CAPTURE
Land Development Consultants

EARTHWORKS MANAGEMENT PLAN

CARTER GROUP LIMITED
RYANS ROAD DEVELOPMENT

MARCH 2025

Document Record

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Contents

1 Introduction

1.1 Purpose

Carter Group Limited proposes to construct a 126-lot industrial development at 104 Ryans Road, Harewood, Christchurch.

The purpose of this Earthworks Management Plan (EMP) is to provide the Erosion, Sediment and Dust Management (ESDM) measures and to outline the proposed earthworks staging, methodology, extent, description and schedule/program of works. The EMP is a live document that needs be reviewed and updated, if required, in consultation with the appointed contractor prior to commencement of construction works onsite.

This EMP details the necessary measures required to mitigate environmental issues associated with earthworks activities, thereby minimising or preventing undue erosion and the risk of sediment laden stormwater discharges into the receiving environment, protection of the surrounding environment from dust emissions and mitigating any other environmental issues that may arise during the construction works.

The proposed ESDM measures have been developed with reference to the Environment Canterbury (ECan, 2023) Erosion and Sediment Control Toolbox for Canterbury and Auckland Council Erosion and Sediment Guide for Land Disturbing Activities (GD05).

The development is proposed to be undertaken in two stages as shown in Figure 1. A full set of earthworks drawings are located in **Appendix A**.

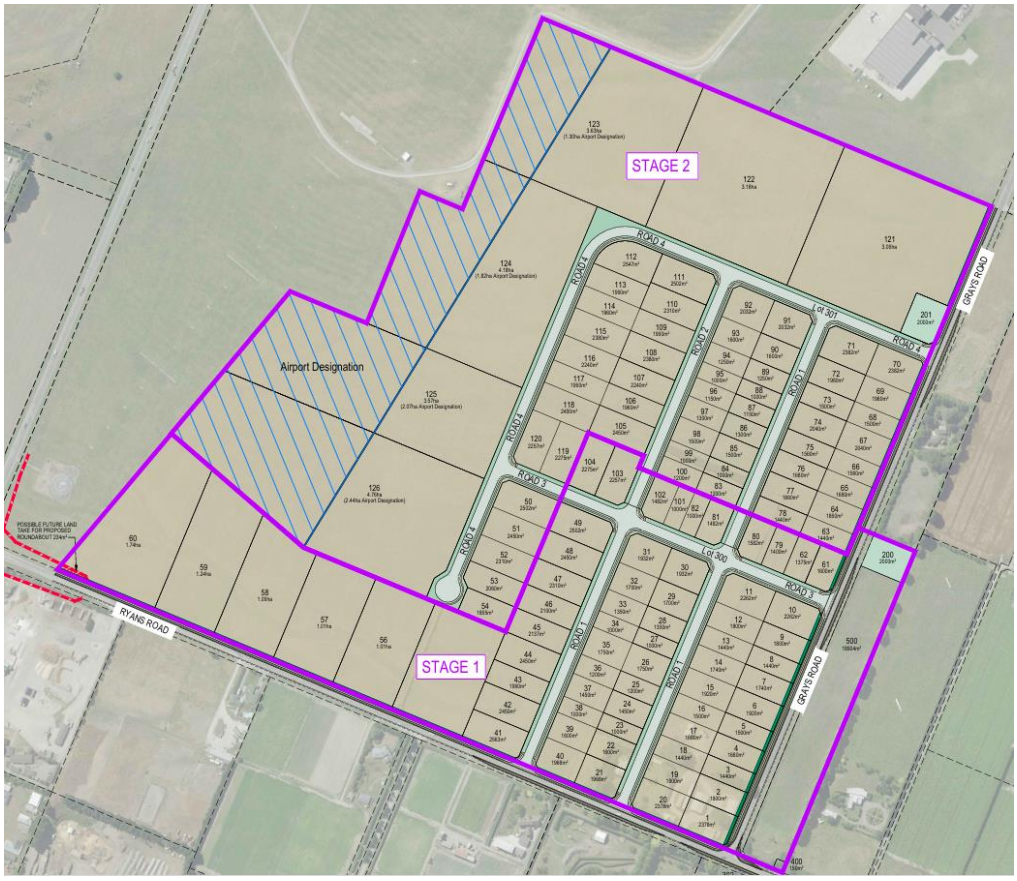


Figure 1 – Development Plan with Staging

1.2 Legal Description

The Ryans Road development comprises 2 separate parcels of land as described in Table 1.

Site Address	Appellation	Area (ha)	Record of Title (RT)
104 Ryans Road	Lot 4 DP 22679	31.5592	CB 7A/401
20 Grays Road	Pt Lot 1 DP 2837	2.1069	
104 Ryans Road	Pt Lot 3 DP 22679	23.9758	CB 13A/1098
	Total Area:	**57.6419**	

Table 1

The site is currently zoned Rural Urban Fringe Zone under the Christchurch City Council (CCC) District Plan. The site adjoins the Christchurch International Airport Limited (CIAL) land to the west and as a result there is a designation over a western portion of the property as shown in Figure 1 (blue hatched area).

The CCC District Plan does not show any natural hazards or cultural heritage overlays on the property.

1.3 Resource Consents

This EMP has been prepared to support an application under the Fast-track Approvals Bill.

The Contractor is to read all consent documents and is to always ensure adherence with the conditions of any approvals.

2 Site Description

2.1 Location

The site is located on the northern side of Ryans Road approximately 100m to the east of Pound Road and Ryans Road intersection. The site adjoins the Christchurch International Airport (CIAL) on the western and northern boundaries and Grays Road on the eastern boundary.

The neighbouring properties fronting Ryans Road to the south of the site are rural lifestyle blocks and a contractor's compound. There is one rural lifestyle block adjacent to the site on Grays Road.

2.2 Topography and Site Features

The topography of the existing site is generally sloping west to east at an approximately gradient of 1:200 (0.5%). The highest elevation of the site is 38.75m and the lowest 33.0m based on New Zealand Vertical Datum 2016.

The site is currently in pasture and there is an existing vacant dwelling and several farm sheds on the property in the southeastern corner near the intersection of Ryans Road and Grays Road. Vegetation within the site consists of several areas of large trees located around the buildings and a few hedge rows on the property. The buildings and vegetation will be cleared prior to earthworks activities taking place.

There is an existing irrigation well situated approximately in the middle of the site. The well reference number is M35/3176.

2.3 Soils

A geotechnical investigation report of the property has been completed by Tetra Tech Coffey, where they undertook 25 test pits across the site to determine the existing ground conditions.

A summary of the subsurface profile is outlined in Table 4 of Tetra Tech Coffey's report copied below.

Table 4: Ground model

Layer	Top of layer (mbgl)	Base of layer (mbgl)	Thickness (m)	Density
Topsoil	0.0	0.25 - 0.3	< 0.3	N/A
SAND	0.25-0.3	~1.0 - 4.0*	1.0 - 1.5	N/A
Sandy GRAVEL	~3.5 -4.0	Unknown	> 14.0	Dense to Very dense
*Depth to gravel between 1.0 and 2.0mbgl in TP-20, TP-21 and TP-22, more typically between 3.0 and 5.0mbgl across the remainder of the site				

The subsurface conditions appear to be consistent with published geological information and there are no concerns as to the suitability of the land for development.

2.4 Groundwater

Groundwater was not encountered at any of the site-specific test pits, and there are no monitored wells onsite. However, there are two ECAN monitored wells nearby (approx. 0.5km and 1.0km from site boundaries) ground water depths stated in Table 2.

Well number	Depth to groundwater (85^{th} percentile)	Location
M35/1111	16.76m	633 Pound Road
M35/3614	12.35m	CIAL - 151 Grays Road

Table 2 – ECAN Monitored Wells

The onsite irrigation well recorded depth to ground water when installed is 14.52m which is consistent with the ECAN wells above.

The groundwater assessment report prepared by Pattle Delamore Partners Limited (PDPL), concluded the depth to groundwater at the site is likely to range between around 11.5 to 18m below ground level. Therefore, ground water is not expected to be encountered during construction phase and due to the depth, the site conditions are conducive for stormwater disposal to ground.

2.5 Surface Water

An ecological assessment of the site has been completed by Pattle Delamore Partners Limited and they conclude there are no natural surface water features or springs located on the site.

There is a water race located within Ryans Road along the frontage of the site that flows in a west to east direction. This is a lateral channel of the Paparua Water Race Network (PWRN). It sources water from Waimakariri River near Intake Road and supplies stock drinking water to the surrounding area. The water race channels are considered artificial waterways and have generally either been decommissioned or piped within the Canterbury area as the land-use changes from rural urban fringe to industrial or residential.

2.6 Contamination

A Detailed Site Investigation (DSI) for contamination has been undertaken on the site by Tetra Tech Coffey (TTC). The sampling identified some areas are above background concentrations and two isolated areas above human health guidelines for contamination. Refer to Figure 2 with the sampling locations and identified contamination areas.

A summary of the contamination identified onsite is detailed below:

- TP-01, 3-9, 11, and 13-15 - minor exceedances from pesticides in the open paddock areas.
- TP-19 and 25 – metals slightly above background (Arsenic and Cadmium respectively)
- S101-104, 107-114, 116, 118-121, 123 – background exceedances due to elevated heavy metals levels around the buildings, with S113 and 116 arsenic levels above human health guidelines.

The contamination found on site is considered overall minor and consistent with a site of this nature. The contamination will be remediated in accordance with industry standards in accordance with a Remediation Action Plan prepared by TTC prior to earthworks commencing onsite. Once remediation is completed, a Site Validation Report will be completed.

Figure 2 – TTC Environmental Sampling Plan

3 Scope of Works

3.1 Earthworks

Earthworks are required to convert the current land into an industrial subdivision. The development and associated earthworks are proposed to be undertaken into two stages.

Given the overall size of the site, the earthworks have been confined to the roading corridors and construction of infrastructure to limit the amount of exposed area open at any one time.

The proposed earthwork quantities for each stage of works are outlined in Table 3.

Description	Volume (m^3)		
	Stage 1	**Stage 2**	**Total**
Topsoil to stockpile	7,470	10,890	18,360
Cut onsite	3,225	4,455	7,680
Fill onsite	3,278	5,652	8,930
Excess spoil from civil works	1,250	1,250	2,500
Cut to stockpile	1,197	53	1,250
Topsoil respread	3,150	3,990	7,140
	Area (ha)		
	Stage 1	**Stage 2**	**Total**
Earthworks Area	2.49	3.63	6.12

Table 3 – Earthwork Quantities

An average topsoil organic layer depth of 300mm has been adopted for the earthworks modelling and volumes.

The maximum anticipated earthwork cut depths are:

- 0.5m within the roading areas.
- 2.5m for civil drainage works.
- 5.0m - 6.0m for infiltration soakage pits.

Therefore, groundwater at an approximate depth of 11.5 to 18 metres below ground level is not expected to be encountered during the earthworks associated with the development.

