



Prime Consulting Engineers Pty. Ltd.

**FLOOD STUDY USING HEC-RAS
FOR RESIDENTIAL DEVELOPMENT
AT
20 The Esplanade
NARRABEEN NSW 2101**

Ref: R-22-261-1A

Date: 07/10/2022

Amendment: -

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Dear Mr Jason Smith,

Re: **Flood Study – Demolition of Existing Structures & Construction of a New 2-Storey Dwelling and Swimming Pool at 20 The Esplanade Narrabeen NSW 2101**

1 Introduction

Prime Consulting Engineers has been engaged by Shobha Designs to prepare a Flood study report using HEC-RAS for development of new Two Storey Dwelling and Swimming Pool at 20 The Esplanade Narrabeen NSW 2101 in respect to flood during an ARI 1:100 rainfall events (1% AEP).

We can confirm that we have reviewed the existing survey levels, existing site plan and new development plan to prepare the flood modeling for existing and post development condition using HEC-RAS.

At present there is a double-storey house at the property. The proposal is to demolish the existing dwelling and build a new two storey house with a swimming pool. See **Appendix A** for the proposed site plan and elevation/sections.



Figure 1 : Aerial Map of 20 The Esplanade Narrabeen NSW

2 Report

The purpose of this Flood Study is to establish a 1% AEP flood level at the site for the existing condition using HEC-RAS modeling and compare it with the new post-Development 1% AEP flood level and check the compliance of development with councils Control A2 & C3 listed in Section E11 of the Warringah DCP. This flood report is required as part of documentation for submission for development application.

The resources used for the preparation of this report are:

1. Architectural Plan provided by Shobha Designs (Issue A dated 14/07/2022) **Ref. Appendix A.**
2. Site Survey prepared by Vertex Surveyors (Job No 22039 Issue A dated 14.02.2022) **Ref. Appendix B.**
3. Contour Maps provided by Northern Beaches Council **Ref. Appendix C.**
4. Flood Information Report issued by Northern Beaches Council issued on 14.03.2022. **Ref. Appendix D.**
5. Section E11 of the Warringah DCP.
6. **HEC-RAS Software.**

As per the flood information report issued by Northern Beaches Council, the existing property is flood affected, with High Flood Risk Precinct at the front, Medium Flood Risk Precinct in the middle and Low Flood Risk Precinct at the rear.

1. Flood Effects: The proposed development is a new two storey dwelling and a swimming pool. The property is affected by the 1% AEP and PMF event. 1% AEP and PMF event affects the northern boundary of property. There is no effect of 1% AEP and PMF at the rear of property. The flood levels at different location of development for 1% AEP and PMF is attached with this report on Appendix A.
2. Floor Levels: As per the report received from the council, the 1% AEP Maximum Water level is 3.05 mAHD and PMF Maximum water Level is 5.02 mAHD. The habitable area of the ground floor level of the development is proposed to be at 3.55 mAHD which is 500mm higher than the 1% AEP level. The floor level for the garage and porch (non-habitable area) is 3.19 mAHD and 3.40 mAHD respectively which is at least 300 mm higher than the 1% AEP flood level.

HEC-RAS MODEL

HEC-RAS was used to model the existing and post developed condition of the site to calculate the overland flood level due to the 1% AEP storm event at the site. The catchment area of 3.462 ha was used to calculate the discharge.

The catchment map is attached below:



Figure 2 : Catchment Map

There is a council stormwater pipe system running throughout the western side and southern side of the catchment (**Ref Appendix C**). We have assumed that this pipe picks up 50% of the storm water (from roof area of the houses) at the catchment. Rest of the discharge is assumed to pass through the **property no 14,16,18,20 & 22** at the lower end of the catchment (northern side) to the Narrabeen Lagoon. So, the **effective catchment area(A) = $3.462/2 = 1.731$ ha**

