Warren Smith & Partners

24th August 2017

CIVIL ENGINEERING SERVICES

Macarthur Memorial Park, Varroville

Development Application Report

DOCUMENT CONTROL

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APPROVALS

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Rev #	**Author**	**Status**	**Reviewer**	**Approval**

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1. INTRODUCTION

Warren Smith & Partners (WS+P) has been engaged by the Catholic Metropolitan Memorial Trust (CMMT) to prepare a development application (DA) report for the proposed works located at St Andrews Road, Varroville. This report outlines the stormwater strategy plan and road design associated with the proposed development and aims to address the following: -

- Stormwater drainage works;
- Proposed road design and;
- Sediment and erosion control.

1.1 BACKGROUND

The existing greenfield site is located at St Andrews Road, Varroville NSW, approximately 8km north east of Campbelltown Centre. It is proposed that the site is developed into a cemetery to ensure the continued availability of burial space for the increasing population of greater Sydney. The site is located between Camden Valley Way and the Hume Highway, south of Saint James Road and encompasses several parcels of land known as Lot B, Lot 22 and Lot 1. The development will include the construction of six (6) buildings as follows: -

- Gatehouse information building near the main entrance;
- Chapel;
- Café and flower shop;
- Function Room;
- Ground staff facilities building, and;
- Administration building.

Carpark areas are to be constructed adjacent to the café, the chapel building and the function room. The development will also see the construction of approximately 7.5km of road to facilitate movement across the site.

Please refer to Figure 1 for an aerial view of the development site.

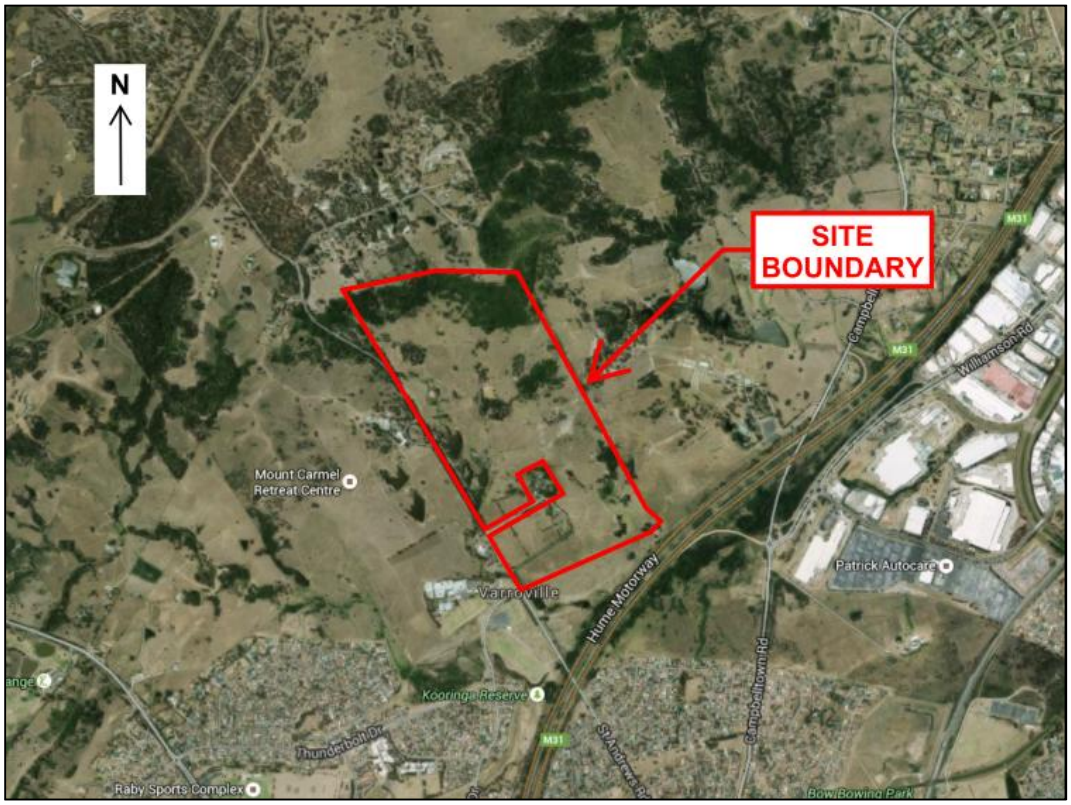


Figure 1: Aerial View of Development Area *(Source: GoogleMaps)*

2. EXISTING STORMWATER INFRASTRUCTURE

A desktop review and site inspection was undertaken in order to determine the existing drainage infrastructure within the development site. The inspection revealed the following: -

- There is a ridge line which runs in a north-south direction in the north east quadrant of site. Water on the eastern side of this ridge line currently runs into the neighbouring property.

- The northern quarter of site grades in a southerly direction at approximately 20%.

- There are a number of verified streams on site which have been classified from Class 1 to Class 3 by Travers Consultants as per the Office of Water guidelines. Please refer to Figure 2 for details of the existing streams.

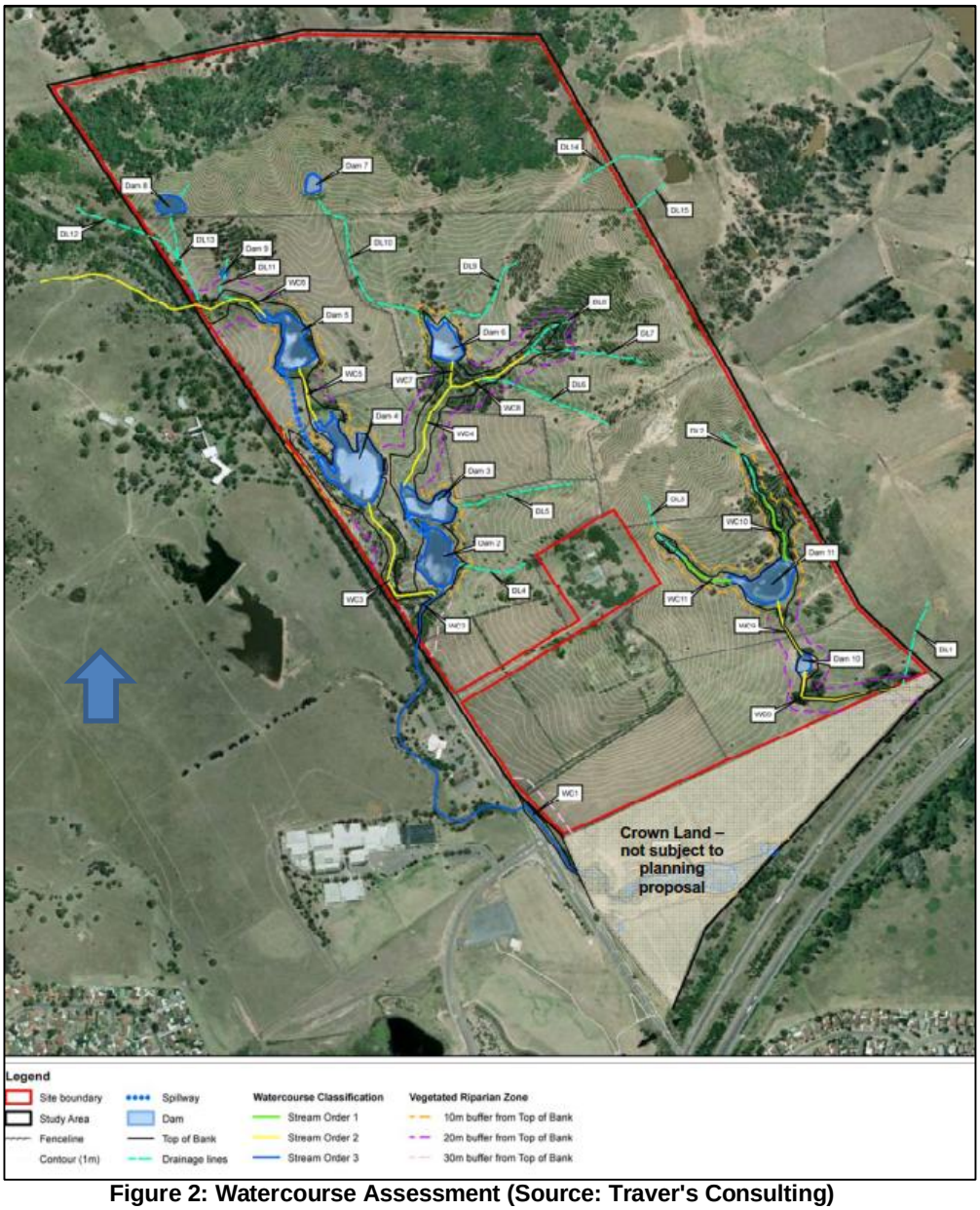


Figure 2: Watercourse Assessment (Source: Traver's Consulting)

- There are three (3) stormwater underline road crossings from the development which traverses St Andrews Road. The most northern crossing is one (1) DN375 pipe, the middle crossing is two (2) DN625 pipes and the southern crossing includes three (3) DN1600 pipes.

- There are nine (9) existing dams on site which are currently drawn from for farming purposes.

- Due to the topography of the site, no catchment area outside the site boundary drains through the property.

- The site surrounds an existing property and driveway known as Varroville House.

Please refer to Figure 3 below for an illustration of the site characteristics.

