WHYTES GULLY LANDFILL: SOIL, WATER & LEACHATE MANAGEMENT PLAN 2021

WOLLONGONG CITY COUNCIL Waste Services

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1 Introduction

1.1 Background

Wollongong City Council was granted project approval from the Department of Planning on 3rd April 2013 (Application Number 11-0094) for Stage 1 Landfill Cell at Whytes Gully. Construction approval was subsequently provided by the EPA on the 23rd August 2013 under the existing EPL 5682.

A modification of this Approval was obtained to replace the 'Eastern Gully Landfill Waste Cutback' with an approved alternative stormwater drainage design 'Eastern Gully Stormwater Diversion on the 11th April 2018'. This approved stormwater drainage design greatly reduces the excavation of landfill waste; and was a significant improvement to the original cutback drainage design.

Condition 5(d) of MP 11_0094 MOD2 instrument requires that this soil, water and leachate management plan is updated to incorporate the final detailed design specifications for stormwater management and collection at the site, including the stormwater upgrade drainage works. Also, within Schedule 3 of the Planning Approval, Council is required to prepare and implement a Soil, Water and Leachate Management Plan.

This plan must include:

- a Site Water Balance
- an Erosion and Sediment Control Plan
- a Leachate Management Plan
- a Stormwater Management Plan
- an Ongoing Monitoring Program

The Whytes Gully Landfill Surface Water and Leachate Management Plan (Rienco Consulting 2008) was submitted within the original approved Landfill Environmental Management Plan (LEMP) in September 2014 and included a site water balance and management plan documentation that reflected the site hydrological conditions at the time. This Report follows on from this document (Appendix One) to address the Independent Environmental Audit (IEA 2020) requirement of providing an updated Soil, Water and Leachate Management Plan.

The prolonged drought conditions followed by extraordinary rainfall events over a short period has meant that updates to this Plan are required to be included in the LEMP in accordance with Schedule 5 (Environmental Management, Reporting and Auditing). This document provides additional information outlining current management methods reviewed after storm events in the first quarter of 2020. The table below addresses the s75W Instrument of Modification Conditions (MOD2). This is in accordance with Condition 3 in Schedule 5.

Requirement	Condition Actions	Relevant Section
Site Water Balance	Identifies the source of water collected or stored on site, including rainfall, stormwater and groundwater. Includes details of all water use on site and any discharges. Describes the measures that will be implemented to minimize water use on site.	Whytes Gully Landfill Site Water Balance (GHD 2021). (Appendix Two)

Erosion and Sediment Control Plan	Is consistent with the requirements in the latest version of the Blue Book. Identifies the activities on site that could cause soil erosion and generate sediment. Describes the measures that will be implemented to minimise soil erosion and transport of sediment and stockpiles are managed.	Stockpile Management Plan (August 2021) (Appendix Three)
Leachate Management Plan	Includes final details of leachate management and collection on site. Includes a remedial action plan.	Whytes Gully Landfill - Leachate Management Systems Update (JPG Engineering 2021) (Appendix Four)
Stormwater Management Plan	Is consistent with the Wollongong DCP. Includes detailed design for the stormwater management and collection system. Demonstrates how the requirements of Condition 15 of the schedule has been addressed. Is updated to the satisfaction of the Secretary prior to the construction of works.	Whytes Gully: Preliminary Stormwater Assessment (2021) (Appendix Five)
An Ongoing Monitoring Program	Includes baseline data. A combined surface and groundwater monitoring program. Includes surface and groundwater impact assessment criteria.	Whytes Gully: Preliminary Stormwater Assessment (2021) (Appendix Five)

2 Site Water Balance

The purpose of this water balance analysis and supporting report is to assess and analyse the leachate and stormwater runoff generation for the existing and future leachate, groundwater and stormwater systems at the site. A model was developed to estimate leachate and stormwater volumes for potential rainfall scenarios and was calibrated against leachate and stormwater pond level data. Groundwater was estimated based on typical values for similar site conditions. The water balance analysis is based on current and future conditions of the site (as of October 2021) and has been prepared in response to the DPIE and EPA compliance requirements.

2.1 Overview

A water balance analysis was developed for the site that considers surface water, baseflow (incl. groundwater), and leachate contributions for both the current and future operation of the site. A summary of the water balance model is described in the following section, including details of the model, inputs, calibration, and outcomes. The full report is provided in Appendix Two.

A water balance model (WBM) was developed using the software, Goldsim. The WBM included quantifying the groundwater, leachate and stormwater generated at the site and allowed for management of waters to be simulated. This included the sites ponds, disposal mechanisms and losses as shown in the Figure 1 and 2 below.

The WBM was developed to allow calibration of model inputs to available data and allowed for simulation of a continuous climatic series from 1900 until 2020 based on historical observations. The WBM reported results daily however also includes sub-daily timesteps as required to allow for travel time and dispersion of rainfall derived infiltration and runoff processes.

Development of the WBM was based on the following parameters:

– Existing stormwater and leachate ponds were estimated using available design information, Geographic Information System (GIS), site aerial imagery and site observations.

– Generation of rainfall derived infiltration and rainfall derived runoff were developed using volumetric runoff coefficients with consideration for advection and dispersion through the system.

– Groundwater was estimated during calibration of the WBM, with consideration to estimates provided in the section above.

– Simulation of leachate and stormwater management was based upon discussions with Council and a review of infrastructure, with consideration for disposal and emergency management procedures.

The incomplete bunding north of the Package 2/3 piggyback area was accounted for in the existing modelling scenario and catchment areas for contribution to the active filling area leachate generation rate. The WBM was developed to allow for simulation of the existing site (including calibration to available data), as well as future stages of the site as it is progressively capped and remediated.

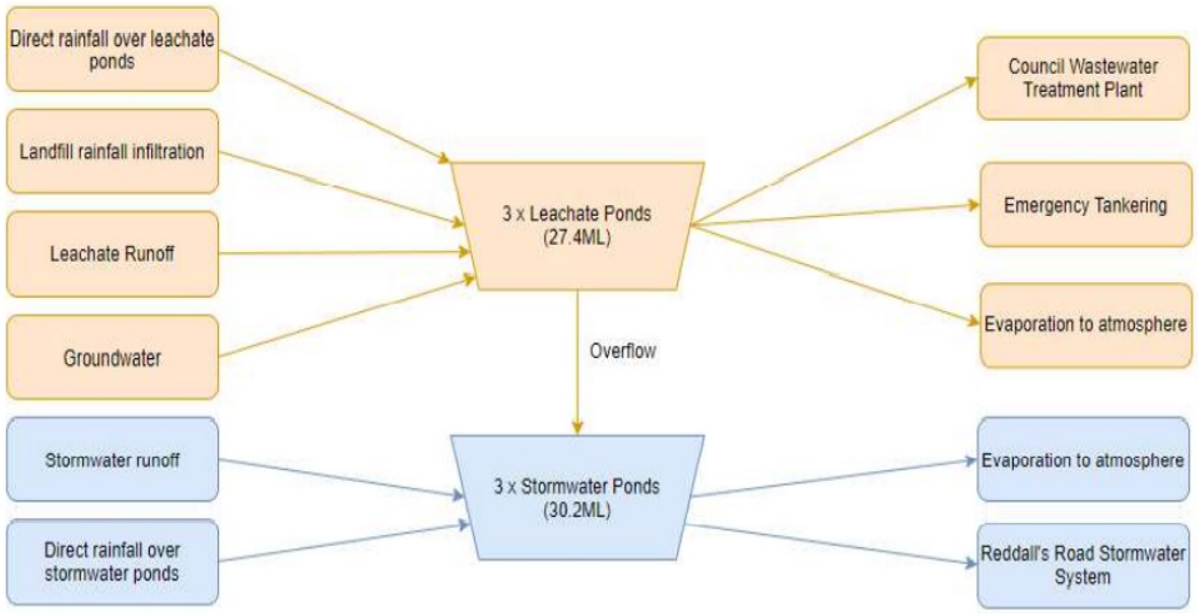


Figure 1 Water Balance Model

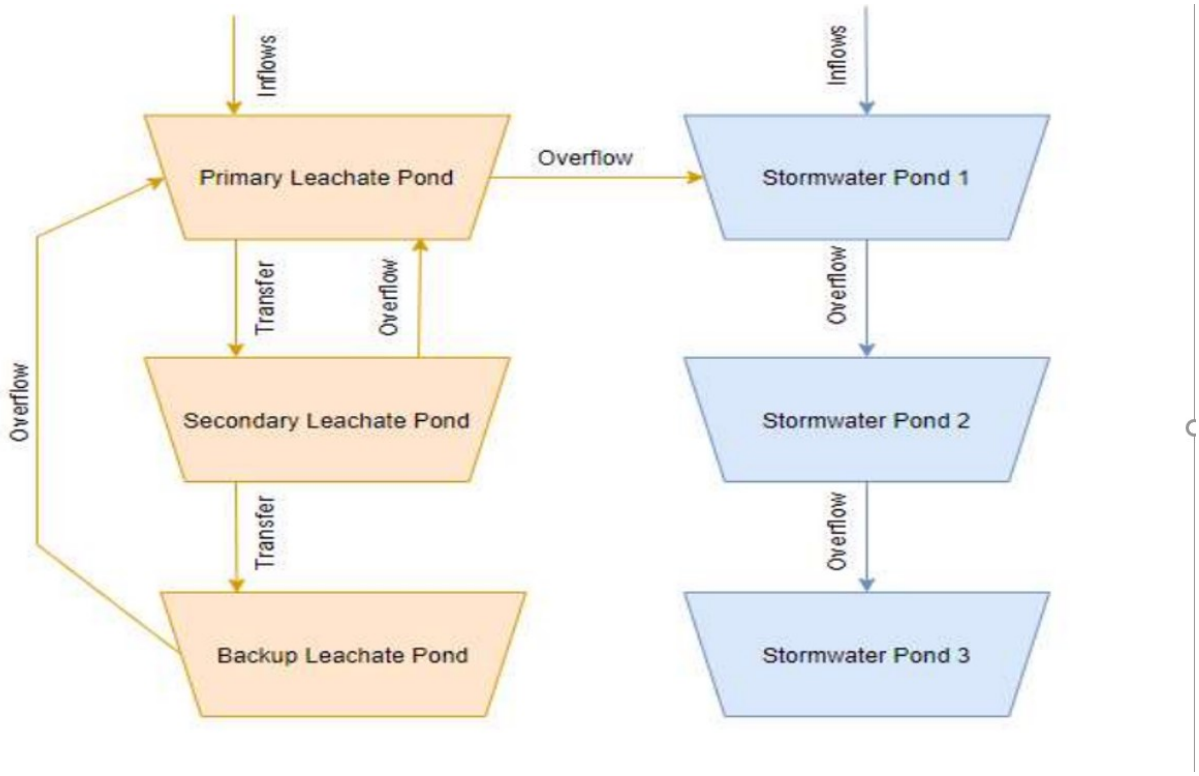


Figure 2 Layout of modelled leachate and stormwater pond systems

2.2 Site Water Balance Outcomes

The key outcomes from the water balance modelling are summarised below:

- Leachate generation is reasonably high, currently estimated to range between 80 to 150 ML/year during dry and wet years, typically approximately 97 ML/yr. Direct rainfall onto the leachate ponds generally ranges from 10 to 30 ML/yr of the 80 to 150 ML/yr and is reasonably steady through future stages.
- Leachate generation is expected to be highest in the current configuration of the site, before decreasing by approximately 20 to 40 ML/yr for Stage 3 and Stage 4, and a further 30 – 80 ML/yr once the final cap is applied.
- Peak daily leachate generation is similar between existing and future stages for more extreme wet periods, suggesting that extreme rainfall onto the ponds is likely to be critical for extreme wet weather management.
- The current configuration of the site is predicted to result in the highest leachate disposal requirement. As the site is progressively capped, the requirement to dispose of leachate decreases over time.
- The requirement to dispose leachate by sewer decreases over time from typically 77.7 ML/yr currently to 15.0 ML/yr once the final cap is applied over the entire landfill area. It is likely that generation would then decrease further.
- Estimation of leachate pond overflow quantities follows the trend of leachate generation, decreasing progressively as the site is capped.
- The leachate storage system appears to readily overflow, however the suitability of the model to predict how leachate is exchanged between the ponds and disposed is difficult to replicate. Despite this, the current disposal rate limit of 250 kL/day (approx. 91 ML/yr) is likely to limit the ability to treat the rates of leachate generated at the site, which typically ranges between 70 and 180 ML/yr. Leachate generation is estimated to exceed the allowable Liquid Trade Waste Agreement disposal rate of 91 ML/year in approximately 61% of years for the modelling period adopting the current configuration.
    - Estimation of leachate overflow quantities indicate that additional leachate treatment/disposal capacity for the existing scenario between 2.4 ML/yr (typical) and 31.4 ML/yr (wet year) is required.

- Large quantities of stormwater are generated at the site based on the current conditions, ranging from 290 ML/yr in drier years to 660 ML/yr in wetter years, with typical values of 430 ML/yr.
- There is limited disposal for stormwater at the site, and it is understood that collected stormwater is not reused from the ponds. Accordingly, disposal by evaporation is the only mechanism – typically around 50 ML/yr, an order of magnitude lower than generation.
- The remainder of stormwater generated at the site that is unable to be disposed, overflows into the receiving environment downstream towards Dapto Creek.
- Stormwater generation and overflow is anticipated to decrease in future stages, as more areas are capped and diverted around the site and into the existing off-site stormwater management systems. – It should be noted that calibration of the stormwater system was not readily available, due to significant, rapid changes in stormwater levels.

Based on the results of the water balance modelling the following recommendations for leachate and stormwater management are provided:

- Final capping and diversion drains should be installed progressively in accordance with the proposed staging plans to:
    - minimise infiltration of rainfall into the capping area; and
    - reduce stormwater contribution to the stormwater ponds through direct discharge of 'clean stormwater' to Dapto Creek.

An application should be made to increase allowable trade waste agreement discharge rates to sewer in the short term to decrease the intensity of predicted leachate overflow events and corresponding increase to leachate treatment plant capacity. Modelling indicates that an additional 2.4 ML/yr (typical) and 31.4 ML/yr (wet year) is required for the existing scenario and an additional 3.9 ML/yr and 10.4 ML/yr for Stage 3 and Stage 4 respectively to address predicted wet year overflows.

3 Erosion and Sediment Control Plan

This Sediment Control Plan is intended to reduce the sediment loading from construction and operational works on the site's stormwater management system. The full report (which includes the new excavation works of the Central Ridge) is provided in Appendix Three. It should be noted that the sediment and erosion control measures provided with this plan are not suitable erosion control to allow direct discharge of surface water off site at this time. For purposes of this management plan and the next stage of construction and operation, the runoff water generated should be considered Dirty Stormwater (per the definitions provided by the Environmental Assessment (EA) (117625003-159-R-Rev0) and Surface Water Assessment (117625003-160-R-Rev0)) and should be routed though the site's stormwater management system. All runoff from the site currently drains to the stormwater ponds as such additional works are not required to facilitate this requirement.

3.1 Legislative Framework and Guidelines

The Whytes Gully Landfill operates under Environmental Protection Licence (EPL) 5862. The EPL includes surface water discharge limits applicable to the site and permits discharge of stormwater from the sites sedimentation ponds provided that the applicable concentration limits are met, and other contaminants are not discharged.

The Whytes Gully New Landfill Cell Project, of which the excavation of the central ridge is a part of, is approved through DPIE Project approval 11_094 (the Project Approval). The Project Approval provides various conditions of consent that should be adhered to including requirements that WCC implement requirements of the following plans and Guidelines:

- Gully New Landfill Cell Construction Environmental Management Plan (ref: 117625003-155-RRev1).
- Whytes Gully New Landfill Cell Landfill Environmental Management Plan (ref: 117625003-061-R-Rev2).
- Landcom (2004) Managing Urban Surface water: Soils and Construction Volume 1 (Blue Book).

- Department of Environment and Climate Change NSW (2008), Managing Urban Surface Water Soils and Construction Volume 2B Waste Landfills.
- Wollongong City Council Development Control Plan (DCP) Chapter E22.

3.2 Key Objectives

The key objectives of this Erosion and Sediment Control Plan include:

- Meeting erosion and sediment control requirements of the Project Approval.
- Reduction of the sediment generation from the works to reduce sediment loading on the Sites Surface Water Ponds.

3.3 Proposed Erosion and Sediment Control Measures

3.3.1 Design Components

The Erosion and Sediment Control Plan includes the following design components:

- Progressive Cover Management (revegetation and/or application of a sprayed polymer erosion cover)
- Check Dams
- Rock Filter Dam
- Sediment Fences

Construction Guidelines (Golder 2019) developed for surface water infrastructure are based on both Landcom (2004), Department of Environment and Climate Change NSW (2008) and Book 5 from Catchment & Creeks and International Erosion Control Association (IECA, 2010). A summary of the erosion and sediment control management measures to be implemented are provided in the table below from Golder (2019). The management measures presented below consists of a treatment train of processes that aims to reduce sediment entrainment and to filter out the entrained sediment before it flows to the onsite ponds. The combination of surface water management techniques in series is consistent with the stated objectives and the recommendations in Landcom (2004) and IECA (2008).

Measure	Control	Application
Progressive cover management	Progressively remove surface cover and vegetation as excavation progresses. Surface cover and vegetation to be removed progressively from upper elevations to lower elevations. Stabilise landform to reduce sediment runoff off site. Establish vegetation cover.	Revegetation by reshaping and revegetating disturbed land into a stable landform and/or application of a sprayed polymer erosion cover. Soils should not be permitted to be exposed for more than 28 days.
Check dams	Control flow velocities and trap small quantities of sediment within catch drains.	Formed using rock at regular intervals along the drainage alignment.
Rock filter dam	Sediment retention trap using settlement and filtration to mitigate sediment pollution flowing downstream	Dam installed within existing drainage alignment.
Sediment fences	Retention trap to mitigate sediment pollution to downslope areas.	Sediment fences installed where required.

The proposed regular check dams and rock filter dams will act as a filter for surface water causing the flows to slow and sediment to settle-out. By utilising these dams in the drainage channels that will capture runoff from the Central Ridge excavation area the majority of entrained sediment will be captured. Excavation and soil cover removal is proposed to progress from upper to lower elevation areas, with the intent of this approach being to utilize the retained vegetation and soil cover below the active excavation area to slow runoff and act as a filter to upper excavation areas. The progressive revegetation of exposed soils will reduce exposed area of soils, limit long term sediment generation and increase the effectiveness of the other erosion control measures and will reduce required de silting of sediment fences, check dams and rock filter dams.

3.3.2 Progressive cover management (revegetation)

The most effective method of erosion control is minimising the exposed soil and by having erosion resistant ground cover. Progressive cover management will be undertaken to rehabilitate disturbed areas as soon as practicable into a stable landform. Land will be reshaped and vegetation in the form of native or a mixture of introduced grasses will be used to stabilise the excavation area and reduce erosion. The soil should be prepared for revegetation with some form of surface roughening to promote vegetation establishment. Alternatively, a sprayed polymer erosion cover or hydromulching can be applied for rapid establishment of vegetative cover and initial soil binding.

3.3.3 Check Dams

The two Existing Drains are to include regularly spaced (vertical distance) Check Dams. Check Dams are a drainage control technique to primarily control flow velocities within unlined drains and additionally offer sediment control through trapping small quantities of sediment. Check Dams are to be constructed from individual sandbags or rock placed along drains at intervals of 0.5m vertical spacing such that level of the base of upgradient check dam matches to the level of crest of the lower check dam.

3.3.4 Rock Filter Dams

Rock filter dams are a sediment control technique primarily used for concentrated surface water flows. Sediment trapping is achieved by both particle settlement within the intermittent shallow settling pond formed by the dam (during high flows) and by filtration of minor flows passing through an aggregate and/or geotextile filter. This Sediment and Erosion Control Plan includes one Rock Filter Dam to be constructed within the existing drainage channel to the south of the central ridge excavation area.

3.3.5 Sediment Fences

Sediment fences are to be placed at the perimeter of disturbed areas and at regular 3.5 m vertically measured spacings across the excavation area. Sediment fences are a form of retention trap used to mitigate sediment movement to downslope lands and waterways. Fences will comprise self-supporting geotextile fabric entrenched 150 mm deep into the ground held up by regularly spaced star-pickets to a height of between 500- 600 mm placed parallel to site contours and perpendicular to flow paths. Sediment fences should be progressively installed as the excavation works commence with the perimeter fences (closest to the Drainage channels) installed prior to excavation commencing. Sediment fences other than the last catch sediment fence closest to the stormwater drainage channels may be omitted where:

- The area upgradient of the proposed sediment fence alignment has been excavated to rock and the exposed rock is not erodible or likely to generate significant sediment; or
- Any areas of exposed up gradient soils (if present) have been effectively revegetated.

3.4 Stockpile Management Plan

It is anticipated that soils materials excavated from the central ridge excavation area will be stockpiled in the current Western Gully Stockpiling area. Where encountered during excavation works, clean topsoil materials should be stockpiled separately for reuse in revegetation activities at the site. Appropriate stockpile tracking should be implemented. A detailed Stockpile Management Plan is provided in Appendix Three.

In summary, erosion control measures to be implemented for stockpiles (as outlined in the Management Plan) include:

- Location of stockpiles more than 30 m from watercourses. Vegetated buffer to be maintained between stockpiles and watercourses.

- Installation of Sediment fences around stockpiles and stockpile areas to manage the migration of fines.
- Maintain vegetated buffer zone of minimum 15 m width between stockpiles and watercourses.
- The surface of stockpiles that are to be in place for more than 28 days should be vegetated as soon as practicable. Soils should not be permitted to be exposed for more than 28 days. Stockpiles of non-erodible materials (i.e. aggregate materials) do not need to be vegetated.
- Dust control measures are to be implemented as required. Measures may potentially include covering of stockpiles and wetting down of stockpiles and application of hydro mulch and or tackifier products to the surface of stockpiles.

3.5 Monitoring and Maintenance Plan

A maintenance plan for erosion and sedimentation control infrastructure is included in the table below from Golder (2019) below. All erosion and sediment control infrastructure outlined in this report should be inspected:

- Immediately after each rainfall event.
- Daily when excavation works are occurring otherwise weekly inspection.

Measure	Trigger Criteria	Maintenance Action
Progressive cover management	Poor regrowth	Water if applicable. Application of a sprayed polymer erosion cover. Consider re-seeding or hydromulch.
Sediment fences	Damaged	Repair/reinstate
	Sediment blocking more than 30% of retention capacity	Remove silt from fence Replace or back-flush any portion
Check dams	Damage to dam structure. Displacement	Reinstate check dam
	Sediment accumulation	Remove any accumulated sediment
	Significant soil scouring around ends of dams	Extend width of dam
	Significant erosion between dams	Install additional intermediate check dams or install channel liner
Rock filter dams	Evidence of erosion damage to filter structure or downstream channel banks	Repair/reinstate
	Accumulated sediment/debris exceeds ~10% of settling pond storage volume	Remove sediment
	Dam drains too rapidly (full dam drains < 8 hours)	Install additional filter aggregate
	Dam drains too slowly	Upstream filter medium to be removed of replaced If geotextile used sediment can be scraped from surface using machinery

4 Leachate Management Plan

4.1 Overview

Leachate collected at the landfill is piped to the first of three leachate treatment ponds where it progressively travels through the system and undergoes biological treatment through natural processes. From there, it is pumped to the onsite leachate treatment plant where it is further treated via a sequencing batch reactor (SBR). The liquid portion of the leachate is then discharged to sewer in accordance with the Trade Waste Agreement and sludge is trucked off-site for safe disposal.

The most practical method of leachate management at Whytes Gully is minimisation. Although historical practices are difficult to rectify, sustainable management and best management practices are implemented in new cell development and constant monitoring and improvement of existing operational infrastructure is undertaken.

At the site, the following integrated methods are used to prevent pollution of water by leachate:

- Leachate Barrier and Collection System
- Surface Water and Sediment controls (see Section 3: Erosion and Sediment Control Plan)
- Leachate Monitoring Program (see Section 5: Stormwater Management Plan)

4.1.1 Leachate Barrier and Collection System

The EPA (2016) Landfill Guidelines require that 'the landfill must have a leachate barrier system to contain leachate and prevent the contamination of surface water and groundwater over the life of the landfill. Pollutants with the potential to degrade the quality of groundwater must not migrate through the strata to any point beyond the boundary of the premises or beyond 150 metres from the landfill footprint, whichever is smaller. If this occurs, additional engineered controls may be required to prevent further pollution migration. It may also be necessary to remediate the existing pollution'.

Reference is also made to schedule 4 condition 17 of the Project Approval and modified schedule 4 condition 18 (MP 11_ 0094 MOD 2) for requirements in relation to leachate management. The primary objective of the leachate barrier system is to provide a physical barrier for stopping leachate migration during the time that it poses significant environmental risk; therefore, neither groundwater nor surface water are affected. Unfortunately, this was not a requirement when the Western Gully Landfill was established in 1984; and subsequently there is no liner system.

4.1.2 Eastern Gully Landfill Leachate Management

The Eastern Gully Landfill was constructed as a lined landfill, with the barrier component of the lining system comprising a high-density polyethylene (HDPE) geomembrane liner (2 mm thickness). This geomembrane liner is underlain by a groundwater drainage layer comprising an approximate 500 mm thick fine gravel layer that is intended to collect any groundwater seepage from the natural materials below the liner. This incorporates a 100 mm diameter collection pipe that drains by gravity to the pond at the toe of the landfill.

The HDPE geomembrane liner in the Eastern Gully is overlain by a blanket leachate drainage layer comprising an approximately 300 mm thick clean sand layer. This layer incorporates two 300 mm diameter leachate collection pipes that drain by gravity to the toe of the landfill - one pipe drains stage 1 and the other pipe drains stage 2. Collected leachate is transferred to the leachate ponds via gravity.

4.1.3 Western Gully Landfill Leachate Management

Collection of leachate was originally through a central 100 mm diameter perforated pipe located at the base of the landfill. This pipe network did not have filter protection and became non-functional early on during the filling process. An alternate leachate collection system was then constructed, and leachate collection horizons were established successively at approximately 5 metre vertical intervals within the landfill mass; comprising a network of finger drains. At the low point on each horizon, flows in the finger drains enter a shallow 300 mm concrete or HDPE pipe; and are conveyed to the base of the landfill batter; a pipe pit was then installed at each horizon. At the toe of the landfill batter, the shallow 300 mm pipe extends through the landfill bund wall to the leachate collection pit near the current landfill access road, where it is transferred to the leachate collection ponds.

Within this Western Gully landfill area, there are two separate collection systems to manage the generation of shallow leachate and a separate one to manage the deeper leachate generation, given that no liner was installed when the landfill was first established.

4.1.4 Western Gully Shallow Leachate Collection System

The shallow leachate drainage system comprises a number of aggregate filled collection trenches each with a perforated collection pipe installed near the trench base. Collected leachate is conveyed under gravity flow through piping installed below the level of Package 2 Landfill Cell to the existing leachate drainage system.

4.1.5 Western Gully Deep Leachate Collection System

The deep leachate collection and drainage system comprises a group of collection wells that form a sump. A HDPE outlet pipe was installed by directional drilling methods through the western gully landfill toe bund to intersect with the base of the collection sump providing drainage under gravity to the site's leachate drainage system.

4.1.6 Leachate Liner

The leachate collection system in all new liner areas comprises a continuous blanket collection layer, comprising either a geo-composite drain or aggregate layer, with a network of leachate collection pipes. The collection pipes are positioned to provide an approximate 50 m (maximium) flow distance from point of entry into the blanket to the nearest pipe and to maintain positive drainage after long term landfill settlement. The system is sized to provide for long term clogging resistance and for pipe clean out access points.

The base of cells 1 to 4 are graded to drain to the south, with a leachate collection sump positioned in the southern corner of each cell. Leachate will drain to the leachate collection sump via gravity. Leachate from the piggyback cells, 2a, 2b and 4a would also drain to one of these four sumps. The sumps are essentially depressions that are filled with drainage aggregate. Each sump drains via gravity to a leachate sump riser outside the perimeter bund. Each leachate sump riser is subsequently drained via gravity through a new leachate drainage pipe to a single external leachate pumping pit for transfer to the leachate ponds and leachate treatment plant.

4.2 Current Leachate Management Practices

JPG Engineering commenced Operation and Maintenance of the Leachate Management Systems at Whytes Gully Landfill in August 2020. Their professional services were engaged to manage and improve leachate management after the stormwater contamination events in the heavy rainfall in February 2020. From the Contract start date to present, numerous upgrades and process modifications have been made or are in the process of being made to the overall system.

These upgrades and process modifications are summarised below with the full list of management activities provided in Appendix Four.

4.2.1 Leachate Collection, Storage and Transfer Systems

- Design, supply and installation of high flow Leachate Transfer Pump Systems between all three Leachate Ponds; Primary (P1), Secondary (S1) and the Backup (B1) has been completed.
- Design, supply and installation of secondary strainer type Pump Suction Pontoon Skids for the Chamber Feed Pumps located in P1 and S1 has been completed. Some benefits of this upgrade include:
- Procurement of spare P1/S1 Chamber Feed Pump has been completed (currently stored in container at Leachate Treatment Plant).
- Installation of electromagnetic flowmeters on both the P1 and S1 Chamber Feed Pump Lines has been completed.
- Hydrostatic Level Probe installation in P1, S1 and B1 Ponds as well as Leachate Chamber 1 and Chamber 2 has been completed.
- Installation of pH and Dissolved Oxygen (DO) measurement systems in the P1 Leachate Dam has been completed.
- Remote automation of the Primary Pond (P1) Surface Aerators has been completed, which allows for the control of P1 Surface Aerators remotely based on pond parameter data.

4.2.2 Leachate Treatment Plant

- The repair of SBR Aspirating Aerator #2 (off-site) has been completed. This aerator was not operational upon Contract handover.
- The Antifoam Pump System was not operational upon Contract handover due to issues with the dosing lines. This has been resolved, however once the system was running it was found that the Anti-Foam product was not effective at controlling the foam during the aeration process. The AntiFoam product has been changed to a silicon based product that has been working effectively.
- Installation of Leachate Feed Pump #1.
- Installation of Effluent Balance Tank. The existing pump was not operational upon Contract handover resulting in sludge build up in the Effluent Balance Tank.
- Design, supply and installation of Effluent Balance Tank discharge strainer to provide pump protection to the Sewer Discharge Pumps has been completed.
- Installation of Sewer Discharge Trade Waste Electromagnetic Flowmeter has been completed. The existing device was not operational upon Contract handover. A downstream isolation valve was also installed on the line to enable isolation of the Sewer Discharge line if any future works are required, avoiding the need to empty the 1.3km Sewer Discharge Rising Main.
- Supply and installation of Dissolved Oxygen (DO) measurement system has been completed. The existing system was not operational upon Contract handover.
- Supply and installation of an electromagnetic flowmeter on the Leachate Blend line has been completed. This will allow control of blend volumes once the Control System Upgrade is complete.
- Analogue (Ultrasonic) level sensors have been installed in the SBR and Effluent Balance Tank.

4.3 Future Directions in Leachate Management

The information collected in the water balance and stormwater management plan will be used to assess the capacity of the current leachate management plant for future expansion works. The Leachate Management Plan Section will be updated on a regular basis now that performance data is available.

5 Stormwater Management Plan

This Management Plan provides an overview of the current stormwater management system, how it is performing and how it can be improved. The Plan also provides a supporting Improvement and Maintenance Program to prioritise Works to ensure compliance and sustainability in stormwater management at Whytes Gully in the future.

5.1 Overview of Stormwater Management at Whytes Gully

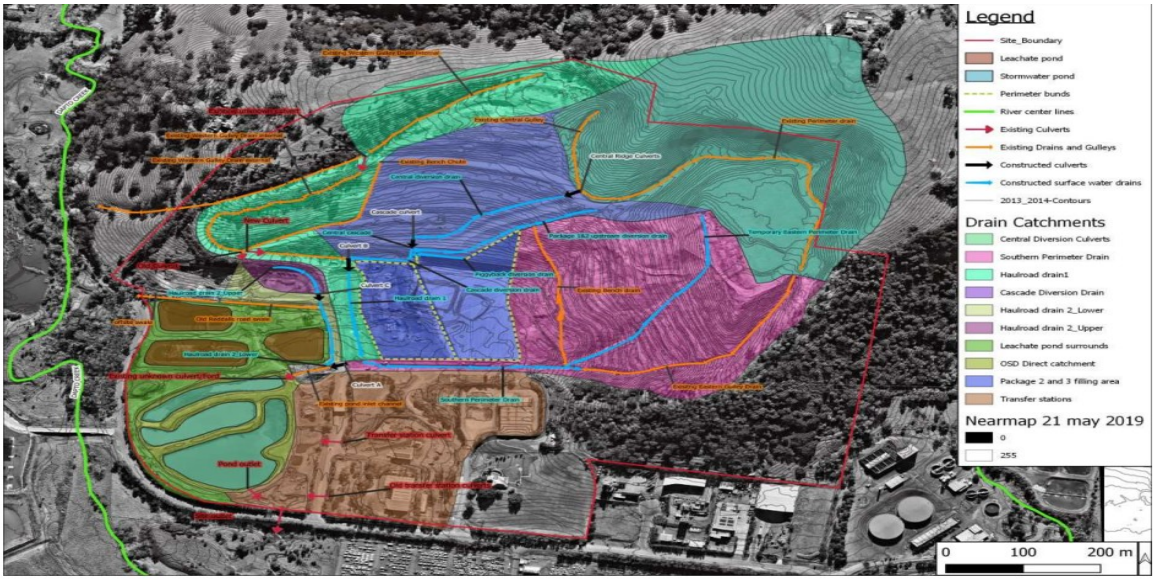
The site surface water management infrastructure encompasses open channel drains, pipes, culverts and various energy dissipation structures. In general, the surface water management encompasses:

- 'Clean' stormwater. Runoff from areas of the site where soil and vegetation have not been disturbed or final capped areas vegetation has been established is considered to be 'Clean'.
- 'Dirty' stormwater. Run off from areas of the site where soils have been disturbed and are likely to generate sediment are considered to be 'Dirty', including areas of immediate cover or final capping that has not fully vegetated.
- 'Leachate': comprises run off from areas of waste or daily cover material as well as leachate generated by the landfill.

Clean surface water is generally diverted around disturbed areas of the site where possible. Dirty surface water is conveyed to the surface water pond system for sediment treatment, storage and eventual discharge. Surface water that comes into contact with waste (leachate) is collected in the leachate collection system.

5.2 Current Stormwater Management System

The current main drainage infrastructure is shown in Figure 1. These are briefly described below and discussed in full in Appendix Five (Site -wide Stormwater Review (Golder 2021).



5.2.1 Existing Western Gully External Drain

This is only one clean stormwater drain that discharges directly into Dapto Creek from the site. All other drains shown in Figure 1 drain dirty stormwater into the pond system.

5.2.2 Central Diversion Drain

The Central Diversion Drain was constructed during the Stage 1 landfill expansion cell works. Reporting catchments include the area north of the Eastern Gully, as well as small northern catchment within the Western Gully. This Drain is connected to the Central Cascade via culverts under a haul road and is designed to convey up to the 1:20 AEP peak flow stormwater event. It was not designed for larger events as it will be removed in the future stages of landfill construction.

5.2.3 Central Cascade

During the development of Stage 1, a gabion cascade structure was constructed at the end of the Central Diversion Drain designed to cope with 1:20 AEP peak flows. This was primarily an energy dissipation structure and was upgraded recently with the further development of Stage 1 and 2A phase plans. Resulting in a 1:100 AEP peak flow capacity.

5.2.4 Cascade Diversion Drain

With the development of Package 2 and 3 phase of the landfill, drainage modifications resulted in the flows from the gabion cascade being directed westward into the Cascade Diversion Drain which confluences with a smaller channel which flows in an eastward direction. This drain is designed to convey the 1:100 peak storm event flows.

5.2.5 Culvert B

Three existing 1.2 metre culverts north of the haul road channel receives flows from the Cascade Diversion Drain as well as existing drains from the west. Flows from both east and west channels were designed to turn 90 degrees for energy dissipation and has been designed for 1:100 AEP peak storm event flows.

5.2.6 Haul Road Drainage Infrastructure

The Haul Road Drains 1 and 2, which rum parallel on the east and west side of the Haul Road respectively, were designed for construction prior to Package 2 and 3 landfill cells to convey peak flows during major storm events. A dissipation basin was designed for Haul Road Drain 1 to reduce flow energy prior to being directed through Culvert A. Culverts A and C have been sized to convey major storm events (1:100 AEP) without overtopping the Haul Road.

5.2.7 Southern Drain

The Southern Drain is a permanent open channel drain on the southern edge of the landfill. It has a gabion mattress lined portion and an inverted box culvert portion. The drain has been sized with capacity for major storm events (1:100 AEP) considering the expanded catchments in future stages.

5.2.8 Surface Water Ponds

All site surface water is currently directed into the Surface Water Pond system located on the south-western portion of the site. The Surface Water Pond system is comprised of three Reed Beds and two Polishing Ponds. The total capacity is approximately 40 000 $m^{3.}$ The polishing ponds discharge through a concrete culvert overflow and then a culvert under Reddalls Road after combining with treated surface water from the transfer stations. The flows then drain through a series of creeks and wetlands before entering Dapto Creek.

5.2.9 Rainsheds

To divert clean runoff away from the landfill cell leachate collection system, a system of channels and pipes (known as the ‘Rainshed’) was designed. The Rainshed consists of an impermeable surface supported by aggregate, creating channels and bunds to divert clean runoff to the temporary eastern drain via outlet pipes. This is a temporary structure in place until the filling of the cell occurs.

5.3 Issues Identified for Improvement in the Existing Stormwater Management System

A site walkover was conducted by Golder and Waste Services staff on the 10th December 2020 to assess the condition and efficiency of stormwater infrastructure at Whytes Gully. The following areas were identified for improvement:

5.3.1 Confluence of Southern Drain and Drain 1

The proposed bund at the southern edge of the basin located at the confluence of the Southern Drain and New Haul Road Drain 1 is not in place. Consideration should be given to bunding as designed.Rip Rap within the confluence of the basin is not visible. Consideration should be given to installing as per design requirements.

5.3.2 Package 1 Filling Plan – Upstream stormwater diversion

Channel erosion and overtopping has recently occurred along the drainage alignment that exists at the north western perimeter of the Package 1 and Package 2 landfill cell, south of the Western Gully Haul Road. These issues are believed to be related to increased catchment draining through this alignment compared to that assumed in the initial design which incorporated the bund mentioned above. This diversion bund should be implemented as per design requirements.

5.3.3 Drainage Channels

Various sections of the drainage channels have sediment accumulation within the interstitial spaces of the aggregate. This sediment has the potential to be eroded and carried during elevated channel flows which can result in elevated sediment load of surface water. There is also vegetation growth in some areas within the drainage channels including grasses, shrubs and trees that may result in reduced channel capacity and increased potential for channel overtopping.

Some areas have evidence of shifting rip rap aggregate and it appears that the Temporary Eastern Drain has collapsed and is in need of repair.

Accumulation of waste materials was noted to occur in the gabion and reno mattress lined portion of the Southern Drain. This area should be cleaned and maintained regularly.

The TRM lined stormwater drainage channels also require regular maintenance. Some areas were noted to not have grass establishment and have signs of erosion. There was some signs of liner damage evident.

5.3.4 Culverts

The main Culverts at Whytes Gully appeared to be functional and free of blockages. Some erosion appears to be occurring at the minor culverts including the accessway to Old Reddalls Road and the western intersection of the Western Gully Haul Road.

5.3.5 Stormwater Ponds

The Ponds are currently being operated via a manual pump out following confirmation of water quality within the pond being compliant with discharge criteria. It is recommended that the operations be reviewed and automated if possible.

Evidence of sedimentation of the ponds and channels was noted and desilting if the system is recommended. A bathymetric survey should be conducted at the same time to accurately measure storage capacity.

5.3.6 Potential Sediment Source Areas

The following areas have the potential to increase sedimentation risk on site:

- Borrow Excavation Areas
- Western Gully Stockpile Area
- Operational Areas
- Landfill Intermediate Cover Batters

5.4 Recommended Preliminary Actions

The following actions are recommended to improve performance of the stormwater management system:

- Development of Sedimentation and Erosion Control Plans for all disturbed and operational areas of the Site.

- Implementation of an inspection and maintenance program for all stormwater drainage infrastructure once upgrade works are undertaken.
- Investigate the suitability of lining at confluence of Southern and Access Road Drain 1 and the need for the proposed bund in the New Haul Road design.
- Implement Diversion Drain as proposed for the Access Ramp Connection design.
- Reconstruction of degraded areas of Rip Rap and TRM lined drains to original design.
- Develop and implement rectification for collapsed section of Temporary Eastern Drain.
- Further review of condition and operation of Stormwater Ponds (e.g. desilting and bathymetric survey).

5.5 Improvement and Maintenance Program

A list of actions to improve performance and reliability of the stormwater management system has been developed based on short, intermediate and long-term strategies. These are discussed below and with appropriate timeframes for completion.

5.5.1 Relocation of Stormwater Monitoring Point 1

Stormwater Monitoring Point 1 was located opposite side of the stormwater discharge outlet on Reddalls Road, Kembla Grange. This point was considered representative of Whytes Gully stormwater discharge quality when the EPL was first issued due to the rural land use surrounding the site. In recent years, there have been significant changes to the catchment, including. an increase in light industrial development. An application to amend the EPL to include this alternate sampling location was submitted and accepted in February 2021 as part of this preliminary assessment.

5.5.2 Desilting of Stormwater Ponds

The ponds currently contain silt, resulting in less than optimum storage and settling volume. It is planned to stage desilting of the three stormwater ponds progressively over the rest of this year. All ponds will have excess sediment removed and stockpiled for reuse on the site. Where possible, the re-established wetland system will be kept to maintain water quality treatment. Siltation control measures will be put in place and all works will be monitored to ensure no water leaves the site during work. The contracting company has been engaged and the first pond works are underway (this will include a bathymetric survey component). Unfortunately, COVID 19 restrictions have impacted project delivery timeframes and as a result desilting and survey works are approximately three months behind schedule.

5.5.3 Stabilisation of Pond Water Quality

The unusually heavy rainfall event of February 2020 (156.5 mm recorded) resulted in leachate migrating into the stormwater management system and impacting water quality. This resulted in a number of treatment methods being put in place based on stormwater analysis results and specialist advice. The methods used were based on a multifaceted approach using a combination of:

• Aeration

• Addition of microorganisms

• Flocking (calcium chloride)

This treatment methodology will continue to be used to maintain and stabilise water quality after rainfall events.

5.6 Water Balance Model for Whytes Gully Waste Facility

The full Site Water Balance is provided in Appendix Two.

5.7 Stormwater Harvesting and Reuse

As part of Wollongong City Council's commitment to sustainable site management, a number of water reuse strategies are being implemented. This will result in reducing pressure on the stormwater management system, reducing operational costs and assist in improving site safety.

Council is currently establishing a rapid fill water tank station on site, which will utilise treated stormwater for dust suppression, emergency management (e.g. firefighting), road cleaning and other site maintenance requirements. The specifications for the project are provided in Appendix Six.

5.8 Automation of Stormwater Management System

Currently, stormwater is discharged via gravity flow or manual pumping. It is also recirculated via manual placing of hoses and pumps as required. This practice is inefficient and requires at least 3 staff to move the heavy equipment, potentially posing an environmental and safety risk. It is planned to automate this system in the near future to allow for flexibility and improved management.

Water quality monitoring was previously conducted through physical sample collection and field analysis as required.

At the beginning of 2021, an insitu monitoring system was installed to automatically collect environmental data including standard water quality parameters and weather data. This has allowed Council to monitor pond quality in real time and improve timely water quality management.

5.9 Drainage Correction and Maintenance based on results of site review of stormwater system.

The site wide stormwater review identified several areas that would improve management on site and alleviate some of the pressure on the pond system. These are detailed in the previous sections and will be prioritised as part of the operations works plan to ensure that best practice design is followed, and optimal drainage performance is maintained.

5.10 Off-site swale Investigation and Rectification

The Golder Sitewide Stormwater Review identified an off-site swale that directed 'dirty' stormwater to an off-site drain. After detailed review of the report; and a ground truthing exercise by Council staff, the swale was confirmed to be located on the northwester portion of the site (Stage 4a). See Figure 3 in the attached Golder Site-wide Stormwater Review (12 August 2021).

The swale directs water to Haulroad Drain 2 (Lower), however it had been temporarily impaired by a bank of soil disturbed on site during some contractor works in the past. There was existing silt fencing and hay bales downstream of the bank that ensured 'dirty' stormwater did not leave the site. This was immediately rectified to ensure stormwater drains into the Haulroad Drain 2(Lower) catchment.

Further erosion/sedimentation controls were placed around the perimeter of the area as recommended in the review.

5.11 Improvement and Maintenance Plan

Strategy	Actions	Timeframe
Relocation of Stormwater Monitoring Point 1	Move sampling point onto the site	Complete
Desilting of Ponds	Scoping Works Bathymetric Survey Silt removal Reed Bed Establishment	Underway December 2021 January 2022 January 2022
Development of a water balance model	Model the stormwater/leachate/ hydrological system at Whytes Gully	Complete
Stormwater Harvesting and Reuse	Rapid Fill Tank Water Station	Underway (See Appendix Seven)

	Hardstand preparation Installation of 2 Tanks Installation of pipe, pump infrastructure	Underway February 2022
Automation of Stormwater Management System	Water Quality Monitoring Network Development of Council real time database Installation of automated pumping/recirculation/discharge system	Complete Complete April 2022
Drainage Correction and Maintenance	Desilting/Clean up of site drains Repair of Damaged Infrastructure (Business Case Development based on site review findings) Litter Removal Maintenance of drainage infrastructure	Underway Underway Weekly & Ongoing Quarterly & Ongoing
Off- site Swale Investigation	Undertake Drainage Assessment Redirect water into Haul Road 2 Drain (Lower) Establish Silt and Sediment Control Measures	Underway Complete Complete

6 Monitoring Plan

Surface and groundwater monitoring is undertaken in accordance with Approval No.11_ 0094 Schedule 4 (conditions pertaining to 'Soil and Water') and is based on the framework outlined in EPL 5862 (Appendix Six).

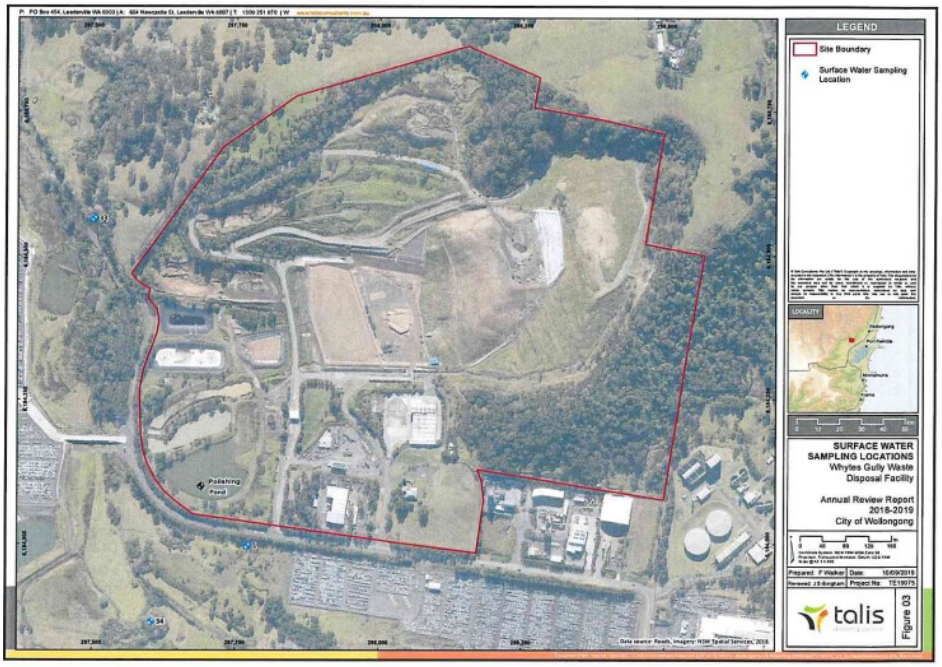
The monitoring plan for Whytes Gully Landfill relating to soil, water and leachate management is outlined in the tables and site plans below.

Table 1 : Surface Water Monitoring

Activity	Description
Purpose	Detect excess sediment loads in stormwater leaving the site and/or potential cross contamination of stormwater with landfill leachate.
Frequency	**Surface Water Monitoring Points**: Following an overflow event, water sampling is undertaken every 24 hours in accordance with EPL 5862; and **Polishing Pond**: During controlled release. Sampled Anually
Location	Sampling locations are those listed in EPL 5862, and included the following: • Monitoring Point 1 – outlet at Reddalls Road • Monitoring Point 33 – Upstream monitoring point; and • Monitoring Point 34 – Downstream Monitoring point In addition, the 'Polishing Pond' is monitored by Council during any controlled release event or overflow.
Methodology	Samples are collected using a 'scoop'; and Field parameters were recorded using a calibrated water quality meter.

	Surface Water Quality Parameters (Point 1, 33 and 34)		
	Annually		
Analytes/Field Parameters	Alkalinity	Calcium	Conductivity (EC)
	Filterable Iron	Magnesium	pH
	Sodium	Temperature	Total phenolics
	Ammonia	Chloride	Dissolved Oxygen
	Fluoride	Nitrate	Potassium
	Sulfate	Total Organic Carbon	Total Suspended Solids
	In addition, the 'Polishing Pond' was subject to analysis for pH and turbidity to ensure the water is suitable for release.		

Figure 3 Surface Water Sampling Locations



The performance criteria for surface water monitoring is detailed in the table below:

Table 2 Surface Water Performance Criteria

Description	Performance Criteria	Reference Document
Stormwater Discharge	No discharge of contaminated stormwater to water under dry weather conditions (*less than 10 mm of rainfall within a 24 hour period).*	EPL 5862
	No discharge of contaminated stormwater to water during a storm event of less than 1:10 year, 24 hour recurrence interval *(less than 297.4 mm of rain within 24 hours*).	
	pH: 6.5 – 8.5	

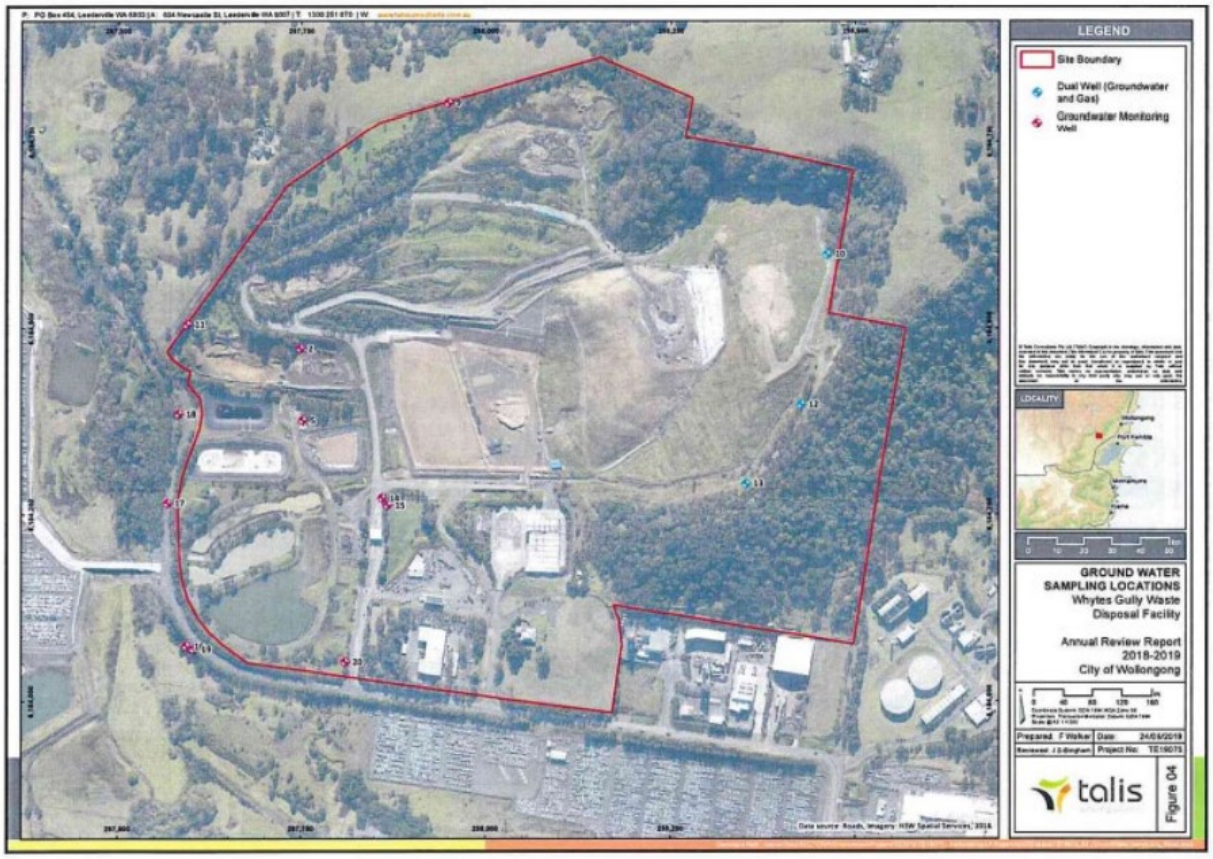
	Turbidity: 40 NTU	
Monitoring Point 1	pH: 6.5 to 8.5 TSS: 50 mg/L	Section 3 (I2) of EPL 5862

In addition to the above, Section 7.4 of the Draft LEMP (Golder 2020) states that all surface water results are to be assessed against the Australian and New Zealand and Australian State and Territory Governments (ANZAST) *Guidelines for Fresh & Marine Water Quality, 2018 (ANZAST 2018).*

Table 3: Groundwater Monitoring

Activity	Description	
Purpose	Detect if groundwater is impacted by leachate.	
Frequency	Quarterly in accordance with EPL 5862.	
Locations	Sampling locations are in accordance with EPL 5862, and included the following monitoring points: 5,9,10,11,12,13,14,15,16,17,18,19 and 20.	
Methodology	Prior to sampling, the sampling the standing water levels (SWLs) are measured using a water level meter; Groundwater samples were collected using a bailer; Field parameters were recorded using a calibrated water quality meter prior to sampling.	
Analytes/Field Parameters	The analysis schedule in accordance with M2.3 of EPL 5862 and included: **Groundwater Parameters**	
	Annually	Quarterly
	Metals: aluminium, arsenic, barium, cadmium, chromium (hexavalent and total), cobalt, copper, lead, manganese, mercury, zinc	Alkalinity
	Benzene, toluene, ethylbenzene, xylene (BTEX)	Major anions and cations: Calcium, magnesium, potassium, sodium, chloride, sulfate
	Fluoride	pH and EC
	Nitrate and nitrite	SWLs
	Organochlorine and organophosphate (OC and OP pesticides)	Total dissolved solids (TDS)
	Polycyclic aromatic hydrocarbons (PAH)	TOC
	Total Petroleum Hydrocarbons (TRH)	Nitrogen – (ammonia)
	Total phenolics	

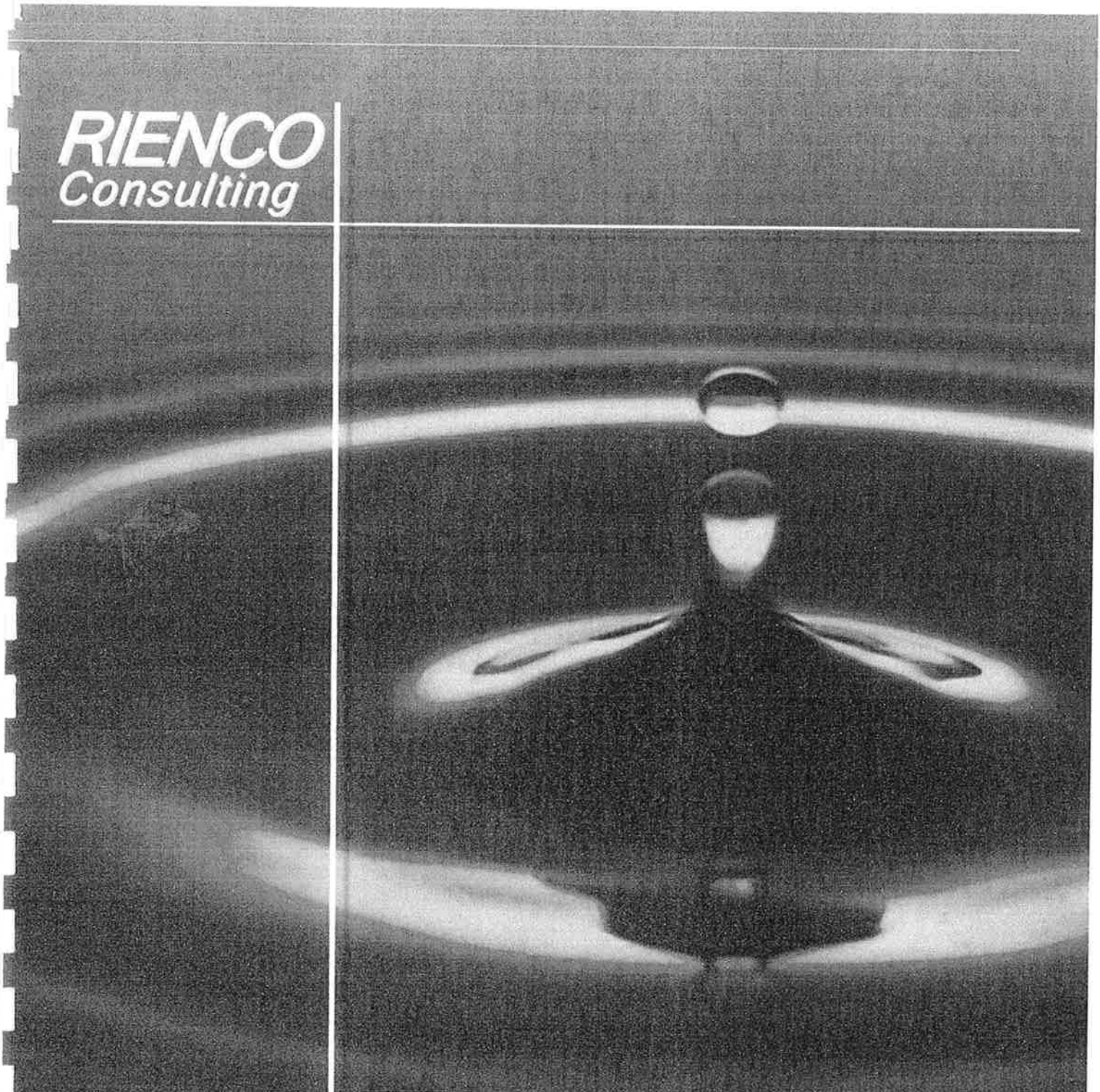
Figure 4 Groundwater Sampling Locations



7 Conclusion

This Soil, Water and Leachate Management Plan updates previous documents and details current site management practices that were put in place to minimise future contamination and overflow events. This report will be updated yearly in accordance with compliance and reporting requirements as part of the Landfill Environmental Management Plan.

