

**Environmental Mitigation Implementation Schedule
WENT Landfill Extension**

Appendix C5 – Landfill Gas

EIA Ref	EM&A Log Ref	Recommended Mitigation Measures (to be implemented when the trigger level is exceeded, where necessary)	Objectives of Recommended Measures & Main Concerns to Address	Who to Implement Measures?	Location of Measures	When to Implement Measures?	What Requirements or Standards for Measures to Achieve?
LFG							
Within WENT Landfill Extension							
S7.6.1	LFG1	Special LFG precautions should be taken due to close proximity of WENT Landfill Extension site to existing landfill to avoid potential hazards of LFG exposure (ignition, explosion, asphyxiation, toxicity).	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire WENT Landfill Extension site	Construction phase	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.1	LFG2	Prominent safety warning signs should be erected on-site to alert all personnel and visitors of LFG hazards during excavation works.					
S7.6.1	LFG3	No smoking or burning should be permitted on-site.					
S7.6.1	LFG4	Prominent 'No smoking' and 'No Naked Flames' signs should be erected on-site.					
S7.6.1	LFG5	No worker should be allowed to work alone at any time in excavated trenches or confined areas on-site.					
S7.6.1	LFG6	Adequate fire fighting equipment should be provided on-site.					
S7.6.1	LFG7	Construction equipment should be equipped with vertical exhaust at least 0.6m above ground installed with spark arrestors.					
S7.6.1	LFG8	Electrical motors and extension cords should be explosion-proof and intrinsically safe for use on-site.					
S7.6.1	LFG9	'Permit to Work' system should be implemented.					
S7.6.1	LFG10	Welding, flame-cutting or other hot works should be conducted only under 'Permit to Work' system following clear safety requirements, gas monitoring procedures and presence of qualified persons to supervise the works.					

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Within WENT Landfill Extension (Cont'd)							
S7.6.1	LFG11	For piping assembly or conduit construction, all valves and seals should be closed immediately after installation to avoid accumulation and migration of LFG. If installation of large diameter pipes (diameter >600mm) is required, the pipe ends should be sealed on one side during installation. Forced ventilation is required prior to operation of installed pipeline. Forced ventilation should also be required for works inside trenches deeper than 1m.	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire WENT Landfill Extension site	Construction phase	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.1	LFG12	Frequency and location of LFG monitoring within excavation area should be determined prior to commencement of works. LFG monitoring in excavations should be conducted at no more than 10mm from exposed ground surface.					
S7.6.1	LFG13	For excavation works, LFG monitoring should be conducted (1) at ground surface prior to excavation, (2) immediately before workers entering excavations, (3) at the beginning of each half-day work, and (4) periodically throughout the working day when workers are in the excavation.					
S7.6.1	LFG14	Any cracks on ground level encountered on-site should be monitored for LFG periodically. Appropriate action should be taken in accordance with the action plan in Table 7.8 of EIA Report.					
S7.6.1	LFG15	LFG precautionary measures involved in excavation and piping works should be provided in accordance with LFG Guidance Note and included in Safety Plan of construction phase. Temporary offices or buildings should be located where free LFG has been proven or raised clear of ground at a separation distance of at least 500mm.					
S7.6.1	LFG16	For large development such as WENT Landfill Extension, a Safety Officer trained in the use of gas detection equipment and LFG-related hazards should be present on-site throughout the groundwork phase. The Safety Officer should be provided with an intrinsically safe portable instrument appropriately calibrated and capable of measuring the following gases: <ul style="list-style-type: none"> • CH₄: 0-100% LEL and 0-100% v/v • CO₂: 0-100% v/v • O₂: 0-21% v/v 					

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Within WENT Landfill Extension (Cont'd)							
S7.6.1	LFG17	Periodically during groundwork construction, the works area should be monitored for CH ₄ , CO ₂ and O ₂ using appropriately calibrated portable gas detection equipment. The monitoring frequency and areas should be established prior to commencement of groundwork either by Safety Officer or appropriately qualified person. Routine monitoring should be carried out in all excavations, manholes, chambers and any other confined spaces that may have been created by temporary storage of building materials on-site. All measurements in excavations should be made with monitoring tube located not more than 10mm from exposed ground surface.	To minimise the risk of LFG hazards to personnel in construction site	DBO Contractor	Entire WENT Landfill Extension site	Construction phase	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.1	LFG18	For excavations deeper than 1m, measurements should be conducted: <ul style="list-style-type: none"> • At ground surface before excavation commences; • Immediately before any worker enters the excavation; • At the beginning of each working day for entire period the excavation remains open; and • Periodically throughout the working day whilst workers are in excavation. 					
S7.6.1	LFG19	For excavations between 300mm and 1m, measurements should be conducted: <ul style="list-style-type: none"> • Directly after excavation has been completed; and • Periodically whilst excavation remains open. 					
S7.6.1	LFG20	For excavations less than 300mm, monitoring may be omitted at the discretion of Safety Officer or appropriately qualified person.					
S7.6.1	LFG21	Where any service voids, manholes and inspection chambers within WENT Landfill Extension site are entered for maintenance and LFG monitoring, all safety requirements should be followed.	To minimise the risk of LFG hazards to personnel in landfill site	DBO Contractor	Entire WENT Landfill Extension site	Construction, Operation, Restoration and Aftercare phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.1	LFG22	Buildings onsite should be incorporated with passive system relying on natural air movement to prevent gas build-up and active system requiring energy input to mechanically move air to protect against LFG build-up. Design measures for sub-surface building services should include generic measures e.g. gas barriers, gas vents and strategic routing of any service utilities away from potential LFG migration pathways.					

