

Project Memo

Client:	Alkina Holdings Ltd	Date:	8 November 2019
Attention:	J Hickey	From:	Mark Bietting
Project No:	ALK001	Revision No:	1
Project Name:	Great Southern Landfill		
Subject:	Independent Peer Review		

Great Southern Landfill EPA Peer Review

This letter summarises the results of the peer review of the hydrogeological and hydrological study components of the proposed Great Southern Landfill works by Golder Associates (Golder), undertaken by SRK in support of the Alkina Holdings Ltd (Alkina) submission currently under review by the EPA. As confirmed by the EPA in writing to Alkina, SRK is an independent organisation and is free from conflicts of interest with respect to the Great Southern Landfill, previous applications for the same property and proposed development, and from Alkina Holdings Ltd.

As outlined in SRK's proposal dated 29 July 2019, this review comprises an evaluation of the following three key aspects of the Golder works:

1. Site characterisation
 - Are the monitoring network and program adequate and fit for purpose?
 - Have groundwater and surface water regimes been adequately delineated and characterised?
 - Have source-pathway-receptor relationships been identified and appropriate mitigation measures proposed where required?
 - Is the conceptual model for the site reasonable? Does it address key components of the site?
2. Mitigation systems
 - Are the mitigation systems appropriate and sufficient to prevent environmental harm, based on the site characterisation?
3. Risk assessment
 - Have risks to off-site users and stakeholders been adequately recognized and assessed, and have reasonable risk mitigation measures been proposed where required?

This review did not entail a detailed review of the engineering design, and was approached from a hydrogeological, geochemical, and environmental management perspective. No new numerical modelling was undertaken, nor assessment of engineering design criteria or engineering drawings beyond a qualitative assessment of whether the design approach was appropriate.

Where provided, SRK reviewed supplementary reports beyond those authored by Golder. These reports include reports produced by the previous proponent and a hydrologist/ hydrogeologist consultancy report commissioned by key stakeholders opposed to the development. A list of all reviewed documents is provided in the attached Appendix A.

This review was completed in consideration of the previously issued works approval (DWER ref: W5830/2015/1), which included a risk treatment profile. The works approval followed approximately four years of site investigation activities and mitigation design to demonstrate that the proposed landfill could be constructed and managed in a manner that satisfied environmental requirements.

A State Administrative Tribunal (SAT) hearing was held on 18 and 19 November 2015 between SUEZ (previous proponent, then known as SITA Australia), the Wheatbelt Joint Development Assessment Panel (JDAP), and the Shire of York. The participating hydrogeological and geological experts issued a joint statement during this hearing:

“...the revised joint statement of hydrogeological and geological experts involves an unequivocal acceptance by all four who participated in its conclusions which should entirely satisfy the Tribunal that any question in relation to ground water [sic], which was the primary driver of environmental concerns, has been comprehensively addressed.”

Subsequently, the SAT accepted the proponent submission stating:

“...the result of these processes of joint conferral is not that the environment in its broadest sense is not an issue, but that it has comprehensively been addressed to the satisfaction of the experts.”

The Alkina submission currently under review by the EPA, of which this independent peer review is a component, comprises a smaller anticipated waste quantity and a larger buffer between the proposed cells and the groundwater table than the SUEZ application. The Alkina submission follows the same principles and philosophies developed by the previous proponent and approved by the SAT.

The DWER risk profile further clarifies that “Medium risks are acceptable and generally subject to regulatory controls that are outcome-based”. In the granting of the surrendered works approval, the DWER designated officer concluded that the identified risks to groundwater and surface water are acceptable, in the context of the landfill engineering design and mitigation planning/ strategies.

SRK considers the works completed to date, comprising site characterisation and the development of a conceptual site model, mitigation planning, and the risk assessment addressing potential impacts to off-site users and stakeholders to be competent and thorough, and to satisfy industry and regulatory standard practices.

The following sections outline SRK's comments and recommendations resulting from the Independent Peer review addressing the three key aspects outlined above.