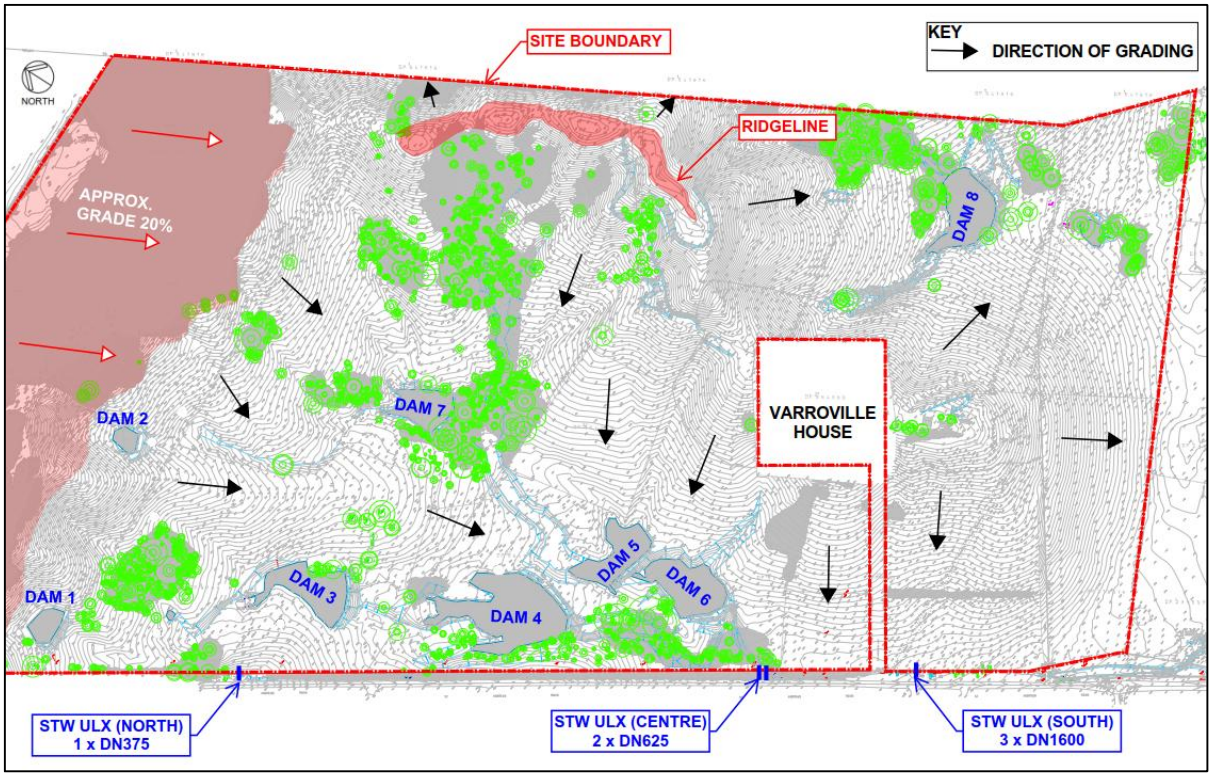


Figure 3: Aerial View of Existing Site Conditions

3. AUTHORITY AND REGULATORY REQUIREMENTS

With reference to the Campbelltown *Development Control Plan (DCP) 2009 – Volume 2* and *Engineering Design for Development – Chapter 4 Stormwater Design,* the council requirements are as follows: -

3.1 STORMWATER DRAINAGE

- All piped stormwater systems shall be designed to cater for storm events up to and including the 10% AEP event, and;
- Overland flow must be designed to cater for storm events up to and including the 1% AEP storm event.

4. PROPOSED ROAD DESIGN

4.1 ALIGNMENT AND LAYOUT

The road alignment was developed to promote ease of access throughout the site. In order to minimise the batter extents from the roads and minimise earthworks required during construction, the longitudinal grade of the roads aim to match the existing topography of the land as much as possible. In all areas where possible, batters from the road connecting to the existing landscape were maintained at 1:6 and to minimise earthworks across the site, certain areas will utilise retaining walls or smaller batters where pedestrian access is not imperative.

Additional considerations to the layout include the movement of hearses across the site. To ensure that there are no issues in vehicle movement, the maximum longitudinal grade for all roads has been set at 10%.

The impact of any road traversing the existing curtilage zone was also carefully considered to ensure minimal works are undertaken in this area. The curtilage zone is the only location which allows access from the northern side to the southern side of the site. Please refer to Figure 4 for details on the extent of the curtilage zone.

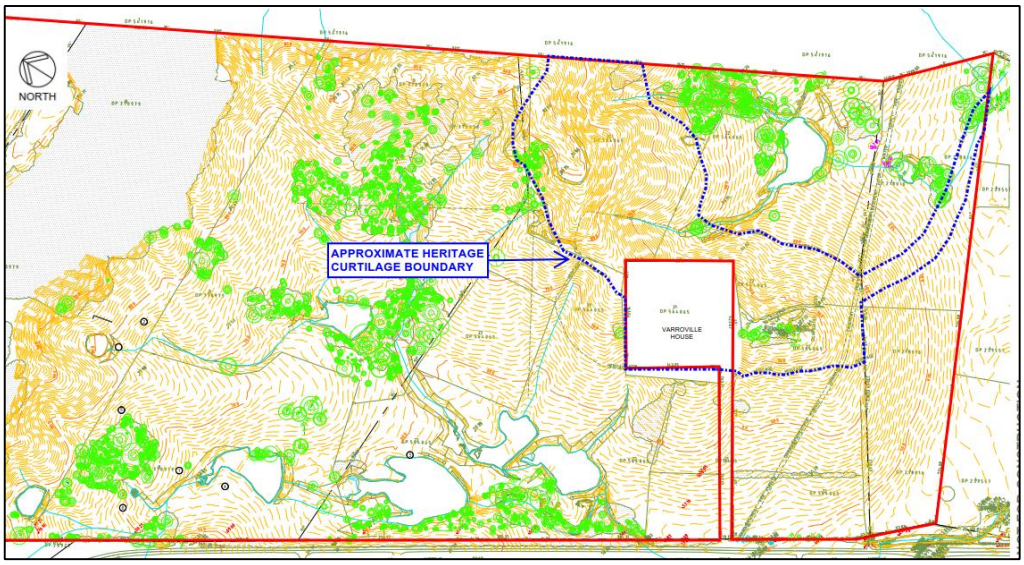


Figure 4: Heritage Curtilage Boundary

It is proposed that one road will run through this area to accommodate access across the site. Three options were considered for this section of the road network. The first option included a winding road which wraps around the existing ridgeline, follows the existing topography for a small period before traversing the contours and connects into a road south east of Varroville house.

Please refer to Figure 5 and Figure 6 for details of the plan layout with proposed batters and longitudinal section through the road.

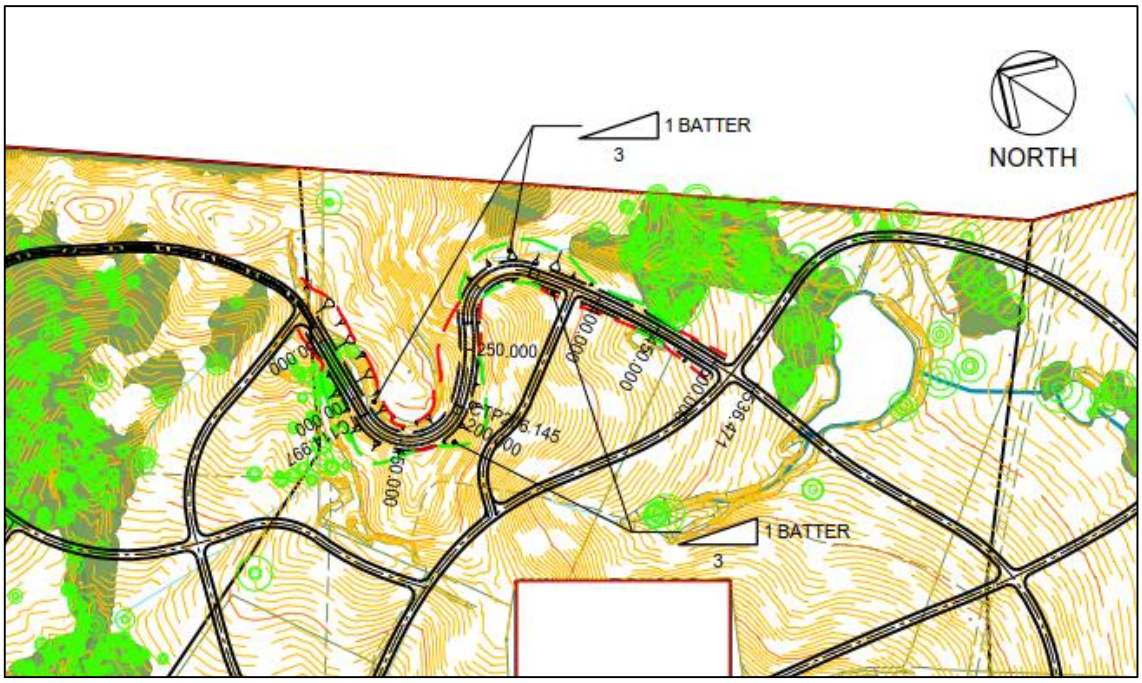


Figure 5: Option 1 Road Layout

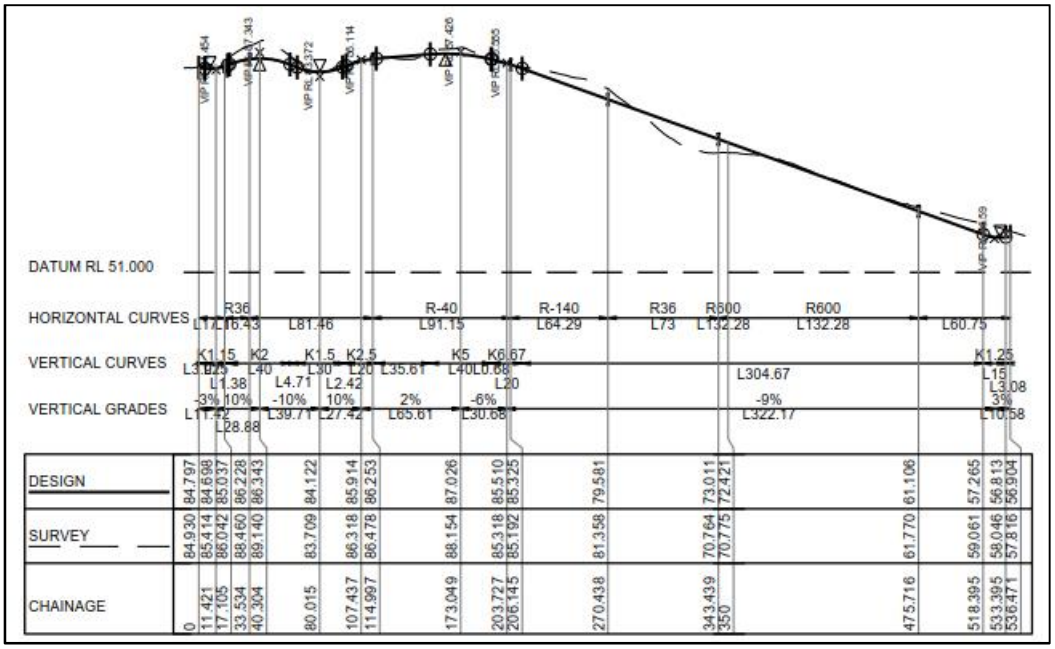


Figure 6: Option 1 Road Longitudinal Section

Although this option has the benefits of maintaining the existing topography for the most part, it was deemed to be visually intrusive to the sight lines stemming from Varroville house as it sits close to the apex of the existing ridgeline. It is also a very indirect path connecting the northern and southern sides of the site which would result in a greater overall construction area.

