	Civil Engineers and Project Managers
A	ISSUED FOR COORDINATION	0 10 20 30 40 50m						
A	24.02.21	1 : 500 @ A1 1 : 1000 @ A3		1:500			BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION	at&l Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au
Issue	Description	Date		Grid MGA	Checked	SH		
				Height Datum AHD	Approved	SH		
							Title	FOR INFORMATION NOT FOR CONSTRUCTION
								A1
							Project - Drawing No.	
							C061	Issue
							20-782	A



		Bar Scales	<p>0 10 20 30 40 50m</p> <p>1:500 @ A1 1:1000 @ A3</p>	<p>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&amp;L</p>	<p>Client</p> <p><b>BRICKWORKS</b> LIMITED</p>	<p>Scales 1:500 Grid MGA Height Datum AHD</p>	<p>Drawn Designed Checked Approved</p>	<p>ALS ALS SH SH</p>	<p>Project</p> <p><b>BRICKWORKS HORSLEY PARK PLANT 2 HARDSTAND EXTENSION</b></p>	<p>Civil Engineers and Project Managers</p> <p><b>at&amp;l</b></p> <p>Level 7, 153 Walker Street North Sydney NSW 2060 ABN 96 130 882 405 Tel: 02 9439 1777 Fax: 02 9923 1055 www.atl.net.au info@atl.net.au</p>
B	ISSUED FOR COORDINATION	03-03-21								
A	ISSUED FOR COORDINATION	24-02-21								
Issue	Description	Date								
<p>Status <b>FOR INFORMATION NOT FOR CONSTRUCTION</b> A1</p> <p>Project - Drawing No. C062 Issue B</p>										



## EROSION AND SEDIMENT CONTROL

### NOTES

#### GENERAL INSTRUCTIONS

1. THE SITE SUPERINTENDENT/ENGINEER WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE LOCATED AS DOCUMENTED.
2. ALL WORK SHALL BE GENERALLY CARRIED OUT IN ACCORDANCE WITH
  - a. LOCAL AUTHORITY REQUIREMENTS
  - b. EPA REQUIREMENTS
  - c. NSW DEPARTMENT OF HOUSING MANUAL "MANAGING URBAN STORMWATER, SOILS AND CONSTRUCTION", 4th EDITION, MARCH 2004.
3. MAINTAIN THE EROSION CONTROL DEVICES TO THE SATISFACTION OF THE SUPERINTENDENT AND THE LOCAL AUTHORITY.
4. WHEN STORMWATER PITS ARE CONSTRUCTED, PREVENT SITE RUNOFF ENTERING UNLESS SEDIMENT FENCES ARE ERECTED AROUND PITS.
5. 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

6. 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:

- (A) INSTALL A SEDIMENT FENCE ALONG THE BOUNDARIES AS SHOWN ON PLAN. REFER DETAIL.
- (B) CONSTRUCT STABILISED CONSTRUCTION ENTRANCE TO LOCATION AS DETERMINED BY SUPERINTENDENT/ENGINEER. REFER DETAIL.
- (C) INSTALL SEDIMENT TRAPS AS SHOWN ON PLAN.
- (D) 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

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

#### SEDIMENT CONTROL

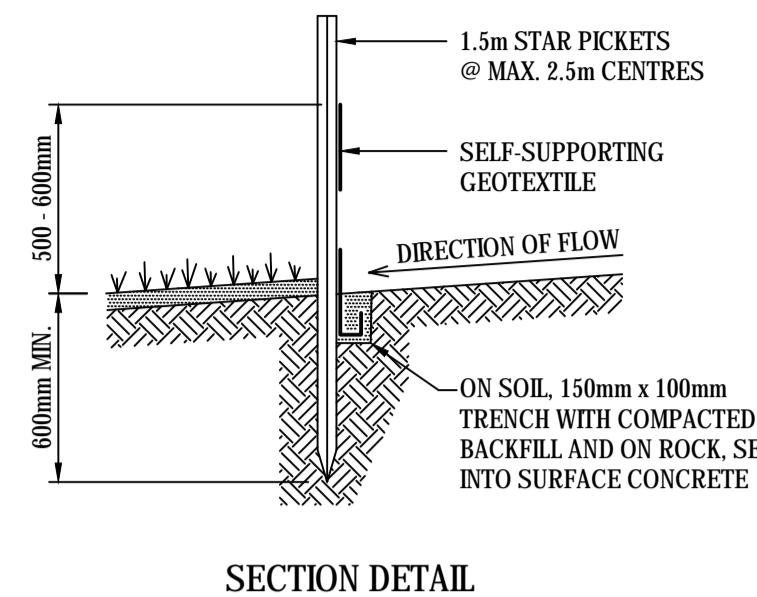
9. STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.
10. 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.

11. 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.

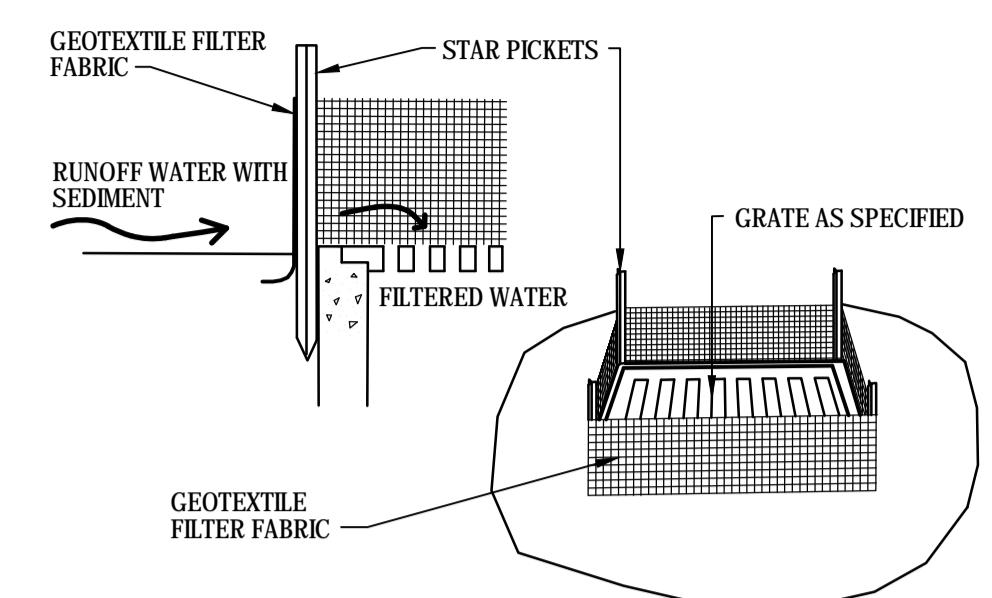
12. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

#### OTHER MATTERS

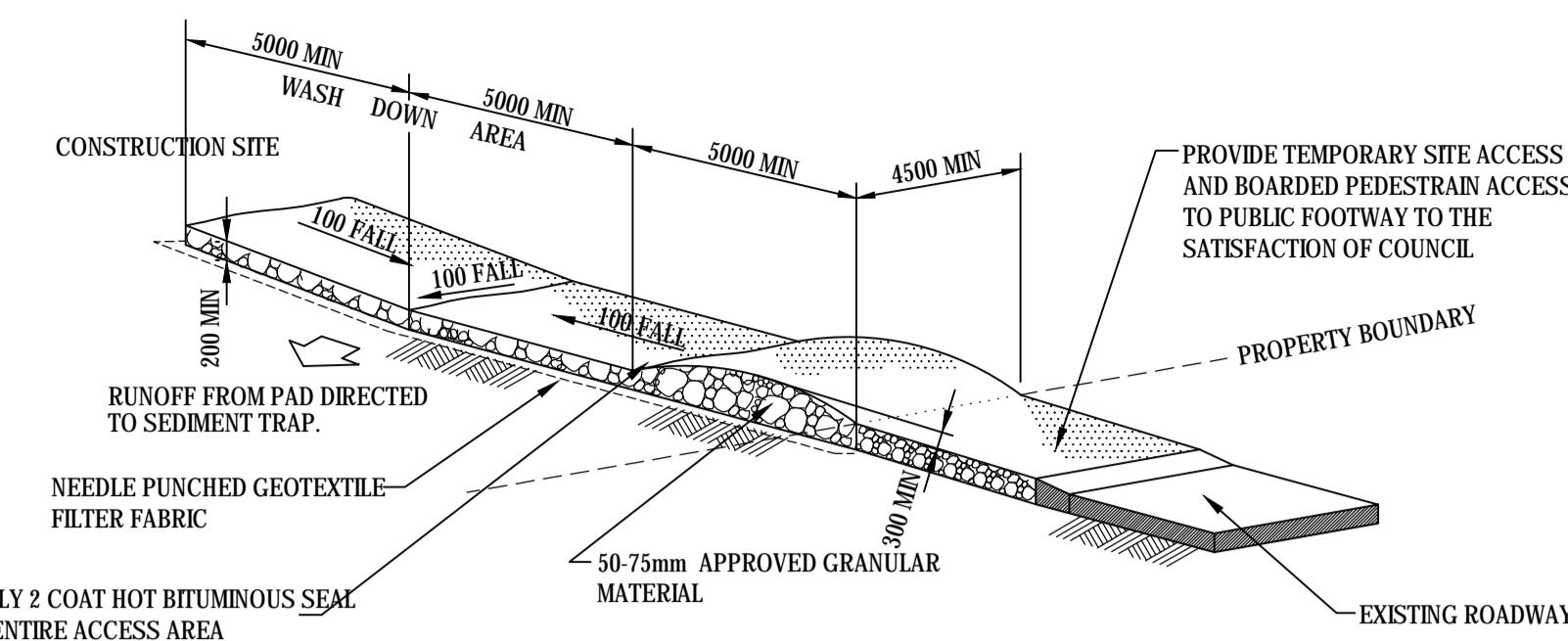
13. ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.
14. ANY EXISTING TREES WHICH FORM PART OF THE FINAL LANDSCAPING PLAN WILL BE PROTECTED FROM CONSTRUCTION ACTIVITIES BY:
  - (A) PROTECTING THEM WITH BARRIER FENCING OR SIMILAR MATERIALS INSTALLED OUTSIDE THE DRIP LINE
  - (B) ENSURING THAT NOTHING IS NAILED TO THEM
  - (C) PROHIBITING PAVING, GRADING, SEDIMENT WASH OR PLACING OF STOCKPILES WITHIN THE DRIP LINE EXCEPT UNDER THE FOLLOWING CONDITIONS:
    - (i) 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
    - (ii) 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
    - (iii) CARE IS TAKEN NOT TO CUT ROOTS UNNECESSARILY NOR TO COMPACT THE SOIL AROUND THEM



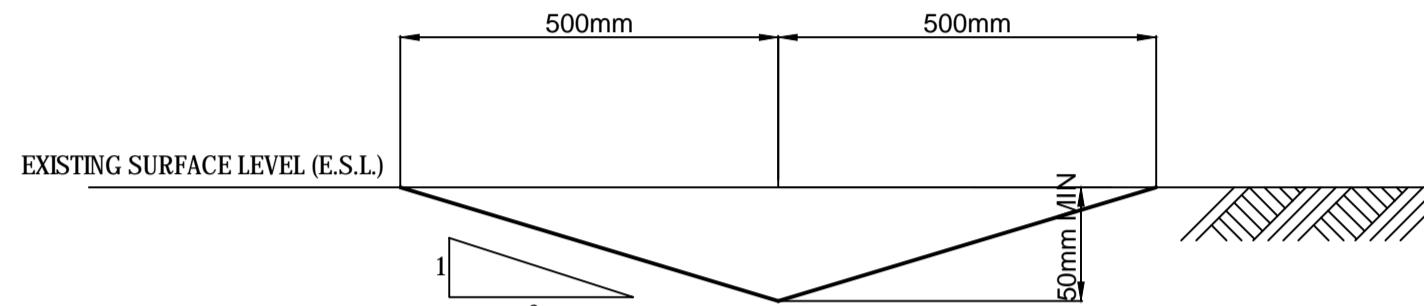
SECTION DETAIL



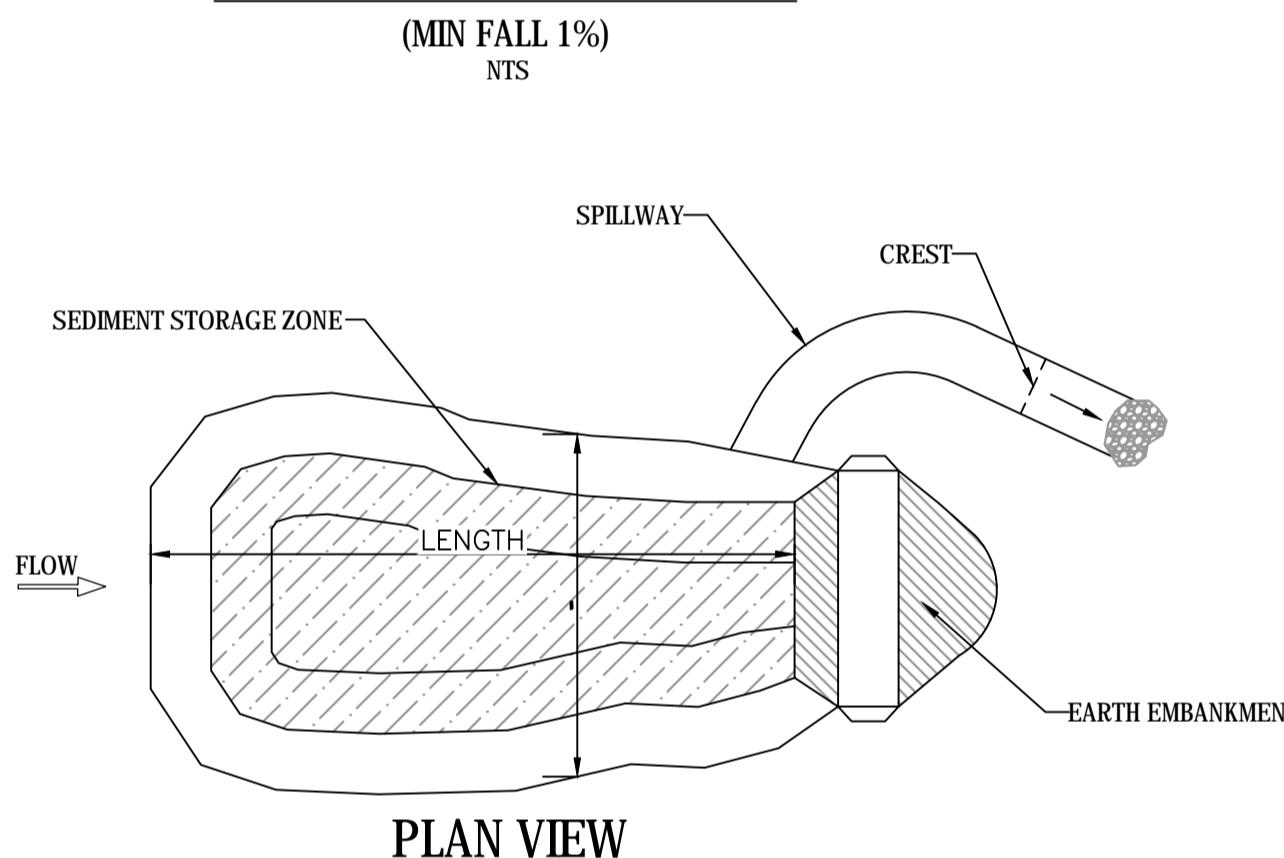
GEOTEXTILE FILTER PIT SURROUND (SD 6-12)



STABILISED SITE ACCESS AND TRUCK WASH DOWN AREA (SD 6-14)



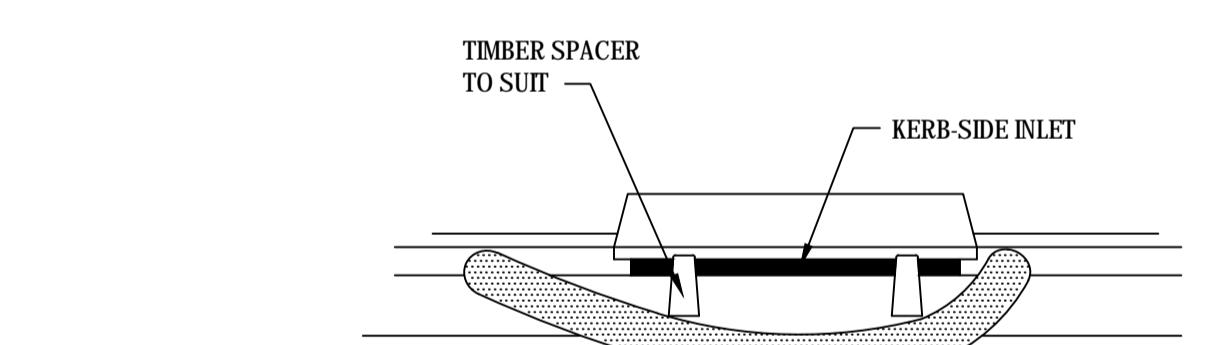
TEMPORARY CATCH DRAIN



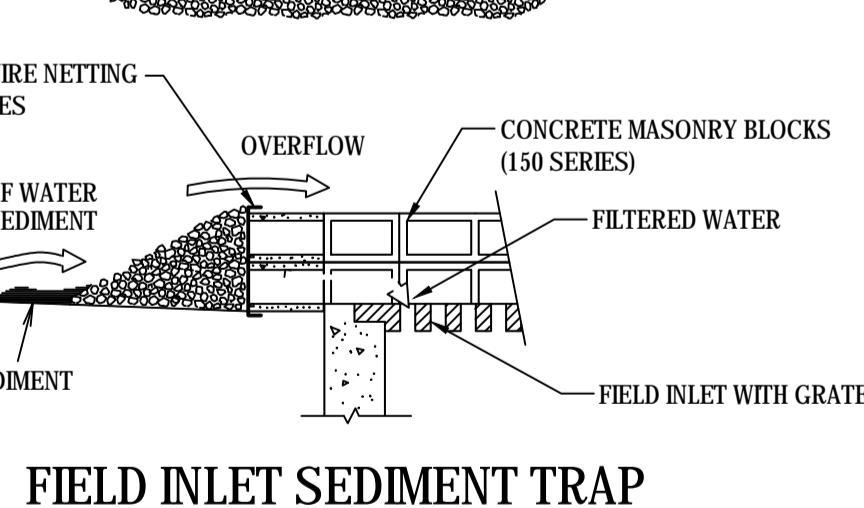
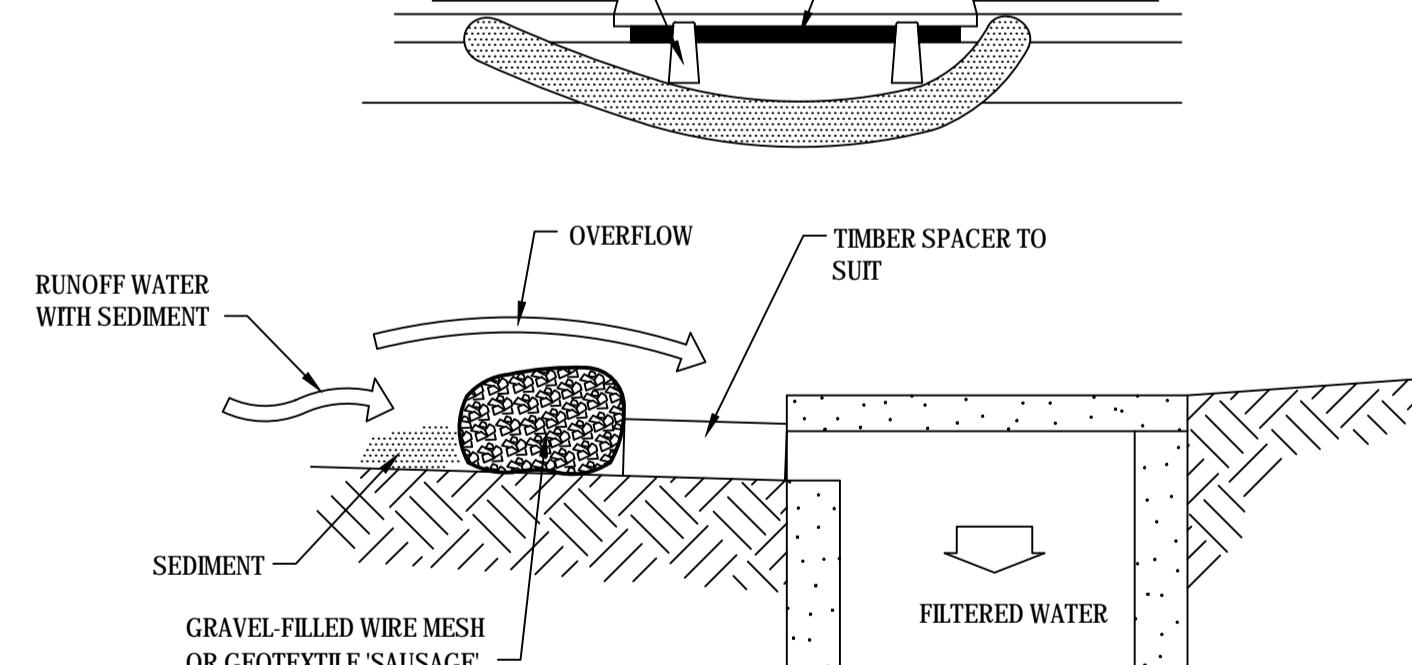
EARTH BASIN - WET TYPE F (SD 6-4)

**BASIN CONSTRUCTION NOTES:**

1. REMOVE ALL VEGETATION AND TOPSOIL FROM BASIN AREA.
2. CONSTRUCT A CUT-OFF TRENCH 500mm DEEP AND 1200mm WIDE ALONG THE CENTRELINE OF THE EMBANKMENT EXTENDING TO A POINT ON THE GULLY WALL LEVEL FOLLOWING THE RISER CREST.
3. MAINTAIN THE TRENCH FREE OF WATER AND RECOMPACT THE MATERIALS WITH EQUIPMENT SPECIFIED IN THE SWMP TO 95% STANDARD PROCTOR DENSITY.
4. SELECT FILL ACCORDING TO THE DIRECTIONS OF THE SWMP THAT IS FREE OF ROOTS, WOOD, ROCK, LARGE STONE OF FOREIGN MATERIAL.
5. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING AT LEAST 100mm DEEP TO HELP BOND COMPACTED FILL TO EXISTING SUBSTRATE.
6. SPREAD FILL IN 100mm TO 150mm LAYERS AND COMPACT AT OPTIMUM MOISTURE CONTENT.
7. CONSTRUCT EMERGENCY SPILLWAY.
8. PLACE A 'FULL OF SEDIMENT' MARKER TO SHOW WHEN LESS THAN DESIGN CAPACITY OCCURS AND SEDIMENT REMOVAL IS REQUIRED.
9. SPILLWAY MAXIMUM BATTER SLOPE SHALL BE 4(1):1(V)



INLET SEDIMENT TRAP (SD 6-11)



FIELD INLET SEDIMENT TRAP

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

**BRICKWORKS**  
LIMITED

Scales

AS SHOWN

Drawn

ALS

Designed

ALS

Grid

MGA

Checked

SH

Height

AHD

Approved

SH

Project

**BRICKWORKS**  
HORSLEY PARK  
PLANT 2 HARDSTAND  
EXTENSION

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Status FOR INFORMATION  
NOT FOR CONSTRUCTION

A1

Project - Drawing No. C065

Issue 20-782

A	ISSUED FOR COORDINATION	24.02.21
Issue	Description	Date

100mm on Original

Date Plotted: 24 Feb 2021 - 04:46PM File Name: F:\20-782 Brickworks Plant 2 Hardstand\6.0 Drgs\Civil\Final\065.dwg

# Appendix C

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Douglas Partners Geotechnical Report



Report on  
Geotechnical Investigation

Lightweight Aggregate Project  
Plant 2, Austral Brick Site  
720 Wallgrove Road, Horsley Park

Prepared for  
Brickworks Ltd

Project 84821.00  
June 2015

Integrated Practical Solutions



## Document History

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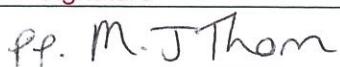
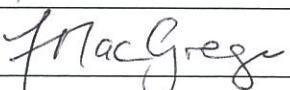
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		25 June 2015
Reviewer		25 June 2015



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APPENDIX A - About this Report

APPENDIX B - Drawing 1 – Test Locations  
 Drawing 2 – Extract from Geological Map  
 Drawing 3 – Cross Section A-A'

APPENDIX C - Field Work Results

APPENDIX D - Laboratory Test Results

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

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## 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 underlined 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  $\pm 1$  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 rippled 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**

Strata Description	Depths to Strata Boundaries (m) (Levels in brackets)				
	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**

Strata Description	Depths to Strata Boundaries (m) (Levels in brackets)				
	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**

Strata Description	Depths to Strata Boundaries (m)				
	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 <sub>L</sub> (%)	w <sub>P</sub> (%)	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<sub>L</sub> = Liquid limit      w<sub>P</sub> = 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 <sup>3</sup> )	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/Screener 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 ripppable 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/m <sup>3</sup> )	Coefficient of Active Earth Pressure (K <sub>a</sub> )	Coefficient of Passive Earth Pressure (K <sub>p</sub> )	Coefficient of Earth Pressure at Rest (K <sub>o</sub> )
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<sub>e</sub> 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.

