Supplementary Flood Assessment

Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW

Final Report

P2208888JR20V02

June 2025

Prepared for AB Rise Pty Ltd C-/ Mecone Group Pty Ltd

environmental science & engineering

Project Details

Report Title	Supplementary Flood Assessment: Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW
Client	AB Rise Pty Ltd C-/ Mecone Group Pty Ltd
Document	P2208888JR20V02
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Document History

Issue	Issue Date	Status	Description / Comment	Author	Reviewer	Approved
1	20/06/2025	Final	Planning Proposal	RD, DD, JR	DM, MS	MS

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Executive Summary

Martens & Associates Pty Ltd (**MA**) have prepared this supplementary flood assessment on behalf of AB Rise Pty Ltd (the **Proponent**) in support of a planning proposal (**PP**) seeking to rezone land for residential purposes at 196 Old Main Road and 263, 269, 271, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW (the **site**).

This assessment has been prepared in response to flood engineering related comments raised by Port Stephens Council (**Council**) in respect of the PP in their Strategic Planning Assessment Report (**SPAR**) dated 4 April 2025. In summary, all elements of the proposal, including roads and lots, will not be impacted by flood water because they will be above the probably maximum flood (**PMF**) level including climate change and will have permanent egress available to areas south of the sand dune. The proposed filling to support the roads has been significantly reduced to accommodate a revised proposed scheme, and detailed updated flood modelling demonstrates that the fill does not result in any detrimental site or off-site impacts in terms of water levels or velocities.

MA have undertaken the following in response to Council's comments:

1. Updated the proposed civil engineering design and flood modelling previously undertaken by MA to reflect the amended site masterplan and to address Council's comments.
2. Reduced the overall fill volume of the proposed earthworks by approximately 236,000 m³ or 20% from the previous proposal.
3. Modified the stormwater drainage design of Catchments E and F to flow to the approved DA infiltration basin and the approved flood mitigation culverts, as well as draining existing trapped low points on adjacent properties, this having a net benefit on the local floodplain environment.
4. Assessed the site against relevant floodway definitions and confirmed that the proposal does not propose fill within a floodway.
5. Undertaken a cumulative impact assessment, demonstrating that there are no adverse flood impacts under potential future development conditions.
6. Explicitly addressed the SPAR flood engineering and civil design comments provided by Council.

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Glossary of Terms

Term	Meaning
AEP	Annual exceedance probability: the probability of a flood event occurring within a year. A 1% AEP flood has a 1% chance of occurring in any given year.
BoM	Bureau of Meteorology
Council	Port Stephens Council (**Council**)
DA	Development application
FPL	Flood planning level
LGA	Local government area
MA	Martens & Associates Pty Ltd
PMF	Probable maximum flood: the most extreme flood event possible for a certain location, with an approximate ARI of 100,000 to 10,000,000 years.
PP	Planning Proposal
SES	NSW State Emergency Service
SIP	Shelter-in-place
Site	196 Old Main Road and 263, 271, 273, 293 and 321 Gan Gan Road, Anna Bay

1 Introduction

1.1 Overview

Martens & Associates Pty Ltd (**MA**) have prepared this supplementary flood assessment on behalf of AB Rise Pty Ltd (the **Proponent**) in support of a planning proposal (**PP**) seeking to rezone land for residential purposes at 196 Old Main Road and 263, 269, 271, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW (the **site**).

1.2 Scope

This supplementary report has been prepared:

1. In response to the flood engineering related comments raised by Port Stephens Council (**Council**) in respect of the PP in their Strategic Planning Assessment Report (**SPAR**) dated 4 April 2025.
2. To reflect the updated site masterplan (Appendix A).

This supplementary flood assessment documents the following:

1. Updates to the proposed civil engineering design previously undertaken by MA (Section 1.4).
2. Updates to the flood modelling and assessment previously undertaken by MA (Section 2), including:
    a. Updated flood impact assessment including velocity impacts (Section 2.4).
    b. Cumulative flood impact assessment (Section 2.5).
    c. Site flood function definition (Section 2.6).
3. Updated commentary on site flood risks and mitigation measures, and preliminary emergency response procedures (Section 3).
4. Itemised response to the Council SPAR flood engineering related comments (Section 4).

1.3 Supporting Documents

This report should be read in conjunction with the following MA flood reports:

1. *Flood Assessment: Proposed Residential Subdivision at 263, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW* (September 2023, P2208888JR02V01). This report was prepared to support the site development application (**DA**) south of the sand dune, and is hereafter referred to as the **MA DA flood assessment**.
2. *Engineering Memorandum: Proposed Torrens Title Subdivision at 263, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW* (October 2024, P2208888JR15V03). This report was prepared to support the site DA as an addendum to the MA DA flood

assessment, and is hereafter referred to as the **MA DA supplementary flood assessment**.

3. *Flood Assessment: Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW* (December 2024a, P2208888JR14V01). This report was prepared to support the site PP north and south of the sand dune, and is hereafter referred to as the **MA PP flood assessment**.

4. *Conceptual Stormwater Management Strategy: Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW* (December 2024b, P2208888JR16V01). This report was prepared to support the site PP north and south of the sand dune, and is hereafter referred to as the **MA PP conceptual stormwater management strategy**.

1.4 Civil Engineering Design Updates

The site masterplan (Appendix A) has been updated in response to the Council SPAR comments. Accordingly, the MA proposed civil engineering design has been updated as follows:

1. Catchment E has been designed with additional details, including:
    a. Catchment E flows to the approved DA infiltration basin north of Catchment E, before flowing through the approved twin flood mitigation culverts through the sand dune (the **flood mitigation culverts**).
    b. The design also includes swales and an internal pit and pipe system to drain adjacent lots trapped low points and convey upstream flows through the flood mitigation culverts.
    c. The updated flood modelling demonstrates the approved DA stormwater system has sufficient capacity to convey these additional flows without causing adverse flood impacts (refer to Section 2.4).
2. Catchment F has been reconfigured, in response to Council's comments, as follows:
    a. The previous design was to drain Catchment F to the existing basin at the intersection of Gan Gan Road and Essington Way.
    b. The updated design is to drain to a stormwater wetland within the southern portion of Catchment F.
    c. This wetland connects to a proposed stormwater pit and pipe system which flows east along Gan Gan Road to the approved DA infiltration basin north of Catchment E, before flowing through the flood mitigation culverts.
    d. The design also includes swales and an internal pit and pipe system to drain adjacent lots trapped low points and convey upstream flows.

e. As with Catchment E, the updated flood modelling demonstrates the approved DA stormwater system has sufficient capacity to convey these additional flows without causing adverse flood impacts (refer to Section 2.4).

3. Catchment G has been reduced in footprint providing reforestation area to the north of Catchment G to allow for ecological connectivity from east to west. The catchment stormwater basin has been reconfigured accordingly.

4. Catchments J and K and the roads servicing these catchments have been removed.

5. The Catchment L stormwater basin has been relocated within Catchment L adjacent to the proposed lots to allow for additional reforestation area.

6. The Catchment M stormwater basin M2 has been enlarged to compensate for the reconfiguration of the Catchment L stormwater basin.

7. The widening of the Anna Bay Main Drain at the downstream (western) site boundary has been removed to address Council concerns about a potential 'pinch point.

These changes result in the following civil and flood engineering improvements to the local catchment:

1. Catchments E and F have been designed to drain existing trapped low points on adjacent properties, which significantly reduces nuisance drainage issues, as well as reducing peak flood levels on these properties.

2. Further, the Catchment E and F civil design reduces flood levels and flood hazards on Gan Gan Road and Old Main Road, improving evacuation capability for the existing population.

3. A reduction in the proposed volume of fill:

    a. The previous proposed earthworks volumes were:

        i. Cut volume of approximately 35,000 m³.

        ii. Fill volume of approximately 1,205,000 m³.

        iii. Cut-fill balance of approximately 1,170,000 m³.

    b. The updated proposed earthworks volumes are:

        i. Cut volume of approximately 30,000 m³.

        ii. Fill volume of approximately 964,000 m³.

        iii. Cut-fill balance of approximately 934,000 m³.

c. The overall cut-fill balance is therefore reduced by approximately 236,000 m^3 or 20% from the previous proposal.

4. The 'pinch point' at the downstream (western) site boundary has been removed.

2 Flood Model Updates

2.1 Overview

Two hydraulic (TUFLOW) models were previously prepared by MA in support of the PP. Both models were updated to reflect the changes made to the proposed development (Section 1.4) as well as undertaking cumulative impact assessment from potential development within the floodplain. The models are described as follows:

1. **North of the sand dune**: Based on the 'regional' TUFLOW model from the Jacobs (2017) *Anna Bay and Tilligerry Creek Flood Study* (the **Jacobs Flood Study**) and used to undertake detailed hydraulic modelling of the site north of the sand dune (refer to Sections 2.5.1, 2.5.3 and 3 of the MA PP flood assessment).

2. **South of the sand dune**: Based on the MA TUFLOW model prepared as part of the MA DA initial and supplementary flood assessments and used to undertake detailed hydraulic modelling at the site south of the sand dune.

2.2 Model Changes

Both the north and south of sand dune flood models were updated to include a probable maximum flood (**PMF**) plus climate change scenario whereby the PMF event was modelled in combination with an increased ocean level for the year 2100 climate change scenario. The adopted climate change ocean level is consistent with the BMT *Port Stephens Coastal Management Program – Stage 2* (2021), which was higher than the Council adopted Jacobs Flood Study level (as detailed in Section 3.2 of the MA PP flood assessment).

2.2.1 Existing Conditions

No changes were made to the existing conditions flood models, other than running the PMF climate change event.

2.2.2 Proposed Conditions

The proposed conditions flood models were updated to incorporate the revised development layout and updated stormwater designs described in Section 2. Model updates included incorporation of updated site grading surfaces, adjustments to topographic inputs for stormwater drainage and detention basins, as well as updates to Manning's roughness zones, infiltration zones, and 1D networks.

2.2.3 Potential Future Development Conditions

The MA proposed conditions model was modified as follows to assess cumulative impacts associated with additional development on the floodplain:

1. Potential future residential developments to the east of the site were represented using z-shape modifications to create fill pads on either side of the Anna Bay Main Drain, with elevations set to Council's flood planning level (**FPL**) of 3.04 mAHD.

The fill pads were conservatively assumed to cover the maximum developable extent of the lots.

2. The widened Anna Bay Main Drain cross-section was extended from the site between the potential development fill pads to represent a likely configuration for the developments consistent with the proposed site layout.

3. Manning's roughness values were updated to reflect potential development surface conditions.

The cumulative development scenario is considered a conservative 'maximum envelope' scenario as it does not include detailed stormwater drainage, grading, flood mitigation design or erosion protection measures, nor does it consider other potential constraints such as impacts on fauna and flora.

2.3 Flood Characteristics

Flood mapping results of water level and velocity impacts for the critical duration 1% AEP flood and PMF events (with and without climate change) under proposed and potential future development conditions are provided in Appendix B, with drawing references summarised in Table 1.

Table 1: Flood map drawing references in Appendix B (MA MapSet P2208888MS13).