A second, more direct, option was considered, the road was modelled running parallel along the eastern boundary and on the other side of the existing ridge, minimising visual impacts from Varroville House. Please refer to Figure 7 and Figure 8 for details.

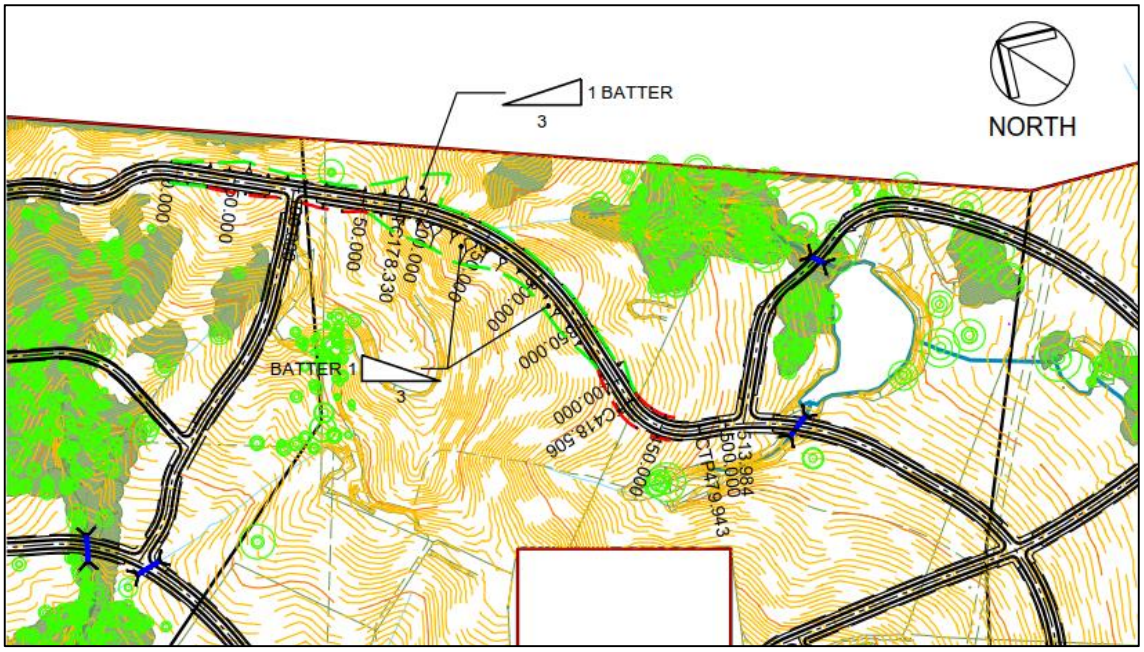


Figure 7: Option 2 Road Layout

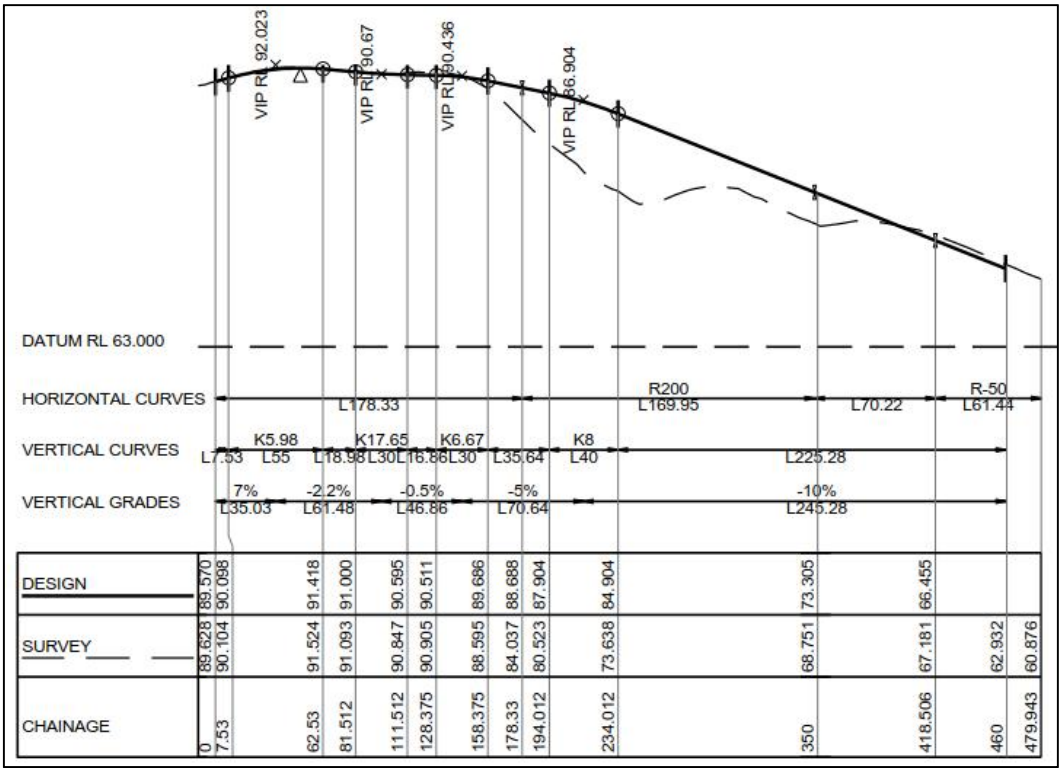


Figure 8: Option 2 Road Longitudinal Section

For this option to match the existing grade of the land, the road longitudinal grade would surpass the 10% maximum grade required for hearses. Therefore, to maintain a maximum grade of 10%, the road area would need to be filled in some locations upwards of 10m and would result in the road appearing much more prominently throughout the landscape.

The final and most preferred option takes the access road just behind Varroville House as seen in Figure 9.

