Concrete Recyclers

martens
consulting engineers

Site Water Management Plan:

Minto Resource Recovery Facility
7 Montore Road, Minto, NSW.

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT
MANAGEMENT

P1203464JR01V06
August 2021

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All enquiries regarding this project are to be directed to the Project Manager.

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1 Introduction

1.1 Overview

This Site Water Management Plan is prepared to support a State Significant Development (SSD) Application for a proposed resource recovery facility development at 7 Montore Road, Minto, NSW (the 'site'). It addresses the specific requirements of the Secretary's Environmental Assessment Requirements (SEARs) (Ref: SSD 5339; July 11, 2017).

1.2 Project Scope and Aim

The objectives of this plan are:

1. Develop a stormwater management system to prevent potential offsite water quality and quantity impacts.

2. Develop a stormwater reuse system.

3. Demonstrate compliance with relevant Water Sharing Plans (WSP).

4. Provide an impact assessment of the proposed development on the adjacent Bow Bowing Creek environment.

5. Provide an assessment of predicted wastewater loads.

6. Assess groundwater impacts.

1.3 Proposed Development

The proposed development is for the construction of a resource recovery facility with an intended capacity of 450,000 tonnes of bricks, concrete and sand processed per annum.

The facility will include the following infrastructure:

- Site office;
- Staff lunch room and associated amenities;
- Weighbridge and wheel wash;
- Feed concrete and product stockpiles;

- Concrete crushing plant housing primary screens, primary and secondary crushers, processed product stockpiles and the dust suppression system;
- Sand washing plant housing primary and secondary screens;
- Pug mill;
- Workshop for general repairs;
- Rainwater tanks;
- Stormwater storage tanks;
- Employee carpark; and
- Driveway and hardstand areas to service site.

1.4 Relevant Planning Controls and Design Principles

The following planning controls and design principles have been consulted and incorporated into the design of the site's stormwater management system:

- Campbelltown City Council (Sustainable City) DCP 2009; and
- BMT WBM (2015) *NSW MUSIC Modelling Guidelines*.

1.5 Consultation

The following agency consultation has been completed during the development of this plan:

Table 1: Agency Consultation.

Agency	Contact	Outcome
NSW Environment Protection Authority (EPA)	Jacqueline Ingham	Proposed development is to ensure any discharge is treated and of an appropriate quality. 'Dirty' and 'clean' parts of the site are to be separate Vehicles leaving the site are to be cleaned via a wheel wash of similar to prevent pollution of surrounding environments.
Department of Industry – Water (DPI Water)	Wayne Connor	The proposed sedimentation basin is exempt from harvestable rights calculations and does not require Water Management Act licenses. Collection of water from office roof is not required to be authorised. No further information is required.

2 Site Description

2.1 Location and Existing Land Use

The site is located at 7 Montore Road, Minto, NSW and lies within the Campbelltown City Council local government area (LGA). It is bounded by existing industrial development to the east and south, Montore Road and existing warehouses to the north and a drainage easement containing Bow Bowing Creek (canal) to the west.

The northern portion of the site contains an unsealed hardstand area and is currently utilised has a construction material storage compound, with two sheds located near the northern boundary.

The southern portion of the site is covered by grass with shrubs/trees along the western boundary.

2.2 Topography and Drainage

The site is predominately flat. The highest point is in the compound area of the site, at approximately 44m AHD. The compound area falls away from Bow Bowing Creek towards the site access. Any runoff from the compound area is assumed to be collected by Council's kerb and gutter system on Montore Road.

Bow Bowing Creek is located approximately 50m west of the site. Section 6 provides an impact assessment of the proposed development on the riparian environment.

3 Stormwater Quality

3.1 Overview

Stormwater retention systems and a thickener system are proposed for the site to collect and treat runoff, preventing offsite migration of sediment contaminated stormwater. Rainwater tanks will be utilised to reuse roof to satisfy toilet flushing demand. Onsite tanks will be utilised to store and supply captured stormwater to satisfy dust suppression and sand washing demands (Section 5).

Design of this system is in accordance with BMT WBM (2015) MUSIC modelling guidelines.

3.2 Water Quality Targets

Section 4.15 of Campbelltown City Council DCP (2009) requires the following pollutant load reduction (of the post-development average annual load of pollutants) criteria be achieved at minimum:

- Post development average annual load reduction for total suspended solids (TSS) – 80%
- Post development average annual load reduction for total phosphorus (TP) – 45%.
- Post development average annual load reduction for total nitrogen (TN) – 45%.

Given the use of the site, Council specifically requires a water quality management strategy developed to achieve an 85% reduction in TSS pollutant load on top of the DCP requirements.

3.3 Modelling Methodology

3.3.1 Overview

Model for Urban Stormwater Improvement Conceptualisation (MUSIC, Version 6.3) was used to evaluate the treatment train effectiveness against Council's water quality objectives. Modelling was undertaken in accordance with BMT WBM (2015) guidelines. A layout is provided in Attachment A – E700.

3.3.2 Climate data

MUSIC was run using the Liverpool (Whitlam Centre) pluviography data obtained from eWater. The data was run on a 6-minute time step from 01/01/1967 – 31/12/1996.

For rates of average potential evapotranspiration data for Sydney was adopted.

3.3.3 Catchment Areas

Catchment areas were subdivided into areas corresponding to roofs, sealed roads and industrial land uses. Catchment area details are provided in Attachment A – E700.

3.3.4 Model Parameters

Input parameters for source and treatment nodes are consistent with BMT WBM (2015) guidelines. The adopted node types for individual catchments are provide in Attachment A – E700.

3.4 Treatment Train Philosophy

The stormwater treatment strategy for the site uses stormwater reuse and end of line controls in accordance with the principles of Water Sensitive Urban Design (WSUD). Individual stormwater quality improvement devices (SQIDs) are outlined in the following sections.

3.4.1 Rainwater tank

A 2 kL rainwater tank is to be provided on the office and lunchroom building to capture roof water. Rainwater from the workshop building is to be connected to a 3 kL rainwater tank. Captured water will be reused for toilet flushing.

3.4.2 Lamella plate thickener

Runoff from northern and southern catchments will be pumped to a lamella plate thickener, located in the sand washing plant (in the site's south). The thickener provides treatment by increasing the solids concentration so that the thickened solids are settled at the vessel base and the clarified water are at the surface. Overflows from the thickener will be directed a 450 kL storage tank for reuse purpose.

The thickener and associated systems have been designed by City Water Technology (CWT). In accordance with CWT Minto Stormwater

Treatment Concept Design report (2021), the thickener has been modelled with 80% removal efficiency for TSS (the report is provided in Attachment F).

3.4.3 Gross pollutant traps (GPTs)

Gross Pollutant Traps (GPT, HumeGard or equivalent) are proposed to remove trash, debris and coarse sediments from stormwater runoff. The modelled treatment efficiency of the HumeGard GPT is based on manufacturer's specifications.

3.4.4 Stormwater storage tank

Stormwater storage tanks are to be provided to collect runoff from northern and southern catchments, they are modelled as rainwater tanks. Modelling specifications are summarised in Table 2.

Table 2: Summary of stormwater storage tank details.

Description	Volume (kL)	Reuse demand (kL/day)
Northern storage tank	450	0
Southern storage tank	450	163.5

3.5 Modelling Results

MUSIC modelling results showing the efficacy of the treatment train have been provided in Table 3.

Table 3: Site MUSIC modelling results

Parameter	Sources	Residual Load	Achieved Reduction	Required Reduction	Complies (Y/N)
TSS (kg/year)	4170	278	93.3	85%	Y
TP (kg/year)	7.16	1.74	75.7	45%	Y
TN (kg/year)	31.6	9.61	69.6	45%	Y
Gross Pollutants (kg/year)	355	0	100	-	-

These results demonstrate that the stormwater reduction targets are able to be achieved. The proposed water quality controls are able to reduce the developed site pollutant loads to the target levels.

3.6 Conclusion

Results indicate that post development water quality objectives will be met by the proposed stormwater treatment train which includes:

- Rainwater tanks to capture roof water for reuse.
- Stormwater storage tanks to capture stormwater for reuse.

- A thickener to treat stormwater.

Further refinement of the model at detailed design stage may alter the sizes and locations of proposed treatment structures; however, performance outcomes of the final design are to achieve specification provided in this report.

4 Stormwater Quantity

4.1 Overview

The developed site shall have well compacted unsealed surfaces which shall be largely impervious and consist of crushed recycled concrete and aggregates.

Volume 2 of Campbelltown City Council's *Sustainable City* Development Control Plan (DCP) (2009) requires that on site detention (OSD) be provided on sites where impervious area is increasing and upgrading downstream stormwater systems are not possible. However, in correspondence with Council (email dated 19/01/2018), Council noted there is no requirement for OSD to be provided for the proposed development.

4.2 Objective

To ensure adequate site drainage is provided by the concept drainage design.

4.3 Concept Site Drainage Network

The proposed pit and pipe network is provided in Attachment A – E100:

- Rainwater from the office and lunchroom building and workshop building shall be directed to a 2 kL and 3 kL rainwater tank respectively for non-potable (toilet flushing) reuse.

- A large portion of stormwater runoff from the site shall be directed to two 3 kL sump pits located in the site's north and south (Attachment A).

- Water from the sump pits shall be pumped to a thickener via floating pumps.

- Treated flow from thickener shall be discharged to a 450 kL stormwater storage tank (located in the site's south). Water stored in the tank shall be used for dust suppression and sand washing. Overflows from the tank shall be directed back to the southern sump pit and treated by a proposed oil and grease arrestor (ie. Humceptor or similar) before discharging into the creek.

- Once the system is overwhelmed, the second pump in the southern sump pit takes over and the pump in the northern sump will reduce its water flow to treatment and start pumping to the 450 kL stormwater storage tank located in the site's north.

- When stormwater storage tanks are full during extreme storm events, water shall overtop and ponding around the top of the sump pits. Eventually, the ponded water shall be pumped out to the thickener for treatment.

- Runoff from the driveway and the entry section of the carpark shall be captured by the proposed pit and pipe network and pumped to the nearest sum pit.

- Runoff from vegetated batters discharge directly to Bow Bowing Creek.

A drainage flow chart is provided in Attachment D.

4.4 Site Discharge Analysis

A site discharge analysis has been undertaken to determine the number of runoff events over 30 years (1967 – 1996). The analysis was completed based on an hourly runoff data obtained from MUSIC model.

The results (refer to the provided spreadsheet - P1203464JS15V01) indicate that all stormwater runoff from the operation areas can be captured by the proposed treatment system as described in Section 4.3 and no untreated stormwater will be directly discharging to Bow Bowing Creek. Therefore, the proposed development will not alter the flow behaviour and impact adversely on the creek.

4.5 SQID Inspections and Maintenance

The proposed stormwater quantity and quality improvement devices (SQID) will require inspections and maintenance to ensure functioning efficiency.

4.5.1 SQID Elements

Key stormwater elements to be managed/maintained at the site includes:

- Pit and pipe network;

- Rainwater tanks;

- A thickener;

- Stormwater storage tanks;

- Outlet structures.

4.5.2 SQID Inspections and Maintenance

SQID element inspection and maintenance is outlined in Table 4.

Table 4: Stormwater Element Inspection and Maintenance

Element	Inspection Frequency	Action	Notes
Pit/pipe Network	Weekly after rain	o Check within pit for debris build-up and remove. o Check within pit for sediment build-up. Collect accumulated sediment and place back into product. o Check for ponding in pits. If found locate and remove blockage.	Review inspection frequency annually.
Rainwater tanks	6 months	o Check inside the tank for sediment build-up and remove. o Check screens around the tank and on any accessories are properly cleaned and unbroken. o Check tank fittings, pump and pipes are in full working order and do not need repairs.	NA
Thickener	6 months	o Check the supporting structure to ensure that lamellas are properly leaning on the supporting structures and the supporting structures are correctly fastened to the walls of the thickener. o Check the lamellar module to find out any areas in the lamellar modular are still clogged with pollutants. O Check bottom scraper, the wear of wheels or skates, the state of concrete to find out if any replacement is required.	NA
Stormwater storage tanks	6 months	o Check inside the tank for sediment build-up and remove. o Check screens around the tank and on any accessories are properly cleaned and unbroken. o Check tank fittings, pump and pipes are in full working order and do not need repairs.	NA
Outlet Structures	6 months	o Check for signs of erosion. o Check for evidence of litter/sediment accumulation at outlets. o Remediate erosion as required following engineer direction. o Remove accumulated sediment/litter at outlet.	NA

5 Proposed Water Reuse Scheme

5.1 Overview

The proposed water reuse scheme for the site has been developed to achieve significant reduction in the site's town water demands. Non potable site water uses include dust suppression, sand washing and toilet flushing. The proposed site water reuse scheme shall supply recycled stormwater for these purposes.

5.2 Water Demand

The client advises that at their operation at Camellia Resource Recovery Facility ("Camellia"), the water cart for dust suppression is 12 kL and sprinklers on crushers and stockpiles are used to supplement water carts.

During winter, the cart is used on average 3 times a day (36 kL/day) and total sprinkler water consumption is approximately 15 kL/day. In summer, water cart usage increases to 8 times a day (96 kL/day) and sprinkler water consumption doubles (i.e. to 30 kL/day).

The sand washing facility is considered as a 'closed' system, where wastewater is recollected and reused within the facility. A certain amount of 'water loss' is expected, mainly due to moisture within the washed product and evaporative loss. According to the client, the amount of water required to supplement the 'loss' is approximately 75 KL/day.

Water demand for toilets shall be approximately 20 L/person/day.

In summary water demands to be supplied by stormwater reuse are:

- Winter dust suppression - 51 kL/day;
- Summer dust suppression – 126 kL/day;
- Sand washing – 75 kL/day.
- Toilet flushing – 0.3 kL/day.

5.3 Water Supply

Dust suppression and sand washing demands shall be satisfied through reuse of stormwater runoff sourced from 450 kL stormwater storage tank (located in the site's south). Water demand for toilet flushing shall be supplied from a 2 kL rainwater tank and a 3 kL rainwater tank adjacent to the office and lunchroom building and workshop building.

Reticulated water supply is then available at the site to provide water once site storages are exhausted.

5.4 Site Water Balance

A daily timestep water balance model (*WatCycle*) was utilised to determine the water saving potential of proposed water reuse systems. Water balance modelling input parameters and results are summarised in Table 5.

Table 5: Water Balance Modelling Inputs and Results.

