Government of Western Australia
Department of Water and Environmental Regulation

Amendment Report

Application for Licence Amendment

Part V Division 3 of the *Environmental Protection Act 1986*

Licence Number	L6818/1997/11
Licence Holder	Shire of Bridgetown-Greenbushes
File Number	DER2015/000123-1
Premises	Bridgetown Waste Management Facility Lot 903 Bridgetown-Boyup Brook Road BRIDGETOWN WA 6255 Legal description – Lot 903 on Plan 189961 As defined by the Premises map attached to the Revised Licence
Date of Report	10 April 2025
Decision	Revised licence granted

Grace Heydon

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Grace Heydon
MANAGER WASTE INDUSTRIES
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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1. Decision summary

Licence L6818/1997/11 is held by the Shire of Bridgetown-Greenbushes (Licence Holder) for the Bridgetown Waste Management Facility (the Premises), located at Lot 903 Bridgetown-Boyup Brook Road, Bridgetown.

This Amendment Report documents the assessment of potential risks to the environment and to public health from proposed changes to the emissions and discharges during the operation of the Premises. As a result of this assessment, Revised Licence L6818/1997/11 has been granted.

The Revised Licence issued as a result of this amendment consolidates and supersedes the existing Licence previously granted in relation to the Premises.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Amendment Report, the Department of Water and Environmental Regulation (the department) has considered and given due regard to its Regulatory Framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary

On 19 September 2024, the Licence Holder submitted an application to the department to amend Licence L6818/1997/11 under section 59 and 59B of the *Environmental Protection Act 1986* (EP Act). The application seeks an amendment to the structure of the report required by condition 24 of the licence. The following changes in the reporting structure have been proposed:

- Part One: to provide a groundwater report based on the available data and make recommendations to allow other requirements of condition 24 to be fulfilled. Once the department has reviewed the report and the recommendations, the Shire will be required to action the recommendations (i.e. drill additional bores on site and undertake monitoring of standing water levels in the winter months.
- Part Two: Using the new data from the recommendations of Part One, the secondary report will be undertaken to complete the requirements as set out in condition 24 of the licence, being:
    - Providing a conceptual model of the hydrogeology at the premises supported by:
        - a detailed description of the geology immediately up and down-gradient of the liquid waste facility, landfill cell 1 and leachate pond including any fracture zones identified; and
        - a detailed description of the depth to groundwater across the premises and an assessment of the groundwater flow regime up and down hydraulic gradient of the liquid waste facility, landfill cell 1, cell 2 and leachate pond;
    - Identifying the extent to which each groundwater monitoring bore may be able to differentiate potential contamination (leachate) arising from the old landfill cells, the liquid waste facility, new landfill cells 1 and 2 and the leachate pond.
    - Recommendations for an ongoing groundwater monitoring regime, capable of identifying potential contamination arising from the old landfill cells, the liquid waste facility, new landfill cells 1 and 2 and the leachate pond.

No changes to the aspects of the existing Licence relating to Category 61, 61A, 62 or 64 have been requested by the Licence Holder.

2.3 Background

A hydrogeological review of the report, *Groundwater Monitoring Plan – Updates to GWMP* (22 April 2016), prepared by Astron Environmental Services Pty Ltd for the premises, was undertaken by the department as part of the risk assessment process for the Licence amendment granted on 22 August 2016. The initial groundwater monitoring bores constructed on the premises (MB3, MB4 and MB5) were analysed and the screen intervals were found to be placed within, and not above, the Pallid Zone clays. The risk assessment considered it likely that leachate could migrate through the surface laterite across the top of the Pallid Zone and therefore, MB3, MB4 and MB5 may not detect groundwater and potential leachate occurring within the surface laterite layer. The bore network was required to be expanded to provide an adequate data set for the detection of leachate occurrence within the deep and shallow geological profiles. Improvement conditions IR1 and IR2 were added to the licence for the purpose of informing the hydrogeology assessment of the premises and future risk assessments.