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**Douglas Partners Pty Ltd**

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## **Appendix A**

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About this Report

## About this Report



### 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**

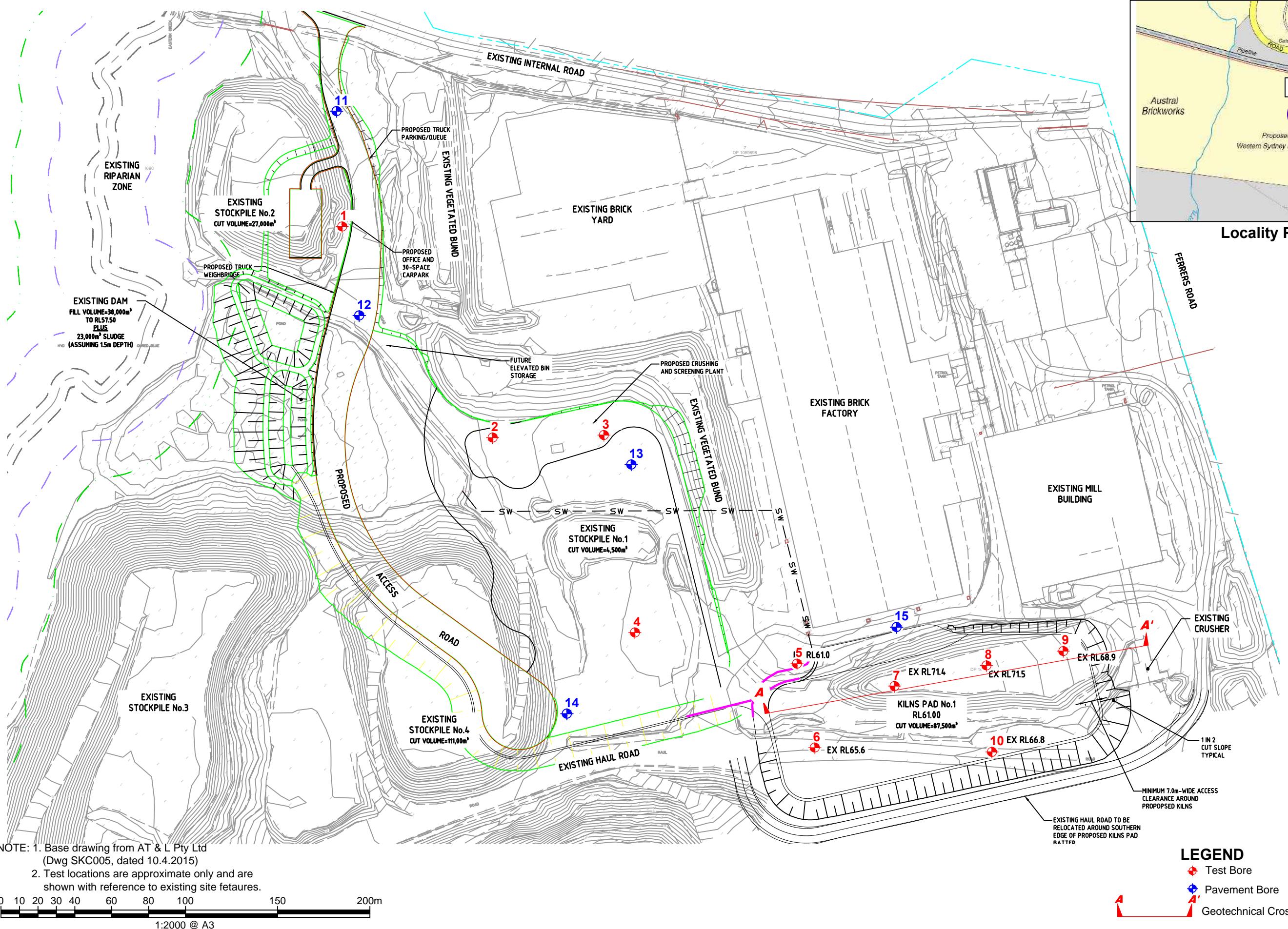
The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

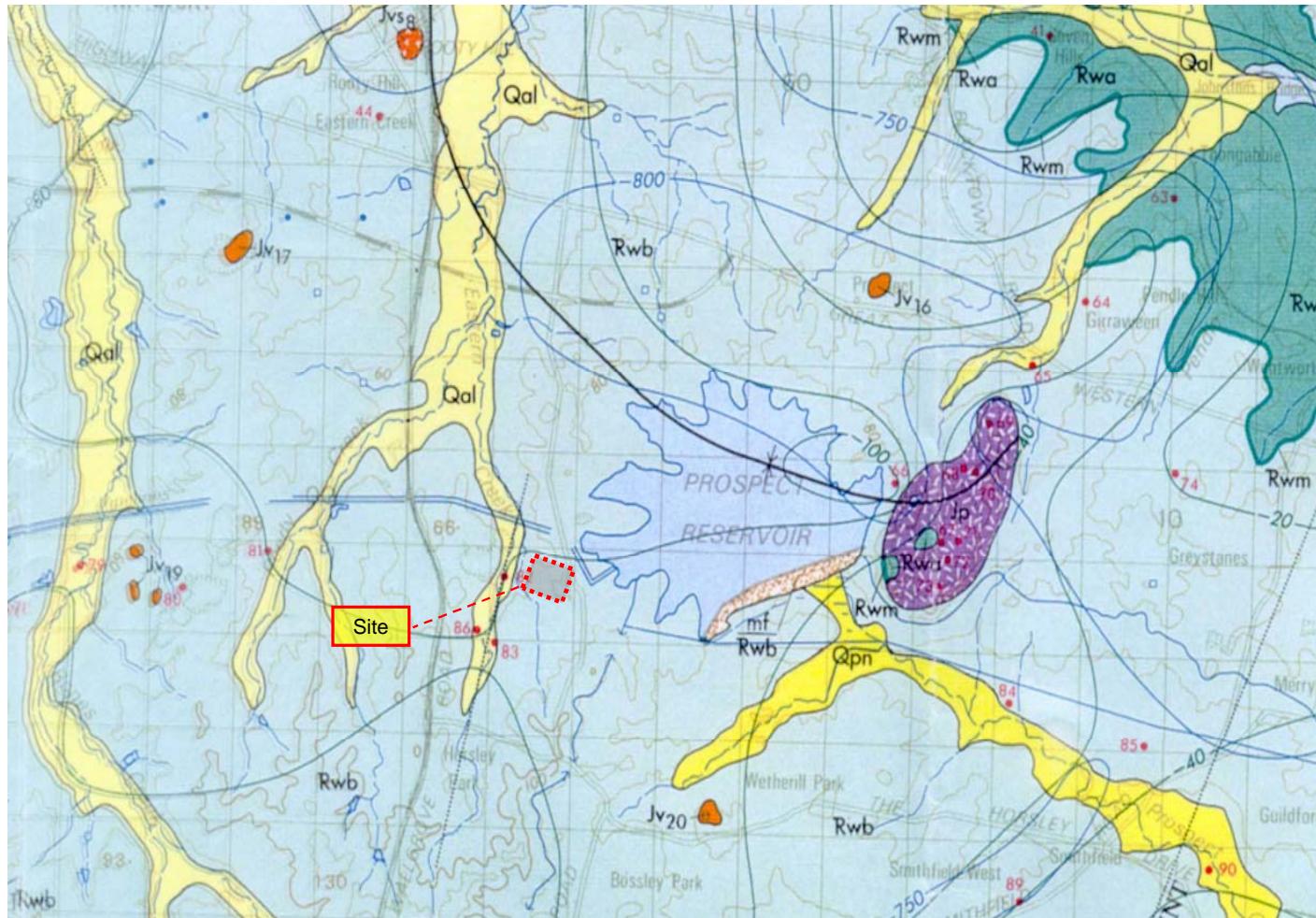
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## **Appendix B**

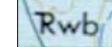
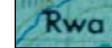
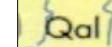
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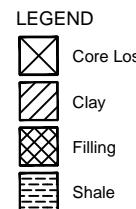
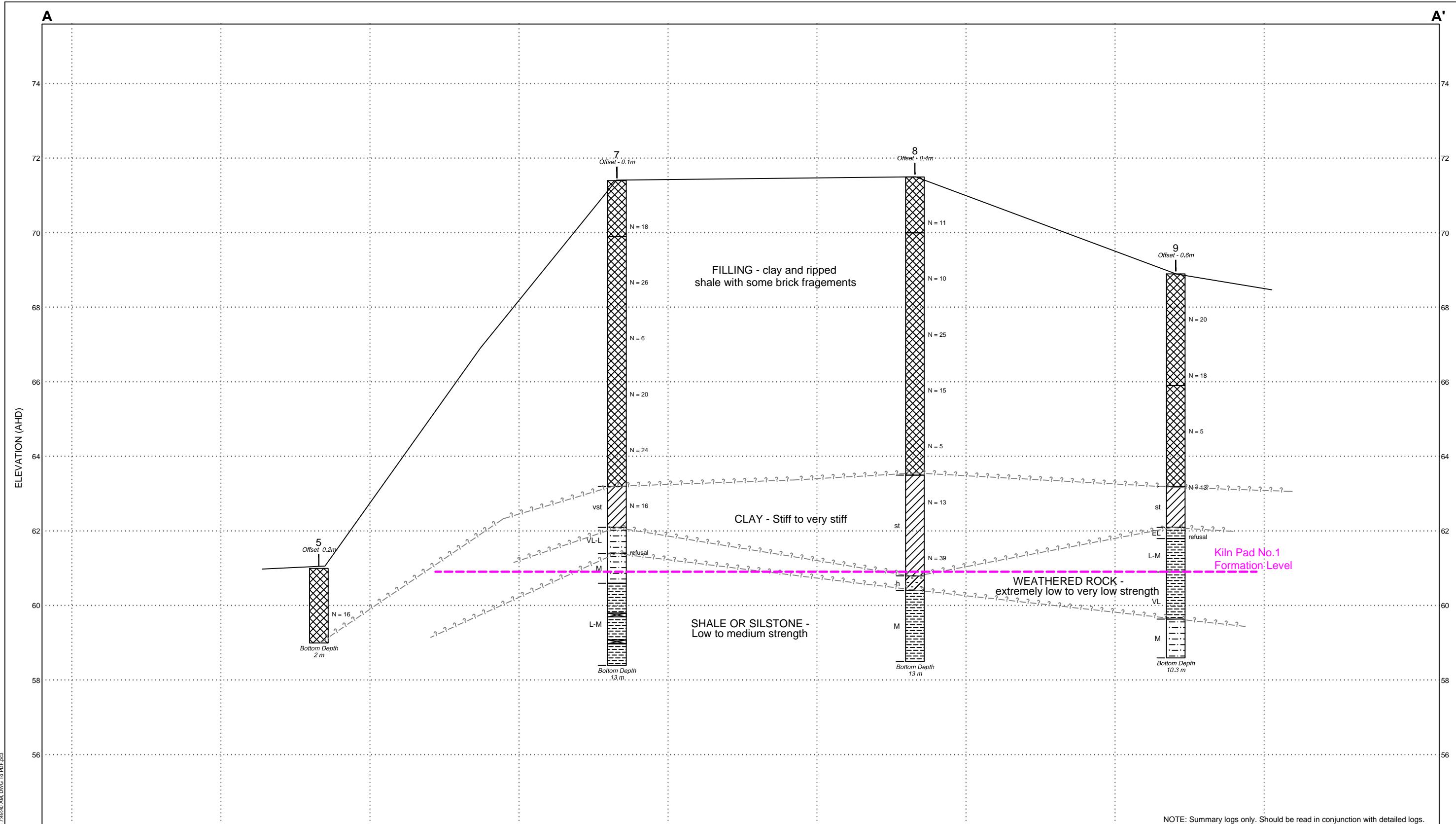
Drawing 1 – Test :Locations  
Drawing 2 – Extract from Geological Map  
Drawing 3 –Cross-Section A-A'



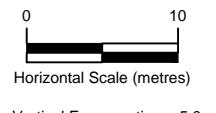


LEGEND

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



ROCK STRENGTH	SOIL CONSISTENCY	TESTS / OTHER
EL - Extremely Low	vs - very soft	N - Standard penetration test value
VL - Very Low	s - soft	WL - Water level
L - Low	f - firm	
M - Medium	st - stiff	
H - High	vst - very stiff	
VH - Very High	vd - very dense	
	h - hard	



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## **Appendix C**

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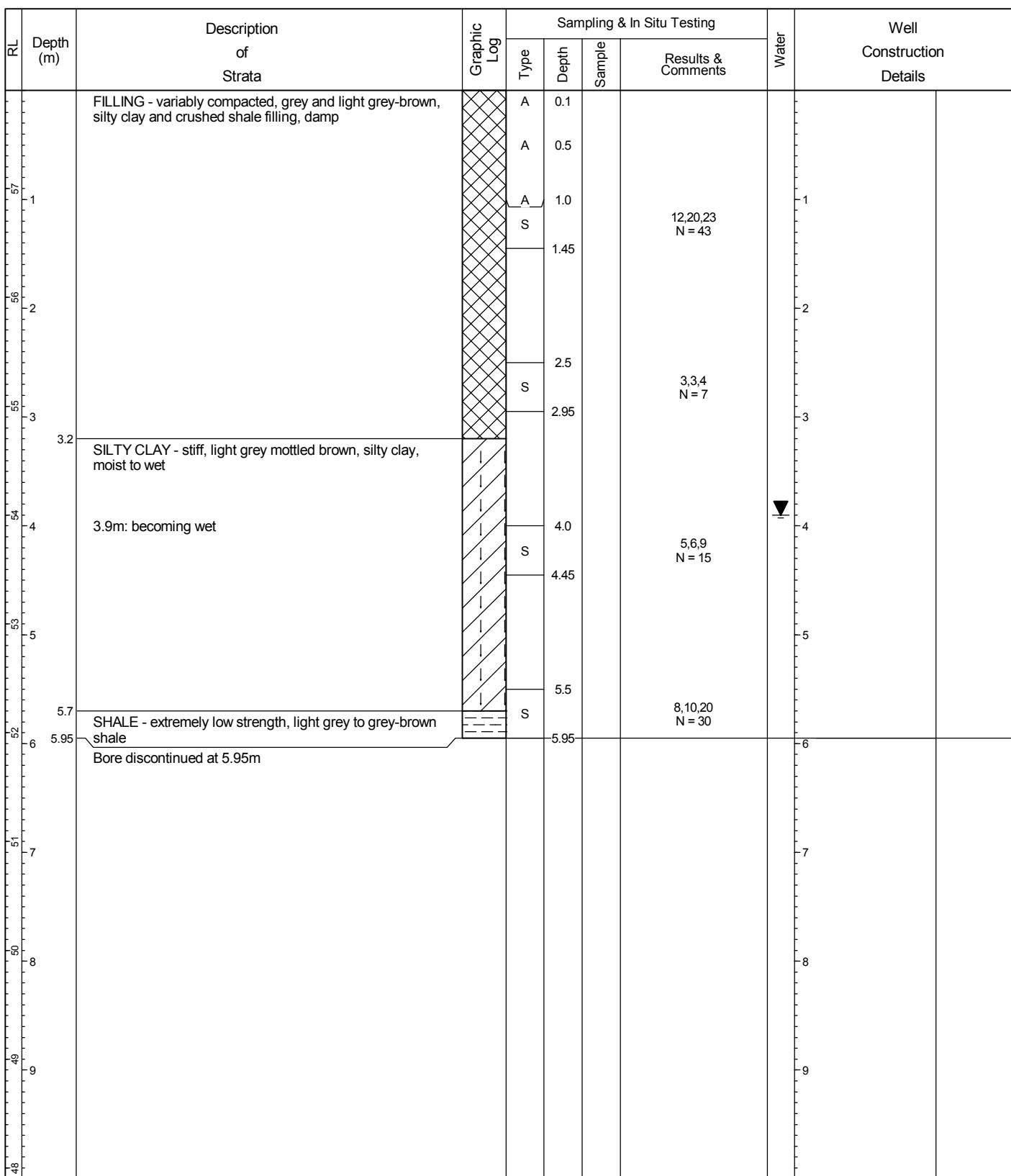
### **Field Work Results**

# 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



## **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:**

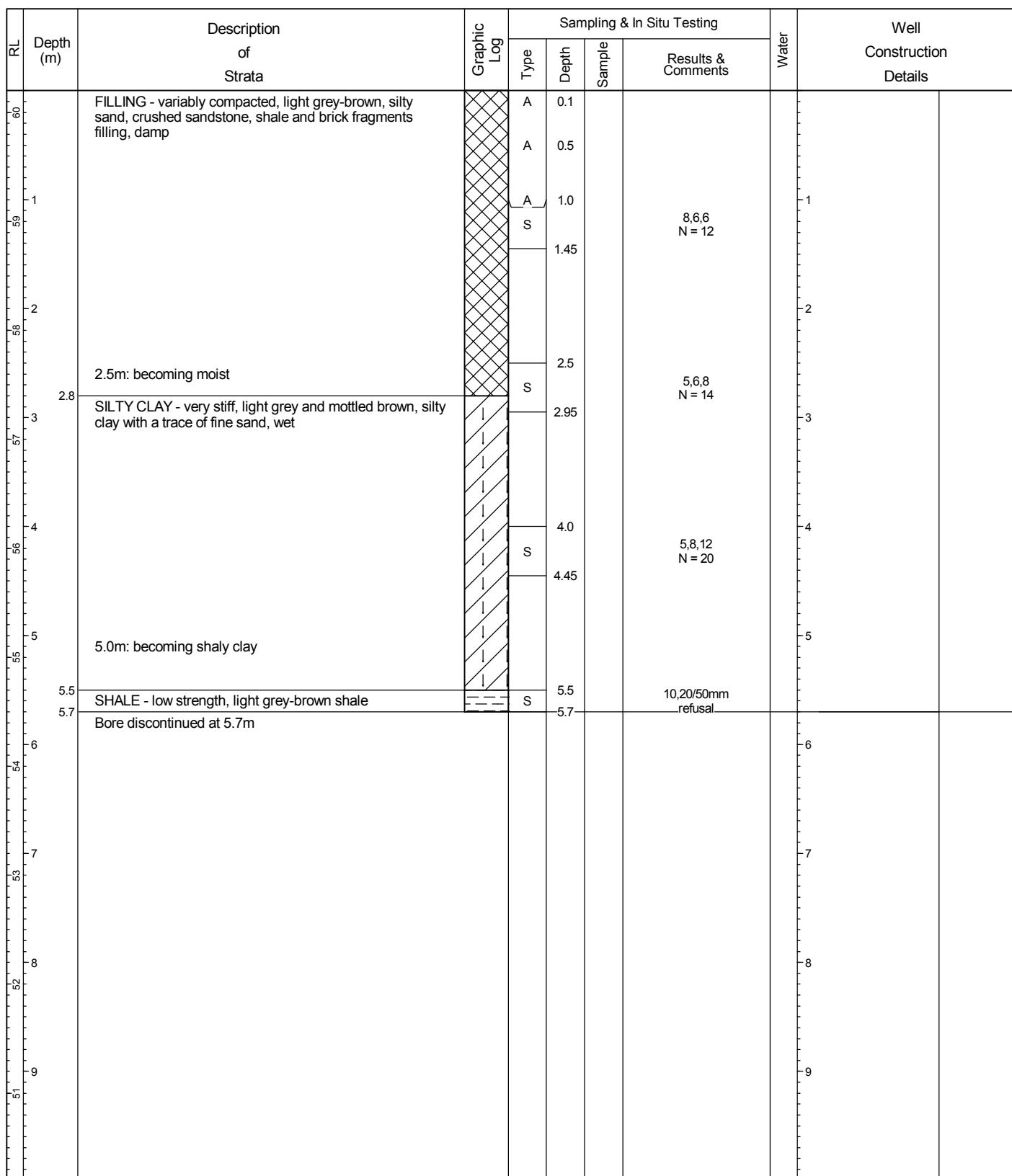
SAMPLING & IN SITU TESTING LEGEND					
A	Auger sample	G	Gas sample	PID	Proton ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test ls(50) (MPa)
BLK	Block sample	U <sub>x</sub>	Tube sample (x mm dia.)	PL(D)	Point load diametral test ls(50) (MPa)
C	Core drilling	W	Water sample	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:** 60.2 AHD  
**EASTING:** 302629  
**NORTHING:** 6255115  
**DIP/AZIMUTH:** 90°/--

