Government of Western Australia
Department of Water and Environmental Regulation

Amendment Report

Licence Number	L7021/1997/15
Licence Holder	City of Karratha
File Number:	DER2013/000622-1~5
Premises	Seven Mile Waste Disposal Facility Seven Mile Road Gap Ridge WA 6714 Legal description – Lot 85 on Plan 180017 and Lot 552 on Plan 71049 CROWN RESERVE 32987 and 33135
Date of Report	28 August 2020
Decision / Proposed Decision	Granted

1. Definitions and interpretation

Definitions

In this Amendment Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
AACR	Annual Audit Compliance Report
ACN	Australian Company Number
AEP	Annual Exceedance Probability
AER	Annual Environment Report
AHD	Australian Height Datum
Amendment Report	refers to this document
BPEM Guidelines	refers to the *Victorian Environmental Protection Agency Guidelines on Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills*, August 2015
Category/ Categories/ Cat.	categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CEO	means Chief Executive Officer. CEO for the purposes of notification means: Director General Department Administering the *Environmental Protection Act 1986* Locked Bag 33 Cloisters Square PERTH WA 6850 info@dwer.wa.gov.au
CS Act	*Contaminated Sites Act 2003* (WA)
Delegated Officer	an officer under section 20 of the EP Act
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)

Term	Definition
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of and during this Review
HDPE	High Density Polyethylene
Licence Holder	City of Karratha
LLDPE	Linear Low Density Polyethylene
Minister	the Minister responsible for the EP Act and associated regulations
NEPM	National Environmental Protection Measure
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
OBE	Operating Base Earthquake
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Amendment Report applies, as specified at the front of this Amendment Report.
PSR	Parallel Submerged Ratio
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act, with changes that correspond to the assessment outlined in this Amendment Report.
Risk Event	as described in *Guidance Statement: Risk Assessment*
SEE	Safety Evaluation Earthquake
TDA	Tyre Derived Aggregate
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
Usual working day	means 0800 – 1700 hours, Monday to Friday excluding public holidays in Western Australia.
Waste	has the same meaning given to that term under the EP Act.

2. Amendment Description

The following guidance statements have informed the assessment and decision outlined in this Amendment Report:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Licence Duration (August 2016)*
- *Guideline: Decision Making (June 2019)*
- *Guidance Statement: Risk Assessment (February 2017)*
- *Guidance Statement: Environmental Siting (November 2016)*

2.1. Purpose and scope of assessment

On 17 January 2020, the City of Karratha (the Licence Holder) submitted a Licence amendment application for the Seven Mile Waste Disposal Facility (L7021/1997/15) located at Seven Mile Road, Gap Ridge (the Premises). The amendment was sought by the Licence Holder for the closure and capping of the Premises' Class II landfill cell, Cell 0. No changes to the Licence design or throughput capacities are proposed as a part of this amendment.

2.2. Background

The Licence Holder commenced operations at the Premises in 1997 and is currently licenced for activities relating to Category 57 (Used tyre storage), Category 61 (Liquid waste facility), Category 61A (Solid waste facility), Category 62 (Solid waste depot) and Category 64 (Class II or Class III Putrescible landfill site).

The Premises is located approximately 9 km south-west of Karratha in the Gap Ridge industrial estate, and covers an area of approximately 100 hectares. A borrow area is located in the Premises south-west corner, with the separate disposal of contaminated hazardous waste and asbestos occurring in the south-east corner. A community recycling centre and liquid waste facility are located in the northern section of the Premises. Stockpiles of accumulated materials such as metals, construction and demolition waste and tyres are located on the western side of the Premises.

A detailed site plan reflecting the current site layout is included in Figure 1.

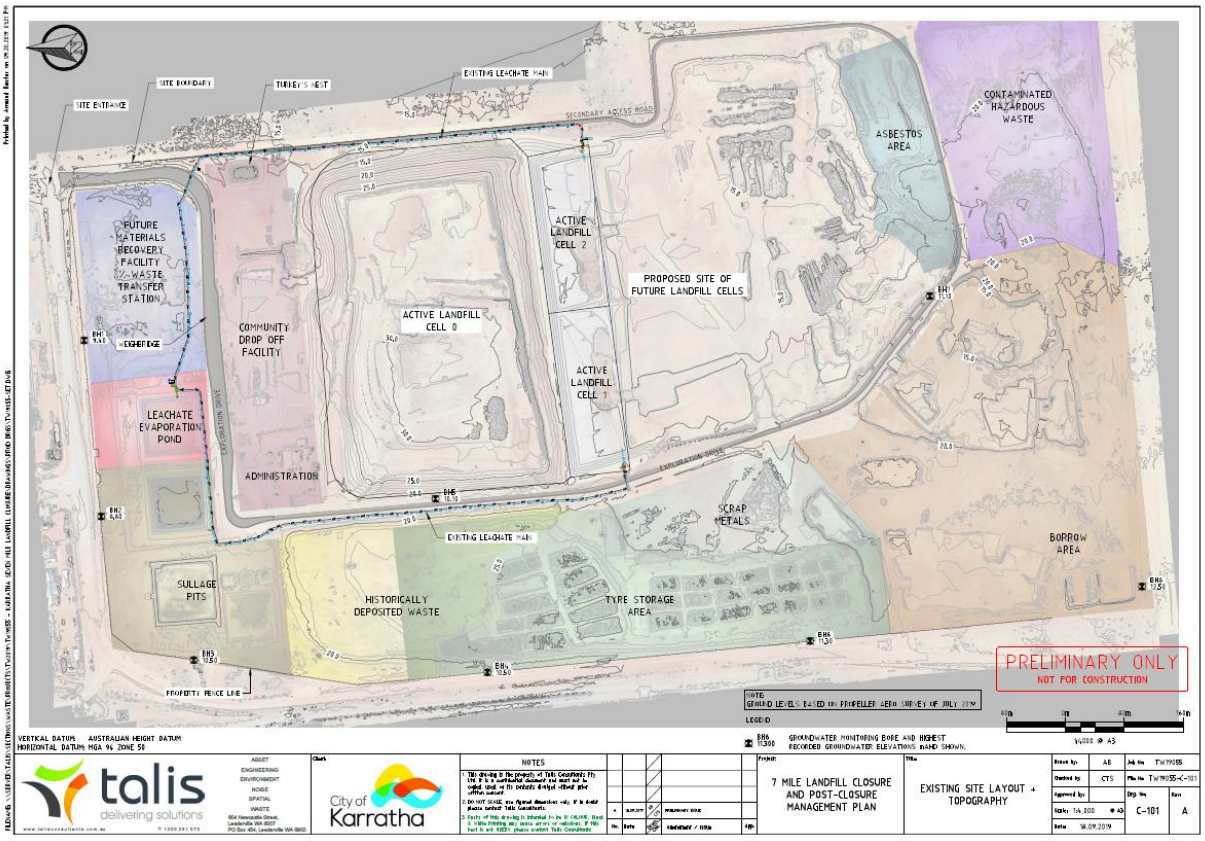

Figure 1: Site plan

3. Proposed Amendments

3.1. Closure and capping of Cell 0

Cell 0 is an unlined Class II landfill cell, which is estimated to reach its maximum design capacity in September 2020. The cell covers an area on the Premises of approximately 145,000 m^2 and is estimated to have a capping area of 129,030 m^2. The proposed date of commencement for closure and capping works is August 2021.

The Licence Holder was given approval for the construction of 12 Class III cells in a staged approach over 20 years, under a Licence amendment issued on 18 May 2017. Class III cells 1 and 2, which are currently in operation at the Premises, were constructed immediately adjacent to the southern slope of Cell 0 and were completed in August 2018. The remaining 10 Class III cells will be progressively constructed to the south of Cells 1 and 2, in the locations as indicated in Figure 2.

It is the intent of the Licence Holder to progressively cap the entire proposed landfill area working along the landfill footprint from north to south, starting with Cell 0 and followed by the filling and capping of the Class III cells in pairs. Based on current waste acceptance quantities, Cells 1 and 2 are estimated to reach capacity in July 2027, with the cells proposed to be capped in August 2027. The final cell 12 is projected to be capped in late 2049. The proposed final capping profile is outlined in Figure 3.

Due to the scope of work presented by the Licence Holder, only the closure and capping of Cell 0 will be assessed as a part of this amendment. The Licence Holder is advised to submit subsequent amendments for the capping of the remaining cells so that an assessment can be undertaken closer to the projected closure date.

