OVERLAND FLOW STUDY & FLOOD IMPACT ASSESSMENT REPORT

Proposed New SEPP Seniors Scheme Development with Basement Carpark

18 Alexander Street, Collaroy NSW

Job No. 210804
Issue A – 10 September 2021

Prepared for: Laxland Group Pty Ltd in association c/- Walsh Architects

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SUMMARY

This assessment has been carried out in general accordance with the intent of the Northern Beaches Council Water Management Policy, Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification. This report presents an analysis and documentation appropriate in defining:

1. A summary of the catchment area of a development site in Alexander Street, Collaroy.
2. Defined flood levels based on hydraulic analysis of the overland flow path influencing the site.

The development is for a proposed new SEPP Seniors Scheme development with basement carpark at 18 Alexander Street, Collaroy and is located within a defined overland flow path. The key objective of this report is to:

1. Ensure the development does not significantly worsen the natural flow path within and adjacent the development site.
2. To confirm the future floor levels and structures can be adequately flood protected.

It was identified through TUFLOW modelling that the natural flow path through the site is not significantly worsened by the development. This analysis, when compared with a global flood study of the area, is site specific and therefore consists of a more detailed and conservative investigation. The development floor levels are to be designed in accordance with the minimum design levels indicated in Table 5.0 of this report.

This assessment has been carried out in general accordance with the intent of Northern Beaches Council Warringah Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification, Section 10 – Flood Risk Management and Section 11 – Overland Flow Flooding of Northern Beaches Council Water Management Policy (2020) – Flood Risk Management, Bureau of Meteorology (BoM) rainfall information, Bureau of Meteorology guidebook: The Estimation of Probable Maximum Precipitation in Australia, Reducing the Vulnerability of Buildings to Flood damage: Guidance on Building In Flood Prone Areas (Prepared for the Hawkesbury Nepean Floodplain management Steering Committee – 2007), Houses for Flood-prone Areas briefing by cement concrete & aggregates Australia, Construction of buildings in flood hazard areas (Australian Building Codes Board – ABCB Standard & NCC of Australia), the NSW Floodplain Development Manual (FDM 2005 - the management of flood liable land), the NSW Floodplain Risk Management Guide (Incorporating 2016 Australian Rainfall and Runoff in studies), and discussions with Council engineers. Provided the recommendations within this report are adhered to, the overland flow component is not envisaged to have significant effects on the proposed development site with negligible impacts to the adjacent neighbouring properties for storms up to and including the 1% AEP flood event.

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Overland Flow Study & Flood Impact Risk Assessment and Report for a Proposed New SEPP Seniors Scheme Development with Basement Carpark at 18 Alexander Street, Collaroy NSW Job Nº 210804

1.0 INTRODUCTION

At the request of Laxland Group Pty Ltd in association with Walsh Architects, RTS Civil Consulting Engineers Pty Ltd (RTS Civil) have reviewed the plans for a proposed new SEPP Seniors Scheme development with basement carpark at 18 Alexander Street, Collaroy in reference to potential overland flooding issues. Provided the recommendations within this report are adhered to, the overland flow component is not envisaged to have significant effects on the proposed development or to the adjacent neighbouring properties for storms up to and including the 1% AEP flood event. The development is therefore recommended for Council approval.

The site topographical survey information, proposed architectural plans, National Elevation Data Framework (NEDF), Elevation Information System (ELVIS) provided by Geoscience Australia, and site investigation information were used to determine flooding extents and impacts as well as to assess any associated risks. The site has been assessed in general accordance with the intent of the requirements of Northern Beaches Council Warringah Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification, Section 10 – Flood Risk Management and Section 11 – Overland Flow Flooding of Northern Beaches Council Water Management Policy (2020) – Flood Risk Management, Bureau of Meteorology (BoM) rainfall information, Bureau of Meteorology guidebook: The Estimation of Probable Maximum Precipitation in Australia, Reducing the Vulnerability of Buildings to Flood damage: Guidance on Building In Flood Prone Areas (Prepared for the Hawkesbury Nepean Floodplain management Steering Committee – 2007), Houses for Flood-prone Areas briefing by cement concrete & aggregates Australia, Construction of buildings in flood hazard areas (Australian Building Codes Board – ABCB Standard & NCC of Australia), the NSW Floodplain Development Manual (FDM 2005 - the management of flood liable land), the NSW Floodplain Risk Management Guide (Incorporating 2016 Australian Rainfall and Runoff in studies), and discussions with Council engineers.

A two-dimensional computer model of the catchment was established to analyse overland flood behaviour under existing and proposed catchment conditions. The model provides information on the extent of flood inundation, flood depths and flood velocities throughout the catchment for the 1% AEP (Annual Exceedance Probability) storm event overland flood events. Results from this study form the technical basis for the flood risk recommendations which identify problem areas and investigates options to reduce the risk of flooding.

1.1 Aim of This Report

This report aims at predominantly investigating the predicted water surface profile for the 1 in 5 and 1 in 100 Year ARI (Average Recurrence Interval) or 20% and 1% AEP (Annual Exceedance Probability) storm event and outlines the methods used. The Probable Maximum Flood (PMF) event was also considered. A DRAINS model was used to determine corresponding catchment runoff and flows through the existing site. Details of existing stormwater infrastructure and a contributing catchment area were assessed, and further information was obtained from desktop investigations and topographical site survey information supplied. The TUFLOW computer program was used to determine the 1% AEP flow velocities for the existing situation and to determine the impact that the development may have on the predicted overland flow path at the subject property.

This report addresses matters relating to stormwater issues such as the conveyance of overland flow through and adjacent to the property in an orderly manner and the demonstration of acceptable flood immunity in general accordance with the intent Council's DCP.

2.0 Site Conditions

The subject site is described as Lot 8 & 9 DP6984, 18 Alexander Street, Collaroy and is situated within the vicinity of the overland flood extents. The site is currently developed with a double storey brick residence with tile roof, a shed, a swimming pool and a concrete driveway. The site is located to the southern side of Alexander Street, near the junction of Pittwater Road and Alexander Street. A site survey has been undertaken by CMS Surveyors and is attached in Appendix D. The survey shows that the site is located adjacent to a natural gully. An easement to drain stormwater runs through the site around the northwest corner of the lot. The site slopes towards the front boundary. Few trees also exist around the site. The impervious area is predominately made up of building footprints and paved areas.

It should be noted that the flood information predicts that the 1% AEP flood extents will inundate approximately 10% of the property to an average depth of approximately 0.1m. This report outlines the flood impacts and risk management requirements specific to the proposed development.

2.1 Existing Council Drainage

There currently is an existing 750mm diameter reinforced concrete pipe (RCP) Council drainage pipeline adjacent to and through the property frontage. This drainage pipeline drains an upstream catchment including runoff from roads, park lands and properties. Surcharge flows are anticipated to be directed towards the development site. The pipeline has been surveyed and the alignment and depth has been located accurately. The depth of the pipe is approximately 1.3m below natural surface levels.

2.2 Existing Topographical Conditions

The site is located adjacent to a natural overland flow path. This overland flow path is draining adjacent to and through the development site in a north-eastern direction. Refer Appendix A and C for details. The subject site is impacted by overland flows from this upstream catchment. Land use within the overland flow catchment consists of residential use.

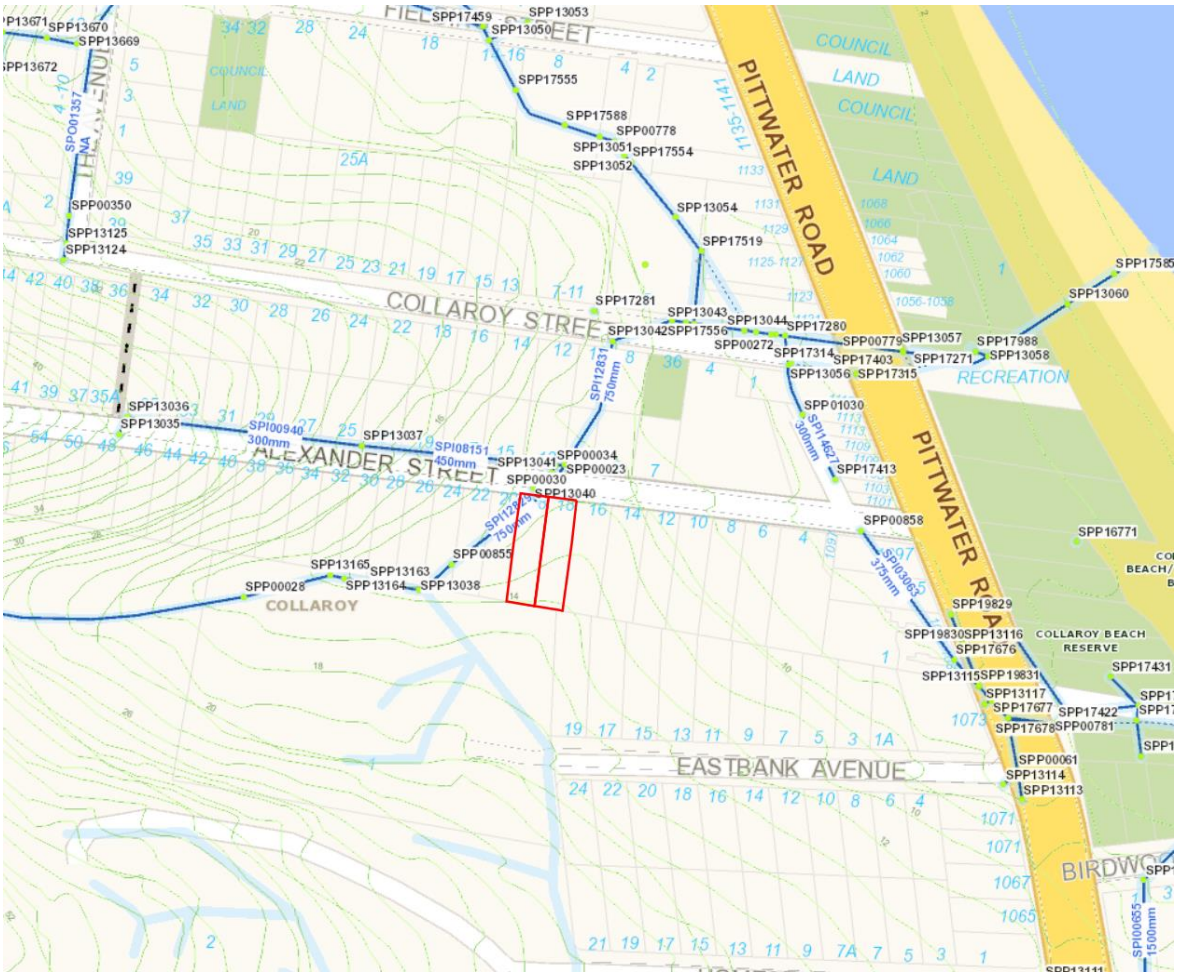

Figure 1.0 – Development Site Locality Plan (Northern Beaches Council Stormwater Maps)

2.3 Proposed Developed Site

It is understood the applicant intends to demolish the existing structures and construct a new SEPP three storey residential Seniors Scheme unit development with a shared below ground basement carpark. The proposed development architectural plans and floor levels are depicted in architectural plans prepared by Walsh Architects. Refer Appendix D for proposed details.

2.4 Northern Beaches Council Flood Mapping

According to Northern Beaches stormwater mapping, the site is burdened within an overland flow path and located adjacent to a main Council drainage pipeline. Refer to Figure 1.0 and Appendix D of this report for

further details on the existing site topography.

3.0 Analysis and TUFLOW Modelling

This overland flow study has utilised topographic and rainfall data obtained from several sources. The origin and types of information underpinning the assumptions used in this study are presented in this section of the report. A DRAINS model (*Version 2018.06 - 64 bit*) was used to determine corresponding catchment runoff to the natural gully located with the development site. The TUFLOW computer program (*release 2018-03-AC TUFLOW_iSP_w64.exe*) was then used to determine the predicted 1% AEP overland flow levels, extent and velocities.

3.1 Design Rainfall

The 20% AEP, 1% AEP and PMF design rainfall was extracted from the ARR2016 and ARR1987 databases on the BoM (Bureau of Meteorology) website for durations of 5 minutes to 3 hours for the development site location. The ARR2016 design rainfall depth information was adopted for this study.

3.2 Flood Data

For the purposes of this report, data has been obtained from numerous sources. This data is required for input into the hydrological and hydraulic models. All data, observations and opinions contained in this report pertain to hydraulic assessment of flood flows at or in the vicinity of the site. This report neither purports to be nor is an investigation into any other aspect of flooding within the site or surrounding catchment. This report and the results contained within are only as accurate as the survey information provided. The report is only valid for the development as proposed and detailed in this report and is not valid for any other design, layout or development.

- Survey: The overland flow assessment is based on Elevation Information System (ELVIS) provided by Geoscience Australia provided by the Land and Property Information (LPI) Department of the NSW Government and detailed local survey provided by the client. It is noted that the catchment wide LiDAR data was relatively consistent with the detailed survey. The site supplied survey has also been included in the model to allow for an accurate site-based assessment. Refer to Appendix D for site survey information.
- Overland Flow Data: Design overland flows were imported as hydrographs from the DRAINS model for the peak 1% AEP storm event for the catchment.
- Aerial Imagery: SIX Maps and Google imagery.
- Historic Flood Information: Flood Study Report for a Proposed Development at 18 Alexander Street, Collaroy prepared by BMB Engineers (February 2020).

3.2 Existing Council Pipeline Capacity

An allowance for the capacity of the existing 750mm diameter reinforced concrete pipelines (RCP) has been considered. This pipeline has an approximate grade of 5%. The calculated pipe capacity of the 750mm pipeline is approximately 2.7m^3/s which was determined using the Manning's equations. However, the full effects of the pipeline have not been considered and a 50% blockage factor has been applied. Any excess flows have been assumed to surcharge the pipeline and contribute to the overland flow component.

Refer Section 3.4 of this report for catchment flows considered, Appendix C for a summary of the results and Appendix D for pipe alignment.

3.3 Contributing Overland Flow

The contributing upstream catchments were determined with the aid of SIX Maps topographical and Council's stormwater network information. Two main contributing catchments have been considered. The catchment draining to the natural gully south of Alexander Street (FC01) of approximately 7.55 Ha and the catchment draining to Alexander Street verge (FC02). While the catchment is urbanised with a buried stormwater pipe network, this study is concerned with flow along the overland flow path.

Hydrological analysis has been undertaken using computer software DRAINS. The DRAINS program is a modelling software package developed for the design and analysis of urban stormwater drainage systems. It utilises the "ILSAX Method" hydrology loss model to convert Australian Rainfall & Runoff Temporal Patterns and rainfall data into runoff hydrographs. The hydrological model analysed design storms ranging in length from 5-minutes through to 3-hours, for average recurrence intervals up to and including the PMF event.

Rainfall was modelled for the catchment in equal time intervals under each storm event and the subsequent runoff routed through a drainage system. To model the runoff for the contributing catchment in relation to the proposed for the development, hydrologic information detailed in Appendix A was used for the DRAINS analysis.

To model the catchment regime contributing to the development, certain hydrological parameters were used for the DRAINS analysis. Below is a summary of the hydrological model characteristics:

- Depression Storage Impervious = 1mm
- Depression Storage Supplementary Area = 5mm
- Depression Storage Pervious = 5mm
- Soil Type = 3 (moderate infiltration rates)
- Percentage Impervious = 60% considered
- Storm Initial Losses = 41.0 mm
- Storm Continuing Losses = 1.8 mm/hr (0.72 mm/hr applied)

Peak flow rates from the catchment regime were determined by modelling various storm durations for each ARI storm in the DRAINS stormwater modelling program with a retardance roughness coefficient of 0.012 and 0.330 for the impervious and pervious percentages respectively. The peak flows are outlined in Table 1.0 of this report.