Parameter	Dust Suppression and Sand Washing System	Toilet System
	Source	
Catchment	2.2 ha (site)	0.13 ha (roof)
Initial Loss (mm)	0.5	0.5
Continuing Loss (mm/hr)	0	0
Pan Evaporation Factor	75%	75%
	Storage	
Volume	450 kL	5 kL [1]
Type	Covered tanks	Covered tanks
	Demands (kL/day)	
Jan	201	0.3
Feb	201	0.3
Mar	163.5	0.3
Apr	163.5	0.3
May	163.5	0.3
Jun	126	0.3
Jul	126	0.3
Aug	126	0.3
Sept	163.5	0.3
Oct	163.5	0.3
Nov	163.5	0.3
Dec	201	0.3
	Annual Savings Assessment	
Total Demand	59.6 ML	0.11 ML
Average Reuse Supply	12.38 ML	0.10 ML
% Saving	20.76%	92.07%

Note:

[1] The 5 kL tank consists of one 2 kL rainwater tank located adjacent to the office and lunchroom building and one 3 kL rainwater tank located adjacent to the workshop building.

Water balance modelling indicates that, on average, 47.22 ML/year of town water, is required to meet average water demands for the proposed development. Stormwater captured and reused on site reduces the average town water demand by approximately 21%.

Completed analysis demonstrates that increased storage of stormwater runoff would have minimum impact on the total water demand for the site.

5.5 Water Reuse System

The site water management and reuse system is summarised as follows:

- Rainwater from the office and lunchroom building and workshop building roof is to be collected and stored in rainwater tanks and used for toilet flushing.
- Stormwater from other roofs and hardstand areas is to be collected and stored for dust suppression via sprinklers and water cart and sand washing.
- Town water will be used for potable uses and to supplement other supplies as required.

The hierarchy of water usage for dust suppression, sand washing and toilet flushing by source is as follows:

1. Captured site stormwater.
2. Reticulated town water supply.

5.6 Compliance with Surface Water Water Sharing Plan (WSP)

The proposed onsite tanks are exempt from licensing and no extraction from Bow Bowing Creek is proposed. Therefore no licensable surface water elements are proposed. The development is therefore compliant with the rules of the WSP.

6 Riparian Impact Assessment

6.1 Overview

DPI Water's response provided with the SEARs requested an assessment of the creek and riparian environment with details of the likely impacts of the proposed development. This section of the report provides that assessment.

6.2 Existing Riparian Conditions

Bow Bowing Creek is a major tributary of Bunbury Curan Creek which joins the Georges River approximately 10km north east of the site. Aside from its headwaters, the creek channel is concrete lined to it confluence with Bunbury Curan Creek. In the vicinity of the site, this concrete channel is approximately 300mm deep and approximately 3.5m wide.

Downstream of the headwaters, the riparian corridor is either absent with industrial development on the right and left 'bank' of the concrete channel; or consists of grassed batters of approximately 20m either side of the channel. Screen planting along industrial lot boundaries is typical as seen at the subject site. Stormwater from industrial areas are discharged to the creek at numerous locations via stormwater pipes with concrete lined flow paths.

Attachment A provides a site plan locating relevant features. Photographs and aerials of Bow Bowing Creek and its riparian corridor are provided in Attachment B.

6.3 Impact Assessment

The site lies partly within 40m of the creek's right bank and is classified as 'waterfront land' and the development will be integrated development under the Water Management Act (2000). Proposed site works are approximately 25m from the top of bank and are consistent with uses on adjacent sites. The proposal includes measures to mitigate potential impacts including water quality and quantity with residual impacts considered negligible.

Development includes the removal of some trees and grass within 40m of the bank. Given the low ecological value of screen planting the impacts are considered low.

A detailed impact assessment is provided in Table 6.

Table 6: Impact Assessment on Nearby Riparian Environment.

Element	Impact	Comment
Channel stability	Negligible	Proposed development is more than 25m from the right top of bank. The low flow channel is concrete lined and high flow banks will be grassed. As proposed development won't discharge to the channel, no impact is anticipated.
Riparian zone	Low	The proposed development will involve the removal of existing screen planting along the western boundary. These trees have been assessed as non-significant by the Flora and Fauna Assessment (REF).
Sediment movement	Negligible	Bow Bowing Creek is concrete lined in the vicinity of the site. Development measures are provided to ensure increases in sediment flux to the creek do not occur. Impacts on sediment movement are therefore not considered significant.
Water quality	Negligible	Proposed stormwater storage tanks and 'ponds' (the site is graded to form a pond above the sump pits) will capture all sediment-laden runoff and treat it prior to reuse. As no discharge from the site is expected, impacts on water quality are considered negligible.
Hydraulic regime	Negligible	Hydrological regime is acceptable. No site OSD is required as indicated by Council.

6.4 Mitigation Measures

Table 6 details proposed measures to mitigate actual and potential environmental disturbances and consequences which are summarised as:

- Capture and treat site runoff to reduce sediment-laden runoff discharging into the creek.
- Reuse of captured stormwater to limit the amount of stormwater discharge.
- Inclusion of stormwater storage tanks and 'ponds' to prevent the stormwater discharge.
- Development outside of creek channel.

7 Wastewater Assessment

7.1 Overview

The SEARs require a wastewater assessment to be undertaken to determine predicted wastewater generation rates and proposed disposal methods. Wastewater generated by the site is limited to sewage generated by site staff. No proposed industrial site use shall generate wastewater other than runoff managed through the site stormwater system.

7.2 Predicted Site Population

The facility will have 15 employees including: foreman, loader drivers, excavator drivers, weighbridge attendants, fitters and labourers at any one time. This figure has been used for the purposes of wastewater load calculations (Section 7.3).

7.3 Predicted Wastewater Load

Based on Table H4 of AS/NZS 1547 (2012) a daily wastewater generation rate of 50 L/person/day is recommended for rural factories with reticulated water supply. Of this 20 L/person/day is expected to be reused for toilet flushing with the remainder for kitchen, handbasin and infrequent shower use. A predicted total wastewater load for the developed site is therefore 750 L/day.

7.4 Wastewater Management

The site is connected to Sydney Water sewer main for sewage disposal. No onsite treatment, reuse or disposal is proposed.

7.5 Adequacy

Connection of the site to reticulated town sewer is considered to be an adequate means of managing site wastewater.

8 Groundwater Assessment

8.1 Existing Groundwater Conditions

Review of NSW government public record (NRATLAS) revealed there are no bores within close proximity to the site, and situated at a comparable topographic location, with groundwater data or standing water level information.

In order to assess the proposed development's impact on groundwater a local groundwater level is assumed at the Bow Bowing Creek channel invert (approximately 39.3 mAHD). Groundwater gradient is assumed to reflect the local surface gradient of approximately 2%.

A conceptual groundwater model has been development and is provided in Attachment C.

8.2 Impact of Proposed Development

The proposed development shall have a negligible impact on groundwater as:

- The highly compacted nature of site surface shall limit infiltration across the site and prevent significant drainage to groundwater. Therefore, it is assumed that there will be no negative impacts regarding salinity.

- Site operation shall not introduce significant potential contaminants to the site. The primary site 'pollutant' is sediment, which poses no risk to groundwater. Other possible pollutants include fuel and lubricants associated with site equipment. Standard practice management and maintenance of equipment, fuel and lubricant storages shall achieve appropriate protection of local groundwater. This should include spill kits, use of bundings, procedures and trainings to contain pollutants in line with the recommendations of AS1940B1993 and AS4452B1997 as required by NSW EPA.

- There will be some areas of significant difference between the existing and proposed landform but generally excavation and grading is within -0.75 to +0.75 m from existing levels. Therefore, no significant excavation is proposed.

During search of the NRATLAS public record, it was also noted that groundwater bores in close proximity to the site (between 1.5km – 8km from the site) were all monitoring bores and not for the purposes of irrigation or domestic use. The overall impact of the proposed development on beneficial groundwater use is considered negligible.

8.3 Compliance with Water Sharing Plan (WSP)

The site lies within the Southern Sydney Rivers WSP area of the Greater Metropolitan Region Groundwater Water Sources. The proposed development includes no excavation, wells or other elements which are expected to intercept groundwater. No extraction of groundwater is proposed. It is concluded that there are no licensable groundwater elements in the development and the development shall have no significant effect on local groundwater gradient. It is therefore considered to be compliant with the rules of the WSP.

8.4 Mitigation Measures

While minimal, risk posed to site groundwater by site equipment and fuel/lubricant storages are considered with recommended mitigation measures as follows:

- All fuel and lubricant to be stored within an approved concrete floored and bunded fuel storage inside the workshop designed in accordance with applicable best practice or regulatory requirements.

9 Integrated Water Cycle Management Plan

9.1 Overview

The following subsections form a summary of the project's integrated water cycle management plan (IWCMP).

9.2 Stormwater Quality

The proposed treatment train for the post developed site, which includes rainwater tanks, a thickener and stormwater storage tanks achieves required Campbelltown City Council water quality performance criteria.

Rainwater tanks with a total volume of 5 kL shall be provided to collect and treat roof water from the office and lunchroom building and workshop building.

Stormwater storage tanks with an approximate total volume of 900 kL shall be provided to capture and retain site stormwater.

A thickener with associated systems is proposed to appropriately treat water prior to reuse.

9.3 Stormwater Quantity

No discharge to Bow Bowing Creek is expected.

9.4 Water Reuse Assessment

Roof water captured from the office and lunchroom building and workshop building shall be reused for non-potable (toilet flushing) reuse. Stormwater from the 450 kL stormwater storage tank shall be reused to satisfy the dust suppression and sand washing demands. Water balance modelling suggests that this water reuse scheme will result in a 20.8% reduction in town water demand.

9.5 Riparian Impact Assessment

The site is partly within 40m of Bow Bowing Creek and is considered waterfront land, therefore the development will be integrated development under Section 89, 90, 91 of the Water Management Act (2000). Given the low ecological value of the riparian environment and the distance between the channel and the site, the development shall have a negligible impact on Bow Bowing Creek. It will have an impact on the riparian corridor as minor removal of existing landscape vegetation is required. This impact however is considered low.

9.6 Wastewater Assessment

Site wastewater generation is limited to sewage from staff. No industrial wastewater, other than runoff managed by site stormwater system, shall be produced.

Predicted peak site population is 15 people, a wastewater generation rate of 50 L/person/day (AS/NZS 1547, 2012) is adopted and peak wastewater load is calculated to be 750 L/day. The site is to be connected to Sydney Water town sewer which shall adequately provide for site sewage management.

9.7 Groundwater Assessment

No site or local groundwater data is available. A conceptual groundwater model for the site has been developed to assess the proposals impact. Groundwater level of 39.3 mAHD being channel invert level of Bow Bowing Creek is assumed with groundwater gradient expected to reflect the local surface gradient of approximately 2%.

No element of the proposed development shall intercept the groundwater table and no groundwater extraction is proposed. Measures are proposed to ensure surface operations do not result in contamination of underlying groundwater. The proposal shall have a negligible impact on groundwater.

9.8 Water Sharing Plan (WSP)

The proposed site basin is exempt from licensing and no extraction from Bow Bowing Creek is proposed. The surface water elements of the project are therefore considered to be consistent with the Greater Metropolitan Region Unregulated River Water Sources WSP.

No groundwater extraction or significant impacts are included in the project proposal. It's therefore considered to be consistent with the Greater Metropolitan Region Groundwater Water Sources WSP.

10 References

BMT WBM (2015) *NSW MUSIC Modelling Guidelines*.

Environmental Investigation Services (EIS) (2018) *Preliminary Stage 1 / Stage 2 Environmental Site Assessment for Former Compound and Container Storage at 7 Montour Road, Minto NSW 2566*.

NSW Office of Water (NOW) (2011) *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources – Background document*.

NSW Office of Water (NOW) (2011) *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources – Background document*.

11 Attachment A – Proposed Development Plans

KEY:

- FINAL SURFACE CONTOUR
- DIVERSION SWALE UPSTREAM OF STOCKPILES
- SITE BOUNDARY
- 6m HIGH FENCE AROUND SITE (HEIGHT INCLUDES ANY RETAINING WALL HEIGHT)
- NORTHERN CATCHMENT OVERLAND FLOW
- SOUTHERN CATCHMENT OVERLAND FLOW
- UNCRUSHED MATERIAL
- CRUSHED MATERIAL STOCKPILE
- SAND/SANDSTONE/PUGMILLED MATERIAL STOCKPILE

NOTES:

- FINAL SURFACE CONTOURS ARE BASED ON PROPOSED, EXISTING AND LIDAR SURFACES.
- 1% AEP FLOOD LEVELS SUPPLIED BY COUNCIL (21/11/2014). MINIMUM FLOOD LEVELS TO BE 0.5M ABOVE FLOOD LEVELS.
- DETAILED CAR PARKING AND VEHICLE ACCESS TO BE DESIGNED TO AS/NZS 2890.1 (LATEST VERSION)
- TOTAL ON SITE CAR PARKING 25 CARS + 1 HANDICAP.
- CONCEPT DESIGN ONLY. SUBJECT TO DETAILED DESIGN.

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
K	**MINOR AMENDMENTS**	**06/08/2021**	**NN**	**AW/EZ**	**SL**	**TH**
J	MINOR AMENDMENTS	16/06/20	GM/JS	SS	SL	TH
I	MINOR AMENDMENTS	02/03/2020	LL	JCF	TH	TH
H	MINOR AMENDMENTS	28/09/2018	JCF/LZ/PB	JCF	TH	TH
G	AMENDMENTS AS PER CLIENT COMMENTS	20/09/2018	PB/JCF/LZ	JCF	TH	
F	CLIENT REQUESTED AMENDMENTS	12/09/2018	JCF/LZ	JCF		
E	CLIENT REQUESTED AMENDMENTS	03/08/2018	LZ	JCF	TH	TH
D	UPDATED AS PER CLIENT REQUEST	06/06/2018	RK/JCF	JCF	TH	TH

PRINTED: ---- - USER: NNIKZAD

A1 / A3 LANDSCAPE (A1LC_v02.0.01)

SCALE: A1 (A3) 1:500 (1:1,000) METRES; A1 (A3) 1:2,000 (1:4,000) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE: MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
LOT 52 DP 618900

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: SITE LAYOUT

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-A400	K

DRAWING ID: P1203464-PS02-R20-A400

CUT FILL ANALYSIS

LESS THAN -3.000m	
-3.000 to -2.250 m	
-2.250 to -1.500 m	
-1.500 to -0.750 m	
-0.750 to -0.150 m	
-0.150 to 0.150 m	
0.150 to 0.750 m	
0.750 to 1.500 m	
1.500 to 2.250 m	
2.250 to 3.000 m	
GREATER THAN 3.000m	

EARTHWORKS SUMMARY

	CUT	FILL
EARTHWORKS VOLUME (m^3)	-1298	7810
EARTHWORKS BALANCE (m^3)	-	6512
IMPORTED PAVEMENT (m^3)	-	6432
TOTAL BALANCE (m^3)	-	80

NOTES:
- EARTHWORKS VOLUMES MEASURED FROM EXISTING LEVELS TO DESIGN SURFACE LEVELS.
- APPROX. 6432 M3 OF HARDSTAND PAVEMENT AT 0.3 M DEPTH REQUIRED (21440 X 0.3).

