BarkerRyanStewart

PLANNING
PROJECT MANAGEMENT
ENGINEERING
CERTIFICATION

ELF MUSHROOMS

Stormwater Management Plan

521 The Northern Road, Londonderry

Our Ref: 20070166
February 2019

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1 Introduction

This report has been prepared to consider the stormwater management options for the proposed mushroom farm to be established at 521 The Northern Road, Londonderry. Barker Ryan Stewart has been engaged to investigate the management of stormwater on the site and determine options for its detention and re-use.

In determining stormwater management options for the site, this report will consider the following:

1. The pre-development site conditions;
2. The extent and nature of the site catchment area;
3. The storage requirements for detention and re-use purposes; and
4. The configuration of the site stormwater drainage system.

2 Existing Site

2.1 Site Location

The site of the proposed mushroom farm is described as 521 The Northern Road, Londonderry (Lot 138, DP 752037) and is located within the Penrith City Council local government area. The site adjoins the auto wreckers on its southern boundary. The northern and western boundaries adjoin existing rural residential properties. The site area is approximately 22.12 hectares and the locality is shown in figure 1 below.

Figure 1 Site Location of 521 The Northern Road, Londonderry

2.2 Existing Site Conditions

The existing site is rural in nature. The majority of the site is undeveloped, although generally cleared, with a pocket of vegetation located in the south-western corner of the site. Isolated small pockets of vegetation are also scattered around the site. A residential cottage is located adjacent to The Northern Road, on the eastern boundary of the site.

The site is generally flat, although the southern half of the site has a slight fall to the south. A small portion in the north-western corner of the site also falls towards the north-west.

The property contains six existing rural dams, with most being small farm dams. The dam in the middle of the southern half of the site is a larger dam and receives runoff from a large portion of the site. This dam will be retained in the proposed development to act as a reservoir for water storage.

2.3 Existing Flow Paths and Catchment

Figure 2 shows the ridge line and corresponding overland flow paths for the existing undeveloped site. Natural contours of the site show that a ridge line exists through the centre of the site (see in red). Only a small area from the road drains to the existing dam which is currently being maintained by 521 The Northern Road, Londonderry prior to discharging into 509 The Northern Road, Londonderry.
Due to the topography of the adjoining northern property there is no external contributing catchment area to the proposed site, water from the proposed development site flows north from the ridge.

Figure 2 Overland Flow path to Landscaping mounds

The site is quite flat around the ridge line with the land gently falling generally in a southerly or westerly direction with little to no fall to the sites north.

3 Proposed Development

3.1 General

The proposed development consists of the establishment of a mushroom farm and associated facilities on the site. The farm will include growing rooms, workshops and sheds, car parking and driveway areas. The configuration of the proposed development is shown on the plan detailed in Appendix A.

3.2 Stormwater Management

3.2.1 Proposed Design

It is proposed to implement an extensive stormwater management system on the site to manage both, the stormwater runoff from rainfall events and runoff from wash-down, cleaning and growing preparation activities. This system will enable the storage of both types of runoff and the re-use of water within the farm, thereby resulting in water quality benefits for site runoff as well as significant cost savings in the operation of the farm and an environmental benefit from the reduction in water consumption. The stormwater runoff will be collected and stored in a proposed 14.7 mega litre dam, whilst the wash-down water from maintenance and cleaning activities will be treated in a 439, 000L wetland system and stored for re-use in a 100,000L tank. Section 4 of the report describes the water balance proposed for the site while section 5 indicates how the peak stormwater discharges shall be addressed during periods of heavy rainfall and section 6 shows how the site will manage to control the discharge of pollutants originating from the development of the site. This wetland system has been designed by another consultant and is not part of this submission.

3.2.2 Stormwater Management System

The stormwater management system will consist of two different drainage systems separating polluted flows from wash down activities and runoff from rainfall events. Stormwater runoff will be collected from roof, driveway and apron areas through a conventional pit and pipe system. This water is directed to the altered dam currently located in the southern half of the site utilised as a reservoir for water storage where it will be stored for re-use for wash down purposes and the cooling towers. Details of water balance calculations can be found in Section 4. The modified dam would also act as detention storage in extreme rainfall events, reducing peak runoff discharges from the impervious areas of the farm back to pre-developed flow rates. Details of estimated peak discharges for pre-developed and post-developed discharges can be found in Section 5.

The second pipe drainage system will collect the runoff from the washout of the growing rooms and adjacent areas. The wash down water will be conveyed by a separate pipe system to the water recycling ponds wetland treatment system located on the southern side of the farm building. The wetland system will treat these waters and the resulting water will then be stored in a 100,000L storage tank, which will be used on the premises for toilet flushing, steam generation, boilers and supplementing demand for cooling towers and irrigation.

With the existing site being generally flat with only slight fall to the south west a minimum pipe grade of 0.5% would be adopted for the pipe network, with 1% slope applying to the pipes draining the washdown water where possible. This was done to minimise filling on the site while ensuring the site could drain to the proposed discharge point.

To ensure that there is no overflow from the water treatment facility of polluted waters into the downstream watercourse, it is proposed to incorporate a small bund wall at the low side of the treatment area, that will have the capacity to contain the maximum operating

treatment volume as well as the 24 hour, 1 in 100 year ARI rainfall event. The volume associated with this storage is 2.4mm per hour over 24 hours across an area of 4200 square metres equating to a volume of 240 cubic metres.

3.2.3 Catchments

The proposed site is situated on a low ridge and will have 4 significant discharge points, one to the west and 3 to the south. Refer to Figure 2 for discharge point locations. The proposed development will comprise of roofed areas, paved area, Water Recycling Ponds treatment area and landscaped areas that will discharge to a storage dam for reuse. Overflows from this dam will discharge to the south via the main discharge point of the site. Table 1 shows the areas contributing to the dam.

Total Site Area =	221 190	m^2
Roofed Area =	88 745	m^2
Paved Area (car park and driveway) =	6 490	m^2
Landscaping Area / Sound Mound Draining to the Dam including dam surface area =	19 640	m^2
Area with no modification to existing flow =	74 180	m^2
Reuse Water Recycling Ponds Treatment Area =	5 560	m^2
Areas used for loss calculations		
Process Area Pavement =	18 725	m^2
Dam Surface Area =	8 430	m^2

Table 1 Site Catchment Areas

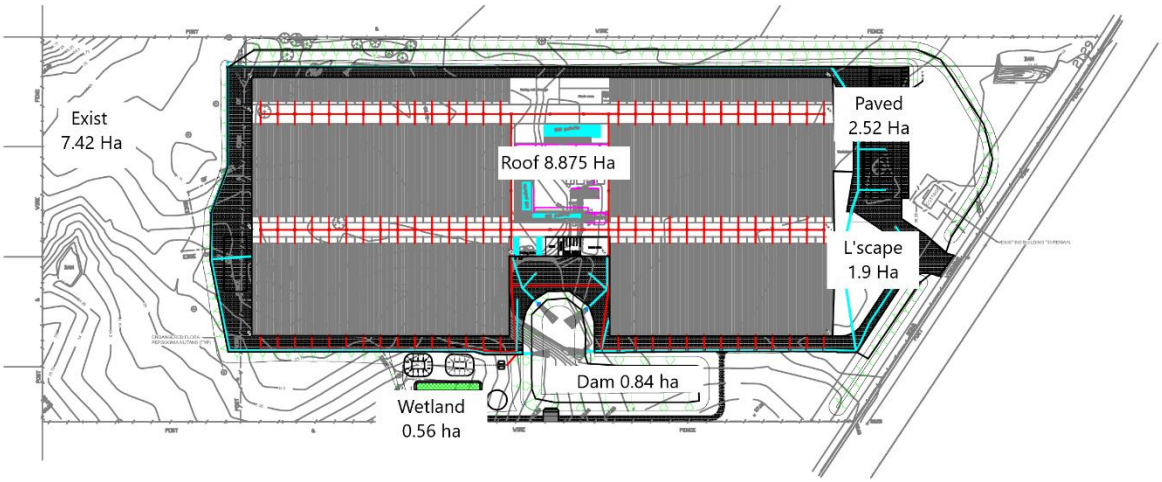


Figure 3 Site Catchments

The proposal directs site runoff from the developed areas into the proposed dam located on the southern side of the buildings. No surface water is blocked from entering the site and any surface runoff from the landscaped section of the sites north and eastern sides will also be directed via catch drains into the dam. The remaining natural drainage paths will remain as they are.

4 Water Balance Calculations

4.1 General

Water balance calculations have been undertaken for the proposed stormwater management system to estimate recycled and mains water usage for the development and determine site discharge volumes under normal operation conditions.

The calculations use daily rainfall figures from some 125 years of records to estimate the average performance of the proposed system, evaporation, water drawn and used by the facility, stormwater capture and stormwater overflow (lost from the system) during periods of heavy rainfall. Figure 4.1 shows a flow chart of the waters incorporated into the assessment.

4.2 Flow Routing Method

A flow routing model was generated to estimate inflow and outflow volumes by using the water balance for each time step of data. (See Equation 4-1).

$$\frac{\Delta S}{\Delta t} = I - O$$ **Equation 4-1**

Where, S is the storage over time (t), I is the net inflow generated from the rain and reuse, and O is the outflow from the site. The computations were completed using Excel and were conducted on daily rainfall information using daily time steps.

4.3 Rain Gauge Data

Daily rainfall records showing the amount of rain each day in millimetres, were obtained from the Bureau of Meteorology, Site Number 67021, RICHMOND - UWS HAWKESBURY, Elevation: 20 m. Suitable daily rainfall data from this station was extracted using records from between 1881 to 2010. A period of data was selected based on quality control flags on the data and a continuous record set with limited data gaps. The period selected is summarised in Table 2.

Summary of Data		
Start Date	1/01/1881	
End Date	1/3/2010	
Total Days Recorded	45682	days
Period	47126	days
Number of Gaps in Records	169	
Number of Gap Days in Records	1648	
Average Daily Rainfall	2.218	mm
Maximum Rainfall event	309.4	mm
Number of Days >1.5mm Rainfall	8332	days
Average Number of Days between events >1.5mm Rainfall	5.48	days

Table 2 Summary of extracted Rainfall Data Records

4.4 Evaporation

Monthly statistics on mean daily evaporation records showing the mean amount of evaporation each day in millimetres was obtained from the Bureau of Meteorology, Site Number 67021, RICHMOND - UWS HAWKESBURY, Elevation: 20 m. A correction factor of 0.75 was used to adjust evaporation rates from the Class A Evaporation pan to dam surface. Mean monthly evaporation statistics are shown in table 3 below.

Month	Mean Daily Evaporation (mm)	Adjusted Daily Evaporation (mm)
January	6	4.50
February	5	3.75
March	4.1	3.08
April	3.2	2.40
May	2.2	1.65
June	1.8	1.35
July	1.9	1.43
August	2.7	2.03
September	3.8	2.85
October	4.8	3.60
November	5.1	3.83
December	5.9	4.43

Table 3 Mean Daily Evaporation (mm)

The following data was used as demand inputs in the calculations:

Water Demand	Rate	Source
Mushroom irrigation	60kl/day	Town water
Growing room wash down	10kl/day	Town water
External wash down	15kl/day	Storage dam, then town water
Cooling towers	30kl/day	Wetland water (Water Recycling Ponds), then storage dam, then town water
Steam generator & boilers	15kl/day	Wetland water (Water Recycling Ponds), then storage dam, then town water
Toilet flushing	7kl/day	Wetland water (Water Recycling Ponds), then storage dam, then town water
Workshop & amenities	2.5kl/day	Town water

Table 4: Water Demand Rates

This demand data was provided by the client, who obtained it from their experience from within their other operating facilities, which currently operate in the same manner as planned for this site. These are maximum expected demands taken from a fully developed and operating plant running at full production. Water demands will be less during the earlier stages of the development.

