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Engineering

Working Beyond Expectations

Stormwater Management Plan

The Rifle Range
Planning Proposal

Property:
Popplewell Street, Fern Bay

Applicant:
Defence Housing Australia

Date:
June 2018

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	Draft	30/09/2016	L Gibbs	A Williams
B	Preliminary Issue	23/01/2017	R Champness	L Gibbs
C	Updated Masterplan	05/05/2017	R Champness	L Gibbs
D	Final	30/05/2017	R Champness	L Gibbs
E	Minor Amendments	21/06/2017	A Van de Mortel	L Gibbs
F	Updated Masterplan	01/06/2018	R Champness	L Gibbs

Executive Summary

ADW Johnson has been engaged by Defence Housing Australia (DHA) to prepare a Stormwater Management Plan to support the planning proposal for the proposed rezoning of the site known as The Rifle Range from E2 to Part R2 and Part E1.

This Stormwater Management Plan specifically addresses both stormwater quantity and quality. It has addressed the impacts of development of the site on the existing drainage regime, determined the stormwater discharge constraints and identified proposed stormwater device measures to adequately treat the stormwater prior to discharging to receiving waters.

This Stormwater Management Plan is based on a concept master plan developed for the site to inform the Planning Proposal.

Based on review of the existing site topography and geotechnical conditions, it has been identified that any surface runoff will infiltrate into the existing sand substrate within the site limits.

A stormwater routing model was created using the XPRAFTS software to determine the required area to infiltrate the site discharge 1% AEP storm events. The results for 1% AEP storm event have been provided in ***Section 5.***

A MUSIC model was used to simulate pollutant source elements for the proposed development to confirm that the stormwater can be adequately treated within the limits of the development. Further details on water quality modelling can be found in ***Section 6***. The results from this study demonstrate that there is adequate capacity within the site to achieve the required performance objectives of the stormwater management.

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1.0 Introduction

ADW Johnson has been engaged by Defence Housing Australia (DHA) to prepare a Stormwater Management Plan to support the planning proposal for the proposed rezoning of the site known as The Rifle Range from E2 to Part R2 and Part E1.

The land subject to this application is located in Fern Bay adjacent to Popplewell Street to the west, Stockton Bight to the east undeveloped land to the north and Stockton Centre to the south. The location of the site is shown in ***Figure 1***.

