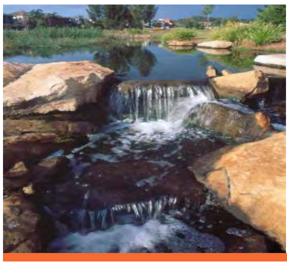
'Precinct 3' Forest Lane, Old Bar

Stormwater & Flood Management Strategy

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Lidbury, Summers & Whiteman

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1 INTRODUCTION

J. Wyndham Prince Pty Ltd has been engaged by Lidbury, Summers & Whiteman, Consulting Surveyors to prepare an updated Stormwater & Flood Management Strategy for the proposed residential development known as 'Precinct 3' Forest Lane, Old Bar. The proposed 'Precinct 3' development comprises a 9-hole golf course and 900 residential lots, south of the township of Old Bar and approximately 1 kilometre north of the village of Wallabi Point. It is situated on vacant land between the existing residences on either side of Bluehaven Drive (known as Ocean Blue Estate) and the sand dunes fronting Old Bar beach (refer to Plate 1.1).

The purpose of this study is to provide support for a Concept Broad-scale Development Application for the whole of the Old Bar Precinct 3 site, to which each individual landowner can use this strategy as a reference to streamline the approval process for each of their sites.

Racecourse Creek drains the western catchments, northwards through the site before turning to the south, after David Street, and discharging onto the beach (refer to Plates 3.3 to 3.5). The total catchment for Racecourse Creek at the Old Bar Beach outlet is estimated to be 357 hectares. The central portion of the site is low-lying and forms the main flow path for the two (2) reaches of Racecourse Creek, which will be incorporated into the proposed water hazards for the future golf course.

A previous Flood Management Strategy was prepared by J. Wyndham Prince for the site (JWP 2006). However, subsequent to it being peer reviewed (GHD 2007) an alternative layout for the golf course was proposed. The impact of this alternative layout on flood risks across the site was assessed for the Greater Taree City Council, (SKM 2009), this alternative arrangement has been adopted in the developed conditions assessment within this current study.

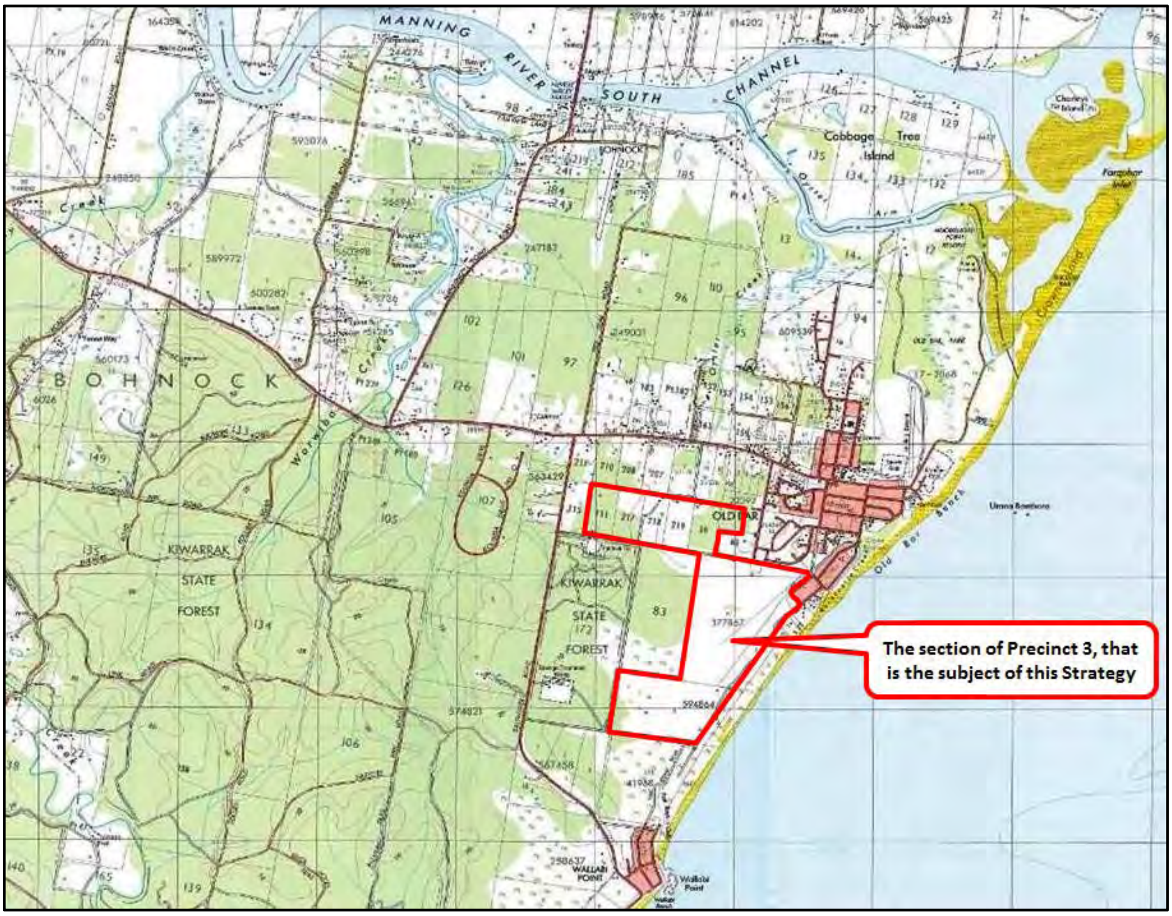


PLATE 1.1 LOCALITY PLAN AND STRATEGY BOUNDARY

The objectives for this updated Stormwater Flood Management Strategy are to:

- Address Greater Taree City Council's requirements (GTCC 2005), for water quality and quantity management;
- Review the latest Floodplain Risk Management Plan and modelling;
- Update the existing hydrologic models to include a refined subcatchment delineation for each individual landowner in order to determine the stormwater management requirements for each site;
- Prepare hydrologic models to determine the size of temporary on-site detention basins required to restrict peak post development to pre development flows for the 20%, 5% and 1% AEP events. Determine peak pre and post development 20%, 5%, 1% AEP and PMF flows for input to the hydraulic model.
- Update existing 2D flood model (TUFLOW) to incorporate the latest surface modelling within the site. Confirm the existing flood extents for the 20%, 5 %, 1 % AEP and PMF events. Multiple iterations of the model are required to represent the site under interim and future permanent development conditions.
- Prepare flood extent, depth and level mapping for the 20%, 5%, 1% AEP and PMF events for the site under existing, interim, and post development conditions.
- Undertake a water quality analysis in MUSIC of stormwater discharges for the site under existing conditions. Determine the minimum treatment device areas required to achieve Greater Taree City Council water quality targets for each individual allotment as interim developments, and the proposed development as a whole;
- Prepare preliminary Stormwater Management Strategy Plan with indicative stormwater management devices to control stormwater peak flows, flooding and the quality of stormwater discharges in accordance with Greater Taree City Council requirements;
- Prepare indicative capital cost estimates for the adopted water cycle management controls together with preliminary estimate of costs for the operation and maintenance of these devices;
- Prepare an updated Stormwater & Flood Management Strategy report detailing the outcomes of the mitigation options investigated and the implications for the ongoing management and operation of the proposed stormwater quantity and quality infrastructure.

2 PREVIOUS REPORTS

2.1 Flood Management Strategy – Precinct 3, Old Bar (JWP, 2006)

In 2006, J Wyndham Prince undertook a Flood Management Strategy which supported the rezoning and development planning process for the Site.

The objective was to recommend an appropriate flood management strategy to allow for the development of Precinct 3 at Old Bar (in accordance with the Old Bar/Wallabi Point Development Strategy) without adversely affecting existing development, future residential development, future golf course development and existing environmental communities in the Precinct 3 catchment. The strategy identifies a flood management solution that maintains pre-development flows and does not exacerbate existing flooding downstream of Precinct 3.

The management solution involves some filling of existing areas of floodplain to create a “playable” golf course (at a level that is not frequently inundated). This includes controlling and defining limits of post-development flood affectation, providing a defined edge between golf course and residential areas and avoiding potential acid sulphate soil impacts. The strategy provides a sustainable regional outcome for stormwater quantity and quality management for the catchment.

Particular constraints attributed to the site are Potential Acid Sulfate Soils and Site Filling, both are summarised as follows.

2.1.1 Potential Acid Sulfate Soils

Class 3 Acid Sulfate Soils are defined by Council (GTCC 2001) as: *“Land where a Development Application is required for works beyond 1 metre below natural ground surface and/or where the water table is likely to be lowered beyond 1 metre below natural ground surface.”*

A geotechnical investigation of the site was undertaken by Coffey Partners International in February 1995 (Coffey, 1995) which found that soils within the site contain significant acid sulfate potential. The geotechnical investigation determined that if soils were excavated from below the current water table, which was measured at approximately RL 3.65 AHD, it was likely that acid conditions would result. Further, acid conditions could be particularly severe if the estuarine grey clays encountered below RL 2.45m AHD were exposed.

Proposed water features within the golf course, which are located over the estuarine clays, will only be excavated to a level of 0.3 m above the estuarine clays, in accordance with the geotechnical recommendations. Consequently the water features should not expose nor interact with Potential Acid Sulfate Soils. Excavation of water features, within the proposed golf course, will not exceed the 1 metre excavation limit imposed by the Old Bar/Wallabi Point Development Strategy.

2.1.2 Land Filling Impact on Flooding

The previous Flood Management Strategy (JWP, 2006) confirmed that the proposed Strategy complied with Council’s standards in regard to siting future residential development above the 1% AEP level (plus the requisite 300 mm freeboard). The strategy also confirmed that flood behaviour resulting from the design will not result in unnecessary risk to life of occupants or rescuers, or in unwarranted public costs.

2.2 Old Bar Precinct 3 Provisional Floodplain Risk Management Plan – (SKM, 2009)

In 2009, Sinclair, Knight Merz were engaged by Greater Taree City Council to prepare a Provisional Floodplain Risk Management Plan for the proposed development of Precinct 3 at Old Bar. It was based on the proposed re-zoning of land, which includes a golf course and 900 residential lots. The proposed development includes the formalisation of a flood detention basin within the golf course, which has been designed to provide improvements in flood conditions in Racecourse Creek and existing properties adjacent to the creek.

The outcomes of the study are summarised as:

- The updated hydrologic and hydraulic modelling was verified against historic flood event information from the June 2007 storm event, and validated against the JWP study (JWP, 2006). The June 2007 flood event was found to be similar to the design 100 year ARI flood event;
- Comparison of the SKM TUFLOW model results with the JWP modelling results indicates that, for the existing conditions:
    - The SKM modelling estimates higher basin flood levels and outflows in the existing storage basin.
    - Peak flows downstream of the basin outlet are lower in the SKM modelling, due to attenuation of inflows in the TUFLOW model and the trapping of flood volume in the existing storage basin.
    - The lower peak flows in Racecourse Creek result in lower flood levels in the SKM TUFLOW model, when compared to the JWP HEC-RAS model;
- The SKM hydrologic and hydraulic models were updated to represent the fully developed study area. The changes to the peak 100 year ARI flood levels in the developed case are:
    - Peak flood levels in the basin are increased by 0.14m to a level of 5.56m AHD;
    - Flood levels in Racecourse Creek, between the basin outlet and just upstream of David Street, decrease typically by up to 0.15m;
    - Flood levels increase on existing properties in the Ocean Links estate, however, these properties are already flood affected in the existing case and the increase in flooding is mainly due to increased local catchment flows, and not due to the proposed development;
- The increase in PMF levels is 0.34m to a level of 6.59m AHD in the proposed basin in the developed case. The PMF levels in both the existing and developed cases are considered to be conservative estimates, since flow breakouts from the basin through the dune system is likely to scour a secondary basin outlet and result in reduced peak flood levels;
- The proposed development provides a reduction in the flood risk to existing properties on Racecourse Creek. Further, the flood risk to existing properties adjacent to the basin (including those on the Ocean Links estate) is not worsened by the developed case flood levels in the proposed basin:
- Forest Lane, which is a major access road to Old Bar, may be passable in events up to the 100 year ARI event in the existing case, but may become impassable in events greater than the 20 year ARI event due to increased catchment flows in the developed case;
- Stream clearing was identified as a potential option for flood mitigation in Racecourse Creek. However, while stream clearing does offer some improvements in flood levels within the creek channel, it is not particularly effective in reducing the number of flood affected dwellings;
- Upgrading the David Street culvert is not considered to be a feasible option due to the high cost involved in upgrading the culvert to, for example, a bridge structure, and the relatively low benefit gained from the upgrade;

- Based on the results of the model calibration run, and considering that the June 2007 calibration event was similar to the 100 year ARI event, a 50% blockage of the David Street culvert in the 100 year ARI event is not likely to cause an increase in above floor flooding on existing properties.
- It is recommended that climate change impacts be considered in the setting of Flood Planning Levels (FPLs) for the proposed development, taking into account the 100 year ARI basin flood level and 500mm freeboard. A FPL of 6.26m AHD, relating to mid-range rainfall increase, is recommended, the high-range rainfall increase scenario FPL of 6.34m AHD may be adopted;
- The Provisional Floodplain Risk Management Plan (FRMP) has found that the proposed development is compatible with the floodplain risk categories, adopted using the guidelines in the Floodplain Development Manual. The Provisional FRMP has considered the impact of climate change, and planning recommendations have been made to manage the existing and future flood risk
- The provision of flood evacuation planning ensures that, in general, there is no increase in safety risk for people located on the floodplain. However, there are a number of issues and options to be considered and resolved to finalise a suitable evacuation route for residents in the north-western section of the proposed development and the Ocean Links Estate.

3 EXISTING ENVIRONMENT

3.1 Landforms and Existing Drainage System

The Precinct 3 site is located within the Greater Taree City Council Local Government Area and consists of approximately 144 ha of land located south and west of the existing village of Old Bar, on the Mid-North Coast of NSW. The site consists of moderately flat land close to the coastal dunes adjoining Old Bar Beach, to a moderately steep forested area west of the Ocean Blue Estate and the Precinct 3 Boundary (refer to Plate 3.1).

PLATE 3.1 - VIEW ACROSS THE SITE

There are two (2) main branches of Racecourse Creek, both of which drain through the subject site.

i. The northern branch drains the northern and north-western sub-catchments across Forest Lane in a south easterly direction; and

ii. The southern branch drains the southern and south-western sub-catchments through the site in a northerly direction.

Both branches join in the broad flat depression that forms the central portion of the site, which is likely to be permanently waterlogged. Refer to Plate 3.2 for a general drainage layout of the site. The main reach of Racecourse Creek drains out of this waterlogged section, in a north-easterly direction, beneath a pedestrian footbridge (refer to Plate 3.3), through a narrow public reserve system and between existing residential developments towards David Street.

Approximately 400 metres northeast of the site, and downstream of the David Street culvert (refer to Plate 3.4), Racecourse Creek turns 180° towards the south and its progress is impeded by the fore-dune running parallel to and west of Old Bar beach. Whereupon Racecourse Creek becomes an intermittently closed and open lagoon that is periodically open to the Pacific Ocean when the sand bar formed at its outlet is periodically eroded during storm flows or breached by high tides and/or storm surge conditions (Refer to Plate 3.5).

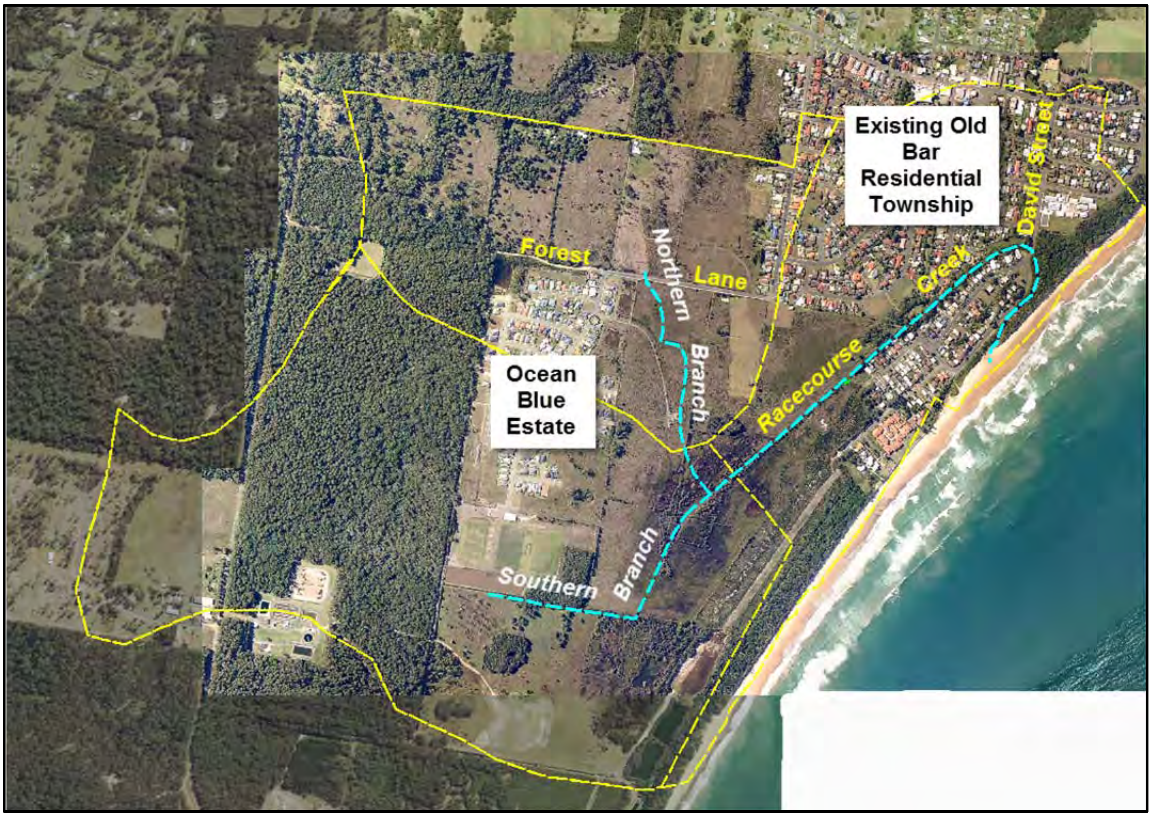


PLATE 3.2 – GENERAL DRAINAGE LAYOUT OF SITE

PLATE 3.3 - CROSS STREET FOOTBRIDGE ACROSS RACECOURSE CREEK

PLATE 3.4 - DAVID STREET CULVERT

PLATE 3.5 - RACECOURSE CREEK DISCHARGE ONTO OLD BAR BEACH

4 PROPOSED DEVELOPMENT AND MODELLING SCENARIOS

A series of flood modelling scenarios were assessed for the development of this Stormwater & Flood Management Strategy for the Old Bar Precinct 3 Site. The hydrological and water quality modelling undertaken, assessed development scenarios where devices within each allotment were designed in accordance with Greater Tare City Council requirements, as if the individual allotment were to be developed in isolation. The detention basin and water quality device designs for each allotment would be adopted for the interim development conditions prior to the construction of the proposed basin within the golf course.

Aside from the existing and developed scenarios, the flood modelling included an interim development scenario as described below in Section 4.3.

4.1 Land Ownership

The Old Bar Precinct 3 Site is currently subject to fragmented ownership which has resulted in the need for individual assessments to determine the site requirements under interim development conditions (refer to Plate 4.1).

The existing Ocean Blue Estate has been assumed to be developed under all conditions, with the exception of the north-western portion, which was considered when detention was assessed for the Archer site.

The Elias Site and Mid Coast Water land was assumed to be undeveloped under all scenarios . It is expected that these sites be assessed independently when it is considered for development at some stage in the future.

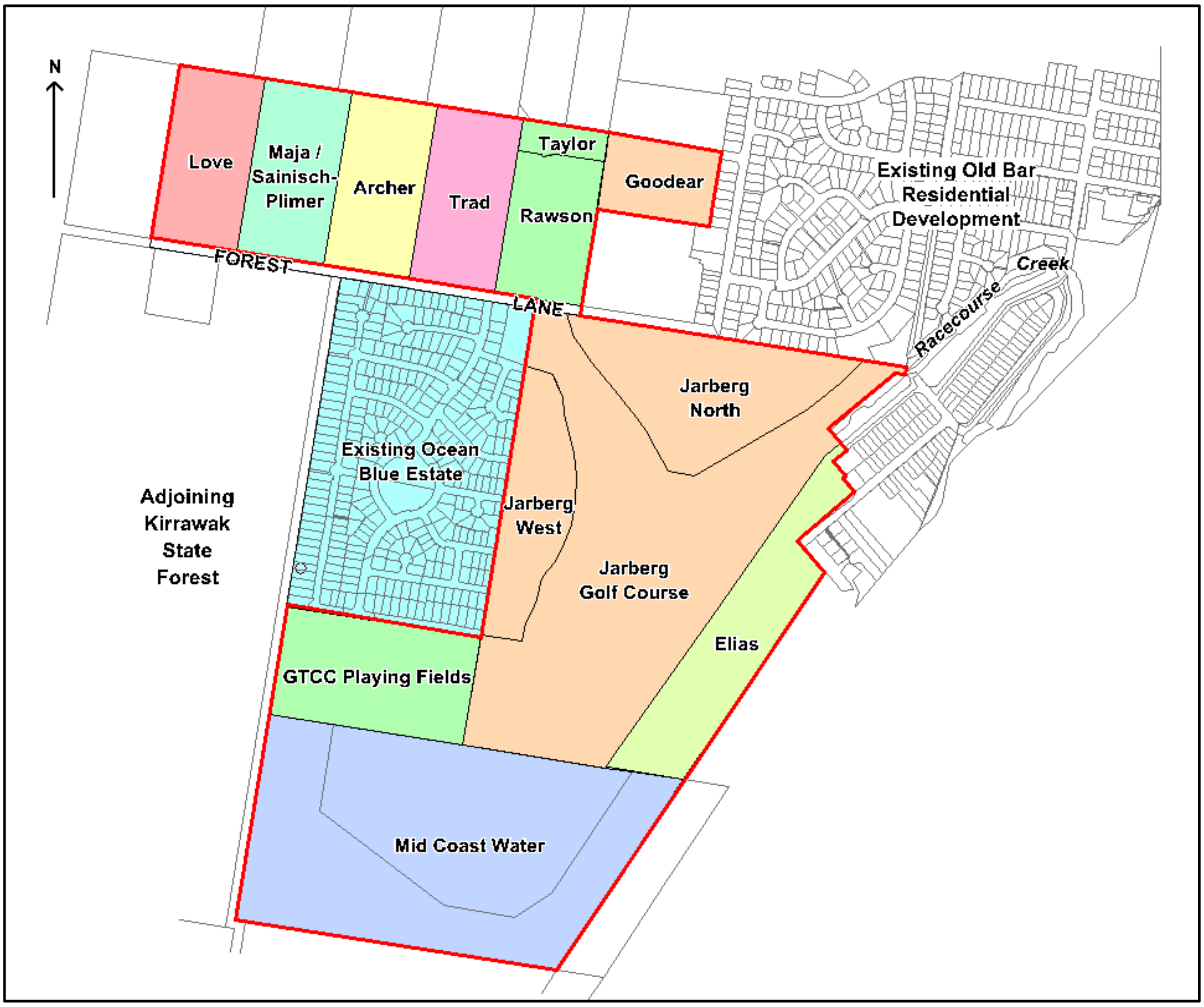


PLATE 4.1 – LAND OWNERSHIP

4.2 Base Case – Old Bar Precinct 3 Site Under Existing Site Conditions

The base case for modelling purposes is the Precinct under current site conditions, to which all development scenarios are compared. This scenario has been assessed in the hydrological and hydraulic models. The water quality model for the existing case has been prepared for the full catchment to the downstream limits of the Precinct 3 site.

- Existing allotments along the northern side of Forest Lane under current site condition, being generally rural residential.
- Jarberg Land under existing site conditions, being generally undeveloped open space area.
- Mid Coast Water Land to the south of Jarberg Land and the Playing Fields immediately to the south of Ocean Blue Estate, including detention systems servicing Ocean Blue Estate, to remain unadjusted throughout all assessments.
- Existing Ocean Blue Estate upstream of the Precinct as being developed as approved. The discharges from the Ocean Blue Estate are released into Forest Lane and Jarberg Land as if the Estate is developed with the approved water quantity devices in place. Catchments C2A and C2B with the Ocean Blue Estate will be compensated for by over detention within the Archer Property. Note that the hydraulic and water quality modelling has assumed that Catchments C2A and C2B are developed but not treated in the base-case scenario.

Indicative Development layout for the base case under existing site conditions is shown below in Plate 4.2

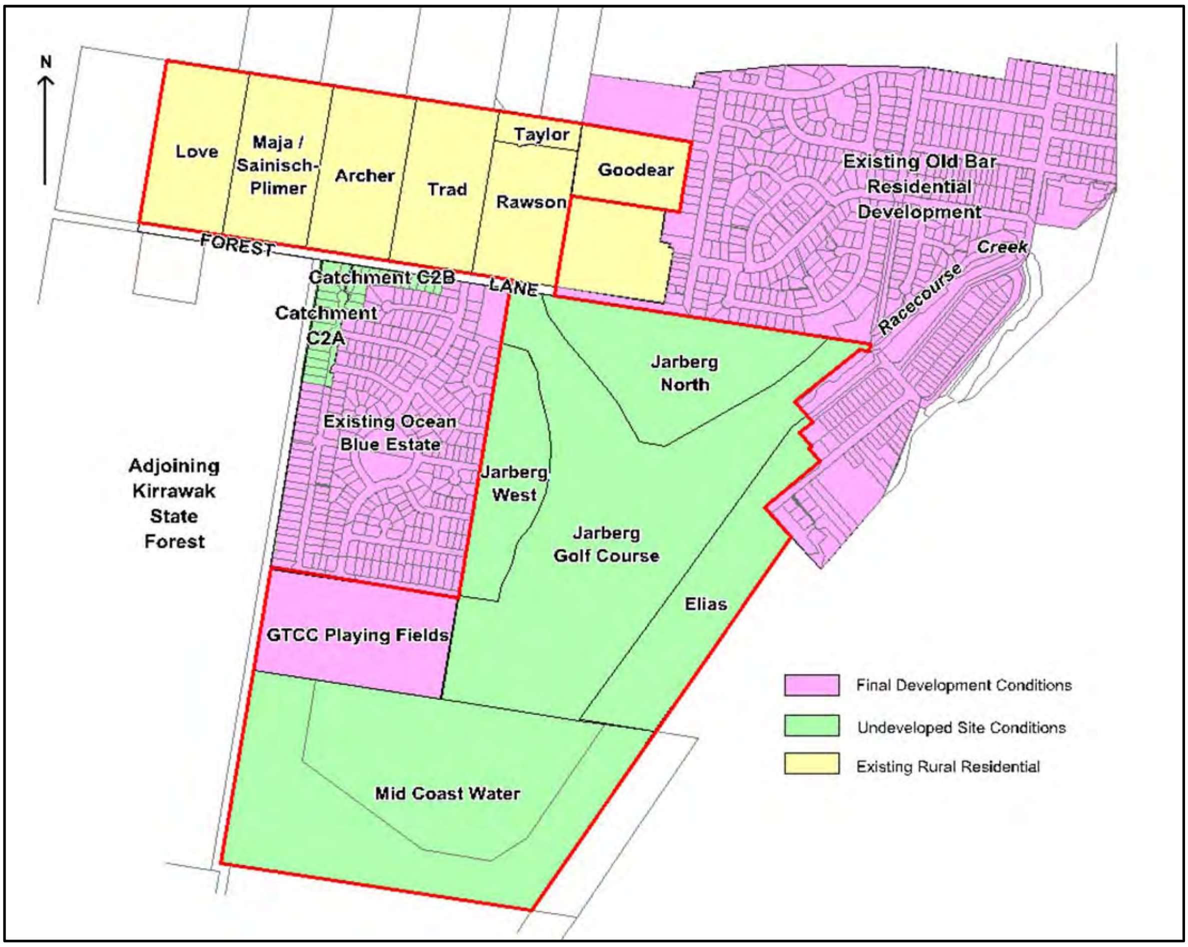


PLATE 4.2 – EXISTING SITE CONDITIONS
NOTE: CATCHMENTS C2A & C2B UNDEVELOPED FOR HYDROLOGICAL ASSESSMENT ONLY

4.3 Interim Scenario - Old Bar Precinct 3 Site Under Interim Development Conditions

The northern portion (north of Forest Lane) of Precinct 3 developed with interim devices including:

- Existing Allotments along the northern side of Forest Lane together with Jarberg North and Jarberg West sites under interim developed site condition, being generally low density residential, with the exception of the property currently owned by Love, which is to be rural residential (with 4,000 m² lots). Each of the allotments to provide independent water quantity and water quality control on site, in accordance with Council requirements.
- Existing Ocean Blue Estate upstream of the Precinct being developed as approved.
- Construction of the main basin discharge control device (without the golf course) as detailed in Appendix E.

All other site conditions remain unchanged from the base case.

The interim detention devices will be required until the construction of the main basin within the golf course. The interim detention devices for the Jarberg North and Jarberg West sites are not required if constructed in conjunction with the main Golf Course basin discharge control device. Indicative Development layout for the Interim development Scenario is shown below in Plate 4.3

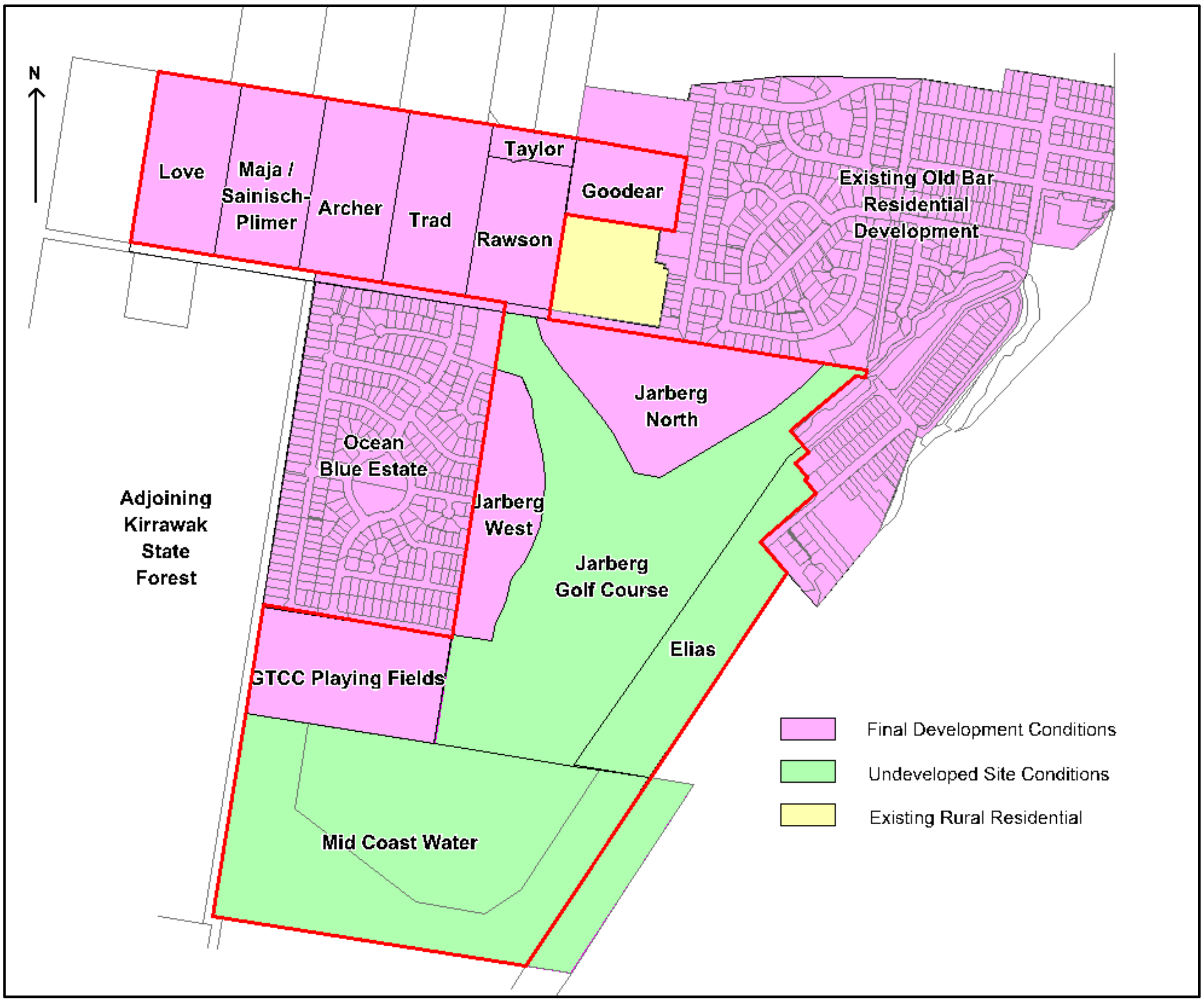


PLATE 4.3 – INTERIM DEVELOPMENT SITE CONDITIONS

4.4 Developed Scenario– Old Bar Precinct 3 Site Under Future Developed Conditions

The Precinct developed with future permanent devices including:

- Existing Allotments along the northern side of Forest Lane under future permanent developed site condition, being generally low density residential, with the exception of the property currently owned by Love, which is to be rural residential with 4,000 m² allotments.
- Jarberg Land under future permanent developed conditions, including proposed golf course with ponds and reserved swamp forest. Proposed residential development within Jarberg North and Jarberg West, each requiring stormwater management devices to detain and treat stormwater quality to Council requirements.
- Existing Ocean Blue Estate upstream of the Precinct as being developed as approved, including Catchments C2A and C2B. The discharges from the Ocean Blue Estate are released into Forest Lane and Jarberg Land as if the Estate is developed with the approved permanent water quality and water quantity devices in place.
- Existing allotment north of Forest Lane, east of Rawson Site and south of Goodear Site to remain as undeveloped. Existing allotment owned by Elias (east of basin location) also to remain undeveloped.

This scenario has been assessed in the hydrological and hydraulic models. The water quality model for the developed case has been prepared for the full catchment to the downstream limits of the Precinct 3 site. The indicative Development layout is shown below in Plate 4.4.

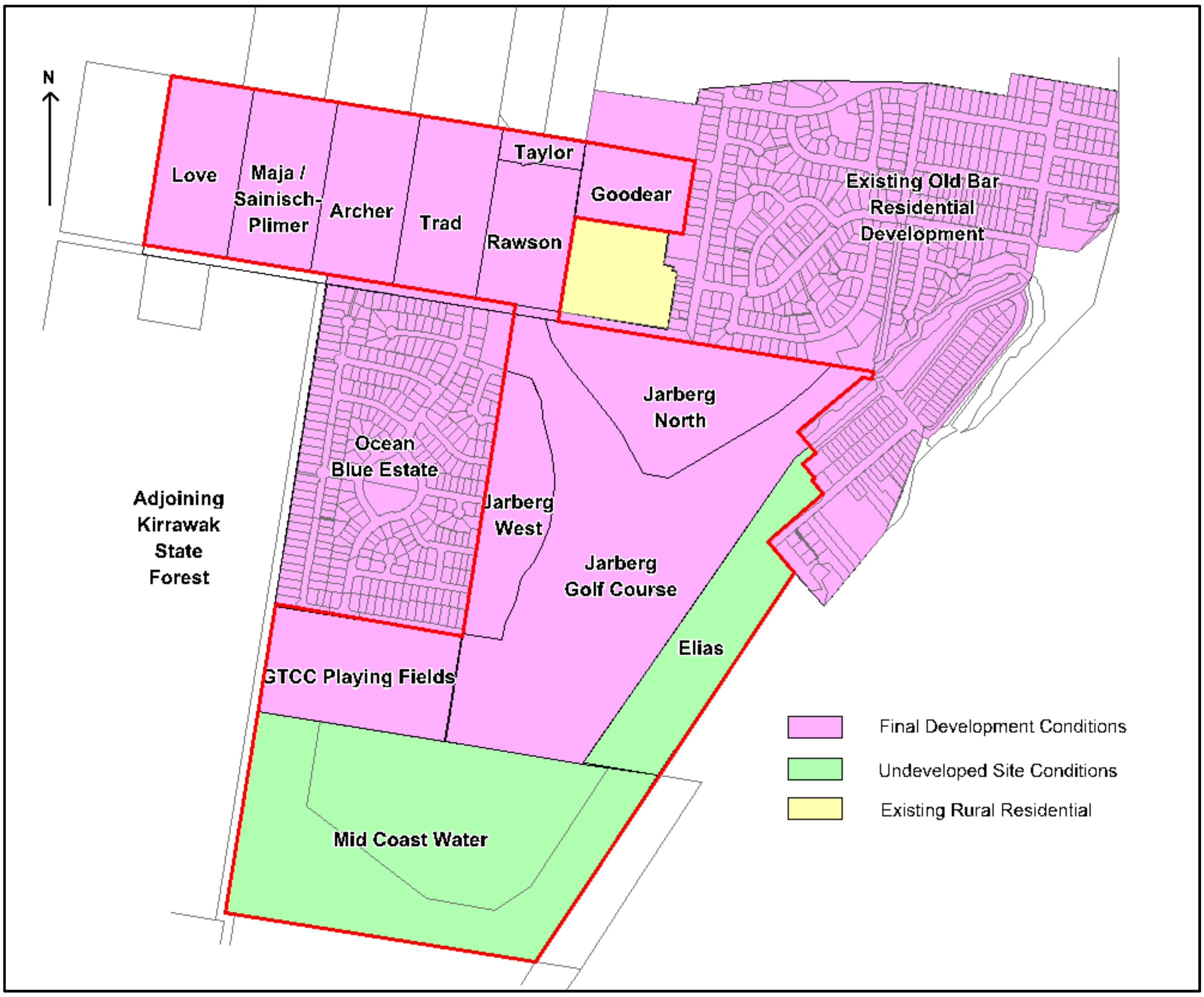


PLATE 4.4 – DEVELOPED SCENARIO SITE CONDITIONS

5 DEVELOPMENT GUIDELINES, OPPORTUNITIES & CONSTRAINTS

The following guidelines were considered in developing the Stormwater and Flood Management Strategy for the Old Bar Precinct 3 Development.

5.1 The Greater Taree City Council Development Control Plan (2010)

The Greater Taree City Council Development Control Plan (GTCC, 2010), together with the relevant Council Development Design Specification (GTCC, 2005), identifies the following objectives for consideration with regard to stormwater management:

- To provide for the disposal of stormwater from the site in efficient and environmentally sensible ways in accordance with Council's ESD objectives.
- Control stormwater and to ensure that developments do not increase downstream drainage flows or adversely impact adjoining or downstream properties.
- To ensure the integrity of watercourses is protected and enhanced in accordance with Council's ESD objectives.
- To provide for on-site detention of stormwater.
- To encourage the reuse of stormwater.

This document also nominates quantitative post construction phase stormwater management objectives for the reduction of various pollutants for a range of new developments to be located in ecologically sensitive areas. The retention criteria for the site are nominated to provide a neutral or beneficial effect on the exiting environment, as specifically required by Council.

Therefore, removal of pollutants and nutrients are to be no greater in the developed case when compared to the site under existing site conditions.

5.2 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design aims to minimise the hydrological impacts of urban development and maximise the multiple use benefits of a stormwater system.

Australian Runoff Quality (ARQ, 2006) identifies the objectives of WSUD to include:

- Reducing potable water demand through water efficient appliances, rainwater and grey water reuse.
- Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent reuse opportunities and/or release to receiving waters.
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to surface waters.
- Preserving the natural hydrological regime of catchments.

Australian Runoff Quality also identifies WSUD as the adoption of the following planning and design approaches that integrate the following opportunities into the built form of cities and towns:

- Detention, rather than rapid conveyance of stormwater.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- Use of vegetation for filtering purposes.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for various uses.

5.3 Stormwater Management Objectives

5.3.1 Overall Objectives

The overall site stormwater management objectives were identified as follows:

Environmental

- Promote an environment where the community can increase their knowledge and understanding of water, which will help modify their behaviour accordingly to more water smart actions.
- Provision of appropriately designed and functional water quality facilities.
- Limitation of downstream discharge peaks and velocities.
- Maintenance of existing downstream water quality.
- Maintenance of environmental flows to ecosystems downstream of the site.

Urban Amenity

- Provision of a Stormwater & Flood Management Strategy that identifies and controls limits of flood affectation and provision of aesthetic design forms that enhance amenity.

Engineering Considerations

- Effective management and control of peak discharges, discharge velocities, site detention, and water quality.
- Industry best practice technical analysis of catchment hydrology and system hydraulic performance.

Economics

- Provision of a cost effective, functional site drainage system that optimises performance, provides maximum value for expenditure and keeps on-going maintenance requirements to a minimum.

5.3.2 Specific Development Objectives

In accordance with the principles of Ecologically Sustainable Development (ESD), the area needs to be designed, developed and maintained in accordance with the following stormwater management objectives:

- Preserve the ecological integrity of the identified swamp forest, sand dunes, and Racecourse Creek.
- Restrict development to above the 1% AEP flood level.
- Incorporate water sensitive urban design principles within the development.
- Ensure post-development water quality complies with Council's requirements.
- Provision of a sustainable aquatic environment that preserves the potential for creating habitat for local indigenous flora and fauna.
- Minimise Council's maintenance requirements for open space, litter control structures and nutrient and sediment removal devices.
- Enhance the biodiversity, ecological health and positive water quality benefits within the riparian corridors to provide an integrated natural resource for the incoming residents.

5.4 Opportunities

In the design of any urban drainage scheme it is desirable to build on the naturally occurring physical and environmental assets of the site to maximise the quality of the ultimate living environment. In particular water should be recognised as an important resource that can enhance and bring a focus to areas accessible to the whole community.

For the Old Bar Precinct 3 site there are major opportunities to:

- Maintain, rehabilitate and enhance the riparian condition within the Precinct.
- Maximise habitat retention along the riparian corridor and swamp forest to provide sustainable aquatic and terrestrial ecosystems.
- Integrate open space areas and golf course within the flood affected land.
- Incorporate storm water reuse schemes to irrigate public reserves, playing fields and proposed golf course wherever possible.

5.5 Constraints

The main constraints to developing Precinct 3 "*are the potential flooding of Racecourse Creek, acid sulphate soil and land owned by State Forests.*" (p.43, GTCC, 2001) The subject site is vacant and devoid of any vegetation that would be of interest to State Forests. Consequently the two (2) constraints of concern relate to flooding and acid sulfate soils and *"in this regard the land subject to flooding and containing Class 3 Acid Sulfate Soils was approved for development of a golf course".* The higher land in the north and west of the site, where residential development is proposed, is outside the area identified as being affected by Class 3 Acid Sulfate Soils and the final landform of all future residential allotments will be above the 1% AEP flood levels. (refer to Section 9).

Other constraints to be considered in the preparation of a Stormwater & Flood Management Strategy for the Precinct include:

- Flows from upstream catchments to be conveyed through the site.
- Water quality and quantity objectives that will require allocation of land for stormwater control structures.
- Potential site salinity and groundwater salinity constraints.
- Water use activities that can cause unnatural charging of groundwater and create rising water tables (e.g. over-irrigation of public areas, sports fields, private lawns and private gardens).
- The need to ensure that flood storage within the floodplain is maintained and the hydraulic conveyance needs of the floodplain are catered for.
- The need to ensure that the peak discharges from the site are maintained at existing levels into Racecourse Creek to minimise the impact of flooding to downstream properties.
- The requirement to ensure that pollutant levels from the site are not increased within the downstream environment as a result of the development.
- Significant areas of the site are below the local PMF flood levels. Evacuation and flood safety in the area will be important considerations.
- Due to the flat nature over a significant portion of the site and providing storage for the floodplain, a significant amount of fill and site reshaping is expected. The flat terrain requires careful design and filling shall be kept to the minimum amount required.

6 PROPOSED STORMWATER MANAGEMENT STRATEGY

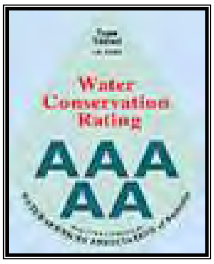
A critical consideration for the Stormwater and Flood Management strategy for the Precinct is the ecological sustainability of the downstream coastal ecosystem. To maintain stormwater quality at the required levels, a 'treatment train' approach is proposed where various types of pollutants are removed and flow volumes and discharge rates are managed by a number of devices acting in series. The stormwater management treatment train will consist of the following elements.

6.1 Water Efficiency

6.1.1 On Lot Treatment

- Implementation of water efficient fittings and appliances in all dwellings (dual flush toilet, AAA shower heads, water efficient taps and plumbing).
- Minimisation of impervious areas through acceptable development controls.
- The provision of rainwater tanks on each allotment, along with implementation of the above water efficient devices, will satisfy the requirements of BASIX. The connection of water tank to service internal uses will ensure any requirements are met and additional benefits are realised.





6.2 Water Quality Measures

6.2.1 Street Level Treatments

i. Inlet Pit Filter Inserts and Gross Pollutant Traps (GPTs)

GPT devices are typically provided at the outlet to stormwater pipes. These systems operate as a primary treatment to remove litter, vegetative matter, free oils and grease and coarse sediments prior to discharge to downstream (Secondary and Tertiary) treatment devices. They can take the form of trash screens or litter control pits, pit filter inserts and wet sump gross pollutant traps.

In theory, inlet pit filter inserts have several advantages over end of pipe GPT's, such as providing a dry, at source collection of litter, vegetative matter and sediment as well as allowing for staged construction works without having to provide additional / temporary GPT units. This may be particularly relevant for portions of the Old Bar Precinct 3 due to the likely staged nature of future development. Pit filter inserts will provide an at source mechanism for treatment of gross pollutants as development proceeds throughout the site.