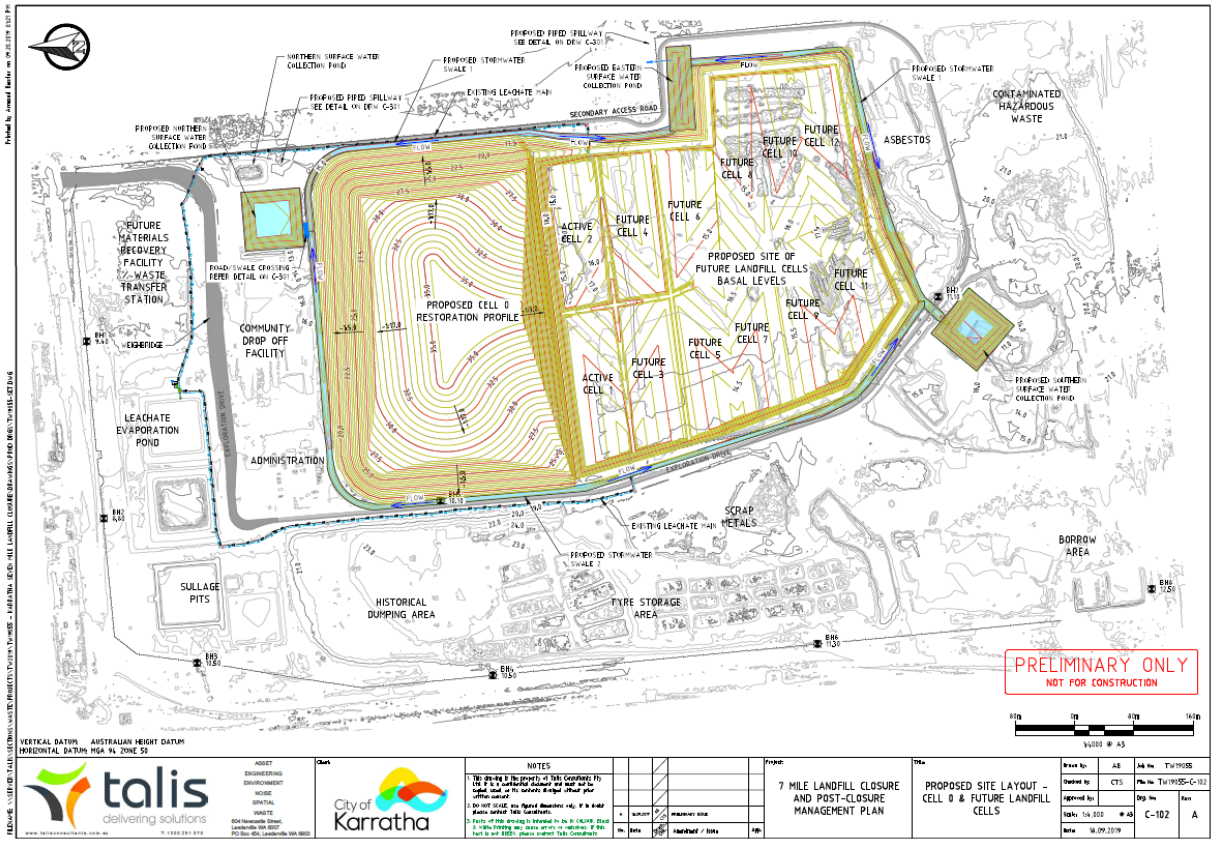

Figure 2: Location of active and future landfill cells

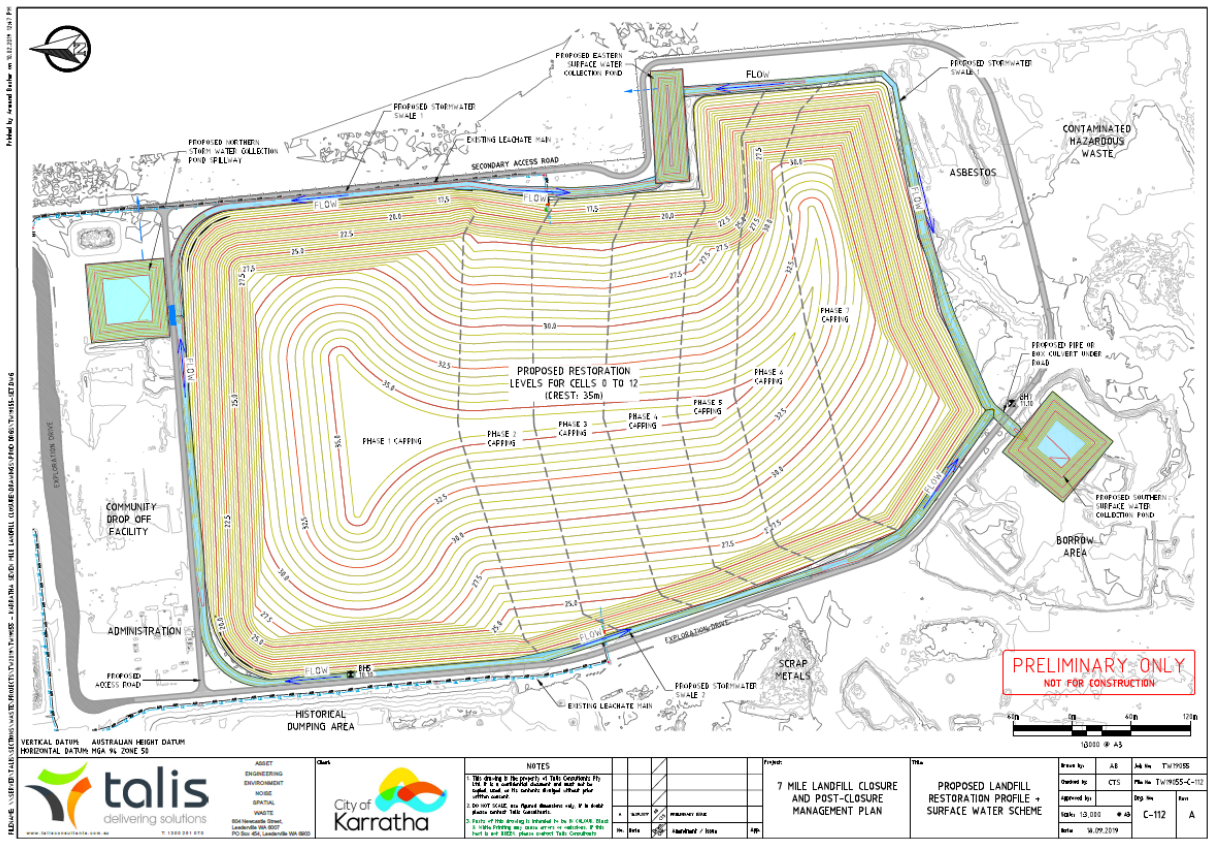

Figure 3: Proposed final capping profile

3.1.1 Capping design

The Licence Holder has proposed the capping system as described in Tables 2 and 3 below (from top down), and as shown in Figure 4. The capping system has been designed to generally conform with the guidance outlined in the *Victorian Environmental Protection Agency Guidelines on Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills* (BPEM Guidelines).

Table 2: Capping system for side slope (gradient 1V:5H)

Top of Landfill
Hydromulch/seeding layer to reduce erosion and advance revegetation
200mm thick topsoil/mulch layer for establishment of vegetation
1000mm thick layer of site won subsoil
Drainage geocomposite
1.5mm thick textured LLDPE geomembrane to provide a low permeability sealing layer
Gas collection geocomposite (geonet) installed above the compacted daily cover layer
200mm thick soil regulating layer
Waste

Table 3: Capping system for crown (gradient 1V:17H)

Top of Landfill
Hydromulch/seeding layer to reduce erosion and advance revegetation
200mm thick topsoil/mulch layer for establishment of vegetation
1000mm thick layer of site won subsoil
Drainage geocomposite
1.5mm thick textured LLDPE geomembrane to provide a low permeability sealing layer
Gas collection geocomposite (geonet) installed above the compacted daily cover layer, with a granular gas collection layer of a minimum of 300mm thick constructed in discrete areas of the upper slopes where required
200mm thick soil regulating layer
Waste

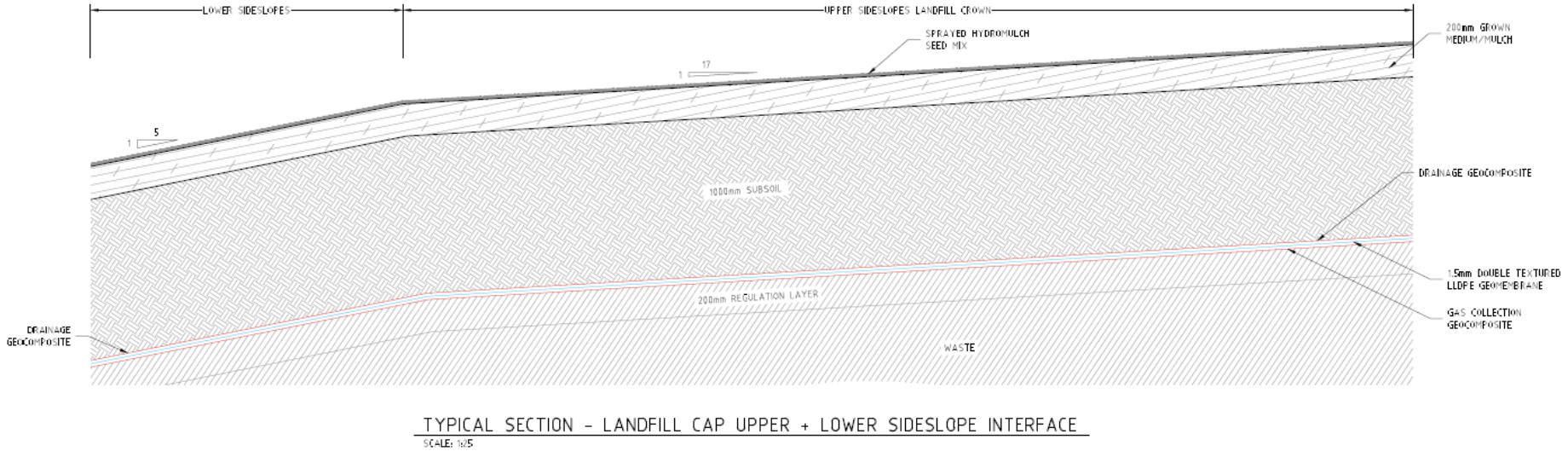

Figure 4: Side slope and crown capping system

3.1.2 Use of Tyre shred as drainage layer

The Licence Holder was granted an amendment on 12 November 2019 to allow for the shredding of stockpiled tyres at the Premises, and for the storage of tyre shed pending reuse. At the time of the November 2019 amendment, it was the intent of the Licence Holder that the tyre shred generated on site be utilised in the landfill capping drainage layer of Cell 0 pending a detailed assessment. The Licence Holder provided justification at the time of submission of this amendment application that the use of shredded tyres or tyre derived aggregate (TDA) within the capping system will provide a suitable, sustainable and economical alternative drainage medium in comparison to a more traditional drainage medium, such as crushed aggregate or a geonet.

Further advice provided to the Department on 26 June 2020 indicated that the Licence Holder now considered the use of TDA within the crown capping system of Cell 0 as not financially feasible to deliver. Further information was provided regarding the use of a drainage geocomposite instead of the previously proposed TDA across the crown of Cell 0, so as to create a consistent capping system across both the crown and side slopes of the cell.

