

21st January 2016

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C/- PEP Consulting
Shay Riley-Lewis
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Dear Shay,

Re: Shortland Waters Seniors Living – Stormwater Management Masterplan Strategy

Northrop Consulting Engineers have been engaged by AVEO to provide civil design services for the proposed seniors living development encompassed within the existing Shortland Water Golf Course, herein known as 'the site'. This letter intends to discuss stormwater management strategies relating to the ultimate and entire development site at a level appropriate for master planning and should be read in conjunction with the attached sketch plans NL150017/SM-01.

This letter does not attempt to provide detailed design solutions to all issues; rather it will establish the key elements of stormwater management at a conceptual level to achieve the requirements of governing Authorities. The master plan contained herein is an evolving long term planning document that shall provide guidance to the implementation of stormwater management measures for subsequent DA approvals.

A schematic of the proposed site is shown below in Figure 1.



Figure 1 – Site Schematic

The proposed stormwater management strategy for the 11ha development site can be summarised as follows;

- Runoff from the proposed access road from the Vale Street Bridge will be collected via a series of pits and pipes at the upper reach of the access road. Captured runoff shall be discharge to the existing stormwater network which is currently piped and discharged to the adjacent drainage gully to the west.
- Runoff from the lower reach of the access road will sheet directly off the pavement across the existing grass towards the adjoining golf course, imitating the natural runoff regime and maintaining dispersed flow.
- Runoff from the new Independent Living Unit (ILU) roof areas will be collected and diverted to above ground harvesting tanks. The harvesting tanks will provide a minimum volume of 2.5kL which will be reticulated internally for toilet flushing and laundry use. In accordance with Table 4.1 of Newcastle City Councils 'Stormwater and Water Efficiency for Development', the volume that can be disposed of by a 2 bedroom dwelling via toilet and laundry re-use is 1.9kL. Overflow from the harvesting tanks will be directed to the underground pipe network for the site;
- Runoff from the community facility roof area will be diverted to a 10kL reuse tank which will be reticulated for toilet flushing. Overflow from the harvesting tanks will be directed to the underground pipe network for the site;
- Runoff from the internal access road and driveways 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;
- Stormwater quantity targets will be achieved by providing a total of approximately 2200m³ of On Site Detention which will be typically located under the driveway pavement. A number of detention devices have been included in the strategy to mimic the anticipated staging of the development. Please refer to section 2. *Stormwater quantity assessment* below for further details;
- Stormwater quality targets will be achieved through the implementation of a number of Water Sensitive Urban Design (WSUD) features including; biofiltration swales, raingardens, GPT devices and rainwater reuse. Similarly to detention, the biofiltration swales have been located to suit the anticipated staging of the development. The biofiltration swales will be located within the 10m landscape zone around the perimeter of the site. A typical cross-section of the biofiltration swales is shown overleaf in Figure 2. Please refer to section 3. *Stormwater quality assessment* below for further details;
- Discharge from the proposed stormwater quality and quantity controls will ultimately be conveyed across the adjoining golf course. The discharge shall be in the form of dispersed sheet flow to prevent erosion of the downstream golf course. Please refer to section 4. *Discharge of Stormwater Runoff* below for further details.



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 NCC DCP 7.06 and in accordance with the Concept Approval for the senior's housing development. A schematic of the DRAINS model is shown below in Figure 3.



The results of the DRAINS analyses are summarised below in Table 1. The respective Permissible Site Discharge and Site Storage Requirements (SSR) are also denoted for specification in subsequent DA's for each stage.

Table 1 – Estimated Peak Runoff

- Gravel trenches;
- Atlantis cells or equivalent proprietary products;
- Tunnel trenches; or
- Blockwork detention tanks.

3. Stormwater Quality Assessment

Pollutant Load Reduction

Pollutant	% post development average annual load reduction
Total Suspended Solids (TSS)	85 %
Total Phosphorous (TP)	65 %
Total Nitrogen (TN)	45 %
Gross Pollutants	90 %

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 'Draft NSW Music Modelling Guidelines.' A schematic of the MUSIC model is shown below in Figure 3.



	Source Load (kg/yr)	Residual Loads (kg/yr)	Percentage Reduction	Target Objectives
Total Suspended Solids (TSS)	9720	1440	85.2 %	85 %
Total Phosphorous (TP)	20.9	6.06	71 %	65 %
Total Nitrogen (TN)	150	78.1	47.9 %	45 %
Gross Pollutants	1760	73.3	95.8 %	90 %

Table 3 above shows the proposed stormwater management strategy is predicted to achieve the load reduction targets, as estimated by MUSIC. As such, it is estimated a total biofiltration area of approximately 850m² will be required to achieve the pollutant reduction targets sitewide. Averaging across the development site, approximately 80m² of biofiltration swale per hectare will be required for subsequent DA's to comply with the requirements of the masterplan stormwater strategy.

