Brickworks Plant 2 Upgrade

Soil and Water Management Plan & Civil Engineering Design Report

CLIENT/ **BRICKWORKS LTD**

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Commercial in Confidence

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1. Introduction

1.1. Background

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

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

1.2. Existing Site

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

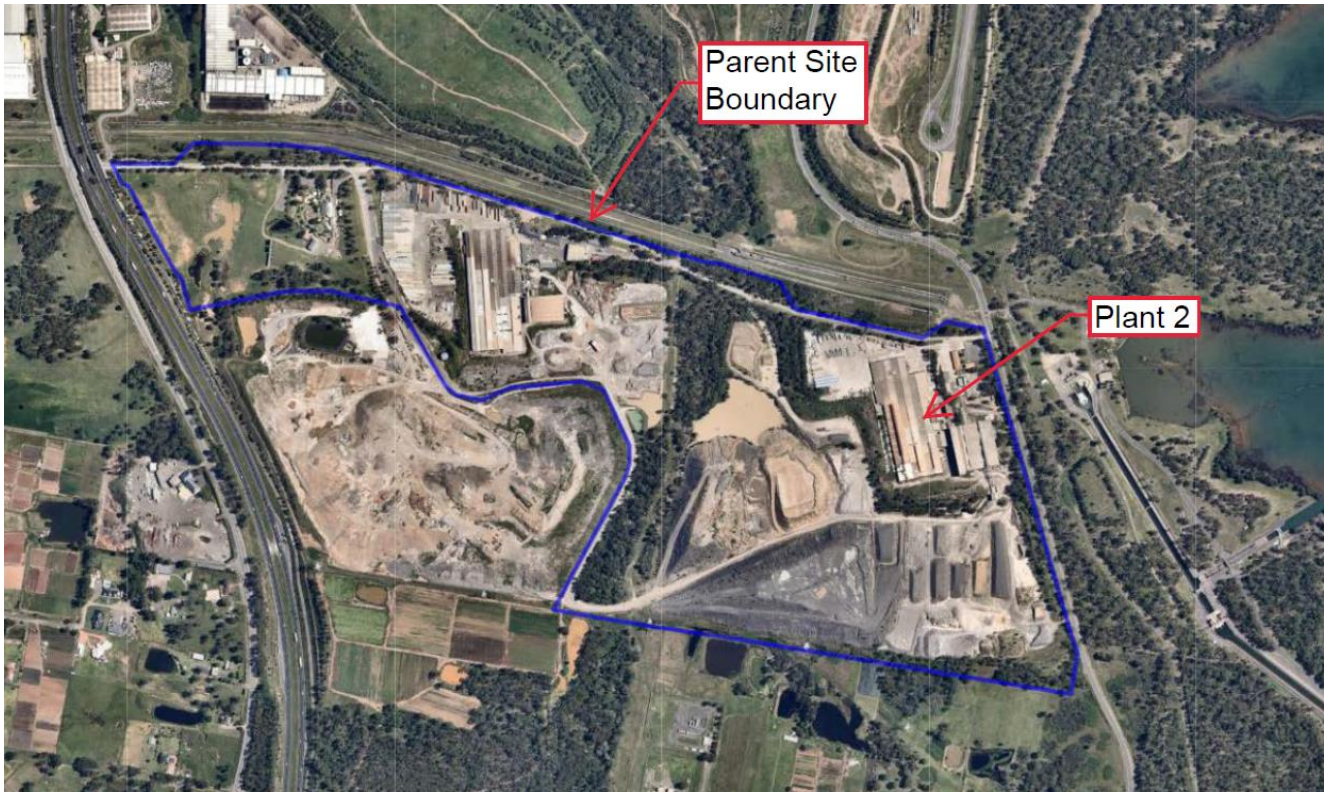
The site comprises an existing brick-making facility with associated factory buildings, access roads, carparks, material stockpiles, basins, offices and amenities. A 1.8km-long paved internal road runs along the northern edge of the site between Wallgrove Road and Ferrers Road.

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

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

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

Figure 1 – *Existing Site Aerial Photo*

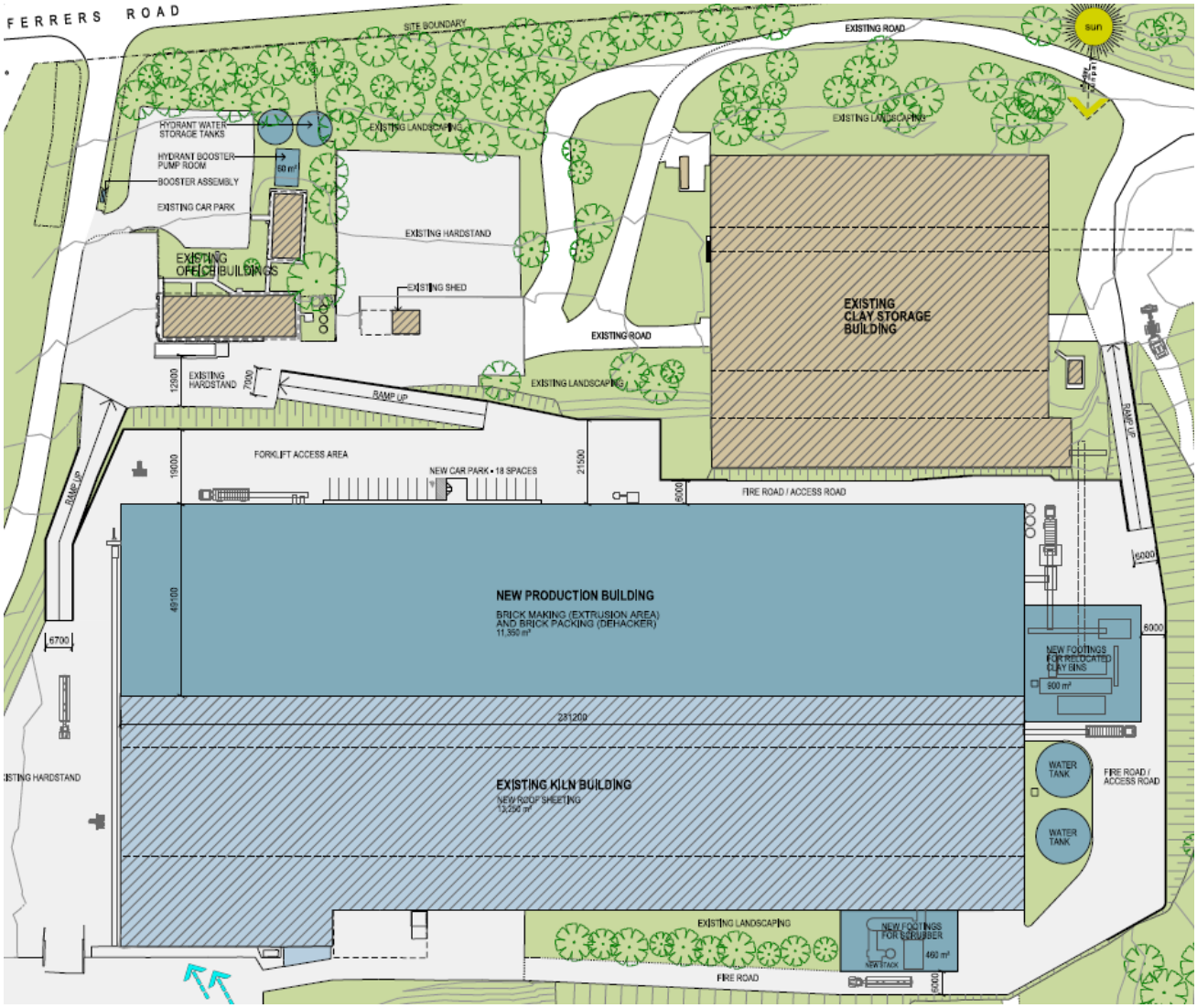


1.3. Proposed Development

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

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

Figure 2 – *Proposed Plant 2 Development*



2. Earthworks

2.1. SEARS

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

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

2.2. Existing Geology

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

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

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

2.3. Proposed Bulk Earthworks

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

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

2.3.1. Excavation

The required total cut volume is estimated to be approximately 93,000m^3 across the site.

Approximately 40,000m^3 of this cut is related to the development works around Plant 2. This volume is primarily generated from excavation into existing berms around the perimeter of the existing facility.

The remaining 53,000m^3 of cut is required in order to remove the existing clay stockpile at the proposed basin location and then excavate the basin itself below natural ground level.

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

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

2.3.2. Batters and Retaining Walls

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

2.3.3. Filling

Filling is not required for the development.

2.4. Erosion and Sediment Controls

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

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

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

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

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

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

2.4.1. Sources of Pollution

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

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

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

2.4.2. Potential Impacts

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

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

2.4.3. RUSLE Analysis

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

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

1. Assess the erosion risk at a site;
2. Identify suitable measures to overcome the erosion risk;
3. Estimate the required capacity of sediment retarding basins; and
4. Compare the effectiveness of various erosion control 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 151 to 225 tonnes/ha/year.

Table 2.1 – *RUSLE Calculation*

Parameter	Value
Rainfall Erosivity Factor, R	2,329.3
Soil Erodibility Factor, K	0.05
Slope Length/Gradient Factor, LS	1.19

Erosion Control Practice Factor, P	1.20
Ground Cover and Management Factor, C	1
Computed Soil Loss (tonnes/ha/year), (A = R x K x LS x P x C)	**166.3**
Soil Loss Class	**2 (low)**

Notes:

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

2.4.4. Construction Methodology

2.4.4.1. Pre-Construction

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

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

2.4.4.2. During Construction

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

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

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

2.4.5. Sediment Basin Design

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

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

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

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

Table 2.2 – *Construction-Phase Sediment Basin Design Calculation*

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

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

2.4.5.1. Sediment Basin Maintenance (Construction Phase)

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

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

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

2.4.5.2. Site Inspection and Maintenance

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

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

2.5. Eastern Creek Riparian Zone

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

2.6. Groundwater

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

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

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

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

2.7. Contamination

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

3 Stormwater Management

3.1. SEARS

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

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

3.2. Hydrology

3.2.1. Existing Pre-Development Catchments

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

3.2.1.1. Existing Catchment A

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

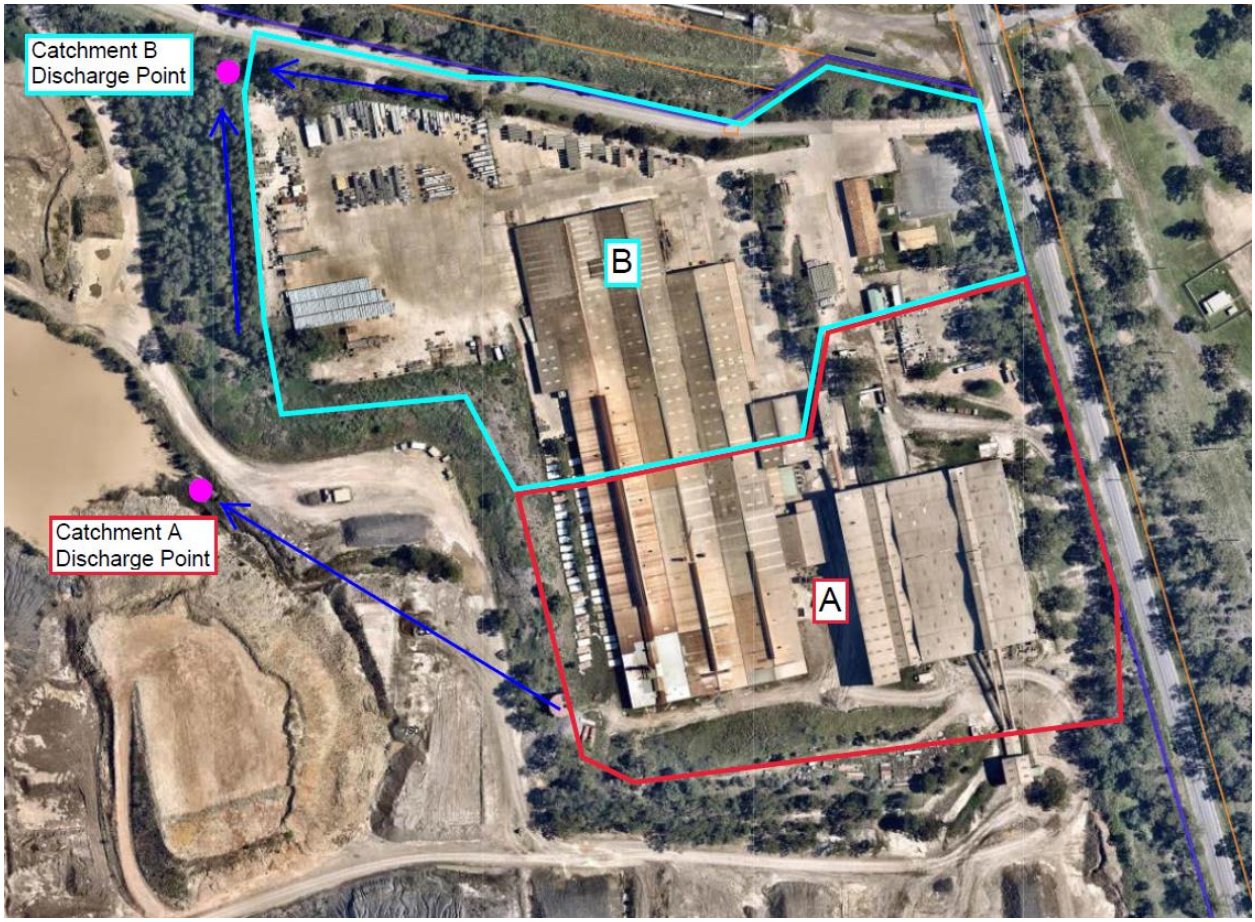
3.2.1.2. Existing Catchment B

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

Table 3.1 – *Existing Catchment Composition*

Catchment	Surface	Proposed Area	Discharge
A	Roof	1.76	Largely impounded but ultimately drains via outlet pipe to existing quarry dam adjacent to Eastern Creek
	Bare Earth	1.62	
	Landscaping	1.08	
	Total	**4.46 ha**	
B	Roof	1.15 ha	Existing piped discharge to vegetated open drain (to Eastern Creek)
	Pavements	3.20 ha	
	Landscaping	1.14 ha	
	Total	**5.49 ha**	

Figure 3 – *Existing Stormwater Catchments*



3.2.2. Proposed Post-Development Catchments

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

3.2.2.1. Proposed Catchment A

All proposed new development areas are included within Catchment A, which covers a total area of approximately 6.0ha with a composition as shown in Table 3.2.

There is a proposed increase of approximately 16,000m^2 impervious area within Catchment A as a result of the development works. For this reason, as well as the Council standards noted in Section 3.4 below, the proposed drainage network from this catchment will be routed through a new on-site detention basin to be constructed to the northwest of the site.

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

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

3.2.2.2. Proposed Catchment B

There are no new development areas proposed within Catchment B and the existing discharge location and characteristics will be maintained. There is also a significant reduction in the catchment size from 5.5ha to 3.8ha due to the following:

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

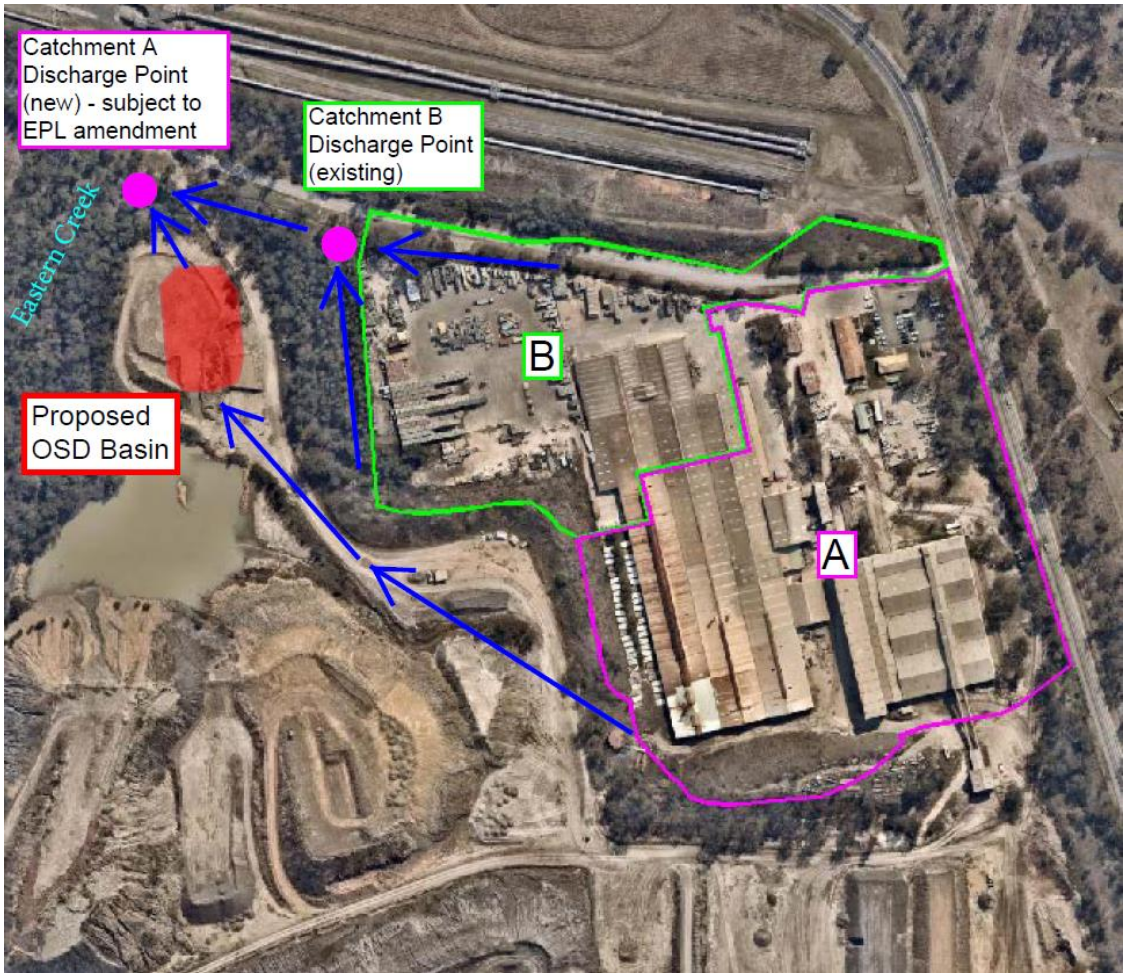
Based on the above factors, there is no intention to provide any OSD within this catchment. The existing discharge point will be maintained and will receive reduced peak flows due to the reduction in catchment area.

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

Table 3.2 – *Proposed Catchment Composition*

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

Figure 4 – *Proposed Stormwater Catchments*



3.2.3. External Catchments

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

3.2.4. Existing Dam

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

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

3.3. Concept Stormwater Drainage Design

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

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

3.4. On-Site Detention

3.4.1. Planning Requirements

Fairfield City Council's *Stormwater Management Policy, September 2017* Section 4.3 identifies that on-site detention is required within the Rural Zone, within which the subject site is located, for all development greater than 30m^2 area.

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

Due to their bulk water supply pipelines being located immediately downstream (north) of the site, WaterNSW also requires 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:

- 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^3 per 100m^2 of developed site using the simplified method.

3.4.3. Analysis

A runoff routing analysis has been undertaken using DRAINS hydraulic modelling software. This software utilises the ILSAX method for comparing inflow and outflow hydrographs for multiple storm events.

The proposed detention basin has been configured to mitigate peak flows for all designated storm durations for the 5 year ARI (18% AEP) and 100 year ARI (1% AEP) storm events in accordance with Council's required design parameters.

Additionally, all storm events between the 1 year ARI (63% AEP) and the 100 year ARI (1% AEP) were modelled to ensure no increase in post-development flows versus existing conditions.

3.4.4. Results

The results of the hydraulic analysis indicated that the proposed OSD basin detailed on Drawing DAC015 has sufficient capacity to mitigate the peak flows off the new development area (Catchment A) in accordance with Council requirements. The results are shown in Table 3.3 below.

Table 3.3 - *Peak Stormwater Flows for the 5 year and 100 year ARI events*

Storm Duration	Allowable PSD (78L/sec/Ha)	5 YR ARI flow	100 YR ARI flow
5 min duration	468 L/s	0 L/s	197 L/s
10 min duration		69 L/s	341 L/s
20 min duration		319 L/s	378 L/s
30 min duration		335 L/s	391 L/s
60 min duration		355 L/s	414 L/s
180 min duration		347 L/s	415 L/s
360 min duration		354 L/s	414 L/s
540 min duration		351 L/s	406 L/s

As requested by Water NSW a comparison of pre-development versus post-development peak flows is also required in order to show that there is no net increase in flows across the boundary of the site into their bulk water supply infrastructure corridor.

Table 3.4 - *Pre-Development vs Post-Development Peak Flow Comparison*

Storm Event (AEP)	Storm Event (ARI)	Pre-Development Flow (m^3/s) (L/s)	Post-Development Flow with Basin* (L/s)	Difference (L/s)	Peak Flow Reduction?
63%	1	1,553	927	-626	Yes
39%	2	2,088	1,166	-922	Yes
18%	5	2,760	1,459	-1,301	Yes
10%	10	3,150	1,633	-1,517	Yes
5%	20	3,680	1,850	-1,830	Yes
2%	50	4,100	2,057	-2,043	Yes
1%	100	4,750	2,260	-2,490	Yes

*Note that to ensure no overall increase in flows leaving the development site, the flows in this column are cumulative of flows through the basin (catchment A) plus flows from Catchment B which bypass the basin.

3.4.5. Detention Basin Design

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

The proposed basin analysed above has a total storage volume of approximately 3,800m^3 below the proposed emergency overflow level (RL56.6). The floor level of the basin is RL 54.7 resulting in a depth of 1.9m below the spillway level. To be conservative, this volume does not include an additional approx. 1,000m^3 volume within the sediment settling and storage zones at the southern end of the basin.

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

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

Refer to AT&L Drawings DAC015, DAC021 and DAC022 included in Appendix A.

3.5. Water Quality Treatment

3.5.1. Planning Requirements

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

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. The overarching requirement is compliance with Section 120 of the Protection of the Environment Act 1997. It is understood that there are also particular license conditions relating to this site - the following is an extract from the EPL concerning water discharge concentration limits:

Table 3.5 – *EPL Pollutant Concentration Limits*

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

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

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

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

Catchment B currently discharges via a separate route to Eastern Creek at the northern end of the site. This drainage alignment does consist of some vegetation which may be providing some ad-hoc treatment along the length of the drainage path.

3.5.3. Proposed Treatment

As part of the proposed development works, the existing treatment methodology outlined above will be adapted and improved to provide better separation between the dirty quarry runoff (which will continue to drain to the existing quarry dam) and the relatively clean runoff from the upgraded Plant 2 roofs and hardstands.

The redevelopment of Plant 2 is focused on Catchment A (refer Section 3.2 above). 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

Runoff from Catchment A will be collected by downpipes and surface inlet pits and conveyed through an underground pipe network to a new stormwater basin to be constructed to the northwest of the site, adjacent to the quarry entry road.

Immediately prior to discharge into the basin, piped flows will be directed through a proprietary gross pollutant trap device – an OceanSave OS1515 or approved equivalent.

The proposed basin will serve two functions: attenuation of peak flows (refer Section 3.4); and sediment removal. An automated rainfall-activated chemical dosing unit will be installed at the basin inlet to dose incoming flows from Plant 2 with a selected chemical flocculant such as polyaluminium chloride. The basin has been designed as a 2-stage system, with a pre-treatment inlet bay separated from the 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 the main pond). Refer to AT&L Drawing DAC015 for the proposed basin general arrangement.

The basin will have both a low-flow and high-flow outlet configuration, ultimately discharging towards Eastern Creek. The low-flow outlet will be provided by a discharge pit with connecting 525mm diameter pipe and the high-flow outlet will be provided by an overflow weir just below the basin crest connecting to a basin spillway.

Prior to discharge to the creek, the outlet pipe will pass through a proprietary filter media cartridge unit – an Ocean Protect Jellyfish 3250-12-2 or approved equivalent.

No changes are proposed to the Catchment B drainage corridor. Runoff from the reduced catchment area will continue to make its way to Eastern Creek via the existing open drainage channel.

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.

Catchment A, which contains the proposed development footprint, is directed through the proposed treatment train. Catchment B, which is largely an existing part of the site not subject to the proposed development, will not be routed through the proposed treatment train and will continue to discharge via the open drainage channel along the northern edge of the site and into Eastern Creek (per existing conditions).

Table 3.6 – *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 3.7 – *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

Table 3.8 – *Storm Flow Pollutant Concentration Parameters*

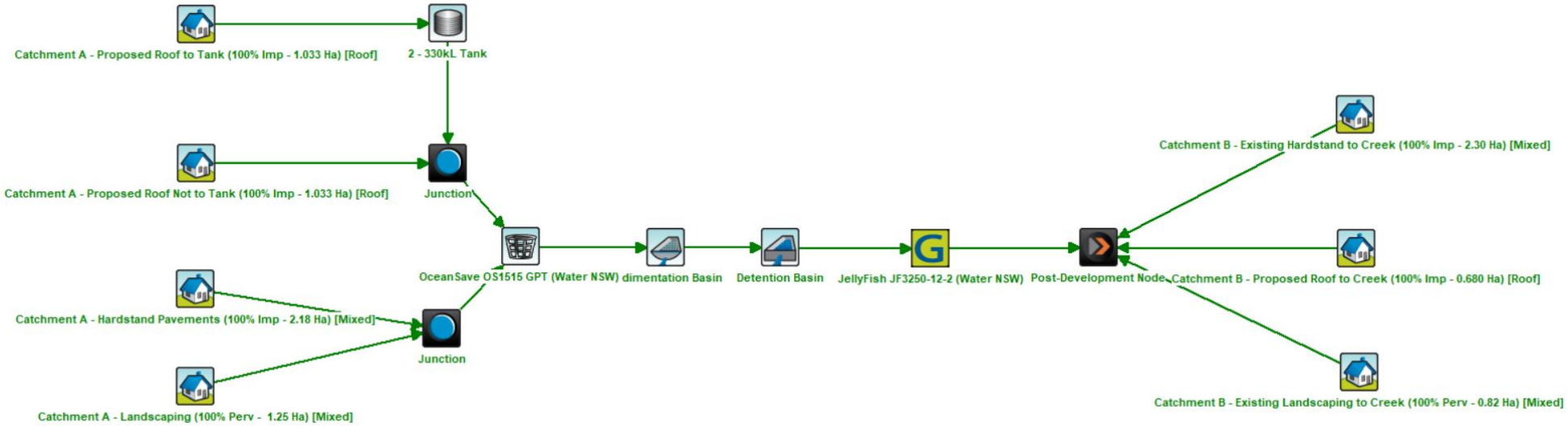
Concentration (log mg/L)	Total Suspended Solids (TSS)		Total Phosphorous (TP)		Total Nitrogen (TN)	
Surface Type	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Roofs	1.30	0.32	-0.89	0.25	0.30	0.19
Sealed Roads	2.43	0.32	-0.30	0.25	0.34	0.19
Unsealed Roads	3.00	0.32	-0.30	0.25	0.34	0.19
Revegetated Land	1.95	0.32	-0.66	0.25	0.30	0.19

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 5 below.

Figure 5 – *MUSIC Model Configuration*



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

	Annual Pollutant Loading (kg/year)			
Scenario/Catchment	**TSS**	**TP**	**TN**	**GP**
Pre-Development	21400	24.0	139	1520
Post-Development (with treatment)	6400	13.8	90.9	586
Difference (Pre-Post)	15000	10.2	48.1	934
% Improvement	70.1%	42.5%	34.6%	61.4%
Neutral or Beneficial Effect? Y/N	**Y**	**Y**	**Y**	**Y**

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 6 and 7.

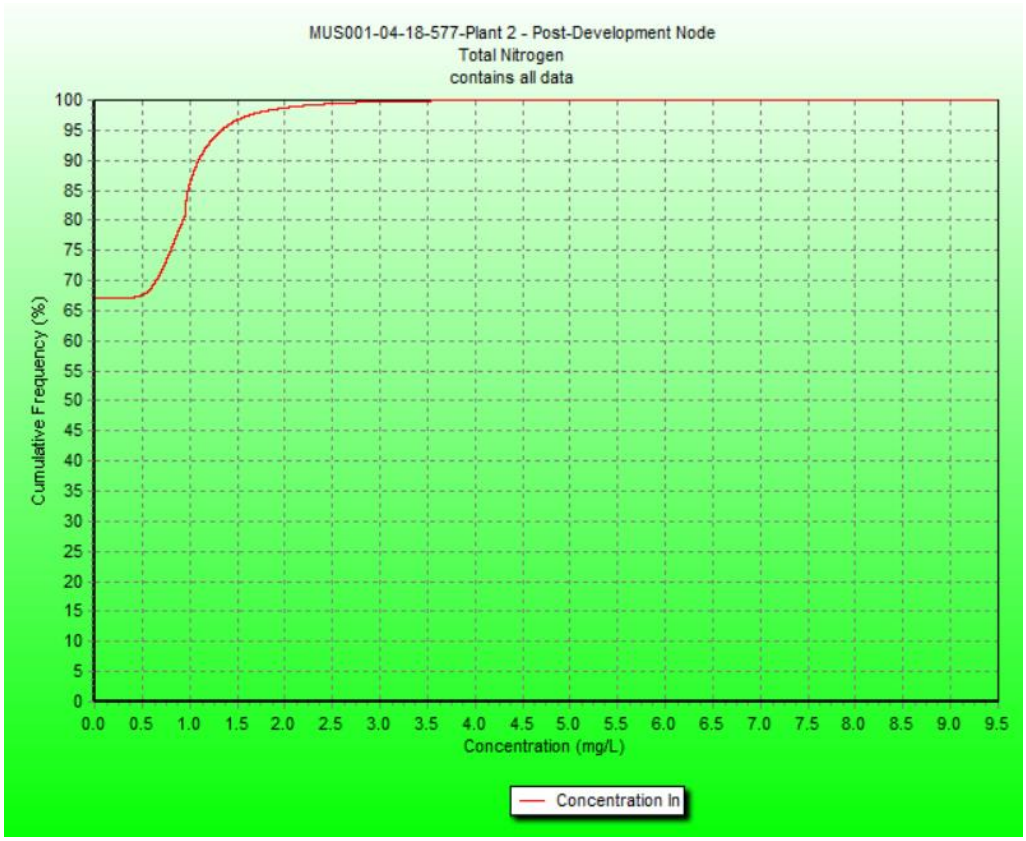
3.5.4.2.2. Treatment Train Effectiveness

Although there are no designated pollutant targets for this development since Fairfield Council does not require water quality treatment in this zone, the results below are provided for reference. These 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. It is noted that the percentage reductions achieved are limited by the fact that Catchment B (existing catchment areas) remain untreated by any formal measures.

Table 3.10 – *MUSIC Model Treatment Train Effectiveness Results*

Pollutant	**Annual Pollutant Loads (kg/yr)**		**Reduction (%)**
	Sources	**Residual**	
Total Suspended Soils	12600	6400	49.2
Total Phosphorous	24.4	13.8	43.4
Total Nitrogen	145	90.9	37.4
Gross Pollutants	1580	586	62.8

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



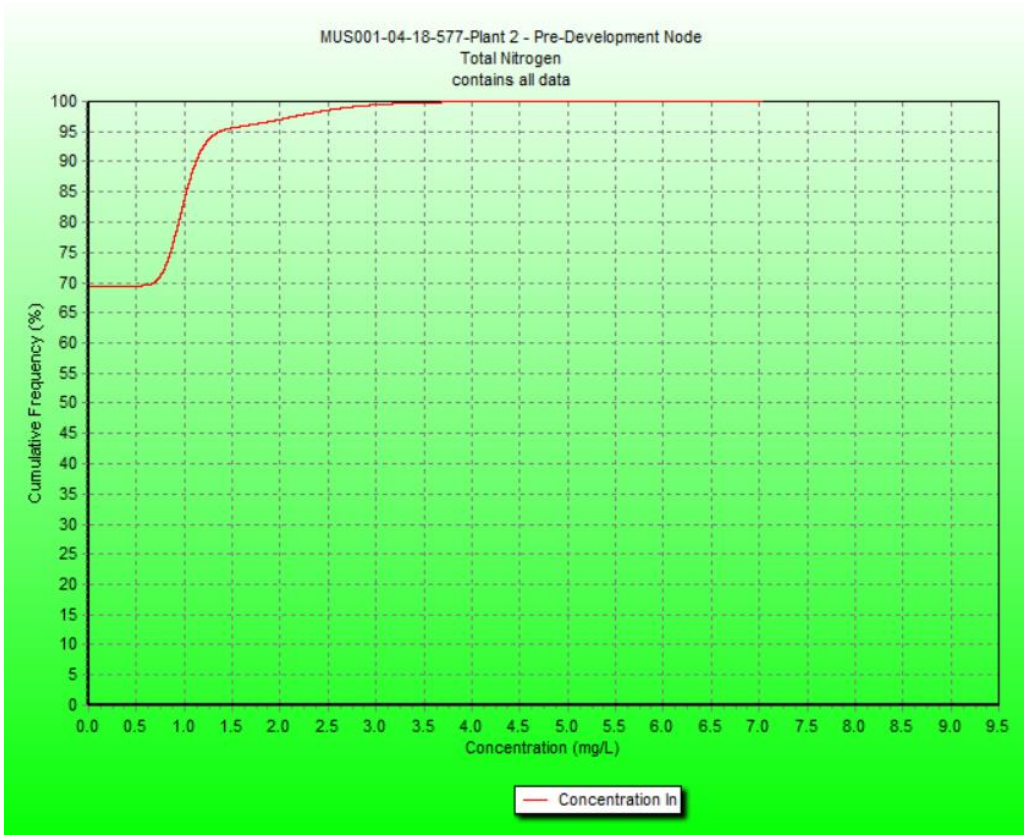
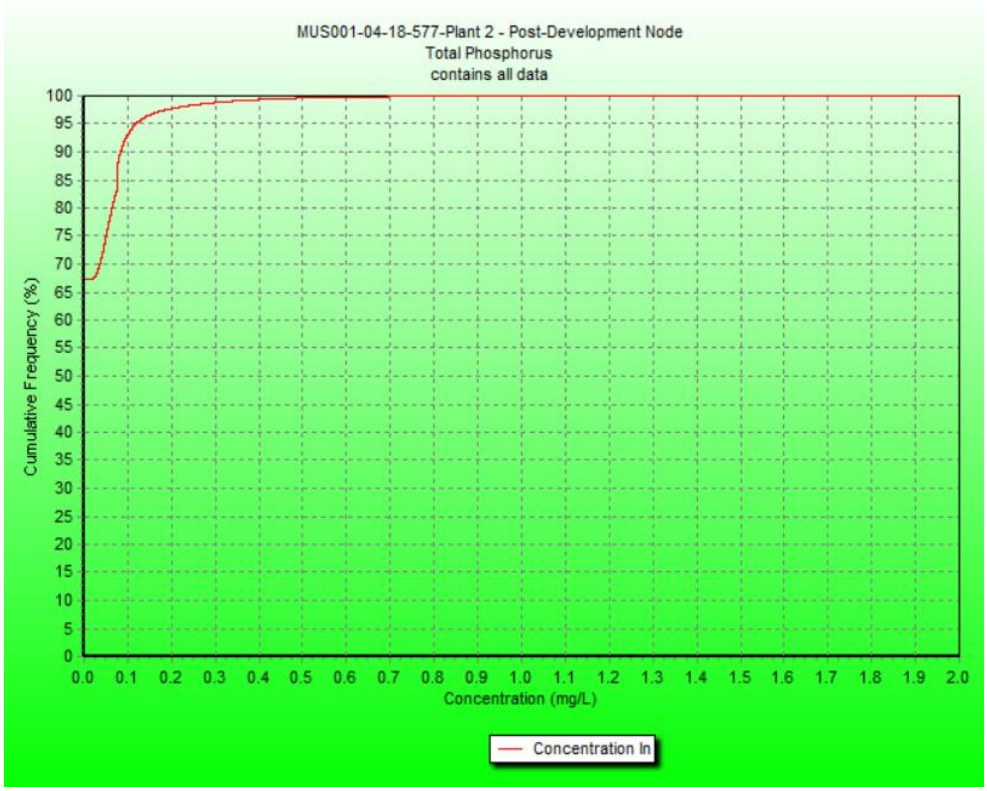
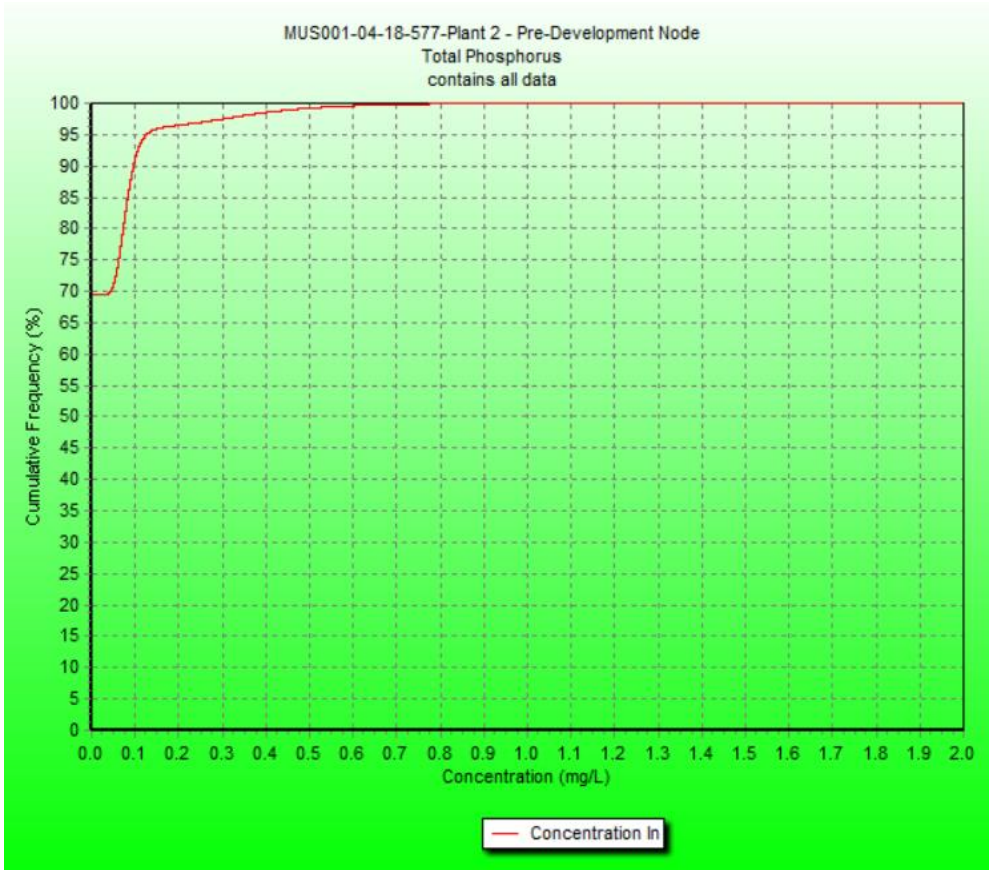


Figure 7 - *TP Cumulative Frequency Pre-Development and Post-Development Comparison*





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 mining site, it will remain in private ownership by Brickworks Ltd.