Monthly monitoring was also required for the period of August 2017 until December 2019 to allow identified data gaps in the local and site-specific hydrogeological interpretation beneath the premises to be assessed. However, this monitoring was not undertaken by the Licence Holder. Therefore, these monitoring conditions were amended through the Licence amendment granted on 28 July 2022 to include two years of monitoring for all monitoring bores installed at the premises (condition 21) and subsequent reporting as per condition 24:

> *Within 90 days of the completion of the 8 quarterly groundwater monitoring periods required under Condition 21, the licence holder must submit to the CEO a report which:*
>
> *(a) Includes the geological profile logs for all groundwater monitoring bores (MB1 through MB12) at the premises;*
>
> *(b) Contains a detailed and updated conceptual model of the hydrogeology at the premises supported by:*
>
> *i. a detailed description of the geology immediately up and down-gradient of the liquid waste facility, landfill cell 1 and leachate pond including any fracture zones identified;*
>
> *ii. a detailed description of the depth to groundwater across the premises and an assessment of the groundwater flow regime up and down hydraulic gradient of the liquid waste facility, landfill cell 1, cell 2 and leachate pond;*
>
> *(c) Identify the extent to which each groundwater monitoring bore may be able to differentiate potential contamination (leachate) arising from the old landfill cells, the liquid waste facility, new landfill cells 1 and 2 and the leachate pond.*
>
> *(d) Include recommendations for any further groundwater monitoring wells required to be installed, including recommendations for ongoing bore sampling.*
>
> *(e) Include recommendations for ongoing groundwater monitoring regime, capable of identifying potential contamination arising from the old landfill cells, the liquid waste facility, new landfill cells 1 and 2 and the leachate pond.*

2.4 Groundwater Monitoring Review

A *Groundwater Monitoring Review* (GWMR) prepared by Lundstrom Environmental Consultants Pty Ltd was submitted to the department on 25 September 2024 to address part of condition 24, being “Part One” of the requested amendment to condition 24.

2.4.1 Lundstrom Environmental Consultants Pty Ltd recommendations

The GWMR recommended the following actions to be undertaken:

1. The installation of new monitoring bores along the western boundary of the premises in accordance with Figure 1.
2. A full suite of water level readings to be undertaken to allow for groundwater levels across the site to be modelled.
3. The analysis of monitoring bore MB8 water quality results in conjunction with MB5 results determine if contamination identified in this well originates from the leachate pond or the active landfill cell.
4. An additional shallow groundwater monitoring bore to be installed just north of MB4 if the Shire proceeds with the future landfill cell proposed.

The GWMR stated that recommendations on the groundwater monitoring for each focus area could only be provided once the permanent groundwater flow at the premises had been determined.

