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CIVIL ENGINEERING REPORT
SSD 7500 MOD1
MINTO INDUSTRIAL DEVELOPMENT

WAREHOUSE MODIFICATION
2-5 CULVERSTON ROAD
MINTO NSW

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1 INTRODUCTION

1.1 Introduction

Costin Roe Consulting Pty Ltd has been commissioned by Tactical Project Management, on behalf of Charter Hall Holdings Pty Ltd, to prepare this Engineering Report in support of a proposed development application for a Modification to State Significant Development, SSD 7500 for an amended masterplan layout for the previously approved Buildings 1B and 1C, and an expansion to Building 1D. We note these buildings are now referred to as Stage 2 Warehouse, Stage 1 Warehouse and Stage 3 Warehouse respectively. We note there are no proposed modifications to Building 1A, noting this is now referred to as Stage 4 Warehouse.

The proposal site is located on the western side of Culverston Road and South of Airds Road, in the suburb of Minto, NSW. The proposed development involves construction of three warehouse distribution type facilities.

SSD 7500 was approved by The NSW Department of Planning & Environment (DPE) for development on 23 June 2017. A modification to the approved Masterplan (Mod1) is proposed to be submitted to The NSW Department of Planning, Industry & Environment (DPIE) by Charter Hall to facilitate a specific user on two of the development lots.

1.2 Scope and Project Description

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Earthworks & Retaining Walls;
- Stormwater Management including stormwater quantity and quality;
- Ecologically Sustainable Development (ESD); and
- Erosion & Sediment Control.

The engineering objectives for the development are to create a site which, based considers the approved SSD7500 requirements and proposed modifications to the Masterplan Layout, responds to the existing topography and site constraints, meets flood planning requirements and provides an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design consistent with the approved SSD7500 stormwater management strategy.

A set of drawings have been prepared to show the proposed civil and stormwater management concept for the proposed industrial development. These drawings are for development approval only and subject to change during detail design.

The consent authority is The DPIE as the proposal considered a State Significant Development (SSD). However as the subject site is located within Campbelltown City Council (CCC) local government area, the engineering and policy requirements of CCC have also been considered in the design.

The projects Planning Secretary's Environmental Assessment Requirements (SEAR's) and associated agency responses for the approved SSD 7500 were provided on 10 March

2016. **Section 1.4** of this report provides specific responses to SEAR's *Soil and Water,* and associated agency items and any differences between those approved and the modified development proposal. It is noted that the majority of items raised in the SEARs and associated agency letters have been managed and addressed via the assessments already undertaken as part of the approved SSD 7500 approval. These differences are further discussed generally in **Section 1.3**, with detailed responses specific to the SEAR's *Soil and Water* in **Section 1.4**.

1.3 Comparison Between SSD 7500 and SSD 7500 MOD1

As noted in **Section 1.1**, this application is for an amendment to the current State Significant Development Approval, SSD 7500, dated 23 June 2017. The revised application is a result an adjustment to the proposed layout, based on a generic warehouse development layout, to suit specific tenant layouts for The Stage 1 and 2 buildings.

Generally the engineering strategy will remain consistent with the approved development however some differences due to the new layout are required.

A comparison of the differences and similarities between the design, engineering strategy and approved impacts for the development are as follows.

Masterplan Layout and Building Levels

The approved SSD 7500 Masterplan Layout (refer **Section 2.3**) is based on the two northernmost warehouses with a floor plan area of 22,000m^2 each, and third warehouse with an area of 23,000m^2.

The proposed modification Masterplan Layout (refer **Section 2.2**) is based on the three warehouses from north to south with floor plan areas of 9,500m^2, 9078m^2 and 31,000m^2. Overall the combined floor area is reduced.

Adjustment to the floor levels of buildings are also proposed as set out in **Table 1.1**. We note the proposed floor levels are within the approved variance of plus or minus 0.5m.

Table 1.1 Approved and Proposed Floor Levels

Building	**Approved FFL (m AHD)**	**Proposed FFL (m AHD)**	**Difference (m)**
Stage 2 (Previous 1B)	47.6	48.0	+0.4
Stage 1 (Previous 1C)	48.5	48.0	-0.5
Stage 3 (Previous 1D)	49.3	49.3	0

We note there are no proposed changes to the size, layout or levels of the Stage 4 Warehouse (previous Warehouse 1A). For reference the Stage 4 Warehouse was approved with a finished floor level (FFL) of 50.7m.

Erosion and Sediment Control

During the construction phase of the development, an Erosion and Sediment Control Program will be implemented to minimise water quality impacts. The overall strategy for erosion and sediment control for the development remains consistent with the original submission with adjustment to suit the new layout and access road as shown on Costin Roe Consulting drawings located in **Appendix A**.

The proposed erosion and sediment control measures are based on the guidelines contained in the Landcom document *Managing Urban Stormwater, Soils and Construction – The Blue Book (1998)* and CCC specifications. A detailed Erosion and Sediment Control Program will be employed throughout the site. The program shall include measure such as temporary sediment basins, silt fences, cut-off drains for polluted stormwater and diversion channels for clean stormwater run-off.

Refer **Section 8**, **Appendix C** and drawings located in **Appendix A**

Road Works and Access

The site is accessed off Culverston Road which is an existing industrial road located within an existing established industrial precinct. There are no proposed road works or changes from the approved access provisions of SSD7500. Refer to updated traffic impact assessment (TIA) by Ason Group.

Earthworks and Retaining Walls

Filling and importation of engineered fill will be required to achieve flood planning levels and to suit the proposed building levels (refer **Table 1.1** and **Section 2.2**)

The proposed building levels, and as such earthworks subgrade levels, are noted to be consistent with the levels nominated on the approved civil and stormwater drawings included in the plus or minus 0.5m variance approved in SSD7500. Overall impacts and considerations associated with earthworks, groundwater, salinity and other geotechnical conditions remain consistent between the approved SSD 7500 and proposed modification proposal.

The indicative locations of the proposed retaining walls are shown on drawings included in **Appendix A**. Some minor retaining (in the order of 1-1.5m in height) will be required around the perimeter of the development, adjacent to existing landscape corridors. Walls are minor and level differences noted to be consistent with the approved SSD7500.

Final details of walls will be completed in conjunction with Landscape Architects during detail design/ construction certificate stage of the project.

Stormwater Management

The proposed drainage layout is shown on drawing **Co14506.00-SSDA40** (refer **Appendix A**). The proposed stormwater management strategy (as detailed in **Sections 4, 5 & 6** of this report remains consistent with the approved SSD 7500 arrangement

however the revised Masterplan Layout requires modification to the internal layout to suit the specific tenant layouts and requirements. The development catchment breakdown and discharge locations remains consistent with approved documents, as does the proposed water quality management strategy and water quantity requirements.

Flood Management

The flood management requirements and impacts associated with the development, in relation to Bow Bowing Creek and surrounding overland flow paths, are set out in the Arcadis EIS document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016) and subsequent response to submission (RtS) letter dated 23 September 2016.

The 1% AEP flood levels adjacent to the development are confirmed in the RtS letter to be RL 46.86m AHD to RL 45.95m in the post development conditions. Flood impacts resulting from the development, as agreed with CCC, are also set out in the RtS letter.

