JW PLANNING

NORTH COORANBONG EXTENSION AREA
WATER MANAGEMENT PRINCIPLES, FLOODING AND
CREEKLINE ASSESSMENT

REZONING APPLICATION

Final DECEMBER 2005

Patterson Britton & Partners Pty Ltd consulting engineers

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1 INTRODUCTION

Patterson Britton and Partners Pty Ltd (*PBP*) has been engaged by JW Planning to identify and address the various water management issues associated with rezoning of the parcel of land known as the North Cooranbong Extension Area (*Site*). The triangular parcel of land has an area of approximately 58 hectares and lies immediately to the west of the original North Cooranbong site for which a Masterplanned rezoning submission is currently under review.

The Masterplan for the adjoining North Cooranbong land identifies this site as also appropriate for a mix of urban and conservation purposes however, further investigations were required to determine the development capability. This report provides advice on several issues relating to the specific development constraints and opportunities associated with the site, and supports a request to Council for rezoning of the site. The issues addressed in this report include:

- Creek assessment (refer Section 2):
- Flooding investigation (refer Section 3); and
- Water management principles (quantity, quality and re-use of stormwater runoff refer Section 4).

The creek assessment ascertained whether the drainage lines across the site would be considered as significant waterbodies (or 'rivers') under the Rivers and Foreshore Improvement Act (R&FI Act), as might be concluded by the Department of Infrastructure Planning and Natural Resources (DIPNR).

The flooding investigation determined the impact of flooding on the site from the nearby Felled Timber Creek and the extent of flooding in the drainage lines traversing the site.

The water management principles have been identified that would be adopted in formation of a sustainable water management strategy for the proposed development. The water management principles have been developed with respect to water sensitive urban design, runoff quantity and quality control and potable water use reduction.

1.1 SITE DESCRIPTION

The site (*Lot 218, DP 755218*) has a total area of approximately 58Ha and is located immediately west of the original North Cooranbong site (*refer Figure 1*). The site is triangular in shape and is surrounded by a variety of rural landuses, including partially forested rural land to the north, northeast and west. Olney State Forest is situated to the southwest, whilst Avondale College and Cooranbong aerodrome facilities are situated to the southeast.

The site is located on undulating terrain and as such has several subcatchments draining generally toward a main valley which drains from the north of the site to Felled Timber Creek in the south.

2 CREEK ASSESSMENT

Patterson Britton and Partners undertook an assessment of the drainage lines within the site area. This was undertaken in order to determine whether the drainage lines across the site would be considered as significant waterbodies (or 'rivers') under the Rivers and Foreshore Improvement Act (R&FI Act), as might be concluded by the Department of Infrastructure Planning and Natural Resources (DIPNR).

A comprehensive site inspection was undertaken by Patterson Britton personnel and an ecologist. Anne Clements which included each of the drainage corridors as shown on topographic mapping information.

Figure 1 shows the results of the creek assessment. Commentary is provided on each drainage line where applicable. The figure forms an initial base plan for the constraints diagram which is to be used in the Masterplan development process. Ultimately, the information contained within **Figure 1** is to be transferred to a site survey and thereby incorporated into the Masterplan layout.

2.1 RIPARIAN AND ECOLOGICAL CORRIDORS

The detailed site assessment determined the nature of the various drainage channels throughout the site in order to map the extent of riparian corridors. The corridor widths were selected based on consideration of various factors such as form, vegetation, ecology, topography and catchment area. The ecological corridors were determined by Anne Clements. The riparian corridors have been mapped resulting in a plan (refer Figure 1) outlining the areas which are to be treated as riparian corridors.

Figure 1 shows which drainage lines are considered significant and indicates areas which should be retained for riparian and drainage corridors. Appropriate corridor widths have been drawn around those watercourses. Elsewhere, stormwater runoff would be controlled by piping minor storms, and conveying major flows along roadways.

Three of the minor drainage lines on the eastern side of the central drainage line were deemed to be significant and as such, have 40m wide buffers associated with them. Connection of the remaining development area would not require roads to traverse the drainage lines thereby minimising the impact on the riparian corridors.

