**JW PLANNING**

# NORTH CORRANBONG RESIDENTIAL DEVELOPMENT
# WATER MANAGEMENT PRINCIPLES

**Issue No. 1**
**JULY 2004**

**Patterson Britton**
& Partners Pty Ltd
consulting engineers

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Document Amendment and Approval Record

| Issue | Description of Amendment | Prepared by [date] | Verified ~~by~~ [~~date~~] | Approved by [~~date~~] |
|---|---|---|---|---|
| 1 | Water Management Principles | OR 9/7/04 | MT 9.7.04 | MT 9.7.04 |

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

Document Reference:
rp5368.01or040707watermanagementprinciples.doc
Time and Date Printed 9 July 2004, 12:32 PM



ACEA The Association of Consulting Engineers Australia

benchmark IN QUALITY AS/NZS ISO 9001

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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 the proposed North Cooranbong residential development.

The following report outlines the water management principles that would be adopted in formation of a sustainable water management strategy for the proposed development. The water management strategy would be developed with respect to water sensitive urban design, runoff quantity and quality control, potable water use reduction and retention/rehabilitation of creekline riparian corridors.

This report addresses and provides advice on the aforementioned issues where they relate to the specific constraints and opportunities associated with the site and supports a request to Council for rezoning of the site. It places 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 assessment of these aspects has been undertaken in conjunction with the ecologist Anne Clements from Anne Clements and Associates. It is important that the ecological and water management response is integrated for this site.

## 1.1 SITE DESCRIPTION

The site has a total area of approximately 279Ha and is located immediately north of the Cooranbong township.

The site is located on undulating terrain and as such has several subcatchments draining in various directions, several of which contain watercourses. Approximately half of the site drains via the main creekline to the southeast, toward Freemans Drive. The remainder of the site is divided into smaller subcatchments which drain generally to the north and west.

In addition to the riparian corridors associated with the aforementioned creeklines there is a potential for an ecological corridor system throughout the site.

## 1.2 PRINCIPLE OBJECTIVES

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 1.3***).

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 residential development.

1. **Minimise Potable Water Demand**

   *Minimise the potable water demand of the development by implementing water saving and water re-use measures (refer* ***Section 2.1****).*

2. **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 2.2****).*

3. **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 2.3****).*

4. **Retain (*and where necessary rehabilitate*) Riparian Corridors**

   *Minimise the impact of the development on existing riparian (and ecological) corridors and where possible improve existing conditions (refer* ***Section 2.4****).*

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

## 1.3 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 new development by setting targets for these indices which all new developments must meet.

The current BASIX requirements are directed at single dwelling developments but from 1$^{st}$ October 2004 these regulations will apply to larger scale developments in the Sydney region. From 1$^{st}$ July 2005, they will apply to the North Cooranbong development site.

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 1$^{st}$ 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 2.1** and **Section 2.2** 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*).

# 2 WATER SENSITIVE URBAN DESIGN

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

Often WSUD is narrowly defined in relation to only stormwater management, however in order to achieve an environmentally sustainable development it should also encompass potable water usage. The North Cooranbong site is seen as an ideal location to apply these principles to achieve a development which would demonstrate an industry best practice commitment to sustainability.

## 2.1 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 the site development approved after July 2005 (*BASIX*).

This would be achieved by implementing water saving measures (*refer **Section 2.1.1***) and water recycling measures (*refer **Section 2.1.2***).

### 2.1.1 Water Saving Measures

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 (*28%*), toilet (*17%*) and washing machine (*16%*).

**Table 1 Typical Household Water Usage**

| Area/Use | *Traditional Household* | | *With Water Saving Devices* | |
|---|---|---|---|---|
| | **Usage l/person/day** | **Percentage of Total Use (%)** | **Usage l/person/day** | **Percentage Reduction (%)** |
| **Internal** | | | | |
| Kitchen | 11.8 | 4.6 | 11.8 | - |
| Bathroom basin | 6.9 | 2.7 | 6.9 | - |
| Laundry basin | 7.9 | 3.1 | 7.9 | - |
| Bath | 8.8 | 3.4 | 8.8 | - |
| Shower | 55.9 | 21.8 | 39.2 | 30% |
| Toilet | 44.2 | 17.2 | 26.9 | 39% |
| Washing machine | 40.2 | 15.6 | 40.2 | - |
| Dishwasher | 1.9 | 0.7 | 1.3 | 29% |
| *Sub Total* | *177.5* | *69* | *143.0* | *24%* |
| **External** | | | | |
| Irrigation | 72.5 | 28.2 | 72.5 | - |
| car washing | 2.3 | 0.9 | 2.3 | - |
| *Sub Total* | *74.8* | *31* | *74.8* | - |
| **TOTALS** | **257.1** | **100** | **217.8** | **15%** |

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. This would directly reduce total potable water usage by approximately 15%.

### 2.1.2 Rainwater Re-Use

#### *2.1.2.1 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 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 savings 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 15% reduction due to water saving devices – see **Section 2.1.1**)*. 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.

#### 2.1.2.2 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 – 100m$^2$ | 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 in order 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 mitigation 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, washing machines, car washing and irrigation. 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.

## 2.2 RUNOFF WATER QUALITY

The Environmental Protection Authority's (*EPA*) specific goals regarding reduction of annual pollutant loads in runoff under developed conditions are listed below.

- total suspended sediments 80% of average annual load;
- total phosphorous 45% of average annual load; and

- total nitrogen 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.

