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FLOOD STUDY REPORT

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North Balgowlah, NSW

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Contents

1. Introduction	3
2. Study Objectives	3
3. HEC-RAS modelling	3
3.1. Site description	3
3.2. Modelling criteria and assumptions	4
3.3. Results	5
4. Discussion	6
4.1. Flood Planning Level (FPL)	6
5. Conclusion and recommendations	7
6. Appendix A - Disclaimer	7
6.1. Limitations of this report	7

1. Introduction

At the request of Northern Beaches Council, a flood assessment has been carried out by VANN BOMA for the proposed dwelling at 52 Woodbine St. North Balgowlah, NSW.

The purpose of this report is to outline the results of the flood assessment, and determination of a recommended Flood Planning Level (FPL), i.e. Minimum habitable Finished Floor Level for the proposed dwelling.

These levels were determined by Hydrological modelling, using Engineering software HEC-RAS to calculate the 1% AEP (Annual Exceedance Probability) i.e 1 in 100 year overland water level through the subject lot.

2. Study Objectives

The objectives of the study include the following:

- To carry out a Flood Assessment to determine the 1% AEP flood level,
- To determine whether the proposed development would exacerbate flood risk to neighbouring properties.

3. HEC-RAS modelling

HEC-RAS engineering software was used to model the hydraulic water flow from the upstream catchment, through to the subject lot. Conservative assumptions and modelling criteria were used where appropriate, to calculate the maximum possible 1% AEP water levels through the site.

3.1. Site description

The site is located in close proximity to an upstream hill, creating a relatively small catchment area depicted below.



Figure 1 – Catchment area (purple hatch) with subject lot outlined in blue.

The site has a general slope from the rear to the front, with a natural surface grade ranging between 5% to 8%.

3.2. Modelling criteria and assumptions

The below assumptions and criteria were used in undertaking the flood assessment. With the intent to ensure the results provide the Maximum possible 1% AEP water levels.

- The 1% AEP rainfall event has been used in the model to determine the maximum surface water levels through the site.
- It has been assumed that existing Council piped drainage networks are either fully blocked and/ or working at 100% capacity. Therefore these have been excluded from the model, meaning all resulting run-off will be surface flows only.
- A surface run-off coefficient of 1.0 has been used, i.e. no soil infiltration or ground storage/ absorption has been assumed.
- A surface friction slope of 5% has been used in the model, being the lower limit between 5% - 8%.

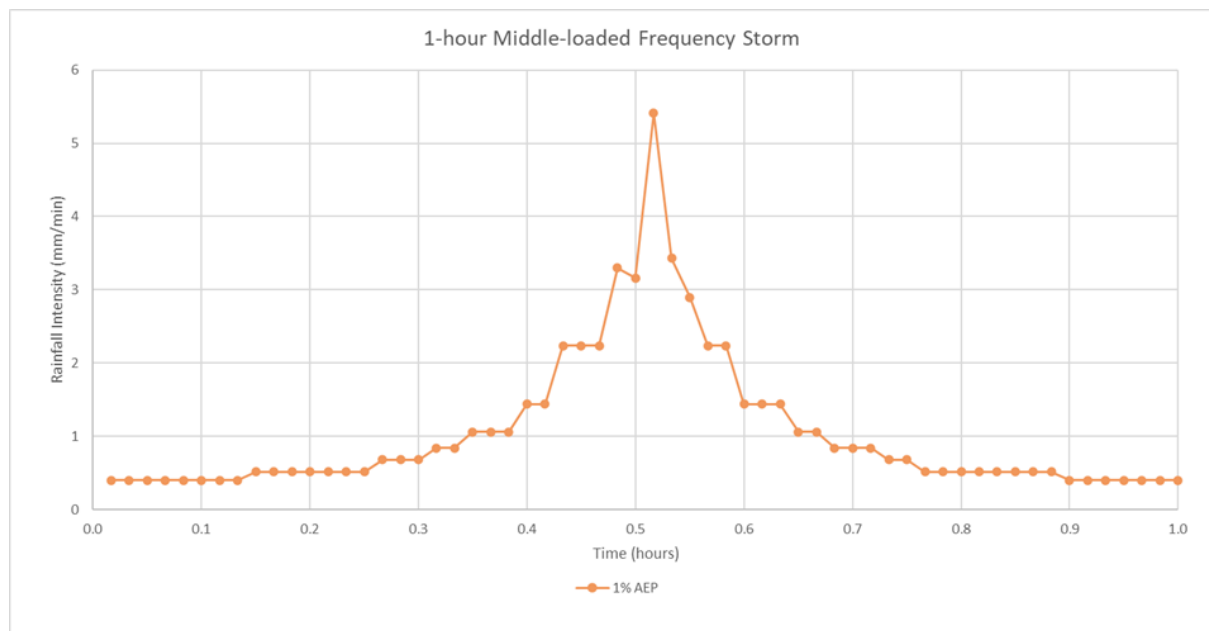


Figure 4 – 1-hour middle-loaded frequency storm (mm/min)

3.3. Results

The HEC-RAS model results have demonstrated that the site is in fact subject to overland flows during the 1% AEP storm event. The water depth varies between approximately 200mm at the rear of the lot, and approximately 400mm at the front of the lot.

