FLOOD RISK MANAGEMENT PLAN

28 Lido Avenue
North Narrabeen

October 2022

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1.0 INTRODUCTION

28 Lido Avenue, North Narrabeen is identified by Northern Beaches Council as being flood affected for the 1 in 100 year and Probable Maximum Precipitation (PMP) storm events. This document details the measures to be taken to ensure that the risks to both the proposed dwelling and occupants are managed and minimised in accordance with Section B3.11 of the Pittwater 21 Development Control Plan.

It is the intention of the author that copies of this plan are kept on site by The Owner where it can be produced for action in case of a significant storm event.

It is also intended that the emergency response signage be fixed to a wall in a clearly visible location. The Owner will ultimately be responsible for the implementation of this plan. The Owner will also be responsible for ensuring tasks are undertaken (or the delegation of those tasks) for major flood events.

The technical data referred to in this Section is drawn from the 2013 Narrabeen Lagoon Flood Study by BMT WBM.

2.0 Site Description

The site is located in the suburb of North Narrabeen and is situated approximately 350m to the west of the Narrabeen Lagoon foreshore. A site locality map is included in Appendix A as is a detail survey plan of the site.

The corner site covers 464.5m^2 in area which grades very slightly from the (rear) eastern to the (front) western boundaries. The site currently contains an existing single storey bungalow style dwelling which sits towards the front of the site. The original section of the existing dwelling is constructed in timber frame and is thought to be approximately 50 years of age.

2.1 Proposed Works

The proposed works could be summarised as:

- Alterations to the ground floor layout
- A first floor addition
- A new open carport
- A new secondary dwelling

Architectural plans for the proposed works are attached in Appendix B.

3.0 FLOOD EVENTS

The site is identified as being flood affected for the 1 in 100 year and Probable Maximum Precipitation (PMP) storm events and maps illustrating subsequent flood hazard extents for the site are contained within Appendix C.

3.1 Forecasts and warnings

There are usually no specific warnings issued by the Bureau of Meteorology for North Narrabeen and as such the monitoring of general warnings for the Sydney metropolitan area with respect to severe weather warnings will be critical in the process of managing risks to the site.

The Bureau of Meteorology website (www.bom.gov.au) has rainfall forecast maps and also any warnings for predicted severe weather events.

The Owner should have their mobile phone number added to the SES contact list for the issue of SMS alerts for severe weather warnings.

3.2 Flood data for the site

The site is categorised by the 2013 Narrabeen Lagoon Flood Study as being affected by the 1 in 100 year and Probable Maximum Flood (PMF) events. A summary of Council flood information for the site is as follows:

- Flood Risk Precinct: High
- 1 in 100 year Flood Level: 3.03 m A.H.D.
- 1 in 100 year Flood Planning Level (FPL): 3.53m A.H.D.
- Existing dwelling ground floor level: 2.59m A.H.D.
- Probable Maximum Flood level (PMF): 4.98m A.H.D.

Note that the Council issued flood data for the site is contained within Appendix C.

3.3 Flood Behaviour

The site sits within the Narrabeen Lagoon catchment. The Narrabeen Lagoon Flood Study has determined that the site is at risk of significant inundation for major flood events.

The study has determined that during major storm events, the water level in Narrabeen Lagoon rises to such a level that tributaries to the lagoon 'back-up' and this will result in flooded roadways and watercourses which would otherwise drain flows away from around the subject site.

To the south-west of the site is Lido Avenue and to the north-east is the main open waterway which drains a large proportion of the surrounding area to the lagoon; as such the site is vulnerable to inundation style flood events.

It is expected that a major flood event would typically be an event where flood waters of relatively low velocity would rise and fall over durations of typically less than 6 hours.

Note that a typical 1 in 100 year flood depth in the central portion of the relatively level site would be approximately 1.0m, albeit at relatively low velocity.

4.0 EMERGENCY RESPONSE

This Flood Risk Management Plan recognises that protection of life is of primary importance, followed by a secondary philosophy of attempting to minimise damage to the proposed dwellings on the site.

The emergency response to a potential flood event will be initiated upon the occurrence of certain 'trigger' threshold, upon which the emergency response plan will be actioned.

4.1 The emergency trigger

It is critical to the success of this plan that during extremely heavy and intense rainfall events The Owner are able to closely monitor the drainage conditions in Lido Avenue and also the eastern portion of the site.

The initial trigger for commencement of the emergency response plan follows the observation of stormwater beginning to inundate the Lido Avenue roadway or overtopping the main open waterway to the rear of the dwelling following extremely heavy and intense rainfall events.

Upon the visual confirmation of this trigger event the emergency responses described in Section 5 are to be enacted.

4.2 Time needed to respond

It is considered that a total period of 15 minutes would be required for The Owner to turn off the relevant mains, services and ensure that all persons within the premises have been notified and are located to the nominated emergency assembly point.

4.3 The emergency assembly point.

The emergency response to a flood event is to 'shelter-in-place' in the upper levels of the primary and secondary dwelling, or to follow directions of the emergency services.

An emergency response plan showing that the upper levels of the primary dwelling and secondary dwelling is easily accessible and adequate to act as a refuge in a significant flood event is provided in Appendix D.

5.0 OWNER RESPONSIBILITIES

The following section describes the on-going responsibilities of The Owner with respect to flood risk management.

5.1 Before the Flood

Trigger for action: Always

- The Owner will ultimately be responsible for the implementation of this plan. The Owner will be responsible for ensuring tasks are undertaken or delegating those tasks;
- Through a systematic induction process, all occupants are to be made aware of the possibility of flooding and the procedures to be followed if a flood were to occur;
- A copy of this plan is to be provided to all occupants, together with an Actions Checklist (Appendix E) and a single page notice (Appendix D);
- The Owner should continue to develop detailed procedures to support the actions required by this plan. Procedures will include clear responsibilities in the event of a flood, and back up resources should key persons not be present;
- The emergency response sign is to be permanently affixed to a wall in a highly visible external location.
- Check the facilities within the primary dwelling for use in a flood emergency, should occupants need to take shelter there. As a minimum these facilities comprise drinking water, toilets, blankets and emergency lighting.

5.2 When a Flood is Likely

Trigger for action: When the forecasts predict severe weather or significant amounts of rainfall (land is saturated) are observed

- The Owner will monitor weather forecasts and warnings; and
- The Owner to enact the emergency response plan
- The Owner should prepare for the emergency assembly to the nominated point.

5.3 During A Flood

Trigger for action: When floodwater has inundated the Lido Avenue roadway &/or the eastern portion of the site:

- The phases of the emergency response shall be:

  The Owner is to request all occupants to evacuate to the emergency assembly area in the upper levels of the primary dwelling.

Follow direction of emergency services including state emergency service.

All occupants should be at the emergency assembly area by the time the flood waters start to significantly inundate the site.

The Owner is to sweep the premises following emergency response to ensure that all occupants have sought refuge to the emergency assembly area.

The Owner is to turn off all power and water and other relevant services.

The Owner is to retreat to the emergency assembly area.

Emergency services to be notified by The Owner of the situation at the site (Appendix F).

5.4 After a Flood

Trigger for action: When emergency services give the all clear to return:

- No occupants should be allowed to leave the site while flooding is occurring or has recently occurred;
- Occupants can enter the site only after the all clear has been given by emergency services or Council;
- Where necessary, the site is to be checked by professionals before any re-use of the site;
- Where possible the Owner are to organise the safe removal of any flood debris from the site;
- The Owner is to arrange an inspection of the sub-floor area under the building and remove any flood debris if required.
- A de-brief is to be held between the occupants and The Owner and may involve emergency services and/or council staff. The flood event and response procedures, including the use of this plan, are to be reviewed; and
- Changes may be made to the plan and the requirements for future emergency evacuations should be reviewed and identify any improvements which may be necessary.

6.0 FLOOD COMPLIANCE

It is proposed to develop the site such that the objectives of Council's Flood Risk Management Policy are met.

6.1 Specific Controls

Section B3.11 of the Pittwater 21 DCP controls are to be applied to the proposed development:

High Flood Risk Matrix – Residential Category

		High Flood Risk Precinct				
		Vulnerable & Critical Use	Residential Use	Business & Industrial Use	Recreational & Environmental Use	Subdivision & Civil Works
A	Flood effects caused by Development	A1 A2	A1 A2	A1 A2	A1 A2	A1 A2
B	Building Components & Structural	B1 B2 B3	B1 B2 B3	B1 B2 B3	B1 B2 B3	
C	Floor Levels	C2 C3	C1 C3 C4 C6	C1 C3 C4 C6 C7	C3	C5
D	Car Parking	D1 D2 D3 D4 D7	D1 D2 D3 D4 D5 D6	D1 D2 D3 D4 D5 D6	D1 D2 D3 D4 D5 D6	D1
E	Emergency Response	E1 E2	E1	E1	E1	E3
F	Fencing	F1	F1	F1	F1	F1
G	Storage of Goods	G1	G1	G1	G1	
H	Pools	H1	H1	H1	H1	H1

Flood Effects Caused By Development

A1 – *Development shall not be approved unless it can be demonstrated in a Flood Management Report that it has been designed and can be constructed so that in all events up to the 1% AEP event:*

(a) There are no adverse impacts on flood levels or velocities caused by alterations to the flood conveyance; and
(b) There are no adverse impacts on surrounding properties; and
(c) It is sited to minimise exposure to flood hazard. Major developments and developments likely to have a significant impact on the PMF flood regime will need to demonstrate that there are no adverse impacts in the Probable Maximum Flood.

Outcome – The provisions of this Flood Risk Management Report demonstrate that the flood risks have been adequately addressed in accordance with the provisions of the *Flood Prone Land Design Standard.*

A2 – *Development shall not be approved unless it can be demonstrated in a Flood Management Report that in all events up to the 1% AEP event there is no net loss of flood storage.*

Consideration may be given for exempting the volume of standard piers from flood storage calculations.

If Compensatory Works are proposed to balance the loss of flood storage from the development, the Flood Management Report shall include detailed calculations to demonstrate how this is achieved.

Outcome – There are no significant ground level works external to the existing dwelling that will reduce the site's flood storage.

The proposed secondary dwelling is to be constructed on an open pier/footing system that will be above the 1 in 100 year flood level.

The proposed carport will be constructed with posts with open sides and at the existing ground level and will not reduce the site's flood storage.

Building Components and Structural Soundness

B1 - *All buildings shall be designed and constructed with flood compatible materials in accordance with "Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas", Hawkesbury-Nepean Floodplain Management Steering Committee (2006).*

Outcome – All new building elements below the Flood Planning Level of R.L. 3.53 m A.H.D. shall be constructed from flood compatible materials.

A table of equivalent flood compatible materials is contained within Appendix G.

B2 – *All new development must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. Where shelter-in-place refuge is required, the structural integrity for the refuge is to be up to the Probable Maximum Flood level. Structural certification shall be provided confirming the above.*

Outcome – All new building elements are to be designed, constructed and/or modified to ensure structural integrity or immersion and impact of velocity and debris up to the level of the Probable Maximum Flood Level of R.L. 4.98 m A.H.D, as shelter-in-place refuge is required.

Structural certification has been provided in this report under Appendix H.

B3 – *All new electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level.*

All existing electrical equipment and power points located below the Flood Planning Level must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.

Outcome – All new electrical equipment, wiring, fuel lines and any other service pipes and connections are to be waterproofed to the Flood Planning Level.

All existing electrical equipment and power points located below the Flood Planning Level will have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.

Floor Levels

C1 – *New floor levels within the development shall be at or above the Flood Planning Level.*

Outcome – Complies as all proposed habitable floors for the proposed first floor addition and secondary dwelling will be constructed above the Flood Planning Level of RL 3.53m

C3 – *All new development must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no net loss of flood storage in all events up to the 1% AEP event.*

For suspended pier/pile footings:

(a) The underfloor area of the dwelling below the 1% AEP flood level is to be designed and constructed to allow clear passage of

floodwaters, taking into account the potential for small openings to block; and

(b) At least 50% of the perimeter of the underfloor area is of an open design from the natural ground level up to the 1% AEP flood level; and

(c) No solid areas of the perimeter of the underfloor area would be permitted in a floodway

Outcome – The proposed secondary dwelling foundations are to be constructed of open pier design to allow clear passage of floodwaters

At least 50% of the sub-floor area cladding of the secondary dwelling is of open design from the natural ground level up to the 1% AEP flood level

The proposed secondary dwelling is not in a floodway and as such this condition does not apply.

C4 – *A one-off addition or alteration below the Flood Planning Level of less than 30 square metres (in total, including walls) may be considered only where:*

(a) it is an extension to an existing room; and

(b) the Flood Planning Level is incompatible with the floor levels of the existing room; and

(c) out of the 30 square metres, not more than 10 square metres is below the 1% AEP flood level.

This control will not be permitted if this provision has previously been utilised since the making of this Plan.

The structure must be floodproofed to the Flood Planning Level, and the Flood Management Report must demonstrate that there is no net loss of flood storage in all events up to the 1% AEP event.

Outcome – Complies as the alteration is an extension to an existing room with the existing ground floor level incompatible with the Flood Planning Level, and the extension is less than 10 square metres.

C6 – *Consideration may be given to the retention of an existing floor level below the Flood Planning Level when undertaking a first floor addition provided that:*

(a) it is not located within a floodway; and

(b) the original foundations are sufficient to support the proposed final structure above them. The Flood Management Report must include photos and the structural certification required as per Control B2 must consider whether the existing foundations are adequate or should be replaced; and

(c) none of the structural supports/framing of existing external walls of are to be removed unless the building is to be extended in that location; and

(d) the ground floor is floodproofed.

Outcome – The proposed works will not be located within a floodway.

The dwelling will be undergoing significant structural alterations including new footings and framing support elements to ensure that the dwelling can be certified as being structurally adequate for the expected site conditions during a P.M.F. event. Structural certification has been provided in this report under Appendix H.

None of the existing external walls are to be removed except for the rear extension to the north.

The ground floor level is to be floodproofed.

Car Parking

D1 - *Open carpark areas and carports shall not be located within a floodway.*

Outcome – Complies as the new carport is to be located in an area which is not considered to be a floodway.

D2 – *The lowest floor level of open carparks and carports shall be constructed no lower than the natural ground levels, unless it can be shown that the carpark or carport is free draining with a grade greater than 1% and that flood depths are not increased.*

Outcome – Complies as the new carport is to be constructed at the existing ground level.

