Our Ref: 80219022-18-111:PL
Contact: Garry Neville

7 December 2018

Petrin Holdings
c/-GAT & Associates Pty Ltd
PO BOX 96
Haberfield NSW 2045

Attention: Dario Petrin

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

Phone +61 2 9496 7700
Fax +61 2 9439 5170

www.cardno.com

Dear Dario,

FLOOD ASSESSMENT - 71 ST ANDREWS ROAD VARROVILLE

Cardno (NSW/ACT) has been engaged by Petrin Holdings to undertake a flood assessment of the existing overland flowpath adjacent to the proposed residential subdivision at 71 St Andrews Road Varroville. This report has been prepared to:

- Summaries the result of the hydraulic assessment of the overland flow path;
- Provides guidance to the flood planning level for the proposed lots; and
- Addresses the Section 6 of the letter "Draft Planning Proposal 500/2018/E-LPEA – 71 St Andrews Road, Varroville" on 7th August 2018.

Catchment Analysis

The existing overland flow path is located approximately 50m to the east of the proposed development site. It is running parallel with the lot boundary flowing from south west to north east, conveying stormwater flow to Bonds Creek, traverses through the existing Willowdale development. The overland flow path has a contributing catchment of approximately 61ha, which consists of the Stage 4 and 5 of Emerald Hills Development and the existing bushlands adjacent to the flow path. Figure 1 shows the extent of the catchments that are draining to the existing overland flowpath.

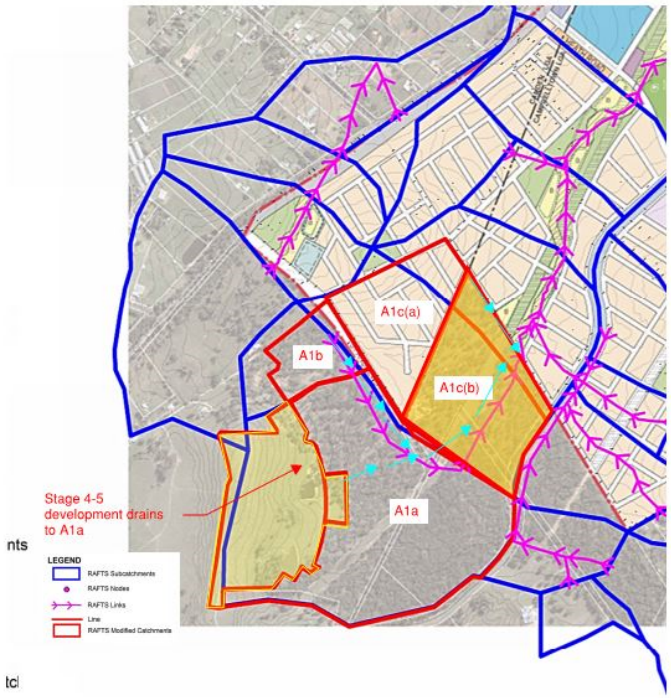


Figure 1 Catchment Plan

The hydrology of the catchment has been modelled by XP-RAFTS using the Australian Runoff and Rainfall 2016 procedures. The rural initial loss and continue loss were downloaded from the AR&R data hub, 37mm and 2.3mm respectively. The Indirectly Connected Areas assumed to have losses equivalent to 60% of the rural losses. The rainfall data was obtained from Bureau of Meteorology website. The 1% AEP peak flows along the flow path is shown in Table 1.

Table 1 Peak Flows

Location	1% AEP peak flow (m3/s)
At the start of the flow path	3.36
Near St Andrews Road	4.60
30m from the upstream end of Bonds Creek	5.22

Hydraulic Assessment

Hydraulic modelling software, HEC-RAS, was used to analyse the flood levels along the existing overland flow path. The existing model is based on the 0.5m contours from the LiDAR survey and imported to HEC-RAS from 12D design software. Cross sections has been created at 10m intervals along the centreline of the overland flow path. The overland flow path can be found in the sketch enclosed in this report.

The roughness coefficient Manning's 'n' used in the analysis was 0.035 along the centre and the left bank (area where the easements are located) of the flow path, as the area is mainly grass pastures. The right bank is grassed area with trees scattered across the site, which has a Manning's 'n' of 0.055.

The boundary condition for the analysis was assumed to be normal depth.

Results

The 1% AEP flood levels along the existing overland flow path that is adjacent to the proposed subdivision is between RL 102.12m and RL 98.30m. Table 2 shows the flood levels at different location of the overland flow path.

Table 2 1% AEP Flood Level (Existing Condition)

Location	1% AEP Flood Level (RLm)	Flood Planning Level (RLm)
CH 500 (St Andrews Road)	101.62m	102.12m
CH 380	100.58m	101.05m
CH 340	100.35m	100.85m
CH 280	99.85m	100.35m
CH 240	99.52m	100.02m
CH 80	98.65m	99.15m
CH 30	98.30m	98.80m

Table 2 shows the existing flood levels and the flood planning levels for the proposed development site. The flood extent as shown in the attached sketch indicates the site is not affected by the 1% AEP flood event and the existing surface is higher than the flood planning level.

The proposed lot fronting Gratham Crescent, located on the eastern side of the overland flowpath is also above the 1% AEP flood extent at RL 98.30m, the flood planning level for the lot would be at RL 98.80m. Based on the Lidar data, the existing surface level is at approximately RL 98.50m, which requires approximately 300mm fill over the site.

The proposed lots along St Andrews Road are not affected from the regional flood water along the existing overland flowpath. The localised ponding depth and flow widths along St Andrews Road would be assessed in the detailed design stage.

