Appendix L

Hydrology engineering advice report

Settlement City Shopping Centre – Port Macquarie
Environmental Assessment proposed Stage 1

ING REAL ESTATE

Manidis Roberts

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ING Real Estate

Engineering Advice
Proposed Settlement City Re-development, Port Macquarie

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ENVIRONMENTAL

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Executive Summary

Overview

This report is prepared to support a project application for a proposed expansion and partial redevelopment to the Settlement City Shopping Centre at the corner of Park and Bay St, Port Macquarie. The report addresses a range of issues covering:

- Stormwater management, re-use and water quality implications.
- Geotechnical site constraints.

Site Description

The existing Settlement City Shopping Centre is located on Lots 4 and 5 DP 1018087 and Lot 2 DP 702484. T he site is approximately 7.4 ha in area and is understood to have been previous filled with material likely to have been derived from dredging of the Hasting River.

The site is generally level at an elevation of 3.0 – 4.0 mAHD. Drainage is through a series of surface and piped drainage ways discharging to the Hastings River and associated canals. No sub-surface investigations have been completed, however, it is inferred that Groundwater levels shall be approximately equivalent to levels in adjacent tidal inlets.

Results

A range of geotechnical constraints have been identified on the site. Issues identified include potential for differential settlements due to compaction of underlying clay, peat and silt layers; groundwater impacts and settlement if dewatering occurs; salinity impacts on foundations; and acid sulfate soils. Each of the identified geotechnical constraints on the site are considered to be manageable through standard engineering design.

The existing site stormwater system provides drainage of the site to the receiving waters without treatment. Following the proposed site redevelopment much of the site drainage shall be treated through new stormwater treatment systems. The proposed redevelopment reduces the surface area of bitumen carparks (potential source of PAH from bitumen and pollutants from vehicles) and replaces it with concrete carparks and new roof areas.

The incorporation of 'HumeCeptor', 'HumeGard' or similar gross pollutant and grease and oil capture systems within the piped site discharge to the west shall allow for further stormwater renovation ensuring that the proposed site redevelopment shall have a significant beneficial impact on the overall site discharge water quality.

DRAINS modelling was used to compare pre-development (existing) and post-development flow rates from the site. The site was divided into 3 catchments according to discharge points (i.e. Hastings River, the canal system or beneath Park Street).

It was found that the northern and western catchments (draining to the Hastings River and canal system respectively) remained unchanged in terms of their pre- vs post-development impervious area. The south eastern catchment (draining to Park Street) has an increased pervious area resulting in a slight decrease in discharge flow rates. The post-developed site therefore achieves policy objectives of no net increase in site discharge.

Stormwater management recommendations are as follows;

1) Renewed stormwater system as part of building and road construction on the eastern area of the site replacing existing Panthers club and car park drainage systems.

2) Collection of stormwater from the existing metal roof areas and / or new roof top parking area and the capture of this water on-site for reuse through non-potable site uses such as toilet flushing and irrigation.

3) A 3m wide pervious pavement 'strip' with vegetation planting is to be provided allowing either side of Entertainment Street to maximise infiltration of overland flow in this area. Paving product such as Borals 'Hydrapave' are to be used.

4) The use of stormwater for toilet flushing in new amenities, site irrigation and external washdown is recommended.

The sandy nature of site soils and gentle site grades means that sediment and erosion control measures such as sediment fences, shake down areas and (possibly) sedimentation basins shall be readily incorporated in to the construction plan to ensure no construction phase impacts on receiving water.

Conclusions

Identified site geotechnical constraints are considered to be comparatively minor and shall be readily overcome using conventional engineering practices and methods.

The proposed expansion and redevelopment of the site shall result in a net beneficial impact on the local hydrology and water quality impacts of the site. The reclamation of clean stormwater and beneficial re-use shall minimise the redevelopment's demand for additional town water as well as reducing discharge volumes. The proposed water quality control measures shall ensure that post-development water quality outcomes are considerably better than the existing case.

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1 Overview

1.1 Report Background

This report has been prepared by Martens and Associates Pty Ltd to assess a range of water management and geotechnical engineering related site constraints related to the proposed re-development of the existing Settlement City Shopping Centre expansion and partial redevelopment at Port Macquarie. SEPP 71 does not apply to this project application. However since it provides a thorough list of issues to be considered, it has been used as a guideline for reporting on the site.

Investigations completed have been of a preliminary nature and are largely based on desktop reviews of available information. Such an investigation is appropriate for a 'project plan' submission. Additional analysis is required following approval and prior to lodgement of the site construction certificate (CC). Specifically, this report addresses the following issues associated with the proposed development:

1. Stormwater management requirements based on available site information, results of DRAINS (stormwater quantity) modelling and relevant state and local government policy, including advice on collection, re-use and disposal.

2. Appraisal of options for stormwater storage and non-potable re-use including toilet flushing, irrigation and commercial cleaning.

3. Identification of likely site geotechnical constraints.

4. Management recommendations for site soils.

1.2 Development Background

It is understood that the proposed site development comprises an expansion and partial redevelopment of the Settlement City Shopping Centre at Port Macquarie, including the construction of new commercial structures and demolition of structures as follows:

- Expansion of retailers area (including large format and specialty stores.
- Inclusion of cinemas and bowling and commercial offices.
- A new multi-deck carpark.

The remainder of the site is to be used for loading areas, landscaping and ancillary purposes such as outdoor dining and access roads.

