1.7 Appendix 7 – Flood Investigation Report

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OLD BATHURST ROAD, EMU PLAINS
PROPOSED INDUSTRIAL REZONING

Issue No. 1
FEBRUARY 2006

Patterson Britton
& Partners Pty Ltd
consulting engineers

Bernard & Linna Le Boursicot

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Document Amendment and Approval Record

Issue	Description of Amendment	Prepared by [date]	Verified by [date]	Approved by [date]
01	First Issue	FMC 9/2/06	9.2.06	9/2/06

Note: This document is preliminary unless it is approved by a principal of Patterson Britton & Partners.

Document Reference: rp6223fmc060209 - issue 1.doc
Time and Date Printed 9 February 2006, 2:21 PM

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1 INTRODUCTION

This report has been prepared on behalf of Bernard & Linna Le Boursicot.

It is proposed to rezone Lot 4 of DP574650 in Emu Plains for the purposes of industrial development. The site fronts both Old Bathurst and Russell Street.

The land is situated on the lower reaches of Emu Plains in on the southern bank of the Hawkesbury-Nepean River. A concrete lined channel (*Lapstone Creek*) bisects the site in the south, crossing Russell Street at a causeway.

Patterson Britton & Partners have been engaged to prepare supporting documents to accompany the rezoning application, including assessing the impacts of flooding from the Hawkesbury-Nepean River on the site and adjacent lands, water management issues and servicing feasibility.

2 THE REGIONAL FLOOD MODEL

The flooding assessment has been undertaken with the aid of a two dimensional RMA hydrodynamic computer model, capable of modelling the landscape and the building footprints.

The model is based on a model developed for the NSW Government and the Penrith Lakes Development Corporation for the proposed Penrith Lakes Scheme. This model has been extensively developed to replicate geomorphic features within the main river channel between surveyed cross-sections, to simulate the river to lake weir flows of the Penrith Lakes Scheme, and to calibrate to both the physical model undertaken by Water Research Laboratories and the MIKE-21 model undertaken by Lawson & Treloar.

The model was subsequently upgraded to include Emu Plains and Peach Tree Creek using additional survey in the Emu Plains area, details of the railway line culverts, and details from the 1:4000 orthophoto maps in the Peach Tree Creek area. Further extensive upgrading has been undertaken for Penrith Council utilising a detailed ALS DTM. The model extends from the upstream of the freeway crossing of the Hawkesbury-Nepean River, downstream to Yarramundi.

The model network consists of a mesh of variable sized quadrilaterals and triangles, similar in nature to a triangulated irregular network (*TIN*). Each quadrilateral or triangular element represents a portion of the ground surface defined by elevations at the corner and midside nodes. The elements also represent roughness of the surface defined by Manning's n or Chezy C values. The flexible nature of the network permits complex changes in topography, built environment and hydraulic conditions to be modelled with appropriate degrees of accuracy or representation. Large buildings or tightly packed blocks of buildings can be eliminated from the network and more sparsely built areas such as residential and commercial estates can be represented with high roughness values.

3 FLOODING ASSESSMENT

The objective of the flooding assessment is to identify flooding behaviour across and in the vicinity of the site and to assess the likely consequences of development of the site for industrial uses.

The assessment has been undertaken by a review of two dimensional modelling for existing conditions using the results from Council's RMA model of the Penrith reaches of the Hawkesbury-Nepean River. Both 100 yr ARI and 200 yr ARI regional flooding was assessed.

3.1 SETTING

The site lies towards the western edge of the Emu Plains floodplain with the north end penetrating into the floodplain on its approach to the river channel, **Figure 1**.