Table 1.0 – Table of Flow Rates for the Catchment

Storm Duration	Overland Flow Rate (FC01)			Overland Flow Rate (FC02)
	1% AEP Event	Pipeline Capacity	Reduced 1% AEP Event (50% Blockage)	1% AEP Event
Peak	3.72 m^3/s	2.70 m^3/s	2.37 m^3/s	1.03 m^3/s
2-hour	1.89 m^3/s	2.70 m^3/s	0.54 m^3/s	0.53 m^3/s

Therefore:

- The 1% AEP TUFLOW input flows considered were 2.37 m^3/s and 1.03 m^3/s respectively.
- The 5% AEP TUFLOW input flows considered were 1.03 m^3/s and 0.66 m^3/s respectively.
- The PMF TUFLOW input flows considered were 5.53 m^3/s and 1.54 m^3/s respectively.

Refer to Section 2.1 of this report for further explanation and Appendix A for a summary of the results.

3.4 TUFLOW Analysis Pre & Post Developed Flood Extent

An investigation of flood behaviour in a catchment was undertaken using the TUFLOW modelling software to determine the 20% AEP, 1% AEP and PMF flood levels, velocities and provisional hazard categorisation of surface flow. A TUFLOW 1D/2D model was used to hydraulically route flows through the catchment and to derive flow depths, velocities and hazard for the pre and post development scenarios. This section describes the hydraulic modelling approach and hydraulic model development.

3.4.1 General

The modelled area extends over the subject site and into the adjoining upstream and downstream catchment. Sub-catchment diversions, slopes, overland flow paths and land use (pervious and impervious) parameters were assessed as part of the hydrological modelling associated with the catchment.

Different hydraulic modelling approaches can be applied according to the floodplain's hydraulic characteristics and the objectives of the study. The simpler methods combine the left and right overbank floodplain areas and the main channel into a one-dimensional (1D) representation. This approach is relatively simple, computationally fast and is generally appropriate for modelling flows through pipe networks and straight sections of formed open channel. The main limitation of such 1D modelling approaches is that flow is assumed to occur in a linear direction, and the water levels across the floodplain are assumed to be at the

same level as the main channel.

A more detailed two-dimensional (2D) approach is recommended in areas where significant differences can occur between the channel flood levels and the floodplain flood levels. This approach is also preferable where separate flow paths and flow around catchment obstructions occur which is the case in this assessment. This is a more complex analysis, which requires greater data requirements and computational resources.

3.4.2 TUFLOW 1D Model Domain

The piped drainage network within the catchment were not represented in the TUFLOW model.

3.4.3 TUFLOW 2D Model Domain

The 2D hydraulic model domain for the preliminary hydrologic assessment covers the area in the '2D model domain', while the 2D hydraulic domain for detailed assessment of the behaviour of the 1% AEP floodwaters covers only the area depicted as 'study area'. A square grid was utilised for this study, with a grid size of 2m employed for the preliminary hydrologic analysis and a 2m grid used for detailed hydraulic assessment of flood behaviour near the subject site. Each grid element contains information on ground topography, surface resistance to flow and initial water level.

The grid cell size ranging from 2m to 5m is considered to be sufficiently fine to appropriately represent the variations in floodplain topography and land use within the study area for hydrologic assessment, while the finer 1m grid is appropriate for detailed hydraulic assessment. It should be noted that TUFLOW samples elevation points at the cell centres, mid-sides and corners, as a consequence, a 2m square cell size results in surface elevations being sampled every 1m.

Linear features that potentially influence flow behaviour, such as gullies and levees were incorporated into the topography using 3D shape files to ensure that these were accurately represented in the model. It is noted that although boundary walls and fences can significantly affect local overland flow paths, these have not been explicitly incorporated into the model in urban areas unless deemed critical to the study otherwise these instead area considered in the setting of appropriate Manning's 'n' values for these areas.

3.4.4 Variable Definitions

Please refer to Appendix A for the visual representation of the contributing upstream catchment.

- Catchment: The local upstream catchments were delineated from existing elevation data and Council's adopted flood report.
- Overland Flow Data (Upper Boundary Conditions): Design overland flows were imported as hydrographs from the DRAINS model for the peak 1% AEP storm events and applied to the model upstream from the

site.

- Lower Boundary Condition: A water level versus flow (stage-discharge) curve has been adopted which is generated by TUFLOW by specifying a boundary slope of 0.01.
- Hydraulic Roughness Parameters: The adopted roughness parameters for the hydraulic model are based on site-observations and aerial photography. The Manning's 'n' roughness values adopted in the hydraulic model directly relating to the site are 0.020 for roads and 0.035 for urban properties (not including buildings).
- Buildings: All existing buildings and structures within and adjacent the development site have been modelled as solid impervious structures. As such, they form physical barriers to the flow of floodwaters rather than applying a material roughness to these building footprints. Buildings located 30m or more upstream stream and downstream were modelled with a higher Manning's n' roughness value in the hydraulic model of 1.0.

3.4.5 Design Flood Estimation

Design overland flows were imported as hydrographs from the DRAINS model for 1% AEP storm event.

3.4.6 Provisional Hydraulic Hazard Category

The degree of hazard which is attributed to flooding considered the outcomes of the hydraulic modelling in association with the following factors; Size of flood, Effective warning time, Flood awareness, Rate of rise of floodwater, Duration of flooding, Evacuation problems, Effective flood access and Type of development.

Hazard categories are defined as high, intermediate or low hazard and are based on the guidelines outlined in the NSW Floodplain Development Manual (2005).

3.4.7 Boundary Conditions

Typical model boundary conditions include flows entering the model domain from upstream, backwater effects from hydraulic controls such as chokes and streams downstream, and the flow predicted through the model domain by a separate hydrologic model. Refer section 3.4.4 of this report for further details.

4.0 Results and Conclusions

The TUFLOW model will be provided to Council upon request. Refer Appendix C for more details.

4.1 TUFLOW Results

Refer to Table 2.0 and 3.0 of this report for the TUFLOW predicted 5% AEP, 1% AEP and PMF flood levels corresponding to the development site for both the pre and post development scenarios. The predicted flooding characteristics for the storm events are mapped on the attached drawings within Appendix C.

Table 2.0 – Table of 1% AEP Flood Levels

Flood Level Location	5% AEP Flood Level (AHD)		1% AEP Flood Level (AHD)		PMF Flood Level (AHD)	
	Pre-Developed	Pre-Developed	Pre-Developed	Pre-Developed	Pre-Developed	Pre-Developed
Point A	10.010m	10.010m	10.040m	10.040m	10.152m	10.152m
Point B	9.834m	9.834m	9.921m	9.921m	10.159m	10.159m
Point C	9.681m	9.683m	9.763m	9.765m	9.962m	9.958m
Point D	9.247m	9.253m	9.257m	9.262m	9.432m	9.435m
Point E	9.137m	9.141m	9.148m	9.148m	9.398m	9.400m
Point F	8.789m	8.788m	8.807m	8.806m	8.908m	8.907m
Point G	8.106m	8.106m	8.133m	8.133m	8.204m	8.204m

Table 3.0 – Table of Flood Level 5% AEP, 1% AEP and PMF Increase

Flood Level Location	Increased Flood Level 5% AEP Storm Event	Increased Flood Level 1% AEP Storm Event	Increased Flood Level PMF Storm Event
Point A	0mm	0mm	0mm
Point B	0mm	0mm	0mm
Point C	2mm	2mm	-4mm
Point D	6mm	5mm	3mm
Point E	4mm	0mm	2mm
Point F	-1mm	-1mm	-1mm
Point G	0mm	0mm	0mm

As a result of the development the overland flow extent and levels are envisaged to be altered slightly,

predominantly within and fronting the development site. The overland flow levels are not envisaged to be significantly impacted outside of the development site. The estimated 5mm increase in 1% AEP overland flow fronting the development site and considered adequate provided the proposed building achieves the Council minimum freeboard requirements. The flood levels for both the pre-developed and post-developed site are not envisaged to have a significant impact on the neighbouring properties.

The PMF event was considered in the TUFLOW model for evacuation and onsite refuge purposes as required by Council. The PMF level considered for the site is approximately RL 10.159m AHD.

4.2 Flood Impact Hazard Assessment Summary

Northern Beaches Council has mandatory requirements for properties located on flood affected land specified in Council's Water Management Policy (2020). This section of the report details these overlay requirements, flood impacts and also the recommendations to meet these requirements for the proposed development.

Table 4.0 – Table of Site-Specific Flood Risk Management Information

Flood Category	Overland Flow
Designated Flood Level (5% AEP)	10.010m AHD
Designated Flood Level (1% AEP)	10.040m AHD
Probable Maximum Flood Level (PMF)	10.159m AHD
Flood Velocities (1% AEP)	Varies 0.2 m/s to 1.0m/s
Flood Depths (1% AEP)	Varies 0.1m to 0.3m approx.
Flood Risk Precinct	Low to Medium Flood Risk
Impacts of waterborne objects & Buoyancy	Low to Medium
Impact on surrounding properties	None envisaged
Flood warning	Signage is recommended
Flood levels	No significant increase

4.3 Flood Effects Caused by Development

The topography of the area is predominantly steep with a lesser gradient towards Pittwater Road. The

terrain generally slopes downwards in an easterly direction. The downstream discharge point for the catchment (beneath Pittwater Road) is towards Collaroy beach.

Land use in the area is predominately urban and consists of mainly residential areas with minor commercial and industrial developments. Parks are found south of the catchment. Refer Appendix A for further details.

4.4 Flood Storage Volume

The flood storage replaced by the front components of the development is considered negligible. The TUFLOW model results have demonstrated that there will not be any significant flooding impact due to the proposed development.

4.5 Proposed Flood Levels and Freeboard Requirements

The existing lower ground floor level of the dwelling is RL 10.72m AHD. The proposed finished floor level for the basement carpark, ground, Level 01 and Level 02 floor levels proposed are 7.67m, 10.57m, 13.67m and 16.82m AHD respectively. The minimum freeboard requirements outlined in Northern Beaches Council Water Management Policy are as follows:

1. New habitable Floor areas: generally defined as the 1% AEP storm event plus 500mm freeboard.
2. New non-Habitable Floor areas: generally defined as the 1% AEP storm event plus 500mm freeboard.

Refer to Table 5.0 of this report for minimum freeboard requirements for the proposed development flood levels.

Table 5.0 – Table of Freeboard Levels for Proposed Development

Flood Locations Considered	1% AEP Flood Level (AHD)	Freeboard Provided (mm)	Proposed Floor Level (AHD)
Point A	10.040m	520mm > 500mm	Garage – 10.570m
Point D	9.262m	330mm < 500mm	Driveway Crest – 9.592m

All proposed floor levels can achieve the minimum Council required freeboard levels except for the driveway crest. The driveway crest proposed is at the maximum level possible to comply with Australian Standards and Council requirements (refer Section 6.4 of the report for further explanation). The freeboard of 330mm achieved is considered acceptable according to the NSW Floodplain Development Manual requirements and is recommended to be adopted as the crest level to protect the basement from potential inundation.

4.6 Environmental Impacts

The development is not envisaged to adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.

Prior to construction approval, a sedimentation and erosion control plan and a stormwater management plan are recommended to be provided by a qualified civil or hydraulic engineer. The objective of the stormwater management regime during construction and after must:

a. Minimise the quantity of pollutants such as sediment, litter, nutrients and oil entering adjacent waterways and stormwater drains
b. Minimise and prevent environmental harm to waterways and associated ecosystems
c. Provide an effective stormwater management system that balances environmental, social and economic interests within the community and incorporates water quality controls
d. Ensure stormwater is managed to minimise the impact of flooding
e. Minimise environmental nuisance or harm from land-disturbing activities.
f. Not result in an increase in stormwater runoff rate leaving the site.

4.7 Cost of Flood Damage

The additional economic and social costs that may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner and general community.

Any potential damage to the proposed development as a result of flooding is envisaged to be less when compared to the existing site conditions. The proposed development has been designed to ensure the floor levels are protected or located above the 1% AEP flood levels. As a result, major damage to the proposed development is not expected. The cost of recovery after a major flood event is considered to be low due to the flood mitigation applied to the development. Flood evacuation is not considered to be a major issue therefore any cost for emergency services is not expected as a result of isolation from floodwaters.

4.8 Existing Council Pipeline Requirements

The existing Council pipeline has been accurately located and is indicated in Appendix C. Any proposed footings located adjacent the easement shall be designed to ensure no loading is applied to the pipeline. Details are to comply with Northern Beaches Council Policy Building Over or Adjacent to Constructed Council Drainage Systems and Easements Policy. The dept and invert of the pipeline within the easement has been indicated on the supplied survey and the proposed stormwater management plans prepared by RTS Civil Consulting Engineers and should form as part of the approval documentation. It is recommended that prior to construction, a geotechnical and structural engineer inspect the site conditions surrounding the drainage easement and pipeline so as to provide further recommendations for structural construction requirements. Refer to Figure 2.0 for details.

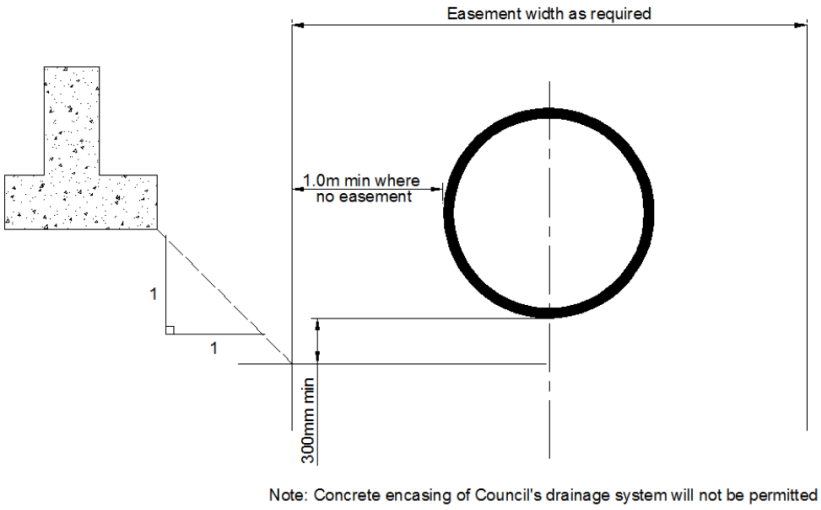

Figure 2.0 – Figure of Footing Placement in Relation to the Council Pipe

5.0 Building Components and Structural Soundness

The proposed works are detailed on the architectural plans shown in Appendix D and consists of a proposed new SEPP Seniors Scheme development with basement carpark.

5.1 Types of Materials to be Used

All new structures may be constructed of concrete, steel, timber and/or brickwork to above the flood levels. Any new development works subject to flooding and overland flows should be constructed of flood compatible materials to ensure the structural integrity of the works is maintained a flood event. For a majority of developments, this is not a crucial aspect to be addressed prior to throughout and after development consent however will likely be enforced as a condition of consent. It is then warranted this aspect be considered in the design phase.

5.2 Recommendations for Structural Design

The velocity verse depth ratio for the site is approximately 0.3. This is considered a "Low Hazard" area outlined in the "*Floodplain Management Manual: the management of flood liable land – January 2001 NSW Government*". This velocity verse depth ratio is also considered generally safe for people, vehicles and buildings according to the Australian Institute for Disaster Resilience (2017) and Australian Rainfall & Runoff (2019) (Refer Appendix B).