RIENCO
Consulting



Whytes Gully Landfill Surface Water and Leachate Management Plan 2008

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WHYTES GULLY LANDFILL SURFACE WATER AND LEACHATE MANAGEMENT PLAN 2008

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Executive Summary

Whytes Gully Landfill is the principal waste facility for Wollongong City. It is located at Reddalls Road, West Dapto to the south west of Wollongong CBD. This report investigates improvements to the operation of the existing landfill in order to reduce generation of leachate from the site and better manage stormwater runoff.

At Whytes Gully, leachate is collected via a sub-surface drainage system beneath the landfill. This collection system drains by gravity to temporary leachate storage ponds before discharge to sewer. Recent wet weather over the period 2007 to 2008 has resulted in accumulation of leachate in excess of the pond capacity, resulting in pond overflow on a more frequent basis than anticipated. An analysis of recorded site rainfall and pond level data for the period April 2007 to July 2008 found that on an average basis approximately 36% of the rainfall which fell on the landfill and ponds was converted to leachate. It was also found that leachate production is highly sensitive to extended periods of wet weather and that this sensitivity is in part due to several small but efficient cross-connections between the leachate and stormwater systems.

In order to reduce leachate generation, Council must reduce the average infiltration rate across the landfill capping including removal of cross-connections. In order to assess the effectiveness of reduced infiltration rates, a monthly water balance of the site was developed. Results demonstrate that a reduction in the area used for active filling to a maximum of 2 hectares, along with an average minimum reduction in infiltration of 10% across the Eastern Gully, will reduce the generation of leachate to more acceptable levels.

Rainfall that does not evaporate or infiltrate to become leachate, is collected in open drains and directed as surface water towards a series of constructed stormwater ponds before discharging into Dapto Creek. The catchment surface over which this surface water flows is generally well protected by vegetation, however there are localised opportunities for scour and erosion. Natural soils are potentially dispersive making focussed effort towards source control of erosion at these sites of high importance.

A two-dimensional hydrodynamic model of the surface flowpaths was constructed and confirms potential cross-connections of surface water into the leachate system that should be removed. Also stormwater pond sizing using the NSW Department of Housing 'Blue Book' found that the existing stormwater ponds are of sufficient volume to provide treatment however stabilisation works and revegetation works are required in order to meet the original design intent.

These observations informed the development of management measures for both the leachate and surface water systems. The selected measures were low cost options that yielded high benefit in terms of the performance objectives sought. Key measures include: reducing the active fill zone to 2 hectares, reducing average infiltration across the Eastern Gully by a minimum 10%, and maintenance of ponds at maximum 50% capacity.

In addition, several non-structural measures were identified for implementation involving:

- *Planning to provide certainty for long term leachate and surface water management.*
- *Investigations to allow targeting of any further short term improvements.*
- *Monitoring to ensure ongoing and improved understanding of system behaviour.*

The complex nature of these systems and their interaction with variable site and climatic conditions warrants a cautious approach. Accordingly, management options that demonstrate clear benefits should be implemented immediately, followed by a period of observation and additional data collection. If continued system failure is observed, even after implementation of 'stand out' solutions, then additional measures should be considered. However with improved data availability these future decisions can be made with more certainty.

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1 Introduction

1.1 Background

Whytes Gully Landfill is the principal waste facility for Wollongong City and is located at Reddalls Road, West Dapto to the south west of Wollongong CBD. For the purpose of environmental licensing the landfill is classified as a 'Class 1' facility able to accept domestic and commercial waste including putrescibles. The landfill commenced operation in 1984 and is managed by Wollongong City Council. A basic site plan is shown below whilst a more detailed version is included in **Appendix A**.

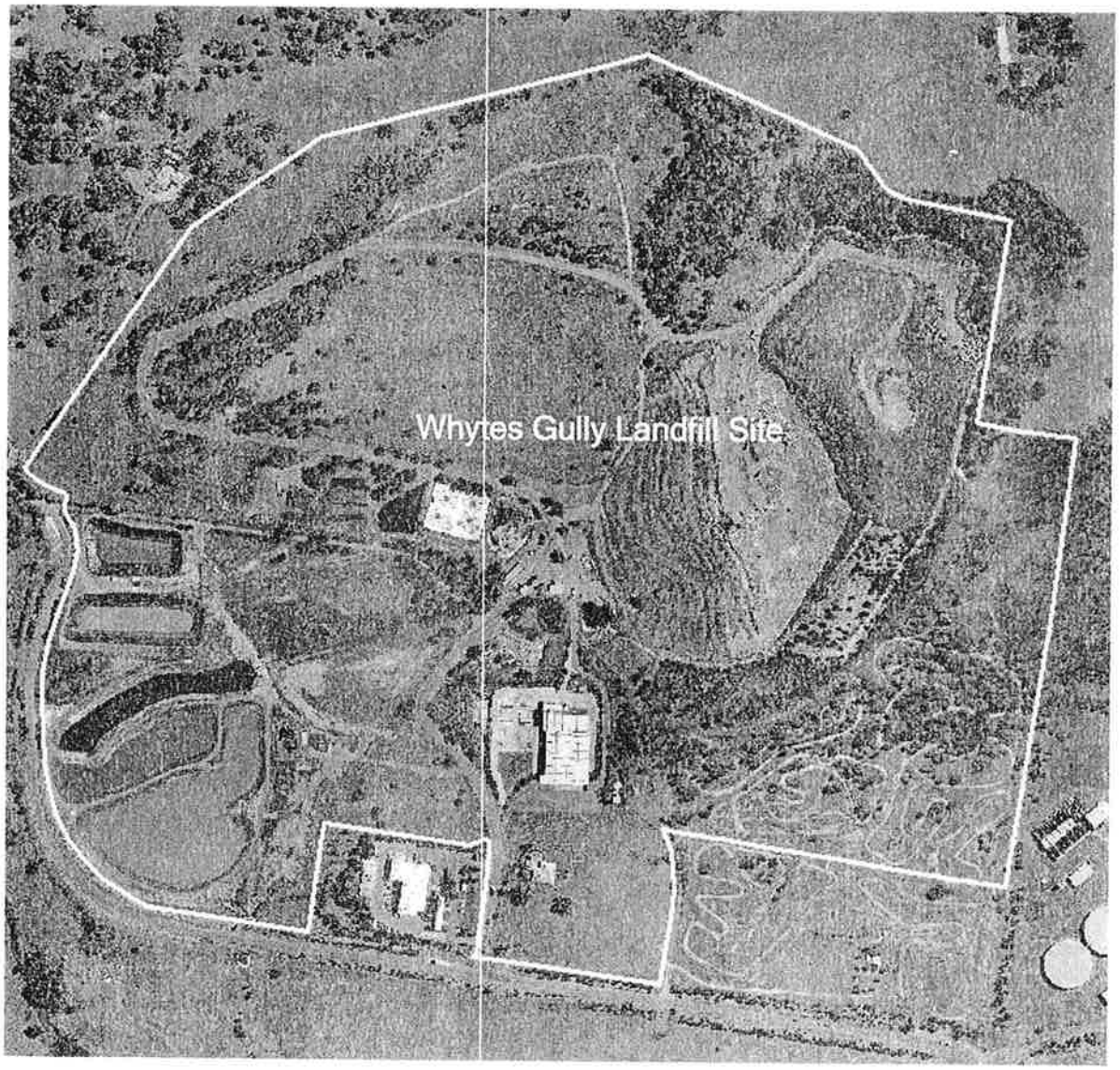


Figure 1.1 Whytes Gully Landfill Site (circa 2006)

As a consequence of past overflows from the leachate ponds, Council is investigating improvements to the operation of the existing landfill in order to reduce generation of leachate from the site and better manage stormwater runoff. As part of this process Council has engaged water engineering specialists, Rienco Consulting, to prepare a 'Surface Water and Leachate Management Plan' for the site in its current state of development (this document) to highlight the causes of these past problems and provide guidance in respect to their elimination.

1.2 Objectives

The objectives of this investigation and Plan are then to;

- Describe the existing surface water and leachate collection system
- Identify possible causes of leachate overflow or polluted stormwater
- Identify and assess available short term management options to address problems
- Develop a list of specific recommended actions to be implemented immediately
- Develop a list of considerations for future surface water and leachate management

1.3 Limitations

This document relates to the existing site and its current operational regime. The site is anticipated to change physically over time due to normal filling activities. Aspects of its operation may also change due to changes in waste material availability, waste management technology and legislative environment. It is also noted that Council may be seeking approval for an expansion of the site.

Any significant changes to the site and its operation may change the behaviour and interaction of surface water and leachate on the site. The advice provided herein may therefore lose relevance or need to be altered as time passes. Accordingly it is recommended that a periodic review of this plan be undertaken on an annual basis or before significant changes occur at the site.

2 General Site Description

2.1 Overview

The landfill site comprises two natural gullies known as the 'Western Gully' and 'Eastern Gully', located at the base of a prominent escarpment ridgeline. Landfilling commenced in the Western Gully in 1984 and was completed in 1993. The Eastern Gully is currently subject to filling operations and has approximately 4 years of remaining capacity.

Both gullies have been constructed as a series of stacked horizontal cells, progressively terraced in an upslope direction. The outer faces (sloping) of each cell combine to form an 'intermediate cover' for the entire emplacement on completion. The material used for the outer face is locally sourced VENM, preferably with high clay content.

The uppermost horizontal face of each cell is buried beneath the next cell above and comprises of coalwash (Western Gully) or slag (Eastern Gully). This material is referred to as 'daily cover'. Each cell is approximately 3m in total thickness and is made up of a series of 'lifts', each of which are also covered by a thin layer of daily cover to form a trafficable surface.

Over the period of operation of the site, Council has observed a significant change in the nature of materials available for use as intermediate cover. Council has observed that the clay content of the Western Gully's intermediate capping is on average higher than the Eastern Gully. The Western Gully also has gentler grade which has resulted in thicker capping with higher rates of compaction. It is also noted that the Western Gully does not have a base liner and is founded on bedrock whilst the Eastern Gully has an impermeable base liner.

To the south of the landfill and at the valley low point there are several large constructed ponds that collect leachate and stormwater from the site. These ponds and their collection systems are described in **Section 2.2** and **Section 2.3**.

Final capping with high clay content compacted material has not yet been undertaken at the site pending the possible development of a third emplacement stage as described in **Section 2.4**. However for modelling purposes the Western Gully capping has been characterised as performing more like a final cap layer.

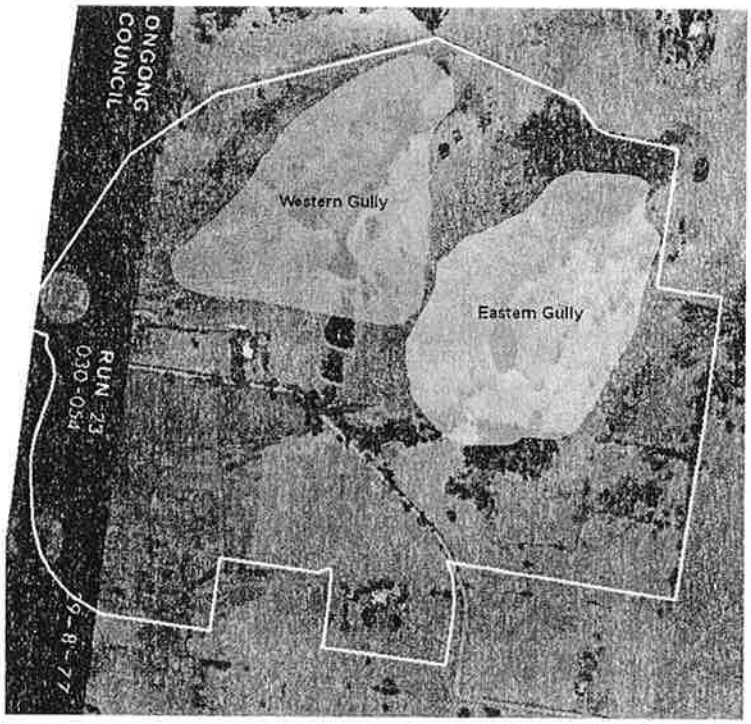


Figure 2.1 Aerial Photo of Landfill Site circa 1977 (before landfill)

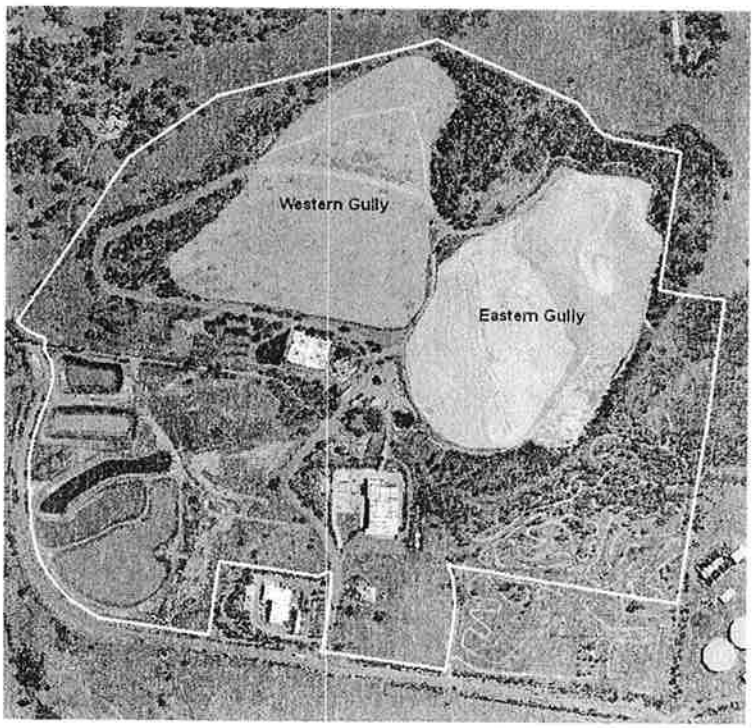


Figure 2.2 Aerial Photo of Landfill Site circa 2006

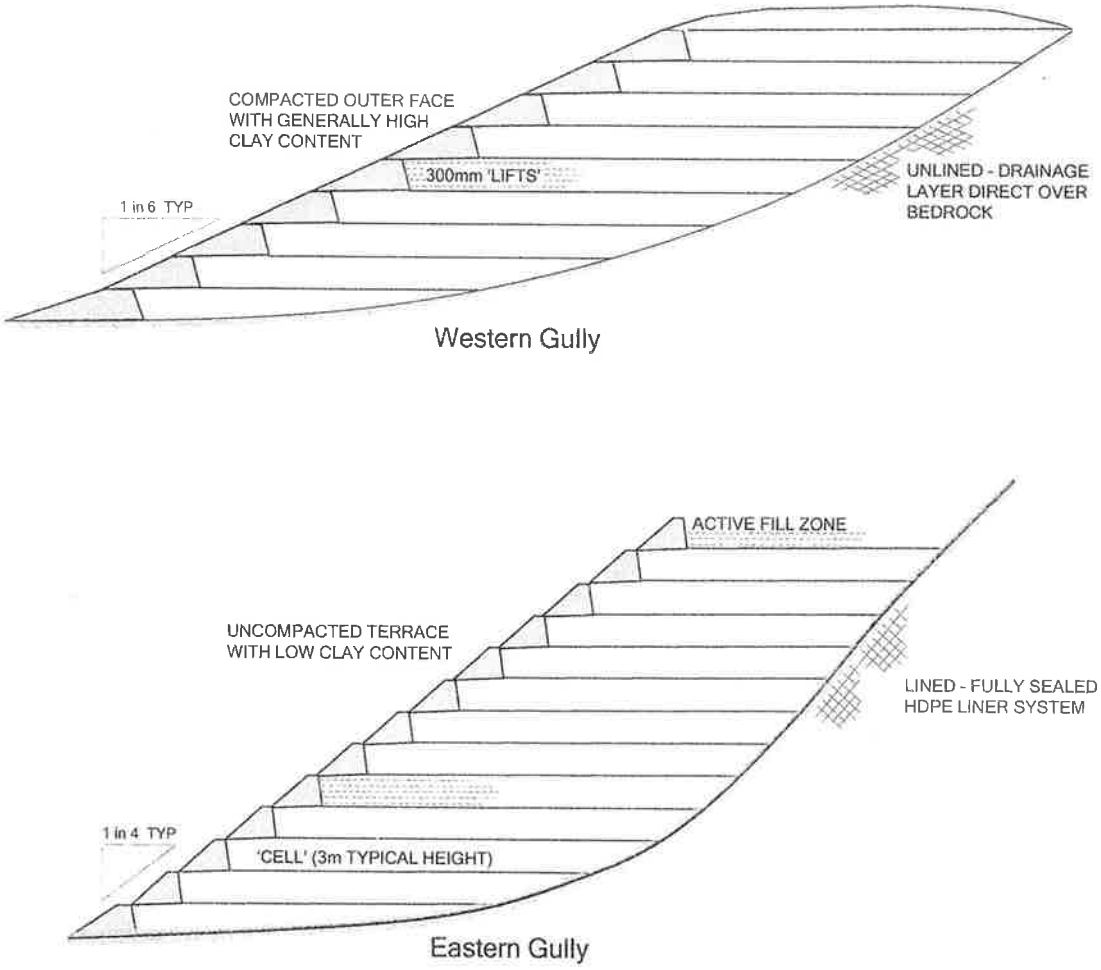


Figure 2.3 Whytes Gully Landfill Typical Sections (not to scale)

2.2 Leachate System

Leachate comprises of water that has come into contact with waste. Leachate is generated by:

1. infiltration of rainfall through the capping into the emplacement proper
2. direct cross-flow of surface water into the leachate collection network
3. importation within waste delivered to the site
4. infiltration of groundwater through the base liner up into the emplaced material

At Whytes Gully, leachate is collected via a sub-surface drainage system located at the base of the landfill. This comprises a sand drainage layer containing a network of slotted collection pipes that drain by gravity to the leachate ponds. There are also several points at which there are cross-connections between surface water and the leachate pipe network. These cross-connections were

originally designed to capture surface runoff from parts of the capping and input them into the leachate system. Collected leachate is then directed to temporary leachate storage ponds.

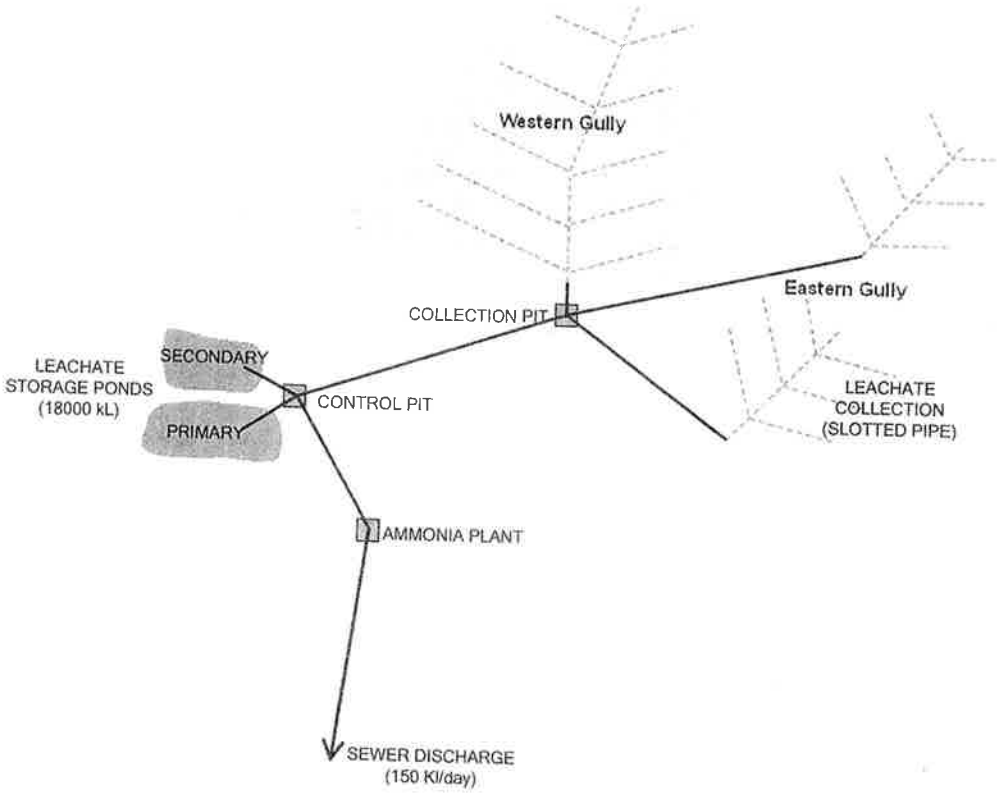


Figure 2.4 Leachate System Components

The leachate ponds at Whytes Gully were constructed in 2004 though not commissioned until 2006. There are two separate ponds referred to as the 'Primary Pond (P1)' and 'Secondary Pond S1' which have a combined storage capacity of approximately 18000 kL. These ponds temporarily store leachate before discharge off site via sewer. Immediately prior to sewer discharge, leachate is treated to reduce its ammonia concentration in compliance with Council's trade waste agreement. It is noted that sewer discharge is currently limited to a maximum of 150 kL per day due to capacity constraints in the downstream sewer trunk main. Discharge via tanker truck is also undertaken on demand to supplement this discharge capacity.

The adopted design criterion used to establish the leachate storage volume was capture of the '1 in 25 year 24 hour' storm event. This was assessed using a calibrated daily time-step water balance model and a design storm event of 360mm total rain depth over a 24 hour period (Forbes Rigby,

2002). Capture of the design event assumed a maximum starting volume (at the beginning of the design event) of 8100 kL. It was recommended in this earlier report that Council maintain the ponds at or below this volume and that the area of daily cover must be minimized in order to achieve this.

2.3 Surface Water System

Surface water runoff occurs during heavy rainfall when the infiltration capacity of the soil is exceeded. This water is collected in open drains and directed towards a series of constructed stormwater ponds. Where possible, surface water from those parts of the catchment that are outside the landfill site or that remain undisturbed have been directed away from the stormwater ponds. Some surface runoff from those areas of landfill comprising daily and intermediate cover is also directed towards the leachate collection system.

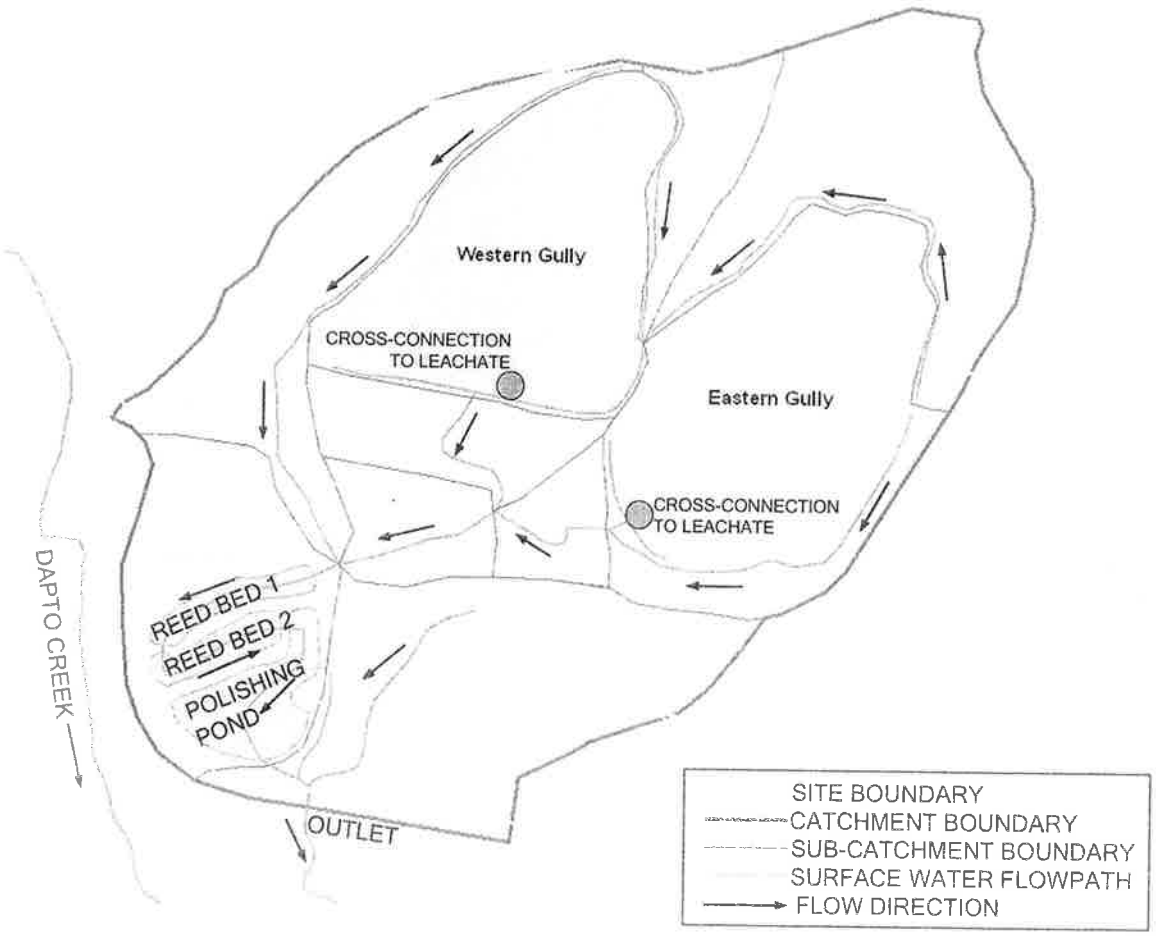


Figure 2.5 Surface Water System Components

The stormwater ponds were constructed in 2004 at the same time as the leachate ponds. They comprise three sequentially connected ponds, configured with a linear flow path to enhance their treatment capacity. Ponds 1 and 2 include 'reed beds' designed to contain thick vegetation and enhance stormwater treatment, whilst the last pond is much deeper and is predominantly open

water. The stormwater ponds have a combined static (permanent) volume of approximately 32,000 kL and a dynamic volume (between the level of the low flow outlet and spillway) of 8,000 kL. This dynamic storage is designed to drain out of the stormwater ponds over a period of 36 hours.

2.4 Future Landfill Extension 'Stage 3'

The Western Gully and Eastern Gully were each planned and designed separately as Stage's 1 and 2 of the overall landfill operation. A third and final stage (also referred to as the 'Western Gully Extension') has been identified for future expansion of available landfill capacity. Conceptually the third stage is proposed to extend out from the current landfill, burying both Stage 1 and Stage 2 and bridging between the two.

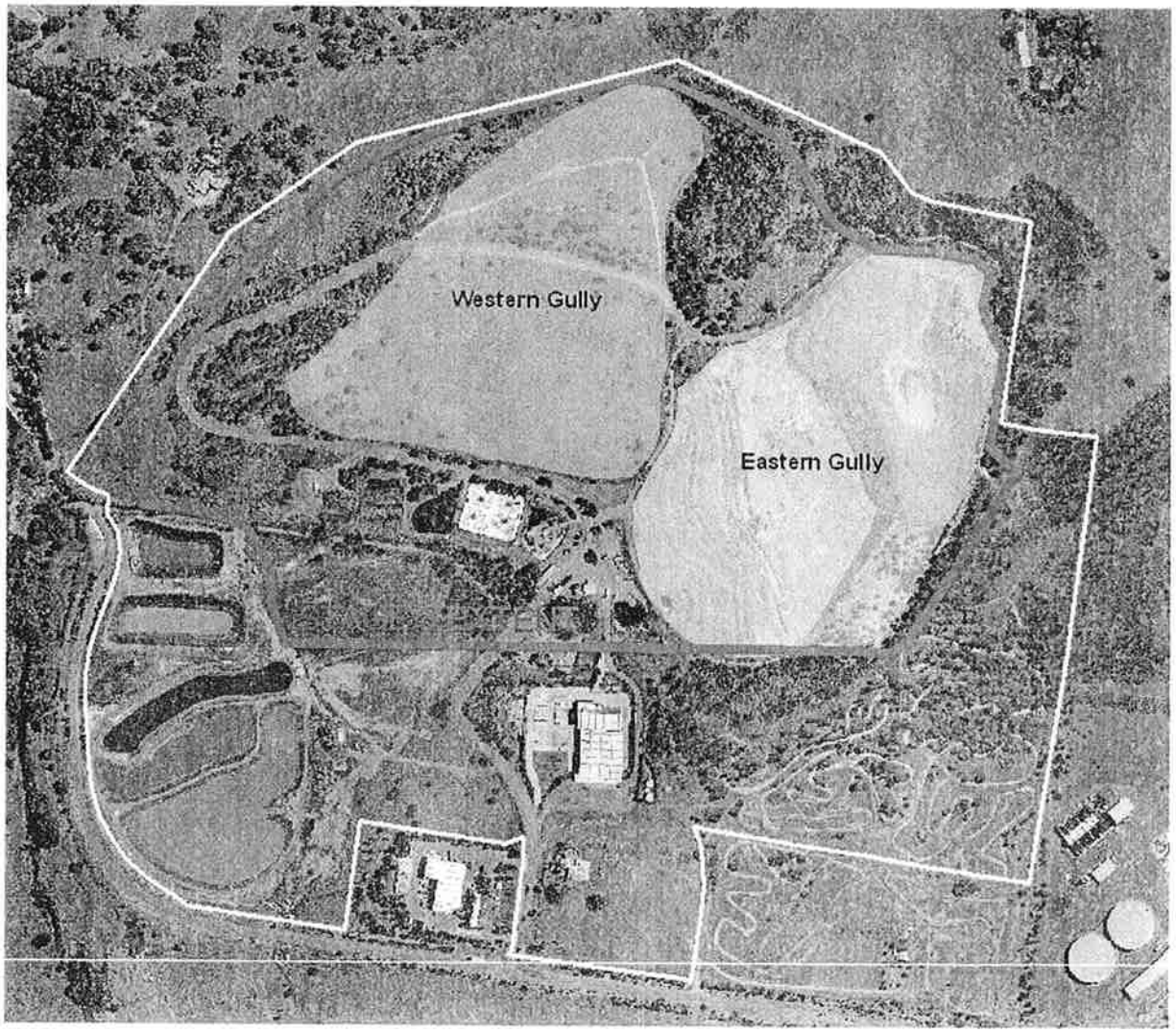


Figure 2.6 Proposed Stage 3 Whytes Gully Landfill (approximate extent only)

Approvals and detailed planning for Stage 3 have not yet commenced. It is anticipated that the Eastern Gully will reach capacity in approximately 4 years time and that Stage 3 will follow on immediately, assuming approval is obtained.

It is noted that the existing leachate and stormwater ponds were designed in anticipation of Stage 3 construction and have been sized and positioned accordingly (Forbes Rigby, 2002).

3 Available Data

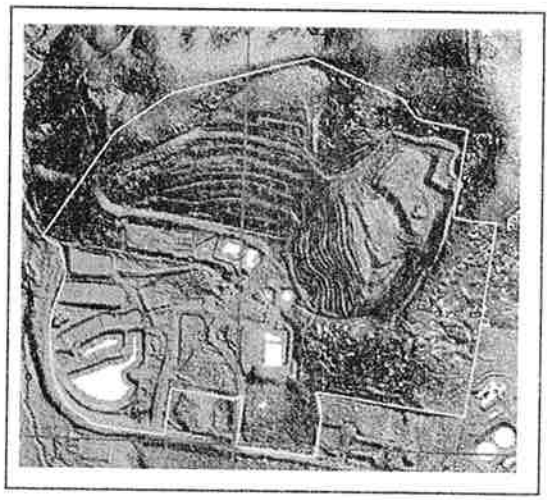
3.1 Spatial

Aerial Photography

High resolution aerial photography recently captured for the site (circa 2006) and surrounds and spatially referenced (see **Appendix A** for larger format graphic).

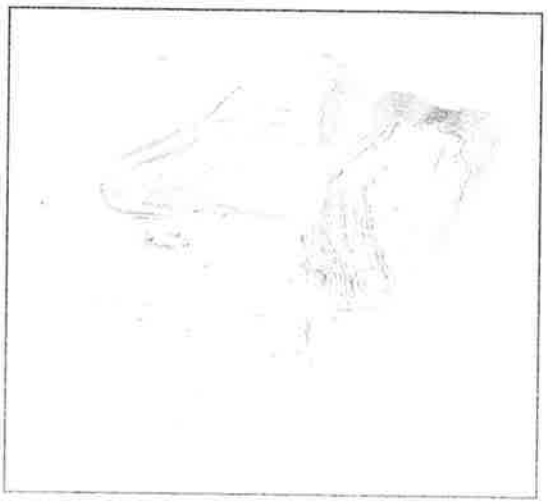
Li DAR

High resolution ground height data recently captured for the site and spatially referenced. This dataset has a nominal height accuracy of +/- 100mm and includes spot heights at typically less than 2m spacing. These spot heights were subsequently processed by Rienco into a Digital Elevation Model (DEM).



Ground Survey

Ground height data captured by Council's surveyors and providing high accuracy (mm) detail of ground features including small topographic features such as table drains and embankment crests. This data is captured on a regular six monthly cycle as part of Council's monitoring program to enable periodic calculation of waste levies. Survey captured in June 2007, December 2007 and June 2008 was obtained for this investigation.



3.2 Non-Spatial

Previous Reports

A number of reports were supplied by Council and include information with respect to water management at the site as follows:

Whytes Gully Landfill Extension Landfill Management Plan (Maunsell, 1992)

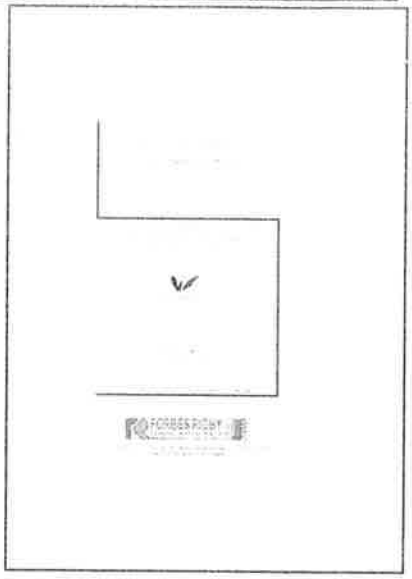
This report was prepared prior to the commencement of the Stage 2 landfill (Eastern Gully) in accordance with the requirements of DECC (formerly NSW EPA). The report provides guidance for the establishment and operation of Stage 2 and includes conceptual details of the proposed landform, filling plan, operations plan, gas control, and surface water and leachate systems.

Whytes Gully Landfill Extension - Environmental Management Plan (Maunsell Pty Ltd 1998)

This LEMP was prepared in 1998 following for the most part the requirements of the EPA Guidelines for Solid Waste Landfills. It was prepared to permit Council to fulfil its regulatory and licencing roles and as a document to promote improvements in landfill operations in the future.

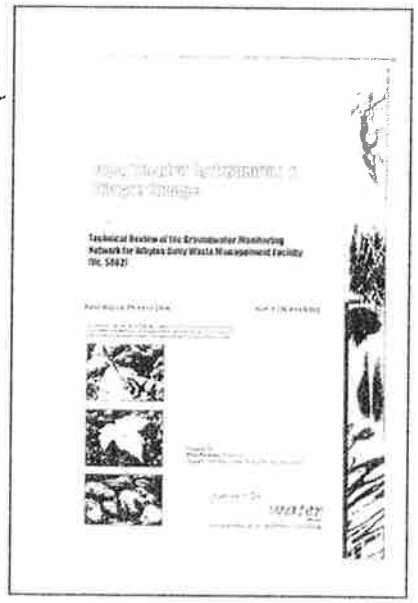
Whytes Gully Landfill Leachate Management Study (Forbes Rigby, 2002)

This study investigated generation of leachate at the site and provided conceptual details for proposed new leachate and stormwater ponds (since constructed). New ponds were required to facilitate site re-configuration, possible future expansion (Stage 3) and to address observed deficiencies in leachate storage. Whilst recommendations were made with respect to appropriate management practices to mimimize leachate generation, the reports focus was conceptual design of new ponds.



Technical Review of the Groundwater Monitoring Network for Whytes Gully Waste Management Facility (Earth2Water, 2008)

This report identified several issues with respect to leachate management at the site. Further groundwater and surface water monitoring was recommended to improve general understanding of the groundwater regime and groundwater/surface water interaction. The report identified high leachate generation potential at the site and the need for additional control measures including improved capping and redirection of stormwater away from leachate collection systems.



Rainfall and Leachate Pond Data

Manly Hydraulic Laboratory (MHL) on behalf of Wollongong City Council maintains a continuous record of both rainfall and leachate pond levels at Whytes Gully. These gauges were installed in late 2006. Available data includes:

- Continuous water level 'Primary Pond' (P1)
- Continuous water level 'Secondary Pond' (S1)
- Continuous rainfall gauge located at Secondary Pond (S1)

Whilst data is collected continuously, data was retrieved for the period of interest (April 2007 to October 2008) in hourly intervals.

Leachate Discharge Records

Council maintains detailed records of the volume of leachate discharged from the ponds to sewer in accordance with its Sydney Water trade waste agreement. Records were supplied for the 2 year period between July 2006 and July 2008 in the form of periodic flow meter readings. For the purpose of analysis these were processed into an average hourly time series.

Due to extended periods of wet weather beginning mid 2007 and resultant elevated leachate pond levels, Council commenced with supplementary discharge of leachate to sewer via tanker truck. Records of tanker volumes were supplied for the period August 2007 to June 2008 in the form of periodic volume records. These were also processed into an average hourly time series.

Other Data

Other information obtained for use in this investigation included:

- Long-term monthly average rainfall statistics for the Wollongong Post Office rainfall gauge located approximately
- Long-term monthly average evaporation statistics for the Sydney Airport weather station

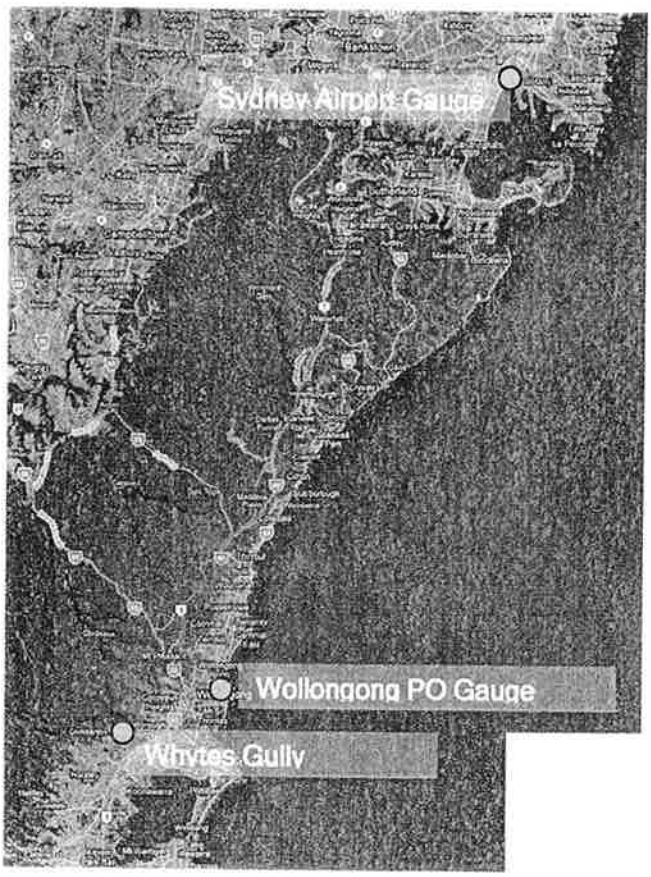


Figure 3.1 Climate Gauge Locations

4 Performance Objectives

4.1.1 Environmental Licencing Requirements

The Whytes Gully landfill is a regulated disposal facility subject to Environmental Protection Licence No. 5862. The conditions of this licence provide minimum performance objectives for leachate and stormwater management systems viz.

"There must be no discharge of leachate to waters under dry weather conditions or storm event(s) of less than 1:25 year 24 hour recurrence interval"

and

"There must be no discharge of contaminated (TSS>50mg/L) *stormwater to waters under dry weather conditions or storm event(s) of less than 1:10 year 24 hour recurrence interval".*

4.1.2 Pond Design Criteria

It is relevant to note the design criteria used for sizing of existing treatment ponds as documented in the *Whytes Gully Landfill Leachate Management Study* (Forbes Rigby, 2002). The ponds were designed with the intent of meeting the performance objectives required under the Environmental Protection Licence described above. Any performance related design criteria will also need to be included or re-assessed as part of this management plan.

Leachate Ponds

Key design criteria used for establishing the storage capacity of the existing leachate ponds included:

- 1 in 25 year 24hr 'design' storm with a total rain depth of 360mm producing 6750 kL of leachate (assessed using a calibrated daily timestep model)
- Approximate 30% average rain to leachate conversion rate incorporating landfill with 5.7 ha 'Daily Cover', 2.7 ha 'Intermediate Cover', and 21 ha 'Final Cover' (based on an assumed worst case daily cover scenario and implementation of Stage 3)
- Maximum wet weather sewer discharge rate of 150kL/day
- Maximum starting pond volume of 8100kL prior to storm commencement (based on assumption of 90% volume of the old leachate ponds).
- New pond volume = 8100kL + 6750kL + 20% factor of safety = 18000kL

Stormwater Ponds

Key design criteria used for establishing the storage capacity of the existing stormwater ponds include:

- Total catchment area draining to stormwater ponds of 50ha
- 1 in 10 year 24 hr 'design' storm with a total rain depth of 288mm producing 70,000kL of stormwater over 24 hours. Average daily discharge rate during the design event of 800 L/s.

- Minimum storage capacity equivalent to the capacity of the old ponds (since decommissioned and removed) on the basis that the old ponds had demonstrated adequate performance (N.B. final design outcome involved ponds with twice the storage capacity of the old ponds).

- Pond layout incorporating good wetland design including linear flowpath, vegetated reed beds, and dynamic storage.

- In the event of leachate pond overflow (due to wet weather or pump failure), the leachate ponds overflow into the stormwater pond system before discharge to Dapto Creek (to provide some pre-treatment).

No specific calculations were undertaken to confirm the ability of the stormwater ponds to ensure licence discharge requirements were met (ostensibly due to the difficulty of demonstrating compliance with a concentration based objective). The ponds were instead designed based on conservative design assumptions and empirical evidence that the previous ponds were providing good performance.

4.1.3 Other Objectives

In addition to the above performance objectives and design criteria, DECC have indicated that the stormwater pond design should now be re-assessed against the requirements of the NSW Department of Housing 'Soils and Construction' Guideline ('The Blue Book'). This re-assessment has been undertaken and is described in **Section 5.2.4**.

5 Existing Behaviour

5.1 Leachate System

5.1.1 Generally

The existing behaviour of the Whytes Gully leachate system can be generally characterised by a continuous but variable flow of leachate that increases during periods of prolonged wet weather. During wet periods, leachate accumulates in the storage ponds resulting in diminished capacity to store leachate produced by any subsequent storms.

As a result of higher than anticipated leachate flows and diminishing available storage, leachate pond overflow events have occurred more regularly than anticipated by design and expected by Council and DECC. Four recent overflow events were observed in June 2007, November 2007, December 2007 and February 2008.

System behaviour over the past two years has been influenced by the following factors:

	Factor	Description
1	**Leachate & Surface Water Interaction**	*There are significant localised cross-connections between the surface water and leachate systems increasing the volume of leachate produced following heavy rain*
2	**Capping Permeability**	*High average permeability of landfill capping materials particularly in areas of daily cover results in conversion of a high proportion of rainfall into leachate*
3	**Patterns of Rainfall**	*The system experiences high average rainfall that varies considerably with climatic cycles (i.e. el nino, la nina). Wet weather events do not often occur in isolation but as a series of wet weather events over several wet months. This significantly increases the volume of leachate base flow during these times.*
4	**Leachate Storage Volume**	*The available total leachate storage volume is fixed (approx 18000 kL) Ponds have been close to full for extended periods during the time that problems have been experienced.*
5	**Discharge Capacity**	*The system has a small but fixed outflow discharge rate (maximum 150kL/day via sewer) The only means of increasing outflow is by tankering.*

Whilst a full and detailed understanding of the above factors and their interaction is desirable, this requires large amounts of information, much of which remains unavailable at this stage. It is also relevant to note that Factors 3, 4 and 5 are reasonably fixed conditions. This plan must therefore focus on understanding (within existing data constraints) the mechanism by which rainfall is converted to leachate via surface water interaction (Factor 1) and capping infiltration (Factor 2), and how this conversion rate might be reduced.

5.1.2 Analysis of Rainfall and Pond Data

Continuous site rainfall and leachate pond level monitoring data was obtained for the period April 2007 to October 2008. Data processing was undertaken in order to convert measured pond levels into a corresponding storage volume. The storage volumes for the 'Primary' and 'Secondary' ponds were then summed to provide a total stored volume at the site. Conversion between pond level and volume was undertaken using a height-storage relationship derived from design drawings of each pond. A time series plot is shown in **Figure 5.1** below.

During this period the collected pond level data experienced several datum shifts (changes in gauge zero) and gauge 'bounces' (unexpected rapid rise and fall of recorded level). Where possible these gauge issues were corrected in the derived time series. It is understood Council has since resolved these issues and that future data will be of a higher overall quality.

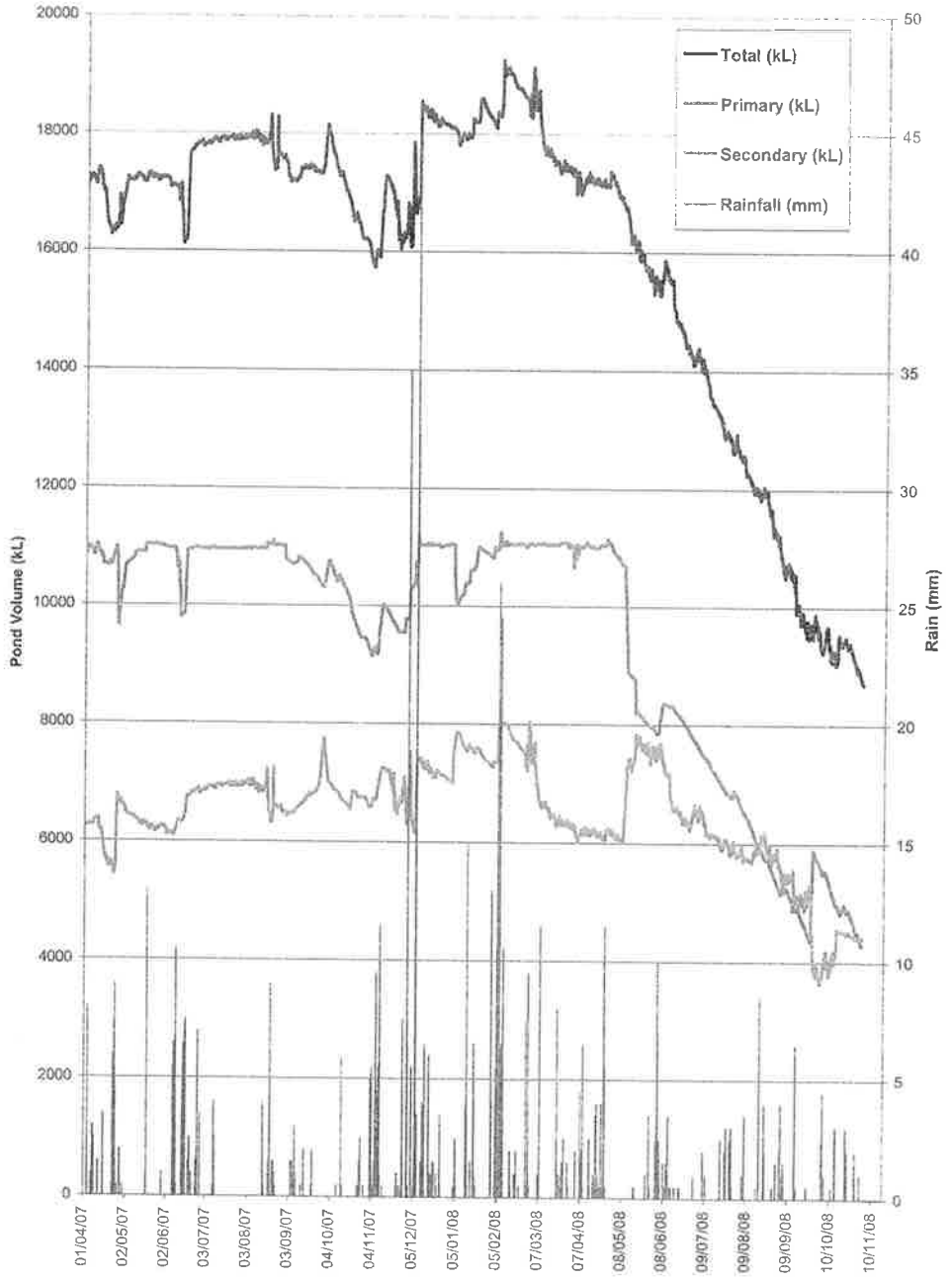


Figure 5.1 Recorded Rainfall and Leachate Pond Volumes April 2007 - October 2008

The time-series plot in **Figure 5.1** shows an extended wet period between April 2007 and April 2008 where the ponds were almost full or overflowing. This corresponds to an equivalent period of high rainfall including four major wet periods in June 2007, November 2007, December 2007 and February 2008. This behaviour confirms the sensitivity of stored leachate volume to extended periods of high rainfall.

Comparison of recent measured monthly rainfall totals against long term averages indicates the rainfall experienced at Whytes Gully between April 2007 and April 2008 was high and that four of these months approached or exceeded long term 90th percentile monthly averages. Observed overflow events occurred during these same extreme wet months.

Table 5.1 Monthly Rainfall at Whytes Gully Compared to Long Term Averages

Month Year	Measured Rainfall (mm)	Long Term Average Monthly Rainfall (mm)*	Long Term 90th Percentile Monthly Rainfall (mm)*
April 2007	132	129	259
May 2007	18	115	226
June 2007	**252**	**107**	**262**
July 2007	19	92	208
August 2007	69	61	141
September 2007	32	65	140
October 2007	19	67	134
November 2007	**230**	**72**	**132**
December 2007	**186**	**86**	**173**
January 2008	92	106	229
February 2008	**291**	**110**	**257**
March 2008	53	118	226
April 2008	111	129	259
May 2008	6	115	226
June 2008	83	107	262
July 2008	47	92	208
August 2008	34	61	141
September 2008	47	65	140
October 2008	67	67	134

** BOM Wollongong Post Office - Gauge no. 068069 (approx 80 years of record)*

Since April 2008 a significant decline in stored leachate volume has been observed to a current level of approximately 9000kL (50% of capacity). The system therefore demonstrates capacity to recover quickly when drier weather resumes, however this currently relies on supplementary tankering of leachate off-site.

In order to gain a more detailed understanding of the proportion of incident rainfall on the landfill converted to leachate during a typical storm, a leachate mass-balance was undertaken. Analysis was undertaken for four separate storm events over the period October to December 2007 (refer **Figure 5.2** and **Table 5.2** below). The calculation accounts for the volume of leachate discharged from the ponds via sewer, supplementary tankering and evaporation.

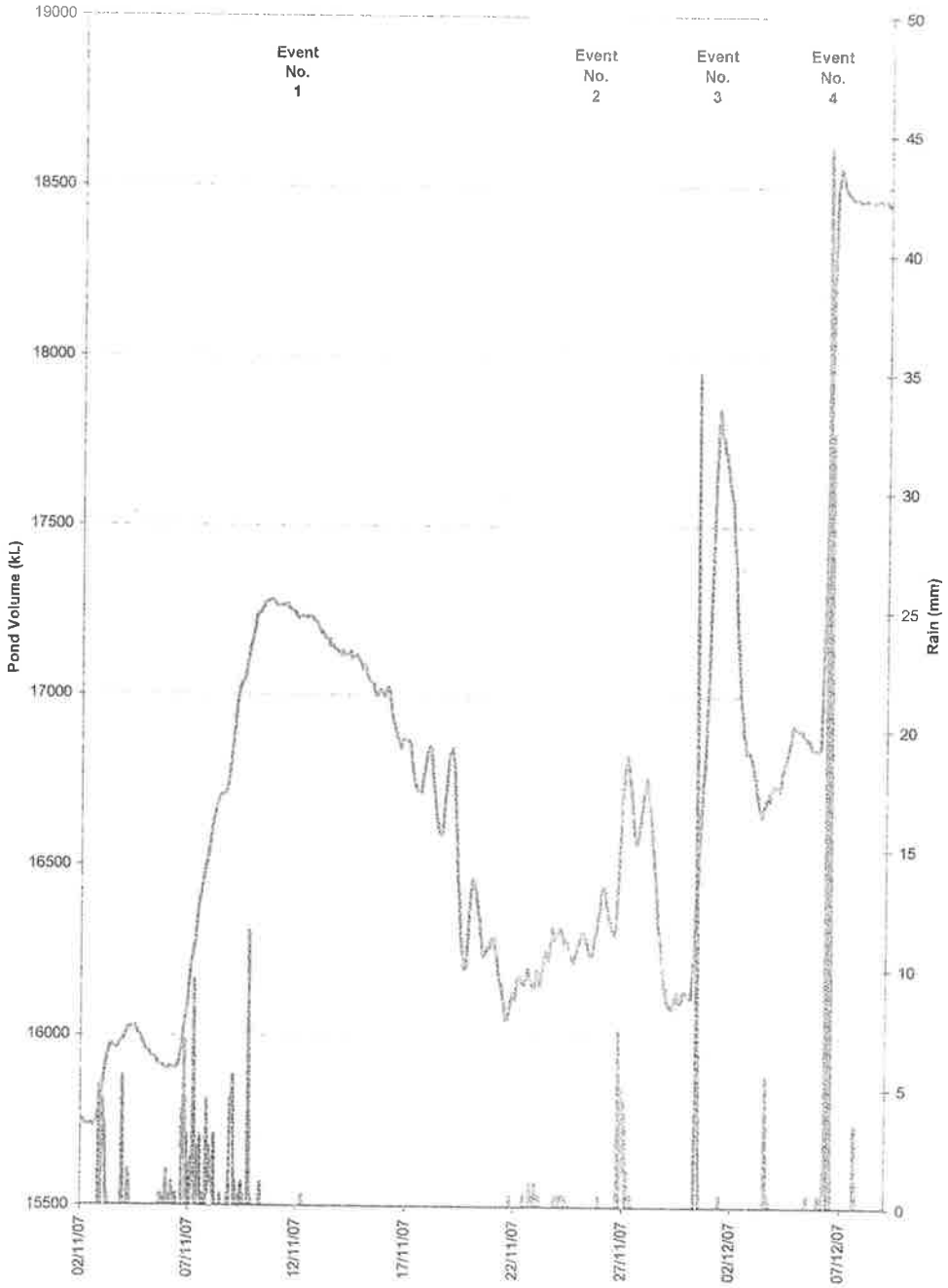


Figure 5.2 Storm Event Analysis Period October 2007 to December 2007

Table 5.2 Whytes Gully Storm Event Analysis

Event No.	1	2	3	4
Type	Storm	Storm	Storm	Storm -overflow
Start Time	2/11/2007	22/11/2007	30/11/2007	3/12/2007
End Time	21/11/2007	29/11/2007	2/12/2007	7/12/2007
No. Days in Event	20	8	3	5
Rain Depth (mm)	138	40	53	129
Total Area of Landfill and Ponds (ha)	20	20	20	20
Area of Ponds Only (ha)	1.2	1.2	1.2	1.2
Total Rain Volume (kL)	27600	7900	10500	25700
Rain Volume Direct Into Ponds (kL)	1656	474	630	1542
Rain Volume Falling on Landfill (kL)	**25944**	**7426**	**9870**	**24158**
Pond Volume Start (kL)	15755	16113	16126	16761
Pond Volume Finish (kL)	16120	16125	16776	18459
Change in Pond Volume (kL)	365	12	650	1698
Discharge Volume (i.e. Sewer-Tanker-Evap) (kL)	3679	1416	530	1039
Total Inflow Into Ponds (kL)	4044	1428	1180	2737
Total Inflow Into Ponds - Less Direct Rainfall (kL)	**2388**	**954**	**550**	**1195**
Leachate as Proportion of Rain On Landfill (%)	**9**	**13**	**6**	**5**
Average Inflow Rate - Excluding Direct Rainfall (kL/d)	120	120	186	241
Average Inflow Rate - Excluding Direct Rainfall (L/s)	1.4	1.4	2.2	2.8

The above analysis indicates that an average 10% of incident rainfall on the landfill surface is converted to leachate and enters the leachate ponds quickly (days). This 'quick' percentage is variable and dependant on the specific characteristics of the storm.

Whilst unable to be measured, a further volume of 'quick' leachate was generated during the four leachate overflow events. The total volume of additional leachate produced during these overflow events is considered to be small on a long term basis (less than 5% of total rainfall), but nevertheless a significant proportion of the leachate that can be produced quickly during a storm.

It is considered that the primary mechanism for this 'quick' leachate production is direct cross-connection between the surface water and leachate systems and preferential flowpaths through the landfill.

