Engineering Value

www.sgce.com.au

Industrial Development

5 Kiora Crescent, Yennora

Flood Study Report - Issue 01

Prepared For Mr Eddie Hawach

Date: Monday, 7 December 20

File Reference: 20190032-R01_flood study [01].docx

+61 2 8883 4239

P.O. Box 7855 Baulkham Hills NSW 2153

Suite 5.03, L5, 156 Pacific Highway St Leonards NSW 2065

ENGINEERS AUSTRALIA
Chartered Professional Engineer
MEMBER

Revision Table

Revision	Date	Issue Description	Issued by	Approved by	Signed
A	25/10/2019	Submission to council	AA	SH	
B	12/11/2019	Submission to council	AA	SH	
C	18/11/2019	Submission to council	AA	SH	
01	08/09/2020	Schedule A submission	AA	SH	
02	07/12/2020	Schedule A submission	MN	SH	

Table of Contents

List of Figures

List of Tables

1 Executive Summary

This document is a flood assessment report for the proposed Industrial development located at 5 Kiora Crescent, Yennora.

The site is legally described as Lot 10 in DP 1233715.

Mr Eddie Hawach is proposing an Industrial Development to replace the existing bitumen carpark at the cul-de-sac of Kiora Crescent.

The Concept Plans prepared by Baini Design P/L show single level industrial factory units with outside parking facilities.

The proposed development is illustrated in Figure 1.1 below.

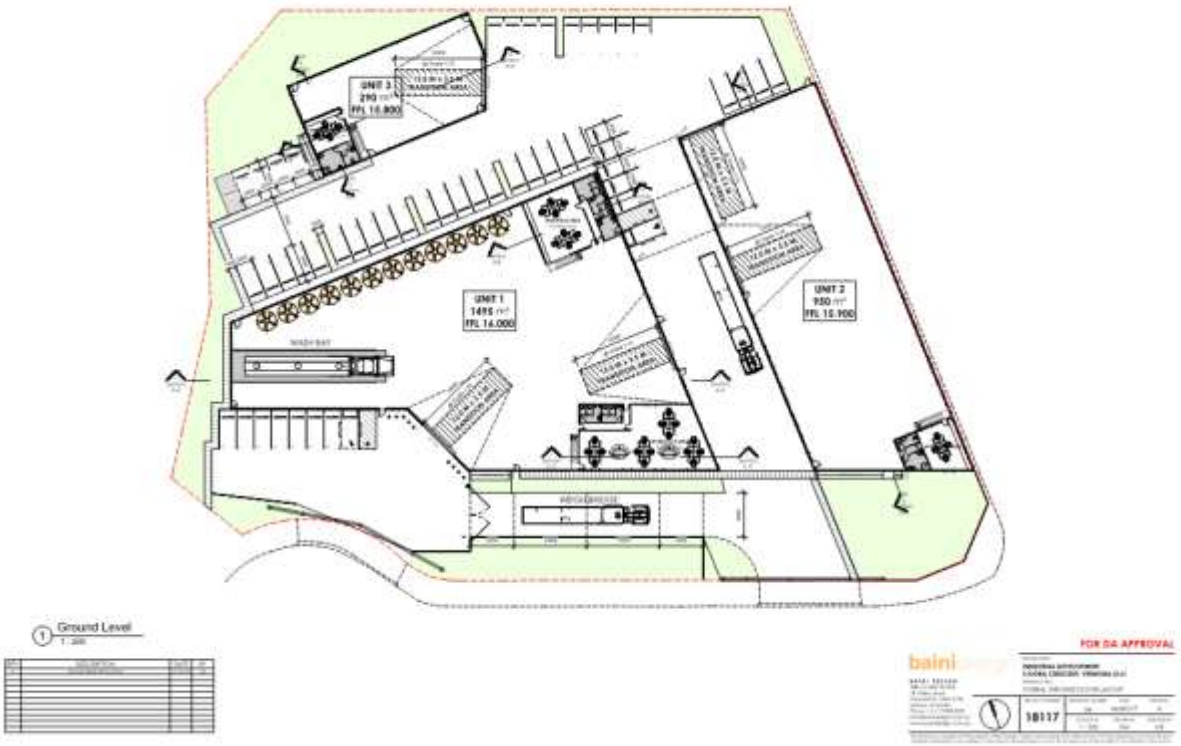

Figure 1.1 Site Plan

The flood assessment report provides:-

- An assessment of the overland flooding from local upstream catchment affecting the site; and
- Addressing the requirements of the local council and the NSW Floodplain Development Manual in relation to Flood Planning Level and potential impact on flooding.

The proposed development has been revised to incorporate the results of this flood study. The Flood Planning Level (FPL) adopted for the proposed is set at RL 15.90, which is 0.5m above the 100-yr ARI flood level and meets the requirements of Cumberland Council as per Table 1.1 below. Reference can be made to A1.5 showing the peak flood level for the proposed scenario.

Table 1.1 Flood Level & FPL Summary Table

Site 5 Kiora Crescent, Yennora	Flood Level 100-yr	FPL 500mm Freeboard
Unit 1	15.50	16.00
Unit 2	15.40	15.90
Unit 3	15.30	15.80

2 Introduction

2.1 Brief

S&G Consultants Pty Ltd (SGC) have been engaged by Baini Design to carry out a flood study in support of the proposed Industrial Development at 5 Kiora Crescent, Yennora.

Cumberland Council requires the flood study because the site is affected by overland flooding associated with the trunk main traversing the site.

The following tasks were carried out:-

- A site visit was undertaken on the 22nd of May 2019 to ascertain on-site conditions and familiarise with the catchment;
- Supplied documents and previous studies were reviewed;
- A flood study involving the set-up of a fully dynamic 1D/2D model is carried out to determine the peak discharges and the flood levels; and
- This report has been compiled.

2.2 Limitations

This report is intended solely for Baini Design and Mr Eddie Hawach as the Client of SGC and no liability will be accepted for use of the information contained in this report by other parties than this client.

This report is limited to visual observations and to the information including the referenced documents made available at the time when this report was written.

