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NL171426.B01

25th January 2018

AVEO

Attention: Clare Brennock clare.brennock@aveo.com.au

Dear Clare,

Re: 79 Cabbage Tree Road, Bayview – Concept Stormwater & Flood Management Strategy

Northrop Consulting Engineers have been engaged by AVEO to provide civil design services for the proposed 25 Independent Living Unit (ILU) addition to the Peninsular Gardens site located at 79 Cabbage Tree Road, Bayview, herein known as 'the site'. The intent of this letter is to present the proposed stormwater management strategy, as well assess the impacts the development may have on the existing flooding regime. The letter should be read in conjunction with drawings NL171426/C01DA-C03DA.

This letter does not attempt to provide detailed design solutions to all issues; rather it will investigate the feasibility of solutions based on information that we have gathered to date from a number of sources and provide outcomes which will be developed further at Construction Certificate and Construction phases of the project.

1. Proposed Stormwater Management Strategy

The proposed stormwater management strategy for the 25 ILU addition, which develops approximately 1.0h of site, can be summarised as follows;

- Runoff from new roof areas will be collected and diverted to above ground re-use tanks. Each unit will be provided with a 3kL rainwater tank. Harvested runoff shall be reused for external irrigation, toilet flushing and clothes washing. A first flush device shall be provided upstream of each tank. Overflow from the tanks will be directed to the underground pipe network for the site;
- Runoff from the internal road network and landscaped areas will be collected via surface inlet pits and conveyed to the stormwater quantity and quality treatment devices for the site via the underground pipe network. All pits collecting road runoff shall be fitted with Stormwater360 Enviropods (or equivalent) to provide pre-treatment to the stormwater runoff;
- Stormwater quantity targets will be achieved by providing 160m³ of On Site Detention located under the internal roadway for the western portion of the site. Refer to section 2. Stormwater quantity assessment for further details;
- Stormwater quality targets will be achieved by providing a biofiltration basin downstream of the works. The basin shall provide a minimum of 40m² of biofiltration media with an extended detention depth of 0.3m. Refer to section 3. Stormwater quantity assessment for further details;
- Outflow from the biofiltration basin will be directed to the existing in ground drainage network to the lawful point of discharge into Councils piped system. The existing in ground drainage will be upgraded as required up to the point of connection to Council network. Detailed calculations will be undertaken at CC stage;

The proposed stormwater management strategy is depicted on drawing NL171426/C02DA.



2. Stormwater Quantity Assessment

In order to minimise the impact of the development on the wider catchment runoff regime, hydrological and hydraulic modelling has been undertaken using the software package DRAINS. In particular, the modelling was undertaken to achieve the objectives outlined in the Pittwater DCP 2014 Section B5.7. A schematic of the DRAINS model is shown below in Figure 1.



Figure 1 – DRAINS Schematic

A few key considerations in preparing the DRAINS model include;

- The existing catchment is characterised as bushland, with the average slope of approximately 30%. As such, the maximum length of sheet flow is considered to be 50m in accordance with the Table 4.6.4 of the *QUDM [2013]*. Applying Friends Equation for sheet flow, the pre-developed time of concentration to the point of discharge is calculated to be approximately 12 minutes.
- The detention system has been designed to over-detain flows from the western portion of the development (which accounts for approximately 70% of the development). In doing so, the eastern portion of the development is released un-detained.

The target objectives can be achieved for the development by implementing 160m³ of On Site Detention. The detention could be provided via an underground detention tank with flows being restricted via the outlet chamber configuration.

Storm Event	Pre-developed	Post-developed		
1 in 5 year ARI	214 L/s	189 L/s		
1 in 10 year ARI	247 L/s	211 L/s		
1 in 20 year ARI	292 L/s	241 L/s		
1 in 100 year ARI	381 L/s	290 L/s		

The results of the DRAINS analyses are summarised below in Table 1.

Table 1 – Estimated Peak Runoff

DRAINS data files can be provided upon request.



3. Stormwater Quality Assessment

In order to minimise any adverse impacts upon the ecology of the downstream watercourses; stormwater treatment devices have been incorporated into the design of the development. The stormwater quality treatment strategy has been assessed against the Pittwater DCP 2014 Section B5.9 for compliance. The DCP references *Australian Rainfall Quality – A Guide to Water Sensitive Urban Design*, of which the treatment targets for pollutant removal and replicated below in Table 2.

Pollutant	% post development average annual load reduction
Total Suspended Solids (TSS)	80 %
Total Phosphorous (TP)	45 %
Total Nitrogen (TN)	45 %

Table 2 – ARQ Pollutant Removal Targets

The performance of the proposed stormwater management strategy was assessed against these targets using the conceptual software MUSIC (Version 6). The MUSIC model was developed in accordance with the Sydney Catchment Authority guide to "Using Music in Sydney's Drinking Water Catchment".

A schematic of the MUSIC model can be seen below in Figure 2.



Figure 2 – MUSIC Schematic

The results from the MUSIC model are shown below in Table 3	The results from the	MUSIC model are	shown below in	Table 3.
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	Source Load (kg/yr)	Residual Loads (kg/yr)	Percentage Reduction	Target Objectives
Total Suspended Solids (TSS)	1010	133	87 %	80 %
Total Phosphorous (TP)	2.11	1.14	46 %	45 %
Total Nitrogen (TN)	19.50	10.3	47 %	45 %

Table 3 – MUSIC Results



Table 3 shows that the proposed stormwater management strategy is predicted to achieve the ARQ load reduction targets, as estimated by MUSIC.

MUSIC data files can be provided upon request.

4. Flood Impact Assessment

The Northern Beaches Council floodmaps identify a floodway to the south of the proposed development. The 1% AEP floodmap provided by Council is replicated below in Figure 3.



Figure 3 – Existing Flood Regime 1% AEP

To avoid impacting on the existing 1% AEP floodway, all earthworks shall tie in to existing site levels at approximately RL 9.0m AHD, as shown on drawing NL171426/C02DA. It is acknowledged that some ILU's will be constructed over the flow path and shall be suspended and supported on columns to minimise impacts to the floodway. These structures shall be designed to withstand flood forces as required by Pittwater DCP and the *Floodplain Development Manual* at CC stage.

Furthermore, the estimated PMF level is approximately 9.7m AHD as provided by Council floodplain engineers. It is noted that all units are located above the estimated PMF level provided and as such comply with Pittwater DCP B3.11.

In the event of extreme flooding resulting in evacuation, egress is available via the existing access road to Cabbage Tree Road.



5. Conclusions

Given the results of the above investigations, it is concluded that the development meets the requirements of the former Pittwater Council DCP. In particular:

- The attenuation of stormwater runoff to match the pre developed scenario has been achieved via the use of On Site Detention;
- The treatment of stormwater runoff for waterborne pollutants is achieved through the proposed treatment train. This includes the use of rainwater harvesting tanks and an end of line biofiltration system; and
- The development is clear of the existing floodway and as such will have no impact on the existing flooding regime. Floor levels are located above the PMF event.

I trust the above meets your requirements; however, if you would like to discuss the development further, then please do not hesitate to contact the undersigned on 0403 101 140.

Yours sincerely,

Aaron Knight <u>Civil Engineer</u> BE (Civil Hons1)