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INTERGRATED WATER CYCLE MANAGEMENT AND CIVIL ENGINEERING REPORT
Alspec Industrial Business Park
Orchard Hills 2748

For DA
September 2024
Revision 06

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1. INTRODUCTION

1.1 General

This Integrated Water Cycle Management and Civil Engineering Report has been prepared to supplement the Development Application (DA) for the proposed Alspec Industrial Business Park Subdivision Works located on Luddenham Road, Orchard Hills, NSW. Refer to the architectural site plan included within Appendix B for a demonstration of the proposed development and the site.

The proposed works are to consist of the following:

- Construction of a collector road running through the middle of the subject site, connecting Paton's Lane to Luddenham Road.
- Construction of a service road, connecting the collector road to the north-west basins and the transgrid easement.
- Proposed bulk earthworks to set future pads within subdivision.
- Construction of multiple flood basins to manage the flooding of the adjacent watercourse to the North-West of the subject site.
- Construction of multiple water quality, detention and stormwater harvesting basins to satisfy Council's WSUD and stormwater detention requirements.

Refer to Figure 1.1 below showing the proposed arrangement of the road infrastructure and future pads.

Figure 1.1 Locality Sketch

The following Engineering matters have been addressed in this report:

- Water Sensitive Urban Design (WSUD)
- Stormwater Detention
- Flooding
- Sediment and Erosion Control
- Road Design
- Site Grading and Bulk Earthworks

The purpose of this report is to summarise the stormwater design, as well as the hydraulic and water quality modelling in order to illustrate that the proposed design is in accordance with engineering best practice principals and the requirements set out in Penrith City Council's development control plan.

A full set of DA Drawings is provided in Appendix A of this report.

1.2 Engineering Objectives/ Principles

The stormwater network has been designed to safely convey minor storm events via a pit and pipe stormwater system with provision for larger, more infrequent storm events overland via an overland flow route. The minor storm event for this development is the 1:20yr ARI storm and the major storm event is the 1:100yr ARI storm. This is as per Council's development control plan (DCP).

In order to ensure no negative impact on downstream ecosystems and waterways, stormwater from the subject site is proposed to be managed through the implementation of water quality systems, detention and sediment and erosion control. Refer to sections 2.1, 2.2, 2.3 and Appendix A for further details.

1.3 Compliance with Relevant Policies

Penrith City Council

The civil engineering component of the aforementioned project has been designed in accordance with the following council codes and policies:

- Penrith City Council Development Control Plan 2014 – E18 Luddenham Road Industrial Business Park
- Penrith City Council Development Control Plan 2014
- Penrith City Council Stormwater Drainage Specifications for Building Developments 2018
- Penrith City Council WSUD Technical Guidelines 2015

E18 Luddenham Road Industrial Business Park

Penrith City Council have developed a sub section in the Penrith City Council DCP 2014 with controls specifically tailored for all developments covered by the Luddenham Road Industrial Business Park Precinct. In the event of any inconsistency between this section and the rest of the DCP, the requirements of Section E18 prevail. The stormwater controls are shown in Section 17.6 – Integrated Water Cycle Management of the Penrith City Council Development Control Plan 2014 Section E18 Luddenham Road Industrial Business Park

Austroads

The design of the collector road and service road is not only in accordance with Council's DCP, but also generally in accordance with:

- Austroads Guide to Road Design Part 3 – Geometric Design
- Austroads Guide to Road Design Part 2 – Pavement Structural Design
- Austroads Guide to Road Design Part 5 – Drainage Design

Australian Standards

The proposed civil engineering and stormwater design is in accordance with the Australian standards, including but not limited to:

- AS2890.1 -2004
- AS2890.2 – 2018
- AS3500.3 – 2021

Sediment and Erosion Control/Stormwater Management

The stormwater design and modelling has been undertaken in accordance with the following:

- Soils and Construction Volume 1– Managing Urban Stormwater – 2004
- Australian Rainfall and Runoff, Volume 1, Revised Edition 1987
- Technical Guidance for Achieving Wianamatta-South Creek Stormwater Management Targets - 2022

1.4 The Site & Its Context

The site is identified as Lot 1 and 2 in DP 1293805 and is located alongside Luddenham Road and Patons Lane.

The site currently comprises of the following general layout:

- Lot 1 DP 1293805: A building, horse stables and associated facilities, and a rectangular network of fenced yards for horse and sheep agistment.
- Lot 2 DP 1293805: Open space paddocks for cattle grazing and four dams.

The site is located within the Wianamatta – South Creek Catchment area and is approximately 124.484 hectares, however only 63.62 hectares of the site is proposed to be developed as a part of this project. The western portion of the site is marked as a future Outer Sydney Orbital Corridor, whilst a portion of the site to the south is noted as an environmental conservation area. A portion of the site to the south is also noted as a Western Sydney Freight Corridor. Additionally, a Transgrid electrical easement runs through the north-western part of the site.

1.5 Catchments

Refer to Figure 1.5 below and drawings C250 and C251 within Appendix A showing the existing and proposed catchment plans for the development. In general, the site is separated into 3 sub-catchments:

- The western catchment drains to the watercourse in the western part of the site. This is approximately 49.59 hectares. The proposed stormwater system is to connect to an existing headwall within Patons Lane which directs stormwater to the north to the watercourse.

- The south eastern catchment drains to Luddenham Road. This catchment is approximately 11.35 hectares. The proposed stormwater system is to connect to an existing headwall within Luddenham Road which directs stormwater to the east.
- The north eastern catchment drains to Luddenham Road. This catchment is approximately 2.68 hectares. The proposed stormwater system is to connect to an existing headwall within Luddenham Road which directs stormwater to the east.

The site is proposed to be regraded to suit the new layout as per the architectural plans in Appendix B. The existing catchment areas are to be retained in general. Refer to drawing C251 in Appendix A. The western part of the site is subjected to flooding. All flooding investigations have been undertaken by Arcadis, refer to Appendix D and section 4 for more details.

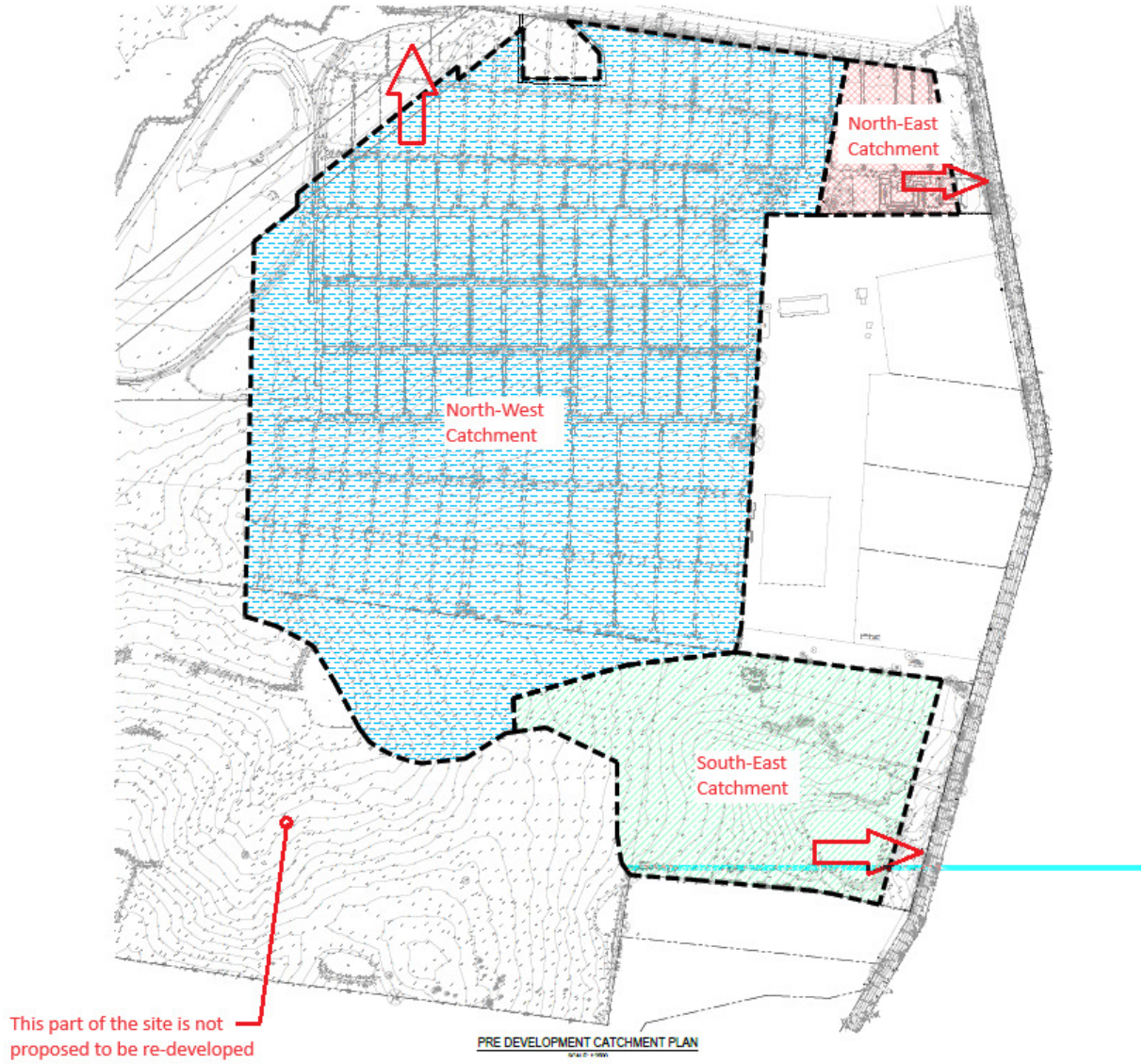


Figure 1.5 Catchment Plan

2. STORMWATER MANAGEMENT

2.1 Introduction

2.1.1 Background

Stormwater controls are proposed to be implemented that ensure that the development does not adversely impact on stormwater flows and water quality of the stormwater system downstream of the site.

The principles and operation of the proposed stormwater system for the development including water quality measures and the components of the internal drainage system are detailed on the Development Application Drawings included in Appendix A.

2.1.2 Key Issues

The key issues and the proposed mitigation measures to be implemented as part of the proposed development are:

- **Stormwater Quantity** - The increased impervious surfaces (such as roads, roofs, driveways, etc) associated with the development will result in an increase in peak stormwater flows from the site during storm events. On Site Detention is required to be considered to ensure that runoff from the development is appropriately managed in accordance with Council's requirements. The site stormwater system has been designed to safely convey the flows through the site and within the capacity of the downstream system. The design and operation of the proposed stormwater system is described in Section 2.2 below.

- **Water Quality** - Urban developments have the potential to increase gross pollutants, sediments, hydrocarbons and nutrient concentrations in stormwater runoff. To limit impact on the downstream water quality, stormwater treatment in the form of gross pollutant traps, and bio retention basins will be provided. Section 2.3 further describes the specific implementation of these measures for the proposed development.

2.2 Stormwater Quantity

As per Penrith City Council's engineering specifications, post-developed flow rates are required to be reduced to pre-developed flow rates up to the 100yr ARI storm event. The stormwater detention strategy varies for each sub-catchment within the site, given the site constraints and proposed layout.

DRAINS Parameters

DRAINS modelling has been undertaken to assess the OSD requirements for the proposed works. Rainfall data of the site was taken from the Australian Rainfall & Runoff (ARR) 2016 Data Hub. Critical storm durations up to 1.5hrs were assessed for both the major and minor storm events.

An ISLAX hydrological model was adopted for all modelling scenarios, with the exception of the north-west pre-developed model, which was based off an XP-RAFTS hydrological model. The parameters for the ISLAX model were as follows:

- Paved area depression storage – 1mm
- Supplementary area depression storage – 1mm
- Grassed area depression storage – 5mm

The site has been graded such that the proposed catchment areas match the site's existing catchment areas, refer to C251 drawing for the post development catchment map. Time of concentration (T_c) values for minor catchment areas

alongside the proposed road works were a standard 5 minutes for impervious areas and 10 minutes for pervious areas. However T_c values for increasingly larger areas such as pad sites were more detailed and were based off factors including flow lengths, flow slopes and retardence coefficients.

Pipe drainage within the internal road reserve has been designed to cater, at a minimum, for the 20 year ARI storm event as per Penrith City Council's requirements. The stormwater overflow system has been designed such that overland flows during the 100 year ARI storm event are wholly contained within the road's kerb and gutter system.

North – Western Catchment

The North-Western Catchment totals 49.59ha and drains towards an existing watercourse that runs through the North-Western part of the site. Since this part of the site drains towards the watercourse, the stormwater design for this catchment has considered the flood modelling from Arcadis. The pre-developed flow rates for this catchment have been calibrated with the data used in the Arcadis flood model. An XP-RAFTS hydrological model has been utilised to estimate the pre-developed conditions for the north-west catchment. The following parameters have been used in order to calibrate with the DRAINS model by Arcadis:

Initial Loss = 10mm
Continuing Loss = 2.5mm/hr
Impervious Area PERN – 0.015
Pervious Area PERN = 0.05 (Rural) and 0.025 (Urban)
B_x = 1.3
Travel time for routing links is based on a 1.5m/s flow velocity

Refer to Table 2.2a which summarises the pre-developed flow rates for the north-west catchment

Total Area for pre-developed catchment C-1J-3A	45.503 hectares
Total Area for pre-developed catchment C-1I-4A-E	13.917 hectares
Peak flow rate for 5% AEP critical storm (combined C-1J-3A and C-1I-4A-E catchments)	4.62 m^3/s
Peak flow rate for 1% AEP critical storm (combined C-1J-3A and C-1I-4A-E catchments)	7.42 m^3/s
Maximum allowable post developed flows in critical 5% AEP storm	0.078$m^3/s/ha$
Maximum allowable post developed flows in critical 1% AEP storm	0.125$m^3/s/ha$

Table 2.2a North-West Pre and Post-developed flows

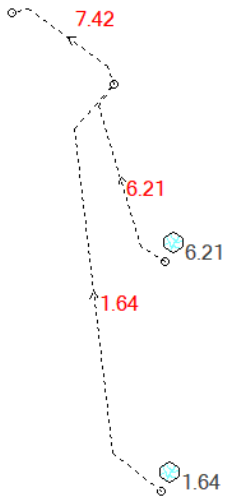


Figure 2.2 Arcadis DRAINS Model 1% AEP Pre- Developed Results

Refer to the DRAINS model '*19221_D2_Arcadis Pre-Dev'* for more details of the pre-developed modelling for the north-west catchment.

Stormwater detention is proposed to be provided in each individual lot within the North-West catchment. These on lot detention storages, which will most likely be in the form of below ground tanks, will be constructed as part of the development works for each pad site. These detention storages are not proposed to be constructed as part of the subdivision works. It should be noted that sediment basins are proposed to be constructed as part of the subdivision works, in order to control sediment and erosion from the pad sites.

In order to ensure that the stormwater system within the collector road and service road have been designed to cater for the final post-developed scenario, preliminary on -site detention storages has been designed in DRAINS for each pad. It is expected that the design of each on-lot OSD will be finalised as a part of the DA submission for each pad site. In general the preliminary OSD storages for each lot has been designed to ensure that the post-developed flows are reduced to below the pre-developed flow rates (refer to the table above). To summarise:

Approximate Storage = 425m^3/ha
Reduce post developed flows in critical 5% AEP storm to = 0.078m^3/s/ha
Reduce post developed flows in critical 1% AEP storm to = 0.125m^3/s/ha

Preliminary OSD Design for the North-West Lots

OSD Tank	Footprint (m^2)	Depth (m)	Volume (m^3)
OSD 1	1,700	1.49	2,533
OSD 2	1,162	1.44	1,673
OSD 3A	1,650	1.39	2,293
OSD 3B	1,300	1.49	1,937
OSD 4A	2,800	1.39	3,892
OSD 4B-1	1,901	1.39	2,642

OSD 4B-2	1,925	1.39	2,676
OSD 4C-1	797	1.49	1,188
OSD 4C-2	944	1.47	1,388

Refer to the DRAINS model '*19221 Drainage design D2 [15]- B LINE.drn'* which has been included as part of the DA submission, for further details. It should be noted that the final design of each on lot OSD system within the north-west catchment will be subject to future detailed design, along with the detailed design of the stormwater system within that lot.

The north-west catchment ultimately drains towards a 4800m^2 bio-retention basin via pit and pipe drainage in the collector road and service road. The bio-retention basin overtops into a 13400m^3 storage basin, which is proposed to store and re-use stormwater for the purposes or irrigation reuse. The key purpose of this storage basin is to provide water quality treatment and to ensure that Council's Mean Annual Run-off Volume (MARV) requirements are satisfied. Flows from the storage basin are captured and directed to the existing Council infrastructure in Patons Lane via a proposed 1500mm diameter pipe.

Refer to the aforementioned DRAINS models and the drawings included within Appendix A which demonstrates that the drainage system has been sized appropriately, and that Council's DCP requirements in terms of stormwater quantity have been addressed.

South – Eastern Catchment

The south-east catchment totals 11.35 hectares and discharges towards Luddenham Road. Given that this catchment has not been considered in the flood modelling, the proposed DRAINS model has been developed separate to any modelling from other consultants. An ISLAX hydrological model was used in the DRAINS modelling.

As per the north-western catchment, stormwater detention is proposed to be provided in each individual lot. These on lot detention storages, which will most likely be in the form of below ground tanks, will be constructed as part of the development works for each pad site. The on site detention systems should be design and approved as part of the future development applications for the future lots. The design of the OSD systems will need to ensure post-developed flows are less than pre-developed values. The road drainage in the south-eastern catchment has therefore been sized to allow for the flows from the pervious pads, given that the final post developed flows will be no grater than this value. It is expected that a full drains hydraulic model will accompany all future lot DA submission to ensure compliance with this requirement.

The stormwater pit and pipe system in the collector road has been designed to cater for flows from the pre-developed pad sites (100% pervious). No future on-lot detention basins have been included in this DRAINS model, as it is expected that the on-lot detention systems will at a minimum be reducing the post-developed flows to the pre-developed flow rates adopted.

The stormwater system is proposed to discharge towards a 2000m^3 storage basin. As per the north-west catchment, the key purpose of this storage basin is to provide water quality treatment and to ensure that Council's Mean Annual Run-off Volume (MARV) requirements are satisfied. Refer to Section 2.4 for more information. Flows from the storage basin discharge towards an existing headwall located in the Luddenham Road reserve to match the existing conditions.

Refer to the DRAINS model '*19221 Drainage design D2[02]- A LINE[08].drn'* which has been included as part of the DA submission, for further details.

North – Eastern Catchment

The north–east catchment totals 2.68 hectares and discharges towards Luddenham Road. As per the south-east catchment, this catchment has not been considered in the flood modelling and therefore the proposed DRAINS model has been developed separate to any modelling from other consultants. An ISLAX hydrological model was used in the DRAINS modelling.