4.5 Assumptions

The following assumptions were made in the calculations:

- The 66 functioning growing rooms demand 60m^3/day for irrigation and 10m^3/day for wash down.
- Growing room irrigation and wash down will be provided by town water, whilst external wash down will be provided by stored dam water.
- Losses from rainfall runoff were estimated at 1mm/m^2 for roof areas, 1mm for pavement areas and 5mm for Landscape areas.
- Losses from external wash down were calculated at 1mm based on 25% of the process area being washed down each day. Given the average recurrence of significant rainfall fall events is around once every 6 days, which equates to no washing down of the areas one day in every six.
- Losses during external wash down are estimated at 5%.
- Overflow from Water Recycling Ponds Treatment area tanks will be directed to the dam.
- All irrigation water will be lost to production and transported off site in soil or mushroom produce.
- No infiltration losses to the groundwater from the dam.
- No outdoor wash down losses during wet days.
- The runoff from the roof, pavement and Landscaping areas to the east of the site would be diverted to the 14.7 ML dam.

4.6 Results

4.6.4 General

A nominal site storage capacity within the dam of 14,700 m^3 has been adopted. This volume will catch 26 % of daily runoff flows according to the established spread sheet. This storage volume will come from the modification of the existing dam and is shown in Appendix A, which contains the draft design plans of the proposed dam.

In addition to the dam storage, the water treatment system will have a maximum operating storage volume of 439m^3 as detailed in Table 5 below, with an additional capacity to contain the 24 hour, 1% AEP storm event above this water level. This extra storage will be provided by local mounding around the treatment area and so contain any water falling on to the pond, wetland and storage facility.

Process Area				**Tank**	Total Storage Volume
Collection Trenches 2x12,000L	Facultative Ponds 75,000L	Aerated Ponds 90,000L	Surface flow Wetlands 2x75,000L	Tank 100,000L	
24m^3	75 m^3	90 m^3	150 m^3	100 m^3	439 m^3

Table 5 Water Recycling Ponds Storage

The storage volume in the dam, Water Recycling Ponds and Treatment storage tank when running full will provide enough capacity to supply the facility with its average daily requirement of 55m^3 for wash down and cooling tower water for approximately 220 days without additional inflow from rainfall or mains supply.

Using the routing spreadsheet, the total annual runoff from the site entering the dam and Water Recycling treatment areas is estimated to average 91,498m^3/year with an average overflow from the dam (and so storm water lost from the site) estimated at 67,794m^3/year. The dam water will be used for top up water in the cooling towers (should the supply from the treatment pond run dry) and for washing down external hardstand areas. Both the internal and external wash down areas would drain into the Water Recycling Pond and wetland system and be treated. The water that will be drawn from the dam is estimated at 14,809 m^3/year. Mains water will always be used as wash down water for the growing rooms for health reasons. A summary of the results, using the daily routing methods of analysis are detailed in Table 6.

Rain water inflow system from site (m^3/year)	Overflow from dam to creek system (m^3/year)	Evaporation from dam and site (m^3/year)	Annual demand by facility (m^3/year)	Dam water used each year (m^3/year)	Reclaimed Water from treatment system (m^3/year)	Mains Demand needed (m^3/year)
91,498	67,794	6,181	50,919	14,154	10,301	26,460

Table 6 Average Annual Water Balance Figures

The external mains demand of 26,460m^3/year (72.5 m^3/day) comprises the base average daily demand for Irrigation, Growing Room wash down and amenities and contributes an annual volume to the treatment storage tank of 10,301m^3/year (28.2m^3/day). The reduction in mains water demand due to the dam and treatment systems is 24,456m^3/year (or 67m^3/day).

4.6.5 Dam Water Usage

During this period it is estimated that the dam will overflow on average 43.2 days/year and will never empty completely. In the period the routing model was run, the minimum volume of water in the dam was observed at 941m^3. A summary of the results are detailed in table 7. It shows that the dam would be able to supply all of the water used in the external wash down and supplement water used by the cooling towers above that drawn from the Treatment Storage tanks. The average reduction of mains potable water per year would be 14,154 cubic metres.

Dam Storage 14.7 ML	
Average Runoff into Dam (m3/day)	91,498
Days Dam is Empty	0
Days Dam is Full over period of run (average days/year) (Percentage)	5,086 40.5 11.1%
Average Mains Reduction (m3/year)	14154

Table 7 Summary Dam Usage

4.6.6 Water Recycling Ponds Water Usage

The Water Recycling Ponds and tank will need to be supplemented for a total of 35,121 days over the period the model was run (on average 280 days/year) and will exceed its designed storage capacity on average less than one day per year. Should the system exceed the

designed operating level it will be stored in the system with an increased water depth across the wetlands. This overflow system has the capacity to store the 24 hour, 1% AEP rainfall event above this designed storage volume. A summary of the results are detailed in table 8 below. It is estimated that there will be an average flow through the water recycling ponds treatment area of 32.14m^3/day (11,731m^3/year) arising from the internal and external wash-down procedure and from the rainfall falling directly on the water recycling ponds.

Water Recycling Ponds Treatment Storage 439m3	
Average Demand for Cooling tower, toilets & boilers (m3/day) (m3/year)	 19.3 7045
Days tank will Need Top Up (days/year) (Percentage)	35121 280.6 77%
Days Treatment storage is Full (days/year) (Percentage)	265 2.2 0.58%
Average Mains Reduction (m3/year)	 10,083

Table 8 Summary Water Recycling Facility Usage

As the treatment system will not have the capacity to cater for the demand of the boilers, toilets and steam generators. It is estimated that there would be an average volume of water drawn from the dam to supplement it of around 19.3m^3/day or 7045m^3/year. This water can be mixed with the wash down water from the growing rooms before entering the water treatment system. This will also reduce the potential issue of allowing high concentrations of the fungicide Carbendazim as noted in the ALS Water Science Groups correspondence dated 6th December, 2010 to enter the system, as it will have the effect of diluting the concentration of the chemical in the wetland waters. On-going testing should be established at the time of establishment in order to ensure the dilution is achieved to acceptable limits.

4.6.7 Climate Change Effects

Climate change has the potential to affect rainfall and hence available water for reuse. Trends in rainfall due to climate change are for increase rainfall and distribution of rainfall. Rainfall gauge data Site Number 67021, RICHMOND - UWS HAWKESBURY, Elevation: 20m was analysed to project potential impacts due to climate change.

Increased variability in rainfall could affect the availability of water due to longer dryer periods and likely more intense storm events.

Given that through global warming there is expected to be only a small increase in periods between significant rainfall events as well as an increase in rainfall associated with these events, more rainfall will be expected to be available within the system. This will impact favourably within the dam system due to its long draw down period but will work in a negative manner for the Water Recycling Ponds wetland system which has a much shorter draw down period. Given the increased rainfall and availability of rainfall for reuse during prolonged dry periods, water from the dam could be pumped into the water recycling ponds treatment area during periods of rainfall, increasing the available reuse potential.

5 Stormwater Design

5.1 General

This section addresses the stormwater management design for the proposed development. A hydrological analysis to determine peak runoff during all storms up to and including the 1 in 100 year Average Recurrence Interval (ARI) event was conducted to ensure water flows on the site are managed. This section of the report firstly highlights the site parameters used to model the site, relating the different catchment characteristics and initial parameters adopted. The general system layout is then discussed outlining the stormwater management strategy for the site and design methodology for estimates of peak flow rates used in sizing stormwater structures.

5.2 Design Methodology

Roof areas would direct rainfall via conventional gutter and downpipe system to pits located in the driveway area. Roof water drainage grades would be a minimum 0.5% and a minimum size of 150mm diameter. All pits would be grated surface inlet pits allowing surface runoff to be captured. Overland flow paths convey water to either the driveway drainage system or directly into the dam for events greater than the 1 in 20 year ARI. For the 100 year ARI event, freeboard would be no less than 200mm for workshop floor level and no less than 300mm to office floor levels.

All storm water and roof drainage has been designed in accordance with AS 3500.3.2 1998 and council engineering guidelines. Pipe materials would be uPVC for pipe sizes up to 300mm diameter and class 2 reinforced concrete pipes for larger sizes.

5.3 Pipe Capacity and Sizing

The pipe network has been sized to cater for peak flow estimates for the 1:20 year ARI event without surcharge from pits within the network in accordance with AS3500. Stormwater originating from storm events greater than the 20 year ARI event will be conveyed by overland flow paths in the same general direction as the piped drainage system.

5.4 Detention Storage

Detention storage requirements have been catered for in the dam to attenuate flows up to the 100 year ARI storm event, with a combination of controls restricting the discharge. The outlet structure is a combination of a weir and a 300mm diameter pipe controlling the discharge to that of pre-developed peak flow rates. The onsite detention storage is located above the permanent storage volume within the dam with the invert of the low flow outlet positioned at the maximum permanent storage level. All designed detention discharge structures have been designed with capacity to carry the peak flow estimates as outlined in AR&R87.

In accordance with Penrith City Council guidelines, the proposed development has provided on-site detention to restrict peak post-development site discharges to peak pre-development levels. The basin has been designed to temporarily detain the runoff produced from the post development site and discharged at a controlled rate through the outlet structures. A spillway was designed to adequately convey the estimated 100 year ARI flow rate without overtopping of the basin embankment. The initial volume of the dam within the DRAINS model was set to full storage level assuming that the dam was full at the start of the rainfall event, even though there is significant water demand from the dam, meaning that it is unlikely to be full at the start of an extreme event.

5.5 Drains Modelling

5.5.1 Site Parameters

The area contributing to the catchment of the stormwater management system is essentially the area of the proposed buildings and surrounding apron and driveway areas. The catchment area draining to the basin totals 14.7ha. For the predeveloped scenario there is a single pervious catchment with estimates from the pre-developed runoff from the site calculated with the kinematic wave equation in the DRAINS model.

The following Table 9 shows the initial site parameters used within the stormwater software modelling program DRAINS.

Hydrological Parameters	
Model	ILSAX
Paved Area Depression Storage (mm)	1
Supplementary Area Depression Storage (mm)	1
Grassed Area Depression Storage (mm)	5
Soil Type	3

Table 9 Site Parameters

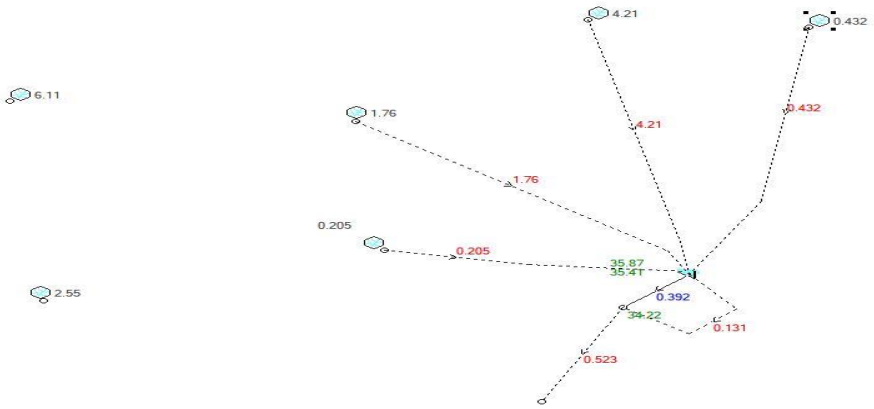
5.5.2 Model Setup

The total catchment area was divided into four main sub catchment categories; roof area, driveway/hardstand area, grassed/landscaped area and the basin. Table 10 shows the sub catchment parameters used for these categories.