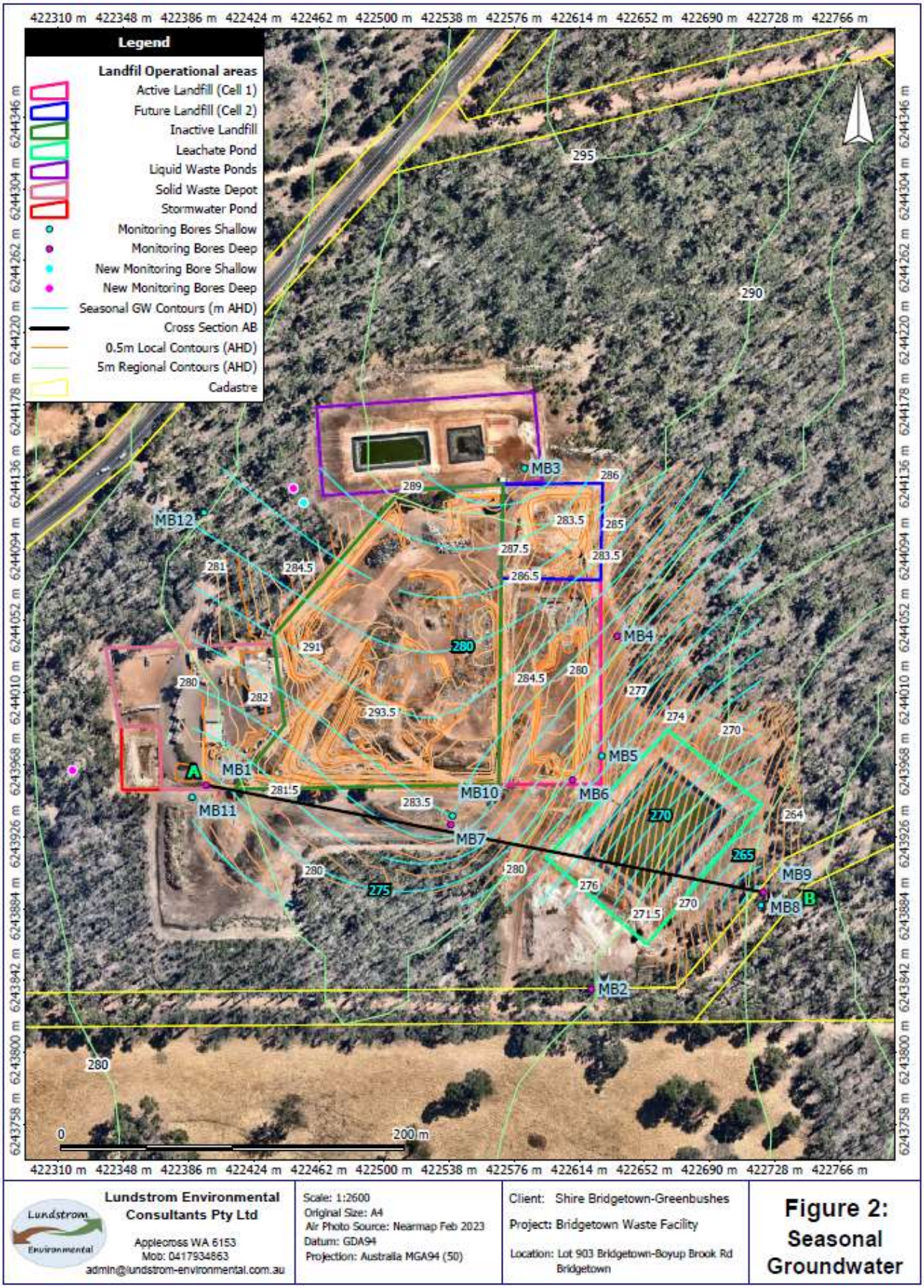

Figure 1: Proposed location of additional groundwater monitoring wells

2.4.2 Contaminated Sites Branch review

The GWMR was referred to the department's Contaminated Sites Branch (CSB) for review to inform the proposed amendment to the licence.

The following information from CSB's Principal Hydrogeologist has been considered:

1. Development of a sound hydrogeological conceptual model of potential source contamination is required prior to a groundwater monitoring network being installed. It is noted that these models are not static and evolve gradually as more hydrogeological information for the site becomes available. Based on this, CSB considers the hydrogeological conceptual model that was presented in the GWMR to be generally technically sound. However, a large number of information gaps were identified in the GWMR that may affect the interpretation of the groundwater monitoring data obtained for the site.
2. The GWMR is only partially correct in stating that the premises is underlain by unweathered granite at a depth of approximately 25 metres. Gneissic rocks that form part of the Balingup Metamorphic Belt underly the premises. The gneisses are strongly banded with quartz-rich zones being interfoliated with zones that are rich in mafic minerals. The quartz-rich zones in the saprock and in underlying bedrock fractures are likely to become conduits for groundwater flow when the gneissic rocks become weathered. Whereas the mafic gneissic bands would form saprock with a high clay mineral concentration which would have limited capacity for groundwater flow.
3. Basement rocks near the premises are overlain by an approximately 25-30 metres thick typical weathered profile. '*This profile consists of a near-surface ferruginous duricrust and pisolitic gravels (colloquially called "laterite") which are typically underlain by mottled ferruginous sandy clays that may contain abundant permeable root channels (often called the "mottled zone" or "sub-laterite"). The mottled zone is in turn underlain by white sandy clays known as "saprolite"… or the "pallid zone". The saprolite probably has a gradational contact with partially weathered rock ("saprock") near the base of the weathered profile*.' The generic conceptual hydrogeological model that likely applies to the premises is shown in Figure 2.