Maintenance access to the basin must be provided to allow for mowing and 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. A maintenance ramp constructed from concrete (maximum grade of 1V:6H) shall be provided at both ends of the basin to allow direct access from the adjacent hardstand pavement onto the floor of the basin.

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 on a once-yearly basis. This will involve an excavator entering the basin via the access ramp 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 at either end of the basin 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

3.7.1. Planning Requirements

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

3.7.2. Water Balance Overview

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

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

3.7.3. Overall Site Runoff

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

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

Table 3.11 – *Catchment Areas and Runoff Coefficients*

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

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

Table 3.12 – *Potential Runoff Generation*

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

3.7.4. Potential Non-Potable Water End Uses

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

- toilet and urinal flushing, hand basin washing – approx. 20L/person/day;

- kitchen (food preparation, washing), drinking;
- air conditioning cooling;
- internal cleaning;
- truck wash;
- external cleaning;
- plant watering; and
- use in the brick manufacturing process.

3.7.5. Total Site Water Demands

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

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

Table 3.13 – *Total Site Water Re-Use Demand*

	Area (m^2)	Re-use Demand
Total Roof Area	32,500	3.25 kL/day
Total External Landscape Area	21,900	1.20 kL/day
Total Manufacturing Process Use	N/A	10.0 kL/day
	TOTAL	**14.45 kL/day**

3.7.6. Rainwater Re-use

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

3.7.7. Rainwater Tank Modelling

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

3.7.7.1. Assumptions

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

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

3.7.7.2. Results

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

Table 3.14 – *MUSIC Rainwater Tank Water Balance Results*

Node Water Balance - Rainwater Tank

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

3.7.7.3. Comparison with Council Requirements

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

Table 3.15 – *Tank Size Calculation per Council Requirements*

	Area (m^2)
Existing Plant 2 Roof Area	21,100m^2
Proposed Plant 2 Roof Area	25,400m^2
New Plant 2 Roof Area	4,300m^2
Total Tank Volume (3,000L tank per 100m^2 of new roof area)	**129kL**

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

3.8. Flooding

3.8.1. 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.

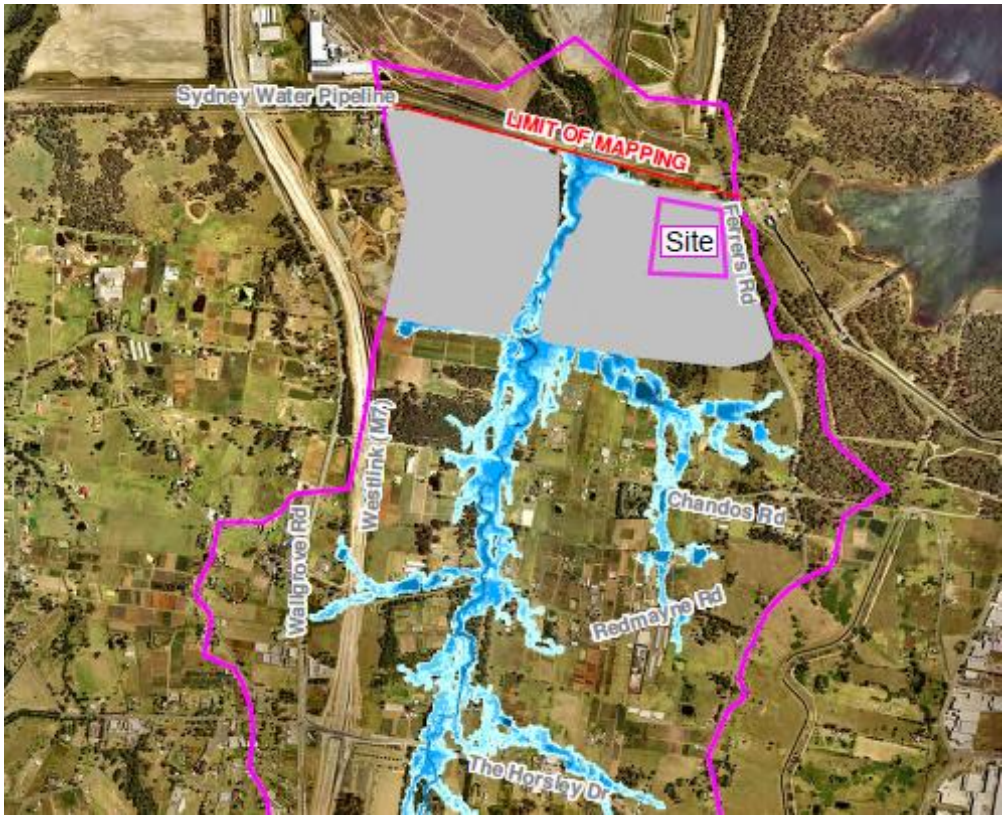
3.8.2. Rural Area Flood Study

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

Figure 9 – *Excerpt from Rural Flood Study 2013: Eastern Creek 100 year ARI Flooding*



3.8.3. BMT Flood Impact Assessment

A new flood impact assessment has been undertaken by BMT in March 2020 using Fairfield City Council's current hydraulic model and the proposed Plant 2 civil design surface prepared by AT&L.

Since the Rural Flood Study 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 pre-development/ existing conditions model.

The results of the TUFLOW flood modelling exercise undertaken by BMT show that at Reporting Points P08 and P09 (immediately upstream and downstream of the bulk water supply pipelines) the afflux in the 5% AEP, 1% AEP and PMF storm events is negative, indicating a reduction in flood levels at these locations in the post-development scenario. Figure 10 below also shows this graphically for the 1% AEP.

The proposed Plant 2 development area is also not directly affected by flooding from Eastern Creek as shown in Figure 11 below.

Please refer to the BMT letter report (Ref. L.S20149.02) enclosed under Appendix D 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 Table 3.4 above; and

3) All local stormwater runoff from roofs and hardstands will be captured and conveyed to discharge points by an underground piped network.

Figure 10 – *Excerpt from BMT Report showing 1% AEP Peak Flood Level Comparison for Pre-Development vs Post-Development Cases*

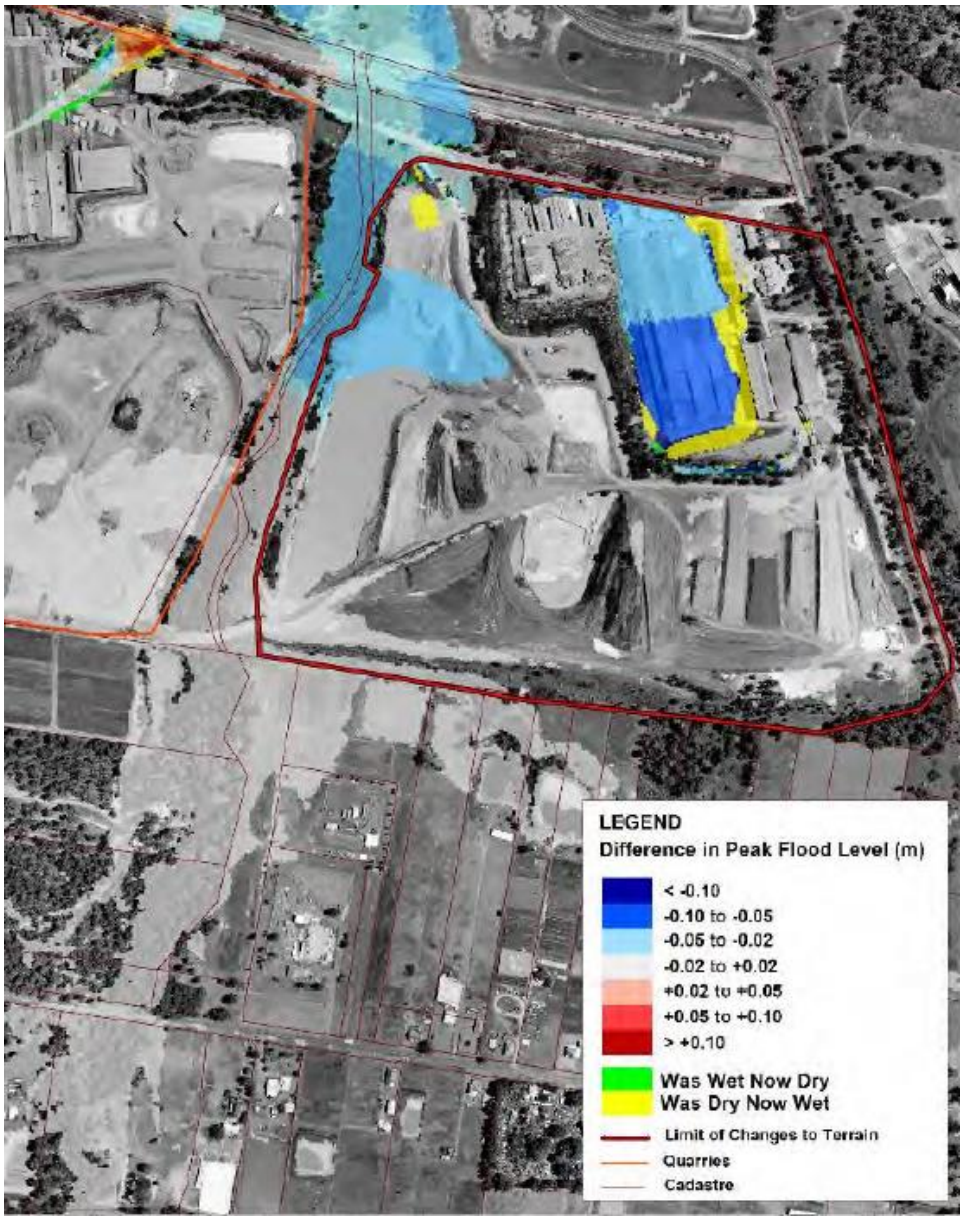
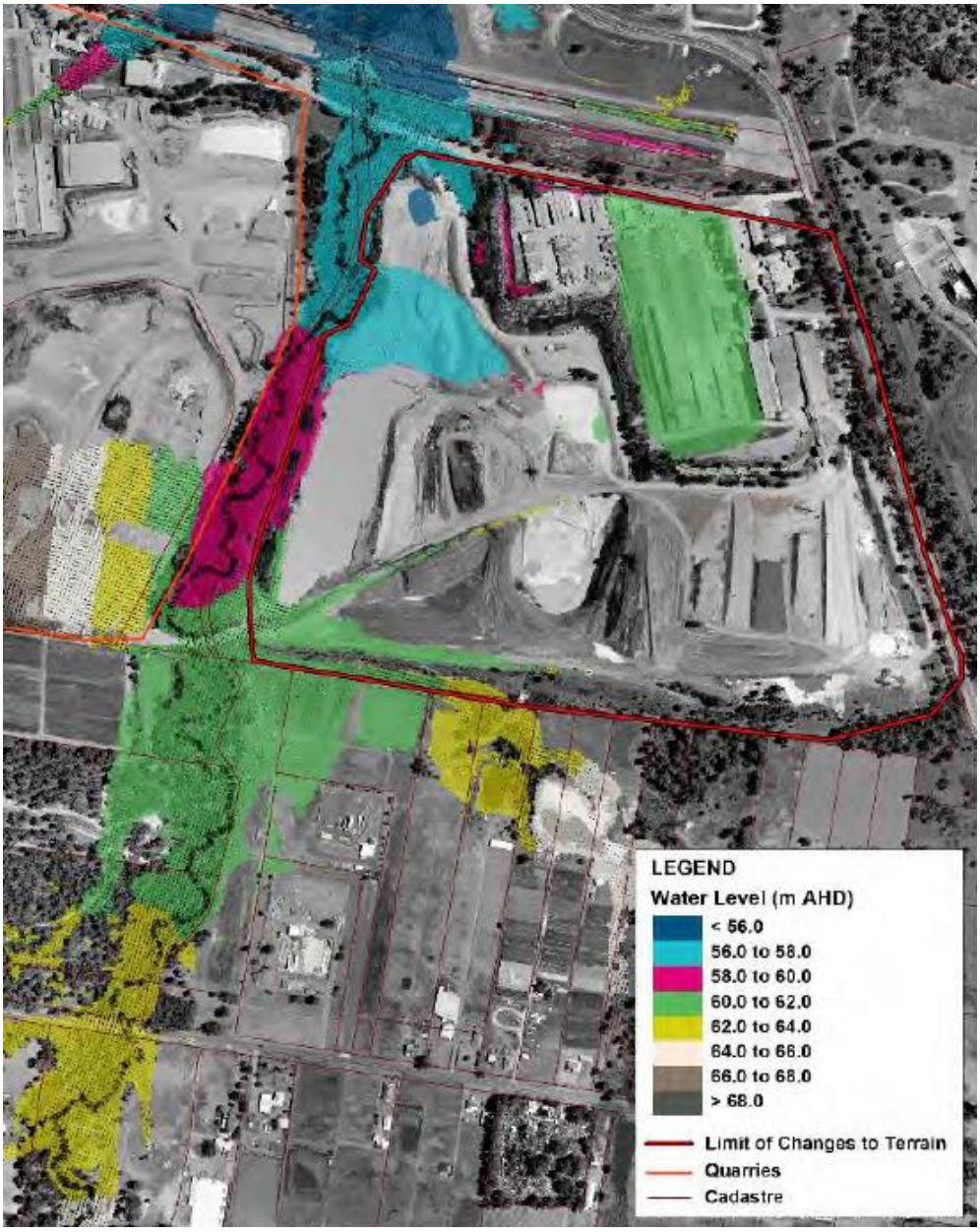


Figure 11 – *Excerpt from BMT Report showing 1% AEP Peak Flood Levels for Post-Development Case*



4 Access & Pavements

4.1. SEARS

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

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

4.2. Existing

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

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

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

4.3. Proposed

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

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

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

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

5 Servicing

5.1. Water Supply

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

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

5.2. Sewerage

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

5.3. Utilities

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

Appendix A

AT&L Civil Engineering Drawings

780 WALLGROVE ROAD, HORSLEY PARK
BRICKWORKS PLANT 2 UPGRADE
CIVIL WORKS PACKAGE

DRAWING LIST

DWG NO.	DRAWING TITLE
DAC001	COVER SHEET, DRAWING LIST AND LOCALITY PLAN
DAC002	GENERAL NOTES AND LEGENDS
DAC003	SITE CONTEXT PLAN
DAC004	GENERAL ARRANGEMENT PLAN
DAC011	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 1
DAC012	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 2
DAC013	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 3
DAC014	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 4
DAC015	SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 5
DAC020	TYPICAL SECTIONS SHEET 1
DAC021	TYPICAL SECTIONS SHEET 2
DAC022	TYPICAL SECTIONS SHEET 3
DAC030	BULK EARTHWORKS CUT/FILL PLAN
DAC031	PAVEMENT PLAN
DAC035	ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 1
DAC036	ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 2
DAC041	RETAINING WALL PLAN SHEET 1
DAC042	RETAINING WALL PLAN SHEET 2
DAC043	RETAINING WALL PROFILE SHEET 1
DAC044	RETAINING WALL PROFILE SHEET 2
DAC050	STORMWATER DRAINAGE CATCHMENT PLAN
DAC055	STORMWATER DETAILS SHEET 1
DAC056	STORMWATER DETAILS SHEET 2
DAC060	EROSION AND SEDIMENT CONTROL PLAN
DAC061	EROSION AND SEDIMENT CONTROL DETAILS

LOCALITY PLAN
N.T.S

Issue	Description	Date
D	RE-ISSUED FOR DEVELOPMENT APPROVAL	20-03-20
C	ISSUED FOR DEVELOPMENT APPROVAL	10-05-19
B	ISSUED FOR REVIEW	09-04-19
A	ISSUED FOR INFORMATION	03-11-18

Bar Scales

100mm on Original

Client: BRICKWORKS LIMITED

Scales

Grid MGA

Height Datum AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	SH

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: COVER SHEET, DRAWING LIST AND LOCAILTY PLAN

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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC001	18-577	D

Date Plotted: 25 Mar 2020 - 02:51PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC001.dwg

CONCRETE NOTES

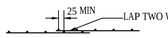
1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600 CURRENT EDITION WITH AMENDMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
2. CONCRETE QUALITY
   ALL REQUIREMENTS OF THE CURRENT ACSE CONCRETE SPECIFICATION DOCUMENT 1 SHALL APPLY TO THE FORMWORK, REINFORCEMENT AND CONCRETE UNLESS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

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

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

   NUMBER OF BARS IN GROUP — BAR GRADE AND TYPE
   17 N 20 250
   NOMINAL BAR SIZE IN mm — SPACING IN mm

   THE FIGURE FOLLOWING THE FABRIC SYMBOL SL IS THE REFERANCE NUMBER FOR FABRIC TO AS 1304.
8. FABRIC SHALL BE LAPPED IN ACCORDANCE WITH THE FOLLOWING DETAIL:



STORMWATER DRAINAGE NOTES

1. STORMWATER DESIGN CRITERIA:
   (A) AVERAGE RECURRENCE INTERVAL:
   1:100 YEARS ROOFED AREAS TO SURCHARGE PIT
   1:20 YEARS EXTERNAL PAVEMENTS
   (B) RAINFALL INTENSITIES:
   TIME OF CONCENTRATION:5 MINUTES
   1:100 YEARS= 218 mm/hr
   1:20 YEARS= 168 mm/hr
   (C) RUNOFF COEFFICIENTS:
   ROOF AREAS: C_{100} = 1.0
   EXTERNAL PAVEMENTS: C_{20} = 0.95
2. PIPES 300 DIA. AND LARGER TO BE REINFORCED CONCRETE CLASS '3' APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS. U.N.O.
3. PIPES UP TO 300 DIA SHALL BE SEWER GRADE uPVC WITH SOLVENT WELDED JOINTS.
4. EQUIVALENT STRENGTH VCP OR FRC PIPES MAY BE USED.
5. ALL STORMWATER DRAINAGE LINES UNDER PROPOSED BUILDING SLABS TO BE uPVC PRESSURE PIPE GRADE 6. ENSURE ALL VERTICALS AND DOWNPIPES ARE uPVC PRESSURE PIPE, GRADE 6 FOR A MIN OF 3.0m IN HEIGHT.
6. PIPES TO BE INSTALLED TO TYPE HS1 SUPPORT IN ACCORDANCE WITH AS 3725 (1989) IN ALL CASES BACKFILL TRENCH WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL COMPACTED IN 150mm LAYERS TO MINIMUM 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. (OR A DENSITY INDEX OF NOT LESS THAN 75)
7. ALL INTERNAL WORKS WITHIN PROPERTY BOUNDARIES ARE TO COMPLY WITH THE REQUIREMENTS OF AS 3500 3.1 (2018) AND AS/NZS 3500 3.2 (2018).
8. PRECAST PITS MAY BE USED EXTERNAL TO THE BUILDING SUBJECT TO APPROVAL BY AT & L.
9. ENLARGERS, CONNECTIONS AND JUNCTIONS TO BE PREFABRICATED FITTINGS WHERE PIPES ARE LESS THAN 300 DIA.
10. WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS, UNSLOTTED uPVC SEWER GRADE PIPE IS TO BE USED.
11. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL.
12. GRATES AND COVERS SHALL CONFORM TO AS 3996.
13. ALL INTERNAL PIT DIMENSIONS TO CONFORM TO AS3500.3 TABLE 8.2.
14. AT ALL TIMES DURING CONSTRUCTION OF STORMWATER PITS, ADEQUATE SAFETY PROCEDURES SHALL BE TAKEN TO ENSURE AGAINST THE POSSIBILITY OF PERSONNEL FALLING DOWN PITS.
15. ALL EXISTING STORMWATER DRAINAGE LINES AND PITS THAT ARE TO REMAIN ARE TO BE INSPECTED AND CLEANED. DURING THIS PROCESS ANY PART OF THE STORMWATER DRAINAGE SYSTEM THAT WARRANTS REPAIR SHALL BE REPORTED TO THE SUPERINTENDENT/ENGINEER FOR FURTHER DIRECTIONS.

SITEWORKS NOTES

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

KERBING NOTES

1. ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 25MPa U.N.O IN REINFORCED CONCRETE NOTES.
2. 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).
3. 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.
4. 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.
5. BROOMED FINISH TO ALL RAMPED AND VEHICULAR CROSSINGS. ALL OTHER KERBING OR DISH DRAINS TO BE STEEL FLOAT FINISHED.
6. 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 ALLOTMENT DRAINAGE PIPES ARE TO BE BUILT INTO THE NEW KERB AND GUTTER WITH 100mm DIA HOLE.

   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 BE RELIED UPON FOR ANY DESIGN OR CONSTRUCTION.

SYMBOL LEGEND

- TELSTRA PIT
- TELSTRA DISTRIBUTION PILLAR
- BOLLARD
- POWER POLE WITH LIGHT
- LIGHT POLE
- SEWER MANHOLE
- SEWER LAMPHOLE
- WATER AIR VALVE
- WATER HYDRANT
- GAS BOX
- GAS MARKER POST
- SIGN
- FLAG POLE
- BASEMENT/CARPARK LEVEL

EROSION AND SEDIMENT CONTROL NOTES

GENERAL INSTRUCTIONS

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 URBANS 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 MOIST (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.

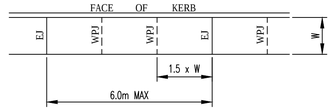
OTHER MATTERS

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.

JOINTING NOTES

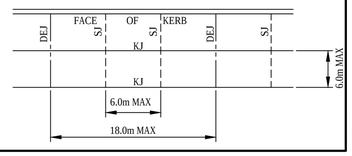
PEDESTRIAN PAVEMENT JOINTS

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



VEHICULAR PAVEMENT JOINTS

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



EXISTING UNDERGROUND SERVICES NOTES

THE LOCATIONS OF UNDERGROUND SERVICES SHOWN IN THIS SET OF DRAWINGS HAVE BEEN PLOTTED FROM SURVEY INFORMATION AND SERVICE AUTHORITY INFORMATION. THE SERVICE INFORMATION HAS BEEN PREPARED ONLY TO SHOW THE APPROXIMATE POSITIONS OF ANY KNOWN SERVICES AND MAY NOT BE AS CONSTRUCTED OR ACCURATE.
AT & L CAN NOT GUARANTEE THAT THE SERVICES INFORMATION SHOWN ON THESE DRAWINGS ACCURATELY INDICATES THE PRESENCE OR ABSENCE OF SERVICES OR THEIR LOCATION AND WILL ACCEPT NO LIABILITY FOR INACCURACIES IN THE SERVICES INFORMATION SHOWN FROM ANY CAUSE WHATSOEVER.

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

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

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

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

Bar Scales

Client: BRICKWORKS LIMITED

Scales
Grid MGA
Height Datum AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: GENERAL NOTES AND LEDENDS

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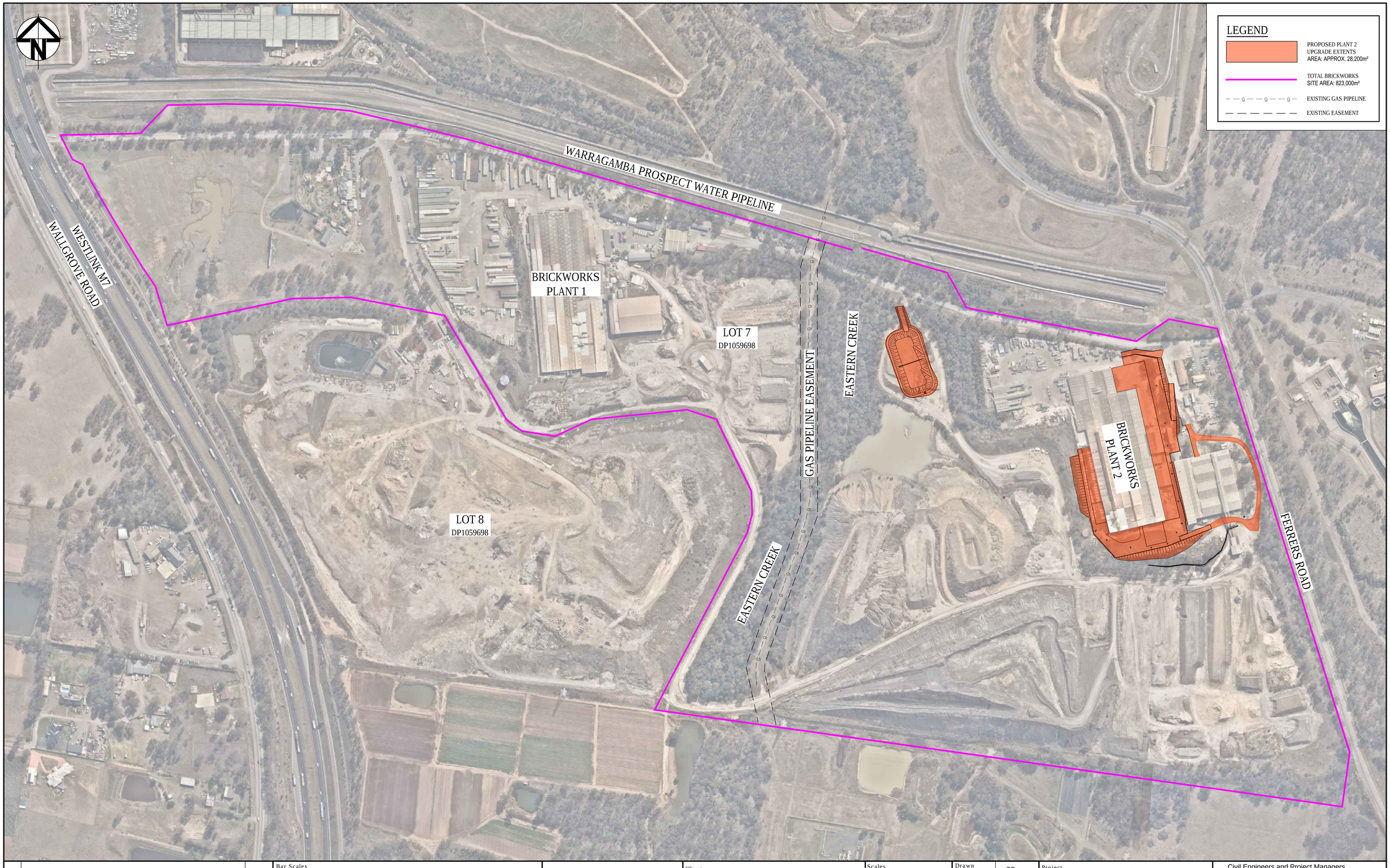
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC002	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:19PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC002.dwg



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

Bar Scales

0 50 100 150 200m

1 : 2500 @ A1

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: SITE CONTEXT PLAN

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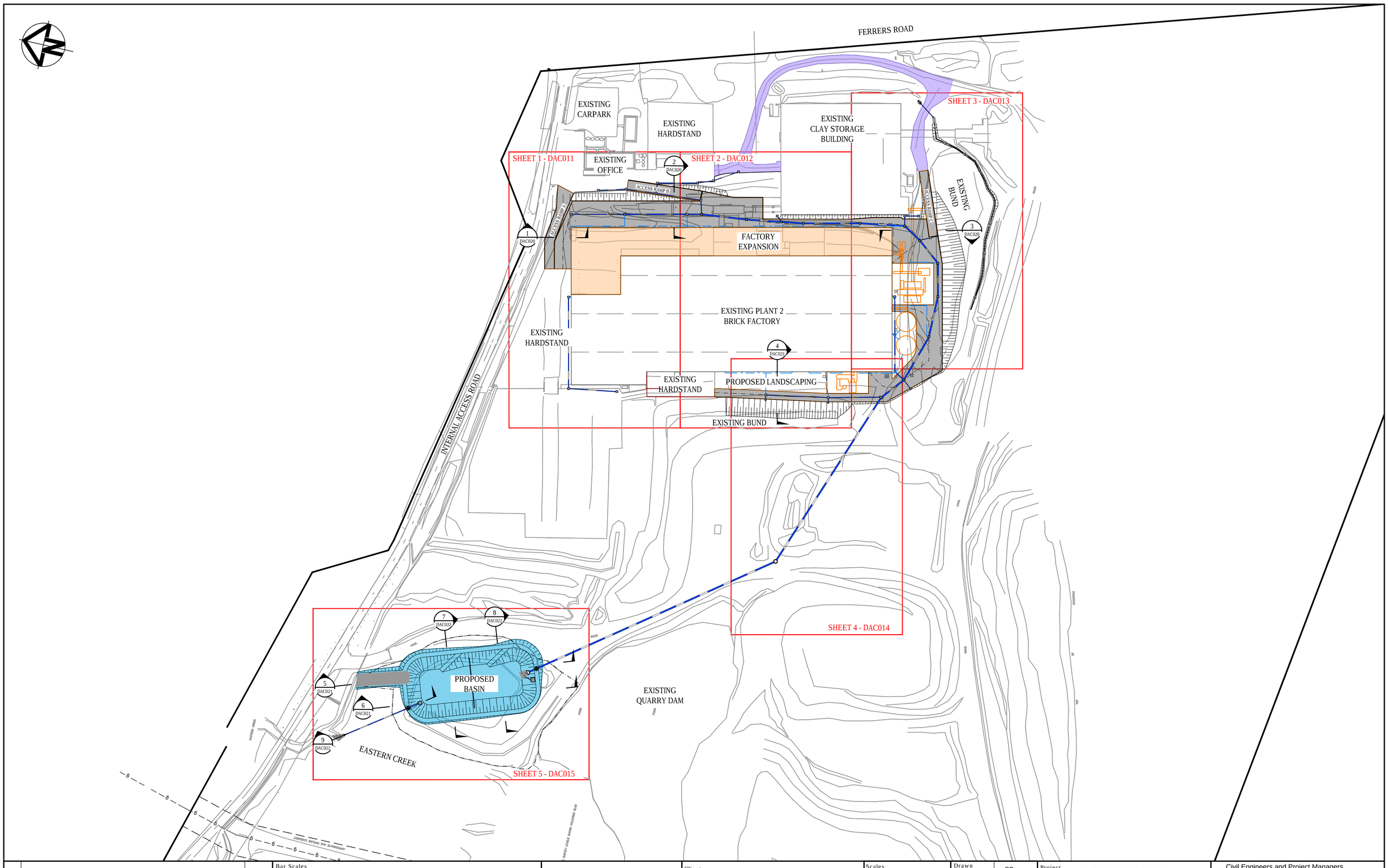
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC003	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:19PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC003.dwg



Issue	Description	Date
D	RE-ISSUED FOR DEVELOPMENT APPROVAL	20-03-20
C	ISSUED FOR DEVELOPMENT APPROVAL	10-05-19
B	ISSUED FOR REVIEW	09-04-19
A	ISSUED FOR INFORMATION	03-11-18

Bar Scales

0 25 50 75 100 125m

1 : 1250 @ A1 1 : 2500 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 1250

Grid: MGA

Height Datum: AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	SH

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: GENERAL ARRANGEMENT PLAN

Civil Engineers and Project Managers
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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC004	18-577	D

100mm on Original

Date Plotted: 25 Mar 2020 - 02:42PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC004.dwg

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED STORM WATER INLET PIT AND PIPE
- PROPOSED STORMWATER OUTLET HEADWALL WITH ENERGY DISSIPATOR
- GD — PROPOSED 300 WIDE HEAVY DUTY GRATED BOX DRAIN
- FP SS — PROPOSED Ø100 SUB SOIL DRAIN & FLUSHING POINT
- PROPOSED 600 WIDE DRAINAGE SWALE
- F 60.15 — FINISHED SURFACE LEVEL
- IL 59.50 — PROPOSED INVERT LEVEL
- KO — PROPOSED KERB ONLY
- PROPOSED W BEAM BARRIER
- PROPOSED CHAIN WIRE FENCE
- PROPOSED RETAINING WALL
- 60.2 — PROPOSED FINISHED SURFACE CONTOUR
- 60.1 — EXISTING SURFACE CONTOUR

7 DP 1059698

INTERNAL ACCESS ROAD

EXISTING HARDSTAND

PROPOSED RETAINING

F60.16

MATCH SMOOTHLY TO EXISTING LEVELS

1V:2H MAX. BATTERS

WALL RW06

ACCESS RAMP A

F61.07

F63.83

F65.31

F60.16

PROPOSED RETAINING

PROPOSED RETAINING

F63.75

F59.93

F60.07

WALL RW01

WALL RW02

F65.01

F60.10

F59.79

F60.10

F60.15

A/1

PROPOSED RETAINING WALL. REFER DWGs DAC042 - DAC046 FOR DETAILS

O/3

O/2

O/1

Ø525

Ø450

NEW SIPHONIC ROOFWATER DRAINAGE DOWNPIPES (DESIGN BY OTHERS)

NEW SIPHONIC ROOFWATER DRAINAGE DOWNPIPES (DESIGN BY OTHERS)

EAVE RL 66.15

RAILS

RAILS

RAILS

19.0m

F59.88

Ø450

1V:2H MAX. BATTERS

B/1

PROPOSED RETAINING WALL RW01

WEIGHBRIDGE

EXISTING OFFICE BUILDING

Ø375

CONSTRUCT NEW PIT OVER EXISTING STORMWATER PIPE

O/4

EAVE RL 63.73

EXISTING STORMWATER DRAINAGE TO REMAIN (DISCHARGES TO SWALE)

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

RIDGE RL 69.86

EXISTING PLANT 2
BRICK FACTORY
(ASSUMED FFL 60.15)

FACTORY EXPANSION
(FFL 60.15)

F59.78

A/2

B/2

MATCH SMOOTHLY TO EXISTING LEVELS

F65.32

F65.39

PROPOSED RETAINING WALL. REFER DWGs DAC042 - DAC046 FOR DETAILS

B/3

WALL RW03

M/4

ACCESS RAMP B

F59.90

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

RIDGE RL 69.86

EAVE RL 66.15

AWNING RL 64.03

EXISTING HARDSTAND

COURBOND SHED

1 DAC020

2 DAC020

SEE DWG. DAC 015 FOR ADJOINING INFORMATION

SEE DWG. DAC 012 FOR ADJOINING INFORMATION

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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 1