In practice, feedback from various Council's have found that inlet pit filter inserts result in an unreasonable maintenance burden, particularly through access for cleaning and damage / vandalism. Pit inserts may be appropriate in low density residential areas where on street parking is unlikely or not permitted and where additional primary / secondary treatment measures are provided downstream in case of pit insert failure.

The form and configuration of GPT's can be further considered at development application and detailed design stages in conjunction with the streetscape design.

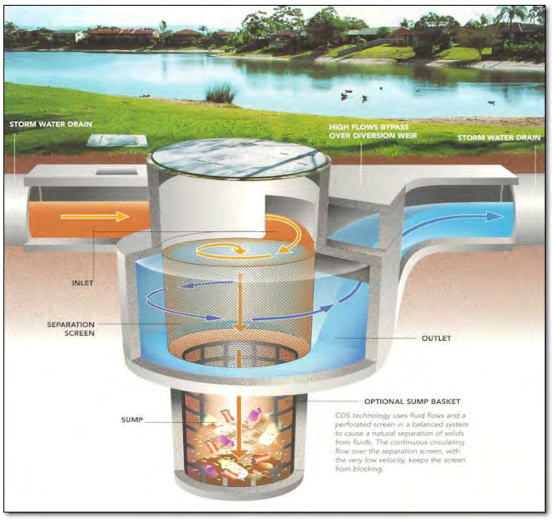


PLATE 6.1 – VORTEX STYLE GPT

6.2.2 *Subdivision / Development Treatment*

i. Bio-retention Systems and Raingardens

Eight (8) bio-retention systems and 'raingardens' are proposed within the development to primarily service the individual allotments to the north of Forest Lane as well as the Jarberg North and Jarberg West sites, prior to discharging into the golf course pond system. Raingardens are large scale, non-linear bio-retention systems. The systems will be appropriately sized to achieve the nutrient reduction targets outlined in the Greater Taree City Council DCP (2010). The bio-retention systems and raingardens will also attenuate first flush flows to reduce the risk of stream erosion within the water courses. The location of the eight (8) bio-retention systems and raingardens are shown on Figures 6.1 and 6.2. Refer to Section 9 for further discussion.

PLATE 6.2 – TYPICAL RAINGARDEN AFTER PLANT ESTABLISHMENT

ii. Wetland

Four (4) interconnected wetlands are proposed for the development, located within the future golf course proposed within the Precinct. The wetlands are to be hydraulically linked and will provide multiple benefits to the Precinct including passive recreation, aesthetics, water quality, potential stormwater harvesting and reuse opportunities and minor volume management. The final configuration of the wetland system will also include wetland planting at appropriate locations.

PLATE 6.3 – TYPICAL WETLAND

iii. Grassed Swale

Grassed swales are proposed to form part of the golf course development, downstream of the proposed playing areas, before discharging into the wetlands. The grassed swales will accept discharges from this part of the development and convey stormwater to the proposed wetland system. The swales will provide conveyance and water quality treatment for this portion of the golf course.

PLATE 6.4 – TYPICAL GRASSED SWALE

The strategy for the Precinct does not preclude the use of additional or alternate WSUD elements within the golf course, the streetscape or landscape. Alternative elements, such as zeolite filters within the golf course playing areas and sand filters to treat stormwater runoff from the rural residential allotments in the Love site, can be considered at the development application and detailed design stages. The use of such elements would require consideration of issues such as practicality in the local environment, safety, maintenance and performance.

6.3 Water Quantity (Flood Control) Measures

6.3.1 Subdivision / Development Treatment

Detention Basins

Peak storm flow attenuation up to the 1% AEP event is addressed through the provision of six (6) interim off-line, and one (1) permanent online detention storages located within the Old Bar Precinct 3 site. This is in addition to three (3) existing, permanent basins provided to service the adjacent Ocean Blue Estate to the west. Refer to Section 8 for further discussion.

A General Arrangement Plan indicating proposed locations for the water quantity and water quality treatments for the Old Bar Precinct 3 Site is included in Figure 7.1 and Figure 7.2.

6.4 Construction Stage

Erosion and sediment control measures are to be implemented during the construction phase in accordance with the requirements of The Greater Taree City Council and the guidelines set out by Landcom (the “Blue Book” 2004).

As the operation of “bio-retention” (raingarden) type water quality treatment systems are sensitive to the impact of sedimentation, construction phase controls should generally be maintained until the majority of site building works (approximately 80%) are complete. Alternatively, a very high level of at source control on individual allotments during the building and site landscaping works, which is regularly inspected by Council officers, would be required.

6.5 Interim Treatment Measures

The raingarden media bed should be protected throughout the civil and housing construction phases of the development. The floor of the raingarden should be lined with either a layer of turf or a sacrificial upper media bed layer and planting that would need to be replaced upon 80% completion of housing construction.

Upon 80% completion of housing construction within the catchment, the turf or sacrificial layer can be removed, replaced and the final media planting completed.

6.6 Long Term Management

Regular maintenance of the stormwater quality treatment devices is required to control weeds, remove rubbish, and monitor plant establishment and health. Some sediment build-up may occur on the surface of the raingardens and within the swales and may require removal to maintain the high standard of stormwater treatment.

Proper management and maintenance of the water quality control systems will ensure long-term, functional stormwater treatment. It is strongly recommended that a site-specific Operation and Maintenance (O & M) Manual is prepared for the systems. The O & M manual will provide information on the Best Management Practices (BMP’s) for the long-term operation of the treatment devices. The manual will provide site-specific management procedures for:

- Maintenance of the GPT structures including rubbish and sediment removal.

- Management of the raingarden including plant monitoring, replanting guidelines, monitoring and replacement of the filtration media and general maintenance (i.e. weed control, sediment removal).
- The owners of the proposed golf course should have a manual which includes the management of the pond system including plant monitoring, replanting guidelines, monitoring and general maintenance (i.e. control of algal blooms, weed control, sediment removal).

7 HYDROLOGIC ANALYSIS

The hydrologic analyses for this study were undertaken using the rainfall - runoff flood routing model XP-RAFTS (Runoff and Flow Training Simulation with XP Graphical Interface) (Willing, 1996 & 1994). The hydrologic analysis for the Old Bar Precinct 3 site was undertaken to determine the requirement and size of detention basins needed to restrict peak post development flows to pre development levels and also to generate peak flow hydrographs for input to the hydraulic model.

7.1 Previous Modelling

A previous assessment was undertaken by J Wyndham Prince (2006) which developed an XP-RAFTS hydrologic model for the entire catchment for Racecourse Creek to the outfall lagoon, which was accepted by Greater Taree City Council and this has been adopted as the base for this investigation. However, as this model covers sub-catchments covering a number of allotments, it was considered too broad to adopt in this study. For example, the entire development area to the north of Forest Lane upstream of the basin, is incorporated within a single node in the previous model. Therefore, a new XP-RAFTS model was prepared for the Old Bar Precinct 3 site that incorporates all individual allotments as separate catchment areas (including the proposed Jarberg West and Jarberg North development areas) to provide a means of determining the appropriate detention requirements for each individual allotment under interim development conditions.

Notwithstanding the above, a comparison of the peak 1% AEP flow was made with the previous modelling and the updated existing case model. The results are summarised in Table 7.1.

TABLE 7.1 – COMPARISON OF PEAK FLOWS

		Discharge		
Location	**Catchment (ha)**	**JWP Previous (2006) (m^3/s)**	**SKM (2009) (m^3/s)**	**JWP Present (2014) (m^3/s)**
Basin Inflow	292	44.3	41.2	46.6
Basin Outflow	292	9.4	12.7	10.9

The comparison of peak flows between the XP-RAFTS models shows that the updated J. Wyndham Prince model results in a higher existing case peak flow for a similar catchment. This is expected as the model is split into multiple catchments, which generally results in higher flows.

XP-RAFTS is known to be sensitive to catchment delineation and slopes and we consider that the J Wyndham Prince 2014 assessment, with greater basin inflows and reduced basin discharges, is conservative and would potentially produce high flood levels within the Precinct.

7.2 Sub-Catchments (Existing)

Sub-catchment areas contributing to the drainage system as undertaken for the original hydrological assessment for the site (JWP, 2006), have been spilt to provide more definition for specific on-site detention assessments. The sub-catchments were established through site investigations, detail survey undertaken by Lidbury, Summers and Whiteman and 1:4000 scale orthophoto maps obtained from the Land Information Centre covering the catchment. The existing catchment layout is presented in Figure 7.1.

Catchment areas representing the proposed development extents were split in accordance with land ownership, to determine detention requirements for each site under interim development conditions (Scenarios A & B).

A comparison of adopted catchment boundaries for the existing areas contributing to the drainage system to previous studies are shown below in Plate 7.1.

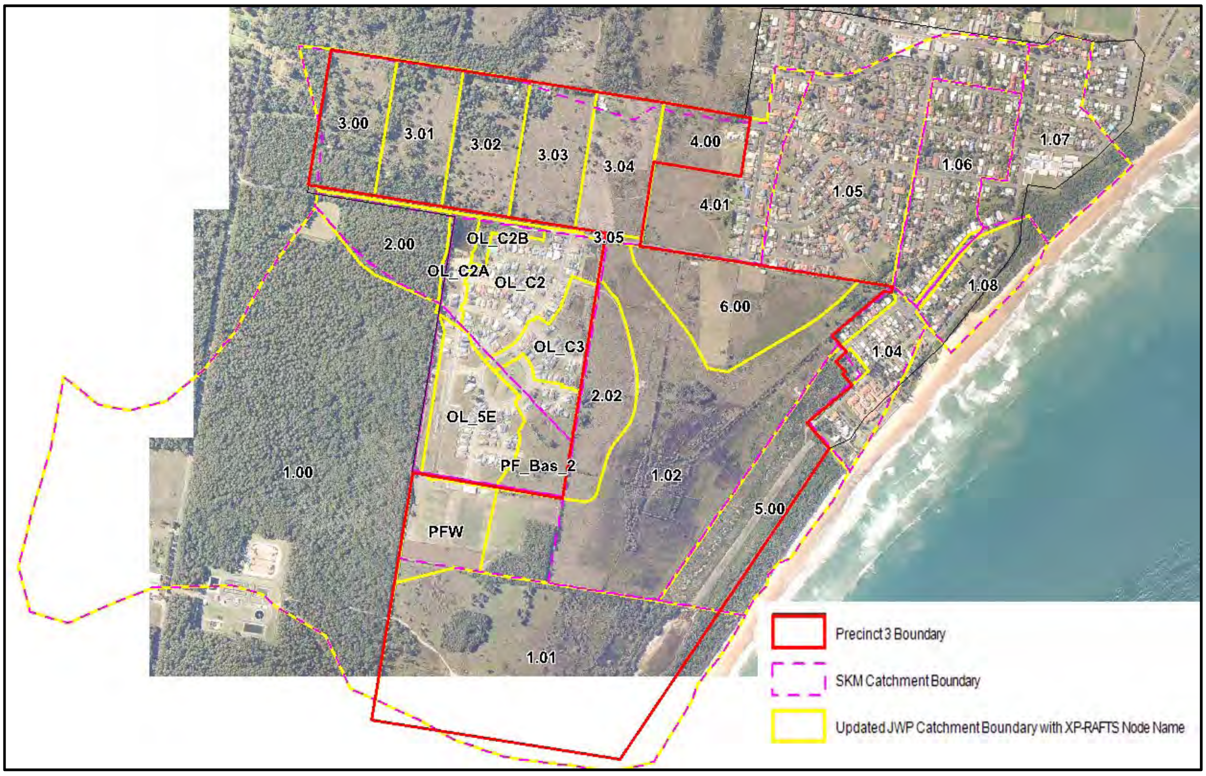


PLATE 7.1 – SUBCATCHMENT EXTENTS

The modelling has included catchments to the outlet of Racecourse Creek to the sea, approximately 1km downstream of the Old Bar Precinct 3 site. This will ensure that a meaningful analysis of any potential impacts that the development of the Old Bar Precinct 3 site may have on downstream areas can be assessed.

A conservative percentage impervious of zero was adopted for the rural catchment under existing conditions. As outlined in Section 4, the existing scenario has assumed that the Council approved Ocean Blue Estate is established (developed), with the exception of the north-western portion of the site, which drains north into Forest Lane. This part of the site has been assumed to be undeveloped under existing site conditions.

The general layout of the existing case XP-RAFTS model is shown in Appendix A.

7.3 Existing Swamp Land

The large depression within the southern portion of the site forms a natural basin which provides significant detention under existing site conditions. This basin has been included in the XP-RAFTS model representing the site under existing site conditions. The adopted stage-storage and stage-discharge relationships of the existing basin is identical to that adopted in the previous study (JWP, 2006). The layout of the existing natural basin is indicated on Figure 7.1.

A significant portion of the Jarberg Land and the Mid Coast Water Land is flat and does not freely drain. Therefore it was assumed that the 100% AEP inundation extents within the swamp area would be impervious in the hydrologic model representing the site under existing conditions (JWP, 2006). This is also consistent with developed conditions for the post-development case model with the established golf course.

7.4 Sub-Catchments (Interim and Post Development)

The developed case sub-catchment areas contributing to the drainage system were maintained to be the same as the existing case catchment boundaries inside and outside the Precinct, with the exception of the basin catchment (existing node 1.02) being split in the developed case into nodes 1.02 (proposed basin) and 1.03 (downstream of proposed basin, refer to Figure 7.2). Sub-catchment boundaries within the Precinct have been determined on the best information available with regard to the Indicative Layout Plan and likely site grading and levels.

Final catchment boundaries and areas contributing to each interim detention basin and water quality device should be confirmed as part of the Development Approval process for each stage of the development. The developed case catchment boundaries are shown on Figure 7.2.

In accordance with the previous modelling accepted by the Greater Taree City Council, a percentage impervious of 0.60 was adopted for the proposed low density residential areas. A calculated fraction imperviousness of 0.15 was adopted for the rural residential areas within the Love site in the developed case, due to the restricted building envelopes.

The property north of Forest Lane, east of the Rawson site and south of Goodear is Lot 7 of DP 1068908. This property is currently being a DA Approved Manufactured Home Estate (GTCC DA-278/2008), which is required to meet predevelopment discharges and water quality objectives onsite. The assessments undertaken as part of this study have assumed that this site is "existing" for all modelling scenarios.

The general layout of the developed case XP-RAFTS model is shown in Appendix A.

7.5 Rainfall Data & XP-Rafts Parameters

7.5.1 Intensity-Frequency-Duration (I.F.D.)

Design rainfall intensity-frequency-duration (I.F.D.) data for the site were obtained using methods set out in Australian Rainfall and Runoff (1987). A summary of the rainfall intensities adopted in this study is provided in Table 7.2. The critical storm durations were determined using these values for each sub-catchment. The 2007 storm event modelled as part of the previous study (SKM, 2006) was not modelled in this study.

TABLE 7.2 – OLD BAR RAINFALL INTENSITIES

Storm Duration (min.)	Rainfall Intensities (mm/hr) Annual Exceedence Probabilty (AEP)			
	20%	5%	1%	PMP
5	152	192	244	-
10	117	148	189	-
15	98	124	158	650
20	86	108	138	-
25	77	97	124	-
30	70	88	113	470
45	56	71	91	400
60	48	61	78	350
90	37.7	48.3	62	290
120	31.8	40.9	53	250
150	-	-	-	210
180	25.0	32.4	42.0	190
240	-	-	-	160
270	19.6	25.6	33.4	-
300	-	-	-	140
360	16.5	21.6	28.4	130
540	13.0	17.1	22.5	-
720	10.9	14.5	19.1	-
1080	8.58	11.4	15.2	-
1440	7.20	9.61	12.8	-
2160	5.58	7.49	10.0	-

7.5.2 XP-RAFTS Parameters

The PERN (n) values and losses adopted for the catchments in the XP-RAFTS modelling are listed in Table 7.3.

TABLE 7.3 – ADOPTED XP-RAFTS PARAMETERS

Parameter	Catchment Condition	Adopted Value
Pern		
	Existing Pervious - Forest	0.1
	Existing Pervious	0.05
	Urban Pervious	0.025
	Urban Impervious	0.015
Losses		
Initial Loss	Pervious Catchment	10.0
Continuing Loss	Pervious Catchment	2.5
Initial Loss	Impervious Catchment	1.0
Continuing Loss	Impervious Catchment	0.0

Link lagging between sub-catchments was adopted throughout the hydrological model. The lag times adopted are generally based on a flow velocity of 2 m/s.

7.6 Calibration

It is normal practice for flood routing models such as XP-RAFTS to be calibrated with historical rainfall and stream flow data for the catchment being investigated in order to produce the most reliable results. The model parameter values (in particular Bx) are adjusted so that the model adequately reproduces observed hydrographs. The calibration process undertaken as part of the previous assessment by J Wyndham Prince (JWP, 2006) concluded with the adoption of Bx = 0.65, which was accepted by Council, and has been adopted in this assessment.

The results indicated in Table 7.1 shows that an adjustment in Bx value could have been undertaken to recalibrate the hydrological model to the adopted Sinclair Knight Merz flows. However, it was concluded that since XP-RAFTS tends to be sensitive to catchment delineation and slopes, the adoption of a Bx value of 0.65 provides a higher peak discharge rate and greater potential flood extents together with a reduction in basin outflows, is considered conservative for this assessment.

7.7 Proposed Interim Basin Volumes

A summary of the proposed interim detention basin volumes for the Old Bar Precinct 3 sites are shown in Table 7.4.

TABLE 7.4 – SUMMARY OF INTERIM DETENTION BASIN VOLUMES

Property	Node	Catchment Area (ha)	Storage Volume (m^3)	Storage Rate (m/ha)	Low Flow Outlet	High Flow Outlet	Rainagrden Bed Area (m^2)
Love	3.0	3.2	450	141	2 x 375 dia IL 15.0	1.6m weir RL 15.6	300
Maja / Sainisch / Plimer	3.01	7.35	1500	204	3 x 375 dia IL 9.1	3.0 m weir RL 9.8	1650
Archer	3.02	7.35	2200	299	3 x 375 dia IL 6.7	3.3 m weir RL 7.5	2800
Trad	3.03	7.35	2250	306	3 x 450 dia IL 5.8	2.8 m weir RL 6.5	2000
Goodear	4.00	4.05	1200	296	2 x 375 dia IL 9.0	2.4 m weir RL 9.7	950
Taylor / Rawson	3.04	11.18	2000	179	3 x 525 dia IL 5.5	4.5 m weir RL 6.4	2000
Jarberg West *	2.02	11.22	2400	214	7 x 450 dia IL 5.0	4.4 m weir RL 5.7	1200 (1900)
Jarberg North *	6.00	11.55	3800	329	3 x 525 dia IL 5.0	5.0 m weir RL 5.7	320 (700)
Jarberg Golf Course Basin *	1.02	290	592000	2041	Refer to drawing in Appendix E		-

* Interim Basin not required if constructed in conjunction with Golf Course Basin
(Larger Raingarden devices) required for compensation if constructed in conjunction with Golf Course

The interim detention storages for the individual sites, which are located offline to the water courses, will capture and attenuate flows from the individual site catchments within the Old Bar Precinct 3 site.

The total catchment area draining to the eight (8) interim basins is approximately 63 hectares. The total volume of storage provided therefore represents approximately 250 m^3/hectare, which is within the range expected for urban development. The indicative location of the detention basins are shown on Figure 6.1.

7.8 Discharge Estimates

Discharge estimates were derived for the existing and developed catchments for storms with AEP's of 20%, 5% and 1% as well as the PMP. A range of storm durations from 15 minutes to 36 hours were analysed to determine the critical storm duration for each sub-catchment.

XP-RAFTS modelling was undertaken to determine the estimated peak discharges from each of the sites and the overall Precinct for the following catchment conditions:

- **Base Case:** Undeveloped site under existing rural conditions, Catchments C2A and C2B in Ocean Blue Estate also undeveloped, remainder of the Estate developed.
- **Interim Conditions:** Interim Site developed with detention systems provided for each individual allotment developed (including the Jarberg North and West sites, but excluding the proposed golf course basin). All catchments within Ocean Blue Estate developed;
- **Developed Conditions:** All Sites developed (excluding Mid Coast Water and Elias Sites) with single on-line detention system in golf course provided.

The 20%, 5% and 1% AEP peak flows from the catchment are presented in Tables 7.5 and 7.6. XP-RAFTS outputs for the individual basins are provided in Tables 7.7 and 7.8. The location of the point of comparison as listed in the below tables are provided in Plate 7.2 below.

PLATE 7.2 – FLOW COMPARISON POINT LOCATIONS

TABLE 7.5 – SUMMARY OF SITE DISCHARGES - INTERIM SITE CONDITIONS (DETENTION ON INDIVIDUAL SITES)

					Interim Developed Conditions Detained (Golf Basin Not Constructed)					
Location	Node	Existing Conditions			Flows			Flow Comparison (Post/Pre)		
		20% AEP	5% AEP	1% AEP	20% AEP	5% AEP	1% AEP	20% AEP	5% AEP	1% AEP
Love Site	3.00d	1.13	1.68	2.28	1.13	1.68	2.29	100%	100%	100%
Maja / Sainisch / Plimer Site	3.01d	2.20	3.26	4.44	2.01	2.97	4.13	91%	91%	93%
Archer Site	3.02d	4.18	6.16	8.43	3.71	5.33	7.51	89%	87%	89%
Trad Site	3.03d	5.50	8.03	10.90	4.91	6.89	9.51	89%	86%	87%
Goodear Site	4.00	0.75	1.09	1.45	0.64	0.95	1.33	85%	87%	92%
Taylor / Rawson Site	3.04	1.94	2.81	3.76	1.73	2.23	3.13	89%	79%	83%
Taylor / Rawson Site at Forest Lane	3.04d	7.27	10.52	14.22	6.56	8.94	12.31	90%	85%	87%
Downstream Forest Lane Culverts	3.05	8.83	12.80	17.35	8.62	11.28	15.45	98%	88%	89%
Jarberg West Outflows	2.02	3.36	4.94	6.50	2.75	3.63	4.86	82%	73%	75%
Jarberg North Outflows	6.00	1.76	2.61	3.54	1.74	2.42	3.31	99%	93%	94%
Main Basin Inflows	1.02	23.78	33.93	46.59	23.42	32.42	44.92	98%	96%	96%
Precinct 3 Outflow	1.03	4.46	7.20	10.85	2.77	5.02	8.07	62%	70%	74%

TABLE 7.6 – SUMMARY OF SITE DISCHARGES – DEVELOPED SITE CONDITIONS (GOLF COURSE DETENTION ONLY)

					Developed Conditions					
Location	Node	Existing Conditions			Flows			Flow Comparison (Pre/Post)		
		20% AEP	5% AEP	1% AEP	20% AEP	5% AEP	1% AEP	20% AEP	5% AEP	1% AEP
Love Site	3.00d	1.13	1.68	2.28	1.03	1.90	2.51	91%	113%	110%
Maja / Sainisch / Plimer Site	3.01d	2.20	3.26	4.44	2.59	3.72	4.95	118%	114%	111%
Archer Site	3.02d	4.18	6.16	8.43	5.68	7.75	9.99	136%	126%	119%
Trad Site	3.03d	5.50	8.03	10.90	7.88	10.57	13.44	143%	132%	123%
Goodear Site	4.00	0.75	1.09	1.45	1.44	1.86	2.25	192%	171%	155%
Taylor / Rawson Site at Forest Lane	3.04d	7.27	10.52	14.22	10.42	13.86	17.51	143%	132%	123%
Downstream Forest Lane Culverts	3.05	8.83	12.80	17.35	13.29	17.84	22.35	151%	139%	129%
Jarberg West Outflows	2.02	3.36	4.94	6.50	4.23	5.97	7.60	126%	121%	117%
Jarberg North Outflows	6.00	1.76	2.61	3.54	3.94	5.13	6.25	224%	197%	177%
Main Basin Inflows	1.02	23.78	33.93	46.59	31.05	41.60	53.51	131%	123%	115%
Precinct 3 Outflow	1.03d	4.46	7.20	10.85	3.39	5.95	9.34	76%	83%	86%

NOTE: Final Peak Flow values are to be determined upon completion of the detailed designs and preparation of the Development Application for each basin.

Peak flows for all locations are included in Appendix A.

7.8.1 Basin Performance

The performance of the basins during the peak 20% and 1% AEP storm events under Interim Conditions (on-site detention for individual sites) and Developed Precinct conditions (golf course detention only) are detailed in Tables 7.7 and 7.8, respectively.

TABLE 7.7 – DETENTION BASIN PERFORMANCE 20% AEP

Property	Node	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Basin Volume Used (m^3)	Storage Depth * (m)	Stage Used * (RL m)
Love	3.0	0.86	0.74	290	0.72	15.72
Maja / Sainisch / Plimer	3.01	1.77	0.88	805	0.66	9.76
Archer	3.02	2.55	0.96	1215	0.79	7.49
Trad	3.03	2.55	1.23	1110	0.69	6.49
Goodear	4.00	1.44	0.64	760	0.71	9.71
Taylor / Rawson **	3.04	3.01	1.73	1080	0.77	6.27
Jarberg West	2.02	4.23	2.75	1355	0.66	5.66
Jarberg North	6.00	3.94	1.74	2445	0.73	5.73
Jarberg Basin	1.02	30.45	3.38	329315	1.41	5.21

* Denotes ponding depth within basin
** Detention includes attenuated inflows from developed Goodear Site

TABLE 7.8 – DETENTION BASIN PERFORMANCE – 1% AEP

Property	Node	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Basin Volume Used (m^3)	Storage Depth * (m)	Stage Used * (RL m)
Love	3.0	1.62	1.44	450	0.99	15.99
Maja / Sainisch / Plimer	3.01	3.13	1.86	1470	0.97	10.07
Archer	3.02	4.03	1.86	2140	1.05	7.75
Trad	3.03	4.03	2.05	1940	0.93	6.73
Goodear	4.00	2.25	1.33	1150	0.97	9.97
Taylor / Rawson **	3.04	4.83	3.13	1970	1.13	6.63
Jarberg West	2.02	7.60	4.86	2380	0.99	5.99
Jarberg North	6.00	6.25	3.31	3680	0.98	5.98
Jarberg Basin	1.02	52.27	9.31	572515	1.87	5.67

* Denotes ponding depth within basin
** Detention includes attenuated inflows from developed Goodear Site

The outlet configuration proposed for the golf course basin is consistent with the configuration previously designed by J Wyndham Prince and modelled by SKM in the previous study (SKM, 2009). Refer to Appendix E for a detailed plan of the proposed outlet configuration.

7.8.2 Discussion of Modelling Results

The XP-RAFTS modelling undertaken has determined that the proposed interim devices are adequate to restrict post development peak discharges from the individual allotments to pre development levels for the 20%, 5% and 1% AEP storm events.

The XP-RAFTS modelling undertaken has also determined that the future permanent detention storage within the proposed golf course is adequate to restrict post development peak discharges from the Precinct, to pre-development levels for the 20%, 5% and 1% AEP storm events. The results of this modelling have been reported in Table 7.6 and demonstrate compliance with The Greater Taree City Council Development Control Plan 2012 (GTCC, 2012) stormwater management objectives.

Opportunities to further optimise the detention basins can be considered at the development application and detailed design stages for each individual development.

The performance of the interim development (i.e. all lots developed with individual detention), will require the construction of the proposed main discharge control device (proposed for the Golf Course), to ensure that peak discharges from the Precinct are in accordance with Greater Taree City Council requirements.

A sensitivity analysis undertaken by J Wyndham Prince, has concluded that interim detention basins on the individual lots would not be required once the main basin discharge control device is constructed.

8 FLOOD MODELLING

The 2D flood modelling of the basin and trunk drainage channels that run through the Old Bar Precinct 3 development was undertaken using TUFLOW (Two-Dimensional Unsteady Flow). TUFLOW is a computational engine that provides two-dimensional (2D) and one-dimensional (1D) solutions of the free-surface flow equations to simulate flood and tidal wave propagation (TUFLOW 2010). TUFLOW is specifically beneficial where the hydrodynamic behaviour in coastal waters, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be difficult to represent using traditional 1D network models.

Flows within the creeks downstream of the Jarberg Land were modelled as 1D channels, with the remaining floodplains modelled as 2D flows. A 2D model provides a better estimation of the effects of momentum transfer between in-bank and overbank flows and the energy losses due to meanders or bends in creeks. MapInfo, a GIS based software tool, was used for interrogating and plotting the results as well as creating the flood extents maps and the flood level difference maps.

Flood modelling for the existing and developed scenarios was undertaken to determine the impact of the Old Bar Precinct 3 development on the flood levels in the creeks.

8.1 TUFLOW Model Set-Up and Modelling Assumptions

As with any flood modelling a number of assumptions are necessary to allow for the modelling process to proceed. The assumptions made within the TUFLOW model for the Old Bar Precinct 3 are summarised below and are provided in more detail in Appendix B. The TUFLOW modelling layout is presented in Figure 8.1.

8.2 Existing Site Modelling

The previous modelling prepared by Sinclair Knight Merz (SKM, 2009) was provided as the basis for the flood modelling and was adopted for this current assessment, including the existing Racecourse Creek configuration downstream of the site, as well as the proposed main golf course basin discharge arrangement designed for the development. Further discussion of the adopted configurations for the Golf Course basin discharge arrangement and the downstream reach of Racecourse Creek are discussed in the previous study (SKM, 2009).

Lidbury, Summer & Whiteman, provided further survey data of the site, including the most up-to-date surface information representing the neighbouring Ocean Blue Estate. This expanded information was adopted in the modelling, as it was determined to evaluate existing site conditions to include the approved Ocean Blue Estate in developed conditions.

8.3 Developed Site Modelling

For the developed case scenario, the proposed basin discharge control arrangement for the future golf course basin within the Jarberg site, which controls flows into Racecourse Creek as prepared by SKM was adopted in this model.

The design surface modelling prepared by LSW for both the Jarberg Land (proposed golf course and adjoining development extents) and the channel arrangement to the north of Forest Lane were used in the developed case modelling (refer to Plate 8.1 – for indicative location of the proposed Northern Channel). It is expected that the configuration of the channel within the road and drainage reserve will be further developed and refined (including proposed culvert crossings) at the development application and detailed design stages.

8.4 Regional Tailwater Conditions

The tailwater conditions adopted in the model are based on the expected maximum likely coastal impacts including storm surge heights, combined with astronomical high tide and wave run-up, which resulted in a tailwater level of RL 1.9 m AHD. This has been determined as a combination of the Astronomical High Tide Level (RL 1.0 m AHD), a high level of Storm Surge (0.6 m – CMM, 1990), and the expected high-range Medium-Term Sea Level Rise at 2040 (0.3 m – CTC, 2004). Details of the assumed adopted heights impacting flood levels applicable to the local coastal area are provided in Table 8.1 below.

TABLE 8.1 – OLD BAR COASTAL FLOOD LEVEL IMPACT

Parameter	Sea Level Impact (m)
Astronomical High Tide Water Level	1.0
Storm Surge (High) (CMM, 1990)	0.6
Expected Peak Medium-Term Sea Level Increase (2040) (CTC, 2004)	0.3
Adopted Tailwater Level	**1.9**

The Floodplain within the Old Bar Precinct 3 site as well as the majority of the downstream Racecourse Creek is located above RL 1.9 and is therefore not affected by regional coastal impacts for the 1% AEP event. Note that the adopted Tailwater does not include the potential impacts of Wave Setup or Wave Run-up, where under severe circumstances could potentially have widespread impact over the entire Old Bar township.

8.5 Flow Diversion Structures

Discharges from the upstream Kirrawak State forest are expected to impact upon both the northern portion of the Ocean Blue Estate and the Council playing fields south of Ocean Blue Estate. Currently, there is an earth mound formed along the western boundary of the Ocean Blue Estate, directing runoff from the forested area north towards Forest Lane (refer to Northern Diversion Bund in Plate 8.1).

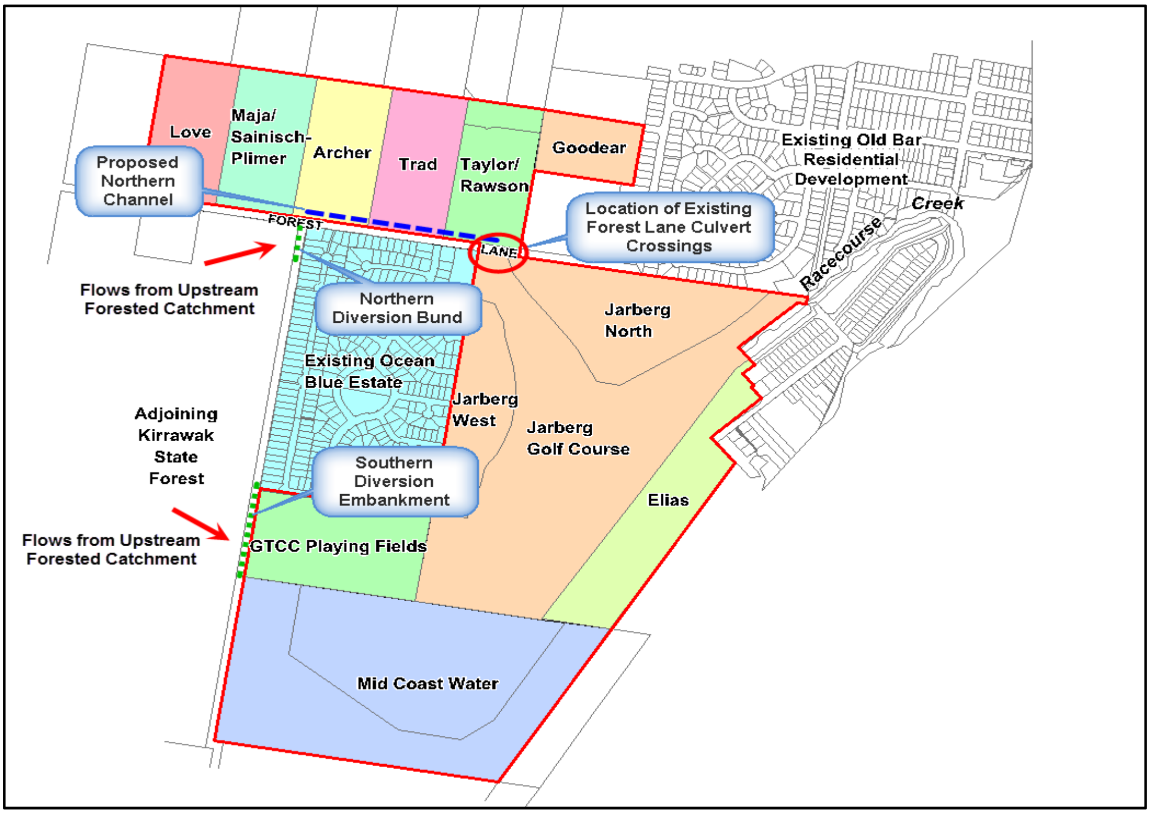


PLATE 8.1 – DRAINAGE SYSTEMS FOR PRECINCT 3 SITE & EXISTING OCEAN BLUE

Preliminary modelling suggests that the existing mound will not have sufficient capacity to divert 1% AEP discharges from the forested catchment without affecting the northern part of the Ocean Blue Estate. .Assessments indicate that the existing northern bund would need to be raised by up to 0.4 m in order to divert upstream around the Ocean Blue Estate. Refer to Plate 8.2, which indicates the approximate level and extent of the diversion bund that has been included in all modelling scenarios.

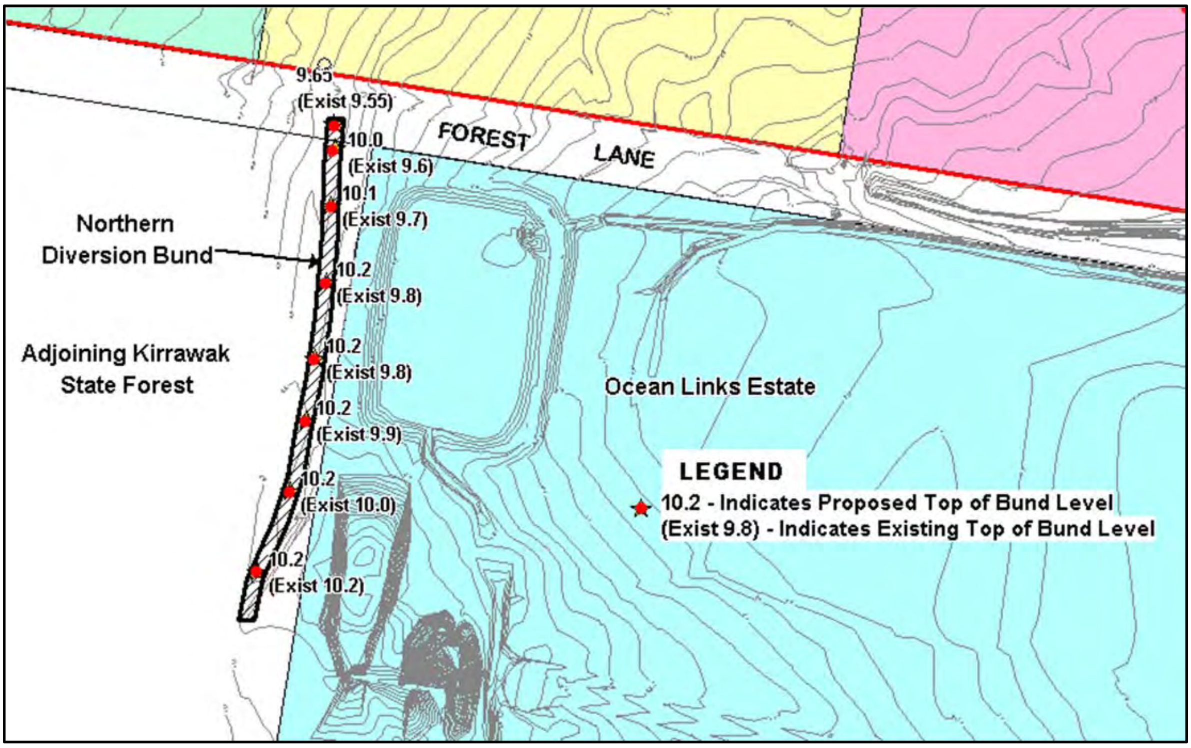


PLATE 8.2 – NORTHERN DIVERSION BUND DETAIL

There is a detention basin within the Council Playing Fields land that currently attenuates discharges from the southern portion of the Ocean Blue Estate. The basin has not been designed to accept and detain upstream inflows from the adjacent forested area. An existing fire trail runs parallel to the forest boundary, which has a low point generally adjacent to the playing fields.

This existing arrangement allows discharges from the forested area to contribute to the playing fields, and hence, the detention system. The diversion bund would be provided when the future fire trail or public access road to the future playing fields in the Mid Coast Water Land are constructed.

It is proposed to provide an embankment for the fire trail along the western boundary of the Ocean Blue Estate, diverting runoff from the forested area south towards the Mid Coast Water Site (refer to Southern Diversion Bund in Plate 8.1). Modelling suggests that the embankment will need to be at RL 6.3, which is up to 0.7 m above existing levels, to have sufficient capacity to divert 20% AEP discharges from the forested catchment to the south of the basin. Refer to Plate 8.3, which indicates the approximate level and extent of the diversion embankment, which has been included in all modelling scenarios.

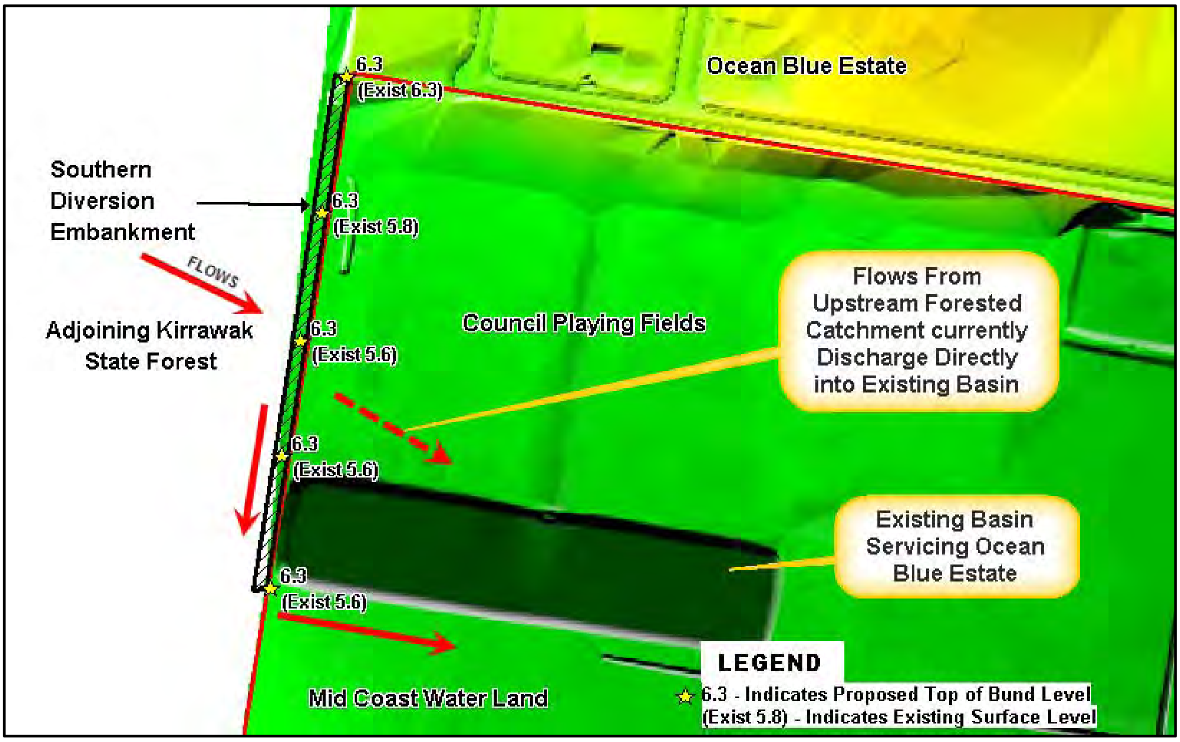


PLATE 8.3 – SOUTHERN DIVERSION EMBANKMENT DETAIL

8.6 Hydraulic Structures Across Proposed Northern Channel

It is expected that as part of the Old Bar Precinct 3 development, there will be a need for the creation of a number of road crossings across the Proposed Northern Channel, along the northern side of Forest Lane in order to provide access across this structure. The configuration of these hydraulic structures has not yet been designed and has been excluded from the modelling completed to date. The hydraulic performance of the proposed channel was assessed to determine if it had the necessary conveyance capacity. However, the possible afflux associated with multiple culvert crossings has not been considered. It is expected that these devices will be designed and modelled as part of the development application and detailed design stage.

Assessment of discharges through the proposed Northern Channel indicate that peak flow velocities within the upstream reaches (adjacent the Archer Site) are up to 2.1 m/s during the peak 1% AEP event and 1.9 m/s during the peak 20% AEP storm event. Flow velocities for the 1% AEP event through the central portion (adjacent the Trad Site) are up to 1.8 m/s, and 1.5 m/s in the lower reaches, adjacent the Rawson Site.

The results of the expected flow velocities within the proposed Northern Channel indicate that, subject to detailed assessment, the upper reaches of the channel may require surface protection (i.e. reinforced turf) to protect the channel from potential erosion due to the flow velocities. The introduction of culvert crossings for access to the development areas from Forest Lane may slow down the flows and requirements for additional erosion protection may not be required, subject to detailed assessment within the proposed channel.

8.7 Existing Forest Lane Culvert Crossings

The existing Forest Lane crossings have been incorporated within the hydraulic modelling to determine the impact of the structure on the proposed northern channel and future developments north of Forest Lane. The existing culvert systems consist of 4 x 2.4m x 0.6m box culverts together with triple 375mm diameter pipes. The development scenario requires that the existing culvert systems be extended in accordance with the proposed Forest Lane widening and upgrades.

8.7.1 *Culvert Assessment*

Separate hydraulic calculations using HY8 have been undertaken to verify the capacity of the culvert system (refer to Appendix C for details). The hydraulic calculations suggest that the culvert system has the capacity to convey approximately 8.8 m³/s without breaching the roadway (existing and designed road level at RL 6.5 m AHD). The 20% AEP discharges to the culverts under developed undetained conditions (no interim basins) is approximately 13.3 m³/s. This assessment has determined that additional culvert would need to be provided if the designed road level of RL 6.50 m AHD is to be maintained as a flood-free access during the peak 20% AEP storm event.

The results of the calculations also indicate that the peak 1% AEP developed discharges (22 m³/s from XP-RAFTS) results in 8.5 m/s discharging through the culverts and 13.9 m³/s surcharging over the roadway. The reduced capacity is due to increased tailwater conditions within the basin storage downstream of Forest Lane. The approximate headwater level on the upstream side of the culvert is RL 6.7 m AHD, assuming that a 100 m long weir at RL 6.50 m AHD is available in Forest Lane.

8.7.2 *Hydraulic Assessment Results*

The TUFLOW results indicate that the culvert system is conveying 8.1 m³/s (headwater RL 6.53 m AHD), with 0.4 m³/s surcharging over the roadway during the peak 20% AEP storm event. This results in a total discharge of up to 9.4 m³/s across Forest Lane at this location, compared to 14 m³/s calculated from XP-RAFTS. This indicates that the TUFLOW modelling has accounted for passive storages within the channel and other overland flood areas, whereas the XP-RAFTS modelling has not.