On-site detention, water quality and storage has been provided for the north-east catchment. A total detention storage of 380m^3 has been provided in the form of a combined detention and storage basin. Refer to Table 2.2 as well as the DRAINS model *'19221 Drainage design D2[10]- Pad1.2 OSD.drn'* which has been included as part of the DA submission, for further details.

	Pre-developed flow rate	Post-developed flow rate
5% AEP Critical Storm	0.656m^3/s	0.388 m^3/s
1% AEP Critical Storm	1.04 m^3/s	0.436 m^3/s

Table 2.2b North-East Pre and Post-developed flows

There are no additional detention requirements for the NE catchment within pad 1. The future design of pad 1 will need to ensure flows from the site discharge to the above ground basin which has been designed as part of this application.

2.3 Water Quality

Council's requirements also dictate that the stormwater be treated before discharging from the site. The requirements dictate that the post developed pollutants be reduced by the following factors:

- Total Nitrogen to be reduced by 65%
- Total Phosphorus to be reduced by 80%
- Total Suspended Solids to be reduced by 90%
- Gross Pollutants to be reduced by 90%

A MUSIC model has been undertaken in order to design the stormwater quality system. Rainfall data was obtained from the Penrith City Council MUSIC e-link. All pollution generation for source nodes were based off the NSW Music Modelling guidelines. The final post-developed scenario for the subdivision has been modelled, however it should be noted that the water quality treatment measures for each lot is expected to be finalised along with the DA submission for each lot.

Summary of Catchment Areas for Music Modelling

Catchment	**Area (hectares)**
North East Catchment	2.68
North West Catchment	49.59
Alspec Pad NW Bypass	0.627
Collector Road NW Bypass	0.635
OSSM Site	0.524
COPE, Spec 2, NW Alspec	16.226
NW Bio-retention Basin Area	1.524
NW Collector Road/Service Road	1.706
NW Future Lots (50% Roof, 40% Hardstand, 10% landscaping)	28.348
South East Catchment	11.35
SE Collector Road	1.293
SE Future Lots (50% Roof, 40% Hardstand, 10% landscaping)	10.057
Residual Site Area (undeveloped)	59.864
Total Site	123.484

The following water quality treatment measures have been proposed in order to satisfy Council's water quality requirements. It should be noted that the concept design for the COPE, OSSM, Alspec and Spec 2 sites have been developed (refer to separate development applications or state significant development applications). In order to ensure that minor recent adjustments to the overall estate WSUD modelling does not requirement continual updating to the WSUD design for each separate DA, the music modelling for the COPE, OSSM, Spec 2 and Alspec sites have been modelled separately to the future lot sites.

North Western Catchment – OSSM Facility

- 9 x Oceanguard Pit Baskets to treat surface water from the road and landscaped surfaces.
- 11 x 690mm Psorb Stormfilters to be installed within an underground tank.
- 10kL of rainwater tank storage to be provided. Stored water will be reused for irrigation purposes in landscaping areas at a rate of 600mm /yr (total demand of 120.6kL/yr). This yields a 89% reuse rate.

North Western Catchment – COPE, Spec 2, Alspec 1 (west)

- A combined 30 x Oceanguard Pit Baskets to treat surface water from the road and landscaped surfaces.
- A combined total of 270kL of rainwater tank storage to be provided (60% of roof area to be directed to rainwater tank). Stored water will be reused for irrigation purposes in landscaping areas at a rate of 600mm /yr (total irrigation area of 9850m2 and demand of 5025kL/yr and 0.5kL/day (truck wash)). This yields an 80% reuse rate.

North Western Catchment – Future Lot Areas

- 140 x Oceanguard Pit Baskets to treat surface water from the road surfaces in the north-west catchment. All inlet pits within the future lots of the north-west catchment will be required to be fitted with pit baskets. Based off the expected road surface areas, an estimate of 140 pit baskets has been adopted.
- A volume of 440kL has been estimated for the total rainwater storage for the north-west lots. It is expected that 60% of all roof areas for the north-western lots will be directed to rainwater storage. Stored water will be reused for irrigation purposes in landscaping areas at a rate of 600mm/yr. This yields a 80% reuse rate.
- A CDS 2028 GPT
- An end of line 4800 m^2 Bioretention Basin with the following parameters:
    - 300mm detention depth
    - 125mm/hr conductivity
    - 500mm filter depth
    - TN Content of 800 mg/kg
    - Orthophosphate Content of 40 mg/kg
    - Vegetated with effective nutrient removal plants
- An 13,400m3 storage basin with an estimated reuse of 55,798kL/yr (based on irrigation area of 9.30 hectares at a rate of 600mm/yr).
- Refer to drawing C260 showing the proposed irrigation areas associated with the rainwater tanks and storage basins.

North Eastern Catchment

- 38x Oceanguard Pit Baskets to treat surface water from road surfaces in the north-east catchment.
- A CDS 1009 GPT
- An end of line 180 m^2 Bioretention Basin with the following parameters:
    - 300mm detention depth
    - 125mm/hr conductivity
    - 500mm filter depth

- TN Content of 800 mg/kg
- Orthophosphate Content of 40 mg/kg
- Vegetated with effective nutrient removal plants

- A 400m^3 storage basin with an estimated reuse of 2792 kL/yr (based on irrigation area of 0.465 hectares at a rate of 600mm/yr). The landscaped area within the eastern portion of the subject site will be irrigated. Reticulation design and details to be provided at the detailed design phase.

South Eastern Catchment

The water quality treatment strategy for the South Eastern Catchment differs from the other two catchments, with water quality devices proposed to be installed on an on-lot basis instead of end of line treatment. The water quality design incorporates the following treatment devices:

- 60 x Oceanguard Pit Baskets to treat surface water from the hardstand surfaces in the south-east catchment. All inlet pits within the future lots of the south-east catchment will be required to be fitted with pit baskets. Based off the expected road surface areas, an estimate of 60 pit baskets has been adopted.
- A volume of 160kL has been estimated for the total rainwater storage for the south-east lot. It is expected that 60% of all roof areas will be directed to rainwater storage. Stored water will be reused for irrigation purposes in landscaping areas at a rate of 600mm/yr. This yields an 80% reuse rate.
- A CDS 1012 GPT
- A combined 140 x 690mm Psorb Stormfilters is expected to be installed on lots located in the South-Eastern Catchment area. The total Future lot area in the SE catchment is 10.057 hectares, meaning a stormfilter will be required to be installed for every 718m^2 of lot area.
- A 2,000m^3 storage basin with an estimated reuse of 12836kL/yr (based on irrigation area of 2.14 hectares at a rate of 600mm/yr). The landscaped area within the southern portion of the subject site will be irrigated. Reticulation design and details to be provided at the detailed design phase.

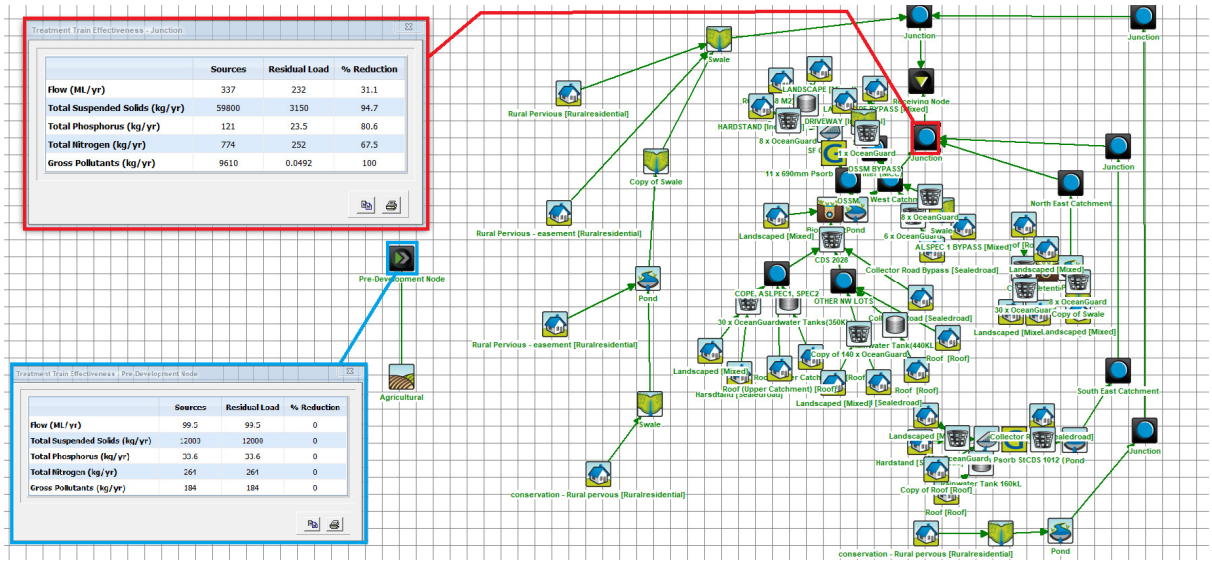


Figure 2.3.1 MUSIC Results

The results from the MUSIC model has been summarised in the table below.

Pollutant	Target Reduction	Pollutant Reduction
Total Nitrogen	65%	67.5%
Phosphorus	80%	80.6%
Suspended Solids	90%	94.7%
Gross Pollutants	90%	100%

Table 2.3.1 Catchment Pollutant Loads

The proposed development meets Penrith City Council's water quality targets as shown by the table above.

Refer to the MUSIC model '*19221_D2 Luddenham final RFI response model[03].sqz'* which has been included as part of the DA submission, for further details.

SEPP 2021 Compliance

The controls from the SEPP 2021 Chapter 6.6 dictate that:

- The effect on the water quality of the water entering a natural waterbody will be as close as possible to neutral or beneficial.
- The impact on water flow in a natural water body will be minimised.

It should be noted that the post developed pollutant rates have been reduced below the pre developed values as demonstrated in Figure 2.3.1. This outcome, in addition to the stormwater quantity results demonstrated in section 2.2, show that Section 6.6 of the 2021 SEPP Controls for development have been complied with.

Water Reuse

Both rainwater harvesting and stormwater harvesting is proposed to be implemented as of the water quality strategy for the subject site. Council requires 80% of non-potable demand to be provided through rainwater or stormwater harvesting storages. Refer to the aforementioned MUSIC model and the table below which demonstrates the reuse rates that have been achieved with each storage.

Storage	Reuse rate (%)
440kL Rainwater Tank (NW Catchment – Future Lots)	80%
13400m^3 Storage Pond (NW Catchment)	94%
270kL Rainwater Tank (COPE, Spec2, Alspec)	80%
10kL Rainwater Tank (OSSM)	89%
400m^3 Storage Pond (NE Catchment)	87%
160kL Rainwater Tank (SE Catchment – Future Lots)	80%
2,000m^3 Storage Pond (SE Catchment)	90%

Table 2.3.2 Stormwater Reuse

Life Cycle Cost Analysis

A life cycle cost analysis of the overall treatment train was exported from the MUSIC model, refer to the below figure for more information. An annual inflation rate of 2.5% was adopted. The life cycle cost analysis was taken over a span of 50 years of which includes installation, maintaining and decommissioning of the treatment train. The total life cycle cost of

the treatment train from the year 2023 is $6,186,086. The estimates annual payment cost is $106,954/year. Refer to the MUSIC model and Appendix F for more details.

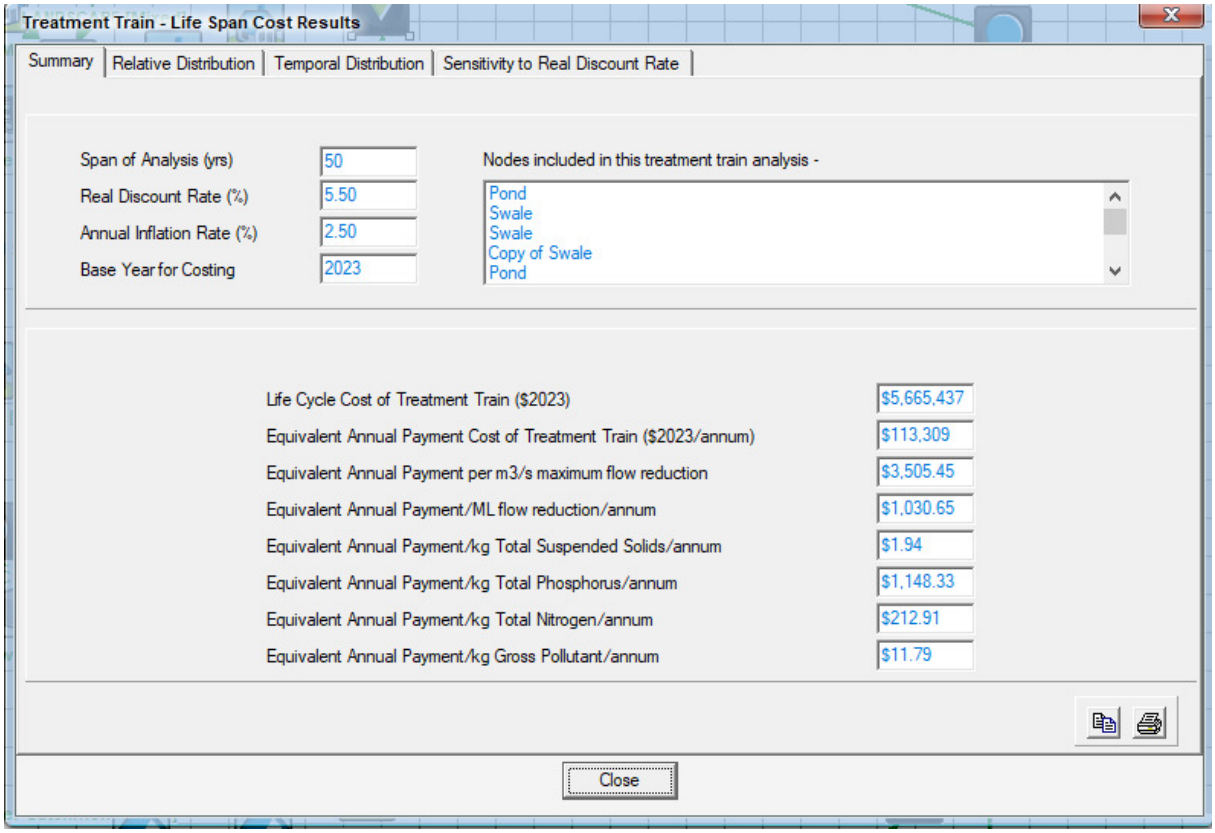


Figure 2.3.2 Life Cycle Cost

An operations and maintenance plan for all stormwater devices during the operational phase of the development has been detailed, refer to Appendix C for more information.

2.4 Mean Annual Runoff Volume (MARV)

As per the E18 Luddenham Road Industrial Business Park DCP, the subject site is required to satisfy the MARV stormwater controls, as outlined in Table E18.7 of the aforementioned DCP. Refer to the table below outlining the requirements.

Option 1: Mean Annual Runoff Volume (MARV) Approach	
MARV	≤ 2 ML/ha/year at the point of discharge to the local waterway
90%ile flow	1000 to 5000 L/ha/day at the point of discharge to the local waterway
50%ile flow	5 to 100 L/ha/day at the point of discharge to the local waterway
10%ile flow	0 L/ha/day at eh point of discharge to the local waterway

Table 2.4.1: MARV Targets

In order to manage the volume of stormwater discharging from the subject site in various storm events, storage basins are required to be implemented as part of the stormwater strategy. Each storage basin will be connected to an irrigation system, which will ensure that the stored water in the basins are being used, and that there is available volume to capture runoff from future storm events. Refer to the summary below, as well as Figure 2.4.1, showing the measures implemented to satisfy the MARV requirements.

- North – Western Catchment: 13400m^3 Storage Basin & 9.3ha Irrigated Area
- North – Eastern Catchment: 400m^3 Storage Basin & 0.465ha Irrigated Area
- South – Eastern Catchment: 2000m^3 Storage Basin & 2.14ha Irrigated Area

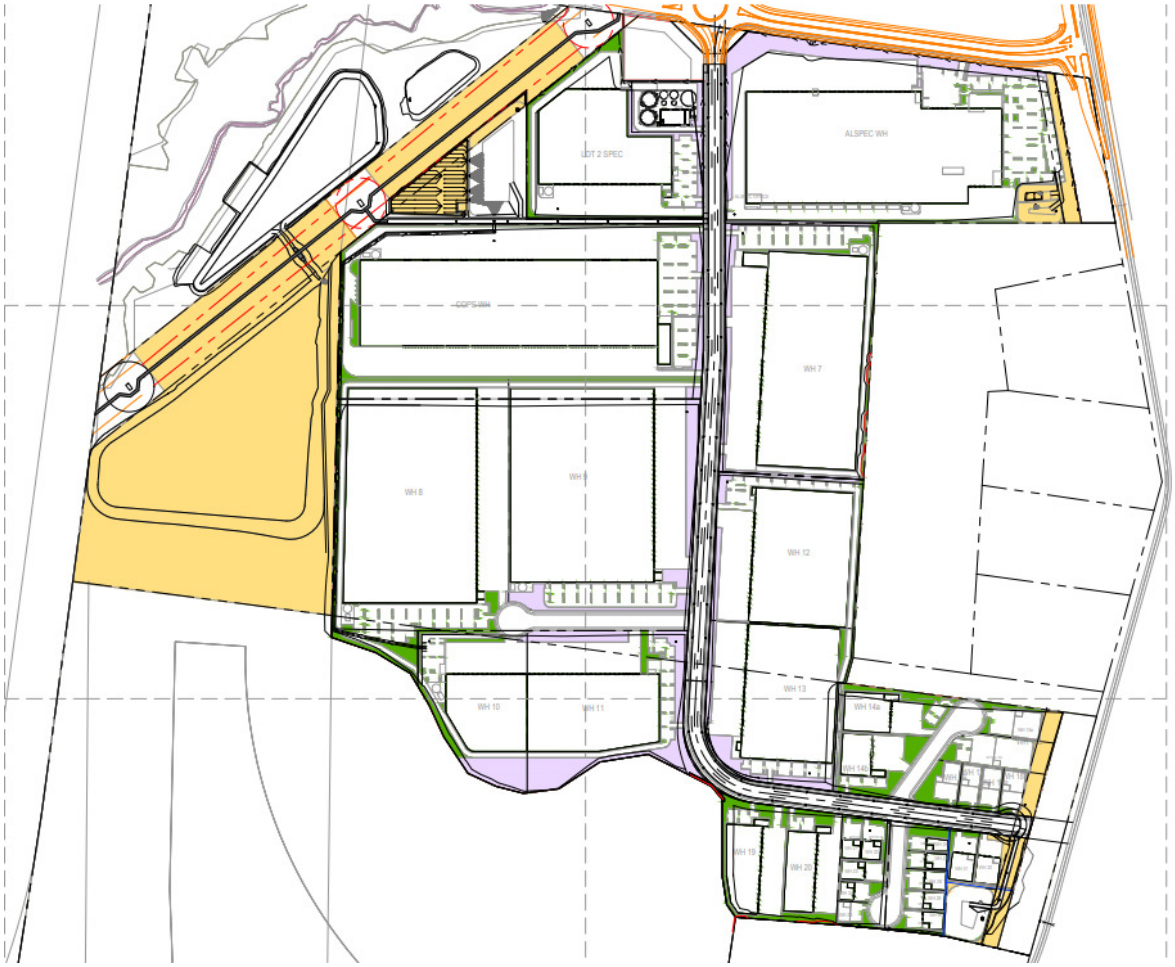


Figure 2.4.1: Storage Basins and Irrigation Areas

Figure 2.4.1 shows the total irrigation area associated with the NE, NW and SE storage basins. A total irrigation area of 11.905 hectares associated with the three storage basins has been modelled in MUSIC. As per drawing C260 and Figure 2.4.1, 14.58 hectares has been provided. This over allowance of irrigation area has been incorporated into the design to compensate for the loss of irrigation area/effectiveness associated with future structures within the orbital corridor.

