Rehabilitation and Landscape Management Sub Plan

Camden Gas Project
February 2024

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1. Introduction

An Environmental Management Plan (EMP) has been prepared for the AGL Upstream Investments Pty Ltd (AGL) Camden Gas Project ('the project' or 'CGP'). This Rehabilitation and Landscape Management Sub Plan (RLMSP) has been prepared to supplement the EMP.

The EMP includes a description of the CGP and the overall environmental management framework for the CGP. This RLMSP has been developed to specifically address and manage landscape and rehabilitation issues for the rehabilitation of the CGP.

The CGP ceased production in August 2023 and all remaining infrastructure including the Rosalind Park Gas Plant (RPGP) is now being decommissioned and rehabilitated.

1.1 Objectives

The objectives of the RLMSP are to avoid unauthorised disturbance to land use or damage to infrastructure, to prevent the introduction and dispersal of noxious weeds, pathogens and pest species and to minimise the impacts to the visual characteristics of the Project area.

As all production operations have now ceased, all sites including gas wells, gas gathering lines, access roads and the RPGP are currently being decommissioned and rehabilitated in consultation with the landowner and in accordance with Project Approvals and the Petroleum Operations Plan (POP).

In order to achieve these objectives AGL will:

- Promptly carry out rehabilitation activities to promote vegetation regrowth in disturbed work areas to a standard consistent with the surrounding area.
- Monitor and maintain vegetation cover to ensure that it is consistent with the surrounding environment in consultation with the landowner.
- Promote and maintain regrowth of vegetation.
- Prevent the introduction and dispersal of noxious weeds, pathogens and pest species.
- Monitor well compounds, access roads, RPGP and gathering line routes following rehabilitation to ensure that areas are suitably vegetated and remain free of weeds, pathogens and pest species.
- Minimise the impacts to the visual characteristics of the project area.
- Avoid unauthorised disturbance to land under rehabilitation.

1.2 Targets

- Close out of identified weed issues as soon as reasonably practicable; and
- Zero incidents or complaints concerning land disturbance, infrastructure, visual impacts, vegetation cover or weed growth.

1.3 Responsibilities

The roles and responsibilities for implementing this RLMSP are summarised in **Table 1.1**. Further responsibilities are assigned to individual roles in **Table 3-2** and **Section 4.1**.

Table 1.1: Roles and responsibilities

Role	Responsibility
Field and Rehabilitation Operator	• Responsible for implementing site specific recommendations as required. • Responsible for ensuring that all employees and contractors under their control are familiar with and adhere to the requirements of the RLMSP. • Responsible for landowner consultation with assistance from the Environment Business Partner in addressing landowner rehabilitation requirements and complaints.
All employees/ contractors	• Responsible for following the induction requirements that arise from their work activities onsite, so as to minimise the environmental impact.
Rehabilitation Manager/ Project Manager/ All leaders	• Responsible for ensuring that all works under their control are undertaken in accordance with the RLMSP. • Responsible for ensuring that all employees and contractors under their control are familiar with and adhere to the requirements of the RLMSP.
Environment Business Partner	• Informing site personnel of the rehabilitation management procedures through the induction program. • Responsible for monitoring procedures and reporting as required by this RLMSP. • Review and update the RLMSP.
Operations Superintendent	• Responsible for monitoring procedures and reporting as required by this RLMSP. • Directly responsible for the implementation of this RLMSP.

2. Requirements

2.1 Key licence/development consent requirements

Table 2.1: Key licence/development consent requirements

Reference	Requirement	Section of this Management Plan
Site Rehabilitation		
DA 15-1-2002: 72, 73 (Sch 3) DA 246-8-2002-i: 29, 30 (Sch 3) DA 282-6-2003i: 120-1 (Sch 4)	Site Rehabilitation The Applicant shall ensure the prompt and effective rehabilitation of all disturbed areas of the site following the completion of construction, operations and associated activities and/or the decommissioning of plant, to minimise the generation of wind erosion dust. The Applicant shall carry out rehabilitation of the site in accordance with the requirements of the DPI and the Site Rehabilitation Management Plan.	Item 3 and Item 6 in Table 3.2 (Section 3.6).
DA-9-1-2005: 26 (Sch 2)	26. The Applicant shall provide landscaping around the well heads using appropriate species, in consultation with the landowner. Note: All works required by this condition have been completed.	Section 3-1 Item 3 in Table 3.2 (Section 3.6)
DA 282-6-2003i: 124-5 (Sch 4)	124. The Applicant shall stabilise and rehabilitate as soon as possible all disturbed soil surfaces with sterile exotic cover crops and local native grasses. The Applicant is not permitted to use Kikuyu and other invasive grass species. 125. The Applicant shall maintain and monitor all rehabilitated riparian zones for a period of at least two years after final planting. Maintenance must include sediment and erosion control, watering, weed control, replacement of plant losses, disease and insect control, mulching and any other requirements for achieving successful vegetation establishment. Note: The Director-General may require the Applicant to prepare and implement a Vegetation Management Plan and remedial works if disturbance is deemed excessive. Note: All works required by these conditions have now been completed.	Item 6 of Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA-183-8-2004i: SOC 48, 49	48. The Proponent shall progressively rehabilitate the MP25 well surface location and any other parts of the site impacted by the development to the satisfaction of the Director-General and Department of Planning and Environment, unless agreed otherwise, and in consultation with the landowner. 49. The Proponent shall consult with the landowner regarding the method of closure and rehabilitation for the twinned GGL between MP16 and MP30. Note: All works required by these conditions have been completed.	Section 3; and Table 3.2 Item 3 and Item 6 in Table 3.2 (Section 3.6)
Petroleum Production Leases 1, 2, 4, 5 and 6, Schedule A, Condition 5	Disturbed land must be rehabilitated to a sustainable/ agreed end land use to the satisfaction of the Director General.	Item 6 in Table 3.2 (Section 3.6).
Rehabilitation Management Plan		
DA 15-1-2002: 25 (Sch 3)	Site Rehabilitation Management Plan 25. The Applicant shall prepare and implement a Site Rehabilitation Management Plan for the whole site. This plan shall include, but not necessarily be limited to: a) details of the staging and timing for rehabilitation works; b) on-going management strategies to ensure the success of rehabilitation works; c) details of the establishment of vegetation and all landscaping to be undertaken including flora species, location of grassed areas, garden beds and other vegetated areas, and mature height and width measurements of all flora species; and d) the measures to remediate sites following the decommissioning of the wells, pipelines and treatment plant.	Section 3 Table 3.2 (Section 3.6)
PA 06_0137: 16-17 (Sch 3)	The Proponent shall progressively rehabilitate the site to the satisfaction of the Director-General, in a manner that is generally consistent with the landform of the surrounding land.	Section 3.6 Item 3 and Item 6 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
PA 06_0138: 18-19 (Sch 3)	The Proponent shall prepare and implement a Rehabilitation Management Plan to the satisfaction of the Director-General. The Plan shall be submitted to the Director-General within 6 months of the date of this approval and shall: a) identify the areas likely to be disturbed by the project; and b) describe the measures that would be implemented to rehabilitate the site.	Table 3.2 (Section 3.6) Item 1 in Table 3.2 (Section 3.6)
PA 06_0291: 1 (Sch 3)	1. Prior to construction commencing at an individual well surface location, the Proponent shall submit a Site Layout Plan of the well surface location to the satisfaction of the Director-General. The Site Layout Plan must be prepared in consultation with the landowner and include details of: a) the site construction layout and construction footprint; b) the wellheads and production compound layout; c) the route of the gas gathering lines and access roads; and d) initial rehabilitation works following construction.	Item 1 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
PA 06_0291: 17-19 (Sch 3)	17. The Proponent shall progressively rehabilitate the site to the satisfaction of the Director-General, in a manner that is generally consistent with the landform of the surrounding land. 18. The Proponent shall prepare and implement a Landscape and Rehabilitation Management Plan for each well surface location to the satisfaction of the Director-General. This Plan must: a) be prepared in consultation with the landowner by suitably qualified experts; b) be submitted to the Director-General for approval prior to commissioning; c) describe in detail the short, medium and long term measures that would be implemented to: i) rehabilitate the site; ii) implement planting of native vegetation; iii) manage the remnant vegetation and habitat on the site; and iv) landscape the site to mitigate visual impacts of the project; d) include a description of what measures would be implemented to rehabilitate the site; and e) details of who is responsible for monitoring, reviewing and implementing the plan. This requirement can also be satisfied by the Site Layout Plan (Schedule 3, condition 1) addressing the above issues as appropriate.	Table 3.2 Section 3.6 Item 1 in Table 3.2 (Section 3.6)
	19. The Proponent shall consult with the landowner in the selection of fencing and other materials to be used for landscaping, to the satisfaction of the Director-General.	Item 3 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
PA 06_0291: SoC 5, 8, 9 (App 3)	(5) The Proponent shall provide a site layout to the Director General prior to construction of a well surface location. The site layout would include information identifying: a) Initial rehabilitation of surplus construction footprint following completion of the construction phase. b) Rehabilitation and Landscape Concept Plan of well surface locations for the post-commissioning phase as well as following final closure of the wells. (8) The Proponent shall prepare and implement a Landscape Management Plan detailing landscaping to be undertaken at well surface locations, including a maintenance program for these landscaping works. Landscaping shall be undertaken using appropriate native species. (9) The Proponent shall take all practicable measures to limit the potential spread of noxious weeds at the site.	Section 3.6 Item 4 in Table 3.2 (Section 3.6) Item 1 in Table 3.2 (Section 3.6) Item 5 in Table 3.2 (Section 3.6) Item 6 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA 15-1-2002: 4 and 25 (Sch 3)	Special Conditions of Approval 4. The Applicant shall submit a development application for a new treatment plan within two (2) years of the date of this consent. Upon the commissioning of the new treatment plant the Applicant shall cease production from the Ray Beddoe Treatment Plant and proceed to rehabilitate the site in accordance with the Site Rehabilitation Management Plan. Site Rehabilitation Management Plan 25. The Applicant shall prepare and implement a Site Rehabilitation Management Plan for the whole site. This plan shall include, but not necessarily be limited to: a) details of the staging and timing for rehabilitation works; b) ongoing management strategies to ensure the success of rehabilitation works; c) details of the establishment of vegetation and all landscaping to be undertaken including flora species, location of grassed areas, garden beds and other vegetated areas, and mature height and width measurements of all flora species; and d) the measures to remediate sites following the decommissioning of the wells, pipelines and treatment plant. Note: All works required by these conditions have been completed for the Ray Beddoe Treatment Plant.	Item 6 in Table 3.2 (Section 3.6)
Gas Gathering Lines		
DA 15-1-2002: 68c (Sch 3) DA 246-8-2002-i: 28c (Sch 3) DA 282-6-2003i: 127b (Sch 4) DA 9-1-2005: 10b (Sch 2) DA 75-4-2005: 38b (Sch 2) PA 06_0137: 15d (Sch 3)	Trenches are to be restored and reseeded with local grass seeds on completion of the work. Note: All works required by these conditions have been completed.	Section 3.1.2; and Table 3.2 (Section 3.6). Item 3 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
PA 06_0137: 15h (Sch 3) PA 06_0138: 17g (Sch 3)	No crown or camber remains along any gas gathering system line, following rehabilitation. Note: All works required by these conditions have been completed.	Item 6 in Table 3.2 (Section 3.6)
DA 282-6-2003i: 123 (Sch 4)	Gas gathering stream crossings may be trenched. For all trenched crossings, the natural bed and bank profiles are to be restored to their original condition, with smooth and even surfaces, following installation of the gas pipe. Note: All works required by these conditions have been completed.	Section 3.2 Item 6 in Table 3.2 (Section 3.6)
DA 282-6-2003i: 122 (Sch 4)	The Applicant shall ensure that all areas of earthworks associated with the construction of the gas gathering system are rehabilitated to the pre-existing site conditions on completion of construction. Note: All works required by this condition have been completed.	Section 3.2 Item 6 in Table 3.2 (Section 3.6)
Vegetation and Landscape Management Plan		
DA 15-1-2002: 23 (Sch 3)	Vegetation and Landscape Management Plan (23) The Applicant shall prepare and implement a Vegetation and Landscape Management Plan for the whole site. This plan shall include, but not necessarily be limited to: a) measures to protect mature trees as part of the well drilling or gas gathering pipeline construction activities; b) details of all landscaping to be undertaken on the site; c) ensure that tree and shrub species used for landscaping of the site are indigenous to the locality; and d) details of a program to ensure that all landscaped areas are maintained in a tidy, healthy state.	Item 7 in Table 3.2 (Section 3.6)
DA 282-6-2003i: 12 (Sch 4)	The site shall be landscaped as shown on the Landscape Design and this landscaping shall be maintained for the life of the development.	Item 7 in Table 3.2 (Section 3.6)
DA 282-6-2003i: 13 (Sch 4)	The Applicant shall prepare and implement a Vegetation and Landscape Management Plan for the Gas Treatment Plant site and the gas well sites. The plan shall include, but not necessarily be limited to:	Table 3-2 (Section 3.6); Item 1 in Table 3.2 (Section 3.6); and

Reference	Requirement	Section of this Management Plan
	a) reasonable measures to protect mature trees as part of the well drilling, gas gathering system and Treatment Plant Site construction activities; b) a landscape strategy detailing the design and proposed planting of trees and shrubs to be undertaken; c) ensuring that tree and shrub species used for landscaping of the site are indigenous to the locality; d) details of a program to ensure that all landscaped areas are maintained in a tidy, healthy state; e) measures intended to maximise the screening of infrastructure from views from the Mt Gilead property through planting and other measures; f) details of the visual appearance of all new buildings, structures and facilities (including paint colours and specifications). New buildings shall be constructed so as to present a neat and orderly appearance and to blend as far as practicable with the surrounding landscape; g) Details of any necessary irrigation system to ensure that adequate supplies of water are made available to all landscaping on site, the trees between the site and Menangle Creek and the trees located on the southern boundary of the Gas Treatment Plant site; h) Details of any necessary methods to be employed in the establishment of trees on cut batters in the event that the excavated surface is not conducive to the planting of vegetation of the type displayed in the Landscape Design; i) provision for assessing and regularly monitoring the health of the trees in the Menangle Creek riparian zone adjacent to the Gas Treatment Plant site. The objective of the monitoring is to determine the health of the trees and to recommend measures (if required) to improve the health of the trees; j) reasonable measures to ensure that mature trees within the riparian corridor along Menangle Creek are retained and protected;	Item 2 in Table 3.2 (Section 3.6); Item 6 in Table 3.2 (Section 3.6); Item 7 in Table 3.2 (Section 3.6);

Reference	Requirement	Section of this Management Plan
	k) details of proposed screening works including supplementary planting along the border of the site with Menangle Creek; l) reasonable measures to minimise the impacts of the gas wells on the cultural heritage landscape of the EMAI; m) details of a monitoring program to assess the effectiveness of all visual impact mitigation measures, particularly the measures used to minimise the visual impacts on the Mount Gilead Homestead; and n) reporting the results of the visual impact monitoring in the Annual Environmental Performance Report. The monitoring results will specifically identify any remedial measures required. The Vegetation and Landscape Management Plan must be submitted and approved by the Director-General prior to commencement of construction on the Gas Treatment Plant site.	

Reference	Requirement	Section of this Management Plan
DA 282-6-2003i: 14 (Sch 4)	14. As part of an independent audit required under condition 18, the Vegetation and Landscape Management Plan must make provision for ensuring that landscaping of the Gas Treatment Plant site and surrounds is maintained in an adequate condition by providing details of a monitoring program. Monitoring must be carried out pursuant to the monitoring program every 6 months for the first two years from the commencement of planting and thereafter every 2 years by an independent and suitably qualified and experienced arborist whose appointment has been approved for the purposes of this condition by the Director-General. The monitoring program must include the following features: a) identification of mature trees surrounding the site which afford screening of the Gas Treatment Plant from Mt Gilead Homestead; b) provision for assessing and regularly monitoring the health of landscaping on the site and the trees in the Menangle Creek riparian zone adjacent to the Gas Treatment Plant site. The objective of the monitoring is to determine the health of the trees and to recommend measures (if required) to improve the health of the trees; c) Description of the health of each tree identified under condition (a); d) Recommendation of reasonable measures to ensure that mature trees within the riparian corridor along Menangle Creek are retained and protected, including trees that lie within the transmission line easement to the East of the site; e) Recommendation for any watering or fertilising that needs to be implemented to maintain the landscaping and surrounding trees; f) Recommendation of how to manage the landscaping to promote the maximisation of growth to maturity. The results and recommendations of the monitoring program must be submitted to the Director-General at the conclusion of each stage of monitoring.	Item 7 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA 282-6-2003i: 15 (Sch 4)	15. (a) The existing trees shown on the Landscape Design adjacent to the southern boundary of the Gas Treatment Plant site, must be retained. They must not be lopped or trimmed except on the advice of an independent arborist whose appointment has been approved for the purposes of this condition by the Director-General that the proposed work is reasonably necessary for safety reasons. The trees must be maintained in a healthy condition. (b) If any of the trees described in this condition ceases to provide screening of the quarry from the Mount Gilead Homestead, as a result of the Applicant's activities (other than trimming or lopping undertaken on the advice of the arborist), the Applicant must provide alternative screening to the satisfaction of the Director-General.	Table 3.2 Section 3.6 Item 7 in Table 3.2 (Section 3.6)
DA-282-6-2003i: 16 (Sch 4)	16. Prior to the commencement of construction on the Gas Treatment Plant site the Applicant must secure the right to implement on land outside the Gas Treatment Plant site for the life of the development any necessary mitigative or screening measures proposed for the Gas Treatment Plant as part of the Vegetation and Landscape Management Plan or as required by this Consent. Note: All works required by this condition have been completed.	Item 7 in Table 3.2 (Section 3.6)
DA-282-6-2003i: 17 (Sch 4)	17. For the purpose of avoiding possible detrimental impact on vegetation screening of the Gas Treatment Plant from the Mt Gilead Homestead due to any clear felling of trees in the area marked "A" on the Applicant's Plan Map Ref M240212 dated 16 June 2004 ("Applicant's Plan") by the holder of the electricity transmission line easement over Lot 1 DP 807555 ("Holder"), the Applicant shall carry out any reasonable and necessary trimming and lopping of those trees provided the Holder requests the Applicant in writing to carry out this trimming and lopping and undertakes in return to refrain from the clear felling of those trees within 5 years of the date of this Consent.	Item 1 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA-282-6-2003i: 18, 19 (Sch 4)	Independent Audit 18. The Applicant shall commission and pay the full cost of an Independent Audit of the performance of the mitigation measures implemented to prevent and minimise visual impacts of the proposal including landscaping, preservation of existing trees, and night-lighting effects. The audit must be conducted within 6 months of the commissioning of the proposed development and every 2 years thereafter, unless the Director-General directs otherwise. This audit must: a) Be conducted by an independent landscape expert who is suitably qualified and experienced and whose appointment has been approved by the Director-General; b) Assess the performance of the visual mitigation measures with specific reference to the effectiveness of mitigation measures in screening the development and lighting from the development from the Mount Gilead Homestead; c) Review the adequacy of the Vegetation and Landscape Management Plan; d) Recommend actions or measures to improve the performance of the visual mitigation measures and the adequacy of the Vegetation and Landscape Management Plan (if required); and e) Be submitted to the Director-General; and f) Be implemented to the satisfaction of the Director-General. 19. Within 2 months of commissioning this audit the Applicant shall submit a copy of the audit report to the Director- General and provide a detailed response to any of the recommendations in the audit report. A copy of the Independent Audit, and/or the results and recommendations of any monitoring carried out under condition 14, will be provided to the owner of Lot 1 DP 807555 by the Director-General upon request.	Item 7 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA-282-6-2003i: 19A, B (Sch 4)	Landscape Planting Plan – Rosalind Park Access Road 19A. The Applicant shall prepare and implement a Landscape Planting Plan for the relocated Rosalind Park access road, to the satisfaction of the Director-General. This plan must be submitted to the Director-General for approval prior to the commencement of construction, and include: a) details of the landscaping measures along the road and visual bund; b) measures to manage and maintain the landscaping; and c) describe the construction rehabilitation measures. 19B. Within 6 months of completion of the landscaping and every 2 years thereafter, unless the Director-General directs otherwise, the Applicant shall commission and pay the full costs of an Independent Audit of the performance of the mitigation measures. The audit shall: a) be conducted by a suitably qualified, experienced and independent person(s) whose appointment has been approved by the Director-General; b) assess the performance of the visual mitigation measures with specific reference to the effectiveness of mitigation measures in screening the road from the Mount Gilead Homestead; c) review the adequacy of the Landscape Planting Plan; d) recommend actions or measures to improve the performance of the visual mitigation measures and the adequacy of the Landscape Planting Plan (if required); and e) be submitted and implemented to the satisfaction of to the Director-General. Note: the Applicant may include this audit in the Independent Audit required under Schedule 4 Condition 18 of development consent Da-282-6-2003-I, dated 16 June 2004. The due date for a combined audit shall be the earlier of the due dates for the separate audits.	Item 7 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
Weed Management		
DA-183-8-2004: 17 (Sch 2) DA-9-1-2005: 29 (Sch 2)	The Applicant is required to prepare and implement a Weed Management Plan for the sites for the life of the development. The Applicant shall submit the Weed Management Plan for the Director-General's approval within one month of the date of this consent.	Section 3.6. Item 5 in Table 3.2 (Section 3.6)
PA 06_0291: SoC 9 (App 3)	The Proponent shall take all practicable measures to limit the potential spread of noxious weeds at the sites.	Item 5 in Table 3.2 (Section 3.6)
PPL 1, 2: 9(c) (Sch) Fields – Apap, EMAI (part), Johndilo, Joe Stanley, Kay Park, Loganbrae, Lipscombe, Mahon	The lease holder must observe any instructions given by any responsible authority with a view to the eradication of noxious weeds. The lease holder must make all reasonable efforts to prevent the introduction and establishment of noxious weeds.	Item 5 in Table 3.2 (Section 3.6)
DA-75-4-2005: 42 (Sch 2)	The Applicant shall prepare and implement a Weed Management Plan for the site for the life of the development. The Applicant shall submit the Weed Management Plan for the Director-General's approval within one month of the date of this consent.	Section 3.6 Item 5 in Table 3.2 (Section 3.6)
Lighting		
DA 15-1-2002: 63 (Sch 3) DA 282-6-2003i: 5 (Sch 4)	The Applicant shall ensure that all external lighting associated with the development is mounted, screened and directed in such a manner so as to not create a nuisance to surrounding land uses. The lighting must be the minimum level of illumination necessary, and in general accordance with the Australian Standard 4282 – 1997 Control of the Obtrusive Effects of Outdoor Lighting. Note: All works required by this condition have been completed.	Table 3.2 Section 3.6 Item 7 in Table 3.2 (Section 3.6)

Reference	Requirement	Section of this Management Plan
DA 282-6-2003i: 4, 8, 11 (Sch 4)	4. The Applicant shall take all practicable measures to minimise any off-site lighting impacts from the development. 8. The Applicant must ensure that wherever possible, any scheduled use of the flare occurs during daylight hours. 11. The Applicant shall record the frequency of the operation of the flare and shall make this information available for inspection by the Director- General on request. The records shall include but not be limited to the following: a) date and time of each flare event; b) duration of each flare event; c) whether the flare operated during daylight or night-time hours; d) the cause for the operation of the flare; e) the number of compressor engines that have been commissioned and operating during the period; and f) comparison of the frequency, night-time frequency, duration and estimated light level of each type of flare event with the flare events predicted in Table 2 of the following report: URS (2003) “Sydney Gas Proposal Stage 2 Coal Seam Methane Project Visual Assessment of Lighting and Flare” prepared by URS for Sydney Gas dated 6 November 2003. Note: All works required by this condition have been completed.	Item 7 in Table 3.2 (Section 3.6)

2.2 Key legislative and regulatory requirements

Table 2.2 lists the applicable New South Wales and Commonwealth legislation and policies for the project.