As a result of the Licence Holder deviation from originally proposed activities, this amendment application has undergone a reassessment to determine the effect of changes to the capping system on the originally derived risk rating for the capping of Cell 0. The effect on landfill stability through the replacement of the proposed TDA drainage layer with a drainage geocomposite is further detailed in Section 3.2 below.

Key Finding: The Delegated Officer notes that the disposal of stockpiled tyres into landfill cells at the Premises, whilst permissible under current licence conditions, does not align with the Tyre Management Plan (TMP) provided as a part of the amendment issued on 19 November 2019. The TMP was used to inform the decision making in the November 2019 amendment as well as this amendment prior to the Licence Holder's provision of advice that TDA would no longer be used within the Capping system of Cell 0.

Tyre disposal will also be subject to compliance with Section 6 of the *Environmental Protection Regulations 1987* and the Department of Fire and Emergency (DFES*) Guidance Note GN02 'Bulk storage of Rubber Tyres including Shredded and Crumbed Tyres'.*

At the time of issuing of this amendment, this matter has been referred to DWER's Compliance and Enforcement branch for follow up with the Licence Holder.

3.1.3 Re-profiling of waste

The Licence Holder has advised that the waste mass of Cell 0 will need re-profiling prior to the commencement of capping works to ensure the proposed gradients of the side slopes can be achieved. It is understood that approximately 90,000 m^3 of waste is required to be excavated from the side slopes and placed on the crown of the landfill. The Licence Holder has advised that this waste will be compacted in the same manner as incoming waste to the landfill cells. The re-profiling of the side slopes is expected to occur several months prior to the commencement of capping works.

The Licence Holder does not anticipate any stability concerns arising from the re-profiling of the waste mass due to differential settlement, as the proposed closure profile gradients of 1V:5H (side slope) and 1V:17H) have been selected to allow for long term landfill settlement. Geocomposite layers within the landfill capping system have the ability to elongate under stress, which acts to maintain the integrity of the layers under localised differential settlement without punctures, tears or cracks occurring.

3.2 Landfill stability

The Licence Holder has submitted stability risk assessment modelling in support of this

amendment application, which has been conducted by Talis Consultants (Talis, October 2019). The methods used in the stability risk assessment include limit equilibrium stability analysis for the derivation of factors of safety for the capping profile (using the SLIDE 8.016 analysis program by RocScience) and a closed-form analysis for the capping stability analysis. Input data required for the analysis included the capping material unit weight, and the drained and undrained shear strength of soils and waste.

The stability risk assessment included consideration of TDA being utilised as the drainage layer within the crown of Cell 0 as originally proposed by the Licence Holder. As the Licence Holder has subsequently advised that they will no longer be using TDA and will instead be using a drainage geocomposite across the crown of the Cell, reference to parameters concerning TDA have been removed within the summary of the stability risk assessment where possible as this information no longer falls within the scope of the application. The stability risk assessment considers the use of a geocomposite drainage layer within the side slopes of the Cell 0 cap and as such, remains suitable to demonstrate capping stability.

Shear testing was conducted to determine the shear strength of the soil for engineering purposes and for input into the equilibrium stability analysis modelling. From the shear testing results, the lowest peak angle of shear resistance was 27.7º with a cohesion of 25.49kPa. Based on this, for the purpose of the stability risk assessment, a conservative material parameter of 27º with a cohesion of 1kPa was used for the 'Pindan' Sandy Silty Clay fill to be used for restoration soils. The Licence Holder has advised that this material will be sourced on-site from the borrow pit. For the waste mass, conservative values for cohesion and shear strength have been selected as 5kPa and 25º.

The geotechnical parameters required for the limit equilibrium stability analysis include the shear strength and unit weight of each material to be used within the capping system. The parameters used for the capping system materials within stability modelling are included in Table 4 below.

Table 4: Material parameters for the limit equilibrium stability analysis

Material	Bulk Unit Weight ɣ (kN/m^3)	Effective cohesion c' (kPa)	Angle of Shearing Resistance Ø' (º)	Undrained Shear Strength s_u (kPa)
Insitu 'Pindan' Sandy Clay	19	1	29 (23)	100
Restoration Soils	19	1	27 (22)	>60
Regulation Layer	19	1	27 (22)	>60
Waste	10	5	25	

Interface testing was also undertaken with the soils sourced from the onsite borrow pit and a selection of typical geosynthetics to be used in the capping system. The summary of laboratory interface testing results is shown in Table 5.

Table 5: Laboratory interface testing

Interface	Peak		Post Peak	
	c' (kPa)	Ø' (º)	c' (kPa)	Ø' (º)
Borrow Pit Soil/Non-Woven Geotextile	11.03	29.77	7.72	24.37
Geonet/Smooth LLDPE	5.61	25.17	4.72	16.70

Geomembrane				
Geotextile/Smooth LLDPE Geomembrane	5.18	20.91	1.83	10.20

The closed form interface analysis has used design parameters for friction angles and cohesion which have been presented in the document '*Stability of Landfill Lining Systems: Report No. 1 Literature Review TR1*' (Jones and Dixon, 2003). These values are lower than the results obtained from the laboratory interface testing and are therefore considered more conservative values for use in the analysis. The TR1 values are outlined in Table 6 below.

Table 6: Closed form Interface Design Parameters

Interface	Peak	Post Peak	Peak	Post Peak	Comments
	c' (kPa)	Ø' (º)	c' (kPa)	Ø' (º)	
Restoration Soil/Geonet (drainage Geocomposite)	0	18	0	14	Conservative values < laboratory measured values for geotextile to restoration soil
Geonet/Textured LLDPE Geomembrane	3	11	9.2	9.1	Values from TR1 < laboratory measured values for geonet to restoration soil
Geotextile/Textured LLDPE Geomembrane	1	26	1	13	Values from TR1, TR1 cohesion for geotextile /textured geotextile membrane reported as 6.9 and 3.6 kPa for peak and residual respectively. More conservative value of 1kPa applied utilised values are less than recent laboratory test values with smooth geomembrane
Geonet/Subgrade	0	18	0	14	Conservative values < laboratory measured values for geotextile to restoration soil.

The stability assessment modelling has adopted pseudo-static seismic return periods with an annual probability of exceedance (AEP) of 1:475 AEP for Operating Base Earthquake (OBE) and 1:1000 AEP for Safety Evaluation Earthquake (SEE). These values have been generated utilising the guidance outlined in the *Selecting Seismic Parameters for Large Dams Guidelines* (Committee on Seismic Aspects of Dam Design, 2009) and the *Guidelines for Design of Dams and Appurtenant Structures for Earthquake* (ANCOLD 2017).

Horizontal seismic load coefficients for the pseudo-static seismic return periods were determined to be 0.042 g for OBE and 0.083 g SEE, based on seismic design values outline in the *National Seismic Hazard assessment of Australia* (Allen, 2018) and the soil classification determined utilising *Australian Standard AS1170.4 – Structural design actions Part 4: Earthquake actions in Australia* (AS1170.4).

The limit equilibrium stability analysis conducted adopted a factor of safety of ≥1.5 for the use of peak shear strength parameters under static loading, ≥1.1 under earthquake loading for OBE, and ≥1.0 for SEE. For the closed form interface analysis, a factory of safety of 1.3 has been used. These values were selected utilising the guidance in the *Stability of Landfill Lining Systems: Report No. 2 Guidance* (Dixon and Jones, 2003) and the *Guidelines on Tailings Dams* (ANCOLD 2019).

Key Finding: The Delegated Officer considers that the parameters derived for input into both the limit equilibrium stability analysis and the closed form interface analysis have been adequately justified by the Licence Holder and appear suitable for landfill stability analysis modelling relevant to Cell 0.

3.2.1 Landfill side slope cap

The northern, eastern and western cap slide slopes are proposed to have a gradient of 1V:5H. The critical slope in terms of the capping analysis is the eastern slope, as it has the highest 1V:5H profile of 12.5 m from the existing ground to the crown of the landfill. The analysis considered the 1V:5H capping profile with a 200 mm think soil regulation layer and a 1.2 m thickness of restoration soils and growth medium. Cell 0 did not have an as-built survey conducted during its construction so an inferred excavation profile has been utilised for the purpose of the stability assessment.

The summary of the limit equilibrium stability analysis, detailing circular and non-circular analysis, is outlined in Table 7 below.

Table 7: Summary of Limit Equilibrium Stability Analysis for Cell 0 Eastern Capping Profile

Scenario	Method	Factory of Safety (FoS)	Comments
Cell 0 Eastern Capping Profile No Seismic Loading	Drained Non-Circular	2.775	1V:5H Capping Profile Acceptable (FoS > 1.5)
Cell 0 Eastern Capping Profile (OBE - 1:475 AEP)	Drained Non-Circular	2.278	1V:5H Capping Profile Acceptable (FoS > 1.1)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP)	Drained Non-Circular	1.932	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile No Seismic Loading	Drained Circular	2.846	1V:5H Capping Profile Acceptable (FoS > 1.5)
Cell 0 Eastern Capping Profile (OBE - 1:475 AEP)	Drained Circular	2.330	1V:5H Capping Profile Acceptable (FoS > 1.1)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP)	Drained Circular	1.978	1V:5H Capping Profile Acceptable (FoS > 1.0)

A sensitivity analysis was also undertaken with reduced shear strength parameters and undrained strength conditions for the Cell 0 eastern capping slope, with a seismic loading of 1:1000 AEP. The sensitivity analysis also considered reduced shear strength parameters and a geonet/LLDPE post peak weak interface, as well as additional reduction of the reported cohesion/adhesion values of the geonet/LLDPE interface to assess implications of further strain softening at the interface. Values use for this analysis are outlined in Table 6. Results of the

sensitivity analysis are outlined in Table 8 below.