In addition to the above irrigation areas, rainwater tanks will be required to be installed in the future lots. A total of 2.88 hectares (over the entire estate) within the lots has been allocated as landscaping area to be irrigated by rainwater

tanks. As per drawing C260 and Figure 2.4.1, 3.27 hectares has been provided. This over allowance of irrigation area has been incorporated into the design to allow for future flexibility in the masterplan design.

Refer to the below figures for the proposal's 10%, 50% and 90%ile stormwater flows.

Stormwater Quantity (flow) Targets - MARV			
Indices	**Result**	**Comply**	**Target**
MARV (ML/ha/yr)	2.00	Yes	≤ 2
90%ile	3,621	Yes	1000 to 5000 L/ha/day
50%ile	18	Yes	5 to 100 L/ha/day
10%ile	0	Yes	0 L/ha/day

Table 2.4.2: MARV Target Compliance

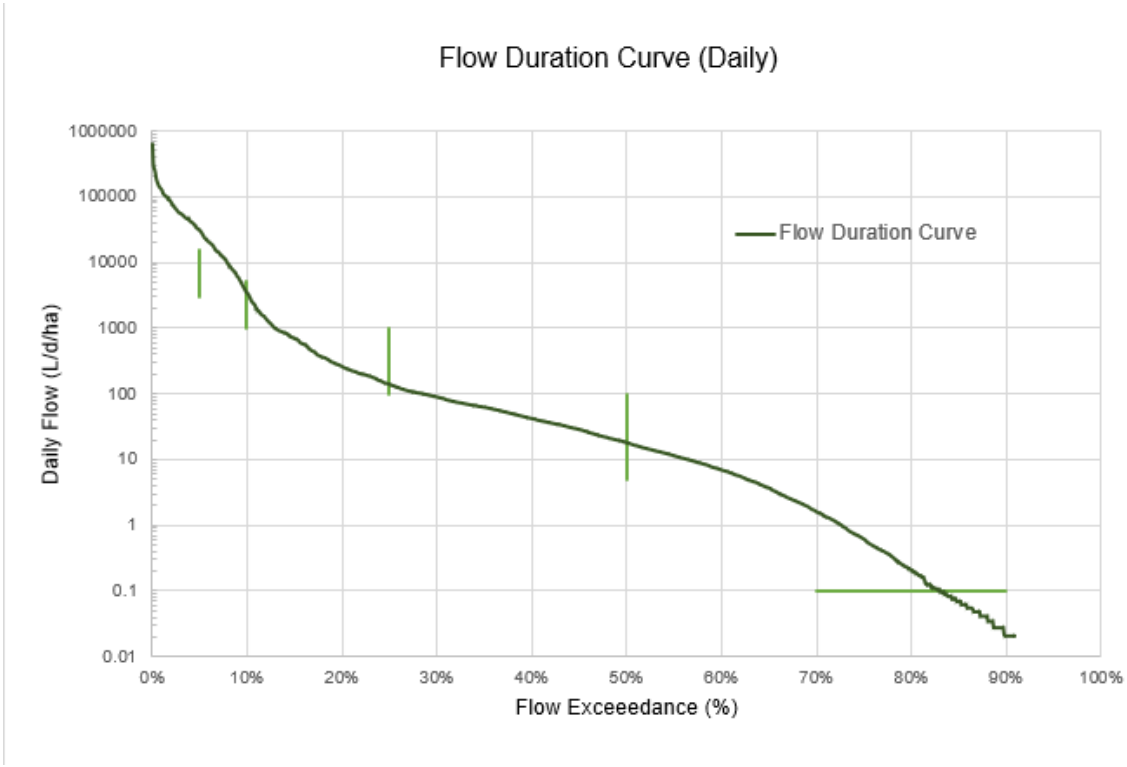


Figure 2.4.3: MARV Target Flow Duration Curve

2.5 Summary of Requirements for Future Lots

Although downstream storage ponds and bio-retention basins have been provided to service the estate, there are additional requirements which will need to be provided as a part of the stormwater design for each lot:

- All lots will need to provide an on site detention system that reduces post developed flows to pre-developed values. This is with the exception of the North-east catchment, which already allows for on-site detention via the proposed basin which forms part of the subdivision works.
- All lots across the estate will need to provide pit baskets in grated pits to act as an additional means to provide water quality treatment. All grated inlet pits within the lots will require a pit basket.
- All lots in the SE catchment to provide Ocean Protect 690mm Psorb cartridges. A total of 140 on-lot cartridges have been estimated for the SE catchment, which is equivalent to 1 cartridge for every 718m2 of lot area.
- All lots to provide a minimum of 10% pervious surfaces (landscaping).
- A total of 440kL rainwater storage has been proposed for the future lots in the NW catchment. This results in a rainwater requirement of 1kL per 260m^2 of total roof area. It is expected that 60% of the total roof area will be directed to the rainwater tank.
- A total of 10kL rainwater storage has been proposed for the OSSM site.
- A combined 270kL rainwater storage has been proposed for the COPE, Alspec(west) and Spec 2 sites. It is expected that a minimum of 60% of the total roof area will be directed to the rainwater tank.
- A total of 160kL rainwater storage has been proposed for the lots in the SE catchment. This results in a rainwater requirement of 1kL per 314m^2 of total roof area. It is expected that 60% of the total roof area will be directed to the rainwater tank.
- All lots to provide a minimum combined irrigation area of 2.88 hectares associated with the on lot rainwater tanks. This is equivalent to approximately 5% of the lot area.
- Refer to the drains models and music model included as part of this DA submission for the complete assumptions and expectations for the management of stormwater flows and treatment across the estate.
- All toilets within the estate will be connected to a recycled water main, and not a stormwater harvesting or rainwater harvesting system.

2.6 On Site Sewer Management (OSSM) Facility

An on-site management facility is proposed to manage wastewater for the estate. The OSSM site is located adjacent to the Endeavour Energy site and the future Patons Lane roundabout. In order for this sewer management facility to effectively manage wastewater from the estate, a significant amount of water demand needs to be connected to the facility to ensure the wastewater can be effectively discharged. This demand is provided in the form of toilet flushing and irrigation reuse. Co-ordination between the demand for the OSSM facility and the stormwater/rainwater harvesting strategy has been undertaken to ensure requirements can be achieved for all purposes.

Refer to drawing C260 in Appendix A and Figure 2.4.1, demonstrating that the irrigation demand for both the recycled water from the OSSM and the stormwater/rainwater to resolve the WSUD requirements, have been achieved. It should also be noted that all toilets in the estate will be connected to the recycled water main, and not rainwater.

3. SEDIMENT AND EROSION CONTROL

Sediment and Erosion Control measures have been implemented to ensure that site run-off is appropriately treated of sediments in accordance with the Penrith City Council's guidelines and the Blue Book "Managing Urban Stormwater- Soils and Construction, 4th Edition (2004) by Landcom.

Sediment and Erosion Control measures have been designed for each pad site. Catch Drains have been designed to collect site run-off during construction. Since each pad site is more than 2000m^2, a sediment basin has been designed for every pad site. The below table is provided to indicate all factors accounted for in the design of every sediment basin. It should be noted that all of the below factors are uniform for all sediment basins on site with the exception of the Length/Slope factor and catchment area.

Constraint	Value	(Source)*
Rainfall Erosivity (R-factor)	2000	Appendix B - Map 10
Length/Slope Gradient Factor, LS	VARIES	Appendix A - Table A1
Soil Erodibility (K-factor)	0.038	Appendix C –Table 19
Erosion Control Practice Factor (P-Factor)	1.3	Appendix A - Table A2
Cover Factor (C-Factor)	1.0 (During earthworks)	Appendix A - Figure A5
Calculated Soil Loss, A (RUSLE equation)	VARIES	A = R K LS P C
Soil Hydrologic Group	D	Appendix C Table 19
75th Percentile 5-day Rainfall Event	21.8mm (Penrith)	Table 6.3a
Volumetric Runoff Coefficient, Cv	0.50	(App. F Table F2)
Catchment Area, A	VARIES	

Table 3.1: Sediment Basin design parameters

Settling Zone volumes and Sediment Zone volumes were calculated based on the above parameters, the catchment areas for each individual pad, 50% of the 1yr ARI flow rate and a sediment settlement co-efficient K_s of 12000s/m. Type B, high efficiency sediment basins are proposed throughout the site in accordance with Council's requirements.

Pad	Area (ha)	Settling zone (m^3)	Sediment zone (m^3)	Total Sediment Basin Vol. (m^3)
Pad 1. East	2.67	117	30	147
Pad 1. West	5.689	351	51	402
Pad 2	3.79	210	36	246

Pad 3a	5.33	252	48	300
Pad 3b North	4.12	216	46	262
Pad 3b South	2.03	138	18	156
Pad 4a	9.04	408	113	521
Pad 4b - East	6.13	255	77	332
Pad 4b - West	6.095	255	58	313
Pad 4c - East	2.39	141	21	162
Pad 4c - West	2.84	168	25	193
Pad 3c	3.32	174	30	204
Pad 5a	2.65	156	33	189
Pad 5b	1.974	135	19	154

Table 3: Sediment Basin volumes

4. FLOODING

Arcadis have conducted a flooding investigation for the Alspec Industrial Business Park works. The north western part of the site is flood affected in all events up to the PMF storm. Refer to Appendix D for the 1% and 5% AEP post-developed flood mapping. A TUFLOW model has been developed in order to model the pre-developed and post-developed conditions for the watercourse that cuts through the north-western part of the site. It should be noted that only the catchment that is directed to the north-west has been included as part of the Arcadis flood investigation, as the catchments that direct flows to Luddenham Rd have no impact on the flood levels to the Watercourse in the north-west part of the site.

Flood Storage basins have been incorporated into the civil engineering design, as shown on drawings C101 and C104 in Appendix A. These basins and associated stormwater pit/pipe works are proposed in order to mitigate the impacts of the development on flooding. Refer to Figure 4 below showing the aforementioned flood basins and refer to the full flood report by Arcadis for further details of the flood modelling.

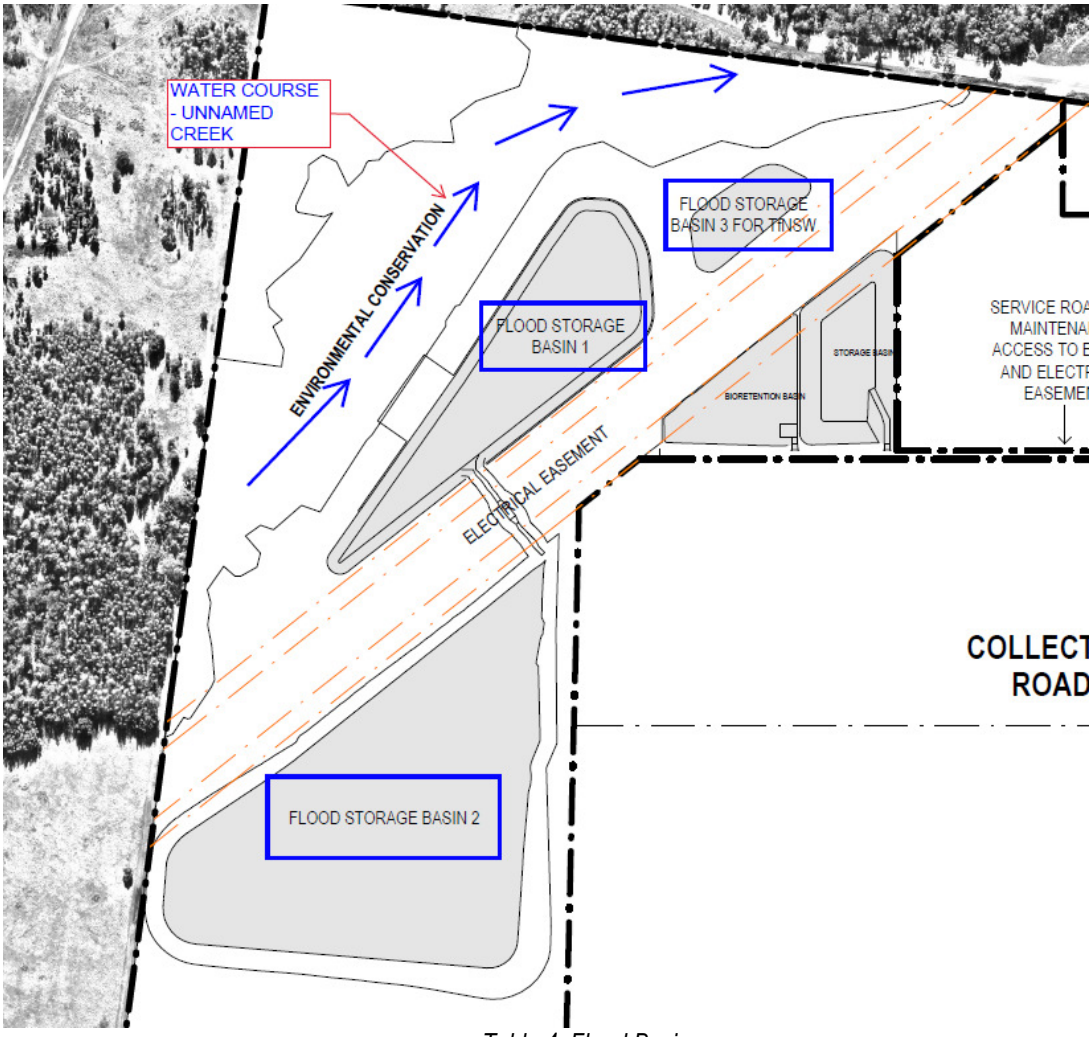


Table 4: Flood Basins

5. TRANSGRID EASEMENT

Refer to drawing C100 – General Arrangement Plan within Appendix A showing the existing easements within the site. There is an existing Transgrid easement for overhead power lines running through the western part of the site. The Transgrid easement has a 34m wide exclusion zone from the centre of the easement, and a 60m diameter exclusion zone around the towers. These details have been shown on the civil drawings and the figure below. Although there are no proposed structures within the Transgrid easement, there are stormwater treatment/detention basins proposed within the easement. Refer to the figure below showing the exclusion zone arrangement within the easement.

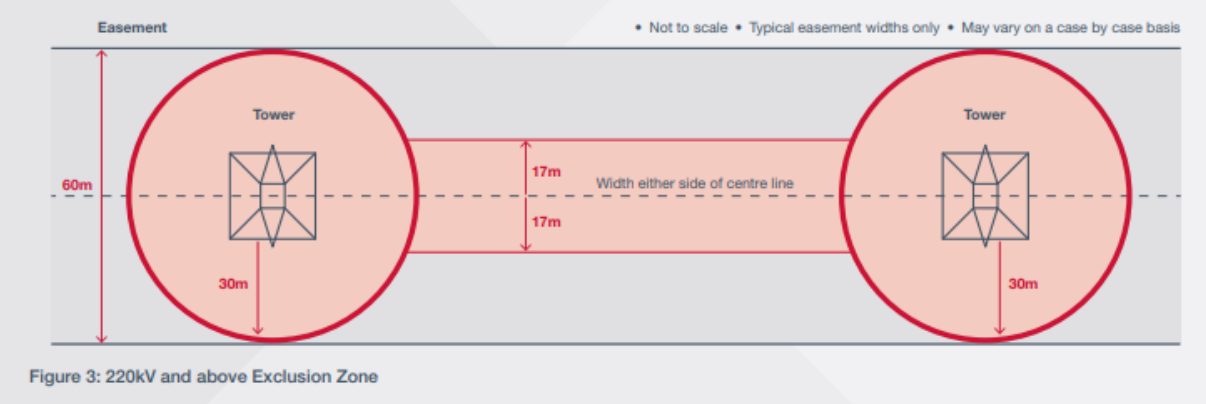


Figure 5.1 Transgrid Easement Layout

6. SITE GRADING AND BULK EARTHWORKS

The proposed basin and collector road levels across the site has been designed with consideration of the following design constraints:

- Ensuring all downstream basins are outside of the 1% flood extent.
- Ensuring all detentions storages are above the 1% flood level.
- Providing sufficient longitudinal fall in the Collector road to ensure that:
    - There is a manageable flood hazard for any flows in the gutter during the PMF event so as to not impact flood evacuation for the lots.
    - The stormwater drainage in the collector road has sufficient fall and thus sufficient capacity.
- Ensure the collector road levels will tie in with the future Luddenham Rd levels and future Paton's Lane levels (with enough flexibility in the design to allow for variances in the future deign of Luddenham Rd and Paton's Lane).
- Ensure basin levels can tie in with the adjacent existing levels.

The proposed pad levels have been designed with consideration of the following design constraints:

- Ensuring the pad levels will enable a functional stormwater system that can provide gravity drainage from the furthest part of the pad and also provide underground detention storage that will be above the 1%AEP HGL of the collector road drainage.
- Ensure some flexibility with driveway locations for each pad with respect to the road levels.
- Balancing cut and fill over the site.
- Balancing the level difference with the various boundaries (including boundaries to the conservation zone, easements, proposed road reserve, and other lot boundaries).

Refer to the bulk earthworks drawing BE01 included in Appendix A, along with drawing C140 and C141 showing site sections. Given the total site area of approximately 123.05 hectares and a total developed area of approximately 72.12 hectares, the net fill of 325,000m^3 required to achieve the proposed bulk earthworks levels is not considered excessive, and is appropriate in order to ensure the overall estate has a functional drainage strategy.

7. ROAD DESIGN

The proposed collector road through the site has been designed in accordance with Austroads guidelines, and Penrith City Council's DCP. Refer to the below excerpts from Council's DCP E18 Luddenham Road Industrial Business Park, which demonstrates the road typologies and the requirements for the road cross sectional design.