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



**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

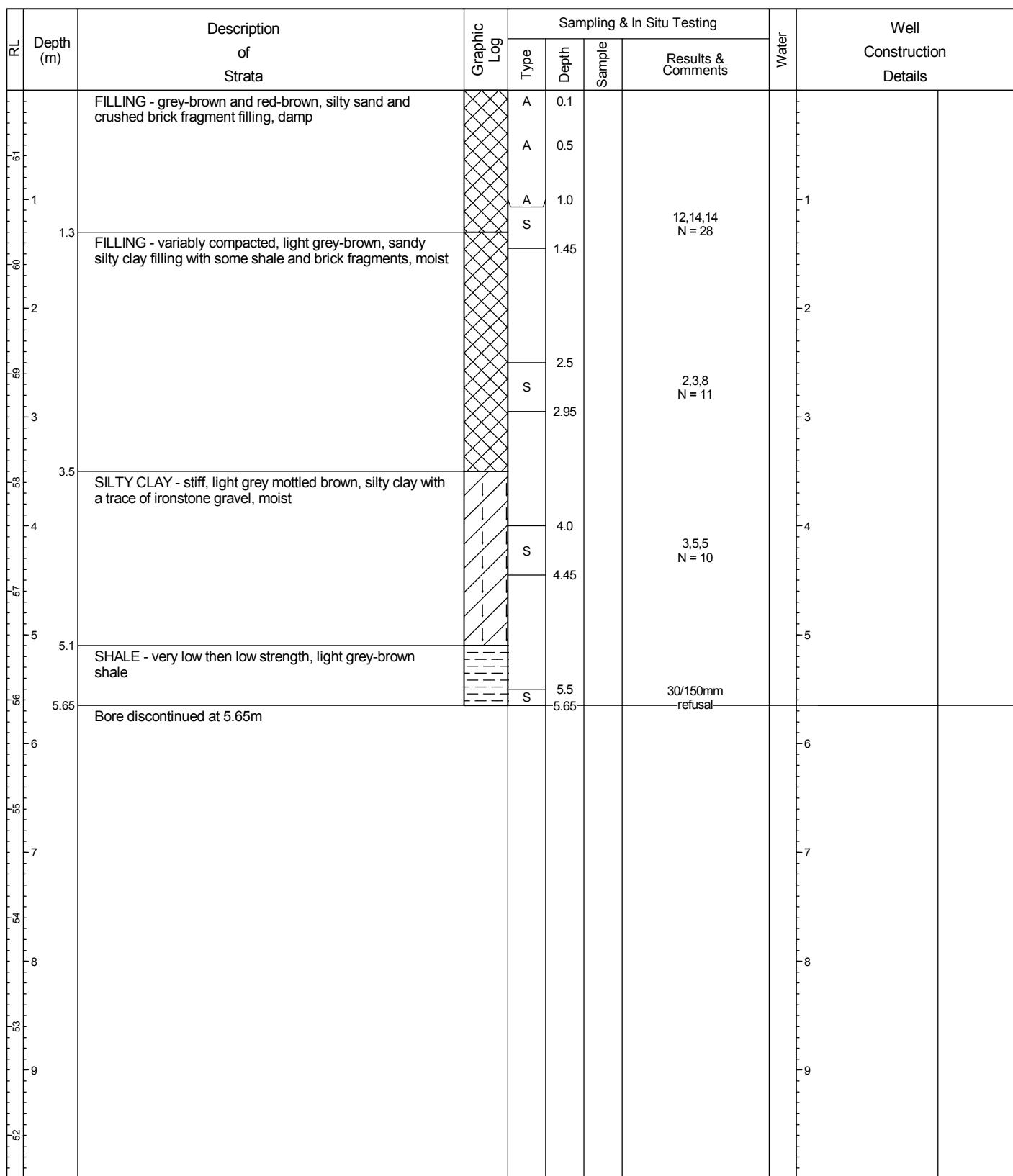
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)
B Bulk sample	P Piston sample	PL(A) Point load axial test ls(50) (MPa)
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test ls(50) (MPa)
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)
D Disturbed sample	D 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:** 61.6 AHD  
**EASTING:** 302690  
**NORTHING:** 6255116  
**DIP/AZIMUTH:** 90°/--

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



**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

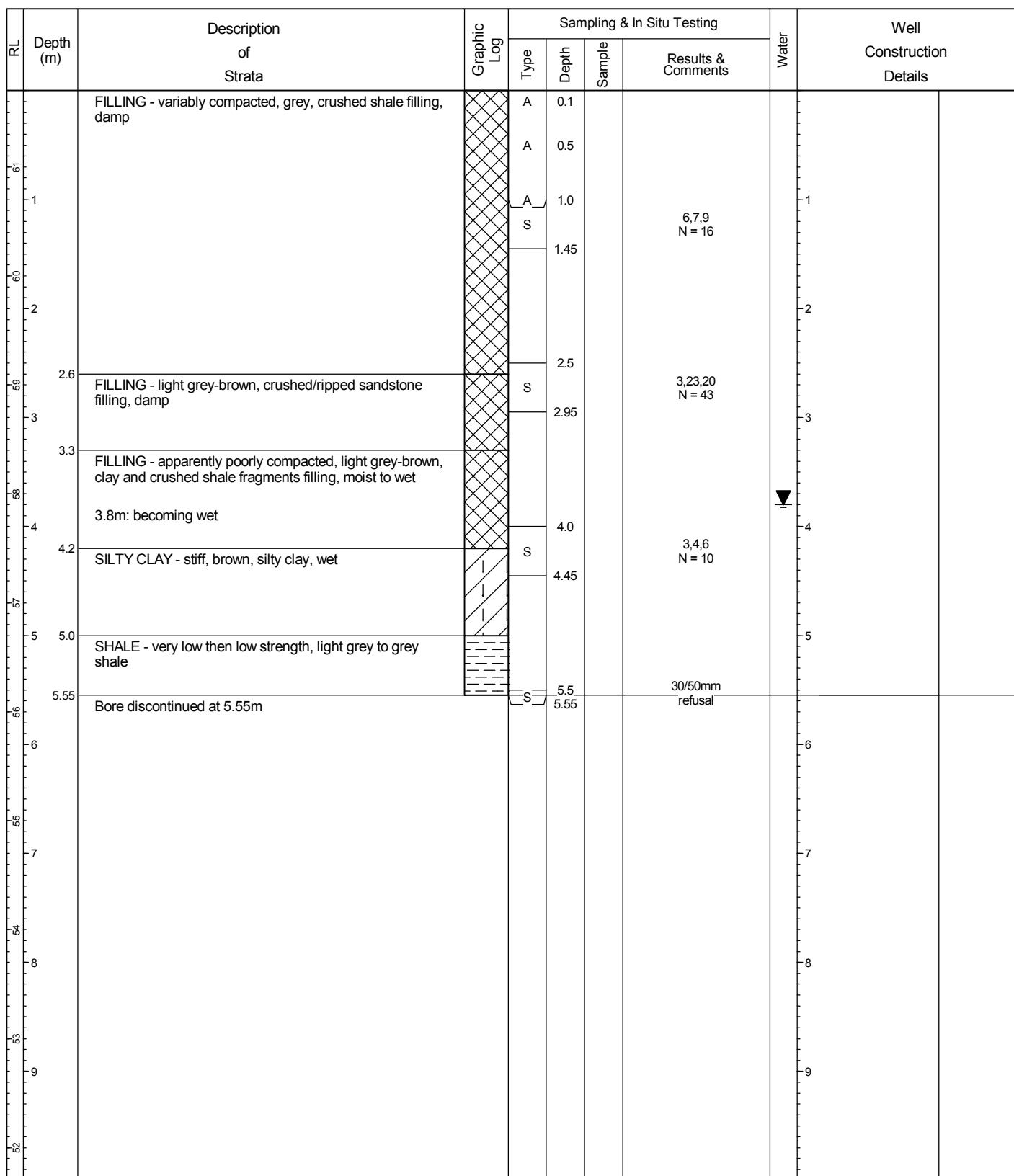
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)
B Bulk sample	P Piston sample	PL(A) Point load axial test ls(50) (MPa)
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test ls(50) (MPa)
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)
D Disturbed sample	D 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:** 61.7 AHD  
**EASTING:** 302707  
**NORTHING:** 6255009  
**DIP/AZIMUTH:** 90°/--

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



**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:**

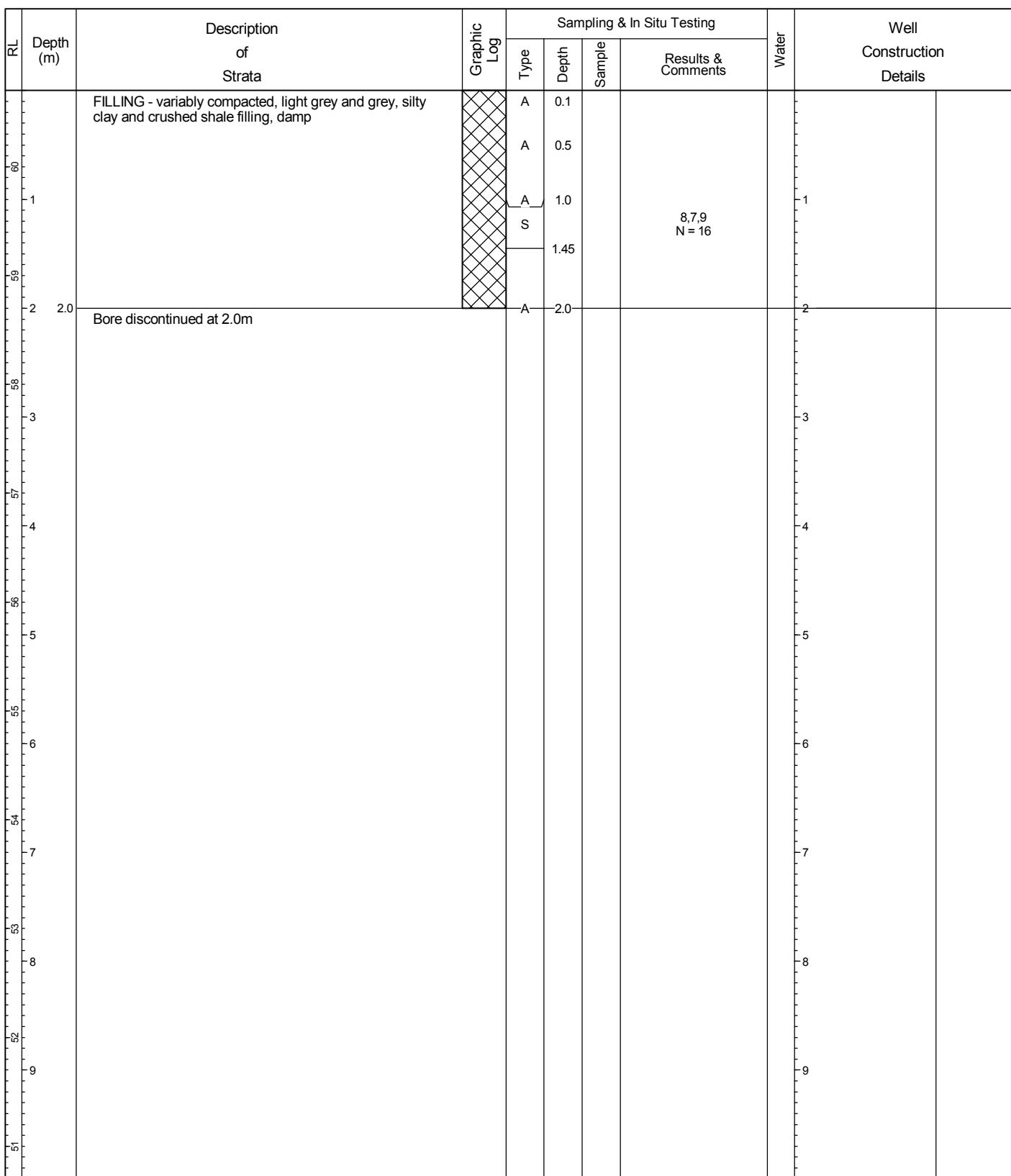
SAMPLING & IN SITU TESTING LEGEND											
A Auger sample	G Gas sample	PID	Photo ionisation detector (ppm)								
B Bulk sample	P Piston sample	PL(A)	Point load axial test ls(50) (MPa)								
BLK Block sample	U Tube sample (x mm dia.)	PL(D)	Point load diametral test ls(50) (MPa)								
C Core drilling	W Water sample	pp	Pocket penetrometer (kPa)								
D Disturbed sample	D 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:** 60.7 AHD  
**EASTING:** 302794  
**NORTHING:** 6254992  
**DIP/AZIMUTH:** 90°/--

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



# 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**

**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

SAMPLES FOR TESTING		TESTS	
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 ls(50) (MPa)
		PL(D)	Point load diametral test ls(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 6

PROJECT 84821

MAY 2015

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

HORSLEY PARK- 84821- BH=6- START=4.10m

4.10m

5m

6m

7m

EOB=7.35m

4.1 – 7.35m

# 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

## **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	PIL(A)	Point load axial test ls(50) (MPa)
BLK	Block sample	U <sub>x</sub>	Tube sample (x mm dia.)	PIL(D)	Point load diametral test ls(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	D	Water seep	S	Standard penetration test
E	Environmental sample	!	Water level	V	Shear vane (kPa)



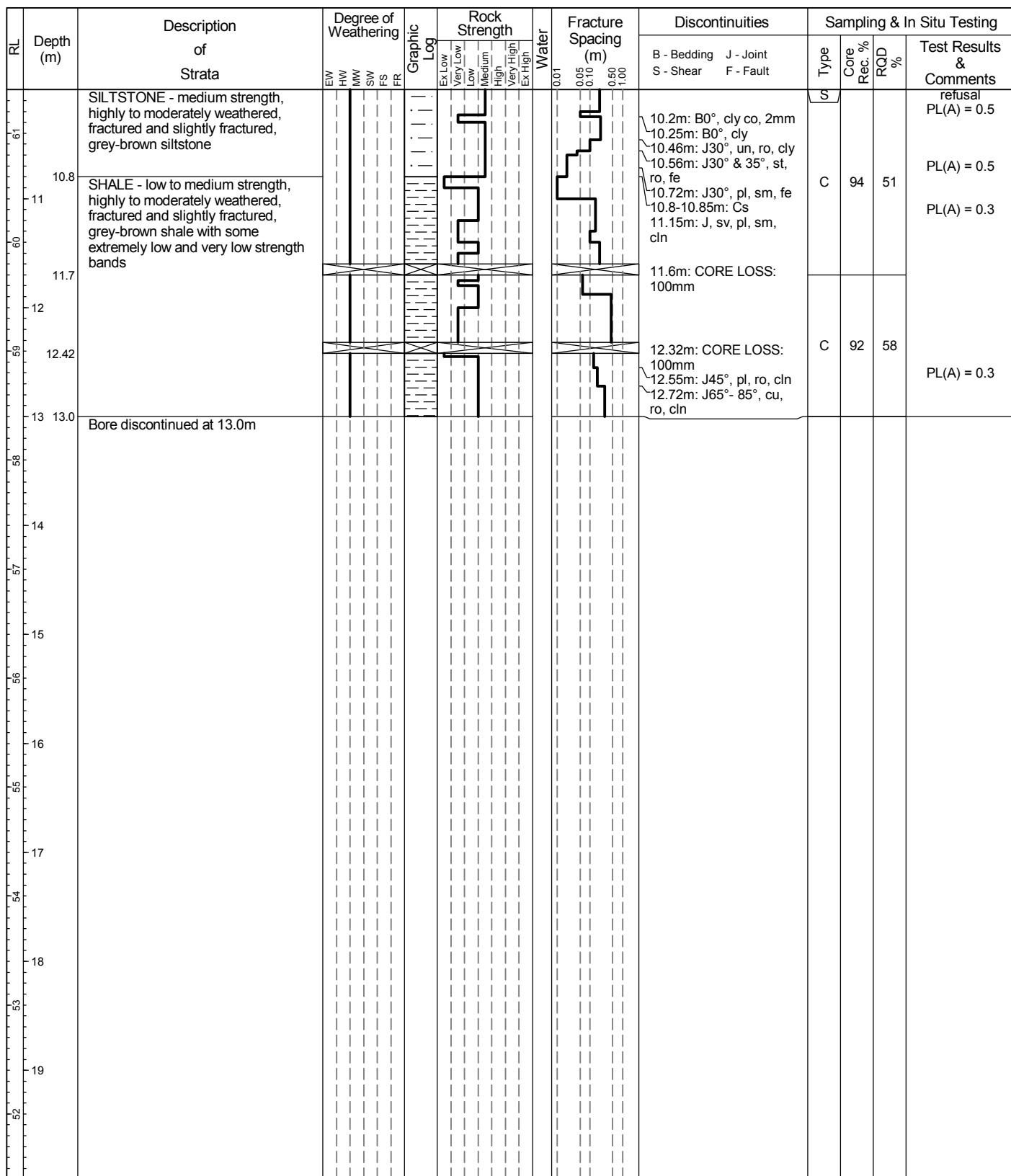
# Douglas Partners

# 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



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**

RL m	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Fracture Spacing (m)	Discontinuities		Sampling & In Situ Testing			
							B - Bedding S - Shear	J - Joint F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
7.1		FILLING - apparently moderately compacted, grey, silty clay and crushed shale fragments filling with some gravel (brick fragments), damp							A			
7.0									A			
1.5		FILLING - variably compacted, light grey, clay and crushed shale and brick gravel filling, moist to wet							S			5,5,6 N = 11
2												
6.9												
3												
8.0	8.0	CLAY - stiff, light grey and brown clay, moist to wet										1,3,7 N = 10
8												
7												
6												
5												
8.8												
6.8												
5.5												
6.5												
5.8												
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 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	PID Photo ionisation detector (ppm)									
B Bulk sample	P Piston sample	PL(A) Point load axial test ls(50) (MPa)									
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test ls(50) (MPa)									
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)									
D Disturbed sample	D Water seep	SP 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:** 71.3 AHD  
**EASTING:** 302897  
**NORTHING:** 6254991  
**DIP/AZIMUTH:** 90°--

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

**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

SAMPLES FOR TESTING		TESTS	
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 ls(50) (MPa)
		PL(D)	Point load diametral test ls(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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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**

**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	PID	Photo ionisation detector (ppm)
B Bulk sample	P Piston sample	PL(A)	Point load axial test ls(50) (MPa)
BLK Block sample	U <sub>x</sub> Tube sample (x mm dia.)	PL(D)	Point load diametral test ls(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:** 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														
			EW	HW		MW	SW			FS	FR	Ex Low	Very Low	Low	Medium	High	Very High	Ex High	B - Bedding	J - Joint	S - Shear	F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
8.8	10.3	SILTSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown siltstone <i>(continued)</i> Bore discontinued at 10.3m	—	—	—	—	—	—	—	—	—	Ex Low	Very Low	Low	Medium	High	Very High	Ex High	9.9m: J30° - 45°, cu, ro, clin	10.15m: J35°, pl, ro, fe			C	100	80	PL(A) = 0.7
9.0	11																									
9.5	12																									
10.0	13																									
10.5	14																									
11.0	15																									
11.5	16																									
12.0	17																									
12.5	18																									
13.0	19																									

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

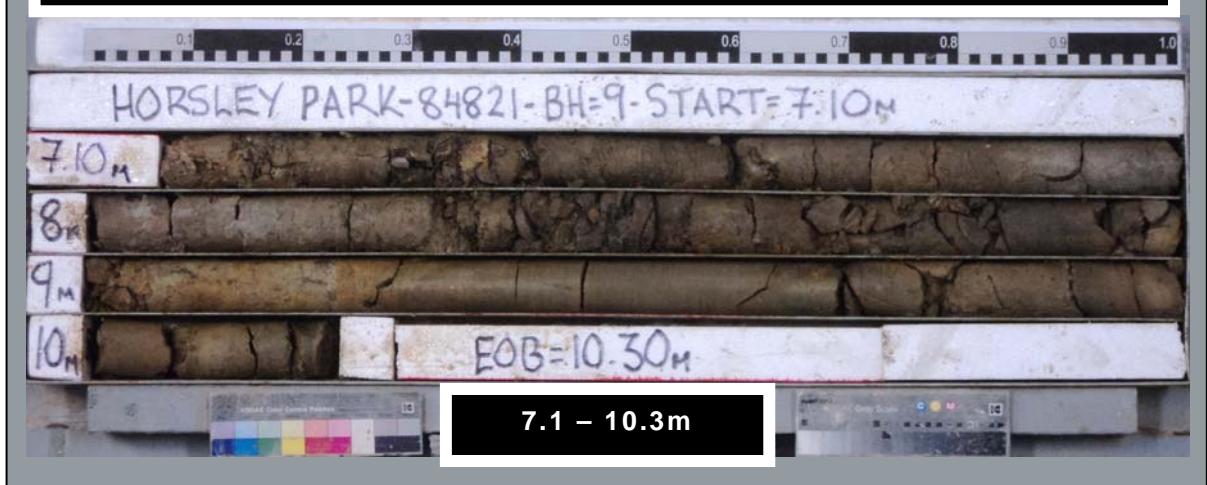
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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

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**

**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

SAMPLES		TESTING	
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
			V
			Shear vane (kPa).