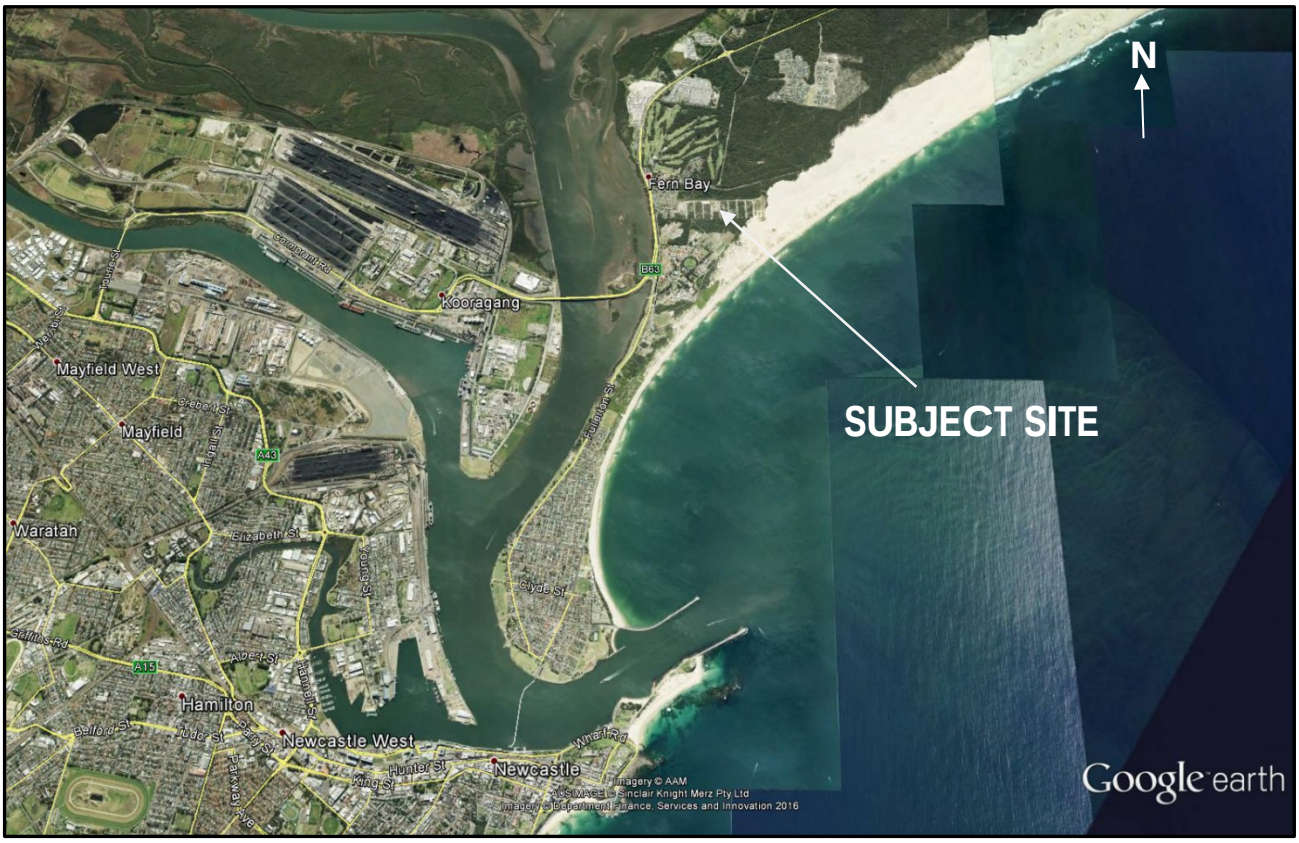

Figure 1 - Site Locality (Google earth).

This report covers the following:

- Existing site and proposed development within ***Section 2***;
- Council's requirements for a Stormwater Management Plan within ***Section 3***;
- Overview of the proposed development within ***Section 4***;
- Stormwater Discharge detailed in ***Section 5***;
- Stormwater Quality detailed in ***Section 6***; and
- Erosion and Sediment Control during construction outlined in ***Section 7***.

2.0 Site Description

2.1 EXISTING SITE

The subject site is located within Port Stephens Council LGA off Popplewell Street at Fern Bay. The site is located on a sand spit between the Pacific Ocean (Stockton Bight) and the Hunter River South Arm as shown in ***Figure 2***. The site has a gentle fall from east to west with a slight tilt to the north.

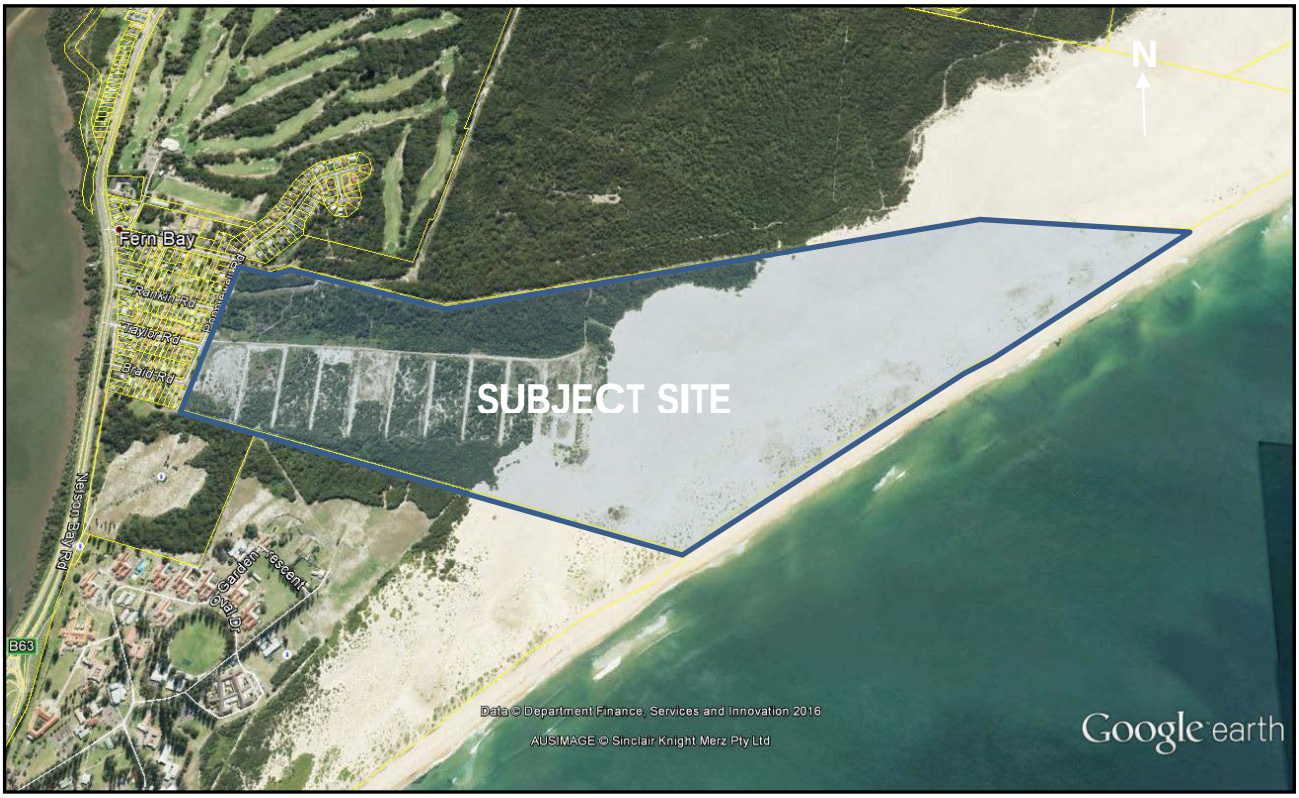

Figure 2 - Existing Site.