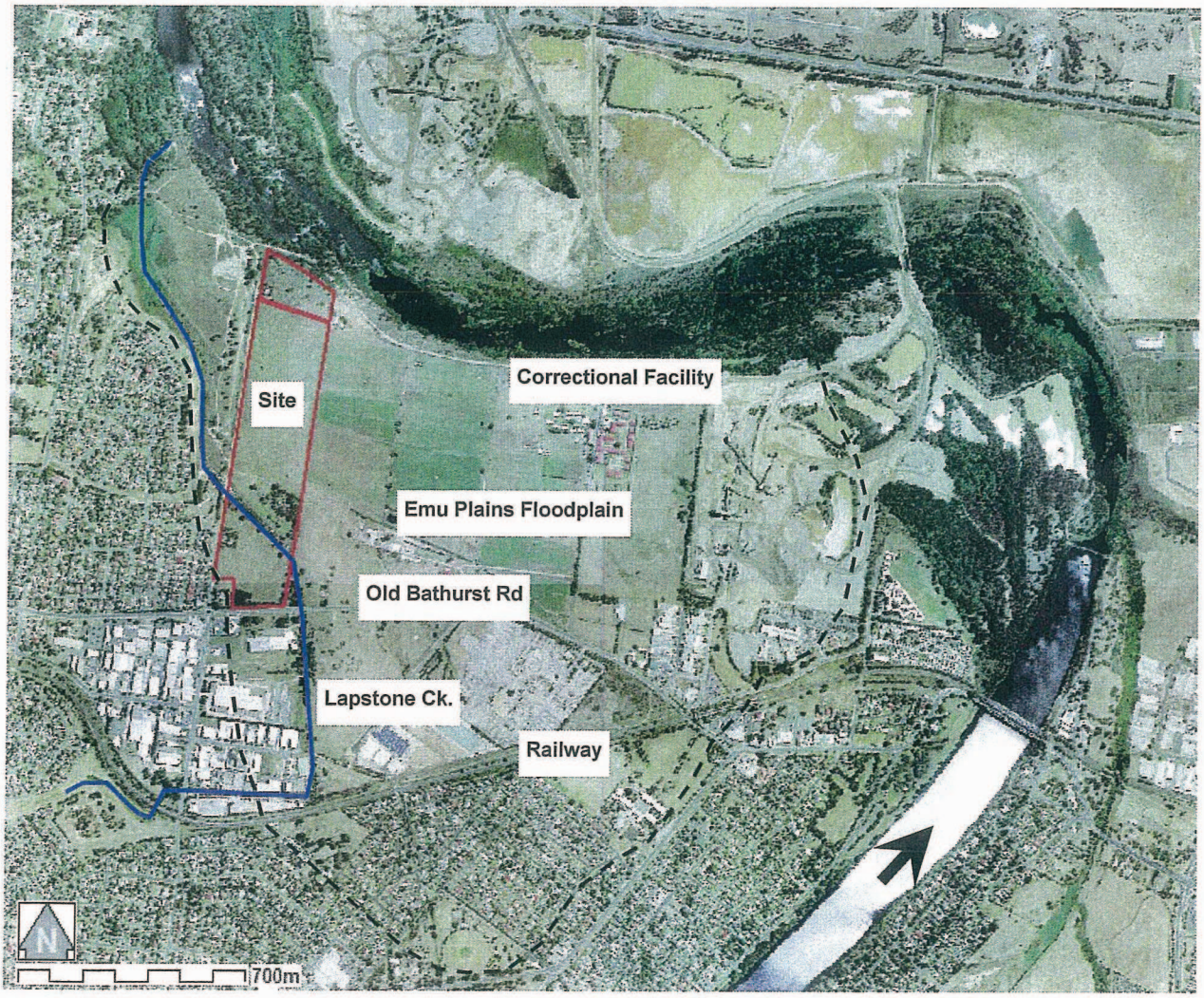

Figure 1 – Site Map

The Emu Plains floodplain abuts the east-west leg of the river as it traverses a large S bend, shifting from a central valley course to a course along the left steep sided edge of the valley. Lapstone Creek passes through the floodplain along its western side bisecting the site through a concrete lined channel. The floodplain is also bisected by the east-west alignment of the Great Western Railway embankment.

The river frontage of the Emu Plains floodplain consists of grassland associated with the correctional facility at the eastern extremity. Old Bathurst Road forms a boundary to the grassland and a strip of industrial development is situated between the road and the railway.