D3 – *Carports must be of open design, with at least 2 sides completely open such that flow is not obstructed up to the 1% AEP flood level. Otherwise it will be considered to be enclosed.*

When undertaking a like-for-like replacement and the existing garage/carport is located on the street boundary and ramping is infeasible, consideration may be given for dry floodproofing up to the 1% AEP flood level.

Outcome – The proposed carport is of open design with at least 2 sides completely open.

D4 – *Where there is more than 300mm depth of flooding in a car park or carport during a 1% AEP flood event, vehicle barriers or restraints are to be provided to prevent floating vehicles leaving the site. Protection must be provided for all events up to the 1% AEP flood event*

Outcome – Restraints are to be provided to prevent vehicles floating away as the 1 in 100 year flood depth at the carport is expected to be approximately 1200mm.

D5 - *Enclosed Garages must be located at or above the 1% AEP level*

Outcome – No enclosed garage area is proposed.

D6 - *All enclosed car parks (including basement carparks) must be protected from inundation up to the Flood Planning Level. All access, ventilation, driveway crests and any other potential water entry points to any enclosed car parking shall be above the Flood Planning Level.*

Where a driveway is required to be raised it must be demonstrated that there is no net loss to available flood storage in any event up to the 1% AEP flood event and no impact on flood conveyance through the site.

Council will not accept any options that rely on electrical, mechanical or manual exclusion of the floodwaters from entering the enclosed carpark

Outcome – No new driveway or enclosed car parks are proposed.

Flood Emergency Response

E1 – *If the property is affected by a Flood Life Hazard Category of H3 or higher, then Control E1 applies and a Flood Emergency Assessment must be included in the Flood Management Report.*
If the property is affected by a Flood Life Hazard Category of H6, then development is not permitted unless it can be demonstrated to the satisfaction of the consent authority that the risk level on the property is or can be reduced to a level below H6 or its equivalent.

If the property is flood affected but the Flood Life Hazard Category has not been mapped by Council, then calculations for its determination must be shown in the Flood Management Report, in accordance with the "Technical Flood Risk Management Guideline: Flood Hazard", Australian Institute for Disaster Resilience (2012).
Where flood-free evacuation above the Probable Maximum Flood level is not possible, new development must provide a shelter-in-place refuge where:

a) *The floor level is at or above the Probable Maximum Flood level; and*
b) *The floor space provides at least 2m^2 per person where the flood duration is long (6 or more hours) in the Probable Maximum Flood event, or 1m^2 per person for less than 6 hours;*
c) *It is intrinsically accessible to all people on the site, plainly evident, and self-directing, with sufficient capacity of access routes for all occupants without reliance on an elevator; and*
d) *It must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; and a first aid kit*

Class 10 classified buildings and structures (as defined in the Building Codes of Australia) are excluded from this control.

In the case of change of use or internal alterations to an existing building, a variation to this control may be considered if justified appropriately by a suitably qualified professional.

Note that in the event of a flood, occupants would be required to evacuate if ordered by Emergency Services personnel regardless of the availability of a shelter-in-place refuge.

Outcome – For the primary dwelling, the emergency response as detailed in this report is to 'shelter-in-place' within the first floor addition to the primary dwelling for significant flood events, or otherwise off-site as directed by Emergency Services.

The first floor addition will be constructed with a floor level of R.L. 5.59m which is above the PMF level of R.L. 4.98m. The floor space provided is roughly 50m^2, sufficient for the number of persons sheltering in place. The first floor is intrinsically accessible to all people on the site.

For the secondary dwelling, the emergency response as detailed in this report is to 'shelter-in-place' within the dwelling for significant flood events, or otherwise off-site as directed by Emergency Services.

The proposed bedroom to the secondary dwelling is at R.L. 4.98m which is at the PMF level of R.L. 4.98m. The floor space provided is roughly 9m^2, sufficient for the number of persons sheltering in place. The proposed bedroom is intrinsically accessible to all people on the site.

The owner of the site should provide items as per d) to provide for a shelter-in-place scenario in potential extreme storm events.

Fencing

F1 - *Fencing, (including pool fencing, boundary fencing, balcony balustrades and accessway balustrades) shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. At least 50% of the fence must be of an open*

design from the natural ground level up to the 1% AEP flood level. Less than 50% of the perimeter fence would be permitted to be solid. Openings should be a minimum of 75 mm x 75mm.

Outcome – The proposed front boundary fence and the rear fence adjacent to the proposed dwelling will be designed to not impede the floor of flood waters and increase flood affectation. At least 50% of the fence face will be of open design up to the 1% AEP flood level.

Storage of Goods

G1 – *Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards.*

Outcome – The Owner is to ensure storage of toxic or potentially polluting goods, materials or other products, which may be hazardous or pollute floodwaters, will not be permitted below the Flood Planning Level.

Pools

H1 - *Pools located within the 1% AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site.*

All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level.

All chemicals associated with the pool are to be stored at or above the Flood Planning Level.

Outcome – No new pool is proposed

7.0 SUMMARY

This report is a plan for the site for major flood events to be incorporated by The Owner into the on-going management protocols for the site to manage the flood risks.

The report contains procedural information to ensure the safety of occupants during flood events and also to ensure the satisfactory performance of any new building elements.

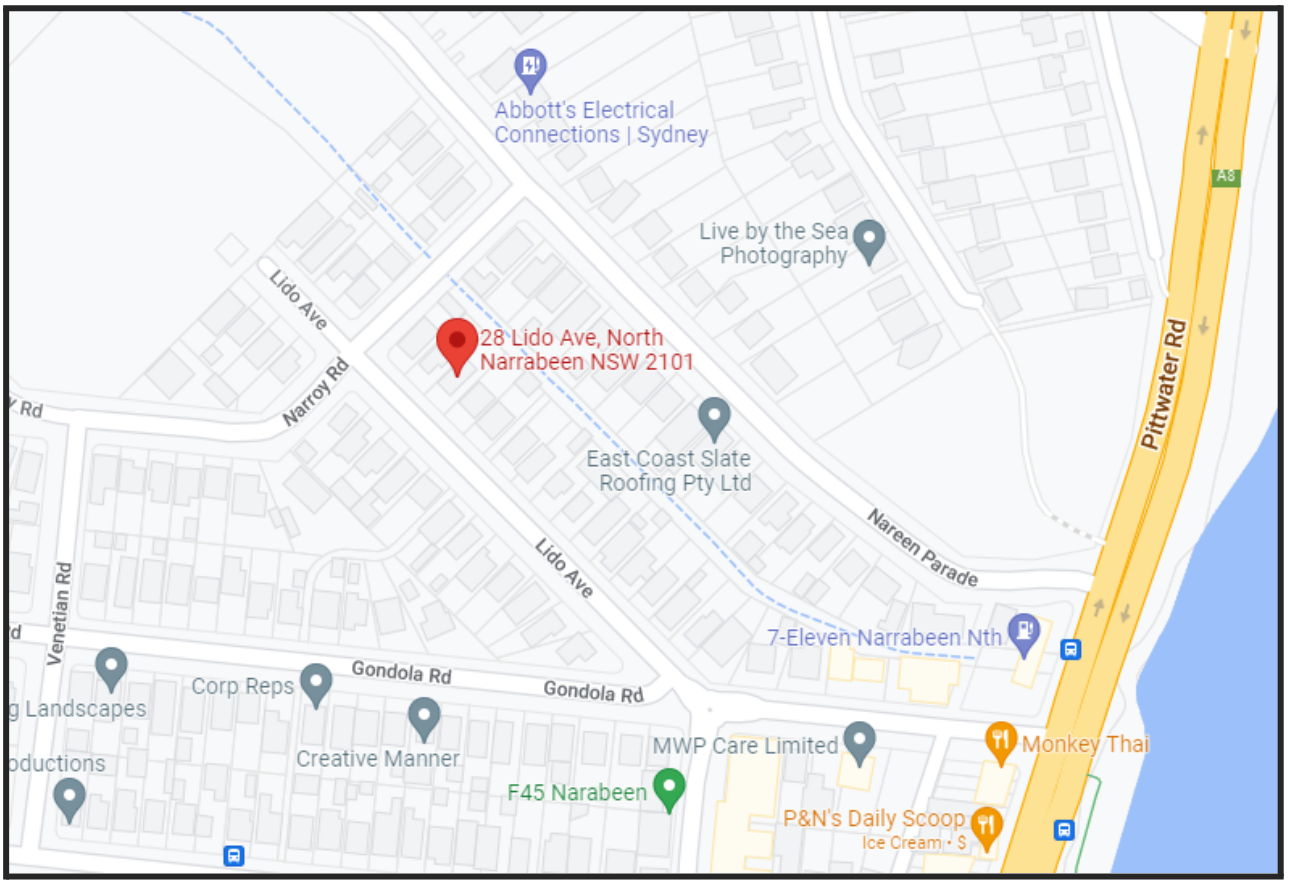
The recommendations and strategies within this report ensure compliance with Pittwater 21 DCP Section B3.11 Flood Prone Land.

Should you have any questions or queries please do not hesitate to contact the undersigned.

TAYLOR CONSULTING

D M SCHAEFER - Director
B.E. Civil (Hons) M.I.E. Aust. N.E.R.

Appendix A



Locality Map - 28 Lido Avenue, North Narrabeen

Appendix B

VIEW 1

VIEW 2

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SITE ANALYSIS PLAN

Drawing No.
DA1101

Issue
2

Date
11.07.22

Drawing Status
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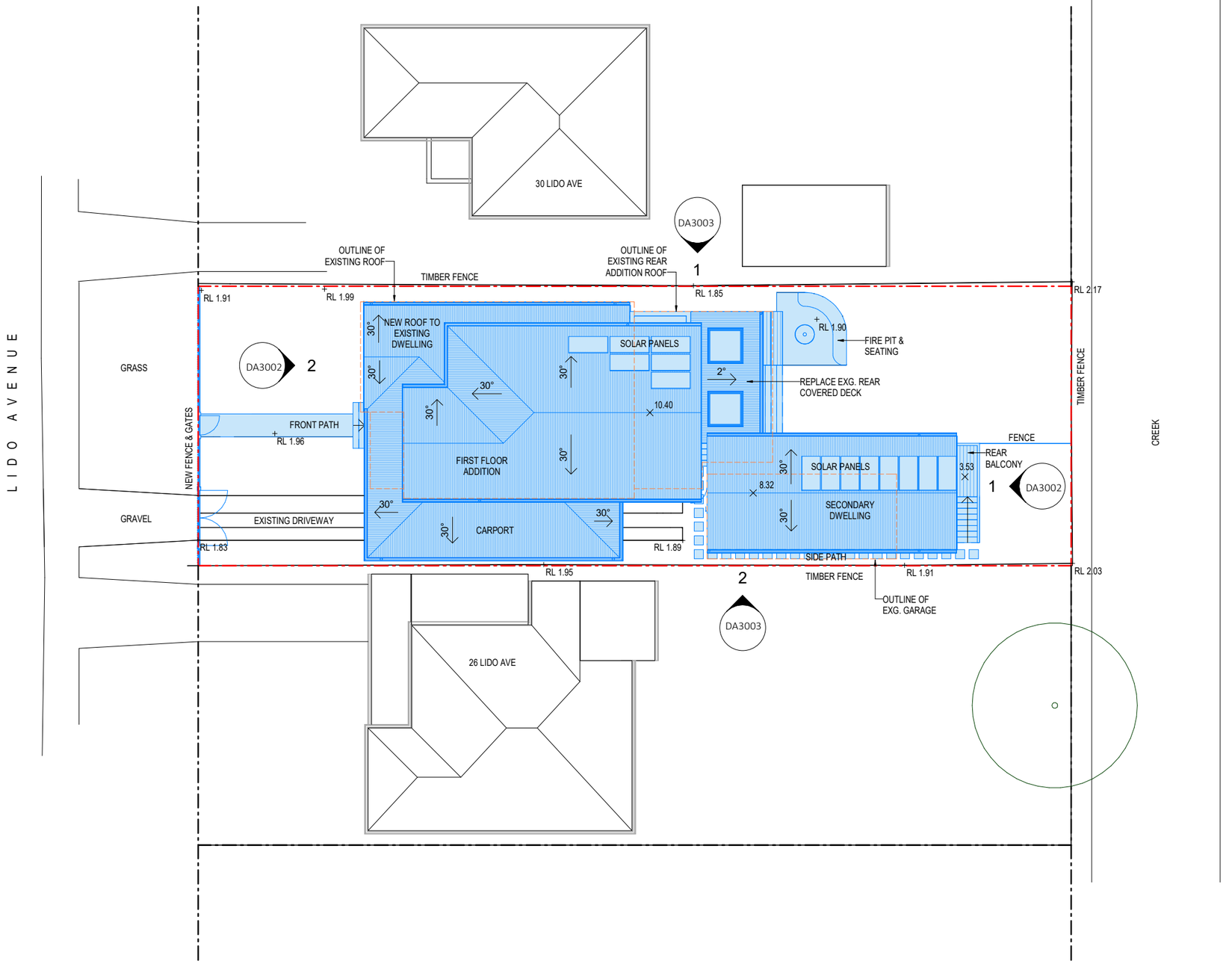