The existing drainage within the subject site consists of site runoff from the southern portion of the site and drains north towards low lying areas. These low lying areas are located between the dune system to the north east of the site and to the north of the site. The site is underlain by an unconfined aquifer, in which the site recharges through infiltration.

2.2 PROPOSED DEVELOPMENT

The planning proposal proposes to rezone the site with a combination of R2 and E1 zones.

The proposed rezoning will allow the redevelopment of the site with a mixture of varying density residential lots.

The planning proposal plan and masterplan of the site is shown in **Figures 3** and **4**.

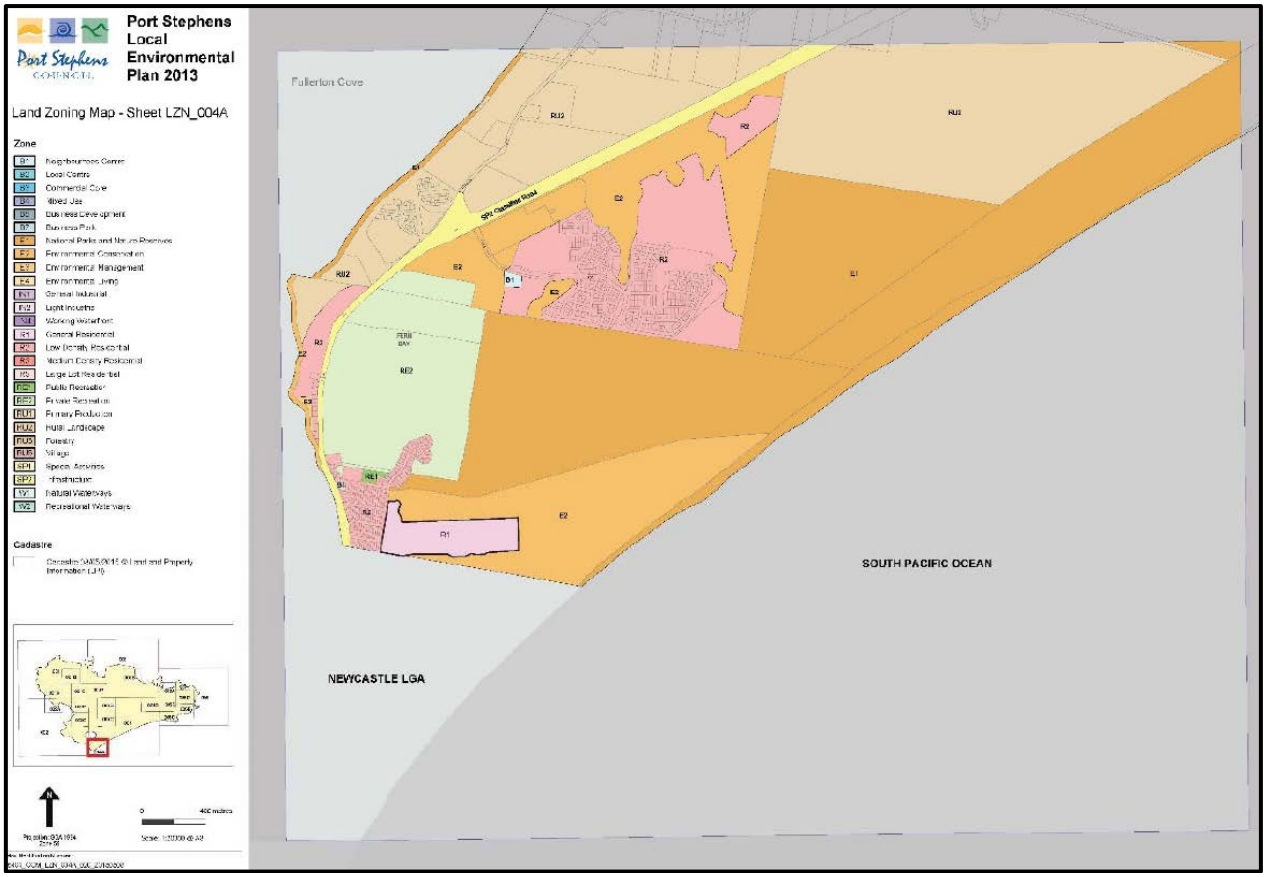

Figure 3 - Proposed Zoning.

Figure 4 - Masterplan.

3.0 Council Requirements

Port Stephens City Council provides objectives and controls for developments within "Port Stephens Development Control Plan 2014" (DCP). *Part B* "General Controls" of the DCP outline relevant controls for subdivision development.

Part B4 "Drainage and Water Quality" of DCP contains compliance requirements for discharge of stormwater from the site.

The objective of B4.A – Stormwater Drainage Plan are:

- To ensure a stormwater drainage plan is submitted when *development* increases *non-permeable surfaces* and will place significant additional flows into *public drainage;*
- To ensure the stormwater drainage plan details a legal and physical point of discharge to minimise impacts on *water balance*, *surface water* and *groundwater* flow regimes and flooding; and
- To implement sustainable mitigation systems that can be maintained using resources available to the maintainer.