1.3 Report Structure

This report is set out as follows:

- Section 2: Site Characterisation
- Section 3: Stormwater Management
- Section 4: Sediment and Erosion Control

2 Site Characterisation

2.1 Location and Site Description

The development site comprises Settlement City Shopping Centre and is located 1.3km east of Port Macquarie business area. Together with the Panthers club, they occupy a site area of 6.4 hectares, with water frontage to the north (the lower Hastings River) and west (canal systems) and road frontage to the east (Park Street) and South (Bay Street). The site is in the Port Macquarie-Hastings Local Government Area on the mid north coast of NSW.

The town centre of Port Macquarie is located approximately 1.0 – 1.5 kilometres to the south-east. The site is bounded by Bay Street to the south, Park Street to the east and canal systems off the Hastings River to the north and west (Figure 1).

The site is identified as Lot 2 in DP 702484 and Lots 4 and 5 in DP 1018087, covering an area of approximately 7.4 ha.

Source: Kempsey 1:25 000 Aerial photo (Dept of Lands) (2003)

Figure 1: The proposed redevelopment site within the local environmental context, Port Macquarie, NSW.

2.2 Land-use Practices

Settlement City Shopping Centre comprises a large discount department store, supermarket, mini major store, specialty stores, food

and beverage outlets and open car parking area. Landscaped areas are generally confined to the boundary fringes. Urban, commercial and recreational land-uses dominate the local area.

Figure 2: Photograph of subject site taken on 11/10/05, viewed to east, Settlement City, Port Macquarie, NSW.

2.3 Climate

The nearest rainfall station is located at Hill Street (St No. 060026), 3.0 km to the south-east of the site. Rainfall data indicate that the local area experiences a mean annual rainfall of 1540 mm. Rainfall is generally highest during the period from December to June [i.e. summer and autumn dominated], with mean monthly totals ranging from 127 to 177 mm per month over this period.

2.4 Topography and Slopes

The site is gently sloped with local relief of less than 0.5 m. It is located on the lower Hastings River floodplain. Surrounding land is described as a near level coastal floodplain with elevations of less than 5 mAHD, with slopes of less than 5%.

Available site development history indicates that the site was filled between 1979 and 1983 prior to its development. Original site levels appear to have been approximately 1.7 – 2.1 mAHD (based on Dept of Lands orthophoto, 1975). The current elevation of the site is between

approximately 3.0 and 4.0 mAHD (based on site survey by Frank O'Rourke & Associates, Aug 2005).

A review of the Port Macquarie 1 : 25 000 topographic map indicates that surrounding lands comprise predominantly coastal flats that have been developed to create the urban centres of Port Macquarie and 'Settlement Shores'.

2.5 Geology

Review of the 1 : 250 000 Geology Map (Hastings, Sheet SH 56-14, 1970), indicates that the site is underlain by Quaternary deposits of alluvium including sand, silt, mud and gravel. Total depth of these deposits is expected to be in excess of 4 m and may be up to 20 m or more. Subsequent to preparation of the Hastings geology map a number of canal systems have been constructed on surrounding lands and the site has been filled.

2.6 Soil Profiles

A walk-over site inspection was undertaken by Martens and Associates on October 11, 2005. Sub-surface soil and groundwater investigations were not undertaken.

Investigations regarding site soils included a review of soil landscape mapping as well as a review of the history of site development. The Kempsey 1:100 000 Soil Landscape Map indicates that the site is located in an area of disturbed terrain. Such areas have been extensively disturbed by human activity. It is inferred that the site has been filled by approximately 1.0 – 2.0 m. A possible source of this fill may have been marine sand dredged from the lower Hastings River.

Natural site soils underlying the fill are most likely of the 'Limeburners' soil landscape, comprising deep siliceous sands to depths greater than 3.0 m developed on barrier or Pleistocene sand deposits. These soils are typically well drained although are likely to be highly acidic and saline.

2.7 Surface Waters

The site is a developed surface with a roof drainage system and pavement drainage system. Natural grades allow discharge through a pipe and drainage network to the east to the Hastings River and also to the north and west towards the canal systems off the Hastings River.

2.8 Flood Control Weir

A flood control weir structure (crest RL – 1.44 mAHD) is located directly to the north of the site in the canal system. The purpose of this structure is to prevent flood flows from upstream passing directly through the canal system and potentially causing damage to developments

adjoining the canal. Rather, it ensures that flood flows continue in the Hastings River around Settlement Point.

2.9 Tidal and Flood Inundation

The site is located adjacent to a system of canals known as Dolphin Keys which join the Hastings River approximately 1 km to the north west of the site. With regard to tidal flow influence the canals adjacent to the western site boundary are approximately 7.0 km upstream from the river mouth, although the northern site boundary is only 2.0-2.5 km directly west of the river mouth. Settlement Point separates the canal system from the lower reach of the river.

Discussions with Council (22.01.2009) and review of *Hastings Flood Study* (Patterson Britton and Partners Pty Ltd, 2006) indicate that the flood planning levels for the site are influenced by the differing effects of flood on the canal system and the Hastings River. Flood planning levels are provided in Table 1.

Table 1: Flood Levels for the site (Port Macquarie Hastings Council, 2009)

Boundary	Influence	Design 100 yr ARI Flood level (mAHD)	20 yr ARI flood level (mAHD)
North	Canals	2.85	2.40
West	Canals	2.85	2.40
East	Hastings River	2.55	2.30

Available information indicates that existing site levels would be a minimum of approximately 0.15 m above the design 100 yr ARI flood level (assuming a worst case scenario of 2.85 mAHD) and proposed ground floor levels are approximately 0.71 m above this height. Council mapping shows the site as being outside of the 100 yr ARI flood event.