The TUFLOW results also indicate that the culvert system has a capacity of 8.6 m³/s, with 9.4 m³/s surcharging over the roadway during the peak 1% AEP storm event. This results in a total peak discharge across Forest Lane of 18 m³/s (as opposed to 22 m³/s peak flow rate to this point as determined in XP-RAFTS) during the peak 1% AEP event.

The results of the TUFLOW assessment indicate that if the Forest Road alignment is constructed at RL 6.50 m AHD, there is expected to be minor surcharge flows during the peak 20% AEP storm event. The 9.4 m³/s surcharges during the 1% AEP storm event under future development conditions are approximately 0.2 m deep with peak velocities up to 2.0 m/s, resulting in a velocity depth product of 0.4 m²/s. For a summary of the Culvert performance assessments undertaken for the Forest Lane culverts, refer to Table 8.2 below.

TABLE 8.2 –HYDRAULIC PERFORMANCE OF FOREST LANE CULVERT SYSTEM

		Calculated from XP-RAFTS and HY8				TUFLOW Results			
Site Conditions	AEP	Discharge (m³/s)	Flow Through Culvert (m³/s)	Road Overflows (m³/s)	Headwater Level (m AHD)	Discharge (m³/s)	Flow Through Culvert (m³/s)	Road Overflows (m³/s)	Headwater Level (m AHD)
Interim Site Conditions (Detained)	20%	8.6	8.6	0.0	6.48	7.4	7.4	0.0	6.38
	1%	15.5	8.3	7.1	6.62	14.8	8.8	6.0	6.63
	PMF	129	13	116	7.27	109	11.8	97	7.15
Developed Site Conditions (No Detention)	20%	13.3	8.4	4.9	6.60	8.4	8.1	0.4	6.53
	1%	22.4	8.5	13.9	6.69	18	8.6	9.4	6.67
	PMF	146	17	129	7.34	120	12.9	107	7.18

8.8 Flood Extent Mapping

Flood extent and depth profile mapping has been completed for the 20%, 5% and 1% AEP and PMF events under all assessed scenarios. The flood depth and extent mapping, together with flood levels at selected locations is shown in Figures 8.2 – 8.13.

The indicative 1% AEP flood level within the basin under interim development conditions is RL 5.60 m AHD. The 1% AEP flood level within the basin under future development conditions, including the golf course construction, is RL 5.57 m AHD, which is consistent with the flood level as determined in the previous study (SKM, 2009).

8.9 Flood Difference Mapping

Maps have also been prepared to illustrate the difference in flood level in 20%, 5% and 1% AEP events when compared to existing case for the various scenarios assessed. The flood difference mapping is provided in Figures 8.14 to 8.19 inclusive. Flood difference mapping comparing the Interim Development Scenario with existing conditions is shown in Figures 8.14 to 8.16. Flood difference mapping shown on Figures 8.17 to 8.19, compares future development conditions with existing conditions. The figures indicate that development of the Precinct, with the recommended controls, will result in some increases in flood levels within the bounds of the Precinct. These increases can be accommodated within the basin/ golf course extents as well as the drainage reserves. Additional filling of the urban areas within the Precinct may also be necessary to ensure adequate freeboard.

The increases in flood levels external to the Precinct include the area around the existing farm dam, located north of Forest Lane, adjacent to the Taylor / Rawson site (Lot 7 DP 1068908). The increase in flood levels are up to 0.3 m (RL 6.77) along the Precinct boundary, where the post development flood levels are raised due to site filling within the Rawson Site. The maximum flood level increase during the peak 1% AEP event under developed conditions is 0.25 m. The area of the adjacent site subjected to flood level increases is currently in and around a farm dam bounded by open paddock in a rural residential site.

The approved DA-278/2008 civil construction design prepared by Northrop provides a detention basin in the south-western corner of the site, which has a 1% AEP TWL of R.L.6.93. The adjacent floor level of the proposed Clubhouse is R.L. 7.60m. It is unclear whether the design for the detention basin considered tailwater effects of the Forest Lane culverts. The TUFLOW modelling undertaken by J Wyndham Prince shows a tailwater of R.L. 6.67m AHD upstream of the Forest Lane Culverts, which affects Lot 7 in the existing condition. Future detailed design of Lot 7 will be influenced by whether the Forest Lane culvert upgrade occurs, which will have an effect on the final top water levels within the site. It is considered that the impact on the adjoining property can be assessed in detail once the final design is undertaken, however impacts should be minimal given the proposed use of the Lot 7 site.

Another area outside of the Precinct subject to increases in flood levels is in the forested area to the north-west of Ocean Blue Estate. These are minor and result in a depth increase of less than 0.05 m during the peak 20% AEP event and up to 0.03 m during the peak 1% AEP event.

Concurrence with the adjoining land owners would be necessary or additional modifications of the proposed mitigation strategy may be necessary.

Flood difference mapping shows that flood levels downstream of the Precinct within Racecourse Creek to the outfall to the sea have not been increased in any scenario assessed. In fact, the modelling has indicated that flood levels along Racecourse Creek downstream of Precinct 3 are decreased by approximately 0.3 m.

The flood level differences at selected locations have also been indicated on the flood difference maps.

9 WATER QUALITY ANALYSIS

The stormwater quality analysis for this study was undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). This water quality modelling software was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology, which is based at Monash University and was first released in July 2002. Version 6.0.1 was released in 2013 and this was adopted for this study.

The model provides a number of features relevant for the development:

- It is able to model the potential nutrient reduction benefits of gross pollutant traps, constructed wetlands, grass swales, bio-retention systems, sedimentation basins, infiltration systems, ponds and it incorporates mechanisms to model stormwater re-use as a treatment technique;
- It provides mechanisms to evaluate the attainment of water quality objectives;

The MUSIC modelling was undertaken to demonstrate that the stormwater management system proposed for the Precinct will result in reductions in overall post-development pollutant loads being discharged from the Precinct comply with the designated target objectives. In the case for the Old Bar Precinct 3 site, Greater Taree City Council requires that the post-development pollutant loads are equal to, or less than existing site conditions.

The Office of Environment and Heritage (DECCW, 2006) have established default parameters for use in MUSIC models to represent the generation of various pollutants by different land uses. A MUSIC model representing both the existing and the proposed Old Bar Precinct 3 Development Site was prepared. This model will be used to demonstrate compliance with the recommended post development annual load reductions in accordance with Greater Taree City Council requirements.

9.1 Catchments

A MUSIC model was established for the proposed stormwater management system for the Old Bar Precinct 3 Site under existing and post development site conditions.

9.1.1 Existing Site Conditions

The model representing the site under existing site conditions has considered that the Ocean Blue Estate is fully developed, without stormwater management devices. These same catchments were also included in the developed case model.

The individual allotments are included in the MUSIC model as "urban" node with assumed percentage imperviousness as indicated in Table 9.1, together with "forested" nodes where appropriate.

The general arrangements and assumptions used in the existing MUSIC model, including the layout under existing site conditions, is provided in Appendix D.

TABLE 9.1 –MUSIC MODEL CATCHMENT EXISTING SITE PARAMETERS

Site Designation	Catchment Type	Catchment Area (ha)	Assumed %Impervous (%)
Jarberg West	Grassed Area	6.92	1
Love	Rural Residential	4.20	1
	Forested	4.00	
Sainish/Palmer	Rural Residential	5.50	1
	Forested	1.85	
Archer	Rural Residential	6.00	3
	Forested	1.35	
Trad	Rural Residential	7.00	3
	Forested	0.35	
Taylor/Rawson	Rural Residential	7.00	3
	Forested	0.13	
Goodear	Rural Residential	4.05	4
Jarberg North	Grassed Area	11.55	1

9.1.2 Developed Site Conditions

The model representing the site under proposed development conditions has considered that the overall Precinct 3 site (except for Mid Coast Water and Elias Land), together with the Ocean Blue Estate is fully developed, together with the stormwater management devices proposed within the Estate included. This modelling scenario is also applicable to the Interim development scenarios A and B, as each of the allotments still require the same devices to effectively treat stormwater runoff under both interim and post-development conditions in order to satisfy Greater Taree City Council water quality requirements.

An overall fraction impervious of 0.60 was adopted (low density residential lot including half road) for both the existing and proposed development areas classed as residential. For the areas designated as rural residential (Love site only), a fraction impervious of 0.15 was adopted due to the restricted building envelopes. The catchments were split into roofs, roads, other impervious area and pervious area, as appropriate to represent each post development subcatchment within the Old Bar Precinct 3 development.

The extent of catchment to each proposed water quality elements is shown on Figure 6.2 with the general arrangements and assumptions used in the overall MUSIC models, including the layout under developed site conditions (in two parts), is provided in Appendix D.

A typical allotment catchment breakdown together with assumed treatment devices is shown below in Plate 9.1. Refer to Appendix D for plans indicating the MUSIC modelling layouts used in the assessment.

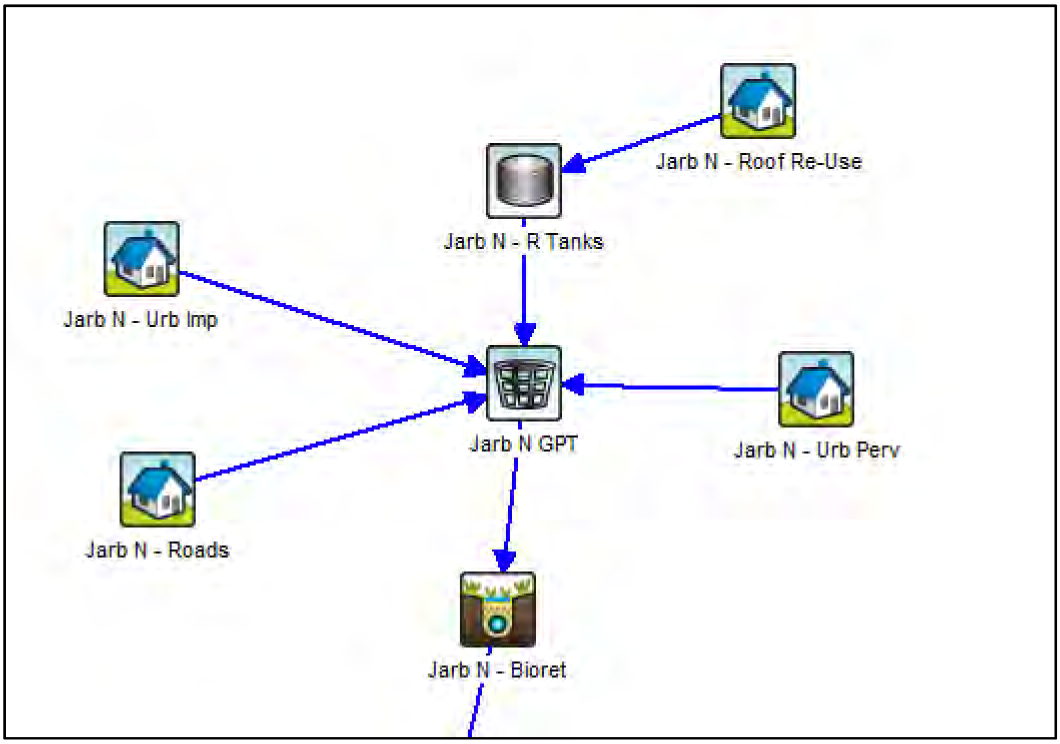


PLATE 9.1 – EXTRACT FROM OLD BAR MUSIC MODEL LAYOUT (JARBERG NORTH CATCHMENT)

9.2 Treatment Devices

9.2.1 Bio-Retention Systems and Raingardens

Approximately eight (8) raingarden bio-retention/ filtration systems are proposed throughout the Old Bar Precinct 3 site. The proposed preliminary development layout facilitates the provision of raingardens within the drainage corridors. The raingardens are located off-line from the major inflows into the interim detention basins to limit scouring of the filter media; preserve the vegetation; and minimise the re-mobilisation of pollutants.

The media beds of the bio-retention systems are typically 400 - 600mm deep with an average particle size of 0.5 mm, a minimum hydraulic conductivity of 100 mm/hr and typical depth of storage above the media of 200 - 300 mm. A discharge control structure can be configured (during the Development Application process) to promote extended detention times if required.

It is assumed that flows in excess of the 3 month ARI storm event will bypass the raingardens. It is assumed that trash and gross sediments will be effectively removed prior to entering the raingardens by either in-line or at source GPT units.

Treatment is attained by detaining flows to promote sedimentation, direct filtration of particulate matter and nutrient stripping by bio-films which establish on the surface of the media bed and within the gravel layer. The organic sandy loam bed and plant system minimises evaporation losses and the raingarden will be constructed with an impermeable barrier to prevent seepage losses and to avoid groundwater salinity impacts.

The size and indicative location of the proposed localised bio-retention and raingarden systems are shown on Figure 6.2. The general features and configuration of the preliminary bio-retention and raingarden systems for the Old Bar Precinct 3 site, as modelled in MUSIC, are detailed in Table 9.2.

TABLE 9.2 –BIO-RETENTION SYSTEMS
GENERAL FEATURES AND CONFIGURATIONS

Catchment Designation	Total Catchment Area Draining (ha)	Assumed % Impervous (%)	Raingarden Filter Bed Area (Based on Post to Pre Treatment Targets) (m²)	(% Catch)
Love	3.2	15	300	0.9%
Maja / Sainisch-Plimer	4.7	60	1650	3.5%
Archer	7.4	60	2800	3.8%
Trad	7.4	60	2000	2.7%
Taylor / Rawson	7.1	60	2000	2.8%
Goodear	4.1	60	950	2.3%
Jarberg North	11.6	60	1200	1.0%
Jarberg West	6.9	60	320	0.5%
Total	**52.3**		**11220**	2.1%
Jarberg North *	11.6	60	1900	1.6%
Jarberg West *	6.9	60	700	1.0%

* Jarberg North and Jarberg West devices w ould need to be increased w hen Golf Course is constructed

The bio-retention / raingarden treatment devices will be required to service the sites as permanent devices in the long term, even when the golf course wetlands are constructed. Note that the Jarberg North and Jarberg West raingarden devices will need to be increased in size (Jarberg North from 1200 m² to 1900 m², and Jarberg West from 320 m² to 700 m²), to assist in compensating for the Golf Course development, if the Golf Course and associated wetlands are constructed.

Details of the expected removal performance together with the general modelling parameters and rainfall data used in the MUSIC modelling are provided in Appendix D.

9.2.2 *Grassed Swale*

Grassed swales are proposed within the Old Bar Precinct 3 site as part of the golf course development, used to treat runoff from the golf course playing area prior to discharging into the wetland system. The grassed swales will provide treatment for runoff to the wetland system while also providing a water quality benefit.

The general features and configuration of the proposed grassed swales servicing the golf course is provided in Appendix D.

9.2.3 *Wetland*

A linked wetland system is proposed within the Old Bar Precinct 3 site as part of the golf course development, forming the base of the proposed detention basin servicing the Precinct. The wetland will provide an aesthetic feature for the Precinct while also providing a water quality benefit. Stormwater flows up to at least the 3 month ARI will be treated by a combination of other water quality devices prior to entering the wetlands.

It is assumed that the overall wetland surface area is approximately 3.26 hectares, based on measurements taken from plans provided by Lidbury Summers & Whiteman. It is also assumed that the wetland will have an extended detention depth of at least 150 mm and a hydraulic retention time of approximately 8 hours. This timeframe is found to be a reasonable balance between effective treatment time and the capacity to treat as much runoff from the upstream development area as possible. A discharge control structure can be configured (during the detailed design process) to promote extended detention times if required. The wetlands will incorporate wetland planting at appropriate locations. The proposed wetland is assumed to be used for irrigation of the proposed golf course and adjacent playing fields.

The location and size of the proposed wetland is shown on Figure 6.2. The general features and configuration of the proposed wetland servicing the Old Bar Precinct 3 site, as modelled in MUSIC, are provided in Appendix D.

9.3 Pollutant Load Estimates – Individual Sites

Total annual pollutant load estimates were derived from the MUSIC assessment based on a stochastic modelling for both the existing and developed site conditions. The estimated annual pollutant loads and reductions for TSS, TP, TN and Gross Pollutants for each of the individual sites within the Precinct are presented in Tables 9.3 – 9.13.

TABLE 9.3 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – LOVE SITE

Pollutant	Existing (kg/yr)	Sources	Discharges (kg/yr)	Change (kg/yr)
TSS	1010	2400	656	-354
TP	2.94	5.54	2.74	-0.2
TN	30.8	44.8	27.1	-3.7
GP	3.29	180	0.9	-2.4

TABLE 9.4 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – MAJA / SAINISCH-PLIMER SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1090	6460	269	-821
TP	3.19	12.9	2.94	-0.25
TN	33.1	90.5	31.0	-2.1
GP	4.31	794	0.5	-3.8

TABLE 9.5 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – ARCHER SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1330	9740	301	-1029
TP	3.66	19.1	3.35	-0.31
TN	37.7	135.0	33.7	-4
GP	52	1250	1.2	-50.8

TABLE 9.6 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – TRAD SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1490	9020	432	-1058
TP	3.97	18.4	3.61	-0.36
TN	41.7	136.0	37.0	-4.7
GP	60.7	1260	1.7	-59.1

TABLE 9.7 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – RAWSON / TAYLOR SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1490	9020	439	-1051
TP	3.97	18.4	3.59	-0.38
TN	41.7	136.0	37.0	-4.7
GP	60.7	1216	0.3	-60.4

TABLE 9.8 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – GOODEAR SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	877	4800	276	-601
TP	2.32	9.5	2.16	-0.16
TN	24.3	73.4	22.0	-2.3
GP	56.8	684	0.9	-55.9

TABLE 9.9 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – COMBINED RAWSON / TAYLOR AND GOODEAR SITES

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	2310	12900	715	-1595
TP	6.33	26.3	5.75	-0.58
TN	65	204.0	59.0	-6
GP	117	1900	1.2	-115.8

The results shown in Table 9.10 indicate the performance of the overall system to the north of Forest Lane, at the discharge point from the Forest Lane culverts.

TABLE 9.10 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – COMBINED SYSTEMS TO DOWNSTREAM OF FOREST LANE CULVERTS

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	22700	55800	17600	-5100
TP	50.1	112	48.5	-1.6
TN	424	826	403	-21
GP	1900	7050	1660	-240.0

TABLE 9.11 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – JARBERG NORTH SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1580	13900	1090	-490
TP	10.2	28.1	6.84	-3.36
TN	86.6	211	68.7	-17.9
GP	7.3	1970	3.7	-3.6

TABLE 9.12 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – JARBERG WEST SITE

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	6960	15500	2830	-4130
TP	17.9	29.9	11.2	-6.7
TN	130	206	105	-25
GP	734	1910	19.8	-714.2

The results shown in Tables 9.11 and 9.12 indicate that the performance of the devices servicing the Jarberg development sites is treating the upstream catchments to a significant level. There is scope to reduce the size of these devices (Jarberg North raingarden 1900 m^2 to 1200 m^2 and Jarberg West raingarden 700 m^2 to 320 m^2), to meet the on-site pre-development targets if the Golf Course is not developed. However, these devices are required to assist in treating discharges from the Precinct, if the Golf Course and wetlands are to be developed.

TABLE 9.13 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – JARBERG NORTH SITE (INTERIM SITE CONDITIONS)

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	1580	13900	1550	-30
TP	10.2	28.1	8.26	-1.94
TN	86.6	211	81.3	-5.3
GP	7.3	1970	3.7	-3.6

TABLE 9.14 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – JARBERG WEST SITE (INTERIM SITE CONDITIONS)

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	6960	15500	4460	-2500
TP	17.9	29.9	15.0	-2.9
TN	130	206	129	-1
GP	734	1910	19.8	-714.2

The results shown in Tables 9.13 and 9.14 indicate the performance of the interim sized devices servicing the Jarberg development sites (Jarberg North raingarden 1200 m² and Jarberg West raingarden 320 m²). The sizes of these devices are configured to meet the on-site pre-development targets if the Golf Course is not developed. However, these devices will need to be increased in size to assist in treating discharges from the Precinct, if the Golf Course and wetlands are to be developed.

9.4 Discussion of Modelling Results – Individual Sites

The results shown in Tables 9.3 to 9.14 for the individual sites indicate that existing flow targets for all sites are met. The stormwater quality treatment trains proposed for the individual allotments will be required for both interim and future long-term development conditions. Results of the system north of Forest Lane (Table 9.10) shows that the treatment systems perform in accordance with Greater Taree City Council's requirements, with pollutant loads effectively reduced to below pre-development levels

9.5 Pollutant Load Estimates – Interim Development Conditions

The estimated annual pollutant loads and reductions for TSS, TP, TN and Gross Pollutants for the overall interim development (without the golf course development and wetlands), to the Precinct 3 outlet, is presented in Table 9.15. The results include discharges from upstream sites already developed (Ocean Blue Estate) and sites not considered for development (Jarberg Golf Course, forested catchments, Elias and Mid Coast Water sites).

TABLE 9.15 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – OVERALL PRECINCT WITH ALL DEVICES (INTERIM SITE CONDITIONS)

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	82200	136000	74700	-7500
TP	195	287	189	-6
TN	1550	2150	1520	-30
GP	6730	15000	5780	-950

9.6 Pollutant Load Estimates – Overall Precinct

The estimated annual pollutant loads and reductions for TSS, TP, TN and Gross Pollutants for the overall system to the Precinct 3 outlet, including upstream sites already developed (Ocean Blue Estate) and sites not considered for development (forested catchments, Elias and Mid Coast Water sites), is presented in Table 9.16.

TABLE 9.16 – SUMMARY OF ESTIMATED MEAN ANNUAL POLLUTANT LOADS & REDUCTIONS – OVERALL PRECINCT WITH ALL DEVICES (DEVELOPED SITE CONDITIONS)

Pollutant	Existing (kg/yr)	Sources (kg/yr)	Discharges (kg/yr)	Change (kg/yr)
TSS	82200	147000	36300	-45900
TP	195	309	134	-61
TN	1550	2270	1550	0
GP	6730	16300	201	-6529

9.7 Discussion of Modelling Results – Overall Precinct

The results indicate that existing pollutant and nutrient targets for the overall Precinct are met when considering the stormwater quality treatment trains proposed for the individual allotments, which will be required for both interim and future long-term development conditions.

Results of the system under interim development conditions (without the golf course construction of wetlands - Table 9.15) shows that the treatment systems perform in accordance with Greater Taree City Council's requirements, with pollutant loads effectively reduced to below pre-development levels.

Results of the system under full development conditions (including the golf course and construction of wetlands and golf course swales - Table 9.16) also shows that the treatment systems perform in accordance with Greater Taree City Council's requirements, with pollutant loads effectively reduced to below pre-development levels.

Alternative treatment arrangements may be proposed for the Golf Course. This may be undertaken at Development Application stage specific for the Golf Course development.

10 INDICATIVE CONSTRUCTION COSTS

A summary of the indicative costs associated with the construction of the wetlands, detention basins, raingardens and the GPT's are presented in Table 10.1 (estimated maintenance costs have not been provided). Note that the cost rates applied are indicative only and no warranty is given regarding the accuracy of these indicative costs.

TABLE 10.1 – SUMMARY OF ESTIMATED CONSTRUCTION COSTS OF STORMWATER MANAGEMENT DEVICES

Site Name	Device (ha)	Size		Unit Rate ($/unit)	Indicative Cost ($)	Total Indicative Cost to Site ($)
Love	GPT	1	unit	45000	45000	
	Basin	450	m³	140	63000	
	Raingarden	300	m²	250	75000	183000
Maja / Sainish-Plimer	GPT	1	unit	50000	50000	
	Basin	1600	m³	140	224000	
	Raingarden	1650	m²	250	412500	686500
Archer	GPT	1	unit	50000	50000	
	Basin	2200	m³	140	308000	
	Raingarden	2800	m²	250	700000	1058000
Trad	GPT	1	unit	50000	50000	
	Basin	2250	m³	140	315000	
	Raingarden	2000	m²	250	500000	865000
Taylor / Rawson	GPT	1	unit	50000	50000	
	Basin	2000	m³	140	280000	
	Raingarden	2000	m²	250	500000	830000
Goodear	GPT	1	unit	40000	40000	
	Basin	1200	m³	140	168000	
	Raingarden	950	m²	250	237500	445500
Jarberg North	GPT	2	unit	50000	100000	
	Basin	3800	m³	140	532000	
	Raingarden	1200	m²	250	300000	932000
Jarberg West	GPT	2	unit	40000	80000	
	Basin	2400	m³	140	336000	
	Raingarden	320	m²	250	80000	496000
Golf Course	Grassed Swales	9000	m²	25	225000	
	Additional Jarberg Raingardens *	1080	m²	250	270000	
	Wetlands	32600	m²	100	3260000	3755000

Note: Cost rates are indicative only and no w arranty is given regarding the accuracy of the construction costs provided
* Additional Raingarden area required w ithin Jarberg North and Jarberg West to enable construction of Golf Course

The raingarden areas denoted for the Jarberg North and Jarberg West sites are for interim site conditions only. The additional raingarden area required to meet the water quality targets if the golf course and wetland construction proceeds, are listed in the Golf Course site costs.

11 CONCLUSION

J. Wyndham Prince Pty Ltd has been engaged by Lidbury, Summers & Whiteman, Consulting Surveyors to prepare an updated Stormwater & Flood Management Strategy for the proposed residential development known as 'Precinct 3' Forest Lane, Old Bar. The proposed 'Precinct 3' development comprises a 9-hole golf course and 900 residential lots, south of the township of Old Bar.

The study has been prepared to support a Concept Broad-scale Development Application for the whole of the Old Bar Precinct 3 site, to which each individual landowner can use this strategy as a reference to streamline the approval process for each of their sites.

The strategy has been prepared to conform with the statutory requirements and industry best practice for stormwater management in this catchment.

The Stormwater and Flood Management Strategy consists of a treatment train consisting of on lot treatment, street level treatment and subdivision / development treatment measures. The structural elements proposed for the development consist of:

- Proprietary GPT units at each stormwater discharge point.
- Eight (8) proposed bio-retention systems and raingardens of total area 11,220 m².
- Eight (8) interim detention basins of approximate total volume 15,750 m^3.
- One (1) permanent detention basin of a total volume of 575,600 m^3 incorporated into the future golf course, which includes over 2,000m of grassed swales and 32,600 m² of wetland area with a volume of 12,300 m^3 for water quality treatment purposes.

Provision of the proposed water quality treatment devices within the development will ensure that the post development stormwater discharges will meet the Greater Taree City Council's water quality objectives for the Old Bar Precinct 3 development.

Existing and post development case hydrology models have been prepared for the Old Bar Precinct 3 site, which incorporate all upstream catchments draining to the site and also including catchments up to approximately 1km downstream to the outfall into the ocean. The hydrologic modelling indicates that inclusion of the proposed interim and permanent detention basins within the Precinct will attenuate peak post development flows to less than existing levels at the outlet from the site.

The detailed flood assessment completed for the strategy has demonstrated that flood levels on the creeks with and without development has shown that urbanisation will result in only minor increases in flood levels outside the Precinct boundary. There is a maximum increase of up to 0.3 m in undeveloped areas. There are no increases within the Racecourse Creek drainage corridor downstream of the site, nor are there increases in areas where existing residential development is located. However, there are localised increases within the existing rural land adjacent the Rawson site (Lot 7 DP 1068908), and within the forested land west of the Ocean Blue Estate.

Provision of the proposed water quality treatment devices within the development will ensure that the post development stormwater discharges will meet Greater Taree City Council's water quality objectives for the Old Bar Precinct 3 development.

The proposed Stormwater and Flood Management Strategy for the developed site provides a basis for the detailed design and development of the site to ensure that the environmental, urban amenity, engineering and economic objectives for stormwater management and site discharge are achieved.

The Stormwater Management Strategy proposed for the Old Bar Precinct 3 development site is functional; delivers the required technical performance; lessens environmental degradation and pressure on downstream ecosystems and infrastructure; and provides for a 'soft' sustainable solution for stormwater management within the release area.

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13 GLOSSARY OF TERMS

12D Model is a powerful terrain modelling, surveying and civil engineering software package used to develop the underlying surface for the 2D modelling.

Annual Exceedance Probability (AEP) means the statistical probability that a certain event is likely to take place.

Australian Rainfall and Runoff (AR&R) refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers, Australia.

Council refers to The Greater Taree City Council

Digital Terrain Model (DTM) is a spatially referenced three-dimensional (3D) representation of the ground surface represented as discrete point elevations where each cell in the grid represents an elevation above an established datum.

Floodplain Development Manual (FDM) and Guidelines (April 2005), the FDM is a document issued by DECCW that provides a strategic approach to floodplain management. The guidelines have been issued by the NSW DoP to clarify issues regarding the setting of FPL's.

Hydrograph is a graph that shows how the stormwater discharge changes with time at any particular location.

Hydrology The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.

J. Wyndham Prince Pty Ltd (JWP) Consultant Civil Infrastructure Engineers and Project Managers undertaking these investigations

MUSIC is a modelling package designed to help urban stormwater professionals visualise possible strategies to tackle urban stormwater hydrology and pollution impacts. MUSIC stands for Model for Urban Stormwater Improvement Conceptualisation and has been developed by Cooperative Research Centre (CRC),

Peak Discharge is the maximum stormwater runoff that occurs during a flood event3

Probable Maximum Flood (PMF) is the largest flood that can possibly be generated as a result of the Probable Maximum Precipitation depth of precipitation.

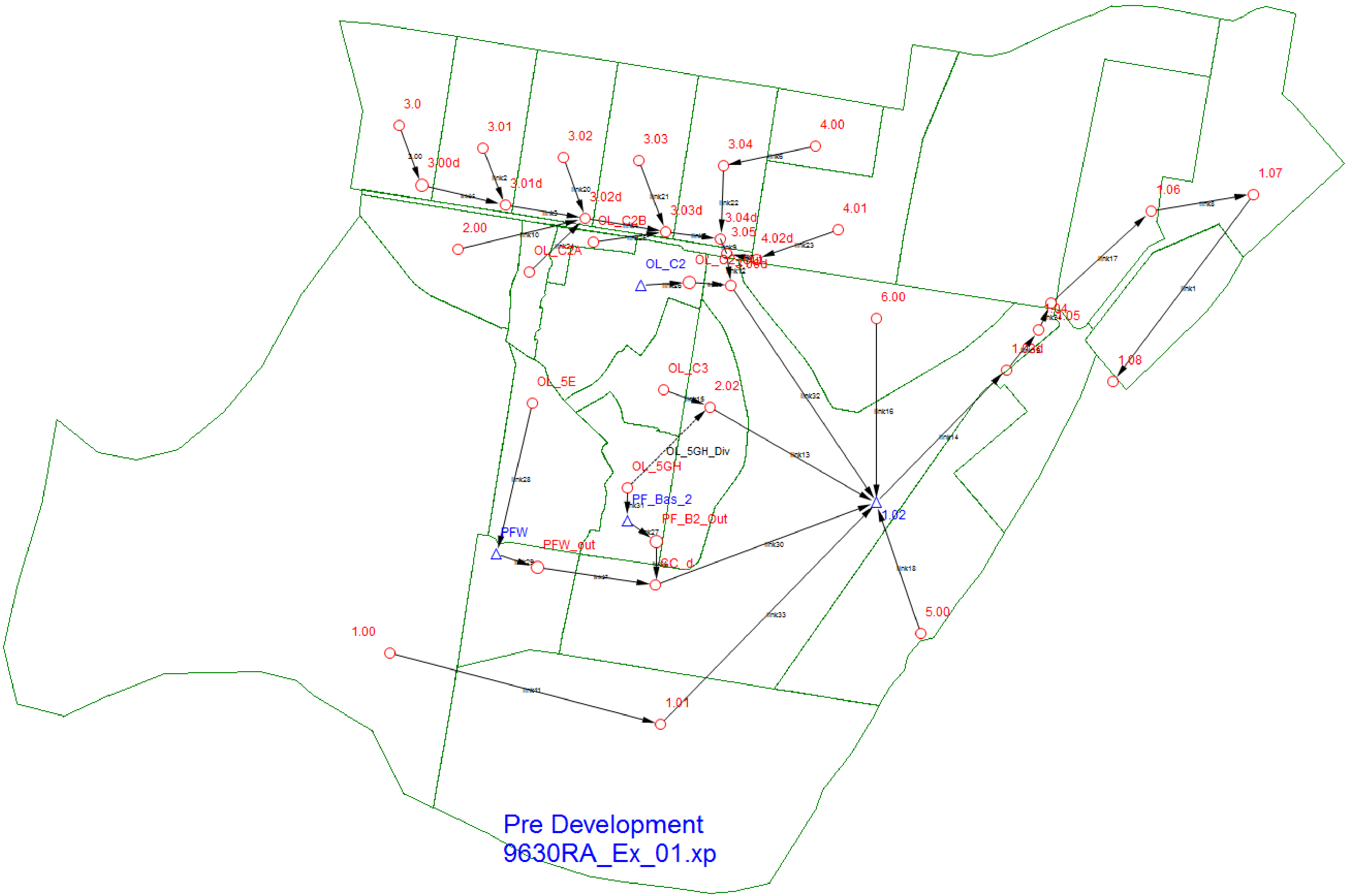
Probable Maximum Precipitation (PMP) is the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends.

Triangular Irregular Network (TIN) is a technique used in the created DTM by developing a mass of interconnected triangles. For each triangle, the ground level is defined at each of the three vertices, thereby defining a plane surface over the area of the triangle

TUFLOW is a computer program that provides two-dimensional (2D) and one dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation. It is specifically beneficial where the hydrodynamic behaviour, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be awkward to represent using traditional 1D network models.

XP-RAFTS runoff routing model that uses the Laurenson non-linear runoff routing procedure to develop a subcatchment stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration data together with dimensionless storm temporal patterns as well as standard AR&R 1987 data.

APPENDIX A – XP-RAFTS OUTPUT RESULTS



3.0
3.01
3.02
3.03
3.04
4.00
3.00d
3.01d
3.02d
3.03d
3.04d
OL_C2B
2.00
OL_C2A
3.05
4.01
4.02d
OL_C2
OL_C3
2.02
6.00
1.06
1.07
1.08
1.04
1.05
OL_5E
OL_5GH_Div
OL_5GH
PF_Bas_2
PF_B2_Out
PFW
PFW_out
1.02
5.00
1.00
1.01
Pre Development
9630RA_Ex_01.xp

Run started at: 14th April 2014 13:29:43

##

Old Bar Precinct 3 Pre Development

Results for period from 0: 0.0 1/ 1/2000
to 11:20.0 4/ 1/2000

##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 2160.
RETURN PERIOD (YRS) = 5.
BX = 0.6500
TOTAL OF FIRST SUB-AREAS (ha) = 256.24
TOTAL OF SECOND SUB-AREAS (ha) = 99.26
TOTAL OF ALL SUB-AREAS (ha) = 355.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	4.810	2.110	1.500	1.500	0.000	100.0	.043	.015	.0462	.0012	2.001
6.00	10.440	1.110	2.500	2.500	0.000	100.0	.048	.015	.0584	.0006	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	6.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	8.000
3.0	4.200	0.000	2.500	0.000	0.000	0.000	.052	0.00	.0388	0.000	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	11.00
OL_C2A	2.190	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0346	0.000	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	7.350	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0503	0.000	13.00
OL_C2B	1.100	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0242	0.000	14.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	4.050	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0369	0.000	15.00
3.04	7.130	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0495	0.000	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	2.000	0.000	100.0	.025	.015	.0261	.0016	16.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03d	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.242	1081.	5.000
1.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	6.543	1080.	5.000
OL_C3	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2645	1021.	0.000
OL_5GH	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.3340	1050.	0.000
2.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6758	1080.	5.000
6.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6699	1080.	0.000
5.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8496	1080.	0.000
PF_Bas_2	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3340	1050.	0.000
PF_B2_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3052	1081.	0.000
OL_5E	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5258	1073.	2.000
PFW	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8740	1080.	2.000
PFW_out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.7272	1090.	0.000
GC_d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.030	1086.	4.000
4.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6507	1046.	0.000
4.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6507	1046.	1.000
3.01	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4214	1080.	0.000
3.0	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.2408	1077.	2.000

3.00d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4699	1080.	2.000
3.01d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.8913	1080.	2.000
2.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3859	1080.	2.000
3.02	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4214	1080.	0.000
OL_C2A	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.1256	1080.	1.000
3.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.824	1080.	2.000
3.03	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4214	1080.	0.000
OL_C2B	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.0631	1070.	1.000
3.03d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	2.308	1080.	2.000
4.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.2322	1073.	2.000
3.04	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6410	1080.	0.000
3.04d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	2.949	1080.	0.000
3.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.622	1080.	10.00
OL_C2	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5227	1044.	0.000
OL_C2_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.5079	1080.	0.000
3.06d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.128	1081.	8.000
1.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	16.175	1080.	0.000
1.03d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.455	1373.	0.000
1.04	5.615	10.00	1.000	2.500	0.000	132.89	201.15	4.537	1320.	0.000
1.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	5.300	1320.	2.000
1.06	5.615	10.00	1.000	2.500	0.000	132.89	201.15	5.648	1320.	1.500
1.07	5.615	10.00	1.000	2.500	0.000	132.89	201.15	6.025	1320.	4.000
1.08	5.615	10.00	1.000	2.500	0.000	132.89	201.15	6.194	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
PF_Bas_2	1050.	.3340	1081.	.3052	9438.4	0.0000	1241.7	5.0800
PFW	1080.	.8740	1088.	.7272	23241.1	0.0000	5357.6	4.8993
OL_C2	1044.	.5227	1080.	.5079	14773.0	0.0000	764.54	4.9622
1.02	1080.	16.18	1373.	4.454	431125.	0.0000	273945.	5.0409

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
PFW	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

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ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =      2160.
RETURN PERIOD (YRS)      =        20.
BX                       =     0.6500
TOTAL OF FIRST SUB-AREAS  (ha) =     256.24
TOTAL OF SECOND SUB-AREAS (ha) =      99.26
TOTAL OF ALL SUB-AREAS (ha)    =     355.50
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	4.810	2.110	1.500	1.500	0.000	100.0	.043	.015	.0462	.0012	2.001
6.00	10.440	1.110	2.500	2.500	0.000	100.0	.048	.015	.0584	.0006	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	6.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	8.000
3.0	4.200	0.000	2.500	0.000	0.000	0.000	.052	0.00	.0388	0.000	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	11.00
OL_C2A	2.190	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0346	0.000	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	7.350	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0503	0.000	13.00
OL_C2B	1.100	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0242	0.000	14.00

3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	4.050	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0369	0.000	15.00
3.04	7.130	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0495	0.000	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	2.000	0.000	100.0	.025	.015	.0261	.0016	16.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03d	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	6.087	1081.	5.000
1.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	9.250	1080.	5.000
OL_C3	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3566	1017.	0.000
OL_5GH	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.4503	1046.	0.000
2.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9163	1080.	5.000
6.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9180	1052.	0.000
5.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.169	1080.	0.000
PF_Bas_2	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4503	1046.	0.000
PF_B2_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4076	1081.	0.000
OL_5E	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7090	1055.	2.000
PFW	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.186	1080.	2.000
PFW_out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.052	1086.	0.000
GC_d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.450	1082.	4.000
4.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.8847	1072.	0.000
4.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.8847	1072.	1.000
3.01	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5789	1080.	0.000
3.0	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.3308	1065.	2.000
3.00d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6458	1080.	2.000
3.01d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.225	1080.	2.000
2.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5313	1080.	2.000
3.02	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5789	1080.	0.000
OL_C2A	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.1725	1077.	1.000
3.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	2.507	1080.	2.000
3.03	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5789	1070.	0.000
OL_C2B	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.0866	1052.	1.000
3.03d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	3.173	1080.	2.000
4.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.3190	1061.	2.000
3.04	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.8806	1069.	0.000
3.04d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	4.053	1080.	0.000
3.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	4.969	1080.	10.00
OL_C2	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7049	1039.	0.000
OL_C2_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6931	1080.	0.000
3.06d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	5.660	1080.	8.000
1.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	22.459	1080.	0.000
1.03d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	7.200	1361.	0.000
1.04	7.487	10.00	1.000	2.500	0.000	196.12	268.55	7.339	1320.	0.000
1.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	8.380	1320.	2.000
1.06	7.487	10.00	1.000	2.500	0.000	196.12	268.55	8.855	1320.	1.500
1.07	7.487	10.00	1.000	2.500	0.000	196.12	268.55	9.372	1320.	4.000
1.08	7.487	10.00	1.000	2.500	0.000	196.12	268.55	9.601	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PF_Bas_2	1046.	.4503	1081.	.4076	13006.9	0.0000	1716.7	5.2634
PFW	1080.	1.185	1084.	1.052	32675.9	0.0000	6449.5	5.0011
OL_C2	1039.	.7049	1080.	.6931	20358.5	0.0000	1252.6	5.1493
1.02	1080.	22.46	1361.	7.199	618410.	0.0000	380948.	5.2320

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
PFW	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 2160.