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
H	**MINOR AMENDMENTS**	**06/08/2021**	**NN**	**AW/EZ**	**SL**	**TH**
G	MINOR AMENDMENTS	28/09/2018	JCF/LZ/PB	CG/JCF	TH	TH
F	CLIENT REQUESTED AMENDMENTS	12/09/2018	JCF/LZ	JCF		
E	CLIENT REQUESTED AMENDMENTS	03/08/2018	LZ	JCF	TH	TH
D	UPDATED AS PER CLIENT REQUEST	06/06/2018	RK/JCF	JCF	TH	TH
C	CLIENT REQUESTED AMENDMENTS	21/03/2018	KW/JCF	JCF	TH	
B	CLIENT REQUESTED AMENDMENTS	09/03/2018	KW	CG/JCF	TH	
A	BALANCE SITE EARTHWORKS	07/11/2017	CG	CG	TH	

PRINTED: ---- - USER: NNIKZAD

A1 / A3 LANDSCAPE (A1LC__v02.0.01)

SCALE: 0 5 10 15 20 25 30 35 40 45 50 METRES
A1 (A3) 1:500 (1:1,000)

GRID: ---
DATUM: mAHD
PROJECT MANAGER: TH
CLIENT: CONCRETE RECYCLERS (GROUP) PTY LTD

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All measurements in millimetres unless otherwise specified.
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PROJECT NAME/PLANSET TITLE
MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
LOT 52 DP 618900

martens & Associates Pty Ltd
Consulting Engineers
Environment
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Geotechnical
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Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: EARTHWORKS CUT & FILL ANALYSIS PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-C600	H

DRAWING ID: P1203464-PS02-R20-C600

NOTES:
- FINAL SURFACE CONTOURS ARE BASED ON PROPOSED, EXISTING AND LIDAR SURFACES.
- SITE RAINFALL TO BE CAPTURED AND STORED ON SITE. REFER TO CONCEPT FLOW CHART PROVIDED IN ATTACHMENT D OF P1203464JR01V06 FOR MORE DETAILS.
- STORMWATER PIPE GRADE TO BE MINIMUM 1%.
- CONCEPT DESIGN ONLY. SUBJECT TO DETAILED DESIGN.

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
P	**MINOR AMENDMENTS**	**01/09/2021**	**NN**	**EZ**	**SL**	**TH**
O	MINOR AMENDMENTS	06/08/2021	NN	AW/EZ	SL	TH
N	MINOR AMENDMENTS	20/05/2021	LL	EZ	SL	TH
M	MINOR AMENDMENTS	19/02/2021	JS	JCF	TH	TH
L	MINOR AMENDMENTS	10/02/2021	LL	AW	TH	TH
K	MINOR AMENDMENTS	16/06/20	GM/JS	SS	SL	TH
J	MINOR AMENDMENTS	02/03/2020	LL	EZ	TH	TH
I	MINOR AMENDMENTS	12/10/2018	RK	EZ	TH	TH

PRINTED: ---- - USER: NNIKZAD

A1 / A3 LANDSCAPE (A1LC__v02.0.01)

SCALE
A1 (A3) 1:500 (1:1,000) METRES
A1 (A3) 1:200 (1:400) METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

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CLIENT
CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE
MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
LOT 52 DP 618900

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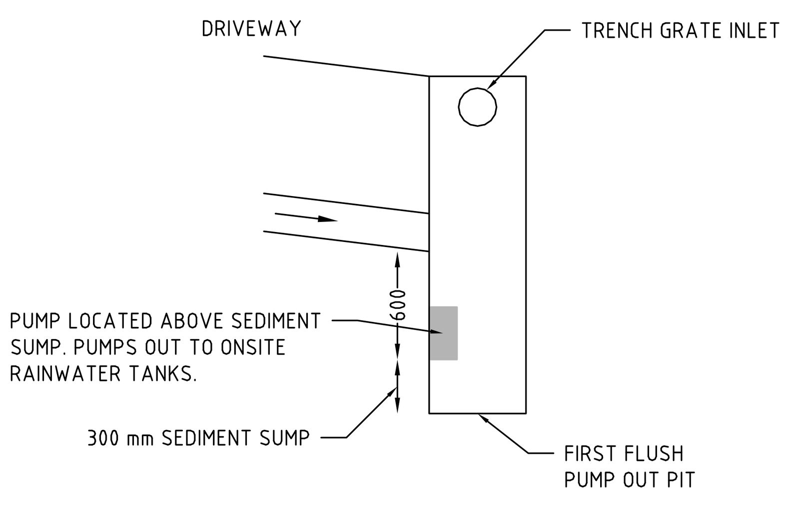
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE
DRAINAGE PLAN

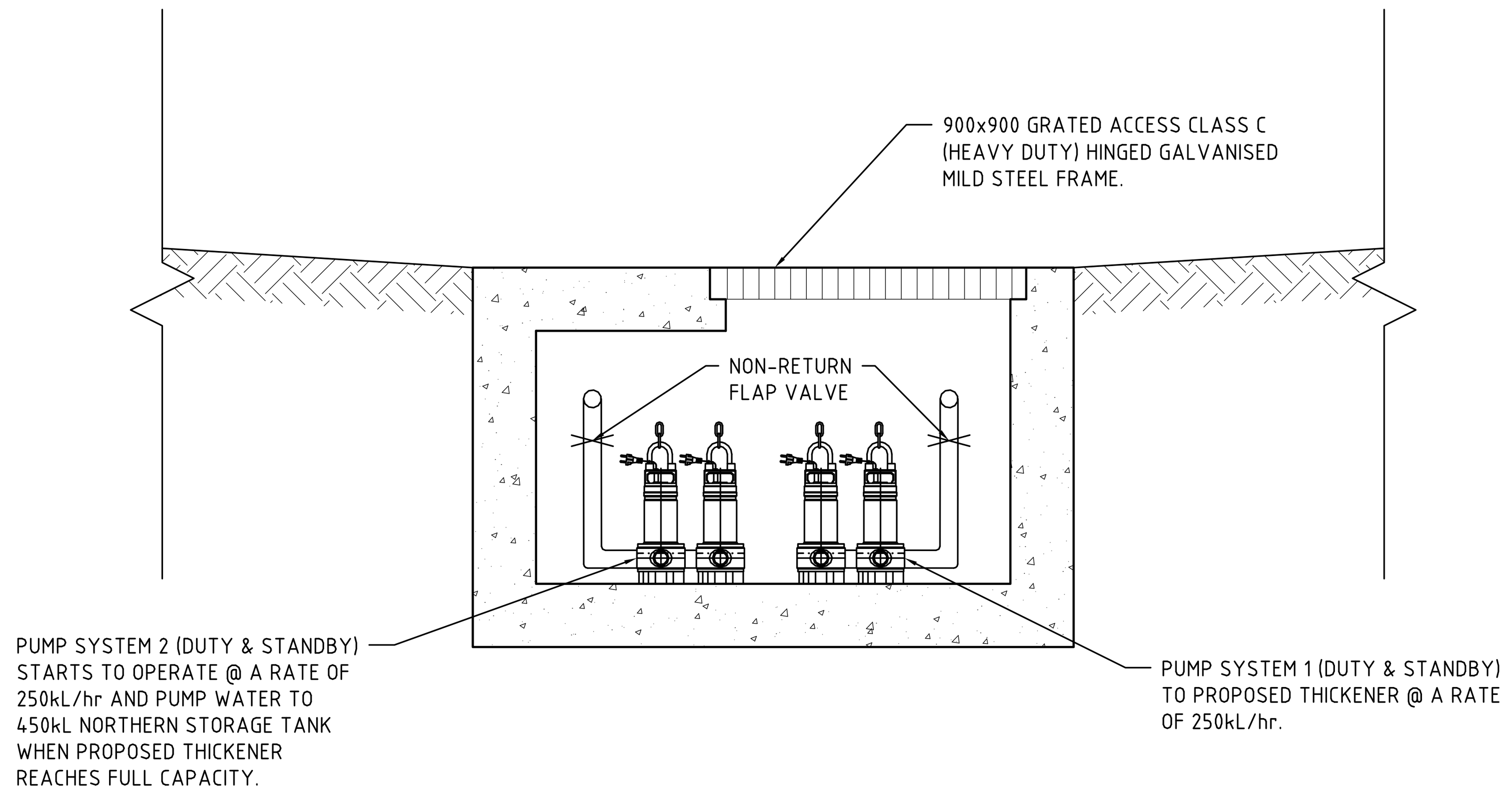
PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-E100	P

DRAWING ID: P1203464-PS02-R20-E100



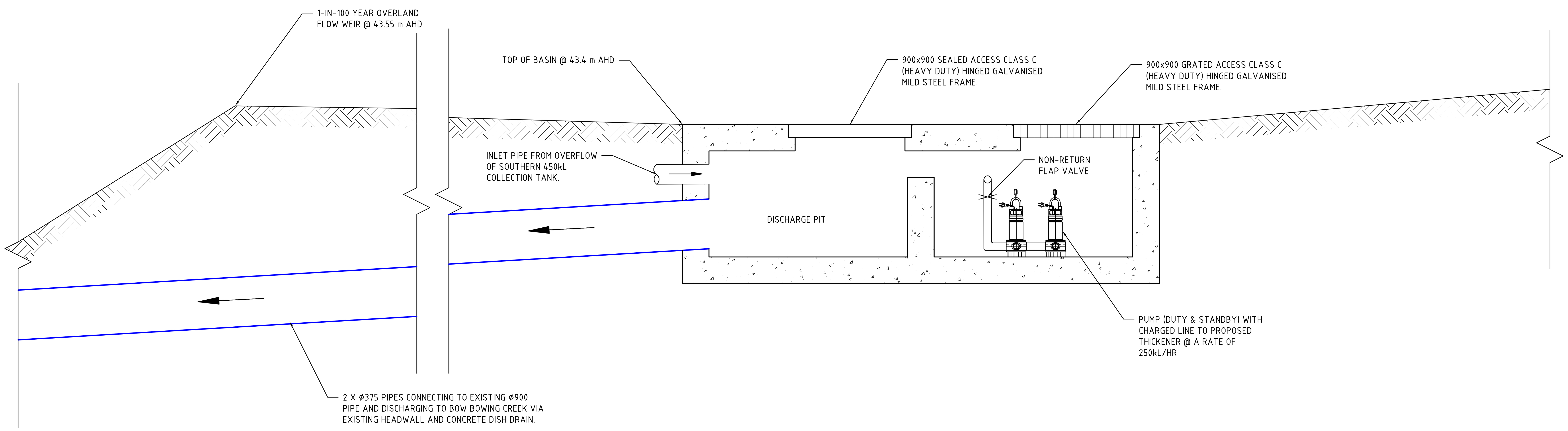
DETAIL: DRIVEWAY FIRST FLUSH PUMP OUT PIT

NOT TO SCALE



SECTION 01 - NORTHERN SUMP AND PUMP OUT PIT CONCEPT DESIGN

NOT TO SCALE



NOTES:
- CONCEPT DESIGN ONLY. SUBJECT TO DETAILED DESIGN.
- PUMP TO BE INSTALLED & SPECIFIED TO MANUFACTURERS DETAILS DESIGNED BY OTHERS.

SECTION 02 - SOUTHERN SUMP AND PUMP OUT/DISCHARGE PIT CONCEPT DESIGN

NOT TO SCALE

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
E	**MINOR AMENDMENTS**	**20/05/2021**	**LL**	**EZ/JCF**	**TH**	**TH**
D	MINOR AMENDMENTS	28/09/2018	JCF/LZ/PB	EZ/JCF	TH	TH
C	AMENDMENTS AS PER CLIENT COMMENTS	20/09/2018	PB/JCF/LZ	JCF	TH	
B	CLIENT REQUESTED AMENDMENTS	12/09/2018	JCF/LZ	EZ/JCF		
A	CLIENT REQUESTED AMENDMENTS	03/08/2018	LZ	JCF	TH	TH

SCALE

GRID | DATUM | PROJECT MANAGER: TH

CLIENT: CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE
MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
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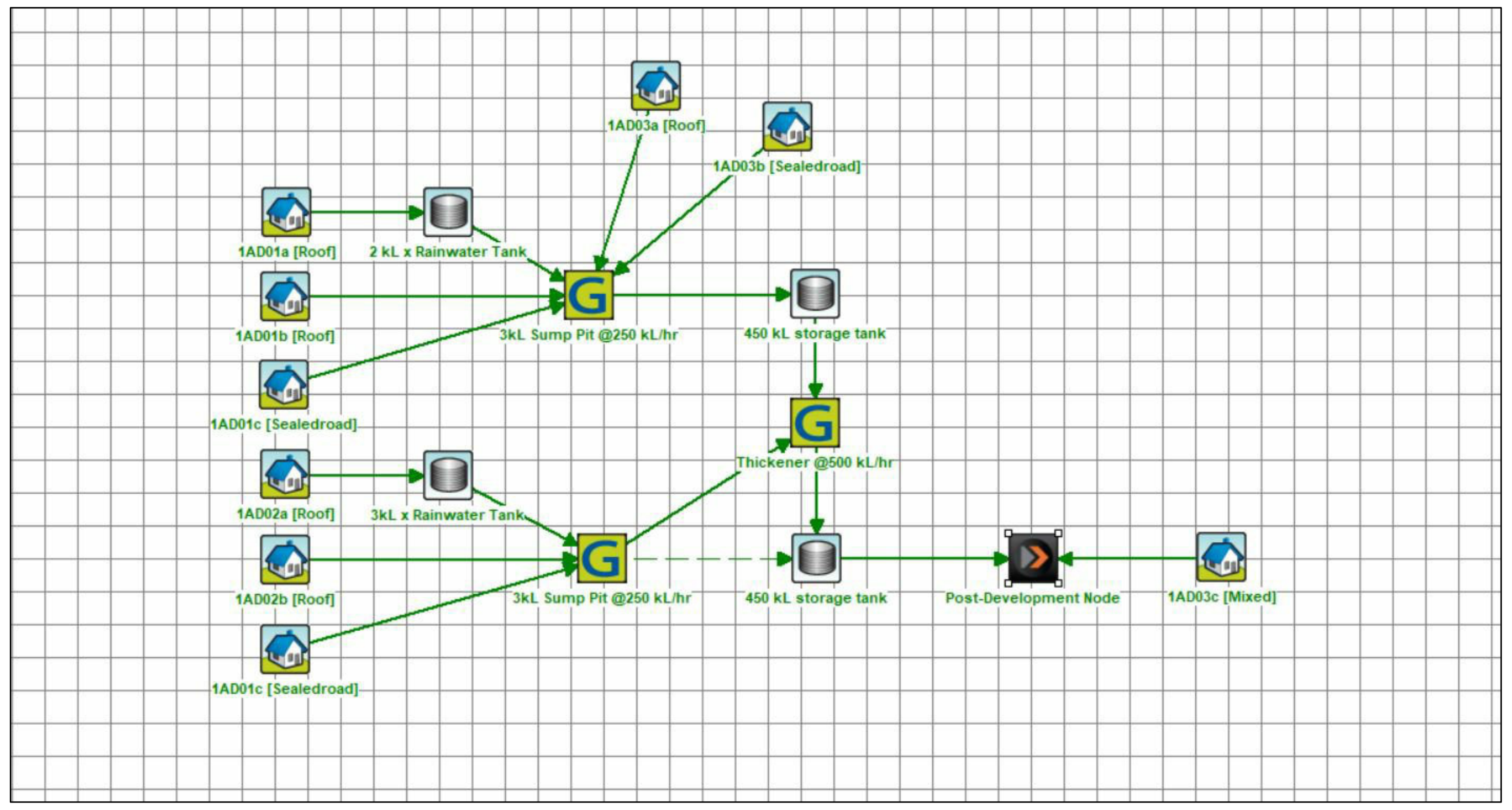
DRAWING TITLE: DRAINAGE DETAILS