Type	**Impervious (%)**	**Pervious (%)**	**tc (min)**
Roof	100	0	10
Driveway/ Hardstand	60	40	10
Grassed/landscaped	0	100	12
basin	80	20	8

Table 10 Sub catchment Parameters

Fall on the driveway/hardstand areas ranges between 1% and 2%, with the long distance the water has to travel the time of concentration will generally be 10 minutes. The following is a diagram showing the set up of the DRAINS model.



5.6 Results

As described in Section 5.1, the detention basin has been designed to temporarily detain the runoff produced from post development flow and discharge it at a controlled rate through an outlet structure. The aim of the spillway is to convey major flows and prevent overtopping of the basin, which may compromise the integrity of the earth embankments. The following Table 12 summarises the detention basin design parameters.

Detention Basin Parameters	
Design Elements	
Top of Bank	RL 36.4m (AHD)
Spillway Base	RL 36.0m (AHD)
Base of Storage	RL 30.0m (AHD)
Low flow pipe invert level	RL 34.27m (AHD)
Depth during 1% AEP event	6.01 m
Crest Width at top of Bank	2 m
Internal Batter slopes	1 : 3
External Batter Slopes	1 : 4

Table 11 Detention Basin Design Parameters

Table 13 below summarises the peak flow and discharge rates attained from the stormwater design of this site.

ARI (1 in)	Pre – Development (l/s)	Post Development (l/s) No Basin	Post Development (l/s) With Basin
2	383	2670	284
5	822	3570	314
20	1510	4790	347
50	2070	5410	408
100	2550	6110	523

Table 12 Peak Runoff and Discharge Results

Table 13 shows that the peak discharge through the low flow outlet is effectively mitigated by the proposed 450mm dia. Outlet pipe and overland spillway. Similarly Table 13 shows that flow rates are restricted to atleast that of the predevelopment levels for the 100, 50, 20, 5 and 2 year ARI events. The corresponding Top Water Level (TWL) in the basin during the maximum discharge storm event is at RL 35.87m. A mound is provided along the southern dam wall set at RL 36.2m AHD which allows for a minimum 300mm free to the top of bank.

The total storage volume proposed within the dam is 25,500m^3. Of this volume 14,700 m^3 is for permanent storage of runoff stormwater and 10,800m^3 is to be used for temporary storage associated with the on-site detention during the 100 year ARI storm event.

6 Stormwater Quality

6.1 General

This section of the report describes the control measures and management of water quality that will be implemented on site. It identifies sources of pollution and how they will be treated to minimise the risk of pollution discharging from the site.

Mushroom Farms are designed with hardstand areas and utilise rich organic material used in the growing process. This has the potential to impact on the downstream waterways. For this reason the stormwater runoff flows and wash down waters within the site are to be separated and treated separately. The wash down water is to be directed to the Water Recycling Pond system while the stormwater runoff will be directed to the dam system for storage or detention purposes.

It is expected that the majority of pollution will be from the washdown of the growing rooms and from the hardstand areas immediately around the growing rooms. Waters will be captured from the growing rooms by the wash down pipe system and directed to the Water Recycling Ponds wetland system and reused where possible in the plant. Hardstand (driveway) surface will be washed into the Water Recycling Ponds wetland system. The model set up to simulate the generation of hardstand pollutants however has not considered this regular wash down, but has however considered the hardstand as a pollution generating surface. It is for this reason that the approach to the simulation is considered to be conservative.

Given that around 26% of runoff from the rainfall events would be captured by the dam and therefore ultimately used by the facility, it is anticipated that the majority of pollution generated from hardstand areas and the building roofs will be taken out of the system by settlement within the dam due to its storage component. The modelling of the site was undertaken using the software MUSIC and set up in accordance with the above description with the reuse function within the pond module of the program.

Water Quality modelling requires the use of continuous rainfall data at a 6 minute to 6 hourly interval. For the concept design of the water sensitive urban design elements MUSIC modelling was utilised. The recorded rainfall from pluviograph number 067105, located at the RAAF base in Richmond, as supplied by the Bureau of Meteorology was imported into MUSIC. This data was simulated for a 6 minute rainfall period interval from 1985 until 1995 to ensure a long-term assessment was conducted on the expected water quality.

Modelling was undertaken for the constructed plant with no dam and compared to the same model with the pond treatment system module with reuse function to simulate the dam. All the subcatchments were modelled according to the Western Sydney Draft MUSIC guidelines, inputting the respective variables for the appropriate land use. A catchment plan is shown in Appendix A.

The following values have been adopted as the Rainfall Runoff parameters for the impervious and pervious scenarios;

	Built up Area
Impervious Area Parameters	
Rainfall Threshold (mm/day)	1.4
Pervious Area Parameters	
Soil Storage Capacity	105
Initial Storage	30
Field Capacity	70
Infiltration Capacity – Coeff a	150
Infiltration Capacity – Coeff b	3.5
Groundwater Properties	
Initial Depth	10
Daily Recharge Rate	25
Daily Baseflow Rate	10
Daily Deep Seepage Rate	0

Table 13 Rainfall Runoff Parameters

The catchment was divided into four distinct runoff areas which all drain to a dam system which was modelled as a pond and detention basin in MUSIC. The areas and their respective classifications are shown in Table 15.

Catchment	Area (ha)	Classifications	Impervious
Building	8.88	Roof	100%
Hardstand	2.52	Sealed Road	100%
Landscaped	3.3	Landscaped	0%

Table 14 Pre Development MUSIC Model Inputs North Eastern catchment

6.2 Developed Site Results with No Controls

The model was run with 6 minute rainfall intervals to determine the post development pollutant loads for the site where no water quality and reuse facilities are incorporated into the facility. The mean annual water quality results from the model are shown below in Table 16 while the results from the flow weighted daily mean criteria are shown in Table 17.

		Loading – no Controls
Flow	**(ML/yr)**	70.6
Total Suspended Solids	**(kg/yr)**	7250
Total Phosphorus	**(kg/yr)**	17.7
Total Nitrogen	**(kg/yr)**	156
Gross Pollutants	**(kg/yr)**	1890

Table 15 Water Quality Loading Results – No Controls

		Mean	Maximum
Flow	**(m^3/s)**	$2.24x10^{-3}$	0.169
Total Suspended Solids	**(mg/L)**	23.0	395
Total Phosphorus	**(mg/L)**	$97.9x10^{-3}$	0.412
Total Nitrogen	**(mg/L)**	0.880	4.00
Gross Pollutants	**(kg/Day)**	5.17	83.5

Table 16 Flow weighted daily Mean Water Concentration – No Controls

6.3 Upgrading Works

In order to reduce the post development pollutant loadings to levels as prescribed in Penrith Councils DCP 2014 and Penrith Councils WSUD Technical Guidelines Version 3 June 2015: Environmental targets (2007) the proposed pond/dam was modelled and found to provide a water quality benefit for the system in addition to providing a reduction to the potable water usage for the mushroom facility. In the modelling the discharge from the spent compost shed was not incorporated as this was to be dealt with by the proposed Water Recycling Ponds sediment trenches and wetland facility as described by Sainty and Associates.

The size of the dam as determined by the water balance calculations has the following properties that were incorporated into the music model;

- A surface area of 5840 square metres,
- A permanent pond volume of 14,700 cubic metres,
- An extended detention depth of 1.6 metres, and
- A reuse component of 38.8KL/day or 14.2ML/year.

Engineering plans showing the location, size and minimum requirements of the pond are shown in Appendix A.

6.4 Development Site Results with Controls

The post development scenario was simulated for 6 minute rainfall intervals, the results of which are summarised in Tables 18 and 19.

		Loading – with Controls
Flow	**(ML/yr)**	42.8
Total Suspended Solids	**(kg/yr)**	866
Total Phosphorus	**(kg/yr)**	5.58
Total Nitrogen	**(kg/yr)**	62.0
Gross Pollutants	**(kg/yr)**	0

Table 17 Water Quality Loading Results- With Controls

		Mean	Maximum
Flow	**(m^3/s)**	$1.39x10^{-3}$	0.115
Total Suspended Solids	**(mg/L)**	2.13	60.4
Total Phosphorus	**(mg/L)**	$13.8x10^{-3}$	0.392
Total Nitrogen	**(mg/L)**	0.150	4.23
Gross Pollutants	**(kg/Day)**	0	0

Table 18 Water Quality Results for Post Development Scenario

A comparison of the site without controls to that of the site with controls is shown below in Table 20.

		No Controls	With Controls	% Reduction
Flow	**(ML/yr)**	70.6	42.8	39.3
Total Suspended Solids	**(kg/yr)**	7250	866	88.0
Total Phosphorus	**(kg/yr)**	17.7	5.58	68.5
Total Nitrogen	**(kg/yr)**	156	62.0	60.2
Gross Pollutants	**(kg/yr)**	1890	0	100

Table 19 Water Quality Loading Results & Comparison

The above tables show that the annual average loads and the mean concentrations have all been reduced in accordance with the requirements of Penrith council.

7 Conclusions

This report has considered the stormwater management options for the proposed mushroom farm to be established at 521 The Northern Road, Londonderry. The options adopted for the management of stormwater on the site include the following components:

- Two separate pipe systems one to collect wash down water and a separate one for stormwater runoff;
- A modified existing dam to provide the dual use of capturing and storing stormwater runoff in addition to providing detention storage;
- A Water Recycling Ponds and wetland system to treat wash down water and store it for re-use in toilet flushing, steam generation and cooling towers.

The calculations and investigations undertaken in the preparation of this report, have found that the above components will operate satisfactorily with the following capacities:

- The modified dam will have a maximum storage capacity of approximately 14.7 megalitres;
- The dam capacity will be sufficient to provide the required 55,000 litres of wash down and cooling tower water per day to the plant for approximately 220 days without additional rainfall;
- The detention storage requirement to reduce developed flows back to pre-developed can be catered for within the modified dam as buffer storage above the full storage level;
- Provide adequate water quality controls for the site to ensure that stormwater leaving the site will conform to at least the minimum water quality requirements as stipulated by the relevant government organisations.

It is expected that if the above system is implemented as part of the development and satisfactorily operated and maintained, then the stormwater management of the site will meet water quality and quantity requirements.

