BUS DEPOT
7A-11 RACECOURSE ROAD, 5-9 FAUNCE STREET & YOUNG STREET
Civil Stormwater Management Report

CLIENT/ **WALUYA PTY LTD**

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Commercial in Confidence

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APPENDIX

Appendix F – Flood Impact Assessment

1. Introduction

This Civil Stormwater Management Report supports the proposed redevelopment of 7A-11 Racecourse Road, 5-9 Faunce Street and Young Street 1 in West Gosford. Refer to Figure 1 for location of the proposed development.

AT&L have been engaged by Waluya Pty Ltd to prepare a Development Application (DA) Civil Stormwater Management Report on the civil and stormwater management requirements for the proposed development.

This report is written to comply with Gosford Development Development Control Plan 2013 (DCP), and Gosford City Council Water Cycle Management requirements.

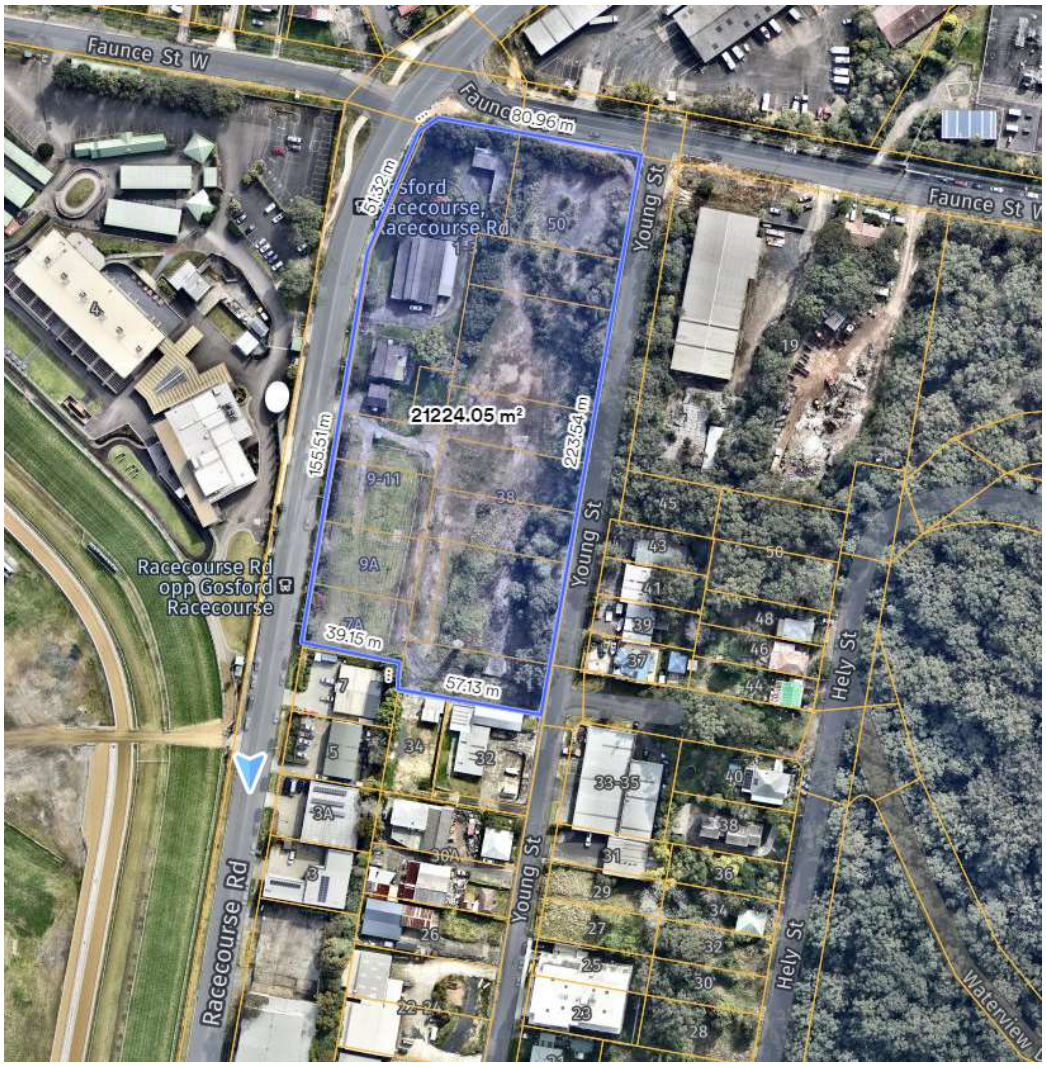


Figure 1 – Site Location (Courtesy of NearMap)

2. Project Description

This development application is for a proposed bus depot with ancillary offices and carparking located at 7A-11 Racecourse Road, 5-9 Faunce Street and Young Street, West Gosford.