Figure 1 depicts a recommended buffer of 40m either side of main drainage path flowing across the site. This divides the land into a large western sector and a slightly smaller eastern sector however, it is understood that the large western sector is to remain undisturbed. This results in a significant proportion of the land able to be retained in its natural state. The corridor will provide an important link to vegetated areas north and south of the site boundaries. Overall, it will provide a significant contribution to the ecological value of the area.

Works within 40m of the top of bank of the creekline within the riparian corridors will require the approval of the Department of Infrastructure, Planning and Natural Resources (*DIPNR*) under the Rivers and Foreshores Improvements Act.

3 FLOODING ASSESSMENT

There are two issues which were considered in assessing the potential impact of flooding on possible development of this site:

- Elevated water levels of Felled Timber Creek; and
- Extent of overland flow through established drainage corridors.

3.1 FELLED TIMBER CREEK

The main drainage path through the site joins Felled Timber Creek approximately 600m south of the property boundary. Although Felled Timber Creek is considerably lower than the site, the size of the catchment (1539Ha) warranted further investigation into the expected flood levels to determine if the 100 year ARI flood level of Felled Timber Creek would inundate the site.

A study was undertaken (Flood and Drainage Assessment – Freemans Drive, Cooranbong prepared by PPK for Avondale Greens Pty Ltd, September 2002) which determined 100 year ARI flood levels at the following two locations of Felled Timber Creek approximately 800m and 1100m downstream respectively of the confluence of the main drainage path with Felled Timber Creek:

"Upstream end of site (west of Bushland Drive)"
"Downstream end of site (west of Bushland Drive)"
8.5mAHD

These expected 100 ARI flood levels were determined by applying Manning's Equation to cross sections of Felled Timber Creek determined from orthophotos and site inspections. It was noted that the peak flow of 112m³/s in Felled Timber Creek controlled the water levels in that section of the site, rather than the backwater effects of Dora Creek or downstream bridges.

Based on this information, the elevated flood water level of Felled Timber Creek expected during a 100 year ARI event could be conservatively estimated at RL 12mAHD and as such, would impinge slightly on the lower reaches of the site. However, given the uncertainty of this predicted flood water level we consider it prudent to set the development limit of the site at a higher level. It is therefore recommended that no development take place below the 15mAHD contour line. It can be seen from **Figure 1** that a significant proportion of the land below the 15mAHD contour line lies within the proposed riparian corridors.

If development below the 15mAHD contour is desired, it would be necessary to undertake a more detailed flood assessment of Felled Timber Creek to establish the flood level with greater certainty.

3.2 OVERLAND FLOWPATHS

The extent of any overland flow within a drainage corridor was determined by the hydrological characteristics of the contributing catchment (*size*, *slope etc*) and the physical characteristics of the drainage corridor (*shape*, *slope etc*).

An assessment of all the drainage corridors and their respective catchments revealed that the peak flows expected during the 100 year ARI storm event would be contained within the proposed riparian corridor widths.

Where corridors are not proposed, a piped stormwater system would be constructed to convey all runoff from storms up to and including the 10 year ARI (*LMCC requirement for public roads*). Flows in excess of this would travel via designated overland flow paths (*roads*). The roads would be designed to convey the peak runoff during the 100 year ARI storm event and measures would be implemented to mitigate hazardous overland flows. Manipulation of flows, layout, piped drainage and grades may be necessary to ensure that the depth velocity product would be limited to 0.4m²/s in pedestrian areas (*recognised as the safe limit for pedestrians*) during all storm events.

4 WATER MANAGEMENT PRINCIPLES

In order for the site to meet the objectives outlined in **Section 1**, the proposed development must be compatible with best practice water and creekline management principles and in particular Water Sensitive Urban Design (*WSUD*). The following section outlines the fundamental WSUD principles which would be applied to the development in order to achieve water sustainability.

In order to achieve an environmentally sustainable development, measures to manage both potable water and stormwater need to be implemented. The North Cooranbong Extension Area site would be developed according to the latest WSUD principles to achieve a development which would demonstrate a strong commitment to sustainability. As such, the water management principles outlined place particular emphasis on the implementation of a water sensitive urban design (WSUD) approach in order to contribute to the long term sustainability of the site and its surrounding environment.