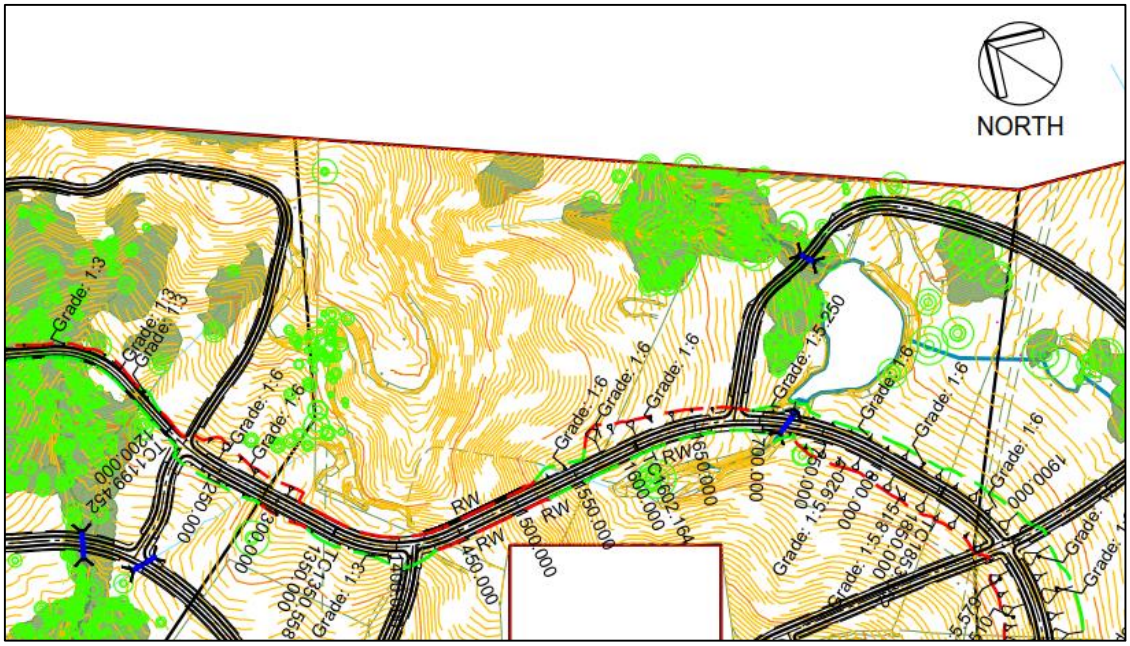


Figure 9: Option 3 Road Layout

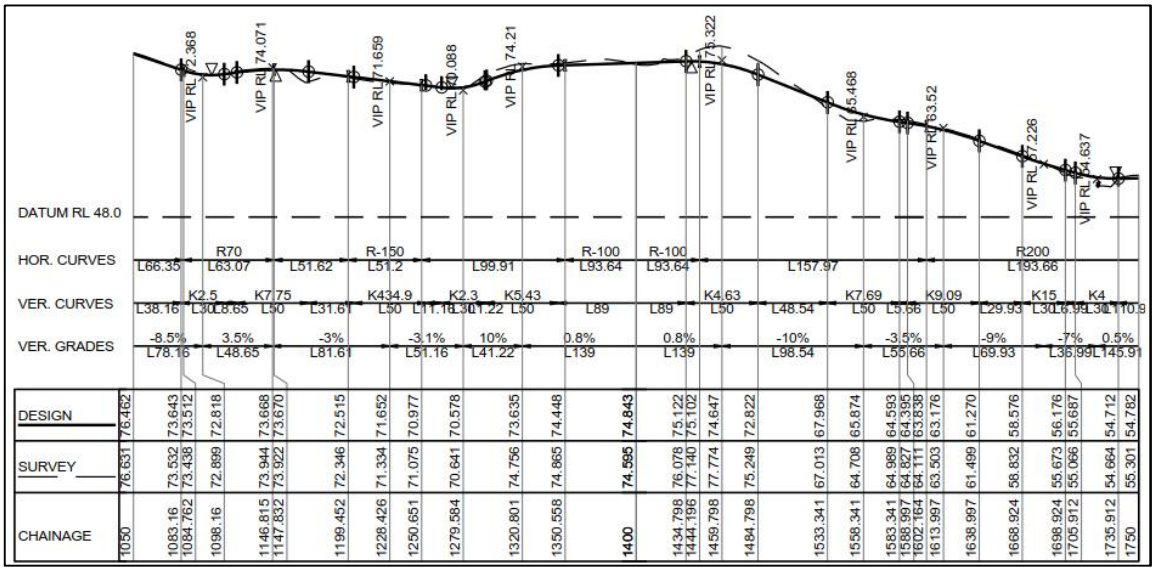


Figure 10: Option 3 Road Longitudinal Section

Although this option places the road in close proximity to Varroville House, it has been cut into the existing landscape in order to minimise visual impacts looking out from the house. Utilising retaining walls on one side of the road also allows a smaller area of construction to be undertake in the curtilage zone. As a result, this option was resolved as the preferred option for movement between the north and south sides of site.

4.2 ROAD WIDTH

The road widths have been determined in consultation with the Rural Fire Service (RFS) and their *Planning for Bushfire Protection* specification. The specification outlines the following requirements for public roads: -

- Roads must be two-wheel drive, all weather roads.
- Perimeter roads are classified as roads which separate bushland from urban areas. These roads must be two-way with a minimum 8m width kerb-to-kerb.
- All other roads are classified as internal roads and their widths are to comply with *Table 4.1* of the specification. An extract is shown in Figure 11 below.

Table 4.1 provides the minimum widths for public roads that are not perimeter roads for the safe access of fire fighting vehicles in urban areas.

Curve radius (inside edge) (metres)	Swept Path (metres width)	Single lane (metres width)	Two way (metres width)
<40	3.5	4.5	8.0
40-69	3.0	3.9	7.5
70-100	2.7	3.6	6.9
>100	2.5	3.5	6.5

Source: AS 2890.2 – 2002.

Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle)

Figure 11: Extract from NSW RFS Specification

- Dead end roads are not recommended. However, if unavoidable they must not be less than 200m in length and incorporate a minimum 12m outer radius turning circle.
- The maximum grade for sealed roads should not exceed 15 degrees (26.8%) and an average grade of not more than 10 degrees (17.6%).
- Public roads directly interfacing the bush fire hazard vegetation are to provide roll top kerbing to the hazard side of the road.

As per correspondence with Traver's Bushfire and Ecology Consultants, the perimeter roads on site have been defined as the road which circulates around the Chapel due to a high bushfire hazard area in close proximity to the built facilities. Consequently, the width of this portion of road must be a minimum of 8m kerb-to-kerb. Please refer to Figure 12 for details on the location of the perimeter road.

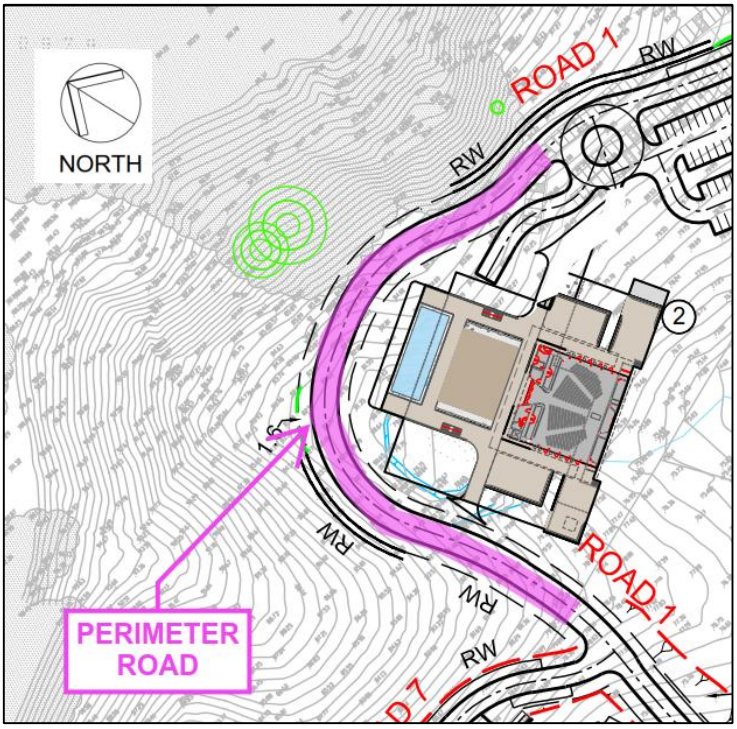


Figure 12: Delineated Perimeter Road

In accordance with Table 4.1 of the Planning for Bushfire Protection specification, the remaining road widths are to be determined as per their curve radii. To comply with this specification, the majority of the proposed roads are required to have a width of 7.5-8m. However, in order to maximise burial space and minimise the cut and fill balance throughout the site, a swept path analysis was run for two (2) 7.8m long medium rigid vehicles (MRV) passing each other at 40km/hr for all two-way road networks. This was undertaken to reduce the width of the roads to as low as reasonably practicable and within acceptable standards of the NSW RFS.

It was concluded and accepted by the RFS that the maximum two-way road width required to achieve these requirements is 6.5m plus 2.1m on each side for parking. As Road 8 and Road 10 are proposed as one-way only, the minimum carriage width was resolved as 3.5m with one side of parking at 2.1m. Please refer to Figure 13 for an illustration of the one-way roads within the site.

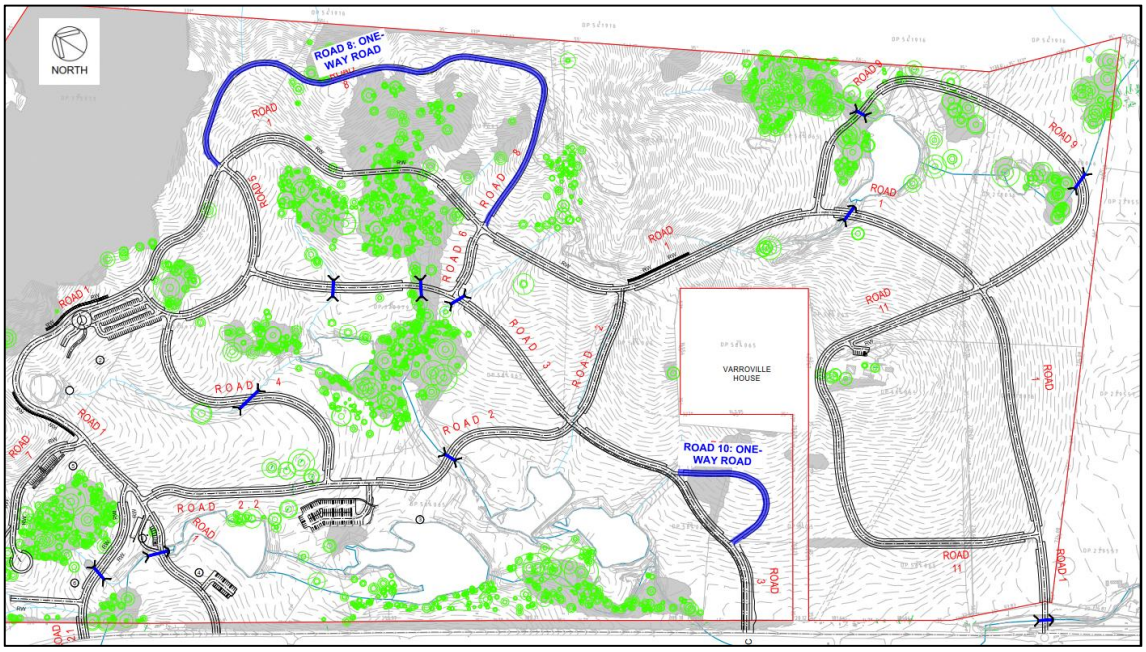


Figure 13: Proposed One-Way Roads

4.3 VISUAL IMPACT

Many iterations of the road layout were undertaken to ensure that the proposed design had minimal impacts on the visual landscape. Two roads especially went through a lengthy design process before arriving at a solution.

Road 11 was initially designed as two (2) separate roads, the northern portion leading to the existing out buildings and the southern portion as a loop road. Please refer to Figure 14 below for details.