The objective of B4.B – On Site Detention are:

- To regulate the impacts on the capacity of the public drainage system.

The objective of B4.C – Water Quality are:

- To ensure development does not impact on water quality through the use of water quality through use of water quality modelling, such as MUSIC Modelling and subsequent WSUD measures;
- To safeguard the environment by improving the quality of stormwater run-off; and
- To ensure water quality is protected and maintained during the construction phase through the conditioning of appropriate measures.

Table 1 - Water Quality Targets (Port Stephens Council DCP, 2014)

Pollutant	Targets
Total Suspended Solids (TSS)	90% of average annual load
Total Phosphorus (TP)	60% of average annual load
Total Nitrogen (TN)	45% of average annual load

Part B5 "Flooding" of DCP containing compliance requirements for flood compliance for a proposed development which is situated within the flood planning area or at or below the flood planning level.

Whilst not located within a flood planning area the subject site due to its drainage regime would be subject to the principles within Part B5.

The objective of B5 – Flooding are:

- *To reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property.*
- *To recognise flood prone land as a valuable resource that should not be sterilised by unnecessarily precluding its development.*
- *That flood risk is considered as early as possible in the planning and development process, is based on the best available flood information and is a flexible, locally-specific, merit-based approach.*
- *To ensure that the use and development of flood prone land has risk consequences that are acceptable to the community, takes into account the full spectrum of flood risks and recognises the social, economic and environmental values of flood prone land.*
- *To implement the principles of the NSW Government 2005, 'Floodplain Development Manual' into new development and satisfy the provisions of PSLEP2013 Clause 7.3.*

4.0 Overview

The planning proposal and concept masterplan has been planned and designed to achieve water cycle management objectives. This process is known as Water Sensitive Urban Design (WSUD). As part of the WSUD approach for this development, the protection of the waterways and management of stormwater within the landscape were key principles. The objectives outlined in Part B of the Port Stephens DCP were incorporated in to the development's WSUD.

The proposed development incorporates measures to manage stormwater prior to discharging into the natural drainage system. A stormwater treatment train is proposed to provide appropriate treatment of pollutant prior to discharging to the natural environ, this is detailed in ***Section 6.***

Construction activity has potential to impact on the adjacent environment and have a detrimental effect on the natural drainage regime. To maintain this area during construction, erosion and sediment controls will be implemented as outlined in ***Section 7***.

5.0 Stormwater Discharge

The existing drainage within the area of the site proposed to be rezoned to residential discharges north toward low lying areas. These low lying areas are located between the dune system to the north east of the site and to the north of the site. The site is underlain by an unconfined aquifer, in which the site stormwater recharges through infiltration.

In the developed scenario for the site the impervious area is increased which will increase the runoff from the hardstand areas, reducing the infiltration occurring within the developed portion of the site and hence increase the volume of infiltration required elsewhere within the site.

An assessment was undertaken using the hydrological model XP RAFTS to determine the required area to achieve infiltration of the critical 1% AEP storm. The model has adopted the following parameters outlined in ***Section 5.1***.

5.1 MODELLING PARAMETERS

5.1.1 Rainfall Intensity

The Rainfall Intensity Frequency Duration (IFD) data adopted was sourced from the Bureau of Meteorology website (IFD AR&R87 application).

5.1.2 XPRAFTS Parameters

The rainfall losses adopted within XPRAFTS are provided in ***Table 2***.

Table 2 - XPRAFTS Rainfall Losses

Parameter	Pervious Area	Impervious Area
Initial Loss (IL)	125.0mm	1.5mm
Continuing Loss (CL)	20mm/hr	0mm/hr

Roughness values (Manning's 'n') were determined based on the terrain and vegetation. For the pervious conditions, the Manning's 'n' was 0.035 while the impervious adopted was 0.02.

5.2 CATCHMENT

The catchment was delineated by analysis of the digital terrain model using LiDAR available survey data and then confirmed by ground inspection.

In the developed scenario the total catchment adopted was 21.05 ha. This is made up of 19.19ha of rezoned/developed land and 1.86ha of undeveloped land.

5.3 STORMWATER ASSESSMENT

To determine the impact on the subject site the XP RAFTS model was created for storm durations range from the 30 minute storm up to the 4,320 min (72 hours).

The site survey determined that the subject site once developed would generally discharge to the north. Subject to development outcome the area to the north east of the site may not be able to receive stormwater overflow, this assessment has therefore assumed that the entire developed site would discharge to the low lying area towards the north of the development.

An assessment of Geotechnical report indicated that at the time of assessment there was groundwater found in one borehole RL 1.0. The groundwater levels within the low lying area of the site is known to fluctuate during wet and dry seasons, with some evidence that the lower area of the site exfiltrate to the surface. Evidence of ponded water was found with aerial photography taken January 10th 2016 after prolonged period of rain (305mm over 4 days) with the water elevation determined to be approximately 2.1m (or 0.4m above the lowest point within the site).