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-E200	E

MUSIC CATCHMENT PLAN

SCALE: NOT TO SCALE



MUSIC MODELLING LAYOUT (P1203464MUS02V03)

MUSIC CATCHMENTS (P12034641MUS02V03)

KEY	DESCRIPTION	MUSIC NODE ID	AREA (ha)	IMPERVIOUS %	MUSIC NODE REFERENCE
NORTHERN CATCHMENT					
	ROOF TO 2kL RWT	1AD01a	0.008	100	NSW MUSIC MODELLING GUIDELINES 2015
	ROOF BYPASS 2kL RWT	1AD01b	0.073	100	NSW MUSIC MODELLING GUIDELINES 2015
	SEALED ROAD TO SEDIMENT BASIN	1AD01c	0.887	100	NSW MUSIC MODELLING GUIDELINES 2015
SOUTHERN CATCHMENT					
	ROOF TO 3kL RWT	1AD02a	0.122	100	NSW MUSIC MODELLING GUIDELINES 2015
	ROOF BYPASS 3kL RWT	1AD02b	0.008	100	NSW MUSIC MODELLING GUIDELINES 2015
	SEALED ROAD TO SEDIMENT BASIN	1AD02c	0.888	100	NSW MUSIC MODELLING GUIDELINES 2015
	ROOF	1AD03a	0.002	100	NSW MUSIC MODELLING GUIDELINES 2015
	SEALED ROAD	1AD03b	0.215	100	NSW MUSIC MODELLING GUIDELINES 2015
	BUFFER	1AD03c	0.147	0	NSW MUSIC MODELLING GUIDELINES 2015
TOTAL SITE					
		TOTAL – OVERALL		2.350	= 100 % OF OVERALL AREA
		TOTAL – IMPERVIOUS		2.203	= 94 % OF OVERALL AREA
		TOTAL – PERVIOUS		0.147	= 6 % OF OVERALL AREA

NOTES:

1. INTERNAL REUSE FOR TOILET FLUSHING IS 20 L/PERSON/DAY.
2. INTERNAL REUSE FOR DUST SUPPRESSION AND SAND WASHING SYSTEM IS 163.5 kL/DAY FOR THE 450 kL STORAGE TANK LOCATED IN THE SITE'S SOUTH.

Treatment Train Effectiveness - Post-Development Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	13.3	4.32	67.4
Total Suspended Solids (kg/yr)	4170	278	93.3
Total Phosphorus (kg/yr)	7.16	1.74	75.7
Total Nitrogen (kg/yr)	31.6	9.61	69.6
Gross Pollutants (kg/yr)	355	0	100

MUISC MODELLING RESULTS (P1203464MUS02V03)

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
C	**MINOR AMENDMENTS**	**01/09/2021**	**NN**	**EZ**	**SL**	**TH**
B	MINOR AMENDMENTS	16/06/20	GM/JS	SS	SL	TH
A	INITIAL RELEASE	15/11/2019	LL	EZ	TH	TH

SCALE: A1 (A3) 1:1,000 (1:2,000) METRES

GRID | DATUM | PROJECT MANAGER: TH

CLIENT: CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE: MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
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DRAWING TITLE: WATER QUALITY CATCHMENT PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-E700	C

DRAWING ID: P1203464-PS02-R20-E700

A1 / A3 LANDSCAPE (A1LC__v02.0.01)

PRINTED: ---- - USER: NNIKZAD

12 Attachment B - Figures

Plate 1: Aerial of riparian corridor neighbouring site.

Plate 2: Aerial of riparian corridor upstream of site.

Plate 3: View of Bow Bowing Creek channel facing upstream from adjacent to site.

Plate 4: View of Bow Bowing Creek channel and stormwater discharge point facing downstream from adjacent to site.

Plate 5: View of riparian corridor facing south. Site boundary on left, channel on right.

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Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	MLK/EZ	**Plates: Bow Bowing Creek**	**FIGURE 1**
Approved:	AN/TH		
Date:	18.10.2018		
Scale:	NA		Job No: P1203464

13 ATTACHMENT C – Conceptual Groundwater Model

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	MINOR AMENDMENTS	28/09/2018	JCF/LZ/PB	JCF	TH	TH
A	CLIENT REQUESTED AMENDMENTS	12/09/2018	JCF	JCF		

SCALE: 0 5 10 15 20 25 30 35 40 45 50 METRES — A1 (A3) 1:500 (1:1,000)

GRID: MGA | DATUM: m AHD | PROJECT MANAGER: TH

CLIENT: CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE: MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
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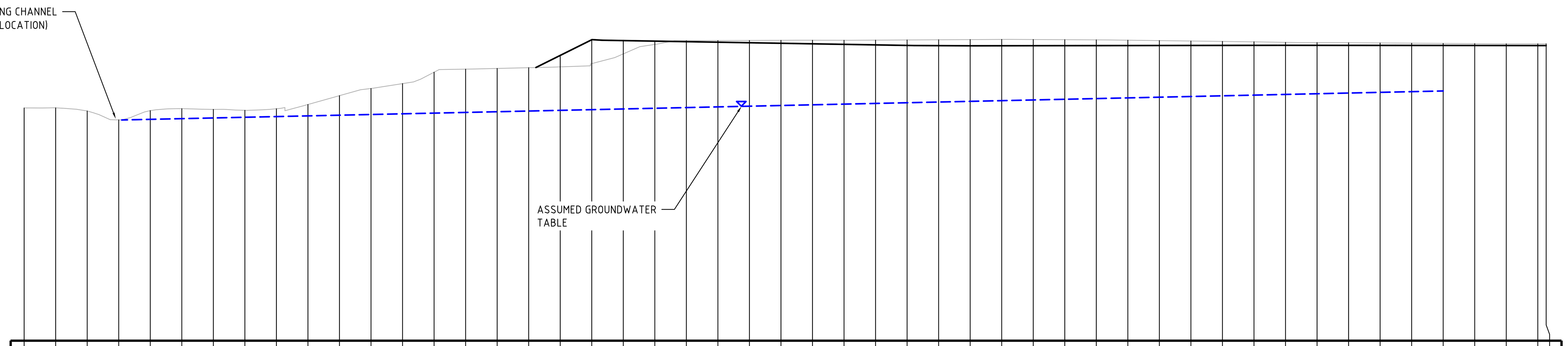
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: RIPARIAN FEATURES CONSTRAINTS PLAN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-A300	B

DRAWING ID: P1203464-PS02-R20-A300



DATUM RL 25.000

CHAINAGE	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000
DESIGN SURFACE LEVELS													
EXISTING SURFACE LEVELS	39.764	39.771	39.572	39.008	39.594	39.719	39.674	39.615	39.715	39.984	40.545	41.000	41.310
CUT / FILL DEPTH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

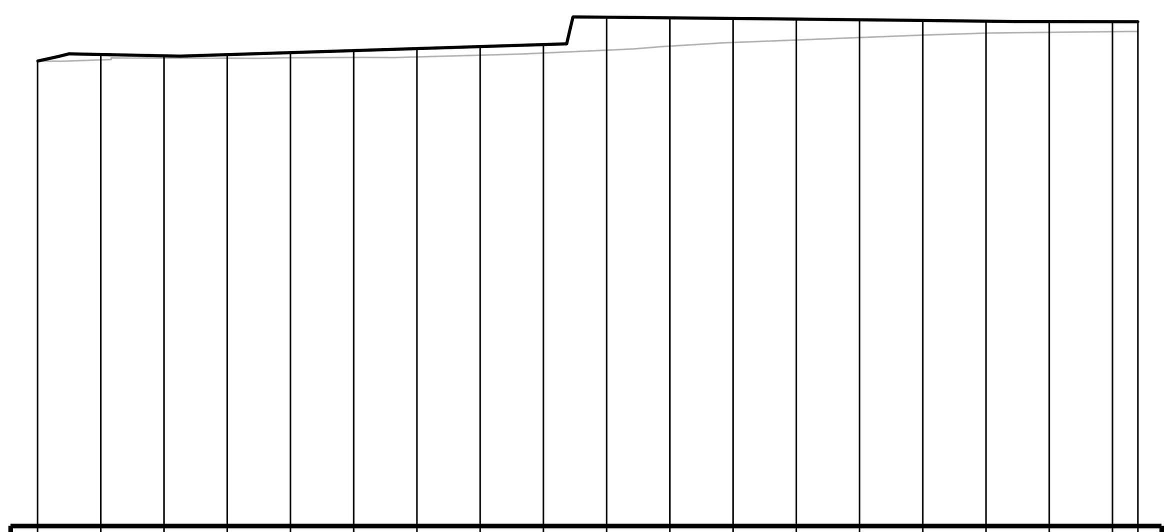
CHAINAGE	26.000	28.000	30.000	32.000	34.000	36.000	38.000	40.000	42.000	44.000	46.000	48.000	50.000
DESIGN SURFACE LEVELS					43.098	44.093	44.039	44.005	43.971	43.937	43.903	43.869	43.835
EXISTING SURFACE LEVELS	42.034	42.228	42.272	42.319	42.372	42.579	43.196	43.797	44.031	44.039	44.047	44.057	44.061
CUT / FILL DEPTH	0.000	0.000	0.000	0.000	0.727	1.514	0.843	0.208	-0.060	-0.102	-0.144	-0.188	-0.226

CHAINAGE	52.000	54.000	56.000	58.000	60.000	62.000	64.000	66.000	68.000	70.000	72.000	74.000
DESIGN SURFACE LEVELS	43.801	43.767	43.733	43.718	43.709	43.711	43.714	43.718	43.721	43.724	43.727	43.731
EXISTING SURFACE LEVELS	44.059	44.067	44.079	44.090	44.101	44.113	44.107	44.096	44.084	44.064	44.038	44.012
CUT / FILL DEPTH	-0.258	-0.301	-0.346	-0.372	-0.392	-0.402	-0.392	-0.378	-0.363	-0.339	-0.310	-0.282

CHAINAGE	76.000	78.000	80.000	82.000	84.000	86.000	88.000	90.000	92.000	94.000	96.000	96.531
DESIGN SURFACE LEVELS	43.734	43.737	43.74	43.738	43.736	43.734	43.732	43.73	43.728	43.726	43.723	43.723
EXISTING SURFACE LEVELS	43.987	43.961	43.926	43.909	43.903	43.888	43.873	43.858	43.843	43.833	43.834	43.835
CUT / FILL DEPTH	-0.253	-0.224	-0.186	-0.171	-0.167	-0.154	-0.141	-0.128	-0.115	-0.107	-0.111	-0.112

SECTION 3 - CONCEPTUAL GROUNDWATER MODEL

SCALE: HORIZONTAL - 1:200
VERTICAL - 1:200



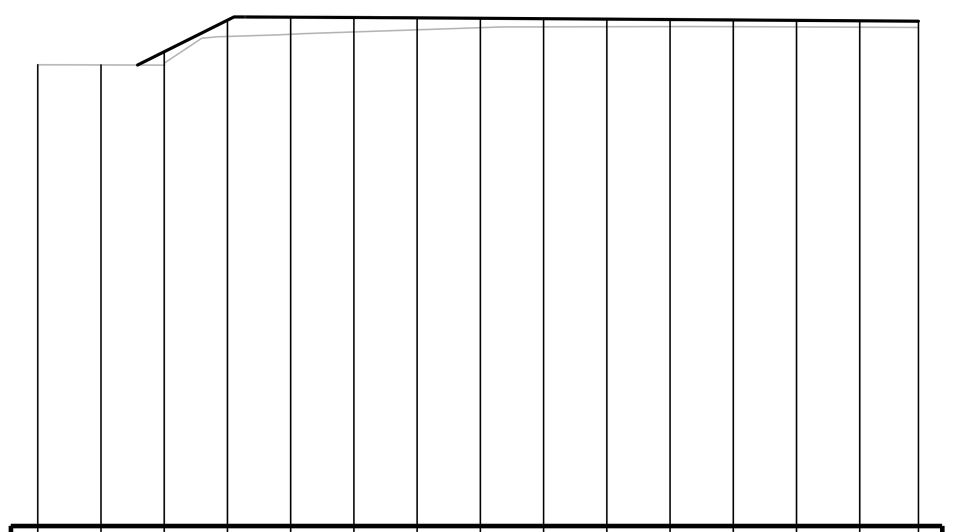
DATUM RL 28.000

CHAINAGE	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000
DESIGN SURFACE LEVELS		42.912	42.87	42.907	42.971	43.035	43.099	43.162	43.226	44.091
EXISTING SURFACE LEVELS	42.706	42.741	42.799	42.794	42.810	42.819	42.835	42.890	42.959	43.049
CUT / FILL DEPTH	0.000	0.171	0.071	0.113	0.161	0.216	0.264	0.272	0.267	1.041

CHAINAGE	20.000	22.000	24.000	26.000	28.000	30.000	32.000	34.000	34.804
DESIGN SURFACE LEVELS	44.071	44.052	44.032	44.01	43.989	43.965	43.953	43.95	43.949
EXISTING SURFACE LEVELS	43.176	43.292	43.370	43.448	43.525	43.588	43.612	43.634	43.639
CUT / FILL DEPTH	0.894	0.757	0.657	0.556	0.454	0.365	0.315	0.265	0.248

