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21 June 2019
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Mr David Djuric
c/o Turnbull Planning International Pty Ltd
2301/4 Daydream Street
Warriewood NSW 2102

Dear David,

Subject: 19 Joseph Street, Avalon Beach - Flood Risk Assessment

1. Introduction

This assessment has been undertaken in support of the Application for a Building Certificate for unauthorised alterations and additions to the existing dwelling at 19 Joseph Street, Avalon Beach. The works are detailed on the architectural plans accompanying the DA; drawings A101 to A104 by Blue Sky Building Designs, dated 27 May 2019 and the site survey by DP Surveying, dated 20 May 2019. They include a replacement carport and a minor extension of the existing dwelling, opening to a timber deck adjacent.

2. Description of existing site and flood regime

The site is a battle-axe block covering 1,073m^2 and located on the eastern side of Joseph Street. The site is gently undulating, with levels varying from approximately RL 1.8m to RL 2.2m AHD and raised paved areas associated with the pool area and main dwelling at RL 2.4m AHD. The floor level of the dwelling and adjacent decks is at approximately RL 2.6m AHD.

Flood information for this assessment was provided by Northern Beaches Council on 23 May 2019, based on the *Avalon to Palm Beach Floodplain Risk Management Study and Plan*, 2017. The site is affected by low hazard flood conditions resulting from overbank flooding associated with Careel Bay.

Flood level information applicable to 19 Joseph Street is summarised in Table 1.

Table 1 *Flood information*

Design flood level (1% AEP/1 in 100 year ARI)	2.40m AHD
Freeboard	0.5m
Flood Planning Level (FPL)	2.9m AHD
Probable Maximum Flood (PMF)	2.57m AHD
Flood Risk Planning Precinct	Low - Medium
Flood Life Hazard Category	H1 – H4
Flood Classification	Flood storage

The flood risk assessments for the entire site during the 1% AEP and PMF events are tabulated below.

Table 2 Flood Risk Assessment – 1% AEP event – flood level 2.40m AHD

Hazard	Likelihood	Consequence	Risk Level
Person in dwelling being impacted by floodwaters	5	Minor	Low
Persons entering floodwaters on property	1	Moderate	Medium
Dwelling being impacted by floodwaters – structural viability	1	Moderate	Medium
Vehicles being impacted by floodwaters	1	Moderate	Medium
Floodwaters entering carport/garage	1	Moderate	Medium
Floodwaters entering dwelling	5	Minor	Low

Table 3 Flood Risk Assessment – PMF event – flood level 2.57m AHD

Hazard	Likelihood	Consequence	Risk Level
Person in dwelling being impacted by floodwaters	5	Minor	Low
Persons entering floodwaters on property	1	Moderate	Medium
Dwelling being impacted by floodwaters – structural viability	1	Moderate	Medium
Vehicles being impacted by floodwaters	1	Moderate	Medium
Floodwaters entering carport/garage	1	Major	High
Floodwaters entering dwelling	5	Minor	Low

The identification of significant risk level categories during the PMF event has necessitated the preparation of this Flood Risk Emergency Assessment.

3. Description of development and impact on local flood behaviour

The original approved development on the site comprised a single storey, three bedroom timber cottage with a swimming pool, shed and a carport located over a portion of the driveway access. The dwelling has been constructed on brick foundations with a largely enclosed subfloor to a floor level of RL 2.60m AHD. The shed and carport were installed at the natural ground level, while the swimming pool coping and adjacent paved area has been raised 200mm to 300mm above the natural ground level to RL 2.4m AHD. The development would be categorised as *Residential* land-use for the purposes of a flood risk assessment under Council's Development Control Plan.

A 22.5m^2 extension (as surveyed) has been added to the northern side of the existing dwelling, with internal access to provide additional space and improve the amenity of the small adjacent bedroom, and external access to a new 7m^2 covered timber deck so the bedroom could be independently accessed and used for an elderly relative. Consideration for a reduced Flood Planning Level is sought as the extension has been constructed to the same floor level as the existing dwelling (RL 2.60m AHD), with the deck slightly lower at RL 2.59m AHD. While this does not satisfy the Flood Planning Level (FPL) of 2.90m AHD, it does provide 200mm freeboard to the 1% AEP flood event and is 30mm higher than the predicted PMF level of 2.57m AHD. Given that the extension is located beyond the mapped extent of the 1% AEP flood, and that the maximum predicted 1% AEP flood depth on the site is 300mm, it is considered that a reduced freeboard standard would not present an excessive risk to the development.