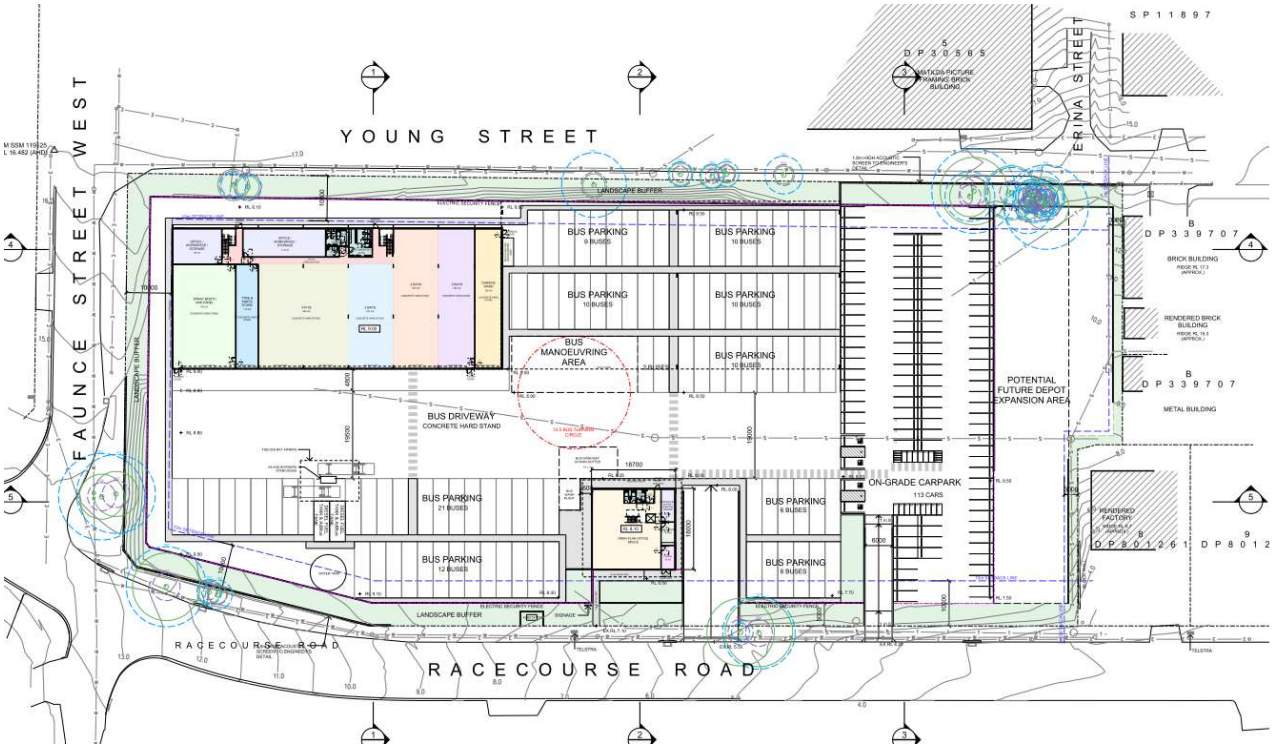


Figure 2 - Proposed Site Plan (Courtesy of DEM)

2.1. Scope of Report

This report outlines the design criteria for:

- Stormwater infrastructure;
- How stormwater is managed across the site;
- Identification of existing utility infrastructure; and
- How the future development will be serviced.

Refer to Appendix B for the Civil Development Application Civil Works Package Drawings.

This report has been prepared to satisfy the requirements and conditions of the following documents:

- Gosford City Council DCP 2013;
- Gosford City Council Water Cycle Management Guidelines; and
- OEH's Managing Urban Stormwater: Soils and Construction Guideline.