EXISTING

PROPOSED

DEMOLISHED

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SITE PLAN

Drawing No.
DA1111

Issue
3

Date
26.10.22

Drawing Status
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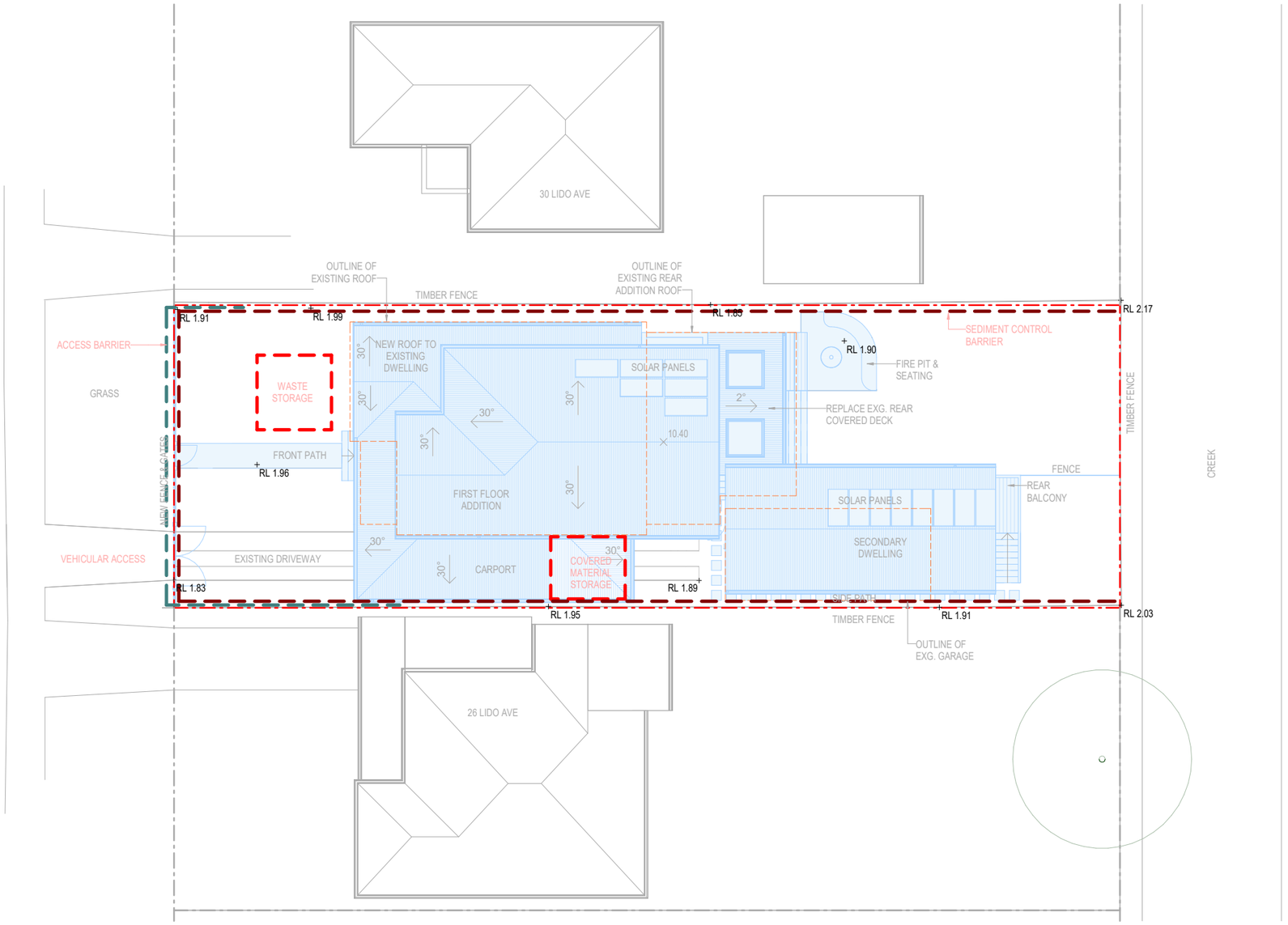

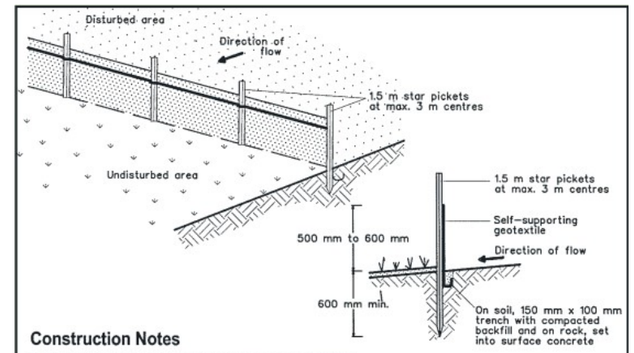

SECTION DETAIL

Construction Notes

1. Construct sediment fence as close as possible to parallel to the contours of the site.
2. Drive 1.5 metre long star pickets into ground, 2.5 metres apart (max.).
3. Dig a 150 mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
4. Fix self-supporting geotextile to upslope side of posts with wire ties or as recommended by geotextile manufacturer.
5. Join sections of fabric at a support post with a 150 mm overlap.
6. Backfill the trenchover the base of the fabric and compact it thoroughly over the geotextile

SEDIMENT FENCE **SD 6-8**

SEDIMENT BARRIER

ACCESS BARRIER

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SEDIMENT CONTROL PLAN

Drawing No. **DA1301**
Issue **3**
Date **26.10.22**
Drawing Status **Not for construction**
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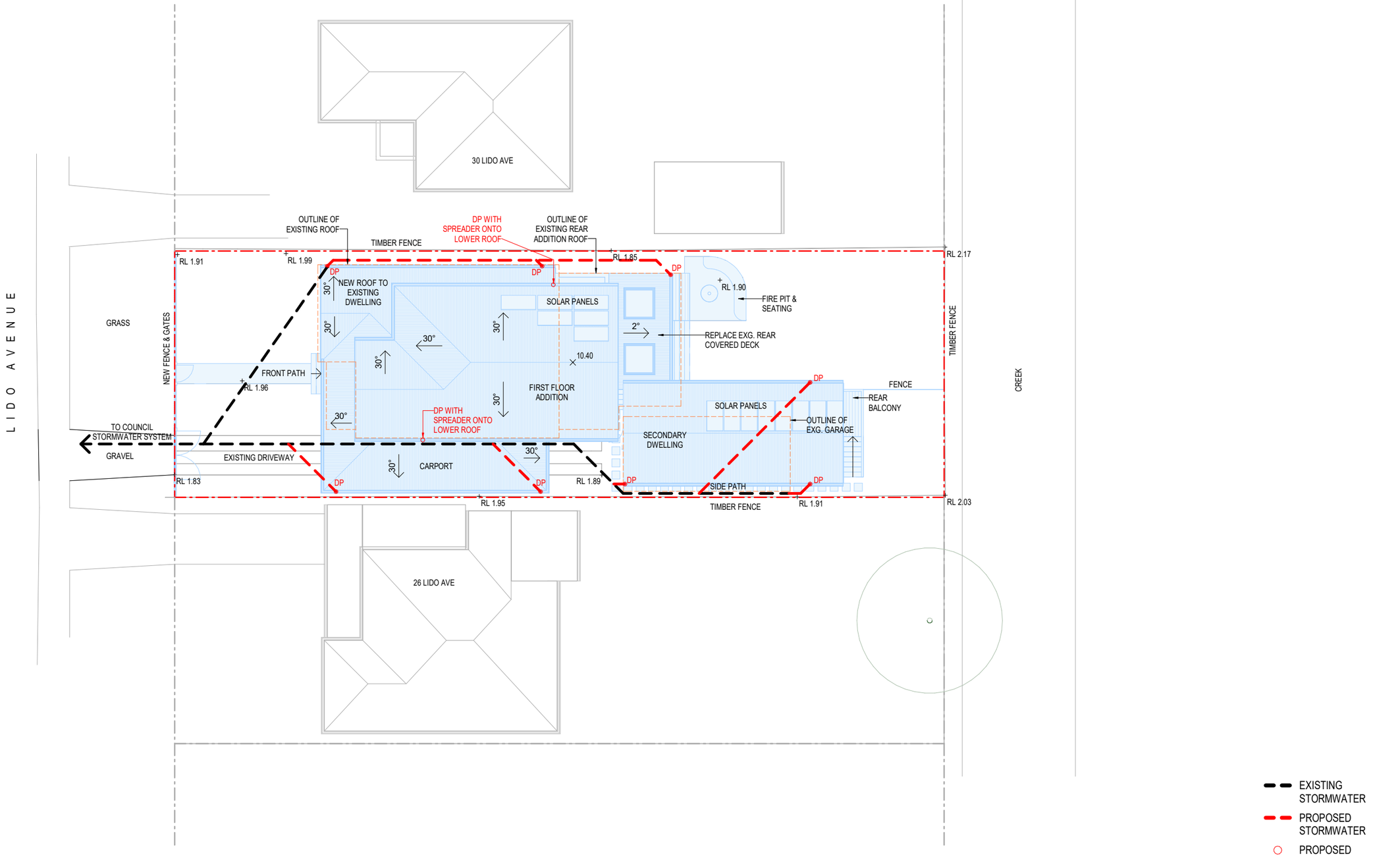

HARRISON architecture

Architect
Robert Harrison

Registration
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Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
STORMWATER PLAN

Drawing No.
DA1401

Issue
3

Date
26.10.22

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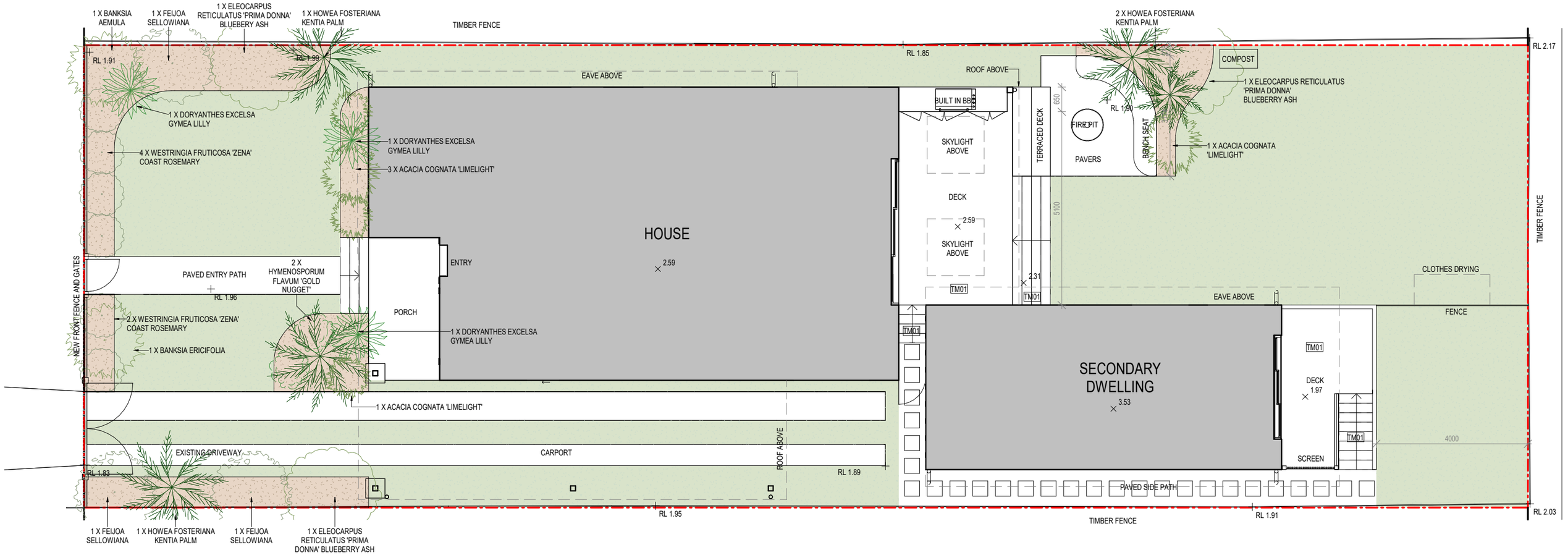

HOWEA FOSTERIANA
KENTIA PALM

WESTRINGIA FRUSTCOSA 'ZENA'
COASTAL ROSEMARY

FEIJOA SELLOWIANA

DORYANTHES EXCELSA
GYMEA LILLY

ACACIA COGNATA 'LIMELIGHT'

BANKSIA AEMULA

HYMENOSPORUM FLAVUM 'GOLD NUGGET'

BANKSIA ERICIFOLIA

ELEOCARPUS RETICULATUS 'PRIMA DONNA'
BLUEBERRY ASH

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
LANDSCAPE PLAN

Drawing No.
DA1501

Issue
4

Date
26.10.22

Drawing Status
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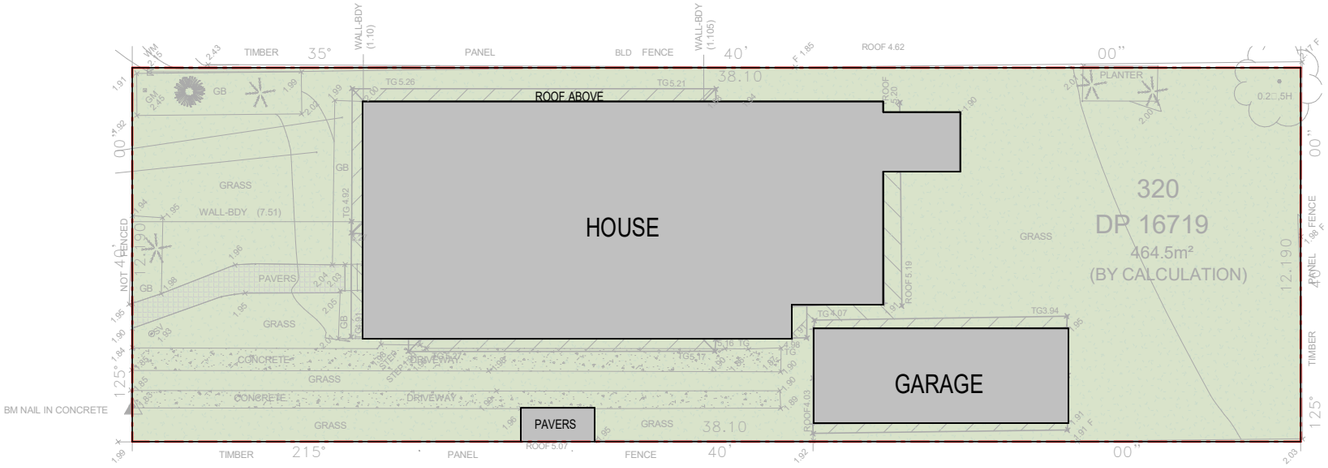
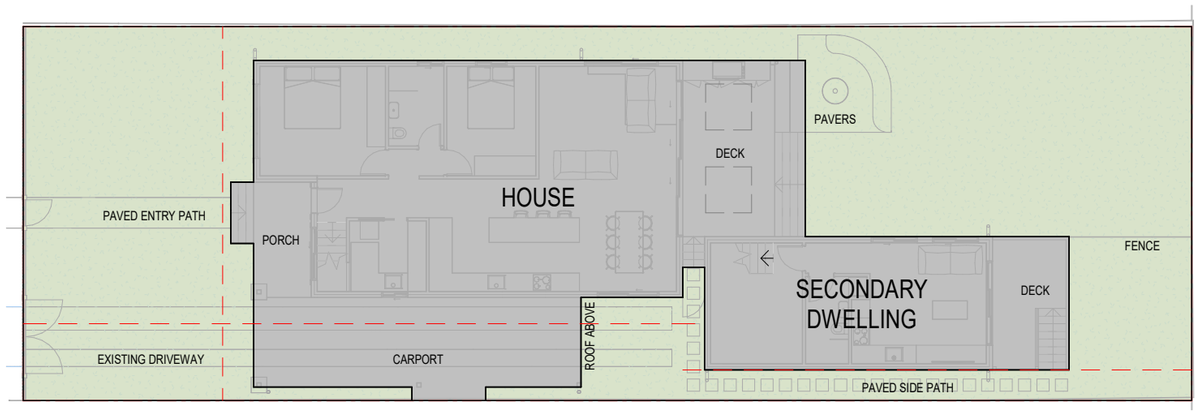