RETURN PERIOD (YRS) = 100.
BX = 0.6500
TOTAL OF FIRST SUB-AREAS (ha) = 256.24
TOTAL OF SECOND SUB-AREAS (ha) = 99.26
TOTAL OF ALL SUB-AREAS (ha) = 355.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	4.810	2.110	1.500	1.500	0.000	100.0	.043	.015	.0462	.0012	2.001
6.00	10.440	1.110	2.500	2.500	0.000	100.0	.048	.015	.0584	.0006	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	6.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	8.000
3.0	4.200	0.000	2.500	0.000	0.000	0.000	.052	0.00	.0388	0.000	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	7.350	0.000	2.500	0.000	0.000	0.000	.058	0.00	.0567	0.000	11.00
OL_C2A	2.190	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0346	0.000	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	7.350	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0503	0.000	13.00
OL_C2B	1.100	0.000	1.500	0.000	0.000	0.000	.050	0.00	.0242	0.000	14.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	4.050	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0369	0.000	15.00
3.04	7.130	0.000	2.500	0.000	0.000	0.000	.050	0.00	.0495	0.000	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	2.000	0.000	100.0	.025	.015	.0261	.0016	16.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03d	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.936	1080.	5.000
1.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	11.955	1080.	5.000
OL_C3	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4472	1012.	0.000
OL_5GH	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.5648	1041.	0.000
2.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.153	1061.	5.000
6.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.161	1064.	0.000
5.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.482	1080.	0.000
PF_Bas_2	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5648	1041.	0.000
PF_B2_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5647	1080.	0.000
OL_5E	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8893	1049.	2.000
PFW	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.493	1080.	2.000
PFW_out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.435	1084.	0.000
GC_d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.993	1080.	4.000
4.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.115	1028.	0.000
4.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.115	1028.	1.000
3.01	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7339	1074.	0.000
3.0	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.4194	1055.	2.000
3.00d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8187	1080.	2.000
3.01d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.553	1080.	2.000
2.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.6738	1080.	2.000
3.02	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7339	1074.	0.000
OL_C2A	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.2187	1071.	1.000
3.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	3.179	1080.	2.000
3.03	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7339	1060.	0.000
OL_C2B	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.1098	1048.	1.000
3.03d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	4.022	1080.	2.000
4.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.4044	1052.	2.000
3.04	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.116	1056.	0.000
3.04d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	5.139	1080.	0.000

3.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	6.292	1080.	10.00
OL_C2	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8841	1035.	0.000
OL_C2_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8820	1080.	0.000
3.06d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.173	1080.	8.000
1.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	28.860	1080.	0.000
1.03d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	10.846	1352.	0.000
1.04	10.030	10.00	1.000	2.500	0.000	278.50	360.07	11.089	1320.	0.000
1.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	12.444	1320.	2.000
1.06	10.030	10.00	1.000	2.500	0.000	278.50	360.07	13.065	1320.	1.500
1.07	10.030	10.00	1.000	2.500	0.000	278.50	360.07	13.746	1320.	4.000
1.08	10.030	10.00	1.000	2.500	0.000	278.50	360.07	14.052	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PF_Bas_2	1041.	.5648	1080.	.5647	17777.2	0.0000	1802.5	5.2966
PFW	1080.	1.492	1082.	1.435	45183.7	0.0000	7169.9	5.0682
OL_C2	1035.	.8841	1080.	.8820	27824.9	0.0000	1471.7	5.2283
1.02	1080.	28.86	1352.	10.85	864759.	0.0000	496778.	5.4123

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
PFW	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

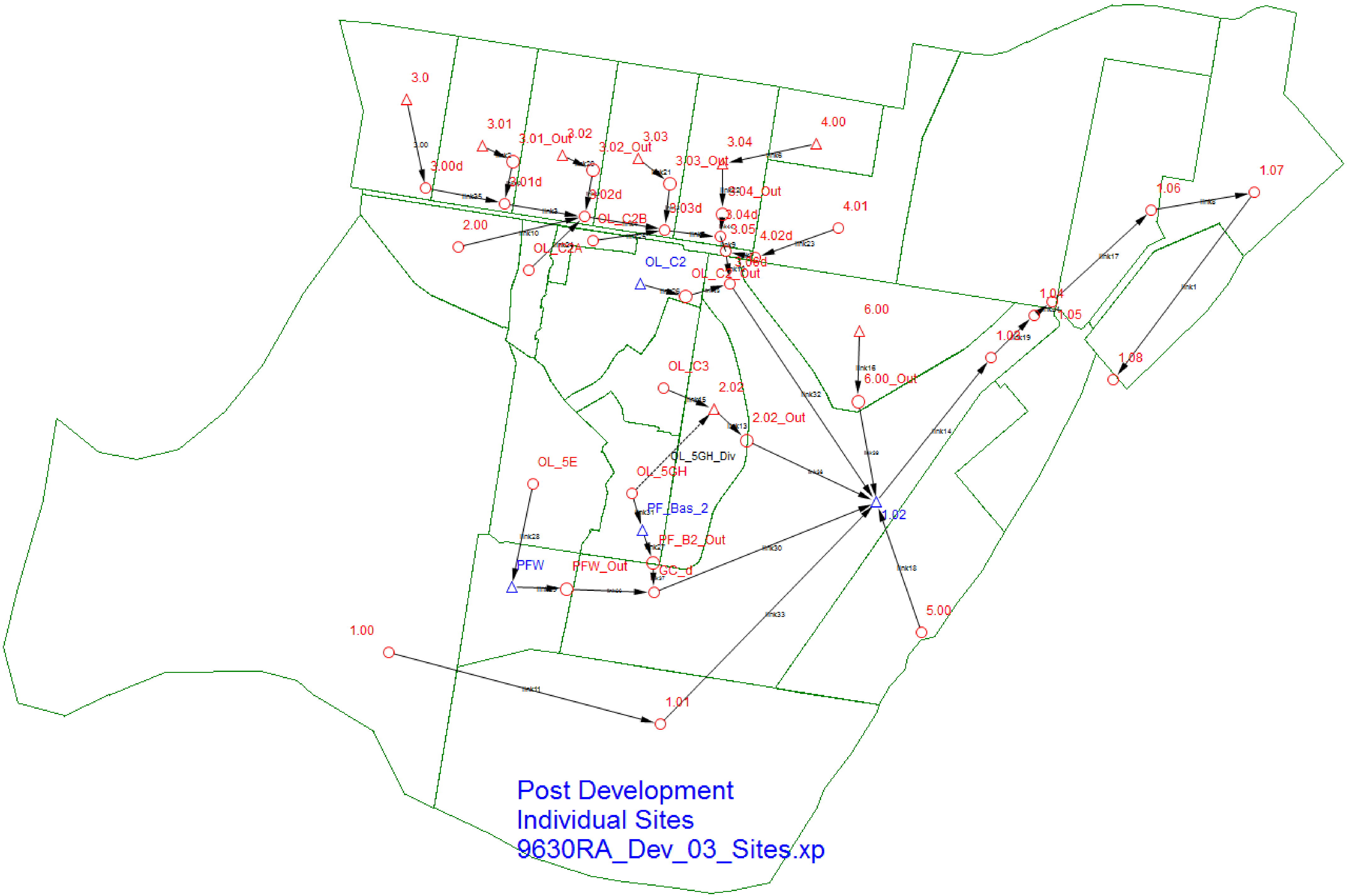
Run completed at: 14th April 2014 13:30:02

20% AEP Peak Discharges - Existing Site Conditions (m^3/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	1.47	3.02	3.86	4.36	4.79	5.14	5.53	4.88	4.67	4.24
1.01	5.98	5.81	6.88	7.06	7.06	8.02	8.83	8.29	7.07	6.54
OL_C3	1.39	1.33	1.50	1.37	0.78	0.58	0.52	0.52	0.34	0.26
OL_5GH	1.58	1.49	1.70	1.54	0.94	0.73	0.65	0.66	0.43	0.33
2.02	2.88	2.73	3.36	2.88	1.76	1.46	1.29	1.32	0.87	0.68
6.00	1.11	1.58	1.64	1.76	1.60	1.41	1.23	1.29	0.87	0.67
5.00	0.60	1.13	1.26	1.34	1.33	1.37	1.30	1.29	1.02	0.85
PF_Bas_2	1.25	1.25	1.25	1.25	0.94	0.73	0.65	0.66	0.43	0.33
PF_B2_Out	0.26	0.34	0.35	0.36	0.37	0.39	0.39	0.36	0.33	0.31
OL_5E	2.44	2.29	2.62	2.37	1.47	1.15	1.02	1.03	0.68	0.53
PFW	2.83	2.77	3.24	2.96	2.12	1.83	1.61	1.67	1.13	0.87
PFW_out	0.22	0.48	0.59	0.65	0.68	0.77	0.95	0.82	0.79	0.73
GC_d	0.42	0.80	0.92	1.00	1.01	1.14	1.33	1.18	1.11	1.03
4.01	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
4.02d	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
3.01	0.63	0.98	1.01	1.08	1.00	0.87	0.75	0.79	0.55	0.42
3.00	0.48	0.67	0.69	0.75	0.60	0.53	0.46	0.48	0.32	0.24
3.00d	0.69	1.00	1.04	1.13	1.04	0.91	0.80	0.85	0.60	0.47
3.01d	1.31	1.98	2.05	2.20	2.03	1.76	1.55	1.63	1.15	0.89
2.00	0.30	0.59	0.63	0.68	0.68	0.65	0.60	0.62	0.48	0.39
3.02	0.63	0.98	1.01	1.08	1.00	0.87	0.75	0.79	0.55	0.42
OL_C2A	0.22	0.31	0.33	0.36	0.31	0.27	0.23	0.24	0.16	0.13
3.02d	2.43	3.79	3.92	4.18	3.98	3.47	3.08	3.24	2.33	1.82
3.03	0.74	1.09	1.12	1.22	1.03	0.90	0.78	0.82	0.55	0.42
OL_C2B	0.13	0.19	0.19	0.21	0.16	0.14	0.12	0.13	0.08	0.06
3.03d	3.24	4.96	5.13	5.50	5.10	4.46	3.95	4.12	2.96	2.31
4.00	0.48	0.66	0.69	0.75	0.59	0.51	0.45	0.46	0.30	0.23
3.04	1.21	1.73	1.79	1.94	1.59	1.39	1.21	1.25	0.84	0.64
3.04d	4.32	6.52	6.77	7.27	6.59	5.76	5.10	5.31	3.78	2.95
3.05	5.51	7.95	8.32	8.83	8.12	7.08	6.23	6.62	4.65	3.62
OL_C2	2.53	2.45	2.76	2.54	1.50	1.15	1.02	1.03	0.67	0.52
OL_C2_Out	0.72	1.00	1.02	1.08	0.99	0.82	0.74	0.76	0.57	0.51
3.06d	6.10	8.79	9.22	9.78	8.94	7.89	6.96	7.26	5.22	4.13
1.02	18.39	19.51	21.86	23.78	22.05	22.91	23.43	22.41	18.53	16.18
1.03d	0.93	1.38	1.66	1.86	2.58	2.81	3.19	3.52	3.69	4.46
1.04	2.38	2.35	2.68	2.42	2.59	2.85	3.24	3.58	3.76	4.54
1.05	9.38	8.80	9.92	9.06	5.92	5.02	5.08	5.24	4.38	5.30
1.06	12.59	11.91	13.44	12.44	7.85	6.59	6.44	6.63	5.10	5.65
1.07	13.92	13.43	14.82	14.65	9.56	8.20	7.83	8.08	6.11	6.03
1.08	14.59	14.45	15.66	15.95	10.45	8.86	8.44	8.67	6.55	6.19

5% AEP Peak Discharges - Existing Site Conditions (m^3/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	2.35	4.74	5.87	6.45	6.84	7.53	7.85	7.08	6.58	6.09
1.01	7.94	7.96	9.59	10.35	10.20	11.78	12.28	11.73	10.06	9.25
OL_C3	1.89	1.79	1.95	1.83	1.02	0.76	0.68	0.69	0.46	0.36
OL_5GH	2.09	2.01	2.28	2.11	1.24	0.96	0.86	0.87	0.58	0.45
2.02	4.35	4.19	4.94	4.41	2.37	1.93	1.71	1.76	1.18	0.92
6.00	1.66	2.34	2.51	2.61	2.14	1.91	1.67	1.74	1.18	0.92
5.00	0.94	1.68	1.83	2.00	2.05	1.89	1.77	1.81	1.42	1.17
PF_Bas_2	1.25	1.25	1.25	1.25	1.24	0.96	0.86	0.87	0.58	0.45
PF_B2_Out	0.30	0.51	0.54	0.61	0.89	0.71	0.67	0.81	0.52	0.41
OL_5E	3.22	3.07	3.49	3.20	1.92	1.51	1.35	1.37	0.91	0.71
PFW	3.80	3.83	4.44	4.11	2.88	2.45	2.16	2.24	1.52	1.19
PFW_out	0.37	0.78	0.92	1.01	1.01	1.25	1.50	1.35	1.17	1.05
GC_d	0.63	1.17	1.34	1.46	1.63	1.81	2.10	2.03	1.64	1.45
4.01	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
4.02d	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
3.01	1.01	1.40	1.46	1.60	1.35	1.18	1.03	1.08	0.75	0.58
3	0.71	0.96	1.01	1.09	0.81	0.71	0.62	0.64	0.43	0.33
3.00d	1.04	1.49	1.54	1.68	1.43	1.27	1.11	1.17	0.82	0.65
3.01d	2.03	2.89	3.00	3.26	2.77	2.42	2.14	2.23	1.57	1.23
2	0.50	0.86	0.91	0.97	1.01	0.90	0.82	0.86	0.66	0.53
3.02	1.01	1.40	1.46	1.60	1.35	1.18	1.03	1.08	0.75	0.58
OL_C2A	0.34	0.47	0.48	0.53	0.41	0.36	0.32	0.33	0.22	0.17
3.02d	3.83	5.47	5.70	6.16	5.49	4.79	4.23	4.46	3.19	2.51
3.03	1.14	1.57	1.62	1.77	1.39	1.21	1.07	1.11	0.75	0.58
OL_C2B	0.20	0.26	0.27	0.30	0.22	0.19	0.17	0.17	0.11	0.09
3.03d	5.05	7.12	7.45	8.03	7.00	6.12	5.41	5.66	4.04	3.17
4	0.72	0.95	1.01	1.09	0.79	0.68	0.61	0.62	0.41	0.32
3.04	1.84	2.47	2.59	2.81	2.14	1.86	1.64	1.70	1.14	0.88
3.04d	6.71	9.32	9.81	10.52	9.02	7.88	6.97	7.28	5.16	4.05
3.05	8.39	11.27	11.90	12.80	11.04	9.67	8.49	9.03	6.34	4.97
OL_C2	3.39	3.25	3.67	3.40	1.97	1.51	1.35	1.37	0.90	0.70
OL_C2_Out	1.09	1.49	1.60	1.83	1.43	1.23	1.05	1.18	0.84	0.69
3.06d	9.15	12.55	13.12	14.08	12.20	10.83	9.53	9.90	7.12	5.66
1.02	24.01	28.00	31.16	33.93	32.09	32.13	32.23	31.50	25.92	22.46
1.03d	1.11	1.82	2.23	2.57	3.60	4.06	4.77	5.34	5.74	7.20
1.04	3.06	3.03	3.37	3.14	3.60	4.11	4.86	5.43	5.84	7.34
1.05	12.13	11.53	13.05	12.04	7.75	6.48	6.88	7.26	6.68	8.38
1.06	16.25	15.66	17.69	16.47	10.30	8.55	8.70	8.97	7.14	8.86
1.07	18.20	17.74	19.71	19.51	12.67	10.71	10.58	10.94	8.48	9.37
1.08	19.19	19.12	20.87	21.23	13.84	11.60	11.39	11.75	9.05	9.60

1% AEP Peak Discharges - Existing Site Conditions (m^3/s)										
Node	**Storm Duration (minutes)**									
	25	60	90	120	270	360	540	720	1440	2160
1.00	3.59	7.19	8.71	9.51	9.46	10.38	10.36	9.64	8.57	7.94
1.01	9.67	11.77	13.37	14.68	14.36	16.06	16.05	15.65	13.16	11.96
OL_C3	2.28	2.21	2.36	2.22	1.26	0.93	0.84	0.85	0.57	0.45
OL_5GH	2.52	2.54	2.81	2.63	1.53	1.18	1.06	1.08	0.72	0.56
2.02	5.55	5.67	6.50	5.89	3.25	2.39	2.13	2.19	1.47	1.15
6.00	2.53	3.18	3.41	3.54	2.69	2.38	2.12	2.19	1.48	1.16
5.00	1.46	2.45	2.59	2.73	2.73	2.44	2.26	2.34	1.81	1.48
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.18	1.06	1.08	0.72	0.56
PF_B2_Out	0.35	0.83	0.87	0.83	1.19	1.13	1.02	1.07	0.72	0.56
OL_5E	3.84	3.88	4.32	4.04	2.38	1.85	1.66	1.69	1.13	0.89
PFW	4.69	5.00	5.69	5.37	3.64	3.04	2.70	2.80	1.90	1.49
PFW_out	0.62	1.32	1.51	1.63	1.63	1.71	1.87	1.77	1.62	1.44
GC_d	0.94	1.87	2.14	2.32	2.45	2.47	2.64	2.76	2.31	1.99
4.01	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
4.02d	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
3.01	1.50	1.98	2.01	2.17	1.70	1.48	1.30	1.36	0.94	0.73
3.00	1.07	1.29	1.37	1.46	1.02	0.88	0.78	0.80	0.54	0.42
3.00d	1.62	2.03	2.09	2.28	1.83	1.60	1.41	1.48	1.04	0.82
3.01d	3.08	3.97	4.09	4.44	3.51	3.05	2.70	2.82	1.98	1.55
2.00	0.78	1.25	1.28	1.33	1.34	1.16	1.05	1.11	0.84	0.67
3.02	1.50	1.98	2.01	2.17	1.70	1.48	1.30	1.36	0.94	0.73
OL_C2A	0.52	0.64	0.67	0.72	0.52	0.45	0.40	0.41	0.28	0.22
3.02d	5.79	7.62	7.83	8.43	7.00	6.08	5.38	5.65	4.03	3.18
3.03	1.73	2.13	2.22	2.37	1.74	1.52	1.34	1.39	0.94	0.73
OL_C2B	0.29	0.34	0.37	0.39	0.27	0.23	0.21	0.21	0.14	0.11
3.03d	7.55	9.85	10.21	10.90	8.92	7.75	6.87	7.16	5.10	4.02
4.00	1.06	1.28	1.37	1.45	1.00	0.85	0.76	0.78	0.52	0.40
3.04	2.75	3.34	3.53	3.76	2.69	2.32	2.06	2.12	1.43	1.12
3.04d	9.94	12.84	13.35	14.22	11.47	9.95	8.84	9.19	6.52	5.14
3.05	12.37	15.69	16.18	17.35	14.00	12.23	10.77	11.37	7.99	6.29
OL_C2	4.06	4.10	4.49	4.21	2.43	1.85	1.66	1.69	1.12	0.88
OL_C2_Out	1.79	2.39	2.93	2.98	2.06	1.77	1.42	1.63	1.09	0.88
3.06d	13.36	17.18	17.65	18.80	15.49	13.67	12.14	12.44	9.01	7.17
1.02	29.12	39.76	43.30	46.59	43.53	42.26	41.29	41.36	33.63	28.86
1.03d	1.56	2.52	3.02	3.55	5.32	6.13	7.44	8.36	8.76	10.85
1.04	3.64	3.67	4.07	3.81	5.33	6.21	7.58	8.53	8.93	11.09
1.05	14.37	14.32	16.00	14.96	9.51	7.95	9.04	10.38	10.07	12.44
1.06	19.29	19.41	21.78	20.42	12.68	10.44	11.28	11.97	10.59	13.07
1.07	21.75	22.22	24.79	24.42	15.74	13.13	13.64	14.20	11.26	13.75
1.08	23.22	24.02	26.30	26.59	17.20	14.28	14.65	15.19	11.96	14.05

PMF Peak Discharges - Existing Site Conditions (m^3/s)											
Node	Storm Duration (minutes)										
	15	30	45	60	90	120	150	180	240	300	360
1.00	23.61	41.63	56.36	67.16	82.52	89.82	92.31	95.06	92.92	87.21	81.19
1.01	85.43	81.72	90.16	104.43	123.71	135.51	139.69	142.76	137.20	129.11	121.21
OL_C3	19.03	18.36	17.29	15.06	13.04	11.75	10.43	9.54	8.08	7.08	6.23
OL_5GH	22.47	21.55	20.60	18.22	15.26	13.94	12.52	11.62	10.06	8.89	7.85
2.02	56.57	55.31	53.67	48.05	42.58	39.28	35.26	32.97	28.73	25.50	22.58
6.00	15.94	22.91	27.06	27.59	25.97	24.22	21.97	20.61	19.07	17.70	16.10
5.00	9.41	15.43	19.94	22.14	24.67	24.86	23.26	22.27	20.49	18.66	17.04
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
OL_5E	35.10	33.23	31.81	28.37	23.66	21.64	19.36	18.04	15.74	13.95	12.36
PFW	41.56	42.47	42.12	39.05	34.93	32.61	29.70	27.93	24.86	22.55	20.36
GC_d	7.30	13.41	18.32	20.88	23.97	24.46	23.37	22.68	20.86	19.29	17.86
4.01	32.07	33.44	33.10	31.00	28.04	26.76	24.24	23.06	20.14	17.85	15.77
4.02d	32.07	33.44	33.10	31.00	28.04	26.76	24.24	23.06	20.14	17.85	15.77
3.01	9.92	14.27	16.68	17.17	16.21	15.22	13.86	12.97	11.80	10.98	10.04
3.00	7.31	9.92	11.00	10.72	9.97	9.17	8.39	7.97	7.25	6.61	5.96
3.00d	10.72	15.28	17.61	18.12	17.56	16.47	15.09	14.15	12.92	11.94	10.91
3.01d	20.29	28.95	33.10	34.12	33.32	31.27	28.84	27.04	24.49	22.57	20.66
2.00	5.04	8.10	10.21	11.15	12.21	11.85	11.07	10.58	9.55	8.75	8.03
3.02	9.92	14.27	16.68	17.17	16.21	15.22	13.86	12.97	11.80	10.98	10.04
OL_C2A	3.44	4.81	5.47	5.43	5.08	4.69	4.27	4.01	3.67	3.38	3.07
3.02d	37.58	54.06	62.50	65.51	65.26	61.89	57.32	53.81	48.63	44.89	41.31
3.03	11.39	15.94	18.19	18.15	16.97	15.70	14.30	13.44	12.33	11.32	10.29
OL_C2B	2.14	2.79	3.00	2.89	2.68	2.46	2.26	2.15	1.95	1.76	1.57
3.03d	47.83	67.70	78.99	82.36	82.42	78.16	72.36	68.18	61.45	56.87	52.21
4.00	7.37	9.92	10.84	10.50	9.75	8.93	8.20	7.78	7.06	6.42	5.77
3.04	18.44	25.29	28.21	28.12	26.08	24.19	22.08	20.85	18.89	17.33	15.69
3.04d	60.94	85.87	100.17	104.50	104.72	99.48	92.22	86.90	78.49	72.51	66.44
3.05	71.55	101.50	117.35	124.56	126.33	119.54	111.96	105.10	94.73	87.28	80.42
OL_C2	35.36	34.29	32.98	29.05	24.62	22.27	19.92	18.46	15.87	13.94	12.31
3.06d	74.92	105.34	122.21	131.24	133.14	127.83	120.85	115.38	104.37	97.04	89.28
1.02	203.74	217.91	267.59	300.15	340.73	353.87	357.60	365.04	348.46	329.05	307.97
1.03d	5.88	13.19	19.52	26.00	37.66	47.35	53.57	59.40	68.22	74.75	77.68
1.04	27.47	26.45	25.54	26.01	37.69	47.41	53.82	59.91	69.23	75.50	78.71
1.05	129.29	120.00	114.10	102.19	87.29	81.59	73.99	70.95	73.17	80.99	84.84
1.06	151.29	155.70	149.72	137.13	120.13	107.51	98.19	93.29	85.91	83.72	87.47
1.07	163.60	176.75	179.12	168.90	148.01	134.47	121.71	114.86	105.57	99.67	93.58
1.08	167.43	183.79	188.37	180.28	161.50	147.65	133.09	125.42	114.61	107.63	100.63


3.0
3.01
3.01_Out
3.02
3.02_Out
3.03
3.03_Out
3.04
4.00
3.00d
3.01d
3.02d
3.03d
3.04_Out
3.04d
3.05
4.01
4.02d
2.00
OL_C2B
OL_C2A
OL_C2
OL_C2_Out
6.00
6.00_Out
1.04
1.05
1.06
1.07
1.08
OL_C3
2.02
2.02_Out
OL_5GH_Div
OL_5E
OL_5GH
PF_Bas_2
PF_B2_Out
1.02
PFW
PFW_Out
GC_d
5.00
1.00
1.01
Post Development
Individual Sites
9630RA_Dev_03_Sites.xp

Run started at: 14th April 2014 13:31:17

##

Old Bar Precinct 3 Interim Post Development

Results for period from 0: 0.0 1/ 1/2000
to 11:20.0 4/ 1/2000

##

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ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =      2160.
RETURN PERIOD (YRS)      =         5.
BX                       =     0.6500
TOTAL OF FIRST SUB-AREAS  (ha) =     228.69
TOTAL OF SECOND SUB-AREAS (ha) =     128.81
TOTAL OF ALL SUB-AREAS (ha)    =     357.50
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	2.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	3.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	3.001
PFW_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	4.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	4.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	4.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	5.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	5.001
3.0	3.700	0.5000	2.500	2.500	0.000	100.0	.044	.015	.0318	.0004	6.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	6.001
3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	7.000
3.01_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	7.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.002
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	8.000
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	9.000
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	10.00
3.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	10.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.003
OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	11.00
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	12.00
3.03_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	12.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.004
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	13.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	13.00
3.04_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	13.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.005
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	5.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	14.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	14.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	5.003
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	15.00
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	15.00
2.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	15.00
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	16.00
6.00_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.242	1081.	5.000
1.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	6.543	1080.	5.000
5.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8496	1080.	0.000
OL_5E	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5258	1073.	2.000
PFW	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8740	1080.	2.000
PFW_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.7272	1090.	0.000
OL_5GH	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.3340	1050.	0.000
PF_Bas_2	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3340	1050.	0.000
PF_B2_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3052	1081.	0.000

GC_d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.030	1086.	4.000
4.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6507	1046.	0.000
4.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6507	1046.	1.000
3.0	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2443	1063.	2.000
3.00d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4734	1080.	2.000
3.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4408	1078.	0.000
3.01_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4407	1080.	0.000
3.01d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.9141	1080.	2.000
2.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3859	1080.	2.000
OL_C2A	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.1347	1020.	1.000
3.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4520	1027.	0.000
3.02_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4520	1080.	0.000
3.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.886	1080.	2.000
OL_C2B	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.0676	1021.	1.000
3.03	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4520	1027.	0.000
3.03_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4519	1080.	0.000
3.03d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	2.406	1080.	2.000
4.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2491	1008.	2.000
3.04	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6875	1080.	0.000
3.04_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6868	1080.	0.000
3.04d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	3.092	1080.	0.000
3.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.766	1080.	10.00
OL_C2	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5227	1056.	0.000
OL_C2_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.5079	1080.	0.000
3.06d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.271	1081.	8.000
OL_C3	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2645	1021.	0.000
2.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6900	1038.	0.000
2.02_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6900	1069.	5.000
6.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.7103	1033.	0.000
6.00_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.7064	1080.	0.000
1.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	16.367	1080.	0.000
1.03	5.615	10.00	1.000	2.500	0.000	132.89	201.15	2.773	1465.	0.000
1.04	5.615	10.00	1.000	2.500	0.000	132.89	201.15	2.832	1468.	0.000
1.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.520	1320.	2.000
1.06	5.615	10.00	1.000	2.500	0.000	132.89	201.15	4.139	1080.	1.500
1.07	5.615	10.00	1.000	2.500	0.000	132.89	201.15	4.935	1080.	4.000
1.08	5.615	10.00	1.000	2.500	0.000	132.89	201.15	5.308	1080.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	.8740	1088.	.7272	23241.1	0.0000	5357.6	4.8993
PF_Bas_2	1050.	.3340	1081.	.3052	9438.4	0.0000	1241.7	5.0800
3.0	1063.	.2443	1065.	.2443	5921.4	0.0000	133.07	15.384
3.01	1078.	.4408	1080.	.4407	11669.1	0.0000	298.61	9.5144
3.02	1027.	.4520	1080.	.4520	12774.0	0.0000	316.36	7.1197
3.03	1027.	.4520	1080.	.4519	12774.0	0.0000	390.57	6.2071
4.00	1008.	.2491	1080.	.2490	7038.7	0.0000	357.36	9.3875
3.04	1080.	.6875	1080.	.6868	19431.8	0.0000	417.05	5.9842
OL_C2	1056.	.5227	1080.	.5079	14773.0	0.0000	764.48	4.9621
2.02	1038.	.6900	1069.	.6900	19498.3	0.0000	586.82	5.3245
6.00	1033.	.7103	1080.	.7064	20074.7	0.0000	1498.8	5.4911
1.02	1080.	16.37	1463.	2.756	450675.	0.0000	329771.	5.1463

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
3.0	1.0	1.000		0.000	20.000	0.2000
3.01	1.0	1.000		0.000	20.000	0.2000
3.02	1.0	1.000		0.000	20.000	0.2000
3.03	1.0	1.000		0.000	20.000	0.2000
4.00	1.0	1.000		0.000	20.000	0.2000
3.04	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
2.02	1.0	1.000		0.000	20.000	0.2000
6.00	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 2160.
RETURN PERIOD (YRS) = 20.
BX = 0.6500
TOTAL OF FIRST SUB-AREAS (ha) = 228.69
TOTAL OF SECOND SUB-AREAS (ha) = 128.81
TOTAL OF ALL SUB-AREAS (ha) = 357.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	2.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	3.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	3.001
PFW_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	4.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	4.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	4.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	5.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	5.001
3.0	3.700	0.5000	2.500	2.500	0.000	100.0	.044	.015	.0318	.0004	6.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	6.001
3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	7.000
3.01_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	7.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.002
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	8.000
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	9.000
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	10.00
3.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	10.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.003
OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	11.00
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	12.00
3.03_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	12.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.004
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	13.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	13.00
3.04_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	13.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.005
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	5.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	14.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	14.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	5.003
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	15.00
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	15.00
2.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	15.00
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	16.00
6.00_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	#2	Cont. Loss #1 (mm/h)	#2	Excess Rain #1 (mm)	#2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	6.087	1081.	5.000
1.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	9.250	1080.	5.000
5.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.169	1080.	0.000
OL_5E	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7090	1055.	2.000
PFW	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.186	1080.	2.000
PFW_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.052	1086.	0.000
OL_5GH	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.4503	1046.	0.000
PF_Bas_2	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4503	1046.	0.000
PF_B2_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4076	1081.	0.000
GC_d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.450	1082.	4.000
4.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.8847	1072.	0.000
4.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.8847	1072.	1.000
3.0	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3343	1052.	2.000
3.00d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6492	1080.	2.000
3.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.5983	1066.	0.000
3.01_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5983	1080.	0.000
3.01d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.247	1080.	2.000
2.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5313	1080.	2.000
OL_C2A	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.1816	1008.	1.000
3.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.6095	1019.	0.000
3.02_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6095	1079.	0.000
3.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	2.570	1080.	2.000
OL_C2B	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.0912	1016.	1.000
3.03	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.6095	1019.	0.000
3.03_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6094	1080.	0.000
3.03d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	3.270	1080.	2.000
4.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3359	1003.	2.000
3.04	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9272	1076.	0.000

3.04_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.9270	1080.	0.000
3.04d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	4.197	1080.	0.000
3.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	5.112	1080.	10.00
OL_C2	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7049	1039.	0.000
OL_C2_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6930	1080.	0.000
3.06d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	5.804	1080.	8.000
OL_C3	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3566	1017.	0.000
2.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9305	1055.	0.000
2.02_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.9305	1073.	5.000
6.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9578	1026.	0.000
6.00_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.9560	1080.	0.000
1.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	22.655	1080.	0.000
1.03	7.487	10.00	1.000	2.500	0.000	196.12	268.55	5.016	1405.	0.000
1.04	7.487	10.00	1.000	2.500	0.000	196.12	268.55	5.098	1404.	0.000
1.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	6.095	1320.	2.000
1.06	7.487	10.00	1.000	2.500	0.000	196.12	268.55	6.566	1320.	1.500
1.07	7.487	10.00	1.000	2.500	0.000	196.12	268.55	7.080	1320.	4.000
1.08	7.487	10.00	1.000	2.500	0.000	196.12	268.55	7.303	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	1.185	1084.	1.052	32675.9	0.0000	6449.5	5.0011
PF_Bas_2	1046.	.4503	1081.	.4076	13006.9	0.0000	1716.7	5.2634
3.0	1052.	.3343	1068.	.3343	8597.5	0.0000	160.04	15.450
3.01	1066.	.5983	1080.	.5983	16431.3	0.0000	389.91	9.5639
3.02	1019.	.6095	1079.	.6095	17603.9	0.0000	408.39	7.1713
3.03	1019.	.6095	1080.	.6094	17603.9	0.0000	528.26	6.2736
4.00	1003.	.3359	1074.	.3359	9700.0	0.0000	409.18	9.4344
3.04	1076.	.9272	1080.	.9270	26778.9	0.0000	603.70	6.0646
OL_C2	1039.	.7049	1080.	.6930	20358.5	0.0000	1252.5	5.1493
2.02	1055.	.9305	1073.	.9305	26871.6	0.0000	699.76	5.3805
6.00	1026.	.9578	1080.	.9560	27664.0	0.0000	1789.5	5.5716
1.02	1080.	22.65	1405.	4.992	639154.	0.0000	452076.	5.3604

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
3.0	1.0	1.000		0.000	20.000	0.2000
3.01	1.0	1.000		0.000	20.000	0.2000
3.02	1.0	1.000		0.000	20.000	0.2000
3.03	1.0	1.000		0.000	20.000	0.2000
4.00	1.0	1.000		0.000	20.000	0.2000
3.04	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
2.02	1.0	1.000		0.000	20.000	0.2000
6.00	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 2160.
RETURN PERIOD (YRS) = 100.
BX = 0.6500
TOTAL OF FIRST SUB-AREAS (ha) = 228.69
TOTAL OF SECOND SUB-AREAS (ha) = 128.81
TOTAL OF ALL SUB-AREAS (ha) = 357.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	27.740	12.620	1.000	1.000	0.000	100.0	.050	.015	.1585	.0036	1.001
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	2.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	3.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	3.001
PFW_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	3.002
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	4.000
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	4.001
PF_B2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	4.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	5.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	5.001
3.0	3.700	0.5000	2.500	2.500	0.000	100.0	.044	.015	.0318	.0004	6.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	6.001

3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	7.000
3.01_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	7.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.002
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	8.000
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	9.000
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	10.00
3.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	10.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	6.003
OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	11.00
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	12.00
3.03_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	12.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.004
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	13.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	13.00
3.04_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	13.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	6.005
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	5.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	14.00
OL_C2_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	14.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	5.003
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	15.00
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	15.00
2.02_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	15.00
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	16.00
6.00_Out	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0001	0.000	16.00
1.02	12.480	26.440	.5000	.5000	0.000	100.0	.049	.015	.1455	.0075	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.936	1080.	5.000
1.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	11.955	1080.	5.000
5.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.482	1080.	0.000
OL_5E	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8893	1049.	2.000
PFW	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.493	1080.	2.000
PFW_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.435	1084.	0.000
OL_5GH	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.5648	1041.	0.000
PF_Bas_2	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5648	1041.	0.000
PF_B2_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5647	1080.	0.000
GC_d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.993	1080.	4.000
4.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.115	1028.	0.000
4.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.115	1028.	1.000
3.0	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4228	1045.	2.000
3.00d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8222	1080.	2.000
3.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7532	1050.	0.000
3.01_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7494	1080.	0.000
3.01d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.572	1080.	2.000
2.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.6738	1080.	2.000
OL_C2A	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.2278	1053.	1.000
3.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7645	1037.	0.000
3.02_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7598	1080.	0.000
3.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	3.233	1080.	2.000
OL_C2B	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.1144	1009.	1.000
3.03	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7645	1037.	0.000
3.03_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.7645	1079.	0.000
3.03d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	4.111	1080.	2.000
4.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4212	997.0	2.000
3.04	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.163	1078.	0.000
3.04_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.163	1080.	0.000
3.04d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	5.273	1080.	0.000
3.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	6.426	1080.	10.00
OL_C2	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8841	1035.	0.000
OL_C2_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8820	1080.	0.000
3.06d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.304	1080.	8.000
OL_C3	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4472	1012.	0.000
2.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.167	1033.	0.000
2.02_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.167	1059.	5.000
6.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.201	1016.	0.000
6.00_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.201	1080.	0.000
1.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	29.042	1080.	0.000
1.03	10.030	10.00	1.000	2.500	0.000	278.50	360.07	8.066	1387.	0.000
1.04	10.030	10.00	1.000	2.500	0.000	278.50	360.07	8.196	1386.	0.000
1.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	9.536	1320.	2.000
1.06	10.030	10.00	1.000	2.500	0.000	278.50	360.07	10.151	1320.	1.500
1.07	10.030	10.00	1.000	2.500	0.000	278.50	360.07	10.825	1320.	4.000
1.08	10.030	10.00	1.000	2.500	0.000	278.50	360.07	11.117	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	1.492	1082.	1.435	45183.7	0.0000	7169.9	5.0682
PF_Bas_2	1041.	.5648	1080.	.5647	17777.2	0.0000	1802.5	5.2966
3.0	1045.	.4228	1039.	.4228	12101.2	0.0000	173.58	15.481
3.01	1050.	.7532	1080.	.7494	22738.8	0.0000	528.64	9.6340
3.02	1037.	.7645	1080.	.7598	24060.5	0.0000	593.60	7.2604
3.03	1037.	.7645	1079.	.7645	24060.5	0.0000	637.38	6.3216
4.00	997.0	.4212	1076.	.4212	13257.6	0.0000	455.09	9.4746
3.04	1078.	1.162	1080.	1.162	36599.5	0.0000	715.83	6.1123
OL_C2	1035.	.8841	1080.	.8820	27824.9	0.0000	1471.7	5.2283
2.02	1033.	1.167	1059.	1.167	36726.9	0.0000	802.08	5.4277
6.00	1016.	1.201	1080.	1.201	37809.6	0.0000	2010.7	5.6272
1.02	1080.	29.04	1387.	8.028	888122.	0.0000	591216.	5.5829

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
3.0	1.0	1.000		0.000	20.000	0.2000
3.01	1.0	1.000		0.000	20.000	0.2000
3.02	1.0	1.000		0.000	20.000	0.2000
3.03	1.0	1.000		0.000	20.000	0.2000
4.00	1.0	1.000		0.000	20.000	0.2000
3.04	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
2.02	1.0	1.000		0.000	20.000	0.2000
6.00	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

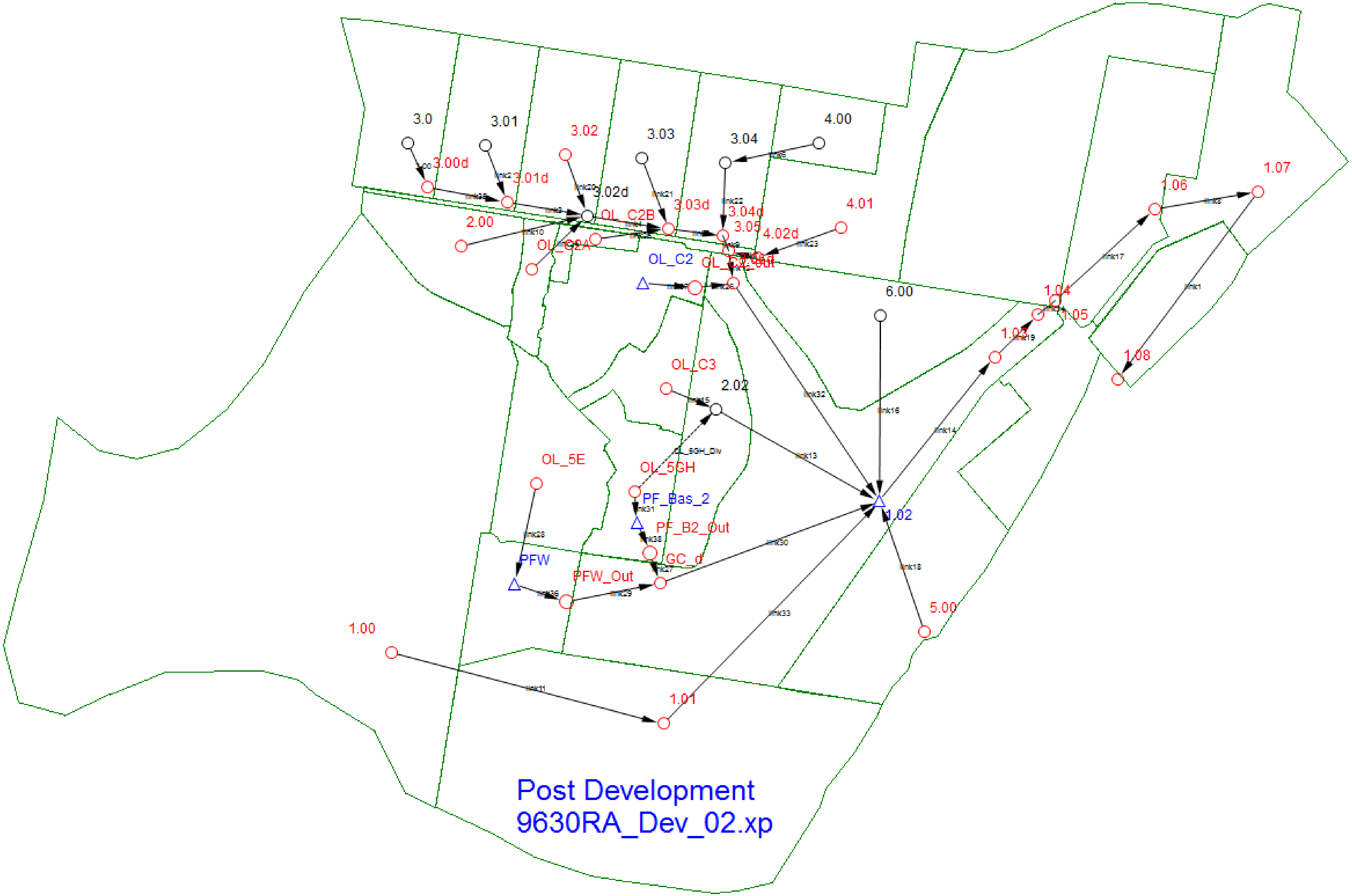
Run completed at: 14th April 2014 13:31:41

20% AEP Peak Discharges - Interim Developed Site Conditions (m^3/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	1.47	3.02	3.86	4.36	4.79	5.14	5.53	4.88	4.67	4.24
1.01	5.98	5.81	6.88	7.06	7.06	8.02	8.83	8.29	7.07	6.54
5.00	0.60	1.13	1.26	1.34	1.33	1.37	1.30	1.29	1.02	0.85
OL_5E	2.44	2.29	2.62	2.37	1.47	1.15	1.02	1.03	0.68	0.53
PFW	2.83	2.77	3.24	2.96	2.12	1.83	1.61	1.67	1.13	0.87
PFW_Out	0.22	0.48	0.59	0.65	0.68	0.77	0.95	0.82	0.79	0.73
OL_5GH	1.58	1.49	1.70	1.54	0.94	0.73	0.65	0.66	0.43	0.33
PF_Bas_2	1.25	1.25	1.25	1.25	0.94	0.73	0.65	0.66	0.43	0.33
PF_B2_Out	0.26	0.34	0.35	0.36	0.37	0.39	0.39	0.36	0.33	0.31
GC_d	0.42	0.80	0.92	1.00	1.01	1.14	1.33	1.18	1.11	1.03
4.01	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
4.02d	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
3.00	0.54	0.73	0.84	0.86	0.64	0.55	0.48	0.49	0.32	0.24
3.00d	0.71	1.00	1.05	1.13	1.05	0.90	0.81	0.85	0.60	0.47
3.01	1.51	1.49	1.77	1.56	1.14	0.96	0.85	0.87	0.57	0.44
3.01_Out	0.74	0.85	0.87	0.88	0.85	0.78	0.73	0.75	0.57	0.44
3.01d	1.42	1.85	1.91	2.01	1.89	1.68	1.54	1.60	1.17	0.91
2.00	0.30	0.59	0.63	0.68	0.68	0.65	0.60	0.62	0.48	0.39
OL_C2A	0.71	0.68	0.76	0.70	0.40	0.30	0.26	0.27	0.17	0.13
3.02	2.40	2.30	2.55	2.36	1.34	1.00	0.89	0.90	0.58	0.45
3.02_Out	0.88	0.94	0.94	0.96	0.88	0.82	0.76	0.77	0.58	0.45
3.02d	2.72	3.51	3.60	3.71	3.69	3.31	3.06	3.22	2.39	1.89
OL_C2B	0.39	0.37	0.40	0.37	0.20	0.15	0.13	0.13	0.09	0.07
3.03	2.40	2.30	2.55	2.36	1.34	1.00	0.89	0.90	0.58	0.45
3.03_Out	1.12	1.17	1.21	1.23	1.06	0.93	0.82	0.85	0.58	0.45
3.03d	3.75	4.66	4.77	4.91	4.78	4.30	3.93	4.15	3.05	2.41
4.00	1.36	1.30	1.44	1.32	0.74	0.55	0.49	0.49	0.32	0.25
3.04	2.68	2.69	3.01	2.74	1.82	1.46	1.32	1.35	0.89	0.69
3.04_Out	1.52	1.65	1.70	1.73	1.55	1.43	1.25	1.32	0.87	0.69
3.04d	5.26	6.21	6.36	6.56	6.26	5.65	5.13	5.40	3.91	3.09
3.05	6.72	8.01	8.39	8.62	7.79	7.13	6.38	6.74	4.78	3.77
OL_C2	2.52	2.44	2.76	2.53	1.50	1.15	1.02	1.03	0.67	0.52
OL_C2_Out	0.72	1.00	1.02	1.08	0.99	0.82	0.74	0.76	0.57	0.51
3.06d	7.44	8.95	9.41	9.66	8.60	7.95	7.10	7.39	5.34	4.27
OL_C3	1.39	1.33	1.50	1.37	0.78	0.58	0.52	0.52	0.34	0.26
2.02	3.79	3.58	4.23	3.74	2.01	1.52	1.35	1.37	0.89	0.69
2.02_Out	2.55	2.57	2.75	2.65	1.84	1.48	1.31	1.34	0.89	0.69
6.00	3.63	3.50	3.94	3.63	2.09	1.57	1.39	1.41	0.92	0.71
6.00_Out	1.10	1.56	1.61	1.74	1.52	1.34	1.16	1.26	0.88	0.71
1.02	17.36	20.51	21.62	23.35	22.78	22.77	23.42	22.61	18.67	16.37
1.03	1.04	1.42	1.70	1.90	2.64	2.88	3.32	3.65	3.86	4.64
1.04	2.89	2.84	3.27	2.96	2.68	2.94	3.38	3.73	3.96	4.76
1.05	9.89	9.29	10.51	9.60	6.28	5.31	5.39	5.56	4.58	5.52
1.06	13.03	12.36	13.97	12.93	8.20	6.87	6.75	6.95	5.33	5.87
1.07	14.34	13.88	15.34	15.14	9.90	8.49	8.14	8.40	6.34	6.25
1.08	15.02	14.90	16.19	16.44	10.79	9.14	8.75	8.98	6.79	6.42