2.3 Reference Documents

The following documents have been referenced in this report:-

1. **Site survey prepared by New South Surveys P/L ref. 118097 dated 04/04/2018;**
2. **Architectural drawings prepared by Baini Design P/L;**
3. **NSW Government the Floodplain Development Manual – The management of Flood Liable Land (2005);**
4. **Engineers Australia, *Australian Rainfall & Runoff* (AR&R 1999);**
5. **Aerial Scanning Data (ALS) for the study area received from LPI; and**
6. **Holroyd Council DCP 2013 Part A Section 8 Flood Prone Land.**

3 Natural & Built Environment

3.1 Local and Regional Context

The site is located in the Local Government Area of Cumberland City Council (Holroyd) and falls within the Prospect Creek catchment.

The site is made of a single lot with a total area of 7221m^2 (Lot 10 DP 1233715) and is bounded by Kiora Crescent to the South and adjoining properties in all other directions. Reference is made to Appendix 4 for a copy of the detailed survey plan. Also refer to the figures below for photos of the site & adjacent properties.

The site has an irregular rectangular shape and is characterised by a low lying area through the middle and presents a general gradient from South East & North West to the middle.

Figure 3.1 Locality Plan

3.2 Development Description

Baini Design Pty Ltd provided the design of the Industrial Factory Units. Key features of the proposed development include:-

- Three single level factory unit structures;
- 50 car parking spots and 5 internal driveway ramps with access off Kiora Crescent;
- Washing bay and weigh bridge for trucks; and
- The proposed development covers most of the site area and improves pre conditions with the inclusion of landscaped areas.

More details of the proposed development are included on the architectural drawings. Reference is made to Appendix 3 for a copy of some of the architectural Site plan.

4 Glossary

Annual Exceedance Probability (AEP)

The chance of a flood of a given or a larger size occurring in any one year, usually expressed as a percentage.

Australian Height Datum (AHD)

A common national surface level datum approximately corresponding to mean sea level.

Average Recurrence Interval (ARI)

The long term average number of years between the occurrence of a flood as big as or larger than the selected event.

Catchment

The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Flood

Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse.

Flood Liable Land or Flood Prone Land

Land susceptible to flooding by the PMF.

Flood Planning Levels (FPLs)

Are the combinations of flood levels and freeboards selected for floodplain risk management purposes.

Freeboard

Is a factor of safety typically used in relation to the setting of floor levels.

Habitable Room

In industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to damage in the event of a flood.

Peak Discharge

The maximum discharge occurring during a flood event.

Probable Maximum Flood

PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation.

Probable Maximum Precipitation

PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year.

Runoff

The amount of rainfall which actually ends up as stream flow.

5 Authorities Requirements

5.1 Holroyd DCP 2013

The controls for development in flood liable land are detailed in Council's DCP 2013 under Part A Section 8 Flood Prone Land. The following is an extract from Council's DCP which summarises their requirements based on flood risk precinct and category of development.

Part A

General Controls

Land use categories see table 1 / Planning Consideration	Flood Risk Precincts (FRPs)																									
	Low Flood Risk										Medium Flood Risk								High Flood Risk							
	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivisions	Filling	Residential	Commercial or Industrial	Tourist Related evelopment	Open Space or Non-Urban	Re-development	Minor Additions	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivisions	Filling	Residential	Commercial or Industrial	Tourist Related evelopment	Open Space or Non-Urban	Re-development	Minor Additions	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivisions	Filling	Residential	Commercial or Industrial	Tourist RelatedDevelopment	Open Space or Non-Urban	Re-development	Minor Additions
Design Floor Level	3	3			2,5	2,5	2,5			4					2,5	2,5	2,5	1	5,6	4								1	5,6	4
Building Components	2	2													1	1	1	1	1	1								1	1	1
Structural Soundness	2	2													1	1	1	1	1	1								1	1	1
Flood Effects	2	2	2	1	2	2	2							1	2	2	2	2	1	2								1	1	2
Evacuation	2,4	2,4	3,4		4	3,4	3,4						3,4		3,4	3,4	3,4	1	3,4	3,4								1	3,4	3,4
Management and Design	4	2,4	1										1		3	4	4	3,4	4,5	3,4								3,4	4,5	3,4

Not relevant

Unsuitable Land Use

NOTES:
Terms are defined in Part K of the DCP.

Filling
Filling of the site, where acceptable to Council, may change the Flood Risk Precinct considered to determine the controls applied in the circumstances of individual applications.

Freeboard
Freeboard to habitable floor level equals an additional height of 500mm.
For sites subject to local overland flooding only, the freeboard to habitable floor level can be reduced to the following:
i) Upstream catchment area <2ha – freeboard 200mm minimum;
ii) Upstream catchment area >16ha – freeboard 500mm minimum;
iii) Upstream catchments between 2 to 16ha – freeboard may vary linearly between 200mm to 500mm.

Design Floor Level
1. All Floor Levels shall be equal to or greater than the 20% AEP flood level plus freeboard unless justified by site specific assessment.
2. Habitable floor levels shall be equal to or greater than the FPL (1% AEP flood plus freeboard).
3. All Floor Levels shall be equal to or greater than the PMF event.
4. Floor levels shall be as close to the design floor level as practical & no lower than the existing floor level when undertaking alterations or additions.
5. Floor levels of open car parking areas and garages shall be 150mm above the 1% AEP flood. This may be achieved with an suspended floor which allows the continued passage of flood waters or filling if justified by a site specific assessment, (subject to "Flood Effects" and other controls below new line). Basement car parking must be protected from the 1% AEP flood plus freeboard of 500mm, except where, in Council's view, it is impractical to do so, but freeboard shall not be less than 150mm.
6. Habitable floor levels of residential, commercial and industrial re-development shall be protected to the FPL (1% AEP flood level plus freeboard). For Commercial/Industrial sites where it is impractical to achieve this (and subject to Council approval) the building is to be effectively flood proofed to FPL and the floor level is to be as high as practical.

Building Components & Method
1. All structures to have flood compatible building components below or at the FPL (1% AEP flood level plus freeboard).
2. All structures to have flood compatible building components below or at the PMF event level.

Structural Soundness
1. Engineers report to demonstrate and certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including the FPL (1% AEP flood plus freeboard).
2. Engineers Report to demonstrate and certify that any structure can withstand the forces of floodwater, debris & buoyancy up to & including a PMF event.