Proposed developments shall be designed to withstand damage due to scour, debris or buoyancy forces. Additional measures, including site drainage need to be considered with slab on ground construction. As per

above, this is not a crucial aspect to be addressed prior to development consent however should be addressed as a condition of consent. It is then warranted this aspect be considered in the detail design phase. The proposed new structure should be designed and inspected by a suitably qualified structural engineer certifying that the proposed structure (including building components, fences, etc.) is adequate to withstand flood forces (overland flow and uplift actions) up to and including the PMF or Flood Planning Level, whichever is greater. This shall be in accordance with the requirements specified in the NSW Floodplain Development Manual. Buoyancy, floodwater with debris, wave action, the flood compatibility of materials, and waterproofing shall be addressed in accordance with the Manual. The class of construction, methods and materials are to be approved by Council prior to the issue of a construction certificate.

The basement walls adjacent to the driveway, garbage room, footings and ground floor slab structures must be also designed to ensure they are adequate to withstand flood forces to the levels indicated above. The design is to ensure flood-proofing techniques are incorporated i.e. to ensure the structure is not substantially affected by exposure to floodwater. There are two types of floodproofing for this type of construction proposed, dry and wet. Wet floodproofing is recommended for this development which is the essence of 'resilient' construction. It involves designing the habitable structures to tolerate floodwater exposure with cosmetic damage that needs only cleaning or minor repair when the water recedes.

Further design and construction techniques for this type of floodproofing is defined in *Houses for Flood-prone Areas* by *Cement Concrete & Aggregates Australia* and is recommended to be incorporated into the structural design.

5.3 Waterproofing Methods

It is anticipated that goods and materials will be stored within the building. The proposed floor levels and driveway crest provide sufficient area to store materials above the 1% AEP flood level.

Connection to mains power supply, including metering equipment should be located at or above the 1% AEP flood level plus 500mm freeboard. Heating and air-conditioning systems, including fuel supply and ducting, should be installed at or above the 1% AEP flood level plus 500mm freeboard. Where this is not possible, they should be installed in such a manner as to minimise damage from submersion. All electrical power points, wiring and services to be fitted at or above the 1% AEP flood level plus 500mm freeboard in accordance with the minimum design levels indicated in Table 5.0 of this report. The electrical meter (with a surge protector) and any other electrical motors, valuable equipment / materials etc must be permanently located 500mm above the 1% AEP. Provisions are to be made to ensure any other electrical and valuable equipment / materials can be easily removed and stored 500mm above the 1% AEP. Required levels may meet the same requirements outlined in Table 5.0 of this report.

5.4 Fencing Requirements

Any proposed fencing, alternative to pool type fencing, along the frontage of the property is to be designed by a structural engineer to withstand hydrostatic forces up to and including the 1% AEP event and flood debris. Openings may be provided, at Council discretion, to ensure the 1% AEP floodwater is able to flow unimpeded. Consideration may be given to fencing being hinged providing the hinge opens in the direction of the water flow and there are no structures, including plants, trees or garden beds, which would impede such opening.

5.5 Pool Requirements

No pools are proposed for this development.

6.0 Manage Risk to Life

The proposed development is not envisaged to result in any increased risk to human life and controls for risk to life for floods up to the Flood Planning Level have been considered.

6.1 Flood Emergency Response

The velocity verse depth ratio for the site is approximately 0.3. This is considered a "Low Hazard" area for persons as outlined in the "*Floodplain Management Manual: the management of flood liable land – January 2001 NSW Government*". This velocity verse depth ratio is also considered generally safe for people, vehicles and buildings according to the Australian Institute for Disaster Resilience (2017) and Australian Rainfall & Runoff (2019) (Refer Appendix B).

During flood events, many roads may be cut off by floodwaters which may make the escape by vehicle difficult. Travelling through floodwaters on foot or in a vehicle is also dangerous due to hidden obstructions from floodwaters, chance of being swept away (on foot or within vehicle), or risk of polluted and contaminated floodwaters. In the unlikely event of an emergency due to overland floodwaters, residents are encouraged to first assemble inside and contact emergency services. The proposed ground floor, level 01 and level 02 floor levels are located at 0.53m, 3.63m and 6.78m respectively above the 1% AEP overland flow levels. Further to this, the proposed driveway crest and floor levels are respectively located at 0.16m and 0.41m or more above the PMF overland flow levels. These areas are considered to be adequate areas of refuge (shelter-in-place).

The State Emergency Service of New South Wales (NSW SES) is responsible for providing flood updates and issuing Flood Evacuation Warnings and Flood Evacuation Orders. Flood information issued by the NSW SES may be received by local, radio and television news, SMS messaging, Facebook and door-knocking in affected communities. The timing for evacuation of persons is to be established in consultation with the NSW SES. It is strongly recommended to register the mobile number to SES to receive notification about flood warning

when there is intense rain at Sydney region and Northern Beaches area.

Refer to Section 6.2 of the report for further details.

6.2 Flood Warning and Evacuation

It should be noted that floodwaters may rise rapidly with little warning, inhibiting evacuation of and emergency access to the property. Occupants are to be aware of the risk of floodwaters entering the property. At the first signs of high rainfall events, likely the 5% AEP event, occupants are to check weather reports for possible forecast warnings issued. If a warning has been issued, this flood risk management plan should be implemented. A copy should remain onsite at all times.

Residents are required and may be instructed by the State Emergency Services (SES) or police or similar regulating authority to evacuate the premises and seek higher ground. If so, residents must evacuate within a vehicle and take refuge above the PMF extent. Alternatively, if deemed unsafe to evacuate the property, occupants may evacuate to the ground floor level (or higher) of the building as this area is located 10.159m above the PMF overland flow levels and are considered to be adequate areas of refuge (shelter-in-place).

6.3 Storage of Goods

The storage of products which, in the opinion of Council, may be hazardous or pollute floodwaters, must be placed at a minimum of 500 mm above the height of the 1% AEP flood or placed within an area protected by bunds or levees such that no flood waters can enter the bunded area if the flood level rose to a level of 500 mm above the height of the 1% AEP flood. The development is not envisaged to contain major hazardous substances.

6.4 Car Parking

The car parking is located within the proposed belowground basement carpark. Carparking within driveway areas is not to be expected. The driveway crest proposed is the maximum level possible to comply with Australian Standards and Council requirements. The provided 1% AEP freeboard of 330mm is less than Council's minimum requirement by 170mm, however this is considered acceptable according to the NSW Floodplain Development Manual requirements and is therefore recommended to be adopted as the crest level to protect the basement from potential inundation. It should be noted that the proposed driveway crest is located at 0.16m above the PMF overland flow level.

Driveway access grades are to comply with Council and Australian Standards AS2890.1 access requirements.

7.0 Authors Qualifications and Experience

Rhys Mikhail – Over 15 years of professional experience in civil engineering and stormwater hydraulic and flood management. Director and Civil Engineer at RTS Civil Consulting Engineers Pty Ltd with the following

qualifications; BE (Civil) Hons MIEAust CPEng (2570082) NER RPEQ (17480) APEC IntPE(Aus), NSW Professional Engineer (PRE0000266) and NSW Design Practitioner (DEP0000285).

8.0 CONCLUSION

This report has been prepared to document a strategy to manage overland flow adjacent to and through the site and to set minimum finished floor levels. The increase in overland flow levels up to and including the PMF flood event is expected to increase marginally as a result of proposed structures located within the overland flow extent. The flood levels on adjacent properties are not significantly impacted as a result of the development. The new floor levels are to be designed in accordance with the minimum design levels indicated in Table 5.0 of this report.

The premises have been assessed in accordance with the intent Northern Beaches Council Warringah Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification, Section 10 – Flood Risk Management and Section 11 – Overland Flow Flooding of Northern Beaches Council Water Management Policy (2020) – Flood Risk Management, Bureau of Meteorology (BoM) rainfall information, Bureau of Meteorology guidebook: The Estimation of Probable Maximum Precipitation in Australia, Reducing the Vulnerability of Buildings to Flood damage: Guidance on Building In Flood Prone Areas (Prepared for the Hawkesbury Nepean Floodplain management Steering Committee – 2007), Houses for Flood-prone Areas briefing by cement concrete & aggregates Australia, Construction of buildings in flood hazard areas (Australian Building Codes Board – ABCB Standard & NCC of Australia), the NSW Floodplain Development Manual (FDM 2005 - the management of flood liable land), the NSW Floodplain Risk Management Guide (Incorporating 2016 Australian Rainfall and Runoff in studies), and discussions with Council engineers.

The proposed development is not envisaged to have an adverse effect on surrounding properties provided the recommendations of this report are applied. Therefore, the proposed development generally meets the intent of Council requirements. The development application is recommended for Council approval.

We trust that this report meets with Council requirements for flood risk management analysis. Please contact the author if further clarification is required.

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Rhys Mikhail
Director | Principal Engineer | Design Practitioner
BE (Civil) Hons MIEAust CPEng NER RPEQ APEC IntPE(Aus)

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9.0 REFERENCES

TUFLOW User Manual Build 2017-09-AC Bewsher Consulting and BMT WBM (2017)

Northern Beaches Council Warringah Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification

Northern Beaches Council Water Management Policy (2020) Section 10 – Flood Risk Management

Northern Beaches Council Water Management Policy (2020) Section 11 – Overland Flow Flooding

SIX Maps contour information obtained

New South Wales Government's Floodplain Development Manual (FDM 2005)

Hawkesbury-Nepean Floodplain Management Steering Committee (HNFMSC). (2006). Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas. Available from http://www.ses.nsw.gov.au/content/documents/pdf/resources/Building_Guidelines.pdf

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Queensland Urban Drainage Manual QUDM (2013) Third edition 2013 – provisional

Reducing the Vulnerability of Buildings to Flood damage: Guidance on Building in Flood Prone Areas (Prepared for the Hawkesbury Nepean Floodplain management Steering Committee – 2007)

Houses for Flood-prone Areas briefing by cement concrete & aggregates Australia

Construction of buildings in flood hazard areas (Australian Building Codes Board – ABCB Standard & NCC of Australia)

APPENDIX A – CATCHMENT AND COUNCIL INFORMATION

Figure A1 – TUFLOW Domain and Boundary Condtion Locations and Surface Contours for Global Catchment (NTS)

MANNINGS EQUATION FOR PIPES FLOWING FULL				
PIPE DIAMETER		0.750	M	
SLOPE	M/M	0.050		
MANNINGS n		0.012		
CALCULATIONS				
PIPE AREA		0.442		SQUARE M
WETTED PERIMETER		2.356		M
HYDRAULIC RADIUS		0.188		M
Froude No.		2.250		must be less than 1 for subcritical flow
V	=	**6.104**		METERS PER SECOND
Q	=	**2.6971**		CUBIC METERS PER SECOND

Figure A2 – Existing Drainage Pipeline Mannings Capacity Calculations

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.45	2.74	3.67	4.32	4.97	5.86	6.56
2 min	4.09	4.51	5.87	6.81	7.71	8.96	9.94
3 min	5.65	6.26	8.18	9.52	10.8	12.6	14.0
4 min	7.07	7.85	10.4	12.1	13.8	16.2	18.0
5 min	8.36	9.30	12.3	14.5	16.6	19.5	21.8
10 min	13.3	14.8	20.0	23.6	27.2	32.2	36.1
15 min	16.6	18.6	25.1	29.7	34.3	40.5	45.4
20 min	19.1	21.4	28.8	34.0	39.3	46.4	52.0
25 min	21.1	23.7	31.7	37.4	43.1	50.9	57.0
30 min	22.8	25.5	34.1	40.1	46.2	54.4	60.9
45 min	26.6	29.6	39.3	46.1	52.9	62.1	69.4
1 hour	29.4	32.6	43.0	50.3	57.6	67.6	75.4
1.5 hour	33.5	37.1	48.5	56.6	64.6	75.7	84.5
2 hour	36.8	40.6	52.9	61.5	70.3	82.4	92.0
3 hour	41.9	46.1	59.9	69.8	79.8	93.7	105
4.5 hour	48.1	52.9	68.8	80.3	92.1	109	122
6 hour	53.2	58.6	76.5	89.6	103	122	138
9 hour	61.9	68.4	90.1	106	123	146	166
12 hour	69.3	76.8	102	121	141	168	191
18 hour	81.6	91.0	123	146	171	206	234
24 hour	91.7	103	140	168	197	237	270
30 hour	100	113	155	187	220	264	300
36 hour	108	122	168	203	239	287	326
48 hour	120	136	190	229	270	324	366
72 hour	137	156	219	265	311	372	419
96 hour	148	169	237	286	335	399	447
120 hour	156	178	248	297	347	412	462
144 hour	161	183	253	302	353	418	468
168 hour	164	185	255	303	354	419	469

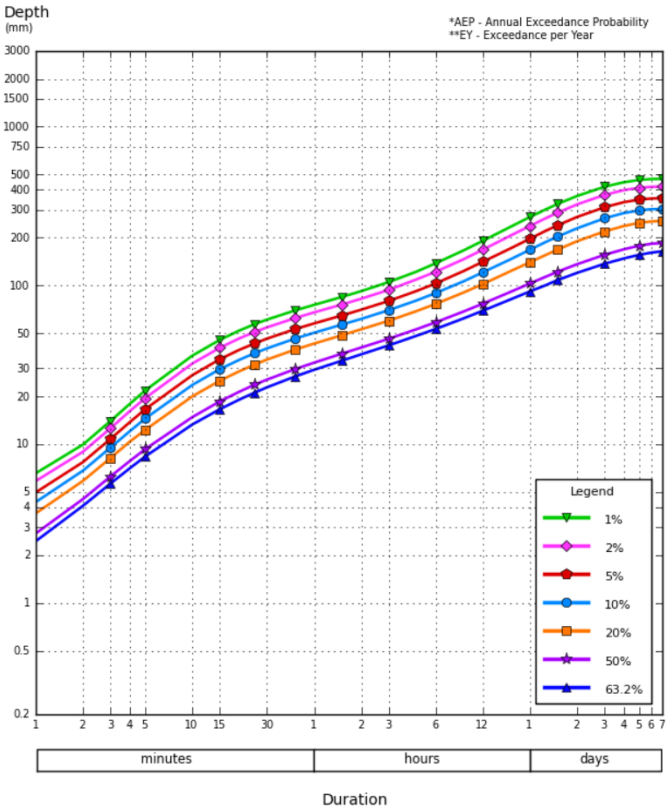
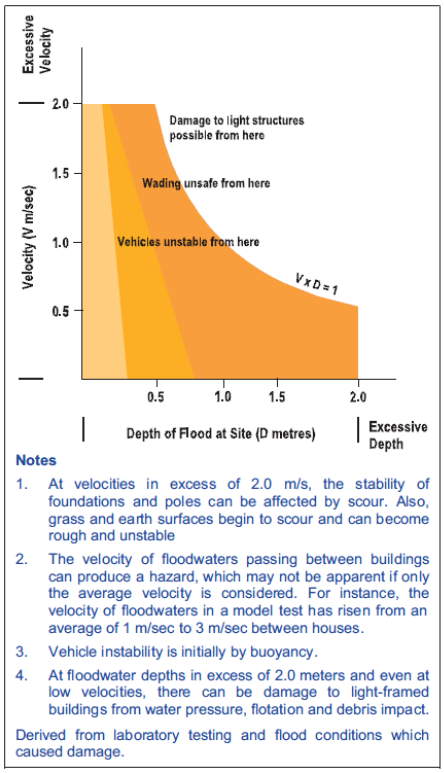