With respect to the DCP requirements for floor levels within the medium flood risk precinct, the FPL is 300mm higher than the floor levels of the existing dwelling. Two steps would have been required to access the extension from the existing bedroom, making it incompatible for the intended use by an elderly relative. The extension is a one-off addition of 22.5m^2, although 14% of the internal floor space and is located beyond the extent of the identified flood fringe area.

The original 15m^2 carport has been demolished and a new 42m^2 replacement carport has been partly constructed. The original carport is reported to have been supported by six, nominally 125mm square corner posts, replaced by eight 125mm square timber posts on steel brackets. The ground level within the carport is generally RL 2.2m AHD (the lower levels indicated on the survey generally reflect ground levels that have been excavated for the post footings and are yet to be backfilled), so the depth of flooding during the 1% AEP event would not be expected to exceed 200mm. This would generally be considered to be safe for vehicles. Nevertheless, the carport is located within the "handle" of the battle-axe and flanked by boundary fences to the north and south and access gates to the east and west that would impede the passage of a vehicle made buoyant by floodwaters.

The foundations for all works have been constructed at approximately the adjacent ground level and would have minimal impact on flood storage and conveyance. The subfloor structure of the extension is open to allow for the unimpeded passage of floodwaters. The demolition and removal of the existing carport and removal of vegetation and levelling of the ground surface at the location of the extension would mitigate the impact of the works on the available flood storage during the 1% AEP event and it is not expected therefore that the works would have a significant impact on the existing flood regime. Calculations of the impact of the works on flood storage are presented in Figure 1 and summarised in Table 4.

All works below the PMF have been constructed from flood compatible materials and have been reviewed by a structural engineer to confirm their suitability to withstand the hydraulic forces from the 1% AEP and PMF flows (Taylor Consulting, 20 June 2019). The requirements of the DCP as they relate to the works are summarised in Appendix A.

Table 4 *Impact of proposed works on flood storage volume within 1% AEP extent*

Construction element	Approx flood volume
Levelling of subfloor and removal of vegetation	-1.50m^3
Demolition of existing carport	-0.02m^3
Total demolition and removal	**-1.52m^3**
Construction of studio and deck	+0.75m^3
Construction of new carport	+0.03m^3
Total construction	**+0.78m^3**

4. Evacuation Response and Shelter-In-Place Development Controls

The site lies within the floodplain on the south-eastern side of Careel Bay, in an area designated low hazard flood fringe and predominantly characterised by the backwater effects of the tidal outlet to Pittwater. Due to the relatively small catchment area, the predicted critical flood durations are up to two hours, indicating that the catchment is prone to flash flooding and there will be very limited notice that can be provided to prepare for a significant flood event.

Both the original dwelling and the extension have been constructed above the PMF level, providing a suitable option for residents to "shelter in place" during significant flood events. The available flood refuge area has three bedrooms, two bathrooms, a kitchen and living areas with a minimum floor level 30mm higher than the PMF level. The prescriptive controls required to satisfy Council's shelter in place requirements are summarised in Table 5.