We confirm the proposed revised floor levels meet flood planning requirements (i.e. levels are higher than the 1% AEP flood level plus 0.5m of freeboard), and that there are no changes to the previously approved flood impacts or flood behaviour. Refer **Section 7** for further discussion on flooding.

Water Balance

A water balance was included in the SSD 7500 EIS set out in *Section 5* of the Arcadis EIS document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).

We note some minor variance in the approved water balance would result due to the reduced overall floor area in the Modification proposal masterplan layout. The reduced floor area would result in a minor reduction in potable water demand and also wastewater generation. This means and overall reduction in potential impacts from the approved development. Given similar, though slightly improved, outcomes relating to water balance assessments no further work on water balance is required as part of the modification. Refer Section 5 of the approved EIS document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016) for further information relating to water balance requirements.

1.4 Sear's And Agency Response Items

This section of the report addresses covers items relating to the Planning SEAR's, dated 10 March 2016, and associated agency responses. It is noted that new SEAR's are not required for the current modification proposal, as such we have provided responses to the original SEAR's *Soil and Water*, and from relevant agencies.

It is noted that the majority of items raised in the SEARs and associated agency letters will be managed and addressed via works and approved assessments already undertaken as part of the approved SSD 7500 proposal.

Further reference to the EIS should be made for confirmation of how the SEAR's have been addressed for non-civil engineering related items.

In relation to the following **Tables 1.2** and **1.3** sections referenced relating to the approved SSD7500 relate to *Appendix 10 Flooding and Stormwater* (dated 27 April 2016), and for the modification proposal relate to sections within this document.

Table 1.2. Secretary's Environmental Assessment Requirements

SEARs Reference	Key Assessment Requirement	Where Addressed (SSD 7500)	Where Addressed (SSD7500 Mod 1)
Soils and Water	A description of the water demands	Section 5	Section 4
	A description of the measures to minimise water use.	Section 5	Section 4
	A detailed water balance.	Section 5	Section 4
	A description of wastewater generated on-site.	Section 5	Section 4
	A description of the proposed erosion and sediment controls during construction and operation.	Section 6	Section 8 & Appendix C
	A description of the surface and stormwater management system, including on-site detention, and measures to treat or re-use water	Sections 3 and 5	Sections 4 to 6
	An assessment of potential groundwater impacts associated with the development	Section 5	Section 3
	An assessment of the impact of flooding on the development for the full range of flood events up to the probable maximum flood	Section 3	Section 7
	An assessment of the impact of the proposed development on flood behaviour; and	Section 3	Section 7
	Details of impact mitigation, management and monitoring measures	Sections 3 to 5	Sections 3 to 8

Table 1.3. Government Agency Key Issues

Agency	*Item & Response*
NSW Department of Primary Industries (DPI) - Attachment A 'Surface Water Assessment	*The predictive assessment of the impact of the proposed project on surface water sources should include the following:* *Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.* *Identification of all surface water sources as described by the relevant water sharing plan.* *Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.* *Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.* *Assessment of predicted impacts on the following:* *- flow of surface water, sediment movement, channel stability, and hydraulic regime,* *- water quality,* *- flood regime,* *- dependent ecosystems,* <u>Response</u> Assessment of the noted DPI have been included in the approved SSD7500 in *Sections 3 to 5* of the Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016). This report summarises similarities and confirms consistency with the previously accepted impacts and mitigation measures relating to surface water and soils. We note that there are no nearby water license users and management of surface water runoff during operation is consistent and improved from the existing car storage use on the land, the approved development and layout changes proposed in the modification application.
DPI	*Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.* <u>Response</u> There are no proposed surface or groundwater storage activities (other than rainwater reuse) proposed for the development.
DPI	*Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).* <u>Response</u> There are no volumetric water licensing requirements or proposals for ongoing water take following completion of the project.
DPI	*The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and*

Agency	*Item & Response*
	reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased. Response Sydney Water is the water supply authority for the suburb of Minto. Water supply has been confirmed as being available and approved in SSD7500. Refer *Sections 5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
DPI	*A detailed and consolidated site water balance* Response Refer *Sections 5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
DPI	*Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts* Response Impacts relating to surface water runoff and items noted above have been confirmed to be consistent in the SSD7500 approved concept and EIS. Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
DPI	*Full technical details and data of all surface and groundwater modelling.* Response Impacts relating to surface water runoff and items noted above have been confirmed to be consistent in the SSD7500 approved concept and EIS. Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
DPI	*Proposed surface and groundwater monitoring activities and methodologies* Response Impacts relating to surface water runoff and items noted above have been confirmed to be consistent in the SSD7500 approved concept and EIS. Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
DPI	*Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.* Response Impacts relating to surface water runoff and items noted above have been confirmed to be consistent in the SSD7500 approved concept and EIS. Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).

Agency	*Item & Response*
DPI	*Consideration of relevant policies and guidelines* Response Consideration to relevant state and local planning policies have been made. The measure and policies adopted for the SSD7500 Mod1 proposal remain consistent with the approved SSD7500 EIS.
Office of Environment & Heritage	*Commentary on water quality and flooding – how this will be dealt with in the proposal* Response Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).
Sydney Water	*Commentary on integrated water management strategy including alterative water supply, WSUD and proposed end uses* Response Refer **Section 4 to 8** of this report and *Sections 3-5* of the SSD7500 approved Arcadis document *Appendix 10 Flooding and Stormwater* (dated 27 April 2016).

2 SITE & DEVELOPMENT CHARACTERISTICS

2.1 Location & Site Description

The development site is located on the western side of Culverston Road, South of Airds Road, east of Bow Bowing Creek trunk drainage channel and north of Rose Payton Drive in the suburb of Minto. The proposal site and Stage 1, 2 and 3 Warehouses are located on the northern portion of the project area, as shown in **Figure 2.1.**

