STORMWATER MANAGEMENT PLAN

FOR

BELFAST WATER TREATMENT PLANT BANKABLE FEASIBILITY STUDY

EXXARO

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TERMS, ACRONYMS AND ABBREVIATIONS

Table 1 lists the acronyms and abbreviations used in this document.

Table 1: List of Acronyms and Abbreviations

ABBREVIATION	DEFINITION
EIA	Environmental Impact Assessment
EXX	Exxaro
IWUL	Integrated Water Use License
NGL	Natural Ground Level
PCD	Pollution Control Dam
RFW	Raw Feed Water
WTP	Water Treatment Plant

DEFINITIONS

The definitions listed below apply to this document. For more details, please consult the Glossary.

TERM	DEFINITION
ATTENUATION STRUCTURES	Infrastructure designed to temporarily store stormwater to reduce peak flows and allow for controlled release. This helps to prevent flooding and erosion downstream.
CLIENT	Exxaro.
CONTAMINATED STORMWATER	Stormwater that has come into contact with contaminants such as oil, chemicals, or heavy metals, typically from industrial or mining operations. This water may pose environmental risks and must be managed to prevent pollution.
EIA	A process used to assess the environmental and socio-economic impacts of a proposed project or development. In this context, the EIA evaluates the potential impacts of the proposed Water Treatment Plant facility at Exxaro Belfast Coal Mine.

TERM	DEFINITION
ECSA	Engineering Council of South Africa.
ENERGY DISSIPATER	A structure or technique used to reduce the velocity of stormwater flow and prevent erosion or damage at the outlet of a drainage system. Common examples include rock rip-rap, gabions, and other engineered solutions.
ENGINEER	The individual, or company, responsible for the design, for preparation of the Drawings (or approval of Drawings prepared by others) and where applicable, inspection of construction for conformity with design.
FLOOD RECURRENCE INTERVAL	The frequency with which a given flood event (with a specified magnitude) is expected to occur, typically expressed as a ratio (e.g., 1:50-year or 1:20-year). A 1:50-year flood event has a 2% chance of occurring in any given year.
INTERLOCKS	Mechanical or electronic devices that ensure that certain systems (such as bunding and spill containment) operate in a controlled and safe manner, often used in chemical handling areas to prevent accidental spills or releases.
PCD	A facility used in industrial and mining settings to contain and manage contaminated water and prevent it from polluting the surrounding environment. PCDs are designed to store contaminated runoff until it can be treated or safely disposed of.
PRECIPITATION CATCHMENT AREA	A defined area that collects rainfall or other forms of precipitation, which then contribute to runoff that is directed through stormwater systems. This area's characteristics influence runoff calculations.
RUNOFF COEFFICIENT	A dimensionless value that represents the fraction of rainfall that becomes runoff from a particular surface. It is used to calculate stormwater runoff and varies depending on land use, surface type, and soil characteristics.
IWUL	A legal document issued by the Department of Water and Sanitation (DWS) in South Africa. It permits the holder (in this case, Exxaro) to use water for specific purposes, such as water treatment, discharge, or storage, while complying with environmental regulations.
SANRAL	South African National Roads Agency Limited.
SANS	South African National Standards.
SOILSAVER	A geotextile material used to stabilize soil on slopes or embankments, reducing erosion and promoting vegetation growth. It is commonly used in areas that require fast stabilization, especially in construction zones.
STORMWATER	Water that results from precipitation and runs off from land surfaces such as roads, buildings, and other hard surfaces. It is usually directed to stormwater drains and may require treatment or attenuation before discharge.
TIME OF CONCENTRATION	The time it takes for water to flow from the furthest point of a catchment area to the outlet. It is used to calculate peak flow rates in stormwater drainage systems and is influenced by factors such as catchment shape and slope.
V-DRAIN	A type of stormwater drainage channel with a V-shaped cross-section, often used in areas with significant surface runoff. V-drains are designed to direct water away from infrastructure while preventing erosion and flooding.
WTP	A facility designed to treat water (in this case, stormwater, contaminated water, or process water) to meet required quality standards before being released into the environment or used within the mining operation.

REFERENCES

The following documents are either **Applicable Documents** - applicable to the extent specified herein and thus forming part of this document. The applicability will generally relate to the Project in terms of policy, procedures, standards, qualification, etc.; or **Reference Documents** - where the information concerned has been fully extracted from the reference document and added to this document, or where the reference document contains information relevant to this document, or for information only.

NO.	DOCUMENT NAME	ACONEX DOCUMENT NUMBER
1	Design Requirements Storm Water Rev 1	EXX-ECL-STD-0011
2	Drainage Manual: The South African National Roads Agency Limited (5th Ed.)	SANRAL Drainage Manual
3	Regulations on use of water for mining and related activities aimed at protection of water sources	NATIONAL WATER ACT, 1998 (ACT NO.36 of 1998)
4	WTP Area Block Plan	BCU-S01-730-ME-LO-0001
5	WTP Stormwater Layout and Management Plan	BCU-S01-729-CL-LO-0003
6	WTP Stormwater Details	BCU-S01-729-CL-DE-0001
7	Civil and Structural Design Criteria	BCX-000017-12955-ENG-DCR-0004
8	Civil and Structural Design Report	BCX-000017-12955-ENG-RPT-0022
9	Civil Design Requirements For Road Geometry	EXX-ECL-STD-0008

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1. INTRODUCTION/BACKGROUND

Exxaro Belfast Mine is exploring efficient and sustainable technological solutions to meet its current and future water treatment needs. This initiative is aimed at supporting the mine's operational objectives while minimizing environmental impact. As part of this effort, multiple studies have been conducted to evaluate alternative water treatment technologies and processes, with the goal of improving water quality management on-site.

This report presents an assessment of the stormwater and contaminated stormwater systems required for the proposed Water Treatment Plant (WTP) facility infrastructure. The analysis focuses on the stormwater infrastructure on and around the newly proposed terrace, and outlines the solutions implemented to address runoff, contamination, and erosion, ensuring compliance with both Environmental Impact Assessment (EIA) and Integrated Water Use License (IWUL) requirements. The report provides detailed analyses of the stormwater and wash water management systems, including separate management approaches for stormwater and contaminated wash water.

2. PROJECT LOCATION

The proposed WTP facility will be located within the secured area of Exxaro Belfast Coal Mine, situated in the Mpumalanga Province, approximately 55 km east of Middelburg and 20 km south-west of Belfast. The site forms part of the Witbank Coalfield, situated to the south of the N4 highway.

The facility will be positioned to the south-east of the main plant and to the east of the existing export stockpiles, near PCD 4 (Pollution Control Dam 4), as depicted in the project layout plan below. The proposed facility will be integrated into an existing operational environment, where the design of the stormwater management system will ensure minimal disruption to the natural hydrology of the area.

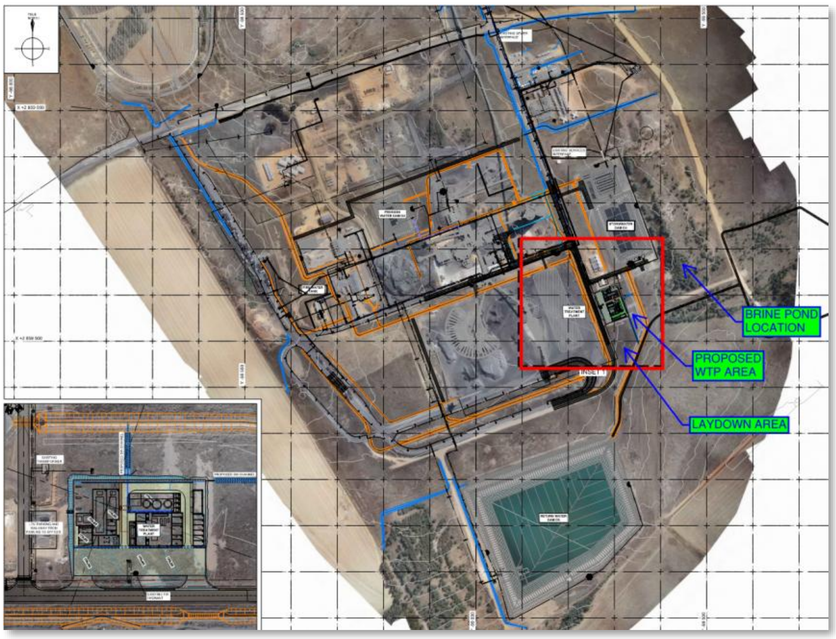


Figure 1: Proposed Site Layout

3. PURPOSE OF THE STORMWATER MANAGEMENT PLAN

The primary purpose of the Stormwater Management Plan is:

- Safeguard the development and infrastructure of the WTP.
- Preserve the surrounding natural environment and water resources.
- Protect existing streams, wetlands, and drainage lines wherever feasible.
- Mitigate the anticipated increase in surface runoff into natural drainage systems.
- Maintain water quality by protecting underground resources from contamination.
- Protect existing on-site infrastructure services.
- Implement efficient methods to control and manage runoff.
- Pursue environmental sustainability in parallel with economic development goals.

The Wash Water Management Plan specifically aims to:

- Protect the development, mine property, and infrastructure.
- Facilitate drainage around critical infrastructure.
- Contain and manage potentially contaminated water to prevent contamination of the natural environment.

4. DESIGN PHILOSOPHY AND PROPOSED STORMWATER SYSTEM

4.1 OVERVIEW

The stormwater management system will be designed to minimize disruption to natural drainage systems. Efforts will be made to collect and manage stormwater in designated areas and release it in an environmentally responsible manner, while preserving and protecting natural drainage routes where possible. Dirty water will be contained and/or discharged into the mine’s existing dirty water stormwater systems.

4.2 EROSION CONTROL AND SURFACE RUN-OFF MANAGEMENT

Design measures will incorporate erosion protection at key stormwater outlets. This is essential due to the higher concentrated flow velocities from drainage channels, such as V-drains. Erosion control solutions will include the use of stone pitching, energy dissipators and lined drains.

To further reduce erosion risks, the following additional measures will be implemented:

- The establishment of more frequent cut-off channels and berms to redirect overland flow from hardstand areas.

It is imperative that the stormwater system remains separate from contaminated water systems. All wash water inside bunded areas will be collected in sumps within bunded areas, where it will be pumped back into the process plant for treatment, avoiding discharge into the environment.

4.3 ROADS AND HARDSTANDS

The design of internal roads will include crossfalls to direct runoff to the road edges, minimizing ponding. Stormwater will be collected via grated channels and concrete-lined v-drains, ultimately being conveyed to the main trapezoidal stormwater channel, which will discharge into the bulk stormwater collector located below the site and eventually release into Dam 5.

Hardstand areas, roads, and terraces will be considered "hardened" surfaces with a runoff coefficient that reflects their impervious nature. Natural, sandy areas will have a lower runoff coefficient due to their ability to absorb water, especially where vegetation is minimal.

4.4 STORMWATER HYDROLOGY AND METHOD OF ANALYSIS

The Rational Method will be employed for estimating peak stormwater runoff rates. This method is widely used for small to medium-sized catchments due to its simplicity and ease of application. While the Rational Method has some limitations, such as the assumption of uniform rainfall intensity and the need for expert judgment in selecting runoff coefficients, it remains suitable for estimating runoff in catchments smaller than 15 km² in South Africa.

The method will be applied using the following basic rainfall data for the region:

Table 2: Rainfall Data

Return Period	Rainfall Depth (mm)	Rainfall Intensity (mm/hr)
1:5	26	104
1:10	32	128.1
1:20	39.4	157.7
1:50	51.9	207.6

The Rational Method $Q = \frac{f_t * C * A * I}{(1000*3600)}$, where

- Q = the maximum/peak rate of run-off in cubic metres per second (m^3/s)
- f_t = Adjustment factor for the recurrence interval storm considered
- C = Run-off coefficient
- I = Rainfall intensity (mm/hour)
- A = Catchment area (m^2)

The design parameters for the storm water infrastructure to be installed for the mine can be summarised as follows:

- Flood recurrence intervals (Bulk Network) : 1:50
- Flood recurrence intervals (Internal Network) : 1:20
- Design life of Attenuation structures : 50 years
- V-drain Material : Concrete
- Concrete strength : 35 MPa
- Blinding : 10 MPa
- Bedding Material : Class C

4.5 DRAINAGE SYSTEM DESIGN

Stormwater channels will be designed using established empirical formulas such as Manning's and Chezy's for open-channel flow. The hydraulic design will account for factors such as concrete roughness, flow transition losses, and bend losses. From flow calculations using the Mannings n-value, the absolute roughness k-value was calculated.

Design criteria for hydraulic analysis of drainage systems.

- Stormwater systems inside the plant are designed for 1:20 year peak flow (conservative approach).
- Open stormwater main collectors are designed as trapezoidal 600 mm minimum width with side slope of 1:2.
- All the channels in the dirty water area are concrete lined. Channels conveying clean water are either unlined unless the velocity criteria and minimum slope necessitates the channel to be lined.
- Permissible velocity in reinforced concrete lined channels is 6 m/s and joints should be design to withstand pulsating pressure changes for velocities higher than 2.5m/s. The linings of channels that carry high-velocity flow should be poured as nearly monolithic as possible, without expansion joints or weep holes, and using as few construction joints as possible. Construction joints

should be made watertight. Longitudinal and transverse reinforcing steel should be used throughout to control cracking with the longitudinal steel carried through the construction joints. The lining should be anchored to the slope as necessary by reinforced cut-off walls to prevent sliding.