2.10 Climate Change and Predicted Sea Level Rise

The potential impacts of climate change induced sea level rise are considered in this assessment. According to DECC (2007) sea level rise on the NSW coast is expected to be in the range of 0.18 to 0.91m by 2100.

Assuming a worst case scenario of 0.91m of sea level rise and an existing mean high water summer solstice level of 0.986 mAHD, the post climate-change mean high water summer solstice water level at the mouth of the Hastings River would be 1.9 mAHD. Given the distance from the mouth of the river to the site and the height of the Park Street bridge (4.65 mAHD), it is not expected that tidal influence would be attenuated significantly. We therefore consider the possible site impacts of this post-climate change water level to the site.

Given design ground floor levels are 3.56m, approximately 1.66m above this height, it is concluded that climate induced sea level rise poses minimal additional risk to the proposed development.

Another possible outcome of climate change could be increased frequencies and magnitude of flood events due to increased rainfall intensities (DECC, 2007). Review of DECC (2007) indicates that increased rainfall intensity of the order of 5 – 10% is possible for the Northern Rivers area. While this may lead to increased flood levels, such change will be readily accommodated with the provided 710mm freeboard between the current 1% AEP level (2.85m) and the adopted site finished floor levels of 3.56m. The site is considered to have sufficient adaptive capacity to accommodate the possible impacts of sea level rise.

2.11 Groundwater

No sub-surface investigations were carried out on site, therefore groundwater information has been inferred from local hydrology and topography. Given the site's close proximity to the lower Hastings River and the expected permeable nature of site soils, groundwater would be expected to be at a level approximately equivalent to water levels in the adjacent canal systems and river. It is also likely that the water table beneath the site would be highly variable in response to tidal movements and local weather. We estimate that groundwater would be located at a depth of approximately 2.5 m below existing ground level or 0.5 – 1.0 m AHD.

2.12 Geotechnical Constraints

Given the site's coastal location and history of filling, a number of potential geotechnical constraints have been identified:

- Settlement: The potential presence of layers of readily compressible silt, clay or peat or poorly compacted fill may result in differential settlement of structures. This is particularly the case where heavy masonry or concrete structures are used.

- Groundwater: As groundwater is estimated to be at a depth of approximately 2.5 m below the ground surface, any construction works near this depth may require dewatering. This may lead to potential acid sulfate soil, differential settlement and saltwater ingress issues.

- Salinity and Acidity: As natural site soils are of marine or estuarine origins there is a likelihood of high salinity and acidity in the soil which may impact foundation materials. Furthermore, the risk of acid generation from actual or potential acid sulfate

soils being excavated shall need to be investigated prior to excavation. This issue is further considered in Section **Error! Reference source not found.**;

- Contamination: Past uses of the site, including filling and commercial use and possible agriculture, raise the possibility of the introduction of contamination to the site soils. This issue is further investigated in Martens Report No. P0501226JR02_v1.

The constraints identified above will require further investigation prior to finalisation of the site development design. Standard engineering strategic remedies for management of identified geotechnical constraints are readily available. None of the identified site geotechnical constraints are considered to be sufficient to overly restrict the proposed site development.

3 Stormwater Management

3.1 Overview

Implications of the proposed site development with regard to site stormwater management have been assessed through a review of available site information and relevant state and local government policies. Options for collection, re-use and disposal of stormwater have been investigated.

Site hydraulic modelling was carried out for the existing and post-development site using the DRAINS modelling package. From these results, advice has been provided with regard to flow regimes and requirements for site stormwater infrastructure to achieve stated objectives.

3.2 Relevant Controls and Policy Objectives

A number of specific planning controls and policy objectives have been considered in the development of the site stormwater management plan. These include:

- Part 3A – Environmental Planning and Assessment Act 1979, Major Infrastructure and Other Projects
- State Environmental Planning Policy (Major Projects) 2005
- State Environmental Planning Policy No. 71 – Coastal Protection
- North Coast Regional Environmental Plan (REP)
- Hastings Local Environment Plan (LEP) 2001
- Port Macquarie – Hastings Shire Council Development Design Specification No. 5 (2003) for Stormwater Drainage Design
- Port Macquarie – Hastings Shire Council Development Design Specification No. 7 (2003) for Stormwater Management

In summary, the above planning controls and policies require there to be no increase in peak stormwater discharges from the site and no added impacts on local water quality such as any increase in release of stormwater pollutants from the site.

3.3 Stormwater Quantity

3.3.1 Existing

The site is highly developed with the majority of the land surface being covered by impervious surfaces such as buildings, roads and car parking areas. Only a minor proportion of the site is covered with pervious landscaping; in the form of boundary planting and along internal roads and in carpark areas.

Drainage of impervious areas is currently provided by a pit and pipe network which drain to the canal system (north and west) or to a mangrove inlet on the Hastings River beyond the eastern site boundary and Park Street. Landscaped fringes drain directly to the canal system by overland flow. No formal stormwater treatment devices were observed in the site drainage system.

For the purposes of assessment, the site was separated into 3 different catchments according to existing stormwater discharge points;

1. A 'western' catchment; consisting of the existing supermarket, carpark and smaller retailers, draining to the canal system,

2. A 'northern' catchment; consisting of the existing Panthers club and loading bay, draining to the Hastings River, and

3. A 'south eastern' catchment'; primarily consisting of the existing carpark and site entrance off Park Street, draining to Park Street.

Each of these catchments was represented in DRAINS modelling as a separate node. A site plan showing discharge points is provided in Attachment A, while DRAINS catchment boundaries are provided in Attachment B.