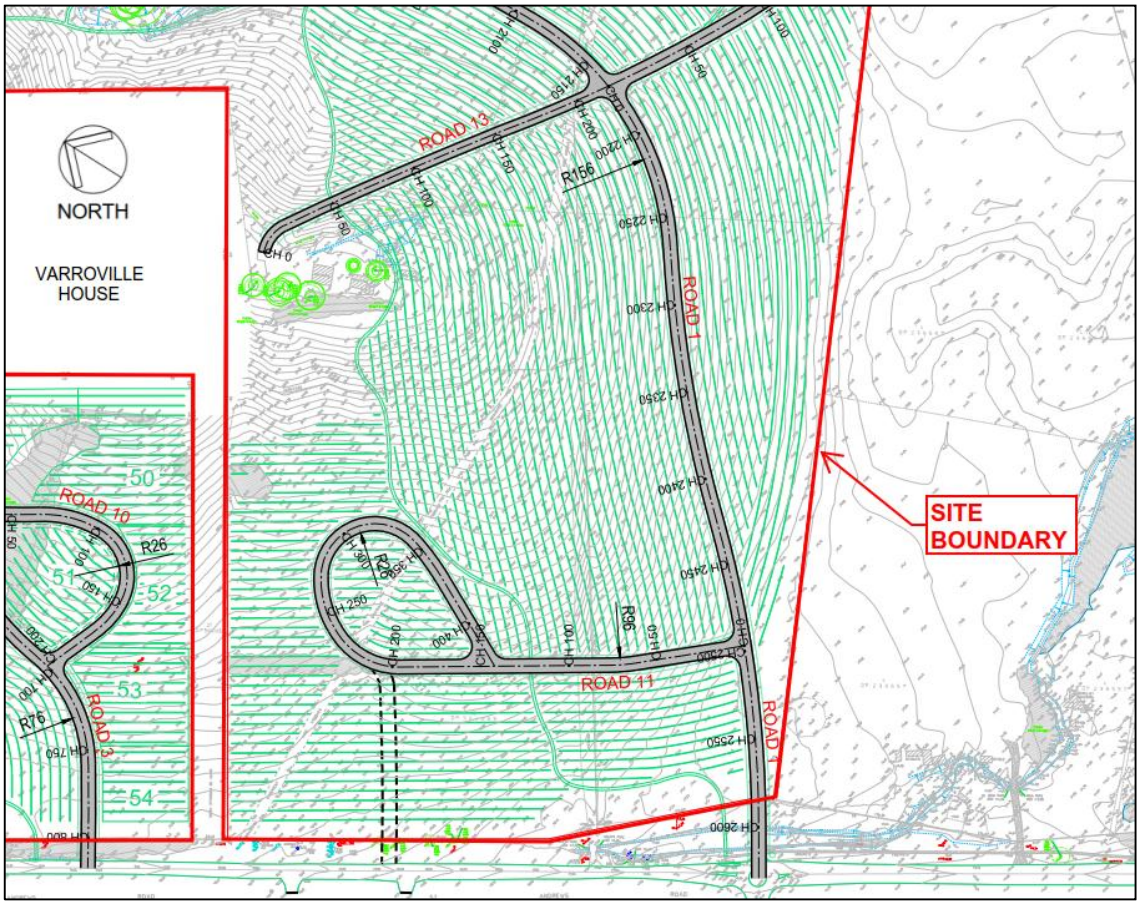


Figure 14: Original 'Road 11' Design Layout

Due to RFS restrictions on dead end roads longer than 200m it was necessary that these roads be linked to provide access to this area of site. The existing topography through this area has a ridgeline which runs in an east-west direction, parallel to Road 1. To minimise the visual intrusion of two (2) roads in close proximity to each other, it is proposed that the combined leg of Road 11 be placed on the other side of the ridge to Road 1. Furthermore, to maintain consistent access through this section of the site, including access to the existing out buildings, Road 11 must sit between the existing buildings and Varroville House. Please refer to Figure 15 for details.

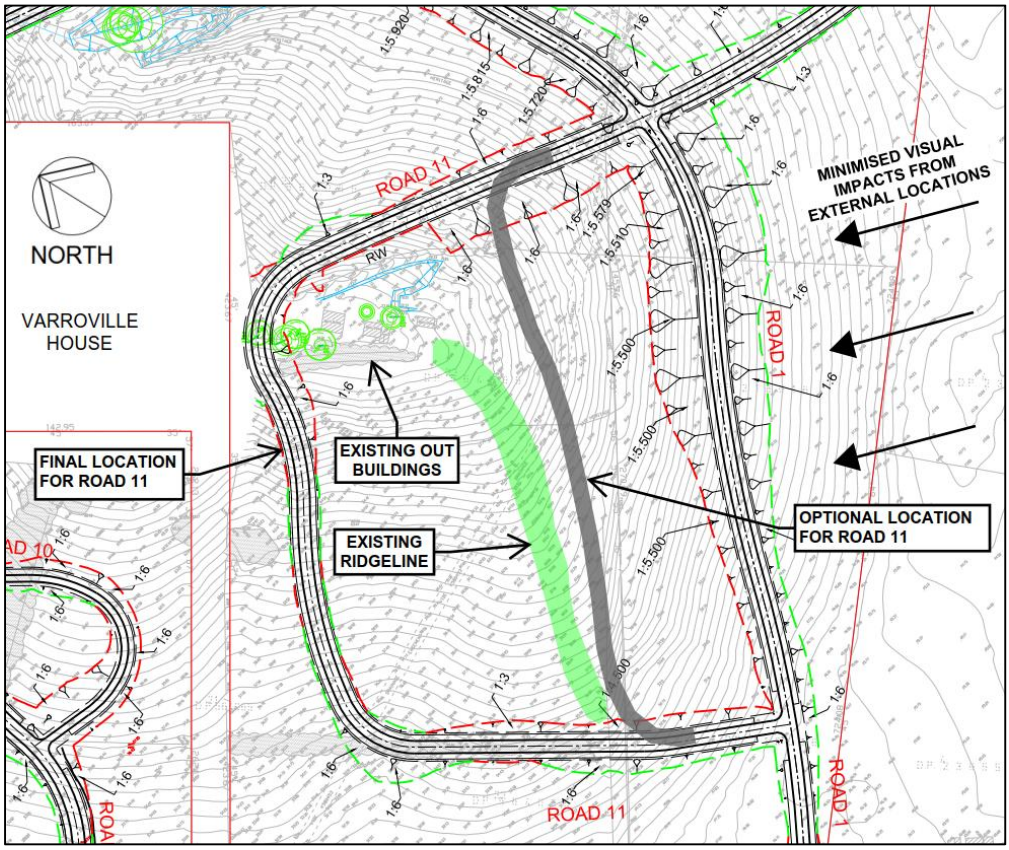


Figure 15: Final Design of Road 11

To minimise external visual impacts along the existing eastern ridgeline, it was originally proposed for Road 8 to run along the western side of the ridge as seen in Figure 16.

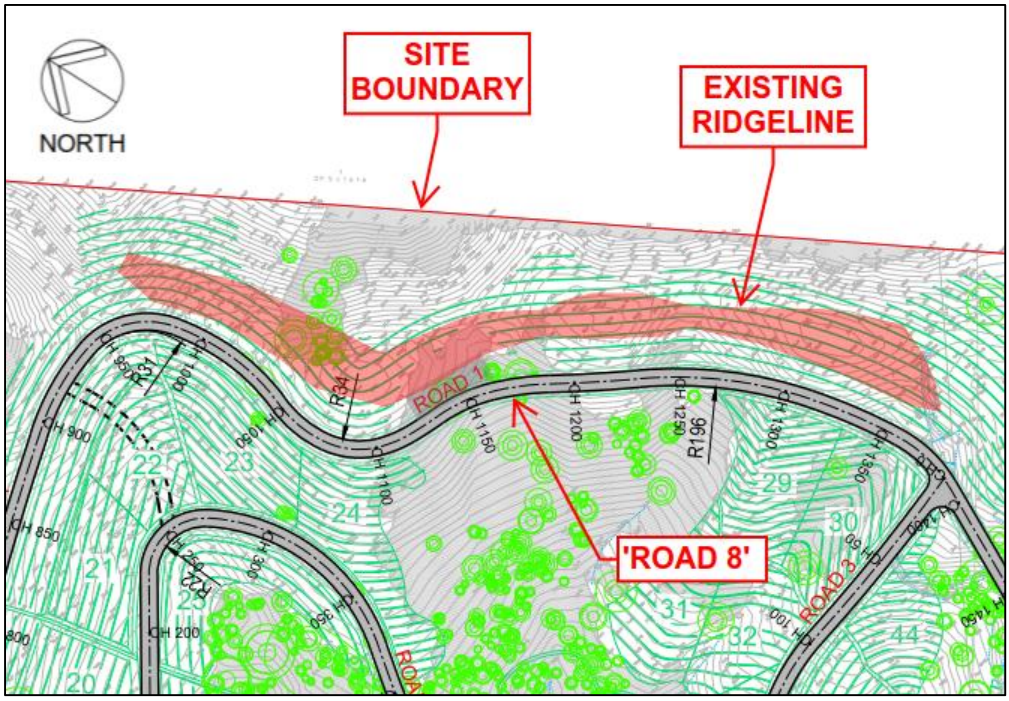


Figure 16: Original Road 8 Design

However, due to the steep topography on the western side of the ridge, this location for Road 8 would result in a large cut into the terrain and a visually obtrusive sight from within the cemetery. To minimise the earthworks required around this area and to achieve a balanced level of visual impact from both within and external to the site, it is proposed that the road winds between the peaks of the ridgeline. This will also reduce the required earthworks. To further minimise this, Road 8 has been designed as a one-way road as detailed earlier. Please refer to Figure 17 for the final alignment of Road 8.

