OPAL VALE SALT VALLEY ROAD CLASS II LANDFILL

LOT 11 CHITTY ROAD, TOODYAY

REHABILITATION MANAGEMENT PLAN

Prepared for

OPAL VALE PTY LTD

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1. Introduction

Opal Vale Pty Ltd (Opal Vale) is committed to the comprehensive closure and rehabilitation of the Salt Valley Road Class II landfill site. This Rehabilitation Management Plan (RMP) sets out the activities to be undertaken as part of the rehabilitation of the site.

The landfill will be progressively closed. As individual landfill cells or portions of the landfill reach the ultimate design profile, these areas will be capped, rehabilitated and closed off.

This RMP provides the framework for the proposed closure and rehabilitation of the landfill site.

2. Future Site Usage

Following the closure and final rehabilitation of the landfill site, the area of past waste placement will be returned back to native vegetation, while the remainder of the area within the Prescribed Boundary will be returned to pasture and/or crops.

An important aspect is to prevent stock from accessing the landfill capped area to enable it to completely rehabilitate over time back to a native bush environment.

3. Site Closure Preparation

At the end of the active landfilling operations, the weighbridge, gatehouse, staff amenities and workshop infrastructure will be removed from site. Internal access roads that are no longer required will be ripped and the area rehabilitated.

The leachate and landfill gas management infrastructure will remain for many years beyond the closure of the landfill operations. These remaining facilities may require additional security measures to be installed to reduce the possibility of vandalism as a result of the site no longer being manned.

4. Landfill Closure

4.1. Environmental Impact

The environmental and social impact of a closed landfill is a function of the type and quantity of waste contained within the landfill, the quality of landfill closure and the distance from the facility to the nearest receptor(s).

The landfill site will be developed and managed to industry best practise and a substantial environmental barrier installed as the landfill cap. Based on these activities, it is not anticipated that there will be any negative environmental impact as a result of the landfill closure. In addition to this, the nearest neighbouring residence is 1.35 km to the north east, which is well beyond the required 150 m buffer zone around the landfill; hence, this receptor will not be impacted by the closure of the facility.

4.2. Closure Capping

The final outcome of the rehabilitated landfill surface is to provide an environment that is long-term sustainable and that will not need ongoing maintenance into the future.

Any significant maintenance work carried out on the landfill cap will result in machinery having to drive over the rehabilitated surface, causing significant damage to the surface and vegetation cover. If this work is done during the wet season when the capped surface is soft, the machinery damage will be significantly greater than if the work were carried out in summer. Consequentially, it is critical that all capping construction and rehabilitation work be carried out to the best possible standard to ensure the least ongoing maintenance requirements.

4.3. Final Landfill Profile

The landfill closure incorporates a final landfill cap with a pre-settlement waste profile at a maximum slope of 1V in 5H (20%). This provides a gradient that achieves a stable, easily manageable slope for capping, rehabilitation and future maintenance.

Appendix No. 1 – Final Pre-settlement Waste Profile Layout Plan provides the design of the final landfill profile.

Over time, the waste mass will settle. This settlement is anticipated to be up to 15% of the waste height. Based on the depth of the waste in the landfill, there could be up to 4 m of settlement at the deepest part of the landfill, tapering gradually down to zero at the landfill perimeter. The impact of this settlement will be to reduce the overall slope on the landfill cap from 1V in 5H, to approximately 1V in 6H. The majority of the settlement will occur uniformly, proportional to the waste depth below the capped surface; however, there will be some localised areas where differential settlement will occur. This differential settlement is not anticipated to be overly dramatic that it will impact on the integrity of the capping system.

4.4. Progressive Closure

It is essential that the landfill be progressively closed and capped as the waste reaches the final waste profile and the capping construction not be left to the end of the landfill life. The benefits of continuous closure include:

- Progressively closing off portions of the site;
- Increased ability to shed surface water off the landfill and hence reducing the quantity of leachate being generated;
- Reducing the ongoing closure liability costs for the landfill as these costs are incurred progressively through the life of the landfill;
- Using the capping costs incurred, as a guide to assist in determining the closure reserves that will be required towards the end of the life of the landfill and during the post closure period;
- Reduced litter generation; and,
- Improved aesthetics.