Flood Condition Scenario	Critical Flood Event	Water Level Impacts	Water Velocity Impacts
Proposed Conditions	1% AEP	Map FL04	Map FL08
	1% AEP (CC)	Map FL05	Map FL09
	PMF	Map FL06	Map FL10
	PMF (CC)	Map FL07	Map FL11
Potential Future Development Conditions	1% AEP	Map FL12	Map FL16
	1% AEP (CC)	Map FL13	Map FL17
	PMF	Map FL14	Map FL18
	PMF (CC)	Map FL15	Map FL19

2.3.1 Existing Conditions

Refer to the MA flood assessment for a full description of modelled existing site flood characteristics, which remain unchanged. The only additional results are for the PMF plus climate change scenario, which for the site north of the sand dune has a peak flood level of 2.73 mAHD, and flood depths typically ranging between 0.3-2.2 m and up to 4.3 m within the Anna Bay Main Drain.

2.3.2 Proposed Conditions

We note the following regarding modelled flood behaviour under proposed conditions:

1. There is no material change to proposed site flood characteristics compared to those previously documented in the MA PP flood assessment as a result of

updates to the proposed conditions flood model, other than areas where proposed fill pads, roads or stormwater basins have been removed or modified.

2. The proposed grading and stormwater design south of the sand dune removes trapped low points and reduces flood affectation on neighbouring properties.

3. All proposed lots and internal site roads remain flood free in all modelled events due to being located above Council's FPL (3.04 mAHD north of the sand dune, i.e. the 1% AEP with climate change level plus 0.5 m freeboard) and the PMF level (with and without climate change).

4. Outside of proposed residential and road areas, proposed flooding conditions are largely unchanged from existing conditions, and the proposed development does not materially alter local flood characteristics.

5. Importantly, north of the sand dune, high tailwater levels cause a 'bathtub effect' on site, associated with low flood velocities and negligible flood conveyance. Although the proposed development includes fill in flood affected areas, the placement of fill within the 'bathtub' does not materially displace floodwater or constrict the floodplain.

2.4 Proposed Condition Flood Impacts

Proposed condition water level and velocity impact maps are shown in Appendix B, with drawing references summarised in Table 1. The results in Appendix B supersede those previously provided in the MA PP flood assessment. We note the following regarding offsite flood impacts associated with the proposed development:

1. The proposed development has negligible offsite impacts on the floodplain environment in all modelled flood events and does not cause any lots to become flood affected.

2. There is no material change to flood levels as a result of the proposed development in all modelled flood events.

3. The proposed improvements to drainage of existing trapped low points south of the sand dune results in material offsite flood benefits in all modelled flood events up to and including the PMF.

4. The proposed development north of the dune reduces the flood affectation of the lots to the south west, resulting in flood levels and velocity benefits in a number of the modelled flood events.

5. Although the peak flood levels in the approved infiltration basin are slightly increased, there are no adverse flood impacts to the existing or approved lots, and the approved DA stormwater system has sufficient capacity to convey the additional flows from Catchments E and F, as well as the upstream areas captured by the PP stormwater design.

6. Velocity increases have been considered in the context of whether they will increase the risk of erosion and scour. Based on the *Soil Conservation Guidelines*

for Queensland (2015) erosion thresholds have been adopted as 1.2 m/s (erodible soils with 1% channel gradient and 50% vegetation cover) and 2.0 m/s (erodible soils with 1-2% channel gradient and 100% vegetation cover). For instance, a velocity increase from 0.2 m/s to 0.8 m/s is unlikely to materially increase the risk of erosion due to being below the above two thresholds. On the other hand, a velocity increase from 1.8 m/s to 2.1 m/s may materially increase the risk of erosion.

7. We note the following for velocity impacts:

    a. Velocity increases are largely less than 0.5 m/s in all modelled events and are contained within rural and bushland areas.

    b. There are no significant offsite velocity impacts as a result of the proposed development (less than 1.0 m/s increase). These impacts are considered acceptable given resulting peak velocities are predominately less than 1.2 m/s which is less than the adopted lower erosion threshold, hence the proposed development will not result in an increased erosion risk.

    c. Isolated increases in velocity (up to 1.5 m/s) occur within the north-south drainage channel in the centre of the site. This is the only location where velocity changes cause erosion thresholds to be exceeded in all modelled events. Testing has demonstrated that the velocity impacts in this location arise due to the overly conservative assumption of the constant flow through the approved flood mitigation culverts, as requested by Council (refer to Section 4). In reality there would likely be no material increase to flood velocities in this area. Regardless, if required, the velocities in this channel can likely be easily mitigated through modified channel grading, establishment of additional riparian vegetation and/or addition of scour protection where necessary. These measures should be designed at the DA stage if required.

8. These flood impacts are of immaterial significance and are considered acceptable.

2.5 Cumulative Flood Impacts

Cumulative water level and velocity impact maps arising from additional development within the floodplain are provided in Appendix B, with drawing references summarised in Table 1. We note the following regarding cumulative offsite flood impacts:

1. There is a negligible change to offsite flood levels resulting from cumulative development of the floodplain in all modelled flood events.

2. There is an area of water level increase within the southeast portion of the PP site north of the sand dune of up to 72 mm in the 1% AEP event, and < 20 mm in all other modelled flood events. These increases do not extend onto neighbouring properties or affect the FPL and so have no consequence. If necessary, as part of the potential future development of the adjacent site, these impacts likely can be easily mitigated through detailed stormwater drainage and grading design of the neighbouring potential future development.

3. Cumulative velocity impacts are predominantly located within and adjacent to flow paths and drainage channels and are minor (less than 0.5 m/s increase) and do not exceed the adopted lower erosion threshold.

4. There is an isolated area of velocity impact where erosion thresholds are exceeded within the Anna Bay Main Drain to the east of the potential fill pads in the PMF with and without climate change events (up to 1.2 m/s increase). These are minor and can likely be easily mitigated through detailed grading design, riparian zone rehabilitation and/or scour protection as part of future development applications.

5. Regardless of the above, as the cumulative development scenario is conservative, these flood impacts are considered acceptable, and demonstrate that the proposed site PP does not adversely affect the local floodplain development potential.

2.6 Site Floodway Definition

2.6.1 Overview

Council's SPAR comments state that the proposed development proposes fill within defined floodway areas.

To determine the floodway extents at the site, MA have assessed the site against the following pertinent floodway definitions:

1. The Jacobs Flood Study definition (hereafter referred to as **Definition 'A'**).

2. The BMT WBM *Williamtown – Salt Ash Floodplain Risk Management Study & Plan* report (2017, the **BMT Flood Study**) definition (hereafter referred to as **Definition 'B'**), which was prepared for the catchment immediately west of the Jacobs Flood Study.

3. The Department of Planning and Environment (**DPE**) *Flood Function: Flood Risk Management Guideline FB02* (2023, the **Flood Function Guideline**) definition (hereafter referred to as **Definition 'C'**).

4. The definition provided in Council's flood certificate information.

2.6.2 Definition 'A'

We note the following regarding Definition 'A':

1. Hydraulic categorisation maps are provided at Figure H-2 of the Jacobs Flood Study.

2. MA have reproduced the hydraulic categories map from the Jacobs Flood Study at Appendix B Map FL01, and have added a 'Manmade Channels' definition.

3. Based on Definition 'A' the only site floodway is the Anna Bay Main Drain. The majority of the remaining site areas are low hazard flood storage and low hazard flood fringe, with some areas of high hazard flood storage.

4. As demonstrated in Appendix B Map FL01, the proposed development footprint is outside floodway areas, and therefore no development is proposed within an existing floodway.

2.6.3 Definition 'B'

We note the following regarding Definition 'B':

1. Hydraulic category definitions are provided at Table 4-8 of the BMT WBM Flood Study.

2. MA have applied these definitions to the existing 1% AEP hydraulic model results north and south of the sand dune, as demonstrated in Appendix B Map FL02.

3. As demonstrated in Appendix B Map FL02, floodway areas within the site are limited to the Anna Bay Main Drain extents, and no development is proposed within an existing floodway area. The majority of the site is flood fringe with some areas of flood storage.

2.6.4 Definition 'C'

We note the following regarding Definition 'C':

1. MA analysed the hydraulic model results to determine the floodway extents at the site in accordance with the encroachment technique outlined in the Flood Function Guideline.

2. In accordance with the Flood Function Guideline, MA iterated the 'encroachment fill pad extents' over the site, maximising and iterating the extents until there were adverse offsite flood impacts.

3. The assessment was undertaken for the existing 1% AEP hydraulic model results within the site boundary north of the sand dune.

4. Refer to Appendix B Map FL03 for the hydraulic categories map adopting Definition 'C'.

5. The floodway extents were determined to be within the Anna Bay Main Drain area. Any encroachment into this area produced adverse offsite flood impacts, however, fill up to the edge of the Anna Bay Main Drain caused acceptable offsite flood impacts.

6. As demonstrated in Appendix B Map FL03, no development is proposed within an existing floodway.

7. The remainder of the site was mapped as flood fringe or flood storage consistent with Definition 'B'.

2.6.5 Council's Flood Certificate Definition

We note the following regarding Council's flood certificate information:

1. Council's flood certificates provide hydraulic categorisation mapping which indicate areas of the site classified as floodway, flood storage and flood fringe.
2. Based on Council's mapping, part of the proposed development footprint at the southwestern site boundary is within an area defined as 'High Hazard Floodway'.
3. However, although Council states that their mapping is derived from the Jacobs Flood Study, comparison of the hydraulic categorisation maps to Jacobs' mapping (Appendix B Map FL01) demonstrate that they are inconsistent.
4. As such, Council have incorrectly stated that their flood information was sourced from the Jacobs Flood Study, and provide no indication of how their floodway definition was actually derived.
5. Council's floodway definition therefore cannot be replicated or assessed based on the detailed MA site specific modelling, and should not be used to determine the site floodway extents.

2.6.6 Summary

In summary:

1. The proposed development footprint is outside the existing floodway extents adopting historically applied methodologies for hydraulic categorisation under definitions 'A', 'B' and 'C'.
2. We conclude that the proposed development does not encroach on the existing floodway extents, and therefore the PP does not 'permit development in floodway areas', consistent with Ministerial Direction 4.1 'Flooding' (2023, the **Directions**) control 3(a).

3 Flood Risk to Life

North of the sand dune, the site is primarily affected by long duration, large scale flooding from the Tilligerry Creek catchment. All habitable areas and roads of the proposed development have been raised to the FPL, which is above the PMF (with and without climate change) level, and therefore residential dwellings and interconnecting roads will not be affected by flooding.

South of the sand dune, the site is also affected by long duration flooding from the local catchment, caused by an increase in the groundwater levels rising above the ground surface. Similar to the development north of the sand dune, all habitable areas have have been raised to the FPL and also flood immunity up to and including the peak PMF level.

All proposed lots north and south of the sand dune can access Gan Gan Road via the two proposed roads over the sand dune. The flood mitigation culverts approved as part of the site DA render Gan Gan Road and Old Main Road flood free up to and including the 1% AEP with climate change event, and at worst these roads are affected by low flood hazards (H1 – generally safe for people vehicles and buildings) in the PMF event. Anna Bay Public School is flood free up to and including the worst case Jacobs Flood Study PMF event. Therefore site occupants from both sides of the sand dune can safely evacuate to Anna Bay Public School in all flood events up to and including the PMF with climate change.

The following preliminary comments are provided to mitigate risks associated with flooding:

1. Evacuation will be the preferred emergency response strategy over shelter-in-place (**SIP**), however, safe SIP is available above the PMF with climate change level for all proposed lots as a measure of last resort.

2. All lots are capable of evacuation up to and including the PMF with climate change event, and site access to Gan Gan Road will not be cutoff by flooding in all events up to and including the PMF with climate change.