Flood Effects
1. Engineers report required to demonstrate and certify that the development will not increase flood effects elsewhere.
2. The impact of the development on flooding elsewhere shall be considered.

Note: When assessing flood effects, the following must be considered:
- loss of storage area in the floodplain;
- changes in flood levels & velocities caused by alteration of conveyance flood waters; and
- cumulative impacts of the development.

Evacuation
1. Reliable egress for pedestrians required during a 20% AEP flood.
2. Reliable egress for pedestrians and vehicles to an area refuge on or off site that is above the PMF level is required during a PMF event.
3. Reliable egress for pedestrians to the lowest habitable floor level is required from the building to an area refuge above the PMF level, either on-site or off-site.
4. Applicant to demonstrate that the development is to be consistent with any relevant flood evacuation strategy or similar plan.

Management and Design
1. Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this Plan.
2. Site Emergency Response Flood plan required (except for single dwelling-houses) where floor levels are below the design floor level.
3. Applicant to demonstrate that area is available to store goods above the FPL (1% flood plus freeboard).
4. No external storage of materials below the FPL (1% flood plus freeboard) which may cause pollution or be potentially hazardous during any flood.
5. The applicant is to prepare an Economic Analysis of Flood Losses (See Appendix 1). The applicant to submit a Flood Preparedness Loss Minimisation Plan.

Figure 5.1 HCC Flood Controls Matrix

6 Local Catchment

The site is affected by overland flooding from the local upstream catchment and primarily the surcharging of councils infrastructure surrounding the proposed development on Kiora Crescent. The runoff from the localised upstream catchment travels overland through the low-lying areas until it reaches the main open culvert structure downstream of the site and connects to Prospect Creek. In this case, the low-lying area is along the middle of the site.

The catchment upstream of the site is predominantly industrial and is characterised by an average gradient of 2% approximately.

6.1 Objectives

The purpose of this flood study is to provide a detailed assessment of the overland flooding and to determine the impacts (if any) that the proposed development will have on the flooding within the site and its surroundings.

The flood study will also determine how the proposed building will be constructed without affecting the flood characteristics (i.e. flood level, velocity and impact on adjoining properties).

In summary, the objectives are as follows:-

- Develop a 1-D and 2-D computer model that can be used to predict the magnitude and extent of future flood events;
- Define design flood levels, velocities and depths for the catchment to establish a benchmark;
- Amend the model to include the proposed development and determine if the latter has an impact on the flooding;
- Propose mitigation measures to eliminate any impacts; and
- Address the requirements of Council's DCP 2013.

7 Hydrology

7.1 Conventional Hydrology

A hydrologic model combines rainfall information with local catchment characteristics to estimate a runoff hydrograph. For this study, XP-STORM was used for the local catchment using Laurenson Method used in XP-Rafts.

Using ARR2016 data, the estimated design rainfalls were applied to the hydrological model in order to determine the design runoff hydrographs. Design peak flood discharges were obtained for the 25min, 45min, 1hr, 1.5hr and 2hr duration for 100-year ARI storm event.

Due to the long computation time, a 4m grid was originally adopted for the purpose of running the above storms and to determine the critical duration storm.

The upstream catchment is predominately Industrial.

Based on the simulation results, the critical duration adopted is 25min. Figure 7.1 below shows the flow hydrograph in 100yr ARI storm event through Norrie Street to Wyanna Grove as the flow is directed from these locations. The peak flow occurs at Norrie Street and is 9.301 cums and the time to peak is 12 minutes. Refer to Figure 7.2 for location of flow lines.

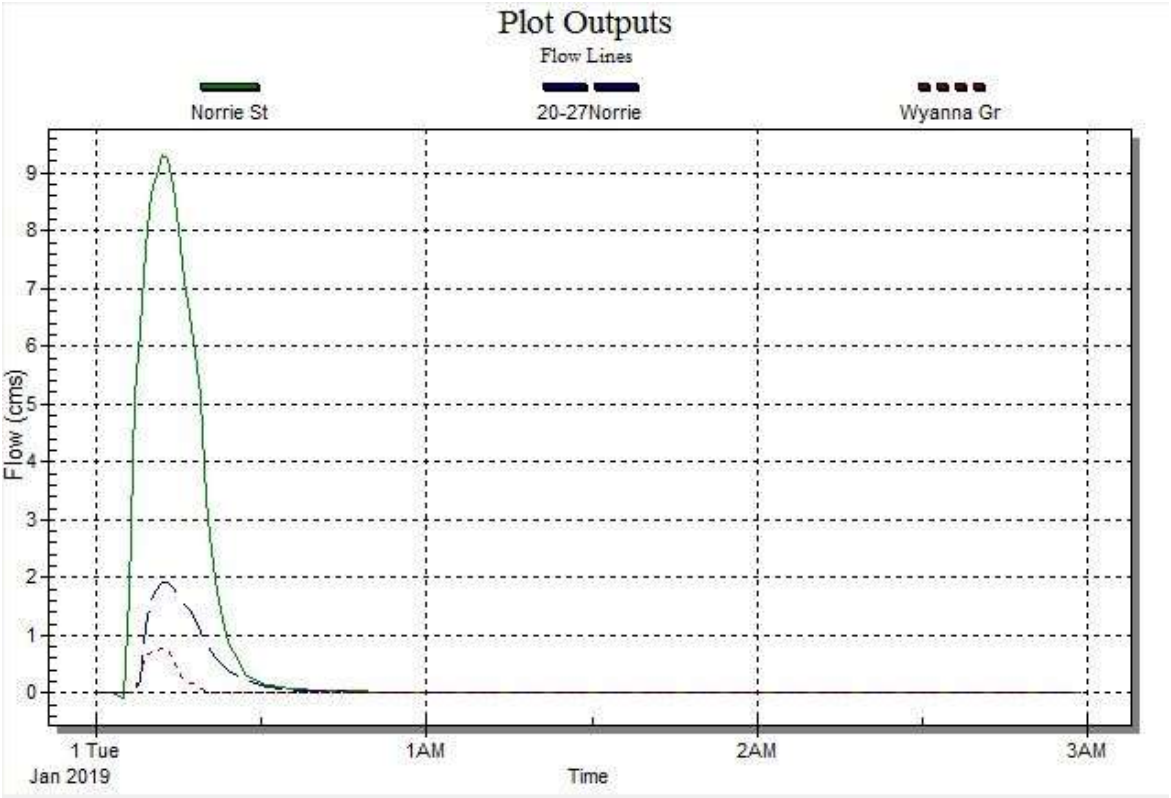

Figure 7.1 Overland Flow Hydrograph Through Norrie Street to Wyanna Grove prior to entering site– 100yr ARI (25min storm duration)

Figure 7.2 Flow lines extract from XP-Storm Model

7.2 Design Rainfall

The design Intensity-Frequency-Duration (IFD) parameters obtained from the Bureau of Meteorology (BOM) for the catchment are presented in Appendix 1**2.**

7.3 Rainfall Losses

The model adopts the 2D roughness and infiltration storm losses as listed in Table 7.1 and 7.2 below.