Table 8: Summary of Sensitivity analysis for Cell 0 Eastern Capping Profile

Scenario	Method	Factory of Safety (FoS)	Comments
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP)	Undrained Circular	2.313	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP)	Undrained Non-Circular	2.260	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength	Drained Circular	1.610	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength	Drained Non-Circular	1.563	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength and Geonet/LLDPE post peak weak interface 9.1º and 9.2kPa	Drained Non-Circular	1.585	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength and Geonet/LLDPE post peak weak interface 9.1º and 9.2kPa	Drained Non-Circular	1.373	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength and Geonet/LLDPE post peak weak interface 9.1º and 3kPa	Drained Non-Circular	1.067	1V:5H Capping Profile Acceptable (FoS > 1.0)
Cell 0 Eastern Capping Profile (SEE - 1:1000 AEP) with reduced shear strength and Geonet/LLDPE post peak weak interface 9.1º and 3kPa	Undrained Non-Circular	1.676	1V:5H Capping Profile Acceptable (FoS > 1.0)

The closed form analysis was undertaken for both peak and post peak conditions, with post peak cohesion/adhesion reduced to 3kPa to align with the sensitivity analysis. The closed form analysis required a parallel submerged ratio (PSR) to be assigned and based on the guidance outlined in the *Stability of Landfill Lining Systems: Report No. 2 Guidance* (Dixon and Jones, 2003), and the proposed capping system layers, relatively low PSR's ranging from 0 to 0.3 were used. For the purpose of the analysis, a PSR of 0.3 was considered to be very conservative within the restoration soil profile due to the hot and semi-arid climate of Karratha.

The closed form analysis determined for the various liner interfaces of the 1V:5H capping profile, and a PSR of 0.3, the minimum reported factor of safety is 1.51 for peak shear strength (restoration soils/geonet interface) and 1.17 for post peak shear strength (restoration soils/geonet interface), both of which are noted to be in excess of the minimum values for both peak and post peak scenarios.

Key Finding: The Delegated Officer has determined that:

- The limit equilibrium stability analysis and closed form analysis demonstrate that an acceptable factor of safety is likely to be achieved for the proposed side slope capping system with a gradient of 1V:5H.
- The sensitivity analysis also demonstrates that an acceptable factor of safety is likely to be achieved under simulated 'worse-case scenario' conditions for the side slope capping system.

3.2.2 Landfill crown cap

The closed form stability analysis which was originally undertaken on the crown of the landfill considered the use of TDA within the crown capping system. When adopting the peak shear strength for the various liner interfaces for the capping profile, and a PSR of 0.3, the minimum reported factor of safety is 6.08 (geonet/regulation layer interface). For post peak shear strength and a PSR of 0.3, the minimum factor of safety is 4.40 (geotextile/LLDPE interface).

The Licence Holder has demonstrated that the proposed capping system of the side slopes of Cell 0, utilising a drainage geocomposite and with a gradient of 1V:5H, will achieve an acceptable factor of safety ensuring cap stability. The Licence Holder considers that the use of the same capping system of side slopes of Cell 0, on the crown of Cell 0, will also be stable at the significantly lower gradient of 1V:17H proposed for the crown. As such, no secondary formal stability assessment has been undertaken for the crown of Cell 0.

Key Finding: The Delegated Officer considers it acceptable that no further stability assessment was conducted for the crown of Cell 0, noting that the stability assessment conducted demonstrated an acceptable factor of safety for the steeper slopes of the side of Cell 0, utilising the same capping system.

3.2.3 Temporary slopes

In support of a previous amendment application for the construction of 12 Class III cells (issued 18 May 2017) the Licence Holder submitted a stability risk assessment for the closure and rehabilitation of Cell 0, which was conducted by Talis Consultants (Talis, November 2016). The capping assessed under this past amendment was not undertaken by the Licence Holder, and the design of the capping system submitted for assessment under this amendment has been updated. However, the Licence Holder has indicated that aspects of the currently proposed capping system have been previously assessed under the 2017 amendment and are still relevant to confirm stability of specific aspects of the capping system.

Both the 2016 and 2019 submitted landfill stability assessments consider the progressive capping of the entire landfill footprint, projected to 2049 for the final Class III landfill cells. It is intended that the landfill is capped in phases working from north to south, with temporary slopes constructed between the most recently capped cells and the active cells. In the case of Cell 0, a temporary slope is proposed to be constructed on the southern boundary, to the north of the active Class III cells 1 and 2. The stability of these temporary slopes has been previously assessed under the 2016 stability assessment, which uses the same material parameters as described for the 2019 stability assessment in Section 3.2 above. As such, temporary slope stability has not been reassessed under the 2019 stability assessment.

The analysis conducted as a part of the 2016 stability assessment was conducted on the existing waste mass gradients adjacent to the future cell excavation side slope, which reflects current waste profile levels (28 m AHD) and the pre-settlement levels for the top of the waste mass (35 m AHD). The waste profile was also extended at the existing gradient of 1V:4H to the future top of the waste pre-settlement levels. The determination of the stability of the existing

waste mass is outlined in Table 9.

Table 9: Stability analysis for existing waste mass

Scenario	Method	Factory of Safety (FoS)	Comments
Existing waste mass	Drained Non-Circular	3.033	Peak drained current temporary 1V:4H waste profile height Acceptable (FoS > 1.5)
Existing waste mass	Drained Non-Circular	2.451	Peak drained future temporary 1V:4H waste profile height Acceptable (FoS > 1.5)

The temporary waste slope on the southern edge Cell 0 is proposed to be maintained at a gradient no greater than 1V:3H until waste is placed against the slope during the Cell 1 and 2 infilling operations. The 2016 stability analysis has modelled the temporary waste slopes across the landfill footprint at 1V:2.5H as a worst-case scenario gradient for a potential 20 m high temporary slope, formed from the intercell bunds to the maximum pre-settlement waste profile height of 35 m AHD. Both peak and post peak shear strength parameters were considered, as outlined in Table 10 below.

Table 10: Stability analysis for temporary waste slopes

Scenario	Method	Factory of Safety (FoS)	Comments
Existing waste mass	Drained Non-Circular	1.543	Peak drained 1V:2.5H temporary waste profile Acceptable (FoS > 1.5)
Existing waste mass	Drained Non-Circular	1.503	Post peak drained 1V:2.5H temporary waste profile Acceptable (FoS > 1.2)

Key Finding: The Delegated Officer considers that the 2016 stability assessment demonstrates that an acceptable factor of safety is likely to be achieved for the temporary waste slope between Cell 0 and Cells 1 and 2.

3.2.4 Construction plant activity

The Licence Holder has advised that to allow access for construction vehicles across the capped landfill cell, haul roads will be constructed from soil materials to a minimum of 1 m deep. Construction vehicles will not be permitted to operate directly on the capping surface. As the capping system will contain geosynthetics, the potential effects of construction plant activity on the side slopes gradient of the cap during the placement of restoration soils has been considered within the stability assessment. The effect of the construction plant on the crown of the cap has been deemed unnecessary by the Licence Holder due to the shallow gradient across the crown of 1V:17H.

The closed form interface analysis has analysed the stability of the side slope under influence of construction operations in line with the procedure outlined in the document '*Analysis of*

equipment loads on geocomposite liner systems' (Kerkes, 1999). The analysis, based on an initial 1 m depth of cover soil, determined a factor of safety of 1.39 for the rupture of the geomembrane, assuming the lowest peak shear strength conditions (11º and 3 kPa) at the geonet/LLDPE interface. The analysis also assumed there to be no limiting tension in the geomembrane and used equipment seen as typical for plant construction work (CAT D6N LGP Bulldozer). A factor of safety above 1.3 is generally considered acceptable, as defined in *Stability of Landfill Lining Systems: Report No. 2 Guidance* (Dixon and Jones, 2003).

Key Finding: The Delegated Officer considers that the stability assessment conducted demonstrates the proposed haul roads for the movement of construction plant equipment across the capped Cell 0 is not likely to have a negative impact on cap stability.

3.2.5 Gas Pressure

The build-up of gas pressure within the capped landfill cell has been considered in the stability assessment, as pore pressures generated by landfill gas can significantly reduce the effective normal stress on the lower geomembrane interface and can lead to instability (Thiel, 1999). The Licence Holder has performed the stability assessment in line with the methodology described in the document '*Design of a gas pressure relief layer below a geomembrane cover to improve stability'* (Thiel, 1999) and the guidance outlined in the *NSW Environmental Protection Authority 'Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*' (NSW EPA Guidelines).

For the purpose of the assessment, the waste mass has been categorised as 'dry' due to the hot semi-arid climate in Karratha. The Licence Holder expects waste stabilization to occur slowly under dry conditions with potential for the process to continue over several decades, with associated low rates of gas production. As such, a nominal gas pressure (Ug) of 2 has been selected, which is considered to be conservative given the expected slower rate of gas generation.

For the interfaces and gas pressures considered, factors of safety of 1.56 (peak) and 1.40 (post peak) were determined for the side slope capping profile at a gradient of 1V:5H, which was considered acceptable. The management of landfill gas by the Licence Holder is discussed in further detail in Section 4.2 below.

4. Emission and Discharge controls

A summary of potential emissions resulting from proposed amendments to the existing licence, along with Licence Holder imposed controls for these emissions, is included in Tables 11 and 12 below.

Table 11: Summary of emissions and applicant controls during construction

Emission	Source	Proposed Controls
Dust	Vehicle movements, earthworks and placement of infrastructure and equipment	All working areas of the Premises are maintained in a damp state utilising an onsite water cart, with water sourced from the onsite extraction bore. Site speed limit of 30km/hr applies.
Noise	Vehicle movements, earthworks and placement of	Site operations occur between 7:00am to 4:30pm. All mobile plant equipment used onsite is regularly maintained.

	infrastructure and equipment	Site speed limit of 30km/hr applies.