3.2 Construction Sequence

The general construction sequence will be as follows:

- Pre-construction meeting with all relevant parties (eg – client, engineers, contractors, territorial authorities, etc)
- Site establishment and contactors compound – existing site access and hardstand area off Ryans Road to be utilised.
- Installation of erosion and sediment control (ESC) measures, as required.

- Removal of existing vegetation and buildings, where required.
- Removal of contamination, where required.
- Strip topsoil to stockpile in staged areas, where required.
- Excavation and balance of cut/fill.
- Placement of excess cut to stockpile and stabilise.
- Re topsoiling completed areas, grass seeding and stabilise progressively.
- Road construction (backfilling, compaction, and surface paving), including kerb and channel installation
- Trenching and installation of services (water, sewer, stormwater, power, fibre)
- Removal of ESC devices once grass is established and areas are stabilised (>80% coverage)
- Final landscaping and planting

The contractor is to provide a Programme of Works prior to commencing onsite.

4 Contractor Responsibilities

4.1 General

The Contractor must ensure that all staff at the site are trained in, and understand the requirements of this EMP, before work commences. This also includes associated resource consent conditions and Environment Canterbury (ECan, 2023) Erosion and Sediment Control Toolbox for Canterbury.

A copy of this EMP and any associated resource consents are to be kept onsite and made available to all personal working onsite.

The contractor is to ensure that all ESDM measures are always maintained and operating in a satisfactory condition, in accordance with the maintenance requirements specified by this plan.

Should the contractor wish to adjust the ESDM practises specified within this plan, the contractor must consult with the engineer and obtain approval prior to implementing changes. The engineer will assess the impact of the changes and, if necessary, recommend additional ESDM measures to further mitigate possible effects on the surrounding environment. It is a specific requirement of this plan that the contractor update the ESDM drawings to reflect any such alterations and that any such alterations be maintained in satisfactory working order.

It is the Contractors responsibility to ensure that no dirty water discharges to the receiving environment or dust beyond the site that is a nuisance, or any other form of environmental damage occurs due to the site works. The ESDM measures proposed by this EMP are a guide only and if the Contractor considers more appropriate measures are necessary, they must inform the Engineer.

4.2 Health and Stafey

Prior to commencement of work the Contractor shall provide a full Site Specific Health and Safety Plan (SSHSP). The plan shall cover the safety of both Contractors staff and any other people or vehicles that may be on the site or pass through or adjacent to the site during the period of the construction works. The Contractor shall implement, actively manage, and adhere to the Safety Plan at all times.

Without limiting the Contractor's obligation to identify and manage all safety issues the Safety Plan should cover as a minimum, the following.

- Specific hazards and methods of dealing with them.
- A process of identification and management of new and existing hazards.
- Safety equipment that will be provided and used.
- A copy of the accident reporting process.
- Arrangements for consideration of issues arising between Contractors and Subcontractors on site.
- A schedule of health and safety meetings.
- Nominated site staff with day to day health and safety responsibilities.
- Staff with overall responsibility for health and safety.
- Procedures for dealing with visitors to the place of work.
- Procedures for employee participation in health and safety on site.

- Audit procedures
- Procedures for dealing with public movements on or around the project site.

4.3 Programme of Works

The Contractor must provide to the Engineer a detailed programme of the work to be undertaken at the site and methodology prior to commencing works. The programme/methodology will be reviewed with the Engineer to determine its appropriateness, and changes will be made where necessary.

The Contractor must stage the construction work to minimise the surface area exposed at any one time. This is to minimise the areas subject to surface erosion due to rainfall, and also to minimise wind erosion and generation of dust during dry conditions.

Where possible, earthworks requiring truck and vehicle movements on unpaved areas of the site should be programmed to be undertaken during dry weather conditions, unless measures are implemented to mitigate possible effects on material being tracked out onto surrounding road.

The ESDM will be implemented continually, until construction has been finished and grass and other vegetation is established on exposed surfaces.

4.4 Notification

The Contractor must notify the Engineer and consenting authority overseeing the construction, not less than 5 working days prior to commencement of each stage of works or in accordance with the requirements of the consent conditions.

4.5 Site Security

The Contractor must provide an effective means of preventing unauthorised vehicle access to the site whilst construction work is progressing. This is to prevent dust generation and sediment from being transported off site by unauthorised vehicle movements and to protect the ESDM measures whilst the site is unoccupied.

4.6 Site Access

Vehicle access to the site will be via a stabilised entrance. It is expected that construction vehicle usage of site will be limited during the earthworks operations because the vehicles/heavy equipment will generally remain onsite (and overnight) unless maintenance or refuelling is required.

4.7 ESDM Maintenance

The Contractor shall prioritise the installation, maintenance and replacement, where necessary, of ESDM measures required under this EMP, ahead of any further work on-site, until such a time as the control measures effectively ensure that sediment is not being transported off site by stormwater flows, equipment movements, or as airborne dust. This is especially relevant when a particular weather event maybe forecast (eg – excess rain).

4.8 Storage and Use of Fuel and Lubricants

There will be no storage of fuel or lubricants, refuelling, or lubrication of vehicles and machinery within 20 m of any surface water. All necessary work on vehicles and machinery shall be kept to a minimum while on site. All maintenance of machinery will occur off site at an area properly designed to handle such work.

All fuels, lubricants or any other hazardous material will be stored onsite securely.

During construction, the earthmoving machinery working the site will be fuelled either direct from diesel tankers, mobile tanks (towed) or possibly from static diesel storage tanks sited at strategic locations within the site. All tanks (static or mobile) will be fitted with:

- Dry break couplings to minimise drips.
- Over-fill prevention devices.
- Catch trays under connection points.
- Spill kits available and instruction on how to use.
- Padlocks on valves.
- Staff training to include spill response procedure and reporting.

4.9 Proximity of Works to Sensitive Receptors

The neighbouring properties to the site have been identified as sensitive receptors with respect to dust discharges.

The engineer and contractor will work closely with CIAL to eliminate, isolate or minimise any potential hazards due to being in proximity to the CIAL runway.

The potential to generate dust will be minimised through the following:

- Minimising the area of exposed soils;
- Minimise stock piling of soil;
- Employing dust suppression techniques to minimise dust from exposed areas and stockpiles; and
- Minimising work carried out in windy conditions. When the wind reaches speeds where dust is visibly being transported from the site, work will cease until either:
  (a) suitable dust suppression can be established to allow work to continue; or
  (b) the wind drops to a level where dust is not being transported off site.

4.10 Construction Noise

Construction noise will be short term and typical of a confined earthworks operation. Mitigation measures to be undertaken in respect of construction noise will be in the form of defined hours of site operation, with noise not exceeding 90 dB measured at the nearest boundary.

Proposed work hours will be:

- 7.00 am to 6.00 pm Monday to Saturday
- No work Sundays and Public Holidays.
- Unplanned emergency work would take place as and when required outside of these hours.

Construction noise should comply with the requirements of NZS 6803:1999.

5 Erosion and Sediment Control Strategy

The control measures outlined in this EMP will need to be implemented before bulk earthworks commence. The control measures must be maintained by the Contractor until the site is fully stabilised.

5.1 Key Erosion and Sediment Control Strategies

This EMP has been prepared in accordance with the ECan Erosion & Sediment Control Toolbox for Canterbury (2023) and adheres to the following principles:

- Control run-on water onsite and treat with appropriate measures;
- Separate “clean” water from “dirty” water;
- Protect the land surface from erosion; and
- Prevent sediment and dust emissions from leaving the site.

This EMP provides a base line of the measures relevant to the control of construction phase stormwater discharges and details the main protocols for ESDM measures, to protect receiving environment from uncontrolled run-off or dust emissions.

In addition to the nature of the activities occurring on site, the need for ESDM is also influenced by:

- Soil type;
- Slope;
- Extent, nature and duration of soil disturbance;
- Climate and season; and
- Size and location of each stage or activity.

5.2 Key Erosion and Sediment Control Measures

The maximum area of exposed surface open at one time for the earthworks should be limited where possible to minimise potential effects. Exposed areas will be stabilised in a progressive manner as areas are completed.

In addition to limiting the amount of exposed area, another key factor around the earthworks design methodology is working around and culverting the existing water race along Ryans Road.

The proposed construction phasing for the water race work is outlined below. Refer to Auckland Council GD05 Section G4.0 for further details.

- Install erosion and sediment devices at downstream end of diversion channel.
- Excavate division channel and stabilise with geotextile cloth.
- Open the downstream end of the diversion channel into the water race outside the extent of works.
- Dam the upstream end of the water race and stabilise with geotextile cloth.
- Dam the downstream end of the water race to isolate the construction area.

- Pump any resultant water within the construction area to a sediment device.
- Install culverts and stabilised embankments.
- Remove the downstream end of the diversion bund.
- Remove the upstream end of the diversion bund to allow water to flow through the culverts.

5.3 Vehicle Access and Stabilisation

Site access shall primarily be from Ryans Road via the existing stabilised vehicle crossing and hardstand area situated near the intersection of Ryans Road and Grays Road. This is subject to consultation with the main contractor once the construction work is awarded.

The movement of vehicles will be monitored and if any sediment is tracking over the hardstand areas and onto the road becomes problematic, then additional options will be considered (i.e., shaker ramp). Additionally, the contractor will be responsible for daily monitoring of existing road surfaces at entry and exit points to ensure that any tracked material is cleaned up and disposed of effectively and efficiently.

The following details a stabilised site entry design requirement.

- Clear the area of unsuitable material and grade the base to a smooth finish. The base must be at least 10 m long and 4 m wide.
- Place woven geotextile over the area and pin and overlap as necessary.
- Place a 150 mm depth of 50 to 150 particle diameter of clean aggregate from the construction site boundary for at least 10 m in length with a width of 4 m. The aggregate must be clean and free of fine particles.
- Place a small bund in the aggregate at the entrance to prevent water running of onto the road.
- Provide drainage from the stabilised entranceway to an open area within the site with adequate capacity to detain and drain the runoff.

5.4 Haul Roads

Vehicle movements around the earthwork area should be via stabilised haul roads. Typically haul roads are 5m in width and stabilised with a minimum of 100mm depth compacted metal course (AP65 or similar). The metal must be sized to avoid entrapment in/between vehicle tyres. Haul road construction should commence as soon as practical to provide erosion control protection.

5.5 Clean Water Diversion

Stormwater run-off from upstream adjacent land, flowing into any part of the construction site, must be diverted around any exposed excavations, if possible, using drains of an acceptable cross-sectional area and grade, excavated into the topsoil or formed via a bund. The site is reasonably flat so clean water topsoil bunds will work well.