Civil Engineers and Project Managers
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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC011	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:20PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC011.dwg

SEE DWG. DAC 011 FOR ADJOINING INFORMATION

SEE DWG. DAC 015 FOR ADJOINING INFORMATION

SEE DWG. DAC 013 FOR ADJOINING INFORMATION

EXISTING BUND

EXISTING HARDSTAND

MATCH TO EXISTING

F60.12 F60.15 F60.17

KO

1V:2H MAX. BATTERS

6.0m

J/1 Ø300 F59.96 J/2

60.0

4 DAC021

RIDGE RL 69.86

EXISTING PLANT 2
BRICK FACTORY
(ASSUMED FFL 60.15)

RIDGE RL 69.86

RIDGE RL 69.86

EAVE RL 66.13

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

FACTORY EXPANSION
(FFL 60.15)

STAIRS

PETROL TANK

RIDGE RL 72.63

F59.80 A/3 19.0m 7.0m

Ø750

60.0 60.8 61.0 60.6 60.4 60.2

F60.15 Ø525 GD

F59.86 A/4 B/4 F60.30

FP

M/3

1V:2H MAX. BATTERS

Ø375

M/2

PROPOSED RETAINING WALL RW03

F59.93

Ø900

F60.30

M/1

EXISTING ROAD TO BE RE-SURFACED WITH GRAVEL PAVEMENT (SEE DWG. DAC 031 FOR DETAILS)

A/5 21.5m

F59.84

60.0 60.0 60.2

F60.00 F60.30

Ø900

WALL RW03

PROPOSED RETAINING WALL. REFER DWGs DAC042 - DAC046 FOR DETAILS

PROPOSED RETAINING

C/1

A/6

F59.95

Ø450

FP

CONSTRUCT NEW MANHOLE OVER EXISTING STORMWATER PIPE

EXISTING ROOFWATER DRAINAGE LINE FROM CLAY STORAGE BUILDING TO BE MAINTAINED

A/7

F59.86

60.0

Ø600

6.0m

F59.98

1V:2H MAX. BATTERS

RIDGE RL 79.18

EXISTING CLAY STORAGE BUILDING
(ASSUMED FFL 67.00)

PROPOSED BUND

PROPOSED LANDSCAPING

F60.06

Ø450

KO

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

K/1

K/2

L/1 Ø300 F60.08 60.0 F59.94 J/3

6.0m

1V:2H MAX. BATTERS

SCRUBBER

Ø600

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED STORM WATER INLET PIT AND PIPE
- PROPOSED STORMWATER OUTLET HEADWALL WITH ENERGY DISSIPATOR
- GD — PROPOSED 300 WIDE HEAVY DUTY GRATED BOX DRAIN
- FP SS — PROPOSED Ø100 SUB SOIL DRAIN & FLUSHING POINT
- PROPOSED 600 WIDE DRAINAGE SWALE
- F 60.15 — FINISHED SURFACE LEVEL
- IL 59.50 — PROPOSED INVERT LEVEL
- KO — PROPOSED KERB ONLY
- PROPOSED W BEAM BARRIER
- PROPOSED CHAIN WIRE FENCE
- PROPOSED RETAINING WALL
- 60.2 — PROPOSED FINISHED SURFACE CONTOUR
- 60.1 — EXISTING SURFACE CONTOUR

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

100mm on Original

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 250

Grid: MGA

Height Datum: AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 2

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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC012	18-577	C

Date Plotted: 13 Mar 2020 - 04:20PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC012.dwg

SEE DWG. DAC 014 FOR ADJOINING INFORMATION

SEE DWG. DAC 012 FOR ADJOINING INFORMATION

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

EXISTING PLANT 2
BRICK FACTORY
(ASSUMED FFL 60.15)

FACTORY EXPANSION
(FFL 60.15)

EXISTING CLAY STORAGE BUILDING
(ASSUMED FFL 67.00)

RIDGE RL 66.05

RIDGE RL 77.68

RIDGE RL 81.97

EAVE RL 74.20

NEW SIPHONIC ROOFWATER DRAINAGE DOWNPIPES (DESIGN BY OTHERS)

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

WALL RW04

1V:2H MAX. BATTERS

CONSTRUCT NEW MANHOLE OVER EXISTING STORMWATER PIPE

EXISTING ROOFWATER DRAINAGE LINE FROM CLAY STORAGE BUILDING TO BE MAINTAINED

RAINWATER TANK

RAINWATER TANK

CLAY BINS

PROPOSED RETAINING WALL. REFER DWGs DAC042 - DAC046 FOR DETAILS

MATCH TO EXISTING

EXISTING ACCESS RAMP

ACCESS RAMP C

PROPOSED RETAINING WALL RW05

PROPOSED INLET HEADWALL

PROPOSED CUT OFF SWALE
600 W x 100 H. 1V:2H BATTERS

PROPOSED OUTLET HEADWALL WITH ENERGY DISSIPATOR

EXISTING BUND

PROPOSED CUT OFF SWALE
600 W x 100 H. 1V:2H BATTERS

EAVE RL 68.50

RIDGE RL 78.11

EAVE RL 76.30

DP 1059698

3
DAC021

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED STORM WATER INLET PIT AND PIPE
- PROPOSED STORMWATER OUTLET HEADWALL WITH ENERGY DISSIPATOR
- GD — PROPOSED 300 WIDE HEAVY DUTY GRATED BOX DRAIN
- FP SS — PROPOSED Ø100 SUB SOIL DRAIN & FLUSHING POINT
- PROPOSED 600 WIDE DRAINAGE SWALE
- F 60.15 — FINISHED SURFACE LEVEL
- IL 59.50 — PROPOSED INVERT LEVEL
- KO — PROPOSED KERB ONLY
- PROPOSED W BEAM BARRIER
- PROPOSED CHAIN WIRE FENCE
- PROPOSED RETAINING WALL
- 60.2 — PROPOSED FINISHED SURFACE CONTOUR
- 60.1 — EXISTING SURFACE CONTOUR

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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 250

Grid: MGA

Height Datum: AHD

Drawn: QD

Designed: QD

Checked: SH

Approved:

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: SITEWORKS AND STORMWATER DRAINAGE PLAN
SHEET 3

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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC013	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:21PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC013.dwg

SEE DWG. DAC 015 FOR ADJOINING INFORMATION

SEE DWG. DAC 013 FOR ADJOINING INFORMATION

EXISTING OUTLET HEADWALL FROM PLANT 2 DRAINAGE

NEW Ø1800 JUNCTION MANHOLE WITH CLASS D COVER

A/16

Ø1200

Ø1200

EXISTING ACCESS TRACK

EXISTING BUND

PROPOSED LANDSCAPING

J/1

J/2

J/3

K/1

K/2

L/1

A/15

4 DAC021

1/3

Ø300 IF59.99

F60.0

Ø450

F60.06

KO

EXISTING STORMWATER DRAINAGE TO BE DEMOLISHED/ABANDONED

F60.08

Ø300

F59.94

6.0m

SCRUBBER

1V:2H MAX. BATTERS

Ø600

F60.04

F60.10

F60.10

21.6m

F59.94

F59.97

OSD TANK

F60.02

Ø1800

F59.92

F60.10

F60.10

F59.87

Ø600

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED STORM WATER INLET PIT AND PIPE
- PROPOSED STORMWATER OUTLET HEADWALL WITH ENERGY DISSIPATOR
- GD — PROPOSED 300 WIDE HEAVY DUTY GRATED BOX DRAIN
- FP SS — PROPOSED Ø100 SUB SOIL DRAIN & FLUSHING POINT
- PROPOSED 600 WIDE DRAINAGE SWALE
- F 60.15 — FINISHED SURFACE LEVEL
- IL 59.50 — PROPOSED INVERT LEVEL
- KO — PROPOSED KERB ONLY
- PROPOSED W BEAM BARRIER
- PROPOSED CHAIN WIRE FENCE
- PROPOSED RETAINING WALL
- 60.2 — PROPOSED FINISHED SURFACE CONTOUR
- 60.1 — EXISTING SURFACE CONTOUR

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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 4

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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC014	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:21PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC014.dwg

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED STORM WATER INLET PIT AND PIPE
- PROPOSED STORMWATER OUTLET HEADWALL WITH ENERGY DISSIPATOR
- GD — PROPOSED 300 WIDE HEAVY DUTY GRATED BOX DRAIN
- FP SS — PROPOSED Ø100 SUB SOIL DRAIN & FLUSHING POINT
- PROPOSED 600 WIDE DRAINAGE SWALE
- F 60.15 — FINISHED SURFACE LEVEL
- IL 59.50 — PROPOSED INVERT LEVEL
- KO — PROPOSED KERB ONLY
- PROPOSED W BEAM BARRIER
- PROPOSED CHAIN WIRE FENCE
- PROPOSED RETAINING WALL
- 60.2 — PROPOSED FINISHED SURFACE CONTOUR
- 60.1 — EXISTING SURFACE CONTOUR

INSTALL 3.0m-WIDE CONCRETE MAINTENANCE ACCESS RAMP AT MAX. 1V:6H GRADIENT.

INSTALL 3.0m-WIDE CONCRETE MAINTENANCE ACCESS RAMP AT MAX. 1V:6H GRADIENT.

EXTENT OF EXISTING CLAY STOCKPILE REMOVAL

1 IN 4 CUT SLOPE TYPICAL

EXISTING ACCESS TRACK

SEE DWG. DAC 012 FOR ADJOINING INFORMATION

HAUL

1 IN 4 FILL SLOPE TYPICAL

PROPOSED EMERGENCY SPILLWAY AT RL56.60 WITH ROCK-LINED SCOUR PROTECTION. FLOWS TO DISCHARGE TO EXISTING OPEN DRAIN

3.0m WIDE ACCESS BERM RL57.10

GROSS POLLUTANT TRAP OCEANSAVE OS1515 OR APPROVED EQUIVALENT

Ø1200

EXISTING QUARRY ENTRY ROAD

IL54.70

INTERNAL CONCRETE WEIR/LEVEL SPREADER TOP RL55.70

PROPOSED SEDIMENT BASIN

A/17

PROPOSED HEADWALL

AUTOMATED FLOCCULANT DOSING UNIT

3% FALL

6.6m

1 IN 4 BATTER SLOPE (TYPICAL)

PROPOSED STORMWATER DETENTION BASIN

25.0m

37.0m

35.9m

1 IN 4 BATTER SLOPE TYPICAL

EXISTING OPEN DRAIN

PROPOSED ENERGY DISSIPATER

P/1

PROPOSED 1200x1200 STORMWATER CONTROL PIT

Ø525

JELLYFISH FILTER UNIT JF3250-12-2 OR APPROVED EQUIVALENT

3.0m WIDE ACCESS BERM RL57.10

POND

P/2

NEW Ø525 RCP TO BE INSTALLED BY PIPE JACKING UNDERNEATH EXISTING VEGETATION

EXISTING QUARRY DAM

PROPOSED OUTLET HEADWALL WITH SCOUR PROTECTION/ENERGY DISSIPATOR TO PREVENT EROSION OF EASTERN CREEK

EASTERN CREEK

EXISTING CLAY STOCKPILE TO BE REMOVED

5 DAC021 · 6 DAC021 · 7 DAC022 · 8 DAC022 · 9 DAC022

Issue	Description	Date
D	RE-ISSUED FOR DEVELOPMENT APPROVAL	20-03-20
C	ISSUED FOR DEVELOPMENT APPROVAL	10-05-19
B	ISSUED FOR REVIEW	09-04-19
A	ISSUED FOR INFORMATION	03-11-18

100mm on Original

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: SITEWORKS AND STORMWATER DRAINAGE PLAN SHEET 5

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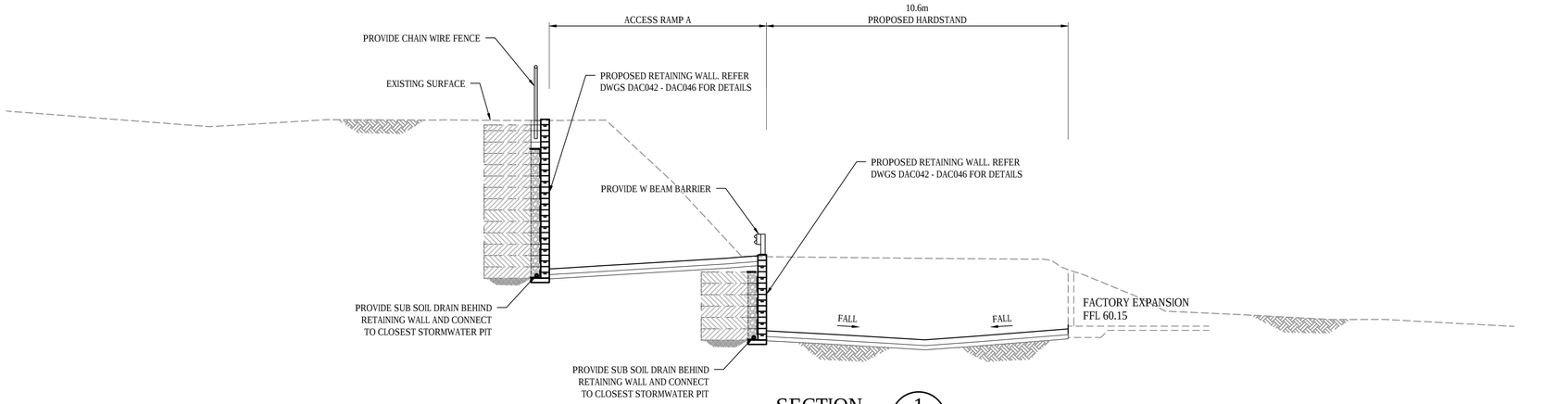
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

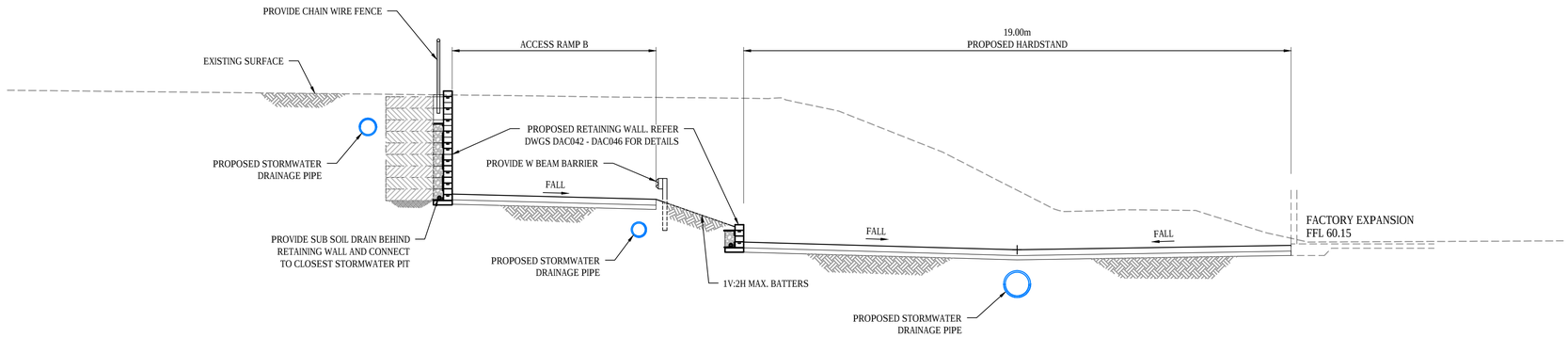
A1

Drawing No.	Project No.	Issue
DAC015	18-577	D

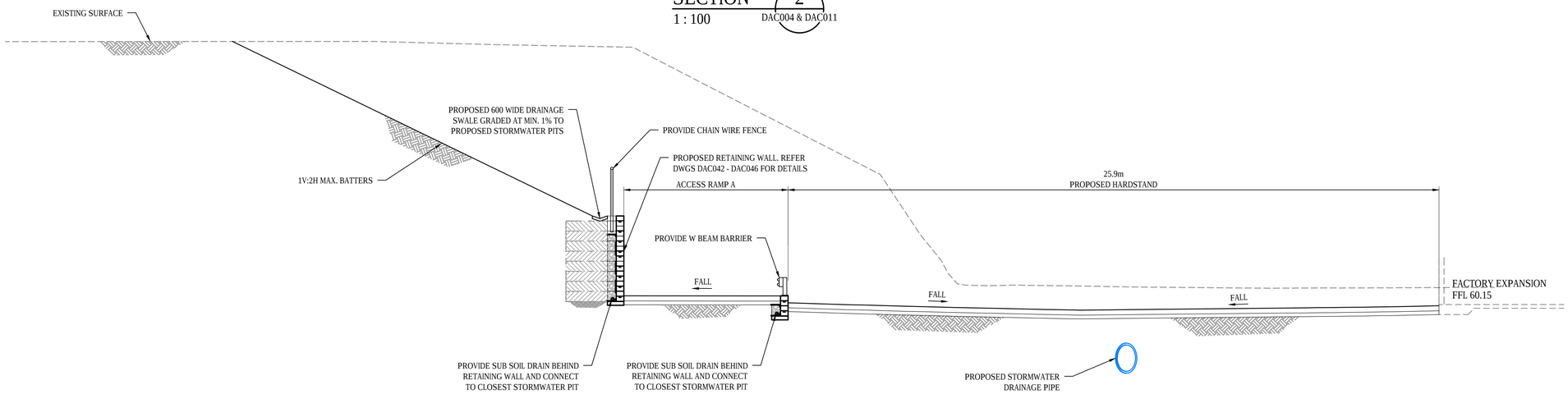
Date Plotted: 25 Mar 2020 - 02:33PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC015.dwg



SECTION 1
1 : 100
DAC004 & DAC011



SECTION 2
1 : 100
DAC004 & DAC011



SECTION 3
1 : 100
DAC004 & DAC013

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

Bar Scales

0 2 4 6 8 10m

1 : 100 @ A1 1 : 200 @ A3

Client: BRICKWORKS LIMITED

Scales	1 : 100
Grid	MGA
Height Datum	AHD
Drawn	QD
Designed	QD
Checked	SH
Approved	

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: TYPICAL SECTIONS SHEET 1

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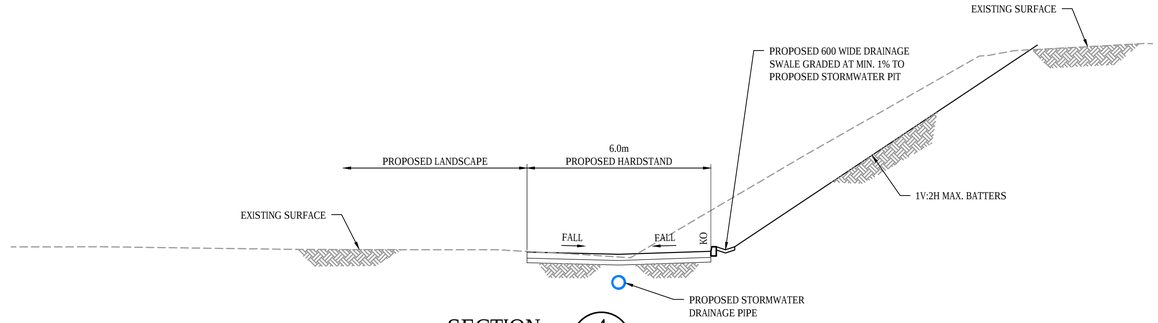
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

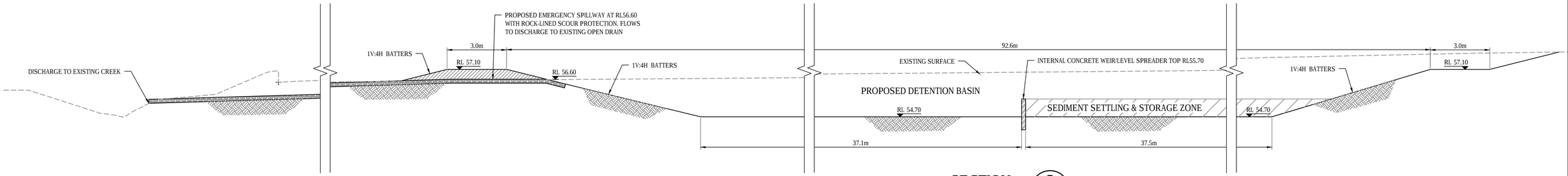
Drawing No.	Project No.	Issue
DAC020	18-577	C

100mm on Original

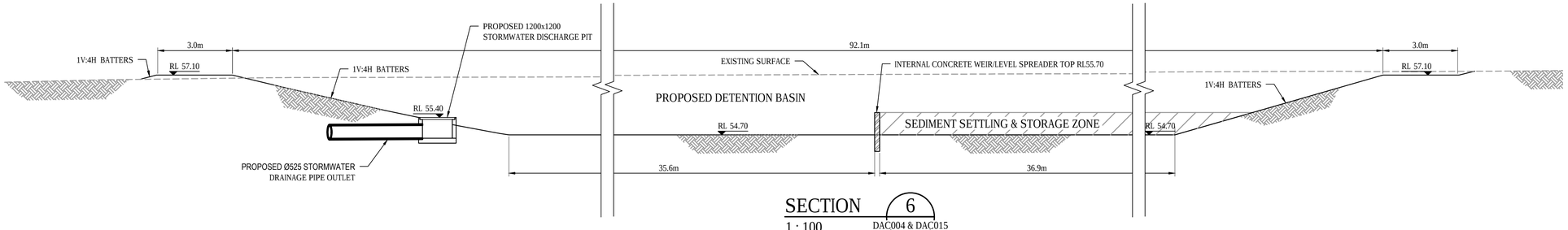
Date Plotted: 13 Mar 2020 - 04:21PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC020.dwg



SECTION 4
1 : 100
DAC004 & DAC012



SECTION 5
1 : 100
DAC004 & DAC015



SECTION 6
1 : 100
DAC004 & DAC015

Issue	Description	Date
D	RE-ISSUED FOR DEVELOPMENT APPROVAL	20-03-20
C	ISSUED FOR DEVELOPMENT APPROVAL	10-05-19
B	ISSUED FOR REVIEW	09-04-19
A	ISSUED FOR INFORMATION	03-11-18

Bar Scales

0 2 4 6 8 10m

1 : 100 @ A1 1 : 200 @ A3

Client: BRICKWORKS LIMITED

Scales	1 : 100
Grid	MGA
Height Datum	AHD
Drawn	QD
Designed	QD
Checked	SH
Approved	SH

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: TYPICAL SECTIONS SHEET 2

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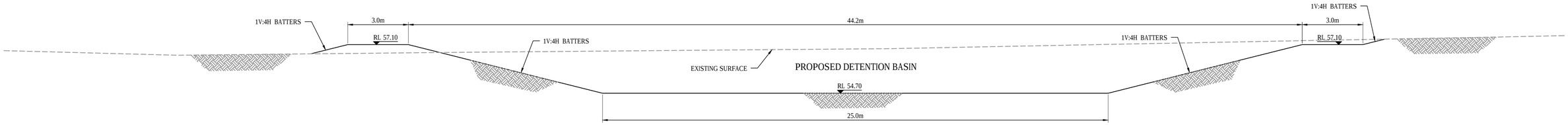
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

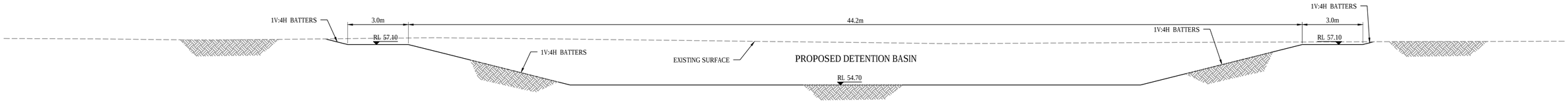
Drawing No.	Project No.	Issue
DAC021	18-577	D

100mm on Original

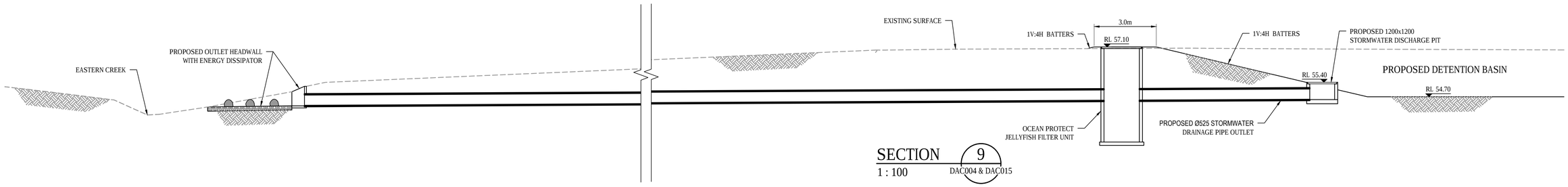
Date Plotted: 25 Mar 2020 - 02:29PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC021.dwg



SECTION 7
1 : 100
DAC004 & DAC015



SECTION 8
1 : 100
DAC004 & DAC015



SECTION 9
1 : 100
DAC004 & DAC015

Issue	Description	Date
D	RE-ISSUED FOR DEVELOPMENT APPROVAL	20-03-20
C	ISSUED FOR DEVELOPMENT APPROVAL	10-05-19
B	ISSUED FOR REVIEW	09-04-19
A	ISSUED FOR INFORMATION	03-11-18

Bar Scales

0 2 4 6 8 10m

1 : 100 @ A1 1 : 200 @ A3

Client: BRICKWORKS LIMITED

Scales	1 : 100	Drawn	QD
		Designed	QD
Grid	MGA	Checked	SH
Height Datum	AHD	Approved	SH

Project
BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title
TYPICAL SECTIONS
SHEET 3

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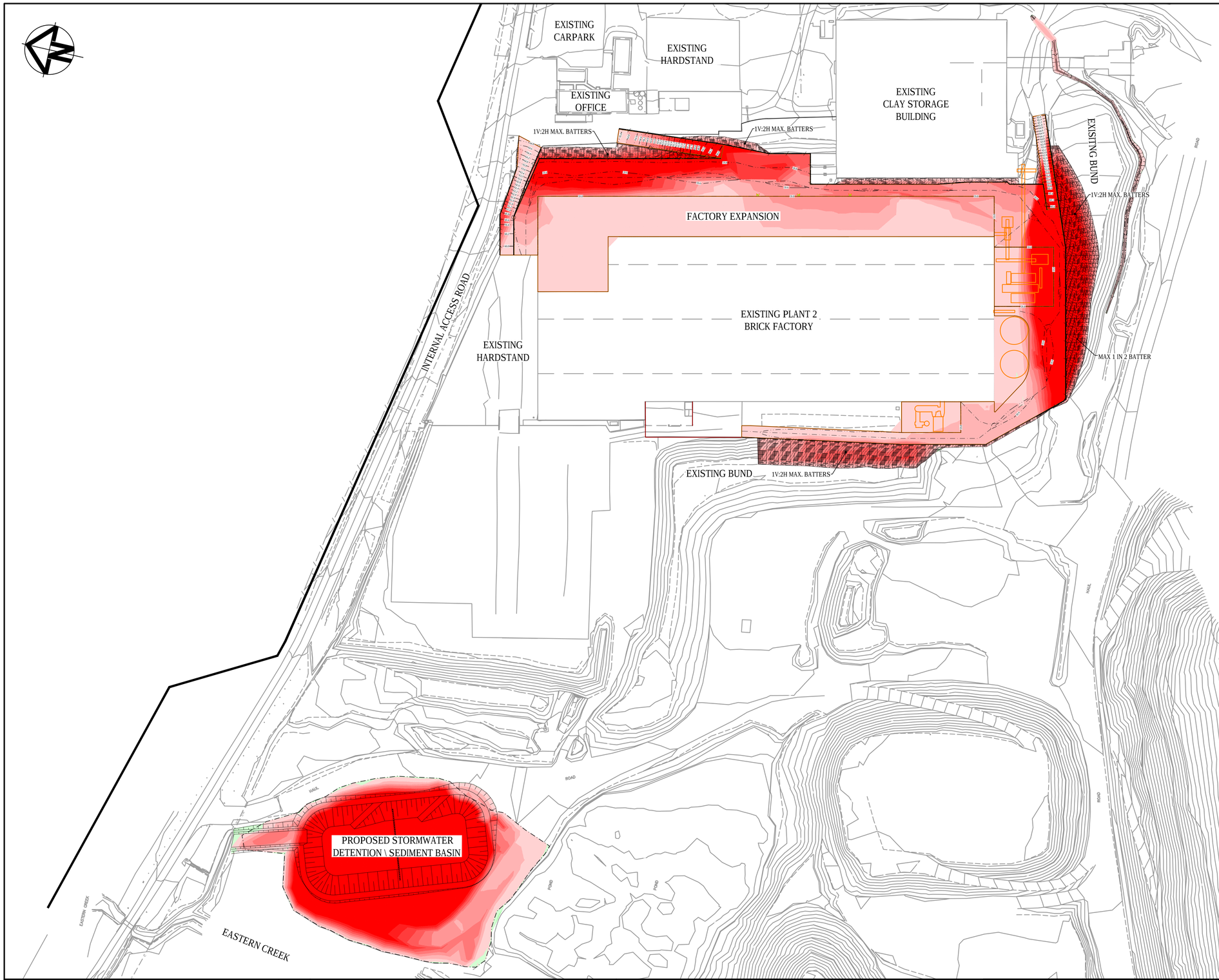
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC022	18-577	D

100mm on Original

Date Plotted: 25 Mar 2020 - 02:41PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC022.dwg



NOTES

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

EARTHWORKS VOLUMES

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

LEGEND

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

EARTHWORKS CUT/FILL LEGEND

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

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

Bar Scales

0 20 40 60 80 100m

1 : 1000 @ A1 1 : 2000 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 1000

Grid: MGA

Height Datum: AHD

Drawn: QD

Designed: QD

Checked: SH

Approved:

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: BULK EARTHWORKS CUT/FILL PLAN

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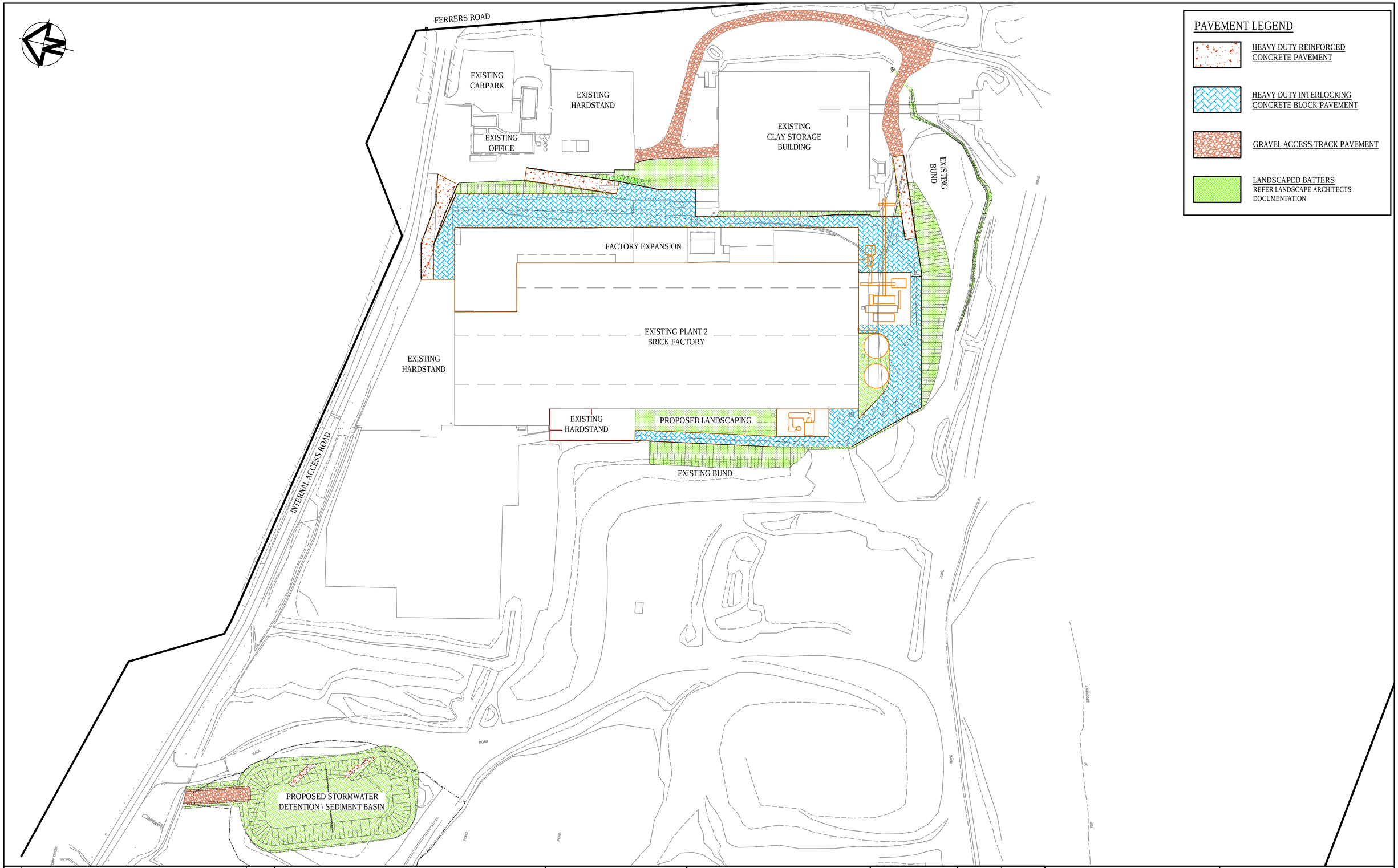
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC030	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:22PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC030.dwg



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

100mm on Original

Bar Scales

0 15 30 45 60 75m

1 : 750 @ A1 1 : 1500 @ A3

Client

BRICKWORKS LIMITED

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

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

PAVEMENT PLAN

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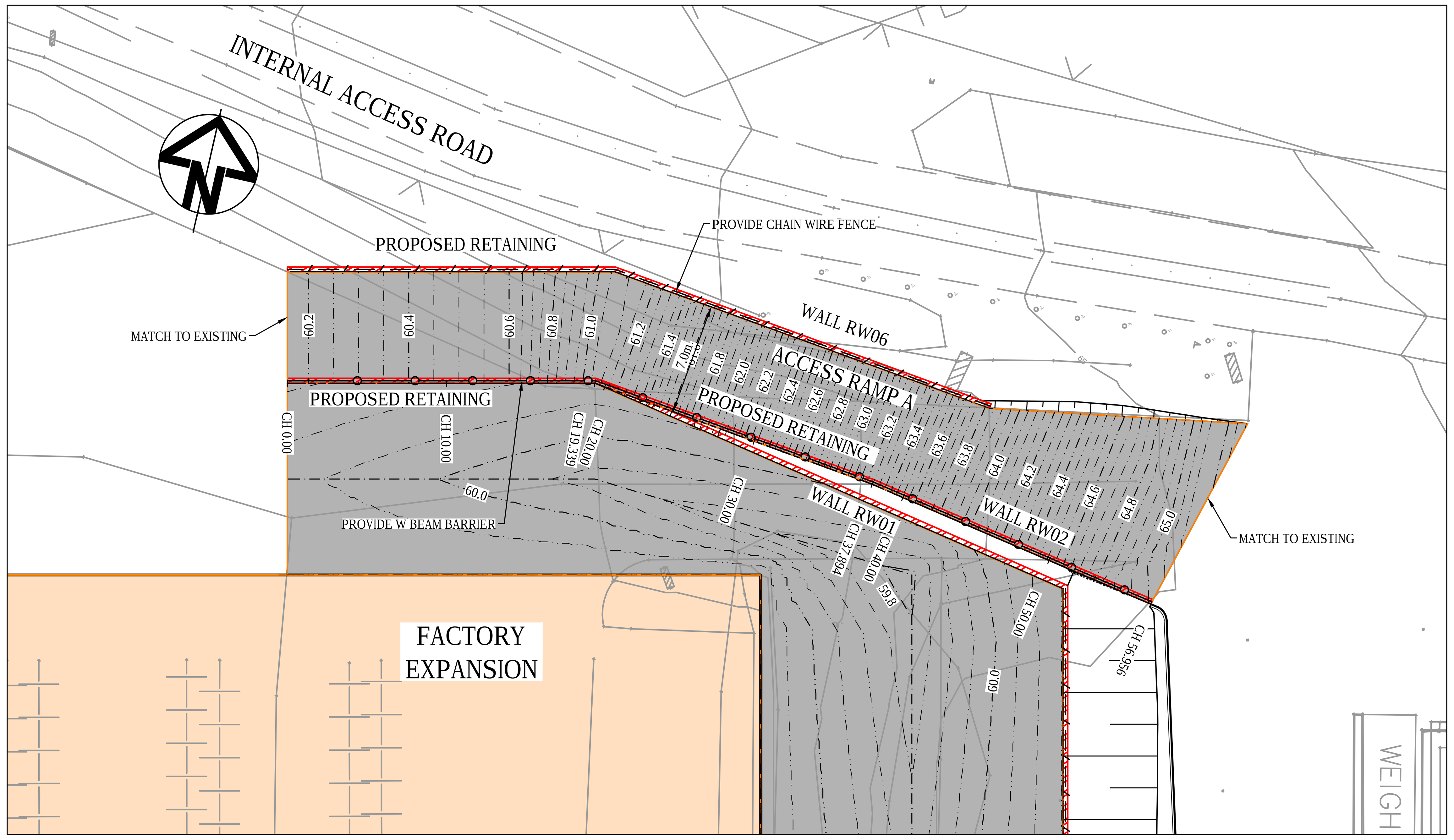
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