5% AEP Peak Discharges - Interim Developed Site Conditions (m³/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	2.35	4.74	5.87	6.45	6.84	7.53	7.85	7.08	6.58	6.09
1.01	7.94	7.96	9.59	10.35	10.20	11.78	12.28	11.73	10.06	9.25
5.00	0.94	1.68	1.83	2.00	2.05	1.89	1.77	1.81	1.42	1.17
OL_5E	3.22	3.07	3.49	3.20	1.92	1.51	1.35	1.37	0.91	0.71
PFW	3.80	3.83	4.44	4.11	2.88	2.45	2.16	2.24	1.52	1.19
PFW_Out	0.37	0.78	0.92	1.01	1.01	1.25	1.50	1.35	1.17	1.05
OL_5GH	2.09	2.01	2.28	2.11	1.24	0.96	0.86	0.87	0.58	0.45
PF_Bas_2	1.25	1.25	1.25	1.25	1.24	0.96	0.86	0.87	0.58	0.45
PF_B2_Out	0.30	0.51	0.54	0.61	0.89	0.71	0.67	0.81	0.52	0.41
GC_d	0.63	1.17	1.34	1.46	1.63	1.81	2.10	2.03	1.64	1.45
4.01	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
4.02d	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
3.00	0.85	1.04	1.24	1.24	0.86	0.72	0.64	0.66	0.43	0.33
3.00d	1.05	1.50	1.55	1.68	1.44	1.26	1.10	1.16	0.83	0.65
3.01	2.07	2.07	2.46	2.16	1.53	1.27	1.13	1.16	0.77	0.60
3.01_Out	0.88	1.18	1.22	1.29	1.19	0.99	0.89	0.90	0.74	0.60
3.01d	1.92	2.68	2.77	2.97	2.62	2.24	1.98	2.05	1.57	1.25
2.00	0.50	0.86	0.91	0.97	1.01	0.90	0.82	0.86	0.66	0.53
OL_C2A	0.95	0.90	0.98	0.92	0.52	0.39	0.35	0.35	0.23	0.18
3.02	3.21	3.05	3.32	3.12	1.75	1.30	1.17	1.19	0.78	0.61
3.02_Out	1.02	1.22	1.25	1.32	1.10	0.95	0.89	0.91	0.75	0.61
3.02d	3.53	4.92	5.07	5.33	5.06	4.34	3.93	4.11	3.20	2.57
OL_C2B	0.51	0.47	0.51	0.48	0.26	0.20	0.17	0.18	0.12	0.09
3.03	3.21	3.05	3.32	3.12	1.75	1.30	1.17	1.19	0.78	0.61
3.03_Out	1.29	1.45	1.49	1.57	1.26	1.16	1.10	1.11	0.78	0.61
3.03d	4.82	6.35	6.55	6.89	6.42	5.59	5.04	5.33	4.08	3.27
4.00	1.86	1.73	1.86	1.75	0.97	0.72	0.64	0.65	0.43	0.34
3.04	3.62	3.52	3.84	3.57	2.29	1.85	1.68	1.71	1.19	0.93
3.04_Out	1.78	2.01	2.07	2.23	1.85	1.68	1.58	1.61	1.18	0.93
3.04d	6.55	8.26	8.50	8.94	8.23	7.22	6.58	6.89	5.25	4.20
3.05	8.75	10.28	10.83	11.28	10.14	9.01	8.21	8.63	6.43	5.11
OL_C2	3.39	3.24	3.66	3.39	1.97	1.51	1.35	1.37	0.90	0.70
OL_C2_Out	1.10	1.49	1.60	1.83	1.43	1.23	1.05	1.18	0.84	0.69
3.06d	9.84	11.56	12.31	12.58	11.20	10.17	9.26	9.50	7.21	5.80
OL_C3	1.89	1.79	1.95	1.83	1.02	0.76	0.68	0.69	0.46	0.36
2.02	5.53	5.24	5.97	5.47	2.64	1.99	1.78	1.81	1.19	0.93
2.02_Out	3.15	3.18	3.61	3.63	2.49	1.98	1.77	1.80	1.19	0.93
6.00	4.87	4.66	5.13	4.79	2.74	2.05	1.83	1.86	1.22	0.96
6.00_Out	1.68	2.14	2.24	2.42	2.01	1.81	1.63	1.71	1.21	0.96
1.02	22.73	28.40	29.79	32.42	32.26	31.82	31.98	31.90	26.08	22.66
1.03	1.27	1.86	2.28	2.62	3.69	4.16	4.91	5.53	5.96	7.42
1.04	3.75	3.72	4.16	3.85	3.72	4.22	5.01	5.64	6.10	7.62
1.05	12.81	12.23	13.84	12.75	8.22	6.85	7.25	7.59	6.94	8.66
1.06	16.86	16.27	18.41	17.10	10.76	8.91	9.06	9.38	7.44	9.13
1.07	18.80	18.34	20.43	20.14	13.11	11.08	10.95	11.34	8.79	9.65
1.08	19.78	19.72	21.60	21.86	14.29	11.97	11.76	12.13	9.37	9.88

1% AEP Peak Discharges - Interim Developed Site Conditions (m³/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	3.59	7.19	8.71	9.51	9.46	10.38	10.36	9.64	8.57	7.94
1.01	9.67	11.77	13.37	14.68	14.36	16.06	16.05	15.65	13.16	11.96
5.00	1.46	2.45	2.59	2.73	2.73	2.44	2.26	2.34	1.81	1.48
OL_5E	3.84	3.88	4.32	4.04	2.38	1.85	1.66	1.69	1.13	0.89
PFW	4.69	5.00	5.69	5.37	3.64	3.04	2.70	2.80	1.90	1.49
PFW_Out	0.62	1.32	1.51	1.63	1.63	1.71	1.87	1.77	1.62	1.44
OL_5GH	2.52	2.54	2.81	2.63	1.53	1.18	1.06	1.08	0.72	0.56
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.18	1.06	1.08	0.72	0.56
PF_B2_Out	0.35	0.83	0.87	0.83	1.19	1.13	1.02	1.07	0.72	0.56
GC_d	0.94	1.87	2.14	2.32	2.45	2.47	2.64	2.76	2.31	1.99
4.01	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
4.02d	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
3.00	1.16	1.38	1.62	1.62	1.08	0.89	0.80	0.82	0.54	0.42
3.00d	1.63	2.05	2.11	2.29	1.84	1.60	1.41	1.48	1.04	0.82
3.01	2.53	2.69	3.13	2.81	1.92	1.57	1.40	1.44	0.96	0.75
3.01_Out	1.30	1.73	1.75	1.86	1.60	1.34	1.15	1.24	0.88	0.75
3.01d	2.89	3.77	3.86	4.13	3.44	2.93	2.55	2.70	1.92	1.57
2.00	0.78	1.25	1.28	1.33	1.34	1.16	1.05	1.11	0.84	0.67
OL_C2A	1.15	1.12	1.20	1.12	0.64	0.48	0.43	0.44	0.29	0.23
3.02	3.88	3.76	4.03	3.80	2.15	1.60	1.44	1.46	0.97	0.76
3.02_Out	1.42	1.71	1.77	1.86	1.47	1.20	1.06	1.12	0.89	0.76
3.02d	5.27	6.93	7.11	7.51	6.70	5.64	4.97	5.30	3.93	3.23
OL_C2B	0.61	0.57	0.61	0.58	0.32	0.24	0.22	0.22	0.15	0.11
3.03	3.88	3.76	4.03	3.80	2.15	1.60	1.44	1.46	0.97	0.76
3.03_Out	1.63	1.87	1.95	2.05	1.56	1.37	1.22	1.27	0.97	0.76
3.03d	6.83	8.83	9.04	9.51	8.42	7.14	6.33	6.65	5.02	4.11
4.00	2.23	2.11	2.25	2.12	1.19	0.88	0.79	0.81	0.53	0.42
3.04	4.35	4.35	4.83	4.34	2.85	2.31	2.04	2.12	1.46	1.16
3.04_Out	2.31	2.84	2.92	3.13	2.37	1.95	1.79	1.85	1.46	1.16
3.04d	8.91	11.41	11.67	12.31	10.70	9.09	8.11	8.47	6.46	5.27
3.05	11.45	14.17	14.41	15.45	13.14	11.16	9.89	10.55	7.93	6.43
OL_C2	4.06	4.09	4.48	4.20	2.43	1.85	1.66	1.69	1.12	0.88
OL_C2_Out	1.79	2.39	2.93	2.98	2.06	1.77	1.42	1.63	1.09	0.88
3.06d	12.53	15.66	16.02	16.92	14.39	12.60	11.22	11.63	8.93	7.30
OL_C3	2.28	2.21	2.36	2.22	1.26	0.93	0.84	0.85	0.57	0.45
2.02	6.92	6.88	7.60	7.06	3.53	2.44	2.19	2.23	1.48	1.17
2.02_Out	4.03	4.23	4.76	4.86	2.95	2.43	2.18	2.23	1.48	1.17
6.00	5.89	5.81	6.25	5.86	3.35	2.51	2.26	2.30	1.53	1.20
6.00_Out	2.36	2.90	3.09	3.31	2.55	2.26	2.00	2.10	1.51	1.20
1.02	27.73	39.36	41.70	44.92	42.83	41.62	40.82	41.25	33.57	29.04
1.03	1.59	2.56	3.07	3.61	5.44	6.29	7.61	8.59	9.02	11.10
1.04	4.49	4.57	5.07	4.72	5.46	6.39	7.77	8.79	9.23	11.39
1.05	15.23	15.21	17.00	15.87	10.08	8.43	9.49	10.84	10.38	12.75
1.06	20.03	20.21	22.68	21.23	13.25	10.92	11.72	12.41	10.90	13.37
1.07	22.47	23.02	25.70	25.23	16.28	13.58	14.08	14.69	11.64	14.05
1.08	23.94	24.82	27.21	27.40	17.74	14.72	15.09	15.65	12.34	14.35

PMF Peak Discharges - Future Developed Site Conditions (m³/s)											
Node	Storm Duration (minutes)										
	15	30	45	60	90	120	150	180	240	300	360
1.00	23.60	41.61	56.33	67.13	82.48	89.78	92.27	95.02	92.89	87.18	81.15
1.01	85.39	81.68	90.12	104.38	123.66	135.45	139.63	142.70	137.15	129.06	121.17
5.00	9.41	15.43	19.93	22.13	24.66	24.85	23.25	22.26	20.48	18.65	17.03
OL_5E	35.09	33.21	31.80	28.36	23.65	21.63	19.36	18.03	15.73	13.94	12.35
PFW	41.54	42.45	42.10	39.04	34.92	32.60	29.69	27.91	24.85	22.55	20.36
PFW_Out	6.96	12.96	17.41	19.75	22.72	23.20	22.12	21.42	19.60	18.03	16.61
OL_5GH	22.45	21.54	20.59	18.21	15.25	13.93	12.52	11.62	10.05	8.89	7.85
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
PF_B2_Out	0.34	0.67	1.18	1.24	1.25	1.25	1.25	1.25	1.25	1.25	1.25
GC_d	7.29	13.40	18.31	20.87	23.96	24.45	23.37	22.67	20.85	19.28	17.86
4.01	32.05	33.43	33.09	30.99	28.03	26.75	24.23	23.05	20.14	17.85	15.76
4.02d	32.05	33.43	33.09	30.99	28.03	26.75	24.23	23.05	20.14	17.85	15.76
3.00	8.27	10.91	11.66	11.35	10.32	9.45	8.78	8.39	7.55	6.79	6.04
3.00d	11.56	16.03	18.18	18.46	17.82	16.59	15.15	14.37	13.10	12.08	10.98
3.01	20.70	21.01	21.35	19.49	18.10	17.00	15.37	14.70	13.10	11.78	10.53
3.01_Out	13.78	17.55	18.82	18.47	16.99	16.09	14.80	14.02	12.67	11.57	10.41
3.01d	21.25	29.61	33.81	34.72	33.46	31.58	28.95	27.22	24.60	22.95	20.95
2.00	5.04	8.10	10.21	11.15	12.20	11.85	11.07	10.57	9.55	8.74	8.03
OL_C2A	9.72	9.39	8.88	7.78	6.67	6.00	5.33	4.87	4.12	3.60	3.17
3.02	32.51	31.42	29.70	25.83	22.31	20.08	17.84	16.32	13.80	12.08	10.64
3.02_Out	8.50	11.05	12.54	13.11	13.04	12.57	11.81	11.18	10.17	9.53	8.86
3.02d	35.90	50.63	58.87	62.27	62.02	59.38	55.22	51.84	46.88	43.69	40.35
OL_C2B	5.08	4.80	4.52	3.94	3.45	3.08	2.70	2.45	2.07	1.81	1.59
3.03	32.51	31.42	29.70	25.83	22.31	20.08	17.84	16.32	13.80	12.08	10.64
3.03_Out	17.83	22.34	22.48	21.21	19.45	18.19	16.54	15.43	13.52	11.98	10.60
3.03d	46.05	62.32	73.34	77.52	78.05	74.30	69.43	65.26	59.37	55.20	50.80
4.00	18.46	17.59	16.51	14.35	12.57	11.24	9.90	9.01	7.61	6.66	5.87
3.04	32.74	36.53	35.76	34.19	30.63	29.10	26.20	24.44	20.90	18.35	16.18
3.04_Out	26.38	33.91	34.35	32.61	29.27	27.52	25.17	23.56	20.69	18.30	16.17
3.04d	63.35	84.17	97.04	100.86	99.70	95.18	88.41	83.59	76.20	70.87	65.16
3.05	83.94	110.30	125.60	129.03	125.43	119.25	109.70	103.60	95.14	88.39	81.14
OL_C2	35.84	34.45	32.93	29.04	24.47	22.23	19.90	18.43	15.87	13.94	12.30
OL_C2_Out	19.50	25.07	25.43	24.42	22.34	20.78	18.89	17.64	15.52	13.83	12.26
3.06d	87.70	115.46	131.75	136.59	133.97	128.25	121.32	114.85	106.49	98.39	90.00
OL_C3	19.02	18.35	17.29	15.05	13.03	11.75	10.43	9.54	8.07	7.07	6.23
2.02	69.60	66.98	63.67	55.77	47.08	42.62	38.03	34.99	29.81	26.04	22.83
2.02_Out	56.83	58.17	55.41	50.99	45.47	41.41	36.82	34.33	29.60	25.99	22.81
6.00	50.08	48.46	45.87	40.10	34.33	31.07	27.69	25.49	21.67	18.99	16.72
6.00_Out	24.67	32.35	33.27	31.94	29.25	27.47	25.09	23.58	20.89	18.67	16.59
1.02	198.05	225.17	281.16	309.17	347.62	362.38	365.45	373.61	351.41	329.95	308.78
1.03	8.04	13.27	19.63	26.10	37.72	47.41	53.64	59.55	68.52	74.98	77.95
1.04	34.74	33.68	32.49	28.92	37.75	47.47	53.95	60.05	69.53	75.73	79.15
1.05	136.51	127.19	121.02	108.30	92.77	86.70	78.62	75.29	73.47	81.44	85.27
1.06	158.50	162.88	156.63	143.23	125.21	112.44	102.65	97.43	89.61	84.61	87.90
1.07	170.81	183.91	186.02	174.98	153.08	138.87	126.01	118.69	109.12	102.93	96.49
1.08	174.64	190.96	195.26	186.36	166.56	152.03	137.38	129.25	118.16	110.88	103.55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3.01
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OL_C2B
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OL_C3
2.02
OL_5E
OL_5GH
PF_Bas_2
PF_B2_Out
GC_d
PFW
PFW_Out
1.02
5.00
1.00
1.01
Post Development
9630RA_Dev_02.xp

Run started at: 14th April 2014 13:30:20

###

Old Bar Precinct 3 Post Development

Results for period from 0: 0.0 1/ 1/2000
to 11:20.0 4/ 1/2000

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ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 2160.
RETURN PERIOD (YRS) = 5.
BX = 0.6500
TOTAL OF FIRST SUB-AREAS (ha) = 208.71
TOTAL OF SECOND SUB-AREAS (ha) = 146.79
TOTAL OF ALL SUB-AREAS (ha) = 355.50

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	15.380	24.980	1.000	1.000	0.000	100.0	.050	.015	.1166	.0052	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	2.001
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	6.002
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	8.000
3.0	3.200	1.000	2.500	2.500	0.000	100.0	.040	.015	.0274	.0006	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	11.00
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	13.00
OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	14.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	15.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	16.00
OL_C2_out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	5.360	31.560	.5000	.5000	0.000	100.0	.025	.015	.0572	.0082	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	#2	Cont. Loss #1 (mm/h)	#2	Excess Rain #1 (mm)	#2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.242	1081.	5.000
1.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	6.641	1080.	5.000
OL_C3	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2645	1021.	0.000
OL_5GH	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.3340	1050.	0.000
2.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6900	1038.	5.000
6.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.7103	1033.	0.000
5.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8496	1080.	0.000
OL_5E	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5258	1073.	2.000
PFW	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.8740	1080.	2.000
PFW_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.7272	1090.	0.000
PF_Bas_2	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3340	1050.	0.000
PF_B2_Out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3052	1081.	0.000
GC_d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.030	1086.	4.000
4.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6507	1046.	0.000
4.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.6507	1046.	1.000
3.01	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4408	1078.	0.000

3.0	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2477	1051.	2.000
3.00d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.4768	1080.	2.000
3.01d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.9176	1080.	2.000
2.00	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.3859	1080.	2.000
3.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4520	1027.	0.000
OL_C2A	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.1347	1020.	1.000
3.02d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	1.890	1080.	2.000
3.03	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.4520	1027.	0.000
OL_C2B	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.0676	1021.	1.000
3.03d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	2.409	1080.	2.000
4.00	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.2491	1008.	2.000
3.04	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.6876	1024.	0.000
3.04d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	3.097	1080.	0.000
3.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.770	1080.	10.00
OL_C2	5.615	10.00	1.000	2.500	0.000	132.89	201.15	0.5227	1056.	0.000
OL_C2_out	5.615	10.00	0.000	2.500	0.000	132.89	0.000	0.5079	1080.	0.000
3.06d	5.615	10.00	0.000	2.500	0.000	132.89	0.000	4.276	1081.	8.000
1.02	5.615	10.00	1.000	2.500	0.000	132.89	201.15	16.418	1080.	0.000
1.03	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.386	1414.	0.000
1.04	5.615	10.00	1.000	2.500	0.000	132.89	201.15	3.443	1413.	0.000
1.05	5.615	10.00	1.000	2.500	0.000	132.89	201.15	4.205	1320.	2.000
1.06	5.615	10.00	1.000	2.500	0.000	132.89	201.15	4.549	1320.	1.500
1.07	5.615	10.00	1.000	2.500	0.000	132.89	201.15	5.060	1080.	4.000
1.08	5.615	10.00	1.000	2.500	0.000	132.89	201.15	5.432	1080.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	.8740	1088.	.7272	23241.1	0.0000	5357.6	4.8993
PF_Bas_2	1050.	.3340	1081.	.3052	9438.4	0.0000	1241.7	5.0800
OL_C2	1056.	.5227	1080.	.5079	14773.0	0.0000	764.48	4.9621
1.02	1080.	16.42	1414.	3.371	460279.	0.0000	328715.	5.2132

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

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ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =      2160.
RETURN PERIOD (YRS)      =        20.
BX                       =     0.6500
TOTAL OF FIRST SUB-AREAS  (ha) =      208.71
TOTAL OF SECOND SUB-AREAS (ha) =      146.79
TOTAL OF ALL SUB-AREAS (ha)    =      355.50
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	#2	Slope #1 (%)	#2	% Impervious #1 (%)	#2	Pern #1	#2	B #1	#2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	15.380	24.980	1.000	1.000	0.000	100.0	.050	.015	.1166	.0052	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	2.001
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	6.002
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	8.000
3.0	3.200	1.000	2.500	2.500	0.000	100.0	.040	.015	.0274	.0006	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	11.00
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	13.00

OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	14.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	15.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	16.00
OL_C2_out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	5.360	31.560	.5000	.5000	0.000	100.0	.025	.015	.0572	.0082	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	6.087	1081.	5.000
1.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	9.343	1080.	5.000
OL_C3	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3566	1017.	0.000
OL_5GH	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.4503	1046.	0.000
2.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9305	1055.	5.000
6.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9578	1026.	0.000
5.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.169	1080.	0.000
OL_5E	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7090	1055.	2.000
PFW	7.487	10.00	1.000	2.500	0.000	196.12	268.55	1.186	1080.	2.000
PFW_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.052	1086.	0.000
PF_Bas_2	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4503	1046.	0.000
PF_B2_Out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.4076	1081.	0.000
GC_d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.450	1082.	4.000
4.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.8847	1072.	0.000
4.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.8847	1072.	1.000
3.01	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.5983	1066.	0.000
3.0	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3378	1030.	2.000
3.00d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6527	1080.	2.000
3.01d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	1.251	1080.	2.000
2.00	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.5313	1080.	2.000
3.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.6095	1019.	0.000
OL_C2A	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.1816	1008.	1.000
3.02d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	2.573	1080.	2.000
3.03	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.6095	1019.	0.000
OL_C2B	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.0912	1016.	1.000
3.03d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	3.274	1080.	2.000
4.00	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.3359	1003.	2.000
3.04	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.9272	1017.	0.000
3.04d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	4.201	1080.	0.000
3.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	5.116	1080.	10.00
OL_C2	7.487	10.00	1.000	2.500	0.000	196.12	268.55	0.7049	1039.	0.000
OL_C2_out	7.487	10.00	0.000	2.500	0.000	196.12	0.000	0.6930	1080.	0.000
3.06d	7.487	10.00	0.000	2.500	0.000	196.12	0.000	5.808	1080.	8.000
1.02	7.487	10.00	1.000	2.500	0.000	196.12	268.55	22.646	1080.	0.000
1.03	7.487	10.00	1.000	2.500	0.000	196.12	268.55	5.953	1374.	0.000
1.04	7.487	10.00	1.000	2.500	0.000	196.12	268.55	6.119	1320.	0.000
1.05	7.487	10.00	1.000	2.500	0.000	196.12	268.55	7.160	1320.	2.000
1.06	7.487	10.00	1.000	2.500	0.000	196.12	268.55	7.632	1320.	1.500
1.07	7.487	10.00	1.000	2.500	0.000	196.12	268.55	8.147	1320.	4.000
1.08	7.487	10.00	1.000	2.500	0.000	196.12	268.55	8.372	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	1.185	1084.	1.052	32675.9	0.0000	6449.5	5.0011
PF_Bas_2	1046.	.4503	1081.	.4076	13006.9	0.0000	1716.7	5.2634
OL_C2	1039.	.7049	1080.	.6930	20358.5	0.0000	1252.5	5.1493
1.02	1080.	22.65	1374.	5.929	648249.	0.0000	442994.	5.4354

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

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ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =      2160.
RETURN PERIOD (YRS)      =       100.
BX                       =     0.6500
TOTAL OF FIRST SUB-AREAS  (ha) =     208.71
TOTAL OF SECOND SUB-AREAS (ha) =     146.79
TOTAL OF ALL SUB-AREAS (ha)    =     355.50
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	84.000	0.000	2.000	0.000	0.000	0.000	.100	0.00	.3592	0.000	1.000
1.01	15.380	24.980	1.000	1.000	0.000	100.0	.050	.015	.1166	.0052	1.001
OL_C3	1.720	2.580	2.000	2.000	0.000	100.0	.025	.015	.0158	.0011	2.000
OL_5GH	2.170	3.260	1.000	1.000	0.000	100.0	.025	.015	.0253	.0018	3.000
2.02	2.770	4.150	1.500	1.500	0.000	100.0	.025	.015	.0234	.0017	2.001
6.00	4.620	6.930	2.500	2.500	0.000	100.0	.025	.015	.0237	.0017	4.000
5.00	14.520	0.3200	2.500	2.500	0.000	100.0	.093	.015	.1210	.0003	5.000
OL_5E	3.420	5.130	1.000	1.000	0.000	100.0	.025	.015	.0320	.0023	6.000
PFW	5.400	0.6000	.5000	.5000	0.000	100.0	.025	.015	.0574	.0010	6.001
PFW_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	6.002
PF_Bas_2	.00001	0.000	.5000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.001
PF_B2_Out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	3.002
GC_d	.00001	0.000	1.000	0.000	0.000	0.000	.050	0.00	0.000	0.000	3.003
4.01	7.370	3.550	2.500	2.500	0.000	100.0	.030	.015	.0342	.0012	7.000
4.02d	.00001	0.000	2.500	0.000	0.000	0.000	.042	0.00	0.000	0.000	7.001
3.01	4.560	2.790	2.500	2.500	0.000	100.0	.050	.015	.0392	.0010	8.000
3.0	3.200	1.000	2.500	2.500	0.000	100.0	.040	.015	.0274	.0006	9.000
3.00d	4.000	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0660	0.000	9.001
3.01d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.001
2.00	6.750	0.000	2.500	0.000	0.000	0.000	.100	0.00	.0866	0.000	10.00
3.02	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	11.00
OL_C2A	0.8800	1.310	1.500	1.500	0.000	100.0	.025	.015	.0129	.0009	12.00
3.02d	.00001	0.000	2.500	0.000	0.000	0.000	.058	0.00	0.000	0.000	8.002
3.03	2.940	4.410	2.500	2.500	0.000	100.0	.025	.015	.0187	.0013	13.00
OL_C2B	0.4400	0.6600	1.500	1.500	0.000	100.0	.025	.015	.0090	.0006	14.00
3.03d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.003
4.00	1.620	2.430	2.500	2.500	0.000	100.0	.025	.015	.0137	.0010	15.00
3.04	2.850	4.280	2.500	2.500	0.000	100.0	.025	.015	.0184	.0013	15.00
3.04d	.00001	0.000	2.500	0.000	0.000	0.000	.050	0.00	0.000	0.000	8.004
3.05	0.1500	0.2200	1.500	1.500	0.000	100.0	.025	.015	.0051	.0004	7.002
OL_C2	3.400	5.100	1.500	1.500	0.000	100.0	.025	.015	.0261	.0018	16.00
OL_C2_out	.00001	0.000	1.000	0.000	0.000	0.000	.025	0.00	0.000	0.000	16.00
3.06d	.00001	0.000	.1000	0.000	0.000	0.000	.050	0.00	.0002	0.000	7.003
1.02	5.360	31.560	.5000	.5000	0.000	100.0	.025	.015	.0572	.0082	1.002
1.03	1.100	0.9000	1.000	1.000	0.000	100.0	.025	.015	.0178	.0009	1.003
1.04	2.600	3.900	1.000	1.000	0.000	100.0	.025	.015	.0278	.0020	1.004
1.05	10.150	15.230	1.000	1.000	0.000	100.0	.025	.015	.0564	.0040	1.005
1.06	4.770	7.150	1.500	1.500	0.000	100.0	.025	.015	.0311	.0022	1.006
1.07	7.110	6.160	2.000	2.000	0.000	100.0	.054	.015	.0588	.0018	1.007
1.08	2.520	3.780	1.000	1.000	0.000	100.0	.025	.015	.0273	.0019	1.008

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.936	1080.	5.000
1.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	12.047	1080.	5.000
OL_C3	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4472	1012.	0.000
OL_5GH	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.5648	1041.	0.000
2.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.167	1033.	5.000
6.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.201	1016.	0.000
5.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.482	1080.	0.000
OL_5E	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8893	1049.	2.000
PFW	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.493	1080.	2.000
PFW_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.435	1084.	0.000
PF_Bas_2	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5648	1041.	0.000
PF_B2_Out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.5647	1080.	0.000
GC_d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.993	1080.	4.000
4.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.115	1028.	0.000
4.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.115	1028.	1.000
3.01	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7532	1050.	0.000
3.0	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4263	1080.	2.000
3.00d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8256	1080.	2.000
3.01d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	1.579	1080.	2.000
2.00	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.6738	1080.	2.000
3.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7645	1037.	0.000
OL_C2A	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.2278	1053.	1.000
3.02d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	3.245	1080.	2.000
3.03	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.7645	1037.	0.000
OL_C2B	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.1144	1009.	1.000
3.03d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	4.124	1080.	2.000
4.00	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.4212	997.0	2.000

3.04	10.030	10.00	1.000	2.500	0.000	278.50	360.07	1.163	1010.	0.000
3.04d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	5.286	1080.	0.000
3.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	6.440	1080.	10.00
OL_C2	10.030	10.00	1.000	2.500	0.000	278.50	360.07	0.8841	1035.	0.000
OL_C2_out	10.030	10.00	0.000	2.500	0.000	278.50	0.000	0.8820	1080.	0.000
3.06d	10.030	10.00	0.000	2.500	0.000	278.50	0.000	7.321	1080.	8.000
1.02	10.030	10.00	1.000	2.500	0.000	278.50	360.07	29.001	1080.	0.000
1.03	10.030	10.00	1.000	2.500	0.000	278.50	360.07	9.335	1356.	0.000
1.04	10.030	10.00	1.000	2.500	0.000	278.50	360.07	9.587	1320.	0.000
1.05	10.030	10.00	1.000	2.500	0.000	278.50	360.07	10.941	1320.	2.000
1.06	10.030	10.00	1.000	2.500	0.000	278.50	360.07	11.557	1320.	1.500
1.07	10.030	10.00	1.000	2.500	0.000	278.50	360.07	12.231	1320.	4.000
1.08	10.030	10.00	1.000	2.500	0.000	278.50	360.07	12.525	1320.	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
PFW	1080.	1.492	1082.	1.435	45183.7	0.0000	7169.9	5.0682
PF_Bas_2	1041.	.5648	1080.	.5647	17777.2	0.0000	1802.5	5.2966
OL_C2	1035.	.8841	1080.	.8820	27824.9	0.0000	1471.7	5.2283
1.02	1080.	29.00	1358.	9.294	897216.	0.0000	572016.	5.6640

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
PFW	1.0	1.000		0.000	20.000	0.2000
PF_Bas_2	1.0	1.000		0.000	20.000	0.2000
OL_C2	1.0	1.000		0.000	20.000	0.2000
1.02	1.0	1.000		0.000	0.5000	0.2000

Run completed at: 14th April 2014 13:30:41

20% AEP Peak Discharges - Future Developed Site Conditions (m^3/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	1.47	3.02	3.86	4.36	4.79	5.14	5.53	4.88	4.67	4.24
1.01	10.89	10.09	11.37	10.57	7.68	8.07	8.94	8.90	7.30	6.64
OL_C3	1.39	1.33	1.50	1.37	0.78	0.58	0.52	0.52	0.34	0.26
OL_5GH	1.58	1.49	1.70	1.54	0.94	0.73	0.65	0.66	0.43	0.33
2.02	3.79	3.58	4.23	3.74	2.01	1.52	1.35	1.37	0.89	0.69
6.00	3.63	3.50	3.94	3.63	2.09	1.57	1.39	1.41	0.92	0.71
5.00	0.60	1.13	1.26	1.34	1.33	1.37	1.30	1.29	1.02	0.85
OL_5E	2.44	2.29	2.62	2.37	1.47	1.15	1.02	1.03	0.68	0.53
PFW	2.83	2.77	3.24	2.96	2.12	1.83	1.61	1.67	1.13	0.87
PFW_Out	0.22	0.48	0.59	0.65	0.68	0.77	0.95	0.82	0.79	0.73
PF_Bas_2	1.25	1.25	1.25	1.25	0.94	0.73	0.65	0.66	0.43	0.33
PF_B2_Out	0.26	0.34	0.35	0.36	0.37	0.39	0.39	0.36	0.33	0.31
GC_d	0.42	0.80	0.92	1.00	1.01	1.14	1.33	1.18	1.11	1.03
4.01	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
4.02d	2.30	2.40	2.90	2.60	1.81	1.46	1.29	1.31	0.84	0.65
3.01	1.51	1.49	1.77	1.56	1.14	0.96	0.85	0.87	0.57	0.44
3.00	0.75	0.82	1.03	0.96	0.69	0.56	0.49	0.50	0.32	0.25
3.00d	0.92	1.05	1.30	1.28	1.03	0.94	0.83	0.87	0.61	0.48
3.01d	2.02	2.16	2.59	2.58	2.04	1.86	1.64	1.73	1.18	0.92
2.00	0.30	0.59	0.63	0.68	0.68	0.65	0.60	0.62	0.48	0.39
3.02	2.40	2.30	2.55	2.36	1.34	1.00	0.89	0.90	0.58	0.45
OL_C2A	0.71	0.68	0.76	0.70	0.40	0.30	0.26	0.27	0.17	0.13
3.02d	4.89	4.82	5.68	5.27	3.98	3.67	3.28	3.47	2.40	1.89
3.03	2.40	2.30	2.55	2.36	1.34	1.00	0.89	0.90	0.58	0.45
OL_C2B	0.39	0.37	0.40	0.37	0.20	0.15	0.13	0.13	0.09	0.07
3.03d	6.95	6.79	7.88	7.27	5.34	4.75	4.24	4.46	3.07	2.41
4.00	1.36	1.30	1.44	1.32	0.74	0.55	0.49	0.49	0.32	0.25
3.04	3.54	3.41	3.80	3.48	2.04	1.52	1.35	1.36	0.89	0.69
3.04d	9.24	9.38	10.42	10.22	7.14	6.19	5.52	5.78	3.94	3.10
3.05	11.63	11.58	13.29	12.65	9.01	7.69	6.84	7.13	4.82	3.77
OL_C2	2.52	2.44	2.76	2.53	1.50	1.15	1.02	1.03	0.67	0.52
OL_C2_out	0.72	1.00	1.02	1.08	0.99	0.82	0.74	0.76	0.57	0.51
3.06d	12.35	12.57	14.31	13.70	9.96	8.51	7.56	7.78	5.38	4.28
1.02	27.35	26.56	29.78	31.05	26.43	23.20	23.55	24.75	19.15	16.42
1.03	0.76	0.97	1.09	1.20	1.46	1.62	1.89	2.16	2.74	3.39
1.04	2.62	2.59	3.06	2.72	2.00	1.82	2.03	2.20	2.82	3.44
1.05	9.61	9.04	10.30	9.37	6.11	5.17	4.98	5.12	3.88	4.21
1.06	12.72	12.09	13.73	12.68	8.02	6.73	6.36	6.53	4.81	4.55
1.07	14.02	13.61	15.11	14.89	9.72	8.33	7.77	8.01	5.83	5.06
1.08	14.70	14.63	15.95	16.19	10.61	8.98	8.39	8.64	6.30	5.43

Node	5% AEP Peak Discharges - Future Developed Site Conditions (m^3/s)									
	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	2.35	4.74	5.87	6.45	6.84	7.53	7.85	7.08	6.58	6.09
1.01	14.06	13.28	15.16	14.13	11.20	11.70	12.35	12.51	10.32	9.34
OL_C3	1.89	1.79	1.95	1.83	1.02	0.76	0.68	0.69	0.46	0.36
OL_5GH	2.09	2.01	2.28	2.11	1.24	0.96	0.86	0.87	0.58	0.45
2.02	5.53	5.24	5.97	5.47	2.64	1.99	1.78	1.81	1.19	0.93
6.00	4.87	4.66	5.13	4.79	2.74	2.05	1.83	1.86	1.22	0.96
5.00	0.94	1.68	1.83	2.00	2.05	1.89	1.77	1.81	1.42	1.17
OL_5E	3.22	3.07	3.49	3.20	1.92	1.51	1.35	1.37	0.91	0.71
PFW	3.80	3.83	4.44	4.11	2.88	2.45	2.16	2.24	1.52	1.19
PFW_Out	0.37	0.78	0.92	1.01	1.01	1.25	1.50	1.35	1.17	1.05
PF_Bas_2	1.25	1.25	1.25	1.25	1.24	0.96	0.86	0.87	0.58	0.45
PF_B2_Out	0.30	0.51	0.54	0.61	0.89	0.71	0.67	0.81	0.52	0.41
GC_d	0.63	1.17	1.34	1.46	1.63	1.81	2.10	2.03	1.64	1.45
4.01	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
4.02d	3.26	3.39	4.00	3.52	2.41	1.91	1.71	1.74	1.14	0.88
3.01	2.07	2.07	2.46	2.16	1.53	1.27	1.13	1.16	0.77	0.60
3.00	1.12	1.20	1.44	1.34	0.91	0.73	0.65	0.66	0.43	0.34
3.00d	1.37	1.53	1.90	1.88	1.43	1.29	1.14	1.20	0.83	0.65
3.01d	2.87	3.07	3.72	3.70	2.79	2.53	2.23	2.34	1.60	1.25
2.00	0.50	0.86	0.91	0.97	1.01	0.90	0.82	0.86	0.66	0.53
3.02	3.21	3.05	3.32	3.12	1.75	1.30	1.17	1.19	0.78	0.61
OL_C2A	0.95	0.90	0.98	0.92	0.52	0.39	0.35	0.35	0.23	0.18
3.02d	6.59	6.64	7.75	7.36	5.52	5.01	4.42	4.69	3.26	2.57
3.03	3.21	3.05	3.32	3.12	1.75	1.30	1.17	1.19	0.78	0.61
OL_C2B	0.51	0.47	0.51	0.48	0.26	0.20	0.17	0.18	0.12	0.09
3.03d	9.42	9.21	10.57	9.89	7.29	6.42	5.69	6.01	4.15	3.27
4.00	1.86	1.73	1.86	1.75	0.97	0.72	0.64	0.65	0.43	0.34
3.04	4.74	4.55	4.95	4.59	2.67	1.98	1.77	1.80	1.19	0.93
3.04d	12.60	12.66	13.86	13.65	9.66	8.31	7.38	7.75	5.32	4.20
3.05	15.77	15.92	17.84	16.99	12.13	10.28	9.15	9.54	6.50	5.12
OL_C2	3.39	3.24	3.66	3.39	1.97	1.51	1.35	1.37	0.90	0.70
OL_C2_out	1.10	1.49	1.60	1.83	1.43	1.23	1.05	1.18	0.84	0.69
3.06d	16.86	17.41	19.32	18.56	13.53	11.45	10.19	10.44	7.29	5.81
1.02	35.37	35.27	39.45	41.60	36.94	32.24	32.33	34.39	26.52	22.65
1.03	1.02	1.17	1.34	1.44	2.02	2.54	3.33	3.93	4.76	5.95
1.04	3.50	3.50	3.98	3.66	2.58	2.58	3.38	4.01	4.88	6.12
1.05	12.56	12.01	13.66	12.56	8.07	6.71	6.56	6.75	5.65	7.16
1.06	16.58	16.03	18.21	16.89	10.61	8.77	8.39	8.62	6.34	7.63
1.07	18.50	18.10	20.22	19.93	12.95	10.94	10.30	10.62	7.72	8.15
1.08	19.49	19.48	21.39	21.65	14.13	11.83	11.10	11.47	8.36	8.37

1% AEP Peak Discharges - Future Developed Site Conditions (m^3/s)										
Node	Storm Duration (minutes)									
	25	60	90	120	270	360	540	720	1440	2160
1.00	3.59	7.19	8.71	9.51	9.46	10.38	10.36	9.64	8.57	7.94
1.01	16.60	16.55	19.03	17.60	15.19	15.91	16.07	16.44	13.43	12.05
OL_C3	2.28	2.21	2.36	2.22	1.26	0.93	0.84	0.85	0.57	0.45
OL_5GH	2.52	2.54	2.81	2.63	1.53	1.18	1.06	1.08	0.72	0.56
2.02	6.92	6.88	7.60	7.06	3.53	2.44	2.19	2.23	1.48	1.17
6.00	5.89	5.81	6.25	5.86	3.35	2.51	2.26	2.30	1.53	1.20
5.00	1.46	2.45	2.59	2.73	2.73	2.44	2.26	2.34	1.81	1.48
OL_5E	3.84	3.88	4.32	4.04	2.38	1.85	1.66	1.69	1.13	0.89
PFW	4.69	5.00	5.69	5.37	3.64	3.04	2.70	2.80	1.90	1.49
PFW_Out	0.62	1.32	1.51	1.63	1.63	1.71	1.87	1.77	1.62	1.44
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.18	1.06	1.08	0.72	0.56
PF_B2_Out	0.35	0.83	0.87	0.83	1.19	1.13	1.02	1.07	0.72	0.56
GC_d	0.94	1.87	2.14	2.32	2.45	2.47	2.64	2.76	2.31	1.99
4.01	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
4.02d	4.21	4.48	5.00	4.52	3.01	2.35	2.11	2.15	1.42	1.12
3.01	2.53	2.69	3.13	2.81	1.92	1.57	1.40	1.44	0.96	0.75
3.00	1.45	1.63	1.84	1.70	1.14	0.90	0.81	0.82	0.54	0.43
3.00d	1.82	2.15	2.51	2.48	1.85	1.62	1.44	1.50	1.05	0.83
3.01d	3.60	4.23	4.92	4.95	3.58	3.16	2.80	2.92	2.01	1.58
2.00	0.78	1.25	1.28	1.33	1.34	1.16	1.05	1.11	0.84	0.67
3.02	3.88	3.76	4.03	3.80	2.15	1.60	1.44	1.46	0.97	0.76
OL_C2A	1.15	1.12	1.20	1.12	0.64	0.48	0.43	0.44	0.29	0.23
3.02d	8.24	8.61	9.99	9.67	7.12	6.30	5.58	5.88	4.10	3.25
3.03	3.88	3.76	4.03	3.80	2.15	1.60	1.44	1.46	0.97	0.76
OL_C2B	0.61	0.57	0.61	0.58	0.32	0.24	0.22	0.22	0.15	0.11
3.03d	11.52	11.81	13.44	12.80	9.29	8.06	7.15	7.50	5.21	4.12
4.00	2.23	2.11	2.25	2.12	1.19	0.88	0.79	0.81	0.53	0.42
3.04	5.79	5.62	5.99	5.62	3.27	2.43	2.19	2.22	1.48	1.16
3.04d	15.63	16.12	17.51	17.29	12.19	10.40	9.25	9.66	6.67	5.29
3.05	19.78	20.36	22.35	21.72	15.30	12.83	11.43	11.88	8.14	6.44
OL_C2	4.06	4.09	4.48	4.20	2.43	1.85	1.66	1.69	1.12	0.88
OL_C2_out	1.79	2.39	2.93	2.98	2.06	1.77	1.42	1.63	1.09	0.88
3.06d	21.52	22.65	24.32	23.69	17.24	14.28	12.81	13.02	9.18	7.32
1.02	42.27	46.91	50.79	53.51	48.29	42.42	41.44	44.47	34.20	29.00
1.03	1.28	1.41	1.68	1.93	3.63	4.41	5.70	6.69	7.59	9.34
1.04	4.27	4.39	4.91	4.55	3.67	4.49	5.81	6.87	7.77	9.59
1.05	15.00	15.03	16.84	15.70	9.95	8.23	8.24	9.09	8.91	10.94
1.06	19.78	20.01	22.51	21.05	13.12	10.76	10.49	10.90	9.43	11.56
1.07	22.19	22.83	25.52	25.05	16.16	13.46	12.86	13.38	10.17	12.23
1.08	23.67	24.62	27.03	27.21	17.62	14.60	13.87	14.41	10.87	12.53

PMF Peak Discharges - Future Developed Site Conditions (m³/s)											
Node	**Storm Duration (minutes)**										
	15	30	45	60	90	120	150	180	240	300	360
1.00	23.51	41.48	56.15	66.93	82.22	89.51	91.98	94.71	92.64	86.94	80.94
1.01	157.20	142.71	135.89	124.25	121.80	135.08	137.39	139.43	133.47	127.81	119.52
OL_C3	18.96	18.30	17.24	15.02	13.00	11.72	10.41	9.52	8.05	7.06	6.22
OL_5GH	22.38	21.48	20.53	18.17	15.21	13.90	12.49	11.59	10.03	8.86	7.83
2.02	69.36	66.78	63.50	55.64	46.96	42.50	37.93	34.90	29.74	25.98	22.77
6.00	49.91	48.32	45.75	40.01	34.24	30.99	27.63	25.42	21.61	18.94	16.68
5.00	9.37	15.37	19.86	22.07	24.59	24.79	23.19	22.21	20.43	18.60	16.99
OL_5E	34.97	33.12	31.72	28.30	23.59	21.58	19.31	17.98	15.69	13.91	12.32
PFW	41.40	42.32	41.98	38.94	34.83	32.52	29.62	27.84	24.79	22.49	20.31
PFW_Out	6.92	12.90	17.34	19.68	22.65	23.13	22.05	21.36	19.55	17.98	16.56
PF_Bas_2	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
PF_B2_Out	0.34	0.67	1.18	1.24	1.25	1.25	1.25	1.25	1.25	1.25	1.25
GC_d	7.25	13.35	18.24	20.81	23.89	24.38	23.30	22.61	20.80	19.23	17.81
4.01	31.94	33.33	33.00	30.92	27.96	26.68	24.17	22.99	20.09	17.80	15.72
4.02d	31.94	33.33	33.00	30.92	27.96	26.68	24.17	22.99	20.09	17.80	15.72
3.01	20.64	20.94	21.28	19.44	18.05	16.96	15.34	14.66	13.06	11.75	10.50
3.00	10.60	12.07	12.04	11.84	10.42	10.01	9.06	8.73	7.69	6.84	6.05
3.00d	13.50	16.88	18.35	18.67	17.83	16.48	15.24	14.67	13.29	12.14	10.99
3.01d	23.21	30.15	34.47	35.15	34.06	31.66	29.03	27.37	25.08	23.25	21.11
2.00	5.02	8.07	10.18	11.12	12.17	11.82	11.04	10.54	9.52	8.72	8.01
3.02	32.40	31.33	29.63	25.77	22.25	20.03	17.80	16.28	13.77	12.05	10.61
OL_C2A	9.69	9.36	8.86	7.77	6.66	5.98	5.32	4.86	4.11	3.59	3.16
3.02d	52.26	60.53	63.35	65.46	63.88	61.43	55.93	53.39	49.23	45.68	41.78
3.03	32.40	31.33	29.63	25.77	22.25	20.03	17.80	16.28	13.77	12.05	10.61
OL_C2B	5.06	4.79	4.51	3.93	3.44	3.07	2.69	2.45	2.07	1.81	1.59
3.03d	71.99	80.66	86.41	86.38	81.05	76.66	71.61	67.89	62.32	57.65	52.81
4.00	18.40	17.54	16.47	14.32	12.53	11.21	9.88	8.99	7.59	6.65	5.86
3.04	39.57	41.02	39.63	36.54	33.41	30.16	26.67	24.68	20.92	18.33	16.15
3.04d	94.93	108.62	114.14	114.59	107.49	101.47	92.49	88.63	80.30	73.83	67.51
3.05	119.78	138.43	145.92	144.25	135.12	127.49	117.47	110.63	100.92	92.17	83.76
OL_C2	35.73	34.35	32.84	28.97	24.41	22.18	19.86	18.38	15.83	13.90	12.27
OL_C2_out	19.39	24.98	25.35	24.36	22.28	20.73	18.84	17.59	15.49	13.79	12.23
3.06d	124.85	144.76	153.70	152.47	145.12	141.22	130.65	123.24	112.36	102.25	92.70
1.02	279.71	294.50	344.22	347.20	350.70	366.14	365.86	376.23	352.93	332.77	307.38
1.03	7.86	9.60	15.07	17.74	20.71	23.94	26.16	28.09	31.32	34.77	36.91
1.04	34.48	33.48	32.32	28.79	25.02	23.98	26.33	28.48	31.76	35.57	37.69
1.05	135.93	126.73	120.60	107.97	92.02	85.49	77.40	74.03	68.27	64.67	61.65
1.06	157.83	162.31	156.12	142.81	124.54	111.24	101.33	96.10	87.98	82.33	77.36
1.07	170.09	183.27	185.41	174.48	152.34	137.85	124.60	117.24	107.44	100.66	94.08
1.08	173.91	190.29	194.62	185.83	165.79	150.97	135.95	127.78	116.46	108.60	101.12

APPENDIX B – TUFLOW MODELLING ASSUMPTIONS

Digital Terrain Model (DTM)

The terrain for the Old Bar Precinct 3 site TUFLOW model consists of the existing surface data provided by SKM and supplementary data from Lidbury Summer & Whiteman. Modifications to the terrain were incorporated to reflect the proposed development in the developed conditions, such as site regrading, filling of the site basins and creation of trunk drainage channels.