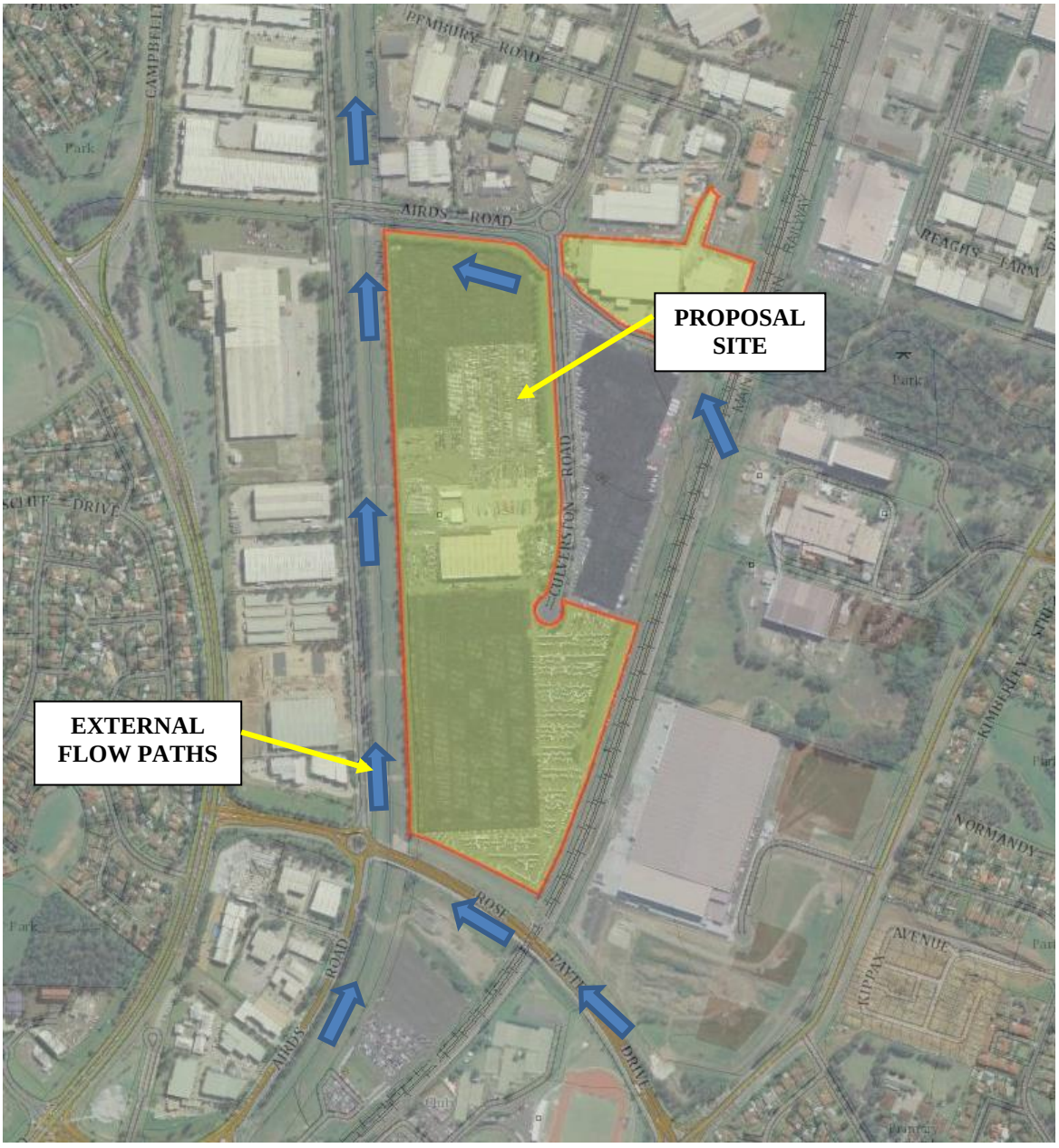

Figure 2.1 Locality Plan & Flow Paths (Source: Six Maps 2021)

The approved proposal site encompasses an area of 29.36 Ha. The land is currently being used as a car and vehicle storage facility and comprises significant impervious surfaces (approx. 95% site coverage) with hail nets for vehicle protection.

The proposal site is noted to be within a long established industrial area of Minto and is surrounded by many industrial developments and no nearby residential receivers.

The following descriptions of the existing site are:

- The land use on the site is currently industrial and a fully developed and paved vehicle storage facility.
- Formal drainage systems and dedicated pipe drainage outlets to Bow Bowing Creek and Culverston Road exist. There are three outlets available for the Stage 1, 2 and 3 Warehouses to Bow Bowing Creek and a further three available to Culverston Road.
- Watercourses are identified adjacent on the site, noting these consist of engineered channels as part of trunk drainage infrastructure for the Minto industrial precinct – refer **Figure 2.1** and **Section 7**.
- Previous survey information shows that the land falls from the north and north-west to the east and south-east corner of the site. The highest level on the site, at RL 56.65m AHD, is located at the south-east corner of the site and the lowest level is RL 46.0m AHD at the north-west corner.
- Inverts within Bow Bowing Creek are shown to vary from RL 45m AHD (upstream southern end of site) to RL 43m AHD (downstream adjacent to northern end of the site).
- The grades over the site are in the order of 1-2%.

2.2 Proposed Development

The proposed construction works for this submission comprises construction of four warehouse facilities with the Stage 1, 2 and 3 Warehouses being modified from the original approved layout.

The development comprises the following elements:

- Four steel framed warehouse buildings (noting the Stage 4 Warehouse is not part of this modification application);
- Ancillary office space on the east of Stage 1, 2 and 3 warehouse buildings and on the north of Stage 4;
- At grade car parking on the street frontage of buildings with access from the existing Culverston Road cul-de-sac;
- Truck circulation and loading areas;
- Fire brigade access around the full perimeter of each building and development site; and
- Stormwater drainage and flood management systems completed in accordance with the Stormwater Management Strategy approved under SSD 7500.

Refer to **Figure 2.2** for the proposed site layout as produced by Watch This Space Architects.

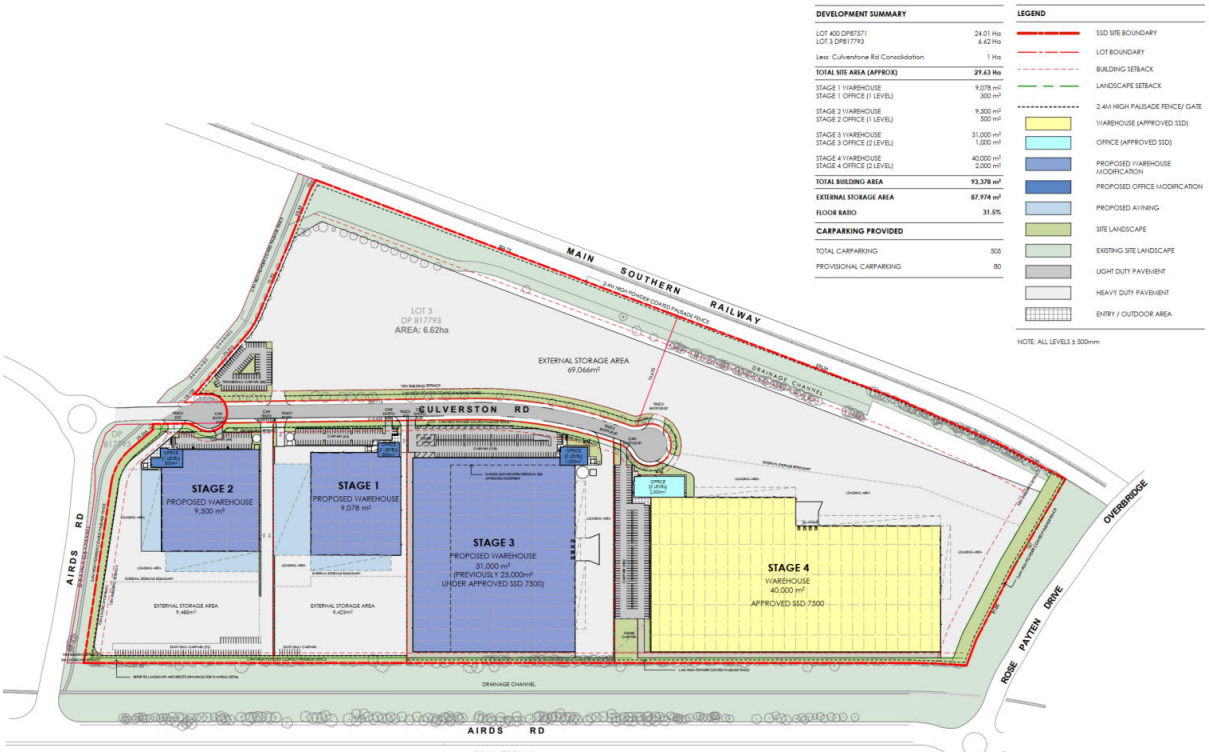

Figure 2.2. Proposed Development Layout

Adjustment to the floor levels of buildings are also proposed as noted below and set out in **Table 1.1**. We note the proposed floor levels are within the approved variance of plus or minus 0.5m.