It should be noted that Council have requested an adjustment to the layout shown in figure 7.1 in the form of a 600mm landscaping strip adjacent to the property boundary on both sides of the collector road. This change has been adopted and shown in drawing C130 in Appendix A.

Figure E18.8 Collector Road Cross Section

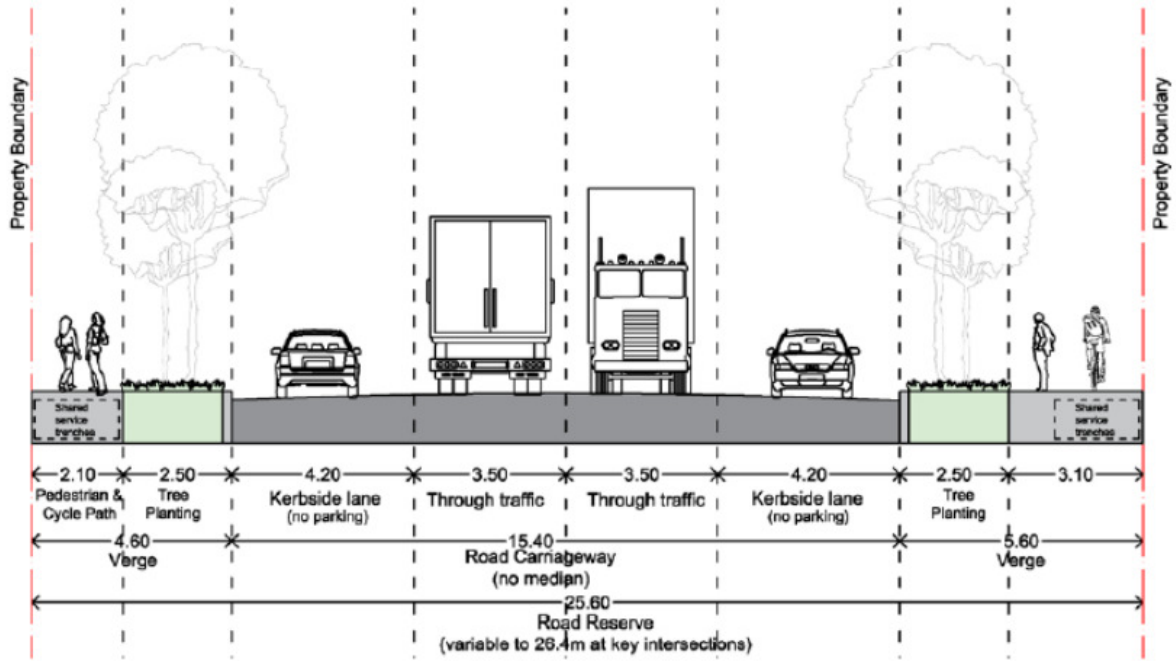


Figure 7.1 Collector Road Cross Section

Component	Industrial Road	Collector Road	Distributor Road
Signposted speed	50km/hr	50km/hr	60km/hr
Pedestrian and cycle path (within verge width)	Verge 1 – 1.5m path Verge 2 – 2.5m shared path	Verge 1 – 1.5m path Verge 2 – 2.5m shared path	Verge 1 – 2.5m shared path Verge 2 – 2.5m shared path
Through traffic lane	2 x 3.5m = 7.0m	2 x 3.5m = 7.0m	2 x 3.5m = 7.0m
Kerbside / travel lane	2 x 4.0m = 8.0m (No Parking	2 x 4.2m = 8.4m (No Parking)	2 x 4.5m = 9.0m (No Parking)
Central median widths*		0.8m* (mid-block) required only at key signalised intersections and locations to separate opposing movements which may cause conflicts	1.6m (mid-block) and 5.0m required at the intersection of a collector road, distributor road, arterial road, or at any signalised intersection
Road carriageway width	15.0m (mid-block)	15.4m (mid-block no median) 16.2 (mid-block with median)	18.6m (mid-block with 1.6m median) Variable – subject to detailed intersection design and approval of road authority.
Verge width (both sides of road)	Verge 1 – 4.0m Verge 2 – 5.0m	Verge 1 – 4.6m Verge 2 – 5.6m	Verge 1 – 6.5m Verge 2 – 6.5m
Street tree planting	1.9m (both sides of road)	2.5m (both sides of road)	3.5m (inclusive of 2m clearance zone requirement on both sides of road)
Road reserve width (total)	24.0m (mid-block)	25.6m (mid-block no median) 26.4m (mid-block with 0.8m wide median)	30.6m Variable – subject to detailed intersection design and approval of road authority.

Table 7.2 Road Typologies

Additionally, refer to drawings C650 and C651 within Appendix A, showing the turning paths of the largest expected vehicle (B-Double) navigating the bend in the road, as well as the turning head. These drawings demonstrate that all vehicles will be able to safely navigate the proposed road, whilst staying within the lane lines. It should be noted that the proposed turning head is a temporary structure. A left-in left-out intersection in the South-East corner which connects to Luddenham Road is expected to form part of the ultimate design. The proposed levels of the collector road and turning head have been co-ordinated with the expected future levels of the intersection.

Pavement Design

The concept pavement design for the service road and collector road has been based off the following estimates equivalent standard axles (ESAs):

Collector Road = 1 x 10^7 ESAs

Service Road = 2 x 10^5 ESAs

The above expected traffic loading is consistent with Penrith Council guidelines, and is considered an appropriate approximation for the pavements.
Refer to the pavement design on drawings C500 and C501 in Appendix A for the full details of each proposed pavement. These pavements have been designed in accordance with Austroads Part 2 Pavement Structural design, where a thin bituminous surfacing is laid over compacted road base. It should be noted that in areas of significant fill, the proposed collector road pavement has been reduced in thickness, assuming that quality imported material can raise the effective CBR of the subgrade. The pavement design is to be further detailed at the design development phase.

8. CONCLUSION

Appropriate stormwater management practices are proposed to be implemented that minimise the impact of development on the existing stormwater system in terms of water quality whilst ensuring safe and efficient conveyance of runoff and the provision of adequate freeboard to the future warehouses. The design is in accordance with both Penrith City Council's requirements and best practice principles; hence it can be ensured that there will be minimal impact on the existing environment as a result of the proposed development.

In particular, the following controls from the E18 Luddenham Road Industrial Business Park DCP have been addressed within this report:

- Stormwater Quality Targets
- Stormwater Detention
- Sediment and Erosion Control Measures
- Stormwater Flow Targets (MARV)
- Operation and Maintenance of WSUD Infrastructure
- Life Cycle Cost Analysis
- Water Conservation
- Bulk Earthworks and Grading
- Road Design

The proposed stormwater design, as summarised in this report and further detailed in the civil drawings in Appendix A, satisfies each of the above controls.

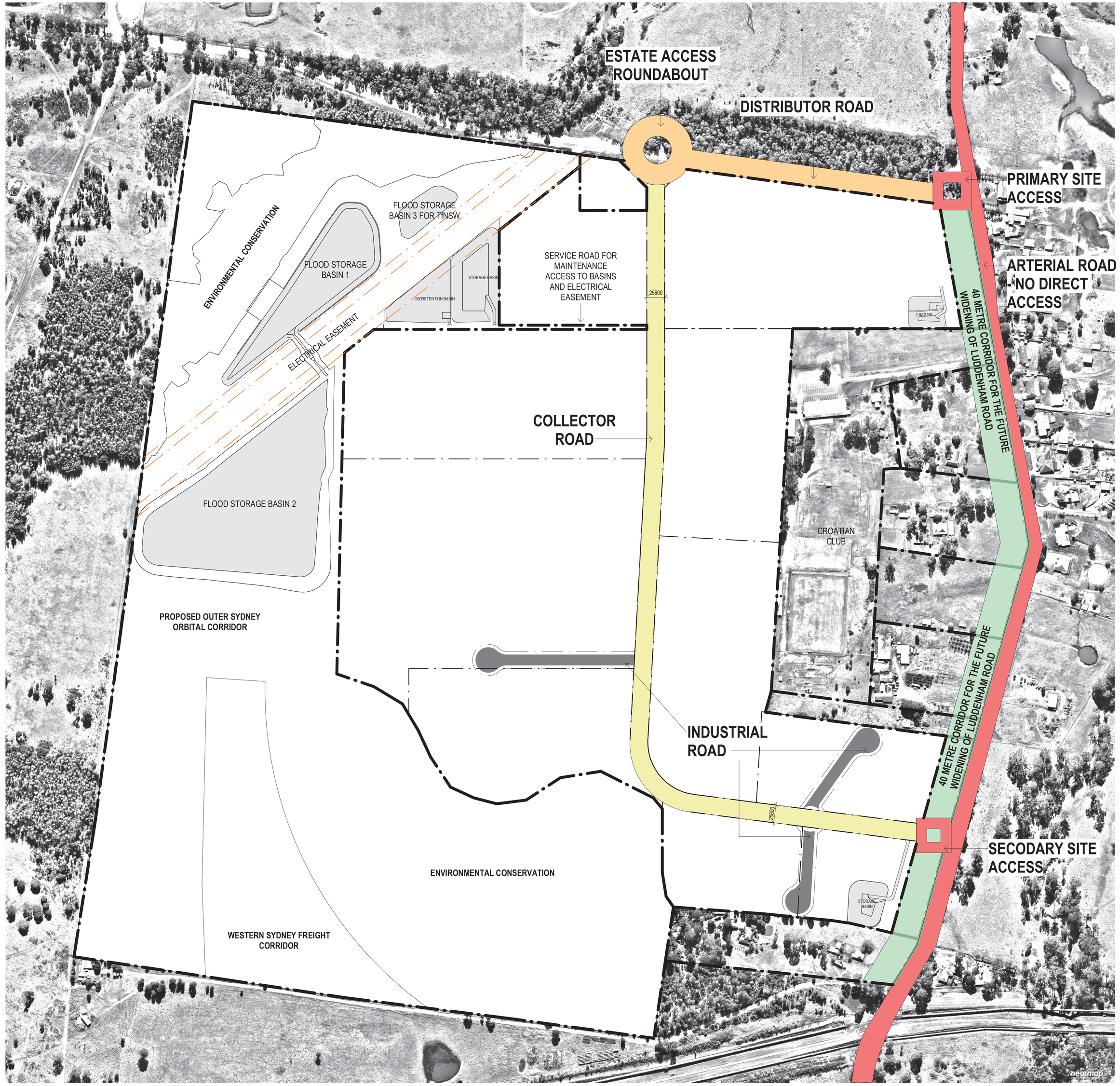
REFERENCES

- Penrith City Council Development Control Plan 2014 – E18 Luddenham Road Industrial Business Park
- Penrith City Council Development Control Plan 2014
- Penrith City Council Stormwater Drainage Specifications for Building Developments 2018
- Penrith City Council WSUD Technical Guidelines 2015
- Technical Guidance for achieving Wianamatta South Creek Stormwater Management Targets guidelines 2022

Appendix A – Civil Plans

Drawings included as separate file due to file size.

Appendix B – Architectural Plans



Client

alspec ALUMINIUM SYSTEMS SPECIALISTS

Issue	Description	Date
A	ISSUED FOR INFORMATION	14/03/24

Project Name
Alspec Industrial Business Park

Project Address
Luddenham Road, Orchard Hills NSW

Key Plan
0 2000 5000

Drawing Title:
LEP & DCP MAPPING - DCP Mapping Overlay of Road Network & Site Access

Author:	Checker:	Sheet Size:	Scale:
MJ	NG	A1	1:3000

Drawing Number: **11178_DA102**

Issue: **A**

nettletontribe

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ALSPEC INDUSTRIAL BUSINESS PARK	
14-Mar-24	DA103
TOTAL LANDTAKE (m²)	**1,253,773**

Zone Name		Zone Area (m²)
C2	Environmental Conservation	252,574
E4	General Industrial	664,317
RU2	Rural Landscape	248,738
TIA	Transport investigation area	22,091
TIN	SEPP (Transport and Infrastructure) 2021	66,054
Lot Subdivision Total		**1,253,773**

Client

alspec ALUMINIUM SYSTEMS SPECIALISTS

HBB

Issue	Description	Date
A	ISSUED FOR INFORMATION	14/03/24

Project Name
Alspec Industrial Business Park

Project Address
Luddenham Road, Orchard Hills NSW

Key Plan
0 2000 5000

Drawing Title:
BULK EARTHWORKS PLANS - Zoning Plan Overlay

Author:	Checker:	Sheet Size:	Scale:
MJ	NG	A1	1:3000

Drawing Number: **11178_DA103**

Issue: **A**

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ALSPEC INDUSTRIAL BUSINESS PARK	
14-Mar-24	DA104
TOTAL LANDTAKE (m²)	**1,253,773**

Lot Name	Lot Area (m²)
Lot 1	83,563
Lot 2	36,878
Lot 3	147,357
Lot 4	265,110
Lot 5	46,321
Lot 6	7,152
Lot 7	11,794
Lot 8	34,138
Lot 9	615,089
Lot 99	6,372
Lot Subdivision Total	**1,253,773**

Client

alspec ALUMINIUM SYSTEMS SPECIALISTS

HBB

Issue	Description	Date
A	ISSUED FOR INFORMATION	14/03/24

Project Name
Alspec Industrial Business Park

Project Address
Luddenham Road, Orchard Hills NSW

Key Plan
0 2000 5000

Drawing Title:
BULK EARTHWORKS PLANS - Draft Subdivision Plan

Author:	Checker:	Sheet Size:	Scale:
MJ	NG	A1	1:3000

Drawing Number: **11178_DA104**

Issue: **A**

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ALSPEC INDUSTRIAL BUSINESS PARK	
14-Mar-24	DA105
TOTAL LANDTAKE (m²)	**1,253,773**

Constraints Name	Constraints Area (m²)
40m Luddenham Road Widening Corridor	18,947
Access Road	2,326
Collector Road (25.6 m)	34,138
EE	6,372
Residual Land	612,763
Constraints Total Area(m²)	**674,545**

Pad Name	Pad Area (m²)
Pad 1	83,563
Pad 2	36,878
Pad 3a	53,360
Pad 3b	60,747
Pad 3c	33,249
Pad 4a	90,404
Pad 4b	122,263
Pad 4c	52,443
Pad 5a	26,588
Pad 5b	19,733
Total Developable Area (m²)	**579,228**

Client

alspec ALUMINIUM SYSTEMS SPECIALISTS

HBB

Issue	Description	Date
A	ISSUED FOR INFORMATION	14/03/24

Project Name
Alspec Industrial Business Park

Project Address
Luddenham Road, Orchard Hills NSW

Key Plan
0 2000 5000

Drawing Title:
BULK EARTHWORKS PLANS - Lot Pad Arrangement Plan

Author:	Checker:	Sheet Size:	Scale:
MJ	NG	A1	1:3000

Drawing Number: **11178_DA105**

Issue: **A**

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Appendix C – Operations and Maintenance Manual

The following maintenance plans have been prepared for the Alspec Industrial Business Park project in Luddenham Road, Orchard Hills. These maintenance plans reflect the stormwater infrastructure that is proposed to form part of the water sensitive urban design (WSUD) strategy. Given that some of the infrastructure are proprietary products, further information on maintenance can be provided by the manufacturer.

Refer to the following list of assets which have been addressed in this operation and maintenance manual (in order):

- Ocean Protect – OceanGuard Pit Basket
- Ocean Protect – Stormfilter
- Gross Pollutant Trap – CDS Unit
- Bioretention Basins
- Storage Ponds

OCEAN PROTECT

OceanGuard™

Operations & Maintenance Manual

Table of Contents

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes as recommended by the manufacturer.

The OceanGuard technology is a gully pit basket designed to fit within new and existing gully pits to remove pollution from stormwater runoff. The system has a choice of Filtration liners, designed to remove gross pollutants, total suspended solids and attached pollutants as either a standalone technology or as part of a treatment train with our StormFilter or Jellyfish Filtration products. OceanGuard pit baskets are highly effective, easy to install and simple to maintain.

Why do I need to perform maintenance?

Adhering to the maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up), but most of all ensures the long term effective operation of the OceanGuard.

Health and Safety

Access to pits containing an OceanGuard typically requires removing (heavy) access covers/grates, but typically it is not necessary to enter into a confined space. Pollutants collected by the OceanGuard will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or sharp objects such as broken glass and syringes. For these reasons, there should be no primary contact with the waste collect and all aspects of maintaining and cleaning your OceanGuard require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel, as a result it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the OceanGuard pit insert, precautions should be taken in order to minimise (or when possible prevent) contact with sediment and other captured pollutants by maintenance personnel. In order to achieve this the following personal protective equipment (PPE) is recommended:

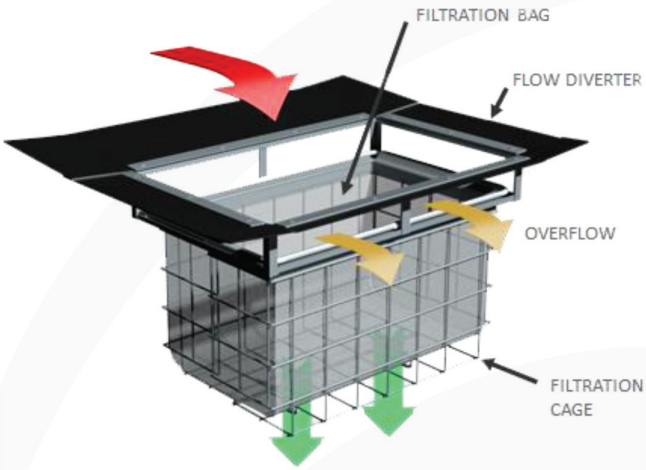
- Puncture resistant gloves
- Steel capped safety boots,
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

The OceanGuard pit insert is designed to be maintained from surface level, without the need to enter the pit. However depending on the installation configuration, location and site specific maintenance requirements it may be necessary to enter a confined space occasionally. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry.

How does it Work?

OceanGuard is designed to intercept stormwater as it enters the stormwater pits throughout a site. The OceanGuard has diversion panels that sit flush with the pit walls, this ensures that as stormwater enters at the top of the pit it is directed to the middle of the insert where the Filtration bag is situated. The filtration bag allows for screening to occur removing 100% of pollutants greater than the opening of the filtration material (200micron, 1600micron bags available).



During larger rain events the large flows overflow slots in the flow diverter of the OceanGuard ensure that the conveyance of stormwater is not impeded thus eliminating the potential for surface flooding. As the flow subsides, the captured pollutants are held in the OceanGuard Filtration bag dry. The waste then starts to dry which reduces the magnitude of organic material decomposition transitioning between maintenance intervals.

Maintenance Procedures

To ensure that each OceanGuard pit insert achieves optimal performance, it is advisable that regular maintenance is performed. Typically the OceanGuard requires 2-4 minor services annually, pending the outcome of these inspections additional maintenance servicing may be required.

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the OceanGuard.