SECTION 4

SCALE: HORIZONTAL - 1:200
VERTICAL - 1:200



DATUM RL 28.000

CHAINAGE	0.000	2.000	4.000	6.000	8.000	10.000	12.000	14.000
DESIGN SURFACE LEVELS			42.999	43.997	44.092	44.082	44.071	44.058
EXISTING SURFACE LEVELS	42.587	42.582	42.572	43.482	43.552	43.625	43.693	43.760
CUT / FILL DEPTH	0.000	0.000	0.427	0.515	0.534	0.444	0.359	0.272

CHAINAGE	16.000	18.000	20.000	22.000	24.000	26.000	27.857
DESIGN SURFACE LEVELS	44.044	44.031	44.018	44.004	43.991	43.978	43.965
EXISTING SURFACE LEVELS	43.785	43.790	43.795	43.791	43.784	43.776	43.767
CUT / FILL DEPTH	0.227	0.200	0.173	0.153	0.137	0.122	0.113

SECTION 5

SCALE: HORIZONTAL - 1:200
VERTICAL - 1:200

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
E	**MINOR AMENDMENTS**	**28/09/2018**	**JCF/LZ/PB**	**CG/JCF**	**TH**	**TH**
D	CLIENT REQUESTED AMENDMENTS	12/09/2018	JCF/LZ	JCF		
C	UPDATED AS PER CLIENT REQUEST	06/06/2018	RK/JCF	JCF	TH	TH
B	CLIENT REQUESTED AMENDMENTS	09/03/2018	KW	CG/JCF	TH	
A	BALANCE SITE EARTHWORKS	07/11/2017	CG	CG	TH	

SCALE
0 2 4 6 8 10 12 14 16 18 20 METRES
A1 (A3) 1:200 (1:400)

GRID: ---
DATUM: MAHD
PROJECT MANAGER: TH

CLIENT
CONCRETE RECYCLERS (GROUP) PTY LTD

PROJECT NAME/PLANSET TITLE
MINTO CONCRETE RECYCLERS
SITE EARTHWORKS
7 MONTORE ROAD, MINTO NSW 2566
LOT 52 DP 618900

martens & Associates Pty Ltd
Consulting Engineers
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Civil
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Email: mail@martens.com.au Internet: www.martens.com.au

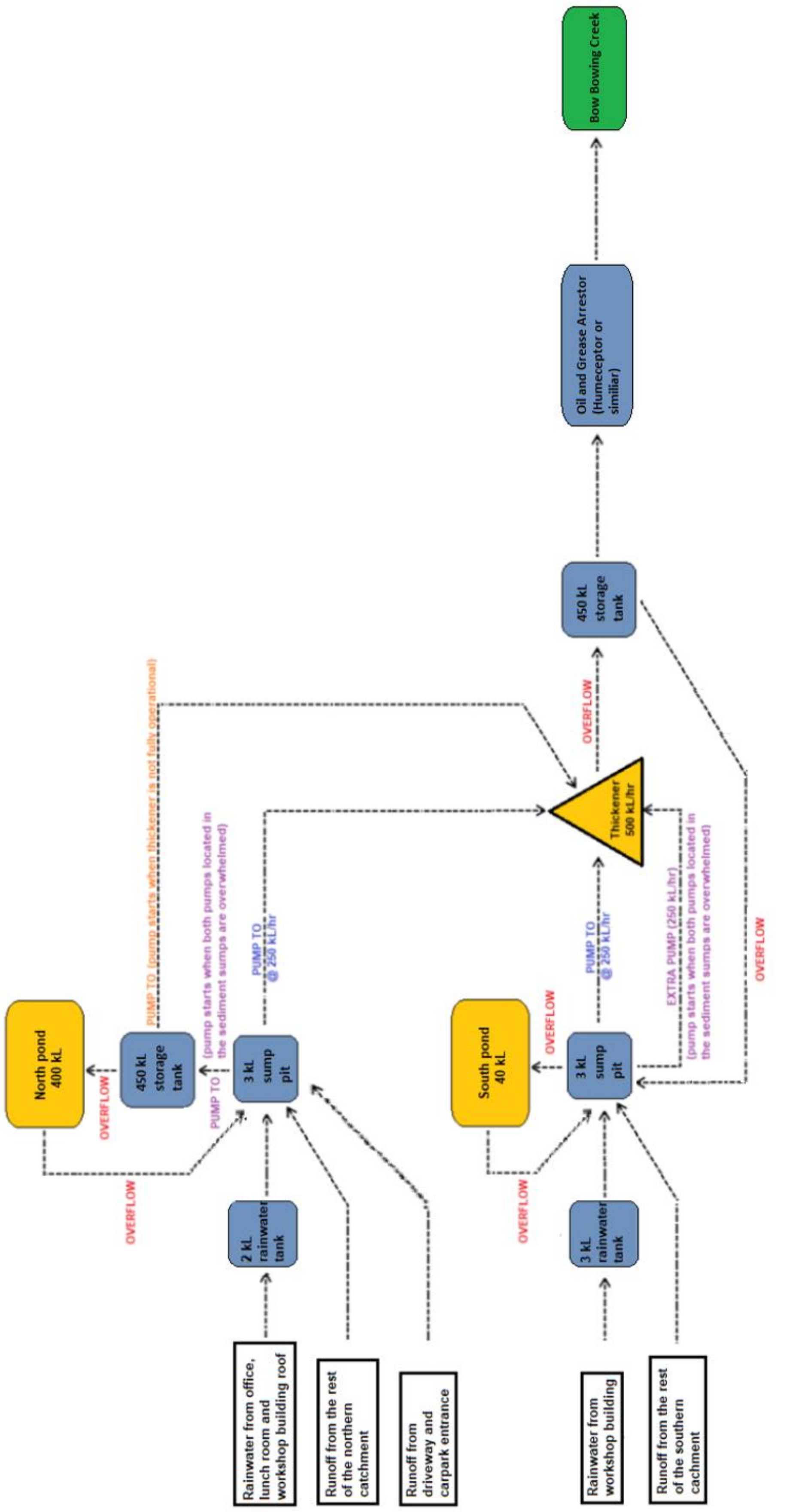
DRAWING TITLE
EARTHWORKS SECTIONS
SHEET 02

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1203464	PS02	R20	PS02-C701	E

DRAWING ID: P1203464-PS02-R20-C701
A1 / A3 LANDSCAPE (A1LC_v02.0.01)

14 ATTACHMENT D – Drainage Flow Chart

martens



Martens & Associates Pty Ltd ABN 85 070 240 890		Environment | Water | Wastewater | Geotechnical | Civil | Management	
Drawn:	EZ	Drainage Flow Chart	FIGURE 2
Approved:	SL		
Date:	25.08.2021		
Scale:	NA		Job No: P1203464

15 ATTACHMENT E – Council Flooding Information

3 October 2019

Lee Zhou
lzhou@martens.com.au

Dear Sir/ Madam

Flood advice – 7 Montore Road, Minto

Council refers to your flood advice requested, dated 10 July 2019 for the abovementioned property.

Council advises as follows:

1. The abovementioned property is a Flood Control Lot with respect to 1% Annual Exceedance Probability (AEP) flood due.

   A Flood Control Lot is defined in the State Environment Planning Policy (Exempt and Complying Development Codes) 2008 - REG 1.5 as “a lot to which flood related development controls apply in respect of development for the purposes of industrial buildings, commercial premises, dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (other than development for the purposes of group homes or seniors housing).

2. In accordance with the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008, I can confirm that the abovementioned property is **NONE** of the following:

   - Flood storage area
   - Floodway area
   - Flow path
   - High hazard area
   - High risk area

3. The minimum fill and floor level controls for any development on this property due to a 1% AEP flood event are provided in the table and shown on the enclosed Fill Level and Floor Level Location Plan.

Location	Minimum Fill Level (1% AEP Flood Level) (m AHD)	Minimum Floor Level (m AHD)
A	43.2	43.7
B	43.5	43.8
C	42.5	43.0
D	42.4	42.9
E	42.4	42.9

4. Please note that the required finished floor levels (FFL's) are defined by the relevant 1% flood level plus freeboard as defined in Table 4.1 of Council's Engineering Design for Development. Council does not have any information regarding floor levels of the existing building and if concerns are held with respect to any areas of the site, floor levels may need to be confirmed by a registered surveyor.
5. Any development of this site will require drainage to be accommodated in accordance with the Campbelltown City Council Engineering Design Guide for Development.
6. The floor level of the building must also comply with the requirements set out in Clause 3.1.2.3 of Volume 2 of the Building Code of Australia and Section 4.5 of the Engineering Design Guide for Development. Further controls may be applied at development application stage if the site is affected by a Section 88B (Conveyancing Act) Restriction.
7. Development consent and/or construction consent may be required for any development of this property.
8. The requested Council Stormwater Network Plan is attached.

If you require any further information, please contact Council's Coordinator Stormwater and Structural Design, Cathy Kinsey via email at cathy.kinsey@campbelltown.nsw.gov.au.

Yours sincerely

per Mark Wolczak
Executive Manager Infrastructure

AB

CAMPBELLTOWN CITY COUNCIL

7 Montore Road,
Minto

Fill Level and Floor
Level Location Plan

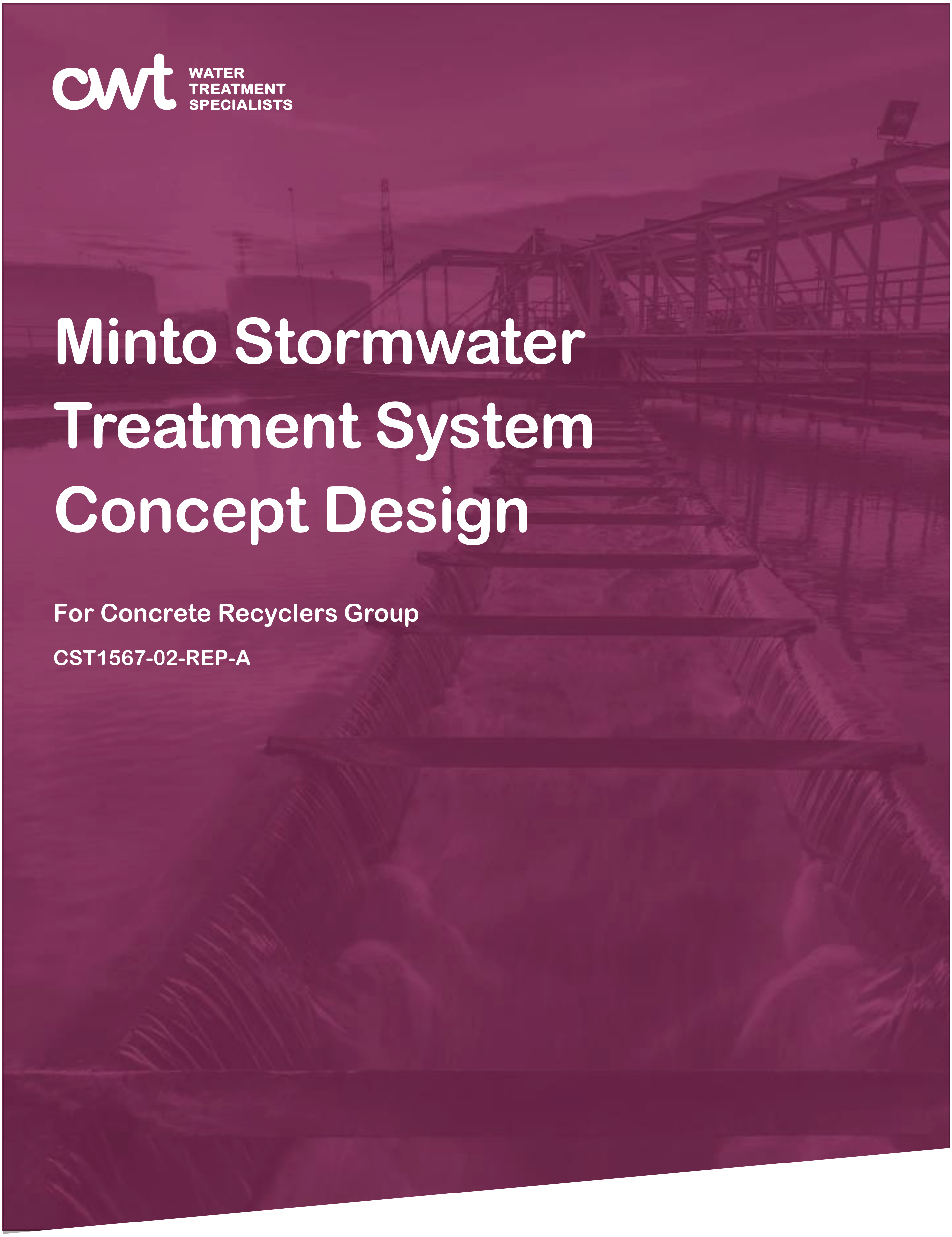
Accuracy of the information shown on this plan is not guaranteed.

All service levels and locations should be confirmed on site.

Council does not have details of drainage lines within private property where these service only private lots.

The contour information is based on Airbo LaserSurvey provided by NSW Land and Property Information 2011. Any changes to the topography since that time may not be reflected in these plans.

16 ATTACHMENT F – Minto Stormwater Treatment System Concept Design Report



CWT WATER TREATMENT SPECIALISTS

Minto Stormwater Treatment System Concept Design

For Concrete Recyclers Group

CST1567-02-REP-A

17 August 2021

Minto Stormwater Treatment System Concept Design

For Concrete Recyclers Group

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BESTPRACTICE CERTIFICATION ISO9001 QUALITY MANAGEMENT SYSTEM | BESTPRACTICE CERTIFICATION ISO14001 ENVIRONMENT MANAGEMENT SYSTEM | BESTPRACTICE CERTIFICATION AS4801 OH&S MANAGEMENT SYSTEM

Issue Date	Revision	Issued to	Prepared by	Reviewed by	Comments
17/08/2021	A	Concrete Recyclers	JM	MMC	Draft for comment

Contents

Tables

1 Introduction

City Water Technology (CWT) was engaged by Concrete Recyclers Group (CRG) to develop a concept design for a thickener and associated systems as part of an onsite stormwater and runoff treatment system as a proposed recycling plant to be located in Minto, NSW.

1.1 Background

Concrete Recyclers Group is in the development stage for the creation of a construction material recycling plant which is designed to recycle concrete, brick, asphalt, sand and sandstone into aggregate and other products for reuse. This process includes the storage, crushing, screening and washing of materials leading to rain and wash runoff with elevated suspended solids and pH.

The proposal includes splitting the site into two catchment zones, each to be pumped directly from a sump or via a storage tank, to a common 500 kL/h thickener for reduction of suspended solids, with acid dosing for pH adjustment. The treated water would then enter a 450 kL storage tank, and then reused on site or discharged, when required, into the Bow Bowing Creek via an oil and grease separation process.