4.5. Landfill Gas Management

Active landfill gas extraction will continue for potentially 30 years beyond the operational life of the landfill. Based on forecast landfill gas generation quantities, it is anticipated that the peak gas production will occur approximately two years after the closure of the Stage 1 landfill, and beyond that, start to slowly drop off. Theoretical gas decay curves indicate that landfill gas will continue to be generated within the landfill for up to 70 years beyond the closure of the landfill; however, active extraction is only anticipated to occur for up to 30 years.

Beyond the active extraction phase, when the landfill is only generating small quantities of gas, the soil landfill capping layer has an ability to oxidise some methane as the landfill gas passes through the cap and hence reduce the emissions from the site.

4.6. Leachate Management

The active leachate management will typically continue in line with landfill gas production as gas production is an indicator that the landfill waste mass is still biodegrading and hence producing leachate. Consequently, leachate management is likely to continue for potentially 30 years beyond the operational life of the landfill. It is however anticipated that the quantity and contamination level of the leachate will decrease over time (again, in conjunction with the decrease in landfill gas quantity).

4.7. Infrastructure Requirements

There will be a need for perimeter fencing to be installed around the capped surface to control fauna and stock access, to prevent damage to the vegetation and capped surface. Some existing fencing may still be in place as part of the previous landfill operations, but most of this would be removed to facilitate the construction of the capping layer.

After approximately 15 years of landfill closure (half way through the 30 post closure gas and leachate management period), it will likely be necessary to replace the gas flaring system and some, if not all of the leachate pond liners.

4.8. Surface Preparation

Once waste placement has ceased in an area and the final waste profile obtained, the area is to be well compacted (by the waste compactor) to provide a firm waste surface and then covered with temporary cover material (300 mm deep). This surface will then be left for potentially up to 12 months while further areas of the landfill reach final waste profile. During this period, vertical gas wells of up to 20 m deep will be drilled into the waste mass and connected, via a network of distribution pipes to the flare.

4.9. Capping Area

Once there is a reasonable area of completed waste placement a contractor will install the capping works in accordance with the DER Works Approval. Typically there will need to be approximately 2 ha of capping to be undertaken to justify the mobilisation of a contractor and provide sufficient area for up to 10 gas wells. It is also not ideal to have numerous small areas being capped as the capping system then ends up with significantly more construction joins between these small capped areas. Two hectares is seen as an efficient area for a single campaign capping exercise. This would equate to four campaigns for the Stage 1 landfill area (9 ha).

4.10. Capping System

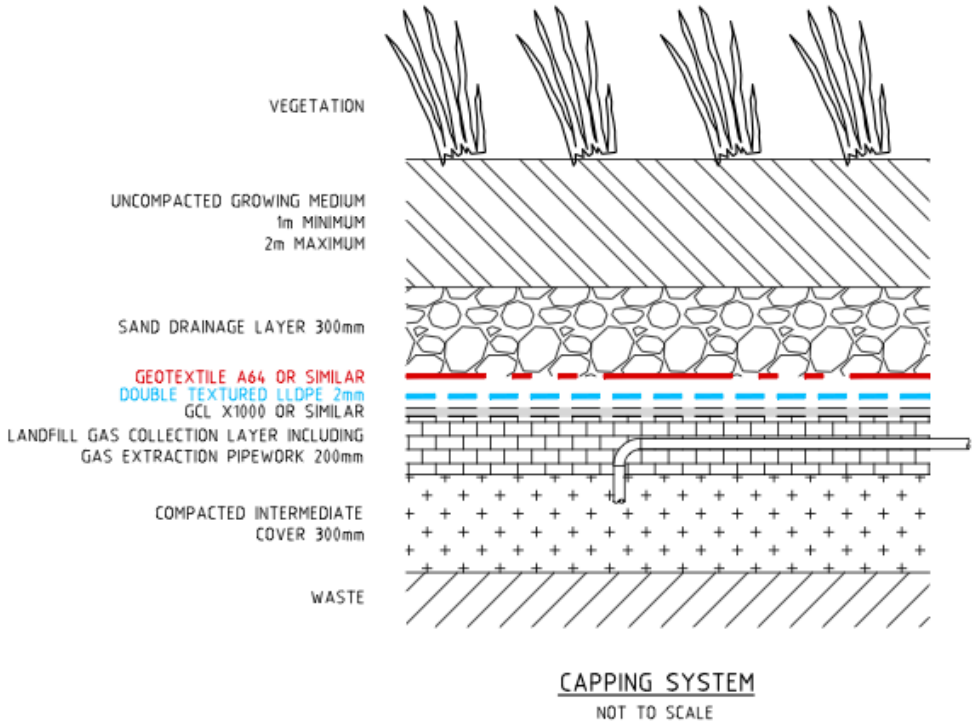
The landfill cap will consist of a geosynthetic lining system overlaid with a 1 m to 2 m layer of clayey material sourced from onsite available materials. This will typically consist of overburdened clay from the existing and future clay excavation.