3.3.2 Proposed

The current project plan for the site re-development primarily involves;

1. Expansion of the existing south-eastern carpark area to a multi-story facility,

2. An expansion and partial redevelopment of shopping and retail facilities; and

3. An increase in internal landscaped and pervious areas.

In terms of changes within the identified catchments; there is no net increase in impervious area within the northern and western catchments – only a change in the nature of these surfaces. Within the south-eastern catchment, a 3m wide pervious landscape 'strip' is

recommended on either side of the main entry/exit road ('Entertainment Street'). This has been provided to compensate for some loss of landscaping throughout the parking area. It is proposed to increase pervious area within the catchment. Table 2 summarises DRAINS input catchment details.

Table 2: DRAINS catchment details

Scenario	Catchment ID	Total Area (ha)	Impervious Area (%)	Pervious Area (%)
Existing	Northern	1.393	98	2
	Western	4.257	98	2
	Existing South Eastern	1.596	96	4
Proposed	Western	4.257	98	2
	Northern	1.393	98	2
	Post Dev South Eastern	1.596	92	8

A 'proposed development' scenario in DRAINS was created to reflect these changes. The 5yr, 20yr and 100yr ARI events were considered for all standard durations up to and including the 12 hour event for both the pre-development (existing) and post-development scenarios. Discharges from each catchment under each scenario were then compared.

3.3.3 Results

DRAINS results are summarised in the following tables:

Table 3: 5yr ARI DRAINS results.

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	0.713	0.713	0	0.337	0.337	0	0.36	0.35	-0.01
10	1.14	1.14	0	0.5	0.5	0	0.556	0.541	-0.015
30	1.48	1.48	0	0.548	0.548	0	0.616	0.603	-0.013
60	1.37	1.37	0	0.47	0.47	0	0.525	0.517	-0.008
90	1.3	1.3	0	0.497	0.497	0	0.555	0.547	-0.008
120	1.35	1.35	0	0.528	0.528	0	0.584	0.576	-0.008
180	1.01	1.01	0	0.331	0.331	0	0.376	0.37	-0.006
360	0.651	0.651	0	0.213	0.213	0	0.242	0.239	-0.003
540	0.576	0.576	0	0.189	0.189	0	0.215	0.212	-0.003
720	0.576	0.576	0	0.188	0.188	0	0.215	0.212	-0.003

Table 4: 20yr ARI DRAINS results

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	0.954	0.954	0	0.451	0.451	0	0.484	0.473	-0.011
10	1.53	1.53	0	0.665	0.665	0	0.746	0.731	-0.015
30	2.01	2.01	0	0.748	0.748	0	0.844	0.833	-0.011
60	1.92	1.92	0	0.657	0.657	0	0.735	0.726	-0.009
90	1.77	1.77	0	0.678	0.678	0	0.758	0.75	-0.008
120	1.84	1.84	0	0.718	0.718	0	0.795	0.79	-0.005
180	1.38	1.38	0	0.451	0.451	0	0.514	0.508	-0.006
360	0.883	0.883	0	0.289	0.289	0	0.329	0.326	-0.003
540	0.773	0.773	0	0.253	0.253	0	0.289	0.286	-0.003
720	0.774	0.774	0	0.253	0.253	0	0.289	0.287	-0.002

Table 5: 100yr ARI DRAINS results

	WESTERN CATCHMENT			NORTHERN CATCHMENT			SOUTH EASTERN CATCHMENT		
DURATION (MINS)	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE	EXISTING	PROPOSED	CHANGE
5	1.27	1.27	0	0.601	0.601	0	0.647	0.636	-0.011
10	2.05	2.05	0	0.888	0.888	0	1	0.985	-0.015
30	2.55	2.55	0	0.935	0.935	0	1.06	1.05	-0.01
60	2.48	2.48	0	0.844	0.844	0	0.946	0.938	-0.008
90	2.29	2.29	0	0.87	0.87	0	0.974	0.967	-0.007
120	2.39	2.39	0	0.931	0.931	0	1.04	1.03	-0.01
180	1.75	1.75	0	0.574	0.574	0	0.654	0.649	-0.005
360	1.11	1.11	0	0.362	0.362	0	0.414	0.411	-0.003
540	0.967	0.967	0	0.316	0.316	0	0.361	0.359	-0.002
720	0.961	0.961	0	0.314	0.314	0	0.359	0.357	-0.002

DRAINS results confirm that for the 'western' and 'northern' catchments, given that there is to be no net change in the total site impervious area, the proposed expansion and partial redevelopment shall not impact on site hydraulics. The net increase in pervious area in the south eastern catchment has resulted in a slight decrease (by an average of 1.4%) in 'maximum flow discharge' across each ARI event.

Thus, in accordance with relevant planning controls and policies, the proposed expansion and partial redevelopment of the site is expected to result in no net increase in peak stormwater discharges.

3.3.4 Preliminary Stormwater Management Recommendations

Through the redevelopment of the site a range of improvements to the stormwater system are recommended to achieve both efficient site

drainage and to achieve objectives of Ecologically Sustainable Design (ESD). For the purpose of the concept plan it has been assumed that all site areas to the north and west may be adequately drained to the canal system or Hastings River as is the current situation. Recommendations for inclusion in the development include:

1. Renewed stormwater system on the eastern area of the site with replacing existing Panthers club and car park drainage systems. System is to be designed to Council's specification. In-line stormwater quality controls are to be included on these new pipe systems.