Duration	Annual Exceedance Probability (AEP)						
	63.2%	50%#	20%*	10%	5%	2%	1%
5 min	98.5	110	147	172	198	233	261
6 min	93.5	104	140	165	190	224	252
10 min	78.1	87.6	118	140	162	192	216
20 min	56.3	63.2	85.5	101	117	139	156
30 min	44.7	50.1	67.4	79.6	91.9	109	122
1 hour	28.8	32.1	42.6	50.0	57.4	67.5	75.6
2 hour	18.1	20.0	26.2	30.6	35.0	41.2	46.1
3 hour	13.8	15.2	19.8	23.1	26.5	31.2	35.0
6 hour	8.74	9.64	12.6	14.8	17.1	20.3	22.9

Figure 3 : 1% Annual Exceedance Probability (AEP) table

The **Run-off coefficient (C)** for the site is assumed to be **0.4**.

The Design Rainfall Data System (2016) from BOM,

Maximum rainfall intensity (I) for 1% AEP event is **261 mm/hr**.

Based on the parameters described above:

The total Discharge through Property no 14,16,18,20 & 22 is:

$$Q_o = CIA/360 = 0.4 \times 261 \times 1.731 / 360 = 0.501 \text{ m}^3/\text{s}$$

So, the net discharge through 20 The Esplanade Narrabeen (**Qnet**) = $0.501/5 = 0.10 \text{ m}^3/\text{s}$

Pre-Development Site Modeling

The cross sections along the Stations 1 to Section 9 as shown in the predevelopment plan attached was plotted in HEC-RAS and the discharge of 0.1 m³/s was introduced to calculate the overland flood level for 1% AEP. The section through the stations is attached with this report.