3.2 100 YEAR ARI FLOOD

As levels in the Hawkesbury-Nepean River rise, water initially backs up Lapstone Creek and onto the floodplain. This is joined by water which emanates from a breakout upstream of the S bend where the Hawkesbury-Nepean waters back up and escape from Knapsack Creek flowing overland onto the Emu Plains floodplain, and passing through openings in the railway embankment. A short time later the river breaks its left bank around the S bend and the majority of the Emu Plains floodplain becomes inundated.

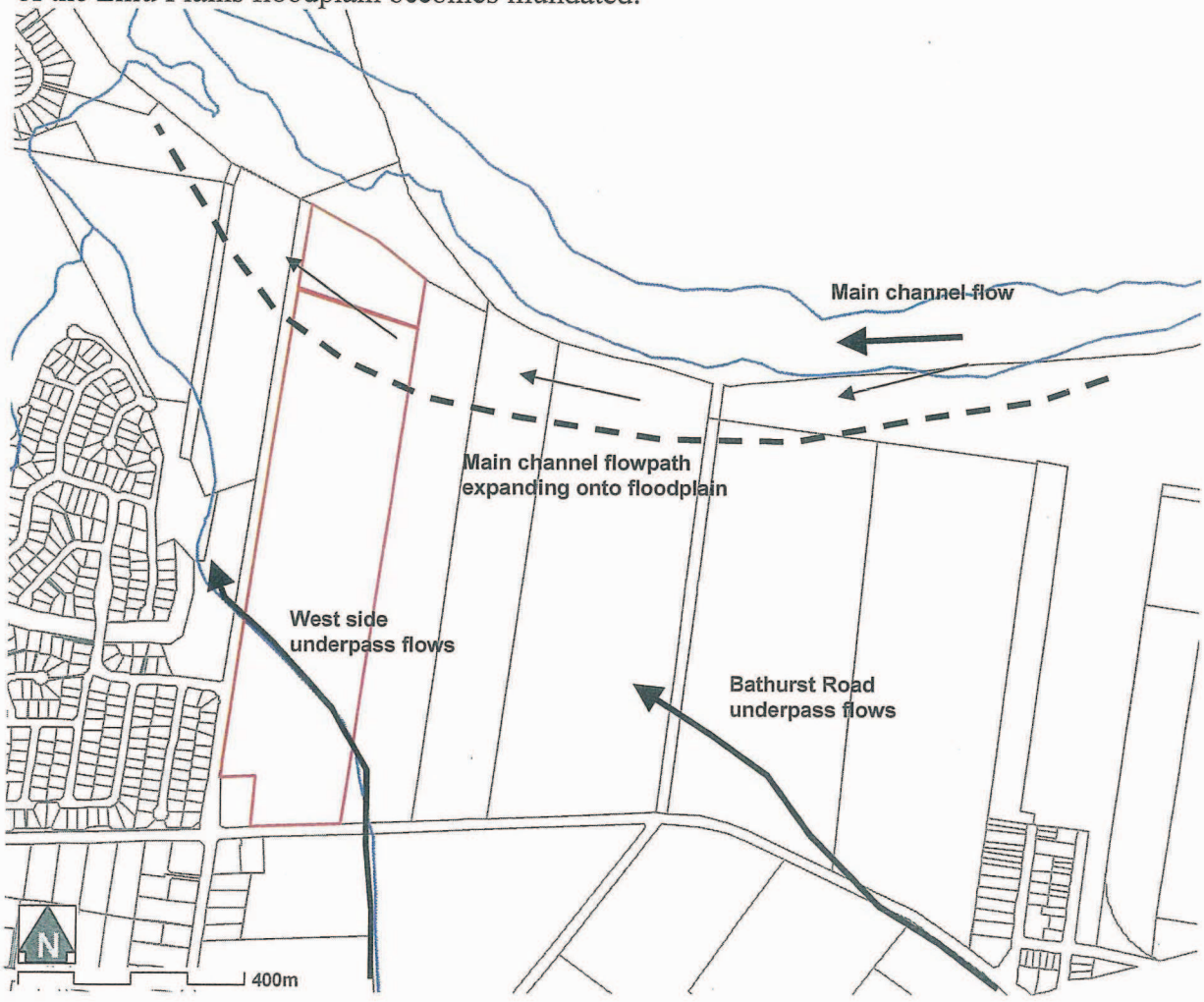

Figure 2 – Schematic representation of floodplain flows

At the peak of the 100 yr ARI flood, the flow leaving the start of the S bend expands around the correctional facility onto the edge of the floodplain. This is joined by flows expanding across the floodplain having passed through the Old Bathurst Road railway underpass. Additional flows cross through railway embankment openings to the west and pass through the Lapstone Creek corridor. A schematic diagram of these flowpaths is shown in **Figure 2** and results of the model depicting peak water level and velocity vectors are shown in **Figure 3**.

Depths across the majority of the existing site range from 0 to 2m and the peak 100 yr ARI water level is 23.6 to 23.7 m AHD along the east side.

