Integrated Water Cycle Management Report

Lot 437 DP 755242
1377 Hue Hue Road,
Wyee

22/03/2024 | Topa Property | Revision F

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Commercial in Confidence

Document Control

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F	Rory McLoughlin	Christopher Scholes	Stephen Brain	22/03/2024	Land Zoning Plan updated

Table of Contents

Executive Summary

Orion Consulting (Orion) has been engaged by Topa Property to prepare an Integrated Water Cycle Management (IWCM) report to accompany a planning proposal over 1377 Hue Hue Road, Wyee.

This report has been prepared by Orion for Topa Property to determine the flood extents adjacent to 1377 Hue Hue Road, Wyee and establish preliminary sizing for a combined biofiltration and On-Site Detention basin to meet water quality and quantity targets in accordance with Lake Macquarie Council's design requirements.

This report demonstrates that the current proposed integrated water cycle management strategy proposed meets the flooding, stormwater management and water sensitive urban design requirements as specified by Lake Macquarie Council and is also in accordance with the Department of Planning and Environment Flood Risk Management Guideline LU01 2023.

Glossary of Terms

As compiled from the NSW Government Floodplain Development Manual 2005 unless otherwise noted.

Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m^3/s or larger event occurring in any one year (see ARI).
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average Annual Damage (AAD)	Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
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. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event. **A note on terminology:** The following conversion table as extracted from Australian Rainfall and Runoff 2019, book1, chapter 2 section 2.5.5 below provides a guide to convert ARI to AEP. ARI terminology is noted as being generally the accepted terminology under Australian Rainfall and Runoff 1987 guidelines whiles AEP terminology is noted as being the accepted terminology under Australian Rainfall and Runoff 2016 - 2019 guidelines and onwards.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	19.5
	0.02	2	50	49.5
	0.01	1	100	99.5
Very Rare	0.005	0.5	200	199.5
	0.002	0.2	500	499.5
	0.001	0.1	1000	999.5
	0.0005	0.05	2000	1999.5
Extreme	0.0002	0.02	5000	4999.5
			↓	
			PMP/ PMP Flood	

Bio-filtration system	A well-vegetated, retention cell or pond designed to enhance water filtration through a specially prepared sub-surface sand filter. Bio-retention cells may be incorporated into grass or vegetated swales or may be a stand-alone treatment system. The system incorporates vegetation with medium-term stormwater retention and sub-surface filtration/infiltration. Also known as bio-filtration systems or biofilters. (QDUM 2013)
Bypass flow	That portion of the flow on a road or in a channel which is not collected by a gully inlet or field inlet, and which is redirected out of the system or to another inlet in the system. (QDUM 2013)
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.
Consent authority	The Council, Government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.

Detention basin	A large, open, free draining basin that temporarily detains collected stormwater runoff. These basins are normally maintained in a dry condition between storm events. (QDUM 2013)
Development	Is defined in Part 4 of the Environmental Planning and Assessment Act (EP&A Act). infill development: refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. new development: refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. redevelopment: refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.
Disaster plan (DISPLAN)	A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
Effective warning time	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
Emergency management	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
Extended detention	A stormwater detention basin or tank designed to drain over a period of days rather than hours to enhance its pollution retention and solar treatment while minimising the adverse

	effects of coincident flooding downstream of the basin. (QDUM 2013)
Flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.
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, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood awareness	Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
Flood education	Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
Flood fringe areas	The remaining area of flood prone land after floodway and flood storage areas have been defined.
Flood liable land	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level (see flood planning area).
Flood mitigation standard	The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
Flood plan (local)	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at State, Division and local levels. Local flood plans are prepared under the leadership of the State Emergency Service. flood planning area The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the “flood liable land” concept in the 1986 Manual.
Flood Planning Levels (FPLs)	FPL’s are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the “standard flood event” in the 1986 manual.

Flood prone land	Is land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
Flood proofing	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.
Flood readiness	Flood readiness is an ability to react within the effective warning time.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. future flood risk: the risk a community may be exposed to as a result of new development on the floodplain. continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
Floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
Floodplain risk management plan	A management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.

Floodway areas	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flows, or a significant increase in flood levels.
Freeboard	Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.
GPTs	Trash rack and/or sediment collection sump usually located at or near the end of a stormwater pipe. (QDUM 2013 in part)
Grass swale	Shallow, low-gradient, grass-lined overland flow path used primarily for stormwater treatment. (QDUM 2013)
Habitable room	in a residential situation: a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom. in an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Hazard	A source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in the Manual.
Hydraulics	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
Hydrograph	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.
Hydrology	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
Intensity-frequency-duration data (IFD)	Basic rainfall data used in the calculation of rainfall runoff rates. (QDUM 2013)
Local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam. local drainage Are smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
Major design storm	The rainfall event for the AEP chosen for the design of the Major Drainage System. (QDUM 2013)

Major drainage system	That part of the overall drainage system which conveys flows greater than those conveyed by the Minor Drainage System and up to and including flows from the Major Design Storm. (QDUM 2013)
Major overland flow path	An overland flow path that drains water from more than one property, has no suitable flow bypass, and has a water depth in excess of 75mm during the major design storms; or is an overland flow path recognised as significant by the local government. (QDUM 2013)
Manning's roughness coefficient	A measure of the surface roughness of a conduit or channel to be applied in the Manning's equation. (QDUM 2013)
Mathematical/computer models (TUFLOW, WBNM)	The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.
Minor design storm	The rainfall event for the AEP chosen for the design of the Minor Drainage System. (QDUM 2013)
Minor drainage system	That part of the overall drainage system which controls flows from the Minor Design Storm e.g. kerbs and channels, inlets, underground drainage etc. for the purpose of providing pedestrian safety and convenience, and vehicle access. (QDUM 2013)
Minor, moderate and major flooding	Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood: minor flooding: causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded. moderate flooding: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered. major flooding: appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.
Modification measures	Measures that modify either the flood, the property or the response to flooding. Examples are indicated in Table 2.1 with further discussion in the Manual.
Peak discharge	The maximum discharge occurring during a flood event.
Probability	A statistical measure of the expected chance of flooding (see AEP).

Probable Maximum Flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
Probable Maximum Precipitation (PMP)	The 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, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Stage	Equivalent to "water level". Both are measured with reference to a specified datum.
Stage hydrograph	A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
Survey plan	A plan prepared by a registered surveyor.
Water Sensitive Urban Design (WSUD)	A set of design elements and on-ground solutions that aim to minimise impacts on the water cycle from the built urban environment. It offers a simplified and integrated approach to land and water planning by dealing with the urban water cycle in a decentralised manner consistent with natural hydrological and ecological processes. (QDUM 2013)
Water surface profile	A graph showing the flood stage at any given location along a watercourse at a particular time.

1 Introduction

1.1 Site Description

The subject site is located within the Lake Macquarie City Council LGA, west of the existing Wyee township and is bounded by Hue Hue Road to the north, existing residential development to the east, Digary Road to the west and existing E2 zoned land to the south which contains Mannering Creek.

The proposed development is a new subdivision by Topa Property with a development footprint of approximately 4.56 hectares over what is currently rural farmland. The approximate development footprint extents are shown in the figure below.

Figure 1 1377 Hue Hue Road Locality (Imagery courtesy of Nearmap ©)

A planning proposal to amend the Lake Macquarie Local Environmental Plan 2014 is proposed to reconfigure the existing land zoning of the site. The existing site is split between RU2 Rural Landscape and E2 Environmental Conservation Land. The RU2 Rural Landscape zoning is proposed to be changed to R2 Low Density Residential Land.

The site has a slight slope of 5-6% from the northwest of the site roughly towards the south where the slope eases to approximately 1-3% approaching Mannering Creek.

1.2 Proposed Development

Topa Property are proposing a residential subdivision over the subject site. A copy of the proposed site layout is presented in Appendix A to this report.

The proposed layout includes an extension of Lawrence Avenue from the adjoining development to the East of the site, construction of Digary Road, construction of a newly proposed road (Road 3 in the attached layout) and establishment of 52 residential lots ranging from 450m^2 to 699m^2.

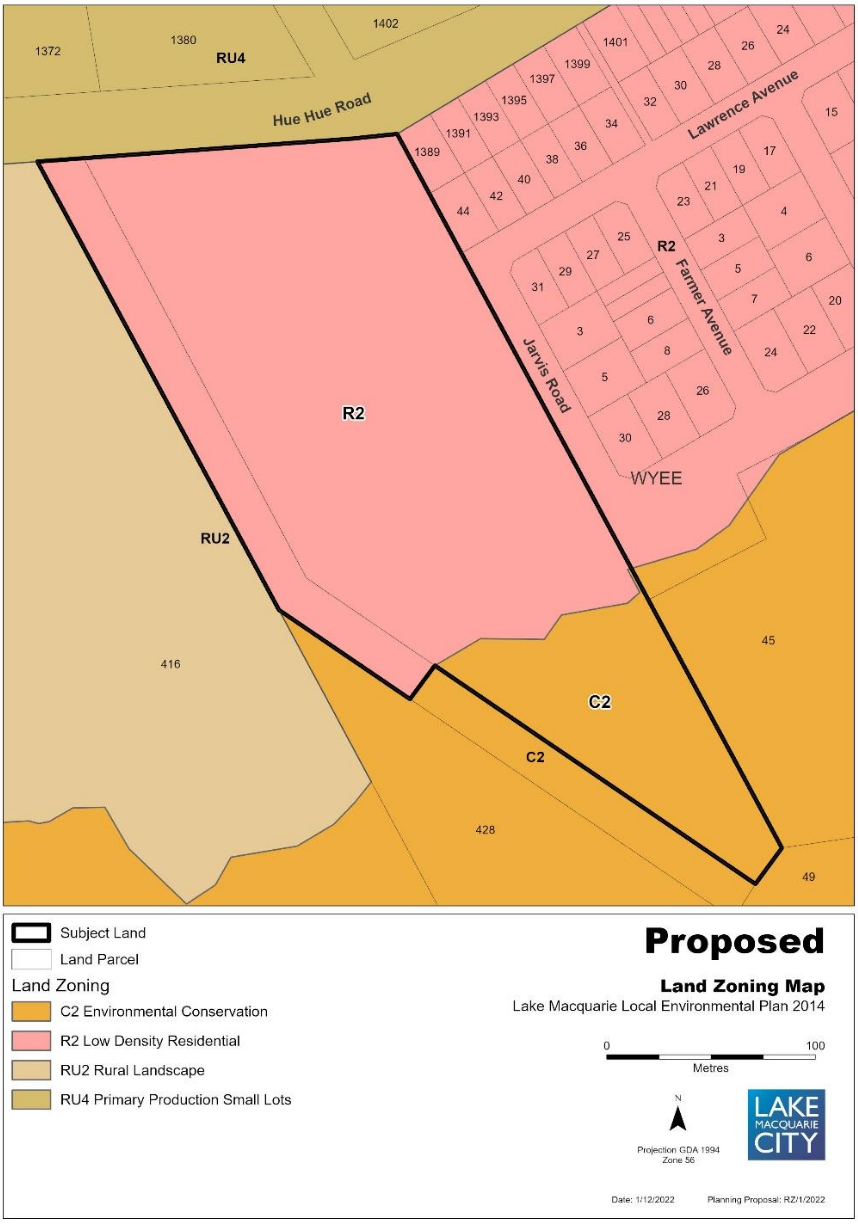


Figure 2 Land Zoning Map

1.3 Objectives

The purpose of this report and assessment is to design, establish and present the full integrated water cycle management (IWCM) strategy for the proposed masterplan that considers:

- Stormwater management controls that meet the intent of Lake Macquarie City Council's Wyee Development Control Plan (hereinafter referred to as 'the DCP').

- Provide adequate detail for the hydraulic arrangement of proposed controls for the detailed design phases in the future such that the IWCM strategy presented in this report is maintained.

- Stormwater management controls that will not have significant adverse effect on flood behavior. Known as a 'no-net-negative' approach, this approach aims is to mitigate any risks associated with flood hazard to people and property by the proposed development.

- Water Sensitive Urban Design (WSUD) to meet the stormwater management objectives as set by the DCP for the post-developed percentage reduction targets for total suspended solids, phosphorus, nitrogen, gross pollutants, and the stream erosion control ratio.

- Implementation of structured water quality treatment trains and conventional stormwater quality improvement devices to minimize pollutant loads and to minimize total number treatment devices to simplify long-term maintenance requirements.

1.4 Study Methodology

The study methodology is in two distinct components:

1. Water quantity and overland flow assessment that includes the design of on-site stormwater detention (OSD) and flood mitigation controls and,
2. Water quality or WSUD controls in the form of designing and integrating gross pollutant traps (GPT's) and bioretention systems.

1.4.1 Water Quantity Methodology

- Development of overall catchment plans encompassing the whole study area with clear structure for a suitable rainfall-runoff-routing hydrologic model.

- Development of a WBNM (Watershed Bounded Network Model) rainfall-runoff-routing hydrologic model for both pre-developed and post-developed scenarios for assessment. It is noted that ARR2019 design methodologies and rainfall data have been adopted to maintain continuity and consistency with the current assessment guidelines and current catchment-wide flood study prepared by WMA Water.

- Development of a combined conceptual civil design model of the site to inform road grades and levels, particularly around the proposed basins. Preliminary design and grading of the basin has been undertaken to incorporate informed sizing and water staged-storage relationships for the proposed controls in the WBNM model.

- Development of a 2D TUFLOW hydraulic model based on Lidar for pre-developed scenarios for detailed hydraulic assessment to determine the flood extents for the critical 1% Annual Exceedance Probability (AEP) storm event with and without climate change considerations and the Probable Maximum Flood (PMF). The 2D model is to utilize the inflow hydrograph data from the WBNM model for the upper model reaches as well as local catchments surrounding the development site.

WBNM is an industry standard runoff routing model originally developed in Wollongong in the mid 1970's. It is widely adopted for hydrological modelling for natural or partially developed urban catchments in Southeast NSW and is well documented and referenced in engineering research literature. It is noted that this model has been developed from primarily statistical data from coastal catchments on the South Coast of NSW and has been utilized for the catchment-wide study of this catchment by WMA Water.

TUFLOW (classic) is a finite difference second order implicit solver resolving 2D continuity and momentum, depth averaged shallow water equations and the Tuflow model is designed for calculating floodplain hydraulics. TUFLOW is an industry adopted standard both domestically and internationally backed by an active development team, extensive research, and benchmark studies.

1.4.2 Water Quality Methodology

- Development of a detailed catchment plan encompassing a breakdown of total lots and proposed land use by sub-catchment.

- Development of a MUSIC Model (Model for Urban Stormwater Improvement Conceptualization) for the proposed developed case to assess the percentage reduction target requirements for the proposed development.

2 Adopted Information

2.1 Pre-Existing Flood Studies and Water Cycle Management Plans

2.1.1 Flood Studies for Eight Residual Lake Macquarie Waterway Tributary Catchments – WMAwater, August 2021

The report by WMAwater (2021) was prepared for Lake Macquarie City Council to determine design flood extents for the eight study areas presented in the report. This is inclusive of the Mannering Creek tributary which the proposed development site adjoins.

Some key points for this study are as follows:

- Adoption of a WBNM hydrological model and a complementing 2D TUFLOW Hydraulic model over the study area.
- Australian Rainfall and Runoff 2019 rainfall data and modelling guidelines adopted.
- Calibration with existing/historical regional flood studies.

2.1.2 Stormwater Management Report – ADW Johnson, August 2015

The report by ADW Johnson (2015) was prepared generate a Water Cycle Management Plan for the development over adjoining property to the East of 1377 Hue Hue Road.

Some key points for this study are as follows:

- Adoption of a WBNM hydrological model utilizing ARR1987 Methodology
- Assessment of the afflux as a result of the Soreina Drive crossing over Mannering Creek, approximately 450m downstream of 1377 Hue Hue Road.
- Summary of both stormwater quantity and quality objects for the development over the adjoining site.

2.2 Survey Data

2.2.1 ALS / LiDAR Survey Data

Aerial Laser or LiDAR Scanning data was obtained from the ELVIS - Elevation and Depth Foundation Spatial Data website for the catchment area. The following ALS data has been adopted:

- 1m DEM (digital elevation model) data as published by NSW Land Registry Services (ex LPI) and dated April 2019.

2.2.2 Aerial Imagery

Historical and recent aerial imagery of the site was obtained through Nearmap for documentation purposes.

2.2.3 Cadastral Data

Cadastral data of the surrounding lot boundaries was obtained through NSW LRS Spatial Information Exchange 'Clip & Ship' data service.

It is noted that Cadastral Data does not substitute detailed boundary definition by registered surveyor and should be used with care for indicative information only.

3 Hydrology – WBNM Model

3.1 Catchment Delineation

To develop a hydrological model, the available LiDAR data was used to delineate sub- catchments within the study area. The sub-catchment delineation is consistent with the catchment plan presented in the ADW Johnson report dated August 2015 as prepared for the development over the site adjoining 1377 Hue Hue Road.

The figure below shows an extract of the pre-developed scenario catchment plan and can be found in full in Appendix B.