Figure 1 Flood storage encroachments and compensations

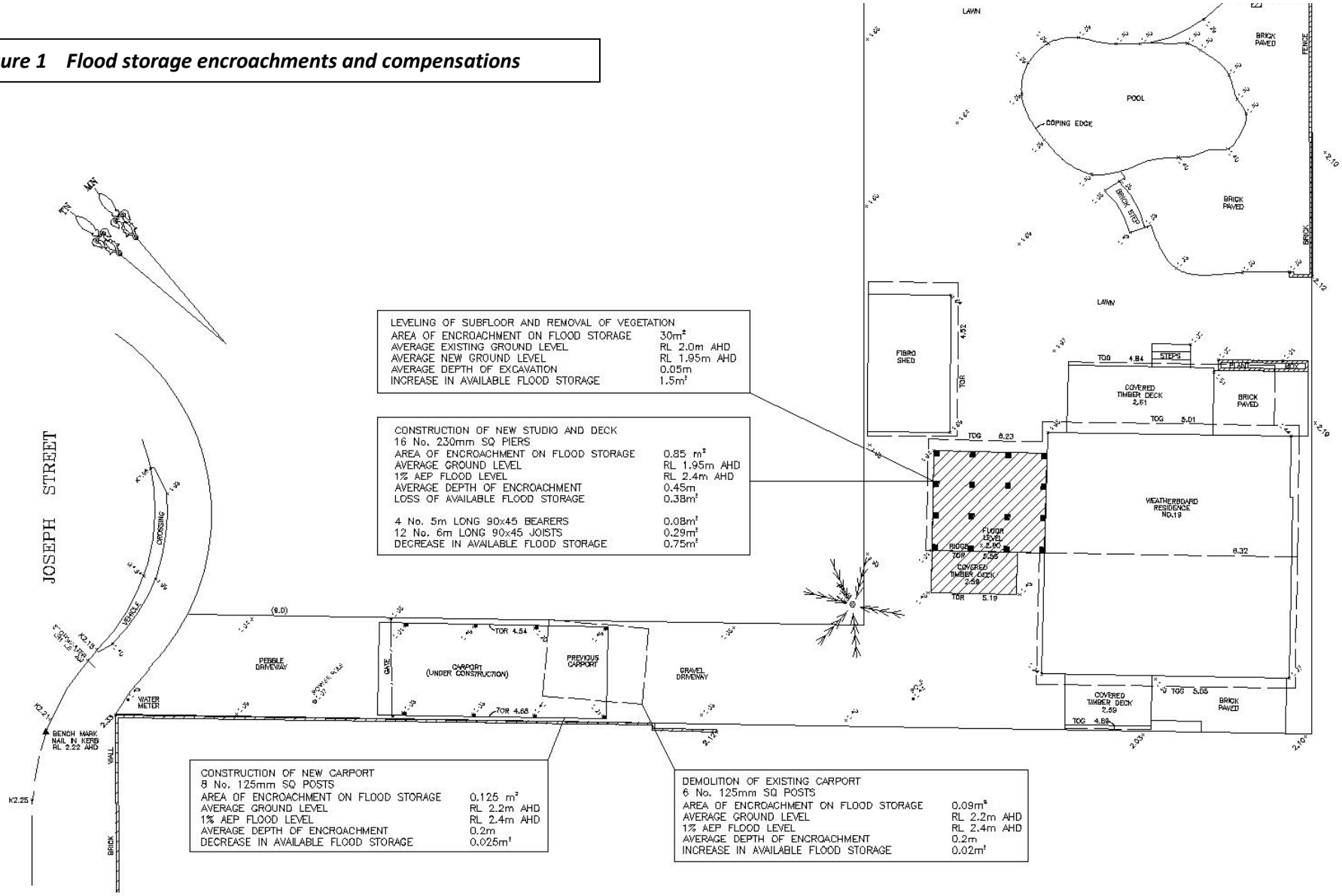

Table 5 Shelter-in-Place Requirements

Land Use Group	Residential
Control 1 – Flood Risk Emergency Assessment	Accompanying report prepared
Control 2 – Minimum Floor Level	The floor level (FFL 2.60m AHD) provides 30mm freeboard to the PMF level and an extensive shelter-in-place refuge.
Control 3 – Floor Space Requirement	The dwelling is located above the PMF level, providing a shelter-in-place refuge area suitable for either long or short duration flood events. The total internal floor area exceeds 100m^2, providing ample floor space per resident for a three bedroom plus studio home.
Control 4 – Accessibility	The flood refuge area can be accessed from the driveway access and rear garden.
Control 5 – Building Stability	The building would be able to withstand the flood effects of the PMF design flood depths and velocities.
Control 6 – Serviceability	The shelter-in-place refuge (the dwelling) should be fitted with the following emergency items: • sufficient clean water for all occupants; and • portable radio with spare batteries; and • torch with spare batteries; and • first aid kit.