The above estimates of 'quick' leachate production do not allow for slow storage and release of rainfall that infiltrates the capping, is absorbed into the emplacement proper and then slowly released over subsequent weeks and months. The equivalent mass-balance calculation to Table 5.2, if undertaken over the entire 14 month period April 2007 to July 2008 (i.e. combination of storms and inter-event dry periods) indicates that during this period a total rain volume of 308,000 kL fell on the landfill surface and that this generated approximately 76,000 kL of leachate (N.B. this excludes the volume of leachate overflow unable to be measured). This translates into 25%

conversion of rainfall to leachate (excluding overflow) or a further 15% of incident rainfall in addition to the calculated 10% 'quick' release.

Mass balance calculations from inter-event dry periods indicate a typical slow release rate for this 'slow' leachate component of approximately 140kL per day (1.6 L/s). This is an upperbound and expected to reduce during normal to dry years.

During the 14 month period April 2007 to July 2008, a further volume of 20,000 kL of leachate was generated by rain falling direct on the pond surface. This represents a further 6% rainfall to leachate conversion and confirms that direct rainfall is a significant contributor to leachate pond inflows.

Combining estimated values for 'quick' leachate (10%), pond overflow (5%), 'slow' leachate (15%), and direct rainfall (6%), suggests that on a long term basis (during a reasonably wet period) approximately 36% of incident rainfall on the combined landfill and leachate pond surfaces becomes inflow to the leachate ponds. The remainder of incident rainfall is converted to surface runoff or evaporates/transpires from the landfill surface.

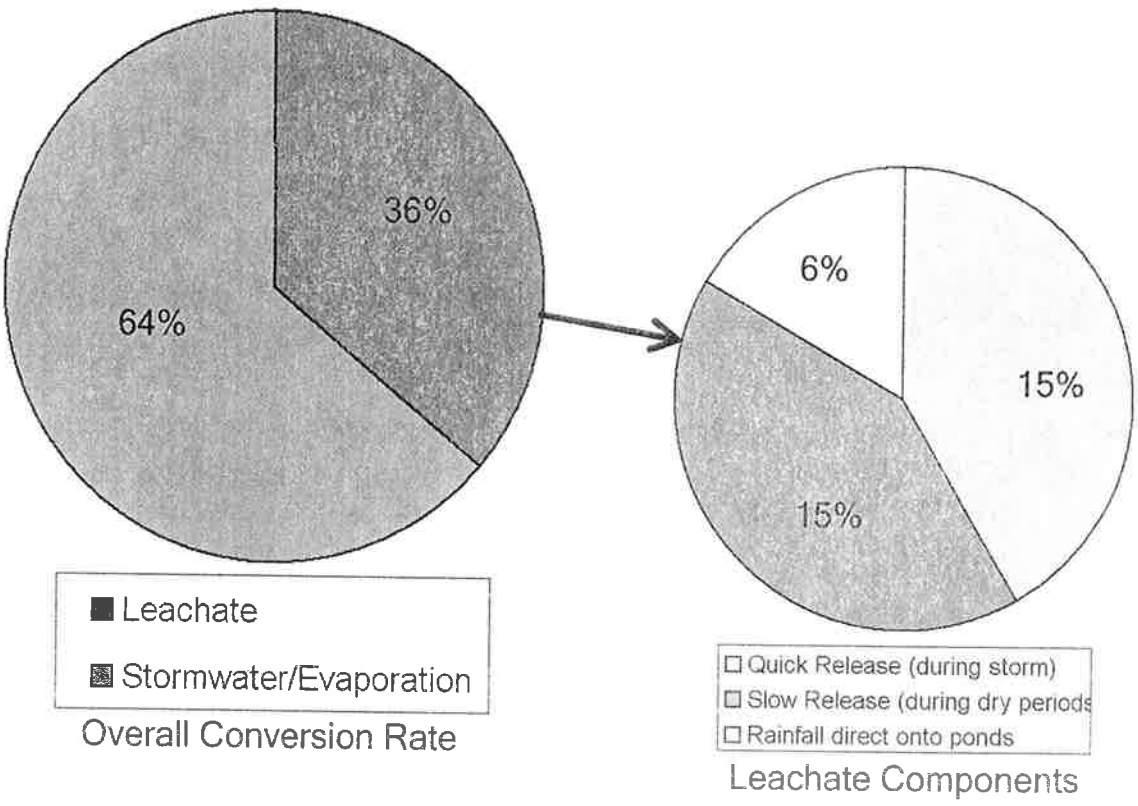


Figure 5.3 Conversion of Rainfall to Leachate at Whytes Gully

As an interesting comparison the previous investigation that formed the basis of the leachate pond design (Forbes Rigby, 2002), found a long term rainfall to leachate conversion rate of 28% (calculated using a calibrated daily balance model over a 5 year period between 1997 and 2001). This is slightly lower but generally consistent with the results of the mass balance described above and gives confidence to the design basis of the existing leachate ponds. However the observed

frequency of recent overflow events highlights the sensitivity of leachate production to increases in leachate generation rates during wet weather and the difficulty of applying a simplistic '1 in 25 year' design criteria to areas with re-current storm rainfall patterns. To meet the intent of the original design criteria, Council must reduce leachate generation rates and ensure the leachate ponds are maintained at lower levels even during wet periods.

5.1.3 Conclusion

Key conclusions that can be made with respect to leachate behaviour at Whytes Gully include:

- Stored leachate volume is sensitive to extended periods of high rainfall as experienced over the period April 2007 to April 2008. This is a reflection of rainfall patterns in the Illawarra (i.e. wet weather events do not occur in isolation), high leachate generation rates (i.e. high capping permeability and cross-connections with surface water) and the limited available discharge capacity of the leachate system (i.e. fixed rate sewer disharge).
- On a long term basis approximately 36% of rainfall on the combined landfill and leachate pond surfaces is currently converted to leachate. This is comprised of approximately 15% which is quickly converted (during a storm event), 15% which is slowly converted (over subsequent weeks and months) and 6% direct rainfall into the leachate ponds.
- Mass balance calculations from baseflow periods indicate a typical long term leachate release rate during dry periods of approximately 140kL per day (1.6 L/s). This is an upperbound and expected to reduce during normal to dry years.
- The leachate system demonstrates capacity to recover quickly (i.e. storage levels drop) when drier weather resumes, however this currently relies on supplementary tankering of leachate off-site.
- To meet the intent of the original design criteria, Council must reduce leachate generation rates and ensure the leachate ponds are maintained at lower levels even during wet periods.
- Improved leachate monitoring would enable improved understanding of seasonal variations and the relative contribution of different areas of the landfill to leachate production. This would in turn assist with development of additional targeted management measures.

5.2 Surface Water System

5.2.1 Generally

The Whytes Gully site has an overall catchment of 50 ha stretching between the top of a ridge to the north and Reddalls Road to the south. The entire catchment drains through the Whytes Gully stormwater treatment ponds prior to discharge (refer Figure 2.5).

The catchment includes disturbed landfill areas including areas of intermediate and daily cover, hardstand areas, buildings and an internal road system. Due to topographic constraints, undisturbed areas in the upper catchment (north of the landfill) also drain through the site. A series

of cut-off drains direct flow from these upstream areas past the active fill zone and into the stormwater ponds.

Whilst the surface water system appears to perform reasonably well during minor storm events, problems have been observed during heavy rainfall including:

- Flow breaking out across the tip face and/or entering the leachate system via direct connections with that system (via open pits and risers)
- Ammonia and sediment laden stormwater passing through the stormwater ponds

A preliminary assessment has been undertaken in order to confirm the behaviour of the existing surface water system and the extent to which observed problems warrant a major review. This assessment focuses on the three key interconnected elements of the surface water system, viz:

1. The catchment surface (**Section 5.2.2**)
2. The surface water collection and conveyance systems (**Section 5.2.3**)
3. The stormwater treatment ponds (**Section 5.2.4**)

5.2.2 Catchment Surface

The catchment surface can be characterised as:

- Steep with highly modified topography
- Well vegetated but with localised areas of disturbance
- Variable soil types including a significant proportion of imported soil and cover materials, natural soils are fine and potentially dispersibie clays

On a long term basis, it is anticipated that the catchment will have a surface water yield equivalent to approximately 30% of incident rainfall. This is a typical value for a rural catchment in the Illawarra (ref: *Table F2, Managing Urban Stormwater: Council Handbook (Draft) NSW EPA, 1998*). However the catchments steep topography and clay dominated soil types will result in much higher rainfall to runoff conversion during heavy storms (approaching 100% for short periods).

Whilst the catchment is generally well protected against erosion due to a good cover of vegetation, heavy rainfall can also result in localised scour and rilling in areas of cover disturbance. These areas include:

- The active tip face
- Areas of intermediate cover with poor vegetation cover
- Temporary stockpiles
- Unlined cut-off drains
- Steep outer terraces of the Eastern Gully
- Hardstand areas used for scrap metal collection and composting

Although not specifically an erosion problem, sediment is also entrained into the surface water system through wash-off of accumulated soil and particulates on internal haul roads.

Council has a number of smaller stormwater treatment ponds located around the site to provide pre-treatment of surface water from the catchment before entering the main stormwater pond system. However given the potentially dispersive soils at the site a more focussed effort towards source control of sediment is suggested with appropriate recommendations to be incorporated into this management plan.

5.2.3 Collection Systems

In the initial design of the surface stormwater collection system, all runoff from the emplacement capping was deliberately collected by a series of sloped benches and swales and directed into the stormwater or leachate collection system at the toe of the emplacement.

In general, surface runoff from the benches is directed:

- For the Western Gully - toward a surface drain formed along the eastern edge of the Western Gully. This runoff is then directed into the stormwater ponds, however during heavy rainfall this can overtop into an open leachate collection pit at the bottom end of the central drain.
- For the Eastern Gully - toward the east where it flows down the eastern side of the Eastern Gully in an open drain formed by the intersection of the emplaced fill and the membrane lining the gully. This runoff is directed into an open collection pond at the toe of eastern Gully and into a leachate line riser inlet. Due to settlement of the landfill the east flowing benches do not have sufficient capacity for large storm events and can result in overflow down the face of the terraces.

Surface runoff from land above and to the east of the Western Gully and Eastern Gully is directed via perimeter surface drains around the emplacements into small stormwater collection ponds. Any surface runoff from the benches that does not enter the leachate collection pit (Western Gully) or pond (Eastern Gully) spills into the stormwater treatment system via these small collection ponds.

As a consequence of this arrangement, a considerable volume of surface runoff that need not be directed into the leachate system enters the leachate system in any event capable of generating surface runoff. In events capable of overtopping the Eastern Gully collection pond, surface runoff from the emplacement benches mixes with leachate already in the collection pond at the start of the storm. The surface and leachate systems are shown diagrammatically in **Figure 2.4** and **Figure 2.5**.

To confirm anecdotal descriptions of surface flow behaviour and to provide a framework against which future works might be evaluated, a 2D hydrodynamic (Tuflow) model of the site was constructed. The hydrodynamic model incorporates the full catchment down to Reddalls Road and was simulated using an intense storm equivalent to the 100 Year Average Recurrence Interval, 1 hour duration storm developed using the methodologies prescribed in Australian Rainfall & Runoff (2001). Surface topography was defined using the topography existing in December 2007. As shown in **Figure 5.4** and **Figure 5.5** below, the modelled flow paths and observations are in good agreement.

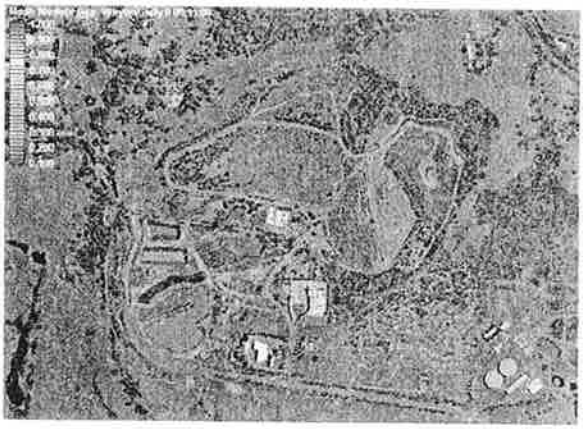


Figure 5.4 Flow Depths 15 min into Storm

Figure 5.5 Flow Depths 45 min into Storm

The model reinforces earlier observations that surface water has and will continue to enter the leachate system at the following locations, in all significant storm events, unless steps are taken to modify flow behaviour at these locations:

- The collection pond at the toe of the Eastern Gully which was designed to capture surface water runoff from the outer face benches of the Eastern Gully and direct into the leachate system.
- The open leachate collection pit in the leachate system located at the toe of the Western Gully, which are located in or adjacent to a surface stormwater flowpath.
- As surface flow directly into the leachate storage ponds either as overland flow, from the adjacent emplacement face or direct rainfall.

In addition, the model reinforces the view that any leachate contained in the Eastern Gully collection pond has and will continue to mix with any stormwater in all significant storm events, unless steps are also taken to modify flow behaviour at this location.

5.2.4 Stormwater Treatment Ponds

The stormwater treatment ponds provide treatment to surface water prior to discharge from the site. The pond design is typical of a constructed wetland with a linear flowpath, reed beds, dynamic storage and polishing pond.

The general observation has been made that the ponds perform well with respect to licensed discharge limits, though during recent overflow events mixing with leachate resulted in detection of ammonia in grab sampling undertaken at the overall discharge point. Periodic monitoring has also indicated sediment laden water discharging from the ponds following heavy rainfall. Whilst the ponds observe good design practice, vegetation within the reed beds was not able to be well established due to drought conditions at time of planting. Localised scour can also be observed around the pond shoreline and spillways connecting the reed beds. These factors will contribute to reduced treatment effectiveness compared to that anticipated at design.

Performance of the ponds is unable to be assessed in a detail manner with currently available information, however DECC has requested that a sensibility check be undertaken using the requirements of the NSW Department of Housing's *Managing Urban Stormwater: Soils and Construction* (2004), also known as the 'Blue Book'.

The following table documents the key input assumptions used in calculating pond size in accordance with the Blue Book. Parameters and their values were estimated from relevant tables and figures in the document. It is noted that a higher than normal 90th percentile rainfall depth was adopted in keeping with the high environmental outcomes being sought. A standard calculation spreadsheet providing further detail is included in **Appendix B**.

Parameter	Value
Catchment Area (ha)	50
Disturbed Area (ha)	20
Soil Type	D,F
Design Rainfall (days)	5
Design Rainfall (percentile)	90
Design Rainfall Depth (mm)	60.8
Rainfall Erosivity Factor (R-factor)	5840
Runoff Co-efficient (Cv)	0.63

Using this approach an estimated sediment basin volume of approximately 29,000 m^3 is calculated, comprising of a 19,000 m^3 settling volume and 10,000 m^3 sediment storage. This compares to a total volume within the existing ponds of 40,000 m^3, comprising of 32,000 m^3 of permanent (static) storage and 8000 m^3 of dynamic storage (drawn down over 36 hours).

Although the design basis of the existing stormwater ponds is more closely aligned to that of a constructed wetland, the above sensibility check again confirms the general adequacy of the stormwater pond volume. Nevertheless, observations of ammonia and sediment laden stormwater leaving the site are continued cause for concern.

As part of this management plan, improved leachate management will reduce the potential for overflow into the stormwater ponds thereby reducing potential for contamination of stormwater with ammonia and other typical leachate contaminants. Improved source control to reduce the mobilisation and transport of fine clays from erosion sites in the catchment will also lead to improved water quality in the ponds. With respect to the stormwater ponds themselves, stabilisation works and establishment of vegetation in accordance with the original design intent will enhance the ability of the ponds to treat stormwater to the high standard which is sought.

5.2.5 Conclusions

Key conclusions that can be drawn with respect to existing surface water behaviour at Whytes Gully are:

- The catchment is generally well protected against erosion due to a good cover of vegetation, however heavy rainfall can result in localised scour and rilling in areas of cover disturbance.
- Given the potentially dispersive soils at the site, a more focussed effort towards source control of sediment is required.
- A potentially considerable volume of surface water enters the leachate system at existing collection points at the foot of each landfill gully. Sealing of these entry points will be an important for managing excess leachate generation.
- A sensibility check undertaken in accordance with the NSW Department of Housing 'Blue Book' confirms the general adequacy of the stormwater pond sizing. However, stabilisation works and establishment of vegetation in accordance with the original design intent should be undertaken to improve their performance.

6 Management Options

6.1 General Approach

The general approach towards surface water and leachate management suggested for the site involves selection of low cost options that yield high benefit in terms of the performance objectives sought. In addition, an approach that targets observed problems at their source should be developed in preference to 'end of pipe' treatment solutions, as these may encourage poor site management practices.

Notwithstanding the fact that a reasonable understanding of the leachate and surface water management systems has been achieved, the complex nature of these systems and their interaction with variable site and climatic conditions warrants a cautious approach. Accordingly, management options that demonstrate clear benefits should be implemented immediately, followed by a period of observation and additional data collection. If continued system failure is observed, even after implementation of 'stand out' solutions, then additional measures should be considered. However with improved data availability these future decisions can be made with more certainty.

Any management decisions made should also be mindful that the site is in an interim phase and may undergo considerable change as part of the proposed Stage 3 expansion.

The remainder of this chapter outlines recommendations for specific measures to be undertaken in the short term, in order to improve leachate and surface water management at the site. **Chapter 7** then consolidates these measures into a concise list of actions, a 'Surface Water and Leachate Management Plan'.

6.2 Leachate System

6.2.1 Available Options

Leachate management at Whytes Gully includes the following available options:

1	Reduce generation of leachate	A. Decrease capping permeability
		B. Eliminate cross-connections between surface water and leachate systems
		C. Rain cover over leachate ponds
2	Increase available temporary storage	A. Increase leachate storage pond capacity
		B. Re-injection of leachate into landfill
3	Increase the rate of leachate discharge	A. Increased sewer discharge
		B. Supplementary tankering
		C. Irrigation onto landfill surface

Based on the observed behaviour of the system as described in **Chapter 5**, the most effective short term strategy recommended for the site is a combination of Option 1A, 1B and 3B. Both Options 1A and 1B provide a robust solution by targeting the problem at its source (i.e. decreasing the generation of leachate). Option 3B is considered a good solution for providing the temporary increase in discharge necessary to maintain freeboard in the ponds during prolonged wet weather. Further description of these measures and conceptual assessment of their benefits is provided in **Section 6.2.2**.

Other available leachate management options are either costly for the benefit derived (1C, 2A, 3A), or are of questionable effectiveness during prolonged wet weather (2B, 3C). These options are also less focussed on targeting the problem (i.e. excess leachate production during wet weather), and if implemented could encourage poor capping management practices. These less effective options could be re-explored in the future if further changes in leachate management are sought or if the cost of these options is reduced, for example if additional sewer discharge capacity became available at low cost.

6.2.2 Conceptual Water Balance Modelling

Model Overview

Leachate management improvements were assessed using a conceptual landfill water balance model constructed for the site in consultation with DECC. A conceptual model diagram is shown in **Figure 6.1** below.

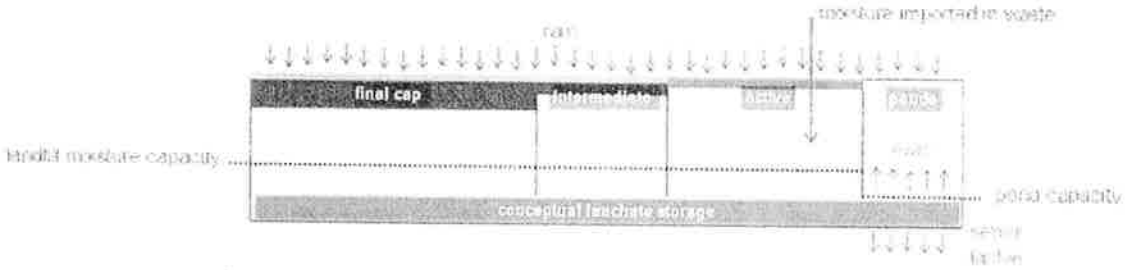


Figure 6.1 Conceptual Landfill Water Balance Model

A detailed description of the model and its components is included in **Appendix C**. In summary, the model incorporates:

- Conceptual water balance using averaged monthly rainfall
- Ability to include high rainfall (90th percentile) wet years
- Consideration of different capping types and leachate generation rates
- Allowance for leachate losses (discharge to sewer, tankering and evaporation from ponds)
- Ability to vary the above factors over a 20 year forward looking simulation period to assess impact of future management changes

- Allowance for importation of leachate within waste
- Overall 'lumped' moisture accounting (i.e. no separate consideration between leachate stored in the landfill and in the ponds)

The conceptual water balance model was used to assess the average reduction in leachate generation that must be achieved in order to achieve long-term improvements. In practical terms, these reductions are achieved by decreasing the average permeability of the landfill through improved capping and elimination of cross-connections between the surface water and leachate systems.

Modelled Leachate Generation Rates

A key input for the conceptual water balance model is the leachate generation rate of the landfill, i.e. the rate at which rainfall is converted to leachate (a function of landfill permeability). Whilst Council has endeavoured to ensure the landfill is constructed in a manner that reduces the infiltration of rainfall, there are practical considerations that result in variable infiltration across the site at any point in time.

The active fill zone (also referred to as 'Daily cover') requires free-draining materials that are quickly trafficable after rainfall. These areas are expected to experience high infiltration.

Areas of 'intermediate cover' do not require the same degree of trafficability, however variable infiltration is expected as the quality and quantity of available VENM materials changes over time. Also the level of compaction that can be achieved varies according to the slope of the outer cell face. In this regard, Council has observed changes in cover material at Whytes Gully, in particular:

- The first few cells of the Western Gully (i.e. bottom of the slope) were constructed using coalwash as both daily and intermediate cover
- Intermediate cover on the Western Gully then quickly transitioned to higher clay content VENM
- During construction of the upper half (approximately) of the Western Gully high quality clay materials were available for use
- The lower (steeper) half of the Western Gully was compacted by track rolling with an excavator during cell construction whereas the upper (flatter) half was able to be compacted using a roller on completion
- Over the period of construction of the Eastern Gully the quality and quantity of VENM available has declined
- The generally steeper slopes of the Eastern Gully have resulted in lower compaction rates on intermediate cover areas (i.e. similar to lower half of the Western Gully)

Based on the above observations, modelling for this and previous investigations have assumed that the Western Gully capping layer behaves in a similar manner to a final capping layer (i.e. low

average permeability), whilst the Eastern Gully intermediate cover and daily cover areas are much more permeable.

The most permeable locations within the landfill are those locations where direct cross-connections occur between the surface water and leachate systems. Whilst these cross-connections are small in area and only operate during heavy storms, they are highly effective and can inject large quantities of water into the leachate system during major events (refer **Section 5.2.3**).

Based on the analysis described in **Chapter 5**, an existing average leachate generation rate of approximately 36% was established for the landfill and the ponds. This is an averaged value and in reality incorporates a wide range of cover types and permeability across the site including direct connections with surface water.

For the purpose of modelling, an existing case distribution of leachate generation rates across the site was assumed. Due to uncertainty attached to these values 'low', 'medium' and 'high' leachate generation rates were modelled for the existing case scenario.

Table 6.1 Modelled Leachate Generation Rates

		Leachate Generation Rate		
Location	**Area (ha)**	**Low**	**Medium**	**High**
Western Gully	9.2	10	10	10
Eastern Gully - Intermediate	3.9	30	40	50
Eastern Gully - Active Zone	5.7	60	70	80
Ponds	1.2	90	90	90
Weighted Average Permeability		*33*	*38*	*43*

The 'medium' leachate generation scenario is most closely comparable to the results of the analysis undertaken in **Chapter 5** with a weighted average permeability of 38% (c.f. a calculated value of 36%) The medium scenario was adopted as a baseline starting condition from which management scenarios were applied and assessed.

For all scenario's, leachate generation rates for the Western Gully and Ponds were held fixed as there is less uncertainty associated with these rates and less scope to easily reduce them.

Management Scenarios

Four management scenarios were modelled for a 20 year forward looking simulation period commencing July 2008 and ending July 2028 as described in **Table 6.2** below.

It is noted that this modelling intends to demonstrate the effectiveness of these management scenarios as applied to the current site. Accordingly the overall area of the site and its various capping types were fixed for the full 20 year simulation period, except where a specific change in capping condition formed part of the management scenario. In reality the site will change from year to year as part of normal site development. As long as these changes are consistent with the

adopted management scenario, then any future changes will not compromise the predicted outcomes.

Table 6.2 Modelled Leachate Management Scenarios

Scenario	Description
Scenario 1	**Existing Case** *Assumes no change in capping areas or their management, continued high rate sewer discharge (150 kL/d) and tankering, with wet year approximately every ten years.*
Scenario 2	**Reduced Active Zone and 10% drop in leachate generation** *Assumes active zone (daily cover) reduced to 2ha in extent, infiltration reduced by an average 10% for intermediate and active areas (i.e. from 40% to 30% and 70% to 60% respectively) through improved capping and drainage. Continued high rate sewer discharge (150 kL/d) but no tankering. Wet year approximately every ten years.*
Scenario 3	**Reduced Active Zone and 20% drop in leachate generation** *Assumes active zone (daily cover) reduced to 2ha in extent, infiltration reduced by an average 20% for intermediate and active areas (i.e. from 40% to 20% and 70% to 50% respectively) through improved capping and drainage. Continued high rate sewer discharge (150 kL/d) but no tankering. Wet year approximately every ten years.*
Scenario 4	**Scenario 3 with Reduced Sewer Discharge** *Assumes active zone (daily cover) reduced to 2ha in extent, infiltration reduced by an average 20% for intermediate and active areas through improved capping and drainage. Medium rate sewer discharge (120 kL/d) but no tankering. Wet year approximately every ten years.*

Model Results

The model results from each of the four scenarios are presented below as a series of graphs showing the modelled change in leachate over a 20 year forward looking simulation period commencing July 2008 and ending July 2028. A 90th percentile wet year was applied at Year 1, 10 and 20.

Each graph shows a thin black dashed line representing a total theoretical capacity of the landfill to retain leachate, comprising of leachate storage within both the landfill and in temporary storage ponds. This capacity increases slowly over time as the landfill grows in volume. It can be inferred that any scenario that results in a cumulative leachate volume increasing over time at a rate faster than the total theoretical capacity will result in system failure (i.e. pond overflow).

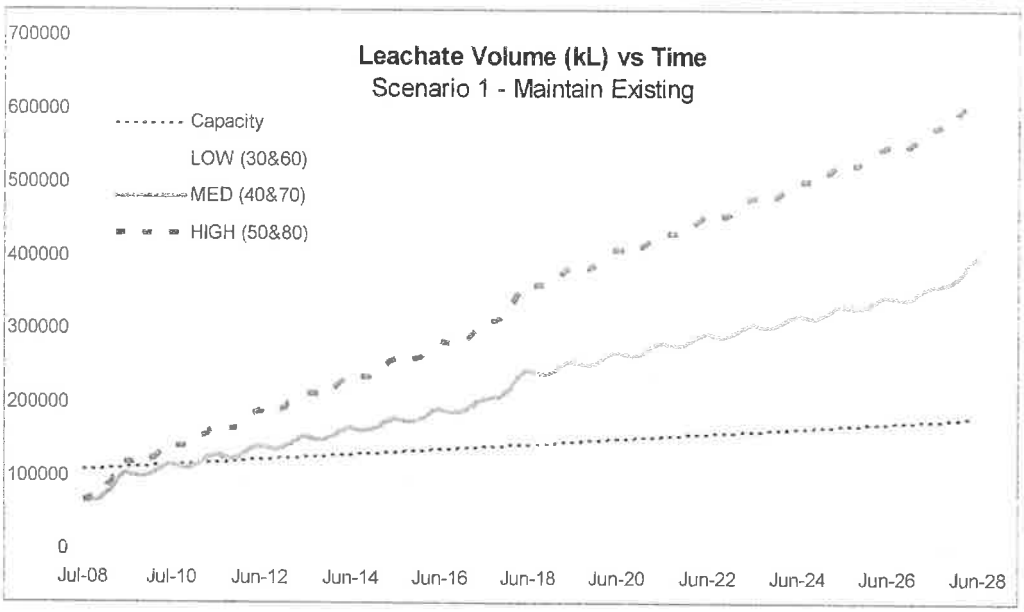


Figure 6.2 Change in Leachate Volume with Time - Scenario 1

The Scenario 1 model results (**Figure 6.2** above) demonstrate that under existing conditions there is a high tendency to accumulate leachate with time for all assumed leachate generation rate conditions (low, medium and high). Separation between the three curves shows high sensitivity to assumed infiltration rates on the intermediate and active zones. Whilst it is difficult to confirm which of the three curves is closest to the current reality, all show leachate accumulation and suggest action is required to change the current situation.

For comparative purposes, each subsequent graph in the remainder of this section also shows the results of the above scenario (Scenario 1), including low, medium, and high leachate generation rate conditions. It is again noted however that each scenario adopts the 'medium' condition as a baseline from which possible improvements are to be made. The altered scenario condition is shown as a thick black line in each graph.

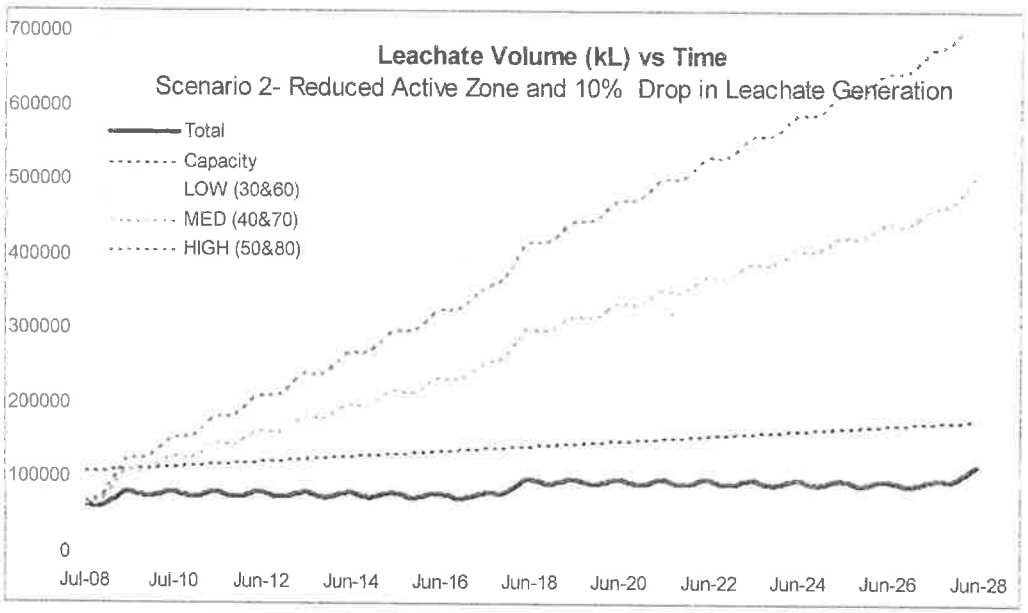


Figure 6.3 Change in Leachate Volume with Time - Scenario 2

Implementation of Scenario 2 (shown above) demonstrates that a significant reduction in leachate accumulation can be achieved through adoption of the suggested measures. At the end of the 20 year simulation period, implementation of Scenario 2 results in a reduction in accumulated leachate from 500,000 kL down to 120,000 kL, representing an overall reduction of 380,000kL.

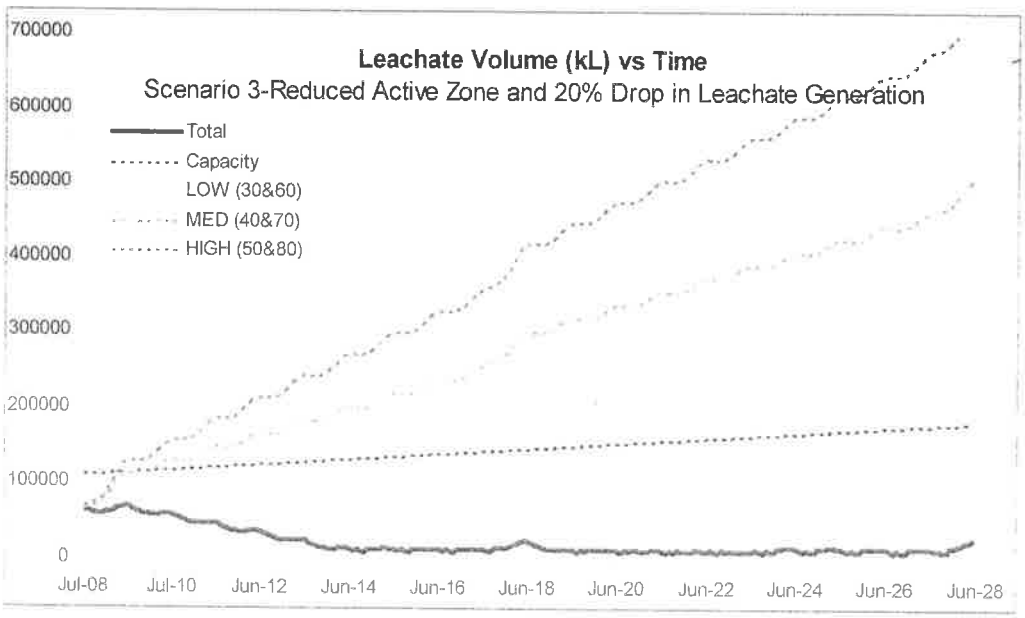


Figure 6.4 Change in Leachate Volume with Time - Scenario 3

Implementation of Scenario 3 demonstrates even further reductions in leachate accumulation can be achieved to the point where the landfill will effectively become dry in approximately 5 years, after which time the system will require only maintenance levels of leachate storage and disposal.

It is again noted that the results presented are based on a conceptual model only, it is anticipated that there will be more actual variation in leachate stored over time and that even after an effective drying out stage is achieved, prolonged wet periods will result in leachate accumulation spikes close to the theoretical capacity of the system. Importantly however the overall balance between leachate generation and discharge rates are more strongly in favour of a dry system.

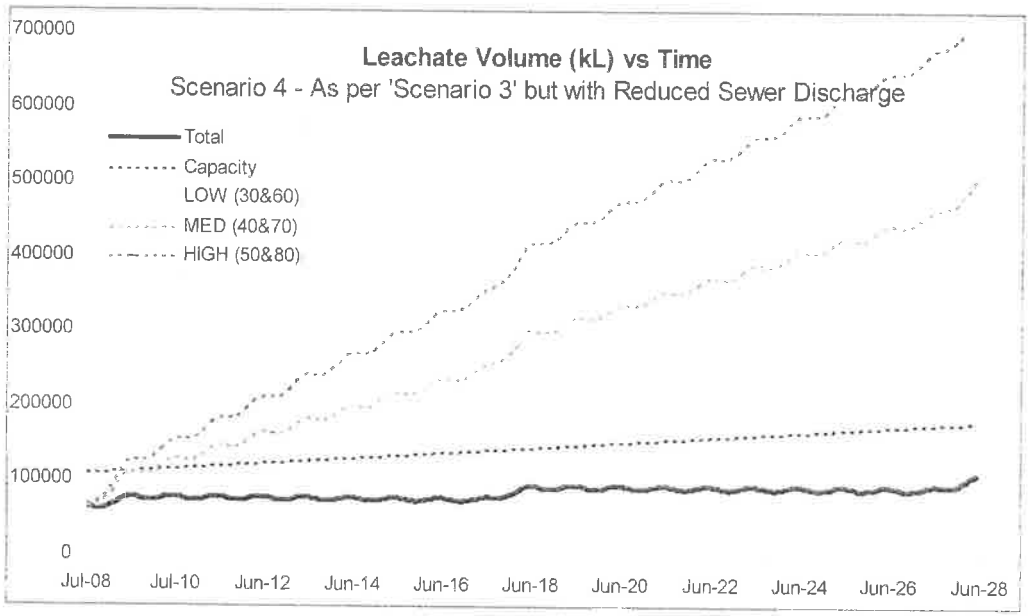


Figure 6.5 Change in Leachate Volume with Time - Scenario 4

Scenario 4 demonstrates the impact of a small reduction in sewer discharge rate from 150 kL/day to 120 kL/d. While leachate accumulation remains below total theoretical capacity, it continues to increase slowly with time. A high sewer discharge rate should therefore be maintained until such time as the area of intermediate capping transitions to a highly impermeable final capping.

Implementation

The above results indicate that effective leachate management will require a significant reduction in the area associated with active filling from a current 5.7 ha to 2 ha, as well as a reduction in leachate generation on the Eastern Gully by a minimum of 10% but preferably by 20%.

Based on discussions with Council the reduction in active fill zone can be achieved via a modified approach to waste emplacement including a temporary transfer station already implemented and used by the public. This enables the area required for active tipping to be reduced to that required by commercial waste trucks only. In the longer term this transfer station will be formalised and located near the main entry of the site.

Reductions in leachate generation by a minimum of 10% on the Eastern Gully are to be achieved by a combination of measures including:

- Sealing of existing surface water and leachate cross-connections
- Progressive modification of the active fill zone to create cells with increased surface cross-fall towards the edge of the emplacement
- Sealing of the interface between the base liner and the active fill zone so that clean surface water from the base liner is not encouraged to find preferential flowpaths through the landfill and instead remains in the surface water system
- Use of temporary flexible geo-membranes to decrease permeability of intermediate and active (daily) cover areas on the Eastern Gully. Options include spray on polymeric coatings, PVC plastic sheeting buried beneath topsoil, or EPDM flexible rubber liner. It is understood that Council is currently trialling spray-on coating options and if successful will consider implementation over a larger area. Geotechnical investigation and leachate monitoring will be used to assess to which areas these membranes and coatings are best applied (refer **Section 6.4**).

Council should also commence stockpiling of clay based VENM on the top of the Eastern Gully to provide a reduction in infiltration during the period of stockpiling and for the longer term to ensure availability of materials for future capping of the overall site.

A further available option subject to geotechnical investigation and review of construction feasibility may be the reshaping of the Eastern Gully intermediate cover terracing to increase drainage cross-fall. This can be achieved by regrading the crest of each existing terrace downslope and away from the outer face of the adjoining cell. Material obtained from trimming could be used to create increased longitudinal fall on selected terraces (say every 5th terrace) to convey accumulated surface water away to the edge of the landfill. This option may be difficult to pursue due to construction safety issues and should be carefully assessed prior to commencement.

Conclusions

- The conceptual model results confirm a high sensitivity between leachate generation rate and long term accumulation of leachate.
- In order to improve the balance between leachate generation and discharge, Council must decrease the area of active filling (daily cover) to a minimum of 2 hectares, and reduce the rate of infiltration through the landfill capping on both the active zone and intermediate cover areas by a minimum of 10% (but preferably by 20%).
- A 20% reduction in infiltration rates will see the landfill become effectively dry after 5 years. This means the amount of leachate being produced will drop significantly and allow reduced average sewer discharge.
- Existing rates of sewer discharge will need to be maintained, however large reductions in infiltration will enable Council to decrease sewer discharge rates over time.

- Whilst not able to be demonstrated by this conceptual model, it is anticipated that even if the landfill becomes effectively dry, prolonged wet periods will result in spikes of leachate accumulation. More intense management of leachate during these periods will continue to be required even after implementation of this plan.

6.3 Surface Water System

Based on the observed performance of the surface water system and the analysis described in Chapter 5, it is recommended that the following surface water management options be pursued:

- Improved management practices to reduce sediment transport from erosion risk areas. This will include a combination of typical sediment and erosion control strategies including cleanwater diversion, mulching, hydroseeding, silt fences, hay bale barriers and temporary sediment basins.

- Sealing of existing cross-connections between the surface water and leachate systems, located at the toe of the Eastern and Western Gully emplacements

- Improvements to the existing stormwater ponds, including stabilisation works around the pond shoreline and establishment of vegetation in accordance with the original design intent.

6.4 Planning Investigations & Monitoring

The following non-structural works are recommended for consideration as part of the overall management strategy:

Planning

- Commence planning for the proposed Stage 3 landfill expansion including preliminary designs and approvals. This activity will permit longer term planning for leachate and surface water management infrastructure to be undertaken with greater certainty. As part of this planning and design process, consideration should be given to ways in which the Stage 3 expansion can reduce leachate generation and better manage surface water in both the short term (during the active life of Stage 3) and in the longer term.

- Finalise proposals for a Waste Transfer Station located near the site entrance. Once implemented this facility will improve the management of commercial and domestic vehicles accessing the tip face and allow the active filling zone footprint to be kept to a minimum.

Investigations

- Undertake a geotechnical investigation in order to gain better appreciation of the permeability of existing capping materials across the site and to assist with identification and targeting of measures required to reduce the infiltration of rainfall through the various capping layers. A technical brief has been prepared for this work and is included in Appendix D.

- Undertake a brief annual review of this document and the assumptions contained within it. If significant change in the site occurs or if there is significant change in the way in which

Council must manage the landfill operation then different strategies may be warranted. The annual review should include a summary analysis of the rainfall, pond and discharge data and discussion of observed trends in average leachate production. A reduction in leachate production should be observed if the recommendations of this plan are implemented successfully.

Monitoring

- Monitoring of the flow of leachate in each of the separate leachate lines entering the collection pit should be undertaken in order to assess the relative contribution of leachate from different segments of the landfill. This will allow future additional management measures to better target the source of greatest leachate volume.

- Maximum Height Indicators (MHI) should be installed near the overflow spillways on each of the leachate storage ponds. These could be used in conjunction with the existing continuous monitoring gauges to better assess the volume of leachate discharge in the event of future overflow. It is noted that the continuous gauges do not have sufficient resolution at this depth to permit accurate measurement without the additional ability to correct the data using MHI results.

- Monitoring of leachate pond levels and rainfall at the site should continue in order to permit periodic checks on leachate production rates and assess the adequacy of the measures described in this plan.

- Additional surface water monitoring in accordance with recommendations of the recent report by Earth2Water (2008). This will enable improved assessment of the effectiveness of the surface water treatment ponds.

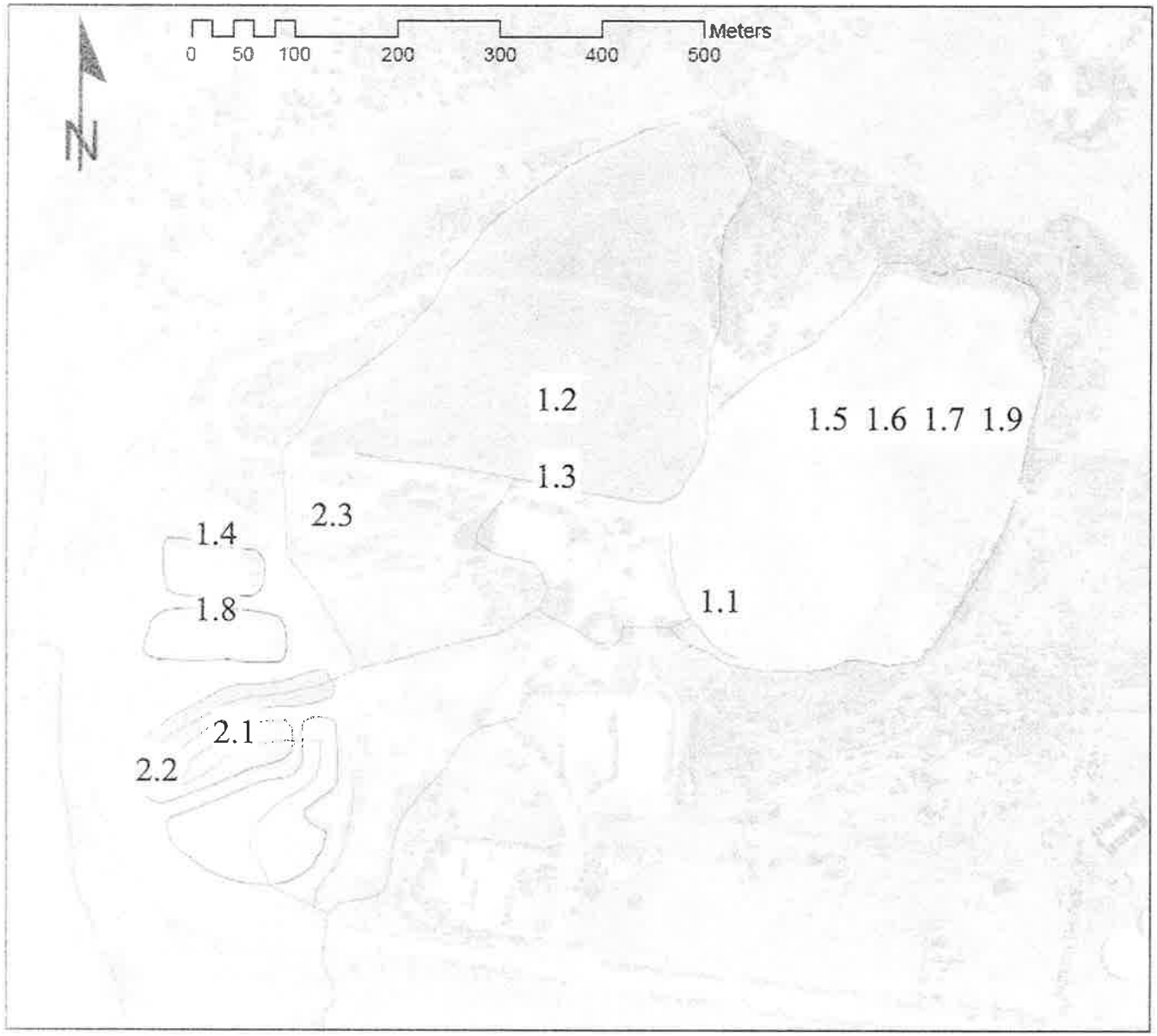
7 Surface Water and Leachate Management Plan 2008

The measures proposed as part of this Surface water and Leachate Management Plan are listed in the table below and are also shown in **Figure 7.1** overleaf.

Table 7.1 Proposed Surface Water and Leachate Management Measures

	Description of Proposed Measures	Indicative Cost ($K)	Indicative Timing (months)
1	**Leachate Management**		
1.1	Cap and remove leachate pit at toe of Eastern Gully	10	3
1.2	Cap risers within Western Gully	2	3
1.3	Seal concrete leachate pits at toe of Western Gully	5	3
1.4	Bunding of leachate ponds to protect from surface sheet flow	1	3
1.5	Reduce footprint of Active Zone to 2 ha (including tip face)	*[a]*	6
1.6	Improve surface drainage of active zone (increase cross-fall)	*[a]*	6
1.7	Reduce permeability of intermediate cover and active fill zone on Eastern Gully by 10% minimum (preferably by 20%)	100	6
1.8	Maintain ponds at 50% storage maximum, resume tankering if required.	50	ongoing
1.9	Stockpiling of clay based VENM for future capping	*[a]*	ongoing
	Surface Water Management		
2.1	Refurbishment of stormwater ponds to ensure plant re-establishment within reed beds in accordance with original design.	50	24
2.2	Improved armouring of spillways between reed beds to prevent erosion	10	3
2.3	Improved sediment control on disturbed sites	*[a]*	ongoing
	Planning, Investigations & Monitoring		
3.1	Install flow monitoring equipment on leachate lines	30	3
3.2	Install Maximum Height Indicators on leachate ponds	2	3
3.3	Undertake geotechnical investigation of existing capping materials	20	6
3.4	Engage consultants to undertake design of waste transfer station	50	12
3.5	Engage consultants to prepare concept design and gain approvals for Stage 3	250	36
3.6	Continued monitoring of leachate pond levels and rainfall	*[a]*	ongoing
3.7	Additional surface water monitoring in accordance with Earth2Water report (2008)	*[a]*	ongoing
3.8	Annual review of the Surface Water and Leachate Management Plan	*[a]*	ongoing

[a] assume no cost if undertaken as part of normal operations



	Description of Proposed Measures
1	Leachate Management
1.1	Cap and remove leachate pit at toe of Eastern Gully
1.2	Cap risers within Western Gully
1.3	Seal concrete leachate pits at toe of Western Gully
1.4	Bunding of leachate ponds to protect from surface sheet flow
1.5	Reduce footprint of Active Zone to 2 ha (including tip face)
1.6	Improve surface drainage of active zone (increase cross-fall)
1.7	Reduce permeability of intermediate cover and active fill zone on Eastern Gully by 10% minimum (preferably by 20%)
1.8	Maintain ponds at 50% storage maximum, resume tankering if required.
1.9	Stockpiling of clay based VENM for future capping
2	Surface Water Management
2.1	Refurbishment of stormwater ponds to ensure plant re-establishment within reed beds in accordance with original design.
2.2	Improved armouring of spillways between reed beds to prevent erosion
2.3	Improved sediment control on disturbed sites
3	Planning, Investigations & Monitoring
3.1	Install flow monitoring equipment on leachate lines
3.2	Install Maximum Height Indicators on leachate ponds
3.3	Undertake geotechnical investigation of existing capping materials
3.4	Engage consultants to undertake design of waste transfer station
3.5	Engage consultants to prepare concept design and gain approvals for Stage 3
3.6	Continued monitoring of leachate pond levels and rainfall
3.7	Additional surface water monitoring in accordance with Earth2Water report (2008)
3.8	Annual review of the Surface Water and Leachate Management Plan

Whytes Gully Landfill Surface Water and Leachate Management Plan 2008

8 General Guidance for Future Plans

The following heads of consideration are provided for future site management plans, new infrastructure or site operations that either directly or indirectly impact on surface water and leachate systems at Whytes Gully:

- The existing leachate storage and stormwater management ponds have been designed on the basis of several key assumptions (refer **Chapter 4**). Consideration should be given to how any future activity might impact on these assumptions and therefore pond performance. If the impact is significant then action should be taken to change the activity or alternatively to make a compensatory increase in pond capacity or effectiveness.

- Leachate generation is highly sensitive to the infiltration rate of the capping material. Future capping construction should look to make use of materials with low permeability, particularly in areas of shallow grade. Stockpiling of clay based VENM materials for future capping is recommended.

- Leachate generation is highly sensitive to the area of active filling as this area is typically permeable and of shallow grade in order to meet trafficability requirements. The area of active filling should be kept to a minimum footprint less than 2 hectares.

- If Stage 3 proceeds, the current capping material on (Stages 1 and 2) will at some stage be stripped and replaced with a base liner for Stage 3. The stripping of old cap materials is a sensitive activity that will impact on leachate generation and stormwater quality. An appropriate construction design and schedule should be devised that minimises the risk of this activity.

- Do not re-introduce cross-connections between the surface water and leachate collections systems. These cross-connections significantly increase leachate generation.

- Future designs should look for opportunity to divert clean water away from the leachate and stormwater treatment ponds to minimise their hydraulic loading.

- Future design should look to maximise the gradient of landfill capping materials (daily, intermediate and final) whilst still meeting compaction and permeability requirements. Designs should at the same time minimise the gradient of surface water collection drains traversing the landfill to minimise erosion. If required, hard lining (gabion mattress or equivalent) should be employed in the invert of surface water drains in steep areas.

- The existing system is constrained by a fixed discharge capacity. This capacity cannot be increased in a cost effective manner at this stage, however future development of West Dapto will likely result in additional trunk main capacity. Additional sewer discharge capacity for wet weather periods should be sought at this possible future stage.

- When developing any temporary surface capping strategies, consider minimisation of the impact on vegetation cover, as vegetation provides erosion protection and reduces average capping saturation during inter-event periods (due to enhanced evapo-transpiration).

SITE PLAN

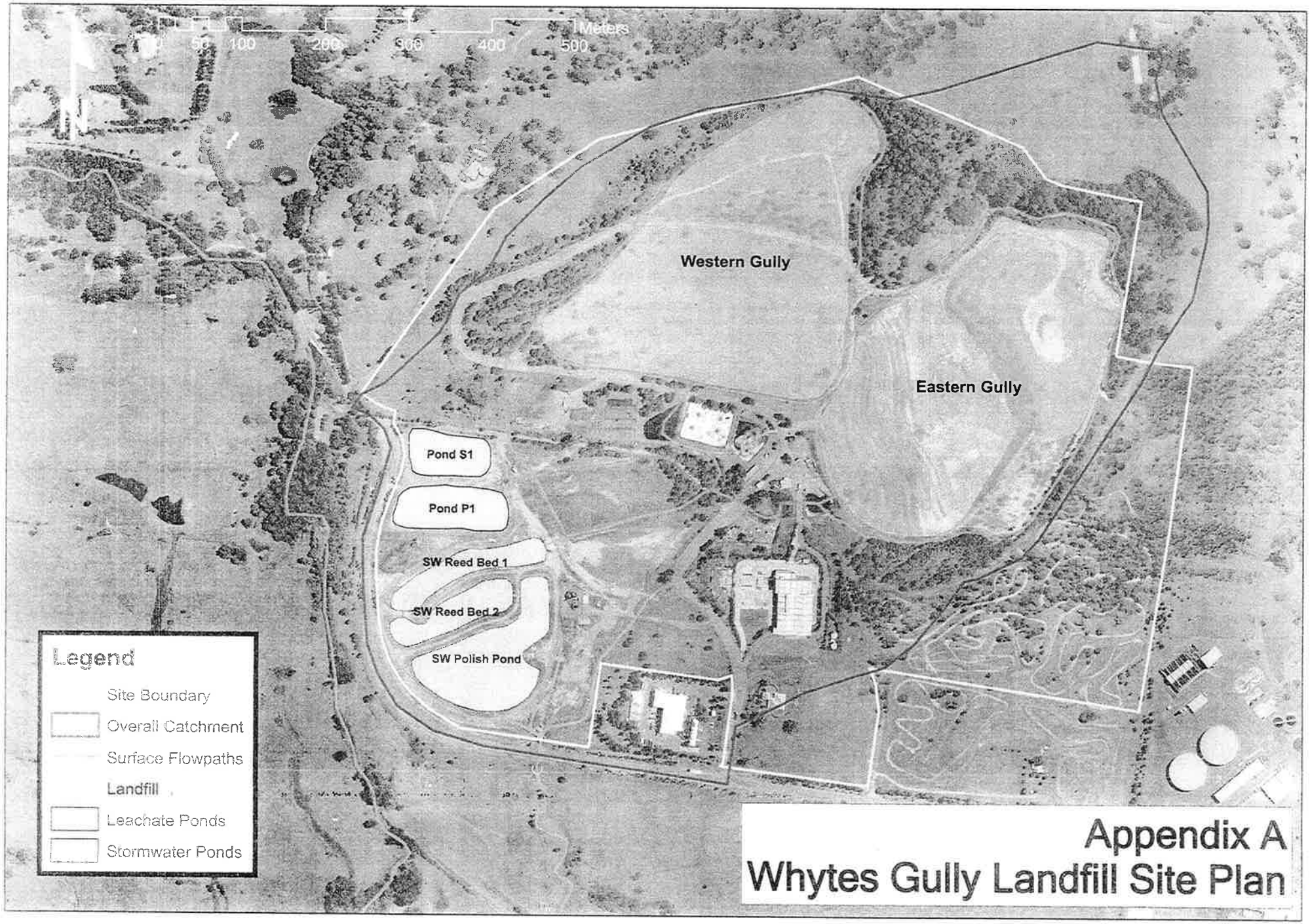
A

A

A

A

APPENDIX A



Appendix A
Whytes Gully Landfill Site Plan

STORMWATER POND CALCULATIONS

B

B

B

B

APPENDIX B

3. Volume of Sediment Basins: *Type C* Soils

Basin volume = settling zone volume + sediment storage volume

Settling Zone Volume

The settling zone volume for *Type C* soils is calculated to provide capacity to allow the design particle (e.g. 0.02 mm in diameter) to settle in the peak flow expected from the design storm (e.g. 0.25-year ARI). The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle. Peak flow/discharge for the 0.25-year, ARI storm is given by the Rational Formula:

$$Q_{tc,\,0.25} = 0.5 \times [0.00278 \times C_{10} \times F_y \times I_{1yr,\,tc} \times A\,]\ (m^3/sec)$$

where:

$Q_{tc,0.25}$ = flow rate (m^3/sec) for the 0.25 ARI storm event

C_{10} = runoff coefficient (dimensionless for ARI of 10 years)

F_y = frequency factor for 1 year ARI storm

$I_{1\,yr,tc}$ = average rainfall intensity (mm/hr) for the 1-year ARI storm

A = area of catchment in hectares (ha)

Basin surface area (A) = area factor x $Q_{tc,\,0.25}$ m^2

Particle settling velocities under ideal conditions (Section 6.3.5(e))

Particle Size	Area Factor
0.100	170
0.050	635
0.020	4100

Volume of settling zone = basin surface area x depth (Section 6.3.5(e)(ii))

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 100 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.5(e)(iv)), in which case the "Detailed Calculation" spreadsheets should be used.

Total Basin Volume

Site	$Q_{tc,\,0.25}$ (m^3/s)	Area factor	Basin surface area (m^2)	Depth of settling zone (m)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)	Basin shape		
								L:W Ratio	Length (m)	Width (m)
WGL	2.010	4100	8240	0.6	4944	4944	9888			
		4100								
		4100								
		4100								
		4100								
		4100								

2. Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$$

where:
- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F
- F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Peak flow calculations, 1

Site	A (ha)	tc (mins)	Rainfall intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
WGL	50	35	53	90	102	118	140	156	0.88

Peak flow calculations, 2

ARI yrs	Frequency factor (F_y)	Peak flows						Comment
		WGL						
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m3/s)	
$1_{yr,tc}$	0.62	4.019						Zone C <500m
$5_{yr,tc}$	0.9	9.908						Zone C <500m
$10_{yr,tc}$	1	12.477						Zone C <500m
$20_{yr,tc}$	1.1	15.877						Zone C <500m
$50_{yr,tc}$	1.1368571	19.468						Zone C <500m
$100_{yr,tc}$	1.1792	22.501						Zone C <500m

SWMP Commentary, Standard Calculation

Note: These "Standard Calculation" spreadsheets relate only to low erosion hazard lands as identified in figure 4.6 where the designer chooses to not use the RUSLE to size sediment basins. The more "Detailed Calculation" spreadsheets should be used on high erosion hazard lands as identified by figure 4.6 or where the designer chooses to run the RUSLE in calculations.