Figure A3 – Design Rainfall Data System (2016) Design Rainfall Depths

APPENDIX B – FLOOD HAZARD RISK LEVEL



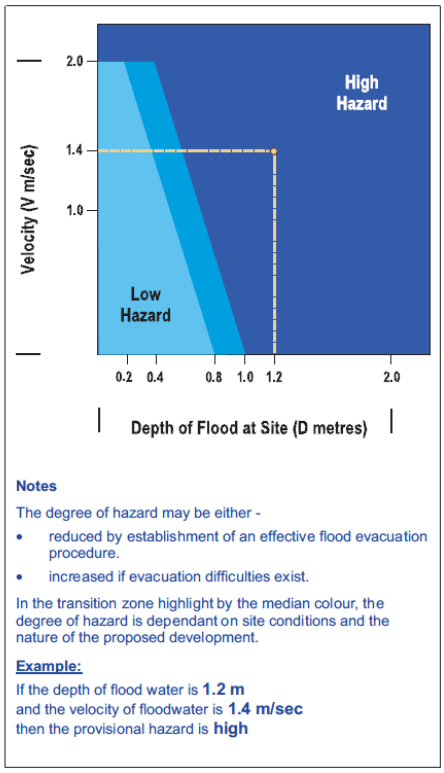


Figure B1 – Flood Hazard Curve Risk Level for the Development

Note: This information is based on the NSW Government Floodplain Management Manual (2005)

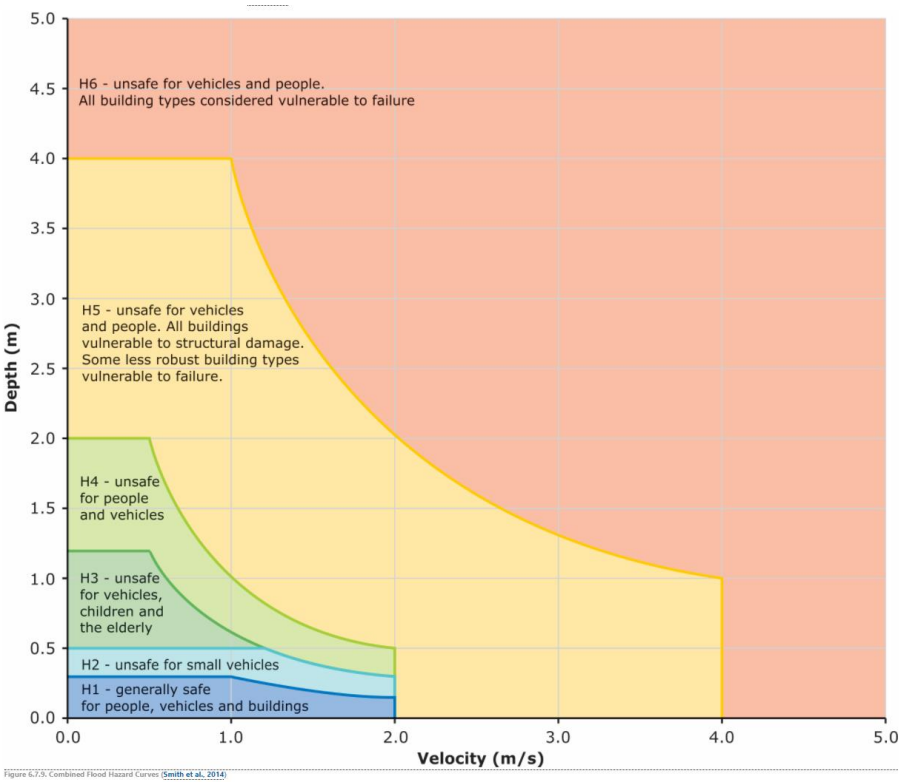
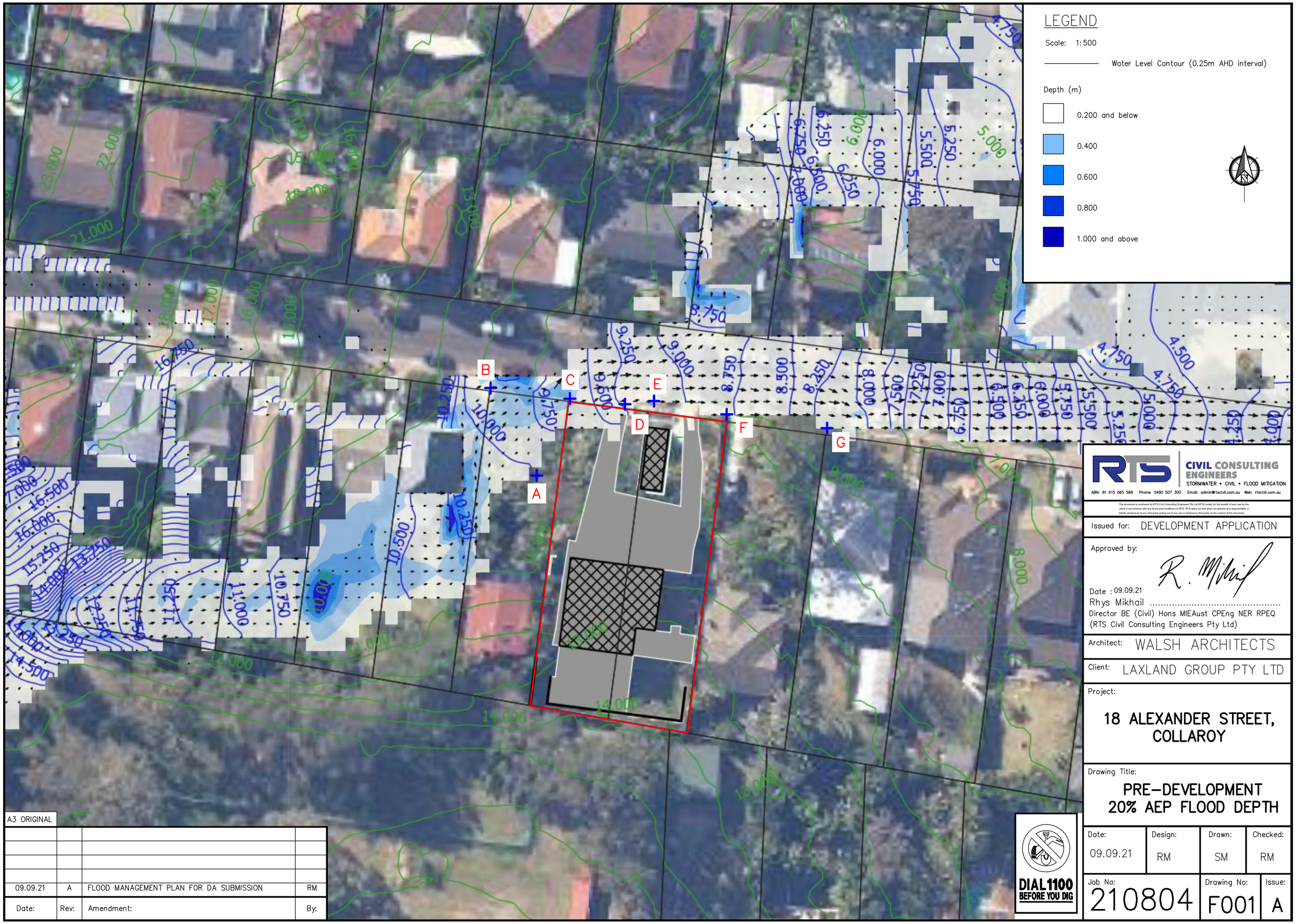


Figure B2 – Combined Flood Hazard Curves

Note: This information is taken from Figure 6.7.9 from Australian Rainfall & Runoff 2019

APPENDIX C – TUFLOW MODEL FLOOD MAPPING PLANS



09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
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Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT 20% AEP FLOOD DEPTH

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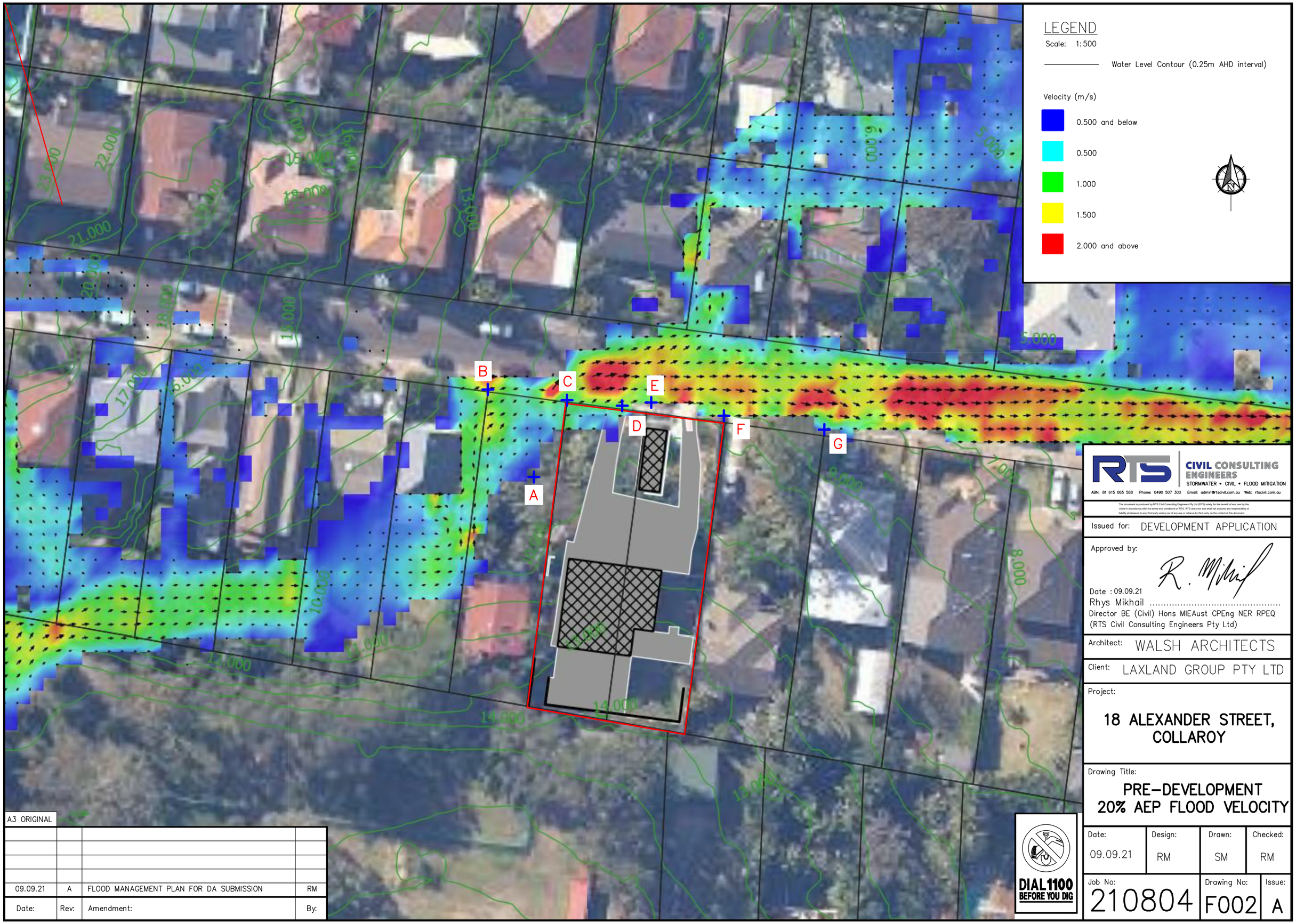

LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Velocity (m/s)

- 0.500 and below
- 0.500
- 1.000
- 1.500
- 2.000 and above

N

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LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Hazards

- Low Hazard
- Medium Hazard
- High Hazard
- Flood Fringe

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PRE-DEVELOPMENT 20% AEP FLOOD HAZARD MAP

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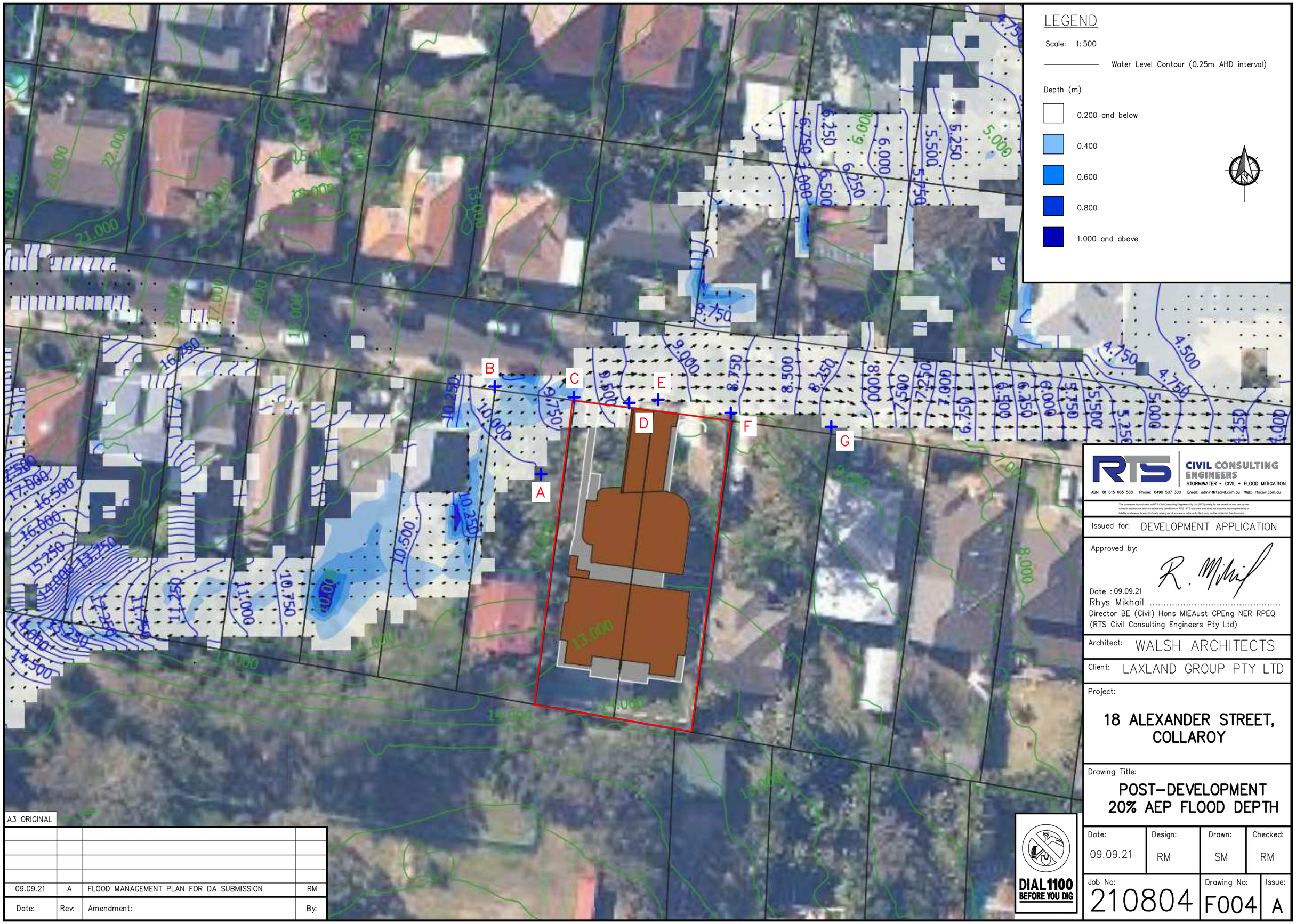