Table 12: Summary of emissions and applicant controls during operation and post-closure of Cell 0

Emission	Source	Proposed Controls
Dust	Exposed final capping profile	Upper surface of capping system will consist of 200 mm of topsoil mixed with compost and mulch. Landfill cap will be rehabilitated using native plant species. Hydromulch including binding agents and tackifiers will be applied to cap surface, which will bind the surface layer until vegetation is established.
Leachate	Decomposition of wastes in the capped landfill cell Infiltration of surface water through the landfill cap into the waste mass	Refer to Section 4.1
Landfill gas		Refer to Section 4.2

4.1 Leachate management

Cell 0 is an unlined Class II landfill cell with no underdrainage system or leachate extraction system. When capped, Cell 0 is expected to generate leachate over time due to the decomposition of wastes within the cell. This process can be accelerated where stormwater is able to infiltrate into the waste mass through the capping system. Landfill leachate has the capacity to infiltrate underlying groundwater through the unlined base and sides of Cell 0.

4.1.1 Surface water management

The capping system proposed by the Licence Holder has been designed to generally conform to the BPEM Guidelines. A Linear Low Density Polyethylene (LLDPE) geomembrane is proposed to be installed in crown capping system of the landfill and will integrate with the geocomposite layer of the side slope capping system, as detailed in Figure 6. The design of this system is understood to capture any subsurface water which has managed to infiltrate through the subsoil, and divert this water to the base of the landfill slopes.

As capping is expected to progress in stages across the current and future Class III cells at the Premises, the final capping profile inclusive of Cell 0 incorporates surface water management infrastructure to prevent the infiltration of surface water into the waste mass. It is understood that all surface and subsurface water will flow down the slopes of the landfill into perimeter surface water swales, out falling into surface water attenuation ponds. The design indicates that swale drains will be earth lined channels with rock armouring (maximum diameter of 75 mm) to maintain their integrity, and will also be lined with a separation geotextile. The Licence Holder has indicated that the three surface water ponds will be constructed in low areas of the northern, eastern and southern sides of the landfill footprint and will be excavated to 3.5 m in depth, will be lined with High Density Polyethylene (HDPE) and provided with a pump or mobile facility to enable recovery of the stored water for dust suppression. The surface water runoff from the final capping profile is considered to originate from different catchment areas of the landfill cap, with surface water from each catchment area directed to a perimeter swale and subsequently to its corresponding attenuation pond. The surface water management infrastructure is detailed in

Figure 7 below.

Stormwater or surface water which comes into contact with the uncapped temporary waste slope on the southern edge of Cell 0 will be considered as leachate and is expected by the Licence Holder to flow towards the basal leachate collection systems of Class III cells 1 and 2. The Licence Holder will prevent surface water from spilling over the temporary waste slope by an edge protection bund on the crown of the cap.

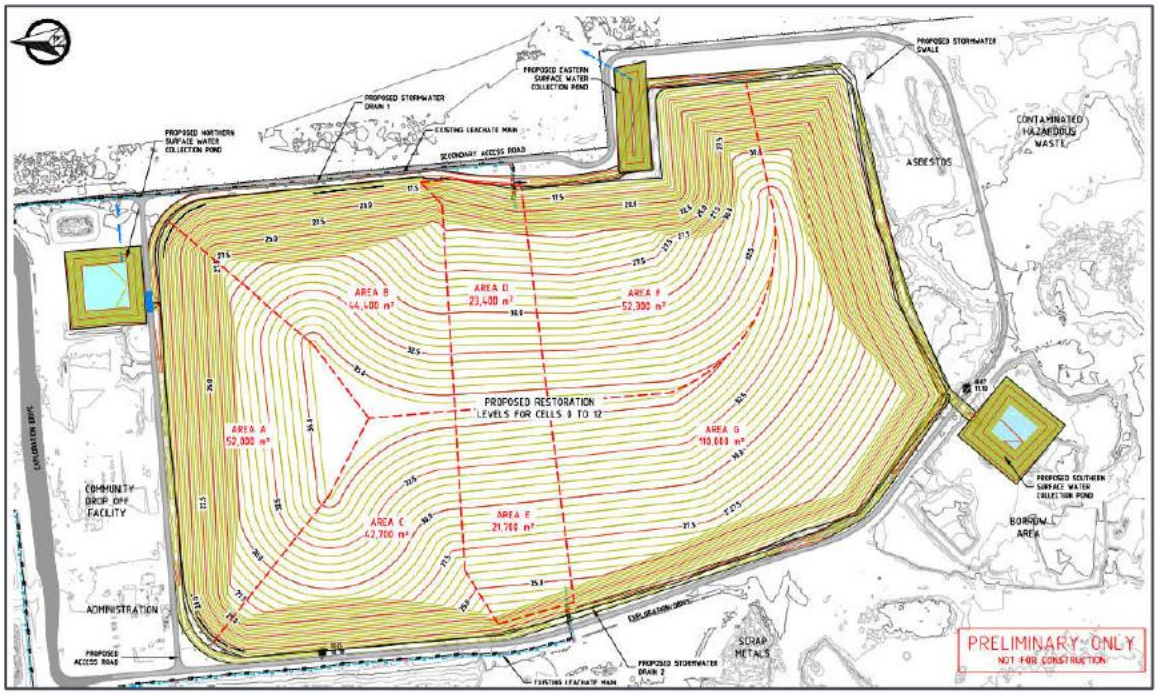

Figure 7: Surface water management infrastructure and landfill cap catchment areas

As a part of this amendment, aspects of the surface water management infrastructure are proposed to be constructed which act to divert and capture surface water runoff from Cell 0. This will include the northern pond and associated inlets and outlets, sections of the surface water swales and an associated pipe crossing (Phase 1). The northern pond has been designed to accommodate a 1% AEP storm event for a 24 hr duration.

In support of surface water management infrastructure design, and the holding capacity of the northern pond, the Licence Holder has submitted surface water modelling data utilising a surface water pond and drainage swale sizing algorithm based on local climate data including rainfall depth and intensity. This assessment concluded that both the individual aspects of the surface water management system and the system as a whole has the capacity to accommodate surface water run off generated from a 1% AEP storm event for a 24 hr duration. In the event of a severe rainfall event greater than a 1% AEP 24hr event, the three surface water ponds are fitted with emergency spill ways to prevent the ponds from overtopping and ensure that any discharge of accumulated surface water is in a controlled manner away from the landfill cells.

To ensure that the constructed surface water management system is functioning effectively, the Licence Holder has proposed to conduct biannual sampling at discharge points to the surface water ponds to test for any evidence of landfill leachate. Should landfill leachate be found within samples tested, further investigation can be undertaken to identify the source of the leachate and action taken to address any failures in the capping system. The Licence Holder anticipates that the frequency of sampling can be reduced after the first 5 years following the rehabilitation of the landfill cell.

Key Finding: The Delegated Officer notes that as Cell 0 does not have a basal lining system, there remains a residual risk for landfill leachate to infiltrate into underlying groundwater. This risk is however considered to decrease once the cell is capped.

The Delegated Officer considers that the proposed surface water management infrastructure is likely to be sufficient to reduce the infiltration of surface water to the waste mass over time, and is likely to minimise the formation of leachate.

4.1.2 Landfill revegetation

The Licence Holder has proposed the upper surface of the capping system to consist of a 200 mm layer of topsoil mixed with compost and mulch. This layer is designed to provide protection for the planting of suitable vegetation which when established, will bind the surface materials together. It is considered that this revegetation layer will enhance the stability of the slopes of the landfill and replicate the appearance of the existing landscape.

The revegetation layer proposed incorporates native species from the Karratha and Pilbara regions. Hydromulch will be applied over the top of the revegetation layer to stabilise the soil, supress weed growth, accelerate the establishment of vegetation and protect vegetation and soils from displacement due to surface water runoff. Tube stock species will be selected at a later date when smaller vegetation is already established.

The Licence Holder has advised that they will only choose native species with shallow root systems whose roots are unlikely to reach the LLPDE membrane within the crown capping system.

Key Finding: Any damage to the geotextile layers of the capping system from root growth of selected vegetation may allow stormwater to infiltrate into the waste mass, which may in turn increase leachate generation and cause adverse effects to landfill stability.

The Delegated Officer considers that the proposal by the Licence Holders to only use shallow rooted vegetation for landfill revegetation works is likely to reduce the risk of damage to the geotextile and capping system as a whole.

4.1.3 Groundwater monitoring

The depth to groundwater at the Premises ranges between 7.8 to 11.4 meters below ground level (mbgl), with a groundwater separation distance of 3.3 mbgl maintained from the base of the Class III landfill cells as a minimum following the wet season. Groundwater is understood to move generally in a north easterly direction across the Premises, and discharges approximately 7 km away into Nickol Bay.

The Premises has groundwater monitoring bores both up and down hydraulic gradient of Cell 0 and the remaining landfill footprint. The groundwater monitoring schedule on the existing licence is considered sufficient to monitor any impact to groundwater arising from the landfill cells. No additional groundwater monitoring is proposed as a part of this amendment.

A network of twelve groundwater monitoring bores currently exists at the Premises, with conditions specified on the Premises existing licence for the quarterly monitoring of groundwater parameters. The bores are monitored for the purpose of noting any impacts to groundwater that may be a consequence of Premises activities. Four bores on the eastern boundary of the Premises were included within the Licence's groundwater monitoring schedule as a part of a licence amendment, which was issued May 2020. Information confirming the condition, depth and screening intervals of these additional bores was provided to the Department on 30 July 2020.

With the inclusion of the eastern bores into the Premises groundwater monitoring schedule,

bores are present both up and down hydraulic gradient of Cell 0.

4.2 Landfill Gas collection

The gas collection layer in the crown of the landfill will primarily be composed of a geocomposite (geonet) however the Licence Holder has proposed to utilise a 300 mm thick granular gas collection layer in discrete areas of the upper slopes as required. The side slope capping system will also utilise a gas collection geocomposite (geonet).

4.2.1 GasSim Landfill Gas Monitoring

To determine a suitable landfill gas management design for Cell 0, the Licence Holder has conducted landfill gas modelling using the program GasSim Lite v15 to estimate current and potential landfill gas production from the waste mass. GasSim was developed for the UK Environmental Agency and as such, the model has been designed for input parameters which reflect UK climatic conditions.