1. Site Data Sheet

Site name: Whytes Gully Landfill

Site location: Whytes Gully Landfill, Reddals Road, Kembla Grange

Precinct:

Description of site: Small catchment containing landfill site incorporating a 50ha total catchment of which no more than 20ha is disturbed (conservative)

Site area	Site						Remarks
	WGL						
Total catchment area (ha)	50						
Disturbed catchment area (ha)	20						

Soil analysis

Soil landscape							DIPNR mapping (if relevant)
Soil Texture Group	D						Sections 6.3.3(c), (d) and (e)

Rainfall data

Design rainfall depth (days)	5						See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	90						See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	60.8						See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	16						See IFD chart for the site
Rainfall erosivity (R-factor)	5840						Automatic calculation from above data

Comments: Assume 5 day rainfall depth (standard), 90th percentile rainfall (sensitive site) and type F or D soils

4. Volume of Sediment Basins, *Type D* and *Type F* Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for *Type F* and *Type D* soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

$$V = 10 \times C_v \times A \times R_{y\text{-}\%ile,\ x\text{-}day} \ (m^3)$$

where:

10 = a unit conversion factor

C_v = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

R = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 50 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)), in which case the "Detailed Calculation" spreadsheets should be used.

Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
WGL	0.63	60.8	50	19152	9576	28728

CONCEPTUAL LEACHATE WATER BALANCE MODEL

C

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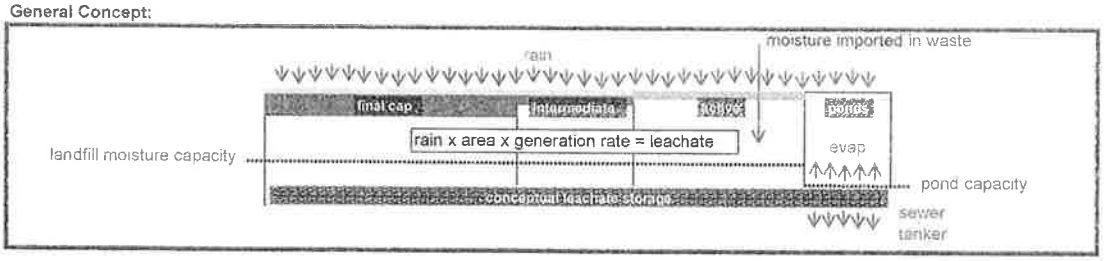
APPENDIX C

LEACHATE FORECAST MODEL - NOTES

General Concept:



Key Limitations:

- *Planning tool only. Do not use for design purposes.*
- *Monthly timestep does not account for shorter term physical processes such as rainfall intensity and antecedant moisture.*
- *Averaging of rainfall does not account for typical patterns of rainfall in Eastern Australia (i.e. episodic 'la nina' & 'el nino')*
- *Leachate generation rates must implicitly account for any variability within capping material of a particular class*
- *Does not differente between leachate in landfill and leachate in ponds nor any migration between.*

Notes on General Model Construction:

A1 *Model uses average monthly rainfall for the site but has facility to incorporate up to three 'wet years' (see note A2)*

A2 *Model uses 90th percentile monthly rainfall (i.e.'wet year') for year numbers entered in yellow cells (maximum of 3). Leave blank if only average rainfall to be used.*

A3 *This column contains a list of 'year no.s' that are used to automatically assign data from yellow cells (user input data) to the water balance model below. This allows accounting for yearly variation of management activities such as changes in landfill capping in accordance with a filling plan, or progressive reduction in infiltration through improved drainage.*

B1 *Area of landfill that comprises of final capping (i.e. low permeability, well compacted materials of a permanent nature)*

Notes Specifically Related to This Site:

Monthly data from Bureau of Meteorology (Wollongong Post Office - gauge no. 068069)
Wet year assumed in Year No. 1, 10 and 20 (i.e. approximately once every 10 years)

This model was run for a full 20 year period commencing July 2008.

As at December 2007 the site had a total 'final cap' area of 9.2ha represented by the Western Gully (measured using precise computer based measurement)

B2	*Area of landfill that comprises of intermediate capping (i.e. moderate permeability uncompacted materials of a semi-permanent nature)*	*As at December 2007 the site had a total 'intermediate' area of 3.9ha represented by the steep terraces on the southern half of the Eastern Gully (measured using precise computer based measurement)*
B3	*Area of landfill that is being actively filled and comprises of daily cover only (i.e. low permeability, poorly compacted material)*	*As at December 2007 the site had a total 'active fill' area of 5.7ha represented by the Eastern Gully tip face and the intermediate cover to the north which is relatively flat and drains across the tip face and therefore included as part of the active zone (measured using precise computer based measurement)*
B4	*Area of leachate ponds (and areas surrounding) that contribute to leachate generation.*	*As at December 2007 the site had a total 'pond' area of 1.2ha represented by the pond surface and adjoining plastic lined areas (measured using precise computer based measurement)*
C1	*Proportion of rainfall that is converted to leachate. Adopted rate must allow for surface runoff and evapotranspiration which are proportional to the composition of the capping material, vegetation cover, slope and rainfall intensity.*	*Assumed rate of 10%. Low infiltration is expected for tight compacted clay (K = 1x10-9) on a steep slope with high intensity rainfall and vigourous vegetation growth (i.e. high evapotranspiration).*
C2	*Proportion of rainfall that is converted to leachate. Adopted rate must allow for surface runoff and evapotranspiration which are proportional to the composition of the capping material, vegetation cover, slope and rainfall intensity.*	*Intermediate cover areas expected to have higher permeability due to poor compaction and moderate permeability materials (variable mix of sand, silt, clay). At Whytes Gully, mitigating factors include steep slope, high rainfall intensity and thick vegetation. Modelled range between 30% and 50%.*
C3	*Proportion of rainfall that is converted to leachate. Adopted rate must allow for surface runoff and evapotranspiration which are proportional to the composition of the capping material, vegetation cover, slope and rainfall intensity.*	*Active (daily cover) areas expected to have higher permeability due to poor compaction, flat slope and high permeability materials (uncemented slag material). Some evaporation from surface moisture store may occur following light rain. Modelled range between 60% and 80%.*
C4	*Proportion of rainfall that is converted to leachate. Adopted rate must allow for surface runoff and evapotranspiration which are proportional to the composition of the capping material, vegetation cover, slope and rainfall intensity.*	*Pond areas expected to have higher permeability, 100% for water surface but slightly reduced for evap off plastic liner around pond, say 90% average for entire pond area.*
D1	*Loss of leachate via discharge to sewer. Monthly rate in kL. For numerical stability losses no longer occur when total volume of leachate in the system drops below a certain threshold (refer Note G3).*	*Three rates adopted depending on scenario: low pumping rate (90kL/day or 2738kL/month), medium pumping rate (120kL/day or 3650kL/month), high pumping rate (150kL/day or 4563kL/month). A medium pumping rate is equivalent to using the low rate and high rate each 50% of the time.*

D2	*Loss of leachate via tanker truck. Monthly rate in kL. For numerical stability losses no longer occur when total volume of leachate in the system drops below a certain threshold (refer Note G3).*	*Single rate adopted (29kL/day or 882kL/month) based on average tanker rates during period 2007-2008*
D3	*Loss of leachate via evaporation from ponds. Monthly rate in kL. For numerical stability losses no longer occur when total volume of leachate in the system drops below a certain threshold (refer Note G3).*	*Single rate adopted of 760kL/month calculated as an average 152mm of monthly evaporation (Sydney Airport BOM Gauge) multiplied by an average pond area of 0.5ha.*
E1	*Monthly Leachate Generation - Monthly volume of leachate imported in waste. Calculated automatically as typical leachate content multipled by monthly imported waste tonnage.*	*Assume 10,000 tonnes per month with a typical free leachate content of 0.03kL/tonne*
E2	*Monthly Leachate Generation - Monthly volume of leachate generated from areas of final capping. Calculated automatically using rainfall multiplied by area multiplied by generation rate.*	*Calculated using assumed rainfall, area and leachate generation rate*
E3	*Monthly Leachate Generation - Monthly volume of leachate generated from areas of intermediate capping. Calculated automatically using rainfall multiplied by area multiplied by generation rate.*	*Calculated using assumed rainfall, area and leachate generation rate*
E4	*Monthly Leachate Generation - Monthly volume of leachate generated from areas of active fill (daily cover). Calculated automatically using rainfall multiplied by area multiplied by generation rate.*	*Calculated using assumed rainfall, area and leachate generation rate*
E5	*Monthly Leachate Generation - Monthly volume of leachate generated by rainfall direct on ponds and surrounds. Calculated automatically using rainfall multiplied by area multiplied by generation rate.*	*Calculated using assumed rainfall, area and leachate generation rate*
F1	*Total volume of leachate stored within the landfill and ponds. Calculated on a monthly basis as the total volume of leachate from the previous month PLUS leachate generated in the month MINUS leachate lost in the month. Starting values for first month calculated from user inputs (see Notes G1 and G2). Does not account for loss of leachate during pond overflow.*	*Calculated value (also see Note G2)*

F2	*Total 'capacity' of landfill to assimilate leachate. Notional capacity of storage within landfill calculated as: total emplaced tonnage of waste (tonnes) MULTIPLIED by leachate capacity (kL/tonne) PLUS capacity of leachate ponds. Formula accounts for continual monthly import of waste (and therefore continual increase in notional capacity). Not used for leachate water balance but included for graphing purposes. Prolonged periods where stored leachate exceeds the total capacity, signifies the need for improved leachate management.*	*Calculated value (also see Note G2)*
G1	*Reference table of various leachate discharge rates. Not used by any formulae in spreadsheet but should be manually entered into relevant user input cells (see D1 and D2)*	*Sewer rates based on WCC's current arrangements with Sydney Water. Medium rate to be used for years where 50% of time on high rate and 50% on low rate. Tanker rates based on recorded data during period 2007 to 2008.*
G2	*Landfill parameters: Total volume of waste in landfill; volume of waste imported monthly; typical maximum free leachate content of waste (i.e. above background moisture levels able to freely drain out over time); leachate content at start of simulation*	*Estimated values for Whytes Gully*
G3	*Pond parameters: Total volume of leachate ponds; volume of pond at start of simulation; average surface area of leachate pond (for evaporation calculation); monthly evaporation rate; and 'stop loss threshold' which is a leachate storage threshold below which no further losses are assumed (equivalent to an effectively 'dry' landfill).*	*Estimated values for Whytes Gully. Pond volume based on new leachate pond design capacity. Assumed 100% full at start due to wet antecedant conditions. Evaporation based on typical annual evaporation of 1800mm as measured at Sydney Airport BOM gauge.*
G4	*This is a volume check in order to test that the calculations correctly balance leachate inputs and outputs. Some numerical error occurs due to rounding and zeroing of storages and losses. If total volume error is less than 1% then the balance is considered acceptable. If greater, the user should check all input data and calculations.*	*Calculated value*
G5	*These columns contain additional results that have been copy and pasted from calculation columns for inclusion in the graphs 'source data' range. These are static values and do not update automatically. Delete if not required.*	*Calculated values. The 'Scenario 1 - Maintain Existing' Low, Medium and High infiltration curves have been included on all graphs for reference purposes.*

LEACHATE FORECAST

Site: WHYTES GULLY LANDFILL, WEST DAPTO
Scenario: 1 - Maintain Existing
Description: Assume no change in capping areas or their management, continued high rate sewer discharge and tankering, with wet year approximately every ten years
Results: High sensitivity to infiltration rates on intermediate and active zone, adopt medium range as reference condition for further scenario analysis

Rainfall (mm)

	Monthly Rainfall	
	Average mm	90th%ile mm
January	106	140
February	110	146
March	118	157
April	129	172
May	115	153
June	107	142
July	92	122
August	61	81
September	65	87
October	67	89
November	72	96
December	86	114
Total	1129	1499

Assume Avg monthly rainfall except for:
90th %ile Rain in Year No. 1
90th %ile Rain in Year No. 10
90th %ile Rain in Year No. 20

	Leachate Generation Areas (ha)				Leachate Generation Rates (%)				Monthly Leachate Losses (kL)		
Year No	Final Cap	Intermediate	Active	Ponds	Final Cap	Intermediate	Active	Ponds	Sewer	Tanker	PondEvap
1	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
2	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
3	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
4	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
5	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
6	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
7	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
8	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
9	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
10	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
11	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
12	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
13	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
14	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
15	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
16	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
17	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
18	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
19	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760
20	9.2	3.9	5.7	1.2	10	40	70	90	4563	882	760

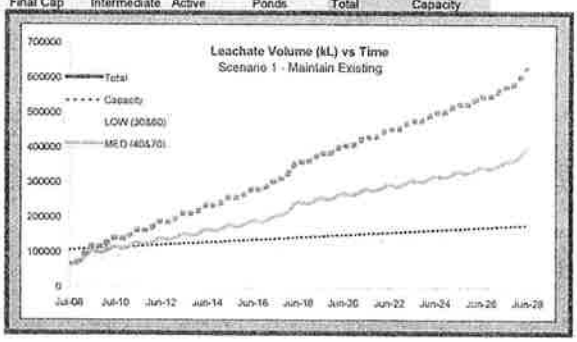
4563	882	760

Monthly Leachate Generation (kL)

Imported	Final Cap	Intermediate	Active	Ponds
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				
150				

Total Leachate (kL)

Total	Capacity



66158	108000

Sewer & Tanker Rates

Sewer High (kL/month)	4563
Sewer Med (kL/month)	3650
Sewer Low (kL/month)	2738
Tanker (kL/month)	882

Landfill Parameters

Total waste volume start (t)	3000000
Monthly imported waste (t)	10000
Leachate capacity (kL/t)	0.03
Leachate at start (kL/t)	0.015

Pond Parameters

Pond capacity (kL)	18000
Pond Start Vol (%)	100
Water Surface Area (ha)	0.5
Monthly evap (mm)	152
Stop Loss Threshold (kL)	16000

Volume Check

Leachate Generated (a)	1824467
Total Losses (b)	1469200
Change in Storage (c)	332108
(a) - (b) - (c) =	3158
%	0.17

OK

Additional Results for Graph

Caution: data columns below are static !!!

GEOTECHNICAL BRIEF

D

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APPENDIX D

Technical Brief 001

Characterisation of Existing Capping Materials at Whytes Gully Landfill

Project Background

Whytes Gully Landfill is the principal waste facility for Wollongong City and is located at Reddalls Road, West Dapto to the south west of Wollongong CBD. For purposes of licensing the landfill is classified as a 'Class 1' facility able to accept domestic and commercial waste including putrescibles. The landfill commenced operation in 1984 and is managed by Wollongong City Council.

Council is making improvements to the operation of the existing landfill in order to reduce generation of leachate from the site. Council has engaged water engineering specialists, Rienco Consulting, to prepare a 'Surface Water and Leachate Management Plan'. Preliminary investigations by Rienco have highlighted the sensitive relationship between leachate generation and the permeability of capping materials.

A geotechnical investigation has been recommended by Rienco in order to gain better appreciation of the permeability of existing capping materials and to assist with identification and targeting of improvement measures.

Site Description

The landfill site comprises of two natural gullies known as the 'Western Gully' and 'Eastern Gully', located at the base of a prominent escarpment ridgeline. Landfilling commenced in the Western Gully and was completed in the late 1990's. The Eastern Gully is currently subject to filling operations and has approximately 4 years of remaining capacity.

Both gullies have been constructed as a series of overlying horizontal cells progressively terraced in an upslope direction. The outer faces (sloping) of each cell combine to form an 'intermediate cover' for the entire emplacement on completion. The material used for the outer face is locally sourced VENM, preferably with high clay content. The upper faces (flat) of each cell are each buried beneath the next cell above and generally comprise of coalwash (Western Gully) or slag (Eastern Gully). This material is referred to as 'daily cover'. Each cell is approximately 3m in total thickness and is made up of a series of 'lifts', each of which are also covered by a thin layer of daily cover to form a trafficable surface.

A sketch is attached showing aerial photography of the site taken in 2006 along with digitized polygons showing areas of different cover material based on December 2007 survey.

Whilst Council has endeavoured to ensure the landfill is constructed in a manner that reduces the infiltration of rainfall, there are practical considerations that result in variable infiltration across the site at any point in time. 'Daily cover' requires free-draining materials that are quickly trafficable after rainfall. As expected, these areas experience high infiltration. Areas of 'intermediate cover' do not require the same degree of trafficability, however variable infiltration is expected as the quality

and quantity of available VENM materials changes over time. Also the level of compaction that can be achieved varies according to the slope of the outer cell face.

In this regard, Council has observed changes in cover material at Whytes Gully, in particular:

- The first few cells of the Western Gully (i.e. bottom of the slope) were constructed using coalwash as both daily and intermediate cover
- Intermediate cover on the Western Gully then quickly transitioned to higher clay content VENM
- During construction of the upper half (approximately) of the Western Gully high quality clay materials were available for use
- The lower (steeper) half of the Western Gully was compacted by track rolling with an excavator during cell construction whereas the upper (flatter) half was able to be compacted using a roller on completion
- Over the period of construction of the Eastern Gully the quality and quantity of VENM available has declined
- The generally steeper slopes of the Eastern Gully have resulted in lower compaction rates on intermediate cover areas (i.e. similar to lower half of the Western Gully)

Scope of Services

The services required under this brief are for the provision of geotechnical advice relating to the characterisation of surface capping materials across the existing landfill including description of: general capping material type; thickness; density; permeability; and how these characteristics vary spatially and with depth.

It is envisaged that the work required will involve a combination of both field and lab testing. Initially field testing would be undertaken at a large number of locations (e.g. hand DCP) to confirm spatial variation in capping material. This would then be followed by more detailed characterisation for a sub-set of these locations. Separate sampling will be required for areas of intermediate and daily cover, and also locations where there is a known variation in cover material and compaction type (as described above and in the attached sketch and as observed on site).

The key deliverable will be an interpretive report containing test results, summaries, geotechnical interpretation, and interpretive plans and figures (showing spatial variation). The consultant is also to provide co-ordinate details for test locations for Council's future reference (MGA94 Zone 56). GPS positioning will be accepted provided co-ordinate locations are accurate to within approximately 5m.

Proposal Submission & Conditions of Engagement

The client for this project is Wollongong City Council with engagement in accordance with Council's standard supply contract conditions (refer http://www.wollongong.nsw.gov.au/business/5241.asp).

To allow comparison of tenders, proposals should be submitted on a provisional lump sum basis assuming a total of 30 field test locations, 10 of which will be subject to detailed lab testing. A separate schedule of rates should be supplied for each of the tests to be undertaken, along with a suggested minimum number of sample locations and tests. Prior to engagement Council will liaise

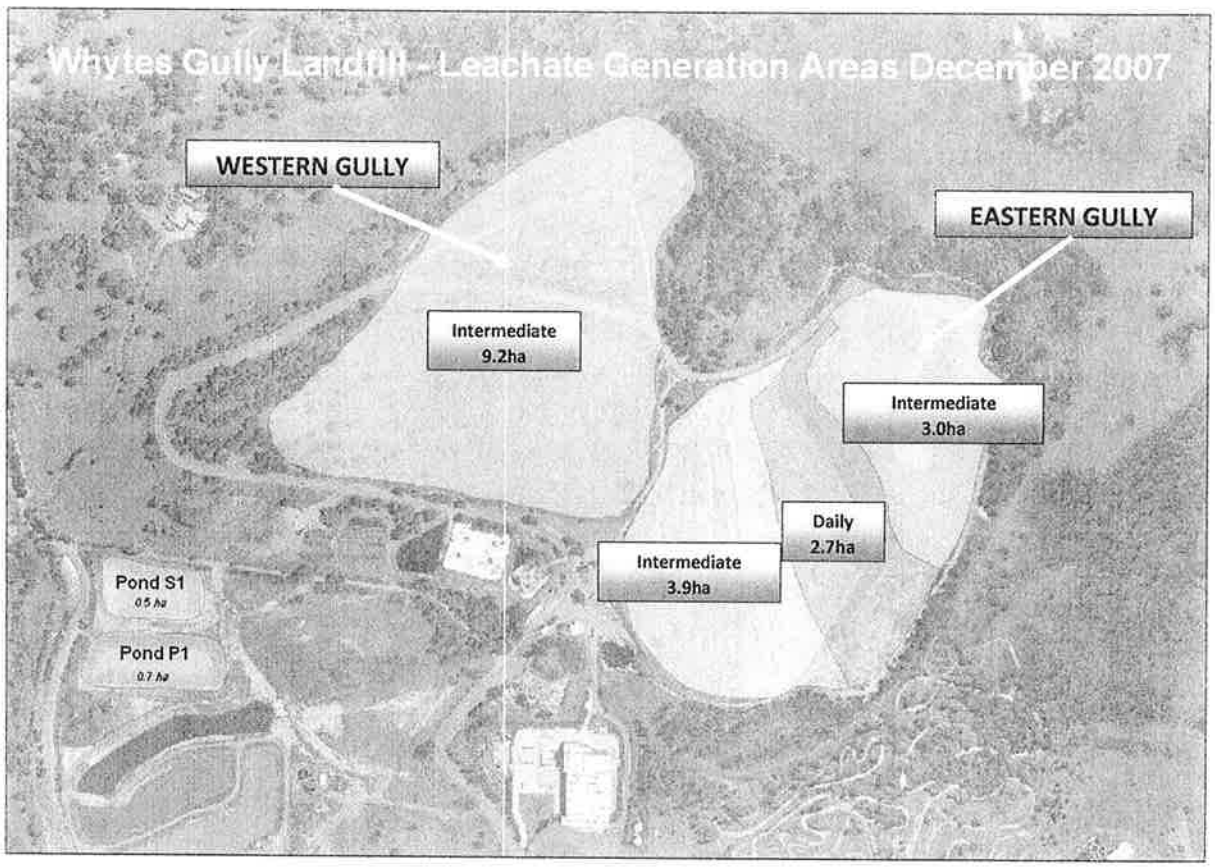
with the preferred tenderer to confirm the testing regime to be adopted and adjust the lump sum fee accordingly. The recommended testing regime should balance minimisation of costs with the need to quantify any significant spatial variability in the characteristics of capping materials.

If tenderers have alternative investigation methodologies that they would like to propose, then they are encouraged to supply details in their proposal as a separate option for Council's consideration.

Proposals are to be submitted electronically to Rienco Consulting (steve.roso@rienco.com.au) and addressed as follows:

Wollongong City Council
c/o Rienco Consulting
PO BOX 5431
Wollongong NSW 2500

During proposal preparation, tenderers should contact Steve Roso of Rienco Consulting for further assistance and information (steve.roso@rienco.com.au or ph 0400 562 162).


Whytes Gully Landfill - Leachate Generation Areas December 2007
WESTERN GULLY
EASTERN GULLY
Intermediate
9.2ha
Intermediate
3.0ha
Daily
2.7ha
Intermediate
3.9ha
Pond S1
0.5 ha
Pond P1
0.7 ha

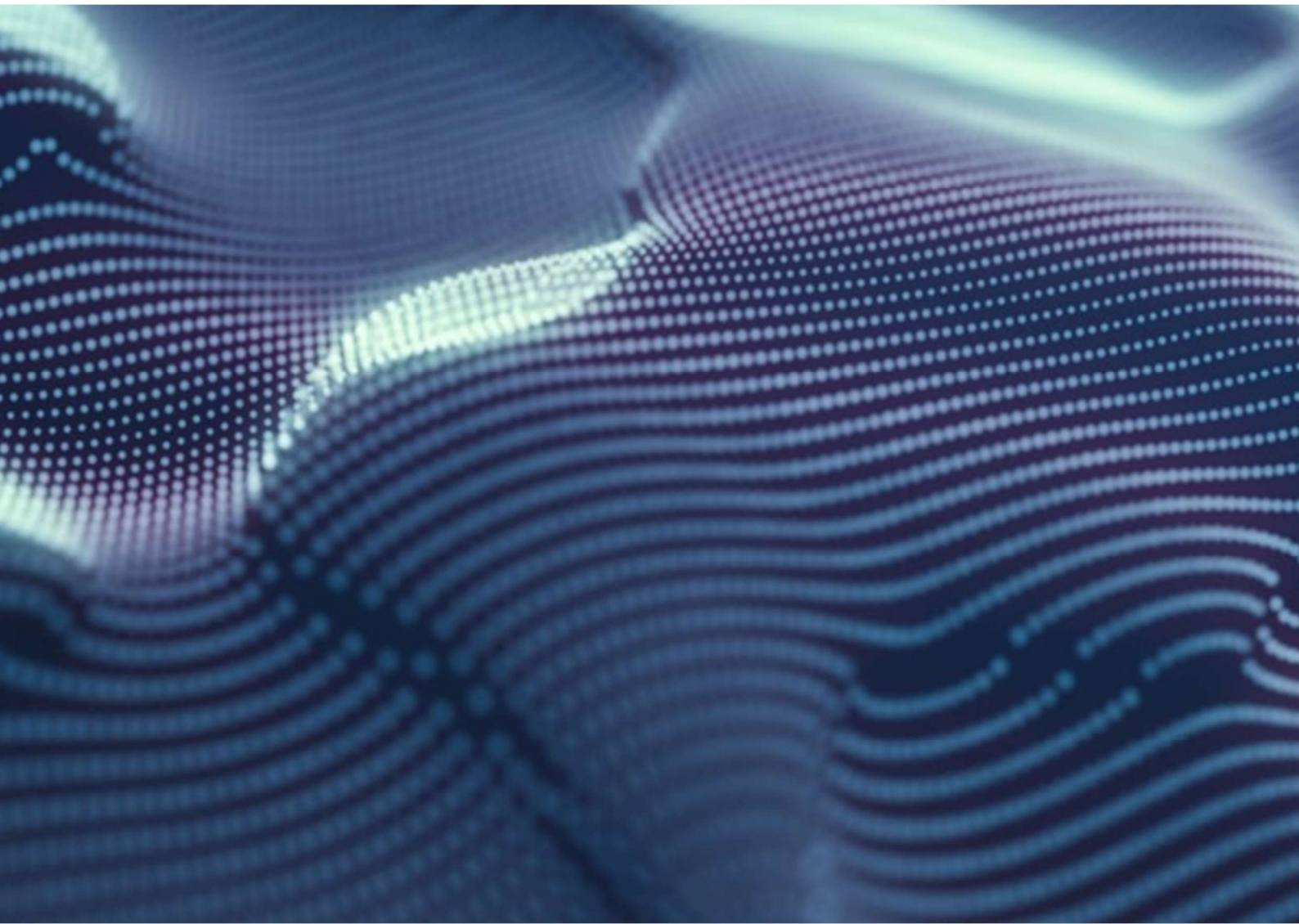
Water Balance Analysis

Wollongong Waste and Resource Recovery Park

Wollongong City Council

23 November 2021

→ The Power of Commitment



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1. Introduction

1.1 Background

Wollongong City Council (Council) operates the Wollongong Waste and Resource Recovery Park (the site), located at 133 Reddalls Road, Kembla Grange, NSW. The operation of the site (including landfilling of waste) is an essential service for the people and industries of the Wollongong Local Government Area.

Recently, Council was issued a Notice of variation of licence (EPL No. 5862) by the EPA dated 12 March 2021. The Notice covered the following:

> B. On 17 November 2020 the Environment Protection Authority (EPA) provided correspondence to the licensee requesting information on how it intends to address numerous exceedances of the licence limit for total suspended solids (TSS) during overflow events.
>
> C. On 4 December 2020 the licensee provided a response outlining a number of measures it intends to take to address the issue.
>
> D. The Notice varies the licence to include a Pollution Reduction Program (PRP) that requires the licensee to prepare and submit reports investigating the overflow TSS exceedances issue and providing recommendations.

Other observations/variations were identified in the Notice including item A and items E to L which are not covered by this report.

The following related conditions were added to EPL 5862:

8 Pollution Studies and Reduction Programs

U1 Stormwater Improvement Plan

U1.1 By no later than 28 August 2021 the licensee must submit a preliminary assessment and update of the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater management system and develop an improvement and maintenance plan.

U1.2 By no later than 3 December 2021 the licensee must prepare a comprehensive water balance based on current and future landfill operations. The water balance must consider leachate, groundwater and stormwater at the premises.

U1.3 By no later than 31 March 2022 the licensee must submit an independent assessment of the revised stormwater management system prepared by a suitably qualified and experienced independent person. The assessment must include recommendations for improvements to the management of the system to prevent overflow events and ensure compliance with relevant licence limits.

GHD has completed a water balance assessment to address EPA requirement U1.2.

1.2 Purpose of this report

The purpose of this water balance analysis and supporting report is to assess and analyse the leachate and stormwater runoff generation for the existing and future leachate, groundwater and stormwater systems at the site. A model was developed to estimate leachate and stormwater volumes for potential rainfall scenarios and was calibrated against leachate and stormwater pond level data. Groundwater was estimated based on typical values for similar site conditions. The water balance analysis is based on current and future conditions of the site (as of October 2021) and has been prepared in response to the revised EPL condition U1.1 and U1.2.

The assessment did not include modelling of water quality parameters.

1.3 Reliance

We have relied upon the following information to undertake the water balance modelling:

- Department of Environment and Climate Change (2008), Managing Urban Stormwater: Soils and construction – Volume 2B Waste Landfills (the Blue Book)
- Forbes Rigby Pty Ltd (2003) Statement of Environmental Effects for New Leachate and Stormwater Treatment Ponds, Whytes Gully Waste Disposal Depot
- Golder (2012), Technical Memorandum - Leachate generation and water balance modelling
- Golder (2012), Volume II EIS – G1 Geotech Report, G3 Hydrogeological Report, G4 Surface water report. G5 Leachate and water balance report
- Golder (2012), Volume IV EIS – Appendix O Preliminary Design Report, Appendix P Landfill Environmental Management Plan (LEMP)
- Golder (2017), Memorandum - Whytes Gully new landfill cell – Leachate water balance update – Methodology
- Golder (2017), Wollongong Waste and Resource Recovery Facility: Water Balance Assessment
- Golder (2021), Observations of site stormwater infrastructure at Wollongong Waste and Resource Recovery Park
- Landcom (2004). Manual Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition).
- NSW EPA (2016), Environmental Guidelines: Solid Waste Landfills, 2nd Edition dated April 2016.
- NSW EPA (2016). Environmental Guidelines Solid Waste Landfills
- NSW EPA, Site Environmental Protection Licence (EPL) No. 5862, version 12 March 2021
- SILO climatic data - patched Point Data (co-ordinates: -34.45, 150.80) including rainfall and evaporation from 1900 to 2020
- Wollongong City Council (2021) Preliminary Assessment: Stormwater Management System (EPL 5862)

1.4 Scope and limitations

This report: has been prepared by GHD for Wollongong City Council and may only be used and relied on by Wollongong City Council for the purpose agreed between GHD and Wollongong City Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Wollongong City Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 3 to 5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Wollongong City Council and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Existing conditions

2.1 Topography

The Whytes Gully landfill is located on the southern foothills of Mount Kembla, and the landfill area has been created through the filling of gullies located on the south facing slopes. The crest of these gullies is around 100 m AHD, and the uppermost elevation of landfilling extends to around 85 m AHD.

For conceptualisation purposes, the landfill has been split into two areas as previously described by Golder (2012) and referred to as the Western Gully and Eastern Gully. The Western Gully was operated between 1984 and 1993, and the Eastern Gully between 1993 to the present day. The Western Gully is bounded by the Western Ridge to the west, and the Central Ridge separates it from the Eastern Gully landfill.

Golder (2012) document that both the Western Gully and Eastern Gully were constructed through the stripping of thin colluvial soils and residual soils. In places the gullies were fully stripped to the rock head, however, in the lower elevations, the full depth of residual material may not have been removed. The Western Gully was not constructed with a lining system, however, the Eastern Gully had an engineered lining system.

2.2 Leachate management

The existing leachate management relies on a gravity fed leachate collection system. The western gully historical landfilling area is unlined with a leachate collection system at the base and the eastern gully is lined with a deep drainage system installed. The landfill expansion cells have an engineered base liner system with leachate collection system. Leachate from all cells drain to the primary leachate pond (P1) where it is treated by aeration. Once a certain level is reached, the leachate is pumped to the secondary leachate pond (S1) and transferred to the backup leachate pond as required by pumping. The total capacity for leachate storage is 26,000 m^3. Leachate is treated at the treatment plant prior to discharge to sewer in accordance with the trade waste agreement. The leachate treatment plant uses sequencing batch reactor technology and has the capacity to treat up to 250 kL per day.

On 11 February 2020 approximately 100,000 litres of leachate was tankered off site for disposal following significant rainfall events. This event resulted in a breach when leachate entered the stormwater management system.

2.2.1 Trade waste agreement

The current consent to discharge industrial wastewater was approved by Sydney Water on 14 August 2017 (refer Appendix B). The existing discharge limits are summarised as follows:

– Instantaneous maximum rate of gravitated discharge 7 litres per second
– Maximum daily discharge 605 kilolitres
– Average daily discharge 250 kilolitres

Discharge quality parameters and concentration limits are outlined in the trade waste agreement as long term average daily mass, maximum daily mass and standard.

2.3 Stormwater management

The stormwater management system at the site comprises a network of surface water runoff diversion drains and culverts that gravity drain to the sedimentation pond and two polishing ponds (in series) as shown in Figure . The whole landfill area drains to the stormwater ponds (other than collected leachate). Based on the 2003 Forbes Rigby design, the total capacity of the stormwater system is 40,000 m^3. As landfilling progresses and the landfill cells are progressively rehabilitated, final capped catchment areas are intended to be diverted from the stormwater ponds and the size of the ponds downgraded.

The current stormwater system comprises:

– A series of diversion drains along the perimeter of the landfill, haul roads and around the landfill expansion cells gravity drains surface water runoff south west towards the stormwater ponds. The drains are generally lined with rip rap or gabion mattresses to control erosion.
– Diversion bunding north of the Package 2/3 piggyback liner area is incomplete and allows some surface water ingress into the active filling area
– The collected surface water enters the stormwater ponds from the north east inlet
– Water is transferred between the three northern reed beds via spillways and is treated via macrophyte plant species intended for nutrient stripping and enhanced sedimentation
– Two polishing ponds in the south to allow for settlement and storage of organically bound nutrients and particles
– The polishing ponds discharge stormwater through a concrete culvert that drains to a culvert under Reddalls Road after mixing with treated surface water from the transfer stations. The discharge water flows through a series of creeks and wetlands before entering Dapto Creek

The southern outlet pond is operated by pumping following confirmation of water quality within the Environment Licence Conditions for stormwater discharge.

The licence discharge limits are as follows:

– L1.2 There must be no discharge of contaminated stormwater to waters under dry weather conditions (less than 10 mm of rainfall within a 24 hour period) or a storm event/s of less than 1:10 year, 24 hour recurrence interval (less than 297.4 mm of rainfall within a 24 hour time period).

  Discharges of contaminated stormwater from the stormwater ponds caused by a 1:10 year, 24 hour recurrence interval storm event or greater do not constitute a breach of this licence.[1]
– L2.4 Water and/or Land Concentration Limits

  Point 1: pH 6.5-8.5 and maximum 50 mg/L total suspended solids

2.3.1 Surface water discharge

Surface water monitoring is conducted annually in February, prior to opportunistic releases and following overflow events. The monitoring point is located at the outlet location of the southern polishing pond (EPL monitoring Point 1). Monitoring data was provided by Council for the period between 7 July 2016 and 30 April 2021 along with stormwater pond level measurements between May 2019 and May 2021. The data indicated:

– There were 53 controlled releases recorded between July 2016 and April 2021. The average number of controlled releases is 11 per year.
– There were 3 overflow events recorded, one in 2016 and two in 2017.
– The pond level data indicates the ponds appeared to be full and spill/discharge 7 times over the 2 year monitoring period between May 2019 and May 2021. This is generally consistent with Volume 2B of the Blue Book (Department of Environment and Climate Change 2008) which generally indicates sizing for a 90th percentile storm event will result in 2-4 spills per year.

[1] Licence condition L1.2 is a leachate management requirement and should be reviewed and updated.

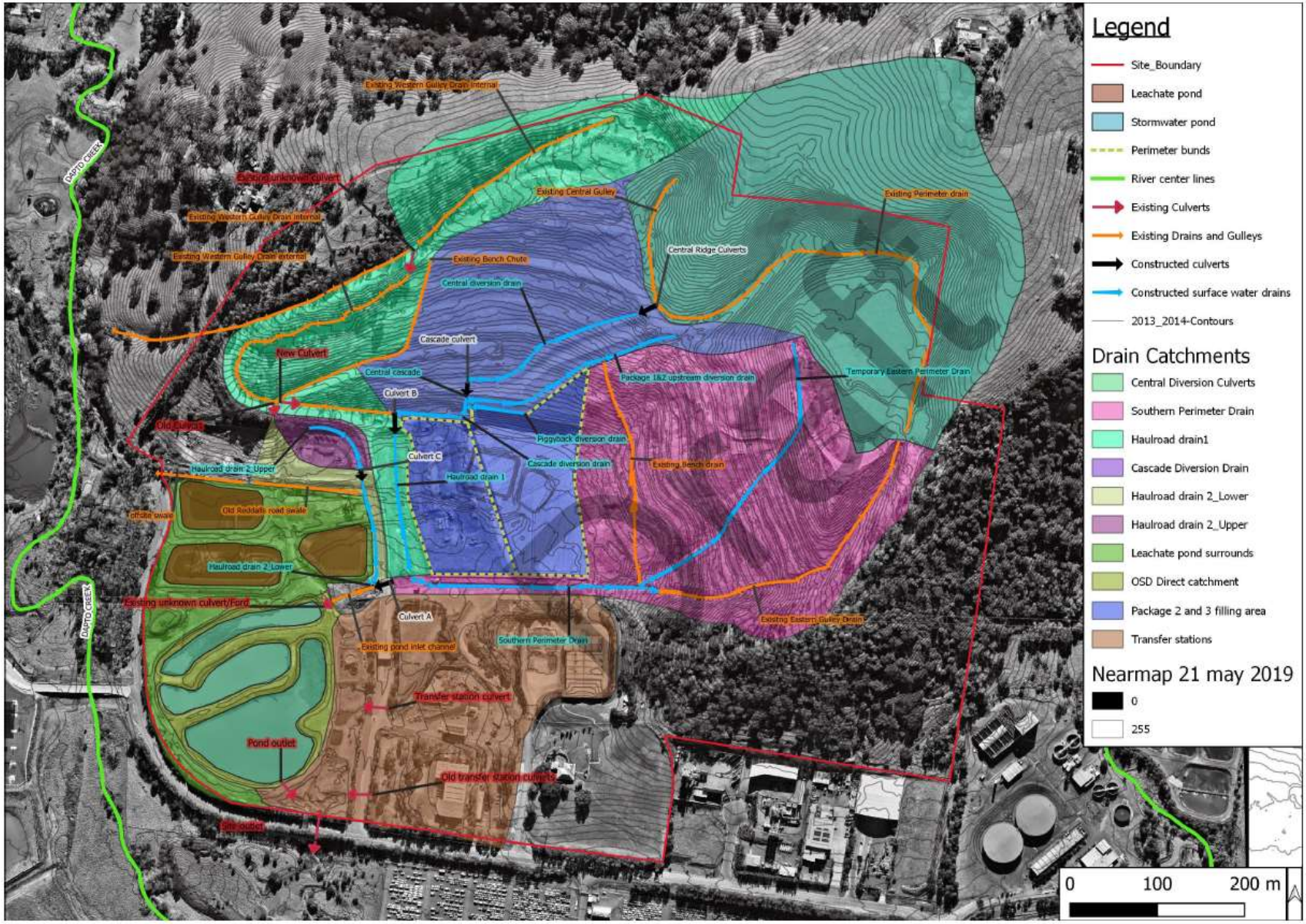


Figure 1 *Conceptual stormater management configuration (Golder 2021)*

3. Assessment of groundwater contribution

Previous water balance assessments completed for the Whytes Gully landfill have considered groundwater to be contributing to the overall leachate volumes being extracted from historical filling areas (Golder 2012, Golder 2017). To quantify the contribution of groundwater to the overall water balance, the reported hydrogeological setting was assessed and described in this section.

3.1 Evidence of spring activity

Golder (2012) document that springs were identified in the Eastern Gully prior to its filling. A review of aerial imagery indicates that both the Western and Eastern Gully had drainage lines emanating from them, and areas of verdant vegetation growth. This supports the anecdotal evidence of the presence of spring activity in the areas now subject to landfilling.

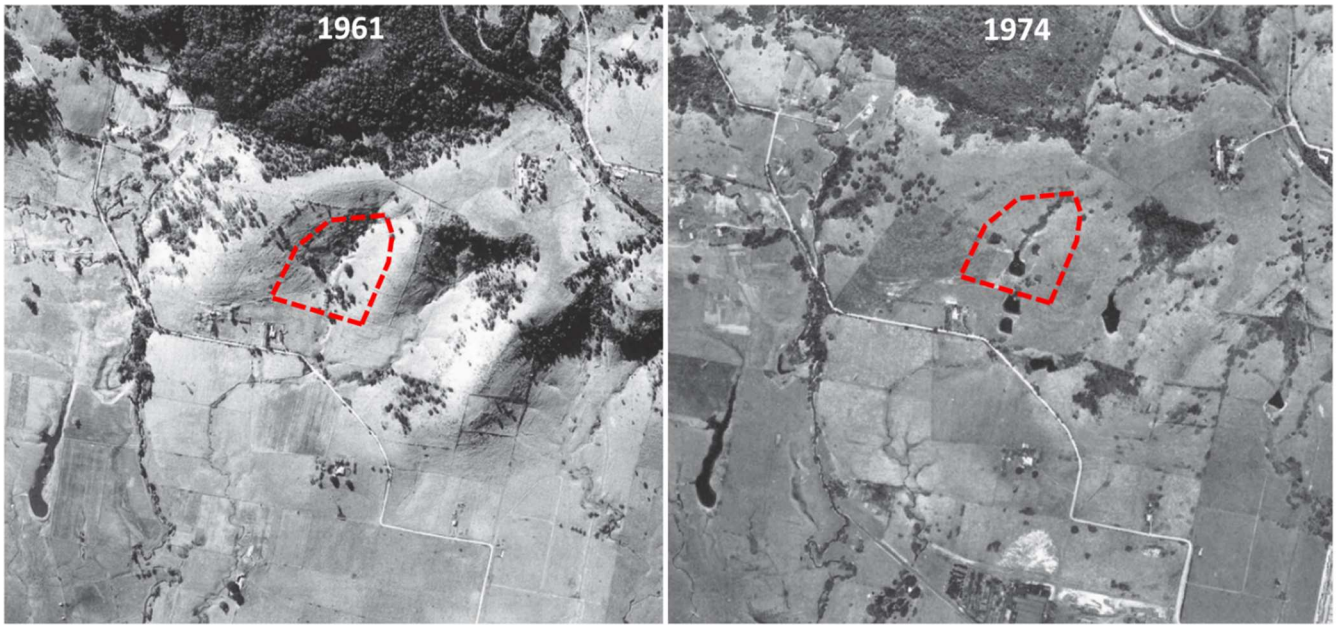


Figure 2 Aerial imagery

Source: Golder 2012

3.2 Geological setting

The landfill is located with the indurated sediments of the Permo-Triassic Sydney Basin. Golder (2012) describe the bedrock to comprise Permian age sandstones and siltstones of the Pheasants Nest and Budgong Sandstone. These sediments have been weathered, and geologically more recently, colluvial and alluvial deposits have formed in the lower elevations.

Multiple phases of investigation drilling and monitoring bore construction have been undertaken at the landfill, from which Golder (2012) interpreted geological sections through the landfill. An interpretative section has been shown as Figure 3, however, underlying the landfill, the thickness of residual soils and weathered rock is unknown (and potentially absent in places).

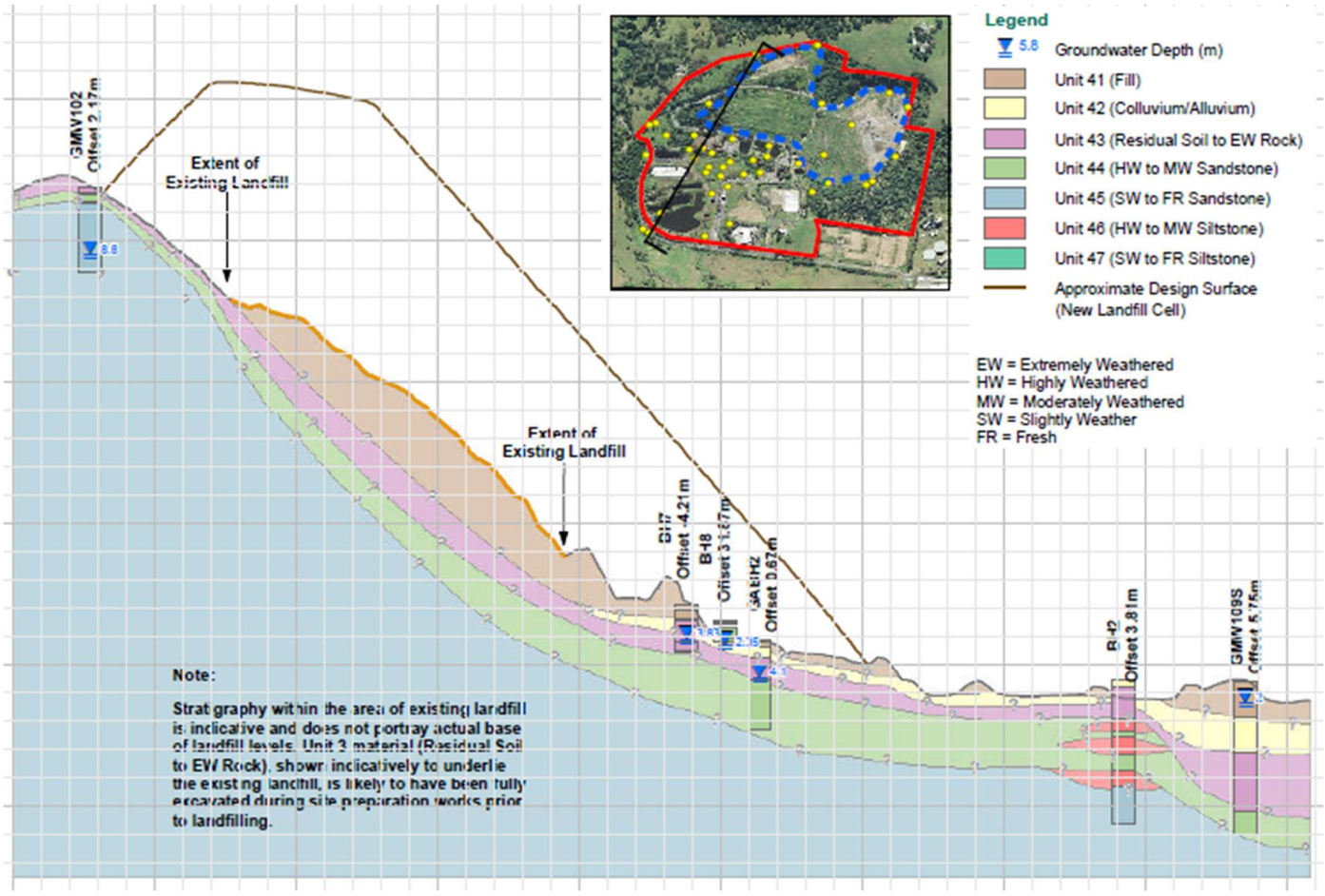


Figure 3 *Interpreted geological section*

Source: Golder 2012

3.3 Hydrogeology overview

3.3.1 Identified aquifers

Based upon the site drilling, groundwater has been intersected in the indurated Permian sediments, as well as the unconsolidated alluvial and colluvial sediments identified at lower elevations.

Using the interpreted geological section, from a high-level hydrogeological perspective, it is possible to simplify the various formations into two basic aquifer systems which are described below:

– Indurated Permian sediments

  Within these aquifers, groundwater is (mostly) transmitted by secondary porosity flow mechanisms in these rocks such as fractures, joints, and other discontinuities within the rock mass. Primary porosity flow (that is, movement between grains) is mostly negligible to low depending upon grainsize, but can be greater where the original matrix has been altered by weathering. On a local scale, the hydraulic character of the aquifers may vary because of:

  - Weathering
  - Nature of fracturing (size, density, persistence, infilling)
  - Nature of their formation, such as dykes, and contact metamorphism
  - Tectonic history
  - Local variations in lithology

– Unconsolidated alluvial, colluvial sediments and fill

  Within porous media aquifers, groundwater is stored and transmitted by primary porosity flow (flow between the interstices and pore spaces of the sedimentary grains). The porous media formations in the study area include the Quaternary alluvial and colluvial sediments, which comprise variable mixtures of the sands, gravels, clays, and silts. These are found at the lower elevations within the project area.

  The alluvials are laterally restricted to the present day drainage lines and waterways, and in some cases can have a high degree of interaction with waterways.

3.3.2 Inferred groundwater flow

All aquifers are water table (unconfined) aquifers from a regional perspective. However, with increasing depth of burial beneath fine grained colluvial and alluvial sediments, the bedrock aquifers can become increasingly confined.

Overall groundwater flow is towards the lower lying areas, i.e., towards the drainage systems etched into the basement topography, with water levels being a subtle or subdued reflection of the topography. Figure 4 (Golder 2012) shows the inferred groundwater contours at the site. Where the water table shallows, or there are abrupt changes in topography, groundwater may daylight as spring flow.

Multiple flow systems (local, intermediate, and regional) may develop in the bedrock (and are relevant to all Permo-Triassic aquifers). The local flow systems are expected to predominate with flow occurring through the saprolitic (weathered profile) of the bedrock aquifers and overlying saturated residual zones where permeability (and storage) is high. A contrast in the hydraulic conductivity and aquifer storage may exist between the upper parts of bedrock, and the deeper, fresher bedrock.

Local flow systems can develop in this terrain, and where infiltrating rainfall can flow along the bedrock interface, or locally via shallow fractures. Where saturated fractures daylight, groundwater springs result. These springs can be permanent, particularly in the lower elevations, or ephemeral, flowing only after wetter periods. As per the water level behaviour, prevailing climate can influence spring flows, and during extended low rainfall recharge periods, the springs may reduce, or cease in flow.

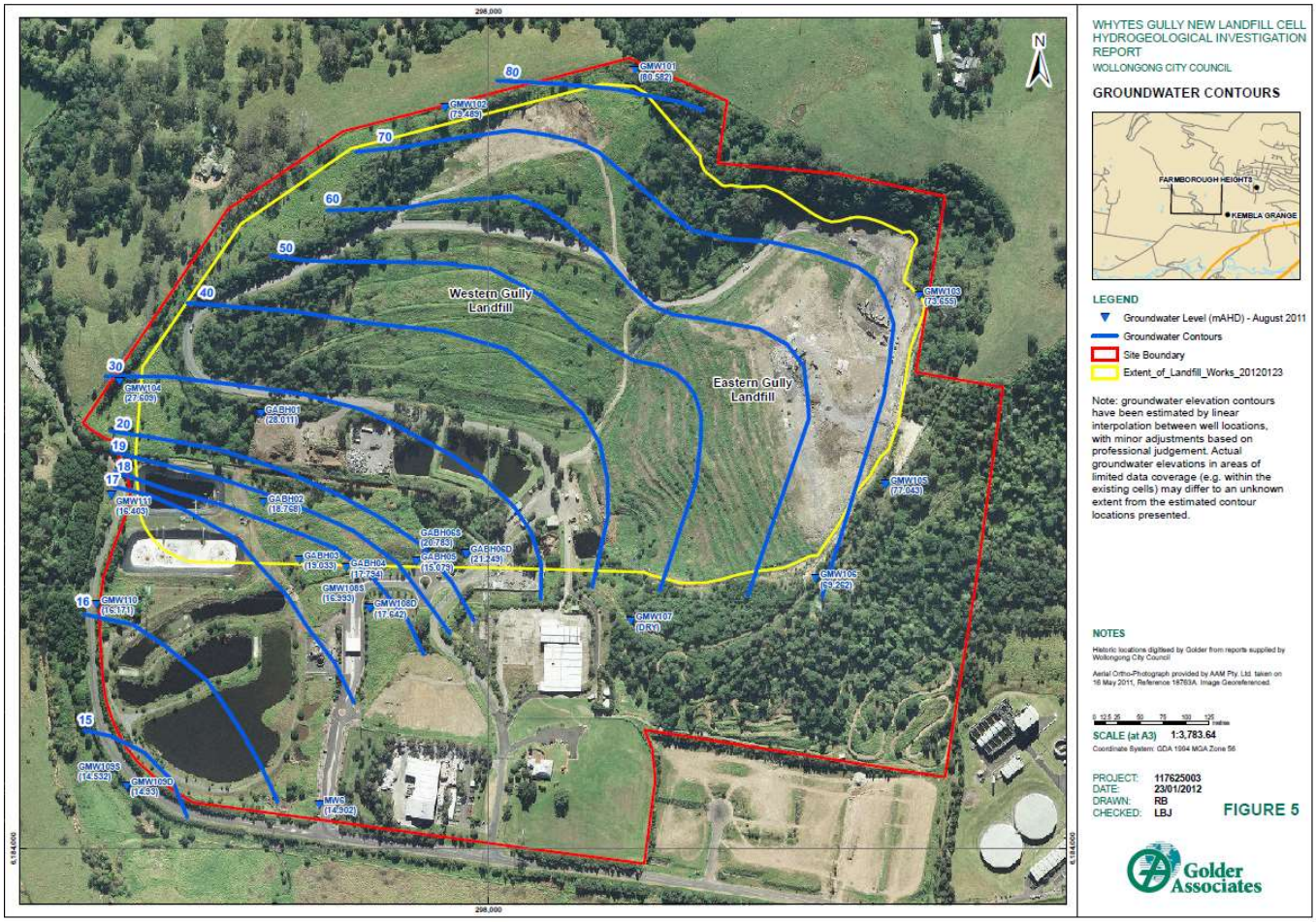


Figure 4 *Inferred groundwater contours (Golder 2012)*

3.3.3 Aquifer hydraulic conductivity

Golder (2012) report hydraulic conductivities from the slug testing of onsite monitoring bores. These conductivities have been summarised in Table 1 and are based on two groundwater bores screened in alluvium and five groundwater bores screened in shallow rock. The hydraulic conductivity of a sand typically ranges from 0.1 m/day to 10 m/day and therefore the sandstone is at the lower end of a range that can be reasonably expected for permeable materials.

Table 1 *Hydraulic conductivities*

Bore ID	Lithology	Hydraulic Conductivity	
		m/s	m/day
GABH02	Sandstone; Medium to fine grained (HW-MW)	5e-6	0.43
GABH05	Sandstone; Fine grained (HW – SW)	4e-6	0.35
GMW104	Sandstone; Fine grained (MW)	5e-8	0.0043
GMW105	Sandstone; Fine to medium grained (MW)	1e-5	0.86
GMW108D	Sandstone; Fine grained (HW - MW)	7e-6	0.6
GMW108S	Clay and sandy clay	6e-6	0.52
GMW109D	Sandy silty clay	3e-6	0.26
GMW109S	FILL; Clay, with clayey sand	1e-5	0.86

Source: Golder 2012.

3.4 Groundwater potentiometry

Water level measurements are taken quarterly from the landfill monitoring bores. The monitoring bore hydrographs are shown in Figure 5 and have been presented to characterise the seasonal groundwater response. The hydrographs have been presented over two reduced groundwater level ranges, as there is a considerable difference in elevation between the northern, elevated part of the site, and the flatter topographies to the south.

The water level monitoring data was received from Council and there are multiple monitoring anomalies, as water levels can change by over 6 m in some instances. In general terms, most monitoring bores show very limited seasonal fluctuation, i.e., generally less than 1 m variation.

A monthly residual mass curve of rainfall has been prepared to identify long term rainfall trends and has also been presented in Figure 5. The rainfall data was sourced from Bellambi AWS climate station (68228) for the period 1990 to 2021, to characterise the influence of climate on groundwater levels. The absolute value of the residual mass curve is not significant; however the slope of the curve is:

– A positive slope indicates a wetter than average period
– A negative slope indicates a drier than average period
– A section of both negative and positive indicates a period of generally average rainfall
– The grade of the slope indicates how much wetter or drier than average the climate is

The residual mass curve indicates that the rainfall has been above average between 2013 and 2017, below average between 2017 and 2019, and relatively average since this period. In unconfined or water table aquifers, with relatively shallow water tables, increases in rainfall tend to result in a corresponding increase in groundwater levels. Such a response has not been obviously identified in the monitoring bore hydrographs. The relatively stable response in the hydrographs could be due to:

– Very low recharge rates in the bedrock aquifer
– In some parts of the site, groundwater levels in monitoring bores may be being artificially recharged by near site features. For example, leaking lagoons, stormwater channels or leaking buried services.