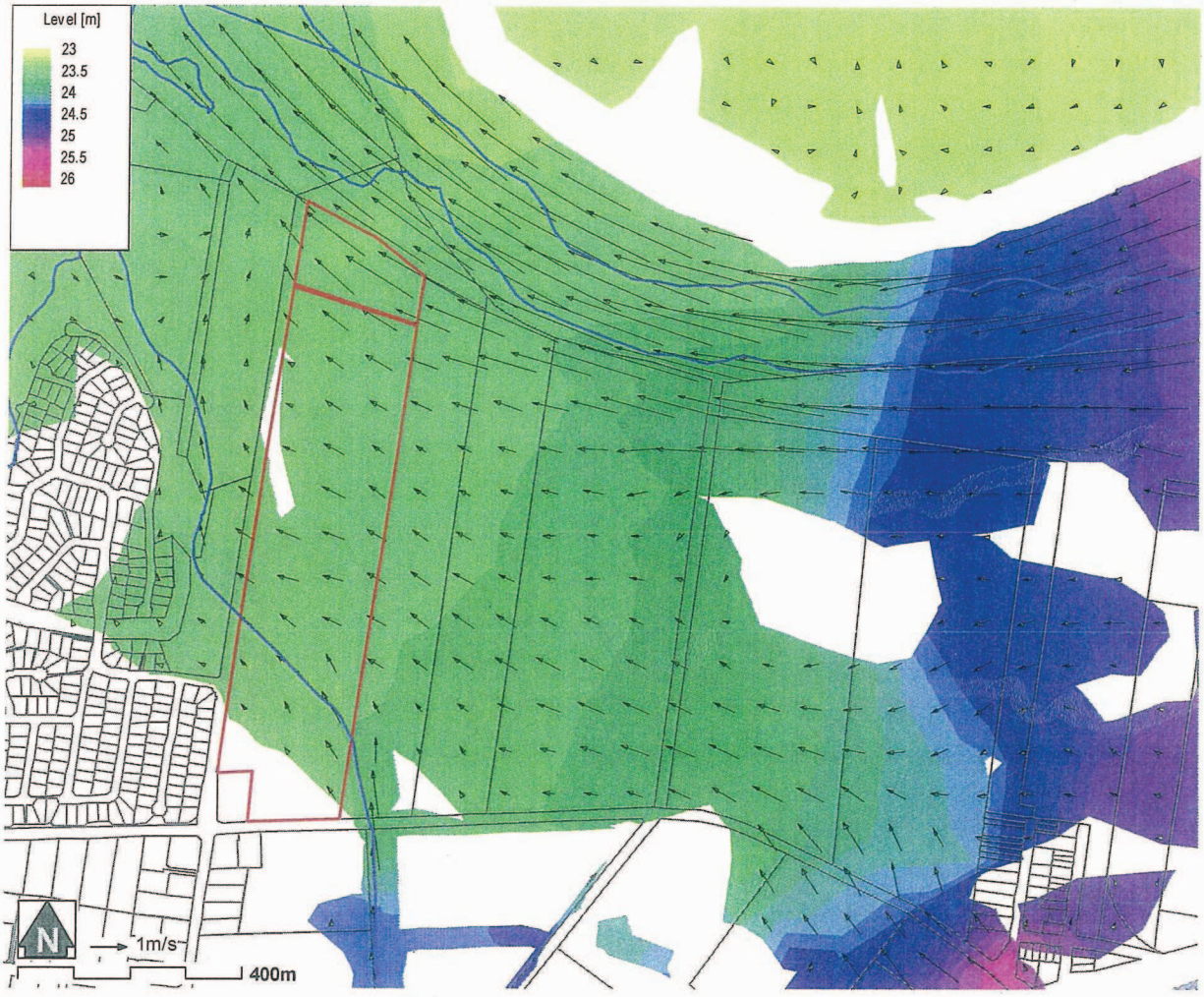

Figure 3 – 100 yr ARI flood peak water level and velocity vectors

3.3 200 YEAR ARI FLOOD

At the peak of the 200 yr ARI flood, the flow expands around the correctional facility onto the floodplain to a greater extent than the 100 yr flood and is likewise joined by flows from the railway underpasses. There is an additional component across the floodplain from the east where flows turn sharply from the start of the S bend, **Figure 4.**

Depths across the majority of the site range from 1.2 to 3.2m and the peak water level for the 200 yr ARI flood is 24.8 to 24.9m AHD along the east side.