Table 2.2: Legislation and policies

Legislation / Policy	Relevance
NSW Environmental Planning and Assessment Act (EP&A Act)1979	The *Environmental Planning and Assessment Act 1979* (EP&A Act) and Regulation include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment, and provide opportunity for public involvement.
Biosecurity Act 2015	The objective of the *Biosecurity Act 2015* is to provide a framework for the prevention, elimination and minimisation of biosecurity risks, including pest and weed species. The following weed species are known to occur with the site and it's surrounds: • African Boxthorn (*Lycium ferocissimum*) • Blackberry (*Rubus fruticosis*) • Bridal Creeper (*Asparagus asparagoides*) • Paterson's Curse (*Echium* sp.) • Broad-leaf Privet (*Ligustrum lucidum)* • Narrow-leaf Privet (*Ligustrum sinense*) • Willows (*Salix* sp.) • Tiger pear (*Opuntia aurantiaca*). A number of other priority weeds are listed in the region, as per the NSW WeedWise Register (NSW Department of Primary industries, 2018). In accordance with the *Biosecurity Act 2015*, there is a duty to prevent, eliminate or minimise any biosecurity risk. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

3. Management

3.1 Well rehabilitation overview

The overall objective of undertaking rehabilitation at each of the well surface locations is to return the land to pre-operational land use and condition or better.

Rehabilitation of well surface locations would be undertaken in two main stages. These include:

1. Initial rehabilitation of surplus construction footprint following completion of the well drilling and construction phase to the commissioning and maintenance area; and
2. Final rehabilitation of well sites following closure of the wells.

The rehabilitation requirements for each well will be determined in accordance with the landowner, the agreement between the landowner and the company and the conditions of the development consent for the area. The surrounding land uses and options to minimise environmental impact would also be taken into consideration.

3.1.1 Initial well rehabilitation

The initial rehabilitation of surplus construction areas would be undertaken following the construction phase of the development. The initial construction footprint generally comprises a level well pad area and lined drill pit(s) with an excavated depth of approximately 2 to 3 metres.

Once the well has been drilled, stimulated, completed and production testing has been undertaken, surplus construction areas would be rehabilitated, and the construction footprint surrounding the well would be reduced to the commissioning (which includes dewatering) and maintenance area.

Typically, only the immediate wellhead infrastructure and equipment required for well commissioning would remain at the well surface location. Initial well rehabilitation has previously been completed at all sites, and all remaining sites are now progressing to closure and final well rehabilitation.

3.1.2 Closure and final well rehabilitation

Upon completion of gas production operations, closure of the wells and rehabilitation of the well sites and gas gathering systems is undertaken.

The final stage rehabilitation works include:

- Removing plant and equipment from well surface locations and removal of fenced compounds;
- Filling in excavated areas and trenches;
- Sealing/ plugging and abandonment of wells generally in accordance with the NSW Code of Practice for Coal Seam Gas Well Integrity;
- Lightly ripping disturbed areas; and
- Rehabilitation, contouring, and re-vegetating disturbed areas. Re-vegetating would include broadcast of seed and ongoing maintenance and monitoring activities to ensure successful vegetation cover is promptly established.

In order to prevent impact on future mining, the PPL conditions require removal of the steel pipe/casing from the coal seam and to log the location of the well. These activities are undertaken during the closure and rehabilitation of a well surface location unless otherwise agreed to by Department of Regional NSW – Mining, Exploration and Geoscience (DRN-MEG).

Final rehabilitation is undertaken in consultation with and to the satisfaction of the DRN-MEG and Environment Protection Authority (EPA). Site Specific Rehabilitation Completion Criteria is developed in consultation with the landowner and the DRN-MEG and EPA to ensure that final rehabilitation is thorough and effective. Monitoring is undertaken to ensure final rehabilitation has been successful. Such monitoring methods are determined based on the land use type and the selected rehabilitation model.

3.2 Rehabilitation of gas gathering lines

The preferred method of final rehabilitation for the gas gathering system is to purge with air, water or nitrogen in order to remove remaining gas, seal and then leave the valuable infrastructure in position for future beneficial use and to prevent any further environmental disturbance. All gas gathering line marker posts are removed from the surface.

The rehabilitation method for the gas gathering lines is subject to consultation with the landowner. Should removal of the gas gathering system be required, the excavated trench is backfilled and rehabilitated, including contouring and re-vegetation, the same as the initial rehabilitation following installation of the gathering lines.

3.3 Rehabilitation of access roads

Private roads and tracks used during operations are returned to their pre-operations state, or to a condition agreed by the landholder. As the urban development proceeds within the locality and new roads are provided, requirements for, and location of access roads may vary. AGL will work with this to adapt to the evolving nature of road development and access provision in the locality.

3.4 Rehabilitation of Rosalind Park Gas Plant

Decommissioning of the RPGP has commenced and rehabilitation will commence in 2024.

Decommissioning and rehabilitation of the site will involve removal of all redundant buildings, infrastructure, surfaces and machinery. The flare pit and sediment basin will be backfilled and the site will be recontoured as near as possible to its original contours to the satisfaction of the landowner. Only where necessary will planted screen trees be removed to enable land re-contouring. AGL will aim to retain as many screen trees as possible. If required, suitable topsoil will be imported to enable rehabilitation.

The overarching rehabilitation objective is to restore the land as far as reasonably practicable to its pre-disturbance land use at the end of its operational life; that is, primarily agricultural land comprising grazing on improved pasture. Following plant decommissioning disturbed areas will be seeded with improved pasture species agreed with the landowner to re-establish a grazing land use.

A *Closure Phase Landscape Management Plan* has been produced for the Rosalind Park Gas Plant and is included as **Appendix A**.

3.5 Rehabilitation models

The typical rehabilitation models used for different land use types are described in the **Table 3.1**. The rehabilitation for each site is to be completed in line with the relevant development consent conditions and in consultation with the landowner to fit generally with the surrounding area.

Table 3.1: Rehabilitation models

Land use	Rehabilitation Goal/ Model/ Objective	Description of Rehabilitation Works
Rural	Pasture (or Cultivation Paddock)	Area will be re-vegetated using a pasture seed blend in consultation with the Landowner. If exotic species are used, the seeds will be sterile. (In circumstances where the landowner takes responsibility for revegetation works, this rehabilitation model is referred to as 'Rural: Cultivation Paddock')
	Pasture with Native Tree Re-vegetation	Area will be re-vegetated with a pasture seed blend in consultation with the landowner. Native local trees will also be planted at a density consistent with the surrounding area.
Industrial	Return to pre-existing state	Landform and area will be reinstated to a condition equal to or better than it was prior to AGL construction works commencing in consultation with the landowner.
Urban/Residential	Specific goal to be confirmed depending on sub-category of urban use (e.g. park, streetscape, commercial etc)	Area to be re-vegetated and/or landscaped consistent with the surrounding area in consultation with the Landowner.

All of the above is subject to the relevant License/ Development Consent conditions.

3.6 Management measures

The landscape and rehabilitation management strategies in **Table 3.1** are designed to meet and fit in with site specific recommendations from the various Environmental Assessments and consents for the project.

It should be noted that the measures outlined in **Table 3.2** relating to weed management have been included in this RLMSP to address the requirement to prepare a Weed Management Plan (see **Section 2.1**) as part of the CGP.

Table 3.2 summarises the measures to be implemented to manage potential landscape and rehabilitation issues and outlines responsibilities for their implementation.

Table 3.2: Landscape and rehabilitation management measures

Activity	Action	Responsibility
1 General	a) The induction program shall inform all employees and contractors about rehabilitation management measures, control procedures for weeds, pathogens and pest species and the designated work areas and access routes and procedures.	Environment Business Partner

Activity	Action	Responsibility
	b) This RLMSP must be submitted to the Director General within 6 months of development approval, is to be approved by the Director General and shall be fully implemented across the CGP. Note: This Action is complete.	Environment Business Partner
	c) Prior to construction commencing at Spring Farm and Menangle Park well surface locations, a site layout plan shall be prepared in consultation with the land owner to be submitted to the Director General. It will include construction layout and footprint, wellheads and production compound layout, route of gas gathering lines and access roads, and initial rehabilitation works following construction. It shall also include a Rehabilitation and Landscape Concept Plan of well surface locations for the post-commissioning phase as well as following final closure of the wells. Note: This Action is complete.	Environment Business Partner / Manager Asset Property Services
	d) Vegetation and Landscape Management Plan for the Gas Treatment Plant site and the gas well sites shall include: details of an irrigation system for trees on the site, methods in establishing of trees on cut batters if excavated surfaces are not conducive to planting vegetation displayed in the landscape design, provisions for monitoring tree health, measures to minimise heritage impacts of gas wells, and details of monitoring program to affect effectiveness of visual impact mitigation measures.	Environment Business Partner
	e) All operations activities including rehabilitation and maintenance shall be restricted to the compound area or designated gathering line corridor and designated access routes (where possible).	Operations Superintendent
	f) Trees within an area marked “A” on the Applicants map, may be lopped and trimmed as necessary if the holder requests the applicant in writing, in return to refrain from clear felling of those trees within 5 years of the date of consent (refer to DA-282-6-2003i: 17 (Sch 4) in Table 2-1).	Environment Business Partner
2 Visibility	a) For well surface locations where residents may be exposed to extended periods of uninterrupted views during construction, green mesh or other appropriate fencing is to be erected around the construction compound in accordance with the recommendations of the relevant EA or Site Plan.	Environment Business Partner

Activity	Action	Responsibility
	b) The Vegetation and Landscape Management Plan for the Gas Treatment Plant site and the gas well sites shall include details of the visual appearance of all new buildings. New buildings will be constructed in a way that is to be of neat and orderly appearance and blend with surrounding landscape. It will also include measures to minimise visual impacts on Mount Gilead Homestead including monitoring of the Annual Environmental Performance Report and remedial measures will be identified.	Environment Business Partner
3 Initial Rehabilitation (Note: these actions are complete)	a) Stabilisation and rehabilitation shall be undertaken as soon as works are complete, in consultation with the landowner, using sterile exotic crops and local native grasses. No kikuyu and other invasive grass species will be used. b) All rehabilitation works would be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and re-vegetation in accordance with the requirements of the Office of Coal Seam Gas, the EMP and this Sub Plan. c) Earthworks, vegetation clearing and soil disturbance would be limited to the construction and operational footprint as appropriate. d) Existing vegetation will be maintained wherever possible. e) Native screen trees may be planted around the well site using appropriate species in consultation with the landowner. f) All waste materials and equipment shall be removed from the area once backfilling and tie-ins are completed. g) Sediment control measures shall be implemented where necessary to prevent erosion and water contamination. (See Soil and Water Management Sub Plan). h) Areas to be rehabilitated shall be graded to reinstate pre-existing surface contours and natural drainage patterns. i) All fences which were cut and replaced by gates during operations shall be repaired to at least the equivalent pre-operations condition, unless permanent gates or other arrangements are agreed with the landholder. j) Selection of fencing and other materials used for landscaping shall be undertaken in consultation with	Environment Business Partner / Field and Rehabilitation Operator

Activity	Action	Responsibility
	the landowner to the satisfaction of the Director-General (where required). k) Initial rehabilitation of the well construction compound and gas gathering lines is to be consistent with the established character of surrounding land. l) All flagging and bunting installed for environmental or safety reasons shall be removed.	
4 Stockpiles	a) Cleared vegetation shall be stockpiled separately for subsequent re-spreading within the compound during site rehabilitation. b) Disturbed areas shall be progressively rehabilitated as soon as practicable.	Environment Business Partner / Field and Rehabilitation Operator)
5 Weed and Pathogen control and monitoring	a) A weed management plan shall be prepared, submitted to the Director-General within one month of the date of consent, and implemented for the life of the development. b) The well site, restored access tracks and gathering line routes shall be inspected for 12 months (or until landowner signs off) following the completion of rehabilitation, for evidence of soil settlement, weeds and pest animals. c) Active weed control shall be required at sites identified as infested for at least one year after construction. Additional appropriate control measures shall be utilised after this time, on the basis of monitoring results. d) Herbicides are to be used to kill noxious weeds. Drift, drip or run-off to surface waters or non-target species is to be avoided. Personnel using herbicides are to be appropriately trained and qualified. e) All instructions provided by any responsible authority (with respect to the eradication of noxious weeds) shall be observed, and all reasonable efforts shall be made to implement measures to prevent the introduction and establishment of noxious weeds. f) On first (and subsequent) entry to the District and prior to entering the construction area all vehicles, equipment and portable infrastructure shall be washed by air or water or demonstrated they are clean (namely, certificate/or other document to show they have been cleaned down), prior to coming to site. This shall be done prior to mobilisation to site. g) Cleaning shall be thorough so as to remove all soil or organic matter from the surfaces of vehicles, equipment and portable infrastructure, including the undercarriage.	Environment Business Partner / Field and Rehabilitation Operator

Activity	Action	Responsibility
	h) Topsoil and vegetation material shall be re-spread in the immediate vicinity of the area of origin to limit the potential spread of weeds and pathogens. i) All plant and equipment shall be inspected and be free of invertebrates and pest species prior to coming on site. j) Waste management shall be implemented to avoid attracting vertebrate pests (see Waste Management Sub Plan).	
6 Final Rehabilitation	a) All rehabilitation works would be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and re-vegetation in accordance with the EMP and this Sub Plan. b) Earthworks, vegetation clearing and soil disturbance would be limited to the construction and operational footprint as appropriate. c) Existing vegetation will be maintained wherever possible. d) If removal of the gas gathering system is required, the excavated trench would be backfilled and rehabilitated, including contouring and re-vegetation. e) All areas associated with the construction and operation of the gas gathering system shall be rehabilitated to the pre-existing site conditions unless otherwise agreed by the landowner. f) Final well site rehabilitation is to be completed in accordance with the Site Specific Rehabilitation Completion Criteria to the satisfaction of the Director-General, DRN-MEG and EPA, in consultation with the landowner, and in a manner that is generally consistent with the landform of the surrounding land. g) Re-vegetating would typically include but not be limited to broadcast of seed and ongoing maintenance and monitoring activities for 12 months or until landowner signs off. h) For all trench crossings, the natural bed and bank profiles shall be restored to their original condition with smooth and even surfaces following installation of the gas pipe. i) Stabilisation and rehabilitation shall be undertaken as soon as works are complete, using sterile exotic crops and local native grasses. No kikuyu and other invasive grass species will be used unless approved by the landowner.	Environment Business Partner / Field and Rehabilitation Operator

Activity	Action	Responsibility
	j) All private tracks used during operations will be returned to their pre-operations state, or to a condition agreed by the landholder. k) Site rehabilitation shall protect any remnant local native riparian vegetation and restore riparian zones affected by the work in accordance with the conditions and plans. l) Rehabilitated riparian zones shall be monitored and maintained for at least two years after final planting. m) Maintenance shall include watering, weed control, replacement of plant losses, disease and insect control, mulching etc. n) No crown or camber shall remain along any gas gathering system line following rehabilitation.	
7 Rosalind Park Gas Plant / Access Road	a) A Vegetation and Landscape Management Plan shall be prepared and implemented. It shall detail landscaping to be undertaken including a maintenance program for landscaping, measures to protect mature trees, ensuring that tree and shrub species used for landscaping of the site are indigenous to the locality, and details that ensure all landscaped areas are maintained in a healthy, tidy state.	Environment Business Partner
	b) The Vegetation and Landscape Management Plan shall be submitted and approved by the Director-General prior to commencement of construction on the Gas Treatment Plant site. Note: This Action is complete.	Environment Business Partner
	c) A Landscape Planting Plan shall be prepared and implemented for the relocated Rosalind Park access road, to be submitted to the Director-General prior to the commencement of construction. It shall be prepared in accordance with the requirements detailed in DA-282-6-2003i: 19A, B (Sch 4) (refer to Table 2-1). Note: This Action is complete.	Environment Business Partner
	d) All visual mitigation measures regarding screening intended to hide infrastructure from views from the Mt Gilead Homestead (e.g. through planting) shall be undertaken.	Environment Business Partner
	e) The right to implement any necessary mitigation or screening measures proposed for the Gas Treatment Plant as part of the Vegetation and Landscape Management Plan on land outside the Gas Treatment Plant site (for the life of the development) shall be secured prior to construction. Note: This Action is complete.	Environment Business Partner

Activity	Action	Responsibility
	f) Existing trees shown on the Landscape Design adjacent to the southern boundary of the Gas Treatment Plant site, shall be retained (in a healthy condition) and will not be lopped or trimmed unless advised by an independent arborist and approved by the Director- General for safety reasons.	Environment Business Partner
	g) An independent audit of the mitigation measures (implemented to prevent and minimise visual impacts of the proposal including landscaping, preservation of existing trees, effectiveness of mitigation measures in screening from the Mount Gilead Homestead, and night- lighting effects) shall be undertaken within 6 months of the commissioning of the proposed development and every 2 years thereafter, unless the Director-General directs otherwise. The audit will also involve reviewing and making recommendations on the Landscape Management Plan (if required). It will be prepared in accordance with the requirements outlined in DA-282-6-2003i: 18, 19 (Sch 4) and shall be submitted to the Director-General within 2 months of the commissioning of the audit (refer to Table 2-1). A copy of the audit (and/or results of and recommendations of monitoring) will also be provided to the owner of Lot 1 DP 807555 by the Director-General upon request.	Environment Business Partner
	h) The site shall be landscaped as shown on the Landscape Design and this landscaping shall be maintained for the life of the development.	Environment Business Partner
	i) As part of an independent audit required, the Vegetation and Landscape Management plan shall provide details of a monitoring program. Monitoring shall be carried out pursuant to the monitoring program every 6 months for the first two years of planting and every 2 years thereafter by an independent arborist and include the features outlined in DA 282-6-2003i: 14 (Sch 4) (refer to Table 2-1). The results and recommendations of the monitoring program shall be submitted to the Director- General at the conclusion of each stage of monitoring.	Environment Business Partner
	j) A Landscape and Lighting Assessment will be conducted of the RPGP every two years. Landscaping will be conducted in accordance with the Vegetation and Landscape Management Plan.	Environment Business Partner
	k) Continued monitoring and review will be conducted to ensure the Vegetation and Landscape Management Plan outcomes and objectives are achieved.	Environment Business Partner

Activity	Action	Responsibility
	l) All external lighting associated with the development shall be mounted, screened and directed in such a manner so as to not create a nuisance to surrounding land uses. The lighting will also be the minimum level of illumination necessary, and in general accordance with the Australian Standard 4282 – 1997 Control of the Obtrusive Effects of Outdoor Lighting. Note: This Action is complete.	Environment Business Partner
	m) All practicable measures will be undertaken to minimise any off-site lighting impacts from the development. Note: This Action is complete.	Environment Business Partner
	n) Where possible, the scheduled use of flares shall be restricted to daylight hours. Note: This Action is complete.	Operations Superintendent
	o) The frequency of the operation of the flare will be recorded and this information shall be made available for inspection by the Director-General on request. The records will be undertaken in accordance with the necessary requirements detailed in DA 282-6-2003i: 4, 8, 11 (Sch 4) (refer to Table 2-1). Note: This Action is complete.	Operations Superintendent

4. Monitoring and reporting

4.1 Monitoring requirements

Rehabilitation and landscape monitoring requirements for CGP include the following:

- **Environment Business Partner** to:
  - inspect the well site, restored access tracks and gathering line routes for 12 months* following the completion of initial and final rehabilitation, for evidence of soil settlement weeds and pest animals. Additional rehabilitation maintenance works to be completed (as necessary) during the 12 month* period following the completion of rehabilitation.
- **Environment Business Partner** and **Field and Rehabilitation Operator** to inspect the rehabilitated area at the expiry of the 12 month* initial and final rehabilitation periods to ensure the site has been rehabilitated to meet AGL's and the landowner's standard.
- **Field and Rehabilitation Operator** to consult with the Landowner on the rehabilitation.
- **Field and Rehabilitation Operator** to confirm landowner acceptance of final rehabilitated land through the AGL Landowner Rehabilitation Sign-Off Form at the end of works.

*Note – Monitoring for a period of 12 months following the completion of rehabilitation is subject to consultation between AGL, the Landowner, DRN-MEG and the EPA. Depending on weather conditions and Landowner requirements, the 12 month period may be reduced or extended accordingly to ensure that the site is appropriately rehabilitated.

4.2 Reporting requirements

The **Environment Business Partner** is responsible for reporting on rehabilitation performance in the CGP Annual Environmental Performance Report.

The **Environment Business Partner** is responsible for completing the Environmental Management Sub Plan Compliance Audit – Rehabilitation and Landscape and reporting findings to the Operations Superintendent.

4.3 Records

Landscape and rehabilitation records to be maintained by AGL include:

- Environmental Management Sub Plan Compliance Audit, including:
  - Photographic records of disturbed areas during the rehabilitation period, as appropriate;
  - AGL Landowner Rehabilitation Sign-Off Form.

5. Administrative

5.1 Training and competence

Section 5.2 of the CGP EMP details the Training and Competence requirements.

5.2 Site specific plans

As site specific Rehabilitation Completion Criteria is developed for each well, it will be appended to the Petroleum Operations Plan.

5.3 Definitions

Currently not applicable.

5.4 HSEMS references

- AGL Health, Safety and Environment Policy
- AGL-HSE-STD-009.1 Land Standard
- AGL-HSE-SDM-009.1 Land Standard Methodology

5.5 References

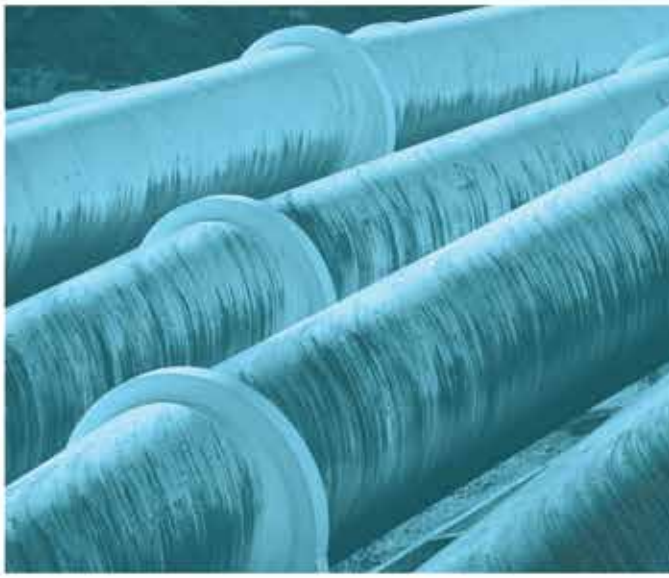
- Vegetation and Landscape Management Plan Proposed Gas Treatment Plant, prepared by URS, 28 June 2004.
- Sydney Gas Proposal Stage 2 Coal Seam Methane Project Visual Assessment of Lighting and Flare, prepared by URS, 6 November 2003.
- RPGP Road Landscape and Rehabilitation Management Plan, prepared by URS, July 2007 43177475.
- Camden Gas Project Petroleum Operations Plan Version 14, prepared by AGL, June 2021.
- NSW Department of Primary Industries, NSW WeedWise Register, *http://weeds.dpi.nsw.gov.au/*

Appendix A: Closure Phase Landscape Management Plan


Closure Phase Landscape Management Plan

Rosalind Park Gas Plant (RPGP), Lot 35 Medhurst Road, Menangle NSW

Prepared for AGL Upstream Investments Pty Ltd
February 2024

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Closure Phase Landscape Management Plan

Rosalind Park Gas Plant (RPGP), Lot 35 Medhurst Road, Menangle NSW

Report Number

J200774 RP6

Client

AGL Upstream Investments Pty Ltd

Date

21 February 2024

Version

v3

Approved by

Bret Jenkins
Associate Director
21 February 2024

Executive Summary

EMM Consulting Pty Limited (EMM) was engaged by AGL Upstream Investments Pty Ltd (AGL) to prepare a closure phase landscape management plan (CLMP) for the Rosalind Park Gas Plant (RPGP) ('the site') at Menangle, NSW.