5. Conclusion

The completed extension and the carport under construction at 19 Joseph Street, Avalon Beach are not expected to have a significant impact on upstream or downstream flood levels, flow velocities or distribution, flood response or the safe evacuation of the property or neighbourhood. A flood refuge would be available to accommodate residents during extreme flood events and the intent of most of the prescriptive controls of Northern Beaches (Pittwater) Council's shelter in place requirements can be satisfied by the proposal, with consideration requested for a reduction in the Flood Planning Level to facilitate practical continuity of the 22.5m^2 addition with the rest of the dwelling. The constructed floor level provides 30mm freeboard to the PMF and is 200mm above the predicted 1% AEP flood level in a low hazard, flood fringe area. Conceivably, the extension could be described as foyer to the existing bedroom, in which case it would comply under section F9 of the flood risk requirements.

Please do not hesitate to contact me if you have any queries regarding the above assessment.

Yours sincerely,

Kate Waddington
BE(Hons) MEngSci (Water Resources)
MIEAust CPEng NER

Appendix A *Medium Flood Risk Planning Precinct Requirements – Residential Land Use*

Planning Consideration		Assessment
A Flood effects caused by development		
1	Development (including earthworks and subdivision) shall not be approved unless it can be demonstrated in a Flood Management Report that it complies with the *Flood Prone Land Design Standard* found on Council's webpage.	It is not expected that the development would have had a significant impact on the 1% AEP flood characteristics.
3	The applicant shall include in their submission, calculations to illustrate that any fill or other structures that reduce the total flood storage are replaced by compensatory works.	The works would generally have been offset by the removal of the existing vegetation and carport and are not expected to have made a significant difference to the available flood storage on the site. Options for providing additional flood storage are available if required. Refer to Figure 1 and Table 4 for details.
B Drainage infrastructure and creek works		
1	Flood mitigation works or stormwater devices that modify a major drainage system, stormwater system, natural water course, floodway or flood behaviour within or outside the development site may be permitted subject to demonstration through a Flood Management Report that they comply with the *Flood Prone Land Design Standard* found on Council's webpage.	No modifications to drainage infrastructure or natural watercourses are proposed.
2	A Section 88B notation under the Conveyancing Act 1919 may be required to be placed on the title describing the location and type of flood mitigation works with a requirement for their retention and maintenance.	No flood mitigation works proposed other than the demolition of existing structures as compensatory works.
C Building components and structural		
1	All buildings shall be designed and constructed as flood compatible buildings in accordance with *Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas*, Hawkesbury-Nepean Floodplain Management Steering Committee (2006).	The building has been constructed from flood compatible materials below the PMF level and would withstand the forces of the PMF flood.
2	All structures 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. Structural certification shall be provided confirming the above. Where shelter-in-place refuge is to be provided the structural integrity is to be to the Probable Maximum Flood level.	
3	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.	All electrical fittings and inlets to service pipework are at least 240mm above the FFL of 2.6m AHD. This places them above the PMF level and provides 440mm freeboard to the 1% AEP flood level.

Planning Consideration		Assessment
D Storage of Goods		
1	Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards.	Storage facilities for hazardous or potentially polluting materials are available above the PMF level.
2	Goods, materials or other products which may be highly susceptible to water damage are to be located/stored above the Flood Planning Level.	Storage areas are available above the PMF level.
E Flood Emergency Response		
1	Development shall comply with Council's *Flood Emergency Response Planning for Development in Pittwater* Policy and the outcomes of any Flood Risk Emergency Assessment Report where it applies to the land.	Refer to Section 4 of this report.
2	New development must provide an appropriately sized area to safely shelter in place above the PMF level and appropriate access to this area should be available from all areas within the development.	Occupants would be able to safely shelter in place for events up to and including the PMF.
F Floor Levels		
1	New floor levels within the development shall be at or above, the FPL. A reduced Flood Planning Level may be considered only where it is permitted in this Development Control Plan. The structure must be flood proofed (wet or dry) to the Flood Planning Level. This control cannot be applied to critical or vulnerable uses.	New floor levels are located above the PMF level and the structure is floodproofed to the PMF level and 200mm above the 1% AEP flood level.
2	All development structures must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no loss of flood storage in a 1% AEP Event. Where the dwelling is located over a flow path it must be elevated on suspended pier/pile footings such that the level of the underside of all floors including balconies and decks within the flood affected area are at or above, or raised to the Flood Planning Level to allow clear passage of the floodwaters under the building. The development must comply with the *Flood Prone Land Design Standard*.	The studio and deck extension has been constructed with suspended flooring over piered columns such that the substructure would allow the clear passage of the floodwaters in compliance with the *Flood Prone Land Design Standard.*
3	Where the lowest floor has been elevated to allow the passage of flood waters, a restriction shall be imposed on the title of the land, pursuant to S88B of the Conveyancing Act confirming that the undercroft area is not to be enclosed.	No enclosure of undercroft proposed.

