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Dear Les

Banksia Road Landfill Hydrogeologic Risk Assessment and Groundwater Monitoring Program Review - Report Overview

360 Environmental Pty Ltd (360 Environmental) was commissioned by Cleanaway Solid Waste Management Pty Ltd (Cleanaway) to undertake a hydrogeologic risk assessment and review the suitability of the groundwater monitoring program currently being undertaken at the Banksia Road Waste Disposal Site, located at Lot 2, Banksia Road, Crooked Brook, WA (“the site”).

The purpose of this assessment was to support the existing works approvals/licence amendment processes (as required) and design a water quality monitoring program to ensure that Cleanaway’s waste disposal operations at the site are not adversely impacting the underlying aquifers.

The objectives of the groundwater monitoring review were to determine:

- Whether the existing groundwater monitoring network is sufficient to determine if there is impact to the underlying aquifers, given consideration to the local geology and hydrogeology and proposed future site infrastructure/activities
- Whether the analytical suite is adequate and complete given the activities undertaken at the site
- Whether the existing frequency of sampling and analysis is appropriate.

The following summary should be read in conjunction with the Banksia Road Waste Disposal Facility – Hydrogeologic Assessment and Groundwater Monitoring Program Review (360 Environmental, March 2021).

1 Site Overview

Cleanaway has operated the Class III (mid-level) landfill site 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.

Several new landfill cells are proposed to be progressively constructed across the eastern portion of the property to meet the future waste disposal demands for the region.

2 Groundwater Regime

2.1 Onsite Aquifer Characteristics

Drilling and installation of groundwater monitoring bores has confirmed the presence of two groundwater systems at the site, a shallow superficial aquifer between 20 m and 50 m (shallower in the western portion and deeper in the in the eastern higher elevation portion of the site) below the surface and the permanent, confined aquifer (Leederville Aquifer) between 35 m and 45 m below the surface.

Groundwater within the superficial formation generally flows westward. Previous investigations at the site have reported minimal groundwater within the superficial formation (i.e., in shallow groundwater bores) and the likely suggestion is that the system is seasonally perched, and the perched layers are inconsistent and discontinuous across the site.

The Leederville aquifer in general serves as a domestic water supply for the Dardanup area and is the most utilised aquifer in the area. The Priority 1 Dardanup water reserve is located approximately 2.5 km to the northwest of the sites north western boundary, however the site itself is not located within a drinking water protection area.

2.2 Risks of Landfill Operations to Groundwater

Based upon the desktop review of hydrogeologic conditions and risks from landfill operations, it is concluded that operation of the landfill presents a low risk of resulting in contamination to the underlying superficial and Leederville aquifers on the basis that:

- The superficial formation comprises a thick sequence of low permeability clays with variable silty and sandy clay lenses. The superficial aquifer is largely unsaturated

(minimum of 20 m unsaturated profile), although localised ephemeral perched aquifers may be present. Water is present within the superficial aquifer in the western portion of the site just above the contact with the underlying Leederville aquifer.

- Groundwater monitoring data acquired for the site, does not provide conclusive evidence of landfill leachate impacts to groundwater beneath the site to date.
- Although there remain data gaps regarding the hydrogeological properties beneath the site, the vertical migration distance required for groundwater contamination to occur, the low permeability of the aquifer, and the distances to identified receptors (at least 1 km) suggest that while potential exposure mechanisms have been identified, the risk of this occurring is low.

Regardless, due to the scale and nature of landfilling operations, the implementation of a robust groundwater monitoring program at the site is warranted.

3 Recommendations for Monitoring Program

The groundwater monitoring network currently comprises 28 wells that target both the superficial and the Leederville aquifers through shallow and deep groundwater wells at several locations across the site, however several of the wells are currently dry or blocked. A data gap evaluation was undertaken with respect to the following groundwater related aspects:

- Degree of understanding of site geology and aquifers
- Degree of understanding of groundwater flow direction
- Background water quality
- Monitoring well locations with respect to current and proposed operations
- Suitability of the existing monitoring well construction
- Suitability of the monitoring analytical suite and frequency.

Based on the data gap analysis several high and moderate priority actions were identified for which the following recommendations are made regarding the monitoring network and program:

- The current groundwater monitoring suite and frequency as defined in DWER Licence L8904/2015/1 and the Radionuclide Management Plan is largely appropriate to monitor the risks from the landfill. The DWER licence monitoring suite should also be applied to all newly installed wells. Radionuclide monitoring should specifically be added to the proposed new wells installed around Tronox Cell 2/2A.
- Annual monitoring of landfill leachate from PLP1, LEP1, LEP3 and the new Tronox Leachate Pond (TLP) is warranted to provide a comparison point for the interpretation of the groundwater data and identify any changes in leachate quality over time. Consideration should be given to the addition of pathogens to the monitoring suite, and

if identified, consideration should be giving to the addition of pathogens to the groundwater monitoring program.