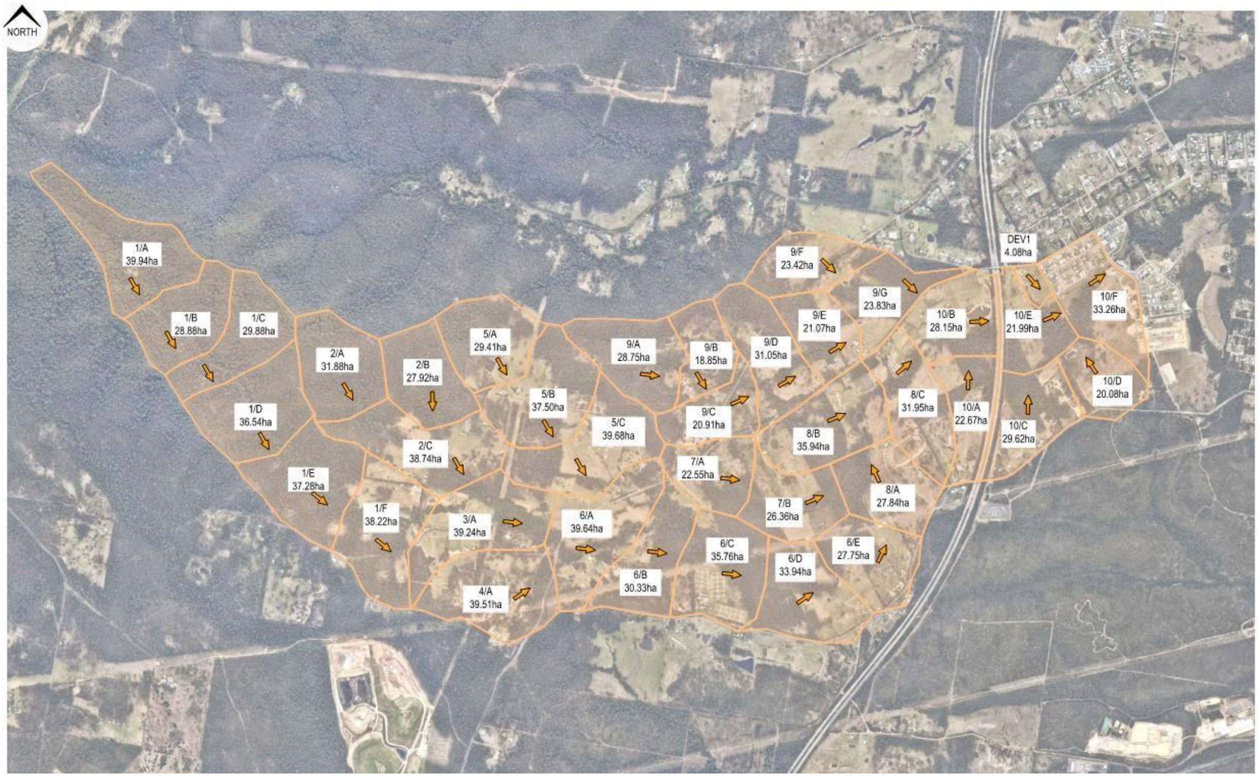


Figure 3 Pre-Developed Scenario Catchment Plan

3.2 WBNM Input Data

3.2.1 Rainfall Data

ARR2019 Rainfall data for the Wyee township was extracted by Orion from the Bureau of Meteorology website. The rainfall depth data was acquired by Orion from the Bureau of Meteorology's Design Rainfall Data System.

3.2.2 Rainfall Losses

To account for soil infiltration losses an Initial Loss - Continuing Loss (ILCL) model was adopted with the parameters shown in Table 2 below. The initial loss rate was adopted from the Probability-Neutral Burst Initial Losses as presented in Table 15 of the Flood Studies for Eight Residual Lake Macquarie Waterway Tributary Catchments as prepared by WMA. The initial losses have been adopted based on the critical storm durations determined for each AEP.

The continuing loss rate has been factored in accordance with ARR 2019 and DPIE recommendations utilizing the data obtained ARR 2019 Datahub data.

Table 1 Soil Loss Model Parameters

Parameter		20% AEP Loss	10% AEP Loss	5% AEP Loss	2% AEP Loss	1% AEP Loss
Initial Loss (pervious) (mm)		18.7	18.7	14.1	15.8	11.4
Continuing Loss (pervious) (mm/hr)		1.12	1.12	1.12	1.12	1.12
Initial Loss (impervious) (mm)		1.0	1.0	1.0	1.0	1.0
Continuing Loss (impervious) (mm/hr)		0	0	0	0	0

3.3 Calculated Flow Rates

The below tables summarize the pre-development and post-development flow rates both at the outlet of the development site and at the Soreina Drive crossing (outlet of catchment 10/F). The on-site detention strategy is to ensure that the post-development flow at these two locations is reduced to pre-development conditions.

Table 2 Critical Pre-Development Flow Rates

Annual Exceedance Probability (AEP) (%)	Catchment Dev1	Catchment 10/F
20	0.437	33.514
10	0.551	46.218
5	0.792	60.884
2	0.958	73.216
1	1.190	88.415

Table 3 Critical Post-Development Flow Rates (exclusive of On-Site Stormwater Detention)

Annual Exceedance Probability (AEP) (%)	Catchment Dev1	Catchment 10/F
20	0.728	33.481
10	0.906	46.199
5	1.167	60.799
2	1.577	73.247
1	1.879	88.323

As presented above, the total discharge calculated at Soreina Drive is lower in the post- development scenario than the pre-development. This is due to the longer peak time of the entire catchment. The post-development scenario will result in a faster response time for the development site then the pre-development scenario which results a lower peak for the overall catchment.

The proposed On-Site Detention System shall ensure that the peak flow from the development site is reduced to pre-development levels whilst still ensuring that the peak flow from the total catchment remains below pre-development levels.

3.4 Post-Developed Scenario Management Strategy

In order to reduce post developed flows back to or improve on the pre-developed scenario an on-site stormwater detention basin is to be implemented within the development, integrated into the open space, and combined water cycle management strategy.

The on-site stormwater detention (OSD) strategy has been designed to cater for post developed flows discharging from the proposed development site.

3.4.1 On-Site Stormwater Detention Arrangement & Performance

The following table below summaries the proposed OSD storage structures and bypass catchments. A copy of the concept stormwater basin layout is presented in Appendix C.

Table 4 On-Site Stormwater Detention Facilities

Basin	Total Storage Volume Required – 100 Year ARI (m^3)	Outlet Control Configuration
Basin	1066	○ 525mm diameter outlet at centre RL 24.150 ○ 0.9m weir at RL 25.360 ○ 1.2m weir at RL 25.450 ○ 5m Wide Emergency Spillway at RL 25.750

The resulting basin outflow for the storm events up to the 1% AEP is summarized below. The below table summarizes the flows from the proposed development site and the total catchment flow to Soreina Drive.

Table 5 Critical Post-Development with OSD Flow Rates

Annual Exceedance Probability (AEP) (%)	Catchment Dev1 (m^3/s)	Catchment 10/F (m^3/s)
20	0.375	33.414
10	0.422	46.051
5	0.596	60.695
2	0.893	73.925
1	1.150	88.168

A summary of the pre-development to post-development scenario with OSD included is presented in the table below.

Table 6 Pre-Development vs Post-Development Flow Difference Summary

Annual Exceedance Probability (AEP) (%)	ΔQ Dev1 (m^3/s)	ΔQ 10/F (m^3/s)
20	0.062	0.100
10	0.129	0.167
5	0.196	0.189
2	0.065	0.291
1	0.040	0.247

The results demonstrated above show that the discharge control regime proposed for the basin is effective in reducing the post-development flow to that of the pre-development.

scenario at both the discharge point from the development site and for the total catchment to Soreina Drive.

Table 7 OSD Storage Facility Water Level Summary

Annual Exceedance Probability (AEP) (%)	m (AHD)	Volume (m^3)
20	25.143	279
10	25.343	485
5	25.507	675
2	25.640	843
1	25.728	965
Top of Bank (Max.) RL	**25.800**	

4 Hydraulics – TUFLOW Model

To determine the extent of flood affected land surrounding the development site, a 2D TUFLOW Hydraulic model had been set up to assess the 1% AEP, 1%AEP+20%CC and PMF flood extents over the study area. For the 2D TUFLOW hydraulic model a selection of the primary model parameters is shown below.

TUFLOW (classic) is a finite difference second order implicit solver resolving 2D continuity and momentum, depth average shallow water equations and is specifically designed for calculating floodplain hydraulics. TUFLOW is an industry adopted standard both domestically and internationally backed by an active development team, extensive research, and benchmark studies.

Table 8 TUFLOW Model Parameters

Parameter	Value	Units
2D Domain Area	65.1	ha
Grid Cell Size	2	m
Timestep	1	sec
Cell Cut-off Depth	0.05	m

4.1 Material Parameters

The following table below presents the materials Mannings 'n' roughness coefficients and impervious area fractions adopted within the hydraulic model.

Table 9 Original Study Material Properties

Material	Manning's n Roughness Coefficient
Pasture/Open Farmland/Grass	0.05
Road Corridors	0.02
Low Density Residential Lots	0.1
Light Vegetation	0.07
Dense Vegetation	0.1
Future Low Density Residential Lots	0.05

4.2 Model Set-Up

Key elements of model setup include:

- Inflow hydrographs throughout the model domain to reflect the sub-catchments used in the hydrological model.
- An inflow hydrograph has been placed immediately downstream of the highway watercourse crossing. The hydrograph reflects the upstream catchment.
- The downstream boundary condition has been input as a HQ boundary condition, reflecting the water level at the Soreina Drive crossing.

4.3 Tailwater Control

A ‘HT’ type (Water Level (H) versus Time (T) TUFLOW boundary condition was applied at the Soreina Drive crossing. The ‘HT’ boundary was set at 22m AHD based on the approximate water level at Soreina Drive presented in the flood study prepared by WMAwater.

4.4 Sensitivity Analysis

A sensitivity analysis was undertaken to determine the model’s reactivity to variance in a number of input parameters. The parameters reviewed were the input hydrology, the Manning’s n roughness coefficients and the downstream tailwater control level.

4.4.1 Temporal Patterns

A number of runs were performed to determine the difference in calculated flood levels based on the differing temporal patterns used in the ARR2019 methods. The two focal patterns were the median calculated flow rate as determined using WBNM and the maximum calculated flow rate using WBNM.

The difference in peak flow rates for the median storm temporal pattern and worse case temporal pattern are presented below.

Table 10 Peak Flow Rate Comparison (Temporal Patterns)

Annual Exceedance Probability (AEP) (%)	Median TP (m^3/s)	Worse Case TP (m^3/s)
1	88.415	94.555

Both storms were run in TUFLOW to assess the impact on flood extents. It was found the difference between temporary patterns had little impact on the flood extents. Due to the scale of the floodplain, the additional water in the worst-case temporal pattern resulted in a 40mm water level different at the development site. This was considered to be negligible for the purposes of this flood report. The median storm temporal pattern was adopted for the flood extents mapping.

4.4.2 Manning’s n Roughness Coefficients

As required by the Biodiversity and Conservation Division (BCD) of the Department of Planning, a sensitivity analysis has been undertaken to compare outputs from simulations using the roughness values in **Table 9** and the roughness values adopted in the WMA Water Report. The values from the WMAwater Report values are tabulated below:

Table 11 Materials Properties adopted from WMAwater Report

Material	Manning's n Roughness Coefficient
Pasture/Open Farmland/Grass	0.04
Road Corridors	0.02
Low Density Residential Lots	0.05
Light Vegetation	0.025
Dense Vegetation	0.045
Future Low Density Residential Lots	0.05

The simulations for this sensitivity analysis have illustrated that the originally modelled values output more conservative flood levels at the site.

Refer to figure 1, Orion manning's n catchment data and figure 2, WMA manning's n catchment data for the 1%AEP flood event.

Note there is a reduction in the flood volumes for the 1% AEP flood event using the WMA manning's n catchment data, however the flood extents are very similar.

Refer to figure 3, Orion manning's n catchment data and figure 2, WMA manning's n catchment data for the Probable Maximum flood event (PMF).

Note there is a reduction in the flood volumes for the PMF flood event using the WMA manning's n catchment data, however the flood extents are similar.

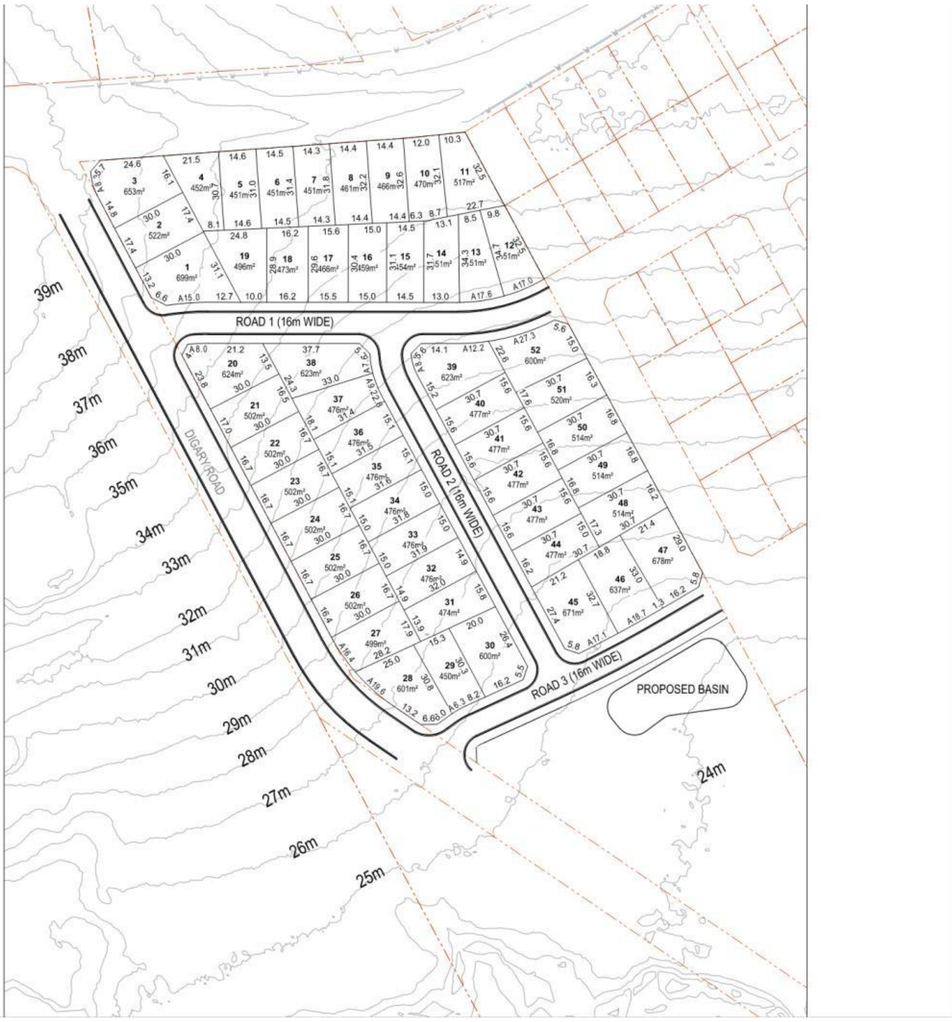


Figure 1 – Flood modelling is based on the existing site levels. The detailed design of the subdivision will include local raising of road 3 to be above RL 25.8 to be above the proposed basin crest, and to connect to the road networks to the east and west.