	Planning Consideration	Assessment
	F Floor Levels	
4	A one- off addition or alteration below the Flood Planning Level of less than 30 square metres or an increase of less than 10% of the ground floor area (whichever is the lesser) for residential development may be considered only where: (a) it is an extension to an existing room (b) the Flood Planning Level is incompatible with the floor levels of the existing room This control will not be permitted if this provision has previously been utilised since the making of this Plan. The structure must be flood proofed to the Flood Planning Level.	The extension (internal and external) totals 29.5m^2, or 17% of the total 176.6m^2 building footprint. Excluding the external decks, the 22.5m^2 bedroom (foyer) extension comprises 16% of the 141.3m^2 internal floor space and is intended to improve the amenity of the adjacent bedroom, which is very small. Consideration of a reduced FPL is requested as the floor levels are above the PMF level, the site is in a flood fringe area, the predicted flood depths are minor and, as a consequence, the FPL is considered overly conservative in this case.
6	Any existing floor level may be retained below the Flood Planning Level when undertaking a first floor addition provided that: (a) it is not located within a floodway; (b) there is no increase to the building footprint below the Flood Planning Level; (c) it is flood proofed to the Flood Planning Level;	Not applicable – no first floor addition proposed.
8	The minimum floor level of any first floor additions shall be at or above the PMF level.	Not applicable – no first floor addition proposed.
9	Foyers – consideration may be given to a minimum floor level of a foyer being set at the 5% AEP flood level, provided it can be demonstrated that it complies with the *Flood Prone Land Design Standard*.	The extension may be considered as a foyer entry to the existing bedroom and complies with the *Flood Prone Land Design Standard*.
	G Car parking	
1	Open carpark areas and carports shall not be located within a floodway.	The carport is located within a flood fringe area, not within a floodway.
2	The lowest floor level of open carparks and carports (unroofed or with open sides) shall be constructed no lower than the natural ground levels.	The carport has been constructed at the adjacent natural ground level.
3	All enclosed car parks must be protected from inundation up to the relevant flood planning level. For example, basement carparks must be provided with a crest at the entrance, the crest of which is at the relevant Flood Planning Level. All access, ventilation and any other potential water entry points to any enclosed car parking shall be above the relevant Flood Planning Level. Council will not accept any options that rely on electrical, mechanical or manual exclusion of the floodwaters from entering the enclosed carpark.	Not applicable.
5	Enclosed Garages must be located at or above the 1% AEP level.	Not applicable.
6	Carports must comply with the *Flood Prone Land Design Standard*.	The carport has been constructed of flood compatible materials (timber posts on steel footings) with an open design for the free passage of floodwaters between the existing natural ground level and the Flood Planning Level.

Planning Consideration		Assessment
G Car parking		
7	Where a driveway is required to be raised it must be demonstrated that there is no loss to flood stage in the 1% AEP flood event and no impact on flood conveyance through the site.	Not applicable.
8	Multi Dwelling Housing and Shop Top Housing residential carparking – consideration may be given to a minimum floor level for open or covered carparking being set at the 5% AEP flood level, provided it can be demonstrated that it complies with the *Flood Prone Land Design Standard*.	Not applicable.
H Fencing		
1	Fencing, including pool fencing, shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. Appropriate fencing must comply with the *Flood Prone Land Design Standard* in addition to other regulatory requirements of pool fencing.	Not applicable – no new fencing proposed.
I Pools		
1	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.	Not applicable – the existing pool has been previously approved.