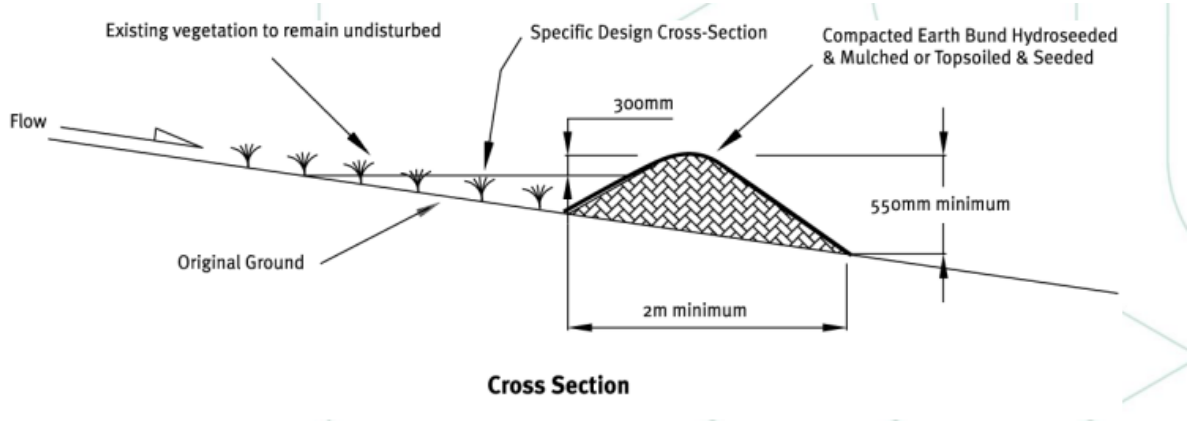
Diversions are constructed for a 5% annual exceedance probability (AEP) storm.

Runoff diversions are channels that are usually constructed across a slope. This design means that a bund is usually needed on the downslope side to prevent flow from spilling out of the channel. A bund is earth that is formed into an embankment to hold back water.

Clean Water Diversions may be.

- Drains, usually lined with an erosion-resistant material such as spray-on copolymer or needle-punched fabric,
- Existing or new stormwater reticulation systems,
- A combination bank or bund with excavated upslope channel,
- An earth bank, which is often made from compacted and stabilised topsoil.

Standard detail shown below.



Cross Section

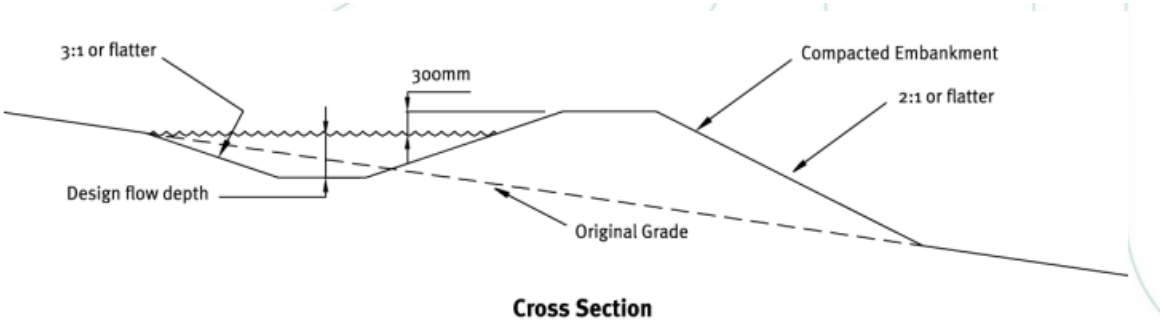
Clean Water Diversions design essentials:

- The longitudinal gradients need to be less than 2%. If more than 2%, a channel/lining will need to be used. They should be stabilised and not at risk of eroding,
- Plan and construct all perimeter diversion works as part of the initial site establishment and development,
- Prioritise these works and install the most important upslope control first,
- Define the route and survey it to achieve the correct gradient,
- Construct drains with a uniform grade along the invert because sudden decreases may cause sediment to accumulate and the bank to overtop,
- Make sure that the bunds associated with the diversions are well compacted and stabilised. In some cases, this may require specific geotechnical design to ensure the stability and integrity of the structure,
- Stabilise all diversion areas. One method is to carefully set aside and replace existing grass and topsoil sods in the invert of the newly constructed drain, or over the newly constructed bund,
- Monitor diversions for erosion. Depending on the type of soils on site, erosion control will probably be needed where the gradients are greater than 2% or where the design velocities exceed 1 m/sec,
- Ensure the finished cross-section meets all design requirements,
- Provide an adequate outlet for each diversion. The outlet may be a stable channel (eg rip-rap, geotextile), vegetated or paved area, stable watercourse or pipe outlet. In all cases, the outlet must convey runoff to a point where outflow will not cause damage (erosion, flooding). Vegetated outlets should be installed before diversion construction, to make sure that the vegetative cover is established in the outlet channel.

5.6 Dirty Water Diversion

Water that is 'dirty' has run through a works area and contains sediment, so needs treatment before it is discharged. Dirty water is managed by creating a diversion, with a non-erodible channel and/or bund that conveys dirty water.

Diversions are to be constructed to convey the 5% annual exceedance probability (AEP) storm + 300mm. Refer to typical section below.



Cross Section

Dirty Water Diversion design essentials:

- Diversions must have sufficient capacity to safely carry the flow from a 5% annual exceedance probability (AEP) storm, plus a freeboard of 300mm,
- Diversion gradients greater than 2% may need to be lined, to minimise erosion,
- If design velocities are over 1 metre per second (m/sec), a channel liner may be needed to prevent erosion,
- The grade along the diversion should be as even and uniform as possible. This is because increases in grade can cause scour, and sudden decreases can cause sediment to accumulate, so that the drain overtops,
- Outlets from all diversions must discharge to an appropriate sediment control device for treatment.

5.7 Silt Fencing

Sediment fences are to be placed around the perimeter of the construction site to provide a protective barrier between the site and the external road or neighbouring properties.

The sediment fences are to be constructed as per the ECan ESC Toolbox for Canterbury (2020), with the following measures being adhered to:

- The sediment fence will be of woven geotextile,
- Reinforcing chain mesh will be installed behind the fence for strength, as required,
- Will be sighted parallel to the contour,
- Fence height above ground will be no less than 400mm,
- Minimum depth of fabric buried below ground will be 200mm,
- The fence will be supported with steel waratah posts (with plastic safety caps) or by 50mm tanalised timber posts,
- Minimum post length will be 800mm, driven 400mm into the ground,

- Maximum post spacing will be 2m,
- 500mm (vertical height) upslope return at each end of the fence so that water does not outflank the ends of the fence,
- The maximum length of individual sediment fences shall not exceed 50m,
- The fabric will be secured to the upslope side of posts and support wires and will be fastened with wire ties, heavy gauge wire staples or gang nails,
- The trench will be backfilled over the toe of the fabric and thoroughly compacted.

Figure 3 below shows the sediment fence typical construction detail.

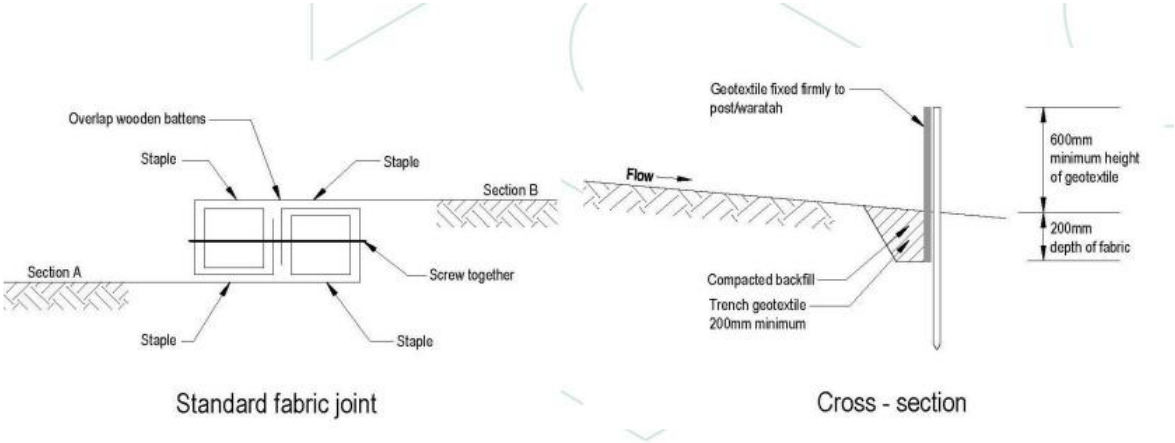
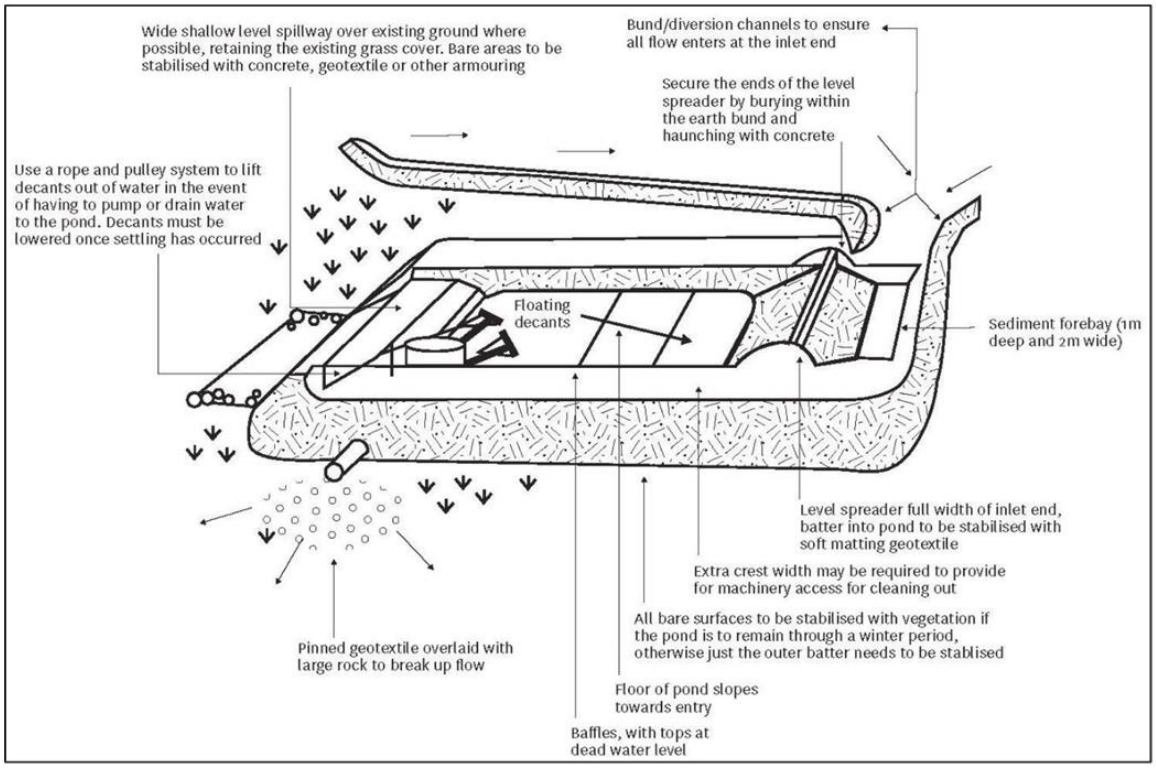