8 References

Penrith City Council, *"Water Sensitive Urban Design (WSUD) Policy"2013 & "WSUD Technical Guidelines" 2015*. Website: http://www.penrithcity.nsw.gov.au/last updated

Penrith City Council, "Stormwater Drainage for Building Developments" *Draft 2013.* Website: http://www.penrithcity.nsw.gov.au/last updated

Penrith City Council, "Development Control Plan – C3 Water Management" *2014.* Website: http://www.penrithcity.nsw.gov.au/last updated

Hare C.M. (1981) "Energy Losses in Pipe Systems", Advances in Urban Drainage Design, Insearch Ltd, NSW Institute of Technology

Appendix A

Drainage Plans

A1

PROJECT NO: SY180007E1 REV - C

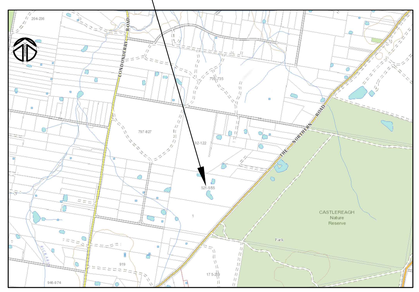
PENRITH CITY COUNCIL
PROPOSED AGRICULTURAL DEVELOPMENT
521-555 THE NORTHERN ROAD, LONDONDERRY
DRAINAGE PLANS

GENERAL NOTES

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH PENRITH CITY COUNCIL'S WORKS SPECIFICATION CIVIL - 2005 REQUIREMENTS AND/OR AS DIRECTED BY THEIR REPRESENTATIVE.
2. THE CONTRACTOR IS TO IDENTIFY, LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION WORKS AND WHERE NECESSARY MAKE ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST WHERE NECESSARY.
3. COUNCIL'S TREE PRESERVATION ORDER MUST BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT THE PRIOR APPROVAL OF COUNCIL.
4. ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE WORK HEALTH & SAFETY ACT 2011 AND ALL RELEVANT OCCUPATIONAL HEALTH & SAFETY POLICIES AND REGULATIONS.
5. DIMENSIONS SHALL NOT BE SCALED FROM THE PLANS. CLARIFICATION OF DIMENSIONS SHALL BE SOUGHT FROM THE SUPERINTENDENT OR REFERRED TO THE DESIGNER.
6. SURVEY MARKS SHOWN THUS ▲ SHALL BE MAINTAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE ENGINEER SHALL BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL.
7. ALL NEW WORK IS TO MAKE A SMOOTH JUNCTION WITH EXISTING CONDITIONS.
8. THE CONTRACTOR IS NOT TO ENTER UPON NOR DO ANY WORK WITHIN OR ON ADJACENT LANDS WITHOUT THE PRIOR APPROVAL OF THE SUPERINTENDENT AND THE WRITTEN PERMISSION OF THE OWNERS.
9. SEDIMENT MEASURES SHALL BE IMPLEMENTED PRIOR TO SOIL DISTURBANCE IN KEEPING WITH THE 4th EDITION OF LANDCOMS "SOILS AND CONSTRUCTION - MANAGING URBAN STORMWATER" MARCH 2004 TO THE SATISFACTION OF COUNCIL'S REPRESENTATIVE AND AS SHOWN IN THESE DRAWINGS.
10. THE CONTRACTOR SHALL CLEAR AND DISPOSE OF ONLY THOSE TREES THAT ARE CONDEMNED BY THE PLANS. COUNCIL'S TREE PRESERVATION ORDER SHALL BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT PRIOR APPROVAL.
11. THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH, FENCES, OUT HOUSES, CAR BODIES, DEBRIS, ETC. THE CONTRACTOR SHALL NOT DISPOSE OF ANY DEBRIS BY BURNING OFF IN AN OPEN FIRE.
12. UNSOUND MATERIALS AS DETERMINED BY COUNCIL'S REPRESENTATIVE SHALL BE REMOVED FROM ROADS AND LOTS PRIOR TO ANY FILLING.
13. ALL SITE REGRADING AREAS SHALL BE GRADED TO THE SATISFACTION OF COUNCIL'S REPRESENTATIVE. THE CONTRACTOR SHALL TAKE LEVELS ON THE EXISTING SURFACE AFTER STRIPPING TOPSOIL AND PRIOR TO COMMENCING ANY FILL OPERATIONS.
14. SURPLUS EXCAVATED MATERIAL SHALL BE PLACED OR DISPOSED OF IN ACCORDANCE WITH THE CONTRACT, OR AS DIRECTED BY THE SUPERINTENDENT.
15. ALL SITE FILLING SHALL BE PLACED IN LAYERS NOT EXCEEDING 300mm AND COMPACTED IN ACCORDANCE WITH COUNCIL'S SPECIFICATION AND BE TESTED AT THE REQUIRED INTERVALS BY AN APPROVED N.A.T.A. GEOTECHNICAL LABORATORY.
16. MINIMUM 150mm THICK TOPSOIL SHALL BE SPREAD ON ALL FOOTPATHS, BERMS, BATTERS AND SITE REGRADING AREAS. EXCESS TOPSOIL SHALL BE DISPOSED OF AS DIRECTED BY THE SUPERINTENDENT.
17. ALL LAND DISTURBED BY EARTHWORKS SHALL BE SPRAY-GRASSED, OR SIMILARLY TREATED TO ESTABLISH GRASS COVER. SEED MIXTURES ARE TO BE APPROVED BY COUNCIL PRIOR TO SPRAYING. ALL GRASSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.
18. THE CONTRACTOR SHALL MAINTAIN DUST CONTROL THROUGHOUT THE DURATION OF THE PROJECT.
19. ALL PITS DEEPER THAN 1.2m SHALL HAVE STEP IRONS PROVIDED IN ACCORDANCE WITH COUNCIL'S STANDARDS.
20. ALL DRAINAGE LINES THROUGH LOTS SHALL BE CONTAINED WITHIN THEIR EASEMENTS AND CONFORM WITH COUNCIL'S STANDARDS.
21. ALL DRAINAGE LINES ON HIGH SIDE AND UNDER ROADS SHALL BE BACKFILLED SHARP SAND AND HAVE 3.0m OF AGRICULTURAL LINE WRAPPED IN AN APPROVED FILTER FABRIC, DISCHARGING INTO THE DOWNSTREAM PIT.
22. SUBSOIL DRAINS SHALL BE CONSTRUCTED TO THE SATISFACTION OF COUNCIL'S REPRESENTATIVE.
23. PRECAST KERB INLET LINTELS SHALL BE USED ON GULLY PITS. GRATES SHALL BE "WELDLOK" TYPE GG 78-51 OR APPROVED EQUIVALENT.
24. PROVIDE VEHICULAR ENTRIES IN KERB AND GUTTER WHERE SHOWN OR WHERE DIRECTED BY THE SUPERINTENDENT.
25. GUIDE POSTS SHALL BE 100mm X 50mm HARDWOOD, PAINTED WHITE WITH REFLECTORS.
26. ERECT STREET NAME SIGNS, CONDUIT WARNING SIGNS AND NO THROUGH ROAD SIGNS WHERE SHOWN OR WHERE DIRECTED BY COUNCIL'S REPRESENTATIVE.
27. CONDUITS SHALL BE LAID AFTER POSITIONS HAVE BEEN DETERMINED BY THE RELEVANT AUTHORITIES AND BEFORE FINAL A.C. IS LAID
28. POSITION OF CONDUITS SHALL BE MARKED ON THE KERB.
29. FELLED TREES SHALL BE SALVAGED FOR RE-USE AS WOODCHIP MULCH OR LOG FORM FOR SITE REHABILITATION, NON-SALVAGEABLE MATERIAL SUCH AS STUMPS AND ROOTS SHALL BE DISPOSED OF OFF SITE.
30. THE CONTRACTOR SHALL PROVIDE MINIMUM 24 HOURS NOTICE TO COUNCIL'S REPRESENTATIVE FOR ALL INSPECTIONS.
31. THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO THE ADJOINING PROPERTIES.
32. THE CONTRACTOR SHALL UNDERTAKE TRAFFIC CONTROL MEASURES TO COUNCIL'S SATISFACTION AND SHALL DISPLAY ALL APPROPRIATE WARNING SIGNS THROUGHOUT THE DURATION OF CONSTRUCTION.
33. ALL NATURAL SURFACE DATA HAS BEEN DETERMINED BY TERRAIN MODELLING. ALL CONSTRUCTION SITE WORKS MUST BE CARRIED OUT USING THE BENCH MARKS SHOWN ON THESE DRAWINGS.

Prepared for: ELF MUSHROOMS BECKHART PTY LTD

LOCATION OF WORKS



LOCALITY SKETCH
NOT TO SCALE

SHEET INDEX

SHEET No.	DESCRIPTION
COVER SHEET	COVER SHEET - GENERAL NOTES, SHEET INDEX AND LEGEND
1	DETAIL PLAN SHEET
2	LONGITUDINAL & TYPICAL CROSS SECTIONS
3	CROSS SECTIONS
4	CROSS SECTIONS
5	CATCHMENT PLAN
6	DRAINAGE CALCULATIONS AND LONGITUDINAL SECTION
7	EROSION & SEDIMENT CONTROL PLAN
8	EROSION & SEDIMENT CONTROL DETAILS
9	LINEMARKING PLAN

LEGEND

- ROOF DRAINAGE LINE
- PROPOSED CLEAN WATER DRAINAGE LINE
- PROPOSED DIRTY WATER DRAINAGE LINE
- 24 — NATURAL SURFACE CONTOUR
- 79.2 — DESIGN SURFACE CONTOUR
- TABLE DRAIN
- EXISTING HEADWALL
- PROPOSED HEADWALL
- LIMIT OF CONSTRUCTION — LIMIT OF WORKS
- PIT 1/2 — PIT NUMBER
- SS — SUBSOIL DRAINAGE LINE
- GRATED SURFACE INLET PIT
- SEALED PIT
- KERB INLET PIT