	Description of Typical Activities	Frequency
Minor Service	Filter bag inspection and evaluation Removal of capture pollutants Disposal of material	2-4 Times Annually
Major Service	Filter Bag Replacement Support frame rectification	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Minor Service

This service is designed to return the OceanGuard device back to optimal operating performance. This type of service can be undertaken either by hand or with the assistance of a Vacuum unit.

Hand Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Use two lifting hooks to remove the filtration bag
4. Empty the contents of the filtration bag into a disposal container
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Vacuum Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Vacuum captured pollutants from the filtration bag
4. Remove filtration bag
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Major Service (Filter Bag Replacement)

For the OceanGuard system, a major service is a reactionary process based on the outcomes from the minor service.

Trigger Event from Minor Service	Maintenance Action
Filtration bag inspection reveals damage	Replace the filtration bag[1]
Component inspection reveals damage	Perform rectification works and if necessary replace components[1]

[1] Replacement filtration bags and components are available for purchase from Ocean Protect.

Additional Reasons of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, all OceanGuard pits that potentially received flow should be inspected and cleaned. Specifically all captured pollutants from within the filtration bag should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. All filtration bags should be rejuvenated (replaced if required) and re-installed.

Blockages

The OceanGuards internal high flow bypass functionality is designed to minimise the potential of blockages/flooding. In the unlikely event that flooding occurs around the stormwater pit the following steps should be undertaken to assist in diagnosing the issue and implementing the appropriate response.

1. Inspect the OceanGuard flow diverter, ensuring that they are free of debris and pollutants
2. Perform a minor service on the OceanGuard
3. Remove the OceanGuard insert to access the pit and inspect both the inlet and outlet pipes, ensuring they are free of debris and pollutants

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the OceanGuard pit insert after a major storm event. The inspection should focus on checking for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants disposed.

Disposal of Waste Materials

The accumulated pollutants found in the OceanGuard must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filtration bag has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our OceanGuard system we offer long term pay-as-you-go contracts, pre-paid once off servicing and replacement filter bags.

For more information please visit www.OceanProtect.com.au

StormFilter

Operations & Maintenance Manual

Table of Contents

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes for the StormFilter as recommended by the manufacturer.

The StormFilter is designed and sized to meet stringent regulatory requirements. It removes the most challenging target pollutants (including fine solids, soluble heavy metals, oil, and soluble nutrients) using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and, through ongoing product enhancements, the design continues to be refined for ease of use and improved performance.

Why do I need to perform maintenance?

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up), but most of all ensures the long term effective operation of the StormFilter.

Health and Safety

Access to a StormFilter unit requires removing heavy access covers/grates, and it is necessary to enter into a confined space. Pollutants collected by the StormFilter will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or objects such as broken glass and syringes. For these reasons, all aspects of maintaining and cleaning your StormFilter require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel. As a result, it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the StormFilter, precautions should be taken in order to minimise (or, if possible, prevent) contact with sediment and other captured pollutants by maintenance personnel. The following personal protective equipment (PPE) is subsequently recommended:

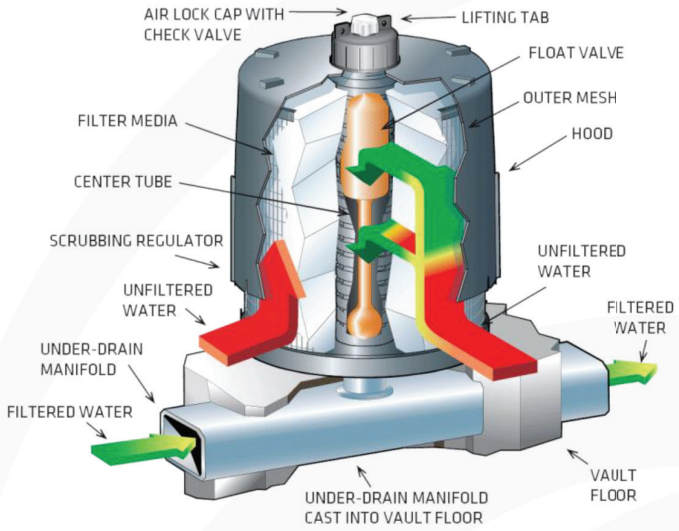
- Puncture resistant gloves
- Steel capped safety boots
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities, it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site-specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

Whilst some aspects of StormFilter maintenance can be performed from surface level, there will be a need to enter the StormFilter system (confined space) during a major service. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry applications.

How does it Work?

Stormwater enters the cartridge chamber, passes through the filtration media and begins filling the cartridge center tube. When water reaches the top of the cartridge the float valve opens and filtered water is allowed to drain at the designed flow rate. Simultaneously, a one-way check valve closes activating a siphon that draws stormwater evenly throughout the filter media and into the center tube. Treated stormwater is then able to discharge out of the system through the underdrain manifold pipework.



As the rain event subsides, the water level outside the cartridge drops and approaches the bottom of the hood, air rushes through the scrubbing regulators releasing the water column and breaking the siphon. The turbulent bubbling action agitates the surface of the cartridge promoting trapped sediment to drop to the chamber floor. After a rain event, the chamber is able to drain dry by way of an imperfect seal at the base of the float valve.

Maintenance Procedures

To ensure optimal performance, it is advisable that regular maintenance is performed. Typically, the StormFilter requires an inspection every 6 months with a minor service at 12 months. Additionally, as the StormFilter cartridges capture pollutants the media will eventually become occluded and require replacement (expected media life is 1-3 years).

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the StormFilter.

	Description of Typical Activities	Frequency
Inspection	Visual Inspection of cartridges & chamber Remove larger gross pollutants Perform minimal rectification works (if required)	Every 6 Months
Minor Service	Evaluation of cartridges and media Removal of accumulated sediment (if required) Wash-down of StormFilter chamber (if required)	Every 12 Months
Major Service	Replacement of StormFilter cartridge media	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Inspection

The purpose of the inspecting the StormFilter system is to assess the condition of the StormFilter chamber and cartridges. When inspecting the chamber, particular attention should be taken to ensure all cartridges are firmly connected to the connectors. It is also an optimal opportunity to remove larger gross pollutants and inspect the outlet side of the StormFilter weir.

Minor Service

This service is designed to ensure the ongoing operational effectiveness of the StormFilter system, whilst assessing the condition of the cartridge media.

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. Evaluate StormFilter cartridge media (if exhausted schedule major service within 6 months)
4. Measure and record the level of accumulated sediment in the chamber
   (if sediment depth is less than 100 mm skip to step 9)
5. Remove StormFilter cartridges from the chamber
6. Use vacuum unit to removed accumulated sediment and pollutants in the chamber
7. Use high pressure water to clean StormFilter chamber
8. Re-install StormFilter cartridges
9. Replace access cover(s)

Major Service (Filter Cartridge Replacement)

For the StormFilter system a major service is reactionary process based on the outcomes from the minor service, specifically the evaluation of the cartridge media.

Trigger Event	Maintenance Action
Cartridge media is exhausted[1]	Replace StormFilter cartridge media[2]

[1] Multiple assessment methods are available, contact Ocean Protect for assistance
[2] Replacement filter media and components are available for purchase from Ocean Protect.

This service is designed to return the StormFilter device back to optimal operating performance

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. By first removing the head cap, remove each individual cartridge hood to allow access to the exhausted media.
4. Utilise a vacuum unit to remove exhausted media from each cartridge
5. Use vacuum unit to remove accumulated sediment and pollutants in the chamber
6. Use high pressure water to clean StormFilter chamber
7. Inspect each empty StormFilter cartridges for any damage, rectify damage as required
8. Re-fill each cartridge with media in line with project specifications
9. Re-install replenished StormFilter cartridges
10. Replace access cover(s)

Additional Types of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, the StormFilter unit should be inspected and cleaned. Specifically, all captured pollutants and liquids from within the unit should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. Additionally, it will be necessary to inspect the filter cartridges and assess them for contamination, depending on the type of spill event it may be necessary to replace the filtration media.

Blockages

In the unlikely event that flooding occurs upstream of the StormFilter system the following steps should be undertaken to assist in diagnosing the issue and determining the appropriate response.

1. Inspect the upstream diversion structure (if applicable) ensuring that it is free of debris and pollutants
2. Inspect the StormFilter unit checking the underdrain manifold as well as both the inlet and outlet pipes for obstructions (e.g. pollutant build-up, blockage), which if present, should be removed.

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the StormFilter after a major storm event. The focus is to inspect for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants should be removed and disposed.

Disposal of Waste Materials

The accumulated pollutants found in the StormFilter must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filter media has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

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OPERATION AND MAINTENANCE MANUAL

Version: November 2014

CDS UNIT MODEL

PROJECT NUMBER

SITE ADDRESS

INSTALLER;

CDS UNIT OWNER

CDS Technologies is part of the Rocla Pipeline Company.
ABN 31000032191 www.rocla.com.au
72 Orchardleigh Street, PO Box 748 GUILDFORD NSW 216
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Contents

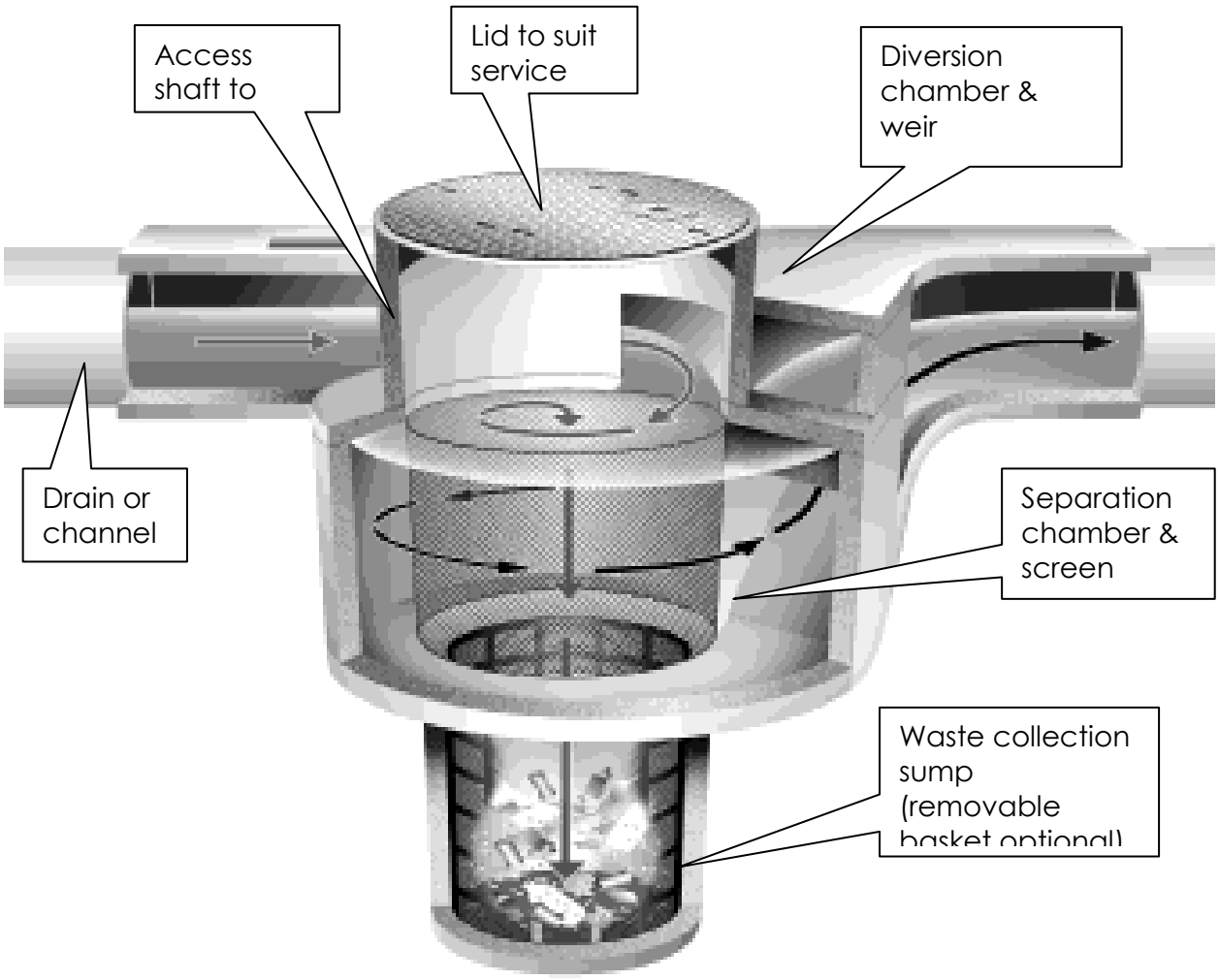
1 Preamble

1.1 CDS Technologies has been established to provide a cost-effective way to achieve environmental sustainability in water quality. The company is committed to its Clients and the environment, however its focus is on the development, manufacture, construction, installation, maintenance and repair of the CDS units.

1.2 The CDS owner may opt to perform their own cleaning or contract the cleaning to a pre-qualified contractor. Pre-qualified contractors are approved by CDS Technologies to perform inspections and cleaning in conformance with CDS Technologies Specification. They have demonstrated that they can meet all safety and environmental legislation and are adequately insured. These contractors can provide very competitive rates, provide valuable feedback on the CDS operation and will take the worry and effort out of the maintenance process.

1.3 Definitions

CDS For simplicity, the letters CDS will be taken to mean a CDS unit.



2 Inspections

2.1 Routine Inspections

2.1.1 Routine inspections are recommended to ensure the CDS is functioning correctly and indicate when cleaning is necessary. These should be carried out on a regular monthly basis. Additionally, it is recommended that a non-scheduled inspection be carried out after any heavy downpour or prolonged period of wet weather. These inspections are the responsibility of the CDS unit owner, unless other arrangements have been made with CDS Pty Ltd. Due to the efficiency of the CDS design, it is likely that they will collect large quantities of pollutants during significant rainfall events. Inspections after heavy rain are therefore even more important than scheduled inspections.

2.1.2 The routine inspection involves removing the access hatch in the CDS main lid and visually checking the visible part of the screen, the percentage of water surface occupied by floatables and measuring the level of accumulated debris in the sump.

2.1.3 This level can be calculated using a survey staff or weighted string line, by measuring the distance from the estimated top of the debris to the top of the lid. A chart is provided on the data sheet that allows the depth measurement to be converted into a percentage full. The data sheet is located in Appendix D. CDS can also provide simple Excell spreadsheet programs for constructed units on request.

2.1.4 When the accumulated material reaches the level of the top of the sump (100% full), it is recommended that it be emptied.

2.1.5 Should the trapped material be allowed to accumulate and rise into the separation chamber, i.e. above the bottom of the screen, the efficient operation of the unit will be compromised with subsequent flows possibly leading to screen blockage.

2.1.6 A standard report for a routine inspection is shown at Appendix A. This should be faxed to the CDS unit owner and CDS Technologies head office. This information helps in future CDS unit sizing and cleaning frequency estimations.

2.1.7 CDS Technologies should be informed if there is any damage or non-functionality observed with the CDS through the completion and forwarding of the 'Damage and Non-Functionality Report' included in Appendix A.

2.2 Annual Inspection

2.2.1 CDS recommends Annual Inspections involving dewatering the unit and checking the condition of the screen, area behind the screen , diversion chamber , weir, lids and any special features of the unit (Baskets can be excluded from this because they can be inspected at every cleanout).

2.2.2 The Damage or Non-Functionality Report (Appendix C) can be used to record any damage or wear and tear that will require attention.

2.2.3 This is also a good opportunity to apply grease to the frame of any cast iron lids and/or lubricate padlocks.

3 Recommended Cleaning Methods

3.1 There are several factors influencing the choice of cleaning method, the main factor being CDS unit size. Other factors include access, equipment availability, required frequency, cost any restrictions, eg units in tidal locations cannot generally be cleaned by eduction.

Unit Size (Screen Diameter mm)	Recommended Cleaning Method	Comments
500 (PL0506)	Suction	Unit not designed for basket; total volume of water and waste is well within range of standard eduction equipment
700 (P0708 series)	Suction	Unit not designed for basket; total volume of water and waste is well within range of standard eduction equipment
900 (P1000 Series)	Suction/basket	Suction is the most cost-effective method.
1500 (P1512 series)	Suction/basket	Suction is the most cost effective method.
2000 (P2000 series)	Suction/basket/ grab	Grab is the most cost effective method.
3000 (P3000 series)	Suction/grab	Grab is the most cost effective method.

3.2 The basket is available for purchase from CDS Technologies and consists of a fabricated fibreglass and steel lifting ring supporting a reinforced fabric basket and connected by SWR slings and shackles. The basket has stainless steel quick-release closures and buckles. A basket is preferred in units which are below low tide or where other methods are not feasible.

3.3 The following chapters detail procedures for each of the recommended methods with illustrations, and include safety information and related regulations.

4 Basket Cleaning

The following is a recommended procedure for emptying the CDS unit fitted with an optional collection basket (this procedure is shown in Figure 4.1). See also Hazard Analysis at Section 4.8.

For units fitted with an Oil Baffle the Oil must be removed using the methodology for Eduction Cleaning prior to the removal of the basket process. See Section 5.

4.1 Remove lid(s) from access chamber

CDS units in trafficked areas (roadways) are fitted with load-class lids (Gatic). The lids are usually multi-part and have tapered edges. Special lifting levers are required to remove them. Larger units in trafficked areas may have RSJ beams to support the lid structure. These also must be removed. If the lifting tackle for the basket is hanging from the RSJ, it must be disconnected and temporarily connected to the inside of the access shaft while the RSJ is removed.

CDS units in non-trafficked areas (parks or reserves) may be constructed from fibreglass, galvanised steel or timber and may be single or of multi part construction. Fibreglass lids on models F0908/0912 can be easily removed by hand after unlocking with a T bar key.

Galvanised and timber lids have adequate lifting points to assist in removal by crane.

When working in a roadway, utilise appropriate traffic control measures.

For safety reasons, any staff working over the open unit should wear a safety harness tied back to an immovable object.

4.2 Connect lifting tackle

Subject to access, the following crane capacities should be adequate to lift full baskets from the sumps of CDS units.

The estimate of the full basket weight can be obtained from the CDS unit Data Sheet.

900mm CDS	5 tonne capacity crane minimum
1500mm CDS	8 tonne capacity crane minimum
2000mm CDS	12 tonne capacity crane minimum
3000mm CDS	15 tonne capacity crane minimum

The crane needs to be able to raise the bottom of the basket, which is up to 7 metres below the lifting ring, over the side of the truck being used to transport the waste.

The crane should be located on suitably firm ground and

operated by a qualified crane operator and guided by a qualified dogman. All staff on the ground in the vicinity of the unit should wear hard hats.

The lifting ring, which is temporarily attached to the side of the CDS, is to be attached to the crane hook.