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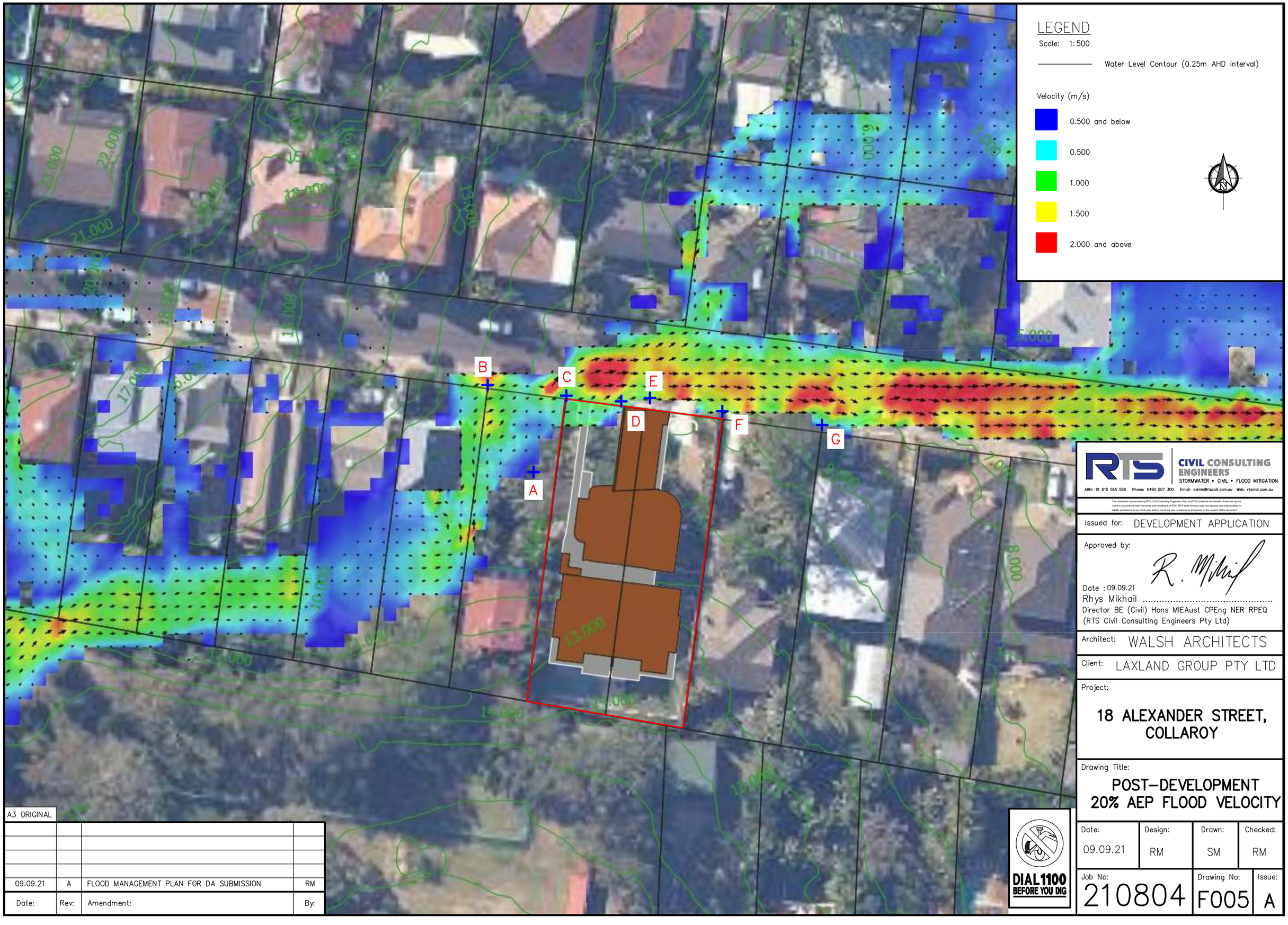

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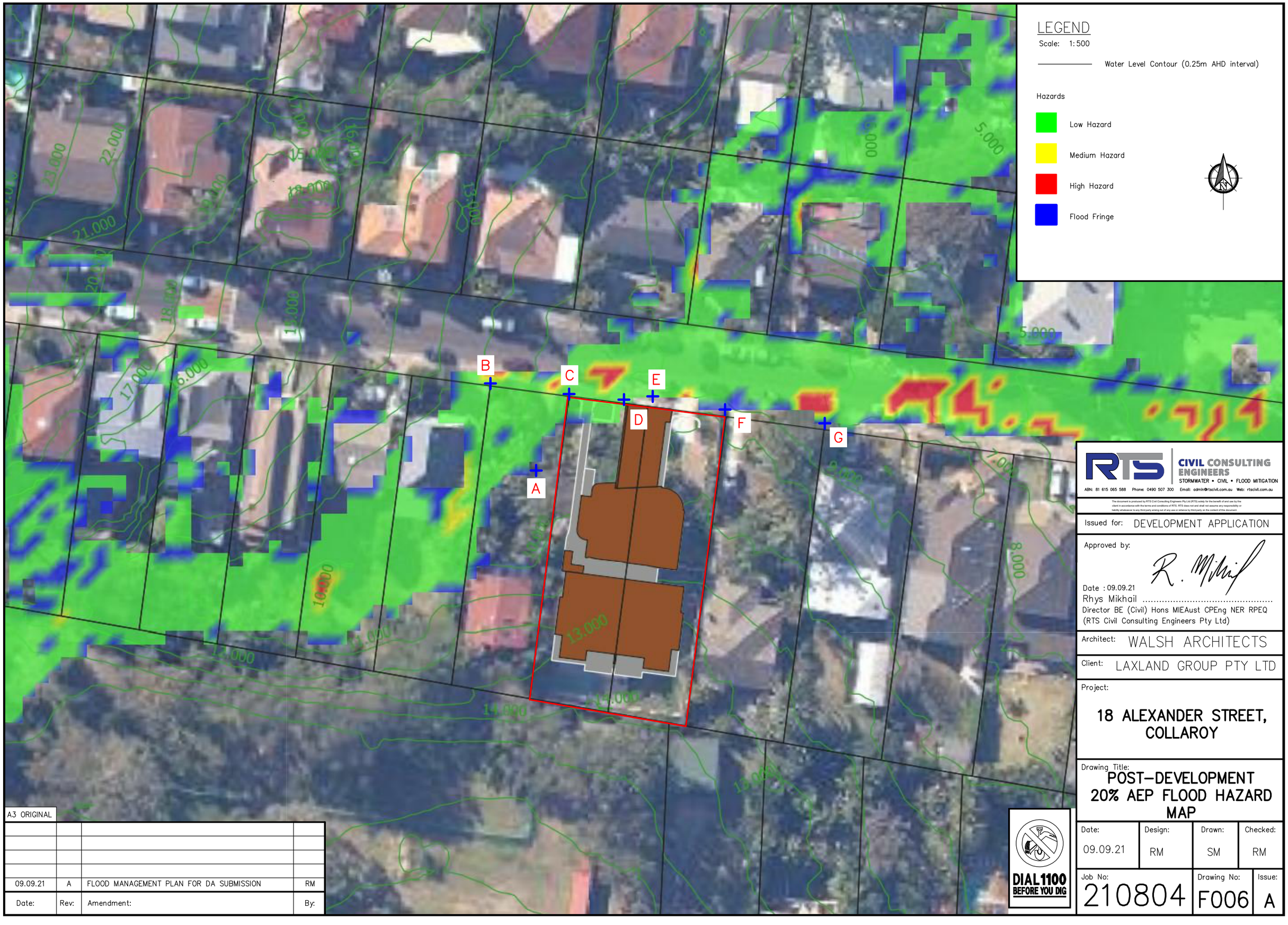

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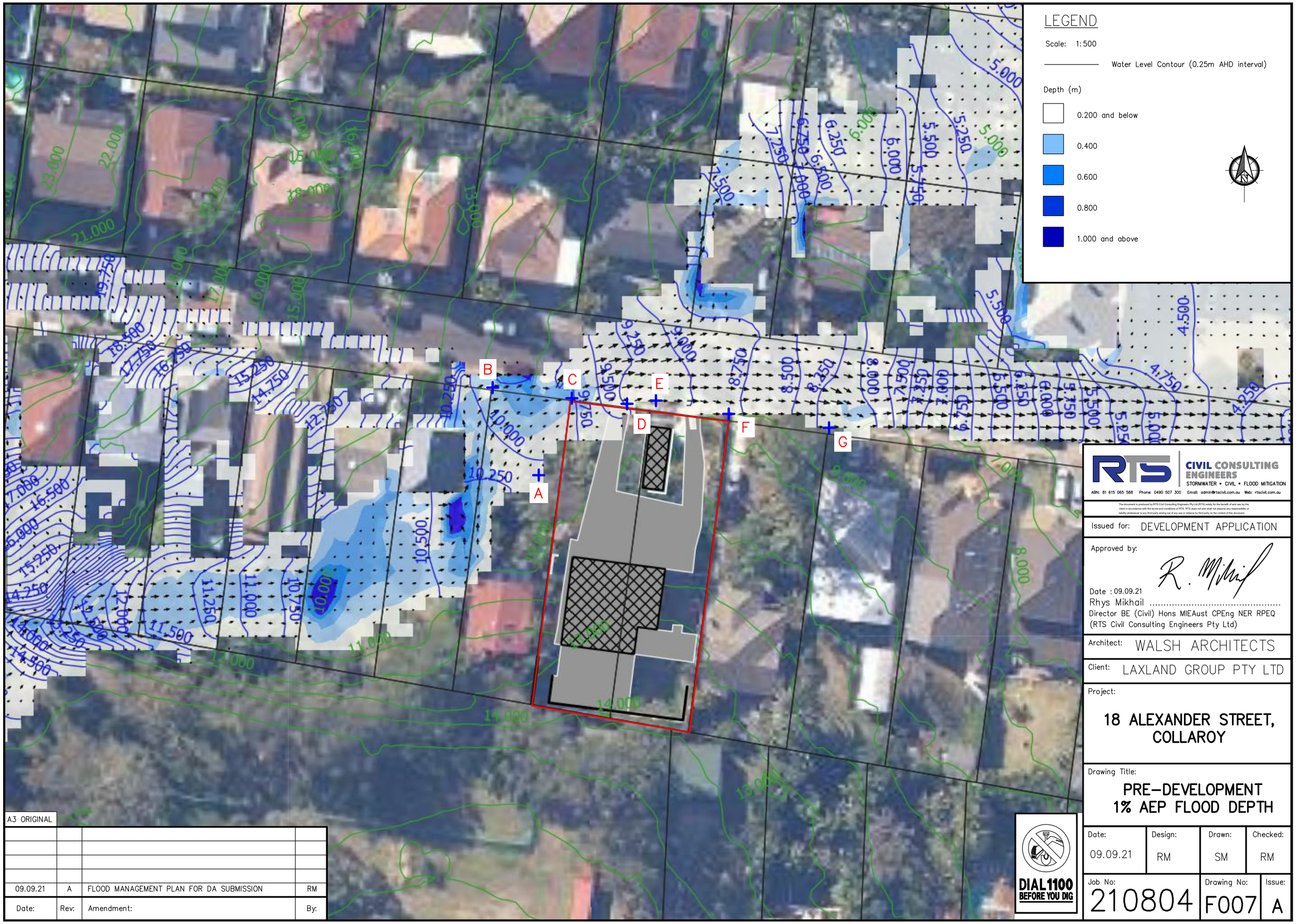

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PRE-DEVELOPMENT 1% AEP FLOOD DEPTH

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LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Velocity (m/s)

- 0.500 and below
- 0.500
- 1.000
- 1.500
- 2.000 and above

N

A
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C
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Director BE (Civil) Hons MIEAust CPEng NER RPEQ
(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT 1% AEP FLOOD VELOCITY

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F008	A

LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Hazards

- Low Hazard
- Medium Hazard
- High Hazard
- Flood Fringe

A
B
C
D
E
F
G

A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

Rhys Mikhail .....

Director BE (Civil) Hons MIEAust CPEng NER RPEQ
(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

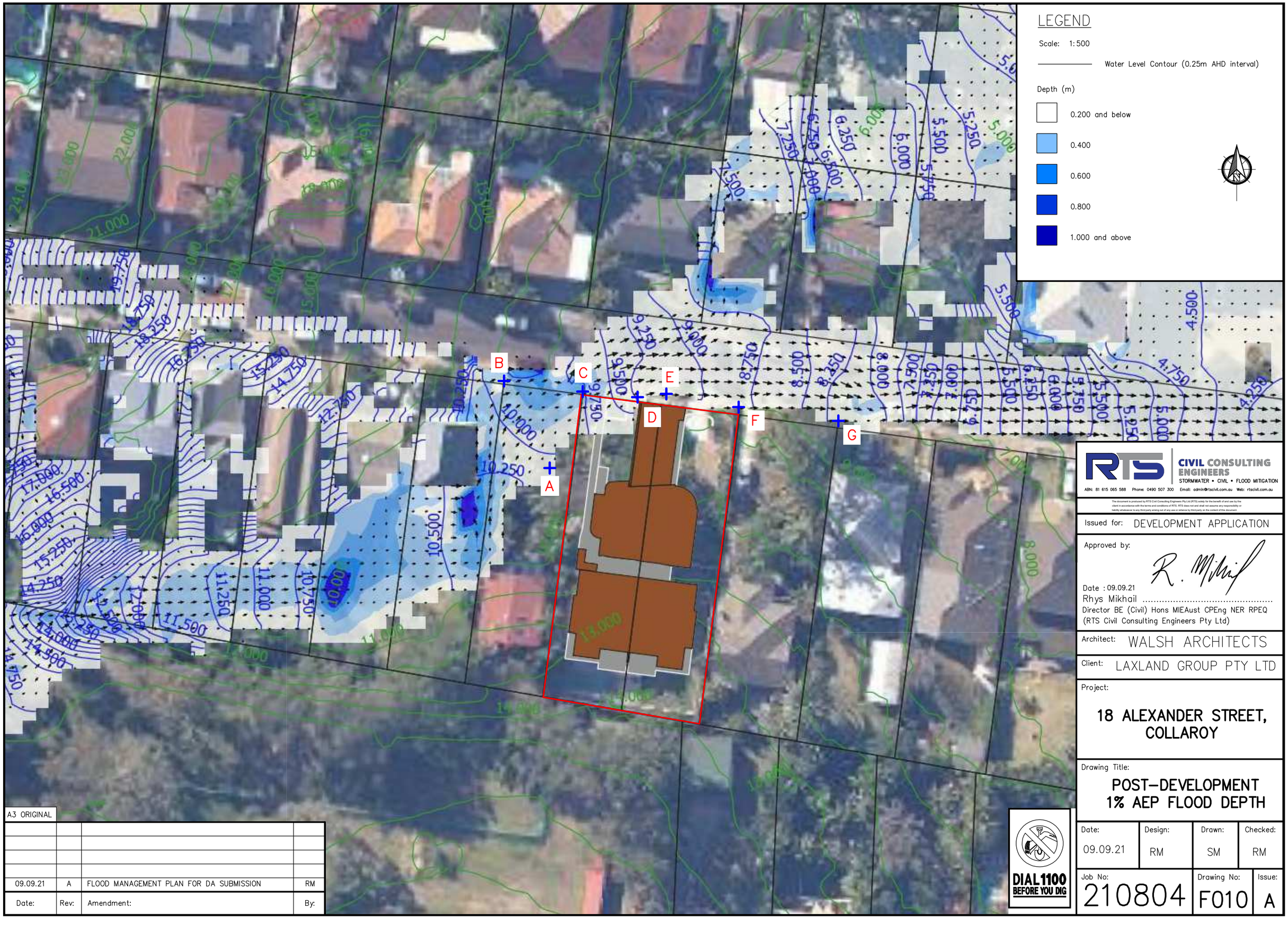
18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT 1% AEP FLOOD HAZARD MAP

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F009	A



A3 ORIGINAL

09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

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Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