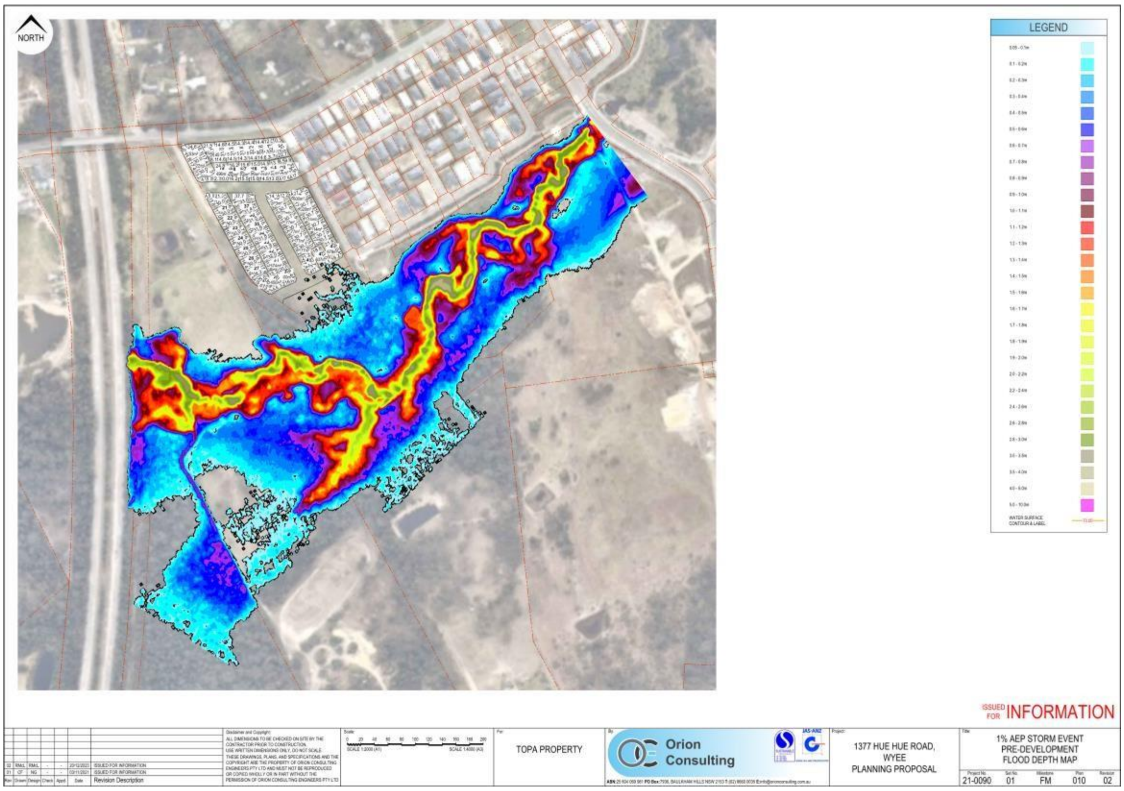


Figure 2 - 1% AEP predevelopment flood extent with original Manning's n values

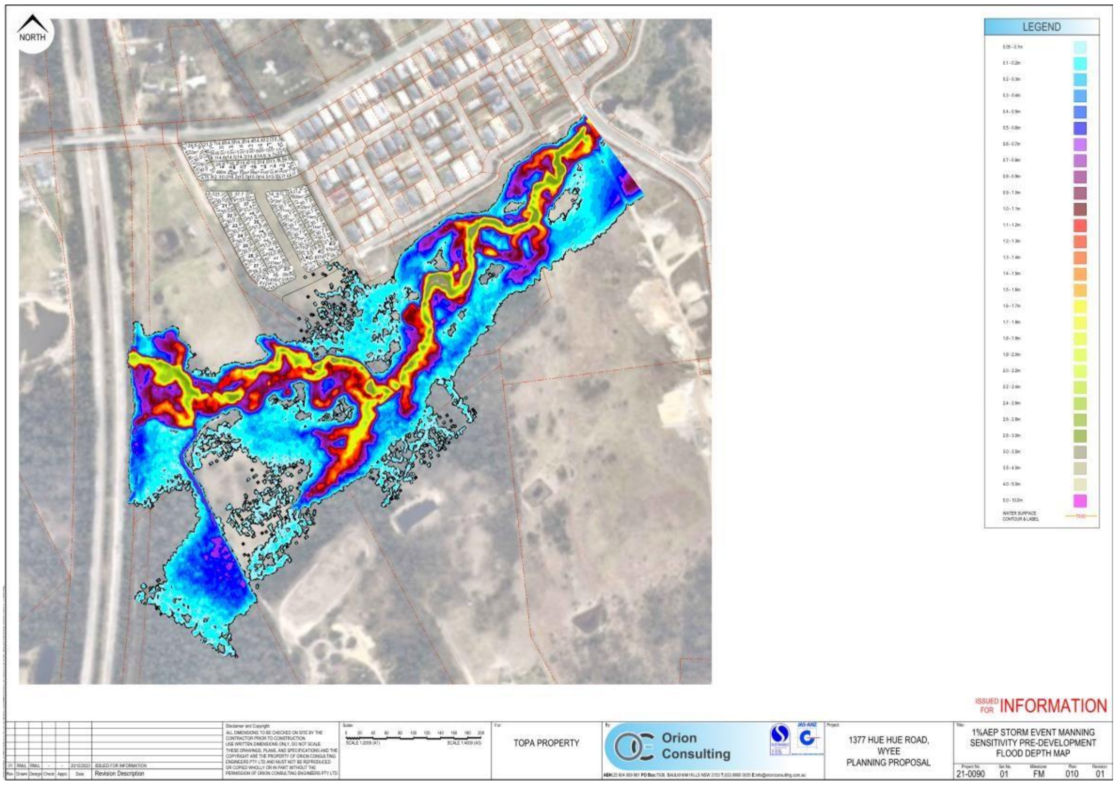


Figure 3 - 1% AEP predevelopment flood extent with WMA Manning's n values

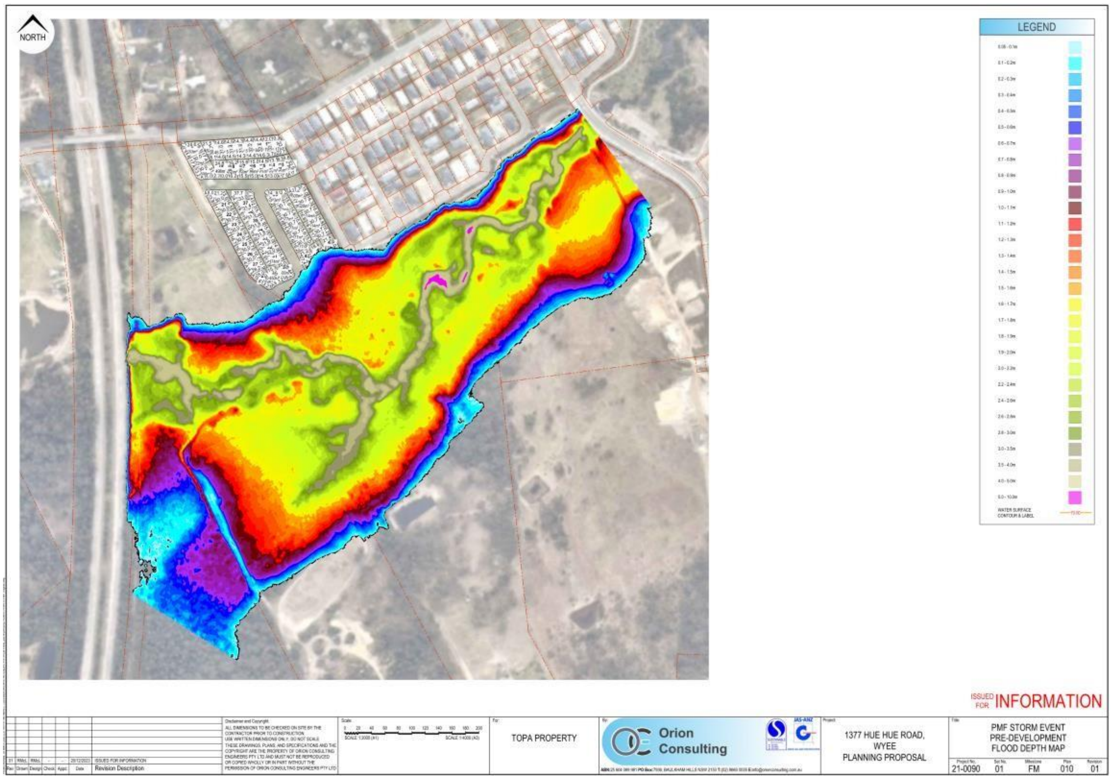


Figure 4 - PMF predevelopment flood extent with Original Manning's n values

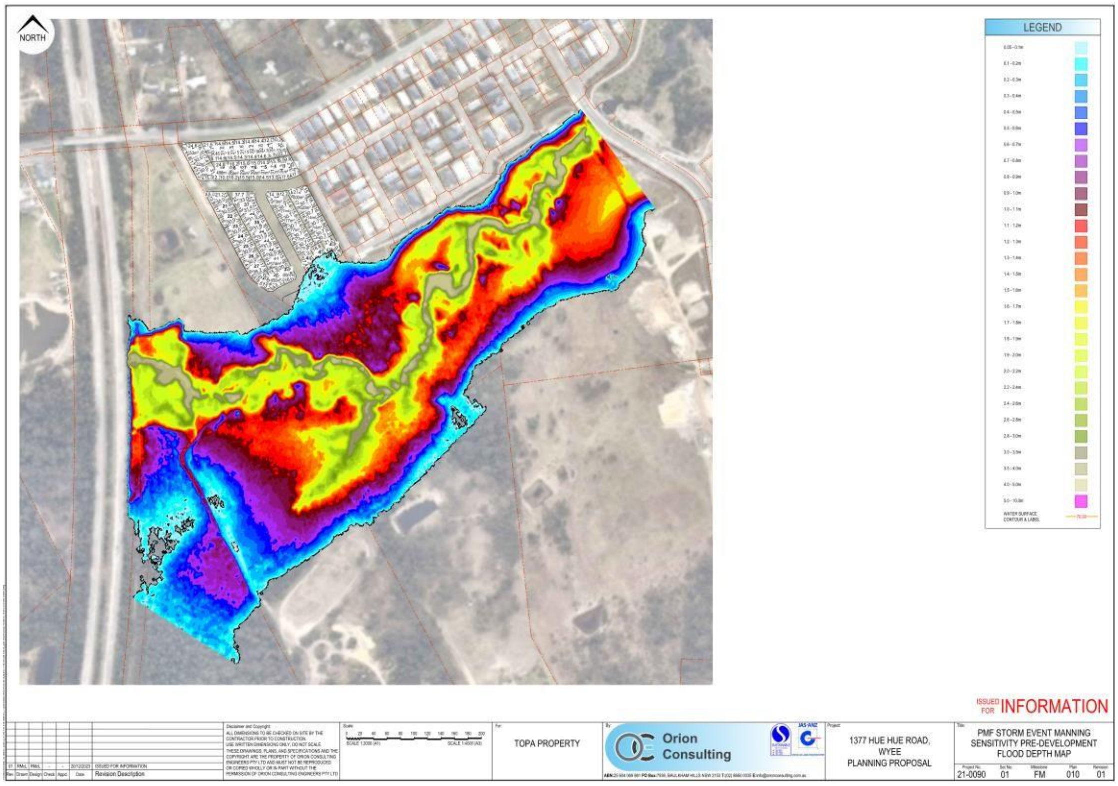


Figure 5 - PMF predevelopment flood extent with WMA Manning's n values

4.4.3 Tailwater Levels

The water level at Soreina Drive was also tested to determine the impact it had on flood levels over the development site.
A sensitivity analysis was undertaken by varying the tailwater at Soreina Drive. The tailwater levels tested are presented in the table below.

Table 12 Tailwater Levels for Sensitivity Analysis

Location	ADW Johnson Study (m AHD)	WMAwater (m AHD)
Soreina Drive	22.8	22.0

It was determined that any variance in the tailwater level appears to have no adverse impact on the calculated flood extents within the proposed development site. The location of outlet boundary condition is sufficiently downstream of the site and does not impact the calculated water levels. The 'HT' tailwater condition is considered appropriate for the study undertaken in this report. The WMAwater tailwater level was adopted due as the WMA water report utilizes ARR2019 whereas the ADW Johnson report was prepared using ARR1987 hydrology.

4.5 Climate Change Impact Analysis

As requested by the Biodiversity and Conservation Division (BCD) of the Department of Planning, a sensitivity analysis has been undertaken to determine the impact on the flood results associated with a 20% increase in rainfall due to climate change. The results show a very small increase in flood extent and depth but no significant effect on the subdivision lot extent.

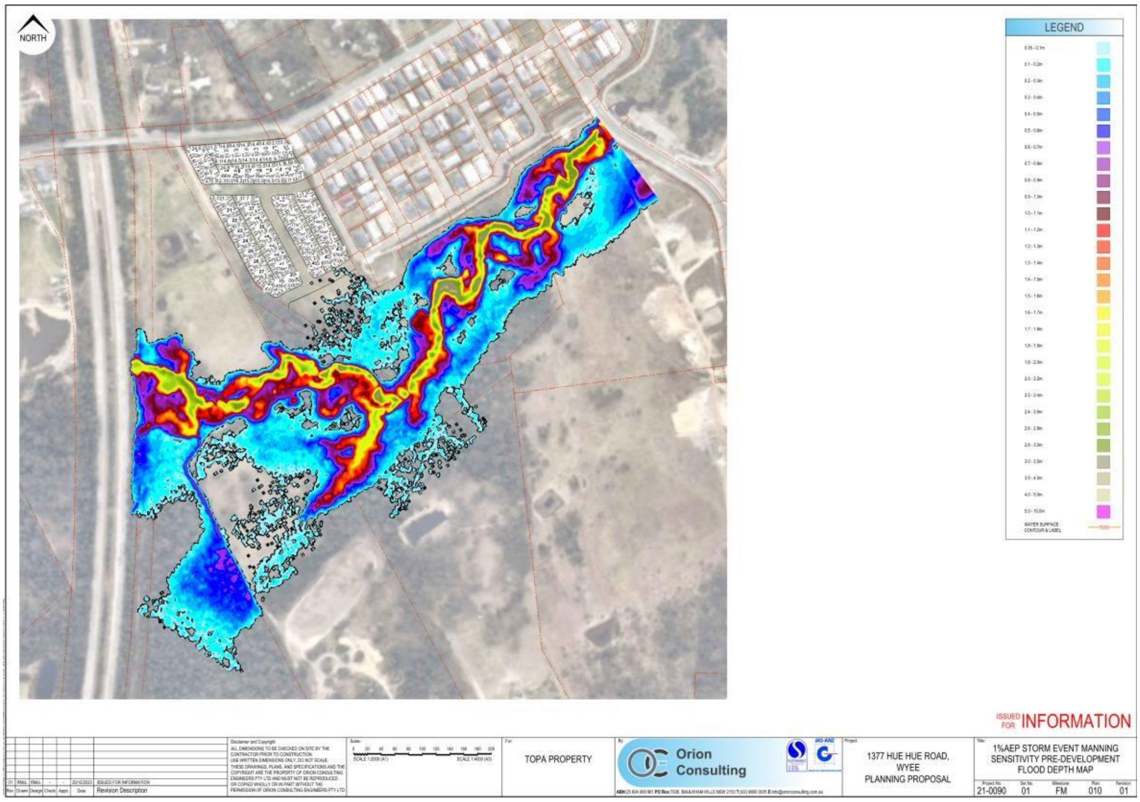


Figure 6 - 1% AEP predevelopment flood extent with WMA Manning's n values

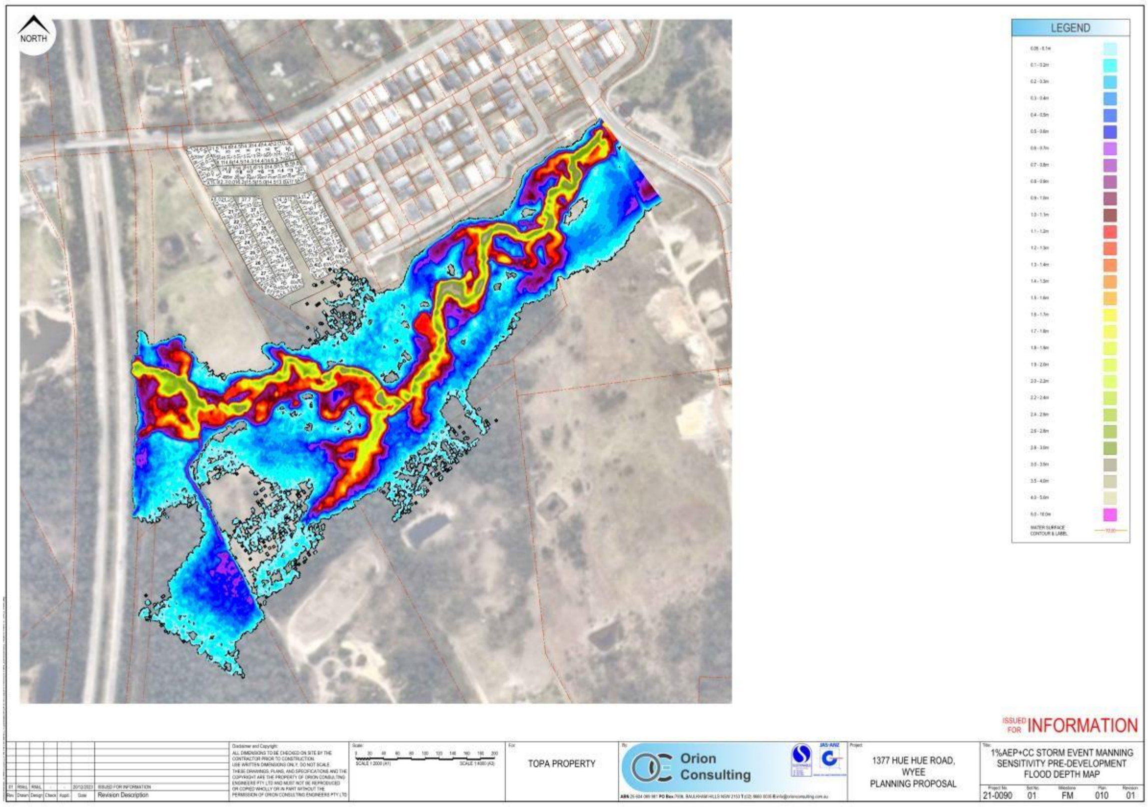


Figure 7 - 1% AEP predevelopment flood extent with WMA Manning's n values and +20% rainfall for Climate Change

4.6 Results Analysis

The 1% AEP critical storm events were run with a 2-metre grid resolution for the full duration of the storm event. The depth & water surface level, velocity and hydraulic hazard mapping is presented in Appendix D.

Key points observed for the existing flood extents include:

- Mannering Creek Riparian Corridor passes through the southern boundary of the site.
- A defined channel is located along the southern boundary.
- Mannering Creek has overbank flooding within the Riparian Corridor in the area surrounding the development site.
- The calculated 1% AEP water level varies between 23.75 to 24.80 AHD across the development site.
- The proposed lot layout presented in Appendix A is above the flood extents of Mannering Creek. A minimum finished floor level would be between 26.20 and 26.80m AHD dependent on the location of the future dwellings.
- The natural ground level within the proposed lots presented in Appendix A is RL 24.8m and above. The detailed design of the subdivision will include local raising of road 3 to be above RL 25.8 to be above the proposed basin crest, and to connect to the road networks to the east and west. It is considered that the proposed layout and associated rezoning is suitable as the land is located outside of the flood extents and above the flood planning level.

4.7 Additional Results Analysis

- We have reviewed the impact of the change between the Manning's n value used in the original report to that used in the WMA model for the other modelled areas of the catchment. We note that the results show the flood extents and flood depths are marginally less under the WMA catchment roughness figures which are less conservative that those used in the original Orion flood assessment for the 1%AEP flood model results and for the PMF model results. We note that as the natural ground level within the proposed lots presented in Appendix A is RL 24.80m and above. It is considered that the proposed layout levels and associated rezoning remains suitable as the proposed subdivision land will be located outside of the 1% AEP flood extents and above the flood planning level.

- As requested by the Biodiversity and Conservation Division (BCD) of the Department of Planning, a sensitivity analysis has been undertaken to determine the impact on the flood results associated with a 20% increase in rainfall due to climate change. The sensitivity analysis results for the impacts of climate change have not illustrated a significant flood risk increase to the proposed subdivision site nor an increase in flood risk elsewhere due to the development.

5 Water Quality

The water quality or water sensitive urban design strategy for the proposed development has been determined through the adoption and implementation of a MUSIC model.

5.1 MUSIC Setup

The software program MUSIC was used to develop a site-specific water quality treatment strategy that will satisfy the pollutant reduction targets required by Council. The MUSIC model was established utilizing MUSIC-link to Lake Macquarie City Council. Using the LMCC South Catchments 6-minute rainfall data.

The established MUSIC model set-up is shown in the figure below.

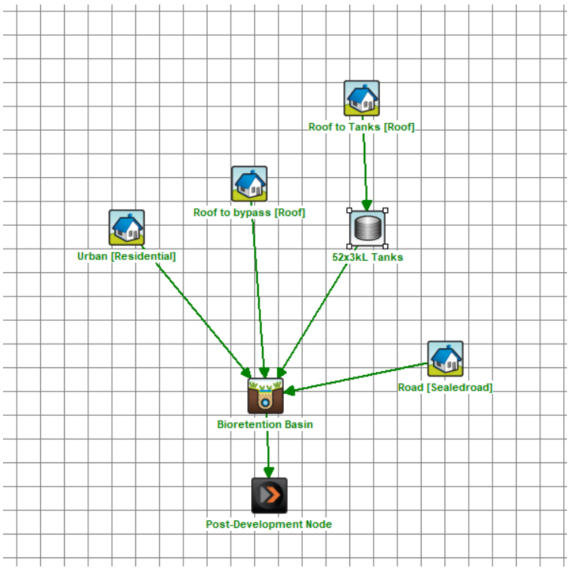


Figure 4 MUSIC Model

5.2 Assessment Metrics

The Lake Macquarie City Council DCP 2013 Section 5.4.1 identifies the following assessment criteria for water sensitive urban design:

Table 13 Lake Macquarie City Council DCP 2013 Pollutant % Reduction Targets

Pollutant	% Reduction Targets
Total Suspended Solids (TSS)	80
Total Phosphorus (TP)	45
Total Nitrogen (TN)	45

5.3 Treatment Train Strategy

The following water quality control assets are proposed for implementation:

i. Rainwater tanks – A 3,000 litre rainwater tank has been modelled on each lot based on the proposed layout presented in Appendix A.

ii. A bio-retention system – A bio-filtration media with planting is proposed within the based and sized to adequately capture fine sediments and air pollutant removal. A copy of the concept stormwater strategy is presented in Appendix C.