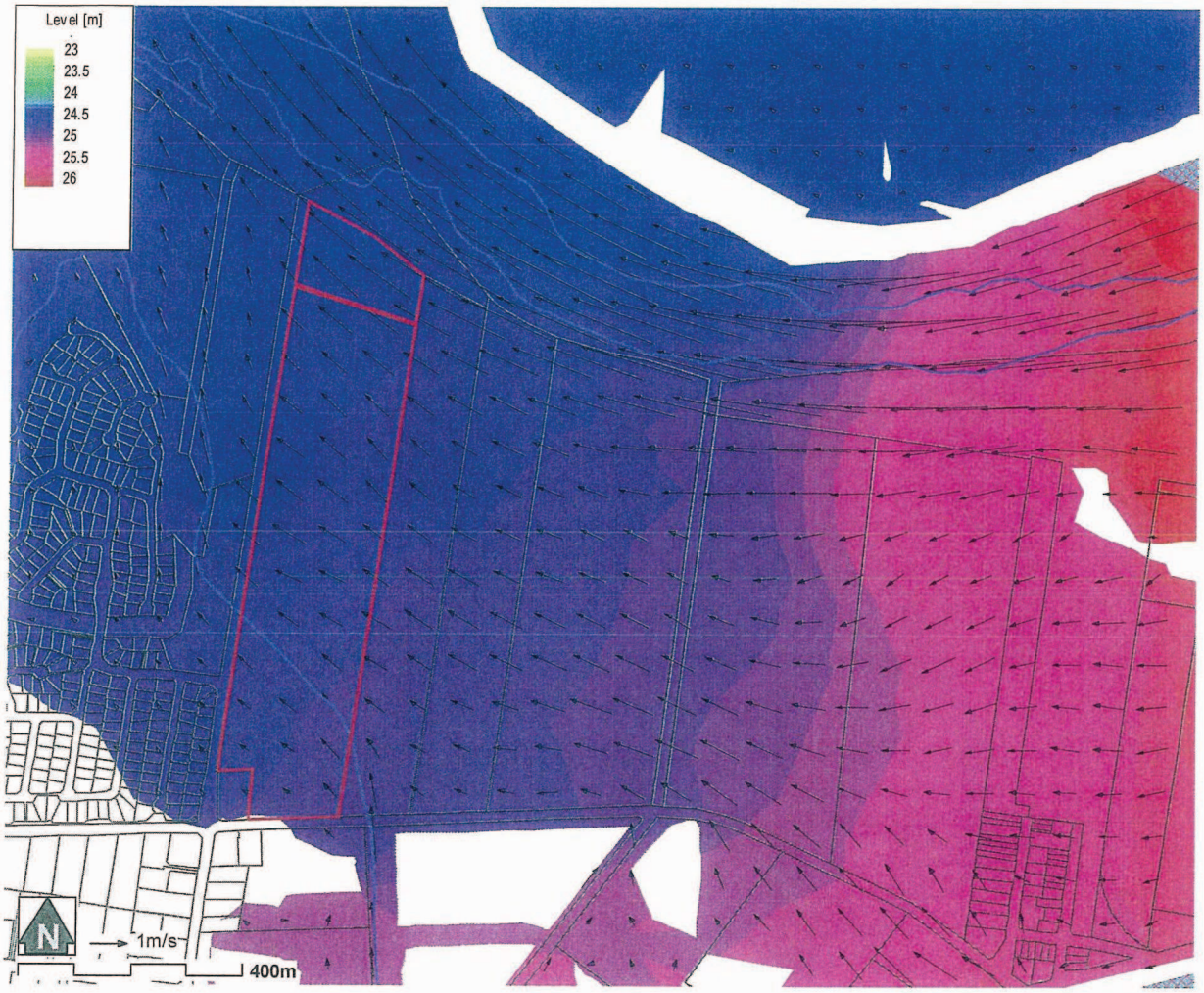

Figure 4 – 200 yr ARI flood peak water level and velocity vectors

3.4 IMPACTS

The flow expanding onto the floodplain from around the correctional facility forms a shear zone or edge with the remaining flow across the area. The maintenance of this corridor as a flowpath will likely be an essential component in minimising impacts of development on the site. This would exclude development on a portion of the lot towards the river.

Its is assumed that the building areas for an eventual sub-division would be filled to the 100 year flood level plus a 500 mm freeboard allowance, and that the roads would be constructed to the 100 year level minus 250 mm to meet Council's floodplain development requirements. It is also assumed that some form of open corridor would be maintained for Lapstone Creek.

The impact of any development on 100 yr ARI Hawkesbury-Nepean flood behaviour would likely be limited to slight increases in peak levels along the eastern side of the site as overland flows from the Old Bathurst Road underpass would be diverted into the Lapstone Creek and main channel flowpaths.

The impact of any development on 200 yr ARI Hawkesbury-Nepean flood behaviour is expected to be similar to the 100 yr flood with the addition of the extra overland flows being somewhat compensated for by flow passing across the site between the buildings with the increased water levels.