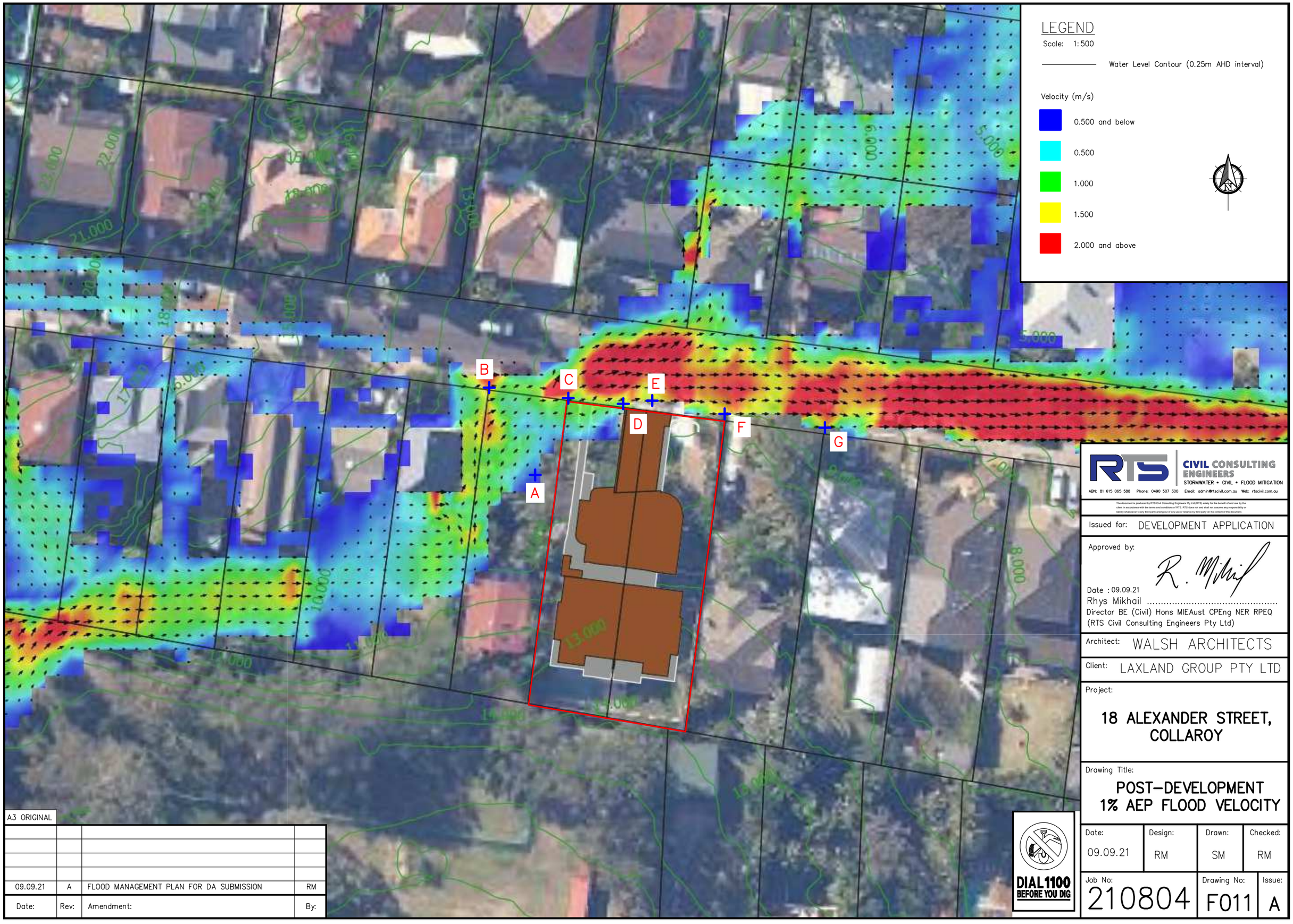
18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST–DEVELOPMENT 1% AEP FLOOD DEPTH

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F010	A



A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

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Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST-DEVELOPMENT 1% AEP FLOOD VELOCITY

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F011	A

LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Hazards

- Low Hazard
- Medium Hazard
- High Hazard
- Flood Fringe

N

A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

Rhys Mikhail .....

Director BE (Civil) Hons MIEAust CPEng NER RPEQ

(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

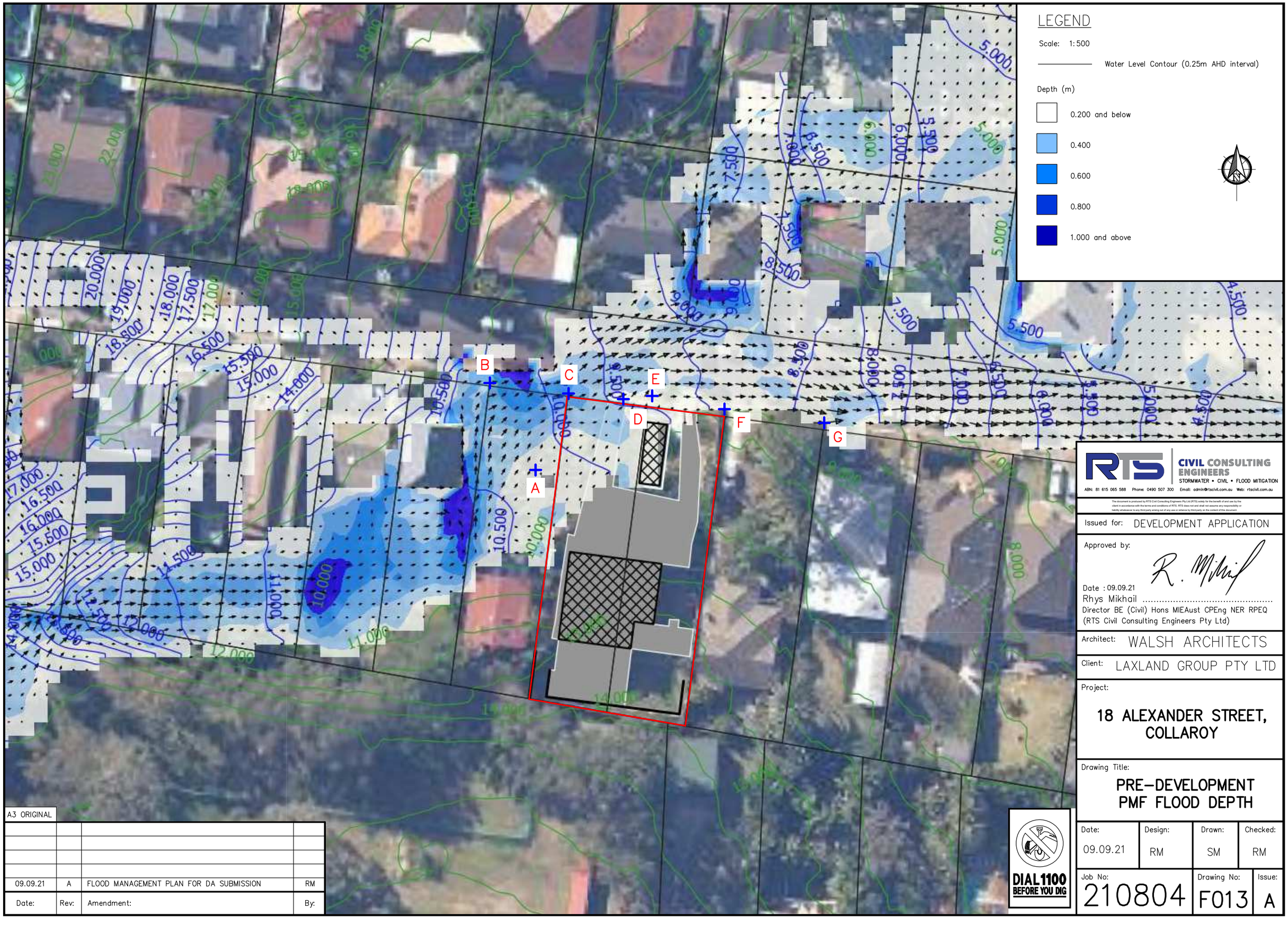
18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST-DEVELOPMENT 1% AEP FLOOD HAZARD MAP

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F012	A



LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Depth (m)

- 0.200 and below
- 0.400
- 0.600
- 0.800
- 1.000 and above

N

DIAL 1100 BEFORE YOU DIG

A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

RTS CIVIL CONSULTING ENGINEERS
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ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

Rhys Mikhail .....

Director BE (Civil) Hons MIEAust CPEng NER RPEQ
(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

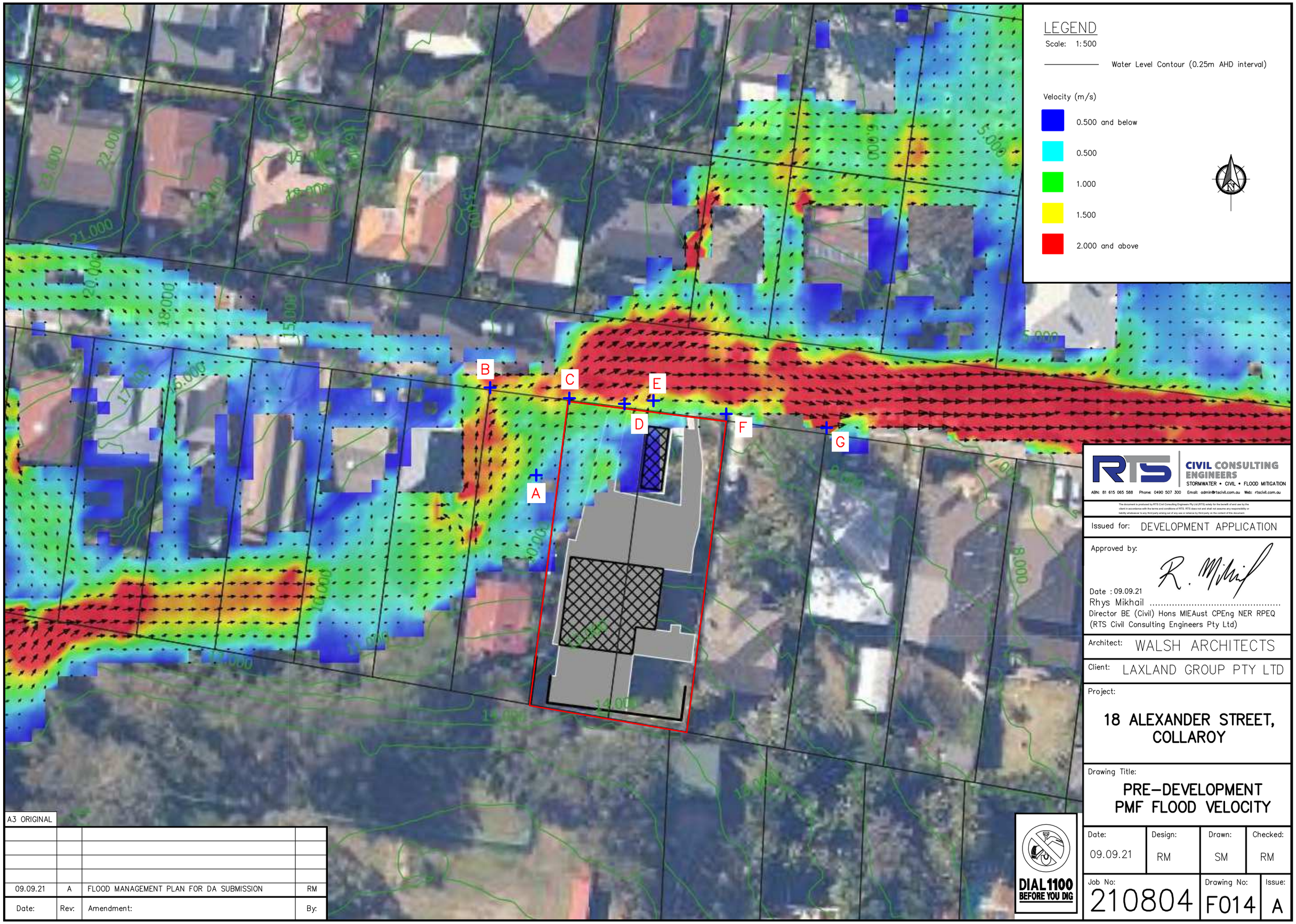
18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT PMF FLOOD DEPTH

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F013	A



LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Velocity (m/s)

- 0.500 and below
- 0.500
- 1.000
- 1.500
- 2.000 and above

N

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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Director BE (Civil) Hons MIEAust CPEng NER RPEQ
(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT PMF FLOOD VELOCITY

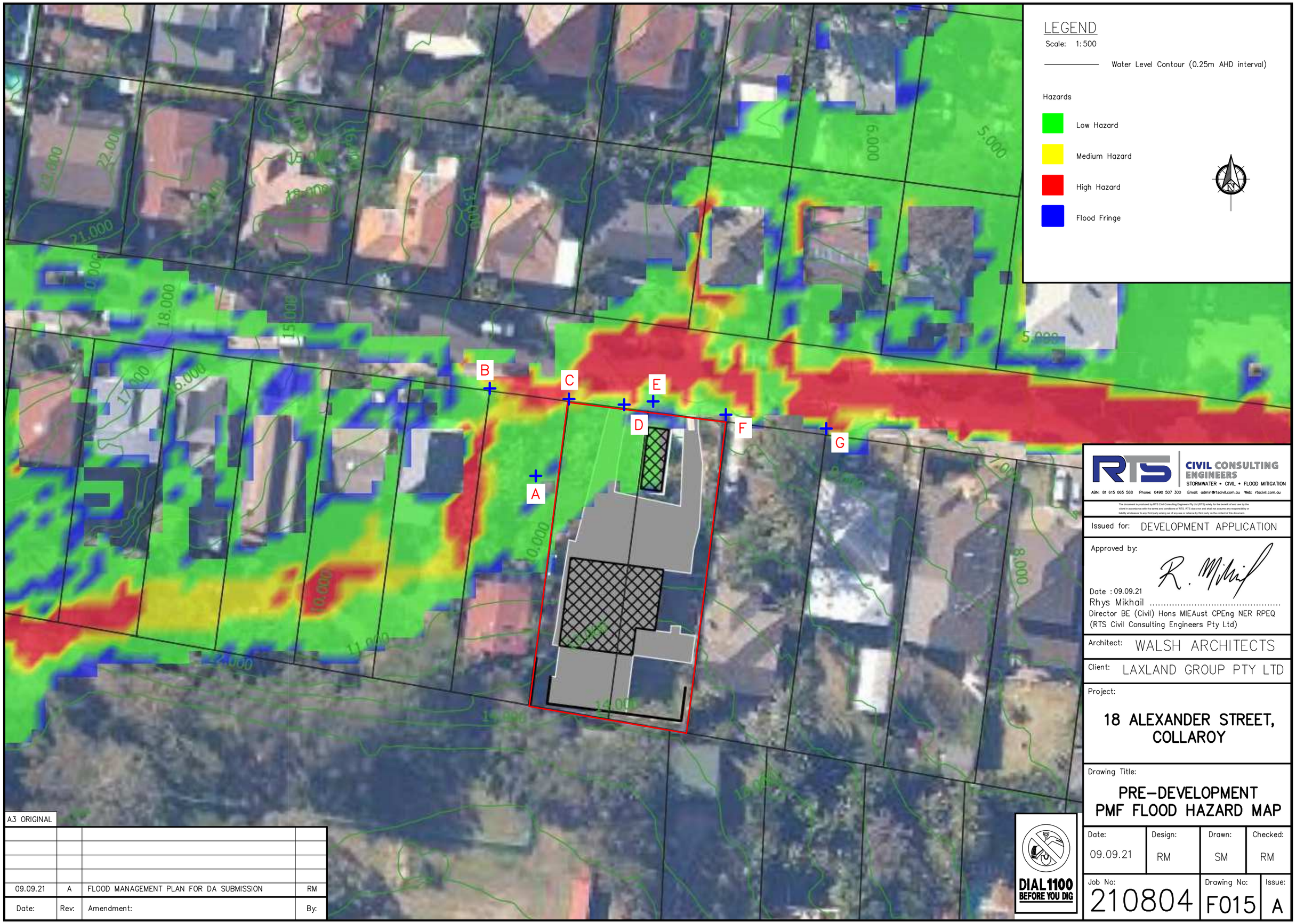
Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F014	A