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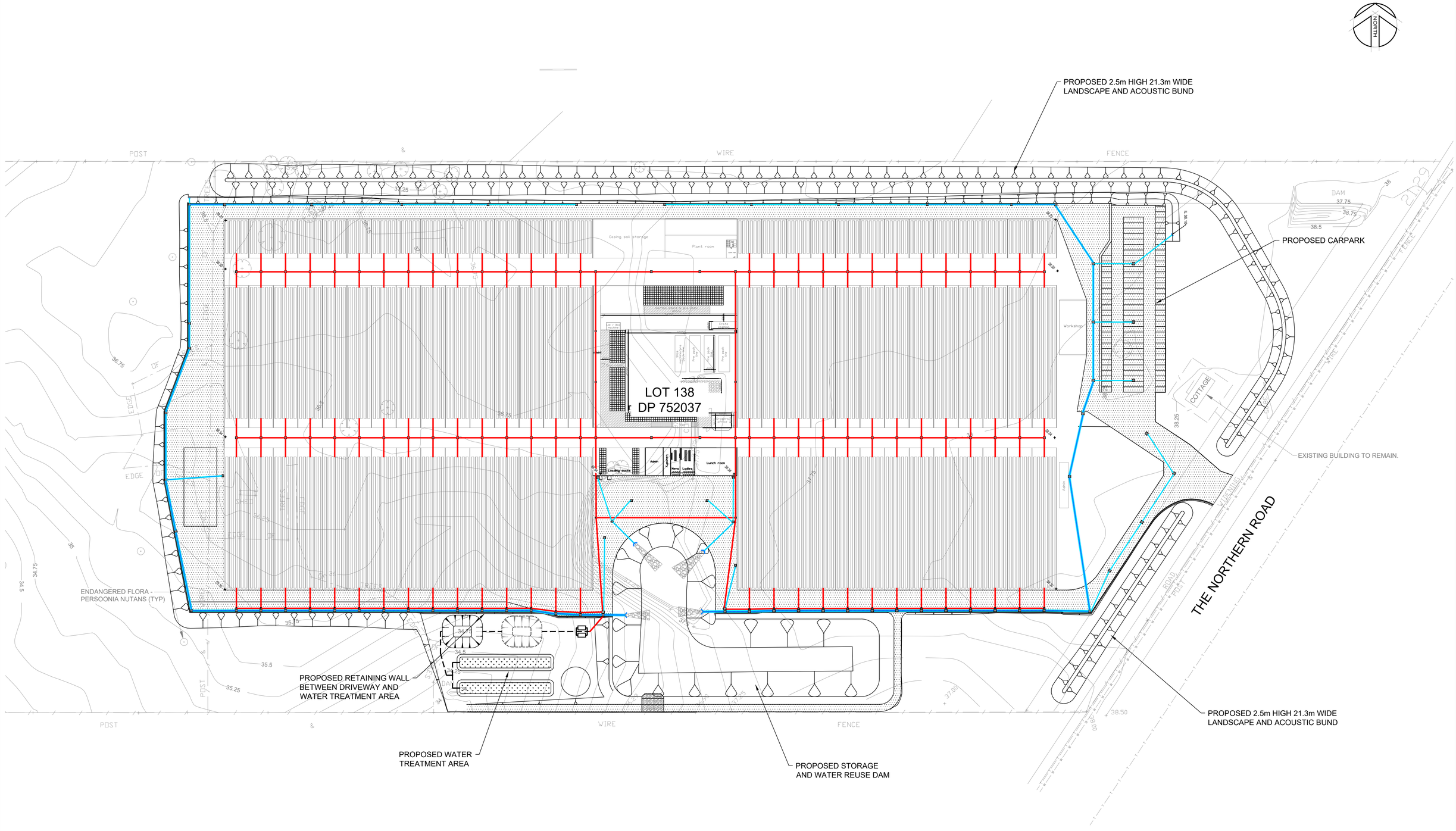
A1



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GENERAL ARRANGEMENT PLAN

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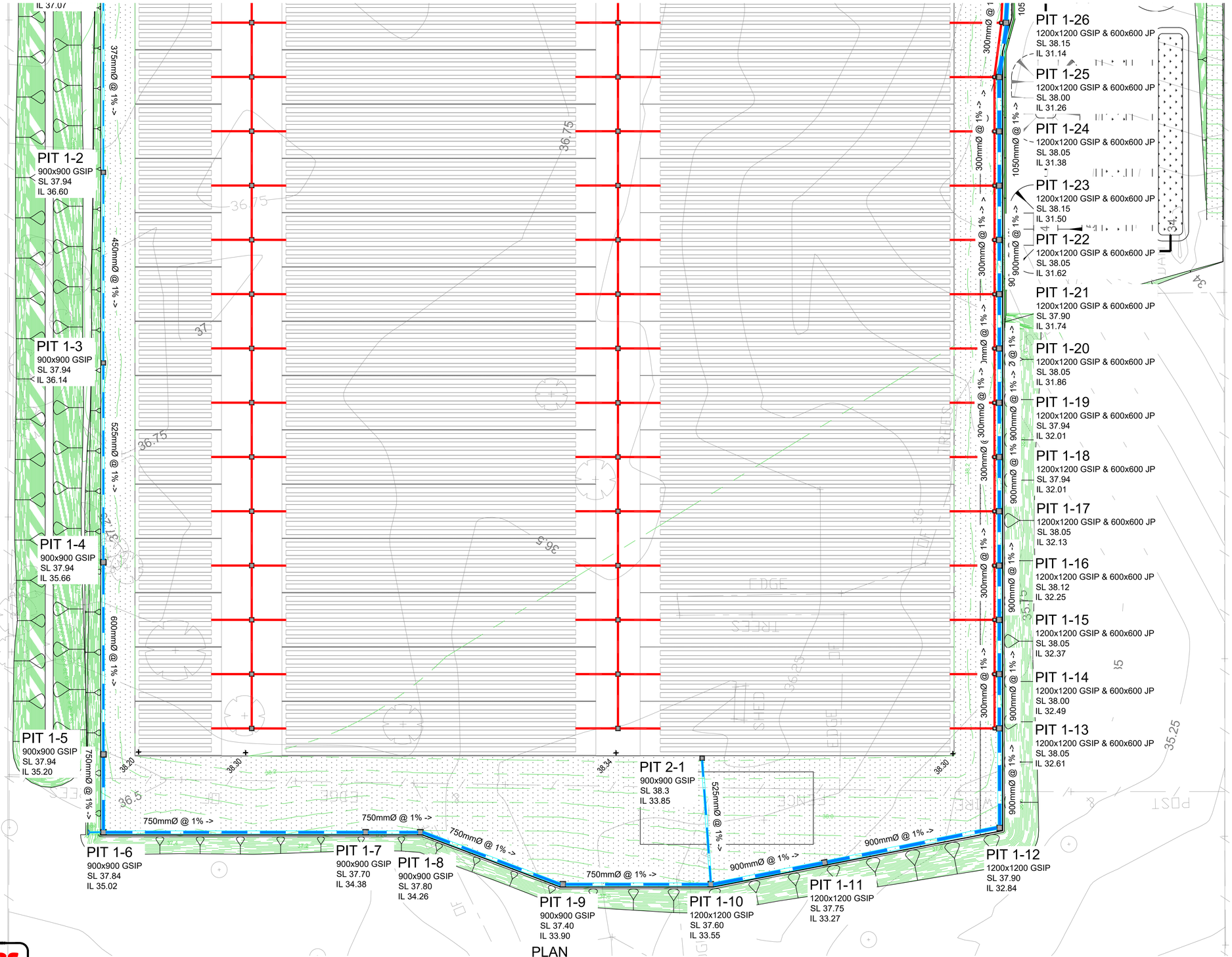

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DRAINAGE DETAIL PLAN SHEET 1

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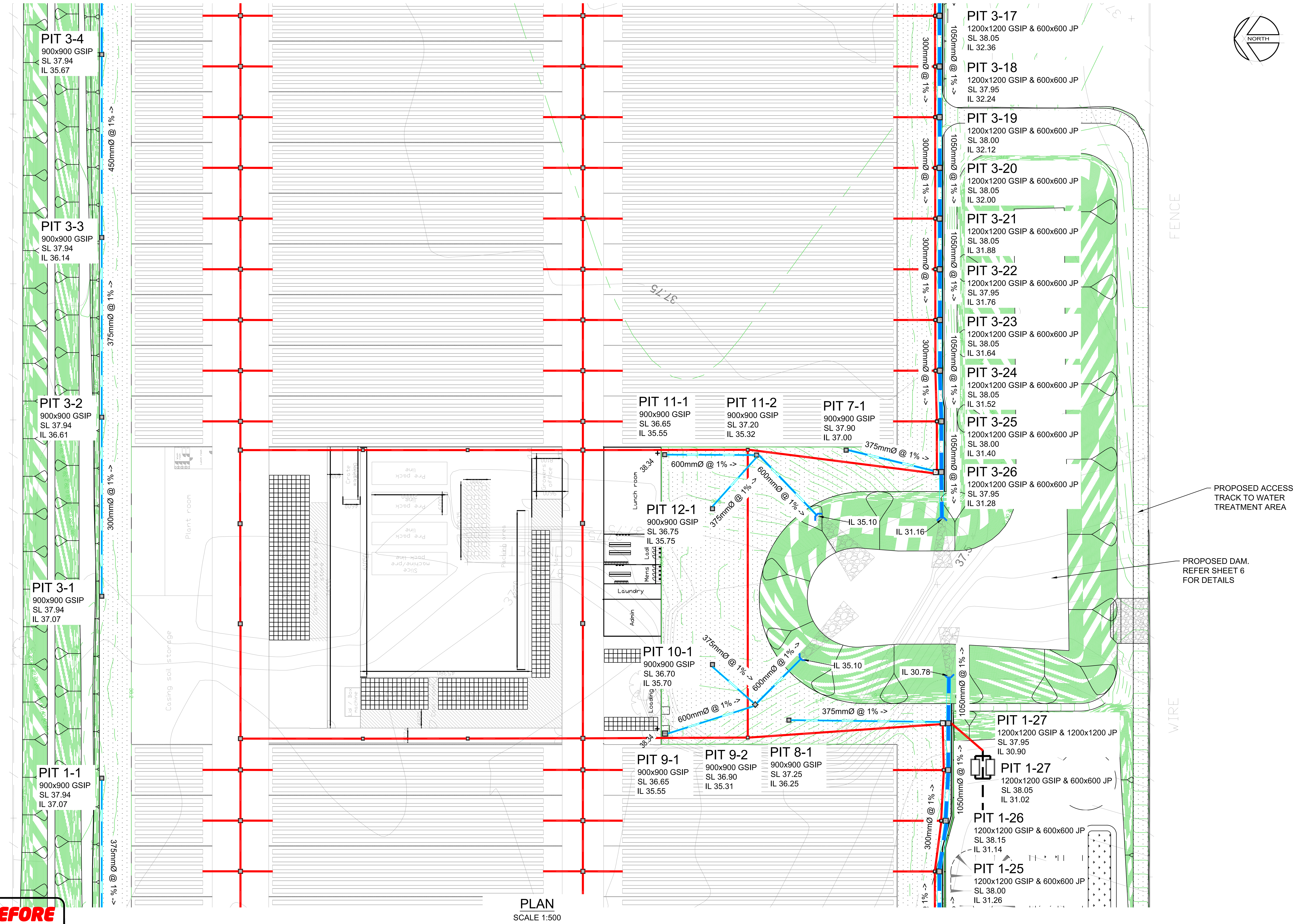

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DRAINAGE DETAIL PLAN SHEET 2