A grid size of 5 m was adopted in the TUFLOW model. This grid size was found to be a reasonable balance between computing time and flooding definition.

Catchment Roughness

One of the advantages of using TUFLOW for the hydraulic assessment is that different landuse can be assigned different roughness factors. For the Old Bar Precinct 3 site, the following roughness assumptions are summarised in the below table.

TABLE B.1 – TUFLOW MATERIAL ROUGHNESS

Mannings 'n'	Description
0.05	Grassland, uneven surface - default
0.12	Heavily vegetated, thick understorey
0.07	Moderate to heavy vegetation, moderately thick understorey
0.06	Swamp forest
0.04	Swamp open water
0.035	Pond
0.15	Residential Low Density
0.035	Turf
0.02	Road
0.03	Dirt Road and open bare ground
0.02	Golf course pond
0.03	Fairway
0.3	Building

It was assumed that the drainage channels within the Old Bar Precinct 3 site in the developed case will be maintained. A Manning's value of 0.035 has therefore been applied.

Boundary Conditions

The boundary conditions adopted in the TUFLOW model are as follows:

- UPSTREAM – Flow hydrographs were applied as inputs at the upstream boundary of the Old Bar Precinct 3 site.
- LOCAL INFLOWS – Local inflow hydrographs were included in the model (as SA layers) at locations representing various sub-catchments within the Old Bar Precinct 3 site.
- DOWNSTREAM – The Old Bar Precinct 3 site is not affected by the tailwater effects from the ocean. Therefore an astronomical high tide in conjunction with storm surge and expected increase in sea level was adopted as the downstream boundary condition.

APPENDIX C – HYDRAULIC ASSESSMENT CALCUATIONS FOR FOREST LANE CULVERT CROSSING

HY-8 Analysis Inputs

Crossing Properties

Name: Forest Lane

Parameter	Value	Units
DISCHARGE DATA		
Minimum Flow	1.00	cms
Design Flow	12.00	cms
Maximum Flow	21.00	cms
TAILWATER DATA		
Channel Type	Enter Rating Curve	
Channel Invert Elevation	5.40	m
Rating Curve	Define...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.00	m
Crest Length	100.00	m
Crest Elevation	6.50	m
Roadway Surface	Paved	
Top Width	15.00	m

Culvert Properties

Culvert 1
Culvert 2

Add Culvert
Duplicate Culvert
Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 1	
Shape	Concrete Box	
Material	Concrete	
Span	2400.00	mm
Rise	600.00	mm
Embedment Depth	0.00	mm
Manning's n	0.0120	
Inlet Type	Conventional	
Inlet Edge Condition	Square Edge (90º) Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.00	m
Inlet Elevation	5.47	m
Outlet Station	20.00	m
Outlet Elevation	5.47	m
Number of Barrels	4	

Crossing Properties

Name: Forest Lane

Parameter	Value	Units
DISCHARGE DATA		
Minimum Flow	1.00	cms
Design Flow	12.00	cms
Maximum Flow	21.00	cms
TAILWATER DATA		
Channel Type	Enter Rating Curve	
Channel Invert Elevation	5.40	m
Rating Curve	Define...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.00	m
Crest Length	100.00	m
Crest Elevation	6.50	m
Roadway Surface	Paved	
Top Width	15.00	m

Culvert Properties

Culvert 1
Culvert 2

Add Culvert
Duplicate Culvert
Delete Culvert

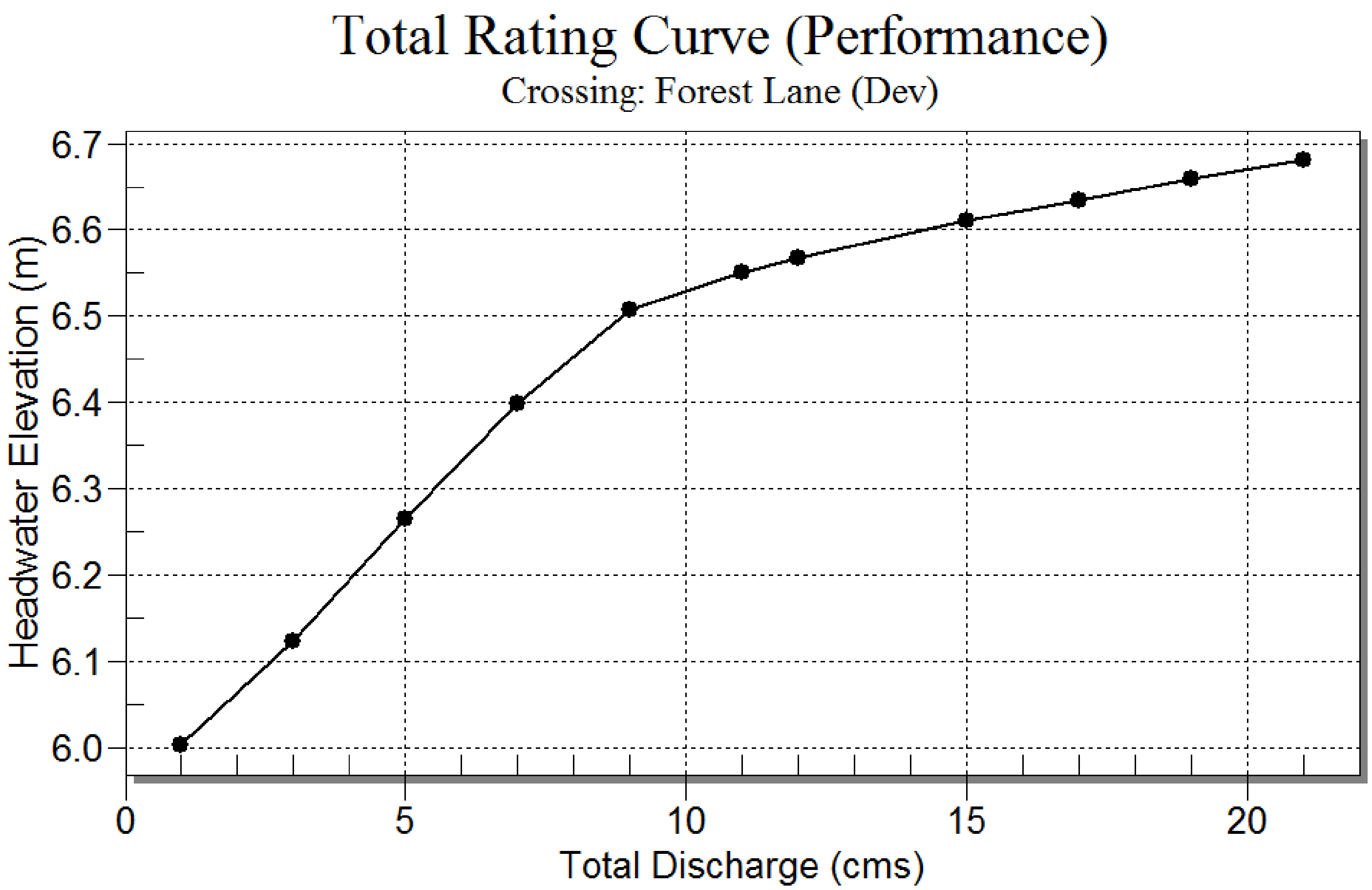
Parameter	Value	Units
CULVERT DATA		
Name	Culvert 2	
Shape	Circular	
Material	Concrete	
Diameter	375.00	mm
Embedment Depth	0.00	mm
Manning's n	0.0120	
Inlet Type	Conventional	
Inlet Edge Condition	Square Edge with Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.00	m
Inlet Elevation	5.68	m
Outlet Station	20.00	m
Outlet Elevation	5.60	m
Number of Barrels	3	

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Forest Lane (Dev)

Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Culvert 2 Discharge (cms)	Roadway Discharge (cms)	Iterations
6.00	1.00	0.96	0.05	0.00	20
6.12	3.00	2.87	0.13	0.00	10
6.27	5.00	4.78	0.22	0.00	5
6.40	7.00	6.68	0.31	0.00	5
6.51	9.00	8.49	0.40	0.10	13
6.55	11.00	8.74	0.41	1.82	6
6.57	12.00	8.70	0.41	2.88	5
6.61	15.00	8.54	0.40	6.05	5
6.63	17.00	8.42	0.39	8.17	4
6.66	19.00	8.09	0.38	10.52	4
6.68	21.00	7.74	0.36	12.89	4
6.50	8.79	8.40	0.39	0.00	Overtopping



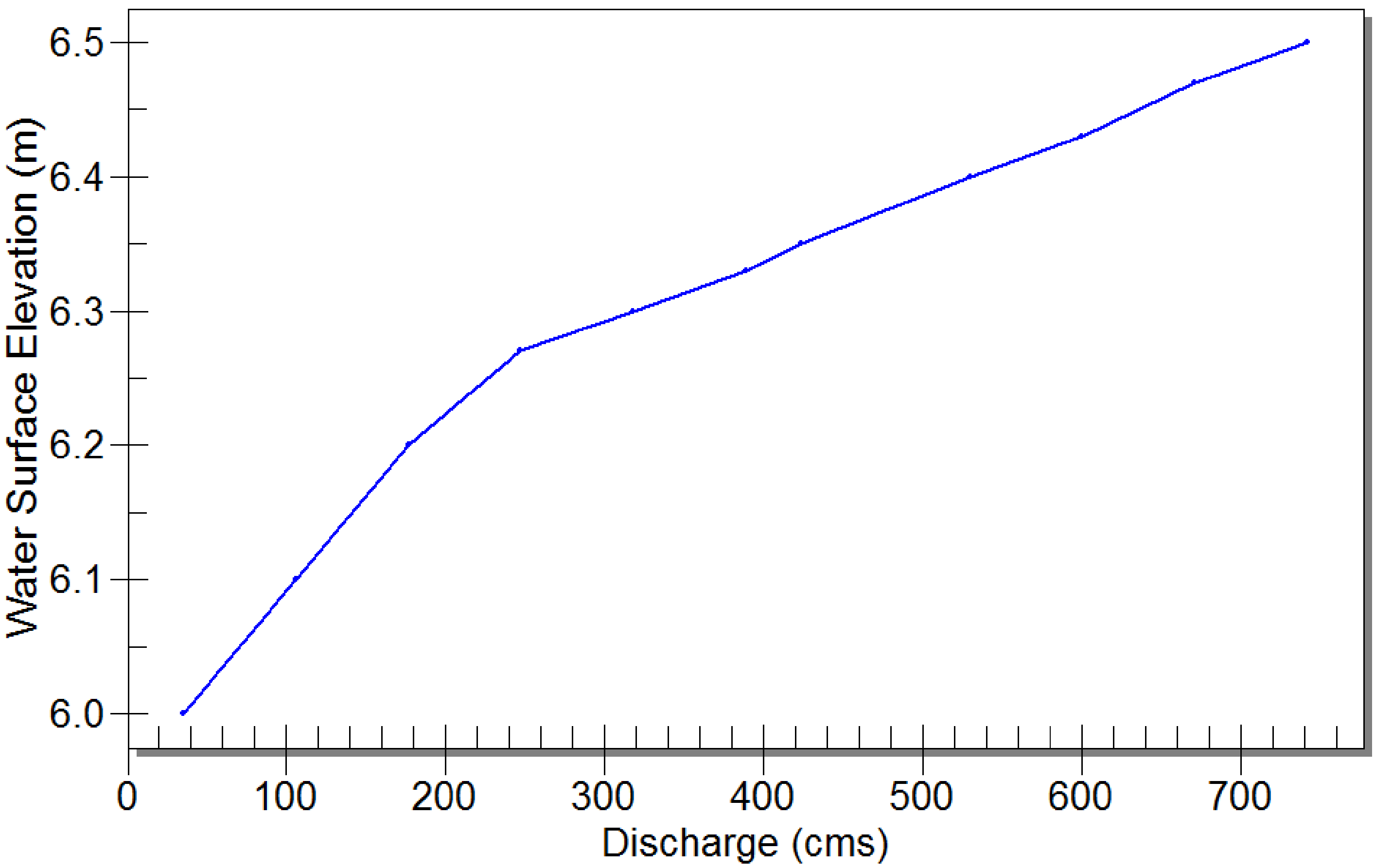
HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Forest Lane (Dev)

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
1.00	0.96	6.00	0.17	0.53	3-M2t	0.60	0.10	0.53	0.60	0.19	0.00
3.00	2.87	6.12	0.36	0.65	4-FFf	0.60	0.21	0.60	0.70	0.50	0.00
5.00	4.78	6.27	0.50	0.80	4-FFf	0.60	0.29	0.60	0.80	0.83	0.00
7.00	6.68	6.40	0.62	0.93	4-FFf	0.60	0.37	0.60	0.87	1.16	0.00
9.00	8.49	6.51	0.75	1.04	4-FFf	0.60	0.43	0.60	0.90	1.47	0.00
11.00	8.74	6.55	0.77	1.08	4-FFf	0.60	0.44	0.60	0.93	1.52	0.00
12.00	8.70	6.57	0.76	1.10	4-FFf	0.60	0.44	0.60	0.95	1.51	0.00
15.00	8.54	6.61	0.75	1.14	4-FFf	0.60	0.43	0.60	1.00	1.48	0.00
17.00	8.42	6.63	0.74	1.16	4-FFf	0.60	0.43	0.60	1.03	1.46	0.00
19.00	8.09	6.66	0.72	1.19	4-FFf	0.60	0.42	0.60	1.07	1.40	0.00
21.00	7.74	6.68	0.70	1.20	4-FFf	0.60	0.41	0.60	1.10	1.34	0.00

Downstream Channel Rating Curve



APPENDIX D – MUSIC MODELLING PARAMETERS

TREATMENT DEVICES

Treatment Device Performance Parameters

The performance parameters adopted for the devices used in the MUSIC model for the Old Bar site are in accordance with default values, and are summarised below in Table D.1.

TABLE D.1 – MUSIC – PERFORMANCE PARAMETERS

	Bio-Retention		Rainwater Tanks		Wetland		Grassed Swale	
Pollutant	**k (m/yr)**	**C* (mg/L)**	**k (m/yr)**	**C* (mg/L)**	**k (m/yr)**	**C* (mg/L)**	**k (m/yr)**	**C* (mg/L)**
TSS	8000	20.000	400	12.000	1500	6.000	8000	20.000
TP	6000	0.130	300	0.130	1000	0.060	6000	0.130
TN	500	1.400	40	1.400	150	1.000	500	1.400

Golf Course Wetland System

The parameters adopted in the assessment of the Golf Course Wetland System is summarised below in Table D.2. The combined wetland system is assumed to be modelled as a single device, which is used for irrigation purposes over the proposed golf course. It was estimated that the golf course requires approximately 20 mm per week of irrigation, which equates to over 85,000 ML/year for 8.25 ha of golf course. It was conservatively assumed that the pond will provide 20,000 ML/year, which is less than a quarter of the golf course requirements.

TABLE D.2 – GOLF COURSE WETLAND SYSTEM – GENERAL FEATURES & CONFIGURATION

Combined Golf Course Wetland System	
High Flow By-Pass (m^3/s)	3.0
Surface Area (m^2)	32600
Extended Detention Depth (m)	0.15
Permanent Pool Volume (m^3)	12300
Seepage Loss (mm/hr)	0
Evaporative Loss as % of PET	100
Outlet Properties	
Equivalent Pipe Diameter (mm)	434
Overflow Weir Width (m)	5.0
Notional Detention Time (hrs)	8.0
Re-Use Parameters	
Golf Course Irrigation Area - Tees, Greens & Fairways (ha)	8.25
Adopted Average Irrigation Requirement (mm/week)	20
Adopted Maximum Pond Drawdown for Re-Use (m)	0.15
Equivalent Annual Re-Use Requirement (ML/year)	85800
Adopted Annual Re-Use Requirement (ML/year)	20000

The expected sediment and nutrient removal performance of the wetland system was determined using the default equations and parameters provided in the MUSIC model. The water quality reduction mechanisms in MUSIC are based on an exponential decay equation referred to as the k – C* curve. It was assumed that the wetland will be used for irrigation of the adjacent golf course, we have conservatively assumed only about one quarter of golf course irrigation requirements will be provided by the wetland system

A summary of the estimated performance of the wetland system is discussed in Section 9 of this report.

Once the catchment upstream of the wetland is stabilised, maintenance would generally involve plant replacement, weed control, repair of localised erosion and minor structural damage and the removal of localised sediment build-up. This would be undertaken on a quarterly basis on average with vegetation replacement budgeted for on a decadal cycle.

Golf Course Grassed Swale System

The parameters adopted in the assessment of the Golf Course grassed swale system is summarised below in Table D.3. The combined length of the grassed swales are assumed to have a cumulative effective length of approximately 2000 m long, and is 5 m wide at a longitudinal grade of 0.5%. The grassed swale is modelled as a very shallow device and is to be provided downstream of the golf course playing area within the "rough" area of the golf course, effectively a buffer between the fairways and the wetland edge. The swale has not been assumed to treat runoff from the golf club development area.

TABLE D.3 – GOLF COURSE GRASSED SWALE SYSTEM – GENERAL FEATURES & CONFIGURATION

Swale Properties	
Low Flow By-Pass (m^3/s)	0.0
Length (m)	2000
Bed Slope (%)	0.5
Base Width (m)	1.0
Top Width (m)	5.0
Depth (m)	0.01
Vegetation Height (m)	0.1
Exfiltration Rate (mm/hr)	3.6
Calculated Swale Properties	
Mannings N	0.321
Batter Slope	1:200
Velocity (m/s)	0.007
Hazard (m^2/s)	0.0
Cross Sectional Area (m^2)	0.03
Swale Capacity (m^3/s)	0.0

The expected sediment and nutrient removal performance of the grassed swale system was determined using the default equations and parameters provided in the MUSIC model. The water quality reduction mechanisms in MUSIC are based on an exponential decay equation referred to as the k – C* curve.

Rainfall Data

The MUSIC model is able to utilise rainfall data based on 6 minute, hourly, 6 hourly and daily time steps. A 6 minute time step was used in the analysis which was chosen in accordance with the recommendations for selecting a time step within the MUSIC User's Manual.

Rainfall records for the area were obtained from the Bureau of Meteorology. The nearest rainfall station to the site with a reasonable period of 6 minute rainfall data for a suitably representative period of rainfall for the site was Taree:

Station No	Location	Years of Record	Type of Data
67015	Taree	1967 - 1976	6 minute

The mean annual rainfall in the data set used in the modelling is 1237 mm, while the mean annual rainfall for Taree is 1179 mm, and 1338 mm for Harrington (combined average mean of 1259 mm. The rainfall and potential evapo-transpiration data for the period analysed is shown on the graph which is provided in Plate 1.

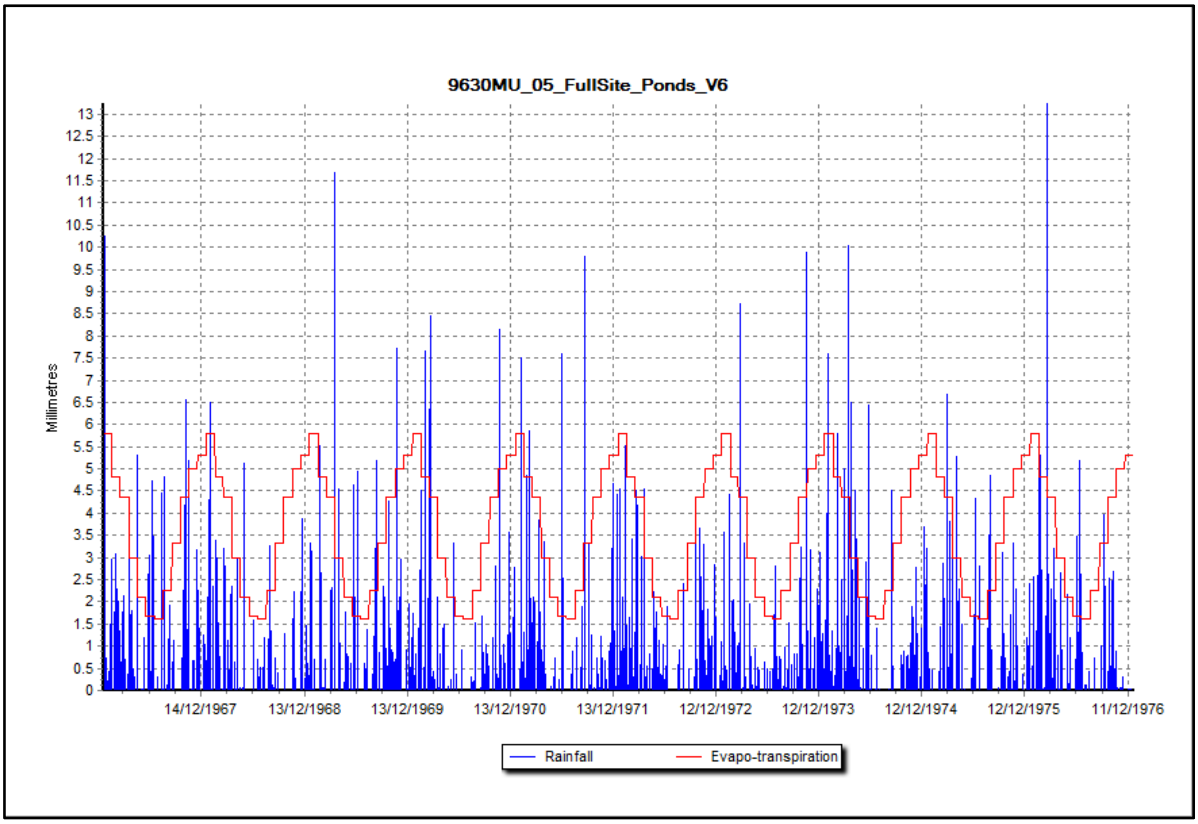


PLATE D.1 – RAINFALL & EVAPO-TRANSPIRATION DATA ADOPTED FOR THE OLD BAR PRECINCT 3 SITE

A summary of the rainfall data set (Taree 1967 – 1976) used in the MUSIC model for the Old Bar Precinct 3 site and comparable rainfall data sets provided by the Bureau of Meteorology rainfall station gauges in Taree and Harrington is shown below in Table D.4.

TABLE D.4 – SUMMARY OF RAINFALL DATA FOR THE SITE

Property	Bureau of Meteorology Data (Taree 060030)	Bureau of Meteorology Data (Harrington 060023)	Average of Bureau of Meteorology Data	Adopted MUSIC Model Data Set (1967 - 1976)
Mean Yearly Rainfall (mm)	1179	1338	1259	1237
Decile 1 Rainfall (mm)	776	916	846	849
Decile 5 Rainfall (mm)	1135	1271	1203	1201
Decile 9 Rainfall (mm)	1692	1786	1739	1610
Mean No. Rain Days	116	129	122.4	134.6
Mean No. Rain Days > 1mm	89	105	96.8	98.0
Mean No. Rain Days > 10mm	30	36	33.1	32.9
Mean No. Rain Days > 25mm	12	13.7	12.9	12.8

Soil / Groundwater Parameters and Pollutant Loading Rates

In the absence of site specific data, the soil / groundwater parameters and pollutant loading rates adopted for the natural and urban catchments of the Old Bar Precinct 3 site, were based on the recommended parameters provided by the Draft MUSIC Modelling Guidelines for NSW as prepared by the Sydney Metropolitan Catchment Management Authority (SMCMA, 2010). The adopted parameters are consistent with a site with a Mean Annual Rainfall depth greater than 1000 mm and are presented in Tables D.5 and D.6.

TABLE D.5 – ADOPTED SOIL / GROUNDWATER PARAMETERS FORTHE SITE
(Source : DECC Technical Note)

		Urban	Non-Urban
Impervious Area Parameters			
Rainfall threshold (Roof 0.5, Road 1)	mm/day	1.4	1.4
Pervious Area Parameters			
Soil storage capacity	mm	170	175
Initial storage	% of capacity	30	30
Field capacity	mm	70	55
Infiltration capacity coefficient - a		210	215
Infiltration capacity coefficient - b		4.7	2.4
Groundwater Properties			
Initial depth	mm	10	10
Daily recharge rate	%	50	55
Daily baseflow rate	%	4	10
Daily deep seepage rate	%	0	0

TABLE D.6 – ADOPTED EVENT MEAN CONCENTRATIONS (SOURCE: CRCCH)

	Roofs		Roads		Remaining Urban		Golf Course		Forest		Rural	
Pollutant	Base Flow (mg/L)	Storm Flow (mg/L)	Base Flow (mg/L)	Storm Flow (mg/L)	Base Flow (mg/L)	Storm Flow (mg/L)	Base Flow (mg/L)	Storm Flow (mg/L)	Base Flow (mg/L)	Storm Flow (mg/L)	Base Flow (mg/L)	Storm Flow (mg/L)
TSS	-	20.0	-	269	15.8	141	15.8	160	6.03	39.8	14	90
TP	-	0.129	-	0.501	0.141	0.251	0.141	0.33	0.032	0.079	0.06	0.22
TN	-	2.00	-	2.19	1.29	2.00	1.29	3.09	0.302	0.891	0.9	2.00

Treatment Device Performance

Each element of the series of treatment practice (commonly referred to as a treatment train), as represented in the MUSIC model for the Old Bar Precinct 3 site, is described below.

Rainwater Tanks

The impacts of the use of rainwater tanks, provided on each allotment, were modelled using the "Rainwater Tank" node with the following design assumptions:

Roof Area & Area Discharging to Rainwater Tank

It has been assumed that 100% of all of the roofed areas will be directly connected to rainwater tanks, in accordance with the recommendations outlined in the NSW MUSIC modelling Guidelines (SMCMA, 2010). The average roof area for the residential areas was assumed to be based on an average roof area of approximately 250m^2 per lot. For the rural residential areas, the roof area was assumed to be 350m^2 per lot.

Average Rainwater Tank Size

The average rainwater tank size adopted in the investigation is in accordance with Sydney Water recommendations of a minimum tank size of 5000 litres for residential properties. Of the 5000 litres available, it is assumed that top up of the tank from the potable water main would occur once the volume of water remaining in the tank dropped below 20%. Therefore, for the volume available for stormwater storage adopted in the modelling was 4000 litres.

Average Reuse

The average reuse amount adopted in the investigation was based on 2.5 occupants per household, which was 305 litres per urban household and 278 litres per rural household per day for toilet flushing, and laundry use, with an additional 112 kilolitres per household per year for outdoor use (based on PET – rain). The total volumes adopted in the modelling were based on the lot arrangement as provided by LSW in 2013, which is equivalent to about 10 – 11 dwellings per hectare for the low density development. The adopted re-use parameters are based on the Draft MUSIC modelling Guidelines (SMCMA, 2010):

Urban Residential Development

Average Annual Water Usage	223 kl/yr. (612 l/day)
Water Usage for Toilet Flushing and laundry	111 kl/yr. (305 l/day)
Outdoor	112 kl/yr. (307 l/day)

Rural Residential Development

Average Annual Water Usage	214 kl/yr. (585 l/day)
Water Usage for Toilet Flushing and laundry	102 kl/yr. (278 l/day)
Outdoor	112 kl/yr. (307 l/day)

Bypassing Flows

It was assumed that flows from the roof area in excess of the 1 year ARI storm event would bypass the rainwater tanks, which is equivalent to approximately 5 l/s per dwelling.

Litter and Sediment Control Structures

Drainage systems collecting runoff from local roads and hardstand areas, throughout the Old Bar Precinct 3 site, have been modelled with Gross Pollutant Traps (GPTs) to remove litter and coarse sediment prior to discharge into the downstream drainage systems, bio-retention raingardens and riparian corridors. GPTs are available as inlet pit filter inserts, purpose built cast in situ systems or precast proprietary traps using either dry or wet sump storage chambers.

The criterion, used to assess the performance of the GPTs in the MUSIC model, was based on the credit given to vortex-type GPTs and adopted pollutant removal efficiencies is in accordance with the NSW MUSIC Modelling Guidelines (SMCMA, 2010). It is expected that the site drainage strategy would require approximately ten (10) major GPTs (at least one per bio-retention and swale system and at road connections into trunk drainage systems).

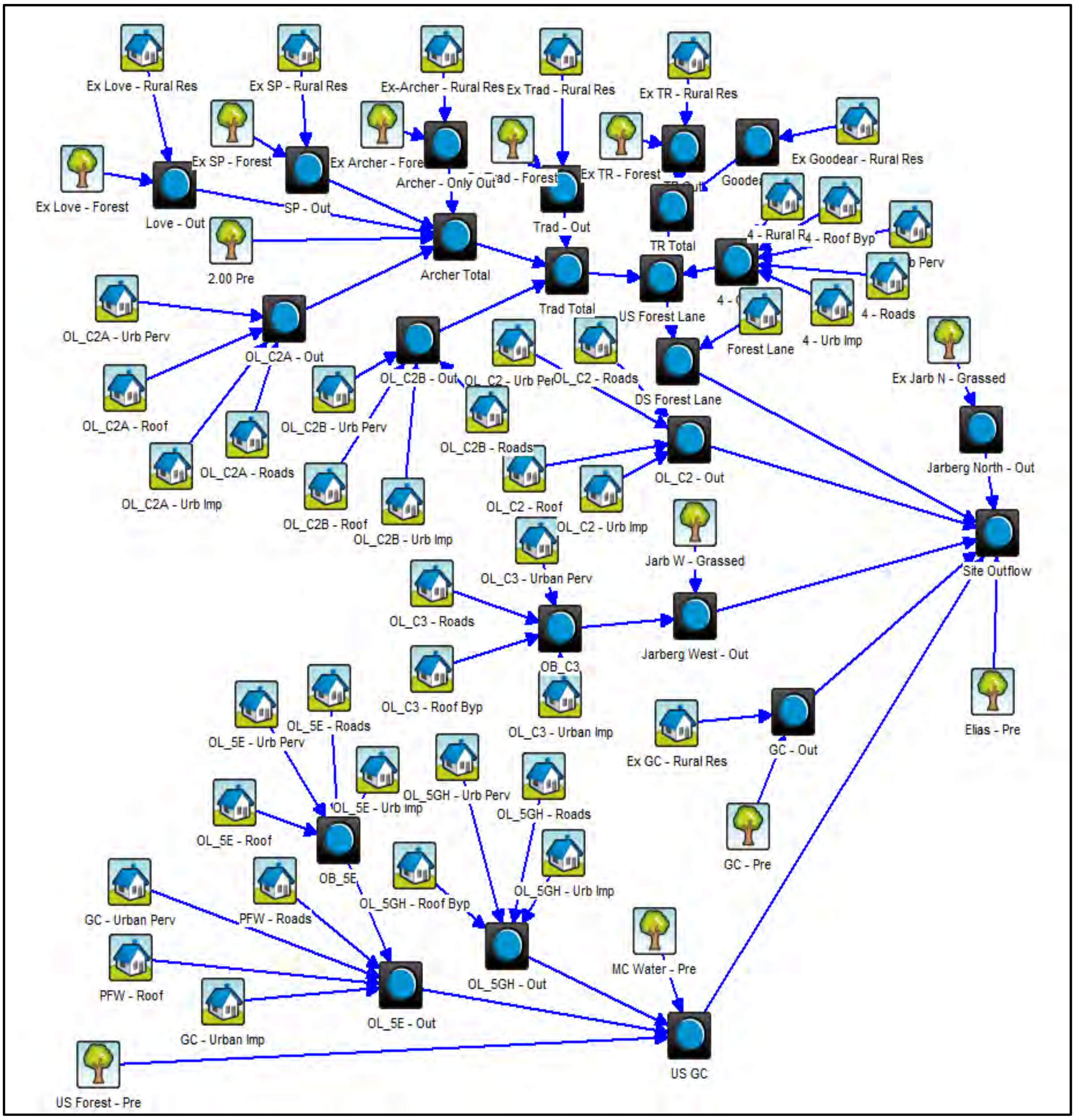


PLATE D.2 – MUSIC MODEL LAYOUT FOR THE OLD BAR PRECINCT 3 SITE – EXISTING SITE CONDITIONS

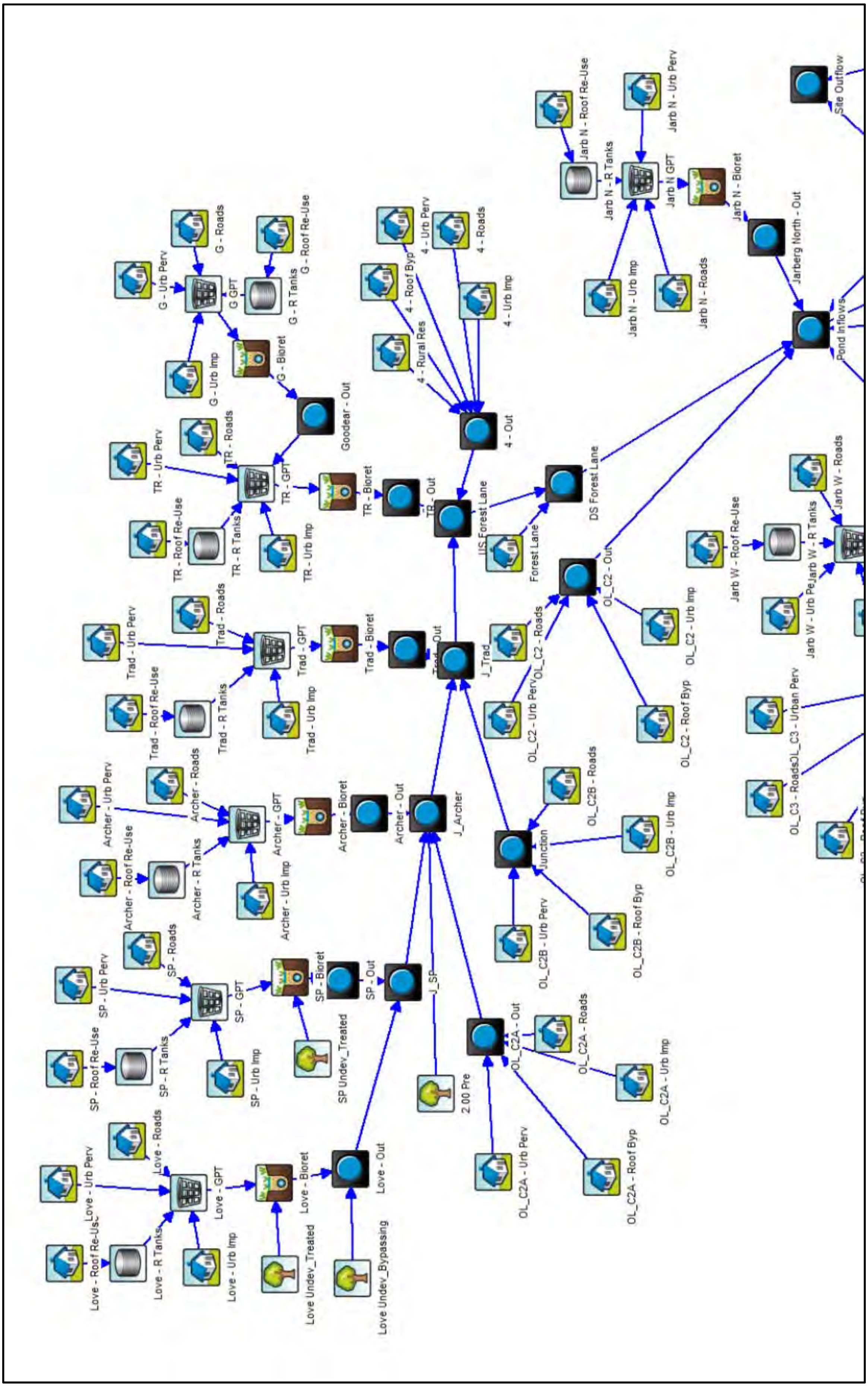


PLATE D.3A – MUSIC MODEL LAYOUT FOR THE OLD BAR PRECINCT 3 SITE – DEVELOPED SITE CONDITIONS (NORTHERN CATCHMENTS)

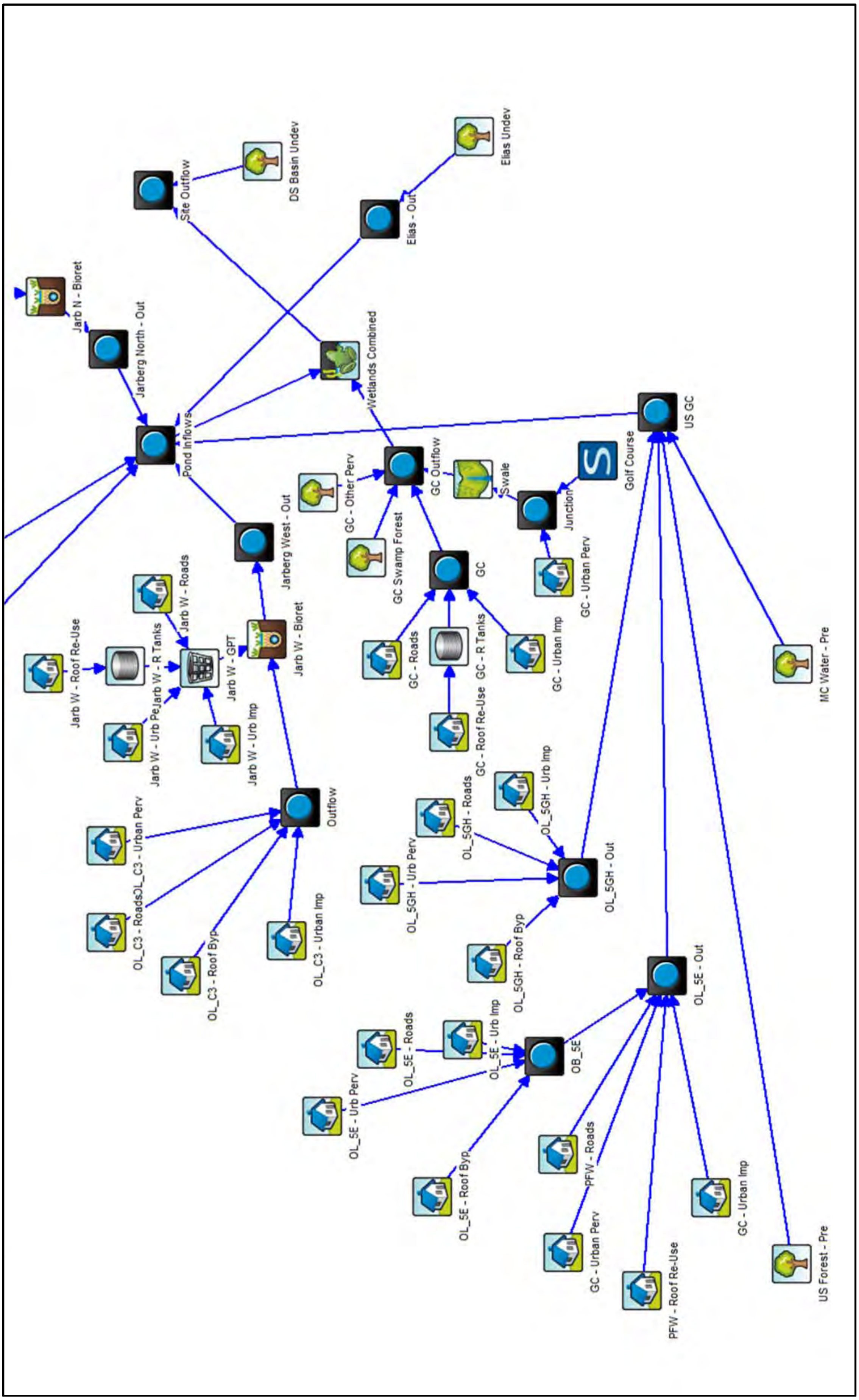
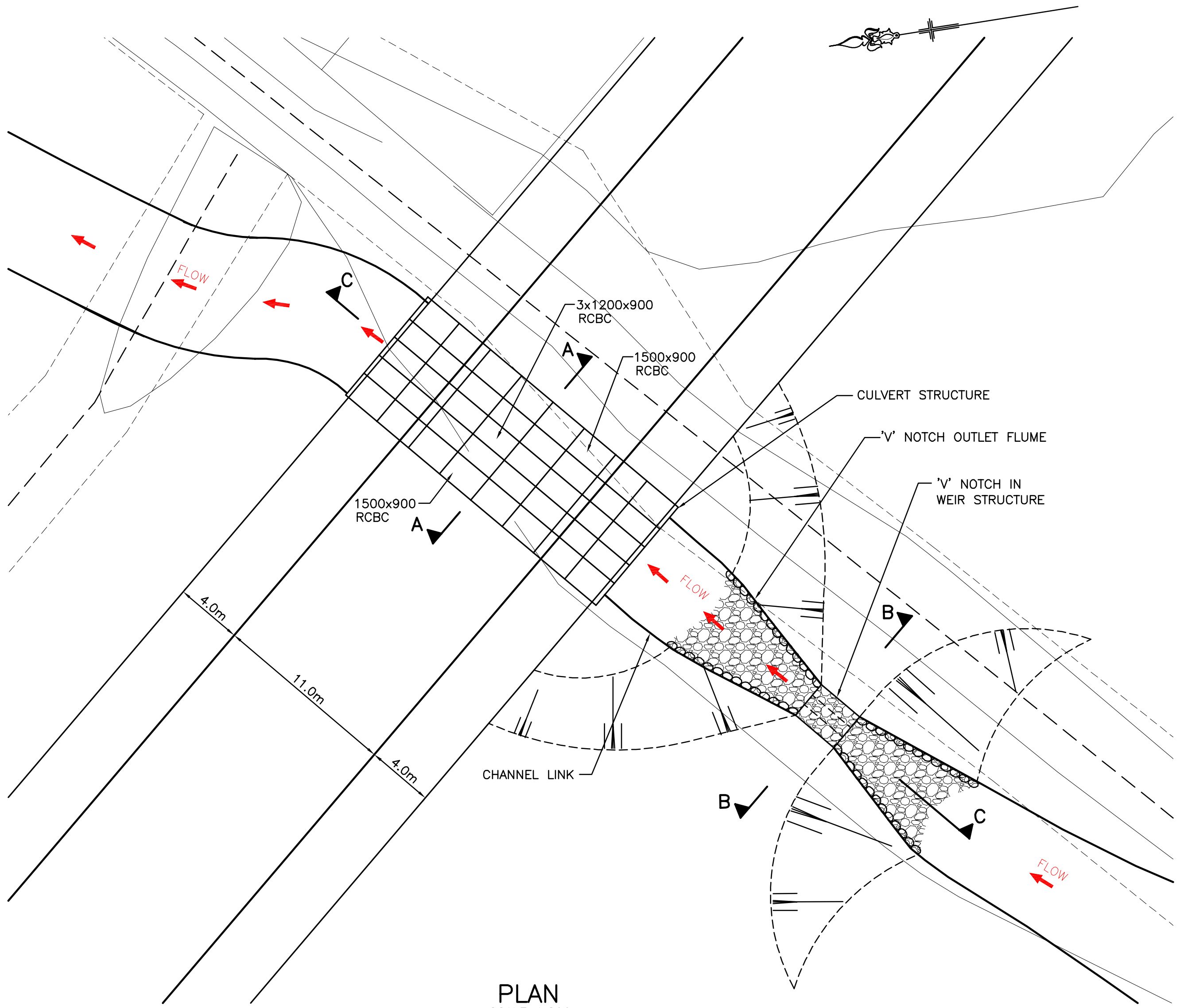
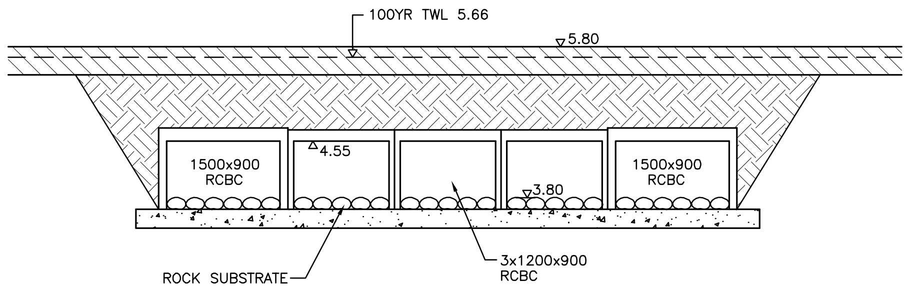


PLATE D.3B – MUSIC MODEL LAYOUT FOR THE OLD BAR PRECINCT 3 SITE – DEVELOPED SITE CONDITIONS (SOUTHERN CATCHMENTS)