The site is located approximately 65 kilometres (km) south-west of the Sydney, and previously operated as a natural gas processing and treatment plant, processing coal seam natural gas from the Camden Gas Project.

AGL propose to close and rehabilitate the site in 2023/2024, surrender the development approvals and petroleum leases and handover the land to the landowner. Closure of the site will involve removal of all redundant buildings, infrastructure, surfaces and surfaces and machinery. The flare pit and sediment basins will be backfilled. As stripped site topsoil was used as part of the landscaping program undertaken early in the project life, suitable topsoil will need to be imported to enable rehabilitation.

Having reached the end of its operational life, the overarching rehabilitation objective is to restore the land as far as reasonably practicable to its pre-disturbance land use; that is, primarily land and soil capability (LSC) class 6 and 7 agricultural land comprising grazing on improved pasture. Following plant decommissioning disturbed areas will be reshaped and reseeded (by hydro-mulching and/or direct seeding) with improved pasture species agreed with the landowner to re-establish a grazing post-project land use.

The access road will be retained to provide access during rehabilitation activities. Following rehabilitation, the access road will be retained to provide access to the site for ongoing land management activities to support the post-project grazing land use such as weed control, bushfire management, fence and livestock management.

The purpose of this CLMP is to provide detailed technical specifications for the establishment and maintenance of vegetation for decommissioned and reshaped areas of the project to achieve consistency with the rehabilitation objectives and landowner expectations.

Acronyms and Abbreviations

CLMP	Closure Landscape Management Plan
RPGP	Rosalind Park Gas Plant
MMSCFD	Million standard cubic feet per day
kPag	Kilopascal gauge
DPE	NSW Department of Planning and Environment (*former*)
RR	NSW Resource Regulator
LSC	Land and soil capability
RUSLE	Revised Universal Soil Loss Equation
SLC	Soil loss classes
ESP	Exchangeable sodium percentage
EMP	Exchangeable magnesium percentage
ARI	Average recurrence interval
t/ha/yr	tonnes per hectare per year
ESCP	Erosion and sediment control plan
EPA	NSW Environment Protection Authority
ENM	Excavated natural material
EPL	Environment Protection Licence

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Tables

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1 Introduction

1.1 Introduction

EMM Consulting Pty Limited (EMM) was engaged by AGL Upstream Investments Pty Ltd (AGL) to prepare a closure phase landscape management plan (CLMP) for the Rosalind Park Gas Plant (RPGP) at Menangle, NSW ('the site').

The site is located approximately 65 kilometres (km) south-west of the Sydney and previously operated as a natural gas processing and treatment plant, processing coal seam natural gas from the Camden Gas Project.

1.2 Context

The RPGP was installed to processes coal seam natural gas obtained from various remotely located wellheads to pipeline quality product, for delivery into Jemena's pipeline. AGL operated the RPGP with three reciprocating compressors, providing a total plant capacity of 26 Million standard cubic feet per day (MMSCFD). Compressor #1, commissioned in December 2004, can flow 12 MMSCFD gas at 7,000 kilopascal gauge (kPag)discharge pressure when operated at 70 kPag suction pressure. As part of the Camden Phase 2 plant upgrade project during 2006–2007, two additional compressor packages, Compressor #2 and Compressor #3, identical to each other, with capacity of 7 MMSCFD each (under the above suction and discharge pressure conditions) were installed.

In addition to the main process equipment enabling gas compression, gas was dehydrated via a dehydration unit and delivered through the custody transfer metering skid and gas odouriser prior to entering the Sale Gas pipeline. A flare package was used to safely dispose of gas during facility upsets, Fuel and instrument gas to run the compressor, plant instrumentation and dehydration utilities was obtained from the main process line downstream of the metering skid filter.

AGL propose to close and rehabilitate the site in 2023/2024, surrender the development approvals and petroleum leases and handover the land to the background landowner.

1.3 Purpose

The purpose of this CLMP is to provide detailed technical specifications for the establishment and maintenance of vegetation for decommissioned and reshaped areas of the project for AGL and its revegetation providers following removal of all buildings, machinery, infrastructure, services, hardstands and pavements. The access road will be retained to support the post-project land use.

1.4 Legislative requirements

1.4.1 *Environmental Planning and Assessment Act 1979*

The RPGP is authorised under DA 282-2006-i which was last modified in March 2017 (MOD13). The conditions that relate to rehabilitation and closure are provided in Table 1.1.

Table 1.1 DA 282-6-2003-I MOD 13 closure and rehabilitation conditions

Schedule	Condition No.	Condition	Where addressed	Comments
4	83	The Applicant shall document in detail the decommissioning of all sediment and erosion controls and any other water diversion structures to the satisfaction of the Director-General. The Applicant shall ensure that the decommissioning meets the requirements of the most recent version of the NSW Department of Housing's publication "Managing Urban Stormwater: Soils and Construction" (3rd Edition 1998).	Sections 3.1, 3.2 and 4	
4	120	The Applicant shall ensure the prompt and effective rehabilitation of all disturbed areas of the site following the completion of construction, operations and associated activities and/or the decommissioning of plant, to minimise the generation of wind erosion dust.	Sections 3.1, 3.2 and 4	
4	121	The Applicant shall carryout rehabilitation of the site in accordance with the requirements of the Division of Resources and Energy (now Resources Regulator).	N/A	

Rehabilitation is discussed briefly in section 3.15 of the original environmental impact statement (EIS) for the project (Sydney Gas 2003). Key commitments from the EIS are as follows:

- All disturbed areas will be restored as near as practicable to pre-existing conditions and contours.
- Stock and personnel will be kept out of areas being rehabilitated to allow regeneration to occur.
- At the end of the Project's life, all surface infrastructure will be removed prior to full site restoration being undertaken.
- Upon decommissioning of the gas field infrastructure and cessation of gas production, the most likely option for the Plant site would be the salvage and sale of all equipment, building and facilities, ripping of hardstand and compacted areas, the reprofiling and filling of any voids, spreading of retained topsoil and revegetation with a species mix compatible with the former vegetation.

2 Rehabilitation constraints

2.1 Rehabilitation domains

Rehabilitation domains are commonly used in the mining industry to delineate discrete project elements based on landscape management units with a unique operational and functional purpose during operation and therefore have similar characteristics for managing environmental and rehabilitation issues.

The rehabilitation domain concept is appropriate for the site as there are two discrete rehabilitation elements:

- Domain 1 Includes all the site other than the access road.
- Domain 2 includes the access from the intersection with Medhurst Road (Figure 2.1).

2.2 Soils

The soil landscapes of the RPGP include (Figure 2.2):

- Blacktown soil landscape.
- Hawkesbury soil landscape.
- Disturbed terrain soil landscape.

2.2.1 Blacktown soil landscape

The key constraints of the dominant soils in the Blacktown soil landscape are provided in Table 2.1.

Table 2.1 Blacktown soil landscape

Dominant soils	Constraints
Bt1	Low wet bearing strength Low fertility Sodicity (localised) Strongly acidic
Bt2	Low wet bearing strength Hard setting Low fertility Sodicity (localised) Strongly acidic High potential aluminium toxicity

Table 2.1 Blacktown soil landscape

Dominant soils	Constraints
Bt3	High shrink-swell (localised)
	Low wet bearing strength
	Low permeability
	Low available water-holding capacity
	Salinity (localised)
	Sodicity (localised)
	Very low fertility
Bt4	High shrink-swell (localised)
	Low wet bearing strength
	Low permeability
	Low available water-holding capacity
	Salinity (localised)
	Sodicity (localised)
	Very low fertility
	Strongly acidic
	Very high potential aluminium toxicity
	High erodibility

2.2.2 Hawkesbury soil landscape

The key constraints of the dominant soils in the Hawkesbury soil landscape are provided in Table 2.2.

Table 2.2 Hawkesbury soil landscape

Dominant soils	Constraints
Ha1	High permeability
	Low water holding capacity
	Low fertility
	High erodibility (concentrated flow)
	Strongly acidic
	Stoniness
	High potential aluminium toxicity
Ha2	Stoniness (localised)
	High permeability (localised)
	Very low fertility
	High erodibility
	High potential aluminium toxicity
Ha3	Very low fertility
	High erodibility
	Strongly acidic
	High potential aluminium toxicity

Table 2.2 Hawkesbury soil landscape

Dominant soils	Constraints
Bt4	High shrink-swell (localised)
	Low wet bearing strength
	Low permeability
	Low available water-holding capacity
	Salinity (localised)
	Sodicity (localised)
	Very low fertility
	Strongly acidic
	Very high potential aluminium toxicity
	High erodibility

2.2.3 Disturbed terrain soil landscape

The Disturbed terrain soil landscape describes soil that has been disturbed by human activity to a depth of at least 1 metre (m). The original soil has been removed, greatly disturbed or buried.

The constraints of this soil landscape depend on the background soil landscape and/or the source of any imported fill.

2.2.4 Soil sampling

Limited sampling for erosion and agronomic parameters was undertaken by EMM during the target contaminated site investigation in 2021. The location of the sample sites is shown in Figure 2.2.

SS1 is located on the south-western corner of the flare pit which appears to be natural subsoil. BH26 is at the toe of a cut batter near the self-bunded fuel tanks through hardstand material. BH27 is located on an unsealed area of the hardstand.

Sample details and identified constraints are provided in Table 2.3 and the laboratory results are provided in Appendix A.

Table 2.3 Site soil sample depths and constraints

Sample ID	Depth	Texture	Identified constraints
SS01	0 - 0.1m	Medium clay	• Very high salinity • Strong sodicity • Low phosphorous • Very strong alkalinity
	0.1–0.2m	Light clay	• Very high salinity • Strong sodicity • Low phosphorous • Very strong alkalinity

Table 2.3 Site soil sample depths and constraints

Sample ID	Depth	Texture	Identified constraints
BH26	0–0.1m	Light clay	• Sodicity • Low nitrogen and phophorous
	0.2–0.3m	Light clay	• Sodic and magnesic • Low plant available nutrients
BH27	0–0.1m	Sandy loam	• Strong alkalinity • Low plant available nutrients
	0.25–0.35	Light clay	• Moderate alkalinity • Low phosphorous • Sodic and highly magnesic

The soil testing data shows that the in-situ subsoil materials are generally hostile to plant growth and have a very high erosion potential. While it is possible to ameliorate the soils to form a suitable growth medium, a better rehabilitation outcome will be able to be achieved by importing suitable topsoil. Suitable topsoil can be obtained from the sand and soil quarry at Menangle which is located approximately 6 km from site.

2.3 Land and soil capability

The land and soil capability assessment scheme (OEH 2012) ('LSC scheme') uses 'LSC classes' that distinguish between the inherent physical capacity of the land to sustain a range of land uses (and management practices) in the long term without leading to degradation of soil, land, air and water resources.

With reference to the eSPADE database (OEH 2016) and OEH (2017) the project area is mapped at the state scale as LSC Classes 6 and 7, which represents land with a range of capability, from land with 'slight limitations', capable of a wide variety of land uses (LSC class 2 and 3), to 'high to severe limitations' to cropping (LSC class 5 and 7) (Table 2.4).

Modelled regional LSC mapping from eSPADE (OEH 2016) is presented in Figure 2.3.

Table 2.4 Land and soil classifications mapped for the project area

LSC Class [1]	Description
Class 6 – Low capability land	• Land has very high limitations for high-impact land uses. • Land-use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to present severe land and environmental degradation.
Class 7 – Very low capability land	• Land has severe limitations that restrict most land uses and generally cannot be overcome. • On-site and off-site impacts of land management practices can be extremely severe if limitations are not managed. • There should be minimal disturbance of native vegetation.

Note: 1. As per OEH (2012).

The modelled LSC classes are a function of slope, gully and tunnel erosion hazard, and the risk of soil structural decline. EMM recommends that all rehabilitated areas have a minimum soil depth of 0.5 m which includes 0.4 m of Virgin Excavated Natural Material (VENM) and a minimum topsoil depth of 0.1 m to re-establish the pre-disturbance LSC classes.

KEY

- Gas plant boundary
- Cadastral boundary
- Proposed road centreline
- Watercourse

Rehabilitation domain

- Domain 1
- Domain 2

Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006)

0 100 200 m

GDA 1994 MGA Zone 56

N

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Project rehabilitation domains

AGL Camden
Rehabilitation and landscape plan
Figure 2.1

EMM
creating opportunities

KEY

- Gas plant boundary
- Cadastral boundary
- Proposed road centreline

Monitoring location

- Borehole
- Surface soil sample

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Source: EMM (2021); Nearmap (2020); DFSI (2017); GA (2011); ASGC (2006)

0 25 50 m

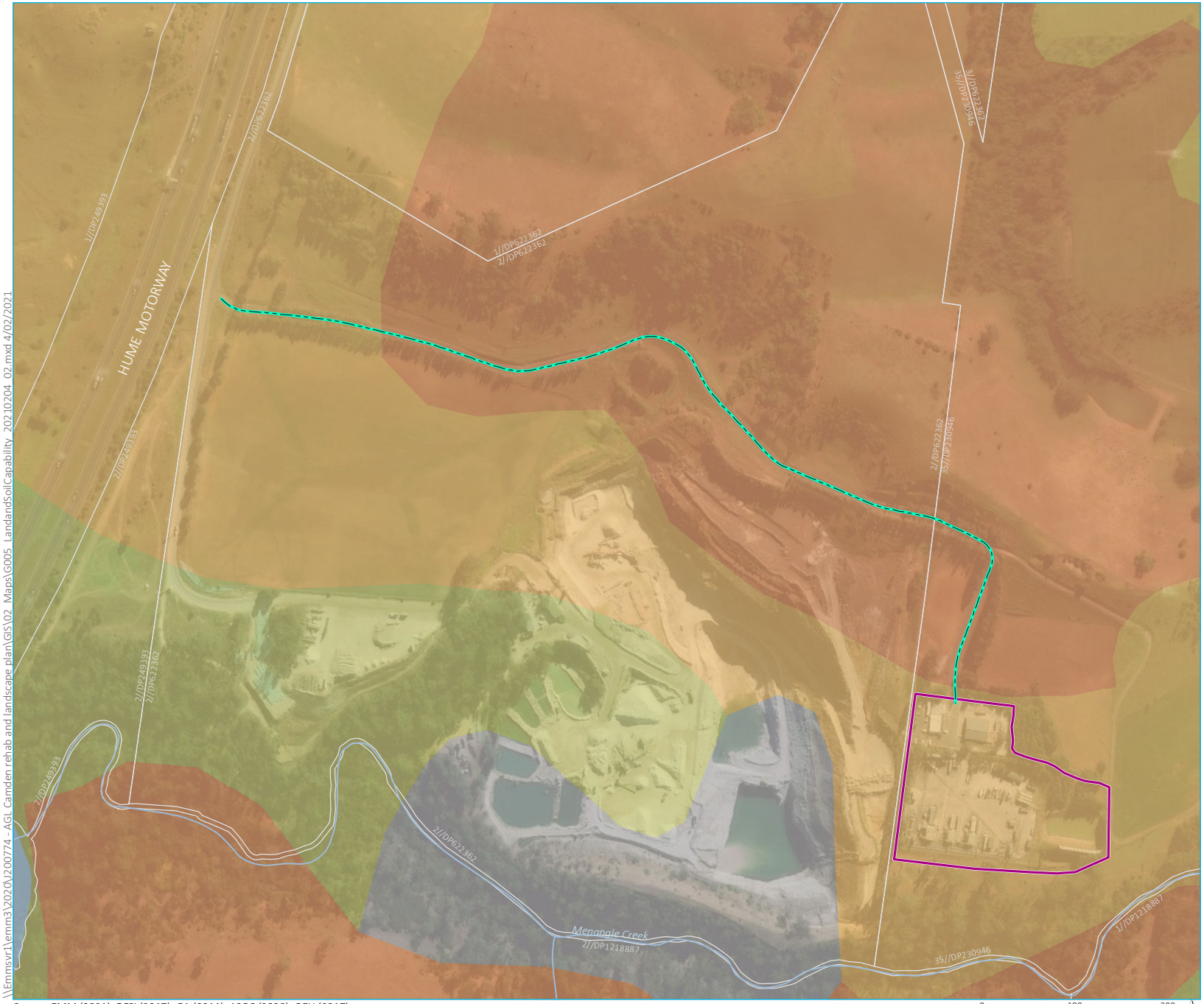
GDA 1994 MGA Zone 56

N

Soil sampling locations

AGL Camden
Rehabilitation and landscape plan
Figure 2.2

EMM
creating opportunities



KEY

- Gas plant boundary
- Cadastral boundary
- Proposed road centreline
- Watercourse

Land and soil capability

- Class 4 | Moderate to severe limitations
- Class 6 | Very severe limitations
- Class 7 | Extremely severe limitations
- Disturbed terrain
- Water

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Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006); OEH (2017)

0 100 200 m

GDA 1994 MGA Zone 56

N

Project modelled land and soil capability

AGL Camden
Rehabilitation and landscape plan
Figure 2.3

EMM
creating opportunities

2.4 Erosion hazard

The process for the assessment of erosion hazard in NSW is detailed in section 4.4.1 of Landcom (2004). It is a two-step process that considers overall project erosion hazard in considering slope and rainfall erosivity (R-Factor) and then a more detailed assessment where land soil loss classes (SLC) are determined using annual soil loss calculated using the revised universal soil loss equation (RUSLE) using site specific slopes and a nominal slope length of 80 m. The SLC dictates specific erosion management and mitigation measures as detailed in Landcom (2004).

An assessment of the erodibility of the soil itself is important as the presence or absence of a highly erodible dispersive soil will significantly influence the project drainage, erosion and sediment control requirements.

When a sodic soil (exchangeable sodium percentage (ESP) >6%, or a magnesic soil (exchangeable magnesium percentage (EMP) >20%) comes into contact with non-saline water, water molecules are drawn in-between the clay platelets causing the clay to swell to such an extent that individual clay platelets are separated from the aggregate. This process is known as dispersion. Dispersive soils have an extreme rill, gully and tunnel erosion risk and can erode irrespective of surface treatments (eg rock lining) applied to the soil surface.

2.4.1 Soil erosion hazard analysis

The erosion potential of a soil is determined by its physical and chemical properties and is expressed as its K-Factor (t.ha.h)/(ha.MJ.mm). Table 2.5 provides a soil erodibility ranking for K-Factor from Rosewell (1993).

Table 2.5 Soil erosion ranking[1]

K-Factor (t ha h ha^{-1} $MJ^{-1}mm^{-1}$)	Erosion potential
<0.02	Low
>0.02 to <0.04	Moderate
>0.04	High

Site soil sampling identified the presence of sodic and magnesic subsoils within the project area (Appendix A). Loch *et al.* (1998) determined various sodic soils to have a K-Factor ranging from 0.056–0.106 t ha h $ha^{-1}MJ^{-1}mm^{-1}$. A K-Factor of 0.071 t ha h $ha^{-1}MJ^{-1}mm^{-1}$ has been adopted based on soil sample results to determine the erosion hazard of project subsoils.

2.4.2 Slope and rainfall erosivity erosion hazard analysis

Landcom (2004)[2] nominates additional requirements for lands of SLC 4 and higher.

The first step in the hazard assessment uses a nomograph from Figure 4.6 of Landcom (2004) (reproduced as Figure 2.4) that considers slope of the land and the rainfall erosivity (R-Factor) to provide a low or high erosion hazard.

1 Rosewell 1993

2 Landcom (2004), section 4.4.2(c)

The R-Factor is calculated using the formula:

$$R = 164.74\ (1.1177)^{S}\ S^{0.6444}$$

where, S is the 2-year average recurrence interval (ARI), 6 hour rainfall event (0.5EY, 6 hour event) (Rosewell & Turner 1992).

S equals 8.43 millimetres per hour (mm/h).

The calculated R-Factor for the site is 1663 $MJmmha^{-1}h^{-1}$.

Slopes in the existing site disturbance areas (future rehabilitation areas) generally range from 0–>20% (0–90°) (Figure 2.5).

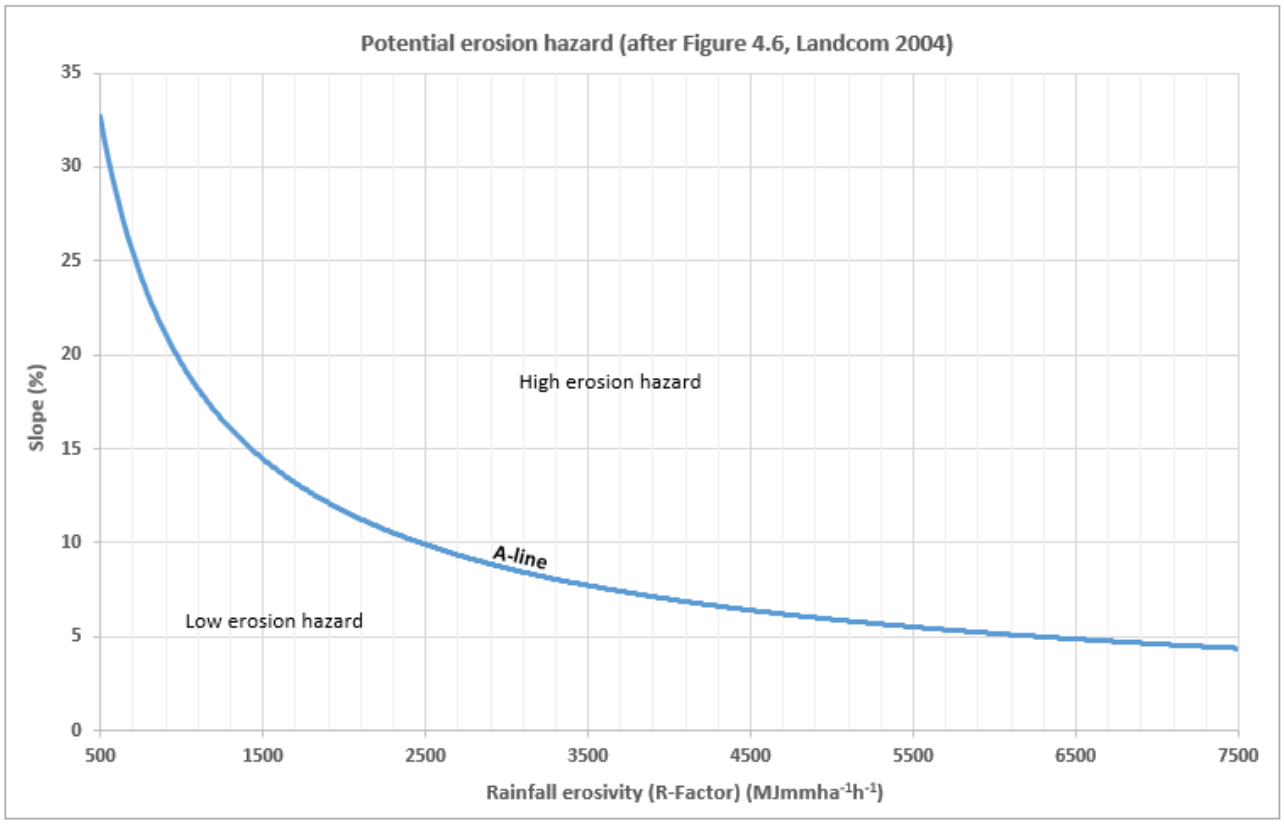


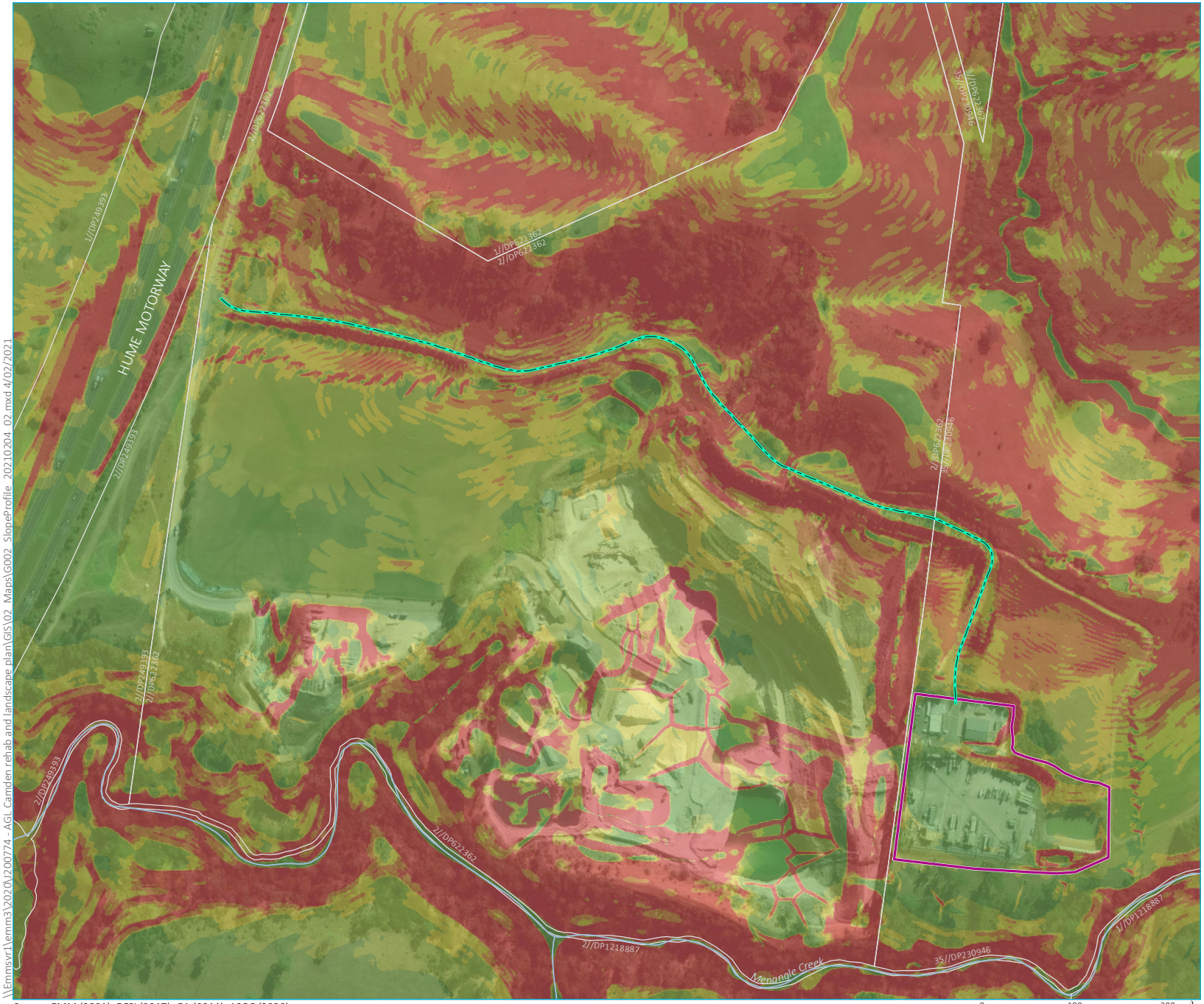
Figure 2.4 Assessment of potential erosion hazard (Landcom 2004)

Applying these parameters to the erosion hazard nomograph results in a low to high erosion due to slope and rainfall. On this basis, further analysis of SLCs is required.