Proposed building levels are as follows:

- Stage 1 = 48.0m AHD +/-0.5m
- Stage 2 = 48.0m AHD +/-0.5m
- Stage 3 = 49.3m AHD +/-0.5m

We note there are no proposed changes to the size, layout or levels of Stage 4 Warehouse. For reference Stage 4 Warehouse was approved with a finished floor level (FFL) of 50.7m +/-0.5m.

2.3 Approved SSD7500 Development Summary

As noted throughout this report, an approval for development was granted by DPE for SSD7500 on 23 June 2017. A brief discussion of the approved development is provided for information.

The proposed development involves construction of four warehouse buildings as shown in **Figure 2.3**.

Approved building levels are as follows:

- Building 1B (now Stage 2) = 47.6m AHD +/-0.5m
- Building 1C (now Stage 1) = 48.5m AHD +/-0.5m
- Building 1D (now Stage 3) = 49.3m AHD +/-0.5m

Project works, as approved, include the following elements:

- Earthworks and retaining walls to facilitate flat pads for the approved warehouse/ distribution building developments;
- Internal and external Infrastructure works including stormwater, energy, telecommunications, water supply and sewer;
- Construction of stormwater management measures including provision of stormwater pollutant removal devices; and
- Provision of internal drainage systems to existing drainage discharge locations.

The approved masterplan layout is shown in **Figure 2.3**.

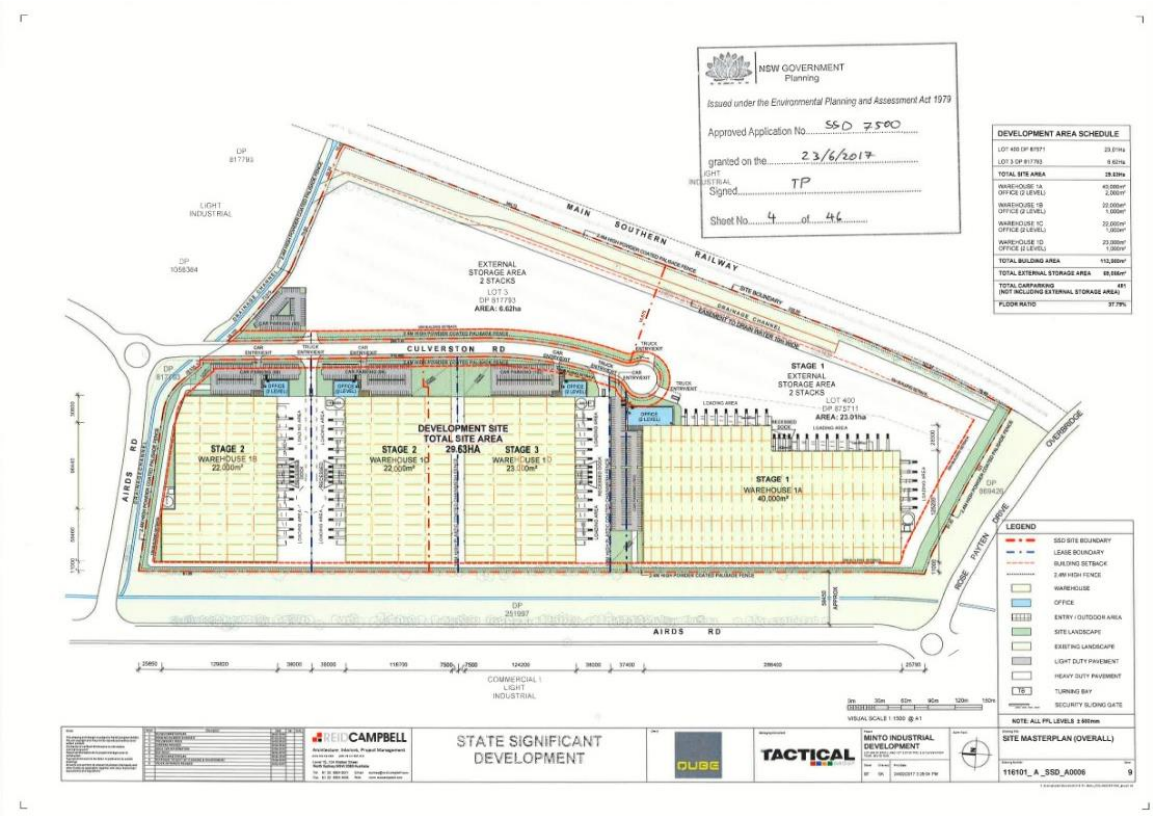

Figure 2.3. Approved SSD76500 Masterplan Layout

3 SITE WORKS

3.1 Geotechnical and Geological Profile

A geotechnical assessment has been completed by Golder Associates as part of the SSD7500 EIS. The site conditions and proposed modification conditions remain consistent between the SSD7500 approval and modification proposal. Refer report *Geotechnical Investigation for Warehousing Development* (Golders Ref: 1648232-002-R-Rev0, dated April 2016) for detailed information pertaining to geotechnical profile and investigations.

The 1:100,000 Wollongong-Port Hacking Geological Sheet (GS 9029-9129, 1985) indicates that ground conditions at the site comprise of Quaternary paleochannel deposits, including fluvial sand, clay and silt. The paleochannel is underlain by Ashfield Shale and Hawkesbury Sandstone.

Acid Sulfate Risk Maps (ASRIS) indicate the area is in a region with no known occurrence of acid sulfate soils. Acid sulfate soils are generally only expected at elevations of less than 5 m AHD in coastal areas (RTA,2005), and are not expected at the site due to its elevation of approximately 45 to 50 m AHD.

The Golders investigation describes the subsurface profile as follows:

"Unit 1 – Fill

Unit 1A - Topsoil

Topsoil was only observed on the fringes of the site, generally associated with the surrounding garden areas. Topsoils generally consisting of clays and silts, were encountered in four boreholes (GA-BH02, GA-BH03, GA-BH04 and GA-BH05). The topsoils generally extend to depths between 0.1 m and 0.4 m depth below ground surface, with an average thickness of 200 mm. At the time of the investigation the topsoil was generally dry and underlain by "Fill" (i.e. soil Unit 1c described below).

Unit 1B – Hardstand Pavement

An asphalt or concrete hardstand covers the majority of the site. An asphalt pavement surface approximately 30 mm thick was encountered at two borehole locations (GA-BH07 and GA-BH08). The asphalt was observed to be generally dark grey, poorly bound and was underlain by a thin layer of sub-base gravelly sand, extending to depths of 0.4 m and 0.2 m below the ground surface.