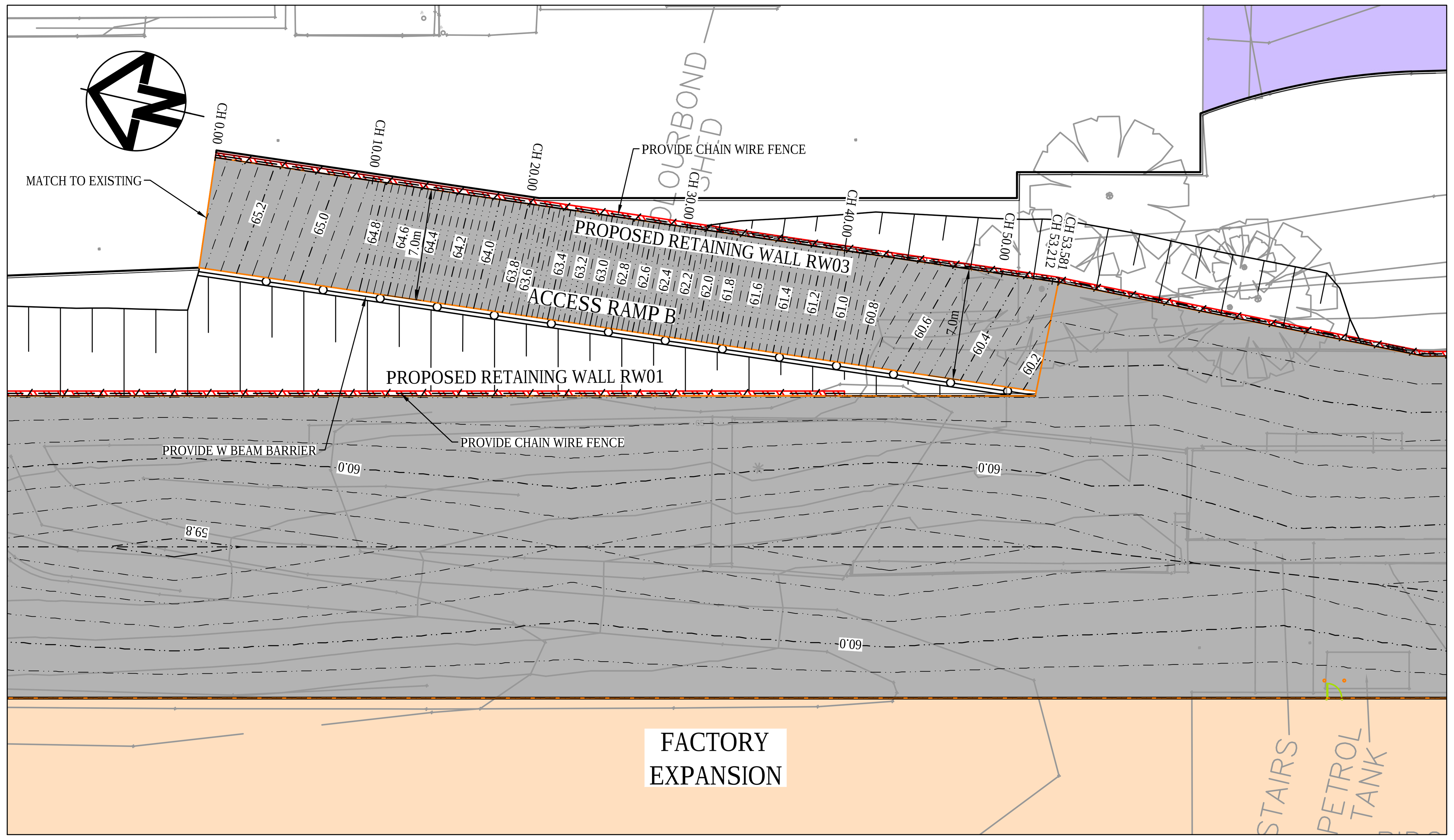
A1

Drawing No.	Project No.	Issue
DAC031	18-577	C

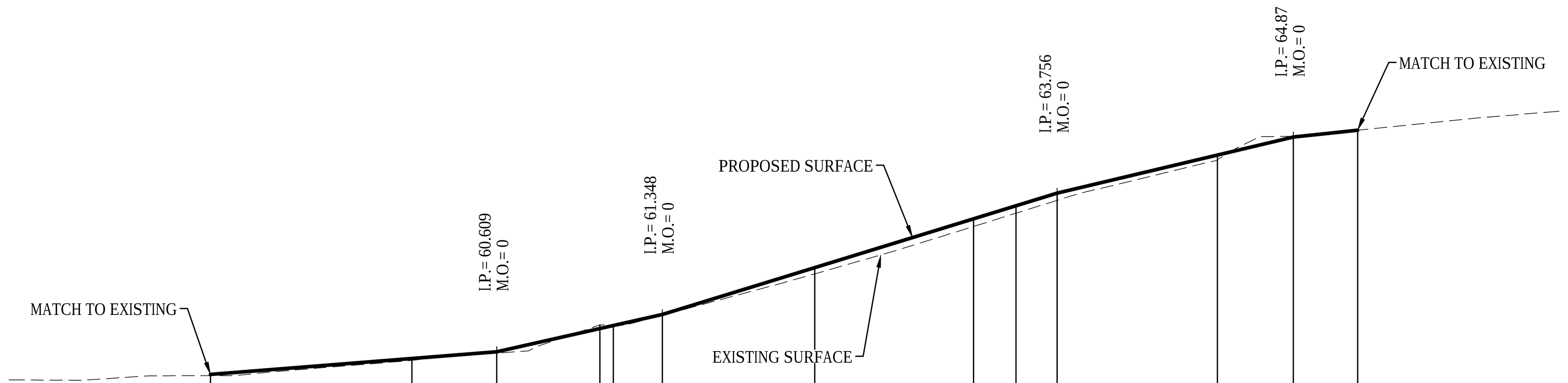
Date Plotted: 13 Mar 2020 - 04:22PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC031.dwg



ACCESS RAMP A
1 : 250



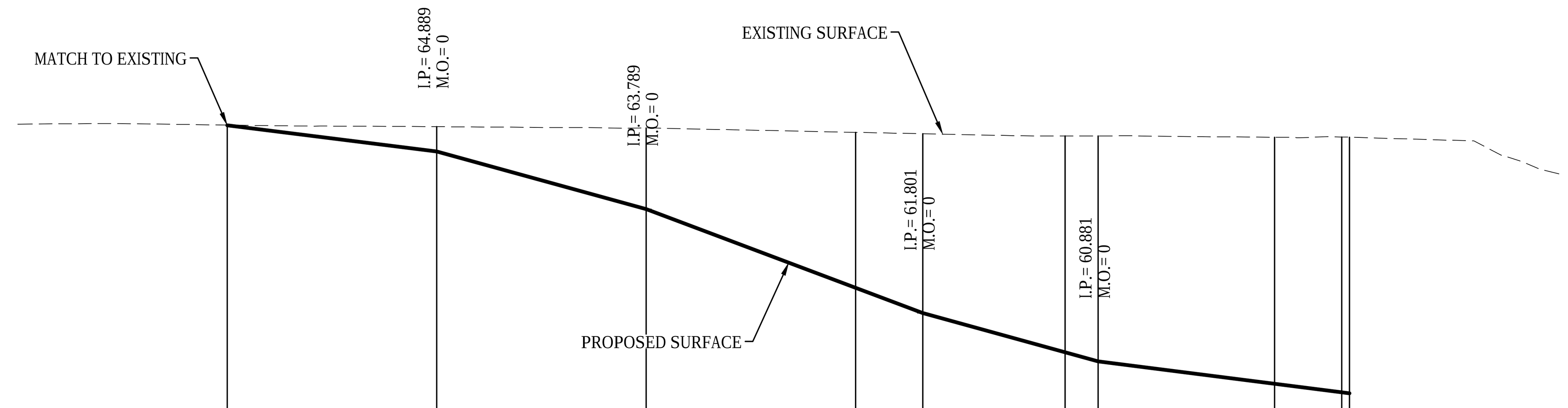
ACCESS RAMP B
1 : 250



HORIZONTAL													
VC LENGTH													
GRADE	3.2%		9%			12.3%				9.5%		4.3%	
Datum RL54													
PROPOSED SURFACE LEVEL	60.158	60.475	60.609	61.070	61.129	61.348	62.277	63.247	63.506	63.756	64.512	64.870	65.006
EXISTING SURFACE LEVEL	60.134	60.439	60.582	61.142	61.138	61.333	62.155	63.096	63.360	63.616	64.424	64.885	65.006
CHAINAGE	0.000	10.000	14.220	19.339	20.000	22.433	30.000	37.894	40.000	42.042	50.000	53.759	56.956

TP

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



HORIZONTAL										
VC LENGTH										
GRADE	-5%	-11%	-15%		-11%		-5.1%			
Datum RL54										
PROPOSED SURFACE LEVEL	65.389	64.889	63.789	62.285	61.801	61.055	60.881	60.453	60.290	60.271
EXISTING SURFACE LEVEL	65.393	65.361	65.338	65.253	65.227	65.184	65.185	65.160	65.165	65.160
CHAINAGE	0.000	10.000	20.000	30.000	33.212	40.000	41.581	50.000	53.212	53.581

TP

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

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

Bar Scales
0 2 4 6 8 10m
1 : 100 @ A1 1 : 200 @ A3
0 5 10 15 20 25m
1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: ACCESS RAMPS LONGITUDINAL SECTIONS SHEET 1

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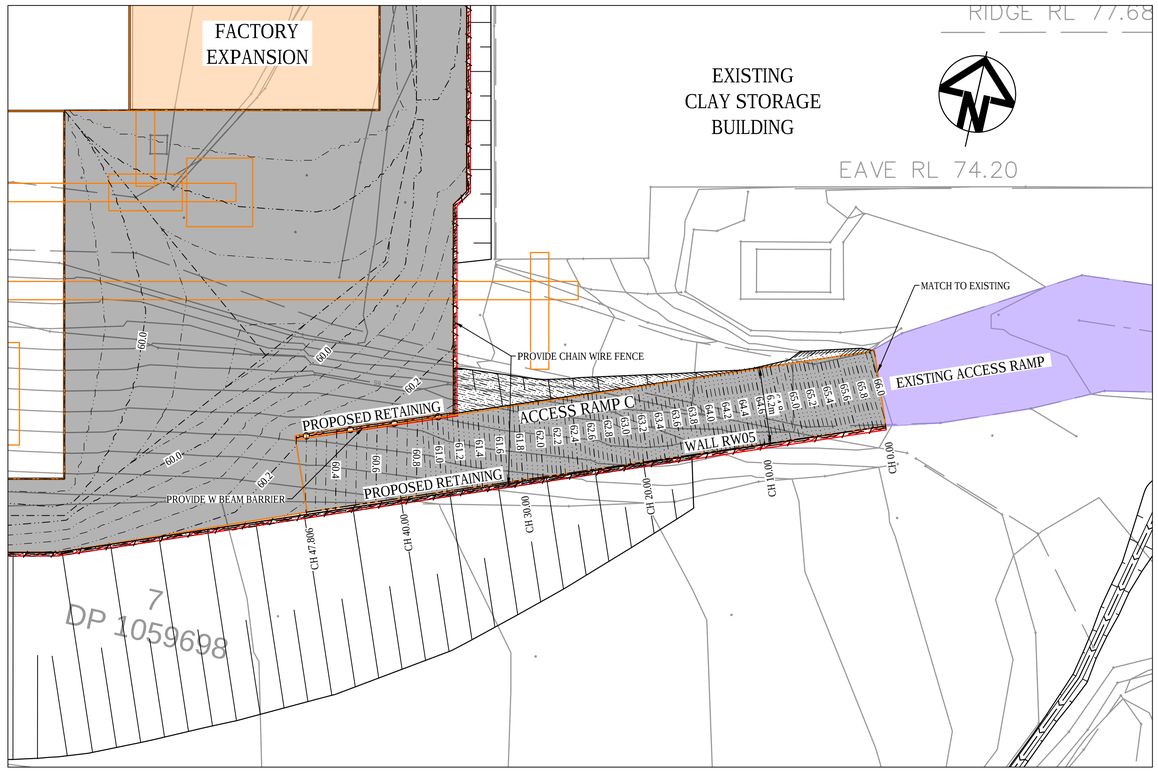
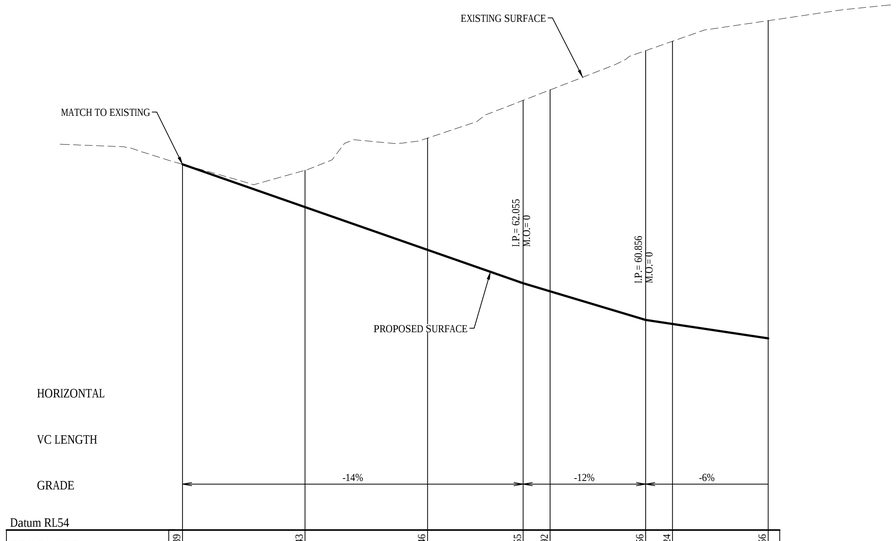
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION
A1
Drawing No. DAC035 | Project No. 18-577 | Issue C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:22PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC035.dwg



ACCESS RAMP C
1 : 250



PROPOSED SURFACE LEVEL	65.939	64.543	63.146	62.055	61.792	60.856	60.724	60.256
EXISTING SURFACE LEVEL	65.939	65.744	66.792	68.026	68.366	69.646	69.955	70.626
CHAINAGE	0.000	10.000	20.000	27.806	30.000	37.802	40.000	47.806

TP

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

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

Bar Scales

0 2 4 6 8 10m
1 : 100 @ A1 1 : 200 @ A3

0 5 10 15 20 25m
1 : 250 @ A1 1 : 500 @ A3

Client
BRICKWORKS LIMITED

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

Project
BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title
ACCESS RAMPS
LONGITUDINAL SECTIONS
SHEET 2

Civil Engineers and Project Managers
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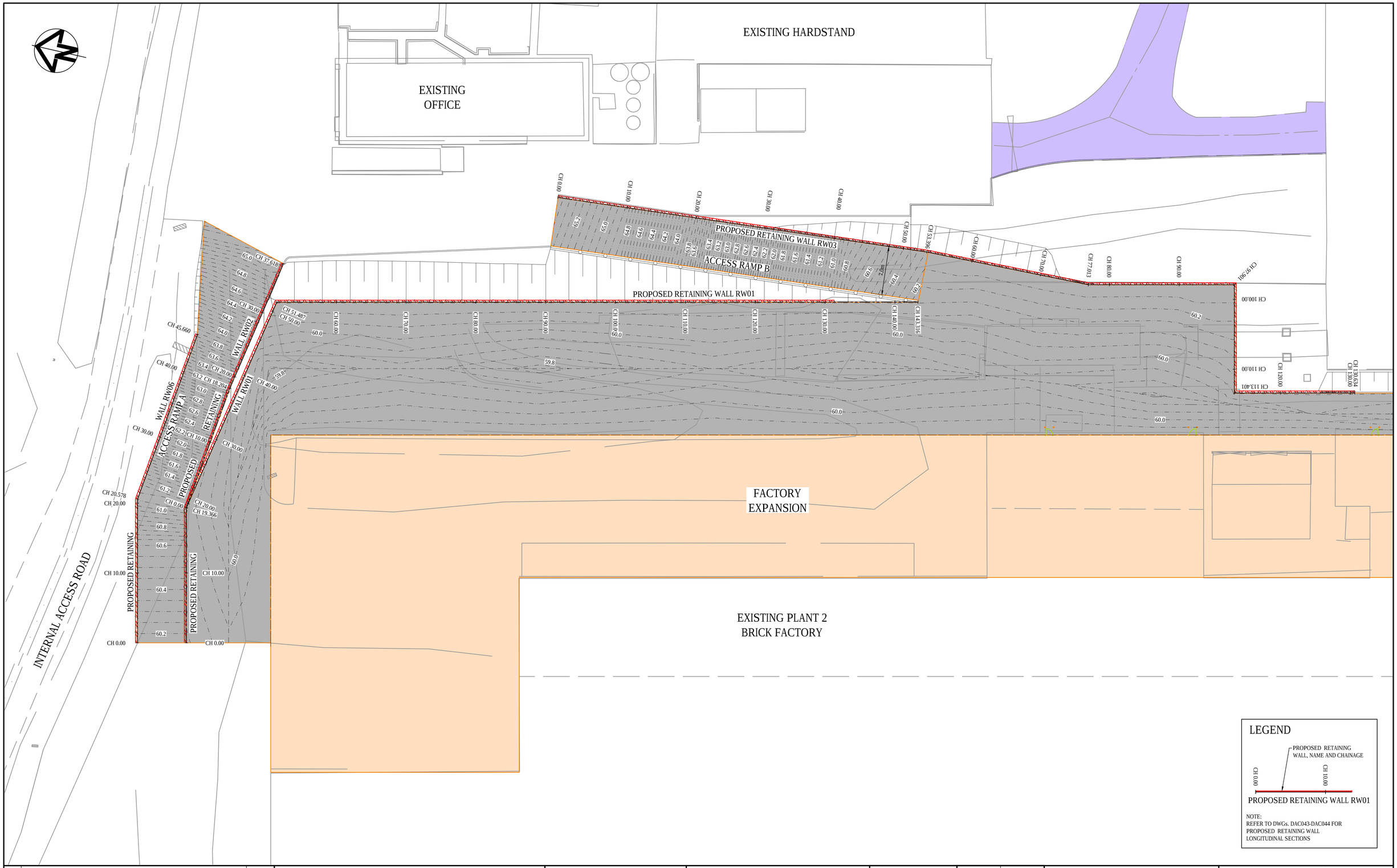
Status
FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC036	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:23PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC036.dwg



LEGEND

PROPOSED RETAINING WALL, NAME AND CHAINAGE

(CH 0.00) — (CH 110.00)

PROPOSED RETAINING WALL RW01

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

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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: RETAINING WALL PLAN SHEET 1

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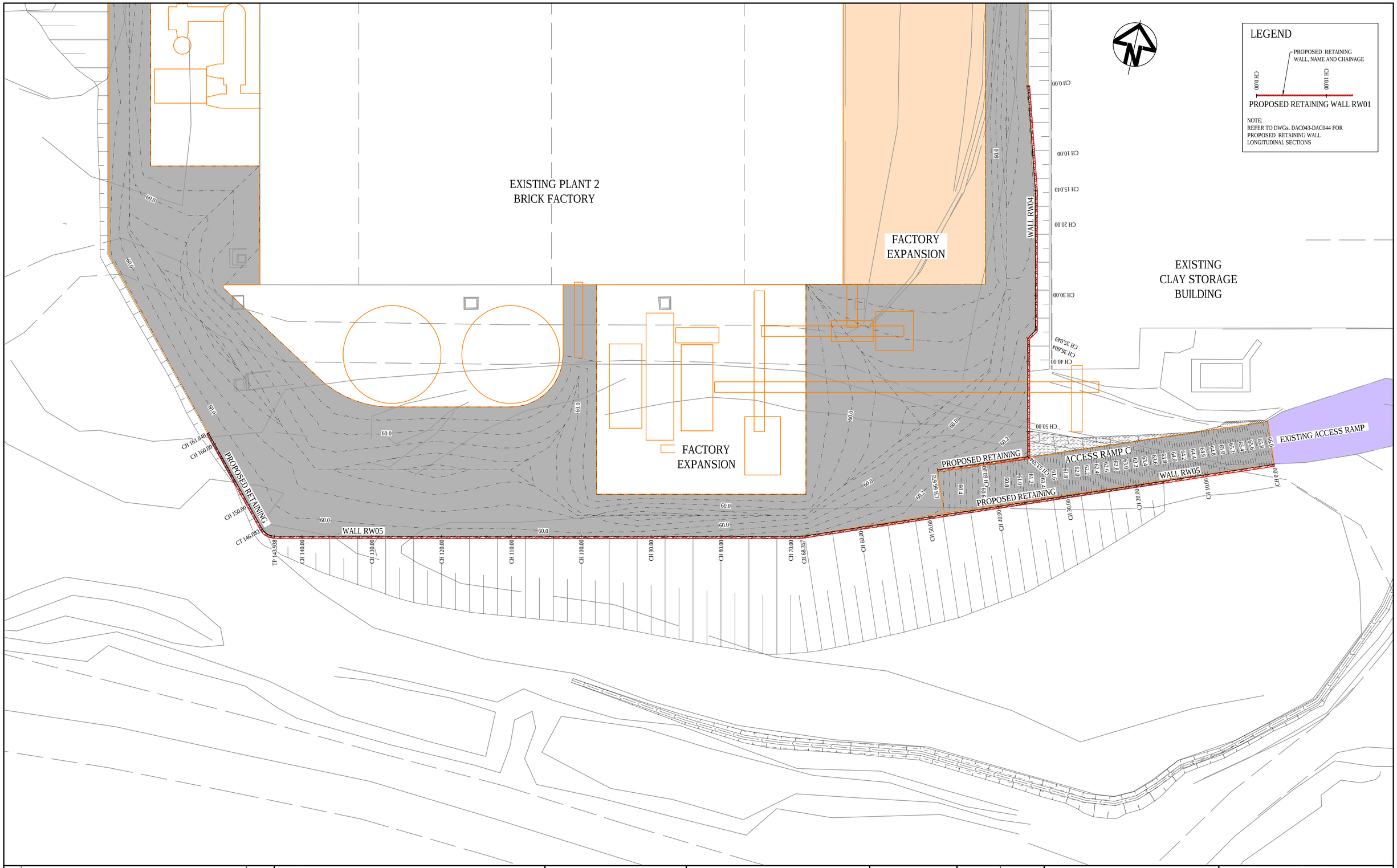
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC041	18-577	C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:23PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC041.dwg



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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: RETAINING WALL PLAN SHEET 2

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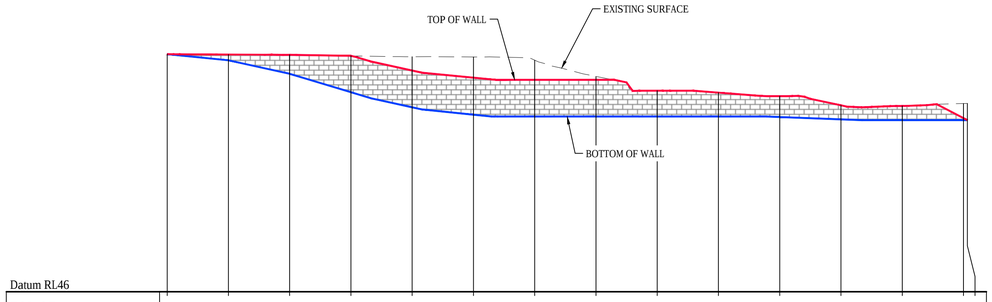
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC042	18-577	C

100mm on Original

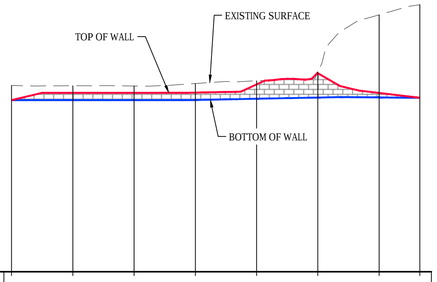
Date Plotted: 13 Mar 2020 - 04:23PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC042.dwg



Datum RL46														
TOP OF RETAINING WALL	65.39	65.36	65.34	65.25	64.05	63.45	63.30	63.30	62.41	62.25	61.96	61.22	61.16	60.17	60.00
BOTTOM OF RETAINING WALL	65.39	64.89	63.79	62.28	61.05	60.45	60.30	60.30	60.30	60.30	60.26	60.07	60.00	60.00	60.00
HEIGHT OF RETAINING WALL	-0.00	-0.47	-1.55	-2.97	-3.00	-3.00	-3.00	-3.00	-2.11	-1.95	-1.70	-1.15	-1.16	-0.16	0.00
EXISTING SURFACE LEVEL	65.39	65.36	65.34	65.25	65.18	65.16	64.90	63.58	62.41	62.25	61.96	61.22	61.16	61.36	61.37
CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	130.634

RETAINING WALL RW03 PROFILE

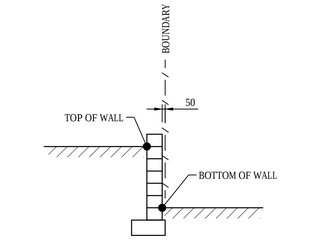
SCALE 1:500 HORI.
1:250 VERT.



Datum RL46							
TOP OF RETAINING WALL	60.00	60.60	60.60	60.62	61.29	62.20	60.59	60.19
BOTTOM OF RETAINING WALL	60.00	60.00	60.00	60.02	60.12	60.22	60.23	60.19
HEIGHT OF RETAINING WALL	0.00	-0.60	-0.60	-0.60	-1.17	-1.98	-0.37	0.00
EXISTING SURFACE LEVEL	61.21	61.18	61.16	61.36	61.58	62.30	66.97	67.79
CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	66.655

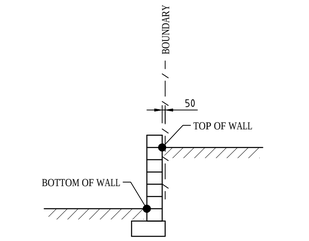
RETAINING WALL RW04 PROFILE

SCALE 1:500 HORI.
1:250 VERT.



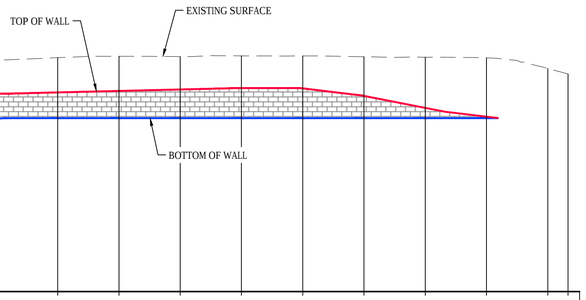
TYPICAL RETAINING WALL SETOUT DETAIL - IN FILL

1 : 50



TYPICAL RETAINING WALL SETOUT DETAIL - IN CUT

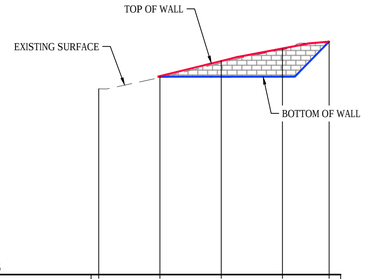
1 : 50



Datum RL46															
TOP OF RETAINING WALL	60.16	60.48	61.13	62.15	62.15	62.15	62.25	62.37	62.49	62.61	62.58	61.97	60.99	60.27	60.07	60.07
BOTTOM OF RETAINING WALL	60.16	60.12	60.15	60.04	59.96	60.12	60.15	60.15	60.15	60.15	60.15	60.15	60.15	60.15	60.15	60.15
HEIGHT OF RETAINING WALL	-0.00	-0.36	-0.98	-2.11	-2.19	-2.04	-2.10	-2.22	-2.34	-2.45	-2.43	-1.82	-0.84	-0.12	0.08	0.08
EXISTING SURFACE LEVEL	60.13	60.44	61.13	62.12	63.31	64.83	65.09	65.20	65.18	65.23	65.23	65.16	65.12	65.07	64.21	63.76
CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	143.316

RETAINING WALL RW01 PROFILE

SCALE 1:500 HORI.
1:250 VERT.



Datum RL46					
TOP OF RETAINING WALL	61.07	62.20	63.42	64.45	65.01
BOTTOM OF RETAINING WALL	60.08	62.15	62.15	62.15	65.01
HEIGHT OF RETAINING WALL	-0.99	-0.04	-1.27	-2.30	0.00
EXISTING SURFACE LEVEL	61.15	62.08	63.28	64.35	65.01
CHAINAGE	0.000	10.000	20.000	30.000	37.618

RETAINING WALL RW02 PROFILE

SCALE 1:500 HORI.
1:250 VERT.

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

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

0 10 20 30 40 50m

1 : 500 @ A1 1 : 1000 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: RETAINING WALL PROFILE SHEET 1

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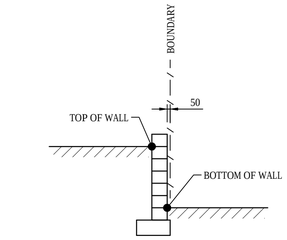
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC043	18-577	C

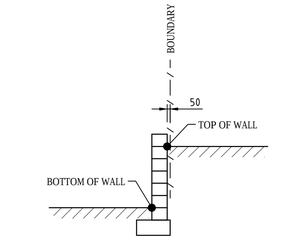
100mm on Original

Date Plotted: 13 Mar 2020 - 04:23PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC043.dwg



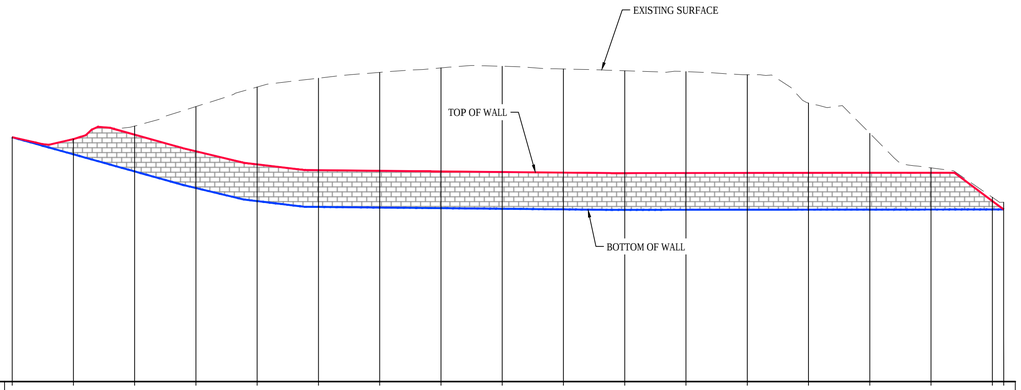
TYPICAL RETAINING WALL SETOUT
DETAIL - IN FILL

1 : 50



TYPICAL RETAINING WALL SETOUT
DETAIL - IN CUT

1 : 50

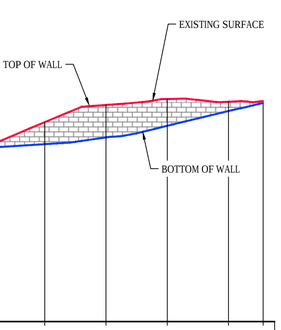


Datum RL46

TOP OF RETAINING WALL	65.94	65.79	66.15	64.79	63.72	63.25	63.20	63.15	63.10	63.05	63.01	63.02	63.02	63.03	63.03	63.04	60.74 60.04
BOTTOM OF RETAINING WALL	65.94	64.54	63.15	61.79	60.72	60.25	60.20	60.15	60.10	60.05	60.01	60.02	60.02	60.03	60.03	60.04	60.04 60.04
HEIGHT OF RETAINING WALL	-0.00	-1.24	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-0.69 0.00
EXISTING SURFACE LEVEL	65.94	65.79	66.85	68.44	70.03	70.76	71.23	71.60	71.73	71.51	71.36	71.29	71.04	68.73	66.26	63.44	61.04 60.63
CHAINAGE	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000 161.948

RETAINING WALL RW05 PROFILE

SCALE 1:500 HORI.
1:250 VERT.



Datum RL46

TOP OF RETAINING WALL	60.16	62.27	63.67	64.16	63.93	64.00
BOTTOM OF RETAINING WALL	60.16	60.48	61.03	61.97	63.18	63.83
HEIGHT OF RETAINING WALL	0.00	-1.80	-2.64	-2.19	-0.76	-0.18
EXISTING SURFACE LEVEL	60.16	62.27	63.67	64.16	63.93	64.00
CHAINAGE	0.000	10.000	20.000	30.000	40.000	45.660

RETAINING WALL RW06 PROFILE

SCALE 1:500 HORI.
1:250 VERT.