- Due to the original drilling methods used, a few existing wells are interpreted to be screened over both the superficial and Leederville aquifers. Future groundwater monitoring well installations should be undertaken using an appropriate drilling method including diamond drilling, sonic drilling or rotary air blast. These methods return reliable geologic “cores” which will allow for an improved understanding of the geologic conditions beneath the site, enable accurate identification of water strike, and ensure well screens are appropriately placed so that screening over multiple aquifers does not occur.
- Consideration should be made for the decommissioning and replacement of monitoring wells screened over the superficial and Leederville aquifers (SE1D, SE3D, SE6D, SE7D, SE8D and SE10D) if impacts to their shallow well pairs arise to ensure that impacts in the superficial aquifer do not have a direct pathway to the underlying Leederville aquifer via the wells themselves.
- Well pairs should be replaced if they are destroyed during operations. (i.e. replace wells GW9S&D and SE10S&D if they are destroyed by the potential future construction of LEP4).
- The progressive installation of thirteen additional monitoring well pairs (Figure 1) is recommended to address data gaps in the spatial coverage of the monitoring network associated with current and future proposed landfill cells. The shallow well should target the saturated zone within the superficial aquifer and the deep well should be screened and isolated in the upper portion of the Leederville Aquifer.
- The proposed wells should be installed approximately 12 months before commissioning of the new landfill cells to allow for an initial baseline groundwater monitoring event to occur before landfill operations in the area commence.

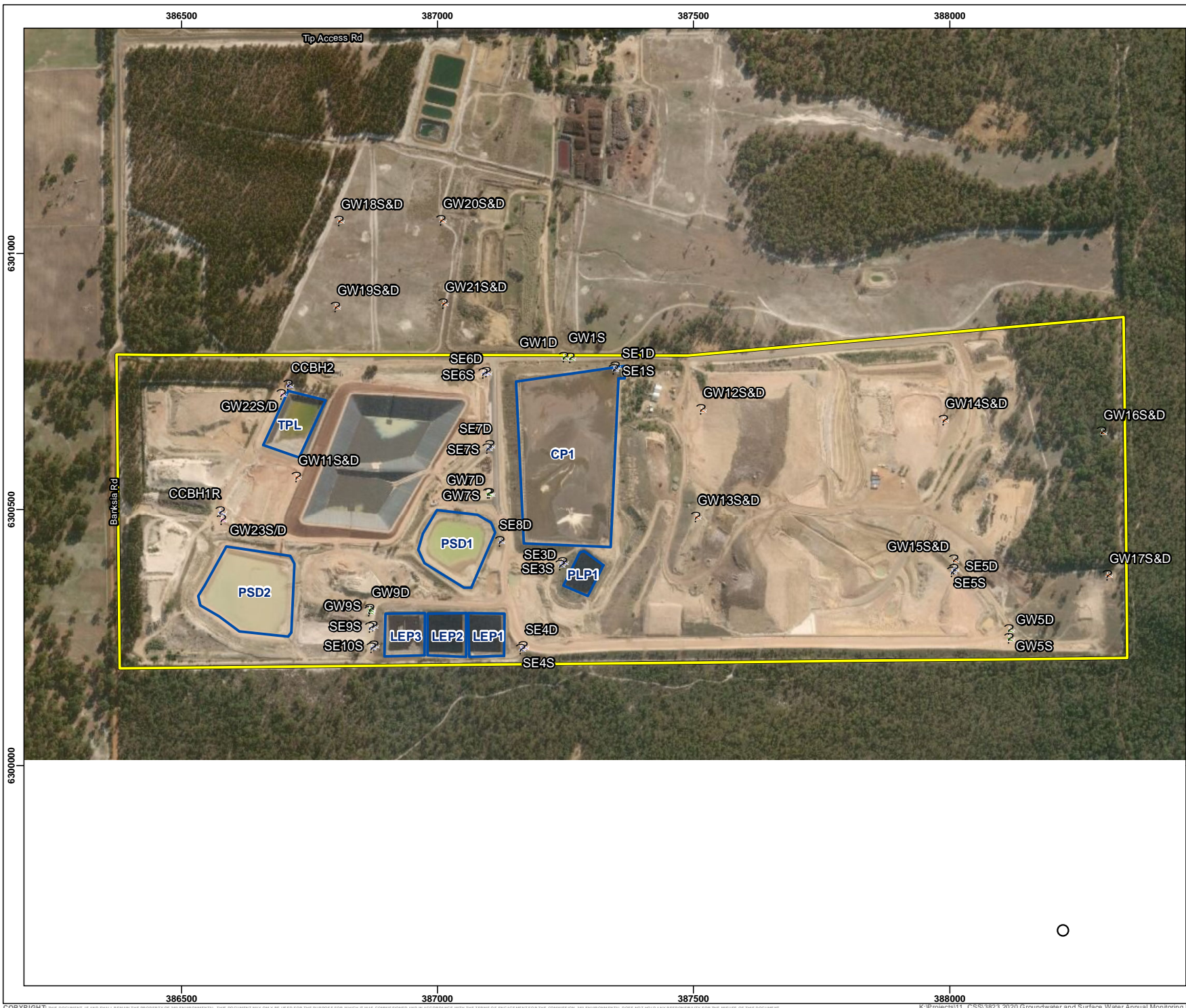
For and on behalf of 360 Environmental Pty Ltd



Julie Palich – Principal Hydrogeochemist

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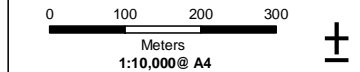
Figure 1: Existing and Proposed Monitoring Locations



- ### Legend
- Site Boundary
 - Surface Water Pond
 - ? Monitoring wells (installed 2018)
 - ? Monitoring wells (installed pre-2018)
 - ? Proposed Groundwater Monitoring Wells
 - ? Proposed Replacement Groundwater Monitoring Wells

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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LOCALITY MAP



PROJECT ID	DATE
3823	18/02/2021

HORIZONTAL DATUM AND PROJECTION
 GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	JP	JP	0

Cleanaway Solid Waste Pty Ltd
 Lot 2, Banksia Road, Crooked Brook, WA

Groundwater Assessment and Monitoring Programme Review

Figure

Groundwater and Surface Water Sampling Locations