Due to the hot semi-arid climate in Karratha, the Licence Holder expects wastes placed into a landfill cell will dry out completely between rainfall events. Moisture content has been considered to average between 1-2% and as such, the modelling of landfill gas generation has considered and categorised the waste as 'dry'. The Licence Holder has however, acknowledged that the influence of non-variable default parameters within the model remains unknown, and that the model was originally established for use with landfills containing primarily putrescible wastes. It is therefore also acknowledged that the model may not be a suitable measure for gas generation from a cell such as Cell 0, which contains a diverse waste stream. Other data limitations of the modelling include the age of the waste input tonnages and composition values (based only records from the 2018-2019 period). Due to the age of Cell 0, and the lack of detailed waste disposal records, it is considered that this waste input and composition data may not accurately reflect the actual volume and composition of waste within Cell 0.

Notwithstanding the recognised limitations, the results of the GasSim modelling indicate that gas generation will peak at a rate of 525m^3/hr by 2050 for the final landfill capping profile inclusive of Cell 0, and require active extraction and management. The bulk landfill gas flow rate for just Cell 0 was calculated to be 190m^3/hr and is anticipated to peak at the time of capping and then begin declining exponentially, as shown in Figure 8 below.

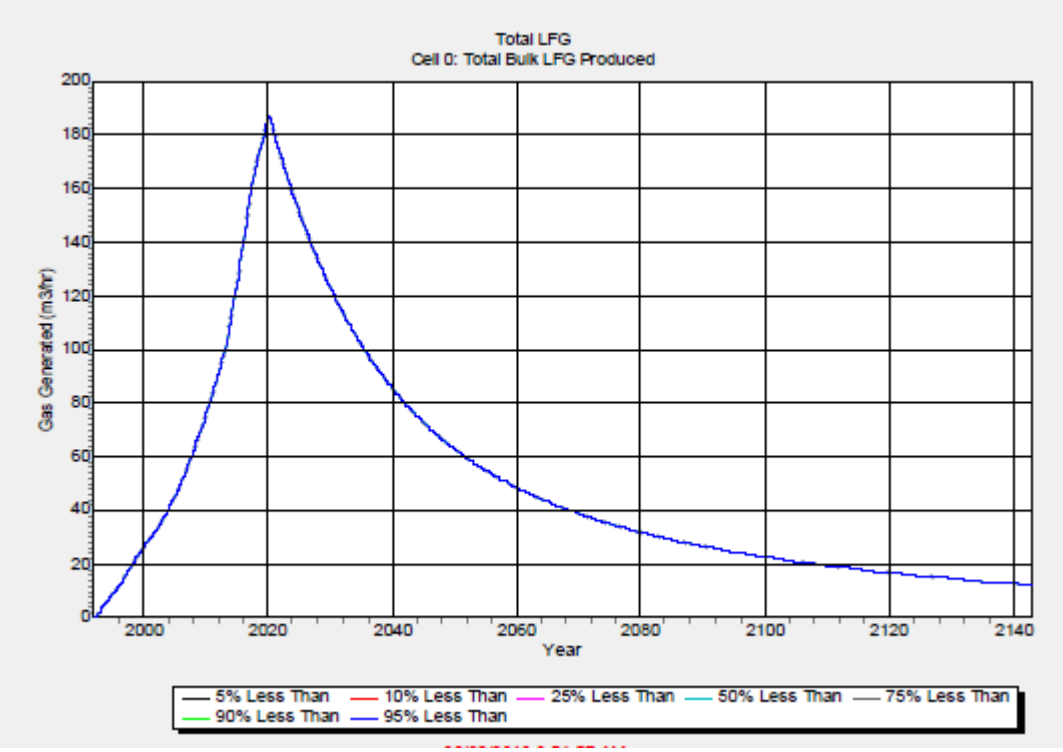

Figure 8: Predicted landfill gas generation from the capped Cell 0, assuming no waste is placed in the Cell 0 footprint following capping or in adjacent Cells 1 and 2.

4.2.2 Landfill Gas Infrastructure

Based on the results of the GasSim modelling, the Licence Holder proposes to install gas wells immediately prior to the capping of Cell 0. These wells will be designed to initially be a passive system (passive venting of landfill gas to the atmosphere), however they will have the capacity to be converted to an active system once gas generation rates are confirmed to have surpassed a 100m^3/hr threshold (the threshold considered within the BPEM guidelines and adopted by the Licence Holder).

The proposed infrastructure consists of 46 vertical gas wells as shown below in Figure 9. No wells are proposed to be installed on the side slopes of the capped cell due to the risk of oxygen ingress resulting from the negative pressure induced under the cap for the eventual active system. Due to the identified limitations of the GasSim model, the Licence Holder has proposed to initially conduct passive landfill gas monitoring for 6 months to verify the modelled gas generation rate. Following this initial monitoring, it is proposed that the wells are monitored on a quarterly basis.

During the passive phase, the Licence Holder will fit the wells with aspiromatic cowls, which through rotation, generate negative pressure to encourage landfill gas to migrate out of the capped cell. The Licence Holder will locate the sampling point on the wells at the interface with the vent and the LLDPE is intended to be sealed with a neoprene collar with steel banding to prevent any gas egress on the outside of the vent. Once the landfill cap is complete, the well is expected to protrude approximately 1 m above the restoration soils. During the active phase, the Licence Holder has proposed to replace the aspiromatic cowls with a sealed connection to the landfill gas ring main via a UV resistant flexible hose to account for the differential settlement between the well and the main. Both passive and active wells are detailed in Figure 10 below.

A determination for the future management of landfill gas will be made by the Licence Holder following gas vent monitoring. The Licence Holder has indicated at the time of this amendment that gas treatment is most likely to be via low-calorific flaring.