The management of stormwater discharge from the site is therefore proposed to include the infiltration of stormwater throughout the higher areas of the site post water quality treatment. This is proposed to occur within infiltration basins located amongst the development footprint with basins (linear) located north of the development site, these basins are proposed to vary in elevation between RL 4.0 and 6.0.

XPRAFTS models were prepared adopting an infiltration area ranging from 2,000m^2 to 14,500m^2 to determine an appropriate infiltration area to limit the flood depth to below or equal to 1m.

Geotechnical report prepared by Douglas Partners (Nov 2016) identified the site permeability rates varied across the site from 295mm/hr (7.08m/day) to 1980mm/hr (47.5m/day), with a recommended infiltration rate of 36mm/hr to be adopted for modelling purposes.

5.4 STORMWATER RESULTS

The model results indicate that a total infiltration area of 14,500 m^2 with an adopted peak flood depth of 1 m during the critical 1% AEP storm.

The critical storm event was determined to be the 48 hour (2,880 min). These results indicate that there is sufficient available infiltration zone within the site to cater for the proposed development of the land during the critical 1% AEP Storm event.

5.5 EXTREME EVENTS

An assessment of site flow paths based on a review of topographical maps has determined that the site is confined by surrounding coastal dunes to the east, and north, higher ground to the south and Popplewell Street at its southern end at RL 6.8. As the proposed development site (R2 land) varies in elevation from RL 5.0 to 7.0 there is no overland flow path from the site to Nelson Bay Road. The developed site will discharge north to the low lying area which at its lowest is approximately RL 1.7.

It is known that the groundwater levels within the low lying area can vary during wet climatic conditions and exfiltrate to the surface. This will reduce the holding capacity within surface area. An assessment was undertake to determine the available storage within the low lying area between an adopted peak groundwater elevation (RL 2.4) and an estimated minimum development level of RL 4.7.

It was determined that the available storage is 132 000 m^3. This storage volume can contain approximately double the volume of the 72hr 1% AEP storm event, assuming no infiltration occurs within the development site and all surface water discharges to the low area.

5.6 SEA LEVEL RISE AND CLIMATE CHANGE

The subject site ranges in elevation from RL 2.0 m AHD to approximately 7.0 m AHD within the proposed development zoned land, and to an elevation of 16 m AHD within the dune system to the east of the site.

The subject site is separated from the effect of the Hunter River flooding by elevated levels within existing development to RL 6.0 m AHD to the west, and is separated from the sea by the dune system to the east.

The Lower Hunter River Flood Study (Greens Rocks to Newcastle) 1994 prepared by Lawson and Treloar on behalf of Port Stephens Council and Newcastle City Council was updated in 2008 by DHI Water and Environmental Pty Ltd on behalf of Newcastle City Council due to increased intensification of development within Hexham area and the use of up to date numerical modelling techniques. The DHI report identified that the 1% AEP flood level at Stockton Bridge with the adopted sea level rise is 1.34 m AHD. A sensitivity assessment within the DHI report indicated that with a 20% increase in Hunter River discharge the 1% AEP flood level at Stockton Bridge is 1.51 m AHD, this is considered an appropriate assessment of the Hunter River Flood level including sea level rise and Climate Change.

The subject site is protected from the effects of sea level rise from both the east and west, and is above the predicted Hunter River 1% AEP flood level, therefore it is considered that the proposed rezoning of the development is not constrained due to sea level rise of climate change effects. A Coastal Engineering Assessment has been prepared by BMT WBM Pty Ltd and submitted as part of the planning proposal for the site.

6.0 Stormwater Quality

The Stormwater management strategy for the site focuses on minimising impact of the development on the receiving waters adjacent to the site. The subject site discharges to the low lying areas to the north. At these locations the stormwater from the site infiltrate into the unconfined aquifer below.

To maintain stormwater quality to the prescribed levels in Port Stephens Council DCP a treatment train approach is proposed, where a number of devices are used to cleanse the site discharge prior to discharging to the infiltration zones.

A MUSIC model was prepared to determine the required land take to facilitate appropriate stormwater treatment devices.

A typical 1 ha catchment was setup to represent the proposed residential usage.

6.1 MUSIC MODELLING

The MUSIC model included the following treatment train approach:

- Gross Pollutant Trap; and
- Bio filtration basin.

The use of BASIX compliant rainwater tanks is recommended in future modelling, however for the purpose of determining required land take rainwater tanks have been excluded.

It is noted that the above treatment train devices have been adopted for the purpose of determining the appropriate land take required to facilitate the appropriate treatment of stormwater. Alternate devices such as swales, buffer strips, constructed wetlands could be used.

Pollutant source inputs were obtained from the *'Draft NSW MUSIC Modelling Guidelines'* (BMT WBM, 2010). The parameters adopted for the varying land uses were implemented in accordance with Table 3-2 of the above stated document. The rainfall-runoff parameters were updated where appropriate to meet PSC's set rainfall-runoff parameters within MUSIC-link.