SITE AREA = 464.5m²
EXISTING HARD SURFACE AREA = 161.2m²
EXISTING LANDSCAPED AREA = 303.3m²

1 LANDSCAPE AREA PLAN EXISTING

1 : 200



SITE AREA = 464.5m²
PROPOSED HARD SURFACE AREA = 217m²
PROPOSED LANDSCAPED AREA = 247m²

2 LANDSCAPE AREA PLAN PROPOSED

1 : 200

HARRISON architecture

Architect
Robert Harrison
Registration
9577

Client
Jansen
Project Address
28 Lido Ave North Narrabeen

Drawing name
LANDSCAPED AREAS

Drawing No. **DA1502**
Issue **3**
Date **11.07.22**
Drawing Status **Not for construction**
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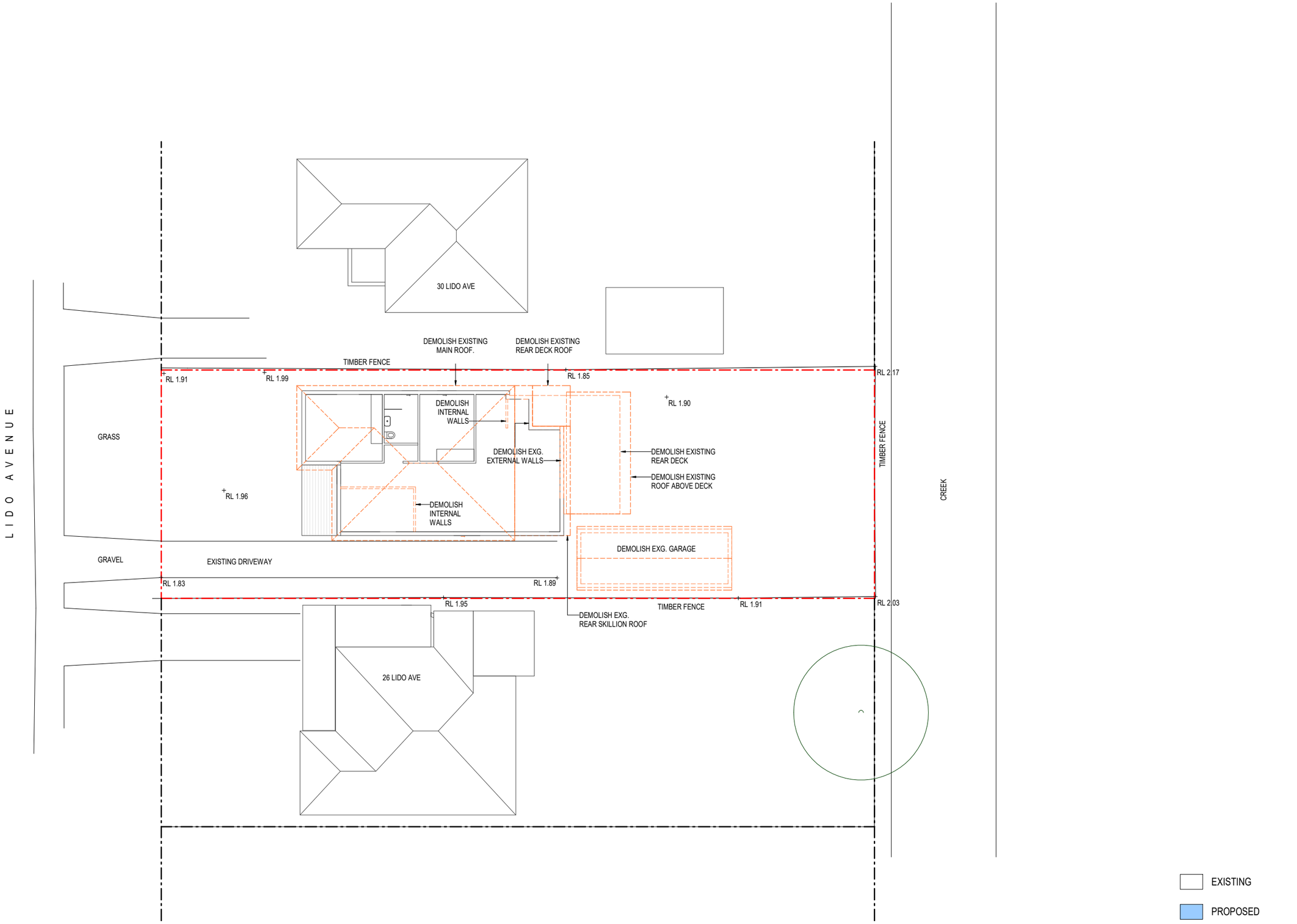


HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
DEMOLITION PLAN

Drawing No.
DA2001

Issue
2

Date
11.07.22

Drawing Status
Not for construction

Scale
1:200 @ A3

TIMBER FENCE

RL 1.91 RL 1.99 RL 1.85 RL 2.17

6500 FRONT SETBACK

DA3002 2

DA3003 1

EAVES ABOVE DP DP ROOF ABOVE DP

REPLACE WINDOW 650 2200 650 BEDROOM ROBE BATHROOM BEDROOM ROBE LOUNGE

BUILT IN BBQ SKYLIGHT ABOVE TERRACED DECK FIRE PIT RL 1.90 PAVERS BENCH SEAT

DECK 2.59 SKYLIGHT ABOVE 2.31

EXISTING HOUSE

ENTRY PORCH STAIRS W/D LAUNDRY LINEN F WALL OVEN CHUTE ISLAND KITCHEN DINING

1000 PAVED ENTRY PATH RL 1.96

1 DA3101

NEW FRONT FENCE AND GATES

EXISTING DRIVEWAY RL 1.83

CARPORT BIN STORAGE ROOF ABOVE

DP DP RL 1.95 SIDE SETBACK RL 1.89

1700 200 950 100 2500 100 4900

1875 200 950 100 950 950 600 100 750 4150 3165 200 710

1000 SIDE SETBACK 6852 6500 REAR SETBACK TIMBER FENCE

EAVES ABOVE SECONDARY DWELLING

LDY F LOUNGE 3.53 KITCHEN BEDROOM 4.98 BATHROOM DECK 1.97 SCREEN

FENCE 1 DA3002

PAVED SIDE PATH DP DP

EAVES TIMBER FENCE OUTLINE OF EXG. GARAGE RL 1.91 RL 2.03

1000 SIDE SETBACK

2 DA3003

EXISTING

PROPOSED

DEMOLISHED

HARRISON architecture

Architect
Robert Harrison

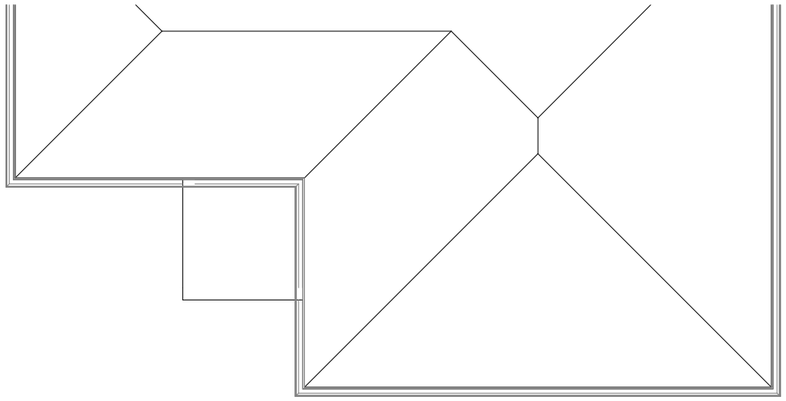
Registration
9577

Client
Jansen

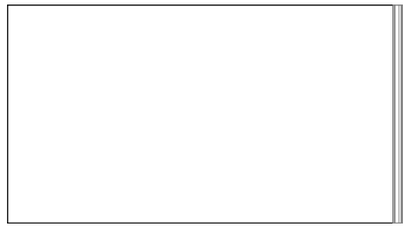
Project Address
28 Lido Ave North Narrabeen

Drawing name
GROUND FLOOR

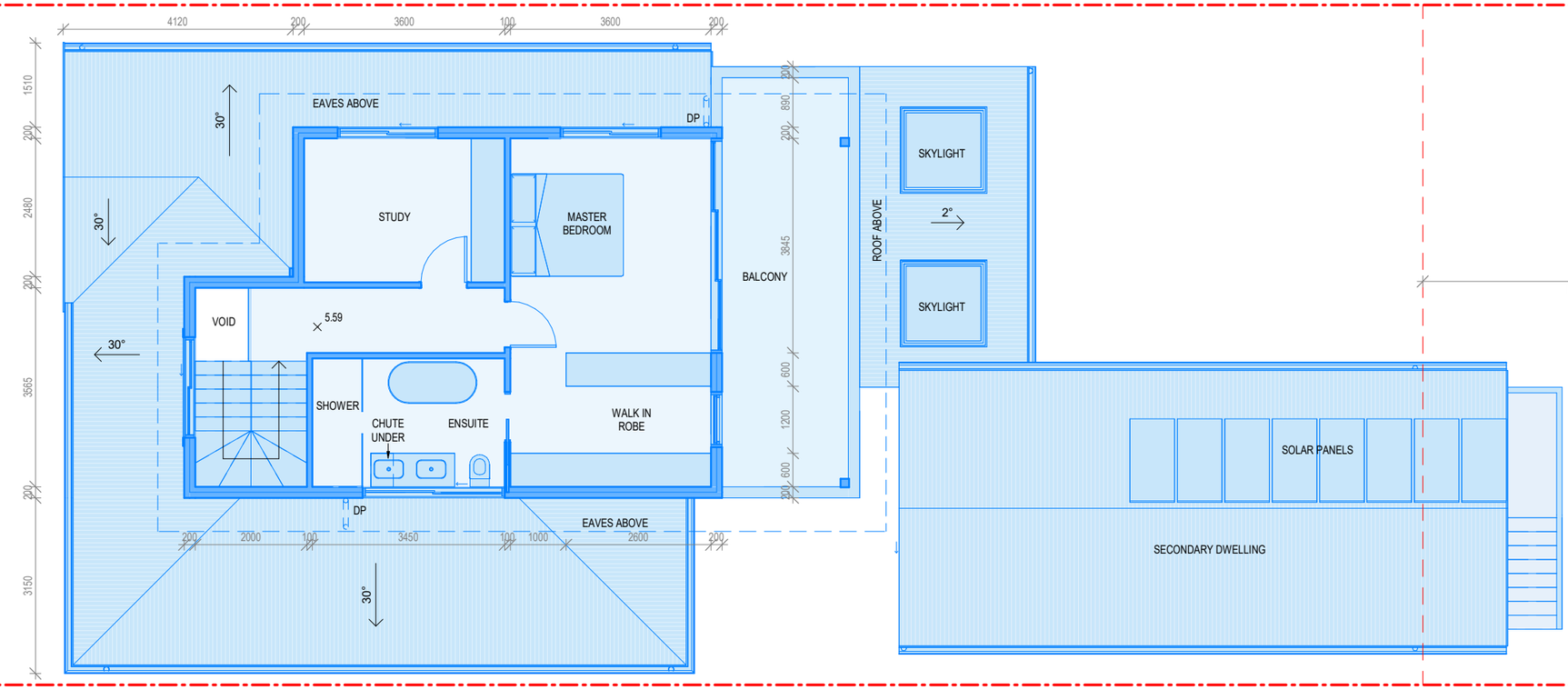
Drawing No. **DA2100**
Issue **8**
Date **26.10.22**
Drawing Status **Not for construction**
Scale **1:100 @ A3**