4.3 Lifting the basket

If the unit is especially full or there is a great deal of floating material on the surface, it is recommended that the basket be raised slowly to reduce turbulence in the separation chamber which can wash floatable items over the rim of the basket.

Floating material should be pushed towards the centre to ensure it is caught as the basket rises. If some floating material remains in the CDS unit, it will likely be removed next time or it is possible to create a backwash by "dunking" the basket under the surface and quickly back up again. If the basket is found to have a significant amount of material "nesting" on the lifting collar, it is recommended that this material be pushed down into the basket using a broom, rake, shovel or staff before removing the basket completely from the unit.

With the bottom of the basket raised above the water level, allow water to drain back into the CDS unit for a few minutes.

Lift and place basket into truck and allow it to settle to relieve tension in securing straps. Release the Quick-release couplings that hold the basket closed.

Raise basket and allow contents to discharge into truck.

Lower basket and remove any trapped contents. If material is tangled in lifting slings, remove it.

Waste should not be handled unless appropriate protective gloves are worn.

Close basket and secure straps with Quick-release couplings. Place and position basket back in the CDS unit. It is sometimes advisable to weight the basket with two or three bricks to prevent the fabric from billowing up.

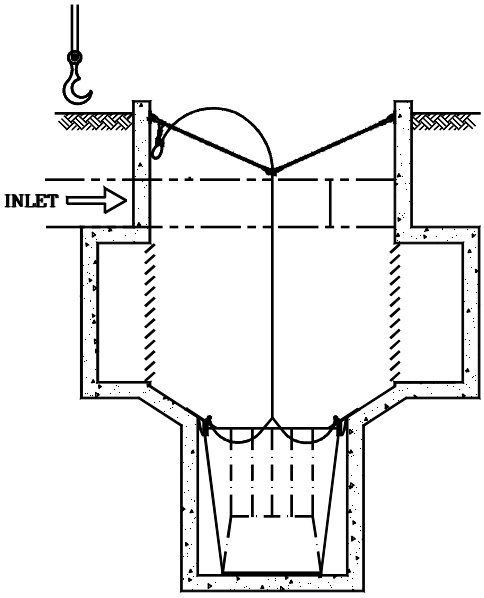
Check the separation screen for blockage or damage. Any material caught on the screen should be hosed or scrubbed off with a hard-bristle broom.

A significant quantity of material blocking the screen can be regarded as evidence of non-functionality and reported to CDS Technologies. If any damage is apparent, it should be reported to CDS as soon as practicable to enable a site inspection to be done. The phone number is listed on the CDS Data Sheet.

Replace lifting tackle and lids to their normal position.

NB It is important that the lifting cable hangs vertically down from the centre of the lid so as not to impede the circular flow of water in the CDS.

4.4	Disposal of Pollutants	Record the quantity of pollutants removed from the CDS with a visual assessment of the breakdown by type: • % silt and sediment • % litter • % vegetation A note should be made of any unusual or large items, eg. oil, paint, car tyres etc. Dispose of pollutant material at an approved tipping site, ie. a tip which is licensed by the Waste Authority in the relevant state. A record of the weight of the material extracted should be kept. The weight may be read by the crane, or the weigh station as the disposal truck enters the tip. The weight should be recorded on the CDS Cleanout Report (Appendix B). Care should be taken to: Cover the load en-route to the tip and to ensure that none of the litter from the load escapes from the truck. Adequately drain the material before leaving the site.
4.5	Tidy Site	Tidy the site of any debris prior to leaving.
4.6	Complete and Forward Cleaning Report	Complete Cleaning Report (Appendix B) and forward to the CDS unit owner. If there is any damage or non-functionality, complete Damage or Non-Functionality Report (Appendix C) and forward to the CDS Contact Person listed on the CDS Data Sheet.
4.7	Annual Clean and Inspection	On an annual basis the CDS should be pumped down as described in the section on Suction Cleaning, the basket removed, the sump pumped out and thoroughly cleaned of any debris that may have accumulated under the basket. The water from the sump is either disposed of appropriately to sewer or pumped upstream so that it can be released and retreated by the CDS unit. A close inspection should be carried out on the screen, basket, lifting tackle etc and any maintenance requirements should be reported. Inform CDS Technologies when this annual service is to occur if they are required to attend. Inspect the return channel behind the screen and remove any accumulated silt or other deposits, if present. Record details in the "Comments" section of the 'Clean Out Report'.



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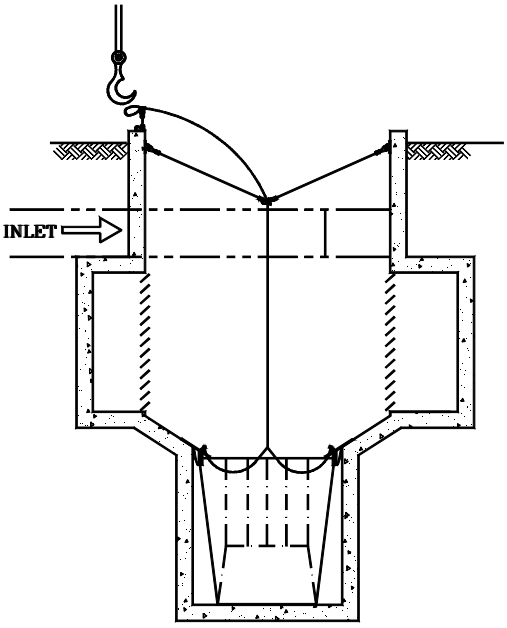

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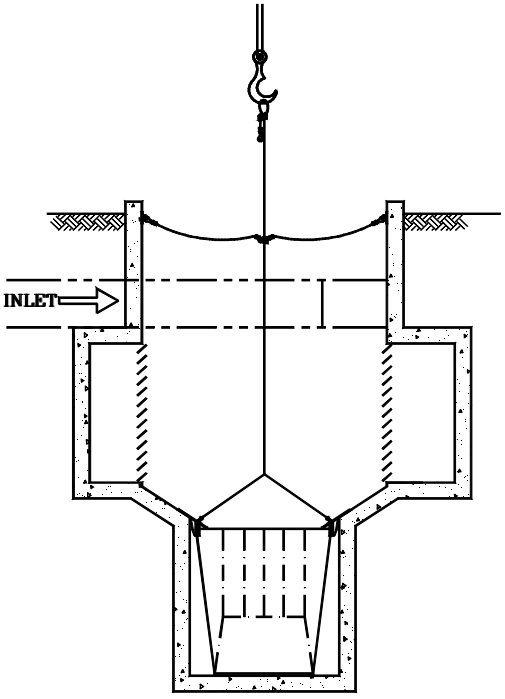

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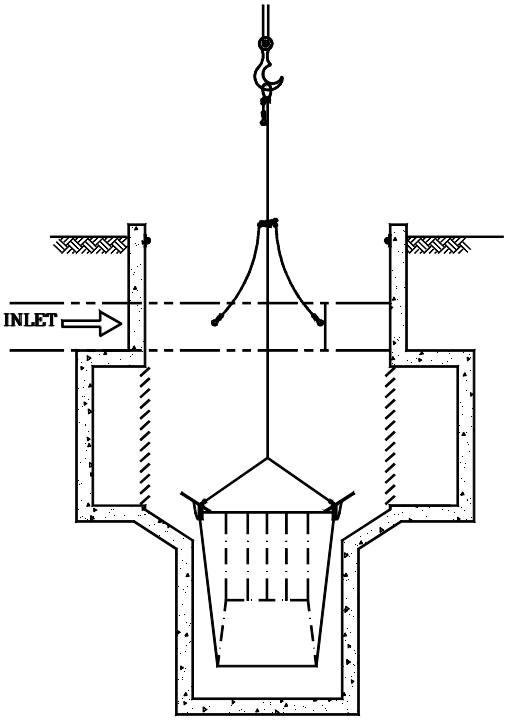

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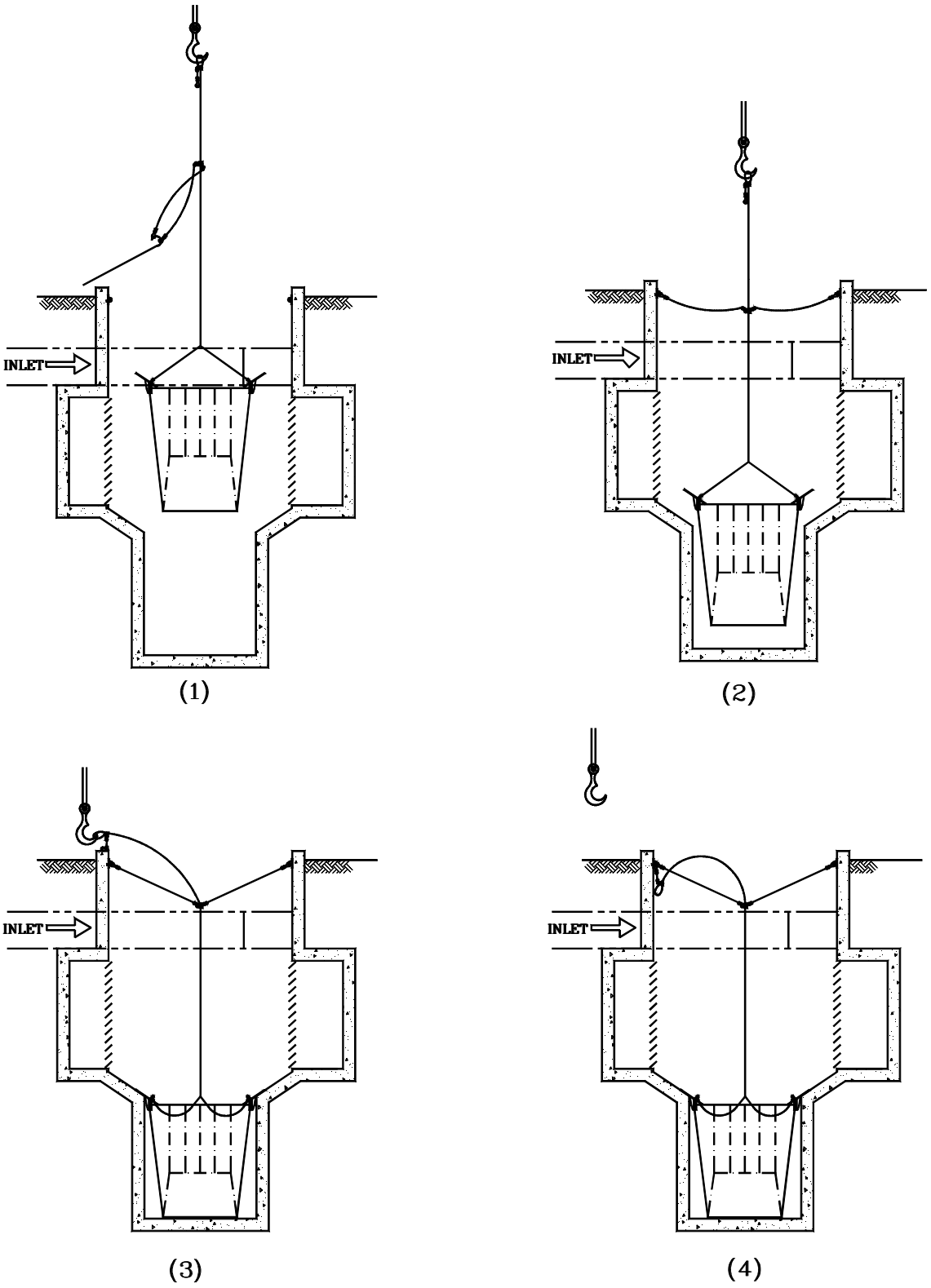
LIFTING OPERATION



LOWERING OPERATION

Figure

4.8 HAZARD ANALYSIS

Activity: Basket Cleaning of CDS Unit

Task	Possible Hazard	Hazard Control
Site Establishment	Traffic Hazards	Implement Traffic Control Plan Obtain Road Closure Approval if necessary
	Risk to Pedestrian	Care to be taken when driving cranes, trucks etc. through public areas. Use assistant to guide reversing vehicle and ward off pedestrians In high pedestrian traffic areas, erect barricades around open CDS unit
Remove CDS Lid	Manual Handling	Correct Manual Lifting Techniques PPE : Steel cap boots, hard hat, gloves Lifting tackle in good condition. Crane in good condition, qualified operators. Crane near overhead electrical cables 3m clearance required to overhead electrical cables
Remove Basket	Lifting Cable Breaks	Check basket lifting tackle for deterioration. Check cable as it emerges from under the water for deterioration. No person to stand under basket as it is removed.
	Person fall into CDS unit	It is not possible to remove the CDS basket whilst barriers are placed around CDS unit. Therefore special care must be taken whilst working around the open CDS unit.
Empty Basket into truck	Biological contamination Basket swings hitting employee	Wear gloves and wash hands afterwards with anti-bacterial soap. PPE, hard hat
Replace Basket	See Remove Basket	
Replace CDS lid	See Remove CDS Lid	

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5 SUCTION CLEANING

The following is a procedure for emptying the CDS unit using a truck-mounted suction unit (this procedure is shown in Figure 5.1). See Hazard Analysis at Section 5.8.

UNITS FITTED WITH OPTIONAL OIL BAFFLES

In the case of Units fitted with an Oil baffle the oil must be removed by eduction prior to de-watering.

Oil will be sitting on the surface at the fluid level inside the screen in the unit; this will be visible through the lid at surface level.

The eduction hose is carefully lowered into the oil, care being taken not to protrude below the oil level and the oil removed by suction.

The depth of the oil on the surface can be gauged by the oil residue on the dipping staff used to establish the level of pollution contained in the sump.

This oil will be securely quarantined or retained in a vessel for disposal

NB: Eduction or the use of absorbent material such as Oil Absorbent Pillows is the only way to remove the oil, the grab or basket method is still a clean out method for the remainder of the pollutant but the oil must be removed first.

Remove lid

5.1	Stop inflow	If necessary, the incoming flow can be blocked using a drop-board or sandbags stacked across the inlet. Ensure that the flow is low enough for a person to safely enter the chamber to place the drop-board. NB If working in a roadway, erect appropriate traffic control measures.
5.2	Pump down the separation chamber	Place a flex drive pump or suction hose in the outlet of the separation chamber, ie outside the screen. This water can be discharged downstream because it has passed through the screen, therefore it has undergone treatment. Other options that may be considered include pumping the water upstream of the inlet. It may be necessary to remove water removed from the unit and transport it by tanker to an approved disposal site or it may be discharged to sewer if approved by local water authority. Do not pump water from the inside of the screen directly downstream. Access to the outside of the screen is via the Diversion Chamber. The water level will drop to the top of the sump.
5.3	Remove debris by suction	Using a "Super sucker" type suction cleaner, remove the debris from the sump (Experience has shown that the common Council Road Sweeper Eductor is not nearly as

efficient at removing the debris).

For larger units, removal by suction may require the assistance of a suitably qualified "Confined Spaces" worker, lowered into the CDS unit to manually direct the nozzle of the suction hose and remove blockages. Any large items or sticks blocking the nozzle may be put to one side and removed manually on completion of the suction process.

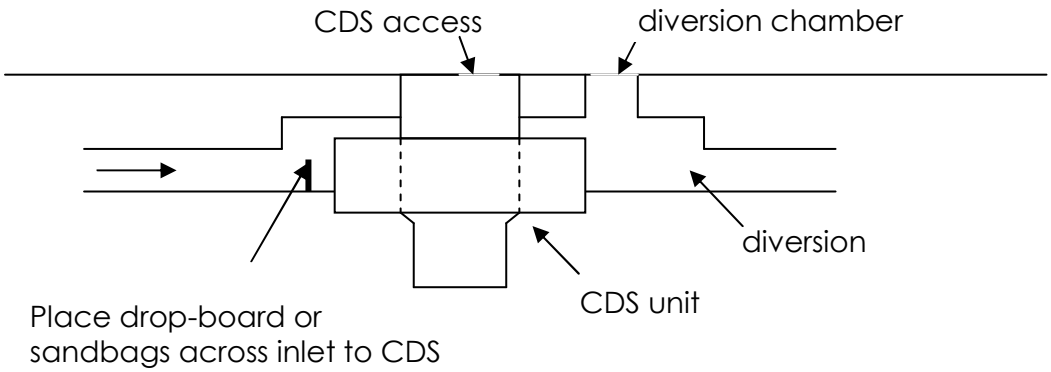
Confined spaces legislation requires that the employee in the unit be harnessed to a tripod-type hoist that is permanently manned above, while a third operator mans the suction machine.

5.4	Disposal of Pollutants	Record the quantity of pollutants removed from the CDS with a visual assessment of the breakdown by type: _____ % silt and sediment _____ % litter _____ % vegetation A note should be made of any unusual or large items, eg. oil, paint, car tyres etc. Dispose of pollutant material at an approved tipping site, ie. a tip which is licensed by the Waste Authority in the relevant state. The free water removed can be discharged back into the CDS unit to minimise transportation and disposal costs. The material should be weighed if possible. Weight should be measured when free water no longer drains out of the material. If this is not possible, an estimation of weight should be made.
5.5	Tidy Site	Tidy the site of any debris prior to leaving.
5.6	Complete and Forward Cleaning Report	Complete Cleaning Report (Appendix B) and forward to CDS owner. If there is any damage or non-functionality, complete Damage or Non-Functionality Report (Appendix C) and forward to the CDS Contact Person listed on the CDS Data Sheet.

Annually the CDS unit should be fully inspected inside and outside the screen to ensure no damage, algal growth or deposition of material has occurred. Any problems should be reported to the CDS owner and to CDS Technologies contact person.