5.4 Sub-Catchment Breakdown

The developed catchments were divided into sub-catchments defining the lots and roads. The fraction impervious adopted for each catchment is as follows:

- Roof Areas: The roof area is assumed to be 60% of the total lot area with 50% of the roof being directed to the rainwater tank and 50% direct connection to the road stormwater network. The roof surface is assumed to be 100% impervious.
- Landscaping: The landscaping area is assumed to be 40% of the lot catchment area with 60% fraction impervious adopted to cater for the hardstand landscaping features such as paving and driveways.
- Road Reserve: 95% fraction impervious has been adopted for the catchment representing the road reserves.

A table showing the catchment breakdown is shown below.

Table 14 MUSIC Model Catchments

Catchment	Catchment to basin (hectares)
Roof to Rainwater Tank	0.803
Roof bypassing Rainwater Tank	0.803
Lot landscaping	1.071
Roads	1.105
Total	3.783

5.5 Water Quality Design

Stormwater will be conveyed through the site through the pit and pipe stormwater system and discharged into a basin fitted with an area of bio-filtration media. The bio-filtration media removes sediments and pollutants present in pre-treated stormwater through filtration and the planting is used for nutrient uptake.

The water quality component of the basin will consist of:

Table 15 Bio-Filtration Basin Parameters

Parameter	Value
Extended Detention Depth (mm)	**200**
Surface Area (m^2)	667
Bio-Retention Area (m^2)	200
Filter Media Thickness (mm)	400

5.6 Water Quality Results

The table below contains a summary of the MUSIC model output demonstrating compliance with the water quality objectives.

Catchment	Source	Residual Load	% Reduction
Total Suspended Solids (TSS) (kg/yr)	4,980	786	84.2
Total Phosphorous (TP) (kg/yr)	9.81	3.49	64.4

Total Nitrogen (TN) *kg/yr)	70.3	38.7	45

The above table demonstrates the percentage reduction targets achieved with the proposed treatment train and water quality management strategy. The proposed treatment train demonstrates that the required Stormwater Management Objectives are achieved and exceeded for all pollutant types.

6 Conclusions and Recommendations

This Integrated Water Cycle Management Report outlines the proposed water quantity and quality measures required to comply with the objectives of the Lake Macquarie DCP.

For both water quantity, floodplain management and water quality the report demonstrates that the proposed management strategies reduce downstream peak flows and flooded depths and meet the relevant regulatory requirements for water quality targets. As such we conclude that this integrated water cycle management strategy is suitable to support the planning proposal.

A summary of key findings is provided below:

i. The proposed site development is outside of the extents of the 1% AEP flood event and also the 1%AEP flood event inclusive of 20% climate change. The proposed development will have negligible impacts on the flooding within Mannering Creek.

ii. The proposed On-site Stormwater Detention system demonstrates a reduction of post-development flows from the site to pre-development levels.

iii. The proposed stormwater quality treatment train demonstrates compliance with Council's pollutant reduction targets.

We note that the modelling and reporting of this strategy is concept in nature and under future development application approvals will be subject to further review as more detailed design of the proposed management methodology is performed.

7 References

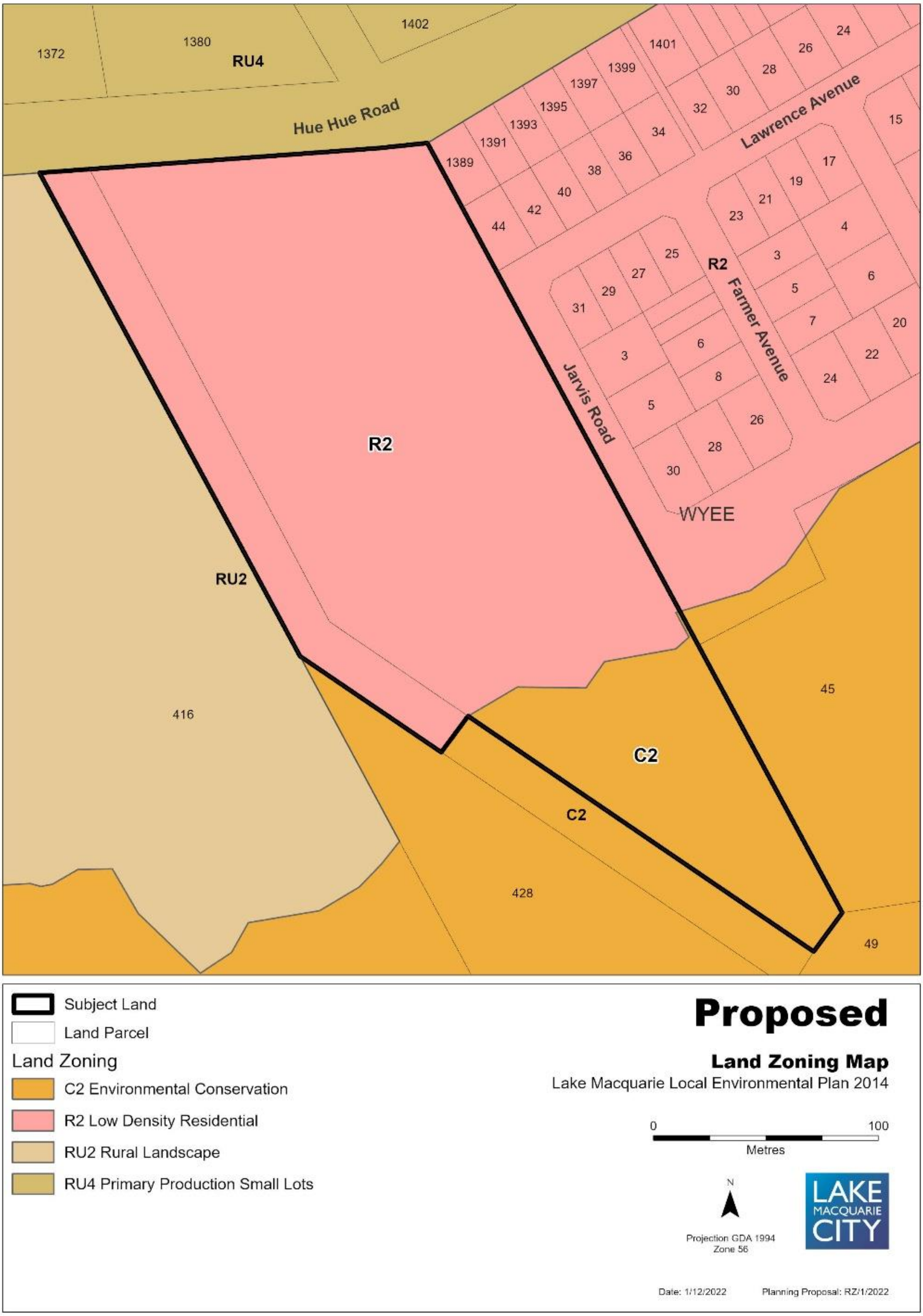
Australian Rainfall and Runoff: A Guide to Flood Estimation, Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), Commonwealth of Australia (Geoscience Australia) 2019

Floodplain Development Manual, NSW Government Department of Infrastructure, Planning and Natural Resources April 2005

Water Cycle Management Guideline Revision 2, Lake Macquarie City Council, June 2013 Using

MUSIC in Sydney Drinking Water Catchment, WaterNSW 2019

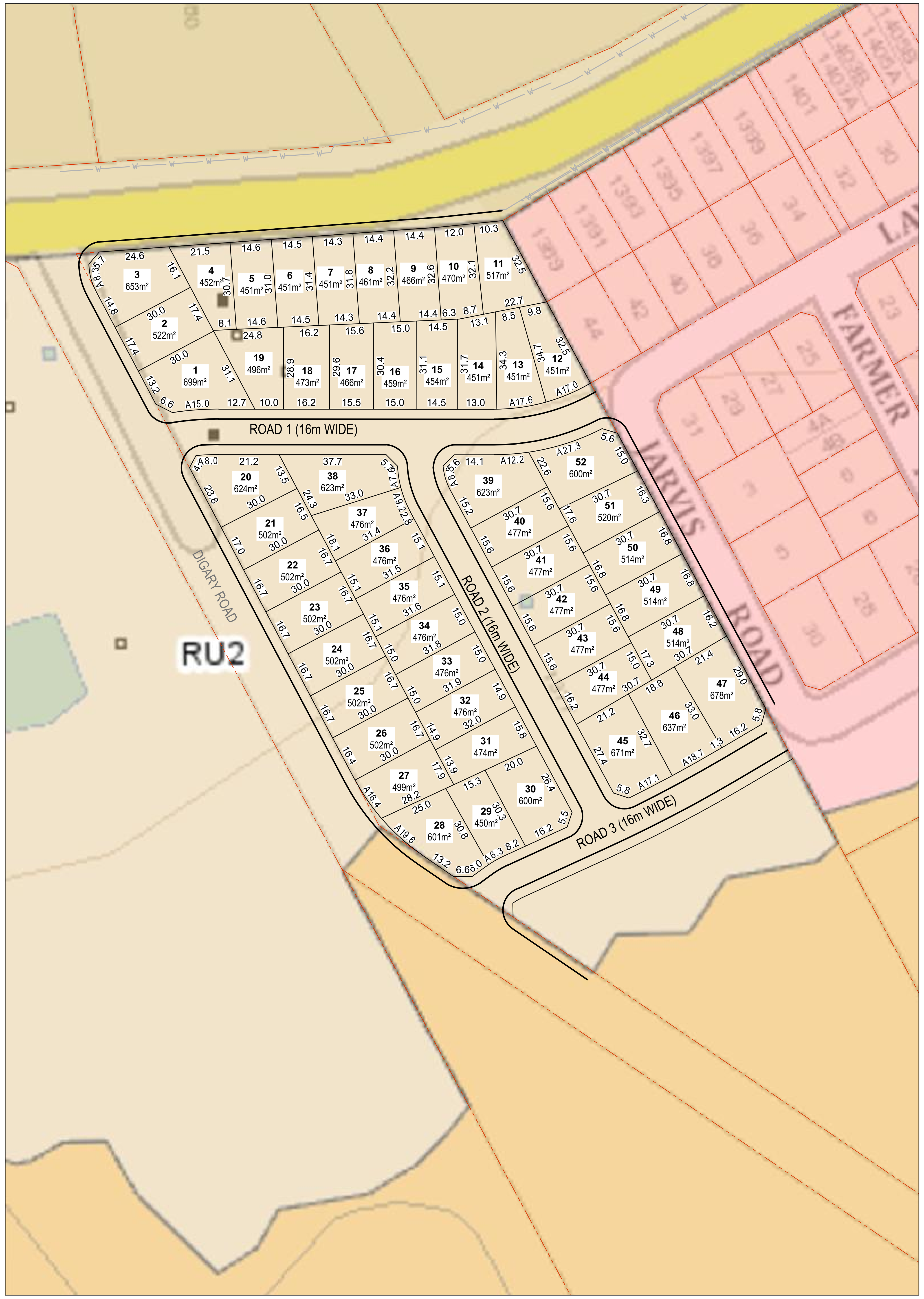
Appendix A – Subdivision Map



NORTH

LEGEND

EXISTING CADASTRAL	- - - - -
PROPOSED LOT	———



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Rev	Drawn	Design	Appd.	Date	Revision Description
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01	PB	PB	-	21/04/2021	ISSUE FOR INFORMATION

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For: NEWQUEST PROJECTS

By: Orion Consulting
CONSULT AUSTRALIA Member Firm

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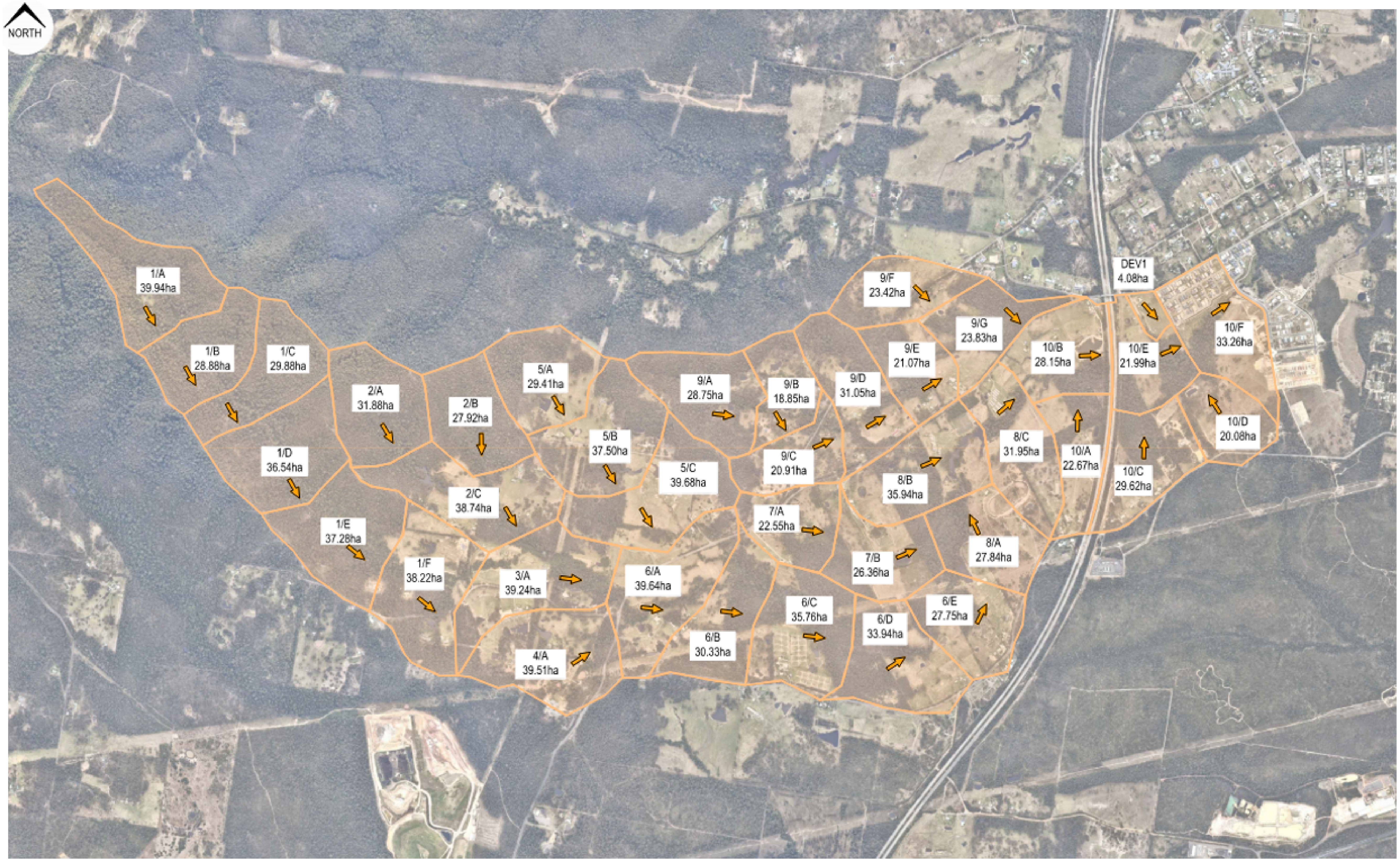
Project: HUE HUE ROAD WYEE

Title: CONCEPT PLAN OF SUBDIVISION

Project No.	Set No.	Milestone	Plan	Revision
21-0089	02	SK	001	03

Appendix B – WBNM Catchment Plan


NORTH
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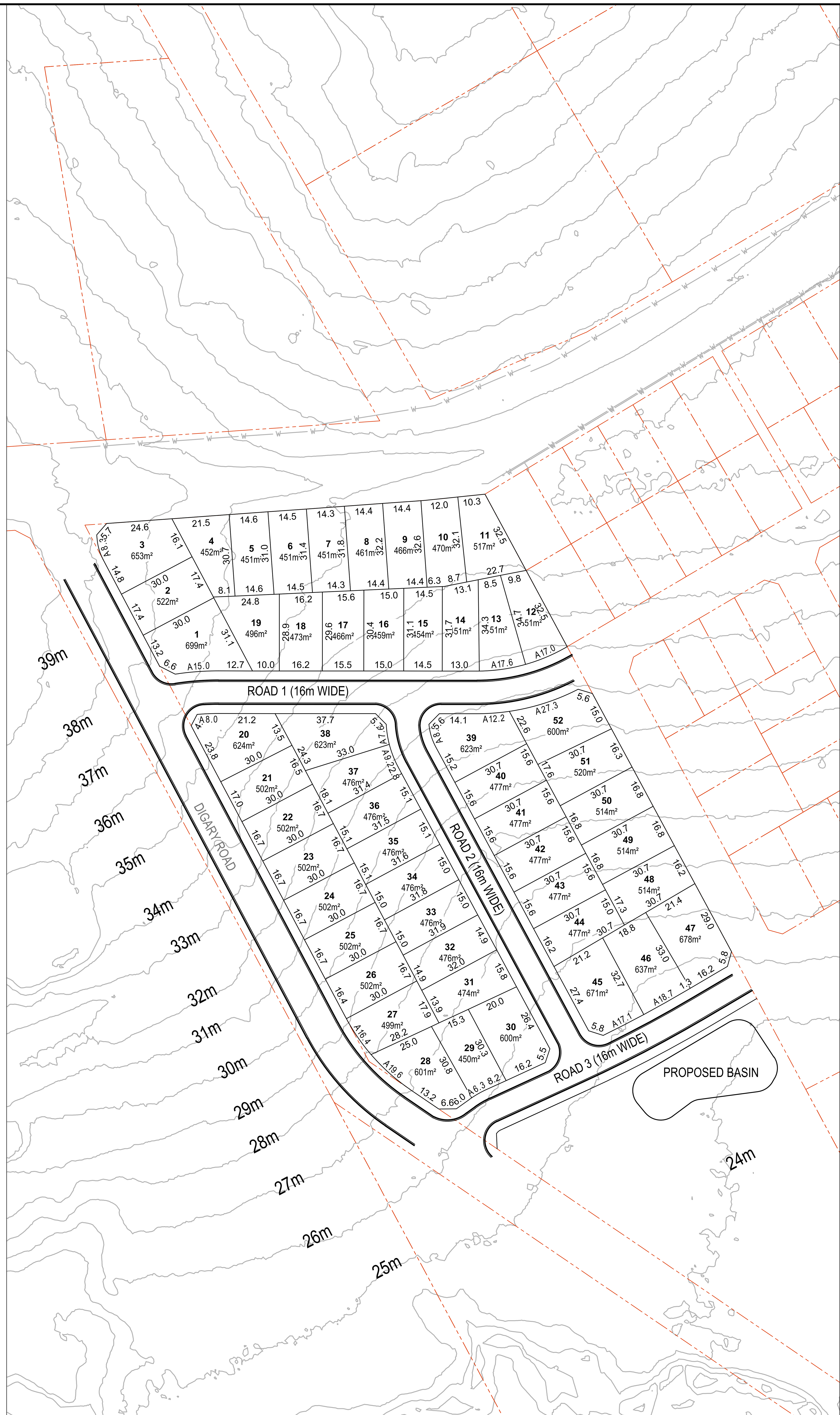
1/B 28.88ha
1/C 29.88ha
1/D 36.54ha
1/E 37.28ha
1/F 38.22ha
2/A 31.88ha
2/B 27.92ha
2/C 38.74ha
3/A 39.24ha
4/A 39.51ha
5/A 29.41ha
5/B 37.50ha
5/C 39.68ha
6/A 39.64ha
6/B 30.33ha
6/C 35.76ha
6/D 33.94ha
6/E 27.75ha
7/A 22.55ha
7/B 26.36ha
8/A 27.84ha
8/B 35.94ha
8/C 31.95ha
9/A 28.75ha
9/B 18.85ha
9/C 20.91ha
9/D 31.05ha
9/E 21.07ha
9/F 23.42ha
9/G 23.83ha
10/A 22.67ha
10/B 28.15ha
10/C 29.62ha
10/D 20.08ha
10/E 21.99ha
10/F 33.26ha
DEV1 4.08ha