1 Site Characterisation / Conceptual Model

The conceptual model developed by Golder is based on historical site data from the previous proponent, regional geological data sourced from publicly available datasets, and from targeted site investigation and monitoring programs undertaken by Golder on behalf of Alkina. The conceptual model is considered reasonable and addresses the site geology and geography, the groundwater flow regimes, and aquifer characterisation.

SRK notes the following regarding the site characterisation and conceptual model:

- The monitoring network has good spatial coverage and is generally positioned to allow for effective water level and water quality monitoring along the inferred source-pathway-receptor route.
 - Consideration should be made to installing additional monitoring wells to the west-northwest of the proposed cells to allow for improved monitoring in this area (north of MB05).
 - Wells with uncertain construction details should be progressively replaced during operations to improve confidence in the monitoring program (Appendix B).
 - Wells with damaged standpipes (e.g. MB11) or well seals (e.g. MB06) should be properly decommissioned and replaced.
- Paleochannels or similar features along the potential hydraulic pathways have not been identified through site investigation activities, including regional geophysical surveys. SRK agrees with Golder's assertion that they are unlikely to be found in areas of concern.
- Determination of aquifer properties, specifically hydraulic conductivity (K), is based on a relatively small dataset of slug test results. Some of the tested wells are of uncertain construction (screened intervals, etc.).
 - Consideration should be made to slug testing all future monitoring wells as they are completed.
 - The range of K values is reasonable for the description of the tested intervals.
 - Hydraulic conductivity estimates are provided as both a range and an average. The “estimated K average” values should be omitted from future reports as this is not a generally accepted method of synthesising K values. SRK notes that averages are not provided for wells with a

range exceeding an order of magnitude, suggesting Golder is aware of the limitations of presenting average K values. If sufficient data exists, an alternate method of presenting this data is as a geometric mean combined with a box-and-whisker type plot showing the distribution of test data.

- Hydraulic conductivity values estimated from tests in wells of uncertain construction should be considered indicative, not exact, and should be confirmed and superseded by tests completed in wells of certain construction.
- If future numerical modelling is planned, consideration should be made to completing multi-well tests to estimate other aquifer parameters (storage, etc.) to support modelling efforts.
- Groundwater flow rates and flow direction are based on a relatively small dataset (limited monitoring network).
 - The inferred groundwater flow direction appears reasonable and reflects the data. SRK agrees that the piezometric surface is a subdued reflection of topography apart from the inferred no-flow boundary imposed by the inferred dyke to the west of the proposed landfill.
 - The inferred dyke should be proven through future site investigation activities as it presents a confinement to potential contaminant migration off-site. SRK agrees that based on the regional geology and the geophysical data, the lineament observed in the processed magnetic intensity data is likely to indicate a north-west to south-east striking, sub-vertical dyke. Regional dykes of this approximate orientation are vertical to sub-vertical; as such, it is reasonable to assume that if this feature is a similar dyke, it would present a barrier to flow. This is considered a relatively low risk and can be completed opportunistically.
 - Rockwater Proprietary Limited (Rockwater) issued a technical response to all of the State Administrative Tribunal (SAT) Expert Witness statements for stakeholders west of the proposed landfill, specifically in regard to potential impacts to surface water and shallow groundwater regimes (2017). These witness statements comprised an unverified groundwater flow model (Topodrive; Appleyard witness statement) and the postulation of a vertical to sub-vertical dyke presenting a barrier to groundwater flow (Waterhouse witness statement). Rockwater proposed that the existing conceptualisation of a shift in groundwater flow direction to the north could be incorrect and inferred a groundwater flow direction shift to the south-west. SRK agrees with Golder's conceptualisation, pending further work to improve discretisation of the flow in this general area and to confirm the presence of the inferred dyke.
 - SRK recommends installation of additional monitoring wells in the area of the inferred change in groundwater flow direction to the west-northwest of the proposed landfill. This will allow for improved discretisation in the groundwater flow regime to the west.
- Source-pathway-receptor relationships have been appropriately identified and described in the conceptual model and in the risk assessment (discussed further in Section 3):
 - Inferred agricultural impacts are discussed in several reports, along with potential salt impacts as an explanation for elevated electrical conductivity values. Water quality inferred to be impacted by pre-landfill activities should be monitoring throughout the year for at least two years to ensure that seasonal influences and trends are understood, and that "background" water quality can be quantifiably distinguished from potential impacts from landfill-related activities.
- Golder notes that rare positive detections of hydrocarbons may be associated with laboratory interference. This is unlikely, considering the internal QA/QC at accredited laboratories and is more likely related to contamination during sampling or transport (i.e. sampling artefact rather than laboratory artefact). SRK agrees that it is unlikely to indicate hydrocarbon contamination of groundwater.