DA3003
1



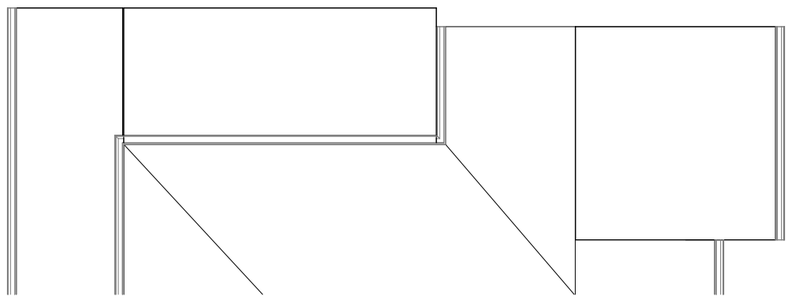
DA3002 2



1
DA3101

6500
REAR SETBACK

1
DA3002



2
DA3003

EXISTING
PROPOSED
DEMOLISHED

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
LEVEL 1

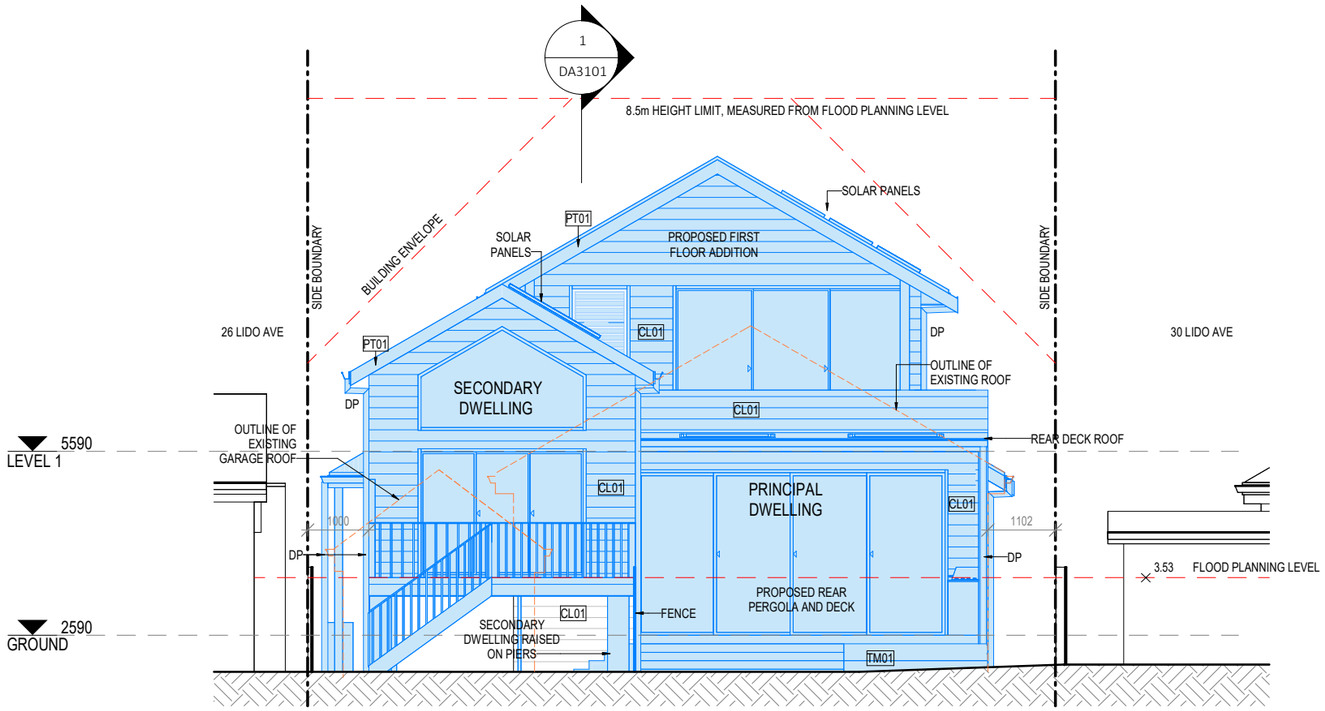
Drawing No.
DA2101

Issue
7

Date
26.10.22

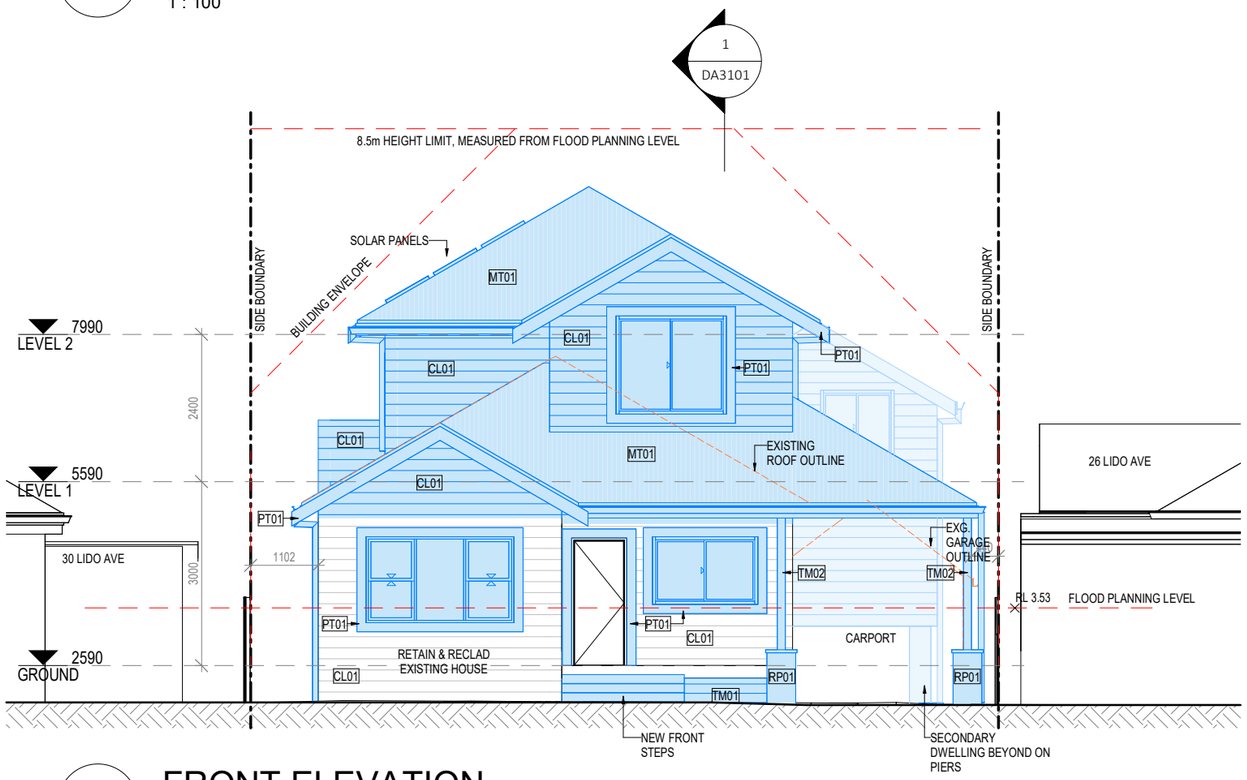
Drawing Status
Not for construction

Scale
1:100 @ A3



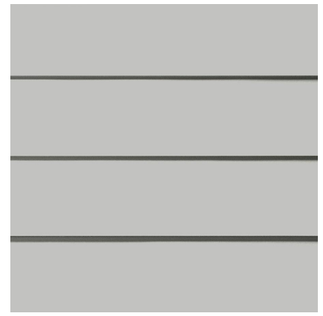
1 REAR ELEVATION

1 : 100



2 FRONT ELEVATION

1 : 100



CL01
JAMES HARDIE SCYON LINEA 180mm
DULUX TRANQUIL RETREAT

MT01
COLORBOND CUSTOM ORB
MONUMENT

PT01
DULUX VIVID WHITE

RP01
RENDER & PAINT
DULUX TRANQUIL RETREAT

TM01
HARDWOOD DECKING & POSTS

EXISTING

PROPOSED

DEMOLISHED

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
FRONT & REAR ELEVATIONS

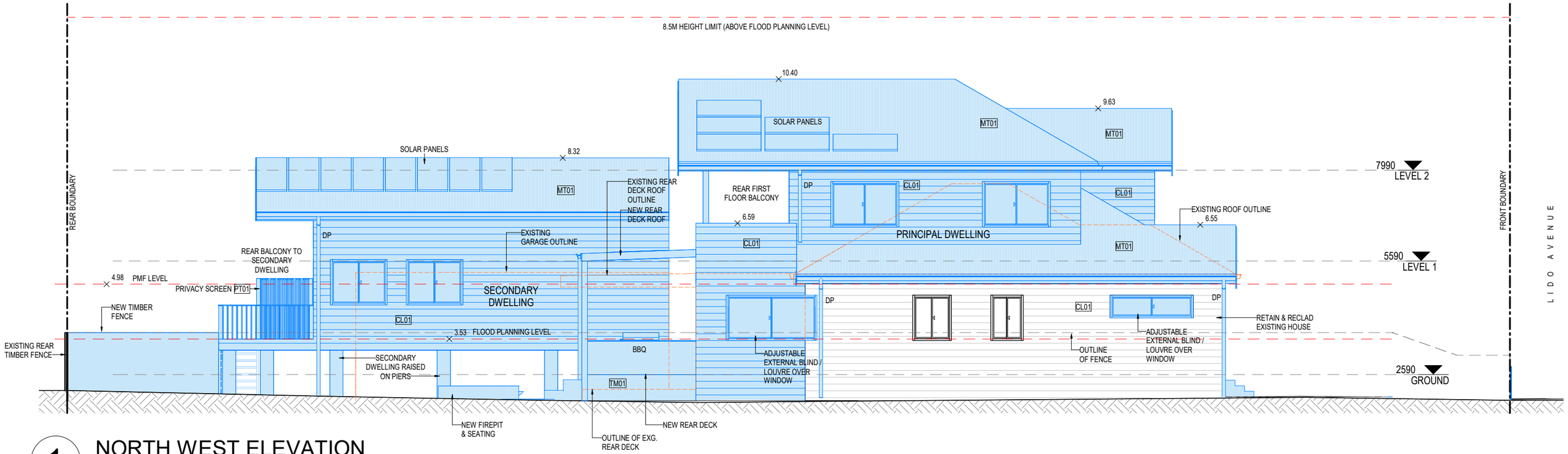
Drawing No.
DA3002

Issue
5

Date
26.10.22

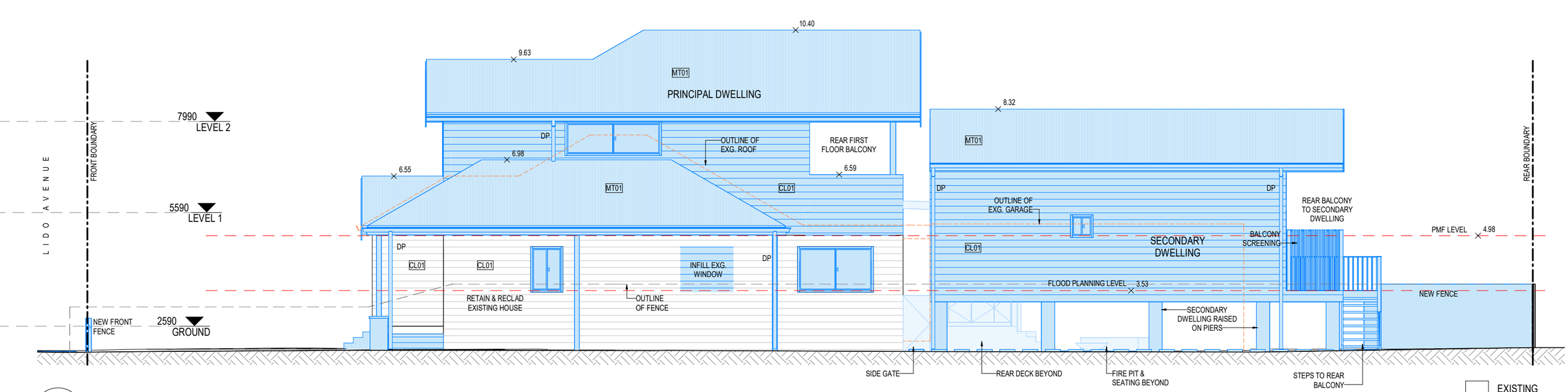
Drawing Status
Not for construction

Scale
1:100 @ A3



1 NORTH WEST ELEVATION

1 : 100



2 SOUTH EAST ELEVATION

1 : 100

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SIDE ELEVATIONS

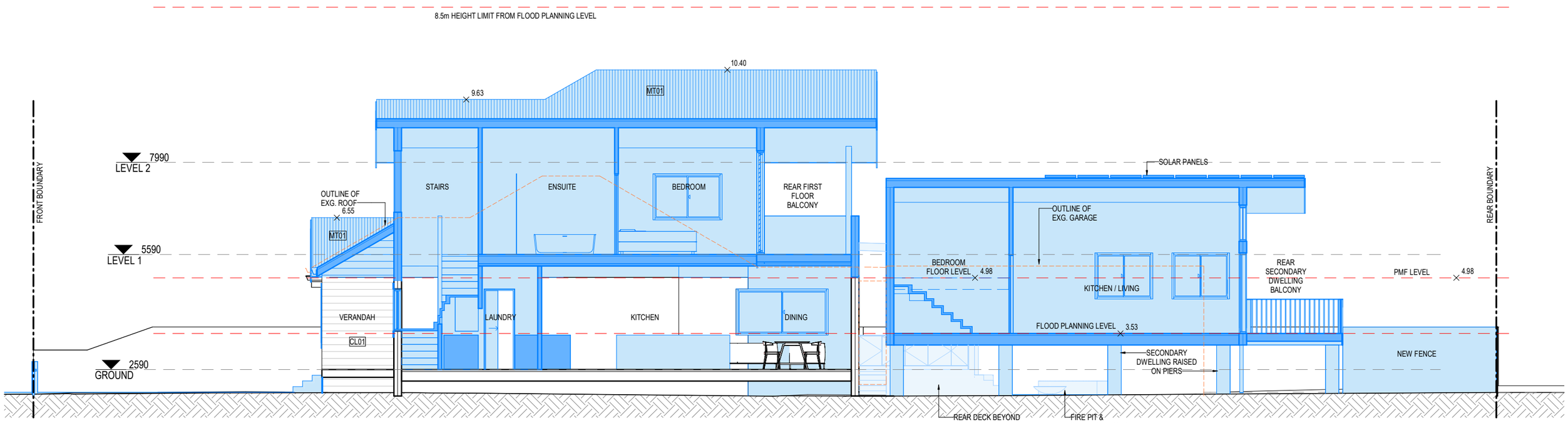
Drawing No.
DA3003

Issue
5

Date
26.10.22

Drawing Status
Not for construction

Scale
1:100 @ A3



EXISTING

PROPOSED

DEMOLISHED

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SECTION 1

Drawing No.
DA3101

Issue
5

Date
26.10.22

Drawing Status
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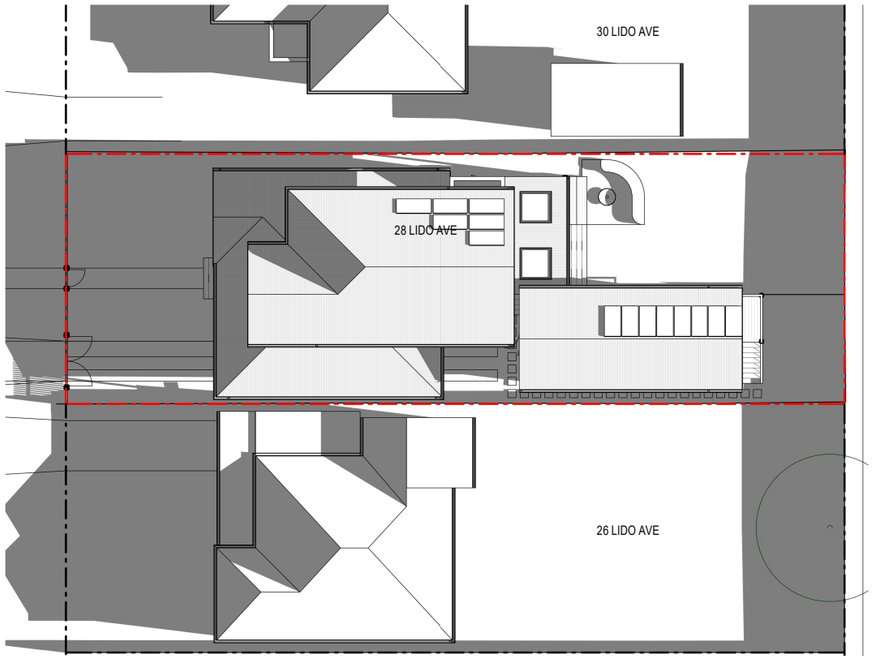
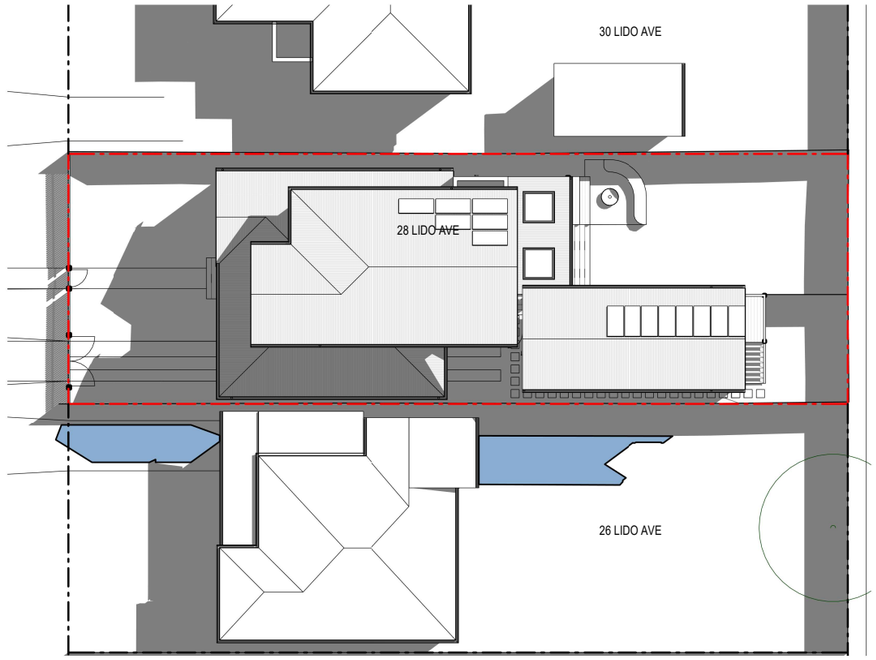
Scale
1:100 @ A3