The capping layer will be a minimum of 1 m thick, and up to a maximum of 2 m. The thicker zones will enable clusters of deeper-rooted species to thrive on the capped surface; hence, providing vegetation diversity.

It is not proposed that a dedicated layer of topsoil be utilised as this is not the naturally occurring situation in the local environment and will primarily promote weed growth. Native vegetation is adequately surviving in the surrounding environment and hence replicating these environmental conditions should be sufficient to sustain native vegetation on the landfill capped areas. By the addition of an organic rich topsoil layer, weed species will thrive to the detriment of the native vegetation.

The capping system is a relatively complex arrangement of geosynthetic and soil layers to achieve the desired maximum allowable leakage rate through the cap. The stability of this capping system is a critical component in the long-term sustainability of the layer works. Prior to any capping works being carried out, the design of the capping system needs to be confirmed by a suitably qualified design engineer in conjunction with the proposed materials to be incorporated into the cap. Prior to construction, the specific geotechnical properties of the particular materials need to be assessed against the theoretical design parameters.

Figure 4.10.1 – Capping System Configuration



4.11. Capping Material

4.11.1. Purpose

The intention of the waste cap is to provide a long-term sustainable barrier between the waste and the environment. The capping system is designed to limit the ingress of moisture to 75% of the leakage rate through the base liner, so as not to accumulate leachate within the landfill.

The intended purpose of the landfill cap includes:

- Provision of a barrier between the waste and the environment;
- Control of moisture ingress;
- Provides a habitat for the establishment of native vegetation;
- Control of erosion of the cap material;
- Prevent vermin access to the decomposing waste;

- Control odour emissions;
- Encourage excess stormwater runoff;
- Ability to accommodate waste settlement;
- Oxidise limited amounts of landfill gas; and,
- Improved aesthetic appeal of the site.

4.11.2. Natural Soil

The natural soil in the immediate area (and the majority of the region) is fine-grained silty soil and hence has a relatively low permeability. This soil is well suited for use as the uncompacted growing medium on top of the geosythetic liner. This is based on the following:

- The natural soil allows surface water to slowly permeate into the cap and be absorbed and stored in the cap (to sustain the vegetation cover). Excess moisture will either pass through the soil layer into the drainage layer above the geosynthetic liner and be drained out of the cap or be shed off the surface of the landfill;
- Is suitable for vegetation to establish on the surface (moisture retention); and,
- Wind and water erosion can be managed.

There will over time be a large surface area of landfill to cover (9 ha) and a limited amount of overburden soil available within the clay operations. Austral Brick removes between 1 m and 2 m of overburden from the pit prior to excavating of useful clay material. This overburden soil supply needs to be carefully managed during landfill operations to ensure that there is sufficient material available for the capping layer and is not to be used for daily of intermediate cover material. Progressive capping of the completed areas of the landfill will ensure that the overburden soil is apportioned appropriately and not simply consumed as regular cover material.

It is preferable that, if there is to be a shortfall in naturally occurring soils (overburden and other clayey materials not suitable for brick and tile manufacturer), that this soil be utilised as landfill capping material in preference to regular cover material. The native vegetation is thriving in this soil; hence, it is better to use this material in the final cap and imported material as regular cover material (which may be less suitable for sustaining the native vegetation).

4.11.3. Imported Capping Material

If there is insufficient onsite capping material, then there will be a need to import additional material. As mentioned above, it is preferable to use the imported material for regular cover material and the naturally occurring overburden material for final capping material.

If imported material is required, ideally, this material should be sourced from the local environment, as this is the soil that the native vegetation is growing in. If soil is imported from afar, it may be that the native vegetation will not survive in that soil

type or struggle to survive and hence leave a cap that will always look like a “capped landfill” and not blend into the natural surroundings.

If the imported soil is sourced from different locations, where possible it should be blended to achieve a homogeneous mix. This will provide a more consistent soil type across the landfill and hence there is more likely to be uniform vegetation growth on the capped surface and hence a more natural appearance.