This civil infrastructure report includes:

- Stormwater Management:
- Piped and Overland Flows;
- Water Sensitive Urban Design (WSUD);
- Dial Before you Dig (DBYD) information (Appendix D); and

3. Stormwater Management

3.1. Proposed Site Stormwater Drainage

All proposed stormwater drainage from the development will be designed in accordance with Gosford City Council/Central Coast Council requirements.

All stormwater is proposed to connect into the existing stormwater infrastructure located within the adjacent council road network Racecourse Road to the west. Stormwater generated within the proposed site will be detained to ensure post-development flows are less than pre-development flows in accordance with the Gosford City Council stormwater guidelines.

Refer to the Civil Drawings in Appendix B for layout and details for the proposed stormwater network across the site.

Stormwater generated within the proposed site will be treated to the Gosford City Council Council DCP water treatment rates using a combination of proprietary treatment devices and natural WSUD elements.

3.2. Hydrology

- Pipe drainage shall be designed to accommodate the 20-year ARI storm event in accordance with Gosford City Council requirements;
- The combined piped and overland flow paths shall be designed to accommodate the 100-year ARI storm event.
- Where trapped low points are unavoidable and potential for flooding private property is a concern, an overland flowpath capable of carrying the total 100-year ARI storm event shall be provided. Alternatively, the pipe and inlet system may be upgraded to accommodate the 100-year ARI storm event;
- Rainfall intensities shall be as per the Intensity-Frequency-Duration table in accordance with Gosford City Council rainfall data;
- Times of concentration for each sub catchment shall be determined using the kinematic wave equation. Minimum time of concentration is 5 mins and the maximum are 20 mins. Runoff coefficients shall be calculated in accordance with AR&R. The fraction impervious shall be determined from analysis of the sub catchments;
- Runoff coefficients shall be calculated in accordance with the ARR&R. The fraction impervious shall be determined from analysis of the sub-catchments;
- Flow width in gutter shall not exceed 2.5m for the 20-year ARI storm event;
- Velocity depth ratios shall not exceed 0.4 for all storms up to and including the 100-year ARI event;
- Bypass from any pit on grade shall not exceed 10 l/s;
- Blockage factors of 10% and 30% shall be adopted for kerb inlet and grated pits respectively; and
- All pits deeper than 1.8m to be reinforced.

3.3. Hydraulics

- A hydraulic grade line HGL design method shall be adopted for all road pipe drainage design. The HGL shall be shown on all drainage long sections;
- The minimum pipe size shall be 375mm diameter RCP (external) and 150mm uPVC (internal);
- Maximum spacing between pits shall not exceed 75m;
- The minimum pipe grade shall be 1% (external) and 0.5% (internal);
- All pipes shall be Rubber Ring Jointed unless noted otherwise;
- The minimum cover over pipes shall be 450mm in grassed areas and 600mm within carriageways;
- Where minimum cover cannot be achieved due to physical constraints the pipe class shall be suitably increased;
- All trafficable pipes shall be a minimum Class 3 Reinforced Concrete Pipes or Fibre Reinforced Cement/ HDPE equivalent;
- The pipe friction coefficients to be adopted shall be:

Materials	Mannings – n	Colebrook-White – k	Min. Pipe Class
RCP	0.012	0.3	3
FRC	0.011	0.15	3

Table 1 - Pipe Details

- All pipes classes shall be designed for the ultimate service loads and where applicable, construction loads will be designed for;
- Pipes discharging to the overland flow path shall adopt a minimum tailwater level equivalent to respective overland flow level;
- Pit Loss coefficients shall be calculated in accordance with Missouri Charts;
- A minimum 150mm freeboard shall be maintained between pit HGL and pit surface levels;
- Overland flowpaths shall maintain a minimum of 100mm freeboard to all habitable floor levels; and
- Pits deeper than 1.2m shall contain step irons at 300 mm centres.

3.4. Modelling Software

DRAINS modelling for the OSD tanks.

MUSIC modelling software has been used to evaluate pollutant loads from the developed lot. MUSIC data files and output results are attached in Appendix C.

3.5. Overland Flows and Flooding

Refer to AT&L flooding report for flood impact assessment for the proposed development.