4.6 TIME OF CONCENTRATION (TC)

The time of concentration is defined as the duration it takes for the excess rainfall, which results in runoff, to travel from the most distant significant point of a natural catchment to the designated point of interest. The shape of the catchment plays a crucial role in determining the length of the flow path.

Given that the catchments in the area are relatively small (< 1 km^2), we recommend using a minimum time of concentration of 15 minutes for all undeveloped areas. This means that if the calculated time of concentration for an industrial site is less than 15 minutes, 15 minutes should be used instead :

- Storm event period – 15 minutes
- Time of Concentration - 15 minutes
- Retention time - 15 minutes
- MAP = 697 mm

4.7 RUN-OFF COEFFICIENTS (C)

Allowances have been made for the various areas and their contribution to the flow and the coefficient of runoff for the various areas is as follows:

The runoff coefficient, denoted as "C," is a value between 0 and 1 that accounts for variations in rainfall across the catchment, infiltration, overland flow velocity during a storm, catchment shape, ground slope, and other factors. Due to numerous uncertain variables, such as soil moisture, vegetation, soil permeability, slope variations, and rainfall intensity, estimating the coefficient "C" can be challenging. As a result, there can be a wide range of possible runoff coefficients. To ensure consistency and minimize discrepancies, the Department of Water Affairs & Sanitation (DWS) table method will be used.

- Grassed areas are taken as 0.35
- Buildings and surfaced roads and hardstands are taken as 1.00
- Gravel roads, terraces, hardstand areas are taken as 0.9

The value of "C" can be obtained from relevant tables. If multiple catchments or sub-catchments contribute to the runoff at the point of interest, and if the values of "C" are not uniform (i.e., there are variations in slopes, vegetation, etc.), then a modified coefficient must be calculated using the following formula:

Overall = (Sum of Ci x Ai) / (Sum of Ai) for all differing sub-catchments “i”.

For undeveloped sites, the value for "C" is determined by summing the contributions of ground slope (Cs), vegetation cover (Cv), and soil permeability or type (Cp). In urban or industrial areas, it is appropriate to combine the percentage contribution of hardened areas with the remaining site area, which is assessed in terms of Cs, Cv, and Cp as described:

Ci for catchment "i" = Csi + Cvi + Cpi

For smaller catchments (<5 km^2), the value of "C" may be considered constant during a storm. However, we recommend applying a modification factor (ft) to reduce runoff for lower-order storms:

- 2 year – ft = 0.50
- 5 year – ft = 0.55
- 10 year – ft = 0.60
- 20 year – ft = 0.67
- 50 year – ft = 0.83
- 100 year – ft = 1

The project has one main area of development that influences the stormwater drainage system which can be split up between the entrance hardstand area, roofs and bunded areas and roads. All stormwater calculations are attached in the appendices.

4.8 ROUGHNESS COEFFICIENTS

The design of drainage waterways, culverts and structures shall be based on sound hydraulic principals in order to effect an optimum combination of efficiency and economy. Roads and hardstands drainage channels shall be designed using the Manning formulae with coefficients of roughness shown in the table below.

Table 3: Open Channel – Manning Roughness Coefficients:

Open Channel Manning Roughness Coefficients	
Lined channels	
Concrete	0.014
Grouted stone	0.025
Rock Rip-Rap	0.035
Paving Blocks	0.025
Gabion	0.028
Unlined channels	
Earth uniform section	0.030
Rock cuts	0.040

5. SITE-SPECIFIC STORMWATER MANAGEMENT:

5.1 OVERVIEW OF WTP TERRACE

The overall terrace area has been divided into 4 collection areas. The areas has been split up to minimise the pressure on the proposed system by distributing the flow into respective drainage systems. Clean stormwater is separated from the contaminated water as far as possible. Dirty water will predominantly be collected in bunds to re-use in the water treatment plant. Each area has a colour code for ease of reference.

Stormwater collected on the terrace is conveyed to either the east or south-east depending on the system it is conveyed to. All systems are released into the main collector further east that eventually release stormwater into dam 5. Stormwater is being collected in concrete channels, v-drains and trapezoidal drains.

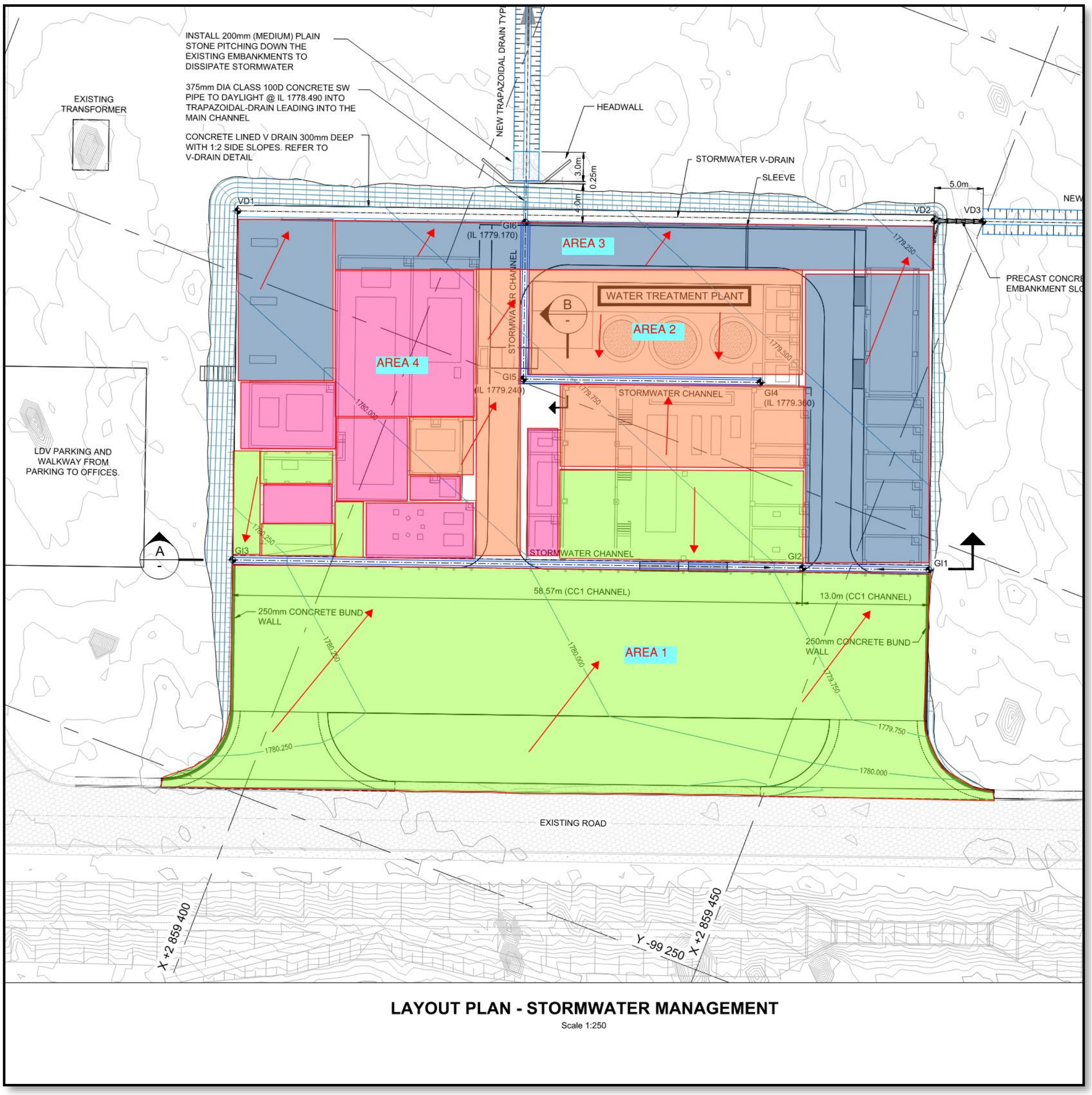


Figure 2: Stormwater Overview

5.2 ENTRANCE AREA 1

The entrance area is approximately 1850m² and slopes in a northernly direction. This area consists of a concrete hardstand, both entrance and exit bellmouth's and minimal roofed area. There is a centrally placed rectangular concrete channel that extends across the terrace to collect all the stormwater generated from the entrance area and hardstands between the water treatment plant and the existing road.

This concrete channel will include a sump measuring 500mm wide, 500mm deep, and 1000mm long, located near the process building to help pump contaminated water back into the water treatment plant. The channel and sump, with a total capacity of approximately 35m³, are designed to handle runoff from a 1:20 year storm in case the sump pump fails. Bund walls are installed at both ends of the channel to contain stormwater on the platform and prevent overflow onto the terrace slopes. In the event of a larger storm (with a non-functioning sump pump), any excess water will flow east along the road between the process plant and chemical store, where it will be captured by the "Area 3" dirty water concrete channel along the terrace edge, which directs water into the mine's dirty water system. The channel is equipped with a bund wall to ensure any overflows at GI 1 are redirected toward the road.

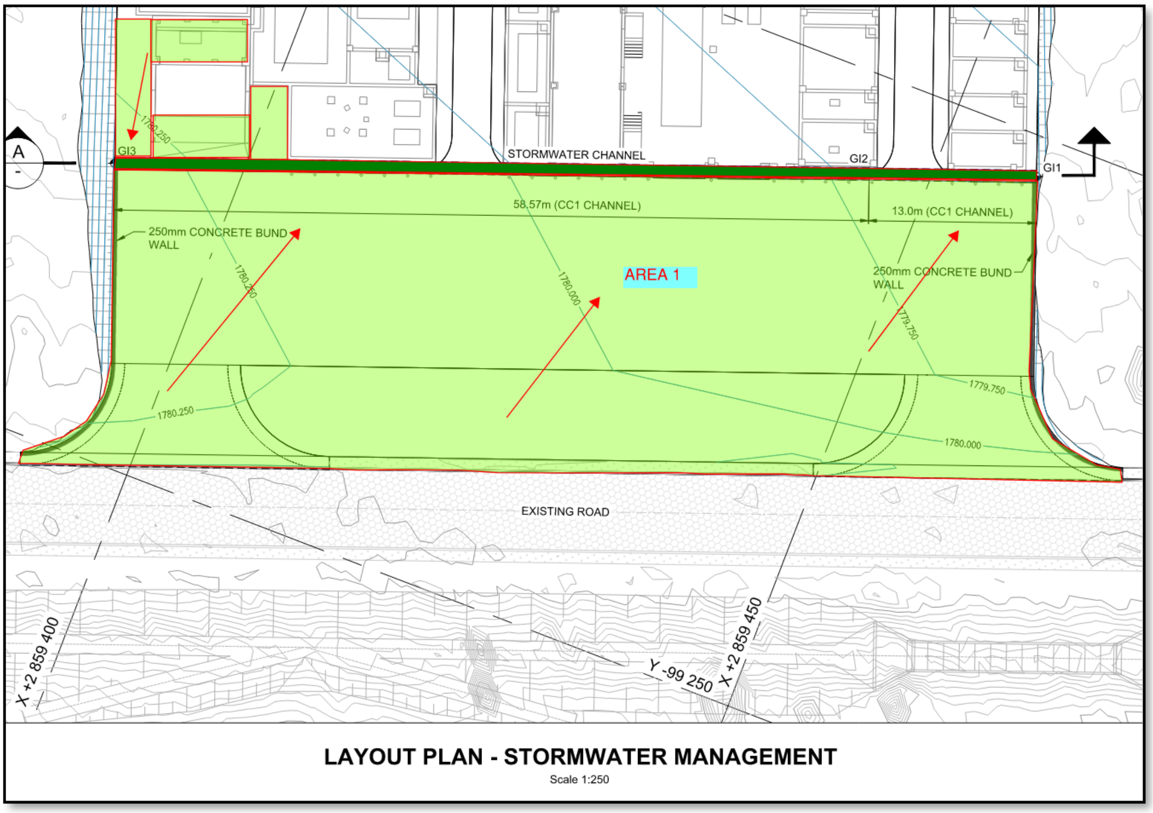


Figure 3: Area 1 - Stormwater Bunded Channel

AREA 1			15 min minimum	15			
			1:20 years peak flow	Exxaro standards			
		Rainfall from Exxaro	157,7				
RUN OFF CALCULATIONS							
Surface Description	Unit	Amount	Area (m²)	C	Ft	A*C*Ft	Peak Flow (1:20)(m³/sec)
developed Land	m²	1850	1850,00	0,9	0,67	1115,55	0,049
TOTAL			1850,00			Qri(pre)	0,049

Figure 4: Area 1 - Stormwater Calculations

5.3 MCC/CIP/RFW TANKS INTO CONCRETE CHANNEL AREA 2

The area around the MCC/CIP/RFW tanks includes a concrete slab and pavers to manage spillage and wash water. The mentioned area drain towards the grated inlet depicted in Figure 5. The internal road network also contributes to this channel as a small section of road slopes towards the channel. The channel has a heavy duty grating specified to allow for heavy operating machinery to pass over the channel without compromising the structural integrity. Stormwater is conveyed through this channel towards the eastern side of the site into a 375mm diameter concrete Class 100D pipe to cross beneath the v-drain. Stormwater will release into a new lined trapezoidal collector off the terrace. Stormwater will be discharged into the main collector further east and will eventually release into dam 5.