Environmental Risk Sciences (EnRiskS) authored a letter report, 'Water Pollution Impact Assessment' (EnRiskS, 2021), for the proposed Minto Resource Recovery Facility to outline site water management and the objectives for discharge into the waterway, including consideration for human health and environmental risks.

1.2 Project Scope

The scope of this project includes the review and discussion of treatment options for TSS removal and pH adjustment, followed by the development of a concept design of a thickener system with coagulant and acid dosing systems. This report will also seek to characterise the expected quality of treated water to be discharged from site.

The upstream limit of the project is the point of entry into the flocculant mixing zone. The catchment zones, storage of stormwater and pumping into the thickener system are outside of the scope of this work.

The downstream limit of the project is the outlet of the thickener system to the treated water storage and sludge extraction from the thickener. Downstream pumping, storage, further sludge treatment and oil and grease separation are outside of the scope of this work.

Equipment to facilitate on site reuse of treated water is also outside of the scope of this work.

Stormwater discharge that bypasses the thickener and dosing systems or flows that are in excess of the design capacity of the thickener, are out of the control of the thickener system and therefore consideration for those conditions are also outside of the scope of this project.

2 Design Basis

Criteria to be used as a basis for design for the stormwater treatment system include:

- Water quality performance.
  - The expected water quality required to be treated based on samples taken at another CRG site.
  - Achievement of water quality targets as identified in EnRiskS Water Pollution Impact Assessment Letter Report.
- Process design assumptions & requirements.
  - Upstream processes;
  - Required flow rates;
  - Control and monitoring requirements;
  - Chemical storage requirements; and
  - Operability and reliability, with consideration for:
    - Robust process to minimise potential failures;
    - Reliability to allow high uptime;
    - Appropriate process redundancy; and
    - Adequate alarming and automatic shutdowns to minimise risk of discharging poor quality water into the environment.

2.1 Water Quality

As the site is as yet undeveloped, there is no site specific water quality data available, however CRG operate several similar resource recovery facilities in Sydney. One such facility, at Wetherill Park, employs similar recycling processes as those proposed for the Minto facility. For the purposes of this report data sampled from the stormwater dam at the Wetherill Park facility has been presented. Note that there were only two samples available, with sample 1 duplicated, and the samples were taken on unspecified dates.

Note that the following data has been included for context, and to use as a basis for the treatment requirements for the thickening and pH correction processes. CWT has not made an individual determination as to the suitability of the discharge water quality benchmarks as presented by EnRiskS.

EnRiskS, in their Water Pollution Impact Assessment, have also derived some guidelines for the resulting discharge water to meet[1]. The following documents were referenced in developing the guidelines: Australian Drinking Water Guidelines (ADWG 2011), Guidelines for Managing Risks in Recreational Waters (Recreational water guidelines, NHMRC 2008), ANZECC Water Quality Guidelines (ANZG 2018), and Australian Guidelines for Water Recycling (NRMMC 2009).

The data has been presented in Table 2-1, alongside:

- Recreational water guidelines, representative of human health requirements.
- ANZECC water quality guidelines, representative of ecological health requirements.
- Typical stormwater values, representative of typical urban stormwater.

Table 2-1: Stormwater from CRG's Wetherill Park North Stormwater Dam

Parameter	Units	Wetherill Park: Measured range in dam	Recreational water guidelines	ANZECC water quality guidelines	Typical stormwater (mean – untreated stormwater)
pH	Unitless	7.9-9.1	6.5-8.5	6.5-8.5	6.35
Electrical conductivity	µS/cm	481-1,020	--	125-2,200	--
Total suspended solids (TSS)	mg/L	6-142	--	--	99.7
Total dissolved solids (TDS)	mg/L	430	600	--	139.6
Turbidity	NTU	6.3	--	0.5-50	50.9
Sulphate	mg/L	27-30	250	--	--
Chloride	mg/L	70-221	250	--	11.4
Calcium	mg/L	27-29	--	--	--
Magnesium	mg/L	10-20	--	--	--
Sodium	mg/L	46-140	180	--	10.63

[1] See Water Pollution Impact Assessment letter report (EnRiskS 2021) for explanations of comparison values.

Parameter	Units	Wetherill Park: Measured range in dam	Recreational water guidelines	ANZECC water quality guidelines	Typical stormwater (mean – untreated stormwater)
Potassium	mg/L	3-7	--	--	--
Fluoride	mg/L	0.2-0.8	1.5	--	--
Ammonia (as N)	mg/L	0.17-3.09	0.5	0.9	1.135
Nitrite (as N)	mg/L	<0.01	30	--	--
Nitrate (as N)	mg/L	0.03-0.08	500	--	--
Oxidised nitrogen	mg/L	0.03-0.08	--	0.04	0.68
Total nitrogen	mg/L	0.25-3.12	--	0.5	3.09
Total phosphorus	mg/L	0.05	--	0.05	0.48
Total organic carbon	mg/L	16-17	--	--	16.9
Arsenic	mg/L	0.002	0.1	0.013	0.009
Cadmium	mg/L	<0.0001	0.02	0.0002	0.0198
Chromium	mg/L	0.001-0.033	0.5	0.001-0.0033	0.009
Copper	mg/L	0.002-0.007	1	0.0014	0.055
Iron	mg/L	0.5-0.87	0.3	--	2.842
Lead	mg/L	<0.001	0.1	0.0034	0.073
Manganese	mg/L	0.226-0.37	5	1.9	0.111
Mercury	mg/L	<0.0001	0.01	0.0006	0.0002
Nickel	mg/L	0.001-0.002	0.2	0.011	0.009
Zinc	mg/L	<0.005	3	0.008	0.293
Oil and grease	mg/L	8-9	--	--	11.47
TRH C6-C9	µg/L	<10	--	--	--
TRH C10-C14	µg/L	<50	--	--	--
TRH C15-C28	µg/L	<100	--	--	--
TRH C29-C36	µg/L	<50	--	--	--

2.1.1 Water Quality Findings and Notes

As seen in the table above

- pH was variable but overall high, ranging from 7.9-9.2 and typically higher than both the recreational water guidelines and typical stormwater mean values.
- TSS was also variable, with the highest value recorded of 142 mg/L, somewhat above the typical stormwater mean value.
- There was only one turbidity measurement, which was relatively low. The one turbidity result coincided with the lowest TSS result, indicating this turbidity reading is likely not indicative of the maximum.
- TDS was high, largely due to high chloride and sodium.
- There were some slightly elevated ammonia, oxidised nitrogen, and total nitrogen results.
- There were some slightly elevated chromium and copper results.

2.1.2 Treatment Targets

Based on the guidance provided by EnRiskS, the following preliminary treatment targets have been adopted for use in development of the concept design, however the scope of this concept design is to address the TSS, turbidity and pH targets.

Note that CWT has not made a detailed assessment as to the suitability and accuracy of these targets, and this is based on the discussion provided by EnRiskS. The following hierarchy had been applied:

- First meeting the ANZECC water quality guidelines for the protection of waterway ecology; followed by
- The protection of human health in the context of recreational use of downstream waterways; then
- Where a guideline is not available for a given parameter, the typical stormwater value is used; and
- Where there is no reference value, the parameter has no target.

Table 2-2: Preliminary Treatment Targets

Parameter	Units	Discharge Target
pH	Unitless	6.5-8.5
Electrical conductivity	µS/cm	125-2,200
Total suspended solids (TSS)	mg/L	<100
Total dissolved solids (TDS)	mg/L	<600
Turbidity	NTU	<50
Sulphate	mg/L	<250
Chloride	mg/L	<250
Sodium	mg/L	<180

Parameter	Units	Discharge Target
Ammonia (as N)	mg/L	<0.9
Nitrite (as N)	mg/L	<30
Nitrate (as N)	mg/L	<500
Total nitrogen	mg/L	<0.5
Total phosphorus	mg/L	<0.05
Chromium	mg/L	<0.0033
Copper	mg/L	<0.0014
Iron	mg/L	<0.3
Lead	mg/L	<0.0034
Manganese	mg/L	<1.9
Oil and grease	mg/L	<11.5

2.2 Process Design Requirements

2.2.1 Upstream Process

The stormwater management system captures runoff from across the site, with the exception of the on-site carpark. There are also rainwater tanks to capture rainfall onto the rooves of various onsite buildings. The site is split into two catchment zones, and the runoff as well as the rainwater tank's overflow is directed into two concrete sedimentation tanks. Large sediment (soil, sand, aggregate etc.) is expected to settle within the sedimentation tanks, with the surface water drawn off and transferred to the thickener system, or if the thickener is at capacity the northern catchment sump pumps transfer excess stormwater to a 450 kL storage tank.

Table 2-3 outlines the process details for the upstream system components.

Table 2-3: Process Overview Upstream of Thickener System

Process Step	Details	
	Northern Catchment	Southern Catchment
Contributing Flows	▲ Runoff from northern catchment, including driveway. ▲ Overflow from collected rainwater from office, lunch room and workshop building rooves	▲ Runoff from southern catchment ▲ Overflow from collected rainwater from workshop roof
Stormwater Storage	▲ Sedimentation tank (400 kL) ▲ Additional storage tank (450 kL)	▲ Sedimentation tank (40 kL)
Sump Pit	▲ 3 kL capacity ▲ Duty/standby variable speed pumps capable of pumping 250 kL/h to the thickener ▲ Duty/standby pump set to fill stormwater storage tank when sump is overwhelmed	▲ 3 kL capacity ▲ Duty/standby variable speed pumps capable of pumping 250 kL/h to the thickener ▲ Duty/standby pump set capable of pumping 250 kL/h to the thickener
Inlet Monitoring	▲ Sump level from pressure transmitter	▲ Sump level from pressure transmitter
	▲ Combined flow monitor to thickener system	
Overflows	▲ Storage tank into sedimentation tank	▲ Nil

2.2.2 Thickener Design Assumptions

The following table documents the stated and assumed process design requirements that have been used for the design of the thickener system and associated chemical dosing systems.

Table 2-4: Thickener Design Basis Assumptions and Design Requirements

Parameter	Assumptions/Requirements

Thickener Design Flow Rate	▲ 500 kL/h feed rate
	  ▲ Does include de-sludge volumes, which is variable and dependent on feed water quality. Outflow from thickener would be lower.
	  ▲ Design should allow for 110% of design flow rate before overflow (not including the intended overflow design of the thickener).

Thickener De-sludge	▲ Raw water TSS <250 mg/L, and the sludge volume to be removed from the thickener should not exceed 2.5% of inflow.

Flow Control and Capacities	▲ Pressure transmitter in stormwater sumps to start variable rate feed pumps.
	  ▲ 250 kL/h pump rate from each sump pit.
	  ▲ Additional 250 kL/h standby pump capacity in southern catchment sump to switch on at high sump level.
	▲ Flow meter on totalised incoming flow.
	▲ Pumping to thickener from Northern 450 kL storage tank triggered on level and thickener availability.

Water Quality Monitoring	▲ Online pH analyser in coagulant mixing tank
	▲ Online analysers on thickener outlet stream:
	  ▲ Electrical conductivity
	  ▲ Turbidity
	  ▲ pH
	  ▲ TSS

Pre-treatment	All water flows via the two sedimentation tanks for settlement of large suspended solids prior to being pumped to the thickener.

System Control	Full automated control based on raw and treated storage levels and online water quality analysers. Pumping to thickener limited to two pump sets (combined 500 kL/h) to prevent overloading of thickener.
Coagulant Dosing	▲ Flow paced from inlet flow meter ▲ Dosed into mixing tank ▲ Duty/standby dosing pumps
pH Adjustment/Acid Dosing	▲ Pre coagulant dosing ▲ Feedback pH adjustment from mixing tank pH analyser ▲ Duty/standby dosing pumps
Chemical Storage	4 major rain events, at maximum required dose rates.
Site Services	Adequate power supply and potable water are available on site.

2.2.3 Downstream Process

From the thickener, the supernatant flows to a 450 kL storage tank for site reuse including dust suppression and wash water for the materials recycling processes. The storage tank can also be filled from a potable supply for site use when there is insufficient run off for reuse.

During rainfall events, excess water entering the storage tank overflows to a discharge pit. From the discharge pit, water flows via an oil and grease arrestor to the Bow Bowing Creek via an existing dish drain.

Table 2-5: Process Overview Downstream of Thickener System

Process Step	Details
Treated Water Storage	▲ Treated stormwater storage tank (450 kL)
Sludge Management	Sludge extracted from thickener will be dewatered on site and disposed of offsite.
Monitoring	▲ Level transmitter on storage tank ▲ Flow switch on discharge line to Bow Bowing Creek
Site Reuse	▲ Various pump sets with isolation valves, check valves, pressure transmitters and accumulators as needed to feed site.
Discharge	▲ Excess water from the treated stormwater storage tank overflows to: ▲ A discharge pit followed by, ▲ An oil and grease arrestor followed by, ▲ Headwall and concrete dish drain to, ▲ The Bow Bowing Creek.

3 Process Parameters and Options

3.1 Turbidity and Particulate Treatment

3.1.1 Overview

From the data available, the TSS and turbidity leaving the sedimentation tanks is expected to be above what is typical for urban stormwater. Both parameters are likely to vary depending on severity of rain fall, time since last rain event and other factors outside of the control of thickener system.

Due to the potential for high turbidity and particulates, a robust process suitable for treating stormwater with high solids loading is required. It is also worth noting that high particulate events are likely to be largely short in duration.

Considering the level of particulates in the raw stormwater and required level of treatment, the removal of particulates is best suited to a settling process with some level of coagulation and flocculation, followed by physical separation via gravity settling. In general, water with high particulate loading requires an increased coagulant dose rate. Both then contribute to more solids to be removed and handled.

3.1.2 Coagulation

The particles in the water (microbes and inorganic solids, colloids) typically have a negative charge on the surface and hence repel each other, remaining in stable suspension. The suspended particles are destabilised by charge neutralisation; i.e. by adding positively charged molecules (such as ferric, Fe^{3+} and aluminium, Al^{3+}) into the water, which will modify the particle surfaces by removing the negative charges and allow particles to approach each other and agglomerate. With gentle mixing, the destabilised particles continue to clump together to form larger visible floc in the process of flocculation. Gravity settling, flotation and/or filtration can then remove the floc.

Good coagulation requires that all coagulant chemicals be mixed very quickly and thoroughly with the water and with sufficient energy so that the particles and the coagulant molecules collide rapidly and often. This is particularly important for the metal coagulants where the initial chemical reactions of adsorption-destabilisation occur in less than 1 second. Two alternative types of mixing may be employed to achieve suitable conditions for coagulation. These are described in the following table.