Table 7.1 Model Land Use Roughness

Land Use	Roughness
Overall Lots	0.05
Road, car parks	0.018

Table 7.2 Infiltration Storm Losses

Infiltration	Initial Loss (mm)	Continuing Loss (mm/hr)
Infiltration Pervious	28	0.76
Infiltration Impervious	2.5	0

7.4 Blockage

For the purpose of this flood impact assessment, the in-ground stormwater infrastructure is assumed to be 50% blocked as per Cumberland Council requirements. This approach is conservative and produces high flood levels across the overland flowpath. However, for the purpose of this assessment, it is considered acceptable.

8 Hydraulic

8.1 Definition

A hydraulic model converts runoff (traditionally from a hydrological model) into water levels and velocities throughout the major drainage/creek systems in the study area (known as the model 'domain', which includes the definition of both terrain and roughness). The model simulates the hydraulic behaviour of the water within the study area by accounting for flow in the major channels as well as potential overland flow paths, which develop when the capacity of the channels is exceeded. It relies on boundary conditions, which include the runoff hydrographs produced by the hydrologic model and the appropriate downstream boundary.

A 1D/2D fully dynamic hydraulic model was established for the study area. XP-Storm and XP-2D, a dynamic hydraulic modelling system developed by XP SOLUTIONS was used in this study. XP-2D is a 2-Dimensional model which uses TUFLOW as its 2D engine. TUFLOW is used world-wide and has been shown to provide reliable, robust simulation of flood behaviour in urban and rural areas through a vast number of applications.

8.2 Model Schematisation

The survey data included in the model was extrapolated from Digital Terrain Model (DTM) created from the ALS (Airborne Laser Scanning) received from Land Property Information (LPI) NSW.

The stormwater infrastructure has been modelled in the 1-D model and is assumed to be 50% blocked as previously advised. This approach is somewhat conservative and assumes that some of the runoff from the contributing local upstream catchment of the site is conveyed overland.

8.3 2D Model Set-Up

Two-dimensional (2D) hydraulic modelling was carried out to determine the flood behaviour in the study area. A large grid size of 4m was used for the overall catchment. A fine grid of 2m is used for the site area and its immediate surroundings.

8.4 Model Terrain

A terrain grid (also referred to as a 'topographic' grid) was developed to represent ground elevations based on ALS data provided by LPI, with some modifications based on the cross-section ground survey.

8.5 Buildings

In the existing scenario, there were no obstructions as its current state is an unobstructed car park. Existing buildings surrounding the site were modelled as total obstructions and have been completely removed from the grid (i.e. inactive cells). This was based on existing building outlines extracted from the survey drawings and ortho-rectified imagery.

In the proposed scenario, the existing footprint was replaced with the proposed development. The proposed footprint consisting of 3 factory units was also assumed to be completely blocked for unit 1, therefore resulting in the flooding being removed from the grid. For unit 2 and 3, a flow constriction was included to replicate a structure raised on piers to allow flow to pass through. An internal driveway was modelled as a flow constriction with void area as the driveway inclined to the flood planning level and the loading dock area was modelled as an elevation shape to model the finished surface level of the slab. The loading dock area will be 900mm below the factory unit finished floor level.

8.6 Hydraulic Roughness

The hydraulic roughness for the 2D model grid was determined using both aerial photography and site inspections carried out during the study. The Manning's roughness as adopted in the rain-on-grid model for every land use is included in Table 7.1.

8.7 Boundary Conditions

Downstream Boundary

The site currently drains to a 3.6x2.4m Box culvert connected to a minor creek linked to Prospect Creek via a concrete headwall. A fixed tailwater level RL 9.0m AHD was adopted as the downstream outfall boundary condition. This tailwater level is taken upstream of the minor creek stream approximately 830m away from the site and is 6m lower. As such, this tailwater level has no impact on the flood modelling results.

9 Results

9.1 Design Flood Modelling Results

Design flood modelling was undertaken for the 100-yr ARI design flood event. The peak water level, depth, and velocity for each 2mx2m grid cell in the study area were determined. The flooding occurs due to overland flows being carried out by the road network and the low-lying areas within private properties when the in-ground drainage capacity is exceeded.

The existing (base) scenario was modelled with the existing structures on site.

The proposed scenario is modelled with the proposed multi-unit building footprint added as total obstructions.

9.2 Flood Planning Level

The Flood Planning Level (FPL) recommended in the NSW Floodplain Development Manual (2005) and Council's DCP 2013 is 0.5m above the calculated 100-yr ARI flood level across the site and 0.15m for carparking areas, garages and basement entry.

The 100-yr flood level and suggested minimum building habitable floor levels for the site are shown on table 1.1.

9.3 Discussion

9.3.1 Impact of Proposed Development

Flooding occurs along the site because the in-ground drainage infrastructure is under capacity. This occurs when the capacity of the local infrastructure capacity is exceeded, and runoff is conveyed by the road network and through private property.

The peak flow passing through Norrie Street is approximately 9.311m3/s assuming that the surrounding in-ground infrastructure is 50% blocked and the runoff is conveyed overland. Three quarters of the site that make up the development site is affected by overland flows as shown in the flood maps for the existing base case scenario. This is the South Eastern corner to the North Western corner of the site.

The proposed development has been modelled in its proposed form and it will potentially increase the flood levels in the vicinity of the site because the development covers most of the site area and flows are shifted towards the north west by the development.