4.12. Growing Medium Thickness

The thickness of the growing medium will primarily be a function of vegetation survival and diversity. If the layer is too thin, the vegetation will only survive for a few years until the plants’ water demand is greater than the moisture retention in the soil. At this time certain species will start to die off and the cap will be left vegetated with one or two species of small shrubs. The cap should ideally be approximately 2 m thick; however, this consumes large quantities of capping material. As a minimum the cap should be at least 1 m thick with substantial areas of up to 2 m.

If a thinner cap (<1.0 m) is utilised it is likely that this depth of cap will be less sustainable, the vegetation will not adequately survive and the capping material will be subjected to progressive erosion (wind and water) and ultimately the landfill cap will need to be reinstated at sometime in the future (at significant additional cost).

4.13. Vegetation

Native vegetation is to be used on the landfill cap. The primary reason is that the native vegetation is currently thriving in the remaining vegetated portions of the site, once established; the capped landfill surface would blend into the natural environment, be long-term sustainable and provide an improved habitat for small native fauna.

The plant species will be selected from a range of shallow rooted plants and shrubs, ideally similar to the surrounding vegetation on site. Prior to the cap construction, a specialist native vegetation horticulturist will be consulted to determine the most appropriate plant species to utilise. The horticulturist will advise and arrange for the collection of native seeds from the larger Lot 11 or further afield. These seeds will be used to rehabilitate the capped surface, as well as spare seeds retained for infill seeding in the event that there are some barren patches on the cap.

Ultimately it is a matter of trial and error to see which plant species survive on the landfill capping surface. Initially a wide range of up to 15 species will be utilised (subject to the advice of the horticulturist) and then over time (a number of years) the stronger species will outperform those that are not suited to the landfill capping environment.

It is preferable to broadcast seeds across the landfill cap as opposed to planting tube stock. The primary advantage is that a significantly larger number of seeds can be applied to the landfill cap for the same effort/cost as would be applicable to a far smaller number of tube stock. Experience on other landfill caps has indicated that within two years it is difficult to identify which plants originated as tube stock or seeds.

4.14. Construction

The design and specification for the capping system construction works will be substantially based on the Works Approval documentation, with site specific amendments to suit the specific area being covered.

Prior to construction, the capping system design needs to be assessed by an appropriately qualified engineer to confirm that the actual materials to be used in construction conform to the stability requirements of the theoretical design.

All capping works are to be carried out in accordance with a valid Works Approval, which, amongst other things, includes the appropriate Construction Quality Assurance and reporting.

When installing the growing medium, care is to be taken not to compact the soil layer other than what is achieved via the placement machinery tracking over the surface during the material placement and spreading operation. From a rehabilitation point of view, greater vegetation survival and growth will be achieved if the soil is only lightly compacted.

The capping soil is simply to be spread out over the surface, to the required thickness. The growing medium is a single uncompacted layer and hence there is no need for placing the material in a number of lifts. It is more efficient to place the full soil layer thickness in a single operation. This also limits the amount of compaction applied to the soil by the construction equipment and hence provides a better growing environment for the vegetation.

4.15. Surface Water Management

The cap profile, thickness and uncompacted nature has been designed to allow surface water infiltration into the growing medium. This is a desirable situation as there is a need for moisture to be retained within the capping material in order to sustain the vegetation planted on top of the landfill cap. In periods of heavy rainfall it is likely that there will be some runoff from the capped areas and also a limited amount of moisture seeping through the soil layer into the drainage layer. Initially, when the plants are relatively small and only require a small amount of moisture, excess moisture will percolate through the soil layer into the drainage layer. However, in time as the plants grow and consume more and more moisture, less water will end up in the drainage layer. The ideal situation is that the vegetation consumes all moisture within the growing medium and no water ends in the drainage layer. This will then be the point of equilibrium where the maximum growth of vegetation has been established on the landfill cap in accordance with available moisture content.

Due to the relatively gentle slopes on the landfill cap (maximum 1V in 5H), it is unlikely that there would be any significant surface water run-off from the capped landfill surface except in heavy rainfall events. In these circumstances, the runoff is to be directed away from the landfill perimeter.