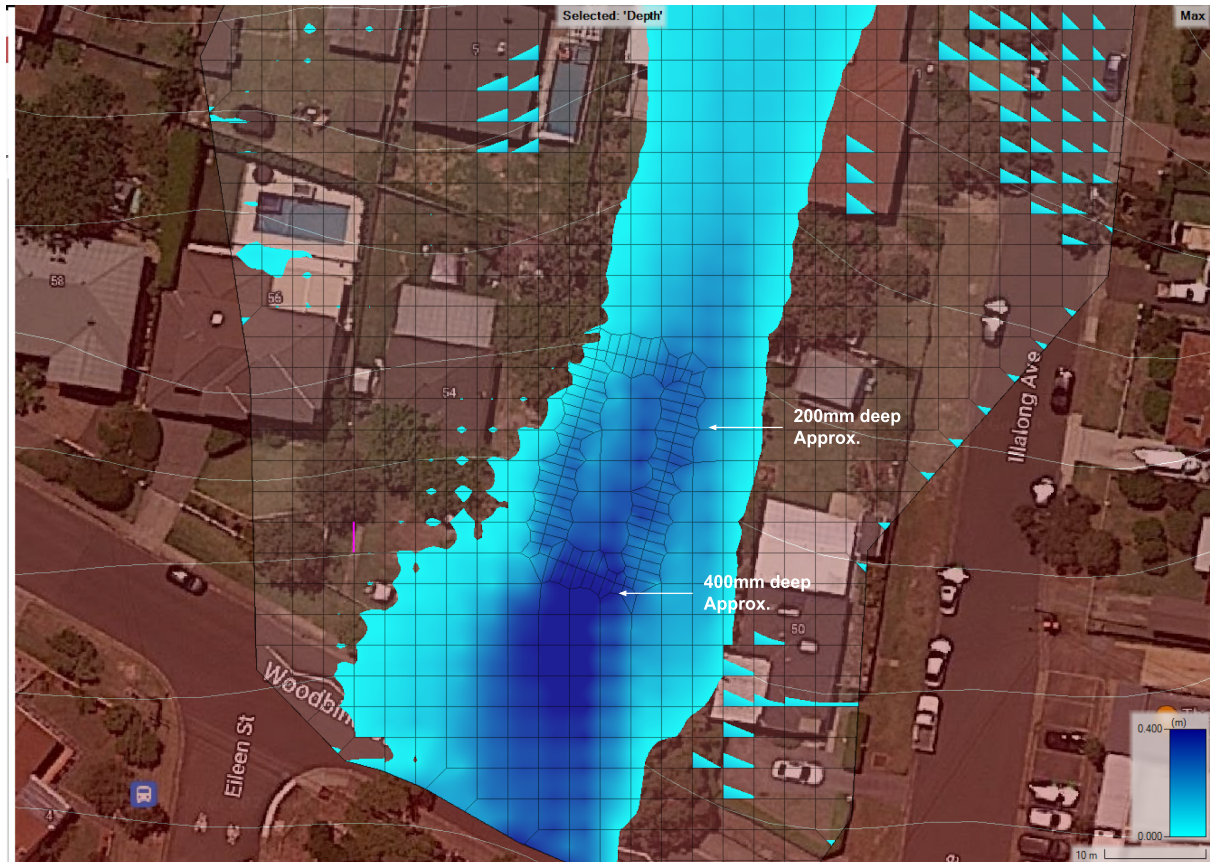


Figure 2 – Flood water depth range, above Natural Ground Level

4. Discussion

Based on the latest proposed development plans, with the exception of the 3.6m rear deck (outdoor), the rear most habitable floor area is situated over the Natural Ground Level (NGL) 84.10 Approx. The front of the house will be situated at NGL 83.00 Approx.