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

100mm on Original

Bar Scales

0 5 10 15 20 25m

1 : 250 @ A1 1 : 500 @ A3

0 10 20 30 40 50m

1 : 500 @ A1 1 : 1000 @ A3

Client

BRICKWORKS LIMITED

Scales 1 : 500H 1 : 250V

Grid MGA

Height Datum AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

RETAINING WALL PROFILE
SHEET 2

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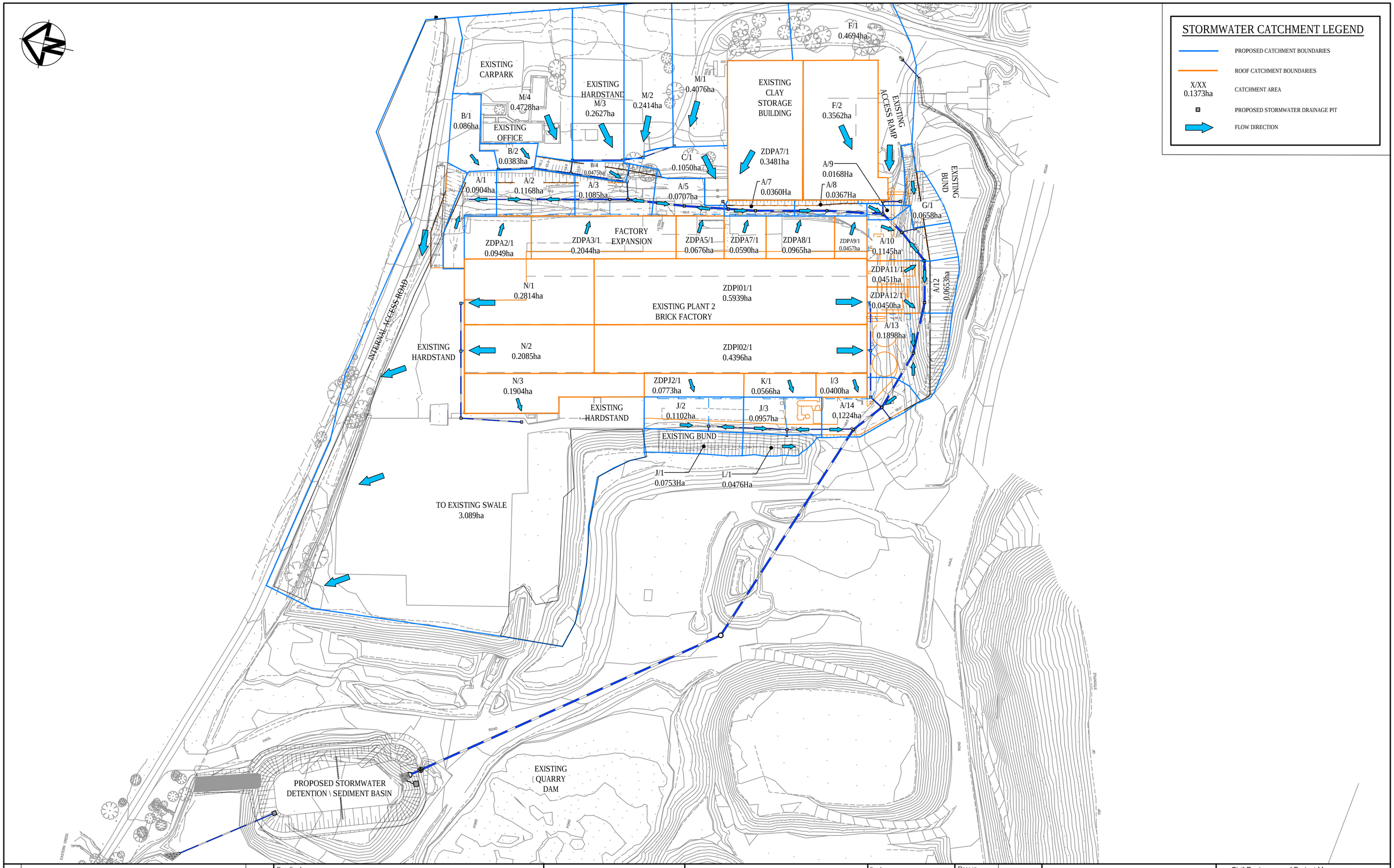
Status FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC044	18-577	C

Date Plotted: 13 Mar 2020 - 04:23PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC044.dwg



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

100mm on Original

Bar Scales

0 20 40 60 80 100m

1 : 1000 @ A1 1 : 2000 @ A3

Client: BRICKWORKS LIMITED

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

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: STORMWATER DRAINAGE CATCHMENT PLAN

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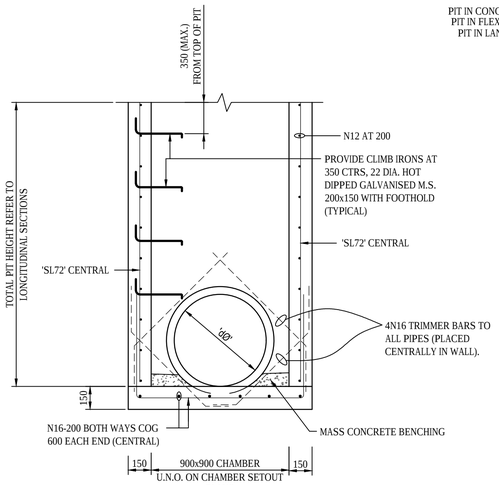
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

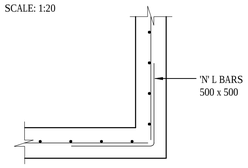
Drawing No.	Project No.	Issue
DAC050	18-577	C

Date Plotted: 13 Mar 2020 - 04:24PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC050.dwg



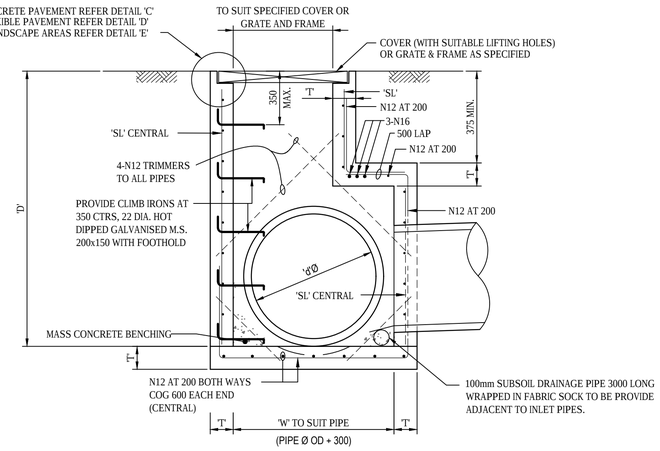
PIT CHAMBER DETAIL FOR PIPES UP TO 525Ø

SCALE: 1:20



TYPICAL CORNER DETAIL

SCALE 1:20



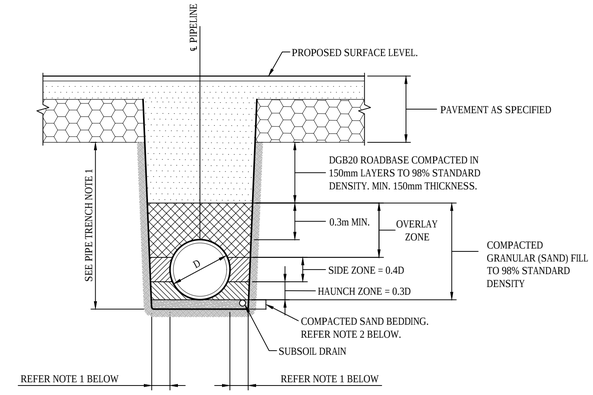
PIT CHAMBER DETAIL FOR PIPES FROM 600Ø TO 1200Ø

(ENLARGED CHAMBER)

SCALE: 1:20

PIPE DIA. 'ØØ'	WIDTH 'W'	DEPTH 'D'	FABRIC/COV 'SL'
600 to 675	900	1200-2400	SL72
750	1000	1200-2400	SL72
825	1150	1200-2400	SL72
900	1200	1200-2400	SL82
1050	1350	1300-2400	SL92
1200	1500	1500-2800	SL102

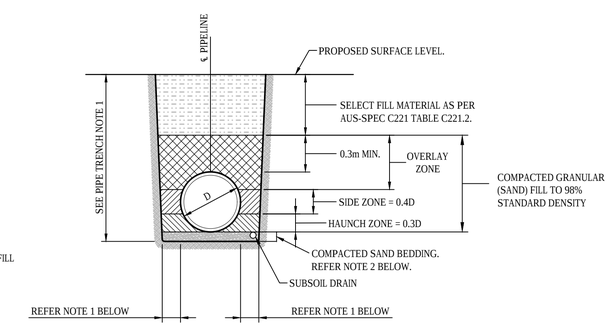
CHAMBER DEPTH EXCEEDING 2m IN HEIGHT WILL BE DESIGNED AND APPROVED BY STRUCTURAL ENGINEER



PIPE TRENCH BELOW PAVEMENT

N.T.S.

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



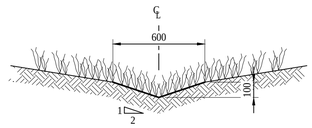
PIPE TRENCH BELOW LANDSCAPING (HS3)

N.T.S.

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

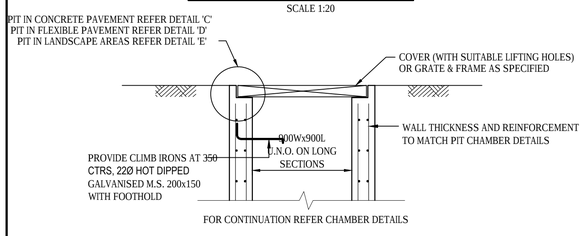
PIPE TRENCH NOTES

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



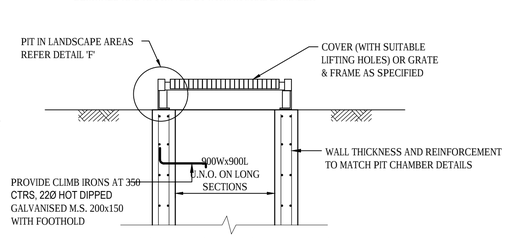
600 WIDE GRASSED SWALE

SCALE 1 : 20



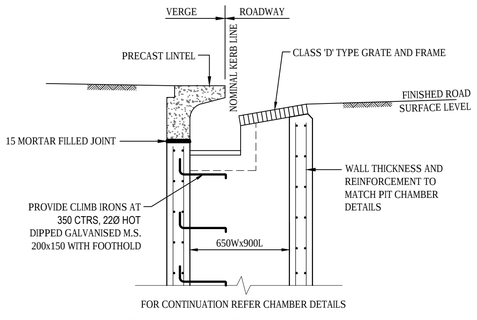
STANDARD SURFACE INLET OR SEALED JUNCTION PIT

SCALE: 1:20



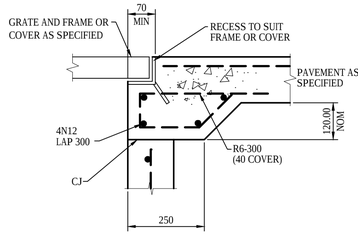
STANDARD SURCHARGE SURFACE INLET PIT

SCALE: 1:20



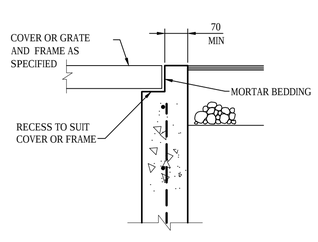
STANDARD GRATED KERB INLET PIT WITH LINTEL

SCALE: 1:20



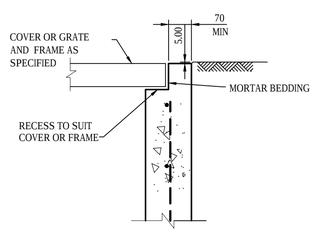
DETAIL "C"

SCALE 1:10



DETAIL "D"

SCALE 1:10



DETAIL "E"

SCALE 1:10

NOTE

1. STANDARD GULLY PITS REFER TO STRATHFIELD COUNCIL STANDARD DRAWING FOR DETAILS
2. FOR INLET SIZE, PIT CHAMBER SIZE AND SETOUT REFER TO STORMWATER LONGITUDINAL SECTIONS ON DRAWING C851 - C854
3. REINFORCING MESH IS TO BE BENT TO LAP 300 AROUND ALL CORNERS. VERTICAL BARS ARE NOT TO BE CUT. ALTERNATELY PROVIDE N12 "L" BARS (500x500) AT 400 VERTICAL CTS.
4. COMPRESSIVE STRENGTH (F'c) FOR CAST IN SITU CONCRETE SHALL BE A MINIMUM 32 MPa AT 28 DAYS.
5. TOP OF BENCHING SHALL BE ½ OF OUTLET PIPE DIAMETER.
6. 100mm SUBSOIL DRAINAGE PIPE 3000 LONG WRAPPED IN FABRIC SOCK TO BE PROVIDE ADJACENT TO INLET PIPES.
7. ALL PITS SHALL BE PROVIDED WITH A LOCKING CLIP.
8. PIT GRATE TO BE 'WELDLOK' GULLY GRATE GG 78-50 OR APPROVED EQUIVALENT.
9. DURING INSTALLATION OF GRATE AND FRAME CONTRACTOR IS TO ENSURE CLEARANCE BETWEEN LINTEL AND OPENED GRATE (REFER TO INSTALLATION TOLERANCE).
10. PROVIDE STEP IRONS AS INDICATED FOR PITS DEEPER THAN 1200.
11. N12 AT 200 CENTRALLY PLACED MAY BE USED IN LIEU OF MESH. LAP 500 AT CORNERS
12. MINIMUM REINFORCEMENT COVER TO BE 45mm UNLESS NOTED OTHERWISE
15. CHAMBER DEPTH EXCEEDING 2m IN HEIGHT WILL BE DESIGNED AND APPROVED BY STRUCTURAL ENGINEER
16. CONCRETE STRENGTH: - UNLESS NOTED OTHERWISE

ELEMENT	f'c MPa (28 DAYS)	SLUMP	MAX AGG SIZE	CEMENT TYPE
PITS	32	80mm	20mm	GP

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

Bar Scales

0 100 200 400 600 800 1000mm

1 : 10 @ A1 1 : 20 @ A3

0 500 1000 1500 2000mm

1 : 20 @ A1 1 : 40 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 10, 1 : 20

Grid: MGA

Height Datum: AHD

Drawn: QD

Designed: QD

Checked: SH

Approved:

Project: BRICKWORKS PLANT2 UPGRADE 780 WALLGROVE ROAD HORSLEY PARK

Title: STORMWATER DETAILS SHEET 1

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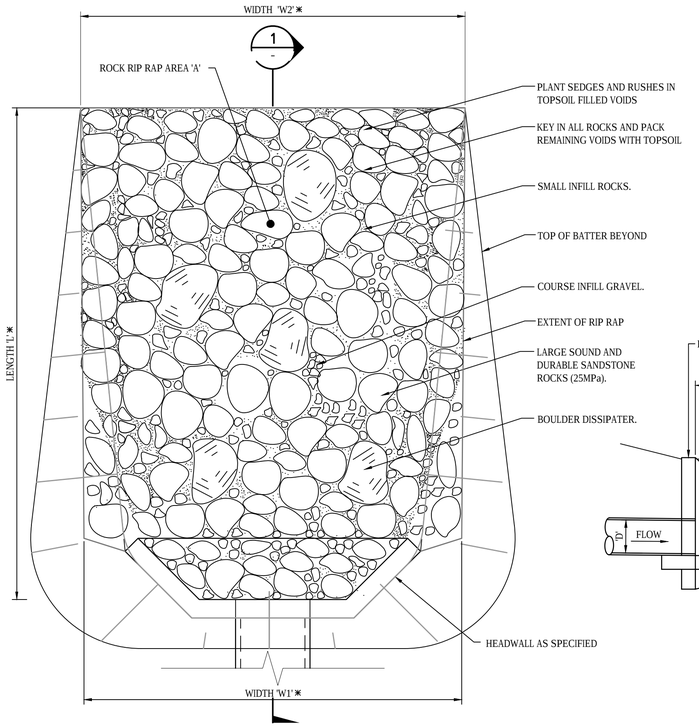
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No. DAC055 | Project No. 18-577 | Issue C

100mm on Original

Date Plotted: 13 Mar 2020 - 04:24PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC055.dwg

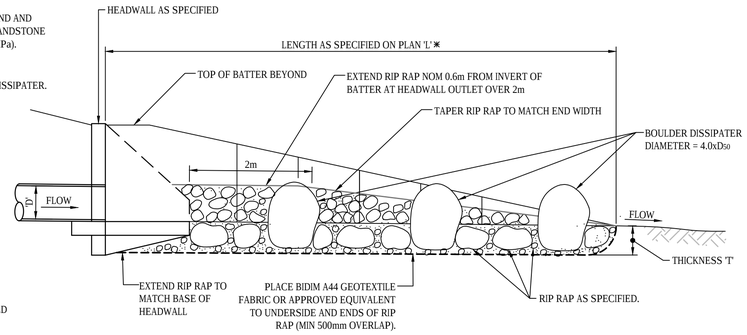


PLAN
SCALE NTS

ROCK RIP RAP GRADATION SIZE

SPHERICAL DIA	% OF RIP RAP SMALLER (ie RIP RAP PASSING THROUGH SIEVE)
1.5-2.0 D_{50}	100%
D_{50}	50%
0.3-0.4 D_{50}	10-20%

D_{50} = MEDIAN ROCK SIZE AS SPECIFIED



SECTION 1 / NTS

TYPICAL ROCK RIP RAP ENERGY DISSIPATER SCOUR PROTECTION DETAIL
SCALE NTS

✱- REFER SCOUR PROTECTION SCHEDULE ON THIS DRAWING

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

100mm on Original

Bar Scales
0 1 2 3 4 5m
1 : 50 @ A1 1 : 100 @ A3

Client: BRICKWORKS LIMITED

Scales: 1 : 50
Grid: MGA
Height Datum: AHD

Drawn	QD
Designed	QD
Checked	SH
Approved	

Project: BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: STORMWATER DETAILS
SHEET 2

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Status: FOR REVIEW
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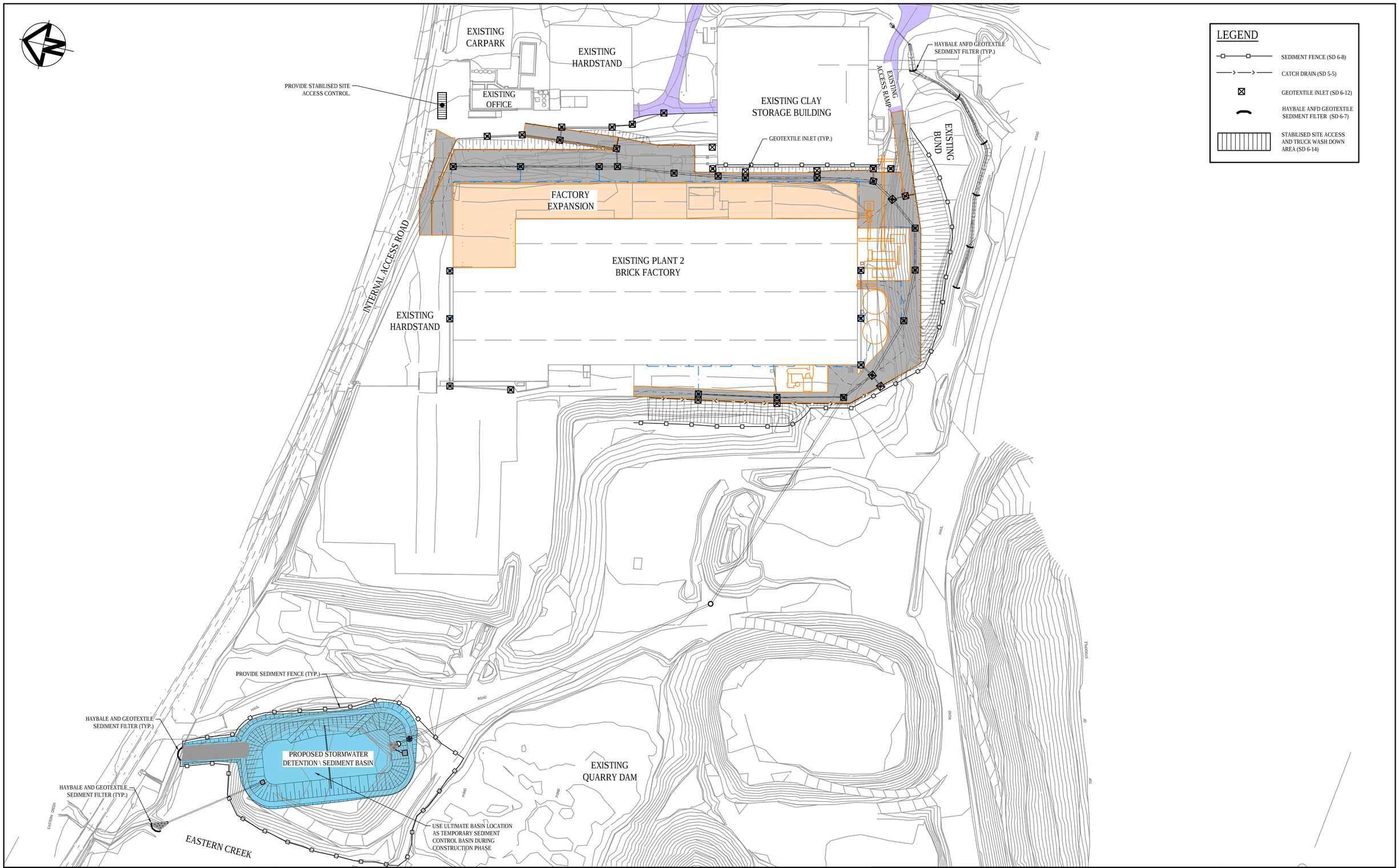
A1

Drawing No.	Project No.	Issue
DAC056	18-577	C

Date Plotted: 13 Mar 2020 - 04:24PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC056.dwg



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

Bar Scales

0 20 40 60 80 100m

1 : 1000 @ A1 1 : 2000 @ A3

Client

BRICKWORKS LIMITED

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

Project

BRICKWORKS
PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title

EROSION AND SEDIMENT CONTROL PLAN

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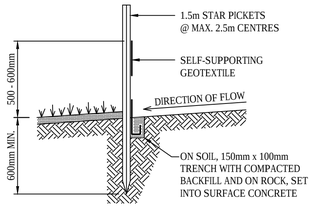
Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

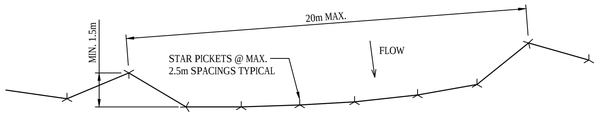
Drawing No.	Project No.	Issue
DAC060	18-577	C

100mm on Original

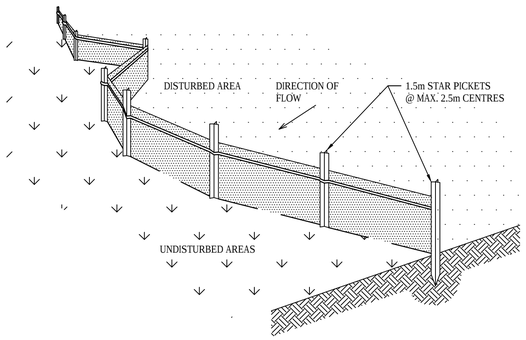
Date Plotted: 13 Mar 2020 - 04:24PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC060.dwg



SECTION DETAIL

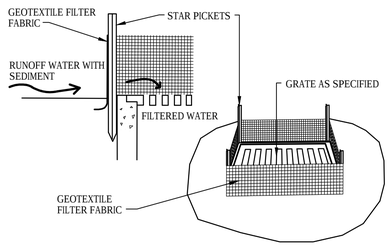


PLAN



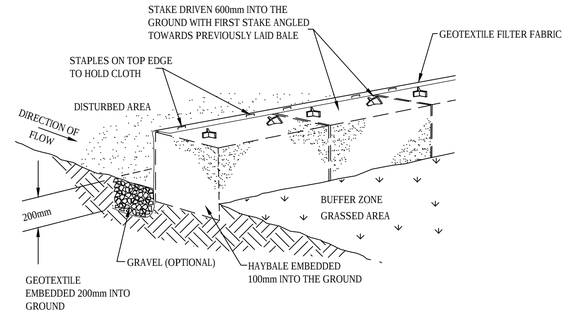
SEDIMENT FENCE (SD 6-8)

SCALE N.T.S.



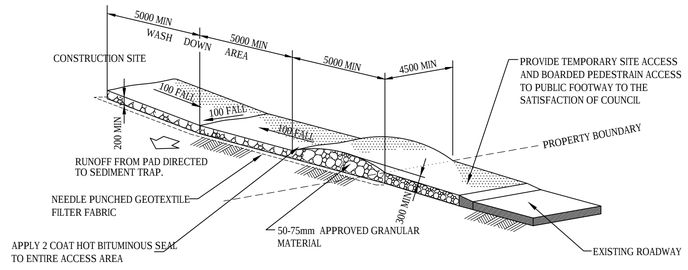
GEOTEXTILE FILTER PIT SURROUND (SD 6-12)

NTS



HAYBALE AND GEOTEXTILE SEDIMENT FILTER (SD 6-7)

NTS



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

NTS

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

100mm on Original

Bar Scales

Client: BRICKWORKS LIMITED

Scales	AS SHOWN	Drawn	QD
		Designed	QD
Grid	MGA	Checked	SH
Height Datum	AHD	Approved	

Project: BRICKWORKS PLANT2 UPGRADE
780 WALLGROVE ROAD
HORSLEY PARK

Title: EROSION AND SEDIMENT CONTROL DETAILS

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Status: FOR REVIEW
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
DAC061	18-577	C

Date Plotted: 13 Mar 2020 - 04:24PM File Name: F:\18-577 Brickworks Plant 2\Drgs\Civil\Final\DA\DAC061.dwg

(co5 \ \Xpa6\x Erosion and Sedimentation Control Details.dwg

Appendix B

Douglas Partners Geotechnical Report

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

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

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	84821.00	Document No.	84821.00.R.001.Rev0
Document title	Report on Geotechnical Investigation Lightweight Aggregate Project, Plant 2 Austral Brick Site		
Site address	720 Wallgrove Road, Horsley Park		
Report prepared for	Brickworks Ltd		
File name	84821.00.R.001.Rev0.Geotechnical.docx		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
Rev 0	Michael Thom	Fiona MacGregor	23 June 2015

Distribution of copies

Revision	Electronic	Paper	Issued to
Rev 0	1		Brickworks Ltd

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	pp. M.J Thom	25 June 2015
Reviewer	F MacGregor	25 June 2015

NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

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Douglas Partners
Geotechnics | Environment | Groundwater

Table of Contents

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

1. Introduction

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

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

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

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

2. Site Description

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

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

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

3. Geology

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

The site is mostly located on the lower slopes of a small north-south trending ridge. At the bottom of the slope there are flatter areas near Eastern Creek which probably represent areas of alluvial soil deposits. The remainder of the site is 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 ±1 m in plan location. Ground surface levels were estimated using the GPS equipment and checked against surface levels provided on drawings supplied by the client.

5. Field Work Results

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

5.1 Bores

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

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

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

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

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

Note: BD: Bore discontinued NE: Not encountered

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

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

Note: BD: Bore discontinued NE: Not encountered

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

Table 3: Summary of Pavement Bores along proposed access roads

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

Note: BD: Bore discontinued

5.2 Groundwater and Depths

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

Table 4: Measured Groundwater Depths

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

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

6. Laboratory Testing

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

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

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

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

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

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

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

Table 6: Results of Compaction and CBR tests

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

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

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

Table 7: Results of Laboratory Testing

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

Note: w = Natural moisture content

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

7. Proposed Development

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

- BH1 Office building
- BH2-3 Crusher/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 rippable with a medium sized bulldozer. If excavation is required into the underlying consistent medium strength shale or siltstone, which is expected below about RL 59-61 m, then this will require heavy ripping or possibly some assistance with rock breaking equipment.

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

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

8.2 Material Re-use

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

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

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

8.3 Embankment over Dam

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

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

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

Further comments on embankment slopes are given in Section 8.5.

8.4 Site Preparation and Earthworks

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

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

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

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

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

8.5 Engineering Slopes

8.5.1 Cut Slopes

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

Table 8: Maximum Recommended Cut Batter Slopes

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

Notes: H = horizontal, V = vertical

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

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

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

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

Table 9: Design Parameters for Excavation Support Structures

Material	Bulk Unit Weight (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Passive Earth Pressure (K_p)	Coefficient of Earth Pressure at Rest (K_o)
Existing variably compacted filling	20	0.4	2.5	0.6
Stiff to hard residual clays	20	0.3	3.3	0.45
Variably weathered shale	22	0.2	4.0	0.3
Consistent medium strength shale	22	0.1	5.0	0.2

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

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

8.5.2 Fill Slopes

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

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

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

8.6 Foundations

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

Table 10: Recommended Foundation Design Parameters

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

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

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

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

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

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

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

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

8.7 Pavement Design

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

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

8.8 Disposal of Excavated Material

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

8.9 Design for Earthquake Loading

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

9. Limitations

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

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

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

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

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

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

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

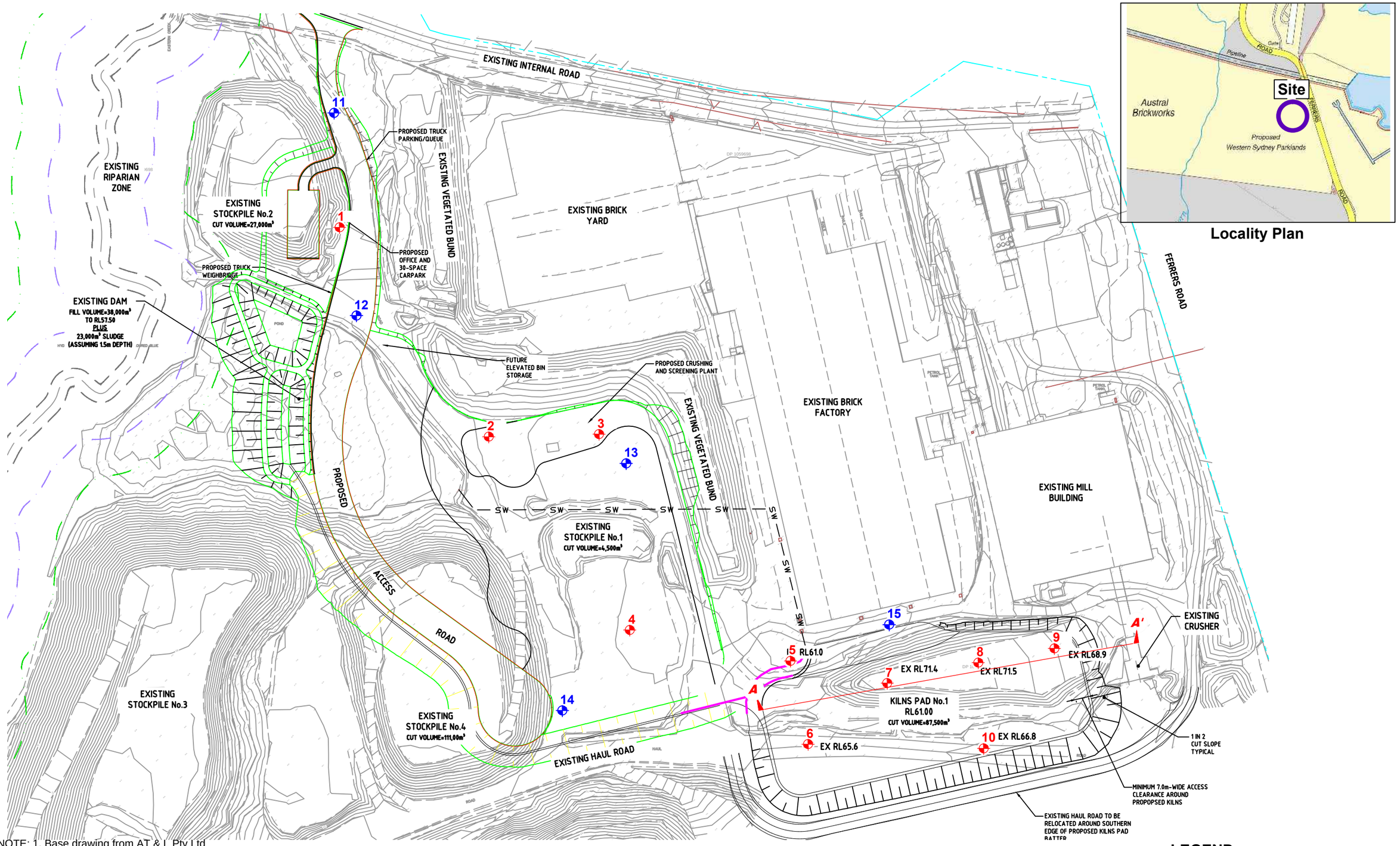
The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawing 1 – Test :Locations

Drawing 2 – Extract from Geological Map

Drawing 3 –Cross-Section A-A’



Locality Plan

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

0 10 20 30 40 60 80 100 150 200m

1:2000 @ A3

LEGEND

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

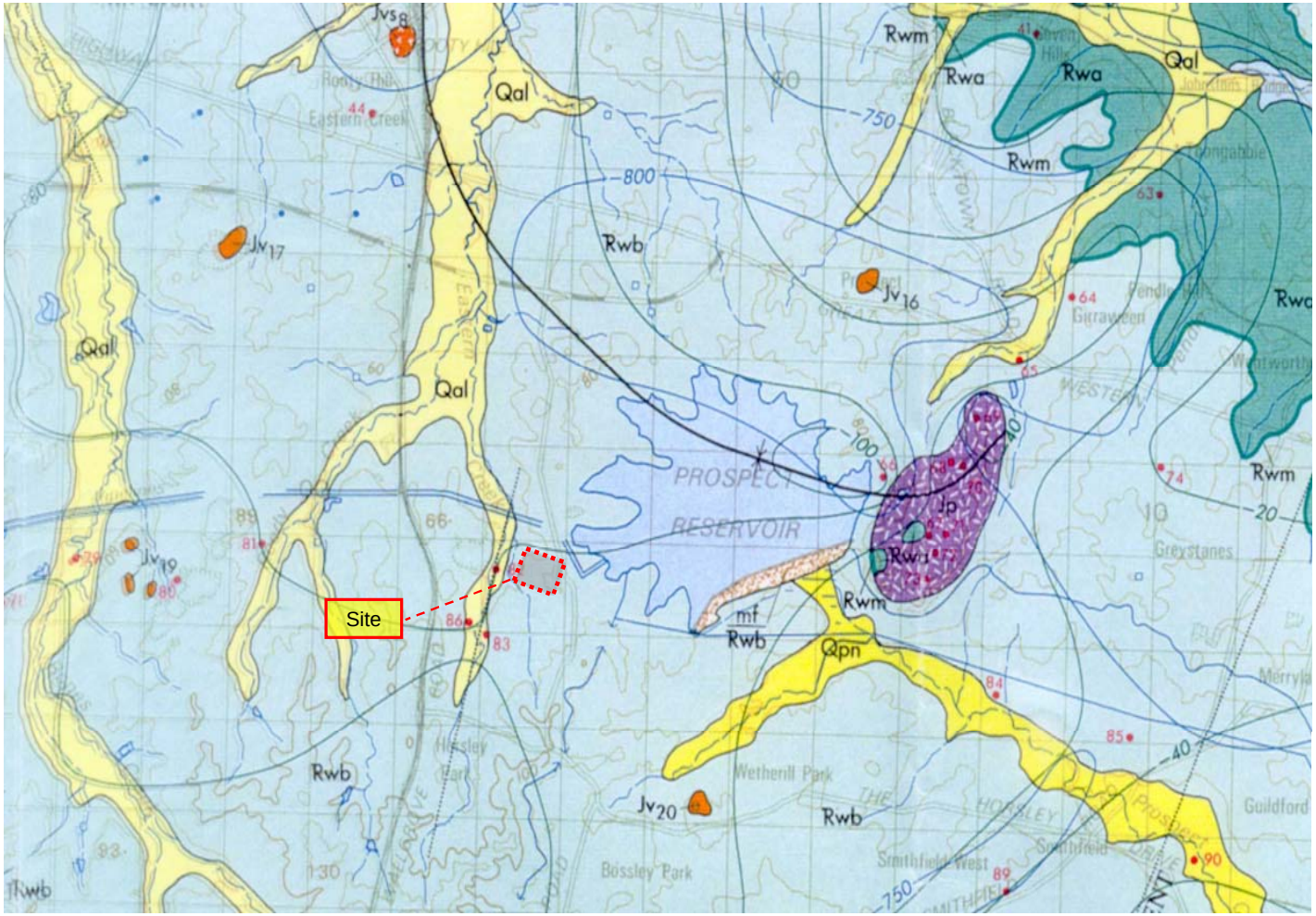
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Brickworks Ltd		TITLE: **Test Locations** **Lightweight Aggregate Project at Plant 2** **Plant 2, Wallgrove Road, HORLSEY PARK**
OFFICE: Sydney	DRAWN BY: PSCH	
SCALE: 1:2000 @ A3	DATE: 2.6.2015	

N

PROJECT No:	84821
DRAWING No:	1
REVISION:	0

P:\84821.00 - HORSLEY PARK - Proposed Kilns\70 Drawings\7.2 Out\84821-1.dwg, 26/06/2015 7:47:44 AM, DWG To PDF.pc3



LEGEND

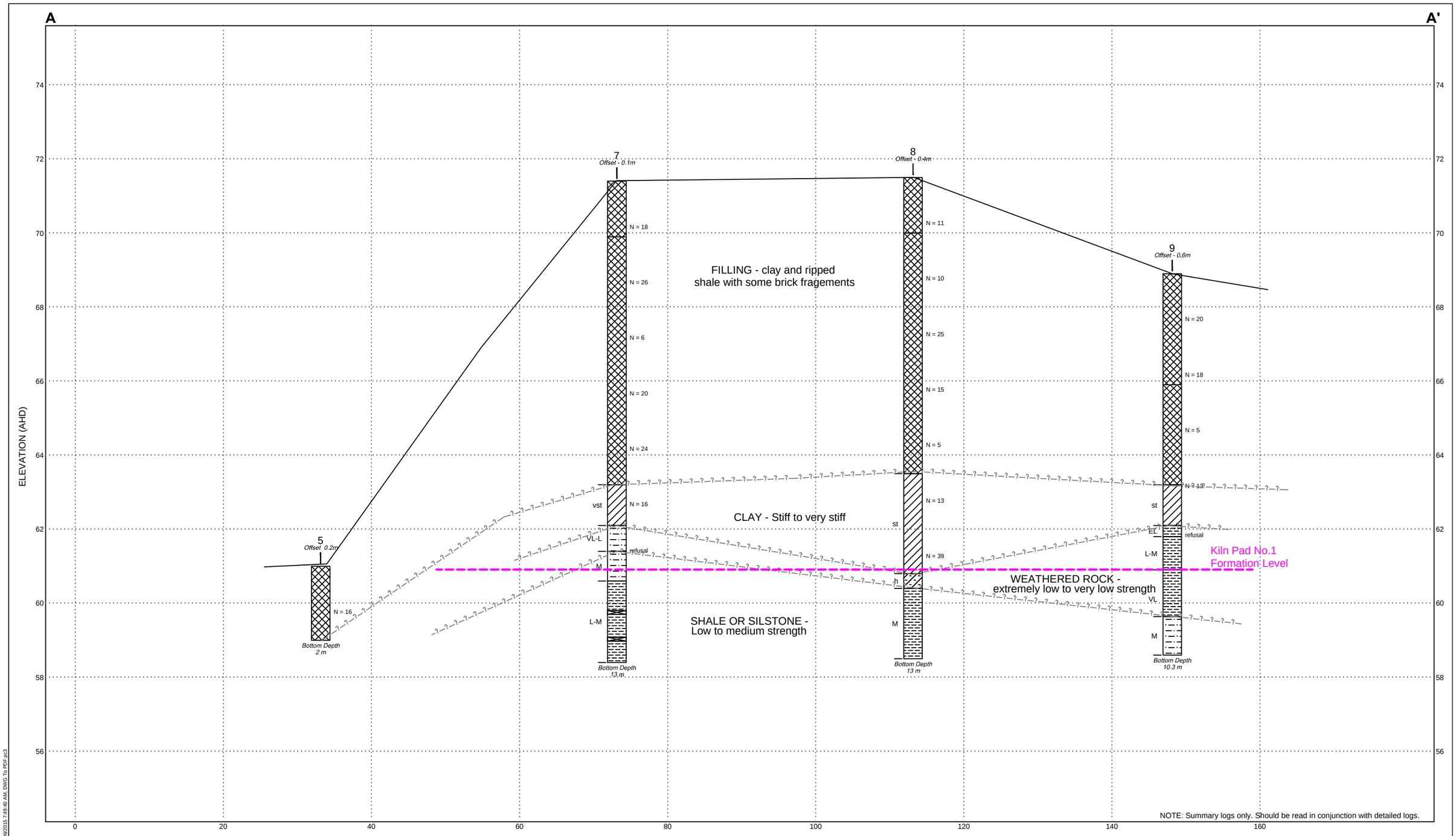
- Rwb — Bringelly Shale
- Rwa — Ashfield Shale
- Jp — Prospect Picrite intrusion
- Qpn — Quaternary Alluvium
- Qal — Quaternary Alluvium
- Volcanic Diatremes