The water management principles developed for this site are in accordance with the requirements of the Lake Macquarie City Council Development Control Plan (*DCP*) No. 1 (*adopted March 2004*), the Lake Macquarie City Council Handbook of Drainage Design Criteria (*adopted March 2004*) and the recently implemented BASIX requirements (*refer Section 4.1*).

The requirements and objectives contained within these publications represent the underlying principles of sustainable development and have been adopted as the four principle objectives for the North Cooranbong Extension Area residential development.

1. Retain (and where necessary rehabilitate) Riparian and Ecological Corridors

Minimise the impact of the development on existing riparian (and ecological) corridors and where possible improve existing conditions (refer **Section 2**).

2. Minimise Potable Water Demand

Minimise the potable water demand of the development by implementing water saving and water re-use measures (refer **Section 4.1**).

3. Minimise Impacts on Water Quality

Ensure there is no impact on water quality (nutrients, sediment and gross pollutants) during and following construction activities, and where possible improve existing conditions (refer Section 4.2).

4. Minimise Impacts on Water Quantity

Minimise the impact of flooding (water quantity) on downstream areas, to ensure the safety of people, property and the stability of channels, and where possible improve existing conditions (refer **Section 4.3**).

Implementation of the stormwater management principles described in this report will ensure that these objectives are achieved.

4.1 BASIX

The Building Sustainability Index (BASIX) assesses the potential performance of new homes against a range of sustainability indices, viz Landscape, Stormwater, Water, Thermal Comfort and Energy. BASIX aims to reduce the environmental impact on these features by setting targets for these indices which all new developments must meet.

According to the BASIX requirements, residential developments must be designed and built to use 40% less drinking-quality water and produce 25% less greenhouse gas emissions than average NSW homes of the same type (the target for reduced greenhouse gas emissions will increase to 40% from 1st July 2006). These targets represent significant yet readily achievable savings in water use and greenhouse gas emissions by homes.

The BASIX requirements relating to water quality (not yet in place) were defined by the Environmental Protection Authority (EPA) which has specific goals regarding reducing the annual pollutant loads for developed conditions. These target reductions for the urban conditions are 80% for Total Suspended Solids (TSS) and 45% for Total Nitrogen (TN) and Total Phosphorous (TP).

Section 4.2 and **Section 4.3** of this report outlines the measures that would be implemented to ensure compliance with the BASIX requirements where they relate to water management (i.e. reduction in potable water usage and reduction in nutrient and sediment loading in stormwater runoff).

4.2 POTABLE WATER USE REDUCTION

The State Government recently announced the target of a 40% reduction in potable water use compared with traditional households will be required for any site development approved after July 2005 (BASIX).

This would be achieved by implementing water saving measures (refer Section 4.2.1) and water recycling measures (refer Section 4.2.2).

A reduction in total potable water use can be achieved through implementation of a combination of the following measures:

- Landscaping with plant species that require minimal water and irrigating with appropriate systems to minimise water loss and evaporation;
- Using water-efficient taps, dual flush toilets, shower roses or flow restricting devices; and
- Providing water efficient washing machines, dishwashers etc.

The main uses of potable water in a traditional household (refer **Table 1**) are garden irrigation (27%), toilet (16%) and washing machine (19%).

Table 1 Typical Household Water Usage

	Traditional Household		With Water Saving Devices	
Area/Use	Usage l/household/day	Percentage of Total Use	Usage I/ household /day	Reduction (%)
Internal		-		,
Kitchen	47.9	5.4	47.9*	-*
Bathroom basin	23.6	2.6	23.6*	_*
Laundry basin	19.7	2.2	19.7*	*
Shower	227.4	25.4	159.2	30%
Toilet	140.8	15.7	84.5	40%
Washing	169.9	19.0	169.9	-
machine	12.2	1.5	0.3	200
Dishwasher	13.2	1.5	9.2	30%
Sub Total	642.5	71.8	514.0	20%
External				
Irrigation	237.3	26.5	237.3	-
car washing	14.8	1.7	14.8	_
Sub Total	252.1	28.2	252.1	-
TOTALS	894.6	100	766.1	14%

^{*}Water saving benefits conservatively assumed as negligible in this investigation.