### 2.2.1 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 2.1.2.2** describes the installation of rainwater re-use tanks in more detail.

### 2.2.2 Bio-retention Swales

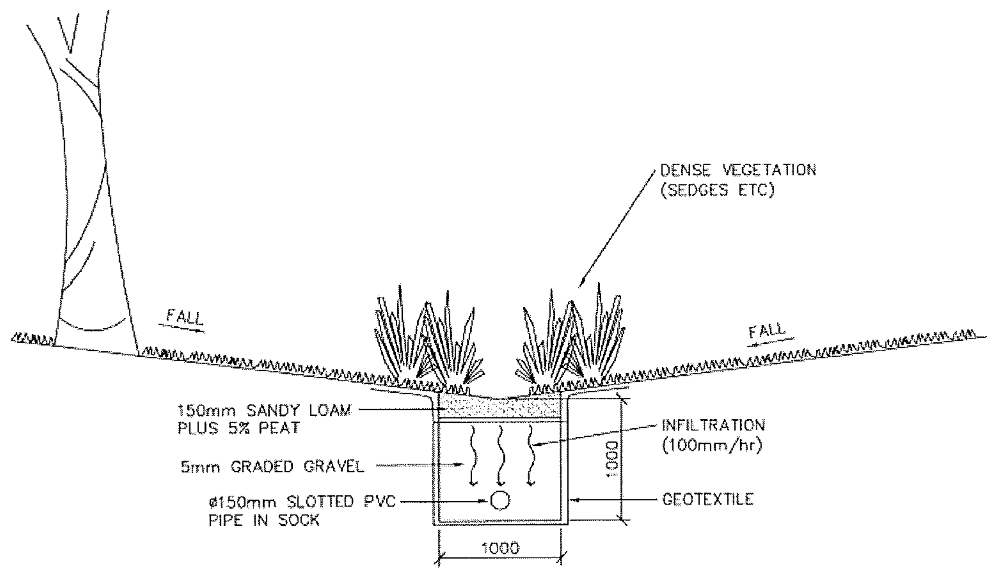
Bio-retention systems are systems that promote the filtration of stormwater through a prescribed filter medium. The type of filter medium determines the effectiveness of the pollutant removal, with material of lower hydraulic conductivity providing the most efficient pollutant removal.

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.




TYPICAL CROSS SECTION
OF A BIORETENTION SWALE
NTS

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.

### 2.2.3 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.

### 2.2.4 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.

### 2.2.5 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.

### 2.2.6 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.

## 2.3 WATER QUANTITY

### 2.3.1 Flooding - Inundation

The 100 year ARI flood flows would be incorporated into the riparian corridors or into the drainage system upstream of the corridors. 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.

### 2.3.2 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. Development of the site would increase imperviousness and thus increase the peak flow rates. All flooding would be contained within the designated riparian corridors where development is not to occur.

A piped stormwater system would be constructed upstream of the corridors to collect and convey all runoff from storms up to and including the 10 year ARI (*LMCC requirement for public roads*) whilst flows in excess of this would travel via designated overland flow paths (*roads*). 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 $0.4m^2/s$ in pedestrian areas (*recognised as the safe limit for pedestrians*) during all storm events.

### 2.3.3 Detention

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

As mentioned in **Sections 2.2.4** and **2.2.5** bioretention basins and wetlands can be designed to temporarily pond 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.

## 2.4 RIPARIAN CORRIDORS

A detailed site assessment was undertaken, in conjunction with Anne Clements from Anne Clements and Associates, to determine the nature of the various drainage channels throughout the site in order to map the extent of riparian corridors. The corridors were selected based on consideration of various factors such as form, vegetation, ecology, topography and catchment area. The various widths of the riparian corridors (*where necessary*) were also determined in accordance with both the ecological and water management requirements.

The riparian corridors, in concert with the ecological corridors have been mapped resulting in a plan (*refer to the attached **Figure***) outlining the areas which are to remain undisturbed (*and possibly enhanced*).

No water management facilities (*e.g. wetlands, infiltration basins*) are to be located within these areas. Minimising the impact of road crossings on the riparian corridors would be ensured by limiting their number but also by locating them appropriately.

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. The corridors have therefore been formulated taking into account the likely requirements of DIPNR.

# 3 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 site, the receiving waters and the surrounding areas.

The principle 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;
- the peak flow rates of stormwater discharge from the site would be maintained at or below existing levels;
- the riparian (*and ecological*) corridors would be maintained; and
- the visual and passive recreational amenity of the development would be enhanced with these features.

# 4 REFERENCES

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

Cooperative Research Centre for Catchment Hydrology (*1999*), *Removal of Suspended Solids and associated Pollutants by a Gross Pollutant Trap*

Cooperative Research Centre for Catchment Hydrology (*Report 99/3, 1999*), *Urban Stormwater Quality: A Statistical Overview*

Environment Protection Authority (*1996*), *Managing Urban Stormwater: Treatment Techniques*

Environment Protection Authority (*1996*), *Managing Urban Stormwater: Council Handbook*

Lake Macquarie City Council (*March 2004*), *Development Control Plan (DCP) No. 1*

Lake Macquarie City Council (*March 2004*), *Handbook of Drainage Design Criteria*

Lake Macquarie City Council (*September 2003*), *Stormwater Treatment Framework and Stormwater Quality Improvement Device Guidelines*