3. Flood free egress along internal site access roads is available for both pedestrians and vehicles, and evacuation can occur in all stages of a flood event up to and including the PMF event with climate change.

4. Access to Anna Bay Primary School is available via Gan Gan Road and Old Main Road in all flood events up to and including the PMF with climate change, and hence evacuation to Anna Bay Primary School is available up to and including the PMF with climate change.

5. The site does not rely on Old Frost Road for flood evacuation.

6. Residents should be aware of weather forecasts and warnings by subscribing to NSW State Emergency Service (**SES**), BOM, Early Warning Network and other relevant warning systems.

4 Response to Council Comments

Table 2 provides an itemised response to the SPAR flood engineering related comments provided by Council dated 4 April 2025.

Table 2: MA response to engineering comments by Council (4 April 2025).

#	Council Comment	MA Response
1	**Development Engineering**	
1a	*The proposal is inconsistent with Ministerial Direction 4.1 Flooding requirements relating to the placement of significant fill within an area of heavily flood prone land.*	• There is no requirement in the Directions which prohibits the placement of fill within flood prone land. • Flood modelling demonstrates that the proposed fill does not cause any adverse offsite flood impacts. • Further, the cumulative flood impact assessment demonstrates that fill associated with potential future development also does not cause any adverse offsite flood impacts. • As discussed at Section 2.6, no filling is proposed in any areas classified as floodway. • No filling is proposed in ARR hazard H5 or H6 areas up to and including the PMF event. • Floodplain filling is commonly undertaken to enable development of flood prone land. PPs where large volumes of fill were approved to enable development on flood prone land include for example: o The Lowes Creek Maryland Precinct Flood affected areas zoned for residential or commercial use were filled to an elevation above the 1% AEP flood level plus 500 mm freeboard. The PP proposes raising residential areas above the FPL of the 1% AEP flood level plus climate change plus 500 mm freeboard, and is therefore safer than the approved Lowes Creek Maryland Precinct. o Aerodrome Drive, Schofields Bulk earthworks were proposed to raise residential land above the local 1 in 500 AEP flood level, though a significant portion of residential land would be inundated by floodwaters 2.0-5.0 m deep in the PMF. The PP proposes raising residential areas above the PMF plus climate change level, and is therefore safer than the approved Aerodrome Drive development.
1b	*There is residual risk associated with the design by the fact that it relies on significant fill and topographical alterations to realise the potential development.*	• As discussed at Section 1.4, the updated civil engineering design significantly reduces the overall-cut fill balance by 236,000 m³ or 20% from the previous proposal. • The filling ensures that all residential areas, including access roads, will be above the PMF plus climate change level such that there is no residual flood risk. This is a highly desirable planning outcome and

#	Council Comment	MA Response
		ensures long-term flood risk management within the precinct, and that the site can be evacuated (should that ever be required) without being impacted by flood water. • The site is located in a very large flood storage basin. The quantity of filling is very small compared to the existing available flood storage. • Detailed flood modelling confirms that the placement of fill as proposed for the PP does not impact on flood function or behaviour, and does not cause any detrimental on-site, off-site or cumulative flood impacts. This is not an unexpected outcome given the large flood storage available.
1c	*The proposal widens a section of Anna Bay Main Drain, creating a pinch point downstream of the development which is not supported.*	• As demonstrated in Appendix A, widening of the Anna Bay Main Drain is significantly reduced compared to the previous proposal. • The widening downstream of the development is no longer proposed and there is no longer a 'pinch point' at this location. • In the eastern portion of the site the Anna Bay Main Drain has been widened to increase local flood storage and conveyance, this improving flows through the residual portions of the downstream main drain. • Detailed flood modelling has demonstrated that the 'pinch point' does not cause offsite flood impacts (Appendix B). Further, the 'pinch point' is not created but represents the existing channel form.
1d	*These risks include potential cumulative impacts for properties in the vicinity and in the catchment.*	• As discussed at Section 2.2.3, MA assessed cumulative flood impacts by simulating a potential future development scenario. • As discussed at Section 2.5, cumulative flood level and velocity impacts resulting from the potential future development are immaterial and are considered acceptable.
1e	*The proposal is inconsistent with Ministerial Direction 4.2 Coastal Management. The Direction does not support rezoning which would enable increased development or more intensive land use on land within a coastal vulnerability area (CVA) identified by State Environmental Planning Policy (Resilience and Hazards) 2021.* *The introduction of the CVA mapping for the site is forthcoming with the finalisation Coastal Risk Planning Clause Planning Proposal (PP-2023-2568) adopted by Council on 25 June 2024 and currently awaiting gazettal at the time of writing.* *The CVA will include land mapped as subject to coastal inundation and tidal*	• MA do not have access to the CVA mapping, and therefore the areas of the site which are subject to coastal inundation is unknown. • Notwithstanding the above, we note that the PP site is located on land several kilometres from the coast, that would be filled to above the PMF and would not be affected by coastal recession in the event of sea level rise.

#	Council Comment	MA Response
	inundation by the Port Stephens Coastal Risk Management Program (CMP) that applies to the site.	
1f	*There are concerns that access to the site via Frost Road would require significant upgrades. The road reserve of Frost Road is constrained and it may not be possible to provide sufficient road widening to allow for construction of an auxiliary lane to Saltbush Avenue as proposed.* *Significant upgrades would be required to manage the safety risk of traffic attempting to turn out of Frost Road onto Nelson Bay Road.*	• Design of the access road to the site via Frost Road is a matter for the detailed design stage. • The proposed development proposes two alternative access roads to the site via Gan Gan Road, which is not expected to require significant upgrades under the PP.
2	**Section B – Relationship to strategic planning framework**	
2a	*The site is mapped as flood prone (primarily high hazard flood storage) with overland flow paths and defined floodways on site. The site is additionally mapped as subject to coastal inundation and tidal inundation in the CMP.* *The proposal seeks to overcome these constraints by filling the land. This would involving importing extensive fill (which has not been quantified) to make roads and residential land flood free. This intended approach is inconsistent with the HRP and presents significant risk, should the proposed solutions be unable to be implemented following rezoning.*	• Refer to responses to 1(a)-(d). • The site is not 'primarily high hazard flood storage'. Rather as discussed in Section 2.6 and shown in Appendix B Maps Map FL01, Map FL02 and Map FL03, the site is primarily low hazard flood storage or flood fringe, and the only floodway is the Anna Bay Main Drain (which is not proposed to be residential). • As discussed at Section 1.4, the updated proposed earthworks volumes have a cut-fill balance of approximately 934,000 m³, which represents a significant 20% reduction from the previous proposal. • The PP presents no flood risk to people and property, and is therefore consistent with the Hunter Regional Plan (**HRP**) 2041.
2b	*The NSW natural hazard management and risk management framework does not encourage the rezoning of land for residential development in areas subject to flooding and coastal risk.*	• Refer to responses to 1(a)-(d). • Flood prone land is routinely developed and rezoned in NSW.
2c	*The proposal is inconsistent with this strategy* [7.8] *because it seeks to create a future residential area of more than 500 dwellings where residents will be exposed to bushfire, flood and coastal hazards. The proposal seeks to overcome this constraint by seeking to fill the land. This approach does not resolve the objective of the HRP and the aim to avoid placing residents in locations of known risk.*	• Refer to responses to 1(a)-(d). • Residents will not be exposed to flood hazards. • The PP site's location and proposed filling will ensure that coastal hazards are avoided. This is a common response to managing coastal hazards.
2d	*In considering the proposal, the SES provided preliminary comment during the scoping process that the proposal is on a high-risk floodplain. In its comments, the SES:*	• Refer to responses to 1(a)-(d). • No residents will be exposed to flood risks at the site because all roads and dwellings will be above the PMF with climate change. • There will be no impact on SES resourcing.

#	Council Comment	MA Response
	• *recommended not proceeding with the planning proposal as this would increase the number and exposure of residents to flood risk due to significant flooding constraints*	• No increases in government spending on emergency management services will be incurred. • There will be no change to SES flood operations because future residents can safely leave the site at all times up to and including the peak of the PMF plus climate change.
2e	• *commented the proposal is likely to result in significant increased requirements for government spending on emergency management services, flood mitigation and emergency response measures*	• Refer to response to 2(d).
2f	• *commented the proposed development would further increase the complexity of flood operations for the LGA, and directly transfer the risk to SES for warning, evacuation, and potentially rescue.*	• Refer to response to 2(d).
2g	*The proposal is inconsistent with the Greenfield Housing Criteria because it seeks to rezone land that has the potential to be isolated in flood events. The proposal does not demonstrate compliance with the Flood Risk*	• Refer to response to 2(d). • Residential areas will not be isolated by floodwaters in all events up to and including the PMF with climate change. Safe evacuation to Gan Gan Road, Old Main Road and Anna Bay Public School is available.
3	**Focus area 4: Resilience and Hazards** 4.1 Flooding	
3a	*The proposal is inconsistent with this Direction because it seeks to rezone approximately 50 hectares of land within a high hazard flood storage area for residential use.*	• Refer to responses to 1(a)-(d).
3b	*The proposal requires the placement of significant fill within flood prone land, which is largely defined as high hazard flood storage area with overland flow paths and defined floodways.* *The volume of fill required to make the site suitable for residential use is not quantified in the proposal. However supporting studies indicate filling of up to approximately 2 - 3m above existing ground level within proposed lots and roadways would be required to make the site suitable or residential use.* *The potential volume of fill and extensive works required to make the land flood free is not considered as being of minor significance to justify the inconsistencies of the proposal against the requirements of the Direction.*	• Refer to responses to 1(a)-(d) and 2(a).

#	Council Comment	MA Response
3c	*The proposal submits that although the existing site is within the flood planning area, the Flood Assessment (Martens, 2024) demonstrates that the proposed earthworks can raise residential land and access above the above the flood planning level (FPL) and probable maximum flood (PMF) level. The proposal submits that, once the fill is imported and the landform established, the future development will be flood free with minor impact. This intended approach is inconsistent with the requirements of the Direction, which provides that a proposal must not rezone land within the FPA to a residential zone, permit development for the purposes of residential development in high hazard areas, or permit a significant increase in the development and or dwelling density of that land.*	• Refer to responses to 1(a)-(d). • Direction 4.1 does not require an assessment based on the existing landform. If that were the case, there would be no future development of flood prone land, effectively sterilising such land. This is contrary to the NSW Floodplain Development Policy which recognises that flood prone land is a valuable resource and that its development should be undertaken using a merit-based approach taking into account social, economic and ecological factors, as well as flooding considerations.
3d	*The placement of significant fill, combined with the lack of cumulative impact assessment within the catchment, as well as the extensive scale of the proposal within the flood planning area, is in excess of what could reasonably be considered to be of minor inconsistency to justify the proposal against the requirements of this Direction.*	• Refer to responses to 1(a)-(d) and 2(a).
5	**Supporting plans and studies** Flood Assessment (Martens, 2024)	
5a	*The proposal adopts the position that, once the fill is imported and the new landform is established, the future development provisions are consistent with Ministerial Direction 4.1 Flooding. However, the extent of filling required is not considered to be of minor significance. It is further understood that the State government assesses consistency with the Direction based on current landform, further highlighting the difficulty in seeking to rezone the site for residential use.*	• Refer to responses to 1(a)-(d) and 3(c).
5b	*The submitted Flood Assessment demonstrates negligible impacts of the fill as a result of the proposed development. It is, however, likely that there is a threshold for the amount of fill that can be brought into the catchment before it makes a material impact on the floodplain due to the loss of flood storage areas. Consideration is not given to the cumulative impacts of the proposal to ensure filling is appropriate in this*	• Refer to response to 1(d).