A high erosion hazard requires further detailed assessment in accordance with section 4.4.2 of Landcom (2004) to determine soil loss classes (Table 2.6).

Table 2.6 Soil loss classes (adapted from Table 4.2 Landcom 2004)

Soil Loss Class (SLC)	Calculated soil loss (t/ha/yr)	Erosion hazard
1	0–150	Very low
2	151–225	Low
3	226–350	Low-moderate
4	351–500	Moderate
5	501–750	High
6	751–1,500	Very high
7	>1,500	Extremely high



KEY

- Gas plant boundary
- Cadastral boundary
- Proposed road centreline
- Watercourse

Slope percentage

- 0 - 5 %
- 5 - 10 %
- 10 - 15 %
- 15 - 20 %
- > 20 %

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Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006)

Slope profile

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Rehabilitation and landscape plan
Figure 2.5

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Soil loss classes are determined calculating the annual average soil loss using the RUSLE with a nominal 80 m slope length, soil surface cover factor (C-Factor) of 1 (100% bare soil) and a soil conservation factor (P-Factor) of 1.3 (compacted and smooth soil).

Calculated indicative soil loss in tonnes per hectare per year (t/ha/yr) for slopes ranges from 1–40% for the Project are provided in Table 2.7.

Table 2.7 Annual average soil loss (t/ha/yr)

Slope	1%	10%	14%	20%	25%	30%	40%
R (calculated)	1663	1663	1663	1663	1663	1663	1663
K (Loch et al 1998)	0.071	0.071	0.071	0.071	0.071	0.071	0.071
LS (Table A1 Landcom 2004 and USDA 1997)	0.19	2.81	4.61	7.32	9.51	11.6	15.67
P (Table A2 Landcom 2004)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
C (Figure A5 Landcom 2004)	1	1	1	1	1	1	1
Soil loss t/ha/yr	**29.16**	**431.32**	**707.61**	**1123.6**	**1459.74**	**1780.54**	**2405.26**

Applying the calculated annual average soil loss to Table 2.6 results in a SLC ranging from 1 (very low) to 7 (extremely high).

As stipulated in section 4.4.2 of Landcom (2004), increased erosion and sediment control management requirements apply to land rated as SLC ≥4.

The project area is in rainfall zone 4 (Figure 2.6). Land disturbing works in highly sensitive lands should be scheduled for periods when rainfall erosivity is low. Landcom 2004 defines highly sensitive lands as:

1. always on SLC 7 lands; and
2. at certain times of the year:
    a) on SLC 5 or 6 lands in all rainfall zones; and
    b) on SLC 4 lands in rainfall zones 5 and 11.

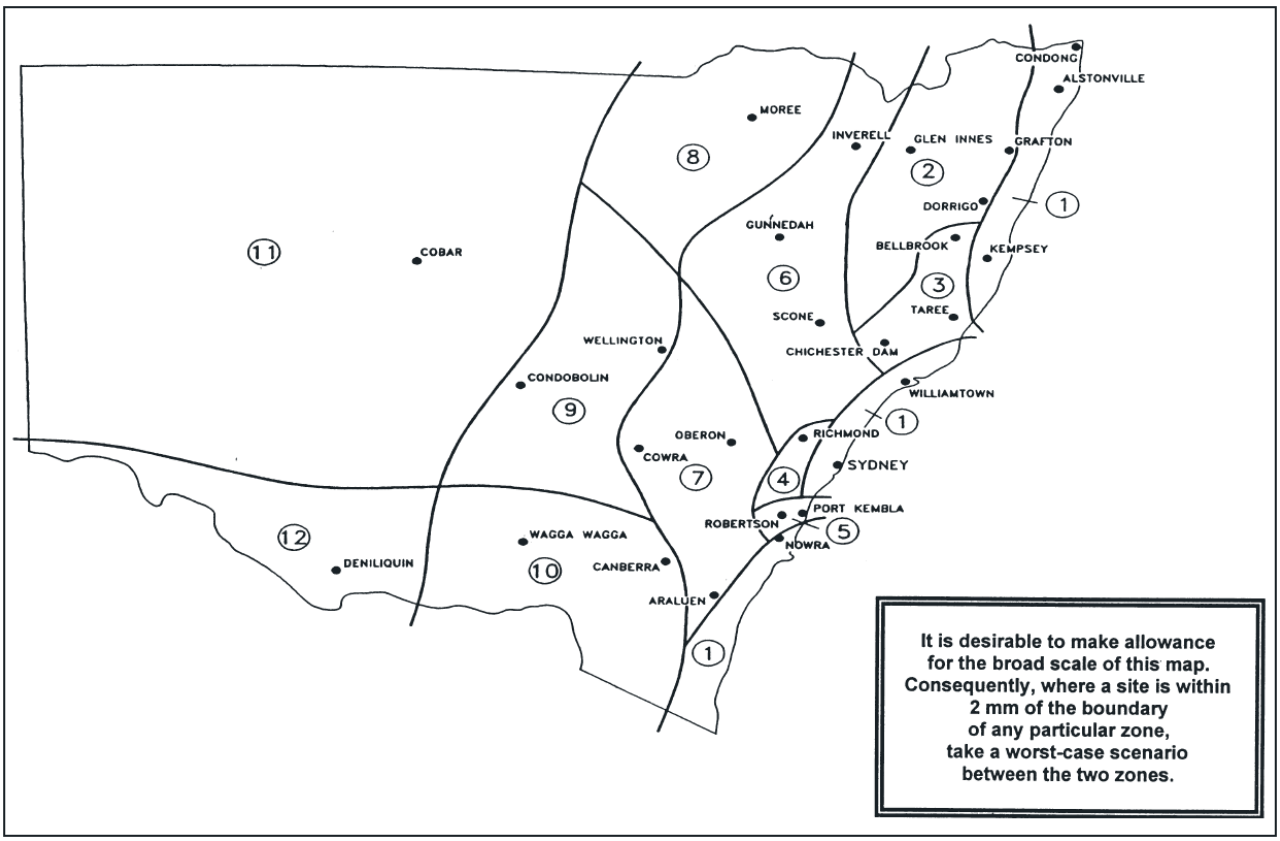
Waterfront lands are regarded as SLC 6 lands (Landcom 2004).

Low and high rainfall erosivity periods for Zone 4 are provided in Table 2.8.

Table 2.8 Zone 4 high and low rainfall erosivity periods

SLC	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
1-4	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
5	L	L	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
6	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
7	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Erosion and sediment control plans (ESCPs) will need to be prepared for the rehabilitation works. Where possible major land disturbing works such as culvert removal, pavement and road base removal should be scheduled to avoid the high rainfall erosivity risk period from late December through to early April.



Source: Landcom (2004)

Figure 2.6 Rainfall zones

3 Rehabilitation by domain

Substantial landscaping and revegetation works were undertaken in both domains early in the life of project in accordance with Schedule 4, Conditions 12–14 of DA 282-6-2003-i and the subsequent Vegetation and Landscape Management Plans prepared and implemented in accordance with Schedule 4, Condition 13 of DA 282-6-2003-I (Photograph 3.1 to Photograph 3.4).

Photograph 3.1 Native trees on the cut batter

Photograph 3.2 Trees on cut batter

Photograph 3.3 Native trees successfully established on the access road

Photograph 3.4 Native trees on internal access road cut batter

Because of the plantings and revegetation works undertaken on the cut and fill batters, and no evidence of erosion or instability, major land reshaping works will only be undertaken on batters with limited tree density to minimise disturbance to the well-established self-sustaining vegetation.

This rehabilitation plan assumes that all built infrastructure and associated services have been terminated, removed and demolished except for the access road (Domain 2) which will be retained to support the post-project land use. Any contaminated material either bioremediated on site or removed from site and taken to an appropriately licenced facility for disposal.

The contractor(s) undertaking the works will need to prepare ESCPs in accordance with Schedule 4 conditions 80 to 84A of DA 282-6-2003-i.

Detailed specifications for rehabilitation materials, installation and maintenance is provided in Section 4.

Appendix A shows the rehabilitation plan for the RPGP, including sediment and erosion controls, existing trees to be retained and final land contours.

3.1 Domain 1 – RPGP

The key rehabilitation works for Domain 1 are to:

- remove any pavement and demolition waste and transport to an appropriate waste or recycling facility for disposal or reuse;
- backfill the flare pit and adjacent sediment basin, and the sediment basin at the entry to the site;
- reshape the cut batters with limited tree cover;
- remove the existing culvert and stabilise the western clean water diversion drain;
- ameliorate in-situ subsoils or important suitable VENM and topsoil to re-establish LSC class 7 grazing lands (0.4 m deep subsoil/VENM plus 0.1m topsoil); and
- direct seed with pasture species and hydro-mulch.

The sediment basin adjacent to the flare pit shall remain until 70% soil surface cover has been achieved on all disturbed areas. If the sediment basin is to be removed prior to vegetation achieving 70% cover, appropriate sediment controls such as silt fences or straw bales will be installed to limit sedimentation impacts to downstream areas.

3.1.1 Pavement materials, building and demolition waste

Any bitumen, asphalt, concrete and any other remaining demolition waste must be excavated and transported off-site to an appropriately licenced waste or recycling facility for disposal or reuse.

Uncontaminated road base and gravels may satisfy the criteria of Excavated Natural Material (ENM) and:

- re-used on site for backfilling trenches and the flare pit in accordance with *The excavated natural material order 2014* (EPA 2014) ('the ENM order') issued by the NSW Environment Protection Authority (EPA) under clause 93 of the *Protection of the Environment (Waste) Regulation* 2014 (Waste Regulation); or
- off site in accordance with *The excavated natural material exemption 2014* (EPA 2014a).

Verification sampling of road base and gravels to confirm classification as ENM must be undertaken in accordance with the ENM order before such material can be considered for re-use on site or transportation to another site to be applied to land as engineering fill or for use in earthworks in accordance with the ENM exemption.

If the road base and gravels cannot be classified an ENM they will need to be excavated and removed from site to an appropriately licenced waste facility.

As road base materials and gravels are not suitable for re-establishing an LSC class of 7, they must be excavated and removed down to surface of the subsoil. This subsoil must be:

- tested and ameliorated so that ESP is less than or equal to 4% and EMP is less than or equal to 20%; and
- contour-scarified prior to the application of topsoil.

Imported topsoil shall comply with the specifications in section 4, and reinstated to a minimum depth of 0.1 m. The topsoil shall then be direct seeded and/or hydro-mulched in accordance with section 4.

3.1.2 Back-filling and reshaping

To maximise the opportunity for grazing it is proposed that the flare pit and adjacent sediment basin, and the sediment basin at the entry to the site, be backfilled to reinstate the pre-development contours to the maximum possible extent. Some small saplings (trunk diameter less than 100 millimetres (mm) at 1 m above ground level) and natural regrowth trees may need to be removed during the dewatering and backfilling operations of the flare pit sediment basin, or to otherwise enable land reshaping works to achieve suitable drainage.

i Flare pit

The flare pit will be dewatered by AGL and allowed to dry. Following dewatering the liner in the flare pit shall be removed and transported off-site to appropriate licenced waste facility for disposal. The flare pit will then be backfilled to achieve a free draining surface profile.

If there is a deficit of backfill material, then appropriate ENM and/or Virgin Excavated Natural Material (VENM) will need to be imported.

The top layer of the backfilled flare pit shall consist of 0.4 m of subsoil/VENM capped with 0.1 m of suitable topsoil.

Soil testing (section 2.2 and Appendix A) has determined the subsoil to be sodic and magnesic. It will need to be ameliorated with gypsum during the backfilling process to minimise its erosion potential and create appropriate conditions for vegetation establishment so that the ESP is less than or equal to 4% and EMP is less than or equal to 20%. The subsoil shall be contour scarified prior to the application of topsoil. Imported topsoil shall comply with the specifications in section 4, and shall have a minimum depth of 0.1 m. The topsoil shall then be direct seeded and/or hydro-mulched in accordance with section 4.

The backfill below the top 0.5 m shall be compacted to achieve relative compaction of not less than 95% Proctor Maxum (Proctor Compaction Test). The next 0.4 m above this compacted layer shall be track rolled to consolidate the subsoil. The top 0.1 m of topsoil shall not be compacted.

The finished profile of the backfill shall be free draining.

ii Entry sediment basin

The entry sediment basin requires backfilling to the extent that it becomes a free draining swale with either a trapezoidal or ‘u’ shaped profile. Any turbid water in the entry sediment basin will need to be treated and discharged in accordance with the requirements of Environment Protection Licence Number 12003 (EPL12003).

The entry sediment basin shall then be backfilled, topsoiled and revegetated in the same manner as the flare pit. No trees are to be disturbed during the dewatering and backfilling operations.

iii Flare pit sediment basin

Any turbid water in the flare pit sediment basin will need to be treated and discharged in accordance with the requirements of EPL12003. The flare pit sediment basin shall then be backfilled, topsoil and revegetated in the same manner as the flare pit.

3.1.3 Western clean water diversion drain

The clean water diversion drain of the western boundary of the RPGP will remain to convey run-on water from the north and east to Menangle Creek. An access track between the site and neighbouring quarry currently crosses the drain via a small culvert. The culvert and access track material will need to be removed to form an open channel with identical dimensions to the drain upstream and downstream of the culvert.

The drain will need to be over-excavated to allow for 0.1 m depth of topsoil to be placed in the impacted area with the finished level consistent with the existing drain. The topsoil shall be protected using 400 grams per square metre (gsm) Coir mesh installed with an upstream and downstream anchor trench and stapled at 0.3 m centres in accordance with Appendix B and then direct seeded and hydro-mulched in accordance with section 4.

The downstream end of the drain is actively eroding. The rock protection will need to be removed, over-excavated and additional rock protection installed. Any subsoil exposed during excavation shall be ameliorated with gypsum so that the ESP is ≤4% and EMP is ≤20%.

3.2 Domain 2 – Access road

The access road is approximately 1,100 m long, bitumen sealed and with seven (7) culverts to allow the safe passage of up-slope runoff. As shown in Photograph 3.3, substantial landscaping works have been undertaken along the alignment and vegetation cover is dense, with no active erosion in the drainage system for the road. The access road will be required for site access to complete the rehabilitation of the Domain 1.

No rehabilitation is proposed for the access road and it will be retained in its current condition to support the ongoing post-project land use.

4 Rehabilitation specifications

The following specifications shall be used for rehabilitation materials, installation and maintenance.

4.1 Materials for rehabilitation

4.1.1 Imported topsoil

Imported topsoil must be suitable for the culture of all plant material. It must:

- comply with *AS4419 – Soils for Landscaping and Garden use*;
- be classified sandy loam or heavier texture and must have a minimum clay content of 15%;
- be of a friable porous nature;
- contain no refuse or materials toxic to plant growth;
- contain no stumps, roots, clay lumps or stones larger than 50 mm in size;
- have an organic content of at least 5% by mass as determined by the method specified in AS 1289 D1.1 Part D;
- have a pH in the range of 5–6.5;
- have a soluble salt content not exceeding 0.06% by mass;
- be suitable for phosphorus sensitive plants; and
- be free of weed and weed refuse material.

HOLD POINT 4.1.1	
Process Held:	**Delivery of imported general purpose topsoil.**
Requirement:	**Prior to the delivery of topsoil, the topsoil supplier shall submit a statement verifying that the topsoil complies with the specified requirements. The statement must quote test results and must certify that the topsoil is not contaminated topsoil.**
Release of Hold Point:	**AGL will consider the submitted supplier statement and test results prior to authorising the release of the Hold Point (acceptance of topsoil).**

4.1.2 Soil ameliorants

Fertiliser shall be applied at rates determined by a soil scientist from site specific soil testing. Fertiliser shall be a mineral based, non-water soluble inoculated with mycorrhizae and beneficial soil bacteria such as Troforte Fert-O-Lawn.

Unless otherwise approved by the Principal, fertiliser must be applied at a minimum application rate of 400 kilograms per hectare (kg/ha) or increased as directed by a soil scientist.

Fertiliser must be included in the subsoil amendment to ensure Phosphorus (P) and Potassium (K) is available at depth for the developing plants.

Fertiliser applied to the subsoil must account for at least 30% of the total fertiliser application rate as detailed by a soil scientist.

Liquid fertilisers must not be used.

Fertiliser shall have an N:P:K analysis in accordance with Table 4.1.

Table 4.1 Fertiliser N:P:K range

Nutrient	Range
Nitrogen (N)	10–22
Phosphorus (P)	5–15
Potassium (K)	5–15

Fertiliser must be delivered to the site in unopened standard bags or containers bearing the manufacturer's details and analysis and quantity of its constituents.

WITNESS POINT 4.1.2	
Process Witnessed:	**Application of fertiliser and soil ameliorants.**
Requirement:	An AGL representative shall supervise the application of fertiliser and soil ameliorants to validate that the correct ameliorants have been applied and at the rates specified above, or at the advice of a soil scientist.

4.1.3 Agricultural lime, dolomite and gypsum

Agricultural lime, agricultural dolomite and agricultural gypsum shall not be in a liquid form.

Agricultural lime shall be naturally occurring limestone (calcium carbonate $CaCO_3$).

Agricultural dolomite shall be naturally occurring dolomite (calcium magnesium carbonate $CaMg(CO_3)_2$).

Agricultural lime and agricultural dolomite shall have:

a) a neutralising value (NV) of 90 or above, determined using the Test Method 19A1 from the Soil Chemical Methods: Australasia (2011) by Rayment and Lyons;

b) a pH value of 8.5 +/- 0.5, determined using the test method in accordance with Clause 5.5 of AS 4419; and

c) a particle size distribution of:

i) 100% by weight to pass a 5 mm sieve;

ii) 95% by weight to pass a 3.5 mm sieve, and

iii) 40% by weight to pass a 0.15 mm sieve.

Agricultural gypsum shall be naturally occurring gypsum (calcium sulfate CaSO42H2O). Crushed plaster board is not permitted.

Agricultural gypsum shall have:

a) a minimum 80% of gypsum;

b) a moisture content of <15%;

c) have a total content (x-ray fluorescence test) of:

i) 20% calcium (Ca);

ii) 15% sulphur (S); and

iii) <2% sodium chloride (NaCl);

d) if manufactured – have a total content of heavy metals:

i) <0.001% cadmium (Cd); and

ii) <0.01% lead (Pb);

e) have a particle size distribution of:

i) 100% by weight to pass a 6 mm sieve;

ii) 80% by weight to pass a 4 mm sieve; and

iii) 50% by weight to pass a 2 mm sieve.

Delivery of agricultural lime, agricultural dolomite and agricultural gypsum shall be accompanied by a delivery docket stating at least the:

a) name of supplier;

b) certification that material is in accordance with the material requirement;

c) quantity; and

d) delivery docket number.

4.1.4 Hydro-mulch

i Organic material for hydro-mulch

Organic material to be used for hydro-mulch or any proprietary branded products designed to be used in a hydroseeder must be manufactured primarily from straw and:

a) be thermally processed to mitigate risk of pathogens, weed propagules and to prevent hydrophobicity;

b) defibrillated and/or mechanically abraded;

c) contain 80% of the fibres within any one batch of the material with an average length of no less than 10 mm and diameter of no less than 0.5 mm;

d) have a Carbon (C) to Nitrogen (N) ratio no higher than 50:1;

e) be packaged in water and vermin proof packaging with a label containing the:

   i) manufactures name and contact information;

   ii) batch number and date of packaging;

   iii) country and state of origin;

   iv) moisture content at the time of packaging; and

   v) weight and volume of the product at the time of packaging.

The packaging shall be retained following application for inspection to confirm application rates.

HOLD POINT 4.1.4	
Process Held:	**Application of hydro-mulch.**
Requirement:	**Prior to the delivery of hydro-mulch and hydro-mulch application, the supplier shall submit to AGL a sample of the hydro-mulch organic material and a statement from the manufacturer demonstrating compliance with clause 4.1.4.**
Release of Hold Point:	**AGL will consider the sample and documents prior to authorising the release of the Hold Point (approval to apply hydro-mulch).**

ii Binders for hydro-mulch

Binders for hydro-mulches must consist of cross-linking, non-renewable hydro-colloid biodegradable glues with the following characteristics:

a) biodegradable;

b) readily dispersible;

c) highly soluble;

d) self-hydrating, and

e) display a delayed development of viscosity before final thickening takes place.

The following types of binder must not be used in hydro-mulches:

- polyacrylamide binders; and
- soil stabilising polymers specifically designed and used for erosion control.

4.1.5 Water

Water used must be potable or obtained from a source which contains no toxins or pollutants or any substance which would adversely affect the growth of any of the plants to be sown.

When the use of non-potable water is proposed, test the source and, prior to sowing; provide the Principal with verification that the water is free of toxins or pollutants or substances which would adversely affect the growth of plants to be sown.