2. Collection of stormwater from the existing metal roof areas and / or new roof top parking area and the temporary storage of this water on-site for non-potable uses would be a positive water management outcome. Significant town water savings may be possible in the long term if stormwater reclamation is included in the site's re-development.

3. A 3m wide pervious pavement 'strip' with vegetation planting is recommended on either side of Entertainment Street to maximise infiltration of overland flow in this area. Materials such as Boral's 'Hydrapave' are considered suitable for this area.

4. Site layout and grading should be designed to maximise infiltration of overland flow through pervious areas, with excess runoff conveyed by the road stormwater system. Along the northern and western site boundaries, landscaped fringes would allow excess runoff to drain directly to the canal system by overland flow.

5. The use of stormwater for toilet flushing in new amenities, site irrigation and external washdown is recommended. This shall achieve a reduction in site discharges as well as a reduced town water demand. Infrastructure required would be limited to storage tanks, which could be provided below the ground floor level, and pumping and reticulation systems. Sizing of tanks, pumps and reticulation would be determined subsequent to finalisation of landscaping plans and water demand analysis at construction certificate stage. It is anticipated that a reservoir of the order of 100 kL with town water backup would be sufficient for the site.

6. No specific requirements are given in Council policy for on-site stormwater detention. As there is no major proposed

change in the proportion of impervious surfaces there shall be no increase in site stormwater discharge. The inclusion of stormwater reclamation tanks in the design would provide some degree of integrated on-site retention capacity, thus achieving a small reduction in overall stormwater flows from the site.

A plan showing the proposed drainage concept for site re-development and suggested locations for stormwater storages and infrastructure is provided in Attachment A.

3.4 Stormwater Quality

The proposed expansion and partial redevelopment is expected to result in an improvement to the quality of stormwater discharged from the site. Improved water quality shall be achieved in three ways:

1. Reduction of overall flows through stormwater reclamation and re-use.

2. Inclusion of new and effective stormwater treatment devices.

3. Improvement in stormwater quality through reduced contaminant generation rates as a result of modifications to land surfaces (as detailed in Table 6).

Table 6: Comparison of land surface types and stormwater quality for proposed Settlement City Re-development, Port Macquarie, NSW.

Land Surface Type	Stormwater quality based on contaminant generation from surface	Modifications due to proposed re-development	Overall effect on site stormwater quality
Steel roofs of commercial buildings	Good	Increase	Improved
Concrete roof top car parking areas	Average	Increase	Unchanged
Bitumen road pavements and car parking areas	Poor	Decrease	Improved
Soft landscaping and associated footpaths along canal frontage	Very good	Negligible	Unchanged

The overall result of the expansion and partial redevelopment shall be an increase in the area occupied by steel roofs and concrete roof top car parking areas by a decrease in bitumen paved areas. This shall provide improved stormwater quality through a decrease in the generation of contaminants such as sediments, oil and grease.

Proposed in-line stormwater quality control system for the development include:

1. Humeceptor treatment systems, and

2. Storage/re-use tanks for collection and retention of runoff from impervious surfaces.

These water quality control measures and their likely beneficial input are briefly discussed below.

'Humeceptor' and 'HumeGard' (litter only) treatment systems function as advanced gross pollutant traps, significantly reducing sediment, nutrient, oil and grease and litter loads in stormwater. They should be appropriately sized at the construction certificate stage, to achieve greater than 70% retention of annual litter load (larger than 5 mm) and 90% retention of annual coarse sediment load (>0.125 mm diameter).

The collection and detention of water from roof and paved areas in the proposed stormwater reclamation tanks will provide additional water quality benefits through physical filtration and sedimentation.

3.5 Summary

The proposed expansion and partial redevelopment shall intrinsically improve stormwater quality through a reduction in bitumen car park areas and replacement with roofed areas and concrete car parks. It also provides an opportunity for improved stormwater treatment technology to be incorporated. Overall we conclude that the expansion and partial redevelopment will result in an improved local environmental outcome through reduction of stormwater discharges, improvement of local water quality and reducing demand on local water supply.

4 Water Supply and Sewage

4.1 Overview

A brief review has been undertaken with regard to the current water supply and sewage infrastructure servicing the Settlement City Shopping Centre and Panthers Club. The capability of existing infrastructure to support the proposed expansion and partial redevelopment has been assessed in light of estimated water demands and wastewater generation.

4.2 Water Demand for Proposed Re-development

Current water supply to the site is from a 450 mm diameter trunk mains along the south side of Bay Street. A 200 mm diameter connection runs into the site. On the basis that the existing commercial development occupies an area of 19,240 m^2, it is estimated that the current peak water demand is approximately 1.73 L/s (based on a typical peak hourly demand rate of 0.9 L/s/ha for commercial developments, from the WSA Water Supply manual).

The proposed new Stage 1 development with a total of 35,918 m^2 (15,915 m^2 of additional area) of commercial space will therefore add a peak hourly demand of approximately 1.50 L/s. The existing 200 mm connection is considered adequate for this supply, although detailed analysis to confirm this is to be completed at detailed design stage.

Preliminary discussions with Port Macquarie-Hastings Council (28.01.2009) indicate that the proposed expansion and partial redevelopment will not place undue strain on the existing 450mm water main. An upgrade to the 200mm connection is also unlikely; however this will need to be confirmed at CC stage. It should be noted that detailed analysis shall be completed at CC stage to determine if any system augmentation will be required.

Importantly, the proposed stormwater reclamation strategy shall reduce the demand on town water supply by replacing some use with stormwater.