#	Council Comment	MA Response
	catchment. Additionally, the area is not identified in strategic land use plans (HRP, LHS, HSP, Anna Bay Strategy) to support cumulative filling.	
6	**Conceptual Stormwater Management Strategy (Martens, 2024)**	
6a	*Assessment has identified the following stormwater concerns:* • *It is proposed to drain Catchment F to the existing basin at the intersection of Gan Gan Road and Essington Way. This basin has limited capacity to accept additional flow with known ponding issues in the area during recent storm events. It is recommended runoff be directed elsewhere where practical. Alternatively, a full hydraulic assessment of the basin would need to be carried out to ensure there is sufficient capacity to handle additional flows during the full range of storm events.*	• As discussed at Section 1.4, stormwater drainage of Catchments E and F have been modified and now flows from both are conveyed to the approved DA infiltration basin, before flowing through the approved flood mitigation culverts. • The flood model represents a full hydraulic assessment of the approved DA stormwater system under proposed conditions, and demonstrates there is sufficient capacity to accommodate the additional flows from Catchments E and F without causing adverse flood impacts. • As discussed at Section 1.4: ○ The design of Catchments E and F enable drainage of existing trapped low points on adjacent properties, significantly reducing nuisance drainage issues and peak flood levels on these properties. ○ The Catchment E and F civil design reduces flood levels and hazards on Gan Gan Road and Old Main Road, improving evacuation capability. • As discussed at Section 2.4, the proposed design south of the sand dune has an overall offsite flood benefit in all modelled flood events.
6b	• *Catchment E hydraulic assessment is required to ensure sufficient capacity in existing DA stormwater management system to handle any additional flows being redirected.*	• Refer to response to 6(a).
6c	• *The proposal appears to widen a section of Anna Bay Main drain creating a pinch point downstream of the development. This is not supported as it will create flow capacity issues at the pinch point.*	• Refer to response to 1(c).
6d	*The following observations were made on the submitted model that would need to be addressed during detailed design:* • *Model boundaries should extend to the outlet to confirm downstream properties are unaffected*	• As demonstrated in the flood impact maps (Appendix B), there are no material offsite impacts downstream of the proposed development, and therefore there is no need to extend the hydraulic model boundary further downstream.
6e	• *Water level differences have been provided however velocity difference mapping has been excluded. Velocity*	• Velocity difference mapping for the 1% AEP (with and without climate change) and PMF (with and without climate change) events is provided at Appendix B. All

#	Council Comment	MA Response
	mapping would need to demonstrate negligible impacts on neighbouring and downstream properties for a range of events including sensitivity scenarios for low and high tail water events	modelled events have been simulated with low and high tailwater levels. • As discussed at Section 2.4, the proposed development causes negligible offsite velocity impacts in all modelled events, and is therefore considered acceptable.
6f	• *Tailwater levels should be consistent for the entire duration as opposed to coincident and peak*	• MA have adopted a constant tailwater level at the Tilligerry Creek entrance.
6g	• *Peak flows through the culverts have been obtained from MA 2024 report. These should be modelled as constant inflow to ensure peak is captured*	• Although this is considered unnecessarily conservative, the updated flood model north of the sand dune has adopted a constant flow through the approved flood mitigation culverts.
6h	• *The Clark St catchment should not be included in the "existing case" as it is not developed yet*	• Given the DA at the Clark Street catchment has been approved, it is reasonable to assume the development is constructed and operational by the time the PP is approved, hence it is appropriate for inclusion in existing conditions. • Inclusion of the Clark Street catchment is the existing case is conservative because: o It marginally increases flows to the site north of the sand dune. o The approved flood mitigation culverts significantly reduce flood affectation south of the dune, as detailed in the MA DA supplementary flood assessment. If the DA were not included in the existing case, and instead the approved flood mitigation culverts were only represented in the proposed case, the flood benefits south of the dune would be even better than those shown as part of this assessment (Appendix B). o Inclusion of the approved flood mitigation culverts only considers the flood impacts of the PP, which as detailed at Section 2.4, shows further benefits to adjacent properties over and above the improvements from the approved stormwater system.
6i	• *Confirm PMF event has considered climate change (i.e. 2100 event)*	• As discussed at Section 2.2, the flood model has been updated to consider the PMF with climate change event.
6j	• *Confirm 2D swales are captured by the 5m grid resolution.*	• MA adopted sub-grid sampling (**SGS**) which sampled ground surface levels every 1 m, and therefore enables 2D swales to be captured by the TUFLOW model grid.

5 Conclusion

The MA PP and DA flood assessment TUFLOW models were updated to undertake detailed hydraulic modelling of the site based on changes to the proposed development in respect of Council's flood related comments in their SPAR. The models were used to assess the potential flood impacts associated with the proposed development, and cumulative impacts associated with additional development of the floodplain for the 1% AEP flood and PMF events (with and without climate change).

Assessment concluded that:

1. Outside of proposed residential and road areas, proposed flooding conditions are largely unchanged from existing conditions, and the proposed development does not materially alter local flood characteristics.
2. Proposed flood conditions are largely unchanged from the MA PP flood assessment apart from where proposed fill pads have been removed.
3. The proposed development area including site roads are flood free in the 1% AEP flood and PMF events (with and without climate change).
4. The proposed development elements are above the FPL and PMF with climate change levels.
5. The proposed development would have acceptable offsite flood impacts.
6. The cumulative flood impacts are considered acceptable, and demonstrate that the proposed site PP does not adversely affect the local floodplain development potential.
7. The proposed development is compatible with the existing floodplain environment.
8. No development will occur within any floodway.
9. Safe evacuation is available to Anna Bay Public School in all flood events up to and including the PMF with climate change.
10. SIP is available on the site as a measure of last resort in all events up to and including the PMF with climate change.
11. Council's flood related comments are effectively addressed.

6 References

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

BMT (2021), *Port Stephens Coastal Management Program – Stage 2*.

BMT WBM (2015), *Williamtown – Salt Ash Floodplain Risk Management Study & Plan*.

Jacobs (2017), *Anna Bay and Tilligerry Creek Flood Study*.

Martens and Associates (September 2023) *Flood Assessment: Proposed Residential Subdivision at 263, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW* (P2208888JR02V01).

Martens and Associates (October 2024) *Engineering Memorandum: Proposed Torrens Title Subdivision at 263, 273, 293 and 321 Gan Gan Road, Anna Bay, NSW* (P2208888JR15V03).

Martens and Associates (December 2024a), *Flood Assessment: Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW* (P2208888JR14V01).

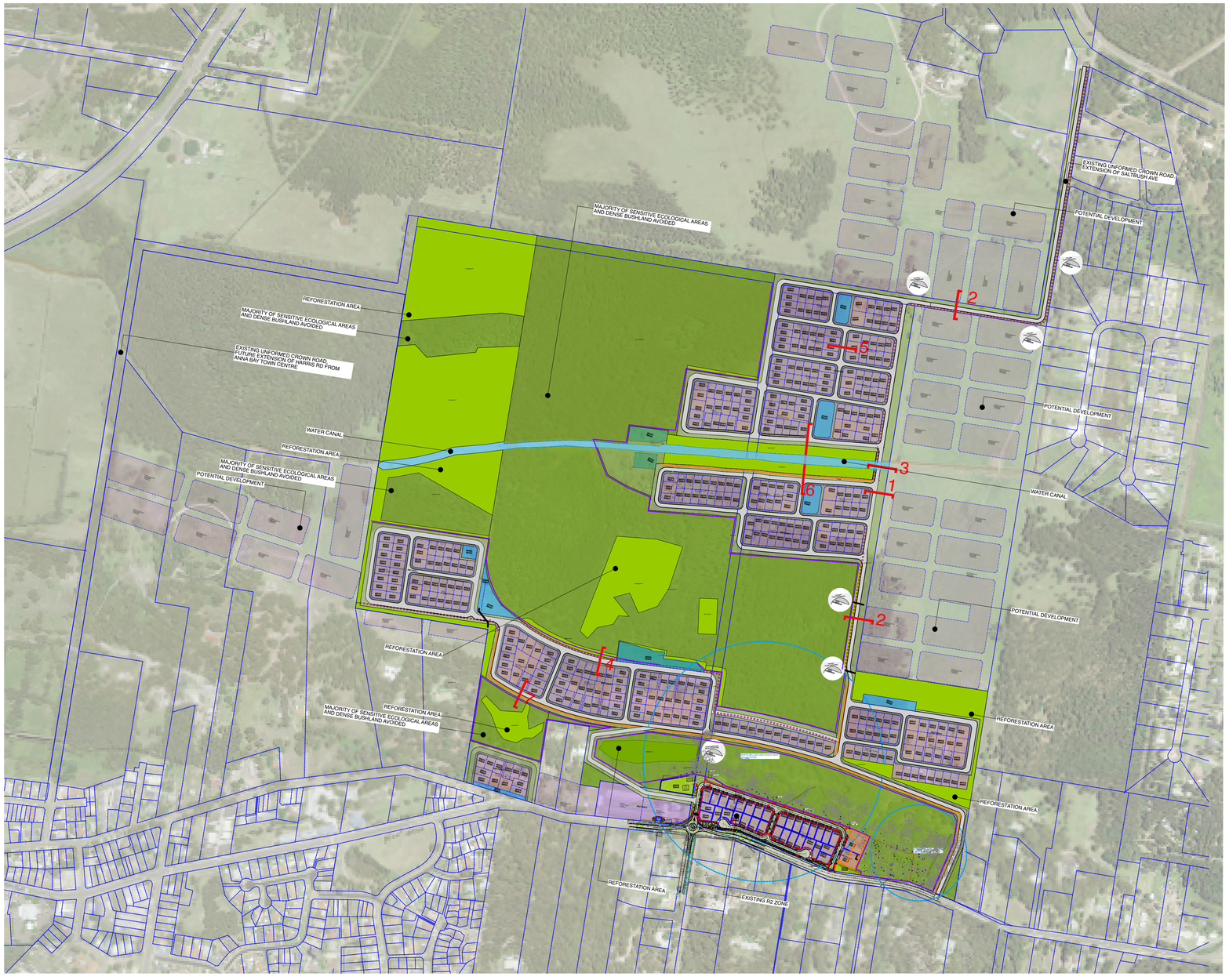
Martens and Associates (December 2024b), *Conceptual Stormwater Management Strategy: Planning Proposal at 196 Old Main Road; 263, 269, 271, 273, 293 & 321 Gan Gan Road, Anna Bay, NSW* (P2208888JR16V01).

NSW Department of Planning and Environment (2023), *Flood Risk Management Manual*.

NSW Department of Planning and Environment (2023) *Flood Function: Flood Risk Management Guideline FB02.*

Queensland Government (2015), *Soil Conservation Guidelines for Queensland*.