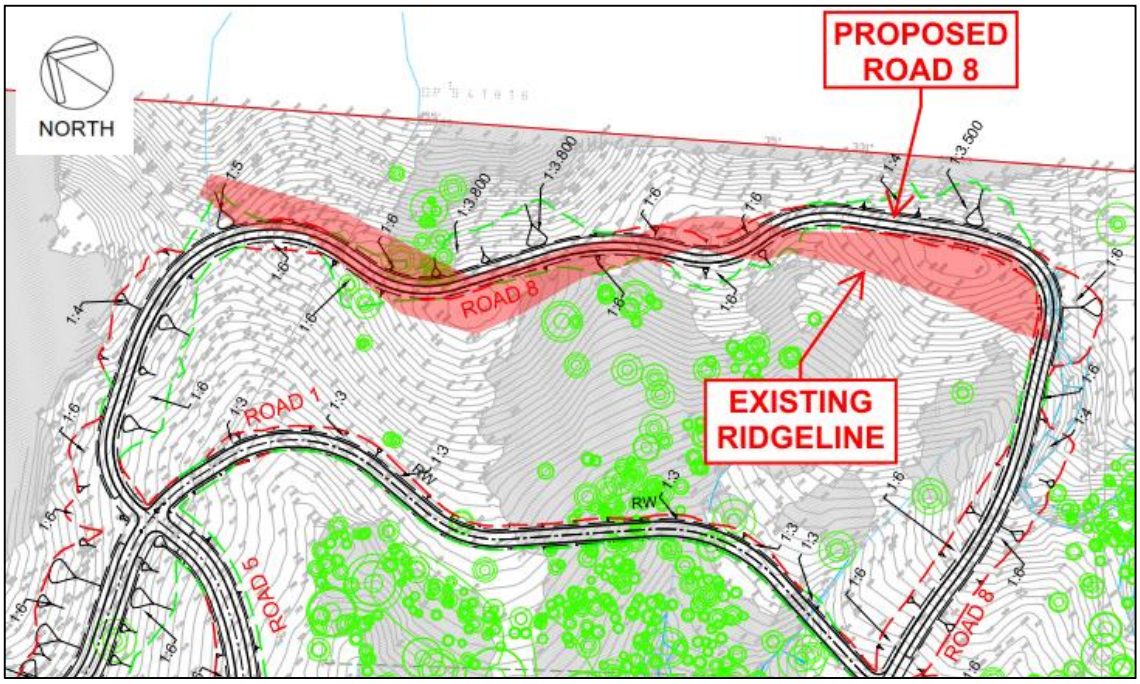


Figure 17: Proposed Road 8 Design

5. PROPOSED STORMWATER DRAINAGE SYSTEM

The stormwater network has been designed to reticulate the majority of the site's catchment to six (6) of the existing dams on site. The undeveloped northern portion of the site will reticulate south to several proposed swales which are to be installed along the boundary of Road 1, Road 7 and Road 8. These swales are sized to capture runoff from the 5% AEP storm event and will connect into the stormwater network in Road 1. This will ensure that there is no risk to public safety due to sheeting overland flows during minor storm events. Please refer to Figure 18 for details.

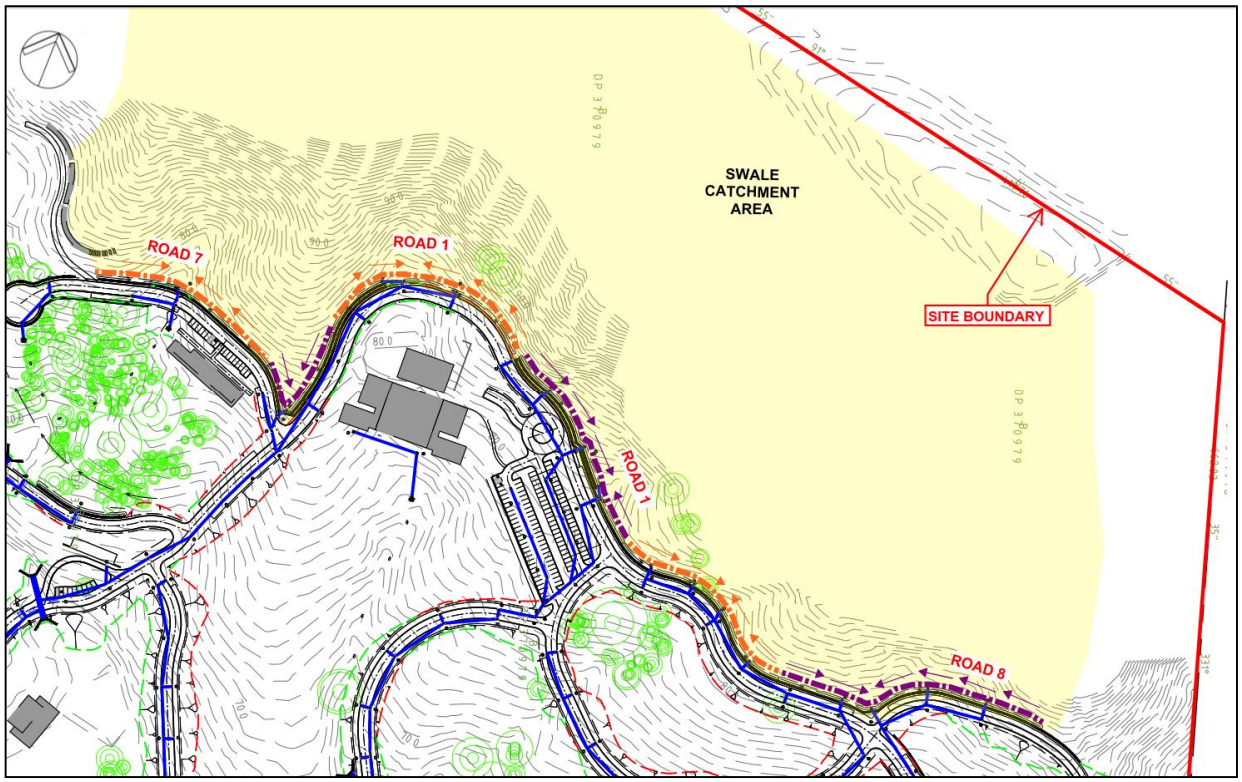


Figure 18: Proposed Northern Swales

The majority of the site will reticulate over land through the burial areas to be captured by the stormwater pit and pipe network in the roads. In two (2) locations, the stormwater network will be piped directly to an existing dam on site for treatment purposes. Please refer to Figure 19 and Figure 20 for details on these stormwater locations.

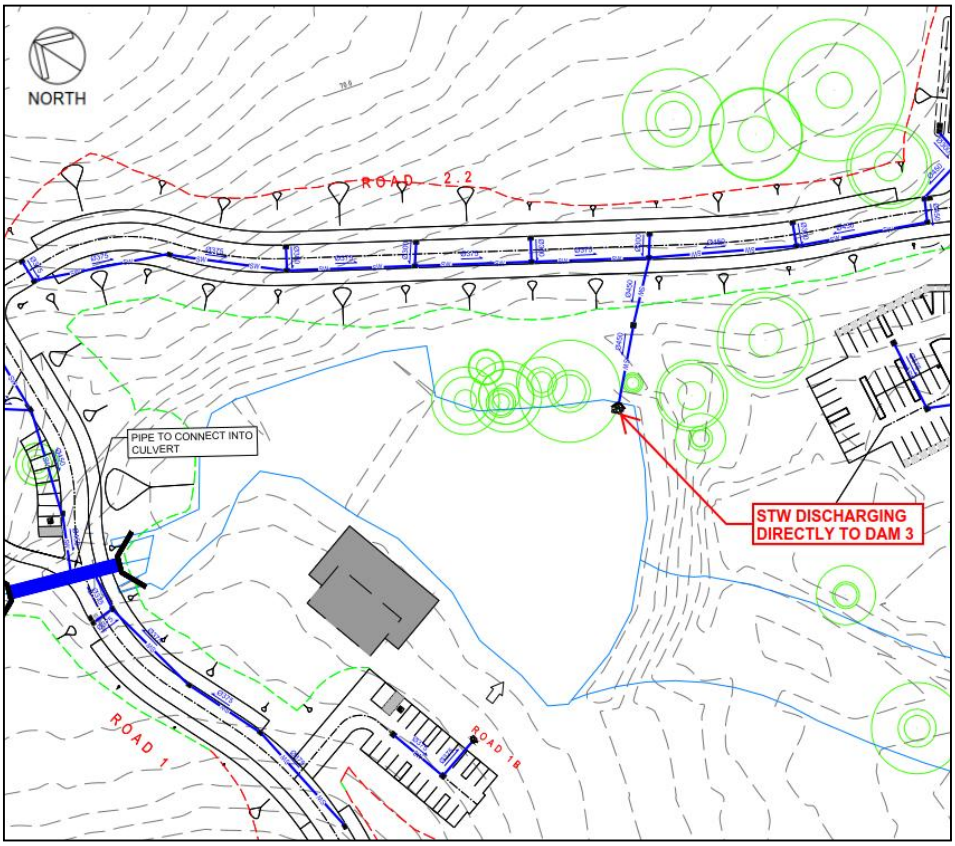


Figure 19: Location 1 of Stormwater Discharging to Dam

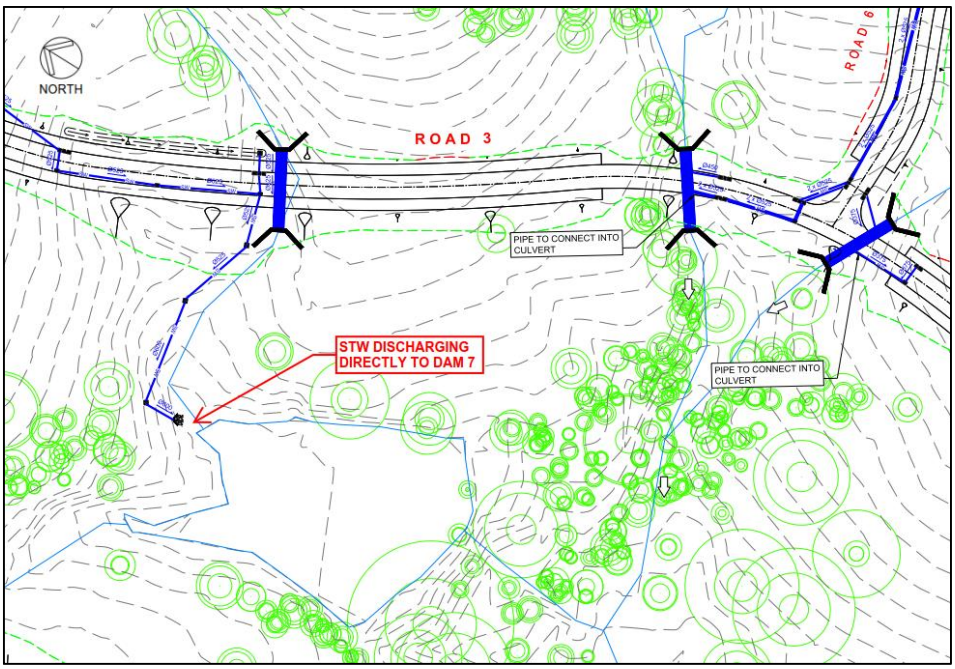


Figure 20: Location 2 of Stormwater Discharging to Dam

In areas where the stormwater cannot be piped directly to a dam, water will be discharged over land and captured by the existing stormwater system which ultimately reticulates to an existing dam. Please refer to Figure 21 for an example of a stormwater reticulation path. Please also refer to the WS+P Development Application drawings for further details.