Should the appropriate industrial zoning be approved, it is recommended that the development application for subdivision highlight the flowpath corridor extent and level at the northern end of the site plus treatment of the Lapstone Creek corridor, and the spacing and elevation between the buildings.

4 WATER MANAGEMENT

This section examines stormwater quantity and quality for site runoff. For discussion of flooding, see other sections of this report.

4.1 WATER QUANTITY

4.1.1 Existing Conditions

The site is currently undeveloped and approximately 24 ha. The Hawkesbury Nepean River borders the site in the north and Lapstone Creek passes through the southern part of the site traversing the site from east to west. A southern portion of the site comprising approximately 12.5 ha drains towards the Lapstone Creek tributary. A number of ephemeral swales also traverse the site in a northwesterly direction in the northern portion, draining towards the Hawkesbury Nepean River.

4.1.2 Hydrology

XP-RAFTS software was used to derive peak flows for the 2, 5, 20 and 100 year average recurrence interval (ARI) storm events for pre-development and post-development conditions, with on-site detention (OSD).

RAFTS was chosen for this investigation because it has the following attributes:

- it can account for spatial and temporal variation in storm rainfall across a catchment;
- it can be used to estimate discharge hydrographs at any location within the catchment;
- it can accommodate variations in catchment characteristics;
- it is able to route hydrographs through detention basins; and
- it has successfully been widely used across NSW.