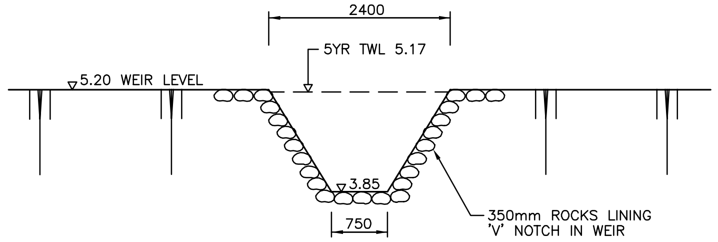
APPENDIX E – DETAILED PLAN OF PROPOSED DISCHARGE CONTROL DEVICE FOR MAIN BASIN



PLAN
SCALE 1:200



SECTION A–A
SCALE 1:50



SECTION B–B
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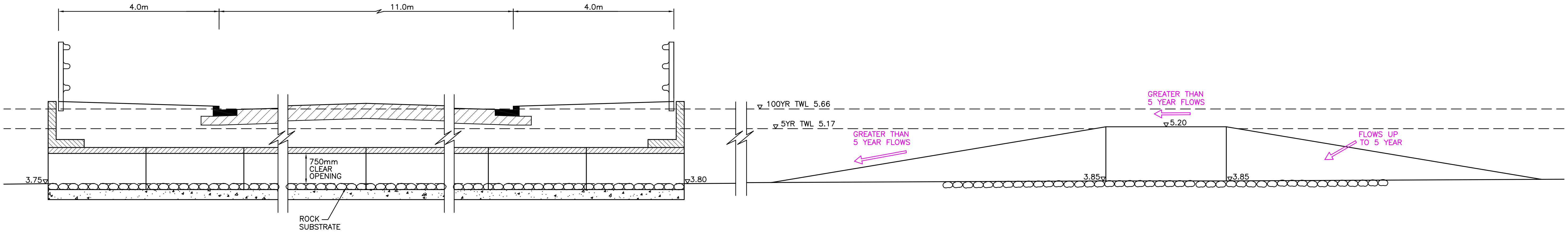

SECTION C–C
SCALE 1:50

1:50 (AT A1) 100 0 100 200 300 400 500 MILLIMETRES

1:200 (AT A1) 4 2 0 4 8 12 16 20 METRES

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DRAWN D.H.
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ORIGIN:
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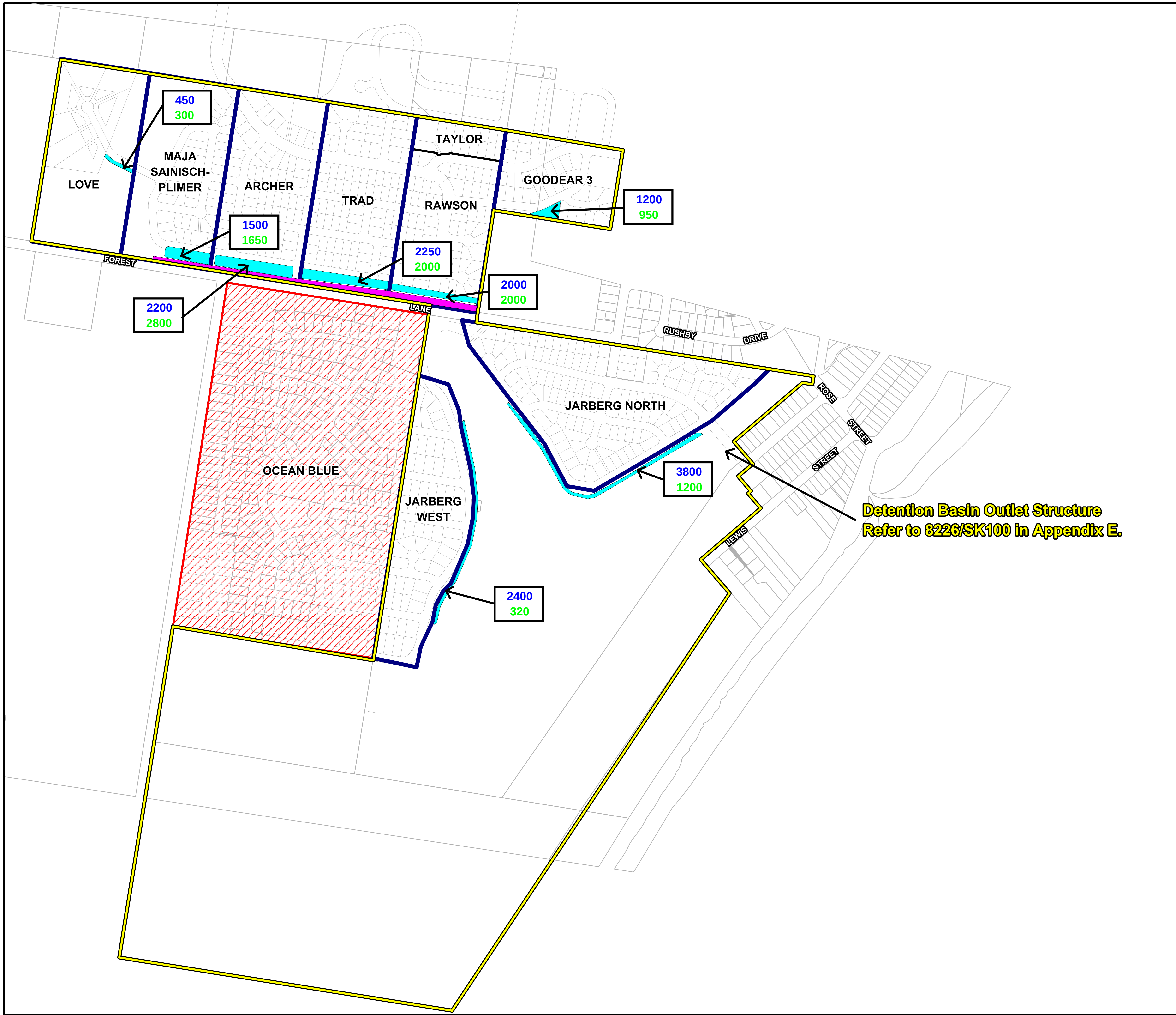
OLD BAR 2008 GOLF COURSE LAYOUT
DETENTION BASIN OUTLET STRUCTURE

PLAN No. 8226/SK100 A
FILE No. 8226SK100
SHEET 1 OF 1 SHEETS

APPENDIX F – FIGURES



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LEGEND

- OLD BAR PRECINCT 3 SITE BOUNDARY
- COMBINED DETENTION BASIN WITH BIORETENTION RAINGARDEN
- DETENTION BASIN CATCHMENT EXTENTS
- UPSTREAM DEVELOPMENT CATCHMENT NOT TREATED
- PROPOSED NORTHERN CHANNEL
- 3800 DETENTION BASIN VOLUME (cu.m)
- 1200 RAINGARDEN BED AREA (sq.m)

N W E S

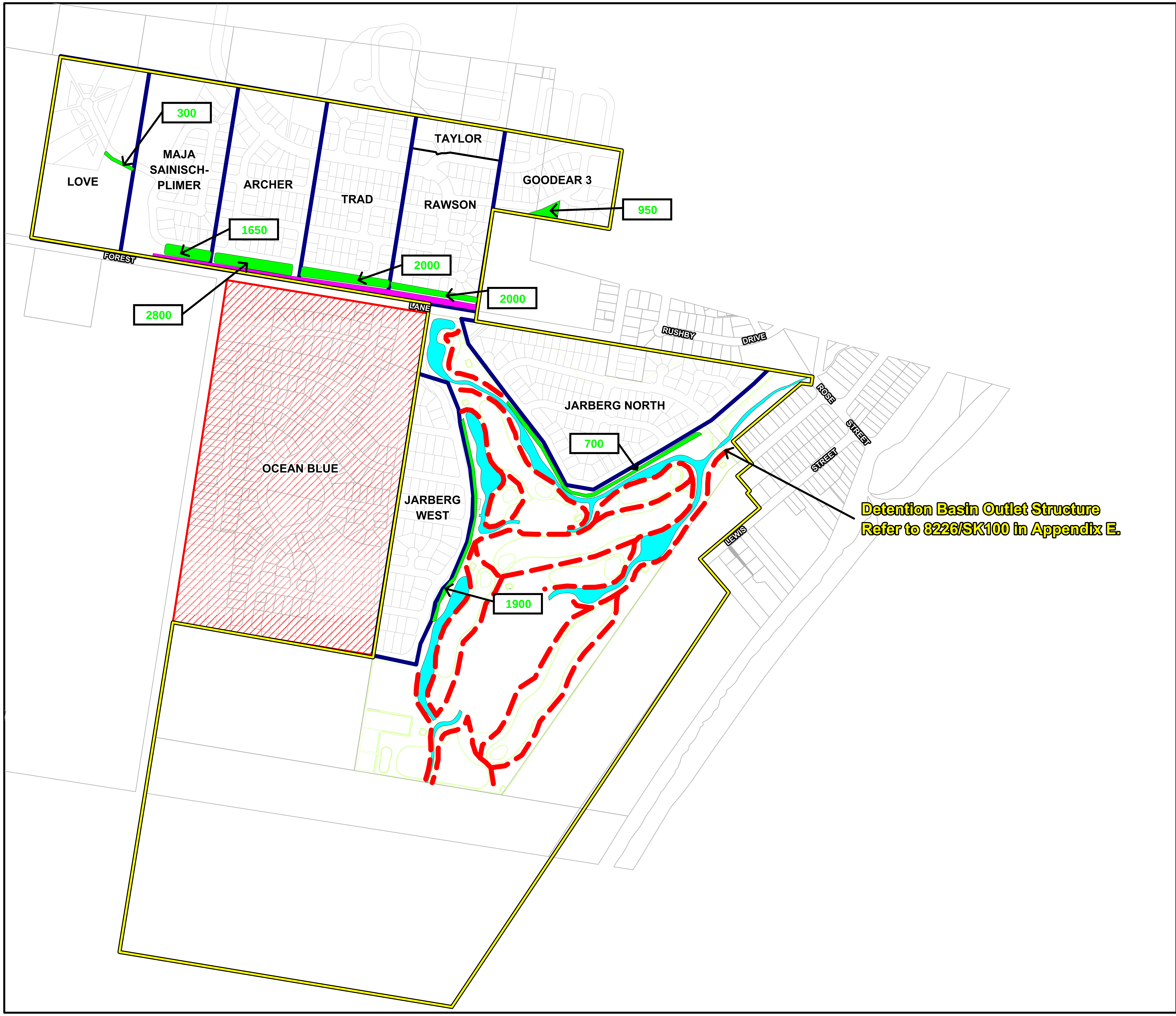
Scale 1: 7,500 @ A3

200 0 200 m

Figure 6.1
Old Bar - Precinct 3, Flood Management Strategy

Water Cycle Management Plan Interim Conditions

File Name: 9630 Fig6.1 WCMP Interim
Date : 22/04/2014 Issue : B



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LEGEND

- OLD BAR PRECINCT 3 SITE BOUNDARY
- PROPOSED BIORETENTION RAINGARDEN
- DETENTION BASIN CATCHMENT EXTENTS
- UPSTREAM DEVELOPMENT CATCHMENT NOT TREATED
- PROPOSED NORTHERN CHANNEL
- PROPOSED POND
- APPROXIMATE EXTENT OF PROPOSED GRASSED SWALE SYSTEM
- 1200 RAINGARDEN BED AREA (sq.m)

N
W E
S

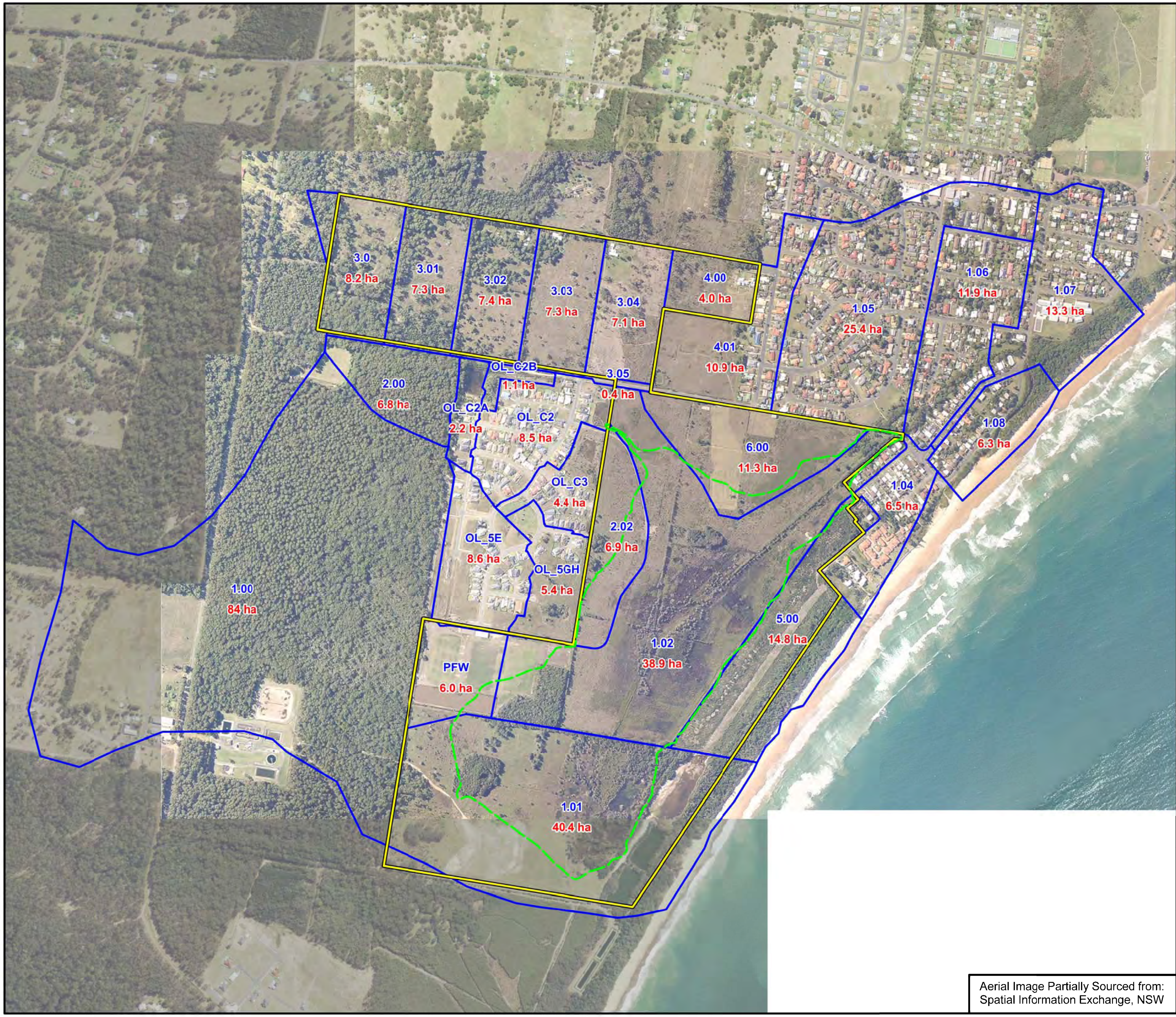
Scale 1: 7,500 @ A3

200 0 200 m

Figure 6.2
Old Bar - Precinct 3, Flood Management Strategy

Water Cycle Management Plan Developed Conditions

File Name: 9630 Fig6.2 WCMP Prop
Date : 15/04/2014 Issue : b



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LEGEND

- OLD BAR PRECINCT 3 SITE BOUNDARY
- SUB-CATCHMENT AREA
- 1.01 XP-RAFTS NODE
- 43.1 ha CATCHMENT AREA
- EXISTING BASIN EXTENTS

N W E S

Scale 1: 10,000 @ A3

200 0 200 m

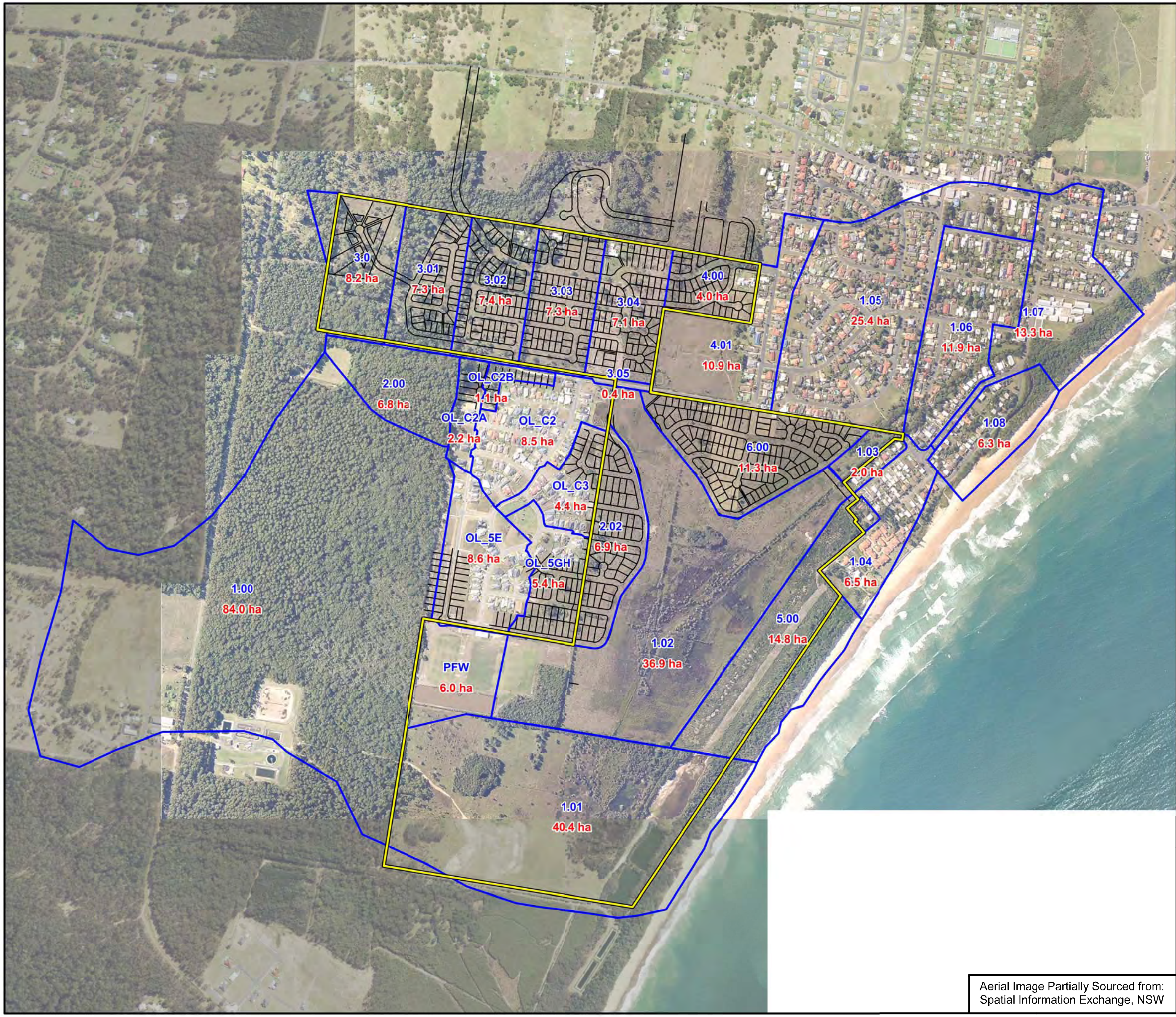
Figure 7.1 Old Bar - Precinct 3, Flood Management Strategy

Existing Catchment Plan

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig7.1 - Catchment Exi

Date : 03/04/2014 Issue : A



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LEGEND

- OLD BAR PRECINCT 3 SITE BOUNDARY
- SUB-CATCHMENT AREA
- 1.01 XP-RAFTS NODE
- 43.1 ha CATCHMENT AREA

N W E S

Scale 1: 10,000 @ A3

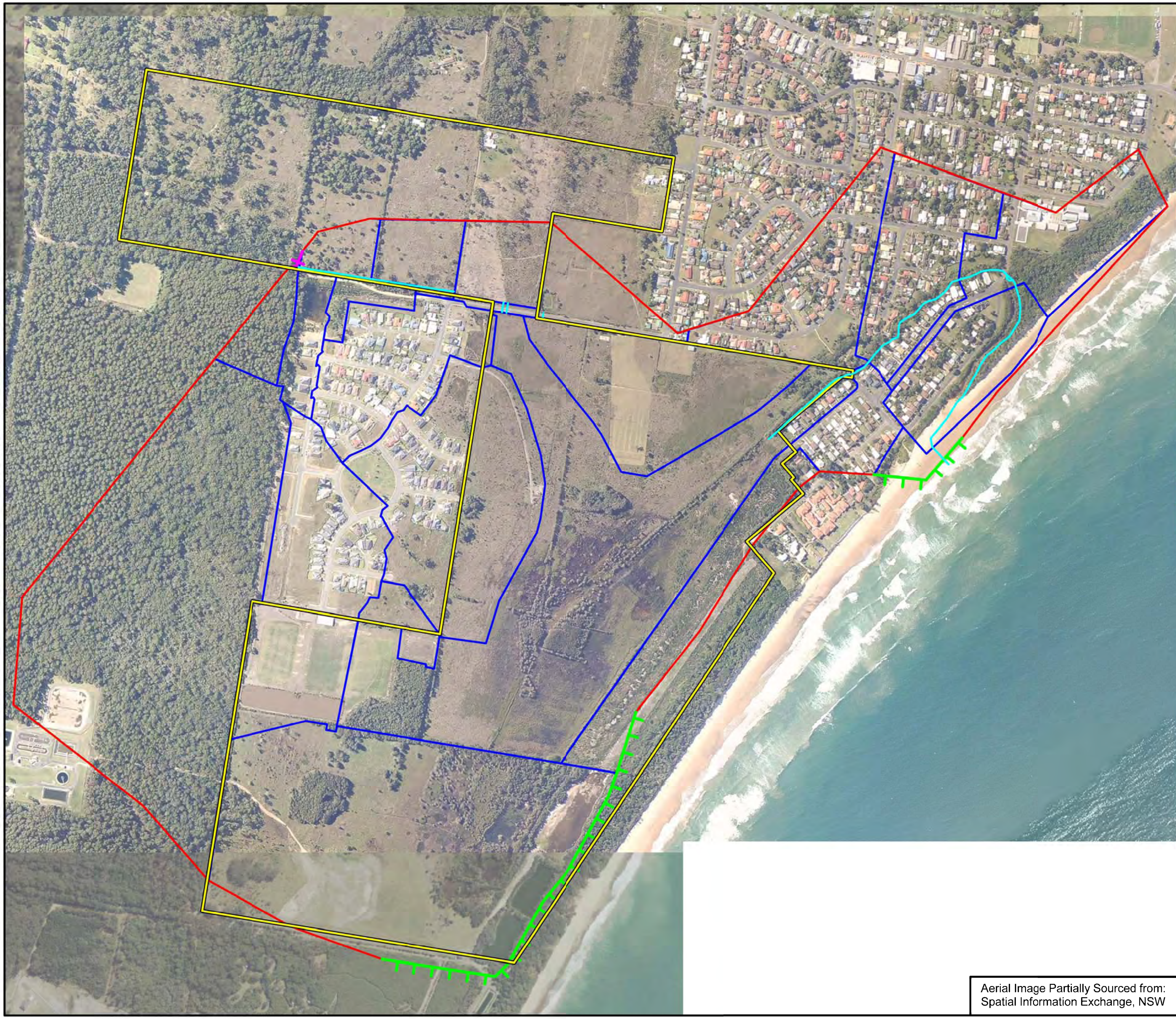
200 0 200 m

Figure 7.2 Old Bar - Precinct 3, Flood Management Strategy

Developed Catchment Plan

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig7.2 - Catchment Prop
Date : 03/04/2014 Issue : A



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LEGEND

- TUFLOW BOUNDARY
- OLD BAR PRECINCT 3 SITE BOUNDARY
- INDICATIVE SOURCE AREA CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT FLOW INPUTS
- HQ MODEL OUTLET
- 1D NETWORK

N W E S

Scale 1: 8,000 @ A3

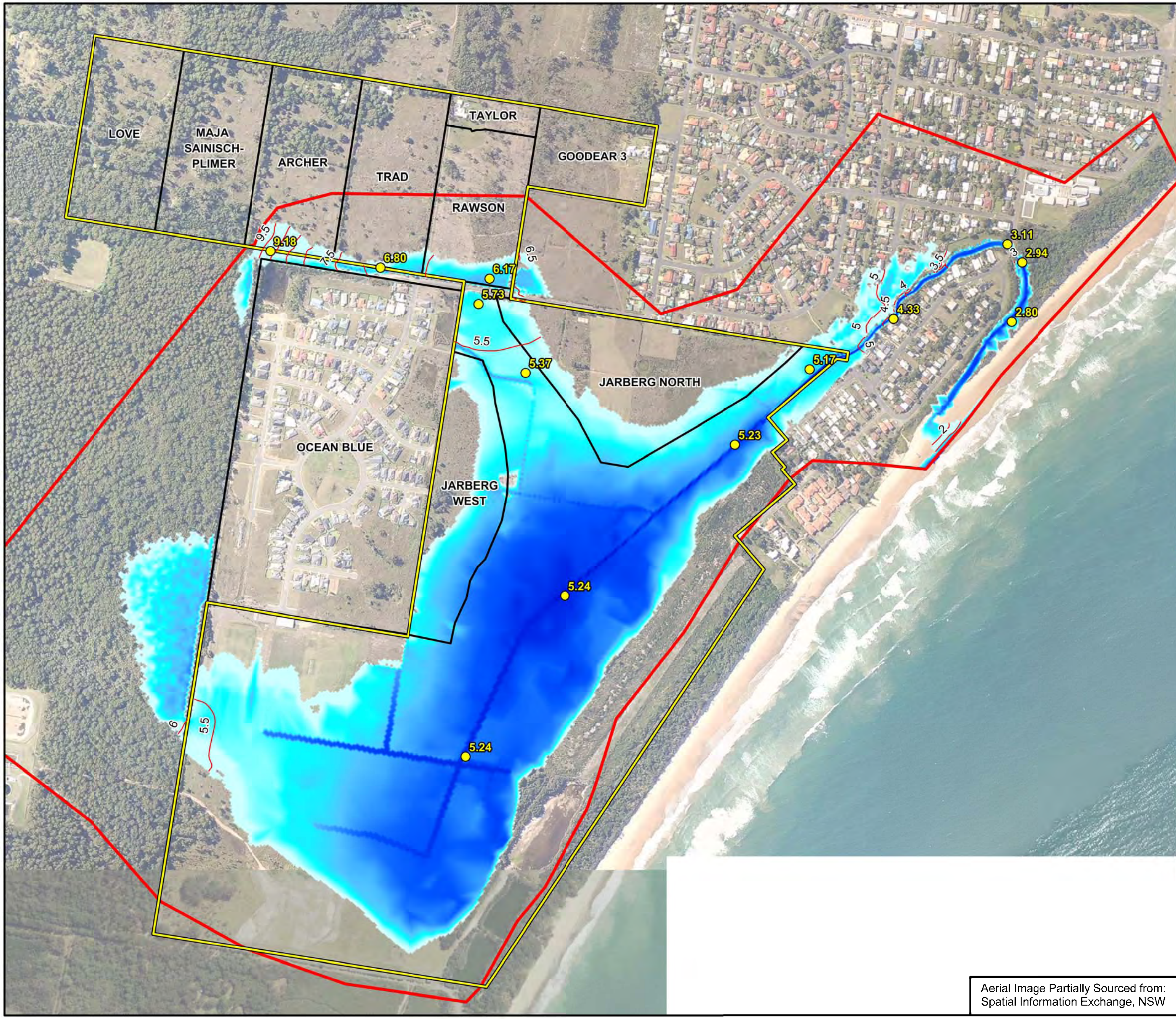
200 0 200 m

Figure 8.1
Old Bar - Precinct 3, Flood Management Strategy

TUFLOW Model Layout

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.1 - TUFLOW
Date : 03/04/2014 Issue : A



Aerial Image Partially Sourced from:
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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

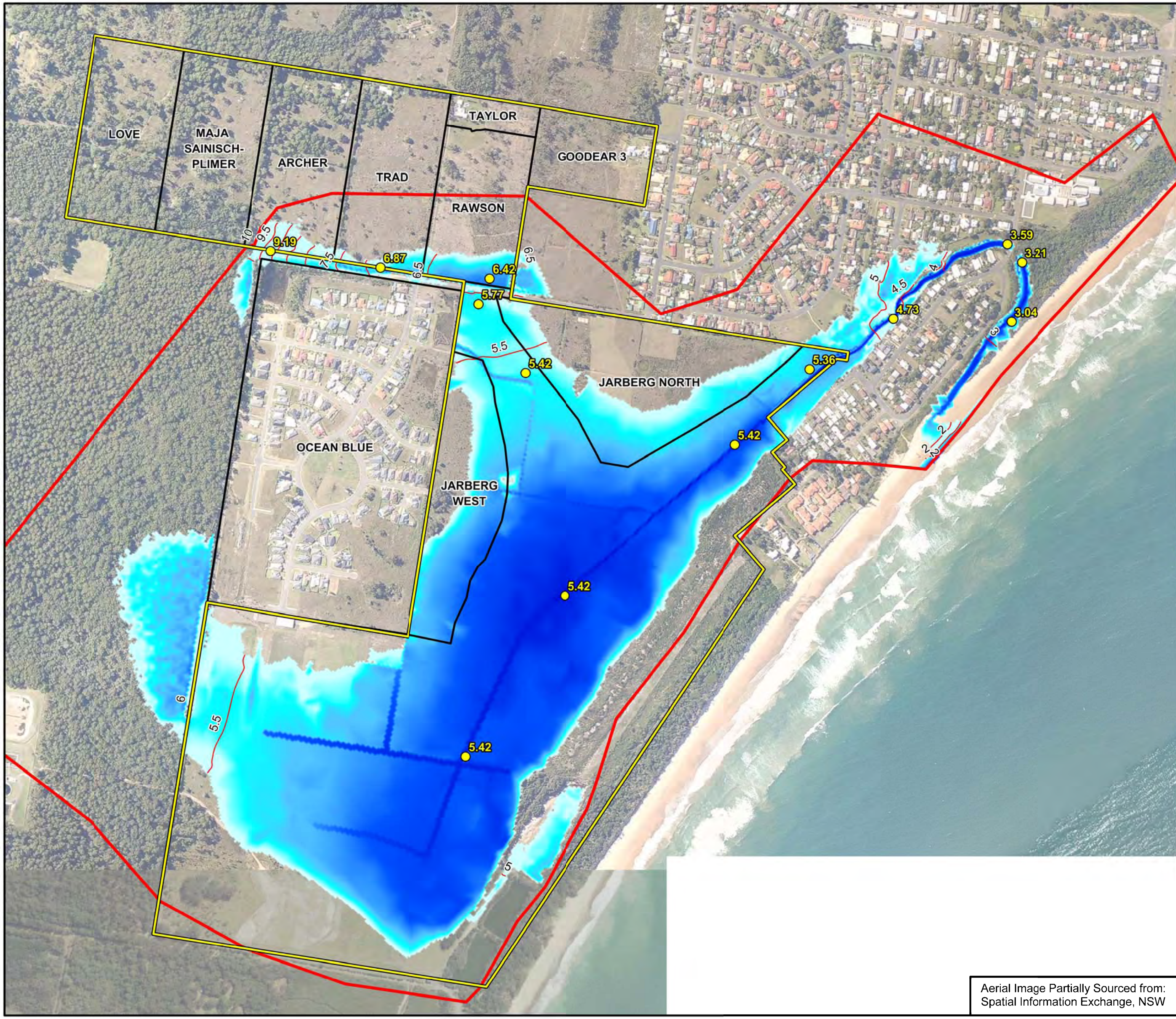
Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.2
Old Bar - Precinct 3, Flood Management Strategy

20% AEP Flood Depth, Level and Extent Plan Existing Conditions

File Name: 9630 Fig8.2 - 20%AEPExi
Date : 14/04/2014 Issue : B



Aerial Image Partially Sourced from:
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LEGEND

STUDY AREA
OLD BAR PRECINCT 3 SITE BOUNDARY
DEPTH (m)
0.0 to 0.2
0.2 to 0.3
0.3 to 0.5
0.5 to 1.0
1.0 to 2.0
2.0 to 3.0
3.0 +
4.5 0.5m FLOOD CONTOUR
FLOOD HEIGHT (m AHD)

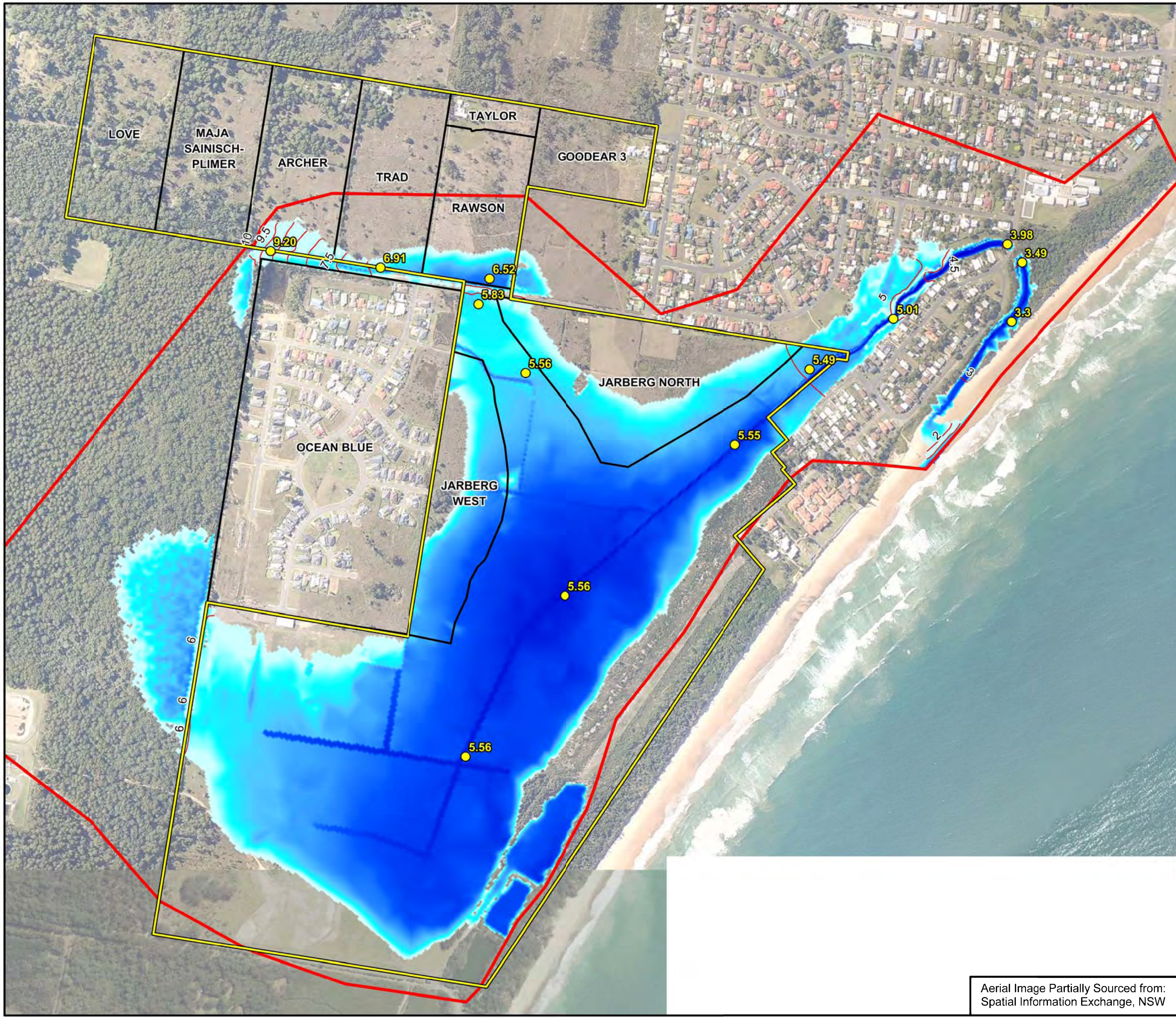
N W E S

Scale 1: 7,500 @ A3
200 0 200 m

Figure 8.3 Old Bar - Precinct 3, Flood Management Strategy

5% AEP Flood Depth, Level and Extent Plan Existing Conditions

File Name: 9630 Fig8.3 - 5%AEPExi
Date : 14/04/2014 Issue : B



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LEGEND

STUDY AREA

OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.4
Old Bar - Precinct 3, Flood Management Strategy

1% AEP Flood Depth, Level and Extent Plan Existing Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.4 - 1%AEPExi
Date : 14/04/2014
Issue : B

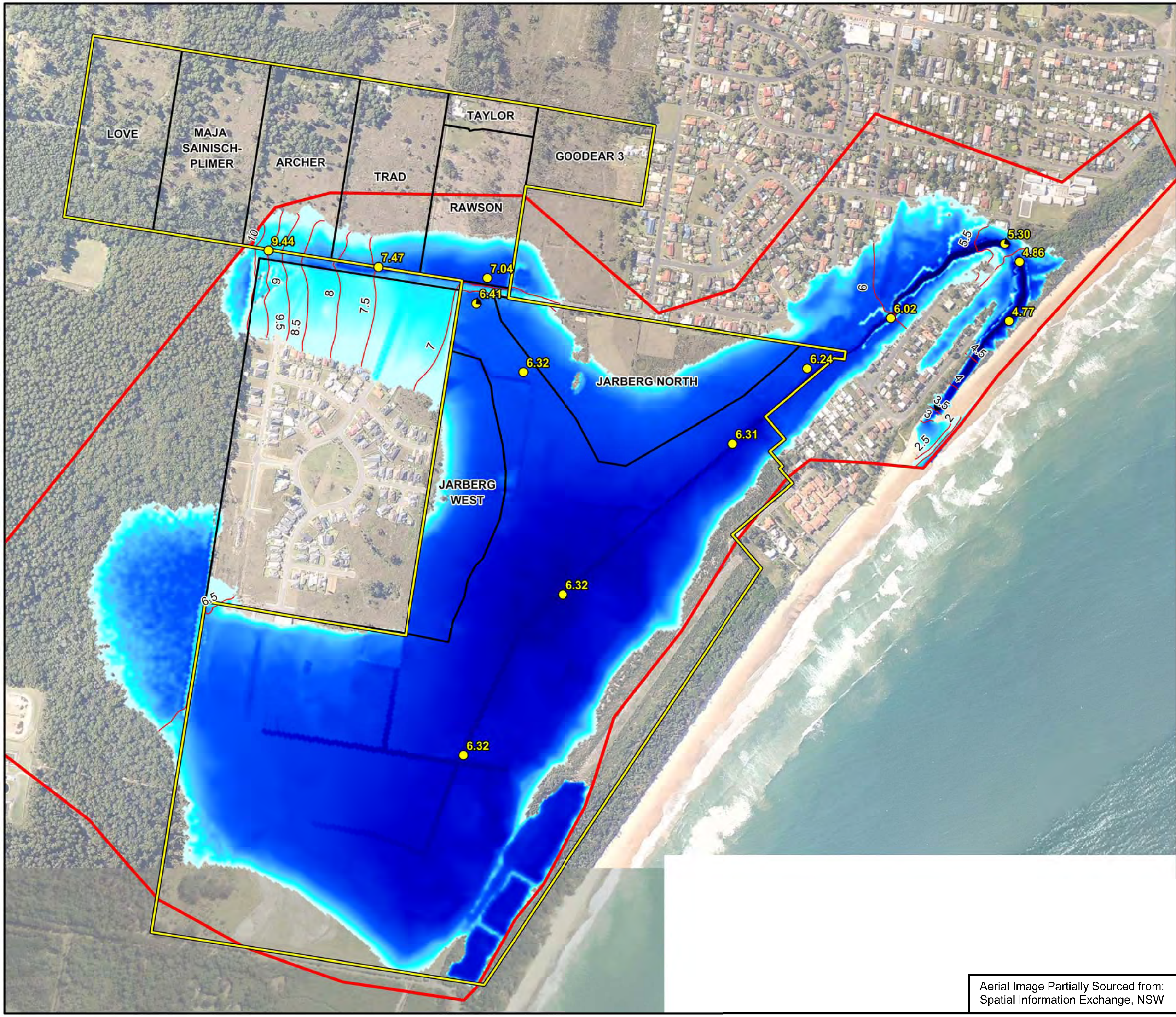

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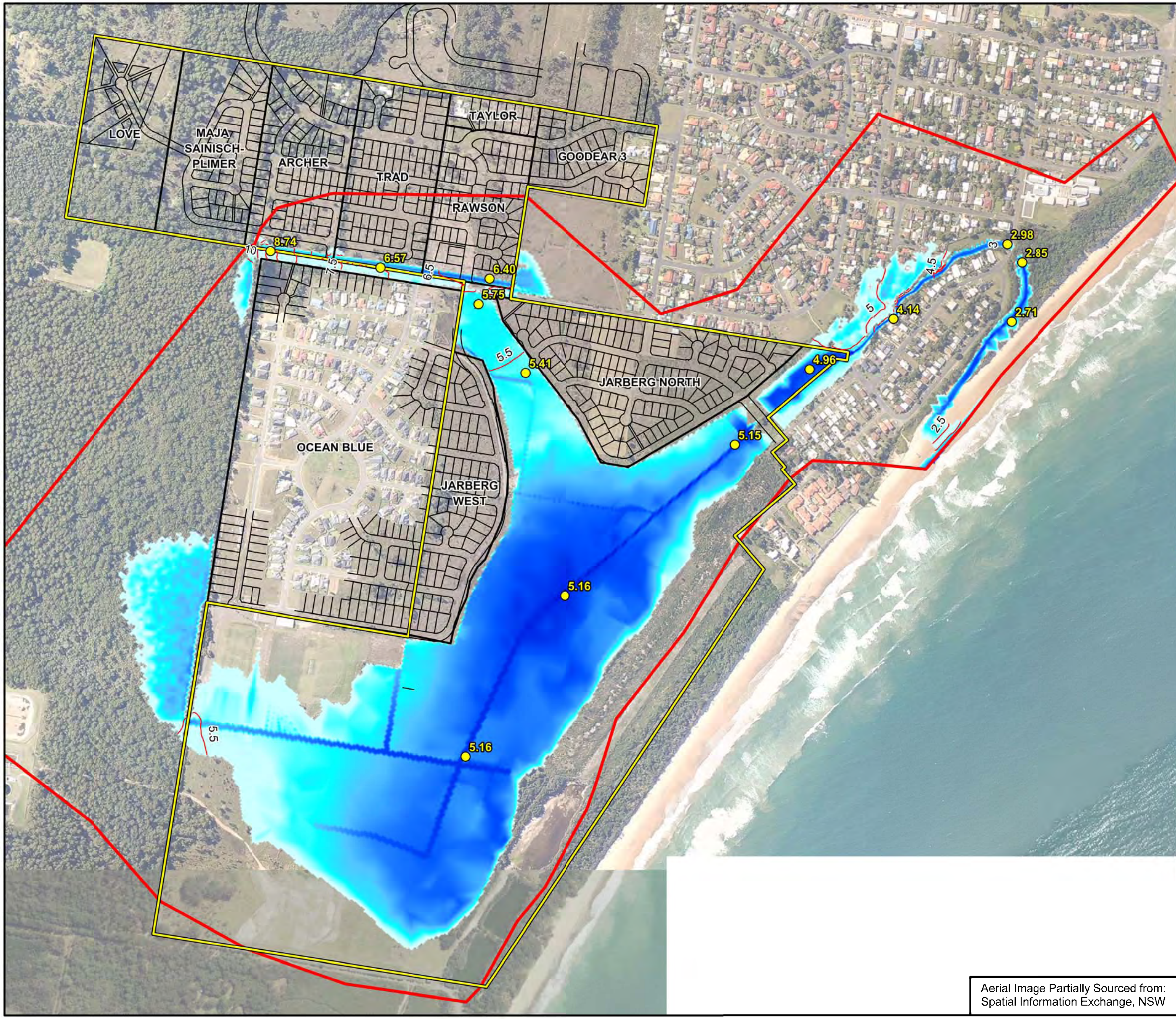
Figure 8.5
Old Bar - Precinct 3, Flood Management Strategy

PMF Flood Depth, Level and Extent Plan Existing Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.5 - PMFExi
Date : 14/04/2014
Issue : B