Unit 1C – Fill

Two soil stockpiles running roughly north-south, parallel to Culverston Road were observed during the investigation. Existing fill material was encountered at all borehole locations and generally comprises medium plasticity silty clay, clay and sandy clay with some angular gravel. It was generally found immediately beneath the topsoil/asphalt pavement or at existing ground surface level and extended to depths between 1.6 m and 4.4 m below ground surface.

Fill was also encountered in all of the hand auger locations within the soil stockpiles. All hand auger holes terminated within the fill unit.

In situ testing (SPTs and pocket penetrometers) indicate the fill is generally very stiff, with firm layers encountered immediately below sub-base layers in boreholes GA-BH07 and GA-BH08.

Unit 2 – Alluvium

The alluvial material encountered generally comprises high plasticity grey and brown clay and was encountered beneath the Unit 1C fill in all boreholes. The exception to this is borehole GA-BH06, which was terminated within the fill at 3 m depth. The alluvium was found at depths as shallow as 1.6 m (GA-BH07) but generally began at about 3 m and continued to greater than 8 m depth below ground surface.

In situ testing (SPTs and pocket penetrometers) indicated the fill is generally stiff to very stiff, with some zones of firm or hard material (GA-BH04)."

3.2 Bulk Earthworks

Filling earthworks will be required to achieve flood planning levels and to suit the proposed development layout. Earthworks volumes and filling are noted to be consistent with the approved development layout.

Details of earthworks would be provided during detail design/ construction certificate stages of the development. Detailed assessment of the earthworks level will be completed during detailed design stage and some adjustment to the final pad and building floor levels (within +/-500mm) may be required subject to final geotechnical testing, topsoil assessments and bulking/compaction allowances.

All imported soil would comprise VENM or ENM, unless otherwise approved and in accordance with EPA guidelines.

Soil erosion and sediment control measures including sedimentation basins will also be provided for the development – please refer to the Soil and Water Management Plan in **Section 8** of this report.

3.3 Groundwater

The Golder Associated investigation identified groundwater at depths of 4-6m below ground level.

The impact on the overall groundwater system was reviewed and confirmed acceptable. Impact as a result of the currently proposed development are negligible given the existing industrial development on the land and anticipated filling on the site

The effect on impact is considered to meet the requirements of the SEARS and initial responses by the NSW DPI.

3.4 Embankment Stability

To assist in maintaining embankment stability, permanent batter slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in **Section 8**.

It is noted that there are no substantial batters proposed for the development.

3.5 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

4 STORMWATER MANAGEMENT

4.1 Hydrologic Modelling and Analysis

4.1.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, CCC and accepted engineering practice, consistent with the approved SSD7500 stormwater strategy.

Runoff from buildings will generally be designed in accordance with *AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.*

Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (2019 Edition), (AR&R).

Storm events for the 20 & 100 Year ARI events have been assessed.

Campbelltown DCP Volume 2 Engineering design for Development June 2009 has been considered in the design and impact assessments.

4.1.2 Minor/ Major System Design

In accordance with CCC *Campbelltown DCP Volume 2 Engineering design for Development June 2009* and generally accepted engineering practice, and the approved SSD7500 drainage system, the piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure for flows above the capacity of the piped system. Overland flow from the property will be directed to Bow Bowing Creek or associated Council trunk drainage systems which flank the perimeter of the development site.

4.1.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for DRAINS modelling for the 5 to 100 Year ARI events, was taken from The Bureau of Meteorology Online IFD Tool.

4.1.4 Runoff Models

Calculation of the runoff from storms of the design ARI, as part of post approval design phases, is recommended to be calculated using the catchment and hydraulic modelling software DRAINS.

The design parameters for the DRAINS model are to be based on the recommendations as defined by council and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Inlet Pit Capacity		

Table 4.1. DRAINS Parameters

4.2 Hydraulics

4.2.1 General Requirements

Hydraulic calculations for the project are recommended to be carried out utilising DRAINS modelling software in the post approval phase of the development. The hydraulic calculations for the individual lots will be carried out by DRAINS during the detail design stage. These calculations ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

4.2.2 Pit Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground/ grate level, for the peak runoff from the Minor System runoff.

The calculated water surface for the peak runoff from the Major System runoff will not exceed a freeboard level of 300mm below the finished floor level of the building/ development pads.

Freeboard to surrounding trunk drainage systems and regional flood levels (i.e. Bow Bowing Creek) will achieved 500mm freeboard.

4.2.3 Public Safety

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

4.2.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

4.2.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI.

4.3 Site Drainage & Stormwater Management Summary

As discussed in **Section 2.1**, existing formal drainage systems are present on the development site constructed and operating to service the existing car storage and processing facility. There are existing dedicated pipe drainage outlets to Bow Bowing Creek and Culverston Road exist. There are three outlets available for the Stage 1, 2 and 3 Warehouses to Bow Bowing Creek and a further three available to Culverston Road.

The proposed stormwater system for the current proposal is to consist of a major/ minor system which conveys surface water from the proposed development lots to in-ground drainage connection points to the estate infrastructure and combined water quality/ detention basin in the north-west corner of the site.

A summary of the main stormwater management measures is provided as follows:

- In-ground drainage system designed to accommodate the 1 in 20 year ARI storm event.
- Overland flow paths to convey the 1 in 100-year ARI storm event from the proposed development site to Bow Bowing Creek or Council perimeter drainage channels.
- Vortech style gross pollutant trap located prior to discharge to Bow Bowing Creek on the west of the development site. Water quality treatment is consistent with the approved SSD 7500, as per Section 4 of ;
- Discharge of stormwater via existing outlets to either Bow Bowing Creek, or Culverston Road (refer drawings in **Appendix A**); and
- Rainwater reuse in accordance with the estate development.

Further discussion on the *Stormwater Management Strategy* is provided in **Section 5** and **Section 6** of this report.

Reference to drawing **Co14506.00-SSDA40** in **Appendix A** shows the proposed drainage and stormwater management layout.

5 WATER QUANTITY MANAGEMENT

Campbelltown City Council does not require water quantity management, or stormwater detention, to be provided for site within established industrial areas with downstream conveyance systems which have sufficient capacity or where there is no change in pre and post development flows. The requirements for water quantity management are included in *Section 4.4* of *Campbelltown DCP Volume 2 Engineering design for Development June 2009.*

We note the existing site is fully developed with almost whole of site comprising impervious buildings, concrete pavements or spray seal bitumen pavement surfaces. There is no change or increase in impervious areas, and as such no increase in runoff as a result of redevelopment.

The approved SSD7500 development, and the current modification does not require stormwater detention, or any other stormwater quantity management measures provided. There are no proposed stormwater management measures proposed as part of this modification.

It is confirmed there is no impact on receiving waterways or downstream systems as a result of the development due to there being no differences in pre and post development runoff volume or peak flow rates.

6 STORMWATER QUALITY, HARVESTING & MAINTENANCE

6.1 Stormwater Quality

There is a need to provide design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters.

The objectives for the development, as per *Section 4.1* of Arcadis *EIS Appendix 10_Flooding and Stormwater* document are:

- Maintain or improve existing water quality
- Prevent bed and bank erosion and instability of waterways
- Incorporate a Water Sensitive Urban Design (WSUD) approach

Development lots, verges and road areas are required to be treated by the Stormwater Treatment Measures (STM's). The STM's shall be sized according to the whole catchment area. The STM's for the development shall be based on a treatment train approach to ensure that the objectives above are met and an improvement in water quality is achieved.