Table 3-1: Types of coagulation mixing

Mixing Type	Descriptions
Rapid mixing	• Fairly vigorous mixing for 30 to 60 seconds • Forms larger flocs more suitable for sedimentation processes
Flash mixing	• Significantly shorter mixing time than rapid mixing. Intense mixing that occurs over a few seconds with the aid of high-energy mixers • Higher mixing energy than rapid mixing to instantaneously mix the coagulant uniformly with the raw water which leads to smaller flocs (pin-flocs) more suited for filtration

The mixing of coagulant is significantly improved by the use of dilution (make up or carrier) water. Typically, dilution ratios of one part of chemical to between 10 and 20 parts of dilution water should be used. Use of dilution water achieves significant premixing that ensures better mixing of the chemical once it is finally added to the mainstream flow.

3.1.2.1 Coagulants

Table 3-2: Comparison of Coagulant Options

Option	Advantages	Disadvantages
Alum	▲ Suitable for lower turbidity water as it forms larger flocs ▲ Can be overdosed for enhanced coagulation to increase organics removal ▲ Cheaper (by weight) than ACH	▲ Narrower optimal pH range (5.5 – 7.5) ▲ Requires higher doses ▲ Produces more sludge ▲ Lowers pH and alkalinity of the water ▲ Risk of increased sulphates in the treated water
ACH	▲ Effective over a wider, higher pH range (6 – 9) ▲ Suitable for high turbidity waters ▲ Requires lower doses ▲ Produces less sludge ▲ Does not significantly affect pH or alkalinity	▲ More expensive (by weight of chemical) than alum
PACl	▲ Effective over a wider, higher pH range than alum (5 – 8) ▲ Cheaper (by weight of chemical) than ACH	▲ Lower Al_2O_3 content than ACH requiring higher doses (approx. double) ▲ Lowers pH of the water ▲ More expensive (by weight of chemical) than alum
Ferric Chloride	▲ Effective over a wide pH range (4 – 11) ▲ Large, rapidly settled floc	▲ Highly corrosive chemical ▲ Consumes significant alkalinity ▲ Risk of increased iron in the treated water ▲ Produces more sludge than aluminium based coagulants
PolyDADMAC	▲ No impact on alkalinity ▲ Low sludge production ▲ Effective for high turbidity waters	▲ More expensive than other coagulants ▲ Produces weaker floc, therefore generally used as a secondary coagulant aid. ▲ Risk of monomer by-product formation (e.g., NDMA) with high doses
Polyacrylamide	▲ Effective for high turbidity waters ▲ Requires low doses	▲ Can cause clogging and blockages ▲ Usage of powdered product requires careful handling to avoid forming lumps ▲ Risk of monomer by-product formation (e.g., NDMA) with high doses

The usage of polymers, either on their own or to act as secondary coagulants, are well worth considering in this application due to their ability to bind large particles. Polymers that are suitable for binding agglomerates together help improve their settling properties and floc strength after coagulation. They include the aforementioned PolyDADMAC, a cationic polyelectrolyte, and polyacrylamide, which can be cationic, anionic, or non-ionic depending on the water quality and treatment processes. Note that cationic polyacrylamides are not safe for environmental discharge as they are known to kill aquatic life.

3.1.3 Coagulant Options

At their Camellia plant, CRG use Hardman's Multifloc A1400 as a primary coagulant, which is a 1% anionic polymer solution.

Hibbs & Associates (Hibbs) carried out some coagulation jar testing on a representative sample of stormwater and presented it in their report 'Wastewater treatment by coagulation & flocculation'. Their jar testing methodology saw them test a wide range of coagulant products and polymer products, both alone and in series.

Overall, the methodology of the testing was limited, including a lack of commonly utilised coagulants, performing only a single dose for each trial allowing a poor comparison between the products, and a jar testing methodology not representative of the process.

Regardless, their results demonstrated that utilising an anionic polymer product as a primary coagulant was comparable to a two stage, coagulation and flocculant aid test. The results from these trials also demonstrated that a range of suitable products could achieve a low settled TSS.

The limited scope of the Hibbs' jar testing means that it is difficult to hold any confidence in the conclusions drawn from the data generated. While their trials showed that the anionic polymer (A1400) was better than the other options trialled, CWT recommends that a more thorough and robust approach be undertaken to confirm the expected product and dose required (ideally under different water quality scenarios) for the treatment process to operate effectively in order to meet discharge requirements.

Considerations for further analysis include:

- Salt-based coagulants (i.e. alum, ACH, ferric etc) requires finer dosing control for good performance, which is operationally complex, and may not be practicable due to high variability in expected feed water quality.
- The low ideal pH range for alum is likely unsuited to this process, as that would require significant acid dosing, and lapses in pH control would result in significantly reduced coagulation performance.
- CRG have had success utilising an anionic polymer to treat stormwater at other sites.

Given that a single product is expected to be used to aid in the coagulation and settling of particles, and that this product is expected to be delivered to site as a ready to use solution, CWT suggest that several products could be interchangeably trialled onsite during the commissioning phase of the plant to identify the most appropriate.

3.1.4 Flocculation

Once the water has been coagulated and the particles destabilised (charges neutralised) gentle mixing allows the tiny floc to collide and aggregate. As the floc grows it becomes more fragile. Therefore, it is important to reduce the mixing energy during flocculation to prevent damage to the floc. Several different systems may be used in WTPs to provide gentle mixing conditions and the necessary time for the floc to grow.

3.1.5 Clarification/Thickening

Clarification removes the bulk of the solids (around 90% typically). Many types of clarifiers or thickeners may be employed, and they fall into several categories depending on whether the floc is allowed to settle or float, or to be adsorbed and filtered through a sludge blanket. There are many variations, but the main applicable types for this use case can be sorted into the following main categories:

- Settling
- Up flow sludge blanket
- Solids contact or sludge recirculation

There are also several proprietary clarifier designs that provide enhanced settling. Clarifiers are designed with particular surface loading (flow) rates and detention times.

3.1.5.1 Settling Clarifiers

Two commonly used clarifiers that have high loading rates and a small foot print are tube settlers and lamella plate clarifiers. Tube settler clarifiers involve placing bundles of inclined tubes in a settling tank configured to allow flocculated water to pass through upward through the tubes. The tube surface provides a lot of surface area for particles to settle, agglomerate and slough down the tube where the sludge settles at the bottom of the settling tank. Lamella clarifiers operate on the same concept as tube settlers by increasing the surface area for enhanced settling.

Some of the advantages and disadvantages of tube settlers and lamella plate clarifiers are shown in the following table.

Table 3-3: Comparison of Tube Settler and Lamella Plate Clarifiers

Clarifier Type	Advantage	Disadvantage
Tube Settler	▲ Up to 50% cheaper than SS lamella plates, UV stabilised PVC much cheaper than stainless ▲ Tube settlers are self-supporting blocks, while plates need specific grooves with fixing mechanism ▲ Can be easily fit into a circular/ square/ rectangular tank ▲ Provides higher settling area compared to plates	▲ Algae growth in/ on tubes may cause maintenance and odour problems
Lamella Plate	▲ Ease of access – possible to remove each lamella plate, easily available for inspection; ▲ Lamella SS plates have a longer life than plastic tube settlers ▲ Metal plates are not subject to damage during periodic cleaning.	▲ Algae growth on plates may cause maintenance and odour problems ▲ Capital cost relative to tube settlers can be significantly higher

Clarifier Type	Advantage	Disadvantage
	▲ The inclined plates provide higher flows per unit area over the same surface area compared to tube settlers ▲ Plate settlers use orifices along the sides of each plate to equalize and distribute flows across each plate and are not subject to surges and uneven basin flows ▲ Lower cost FRP plates are comparable in price with tube settlers made of UPVC, but are known to warp over time leading to short circuiting flow.	

3.1.5.2 Sludge Blanket and Solids Contact Clarifiers

These are high rate clarifiers that consist of a central mixing zone, flocculation and outer sedimentation zone. A baffle wall typically separates the mixing and flocculating zones from the sedimentation zone. Floc formation is promoted by the recirculation of water within the mixing zone and by mixing the influent stream with sludge drawn from the bottom of the clarifier tank.

In sludge blanket clarifiers, a sludge blanket is used in the settling zone. The settled floc in the sedimentation zone accumulates in the bottom of the clarifier tank and is removed periodically to control the volume of sediment floc (the sludge blanket). The upward flow of influent through the sludge blanket causes it to expand. The cross-sectional area of the clarifier typically increases from the bottom of the clarifier to the top, which will reduce the rise rate and prevents the sludge blanket from washing out of the sedimentation zone. Some sludge blanket clarifiers employ pulsed flow whereby flow to the clarifier occurs in periodic pulses which promote mixing of the sludge blanket and enhances floc removal.

Contact Clarifiers make use of a multimedia filters that are made up of coarse filter media configured in series. The coagulated influent water passes through the contact clarifiers where the coarse filter media aids in flocculation and removal of floc.

3.1.6 Thickener Options

The efficiency of standard sedimentation tanks is weak if the removal of fine particles is considered to be the primary aim of storm water treatment. For standard settling tanks dimensioned on the basis of a maximum surface loading rate of 10 m/h the reported suspended solids removal ranges between 0 and 30%.

Sludge blanket and lamella plate thickeners both operate at high rates, somewhat comparable to the proprietary AquaCycle unit in use at another CRG site.

The operation of a sludge blanket thickener requires careful monitoring and operation, to ensure the sludge blanket is maintained. Without the presence of the blanket the performance of the thickener is substantially reduced as design surface ratings are in the order of three times higher in a sludge blanket design than in an up flow design without a sludge blanket.

Due to the highly event-based and therefore highly variable flow rates, a sludge blanket design would likely prove unreliable in removing the bulk of particulates, resulting in high TSS discharge events.

Lamella plates help to overcome the shortcomings of standard sedimentation tanks by increasing the given surface area significantly. They are proven in the fields of chemical and industrial wastewater treatment as a very efficient technology for solid separation.

For this reason, the preferred design is a lamella plate thickener.

3.2 pH Adjustment

3.2.1 Overview

pH adjustment is typically used to:

- Optimise coagulation
- Correct pH for distribution, reuse or discharge, depending on the application.

The pH of site stormwater is expected be generally high and somewhat variable due to the presence of limestone and other mineral dust in site runoff. Stormwater will likely be above the assessed guideline values and thus will need to be reduced below the upper guideline limit of 8.5, at a minimum.

3.2.2 Products Used for pH Correction

Selection of the chemical or chemicals to be used for the adjustment of pH depends largely on what needs to be achieved. Chemicals used for pH adjustment include alkalis such as lime, soda ash or caustic soda, and acids such as hydrochloric acid, sulphuric acid or carbon dioxide (CO_2). In this case, there is a need for pH reduction, and so the selection of an acid is required.

The following table summarises the main advantages and disadvantages of common acids used for pH adjustment.

Table 3-4: Comparison of pH Correction Options

Option	Advantages	Disadvantages
Sulphuric Acid	▲ Manageable to handle ▲ Effective in correcting pH	▲ Exothermic reaction can cause significant heating which could damage piping in the dilution systems ▲ Corrosive chemical requires appropriate materials for storage and handling ▲ Lowers alkalinity as well as pH
Hydrochloric Acid	▲ Easier to handle ▲ Effective in correcting pH ▲ Easy to obtain	▲ Exothermic reaction can cause significant heating which could damage piping in the dilution systems ▲ Corrosive chemical requires appropriate materials for storage and handling ▲ Lowers alkalinity as well as pH
Carbon Dioxide	▲ Weak acid poses lower handling and dosing risks ▲ Effective at stabilising lime softened water ▲ Reduces pH without consuming alkalinity	▲ Storage and handling difficulties for gas system ▲ Less effective as a pH corrector

3.2.2.1 Hydrochloric Acid

Hydrochloric acid (HCl) is generally available at concentrations 25 – 42% $^{w}/_{w}$.

Hydrochloric acid can have fuming issues and the system should be designed to minimise the escape of fumes within enclosed buildings or sheds and to protect electrical and other equipment from fumes. Fuming of the acid can be reduced by diluting the product (adding acid to the water) to <20% HCl concentration.

HCl can also react with metals to produce explosive hydrogen gas, and with sodium hypochlorite or oxidants to produce chlorine gas. The storage and dosing system must be designed to prevent contact with such incompatible materials.

3.2.2.2 Sulphuric Acid

Sulphuric acid (H_2SO_4) is available as a 98% or a 66% $^{w}/_{w}$ strength product.

Reaction of the H_2SO_4 acid with water can be strongly exothermic, requiring appropriate design of the dosing dilution system to guard against splattering and to prevent pipe damage from liberated heat.

3.2.3 pH Adjustment Options

At their Camellia plant, CRG use hydrochloric acid for pH adjustment.

The most important considerations for choosing an acid for pH adjustment at Minto include:

- Ease and safety in storage and handling.
- Suitability for process.
- Ease of procurement and delivery.

Based on this and the comparison provided in the above table, it is recommended that hydrochloric acid be used, due to its slightly easier storage and handling, and CRG's familiarity with the chemical. Sulphuric acid would also be suitable but would come with additional storage difficulties.

3.3 Total Dissolved Solids (TDS)

3.3.1 Overview

Total dissolved solids (TDS) is a measure of the quantity of dissolved salts and non-volatile organic matter. To obtain an accurate TDS value, measurement of weight lost during evaporation of a sample is required. Electrical conductivity (EC) is also sometimes used to infer TDS via a standard ratio. The data provided measured both TDS and EC so this is not necessary.

Stormwater with elevated TDS/EC has the potential to cause ecological damage, however the values are below the water quality guidelines as assessed by EnRiskS.

3.3.2 Removal Methods

TDS is much more difficult to remove than other contaminants. There are several commonly used methods:

- Distillation
- Membranes
- Resins

However, as stated, this is not likely to be required for discharge requirements.

3.4 Heavy Metals

Trace amounts of heavy metals, including chromium and copper, are sometimes found in urban stormwater. Removal of trace heavy metals including both copper and chromium can be achieved by coagulation, but this is dependent on the coagulant used and type of settling process. Other processes including ultrafiltration or activated carbon treatment can also be effective in their removal, however these would likely be considered too expensive and complex for the application of stormwater treatment.

Additional testing for the presence of trace heavy metals should be carried out, and the need for its removal should be further assessed. The inclusion of heavy metals removal could be considered when carrying out coagulation trials.

4 Process Design

4.1 Flow Rate

CRG has advised that the new thickener system should be designed to treat 500 kL/h, or approximately 139 L/s. This will enable treatment of flows sufficient to reduce onsite raw stormwater storage requirements.

The turndown of the sump feed pumps is not known, but for the purpose of this concept design a minimum flow rate of 125 kL/h, or approx. 35 L/s, has been adopted, giving a turndown of approximately 4:1 for the plant.

In addition, the infrastructure shall provide an additional hydraulic capacity of 10% over the design flow before overflow will occur. The hydraulic design capacity shall, therefore, allow for flows up to 550 kL/h or 153 L/s.