1 WINTER 9AM

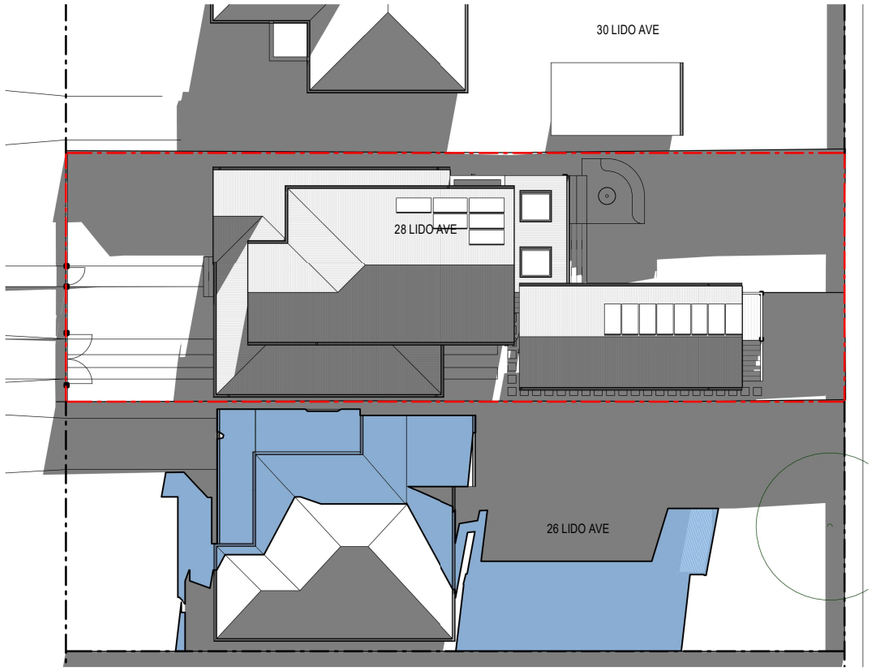
1 : 300

NO ADDITIONAL OVERSHADOWING TO NEIGHBOURING PROPERTIES



2 WINTER 12PM

1 : 300



3 WINTER 3PM

1 : 300

EXISTING SHADOW

ADDITIONAL SHADOW

HARRISON architecture

Architect
Robert Harrison

Registration
9577

Client
Jansen

Project Address
28 Lido Ave North Narrabeen

Drawing name
SHADOW DIAGRAMS

Drawing No.
DA7001

Issue
4

Date
26.10.22

Drawing Status
Not for construction

Scale
1:300 @ A3

Appendix C

FLOOD INFORMATION REPORT - BASIC

Property: 28 Lido Avenue NORTH NARRABEEN NSW 2101
Lot DP: Lot 320 DP 16719
Issue Date: 25/03/2022
Flood Study Reference: Narrabeen Lagoon Flood Study 2013, BMT WBM

Flood Information for lot [1]:

Flood Risk Precinct – See Map A

Flood Planning Area – See Map A

Maximum Flood Planning Level (FPL) [2, 3, 4]: 3.53 m AHD

1% AEP Flood – See Flood Map B

1% AEP Maximum Water Level [2, 3]: 3.03 m AHD

1% AEP Maximum Depth from natural ground level[3]: 1.22 m

1% AEP Maximum Velocity: 0.71 m/s

1% AEP Hydraulic Categorisation: Flood Storage **See Flood Map D**

Probable Maximum Flood (PMF) – See Flood Map C

PMF Maximum Water Level [4]: 4.98 m AHD

PMF Maximum Depth from natural ground level: 3.17 m

PMF Maximum Velocity: 1.75 m/s

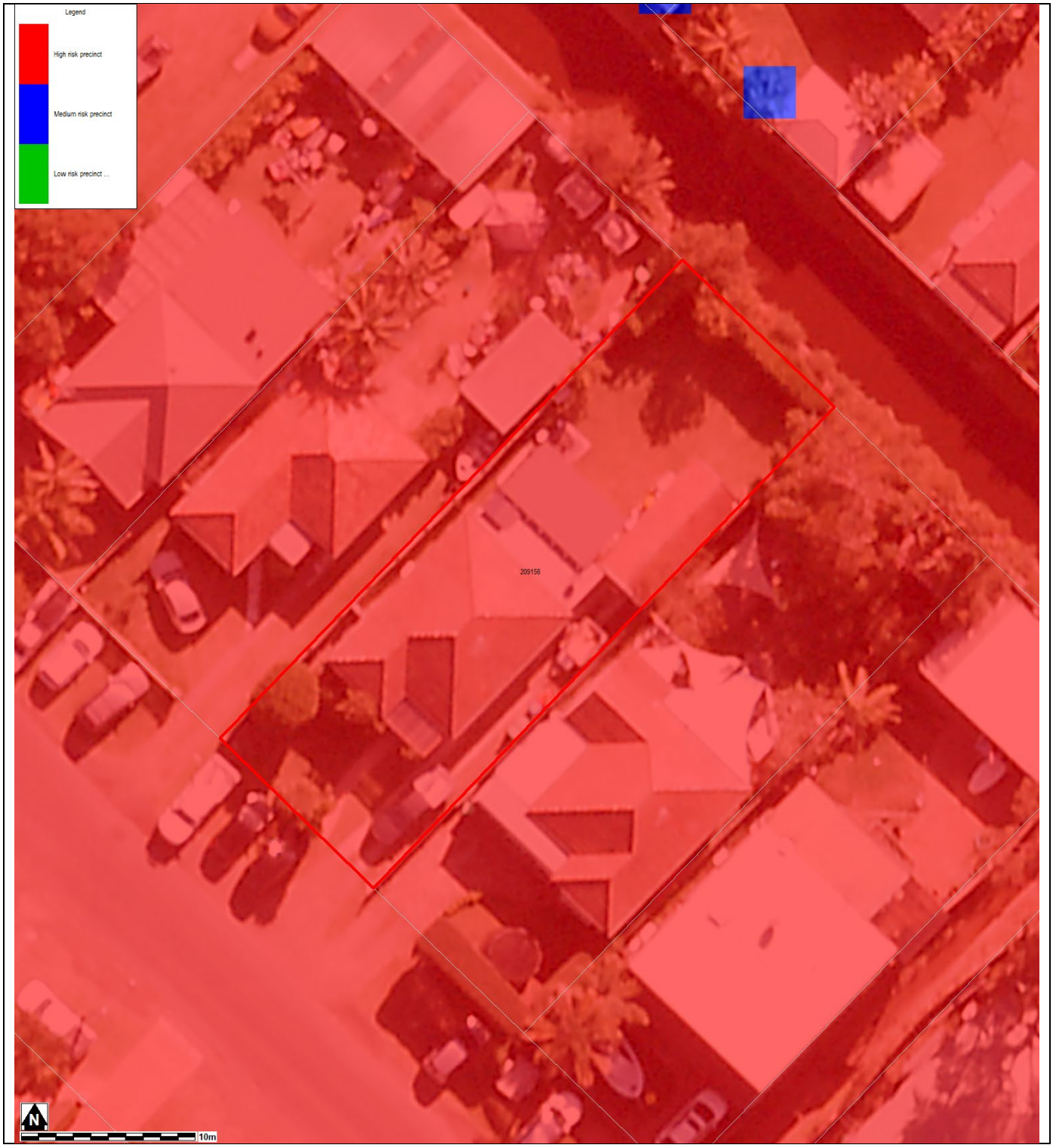
Flood Life Hazard Category – See Map E

[1] The flood information does not take into account any local overland flow issues nor private stormwater drainage systems.
[2] Overland flow/mainstream water levels may vary across a sloping site, resulting in variable minimum floor/ flood planning levels across the site. The maximum Flood Planning Level may be in a different location to the maximum 1% AEP flood level.
[3] Intensification of development in the former Pittwater LGA requires the consideration of climate change impacts which may result in higher minimum floor levels.
[4] Vulnerable/critical developments require higher minimum floor levels using the higher of the PMF or FPL.

General Notes:

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- This is currently the best available information on flooding; it may be subject to change in the future.
- Council recommends that you obtain a detailed survey of the above property and surrounds to AHD by a registered surveyor to determine any features that may influence the predicted extent or frequency of flooding. It is recommended you compare the flood level to the ground and floor levels to determine the level of risk the property may experience should flooding occur.
- Development approval is dependent on a range of issues, including compliance with all relevant provisions of Northern Beaches Council's Local Environmental Plans and Development Control Plans.
- Please note that the information contained within this letter is general advice only as a detail survey of the property as well as other information is not available. Council recommends that you engage a suitably experienced consultant to provide site specific flooding advice prior to making any decisions relating to the purchase or development of this property.
- The Flood Studies on which Council's flood information is based are available on Council's website.

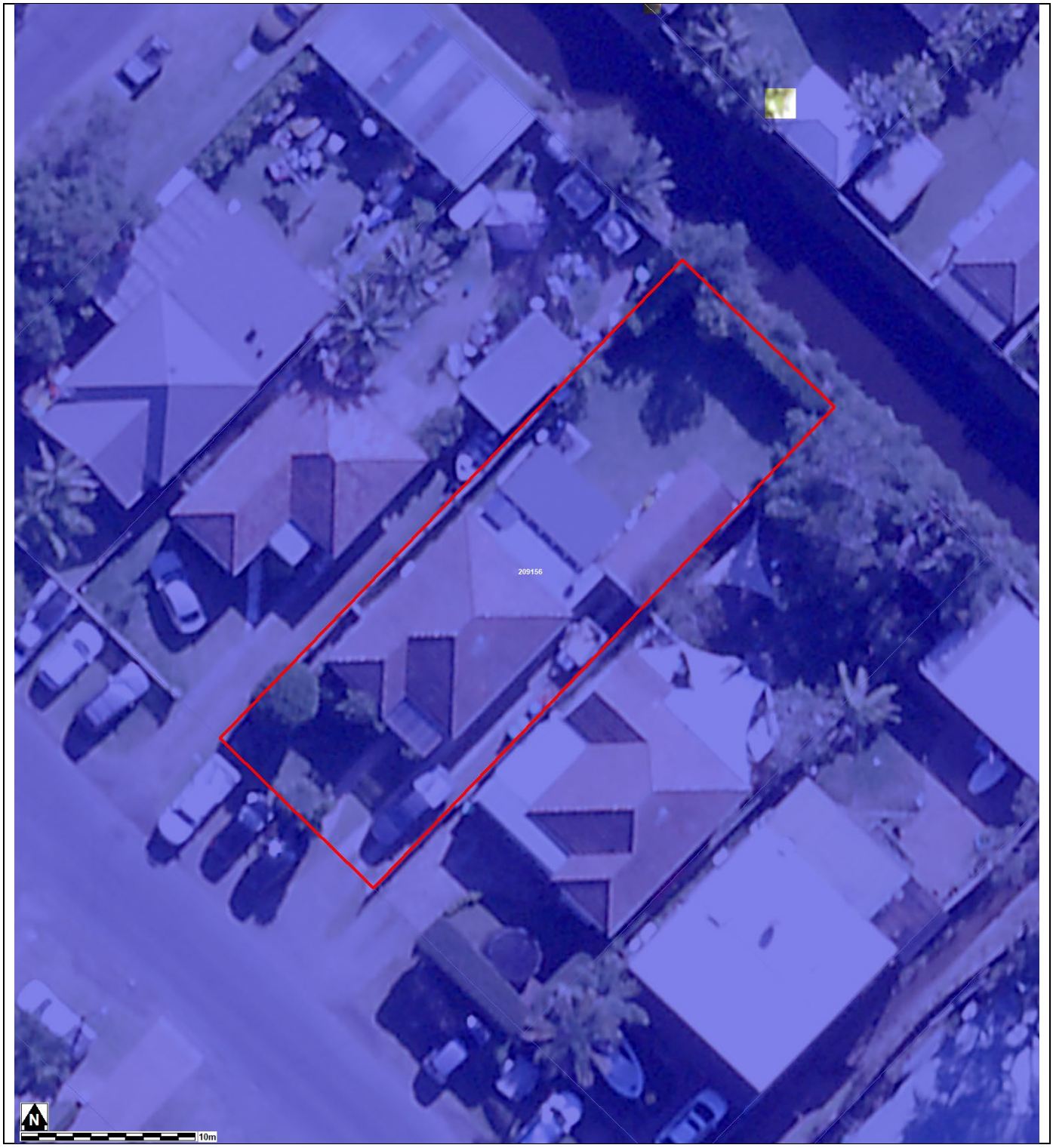
FLOOD MAP A: FLOOD RISK PRECINCT MAP



Notes:

- **Low Flood Risk precinct** means all flood prone land not identified within the High or Medium flood risk precincts.
- **Medium Flood Risk precinct** means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.
- **High Flood Risk precinct** means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard, within the floodway or subject to significant evacuation difficulties (H5 or H6 Life Hazard Classification)
- The **Flood Planning Area** extent is equivalent to the Medium Flood Risk Precinct extent, and includes the High Flood Risk Precinct within it. The mapped extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- None of these mapped extents include climate change.