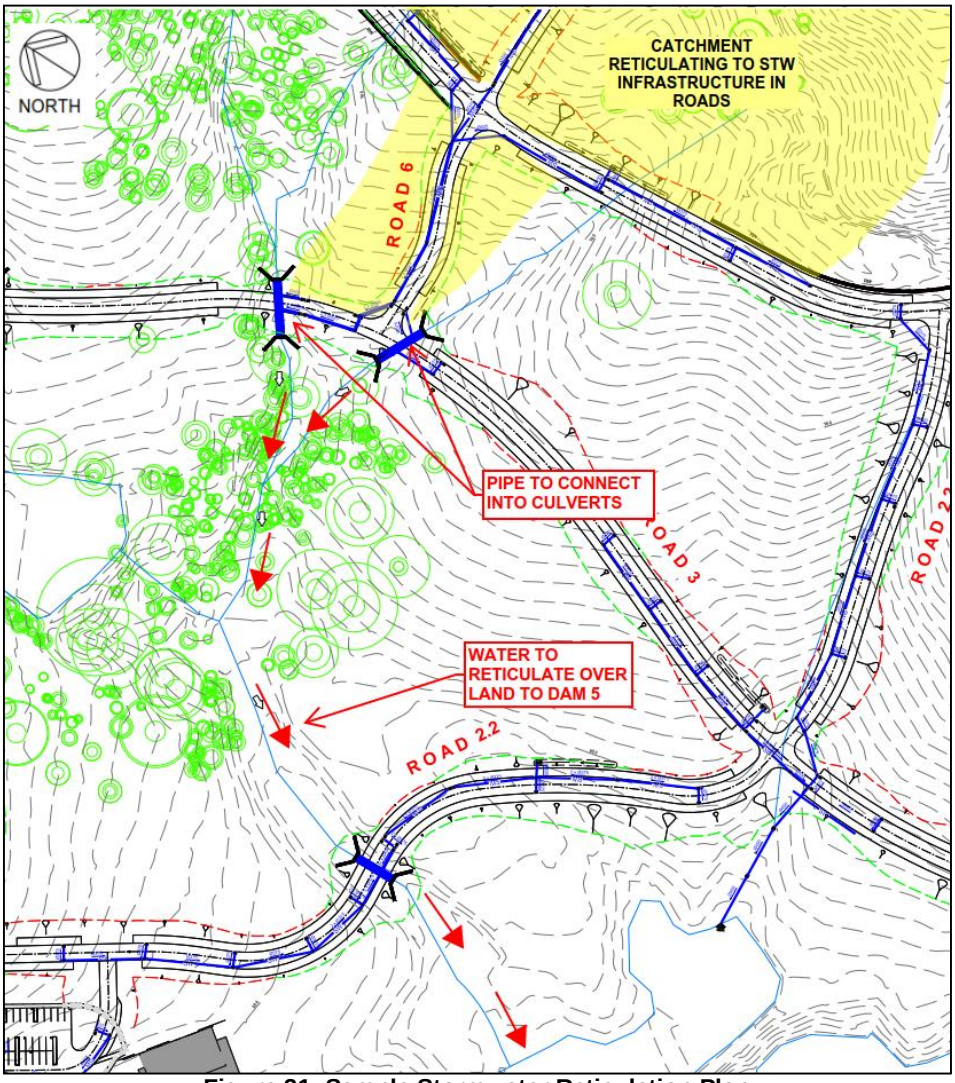


Figure 21: Sample Stormwater Reticulation Plan

Stormwater emanating from the two (2) one-way roads, Road 8 and Road 10 will not be captured by a formalised system and instead will sheet off the road into the grassed areas downstream. Road 8 will also have three (3) sag pits which will discharge water into the Cumberland Plain Woodland area. The majority of Road 9 will reticulate, for the most part, to a number of sag pits prior to discharging into lawn areas.

At ten (10) locations on site, the road network traverses existing verified water courses or drainage lines. In each of these locations, it is proposed that a culvert is installed to maintain the natural flow of water. The culverts have been sized to accommodate the 1% AEP flood event. Approximately 50% of the catchment area draining to the culverts will remain undeveloped. 42% of the developed area will become pervious lawns and 8% will become impervious. Please refer to Figure 22 for the location of each of the proposed culverts and the catchment areas draining to each.

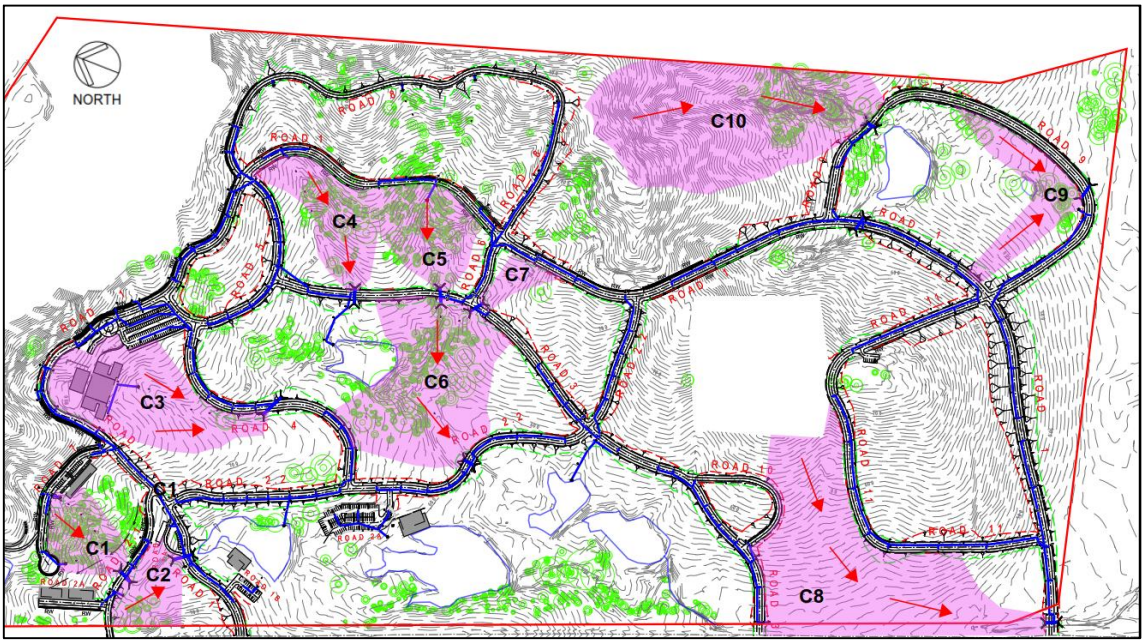


Figure 22: Proposed Culverts and Catchment Areas

A certain portion of overland flow from the site which reticulates directly to the dams or natural watercourses will remain as per the existing conditions. This area is illustrated in Figure 23. Of this area, approximately 79% will remain undeveloped and 13% will be developed into lawn areas.

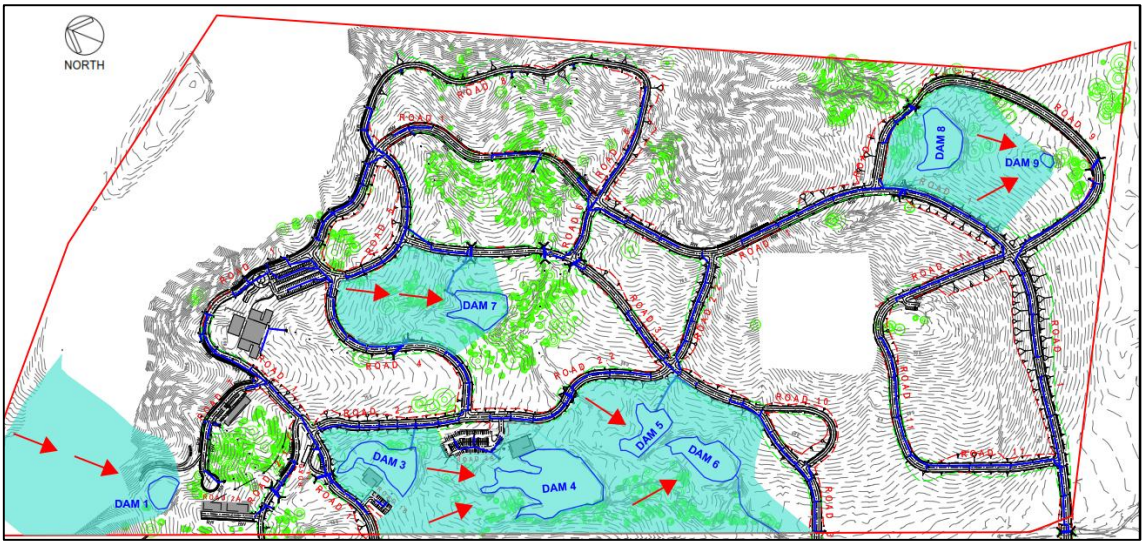


Figure 23: Catchment Areas Reticulating Overland to Existing Dams

9.5% of the total site area will bypass the site's stormwater network. Each of the bypass areas currently reticulate in to neighbouring properties; this will remain unchanged. The change in the flow of water overland will be minimal as the majority of the bypass area will remain undeveloped. Please refer to Figure 24 for an illustration of the bypass areas.