Water used for vegetation works must:

a) have a pH between 6 and 8.5 (inclusive);

b) have a total soluble salts concentration less than 1000 milligrams per litre (mg/L);

c) contain no substances toxic to plant growth;

d) be potable water, and / or recycled water and / or be non-potable water (dam, creek, river and bore water); and

e) not be industrial waste water.

4.1.6 Dye

Dyes selected and used in the course of works covered by this Specification must comply with the requirements in Table 4.2.

Table 4.2 Specifications: dye markers

Material	Requirement
Dye markers – general	Dye markers used in the course of works covered by this Specification shall be vegetable-based and biodegradable. The concentration of dye used must allow the area treated or marked to be easily identified once dry.
Dye marking colours	Dye marker colours shall be as follows: • Red – to indicate application of pesticides, herbicides or fungicides. • Green – to indicate areas subject to hydro-seeding, hydro-mulching or hydraulic growth media.

4.1.7 Coir mesh and fixing pins

Organic fibre mesh used must consist of coconut fibre mesh with a minimum fibre density of 600 g/m^2. Polymer reinforcing materials are not permitted.

Fixing pins must be biodegradable plastic pins 150 mm long legs.

4.2 Vegetation of areas other than open drains

4.2.1 Subsoil/VENM sampling and analysis

Prior to placing topsoil, carry out tests on the subsoils per soil tests outlined in Appendix C showing testing requirements and comparison against appropriate criteria using a National Association of Testing Authorities (NATA) or Australasian Soil and Plant Analysis Council (ASPAC) accredited testing laboratory to ascertain its suitability for revegetation and amelioration requirements.

Sample the subsoil/VENM at each location. Samples for each test must be approximately 1 kg, composed of a composite of 10 sub-samples representative of each subsoil/VENM type taken from the top 300 mm of the surface or batter face and representative of the subsoil/VENM type and not include different soil types or layers.

The subsoil test certificate must contain the date of testing and details of the types of test undertaken, their results and any recommendations on the use of the subsoil/VENM.

HOLD POINT 4.2.1	
Process Held:	**Subsoil/VENM sampling and analysis.**
Requirement:	**Undertake subsoil/VENM sampling in accordance with this clause and produce a subsoil/VENM test certificate prior to the application of ameliorants.**
Release of Hold Point:	**AGL will consider the subsoil/VENM test results prior to authorising the release of the Hold Point.**

4.2.2 Subsoil/VENM amelioration

Ameliorants must be spread at the specified rates to the subsoil/VENM surface, and immediately incorporated into the subsoil/VENM.

The following ameliorant application rates are not to be exceeded unless justification is provided in the subsoil/VENM test certificate:

- Agricultural lime ($CaCO_3$) 15 kg/m^3 (3 kg/m^2 amelioration to 200 mm of subsoil).
- Agricultural dolomite ($CaMg(CO_3)_2$) 15 kg/m^3 (3 kg/m^2 amelioration to 200 mm of subsoil).
- Agricultural gypsum ($CaSO_4.2H_2O$) 15 kg/m^3 (3 kg/m^2 amelioration to 200 mm of subsoil).

The advice of a Soil Scientist should be sought to review laboratory results and identify the required treatment type and rate.

WITNESS POINT 4.2.2	
Process Witnessed:	**Application of ameliorants to subsoil/VENM.**
Requirement:	**AGL must supervise the application of ameliorants to validate that the correct ameliorants have been applied and at the rates specified in this section, in a laboratory soil test certificate or at the advice of Soil Scientist (whichever applies).**

4.2.3 Preparation of subsoil surfaces

Scarify slopes with gradients of 1:3 or flatter generally parallel to the surface contours to a depth of 150 mm to break up the surface of the subsoil/VENM and produce a finely tilled planting bed and remove all stones larger than 100 mm in size, rubbish and other materials that may hinder germination before topsoiling and to incorporate ameliorations. Carry out ground preparation manually within the drip line of vegetation to be retained.

Roughen batters steeper than 1:3 to a depth of 50 mm to form keys in the subsoil to prevent topsoil slipping down the face of the slope, and incorporate ameliorants into the subsoil no earlier than 7 days before seeding. The treated surface must have all furrows aligned with the contours.

WITNESS POINT 4.2.3	
Process Witnessed:	**Preparation of subsoil/VENM surfaces.**
Requirement:	**AGL must supervise surface preparation works to ensure this is undertaken in accordance with this specification.**

4.2.4 Topsoil sampling and analysis

Ensure that that soil testing is undertaken prior to authorisation of release and acceptance of topsoil in accordance with requirements and set criteria outlined in Appendix C by a laboratory that is accredited under NATA or ASPAC for each of the TESTS. Test at the frequency nominated in Table 4.3 to confirm its suitability for use in revegetation works and to determine soil chemistry revegetation constraints soil amelioration and spreading requirements.

Sampling must be carried out by a soil scientist.

Submit to the laboratory for testing with a copy of the relevant testing form.

Table 4.3 Topsoil testing requirements

Tests required	Frequency
Appendix C	One (1) topsoil sample per 500 m^3 with a minimum of one (1) test per imported batch.

HOLD POINT 4.2.4	
Process Held:	**Topsoil sampling and analysis.**
Requirement:	**Undertake topsoil sampling in accordance with this clause and produce a topsoil test certificate addressing the analysis prior to the application of ameliorants.**
Release of Hold Point:	**AGL will consider the subsoil test results prior to authorising the release of the Hold Point.**

4.2.5 Topsoil amelioration

Ameliorate topsoil for the proposed use in accordance with recommendations of soil test certificate prior to use.

Within 7 days of subsoil preparation, apply topsoil uniformly to 100 mm thickness on slopes with gradients 1:4 or flatter, 75 mm thickness on slopes with gradients steeper than 1:4 but less than or equal to 1:3 and 50 mm thickness on batters steeper than 1:3 to all areas which are to be topsoiled.

On slopes which are 1:3 or flatter, cultivate the topsoiled area to a depth of 50 mm by a diamond harrow to provide a roughened surface with soil lumps not exceeding 50 mm dimension.

WITNESS POINT 4.2.5	
Process Witnessed:	**Application of ameliorants to topsoils.**
Requirement:	**AGL must supervise the application of ameliorants to validate that the correct ameliorants have been applied and at the rates specified in this section, in a laboratory soil test certificate or at the advice of Soil Scientist (whichever applies).**

4.2.6 Topsoil application

Topsoil should be applied to a minimum thickness of 100 mm in any areas to be vegetated which do not have a topsoil cover.

Only light harrowing of the reinstated topsoil is to be undertaken given the risk of intermixing subsoils with the topsoil layer. Harrowing should be undertaken across the slope to avoid concentrating surface flows and causing erosion.

4.3 Preparation of seed

Where site conditions are not suitable for the pre-treatment and mixing of seed, this work may be done off site in conditions conducive for this purpose.

HOLD POINT 4.3	
Process Held:	**Use of seed pre-treated off site.**
Requirement:	**A certificate showing the species, variety, weight and place of pre-treatment must be provided for all seed sourced from third-party suppliers in advance of this seed being purchased and brought onto site.**
Release of Hold Point:	**AGL will consider the submitted documents and may inspect the seed prior to authorising the release of the Hold Point (acceptance of seed).**

i Seed mix application rates

Table 4.4 Seed mix application rates by season

Material	Rate per Hectare
All seed applications	
Seed	• Perennial Ryegrass 26 kg/ha • Tall Fescue 30 kg/ha • Cocksfoot 7 kg/ha • Phalaris 7 kg/ha • Red Clover 5 kg/ha • White Clover 5 kg/ha • Sub Clover 5 kg/ha • Couch 5 kg/ha **Warm season cover crop** • Japanese Millet 35 kg/ha **Cool season cover crop** • Wimmera Ryegrass – 30 kg/ha

Adjust the seed quantities using the purity and germination/viability certificates to ensure the application rates equivalent to 100% live seed.

Use appropriate cover crop species to suit the sowing season as shown in Table 4.4.

4.3.2 Preparation for hydro-mulching

Storage tanks, containers and equipment to be used in hydro-mulching must be clean and free of contamination from previous operations.

WITNESS POINT i	
Process Witnessed:	**Cleanliness of storage tanks, containers and equipment to be used in hydro-mulching, hydroseeding and straw mulching.**
Requirement:	**AGL must inspect all infrastructure and equipment to be used for hydro-mulching, hydroseeding and straw mulching activities in advance of works to ensure they are free of contamination.**

The hydro-mulch must comprise the relevant materials and must be applied at the seed rates listed and set out in Table 4., in addition to the blend requirements outlined in Table 4.4.

Table 4.5 Blend rates for hydro-mulch constituent materials

Material	Clause	Rate per hectare
Hydro-mulching		
Ameliorants	4.1.2	In accordance with the soil test certificates
Water	4.1.5	In accordance with manufacturers recommendations
Organic fibres	4.1.4i	4,000 kg/ha for slopes 1:3 or flatter 5,000 kg/ha for batters steeper than 1:3
Binder	0	In accordance with manufacturers recommended rate

Produce hydro-mulch slurry mixtures by adding the specified materials into the tank and agitate until a homogenous blend is obtained.

4.4 Sowing

Seed is to be sown by hydro-mulching or direct seeding in accordance with the specifications below.

4.4.1 Quality control plan

A quality control plan is to be prepared to track the location of and how each lot is to be sown using hydro-mulch or direct seeding. The plan must include, at a minimum:

- the location of the lot (GPS coordinates);
- time and date of seed application;
- drawing reference number of the area to be sown;
- seed batch and serial numbers;
- surface preparation methods used;
- fertiliser type and quantity applied; and
- reference/evidence of the soil testing undertaken and any subsoil and topsoil ameliorants applied.

For hydromulching, the following additional measures must be included:

- hydro-mulch product name and batch numbers where used;
- hydro-mulch volume calculation and product reconciliation by bag count and or serial numbers; and
- binder name and quantity used per tank.

4.4.2 Sowing methods

i Hydo-mulching

Seed must be applied to the lot in the first tank of the application to ensure the seed is in intimate contact with the soil surface. Additional passes to apply the required volume of mulch must be placed over the lot within 24 hours of the seed being applied to the surface and prior to predicted rainfall.

Seed to be used for each operation must be mixed, pre-treated and placed into the sowing equipment on site. Seed must be sown within 5 days of mixing and pre-treatment.

Carry out within 2 days of completion of soil preparation or, if delayed by the weather conditions defined in section 4.4.3, as soon as weather conditions permit. Re-work treated topsoil surfaces if the surface has been impacted by rainfall.

Agitate continuously the slurry to maintain a uniform consistency during application. Apply it uniformly over the whole surface at the rate specified in Table 4.4.

Apply hydro-mulch in two passes, over the whole surface at the rate specified in Table 4.4. Both passes must be applied from two separate directions to eliminate shadowing and to achieve 100% coverage.

ii Direct Seeding

Seed should be stored on site for the minimum practical time before sowing. Seed must be applied as soon as practicable after soil preparation and amelioration.

Seeds may be broadcast mixed with fertiliser in a super-spreader or direct seeding using an agricultural seeder. Seed fertiliser mixes should be well mixed on site to avoid separation of seed and fertiliser materials prior to application.

Topsoil should be gently cultivated after broadcast seeding to ensure adequate soil/seed contact to promote germination.

4.4.3 Weather conditions for seeding

Do not apply hydro-mulch or undertake direct seeding:

- when winds exceed 15 km/h;
- when temperatures exceed 37°C;
- where the ground surface is too wet; or
- during rain periods or when rain appears imminent.

4.5 Vegetation of open drains

4.5.1 Lining with Coir Mesh

Coir Mesh must be placed within two days of topsoil and seeding operations and prior to rain.

Lay the runs of the mesh along the direction of water flow (Appendix B).

Terminate the upstream and downstream ends of the mesh into an anchor trench 150 mm wide by 200 mm deep and pin the mesh to the base of the trench at 100 mm centres. Backfill the trench with soil and compact by foot.

Where lateral overland and concentrated flows can enter the drain install a longitudinal anchor trench 150 mm wide by 200 mm deep and pin the mesh to the base of the trench at 100 mm centres. Backfill the trench with soil and compact by foot.

Minimise erosion under the mesh by installing the mesh in 150 mm wide by 200 mm deep intermittent check slots must be excavated at 10 m intervals.

Lay the mesh taut and evenly over the soil surface without any air pockets but do not stretch or allow the mesh to 'tent' above the soil surface.

The Coir Mesh must be installed such that the first run covers the floor of the drain. Overlap adjacent runs of mesh by 200 mm with the higher run lapped over the lower. The Organic Fibre Mesh must extend fully up the side of the channel and over the crest by at least 300 mm.

Pin the mesh along the sides of each run at spaced 200 mm laterally and 300 mm longitudinally.

End overlaps must extend 150 mm past the check slot for the start of the lower run and pinned at 200 mm centres.

4.6 Maintenance

Maintain all vegetated areas from the day of sowing until completion in accordance with the maintenance schedule given in Table 4.4.

Critical attention must be given to:

- maintaining revegetated areas such that they are free from erosion and achieve 70% soil-surface coverage; and
- ensuring weed identification and suppression is undertaken through the life of the revegetation program, including the control of declared weeds, to minimise competition with sown species.

Localised areas that have not established after treatment must be immediately recultivated and/or reseeded (and re-fertilised) if germination is not successful. Recultivation and follow-up fertiliser application rates must be subject to site appraisal and recommendation from a Soil Scientist.

Table 4.4 Maintenance requirements

Maintenance activities/Tasks	Inspections	Performance of work
Weed Control Noxious and/ or unwanted	Monthly	When present and prior to flowering
Reseeding	Monthly	Re-establish when required
Fertilising	Annually	When nutrient deficiency is evident
Watering	Monthly	Maintain soils moisture levels between 40 and 80% field capacity
Repair sheet and rill erosion	Monthly	When rill/gully erosion has occurred

Records of maintenance activities shall be maintained in a log-book or equivalent record system.

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Appendix A

Site soil test results

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

SESL AUSTRALIA
Environment & Soil Sciences

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 1	Date Received: 27/11/20	Report Status: Final

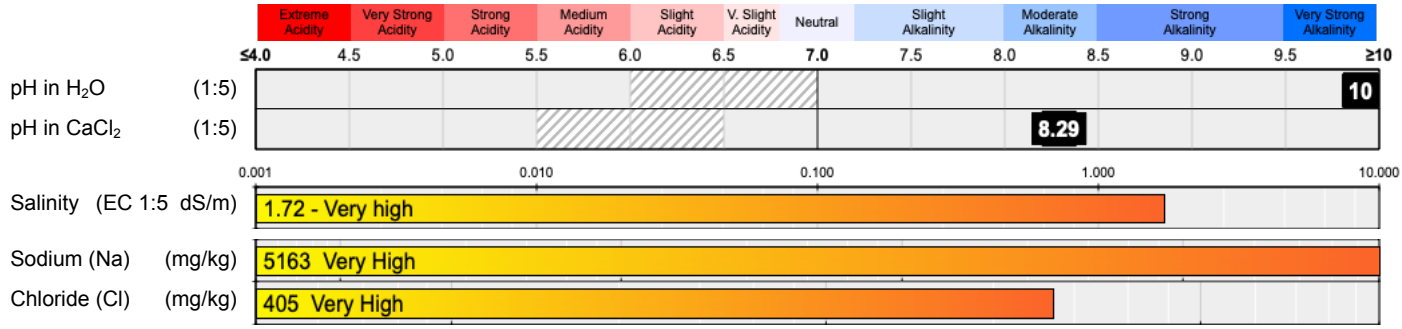
Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**SS01 - 0.0 - 0.1 11/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

RECOMMENDATIONS

Soil sample 'SS01 - 0.0 - 0.1 11/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is very strongly alkaline in H2O and moderately alkaline in CaCl2 with very high salinity and NaCl levels. The soil is highly sodic therefore prone to dispersion. The soil is high in all nutrients aside from phosphorus. Organic matter is moderate at 2.6% The soil is a medium clay with a strong crumb structure.

This soil resembles a subsoil and is not recommended for topsoil use without appropriate management.
1. To convert to a topsoil refer to the Summary Profile.
2. To use as a subsoil or topsoil apply 500g/m2 of gypsum & wait 1 month. Apply a further 500g/m2 of gypsum.
3. Plant only alkaline tolerant species (applies to both as a topsoil or subsoil)
4. If using soil as a topsoil and planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.

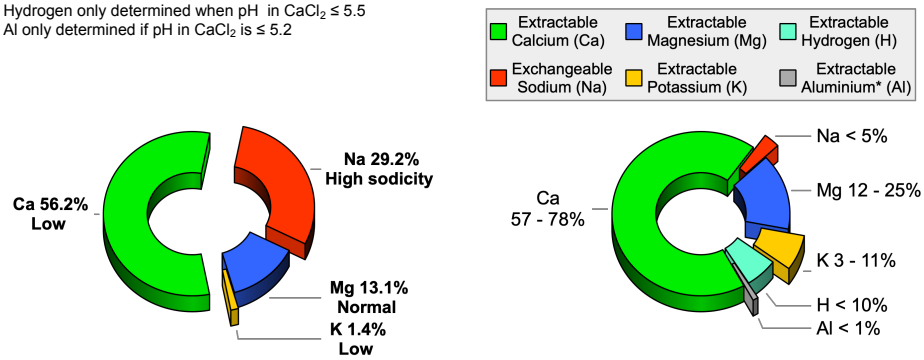
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**4.3**	4.1 – 6.0
Comment: Balanced		
Mg:K	**9.1**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0.02**	< 0.07
Comment: Acceptable		
K:Na	**0**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
22.46	1.11	43.16	10.05		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759 | **Sample N°: 1** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	41		5.5	4	Maintenance
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	433		57.6	51.6	Drawdown
Sulfur (S)	mg S/kg	274		36.4	9	Drawdown
Calcium (Ca)	mg/kg	8650		1150.5	367.5	Drawdown
Magnesium (Mg)	mg/kg	1221		162.4	38.4	Drawdown
Iron (Fe)	mg/kg	539		71.7	73.4	1.7
Manganese (Mn)	mg/kg	135		18	5.9	Drawdown
Zinc (Zn)	mg/kg	4.9		0.7	0.7	0
Copper (Cu)	mg/kg	4.6		0.6	0.8	0.2
Boron (B)	mg/kg	5.7		0.8	0.4	Drawdown

Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

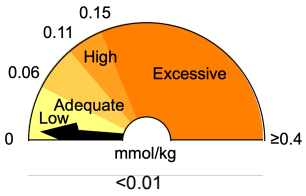
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**76.8**
Eff. Cation Exch. Capacity (eCEC):	**76.8**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **994**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Medium Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Moderate - 1.5**
Estimated clay content:	**40 - 55%**	Structure Size:	**Coarse (>25mm)**	Organic Matter (OM %):	**2.6**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Apedal - Massive**	Est. Field Capacity (% water):	**42**
Tactually organic:	**Not Organic**	Structural Unit:	**No Structure**	Est. Permanent Wilting Point (% water):	**25**
Calculated EC_{SE} (dS/m):	**12.9**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**17**
– Highly saline. Only tolerant plant species grow satisfactorily.		Est. Permeability Class (mm/hr):	**<2.5**	Est. Plant Available Water (mm/m):	**170**
		Additional comments:			

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 2	Date Received: 27/11/20	Report Status: Final

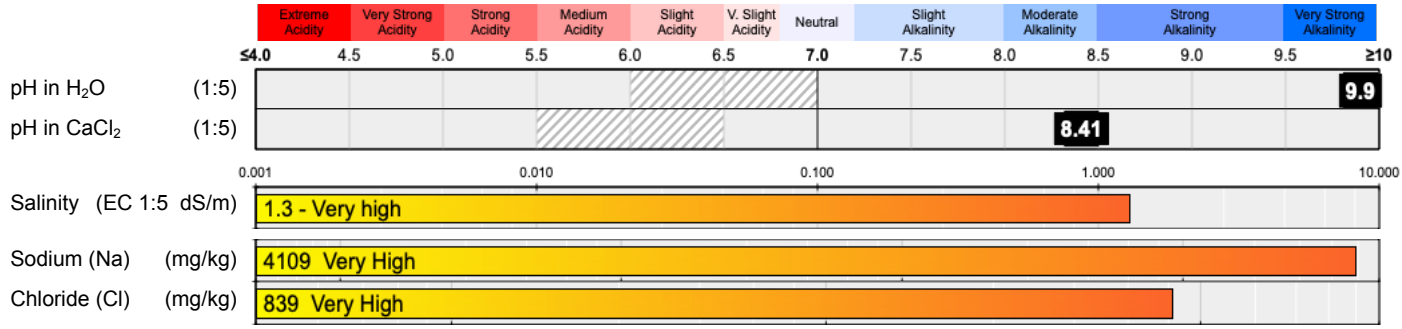
Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**SS01 - 0.1 - 0.2 11/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

RECOMMENDATIONS

Soil sample 'SS01 - 0.0 - 0.2 11/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is very strongly alkaline in H2O and moderately alkaline in CaCl2 with very high salinity and NaCl levels. The soil is highly sodic therefore prone to dispersion. The soil is moderate to high in all nutrients aside from phosphorus. Organic matter is low at 1.7% The soil is a light clay with a moderate crumb structure.

This soil resembles a subsoil and is not recommended for topsoil use without appropriate management.
1. To convert to a topsoil refer to the Summary Profile.
2. To use as a subsoil or topsoil apply 750g/m2 of gypsum & wait 1 month. Apply a further 750g/m2 of gypsum.
3. Plant only alkaline tolerant species (applies to both as a topsoil or subsoil)
4. If using soil as a topsoil and planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.