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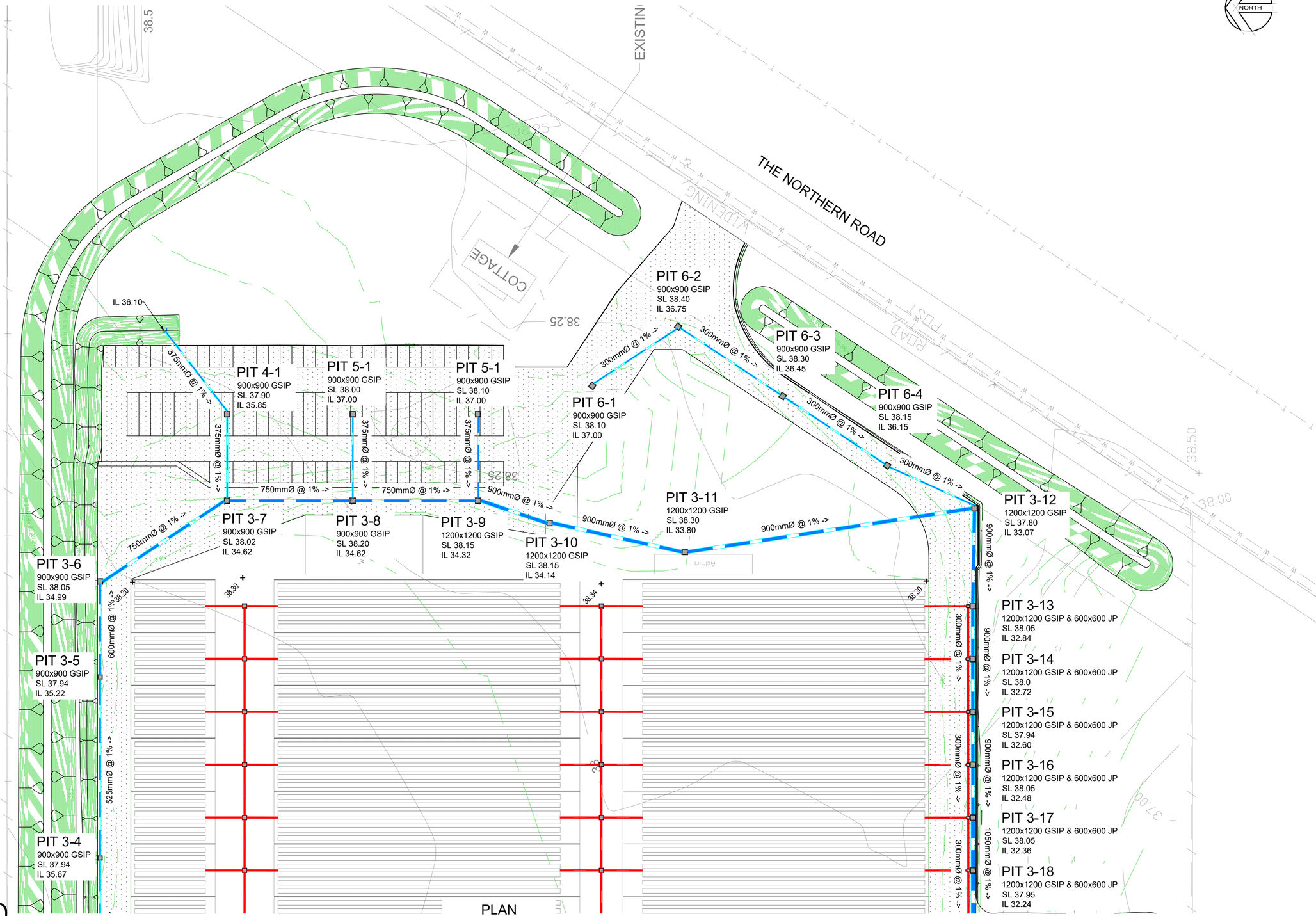

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DRAINAGE DETAIL PLAN SHEET 3

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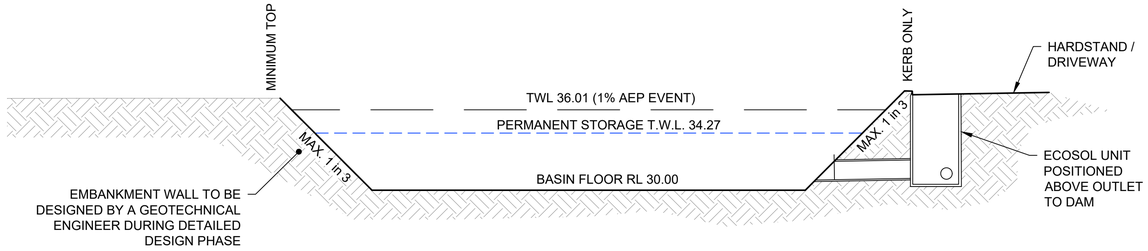
BASIN VOLUMES

PERMANENT STORAGE = 14,700L
ONSITE DETENTION = 12,500L
TOTAL VOLUME = 27,200L



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OSD BASIN DETAIL PLAN

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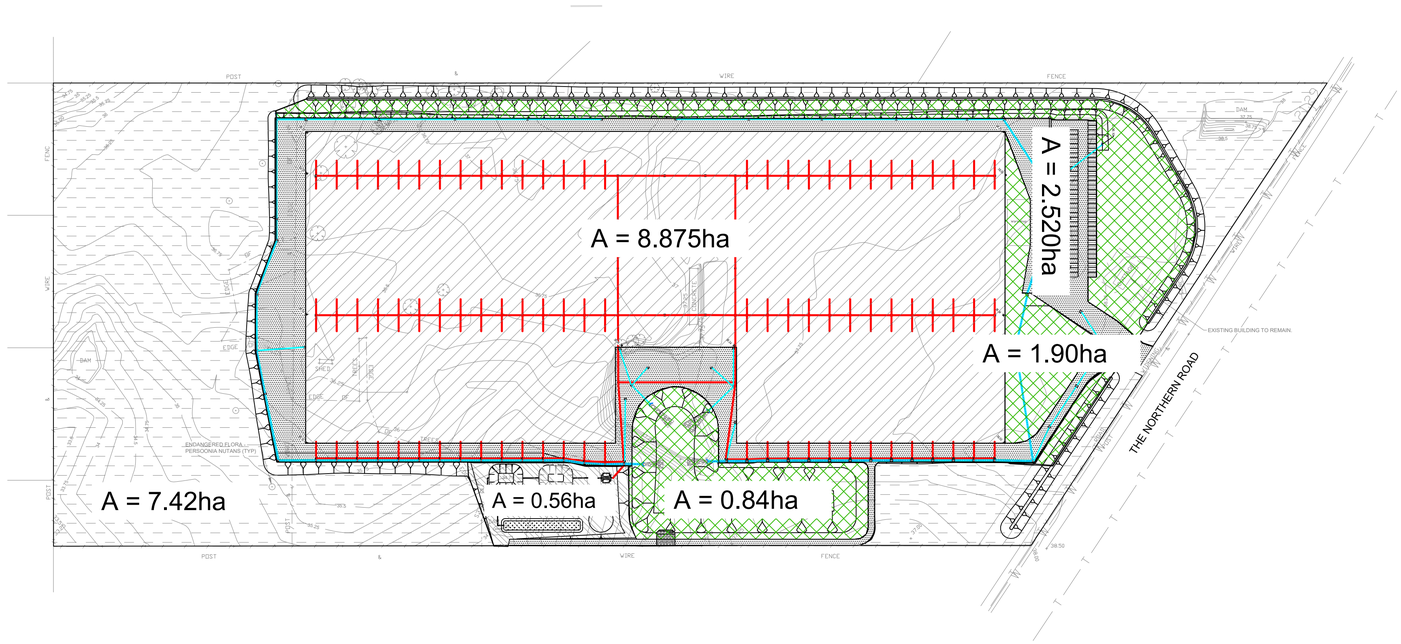

LEGEND

- BYPASS
- BUILDING PAD
- ROAD SURFACE
- PERVIOUS AREA TO DAM / OSD
- MODIFIED AREA BYPASSING DAM

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CATCHMENT PLAN

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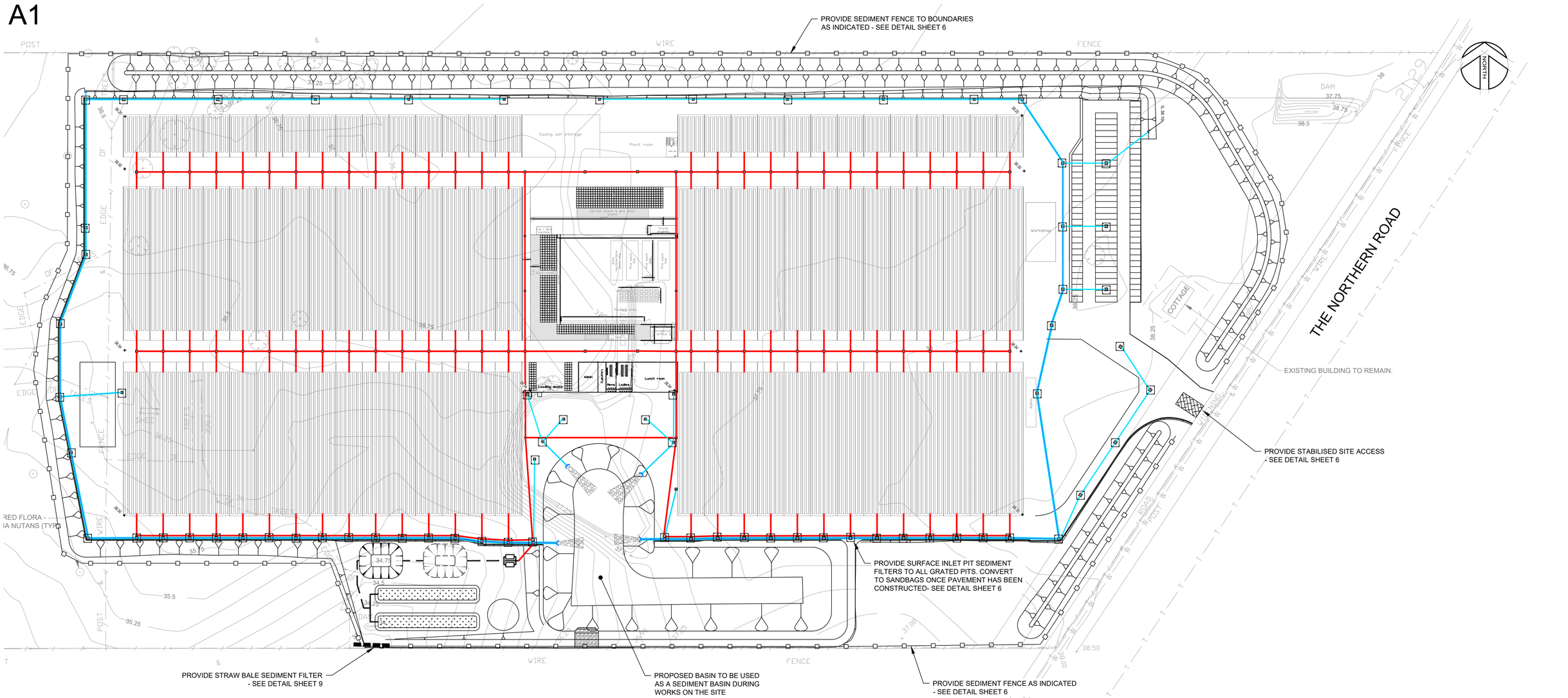