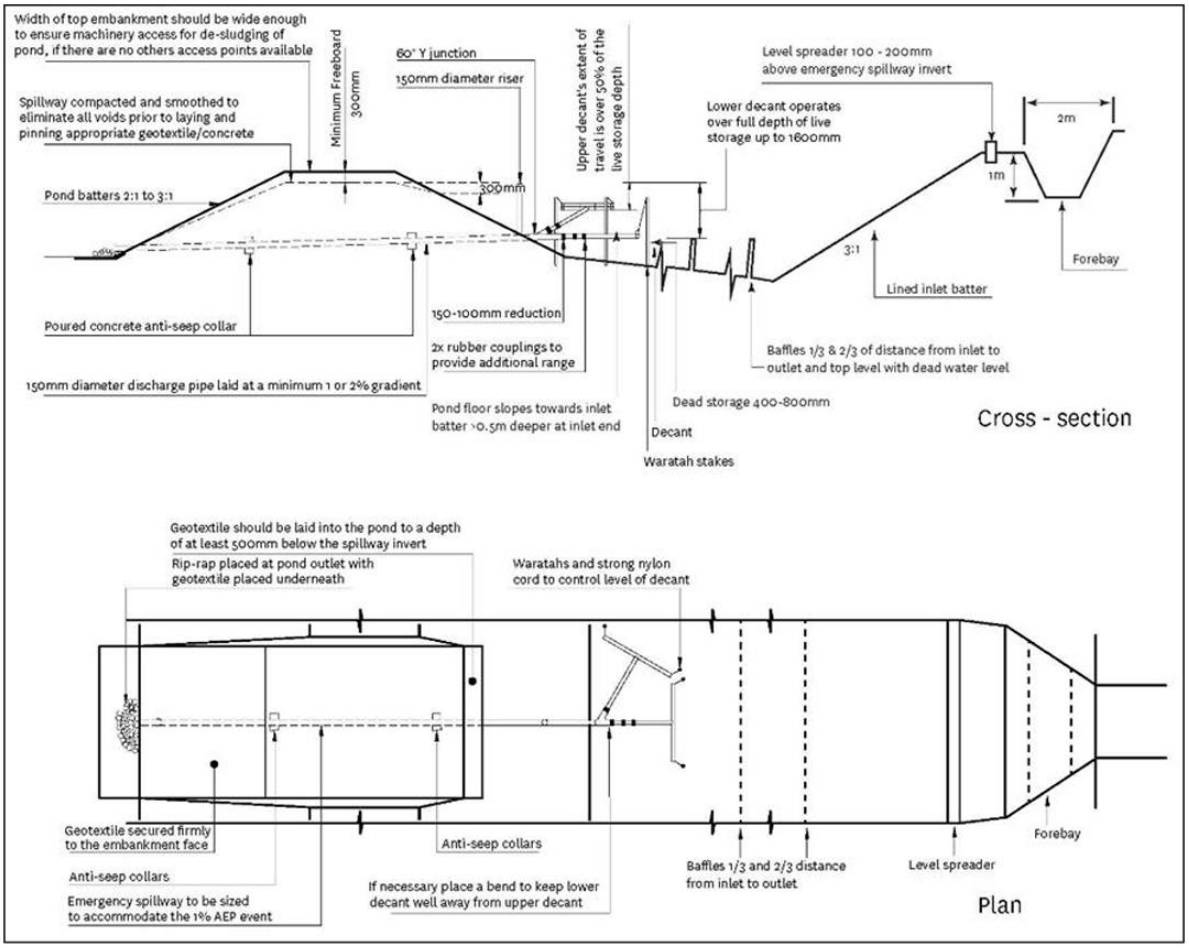
Figure 3 – Sediment Fencing

5.8 Sediment Retention Ponds

All staged construction water runoff (channelled by cut-off drains or internal roading) must be directed to one or more onsite forebays, which will allow sediment to settle out prior to discharging to a sediment retention pond (SRP). Note: one forebay can be sited just upstream of the sediment basin. All bare surface soils and stockpiles must be catered for and runoff from these areas discharged to the sediment basin.

The sediment retention basin design must be in accordance with the ECan Erosion and Sediment Control Toolbox for Canterbury (2023). The following figures provide the sediment retention basin general design requirements.


Wide shallow level spillway over existing ground where possible, retaining the existing grass cover. Bare areas to be stabilised with concrete, geotextile or other armouring
Bund/diversion channels to ensure all flow enters at the inlet end
Secure the ends of the level spreader by burying within the earth bund and haunching with concrete
Use a rope and pulley system to lift decants out of water in the event of having to pump or drain water to the pond. Decants must be lowered once settling has occurred
Floating decants
Sediment forebay (1m deep and 2m wide)
Level spreader full width of inlet end, batter into pond to be stabilised with soft matting geotextile
Extra crest width may be required to provide for machinery access for cleaning out
All bare surfaces to be stabilised with vegetation if the pond is to remain through a winter period, otherwise just the outer batter needs to be stablised
Pinned geotextile overlaid with large rock to break up flow
Floor of pond slopes towards entry
Baffles, with tops at dead water level


Width of top embankment should be wide enough to ensure machinery access for de-sludging of pond, if there are no others access points available
Minimum Freeboard 300mm
60° Y junction
150mm diameter riser
Upper decant's extent of travel is over 50% of the live storage depth
Level spreader 100 - 200mm above emergency spillway invert
Spillway compacted and smoothed to eliminate all voids prior to laying and pinning appropriate geotextile/concrete
Lower decant operates over full depth of live storage up to 1600mm
2m
1m
Pond batters 2:1 to 3:1
300mm
3:1
Forebay
Lined inlet batter
Poured concrete anti-seep collar
150-100mm reduction
2x rubber couplings to provide additional range
Baffles 1/3 & 2/3 of distance from inlet to outlet and top level with dead water level
150mm diameter discharge pipe laid at a minimum 1 or 2% gradient
Pond floor slopes towards inlet batter >0.5m deeper at inlet end
Dead storage 400-800mm
Decant
Waratah stakes
Cross - section
Geotextile should be laid into the pond to a depth of at least 500mm below the spillway invert
Rip-rap placed at pond outlet with geotextile placed underneath
Waratahs and strong nylon cord to control level of decant
Geotextile secured firmly to the embankment face
Anti-seep collars
Anti-seep collars
Emergency spillway to be sized to accommodate the 1% AEP event
If necessary place a bend to keep lower decant well away from upper decant
Baffles 1/3 and 2/3 distance from inlet to outlet
Level spreader
Forebay
Plan

5.9 Soakage Devices

If there is adequate soakage to ground, temporary soakpits can be used as a sediment device.

Soakpit design criteria.

- Base excavated to free draining gravels.
- Geotextile cloth laid in the base to trap sediments.
- Backfilled with gabion rock without fines.
- Provide storage up to the 5% AEP storm volume.

Regular maintenance of the soakpits is required to remove any sediments and to ensure they are operational.

5.10 Stockpiles

Stockpiles (topsoil and subsoil) will need to be established from time to time as part of the works. Stockpiles will need to be moistened by irrigation or stabilised using polymer chemical dust suppressants until they are consolidated to a sufficient degree to prevent erosion or dust. Stockpiles should generally be kept to a maximum height of 6m and side slopes to a minimum but must not be greater than the natural slump angle of the dry material.

Several methods are available for the management of stockpiles depending on the length of time the stockpile is to remain on site:

- Irrigation – suitable for short term stockpiles (i.e. days to weeks).
- Application of mulch or stabilising polymer dust suppressants – suitable for medium term stockpiles (i.e. weeks to months). Re-application may be required.
- Vegetation by spreading grass seed or other fast establishing seed – suitable for longer term stabilisation (i.e. months). This may not be possible depending on weather and soil conditions in which case a medium-term solution may be required until vegetation can be established.

A bund or silt fence should be placed around any soil stockpile should there be a risk of runoff leaving the site confines or entering any clean water diversion drain.

5.11 Grassing / Seeding

Completed cut and fill areas must be reinstated with topsoil immediately and sown with grass seed which can be via drilling or hydroseeding. A copolymer can be applied over the seed if considered necessary. The area of planting/seeding must be maintained to encourage stabilisation of the disturbed surface, including watering of the seeded areas during dry summer conditions.

Seeding is designed to permanently stabilise soil on disturbed areas to reduce sediment and run-off to downstream or off-site areas. To maximise germination and growth rates, the preferred seeding windows for both temporary and permanent grassing are autumn (March and April) and spring (September, October and November). If irrigation is available, grassing may be carried out throughout the summer.

6 Dust Management

The soils underlying the site are prone to generating dust once vegetation is removed. It is imperative that the contractor be able to provide effective dust control, including during periods when earthworks operations cease and there are bare soils present. The following dust control measures, in conjunction with erosion and sediment controls, aim to reduce the generation and transport of dust from disturbed soils.

6.1 Earthworks During Dry Conditions

The operation of earthmoving equipment and vehicles across dry site conditions can mobilise silt into airborne dust. In addition, high wind conditions across exposed (bare soil) surfaces can also cause dust problems. Measures such as watering of exposed surfaces or application of a stabilising polymer to exposed surfaces after construction work is completed, must be undertaken to control dust generation during dry site conditions.

Bulk earthmoving operations should not be undertaken during periods of strong winds, especially when site conditions are dry, unless effective measures to prevent and control the generation of dust are provided, such measures must be discussed with the Engineer for approval.

6.2 Water Supply and Storage

The Ministry for the Environment (2001) recommends an application rate of up to one litre per square metre per hour for effective dust suppression. The period in which maximum dust suppression is required is approximately four hours per day, which equates to 4 m3 per 1,000 m2 per day.

The Contractor will need to ensure they can access an adequate water supply for dust suppression during earthworks.

Therefore, based on staging the earthworks as per the EMP and progressively stabilising areas as they completed, the largest area that would be exposed to this operation at any time is expected to be up to 3.7 hectares. This will be quite controllable with standard water trucks. For a 3.7 ha working area water demand for 5-millimetre per day coverage equates to 185m^3 per day, which can be accommodated by water tankers.

6.3 Sprinkling/Irrigation

Dust control will be via a hose, water tanker or sprinkler system over all areas of exposed soils and the topography allows these methods to be applied to any part of the site.

The implementation of sprinkler irrigation is achievable across the staged earthwork areas.

6.4 Chemical Stabilisation

Stabilised matrix chemicals are a quick and effective method to provide medium term solutions to dust control. This method requires the spreading of chemicals to glue smaller soil particles together, to form larger wind resistant particles. There are various dust suppressant chemicals available, however only chemicals that have been granted a Global Resource Consent by ECan can be used.

The Contractors chosen supplier will recommend the application rate and concentration of chemical to be used, if required.

