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Dear Les

Cleanaway Banksia Road Landfill 2022 Annual Groundwater Monitoring Programme (as per Licence L8904/2015/1) – Report Overview

360 Environmental Pty Ltd (360 Environmental), part of SLR Consulting, was commissioned by Cleanaway Solid Waste Pty Ltd (Cleanaway) to compile groundwater monitoring results for the 2022 monitoring period for the Banksia Road Waste Disposal Site, located at Lot 2, Banksia Road, Crooked Brook, WA (the site).

The groundwater and leachate pond sampling is required to comply with the water monitoring requirements of the Prescribed Premises Licence No. L8904/2015/1 (issue date 3 August 2015, revised October 2021), issued by the Department of Water and Environmental Regulation (DWER).

The key outcomes from the 2022 report are summarised below.

1 Site Overview

Cleanaway has operated the Class III (mid-level) landfill at the Banksia Road site in Dardanup since approval was granted in 2006. The site is operational as an active Class II and III landfill (DWER Category 64) and a liquid waste facility (DWER Category 61) and contains liquid waste cells, solid waste cells, stormwater collection dams and leachate collection ponds.

The eastern portion of the site has been operated as a landfill since approximately 2000 and received only Class II waste until approximately 2006. Since then, the landfill has been receiving both Class II and Class III waste comprising a mixture of municipal, commercial, and industrial waste, as well as residue from Water Corporation wastewater treatment plants. There are currently nine landfill Waste Disposal Cells of which seven are being actively filled, in addition to two liquid and tailings Waste Disposal Cells.

A secondary waste disposal area exists at the top of Cells 3, 4, 4b, 5, 6 and 12 which is typically used for asbestos and quarantine waste placement.

An ephemeral watercourse, Crooked Brook, is located approximately 1 km south and southwest of the site. The brook flows in a north-westerly direction into the Preston River approximately 5.5 km to the west of the site.

During 2021, Cleanaway undertook a review of the existing groundwater monitoring bore network in order to better understand the groundwater quality across the whole site and specifically the down-gradient, near site boundary conditions, to help define potential offsite risks. The drilling and installation of groundwater monitoring wells has confirmed the presence of two groundwater systems at the site, a shallow superficial aquifer between 20 m and 40 m (shallower in the western portion and deeper in the eastern higher elevation portion of the site) below the surface and the permanent, confined aquifer (Leederville Aquifer) varying between 30 m and 40 m below the surface, across the site.

Further drilling and groundwater monitoring well installation during 2021 provided an improved understanding and confirmation of the separate aquifers and importantly, water quality on the downgradient western boundary to help define any potential offsite risks. The drilling also replaced key damaged or dry wells to ensure adequate monitoring coverage across the site.

Groundwater within the superficial formation generally flows to the northwest. Previous investigations at the site have reported minimal groundwater within the superficial formation (i.e., in shallow groundwater wells) and the likely interpretation of this is that the system is highly dependent on rainfall recharge from east of the site and the geologic profile of the site results in the aquifer becoming thin to the east.

The Leederville aquifer general serves as a domestic water supply for the Dardanup area with the Priority 1 Dardanup water reserve located approximately 2.5 km to the northwest of the site's northwestern boundary. The site itself is not located within a drinking water protection area.

2 Monitoring Sites

The groundwater monitoring network targets both the superficial and the Leederville aquifers through shallow and deep groundwater wells across the site. There are a total of 25 groundwater wells onsite however during the 2022 monitoring program 18 were sampled in March 2022; 20 in June 2022; 20 in September 2022 and 20 in December 2022, due to the several wells being dry or blocked. The three leachate ponds included in the October 2021 Licence update were monitored.

Refer to Section 3.4, Tables 4 to 7 of the 360 Environmental 2022 Annual Compliance Report

3 Analytical Suite

The laboratory analytical suite utilised for the 2022 bi-annual and quarterly monitoring complies with Condition 57, Table 21 of the DWER Licence and comprised major ions, metals, nutrients, and organic analytes. All groundwater samples were submitted to laboratories that are National Association of Testing Authorities (NATA) accredited for the required analysis.

Refer to Section 3.4, Tables 4 to 7 of the 360 Environmental 2022 Annual Compliance Report

4 Key Findings

The key findings of the 2022 groundwater monitoring program are summarised below with references to the annual report for further detail.

4.1 Groundwater Flow Direction

Groundwater elevations were consistent with previous investigations and groundwater flow direction in the shallow superficial aquifer was consistently to the northwest. In the Leederville aquifer groundwater flow was reported towards the west.