NOTE: In the unlikely event that the incoming water to the RFW tanks overflow, the discharge will flow onto an apron slab directed towards the abovementioned concrete channel.

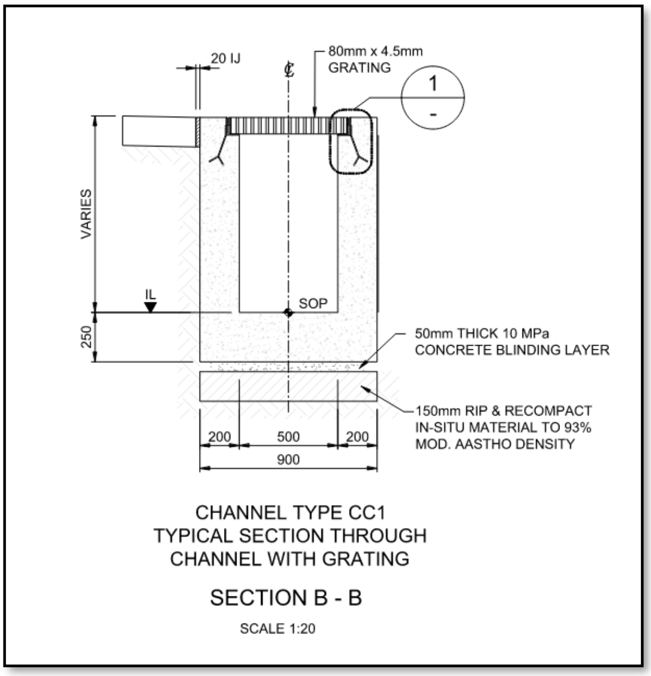


Figure 5: Area 2 - Stormwater Concrete Channel Section

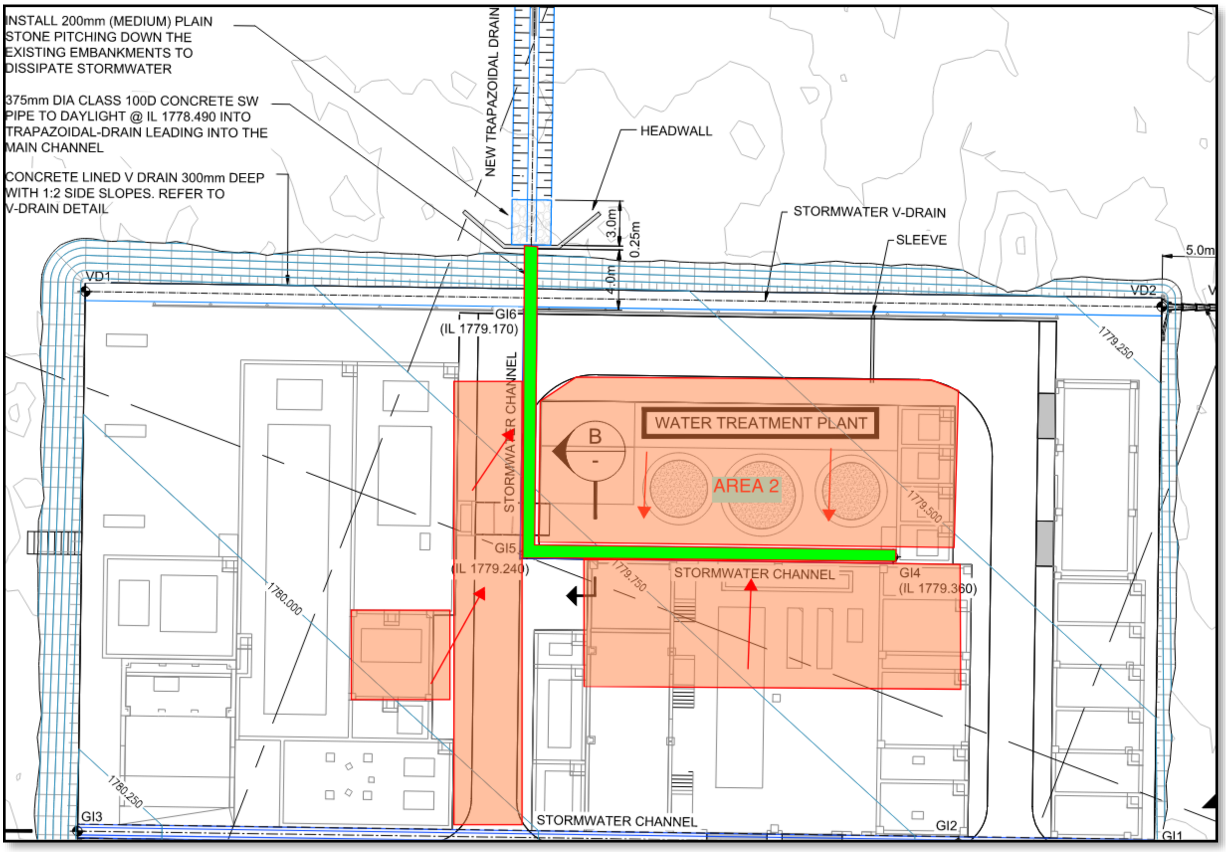


Figure 6: Area 2 - Stormwater Concrete Channel

AREA 2			15 min minimum	15			
			1:20 years peak flow	Exxaro standards			
		Rainfall from Exxaro	157,7				
POST DEVELOPMENT RUN OFF CALCULATIONS							
Surface Description	Unit	Amount	Area (m^2)	C	Ft	A*C*Ft	Peak Flow (1:20)(m^3/sec)
developed Land	m²	700	700,00	0,9	0,67	422,10	0,018
TOTAL			700,00			Qri(pre)	0,018

Figure 7: Area 2 - Stormwater Calculations

5.4 V-DRAIN ON PLATFORM AREA 3

The v-drain on the eastern boundary of the terrace collects and conveys approximately 22% of all stormwater on terrace. The hardstand surface on site has a run-off factor “C” of 0.9 to determine peak flows within the concrete lined v-drain. This channel is located outside any trafficked areas with a Armco barrier installed along the length of the channel to provide protection against maintenance and operating equipment. The v-drain is 300mm deep with 1:2 side slopes which is sufficient to convey the amount of water that is generated from the mentioned area. Stormwater are being conveyed through this channel at a peak flow rate of 0.025m³/sec. Stormwater to be conveyed towards the southern side of the site into precast chutes to manage drainage down the terrace into a new lined trapezoidal collector.

Stormwater will be discharged into the main collector further east and will eventually release into dam 5.

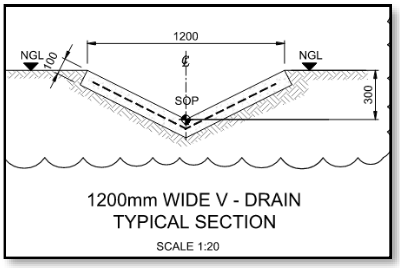


Figure 8: Area 3 - Stormwater V-drain Section

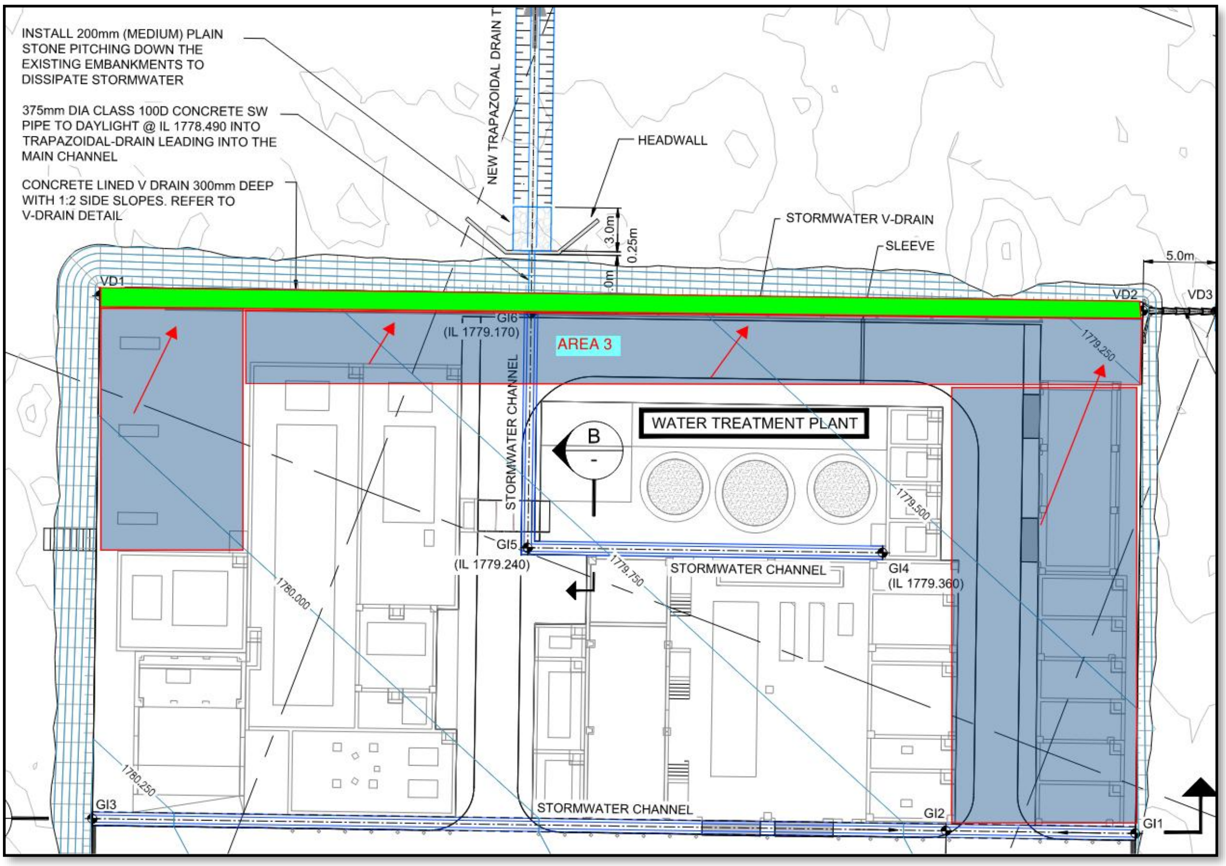


Figure 9: Area 3 - Stormwater Concrete Channel

AREA 3			15 min minimum	15			
			1:20 years peak flow	Exxaro standards			
		Rainfall from Exxaro	157,7				
RUN OFF CALCULATIONS							
Surface Description	**Unit**	**Amount**	**Area (m^2)**	**C**	**Ft**	**A*C*Ft**	**Peak Flow (1:20)(m^3/sec)**
developed Land	m²	950	950,00	0,9	0,67	572,85	0,025
TOTAL			**950,00**			**Qri(pre)**	**0,025**

Figure 10: Area 3 - Stormwater Calculations

5.5 BUNDED AREAS ON PLATFORM AREA 4

The WTP includes several critical process areas that are designed with bunded systems to manage hazardous materials. These bunds serve as secondary containment mechanisms to ensure the safe containment of any potential spills, leaks, or catastrophic failures within the respective facilities. The bunding design philosophy for each area has been specifically tailored to address the risk associated with the storage and handling of chemicals and other hazardous substances. The following outlines the bunded areas, their respective capacities, and the design principles that guide their implementation:

Table 4: Hazardous Chemical Storage Facilities

Bunded Area	Bund Capacity Design Philosophy
Chemical Store	Secondary containment for catastrophic failure. The bund is designed to contain at least 110% of the volume of the largest Intermediate Bulk Container (IBC), or 25% of the total volume of all IBCs, whichever is greater. Additionally, the Process Engineers will ensure that the chemicals stored in these containers are compatible with one another to prevent hazardous reactions in the event of a spill.
CIP Station (Cleaning-in-Place)	Secondary containment for catastrophic failure. The bund must have a capacity of at least 110% of the volume of the largest vessel within the bund. The design ensures containment in the event of an equipment failure or accidental spill.
Dosing station	Secondary containment for catastrophic failure. The bund is sized to contain at least 110% of the largest vessel stored within the station, ensuring containment in case of a spill or failure.
Lime Silo and Lime Mixing Tank	Secondary containment for occasional spillages and stormwater runoff. The bund must have a capacity of at least 25% of the total silo volume to capture potential spillages or runoff, particularly during storm events.
Coagulant	Secondary containment for catastrophic failure. The bund is designed to contain at least 110% of the largest container used for coagulant storage, ensuring that the area is protected from any spill or failure.
Backwash Clarifier	Secondary containment for occasional spillages and stormwater runoff. The bund is designed to hold at least 25% of the clarifier's volume, providing adequate containment for minor spills or run-off during wet weather conditions.
Gypsum Reactor and Clarifier	Secondary containment for occasional spillages and stormwater runoff. The bund capacity is designed to be at least 25% of the clarifier's volume or 10% of the reactor's volume, whichever is greater. This reflects the reduced risk associated with the reactor due to the presence of interlocks and automated control systems that minimize the potential for failure.
Sludge Tank	Secondary containment for occasional spillages and stormwater runoff. The bund is designed to contain at least 110% of the largest tank's volume, ensuring sufficient capacity to manage accidental releases or overflow events.