For the purpose of this concept design, a single major rain event has been defined to require a maximum of 2,000 kL thickener treatment. This is based on the assumption that the northern catchment has been correctly sized to capture a 100 ARI rain event.

4.2 Coagulation

4.2.1 Coagulant Dosing

The coagulation process involves the addition and mixing of chemical coagulant to the raw water to create conditions which agglomerate suspended and dissolved contaminants in the water into floc particles. For the Minto stormwater treatment system, coagulant products should be trialled either before detailed design and construction, or during the commissioning of the plant.

The coagulant will be dosed immediately upstream of rapid mixing, which is designed to disperse the coagulant into the raw water quickly and evenly.

4.2.2 Coagulant Rapid Mixing

The rapid mixing stage should provide at least 30 seconds' detention time for adequate mixing. The mixing gradient (i.e. G value) for the rapid mixing stage should be in the range 500-1000 s^{-1}. This shall consist of a mixing tank with a mechanical mixer and a baffle to prevent short circuiting.

Table 4-1: Coagulant Mixing Design

Item	Details	Value	Comments
Mixing	Mixing gradient (s^{-1})	500-1000	
	Min. contact time (s)	30	
	Max. contact time (s)	120	

4.2.2.1 Coagulation pH Monitoring

An online analyser for pH will be installed on the outlet of the mixing tank.

4.3 Flocculation System

After mixing, the coagulated water will flow on to the flocculation process stage. A single stage flocculation tank will be provided with a mechanical mixer. The flocculation tank will provide the necessary mixing and retention time for formation of floc before water gravitates towards the thickener. At least 20 minutes of flocculation time is required. The tank will also be equipped with a drain line, sized to allow scouring of any settled material.

The mechanical mixer will provide an adjustable mixing gradient between 30 and 150 s^{-1} for the flocculation process.

flocculation tank will be designed to minimise flow short-circuiting.

Table 4-2: Flocculation Systems

Item	Details	Value	Comments
Flocculation zone	Mixing gradient (s^{-1})	30-150	Variable speed mechanical mixing
	Min. contact time (mins)	20	
	Max. contact time (mins)	80	

4.4 Thickener System

The thickener system will be designed to separate approximately 90 % of the solids from the bulk water stream to provide a low-solids water stream for site reuse and discharge as required. The solid-liquid separation will be achieved through settling of the solids, with periodic removal of the settled sludge. To enable a high surface rating, lamella plates shall be used.

- One (1) thickener, receiving full design flow;
- Desludging of the clarifier will be achieved hydraulically.
- A mechanical scraper or rake will be used assist in sludge removal.

Table 4-3: Thickener Design Summary

Item	Details	Value	Comments
High-rate thickener	Max. flow per clarifier (kL/h)	500	Fitted with lamella plates to achieve high-rate settling
	Depth (m)	3-5	
	Plate angle (degrees)	60	
	Plate spacing (mm)	50-80	
	Projected plate surface loading rate (m/h)	0.6	
	Fraction of basin covered by plates	75%	
	Flow direction	Countercurrent upflow	
Sludge rake	Typical speed at outermost point (m/min)	1-2	Assuming variable rake speed.
	Maximum speed at outermost point (m/min)	3	

Note that for this concept design, the clarifier is be designed for high rate, however it is possible that higher rates could be achieved. To enable implementation of a more aggressive design, additional trials would be required.

Clarified water will overflow into a trough and flow to the treated stormwater storage tank.

A sludge rake will be used to assist in directing settled material to settle above the sludge discharge, and to prevent rat-holing and bridging. Settled sludge will be hydraulically withdrawn from the clarifiers , using a valve which opens on an operator adjustable timer, and transferred for further treatment or disposal.

4.4.1 Clarified Water Monitoring

To monitor the clarified water as it flows to the treated stormwater storage, the following online analysers will be installed in the trough:

- pH
- Electrical conductivity
- Turbidity

4.5 Chemical Dosing Systems

4.5.1 Overview

The following chemicals are to be stored and dosed at the Minto plant:

Hydrochloric Acid: Hydrochloric acid will be delivered as a concentrated, liquid product. The product would be delivered in 1000L IBCs. The product will be dosed to a mixing tee, where it mixes with a carrier water stream for dosing.

Coagulant: it is expected that the coagulant would be delivered as a ready to use, liquid product. The product would be delivered in 1000L IBCs. Product as delivered will be dosed to a carrier water stream and dosed into the mixing tank.

All chemical systems will comprise at least one standby and one duty pump and will be flow proportional controlled, with the flow signal supplied from the inlet flow meter to adjust dosing pump flow.

In addition, hydrochloric acid will be pH-trimmed by an online pH meter.

4.5.2 Design Chemical Dosing Rates

Chemical storage and dosing facilities have been sized on the basis of the maximum rates nominated in Table 4-4 below, as estimated based on other systems with similar quality water, but subject to further trials.

Table 4-4: Design Chemical Dosing Rates (as active ingredient)

Chemical System	Dosing Rates mg/L		
	Minimum	Typical	Maximum
Acid Dosing	0	6	12[2]
Primary Coagulant (assumed 1% anionic polyacrylamide)	0.05	0.3	0.6

4.5.3 General

The following aspects of design apply to all chemical dosing systems as applicable:

[2] Maximum HCl dose rate has been estimated using data provided and preliminary water chemistry calculations. Additional capacity could be considered to allow for coagulants requiring lower pH.

- Chemical systems will have at storage suitable for treating several heavy rain events.
- Sufficient capacity of all systems will allow at least three days unattended operation.
- Liquid chemicals will be delivered and dosed from IBCs as a practical approach for the volumes required.
- The dosing systems will include flow-paced dosing to be capable of treating water at various flow rates. A feedback control loop will be provided for hydrochloric acid dosing.
- Liquid dosing systems will be fitted with pulsation dampeners and local calibration tubes.
- Relevant chemical systems and unloading areas will be suitably bunded to contain the chemical in the event of a spillage. Rainwater collection in the bunds will be retained in a sump and tested before disposal.
- All chemical dosing lines will be laid in chemical trenches or trays where appropriate.
- All chemical dosing lines will be appropriately labelled identifying the chemical in the line, the direction of flow and marked with colours to be approved.
- All equipment (including injection equipment and dosing lines) will allow for easy and safe isolation, to facilitate quick repairs without total closure of the plant.
- All equipment will be selected to ensure material compatibility.

4.5.3.1 Chemical Systems Safety

The following safety equipment will be available:

- Deluge-type safety shower/ plunge bath and eyewash facilities complying with AS 4775.
- A hose (25mm diameter minimum) of suitable length to reach all parts of the unloading area and permanently connected to a water tap.
- Material Safety Data Sheets (MSDSs) for each chemical.
- Adequate ventilation for all enclosed chemical areas.
- Fire extinguishers complying with AS 2444.
- Appropriate safety signage.

4.5.4 Coagulant Dosing

The coagulant to be dosed depends on further trials, however a 1% anionic polyacrylamide has been used for the purpose of this concept design.

4.5.4.1 Dosing Point

The dosing point for the coagulant will be into the mixing tank, close to the inflow.

4.5.4.2 Dosing System

The coagulant dosing system will consist of the following components:

- 1 x 1000L IBC;
- 2 dosing pumps, 1 duty/ 1 standby;
- Pipework, valves, in-line strainers, and bunding; and

- Dilution system.

Table 4-5: Coagulant Dosing System Summary

Item	Details	Value	Comments
Dose Rate	Min., Avg., Max.	0.05, 0.5, 1.0	Estimate only. Requires testing to confirm.
Storage	No. of IBCs	1 x 1000L	Based on: 4 major storm events Max. dose and design flow Note that this is in addition to the active IBC.
Dosing pumps	No. of pumps	2	Based on: Max dose and design flow Min dose, min flow
	Max. flow per pump (L/h)	48	
	Configuration	1 duty/ 1 standby	
	Turndown ratio required	99 : 1	

4.5.5 Hydrochloric Acid Dosing

Hydrochloric acid is required for both adjustment of coagulation pH and to ensure final treated water pH is <8.5. The dosing system has been based on a 20% w/w strength solution. A lower strength acid is proposed as it is safer for operators and avoids some storage and delivery material requirements.

4.5.5.1 Dosing Point

The dosing point for HCl will be prior to the mixing tank.

4.5.5.2 Dosing System

The HCl dosing system will consist of the following components:

- 1 x 1000L IBC;
- 2 dosing pumps, 1 duty/ 1 standby;
- Pipework, valves, in-line strainers, and bunding;
- Mixing tee; and
- Flushing/Dilution system.

Table 4-6: Hydrochloric Acid Dosing System Summary

Item	Details	Value	Comments
Dose Rate	Min., Avg., Max.	0, 6, 12	Based on preliminary calculations and subject to coagulant choice.

Item	Details	Value	Comments
Storage	No. of IBCs	1 x 1000L	Based on: 4 major storm events Max. dose and design flow Note that this is in addition to the active IBC.
Dosing pumps	No. of pumps	2	Based on: Max dose and design flow Min dose, min flow
	Max. flow per pump (L/h)	28.6	
	Configuration	1 duty/ 1 standby	
	Turndown ratio required	99 : 1	

5 Control Philosophy

5.1 Control and Monitoring Systems

5.1.1 Overview

The thickener system and associated chemical dosing systems will be designed with sufficient automation for unmanned operation with periodic on-site input from operators.

The plant will include the following control system components:

- Programmable Logic Controller (PLC) system and programming
- Local HMI.
- Local controls for components as applicable.

The works will include preparation of a Functional Specification document which outlines the control details for each equipment item and sub-system of the plant.

5.1.2 Performance Requirements

The control system will be designed to provide:

- Fully automated, remote operation of systems.
- Continuous monitoring.
- Chemical dosing flow pacing, with no hunting or rapid changes to dosing or flowrates.
- Automatic adjustment of some chemical dosing rates based on monitoring feedback loops.
- Calibration testing ability.
- A manual override facility for operation of WTP sub-systems and individual equipment.

5.2 Operational Flow Rates and Flow Ramping

Flow through the thickener system is governed by the sump pumps, which are variable speed and the full design flow rate of the thickener can be fed by each of the two catchments individually, depending on storage and flow conditions.

Ideally, the thickener system should be operated at a flow rate matched to an average required flow, rather than at the maximum design flow rate on an 'on and off' basis. This will minimise the number of plant starts and stops per day, leading to better process performance.

For optimum process performance, sudden changes to the flow rate, particularly sudden increases, should also be avoided. This can be achieved by ramping the flow rate slowly up or down when a change is being made. Flow ramping would best be achieved automatically through the SCADA control system.

5.3 Mixing Tank

The mixing tank provides the residence time and mixing energy required to ensure the coagulant is fully mixed with the incoming stormwater.

The mixer's speed will be operator adjustable controlled via the HMI.

5.4 Thickener

The thickener will receive flocculated water from the flocculation tank and allows sedimentation to occur. The dosed water enters the thickener via the flocculation chamber, and then slowly flows out and upward; the supernatant decants over the launder weir. The settled floc descends to the clarifier's base. A rake/scraper is used to direct settled material into the centre of the vessel for sludge extraction.

Valves on the outlet open in a co-ordinated periodic system to blow down sludge that has accumulated.

Blowdown will be a PLC controlled process and will be initiated by a timer mechanism. The Operator of the plant can adjust the timer set point of the blowdown process and thus allow the blowdown process to occur more or less frequently. The operator will also be able to adjust the period of each blowdown.

After sludge extraction, the sludge line will be scoured with process water.

The Operator can run the blowdown process manually via the HMI display or locally at the valves.

5.5 Chemical Dosing Systems Control

Chemical doses will be able to be selected on the HMI screen in terms of the "mg/L" dose of chemical. The control system will calculate the required dosing pump/ screw feeder rate based on the dose setpoint and the WTP flow rate.

All chemical dosing will be flow proportional, with both the acid and coagulant dosing flow paced from the inlet flow meter.

Acid dosing will be further controlled via feedback from online pH meters.

5.5.1 Hydrochloric Acid

Hydrochloric acid will be dosed to provide pH adjustment.

The required hydrochloric dose rate set point will be entered into the HMI. The dosed water pH set point will also entered and HCl will be automatically controlled to achieve this set point.

The HCl dosing system will operate when the following conditions are satisfied:

- The plant is in operation;
- The flow rate is above an operator set minimum value;
- The HCl dosing system is selected to operate; and
- The HCl dosing systems is available and online.

If the HCl dosing system is selected to operate but is not available due to any system fault, an alarm will be raised and the system will not run.

HCl dosing occurs upstream of the mixing tank.

5.5.2 Coagulant

When coagulant dosing is selected to operate, the required dose rate set point is entered into SCADA.

The dosing system will operate when the following conditions are satisfied:

- The plant is in operation;
- The flow rate is above an operator set minimum value;

- The dosing system is selected to operate; and
- The dosing system is available and online

The coagulant doses into the mixing tank.

An 'Automatic / Manual / Off' selection is provided on SCADA for coagulant dosing pump 1 & 2. Automatic transfer to the standby pump is required on detection of a duty pump failure.

6 Treated Water Characterisation

Based on the water quality data provided and the concept design presented above, an estimate of the supernatant water quality can be made. The following should be representative of discharge water, except for further dilution in the treated water storage tank and oil and grease removal in the arrestor. Note that estimated figures have only been provided for those parameters expected to be significantly altered by the thickener and chemical dosing processes. For those parameters where changes are not expected or not known, a '-' has been shown.

The expected treated water quality has been presented against the target water quality values as derived in Section 2.1.2.

Table 6-1: Expected Treated Water Quality

Parameter	Units	Discharge Target	Estimated Typical Thickened Water Quality
pH	Unitless	6.5-8.5	7.5-8.5[3]
Electrical conductivity	µS/cm	125-2,200	-
Total suspended solids (TSS)	mg/L	<100	5-20
Total dissolved solids (TDS)	mg/L	<600	-
Turbidity	NTU	<50	5-20
Sulphate	mg/L	<250	-
Chloride	mg/L	<250	-
Sodium	mg/L	<180	-
Ammonia (as N)	mg/L	<0.9	-
Nitrite (as N)	mg/L	<30	-
Nitrate (as N)	mg/L	<500	-
Total nitrogen	mg/L	<0.5	-
Total phosphorus	mg/L	<0.05	-
Chromium	mg/L	<0.0033	-
Copper	mg/L	<0.0014	-

[3] pH could be lower if required for coagulation, which would result in a lower final pH. This assumes minimal pH reduction for coagulation.

Parameter	Units	Discharge Target	Estimated Typical Thickened Water Quality
Iron	mg/L	<0.3	-
Lead	mg/L	<0.0034	-
Manganese	mg/L	<1.9	-
Oil and grease	mg/L	<11.5	-

Appendix A Process Flow Diagram