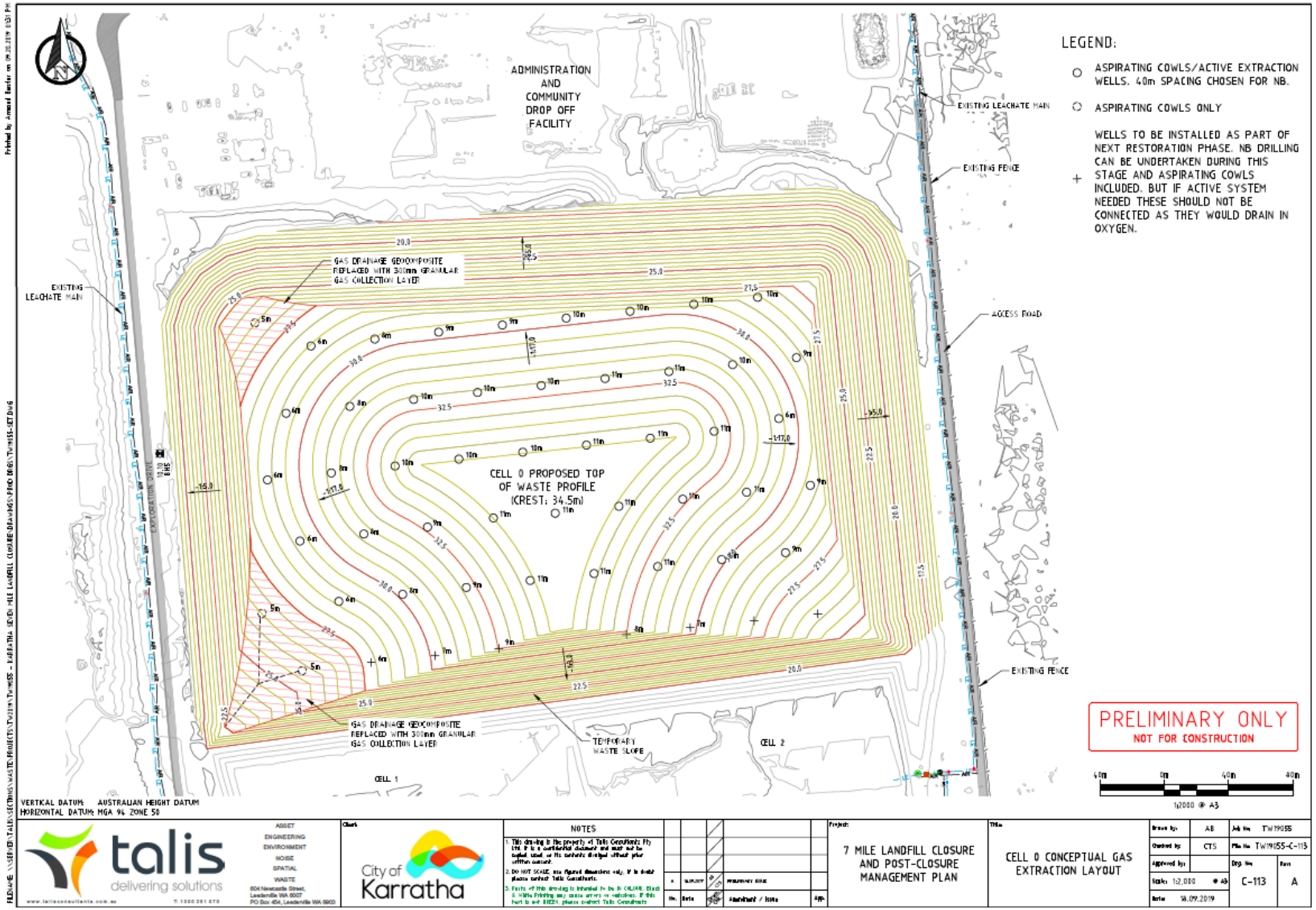

Figure 9: Proposed landfill gas well placement

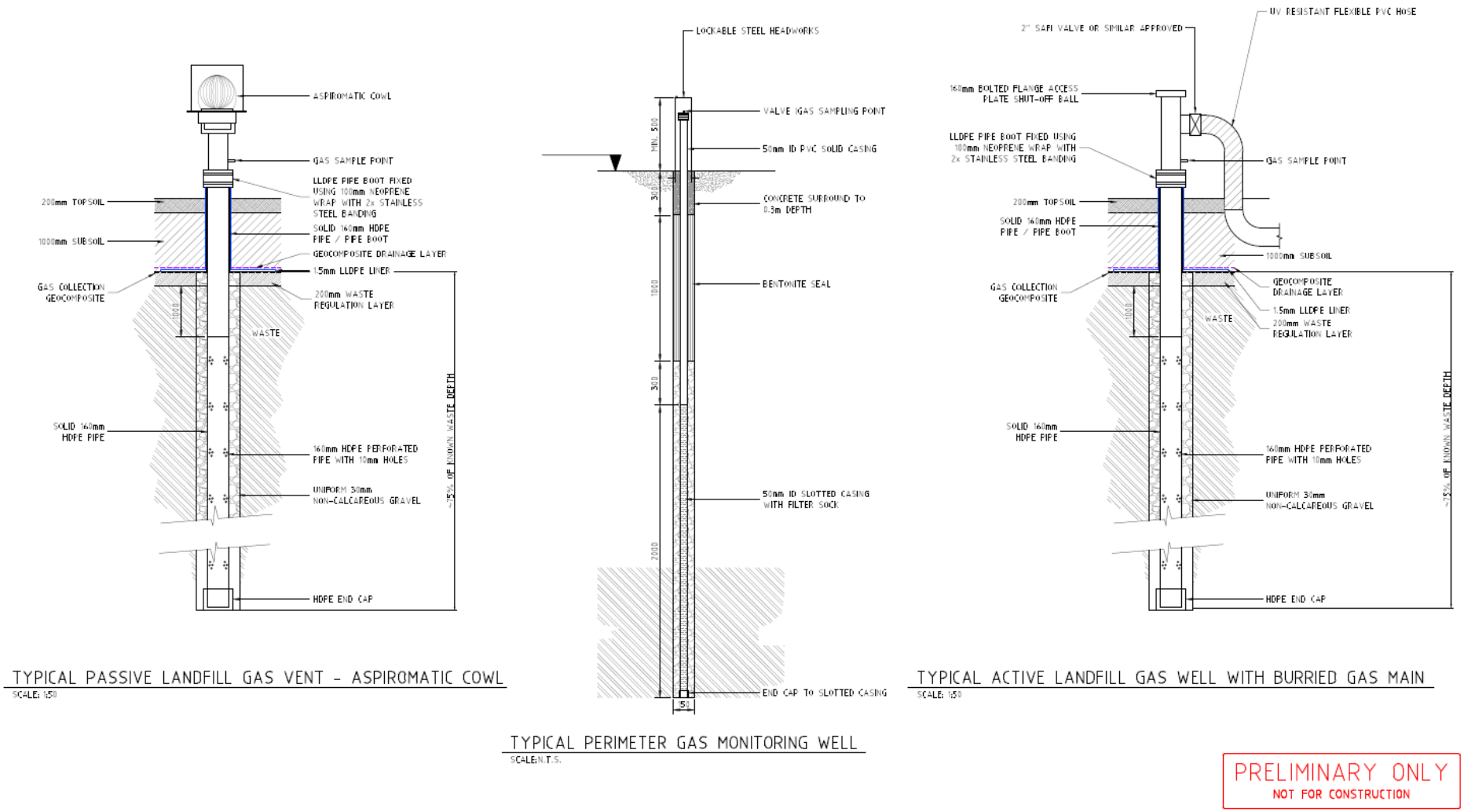

Figure 10: Proposed passive and active landfill gas well design

Key Finding: The Delegated Officer acknowledges the limitations imposed by the choice of the modelling program used to determine suitable landfill gas management.

The Delegated Officer considers that the installation of a passive system for the initial management of landfill gas is necessary so that landfill gas generation can be monitored. The Delegated Officer also notes however, that the passive venting of landfill gas to the atmosphere will not likely be a suitable management method in the longer term.

The Delegated Officer considers it appropriate that a decision regarding the ongoing management of landfill gas should be made after a 6 month monitoring program has been undertaken of landfill gas generation. The addition of conditions within the Revised licence specifying:

- The monitoring schedule of the landfill gas wells for landfill gas generation;
- The requirement for the Licence Holder to submit monitoring results to DWER; and
- The requirement for the Licence Holder to submit a Landfill Gas Management plan to detail a proposed landfill gas treatment suitable for the documented gas generation rate of Cell 0

This is further detailed within the risk assessment outlined in Section 8.

5. Other approvals

The Premises is located in an area zoned as 'Public purposes: Waste disposal and treatment' as defined by the City of Karratha's Local Planning Scheme No. 8. The proposed activities specified under this amendment application fall under the public works exemption, acknowledging that the site is already licenced as a waste management facility. As a result, no planning approvals are required for ongoing Premises activities.

The Licence Holder has provided the following information relating to other approvals as outlined in Table 13.

Table 13: Relevant approvals

Legislation	Number	Approval
Rights in Water and Irrigation Act 1911	201359	Groundwater Licence for the extraction of 50,000 kL per annual period. Expiry 24 May 2028.

6. Amendment history

Table 14 provides the amendment history for L7021/1997/15 over the last decade.

Table 14: Licence amendments

Instrument	Issued	Amendment
L7021/1997/13	20 June 2009	Licence re-issue.
L7021/1997/14	20 June 2012	Licence re-issue.
L7021/1997/14	23 August 2013	Licence amendment for two evaporation ponds.

L7021/1997/14	30 October 2014	Licence amendment for addition of Category 62 and conversion to new format.
L7021/1997/15	11 June 2015	Licence re-issue.
L7021/1997/15	3 December 2015	Licence amendment for administrative changes.
L7021/1997/15	23 December 2016	Licence amendment to accept oily saline water for disposal via evaporation.
L7021/1997/15	18 May 2017	Licence amendment for construction of Class III cells and rehabilitation of existing landfill cell.
L7021/1997/15	29 October 2018	Minor amendment allowing the acceptance of Class III and the use of the constructed Class III cell.
L7021/1997/15	12 November 2019	Licence amendment for the addition of Category 61A, the increase of throughput capacity of Category 57, amalgamation of previous licence and amendment notices, and conversion to new format.
L7021/1997/15	20 May 2020	Licence amendment for an increase in annual waste acceptance, expansion of liquid and solid waste acceptance, expansion of Special Waste Type 1 acceptance, Special Waste Type 3 acceptance, and clarifications to the existing licence containment infrastructure.
L7021/1997/15	28 August 2020	Licence amendment for the closure and capping of Cell 0

7. Location and receptors

Table 15 below lists the relevant sensitive land uses in the vicinity of the Prescribed Premises which may be receptors relevant to the proposed amendment.

Table 15: Receptors and distance from activity boundary

Residential and sensitive premises	Distance from Prescribed Premises Boundary
Commercial Premises	Adjacent to Premises
Stayover Kingfisher Village	1.4 km south-east of Premises
Civeo Karratha Village	2.2 km north-east of Premises
Residential properties	3 km north-east of Premises

Table 16 below lists the relevant environmental receptors in the vicinity of the Prescribed Premises which may be receptors relevant to the proposed amendment.

Table 16: Environmental receptors and distance from activity boundary

Environmental receptors	Distance from Prescribed Premises
Pilbara Groundwater Area (*RIWI Act* 1914)	Premises mapped within this designated area

• Groundwater typically 6-10 m below existing ground level • Hyper saline brackish	
Pilbara Surface Water Area (*RIWI Act* 1914)	Premises mapped within this designated area
Threatened ecological communities • Roebourne Plains gilgai grasslands	Premises mapped within this area
Surface water lines • Seven Mile Creek • Minor non perennial water course	490 m east of Premises

8. Risk assessment

Tables 17 and 18 below describe the Risk Events associated with the amendment consistent with the *Guidance Statement: Risk Assessments*. Both tables identify whether the emissions present a material risk to public health or the environment, requiring regulatory controls.

Table 17: Risk assessment for proposed amendments during construction

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities*	**Potential emissions**	**Potential receptors**	**Potential Pathway and receptor (impact)**	**Applicant controls**					
Construction of Cell 0 capping system	**Dust:** generated from vehicle movements, earthworks and placement of infrastructure and equipment	Commercial Premises adjacent to Premises Stayover Kingfisher village 1.4 km south-east of Premises Civeo Karratha Village 2.2 km north-east of Premises Residential Properties 3 km north-east of Premises	**Air:** Health and amenity impacts	As outlined in Section 4	Moderate	Unlikely	Medium	The Delegated Officer considers that the Licence Holders dust and noise management controls will be adequate to prevent receptors being impacted by either emission arising from capping construction works. There appears to be significant separation distance between the Premises and receptors to ensure they will not be negatively impacted by dust or noise emissions.	General provisions of the EP Act will apply
	Noise: generated from vehicle movements and earthworks				Minor	Unlikely	Low		Noise emissions must comply with the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations).