Appendix C – Concept Engineering Plan

LEGEND

EXISTING CADASTRAL	- - - - -
PROPOSED LOT	———



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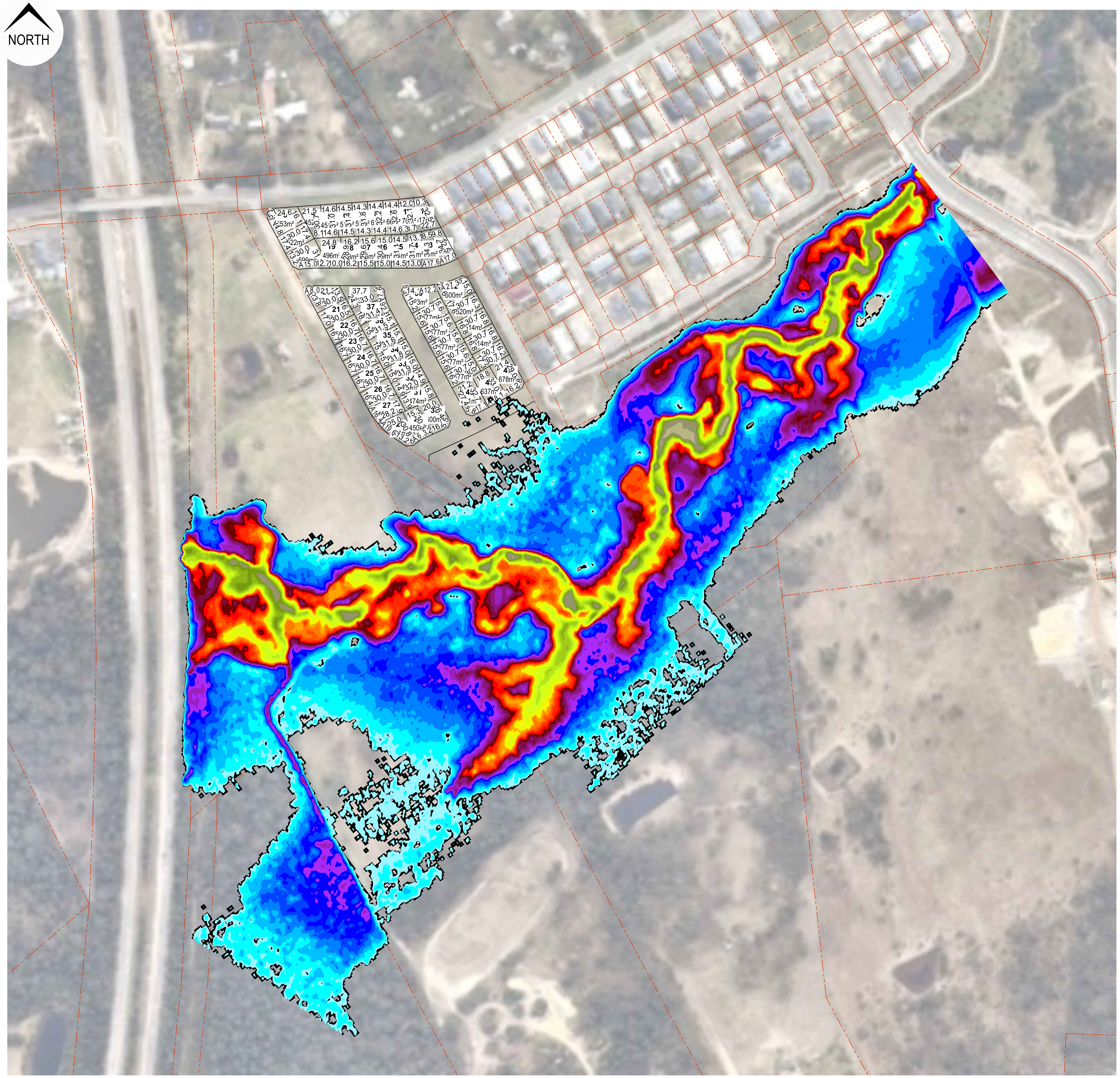
Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: CONCEPT PLAN OF SUBDIVISION

Project No.	Set No.	Milestone	Plan	Revision
21-0090	02	SK	002	01

Appendix D – Flood Mapping



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0.1 - 0.2m	
0.2 - 0.3m	
0.3 - 0.4m	
0.4 - 0.5m	
0.5 - 0.6m	
0.6 - 0.7m	
0.7 - 0.8m	
0.8 - 0.9m	
0.9 - 1.0m	
1.0 - 1.1m	
1.1 - 1.2m	
1.2 - 1.3m	
1.3 - 1.4m	
1.4 - 1.5m	
1.5 - 1.6m	
1.6 - 1.7m	
1.7 - 1.8m	
1.8 - 1.9m	
1.9 - 2.0m	
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2.2 - 2.4m	
2.4 - 2.6m	
2.6 - 2.8m	
2.8 - 3.0m	
3.0 - 3.5m	
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4.0 - 5.0m	
5.0 - 10.0m	
WATER SURFACE CONTOUR & LABEL	70.00

ISSUED FOR **INFORMATION**

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01	CF	NG	-	-	03/11/2021	ISSUED FOR INFORMATION

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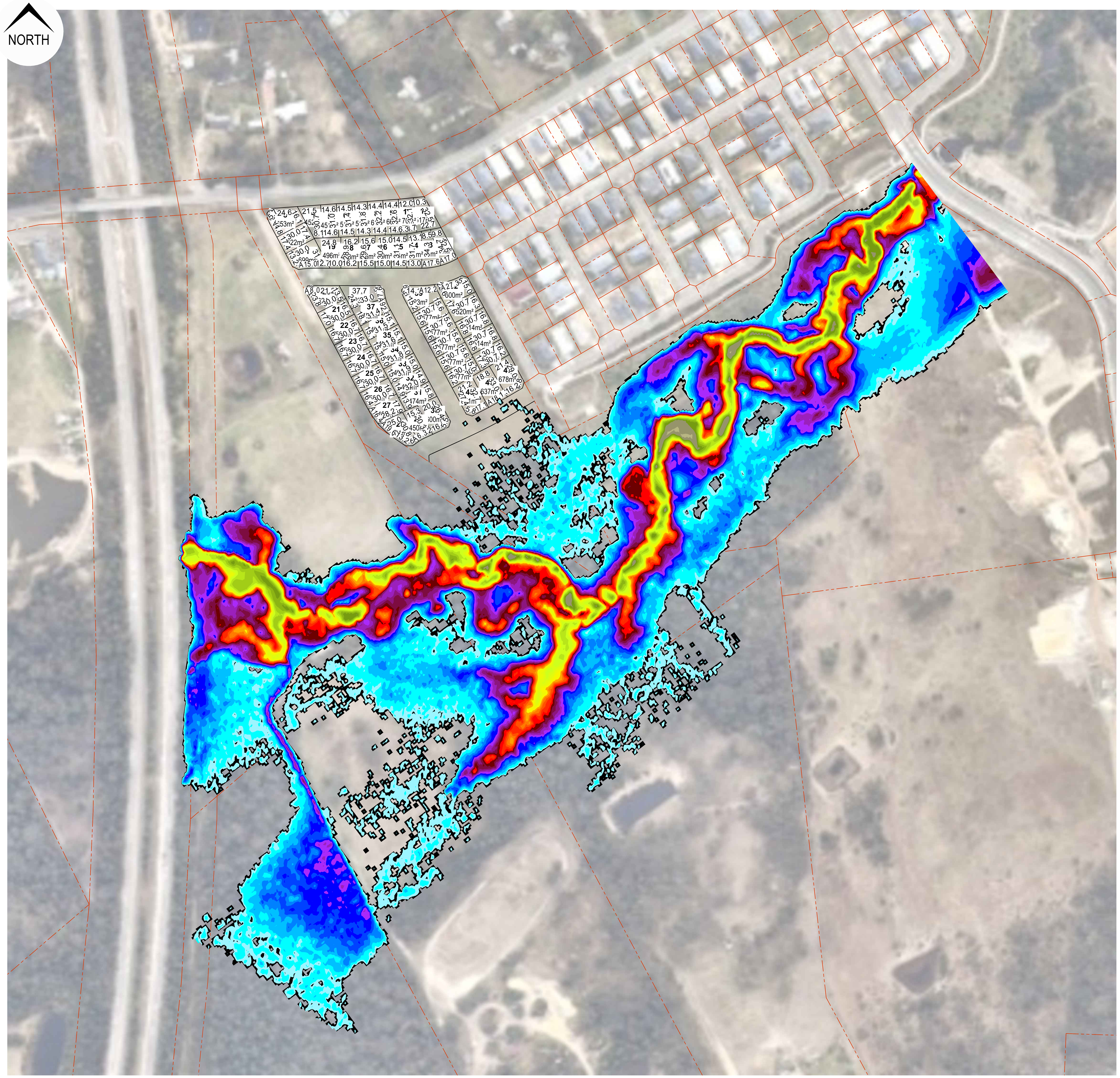
Project:
1377 HUE HUE ROAD, WYEE
PLANNING PROPOSAL

Title:
1% AEP STORM EVENT
PRE-DEVELOPMENT
FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	010	02



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0.3 - 0.4m	
0.4 - 0.5m	
0.5 - 0.6m	
0.6 - 0.7m	
0.7 - 0.8m	
0.8 - 0.9m	
0.9 - 1.0m	
1.0 - 1.1m	
1.1 - 1.2m	
1.2 - 1.3m	
1.3 - 1.4m	
1.4 - 1.5m	
1.5 - 1.6m	
1.6 - 1.7m	
1.7 - 1.8m	
1.8 - 1.9m	
1.9 - 2.0m	
2.0 - 2.2m	
2.2 - 2.4m	
2.4 - 2.6m	
2.6 - 2.8m	
2.8 - 3.0m	
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4.0 - 5.0m	
5.0 - 10.0m	
WATER SURFACE CONTOUR & LABEL	70.00

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Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1%AEP STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
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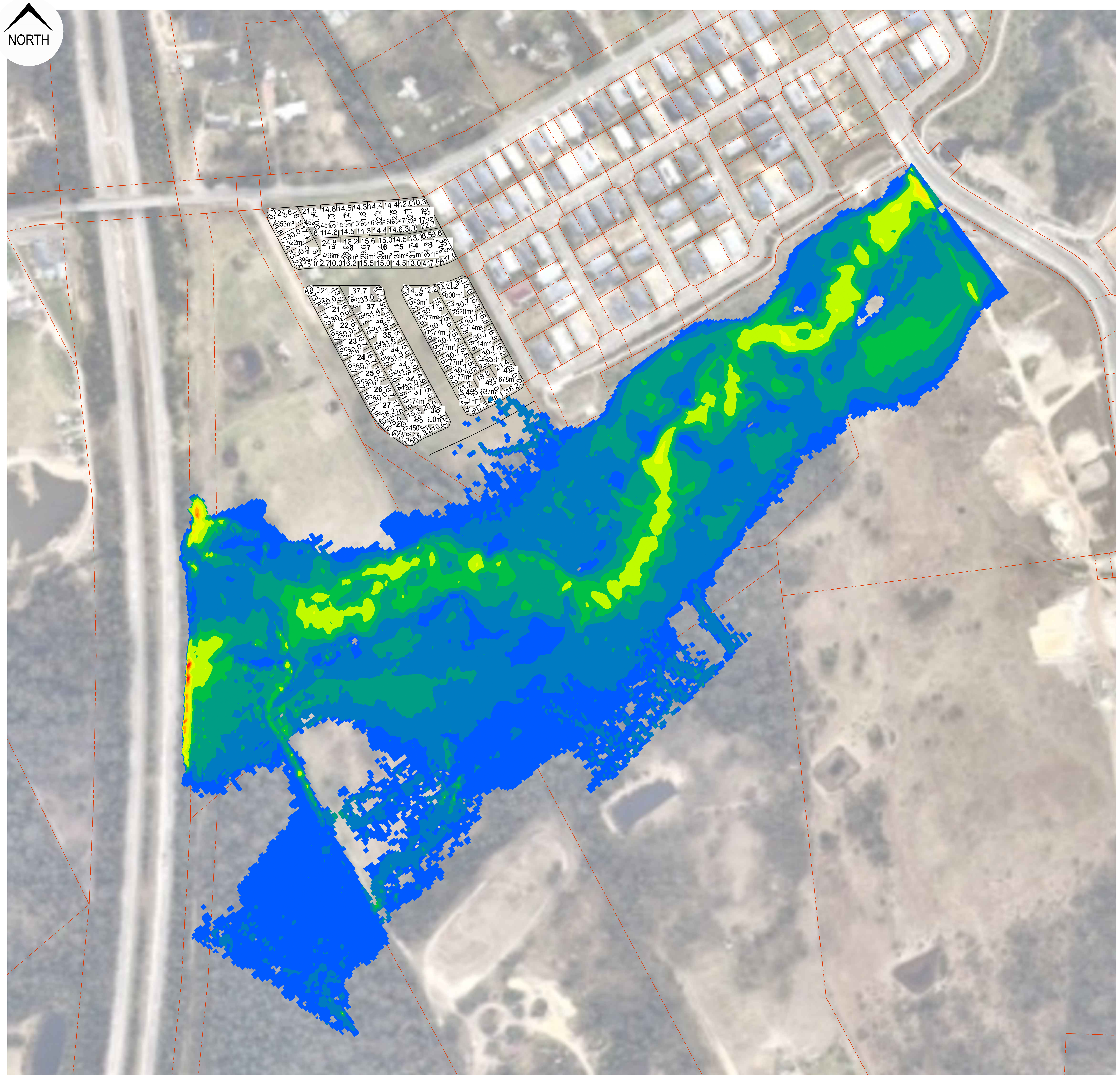

LEGEND

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0.5 - 0.75m/s	
0.75 - 1.0m/s	
1.0 - 1.5m/s	
1.5 - 2.0m/s	
2.0 - 2.5m/s	
2.5 - 3.0m/s	
3.0 - 3.5m/s	
3.5 - 4.0m/s	
4.0 - 5.0m/s	
5.0 - 6.0m/s	
6.0 - 10.0m/s	

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Rev	Drawn	Design	Check	Appd.	Date	Revision Description
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01	CF	NG	-	-	03/11/2021	ISSUED FOR INFORMATION

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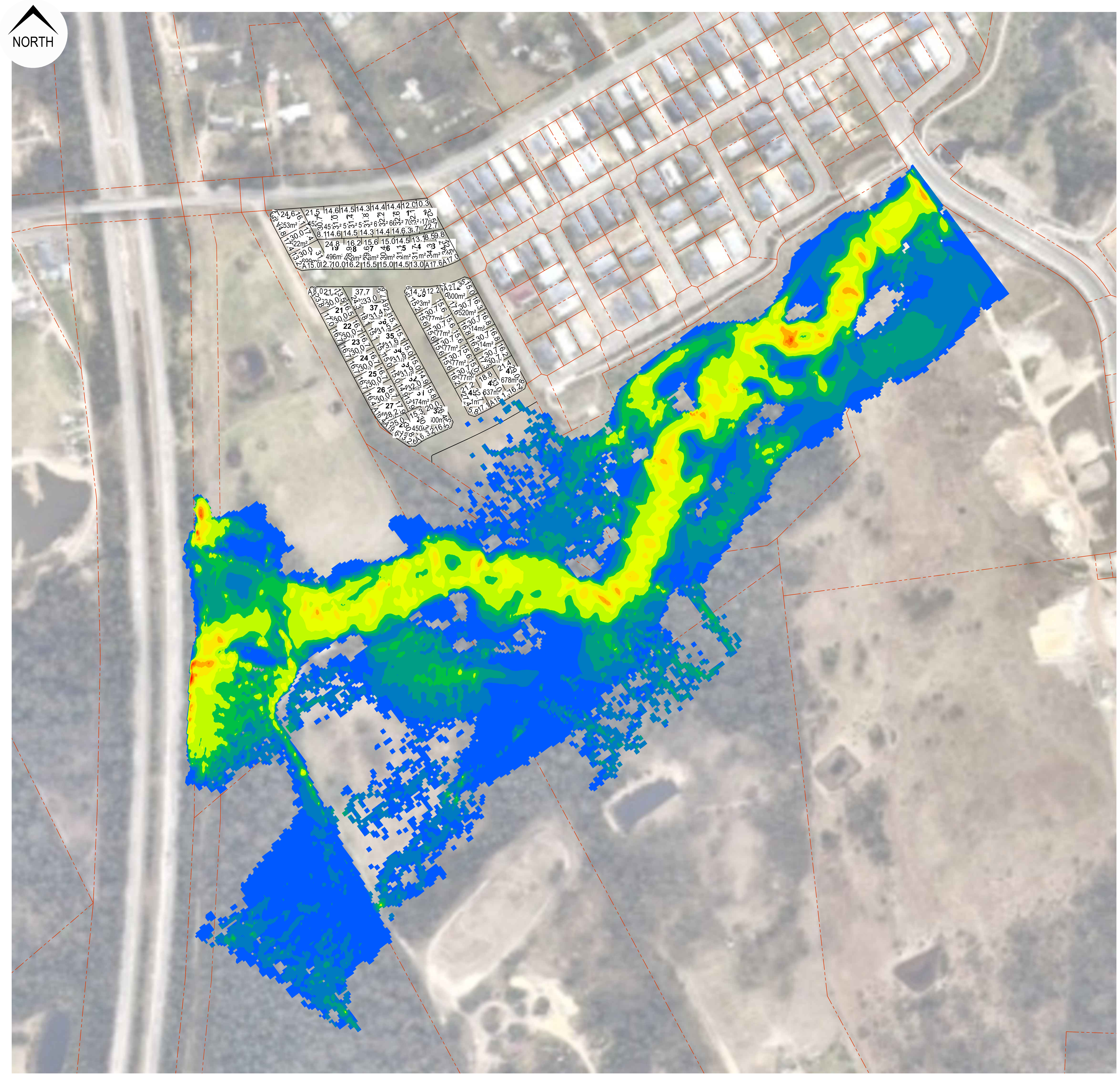
Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP STORM EVENT PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	02