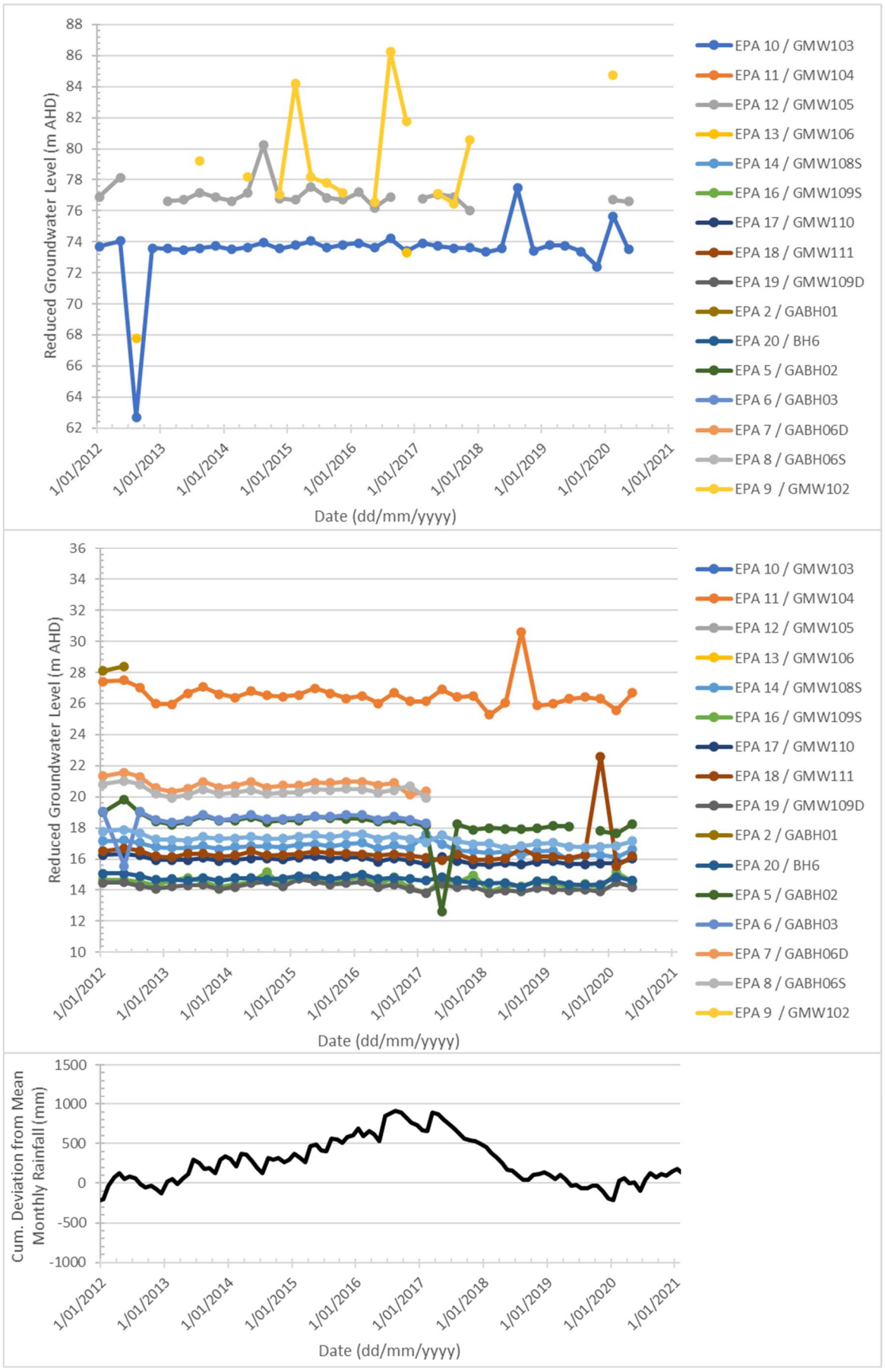


Figure 5 *Monitoring bore hydrograph response*

3.5 Estimate of groundwater recharge

3.5.1 Spring flow assessment

GHD could not identify any historical measurements quantifying spring flow and assumes that these rates have not been quantified. Spring flow rates are likely to be of the order of litres per minute (i.e., <0.1 L/s). It is difficult to gain an understanding of the permanency of springs from the available aerial imagery. Spring locations observed by Council in July 2021 are shown in Figure .

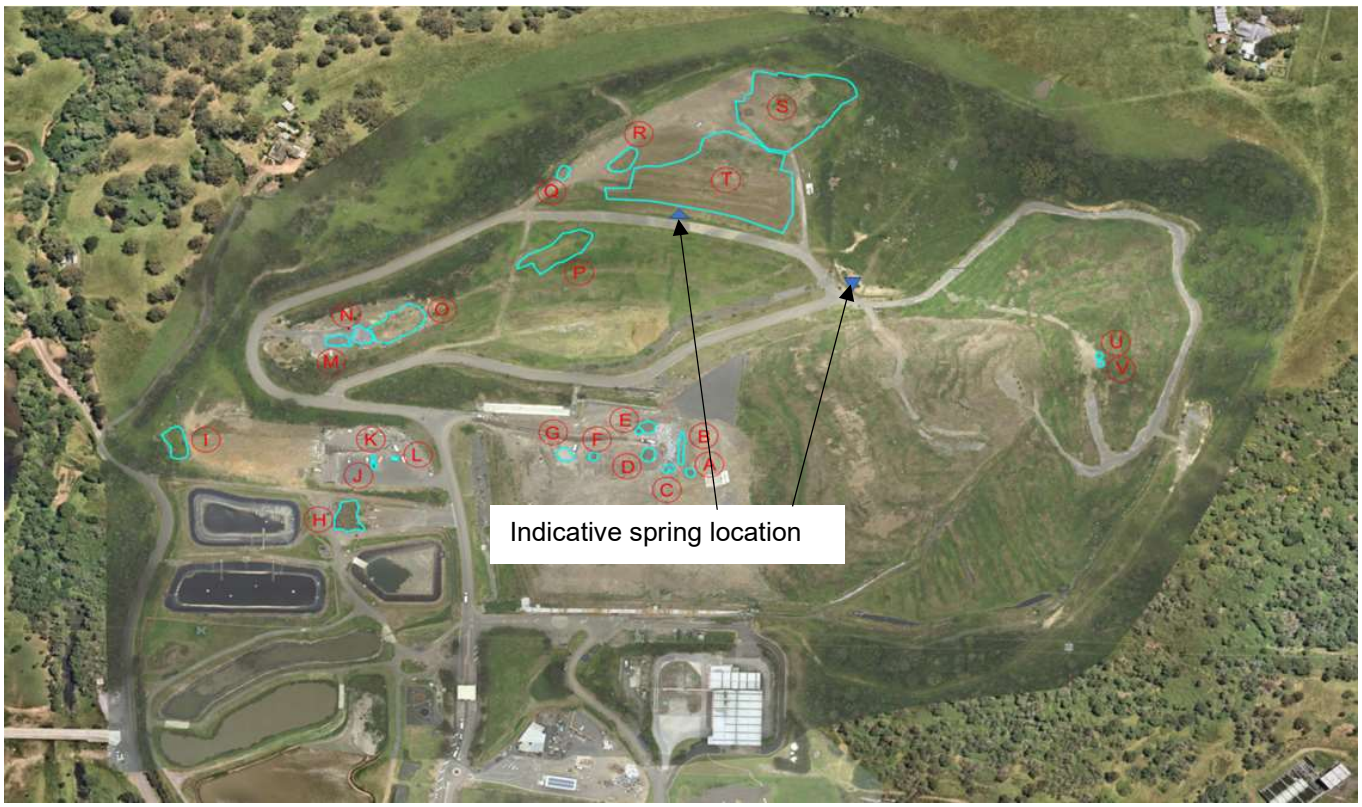


Figure 6 Observed spring locations (WCC 2021)

3.5.2 Approach to quantification of recharge

3.5.2.1 Application of the Darcian method

A hydraulic gradient can be determined from the landfilling area through the groundwater monitoring network, and hydraulic conductivities have been determined through field testing of the bedrock materials. Under these conditions a groundwater flux can be estimated, however, a key unknown is the size of the spring eye, either prior to landfilling commencing, or how it may have changed in size with the ground preparation works that were undertaken prior to landfilling, i.e., the scraping and removing of shallow soils to rock head may have exposed more saturated fractures to daylight.

Under these circumstances, calculation of volumetric flux through the base of the landfill would be highly uncertain and has not been applied.

3.5.2.2 Application of the aerial recharge method

An estimate of the potential contribution of groundwater through the base of the landfill can be determined through an aerial recharge assessment. This approach assumes that a percentage of the annual rainfall that does not form run-off, or is lost through evapo-transpiration process infiltrates below the ground surface and becomes a groundwater accession, i.e., recharge. Required inputs into the analysis are rainfall rates, nett groundwater recharge and catchment supplying the aquifer.

Interpreted catchment

The Western Gully Landfill, as its name implies, was constructed within a gully, separated by ridge lines to the west and east. These ridgelines would likely form groundwater divides, that is:

– On the western side of the landfill (Western Ridge), groundwater recharge would bifurcate, with flow toward the Western Gully Landfill, and a component of groundwater flow would be towards the (south)west and away from the landfill.
– On the eastern side of the landfill groundwater (Central Ridge) flow similarly bifurcates with flow into the Western Gully Landfill, and flow towards the Eastern Gully Landfill.

A catchment area that would potentially result in rainfall recharge into the Western Gully Landfill was estimated based upon review of available contour information and determined to be around 2.5 ha.

Annual rainfall

Rainfall information was obtained from the Bellambi AWS climate station (68228) for the period 1990 to 2021, and the average, 75th percentile and 90th percentile annual rainfall was 1,160 mm, 1,380 mm, and 1,490 mm respectively. In the absence of site specific rainfall monitoring, this climate station is considered representative of site rainfall conditions.

Recharge to the bedrock

Recharge rates to the bedrock aquifer are unknown and therefore a sensitivity analysis was undertaken assuming 3% to 10% of annual rainfall.

Results

The results of the recharge analysis have been summarised in Table 2. The inflow rates into the Western Gully Landfill are estimated at between 0.03 L/s and 0.1 L/s with wetter years providing an additional 20% to 30% increase in flow rate.

Table 2 Groundwater recharge estimate

	Average Rainfall Year			75th% Annual Rainfall Year			95th% Annual Rainfall Year		
Recharge rate	3%	5%	10%	3%	5%	10%	3%	5%	10%
Estimated recharge area (m^2)	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Annual Rainfall (m)	1.16	1.16	1.16	1.38	1.38	1.38	1.49	1.49	1.49
Groundwater Recharge									
m^3/y	871	1,452	2,905	1,035	1,725	3,451	1,117	1,863	3,726
ML/y	0.87	1.45	2.91	1.04	1.73	3.45	1.12	1.86	3.73
kL/day	2.39	3.98	7.96	2.84	4.73	9.46	3.06	5.10	10.21
L/s	0.03	0.05	0.09	0.03	0.05	0.11	0.04	0.06	0.12

4. Water balance model

A water balance analysis was developed for the site that considers surface water, baseflow (incl. groundwater), and leachate contributions for both the current and future operation of the site. Details of the water balance model are described in the following section, including details of the model, inputs, calibration, and outcomes.

4.1 Site specific climate data

Site specific climate data was derived from SILO Australian database of climate, provided by the Queensland Department of Environment and Science. The data was extracted as Patched Point Data (co-ordinates: -34.45, 150.80), which combines observations and interpolations to provide daily data at selected locations. Rainfall data was extracted daily from 1900 until 2020. While it is noted that rainfall data is measured at the site, the temporal extent of data was limited, and as such the continuous SILO data set was utilised.

A range of evaporation data was extracted from SILO. Estimates for Morton's Wet Areal Evapotranspiration (ETMW) was used in the model to estimate evaporation from water storages extracted daily from 1900 until 2020. Local evapotranspiration scaling factors were developed during calibration described in Section 4.6 for both HDPE geomembrane lined surfaces (e.g., leachate ponds) and the stormwater treatment system.

Long term climate data indicates that rainfall commonly exceeds evapotranspiration at the site, occurring in 50% of years from 1900 until 2020. Average annual rainfall is 1,300 mm compared to evapotranspiration of 1,230 mm.

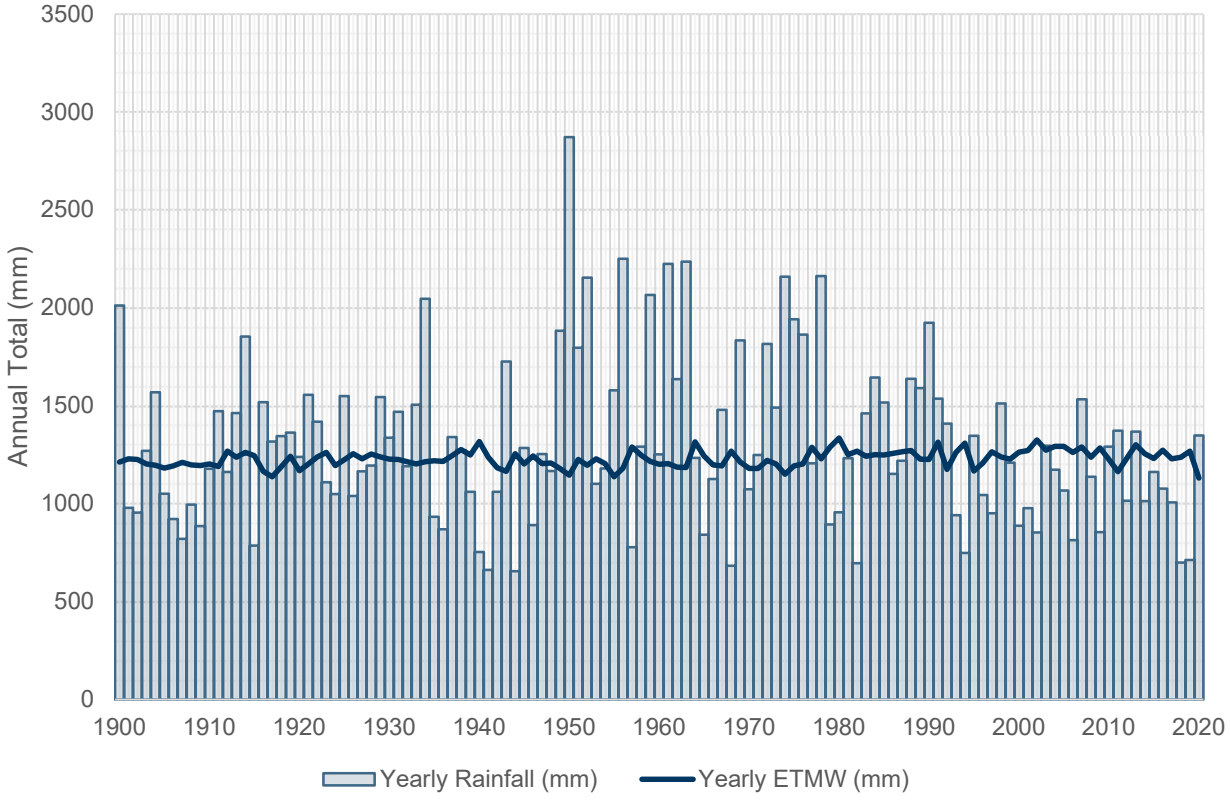


Figure 7 ***Extracted rainfall and evaporation data for Kembla Grange, NSW***

4.2 Analytical water balance model

A water balance model (WBM) was developed using the software, Goldsim. The WBM included quantifying the groundwater, leachate and stormwater generated at the site and allowed for management of waters to be simulated. The WBM included the sites ponds, disposal mechanisms and losses as shown in the Figure 8 and .

4.2.1 Model parameters

The WBM was developed to allow calibration of model inputs to available data and allowed for simulation of a continuous climatic series from 1900 until 2020 based on historical observations. The WBM reported results daily however also includes sub-daily timesteps as required to allow for travel time and dispersion of rainfall derived infiltration and runoff processes.

Development of the WBM was based on the following parameters:

– Existing stormwater and leachate ponds were estimated using available design information, Geographic Information System (GIS), site aerial imagery and site observations.
– Generation of rainfall derived infiltration and rainfall derived runoff were developed using volumetric runoff coefficients with consideration for advection and dispersion through the system.
– Groundwater was estimated during calibration of the WBM, with consideration to estimates provided in the section above.
– Simulation of leachate and stormwater management was based upon discussions with Council and a review of infrastructure, with consideration for disposal and emergency management procedures. The incomplete bunding north of the Package 2/3 piggyback area was accounted for in the existing modelling scenario and catchment areas for contribution to the active filling area leachate generation rate.

The WBM was developed to allow for simulation of the existing site (including calibration to available data), as well as future stages of the site as it is progressively capped and remediated.

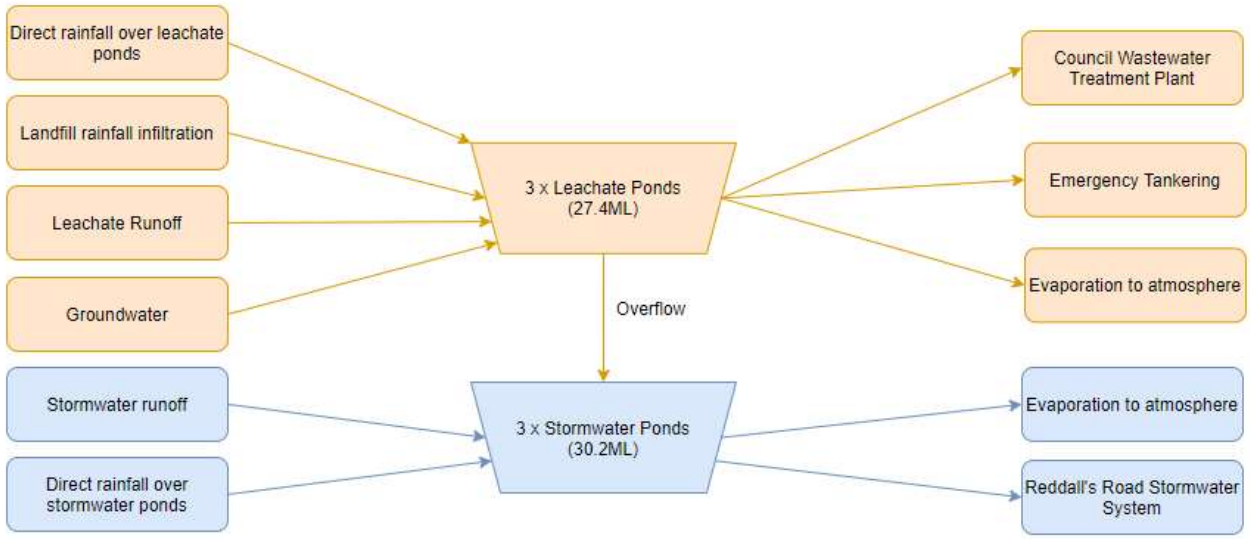


Figure 8 Water balance model layout

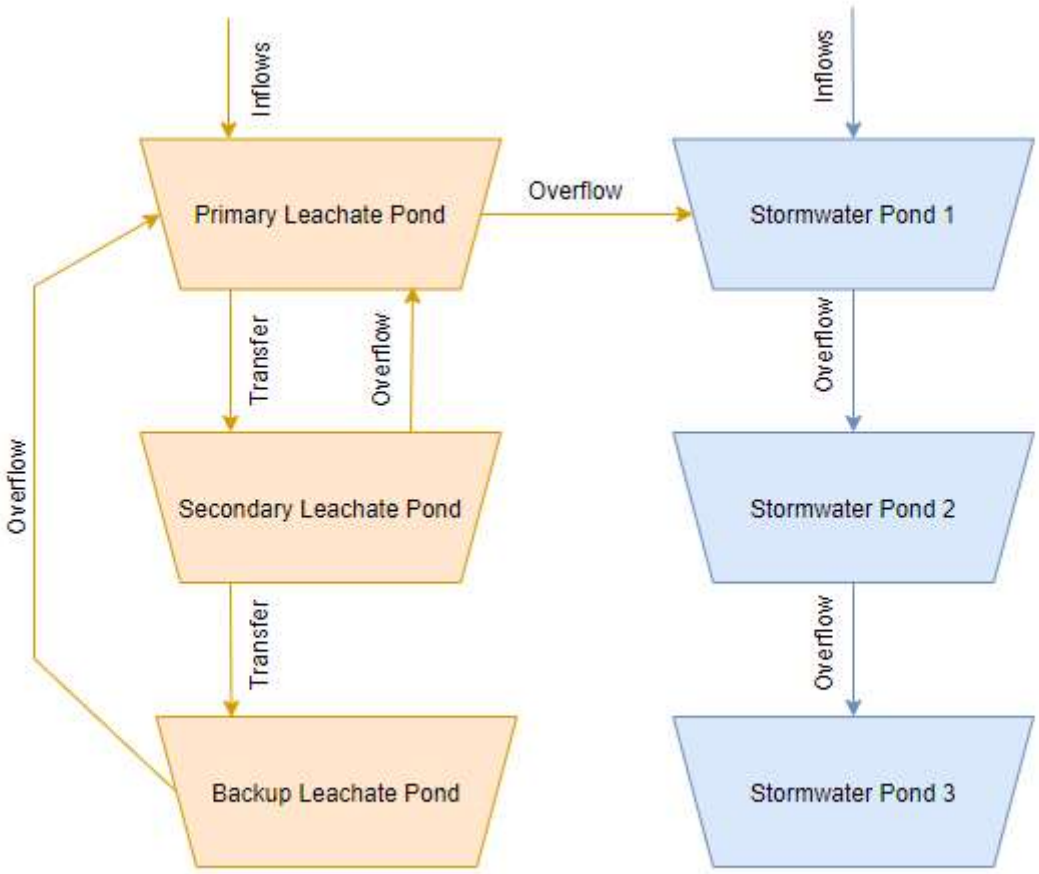


Figure 9 *Layout of modelled leachate and stormwater pond systems*

4.3 Site staging

Staging plans for the site's future operation are included in Appendix A. These stages were assessed to determine the future catchment areas and land-use types at the site which contribute to both leachate and stormwater generation.

4.3.1 Catchment staging

Table 3 *Staged catchment areas*

Catchment	Existing	Stage 3	Stage 4	Final Cap
Drainage directly to the Leachate Ponds	38,700 m^2	28,700 m^2	34,100 m^2	34,100 m^2
Active Cell	33,700 m^2	67,600 m^2	60,000 m^2	0 m^2
Landfill area (excl. Final Cap Area)	400,200 m^2	197,800 m^2	144,400 m^2	110,800 m^2
Drainage directly to the Stormwater Ponds	34,600 m^2	34,600 m^2	18,100 m^2	18,100 m^2
Final Cap area	0 m^2	191,600 m^2	264,600 m^2	358,000 m^2

For each stage, the catchment was broken down into land-use types identified in the following tables.

Table 4 Existing land-use breakdown

Land-use type	Leachate Ponds	Active Cell	Landfill area	Stormwater Ponds	Final cap
Natural surfaces (undisturbed)	0%	0%	17%	0%	NA
Disturbed surfaces	0%	0%	46%	62%	NA
Active tipping face	0%	5%	0%	0%	NA
Daily and intermediate cover	0%	89%	31%	0%	NA
Final cap	0%	0%	0%	0%	NA
Hardstand and buildings	0%	6%	8%	0%	NA
Wet areas (i.e., ponds)	100%	0%	0%	38%	NA

Table 5 Stage 3 land-use breakdown

Land-use type	Leachate Ponds	Active Cell	Landfill area	Stormwater Ponds	Final cap
Natural surfaces (undisturbed)	0%	0%	33%	0%	0%
Disturbed surfaces	0%	0%	39%	57%	0%
Active tipping face	0%	2%	0%	0%	0%
Daily and intermediate cover	0%	94%	20%	0%	0%
Final cap	0%	0%	0%	0%	98%
Hardstand and buildings	0%	4%	8%	0%	2%
Wet areas (i.e., ponds)	100%	0%	0%	43%	0%

Table 6 Stage 4 land-use breakdown

Land-use type	Leachate Ponds	Active Cell	Landfill area	Stormwater Ponds	Final cap
Natural surfaces (undisturbed)	0%	0%	32%	0%	0%
Disturbed surfaces	0%	0%	43%	70%	0%
Active tipping face	0%	3%	0%	0%	0%
Daily and intermediate cover	0%	88%	23%	0%	0%
Final cap	0%	0%	0%	0%	99%
Hardstand and buildings	0%	9%	1%	0%	1%
Wet areas (i.e., ponds)	100%	0%	0%	30%	0%

Table 7 Final Stage land-use breakdown

Land-use type	Leachate Ponds	Active Cell	Landfill area	Stormwater Ponds	Final cap
Natural surfaces (undisturbed)	0%	0%	42%	0%	0%
Disturbed surfaces	0%	0%	58%	70%	0%
Active tipping face	0%	0%	0%	0%	0%
Daily and intermediate cover	0%	0%	0%	0%	0%
Final cap	0%	0%	0%	0%	97%
Hardstand and buildings	0%	0%	0%	0%	3%
Wet areas (i.e., ponds)	100%	0%	0%	30%	0%

4.3.2 Infrastructure staging

As the site is progressively staged, stormwater and leachate storage infrastructure are progressively taken offline and replaced. This is shown in the staging plans in Appendix A, however, generally includes the following. This staged approach is considered in the water balance model.

Table 8 Staged infrastructure adjustments

Existing Infrastructure	Stage 3	Stage 4	Final Cap
Leachate Primary	No Change	Taken Offline	Remains Offline
Leachate Secondary	No Change	Taken Offline	Remains Offline
Leachate Backup	Taken Offline	Remains Offline	Remains Offline
Stormwater – Batch 1	No Change	Becomes Leachate Secondary	Remains Leachate Secondary
Stormwater – Batch 2	No Change	Becomes Leachate Primary	Remains Leachate Primary
Stormwater – Batch 3	No Change	Becomes the only storm pond	Remains the only storm pond

4.4 Generation model

4.4.1 Leachate generation model

The WBM included estimates of leachate generation. Leachate was estimated at the site based on volumetric infiltration coefficients, with consideration for the advection and dispersion of generated leachate as it is collected and percolates the site's gravity drainage system. Volumetric coefficients, advection time and dispersion time were determined during calibration.

The leachate generation model approach is visualised below identifying the processes.

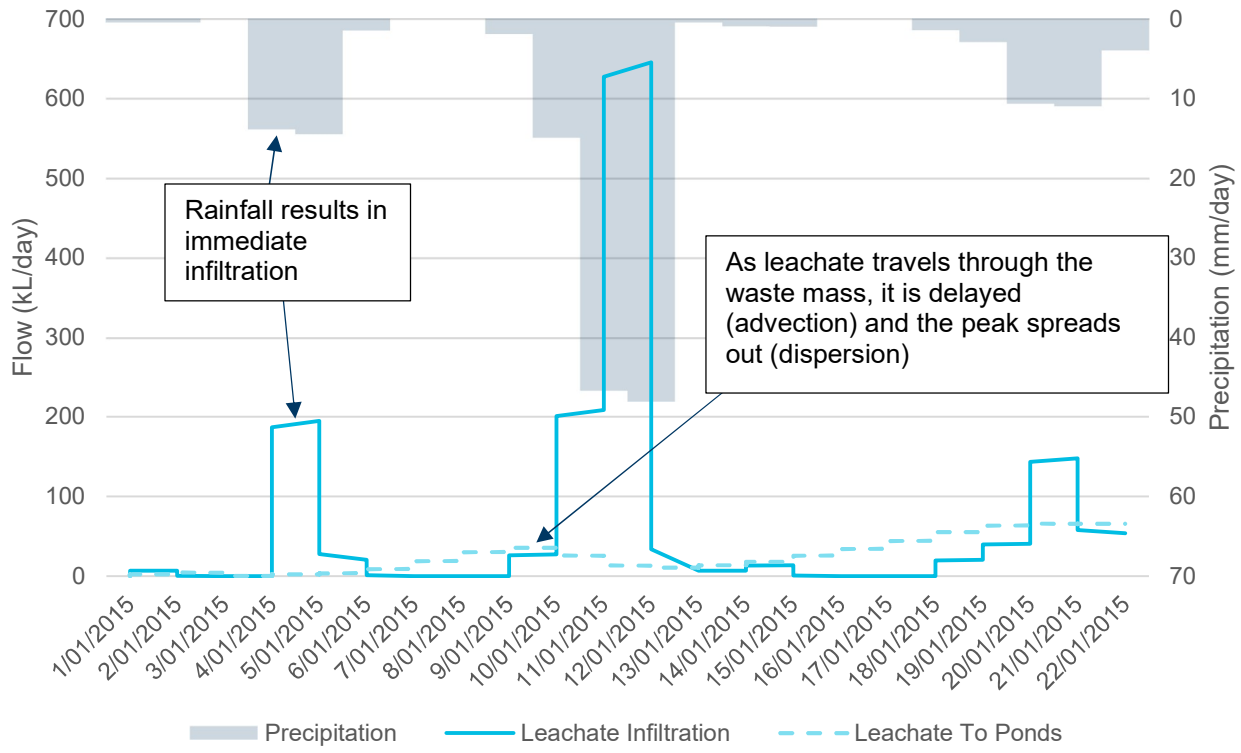


Figure 10 Visualisation of the leachate generation model

4.4.2 Stormwater generation runoff model

The WBM included estimates of stormwater generation. Stormwater was estimated at the site based on volumetric infiltration coefficients. Volumetric coefficients were refined during calibration.

4.4.3 Baseflow model

Baseflow (incl. groundwater) generation was estimated during the calibration process, with consideration to estimates in Section 3.5. Baseflow is considered a combination of moisture extracted from buried wastes, combined with groundwater flow, and can be a significant source of leachate generation, above the peaks associated with rainfall derived infiltration where field capacity of the waste is exceeded.

4.5 Water management

4.5.1 Leachate management

Leachate collected in the gravity drainage system flows to a series of leachate ponds located in the west of the site. These leachate ponds currently consist of a primary, a secondary and a backup pond. Leachate drains directly to the primary leachate pond and is transferred as required between these the other two ponds for treatment and to manage levels in attempt to reduce the frequency of spills.

Leachate is managed through three mechanisms:

– Disposal by enhanced evaporation (with aeration)
– Disposal to sewer via the wastewater treatment plant
– Emergency disposal via tankering

4.5.2 Stormwater management system

Collected stormwater currently flows into a network of three storage and treatment lagoons. The last lagoon in the series flows through an existing outlet structure where it discharges under Reddalls Road, flowing into Dapto Creek. The stormwater pond system is partially regulated. A description of the stormwater management system is provided in section 2.3.

4.6 Calibration

4.6.1 Calibration procedure

The developed WBM was calibrated to allow for estimation of both physical parameters (e.g., volumetric coefficients, evaporation processes) as well as operational parameters (e.g., material transfer and emergency procedures).

Calibration was undertaken using leachate generation estimates (actual outflows from the leachate system into leachate storage - provided by JPG), leachate pond (Primary and Secondary) and stormwater ponds (Polishing lagoon only) levels. JPG leachate generation estimates are attached as Appendix C. Data for the remaining three ponds (northern stormwater ponds and backup leachate storage pond) is not available and is a limitation of the calibration. The calibration process was undertaken using pond levels recorded between 2015 and 2021. Due to the limited data available, only calibration was undertaken, without validation. It is recommended that ongoing calibration and validation be undertaken to better refine the model as more data becomes available.

The following parameters were calibrated to:

– Volumetric runoff/infiltration percentages
– Advection and dispersion time
– Groundwater generation
– Leachate pond transfer procedures

– Leachate pond disposal procedures
– Local evapotranspiration factors
– Stormwater and pond leakage.

Limitations

Users of this calibrated water balance model should note the limitations of the calibration approach. Specifically, the calibration of a water balance model to numerous datasets, collection points and time-frames poses a risk that the calibrated data set does not physically represent the actual operational processes at the site. That is, where different data sets are available, for example the shorter-term leachate generation estimates provided by JPG and longer-term leachate pond volumes provided by Council, the calibrated data may not produce similar model parameters.

GHD note that within this calibrated water balance model the leachate generation parameters were calibrated to leachate generation estimates provided by JPG. Operational data on pond transfers was not captured in the WBM as the model does not include leachate management measures (such as pumping to backup pond) prior to significant rainfall events in response to weather forecasts, or stormwater management measures such as opportunistic discharge of stormwater following water quality testing.

It is recommended that calibration should be undertaken regularly throughout the life of the landfill as additional data becomes available. The WBM should be reviewed as site operations change from the assumptions in this water balance assessment, additional data collection points may be required to reflect updated infrastructure.

4.6.2 Calibration results

The calibration was optimised based on iterating multiple portions of the WBM using both Root-Mean-Squared-Error, and a modified Nash-Sutcliffe Efficiency relationship for available data. The calibration results are presented in Figure 11 to Figure 14 below.

Leachate system

The leachate calibration results show that the site observations are generally well matched by the model simulation. Leachate generation is well calibrated, generally matching daily observations well, as well as on cumulative weekly basis. This suggests the approach is suitable for predicting leachate generation.

The quality of the calibration available for the leachate pond system was of lower efficiency than for generation, however levels are generally predicted within 1 to 2 ML of observations. It is likely that active site management of leachate is based on forecasts rather than reacting to site conditions. Further, utilisation of the backup pond (which is not currently monitored) may affect results.

Stormwater system

The stormwater calibration results show that the observations cannot be well replicated by the model simulation. This is expected as the modelled pond where calibration can be benchmarked is the third in a series of ponds. Site observations suggest that additional quantities of water are being managed by the upstream ponds, which is not well replicated in the model. Further there appears to be some disposal, leakage or management mechanisms that allows the water to be managed beyond evaporation. It is understood that stormwater is periodically released on-site during favourable conditions to keep water levels as low as possible. This opportunistic management in response to water quality objectives cannot be determined in the current model.

Data available for calibration shows extreme variation in water levels, in part with rapid volumetric changes. This may be the result of leakage from the stormwater ponds and should be further investigated.

Nonetheless, the model was established to allow simulation of stormwater generation at the site, and is likely a suitable estimate for cumulative stormwater generation over long periods. A review of the volumetric changes against the surface water quality discharge testing dates indicated correlation between water quality testing and discharge of stormwater on 12 January 2021, 21 January 2021, 4 February 2021, 22-23 February 2021, and 9 March 2021.

Future efforts of data collection at the site, should consider capturing of stormwater flow rates reporting into the stormwater system.

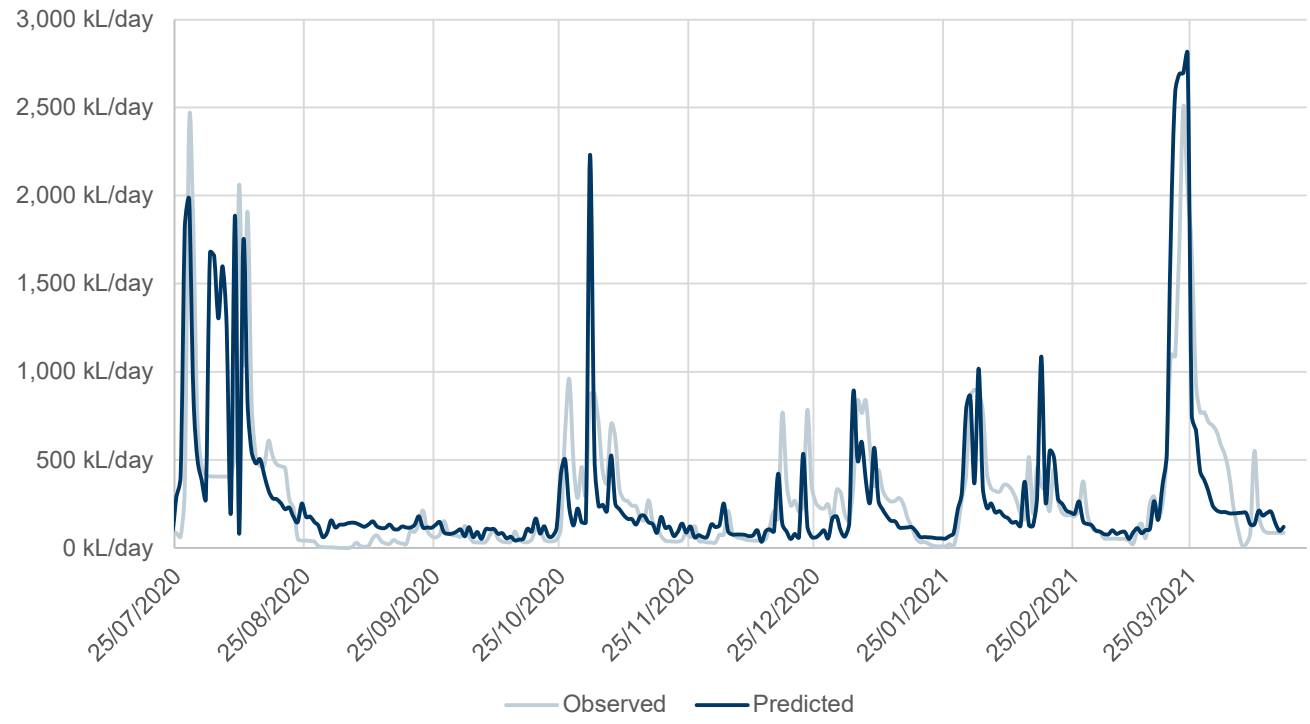


Figure 11 Leachate generation (Observed provided by JPG) – observed and calibrated model simulation results

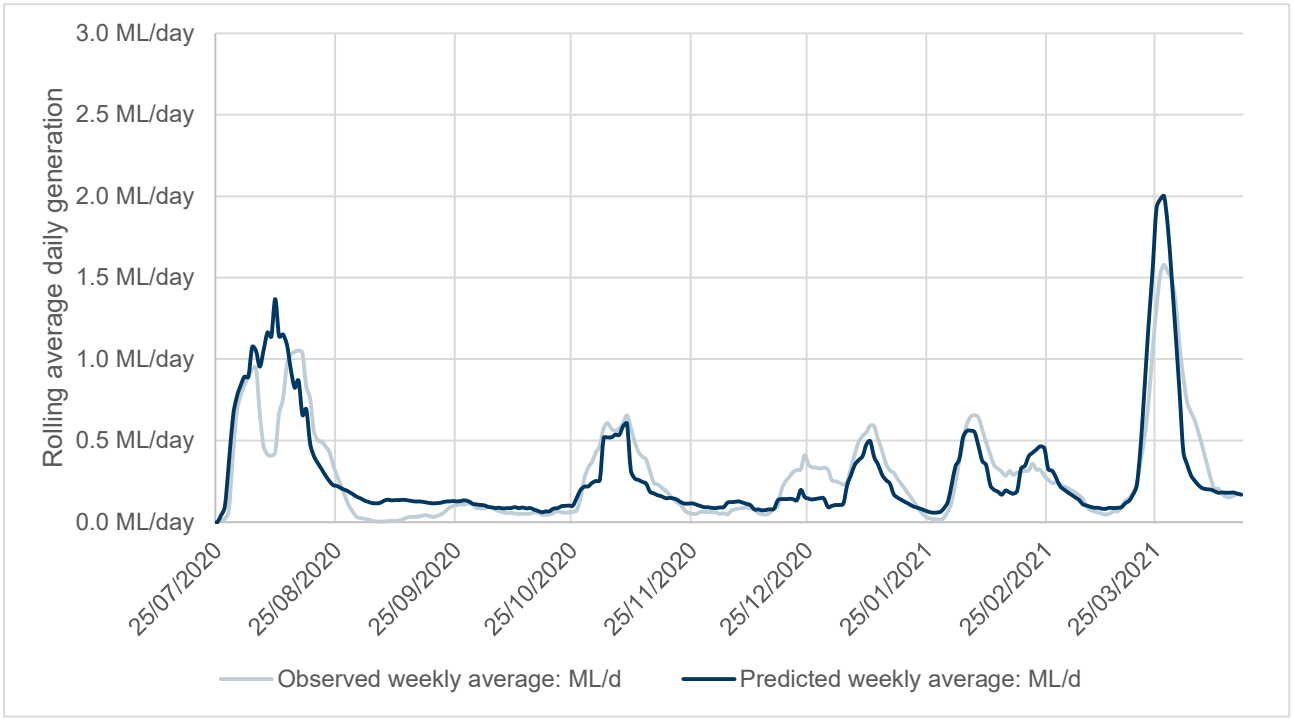


Figure 12 Daily Leachate generation weekly rolling average (Observed provided by JPG) – observed and calibrated model simulation results

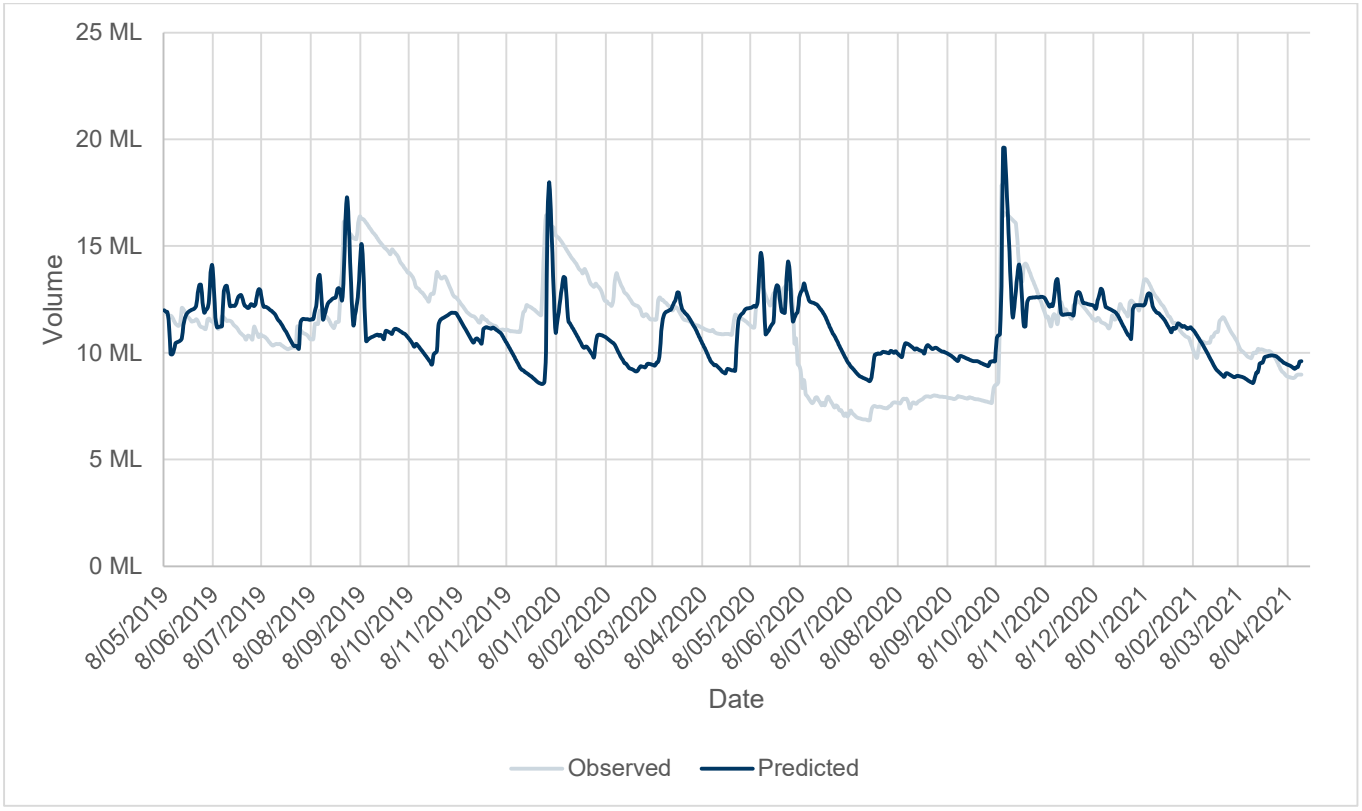


Figure 13 ***Primary and secondary leachate pond volume – observed and calibrated model simulation results***

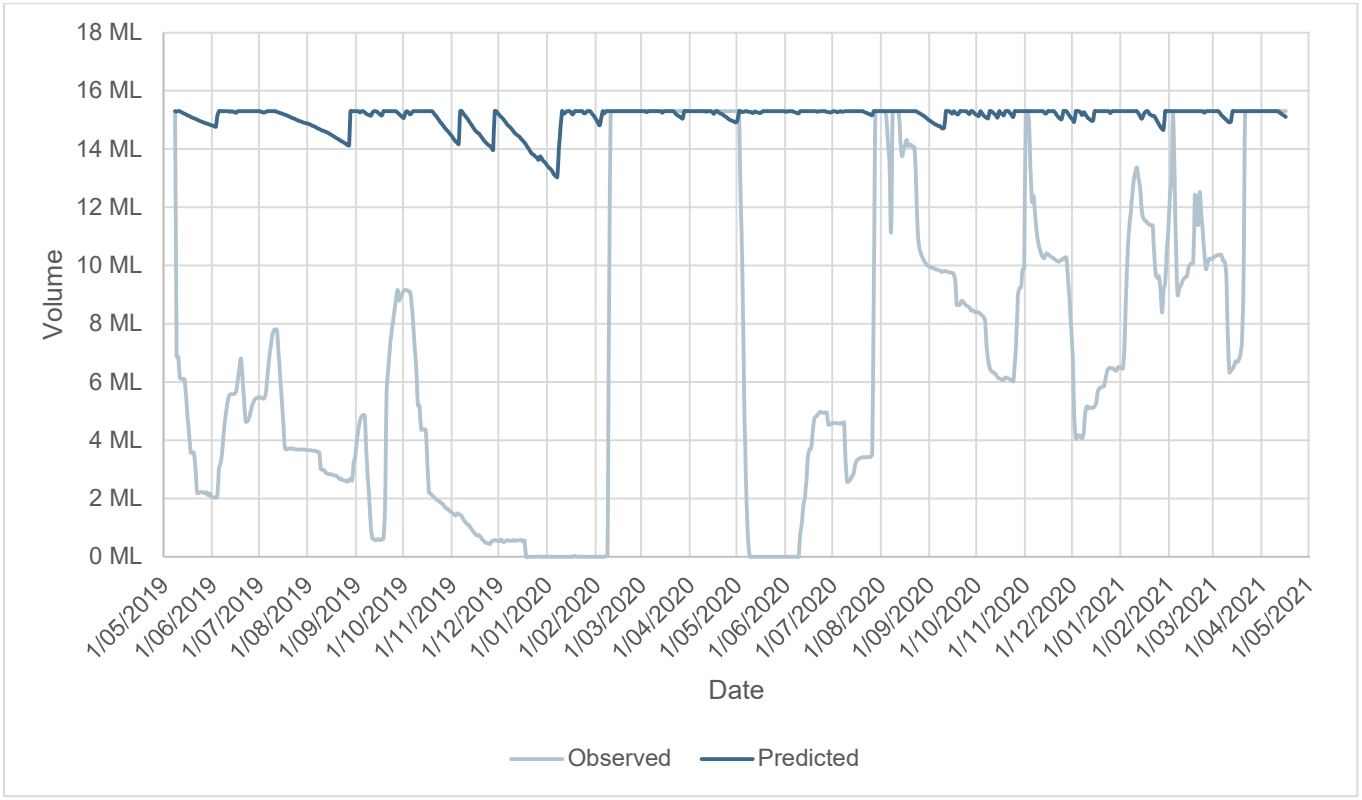


Figure 14 ***Stormwater polishing pond – observed and calibrated model simulation results***

4.6.3 Adopted calibration parameters

Based upon the calibration results and procedure above, the calibrated parameters were adopted for the current state of the site. Calibrated parameters are presented below. It is noted that these results are preliminary, based on available data – these should be reviewed and consider potential modifications as necessary.

Infiltration parameters

Table 9 Infiltration process

Land-use	Volumetric infiltration coefficient	Advection (hours)	Dispersion (hours)
Natural surfaces (undisturbed)	Does not report to the leachate system	Not applicable	Not applicable
Disturbed surfaces	Does not report to the leachate system	Not applicable	Not applicable
Active Tipping Face	100%	0 hr	170 hr
Daily and Intermediate cover	15.00%	32 hr	110 hr
Final cap	1.00%[2]	32 hr	110 hr
Hardstand and buildings	0%	Not applicable	Not applicable
Wet areas (i.e. ponds)	Not applicable	Not applicable	Not applicable

Runoff parameters

Table 10 Infiltration process

Land-use	Volumetric runoff coefficient	Advection (hours)	Dispersion (hours)
Natural surfaces (undisturbed)	65%[2]	Not used	Not used
Disturbed surfaces	80%[2]	Not used	Not used
Active Tipping Face	0%	Not used	Not used
Daily and Intermediate cover	85%	Not used	Not used
Final cap	95.00%[3]	Not used	Not used
Hardstand and buildings	98.00%	Not used	Not used
Wet areas (i.e. ponds)	100%	Not used	Not used

Ground water and baseflow generation

Baseflow from the waste mass (including groundwater) into the leachate pond was estimated using a calibrated relationship based upon the 3-month average daily rainfall. This baseflow includes the ongoing generation of leachate which is expected to occur even during drier times as waste materials decomposes and releases moisture, and groundwater flows into the waste mass, typically estimated as 40 ML/year, but decreasing to around 20 ML/year during drier periods. The baseflow from leachate materials is anticipated to generally be an order of magnitude higher than groundwater flows based on Section 3.3.2.

Table 11 Modelled relationship for baseflow

Management system	Adopted baseflow
Leachate	50 x [12-day average daily rainfall in mm] $^{0.85}$ kL/day

For future stages, baseflow is scaled by the effective infiltration area relative to existing configuration to account for decreases in leachate generation as the site is progressively capped.

[2] No calibration was undertaken for final cap. Typical values adopted.
[3] Limited calibration was available for runoff coefficients. Typical values were adopted and should be reviewed

Table 12 Baseflow scaling factors for future stages

Stage	Baseflow scaling factor
Existing Stage	1.00
Stage 3	0.68
Stage 4	0.63
Final landform	0.08

Leachate transfer rules

Leachate is transferred between the ponds, for treatment and to manage levels and minimise the risk of overflows from the primary pond. The leachate rules adopted based on calibration include:

– Leachate inflow is allocated to the primary pond up to 7.4 ML, followed by the secondary pond up to 7.4 ML, and then the backup pond. If excess leachate is present, the backup pond is completely filled, followed by the secondary and then primary pond.
– Once the primary pond reaches a trigger volume of 3.0 ML, leachate is transferred to the secondary pond at a rate of 30 L/s in attempt to maintain levels at the trigger volume.
– Once the secondary pond reaches a trigger of 6.28ML, leachate is transferred to the backup pond at a rate of 30 L/s in attempt to maintain levels at the trigger volume.

Leachate disposal mechanisms

Active leachate disposal (excl. evaporation) is undertaken to manage leachate quantities. This is understood to include discharge to sewer via the onsite wastewater treatment plant, and using emergency tankering. Disposal through evaporation also occurs from the site's ponds, enhanced by aeration.

Disposal to sewer

Leachate is disposed to Sydney Water's sewage system via Council's wastewater treatment plant. In the model, this is simulated as follows:

– A 12-month average disposal rate of 250 kL/day is imposed, with a maximum disposal rate of 605 kL/day (per the Trade Waste Agreement).
– The disposal mechanism preferentially dewaters the leachate ponds in the following order: backup pond, secondary pond, primary pond.

The disposal rate varies based upon the proportion that the leachate ponds are full based on the following relationship:

Table 13 Leachate disposal rate relationship

Leachate stored percentage of total capacity	Disposal rate
≤ 47%	0 kL/day
≤ 58%	22 kL/day
≤ 60%	53 kL/day
≤ 61%	101 kL/day
≤ 90%	126 kL/day
≤ 95%	146 kL/day
> 95%	605 kL/day (max.)

Emergency tankering

Due to data limitations, calibration of emergency tankering was not able to be well calibrated as tankering is understood to be used based on rainfall forecasts in conjunction with observed conditions, rather than based on observed conditions alone.

Evaporation disposal

Leachate is also disposed through evaporation from the ponds. Evaporation from leachate ponds of this type is anticipated to be higher than background evapotranspiration as it is enhanced by the black HDPE (which absorbs excess heat), and through mechanical aeration. A scaling factor was applied to HDPE and aerated ponds of 1.46, and a scaling factor of 1.00 for stormwater ponds.

4.7 Model simulation results

The calibrated water balance model was simulated on a daily timestep for the period 1900 – 2020 (120 years total) based on historical and interpolated meteorological point-data sourced from SILO for the site (as per Section 4.4.2). Simulations were undertaken for the existing, Stage 3, Stage 4 and Final Cap scenarios. It is understood, following discussions with Council, that a new leachate management system is proposed at the site and will be brought online to automatically manage the leachate system.

Preliminary details of the proposed systems have been included as potential inputs to the model and reflect the results below. Generally as follows:

– Final cap infiltration percentage: 1%
– Tankering of leachate commences at 95% capacity with 1x25 kL tanker running twice per hour for 10 hours per day.
– Disposal to leachate starts at 10% capacity at 200 kL/day and increases at 80% capacity to 605 kL/day
– Leachate is transferred from the primary to secondary pond to maintain 60% capacity at a rate of 30 L/s, and to the backup pond (when applicable) to maintain a capacity of 85% at a rate of 20 L/s.

4.7.1 Leachate system

4.7.1.1 Leachate generation

Estimations of leachate generation was undertaken from the water balance model over the existing and future stages. These results suggest that:

– Leachate generation is reasonably high, currently estimated to range between 80 to 150 ML/year during dry and wet years, typically approximately 97 ML/yr. Direct rainfall onto the leachate ponds generally ranges from 10 to 30 ML/yr of the 80 to 150 ML/yr and is reasonably steady through future stages.
– Leachate generation is expected to be highest in the current configuration of the site, before decreasing by approximately 20 to 40 ML/yr for Stage 3 and Stage 4, and a further 30 – 80 ML/yr once the final cap is applied.
– Peak daily leachate generation is similar between existing and future stages for more extreme wet periods, suggesting that extreme rainfall onto the ponds is likely to be critical for extreme wet weather management.

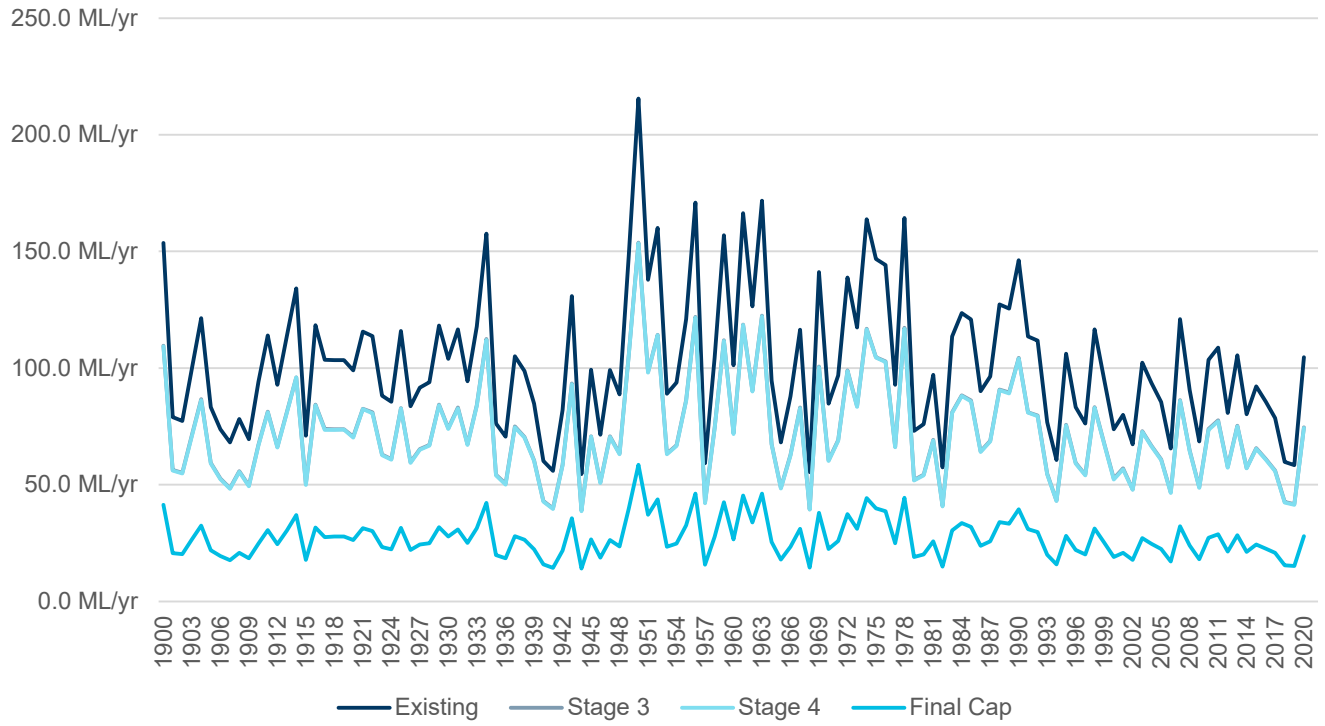


Figure 15 *Simulated annual leachate generation*

Table 14 *Leachate generation during dry, typical, and wet years*

Leachate generation	Existing	Stage 3	Stage 4	Final Cap
Dry (10%ile)	68.1 ML/yr	48.6 ML/yr	48.3 ML/yr	17.8 ML/yr
Typical (50%ile)	97.0 ML/yr	69.1 ML/yr	68.9 ML/yr	25.9 ML/yr
Wet (90%ile)	146.2 ML/yr	104.3 ML/yr	104.0 ML/yr	39.5 ML/yr

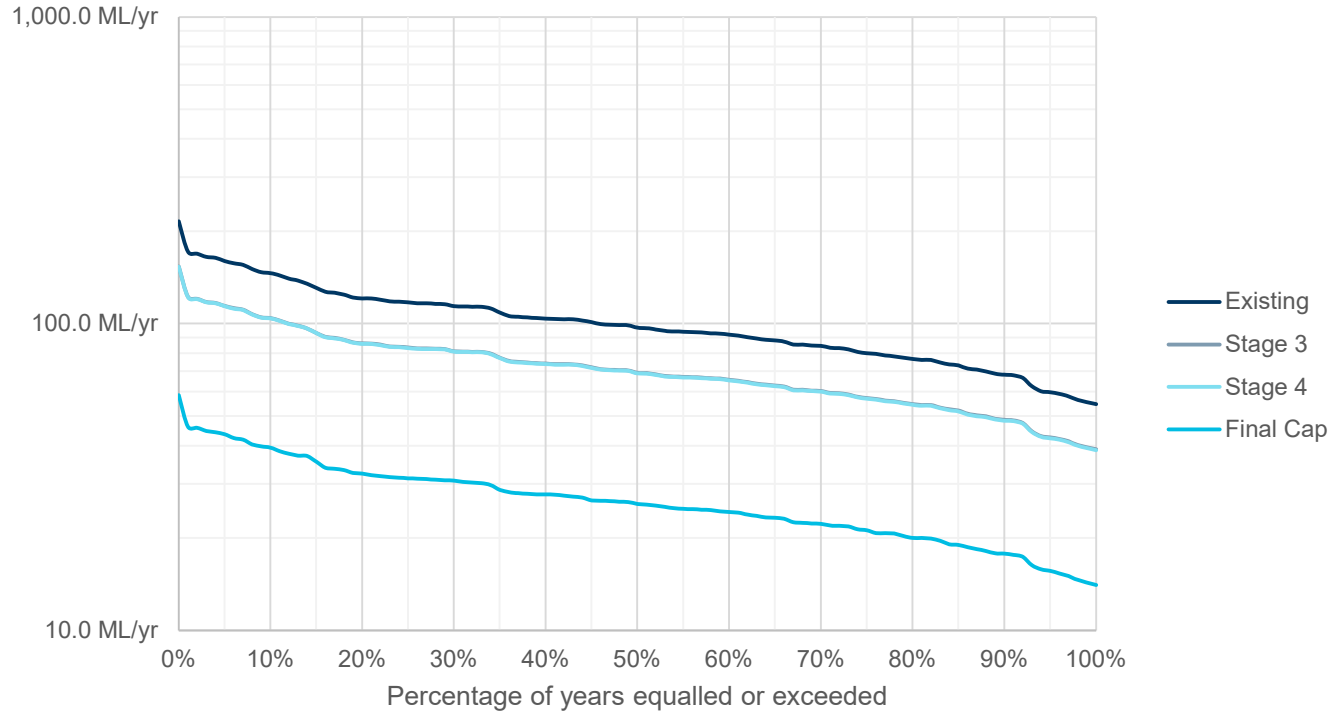


Figure 16 *Exceedance curve of annual leachate generation*

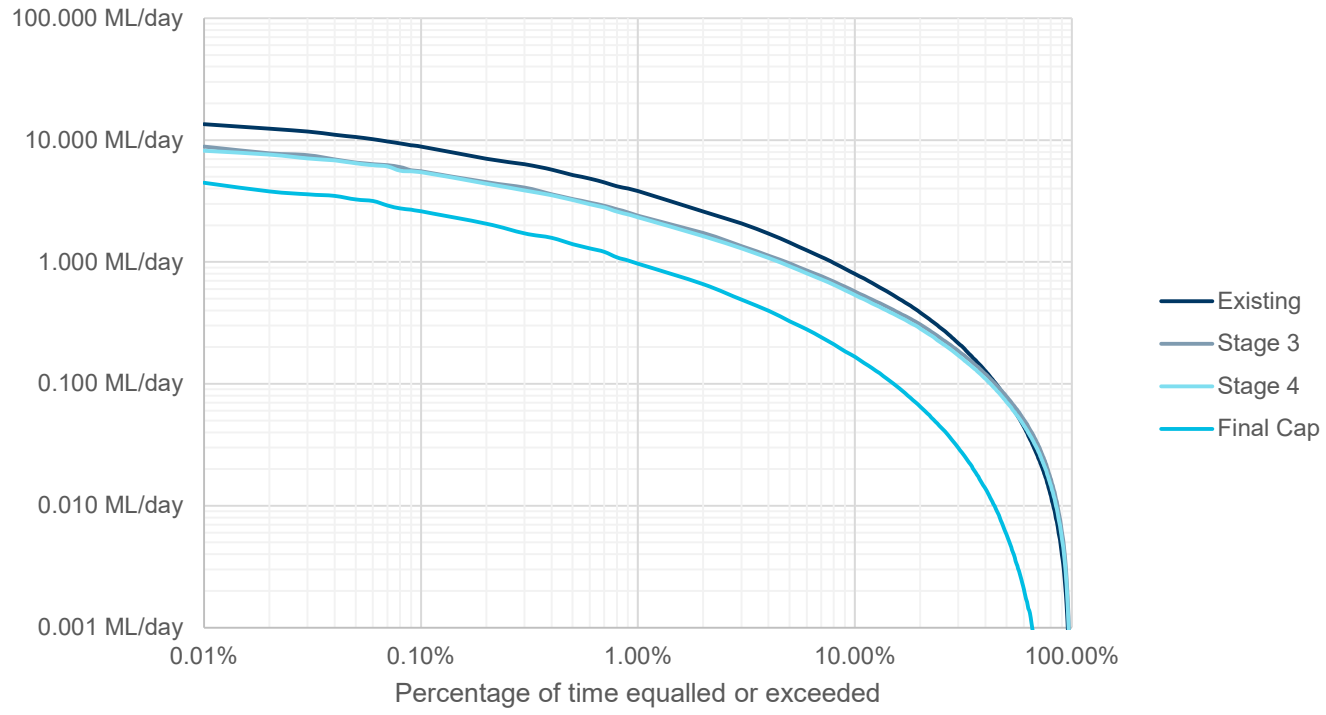


Figure 17 Exceedance curve of daily leachate generation

4.7.1.2 Leachate disposal rates

Modelled leachate disposal rates and tankering are shown below for all scenarios. Results are shown for the existing system configuration as well as the proposed system configuration. Results of the leachate disposal mechanisms suggest that:

– The current configuration of the site is predicted to result in the highest disposal requirement. As the site is progressively capped, the requirement to dispose of leachate decreases over time.
– The requirement to dispose by sewer decreases over time from typically 77.7 ML/yr currently to 15.0 ML/yr once the final cap is applied over the entire landfill area. It is likely that generation would then decrease further.