Appendix A – Proposed Masterplan



1 Proposed Masterplan
1:5000

BKA Architecture
22011 Gan Gan Rd, Anna Bay

Calculations

Site Area **Gan Gan Rd** **1,186,830 m2** **approx**

Stage	Section	Residential Area m2	Standard Blocks # 500m2 16.7m x 30m R2	Dual Occupation # 600m2 20m x 30m R2	Dwellings # R2
Stage 1	A	8,138	16		16
	B	8,153	16		16
	C	2,854	2	0	2
Stage 2	EA	6,337			25
	EB	4,328			25
	FA	7,422	10	2	14
Stage 3	GA	6,385	10	2	14
	GB	7,944	12	3	18
	GC	11,270	8	10	28
Stage 4	HA	8,083	16		16
	HB	5,724	10	1	12
	HC	8,097	8	2	12
	HD	5,743	10	1	12
	HE	9,766	18	1	20
Stage 5	IA	12,127	18	3	24
	IB	7,957	14	1	16
	IC	9,783	8	4	16
	ID	5,728	10	1	12
	IE	5,728	10	1	12
	IF	7,728	8	2	12
	IG	6,068	12		12
	IH	8,073	16		16
	IJ	8,071	16		16
Stage 6	NA	7,212	12	1	14
Stage 7	MA	11,622	12	7	26
	MB	15,050	24	3	30
	MC	15,858	16	11	38
Stage 8	LA	8,071	16		16
	LB	7,644	14	1	16
	LC	7,712	14	1	16
TOTAL		**225,530.66**	**322**	**58**	**488**

TOTAL Dwellings	**488**	
TOTAL Lots	**380**	plus 2 Multi Dwelling Housing Lots
NOTE: Excludes current R2 zoning (DA)		

General Notes

DO NOT SCALE FROM DRAWING. USE FIGURED DIMENSIONS ONLY. CHECK ALL DIMENSIONS ON SITE BEFORE ANY MANUFACTURE OR CONSTRUCTION

All dimensions are in millimetres unless stated otherwise.
All architectural, drawings are to be read in conjunction with the relevant consultant documents. All dimensions and levels are to be checked and verified on site prior to the commencement of work, shop drawings or fabrication of any components. Refer all discrepancies to the Architect for determination. Drawings are not to be scaled, use only figured dimensions. This drawing is copyright and must not be retained, copied or used without the permission of BKA Architecture. This document has been prepared for and on behalf of the clients noted on the drawing, BKA Architecture's responsibility is to these clients only and not to any third party who may rely on these documents.
Nominated Architects (NSW) - John Baker 3552, John Kavanagh 5999

Rev	Date	Issue
A	4/3/2024	Preliminary Issue to Council
B	22/3/2024	Issue for Scoping Report
C	3/12/2024	Issue for Planning Proposal

Client
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Scale at A1 1:5000
North
Project Address Gan Gan Road, Anna Bay
Date 3/12/2024
Drawn VK, JG
Checked JG
Status Not for Construction

Drawing
Proposed Masterplan and Yield

Project No. **22011**
Revision **C**
Drawing No. **A100**

Appendix B – Flood Maps

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Development Footprint

Definition 'A' Hydraulic Categories

- High Hazard Floodway
- High Hazard Flood Storage
- High Hazard Flood Fringe
- Low Hazard Floodway
- Low Hazard Flood Storage
- Low Hazard Flood Fringe
- Manmade Channels

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmap (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Definition 'A' extracted from the 'Provisional Flood Hazard and Hydraulic Categories' map (Figure H-2) from the Jacobs Flood Study (2017), and MA have added a 'Manmade Channels' definition.

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Map Title / Figure:

Existing Condition
Hydraulic Categories – Definition 'A'

FL01	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Development Footprint

Definition 'B' Hydraulic Categories

- Flood Fringe
- Flood Storage
- Floodway

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

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Viewport A

Notes:
- Aerial from Nearmap (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Definition 'B' derived from Table 4-8 of the BMT WBM Flood Study (2017) and applied to the 1% AEP enveloped results.
- Floodway is defined as areas where the VD product (Velocity x Depth) > 0.3 m²/s.
- Flood storage is defined as areas where the VD product < 0.3 m²/s and peak depth > 0.5 m.
- Flood fringe is defined as areas where the VD product < 0.3 m²/s and peak depth < 0.5 m.

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Map Title / Figure:

Existing Condition
Hydraulic Categories – Definition 'B'

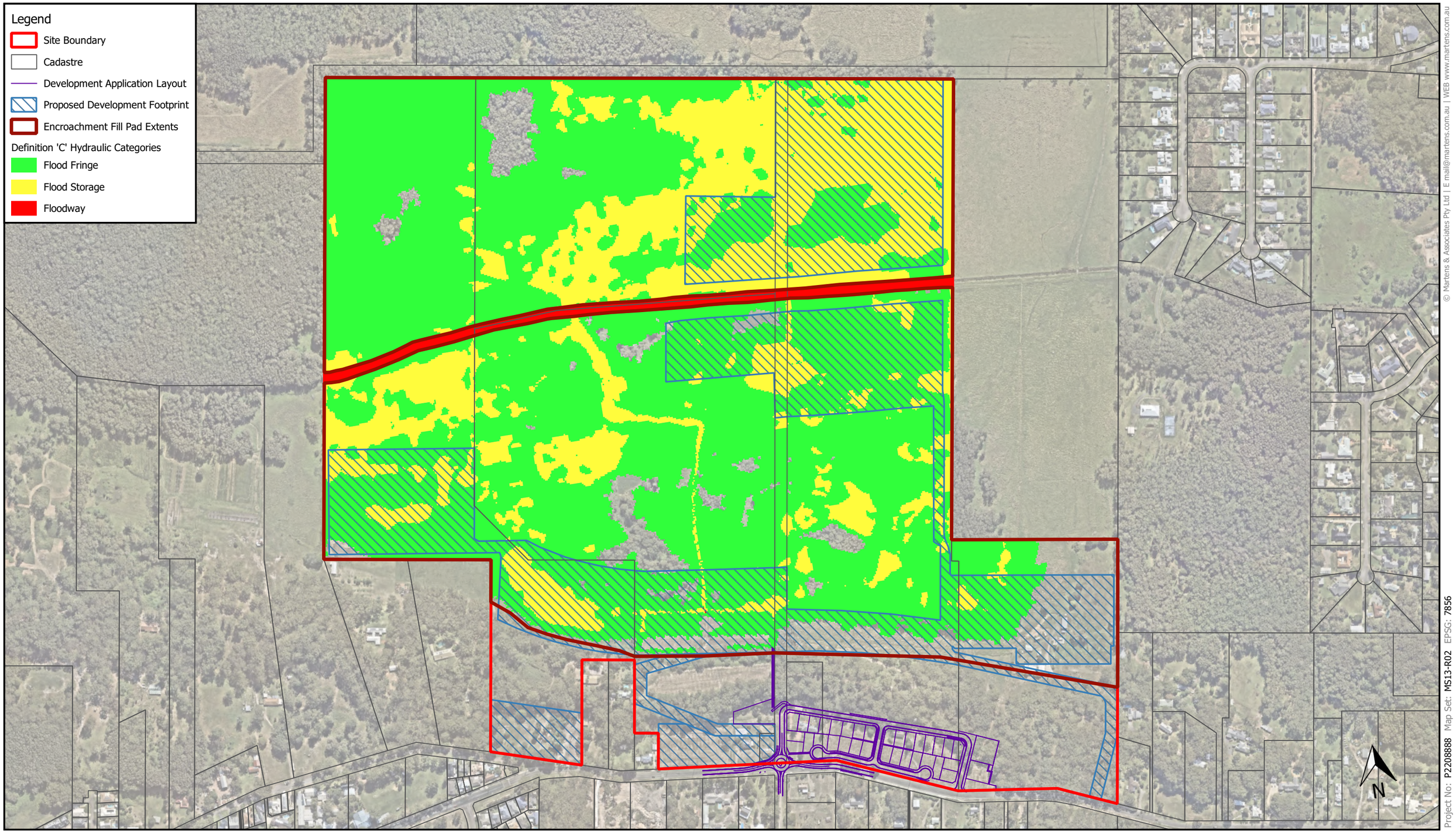
FL02	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Development Footprint
- Encroachment Fill Pad Extents

Definition 'C' Hydraulic Categories

- Flood Fringe
- Flood Storage
- Floodway



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Viewport A

Notes:
- Aerial from Nearmap (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Definition 'C' based on the encroachment technique outlined in the Flood Function Guideline (2023) and applied to the 1% AEP enveloped results.
- Floodway defined by iterating the encroachment fill pad extents until acceptable limit of impact observed.
- Flood storage is defined as areas where the VD product < 0.3 m²/s and peak depth > 0.5 m.
- Flood fringe is defined as areas where the VD product < 0.3 m²/s and peak depth < 0.5 m.

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Map Title / Figure:

Existing Condition
Hydraulic Categories – Definition 'C'

FL03	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

1% AEP Enveloped Results – Proposed Condition Water Level Impact

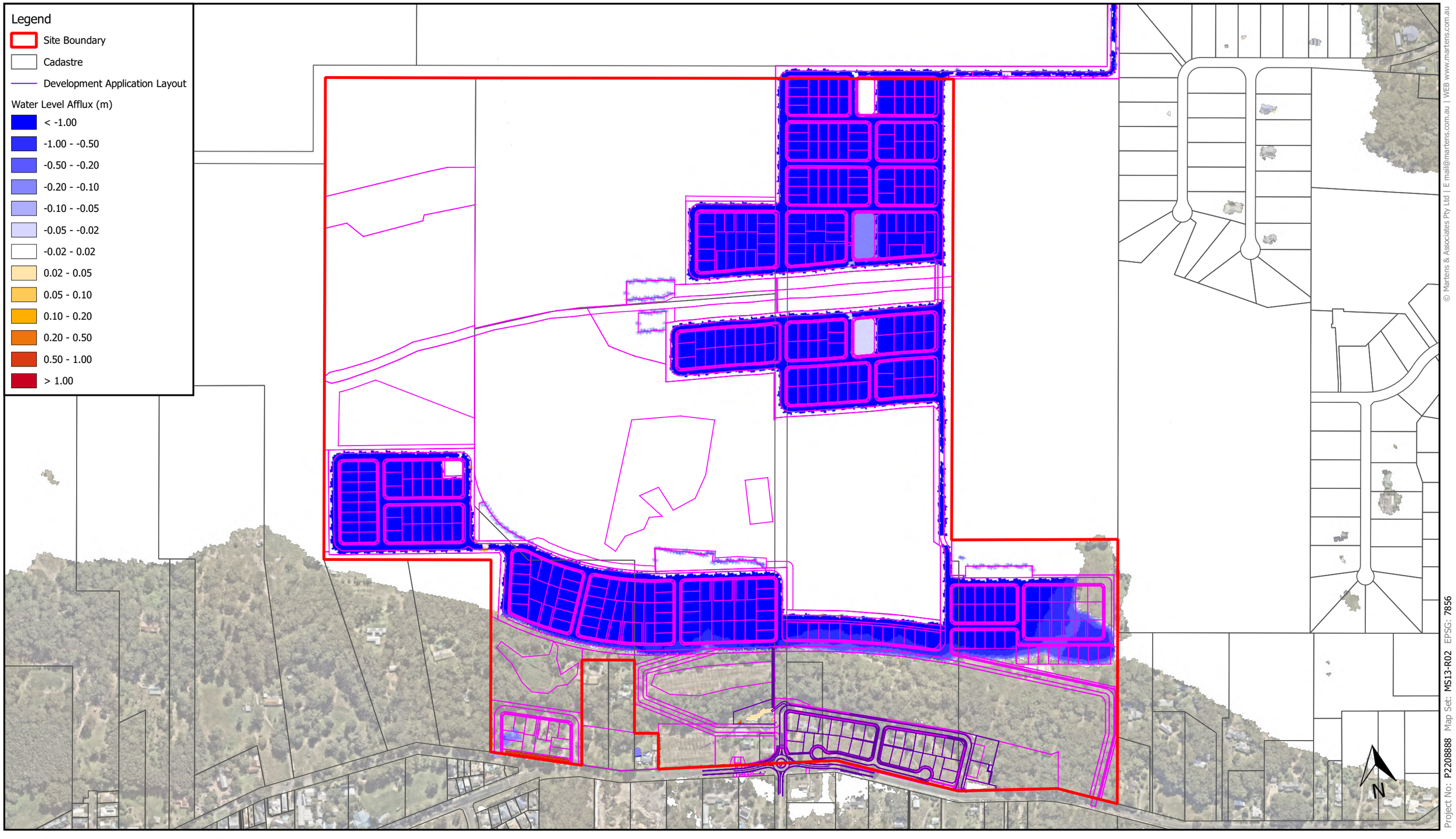
FL04	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