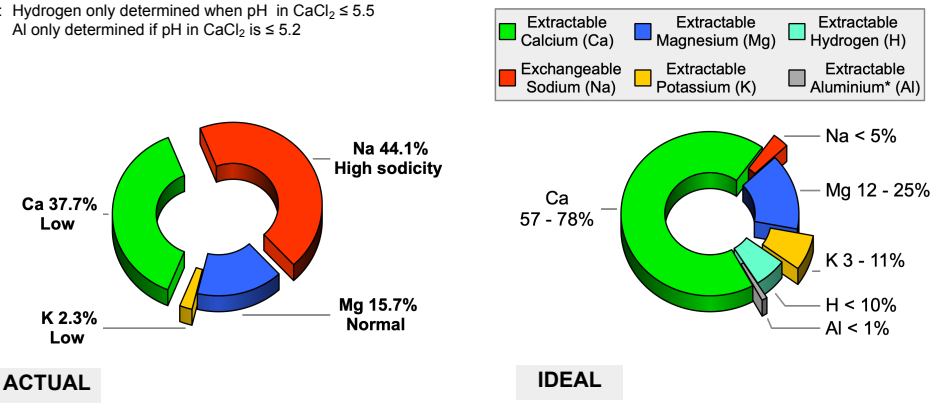
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**2.4**	4.1 – 6.0
Comment: Calcium low		
Mg:K	**6.7**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0.04**	< 0.07
Comment: Acceptable		
K:Na	**0.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
17.87	0.95	15.25	6.38		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

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Soil Chemistry Profile

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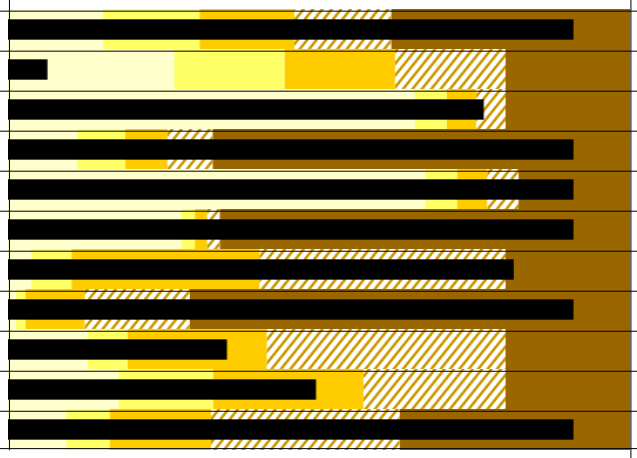
Batch N°: 58759 | **Sample N°: 2** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	31		4.1	4	Maintenance
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	371		49.3	51.6	2.3
Sulfur (S)	mg S/kg	188		25	9	Drawdown
Calcium (Ca)	mg/kg	3060		407	367.5	Drawdown
Magnesium (Mg)	mg/kg	775		103.1	38.4	Drawdown
Iron (Fe)	mg/kg	561		74.6	73.4	Drawdown
Manganese (Mn)	mg/kg	137		18.2	5.9	Drawdown
Zinc (Zn)	mg/kg	2.2		0.3	0.7	0.4
Copper (Cu)	mg/kg	3.9		0.5	0.8	0.3
Boron (B)	mg/kg	3.9		0.5	0.4	Drawdown



Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

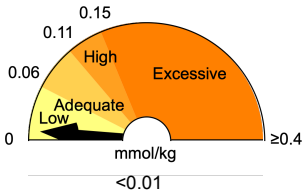
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**40.5**
Eff. Cation Exch. Capacity (eCEC):	**40.5**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **1384**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Light Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Low - 1**
Estimated clay content:	**35 - 40%**	Structure Size:	**Coarse (>25mm)**	Organic Matter (OM %):	**1.7**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Apedal - Massive**	Est. Field Capacity (% water):	**38**
Tactually organic:	**Not Organic**	Structural Unit:	**No Structure**	Est. Permanent Wilting Point (% water):	**23**
Calculated EC_{SE} (dS/m):	**11.2**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**15**
– Highly saline. Only tolerant plant species grow satisfactorily.		Est. Permeability Class (mm/hr):	**>120**	Est. Plant Available Water (mm/m):	**150**
		Additional comments:			

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 3	Date Received: 27/11/20	Report Status: Final

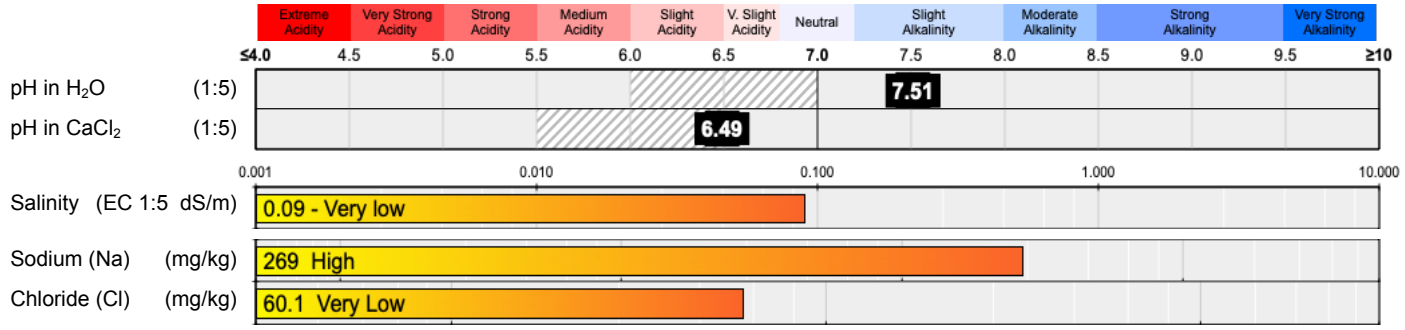
Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**BH26 - 0.0 - 0.1 10/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

RECOMMENDATIONS

Soil sample 'BH26 - 0.0 - 0.1 10/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is slightly alkaline in H2O and very slightly acidic in CaCl2 with very low salinity and Cal with high Na levels. The soil is highly magnesic plus sodic therefore prone to dispersion. The soil is deficient in all macronutrients aside from magnesium and manganese. Organic matter is low at 2% The soil is a light clay with a moderate crumb structure.

This soil resembles a subsoil and is not recommended for topsoil use without appropriate management.
1. To convert to a topsoil refer to the Summary Profile.
2. To use as a subsoil or topsoil apply 500g/m2 of gypsum.
3. If using soil as a topsoil and planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.
4. If using soil as a topsoil apply urea at 20g/m2 and sulphate of potash at 50g/m2

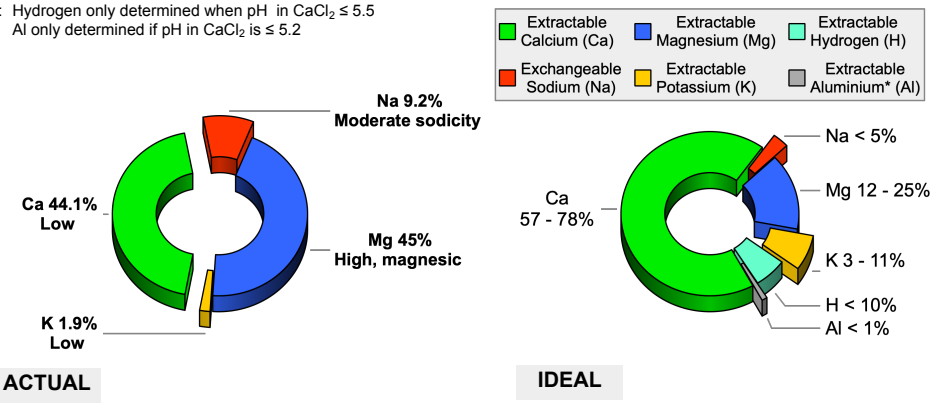
pH and ELECTRICAL CONDUCTIVITY



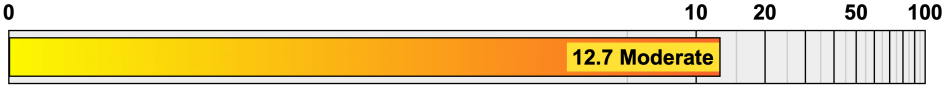
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2 \leq 5.5$
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**1**	4.1 – 6.0
Comment: Calcium low		
Mg:K	**23.8**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.02**	< 0.07
Comment: Acceptable		
K:Na	**0.2**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
1.17	0.24	5.60	5.71		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759 | **Sample N°: 3** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	0.99		0.1	4	3.9
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	95.3		12.7	34.8	22.1
Sulfur (S)	mg S/kg	11		1.5	9	7.5
Calcium (Ca)	mg/kg	1120		149	248	99
Magnesium (Mg)	mg/kg	694		92.3	25.8	Drawdown
Iron (Fe)	mg/kg	158		21	73.4	52.4
Manganese (Mn)	mg/kg	150		20	5.9	Drawdown
Zinc (Zn)	mg/kg	2.1		0.3	0.7	0.4
Copper (Cu)	mg/kg	3.1		0.4	0.8	0.4
Boron (B)	mg/kg	0.3		0	0.4	0.4

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

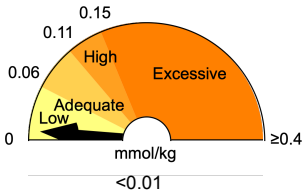
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**12.7**
Eff. Cation Exch. Capacity (eCEC):	**12.7**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **340**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Light Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Low - 1.2**
Estimated clay content:	**35 - 40%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**2**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**38**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**23**
Calculated EC_{SE} (dS/m):	**0.8**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**15**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**2.5 - 5**	Est. Plant Available Water (mm/m):	**150**
		Additional comments:			

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 4	Date Received: 27/11/20	Report Status: Final

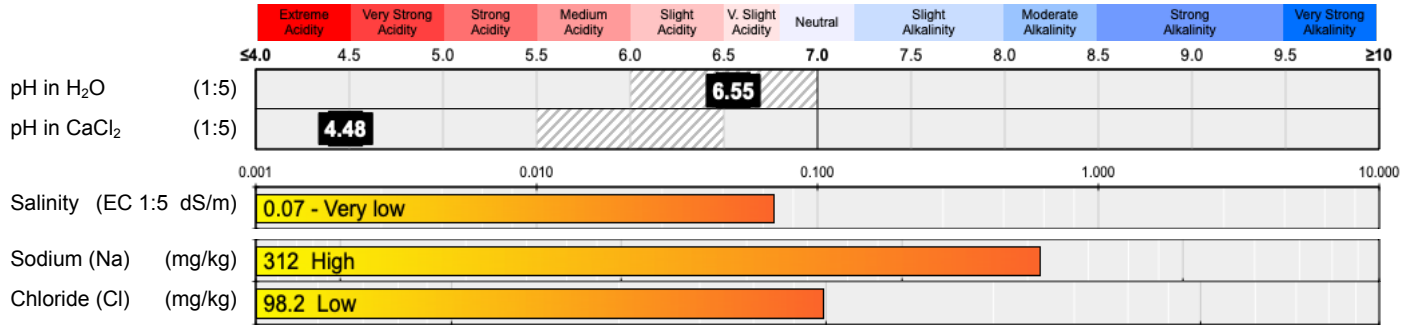
Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**BH26 - 0.2 - 0.3 10/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

RECOMMENDATIONS

Soil sample 'BH26 - 0.2 - 0.3 10/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is very slightly acidic in H2O and very strongly acidic in CaCl2 with very low salinity and Cl with high Na levels. The soil is highly magnesic plus sodic and acidic therefore prone to dispersive and hostile conditions. The soil is deficient in all macronutrients aside from magnesium. Organic matter is very low at 0.9% The soil is a light clay with a moderate crumb structure.

This soil resembles a subsoil and is not recommended for topsoil use without appropriate management.
1. To convert to a topsoil refer to the Summary Profile.
2. To use as a subsoil or topsoil apply 500g/m2 of gypsum plus lime at 170g/m2
3. If using soil as a topsoil and planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.
4. If using soil as a topsoil apply urea at 20g/m2 and sulphate of potash at 40g/m2

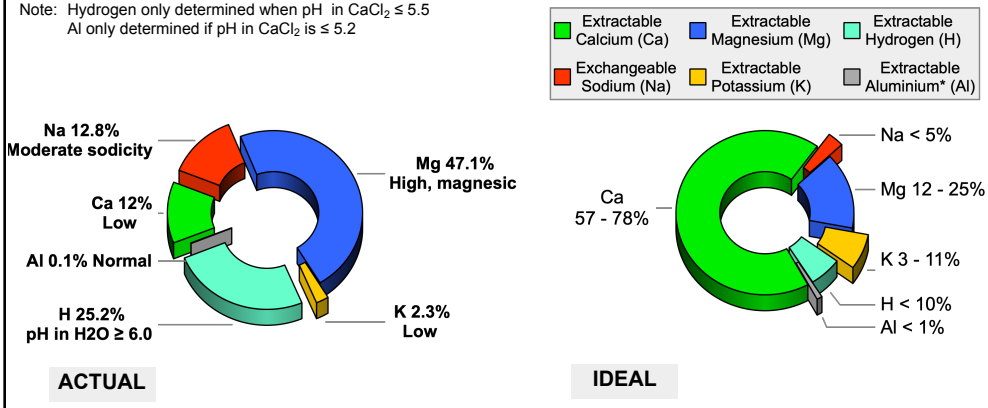
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.3**	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	**20.8**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.04**	< 0.07
Comment: Acceptable		
K:Na	**0.2**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
1.36	0.24	1.27	4.99	2.67	0.01

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Mailing Address: PO Box 357, Pennant Hills NSW 1715
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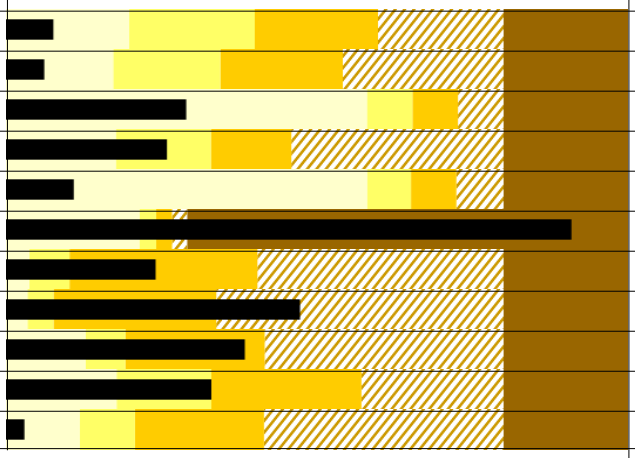
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759 | **Sample N°: 4** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	2		0.3	4	3.7
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	94.9		12.6	34.8	22.2
Sulfur (S)	mg S/kg	22		2.9	9	6.1
Calcium (Ca)	mg/kg	254		33.8	248	214.2
Magnesium (Mg)	mg/kg	606		80.6	25.8	Drawdown
Iron (Fe)	mg/kg	166		22.1	73.4	51.3
Manganese (Mn)	mg/kg	26		3.5	5.9	2.4
Zinc (Zn)	mg/kg	2.4		0.3	0.7	0.4
Copper (Cu)	mg/kg	2.6		0.3	0.8	0.5
Boron (B)	mg/kg	<0.1		0	0.4	0.4



Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

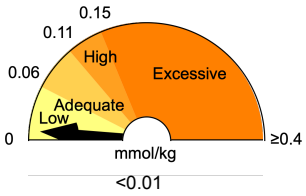
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.6**
Sum of Base Cations (cmol(+)/kg):	**7.9**
Eff. Cation Exch. Capacity (eCEC):	**10.6**
Base Saturation (%):	**74.53**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**1**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **674**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Light Clay**
Estimated clay content:	**35 - 40%**
Tactually gravelly:	**Gravelly**
Tactually organic:	**Not Organic**
Calculated EC_{SE} (dS/m):	**0.6**

– Non-saline. Salinity effects on plants are mostly negligible.

Munsell Colour:	**-**
Structure Size:	**Medium (11 - 25mm)**
Structural Organisation:	**Pedal - Moderate**
Structural Unit:	**Crumb**
Potential infiltration rate:	**Slow**
Est. Permeability Class (mm/hr):	**2.5 - 5**
Additional comments:	

Organic Carbon (OC %):	**Very low - 0.6**
Organic Matter (OM %):	**0.9**
Est. Field Capacity (% water):	**38**
Est. Permanent Wilting Point (% water):	**23**
Est. Plant Available Water (% water):	**15**
Est. Plant Available Water (mm/m):	**150**

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 5	Date Received: 27/11/20	Report Status: Final

Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**BH27 - 0.0 - 0.1 10/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

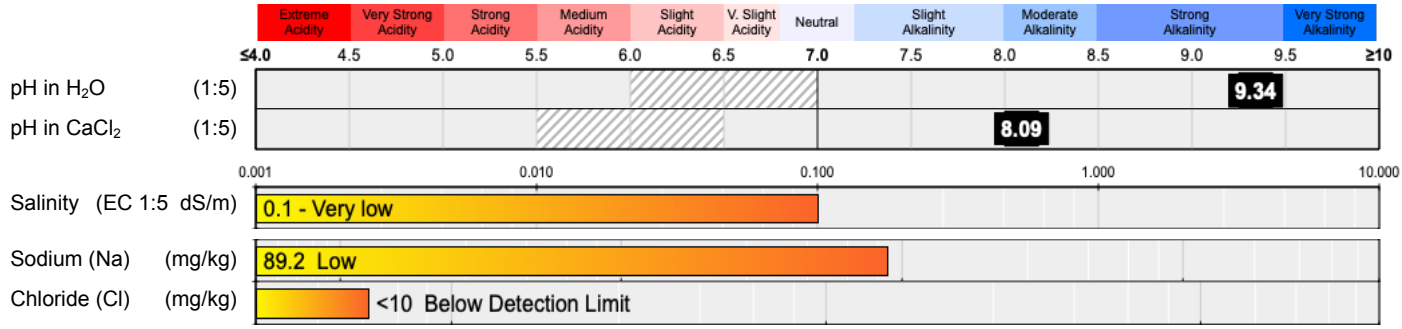
RECOMMENDATIONS

Soil sample 'BH27 - 0.0 - 0.1 10/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is strongly alkaline in H2O and moderately alkaline in CaCl2 with very low salinity and NaCl levels. The soil is highly calcic. The soil is deficient in N, P, K but high in S, Ca and Mg. Organic matter is very low at 0.9% The soil is a sandy loam with a moderate crumb structure.

This soil resembles a topsoil.

1. Plant only alkaline tolerant species.
2. If planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.
3. Apply urea at 20g/m2 and muriate of potash at 70g/m2

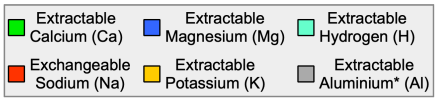
pH and ELECTRICAL CONDUCTIVITY

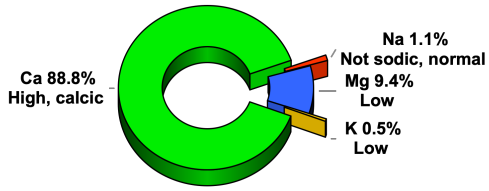


CATION BALANCE

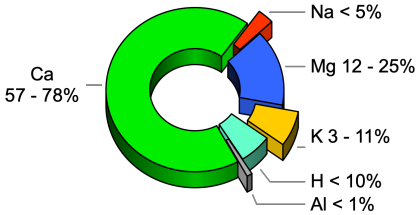
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2





ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**9.4**	4.1 – 6.0
Comment: Magnesium low		
Mg:K	**17.8**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.01**	< 0.07
Comment: Acceptable		
K:Na	**0.5**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.39	0.18	30.27	3.21		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

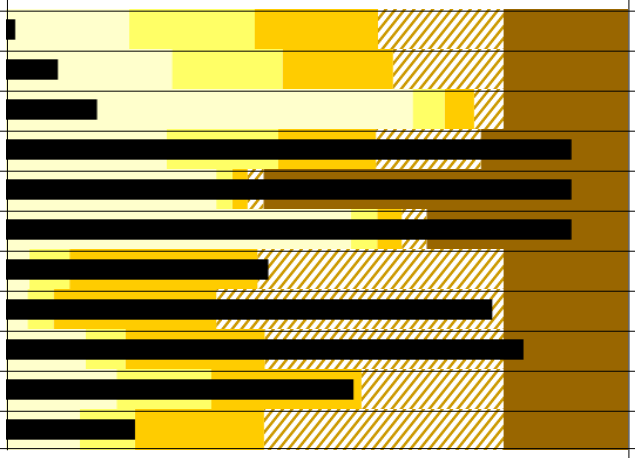
Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759 | **Sample N°: 5** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	0.39		0.1	4	3.9
Phosphorus (P)	mg P/kg	6.58		0.9	8.4	7.5
Potassium (K)	mg/kg	71		9.4	51.6	42.2
Sulfur (S)	mg S/kg	81		10.8	9	Drawdown
Calcium (Ca)	mg/kg	6070		807.3	367.5	Drawdown
Magnesium (Mg)	mg/kg	390		51.9	38.4	Drawdown
Iron (Fe)	mg/kg	291		38.7	73.4	34.7
Manganese (Mn)	mg/kg	43		5.7	5.9	0.2
Zinc (Zn)	mg/kg	5.2		0.7	0.7	0
Copper (Cu)	mg/kg	4.4		0.6	0.8	0.2
Boron (B)	mg/kg	0.7		0.1	0.4	0.3



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

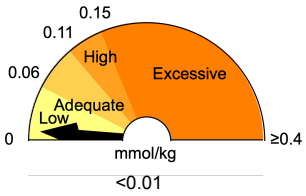
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**34.1**
Eff. Cation Exch. Capacity (eCEC):	**34.1**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **0**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Sandy Loam**
Estimated clay content:	**10 - 20%**
Tactually gravelly:	**Gravelly**
Tactually organic:	**Not Organic**
Calculated EC_{SE} (dS/m):	**1.4**

– Non-saline. Salinity effects on plants are mostly negligible.

Munsell Colour:	-
Structure Size:	**Medium (11 - 25mm)**
Structural Organisation:	**Pedal - Moderate**
Structural Unit:	**Crumb**
Potential infiltration rate:	**Rapid**
Est. Permeability Class (mm/hr):	**>120**
Additional comments:	

Organic Carbon (OC %):	**Very low - 0.5**
Organic Matter (OM %):	**0.9**
Est. Field Capacity (% water):	**26**
Est. Permanent Wilting Point (% water):	**9**
Est. Plant Available Water (% water):	**17**
Est. Plant Available Water (mm/m):	**170**

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759	Sample N°: 6	Date Received: 27/11/20	Report Status: Final

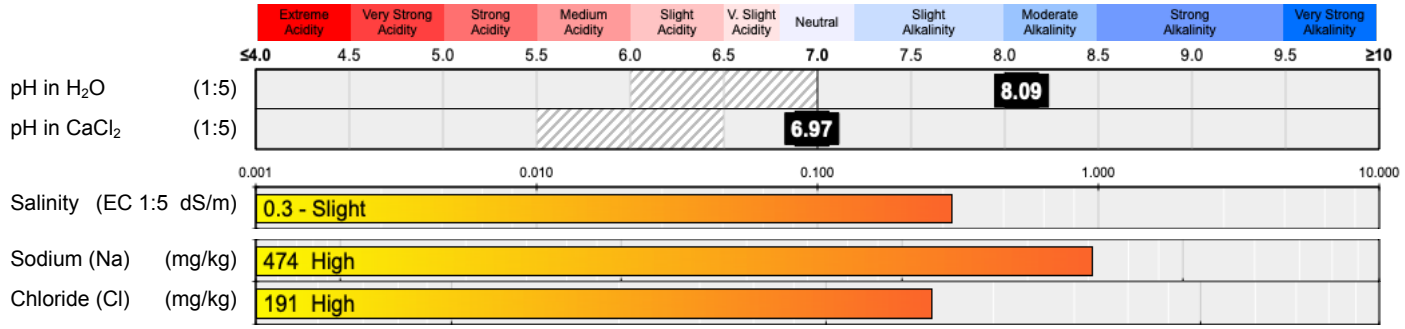
Client Name:	**EMM Consulting**	Project Name:	**Soil Testing**
		SESL Quote N°:	
Client Contact:	**Michael Frankcombe**	Sample Name:	**BH27 - 0.25 - 0.35 10/11/2020**
Client Order N°:		Description:	**Soil**
Address:	**Level 3, 175 Scott St Newcastle NSW 2300**	Test Type:	**FSC_Plus, EAT**

RECOMMENDATIONS

Soil sample 'BH27 - 0.25 - 0.35 10/11/2020' was assessed for the purpose of identifying any erosion and revegetation constraints. This sample is moderately alkaline in H2O and neutral in CaCl2 with slight salinity and high NaCl levels. The soil is highly magnesic plus sodic therefore prone to dispersive conditions. The soil is deficient in all macronutrients aside from nitrogen and magnesium. Organic matter is low at 1.5% The soil is a light clay with a moderate crumb structure.