Components of the treatment train for the Modification Proposal remain consistent with the approved SSD 7500 Water Quality Strategy. These are as follows:

- Treatment via gross pollutant trap be provided at each discharge point. the specified GPT will achieve pollutant reduction removal rates of approximately 90% of GP's, 65% of TSS, 35% of TP, 10% of TN and 60% of TH (per *Table 5* of approved SSD7500, Arcadis *EIS Appendix 10_Flooding and Stormwater* document). STM's for development site are to be specified based on individual use on each development lot. Typical examples of acceptable site STM's include end-of-line gross pollutants traps (GPT's) such as Ecosol RSF4000, Rocla CDS, Humeceptor and at source methods such as pit inserts equivalent to Stormwater360 Enviropods;
- A portion of the future building roofs will also provide a level of treatment via rainwater reuse and settlement within the rainwater tank.

Refer to drawing **Co14506.00-SSDA40** for location and details of stormwater quality devices.

6.2 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting will be considered for the warehouse developments in this application with re-use for non-potable applications. Internal uses include such

applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the non-potable water demand for the individual future developments.

In general terms the rainwater harvesting systems will be in-line tanks for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system.

Rainwater falling on roofs is soft, clear and generally low in microbial and chemical contamination. Any contamination of rainwater generally occurs during collection and storage. The use of simple and cost effective rainwater collection and treatment systems ensures reliable operation and water quality for non-potable use. The proposed rainwater treatment will be a first flush diverter in accordance with council engineering guidelines.

Indoor and outdoor water demand and rainwater tanks sizing will be based on individual site requirements. Tank sizing, locations and demand reductions are subject to detailed analysis during construction certificate stage by the Hydraulic Engineering Consultant consistent with the current SSD 7500 approval.

6.3 Maintenance and Monitoring

It is important that each component of the stormwater system and water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared and included as **Appendix B** to assist in the effective operation and maintenance of the various water quality components.

Inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the below nominated frequency it is recommended that inspections are made following large storm events.

7 EXTERNAL CATCHMENTS AND FLOODING

As part of the SSD 7500 EIS, an assessment of flooding in relation to the site was completed. Outcomes of the flood assessment are included in the Arcadis *Appendix 10 - Flooding & Drainage* document, and subsequent RtS letter dated 23 September 2016.

The assessments completed, and approved, in 2016 were made with consultation with CCC. The proposed modification proposal remains consistent with the 2016 assessment and approval.

The 2016 assessment confirmed the following outcomes and recommendations:

- The 1% AEP flood levels adjacent to the Stage 1, 2 and 3 Warehouses are confirmed in the RtS letter to be RL 46.86m AHD to RL 45.95m in the post development conditions (refer **Figure 7.1** and **7.2**).
- Flood impacts resulting from the development are noted by CCC as being marginal in the post development conditions and the difference in flood level between the filled site and unfilled site "are generally small".
- The site is noted to be inundated in the PMF hence consideration to risk to property and life is required. The future developments are noted to require local flood management plans which set out on-site refuge, information for users of the site to be informed of flood behaviour, and collaboration with CCC, SES in developing the flood response plan.

Figures 7.1 and **7.2** show flood level locations and flood levels for the 1% AEP event in the pre and post development conditions, as per the RtS letter dated 23 September 2016. Relevant locations to the modification proposal are Locations 1, 2 and 3. Of lesser importance, though still relevant, are locations 16, 17 and 18.

Flood planning levels (FPL) per councils requirement of 0.5m above the 1% AEP are RL 47.36m AHD to RL 46.45m. It is confirmed the proposed building levels (refer Section 2.2) meet councils FPL requirements.

Given the proposed modification proposal remains consistent with the outcomes and recommendations of the 2016 assessment and approval, no further flood assessments or modelling is required for this modification application.

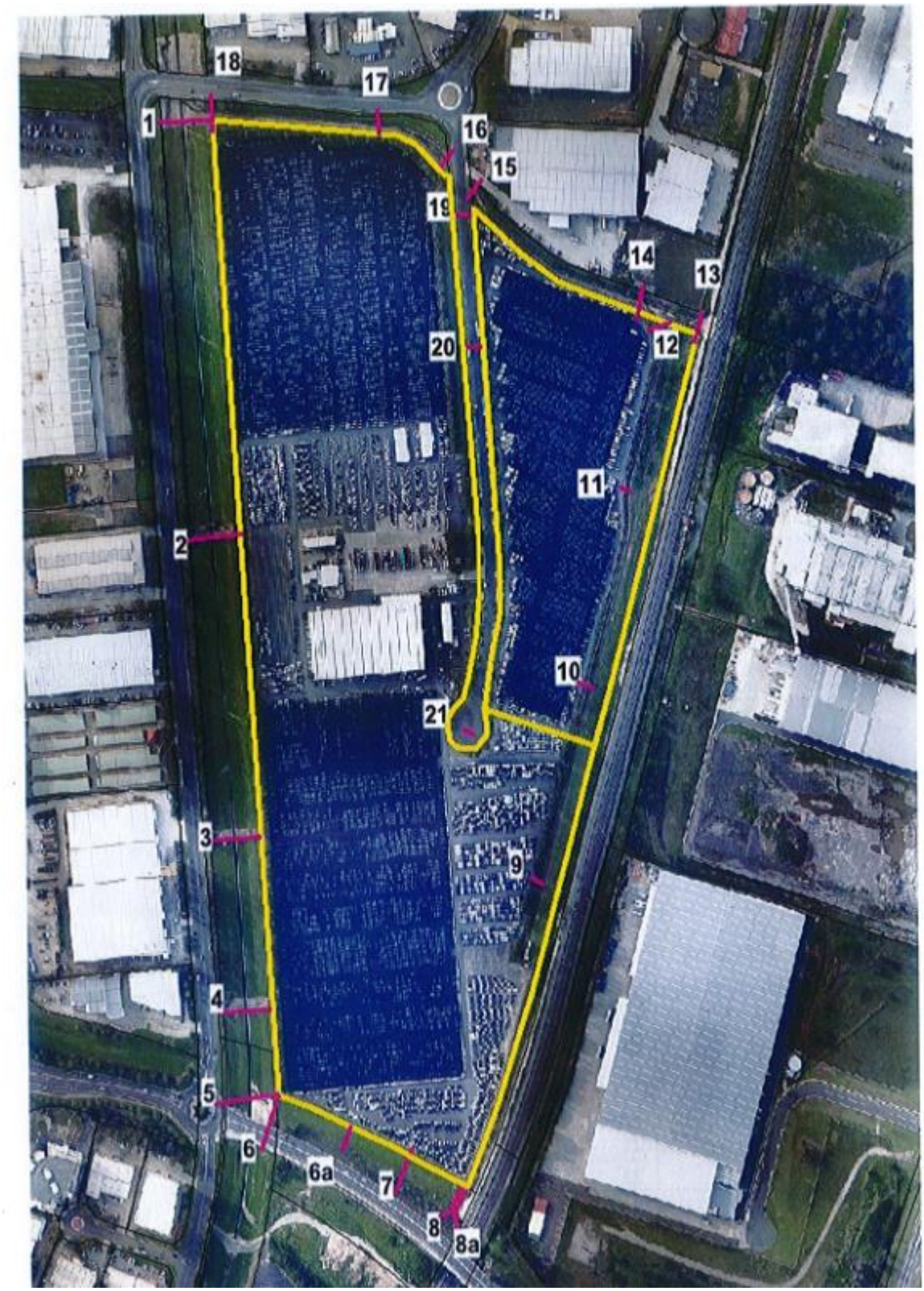

Figure 7.1. 1% AEP Flood Level Location Map

1% AEP flood levels based on the existing topographic condition (Column 1) and raised the site by 10m (column 2)