These bunded areas are strategically designed to mitigate the risk of hazardous material release into the environment. They are sized based on the potential for either catastrophic failure or minor spills and runoff.

The bunds have been carefully engineered to handle stormwater runoff and other incidental spillages during routine operations. Specifically, these bunds are capable of managing storm events with a 1:50-year return period, designed to withstand peak flows for a 15-minute duration without overtopping or causing environmental discharge.

These bunding systems are crucial for ensuring that hazardous materials remain safely contained within designated areas, reducing the risk of contamination or harm to the surrounding environment. The stormwater runoff captured by these bunds will be managed through appropriate drainage systems to prevent any unintended discharge of hazardous substances during heavy rain or other extreme weather events.

It should be noted that the bund capacity is calculated based on a flat surface. However, in reality, the surface is cast to the gradient off the terrace, and the height of the bund walls increases, which provides additional capacity. This extra volume will be considered as additional freeboard capacity.

Table 5: Stormwater Bunded Area Calculations

Bunded Area	Bund Capacity (m^3)	Required Capacity for Spillage (m^3)	Required Capacity for SW (m^3)	Worst Case % Utilised
Dosing Station	1.76	1.65	0.19	93.75
Lime Silo	14.22	14.00	2.20	98.47
Coagulant	1.76	1.10	0.27	62.50
Backwash Clarifier	18.95	12.50	2.93	65.95
Gypsum Reactor	23.51	12.50	3.63	53.17
Sludge Tank	10.08	10.00	1.30	99.22

NOTE: The "Worst Case % Utilised" refers to the ratio of the bund's total capacity that is used in the worst case scenario , where either the hazardous material spillage and the stormwater runoff are taken into account.

The bund capacity calculations ensure that these areas will not only contain hazardous materials but also effectively manage stormwater runoff, minimizing the risk of contamination and environmental harm during adverse weather conditions. The above bunded areas were assessed as they are exposed to weather conditions and do not have a canopy or enclosure.

RUN OFF CALCULATIONS								
Surface Description	Area (m^2)	C	Ft	A*C*Ft	Peak Flow (1:10) (m^3/sec)	Pre-Development Run Off Vri(pre)=Qri*60*Tc(m^3)	Bund Capacity	Check
Dosing Station	5,03	0,90	0,83	3,75	0,0002	0,19	1,76	OK
Lime Silo	56,87	0,90	0,83	42,48	0,0024	2,20	14,22	OK
Coagulant	7,04	0,90	0,83	5,26	0,0003	0,27	1,76	OK
BW Clarifier	75,81	0,90	0,83	56,63	0,0033	2,93	18,95	OK
Gypsum Reactor	94,03	0,90	0,83	70,24	0,0040	3,63	23,51	OK
Sludge Tank	33,60	0,90	0,83	25,10	0,0014	1,30	10,08	OK

Figure 11: Area 3 - Stormwater Bunded Areas Calculations

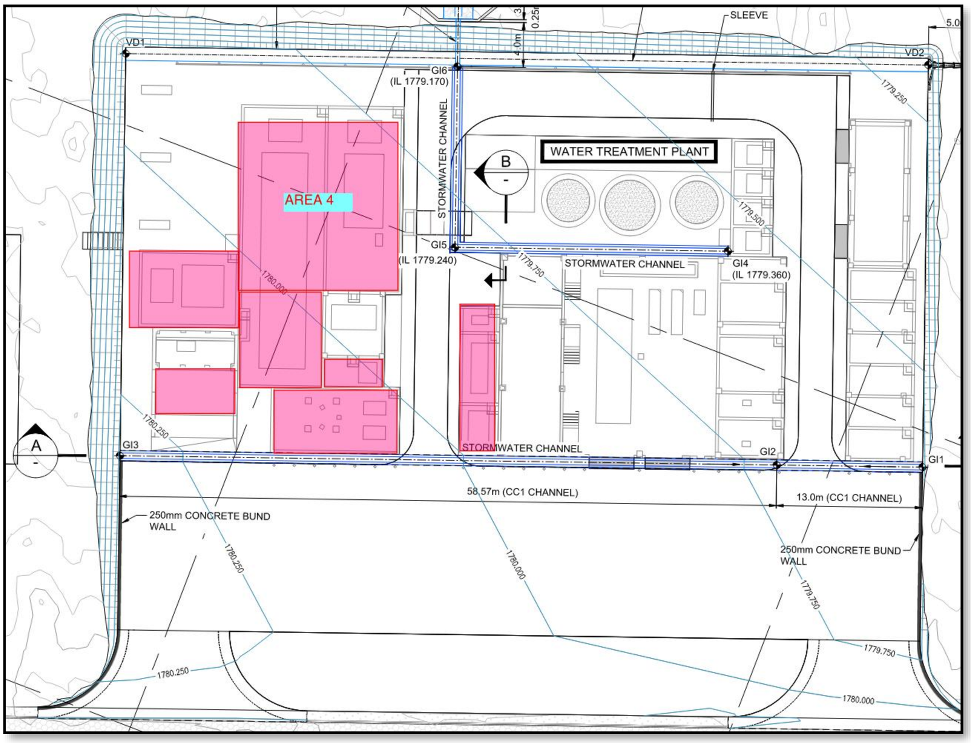


Figure 12: Area 3 – Layout of Bunded Areas

5.6 AREA SURROUNDING THE WTP TERRACE

The natural ground levels around the WTP terrace, between the gravel road and the existing dirty water channel from Dam 4 to Dam 5, slope generally from north-west to south-east. Therefore, stormwater will be collected in the new channels or the existing dirty water channel, as is currently the case. Although the runoff factor from the WTP terrace increases, the processing plant area does not contribute entirely to runoff, so there is minimal increase in overall runoff into Dam D5 compared to current conditions. The only areas on the platform that will additionally contribute in run-off is Area 2 and Area 3 which generates an additional 34m³ of stormwater during a 1:50 year 15 minute storm intensity which is negligibly small. However stormwater is still being released in a controlled manner and mitigation measures are in place to control erosion.

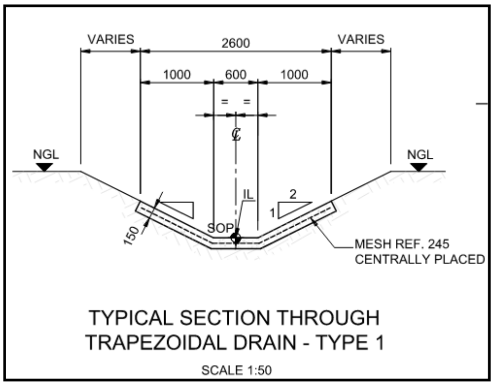


Figure 13: Stormwater Main collector off the platform

6. MONITORING AND MAINTENANCE

6.1 MONITORING

The storm water system must be monitored during construction at regular intervals by the Environmental Control Officer (ECO) in terms of the Environmental Management Programme (EMPr).

During the construction phase of the development, the construction process should be monitored against the EMPr, and should pay attention to the following aspects:

- Implementing temporary attenuation measures, such as earth berms to retain surface run-off from construction activities and to avoid any damage to construction works.
- Providing a silt screen at all grid inlets to collect debris and silt during times of heavy rain.
- Controlling dust, especially during the construction of roads and platforms.
- Placing topsoil and grass sods onto cut/fill embankments to reduce runoff and velocity, including the use of Soilsaver where embankments are steep.

On completion of the construction, the maintenance team will be responsible to monitor the storm water system and attenuation facilities to identify improvements / maintenance. The factors to be monitored include the functionality and impact of the system on platforms and open areas further downstream.

The post development monitoring process should be done at regular intervals (suggested 6 monthly) to include the following activities:

- Product (open grass lined drains, grid inlets, splay inlets, headwalls, concrete pipes, overflow/outlet structure).
- Type of maintenance (rehabilitation, improvement, new).

- Urgency (immediate, next 6 months, next 12 months) and description of work to be carried out.

6.2 OPERATION AND MAINTENANCE

The stormwater system, as designed, requires no manual operation and is self-regulating. The sumps will be provided with submersible pumps specified by Proxa. Sumps are equipped with submersible pumps operated by plant staff. Routine inspections are conducted twice daily to ensure sump conditions are optimal and to check for any spillages (e.g., chemicals or sludge). Any spillages are cleaned and directed into appropriate sumps for recovery. Specific procedures are in place for sumps, such as the centrifuge building sump, which pumps sludge back into the sludge tank, and the process building sump, which normally directs water to the rainwater drain, with rerouting measures available in case of spills.

Preventative maintenance is carried out according to the manufacturer's recommended intervals, focusing on sump pumps and related equipment. This ensures the system operates efficiently and is maintained to its original design. Maintenance activities also prioritise addressing any potential issues promptly to prevent damage or failure.

During the construction phase, surface runoff will be carefully managed with temporary measures until the system is fully operational. The Environmental Control Officer (ECO) will oversee runoff monitoring during this period. Routine maintenance tasks include clearing drains, removing silt from collection points, controlling vegetation, and mowing embankments. For more specialised work, such as replacing stormwater pipes or addressing attenuation areas, it is recommended to engage specialist service providers.

Routine maintenance will be the responsibility of the maintenance team and should include:

- Clearing of side drains, storm water pipes and collection points.
- Removal of silt from collection points and silt traps.
- Plant/weed control.
- Cutting grass on embankments.

7. RECOMMENDATIONS

The following recommendations are made for the proposed Water Treatment Plant at Exxaro Coal Mine:

1. That the storm water design parameters used in the design of the storm water management system are accepted and approved.
2. The detail design of the storm water system includes recommendations of this plan.
3. The storm water system must be kept separate from the sewerage system.

4. All chemicals, cement, fuel and other hazardous material used during construction should be stored in controlled areas.

5. Concentration of storm water should be prevented where possible, but energy dissipaters should be provided in areas of concentration.

6. On completion of the construction of hardstands, structures, roads and parking areas, all remaining exposed embankments and open areas must be vegetated as soon as possible, including the use of “Soilsaver”, where necessary.

7. During the construction phase, the following aspects should be closely monitored by the ECO to ensure the contractor complies:

    - Temporary berms and cut-off drains must be provided on site to collect run-off, especially until the stormwater network are complete and functional.

    - Silt screens must be provided at the grid inlets / splayed construction during road construction.

    - Topsoil must be conserved on site and prevented from entering the stormwater system.

    - Exposed embankments, cut/fill slopes and open areas must be vegetated as soon as possible to reduce runoff.

    - Dust control during construction must be applied at all times.

    - Excess spoil material from topsoil or bulk earthworks must be placed in areas or even removed entirely off site to minimise silt deposition, scouring and soil erosion.

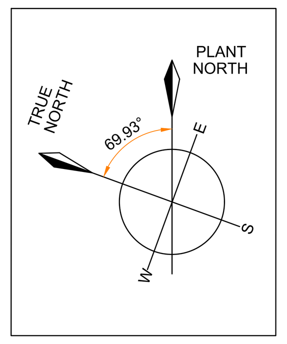
    - Post construction, all exposed areas must be covered in vegetation, grass or landscaped.

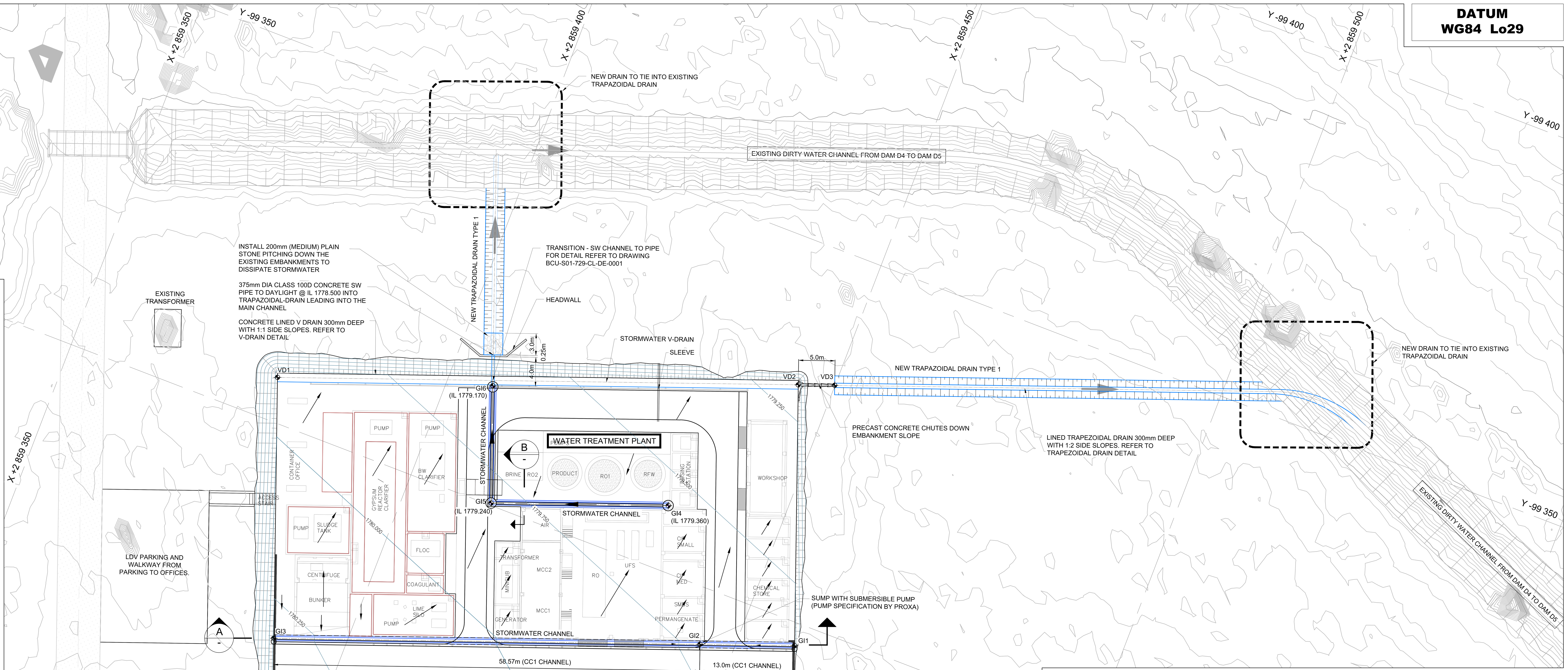
8. CONCLUSION

The stormwater management plan for the proposed WTP facility at Exxaro Belfast Mine has been designed to meet environmental and regulatory standards, ensuring the protection of local water resources and the surrounding environment. The proposed system offers a comprehensive solution to manage both clean and contaminated stormwater, while promoting sustainable development and mitigating potential environmental impacts.