Table 15 Disposal mechanisms during dry, typical, and wet years. Existing system configuration

Metric	Existing	Stage 3	Stage 4	Final Cap
Sewer disposal rate:				
- 10%ile	- 60.3 ML/yr	- 38.9 ML/yr	- 35.9 ML/yr	- 8.1 ML/yr
- 50%ile	- 77.7 ML/yr	- 61.2 ML/yr	- 54.6 ML/yr	- 15.0 ML/yr
- 90%ile	- 91.1 ML/yr	- 83.8 ML/yr	- 80.3 ML/yr	- 27.3 ML/yr
Tankering rate:				
- 10%ile	- 0.0 ML/yr	- 0.0 ML/yr	- 0.0 ML/yr	- 0.0 ML/yr
- 50%ile	- 4.1 ML/yr	- 0.0 ML/yr	- 0.0 ML/yr	- 0.0 ML/yr
- 90%ile	- 37.6 ML/yr	- 5.9 ML/yr	- 9.3 ML/yr	- 0.0 ML/yr
Evaporation:				
- 10%ile	- 10.4 ML/yr	- 8.4 ML/yr	- 11.3 ML/yr	- 9.5 ML/yr
- 50%ile	- 14.0 ML/yr	- 10.1 ML/yr	- 13.2 ML/yr	- 10.9 ML/yr
- 90%ile	- 19.4 ML/yr	- 13.9 ML/yr	- 15.4 ML/yr	- 12.1 ML/yr

4.7.1.3 Leachate ponds performance

Modelled leachate pond performance are shown below for all scenarios. Results are shown for the existing system configuration as well as the proposed system configuration. These results suggest that:

– Estimation of overflow quantities follows the trend of leachate generation, decreasing progressively as the site is capped.

– The system appears to readily overflow, however the suitability of the model to predict how leachate is exchanged between the ponds and disposed is difficult to replicate. Despite this, the current disposal rate limit of 250 kL/day (approx. 91 ML/yr) is likely to limit the ability to treat the rates of leachate generated at the site, which typically ranges between 70 and 180 ML/yr. Generated leachate is expected to exceed the allowable LTWA (liquid trade waste agreement) disposal rate, with Sydney Water, of 91 ML/year in approximately 61% of years based on long-term modelling of the existing site configuration. This may warrant investigations to adjust the current TWA and site infrastructure.

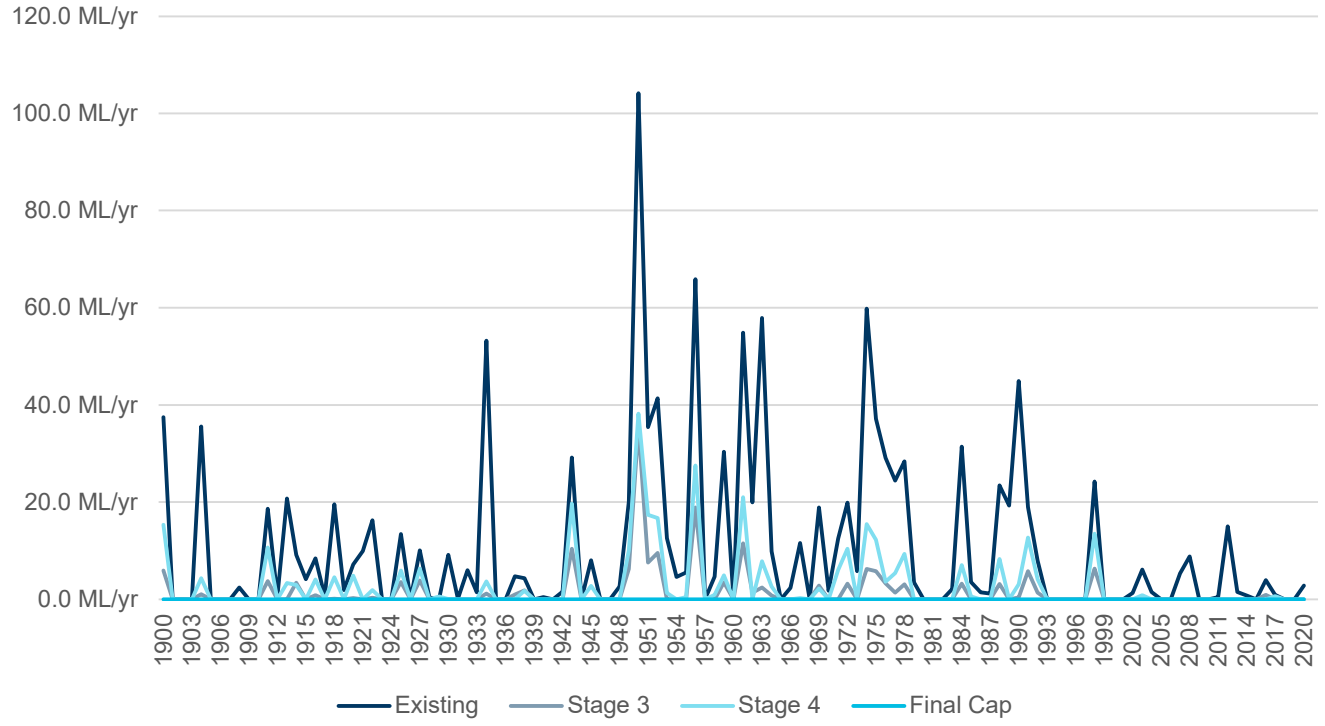


Figure 18 *Simulated annual leachate overflow. Existing Configuration*

Table 16 *Leachate overflow during dry, typical, and wet years. Existing Configuration*

Overflow	Existing	Stage 3	Stage 4	Final Cap
Dry (10%ile)	0.0 ML/yr	0.0 ML/yr	0.0 ML/yr	0.0 ML/yr
Typical (50%ile)	2.4 ML/yr	0.0 ML/yr	0.0 ML/yr	0.0 ML/yr
Wet (90%ile)	31.4 ML/yr	3.9 ML/yr	10.4 ML/yr	0.0 ML/yr

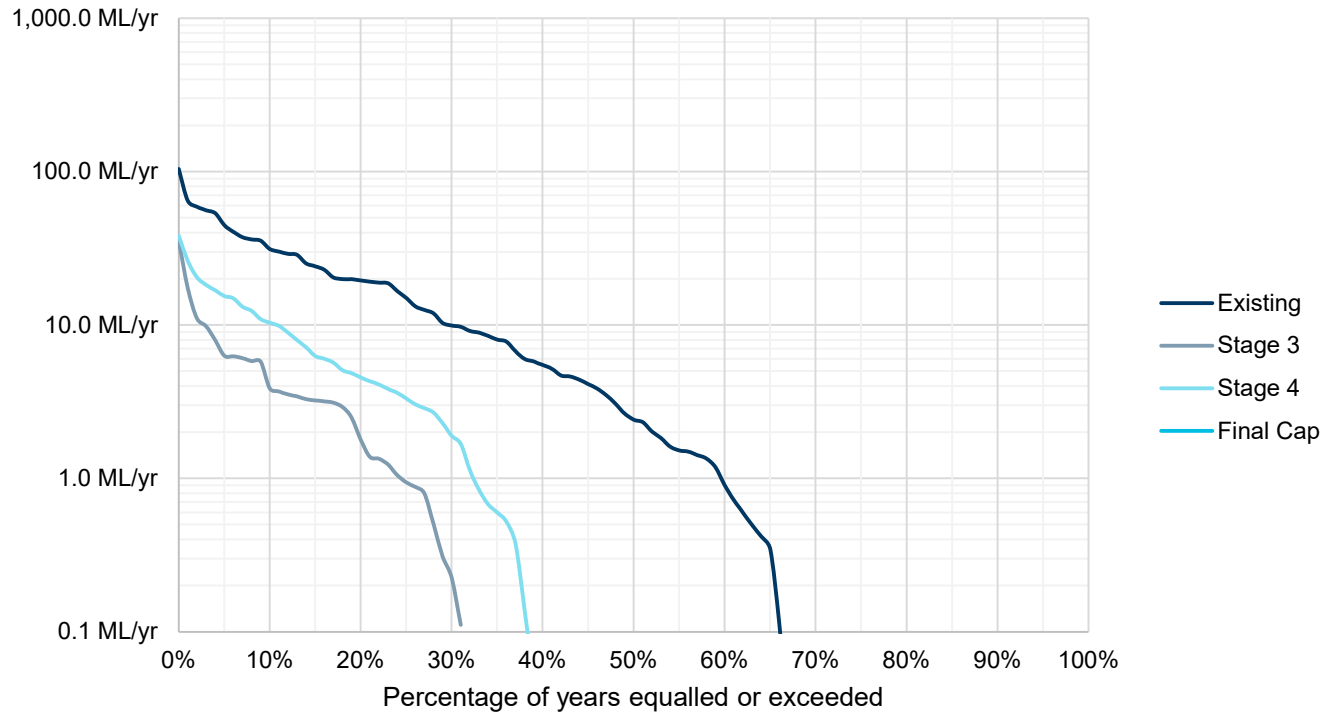


Figure 19 *Exceedance curve of annual leachate overflow. Existing Configuration*

4.7.2 Stormwater system

Results of the stormwater system are presented below as a time-series graph. Analysis of the results, suggest the following:

– Large quantities of stormwater are generated at the site based on the current conditions, ranging from 290 ML/yr in drier years to 660 ML/yr in wetter years, with typical values of 430 ML/yr.
– There is limited disposal for stormwater at the site, and it is understood that collected stormwater is not re-used from the ponds. Accordingly, disposal by evaporation is the only mechanism – typically around 50 ML/yr, an order of magnitude lower than generation.
– It is however noted under current management practices, stormwater is periodically released on-site during favourable conditions to keep water levels as low as possible. These releases are unable to be modelled.
– The remainder of stormwater generated at the site that is unable to be managed by the ponds overflows into the Reddalls Road stormwater drainage network towards Dapto Creek.
– Stormwater generation and overflow is anticipated to decrease in future stages, as more areas are capped and diverted around the site and into the existing off-site stormwater management systems.

It should be noted that calibration of the stormwater system was not readily available, due to significant, rapid changes in stormwater levels. Estimations of overflow and evaporation should consider the above. Results should be noted as being useful for estimating the quantity of generated stormwater at the site through the progressive landfilling of the site.

Table 17 *Stormwater pond during dry, typical, and wet years.*

Metric	Existing	Stage 3	Stage 4	Final Cap
Stormwater generation:				
- 10%ile	- 301.8 ML/yr	- 193.8 ML/yr	- 145.8 ML/yr	- 79.9 ML/yr
- 50%ile	- 447.9 ML/yr	- 287.6 ML/yr	- 216.4 ML/yr	- 118.5 ML/yr
- 90%ile	- 689.2 ML/yr	- 441.3 ML/yr	- 331.7 ML/yr	- 182.8 ML/yr
Evaporation:				
- 10%ile	- 27.9 ML/yr	- 27.8 ML/yr	- 15.1 ML/yr	- 15.1 ML/yr

Metric	Existing	Stage 3	Stage 4	Final Cap
- 50%ile	- 29.0 ML/yr	- 28.9 ML/yr	- 15.7 ML/yr	- 15.7 ML/yr
- 90%ile	- 30.3 ML/yr	- 30.3 ML/yr	- 16.5 ML/yr	- 16.4 ML/yr

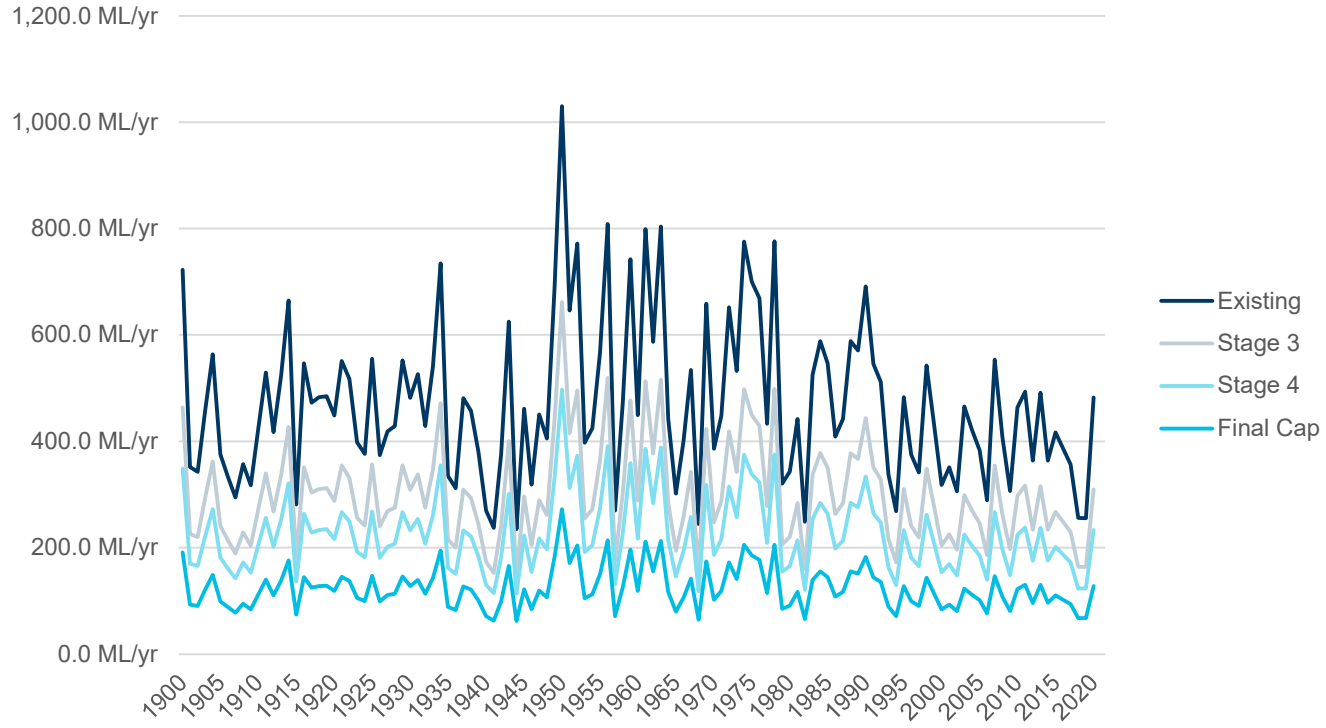


Figure 20 *Simulated stormwater generation*

5. Conclusions and recommendations

The follow key conclusions from the water balance modelling are summarised as follows:

- Leachate generation is reasonably high, currently estimated to range between 80 to 150 ML/year during dry and wet years, typically approximately 97 ML/yr. Direct rainfall onto the leachate ponds generally ranges from 10 to 30 ML/yr of the 80 to 150 ML/yr and is reasonably steady through future stages.
- Leachate generation is expected to be highest in the current configuration of the site, before decreasing by approximately 20 to 40 ML/yr for Stage 3 and Stage 4, and a further 30 – 80 ML/yr once the final cap is applied.
- Peak daily leachate generation is similar between existing and future stages for more extreme wet periods, suggesting that extreme rainfall onto the ponds is likely to be critical for extreme wet weather management.
- The current configuration of the site is predicted to result in the highest leachate disposal requirement. As the site is progressively capped, the requirement to dispose of leachate decreases over time.
- The requirement to dispose leachate by sewer decreases over time from typically 77.7 ML/yr currently to 15.0 ML/yr once the final cap is applied over the entire landfill area. It is likely that generation would then decrease further.
- Estimation of leachate pond overflow quantities follows the trend of leachate generation, decreasing progressively as the site is capped.
- The leachate storage system appears to readily overflow, however the suitability of the model to predict how leachate is exchanged between the ponds and disposed is difficult to replicate. Despite this, the current disposal rate limit of 250 kL/day (approx. 91 ML/yr) is likely to limit the ability to treat the rates of leachate generated at the site, which typically ranges between 70 and 180 ML/yr. Leachate generation is estimated to exceed the allowable Liquid Trade Waste Agreement disposal rate of 91 ML/year in approximately 61% of years for the modelling period adopting the current configuration.
- Estimation of leachate overflow quantities indicate that additional leachate treatment/disposal capacity for the existing scenario between 2.4 ML/yr (typical) and 31.4 ML/yr (wet year) is required.
- Large quantities of stormwater are generated at the site based on the current conditions, ranging from 290 ML/yr in drier years to 660 ML/yr in wetter years, with typical values of 430 ML/yr.
- There is limited disposal for stormwater at the site, and it is understood that collected stormwater is not re-used from the ponds. Accordingly, disposal by evaporation is the only mechanism – typically around 50 ML/yr, an order of magnitude lower than generation.
- The remainder of stormwater generated at the site that is unable to be disposed, overflows into the receiving environment downstream towards Dapto Creek.
- Stormwater generation and overflow is anticipated to decrease in future stages, as more areas are capped and diverted around the site and into the existing off-site stormwater management systems.
- It should be noted that calibration of the stormwater system was not readily available, due to significant, rapid changes in stormwater levels.

Based on the results of the water balance modelling the following recommendations for leachate and stormwater management are provided:

- Final capping and diversion drains should be installed progressively in accordance with the proposed staging plans to:
  - minimise infiltration of rainfall into the capping area; and
  - reduce stormwater contribution to the stormwater ponds through direct discharge of ‘clean stormwater’ to Dapto Creek
- An application should be made to increase allowable trade waste agreement discharge rates to sewer in the short term to decrease the intensity of predicted leachate overflow events and corresponding increase to leachate treatment plant capacity. Modelling indicates that an additional 2.4 ML/yr (typical) and 31.4 ML/yr (wet year) is required for the existing scenario and an additional 3.9 ML/yr and 10.4 ML/yr for Stage 3 and Stage 4 respectively to address predicted wet year overflows. Sensitivity analysis for discharge rates to sewer

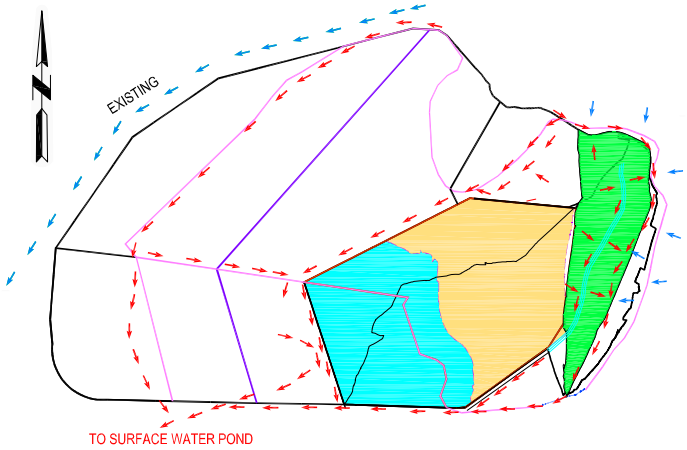
indicates that increasing the capacity by 150% is likely to reduce annual average overflow by 60% and increasing the capacity by 200% is likely to reduce the annual average overflows by 81%.

- The existing leachate treatment system should be upgraded to correspond to any increase in allowable disposal rate including consideration of lower reliance on pond aeration for pre-treatment of the leachate
- Prior to extreme rainfall events, the stormwater and leachate ponds shall be operated to manage the risk of overflows in line with current practices. An automatic pumping system is planned to be installed by April 2022.
- It is recommended that calibration should be undertaken regularly throughout the life of the landfill as additional data becomes available. The WBM should be reviewed as site operations change from the assumptions in this water balance assessment, additional data collection points may be required to reflect updated infrastructure.
- Implementation of the proposed improvement and maintenance plan outlined in the Preliminary Assessment: Stormwater Management System (EPL 5862) report (Wollongong City Council 2021)
  - Stormwater pond upgrades including desilting of the stormwater ponds including bathymetric survey and reed bed establishment (currently underway)
  - Installation of infrastructure to facilitate stormwater harvesting and reuse (underway)
  - Repair and maintenance of any damaged stormwater diversion infrastructure to improve segregation between stormwater and leachate drainage systems including bunding north of Package 2/3 (underway)
  - Off site drainage swale investigation works (drainage assessment underway)
  - Leachate treatment system and pond upgrades
  - Landfill cover upgrades including trialling of biocover to decrease erosion and sedimentation

Appendix A

Staging Plans

NOTE: DRAWINGS SHOW REPRESENTATIVE CONDITIONS AT AN INTERMEDIATE TIME DURING LINING AND FILLING OF EACH STAGE



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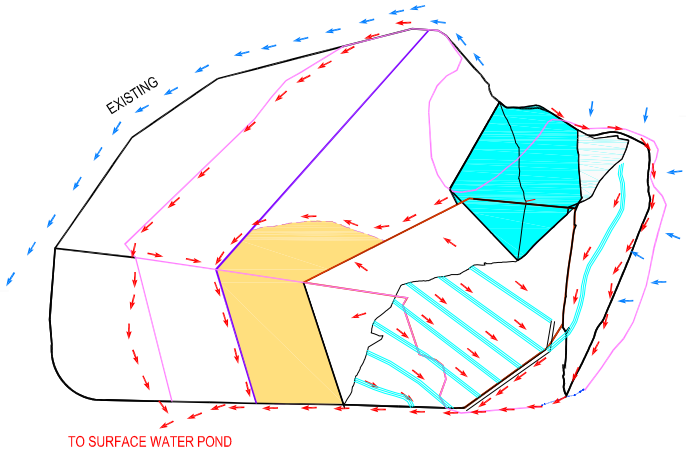

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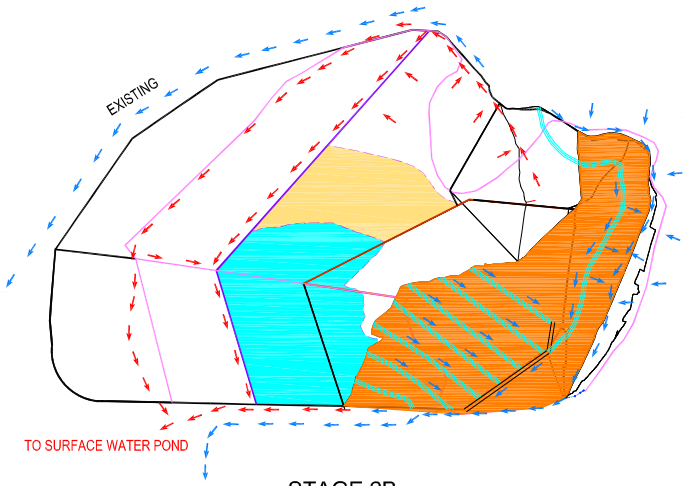

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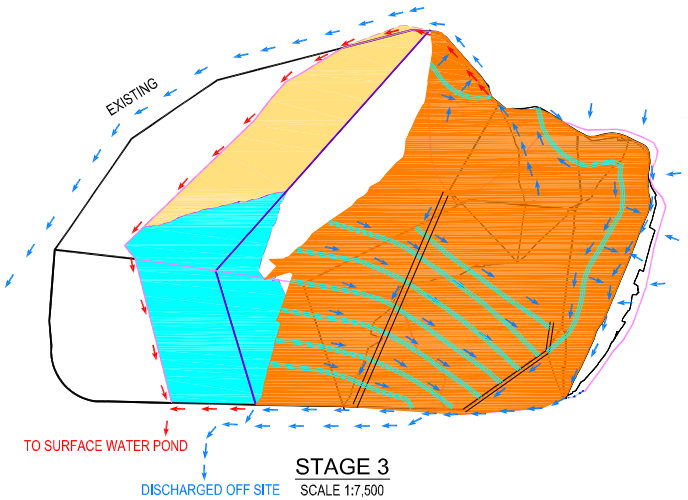

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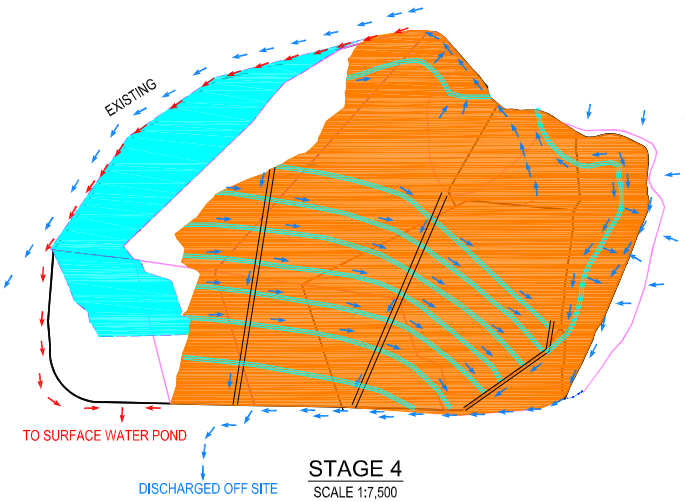

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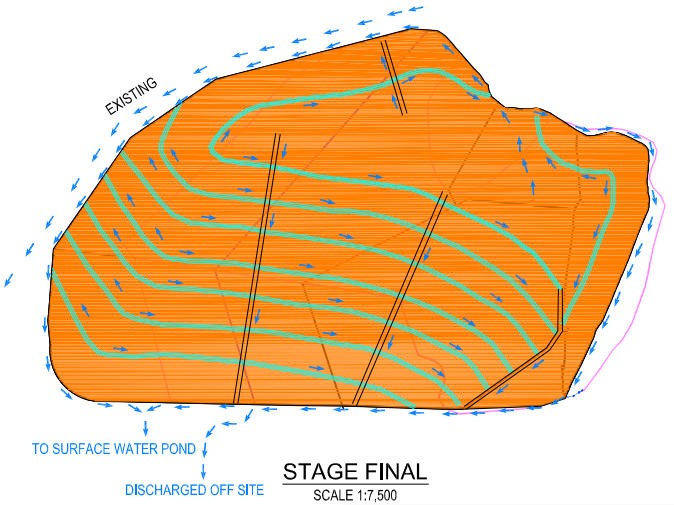

STAGE FINAL
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LEGEND

- CLEAN WATER
- DIRTY WATER
- WASTE CUTBACK AREA
- ACTIVE FILLING AREA
- LINING AREA
- CAPPED AREA
- PROPOSED BENCHES
- PROPOSED DROP STRUCTURE

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REVISION	DESCRIPTION	DRAWN	DRAWN CHECK	DESIGN	DESIGN CHECK	AUTHORISED	DATE
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A	DRAFT - ISSUED FOR CLIENT REVIEW	C GIBCUS	R HUYNH	R HUYNH	G SCHMERTMANN	G SCHMERTMANN	23.01.2012

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LEAD PROJECT DRAFTER	PROJECT MANAGER	SCALE	SHEET SIZE
EJ JEET	J McMAHON	1:7,500	A3

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PROJECT: WHYTES GULLY LANDFILL - NEW CELL DESIGN

DRAWING TITLE: SURFACE WATER MANAGEMENT SYSTEM CONCEPT PLAN

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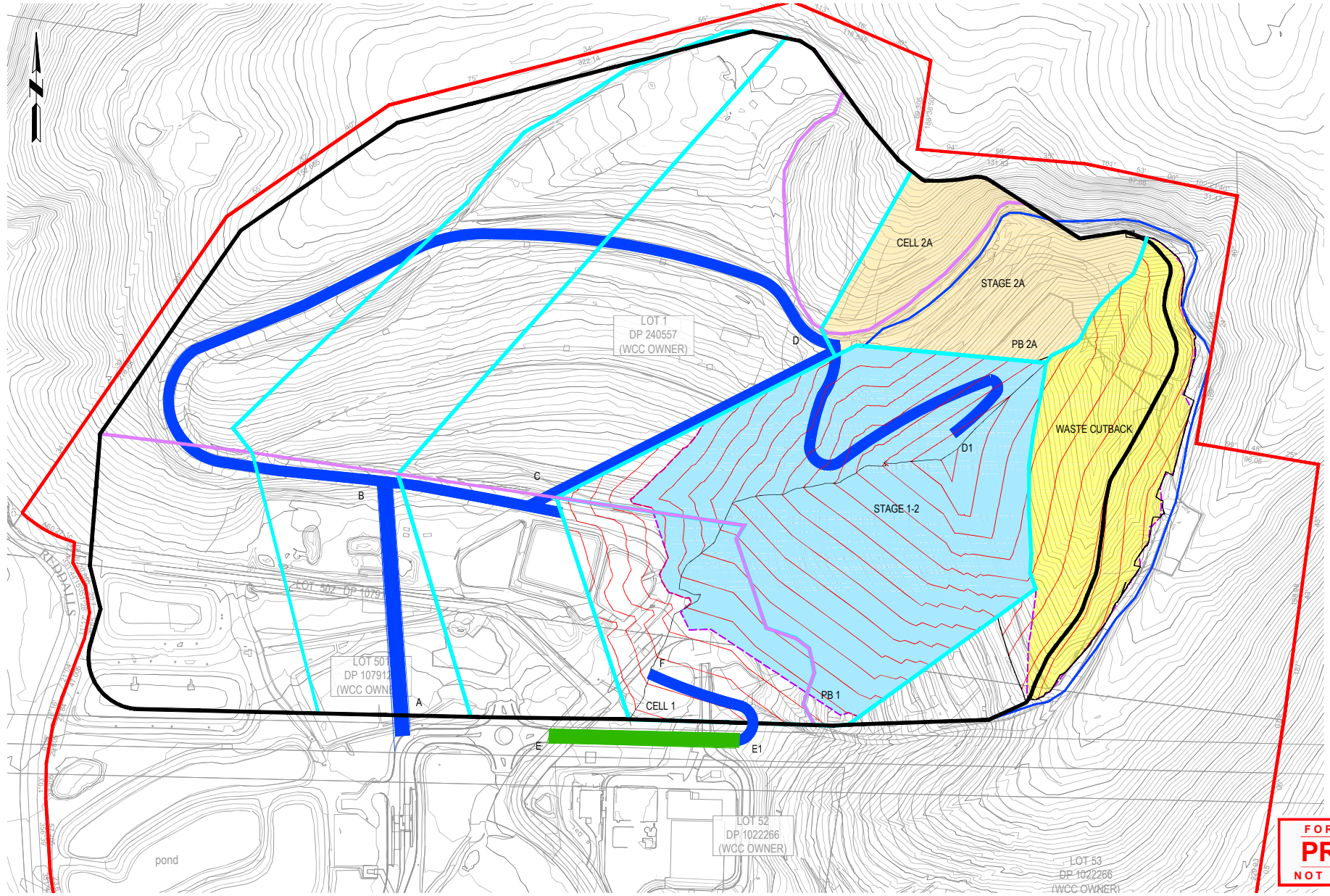

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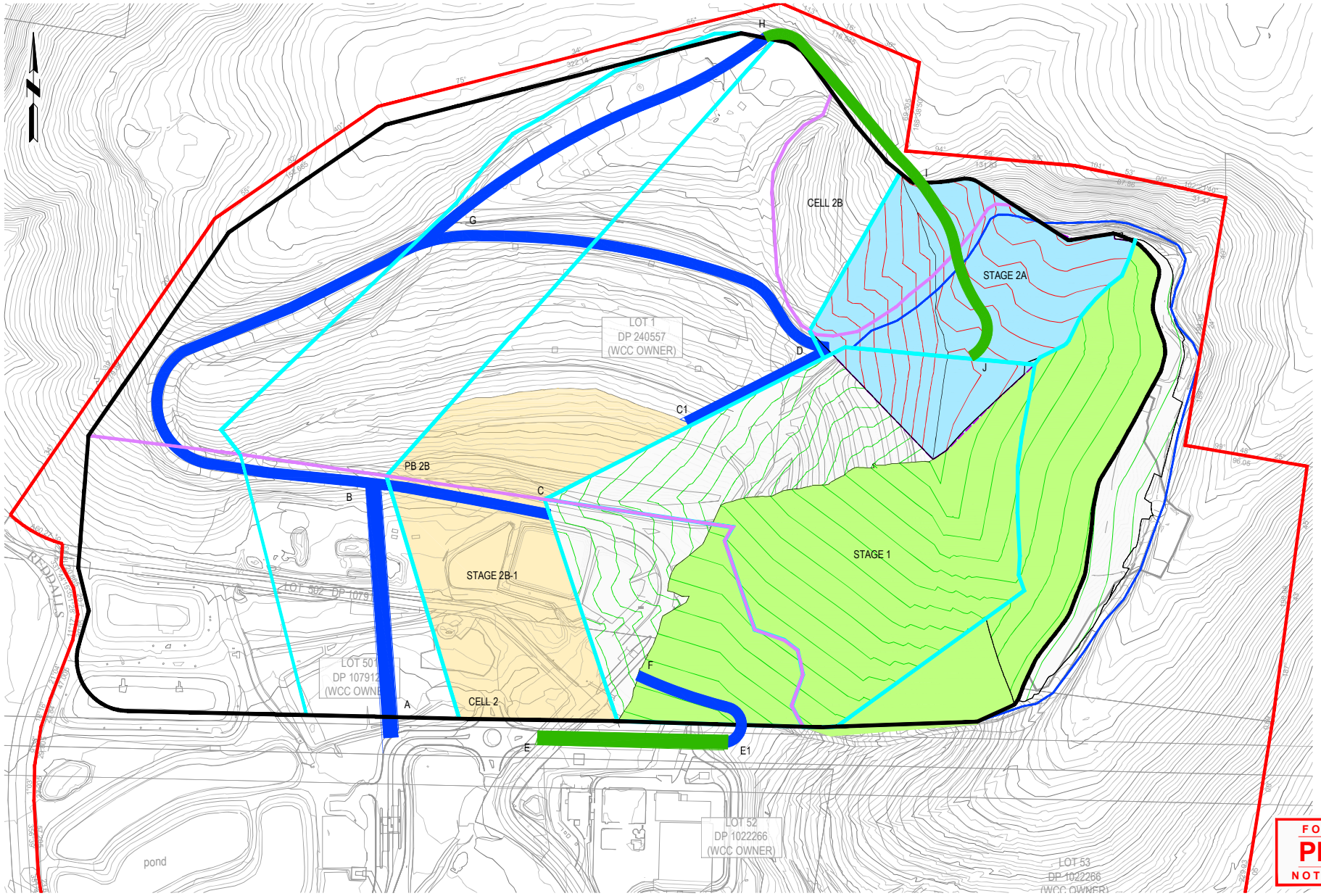

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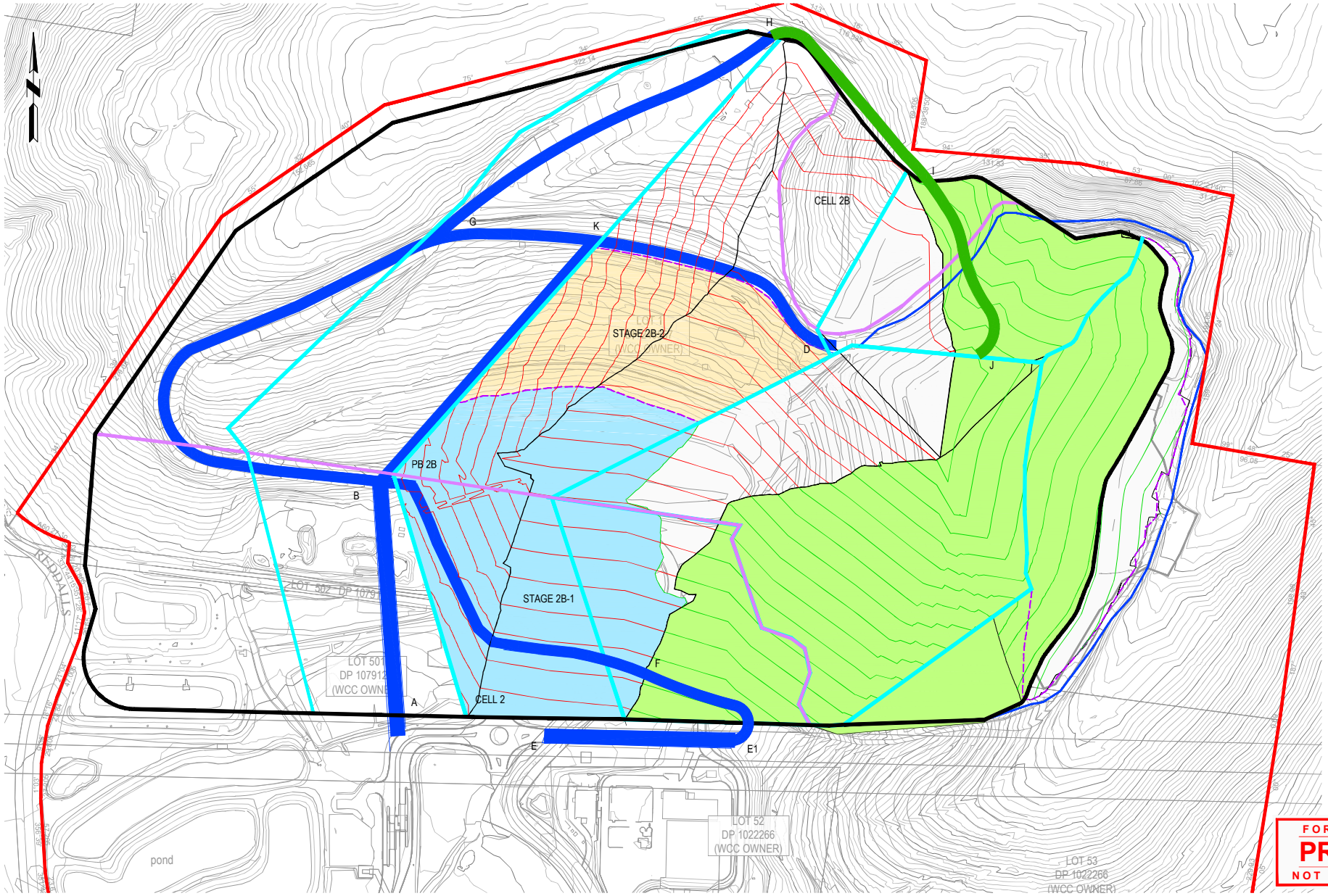

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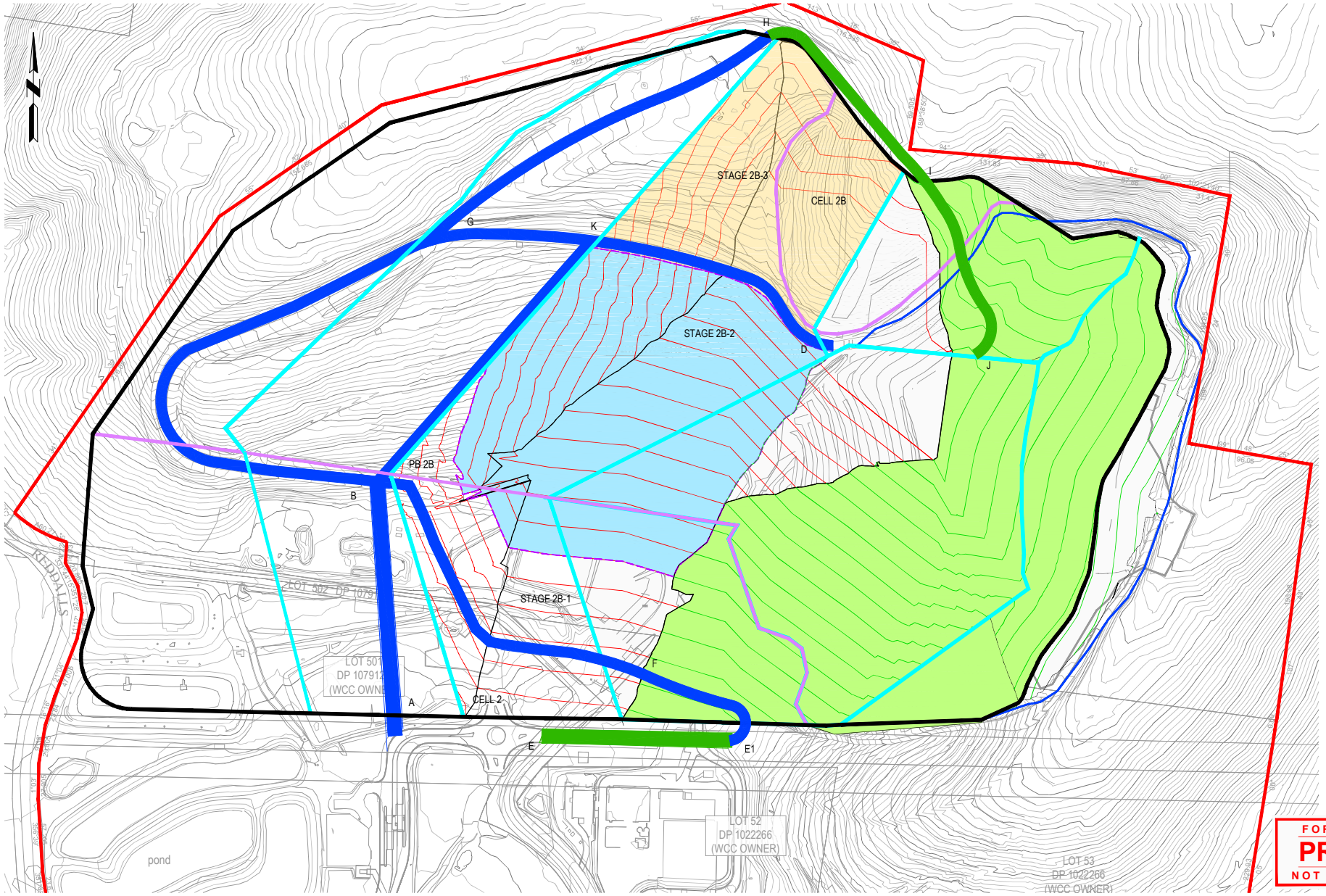

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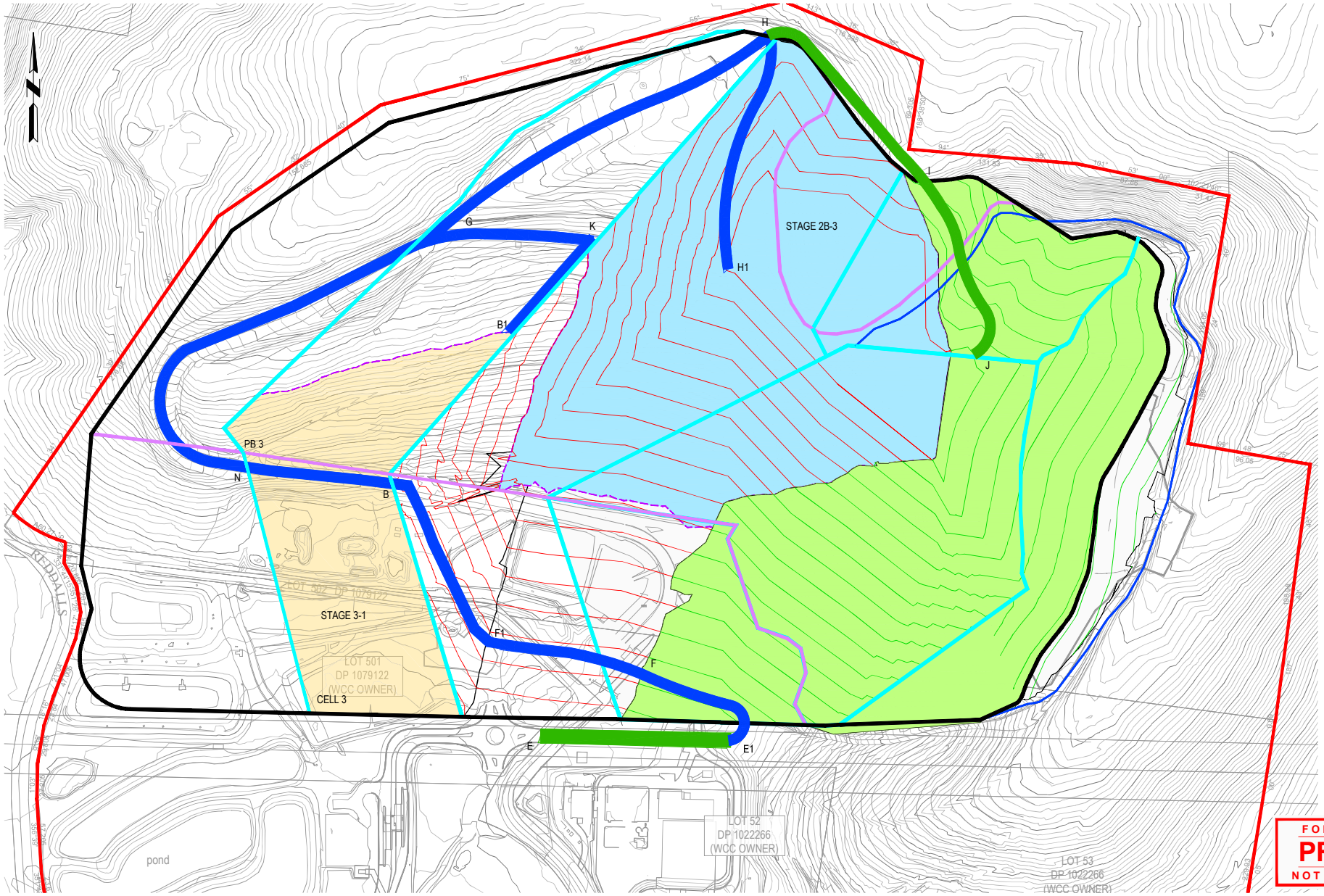

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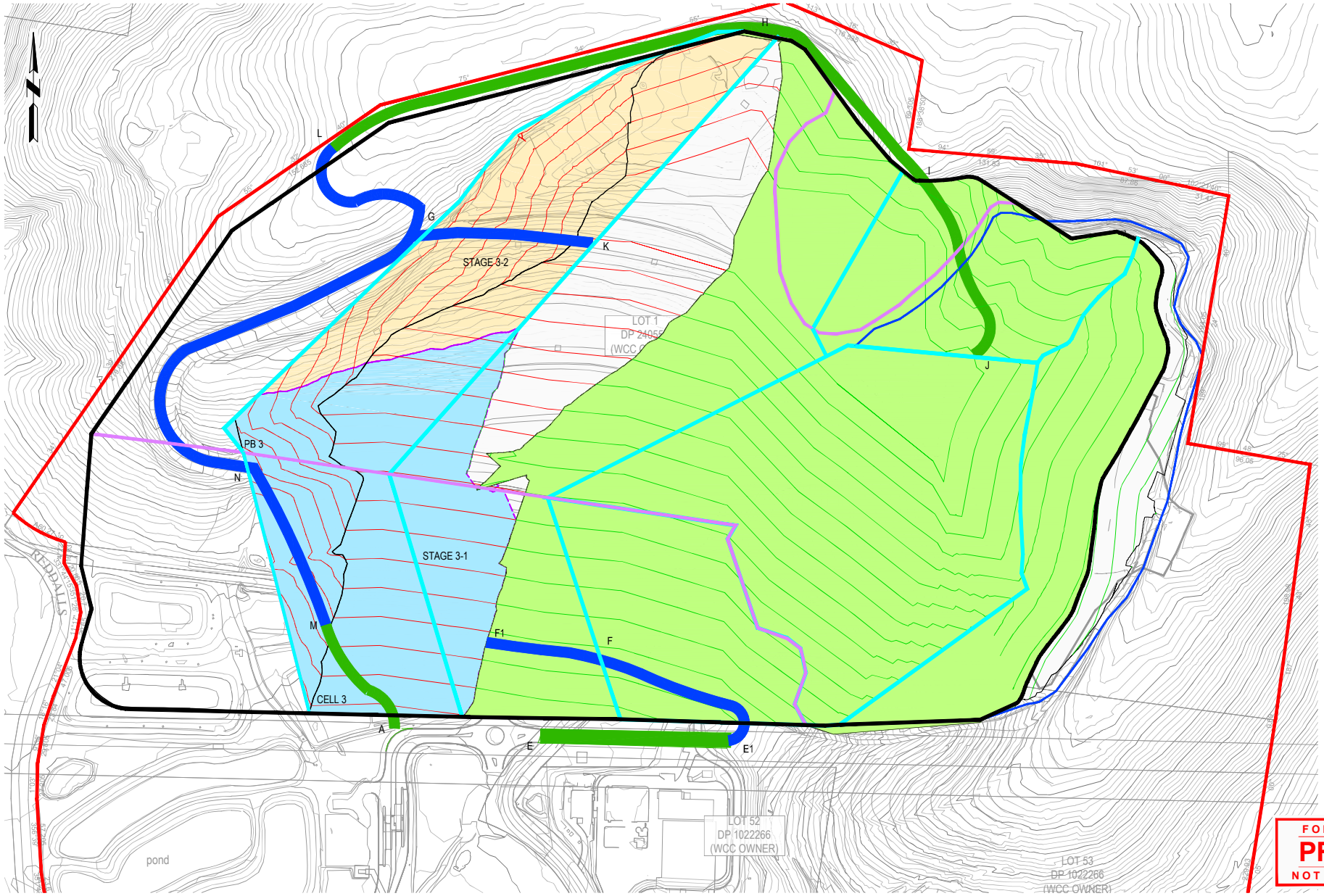

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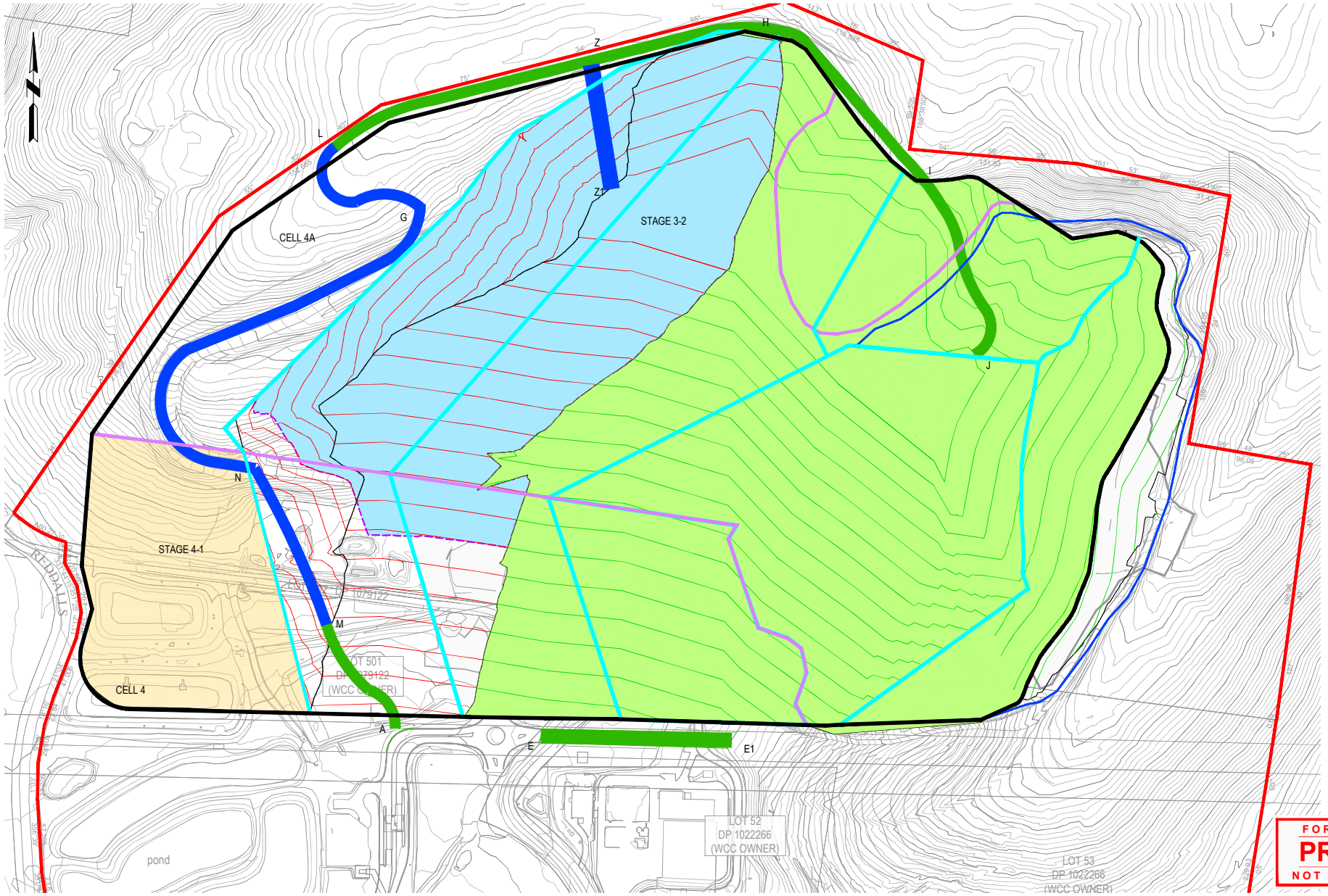

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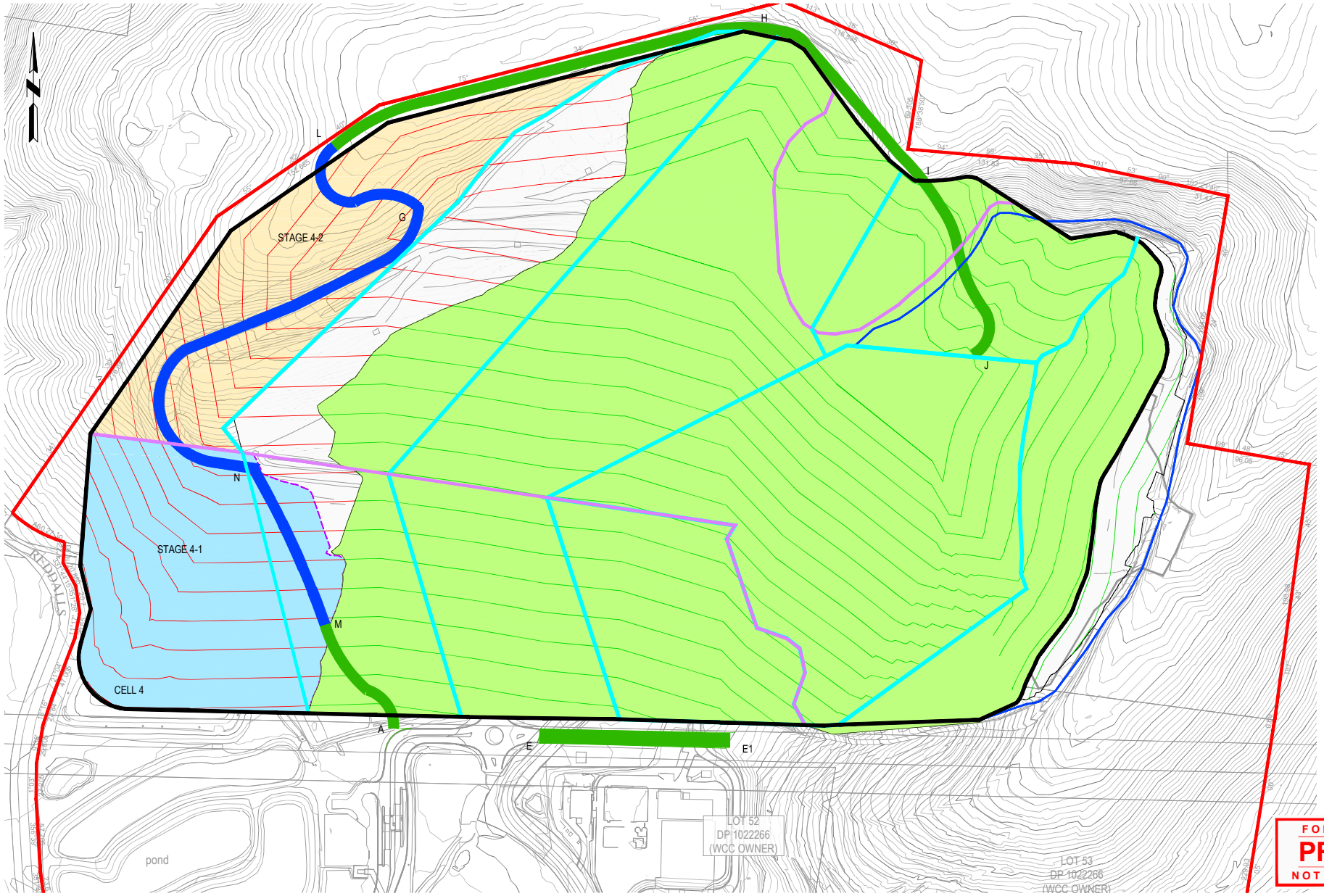

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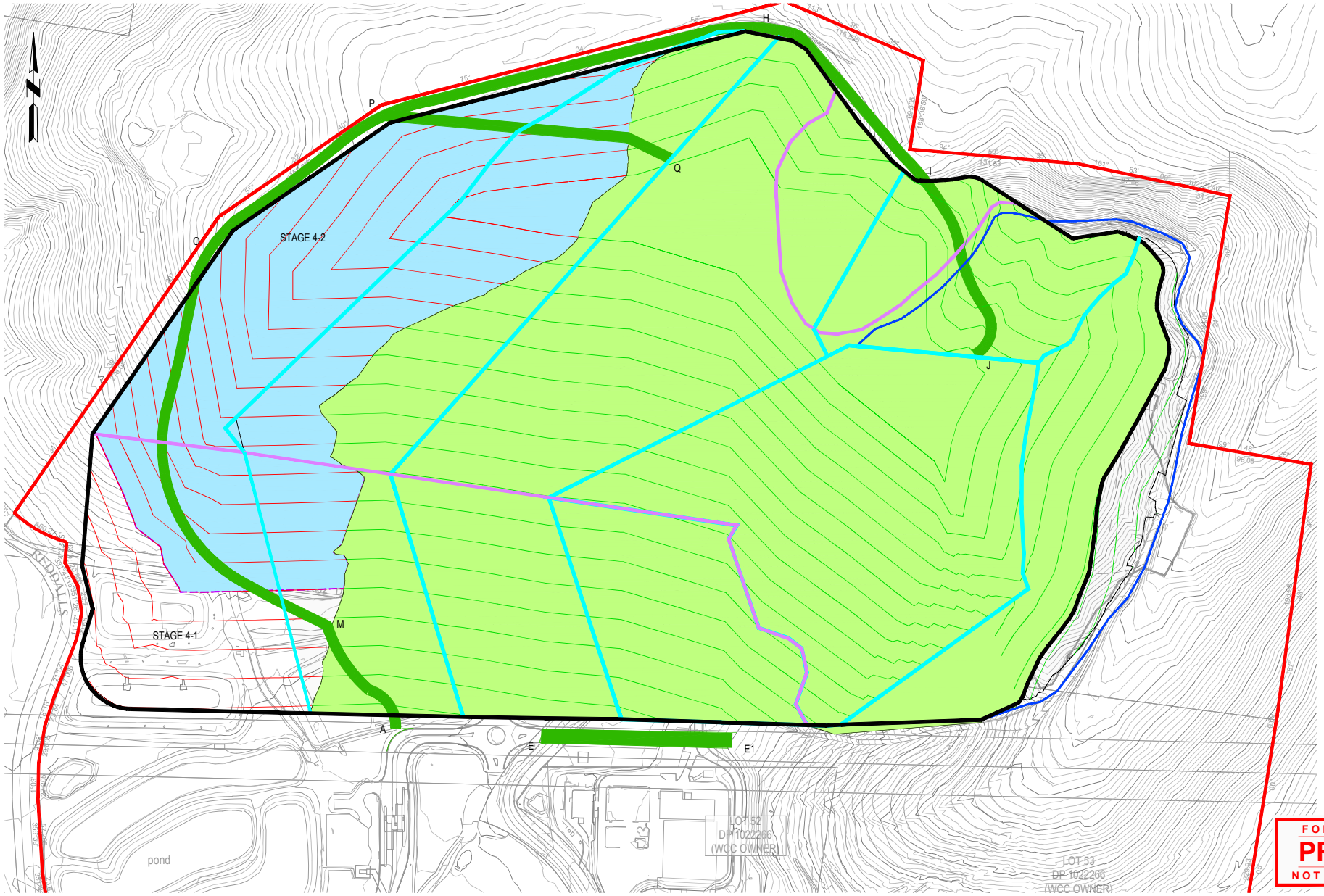

LEGEND

- FILLING
- LINING
- TEMPORARY ROAD
- PERMANENT ROAD
- CAPPING
- END OF STAGE CONTOUR (CURRENT STAGE)
- END OF STAGE CONTOUR (FINISHED STAGES)
- PROPERTY BOUNDARY
- EXTENT OF LANDFORM
- STAGING BOUNDARY
- CELL BOUNDARY
- EXISTING CONTOURS

FOR DISCUSSION ONLY
PRELIMINARY
NOT FOR CONSTRUCTION

1:3,000

0 60 120 180m

Golder Associates
www.golder.com
GOLDER ASSOCIATES PTY. LTD.