6.5 Physical Dust Control Barriers

Stabilised Mulch, aggregate or matting can be a quick and effective means of dust control for a recently disturbed area and can be used where conditions are unsuitable for establishing grass. Care must be taken with the mulch variety selected to ensure that it will not itself be disturbed by windy conditions.

Natural or constructed wind breaks or barriers can reduce wind velocity through a site and therefore reduce the possibility of suspended particles. Wind breaks can comprise of trees or shrubs left in place during site clearing or constructed barriers such as a wind fence, tarp curtain, hay bales, crate wall or sediment fence. If implementing constructed wind breaks, the contractor must ensure they are adequately secured by staking or tying down to avoid movement during high wind.

7 Discovery of Soil Contamination or Artefacts

If any contaminated soil or suspected contaminated soil is found during earthworks on the site, work must cease within the area of discovery and the Engineer notified so soil sampling can be arranged. The contractor shall isolate the area with temporary fencing or similar, to ensure disturbance does not happen until the test results are received. Once the results are obtained, approximately 5 days post sampling, and the extent and type of contamination is known, remediation measures will be determined in conjunction with the environmental engineer and consenting authorities.

In the event of the accidental or unexpected discovery of archaeological features, including human remains:

- All work within the vicinity of the discovery should cease immediately.
- A buffer of at least 5 m should be set up around the discovery and this should be marked on the ground, preferably with pegs and tape, or similar.
- All machinery and plant should be removed from the buffer zone where this is possible.
- The site archaeologist, or other qualified archaeologist and Heritage New Zealand (HNZ) must be informed.
- If the discovery is of Māori origin, the relevant Runanga must be contacted immediately.
- Appropriate protocols (tikanga) should be observed.
- If the discovery is of human remains, the New Zealand Police must be informed.
- The archaeologist must take relevant steps to secure the area of the discovery following consultation with the Runanga.
- The archaeologist must assess the discovery and advise Heritage New Zealand and the consent holder on the relevant steps to be taken.
- Works in the area of the discovery must not recommence until authorised in writing by the archaeologist in consultation with HNZ any other affected parties.

8 Monitoring and Maintenance

It is the Contractors responsibility to monitor and maintain all ESDM measures and to ensure that no sediment laden water or dust is discharged off site, and to ensure that no other environmental damage can result due to the development works.

8.1 Resource Consent Requirements

Monitoring of construction must be in compliance with the approved Resource Consent conditions and industry standards.

8.2 Monitoring and Maintenance Requirements

8.2.1 Pre-Construction

The Engineer, in association with the Contractor, will develop an inspection and reporting procedure in accordance with the requirements of this EMP and any relevant consent document. The appropriate monitoring and reporting schedule to be developed must be consistent with the site characteristics, earthworks activity and potential environmental risks associated with the work to be performed.

A pre-construction meeting must be held with the contractor, engineer and consenting authority prior to commencement of works onsite to discuss.

- Timeframes for key stages of works authorised under the consent.
- Resource consent conditions
- Approved ESDM plans and EMP requirements
- Construction Traffic Management Plan
- Site Specific Health and Safety Plan
- Insurance cover

8.2.2 During Non-Work Periods

The contractor must continue to monitor and maintain all erosion, sediment and dust management (ESDM) measures during periods when work on site ceases (for any unforeseen reason) and until the reinstated areas are sufficiently stabilised to allow ESDM measures to be decommissioned.

8.2.3 Daily Maintenance

During work and at the completion of each day, the site supervisor shall inspect:

- Any drains, bunds or sediment fences that are damaged will need to be reinstated as necessary.

- Any drains that are filled with sediment or damaged will be reinstated as necessary.
- The dust suppression irrigation is operational and sufficient water is available.
- The stabilised site entry is operational.
- Any mud tracked onto the road must be swept up.
- Review weather forecast and plan accordingly.

These measures will need to continue should there be any period in which work stops.

8.2.4 Weekly Inspection of Control Measures

All measures will be inspected at least weekly, and the inspection documented on a check sheet (these measures will need to continue during site close down periods).

All measures will be maintained in good working order; if repair is necessary, it will be initiated within 24 hours of inspection.

- The diversion systems shall be inspected for erosion or sediment scour and repaired or protected immediately after damage has occurred.
- Sediment fences (if used) must be inspected for tears, fabric clogging, to see if fabric is securely attached to the posts, lose wires or supports, leaking joints, overtopping, outflanking and/or undercutting. Sediment will be removed when the depth exceeds 30% the height of the fence.
- Reinstated and seeded areas will be inspected for bare spots, washout and unhealthy growth.
- Sediment devices to ensure it does not have undue sediment build up, inlets and outlets are free draining, there is no scour and erosion and that all components are operational.

8.2.5 General Inspections

All measures will be inspected before and immediately following rainfall events that generate runoff, or wind events that may generate dust, with any required maintenance undertaken immediately, or additional methods implemented to ensure ESDM measures are maintained on the site during the rainfall event.

8.2.6 Maintenance During Large Storm Events

Site monitoring shall be undertaken during heavy rainfall events. The person undertaking this monitoring must be able to inspect and repair/replace any control measures that are not working effectively.

The responsible person will need to implement additional control measures in the event of system overload to ensure that effects of overland flows of stormwater are effectively mitigated.

8.2.7 Dust Complaints Procedure

Should any dust complaints be received, they will be investigated immediately and measures taken to minimise the dust being generated from the site.

The Contractor will keep written records of any complaints received. Details to be kept include the following:

- Date and time of the complaint.
- Location of discharge reported.
- Contact details of who the complaint was received from.
- Weather conditions at the time of the complaint.
- Likely cause of the discharge; and
- What corrective action was taken to address the complaint.

This information will be made available to the Engineer upon request.

8.2.8 Record of Maintenance

A record of inspection and maintenance shall be kept by the Contractor and made available upon request to the Engineer.

The ECan erosion and sediment control toolbox checklists can be used as the template for the inspection records.

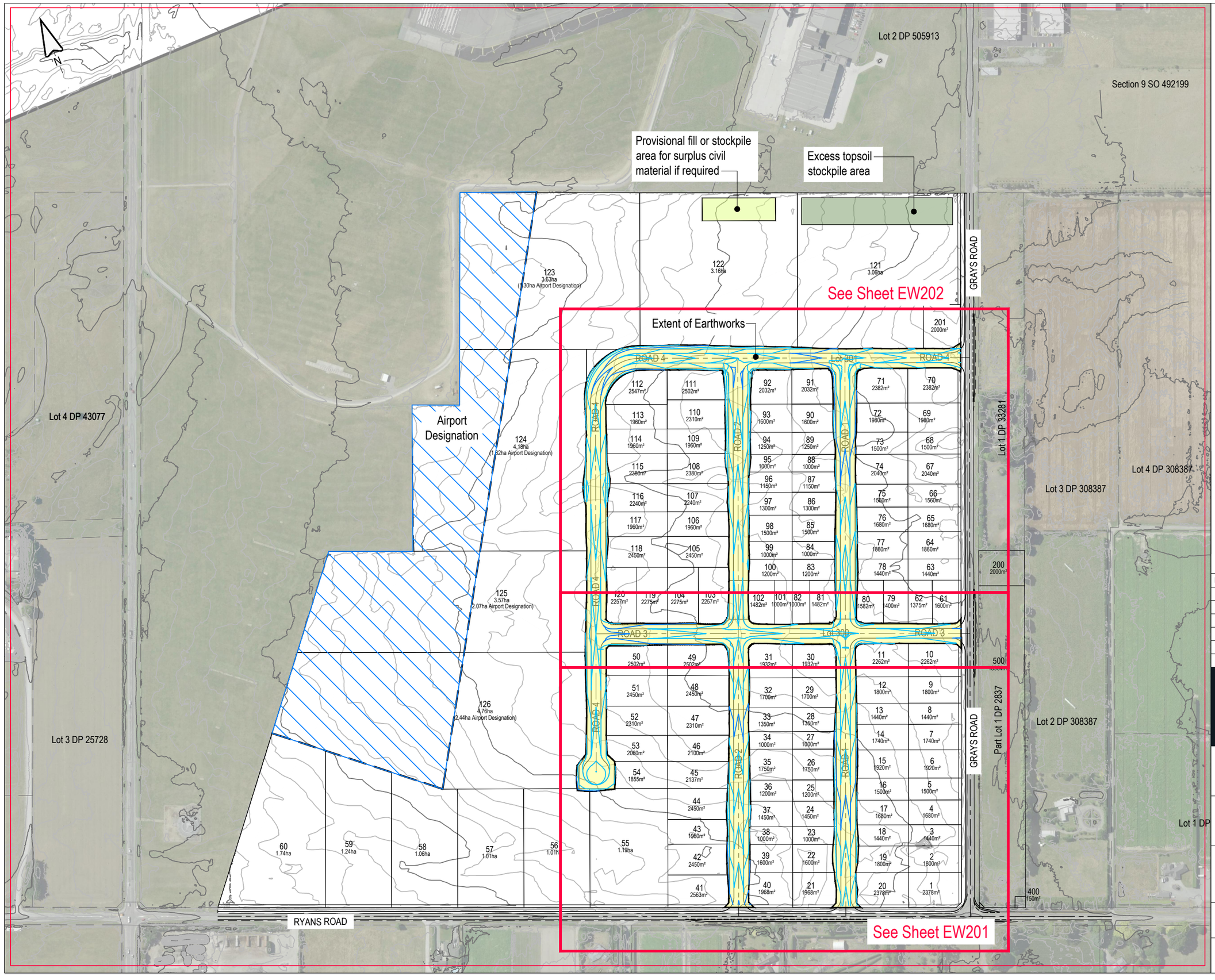
9 Decommissioning

ESDM measures will be decommissioned only after earthworks activities have ceased and all areas upstream (or downstream) of the installed ESDM measures have been stabilised. Each measure will be decommissioned in accordance with the procedures given in the ECan Erosion and Sediment Control Toolbox (2023).

Any areas disturbed by the decommissioning of measures will be stabilised via one of the methods discussed in this report, such as mulching, erosion control mats or reseeded with quick germinating grasses.

All rehabilitation programmes implemented are subject to inspection and repair until they are fully established and form part of the permanent features. Grass must be >80% established for an area to be considered stabilised.

Appendix A – Earthworks Plans



Notes:

1. Levels are in terms of NZVD2016.
2. Existing contours are based on topographical survey and lidar data.
3. Proposed contours are finished design surface.

Legend:

- Existing Contours (0.25m)
- Proposed Contours (0.25m)

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
EXISTING & PROPOSED CONTOURS - OVERALL

STATUS	SCALE	SIZE
FOR APPROVAL	1:4000	A3

PROJECT	DRAWING NO	REVISION
1252	RC-EW200	A

Notes:

1. Levels are in terms of NZVD2016.
2. Existing contours are based on topographical survey and lidar data.
3. Proposed contours are finished design surface.