By integrating sustainable stormwater management practices and ensuring compliance with EIA and IWUL guidelines, the project aims to improve operational efficiency while minimizing the mine’s environmental footprint.

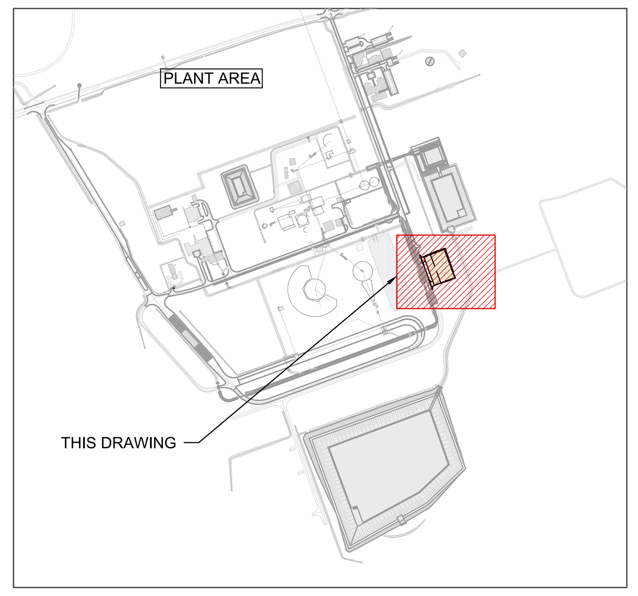
APPENDIX A: CIVIL INFRASTRUCTURE DRAWINGS





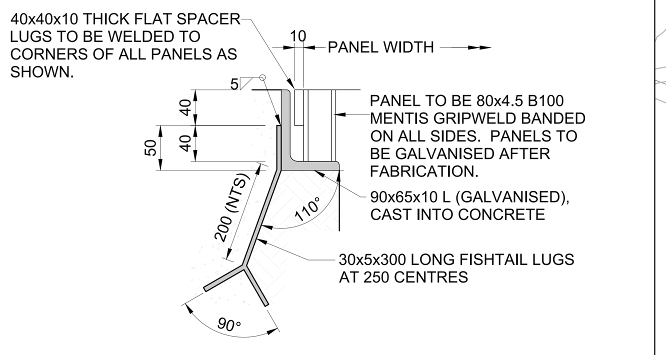
LAYOUT PLAN - STORMWATER MANAGEMENT

Scale 1:250



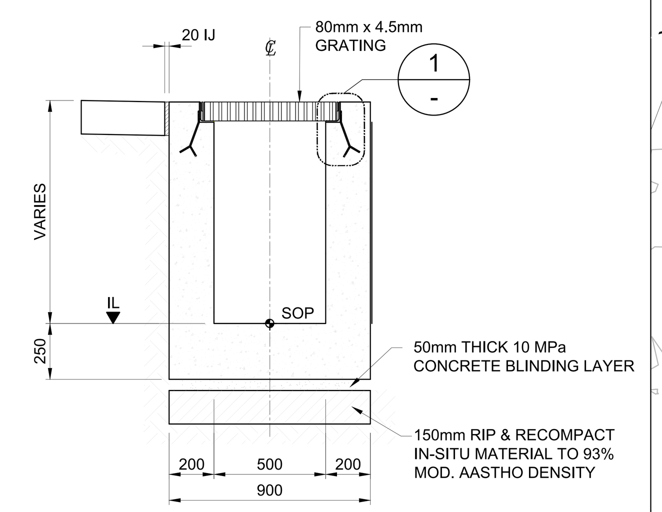
KEY PLAN

Scale 1:10 000



(TYPICAL 80mm GRATING EDGE SUPPORT)

DETAIL 1



CHANNEL TYPE CC1
TYPICAL SECTION THROUGH
CHANNEL WITH GRATING

SECTION B - B

SCALE 1:20

V - DRAIN SETTING OUT POINTS LIST DATUM WG84 Lo29			
POINT	Y COORD	X COORD	COVER LEVEL
VD1	-99305.939	2859378.083	1779.308
VD2	-99330.633	2859445.258	1778.593
VD3	-99332.358	2859449.952	TBC ON SITE

GRID INLET SETTING OUT POINTS LIST DATUM WG29			
POINT	Y COORD	X COORD	COVER LEVEL
GI1	-99296.965	2859457.634	1779.591
GI2	-99292.480	2859445.433	1779.721
GI3	-99272.272	2859390.459	1780.306
GI4	-99308.729	2859434.538	1779.558
GI5	-99300.327	2859411.683	1779.802
GI6	-99315.467	2859406.117	1779.620

GENERAL NOTES:

1. DATUM
   ALL COORDINATES TO WG84 Lo29
2. DO NOT SCALE THIS DRAWING, WORK IN FIGURED DIMENSIONS ONLY.
3. WHEN IN DOUBT, ASK.
4. STRAIGHT LINE GRADES BETWEEN SETTING OUT POINTS U.O.N.
5. WHERE POSSIBLE EXISTING TREES TO BE RETAINED AND TRIMMED BACK AS NECESSARY.
6. ALL SETTING OUT TO BE DONE BY COORDINATES.
7. ANY DISCREPENCIES ON THE DRAWING TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO THE IMPLEMENTATION OF ANY WORKS.
8. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 OR SANS 2001 (AS APPLICABLE) AND PROJECT SPECIFICATIONS.
9. AS PER SANS 2001 BE, A CLASS 1 DEGREE OF ACCURACY IS REQUIRED
10. ENGINEER TO INSPECT ALL CUT FACES AND BASE AND ADVISE OF ANY ADDITIONAL MEASURES TO BE TAKEN.

SW CHANNEL NOTES

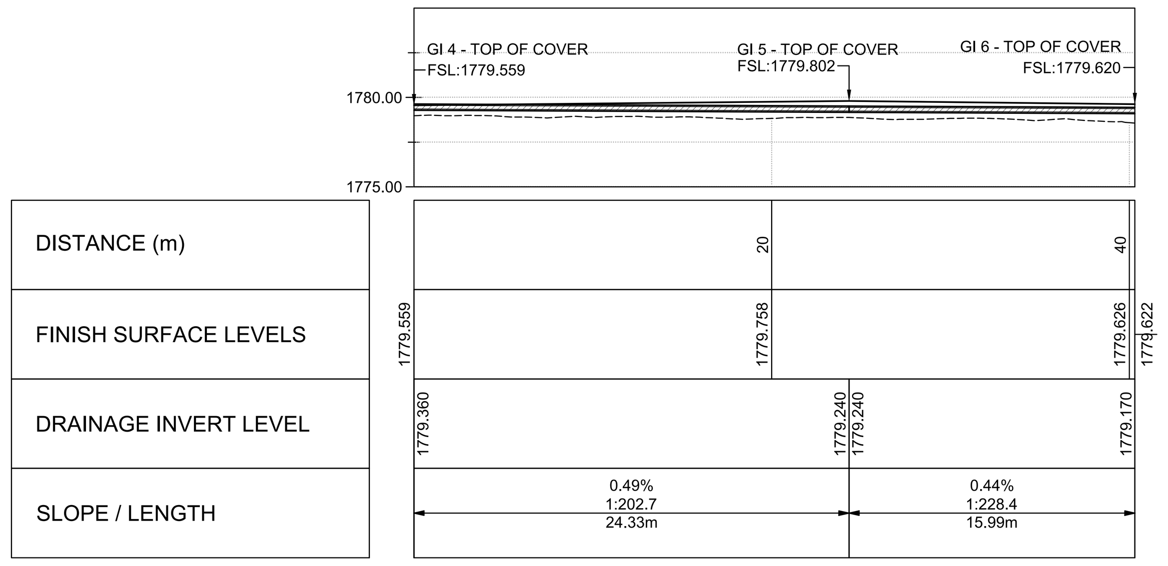
1. CHANNELS ARE CAST IN ALTERNATE SECTIONS OF 6m LENGTHS WITH JOINTS CUT AT 3m INTERVALS TO A DEPTH 50mm AND FINISHED WITH A GROOVING TOOL. EXPANSION JOINTS TO BE PROVIDED EVERY 24m.
2. 50mm BLINDING LAYER UNDER ALL CONCRETE DRAINS U.O.N.
3. P.V.C BASE SEAL WATERSTOP (150mm WIDE EITHER SIDE OF JOINT) EARTH SHIELD OR SIMILAR APPROVED REQUIRED BENEATH EXPANSION JOINTS.
4. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 & 2001(WHICHEVER IS THE LATEST).
5. ALL CONCRETE COVER FOR REINFORCEMENT TO BE 50mm U.O.N.
6. CONCRETE GRADES:
   BLINDING - 10/19/B
   CONCRETE - 35/19/S + 1% PENETRON
7. MINIMUM LAP FOR MESH TO BE NOT LESS THAN 450mm U.O.N.
8. ALL EXPOSED CORNERS MUST BE ROUNDED TO A MINIMUM RADIUS OF 10mm OR BE CHAMFERED 25mm x 25mm

ABBREVIATIONS

FBE(FSL)	-	FINISHED SURFACE LEVEL
FBEL	-	FINSHED BULK EARTHWORKS LEVEL
UON	-	UNLESS OTHERWISE NOTED
FRL	-	FINISHED ROAD LEVEL
TOC	-	TOP OF CONCRETE
SOP	-	SETTING OUT POINT