Douglas Partners
Geotechnics / Environment / Groundwater

Extract from Geological Map
Lightweight Aggregate Project at Plant 2
Wallgrove Road, Horsley Park

Client: Brickworks Ltd

Project:	84821
DWG	2
REV:	-
DATE:	June 2015



LEGEND

- Core Loss
- Clay
- Filling
- Shale
- Shaly Clay
- Siltstone

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
WL - Water level

0 10
Horizontal Scale (metres)

Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Brickworks Ltd		TITLE: **Cross-Section A-A'**	PROJECT No: 84821
OFFICE: Sydney	DRAWN BY: MJT/LD	**Lightweight Aggregate Project at Plant 2**	DRAWING No: 3
SCALE: 1:500 (H) 1:100 (V) @ A3	DATE: 22.06.2015	**Wallgrove Road, Horsley Park**	REVISION: 0

P:\84821.00 - HORSLEY PARK - Proposed Kilns\7.0 Drawings\7.2 Dun\84821-3.dwg, 26/06/2015 7:49:40 AM, DWG To PDF.pc3

Appendix C

Field Work Results

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
57	0	FILLING - variably compacted, grey and light grey-brown, silty clay and crushed shale filling, damp		A	0.1				
				A	0.5				
	1			A	1.0				
				S	1.45		12,20,23 N = 43		
56	2								
				S	2.5		3,3,4 N = 7		
55	3				2.95				
	3.2	SILTY CLAY - stiff, light grey mottled brown, silty clay, moist to wet							
54	4	3.9m: becoming wet		S	4.0		5,6,9 N = 15	▼	
					4.45				
53	5								
					5.5				
	5.7			S			8,10,20 N = 30		
52	6	SHALE - extremely low strength, light grey to grey-brown shale			5.95				
	5.95	Bore discontinued at 5.95m							
51	7								
50	8								
49	9								
48									

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: Free groundwater observed at 3.9m whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
60	0	FILLING - variably compacted, light grey-brown, silty sand, crushed sandstone, shale and brick fragments filling, damp		A	0.1				
				A	0.5				
59	1			A	1.0				
				S	1.45		8,6,6 N = 12		
58	2	2.5m: becoming moist		S	2.5		5,6,8 N = 14		
57	2.8	SILTY CLAY - very stiff, light grey and mottled brown, silty clay with a trace of fine sand, wet		S	2.95				
56	4			S	4.0		5,8,12 N = 20		
					4.45				
55	5	5.0m: becoming shaly clay							
	5.5	SHALE - low strength, light grey-brown shale		S	5.5		10,20/50mm refusal		
54	5.7	Bore discontinued at 5.7m			5.7				
	6								
53	7								
52	8								
51	9								

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
61	0	FILLING - grey-brown and red-brown, silty sand and crushed brick fragment filling, damp		A	0.1				
				A	0.5				
	1			A	1.0				
	1.3			S	1.45		12,14,14 N = 28		
60		FILLING - variably compacted, light grey-brown, sandy silty clay filling with some shale and brick fragments, moist							
	2				2.5				
59				S			2,3,8 N = 11		
	3				2.95				
	3.5								
58		SILTY CLAY - stiff, light grey mottled brown, silty clay with a trace of ironstone gravel, moist							
	4				4.0				
				S			3,5,5 N = 10		
57					4.45				
	5								
	5.1								
56		SHALE - very low then low strength, light grey-brown shale		S	5.5		30/150mm refusal		
	5.65	Bore discontinued at 5.65m			5.65				
55	6								
54	7								
53	8								
52	9								

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 5.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
61	0	FILLING - variably compacted, grey, crushed shale filling, damp		A	0.1				
				A	0.5				
	1			A	1.0				
				S	1.45		6,7,9 N = 16		
60	2				2.5				
	2.6	FILLING - light grey-brown, crushed/ripped sandstone filling, damp		S	2.95		3,23,20 N = 43		
59	3								
	3.3	FILLING - apparently poorly compacted, light grey-brown, clay and crushed shale fragments filling, moist to wet							
58		3.8m: becoming wet						▼	
	4				4.0				
	4.2	SILTY CLAY - stiff, brown, silty clay, wet		S	4.45		3,4,6 N = 10		
57	5								
	5.0	SHALE - very low then low strength, light grey to grey shale							
	5.55	Bore discontinued at 5.55m		S	5.5 5.55		30/50mm refusal		
56	6								
55	7								
54	8								
53	9								
52									

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 Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
60	0	FILLING - variably compacted, light grey and grey, silty clay and crushed shale filling, damp		A	0.1				
				A	0.5				
	1			A	1.0				
59				S	1.45		8,7,9 N = 16		
	2	2.0 Bore discontinued at 2.0m		A	2.0				
58	3								
57	4								
56	5								
55	6								
54	7								
53	8								
52	9								
51									

RIG: Scout 1 **DRILLER:** RKE **LOGGED:** SI **CASING:** Uncased
TYPE OF BORING: Solid flight auger to 2.0m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
65	0	FILLING - variably compacted, light grey and brown, crushed shale, sandstone and brick fragments filling, humid							A			
	1								A			
									A			30/150mm refusal
									S			
64	2											
	2.2	SILTY CLAY - very stiff to hard, light grey and mottled red-brown, silty clay with some ironstone gravel, most							S			10,14,15 N = 29
63	3							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	3.8	SILTSTONE - very low strength, light grey-brown siltstone										
62	4											35/100mm refusal
	4.1	SILTSTONE - medium strength, highly to moderately weathered, slightly fractured, grey-brown siltstone with some very low strength bands						4.25 & 4.44m: B0°, fe, cly, Cz 4.51m: J35°, un, ro, fe 4.58m: J70°, un, ro, cln 4.75-4.85m: J65° & 85°, st, ro, cln 5.26m: B5°, cly, 2mm 5.35 & 5.5m: Cz, 20mm 5.63m: J45°, pl, sm, fe 5.85 & 5.88m: Cs 6.15, 6.55 & 6.65m:	S			PL(A) = 0.4
61	5								C	100	67	
60	6											PL(A) = 0.5
	6.15	SHALE - very low strength, highly weathered, slightly fractured, grey-brown shale										
59	6.85	SHALE - medium strength, slightly weathered, slightly fractured, grey shale							C	100	48	PL(A) = 0.4
	7											
	7.35	Bore discontinued at 7.35m										
58	8											
57	9											
56												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger to 4.0m; Rotary to 4.1m; NMLC-Coring to 7.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 6 PROJECT 84821 MAY 2015

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

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
71	0	FILLING - apparently variably compacted, grey to grey-brown, silty clay and crushed shale filling, damp							A			
									A			
	1								A			
									S			5,7,11 N = 18
70	1.5	FILLING - variably compacted, grey, silty clay, crushed shale and brick fragments filling, moist to wet										
	2											
69									S			7,8,18 N = 26
	3	3.0m: becoming wet										
68												
	4								S			0,2,4 N = 6
67												
	5											
66									S			7,10,10 N = 20
	6											
65												
	7								S			7,11,13 N = 24
64												
	8											
63	8.2	CLAY - very stiff, light brown to orange-brown clay, slightly silty with a trace of ironstone gravel, moist							S			8,7,9 N = 16
	9											
62	9.3	SILTSTONE - very low to low strength, light grey-brown siltstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				20/50mm
	10.0											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.0m; NMLC-Coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Borehole moved 3.0m. Standpipe installed to 13.0m (screen 11.0-13.0m; gravel 10.0-13.0m; bentonite 9.0-10.0m; backfill to GL; 0.5m stick-up)

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
61		SILTSTONE - medium strength, highly to moderately weathered, fractured and slightly fractured, grey-brown siltstone						10.2m: B0°, cly co, 2mm 10.25m: B0°, cly 10.46m: J30°, un, ro, cly 10.56m: J30° & 35°, st, ro, fe 10.72m: J30°, pl, sm, fe 10.8-10.85m: Cs 11.15m: J, sv, pl, sm, cln	S			refusal PL(A) = 0.5
	10.8											
60	11	SHALE - low to medium strength, highly to moderately weathered, fractured and slightly fractured, grey-brown shale with some extremely low and very low strength bands							C	94	51	PL(A) = 0.5 PL(A) = 0.3
	11.7							11.6m: CORE LOSS: 100mm				
59	12								C	92	58	
	12.42							12.32m: CORE LOSS: 100mm 12.55m: J45°, pl, ro, cln 12.72m: J65°- 85°, cu, ro, cln				PL(A) = 0.3
58	13											
	13.0	Bore discontinued at 13.0m										
57	14											
56	15											
55	16											
54	17											
53	18											
52	19											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 10.0m; NMLC-Coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Borehole moved 3.0m. Standpipe installed to 13.0m (screen 11.0-13.0m; gravel 10.0-13.0m; bentonite 9.0-10.0m; backfill to GL; 0.5m stick-up)

SAMPLING & IN SITU TESTING LEGEND

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

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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 7 PROJECT 84821 MAY 2015

10.0 – 13.0m

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	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing			
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
71	0	FILLING - apparently moderately compacted, grey, silty clay and crushed shale fragments filling with some gravel (brick fragments), damp							A			
									A			
	1								A			
70									S			5,5,6 N = 11
	1.5	FILLING - variably compacted, light grey, clay and crushed shale and brick gravel filling, moist to wet										
	2											
69									S			1,3,7 N = 10
	3											
68												
	4								S			5,11,14 N = 25
67												
	5											
66									S			8,7,8 N = 15
	6											
65												
	7								S			0,2,3 N = 5
64												
	8											
	8.0	CLAY - stiff, light grey and brown clay, moist to wet										
63									S			3,5,8 N = 13
	9											
62												

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 Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
61		CLAY - stiff, light grey and brown clay, moist to wet *(continued)*						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			8,14,25 N = 39
	10.7	SHALY CLAY - hard, light grey mottled brown, shaly clay, damp										
60	11.1	SHALE - medium strength, highly to moderately weathered, fractured then slightly fractured, grey-brown shale with some very low strength bands						11.15m: J30°, pl, sm, cly 11.31-11.41m: fg 11.52m: J30°, pl, ro, fe 11.66m: J30°, pl, sm, cly 11.9 & 11.96m: B5°, fe 12.4-12.7m: B (x3) 0°-5°, fe 12.9m: J80°, pl, sm, cln	C	100	75	PL(A) = 0.4 PL(A) = 0.5
59	13.0	Bore discontinued at 13.0m										
58												
57												
56												
55												
54												
53												
52												

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.5m; HQ to 11.1m

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

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 8 PROJECT 84821 MAY 2015

11.1 – 13.0m

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
69	0	FILLING - variably compacted, grey and red-brown, silty clay and crushed shale filling with some brick fragments, damp			A			
					A			
68	1				A			
					S			8,13,7 N = 20
67	2							
					S			5,9,9 N = 18
66	3							
	3.0	FILLING - poorly compacted, light brown, silty sandy clay filling with some crushed shale fragments, wet						
65	4				S			3,3,2 N = 5
64	5							
	5.7	CLAY - stiff, light grey mottled brown, slightly silty clay, wet			S			4,5,8 N = 13
63	6			Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	6.8	SHALE - extremely low strength, grey-brown shale with low strength bands			S			35/100mm refusal
62	7							
	7.1	SHALE - low to medium strength, highly to moderately weathered, slightly fractured, grey-brown shale		7.2m: B0°, cly 7.35-7.3m: Cs 7.6m: J45°, pl, sm, fe	C	100	64	PL(A) = 0.3
61	8			7.85m: J60° & 85°, st, ro, fe 8.26m: J35°, pl, ro, fe				
	8.0	SHALE - very low strength, highly to moderately weathered, slightly fractured, grey-brown shale with some low strength bands		8.86-8.76m: J85°, pl, sm, cln 9m: J40°, pl, ro, fe				PL(A) = 0.2
60	9							
	9.26	SILTSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown siltstone		9.55m: J65°, pl, ro, fe 9.7m: J45°, pl, ro, fe	C	100	80	PL(A) = 0.6

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 Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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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 (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
69		SILTSTONE - medium strength, slightly weathered, slightly fractured, light grey-brown siltstone *(continued)*						9.9m: J30°- 45°, cu, ro, cln	C	100	80	PL(A) = 0.7
	10.3	Bore discontinued at 10.3m						10.15m: J35°, pl, ro, fe				
58	11											
57	12											
56	13											
55	14											
54	15											
53	16											
52	17											
51	18											
50	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 Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 9 PROJECT 84821 MAY 2015

7.1 – 10.3m

BOREHOLE LOG

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

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

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

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
67	0	FILLING - variably compacted, grey and brown, silty clay and crushed shale filling with some brick fragments	EW HW MW SW FS FR		Ex Low, Very Low, Low, Medium, High, Very High, Ex High		0.01, 0.05, 0.10, 0.50, 1.00	Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A A A S			35/150mm refusal
66	1											
65	2											
	2.55	SILTSTONE - very low to low strength, light grey-brown siltstone							S			9,30/150mm refusal
64	2.8 3	SILTSTONE - medium strength, moderately weathered, slightly fractured, grey-brown siltstone						2.95-3.56m: B's (x3) 0°, cly vn, fe 3.65m: B5°, fe, cly, 5mm 3.7m: J65°, pl, ro, cly 3.82m: J75°, un, ro, cly 3.95-4.0m: Cs 4.08-4.12m: Cs 4.25-4.28m: Cs 4.42-4.5m: Cs 4.7m: B0°, fe 4.9m: J55°, pl, ro, fe 5.14m: J45°, pl, sm, fe	C	100	70	PL(A) = 0.4 PL(A) = 0.4
63	3.95 4	SHALE - very low and medium strength, highly to moderately weathered, slightly fractured, light grey-brown to grey shale										
62	5											
61	5.75 6	INTERBEDDED SHALE/SILTSTONE - medium strength, moderately and slightly weathered, fragmented then slightly fractured, grey-brown shale interbedded with siltstone						6.12-6.15m: Cs 6.2-6.53m: B's, fe, cly vn	C	100	79	PL(A) = 0.4 PL(A) = 0.7
60	7.0 7	SHALE - medium strength, fresh, slightly fractured and unbroken, grey shale						7.04m: J70°, pl, sm, cln				PL(A) = 0.5
59	8											PL(A) = 0.4
	8.4	Bore discontinued at 8.4m						8.3m: B0°, cly co, 3mm				
58	9											

RIG: Scout 4 **DRILLER:** RKE **LOGGED:** SI **CASING:** HW to 2.8m

TYPE OF BORING: Solid flight auger to 2.8m; NMLC-Coring to 8.4m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 8.4m (screen 5.4-8.4m; gravel 5.0-8.4m; bentonite 4.0-5.0m; backfill to GL with 0.6m stick-up)

SAMPLING & IN SITU TESTING LEGEND

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

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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 10 PROJECT 84821 MAY 2015

2.8 – 7.0m

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PROPOSED AGGREGATE FACILITY – HORSLEY PARK

BORE 10 PROJECT 84821 MAY 2015

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

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.

Soil Descriptions

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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 loner 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:

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

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

Stratification Spacing

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

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

Symbols & Abbreviations

Douglas Partners

Introduction

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

Drilling or Excavation Methods

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

Water

▷	Water seep
▽	Water level

Sampling and Testing

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

Description of Defects in Rock

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

Defect Type

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

Orientation

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

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

Coating or Infilling Term

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

Coating Descriptor

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

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

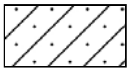
Soils


Topsoil

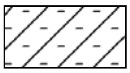

Peat


Clay

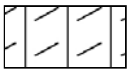

Silty clay

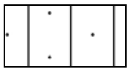

Sandy clay

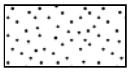

Gravelly clay

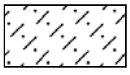

Shaly clay

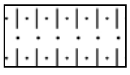

Silt


Clayey silt


Sandy silt

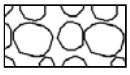

Sand

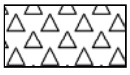

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

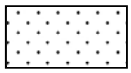

Talus

Sedimentary Rocks

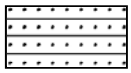

Boulder conglomerate

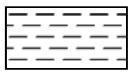

Conglomerate


Conglomeratic sandstone

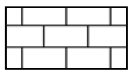

Sandstone


Siltstone


Laminite

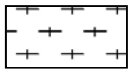

Mudstone, claystone, shale

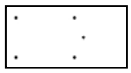

Coal


Limestone

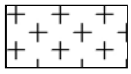
Metamorphic Rocks

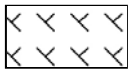

Slate, phyllite, schist

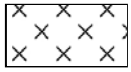

Gneiss

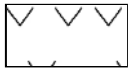

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix D

Laboratory Test Results

Douglas Partners
Geotechnics / Environment / Groundwater

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PO Box 472
West Ryde NSW 1685
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Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client: Brickworks Ltd

Project: Geotechnical Investigation

Location: 780 Wallgrove Rd, Horsley Park

Project No: 84821
Report No: 1
Report Date: 09/06/2015
Date Sampled: -
Date of Test: 04/06/2015
Page: 1 of 1

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

Legend:
W_F Field Moisture Content
W_L Liquid limit
W_P Plastic limit
PI Plasticity index
LS Linear shrinkage from liquid limit condition (Mould length125mm)

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

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

Sampling Methods: Sampled by Engineering Department

Remarks:

NATA Accredited Laboratory Number: 828

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

Tested: LW
Checked: MM

Mark Matthews
Laboratory Manager

Douglas Partners
Geotechnics / Environment / Groundwater

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Determination of Emerson Class Number of Soil

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

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

Test Methods: AS 1289 3.8.1

Sampling Methods: Sampled by Engineering Department

Remarks:

NATA Accredited Laboratory Number: 828

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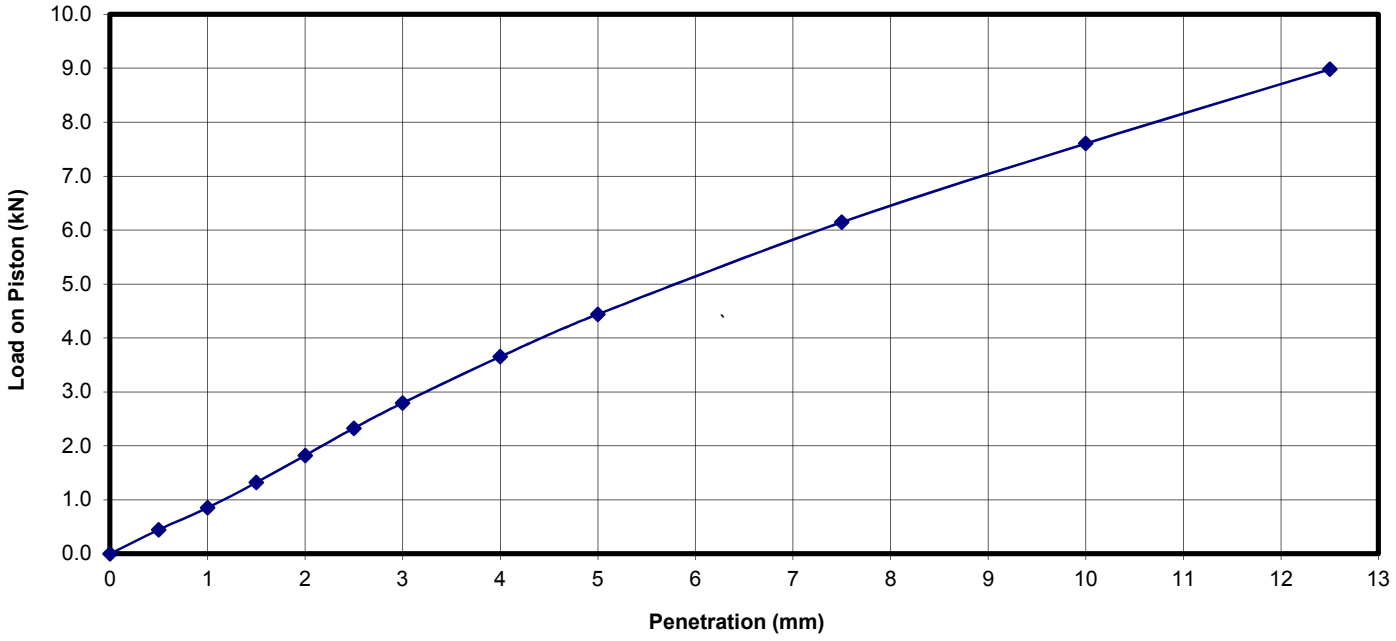
Results of California Bearing Ratio Test

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



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

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 5% Excluded

LEVEL OF COMPACTION: 100% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 0.4%
MOISTURE RATIO: 96% of STD OMC **SOAKING PERIOD:** 5 days

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**25**

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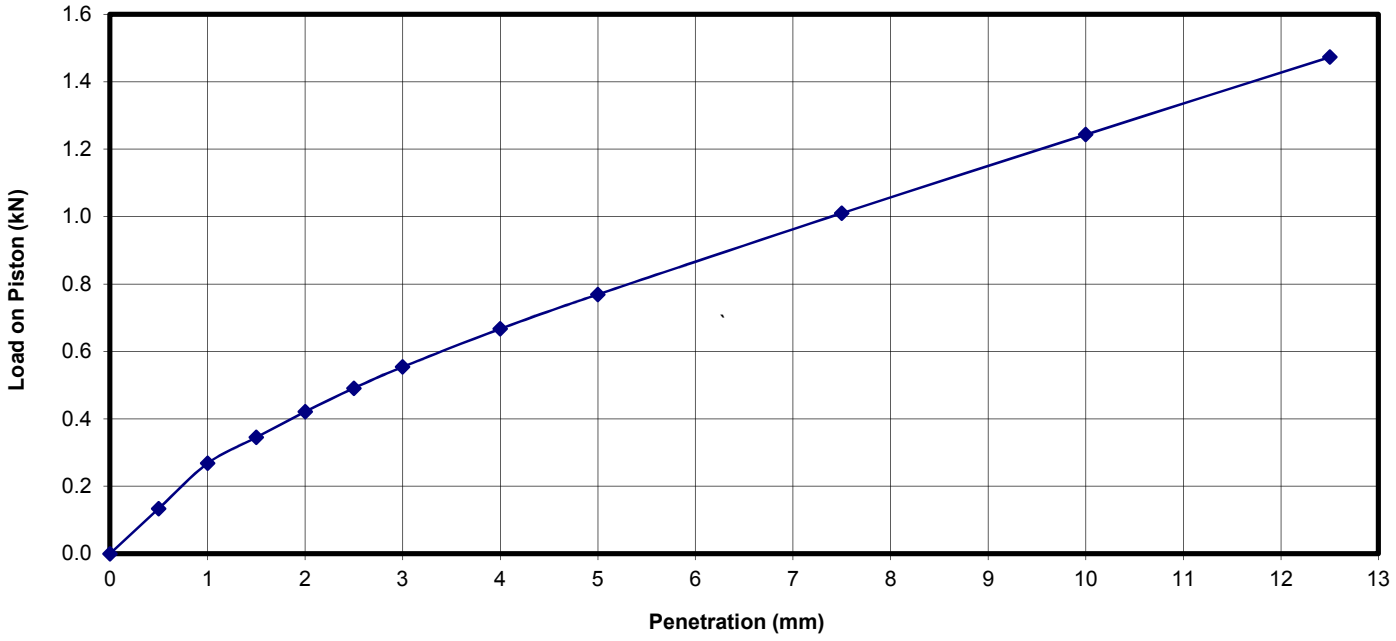
Results of California Bearing Ratio Test

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



Description: Grey shaly silty clay (24 hrs curing)

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 2% Excluded

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 100% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 1.9%

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**4**

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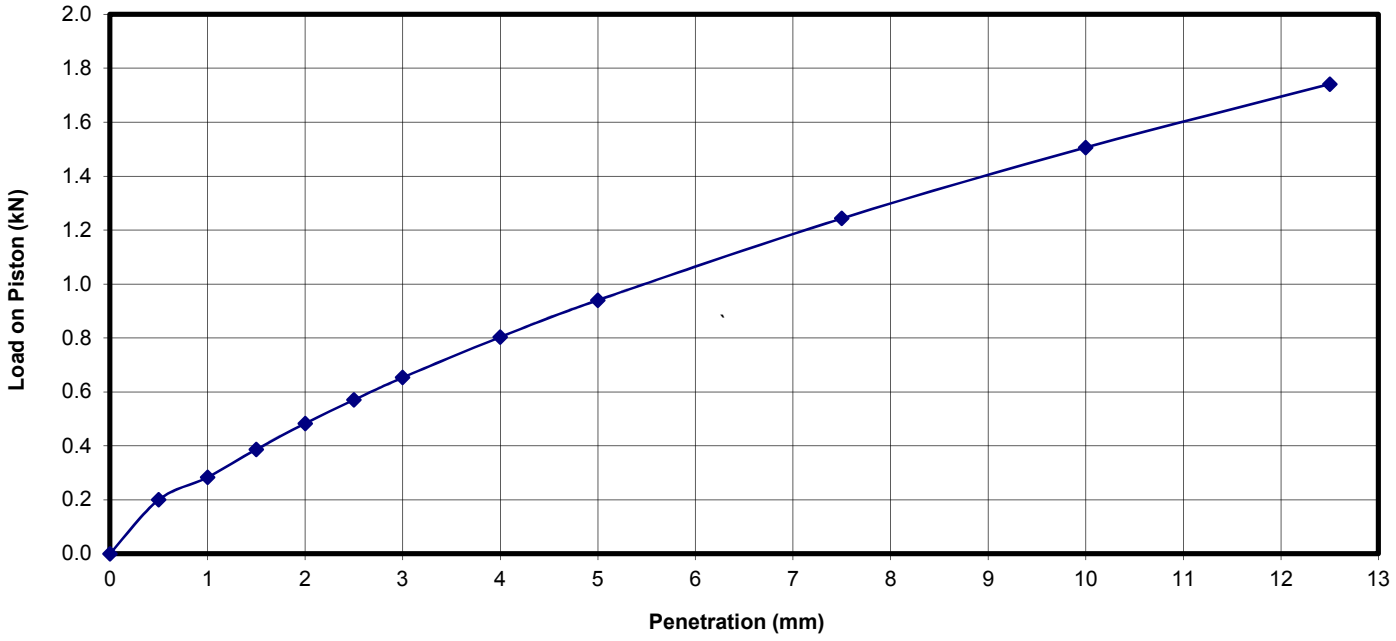
Results of California Bearing Ratio Test

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



Description: Grey shaly silty clay (5-day soak)

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 99% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 5 days
SWELL: 2.6%

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**4.5**

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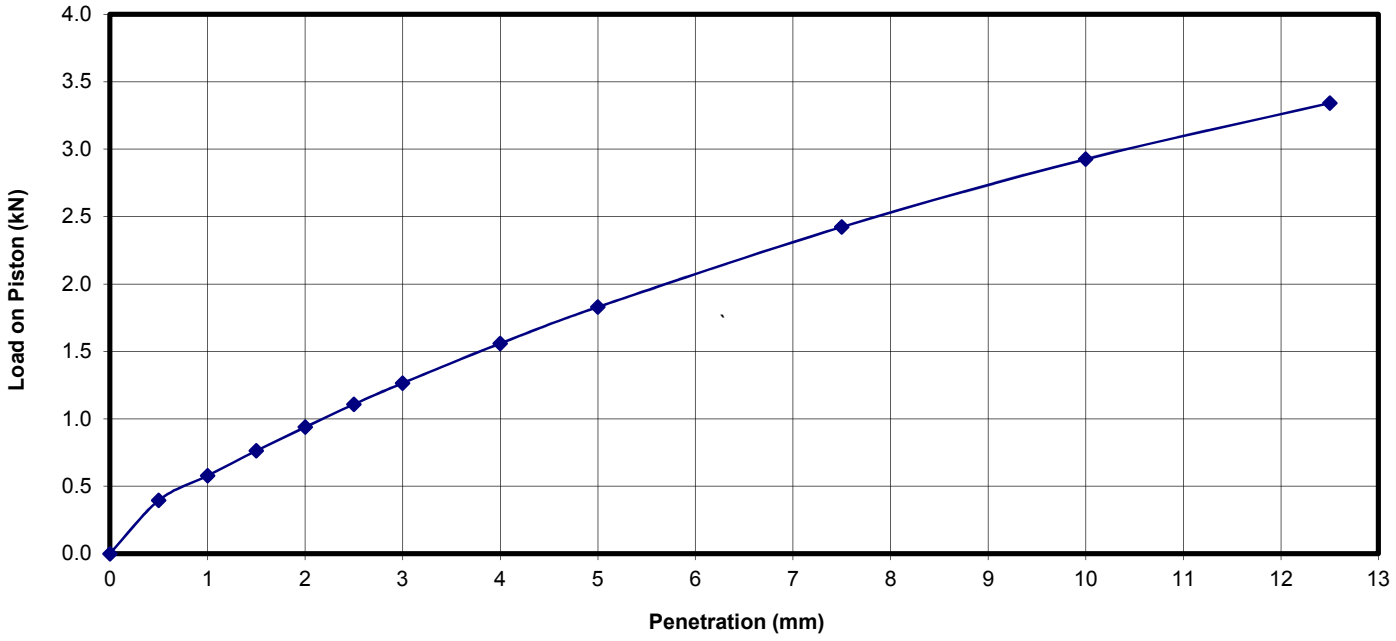
Results of California Bearing Ratio Test

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



Description: Yellow brown clay with some gravel

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 2% Excluded

LEVEL OF COMPACTION: 99% of STD MDD
MOISTURE RATIO: 102% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.5%

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**9**

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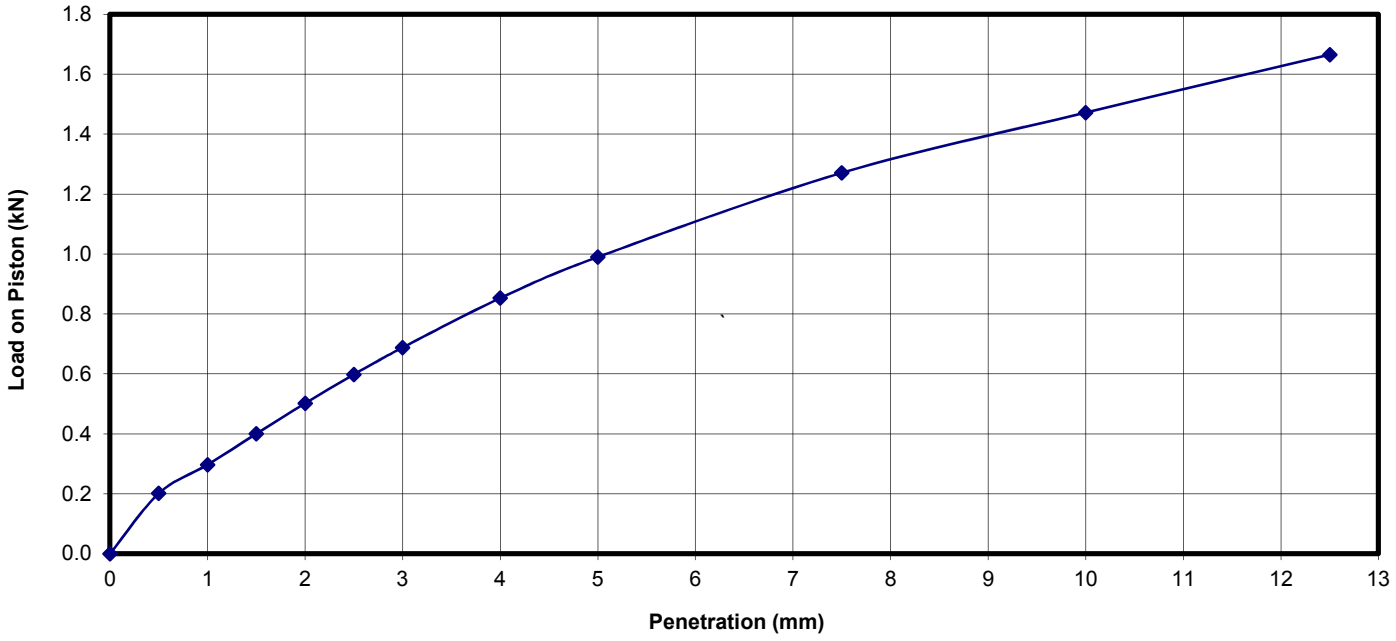
West Ryde NSW 2114
Phone (02) 9809 0666
Fax (02) 9809 4095

Results of California Bearing Ratio Test

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



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

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 3% Included

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 104% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 5 days
SWELL: 0.4%

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**5**

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

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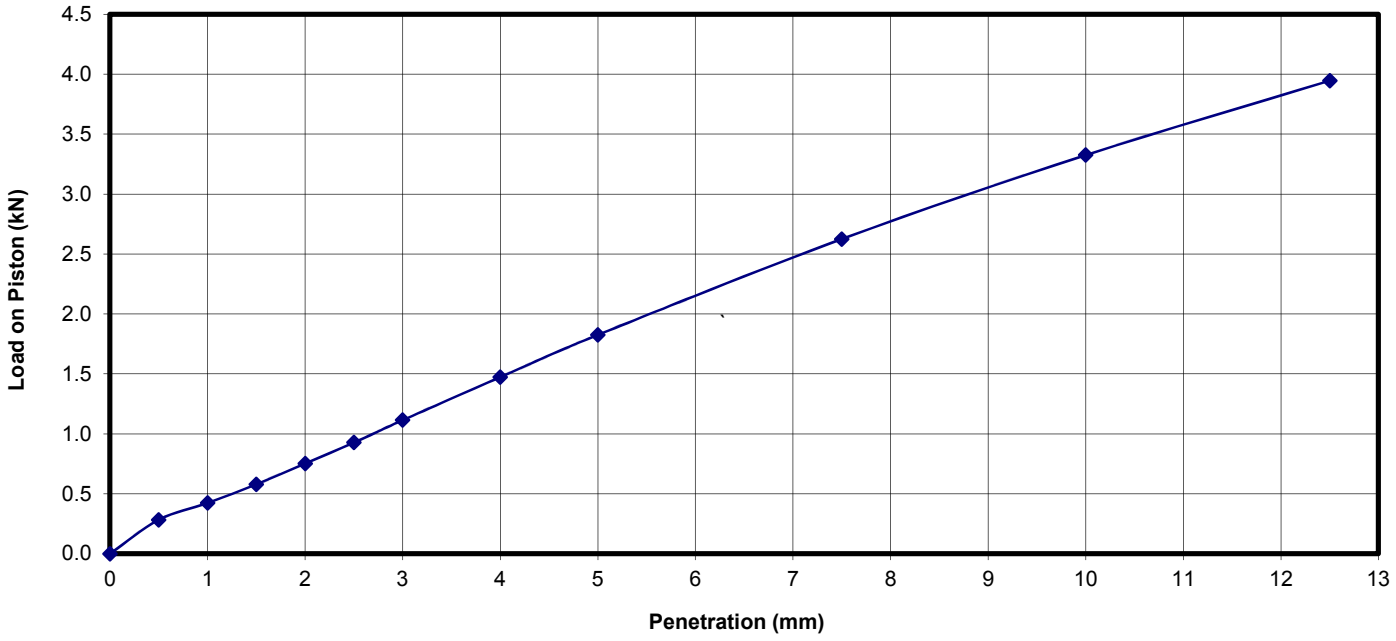
Results of California Bearing Ratio Test

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



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

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

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 4% Excluded

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 105% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.2%

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

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**9**

NATA Accredited Laboratory No 828
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Accredited for compliance with ISO/IEC 17025

Michael Gref
Senior Technician

Douglas Partners
Geotechnics / Environment / Groundwater

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West Ryde NSW 2114Phone (02) 9809 0666
Fax (02) 9809 4095

Results of Moisture Content Test

Client :	Brickworks Ltd	**Project No. :**	84821
Project :	Geotechnical Investigation	**Report No. :**	8
Location :	780 Wallgrove Rd, Horsley Park	**Report Date :**	15/06/2015

Test Location	Depth (m)	Date Sampled	Date Tested	Description	Moisture Content (%)
BH1	1.0	29/05/2015	11/06/2015	Grey and light grey-brown silty clay and crushed shale filling	6.2
BH10	1.0	29/05/2015	11/06/2015	Grey 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 C

Bulk Water Supply Infrastructure Map

NSW GOVERNMENT 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

Cadastre

Cadastre 16/11/2011 © NSW LPI

N

0 250 500 750 m

Projection: MGA Zone 56
Datum: GDA94

Scale: 1:20,000 @ A3

Map Identification Number

SEPP_WSP_BWS_004_020_20111122

Warragamba Bulk Water Supply Pipelines

Eastern Creek

Plant 2 Site

Appendix D

BMT Flood Impact Assessment

BMT WBM Pty Ltd
Suite G2, 13-15 Smail Street
Ultimo NSW 2007
Australia

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

ABN 54 010 830 421

www.bmtwbm.com.au

Our Ref: L.S20149.02_BrickworksQuarry_FIA.docx

25 March 2020

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 2 March 2020.