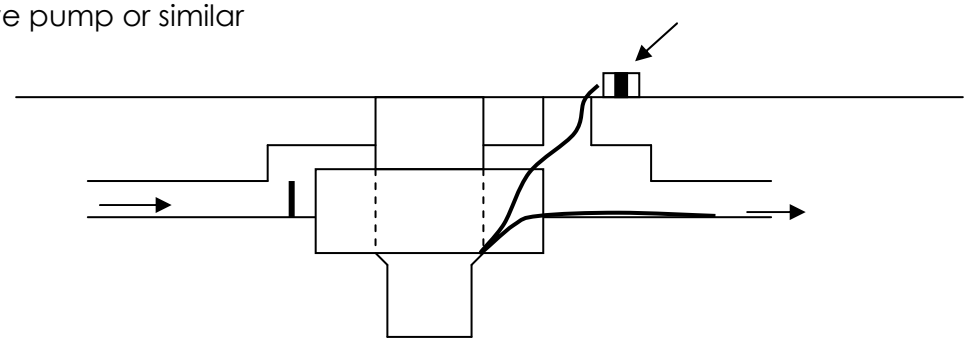
5.7 PROCEDURE

Stop Inflow

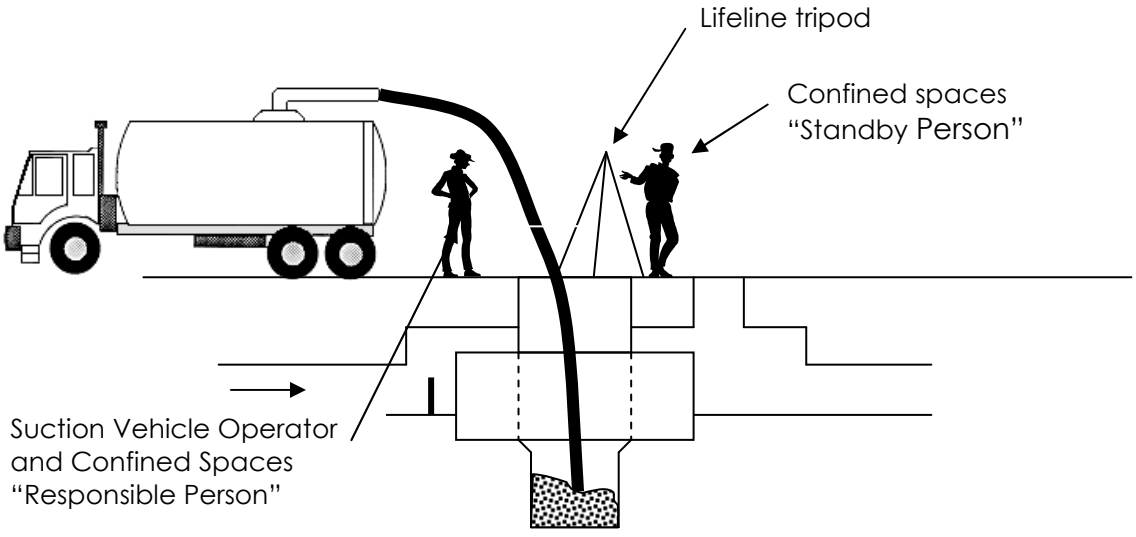


Pump down the separation chamber from the outside of the screen

Flexi-drive pump or similar



Remove debris by suction



NB: A person may be needed inside the CDS unit to guide the head of the suction hose.
All 3 staff in this method require Confined Spaces Training.

5.8 HAZARD ANALYSIS

Activity : Cleaning CDS units by vacuum loading

WHAT CAN GO WRONG	*HOW WILL IT BE MANAGED*
Proposed Work: Cleaning of C.D.S. units of various sizes by Vacuum Loading at various locations. <u>Consequences</u> Possible Road Work Entry into Confined Spaces	Field staff will be certified through AS2865 and safety inducted prior to commencing fieldwork. A supervisor will issue each crew with a work schedule for the day. The responsible person will ensure each site is handled with extreme care. Should roadwork be required, the crew will have the correct signs, barricades and appropriate dress.
Confined Space Category: Deterioration of air quality may occur within a confined space resulting in a category change. Illegal dumping of trade waste / chemicals may also result in confined space category changes.	The responsible person will ensure: Gas testing is undertaken for the duration of the work. If gas levels are above AS2865 allowable levels postpone work until reasonable levels can be achieved. Force ventilation equipment is available, on site, and can be used if required. Vacuum truck draws fresh air into chamber. Personnel entering the confined space will wear all the appropriate safety gear, including hard hat, steel capped boots, overall, eye protection, gloves and be connected to an approved lifeline/tripod set-up at all times whilst in the confined space. Remove other manhole lids in vicinity of work. Should trade waste chemicals become evident all work will cease, evacuation will proceed. Once evacuation is complete C.D.S. will be notified immediately. Self rescue unit to be worn.

WHAT CAN GO WRONG	*HOW WILL IT BE MANAGED*
Isolation of Work Site: Partial blockage/diversion boards, installed upstream to divert flows, may fail resulting in increased flow conditions.	The responsible person will ensure: Isolation of the work site by ensuring level of flow is at workable levels prior to confined space entry. The work can be done during low flow conditions. Flow levels are monitored upstream of the work location. Personnel entering the confined space will wear all the appropriate safety gear, including hard hat, steel capped boots, overall, eye protection, gloves and be connected to an approved lifeline/tripod set-up at all times whilst in the confined space.
Pre-entry Inspection: Air quality may exceed As2865 limits. Excessive flow conditions Presence of fumes, smells and noxious gases.	Gas detection will be undertaken prior to commencing confined space work. Gas detection is to continue for the entirety of the work. The work crew will complete an Entry Permit once they have tested for gas. Copy of Entry Permit to be forwarded to C.D.S. Should excessive flows be present work is not to proceed until such time that flows are at acceptable levels.

Access: Manhole/Access lid dimensions may not comply with Australian Standards. General public and road access routes may be interrupted. Suction hose restricts size of manhole.	The responsible person will ensure: Access will only be undertaken if it is possible, through the manhole opening. Entry will NOT take place into a manhole/confined space if these site-opening sizes do not conform to Australian Standards. The entrant will wear a safety harness. Appropriate signs and barricades will be used around the work area to ensure public and traffic routes are kept to a minimum. All tools, manhole lids and other equipment is to be kept within the barricaded area. Suction hose to be removed whilst assessing/egressing the manhole.
WHAT CAN GO WRONG	***HOW WILL IT BE MANAGED***
Methods of Work: Failure of safety equipment while in use. Noise may impact on the employees and the residents/public.	The responsible person will ensure: Daily inspection of all equipment will take place prior to work commencing. This will ensure equipment is maintained in good condition. Noise levels throughout this contract will comply with the EPA's Noise Control Manual. Personnel will have earplugs available for their use as and when required.
Suitable Workers: Unqualified workers without training working within a Confined Space.	All persons working on a cleaning project will have undertaken and are currently certified to work under AS2865. All staff is trained in the use of the equipment and materials to be used for this project. Other training will include and is not limited to a Safety Induction, First Aid/CPR Training.

	The responsible person will ensure: Only AS2865 certified person could enter a Confined Space to carry out work. All staff members working on-site are carrying their Confined Space tickets.
Rescue Precautions:	The responsible person will ensure: Each field crew will have undertaken a Safety Induction. Each crew will be equipped with a First Aid Kit and a mobile telephone.
Traffic & Public Access: Manholes are located on roads, footpaths and private property. The work may cause disruption to motorists and residents living in the area.	The responsible person will ensure: Traffic control measures including signs, barricades and witches hats are used on roadways. Barricades and pedestrian diversion shall be utilised on footpaths and on private property.

WHAT CAN GO WRONG	***HOW WILL IT BE MANAGED***
Illumination: Poor lighting may result in slips and falls.	The responsible person will ensure: Dolphin torches are used in the confined space in conjunction with miners lights fixed to the entry workers helmet. The stand-by person will have a 12v light that he/she can shine from above to help light up the area.
Ventilation: Fumes, smells and unacceptable gas levels.	The responsible person will ensure: Gas testing is undertaken for the duration of the work. If gas levels are above AS2865 allowable levels postpone work until reasonable levels can be achieved. Force ventilation equipment is available, on site, and can be used if required. Stand-by person will remain at the entry/exit point to allow emergency exit if required. Personnel entering the confined space will wear all the appropriate

	safety gear, including hard hat, steel capped boots, overalls, eye protection, gloves and be connected to an approved lifeline/tripod set-up at all times whilst in the confined space. Should air quality deteriorate work will cease, evacuation will proceed.
Contents / Hazard: Sharp objects, syringes and hazardous materials.	The responsible person will ensure: Site inspection, prior to commencing confined space work, is to take place. Retrieved hazardous materials and sharp objects or syringes are to be disposed of correctly.
Fire / Explosion Risk: Fuels and Oils	The responsible person will ensure: Confined space is evacuated immediately if the Lower Explosive Limit (LEL) exceeds 5% on Gas Detector.

WHAT CAN GO WRONG	***HOW WILL IT BE MANAGED***
Temperature: No hot work is expected.	N/A
Electrical Isolation: Possibility of electrocution.	The responsible person will ensure: Isolation of electrical equipment. All electrical equipment to be used is inspected prior to undertaking any work. All electrical equipment used in confined spaces shall be low-voltage.
Manual Handling of Manhole:	The responsible person will ensure: Mechanical lifting equipment shall be used. All manhole covers are put back on pits and manholes before leaving site.

6 CLAMSHELL (GRAB) CLEANING

The following is a procedure for emptying the CDS unit using a tipper-truck-mounted clamshell or grab bucket (this procedure is shown in Figure 6.1). This method is available for 2m & up diameter CDS units due to the physical size of the bucket. Currently only two of the units exists in Australia, based in Sydney and Melbourne, which can service all states. Contact your CDS representative to arrange for a quotation. See Hazard Analysis at Section 6.7.

For units fitted with an Oil Baffle the Oil must be removed using the methodology for Eduction Cleaning prior to the grab process. See Section 5.

6.1	Remove lids	See section 4.1
6.2	Remove debris by clamshell	Ensure clamshell does not contact screen as damage can occur. Clamshell should be perforated and should be lifted clear of water surface and allowed to drain. Using the clamshell, load the waste into the tipping body of the truck. The truck should be positioned so that water draining from the body drains back into the CDS. Drain waste thoroughly before proceeding to tip.
6.3	Scoop floating waste	Using a pool scoop, remove the floating litter from the surface of the water in the separation chamber. Replace lid.

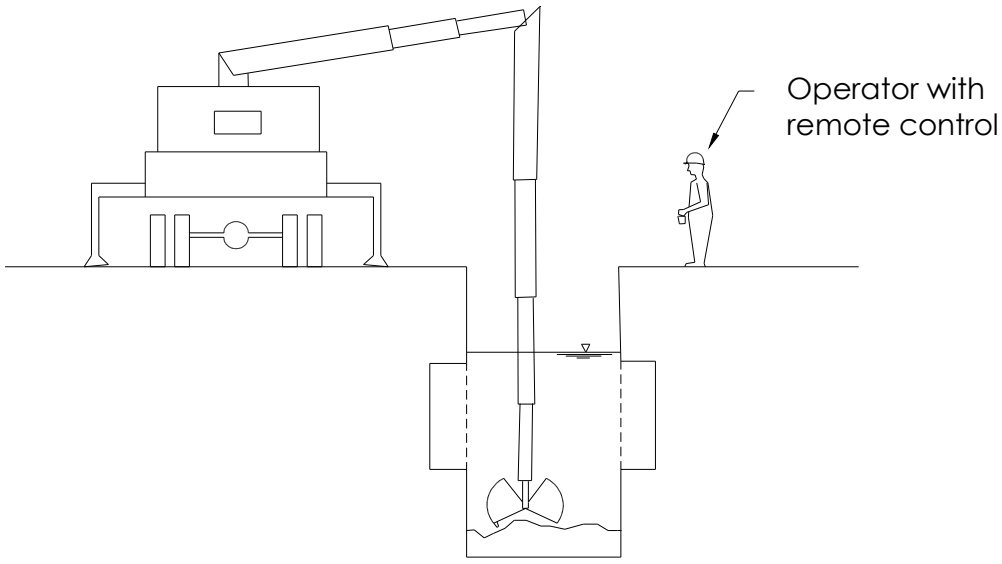


Figure 6.1 Clamshell bucket operation

6.4	Disposal of Pollutants	Record the quantity of pollutants removed from the CDS with a visual assessment of the breakdown by type: _____ % silt and sediment _____ % litter _____ % vegetation A note should be made of any unusual or large items, eg. oil, paint, car tyres etc. Dispose of pollutant material at an approved tipping site, ie. a tip which is licensed by the Waste Authority in the relevant state. Any free water removed can be discharged back into the CDS unit to minimise transportation and disposal costs. The material should be weighed if possible. Weight should be measured when the free water no longer drains out at the material. If this is not possible, an estimation of weight should be made.
6.5	Tidy Site	Tidy the site of any debris prior to leaving.
6.6	Complete and Forward Cleaning Report	Complete Cleaning Report (Appendix B) and forward to CDS owner. If there is any damage or non-functionality, complete Damage or Non-Functionality Report (Appendix C) and forward to the CDS Contact Person listed on the CDS Data Sheet.

Annually the CDS unit should be fully inspected inside and outside the screen to ensure no damage, algal growth or deposition of material has occurred. Any problems should be reported to the CDS owner and to CDS Technologies contact person.

6.7 HAZARD ANALYSIS 1

Activity : Grab Cleaning of CDS Unit

Task	Possible Hazard	Hazard Control
Site Establishment	Traffic Hazards	Implement Traffic Control Plan Obtain Road Closure Approval if necessary
	Risk to Pedestrian	Care to be taken when driving cranes, trucks etc. through public areas. Use assistant to guide reversing vehicle and ward off pedestrians In high pedestrian traffic areas, erect barricades around open CDS unit
Remove CDS Lid	Manual Handling	Correct Manual Lifting Techniques PPE : Steel cap boots, hard hat, gloves Lifting tackle in good condition. Crane in good condition, qualified operators. Crane near overhead electrical cables 3m clearance required to overhead electrical cables
	Person fall into CDS unit	Special care must be taken whilst working around the open CDS unit. Place barricade round open CDS unit. Place wire ladder into CDS unit fixed to truck.
Empty Bucket into truck	Biological contamination Bucket swings hitting employee	Wear gloves and wash hands afterwards with anti-bacterial soap. PPE, hard hat
Replace Basket	See Remove Basket	
Replace CDS lid	See Remove CDS Lid	

7 Safety Regulations

7.1 The safety regulations applying in the State or Territory are to be strictly adhered to.

7.2 The party performing the cleaning is to be fully aware of all applicable safety regulations and ensure that all staff are adequately trained in safe working practices.

7.3 These safety regulations include but are not limited to:

- 7.3.1 Occupational Health and Safety Legislation
- 7.3.2 Confined Spaces Legislation
- 7.3.3 Motor Traffic Legislation
- 7.3.4 Scaffolding and Lifts Regulations
- 7.3.5 Health Regulations dealing with handling of hazardous substances
- 7.3.6 Hazardous Substances Legislation
- 7.3.7 Manual Handling Regulations
- 7.3.8 Plant Operating Instructions
- 7.3.9 Traffic and Pedestrian Safety Standards.

7.4 Adequate insurances should be carried to cover Public Liability and Worker Injury.

8 Environmental Responsibility

8.1 CDS Technologies is committed to improving the environment with its products. It is essential therefore that the process of cleaning the CDS is performed in a manner, which is environmentally responsible. Simply, there must not be any waste left on the site or anything other than the treated water discharged into the environment. The waste must be disposed of in a best practice manner with regard to environmental legislation.

8.2 The party performing the cleaning must be aware of all environmental legislation applicable to these operations and ensure that all employees are trained in work practices complying with the legislation.

8.3 This legislation includes but is not limited to:

8.3.1 Local Government Regulations
8.3.2 Clean Waters Act
8.3.3 Waste Disposal Regulations
8.3.4 Litter Regulations

9 Documentation

9.1 There are only 3 documents generated by the inspection and cleaning of the CDS.

9.2 Inspection Report

Appendix A to be completed for each inspection and copy forwarded to CDS owner.

9.3 Cleaning Report

Appendix B is to be completed for each clean and forwarded to CDS owner.

9.4 Damage or Non-Functionality Report

Appendix C is to be completed upon observance of any damage or extraordinary occurrence affecting the normal operation of the CDS. Examples of these are:

9.4.1 damaged screen
9.4.2 damaged exclusion bars
9.4.3 damaged lids
9.4.4 screen blockage
9.4.5 repeated inlet blockage, and such like.

CDS Technologies will discuss with the CDS owner any remedial action required.

9.5 CDS Data Sheet

Appendix D - This contains relevant information about each CDS and includes contact phone numbers for CDS Contact Personnel including after hours numbers.

9.6 Any damage or non-functionality of the CDS unit should be reported on a Damage or Non-functionality Report (Appendix C) to CDS/Rocla

Inspection Form

Appendix A

Date: _____

Cleaning Contractor Company: _____

Phone No: _____ Fax No: _____

Inspection Person: _____

Unit Identification: _____

Percent cover of floatables on surface: _____

State of the screen (if visible): _____

Depth from base to lid: _____

Depth of accumulated solids: _____

Percent full: _____

Comments: _____

_____

_____

_____

Signed: _____

The report is to be faxed to the CDS owner.

CDS Clean Out Report

Appendix B

Date:

Cleaning Contractor Company:

Phone No:

Fax No:

Contact Person:

Unit Identification:

Address:

Method of Cleaning:

Time Taken:

Volume or mass of removed material:

Breakdown of material: _____Oil Quantity in litres

_____%silt and sand

____%litter

____%vegetation

Safety Procedures implemented in accordance with Hazard Analysis : Yes No

Comments:

Signed:

This report is to be faxed to the CDS owner.