To reduce and in fact eliminate the impacts caused by the development, the following mitigation measures are proposed:-

- Upgrade the stormwater inlet capacity by constructing new internal pits connected by stormwater pipes ranging in different sizes to collect overland flow and re-direct it around the proposed structure to minimise the flooding impact as per fig. A1.9;

- Provide 100mm cut in the proposed car park at the front of the site and 150mm cut in all proposed landscaped areas to create an overland flow path for water travelling from the South Eastern corner. This will require adequate grading to pits;
- Provide a maximum of 300mm cut in parking areas located within the drainage easement zone to allow sufficient flood storage. The proposed car parking area is intended to slope towards the landscape area on the northern boundary and allow for the overland flow path to be redirected around the proposed structure and collected by proposed pits. This will require adequate grading to pits;
- Raise Unit 2 and 3 on piers to allow for overland flow to pass under the proposed structure as it did in its existing state. Lowering the natural surface by 100mm under the proposed structure will be required to act as flood storage area and allow overland flow to be redirected into the pit and pipe network proposed. Unit 1 will be raised to the flood planning level and will not require void areas; and
- The internal driveway of unit 2 to be inclined to the finished floor level with a void area on the underside of driveway slab. The internal loading dock area to have a surface level 900mm below the factory unit finished floor level. Louvres to surround the docking area for overland flow to pass in its natural state and for security reasons.
- Flood fencing to be installed in accordance with councils standard drawing SD8025. Refer to appendix 5.

Once these measures are implemented, the results of the hydraulic modelling of the localised catchment indicate that the proposed Industrial development at 5 Kiora Crescent does not have an adverse impact on the flooding behaviour elsewhere in the floodplain. There is very minimal upstream afflux created by this development. The modelling results also suggest that there is very minimal downstream impact in the adjoining sites.

A flood impact map has been reproduced to show the extent of the impact of the development on the 100-yr ARI flood level. A +/-0.01m threshold was adopted to simulate a neutral impact.

9.3.2 Council's Requirements

This section of the report demonstrates how the proposed development will achieve Council's requirements as outlined in DCP 2013.

9.3.2.1 Floor Levels

The proposed flood study has determined the flood level across the site in a 100-yr ARI storm event and proposed a 0.5m freeboard to achieve the Flood Planning Level which provides the Council's requirements and the floodplain Development Manual.

The proposed ground floor levels proposed by the architect are at the minimum Flood Planning Levels shown in table 1.1. A 0.15m freeboard has been provided above the flood level where an accessible parking spot has been allocated. The remaining car parking allocations have been designed to encounter minor ponding whilst maintain a Velocity-Depth product of less than $0.4m^2/s$ to ensure minimal impact on the upstream catchment.

9.3.2.2 Building Components

This flood study recommends that all structures to have flood compatible building components and be able to withstand the hydraulic forces of 100-yr ARI velocities (RL 15.90m AHD as per the outcome of this flood study).

9.3.2.3 Structural Soundness

This flood study recommends that a Flood Risk Assessment by a suitably qualified structural engineer be carried out during detailed design stage to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to the 100-yr ARI flood level. This will be provided during detailed design stage.

9.3.2.4 Flood Affectation

The results of the modelling undertaken for this flood study indicates that the proposed development will not increase flooding depth nor negatively impact on the velocities of the flood waters upstream or downstream in a 100-yr ARI flood event.

The flood impact map included in Flood Mapping Appendix 1clearly demonstrates that there are no cumulative impacts for multiple potential developments in the vicinity because the proposed development footprint is outside the overland flooding extent.

The characteristics of the overland flooding are not altered by the proposed development (i.e. extents, flows, velocities, hazard). If all other proposed developments achieve the same outcomes, then the cumulative impact will be negligible in the floodplain.

9.3.2.5 Evacuation

The flooding associated with local overland flows is considered flash flooding. Flash flooding does not give enough warning time to allow evacuation off site in a suitable and safe manner. As such, it is more prudent to remain within the site and evacuate vertically to the upper level office spaces within the building until the flood waters have receded.

9.3.2.6 Management and Design

A Site Emergency Response Flood Plan may be required, subject to Council's requirements.

Due to the residential nature of this development, the storage of materials which may cause pollution or be potentially hazardous during a flood is not proposed.

9.3.3 Previous Studies completed within Cumberland Council

SGC have completed a flood study for Industrial Units previously within Cumberland Council. 132 Warren Road, Smithfield shared similar concerns related to flood inundation within parking areas. It was found that raising the carpark to the required freeboard will cause a negative impact on the flood levels immediately upstream of the site. The solution was to allow ponding within the car parking area whilst maintaining a Velocity-Depth product of less than 0.4m2/s to ensure the impact upstream maintained minimal.

10 Schedule A - Responses

Please refer to responses in red below.

2. DADCA03- Boundary Fencing Flood Affected Areas

The development site has been identified as a flood affected site in the 1% Annual Exceedance Probability (AEP) storm event. In order to ensure fencing does not result in the undesirable obstruction of the free flow of floodwater, Council's relevant Development Control Plan requires that all boundary fencing within the flood affected area(s) as identified in the submitted flood report [to be constructed in accordance with Council's standard detail SD8025. This involves pool type fencing being provided at the base of the boundary fence to the extent of the post-developed 1% AEP flood. Stormwater plan must denote the location and state the requirement for construction of the fence as per standard drawing SD8025.

(Reason: To ensure adjoining property owners consent to the fencing)

Stormwater plans to denote flood fence in aaccordance with council's standard detail SD 8025. The standard detail has been included in this report in appendix 5.

3. DADCZ01 - Identification of Location and layout of existing Council pipe

Appropriate investigation such as CCTV or any accepted procedures of detailed investigation survey shall be carried out by a suitably qualified professional to establish and confirm the location, layout of the existing council pipe including size, invert levels and obvert levels, and its offsets/coordinates with respect to the property boundaries. The layout survey plan including the exclusion zone (zone of influence of structural load), the CCTV footage, the report of the CCTV results etc., shall be submitted to the council for consideration. The plan shall also show the buffer area for the drainage easement along the centreline of the pipe covering width equivalent to the diameter of the pipe plus 1m further on either edge of the pipe (totalling the diameter of pipe plus 2m) with its centreline following the centreline of the existing pipe. The confirmed layout and location of the pipeline shall be incorporated into the stormwater plan, landscape plan, and the architectural plan. Any proposed structure shall be outside the edge of the drainage easement and/or exclusion zone whichever is wider.