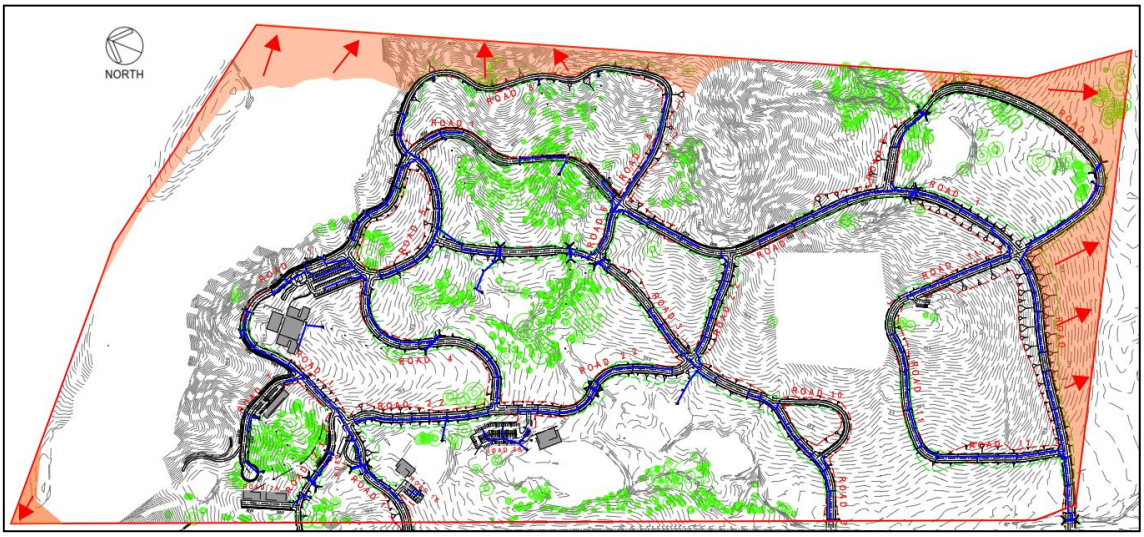


Figure 24: Bypass Areas

5.1 DRAINS MODEL INPUT PARAMETERS

Stormwater flows were calculated for both the pre-development and post development scenarios using an ILSAX model in DRAINS in order to size the pipe network on site. DRAINS is a stormwater drainage design and analysis program which performs hydraulic grade line analysis and generates flows that occur in a drainage system for a particular AEP storm event.

The catchment characteristic factor values used in the DRAINS model have been taken from *Campbelltown City Council's* DCP and are listed below: -

- Soil Type – Normal 3.0
- Paved (Impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Antecedent Moisture Condition 3.0
- Blockage Factor for On-Grade Pits 20%
- Blockage Factor for Sag Pits 50%

The rainfall data has been taken from the Bureau of Meteorology Rainfall IFD Data System using local coordinates.

5.2 STORMWATER AND FLOODING ASSESSMENT

As per the Campbelltown City Council's Engineering Guidelines, no development is to create a condition which would be beyond the capacity of the existing downstream drainage system. As the majority of the development is reticulating to existing private dams onsite, no council assets are immediately affected by the post development runoff. Any overland flow from the site would reticulate across the site's southern boundary or the western boundary after the four (4) consecutive dams, as per the existing condition. Water reticulating across the southern boundary would reticulate approximately 350m over pervious farmland before reaching Bunbury Curran Creek.

The DRAINS models were run for the 10%, 5% and 1% AEP storm events. It has also been noted that the current DCP requests that all stormwater modelling results be presented. As the development site consists of seven (7) separate DRAINS models, the results can be provided upon request.

A flood study was undertaken for the proposed site conditions by WMA Water, dated 4 August 2017. The flood modelling determined that the development created minimal offsite impacts to St Andrew's Road from the southern end of Road 2.2. This impact totals less than 50mm. Please refer to WMA Water flood modelling maps for further details.

6. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the general requirements outlined below.

6.1 SITE PROTECTION MEASURES

It is proposed to provide the following in order to inhibit the movement of sediment off the site during the demolition and construction phases.

6.1.1 SITE ACCESS

Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry consisting of a 1.5m long by 3m wide ‘cattle rack’.

6.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt down slope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following:-

- Geotextile fabric buried to a maximum of 100mm below the surface;
- Overlapping any joins in the fabric;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event;
- Any Council owned road kerb entry and or gully pits will be protected by Atlantis Filter Bales and EcoSock. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

6.2 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.

6.2.1 DUST CONTROL

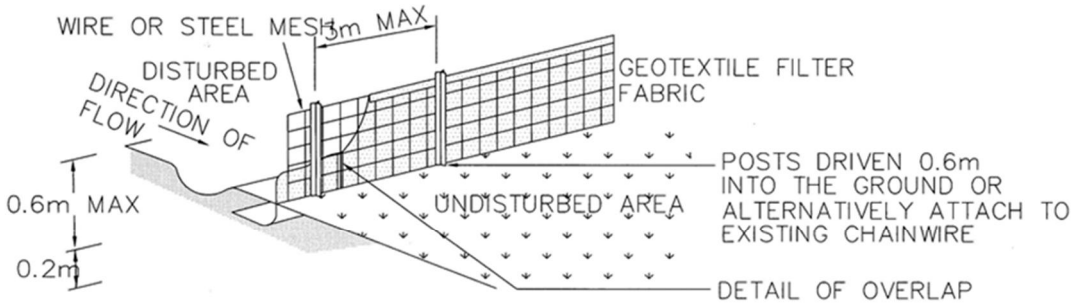
The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with RMS and local Council Guidelines.
- Soil transport vehicles will use the single main access to the site.
- There will be no burning of any materials on site.
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by wind. The watercraft will be equipped with a pump and sprays.
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on site during the construction of the works.
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to travelling on Council Roads.
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

6.2.2 MAINTENANCE

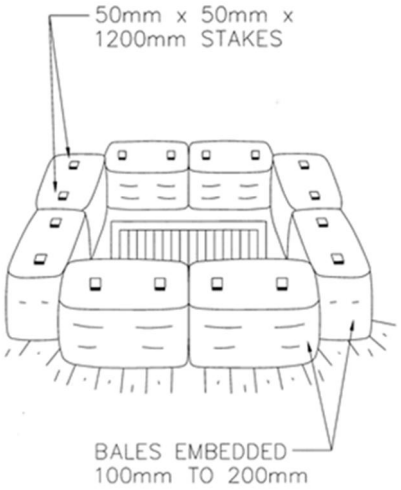
- It will be the responsibility of the site foreman for the building contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary.
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site.
- Gutters and roadways will be kept clean regularly to maintain them free of sediment.
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient as quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site; and,
- Materials processing equipment suitable comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site and the adjacent public roads, footpaths and environment.



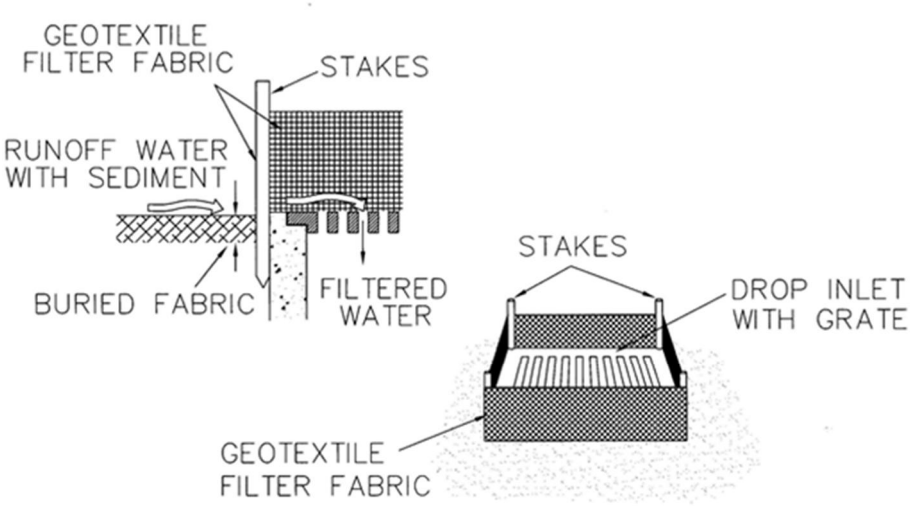
SEDIMENT CONTROL FENCE

NTS



STORMWATER PIT
SEDIMENT TRAP

NTS



GEOTEXTILE FILTER FABRIC DROP INLET
SEDIMENT TRAP

NTS

Atlantis Sediment Control Filter Bales

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply witht environmental and regulatory requirements.

Durable, Dependable, Reusable.
Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and re-useable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.

Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

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1. FilterBales frames are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc.

2. Filter medium (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil.

3. FilterBales have a seven (7) stage filtration system:

1. In through the filter bag
2. Through the perforated plastic structure wall
3. In through the filter cartridge bag
4. Through the bio engineered filter medium
5. Out through the filter cartridge bag
6. Out through the perforated plastic structure wall
7. Out through the filter bag

4. The filter bag is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile.

5. FilterBales work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events'. During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application.

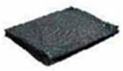
6. EcoSocks are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag.

7. FilterBales are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems

Product Range

Item No.	Description	
HFB001	**High FilterBale,** suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	**Low FilterBale,** suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	**Directional EcoSock,** can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	

Accessories

Item No.	Description	
FCR004	**WaterClean Filter Cartridges** contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

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