DIAL 1100 BEFORE YOU DIG

A3 ORIGINAL

Date:	Rev:	Amendment:	By:
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM



LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Hazards

- Low Hazard
- Medium Hazard
- High Hazard
- Flood Fringe

N

A3 ORIGINAL

09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

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Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

PRE-DEVELOPMENT PMF FLOOD HAZARD MAP

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F015	A

LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Depth (m)

- 0.200 and below
- 0.400
- 0.600
- 0.800
- 1.000 and above

A
B
C
D
E
F
G

A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

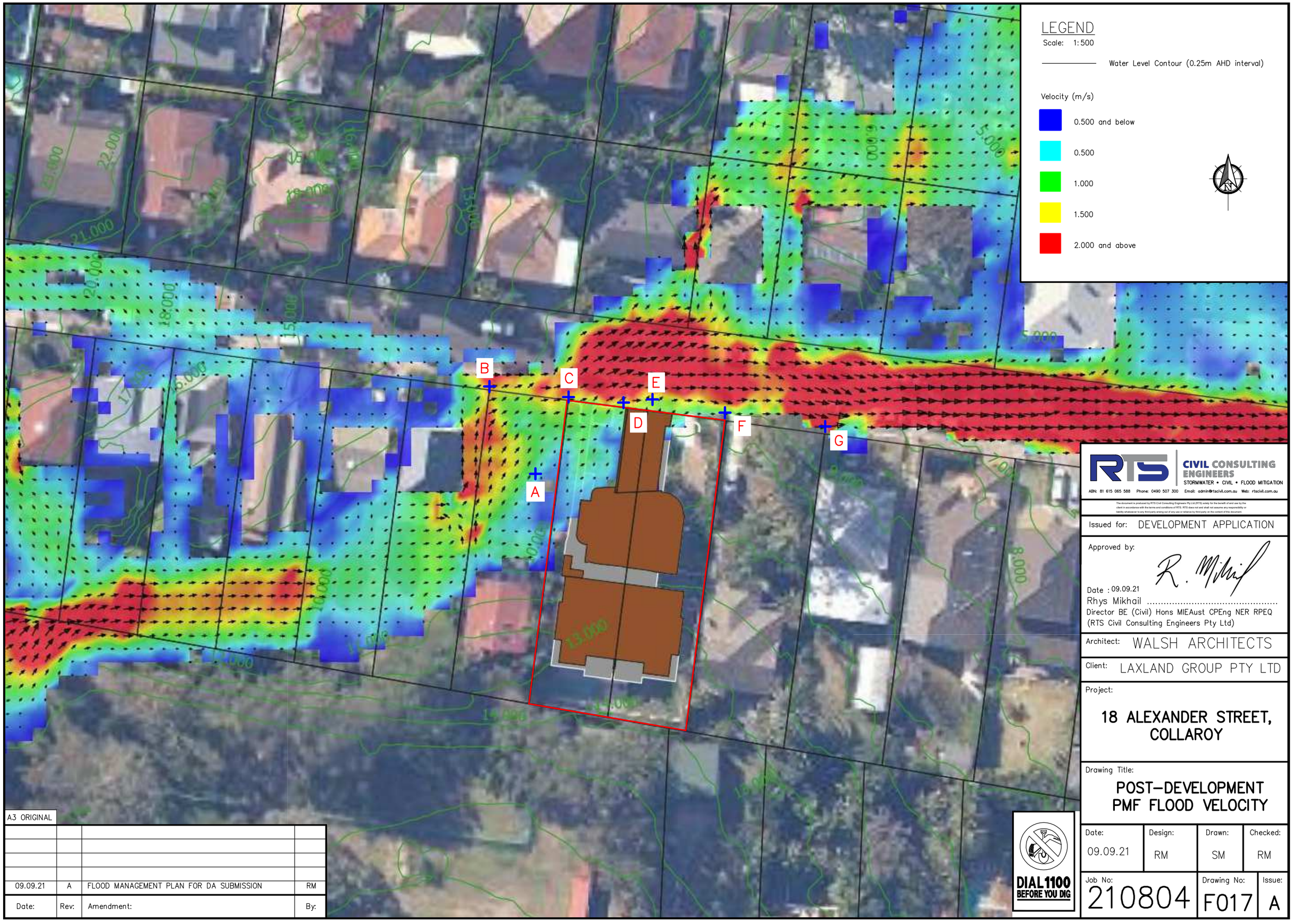
Drawing Title:

POST-DEVELOPMENT PMF FLOOD DEPTH

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F016	A

DIAL 1100 BEFORE YOU DIG



A3 ORIGINAL

09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

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ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

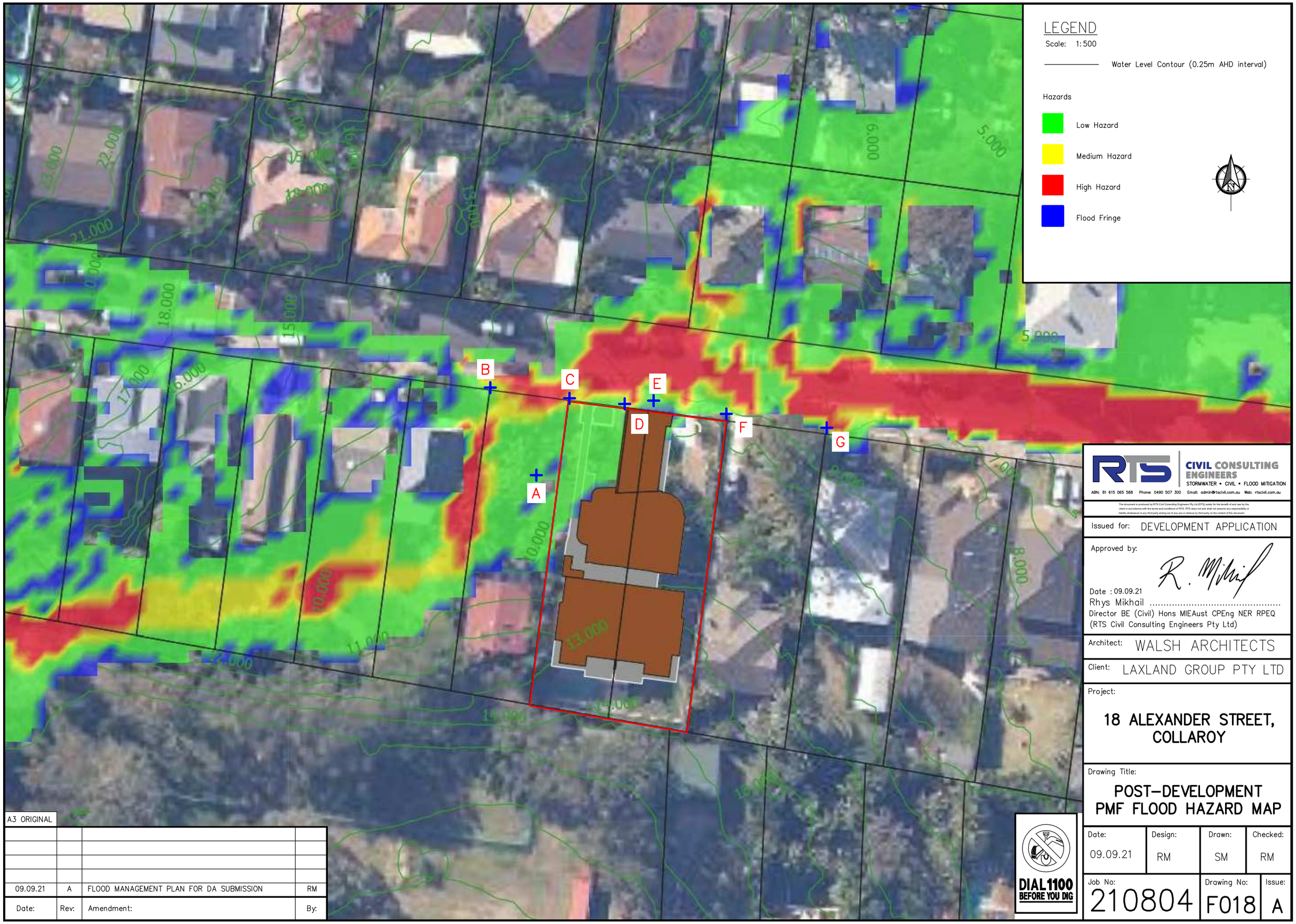
18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST-DEVELOPMENT PMF FLOOD VELOCITY

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F017	A



LEGEND

Scale: 1:500

Water Level Contour (0.25m AHD interval)

Hazards

- Low Hazard
- Medium Hazard
- High Hazard
- Flood Fringe

09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

A3 ORIGINAL

DIAL 1100 BEFORE YOU DIG

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

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(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST-DEVELOPMENT PMF FLOOD HAZARD MAP

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F018	A

A3 ORIGINAL			
09.09.21	A	FLOOD MANAGEMENT PLAN FOR DA SUBMISSION	RM
Date:	Rev:	Amendment:	By:

DIAL 1100 BEFORE YOU DIG

RTS CIVIL CONSULTING ENGINEERS
STORMWATER • CIVIL • FLOOD MITIGATION
ABN: 81 615 065 588 Phone: 0490 507 300 Email: admin@rtscivil.com.au Web: rtscivil.com.au

Issued for: DEVELOPMENT APPLICATION

Approved by:

Date : 09.09.21

Rhys Mikhail .....

Director BE (Civil) Hons MIEAust CPEng NER RPEQ
(RTS Civil Consulting Engineers Pty Ltd)

Architect: WALSH ARCHITECTS

Client: LAXLAND GROUP PTY LTD

Project:

18 ALEXANDER STREET, COLLAROY

Drawing Title:

POST–DEVELOPMENT 1% AEP FLOOD DIFFERENCE

Date:	Design:	Drawn:	Checked:
09.09.21	RM	SM	RM

Job No:	Drawing No:	Issue:
210804	F019	A

APPENDIX D – SITE SURVEY AND PROPOSED PLANS

A3

Notes:

- **BOUNDARIES HAVE NOT BEEN DEFINED (TITLE DIMENSIONS ONLY) - BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY.**
- **A BASIC BOUNDARY SURVEY HAS BEEN UNDERTAKEN SUITABLE FOR COUNCIL DA SUBMISSION (TITLE DIMENSIONS ONLY) - BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY.**
- **IF CONSTRUCTION ON OR NEAR BOUNDARIES IS REQUIRED IT IS RECOMMENDED THAT THE BOUNDARIES OF THE LAND BE MARKED.**

(X) DENOTES EASEMENT 3.05m WIDE

NORTH

1
DP.940388

175° 54' 00"
47.955

00"

15
DP.139919

8
DP.6984

12.190

12.200

23'

355° 54' 00"
47.420

STREET

ALEXANDER

54'

12.190

8.97 TKB

450Ø PIPE

750Ø PIPE

BURIED PIT
APPROX 1.3m DEEP

9.15 PIT
8.10 IL
9.13 PIT
9.33 LIN
9.20 LIN
9.31 LIN

9.41 NS
9.44 NS
9.59 NS
9.65 NS
9.91 NS

BURIED PIT

9.63 TKB

BENCH MARK
NAIL IN CONCRETE
RL 9.59 (AHD)

9
DP.6984

85°

12.200

268°

175° 54' 00"
46.895

1
DP.572945

10
DP.6984

NOTE:

THE NATURAL SURFACE LEVELS SHOWN ARE GROUND LEVELS OF THE LOCATED PIPE CENTERLINE. DUE TO THE SUBSTANTIAL CONCRETE ENCASING, DEPTHS WERE NOT ABLE TO BE CONFIRMED THROUGHOUT THE WHOLE PIPE.

NOTE:

ORIGIN OF LEVELS
DATUMN: AUSTRALIAN HEIGHT DATUM (AHD)
BM ADOPTED: PM3984
RL: 4.115
SOURCE: S.C.I.M.S (31/07/19)

LEGEND

IL = INVERT LEVEL
LIN = LINTEL
NS = NATURAL SURFACE
TKB = TOP OF KERB

1	FIRST ISSUE	12/08/19

CLIENT: BRENDAN WAIGHTS
PLAN SHOWING AS BUILT SURVEY OF LOCATED STORMWATER PIPE
No. 18 ALEXANDER STREET
COLLAROY 2097, NSW

C.M.S. Surveyors Pty. Ltd.
A.C.N 096 240 201
PO Box 463 Dee Why NSW 2099
2/99A South Creek Road, Dee Why NSW 2099
Phone: (02) 9971 4802 Fax: (02) 9971 4822
E-mail: info@cmssurveyors.com.au

SURVEYED	DRAWN	CHECKED	APPROVED
JB	JB	JB	SM

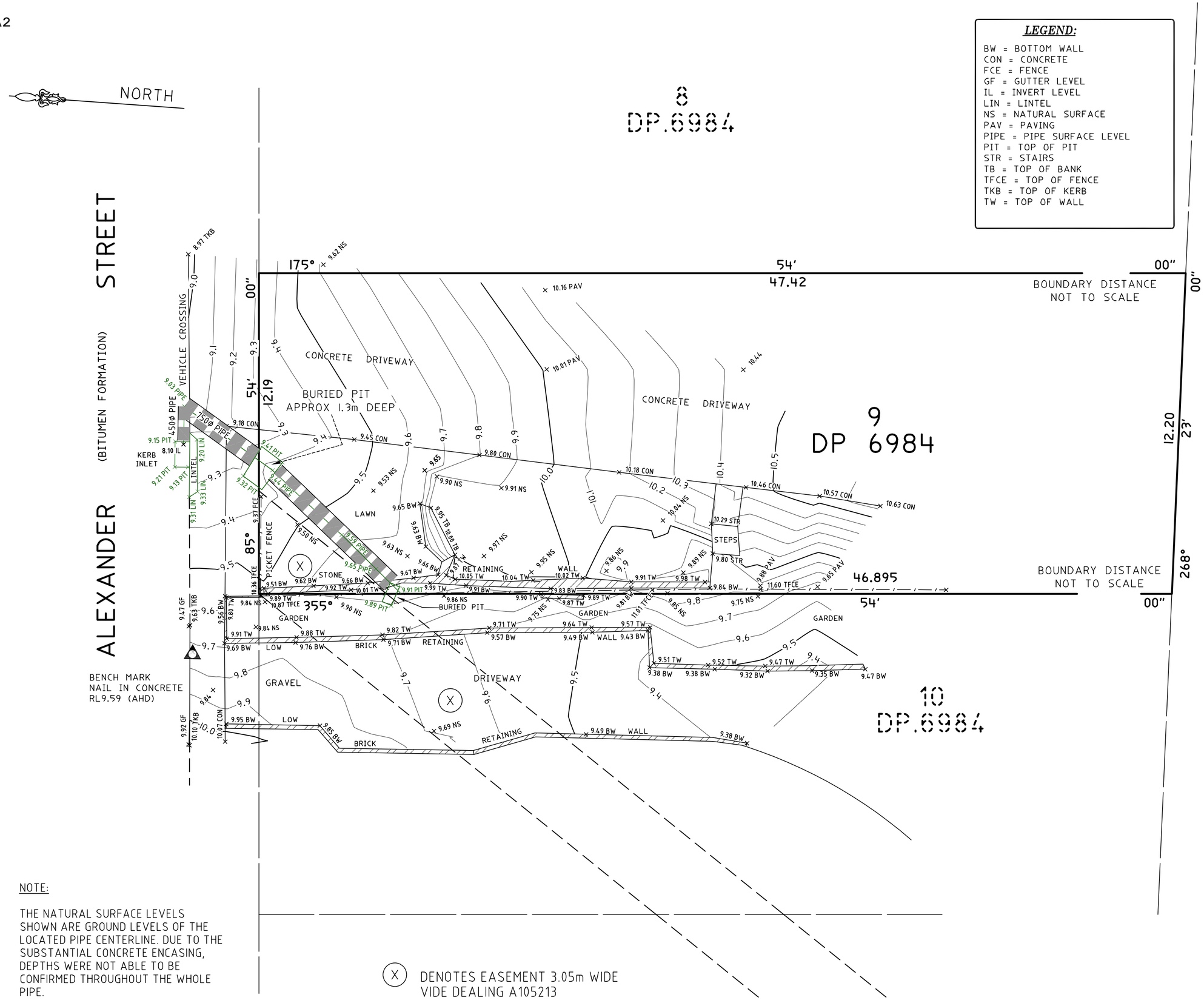
SURVEY INSTRUCTION	SCALE	DATE OF SURVEY
18733	1:150 @ A3	07/08/19

DRAWING NAME
PIPE LOCATION

CAD FILE
18733 PICKUP.dwg

ISSUE
1

A2



NOTE:

THE NATURAL SURFACE LEVELS SHOWN ARE GROUND LEVELS OF THE LOCATED PIPE CENTERLINE. DUE TO THE SUBSTANTIAL CONCRETE ENCASING, DEPTHS WERE NOT ABLE TO BE CONFIRMED THROUGHOUT THE WHOLE PIPE.