Any damage or non-functionality of the CDS unit should be reported on a Damage or Non-functionality Report Appendix C to CDS /Rocla

Appendix C

Damage or Non-functionality Report

Date:_____

Unit Identification:

Address:_____

Company doing inspection/cleaning:

Contact Person:

Phone:_____Fax:

Nature of damage or problem:

Signed:_____

This report is to be faxed to CDS/Rocla

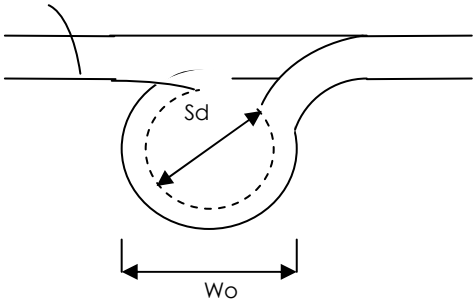
CDS Unit Data Sheet

Appendix D

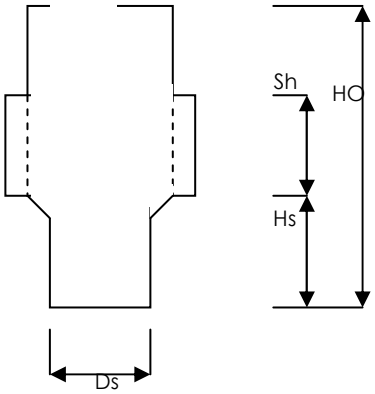
Name:		Unit Name:	
Address:		Unit No:	
		Unit Address:	
Contact Person:		Site:	
Phone:		Truck Instruction:	
Fax:		Keys:	
Mobile:		Lid Type:	
CDS Rep:		Lid Size:	
Phone:		Emptying Method(s):	Oil removed: Yes/No
After Hours:		Date Operational:	

Technical Data

Screen diameter (Sd) =
Screen height (Sh) =
Over all height (H0) =
Over all width (Wo) =
Sump diameter (Ds) =
Sump Height (Hs) =
Sump total volume (Vt) =
Unit weight of solid material (γ) 800t/m^3
Estimate weight of full basket =



Depth from Lid to Pollution	Volume m^3	Weight tonnes	Percent Full
Screen bot			> 100
Sump Top			100
			90
			80
			70
			60
			50
			40
			30
			20
			10
Base =	0.00	0.00	Base Sump



1 LONG TERM MAINTENANCE TASKS

1.1 Schedule of visits

1.1.1 Schedule of Site Visits (Regular Inspec & Maint)	
Purpose of visit	Frequency
Inspection	Regular inspection and maintenance should be carried out to ensure the system functions as designed. It is recommended that these checks be undertaken on a three monthly basis during the initial period of operating the system. A less frequent schedule might be determined after the system has established.
Maintenance	

1.2 Tasks

The scope of maintenance tasks should include verifying the function and condition of the following elements:

- Filter media
- Horticultural
- Drainage infrastructure
- Other routine tasks

1.2.1 FILTER MEDIA TASKS	
Sediment deposition	Remove sediment build up from forebays in raingardens and from the surface of bioretention street trees. Frequency – 3 MONTHLY AFTER RAIN
Holes or scour	Infill any holes in the filter media. Check for erosion or scour and repair, provide energy dissipation (e.g. rocks and pebbles at inlet) if necessary. Frequency – 3 MONTHLY AFTER RAIN
Filter media surface porosity	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A symptom may be that water remains ponded in the raingarden or tree pit for more than a few hours after a rain event. Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants. For bioretention tree pits without understorey vegetation, any accumulation of leaf litter should be removed to help maintain the surface porosity of the filter media. Frequency – 3 MONTHLY AFTER RAIN
Litter Control	Check for litter (including organic litter) in and around treatment areas. Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered. Frequency – 3 MONTHLY OR AS DESIRED FOR AESTHETICS

1.2.2 HORTICULTURAL TASKS	
Pests and Diseases	Assess plants for disease, pest infection, stunted growth or senescent plants. Treat or replace as necessary. Reduced plant density reduces pollutant removal and infiltration performance. Frequency – 3 MONTHLY OR AS DESIRED FOR AESTHETICS
Maintain original plant densities	Infill planting: Between 6 and 10 plants per square metre should (depending on species) be adequate to maintain a density where the plant's roots touch each other. Planting should be evenly spaced to help prevent scouring due to a concentration of flow. Frequency – 3 MONTHLY OR AS DESIRED FOR AESTHETICS
Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of such weeds can reduce dominant species distributions and diminish aesthetics. Weed species can also compromise the systems long term performance. Inspect for and manually remove weed species. Application of herbicide should be limited to a wand or restrictive spot spraying due to the fact that raingardens and bioretention tree pits are directly connected to the stormwater system. Frequency – 3 MONTHLY OR AS DESIRED FOR AESTHETICS
1.2.3 DRAINAGE TASKS	
Perforated pipe	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged. A small steady clear flow of water may be observed discharging from the perforated pipe at its connection into the downstream pit some hours after rainfall. Note that smaller rainfall events after dry weather may be completely absorbed by the filter media and not result in flow. Remote camera (e.g. CCTV) inspection of pipelines for blockage and structural integrity could be useful. Frequency – 6 MONTHLY AFTER RAIN
High flow inlet pits, overflow pits and other stormwater junction pits	Ensure inflow areas and grates over pits are clear of litter and debris and in good and safe condition. A blocked grate would cause nuisance flooding of streets. Inspect for dislodged or damaged pit covers and ensure general structural integrity. Remove sediment from pits and entry sites etc. (likely to be an irregular occurrence in mature catchment). Frequency – MONTHLY AND OCCASIONALLY AFTER RAIN
1.2.4 OTHER ROUTINE TASKS	
Inspection after rainfall	Occasionally observe raingarden or bioretention tree pit after a rainfall event to check infiltration. Identify signs of poor drainage (extended ponding on the filter media surface). If poor drainage is identified, check landuse and assess whether is has altered from design capacity (e.g. unusually high sediment loads may require installation of a sediment forebay). Frequency – TWICE A YEAR AFTER RAIN

1.2.5 FORM (REGULAR INSPECTION & MAINTENANCE)			
Location	**Raingarden/Tree Pit**		
Site Visit Date:		Site Visit By:	
Weather:			
Purpose of the Site Visit	Routine Inspection	☐	Complete section 1 (below)
	Routine Maintenance	☐	Complete sections 1 and 2 (below)

NOTE: Where maintenance is required ('yes' in Section 2), details should be recorded in the 'Additional Comments' section at the end of this document.

1. Filter media				
*In addition to regular inspections, it is recommended that inspection for damage and blockage is made after significant rainfall events that might occur once or twice a year.	Section 1		Section 2	
	Maintenance Required?		Maintenance Performed	
	Yes	No	Yes	No
Filter media (CIRCLE – pooling water/accumulation of silt & clay layer/scour/holes/sediment build up)	☐	☐	☐	☐
Litter (CIRCLE – large debris/accumulated vegetation/anthropogenic)	☐	☐	☐	☐
2. Vegetation				
Vegetation health (CIRCLE – signs of disease/pests/poor growth)	☐	☐	☐	☐
Vegetation densities (CIRCLE – low densities– infill planting required)	☐	☐	☐	☐
Build up of organic matter, leaf litter (CIRCLE – requires removal) BIORETENTION TREE PITS ONLY	☐	☐	☐	☐
Weeds (CIRCLE – isolated plants/infestation) (SPECIES – ……)	☐	☐	☐	☐

3. Pits, pipes and inflow areas				
	Section 2		Section 3	
	Maintenance Required?		Maintenance Performed	
	Yes	No	Yes	No
Perforated pipes (CIRCLE – full blockage/partial blockade/damage)	☐	☐	☐	☐
Inflow areas (CIRCLE – scour/excessive sediment deposition/litter blockage)	☐	☐	☐	☐
Over flow grates (CIRCLE – damage/scour/blockage)	☐	☐	☐	☐
Pits (CIRCLE – poor general integrity/sediment build up/litter/blockage)	☐	☐	☐	☐
Other stormwater pipes and junction pits (CIRCLE – poor general integrity/sediment build up/litter/blockage)	☐	☐	☐	☐

4. Additional Comments

Storage Ponds – Maintenance Schedule		
Item	**Action**	**Frequency**
Pond Inlet		
Blockage	Response: Unblock inlet and outlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	6 months
Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	6 months
Batters		
Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	6 months
Storage Area		
Floating plants	Response: Mechanical removal is best suited to large WSUD assets or large amounts of floating plants. In most cases, floating plants can be removed by hand using rakes and/or floating booms. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).	6 months
Mosquitos	Response: Remove any potential mosquito habitats. Fill in isolated depressions which could fill with water after rain. Removal of dead or rafting edge vegetation around deep water zones which can create isolated pockets of water protected from predators. Maintain water in deep pools to provide ongoing refuge for mosquito predators such as small native freshwater fish and macroinvertebrates. Information: If there is an ongoing issue and nuisance population of mosquitoes in the WSUD asset, a site specific investigation should be undertaken to understand the cause and identify suitable actions	6 months
Sediment Accumulation	Response: Clean out and dispose of accumulated sediment. Information: Sediment must be dried on site and transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).	6 months
Water quality (oil slicks, odour, algae)	Response: Minor slicks can be left alone if not impacting vegetation or asset function. The impact of moderate or major oil slicks should be minimised immediately with barriers such as floating booms. The outlet of the asset should be closed to prevent the risk of the oil spill entering downstream environments. For major spills, it will be necessary to remove the bulk of the spill with an eductor truck. If blue-green algae is present, or if there are other public health and safety concerns, signage should be placed around the temporary sediment basin and public access restricted through temporary fencing. Specialist advice should be sought before actions are undertaken. Excessive filamentous algal	6 months

	biomass can impact asset function by blocking inlets and outlets. If the algae are impacting the function of the sediment basin, it can be removed by hand using rakes or with specialist machinery. Information: Blue-green algae presents a human health risk and must be eliminated or managed to protect the safety of the public as a priority. Filamentous algae can form visible chains which can appear as algal mats in both open and shallow water areas	
Pumps, Filters and valves		
Pump	Response: Clear any accumulated dust or debris. Check to see if power supply is switched on. Regularly service by a licensed professional, in line with manufacturer's instructions. Information: Contact the manufacturer, an electrician or a licensed plumber if you suspect there is a problem. DO NOT tamper with these systems as they have the potential to contaminate the mains water supply.	6 months
Filter	Response: Clean and replace cartridges, in line with manufacturer's instructions. Information: Typically the filter (if present) will require the most frequent attention.	6 months
Valves	Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	6 months

Rainwater Tank– Maintenance Schedule		
Item	**Action**	**Frequency**
Roof, gutters and downpipes		
Roof and gutters	Response: Clean roof and gutters. Remove moss, lichen and debris. Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.	6 months
Downpipes and screens	Response: Manual removal of debris. Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.	6 months
First flush device	Response: Manual removal of debris. Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.	6 months
Tank Inlet		
Screen	Response: Remove grate and screen. Clean and repair as required. Information: Remove grate and screen and examine for rust or corrosion, especially at corners or welds. Depending on the type of screen, replacement may be as simple as just placing another screen on the existing fitting with no tools required.	6 months
Tank		
Overflow	Response: Repair overflow as necessary, remove debris and ensure adequate connection to stormwater drain. Information: If the overflow was previously not connected to a stormwater drain, check that erosion has not been caused.	6 months
Body integrity	Response: Remove grate to inspect internal walls. Check the condition of the tank walls and roof to ensure no holes, cracks or spalling have arisen due to tank deterioration. Contact licensed plumber to repair any defects or leaks as necessary. Information: Do not enter tank without confined space certification. Secure any open access covers to prevent risk of entry.	6 months
Base stability	Response: Contact licensed plumber if integrity is questionable. Information: If tank is on a stand or concrete slab, check structural integrity of support.	6 months
Sludge	Response: Siphon the bottom portion of the sediment from the tank or empty and rinse the tank by opening the cleaning outlet and allowing the water and sludge to pass out. Ensure sludge is appropriately disposed of. Information: First flush systems and mesh screens on tank inlets will reduce the amount of sediment and debris entering the tank thereby extending the time required before desludging is needed.	6 months

	For large tanks, it is recommended a professional tank cleaner be employed as confined space entry may be required. Plastic tanks should be tied down prior to being emptied if strong winds are present. Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse onsite). A pit is considered a confined space, requiring safety equipment and training.	
Mains backup, flow meter and backflow		
Potable mains backup device	Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	6 months
Backflow prevention device	Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	6 months
Flow meter	Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions. Information: Flow meters are an easy way to tell if the system is working. Frequent flow readings ensure issues are detected early.	6 months
Valves		
Valves	Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions. Information: A licensed plumber will be able to advise of Sydney Water's requirements.	6 months

Appendix D – Arcadis Flood Report

Report included as separate file due to file size.

FIGURE BA.1
FLOOD DEPTH AND LEVEL
5% AEP EVENT
DEVELOPED CONDITIONS

N

Unnamed Creek

Patons Lane

Endeavour Energy Switching Station

Development Boundary

Flood Contour

Flood Depth (m)

- <= 0.05
- 0.05 to 0.2
- 0.2 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 100 200 300 400 m

D:\Luddenham\Mapping\FloodMap_Luddenham_01.qgz

FIGURE BA.2
FLOOD DEPTH AND LEVEL
1% AEP EVENT
DEVELOPED CONDITIONS

N

Unnamed Creek

Patons Lane

Endeavour Energy Switching Station

Development Boundary

Flood Contour

Flood Depth (m)

<= 0.05

0.05 to 0.2

0.2 - 0.5

0.5 - 1.0

1.0 - 1.5

1.5 - 2.0

> 2.0

0 100 200 300 400 m

D:\Luddenham\Mapping\FloodMap_Luddenham_01.qgz

Appendix E: MARV Spreadsheet

ENTER DEVELOPMENT AREA (in cell F2)		
Development Area	**123.484**	ha (i.e. the total catchment areas used in MUSIC)

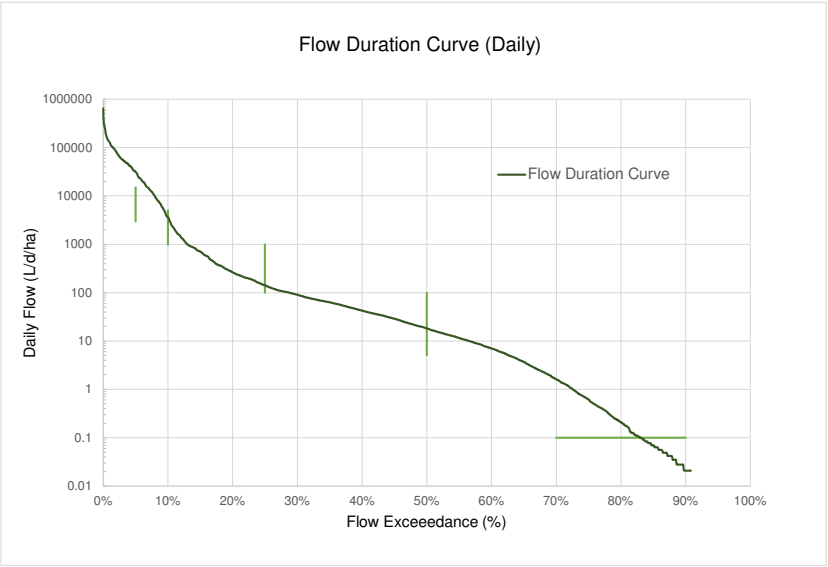
Stormwater Quantity (flow) Targets Option 2- flow percentiles			
Indices	**Result**	**Comply**	**Target**
95%ile	31,579	No	3000 to 15000 L/ha/day
90%ile	3,621	Yes	1000 to 5000 L/ha/day
75%ile	142	Yes	100 to 1000 L/ha/day
50%ile	18	Yes	5 to 100 L/ha/day
Cease to Flow	9%	No	10-30%

Stormwater Quantity (flow) Targets Option 1 - MARV			
Indices	**Result**	**Comply**	**Target**
MARV (ML/ha/yr)	2.00	Yes	≤ 2
90%ile	3,621	Yes	1000 to 5000 L/ha/day
50%ile	18	Yes	5 to 100 L/ha/day
10%ile	0	No	0 L/ha/day

Paste daily flow time series from MUSIC

Date	m3/s	L/ha/day
1/01/1999	0.00426624	2985.0275
2/01/1999	0.00000389	2.72177772
3/01/1999	0.00000354	2.47688769
4/01/1999	0.00000349	2.4419034
5/01/1999	0.00000344	2.40691912
6/01/1999	0.00000339	2.37193483
7/01/1999	0.00000335	2.34394739
8/01/1999	0.0000033	2.3089631
9/01/1999	0.00000325	2.27397882
10/01/1999	0.00000321	2.24599138
11/01/1999	0.00000316	2.21100709
12/01/1999	0.00000312	2.18301966
13/01/1999	0.00000308	2.15503223
14/01/1999	0.00000303	2.12004794
15/01/1999	0.00000299	2.09206051
16/01/1999	0.00000295	2.06407308
17/01/1999	0.00000291	2.03608565
18/01/1999	0.00000287	2.00809822
19/01/1999	0.00014616	102.266075
20/01/1999	0.00036456	255.077451
21/01/1999	0.12039509	84238.7336
22/01/1999	0.43750182	306113.806
23/01/1999	0.03375772	23619.797
24/01/1999	0.00000263	1.84017363
25/01/1999	0.05715527	39990.7302
26/01/1999	0.00000256	1.79119562
27/01/1999	0.00000252	1.76320819
28/01/1999	0.00000249	1.74221762
29/01/1999	0.00000245	1.71423018
30/01/1999	0.00013422	93.9118266
31/01/1999	0.00000239	1.67224904
1/02/1999	0.00000235	1.6442616
2/02/1999	0.00723446	5061.84885
3/02/1999	0.00000229	1.60228046
4/02/1999	0.00000226	1.58128988
5/02/1999	0.00000222	1.55330245
6/02/1999	0.00000219	1.53231188
7/02/1999	0.00000216	1.5113213
8/02/1999	0.00000213	1.49033073
9/02/1999	0.06280148	43941.3031
10/02/1999	0.05773994	40399.8155
11/02/1999	0.00080575	563.771825
12/02/1999	0.00000201	1.40636844
13/02/1999	0.00000199	1.39237472
14/02/1999	0.00000196	1.37138415

Percentile	Flow (L/ha/day)
0.0%	649,485
0.1%	307,667
0.2%	273,500
0.3%	235,444
0.4%	191,990
0.5%	172,873
0.6%	156,910
0.7%	145,949
0.8%	139,425
0.9%	134,200
1.0%	128,275
1.1%	119,583
1.2%	109,930
1.3%	107,138
1.4%	105,056
1.5%	100,554
1.6%	96,562
1.7%	95,466
1.8%	91,023
1.9%	86,815
2.0%	83,868
2.1%	76,066
2.2%	74,478
2.3%	72,024
2.4%	67,816
2.5%	66,049
2.6%	62,911
2.7%	60,485
2.8%	58,662
2.9%	57,371
3.0%	56,504
3.1%	55,083
3.2%	53,169
3.3%	52,209
3.4%	50,418
3.5%	48,759
3.6%	48,110
3.7%	47,243
3.8%	46,952
3.9%	44,169
4.0%	42,747
4.1%	42,051
4.2%	40,966
4.3%	40,320
4.4%	38,560



Appendix F: Water Quality Life Cycle Cost Summary

Treatment Train - Life Span Cost Results

Upstream of Receiving Node

Pond

Swale

Swale

Copy of Swale

Pond

Swale

6 x OceanGuard

Pond

Bioretention

CDS 2028

combined Rainwater Tanks(340KL)

30 x OceanGuard

Rainwater Tank(440KL)

Copy of 140 x OceanGuard

11 x 690mm Psorb StormFilter (MCC)

SF Chamber

Rainwater Tank 10kL

8 x OceanGuard

1 x OceanGuard

Swale

8 x OceanGuard

Swale

Pond

Bioretention

CDS 1009

30 x OceanGuard

8 x OceanGuard

Copy of Swale

Pond

CDS 1012

140 x 690mm Psorb StormFilter (MCC)

SF Chamber

Rainwater Tank 160kL

60 x OceanGuard

Treatment Train - Life Span Cost Results

Span of Analysis (yrs)	50
Real Discount Rate (%)	5.50
Annual Inflation Rate (%)	2.50
Base Year for Costing	2023

Costing Results

Life Cycle Cost of Treatment Train ($2023)	$5,664,594
Equivalent Annual Payment Cost of Treatment Train ($2023/annum)	$113,292
Equivalent Annual Payment per m3/s maximum flow reduction	$3,504.93
Equivalent Annual Payment/ML flow reduction/annum	$1,030.49
Equivalent Annual Payment/kg Total Suspended Solids/annum	$1.95
Equivalent Annual Payment/kg Total Phosphorus/annum	$1,156.81
Equivalent Annual Payment/kg Total Nitrogen/annum	$214.05
Equivalent Annual Payment/kg Gross Pollutant/annum	$11.79