Ref. Appendix E

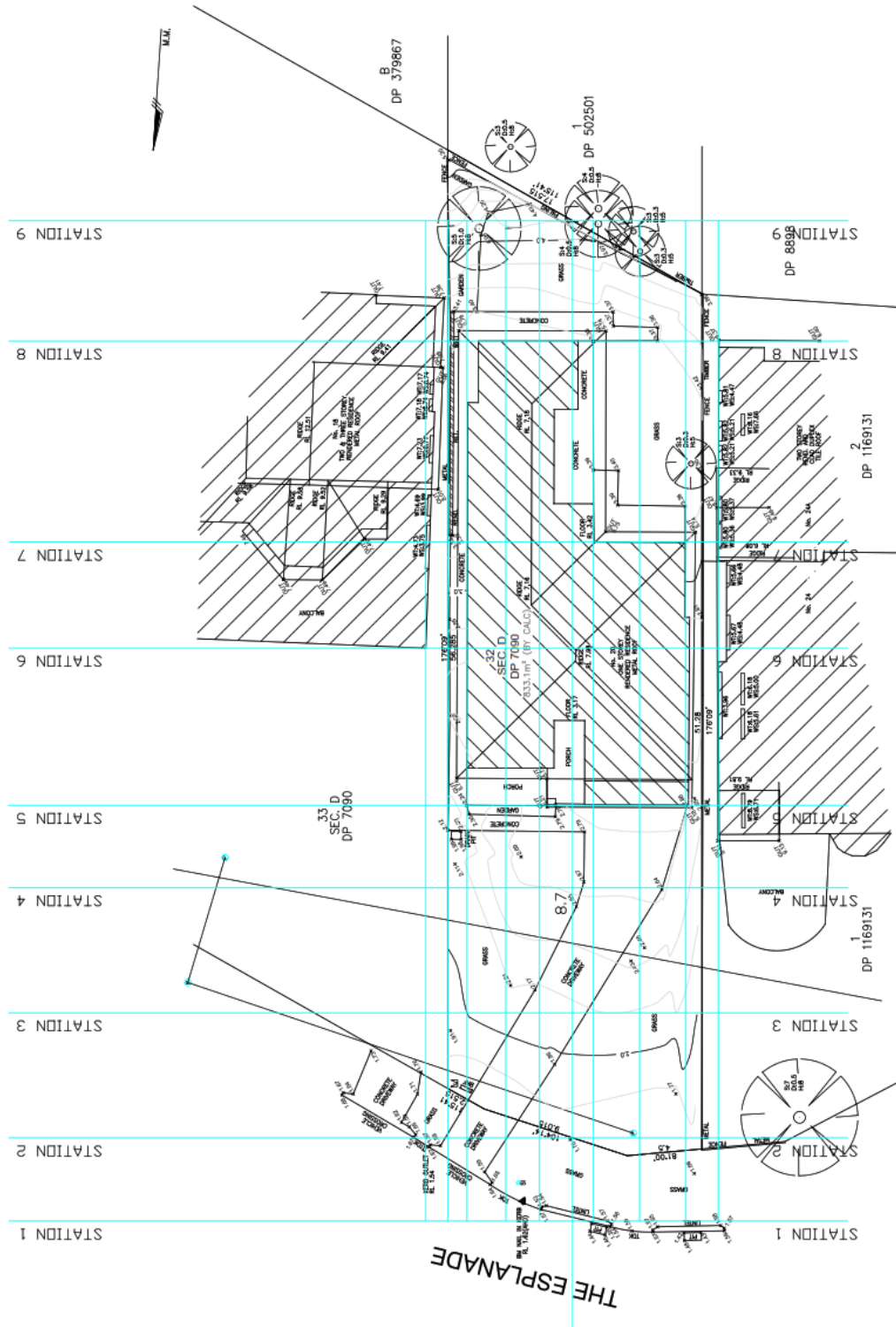


Figure 4 : Predevelopment Plan

Post Development Site Modeling

The cross sections along the Stations 1 to Section 9 as shown in the predevelopment plan attached was plotted in HEC-RAS and the discharge of 0.1 m³/s was introduced to calculate the overland flood level for 1% AEP. The section through the stations is attached with this report.