4.3 Sewage Management for Proposed Re-development

Site wastewater reticulation is currently provided by gravity drainage to one of two site pump stations with transfer to the town sewage treatment plant by 100 mm rising mains which connect to the town sewer mains on Bay Street. The site has a third private pump station and 50 mm rising main servicing the petrol station.

Based on site area, current peak wastewater flows for the site are 1.92 L/s (from on an estimated 75 EP/ha and d-factor of 6.36 according to the WSA Sewage Code).

It is estimated that the proposed re-development will add a further 1.17 L/s to this peak flow rate (based on a total re-developed area of 3.59 ha and a d-factor of 5.46 from the WSA Sewerage Code). The existing rising mains should be adequate for this flow rate, however, detailed assessment and possible upgrade or reconfiguration of pump systems may be required.

Where feasible the proposed expansion and partial redevelopment will be connected to the existing site sewage pumping stations (SPS). If necessary an additional SPS shall be constructed on the site and connected similarly to the town reticulation system. Site sewage reticulation requirements shall be confirmed by detailed analysis to be completed at construction certificate stage.

Discussions with Council staff (19.02.2009) indicate that the expansion and partial redevelopment of Settlement City Shopping Centre is unlikely to impact adversely on Council's sewerage system, external to the site.

5 Sediment and Erosion Control

5.1 Overview

During the construction stage of the proposed expansion and partial redevelopment there will be a potential for soil erosion and sedimentation impacts on adjacent waters. These have potential to cause detrimental impacts on downstream aquatic ecosystems. It is therefore necessary for an appropriate sediment and erosion control plan to be prepared and implemented.

5.2 Key Control Measures

Key control measures to be included in the sediment and erosion control plan are:

- Sediment fences to be installed down slope of significant excavation and construction works and along the canal boundaries prior to commencement of construction.
- Vehicle shake down grid(s) and wheel wash facility to be placed at the site construction exit(s).
- Placement of stabilising fabric in areas to be re-vegetated and landscaped immediately following final grading.
- Implementation of hay bale or filter fence check dams during the construction of major drainage infrastructure including pits and swale drains.

Sediment fences are to be placed along the down slope edge of disturbed areas and constructed according to standard design SD 6-7 (Figure 3). Sediment fences are to be checked weekly and following significant (>10 mm) rainfall events. Sediment is to be removed when 30 % of the storage capacity is filled. Removed sediment is to be placed in site stockpiles or on land up-slope of fences.

Depending on the scale and staging of the construction, a sedimentation basin may also be required on site during construction. If site soils are found to comprise coarse sands these may provide adequate infiltration capacity for site runoff and a sedimentation basin would not be required. If the soils contain significant fines, however, it is likely that a sedimentation basin shall be required. In this case the size and location of the basin should be determined at construction certificate stage.

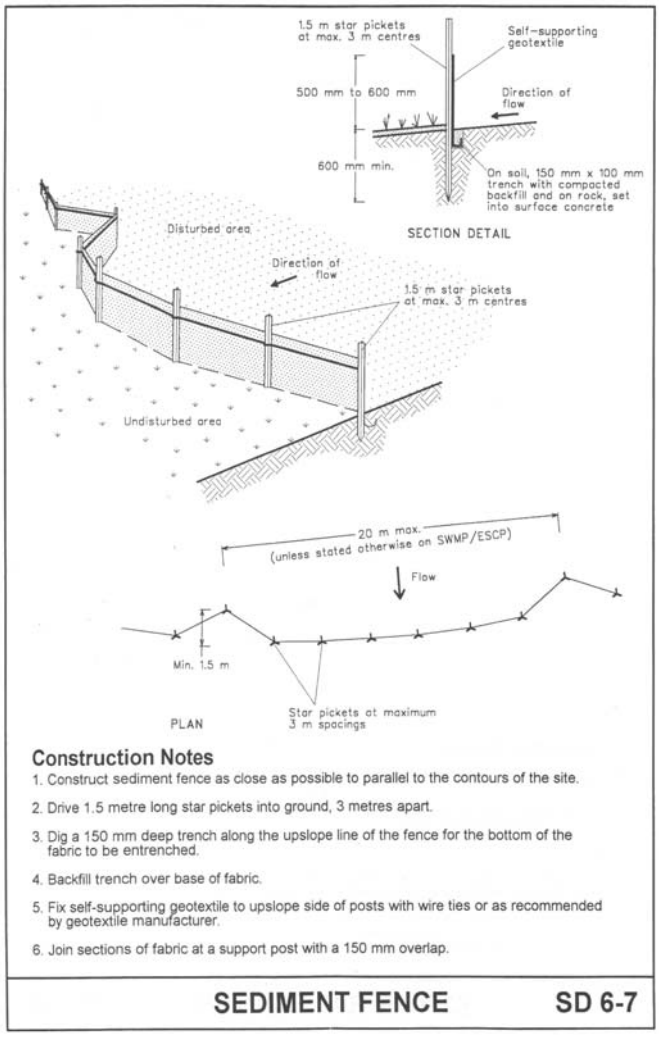

Figure 3: Department of Housing (1998) standard design 6-7: Sediment Fence.

5.3 Detailed Sediment and Erosion Control Plan

A detailed plan indicating proposed sediment and erosion control works should be provided at the construction certificate stage. The plan should be designed in accordance with Council document "*Development Design Specification D7 – Stormwater Management*" and should provide the specific location, construction details and management measures for the proposed works. In addition, a contingency strategy should be provided for large rainfall events during the construction works in areas where flows shall naturally concentrate.

With an appropriately designed and implemented sediment and erosion control strategy the proposed expansion and partial redevelopment will not have excessive detrimental impacts on the local aquatic environment.