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- 0.25 - 0.5m/s
- 0.5 - 0.75m/s
- 0.75 - 1.0m/s
- 1.0 - 1.5m/s
- 1.5 - 2.0m/s
- 2.0 - 2.5m/s
- 2.5 - 3.0m/s
- 3.0 - 3.5m/s
- 3.5 - 4.0m/s
- 4.0 - 5.0m/s
- 5.0 - 6.0m/s
- 6.0 - 10.0m/s

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
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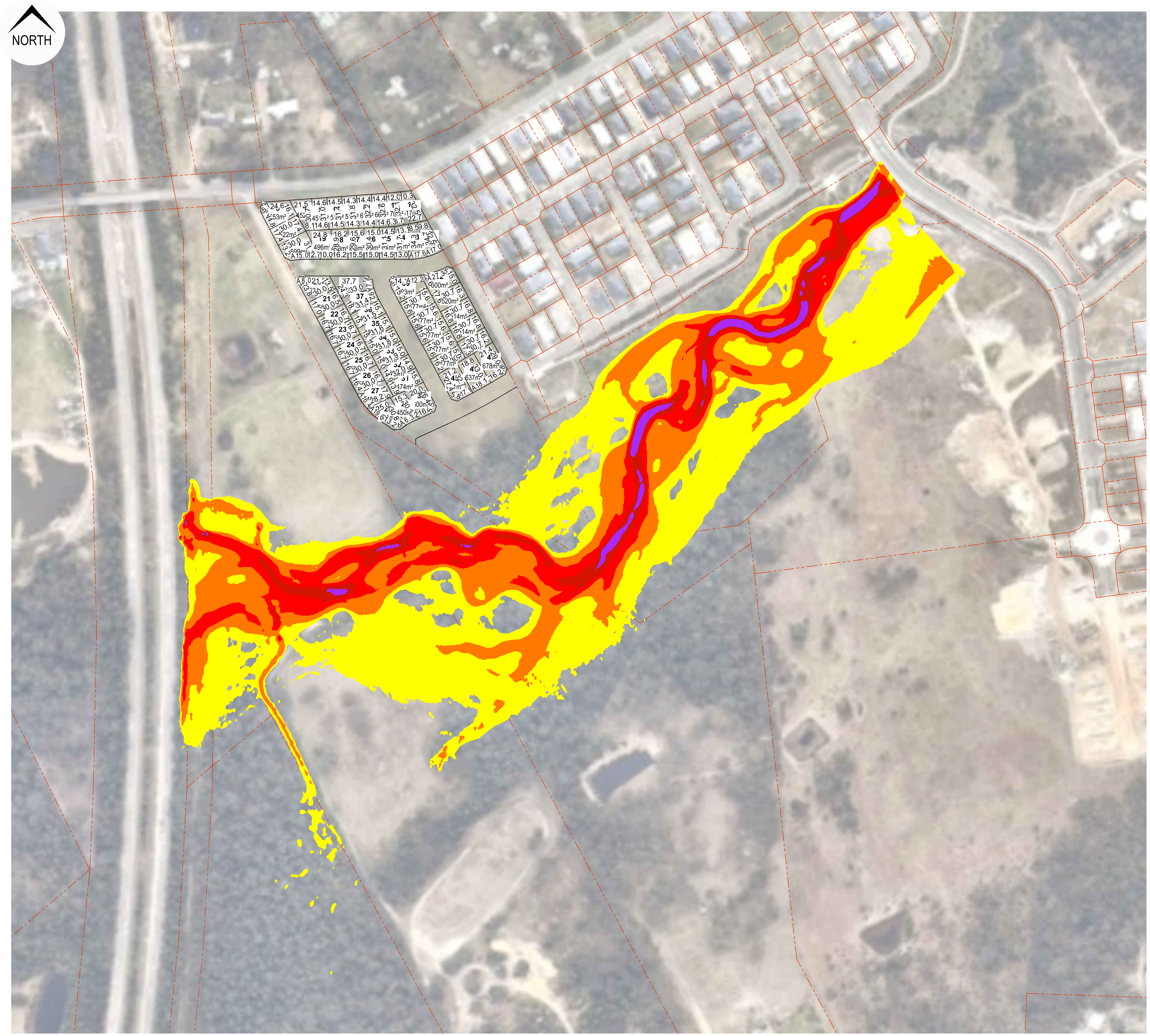
Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	01



LEGEND

HAZARD VULNERABILITY CLASSIFICATION

- H1
- H2
- H3
- H4
- H5
- H6

ISSUED FOR INFORMATION

02	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION
01	CF	NG	-	-	03/11/2021	ISSUED FOR INFORMATION
Rev	Drawn	Design	Check	Appd.	Date	Revision Description

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

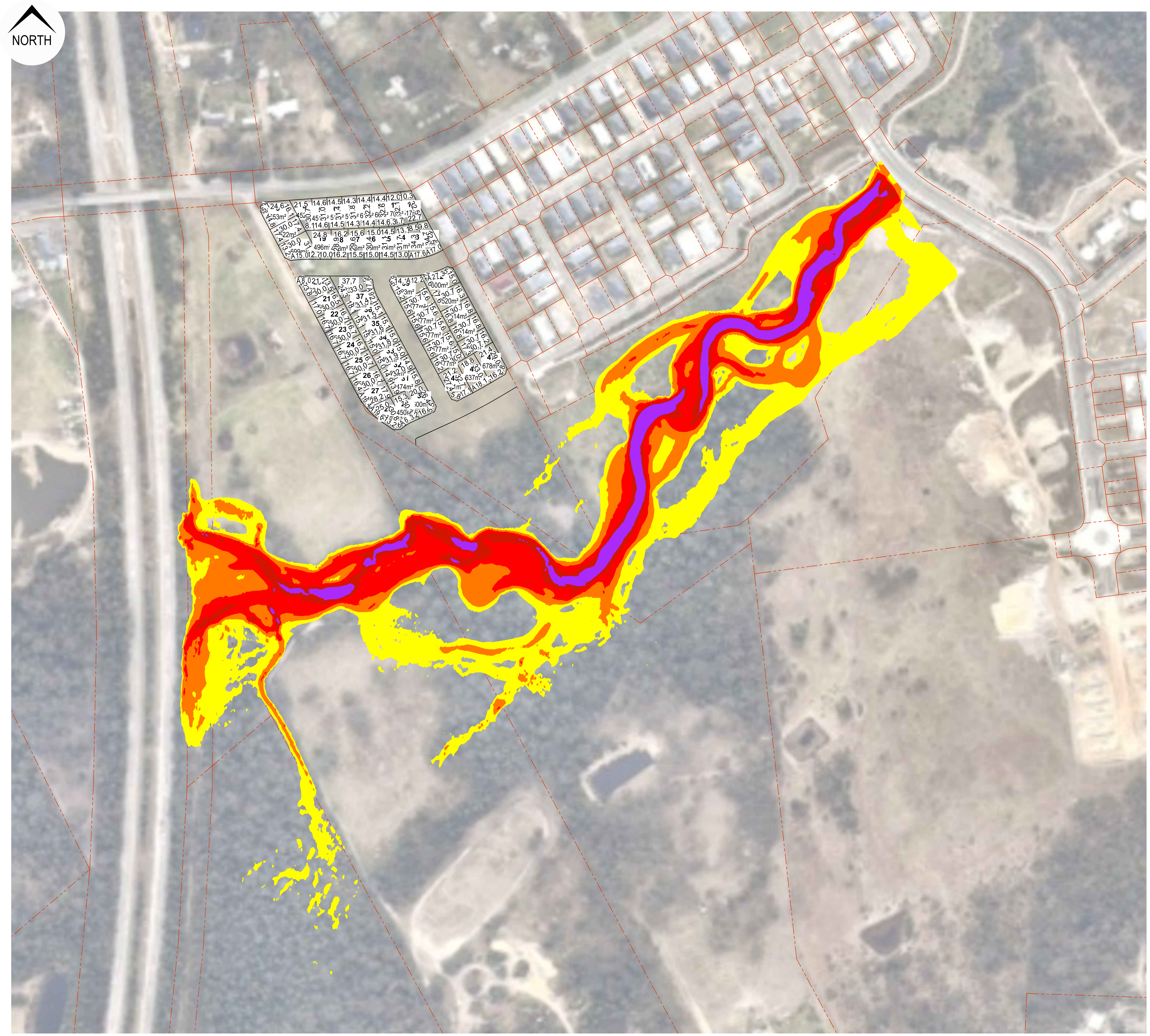
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP STORM EVENT PRE-DEVELOPMENT FLOOD HAZARD MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	014	02



LEGEND

HAZARD VULNERABILITY CLASSIFICATION

- H1
- H2
- H3
- H4
- H5
- H6

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

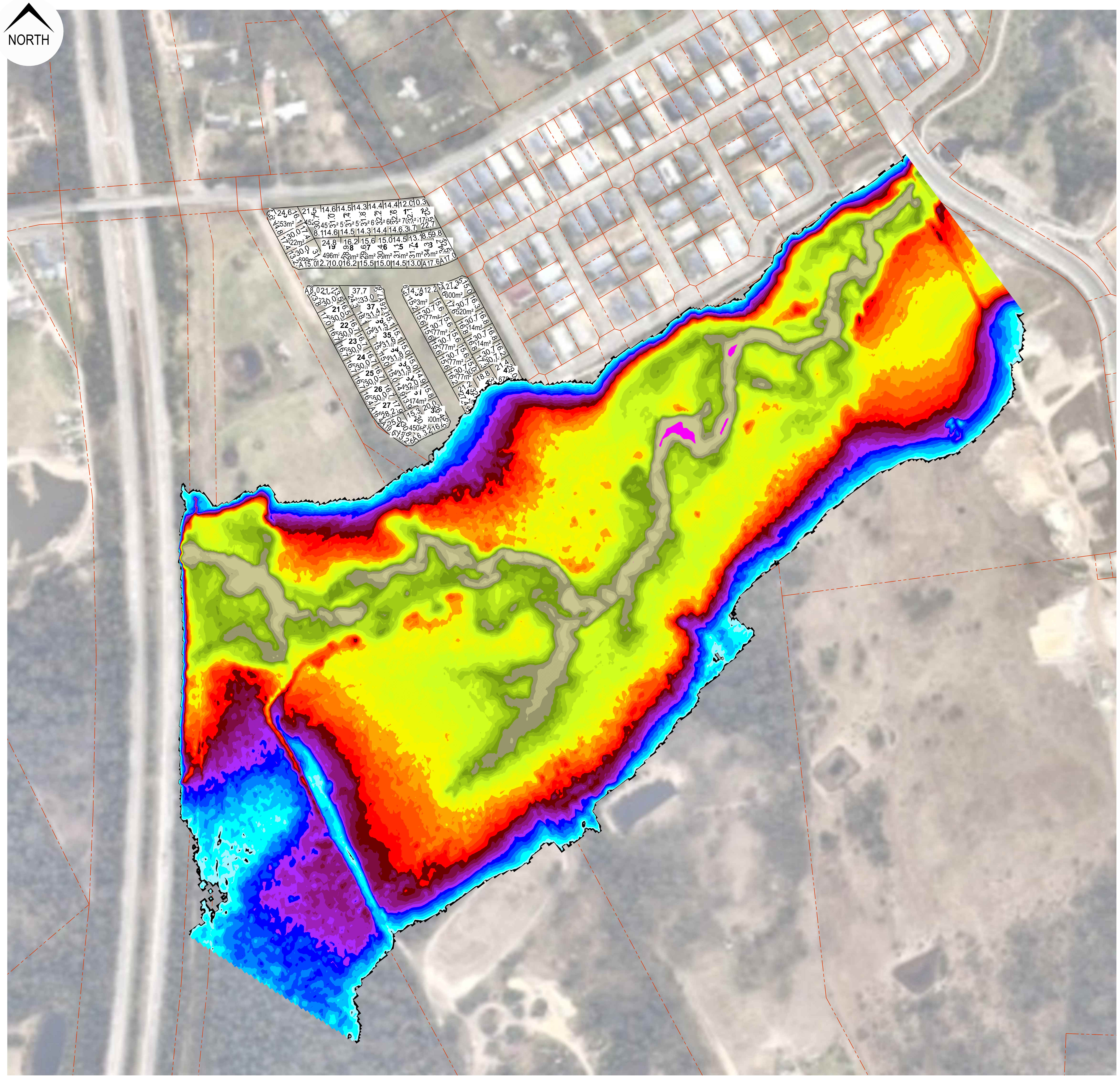
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1%AEP STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD HAZARD MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	014	01



LEGEND

Depth	
0.05 - 0.1m	
0.1 - 0.2m	
0.2 - 0.3m	
0.3 - 0.4m	
0.4 - 0.5m	
0.5 - 0.6m	
0.6 - 0.7m	
0.7 - 0.8m	
0.8 - 0.9m	
0.9 - 1.0m	
1.0 - 1.1m	
1.1 - 1.2m	
1.2 - 1.3m	
1.3 - 1.4m	
1.4 - 1.5m	
1.5 - 1.6m	
1.6 - 1.7m	
1.7 - 1.8m	
1.8 - 1.9m	
1.9 - 2.0m	
2.0 - 2.2m	
2.2 - 2.4m	
2.4 - 2.6m	
2.6 - 2.8m	
2.8 - 3.0m	
3.0 - 3.5m	
3.5 - 4.0m	
4.0 - 5.0m	
5.0 - 10.0m	
WATER SURFACE CONTOUR & LABEL	70.00

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale:
0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

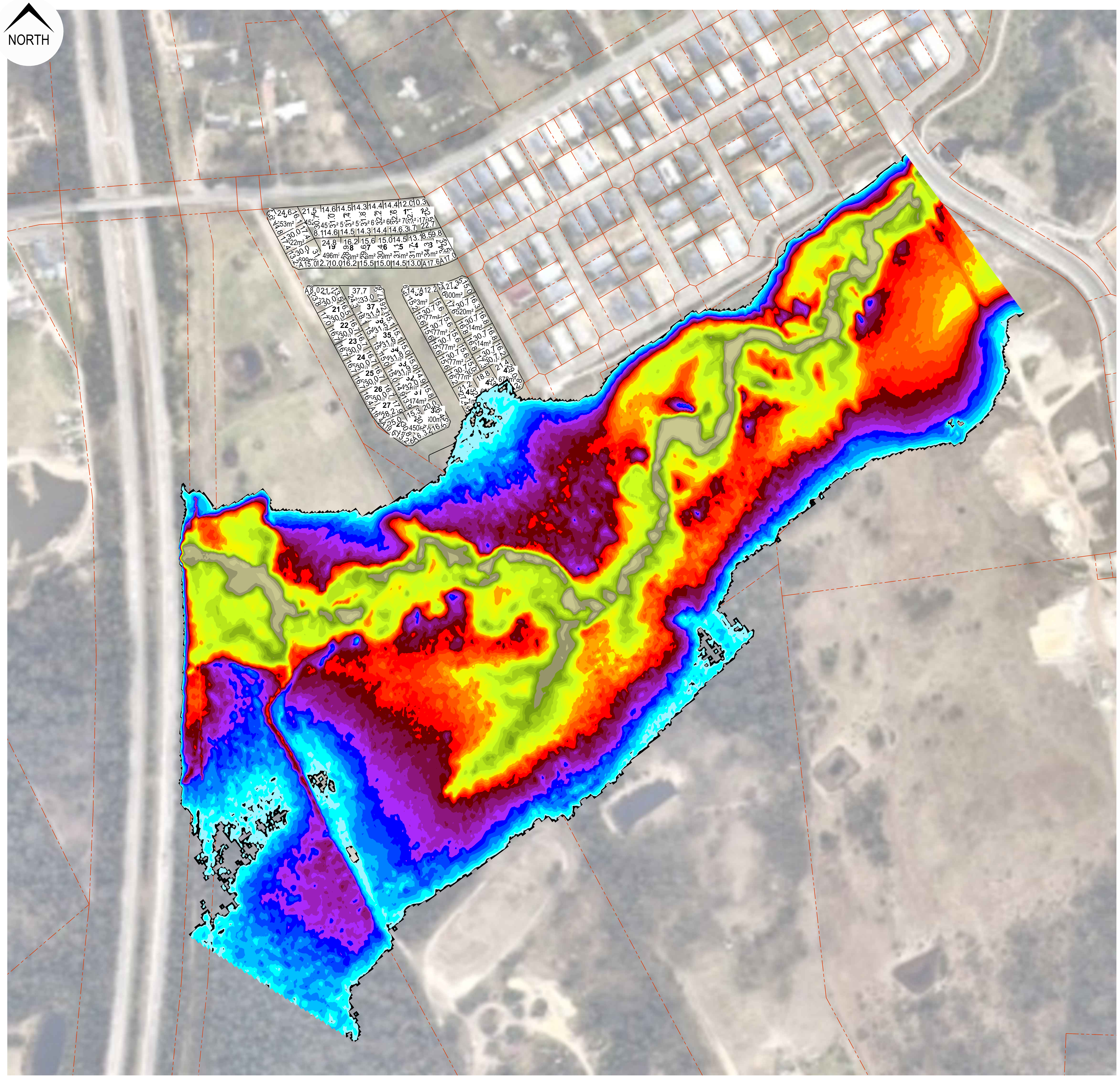
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project:
1377 HUE HUE ROAD,
WYEE
PLANNING PROPOSAL