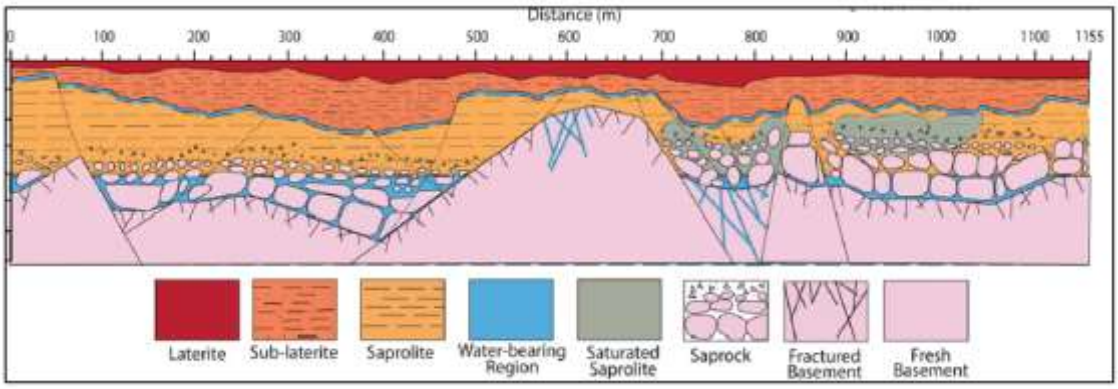

Figure 2: Generic conceptual model of groundwater occurrence in granitic basement rocks that are overlain by a lateritic weathered profile. Figure from *Ohenhen et al. (2023)*

4. Figure 2 indicates that a thin perched aquifer may develop seasonally near the interface with the underlying saprolite. However, perching may also take place at the base of the ferruginous duricrust near the surface (laterite). Due to the presence of macropores in the perched aquifers, hydraulic conductivity may be very high, allowing contaminants to be rapidly transported in shallow groundwater flow several hundred metres to areas of discharge. Contamination of groundwater in the deeper aquifer from surface land use activities may only occur where there is a high level of hydraulic connection with the

shallow groundwater. This interconnection only appears to occur where permeable pathways through saprolite exist, such as where tree roots penetrate the entire weathered profile to the bedrock.

5. *'The landfill site is located on a surface water and groundwater flow divide. Groundwater flow in the shallow aquifer on the western side of the divide flows in a south-westerly direction, and flows in a south-easterly direction to the east of the divide. The direction of groundwater flow in the shallow aquifer is largely driven by the topography of the site.'*

6. There is evidence of groundwater contamination at the premises by leachate landfill. Changes in bicarbonate ion concentrations are considered the greatest indicator of leachate contamination. Groundwater monitoring results from sampling events on the premises showed elevated bicarbonate ion concentrations (up to ten times background levels) in shallow and deep aquifer wells near the southeastern corner of the site (shown by filled red circles in Figure 3). This suggests localised contamination has occurred in this location and is also supported by elevated levels of total nitrogen.