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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 10

PROJECT 84821

MAY 2015

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

HORSLEY PARK-84821-BH=10-START=2.80M

3m

4m

5m

6m

2.8 – 7.0m



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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 10

PROJECT 84821

MAY 2015

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

7m

8m

EOB=8.40m

7.0 – 8.4m



### **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



## 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 <sub>50</sub>	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength ls(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

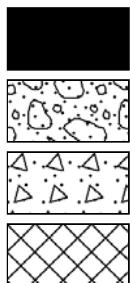
## Other

fg	fragmented
bnd	band
qtz	quartz

# Symbols & Abbreviations

## Graphic Symbols for Soil and Rock

### General



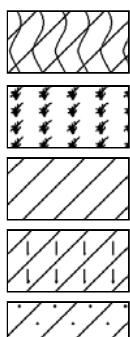
Asphalt

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

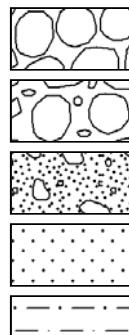
Gravel

Sandy gravel

Cobbles, boulders

Talus

### Sedimentary Rocks



Boulder conglomerate

Conglomerate

Conglomeratic sandstone

Sandstone

Siltstone

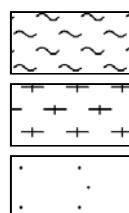
Laminite

Mudstone, claystone, shale

Coal

Limestone

### Metamorphic Rocks

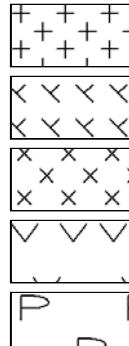


Slate, phyllite, schist

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

<b>Client:</b>	<b>Brickworks Ltd</b>	<b>Project No:</b>	84821					
<b>Project:</b>	Geotechnical Investigation	<b>Report No:</b>	1					
<b>Location:</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date:</b>	09/06/2015					
		<b>Date Sampled:</b>						
		<b>Date of Test:</b>	-					
		<b>Page:</b>	04/06/2015					
			1 of 1					
<b>Test Location</b>	<b>Depth (m)</b>	<b>Description</b>	<b>Code</b>	<b>W<sub>F</sub> %</b>	<b>W<sub>L</sub> %</b>	<b>W<sub>P</sub> %</b>	<b>PI %</b>	<b>*LS %</b>
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<sub>F</sub> Field Moisture Content

W<sub>L</sub> Liquid limit

W<sub>P</sub> Plastic limit

PI Plasticity index

LS Linear shrinkage from liquid limit condition (Mould length 125mm)

**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:**



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Tested: LW  
Checked: MM

Mark Matthews  
Laboratory Manager

## Determination of Emerson Class Number of Soil

<b>Client :</b>	Brickworks Ltd			<b>Project No. :</b>	84821		
<b>Project :</b>	Geotechnical Investigation			<b>Report No. :</b>	2		
<b>Location :</b>	780 Wallgrove Rd, Horsley Park			<b>Report Date :</b>	9/06/2015		
							<b>Page:</b> 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

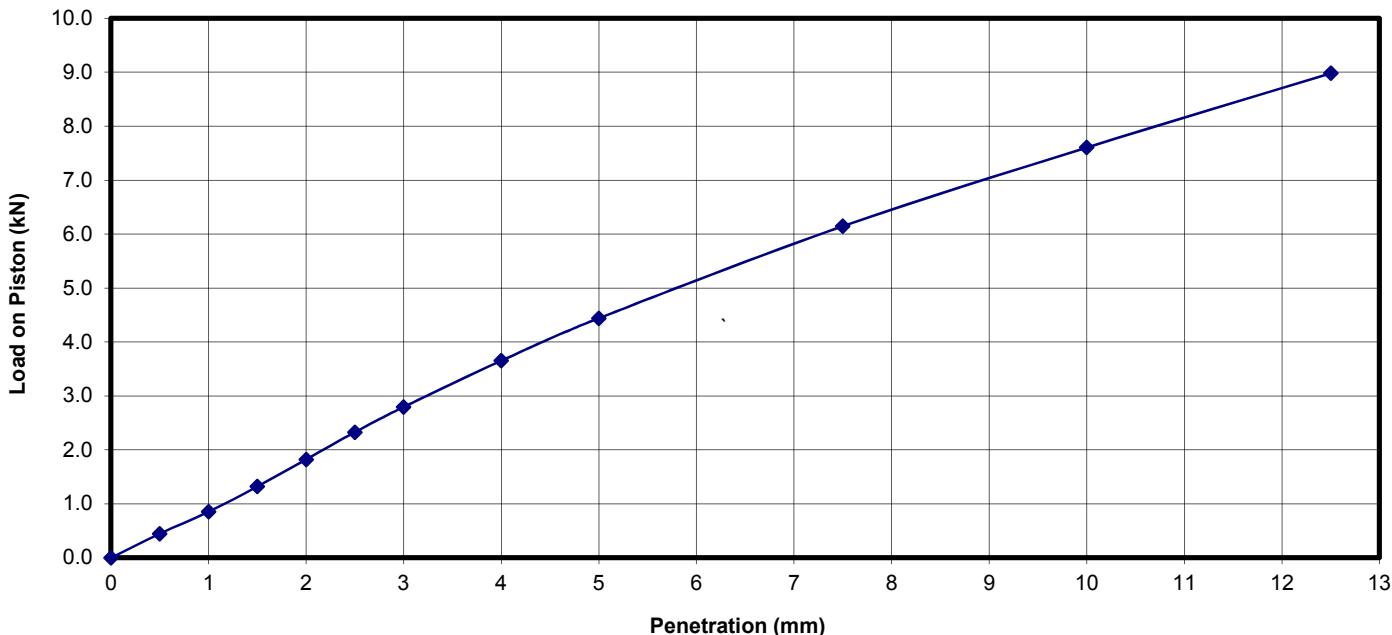
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 Mark Matthews  
 Laboratory Manager

## Results of California Bearing Ratio Test

<b>Client :</b>	Brickworks Ltd	<b>Project No. :</b>	84821.00
<b>Project :</b>	Geotechnical Investigation	<b>Report No. :</b>	3
<b>Location :</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date :</b>	11/06/2015
<b>Test Location :</b>	BH11	<b>Date Sampled :</b>	29/05/2015
<b>Depth / Layer :</b>	0.0 - 0.5m	<b>Date of Test:</b>	9/06/2015
		<b>Page:</b>	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  
**MOISTURE RATIO:** 96% of STD OMC

**SURCHARGE:** 4.5 kg  
**SOAKING PERIOD:** 5 days

**SWELL:** 0.4%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	25



NATA Accredited Laboratory No 828

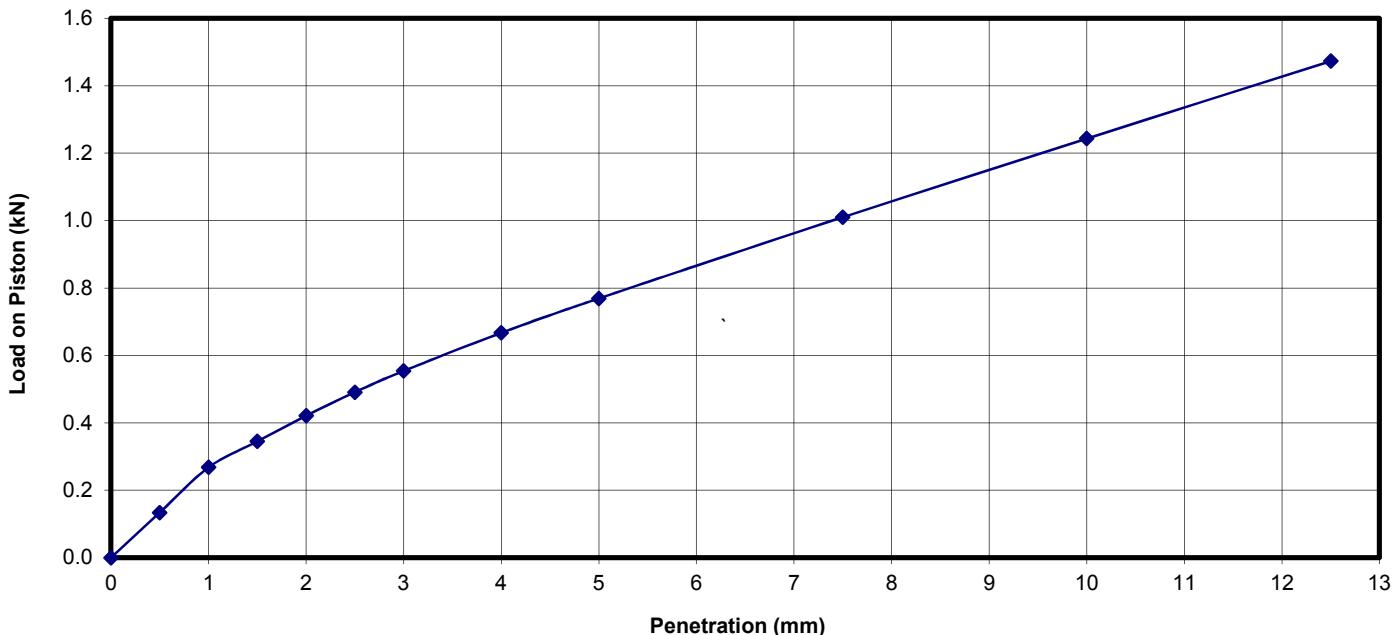
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Mark Matthews  
 Laboratory Manager

## Results of California Bearing Ratio Test

<b>Client :</b>	Brickworks Ltd	<b>Project No. :</b>	84821.00
<b>Project :</b>	Geotechnical Investigation	<b>Report No. :</b>	4
<b>Location :</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date :</b>	11/06/2015
<b>Test Location :</b>	BH12	<b>Date Sampled :</b>	29/05/2015
<b>Depth / Layer :</b>	0.0 - 0.5m	<b>Date of Test:</b>	9/06/2015
		<b>Page:</b>	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  
**MOISTURE RATIO:** 100% of STD OMC

**SURCHARGE:** 4.5 kg  
**SOAKING PERIOD:** 4 days

**SWELL:** 1.9%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	4



NATA Accredited Laboratory No 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

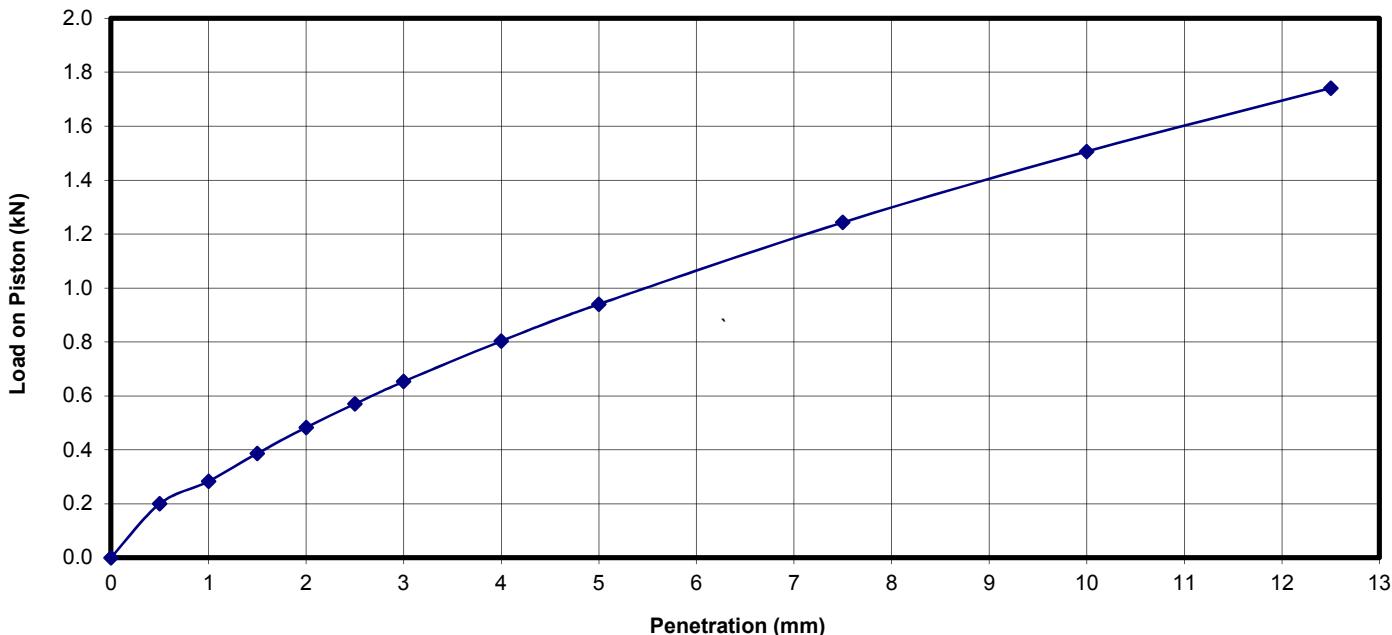
Accredited for compliance with ISO/IEC 17025



Mark Matthews  
Laboratory Manager

## Results of California Bearing Ratio Test

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

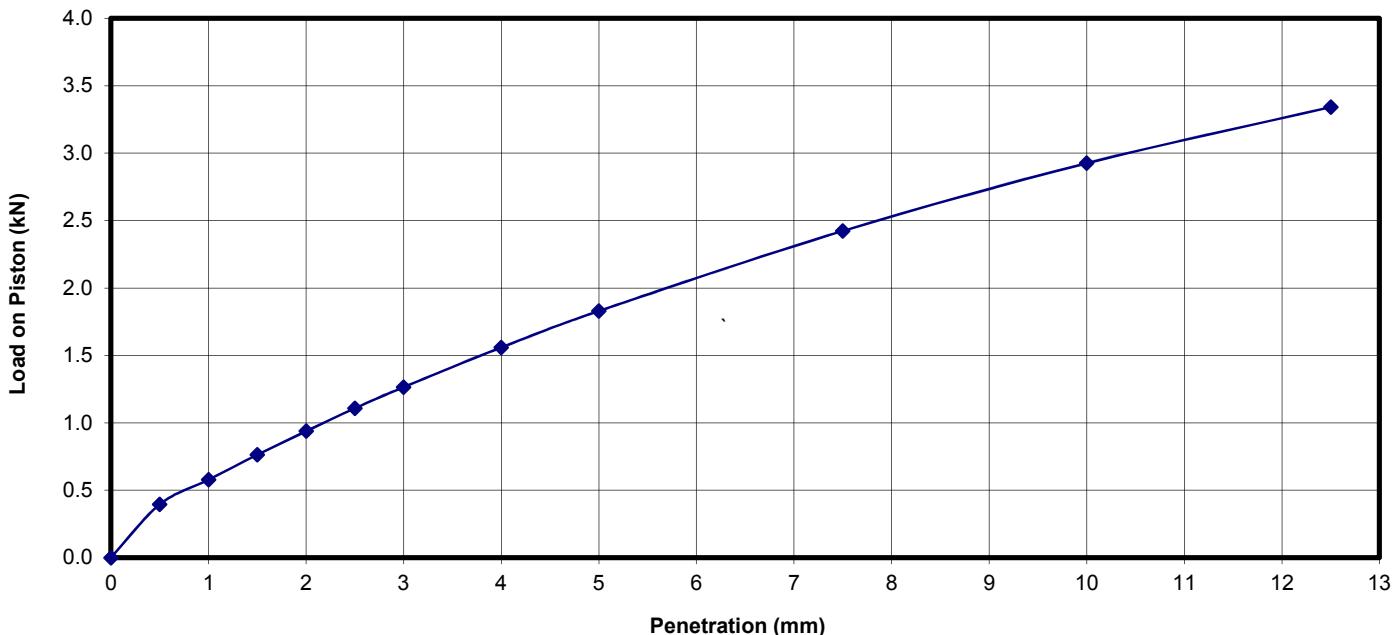
**SWELL:** 2.6%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	4.5

## Results of California Bearing Ratio Test

<b>Client :</b>	Brickworks Ltd	<b>Project No. :</b>	84821.00
<b>Project :</b>	Geotechnical Investigation	<b>Report No. :</b>	6
<b>Location :</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date :</b>	11/06/2015
<b>Test Location :</b>	BH13	<b>Date Sampled :</b>	29/05/2015
<b>Depth / Layer :</b>	0.5 - 1.0m	<b>Date of Test:</b>	9/06/2015
		<b>Page:</b>	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  
**MOISTURE RATIO:** 102% of STD OMC

**SURCHARGE:** 4.5 kg  
**SOAKING PERIOD:** 4 days

**SWELL:** 0.5%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	9



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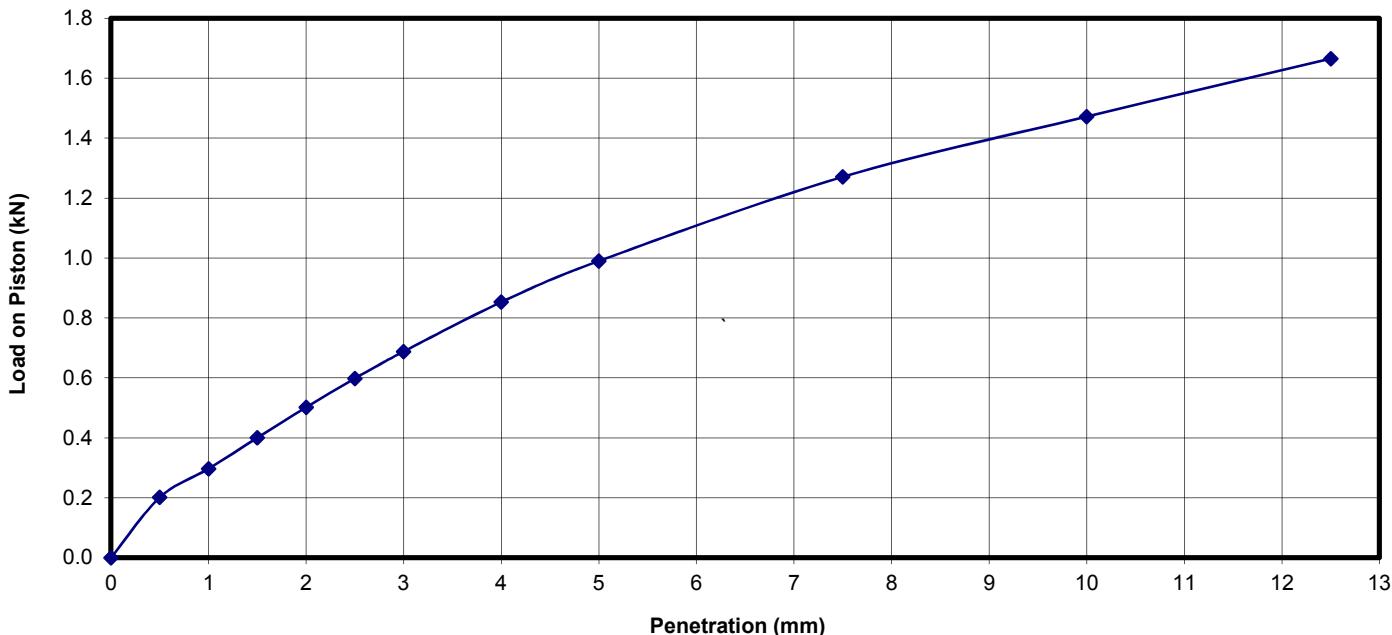
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Mark Matthews  
Laboratory Manager

## Results of California Bearing Ratio Test

<b>Client :</b>	Brickworks Ltd	<b>Project No. :</b>	84821.00
<b>Project :</b>	Geotechnical Investigation	<b>Report No. :</b>	7
<b>Location :</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date :</b>	11/06/2015
<b>Test Location :</b>	BH14	<b>Date Sampled :</b>	29/05/2015
<b>Depth / Layer :</b>	0.5 - 1.0m	<b>Date of Test:</b>	9/06/2015
		<b>Page:</b>	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  
**MOISTURE RATIO:** 104% of STD OMC

**SURCHARGE:** 4.5 kg  
**SOAKING PERIOD:** 5 days

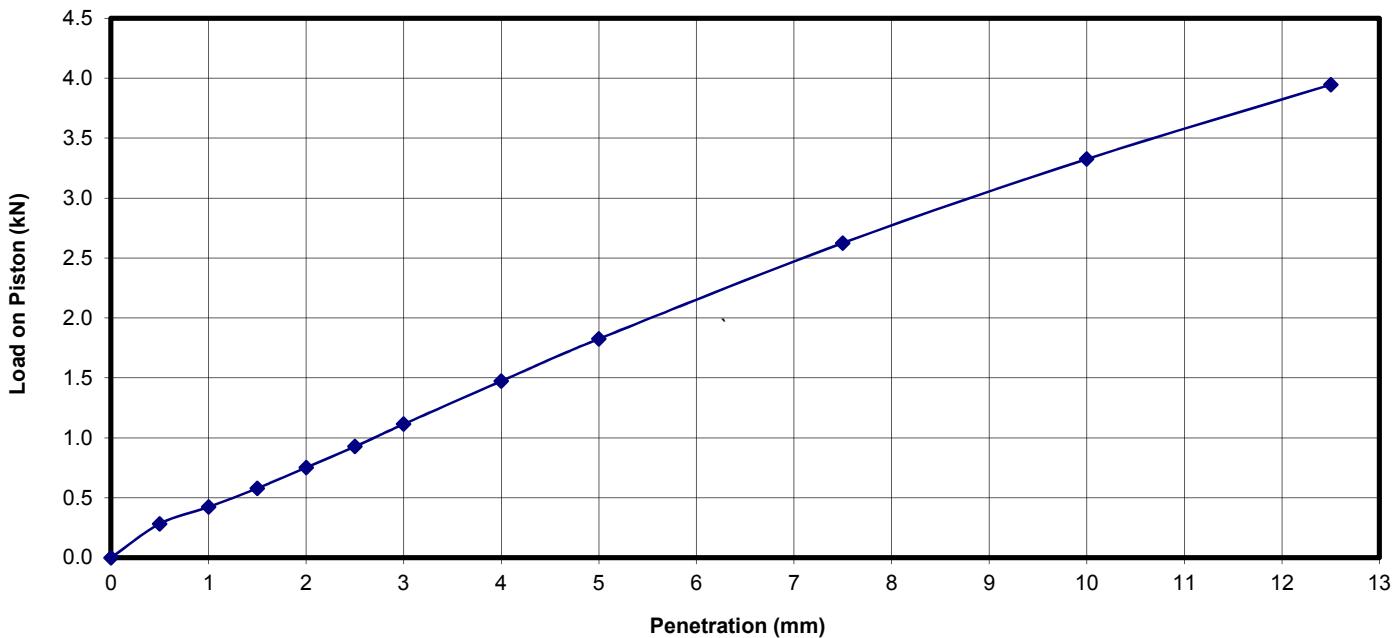
**SWELL:** 0.4%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	5

## Results of California Bearing Ratio Test

<b>Client :</b>	Brickworks Ltd	<b>Project No. :</b>	84821.00
<b>Project :</b>	Geotechnical Investigation	<b>Report No. :</b>	9
<b>Location :</b>	780 Wallgrove Rd, Horsley Park	<b>Report Date :</b>	16/06/2015
<b>Test Location :</b>	BH15	<b>Date Sampled :</b>	2/06/2015
<b>Depth / Layer :</b>	0.5 - 1.0m	<b>Date of Test:</b>	15/06/2015
		<b>Page:</b>	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  
**MOISTURE RATIO:** 105% of STD OMC