EROSION AND SEDIMENT CONTROL PLAN

SCALE 1:1000

EROSION AND SEDIMENTATION CONTROL NOTES

1. PRIOR TO THE COMMENCEMENT OF SITE DISTURBANCE, THE CONTRACTOR SHALL ESTABLISH ALL NECESSARY EROSION AND SEDIMENTATION CONTROL MEASURES IN ACCORDANCE WITH THIS PLAN, COUNCIL'S "CIVIL WORKS SPECIFICATION, PART 2 -CONSTRUCTION", AND THE NSW DEPARTMENT OF HOUSING'S PUBLICATION "MANAGING URBAN STORMWATER - SOILS AND CONSTRUCTION".
2. THE LOCATION OF EROSION AND SEDIMENTATION CONTROL DEVICES SHOWN ON THIS PLAN ARE INDICATIVE ONLY AND SHOULD BE ADJUSTED TO SUIT SITE CONDITIONS.
3. WHERE WORKS ARE DELAYED OR IN ABEYANCE AND DISTURBED AREAS ARE LIKELY TO BE EXPOSED FOR A PERIOD OF TWO MONTHS OR MORE, TEMPORARY REHABILITATION WORKS SHALL BE UNDERTAKEN TO PROTECT THE SITE.
4. ALL DISTURBED AREAS SHALL BE TOPSOILED, SEEDED AND MULCHED WITHIN 20 DAYS OF THE COMPLETION OF THE WORKS.
5. ALL AREAS WITH SLOPES STEEPER THAN 12% (1 in 8) SHALL BE STRAW MULCHED IN CONJUNCTION WITH SEEDING, OR TURFED.
6. SILT BARRIERS LOCATED AROUND KERB INLET AND ROAD PITS SHALL BE REINSTATED FOLLOWING ROAD PAVING WORKS IF IT IS LIKELY THAT UNDISTURBED AREAS WILL STILL DRAIN TO THE PIT.
7. SANDBAGS SHALL BE PLACED ACROSS THE END OF ROAD CONSTRUCTION AT THE COMPLETION OF EACH DAYS WORK TO PREVENT EROSION OF THE CONSTRUCTED MATERIAL.
8. THE CONTRACTOR SHALL CONDUCT WEEKLY INSPECTIONS OF THE SITE TO ENSURE THAT ALL DEVICES AND REHABILITATION AREAS HAVE BEEN ADEQUATELY MAINTAINED. THE CONTRACTOR SHALL ALSO KEEP A LOG BOOK DETAILING SUCH INSPECTIONS, AND RECORDING RAINFALL EVENTS AND OTHER RELEVANT EVENTS.
9. TOPSOIL SHALL BE STOCKPILED IN THE LOCATIONS SHOWN ON THIS PLAN OR AS DIRECTED BY COUNCIL'S ENGINEER. WHERE IT IS LIKELY THAT STOCKPILES WILL REMAIN IN PLACE FOR A PERIOD EXCEEDING 4 WEEKS, THEN THE STOCKPILE SHALL BE STABILISED BY SEEDING OR EQUIVALENT METHODS.

EROSION AND SEDIMENTATION CONTROL NOTES CONT.

10. ALL REVEGETATION WORKS ARE TO BE MAINTAINED, INCLUDING WATERING AND MOWING WHERE NECESSARY UNTIL THE COMPLETION OF THE MAINTENANCE PERIOD.
11. THE MOVEMENT OF VEHICULAR TRAFFIC ON THE SITE SHALL BE CONFINED TO DESIGNATED AREAS DURING CONSTRUCTION WORKS. VEHICULAR ACCESS SHALL BE DENIED TO AREAS TO BE LEFT UNDISTURBED.
12. SITE ACCESS SHALL BE LIMITED TO THE LOCATIONS SHOWN ON THIS PLAN. SHAKE-DOWN AREAS SHALL BE CONSTRUCTED AS SHOWN.
13. DURING CONSTRUCTION WORKS, DUST CONTROL MEASURES SHALL BE IMPLEMENTED TO MINIMISE THE AMOUNT OF DUST GENERATED FROM THE SITE. THESE MEASURES TO BE IMPLEMENTED TO COUNCIL'S SATISFACTION.
14. MAINTENANCE AND CLEANING OF CONSTRUCTION PLANT SHALL BE CARRIED OUT IN AN AREA WHERE RUNOFF CAN BE CONTAINED AND APPROPRIATELY TREATED AND DISPOSED OF.
15. ALL EROSION AND SEDIMENTATION CONTROL DEVICES SHALL REMAIN IN PLACE UNTIL ALL DISTURBED AREAS HAVE ADEQUATELY REGENERATED. THIS STAGE SHALL BE DETERMINED BY THE CERTIFIER.

LEGEND

- PROPOSED HEADWALL
- DIVERSION BANK
- SILT FENCE
- STRAW BALE BARRIER
- GRAVEL SHAKER PAD AT ENTRANCE TO WORKS
- S.P. — TOPSOIL STOCKPILE SITE
- SURFACE INLET PIT SEDIMENT FENCE
- SANDBAG/FILTER SAUSAGE SEDIMENT BARRIER

20 0 20 40 60 80 100 METRES 1:1000

REV	AMENDMENT	ISSUED	DATE
A	FIRST ISSUE	GJ	15/03/18
B	BUNKER ADDED	GJ	23/03/18
C	OSD AMENDED	GJ	19/02/19

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION
SYDNEY P: 02 9659 0005
CENTRAL COAST P: 02 4325 5255
HUNTER P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

Client:

ELF MUSHROOMS
BECKHART PTY LTD

PROPOSED MUSHROOM FARM
521-555 THE NORTHERN ROAD
LONDONDERRY

EROSION AND SEDIMENT CONTROL PLAN

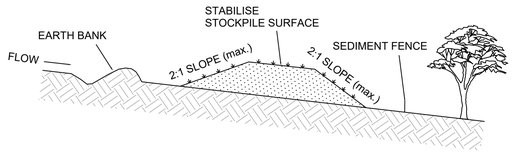
Designed: AJS
Drawn: AJS
Checked: GJ

Scales: Plan 1:1000
Horiz. -
Vert. -
X-Sect. -

Datum: A.H.D.

Plan No.
SY180007E1-08
File Ref. SY180007E1
REV. C
SHEET 8 OF 9 SHEETS

A1



CONSTRUCTION NOTES

1. WHERE POSSIBLE LOCATE STOCKPILE AT LEAST 5 METRES FROM EXISTING VEGETATION, CONCENTRATED WATER FLOWS, ROADS, HAZARD AREAS AND MIN. 1.5m AWAY FROM EMBANKMENTS.

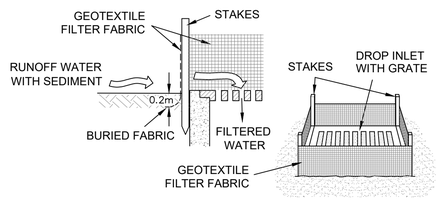
2. CONSTRUCT ON THE CONTOUR AS A LOW, FLAT ELONGATED MOUND.

3. WHERE THERE IS SUFFICIENT AREA TOPSOIL STOCKPILES SHALL BE LESS THAN 2 METRES IN HEIGHT.

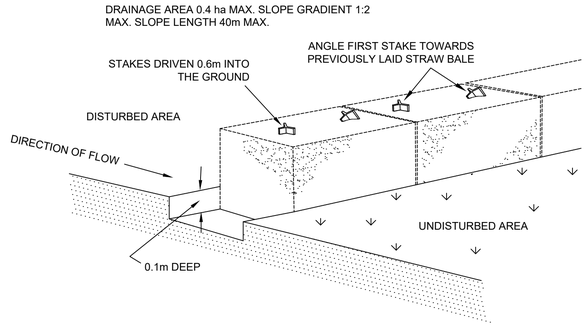
4. REHABILITATE IN ACCORDANCE WITH THE SWMP/ESCP.

5. CONSTRUCT EARTH BANK (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT RUN OFF AROUND THE STOCKPILE AND A SEDIMENT FENCE (STANDARD DRAWING 6-8) 1 TO 2 METRES DOWNSLOPE OF STOCKPILE.

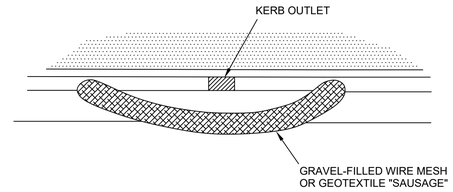
TOPSOIL STOCKPILE



SURFACE INLET PIT SEDIMENT TRAP



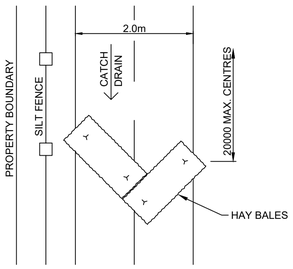
STRAW BALE SEDIMENT FILTER



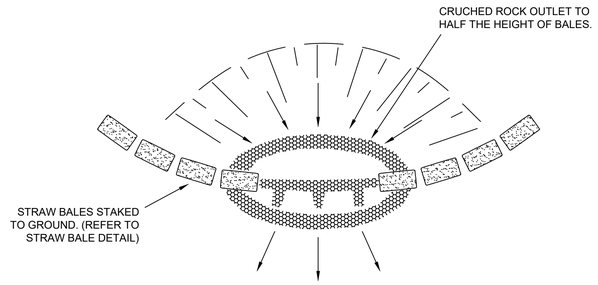
CONSTRUCTION NOTES

1. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH AND FILL IT WITH 25mm TO 50mm GRAVEL.
2. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH X 400mm WIDE.
3. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING FILTER.
4. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

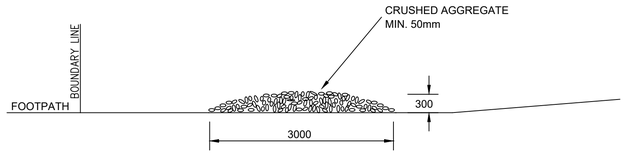
MESH & GRAVEL FILTER "SAUSAGE" BARRIER



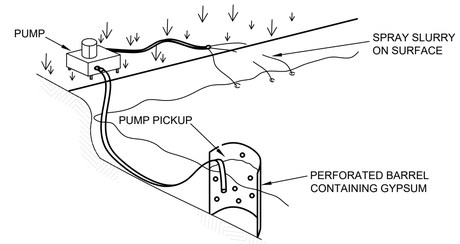
CATCH DRAIN DETAIL



STRAW BALE & CRUSHED ROCK SEDIMENT FILTER



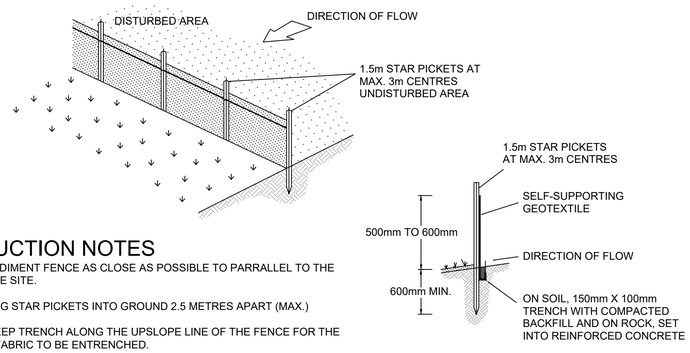
VEHICLE DUST SHAKE DOWN DETAIL



NOTE:
1. FLOCCULATION TO BE USED IF WATER IS NOT CLEAR (IE: SEDIMENT GREATER THAN 50 mg/L) PRIOR TO DISCHARGING FROM TEMPORARY PUMP OUT

2. FOR RATES & AGENTS SEE APPENDIX E OF HOUSING NSW "MANAGING URBAN SW SOILS & CONSTRUCTION".

FLOCCULATION DETAIL



CONSTRUCTION NOTES

1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARRALLEL TO THE CONTOURS OF THE SITE.

2. DRIVE 1.5m LONG STAR PICKETS INTO GROUND 2.5 METRES APART (MAX.)

3. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.