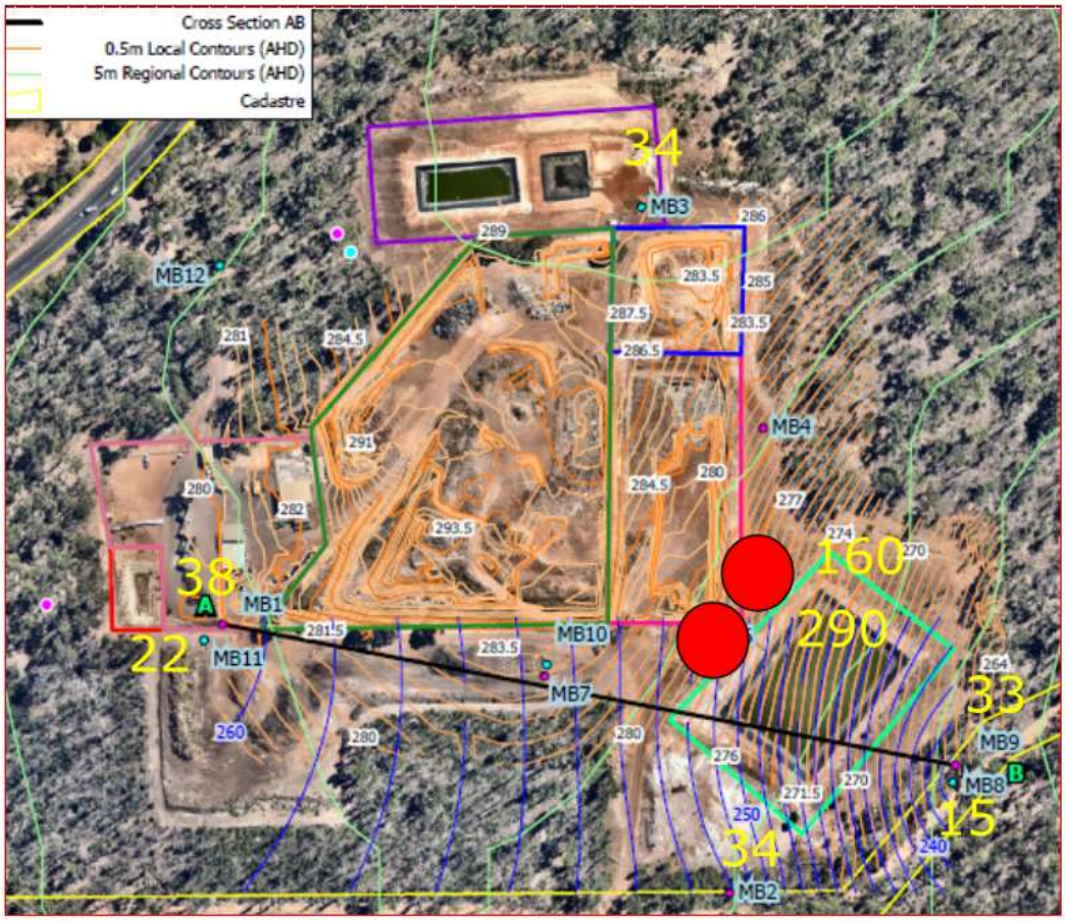

Figure 3: Spatial distribution of bicarbonate ions in groundwater (mg/L) from the shallow and deep aquifer samples collected in November 2022.

7. Elevated iron and aluminium concentrations have been sporadically measured in many bores on the premises. However, this may be of natural origin due to the groundwater in the area being slightly acidic. Concentrations of other metals in the groundwater at the premises are unlikely to be of significant environmental concern as they are low in general.

8. A suite of per- and poly- fluoroalkyl substances (PFAS) is recommended to be included in the analytes monitored in the groundwater to determine whether these compounds could also be contaminating the groundwater.

9. There are '*large gaps in the monitoring of the spatial distribution of groundwater quality, particularly to the west and east of the main landfilling area'*. To fill the gaps in the current groundwater monitoring network, CSB has considered that additional monitoring wells should be installed. However, it is essential that monitoring wells are correctly located. There is insufficient information currently available to suggest appropriate locations for additional bores as groundwater is not uniformly distributed in regolith and in fractured bedrock in the area. Therefore, CSB has recommended that a ground-based geophysical survey is undertaken using electrical techniques which would identify subsurface conductive anomalies. This would indicate the significant groundwater flow paths and targets for monitoring well installation.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk assessments* (DWER 2020).

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

The changes to Licence condition 24 is related to monitoring of impacts to the groundwater from the operation of the landfill and leachate ponds on the premises, with no changes to the operation of this infrastructure proposed. The requested amendment does not change the risk assessment previously undertaken for the premises and therefore, the Delegated Officer considers that a further risk assessment for the proposed amendments is not required.

However, based on the advice from CSB, the Delegated Officer considers that further investigations are required prior to installing new bores to ensure that they are installed in the most appropriate locations to fill existing data gaps. Therefore, the requirement to undertake a ground-based geotechnical survey using electrical techniques to identify suitable locations for additional monitoring wells has been conditioned in the Licence. The Licence Holder will be required to provide the survey results and proposed groundwater monitoring well locations to the department for review prior to well installation.

Once the department has reviewed the results and recommendations from the ground-based geotechnical survey, the Licence Holder is required to install additional monitoring wells, undertake groundwater monitoring, and provide a groundwater monitoring report based on the new monitoring data obtained.

In accordance with CSB advice, the Delegated Officer also considers it appropriate to include a suite of PFAS to the Groundwater Monitoring of Ambient Concentrations table in the Licence.

4. Consultation

Table 1 provides a summary of the consultation undertaken by the department.

Table 1: Consultation

Consultation method	Comments received	Department response
Licence Holder was provided with draft amendment on 22 November 2024	Refer to Appendix 1	Refer to Appendix 1

5. Conclusion

Based on the assessment in this Amendment Report, the Delegated Officer has determined that a Revised Licence will be granted subject to conditions.