Title:
PMF STORM EVENT
PRE-DEVELOPMENT
FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	010	01



LEGEND

Flood depth
0.05 - 0.1m
0.1 - 0.2m
0.2 - 0.3m
0.3 - 0.4m
0.4 - 0.5m
0.5 - 0.6m
0.6 - 0.7m
0.7 - 0.8m
0.8 - 0.9m
0.9 - 1.0m
1.0 - 1.1m
1.1 - 1.2m
1.2 - 1.3m
1.3 - 1.4m
1.4 - 1.5m
1.5 - 1.6m
1.6 - 1.7m
1.7 - 1.8m
1.8 - 1.9m
1.9 - 2.0m
2.0 - 2.2m
2.2 - 2.4m
2.4 - 2.6m
2.6 - 2.8m
2.8 - 3.0m
3.0 - 3.5m
3.5 - 4.0m
4.0 - 5.0m
5.0 - 10.0m
WATER SURFACE CONTOUR & LABEL — 70.00

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

For: TOPA PROPERTY

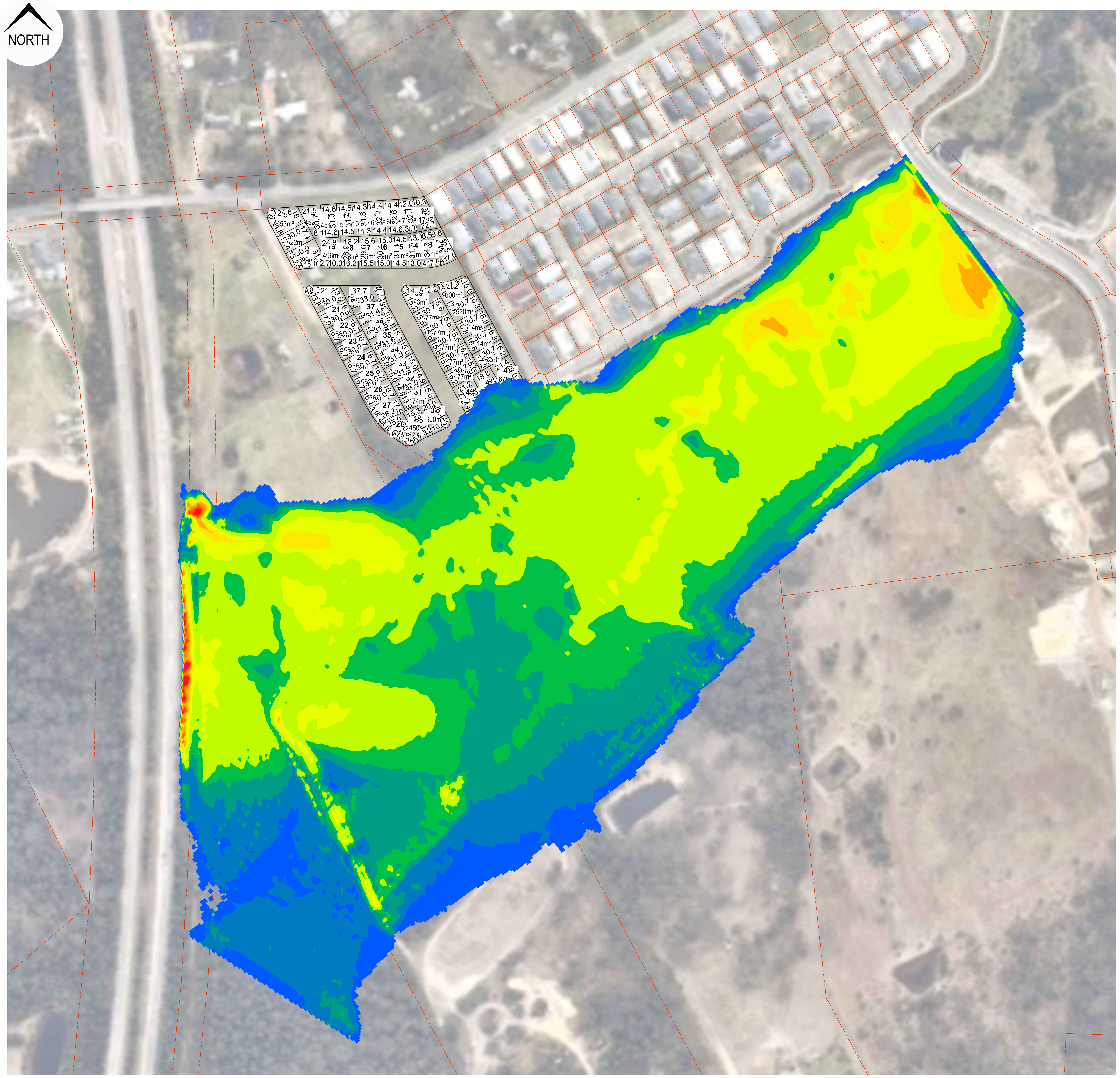
By: Orion Consulting

ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: PMF STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	010	01



LEGEND

0 - 0.25m/s	
0.25 - 0.5m/s	
0.5 - 0.75m/s	
0.75 - 1.0m/s	
1.0 - 1.5m/s	
1.5 - 2.0m/s	
2.0 - 2.5m/s	
2.5 - 3.0m/s	
3.0 - 3.5m/s	
3.5 - 4.0m/s	
4.0 - 5.0m/s	
5.0 - 6.0m/s	
6.0 - 10.0m/s	

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

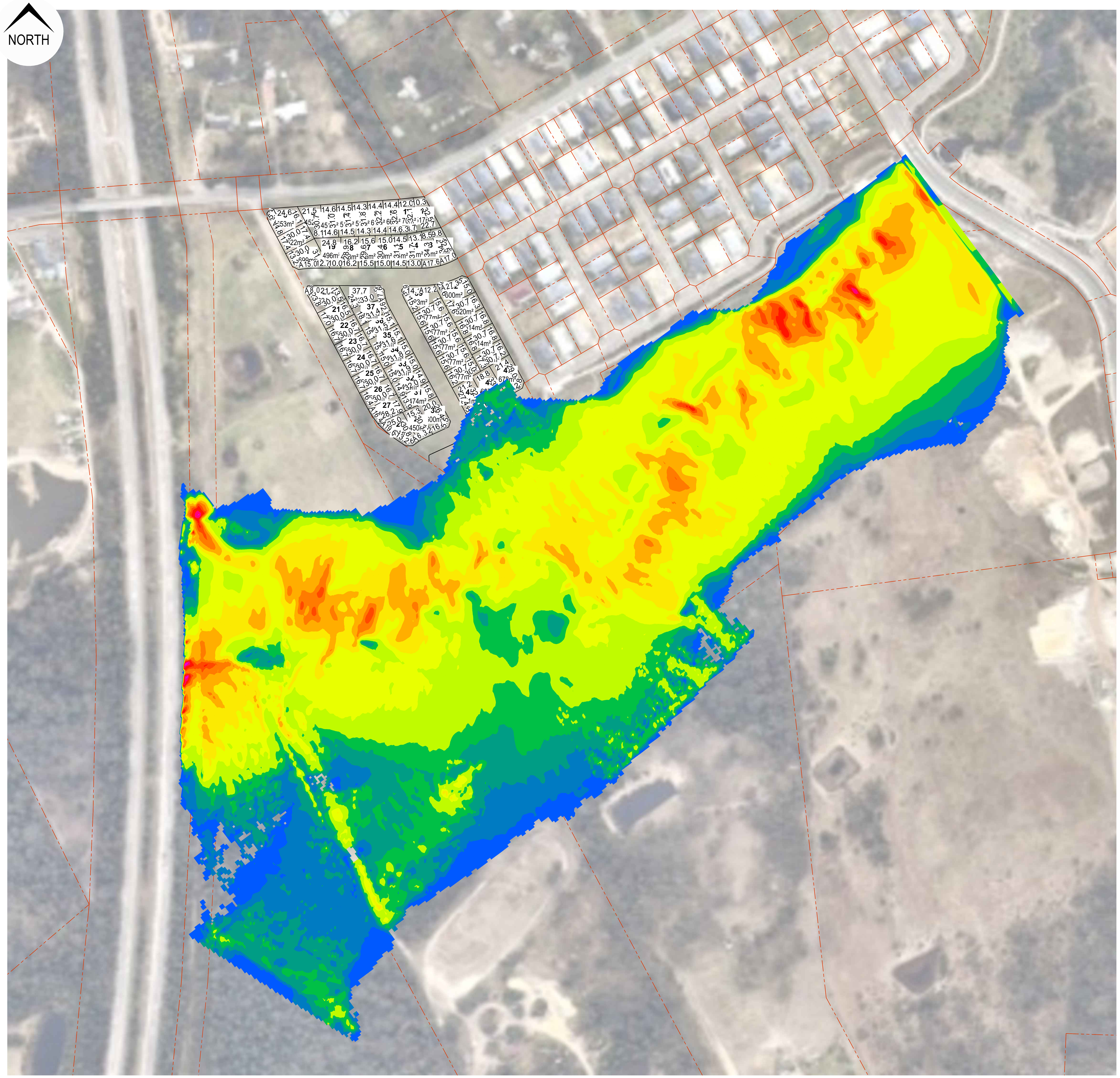
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: PMF STORM EVENT PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	01



LEGEND

Velocity
0 - 0.25m/s
0.25 - 0.5m/s
0.5 - 0.75m/s
0.75 - 1.0m/s
1.0 - 1.5m/s
1.5 - 2.0m/s
2.0 - 2.5m/s
2.5 - 3.0m/s
3.0 - 3.5m/s
3.5 - 4.0m/s
4.0 - 5.0m/s
5.0 - 6.0m/s
6.0 - 10.0m/s

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

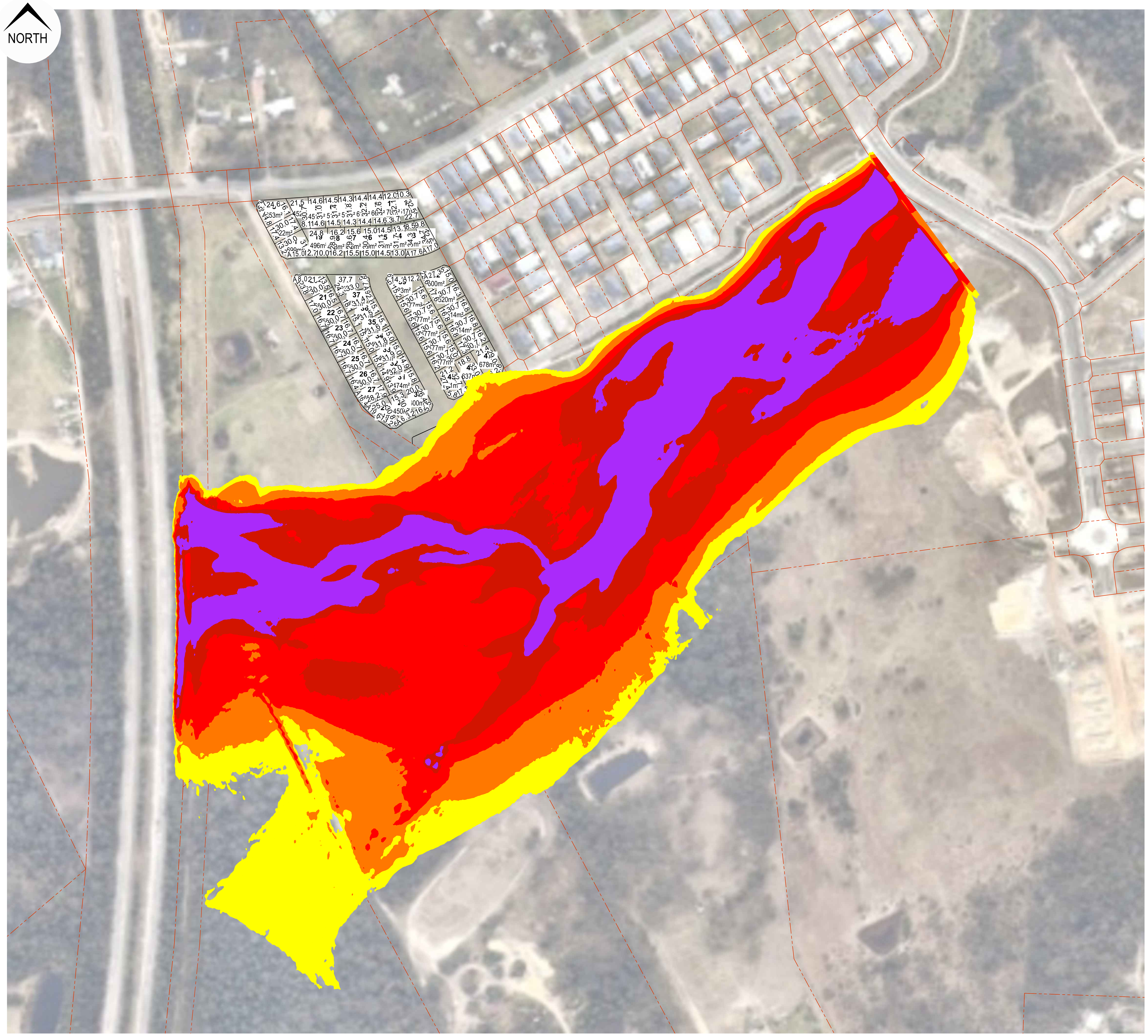
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: PMF STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	01



LEGEND

HAZARD VULNERABILITY CLASSIFICATION

- H1
- H2
- H3
- H4
- H5
- H6

ISSUED FOR **INFORMATION**

01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION
Rev	Drawn	Design	Check	Appd.	Date	Revision Description

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

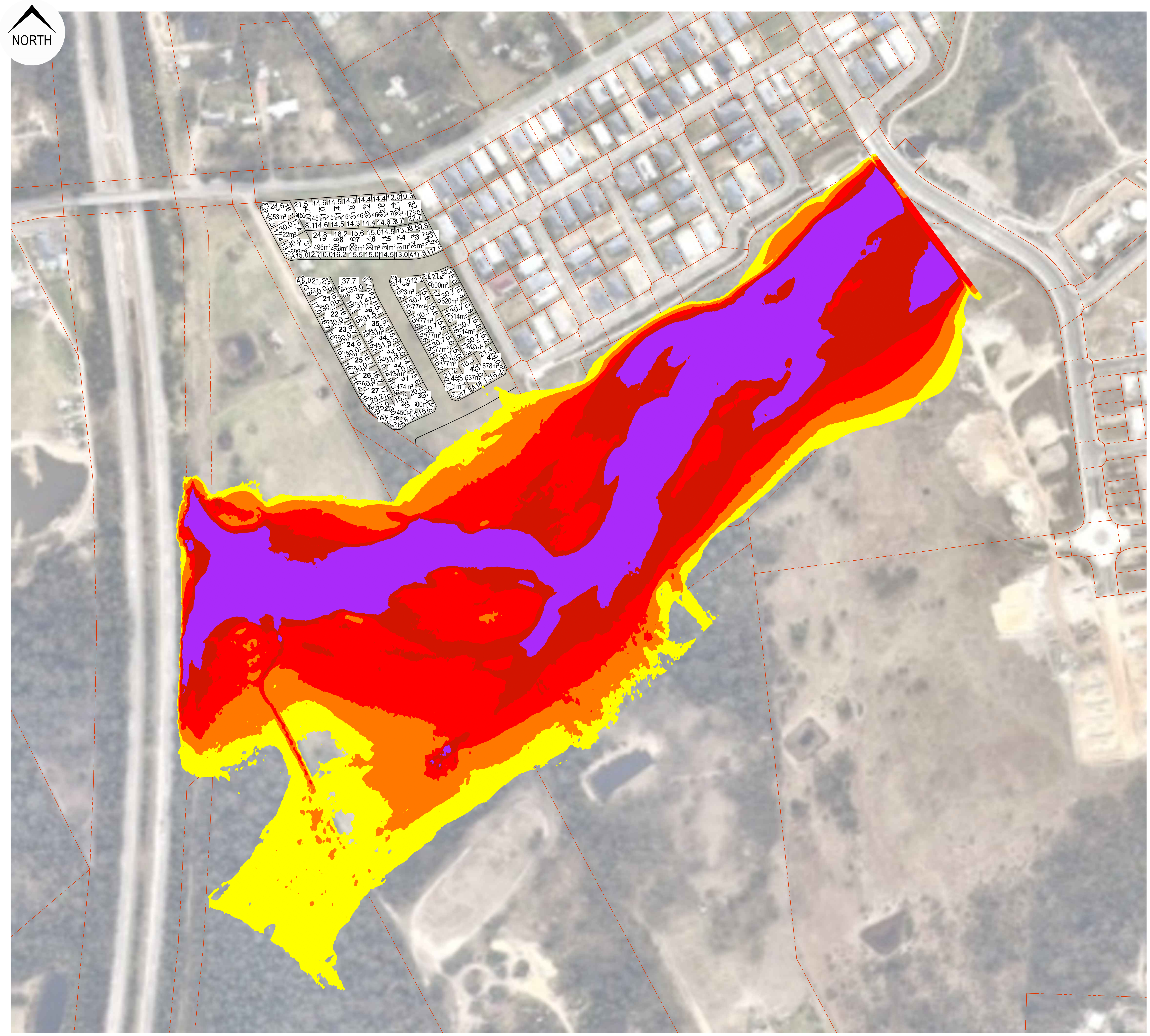
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: PMF STORM EVENT PRE-DEVELOPMENT FLOOD HAZARD MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	014	01



LEGEND

HAZARD VULNERABILITY CLASSIFICATION

- H1
- H2
- H3
- H4
- H5
- H6

ISSUED FOR INFORMATION

01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION
Rev	Drawn	Design	Check	Appd.	Date	Revision Description