This soil resembles a subsoil and is not recommended for topsoil use without appropriate management.
1. To convert to a topsoil refer to the Summary Profile.
2. To use as a subsoil or topsoil apply 600g/m2 of gypsum.
3. If using soil as a topsoil and planting phosphorus tolerant natives and exotics add 80g/m2 of Single Superphosphate. If planting p-sensitive natives add 20g/m2 of Single Superphosphate.
4. If using soil as a topsoil apply urea at 10g/m2 and sulphate of potash at 50g/m2

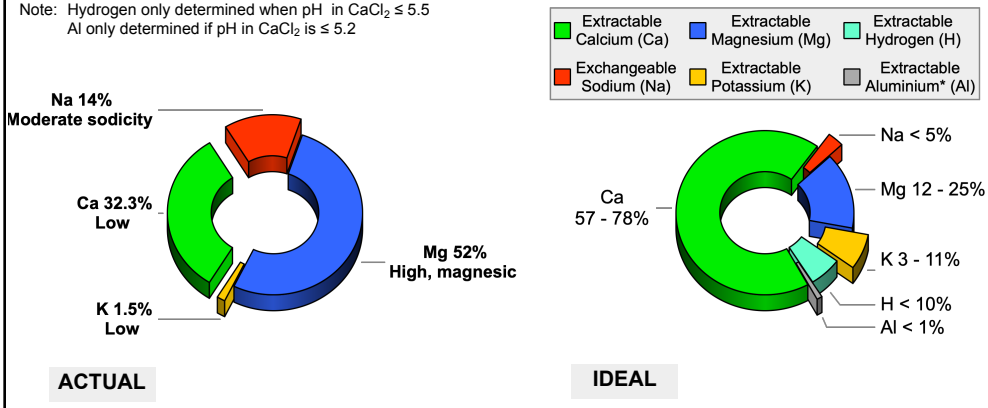
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.6**	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	**34.8**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.02**	< 0.07
Comment: Acceptable		
K:Na	**0.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
2.06	0.22	4.75	7.65		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
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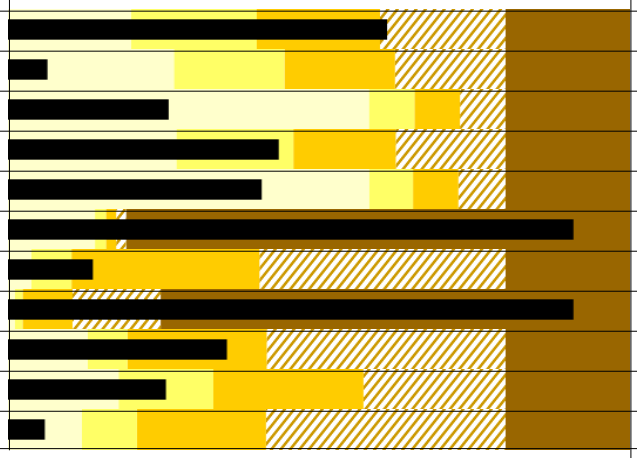
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 58759 | **Sample N°: 6** | **Date Received: 27/11/20** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	16		2.1	4	1.9
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	84.6		11.3	34.8	23.5
Sulfur (S)	mg S/kg	37		4.9	9	4.1
Calcium (Ca)	mg/kg	951		126.5	248	121.5
Magnesium (Mg)	mg/kg	930		123.7	25.8	Drawdown
Iron (Fe)	mg/kg	94.2		12.5	73.4	60.9
Manganese (Mn)	mg/kg	163		21.7	5.9	Drawdown
Zinc (Zn)	mg/kg	2.2		0.3	0.7	0.4
Copper (Cu)	mg/kg	2		0.3	0.8	0.5
Boron (B)	mg/kg	0.2		0	0.4	0.4



Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

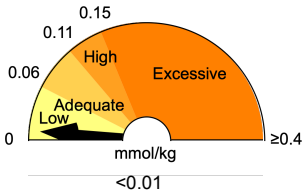
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**14.7**
Eff. Cation Exch. Capacity (eCEC):	**14.7**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **592**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Light Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Low - 0.9**
Estimated clay content:	**35 - 40%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**1.5**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**38**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**23**
Calculated EC_{SE} (dS/m):	**2.6**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**15**
– Slightly saline. Growth on sensitive plant species is affected.		Est. Permeability Class (mm/hr):	**2.5 - 5**	Est. Plant Available Water (mm/m):	**150**
		Additional comments:			

Date Report Generated 20/01/2021

Consultant: Chantal Milner

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Appendix B

Coir mesh installation drawings

B.1 Slope installation

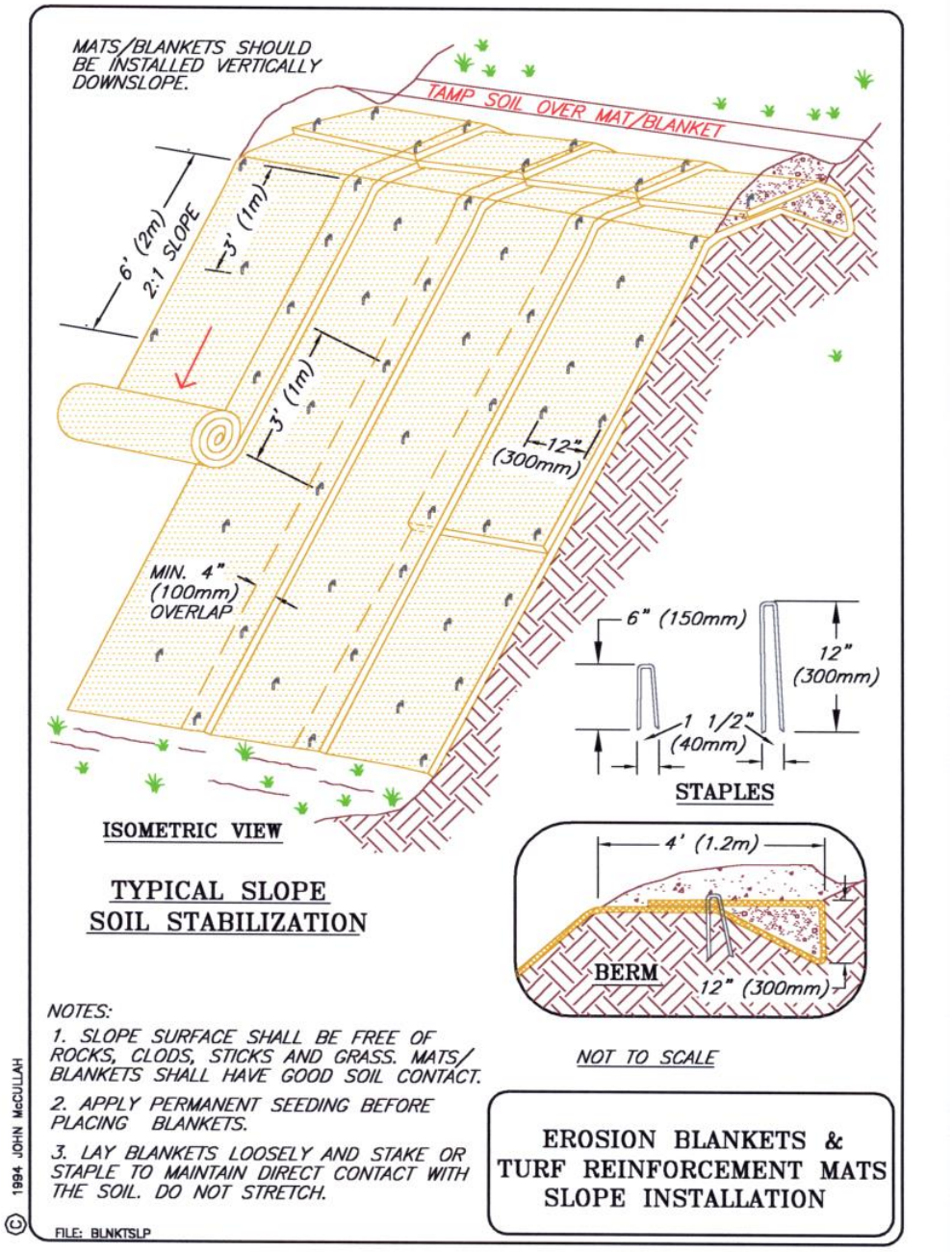


Figure B.1 Coir mesh slope installation

B.2 Open channel installation

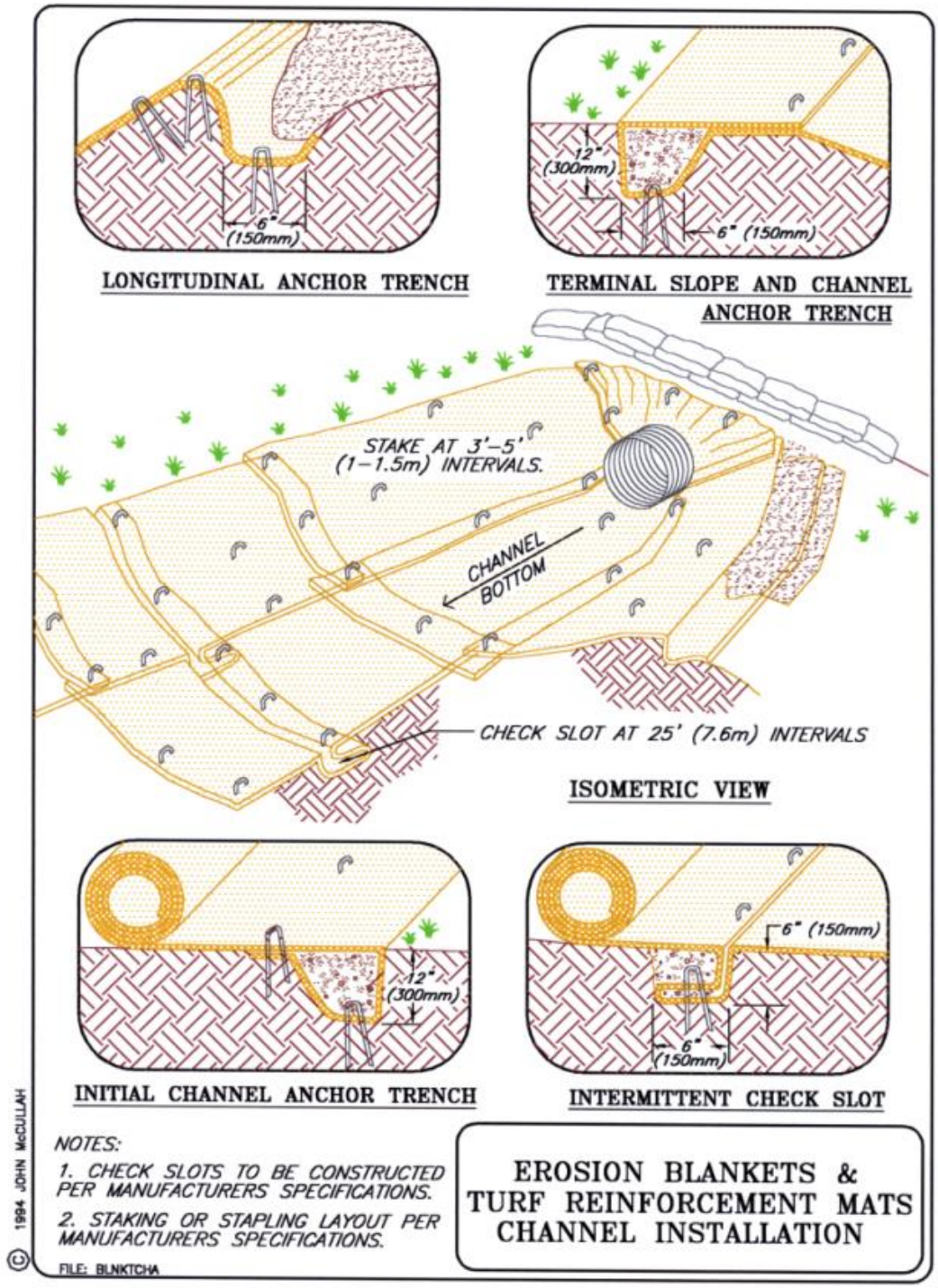


Figure B.2 Coir mesh open channel installation

Appendix C

Soil testing forms

C.1 Subsoil testing form

Table C.1 Subsoil sampling identification

Site sample identification:	**Sample date:**		
Project Name:	Sample Location:		
Job/Contract No:	Site/Stockpile/Batter ID:		
NOTE: Sampling of batters to be taken from surface to 300 mm depth ☐			
Testing Laboratory Sample Identification:			
Laboratory:	Sample No:		Date analysed:
Compliant: ☐		Non-compliant – ameliorate: ☐	
Soil Test Parameter	**Test Method**	**Soil Test Parameter Requirement**	**Soil Test Result**
Refer *Soil Chemical Methods: Australasia – Rayment & Lyons, CSIRO 2011* and AS 4419-2003 – Soils for landscaping and garden use			
pH (H2O, 1:5) – a) General range b) acid soils c) alkaline soils d) strongly alkaline soils	Rayment and Lyons – 4A1 and 4B2	a) >5.5 and <7.5 b) >5.5 and <6.5 c) >7.0 and <8.5 d) ≥8.5	
Electrical conductivity (EC)	Rayment and Lyons – 3A1	<1.2 dS/m	
Electrical conductivity (EC)/Salinity rating	Rayment and Lyons – Table 3.1	<High	
Texture	AS4419 Clause 5.13 – Appendix I	Texture Classification	
Refer Soil Chemical Methods: Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Exchangeable calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	 a) ≥2 meq/100g b) ≥5 meq/100g c) ≥5 meq/100g	
Exchangeable magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	 a) >0.6 meq/100g b) >1.0 meq/100g c) >1.0 meq/100g	
Calcium magnesium ratio (Ca:Mg) Exchangeable form for – a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	 2–10	

Table C.1 Subsoil sampling identification

Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	< =6	
Extractable phosphorus content (Extr. P) a) Very P sensitive plants b) Moderately P sensitive plants c) Non-sensitive P plants	Rayment and Lyons – 9B1	a) <5 mg/kg b) <20 mg/kg c) <100 mg/kg	
Exchangeable potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	a) >0.2 meq/100g b) >0.4 meq/100g c) >0.4 meq/100g	
Exchangeable aluminium (Al) percentage (Al base saturation % = % Al of total cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	a) When pH <6.0 b) Method 15G1	a) <25 b) <40 c) <40	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 15J1	a) >5 meq/100g b) >10 meq/100g c) >10 meq/100g	
When EC > 1.2 dS/m – Soluble Chloride (Cl-) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 5A1	<900 mg/kg	
When EC > 1.2 dS/m – Extractable Sulfur (S) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 10D1	<100 mg/kg	

C.2 Topsoil testing form

Table C.2 Topsoil sampling identification

Site sample identification:	**Sample date:**		
Project Name:	Sample Location:		
Job/Contract No:	Site/Stockpile/Batter ID:		
NOTE: Sampling of batters to be taken from surface to 300 mm depth ☐			
Testing Laboratory Sample Identification:			
Laboratory:	Sample No:		Date analysed:
Compliant: ☐		Non-compliant – ameliorate: ☐	
IMPORTED TOPSOIL ONLY			
Date of Manufacture:	Name of Manufacturer:		
Manufacturer Batch No.:	Compliant: ☐	Non-compliant: ☐	

Soil Test Parameter	**Test Method**	**Soil Test Parameter Requirement**	**Soil Test Result**
Refer *Soil Chemical Methods: Australasia – Rayment & Lyons, CSIRO 2011* and AS 4419-2003 – Soils for landscaping and garden use (Note – Modified requirements are specified below)			
Bulk density (BD)	Clause 5.2	>0.7 kg/L	
Organic matter (OM) (relevant to the organic carbon concentration)	Clause 5.3	3–10%	
pH (H_2O, 1:5) – a) General range b) Acid soils c) Alkaline soils d) Strongly alkaline soils	Rayment and Lyons – 4A1 and 4B2	a) >5.5 and <7.5 b) >5.5 and <6.5 c) >7.0 and <8.5 d) ≥8.5	
Electrical conductivity (EC)	Rayment and Lyons – 3A1	<1.2 dS/m	
Electrical conductivity (EC) / salinity rating	Rayment and Lyons – Table 3.1	<High	
Permeability	Clause 5.12	2–35 cm/hr	
Texture	AS4419 Clause 5.13 – Appendix I	Texture Classification	
Large particles – topsoil to: a) Turfed or grass seeded areas to be mown or slashed b) Batters to be mulched or hydraulic seeded and hydraulically mulched c) Broadacre areas to be seeded with native species	Clause 5.14	a) 100% by weight to pass a 20 mm sieve b) 100% by weight to pass a 50 mm sieve c) 100% by weight to pass a 75 mm sieve	

Table C.2 Topsoil sampling identification

Refer AS 1289.3.8.1 – Methods of testing soils for engineering purposes			
Dispersion – Emerson class number	Method 3.8.1	Class 3–8	
Refer Soil Chemical Methods: Australasia – Rayment & Lyons, CSIRO 2011			
NOTE – Select soil texture range: a) ☐ b) ☐ c) ☐			
Total Nitrogen (TN)	Method 7A1	>0.25%	
Total Carbon (TC)	Method 6B3	≥0.5%	
Extractable Phosphorus content (Extr. P) a) Very P sensitive plants b) Moderately P sensitive plants c) Non-sensitive P plants	Rayment and Lyons – 9B1	a) <5 mg/kg b) <20 mg/kg c) <100 mg/kg	
Exchangeable Potassium (K) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	a) >0.2 meq/100g b) >0.4 meq/100g c) >0.4 meq/100g	
Exchangeable Calcium (Ca) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	a) ≥2 meq/100g b) ≥5 meq/100g c) ≥5 meq/100g	
Exchangeable Magnesium (Mg) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	a) >0.6 meq/100g b) >1.0 meq/100g c) >1.0 meq/100g	
Calcium to Magnesium ratio (Ca:Mg) Exchangeable form for – a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	2–10	
Exchangeable sodium percentage (ESP) (Na base saturation % = % Na of total cations) d) Sands and loamy sands e) Sandy loams to clay loams f) Sandy light clay to heavy clay	When pH ≤7.3 Method 15B3 When pH >7.3 Method 15C1	≤6	
Effective cation exchange capacity (ECEC) (ECEC = sum of exchangeable cations) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 15J1	a) >5 meq/100g b) >10 meq/100g c) >10 meq/100g	
When EC >1.2 dS/m – Soluble Chloride (Cl-) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 5A1	<900 mg/kg	

Table C.2 Topsoil sampling identification

When EC >1.2 dS/m – Extractable Sulfur (S) a) Sands and loamy sands b) Sandy loams to clay loams c) Sandy light clay to heavy clay	Method 10D1	<100 mg/kg	

Appendix D

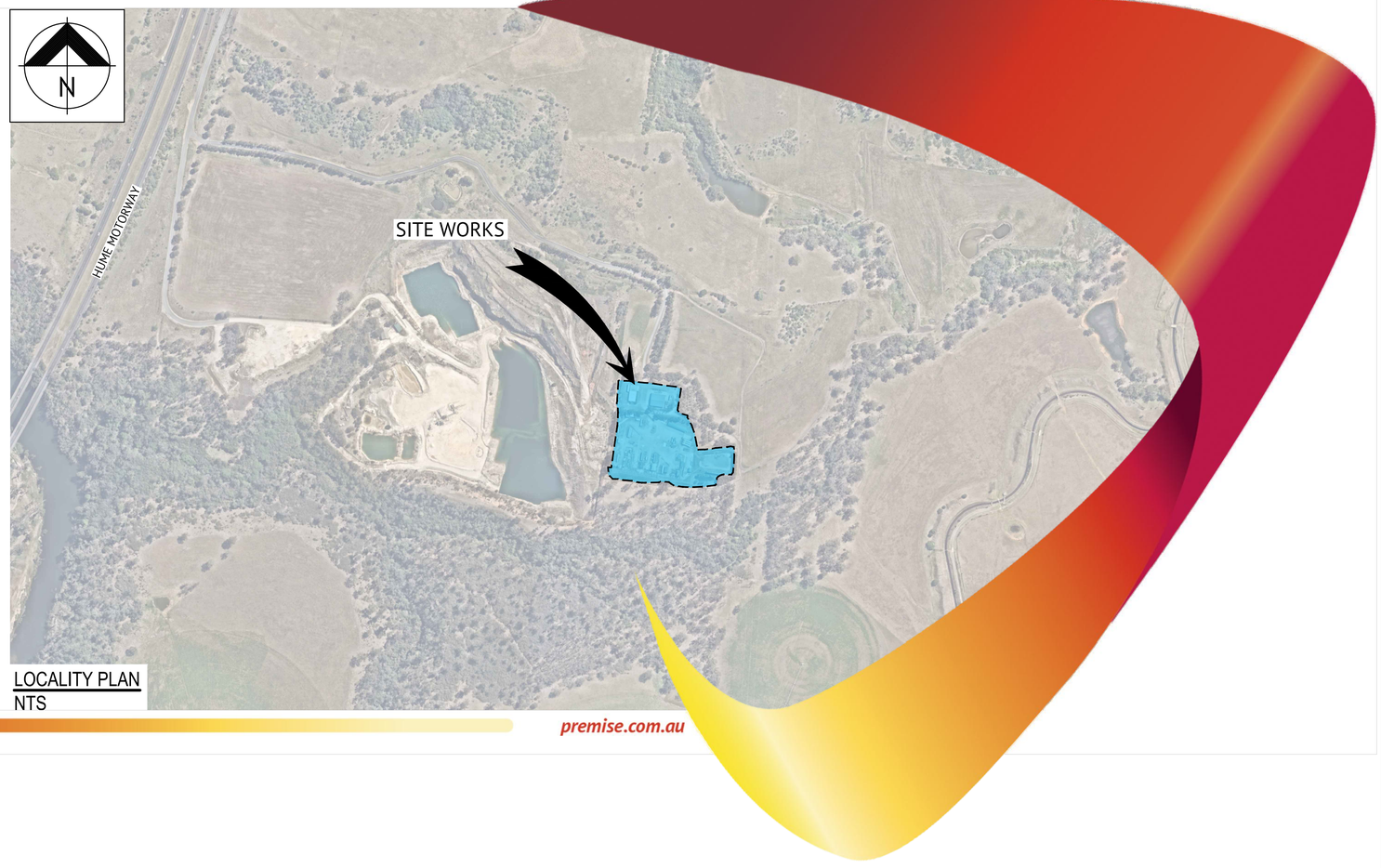
Tree survey and re-grading

TREE SURVEY & SITE REGRADING

ISSUED FOR CONSTRUCTION

DECEMBER 2023

SCHEDULE OF DRAWINGS		
SHEET NO.	SHEET TITLE	REVISION
C001	COVER SHEET & SITE LOCALITY	A
C010	CUT AND FILL PLAN	A
C020	EROSION AND SEDIMENT CONTROL PLAN	A
C021	EROSION AND SEDIMENT CONTROL NOTES AND DETAILS	A
C022	SEDIMENT BASIN CALCULATION	A
C030	CONSTRUCTION SEDIMENTATION AND EROSION CONTROL	A



LOCALITY PLAN
NTS

premise.com.au

nearmap IMAGERY EXTRACTED FROM nearmap.com

SHEET TITLE

COVER SHEET & SITE LOCALITY

JOB CODE 316025

SHEET NUMBER C001

REV A

BEFORE YOU DIG
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LEGEND

- 105.0 — EXISTING CONTOUR (0.5 INTERVAL)
- 105.0 — DESIGN CONTOUR MAJOR (0.5 INTERVAL)
- 105.10 — DESIGN CONTOUR MINOR (0.1 INTERVAL)
- EXISTING TREES
- DESIGN CONTOUR MINOR (0.1 INTERVAL)
- G G SALES PIPELINE

EARTHWORKS VOLUMES

CUT =	8554m³
FILL =	8554m³
BALANCE =	0m³

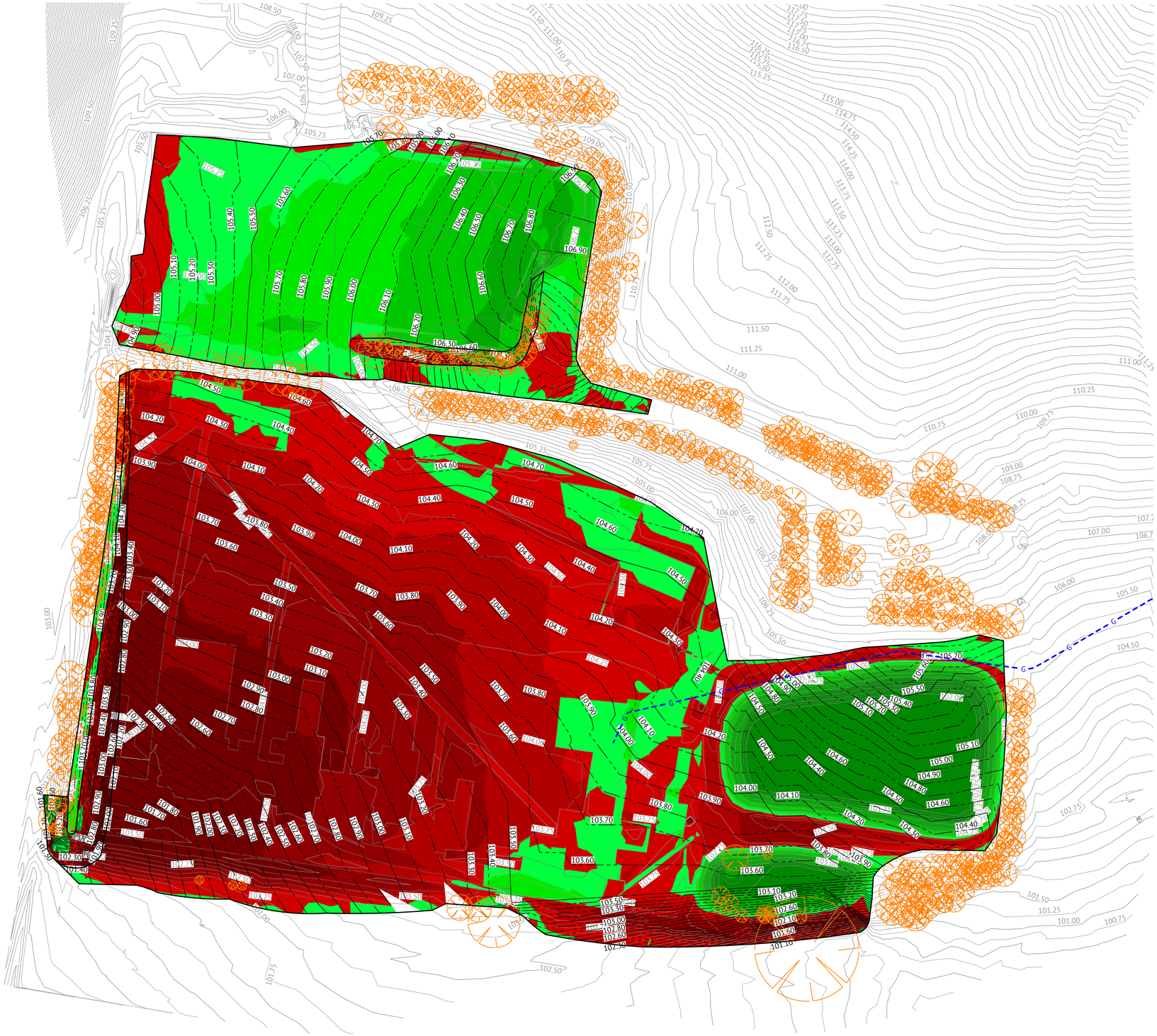
("-" EXPORT, "+" IMPORT)

NOTES:

LEVELS SHOWN HEREON ARE FINAL. BULK LEVELS ARE 100mm BELOW FINAL LEVELS.