Legend:

Existing Contours (0.25m)

Proposed Contours (0.25m)

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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PROJECT

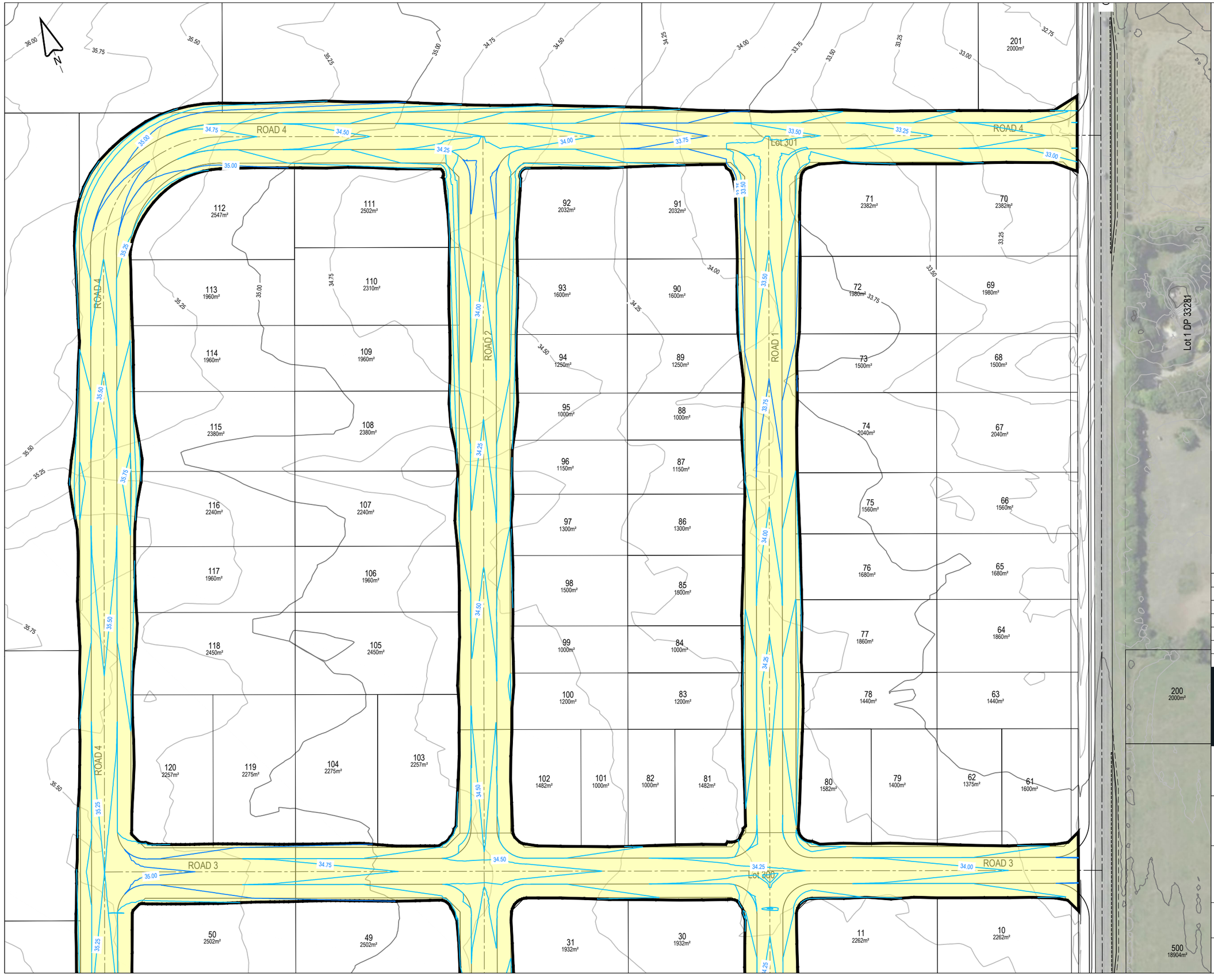
104 RYANS ROAD, HAREWOOD

DRAWING TITLE

EXISTING & PROPOSED CONTOURS (SHEET 1 OF 2)

STATUS	*SCALE*	*SIZE*
FOR APPROVAL	1:1500	A3

PROJECT	*DRAWING NO*	*REVISION*
1252	RC-EW201	A



Notes:

1. Levels are in terms of NZVD2016.
2. Existing contours are based on topographical survey and lidar data.
3. Proposed contours are finished design surface.

Legend:

Existing Contours (0.25m)

Proposed Contours (0.25m)

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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PROJECT
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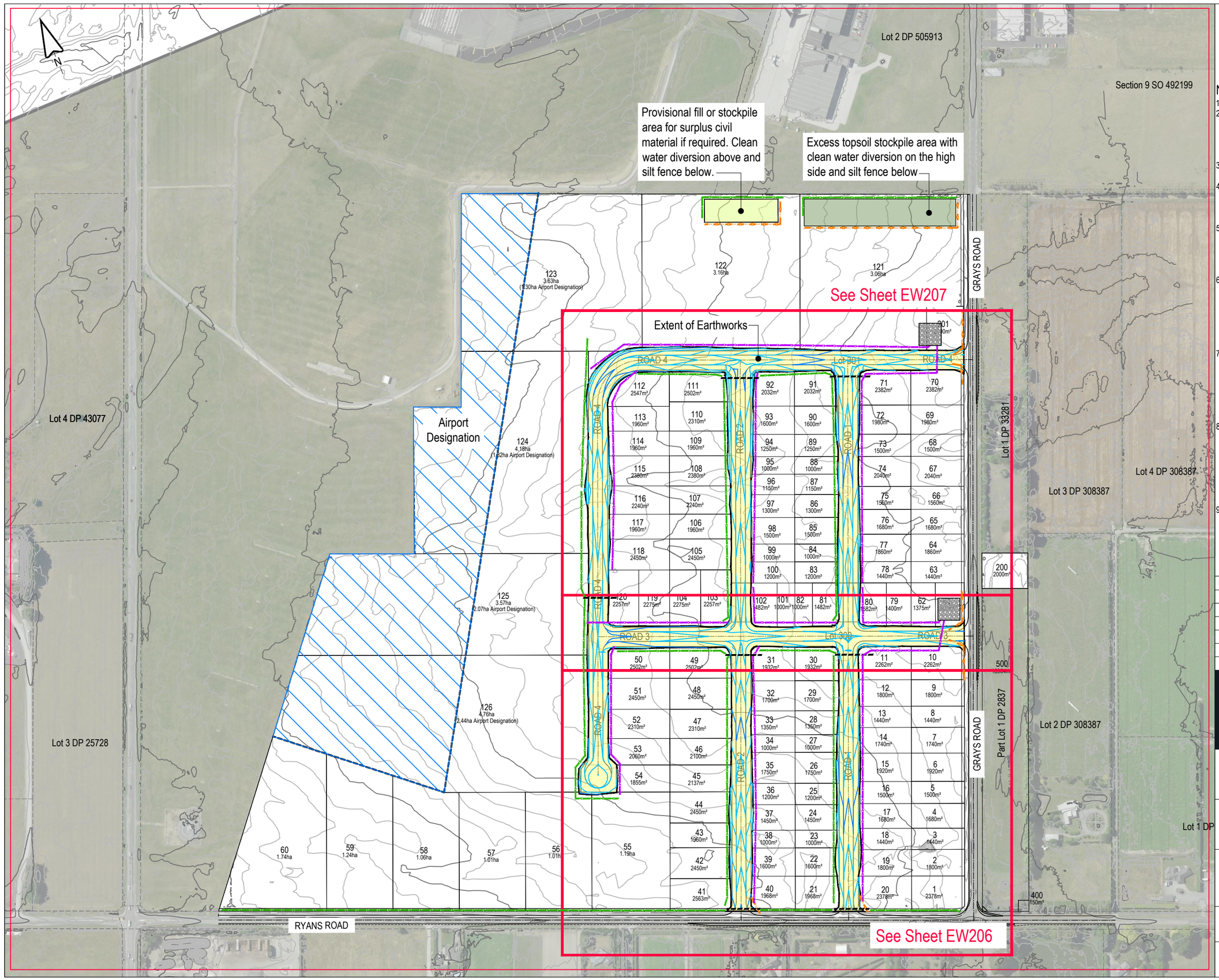
DRAWING TITLE
EXISTING & PROPOSED CONTOURS (SHEET 2 OF 2)

STATUS	*SCALE*	*SIZE*
FOR APPROVAL	1:1500	A3

PROJECT	*DRAWING NO*	*REVISION*
1252	RC-EW202	A



NOTES:

1. TOPSOIL STOCKPILES ARE CONCEPTUAL ONLY.
2. EROSION & SEDIMENT CONTROL MEASURES SHALL BE INSTALLED & INSPECTED BY THE ENGINEER AND/OR LOCAL AUTHORITY REPRESENTATIVE PRIOR TO COMMENCING EARTHWORKS.
3. ALL SURFACES SHALL BE STABILISED ONCE EARTHWORKS ARE COMPLETE.
4. ANY STOCKPILE OF MATERIAL ONSITE SHOULD BE COVERED OR STABLISED TO MINIMISE LOSSES AND SHALL NOT BE LOCATED IN OVERLAND FLOW PATHS OR SITE LOW POINTS.
5. ALL RUBBISH, VEGETATION, DEBRIS ETC SHOULD BE REMOVED FROM THE EARTHWORKS AREA AND REMOVED FROM THE SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF TOPSOIL STRIPPING.
6. ALL EROSION AND SEDIMENT CONTROL MEASURES MUST BE OPERATIONAL PRIOR TO ANY OTHER WORK COMMENCING ON SITE. THE CONTRACTOR SHALL ARRANGE FOR AND ATTEND A PRELIMINARY SEDIMENT CONTROL MEETING ON-SITE WITH THE ENGINEER AND ECAN AND COUNCIL REPRESENTATIVES.
7. THE CONTRACTOR SHALL ENSURE COUNCIL BEST MANAGEMENT PRACTICES ARE IN PLACE DURING THE CONSTRUCTION PERIOD OF DEVELOPMENT, INCLUDING AT SITE ENTRANCES AND EXITS, TO CONTROL DUST, SILT, MUD AND DISCHARGE FROM SITE ENTERING A WATER BODY.
8. FURTHER SEDIMENT CONTROL MAYBE REQUIRED BY THE ENGINEER AS THE PROJECT ADVANCES. THESE WILL BE INSTALLED AS AND WHERE DIRECTED BY THE ENGINEER. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ENSURING THAT THE SITE HAS EFFECTIVE SILT DETENTION FACILITIES OPERATING AT ALL TIMES.
9. ALL SEDIMENT AND EROSION CONTROL FEATURES SHALL BE IN ACCORDANCE WITH ENVIRONMENT CANTERBURY'S EROSION AND SEDIMENT CONTROL TOOLBOX.