The reductions in potable water use due to water saving devices (listed in **Table 1**) have been derived from discussions with Sydney Water and the report. Investigation of Options to Minimise Potable Water Demand and Reduce Wastewater Flows (URS 2003).

In recognition of this, it is recommended that the development incorporate flow restrictors in the kitchen and bathroom, AAA rated shower heads, dual flush toilets and AAA rated dishwashers. It can be seen from **Table** 1 that these measures would directly reduce the total potable water usage by at least 14%.

4.2.1 Rainwater Re-Use

4.2.1.1 Strategy

Water saving devices in combination with reuse of rainwater from rainwater tanks for toilet flushing, washing machines, car washing and irrigation would be implemented throughout the development to achieve the 40% reduction required by the State government.

The re-use of rainwater from rainwater tanks has the potential to make considerable reductions in potable water usage in concert with water saving devices. With full substitution of potable water with recycled water for toilet flushing, washing machines, car washing and irrigation the reduction in potable water usage would be 70% (with the 14% reduction due to water saving devices – see Section 4.2.1). However, full substitution could not be guaranteed due to the variability of rainfall. To analyse this and to determine the most efficient rainwater tank size, a water balance analysis would be undertaken for the entire site for three scenarios (existing, proposed without rainwater re-use, proposed with rainwater re-use) incorporating parameters such as rainfall, imperviousness, water usage, evaporation etc.

4.2.1.2 Rainwater Tanks

Lake Macquarie City Council DCP No. 1 offers two methods for determining the required size of a rainwater tank on a lot by lot basis. The following table is to be used for the simplified method:

Roof Area	Minimum Tank Size Required
$0 - 100 \text{m}^2$	2.500L
100m ² - 200m ²	4,500L
200m ² - 300m ²	7.000L

Based on PBP experience and an initial site analysis, it is estimated at this preliminary stage that the provisions stipulated above would be more than adequate to achieve the 40% reduction in potable water demand target. Importantly, large tank sizes can adversely impact on the private open space and visual amenity of lots. Slimline tanks up to 4kL capacity overcome this problem and provide an overall higher quality residential amenity outcome while still meeting the potable water use reduction objectives.

The alternative calculation method offered by Council determines the required tank size according to the amount of stormwater runoff that must be captured to mimic natural permeability during a 3 month ARI rainfall event (*mitigation depth*). Mitigation depth varies with location depending on rainfall characteristics and soil characteristics but generally this method results in smaller tanks.

A rainwater re-use tank system can be installed in many different configurations including placing the tank above or below ground and using gravity or pressure systems (*pumps*) to deliver rainwater for toilet flushing, car washing, irrigation and possibly washing machines. The rainwater system would also employ a mains top-up scheme to ensure reliable water supply from the tank. When tank water levels are low, during period of little rainfall, the tank is topped up with mains water via a trickle system. This trickle system

reduces the peak demands on the mains water distribution network. Tanks would be fitted with a first flush device which causes the initial volume of runoff (*containing the highest concentration of pollutants*) to bypass the tank.

It is proposed to explore with Council the use of a range of rainwater tank sizes to suit the site and development constraints while still complying with the State government potable water use reduction target. Detailed analysis (*water balance*) can be undertaken at subsequent approval stages to refine the tank sizes to achieve the required targets and the best outcome for the overall design amenity and functionality of the site.

4.3 RUNOFF WATER QUALITY

The Department of Environmental and Conservation's (*DEC – formerly EPA*) specific goals regarding reduction of annual pollutant loads in runoff under developed conditions are listed below.

total suspended sediments
total phosphorous
total phosphorous
total nitrogen
45% of average annual load; and
45% of average annual load.

These targets represent the BASIX requirements (soon to be implemented) and are in general accordance with those listed in Table 2.1 of the Lake Macquarie City Council Stormwater Treatment Framework and Stormwater Quality Improvement Device Guidelines (adopted 1st September 2003 to support DCP No. 1 – Principles of Development).