**SURCHARGE:** 4.5 kg  
**SOAKING PERIOD:** 4 days

**SWELL:** 0.2%

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

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	5.0 mm	9



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Michael Gref  
 Senior Technician

## Results of Moisture Content Test

<b>Client :</b>	Brickworks Ltd			<b>Project No. :</b>	84821
<b>Project :</b>	Geotechnical Investigation			<b>Report No. :</b>	8
<b>Location :</b>	780 Wallgrove Rd, Horsley Park			<b>Report Date :</b>	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 adn 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

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Mark Matthews  
 Laboratory Manager

# Appendix D

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## Bulk Water Supply Infrastructure Map



Planning &  
Infrastructure

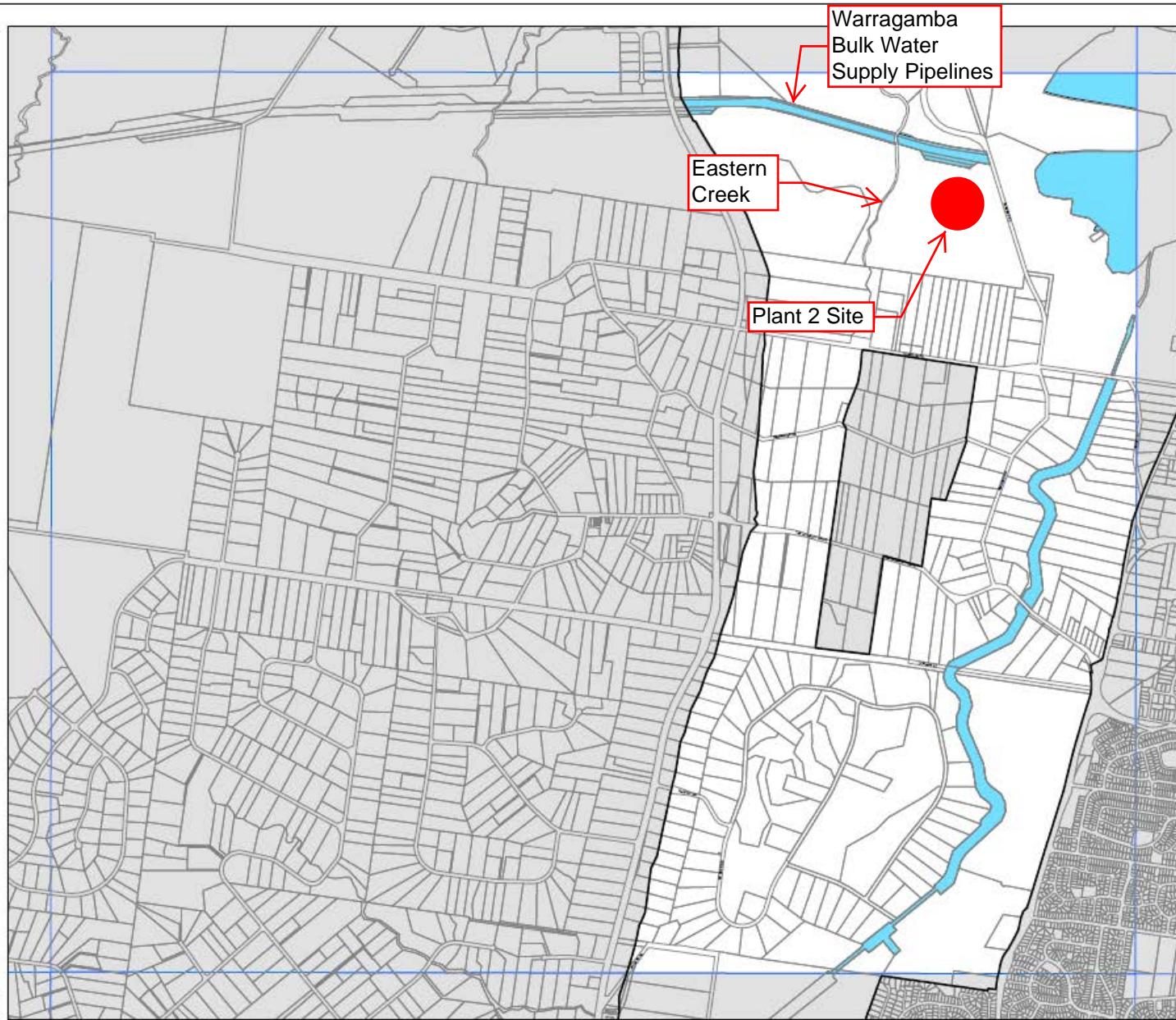
State Environmental Planning  
Policy (Western Sydney  
Parklands) 2009

Bulk Water Supply Infrastructure Map -  
Sheet BWS\_004

Western Parklands  
Bulk Water Supply Infrastructure  
Bulk Water Supply Infrastructure  
Cadastral  
Cadastral 15/11/2011 © NSW LPI



Projection: MGA Zone 56  
Datum: GDA94  
Scale: 1:20,000 @ A3  
Map Identification Number:  
SEPP\_WISP\_BWS\_004\_002\_20111122



# Appendix E

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## BMT Flood Impact Assessment

Our Ref: L.S20149.04\_BrickworksQuarry\_FIA.docx

Tel: +61 2 8960 7755  
Fax: +61 2 8960 7745

08 February 2021

ABN 54 010 830 421

[www.bmt.org](http://www.bmt.org)

AT&L  
Level 7, 153 Walker Street  
North Sydney NSW 2060

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 letter report has been updated to reflect revisions to the design as outlined by AT&L on 4<sup>th</sup> December 2020 and 29<sup>th</sup> January 2021.

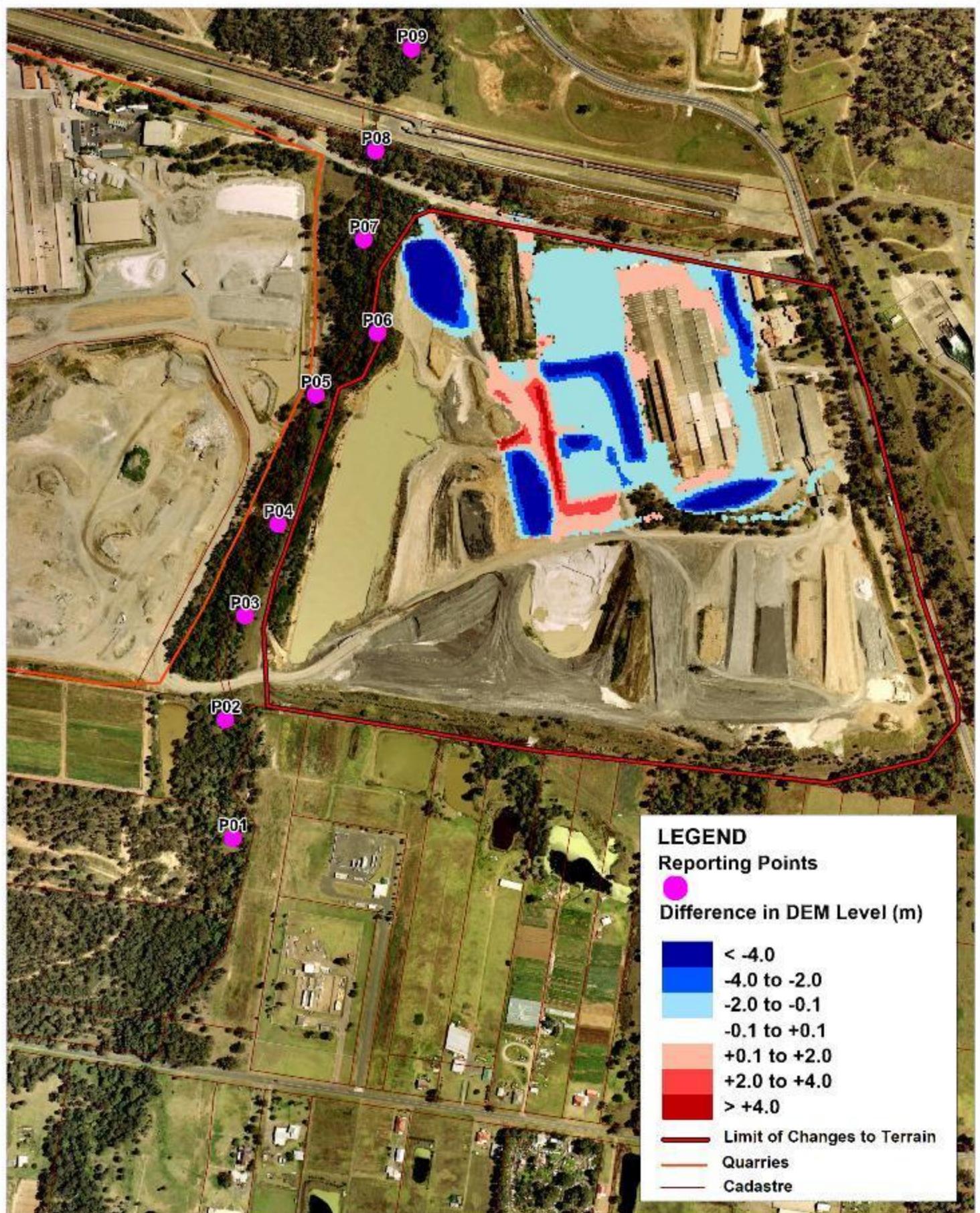
The flood impact assessment was undertaken using Fairfield City Council's current hydraulic model of the Eastern Creek catchment developed as part of the Rural Area Flood Study, Ropes, Reedy and Eastern Creeks – Final Draft (2013).

**Proposed Development and Description of Existing Flood Risk**

The proposed works will involve bulk earthworks to form platform levels for a new manufacturing plant, construction of a new hardstand yard, and associated amenities including the construction of a new stormwater basin, new access road and new stormwater drainage. 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.



Title:  
**Study Area and Reporting Locations**

Figure:  
**1**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 125 250m  
Approx. Scale

- 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

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. Minor changes to the Manning’s “n” roughness were undertaken to reflect the new hardstand area, and the proposed stormwater drainage network was also included. No other land use changes or topographic changes were made.

### **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. Note that filtering of the results has been undertaken by removing areas with depths below 150 mm, and VxD above 0.1 m<sup>2</sup>/s added back in.

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

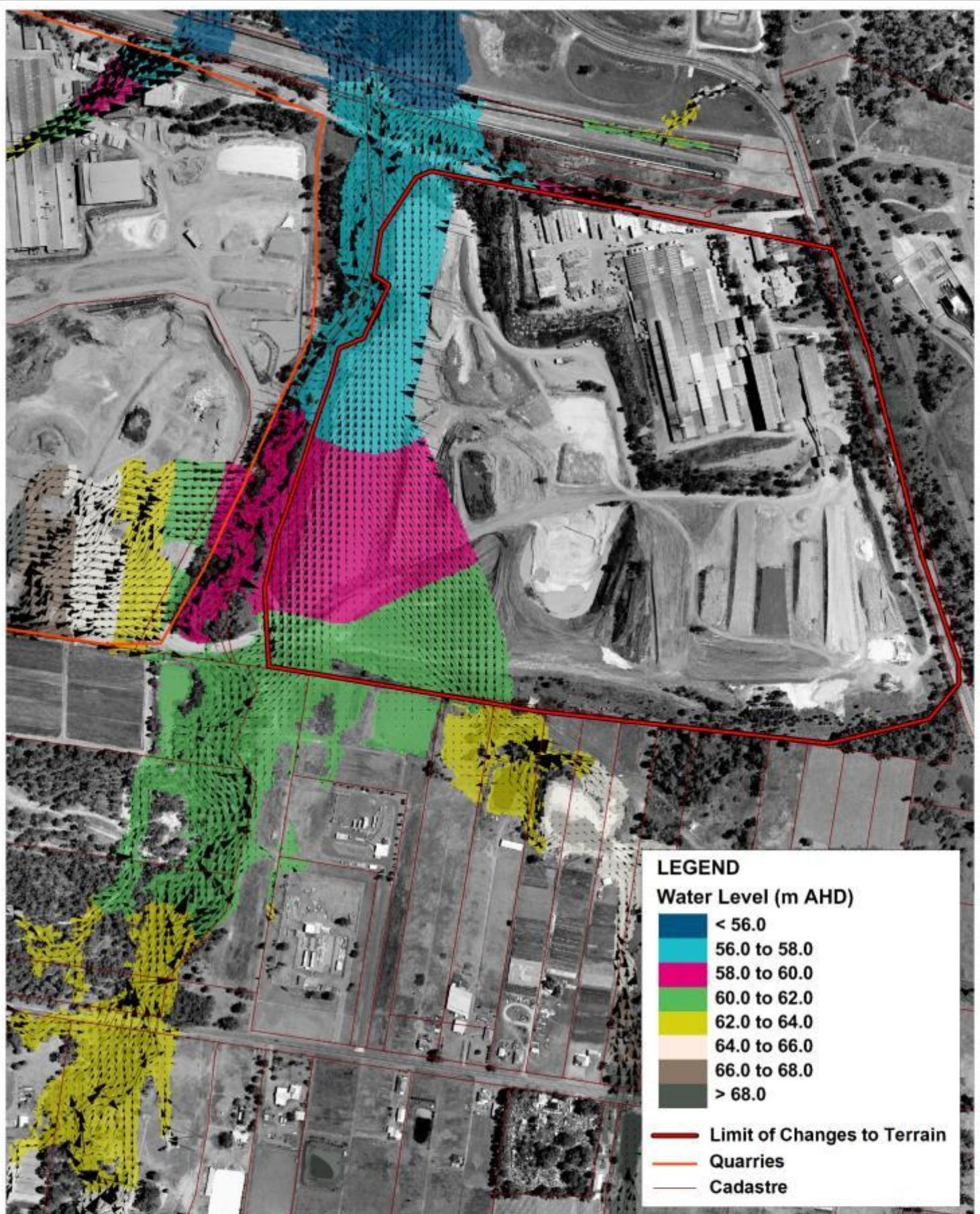
- B1 5% AEP (20 Year ARI) Velocity-Depth Product - Pre Developed
- B2 1% AEP (100 Year ARI) Velocity-Depth Product - Pre Developed
- B3 PMF Velocity-Depth Product - Pre Developed
- B4 5% AEP (20 Year ARI) Velocity-Depth Product – Developed

- 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)**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

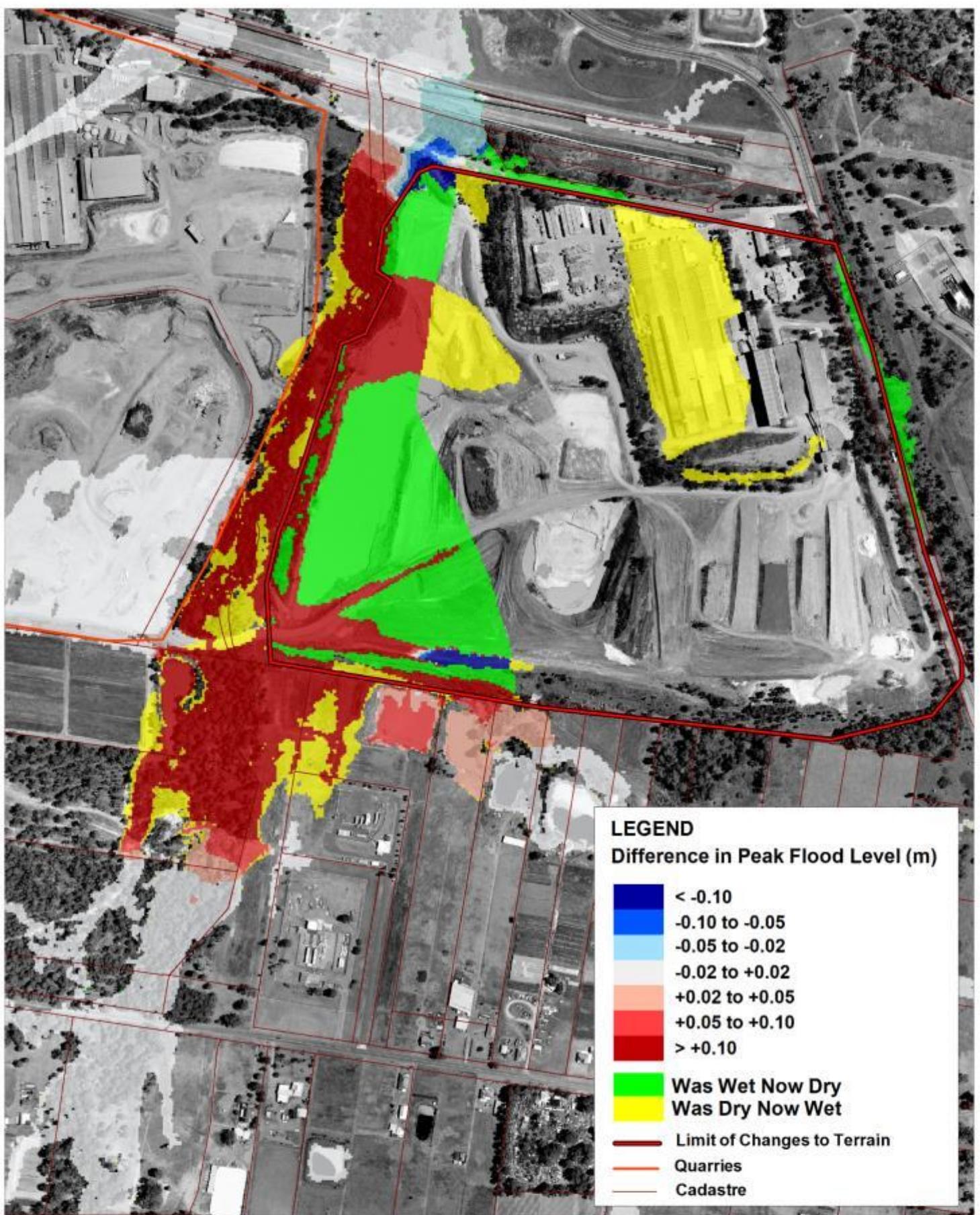


0 125 250m  
Approx. Scale

Figure:  
**02**

Rev:  
-





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

Rev:

-



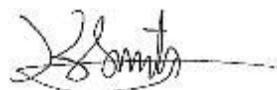
Peak water levels have been extracted along the site for the “pre-developed case” and “developed case” (Table 1). Figure 1 shows the locations reported.

**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	58.83	59.09	61.27	58.83	59.09	61.25	0.00	0.00	-0.02
P05	57.82	58.10	59.95	57.82	58.10	59.67	0.00	0.00	-0.28
P06	57.30	57.62	59.66	57.30	57.62	59.19	0.00	0.00	-0.47
P07	56.86	57.11	58.74	56.86	57.11	58.42	0.00	0.00	-0.32
P08	56.17	56.29	57.43	56.17	56.29	57.42	0.00	0.00	-0.01
P09	55.42	55.57	56.94	55.42	55.58	56.97	0.00	0.01	0.03

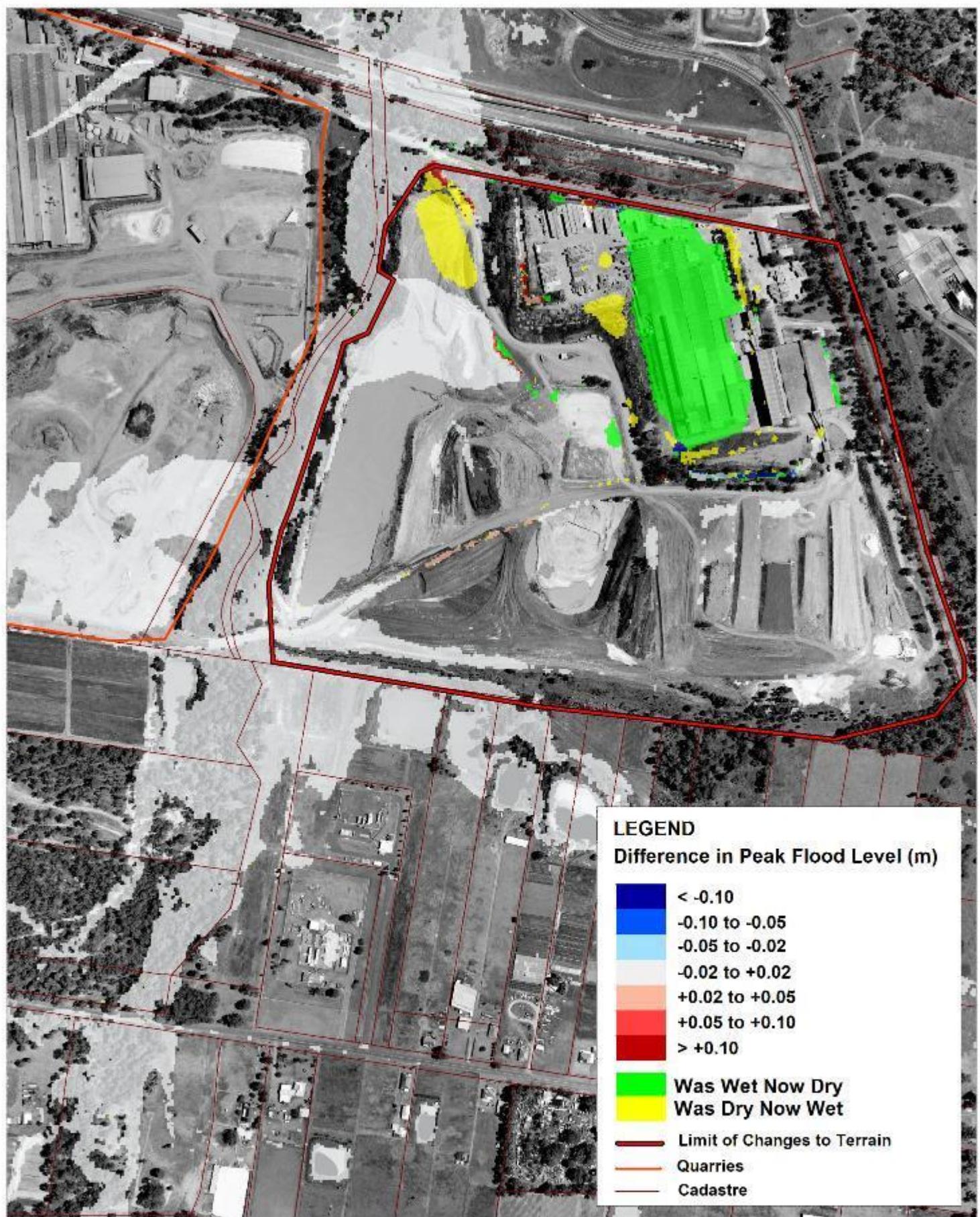
Yours Faithfully

**BMT**



**Kieran Smith**  
Engineer

## Appendix A Flood Level Impact Mapping



Title:

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

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Figure:

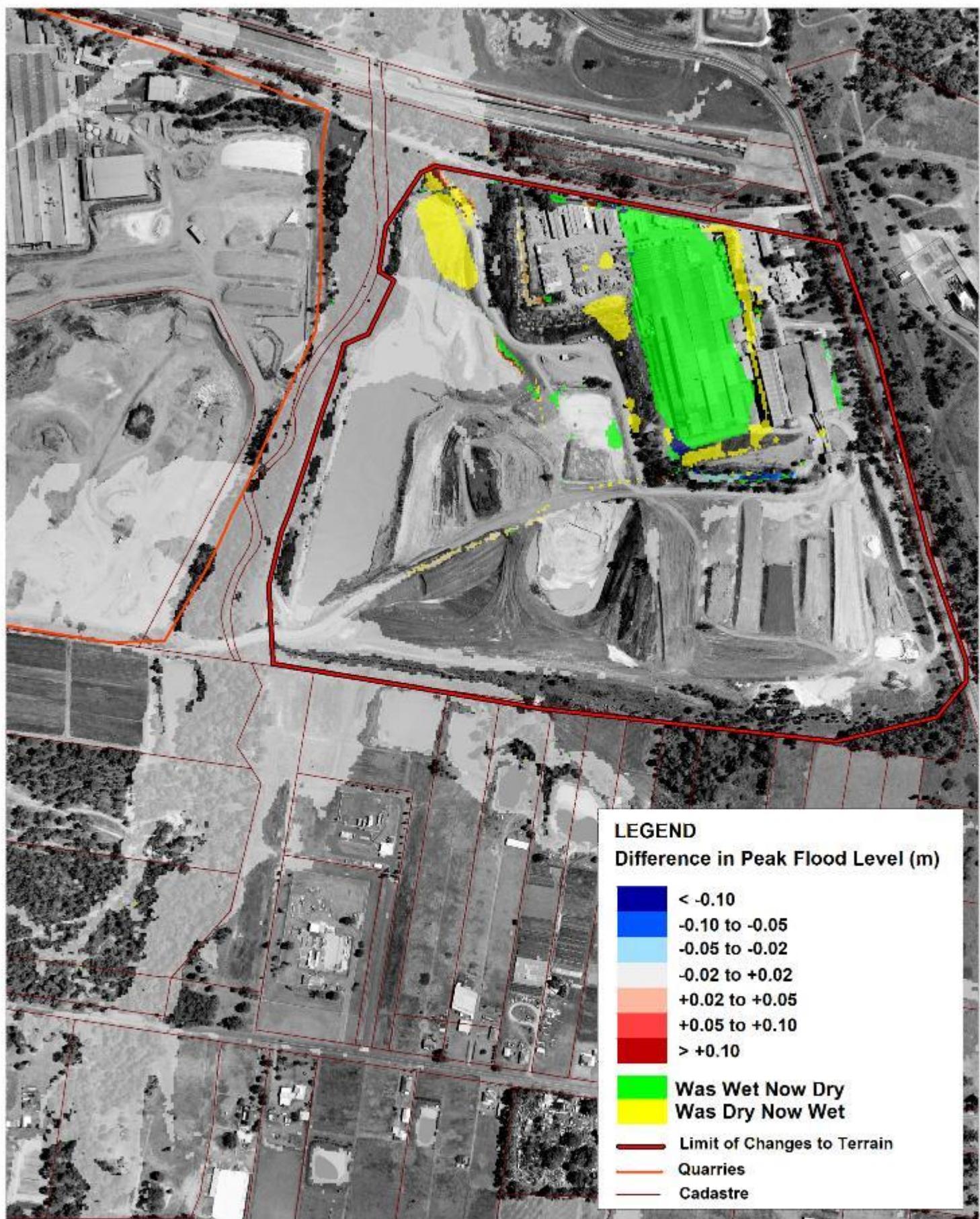
**A-1**

Rev:

-



0 125 250m  
Approx. Scale



Title:

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

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Figure:

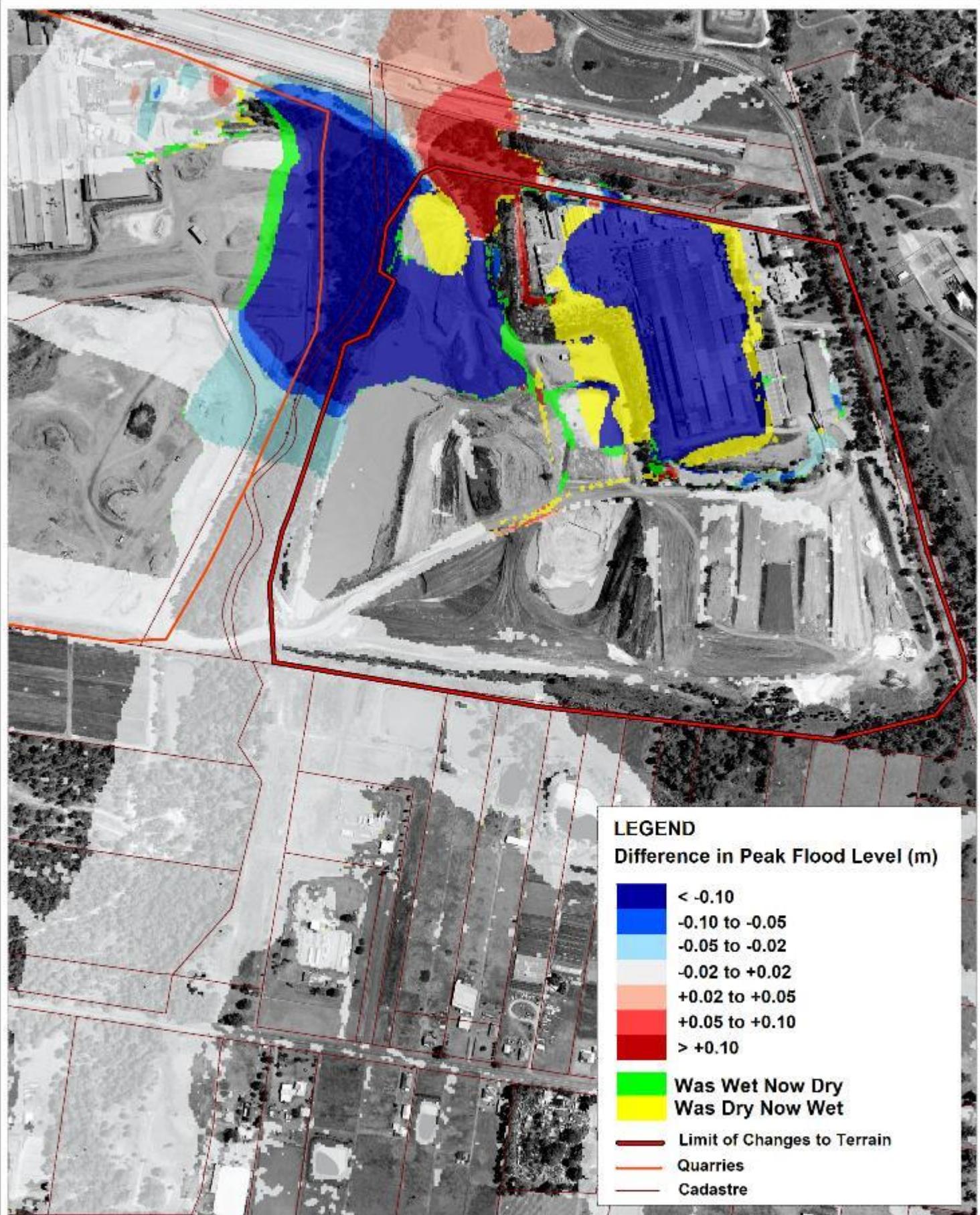
**A-2**

Rev:

-



0 125 250m  
Approx. Scale



Title:

## Flood Level Impacts - Development versus Pre Developed Probable Maximum Flood (PMF)

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

Figure:

**A-3**

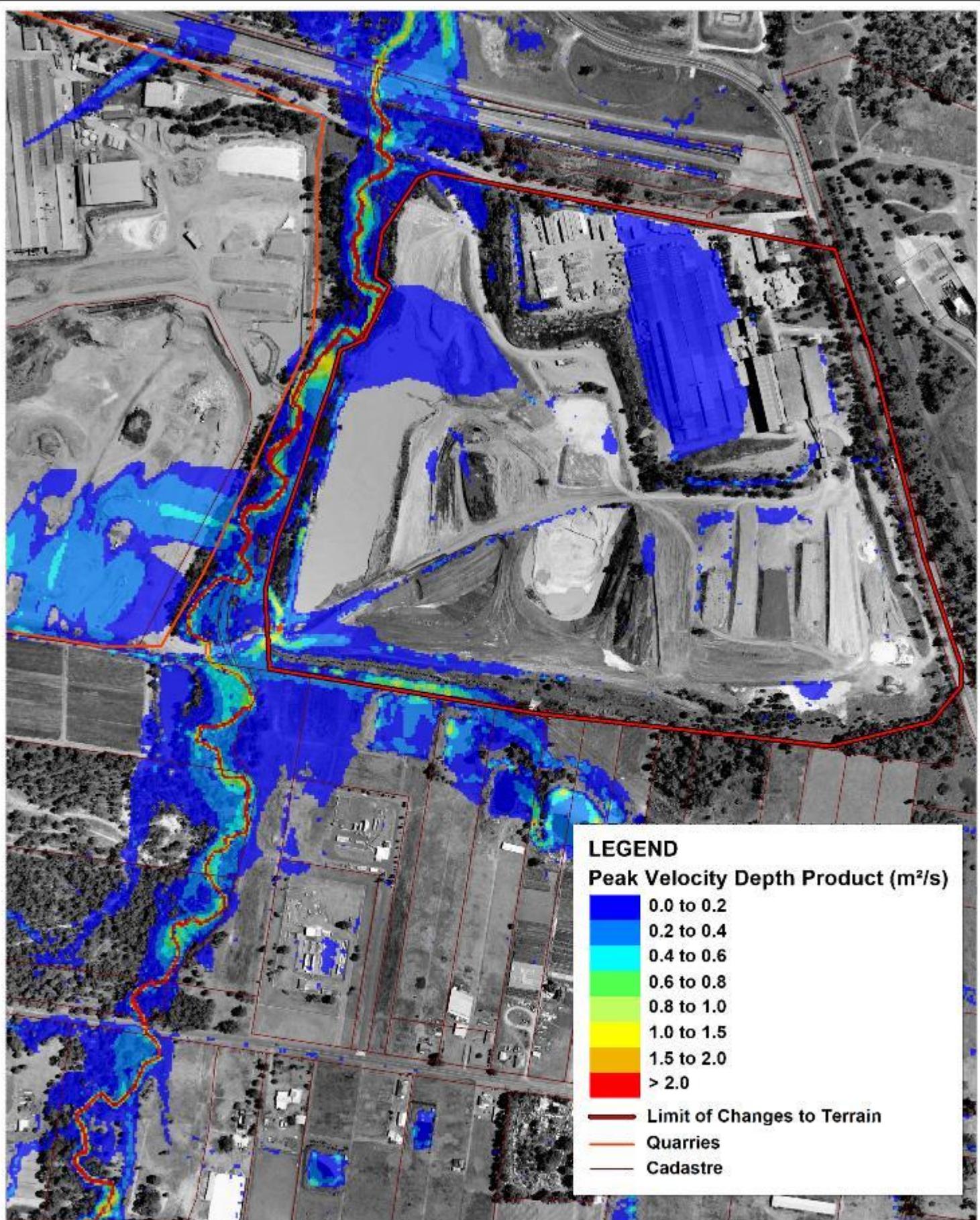
Rev:

-



0 125 250m  
Approx. Scale

## Appendix B Velocity-Depth Product Mapping



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

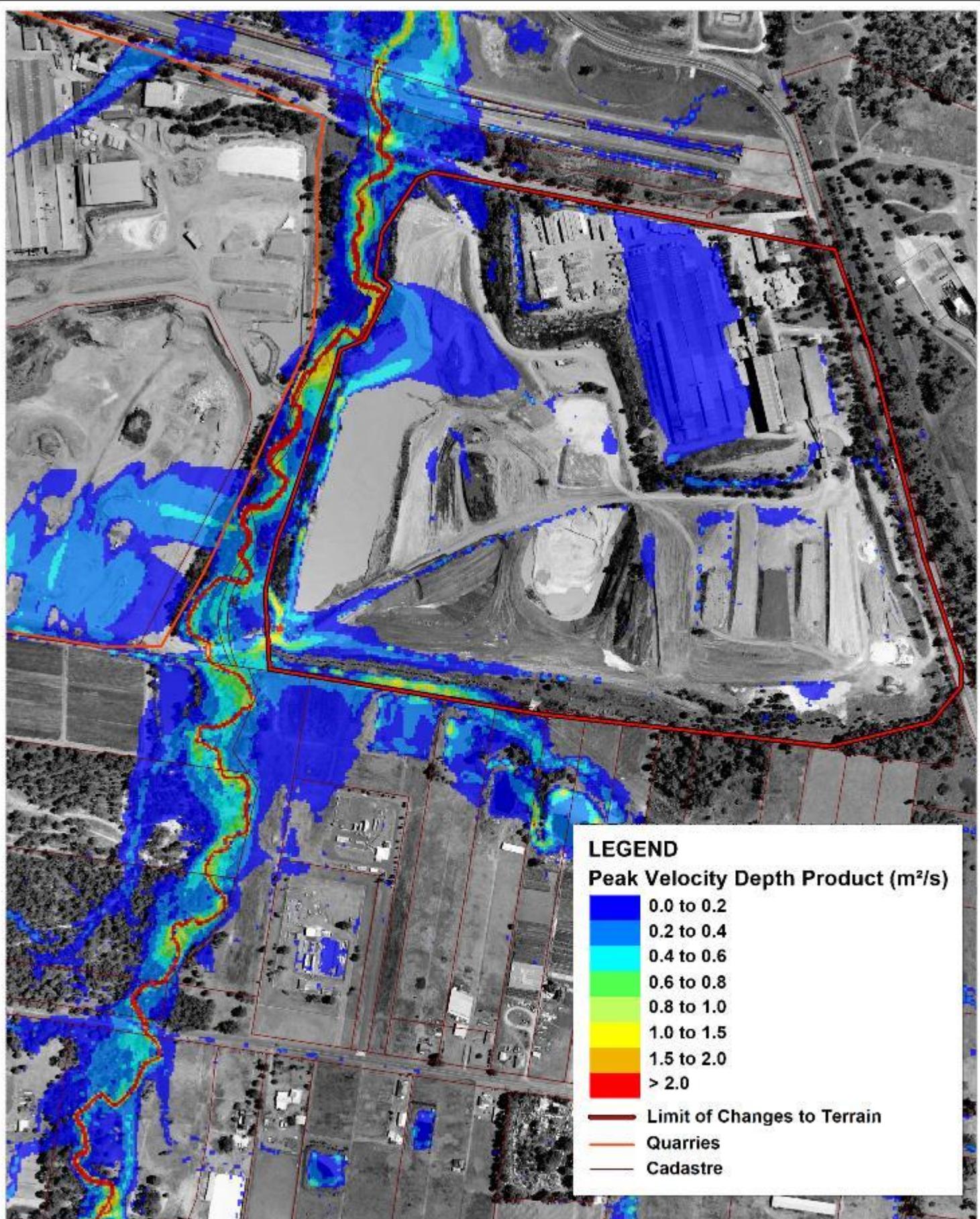
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0 125 250m  
Approx. Scale

Figure:  
**B-1**

Rev:  
-



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

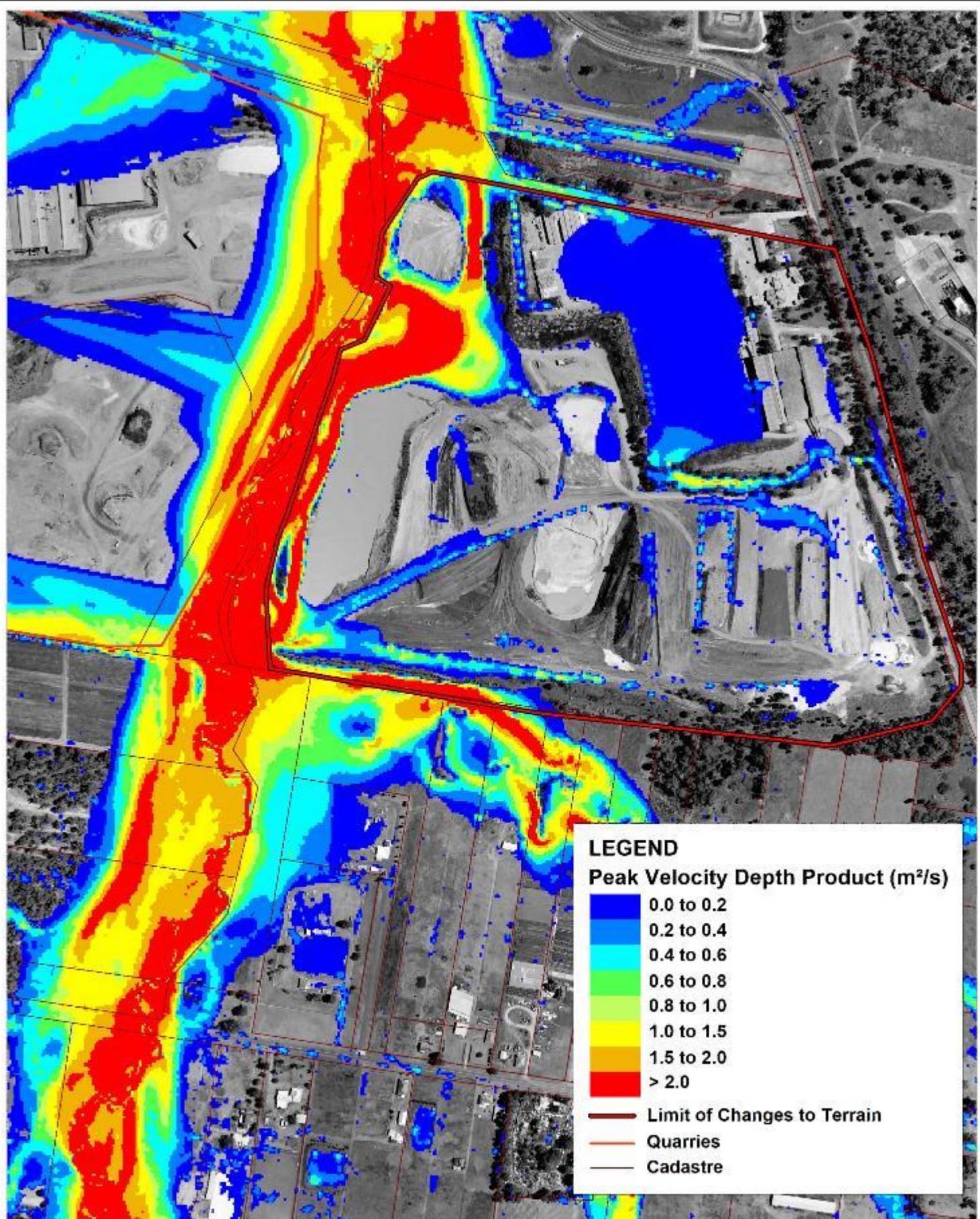
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0 125 250m  
Approx. Scale

Figure:  
**B-2**

Rev:  
-



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

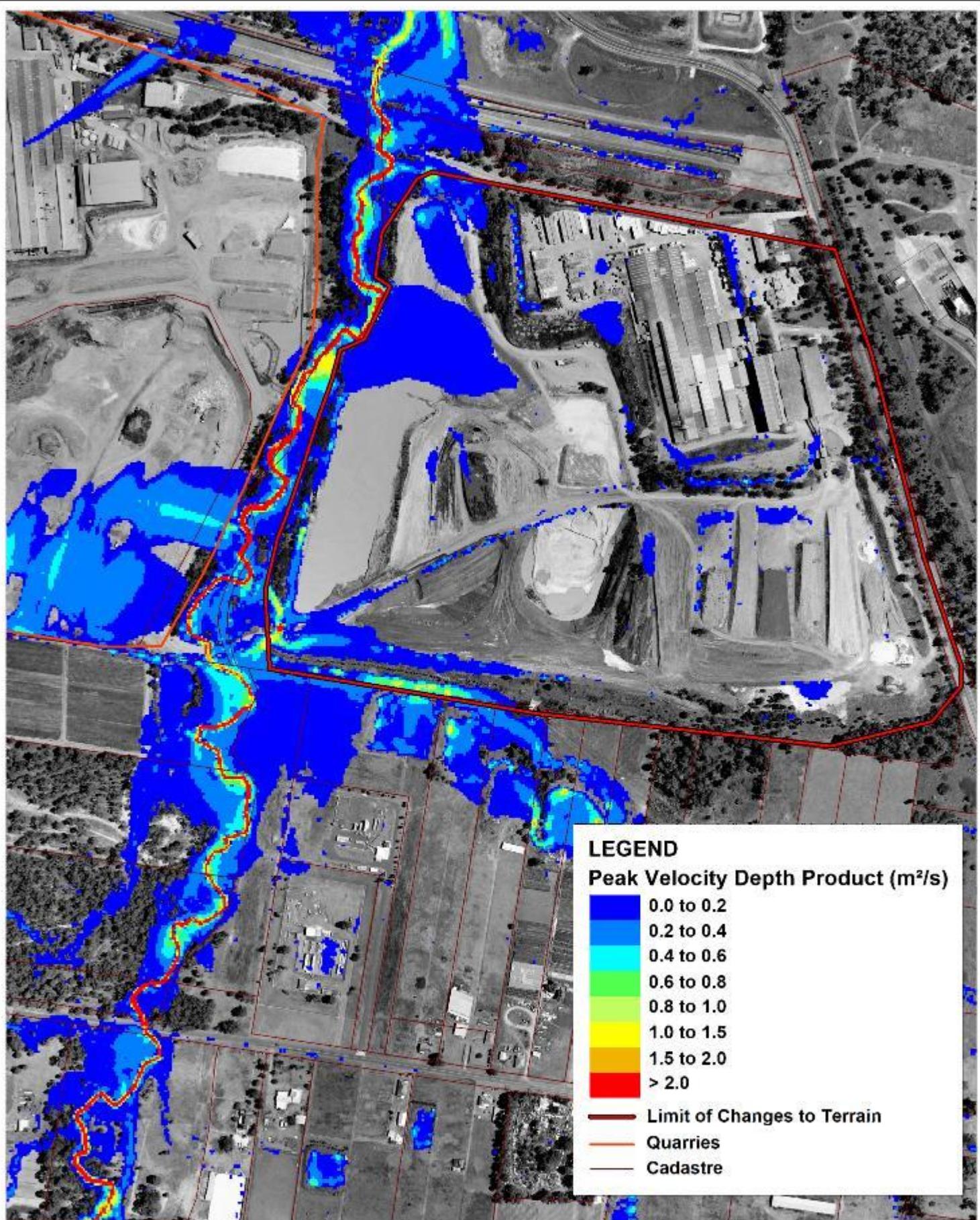
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 125 250m  
Approx. Scale