LEGEND

- GI — GRID INLET SETTING OUT
- VD — V - DRAIN SETTING OUT
- BUNDED AREAS



STORMWATER CHANNEL GI 4 TO GI 6
LONGSECTION

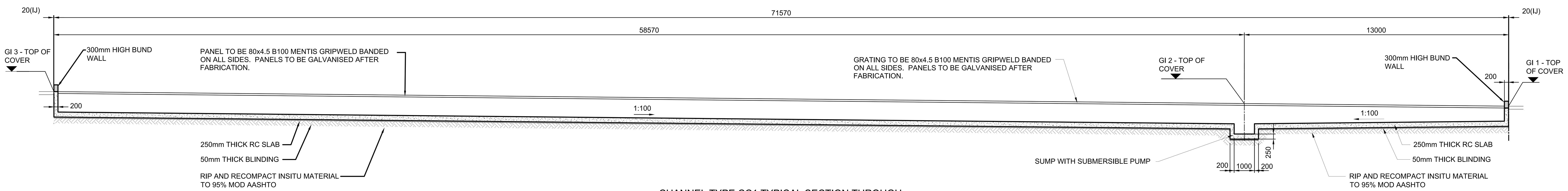
SCALE 1:250

0m 12.5m 25m

SCALE VERTICAL AND HORIZONTAL 1:250

0m 12.5m 25m

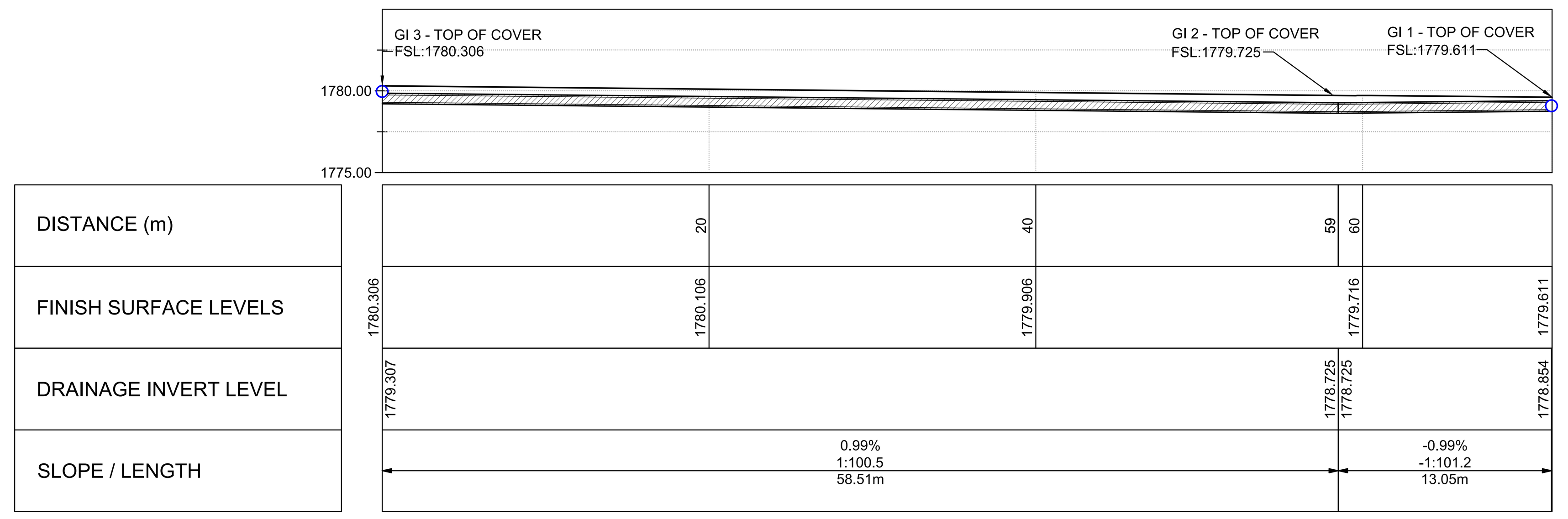
Scale 1:250



CHANNEL TYPE CC1 TYPICAL SECTION THROUGH
CHANNEL WITH GRATING

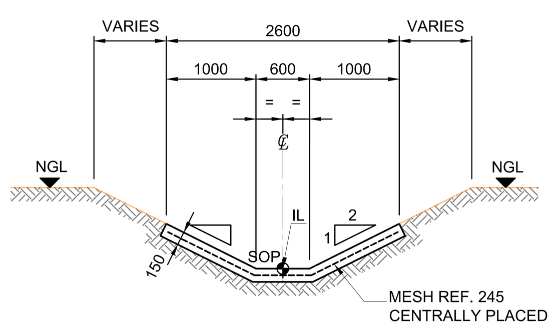
SECTION A - A

SCALE 1:100



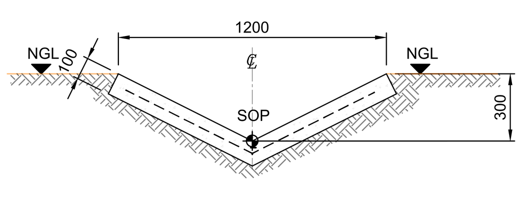
STORMWATER CHANNEL GI 3 TO GI 1
LONGSECTION

SCALE 1:250



TYPICAL SECTION THROUGH
TRAPEZOIDAL DRAIN - TYPE 1

SCALE 1:50



1200mm WIDE V - DRAIN
TYPICAL SECTION

SCALE 1:20

REFERENCE DRAWINGS		REVISIONS					
DRAWING No	DRAWING DESCRIPTION	REV	DATE	REVISION DESCRIPTION	DRN	CHK	APP
BCU-S01-730-EL-GA-0001	PLANT WTP GENERAL ARRANGEMENT	AX	15-11-2024	ISSUED FOR CLIENT REVIEW	BG	PT	PT
BCU-S01-730-CL-LO-0001	BE AND TERRACING GENERAL ARRANGEMENT, SECTION & DETAILS	00	06-12-2024	ISSUED FOR CLIENT APPROVAL	BG	BDP	PT
BCU-S01-730-ME-LO-0001	PLANT TERRACE BLOCK PLAN	01	24-01-2025	ISSUED FOR APPROVAL	BG	BDP	PT
BCU-S01-729-CL-DE-0001	WTP STORMWATER DETAILS						
BCU-S01-160-CL-LO-0001	WTP ROADS LAYOUT						
BCU-S01-160-CL-GA-0001	WTP TRAFFIC AND PEDESTRIAN MANAGEMENT PLAN SH 1						
BCU-S01-160-CL-GA-0002	WTP TRAFFIC AND PEDESTRIAN MANAGEMENT PLAN SH 2						

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	NAME	DATE	NAME	SIGNATURE	DATE
DRAWN BY	B.GRALEWSKA	15-10-2024	ARCHITECTURAL		
CHECKED BY	P.THULSI	24-01-2025	MECHANICAL		
PROFESSIONAL ENGINEER			ELECTRICAL		
NAME : P.THULSI			CIVIL		
PROF. Reg. No : 201901028			STRUCTURAL		
DATE : 24 / 01 / 2025			INSTRUMENTATION		
SIGNATURE : [signature]			PROCESS		
			ENG. MANAGER		

exxaro
POWERING POSSIBILITY

EXXARO ACCEPTANCE			
SIGNATURE	EMP. No.	SIGNATURE	EMP. No.
MECHANICAL	....../......./.......	OWNERS REPRESENTATIVE	....../......./.......
ELECTRICAL	....../......./.......	AREA / PROJECT MANAGER	....../......./.......
CIVIL	....../......./.......	MANAGER ENGEERING	....../......./.......
STRUCTURAL	....../......./.......	PROCESS & PIPING	....../......./.......
ARCHITECTURAL	....../......./.......	INSTRUMENTATION	....../......./.......

CENTRE **EXXARO BELFAST COAL MINE**

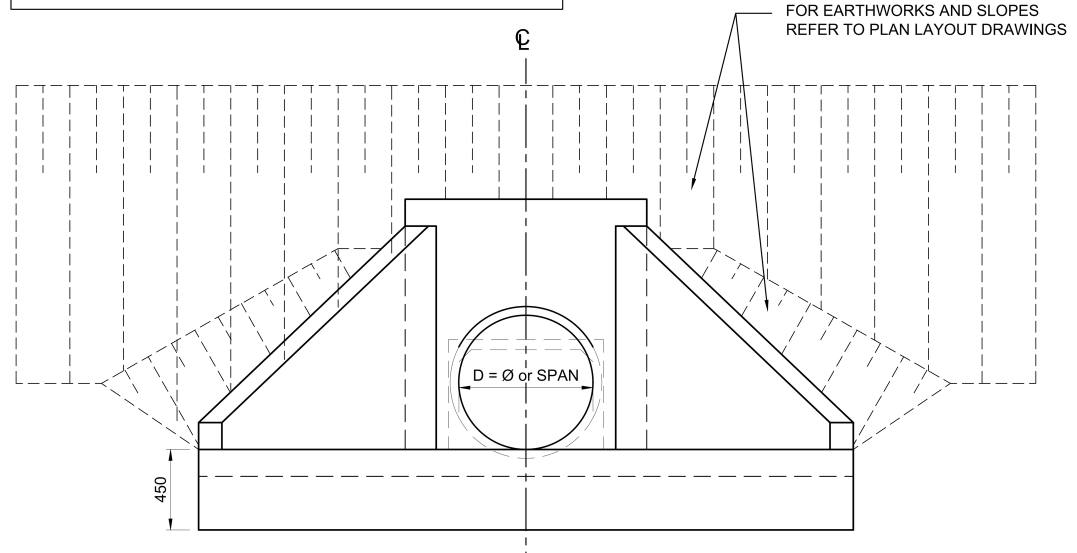
BELFAST WATER TREATMENT SOLUTION
WATER TREATMENT PLANT
INFRASTRUCTURE
WATER TREATMENT PLANT AREA
STORMWATER
STORMWATER MANAGEMENT PLAN
LAYOUT PLAN AND DETAILS

JOB / PROJECT NUMBER	SCALE	DRAWING NUMBER	SHEET	REV	
BCX-000017	AS SHOWN	BCU-S01-729-CL-LO-0003	1/1	01	A0

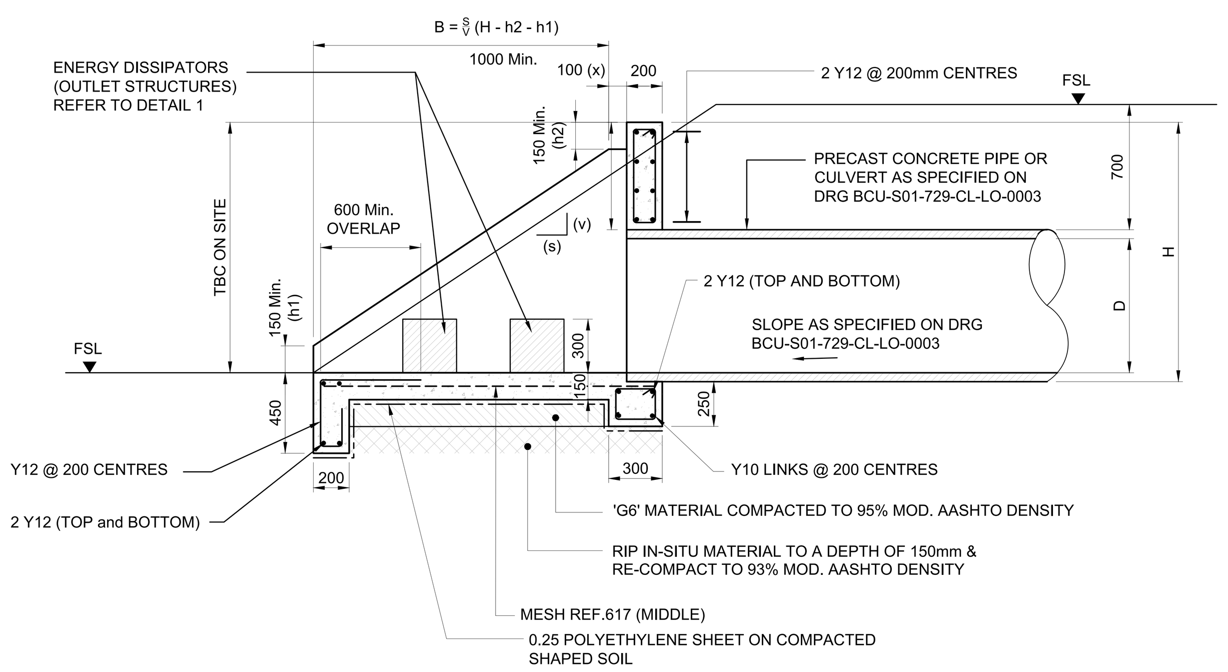
File name: A0 Exxaro-Consultant rev04

EROSION

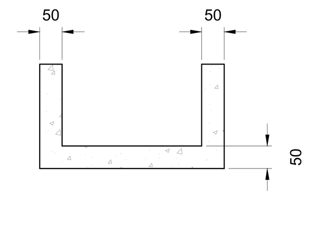
1. EROSION PROTECTION MEASURES AS SPECIFIED BY THE ENGINEER OR AS SPECIFIED ON THE LAYOUT PLANS