4.16. Groundwater Management

The comprehensive landfill capping system will significantly reduce the quantity of rainfall percolating through the waste mass and hence in time decrease the quantity of leachate collecting on the landfill liner and requiring ongoing management. This will have a long-term benefit of reducing the potential for groundwater contamination.

4.17. Site Monitoring and Maintenance

Site monitoring and maintenance will be undertaken beyond the closure of portions of the landfill (continuous capping) to ensure that the closure measures adopted as part of the landfill capping plan are providing an ongoing, sustainable environmental solution.

Site monitoring and maintenance tasks include:

- Monitoring and repair of erosion and settlement of the cap;
- Monitoring of vegetation rehabilitation success and infill planting as needed;
- Monitoring of weed infestation and eradication as appropriate;
- Monitoring landfill gas and leachate management systems and effectiveness;
- Monitoring groundwater and if present, surface water quality;
- Minor maintenance of the active landfill gas extraction system;
- In time, installing new landfill gas flaring infrastructure;
- Relining of the leachate ponds.

Some aspects of site monitoring and maintenance will need to occur regularly such as leachate and landfill gas monitoring, while other tasks will only occur six-monthly such as groundwater monitoring (or whatever duration is required by the DER). In time, as the landfill cap and waste mass stabilise, these activities can be carried out less regularly. The actual timing and regularity of the activities will be a function of the way that the landfill is performing and how quickly it stabilises.

With leachate and landfill gas management having been carried out for many years prior to the closure of the landfill, there will be extensive knowledge and experience built up on how these systems operate and how often they require monitoring and maintenance. And then, in time, as the leachate and gas quality and quantity decreases so will the management effort.

Initially, general site monitoring such as the condition of the fencing, capped surface and weed infestation will occur as a minimum every three months, however, more regularly during the winter rainy period. This would last for at least three years and thereafter the monitoring period will be pushed out according to site needs.

Site maintenance will be on an as needs basis in reaction to issues that have been identified during site monitoring.

Groundwater monitoring will occur every six months (or whatever duration is required by the DER) for potentially five years beyond landfill closure and thereafter, in agreement with the DER, be pushed out to annually. It may be that in time (+10 years) the groundwater monitoring period may be pushed out even further.

Should the monitoring identify a deficiency in the proposed closure methodology, then the methodology needs to be modified to suit the on-site conditions and implemented in the next tranche of progressive landfill closure works.

4.18. Post Closure Period

Due to the long period of waste stabilisation and consequential generation of landfill gas and leachate, it will be necessary that there be site monitoring for up to 30 years beyond landfill closure. Towards the end of this period, an assessment of the degree to which the waste mass has stabilised will provide information as to whether it will be necessary to continue monitoring the site beyond the 30-year period and for how long this is likely to continue.

Effectively, the monitoring period will only be completed once it can be conclusively demonstrated that the landfill site has stabilised to a degree that it no longer requires and ongoing monitoring and maintenance.

5. Review

This Plan covers the rehabilitation of the Salt Valley Road Class II Landfill Facility and is based on current best practise. It is envisaged that over time, as the waste management industry and the site's waste management practices evolve, that this Plan will need to be reviewed and updated.

This RMP should be reviewed and updated in accordance with the following schedule:

- Year 5 (2020) - Review/confirm relevance and update as appropriate; and,
- Year 10 (2025) - Use as a basis for a complete review for the next ten-year period.

Appendices

Appendix No. 1 – Final Pre-Settlement Waste Profile Layout Plan

NOTE:
DESIGN SURFACE SHOWN IS TOP OF WASTE SURFACE. CAPPING LAYER TO BE PLACED ON TOP OF THIS SURFACE.

SCALE 15 0 15 30 (metres)
1 : 750 (A1) , 1 : 1,500 (A3)

FOR APPROVAL
10 DECEMBER 2014

REVISIONS					DRG. FILE	OV-WA-40.dwg	DATE
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B	S.BY.	10/12/14	ISSUE FOR APPROVAL		DRAWN	S.B.Y.	11/14
A	S.BY.	28/11/14	PRELIMINARY ISSUE FOR REVIEW		DES. CHK.	I.W.	
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OPAL VALE PTY LTD

PROPOSED CLASS II LANDFILL (STAGE 1)
LOT 11 CHITTY ROAD, TOODYAY
FINAL PRESETTLEMENT WASTE PROFILE LAYOUT PLAN

SCALE	AS SHOWN
SHEET	20 of
DRG No.	REVISION B OV-WA-40