Details of the flood way	Location	1% AEP flood level (Min. Floor level) based on the existing topographic condition (metres AHD)	1 % flood levels (raised development site by 10m) (metres AHD)
		1	2
Bow Bowing Channel	1	45.88	45.95
	2	46.85	46.86
	3	48.50	48.55
	4	49.75	49.76
	5	50.05	50.05
Formalised grass channel to the south (Rose Payten Drive side)	6	50.05	50.05
	6a	50.08	50.10
	7	50.20	50.20
	8	50.80	50.85
	8a	51.20	51.20
Formalised fabriform channel within the site	9	48.00	48.16
	10	47.20	47.28
	11	47.08	47.14
	12	47.06	47.13
Fabriform channel to the north	13	48.88	48.88
	14	47.03	47.09
	15	46.04	46.12
	16	45.85	45.86
	17	45.78	45.83
	18	45.78	45.83
Culverston Road	19	46.27	46.26
	20	46.50	46.50
	21	48.00	48.12

Figure 7.2. 1% AEP Flood Levels

8 SOIL AND WATER MANAGEMENT PLAN

8.1 Soil and Water Management General

Section 1 provides a summary of the construction works for the Proposal. While all construction activities have the potential to impact on water quality, the key activities are:

- Erosion and sediment control installation.
- Grading of existing earthworks to suit building layout, drainage layout and pavements.
- Stormwater and drainage works.
- Service installation works.
- Building construction works.

Without any mitigation measures and during typical construction activities, site runoff would be expected to convey a significant sediment load. A *Soil and Water Management Plan* (SWMP) and *Erosion and Sediment Control Plan* (ESCP), or equivalent, would be implemented for the construction of the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of *Managing Urban Stormwater – Soils & Construction Volume 1 ('Blue Book')(Landcom, 2004)*.

In accordance with the principles included in the Blue Book, a number of controls have been incorporated into a preliminary ESCP (refer to accompanying Drawings in **Appendix A**) and draft SWMP in **Appendix C**.

The sections below outline the proposed controls for management of erosion and sedimentation during construction of the Proposal, noting measures proposed are consistent with the SSD 7500 approval.

8.2 Typical Management Measures

Sediment Basins

Sediment basins have been sized (based on 5 day 85th percentile rainfall) and located to ensure sediment concentrations in site runoff are within acceptable limits. Preliminary basin sizes have been calculated in accordance with the Blue Book and are based on 'Type F' soils. These soils are fine grained and require a relatively long residence time to allow settling.

Sediment basins for 'Type F' soils are typically wet basins which are pumped out following a rainfall event when suspended solids concentrations of less than 50 mg/L have been achieved.

Sediment Fences

Sediment fences are located around the perimeter of the site to ensure no untreated runoff leaves the site. They have also been located around the existing drainage channels to minimise sediment migration into waterways and sediment basins.

Stabilised Site Access

For the proposal, stabilised site access is proposed at one location at the entry to the works area. This will limit the risk of sediment being transported onto public roads.

8.3 Other Management Measures

Other management measures that will be employed are expected to include:

- Minimising the extent of disturbed areas across the site at any one time.
- Progressive stabilisation of disturbed areas or previously completed earthworks to suit the proposal once trimming works are complete.
- Regular monitoring and implementation of remedial works to maintain the efficiency of all controls.

It is noted that the controls included in the preliminary ESCP are expected to be reviewed and updated as the design, staging and construction methodology is further developed for the Proposal.

9 CONCLUSION

This report has been prepared to support the proposed modification (Mod1) to SSD 7500 for a revised masterplan layout for construction of a warehouse distribution development.

A civil engineering strategy for the site has been developed which provides a best fit solution consistent with the Stormwater Management Strategy and impact assessments approved under SSD 7500. The proposed engineering strategy for this development has been completed consistent with the approved development.

During construction stage, Erosion and Sediment Control Measures are proposed for the site to ensure that all receiving waters are protected from undue pollution and sediment laden stormwater runoff. The strategy comprises erosion control measures consistent with Campbelltown City Council Policy and the Landcom document *Managing Urban Stormwater, Soils and Construction (1998)*. Provided measures include sediment basins, diversion drains, batter control and site construction entries.

During operational phase the stormwater quality will be performed by a treatment train approach of primary treatment of hardstand and other paved surfaces.

It is recommended that the management and mitigation strategies described in this report (consistent with those already approved under SSD7500) be incorporated into the future detailed design. Detailed design may result in changes to the concept however design criteria will be followed.

10 REFERENCES

- *Campbelltown DCP Volume 2 Engineering design for Development June 2009*.
- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004(LANDCOM);
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

11 GLOSSARY

Afflux	The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure. The change in flood surface or depth as a result in a modification or change to the hydraulic flood model scenario.
Australian Height Datum (AHD)	National survey datum corresponding approximately to mean sea level.
Annual Exceedance Probability (AEP)	The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.
Average Recurrence Interval (ARI)	Is statistically the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event. An ARI is the reciprocal of the AEP.
Catchment	The catchment at a particular point is the area of land which drains to that point.
Depth to velocity value (DV)	A ratio of flow depth and velocity used as a measure of safety for pedestrians and vehicles subject to flood water. Normally a maximum DV of 0.4 is recommended for pedestrian safety and 0.6 for vehicles.
Design floor level	The minimum (lowest) floor level specified for a building.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.
Development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
Discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.
Digital Terrain Model (DTM)	A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an

	elevation (DEM) or a series of interconnected triangles with elevations (TIN).
Effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches their location.
First Flush	The initial surface runoff of a rainstorm. During this phase, water pollution in areas with high proportions of impervious surfaces is typically more concentrated compared to the remainder of the storm.
Flood	Above average river, creek, channel or other flows which overtop banks and inundate floodplains or urban areas.
Flood awareness	An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and flood preparedness and consequently suffer greater personal and economic losses.
Flood behaviour	The pattern / characteristics / nature of a flood.
Flooding	The State Emergency Service uses the following definitions in flood warnings: *Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges *Moderate flooding*: low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major flooding*: extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.
Flood frequency analysis	An analysis of historical flood records to determine estimates of design flood flows.
Flood fringe	Land which may be affected by flooding but is not designated as a floodway or flood storage.
Flood hazard	The potential threat to property or persons due to flooding.