Figure:  
**B-3**

Rev:  
-



Title:

## Post Development December 2020 Design Velocity Depth Product - 5% AEP (20 yr ARI)

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



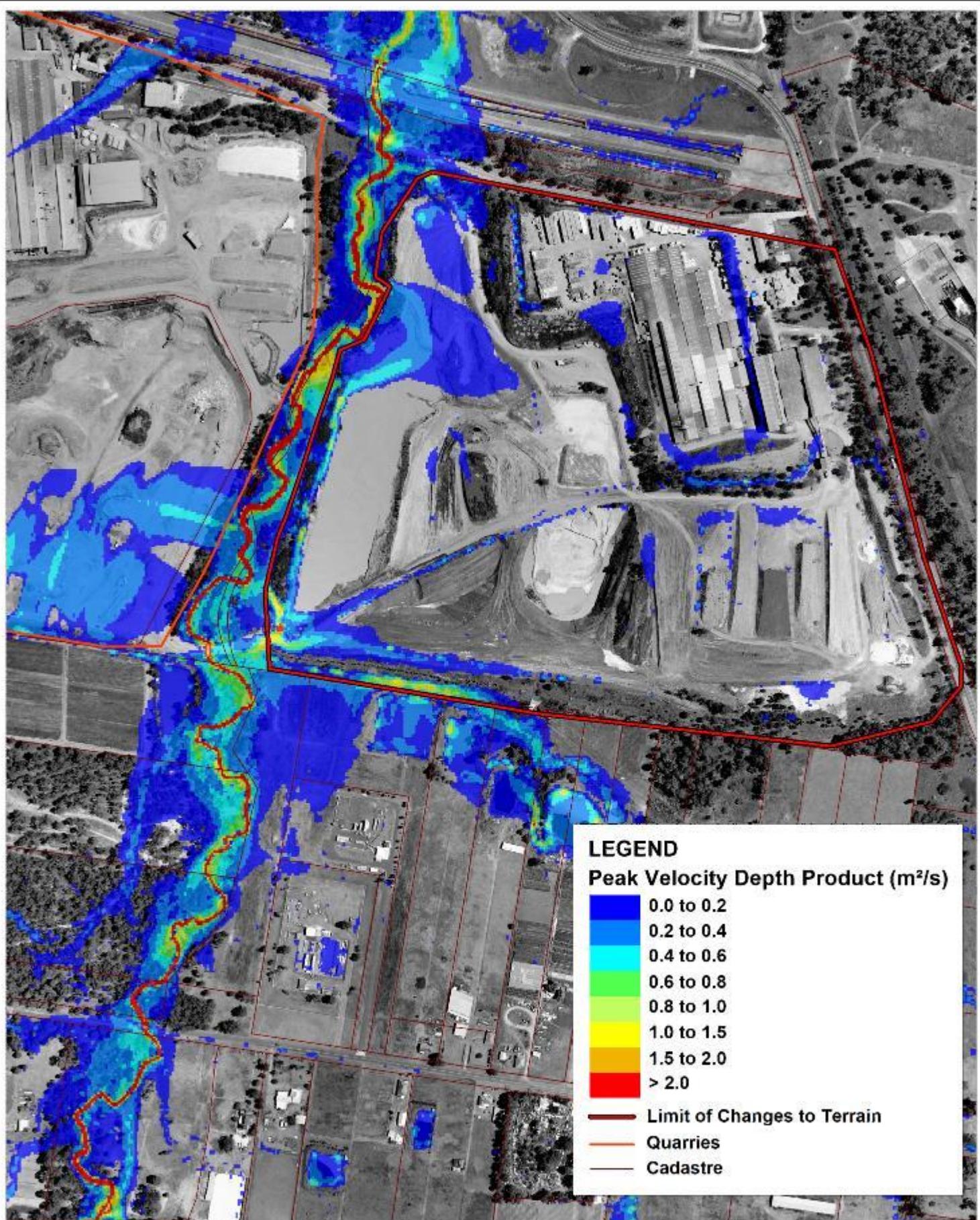
0 125 250m  
Approx. Scale

Figure:

**B-4**

Rev:

-



Title:  
**Post Development December 2020 Design  
Velocity Depth Product - 1% AEP (100 yr ARI)**

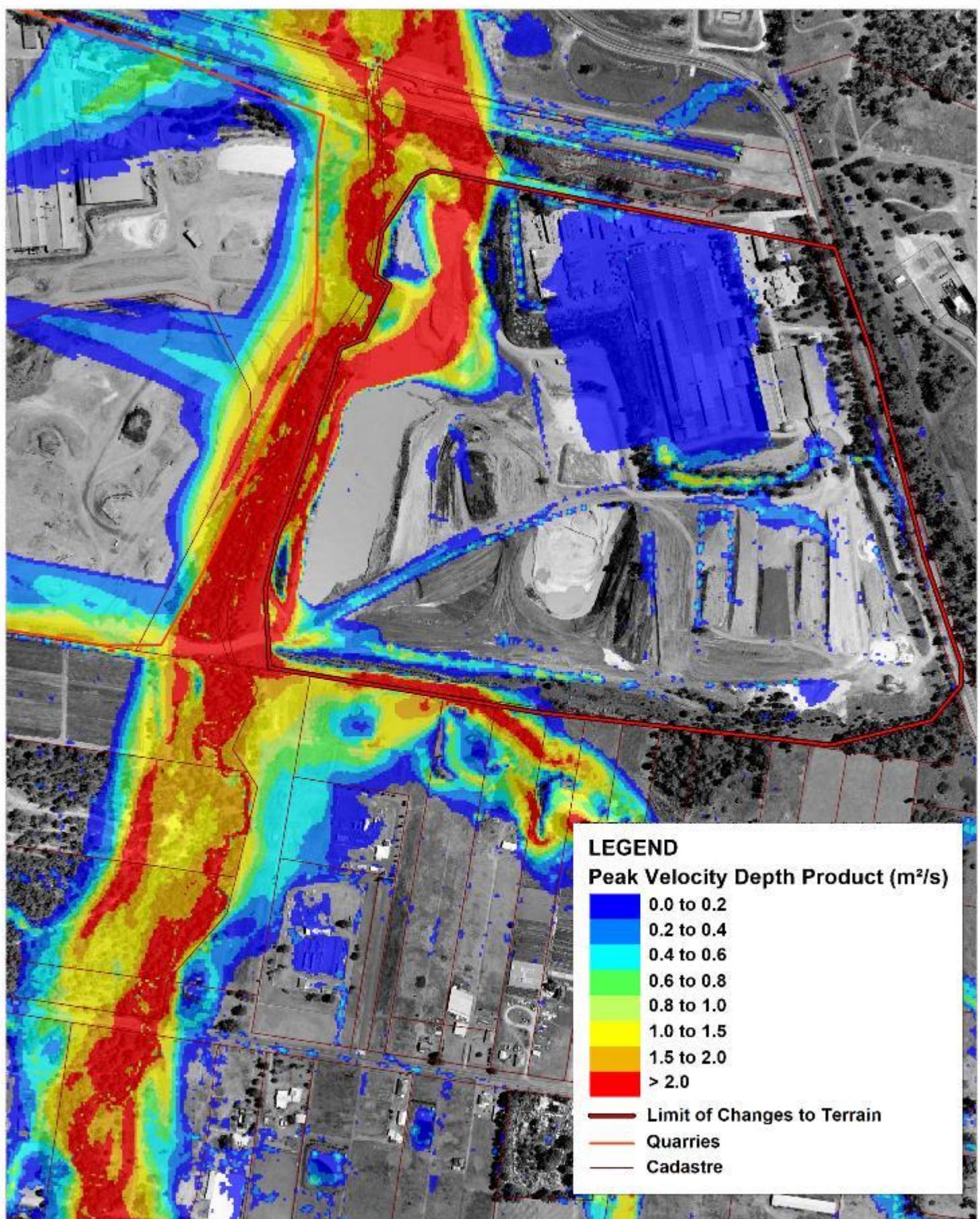
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0 125 250m  
Approx. Scale

Figure:  
**B-5**

Rev:  
-



Title:

## Post Development December 2020 Design Velocity Depth Product - Probable Maximum Flood (PMF)

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0 125 250m  
Approx. Scale

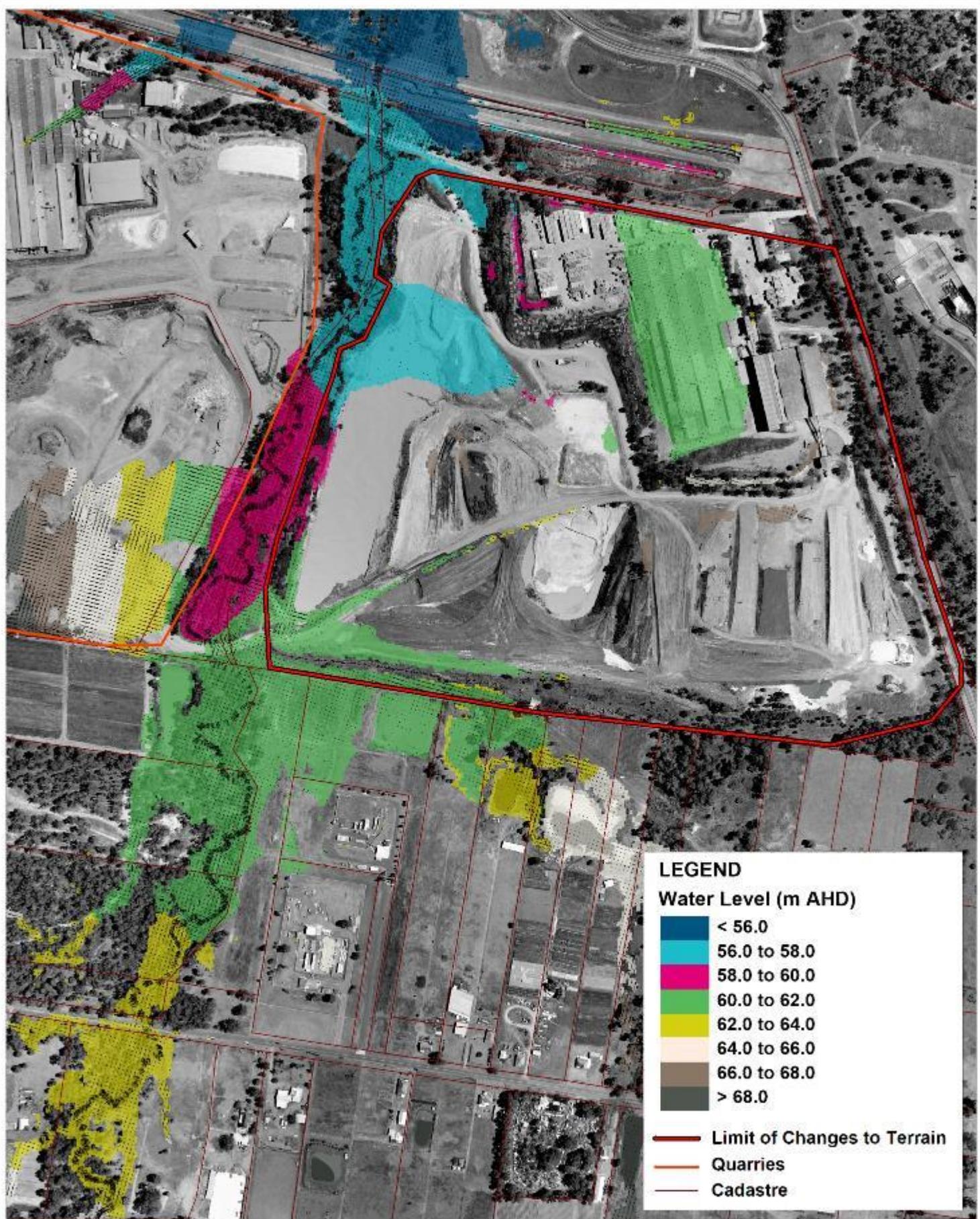
Figure:

**B-6**

Rev:

-

## Appendix C Peak Water Level Mapping



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

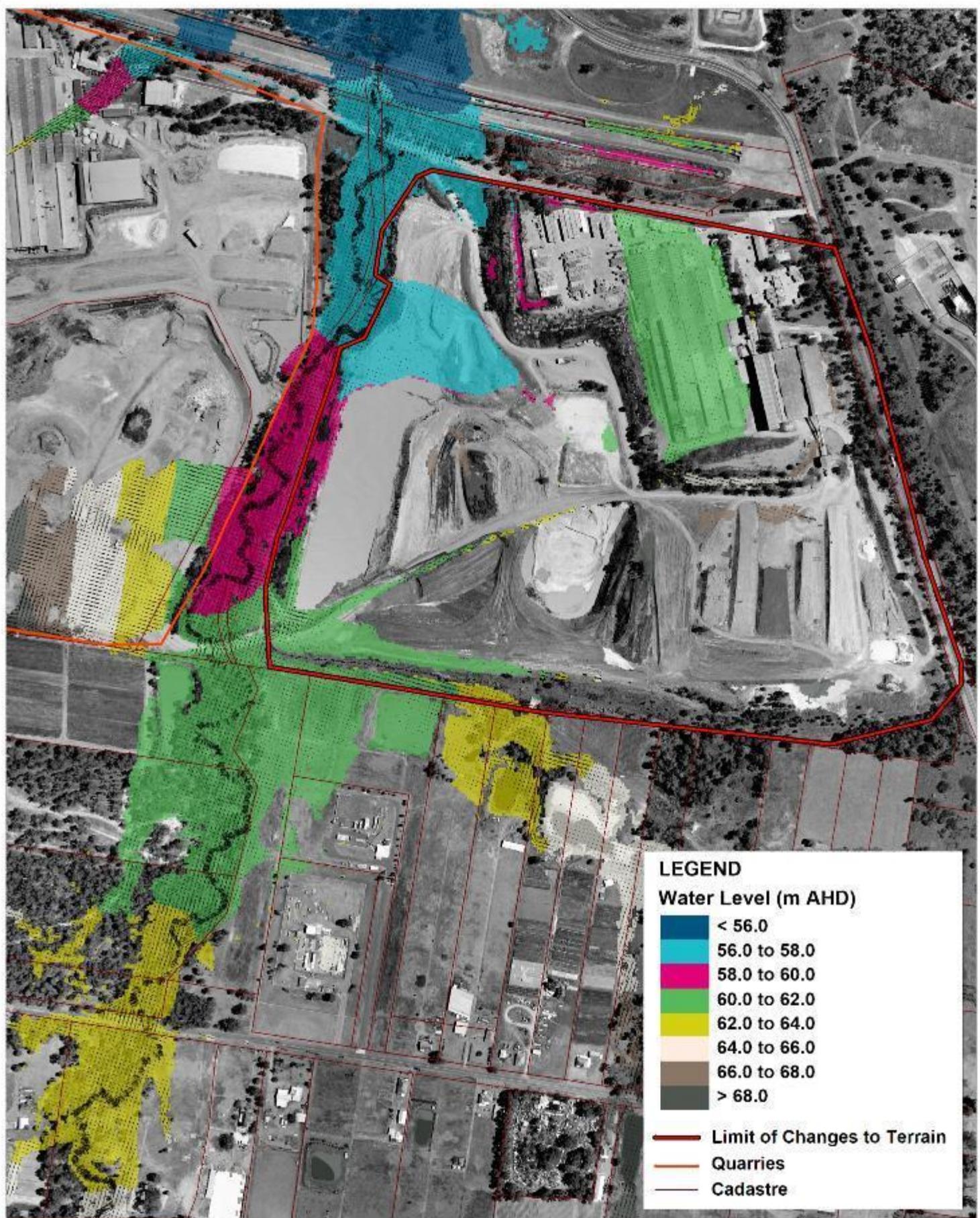
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0 125 250m  
Approx. Scale

Figure:  
**C-1**

Rev:  
-



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

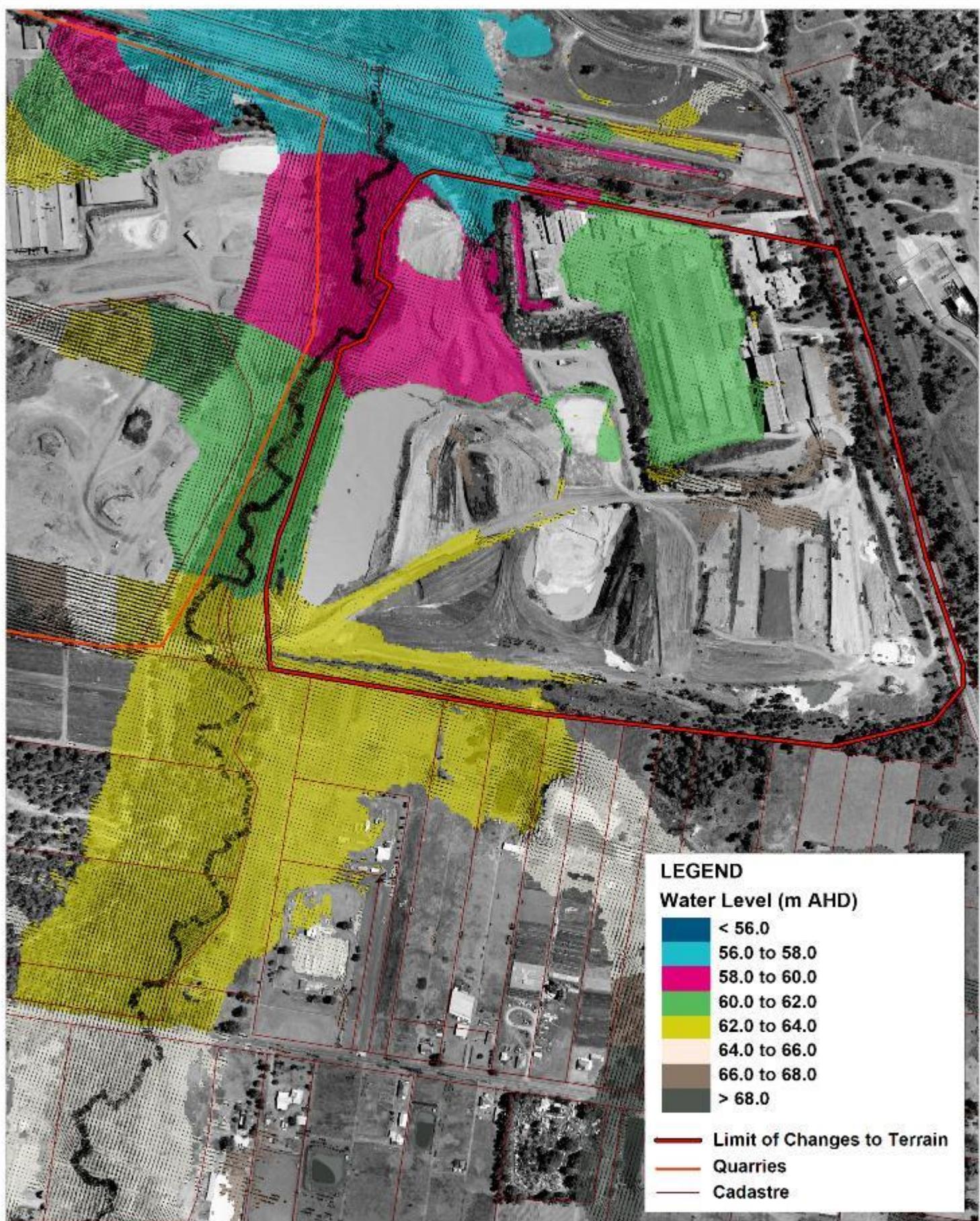
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0 125 250m  
Approx. Scale

Figure:  
**C-2**

Rev:  
-



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

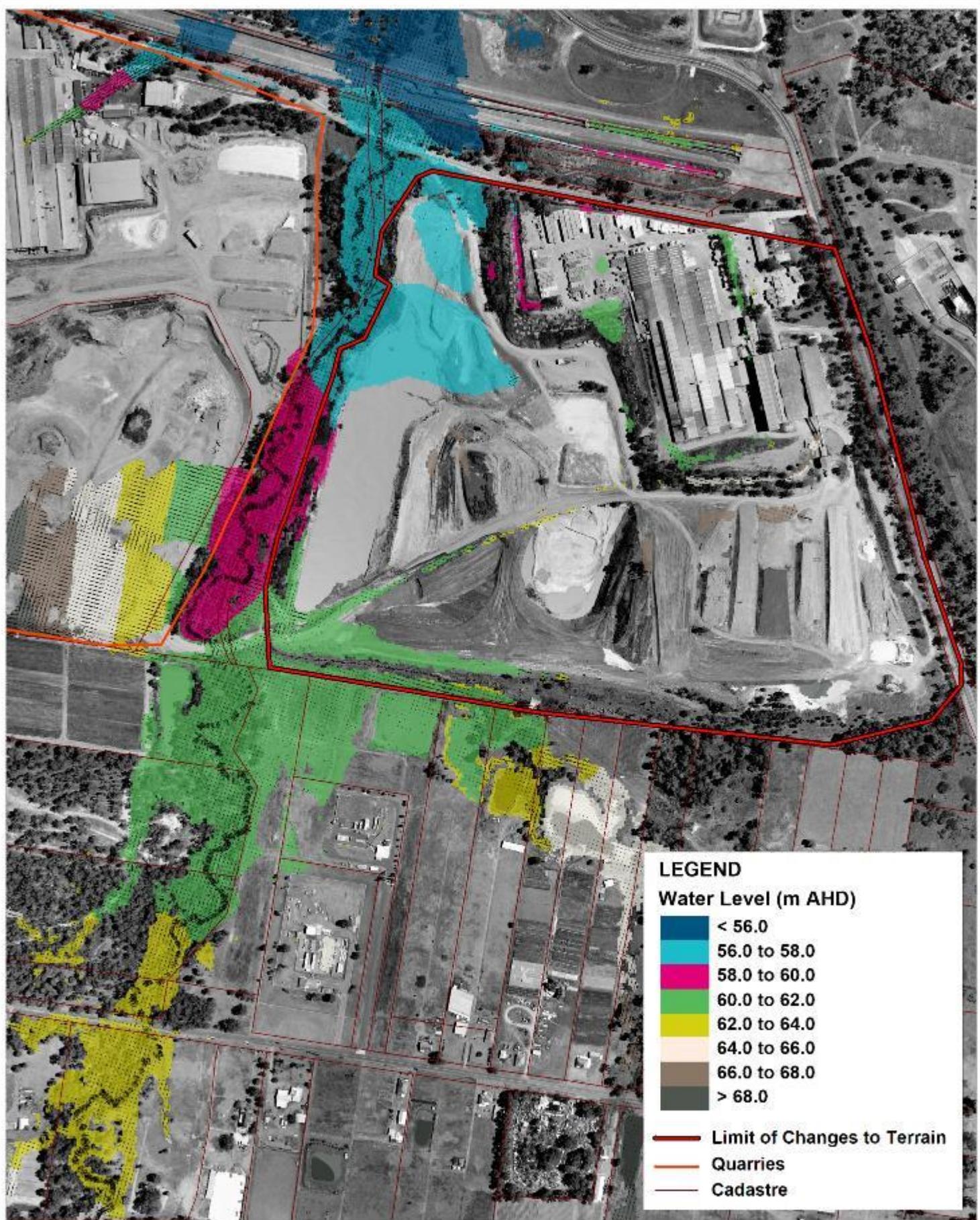
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