1% AEP Climate Change Enveloped Results – Proposed Condition Water Level Impact

FL05	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

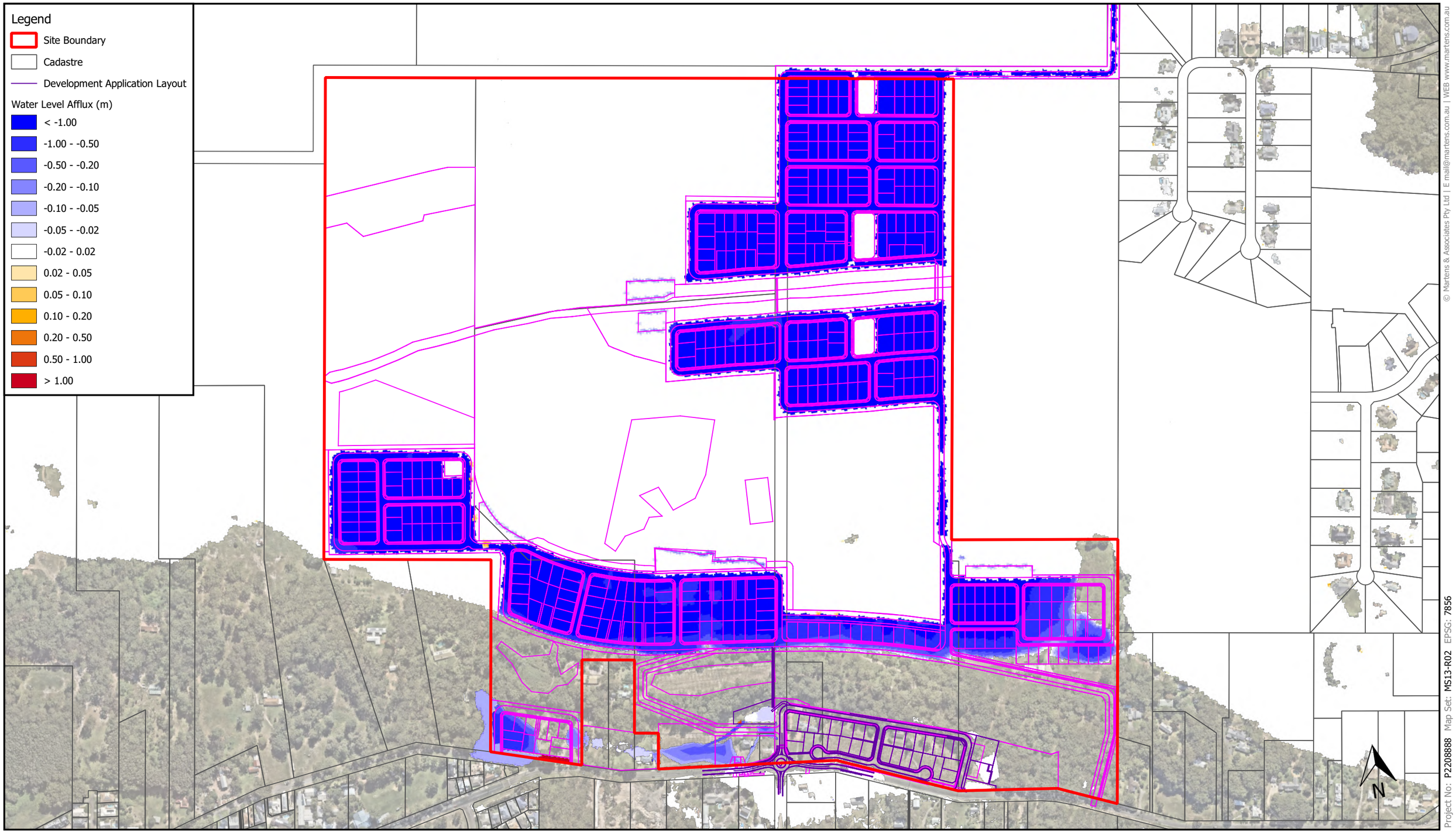
Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00



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Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

PMF Enveloped Results – Proposed Condition Water Level Impact

FL06	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

PMF Climate Change Enveloped Results – Proposed Condition Water Level Impact

FL07	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

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Map Title / Figure:

1% AEP Enveloped Results – Proposed Condition Water Velocity Impact

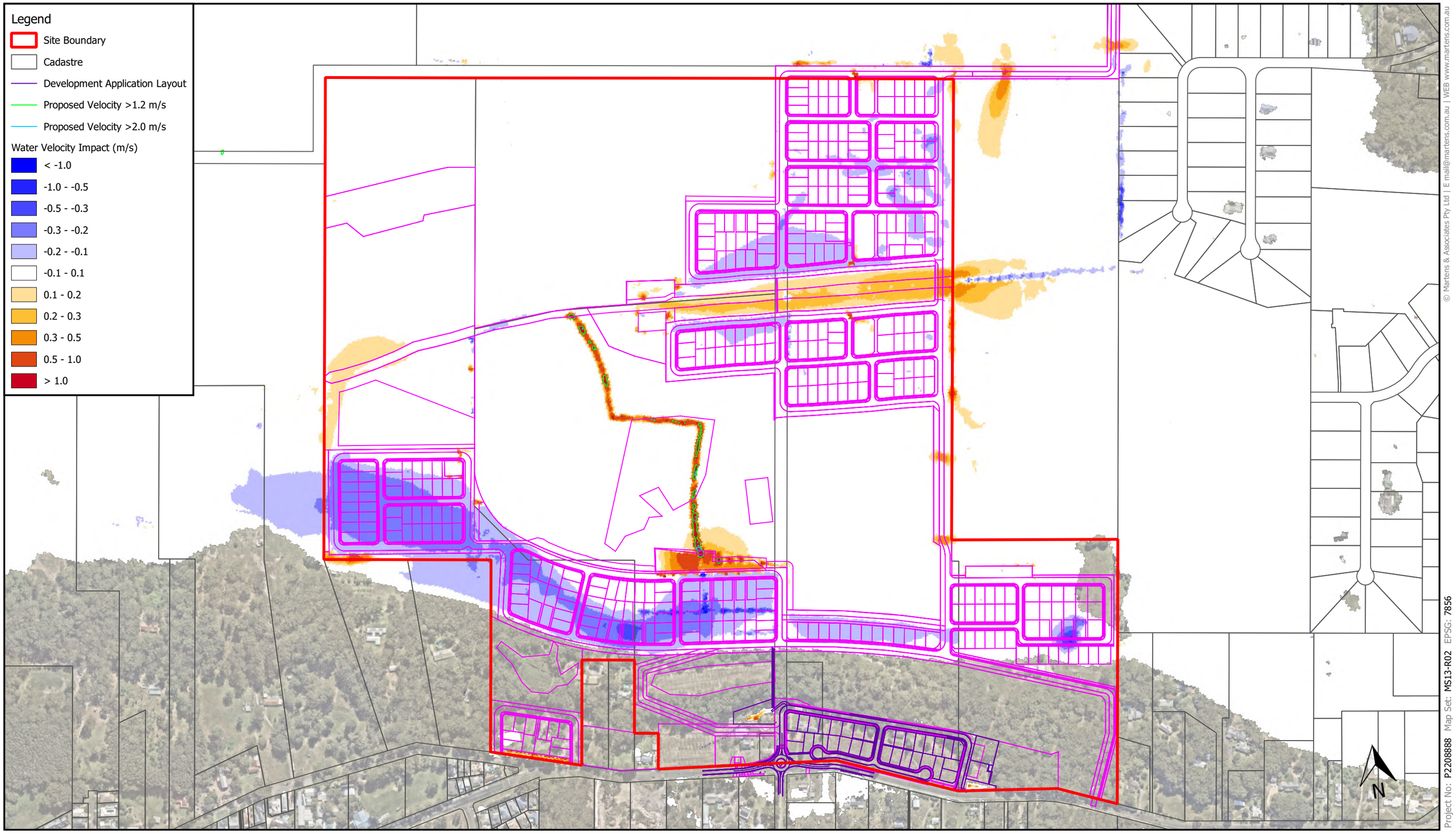
FL08	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

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Map Title / Figure:

1% AEP Climate Change Enveloped Results – Proposed Condition Water Velocity Impact

FL09	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

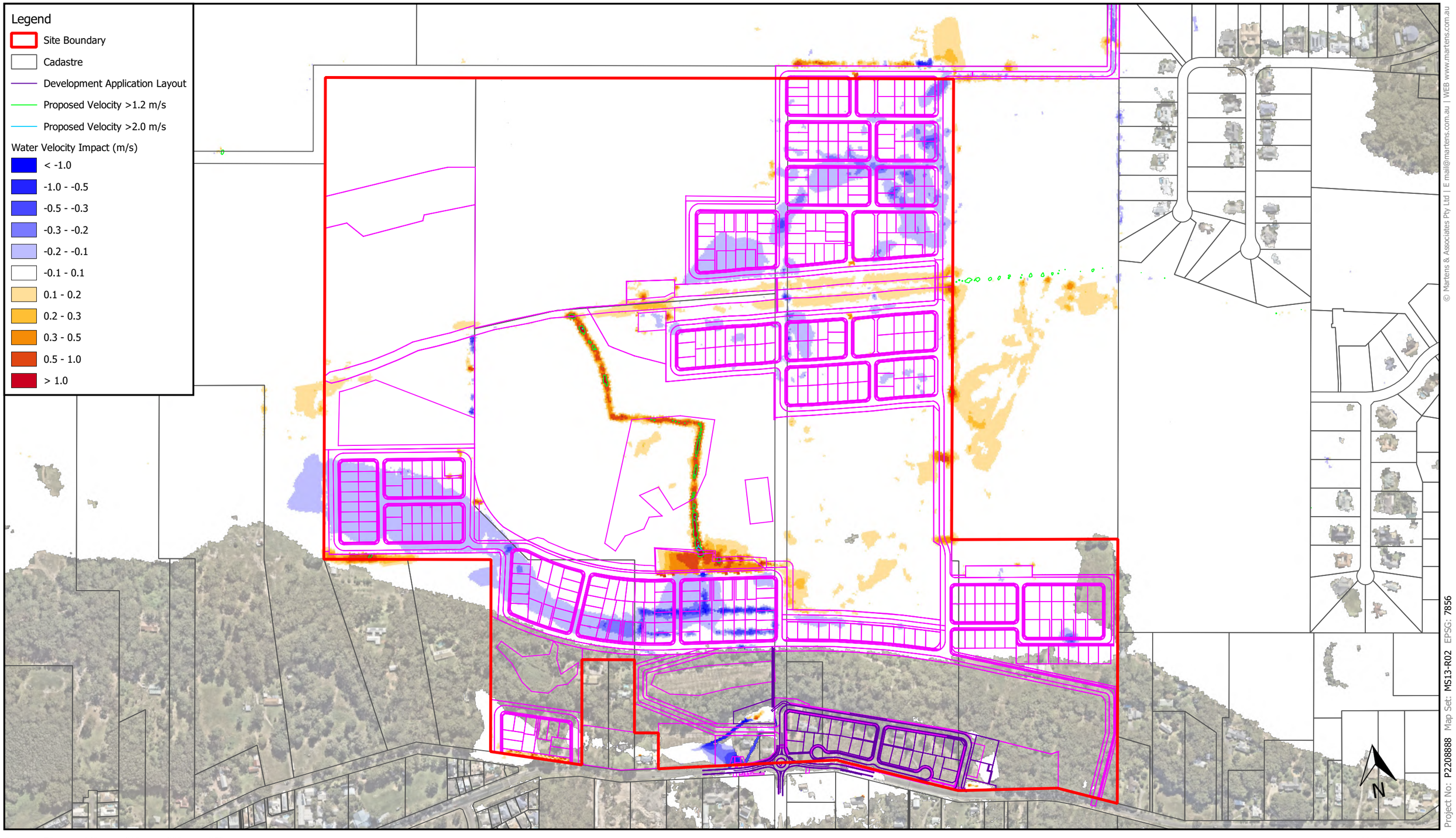
Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Map Title / Figure:

PMF Enveloped Results – Proposed Condition Water Velocity Impact

FL10	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

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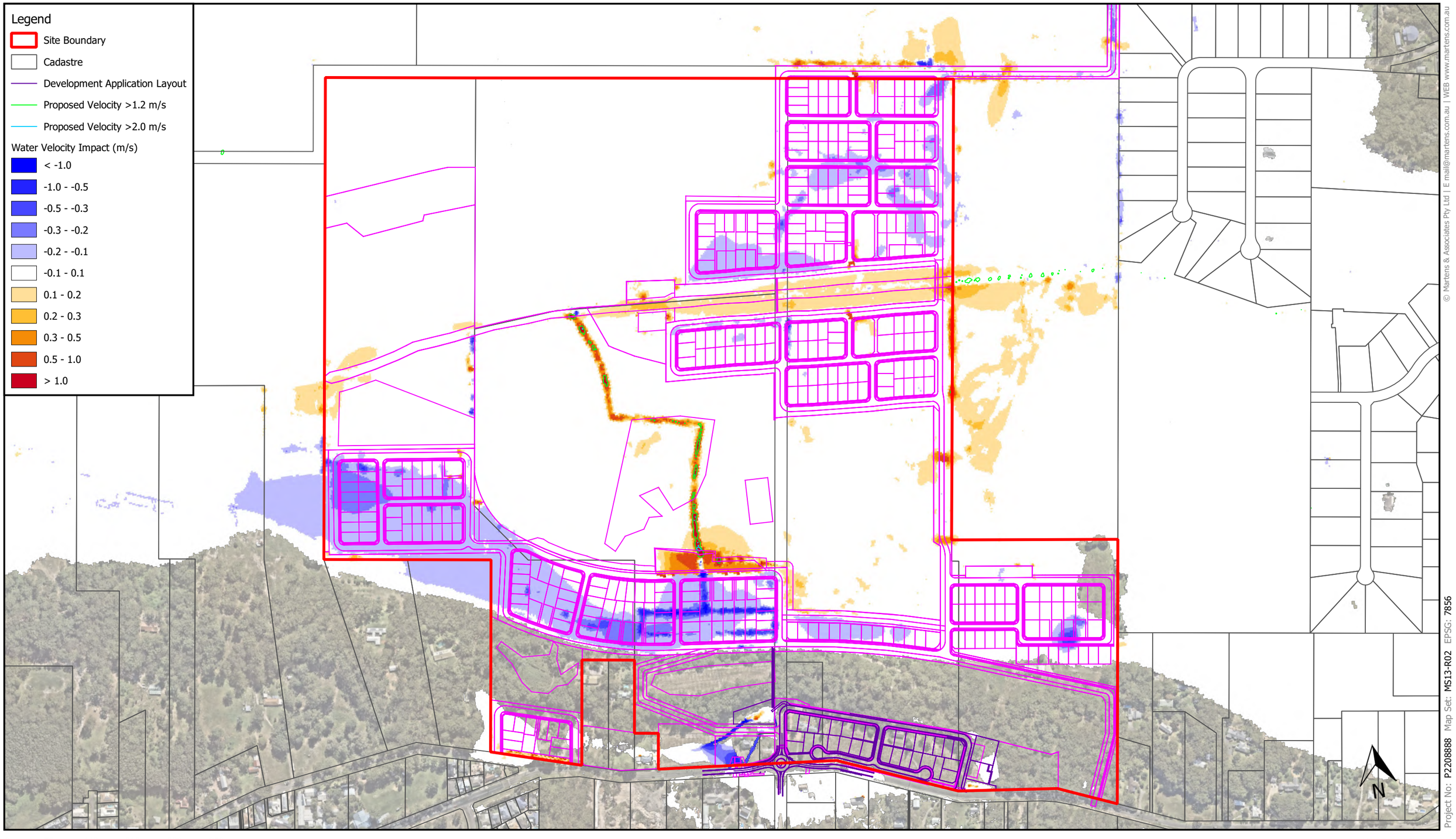
Legend

- Site Boundary
- Cadastre
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Map Title / Figure:

PMF Climate Change Enveloped Results – Proposed Condition Water Velocity Impact

FL11	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

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Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

1% AEP Enveloped Results – Potential Future Development Condition Water Level Impact

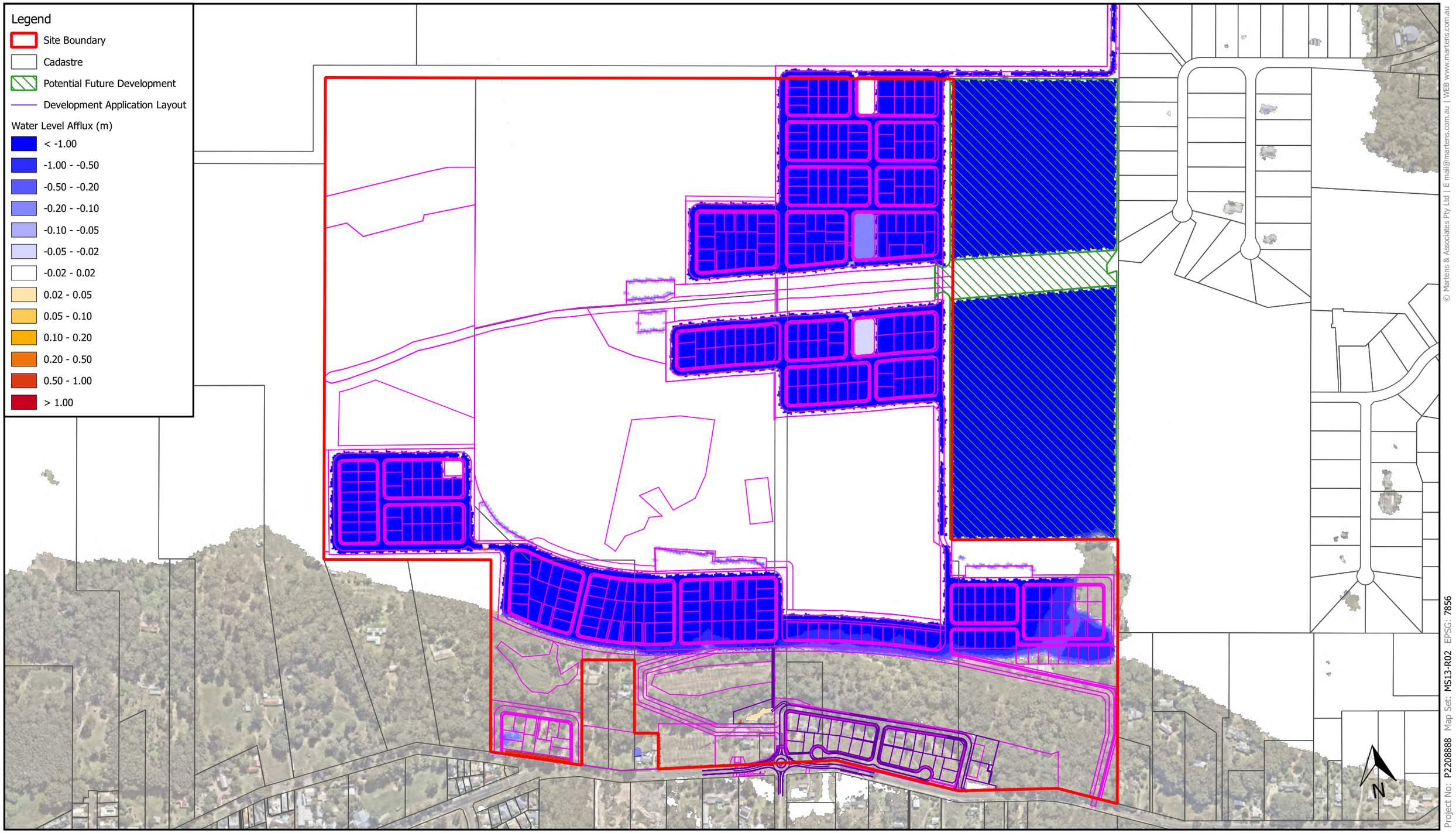
FL12	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00



Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

1% AEP Climate Change Enveloped Results – Potential Future Development Condition Water Level Impact