The Stream Erosion Index (SEI) has been determined for the development based on the guidelines laid out under Section 4.15 of the NCC Technical Manual. The pre developed and developed scenarios were modelled in MUSIC. The recommended pervious area parameters for a silty clay, as laid out in the 'Draft NSW MUSIC Modelling Guidelines' (WBM, 2010), were utilised for both the pre developed and developed scenarios.

Using the generic node in MUSIC the SEI was calculated to be 1.38 which is below the required 2 as stated in the NCC DCP. The reduction of post developed flows has been achieved by the proposed re-use tanks and the extended detention volume above the biofiltration swales.

A summary of the results is provided in Table 4 below.

Scenario	Pre Developed	Developed	SEI	Target SEI
Mean annual flow	18.8 ML/Year	67 ML/Year	-	-
Mean annual flows above stream forming flow	15.9 ML/Year	21.9 ML/Year	1.38	2

Table 4 – Stream Erosion Index

As seen above in Table 4, the proposed stormwater treatment train for the ultimate development will mitigate developed flows to an acceptable level in accordance with NCC's stream erosion index.

MUSIC data files can be provided upon request.

4. Discharge of Stormwater Runoff

Due to the natural lay of the land, it is anticipated the development precinct will have seven (7) locations of discharge. At each discharge location, flow velocities will be limited for the major storm event to prevent the erosion of the downstream golf course through flow spreading and disposal of concentrated flows. In accordance with Table 5.2 of Landcoms '*Managing Urban Stormwater – Soils and Construction*' (the Blue Book), the critical velocity for erosion of Couch grass is 1.8m/s (for storm events less than 6hrs). Applying the principles of weir flow, the estimate discharge velocity for each runoff location is shown overleaf in Table 5. Refer to the attached concept plan for discharge locations.

Discharge Location	Estimate 1% AEP Peak Discharge	Approximate Weir Length	Approximate Depth of Flow	Estimated Discharge Velocity
A	415 L/s	30	50mm	0.3m/s
B	445 L/s	30	50mm	0.3m/s
C	440 L/s	30	50mm	0.3m/s
D-E	800 L/s	50	50mm	0.3m/s
F-E	550 L/s	40	50mm	0.3m/s
G	555 L/s	40	50mm	0.3m/s
H	400 L/s	30	50mm	0.3m/s

Table 5 – Estimate Site Discharge Velocities

As seen above in Table 5, it is estimated that sufficient provisions are available to reduce discharge velocities such that the site runoff is in a controlled manner which will maintain the integrity of the downstream environment (i.e. discharge velocity is less than 1.8 m/s).

In short, concentrated flow is proposed to be spread at each of the discharge points using level spreaders/contour mounds/swales etc. Subsequent DA's for each stage shall apply the minimum specified weir length at the outlet for each catchment.

5. Conclusions

Given the results of the above investigations, it is reasoned the development meets NCCs requirements and has appropriate stormwater management for the downstream environment. In particular:

- The treatment of stormwater runoff for waterborne pollutants is achieved through the proposed treatment train. This includes the use of rainwater harvesting tanks, on site detention, biofiltration swales and raingardens. The biofiltration swales shall be apportioned across the future development stages at a rate of 85m² per ha; and
- Adequate provisions are available to ensure stormwater runoff from the site is discharged in a controlled manner which will maintain the integrity of the downstream environment.

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 4943 1777.