Flood level	The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as "stage".
Flood liable land	Land inundated up to the probable maximum flood – flood prone land.
Floodplain	Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.
Flood Planning Levels (FPL)	Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.
Flood proofing	Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.
Floodplain Management	The coordinated management of activities which occur on flood liable land.
Floodplain Management Manual	A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.
Flood source	The source of the flood waters.
Floodplain Management	A set of conditions and policies which define the benchmark from standard which floodplain management options are compared and assessed.
Flood standard	The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.
Flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
Floodways	Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels or overland flow paths. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.

Freeboard	A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects, uncertainties in the hydrology, uncertainties in the flood modelling and uncertainties in the design flood levels.
Geographical Information System (GIS)	A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.
High hazard	Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.
Historical flood	A flood which has actually occurred – Flood of Record.
Hydraulic	The term given to the study of water flow.
Hydrograph	A graph showing how flow rate changes with time.
Hydrology	The term given to the study of the rain-runoff process in catchments.
Low hazard	Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.
Map Grid of Australia (MGA)	A national coordinate system used for the mapping of features on a representation of the earth's surface. Based on the geographic coordinate system 'Geodetic Datum of Australia 1994'.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
MUSIC	Acronym for Model for Urban Stormwater Improvement Conceptualisation. A computer model which is used to simulate rainfall runoff, associated pollutants within the runoff and expected treatment of the pollutants using different treatment measures.
Probable Maximum Flood (PMF)	An extreme flood deemed to be the maximum statistical flood likely to occur at a particular location.

Probable Maximum Precipitation (PMP)	The greatest statistical depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.
Probability	A statistical measure of the likely frequency or occurrence of flooding.
Riparian Zone	Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.
Runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.
Stage	Equivalent to water level above a specific datum- see flood level.
Treatment train	A term used to describe a series of water quality measures which act in conjunction with one another to provide a combined water quality outcome.
Triangular Irregular Network (TIN)	A mass of interconnected triangles used to model three-dimensional surfaces such as the ground (see DTM) and the surface of a flood.
Velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

Appendix B

DRAFT STORMWATER MAINTENANCE PLAN

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace topsoil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
RAINWATER TANKS			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet - leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			depth as specified by the hydraulic consultant
INLET & JUNCTION PITS			
Inside of pits	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of pits	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
GROSS POLLUTANT TRAP			
Refer to manufacturer's guidelines	Annually/ after major storm.	Maintenance Contractor	Refer to manufacturer's guidelines
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.

Appendix C

DRAFT EROSION AND SEDIMENT CONTROL PLAN & EROSION CONTROL CHECK SHEET

C.1 Introduction

An erosion and sediment control plan (ESCP) is shown on drawing **Co14506.00-SSDA20** with details on **SSDA25**. These are conceptual plans only providing sufficient detail to clearly show that the works can proceed without undue pollution to receiving waters. A detailed plan will be prepared once consent is given and before works start.

C.2 General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued in relation to development at the subject site.
2. Contractors will ensure that all soil and water management works are undertaken as instructed in this specification and constructed following the guidelines stated in *Managing Urban Stormwater, Soils and Construction (1998) "The Blue Book"* and Campbelltown City Council specifications.
3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

C.3 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in Table C.1.

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands	Entry prohibited except for essential management works	

Table C.1 Limitations to access

C.4 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried, and topsoils remain on the surface at the completion of works.
3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.
4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.
5. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.
6. Where practical, foot and vehicular traffic will be kept away from all recently established areas
7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:
    - 2H:1V where slope length is less than 7 metres
    - 2.5H:1V where slope length is between 7 and 10 metres
    - 3H:1V where slope length is between 10 and 12 metres
    - 4H:1V where slope length is between 12 and 18 metres
    - 5H:1V where slope length is between 18 and 27 metres
    - 6H:1V where slope length is greater than 27 metres
8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.
9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used, or the surface will be left in a cloddy state that resists removal by wind.

C.5 Pollution Control Conditions

1. Stockpiles will not be located within 5 metres of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways. Silt/ sediment fences and appropriate stabilisation of stockpiles are to be provided as detailed on the drawings.
2. Sediment fences will:
   a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.
   b) Have a catchment area not exceeding 720 square meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, and internal dimensions that provide maximum surface area for settling, and
   c) Provide a return of 1 metre upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20-year t_c discharge.
3. Sediment removed from any trapping device will be disposed in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.
4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.
5. Temporary soil and water management structures will be removed only after the lands they are protecting are stabilised.

C.6 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service will be provided at least weekly.

C.7 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:
   - At least weekly.
   - Immediately before site closure.
   - Immediately following rainfall events in excess of 5mm in any 24-hour period.

   The self-audit will include:
   - Recording the condition of every sediment control device
   - Recording maintenance requirements (if any) for each sediment control device

- Recording the volumes of sediment removed from sediment retention systems, where applicable
- Recording the site where sediment is disposed
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

2. In addition, a suitably qualified person will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report. The responsible person will ensure that:
   - The plan is being implemented correctly
   - Repairs are undertaken as required
   - Essential modifications are made to the plan if and when necessary

   The report shall carry a certificate that works have been carried out in accordance with the plan.
3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.
4. Proper drainage will be maintained. To this end drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that,
   - No low points exist that can overtop in a large storm event
   - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams of installing additional diversion upslope.
   - Blockages are cleared (these might occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
5. Sand/soil/spoil materials placed closer than 2 meters from hazard areas will be removed. Such hazard areas include and areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.
6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.
7. Excessive vegetation growth will be controlled through mowing or slashing.
8. All sediment detention systems will be kept in good, working condition. In particular, attention will be given to:
   a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them
   b) Degradable products to ensure they are replaced as required, and
   c) Sediment removal, to ensure the design capacity or less remains in the settling zone.
9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.

10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.
11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site stabilised
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

EROSION AND SEDIMENT CONTROL

WEEKLY SITE INSPECTION SHEET

LOCATION . . . . . .

INSPECTION OFFICER . . . . . **DATE** . . . . . .

SIGNATURE . . . . . .

Legend: □ OK □ Not OK N/A Not applicable

Item	Consideration	Assessment
1	Public roadways clear of sediment.	. . . . .
2	Entry/exit pads clear of excessive sediment deposition.	. . . . .
3	Entry/exit pads have adequate void spacing to trap sediment.	. . . . .
4	The construction site is clear of litter and unconfined rubbish.	. . . . .
5	Adequate stockpiles of emergency ESC materials exist on site.	. . . . .
6	Site dust is being adequately controlled.	. . . . .
7	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	. . . . .
8	Up-slope "clean" water is being appropriately diverted around/through the site.	. . . . .
9	Drainage lines are free of soil scour and sediment deposition.	. . . . .
10	No areas of exposed soil are in need of erosion control.	. . . . .
11	Earth batters are free of "rill" erosion.	. . . . .
12	Erosion control mulch is not being displaced by wind or water.	. . . . .
13	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	. . . . .
14	Sediment fences are free from damage.	. . . . .
15	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	. . . . .
16	Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.	. . . . .
17	All sediment traps are free of excessive sediment deposition.	. . . . .
18	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	. . . . .
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	. . . . .
20	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	. . . . .
21	Stabilised surfaces have a minimum 70% soil coverage.	. . . . .
22	The site is adequately prepared for imminent storms.	. . . . .
23	All ESC measures are in proper working order.	. . . . .