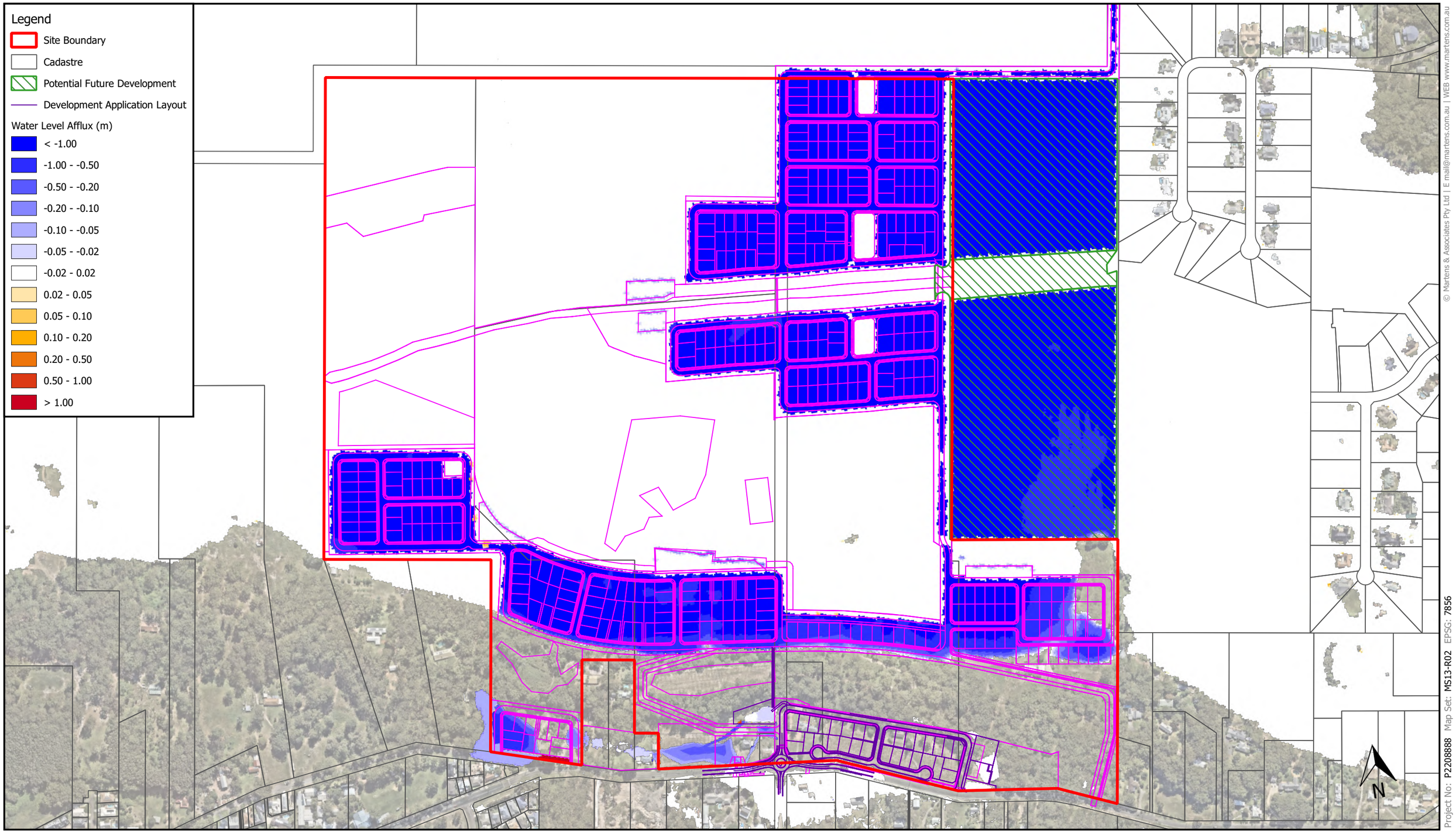
FL13	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

PMF Enveloped Results – Potential Future Development Condition Water Level Impact

FL14	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

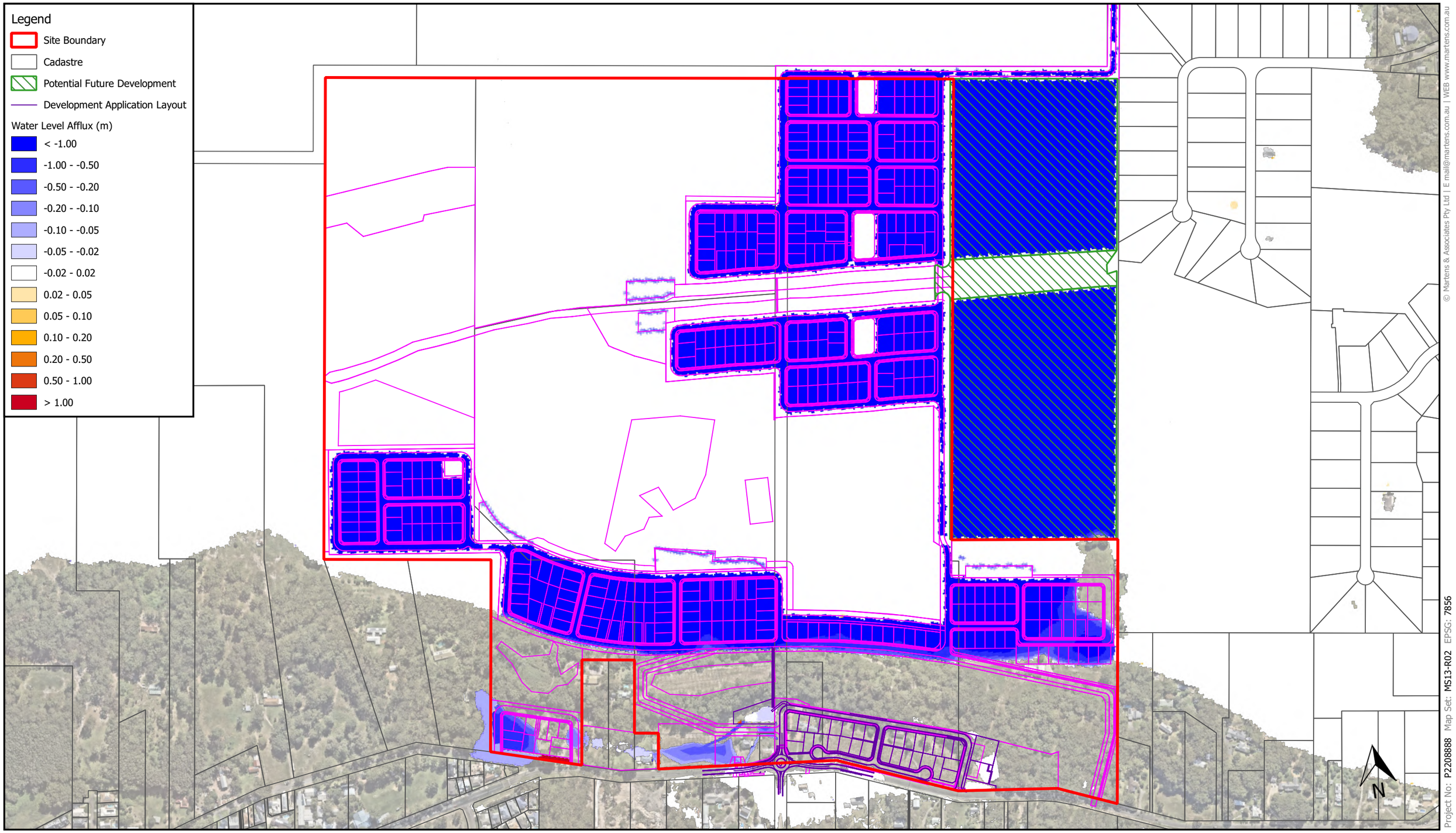
Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout

Water Level Afflux (m)

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

PMF Climate Change Enveloped Results – Potential Future Development Condition Water Level Impact

FL15	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

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Map Title / Figure:

1% AEP Enveloped Results – Potential Future Development Condition Water Velocity Impact

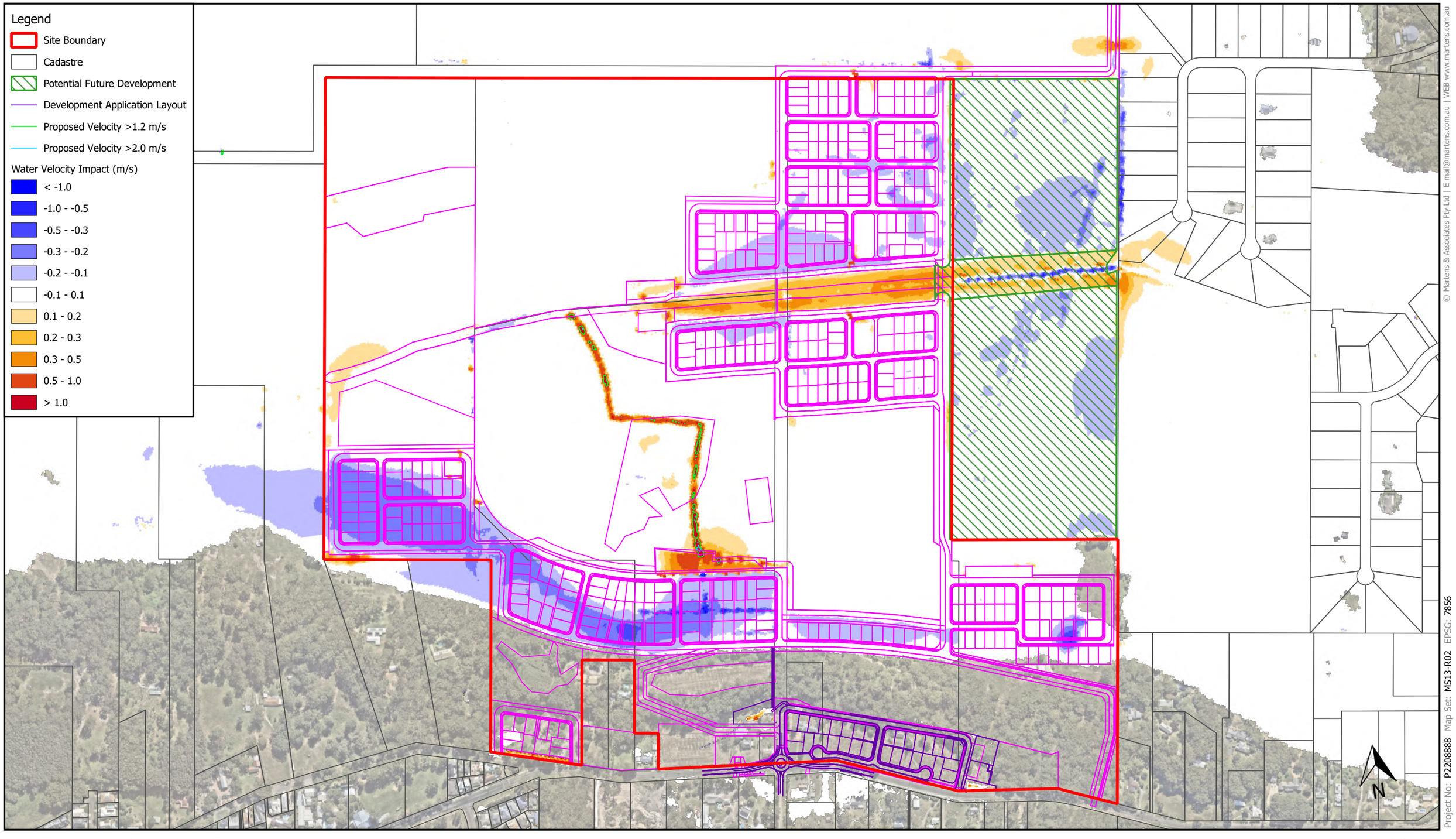
FL16	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0



0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

Map Title / Figure:

1% AEP Climate Change Enveloped Results – Potential Future Development Condition Water Velocity Impact

FL17	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

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Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

Map Title / Figure:

PMF Enveloped Results – Potential Future Development Condition Water Velocity Impact

FL18	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

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Legend

- Site Boundary
- Cadastre
- Potential Future Development
- Development Application Layout
- Proposed Velocity >1.2 m/s
- Proposed Velocity >2.0 m/s

Water Velocity Impact (m/s)

- < -1.0
- -1.0 - -0.5
- -0.5 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

0 70 140 210 280 350 m

1:6000 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2024).
- Cadastre from NSW Spatial Services (2024) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

Project No: P2208888 Map Set: MS13-R02 EPSG: 7856

N

Map Title / Figure:

PMF Climate Change Enveloped Results – Potential Future Development Condition Water Velocity Impact

FL19	Map
Gan Gan Road, Anna Bay, NSW	Site
Residential Planning Proposal	Project
Flood Assessment	Sub-Project
AB Rise Pty Ltd	Client
20/06/2025	Date

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