Table 18: Risk assessment for proposed amendments during operation

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential Pathway and receptor (impact)**	**Applicant controls**					
Exposed final capping profile	**Dust:** lift-off from the capped landfill cell	Commercial Premises adjacent to Premises Stayover Kingfisher village 1.4 km south-east of Premises Civeo Karratha Village 2.2 km north-east of Premises Residential Properties 3 km north-east of Premises	**Air:** Health and amenity impacts	As outlined in Section 4	Moderate	Unlikely	Medium	The Licence Holders proposed revegetation works for the final capping profile of Cell 0 will incorporate hydromulch and binding agents. Established native species will also assist with binding the upper surface of the capping system. The Delegated Officer considers that the revegetation works will act to supress dust-lift of and enhance cap stability.	Condition 6: Capping works specifications
Decomposition of wastes in the capped landfill cell	**Leachate:** arising from the degradation of the waste mass	Seven Mile Creek and minor non perennial water sources – 490 m east of Premises Pilbara Surface Water Area – Premises within designated area Pilbara Groundwater Area – Premises within designated area	**Seepage:** lateral and vertical sub-surface migration of leachate to groundwater	As outlined in Section 4.1	Moderate	Possible	Medium	It has been demonstrated within the capping design that the cap will act to divert stormwater from the crown of the landfill to the surface water management infrastructure at the perimeter of Cell 0. Vegetation incorporated into the final capping restoration profile will be shallow rooted to prevent damage to the LLPDE liner within the capping system. These measures are considered likely to prevent the infiltration of stormwater to the waste mass. The Delegated Officer considers that completion of the capping system will likely reduce the risk and extent of potential leachate emissions.	Condition 6: Capping works specifications

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential Pathway and receptor (impact)**	**Applicant controls**					
		Threatened ecological communities (Roebourne Plains gilgai grasslands) – mapped within Premises area	**Surface runoff:** stormwater potentially contaminated with landfill leachate	As outlined in Section 4.1	Moderate	Possible	Medium	Surface water that has come into contact with the uncapped temporary slope of Cell 0 is to be classified as leachate. This potentially contaminated stormwater is proposed by the applicant to be directed away from the surface water management infrastructure for treatment through the basal leachate collection system of the existing Class III cells. Stormwater collected within the surface water ponds is proposed to be tested biannually to ensure it is not contaminated with landfill leachate. The Delegated Officer considers these measures to be acceptable for the treatment of potentially contaminated stormwater.	Condition 6: Capping works specifications Conditions 30 and 31 – surface water and pond management
	Landfill gas: arising from the degradation of the waste mass	Commercial Premises adjacent to Premises Stayover Kingfisher village 1.4 km south-east of Premises Civeo Karratha Village 2.2 km north-east of Premises Residential Properties 3 km north-east of Premises	**Air:** Health and amenity impacts	As outlined in Section 4.2	Moderate	Possible	Medium	The Delegated Officer acknowledges that due to the limited information surrounding landfill gas generation from Cell 0, the installation of a passive ventilation system is required for monitoring purposes. The Delegated Officer considers that future requirements for the management of landfill gas will need to be determined once monitoring results of gas generation have been obtained. As such, the installation of a passive system is considered acceptable at this stage. Conditions will be included within the Revised Licence specifying gas monitoring requirements and the requirement for the Licence Holder to submit a Landfill Gas Management plan to detail a proposed landfill gas treatment suitable for the documented gas generation rate of Cell 0. It is the responsibility of the Licence Holder to seek necessary approvals from DWER should any modification to the existing landfill gas management infrastructure be required as a part of ongoing landfill gas management at the Premises.	Condition 6: Capping works specifications Conditions 41, 42 and 43: Landfill gas monitoring and submission of management plan

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)

9. Consultation

Table 19: Summary of Applicant consultation

Method	Comments received	DWER response
Applicant referred draft documents (6 August 2020)	The numbering of the Table and Schedule referred to in the acceptance specification of Table 4: Waste acceptance for 'Special Waste Type 3' is incorrect.	Noted – administrative error corrected to reflect correct references.
	Insertion of 'pond' into the process specified for 'Liquid Waste' in Table 5: Waste Processing	The process refers to the treatment of 'Liquid Waste' (i.e. evaporation) rather than the treatment infrastructure (i.e. evaporation pond). Wording will be retained within Licence condition.
	The numbering of the conditions referred to in the processing specifications of Table 5: Waste processing for 'Inert Waste Type 2 - Tyres' is incorrect.	Noted – administrative error corrected to reflect correct references.
	Insertion of 'by landfilling' into the process specified for 'Special Waste Type 3' in Table 5: Waste Processing	Specification of 'by landfilling' included within condition to retain consistency with other waste types accepted for processing by disposal to landfill.
	Condition 21 Disposal of fire water should be into Evaporation ponds 5 and 6 instead of Evaporation pond 7	Reference changed to reflect correct disposal method, noting that if fire water is contaminated with PFAS it will need to be disposed of to Evaporation pond 7, in accordance with the process specifications outlined for 'Liquid Waste' in Condition 13, Table 5.
	Condition 38, Table 11: Leachate monitoring Clarification on reporting requirements for AER. The flow meters on Cell 1 and 2 extraction points, western and eastern ring on Pond 7 are recording continuous flow readings. Should we be reporting Annual cumulative flow (m^3 from both western and eastern ring discharge to Pond 7.	The purpose of continuous leachate monitoring is to determine the amount of leachate generated from Cells 1 and 2, to detect any leaks or faults within the conveyance infrastructure transporting leachate from Cells 1 and 2 to Evaporation Pond 7. If there are two extraction or discharge points for the conveyance of leachate, then all extraction/discharge points should be monitored continuously to ensure an accurate representation of leachate

		generation and leachate conveyance to pond 7. It is also noted that this comment from the Licence Holder is outside of the scope of this amendment application.

10. Conclusion

Based on the assessment in this Amendment Report, the Delegated Officer has determined that a licence amendment will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

10.1. Summary of amendments

Table 20 provides a summary of the proposed amendments and will act as record of implemented changes. All proposed changes have been incorporated into the Revised Licence as part of the amendment process.

Table 20: Licence amendments

Condition No.	Proposed amendments
6 Table 2	Inclusion of landfill capping works specifications
7 Table 3	Inclusion of requirement to conduct construction quality assurance (CQA) testing for the LLDPE membrane of the capping system, and testing specifications
8	Inclusion of requirement for all laboratory tests conducted as a part of CQA testing to be performed in a NATA accredited geosynthetics laboratory
9	Inclusion of requirement for the CQA report to be submitted to the CEO within 30 days of the completion of the capping works
10	Inclusion of requirements surrounding the CQA report submission
13	Deletion of requirement for the submission of a baseline groundwater monitoring assessment, due to the report previously being submitted on 8 June 2020. Below conditions subsequently renumbered
21	Inclusion of allowance to dispose of fire washwater to Evaporation Ponds 5 and 6, in line with waste processing conditions already incorporated into Licence
29	Inclusion of containment infrastructure requirements for the north surface water attenuation pond
30	Inclusion of reference to the north surface water attenuation pond in condition specifying pond management requirements
36	Removal of condition requiring the submission of evidence of the depth, condition and screening intervals of bores 2, 3, 4 and 5, as this was provided to the Department on 30 July 2020. Below conditions subsequently renumbered.

39 Table 12	Inclusion of landfill gas monitoring requirements for Cell 0
40	Inclusion of requirement for a Landfill Gas Management plan to be submitted to the CEO within 12 months of the installation of the gas wells being completed
41	Inclusion of requirements surrounding the Landfill Gas Management plan submission
46 Table 13	Inclusion of the landfill gas monitoring results to be submitted within the Annual Environmental Report
N/A Definitions	Inclusion of definitions for the relevant American Society for Testing And Materials standards relating to the CQA testing requirements
N/A Definitions	Inclusion of definition for the Geosynthetic Research Institutes (GRI) Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
N/A Definitions	Inclusion of a definition for mulch
N/A Schedule 1	Deletion of 'Map of Class III – Cells 1 and 2' as construction works for the cells is complete. Insertion of the following figures in line with the capping works requirements: • Map of capping profile of Cell 0 and associated stormwater management infrastructure • Side slope and Crown capping system of Cell 0 • Phase 1 surface water management swale drain specifications • Surface water management infrastructure specifications • Map of locations of vertical gas wells within Cell 0 • Vertical gas well construction specification
N/A Schedule 2	Deletion of Schedule 2, Prescribed Premises category details moved to front page of licence in line with reformatting to current version

Michael Greenslade

Digitally signed by Michael Greenslade
Date: 2020.08.28 12:47:18 +08'00'

A/MANAGER WASTE INDUSTRIES
REGULATORY SERVICES

An officer delegated by the CEO under section 20 of the EP Act

Appendix 1: Key documents

Document title	Availability
DWER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	accessed at www.dwer.wa.gov.au
DWER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	
DWER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	
DWER, November 2016. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	
DWER, June 2019. *Guideline: Decision Making*. Department of Environment Regulation, Perth.	
D R V Jones and N Dixon, January 2003. *Stability of Landfill Lining Systems: Report No. 1 Literature Review,* UK Environment Agency.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290638/sp1-385-tr1-e-e.pdf
Committee on Seismic Aspects of Dam Design 2009, *Selecting Seismic Parameters for Large Dams Guidelines,* International Commission on Large Dams	https://www.icold-cigb.org/userfiles/files/CIRCULAR/CL1794Annex.pdf
ANCOLD Incorporated, March 2017, *ANCOLD Guidelines for Design of Dams and Appurtenant Structures for Earthquake,* Australian National Committee on Large Dams	https://www.ancold.org.au/wp-content/uploads/2017/03/ANCOLD-Earthquake-Guideline-wm-Draft-270317-v3.pdf
N Dixon and D R V Jones, January 2003*. Stability of Landfill Lining Systems: Report No. 2 Guidance,* UK Environment Agency.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290637/sp1-385-tr2-e-e.pdf
ANCOLD Incorporated, July 2019, *ANCOLD Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure – Revision 1,* Australian National Committee on Large Dams	https://www.ancold.org.au/?product=guidelines-on-tailings-dams-planning-design-construction-operation-and-closure-may-2012
D J Kerkes, 1999, *Analysis of equipment loads on geocomposite liner systems*', Proc. Geosynthetics	http://www.gseworld.com/content/documents/technicalnotes/Practical_Guidance_Related_to_Geosynthetic_Interface.pdf

DOH, December 2014, *Contaminated Sites Ground and Surface Water Chemical Screening Guidelines,* Department of Health, Perth.	accessed at www.doh.wa.gov.au
DFES, November 2019, *Guidance Note GN02: Bulk Storage of Rubber Tyres Including Shredded and Crumbed Tyres,* Department of Fire and Emergency Services, Perth	accessed at www.dfes.wa.gov.au