In order to achieve these objectives, a treatment train approach would be implemented into the development where the stormwater treatment flow path for runoff would generally be:

- 1. runoff from roofed areas would be collected and detained in rainwater tanks with an overflow by-pass to the street (*bioretention*) drainage system;
- 2. large impervious areas such as roads would be directed to bioretention swales where they would be filtered and treated biologically:
- 3. excess flows from the bioretention swales and basins would flow to the pipe drainage system designed to cater for the 10 year ARI event;
- 4. stormwater exiting the pipe drainage system would pass through a gross pollutant trap to remove remaining coarse sediment, litter, debris, oils and greases; and
- 5. stormwater would drain from the GPT to either a wetland or a dry infiltration/bioretention basin for final treatment before discharge to the downstream system.

These processes are described in more detail below.

4.3.1 Rainwater Tanks

In addition to the water re-use benefits evident with installation of a rainwater tank, there are also water quality benefits. Rainwater tanks contribute to the retention of rainwater thus resulting in a reduction of the runoff co-efficient for the development which in turn

reduces the annual pollutant loads. **Section 4.2.2.2** describes the installation of rainwater re-use tanks in more detail.

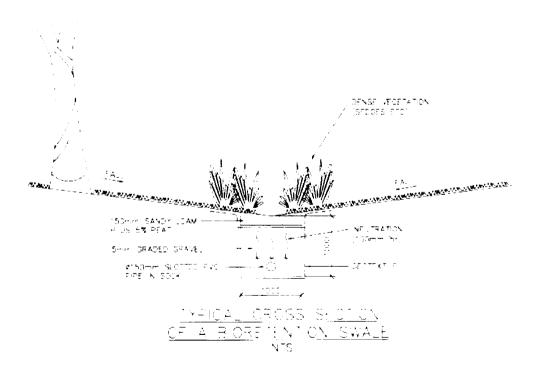
4.3.2 Bio-retention Swales

Bio-retention systems are systems that promote the filtration of stormwater through a prescribed filter medium. The type of filter medium determines the effectiveness of the pollutant removal, with material of lower hydraulic conductivity providing the most efficient pollutant removal.

Bioretention swales would be incorporated into road reserves in the flatter sections of the development where they can aesthetically enhance the visual impact of the development. The swales would be planted with native grasses and fringe vegetation on a layer of coarse sand and soil. Below the swale would be a gravel filled trench approximately 1000mm deep and 1000mm wide wrapped in geo-textile with a perforated pipe at the base.

The purpose of a bio-retention swale is to provide a filtering effect to remove pollutants typically found in urban runoff (*i.e. TN, TP and TSS*). Further treatment would be achieved by filtering through the gravel trench and biological action due to growth on the gravel. Low flows are maintained as much as possible on the surface which would be exposed to sunlight and with turbulence introducing oxygen to the flows. These swales can be located in the streetscape and/or in open space areas.

A typical bioretention swale is shown in the figure below.



Appropriate roads within the development site would be designed to incorporate bioretention swales. These would be incorporated into roads with flat grades enabling

water to temporarily pond (with the construction of check dams) thus increasing the nutrient uptake capacity.

4.3.3 Gross Pollutant Traps

A Gross Pollutant Trap (*GPT*) captures litter, coarse sediment, some nutrients, oils and greases. While the pollutant capture efficiency of various traps may vary, the paper "Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap" (*Cooperative Research Centre for Catchment Hydrology, 1999*) suggests the following efficiencies:

•	gross pollutants	majority
•	sediments	up to 70%
•	total phosphorous	up to 30%
•	total nitrogen	up to 13%

It is vital that the entire catchment is serviced by these GPTs and therefore that they are placed at the end of main stormwater lines or other critical locations and sized accordingly.

4.3.4 Wetland Basins

Constructed wetland systems use sedimentation, filtration and pollutant uptake processes to remove pollutants from stormwater runoff. A wetland system can be constructed to provide allowance for detention volume (extended detention) to aid in the stormwater quantity management. In accordance with best management practise it is recommended that the maximum depth of ponding given the site constraints be limited to 500mm.