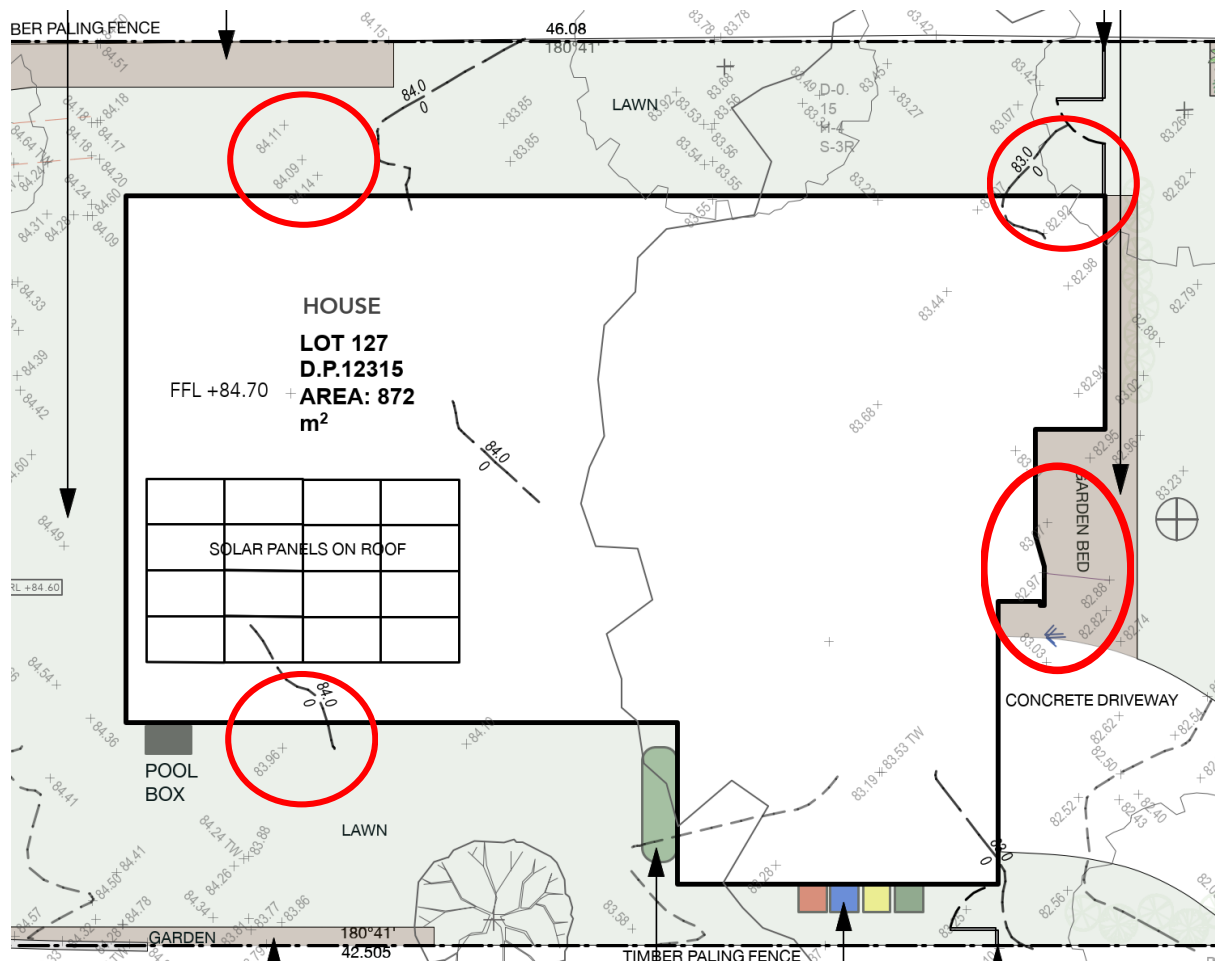


Figure 3 – Natural ground levels at the rear and front of the proposed dwelling house

4.1. Flood Planning Level (FPL)

As aforementioned, given the use of conservative criteria and assumptions in our assessment, we recommend that a Freeboard of 400mm for habitable areas, may suffice for this development.

The resulting FPL for habitable areas at the rear of the property should therefore be set no lower than FFL 84.60. Alternatively this may be raised to FFL 84.70 should the Council stipulate that a 500mm Freeboard is required.

At the front of the property, the FPL for the habitable areas will need to be set no lower than FFL 83.40, or 83.50 should a 500mm Freeboard be required.

5. Conclusion and recommendations

It is thus concluded that the Flood Planning Level has been determined to be no lower than FFL 84.60 and FFL 83.40 for the rear and front floor levels of dwelling, respectively.

Furthermore, the following recommendations must be followed to ensure that the natural overland flow paths are not altered and flooding is not exacerbated in neighbouring properties.

- Natural ground levels and overland flow paths shall be conserved, and not altered majorly.
- All areas of the subfloor, including the structural footings must be designed to allow surface water to flow unimpeded from the rear to the front of the lot.
- The structure and the footings shall be designed and certified by a qualified Structural Engineer to withstand the additional loadings that may result from the flood water and debris. Such loading shall include the following and the combinations of Actions that are listed below. This applies to Structural and non-structural elements.
 - Hydrostatic pressure
 - Hydrodynamic actions.
 - Wave action
 - The impact of possible debris
 - Erosion, and Scour

The materials of construction and the durability design shall consider the possibility of the structural elements being immersed in flood for short durations.

6. Appendix A - Disclaimer

6.1. Limitations of this report

The extent of this investigation was limited to the extent and scope explained above. It is thus possible that other factors exist which were not apparent at the time of this study. No guarantee can be given regarding such matters.

The results of the hydraulic and hydrologic analysis presented in this report are based on a computer model created using HEC-RAS (Hydrologic Engineering Center's River Analysis System). The model is only as accurate as the input data and assumptions used, and the results should be considered preliminary and subject to further refinement. VANN BOMA Engineering makes no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the results or the information, products, services, or related graphics contained in the report. Any reliance you place on such information is therefore strictly at your own risk.