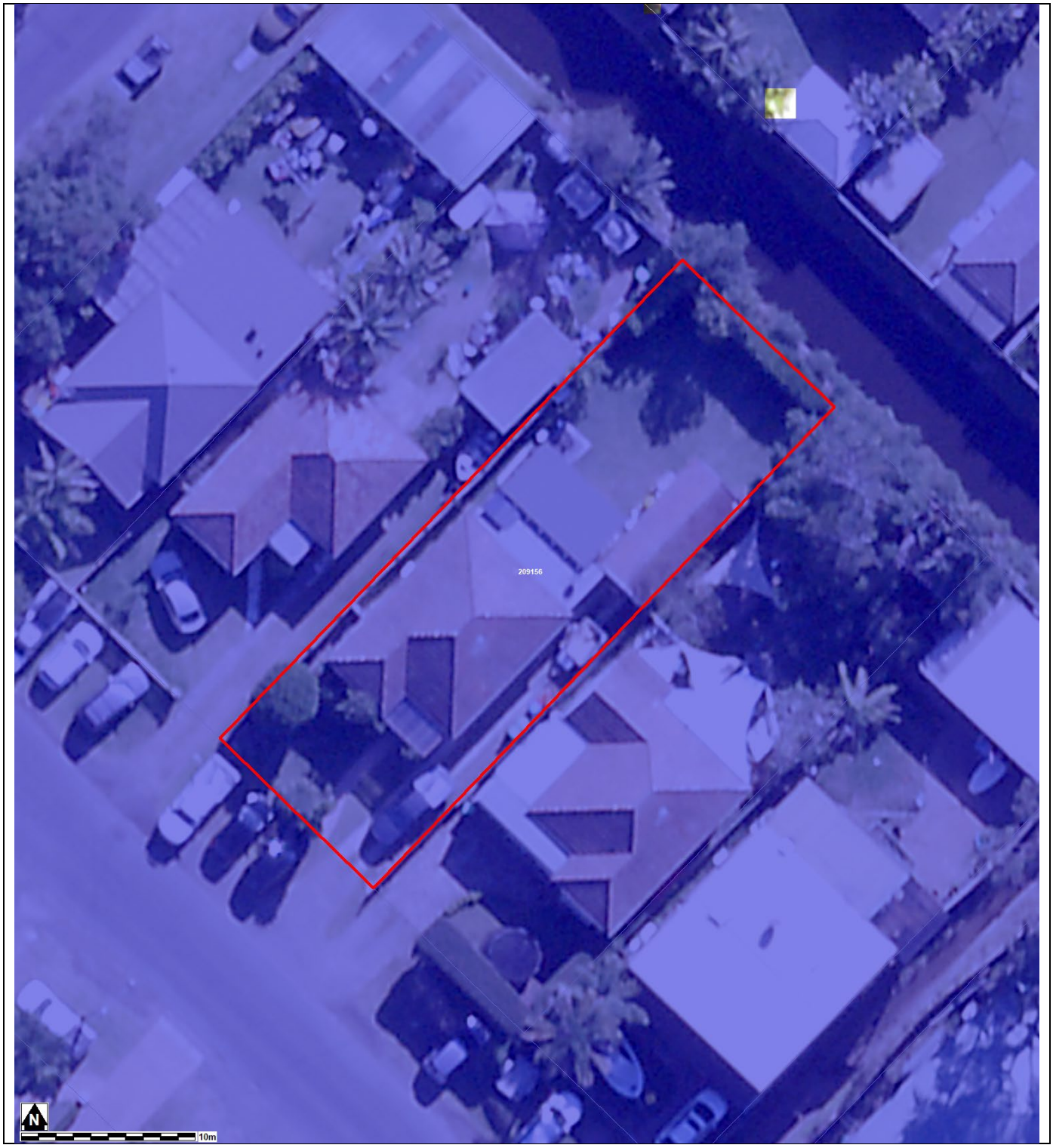
FLOOD MAP B: FLOODING - 1% AEP EXTENT



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Flood events exceeding the 1% AEP can occur on this site.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Narrabeen Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only.

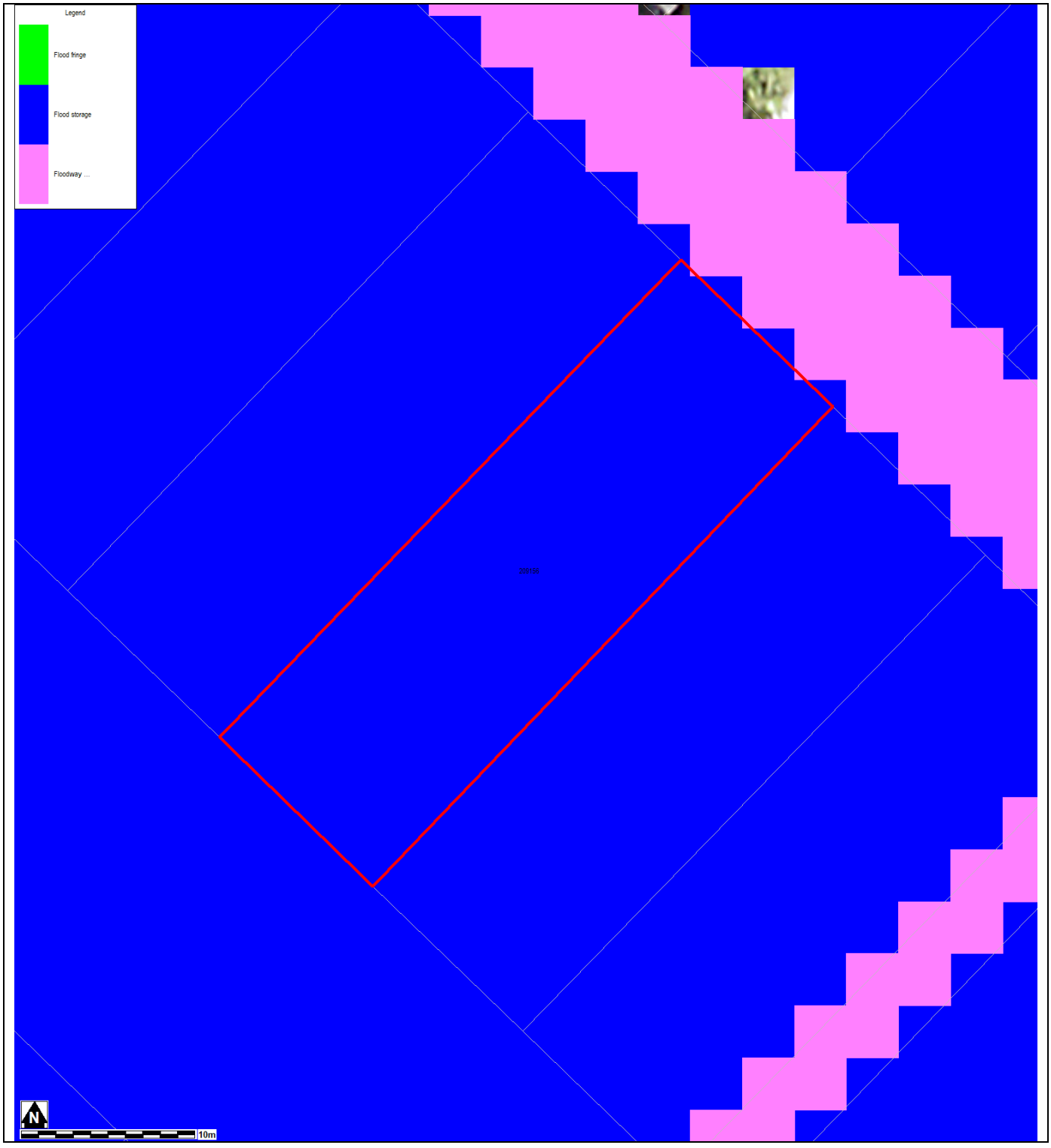
FLOOD MAP C: PROBABLE MAXIMUM FLOOD EXTENT



Notes:

- Extent represents the Probable Maximum Flood (PMF) flood event.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Narrabeen Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only.

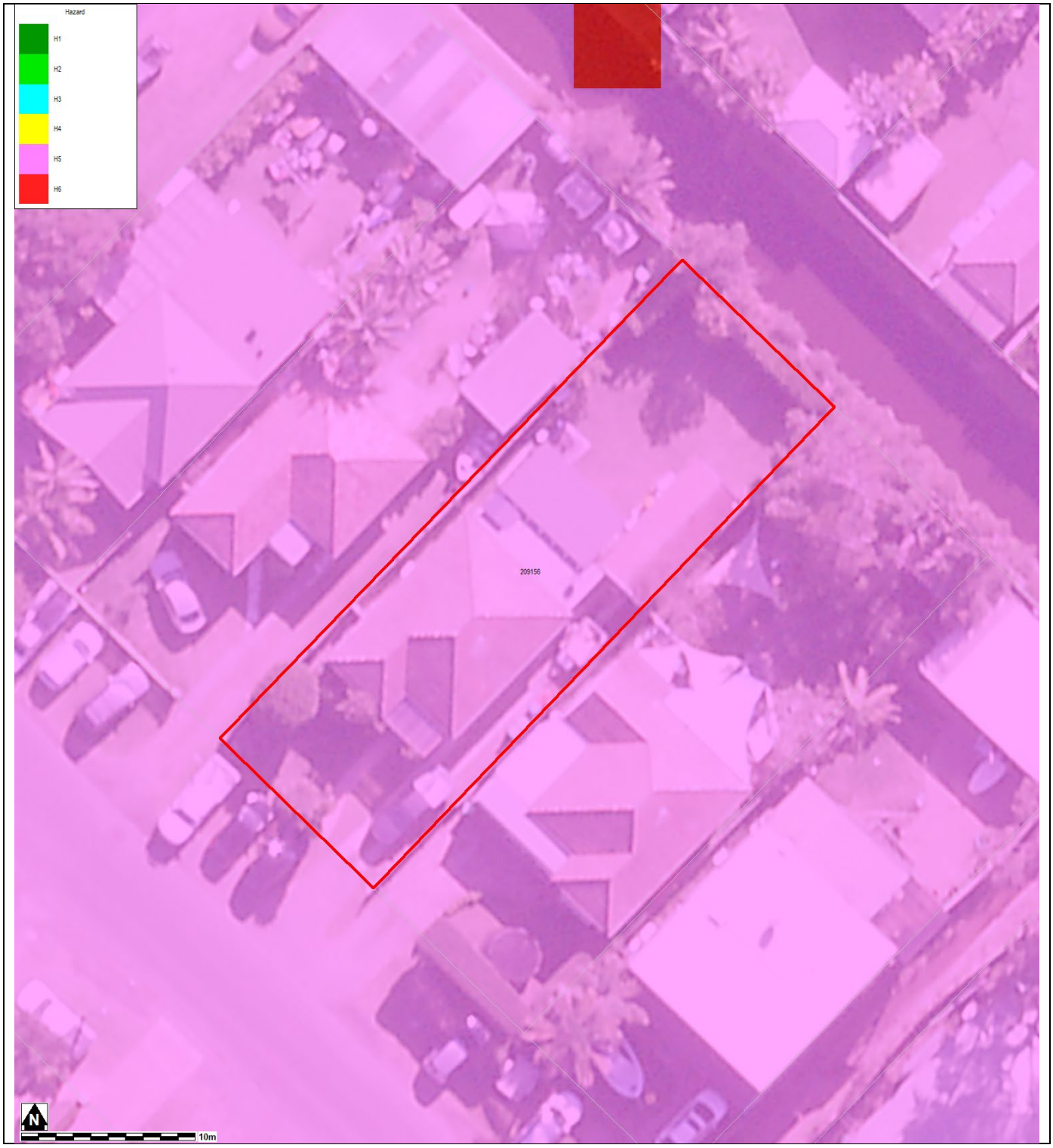
FLOOD MAP D: 1% AEP FLOOD HYDRAULIC CATEGORY EXTENT MAP



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Narrabeen Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only.

FLOOD MAP E: FLOOD LIFE HAZARD CATEGORY



Notes:

- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Narrabeen Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only.

Preparation of a Flood Management Report

Introduction

These guidelines are intended to provide advice to applicants on how to determine what rules apply on flood prone land, and how to prepare a Flood Management Report. The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood related planning requirements.

Planning Requirements for Flood Prone Land

Development must comply with the requirements for developing flood prone land set out in the relevant Local Environment Plan (LEP) and Development Control Plan (DCP). There are separate LEPs and DCPs for each of the former Local Government Areas (LGAs), although preparation of a LGA-wide LEP and DCP is currently under way.

The clauses specific to flooding in the LEPs and DCPs are as follows:

LEP Clauses	DCP Clauses
Manly LEP (2013) – 6.3 Flood Planning	Manly DCP (2013) – 5.4.3 Flood Prone Land
Warringah LEP (2011) – 6.3 Flood Planning Warringah LEP (2000) – 47 Flood Affected Land *	Warringah DCP (2011) – E11 Flood Prone Land
Pittwater LEP (2014) – 7.3 Flood Planning Pittwater LEP (2014) – 7.4 Flood Risk Management	Pittwater 21 DCP (2014) – B3.11 Flood Prone Land Pittwater 21 DCP (2014) – B3.12 Climate Change

* The Warringah LEP (2000) is relevant only for the “deferred lands” which affects only a very small number of properties, mostly in the Oxford Falls area.

Development on flood prone land must also comply with Council’s Water Management for Development Policy, and if it is in the Warriewood Release Area, with the Warriewood Valley Water Management Specification. Guidelines for Flood Emergency Response Planning are available for addressing emergency response requirements in the DCP. These documents can be found on Council’s website on the Flooding page.

Note that if the property is affected by estuarine flooding or other coastal issues, these need to be addressed separately under the relevant DCP clauses.

When is a Flood Management Report required?