Recreation and conservation areas have been successfully incorporated into the design of wetland systems in the past and would be encouraged for this site also.

4.3.5 Infiltration/Bioretention Basins

Infiltration/bioretention basins perform a function similar to bioretention swales promoting filtration of stormwater in order to remove pollutants typically found in urban runoff (i.e. TN, TP and TSS). The infiltration/bioretention basin can be located in public open space on playing fields or can be planted with native grasses and fringe vegetation on a layer of coarse sand and soil thus aesthetically enhancing the visual impact of the development. A drainage system would be constructed beneath the basin in much the same manner as for the bioretention swales. These basins can be constructed to provide allowance for a detention volume to aid in the stormwater quantity management.

4.3.6 Water Quality Control During Construction

Sediment and erosion control plans would be designed in accordance with the NSW Department of Housing "Managing Urban Stormwater – Soils and Construction" (Blue Book) and to the satisfaction of Council. Staging of the development would minimise impacts during construction. These controls would ensure that there are no significant adverse impacts on receiving water quality during construction.

4.4 WATER QUANTITY

4.4.1 Flooding – Inundation

The elevated flood water level of Felled Timber Creek during a 100 year ARI event is not expected to inundate the potentially developable areas within the site. The area of the site is less than 5% the area of the upstream catchment of Felled Timber Creek and accordingly, the impact of development of the site on the expected flood levels would be negligible provided appropriate detention measures are put in place.

4.4.2 Flooding – Overland Flows

All runoff on the site in its current undeveloped state travels overland and drains towards one of several creeklines throughout the site. All flooding would be either contained within the designated riparian/ecological corridors or within roadways.

4.4.3 Detention

It is proposed to collect and detain all runoff from within the site and therefore the discharge of runoff from the site would not induce adverse flooding impacts.

The LMCC Handbook of Drainage Design Criteria (adopted March 2004) requires detention of stormwater with the intention of limiting the maximum runoff (peak flow) from a 20 year ARI storm in the developed state to that of the 5 year ARI storm in the undeveloped (natural) state. It must also be ensured that the maximum runoff (peak flow) from a 100 year ARI storm in the developed state is detained and hence reduced to that of the 100 year ARI storm in the undeveloped (natural) state.

The detention volume could be reduced to reflect the implementation of rainwater tanks. Many Councils throughout NSW concede that, where a rainwater tank is installed in a residential development, a proportion (sometimes as much as 45%) of that rainwater tank volume can be counted as detention storage and as such, discounted from other detention measures. This allowance reflects various studies which have found that rainwater tanks do perform a degree of onsite retention.

Detailed hydrological modelling would be undertaken to determine the detention volume required to ensure peak flows after development do not exceed existing values.

The required volume determined necessary to achieve these detention requirements could be incorporated into the development in a variety of ways.

As mentioned in **Sections 4.3.4** and **4.3.5** bioretention basins and wetlands can be designed to temporarily pond runoff during storm events (*extended detention*) to provide the required volume. Other methods include onsite detention tanks whereby each lot is equipped with a detention tank, and underground storage whereby larger storage tanks are located underground throughout the development. It is envisaged that a combination of these methods would be employed in the final development.

5 CONCLUSIONS

This site represents an opportunity to implement a water management system which would not only ensure sustainability of the development but also contribute to an improvement in the overall environmental quality of the North Cooranbong Extension Area site, the receiving waters and the surrounding areas.

The principal objectives which would be successfully achieved through implementation of this integrated water management plan are:

- the demand for potable water would be reduced by at least 40% compared to that of a traditional household with the introduction of water saving measures and rainwater tanks:
- the export of suspended solids, total nitrogen and total phosphorus would be significantly reduced compared with existing conditions:
- the peak flow rates of stormwater discharge from the site would be maintained at or below existing levels;
- the impact of flooding from either Felled Timber Creek or drainage paths within the site would be avoided:
- riparian (and ecological) corridors would be maintained; and
- the visual and passive recreational amenity of the development would be enhanced with these features.

6 REFERENCES

NSW Department of Housing (1998), Managing Urban Stormwater- Soils and Construction (Blue Book)

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FIGURE