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

For: TOPA PROPERTY

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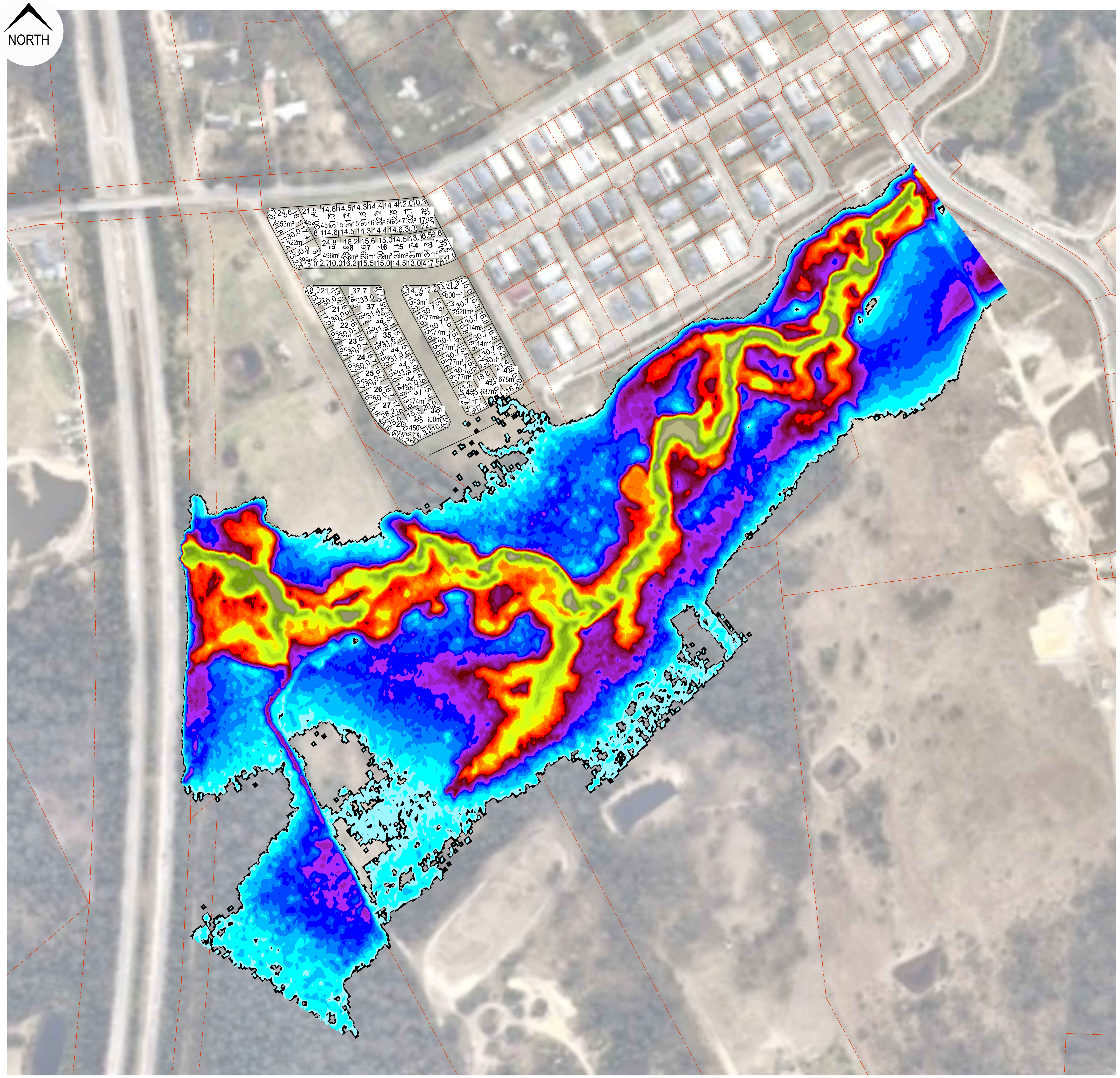
Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: PMF STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD HAZARD MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	014	01



LEGEND

0.05 - 0.1m	
0.1 - 0.2m	
0.2 - 0.3m	
0.3 - 0.4m	
0.4 - 0.5m	
0.5 - 0.6m	
0.6 - 0.7m	
0.7 - 0.8m	
0.8 - 0.9m	
0.9 - 1.0m	
1.0 - 1.1m	
1.1 - 1.2m	
1.2 - 1.3m	
1.3 - 1.4m	
1.4 - 1.5m	
1.5 - 1.6m	
1.6 - 1.7m	
1.7 - 1.8m	
1.8 - 1.9m	
1.9 - 2.0m	
2.0 - 2.2m	
2.2 - 2.4m	
2.4 - 2.6m	
2.6 - 2.8m	
2.8 - 3.0m	
3.0 - 3.5m	
3.5 - 4.0m	
4.0 - 5.0m	
5.0 - 10.0m	
WATER SURFACE CONTOUR & LABEL	70.00

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

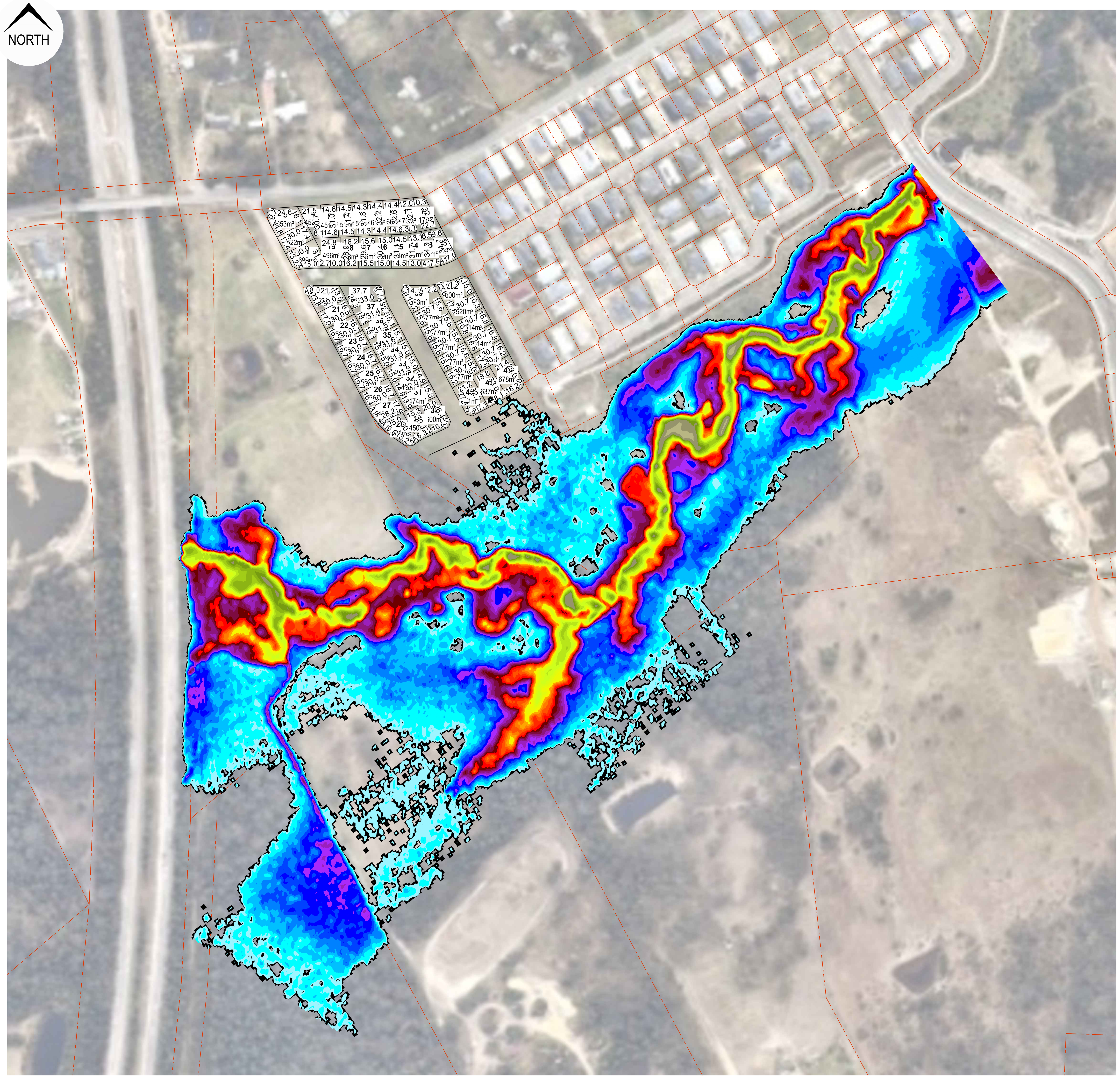
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP+CC STORM EVENT PRE-DEVELOPMENT FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	010	01



LEGEND

Depth	
0.05 - 0.1m	
0.1 - 0.2m	
0.2 - 0.3m	
0.3 - 0.4m	
0.4 - 0.5m	
0.5 - 0.6m	
0.6 - 0.7m	
0.7 - 0.8m	
0.8 - 0.9m	
0.9 - 1.0m	
1.0 - 1.1m	
1.1 - 1.2m	
1.2 - 1.3m	
1.3 - 1.4m	
1.4 - 1.5m	
1.5 - 1.6m	
1.6 - 1.7m	
1.7 - 1.8m	
1.8 - 1.9m	
1.9 - 2.0m	
2.0 - 2.2m	
2.2 - 2.4m	
2.4 - 2.6m	
2.6 - 2.8m	
2.8 - 3.0m	
3.0 - 3.5m	
3.5 - 4.0m	
4.0 - 5.0m	
5.0 - 10.0m	
WATER SURFACE CONTOUR & LABEL	70.00

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

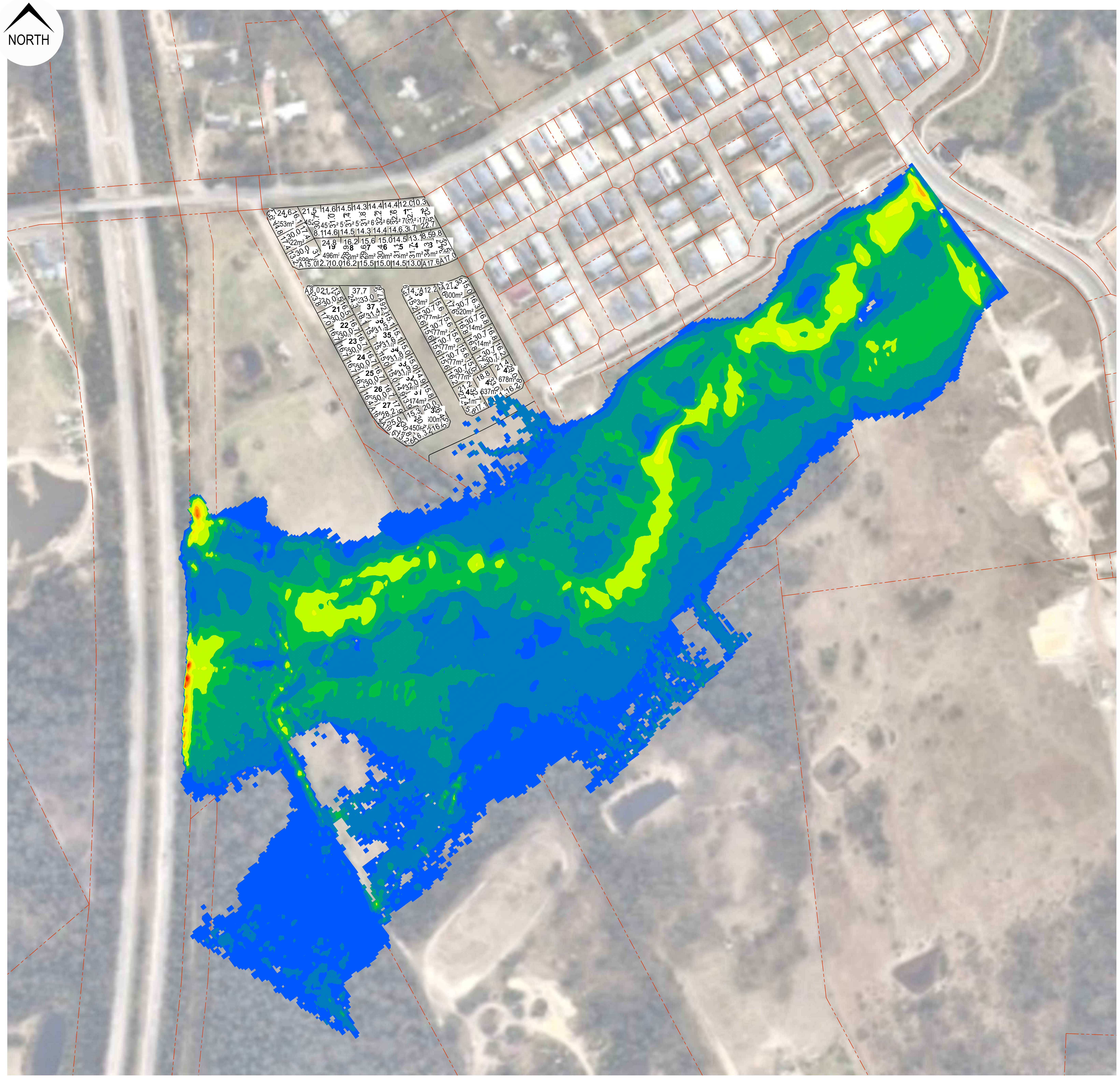
For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1%AEP+CC STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD DEPTH MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	010	01



LEGEND

0 - 0.25m/s	
0.25 - 0.5m/s	
0.5 - 0.75m/s	
0.75 - 1.0m/s	
1.0 - 1.5m/s	
1.5 - 2.0m/s	
2.0 - 2.5m/s	
2.5 - 3.0m/s	
3.0 - 3.5m/s	
3.5 - 4.0m/s	
4.0 - 5.0m/s	
5.0 - 6.0m/s	
6.0 - 10.0m/s	

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

For: TOPA PROPERTY

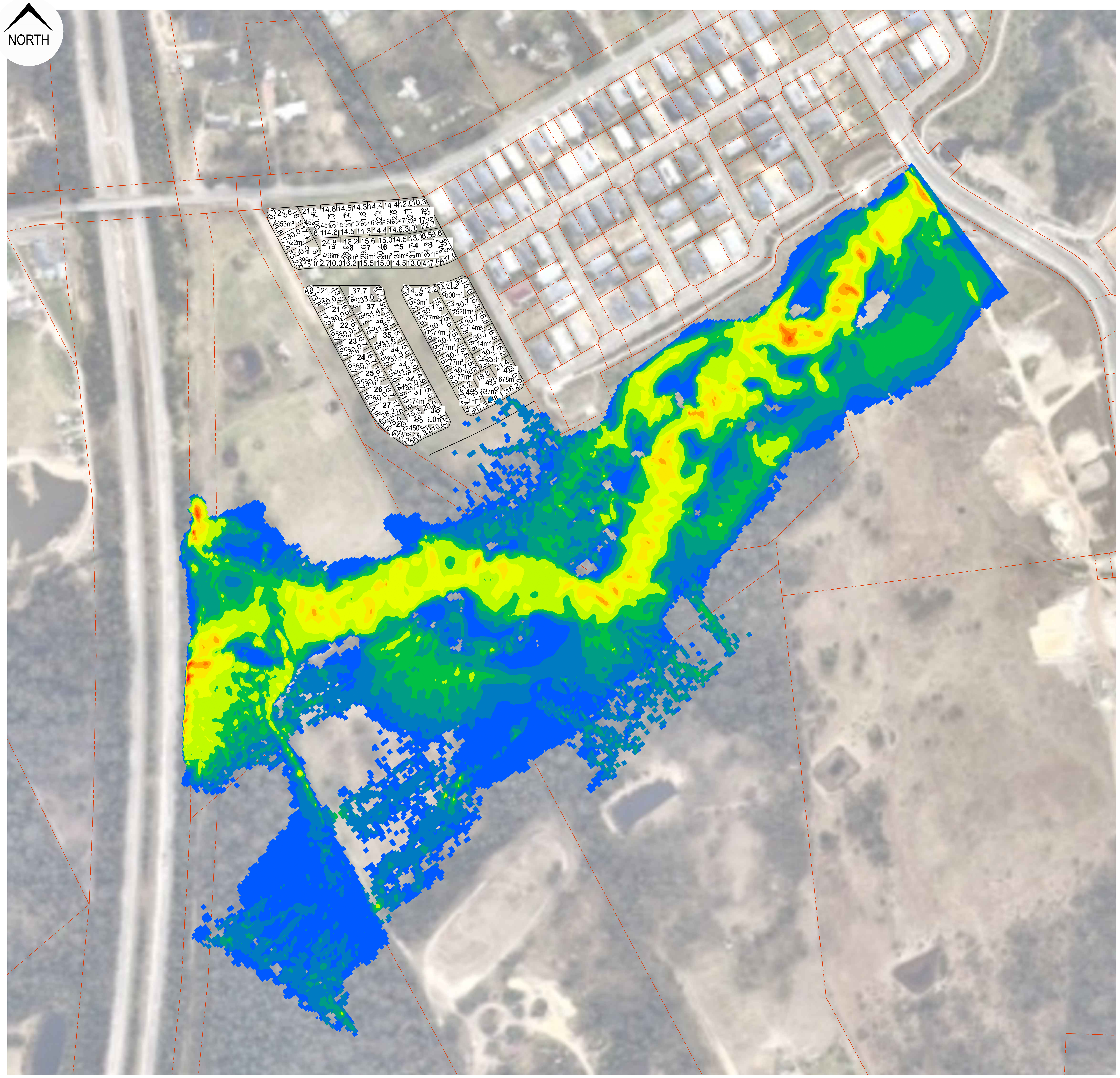
By: Orion Consulting

ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP+CC STORM EVENT PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	01



LEGEND

- 0 - 0.25m/s
- 0.25 - 0.5m/s
- 0.5 - 0.75m/s
- 0.75 - 1.0m/s
- 1.0 - 1.5m/s
- 1.5 - 2.0m/s
- 2.0 - 2.5m/s
- 2.5 - 3.0m/s
- 3.0 - 3.5m/s
- 3.5 - 4.0m/s
- 4.0 - 5.0m/s
- 5.0 - 6.0m/s
- 6.0 - 10.0m/s

ISSUED FOR INFORMATION

Rev	Drawn	Design	Check	Appd.	Date	Revision Description
01	RMcL	RMcL	-	-	20/12/2023	ISSUED FOR INFORMATION

Scale: 0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

For: TOPA PROPERTY

By: Orion Consulting
ABN:25 604 069 981 PO Box:7936, BAULKHAM HILLS NSW 2153 T:(02) 8660 0035 E:info@orionconsulting.com.au

Project: 1377 HUE HUE ROAD, WYEE PLANNING PROPOSAL

Title: 1% AEP+CC STORM EVENT MANNING SENSITIVITY PRE-DEVELOPMENT FLOOD VELOCITY MAP

Project No.	Set No.	Milestone	Plan	Revision
21-0090	01	FM	012	01