4.1.2.1 Proposed Rezoning

Following the proposed rezoning, the relevant planning instrument for the Stormwater Management Plan (SMP) would be Penrith City Council's (Council's) Development Control Plan (DCP) for Industrial Lands. The DCP requires On-Site Detention (OSD) for industrial areas. Post-developed runoff must not to exceed pre-developed runoff for all storm events, demonstrated by the 2, 5, 20, and 100 year ARI events. Council also requires that the 20 year ARI flows be fully piped within the street drainage system.

4.1.2.2 On-Site Detention (OSD)

Council planning staff have advised that there are no requirements governing the maximum impervious area of industrial developments except for building set backs as listed below.

Roadway	Building setback (m)
Old Bathurst Road	15
Internal roads	9
Secondary road frontages for corner lots	5

Building setbacks are to be landscaped with the exception of any access points. Given the maximum standard width for driveways of 15 m, an overall impervious area was conservatively assumed as 95%, including road surfaces. This was used to determine peak flows under post development conditions.

The determination of required on-site detention is based on reducing post-development flows back to existing conditions. Existing conditions were assumed to be rural and 100% pervious. The actual peak flows resulting from proposed development after subdivision may be less, depending on actual impervious areas associated with proposed development.

The northern portion of the site drains directly to the receiving waters of the Hawkesbury Nepean River and undergoes inundation during large storm events, essentially acting as flood storage. As such it is considered appropriate to foregoe formal detention requirements for this section. Furthermore, it is considered that runoff from this area should be allowed to discharge as soon as possible, without being detained, to prevent coincidence with the peak mainriver flows.

The southern portion of the site drains towards the Lapstone Creek which passes through the site. This portion of the site may require detention to prevent increases in Lapstone Creek flows. This would be assessed as part of a development application for the site. Based on reducing post-development flows back to existing conditions, the maximum total site storage requirement was determined to be 3300 cubic metres or 264 m^3/ha. This storage volume was determined for the 1 in 100 year ARI event. For more frequent events, a lower volume of storage would be required.

If detention is found to be required for the portion of the site draining directly to Lapstone Creek, this storage could be provided through a combination of surface storage and OSD tanks. Shallow surface storage could be provided within carpark areas of developments (maximum depth of 300 mm). Pipe outlets from the individual detention discharge control pits would connect into the proposed street drainage system. Individual on-site detention systems may or may not be located within the building set-back area.

4.2 WATER QUALITY

Water quality objectives stated in Council's DCP include the improvement of water quality discharging to the Hawkesbury Nepean River system.

Modelling requirements for large (>50) hectare sites include the analysis of actual distribution of concentrations and loads within storm events. Applicable loading rates given in the DCP are listed in **Table 4-1**

Table 4-1 Average Annual Pollutant Loading Rates

Land Use	Run-off Co-efficient	Coarse Sediment (kg/ha/year)	Fine Particulates (kg/ha/year)	Total Phosphorus (kg/ha/year)	Total Nitrogen (kg/ha/year)	Organic Matter (m^3/ha/year)	Litter (m^3/ha/year)
Pre-development	0.2	90	-	0.16	1.26	0.05	0.01
Industrial	0.52	950	110	1.7	9.5	0.2	0.35

(taken from Penrith City Council's Development Control Plan for Industrial Lands)

However, the DCP also allows adoption of pollutant loading values that differ from the above table provided that it is supported by detailed investigation. For this study, Patterson Britton and Partners have utilised the findings of work by Duncan (1999) as it represents the latest and most comprehensive study of pollutant loading rates for various land uses. It is anticipated that adoption of Duncan's pollutant loading rates would lead to a smaller difference in pre to post annual loads than Council's DCP values.

According to Council's DCP, sites over 5 ha must as a minimum comply with the following pollution retention criteria:

Pollutant	% Reduction
Litter	70
Coarse sediment	80
Nutrients	45
Fine Particles	50
Free Oil and Grease	90

4.2.1 MUSIC Water Quality Model

MUSIC is a continual-run conceptual water quality assessment model developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*). MUSIC can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads. MUSIC is able to conceptually simulate the performance of a group of