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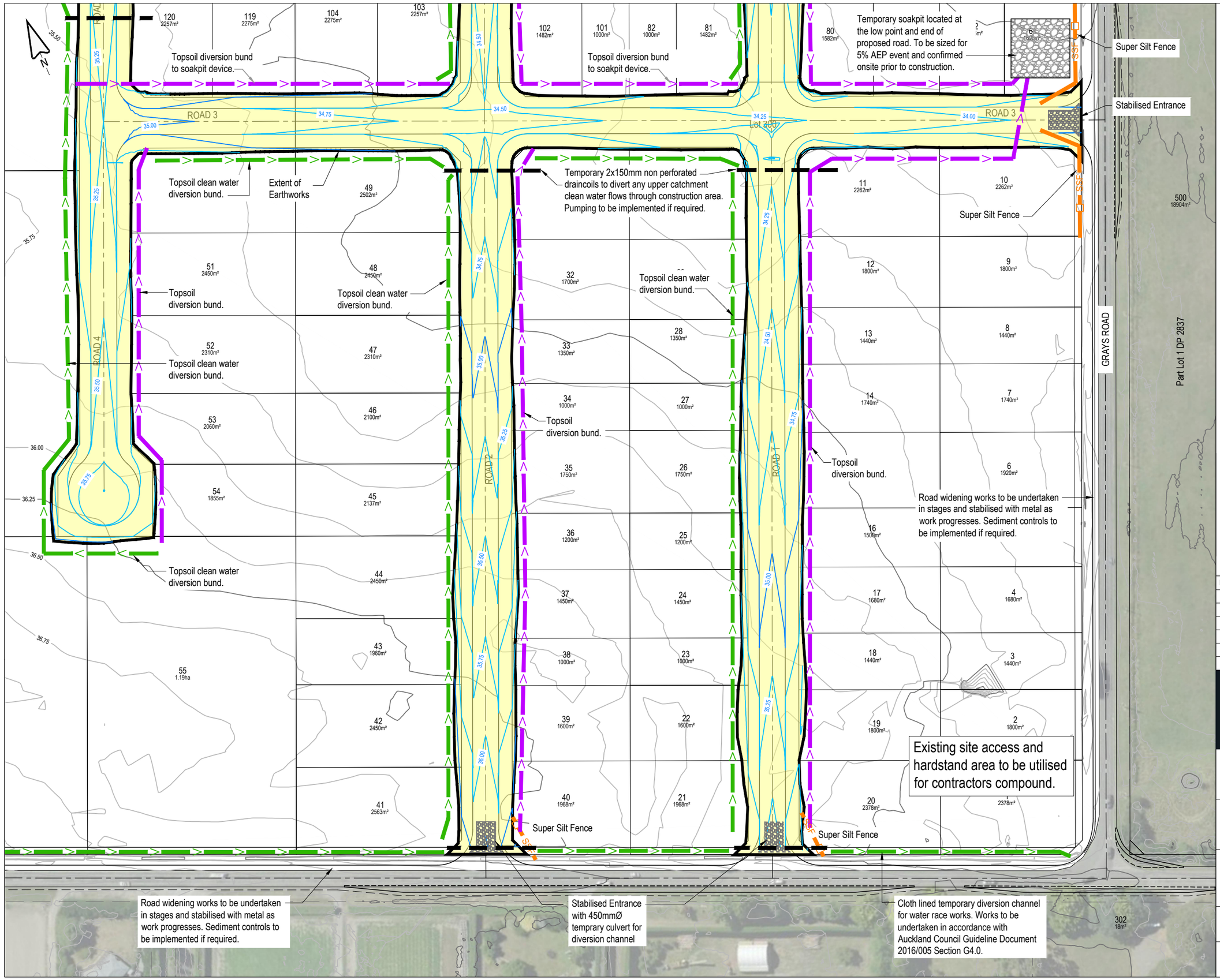
PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
EROSION & SEDIMENT CONTROL PLAN - OVERALL

STATUS	SCALE	SIZE
FOR APPROVAL	1:4000	A3

PROJECT	DRAWING NO	REVISION
1252	RC-EW205	A



NOTES:

1. SEE SHEET EW205 FOR EROSION AND SEDIMENT CONTROL NOTES.

LEGEND:

- EXISTING CONTOURS
- PROPOSED CONTOURS
- EARTHWORKS CATCHMENT
- CLEANWATER DIVERSION
- SSF SUPER SILT FENCE
- RUNOFF DIVERSION

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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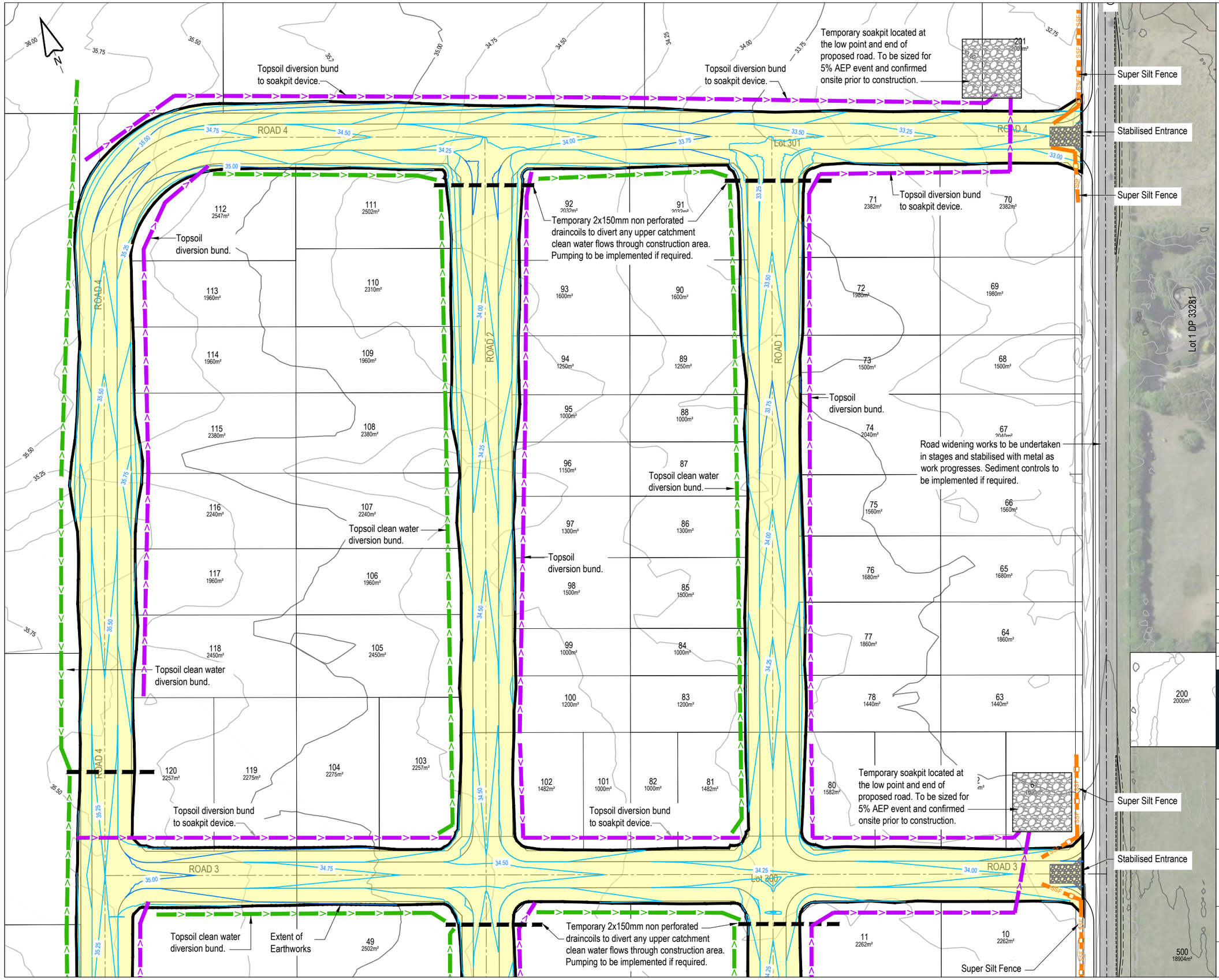
PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
EROSION & SEDIMENT CONTROL PLAN (SHEET 1 OF 2)

STATUS	SCALE	SIZE
FOR APPROVAL	1:1500	A3

PROJECT	DRAWING NO	REVISION
1252	RC-EW206	A



NOTES:

1. SEE SHEET EW205 FOR EROSION AND SEDIMENT CONTROL NOTES.

LEGEND:

- EXISTING CONTOURS
- PROPOSED CONTOURS
- EARTHWORKS CATCHMENT
- CLEANWATER DIVERSION
- SSF SUPER SILT FENCE
- RUNOFF DIVERSION

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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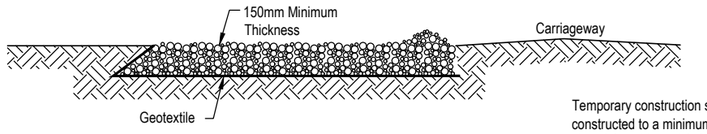
PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
EROSION & SEDIMENT CONTROL PLAN (SHEET 2 OF 2)

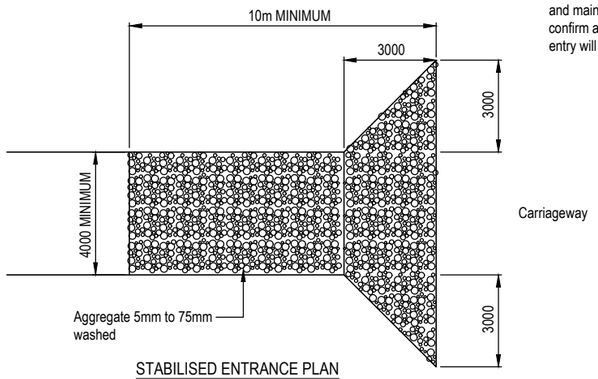
STATUS	SCALE	SIZE
FOR APPROVAL	1:1500	A3

PROJECT	DRAWING NO	REVISION
1252	RC-EW207	A



STABILISED ENTRANCE SECTION
Scale 1:200 (A3)

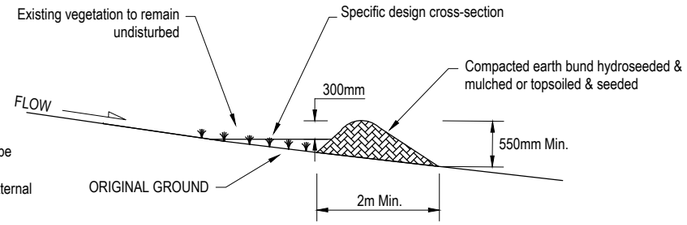
Temporary construction site entry/exit pad constructed to a minimum of 10m of aggregate placed 4m wide and 150mm deep as per the Erosion & Sediment Control Toolbox for Canterbury. Existing road surfaces are to be kept clean throughout the project with daily monitoring and maintenance as required. Contractor to confirm at pre-start meeting where main site entry will be located.