5.1 Summary of amendments

Table 2 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 2: Summary of licence amendments

Condition no.	Proposed amendments
2, Table 2	Renaming of "recyclable wastes" to E-waste to clarify that this waste that is already being accepted at the premises can be accepted. Addition of an acceptance specification for Hazardous Waste to clarify that fluorescent light tubes/globes and both household batteries and vehicle batteries can be accepted.
5, Table 4	Addition of storage requirements for E-waste and Hazardous Waste (fluorescent tubes/globes and batteries).
21, Table 10	Amended to include additional monitoring wells to be sampled once they have been installed and to add a monitoring suite of per-and poly-fluoroalkyl substances (PFAS).
22	Specified actions condition included, requiring: • the Licence Holder to undertake a ground-based geotechnical survey to determine appropriate locations for installation of additional groundwater monitoring wells; • providing the department with the results of the geotechnical survey for review.
23	Condition included for the construction of groundwater monitoring wells in accordance with the results of the ground-based geotechnical survey, following the department's review.
24	Condition added requiring the Licence Holder to submit a construction report to the department for installed monitoring wells.
27	Previously condition 24. Groundwater monitoring reporting requirement amended to reflect changes to monitoring conditions and installation of new bores. Geological profile logs are no longer required as they have previously been provided for existing wells and are required under new condition 24 to be provided for additional new wells.

References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.

3. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
4. Ohenhen, L.O., Maylem M., Kolawole, F., Ismail, A. and Atekwana, E.A., 2023. Exploring for groundwater in sub-Saharan Africa: Insights from integrated geophysical characterization of a weathered basement aquifer system, central Malawi. *Journal of Hydrology: Regional Studies*, **47**, 101433. The paper is available from the following website: https://www.sciencedirect.com/science/article/pii/S2214581823001209.

Appendix 1: Summary of Licence Holder's comments on risk assessment and draft conditions

Condition	Summary of Licence Holder's comment	Department's response
21	On 12 December 2024, the licence holder commented that the department has removed the requirement to only monitor bores MB1, 6 & 9 and have changed it to requiring quarterly monitoring of all bores (total of 7-8 per quarter depending on water flow) for a non-specified time. Could DWER please provide some information about why this is changing without a specified time limit? Increasing water testing at all bore sites quarterly will increase laboratory costs significantly. To rationalise some of this cost, would the Department consider changing this requirement to some of the following: • Baseline monitoring of all bores for the current suite plus PFAS for up to a year (set period) and then reviewing it based on the findings • Targeted bore sampling for PFAS e.g. in the sites south-eastern part of the landfilling area only • Monitoring of PFAS at all bores twice per year (summer and winter representations), or in a cyclical frequency over the course of the year, ensuring all bores are tested and a complete data set gathered over a longer period e.g. 3-4 years • Reducing other water parameters which may be too low to be a concern (from the previous data set) or unlikely to present a concern and replacing them with PFAS.	The Delegated Officer acknowledges that the Shire has undertaken groundwater monitoring to inform baseline groundwater conditions, and this monitoring has been an improvement to monitoring undertaken in previous annual periods. However, there are still substantial gaps in understanding potential groundwater contamination extent, hydrogeology and aquifer depth beneath and in the vicinity of the premises. This is outlined in Section 2.4 (Groundwater Monitoring) of the Decision Report. As such, the department will require quarterly monitoring for contaminant parameters at all bores across the premises. Quarterly monitoring data will provide a more coherent understanding of groundwater to address outstanding data gaps and will better inform the geotechnical survey to ensure new bores are placed in optimum locations. Quarterly monitoring requirements for groundwater beneath landfill sites is also common practice and implemented on the vast majority of Licence's for similar premises across the State. Please note that this is consistent with the current monitoring requirements for the bores that the premises, minus an end date. The Shire is also welcome to submit an amendment application to DWER at a later date and once gaps within groundwater monitoring data have been addressed, to reduce groundwater monitoring frequency. The Delegated Officer notes the Shire's comments on PFAS sampling and at this stage is happy to reduce the sampling frequency for PFAS to annually for all groundwater monitoring bores. Please note that based on the results of this sampling, the department may determine that a higher frequency of sampling is required at a later date.

Condition	Summary of Licence Holder's comment	Department's response
2 & 5	The Shire advised on 10 January 2025 that they noted that electronic waste, fluorescent light tubes/globes and both household batteries and vehicle batteries were not included in the acceptance table in the licence. The Shire noted that these wastes are stored on site temporarily, before transported off site for recycling and requested that these wastes be added to Category 62 of the licence.	The Delegated Officer notes that the acceptance of electronic waste, fluorescent light tubes/globes and both household batteries and vehicle batteries was not included in the original application. The licence holder should note that late-stage additions to an amendment application which were not included in the original amendment scope are usually not accepted. However, the Delegated Officer has allowed the addition of these wastes to the acceptance table as the infrastructure is already on site for their storage. Therefore, their acceptance would not change the risk profile for the premises.