2 Mitigation Systems

- If the proposed intercept drainage system could potentially intersect the 2 m buffer between base of cells and groundwater surface, the system should be assessed in consideration of that buffer. Specifically, this should include an assessment of the Maximum Infiltration Capacity (MIC) and the Natural Discharge Capacity (NDC).
- Leachate management, including line configuration, is consistent with industry best practices and is considered appropriate for a landfill of this design in this geological environment.
- SRK did not note any proposed instrumentation to ensure that the 2 m buffer between the base of the lined cells and the groundwater surface is maintained. If no such instrumentation is currently

proposed, SRK recommends vibrating wire or pneumatic piezometers be installed beneath the liner to ensure this buffer remains intact and to monitor the potential for groundwater mounding.

- Similarly, consideration should be made to installing lysimeters in the buffer downgradient of, and proximal to, the landfill cells. Lysimeters may be more effective in monitoring any potential seepage through the base of the liner, rather than groundwater monitoring wells further downgradient.
- SRK concurs that development of a robust stormwater management plan, as part of an integrated site water management plan, will be sufficient to monitor and mitigate impacts related to sediment transport towards surface water receptors.

3 Risk Assessment

SRK reviewed the risk matrix developed by Golder and considers it to be appropriate and thorough. SRK agrees with Golder's assertion that risk to off-site users and stakeholders has been appropriately quantified and that no appreciable risk remains following implementation of the proposed mitigation mechanisms.

4 Closure

SRK considers the work completed to date by Golder, comprising site characterisation and the development of a conceptual site model, mitigation planning, and the risk assessment addressing potential impacts to off-site users and stakeholders, to be competent and thorough and to satisfy industry and regulatory standard practices. The works completed for the proposed Great Southern Landfill are consistent with the philosophies and principles contained within the previously accepted submission for the Allawuna landfill. As such, SRK agrees with Alkina's assertion that the mitigation planning and strategy, combined with the lower anticipated waste volume and increased buffer between the base of the proposed cells and the local groundwater table, satisfy the unequivocal joint statement issued by the SAT hydrogeological and geological experts.

We trust that this technical memorandum, summarising the results of our technical peer review of the hydrogeological aspects of the proposed landfill, meets Alkina's current needs in support of its application.

Yours faithfully

SRK Consulting (Australasia) Pty Ltd

Signed by:



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Signed by:



Brian Luinstra

Principal Hydrogeologist

Appendix A: Reference List

Filename	Title	Author	Date	Document Type	Comments
2A - 1777197-015-R-F002-1-Rev0_Site Location	Site Location	Golder Associates Pty Ltd	18/07/2017	Map - Plan	
2B - 1777197-015-R-F002-2-Rev0	Site Layout	Golder Associates Pty Ltd	18/07/2017	Map - Plan	
1777197-001-M-Rev0	York Proposed Landfill Site - Water Level Gauging and Sampling Event	Golder Associates Pty Ltd	12/05/2017	Technical Memorandum	
1777197-007-M-Rev0 Surface Water Review	Great Southern LandfillSite - Desktop Review - Surface Water Management	Golder Associates Pty Ltd	18/07/2017	Technical Memorandum	
1777197-008-R-F001-Rev1_SiteLocation	Site Location	Golder Associates Pty Ltd	21/06/2017	Map - Plan	
1777197-008-R-F002-Rev1_SitePlan	Site Plan	Golder Associates Pty Ltd	21/06/2017	Map - Plan	
1777197-008-R-F003-Rev1_Topography_Drainage	Regional Topography, Drainage, and Surface Water Catchment	Golder Associates Pty Ltd	23/06/2017	Map - Physiography	
1777197-008-R-F004-Rev1_Geology	Regional Geology	Golder Associates Pty Ltd	21/06/2017	Map - Geology	
1777197-008-R-F005-Rev1_Typical_Profile	Typical Lateritic Regolith Profile	Golder Associates Pty Ltd	21/06/2017	Lithological Profile	Idealised
1777197-008-R-F006-Rev1_MagIntensity	Total Magnetic Intensity Map Showing Location of Inferred Dyke	Golder Associates Pty Ltd	21/06/2017	Map - Geophysics	
1777197-008-R-F007-Rev1_GWLIune2017	Interpreted Groundwater Level Contours	Golder Associates Pty Ltd	21/06/2017	Map - Groundwater	
1777197-008-R-F008-Rev1_CHM	Conceptual Hydrogeological Section	Golder Associates Pty Ltd	21/06/2017	Cross-Section	Idealised
1777197-008-R-Rev1	Hydrogeological Site Characterisation	Golder Associates Pty Ltd	Sep-17	Report	
1777197-009-R-Rev0 Draft Env Risk Assessment	Desktop Environmental and Social Risk Assessment	Golder Associates Pty Ltd	Jul-17	Risk Register	
1777197-015-L-Rev0 - Cover Letter	Application for Concurrent Works Approval and Licence	Golder Associates Pty Ltd	19/07/2017	Report	incl. Allawuna Landfill reports
1777197-015-R-F007-1-Rev0	Surrounding Land Use and Sensitive Receptors	Golder Associates Pty Ltd	18/07/2017	Map - Plan	
1777197-019-R-Rev3 GSL Design Report	Great Southern Landfill Cell 1, Cell 2 and Ancillary Works	Golder Associates Pty Ltd	Oct-17	Design Report	
1777197-046-L-Rev0_Golder groundwater summary	Summary of Great Southern Landfill Groundwater Assessment and Approval Process	Golder Associates Pty Ltd	13/05/2019	Letter Report	
1777197-049-M-RevA Geochem	Great Southern Landfill Desktop Geochemical Risk Characterisation	Golder Associates Pty Ltd	16/10/2019	Technical Memorandum	
1777197-051-M-RevA Inland Waters HG	Great Southern Landfill Inland Waters - Hydrogeological Conceptualisation and Contingency Planning	Golder Associates Pty Ltd	16/10/2019	Technical Memorandum	
1777197-052-M-RevA leachate pond sizing	Great Southern Landfill - Leachate Pond Sizing	Golder Associates Pty Ltd	25/10/2019	Technical Memorandum	
Attachment 7_Rev0_Map for siting and location	Attachment 7 - Map of Siting and Location	Golder Associates Pty Ltd		Map - Plan	Duplicate of 1777197-015-R-F007-1-Rev0
HELP Model Appendix	Attachment A: Leachate Generation Modelling - HELP Model	Golder Associates Pty Ltd	Oct-19	Report and Model Output Files	
rockwater gsl bore 20180221 - Agenda	Technical Response to Witness Statements	Rockwater Proprietary Limited	Sep-17	Letter	Filename shortened by SRK
W5830-2015-1 decision document	Decision Document - SITA Australia Pty Ltd, Works Approval: W5830/2015/1	Department of Environment Regulation	17/03/2016	Government Document	

Appendix B: Monitoring Bore Replacement

Monitoring Bore	Approximate Location	Rationale for Replacement
GMB01	Up/Cross-gradient north of proposed cells	"background well location"; dry; replacement should be screened below the water table
GMB06	Beneath proposed cells	bore could not be located; consideration should be made to replace with a piezometer or lysimeter
MB04	Down/Cross-gradient south-west of proposed cells past Thirteen Mile Brook	uncertain construction details (screened intervals, total depth)
MB05	Down-gradient west of proposed cells before Thirteen Mile Brook	uncertain construction details (screened intervals, total depth)
MB06	Down/Cross-gradient south of proposed cells past Thirteen Mile Brook branch	artesian; breached well seals; uncertain construction details
MB11	Down-gradient south-west of proposed cells	broken stand-pipe