Refer to Section 5.1 of the 360 Environmental 2022 Annual Compliance Report

4.2 Groundwater Quality

Groundwater at the site is generally slightly acidic with pH values below the lower pH range for drinking water with the exception of SE6S, which reported a neutral pH. Groundwater is fresh to mildly brackish with the deeper aquifer being up to 8 times more saline.

Groundwater could be variously used for non-potable, potable, and livestock watering purposes, depending on the location as the pH is noted to be generally below the applicable range.

Refer to Section 5.2 of the 360 Environmental 2022 Annual Compliance Report

4.3 Analytical Results

Laboratory analytical results are summarised below:

- Nitrogen oxides (NO_x-N) were detected in all monitoring wells during the 2022 GMEs.
- Total nitrogen was detected above LTI in four (4) locations in at least one GME throughout the year.
- Manganese (Mn), was reported above NPUG and ADWG in several isolated monitoring wells over several GMEs.
- No exceedances of Stock Water Guidelines (SWG) were reported.

- Limited and isolated occurrences of other heavy metals [aluminium (Al), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), selenium (Se) and (Zn)], nitrogen, phosphorus and ammonia were reported above the limit of reporting (LOR) but below assessment criteria indicating concentrations present do not pose a risk to potential receptors.
- PFAS/PFOA, hydrocarbons, BTEXN, phenols, PCBs, OC/OP pesticides, TCE/PCE and atrazine were all reported below LOR in the groundwater.

Refer to Section 5.3 of the 360 Environmental 2022 Annual Compliance Report

4.4 Interpretation

- Concentrations of major ions, TRH, PFAS, Cr, Ni and nutrients were reported in concentrations of up to multiple orders of magnitude greater in the leachate ponds than in the groundwater suggesting that there is no connection between the leachate ponds and the groundwater. Further, no mounding of the groundwater is seen in the vicinity of the ponds.
- Major ion concentrations in the deep confined and shallow superficial aquifers reported significant differences in distribution indicating no connection between the two aquifers and the leachate pond major ion distribution is again significantly different to the groundwater indicating no impacts to the superficial aquifer.
- Spatially across the site it is noted that:
 - With the exception of those analytes that can be naturally occurring in the environment (e.g., major ions, metals, and nutrients), analyte concentrations are low and spatially isolated indicating an absence of source associated with the landfill operations.
 - GW15/D located cross-gradient of landfill infrastructure often reports higher analyte concentrations than rest of site. This is considered to be a cross-gradient well pair and therefore not likely to be impacted by the landfill operations. As these two locations often show the highest concentrations on site, it is considered likely that the groundwater at site is more influenced by natural ambient conditions than landfill operations.
 - Total nitrogen (TN) was reported above LOR (0.2 mg/L) in all wells except GW6D (March), GW23D (March, December), GW10D (June, December), GW23S (June), and ranged between 0.2 mg/L (GW23D, September) and 6.0 mg/L (SE6S-R, December), (SE10S, September). GW7S, GW8D, SE6S-R and SE10S reported TN above the LTIG guideline (5 mg/L) in at least one GME each. These wells reported high TN in isolation in one GME per location, either post summer in March or post winter in September and deeper well pairs did not report similar elevated TN concentrations, suggesting that TN fluctuates naturally throughout the aquifer and is not consistently above guidelines.

- Time series plots indicate that the majority of analytes are stable and within the historical range with the exception of:
 - Chloride, which is marginally increasing in GW3D. Chloride is stable in all other monitoring bores both shallow and deep.
 - Nitrogen and nitrate concentrations have been steadily rising in SE6D since mid-2016. Concentrations in 2022 rose from low levels in March to levels comparable with previous data by December 2022. Concentrations in downgradient wells are significantly lower, indicating the nitrogen and nitrate are decreasing quickly in the water column and are not posing a risk to receptors.

Refer to Section 6.2 and 6.3 of the 360 Environmental 2022 Annual Compliance Report

5 Conclusions

Based on the 2022 and historical groundwater and leachate pond analysis there is little evidence to suggest that the landfill operations have impacted the underlying groundwater aquifer. The minor assessment criteria exceedances are generally in up or cross-gradient monitoring locations that would not be impacted by landfill operations, indicating they are representative of background conditions.

This summary should be read in conjunction with the 2022 Annual Compliance Report (360 Environmental)

For and on behalf of 360 Environmental Pty Ltd



Julie Palich – Principal Hydrogeochemist