CLIENT: WOLLONGONG CITY COUNCIL		PROJECT: PRELIMINARY CONCEPT - WHYTES GULLY LANDFILL							
DRAWN BY: EJ JEET	DATE: 21 MARCH 2012	DRAWING TITLE: STAGE 4-2							
CHECKED BY: R HUYNH	DATE: 21 MARCH 2012								
SCALE: 1:3,000	SHEET SIZE: A3	PROJECT No: 117625003	DOC No: 143	DOC TYPE: R	FIGURE No: F017	REVISION: 0	FIGURE 11		

Plot Date: 22 March 2012 Time:10:36:02 AM By: Jeet, Elvin Path: K:\Des\2011\117625003 WHYTES GULLY\FIGURES - File Name:117625003-143-R-F017-REV0.dwg
Xref: 117625003-XREF-EXISTING BREAKLINES.dwg; 117625003-XREF-PROPOSED ROADS.dwg; GAP_LOGO-A3.dwg;

Appendix B

Trade Waste Agreement

Whytes Gully

Sydney WATER

Consent to discharge industrial trade wastewater

Consent to Discharge Industrial Trade Wastewater

SYDNEY WATER CORPORATION

and

WOLLONGONG CITY COUNCIL

A.B.N. 63 139 525 939

ACTIVITY: GARBAGE TIP (GE06)

RISK INDEX: 05

CONSENT NO: 11205

CONNECTION NO: 1

PROPERTY NUMBER: 3656882

You are hereby advised that the Consent made on 17 June 2016 is replaced by this Consent.

This **CONSENT** is made on **day:** 14 **month:** 08 **year:** 2017

Executed for and on behalf of
Sydney Water Corporation

By

.....
(Signature)

Caleb Furner
Manager Major Customers

In the presence of:

Witness

.....
(Signature)

ROSS NIGHTINGALE
(Print name of witness)

Executed for and on behalf of
the Customer:

.....
(Signature)

By

Sandra Pebanszky
(Print name and position of person signing)
who warrants s/he has sufficient authority to execute this consent.

In the presence of:

Witness

.....
(Signature)

JOEL COULTON
(Print name of witness)

SCHEDULE 1
(SUBJECT TO PUBLIC DISCLOSURE)
TRADE WASTEWATER WHICH MAY BE DISCHARGED

1. Trade wastewater substances

(a) The Customer may discharge trade wastewater into the Sewer in a manner whereby the substance characteristics of the trade wastewater are of a type and discharged at a rate, level or concentration equal to or less than that described in this schedule.

(b) The Customer must not discharge trade wastewater into the Sewer in a manner whereby the trade wastewater discharged;

(i) contains, possesses or produces a substance characteristic not provided in, or which may be determined as being contrary to that described in this schedule.

(ii) is at or of a rate, level, or concentration not provided in, or which may be determined as being contrary to, that described in this schedule.

SUBSTANCE	LTADM (kg/day)	MDM (kg/day)	Standard (mg/L)
AMMONIA (AS N)	4	36	100
BIOCHEMICAL OXYGEN DEMAND	10	80	
SUSPENDED SOLIDS	30	150	600
TOTAL DISSOLVED SOLIDS	782	2500	10000

RECONCILIATION PROCEDURES:

LONG TERM AVERAGE DAILY MASS:

The Long Term Average Daily Mass is a twelve month arithmetic average of ALL daily mass discharges as calculated for each composite sample. The Daily Mass discharged is to be calculated for each of the above substances, and checked against the above Long Term Average Daily Mass (kg/day) on the basis of average concentrations of substances discharged (mg/L) over any 24 hour period as determined from composite samples, obtained by either the Customer (in accordance with Schedule 2) or Sydney Water, or a combination of sample results by both.

This average concentration (mg/L) is to be multiplied by the total discharge (kL) as recorded by the Customer's discharge flow meter over the 24 hour period in order to calculate the Daily Mass of substances discharged (kg). Exceeding the Long Term Average Daily Mass does not constitute a Breach.

ACCEPTANCE STANDARD:

The Composite Sample Concentration is to be determined for each of the above substances, and checked against the above Acceptance Standard (mg/L) for each sample obtained. Exceeding the Acceptance Standard constitutes a Breach and will also incur an increased Quality Charge as detailed in Schedule 3.

The Discrete Sample Concentration is to be determined for each of the substances identified at Schedule 2, 2 (b) and checked against the above Acceptance Standard (mg/L) for each sample obtained. Exceeding the Acceptance Standard constitutes a Breach.

MAXIMUM DAILY MASS:

The Daily Mass discharged is to be calculated for each of the above substances, and checked against the above Maximum Daily Mass (kg/day) on the basis of average concentrations of substances discharged (mg/L) over any 24 hour period as determined from composite samples, obtained by either the Customer (in accordance with Schedule 2) or Sydney Water, or a combination of sample results by both.

This average concentration (mg/L) is to be multiplied by the total discharge (kL) as recorded by the Customer's discharge flow meter over the 24hour period in order to calculate the Daily Mass of substances discharged (kg). Exceeding the Maximum Daily Mass constitutes a Breach.

2. The trade wastewater discharged must at all times have the following properties:

Temperature	-	Not to exceed 38 degrees Celsius.
Colour	-	Determined on a system specific basis
pH	-	Within the range 7.0 to 10.0.
Fibrous material	-	None which could cause an obstruction to Sydney Water's sewerage system.
Gross solids (other than faecal)	-	A maximum linear dimension of less than 20 mm, a maximum cross section dimension of 6 mm, and a quiescent settling velocity of less than 3 m/h.
Flammability	-	Where flammable and/or explosive substances may be present, the Customer must demonstrate to the satisfaction of Sydney Water that there is no possibility of explosions or fires occurring in the sewerage system. The flammability of the discharge must never exceed 5% of the Lower Explosive Limit (LEL) at 25° Celsius.

3. Rate of discharge of waste to sewer:

(a) Instantaneous maximum rate of pumped discharge 7 litres per second

(b) Maximum daily discharge 605 kilolitres

(c) Average daily discharge 250 kilolitres

RECONCILIATION PROCEDURE:

The data obtained from applying these procedures is to be checked by the interface of a chart recorder to the Customer's flow metering equipment, or by the installation of flow metering equipment by Sydney Water, for a minimum of 7 days.

SCHEDULE 2

(SUBJECT TO PUBLIC DISCLOSURE)

SAMPLING, ANALYSIS, FLOW RATES AND VOLUME DETERMINATION

1. The Customer must provide and make available for the purpose of sampling and analysis;
   (a) A sampling point located at the pretreatment discharge, excluding domestic sewage and prior to the point of connection to the Sewer.

   (b) Equipment necessary to allow collection of composite automatic samples on either a flow proportional or a time basis.

2. The Customer is to undertake collection and analysis of samples in accordance with the schedule detailed below:

   (a) Composite samples are to be obtained:

   (i) over one full production day by combining equal volumes taken at 30 minute intervals. The volumes are to be such that at least 5,000 millilitres are obtained over the full day. The reading of the Flowmeter meter is to be obtained at the commencement and conclusion of the sampling day.

   (ii) on 11 August 2017 and every 22 days thereafter. If trade wastewater is not discharged on this day, then the sample is to be taken on the next day that trade wastewater is discharged. Trade wastewater includes all non-domestic wastewater discharged to sewer from the premises, including cleaning waste.

   (b) Discrete samples are to be obtained as detailed below, and analysed according to the procedures and methods specified in Sydney Water's published analytical methods, to determine the concentrations or levels of the following substance characteristics:

   pH — at the start and finish of each sample day

   (c) Composite samples are to be analysed according to the procedures and methods specified in Sydney Water's published analytical methods, or methods otherwise agreed to and detailed hereunder, to determine the concentrations or levels of the following substance characteristics

   AMMONIA (AS N)

   BIOCHEMICAL OXYGEN DEMAND

   SUSPENDED SOLIDS

   TOTAL DISSOLVED SOLIDS

   (d) The Customer, or the laboratory contracted by the customer, is to submit results of analyses to Sydney Water within 21 days from the date the sample was taken. All analysis results are to be submitted on the sample analysis report provided as appendices 1 and 2 to this Consent or in such format as may be specified from time to time by Sydney Water.

   (e) All data requested on the sample analysis report must be provided.

   (f) Sydney Water must be notified in writing within 7 days of;

   (i) any failure to obtain samples in accordance with the provisions of Schedule 2; or

   (ii) any loss of any analytical data.

   Where data is unavailable, lost or not provided, the Quality Charge, as detailed in Schedule 3, will be assessed on the basis of the highest Composite Sample concentration recorded in the 12 months prior to the date of the missing sample data.

3. The volume of wastewater discharged must be obtained from the reading of the total flow on the Customer's flowmetering system.

   The rate of waste discharged is to be obtained by the reading of the instantaneous flow rate indicator on the Customer's flowmetering system, or from any chart recorder interfaced to the Customer's flowmetering system.

   The flowmetering system is to be calibrated at least annually at the Customer's expense, by a person or

company approved by Sydney Water and a copy of the calibration certificate supplied to Sydney Water within one month of such certificate being received by the Customer.

If the Customer's flow metering system fails to record data for any period, Sydney Water is to be advised in writing by the Customer within 7 days of any such failure becoming known by the Customer. An estimate of any data not recorded is to be made as follows:

Average of the waste discharged, registered for the four weeks before and/or after the failure to record.

Consent to Discharge Industrial Trade Wastewater

SCHEDULE 3
(SUBJECT TO PUBLIC DISCLOSURE)
PAYMENTS

The charges are effective from 1 July 2017 and will continue until otherwise advised by Sydney Water.

All trade waste fees and charges are subject to CPI adjustments from 1 July each year in accordance with Determination No 1, 2012 made by the Independent Pricing and Regulatory Tribunal (IPART) and are detailed in fact sheets on the Sydney Water website.

1. CHARGES FOR TRADE WASTEWATER DISCHARGE

Sydney Water will conduct a reading of the Customer's discharge meter at approximately 90 day intervals. The volume of trade wastewater discharged for the period since the previous reading will be calculated.

Charges are based on the Daily Mass calculated from composite samples and corresponding meter readings for each sampling day in the billing period, and calculated in accord with (c), (d), (e), and (f) below. The charge for each sampling day is then multiplied by a flow weighting factor to give a flow weighted charge. The total charge for each substance for the billing period is equal to the sum of the flow weighted charges for the billing period.

Total Charge = the sum of the flow weighted charges for the billing period

Flow Weighted Charge = (charge for all sample days) x (flow weighting factor) and:

$$\text{Flow Weighting Factor} = \frac{\text{(total volume discharged during billing period)}}{\text{(sum of volumes discharged during all sample days during billing period)}}$$

In this formula volume discharged refers to the volume of trade wastewater discharged.

(a) Mass Discharged:
For each substance, the Mass Discharged is calculated by multiplying the Composite Sample concentration by the Trade Wastewater discharge for that sample day.

(b) Chargeable Trade Waste Mass:

(i) For the following substances, the Chargeable Trade Waste Mass is equal to the Mass Discharged:

SUBSTANCE
N/A

(ii) For the following substances, the Chargeable Trade Waste Mass is calculated by subtracting the Equivalent Domestic Mass from the Mass Discharged. The Equivalent Domestic Mass is defined as the Domestic Concentration multiplied by the Trade Wastewater discharge.

SUBSTANCE	DOMESTIC CONCENTRATION mg/L
AMMONIA (AS N)	35
BIOCHEMICAL OXYGEN DEMAND	230
SUSPENDED SOLIDS	200
TOTAL DISSOLVED SOLIDS	450

If the resulting Chargeable Trade Waste Mass is zero or negative, then no Quality charges will apply for that substance for that sample day.

(c) Quality Charge:

(i) For the following substances, the Quality Charge is determined by multiplying the Chargeable Trade Waste Mass by the Rate for that substance as detailed in the Industrial Customers Acceptance Standards and charging rates for the applicable financial year fact sheet on the Sydney Water website.

SUBSTANCE
AMMONIA (AS N)
SUSPENDED SOLIDS
TOTAL DISSOLVED SOLIDS

(ii) For the following substances, the Quality Charge is determined by multiplying the Chargeable Trade Waste Mass by the Rate, where the Rate is a function of the composite sample concentration recorded for that sample day.

SUBSTANCE

BIOCHEMICAL OXYGEN DEMAND

(d) Concentration Breach Charge:
Where the Composite Sample concentration is greater than the Acceptance Standards specified in Schedule 1 (with the exception of sulphate), any charges calculated in (c) above will be doubled for that sampling day.

(e) Failure to collect required samples:
Where the Customer fails to collect and analyse samples in accord with this consent the above charges will be assessed on the basis of the highest composite concentrations recorded for any billing period within the previous 12 months and the average daily discharge for the current billing period.

(f) pH and Temperature charges:
Sydney Water regularly assesses its wastewater networks to determine if a system is affected by accelerated odour and corrosion. Where Sydney Water declares a wastewater system to be affected by accelerated odour and corrosion, the temperature and pH charge will only apply if the customer is not committed to or not complying with an effluent improvement program.

2. CHARGES FOR INSPECTIONS

(a) If, in the opinion of Sydney Water, it is necessary for a Business Customer Representative to exercise rights under clause 6.1, the Customer will incur no liability for payment for any such exercise unless the Business Customer Representative has already exercised rights under clause 6.1 on 4 occasions within a period of one year.

(b) If it is necessary, in the opinion of Sydney Water, to carry out more than 4 occasions within a period of one year, the additional inspections will be charged at the current inspection rate.

(c) Any inspection required following up an alleged breach or a default notice will result in a fee payable even if the number of inspections nominated in paragraph 2 (a) has not been exceeded.

(d) For the purposes of 2 (a) and 2 (b), above, one year is defined as the period from 1 July to 30 June the following year.

3. CHARGES FOR ADMINISTRATION OF TRADE WASTE CONSENT

A consent fee per quarter is payable from 1 October 2017.

4. CHARGES FOR VARIATION OR RENEWAL OF TRADE WASTE CONSENT

Where a Variation is made to the Consent a fee will be payable. There will be no charge for renewal.

5. CHARGES FOR GREASE TRAPS

Wastesafe administration charges are levied per pit per year and are not applicable.

6. PAYMENT OF FEES AND CHARGES

An account will be issued for all fees and charges. Any fees or charges payable by the Customer must be paid by the Customer within 30 days of the receipt by the Customer of the account detailing those fees and charges.

Consent to Discharge Industrial Trade Wastewater

SCHEDULE 4
ADDITIONAL REQUIREMENTS

1. EFFLUENT IMPROVEMENT PROGRAM

Not applicable

2. WASTE MANAGEMENT PLAN

The existing pre-treatment will result in the generation of 3 tonne per annum of waste substances in the form of a sludge containing generally solids. The waste substances are, and will continue to be disposed of, in compliance with the requirements of The Environment Protection Authority.

3. OTHER REQUIREMENTS

(a) A Backflow Containment Device must be installed and maintained at the water meter outlet/property boundary in line with Sydney Water's Responsibilities Of Connected Customers Policy.

(b) Backflow individual/zone protection is required on any tap located within 5m of the trade waste apparatus.

DISCHARGE TO SEWER

Schedule 1 provides for a maximum discharge of 605 kilolites per day of treated tip leachate at an instantaneous flow rate not greater than 7 litres per second from the customers treatment plant to a pressure rising main connected to the Sydney Water sewer.

SEWER CONNECTION

Wollongong City Council will be required to decommission the existing connection to the Sydney Water Pressure pipe (rising main from SP1007) and connect to the gravity network when it becomes available, as part of the servicing strategy for the West Dapto Urban Release Area.

EFFLUENT DISCHARGE PUMP

The existing effluent discharge pump must not be altered in specification or replaced without prior written notification and approval from Sydney Water.

SCHEDULE 5
APPARATUS, PLANT AND EQUIPMENT

EXISTING: **SEQUENCING BATCH REACTOR PLANT (SBR):**

1 x SBR tank (280,000 litres) including aerators
1 x Effluent balancing tank (75,000 litres)
1 x Caustic storage tank (3,000 litres)
2 x Effluent pumps
1 x Full Pipe Electromagnetic Discharge Flowmeter
1 x SBR Sludge transfer skip

PROPOSED: Not Applicable

Consent to Discharge Industrial Trade Wastewater

SCHEDULE 6
SPECIAL CONDITIONS

1. DANGEROUS DISCHARGES

In this Schedule, the term "may pose a danger to the environment, the Sewer or workers at a sewage treatment plant";

(a) means an occurrence whereby matter is discharged to the Sewer which either alone or in conjunction with other matter discharged cannot be adequately treated or may cause corrosion or a blockage, explosion or the production of dangerous gases in the Sewer or may adversely affect the operation of a sewer or sewage treatment plant; and

(b) includes, but not so as to restrict the generality of paragraph (a), matter or substances, which is or are;

(i) toxic or corrosive;
(ii) petroleum hydrocarbons;
(iii) heavy metals;
(iv) volatile solvents;
(v) phenolic compounds;
(vi) organic compounds.

2. UNINTENDED DISCHARGES

(a) For purposes of avoiding unintended discharges to the Sewer or the stormwater drainage system, all matter and substances on the Premises must be processed, handled, moved and stored in a proper and efficient manner.

(b) Any substance on the Premises which, if discharged to the Sewer, may pose a danger to the environment, the Sewer or workers at a sewage treatment plant or may harm any sewage treatment process must be handled, moved and stored in areas where leaks, spillages or overflows cannot drain by gravity or by automated or other mechanical means to the Sewer or the stormwater drainage system

3. NOTIFICATION

In the event of a discharge of matter to the sewer that poses or may pose a danger to the environment, the Sewer or workers at a sewage treatment plant the Customer must immediately notify:

(a) 24 HOUR SYDNEY WATER CONTACT TEL: 131 110 FAX: (02) 9822 5688

(b) BUSINESS CUSTOMER SERVICES (8AM TO 5PM MON TO FRI) TEL: 1300 985 227

(c) BUSINESS CUSTOMER SERVICES EMERGENCY CONTACT (24 HOURS) TEL: (02) 8849 5029

4. PROVISION OF SAFE ACCESS

The Customer shall provide safe access to Sydney Water employees visiting the site. In the event that unsafe conditions are identified the Customer must take reasonable steps to correct unsafe conditions and create safe access.

Sydney Water employees must also comply with the Customer's safety policies and procedures and any directions from the Customer's staff while on the Customer's site.

5. ELECTRONIC REPORTING OF SAMPLE ANALYSIS RESULTS

Sydney Water reserves the right to vary this consent to specify the option of reporting by electronic mail as outlined in Schedule 2, 2 (d).

Consent to Discharge Industrial Trade Wastewater

SCHEDULE 7

1. Premises for which Consent is granted
   133 REDDALLS RD, KEMBLA GRANGE NSW 2526

2. Industrial or other commercial activities for which Consent is granted
   GARBAGE TIP (GE06)

3. Discharge point for which Consent is granted
   Sewer connection on the corner of West Dapto and Reddalls Rds. Kembla Grange

4. The date for purposes of clause 3.1 is 1 August 2017

5. The period for purposes of clause 3.2 is 9 months

6. The receiving Treatment Plant is WOLLONGONG Wastewater Treatment Plant / Water Recycling Plant

Consent to Discharge Industrial Trade Wastewater

SCHEDULE 8
NOTICES AND COMMUNICATION ADDRESSES

SYDNEY WATER	MANAGER MAJOR CUSTOMERS PO Box 399 PARRAMATTA 2150	TEL: 1300 985 227 A.H: (02) 8849 5029
CUSTOMER:	SANDRA BELANSZKY WASTE OPERATIONS MANAGER WOLLONGONG CITY COUNCIL LOCKED BAG 8821 WOLLONGONG NSW 2500	TEL: (02) 4227 7037 FAX: n/a

SCHEDULE 9
AUTHORISED OFFICERS

SYDNEY WATER:	MANAGER MAJOR CUSTOMERS PO Box 399 PARRAMATTA 2150	TEL: 1300 985 227 A.H: (02) 8849 5029
Email:	businesscustomers@sydneywater.com.au	
CUSTOMER:	SANDRA BELANSZKY WASTE OPERATIONS MANAGER WOLLONGONG CITY COUNCIL LOCKED BAG 8821 WOLLONGONG NSW 2500	TEL: (02) 4227 7037 FAX: n/a
Email:	sbelanszky@wollongong.nsw.gov.au	

SCHEDULE 10
NOMINATED REPRESENTATIVES

SYDNEY WATER:	MANAGER MAJOR CUSTOMERS PO Box 399 PARRAMATTA 2150	TEL: 1300 985 227 A.H: (02) 8849 5029
CUSTOMER:	BROCK HEYCOTT WASTE OPERATIONS COORDINATOR WOLLONGONG CITY COUNCIL LOCKED BAG 8821 WOLLONGONG NSW 2500	TEL: 0417 295 258 FAX: n/a

Consent to Discharge Industrial Trade Wastewater

APPENDIX 1 (Example)
SAMPLE ANALYSIS REPORT (COMPOSITE)

Consent Number:	11205
Company Name:	WOLLONGONG CITY COUNCIL
Company Address:	133 REDDALLS RD, KEMBLA GRANGE NSW 2526

Sample Type:

- ☐ 6 (composite, manual time based)
- ☐ 7 (composite, manual flow proportional)
- ☐ 8 (composite, automatic time based)
- ☐ 9 (composite, automatic flow proportional)

Start date: ___/___/___
Finish date: ___/___/___
Start time: ____:____ am/pm
Finish time: ____:____ am/pm

grabs taken in sample period: _____
sample intervals min/kL _____
mL per grab: _____

Initial meter reading: _____kL
Final Meter reading: _____kL
Volume discharged: _____kL

Laboratory:

	Acceptance Standard	Measured Units
Substance	**Acceptance Standard (mg/L)**	**Measured Concentration(mg/L)**
AMMONIA (AS N)	100	
BIOCHEMICAL OXYGEN DEMAND		
SUSPENDED SOLIDS	600	
TOTAL DISSOLVED SOLIDS	10000	

COPY OF ORIGINAL ANALYTICAL LABORATORY REPORT TO BE ATTACHED
NOTE: LABORATORY REPORT MUST CERTIFY NATA REGISTRATION FOR EACH ANALYSIS

Comments: _____

Customer Signature: _____ Date: ___/___/___
Designation: _____

OFFICE USE ONLY

Sample No: | | | | | |

EMAIL TO:
ross.nightingale@sydneywater.com.au

Consent to Discharge Industrial Trade Wastewater

APPENDIX 2 (Example)
SAMPLE ANALYSIS REPORT (DISCRETE SAMPLE)

Consent Number:	11205
Company Name:	WOLLONGONG CITY COUNCIL
Company Address:	133 REDDALLS RD, KEMBLA GRANGE NSW 2526

Sample Type: DISCRETE
Date
Time

Laboratory:

Substance	Acceptance Standard (units or mg/L)	Measured Units or Concentration.
pH at start	7 - 10	
pH at finish	7 - 10	

COPY OF ORIGINAL ANALYTICAL LABORATORY REPORT TO BE ATTACHED
NOTE: LABORATORY REPORT MUST CERTIFY NATA REGISTRATION FOR EACH ANALYSIS

Comments: _____

Customer Signature: _____ Date: ___/___/___

Designation: _____

OFFICE USE ONLY

Sample No: | | | | | |

EMAIL TO:
ross.nightingale@sydneywater.com.au

Recitals:

A. Under its Operating Licence, Sydney Water provides sewerage services and treats and disposes of trade wastewater. The objectives of Sydney Water include operating as an efficient business, maximising the net worth of the State's investment and exhibiting a sense of social responsibility by having regard to the interests of the community. Sydney Water has special objectives of reducing risks to human health and preventing degradation of the environment.

B. Sydney Water is granted licences by the Environment Protection Authority, which are subject to conditions to discharge pollutants. A change to a licence condition may require that variations be made to a consent granted by Sydney Water.

C. In the conduct of its business operations, Sydney Water must comply with its obligations, duties and responsibilities under the Act and its Operating Licence and the Protection of the Environment Administration Act 1991, the Protection of the Environment Operations Act 1997 and the Protection of the Environment Legislation Amendment Act 2011.

D. The customer requests that Sydney Water grant consent to the customer for purposes of discharge of trade wastewater from the premises to the sewer.

Sydney Water grants to the customer consent to discharge trade wastewater, subject to the terms and conditions specified in this consent. The customer accepts the consent and agrees to be bound by the terms and conditions of this consent:

1. Definitions and interpretation

1.1 In this consent, unless the contrary intention appears;

Acceptance standards means Sydney Water's published concentration limits for certain substances in trade wastewater.

Act means the Sydney Water Act 1994.

Business Customer Representative means an officer of Sydney Water who is authorised to enter land or buildings for purposes of carrying out his or her duties in relation to Sydney Water's trade wastewater service.

Consent means this consent together with its attached schedules and appendices. Any definitions or standards referred to in this consent but not contained in it are deemed to form a part of this consent with necessary changes being made to accommodate their inclusion.

Authorised officer means:

- with respect to Sydney Water, the person from time to time holding the position pertained in schedule 9 or such other person or position as may be nominated by Sydney Water from time to time;
- with respect to the customer, the person identified, and includes the details specified, in schedule 9 or as may be notified to Sydney Water by the customer from time to time.

Breach means any contravention of or non-compliance with a term, condition or provision of this consent or the Act.

Chargeable trade waste mass means the mass of a pollutant subject to quality or critical substance charges.

Composite sample means a sample of trade wastewater obtained by combining equal volumes at either equal time or flow intervals.

Critical mass charge means the charge applied to some critical and over capacity substances as calculated in accordance with the provisions set out in schedule 3.

Critical substance means a substance determined to be critical and notified from time to time by Sydney Water.

Customer means the party or parties (except Sydney Water) who executes or execute this consent.

Daily mass means the mass of a substance discharged during a 24-hour period.

Default notice means a notice issued in accordance with clause 8.1.

Domestic concentration means the concentration of a pollutant deemed by Sydney Water to be equivalent to that found in domestic wastewater.

Domestic wastewater means water which has in it human faecal matter, urine or refuse of any type produced in, and which is permitted to be discharged to a Sydney Water sewer from, any premises used exclusively for residential purposes.

Environment Protection Authority means the statutory authority established under section15 of the Protection of the Environment Administration Act 1991

Equivalent domestic mass means the mass of a substance that would be expected in the trade wastewater if it were at domestic concentration.

Flow weighted charge means the portion of a substance's charge for a billing period that is attributed to any sample collected in accordance with schedule 2 or, if such sample is required but is not collected, then fixed by Sydney Water in accordance with schedule 2.

Flow weighting factor means a factor used to determine charges as described in schedule 3.

Long term average daily mass means, for each pollutant, the figure listed in schedule 1 and used to determine critical mass charges as described in schedule 3.

Lower explosive limit means the minimum concentration of flammable and/or explosive substances that would result in a fire or explosion.

Mass discharged means the mass of a pollutant discharged on a sample day and is measured by

multiplying the composite sample concentration by the trade wastewater discharge for that sample day.

Maximum daily mass means the greatest mass of a substance permitted for discharge within a 24-hour period.

Over capacity means the status of a substance as determined in accordance with Sydney Water's Trade Waste Policy, 2007.

Over capacity substance means a substance determined to be over capacity and notified from time to time by Sydney Water.

Premises means the land, plant and buildings described and specified in paragraph 1 of schedule 7, on or in which the customer carries on industrial or other commercial activities specified in paragraph 2 of schedule 7.

Quality charge means a pollutant charge applied to trade waste discharges based on the mass of each pollutant discharged to sewer.

Regulator means any statutory authority, which may grant permission, authority or licence to Sydney Water to operate the sewer or treat or dispose of sewage treatment by-products.

Residual products means biosolids, re-use water or such other product intended for re-use as may be developed by Sydney Water from time to time.

Risk index means a ranking applied to the consent by Sydney Water to describe the relative risk of accepting the trade wastewater. Determination of the risk index will be based on the methodology determined from time to time by Sydney Water, or as may be necessary in the opinion of Sydney Water to take into account particular circumstances. The risk index is used to determine, among other things, the amount of self-monitoring required, the number of inspections to be performed by Sydney Water, the annual consent fee and the term of the consent.

Sewer means the sewerage service of Sydney Water, including the sewage treatment plant, discharge to which is facilitated by a discharge point situated on the premises and specified in item 3 of schedule 7.

Significant breach means any breach of a nature outlined at clause 15.2. Such breaches may result in immediate suspension or termination of the consent.

Standard mass charging rate means the charge per kilogram for substances as defined in schedule 3.

Sydney Water means Sydney Water Corporation.

Responsibilities of connected customers policy means Sydney Water's policy detailing the conditions under which Sydney Water will agree to accept trade wastewater to sewer.

Trade wastewater means any liquid and any substance in it that is produced in an industrial or commercial activity at the premises and discharged into the sewer, but does not include domestic wastewater.

Trade waste residue means any substance separated and retained, from trade wastewater being discharged into the sewer.

1.2 In this consent, unless the contrary intention appears:

(a) A reference to an Act or any delegated legislation or instrument made under an Act includes any other Act delegated legislation or instrument as may amend or replace any of them.

(b) A reference to a word or expression

(i) in the singular form includes a reference to the word or expression in the plural form; and

(ii) in the plural form includes a reference to the word or expression in the singular form.

(c) A reference to a party or a natural person includes a reference to a corporation.

(d) A word or expression that indicates one or more particular genders is taken to indicate every other gender.

(e) Headings to clauses and paragraphs are included in this consent to assist understanding of its terms and conditions but are not intended to affect the meaning or application of any term or condition.

(f) A reference to a clause, schedule or appendix is a reference to a clause of or schedule or appendix to this consent and any such schedule or appendix is a part of this consent.

1.3 Remedies available to the parties under this consent;

(a) are cumulative; and

(b) do not prejudice or affect any other remedy available to the parties.

1.4 No rule of construction applies to the disadvantage of a party because that party was responsible for the preparation of this consent or any part of it.

2. Application of certain statutes and laws

2.1 This consent is made under and is subject to the provisions of the Act.

2.2 This consent is governed by and will be performed according to the law applicable in the State of New South Wales.

2.3 Subject to the terms and conditions of this consent the customer has lawful authority to dispose of trade wastewater for purposes of;

(i) Section 115 of the Protection of the Environment Operations Act 1997; and

(ii) Section 49 of the Act; and

3. Commencement and term of consent

3.1 This consent commences on the date specified in paragraph 4 of schedule 7.

3.2 This consent will, unless terminated or renewed in accordance with this consent, continue for the period specified in item 5 of schedule 7.

4. Discharge of trade wastewater into sewer

4.1 The customer may discharge trade wastewater from the premises into the sewer in accordance with the provisions of schedule 1 and schedule 4.

4.2 The customer must not discharge trade wastewater from the premises into the sewer contrary to the provisions of schedule 1 and schedule 4.

4.3 The customer indemnifies Sydney Water against all damages, losses, costs or expenses suffered or incurred by Sydney Water, caused by any unauthorised discharge from the premises in respect of:

(a) injury (including death) or harm to any person; or

(b) damage to property vested in Sydney Water; or

(c) contamination of residual products; or

(d) material harm to any sewage treatment process

provided that the said damages, losses, costs or expenses suffered or incurred by Sydney Water are caused by any unauthorised discharge of trade wastewater or other matter into the sewer by the customer which is in breach of this consent or by any other person from the customer's premises, except to the extent to which the damages, losses, costs or expenses (as the case may be) were caused by either the negligent or wilful act or omission of Sydney Water or a breach of this consent by Sydney Water.

4.4 The customer must take all precautions reasonably practicable to ensure that no person, other than a person acting for or on behalf of or with the consent of the customer, discharges any matter from the premises into the sewer.

4.5 For purposes of this consent, every discharge of matter from the premises into the sewer will be taken to have been a discharge by a person acting for or on behalf of, or with the consent of, the customer.

5. Charges

5.1 The customer must pay Sydney Water charges with respect to trade wastewater discharged to the sewer, the administration of this consent and, when applicable, the processing of grease trap waste determined in accordance with, and within the time and in the manner specified in schedule 3.

5.2 Sydney Water may vary the basis of charges or the charging rates in schedule 3;

(a) as and when determined by the Independent Pricing and Regulatory Tribunal of New South Wales (IPART); or

(b) by written consent with the customer.

6. Inspections

6.1 A Business Customer Representative may enter the premises at any time;

(a) for purposes of inspecting whether the activities of the customer are being conducted in accordance with this consent; or

(b) for the purposes described in Section 38 of the Act or exercising any right or function conferred on Sydney Water under this consent.

This clause does not limit Sydney Water's statutory powers of entry.

6.2 When exercising rights under clause 6.1;

(a) a Business Customer Representative must not cause any delay or inconvenience to the efficient conduct of business activities by the customer which could be reasonably avoided; and

(b) except for any relevant safety precautions, a Business Customer Representative must not be impeded or delayed by any person on the premises.

6.3 If, in the opinion of Sydney Water, it is necessary for a Business Customer Representative to exercise rights under clause 6.1, the customer will make payment in accordance with the provisions of schedule 3.

7. Inquiries

7.1 Sydney Water may convene and determine the terms of reference of a joint inquiry about the circumstances relating to an incident that may have caused a breach.

7.2 An inquiry under clause 7.1 is to be conducted informally and without legal representation for purposes of gathering information about an incident directly from any person who may be expected to know, from his or her own observations, about the circumstances relating to the incident.

7.3 An inquiry under clause 7.1 may be conducted irrespective of whether the incident, the subject of the inquiry, is also the subject of a default notice.

7.4 Before conducting an inquiry under clause 7.1, the customer and Sydney Water may agree about what action, if any (except any action pursuant to a statutory obligation), may be taken with respect to any information that may be gathered during the inquiry.

8. Default procedures

8.1 If, in the opinion of Sydney Water, the customer commits, causes or allows a breach to occur, Sydney Water may issue to the customer a default notice.

8.2 A default notice must;

(a) provide any relevant particular of the breach alleged by Sydney Water, including any particular known to Sydney Water that may assist the customer to ascertain the alleged breach; and

(b) specify that the customer must provide a response in writing to Sydney Water within seven days of receipt of the notice.

8.3 A default notice is not invalid merely because it does not provide a particular that may assist the customer to ascertain the alleged breach.

8.4 Any supply to the customer by Sydney Water of particulars under clause 8.7(a) is taken, for purposes of clause 8.5, to be a default notice under clause 8.1.

8.5 The customer must supply to Sydney Water a written response to a default notice within seven days of receipt of the default notice which must;

(a) request further particulars of the alleged breach; or

(b) describe or explain the circumstances causing;

(i) the event which appeared to Sydney Water to be a breach; or

(ii) the breach to occur; and

(c) describe any action taken with respect to the alleged breach; and

(d) provide a plan of action to be taken by the customer to avoid the occurrence of any incident similar to the alleged breach; or

(e) explain the reasons of the customer for disputing the alleged breach.

8.6 The customer may make one request only for particulars under clause 8.5(a) with respect to a default notice.

8.7 When the customer responds in writing to Sydney Water in accordance with clause 8.5, Sydney Water must within seven days of receipt of that response either;

(a) with respect to clause 8.5(a), provide in writing to the customer any further particulars that it may be able to provide in which case the customer shall be allowed a further seven days from receipt of those particulars to respond as required by clause 8.5(b)

(b) specify to what extent it accepts, rejects or disagrees with the response under 8.5(b) and provide details of any action it proposes to take (including any special requirements it may impose) to deal with the breach.

8.8 The issue by Sydney Water of a default notice is without prejudice to any right or power Sydney Water may have pursuant to this consent or conferred on it by statute or statutory rule.

9. Improvement program

9.1 The customer must, at its own expense, establish and carry out the improvement program specified in, and in accordance with the provisions of, schedule 4.

9.2 If, prior to any failure to comply, the customer notifies Sydney Water that it may not be able to comply with any obligation under clause 9.1, Sydney Water will consider any reasonable proposal of the customer to vary a term or condition of the improvement program.

10. Diligence program

10.1 Within six months of the making of this consent, the customer must give a notice to Sydney Water specifying a current diligence program.

10.2 For purposes of clause 10.1, a diligence program includes a plan, whereby the customer demonstrates that the management of the customer is exercising reasonable care in planning and taking appropriate action, to prevent or minimise the effects of any incident that may constitute a breach.

11. Suspension or termination of consent to discharge trade wastewater

11.1 Sydney Water may suspend the consent granted in clause 4.1 if;

(a) the customer does not comply with clause 8.5, 9.1, 12.1, 12.2 or notice of the suspension is given to the customer; or

(b) Sydney Water is for any reason specified in clause 11.2 unable to accept for treatment trade wastewater that may be discharged by the customer.

11.2 Sydney Water may, by a notice given to the customer, suspend the consent granted in clause 4.1 if, in the reasonable opinion of Sydney Water;

(a) an emergency prevents the sewer from accepting any or certain specified categories of trade wastewater that may be discharged by the customer; or

(b) an event has occurred, which could have an adverse effect on any employee or agent of or contractor to Sydney Water or the sewer, including any biological process.

whether the emergency or event is caused by fire, storm, tempest, flood, malicious damage, act of war, civil disobedience, explosion, earthquake or an act or omission of an employee, or agent of, or contractor to Sydney Water, or an unlawful discharge of matter into the sewer, or some other cause.

11.3 The period of any notice of suspension given under clause 11.2 will be no shorter than any period, which in the opinion of Sydney Water the circumstances dictate.

11.4 The customer must comply with any notice under clause 11.1 or 11.2 subject only to any delay that may be required to safeguard the health or life of any person.

11.5 Any suspension under clause 11.1 or 11.2 must not be for a period longer than, in the opinion of Sydney Water, the circumstances dictate.

11.6 If the customer does not cease discharging trade wastewater in accordance with a notice given under clause 11.1 or 11.2 and Sydney Water is of the opinion that the customer is not taking appropriate measures to stop the discharge, a Business Customer Representative may, with such other persons as he or she may think necessary, enter the premises and take such measures as he or she may think necessary to stop the discharge.

11.7 A suspension under clause 11.1 or 11.2 or any action that may be taken in accordance with clause 11.6 does not give rise to any remedy to the customer against Sydney Water for, or in respect of, the suspension or action.

11.8 Any costs incurred by Sydney Water with regard to taking action under clause 11.6 is a debt payable to

Sydney Water by the customer on demand made by Sydney Water.

11.9 Sydney Water may suspend the consent granted in clause 4.1 if; the discharge of trade wastewater by the customer in accordance with the consent granted under clause 4.1, by itself or in conjunction with the discharges of other persons is likely, in the opinion of Sydney Water, to cause Sydney Water to contravene any legislation, permission, authority or licence granted by a regulator, or any other regulatory authority.

11.10 Any suspension under clause 11.9 must be terminated as soon as Sydney Water is reasonably satisfied that the conditions giving rise to the suspension no longer exist.

11.11 If the customer and Sydney Water cannot agree in accordance with clause 11.10, they will initiate and attend discussions with the regulator to resolve any relevant matter.

11.12 If, after discussions under clause 11.11 the customer and Sydney Water fail to agree in accordance with clause 11.10, the consent granted in clause 4.1 may be terminated by Sydney Water.

11.13 Without limitation of the effect of any other clause in this consent, Sydney Water may terminate or suspend the customer's permission to discharge trade wastewater immediately by written notice to the customer, if in the opinion of Sydney Water the customer's discharge of trade wastewater is in breach of this consent and is likely to cause;

(a) Sydney Water's contravention of the condition of any licence issued to it by the EPA; or

(b) the failure to meet a product specification of

any of Sydney Water's residual products.

(c) Sydney Water to breach or fail to comply with any legislation.

11.14 A suspension under clause 11.9 or 11.13 in accordance with the terms of this consent or a termination under clause 11.12 or 11.13 in accordance with the terms of this consent does not give rise to any remedy to the customer against Sydney Water for or in respect of the suspension or termination.

11.15 Without limitation of the effect on any other clause in this consent, Sydney Water may terminate or suspend the customer's consent to discharge trade wastewater immediately by written notice served on the customer in accordance with Section 100 of the Act, on the occurrence of any one of the following events;

(a) The customer fails to pay to Sydney Water any amount due and payable under this consent within twenty-one days of the due date for payment and such payment is not made within fourteen days of a written request from Sydney Water to do so.

(b) The customer is in breach of the consent and is unable or unwilling to remedy the breach of consent as required by Sydney Water.

The customer acknowledges and agrees that if, following the termination of the consent, it continues to discharge trade wastewater into the sewer, a Business Customer Representative may enter the customer's premises and take all reasonable necessary steps to stop the customer's continued discharge of trade wastewater to the sewer. The right of entry conferred by this clause is in addition to, and not in substitution for, any power of entry conferred on Sydney Water by the Act.

12. Supply of information

12.1 Any information supplied by the customer to Sydney Water for purposes of making this consent or for any purpose of this consent must as far as reasonably possible be a true and complete disclosure by the customer for purposes of enabling Sydney Water to;

(a) determine whether to grant the consent in clause 4.1; and

(b) determine whether there has been any breach of this consent.

12.2 The customer must not, in or in connection with a document supplied to Sydney Water for purposes of making this consent or for any purpose of this consent, furnish information, which is false or misleading in a material particular with regard to the trade wastewater to be discharged to the sewer.

12.3 Sydney Water must not disclose any confidential information obtained in connection with the administration or execution of this consent, unless that disclosure is made;

(a) with the consent in writing of the customer

(b) with other lawful excuse.

13. Sampling

13.1 For purposes of this consent, schedule 2 specifies sampling and analysis criteria, flow rates and volume determinations of trade wastewater to be discharged or discharged under clause 4.1.

13.2 A Business Customer Representative may take as many samples of trade wastewater at any point in any production process or storage facility, or at any other point on the premises, as he or she thinks fit.

13.3 The customer must comply with the provisions of schedule 2.

14. Apparatus, plant and equipment for recording or treating trade wastewater

14.1 The customer must, at its own cost, provide, operate and maintain in an effective and efficient working order, the apparatus, plant and equipment described in schedule 5 for purposes of regulating, treating, determining and measuring the quality, quantity and

rate of discharge of trade wastewater under clause 4.1.

14.2 Sydney Water may require the customer to use its discretion to formulate and take such additional actions as may be appropriate to achieve the objects which, in the opinion of Sydney Water, are necessary for the customer to regulate, treat, determine or measure trade wastewater for purposes of discharge under clause 4.1.

14.3 The customer must, at its own costs, maintain records in such manner as may be required by Sydney Water, of all measurements, sampling and results obtained in the course of treatment and discharge of trade wastewater under clause 4.1.

14.4 The customer must submit to Sydney Water documents containing records of results specified in schedule 2.

14.5 The customer must maintain records of particulars and dates of cleaning and maintaining all apparatus, plant and equipment described in schedule 5 and particulars, dates and method of disposal of trade waste residue from such apparatus, plant and equipment.

14.6 The customer acknowledges that Sydney Water does not approve or warrant that any apparatus, plant or equipment used by the customer is sufficient for purposes of processing or treating trade wastewater for discharge under clause 4.1.

15. Variation and renewal of consent

15.1 Before varying, substituting or adding any process conducted or to be conducted on the premises that may cause the volume, rate or quality of wastewater discharged to change from that agreed under schedule 1 and schedule 4, the customer shall give Sydney Water not less than 14 days written notice of its intention. Any variation, substitution or addition shall only be conducted after receipt of written approval to same and subject to any conditions (including any requirement to vary the terms of this consent) that Sydney Water may impose.

15.2 Sydney Water may vary the terms of this consent where:

(a) Sydney Water alleges a single significant breach or three breaches of the same nature, to have occurred in a six month period; or

(b) in the opinion of Sydney Water, a substantial or material part of any plan of action under clause 8.5(d) may not be completed for a period exceeding 90 days; or

(c) the customer gives Sydney Water notice under clause 15.1.

For the purposes of this clause and without limitation, the following circumstances shall be regarded as being a single significant breach:

(i) an activity or event that could adversely affect; the health and safety of any employee, agent or contractor to Sydney Water, the integrity of Sydney Water assets or the viability of any of Sydney Water's treatment processes or products; or

(ii) failure to achieve effluent improvement program milestone; or

(iii) failure to install pre-treatment; or

(iv) by-pass pre-treatment and/or installation of equipment that facilitates by-pass of pre-treatment; or

(v) flow-meter turned off or bypassed.

15.3 A renewal of this consent may be initiated by the customer:

(a) not less than two months before the date of expiration of this consent, and

(b) not more than six months before the date of expiration of this consent.

15.4 If this consent remains current immediately prior to the expiration of the term detailed in 3.2, or any subsequent terms renewed in accordance with this clause, and:

(a) the customer has not given notice in accordance with clause 20.1 of this consent and;

(b) Sydney Water has not given to the customer at least 30 days' notice prior to the expiration of this consent, of its intention to permit the consent to expire in accordance with clause 3.2

Then this consent shall be deemed to be renewed immediately following its expiration, for a further period of six months.

15.5 Any amended schedules that Sydney Water prepares in response to a variation or renewal will be taken to be incorporated into this consent;

(a) on execution by the customer; or

(b) after 14 days of receipt by the customer of the notice of the variation or renewal.

15.6 The notification of alterations to the critical status of any pollutants does not constitute a variation.

16. Disposal of trade waste residue

The customer must not dispose of any trade waste residue, except in accordance with the requirements of the EPA.

17. Disposal of grease trap wastes

The customer must not dispose of grease trap wastes other than in accordance with Sydney Water's 'Wastesafe' Management System.

18. This consent comprises all applicable terms and conditions

18.1 The provisions of this consent comprise all of the applicable terms and conditions between the parties.

18.2 It is declared by the parties that no further or other promises or provisions are, or will be claimed to be implied, or to arise between the parties by way of collateral or other agreement by reason of any promise, representation, warranty or undertaking given or made by any party (or its agent) to another, on or prior to the

execution of this deed, and the existence of any such implication or collateral or other agreement, is hereby negated by the parties.

18.3 Clauses 18.1 and 18.2 do not prejudice the ability of the parties to vary or amend this consent in accordance with the provisions of this consent or by a further consent in writing.

19. No transfer or assignment

The customer cannot transfer or assign the consent granted in clause 4.1 nor any other right or obligation the customer has or may have under this consent, without the prior consent in writing of Sydney Water.

20. Termination of consent by customer

20.1 Termination of this consent may be effected by the customer upon the giving of at least 30 days' notice in writing to Sydney Water. The notice must state the date on which this consent terminates.

20.2 The customer is bound by the provisions of this consent with regard to any discharge of trade wastewater into the sewer from the premises, including the payment of charges under clause 5.1, from the commencement of this consent until its termination.

20.3 Notwithstanding provisions contained elsewhere in this consent the parties may terminate this consent in writing by mutual agreement provided the parties enter into a further trade waste consent immediately following termination of this consent.

21. Notices and communications

21.1 A notice or communication under this consent must be in writing.

21.2 For purposes of clause 21.1, a notice or communication may;

(a) be left at the address of the addressee; or

(b) be sent by prepaid ordinary post to the address of the addressee; or

(c) sent by facsimile transmission to the facsimile number of the addressee

(d) sent by email to the email address of the addressee

as specified in schedule 8 or such other address as may be notified by the addressee to the other party.

21.3 Unless a later time is specified in it, a notice or communication takes effect from the time it is received.

21.4 Unless the contrary is shown, for purposes of clause 21.3, if a notice or communication is;

(a) a letter sent by pre-paid post, it will be taken to have been received on the third day after posting; or

(b) a facsimile, it will be taken to have been received on receipt by the sender, of the written or oral advice of the addressee that the whole of the facsimile transmission has been received by the addressee in a form that is legible.

22. Miscellaneous

Each party must act in good faith in the implementation of this consent and, without limiting the scope of this obligation, must also seek to resolve any difference or dispute between them as to the consent in good faith.

23. Entire consent

This consent constitutes the entire agreement between the parties in relation to its subject matter. No understanding, arrangement or provision not expressly set out in this consent will bind the parties. Accordingly all correspondence, negotiations and other communications between the parties in relation to the subject matter of this consent that precede this consent are superseded by and merged in it.

Note: This consent has no effect until it is executed for and on behalf of Sydney Water Corporation.