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 and associated amenities. This will include some filling of the existing dam. This assessment focuses on determining the risk of flooding and flooding impacts from Eastern Creek which is immediately west of the site (Figure 1).

Hydraulic Modelling Overview

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

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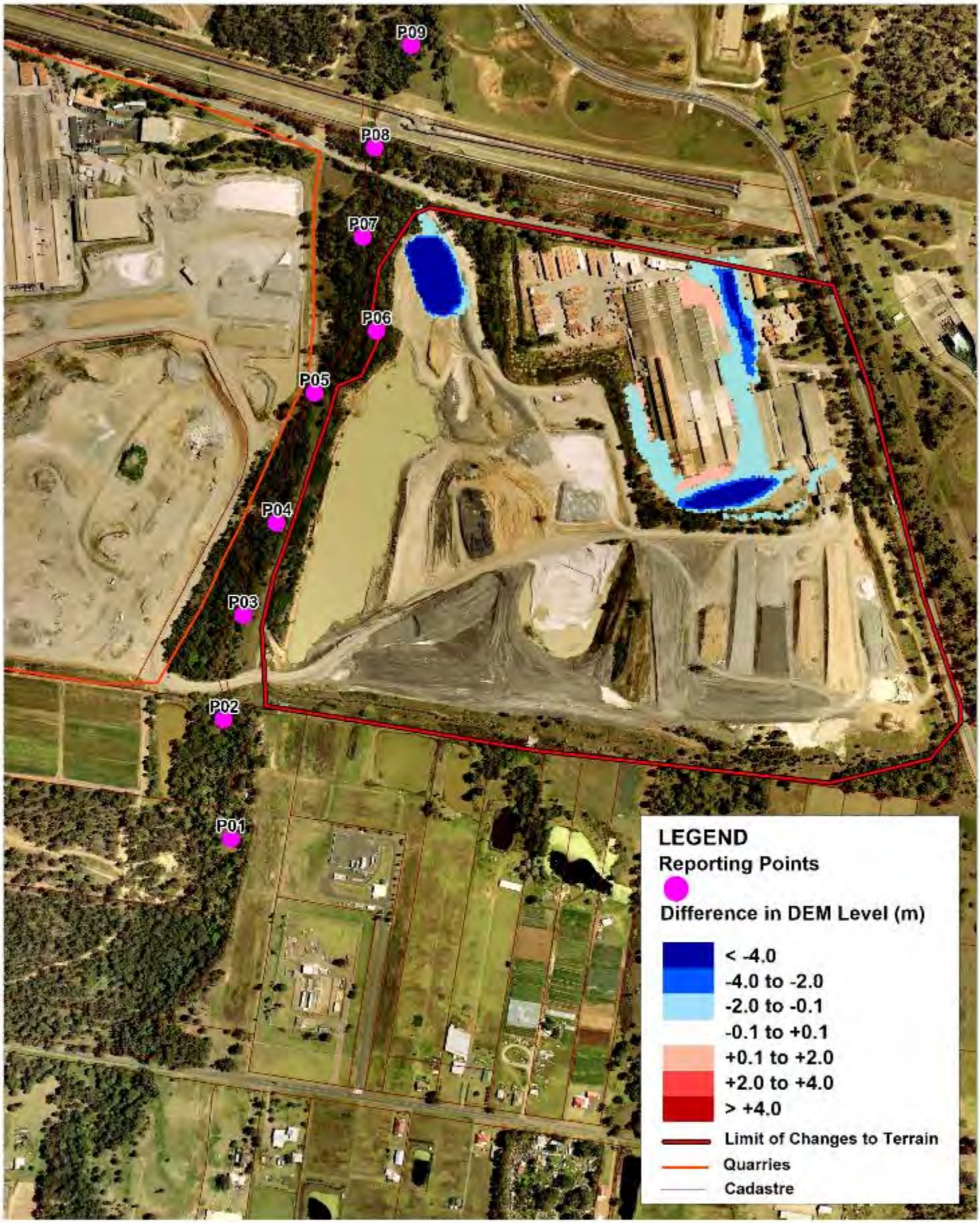

Title:

Study Area and Reporting Locations

Figure:	Rev:
1	-

N

0 125 250m

Approx. Scale

BMT

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- Existing Case Model (Pre-development conditions)

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

- Proposed Case Model

Two proposed development models were developed when preparing the flood impact assessment in order to mitigate flood impacts in Eastern Creek from the development (only the final scenario is reported). Proposed development site topography was provided as 12da files. This terrain data was similarly patched over the pre-development model. Figure 1 shows the change in topography for the Proposed Case versus Existing Case model. No other land use changes including Manning's "*n*" roughness 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^2/s added back in. Sp,e additional filtering was also applied to remove flood "islands" on the Veolia site. Because of this criteria, there are areas (such in the Figure 1 20 year ARI comparisons) where there may be large areas of "newly flooded" or "no longer flooded" which may be areas where depths below 150 mm were present in the model.

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

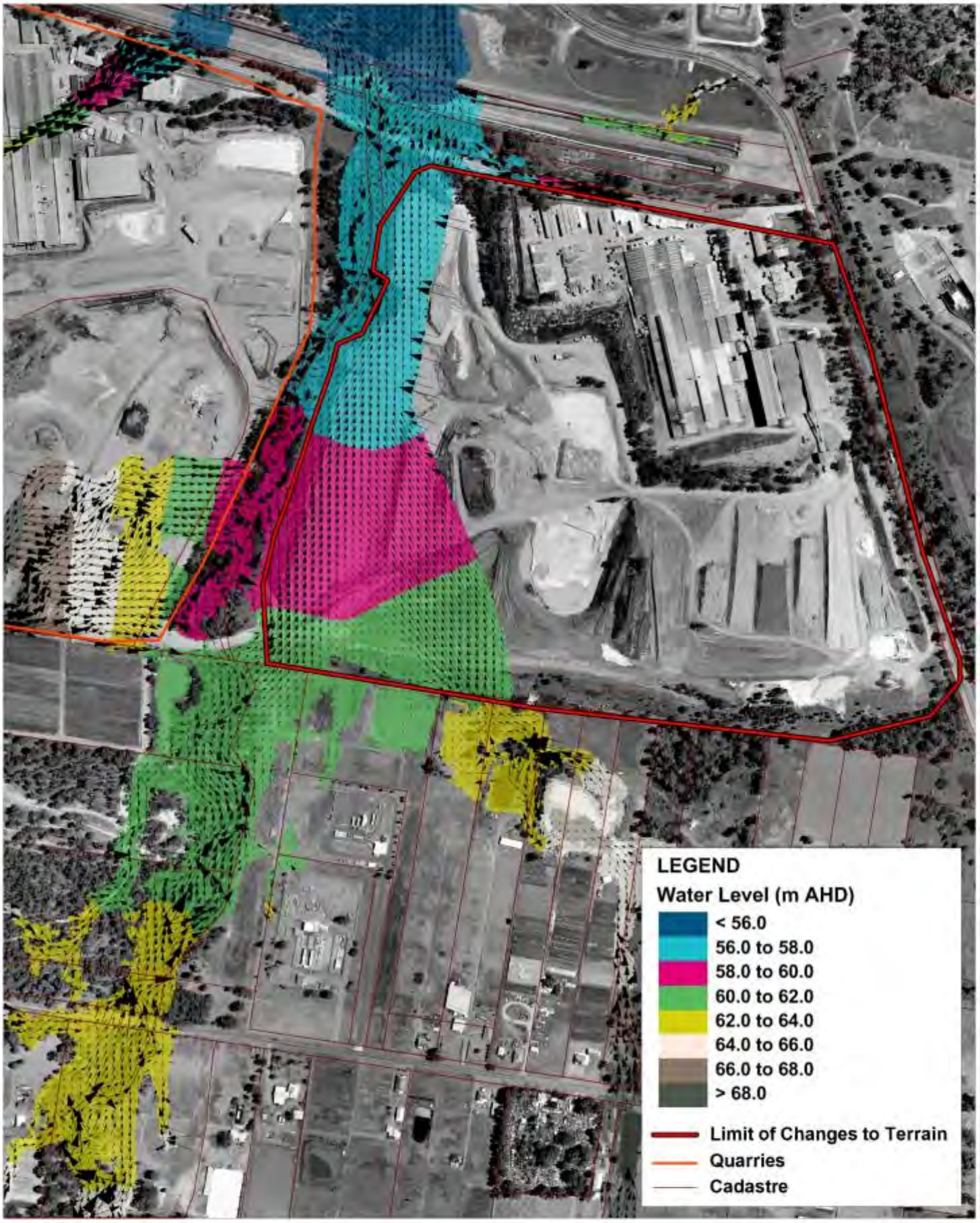
C3 PMF Maximum Water Levels - Pre Developed

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)

Figure: 02

Rev: -

N

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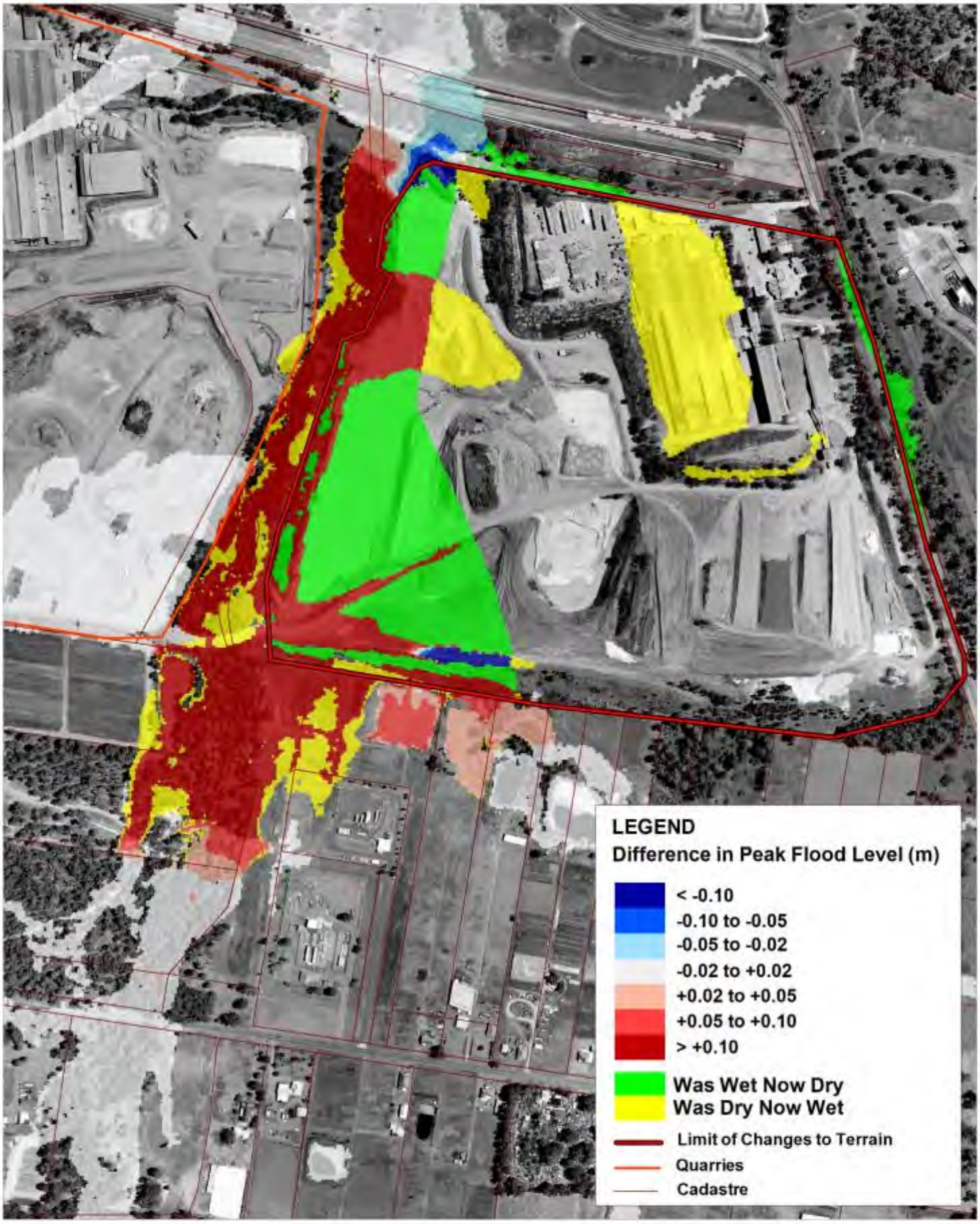
Approx. Scale

BMT

Filepath : S20149\MI\Workspaces\Figure02_100YR_Level.wor



Title:

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

Figure: 03

Rev: -

N

0 125 250m

Approx. Scale

BMT

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

Table 1 Peak Water Levels Results on site (mAHD)

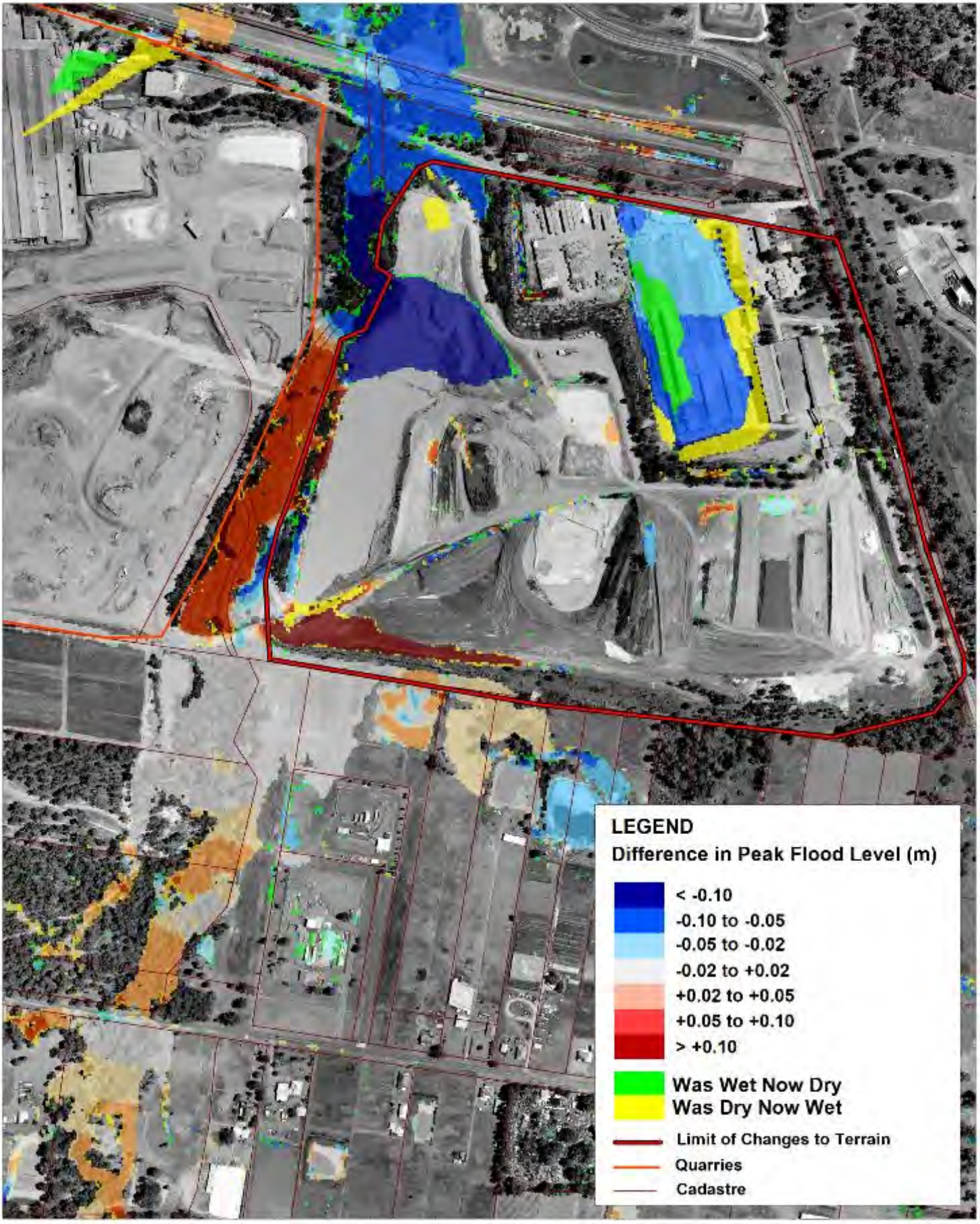
Location	Pre Developed			Post Developed (It 2)			Impacts		
	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF	5% AEP	1% AEP	PMF
P01	61.17	61.33	62.84	61.18	61.33	62.84	0.01	0.00	-0.01
P02	61.11	61.24	62.75	61.10	61.24	62.74	-0.01	0.00	-0.01
P03	59.19	59.56	61.85	59.28	59.56	61.79	0.09	0.00	-0.06
P04	58.75	59.10	61.27	58.84	59.09	61.17	0.08	0.00	-0.10
P05	57.75	58.11	59.95	57.80	58.08	59.81	0.05	-0.03	-0.14
P06	57.22	57.63	59.66	57.10	57.59	59.52	-0.12	-0.03	-0.15
P07	56.80	57.11	58.75	56.70	57.09	58.65	-0.10	-0.03	-0.10
P08	56.16	56.29	57.43	56.10	56.28	57.41	-0.07	-0.01	-0.02
P09	55.40	55.57	56.95	55.34	55.55	56.94	-0.07	-0.02	-0.01

Yours Faithfully

BMT WBM

Joshua Atkinson

Appendix A Flood Level Impact Mapping



Title:

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

Figure: A-1

Rev: -

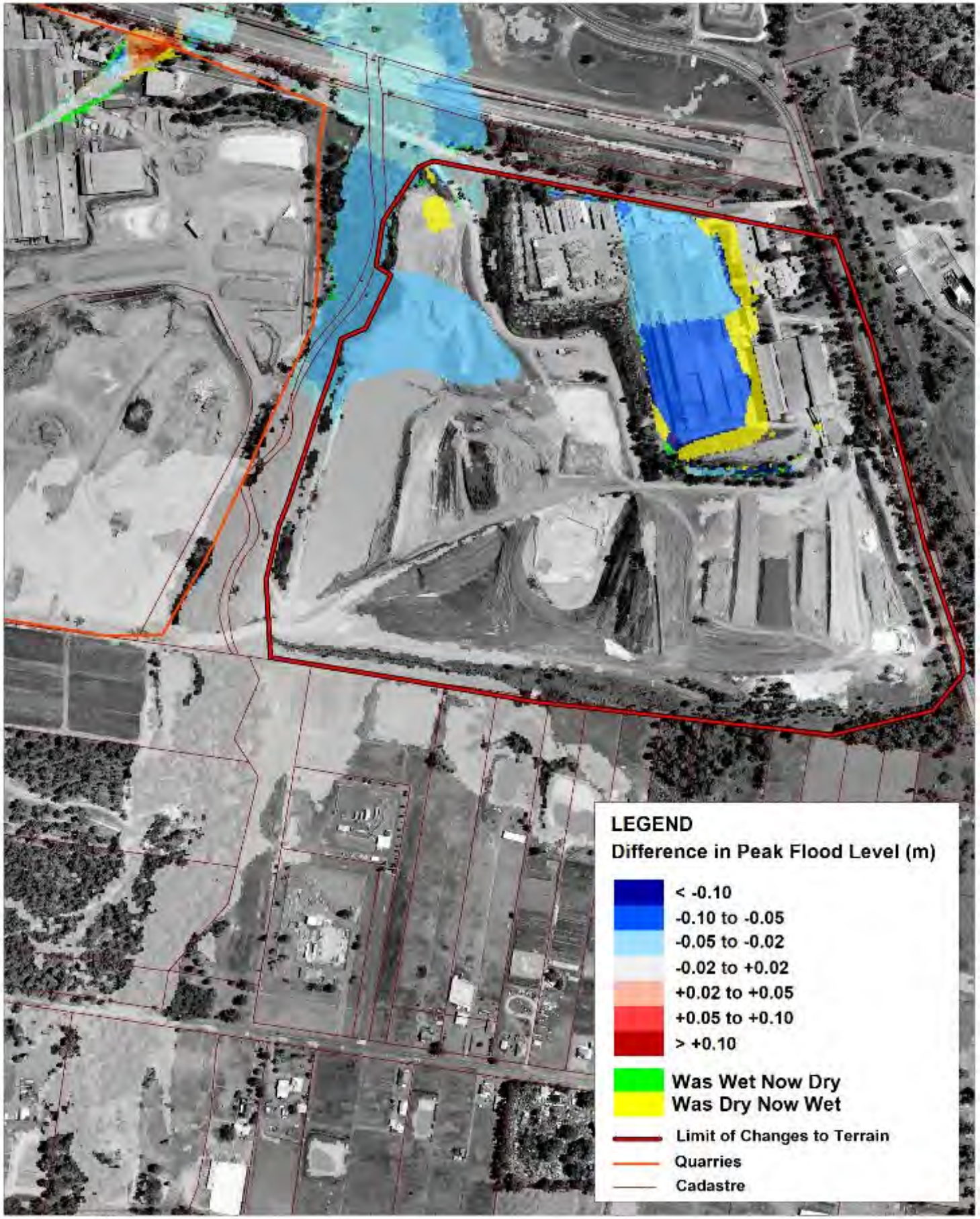
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureA01_020_Imp_PostDv2_PreDv.wor



Title:

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

Figure: A-2

Rev: -

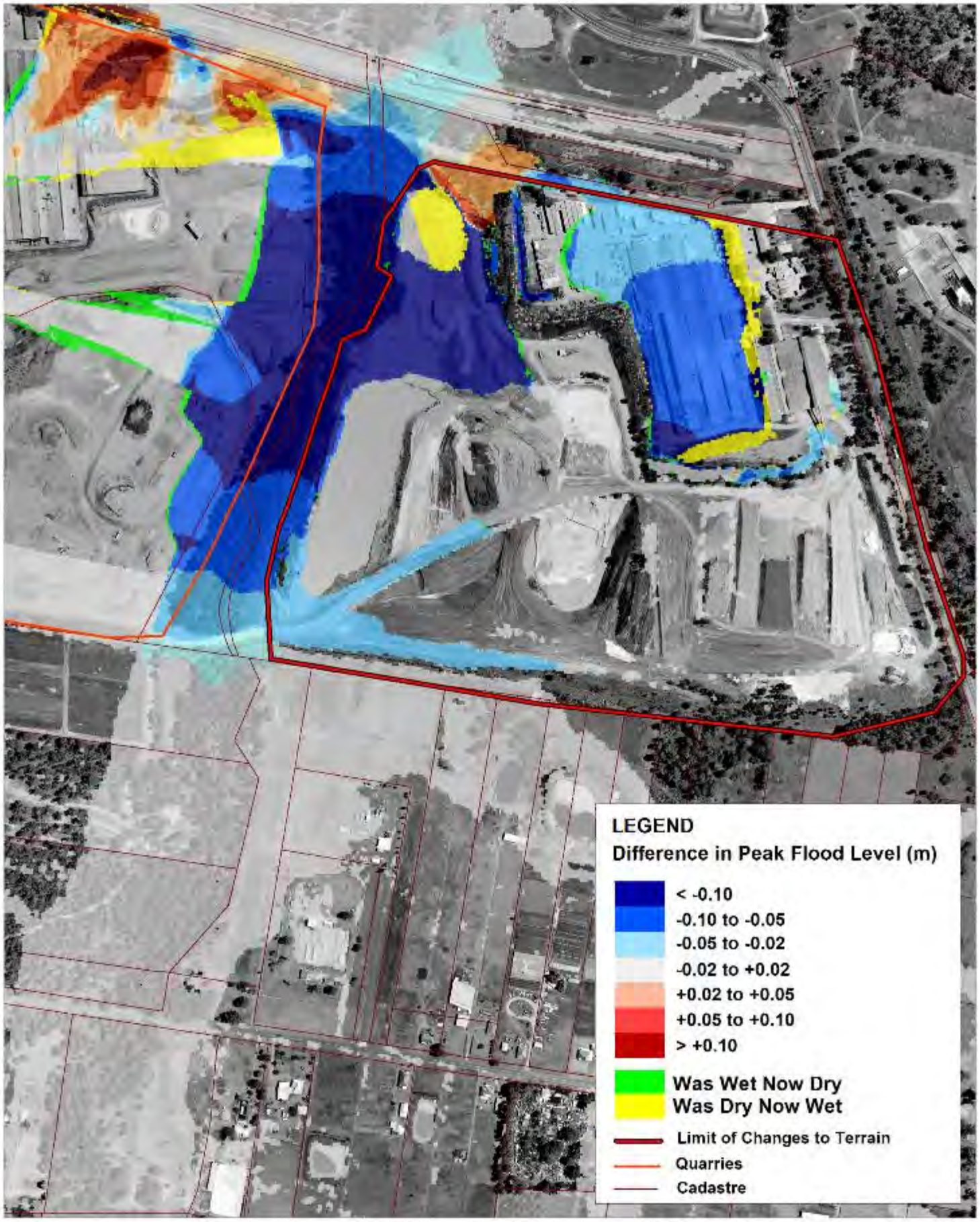
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureA02_100_Imp_PostDv2_PreDv.wor



Title:

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

Figure:	Rev:
A-3	-

N

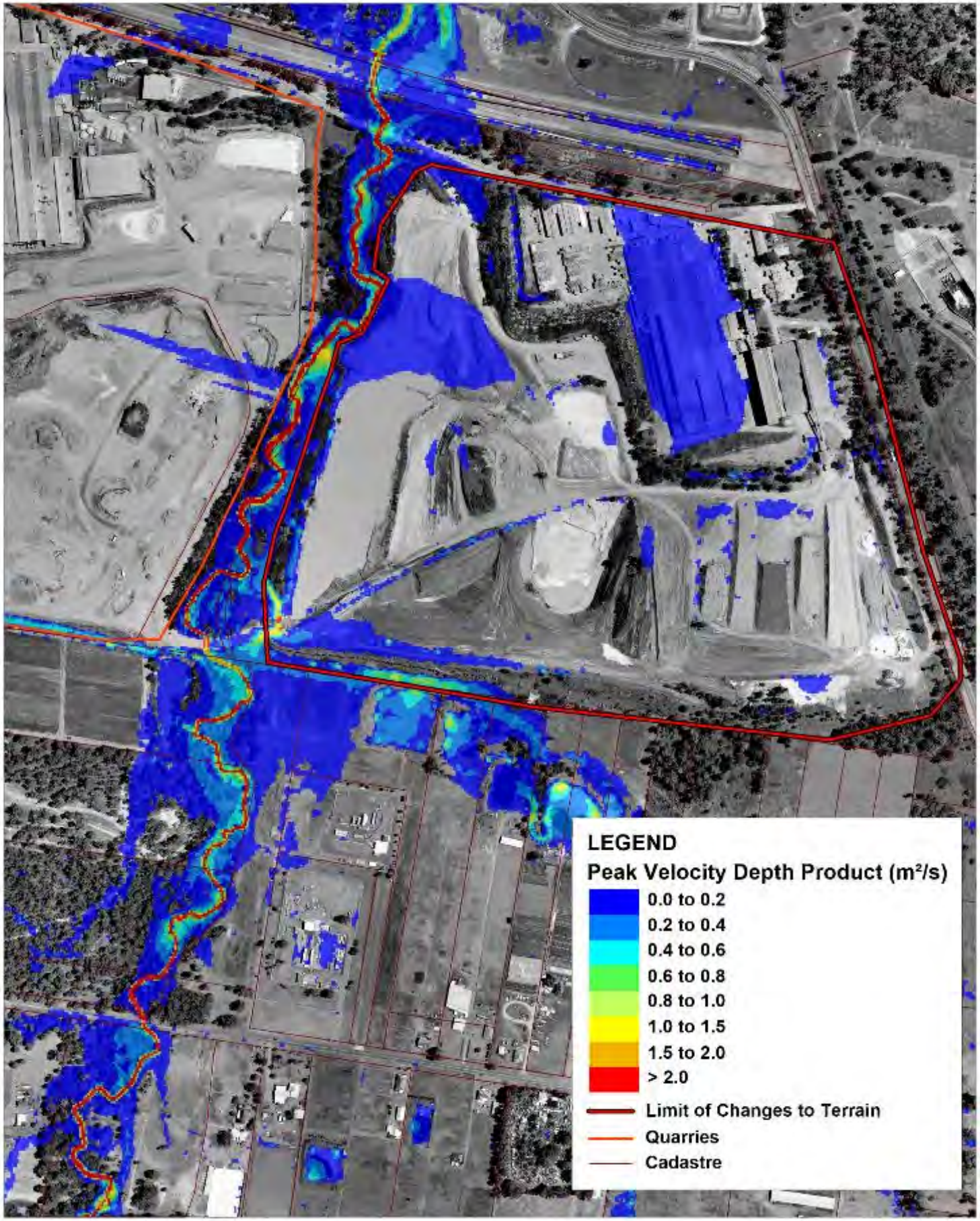
0 125 250m

Approx. Scale

BMT

Filepath : S20149\MI\Workspaces\FigureA03_PMF_Imp_PostDv2_PreDv.wor

Appendix B Velocity-Depth Product Mapping



Title:

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

Figure: B-1

Rev: -

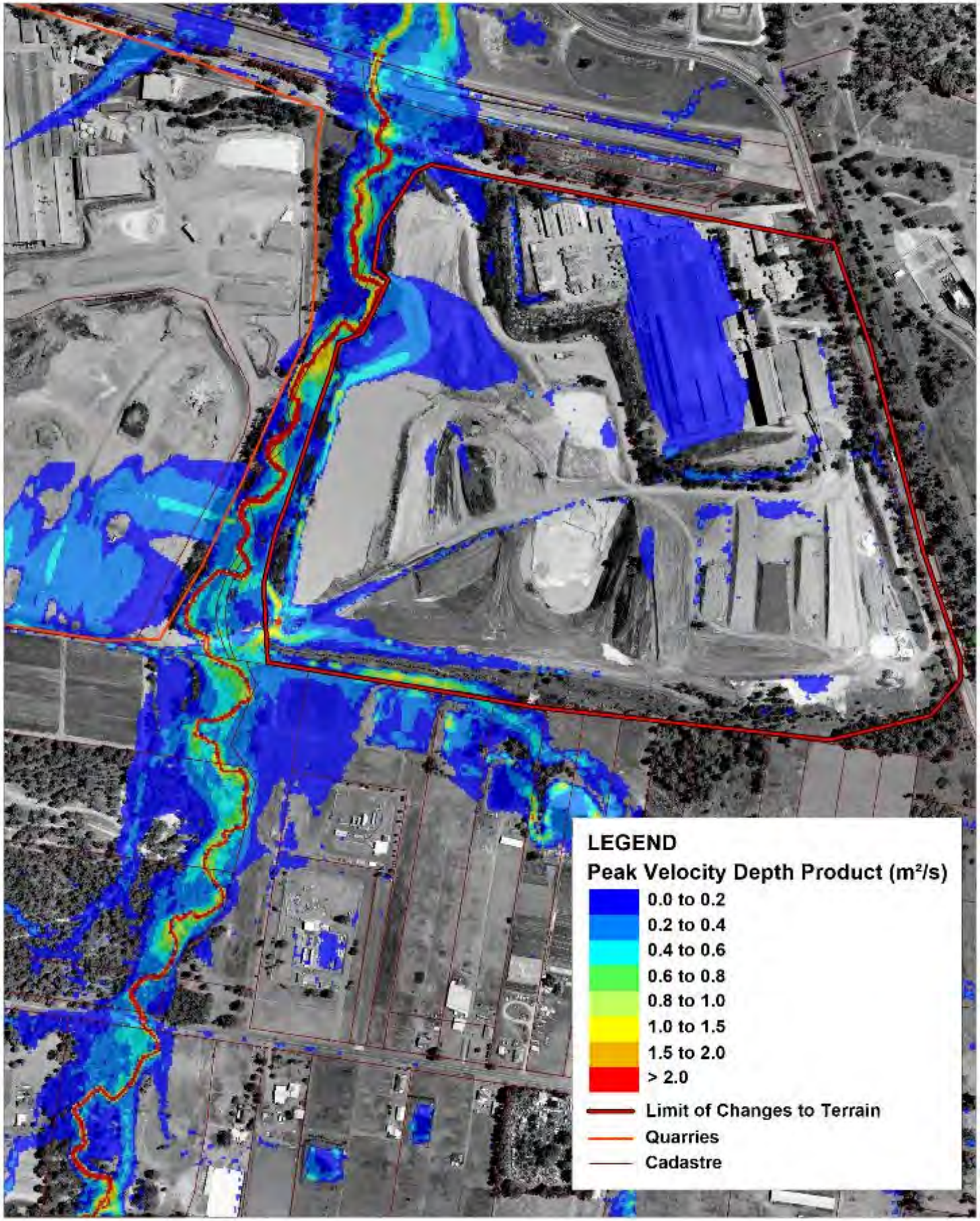
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureB01_020YR_VD.wor



Title:

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

Figure: B-2

Rev: -

N

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Approx. Scale

BMT

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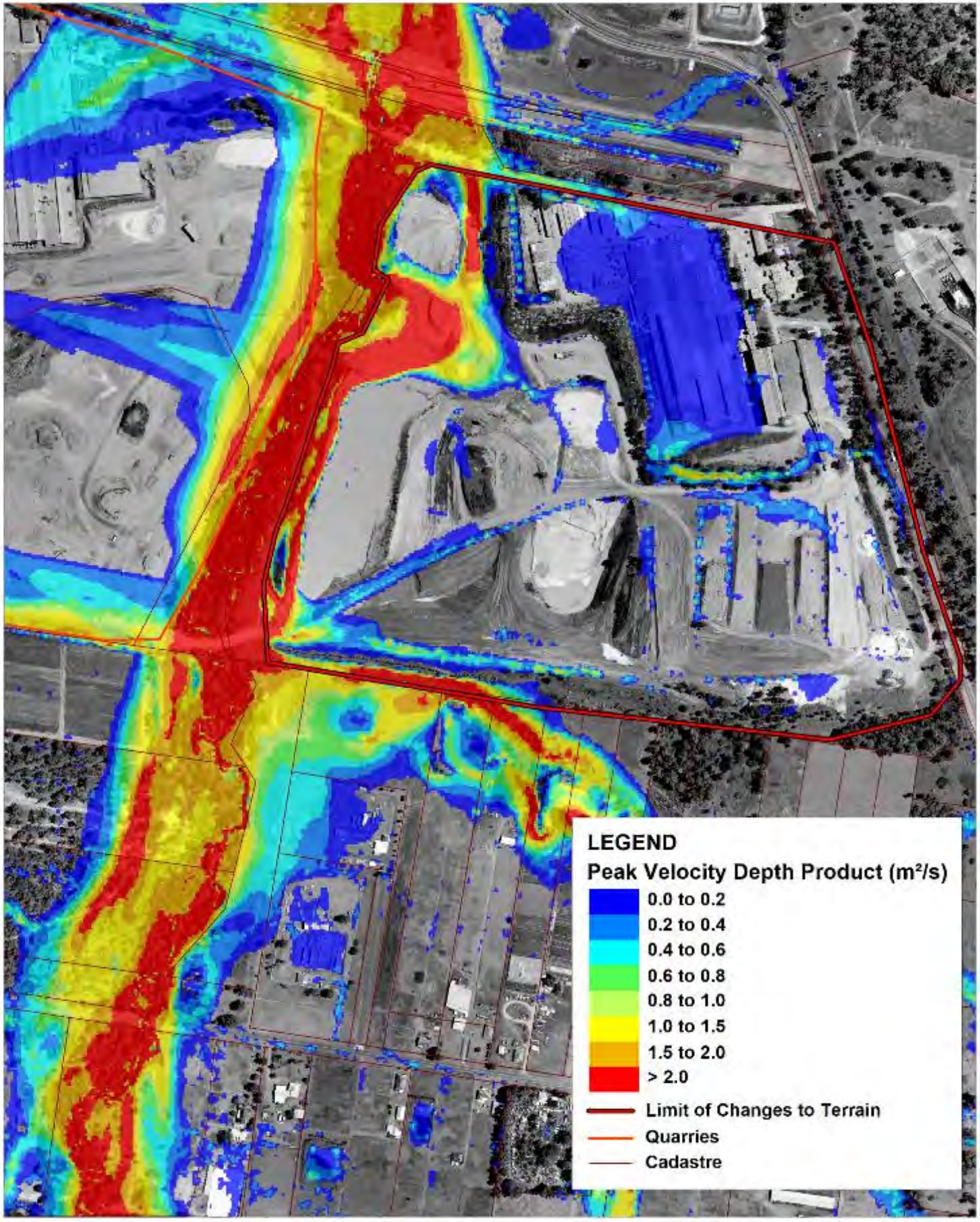