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

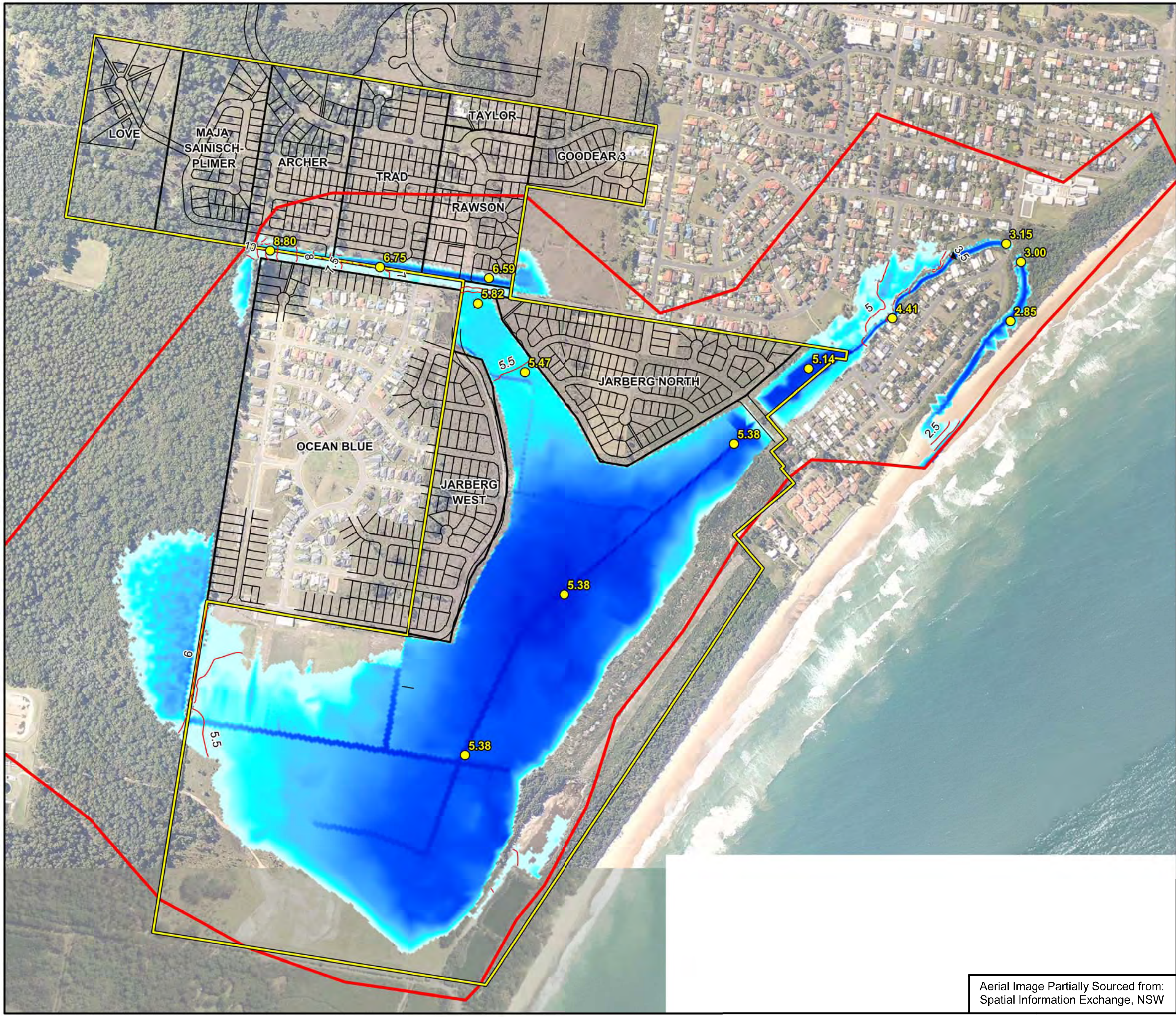
200 0 200 m

Figure 8.6 Old Bar - Precinct 3, Flood Management Strategy

20% AEP Flood Depth, Level and Extent Plan Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.6 - 20%AEPOpt
Date : 14/04/2014
Issue : A



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

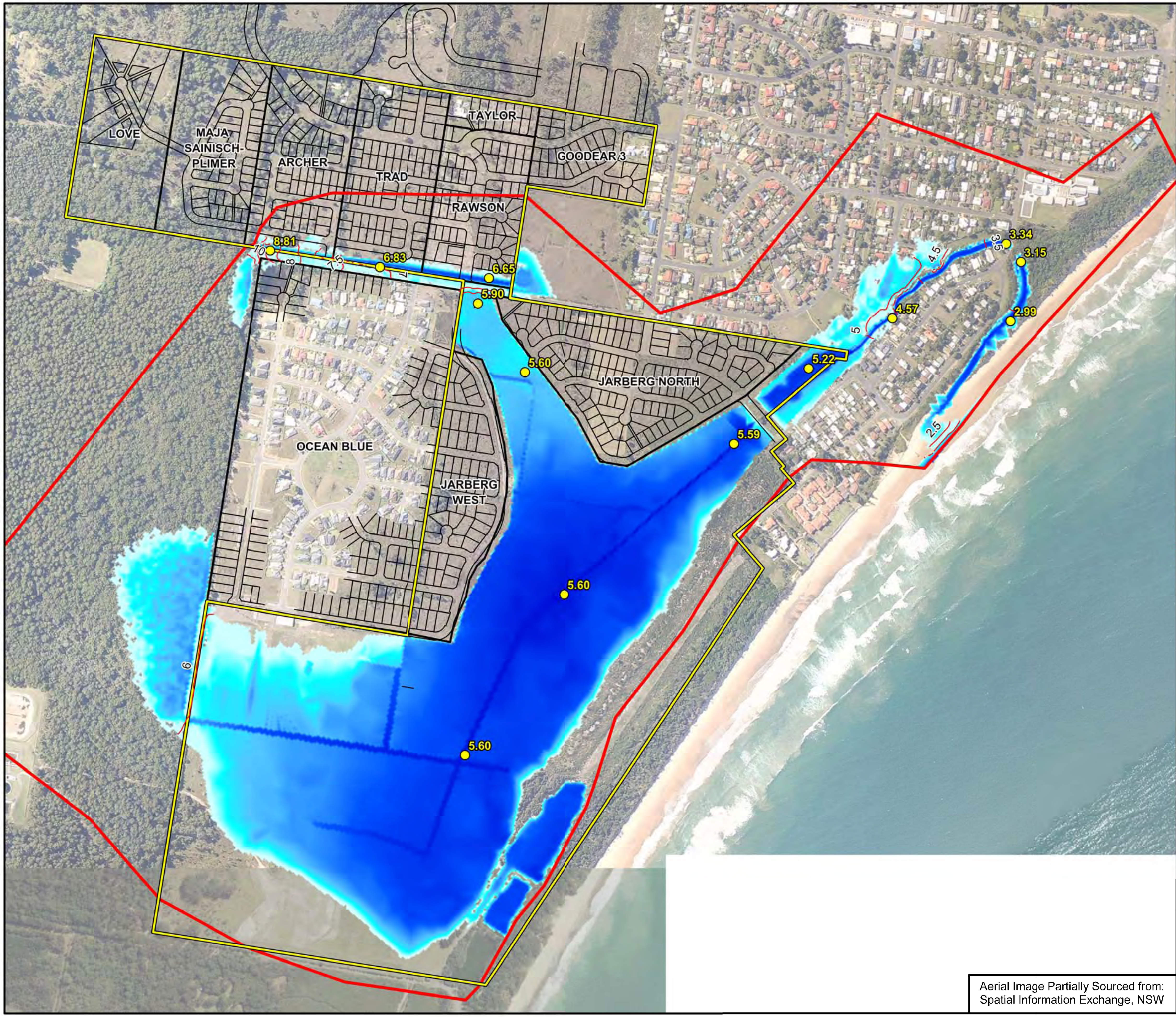
200 0 200 m

Figure 8.7 Old Bar - Precinct 3, Flood Management Strategy

5% AEP Flood Depth, Level and Extent Plan Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.7 - 5%AEPOpt
Date : 14/04/2014
Issue : A



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)

- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 — 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

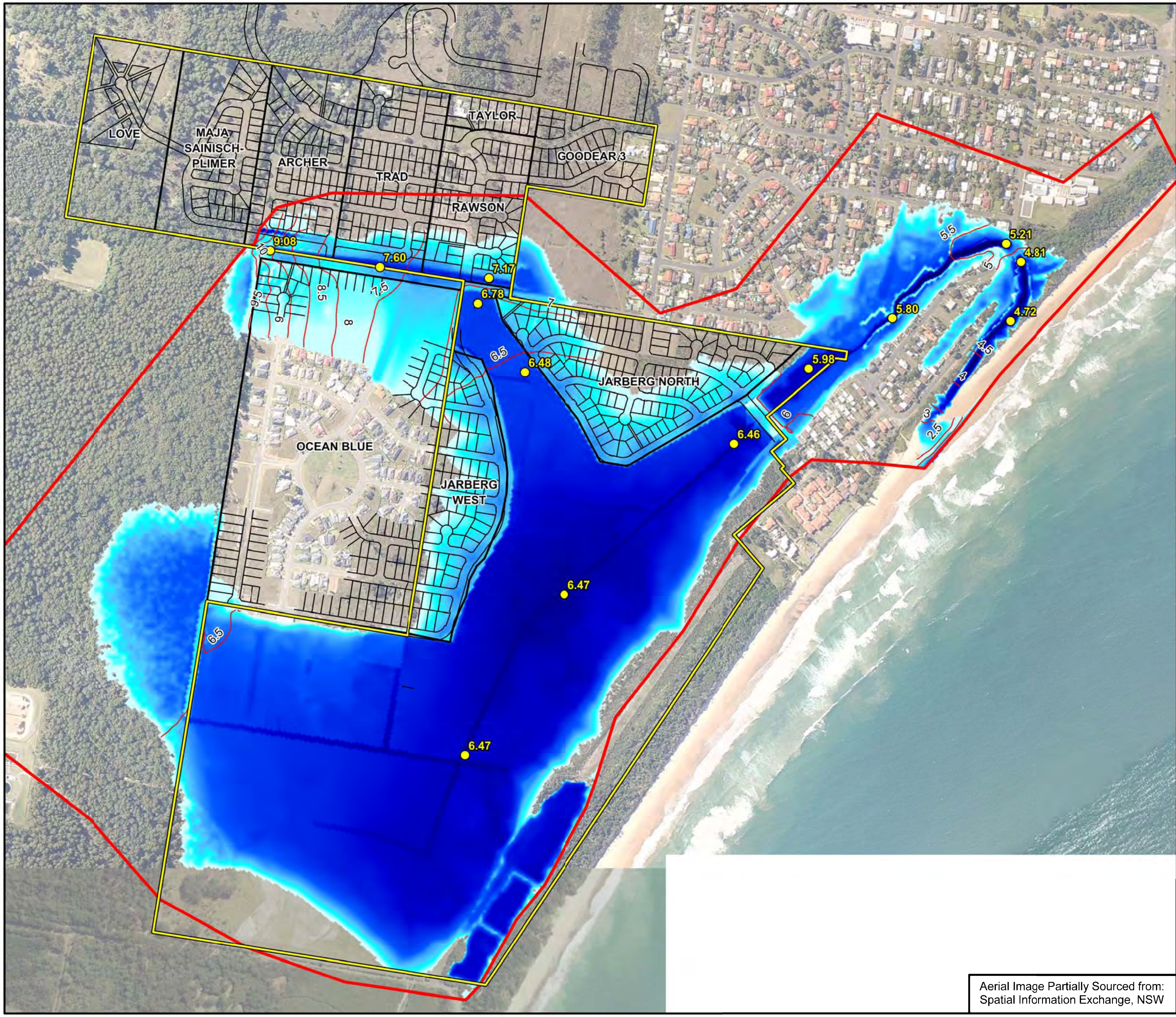
200 0 200 m

Figure 8.8
Old Bar - Precinct 3, Flood Management Strategy

1% AEP Flood Depth, Level and Extent Plan Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.8 - 1%AEPOpt
Date : 14/04/2014
Issue : A



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.9
Old Bar - Precinct 3, Flood Management Strategy

PMF Flood Depth, Level and Extent Plan Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.9 - PMFOpt
Date : 14/04/2014 Issue : A

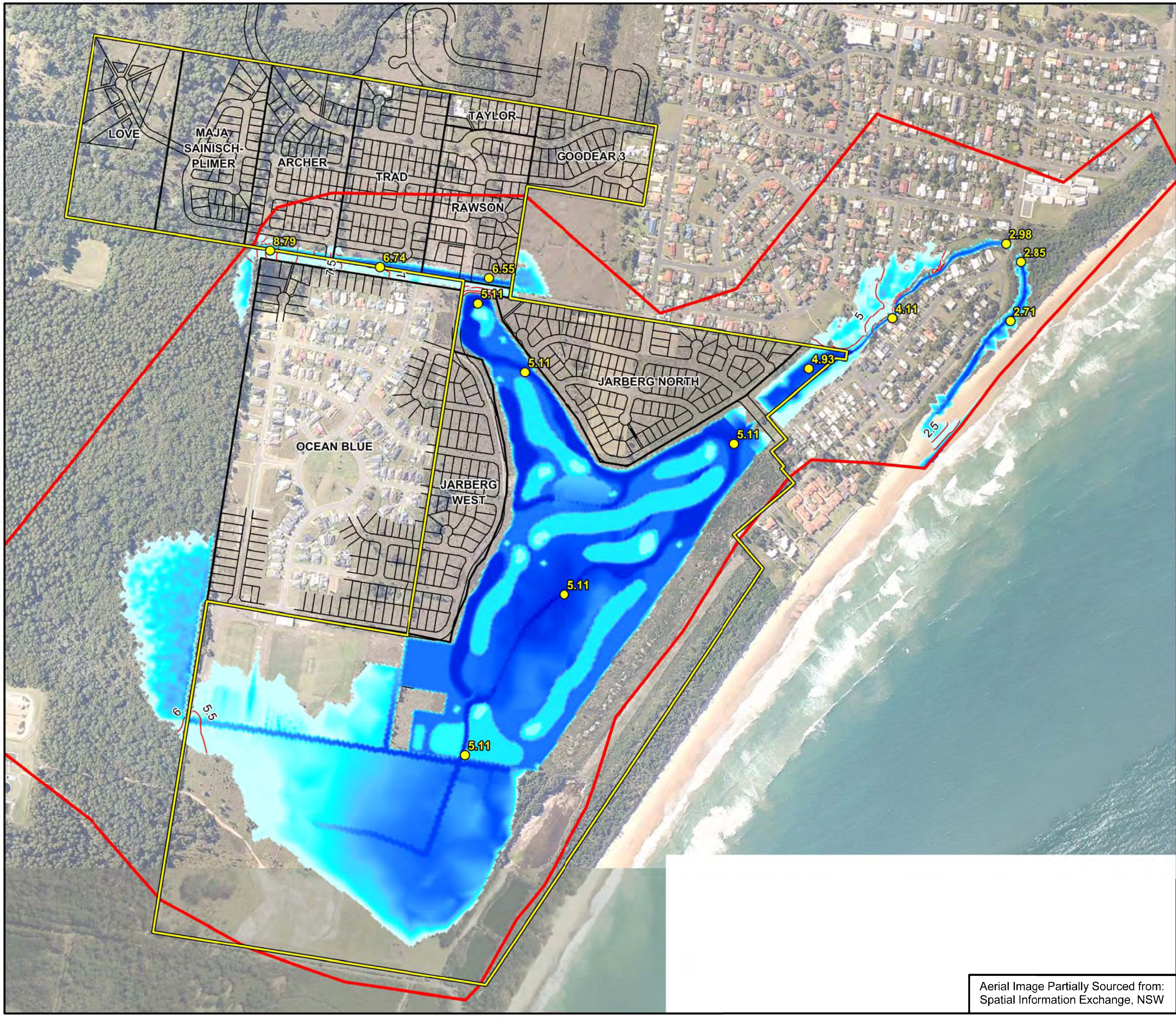

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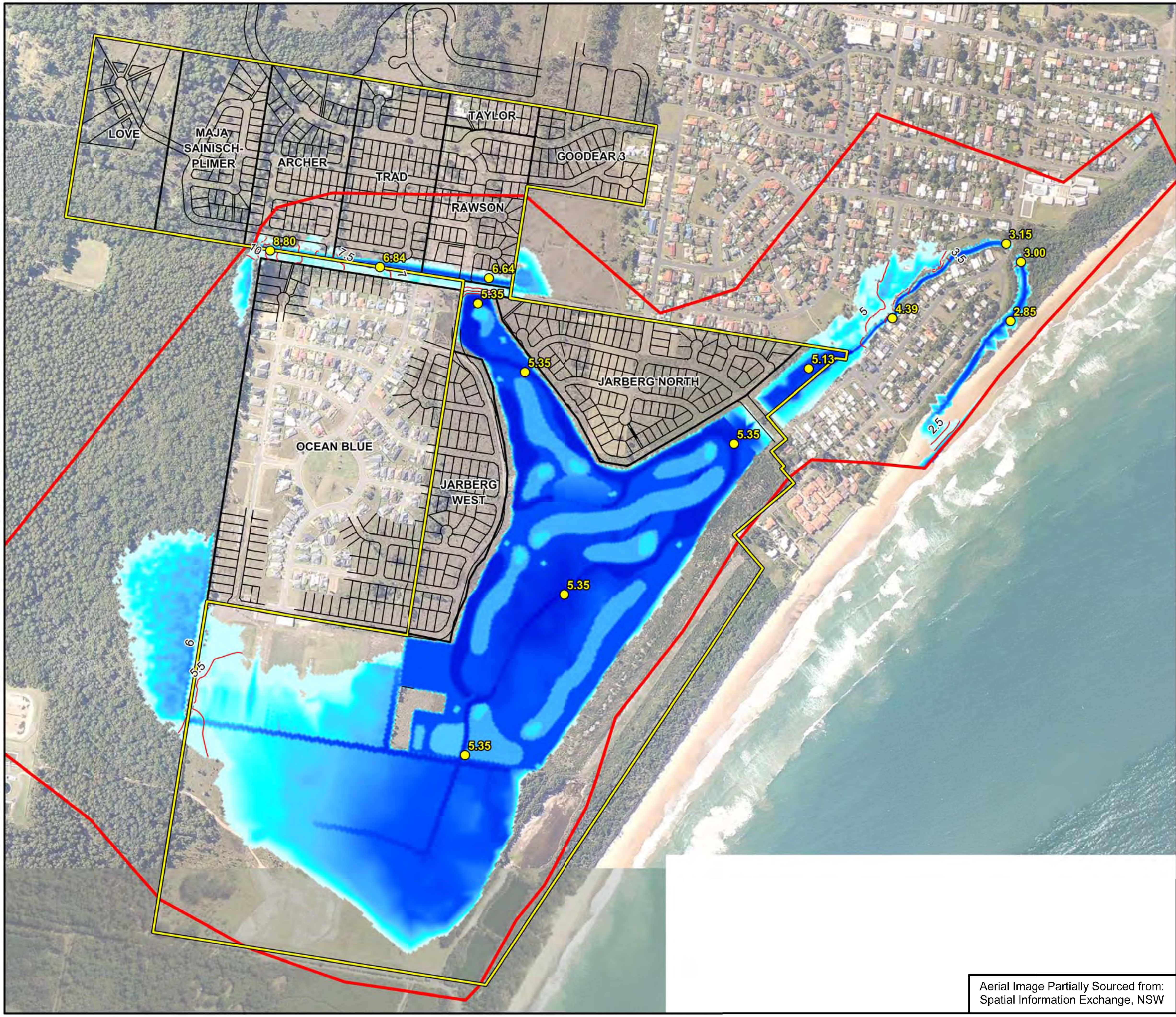
Figure 8.10
Old Bar - Precinct 3, Flood Management Strategy

20% AEP Flood Depth, Level and Extent Plan Developed Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.10 - 20%AEPDev
Date : 14/04/2014 Issue : B



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

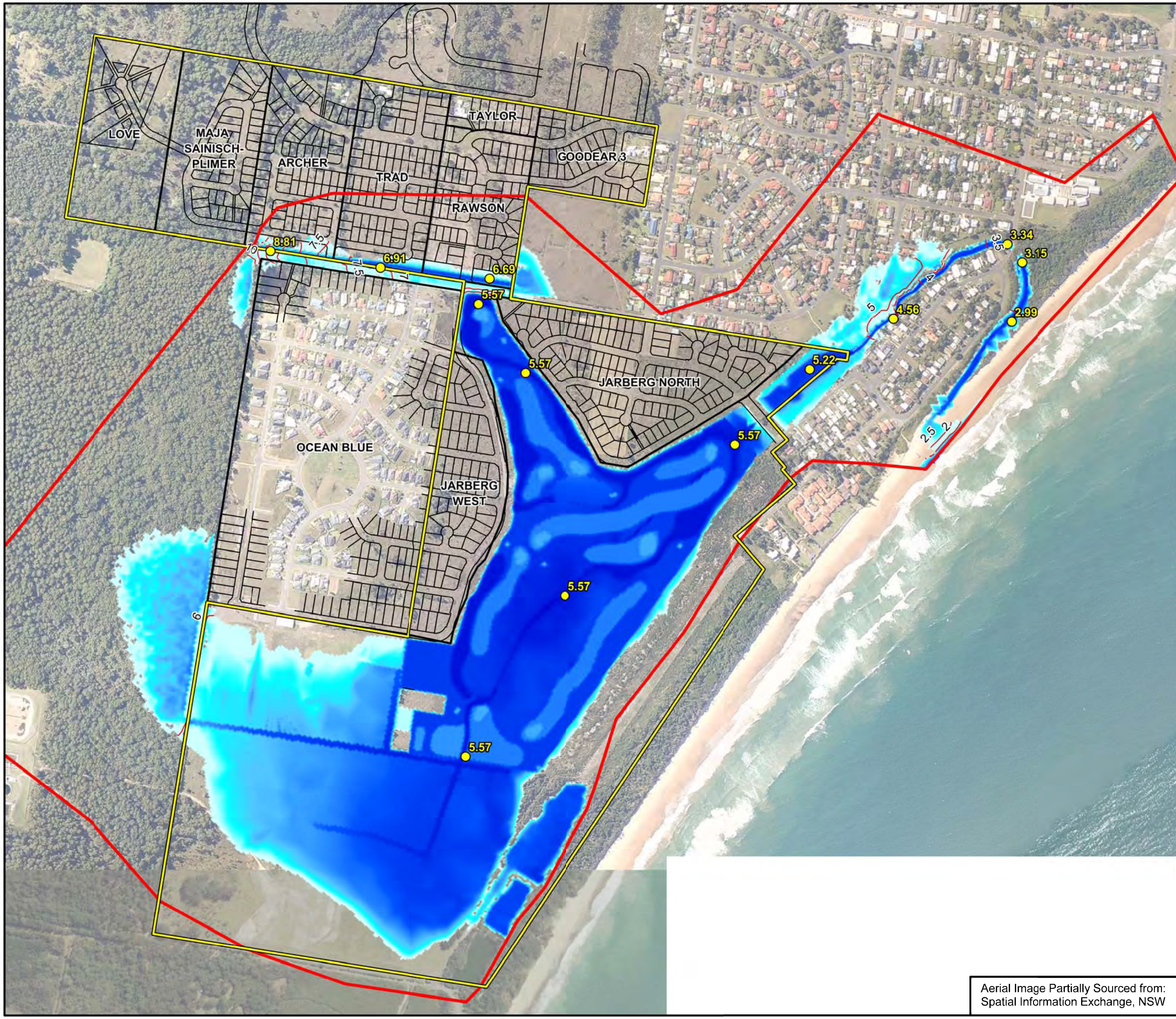
200 0 200 m

Figure 8.11 Old Bar - Precinct 3, Flood Management Strategy

5% AEP Flood Depth, Level and Extent Plan Developed Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.11 - 5%AEPDev
Date : 14/04/2014 Issue : B



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR

FLOOD HEIGHT (m AHD)

N W E S

Scale 1: 7,500 @ A3

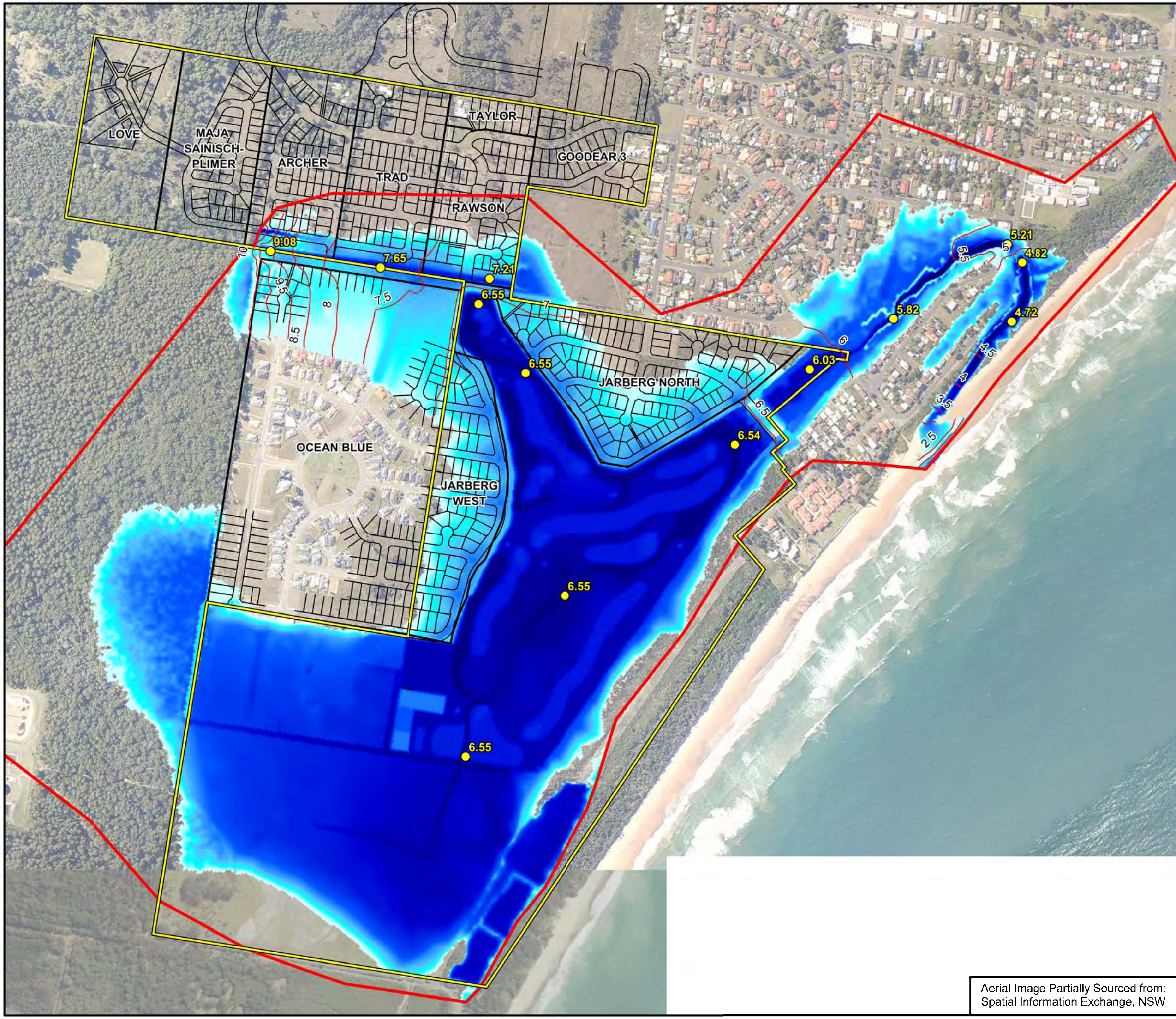
200 0 200 m

Figure 8.12
Old Bar - Precinct 3, Flood Management Strategy

1% AEP Flood Depth, Level and Extent Plan Developed Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.12 - 1%AEPDev
Date : 14/04/2014 Issue : B



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LEGEND

STUDY AREA
OLD BAR PRECINCT 3 SITE BOUNDARY

DEPTH (m)
- 0.0 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 +

4.5 0.5m FLOOD CONTOUR
FLOOD HEIGHT (m AHD)

N W E S
Scale 1: 7,500 @ A3
200 0 200 m

Figure 8.13 Old Bar - Precinct 3, Flood Management Strategy

PMF Flood Depth, Level and Extent Plan Developed Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.13 - PMFDev
Date : 14/04/2014 Issue : B

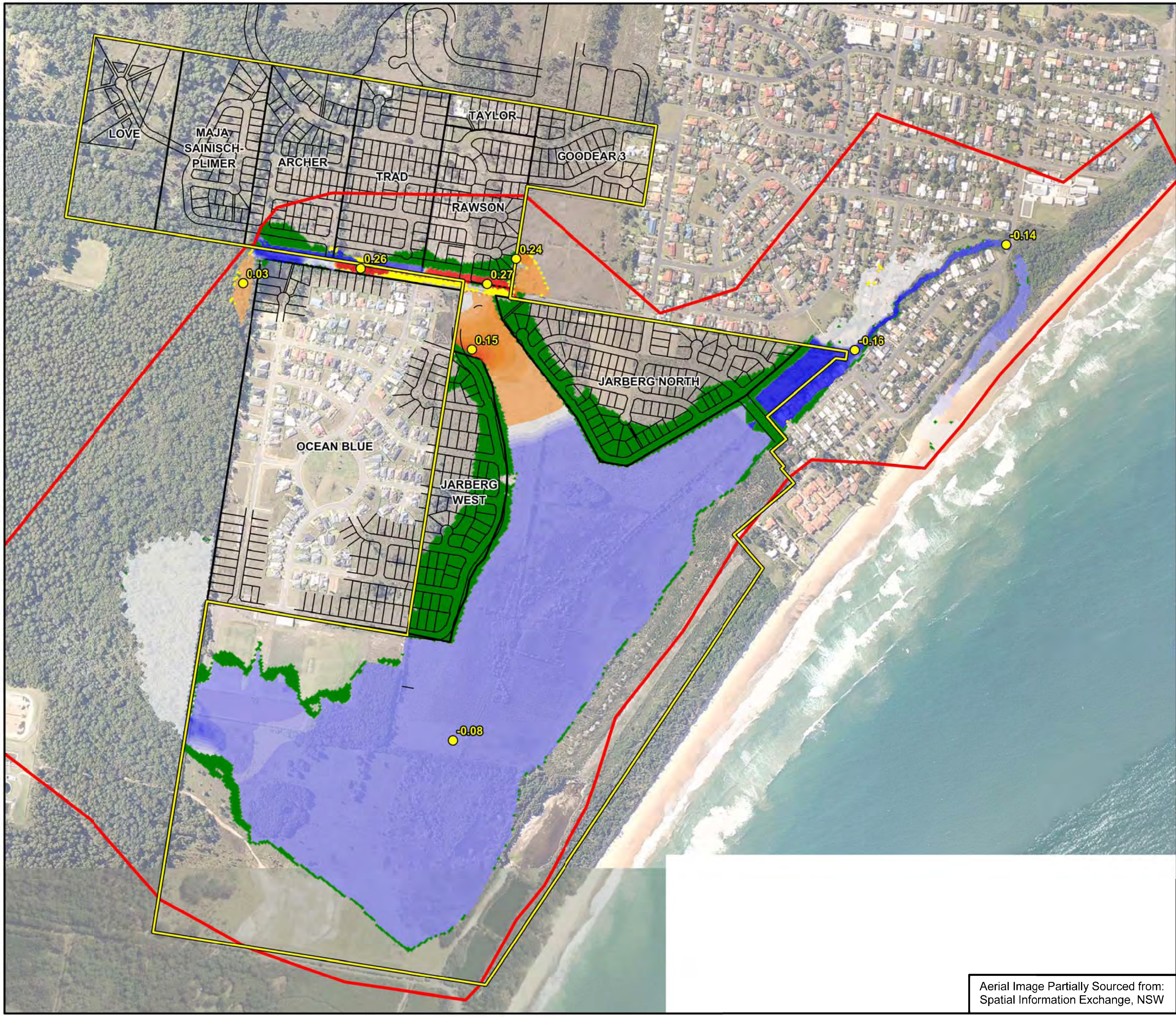

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Figure 8.14
Old Bar - Precinct 3, Flood Management Strategy

20% AEP
Flood Difference Plan
Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.14 - 20%AEPInt Diff
Date : 14/04/2014
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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

INCREASE IN FLOOD LEVELS (m)

-0.2+	0.02
-0.18	0.04
-0.16	0.06
-0.14	0.08
-0.12	0.10
-0.10	0.12
-0.08	0.14
-0.06	0.16
-0.04	0.18
-0.02	0.2+

- -0.02 - +0.02
- AREAS NOW FLOOD FREE IN MODELLED EVENT
- AREAS NOW FLOOD AFFECTED IN MODELLED EVENT
- FLOOD DIFFERENCE (m)

N W E S

Scale 1: 7,500 @ A3

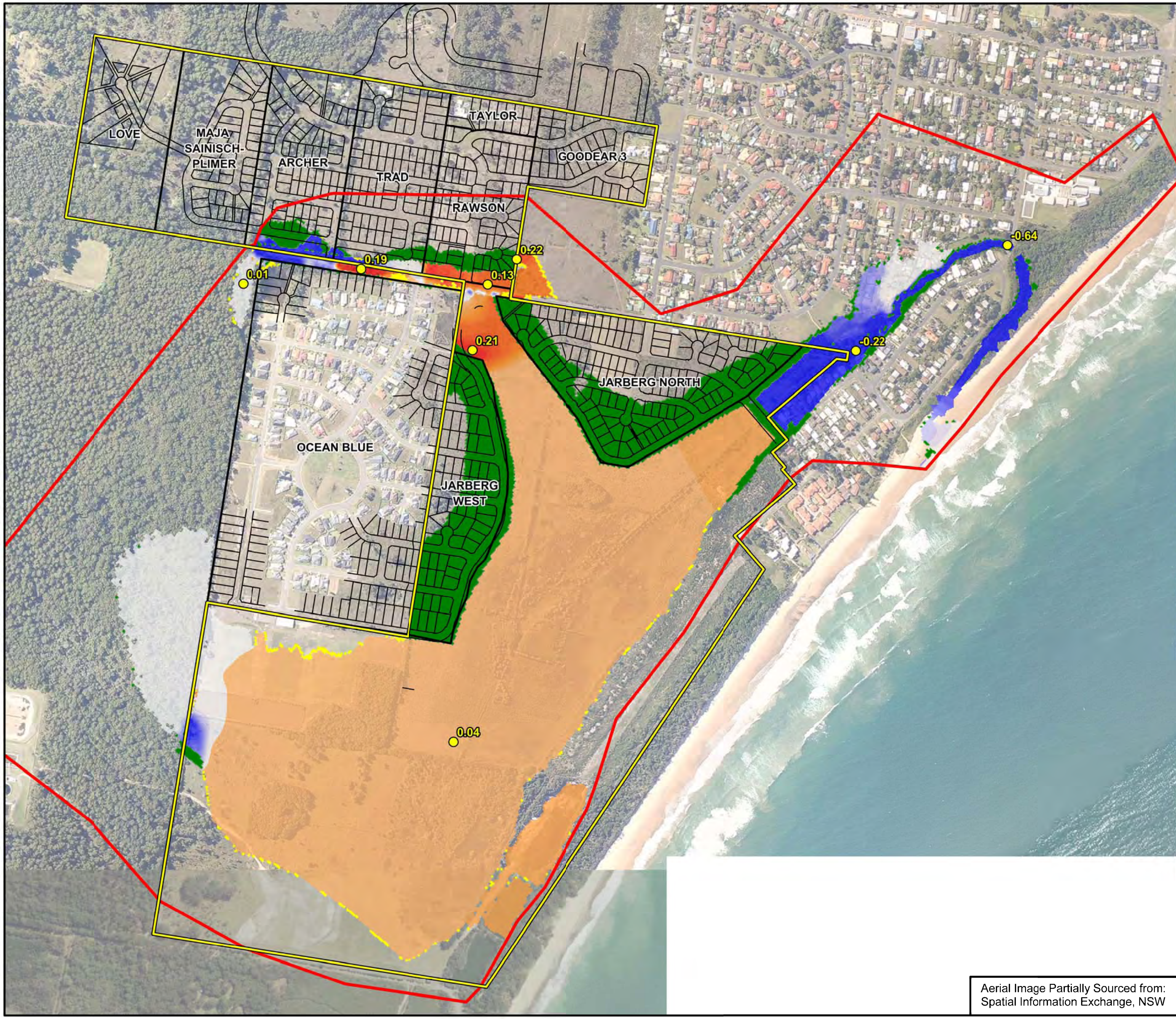
200 0 200 m

Figure 8.15
Old Bar - Precinct 3, Flood Management Strategy

5% AEP
Flood Difference Plan
Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.15 - 5%AEPInt Diff
Date : 14/04/2014
Issue : A



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LEGEND

STUDY AREA
OLD BAR PRECINCT 3 SITE BOUNDARY

INCREASE IN FLOOD LEVELS (m)

-0.2+
-0.18
-0.16
-0.14
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.2+
-0.02 - +0.02

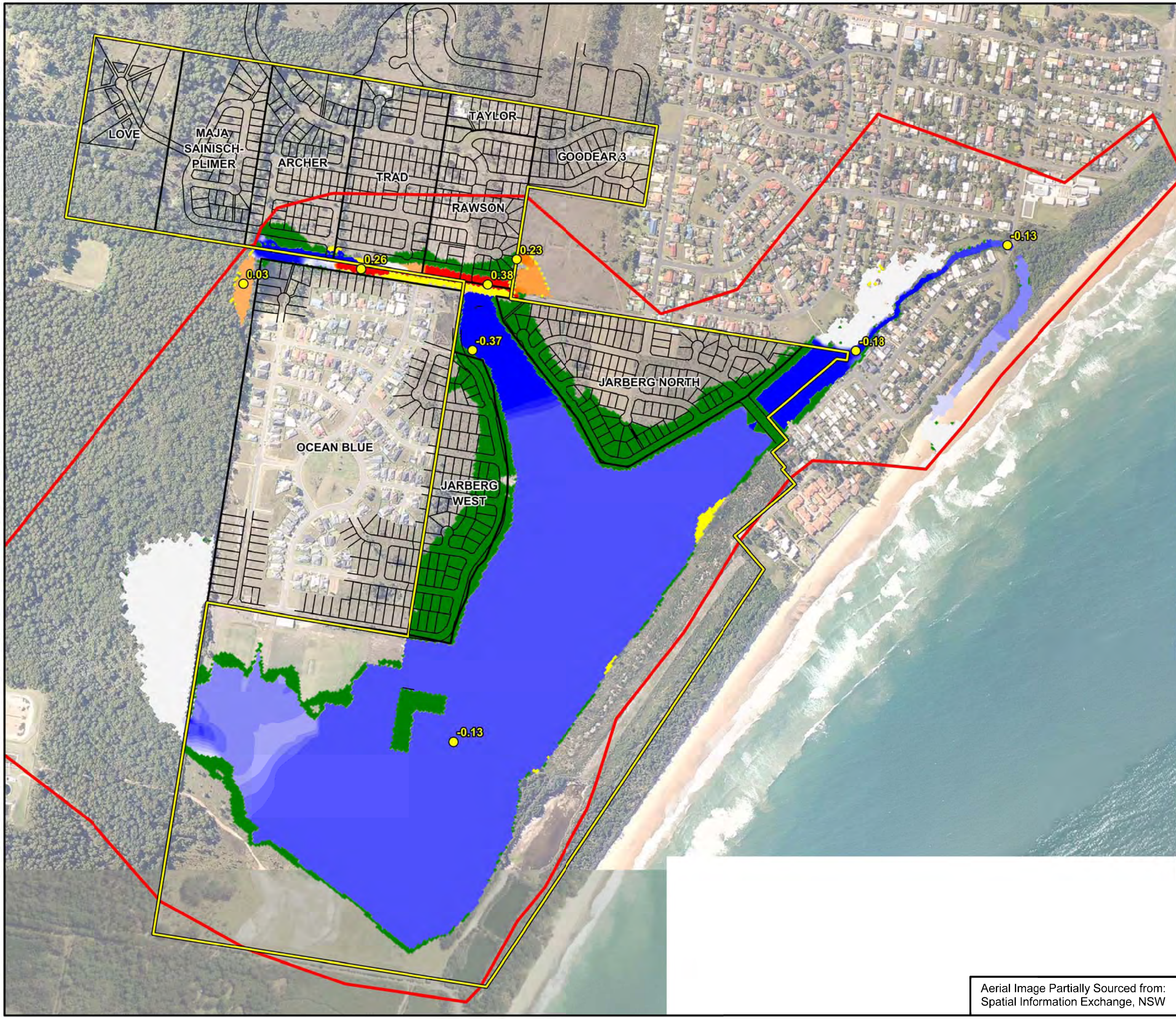
AREAS NOW FLOOD FREE IN MODELLED EVENT
AREAS NOW FLOOD AFFECTED IN MODELLED EVENT
FLOOD DIFFERENCE (m)

Figure 8.16
Old Bar - Precinct 3, Flood Management Strategy

1% AEP
Flood Difference Plan
Interim Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.16 - 1%AEPInt Diff
Date : 14/04/2014
Issue : A



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LEGEND

STUDY AREA
OLD BAR PRECINCT 3 SITE BOUNDARY
INCREASE IN FLOOD LEVELS (m)

-0.2+	0.02
-0.18	0.04
-0.16	0.06
-0.14	0.08
-0.12	0.10
-0.10	0.12
-0.08	0.14
-0.06	0.16
-0.04	0.18
-0.02	0.2+

-0.02 - +0.02
AREAS NOW FLOOD FREE IN MODELLED EVENT
AREAS NOW FLOOD AFFECTED IN MODELLED EVENT
FLOOD DIFFERENCE (m)

N
W E
S

Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.17
Old Bar - Precinct 3, Flood Management Strategy

20% AEP
Flood Difference Plan
Developed Conditions

Aerial Image Partially Sourced from: Spatial Information Exchange, NSW

File Name: 9630 Fig8.17 - 20%AEPDev Diff
Date : 14/04/2014
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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

INCREASE IN FLOOD LEVELS (m)

-0.2+	0.02
-0.18	0.04
-0.16	0.06
-0.14	0.08
-0.12	0.10
-0.10	0.12
-0.08	0.14
-0.06	0.16
-0.04	0.18
-0.02	0.2+

- -0.02 - +0.02
- AREAS NOW FLOOD FREE IN MODELLED EVENT
- AREAS NOW FLOOD AFFECTED IN MODELLED EVENT
- FLOOD DIFFERENCE (m)

N W E S

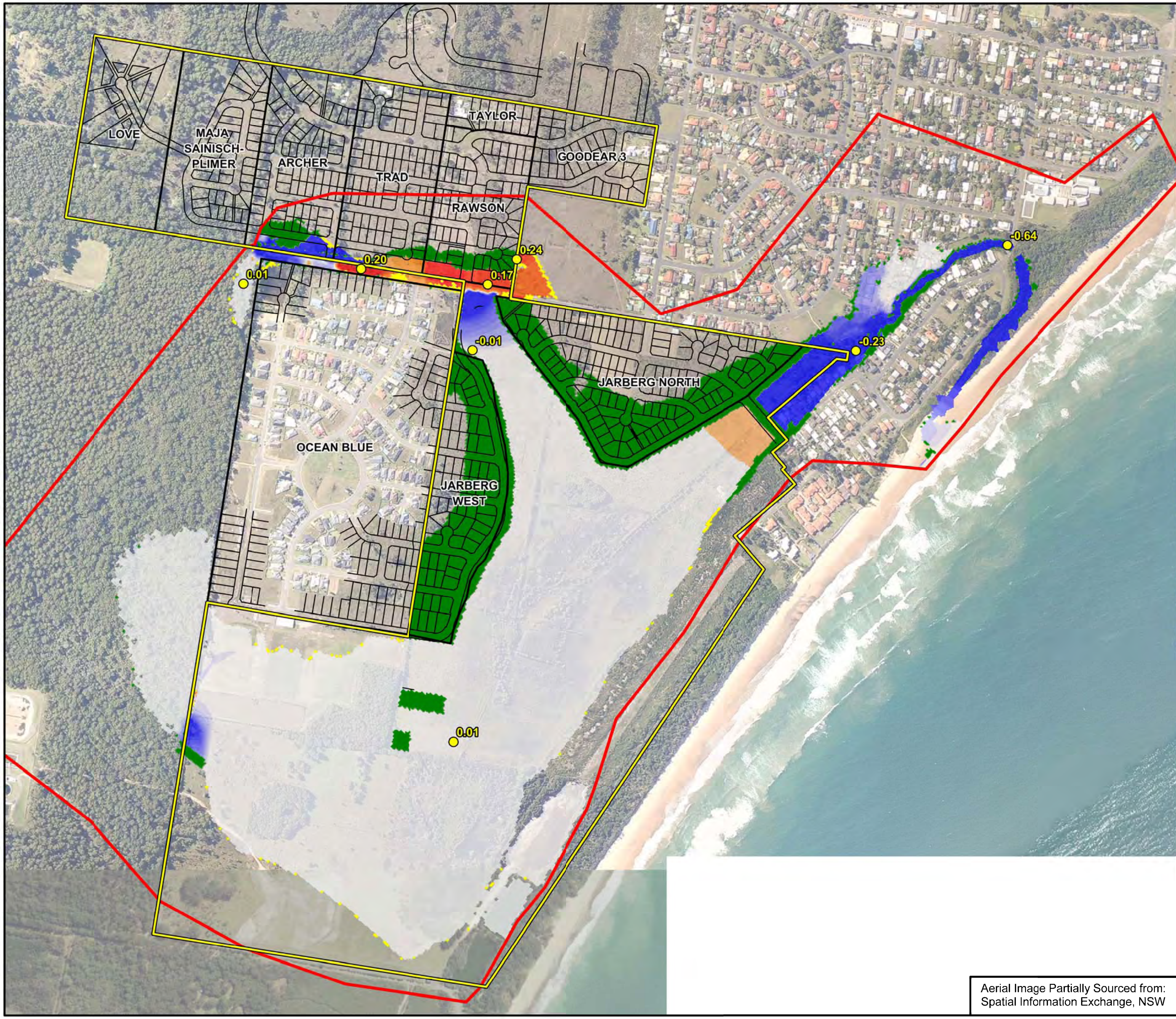
Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.18
Old Bar - Precinct 3, Flood Management Strategy

5% AEP
Flood Difference Plan
Developed Conditions

File Name: 9630 Fig8.18 - 5%AEPDev Diff
Date : 14/04/2014 Issue : B



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LEGEND

- STUDY AREA
- OLD BAR PRECINCT 3 SITE BOUNDARY

INCREASE IN FLOOD LEVELS (m)

-0.2+	0.02
-0.18	0.04
-0.16	0.06
-0.14	0.08
-0.12	0.10
-0.10	0.12
-0.08	0.14
-0.06	0.16
-0.04	0.18
-0.02	0.2+

- -0.02 - +0.02
- AREAS NOW FLOOD FREE IN MODELLED EVENT
- AREAS NOW FLOOD AFFECTED IN MODELLED EVENT
- FLOOD DIFFERENCE (m)

N W E S

Scale 1: 7,500 @ A3

200 0 200 m

Figure 8.19 Old Bar - Precinct 3, Flood Management Strategy

1% AEP Flood Difference Plan Developed Conditions

File Name: 9630 Fig8.19 - 1%AEPDev Diff
Date : 14/04/2014 Issue : B