LEGEND:

BW = BOTTOM WALL
CON = CONCRETE
FCE = FENCE
GF = GUTTER LEVEL
IL = INVERT LEVEL
LIN = LINTEL
NS = NATURAL SURFACE
PAV = PAVING
PIPE = PIPE SURFACE LEVEL
PIT = TOP OF PIT
STR = STAIRS
TB = TOP OF BANK
TFCE = TOP OF FENCE
TKB = TOP OF KERB
TW = TOP OF WALL

NOTES

- **BOUNDARIES HAVE NOT BEEN DEFINED (TITLE DIMENSIONS ONLY) - BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY.**
- **A BASIC BOUNDARY SURVEY HAS BEEN UNDERTAKEN SUITABLE FOR STORMWATER ASSESSMENT (TITLE DIMENSIONS ONLY) - BOUNDARY DEFINITION IS SUBJECT TO FURTHER SURVEY.**
- **IF CONSTRUCTION ON OR NEAR BOUNDARIES IS REQUIRED IT IS RECOMMENDED THAT THE BOUNDARIES OF THE LAND BE MARKED.**
- TREE SIZES ARE ESTIMATES ONLY.
- THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF BRENDAN WAIGHTS
- RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.
- CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.
- CONTOURS SHOWN DEPICT THE TOPOGRAPHY. THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.
- CONTOUR INTERVAL - 0.2 metre. - SPOT LEVELS SHOULD BE ADOPTED.
- THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100.
- DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.
- THIS PLAN HAS BEEN PREPARED UNDER THE SUPERVISION OF A REGISTERED SURVEYOR, S B McEVOY, BOSSI NUMBER 265.
-
- ANY PERMITTED DOWNLOADING, ELECTRONIC STORAGE, DISPLAY, PRINT, COPY OR REPRODUCTION OF THIS SURVEY SHOULD CONTAIN NO ALTERATION OR ADDITION TO THE ORIGINAL SURVEY.
- THIS NOTICE MUST NOT BE ERASED.

HORIZONTAL DATUM:
CO-ORDINATE SYSTEM: ASSUMED

VERTICAL DATUM:
DATUM: AUSTRALIAN HEIGHT DATUM (AHD)
B.M. ADOPTED: PM 3984
R.L. 4.115 (ORDER L3)
SOURCE: S.C.I.M.S. (31/07/19)

2	EXTRA DETAIL ADDED	29/10/19
1	FIRST ISSUE	12/08/19

CLIENT:

BRENDAN WAIGHTS
18 ALEXANDER STREET
COLLAROY NSW 2097

SURVEY PLAN
SHOWING PART DETAIL & LEVELS OVER STORMWATER PIPE AND PART OF LOTS 9 & 10 DP 6984
18 ALEXANDER STREET
COLLAROY NSW 2097

C.M.S. Surveyors Pty Limited
ACN: 096 240 201
PO Box 463 Dee Why NSW 2099
2/99A South Creek Road, Dee Why NSW 2099
Telephone: (02) 9971 4802
Facsimile: (02) 9971 4822
E-mail: info@cmssurveyors.com.au

LGA: NORTHERN BEACHES | SHEET 1 OF 1

SURVEYED	DRAWN	CHECKED	APPROVED
JB/MB	MC	MB	SM

SURVEY INSTRUCTION	SCALE	DATE OF SURVEY
18733	1:100 @ A2	07/08/19

DRAWING NAME
PIPE LOCATION

CAD FILE
18733floodstudy 1.dwg

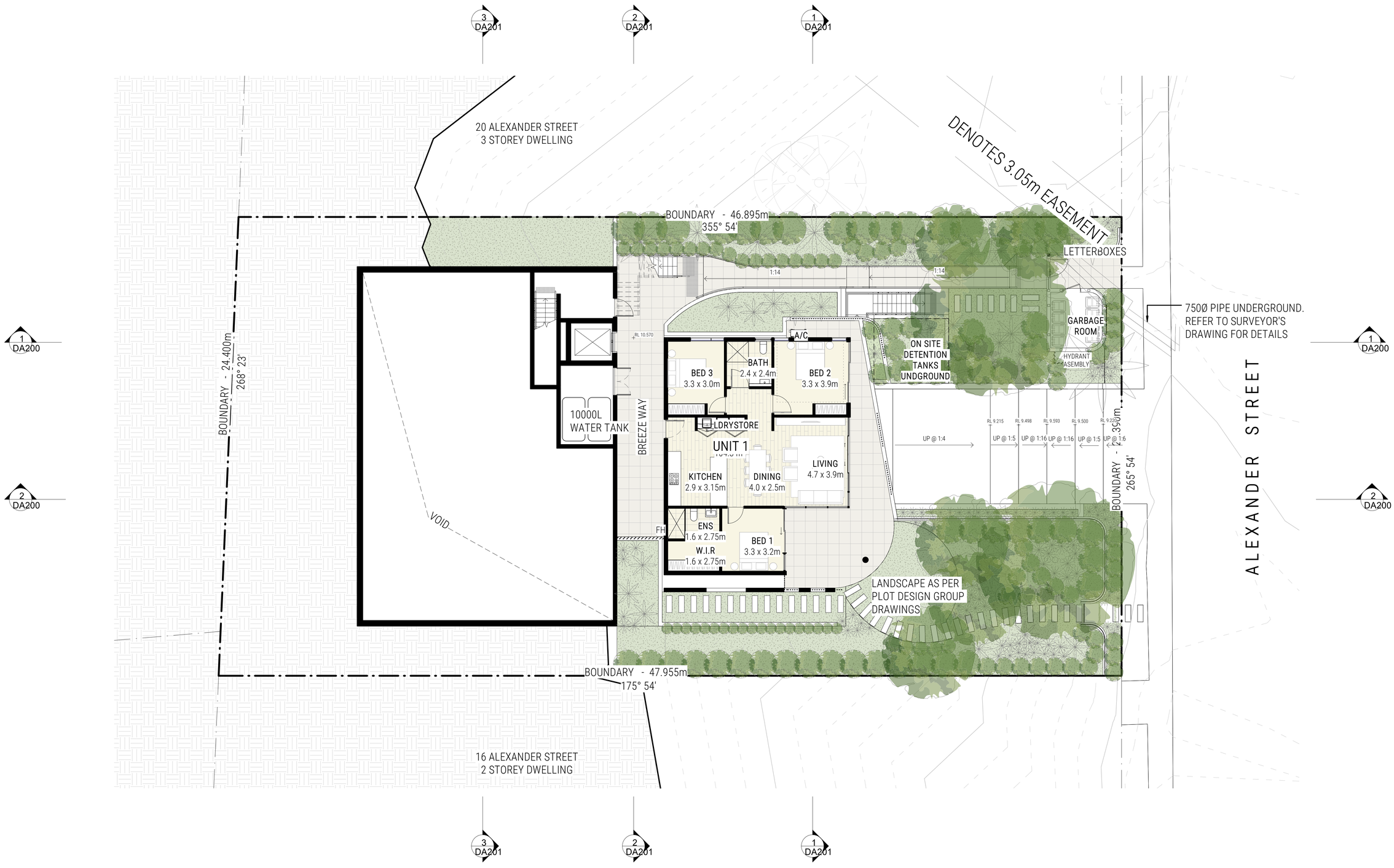
ISSUE
2

WALSH ARCHITECTS

Building 3.3/1 Dairy Rd,
Fyshwick ACT 2609
E: scott@walsharchitects.com.au
P: 0466 049 880
Nominated Architect : Scott Walsh
ACT 2624 | NSW 10366

REV NO.	DESCRIPTION	REV DATE
A	ISSUE FOR DA APPROVAL	03.09.21

BASEMENT PLAN
SHEET NUMBER DA110
REVISION A
SCALE @ A1 1 : 100
18 ALEXANDER ST COLLARO

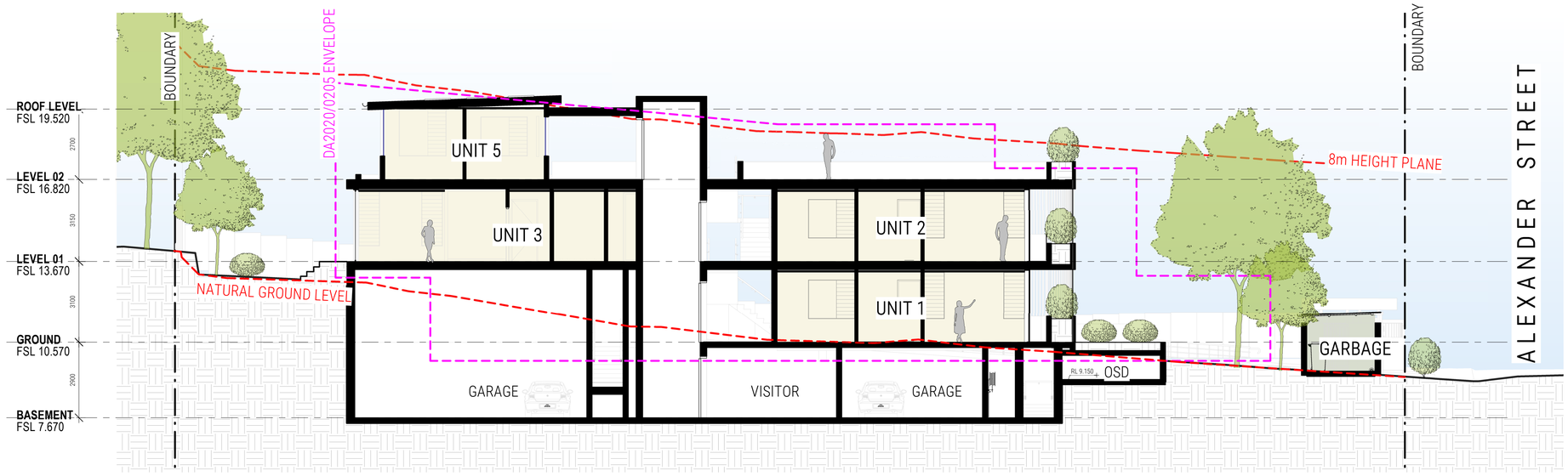


WALSH ARCHITECTS

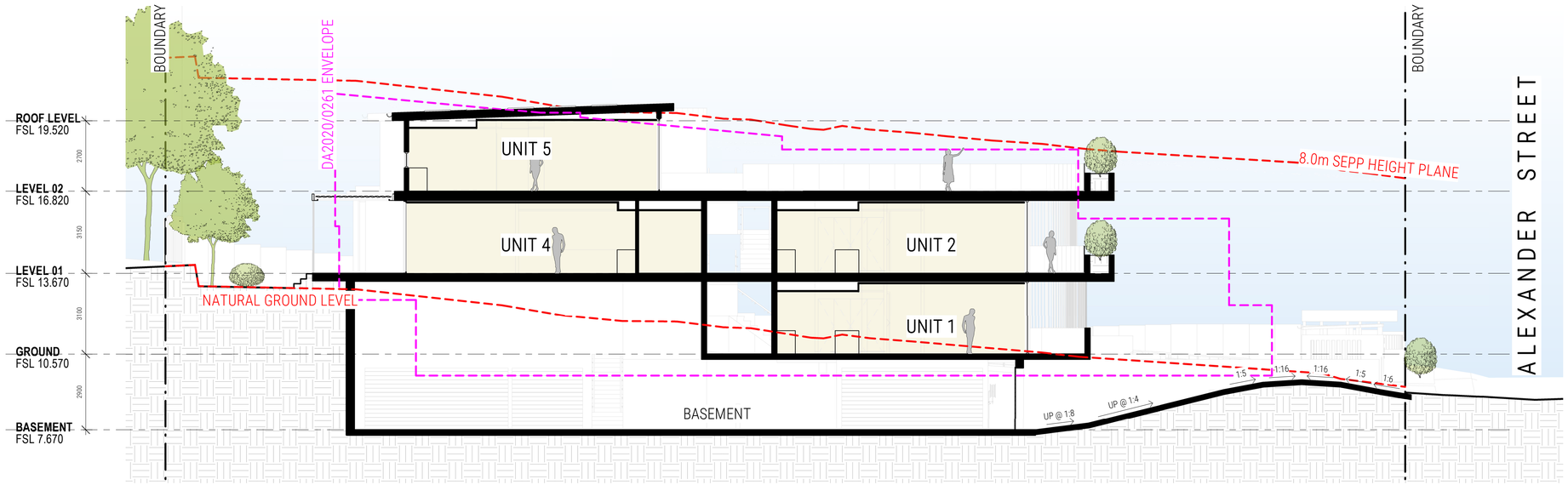
Building 3.3/1 Dairy Rd,
Fyshwick ACT 2609
E: scott@walsharchitects.com.au
P: 0466 049 880
Nominated Architect : Scott Walsh
ACT 2624 | NSW 10366

REV NO.	DESCRIPTION	REV DATE
A	ISSUE FOR DA APPROVAL	03.09.21

UNDERCROFT FLOOR P
SHEET NUMBER DA111
REVISION A
SCALE @ A1 1 : 100
18 ALEXANDER ST COLLARO



1 LONG SECTION 1
DA200 : 100 @ A1



2 LONG SECTION - DRIVEWAY
DA200 : 100 @ A1

WALSH ARCHITECTS
Building 3.3/1 Dairy Rd,
Fyshwick ACT 2609
E: scott@walsharchitects.com.au
P: 0466 049 880
Nominated Architect : Scott Walsh
ACT 2624 | NSW 10366

REV NO.	DESCRIPTION	REV DATE
A	ISSUE FOR DA APPROVAL	03.09.21

SECTIONS
SHEET NUMBER DA200
REVISION A
SCALE @ A1 1 : 100
18 ALEXANDER ST COLLARO