(Reason: To ensure and confirm location and layout of the council pipeline for protection measure)

To be completed by others.

4. DADCZ04 - Revised Flood model and study report

Unless sufficient satisfactory clarification is provided that are acceptable to the council's Engineering and Traffic section, the flood study and the model shall be revised taking account following requirements. The architectural plan and associated stormwater plans shall also be amended to reflect these provisions.

(a) The existing flood affected area that includes whole of the site except a pocket of land outside the flood inundation, on the western side of the subject site as shown on the report, shall not be land filled and left an its natural state.

Units 2 and 3 have been designed to be fully suspended with void area above the 1% AEP flood level plus 500m freeboard. Unit 1 has also been suspended where achievable and proposed in fill where tanks and wash bays are present. The raised ramp is required in order to achieve sufficient 150mm freeboard and grading for accessible parking. The ramp in fill is also required to achieve compliant grading with the trucks entering/ exiting the industrial warehouses of Unit 1 and Unit 2.

(b) The existing flood affected area shall be kept open to allow free flow of flood water, and shall not be blocked/ obstructed that results in loss of flood area, redirection of flow, or change in the characteristics of the flood, or cause impact elsewhere (increase in inundation, velocity, depth or vxd product).

As mentioned in part (a), open areas have been provisioned where achievable and fill has been incorporated to achieve compliance with councils' guidelines and AS2890. As shown in Appendix 1, figure A1.10, there is no impact shown anywhere besides on the site itself.

(c) The flood study model and report must be consistent with the State of Environmental Effect report.

The flood study model is consistent.

(d) The periphery of each of the buildings shall have clear opening to allow floodwater into and out from the underneath of the building.

As mentioned in part (a), open areas have been provisioned where achievable and fill has been incorporated to achieve compliance with councils' guidelines and AS2890.

(e) Tabular presentation of the flood model results, flood water level, natural ground level, velocity, depth, and vxd product for the pre- and post-development scenario at the critical locations such as the each corners of the proposed buildings, each corners of the subject site, in front of the each entrance to the buildings 1, 2 and 3, the centreline intersection of the internal roads, that the middle of the weight bridge etc., and at the critical locations within the adjoining neighbouring properties shall be provided for clear understanding and comparison of the impact. The report shall include the results outlined above for 1% AEP and 5% AEP to clarify and appreciate the behaviour of the flood and its sensitivity with respect to the development.

Flood results have been presented in Appendix 1, figure A1.11 to show the existing ground level, proposed level, flood levels and associated flood results components.. As SGC has demonstrated that the post development has no impact on upstream/ downstream

properties during the 1% AEP storm event, it will not be necessary to provide the 5% AEP results.

(f) The flood levels in the post development scenario in both Public Road and private property must not be increased. The tolerance, level difference, must not exceed 10mm.

As shown in Appendix 1, figure A1.10, there is no impact shown anywhere besides on the site itself.

(g) Provision of PMF flood evacuation and refuse shall be at the second floor and clearly mentioned on the stormwater plan and report.

Evacuation to upper level/ second floor has been clearly mention in section 9.3.2.5 of this report under the title of evacuation. This has been updated in the stormwater plans.

(h) Clarify as to how the post development flood model result show, the inundation area decrease, the flood water level and ponding depth decreased and the depth water decreased whereas the velocity and the vxd product also decreased. This implies that the flow also being reduced through the flow path indicating part of the flow either being redirected somewhere else or eliminated from the system. This is not supported.

As shown in Appendix 1, figure A1.10, there is no impact shown anywhere besides on the site itself.

(i) An electronic copy of the model setup shall also be submitted together with the report

Flood model is attached with the revised flood report.

(Reason: To ensure minimal flood affectation, impact, and protection from the flood)

A1 Appendix 1

Refer to Flood Mapping Revision 01 PDF attached to document.

A2 Appendix 2

IFD Table

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	125	139	181	210	238	276	304
2 min	103	112	140	161	182	209	231
3 min	95.3	104	132	152	172	198	218
4 min	89.8	98.5	126	146	165	191	210
5 min	85.0	93.7	121	140	159	184	203
10 min	67.4	75.1	98.9	115	130	151	166
15 min	56.1	62.5	82.4	95.8	109	126	138
20 min	48.2	53.7	70.6	81.9	92.9	107	118
25 min	42.5	47.2	61.8	71.7	81.2	93.8	103
30 min	38.1	42.2	55.1	63.8	72.3	83.4	91.9
40 min	31.8	35.1	45.5	52.6	59.6	68.8	75.8
45 min	29.5	32.5	42.0	48.5	54.9	63.4	69.9
1 hour	24.4	26.8	34.4	39.7	44.9	51.9	57.3
1.5 hour	18.6	20.4	26.0	29.9	33.9	39.2	43.5
2 hour	15.4	16.8	21.4	24.6	27.9	32.4	36.0
3 hour	11.8	12.9	16.4	19.0	21.6	25.2	28.1
4.5 hour	9.08	9.96	12.8	14.9	17.0	20.0	22.5
6 hour	7.59	8.36	10.9	12.7	14.6	17.3	19.4
9 hour	5.93	6.59	8.77	10.3	12.0	14.3	16.1
12 hour	4.99	5.59	7.56	8.99	10.5	12.5	14.2
18 hour	3.91	4.43	6.14	7.40	8.70	10.4	11.8
24 hour	3.28	3.74	5.28	6.41	7.58	9.12	10.3
30 hour	2.85	3.26	4.66	5.70	6.78	8.15	9.23
36 hour	2.53	2.91	4.19	5.14	6.14	7.39	8.36
48 hour	2.08	2.40	3.50	4.32	5.18	6.22	7.02
72 hour	1.55	1.80	2.64	3.26	3.93	4.69	5.27
96 hour	1.24	1.44	2.10	2.60	3.13	3.72	4.17
120 hour	1.04	1.20	1.74	2.15	2.57	3.05	3.41
144 hour	0.890	1.02	1.48	1.81	2.17	2.56	2.87
168 hour	0.780	0.896	1.28	1.57	1.86	2.20	2.46