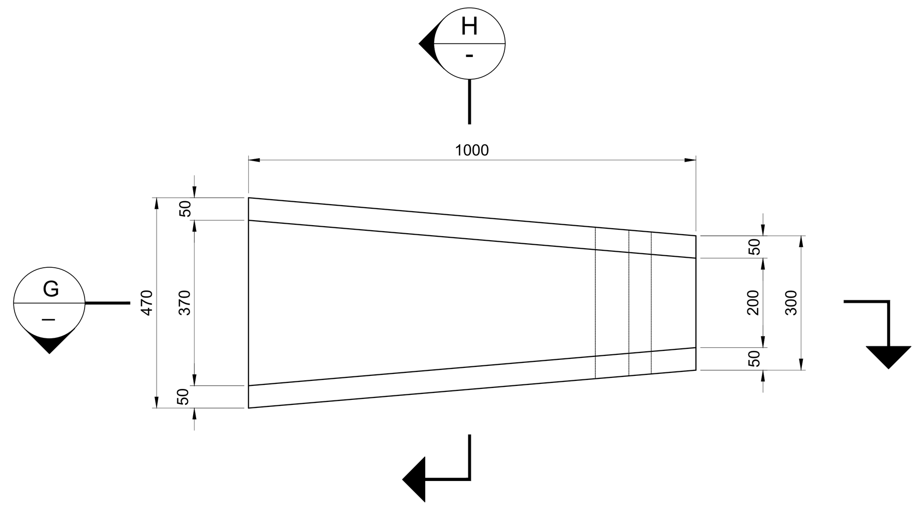
ELEVATION A - A
SCALE 1:25



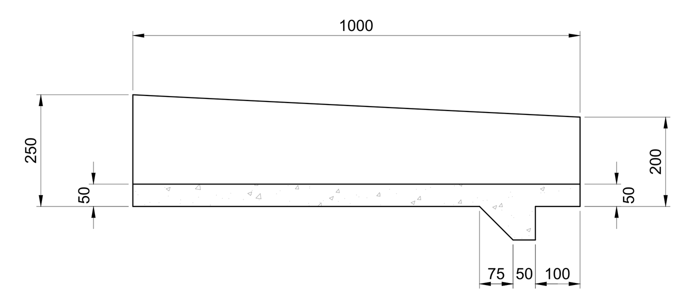
SECTION B - B
SCALE 1:25



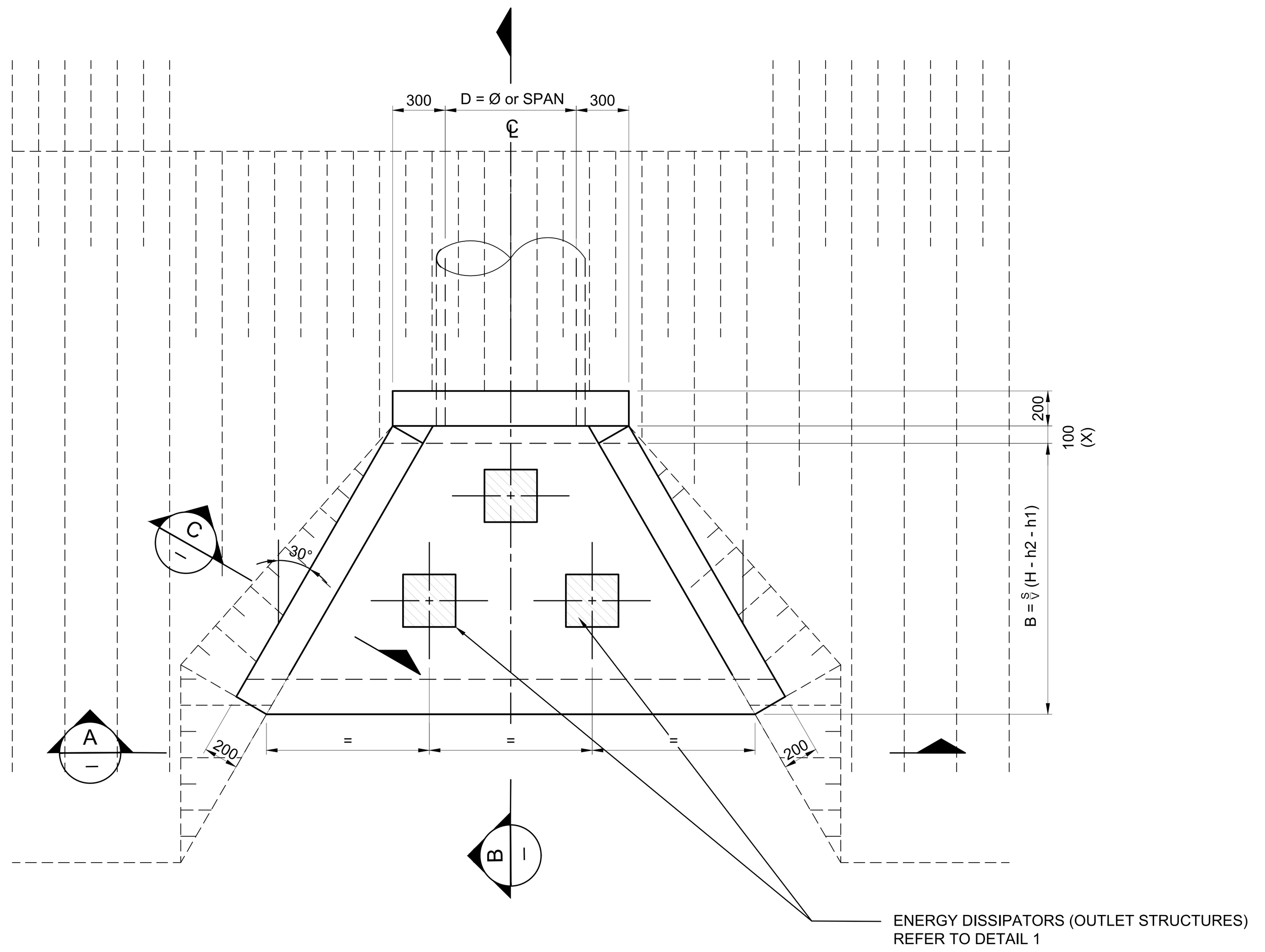
SECTION H
SCALE 1: 10



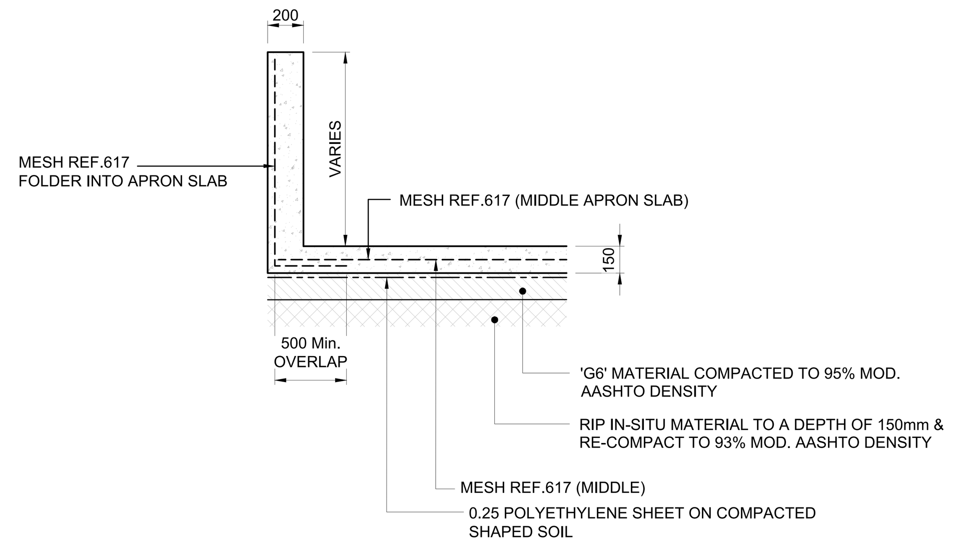
PLAN OF PRECAST CHUTE
SCALE 1:10



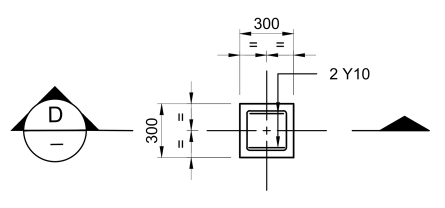
SECTION G
SCALE 1: 10



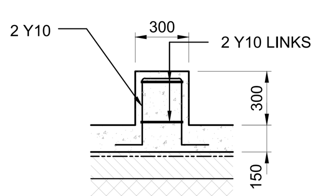
PLAN
INLET & OUYTLET STUCTURE
FOR SINGLE CELLS
SCALE 1:25



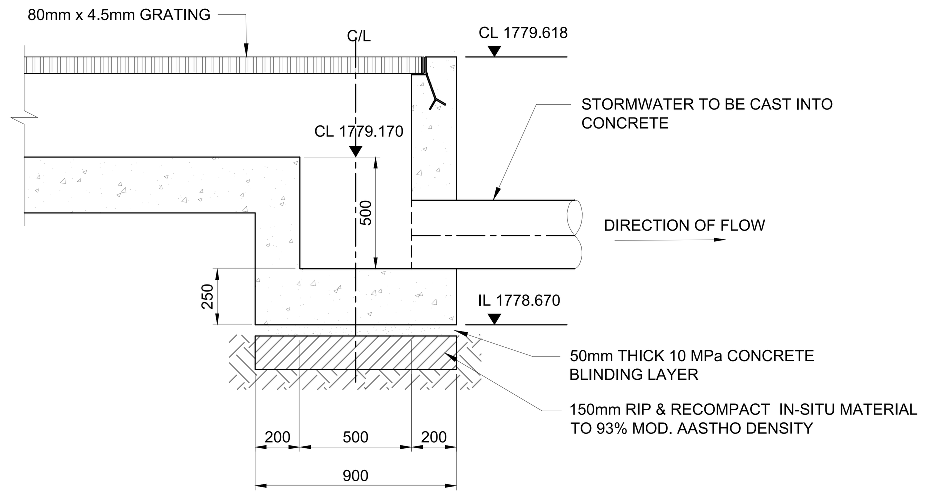
SECTION C - C
SCALE 1:25



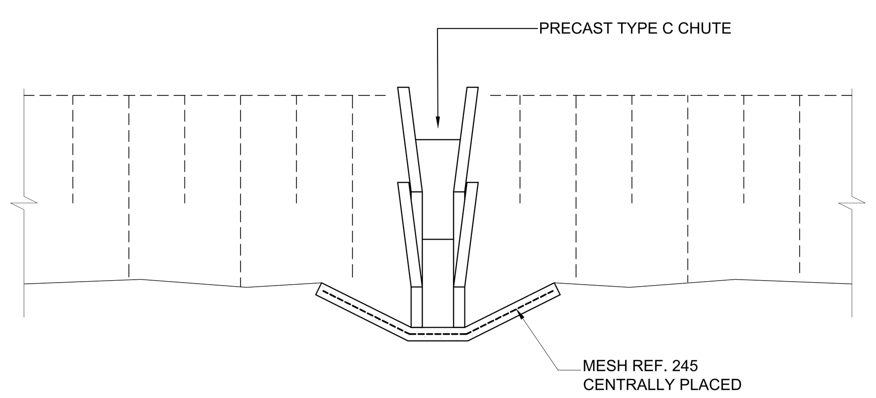
ENERGY DISSIPATOR BLOCK
DETAIL 1
SCALE 1:25



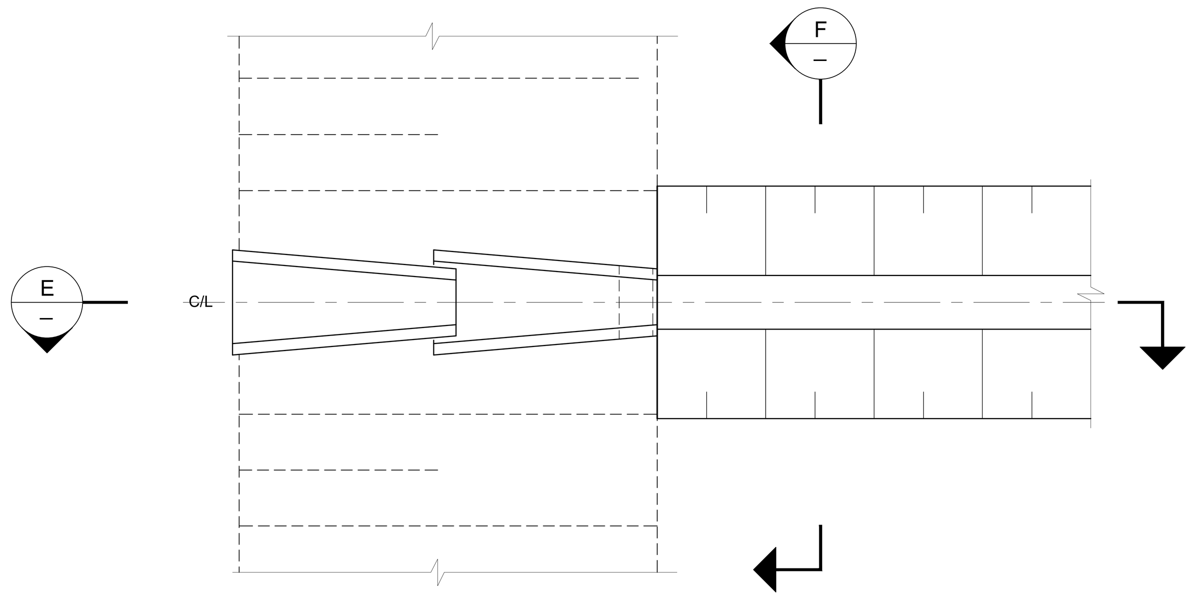
SECTION D - D
SCALE 1:25



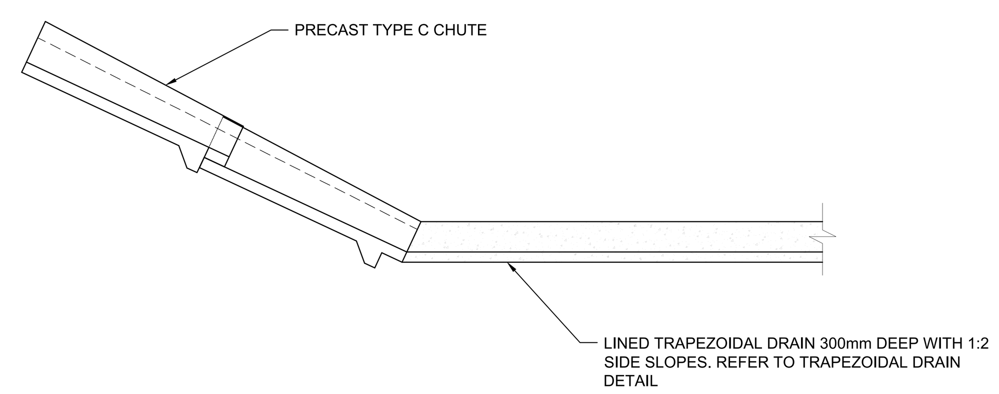
CHANNEL TYPE CC1
TRANSITION DETAIL
SCALE 1:25