0 125 250m  
 Approx. Scale

Figure:  
**C-3**

Rev:  
 -



Title:

## Post Development December 2020 Design Peak Flood Level - 5% AEP (20 yr ARI)

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



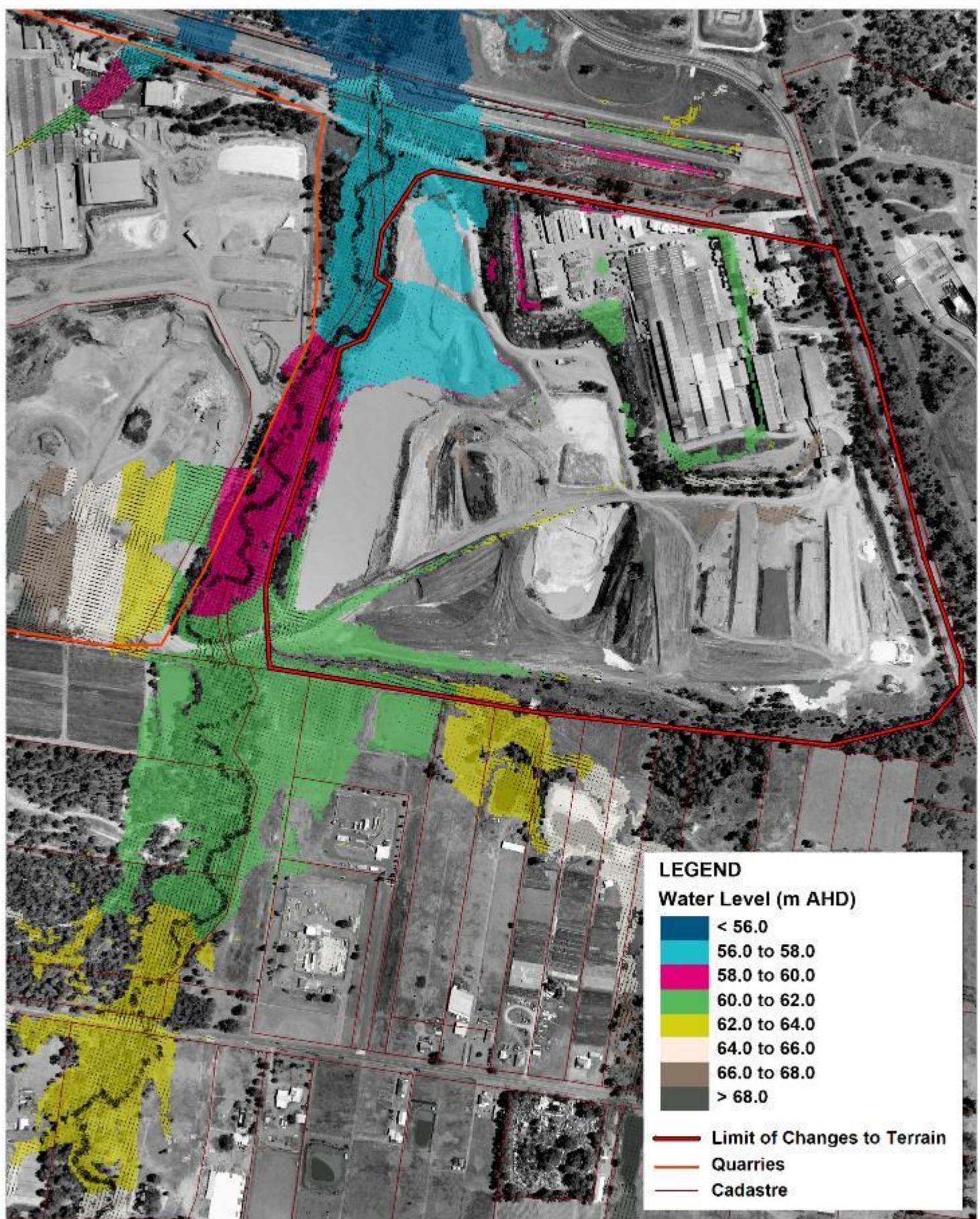
0 125 250m  
Approx. Scale

Figure:

**C-4**

Rev:

-



Title:

## Post Development December 2020 Design Peak Flood Level - 1% AEP (100 yr ARI)

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



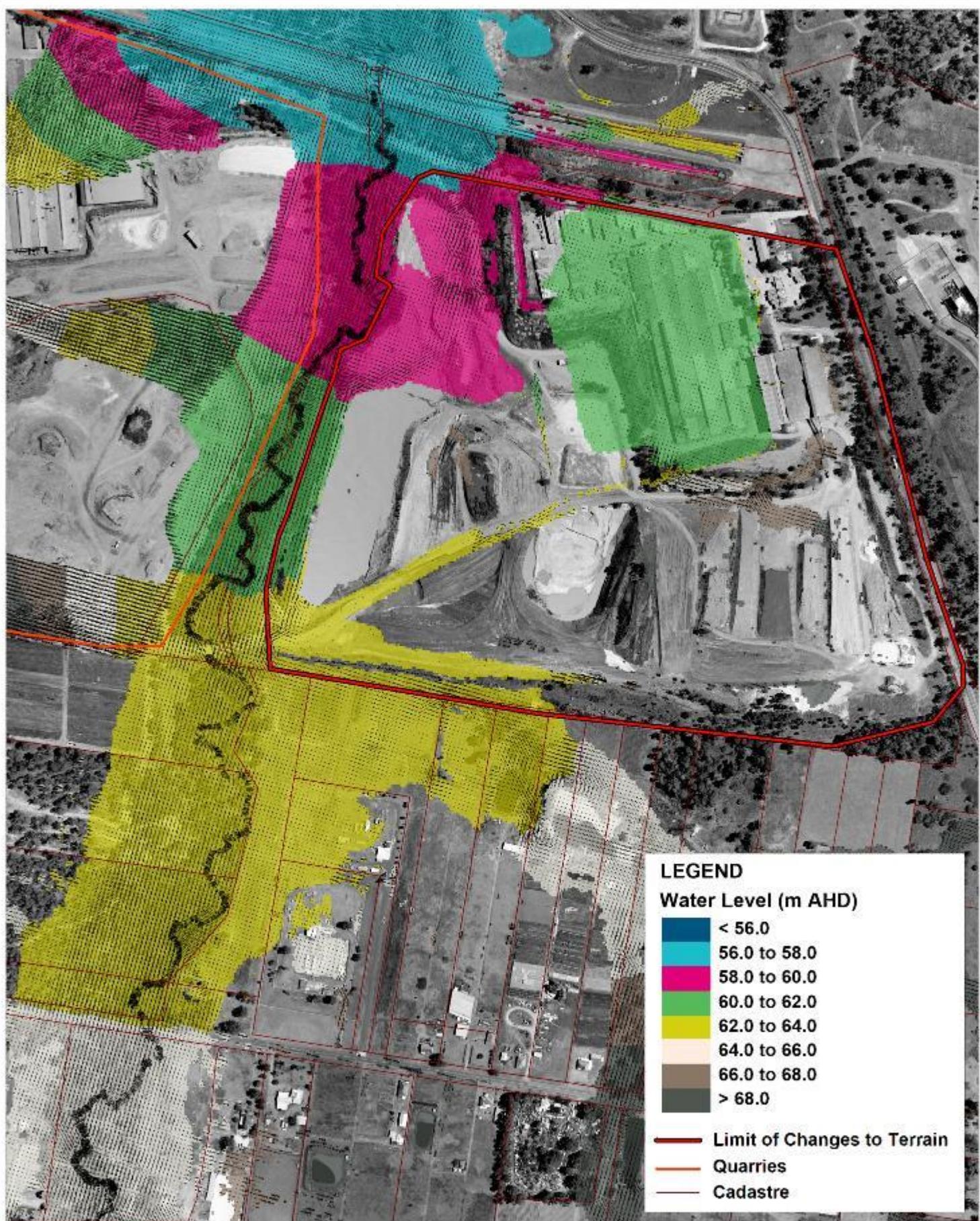
0 125 250m  
Approx. Scale

Figure:

**C-5**

Rev:

-



Title:  
**Post Development December 2020 Design**  
**Peak Flood Level - Probable Maximum Flood (PMF)**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

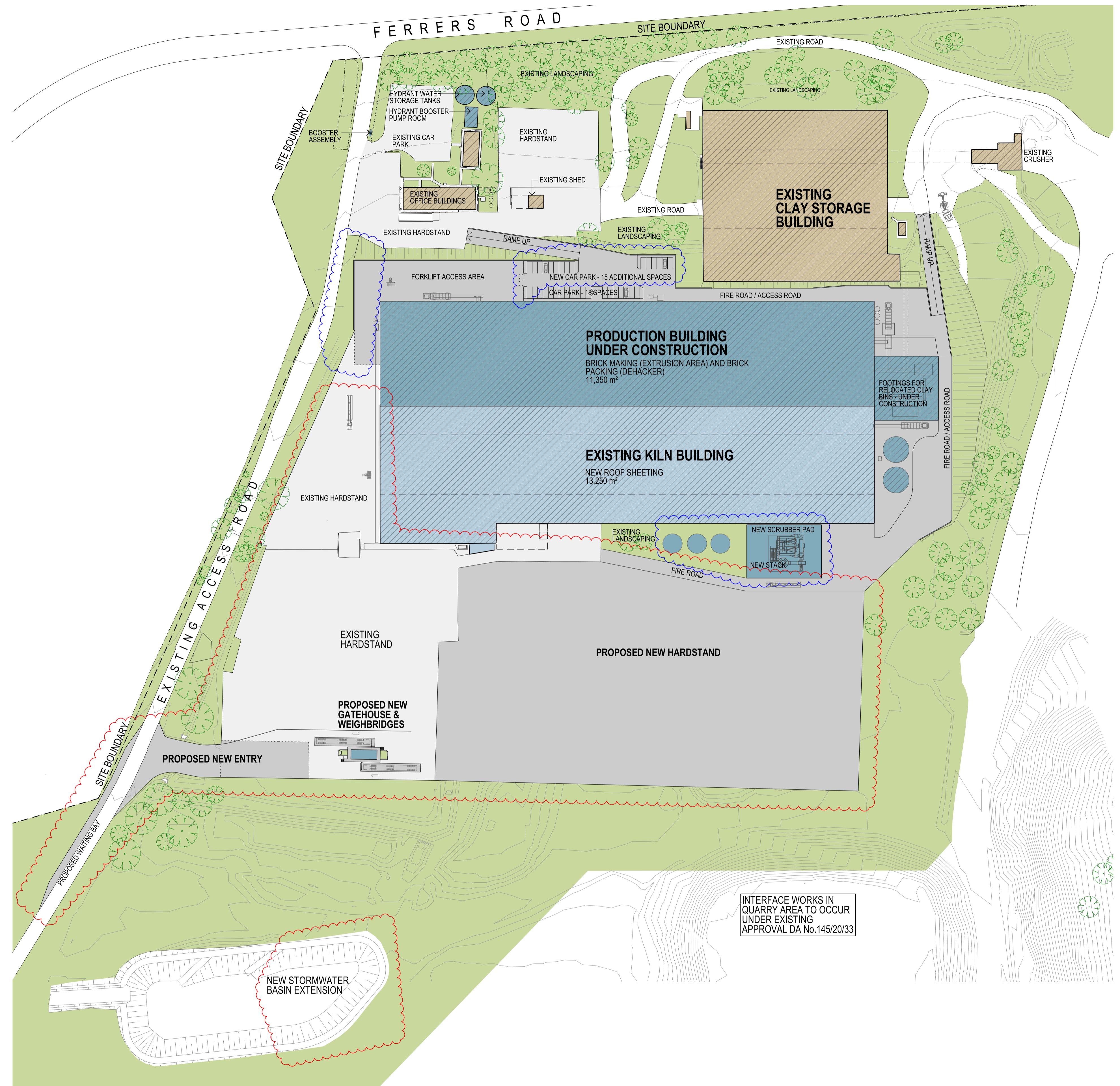


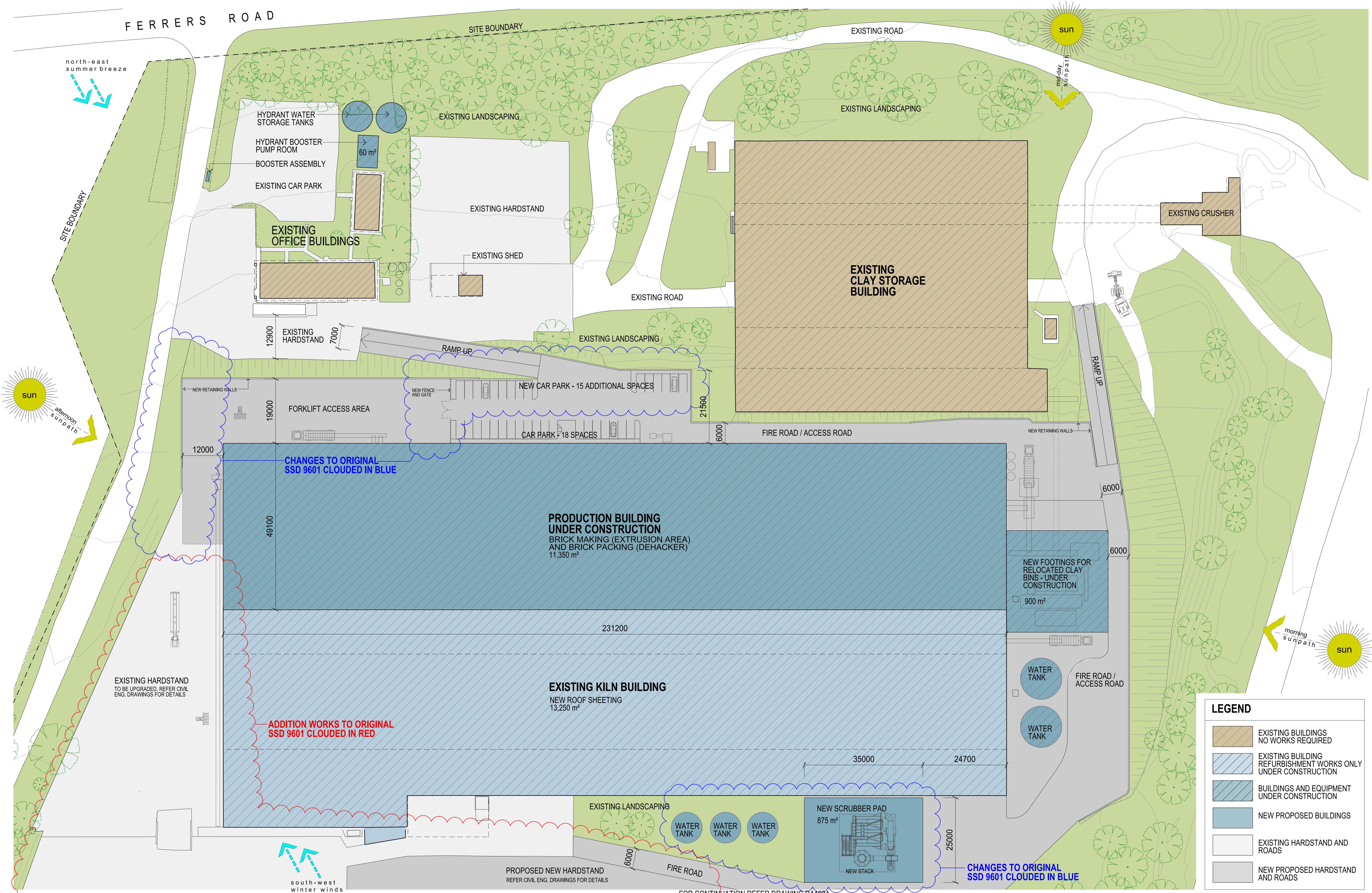
0 125 250m  
Approx. Scale

# Appendix F

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## Architectural Site Plans





**SBA**  
ARCHITECTS

Commercial Industrial Residential Retail Interior Design  
Suite 702, 63 Mount Street, North Sydney NSW 2060  
T 02 9929 9888 F 02 9929 8809  
E Info@sbaarch.com.au W www.sbaarch.com.au

ISSUED FOR SSD 9601  
MODIFICATION APPLICATION 03.03.2021

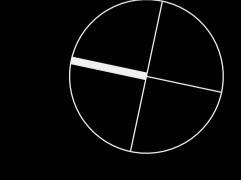
ISSUED FOR DA 06.05.2019

PRELIMINARY DA  
PREFILED FOR INFORMATION  
1 PRELIMINARY DA  
1 Size of new building increased  
A ISSUED FOR DA  
19.12.2018

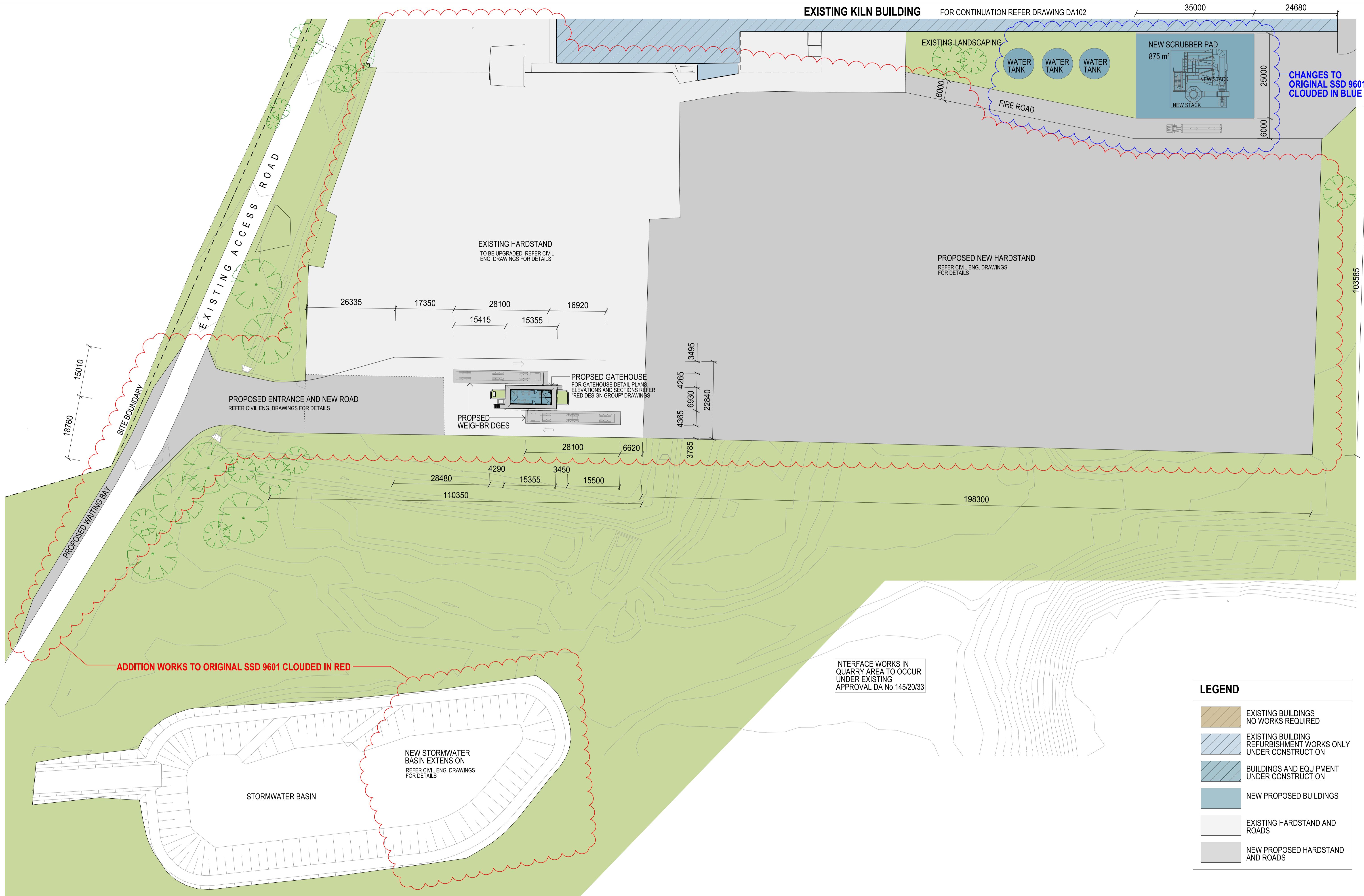
ISSUE REV. DESCRIPTION DATE

## ALTERATIONS AND ADDITIONS OF PLANT NO. 2

A U S T R A L B R I C K S  
174-181 FERRERS ROAD, HORSLEY PARK NW 2157



**SITE PLAN & SITE ANALYSIS PLAN**  
DRAWING TITLE  
DATE AUG 2018  
SCALE 1:1000 @ A3  
1:500 @ A1  
DRAWING NO. 18212  
JOB NO. DA 102  
E





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