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

Figure A2.1 IFD Table (Lat: -33.8623, Long: 150.9687)

A3 Appendix 3

Architectural Plans

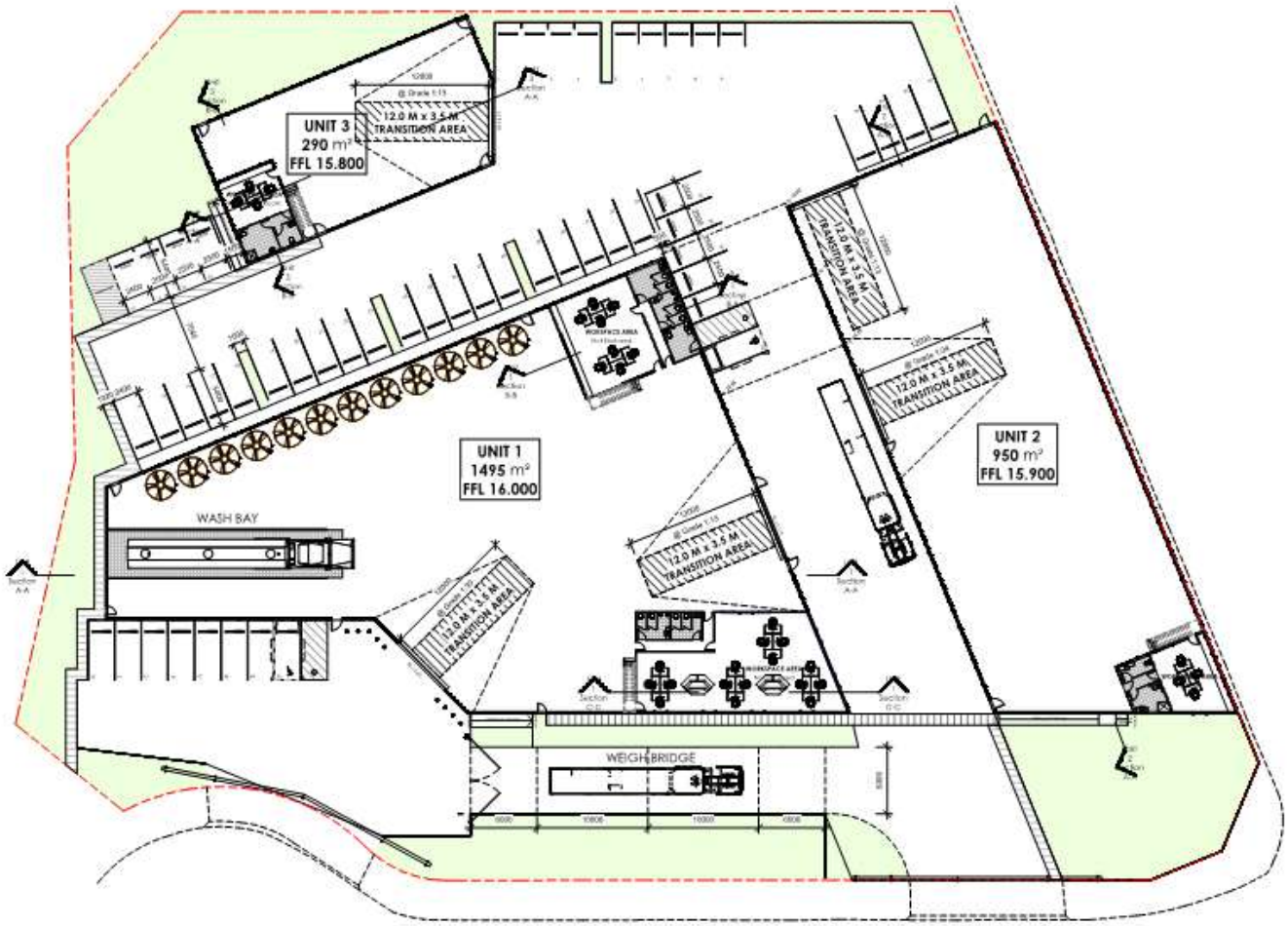

Figure A3.1 Architectural Plan – Site Plan – Baini Design, Ref:18117

A4 Appendix 4

Survey Plans

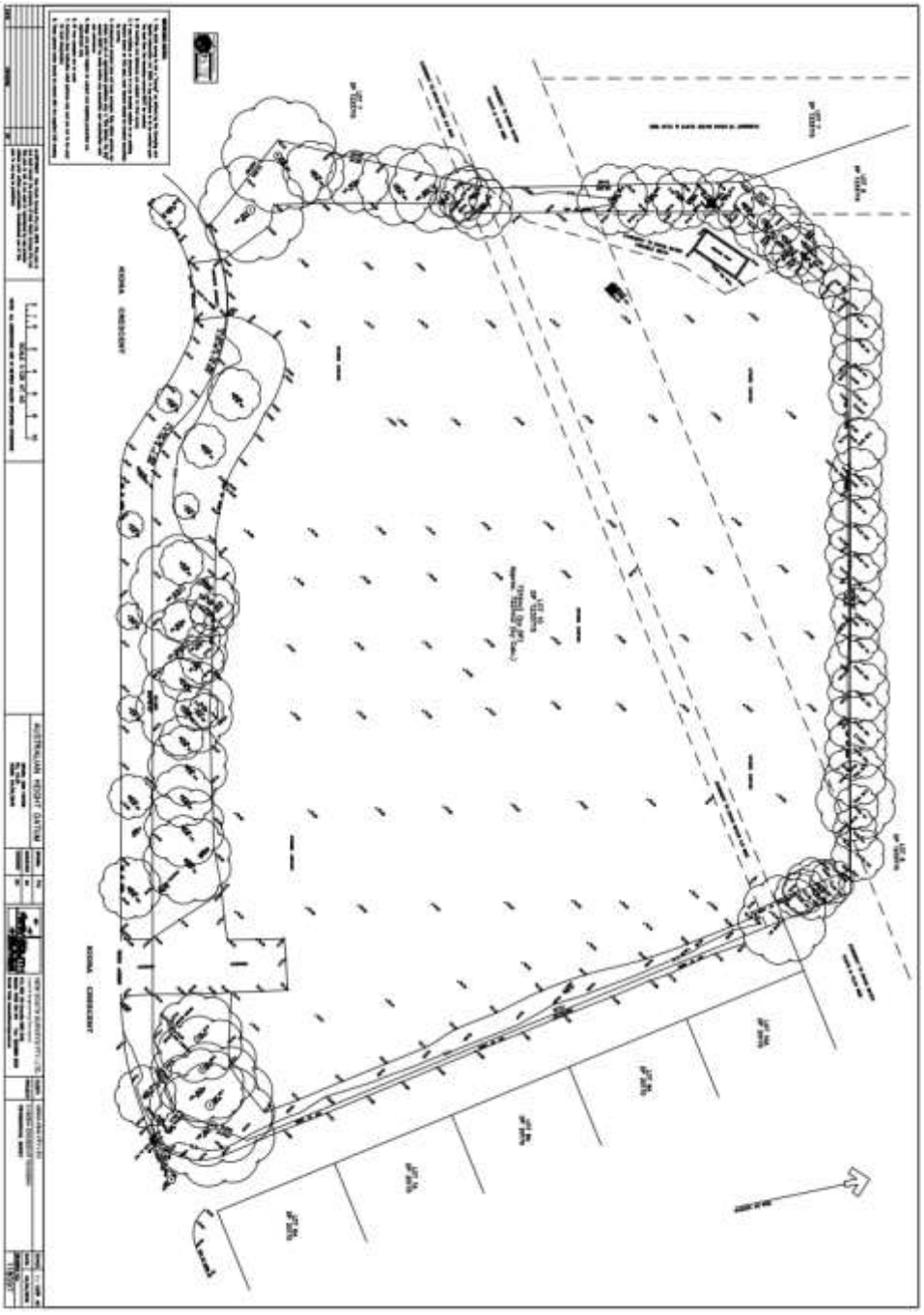