Ann Holt

Aaron Knight
Civil Engineer
BE (Civil) Hons1



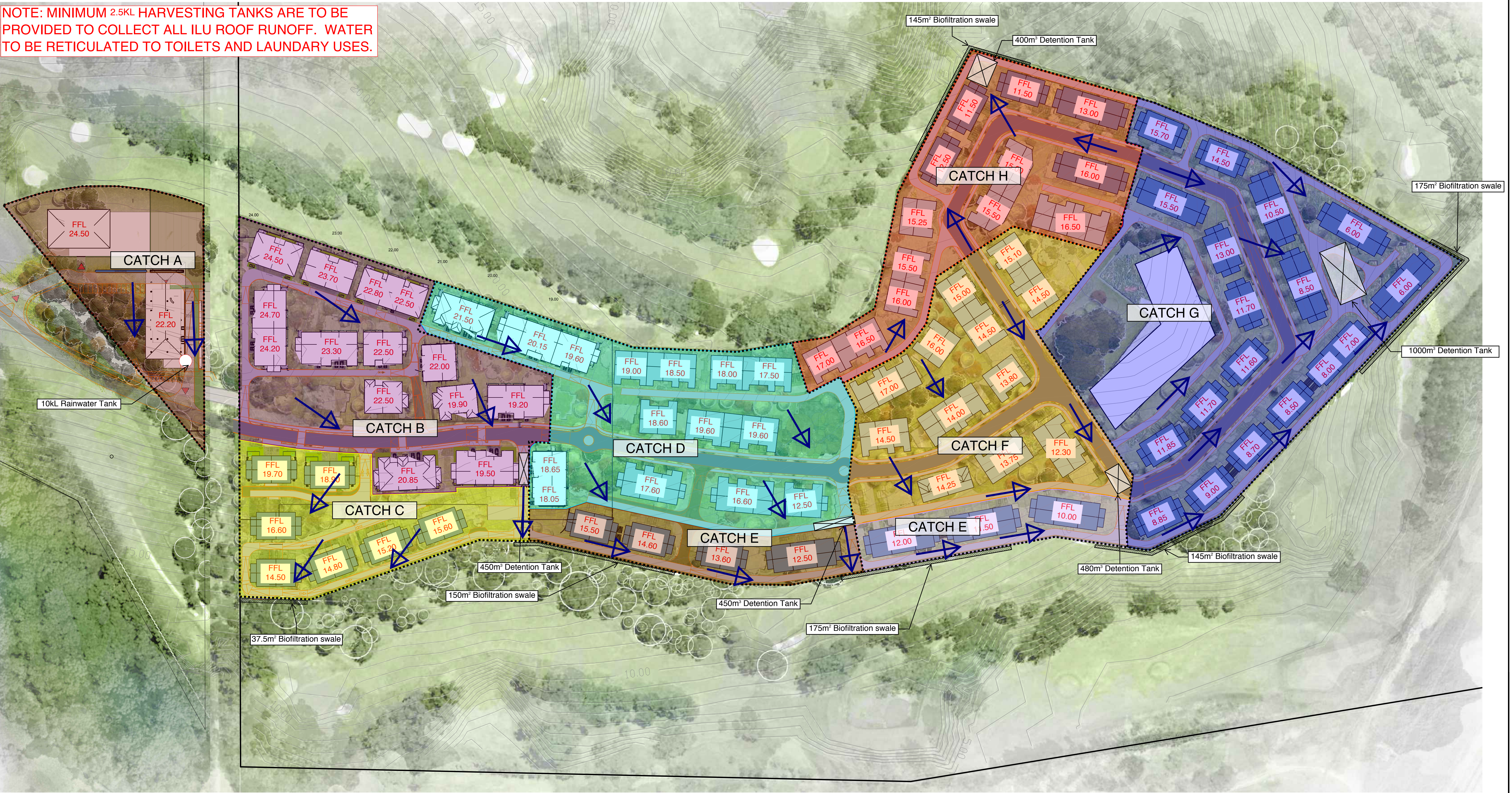
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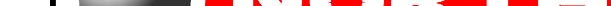
LEGEND

FFL 24.50 DENOTES PROPOSED FFL OF BUILDING. FFL TO BE CONFIRMED AT SUBSEQUANT DA PHASE FOR EACH STAGE.

➡ DENOTES PROPOSED DIRECTION OF STORMWATER RUNOFF

NOTE: MINIMUM 2.5KL HARVESTING TANKS ARE TO BE PROVIDED TO COLLECT ALL ILU ROOF RUNOFF. WATER TO BE RETICULATED TO TOILETS AND LAUNDRY USES.



REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT	ARCHITECT	PROJECT		DRAWING TITLE	JOB NUMBER	
1	DRAFT - ISSUED FOR INFORMATION	AK	CS	AK	4.06.15	 <div>DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED</div>	 <div>THE COPYRIGHT OF THIS DRAWING REMAINS WITH NORTHTROP CONSULTING ENGINEERS PTY LTD.</div>	 Newcastle Suite 4, 215 Pacific Hwy, Charlestown NSW 2290 P.O. Box 180, Charlestown NSW 2290 Ph (02) 4943 1777 Fax (02) 4943 1577 Email newcastle@nortthrop.com.au ABN 81 094 433 100	SHORTLAND WATERS AGED CARE FACILITY	STORMWATER MANAGEMENT CONCEPT MASTERPLAN	NL150017	
2	ISSUED FOR APPROVAL	JH	AB	AK	14.10.15							
								SCALE			<div>DRAWING NUMBER</div> SM-01	<div>REVISION</div> 2
											DRAWING SHEET SIZE = A1	

The proposed stormwater management strategy for the Precinct 2 Independent Living Units (ILUs) shall be in line with the overarching approved Concept Stormwater Management Masterplan. The masterplan catchments for the Precinct 2 development footprint are shown below in Figure 2.



As such, it is proposed to install temporary discharge measures as denoted on Drawing NL150017/C22DA until such time that the future stage is constructed. The temporary measures shall reduce flow discharge velocities to below 1.8m/s for the major storm event to reduce the risk of eroding the downstream golf course as per the approved Concept Stormwater Management Masterplan. Details shall be provided at detailed design stage.

Notwithstanding the above, it is noted that at source controls will be implemented during Stage 2 (i.e. 2.5kL rainwater reuse tanks per villa). Furthermore, additional treatment such as filtration over grass buffer strips shall also be employed during the Precinct 2 works. For example; in the open space parklands; private courtyards; and adjacent to the temporary earth bunds.

Given the results of the above investigations, it is reasoned the development meets NCCs requirements in line with the overarching approved Concept Stormwater Management Masterplan. In particular; adequate provisions have been made to ensure stormwater runoff from the proposed works is discharged in a controlled manner which will maintain the integrity of the downstream environment.

Yours sincerely,

Aaron Knight
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