The residential source node within MUSIC has been adopted, with an impervious percentage of 70%.

The parameters used within the MUSIC model are presented below.

Gross Pollutant Traps

GPTs are utilised as conveyance controls, though they can also be used as an end of line control. For the purposes of this model a High Flow Ecosol GPT has been adopted for the 1 Ha catchment. The treatment node was sourced from the Ecosol website. It is required that at detailed design stage, gross pollutant traps be positioned throughout the development to intercept the majority of stormwater discharging from the development while ensuring that the Gross Pollutant Traps are serviceable and remain efficient during smaller duration storm events.

The removal efficiency of the GPT is summarised in ***Table 3***.

Table 3 - GPT Removal Efficiencies (Ecosol)

Pollutant	% Removal Efficiency
Total Suspended Solids	55
Total Phosphorus	40
Total Nitrogen	40
Gross Pollutants(>2000µm)	99

The high flow bypasses for the modelled GPTs have been set to 100L/s based on a conservatively sized Ecosol model.

Biofiltration Basins

Biofiltration basins are utilised as end of line controls treating the water prior to discharging into the infiltration zone.

Table 4 - Biofiltration Basin Parameters

Parameter	Catchment Urban
Surface Area (m^2)	500
Extended Detention Depth (m)	0.30
Exfiltration Rate (mm/hr)	0
Filter Area (m^2)	400
Filter Depth (m)	0.40
Saturated Hydraulic Conductivity (sandy Loam)	180
Base Lined	no
Vegetated with Nutrient Removal Plants	yes
Underdrain Present	yes
Submerged Zone	no

6.2 WATER QUALITY RESULTS

The average annual pollutant loads from a generic 1Ha catchment are summarised in ***Table 5***.

Table 5 - Treatment Train Effectiveness

Pollutant	Result (%)
TSS (kg/yr)	**97.7**
TP (kg/yr)	**66.8**
TN (kg/yr)	**70.9**
GP (kg/yr)	**100**

From ***Table 5*** it can be seen that the treatment train successfully reduced the pollutant loads.

It is recommended that a whole of site detailed MUSIC model be prepared at future development stages throughout the site to confirm the bio retention basin areas required to treat the catchment based on the ultimate land use.

These results indicate that there is sufficient available land within the site to cater for the proposed development of the land.

7.0 Erosion and Sediment Control

Port Stephens Council requires the use of erosion and sediment controls to manage and contain pollutant runoff, both during construction and as long term permanent treatments thus ensuring the minimisation of impact on the environment. All erosion and sediment controls and practices are to be in accordance with PSC's DCP and *'Managing Urban Stormwater'* by Landcom/NSW Department of Housing.

Long term permanent treatments are outlined as part of the treatment train within ***Section 6.*** The treatment train specified has been shown to sufficiently manage and control the pollutants leaving the development in accordance with Council's pollutant reduction targets.

Treatment devices will be utilised to contain the generated pollutants from the site during construction. These include but are not limited to:

- Sediment Basins;
- Silt Fencing;
- Hay bale and Geotextile Fencing;
- Kerb Inlet Controls;
- Sandbag Kerb Inlet Sediment traps;
- Shaker Ramp; and
- Diversion Drains.

Any clean water entering the site from upstream catchments is to be diverted around the construction site where possible hence remaining clean. Runoff generated from within the site is to be treated and managed using a combination of the above stated treatment devices.

Due to the extents of disturbed areas, the use of sediment basins will be required (Landcom, 2004). During construction, the proposed bio filtration basins will be utilised as temporary sediment basins. Refer to **Appendix A** for a typical Erosion and Sediment Control Plan.

8.0 Conclusion

ADW Johnson were engaged by Defence Housing Australia to prepare a report detailing Stormwater Management to support the rezoning of Lot 5 DP 233358 Popplewell Street Fern Bay from E2 to a combination of E2 to Part R2 and Part E1.

The impact on the existing drainage regime has been assessed in regard to Stormwater discharge, stormwater quality pollutant loads and erosion and sediments controls.

Appropriate erosion and sediment controls implemented to the requirements of Port Stephens Council are required for the construction period to protect downstream receiving waters.

The assessment determined the necessary mitigation measures required to be implemented are able to be readily provided within the subject land. The measures include the construction of stormwater quality devices which are able to adequately reduce pollutant loads to Port Stephens Council requirements, ensuring protection of existing environment and hydrology.