Figure A4.1 Site Survey Plan – New South Surveys, Ref:118097

A5 Appendix 5

Standard Detail – Flood fence SD8025

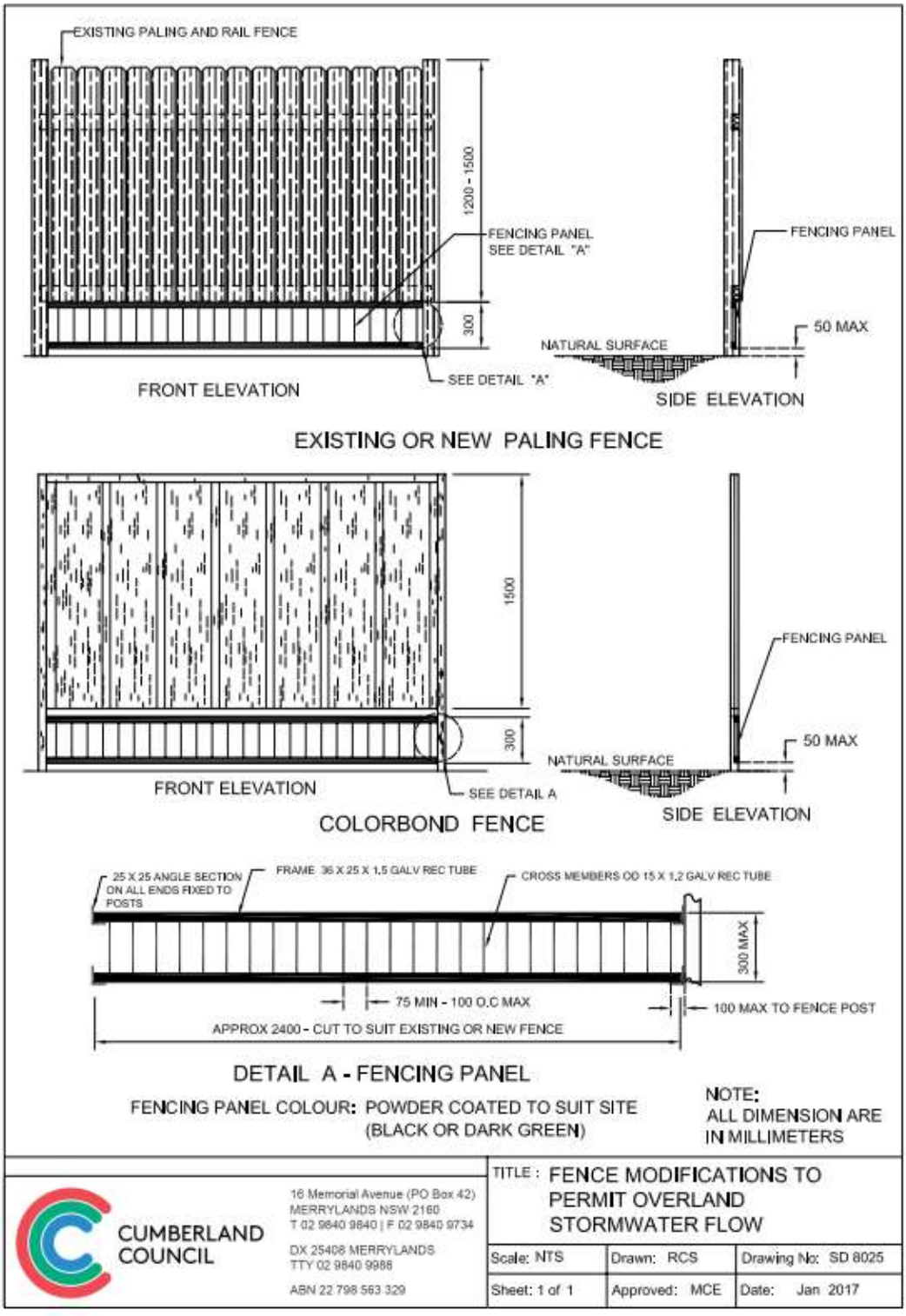

Figure A5.1 Standard Flood Fence Detail – SD 8025

+61 2 8883 4239

P.O. Box 7855 Baulkham Hills NSW 2153

Suite 5.03, L5, 156 Pacific Highway St Leonards NSW 2065