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Within WENT Landfill Extension (Cont'd)							
S7.6.1	LFG23	Any new-built permanent building structures within the WENT Landfill Extension site, forced ventilation and gas detection system with audible alarm should be installed. When the internal atmosphere is detected with >10% of CH ₄ , forced ventilation should be triggered automatically. No person should be allowed to enter or remain in any confined areas when CO ₂ levels >1.5% v/v or O ₂ levels <18% v/v were detected. Access to confined spaces in the WENT Landfill Extension site should be controlled to only authorised persons.	To minimise the risk of LFG hazards to personnel in landfill site	DBO Contractor	Entire WENT Landfill Extension site	Construction, Operation, Restoration and Aftercare phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.1	LFG24	Specific gas protection measures which can be applied to building services have been in Appendix 7.4 of EIA Report. They generally include gas barriers, gas vents, location of service entries above ground, and service conduits passing through Consultation Zone.					
S7.6.3	LFG25	The design of the landfill gas protection measures to be adopted on-site, e.g. utilities, buildings, LFG cut-off trench barrier, monitoring wells and facilities related to the WENT Landfill Extension project will be performed by a landfill gas specialist consultant appointed by future DBO contractor. Moreover, the landfill gas protection measures will be checked and certified by a qualified independent consultant. The contractor shall ensure that the required protective measures are implemented and constructed in accordance with the design and shall establish a maintenance and monitoring programme for ensuring the continual performance of the implemented protection measures. The above requirements shall be included in the tender documents of WENT Landfill Extension project. When the detailed design is available, the future contractor is required to undertake further landfill gas hazard assessment to take account of the more readily available detailed information to finalise the design of the landfill gas protection measures recommended in this report. During the future detailed design stage, a review of the preliminary qualitative LFG hazard assessment presented in the report will be carried out, a detailed qualitative LFG hazard assessment will be prepared and all the report together with the detailed design of gas protection measures will be submitted to EPD for vetting.	To ensure that the design of the landfill gas protection measures is in order and appropriate.	The Project Proponent, DBO Contractor	Entire WENT Landfill Extension site	Detailed Design stage	

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Outside WENT Landfill Extension							
S7.6.2	LFG26	LFG cut-off trench barrier should be built along the site boundary of the WENT Landfill Extension to prevent gas from entering an area, which is keyed into low permeability strata or extends at least 1m below the lowest groundwater level. To relieve the potential build up of gas, it may be necessary to install additional measures for venting the gas such as trenches filled with no-fines, granular material, e.g. gravel, connected to venting pipes which will provide a preferential pathway for the release of gas to atmosphere.	To cut off any gas migration from WENT Landfill Extension to the power station, proposed IWMF and STF which falls into the 250m LFG consultation zone of WENT Landfill and its Extension.	DBO Contractor	Outside WENT Landfill Extension site	Construction phase	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.2	LFG27	Sealing of fault line ends by grouting will be implemented. In the event that investigation works during the detailed design stage identify the presence of laterally persistent faults running beneath the landfill site, and leading towards sensitive receivers, the following works could be carried out: <ul style="list-style-type: none"> • Sealing of any surface exposures of the 'fault' feature exposed during the site formation works. This could be carried out through the application of a shotcrete cover prior to the placement of the landfill liner, which also acts as a barrier to landfill gas migration. • Ground treatment at the landfill boundary, comprising pressurized injection of grout within a series of inclined drillholes formed to intersect the fault at various depths. These would effectively form an impermeable barrier against the lateral migration of landfill gas along the fault line. • Adequate venting of landfill gases such that insufficient pressures develop to result in lateral or downward migration of gas. 	To prevent gas migration through the fault line in particular to the existing Black Point Power Station.	DBO Contractor	Outside WENT Landfill Extension site	Construction phase	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97) Factories and Industrial Undertakings (F&IU) (Confined Spaces) Regulations Code of Practice on Safety and Health at Work in Confined Spaces
S7.6.2	LFG28	LFG monitoring wells will be installed in the ground on the development side of the cut-off trench barrier to measure the concentration of methane and carbon dioxide.	To determine the effectiveness of the cut-off trench barrier in preventing LFG migration.	DBO Contractor	Outside WENT Landfill Extension site	Construction, Operation, Restoration and Aftercare phases	Landfill Gas Hazard Assessment Guidance Note (EPD/TR8/97).