STABILISED ENTRANCE PLAN
Scale 1:200 (A3)

CLEAN WATER DIVERSION:

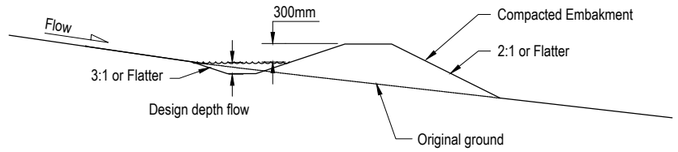
- The diversion channels should be parabolic or trapezoidal in shape
- Ensure internal sides of the bund are no steeper than 3:1, and external sides no steeper than 2:1, as outlined below



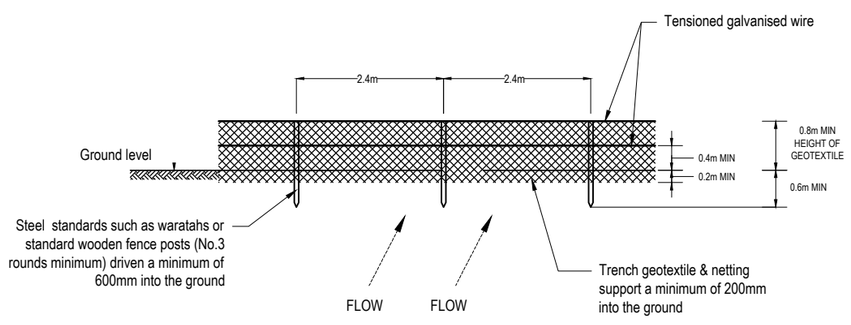
CLEAN WATER DIVERSION CROSS-SECTION
SCALE: 1:50 AT A3

DIRTY WATER DIVERSION:

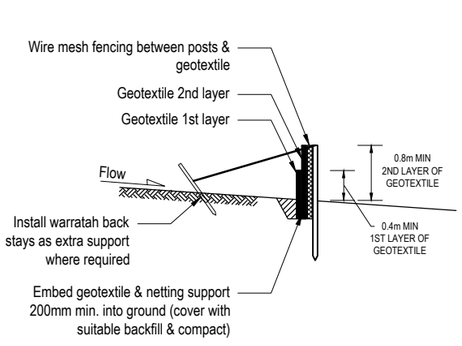
- Drains which can be lined with an erosion-resistant material such as needle-punched fabric
- A combination bank or bund with excavated up-slope channel
- An earthen bank, which is often jmade from compacted soil.



RUNOFF DIVERSION BUND CROSS-SECTION
SCALE: 1:50 AT A3

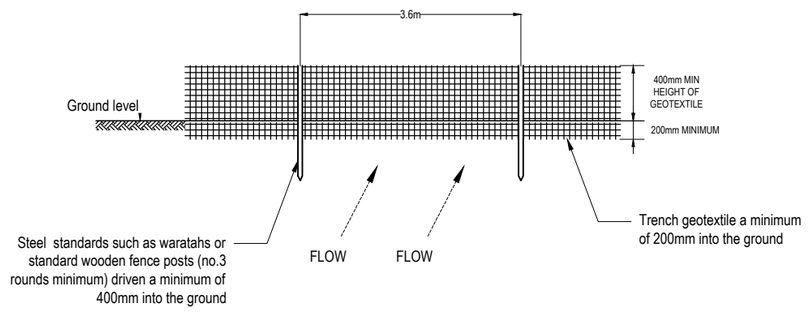


SUPER SILT FENCE ELEVATION
SCALE: 1:75 AT A3

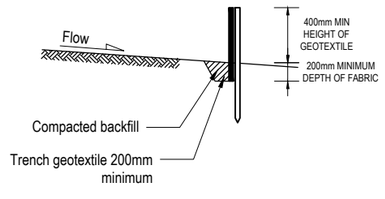


SUPER SILT FENCE CROSS-SECTION
SCALE: 1:75 AT A3

Super silt fence design criteria			
Slope steepness %	Slope length (m) (maximum)	Spacing of returns (m)	Super silt fence length (m) (maximum)
0-10%	unlimited	60	Unlimited
10-20%	60	50	450
20-33%	30	40	300
33-50%	30	30	150
>50%	15	20	75



SILT FENCE ELEVATION
SCALE: 1:75 AT A3



SILT FENCE CROSS-SECTION
SCALE: 1:75 AT A3

Silt fence design criteria			
Slope steepness %	Slope length (m) (maximum)	Spacing of returns (m)	Super silt fence length (m) (maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2-10%	40	60	300
10-20%	30	50	230
20-33%	20	40	150
33-50%	15	30	75
>50%	6	20	40

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
EROSION & SEDIMENT CONTROL DETAILS

STATUS	*SCALE*	*SIZE*
FOR APPROVAL	AS SHOWN	A3

PROJECT	*DRAWING NO*	*REVISION*
1252	RC-EW210	A

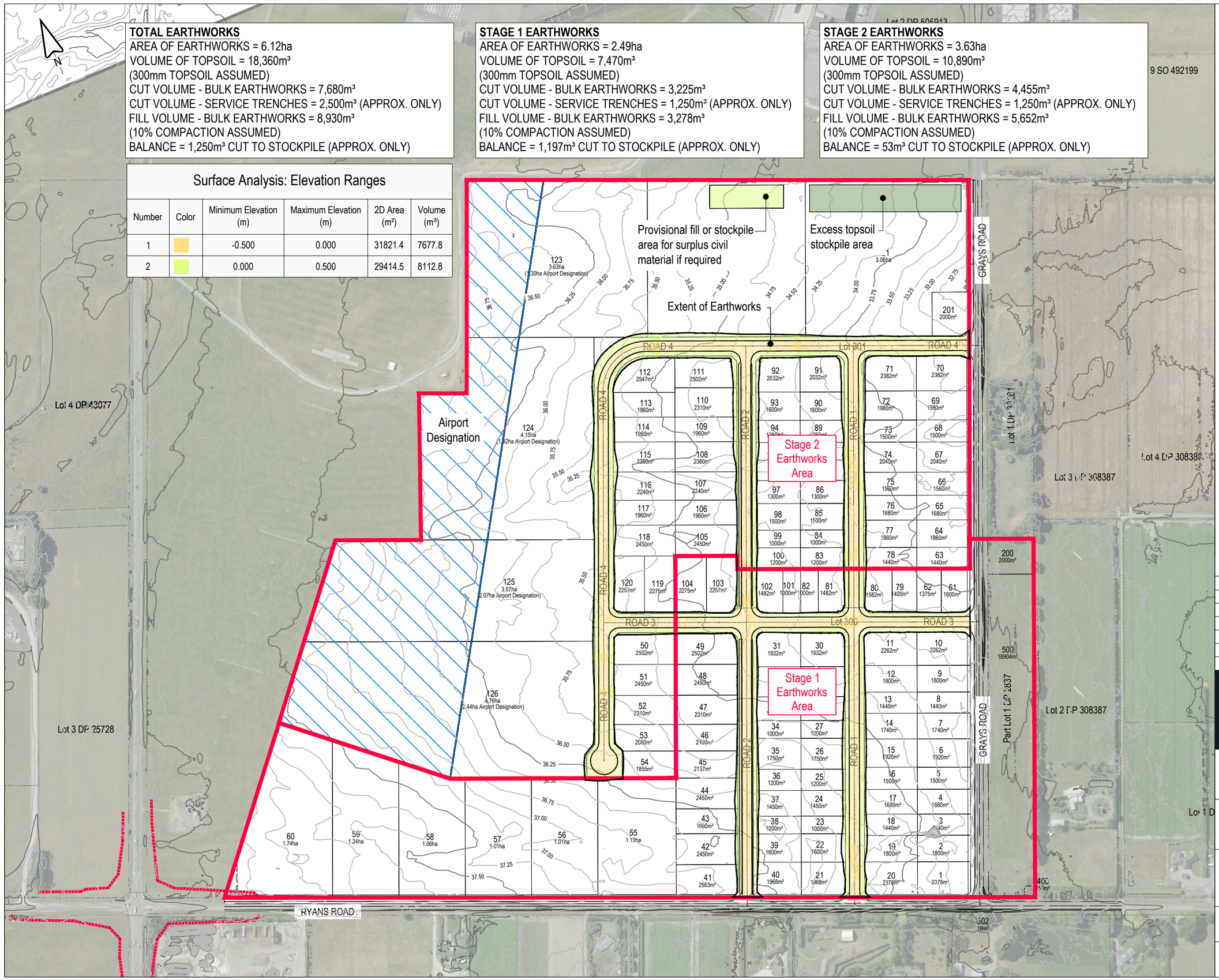
TOTAL EARTHWORKS
AREA OF EARTHWORKS = 6.12ha
VOLUME OF TOPSOIL = 18,360m³
(300mm TOPSOIL ASSUMED)
CUT VOLUME - BULK EARTHWORKS = 7,680m³
CUT VOLUME - SERVICE TRENCHES = 2,500m³ (APPROX. ONLY)
FILL VOLUME - BULK EARTHWORKS = 8,930m³
(10% COMPACTION ASSUMED)
BALANCE = 1,250m³ CUT TO STOCKPILE (APPROX. ONLY)

STAGE 1 EARTHWORKS
AREA OF EARTHWORKS = 2.49ha
VOLUME OF TOPSOIL = 7,470m³
(300mm TOPSOIL ASSUMED)
CUT VOLUME - BULK EARTHWORKS = 3,225m³
CUT VOLUME - SERVICE TRENCHES = 1,250m³ (APPROX. ONLY)
FILL VOLUME - BULK EARTHWORKS = 3,278m³
(10% COMPACTION ASSUMED)
BALANCE = 1,197m³ CUT TO STOCKPILE (APPROX. ONLY)

STAGE 2 EARTHWORKS
AREA OF EARTHWORKS = 3.63ha
VOLUME OF TOPSOIL = 10,890m³
(300mm TOPSOIL ASSUMED)
CUT VOLUME - BULK EARTHWORKS = 4,455m³
CUT VOLUME - SERVICE TRENCHES = 1,250m³ (APPROX. ONLY)
FILL VOLUME - BULK EARTHWORKS = 5,652m³
(10% COMPACTION ASSUMED)
BALANCE = 53m³ CUT TO STOCKPILE (APPROX. ONLY)

Surface Analysis: Elevation Ranges

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume (m³)
1		-0.500	0.000	31821.4	7677.8
2		0.000	0.500	29414.5	8112.8



Notes:

1. Earthwork contours shown depict the cut and fill depth between existing ground surface and the final finished ground surface.

Legend:

- Existing Contours (0.25m)
- Area of Cut
- Area of Fill

REV	DATE	REVISION DETAILS	ISSUED
A	25/02/25	FOR APPROVAL	TL

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PROJECT
104 RYANS ROAD, HAREWOOD

DRAWING TITLE
PROPOSED
CUT & FILL ELEVATIONS

STATUS	*SCALE*	*SIZE*
FOR APPROVAL	1:4000	A3

PROJECT	*DRAWING NO*	*REVISION*
1252	RC-EW220	A