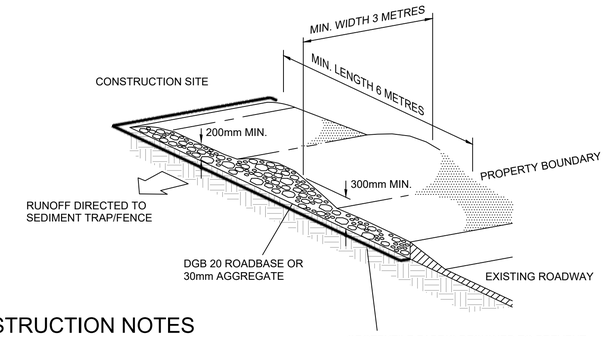
4. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER.

5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.

6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

SEDIMENT FENCE

SECTION DETAIL



CONSTRUCTION NOTES

1. STRIP TOPSOIL AND LEVEL SITE.

2. COMPACT SUBGRADE.

3. COVER AREA WITH NEEDLE-PUNCHED GEOTEXTILE.

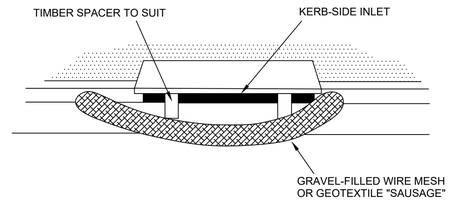
4. CONSTRUCT 200mm THICK PAD OVER GEOTEXTILE USING ROADBASE OR 30mm AGGREGATE. MINIMUM LENGTH 15 METRES OR TO BUILDING ALIGNMENT. MINIMUM WIDTH 3 METRES.

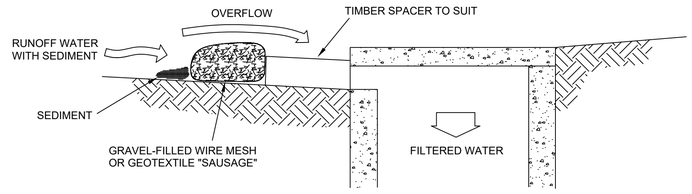
5. CONSTRUCT HUMP IMMEDIATELY WITHIN BOUNDARY TO DIVERT WATER TO A SEDIMENT FENCE OR OTHER SEDIMENT TRAP.

GEOTEXTILE FABRIC DESIGNED TO PREVENT INTERMIXING OF SUBGRADE AND BASE MATERIALS AND TO MAINTAIN GOOD PROPERTIES OF THE SUB-BASE LAYERS.

GEOFABRIC MAY BE A WOVEN OR NEEDLE PUNCHED PRODUCT WITH A MINIMUM CBR BURST STRENGTH (AS3706.4-90) OF 2500 N

STABILISED SITE ACCESS





CONSTRUCTION NOTES

1. INSTALL FILTERS TO KERB INLET ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH X 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

MESH & GRAVEL INLET "SAUSAGE" FILTER

REV	AMENDMENT	ISSUED	DATE
A	FIRST ISSUE	GJ	15/03/18
B	BUNKER ADDED	GJ	23/03/18
C	OSD AMENDED	GJ	19/02/19

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
HUNTER
P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

Client:

ELF MUSHROOMS
BECKHART PTY LTD

PROPOSED MUSHROOM FARM
521-555 THE NORTHERN ROAD
LONDONDERRY

EROSION AND SEDIMENT CONTROL DETAILS

Designed: AJS
Drawn: AJS
Checked: GJ

Scales: Plan -
Horiz. -
Vert. -
X-Sect. -

Datum: A.H.D.

Plan No.
SY180007E1-09
File Ref. SY180007E1
REV. C
SHEET 9 OF 9 SHEETS

Appendix B

Maintenance Schedule

On-site Detention Maintenance Schedule

On-site Detention and Drainage Structures Maintenance Schedule

Site: 106-116 Old Pitt Town Road, Box Hill
Prepared By: Barker Ryan Stewart Pty Ltd
Date: January 2019

Maintenance Action	Frequency	Responsibility	Procedure
OSD system and Discharge Control Pits (DCP)			
Inspect & remove any blockage on orifice	Six monthly	Owner	Remove grate & screen to inspect orifice. See plan for location of DCP
Check attachment of orifice plate to wall of pit (gaps less than 5mm)	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate mounted securely, tighten fixings if required. Seal gaps as required.
Check orifice diameter correct and retains sharp edge	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Inspect screen and clean	Six monthly	Owner	Remove grate and screen if required to clean it.
Check attachment of screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure screen fixings secure. Repair as required.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and examine screen for rust or corrosion, especially at corners or welds.
Inspect pit walls (internal and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect grate for damage or blockage	Six monthly	Owner	Check both sides of grate for corrosion, (especially corners and welds) damage or blockage.
Inspect outlet pipe and remove any blockage	Six monthly	Maintenance Contractor	Remove grate and screen. Ventilate any sumps if present. Check orifice and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.
Check step irons for corrosion (if applicable)	Annually	Maintenance Contractor	Remove grate. Examine step irons and repair any corrosion or damage.

Check fixing of step irons is secure (if applicable)	Six monthly	Maintenance Contractor	Remove grate and ensure fixings secure prior to placing weight on step iron.
Maintenance Action	**Frequency**	**Responsibility**	**Procedure**
Minor Pits			
Inspect pit and remove any sediment/sludge in pit	Six monthly	Owner	Remove grate and screen. Remove sediment/sludge build-up.
Inspect internal walls of pits (and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect and remove any debris/litter/ mulch etc blocking grates of pits	Six monthly	Owner	Remove blockages from grate and check if pit blocked.
Spillway			
Check for correct level, inspect concrete (where applicable) for cracks or spalling	Annually	Owner	Ensure spillway crest level has not been altered or obstructed. Clear any sediment or debris and repair as required.
Basin area			
Inspect storage areas and check for obstructions which may reduce storage volume or impede overland flow of runoff	Six monthly	Owner	Check for unauthorised storage of materials, stockpiles, plants etc and arrange for removal from storage areas.
Inspect storage areas and remove debris/mulch/litter etc likely to block screens/ grates	Six monthly	Owner	Remove debris and floatable material likely to be carried to grates.
Compare storage volume to volume approved. (Rectify if loss >5%)	Annually	Maintenance Contractor	Compare actual storage available with Work-as-Executed plans. If volume loss is greater than 5% arrange for reconstruction to replace the volume lost. Council to be notified of the proposal.
Inspect storages for subsidence near pits	Annually	Maintenance Contractor	Check along drainage lines and at pits for subsidence likely to indicate leakages.

Prepared by: .....
Garry Ryan MIEAust CPEn

Water Quality Structures Maintenance Schedule

Site: **106-116 Old Pitt Town Road, Box Hill**
Prepared By: **Barker Ryan Stewart Pty Ltd**
Date: **January 2019**

Maintenance Action	Frequency	Responsibility	Procedures/ Notes
Inlet and outlet pits (bio pits/raingarden pits)	Six monthly and after each major storm event	Maintenance Contractor	Remove grate to inspect base, remove any blockage and ensure structures are free of debris and sediment build up. Inspect the sediment build up within any sumps and clean out where necessary.
Basin Inflow and Outflow Systems	Six monthly and after each major storm event	Owner	Inspect basin inlets and surrounding areas for scour and litter build up, remove debris and re-establish scour protection where required. Inspect the flow spreader to ensure no blockages and clean any debris.
Subsoil lines	Annually	Owner	Remove capped inspection risers and flush out the pipes, making note of the amount of sediment washed into the collection pit.
Basin Vegetative Cover	Annually and after each major storm event	Owner	Inspect bio-retention surface, remove litter and debris and repair eroded areas by distributing new grass cover or re-mulching.
Basin plant establishment	Daily for at least 2 weeks after construction, weekly thereafter or as required for the first two years	Owner	Water plants/grass. Ensure healthy vegetation, remove and replace any dead or diseased vegetation, remove invasive weeds (herbicides should not be used), prune planting to stimulate growth.
Basin Surface rejuvenation	six monthly	Owner	Remove litter and plant debris. Remove any degraded and/or spoiled discoloured planting medium and top layer of fill soil and replace with fresh mix when ponding of water lasts for more than 12 hours. . Should there be ponding within the basin for a period of 12 hours or more after a rainfall event then an insitu permeability test shall be undertaken in accordance with FAWB Practice Note 1: Insitu Measurement of Hydraulic Conductivity and should this show that the permeability of the filter material does not comply with infiltration rates then reconstruction of the bio basin is required.
Basin Plant Management	Annually	Owner	Ensure healthy vegetation, remove and replace any dead or diseased vegetation, remove invasive weeds (herbicides should not be used), prune planting to stimulate growth. Water all vegetation areas throughout periods of persistent drought.

Prepared by: .....
Garry Ryan MIEAust CPEng

Appendix C

Maintenance Inspection Records

On-site Detention and Drainage Structures Maintenance Inspection Record

Site: 106-116 Old Pitt Town Road, Box Hill
Structures: Above ground basins and structures
Inspection By: **Date:** / /

Maintenance Action	Date Inspected	Inspection Result	Comments
OSD System and Discharge Control Pits (DCP)			
Inspect & remove any blockage or orifice		❑ OK ❑ Not OK	
Check attachment of orifice plate to wall of pit (gaps less than 5mm)		❑ OK ❑ Not OK	
Check orifice diameter correct and retains sharp edge		❑ OK ❑ Not OK	
Inspect screen and clean		❑ OK ❑ Not OK	
Check attachment of screen to wall of pit		❑ OK ❑ Not OK	
Check screen for corrosion		❑ OK ❑ Not OK	
Inspect DCP walls (internal and external, if appropriate) for cracks or spalling		❑ OK ❑ Not OK	
Inspect grate for damage or blockage		❑ OK ❑ Not OK	
Inspect outlet pipe and remove any blockage		❑ OK ❑ Not OK	
Check step irons for corrosion (if applicable)		❑ OK ❑ Not OK	
Check fixing of step irons is secure (if applicable)		❑ OK ❑ Not OK	
Minor Pits			

Maintenance Action	Date Inspected	Inspection Result	Comments
Inspect pit and remove any sediment/sludge in pit		❑ OK ❑ Not OK	
Inspect internal walls of pits (and external, if appropriate) for cracks or spalling		❑ OK ❑ Not OK	
Inspect and remove any debris/litter/ mulch etc blocking grates of pits		❑ OK ❑ Not OK	
Spillway			
Check for correct level, inspect concrete (where applicable) for cracks or spalling		❑ OK ❑ Not OK	
Basin area			
Inspect storage areas and check for obstructions which may reduce storage volume or impede overland flow of runoff		❑ OK ❑ Not OK	
Inspect storage areas and remove debris/mulch/litter etc likely to block screens/ grates		❑ OK ❑ Not OK	
Compare storage volume to volume approved. (Rectify if loss >5%)		❑ OK ❑ Not OK	
Inspect storages for subsidence near pits		❑ OK ❑ Not OK	

Water Quality Structures Inspection Record

Site: **106-116 Old Pitt Town Road, Box Hill**

Inspection By: **Date:** / /

Maintenance Action	Date Inspected	Inspection Result	Comments
Inlet and outlet pits		❑ OK ❑ Not OK	
Basin Inflow and Outflow Systems		❑ OK ❑ Not OK	
GPT structures		❑ OK ❑ Not OK	
		❑ OK ❑ Not OK	
		❑ OK ❑ Not OK	
		❑ OK ❑ Not OK	
		❑ OK ❑ Not OK	