Title:

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

Figure: B-3

Rev: -

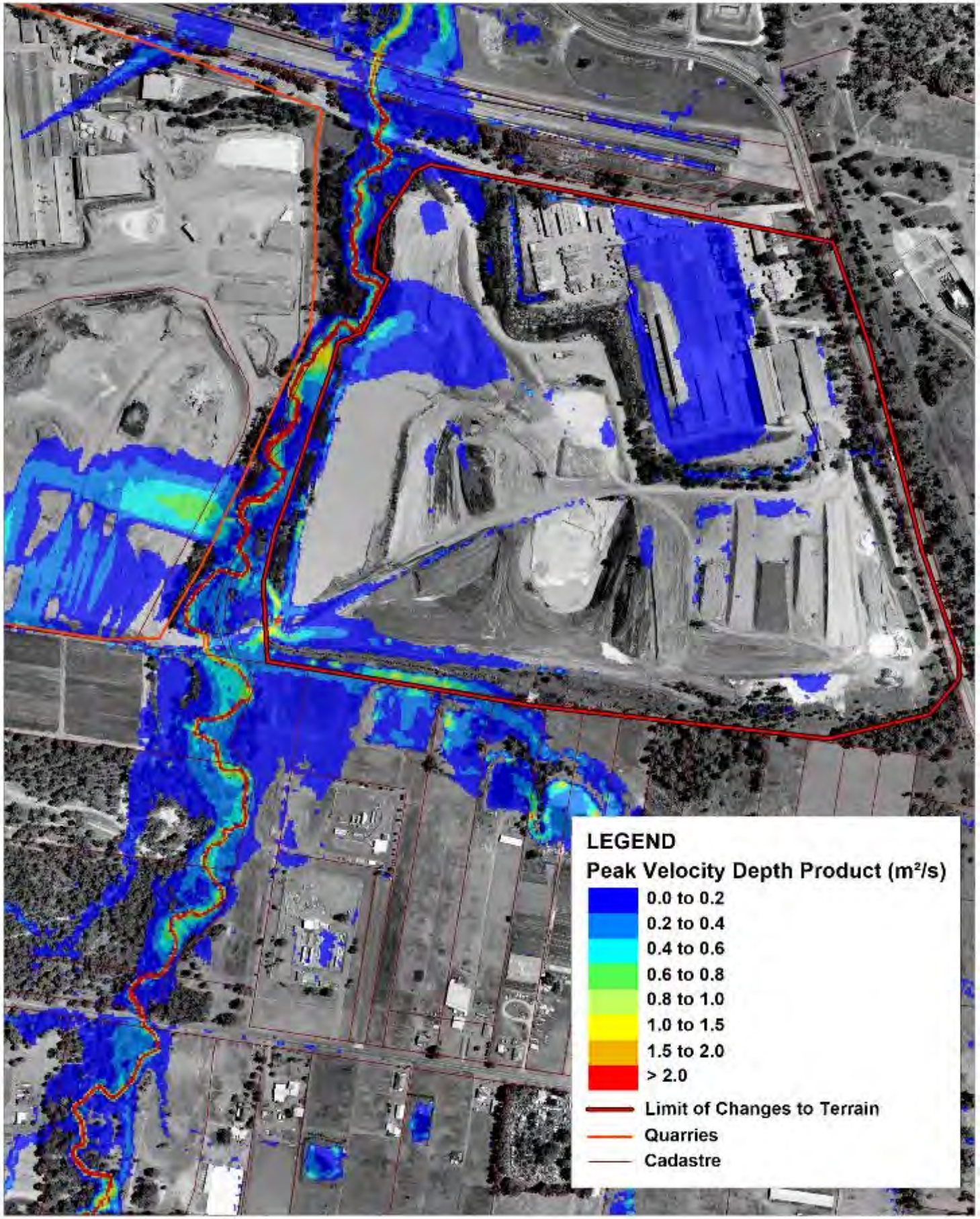
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureB03_PMF_VD.wor



Title:

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

Figure: B-4

Rev: -

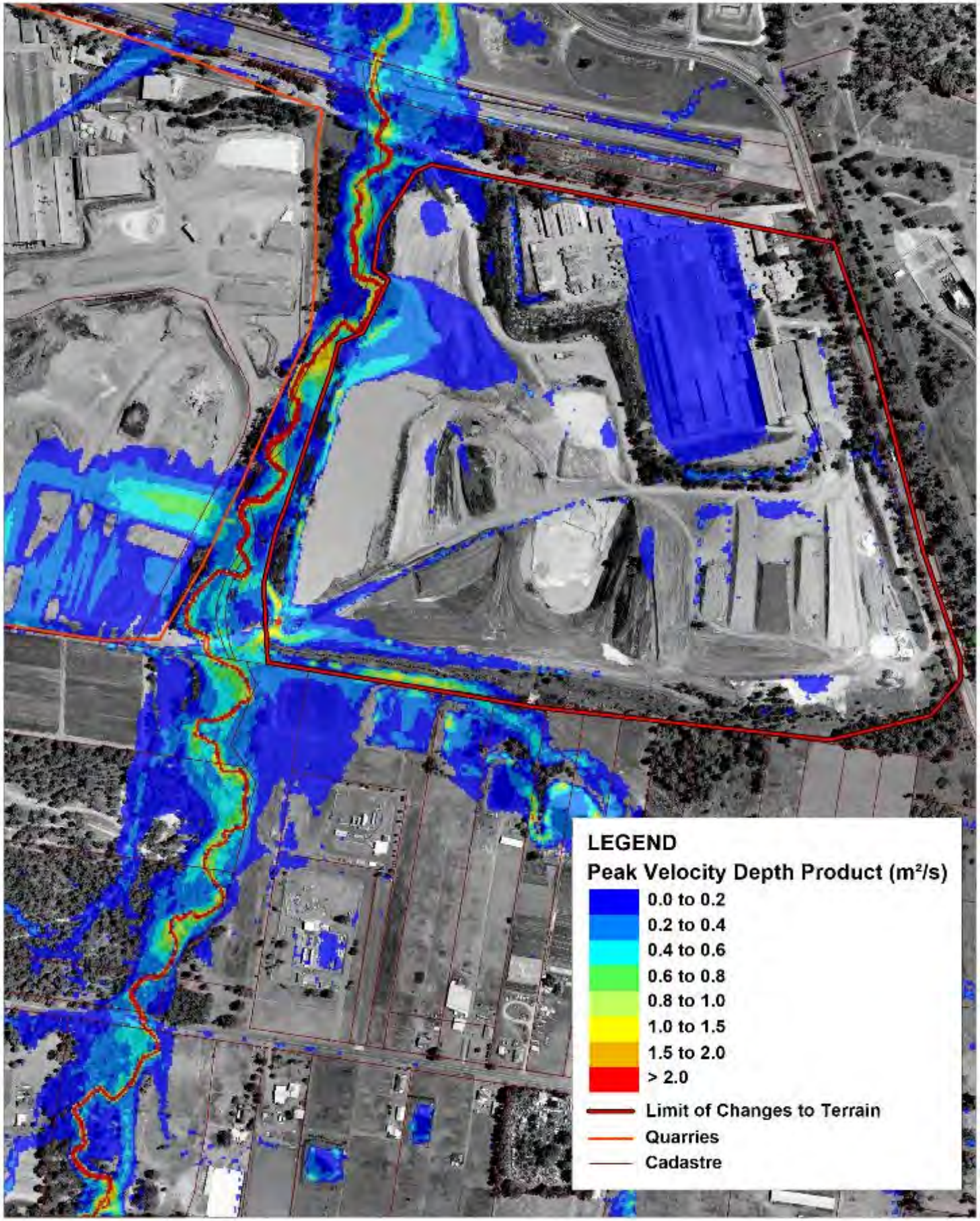
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureB04_020YR_VD.wor



Title:

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

Figure: B-5

Rev: -

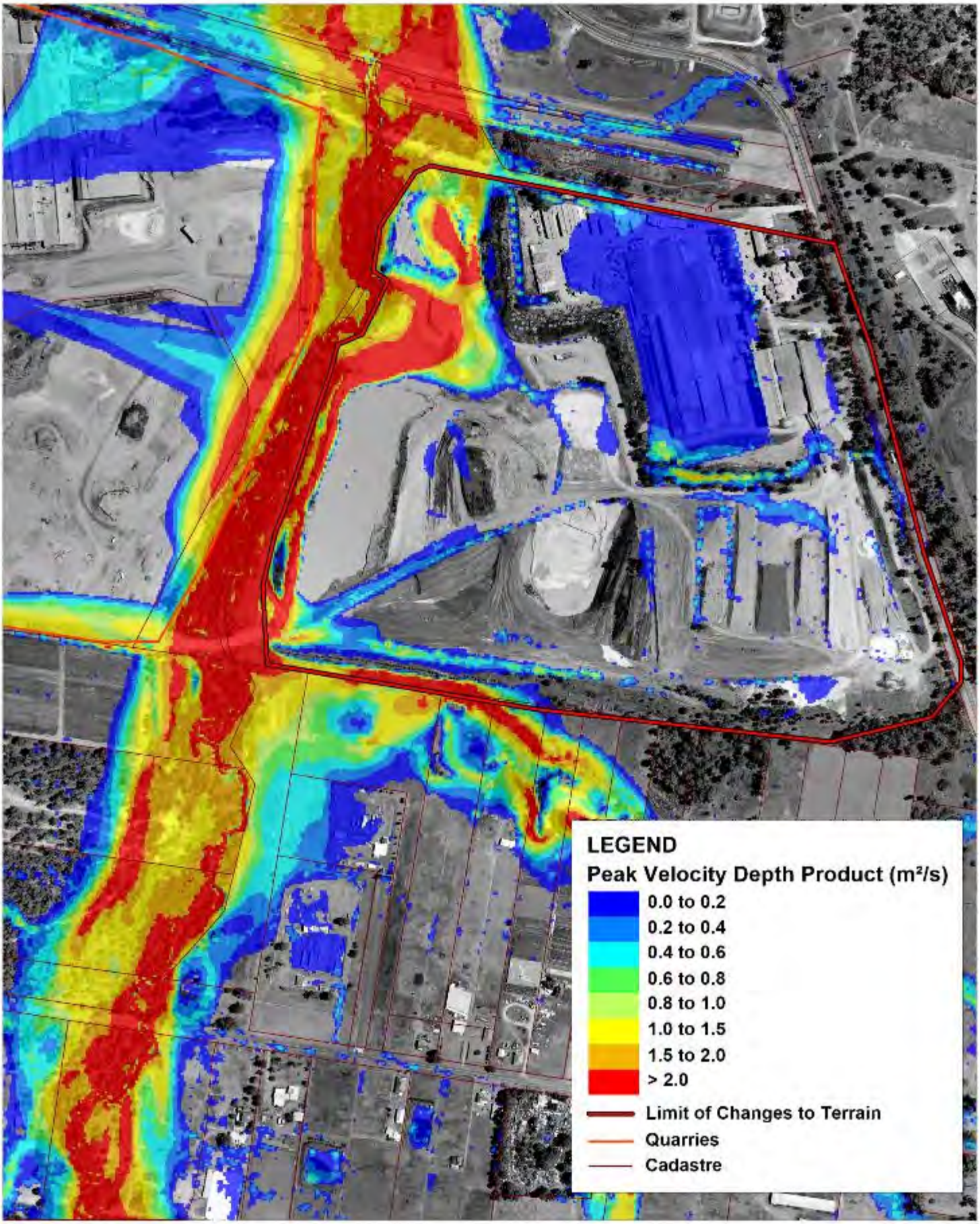
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureB05_100YR_VD.wor



Title:

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

Figure:	Rev:
B-6	-

N

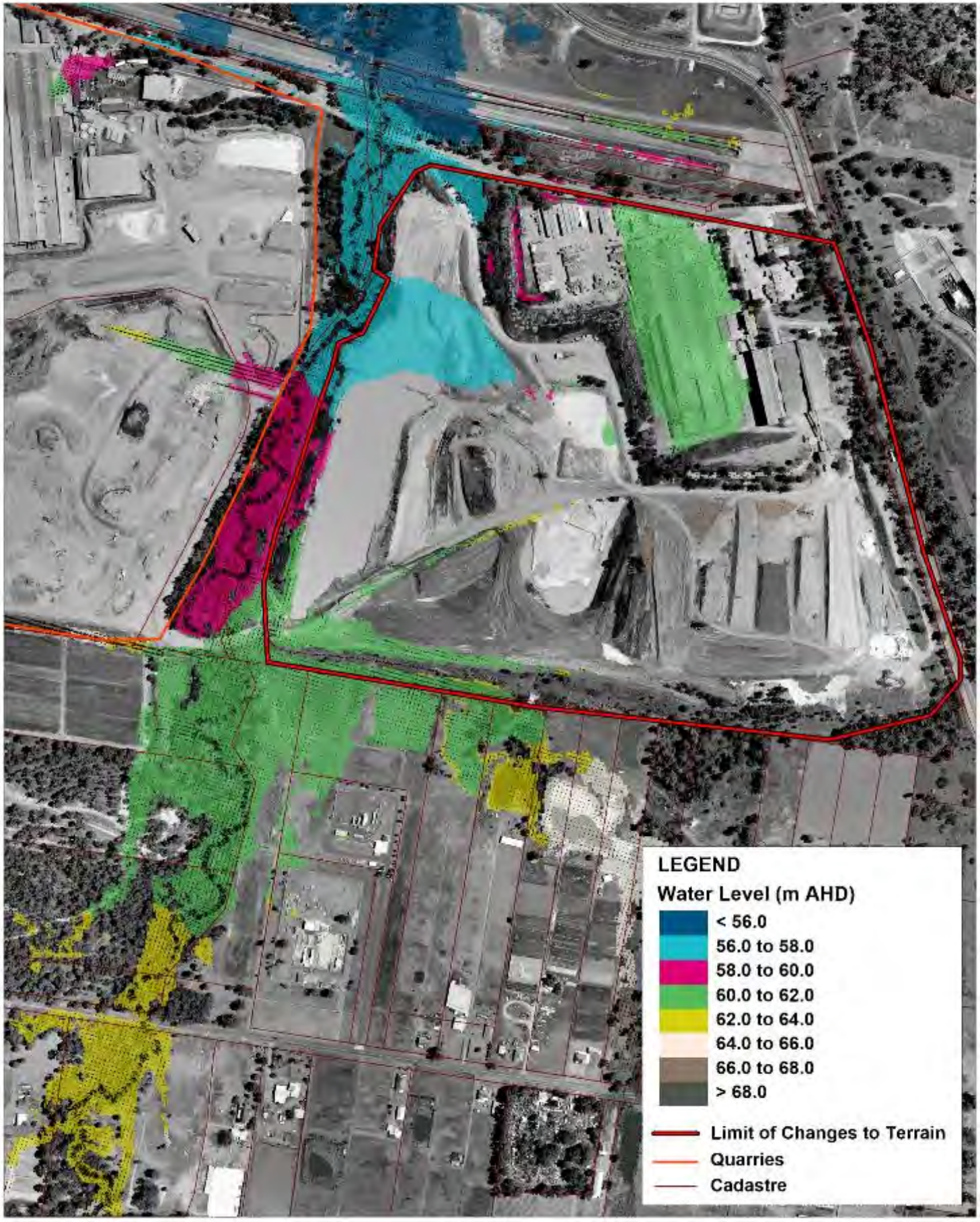
0 125 250m

Approx. Scale

BMT

Filepath : S20149\MI\Workspaces\FigureB06_PMF_VD.wor

Appendix C Peak Water Level Mapping



Title:

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

Figure: C-1

Rev: -

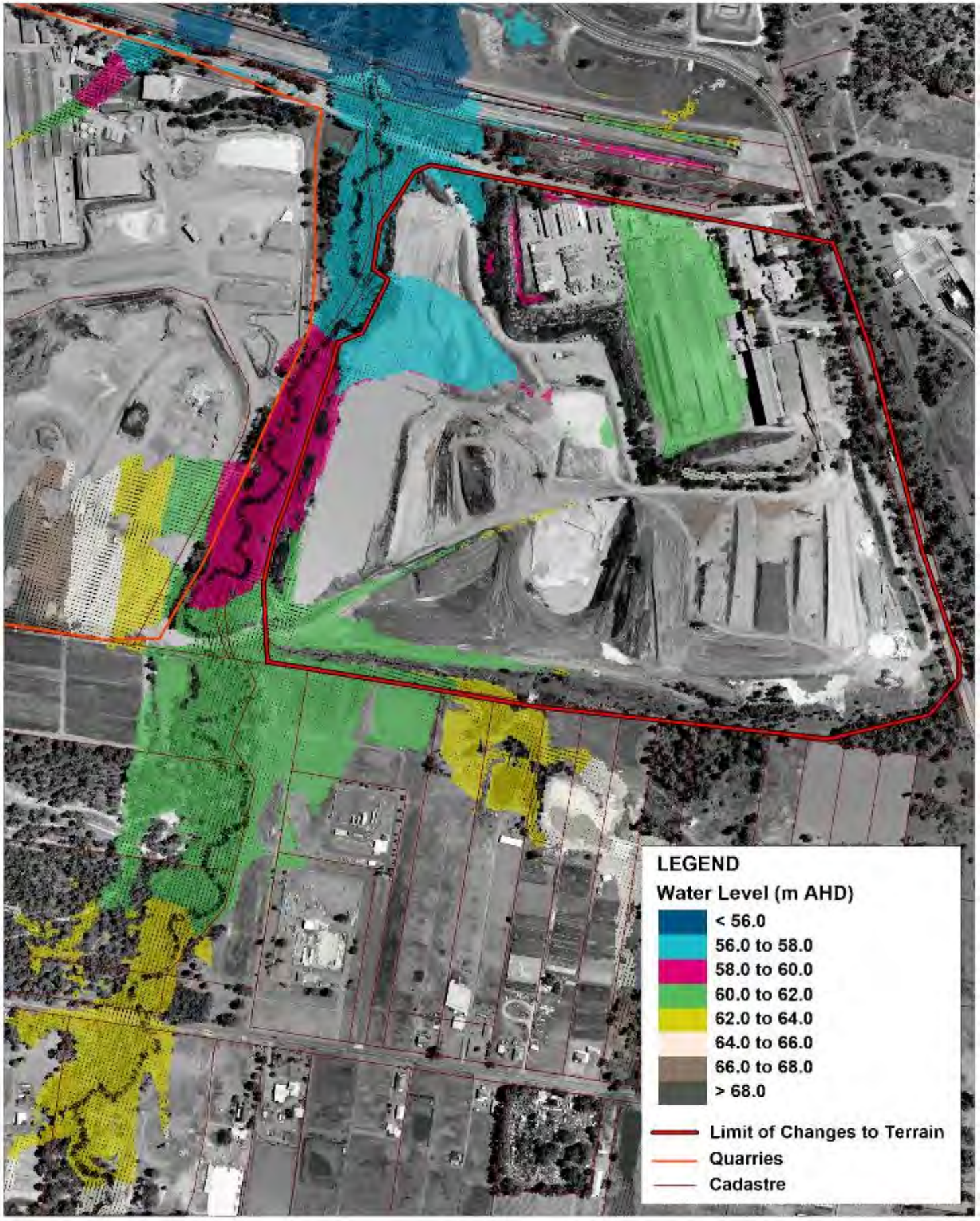
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M1\Workspaces\FigureC01_020YR_Level.wor



Title:

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

Figure: C-2

Rev: -

N

0 125 250m

Approx. Scale

BMT

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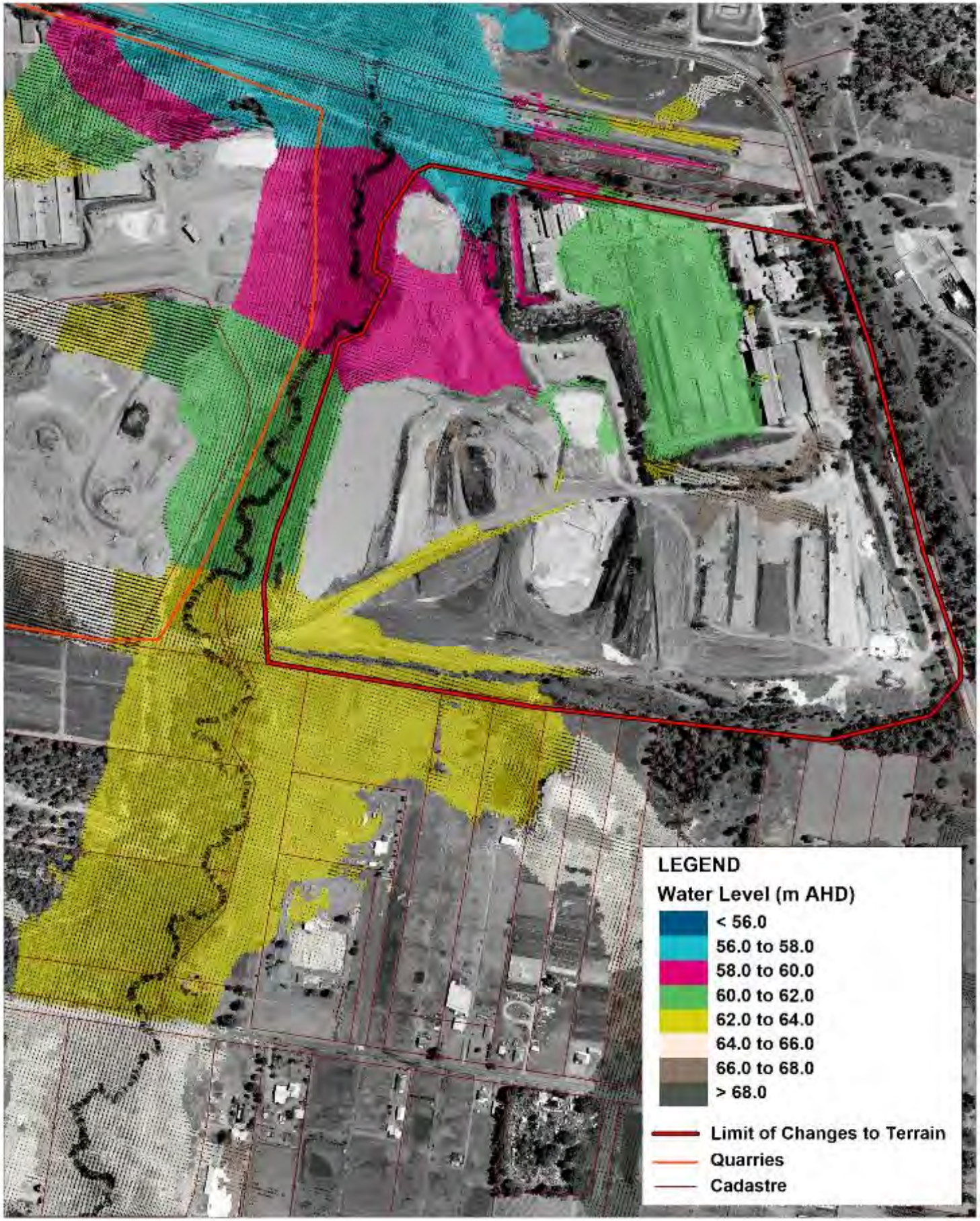


Title:

Pre Development -Peak Flood Level Probable Maximum Flood (PMF)

Figure: C-3

Rev: -

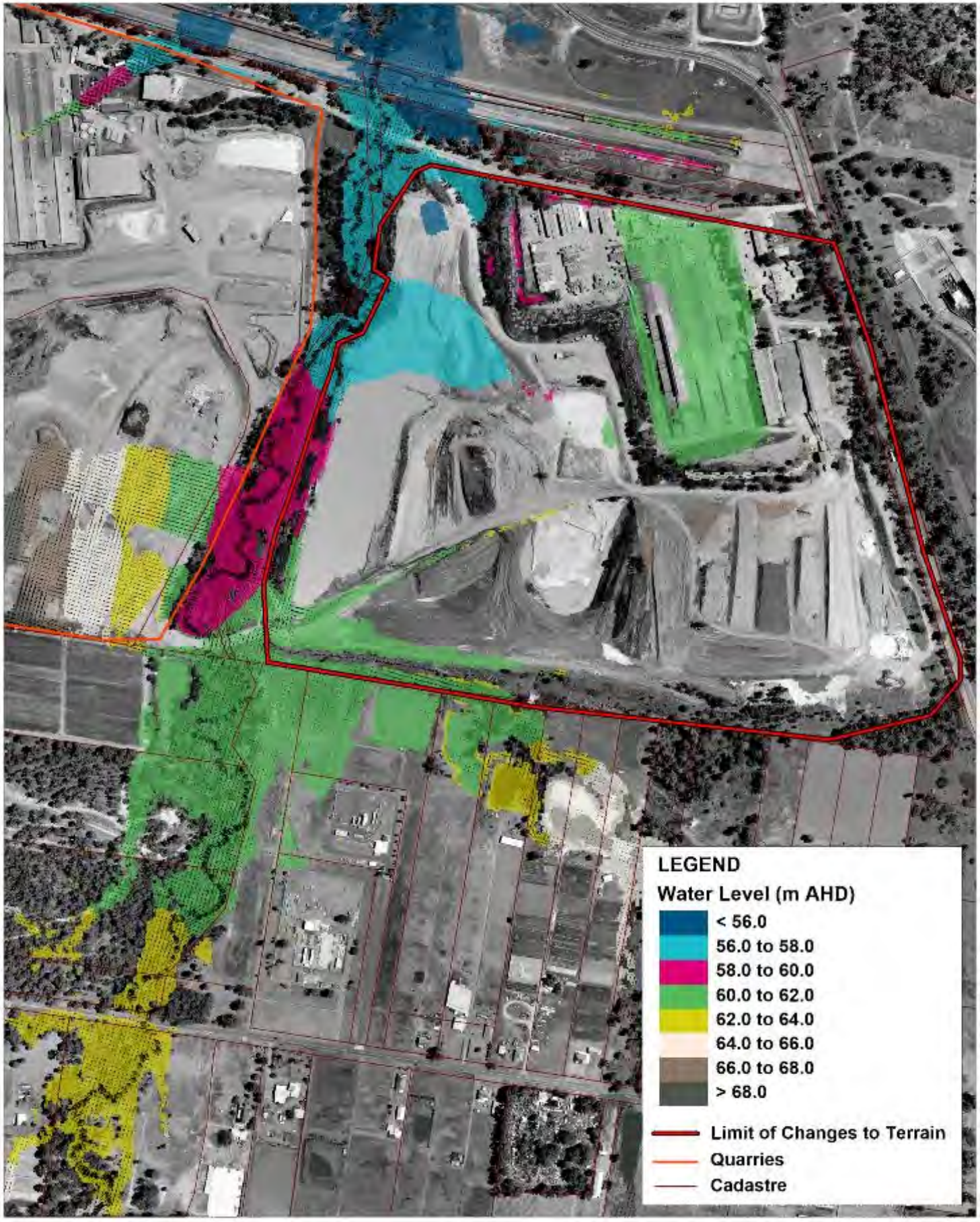
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureC03_PMF_Level.wor



Title:

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

Figure: C-4

Rev: -

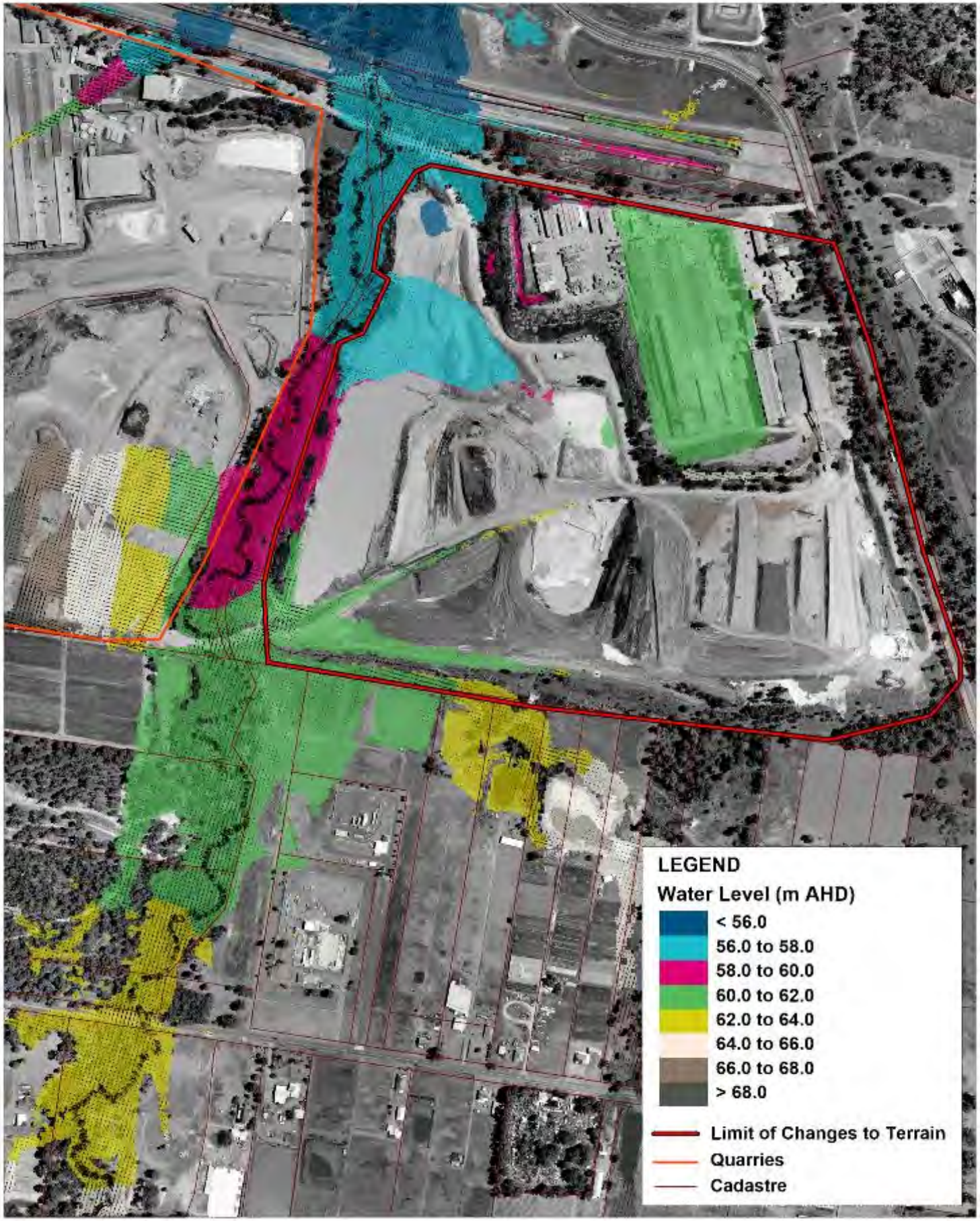
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M1\Workspaces\FigureC04_020YR_Level.wor



Title:

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

Figure: C-5

Rev: -

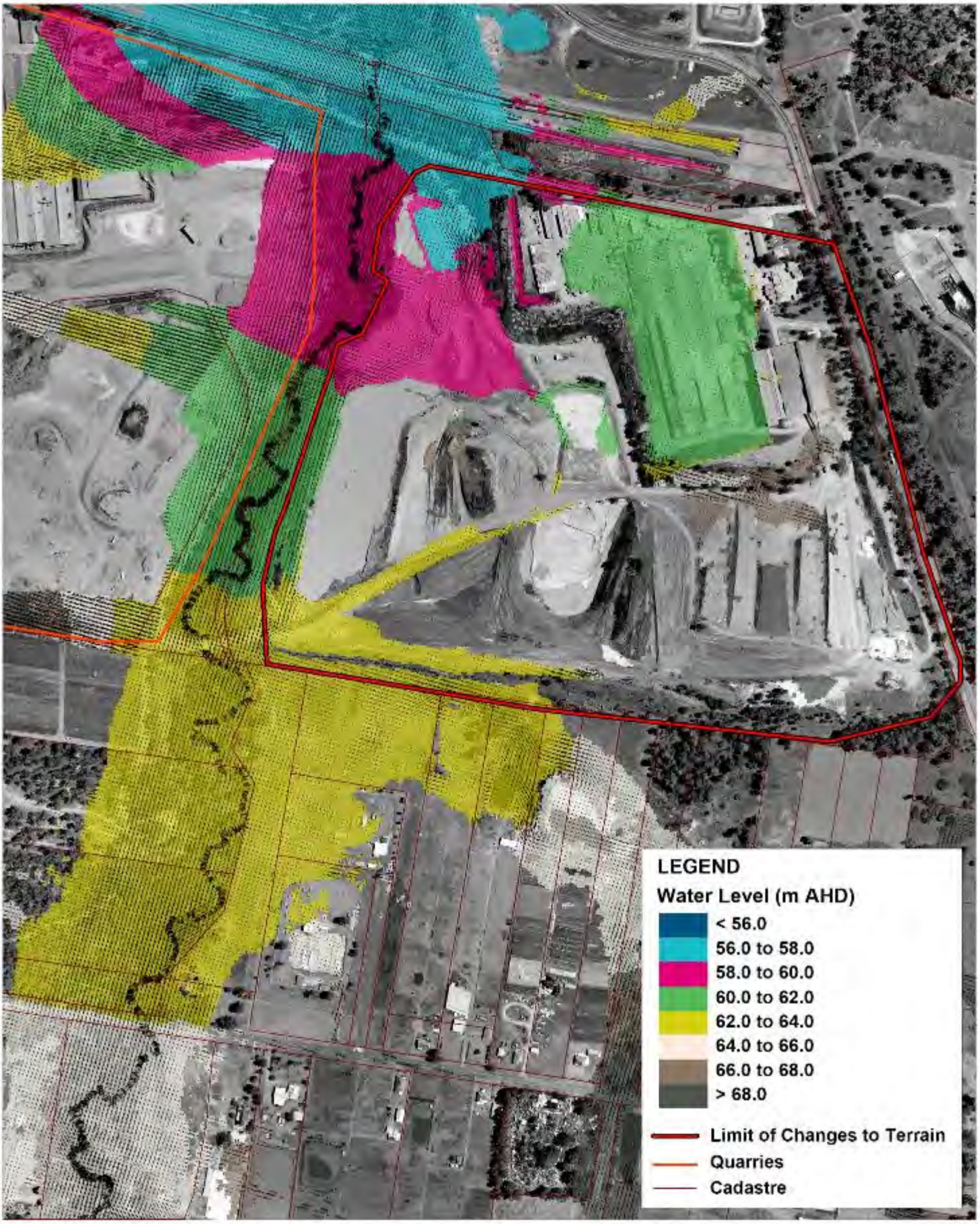
N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\M\Workspaces\FigureC05_100YR_Level.wor



Title:

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

Figure: C-6

Rev: -

N

0 125 250m

Approx. Scale

BMT

Filepath : S20149\MI\Workspaces\FigureC06_PMF_Level.wor

at&l

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