Appendix A – Erosion and Sediment Control

FIGURE A-1 – EROSION AND SEDIMENT CONTROL PLAN

239478(30)-ESK-002_A

DIVERSION DRAIN - CLEAN WATER

DIVERSION DRAIN - DIRTY WATER

SILT FENCE

NO GO FENCE

ver.	date	comment	drawn	pm	level information	scale (A3 original size)
A	24.01.17	INITIAL ISSUE	Z.J.	A.W.	DATUM: LIDAR DATA CONTOUR INTERVAL: 0.5m	0 50 100 125m SCALE: 1:2500 (FULL)

drawing title:

APPENDIX A: EROSION & SEDIMENT CONTROL PLAN

location:	LOT 5 D.P.233358 POPPLEWELL ROAD, FERN BAY
council:	PORT STEPHENS
dwg ref:	239478(30)-ESK-002_A

client: DHA Defence Housing Australia

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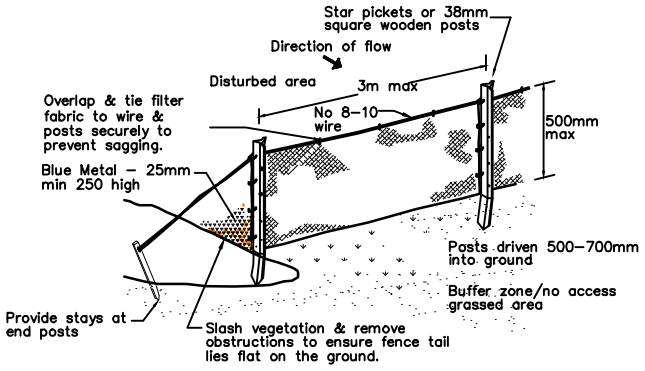
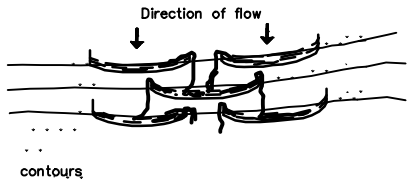
239478(30)-ESK-002_A

NOTES:

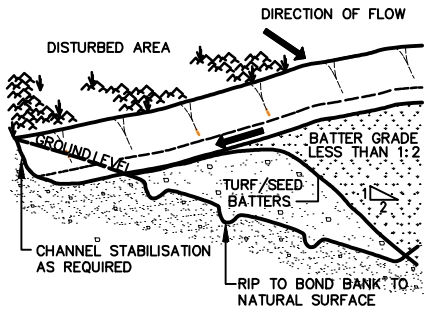
1. ALL TOPSOIL IN SITE REGRADING AREAS AND ROAD RESERVES TO BE STOCKPILED AS DETERMINED ON SITE OR AS SHOWN
2. ALL TOPSOIL TO BE REMOVED BY EITHER EXCAVATOR OR SCRAPER AND MOVED DIRECTLY TO STOCKPILE LOCATION
3. STOCKPILE AREA TO BE FULLY FENCED WITH SILT PROOF FABRIC AT ALL TIMES
4. IMPORTED MATERIAL TO BE PLACED DIRECTLY INTO SITE REGRADING AREAS. IMPORTED MATERIAL IS NOT TO BE STOCKPILED
5. STOCKPILES ARE TO BE REMOVED AS SOON AS PRACTICABLE AND SITES REINSTATED IMMEDIATELY
6. ALL AREAS DISTURBED DURING CONSTRUCTION ARE TO BE RE-INSTATED AND SEEDED IMMEDIATELY
7. ALL SITE REGRADING IS TO BE CARRIED OUT UNDER THE SUPERVISION OF A QUALIFIED GEOTECHNICAL ENGINEER
8. SILT FENCES AND STRAW BALING TO BE PLACED WHERE DIRECTED BY COUNCIL'S ENGINEER AND MAINTAINED AT ALL TIMES
9. WHERE PRACTICAL CATCHDRAINS OR SMALL LEVIES ARE TO BE CONSTRUCTED TO MINIMISE EXTERNAL RUNOFF ENTERING THE SITE
10. DISTURBED AREAS TO BE KEPT TO A MINIMUM.
11. CONTROL CLEAN WATER FROM ABOVE THE SITE, THROUGH THE SITE AND AROUND THE SITE.
12. KEEP CLEAN WATER SEPERATE FROM DIRTY WATER.
13. CONSERVE ALL TOPSOIL, STOCKPILE AND PROTECT FOR REUSE ON SITE.
14. PROTECT ALL DISTURBED AREAS FROM EROSION.
15. MINIMISE SEDIMENTATION.
16. MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES UNTIL COMPLETE REHABILITATION IS ACHIEVED.
17. OBTAIN COUNCIL'S PERMISSION BEFORE CLEARING OF ANY TREES.
18. AN ONSITE MEETING WITH COUNCIL'S SOIL CONSERVATION CONSULTANT PRIOR TO COMMENCEMENT OF WORK WILL BE REQUIRED
19. MAXIMUM HEIGHT OF TOPSOIL STOCKPILE IS TO BE 2.0 METRES.
20. MAXIMUM SIDE SLOPE OF STOCKPILES TO BE 2H:1V