Ref. Appendix E

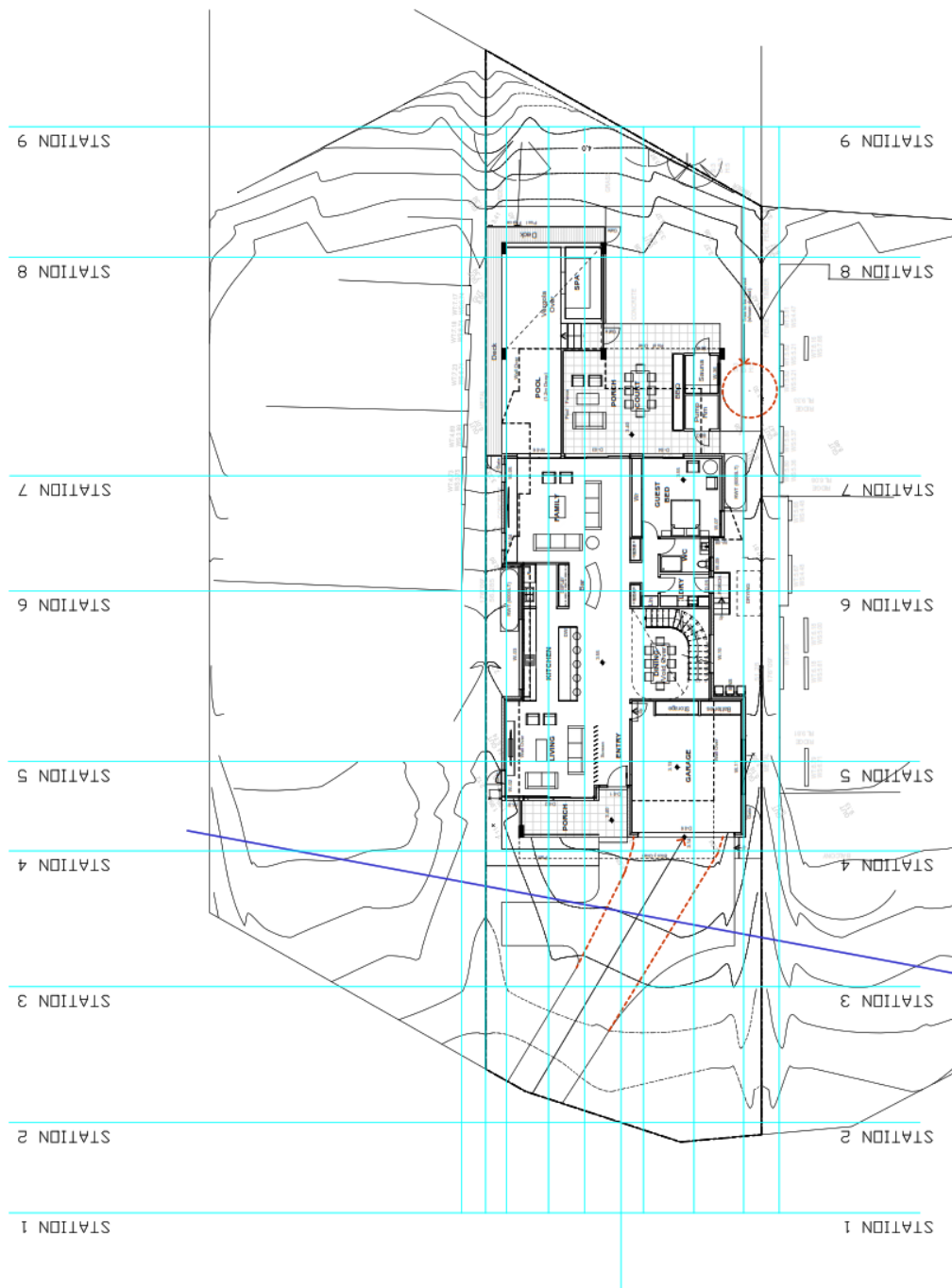


Figure 5 : Post Development Site Plan

The result from the HEC-RAS is summarized in the report below:

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Plan p02 River: Flood Water Reach: 20 The Esplanade Profile: PF 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
20 The Esplanade	60	PF 1	0.10	4.20	4.25	4.25	4.28	0.025364	0.64	0.16	3.74	1.00
20 The Esplanade	8	PF 1	0.10	3.40	3.44	3.44	3.45	0.020519	0.50	0.20	5.88	0.86
20 The Esplanade	7	PF 1	0.10	3.00	3.11	3.11	3.15	0.024573	0.79	0.13	2.00	1.01
20 The Esplanade	6	PF 1	0.10	2.63	2.69	2.69	2.71	0.027107	0.61	0.16	4.28	1.00
20 The Esplanade	5	PF 1	0.10	2.20	2.28	2.27	2.30	0.015739	0.66	0.15	2.37	0.83
20 The Esplanade	4	PF 1	0.10	2.10	2.19	2.19	2.21	0.026214	0.66	0.15	3.32	0.99
20 The Esplanade	3	PF 1	0.10	1.80	1.95	1.95	1.97	0.029542	0.73	0.14	2.78	1.06
20 The Esplanade	2	PF 1	0.10	1.67	1.72	1.71	1.72	0.018278	0.31	0.32	17.60	0.74
20 The Esplanade	1	PF 1	0.10	1.57	1.59	1.59	1.59	0.035847	0.38	0.26	17.60	1.00

Figure 6 : Pre-Development HEC-RAS Result

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Plan p02 River: Flood Water Reach: 20 The Esplanade Profile: PF 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
20 The Esplanade	60	PF 1	0.10	4.20	4.25	4.25	4.28	0.025364	0.64	0.16	3.74	1.00
20 The Esplanade	8	PF 1	0.10	3.40	3.45	3.45	3.46	0.020095	0.53	0.19	4.84	0.87
20 The Esplanade	7	PF 1	0.10	3.00	3.11	3.11	3.15	0.024544	0.79	0.13	2.00	1.01
20 The Esplanade	6	PF 1	0.10	2.65	2.70	2.70	2.72	0.031114	0.62	0.16	4.60	1.06
20 The Esplanade	5	PF 1	0.10	2.20	2.28		2.30	0.015970	0.66	0.15	2.37	0.83
20 The Esplanade	4	PF 1	0.10	2.10	2.19	2.19	2.21	0.026237	0.66	0.15	3.32	0.99
20 The Esplanade	3	PF 1	0.10	1.80	1.95	1.95	1.97	0.025592	0.70	0.14	2.82	0.99
20 The Esplanade	2	PF 1	0.10	1.67	1.72	1.71	1.72	0.018017	0.31	0.32	17.60	0.73
20 The Esplanade	1	PF 1	0.10	1.57	1.59	1.59	1.59	0.036067	0.38	0.26	17.60	1.00