PMF Evacuation Route

The result of the hydraulic analysis has shown the PMF extent is generally outside of the proposed development area, refer to the enclosed flood extent sketch. The proposed roads are generally remain flood free. The PMF flood evacuation route can be provided by a new road connection to Aqueduct Street as shown in the proposed lot layout plan, which then provide access to Camden Valley Way via St Andrews Road or Willowdale Drive.

Recommendations

The hydraulic assessment shows the proposed development site is not affected by the 1% AEP event, however, an onsite detention basin will be required to attenuate the peak flow from the proposed development site. A detailed hydrology and hydraulic assessment should be prepared in the DA stage to provide the required basin storage volume and outlet structure to ensure there will be no adverse flooding impact to the adjacent properties.

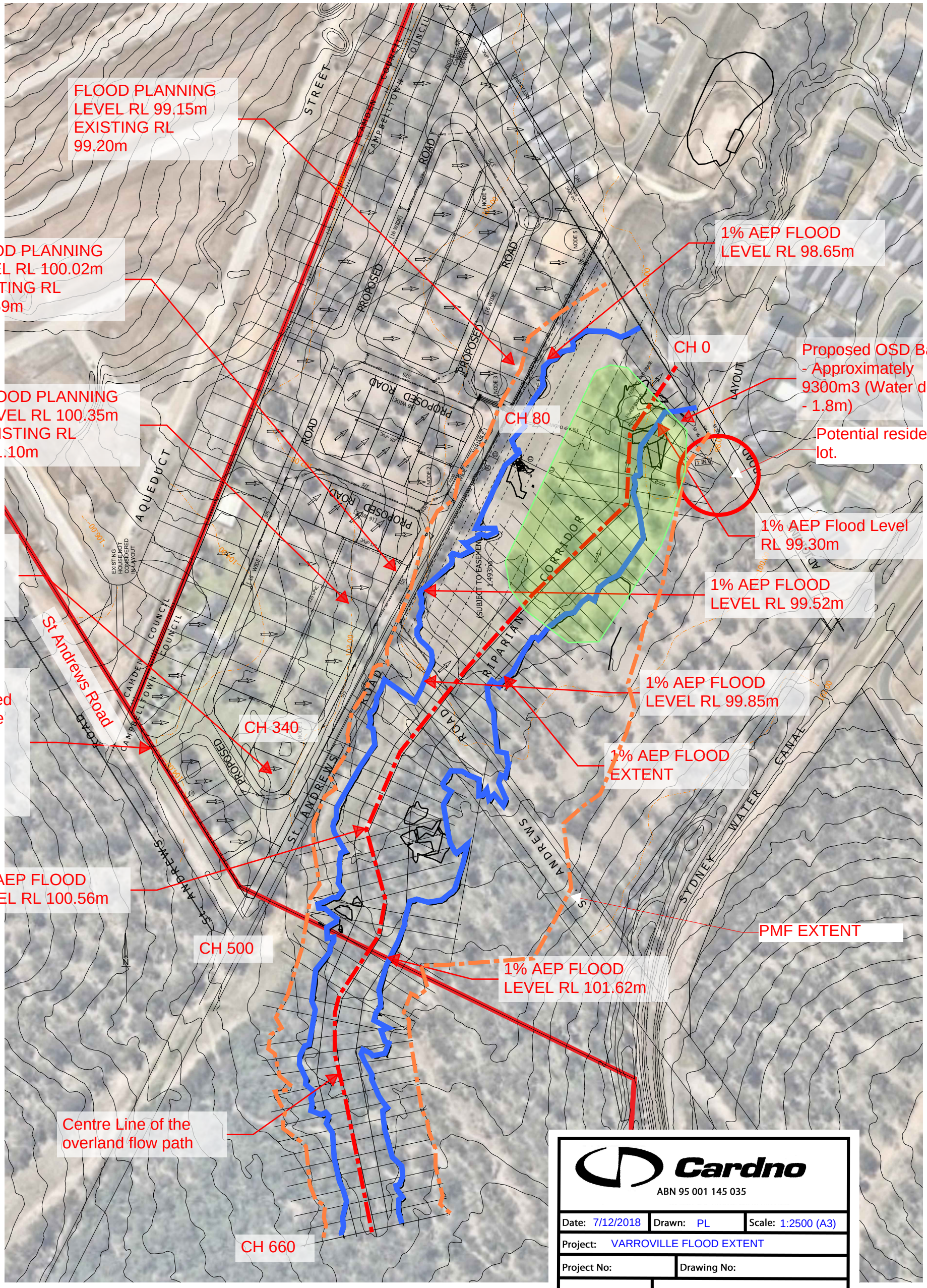
Detailed survey data should be obtained in the detailed design stage to show the existing overland flow path invert levels, banks and the location of the existing dam near Bonds Creek. The survey data will provide a more accurate design for the proposed basin and ensure it can be drained to Bonds Creek.

The PMF flood evacuation route can be provided by a new connection to Aqueduct Street as shown in the sketch.

Yours sincerely,

Pak Lau
Civil Engineer
for Cardno
Direct Line: +61 2 9496 7846
Email: pak.lau@cardno.com.au

Enc: Varroville Flood Extent



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ABN 95 001 145 035

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Project: VARROVILLE FLOOD EXTENT		
Project No:	Drawing No:	
Revision: 4	Status: FOR INFORMATION	
Title: PRELIMINARY FLOOD ASSESSMENT		