SECTION F
SCALE 1: 20



PLAN OF TYPE C CHUTE OUTLET
SCALE 1:20



SECTION E
SCALE 1: 20

GENERAL NOTES ON CONCRETE

1. ALL DIMENSIONS IN MILLIMETERS, UNLESS OTHERWISE NOTED.
2. ALL CONCRETE TO BE CLASS 35/19/S WITH A WOOD FLOAT FINISH UNLESS OTHERWISE SHOWN.
3. DIMENSIONS MUST NOT BE SCALED OR ASSUMED. MISSING DIMENSIONS AND DISCREPANCIES MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER.
4. DIMENSIONS AND ANCHOR BOLT LOCATIONS ARE SYMMETRICAL ABOUT CENTRE LINES UNLESS OTHERWISE NOTED.
5. THE FOLLOWING TYPES OF CEMENT ARE PERMITTED FOR USE IN THE MANUFACTURE OF CONCRETE: CEM I, CEM II / B-S, CEM II / A-D, CEM II / A-V, CEM II / A-W & CEM III / C. CEM III / C MAY ONLY BE USED AS A BLEND WITH CEM I. THE STRENGTH CLASS OF ALL CEMENTS USED IN THE MANUFACTURE OF CONCRETE SHALL BE 42,5N UNLESS OTHERWISE SPECIFIED ON THE DRAWING.
6. CONCRETE STRENGTH IS DEFINED BY "X/Y/Z" WHERE "X" IS THE MINIMUM CUBE CRUSHING STRENGTH IN MPa AT 28 DAYS, "Y: IS THE NOMINAL MAXIMUM COARSE AGGREGATE SIZE IN mm & "Z" IS A LETTER INDICATING THE CONCRETE TYPE AS FOLLOWS :
   S = STRUCTURAL CONCRETE
   A = AGGRESSIVE ENVIRONMENT
   P = PAVING CONCRETE
   B = BLINDING CONCRETE
   WR = WATER RETAINING
7. UNLESS OTHERWISE NOTED, COVER TO REINFORCEMENT IS TO BE 40mm.
   COVER IS TO BE MAINTAINED WITH THE USE OF SUITABLE SPACERS AND LIFTING BLOCKS. THE COVER BLOCKS ARE TO BE FORMED OF SAND/CEMENT MORTAR WITH A MINIMUM CEMENT : WATER RATIO OF 2.5. PATENT UNITS THAT DO NOT CORRODE MAY ALSO BE USED.
8. LATERAL DIMENSIONS GIVEN ON THE DRAWINGS FOR UNDERGROUND CONCRETE ARE BASED ON CASTING AGAINST FORMWORK. WHERE UNDERGROUND CONCRETE IS TO BE CAST AGAINST EXCAVATED FACES WITHOUT FORMWORK, LATERAL DIMENSIONS OF THE CONCRETE MUST BE INCREASED TO PROVIDE A MINIMUM OF 75mm OF CONCRETE COVER AT THE EXCAVATED FACES.
9. CONCRETE SURFACES SHALL BE CURED USING AN APPROVED CURING COMPOUND. (WHERE ACID PROOFING IS TO BE APPLIED TO CONCRETE SURFACE , A WAX BASED CURING COMPOUND IS NOT TO BE USED).
10. UNLESS OTHERWISE NOTED, ALL 90° CORNERS OF ALL EXPOSED CONCRETE TO BE CHAMFERED 20mm x 20mm.
11. BACKFILL ABOVE FOUNDATIONS AND AROUND PLINTHS TO BE IN ACCORDANCE WITH THE SPECIFICATION GIVEN IN THE GENERAL NOTES ON EARTHWORKS (ON THIS DRAWING).
12. ALL GROUTING UNDER STEELWORK AND EQUIPMENT TO BE DONE BY THE CIVIL CONTRACTOR AFTER ERECTION. GENERALLY 30mm OF TO BE PROVIDED UNLESS OTHERWISE NOTED. GROUT TO BE NON-SHRINK ' MASTERFLOW 525 CEMENTITIOUS BEDDING GROUT BY BASF CONSTRUCTION PRODUCTS', OR SIMILAR APPROVED. TO BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS.
13. THE FINISH OF THE TOP SURFACE OF ALL CONCRETE IS TO BE SMOOTH FLOATED IN ACCORDANCE WITH THE PROJECT SPECIFICATION UON. PAVING CONCRETE IS IN ADDITION TO BE LIGHTLY BROOMED IN THE DIRECTION OF THE FALL.
14. WHERE MANUFACTURER'S PRODUCTS ARE SPECIFIED, EQUIVALENT PRODUCTS MAY BE USED FROM OTHER MANUFACTURERS AFTER PRIOR WRITTEN APPROVAL OF THE ENGINEER.
15. ALL BLINDING TO BE 40mm MINIMUM UON.
16. WHERE STEEL PIPES ARE CAST INTO CONCRETE, 50mm OF CONCRETE COVER IS REQUIRED TO REINFORCEMENT AND THE STEEL PIPE / PUDDLE FLANGE. THIS IS TO INSULATE THE PIPE FROM THE REINFORCEMENT AS THE PIPE MAY BE CATHODICALLY PROTECTED.
17. CHUTES SHALL BE SPACED AS SPECIFIED DEPENDING ON SLOPE AND LOCALITY.
18. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 & 2001. (WHICH EVER IS THE LATEST)

REFERENCE DRAWINGS

DRAWING No	DRAWING DESCRIPTION
BCU-S01-730-EL-GA-0001	PLANT WTP GENERAL ARRANGEMENT
BCU-S01-730-CL-LO-0001	BE AND TERRACING GENERAL ARRANGEMENT, SECTION & DETAILS
BCU-S01-730-ME-LO-0001	PLANT TERRACE BLOCK PLAN
BCU-S01-729-CL-DE-0003	WTP STORMWATER LAYOUT AND MANAGEMENT PLAN
BCU-S01-160-CL-LO-0001	WTP ROADS LAYOUT
BCU-S01-160-CL-GA-0001	WTP TRAFFIC AND PEDESTRIAN MANAGEMENT PLAN

REVISIONS

REV	DATE	REVISION DESCRIPTION	DRN	CHK	APP
AX	15-11-2024	ISSUED FOR CLIENT REVIEW	BG	BDP	PT
00	06-12-2024	ISSUED FOR CLIENT APPROVAL	BG	BDP	PT

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CHECKED BY	P.THULSI	05-12-2024

NAME	SIGNATURE	DATE
ARCHITECTURAL		
MECHANICAL		
ELECTRICAL		
CIVIL		
STRUCTURAL		
INSTRUMENTATION		
PROCESS		
ENG. MANAGER		

PROFESSIONAL ENGINEER
NAME : P.THULSI
PROF. Reg. No : 201901028
DATE : 05 / 12 / 2024
SIGNATURE :

exxaro POWERING POSSIBILITY

EXXARO ACCEPTANCE

SIGNATURE	EMP. No.	SIGNATURE	EMP. No.
MECHANICAL	..../..../....	OWNERS REPRESENTATIVE	..../..../....
ELECTRICAL	..../..../....	AREA / PROJECT MANAGER	..../..../....
CIVIL	..../..../....	MANAGER ENGEERING	..../..../....
STRUCTURAL	..../..../....	PROCESS & PIPING	..../..../....
ARCHITECTURAL	..../..../....	INSTRUMENTATION	..../..../....

JOB / PROJECT NUMBER: BCX-000017
SCALE

CENTRE: EXXARO BELFAST COAL MINE

BELFAST WATER TREATMENT SOLUTION
WATER TREATMENT PLANT INFRASTRUCTURE
WATER TREATMENT PLANT AREA STORMWATER
STORMWATER MANAGEMENT DETAILS SH1

DRAWING NUMBER	SHEET	REV	
BCU-S01-729-CL-DE-0001	1/1	00	A0

File name: A0 Exxaro-Consultant rev04

CIVIL GENERAL ARRANGEMENT

SCALE 1 : 100

REFERENCE DRAWINGS	
DRAWING No	DRAWING DESCRIPTION
BCU-S01-730-CL-LO-0001	BEW AND TERRACING
BCU-S01-730-CL-LO-0002	FOUNDATION , BUNDED AREAS & SURFACE BED LAYOUT

REVISIONS					
REV	DATE	REVISION DESCRIPTION	DRN	CHK	APP
AX	15-11-2024	ISSUED FOR CLIENT REVIEW	GN	PT	PT
BX	20-11-2024	STORMWATER V-DRAIN REVISED	GN	PT	PT
00	06-12-2024	ISSUED FOR CLIENT APPROVAL	GN	PT	PT

PRIME SQUARED
CONSULTING ENGINEERS

P.O. Box 68417
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2021
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Oxford Parks
Dunkeld
083 456 1578
083 456 4342

PR0042

CONSULTANT APPROVAL					
	NAME	DATE	NAME	SIGNATURE	DATE
DRAWN BY	GN	22/10/2024	ARCHITECTURAL		
CHECKED BY	PT	05/12/2024	MECHANICAL		
PROFESSIONAL ENGINEER			ELECTRICAL		
NAME : P. THULSI			CIVIL		
PROF. Reg. No : 201901028			STRUCTURAL		
DATE : 05-12-2024			INSTRUMENTATION		
SIGNATURE :			PROCESS		
			ENG. MANAGER		

exxaro
POWERING POSSIBILITY

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EXXARO ACCEPTANCE			
SIGNATURE	EMP. No.	SIGNATURE	EMP. No.
MECHANICAL	......./........./...........	OWNERS REPRESENTATIVE	......./........./...........
ELECTRICAL	......./........./...........	AREA / PROJECT MANAGER	......./........./...........
CIVIL	......./........./...........	MANAGER ENGINEERING	......./........./...........
STRUCTURAL	......./........./...........	PROCESS & PIPING	......./........./...........
ARCHITECTURAL	......./........./...........	INSTRUMENTATION	......./........./...........

JOB / PROJECT NUMBER: BCX - 000017

SCALE: AS SHOWN

CENTRE **EXXARO BELFAST COAL MINE**

BELFAST WATER TREATMENT SOLUTION
WATER TREATMENT PLANT - INFRASTRUCTURE
WATER TREATMENT PLANT AREA

WATER TREATMENT AREA CIVIL GENERAL ARRANGEMENT

DRAWING NUMBER	SHEET	REV	
BCU-S01-730-EL-GA-0002	1 / 1	00	A0

FILE NAME : C:\Users\GaryNoca\PSCE\Kimon Comninos - 2 Projects\PR0042 - BEL WTP\3 Drawings\1 PS\20 Area 20\1 RVT\PR0042-BEL WTP-GA New Concrete.rvt

APPENDIX B: STORMWATER CALCULATIONS

JOB NAME	Proxa - Belfast WTP BFS	JOB NO.	PR0042
STRUCTURE	Civil Infrastructure	DATE	2024/11/27
TITLE	Stormwater volumes	REVISION	001
CALC. NO.	PR0042-10-I-CAL-002	CALC. BY	B. du Plessis

AREA 2			15 min minimum	**15**			
			1:20 years peak flow	**Exxaro standards**			
		Rainfall from Exxaro	**157,7**				
POST DEVELOPMENT RUN OFF CALCULATIONS							
Surface Description	**Unit**	**Amount**	**Area (m^2)**	**C**	**Ft**	**A*C*Ft**	**Peak Flow (1:20)(m^3/sec)**
developed Land	m^2	700	700,00	0,9	0,67	422,10	0,018
TOTAL			**700,00**			**Qri(pre)**	**0,018**

RECTANGULAR DRAIN CALC

EXXARO : WTP
AREA : Platform area
DATE : 2024/11/27

SLOPE 1:	100		
m^3/s	0,018	m^3/hr	66,57
B - width	0,5		
n - mannings	0,014		
Y - depth	0,4		

		Area	B x Y	0,2	
		P	B + 2Y	1,3	
		R	(A/P)	0,154	
		Mannings	Q = 1/nxR^(2/3)AS^(.5)		
Peak flow	0,018	(=)	0,410	Right should equal/bigger left (Not less)	
average flow velocity through concrete = 4,5 - 6,0	5	V = Q / A	2,05	m/s	

JOB NAME	**Proxa - Belfast WTP BFS**	JOB NO.	**PR0042**
STRUCTURE	**Civil Infrastructure**	DATE	**2024/11/27**
TITLE	**Stormwater volumes**	REVISION	**001**
CALC. NO.	**PR0042-10-I-CAL-002**	CALC. BY	**B. du Plessis**

PRIME SQUARED

AREA 3			15 min minimum	**15**			
			1:20 years peak flow	**Exxaro standards**			
		Rainfall from Exxaro	**157,7**				
RUN OFF CALCULATIONS							
Surface Description	**Unit**	**Amount**	**Area (m^2)**	**C**	**Ft**	**A*C*Ft**	**Peak Flow (1:20)(m^3/sec)**
developed Land	m^2	950	950,00	0,9	0,67	572,85	0,025
TOTAL			**950,00**			**Qri(pre)**	**0,025**

V - DRAIN CALC

EXXARO : WTP
AREA : Platform area
DATE : 2024/11/27

SLOPE 1:	100							
m^3/s	0,025	m^3/hr	90,34					
					Area	zy^2=	0,18	
n - mannings	0,014							
z - 1 :	2				P	2y √ 1+z^2	1,34	
Y - depth	0,3							
					R	(A/P) =	0,134	
					Mannings	Q = 1/nxR^(2/3)S^(.5)		
			Peak flow	0,025	(=)	0,34	Right should equal left (Not less)	
		average flow velocity through concrete = 4,5 - 6,0			V = Q / A	1,87	m/s	