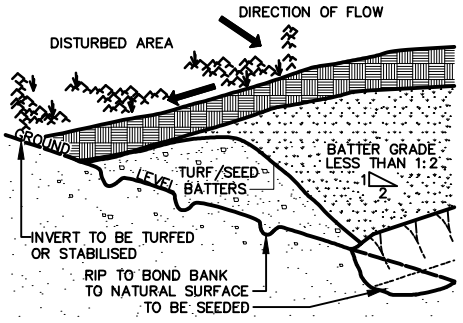
SILT FENCE



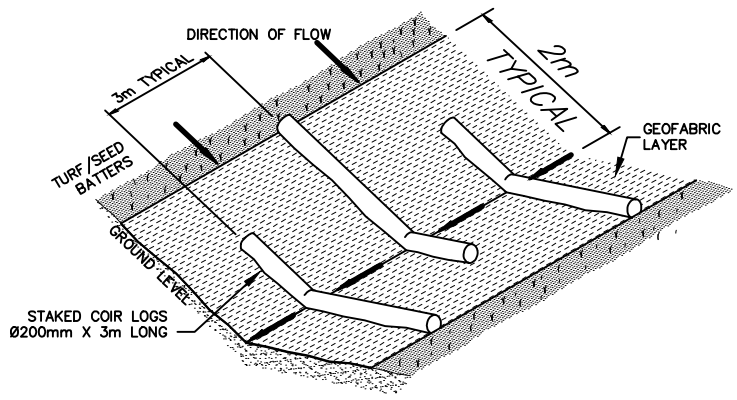
SILT FENCE CONFIGURATION



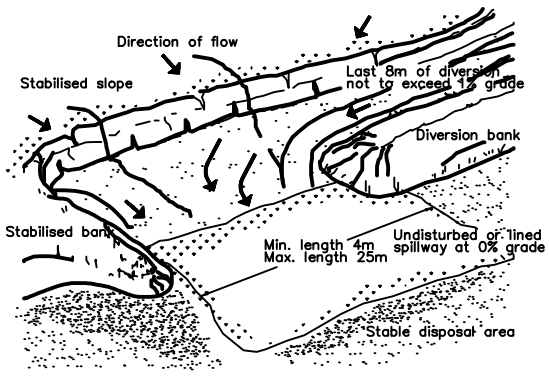
DIVERSION DRAIN



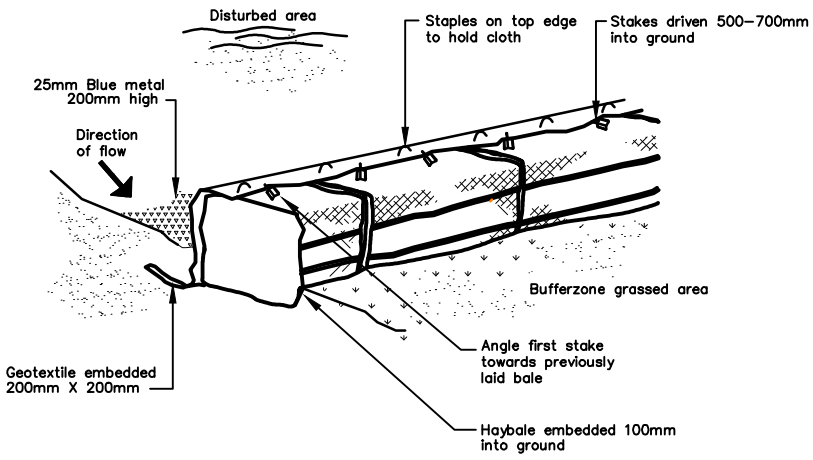
DIVERSION BANK



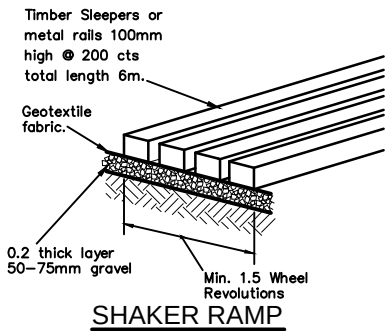
BATTER INTERFACE TREATMENT



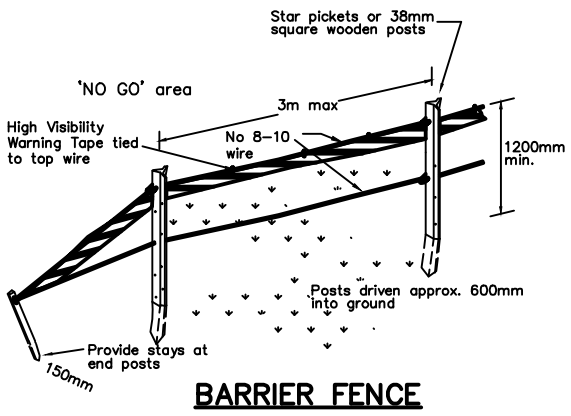
LEVEL SPREADER



STRAWBALE & GEOTEXTILE FENCE



SHAKER RAMP



BARRIER FENCE

ver.	date	comment	drawn	pm	level information	scale (A3 original size)
A	24.01.17	INITIAL ISSUE	Z.J.	A.W.	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100 125m SCALE: 1:2500 (FULL)

drawing title:

APPENDIX A: EROSION & SEDIMENT CONTROL DETAILS

location: LOT 5 D.P.233358 POPPLEWELL ROAD, FERN BAY

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