4. Stormwater Management

4.1. OSD Requirement

As discussed within Section 3.2, OSD is required within the development to ensure the development does not increase the risk of downstream flooding of roads and properties, or erosion of unstable waterways.

The OSD within the site has been designed to achieve the following outcomes:

- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1- and 100-year events. Refer to Table .

Duration	Pre-Developed Flows (m3/s)	Post Developed Flows (m3/s)
1 YR ARI	0.167	0.076
2 YR ARI	0.274	0.090
5 YR ARI	0.447	0.360
10 YR ARI	0.572	0.508
20 YR ARI	0.731	0.658
50 YR ARI	0.957	0.728
100 YR ARI	1.160	0.808

Table 2: Pre-Post Developed Flows from Development Site

4.2. Proposed OSD Tank Details

The proposed OSD tanks will be constructed within the proposed building located between ground floor and level 1 with the proposed WSUD built within the OSD tank. The outlet pipes from the tank will discharge into the street/swale network to the west of the site refer to Appendix C and D for details.

On Site Detention (OSD)	Catchment to Tank (ha)	2-YR OSD Volume (Min.) (m^3)	100-YR TOTAL OSD Volume (Min.) (m^3)	Primary Outlet	Secondary Outlet
Tank 1	2.12	432.90	719.30	200mm Orifice Plate	530mm Orifice Plate

Table 1 - OSD Tank Volumes

Note: OSD discharge conditions to be confirmed upon completion of downstream stormwater survey.

4.3. Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design (WSUD) encompasses all aspects of urban water cycle management, including water supply, wastewater and stormwater management. WSUD is intended to minimise the impacts of development upon the water cycle and to achieve more sustainable forms of urban development.

All stormwater runoff from the buildings only will be directed into water quality measures.

Proprietary treatment devices will treat the water to satisfy Council's water quality requirements. These devices have been modelled as an Ocean Protect Oceansave, Ocean Protect Oeanguards, Ocean Protect Jellyfish and Swale systems By utilising these treatment devices, stormwater draining from the development

will meet the required Gosford City Council water quality treatment rates before discharge into the existing stormwater network.

A summary of the required number and position of the treatment devices is indicated within the stormwater drainage plans within Appendix B. Refer also to Appendix C for a summary of the MUSIC model undertaken.

4.4. WSUD Modelling - Music Model

The MUSIC Model for Urban Stormwater Improvement Conceptualisation (MUSIC X) was used to evaluate pollutants loads from the site.

A conceptual view of the MUSIC model used in this report can be found in Appendix C.

4.4.1. Results

MUSIC modelling results for each stage are presented as mean annual loads at the receiving node indicate that adopted target reductions (as per the Cumberland Council DCP) are achieved, as shown in Table 6. MUSIC Link results are contained within Appendix C.

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	6658	800.30	87.98	85
Total Phosphorus	11.44	4.543	60.28	60
Total Nitrogen	53.13	29.13	45.17	45
Gross Pollutants	535.70	26.62	95.03	90

Table 3 – Overall Site Pollutant Loads

4.5. Ocean Protect Maintenance

The maintenance frequency of the Ocean Protect units is dependent upon several factors:

- Catchment area;
- Surrounding land use;
- Vegetation type;
- Traffic loading; and
- Rainfall patterns.

It is recommenced that during the first year of operation the units should be monitored monthly, with maintenance as required.

To ensure that the unit performs optimally, the material collected via the filter bag should be emptied when the level of material is no more than approximately half to two thirds of the total bag depth or when there is evidence of material overflow.

Additional monitoring should be conducted following moderate to extreme rainfall events when preceding months have had little to no rainfall. This monitoring is considered necessary to accommodate for higher volumes of runoff generated during major rainfall events. It is anticipated greater accumulation of surface contamination during low rainfall periods and to ensure that the units have been damage due to high pipe velocities.

Upon completion of all maintenance the monitoring/maintenance checklist is to be completed and kept for records, as per Ocean Protect manufacturers guidelines.

5. Sedimentation and Erosion Control

5.1. Sedimentation and Erosion Control (Construction)

A Soil and Water Management Plan (SWMP) has been prepared in accordance with the NSW Department of Housing Publication titled: Managing Urban Stormwater – Soils and Construction (2004) for the whole site.
The key objective of the SWMP are:

- Acknowledging the activities on a construction site which may contribute to erosion, sedimentation and water quality impacts;
- The implementation of industry best management practices to minimise adverse water quality and sedimentation impacts brought about through construction activities on waterbodies surrounding the work; and
- Establishment of processes that effectively manage erosion, sedimentation and water quality practices during the life of the project.