6 References

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Water Services Association of Australia (2002) *Water Supply Code of Australia; Second Edition*

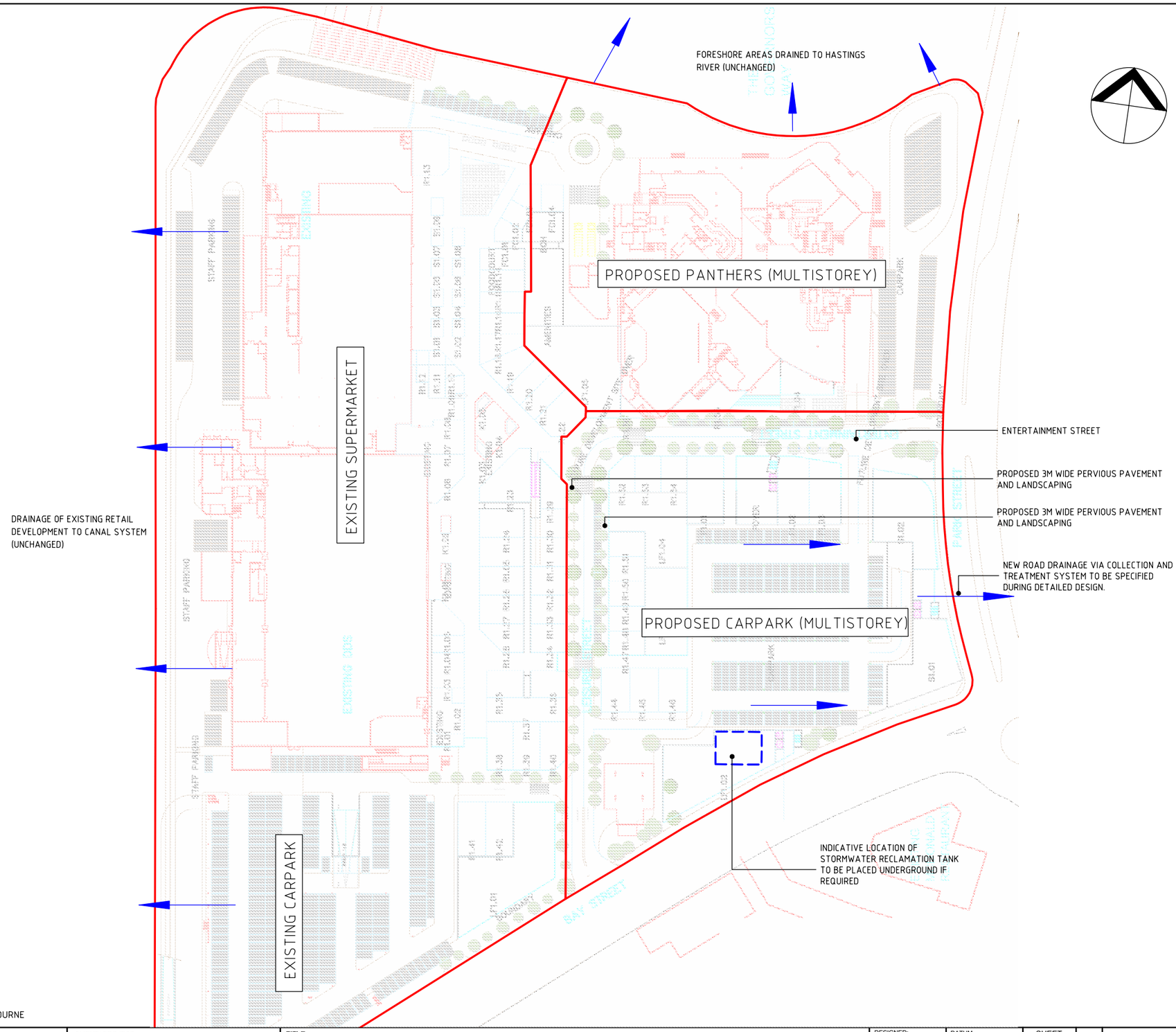
Water Services Association of Australia (2002) *Sewerage Code of Australia; Second Edition*

Attachments

Attachment A: Stormwater Management Concept Plan

Attachment B: Hydraulic Modelling Results

7 Attachment A – Stormwater Management Concept Plan



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All measurements in mm unless otherwise specified.

TITLE
HYDRAULIC MODELLING RESULTS;
SETTLEMENT CITY SHOPPING CENTRE; PORT MACQUARIE

PROJECT MANAGER: ANDREW NORRIS
DRAWING NUMBER: P0902316JD02_v1

DESIGNED:	MLB
DRAWN:	MLB
REVIEWED:	AN
DATUM:	mAHD
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SHEET	1
OF	1 SHEETS
PAPER SIZE:	A1 / A3