Figure 7 : Post Development HEC-RAS Result

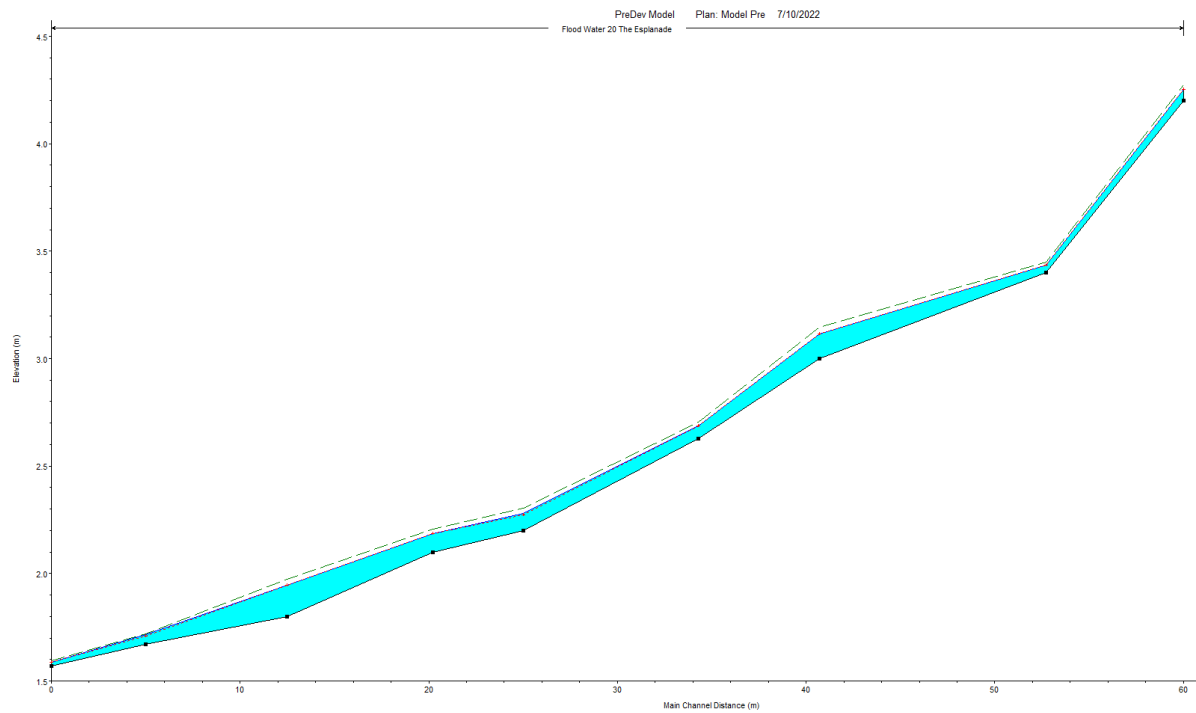


Figure 8 : Water Surface Profile Pre-Development

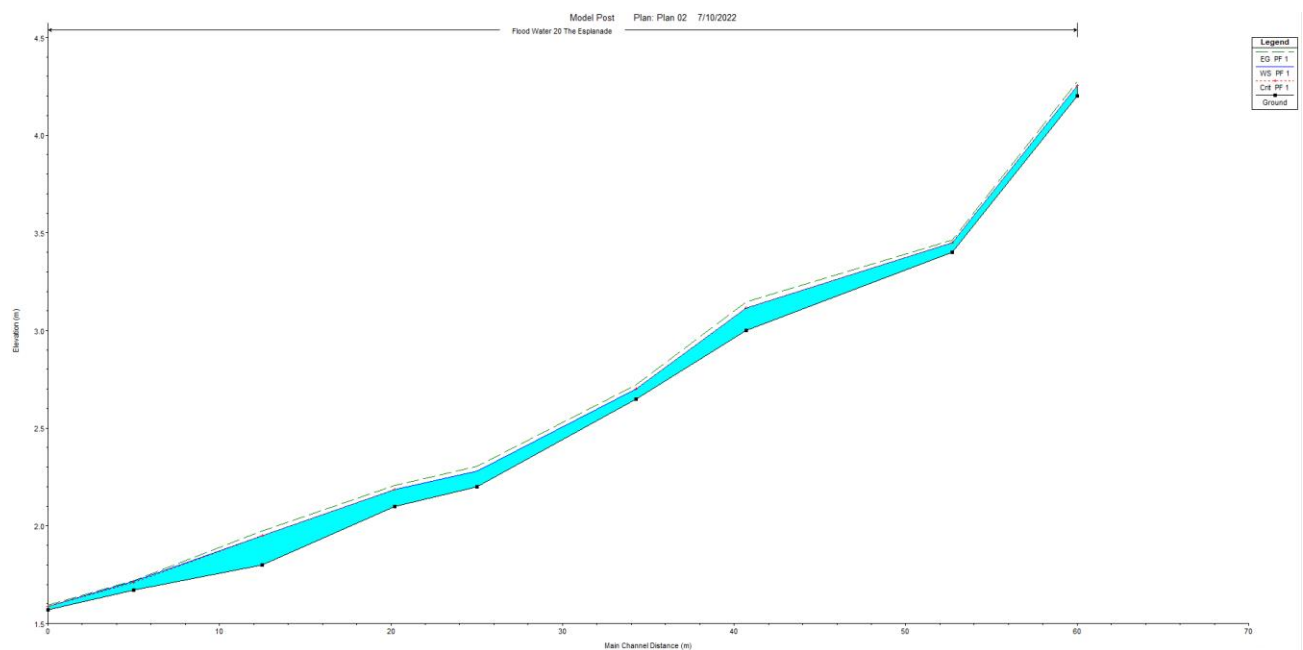


Figure 9 : Figure 8 : Water Surface Profile Pre-Development

The difference in Pre-development and Post-Development water level is negligible <5 mm.

3 Conclusion

Warringah DCP 2011 requires owners of flood affected properties to comply with Council's Flood related development controls listed in Section E11 of the Warringah DCP. The above lot 20 The Esplanade, Narrabeen is affected for Flooding (storm) events exceeding the 1% AEP event, evidenced by the planning flood Map B, refer appendix D below.

The proposed ground floor and garage level of the house are set at the level of 3.55 mAHD and 3.19 mAHD with a freeboard of more than 500mm and 300mm respectively. The swimming pool is proposed to be inground and coping flush with the natural ground level.

The HEC-RAS analysis has revealed that the proposed residential development and swimming pool will have negligible effect on the flood levels. The difference between the pre-development and post development is less than 5 mm thus confirming that no net flood storage is lost by this development. Thus, it is our opinion that the flood water from 1% AEP arriving at the rear of our client's property will not be a problem for the neighboring properties and no flood storage is lost by the new development.

We believe that this report covers the Controls A2 and C3 listed in Section E11 of the Warringah DCP and complies with this requirement.

Your Sincerely

Kevin Zia

BEng, MEng, MIEAust, CPEng, NER



4 APPENDIX A – Architectural Plan



5 APPENDIX B – Survey Plan



6 APPENDIX C – Contour & Council Drainage Plan



7 APPENDIX D – Flood Information By Northern Beaches Council



8 APPENDIX E – HEC-RAS Model