5.1.1. Sources of Pollution

The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and contamination of natural waters include:

- Earthworks undertaken immediately prior to rainfall periods;
- Work areas that have not been stabilised;
- Extraction of construction water from waterways during low rainfall periods;
- Clearing of vegetation and the methods adopted, particularly in advance of construction works;
- Stripping of topsoil, particularly in advance of construction works;
- Bulk earthworks and construction of pavements;
- Works within drainage paths, including depressions and waterways;
- Stockpiling of excavated materials;
- Storage and transfer of oils, fuels, fertilisers and chemicals;
- Maintenance of plant and equipment;
- Ineffective implementation of erosion and sediment control measures;
- Inadequate maintenance of environmental control measures; and
- Time taken for the rehabilitation / revegetation of disturbed areas.

5.1.2. Potential Impacts

The major potential impacts on the riparian environment relate to erosion of distributed areas or stockpiles and sediment transportation. Potential adverse impacts from erosion and sediment transportation can include:

- Loss of topsoil;
- Increased water turbidity;
- Decreased levels of dissolved oxygen;
- Changed salinity levels;
- Changed pH levels;
- Smothering of stream beds and aquatic vegetation;

- Reduction in aquatic habitat diversity;
- Increased maintenance costs; and
- Decrease in waterway capacity leading to increased flood levels and durations.

5.2. Soil and Water Management Plan

5.2.1. Overall Strategy

The following construction methodology will be followed to minimise the impact of sedimentation due to construction works:

- Diversion of "clean" water away from the disturbed areas and discharge via suitable scour protection;
- Diversion of "clean" upstream flow away from disturbed areas, in-line with construction staging (to be confirmed during detailed design);
- Provision of hay bale type flow diverters to catch drainage and divert to "clean" water drains;
- Collection of sediment-laden water into temporary sediment control basins within basement excavation to capture the design storm volume and undertake flocculation (if required);
- Provision of construction traffic shaker grids and wash-down to prevent vehicles carrying soils beyond the site;
- Provision of silt fences to filter and retain sediments at source;
- Rapid stabilisation of disturbed and exposed ground surfaces with hydro-seeding areas where future construction and building works are not currently proposed/

Refer to AT&L Drawings DAC071 to DAC072 for Erosion and Sediment Control Plans, for all proposed control and protection measures across the site.

5.2.2. Design of Sediment and Erosion Control Measures

Suitable erosion and sediment controls shall be provided by the Contractor and maintained throughout all stages of works, including at completion of the bulk earthworks.
All design, documentation, installation and maintenance of sediment and erosion controls will be in accordance with the requirements of:

- Protection of the Environment Operations Act;
- Cumberland Council specifications; and
- Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2.

Ultimately, the final temporary sediment basin locations and sizes will be provided to suit development staging requirements, and will be sized and maintained in accordance with the requirements of the above-mentioned authority documents.

5.3. Site Inspection and Maintenance

The inspection and maintenance requirements outlined in this section must be carried out while either earthworks is being conducted, and all areas re-established.
The Contractor will be required to inspect the site after every rainfall event and at least weekly, and will:

- Inspect and assess the effectiveness of the SWMP and identify any inadequacies that may arise during normal work activities or from a revised construction methodology;
- Construct additional erosion and sediment control works as necessary to ensure the desired protection is given to downstream lands and waterways;

- Ensure that drains operate properly and to affect any repairs;
- Remove spilled sand or other materials from hazard areas, including lands closer than 5 metres from areas of likely concentrated or high velocity flows especially waterways and paved areas;
- Remove trapped sediment whenever less than design capacity remains within the structure;
- Ensure rehabilitated lands have affectively reduced the erosion hazard and to initiate upgrading or repair as appropriate;
- Maintain erosion and sediment control measures in a fully functioning condition until all construction activity is completed and the site has been rehabilitated;
- Remove temporary soil conservation structures as the last activity in the rehabilitation.
- Do not dispose of sediment in a manner that will create an erosion or pollution hazard;
- Submerged inflow pipes must be inspected and de-silted (as required) after each inflow event.