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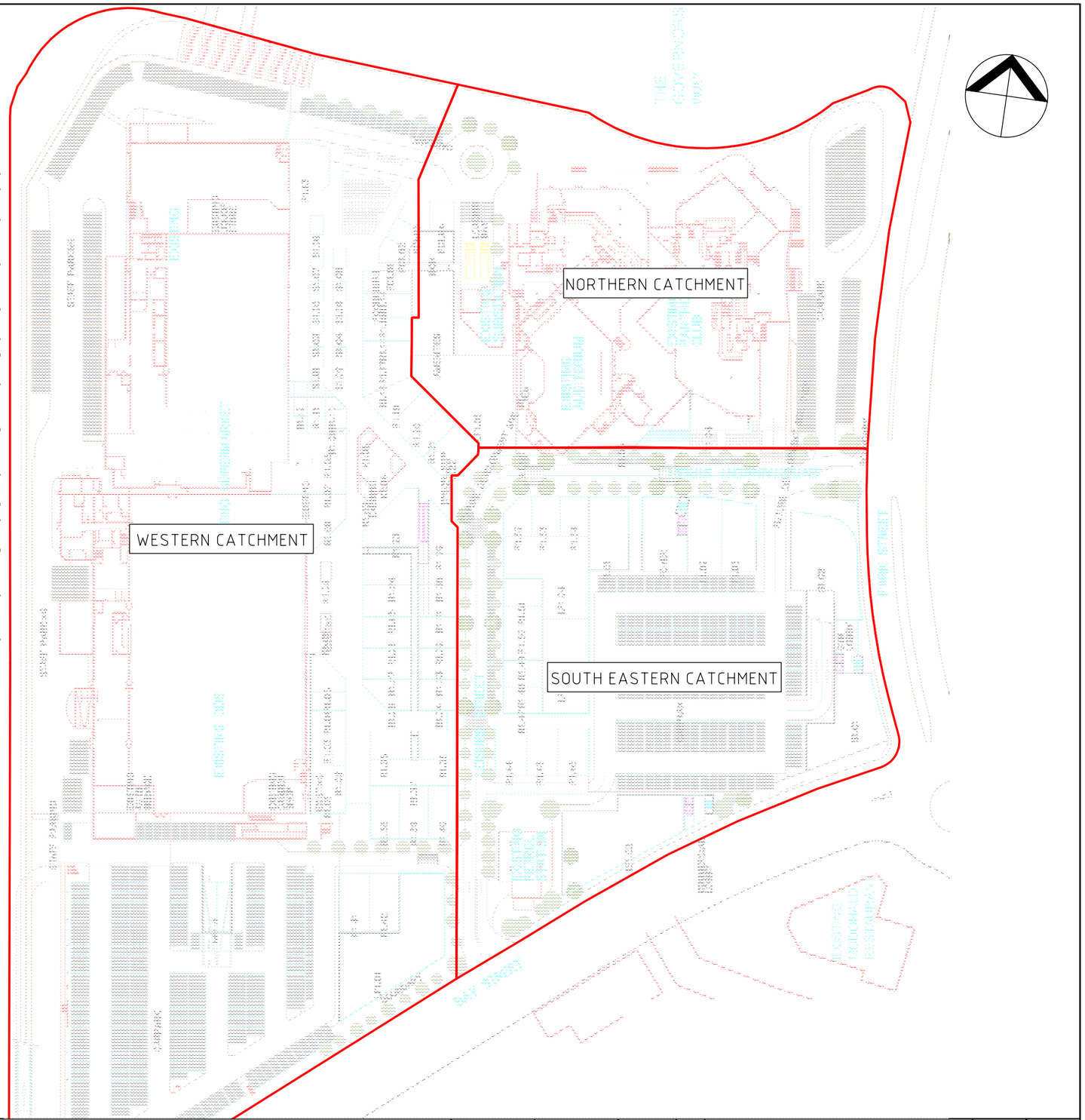
8 Attachment B – Hydraulic Modelling Results

CATCHMENT DETAILS					TIME OF CONCENTRATION	
SCENARIO	CATCHMENT NAME	CATCHMENT AREA	IMPERVIOUS AREA	PERVIOUS AREA	IMPERVIOUS	PERVIOUS
		(ha)	%	%	(min)	(min)
EXISTING	Nothern Catchment	1.393	98	2	9	9
	Western Catchment	4.257	98	2	13	13
	Existing Sth Eastern	1.596	96	4	9.5	9.5
PROPOSED	Western Catchment	4.257	98	2	13	13
	Northern Catchment	1.393	98	2	9	9
	Post Dev Sth Eastern	1.596	92	8	9.5	9.5

HYDRAULIC MODELLING RESULTS - 5 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.548	0.543	0.006	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Western Catchment	1.477	1.464	0.013	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Existing Sth Eastern	0.616	0.604	0.012	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
PROPOSED	Western Catchment	1.477	1.464	0.013	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Northern Catchment	0.548	0.543	0.006	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1
	Post Dev Sth Eastern	0.603	0.579	0.024	AR&R 5 year, 30 minutes storm, average 81 mm/h, Zone 1

HYDRAULIC MODELLING RESULTS - 20 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.748	0.737	0.011	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Western Catchment	2.013	1.989	0.025	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Existing Sth Eastern	0.844	0.821	0.023	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
PROPOSED	Western Catchment	2.013	1.989	0.025	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Northern Catchment	0.748	0.737	0.011	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1
	Post Dev Sth Eastern	0.833	0.786	0.047	AR&R 20 year, 30 minutes storm, average 110 mm/h, Zone 1

HYDRAULIC MODELLING RESULTS - 100 YR ARI					
SCENARIO	CATCHMENT NAME	MAX FLOW Q	MAX FLOW IMPERVIOUS	MAX FLOW PERVIOUS	SIGNIFICANT STORM
		(cu.m/s)	(cu.m/s)	(cu.m/s)	
EXISTING	Nothern Catchment	0.935	0.92	0.015	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Western Catchment	2.553	2.517	0.037	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Existing Sth Eastern	1.06	1.026	0.033	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
PROPOSED	Western Catchment	2.553	2.517	0.037	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Northern Catchment	0.935	0.92	0.015	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1
	Post Dev Sth Eastern	1.05	0.984	0.067	AR&R 100 year, 30 minutes storm, average 148 mm/h, Zone 1



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