A Flood Management Report must be submitted with any Development Application on flood prone land (with exceptions noted below), for Council to consider the potential flood impacts and applicable controls. For Residential or Commercial development, it is required for development on land identified within the Medium or High Flood Risk Precinct. For Vulnerable or Critical development, it is required if it is within any Flood Risk Precinct.

There are some circumstances where a formal Flood Management Report undertaken by a professional engineer may not be required. However the relevant parts of the DCP and LEP would still need to be addressed, so as to demonstrate compliance. Examples where this may apply include:

- If all proposed works are located outside the relevant Flood Risk Precinct extent
- First floor addition only, where the floor level is above the Probable Maximum Flood level
- Internal works only, where habitable floor areas below the FPL are not being increased

Note that development on flood prone land will still be assessed for compliance with the relevant DCP and LEP, and may still be subject to flood related development controls.

What is the purpose of a Flood Management Report?

The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood planning requirements, particularly the development controls outlined in the relevant LEP and DCP clauses. The report must detail the design, measures and controls needed to achieve compliance, following the steps outlined below.

A Flood Management Report should reflect the size, type and location of the development, proportionate to the scope of the works proposed, and considering its relationship to surrounding development. The report should also assess the flood risk to life and property.

Preparation of a Flood Management Report

The technical requirements for a Flood Management Report include (where relevant):

1. Description of development
   - Outline of the proposed development, with plans if necessary for clarity
   - Use of the building, hours of operation, proposed traffic usage or movement
   - Type of use, eg vulnerable, critical, residential, business, industrial, subdivision, etc

2. Flood analysis
   - 1% AEP flood level
   - Flood Planning Level (FPL)
   - Probable Maximum Flood (PMF) level
   - Flood Risk Precinct, ie High, Medium or Low
   - Flood Life Hazard Category
   - Mapping of relevant extents
   - Flood characteristics for the site, eg depth, velocity, hazard and hydraulic category, and the relevance to the proposed development

   If the property is affected by an Estuarine Planning Level (EPL) which is higher than the FPL, then the EPL should be used as the FPL. If the FPL is higher than the PMF level, then the FPL should still be used as the FPL, as it includes freeboard which the PMF does not.

3. Assessment of impacts

- Summary of compliance for each category of the DCP, as per the table below.

	Compliance		
	N/A	Yes	No
A) Flood effects caused by Development			
B) Building Components & Structural Soundness			
C) Floor Levels			
D) Car parking			
E) Emergency Response			
F) Fencing			
G) Storage of Goods			
H) Pools			

- Demonstration of how the development complies with any relevant flood planning requirements from the DCP, LEP, Water Management for Development Policy, and if it is in the Warriewood Valley Urban Land Release Area, with the Warriewood Valley Water Management Specification (2001)

- For any non-compliance, a justification for why the development should still be considered.
- Calculations of available flood storage if compensatory flood storage is proposed
- Plan of the proposed development site showing the predicted 1% AEP and PMF flood extents, as well as any high hazard or floodway affectation
- Development recommendations and construction methodologies
- Qualifications of author - Council requires that the Flood Management Report be prepared by a suitably qualified Engineer with experience in flood design / management who has, or is eligible for, membership to the Institution of Engineers Australia
- Any flood advice provided by Council
- Any other details which may be relevant

Further information and guidelines for development are available on Council's website at:

https://www.northernbeaches.nsw.gov.au/planning-and-development/building-and-renovations/development-applications/guidelines-development-flood-prone-land

Council's Flood Team may be contacted on 1300 434 434 or at floodplain@northernbeaches.nsw.gov.au .

Attachment A

NORTHERN BEACHES COUNCIL
STANDARD HYDRAULIC CERTIFICATION FORM
FORM A/A1 – To be submitted with Development Application

Development Application for

Address of site: 28 LIDO AVENUE, NTH NARRABEEN

Declaration made by hydraulic engineer or professional consultant specialising in flooding/flood risk management as part of undertaking the Flood Management Report:

I, DAMIEN SCHAEFER on behalf of TAYLOR CONSULTING ENGINEERS
(Insert Name) (Trading or Business/ Company Name)

on this the 31/10/22 certify that I am engineer or a
(Date)
professional consultant specialising in flooding and I am authorised by the above organisation/ company to issue this document and to certify that the organisation/ company has a current professional indemnity policy of at least $2 million.

***Flood Management Report* Details:**

Report Title:
FLOOD RISK MANAGEMENT REPORT

Report Date: 31/10/22

Author: DAMIEN SCHAEFER

Author's Company/Organisation: AS ABOVE

I: DAMIEN SCHAEFER
(Insert Name)

Please tick all that are applicable (more than one box can be ticked)

☑ have obtained and included flood information from Council (must be less than 12 months old) (**This is mandatory**)

☑ have followed Council's Guidelines for Preparing a Flood Management Report

☐ have requested a variation to one or more of the flood related development controls. Details are provided in the *Flood Management Report.*

Signature .....

Name DAMIEN SCHAEFER

Appendix D

EMERGENCY FLOOD RESPONSE PROCEDURE

Flood waters can rise very rapidly on this site

Once a warning is received for a possible flood or floodwaters start to inundate the roadway frontage or the eastern portion of the site:

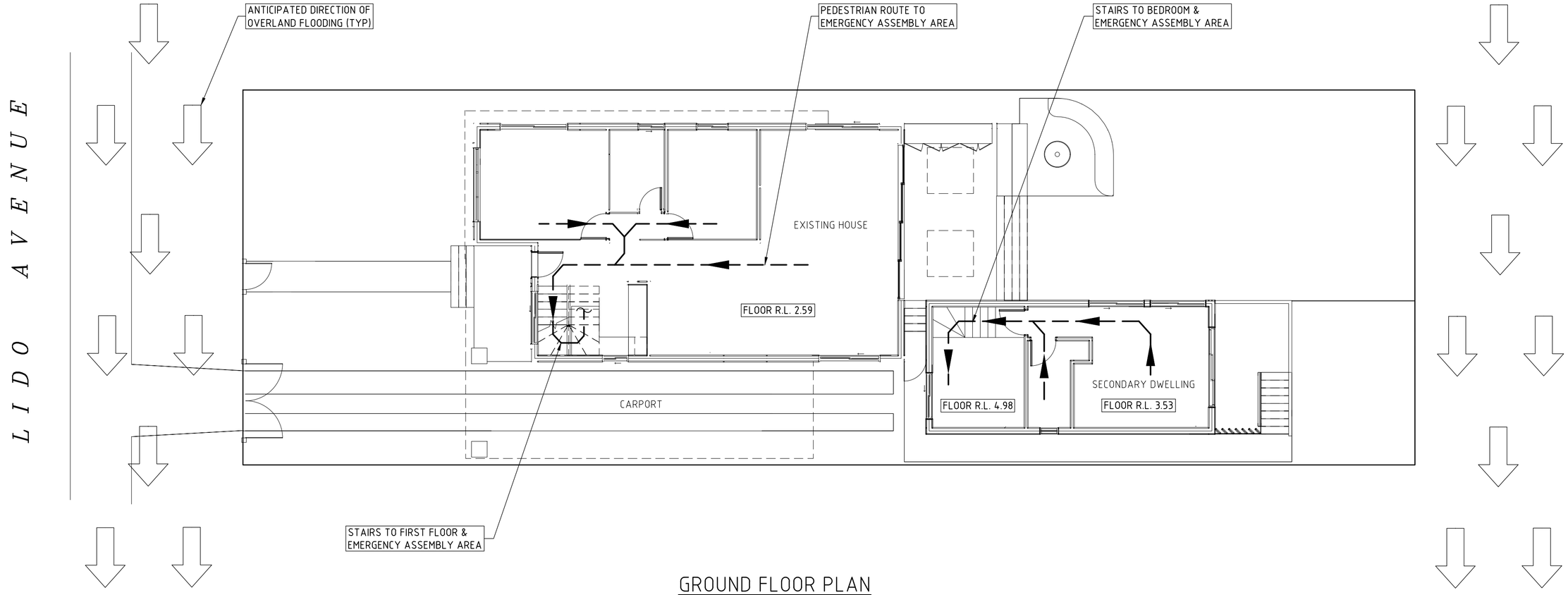
1. All residents should be at the assembly point by the time the flood waters are observed to have inundated the roadway frontage or eastern area of the site.
2. The Owner is to turn off all power, water and other relevant services.
3. Nominated occupants to sweep the promises to ensure that all occupants have sought refuge at the emergency assembly point.
4. Emergency services to be notified by The Owner of the situation at site.

THIS SITE CAN FLOOD

NEVER DRIVE, WALK OR RIDE THROUGH FLOODWATERS

When emergency services give the all clear to leave:

The site will only be opened for Occupants to leave once floodwaters have subsided and the emergency services have given the all clear.



GROUND FLOOR PLAN

SCALE 1:100
SHOWING EMERGENCY RESPONSE TRAVEL ROUTE

ISSUE DATE	REVISION

TITLE
FLOOD EMERGENCY RESPONSE PLAN
28 LIDO AVENUE, NORTH NARRABEEN

DRAWN	DATE	CHECKED	SCALE @ A2
CJM	20 OCTOBER 2022	BE Civil (Hons) MIE Aust.	1:100

TAYLOR CONSULTING
CIVIL & STRUCTURAL ENGINEERS

DRAWING NO
FLOOD–1/A

"Seascape" Suite 7 22-26 Fisher Rd Dee Why NSW 2099 | T 02 9982 7092 | F 02 9982 5898 | enquire@taylorconsulting.net.au | www.taylorconsulting.net.au

Appendix E

Flood Checklists

BEFORE A FLOOD

Trigger for action: Always

Action	Status
● All Occupants to be made aware of site flooding potential	
● Develop detailed emergency procedures, responsibilities and resources	
● Provide all Occupants with an emergency response plan and advise of their responsibilities and delegations	
● Maintain an emergency contacts list	
● Update emergency response procedures annually	

WHEN A FLOOD IS LIKELY

Trigger for action: When the forecasts predict severe weather or significant amounts of rainfall are observed:

Action	Status
● Monitor the severe weather forecasts and predictions	
● The Owner to monitor conditions at the rear of the site	
● The Owner to notify Occupants to proceed to the emergency response area	
● The Owner to shut off nominated services	

DURING A FLOOD

Trigger for action: When water is sighted ponding across the rear of the site:

Action	Status
● Emergency response to be undertaken in an orderly fashion	
● The phases of the emergency response shall be:	
➢ The Owner to request all occupants to proceed to the emergency assembly point.	
➢ All occupants should be at the assembly point by the time the flood waters reach the rear boundary of the site.	
➢ The Owner to sweep premises for remaining persons	
➢ The Owner to retreat to the emergency assembly area.	
● Emergency services to be notified by The Owner of the situation at site.	

Appendix F

Emergency Contacts

Organisation	Role	Contact
Emergency Services	Fire/ambulance/ police	000
Northern Beaches Council	Disaster Coordination Centre	9970 1111
State Emergency Service	SES Local Controller	132 500
Northern Beaches Hospital		02 9105 5000

Appendix G

Flood Compatible Materials and Building Components for New Works

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Flooring and Sub-floor Structure	▪ concrete slab-on ground monolith construction ▪ suspended reinforced concrete slab	Doors	▪ solid panel with water proof adhesives ▪ flush door with marine ply filled with closed cell foam ▪ painted metal construction ▪ aluminium or galvanised steel frame
Floor Covering	▪ clay tiles ▪ concrete, precast or in situ ▪ concrete tiles ▪ epoxy, form-in-place ▪ mastic flooring, formed in-place ▪ rubber sheets or tiles with chemical-set adhesives ▪ silicone floors formed in-place ▪ vinyl sheets or tiles with	Wall and Ceiling Linings	▪ fibro-cement board ▪ brick, face or glazed ▪ clay tile glazed in waterproof mortar ▪ concrete ▪ concrete block ▪ steel with waterproof applications ▪ stone, natural solid or veneer, waterproof grout ▪ glass blocks ▪ glass

	chemical-set adhesive ▪ ceramic tiles, fixed with mortar or chemical-set adhesive ▪ asphalt tiles, fixed with water resistant adhesive ▪ linoleum		▪ plastic sheeting or wall with waterproof adhesive
Wall Structure	▪ solid brickwork, blockwork, reinforced, concrete or mass concrete	Insulation Windows	▪ foam (closed cell types) ▪ aluminium frame with stainless steel ▪ rollers or similar corrosion and water resistant material
Roofing Structure (for Situations where the Relevant Flood Level is Above the Ceiling)	▪ reinforced concrete construction ▪ galvanised metal construction	Nails, Bolts, Hinges and Fittings	▪ brass, nylon or stainless steel ▪ removable pin hinges ▪ hot dipped galvanised steel wire, nails or similar.

Electrical and Mechanical Equipment For buildings constructed on land to which this Plan applies, the electrical and mechanical materials, equipment and Installation should conform to the following requirements.	Heating and Air Conditioning Systems Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the building above the relevant flood level. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.
Main power supply Subject to the approval of the relevant authority the incoming main commercial power service equipment including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the building from the main power supply.	Fuel Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.
Wiring All wiring, power outlets, switches, etc, should to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous	Installation The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the

components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conducts located below the relevant designated flood level should be so installed that they will be self draining if subjected to flooding.	fuel supply line. All storage tanks should be vented to the FPL.
Equipment All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	Ducting All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	Ancillary Structures (steps, pergolas, etc) Suitable water tolerant materials should be used such as reinforced concrete, masonry, sealed hardwood and corrosive resistant metals. Copper Chrome Arsenate (CCA) treated timber is not a suitable material.

Appendix H

TAYLOR
CONSULTING
CIVIL & STRUCTURAL ENGINEERS

31 October 2022

General Manager
Pittwater Council
PO Box 882
MONA VALE NSW 1660

Dear Sir/Madam,

Re: Structural Adequacy - 28 Lido Avenue, North Narrabeen

With reference to the Development Application for the above property, this letter is to advise that I have reviewed the approved plans and inspected the site with respect to the P.M.F. level of R.L. 4.98m A.H.D.

The dwelling will be undergoing significant structural alterations including new footings and framing support elements to ensure that the dwelling can be certified as being structurally adequate for the expected site conditions during a P.M.F. event.

This structural design approach will allow the proposed upper level addition to be utilised as a 'shelter-in-place' refuge during the P.M.F. event in accordance with Council's emergency response requirements.

Should you require any further information please contact the undersigned.

Yours faithfully
TAYLOR CONSULTING

D M SCHAEFER – Director
B.E. Civil (Hons) M.I.E. Aust N.E.R.

REGISTERED NER Engineers Australia