5.4. Conclusion

The erosion control measures proposed for the site will comply with the requirements of Gosford City Council Council DCP and The Department of Environment, Climate Change and Water (DECC).

The proposed SWMP will ensure that the best management practice is applied to the development site in controlling and minimising the negative impacts of soil erosion.

Appendix A

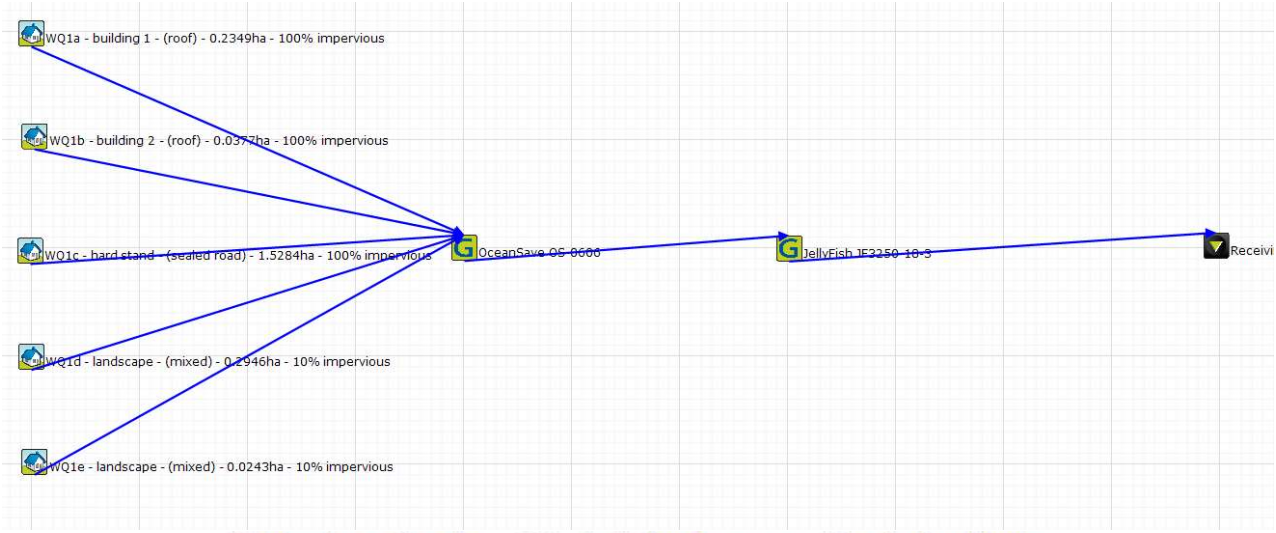
Detailed Site Survey

Appendix B

Civil Development Application Drawings

Appendix C

MUSIC Model and Report



(1) Design : Treatment Train Effectiveness : Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	22.43	22.43	0
Total Suspended Solids (kg/yr)	6658	800.3	87.98
Total Phosphorus (kg/yr)	11.44	4.543	60.28
Total Nitrogen (kg/yr)	53.13	29.13	45.17
Gross Pollutants (kg/yr)	535.7	26.62	95.03

Appendix D

Dial Before you Dig (DBYD)

Appendix E

Drains Results

TANK RL	7.5	m
TANK IL	5	m
VOLUME	see plan	
2YR ORIFICE IL	5.1	m
2YR ORIFICE D	200	mm
2YR ORIFICE CL	5.2	m
2YR WEIR RL	6.35	m
2YR WEIR L	5	m
100YR ORIFICE IL	5	m
100YR ORIFICE D	530	mm
100YR ORIFICE CL	5.265	m
100YR WEIR RL	7.1	m
100YR WEIR L	5	m

AEP	PRE (0% IMP)	POST (90% IMP)	OSD DISCHARGE	BYPASS	PSD < PRE?
1EY	167	417	76	TBC	YES
0.5EY	274	550	90	TBC	YES
20%	447	742	360	TBC	YES
10%	572	930	508	TBC	YES
5%	731	1130	658	TBC	YES
2%	957	1410	728	TBC	YES
1%	1160	1650	808	TBC	YES

Appendix F

Flood Impact Assessment

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