NOTES:

SALES PIPELINE LOCATION BY REIN WARRY AND CO. FILE NO. 6721-C.



CUT/FILL			
Colour	Depth Range (m)		
	-5.000	-2.000	CUT
	-2.000	-1.000	
	-1.000	-0.500	
	-0.500	-0.250	
	-0.250	0.000	
	0.000	0.250	FILL
	0.250	0.500	
	0.500	1.000	
	1.000	2.000	
	2.000	5.000	
	5.000	10.000	

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DATE	REV	DESCRIPTION	REC	APP
11/12/2023	A	ISSUED FOR CONSTRUCTION	PP	MZ

REVISIONS

Premise

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DESIGNED: TUNG PHAM
CHECKED: MICHA ZESCHKE
PROJECT MANAGER: IAN BIGNELL
ENGINEERING CERTIFICATION: MICHA ZESCHKE

SCALE
SCALE 1:500 (A1)
0 10 20 30m
0 10 20 30m
SCALE 1:1000 (A3)
ORIGINAL SHEET SIZE A1

CLIENT: -
PROJECT: TREE SURVEY AND SITE REGRADING
LOCATION: -
SHEET TITLE: CUT AND FILL PLAN

JOB CODE: 316025
SHEET NUMBER: C010
REV: A

BEFORE YOU DIG
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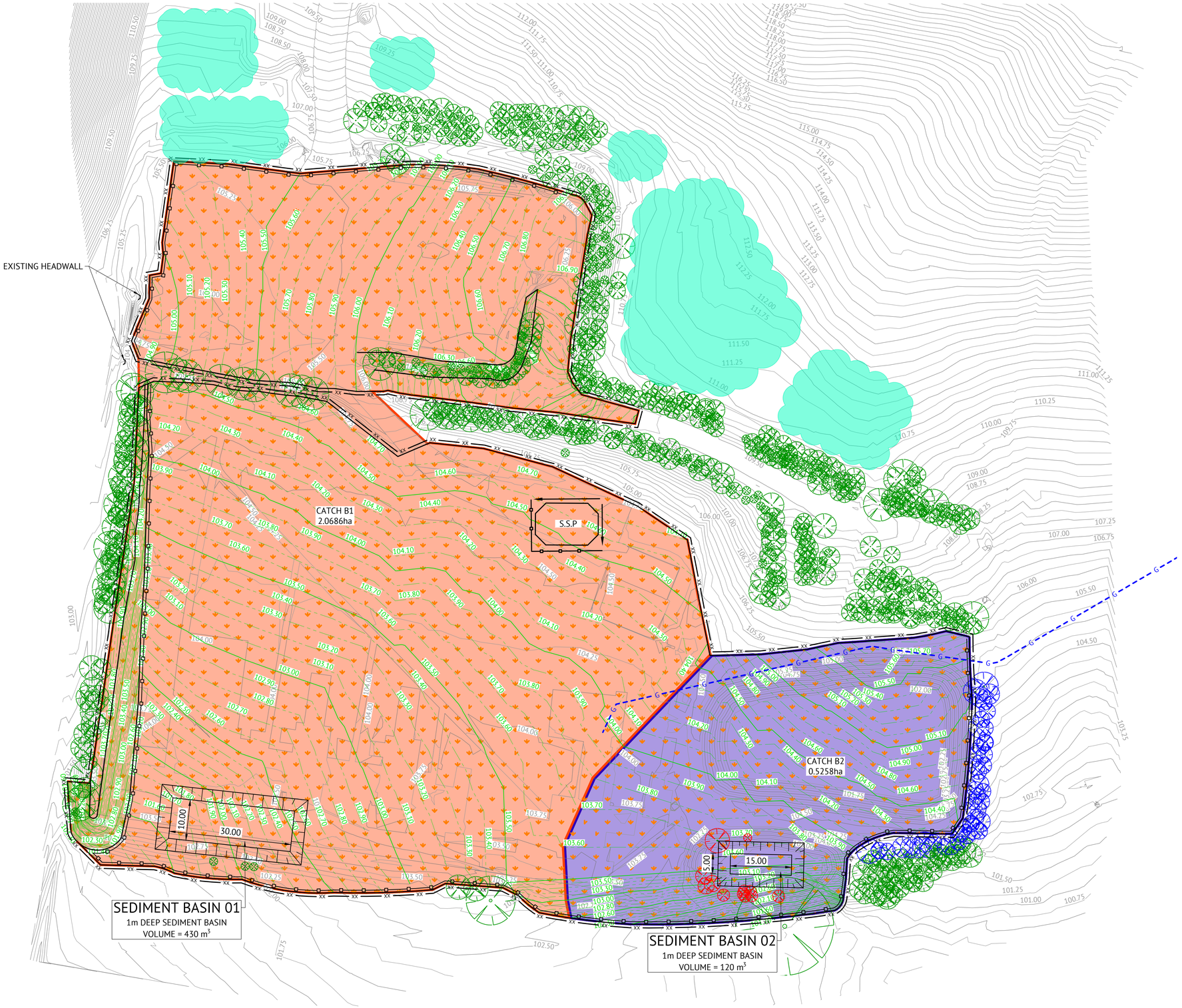
LEGEND

- 105.0 — DESIGN CONTOUR MAJOR (0.5m INTERVAL)
- 105.0 — EXISTING CONTOUR (0.5m INTERVAL)
- EXISTING TREES: TRUNK DIAMETER > 50mm AT 1m ABOVE GROUND LEVEL
- EXISTING HEADWALL
- DISTURBED AREA
- S.S.P — SOIL STOCKPILE IN ACCORDANCE WITH FIGURE SD 4-1 FROM THE LANDCOM SOILS AND CONSTRUCTION MANUAL.
- SEDIMENT FENCE (FIGURE SD 6-8) IN ACCORDANCE WITH THE LANDCOM SOILS AND CONSTRUCTION MANUAL.
- xx — SITE FENCE/LIMIT OF CLEARING & GRADING
- EARTH BANK IN ACCORDANCE WITH FIGURE SD 5-5 FROM THE LANDCOM SOILS AND CONSTRUCTION MANUAL.
- SUB CATCHMENT BOUNDARY FOR BASIN 1
- SUB CATCHMENT BOUNDARY FOR BASIN 2
- G — SALES PIPELINE
- TREES AROUND FLARE PIT NEAREST THE WALL COULD BE IMPACTED UPON WALLS DEMOLITION
- REGROWTH SAPLINGS AND TREES TO BE REMOVED FOR SEDIMENT BASIN REMEDIATION
- UNSURVEYED EXISTING TREES TO BE RETAINED IN THIS AREA



NOTES:
STOCKPILES ARE INDICATIVE ONLY.

NOTES:
SALES PIPELINE LOCATION BY REIN WARRY AND CO. FILE NO. 6721-C.

NOTES:
BASIN ARE EARTHEN WITH 3:1 BATTERS.

NOTES:
DIRECT ALL SURFACE FLOWS OFF DISTURBED AREAS TO SEDIMENT BASINS.

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DATE	REV	DESCRIPTION	REC	APP
11/12/2023	A	ISSUED FOR CONSTRUCTION	PP	MZ

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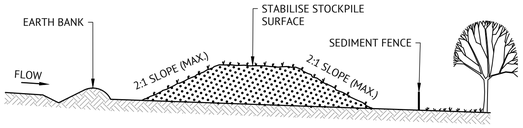
ENGINEERING CERTIFICATION: MICHA ZESCHKE

SCALE
SCALE 1:500 (A1)
0 10 20 30m
SCALE 1:1000 (A3)
ORIGINAL SHEET SIZE A1

CLIENT: -
PROJECT: TREE SURVEY AND SITE REGRADING
LOCATION: -
SHEET TITLE: EROSION AND SEDIMENT CONTROL PLAN

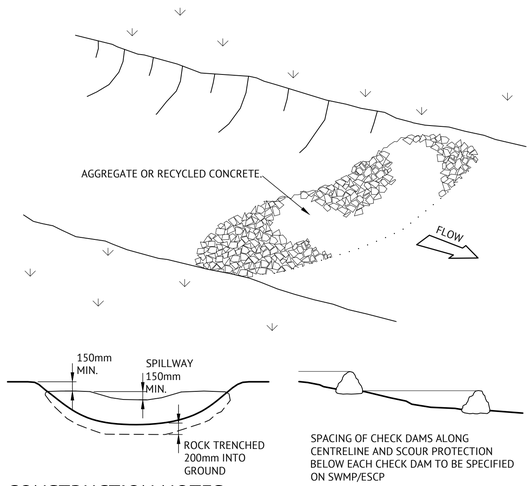
JOB CODE: 316025
SHEET NUMBER: C020
REV: A



CONSTRUCTION NOTES

1. PLACE STOCKPILES MORE THAN 2m (PREFERABLY 5m) FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10.
5. CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-8) 1 TO 2m DOWNSLOPE.

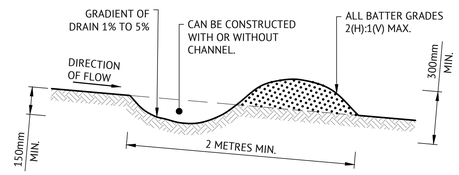
STOCKPILES (SD 4-1)



CONSTRUCTION NOTES

1. CHECK DAMS CAN BE BUILT WITH VARIOUS MATERIALS, INCLUDING ROCKS, LOGS, SANDBAGS AND STRAW BALES. THE MAINTENANCE PROGRAM SHOULD ENSURE THEIR INTEGRITY IS RETAINED, ESPECIALLY WHERE CONSTRUCTED WITH STRAW BALES. IN THE CASE OF BALES, THIS MIGHT REQUIRE THEIR REPLACEMENT EACH TWO TO FOUR MONTHS.
2. TRENCH THE CHECK DAM 200mm INTO THE GROUND ACROSS ITS WHOLE WIDTH. WHERE ROCK IS USED, FILL THE TRENCHES TO AT LEAST 100mm ABOVE THE GROUND SURFACE TO REDUCE THE RISK OF UNDERCUTTING.
3. NORMALLY, THEIR MAXIMUM HEIGHT SHOULD NOT EXCEED 600mm ABOVE THE GULLY FLOOR. THE CENTRE SHOULD ACT AS A SPILLWAY, BEING AT LEAST 150mm LOWER THAN THE OUTER EDGES.
4. SPACE THE DAMS SO THE TOE OF THE UPSTREAM DAM IS LEVEL WITH THE SPILLWAY OF THE NEXT DOWNSTREAM DAM.

ROCK CHECK DAM (SD 5-4)

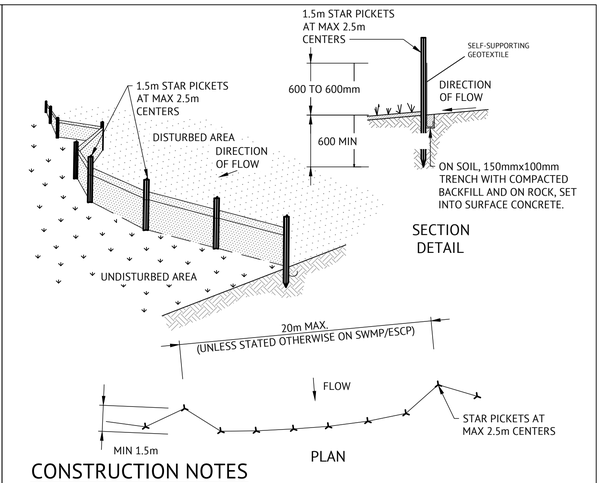


CONSTRUCTION NOTES

1. BUILD WITH GRADIENTS BETWEEN 1 AND 5 PERCENT.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE - WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE THE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.

NOTE: ONLY TO BE USED AS TEMPORARY BANK
WHERE MAXIMUM UPSLOPE LENGTH IS 80 METRES.

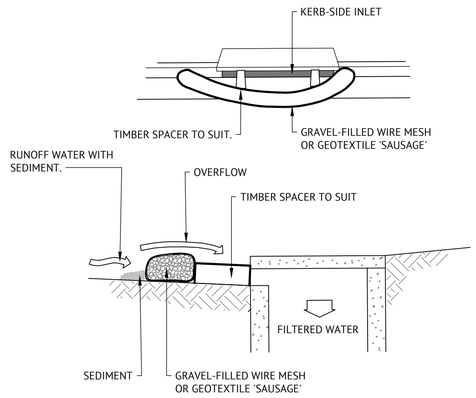
EARTH BANK - LOW FLOW (SD 5-5)



CONSTRUCTION NOTES

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
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 (SD 6-8)

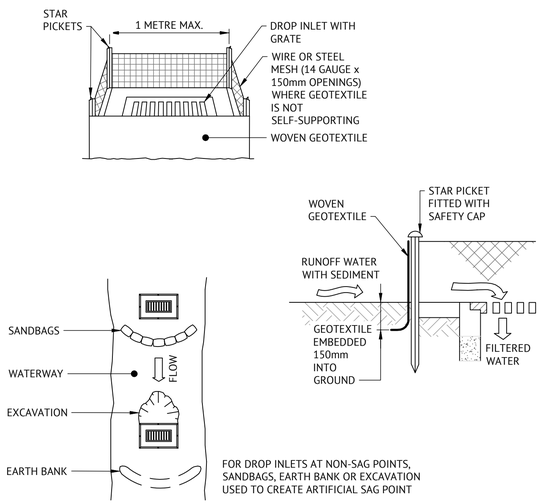


NOTE: THIS PRACTICE ONLY TO BE USED
WHERE SPECIFIED IN APPROVED SWMP/ESCP.

CONSTRUCTION NOTES

1. INSTALL FILTERS TO KERB INLETS 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 THE 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.

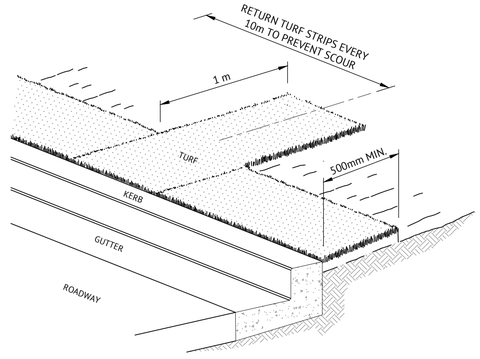
MESH AND GRAVEL INLET FILTER (SD 6-11)



CONSTRUCTION NOTES

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. FOLLOW STANDARD DRAWING 6-7 AND STANDARD DRAWING 6-8 FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1 METRE CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

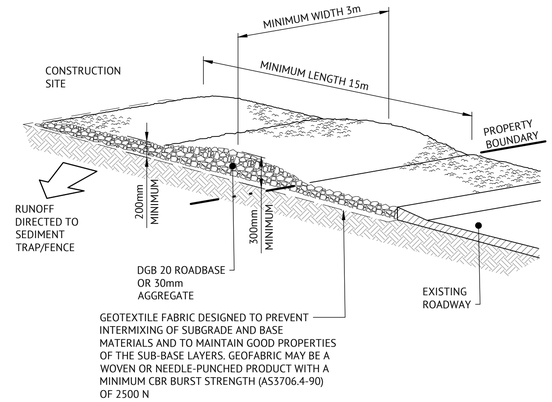
GEOTEXTILE INLET FILTER (SD 6-12)



CONSTRUCTION NOTES

1. INSTALL A 500mm MINIMUM WIDE ROLL OF TURF ON THE FOOTPATH NEXT TO THE KERB AND AT THE SAME LEVEL AS THE TOP OF THE KERB.
2. LAY 1.4m LONG TURF STRIPS NORMAL TO THE KERB EVERY 10m.
3. REHABILITATE DISTURBED SOIL BEHIND THE TURF STRIP FOLLOWING THE ESCP/SWMP.

KERBSIDE TURF STRIP (SD 6-13)



CONSTRUCTION NOTES

1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

STABILISED SITE ACCESS (SD 6-14)

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DATE	REV	DESCRIPTION	REC	APP
11/12/2023	A	ISSUED FOR CONSTRUCTION	PP	MZ

REVISIONS

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CHECKED: MICHA ZESCHKE
PROJECT MANAGER: IAN BIGNELL
ENGINEERING CERTIFICATION: MICHA ZESCHKE

SCALE: N/A
ORIGINAL SHEET SIZE A1

CLIENT: -
PROJECT: TREE SURVEY AND SITE REGRADING
LOCATION: -
SHEET TITLE: EROSION AND SEDIMENT CONTROL NOTES AND DETAILS

JOB CODE: 316025
SHEET NUMBER: C021
REV: A

Note: These "Standard Calculation" spreadsheets relate only to low erosion hazard lands as identified in figure 4.6 where the designer chooses to not use the RUSLE to size sediment basins. The more "Detailed Calculation" spreadsheets should be used on high erosion hazard lands as identified by figure 4.6 or where the designer chooses to run the RUSLE in calculations.

1. Site Data Sheet

Site name: Tree Survey, Site regrading

Site location: Tree Survey, Site regrading

Precinct: CAMPBELLTOWN CITY COUNCIL

Description of site: Earthworks

Site area	Site						Remarks
	B1	B2					
Total catchment area (ha)	2.0686	0.5258					
Disturbed catchment area (ha)	2.0686	0.5258					

Soil analysis

Soil landscape							DIPNR mapping (if relevant)
Soil Texture Group	D	D					Sections 6.3.3(c), (d) and (e)

Rainfall data

Design rainfall depth (days)	5	5					See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	75	75					See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	19.3	19.3					See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	7.6	7.6					See IFD chart for the site
Rainfall erosivity (R-factor)	1420	1420					Automatic calculation from above data

Comments: 1) D type soil. X-day percentile rainfall event adopt Liverpool. 2) IFD adopted from BOM 3) C10 f = 0.75

2. Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$$

where:
- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F
- F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Peak flow calculations, 1

Site	A (ha)	tc (mins)	Rainfall intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
B1	2.0686	10	61.4	95.2	114	133	160	181	0.86
B2	0.5258	6	73.2	113	135	157	189	214	0.86

Peak flow calculations, 2

ARI yrs	Frequency factor (F_y)	Peak flows						Comment
		B1	B2					
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m3/s)	
$1_{yr,tc}$	0.8	0.243	0.074					
$5_{yr,tc}$	0.95	0.447	0.135					
$10_{yr,tc}$	1	0.564	0.170					
$20_{yr,tc}$	1.05	0.691	0.207					
$50_{yr,tc}$	1.15	0.910	0.273					
$100_{yr,tc}$	1.2	1.074	0.323					

4. Volume of Sediment Basins, *Type D* and *Type F* Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for *Type F* and *Type D* soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

$$V = 10 \times C_v \times A \times R_{y\text{-}\%ile,\ x\text{-}day}\ (m^3)$$

where:

10 = a unit conversion factor

C_v = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

R = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 50 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)), in which case the "Detailed Calculation" spreadsheets should be used.

Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
B1	0.50	19.3	2.0686	199.6199	100	299.42985
B2	0.50	19.3	0.5258	50.7397	25	76.10955

ISSUED FOR CONSTRUCTION

DATE	REV	DESCRIPTION		
11/12/2023	A	ISSUED FOR CONSTRUCTION	PP	MZ
			REC	APP

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ENGINEERING CERTIFICATION
MICHA ZESCHKE

SCALE N/A
ORIGINAL SHEET SIZE A1

CLIENT -
PROJECT TREE SURVEY AND SITE REGRADING
LOCATION -
SHEET TITLE SEDIMENT BASIN CALCULATION

JOB CODE 316025
SHEET NUMBER C022
REV A

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LEGEND

- 105.0 — DESIGN CONTOUR MAJOR (0.5m INTERVAL)
- 105.0 — EXISTING CONTOUR (0.5m INTERVAL)
- EXISTING HEADWALL
- G — SALES PIPELINE
- PROPOSED SWALE/BERM (WITH FLOW DIRECTION ARROWS)
- EXISTING SWALE
- HAY BALE BARRIERS
- PROPOSED SEDIMENT FENCE

N

EXISTING HEADWALL

PROVIDE SEDIMENT FENCE ACROSS SWALE. TYP

APPROX. 145m

FLARE PIT TO BE BACKFILLED AFTER REMOVAL OF TOP 300mm

SEDIMENT BASIN 01

SEDIMENT BASIN 02

HAY BALE BARRIERS

NOTES:
NO TREES TO BE REMOVED DURING THESE WORKS.

NOTES:
SALES PIPELINE LOCATION BY REIN WARRY AND CO. FILE NO. 6721-C.

ISSUED FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
11/12/2023	A	ISSUED FOR CONSTRUCTION	PP	MZ

REVISIONS

Premise
ORAN PARK OFFICE
SUITE 301, LEVEL 3 ORAN PARK PODIUM
351 ORAN PARK DRIVE
ORAN PARK, NSW 2570
PH: (02) 4632 6500
WEB: www.premise.com.au

DESIGNED: TUNG PHAM
CHECKED: MICHA ZESCHKE
PROJECT MANAGER: IAN BIGNELL
ENGINEERING CERTIFICATION: MICHA ZESCHKE

SCALE
SCALE 1:500 (A1)
0 10 20 30m
SCALE 1:1000 (A3)
0 10 20 30m
ORIGINAL SHEET SIZE A1

CLIENT: -
PROJECT: TREE SURVEY AND SITE REGRADING
LOCATION: -
SHEET TITLE: CONSTRUCTION SEDIMENTATION AND EROSION CONTROL PLAN

JOB CODE: 316025
SHEET NUMBER: C030
REV: A