Contact Us
To find out more visit
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or call 13 20 92

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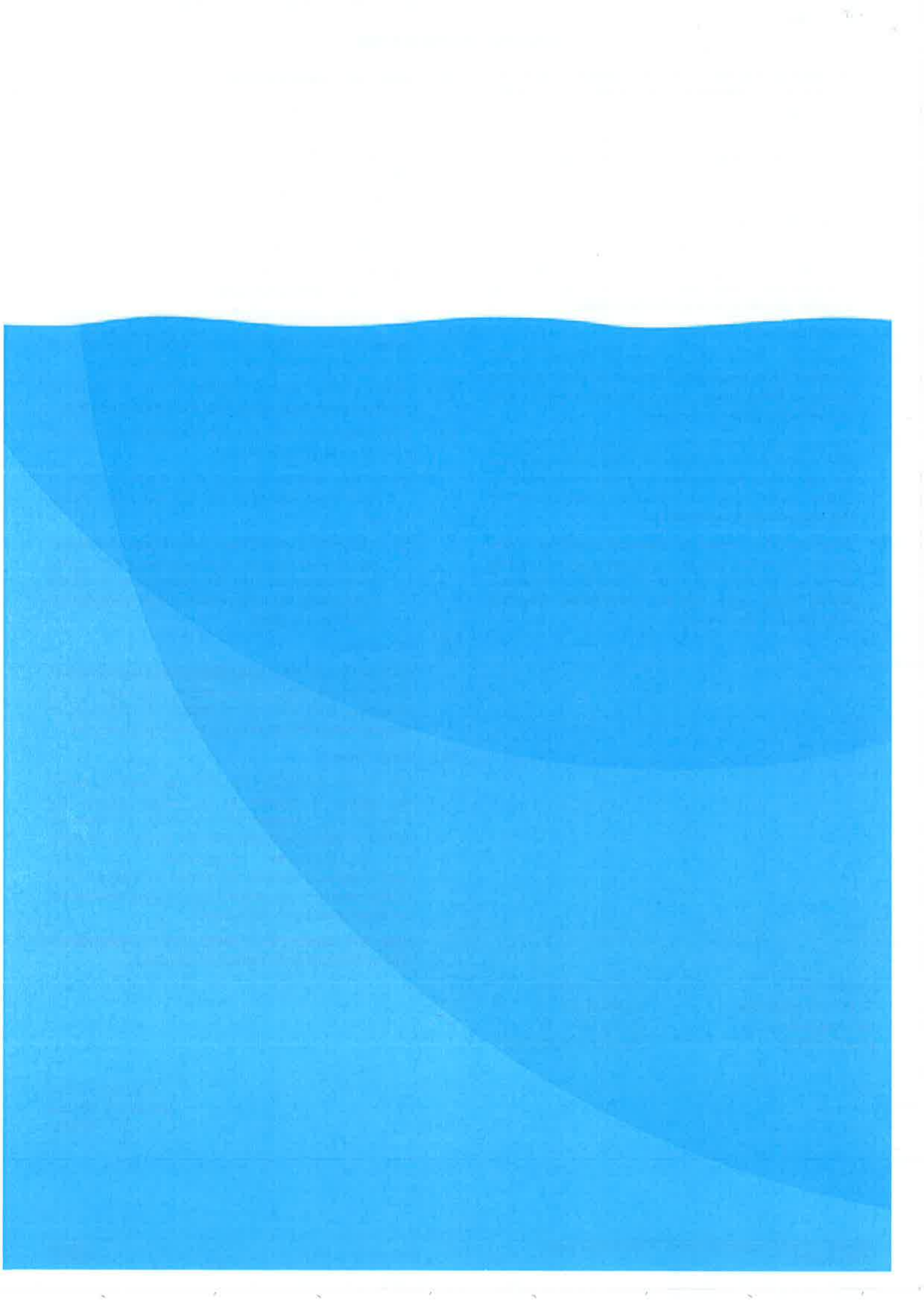

Appendix C

JPG leachate generation data

WCC - Whytes Gully Landfill
Estimated Leachate Generation Data

JPG ENGINEERING

Date	Time	P1 Level	P1 Total Volume (m3)	P1 Difference (m3)	P1 Remaining Capacity (m3)	S1 Level	S1 Total Volume (m3)	S1 Difference (m3)	S1 Remaining Capacity (m3)	B1 Level (Estimate)	B1 Total Volume (m3)	B1 Difference (m3)	B1 Remaining Capacity (m3)	Leachate Discharged to Sewer (m3)	Estimated Leachate Generation (m3)	Rainfall (mm)	Comments
25/07/2020	7:00	2.088	5602.9		4397.1	1.666	3552.9		6047.1	0	0		7800	293.76	293.8	5.0	
26/07/2020	7:00	2.102	5644.9	42.0	4355.1	1.696	3622.4	69.5	5977.6	0	0	0	7800	293.76	405.3	63.0	
27/07/2020	7:00	2.451	6712.2	1067.3	3287.8	1.892	4081.5	459.1	5518.5	0	0	0	7800	293.76	1820.1	45.5	
28/07/2020	7:00	2.069	5545.9	-1166.3	4454.1	3.038	6933.1	2851.7	2666.9	0	0	0	7800	293.76	1979.2	7.5	
29/07/2020	7:00	2.142	5765.4	219.4	4234.6	3.176	7295.9	362.7	2304.1	0	0	0	7800	293.76	875.9	0	
30/07/2020	7:00	2.21	5971.2	205.9	4028.8	3.176	7295.9	0.0	2304.1	0	0	0	7800	293.76	499.6	0	
31/07/2020	7:00	2.24	6062.5	91.3	3937.5	3.176	7295.9	0.0	2304.1	0	0	0	7800	293.76	385.0	0	
1/08/2020	7:00	2.245	6077.8	15.2	3922.2	3.165	7266.8	-29.1	2333.2	0	0	0	7800	293.76	279.9	0	
2/08/2020	7:00	2.25	6093.0	15.2	3907.0	3.142	7206.1	-60.7	2393.9	0.55	1430	1430	6370	293.76	1678.3	0	
3/08/2020	7:00	2.282	6190.8	97.8	3809.2	3.08	7043.1	-163.0	2556.9	1.1	2860	1430	4940	293.76	1658.5	0	
4/08/2020	7:00	2.359	6427.3	236.5	3572.7	2.978	6776.7	-266.4	2823.3	1.5	3900	1040	3900	293.76	1303.9	0	
5/08/2020	7:00	2.337	6359.5	-67.8	3640.5	3.006	6849.6	72.9	2750.4	2	5200	1300	2600	293.76	1598.9	0	
6/08/2020	7:00	2.295	6230.6	-128.9	3769.4	2.925	6639.2	-210.4	2960.8	2.5	6500	1300	1300	293.76	1254.4	0	
7/08/2020	7:00	2.003	5348.9	-881.6	4651.1	2.928	6647.0	7.8	2953.0	2.8	7280	780	520	293.76	199.9	69	
8/08/2020	7:00	2.407	6575.6	1226.7	3424.4	3.069	7014.3	367.3	2585.7	2.8	7280	0	520	293.76	1887.7	8	
9/08/2020	7:00	2.258	6117.4	-458.2	3882.6	3.162	7258.9	244.6	2341.1	2.8	7280	0	520	293.76	80.2	56.5	
10/08/2020	7:00	2.178	5874.2	-243.2	4125.8	3.787	8951.6	1692.8	648.4	2.8	7280	0	520	293.76	1743.3	6.5	
11/08/2020	7:00	2.436	6665.6	791.4	3334.4	3.697	8702.6	-249.01	897.4	2.8	7280	0	520	293.76	836.1	0	
12/08/2020	7:00	2.613	7220.2	554.6	2779.8	3.586	8398.0	-304.68	1202.0	2.8	7280	0	520	293.76	543.7	0.5	
13/08/2020	7:00	2.404	6566.3	-653.9	3433.7	3.89	9238.8	840.83	361.2	2.8	7280	0	520	293.76	480.7	0	
14/08/2020	7:00	2.326	6325.7	-240.6	3674.3	3.865	9168.9	-69.91	431.1	3	7800	520	0	293.76	503.2	5	
15/08/2020	7:00	2.443	6687.3	361.6	3312.7	3.779	8929.4	-239.44	670.6	3	7800	0	0	293.76	416.0	0	
16/08/2020	7:00	2.541	6993.4	306.1	3006.6	3.68	8655.8	-273.64	944.2	3	7800	0	0	293.76	326.2	0	
17/08/2020	7:00	2.622	7248.6	255.2	2751.4	3.583	8389.8	-266.04	1210.2	3	7800	0	0	293.76	282.9	0	
18/08/2020	7:00	2.358	6424.2	-824.5	3575.8	3.875	9196.8	807.07	403.2	3	7800	0	0	293.76	276.4	0	
19/08/2020	7:00	2.425	6631.4	207.2	3368.6	3.786	8948.9	-247.96	651.1	3	7800	0	0	293.76	253.0	0	
20/08/2020	7:00	2.483	6811.9	180.5	3188.1	3.7	8694.4	-254.5	905.6	3	7800	0	0	293.76	219.8	0	
21/08/2020	7:00	2.481	6805.7	-6.2	3194.3	3.7	8636.5	-57.8	963.5	3	7800	0	0	293.76	229.7	0	
22/08/2020	7:00	2.518	6921.3	115.7	3078.7	3.588	8403.4	-233.1	1196.6	3	7800	0	0	293.76	176.3	0	
23/08/2020	7:00	2.564	7065.7	144.4	2934.3	3.481	8112.2	-291.2	1487.8	3	7800	0	0	293.76	146.9	0	
24/08/2020	7:00	2.562	7059.4	-6.3	2940.6	3.468	8077.0	-35.2	1523.0	3	7800	0	0	293.76	252.3	0	
25/08/2020	7:00	2.596	7166.5	107.1	2833.5	3.385	7853.1	-223.9	1746.9	3	7800	0	0	293.76	176.9	0	
26/08/2020	7:00	2.64	7305.6	139.1	2694.4	3.29	7598.6	-254.5	2001.4	3	7800	0	0	293.76	178.4	0	
27/08/2020	7:00	2.68	7432.6	127.0	2567.4	3.187	7324.9	-273.7	2275.1	3	7800	0	0	293.76	147.1	0	
28/08/2020	7:00	2.723	7569.7	137.1	2430.3	3.071	7019.5	-305.4	2580.5	3	7800	0	0	293.76	125.4	0	
29/08/2020	7:00	2.759	7684.8	115.2	2315.2	2.938	6672.9	-346.6	2927.1	3	7800	0	0	293.76	62.3	0	
30/08/2020	7:00	2.799	7813.3	128.4	2186.7	2.807	6335.3	-337.6	3264.7	3	7800	0	0	293.76	84.6	0	
31/08/2020	7:00	2.842	7951.9	138.6	2048.1	2.699	6059.8	-275.5	3540.2	3	7800	0	0	293.76	156.8	0	
1/09/2020	7:00	2.881	8078.1	126.2	1921.9	3.055	6977.6	917.8	2622.4	2.53	6578	-1222	1222	293.76	115.8	0	
2/09/2020	7:00	2.919	8201.5	123.4	1798.5	3.379	7837.0	859.3	1763.0	2.09	5434	-1144	2366	293	131.8	0	
3/09/2020	7:00	2.958	8328.6	127.1	1671.4	3.853	9135.4	1298.4	464.6	1.48	3848	-1586	3952	293	132.5	0	
4/09/2020	7:00	2.63	7273.9	-1054.6	2726.1	3.85	9127.0	-8.4	473.0	1.83	4758	910	3042	293	140.0	0	
5/09/2020	7:00	2.262	6129.6	-1144.3	3870.4	3.764	8887.8	-239.2	712.2	2.325	6045	1287	1755	240	143.5	0.5	
6/09/2020	7:00	2.09	5608.9	-520.7	4391.1	3.673	8636.5	-251.3	963.5	2.58	6708	663	1092	250	141.0	0	
7/09/2020	7:00	2.133	5738.2	129.3	4261.8	3.58	8381.6	-255.0	1218.4	2.58	6708	0	1092	255	129.4	0	
8/09/2020	7:00	2.173	5859.1	120.8	4140.9	3.486	8125.8	-255.8	1474.2	2.58	6708	0	1092	256	121.0	0	
9/09/2020	7:00	2.217	5992.5	133.5	4007.5	3.39	7866.5	-259.2	1733.5	2.58	6708	0	1092	260	134.2	0	
10/09/2020	7:00	2.267	6144.9	152.4	3855.1	3.296	7614.6	-251.9	1985.4	2.58	6708	0	1092	250	150.5	0	
11/09/2020	7:00	2.307	6267.3	122.4	3732.7	3.193	7340.8	-273.8	2259.2	2.58	6708	0	1092	260	122.0	0	
12/09/2020	7:00	2.344	6381.0	113.7	3619.0	3.089	7066.7	-274.1	2533.3	2.58	6708	0	1092	260	113.0	0	
13/09/2020	7:00	2.381	6495.2	114.1	3504.8	2.973	6763.7	-303.0	2836.3	2.58	6708	0	1092	260	114.0	1	
14/09/2020	7:00	2.423	6625.2	130.0	3374.8	2.874	6507.5	-256.2	3092.5	2.58	6708	0	1092	260	133.8	0	
15/09/2020	7:00	2.46	6740.2	115.0	3259.8	2.77	6240.6	-266.9	3359.4	2.58	6708	0	1092	260	108.1	0	
16/09/2020	7:00	2.494	6846.2	106.0	3153.8	2.77	6240.6	0.0	3359.4	2.48	6448	-260	1352	260	106.0	0	
17/09/2020	7:00	2.529	6955.8	109.5	3044.2	2.746	6179.4	-61.3	3420.6	2.405	6253	-195	1547	269	122.3	0	
18/09/2020	7:00	2.566	7072.0	116.2	2928.0	2.778	6261.1	81.7	3338.9	2.3	5980	-273	1820	254	116.0	0	
19/09/2020	7:00	2.603	7188.6	116.6	2811.4	3.178	7301.1	1040.1	2298.9	1.825	4745	-1235	3055	191	116.0	0.5	
20/09/2020	7:00	2.645	7321.5	132.9	2678.5	3.206	7375.3	74.1	2224.7	1.723	4479.8	-265.2	3320.2	191	132.0	7.5	

WCC - Whytes Gully Landfill
Estimated Leachate Generation Data

JPG ENGINEERING

Date	Time	P1 Level	P1 Total Volume (m3)	P1 Difference (m3)	P1 Remaining Capacity (m3)	S1 Level	S1 Total Volume (m3)	S1 Difference (m3)	S1 Remaining Capacity (m3)	B1 Level (Estimate)	B1 Total Volume (m3)	B1 Difference (m3)	B1 Remaining Capacity (m3)	Leachate Discharged to Sewer (m3)	Estimated Leachate Generation (m3)	Rainfall (mm)	Comments
21/09/2020	7:00	2.700	7496.3	174.8	2503.7	3.227	7431.0	55.7	2169.0	1.63	4238	-241.8	3562	191	179.7	0.5	
22/09/2020	7:00	2.737	7614.4	118.1	2385.6	3.706	8727.5	1296.5	872.5	1.08	2808	-1430	4992	132	116.6	0	
23/09/2020	7:00	2.494	6846.2	-768.2	3153.8	3.617	8482.8	-244.7	1117.2	1.42	3692	884	4108	245	116.2	0	
24/09/2020	7:00	2.232	6038.1	-808.1	3961.9	3.518	8212.6	-270.1	1387.4	1.775	4615	923	3185	270	114.8	0	
25/09/2020	7:00	1.951	5194.6	-843.5	4805.4	3.38	7839.6	-373.0	1760.4	2.19	5694	1079	2106	268	130.5	1	
26/09/2020	7:00	1.987	5301.4	106.7	4698.6	3.296	7614.6	-225.0	1985.4	2.19	5694	0	2106	265	146.7	4	
27/09/2020	7:00	2.017	5390.6	89.2	4609.4	3.195	7346.1	-268.5	2253.9	2.19	5694	0	2106	269	89.7	0	
28/09/2020	7:00	2.048	5483.1	92.5	4516.9	3.086	7058.8	-287.3	2541.2	2.19	5694	0	2106	275	80.2	0	
29/09/2020	7:00	2.076	5566.9	83.8	4433.1	2.98	6781.9	-276.9	2818.1	2.19	5694	0	2106	275	81.9	0	Level in S1 fluctuating - aerator turned off. Liner damage?
30/09/2020	7:00	2.106	5657.0	90.0	4343.0	2.935	6665.1	-116.8	2934.9	2.13	5538	-156	2262	275	92.2	0	
1/10/2020	7:00	2.141	5762.4	105.4	4237.6	2.821	6371.2	-293.9	3228.8	2.13	5538	0	2262	280	105.0	0	
2/10/2020	7:00	2.165	5834.8	72.5	4165.2	2.709	6085.2	-286.0	3514.8	2.13	5538	0	2262	280	66.5	2.5	
3/10/2020	7:00	2.203	5950.0	115.1	4050.0	2.847	6438.0	352.8	3162.0	1.89	4914	-624	2886	275	118.9	0	
4/10/2020	7:00	2.223	6010.8	60.8	3989.2	3.21	7385.9	947.9	2214.1	1.42	3692	-1222	4108	275	61.6	0	
5/10/2020	7:00	2.251	6096.1	85.3	3903.9	3.29	7598.6	212.8	2001.4	1.235	3211	-481	4589	275	92.0	0	
6/10/2020	7:00	2.267	6144.9	48.8	3855.1	3.418	7941.9	343.3	1658.1	0.998	2594.8	-616.2	5205.2	275	51.0	0	
7/10/2020	7:00	2.303	6255.1	110.2	3744.9	3.676	8644.8	702.9	955.2	0.62	1612	-982.8	6188	276	106.2	0	
8/10/2020	7:00	2.301	6248.9	-6.1	3751.1	3.691	8686.1	41.3	913.9	0.2	520	-205	7280	275	105.2	3.5	
9/10/2020	7:00	2.266	6141.8	-107.1	3858.2	3.667	8620.0	-66.1	980.0	0.2	520	0	7280	280	106.8	0	
10/10/2020	7:00	2.223	6010.8	-131.1	3989.2	3.642	8551.3	-68.7	1048.7	0.2	520	0	7280	280	80.2	0	
11/10/2020	7:00	2.164	5831.8	-178.9	4168.2	3.636	8534.9	-16.5	1065.1	0.2	520	0	7280	280	84.6	0	
12/10/2020	7:00	2.143	5768.4	-63.4	4231.6	3.628	8512.9	-21.9	1087.1	0.2	520	0	7280	140	54.6	0	
13/10/2020	7:00	2.156	5807.6	39.3	4192.4	3.608	8458.1	-54.8	1141.9	0.2	520	0	7280	80	64.5	0	
14/10/2020	7:00	2.172	5856.0	48.4	4144.0	3.57	8354.3	-103.9	1245.7	0.2	520	0	7280	98	42.5	0	
15/10/2020	7:00	2.198	5934.8	78.8	4065.2	3.51	8190.9	-163.4	1409.1	0.2	520	0	7280	133	48.4	0	
16/10/2020	7:00	2.223	6010.8	75.9	3989.2	3.398	7888.1	-302.8	1711.9	0.2	520	0	7280	280	53.1	0	
17/10/2020	7:00	2.246	6080.8	70.0	3919.2	3.331	7708.2	-179.9	1891.8	0.2	520	0	7280	220	110.2	0.5	
18/10/2020	7:00	2.207	5962.1	-118.7	4037.9	3.328	7700.2	-8.0	1899.8	0.2	520	0	7280	220	93.3	0	
19/10/2020	7:00	2.179	5877.2	-84.9	4122.8	3.34	7732.3	32.1	1867.7	0.2	520	0	7280	220	167.2	7.5	
20/10/2020	7:00	2.136	5747.3	-129.9	4252.7	3.333	7713.6	-18.7	1886.4	0.2	520	0	7280	231	82.3	0	
21/10/2020	7:00	2.085	5593.9	-153.4	4406.1	3.344	7743.0	29.5	1857.0	0.2	520	0	7280	247	123.1	0	
22/10/2020	7:00	2.032	5435.3	-158.6	4564.7	3.336	7721.6	-21.4	1878.4	0.2	520	0	7280	247	67.0	0	
23/10/2020	7:00	1.97	5250.9	-184.4	4749.1	3.336	7721.6	0.0	1878.4	0.2	520	0	7280	252	67.6	0	
24/10/2020	7:00	1.979	5277.6	26.7	4722.4	3.273	7553.3	-168.3	2046.7	0.2	520	0	7280	258	116.4	0	
25/10/2020	7:00	2.086	5596.9	319.3	4403.1	3.214	7396.5	-156.8	2203.5	0.2	520	0	7280	257	419.4	31	
26/10/2020	7:00	2.131	5732.2	135.3	4267.8	3.255	7505.4	108.9	2094.6	0.2	520	0	7280	258	502.2	13	
27/10/2020	7:00	2.109	5666.0	-66.2	4334.0	3.269	7542.6	37.3	2057.4	0.2	520	0	7280	260	231.0	9.5	
28/10/2020	7:00	2.06	5519.0	-147.0	4481.0	3.266	7534.6	-8.0	2065.4	0.2	520	0	7280	283	128.0	2	
29/10/2020	7:00	2.032	5435.3	-83.7	4564.7	3.282	7577.3	42.6	2022.7	0.2	520	0	7280	265	224.0	0	
30/10/2020	7:00	2.251	6096.1	660.7	3903.9	2.986	6797.6	-779.7	2802.4	0.2	520	0	7280	265	146.0	12.5	
31/10/2020	7:00	2.212	5977.3	-118.7	4022.7	2.986	6797.6	0.0	2802.4	0.2	520	0	7280	265	146.3	0	
1/11/2020	7:00	2.053	5498.0	-479.3	4502.0	3.389	7863.8	1066.3	1736.2	0.73	1898	1378	5902	265	2230.0	68	
2/11/2020	7:00	2.134	5741.2	243.2	4258.8	3.399	7890.7	26.9	1709.3	0.73	1898	0	5902	260	530.1	10.5	
3/11/2020	7:00	2.199	5937.8	196.6	4062.2	3.367	7804.7	-86.0	1795.3	0.73	1898	0	5902	128	238.6	0	
4/11/2020	7:00	2.212	5977.3	39.5	4022.7	3.365	7799.3	-5.4	1800.7	0.73	1898	0	5902	212	246.1	0	
5/11/2020	7:00	2.008	5363.8	-613.5	4636.2	3.739	8818.6	1019.3	781.4	0.55	1430	-468	6370	272	209.8	0	
6/11/2020	7:00	2.281	6187.7	823.9	3812.3	3.76	8876.8	58.1	723.2	0.3	780	-650	7020	294	526.0	19	
7/11/2020	7:00	2.278	6178.5	-9.2	3821.5	3.753	8857.4	-19.4	742.6	0.3	780	0	7020	281	252.4	0	
8/11/2020	7:00	2.261	6126.6	-52.0	3873.4	3.75	8849.1	-8.3	750.9	0.3	780	0	7020	281	220.7	0	
9/11/2020	7:00	2.236	6050.3	-76.2	3949.7	3.744	8832.5	-16.6	767.5	0.3	780	0	7020	281	188.2	0	
10/11/2020	7:00	2.204	5953.0	-97.3	4047.0	3.906	9283.6	451.1	316.4	0.12	312	-468	7488	279	164.8	0	
11/11/2020	7:00	2.166	5837.9	-115.1	4162.1	3.9	9266.8	-16.8	333.2	0.12	312	0	7488	296	164.0	0	
12/11/2020	7:00	2.124	5711.1	-126.8	4288.9	3.892	9244.4	-22.4	355.6	0.12	312	0	7488	282	132.8	0	
13/11/2020	7:00	2.081	5581.9	-129.2	4418.1	3.893	9247.2	2.8	352.8	0.12	312	0	7488	306	179.6	0.5	
14/11/2020	7:00	2.041	5462.2	-119.7	4537.8	3.893	9247.2	0.0	352.8	0.12	312	0	7488	301	181.3	9.5	
15/11/2020	7:00	1.989	5307.3	-154.9	4692.7	3.893	9247.2	0.0	352.8	0.12	312	0	7488	301	146.1	0	
16/11/2020	7:00	2.027	5420.4	113.1	4579.6	3.793	8968.3	-278.9	631.7	0.12	312	0	7488	301	135.2	0	
17/11/2020	7:00	2.056	5507.0	86.6	4493.0	3.679	8653.0	-315.3	947.0	0.12	312	0	7488	315	86.4	0	

WCC - Whytes Gully Landfill
Estimated Leachate Generation Data

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Date	Time	P1 Level	P1 Total Volume (m3)	P1 Difference (m3)	P1 Remaining Capacity (m3)	S1 Level	S1 Total Volume (m3)	S1 Difference (m3)	S1 Remaining Capacity (m3)	B1 Level (Estimate)	B1 Total Volume (m3)	B1 Difference (m3)	B1 Remaining Capacity (m3)	Leachate Discharged to Sewer (m3)	Estimated Leachate Generation (m3)	Rainfall (mm)	Comments
18/11/2020	7:00	2.208	5965.2	458.1	4034.8	3.572	8359.7	-293.3	1240.3	0	0	-312	7800	323	175.8	0	
19/11/2020	7:00	2.14	5759.3	-205.8	4240.7	3.567	8346.1	-13.6	1253.9	0	0	0	7800	335	115.5	0	
20/11/2020	7:00	2.07	5548.9	-210.4	4451.1	3.564	8337.9	-8.2	1262.1	0	0	0	7800	339	120.4	0	
21/11/2020	7:00	1.987	5301.4	-247.6	4698.6	3.557	8318.8	-19.1	1281.2	0	0	0	7800	335	68.3	0	
22/11/2020	7:00	1.998	5334.1	32.7	4665.9	3.456	8044.5	-274.3	1555.5	0	0	0	7800	335	93.4	0	
23/11/2020	7:00	2.036	5447.3	113.2	4552.7	3.341	7735.0	-309.6	1865.0	0	0	0	7800	335	138.6	0	
24/11/2020	7:00	2.064	5531.0	83.7	4469.0	3.231	7441.6	-293.4	2158.4	0	0	0	7800	298	88.3	3	
25/11/2020	7:00	2.105	5653.9	123.0	4346.1	3.101	7098.2	-343.4	2501.8	0	0	0	7800	343	122.6	0	
26/11/2020	7:00	2.151	5792.5	138.6	4207.5	2.936	6667.7	-430.5	2932.3	0	0	0	7800	352	60.1	6.5	
27/11/2020	7:00	2.175	5865.1	72.6	4134.9	2.775	6253.4	-346.0	3346.6	0	0	0	7800	346	72.6	0	
28/11/2020	7:00	2.201	5943.9	78.8	4056.1	2.632	5890.1	-363.3	3709.9	0	0	0	7800	346	61.5	0	
29/11/2020	7:00	2.222	6007.7	63.8	3992.3	2.471	5486.5	-346.0	4113.5	0	0	0	7800	346	63.8	0	
30/11/2020	7:00	2.152	5795.6	-212.2	4204.4	2.471	5486.5	0.0	4113.5	0	0	0	7800	346	133.8	0	
1/12/2020	7:00	2.074	5560.9	-234.7	4439.1	2.471	5486.5	0.0	4113.5	0	0	0	7800	354	119.3	0	Issues with S1 level probe with wind
2/12/2020	7:00	2.000	5340.0	-220.9	4660.0	2.541	5661.3	0.0	3938.7	0	0	0	7800	352	131.1	4	S1 Level probe issues corrected
3/12/2020	7:00	1.948	5185.8	-154.2	4814.2	2.563	5716.4	55.2	3883.6	0	0	0	7800	352	252.9	6	
4/12/2020	7:00	1.904	5055.9	-129.9	4944.1	2.514	5593.7	-122.7	4006.3	0	0	0	7800	349	96.4	5.5	
5/12/2020	7:00	1.93	5132.6	76.7	4867.4	2.343	5169.6	-424.2	4430.4	0	0	0	7800	346	76.0	0	
6/12/2020	7:00	1.956	5209.4	76.9	4790.6	2.176	4761.5	-408.1	4838.5	0	0	0	7800	346	77.0	0	
7/12/2020	7:00	1.982	5286.5	77.1	4713.5	2.003	4345.2	-416.3	5254.8	0	0	0	7800	346	77.0	0	
8/12/2020	7:00	2.007	5360.8	74.3	4639.2	1.972	4271.2	-73.9	5328.8	0	0	0	7800	345	74.0	0	
9/12/2020	7:00	2.03	5429.4	68.5	4570.6	1.588	3373.1	-898.2	6226.9	0	0	0	7800	345	68.0	0	
10/12/2020	7:00	2.054	5501.0	71.7	4499.0	1.399	2942.8	-430.3	6657.2	0	0	0	7800	298	72.0	0	
11/12/2020	7:00	2.088	5602.9	101.8	4397.1	1.148	2383.4	-559.4	7216.6	0	0	0	7800	326	101.0	0	
12/12/2020	7:00	2.019	5396.6	-206.3	4603.4	1.107	2293.3	-90.1	7306.7	0	0	0	7800	331	34.6	0	
13/12/2020	7:00	1.941	5165.1	-231.5	4834.9	1.107	2293.3	0.0	7306.7	0	0	0	7800	326	94.5	1	
14/12/2020	7:00	1.929	5129.6	-35.5	4870.4	1.117	2315.3	21.9	7284.7	0	0	0	7800	120	106.5	3.5	
15/12/2020	7:00	1.932	5138.5	8.9	4861.5	1.12	2321.8	6.6	7278.2	0	0	0	7800	79	94.4	3.5	
16/12/2020	7:00	1.985	5295.4	157.0	4704.6	1.186	2467.2	145.4	7132.8	0	0	0	7800	120	422.3	9	Rain water run off into S1?
17/12/2020	7:00	1.99	5310.3	14.9	4689.7	1.188	2471.6	4.4	7128.4	0	0	0	7800	118	137.3	14	
18/12/2020	7:00	1.967	5242.0	-68.3	4758.0	1.191	2478.3	6.6	7121.7	0	0	0	7800	156	94.4	2.5	
19/12/2020	7:00	1.938	5156.2	-85.8	4843.8	1.182	2458.4	-19.9	7141.6	0	0	0	7800	156	50.3	0	
20/12/2020	7:00	1.93	5132.6	-23.6	4867.4	1.183	2460.6	2.2	7139.4	0	0	0	7800	101	79.6	0.5	
21/12/2020	7:00	1.926	5120.8	-11.8	4879.2	1.179	2451.7	-8.8	7148.3	0	0	0	7800	81	60.4	0.5	
22/12/2020	7:00	2.016	5387.6	266.9	4612.4	1.263	2638.0	186.2	6962.0	0	0	0	7800	82	535.1	16	Rain water run off into S1?
23/12/2020	7:00	2.022	5405.5	17.9	4594.5	1.256	2622.4	-15.6	6977.6	0	0	0	7800	122	124.3	11.5	
24/12/2020	7:00	2.008	5363.8	-41.7	4636.2	1.251	2611.3	-11.1	6988.7	0	0	0	7800	117	64.2	0	
25/12/2020	7:00	1.992	5316.2	-47.6	4683.8	1.246	2600.2	-11.1	6999.8	0	0	0	7800	119	60.3	0	
26/12/2020	7:00	1.98	5280.6	-35.6	4719.4	1.243	2593.5	-6.7	7006.5	0	0	0	7800	120	77.7	0	
27/12/2020	7:00	1.971	5253.9	-26.7	4746.1	1.246	2600.2	6.7	6999.8	0	0	0	7800	120	100.0	1.5	
28/12/2020	7:00	1.954	5203.5	-50.4	4796.5	1.239	2584.6	-15.6	7015.4	0	0	0	7800	120	54.1	0	
29/12/2020	7:00	1.957	5212.4	8.9	4787.6	1.257	2624.6	40.0	6975.4	0	0	0	7800	119	167.9	3	
30/12/2020	7:00	1.964	5233.1	20.7	4766.9	1.274	2662.5	37.9	6937.5	0	0	0	7800	119	177.6	10	
31/12/2020	7:00	1.957	5212.4	-20.7	4787.6	1.273	2660.3	-2.2	6939.7	0	0	0	7800	118	95.0	0.5	
1/01/2021	7:00	1.94	5162.1	-50.3	4837.9	1.271	2655.8	-4.5	6944.2	0	0	0	7800	120	65.3	0	
2/01/2021	7:00	1.937	5153.2	-8.9	4846.8	1.284	2684.8	29.0	6915.2	0	0	0	7800	120	140.1	1.5	
3/01/2021	7:00	2.096	5626.9	473.7	4373.1	1.398	2940.5	255.7	6659.5	0	0	0	7800	160	889.4	31	
4/01/2021	7:00	2.175	5865.1	238.2	4134.9	1.408	2963.1	22.6	6636.9	0	0	0	7800	237	497.8	12.5	
5/01/2021	7:00	2.266	6141.8	276.7	3858.2	1.45	3058.1	95.0	6541.9	0	0	0	7800	230	601.8	13.5	
6/01/2021	7:00	2.274	6166.3	24.4	3833.7	1.467	3096.7	38.6	6503.3	0	0	0	7800	318	381.0	8	
7/01/2021	7:00	2.25	6093.0	-73.3	3907.0	1.463	3087.6	-9.1	6512.4	0	0	0	7800	341	258.6	0	
8/01/2021	7:00	2.296	6233.6	140.6	3766.4	1.5	3171.8	84.1	6428.3	0	0	0	7800	345	569.8	11	
9/01/2021	7:00	2.275	6169.3	-64.3	3830.7	1.494	3158.1	-13.7	6441.9	0	0	0	7800	349	271.1	1.5	
10/01/2021	7:00	2.237	6053.4	-116.0	3946.6	1.488	3144.4	-13.7	6455.6	0	0	0	7800	349	219.4	0	
11/01/2021	7:00	2.187	5901.5	-151.9	4098.5	1.481	3128.5	-15.9	6471.5	0	0	0	7800	350	182.2	0	
12/01/2021	7:00	2.125	5714.1	-187.3	4285.9	1.475	3114.9	-13.6	6485.1	0	0	0	7800	355	154.0	0	
13/01/2021	7:00	2.06	5519.0	-195.1	4481.0	1.469	3101.2	-13.6	6498.8	0	0	0	7800	360	151.2	0	
14/01/2021	7:00	1.988	5304.3	-214.7	4695.7	1.462	3085.3	-15.9	6514.7	0	0	0	7800	347	116.5	0	

WCC - Whytes Gully Landfill
Estimated Leachate Generation Data

JPG ENGINEERING

Date	Time	P1 Level	P1 Total Volume (m3)	P1 Difference (m3)	P1 Remaining Capacity (m3)	S1 Level	S1 Total Volume (m3)	S1 Difference (m3)	S1 Remaining Capacity (m3)	B1 Level (Estimate)	B1 Total Volume (m3)	B1 Difference (m3)	B1 Remaining Capacity (m3)	Leachate Discharged to Sewer (m3)	Estimated Leachate Generation (m3)	Rainfall (mm)	Comments
15/01/2021	7:00	1.988	5304.3	0.0	4695.7	1.305	2731.7	-353.7	6868.3	0	0	0	7800	350	115.1	0	
16/01/2021	7:00	1.951	5194.6	-109.7	4805.4	1.2	2498.2	-233.5	7101.8	0	0	0	7800	355	116.5	0	
17/01/2021	7:00	1.933	5141.4	-53.2	4858.6	1.117	2315.3	-182.9	7284.7	0	0	0	7800	355	118.9	0	
18/01/2021	7:00	1.931	5135.5	-5.9	4864.5	1.044	2155.6	-159.6	7444.4	0	0	0	7800	260	94.5	0	
19/01/2021	7:00	1.918	5097.2	-38.4	4902.8	0.964	1982.1	-173.6	7617.9	0	0	0	7800	217	62.0	0	
20/01/2021	7:00	1.966	5239.1	141.9	4760.9	0.773	1573.3	-408.8	8026.7	0	0	0	7800	283	61.8	1	
21/01/2021	7:00	1.951	5194.6	-44.4	4805.4	0.696	1410.7	-162.6	8189.3	0	0	0	7800	220	60.1	1.5	
22/01/2021	7:00	1.937	5153.2	-41.4	4846.8	0.646	1305.8	-104.9	8294.2	0	0	0	7800	205	58.7	0	
23/01/2021	7:00	1.941	5165.1	11.8	4834.9	0.521	1046.1	-259.8	8553.9	0	0	0	7800	180	55.0	0	
24/01/2021	7:00	1.938	5156.2	-8.9	4843.8	0.385	767.3	-278.8	8832.7	0	0	0	7800	180	55.0	0	
25/01/2021	7:00	1.94	5162.1	5.9	4837.9	0.35	696.2	-71.1	8903.8	0	0	0	7800	180	53.0	0	
26/01/2021	7:00	1.931	5135.5	-26.6	4864.5	0.35	696.2	0.0	8903.8	0	0	0	7800	95	68.4	0	
27/01/2021	7:00	1.926	5120.8	-14.8	4879.2	0.35	696.2	0.0	8903.8	0	0	0	7800	99	84.2	1	
28/01/2021	7:00	1.966	5239.1	118.3	4760.9	0.35	696.2	0.0	8903.8	0	0	0	7800	101	219.3	17	
29/01/2021	7:00	1.975	5265.7	26.7	4734.3	0.45	900.0	203.8	8700.0	0	0	0	7800	89	319.5	1	
30/01/2021	7:00	2.075	5563.9	298.2	4436.1	0.58	1168.2	268.2	8431.8	0	0	0	7800	220	786.4	26.5	
31/01/2021	7:00	2.185	5895.4	331.5	4104.6	0.69	1398.1	229.8	8201.9	0	0	0	7800	298	859.3	20	
1/02/2021	7:00	2.199	5937.8	42.5	4062.2	0.693	1404.4	6.3	8195.6	0	0	0	7800	318	366.8	3	
2/02/2021	7:00	2.358	6424.2	486.3	3575.8	0.802	1634.8	230.4	7965.2	0	0	0	7800	301	1017.7	20	
3/02/2021	7:00	2.414	6597.3	173.1	3402.7	0.708	1435.9	-198.9	8164.1	0	0	0	7800	373	347.2	6	
4/02/2021	7:00	2.407	6575.6	-21.7	3424.4	0.653	1320.5	-115.5	8279.5	0	0	0	7800	365	227.8	0	
5/02/2021	7:00	2.37	6461.2	-114.4	3538.8	0.65	1314.2	-6.3	8285.8	0	0	0	7800	373	252.3	0	
6/02/2021	7:00	2.317	6298.0	-163.2	3702.0	0.647	1307.9	-6.3	8292.1	0	0	0	7800	371	201.6	0	
7/02/2021	7:00	2.265	6138.8	-159.2	3861.2	0.646	1305.8	-2.1	8294.2	0	0	0	7800	371	209.7	1	
8/02/2021	7:00	2.203	5950.0	-188.8	4050.0	0.646	1305.8	0.0	8294.2	0	0	0	7800	371	182.2	0	
9/02/2021	7:00	2.146	5777.4	-172.5	4222.6	0.646	1305.8	0.0	8294.2	0	0	0	7800	341	168.5	0.5	
10/02/2021	7:00	2.083	5587.9	-189.6	4412.1	0.646	1305.8	0.0	8294.2	0	0	0	7800	333	143.4	1	
11/02/2021	7:00	2.021	5402.5	-185.4	4597.5	0.645	1303.7	-2.1	8296.3	0	0	0	7800	335	147.5	0	
12/02/2021	7:00	1.952	5197.6	-204.9	4802.4	0.646	1305.8	2.1	8294.2	0	0	0	7800	329	126.2	0	
13/02/2021	7:00	1.974	5262.8	65.2	4737.2	0.709	1438.1	132.2	8161.9	0	0	0	7800	180	377.4	18.5	
14/02/2021	7:00	1.931	5135.5	-127.3	4864.5	0.699	1417.0	-21.0	8183.0	0	0	0	7800	280	131.7	0	
15/02/2021	7:00	1.92	5103.1	-32.5	4896.9	0.698	1414.9	-2.1	8185.1	0	0	0	7800	160	125.4	0	
16/02/2021	7:00	1.969	5248.0	144.9	4752.0	0.698	1414.9	0.0	8185.1	0	0	0	7800	151	295.9	0	
17/02/2021	7:00	2.134	5741.2	493.3	4258.8	0.86	1758.5	343.6	7841.5	0	0	0	7800	251	1087.9	38	
18/02/2021	7:00	2.115	5684.0	-57.2	4316.0	0.857	1752.1	-6.4	7847.9	0	0	0	7800	330	266.4	0	
19/02/2021	7:00	2.137	5750.3	66.3	4249.7	0.925	1897.9	145.9	7702.1	0	0	0	7800	337	549.1	2.5	
20/02/2021	7:00	2.193	5919.6	169.4	4080.4	0.929	1906.6	8.6	7693.4	0	0	0	7800	340	518.0	16.5	
21/02/2021	7:00	2.178	5874.2	-45.5	4125.8	0.925	1897.9	-8.6	7702.1	0	0	0	7800	335	280.9	0	
22/02/2021	7:00	2.155	5804.6	-69.6	4195.4	0.921	1889.3	-8.6	7710.7	0	0	0	7800	330	251.8	0	
23/02/2021	7:00	2.12	5699.1	-105.6	4300.9	0.916	1878.6	-10.8	7721.4	0	0	0	7800	329	212.7	0	
24/02/2021	7:00	2.079	5575.9	-123.2	4424.1	0.914	1874.3	-4.3	7725.7	0	0	0	7800	330	202.5	0	
25/02/2021	7:00	2.031	5432.3	-143.6	4567.7	0.918	1882.9	8.6	7717.1	0	0	0	7800	330	195.0	2	
26/02/2021	7:00	1.996	5328.1	-104.2	4671.9	0.937	1923.8	40.9	7676.2	0	0	0	7800	327	263.7	7	
27/02/2021	7:00	1.961	5224.2	-103.9	4775.8	0.939	1928.1	4.3	7671.9	0	0	0	7800	250	150.4	0	
28/02/2021	7:00	1.939	5159.2	-65.1	4840.8	0.935	1919.5	-8.6	7680.5	0	0	0	7800	210	136.3	0	
1/03/2021	7:00	1.931	5135.5	-23.6	4864.5	0.932	1913.0	-6.5	7687.0	0	0	0	7800	160	129.9	0	
2/03/2021	7:00	1.921	5106.0	-29.5	4894.0	0.927	1902.2	-10.8	7697.8	0	0	0	7800	140	99.7	0	
3/03/2021	7:00	1.905	5058.8	-47.2	4941.2	0.920	1887.2	-15.1	7712.8	0	0	0	7800	156	93.8	0	
4/03/2021	7:00	1.899	5041.2	-17.7	4958.8	0.912	1870.0	-17.2	7730.0	0	0	0	7800	114	79.1	0	
5/03/2021	7:00	1.903	5053.0	11.8	4947.0	0.910	1865.7	-4.3	7734.3	0	0	0	7800	70	77.5	0	
6/03/2021	7:00	1.912	5079.5	26.5	4920.5	0.908	1861.4	-4.3	7738.6	0	0	0	7800	78	100.2	0	
7/03/2021	7:00	1.917	5094.2	14.7	4905.8	0.901	1846.3	-15.0	7753.7	0	0	0	7800	80	79.7	0	
8/03/2021	7:00	1.922	5109.0	14.7	4891.0	0.900	1844.2	-2.1	7755.8	0	0	0	7800	76	88.6	0	
9/03/2021	7:00	1.928	5126.7	17.7	4873.3	0.898	1839.9	-4.3	7760.1	0	0	0	7800	77	90.4	0	
10/03/2021	7:00	1.938	5156.2	29.5	4843.8	0.873	1786.3	-53.6	7813.7	0	0	0	7800	76	51.9	0	
11/03/2021	7:00	1.941	5165.1	8.9	4834.9	0.874	1788.4	2.1	7811.6	0	0	0	7800	78	89.0	0.5	
12/03/2021	7:00	1.948	5185.8	20.7	4814.2	0.881	1803.4	15.0	7796.6	0	0	0	7800	77	112.7	2.5	
13/03/2021	7:00	1.952	5197.6	11.8	4802.4	0.879	1799.1	-4.3	7800.9	0	0	0	7800	77	84.5	0	

WCC - Whytes Gully Landfill
Estimated Leachate Generation Data

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Date	Time	P1 Level	P1 Total Volume (m3)	P1 Difference (m3)	P1 Remaining Capacity (m3)	S1 Level	S1 Total Volume (m3)	S1 Difference (m3)	S1 Remaining Capacity (m3)	B1 Level (Estimate)	B1 Total Volume (m3)	B1 Difference (m3)	B1 Remaining Capacity (m3)	Leachate Discharged to Sewer (m3)	Estimated Leachate Generation (m3)	Rainfall (mm)	Comments
14/03/2021	7:00	1.966	5239.1	41.5	4760.9	0.879	1799.1	0.0	7800.9	0	0	0	7800	60	101.5	4.5	
15/03/2021	7:00	1.927	5123.7	-115.4	4876.3	0.871	1782.0	-17.1	7818.0	0	0	0	7800	240	107.5	8.5	
16/03/2021	7:00	1.954	5203.5	79.8	4796.5	0.887	1816.3	34.3	7783.7	0	0	0	7800	152	266.1	0	
17/03/2021	7:00	1.942	5168.0	-35.5	4832.0	0.907	1859.2	42.9	7740.8	0	0	0	7800	153	160.4	4.5	
18/03/2021	7:00	1.969	5248.0	79.9	4752.0	0.969	1992.9	133.6	7607.1	0	0	0	7800	148	361.6	12.5	
19/03/2021	7:00	1.973	5259.8	11.9	4740.2	1.039	2144.8	151.9	7455.2	0	0	0	7800	373	536.8	21.5	
20/03/2021	7:00	1.949	5188.7	-71.1	4811.3	1.588	3373.1	1228.3	6226.9	0.1	260	260	7540	380	1797.2	28.5	Transferring from P1 to S1 using 4" and 6" Diesel Pumps
21/03/2021	7:00	1.766	4652.4	-536.3	5347.6	2.615	5847.2	2474.2	3752.8	0.2	520	260	7280	380	2577.9	38	Transferring from P1 to S1 using 4" and 6" Diesel Pumps
22/03/2021	7:00	1.956	5209.4	557.0	4790.6	3.193	7340.8	1493.6	2259.2	0.3	780	260	7020	380	2690.6	36	Transferring from P1 to S1 using 4" and 6" Diesel Pumps
23/03/2021	7:00	2.109	5666.0	456.5	4334.0	3.704	8721.9	1381.1	878.1	0.5	1300	520	6500	340	2697.7	45	Transferring from P1 to S1 using 4" and 6" Diesel Pumps
24/03/2021	7:00	2.166	5837.9	171.9	4162.1	3.954	9418.4	696.4	181.6	1.1	2860	1560	4940	379	2807.3	39.5	Transferring from P1 to S1 + P1 to Backup
25/03/2021	7:00	2.376	6479.7	641.8	3520.3	3.863	9163.3	-255.1	436.7	1.1	2860	0	4940	372	758.8	0	
26/03/2021	7:00	2.233	6041.2	-438.5	3958.8	3.803	8996.1	-167.2	603.9	1.45	3770	910	4030	367	671.3	0.5	Transferring from P1 to Backup
27/03/2021	7:00	2.313	6285.8	244.6	3714.2	3.737	8813.1	-183.0	786.9	1.45	3770	0	4030	375	436.6	0	
28/03/2021	7:00	1.984	5292.5	-993.3	4707.5	3.677	8647.5	-165.5	952.5	1.9	4940	1170	2860	375	386.2	0	Transferring from P1 to Backup
29/03/2021	7:00	2.017	5390.6	98.1	4609.4	3.622	8496.5	-151.1	1103.5	1.9	4940	0	2860	375	322.1	0	
30/03/2021	7:00	2.139	5756.3	365.7	4243.7	3.449	8025.6	-470.9	1574.4	1.9	4940	0	2860	347	241.9	0	
31/03/2021	7:00	2.213	5980.4	224.0	4019.6	3.343	7740.3	-285.3	1859.7	1.9	4940	0	2860	275	213.8	0	
1/04/2021	7:00	2.214	5983.4	3.0	4016.6	3.296	7614.6	-125.7	1985.4	1.9	4940	0	2860	326	203.3	0	
2/04/2021	7:00	2.169	5846.9	-136.4	4153.1	3.294	7609.3	-5.3	1990.7	1.9	4940	0	2860	346	204.2	0	
3/04/2021	7:00	2.123	5708.1	-138.8	4291.9	3.290	7598.6	-10.7	2001.4	1.9	4940	0	2860	346	196.5	0	
4/04/2021	7:00	2.076	5566.9	-141.2	4433.1	3.287	7590.6	-8.0	2009.4	1.9	4940	0	2860	346	196.8	0	
5/04/2021	7:00	2.029	5426.4	-140.5	4573.6	3.284	7582.6	-8.0	2017.4	1.9	4940	0	2860	346	197.5	0	
6/04/2021	7:00	1.980	5280.6	-145.8	4719.4	3.284	7582.6	0.0	2017.4	1.9	4940	0	2860	346	200.2	0	
7/04/2021	7:00	1.946	5179.8	-100.7	4820.2	3.285	7585.3	2.7	2014.7	1.9	4940	0	2860	296	197.9	2	
8/04/2021	7:00	1.969	5248.0	68.1	4752.0	3.119	7145.5	-439.7	2454.5	1.9	4940	0	2860	360	135.0	6	
9/04/2021	7:00	2.292	6221.4	973.4	3778.6	3.114	7132.4	-13.2	2467.6	1.45	3770	-1170	4030	345	135.3	0	Transferring from B1 to P1
10/04/2021	7:00	2.314	6288.8	67.5	3711.2	3.110	7121.9	-10.5	2478.1	1.45	3770	0	4030	155	211.9	0	
11/04/2021	7:00	2.259	6120.5	-168.4	3879.5	3.103	7103.5	-18.4	2496.5	1.45	3770	0	4030	371	184.2	0	
12/04/2021	7:00	2.228	6026.0	-94.5	3974.0	3.091	7072.0	-31.5	2528.0	1.45	3770	0	4030	325	199.0	0	
13/04/2021	7:00	2.227	6022.9	-3.0	3977.1	3.064	7001.2	-70.8	2598.8	1.45	3770	0	4030	280	206.2	0	
14/04/2021	7:00	2.212	5977.3	-45.6	4022.7	3.016	6875.7	-125.5	2724.3	1.45	3770	0	4030	314	142.9	0	
15/04/2021	7:00	2.258	6117.4	140.1	3882.6	2.866	6486.9	-388.8	3113.1	1.45	3770	0	4030	346	97.3	0	
16/04/2021	7:00	2.270	6154.1	36.7	3845.9	2.763	6222.7	-264.1	3377.3	1.45	3770	0	4030	347	119.5	0	
17/04/2021	7:00		0.0	-6154.1	10000.0		0.0	-6222.7	9600.0		0	-3770	7800		-16146.8	0	
18/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0	0	
19/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0	0	
20/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0	0	
21/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
22/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
23/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
24/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
25/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
26/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
27/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
28/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
29/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
30/04/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		
1/05/2021	7:00		0.0	0.0	10000.0		0.0	0.0	9600.0		0	0	7800		0.0		

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19 November 2021

Nicole Diatloff
Wollongong City Council
Locked Bag 8821
Wollongong DC NSW 2500

Dear Nicole,

Re: Whytes Gully Landfill - Leachate Management Systems Update

JPG Engineering commenced Operation and Maintenance of the Leachate Management Systems at Whytes Gully Landfill in August 2020. From the Contract start date to present, numerous upgrades and process modifications have been made or are in the process of being made to the overall system. These upgrades and process modifications are listed below in Sections 1.0 and 2.0 with some brief comments. Section 3.0 contains estimated leachate generation and available storage capacity on site as well as sewer discharge and rainfall data.

1.0 Leachate Collection, Storage and Transfer Systems

1. Design, supply and installation of high flow Leachate Transfer Pump Systems between all three Leachate Ponds; Primary (P1), Secondary (S1) and the Backup (B1) has been completed. Some benefits of this system include:
    - Removes the need to hire manually operated diesel pumps prior to and during rainfall events to transfer leachate between Ponds. These pumps are generally in high demand during rainfall periods.
    - WCC Staff are no longer required to work outside during heavy rainfall events setting up pumps and hoses between Ponds (WHS issue).
    - Provides the ability to monitor and control Leachate Storage Management on site in all three Ponds.
        - The pumps can currently be operated manually with automation of the system currently in progress and to be completed as part of the Control System Upgrade.
    - Allows the transfer of high volumes of leachate in line with recent historical leachate generation rates during rainfall periods.
    - Provides the ability to transfer between all three Ponds at any time.
    - Provides the ability to empty S1 and B1 (during dry periods) to allow for increased surge capacity during rainfall periods (Leachate Storage Management).

2. Design, supply and installation of secondary strainer type Pump Suction Pontoon Skids for the Chamber Feed Pumps located in P1 and S1 has been completed. Some benefits of this upgrade include:
    - The secondary strainer reduces the chances of the primary strainer becoming blocked with debris (plastic bags etc.). The P1 and S1 Chamber Feed Pumps are positive displacement pumps and cannot be starved of liquid without being damaged.
    - Increases longevity of the P1/S1 Chamber Feed Pumps.

3. Procurement of spare P1/S1 Chamber Feed Pump has been completed (currently stored in container at Leachate Treatment Plant).

    - These pumps are critical to manage the removal of leachate from site. A spare has been procured that can be swapped out immediately in the event of failure of either the P1 or S1 Chamber Feed Pump, noting that a replacement pump typically has a 4 - 6 week lead time.

4. Installation of electromagnetic flowmeters on both the P1 and S1 Chamber Feed Pump Lines has been completed.

    - The installation of these flowmeters provides process data to assist with operation of the system.
    - If the type of pumps currently operating in P1 and S1 (helical rotor type) are starved of liquid or run dry, this will result in stator damage. This damage can occur within minutes of a starved suction condition occurring. Installation of a flow meter after each pump provides low flow shutoff pump protection for the pumps.

5. Hydrostatic Level Probe installation in P1, S1 and B1 Ponds as well as Leachate Chamber 1 and Chamber 2 has been completed. This system:

    - Provides independent level measurement (from Manly Hydraulics) in all of the Ponds and Chambers 1 / 2. Upon completion of the Control System Upgrade, these level measurements will be used to automate the Chamber Feed Pumps and newly installed Pond Leachate Transfer Pump System based on level data.
    - Assists in Leachate Storage Management and allow high level emergency SMS alarm messaging (to be completed).
    - Is beneficial during rain events, especially events that occur at night. Pumps will run automatically based on Pond levels (to be completed) to minimize the risk of Leachate Pond overflow.
    - There is currently no level measurement in the Backup Pond or Chamber 1 / 2.
    - Chamber 2 level measurement has been installed to inhibit the LTP Feed Pumps if the chamber is empty. This functionality will be completed in line with the Control System Upgrade. Historically, if Chamber 2 has been empty, the LTP Feed Pumps continue to operate dry which has the potential to damage the pumps.

6. Installation of pH and Dissolved Oxygen (DO) measurement systems in the P1 Leachate Dam has been completed. This system:

    - Provides parameter data for the operation of the Surface Aerators in P1.
    - Removes the need for frequent laboratory analysis of leachate in P1.

7. Remote automation of the Primary Pond (P1) Surface Aerators has been completed, which allows for the control of P1 Surface Aerators remotely based on pond parameter data. The surface aerators in P1 remove approximately 70 – 80% of the leachate's ammonia load and their operation is critical to the Site's overall leachate management system.

2.0 Leachate Treatment Plant

1. The repair of SBR Aspirating Aerator #2 (off-site) has been completed. This aerator was not operational upon Contract handover.
2. The Antifoam Pump System was not operational upon Contract handover due to issues with the dosing lines. This has been resolved, however once the system was running it was found that the Anti-Foam product was not effective at controlling the foam during the aeration process. The Anti-Foam product has been changed to a silicon based product that we use at other sites and has been working effectively.
3. Installation of Leachate Feed Pump #1 has been completed. The existing pump was not operational upon Contract handover. Leachate Feed Pump #1 and #2 operate as Duty/Standby Pumps.
4. Installation of Effluent Balance Tank Mixer has been completed. The existing pump was not operational upon Contract handover resulting in sludge build up in the Effluent Balance Tank.
5. Design, supply and installation of Effluent Balance Tank discharge strainer to provide pump protection to the Sewer Discharge Pumps has been completed.
6. Installation of Sewer Discharge Trade Waste Electromagnetic Flowmeter has been completed. The existing device was not operational upon Contract handover. A downstream isolation valve was also installed on the line to enable isolation of the Sewer Discharge line if any future works are required, avoiding the need to empty the 1.3km Sewer Discharge Rising Main.
7. Supply and installation of Dissolved Oxygen (DO) measurement system has been completed. The existing system was not operational upon Contract handover.
8. As the current HMI (Operator Interface) was not operational at Contract handover, a computer has been temporarily installed at the control panel and the HMI software has been integrated onto this. This computer is currently being used for control of the LTP on site, as well as for remote access. A 4G mobile broadband device was also installed and is working effectively.

   The overall Control System Upgrade, which will replace this temporary system with a new PLC and HMI, is currently in progress.
9. Supply and installation of an electromagnetic flowmeter on the Leachate Blend line has been completed. This will allow control of blend volumes once the Control System Upgrade is complete.
10. Supply and installation of a weather protection awning over the Main Electrical Control panel (MCC) has been completed. The weather protection awning removes the safety hazard associated with working on the electrical panel during rain periods, which historically is generally when there is an increased chance of electrical issues at the LTP and should extend the asset life of the MCC.
11. A grate was fabricated and installed over the Caustic Bund Sump to remove the safety hazard associated with the open pit.
12. Analogue (Ultrasonic) level sensors have been installed in the SBR and Effluent Balance Tank. These devices will provide accurate level measurement and control of the LTP once the Control System Upgrade is completed, as opposed to the existing float switch type measurement system which can be unreliable, particularly during periods of heavy foam generation within the SBR.

    The SBR Level prove will be used to control anti-foam dosing which is currently run on time. Under dosing and over dosing of anti-foam is unavoidable with the current time based system.

3.0 Leachate Inventory

The following table (Table 3.1) contains calculated leachate generation and available storage capacity as well as actual sewer discharge rates and rainfall data collected since August 2020.

Table 3.1 – Leachate Generation and Sewer Discharge Data

Month	Average Leachate Discharged to Sewer (m3/day)	Estimated Leachate Generation (m3/day)	Estimated Leachate Storage Capacity Available (m3)*	Monthly Rainfall (mm)
Aug-20	293.8	561.2	4188.0	145.5
Sep-20	245.3	122.0	8140.0	23.5
Oct-20	249.5	193.2	12705.0	150.0
Nov-20	303.8	169.6	14718.0	49.0
Dec-20	211.0	121.8	18127.0	92.5
Jan-21	241.2	247.9	18706.0	150
Feb-21	303.8	292.8	18921.0	113
Mar-21	215.5	588.1	7339.0	242
Apr-21	316.9	158.9	12250.0	8
May-21	362.4	399.2	11225.0	153.5
Jun-21	313.1	134.9	17716.0	39.5
Jul-21	99.0	93.0	17852.0	13.5
Aug-21	77.8	98.8	18131.0	45
Sep-21	73.0	71.9	18165.0	28.5
Oct-21	115.0	144.8	17247.0	113

Table Notes:

- The Leachate Generation and Available Storage Capacity Calculations are estimations only based on the limited Pond Dimension information provided by WCC.
- *The Estimated Leachate Storage Capacity Available is calculated on the last day of the month.

Please do not hesitate to contact John Gray (0408 210 474) or myself (0499 090 877) to discuss any of the above.

Yours faithfully,

Daniel Buxton
Operations and Maintenance Manager, BE (Env.), MIE Aust.
JPG Engineering

Whytes Gully Landfill

Preliminary Assessment: Stormwater Management System (EPL 5862)

Waste Services

WOLLONGONG CITY COUNCIL (OCTOBER 2021)

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Whytes Gully Preliminary Assessment: Stormwater Management System (EPL 5862)

1. Introduction

This Preliminary Assessment provides a review of the current stormwater management system, how it is performing and how it can be improved to address Special Condition U1.1 in EPL 5862. This is in accordance with correspondence from the EPA dated 1st March 2021 and ongoing discussions following on from the leachate seepage/stormwater overflow events of February 2020.

The assessment also provides a supporting Improvement and Maintenance Program to prioritise Works to ensure compliance and sustainability in stormwater management at Whytes Gully in the future.

The Pollution Studies and Reduction Program conditions in EPL 5862 relating to stormwater management (and this preliminary assessment) are as follows:

8 U1.1 By no later than 28 August 2021 the licensee must submit a preliminary assessment and update of the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater management system and develop an improvement and maintenance plan.

8 U1.2 By no later than 3 December 2021 the licensee must prepare a comprehensive water balance based on current and future landfill operations. The water balance must consider leachate, groundwater and stormwater at the premises.

8 U1.3 By no later than 31 March 2022 the licensee must submit an independent assessment of the revised stormwater management system prepared by a suitably qualified and experienced independent person. The assessment must include recommendations for improvements to the management of the system to prevent overflow events and ensure compliance with relevant licence limits.

This Assessment looks at the current stormwater management system, areas that can be improved and how this can be addressed via a proposed actions. Supporting information from Golder is provided based on a study and detailed site inspection conducted earlier this year Appendix One and Two respectively). This will form the basis of **8 U1.3 (independent assessment of the revised stormwater management system).**

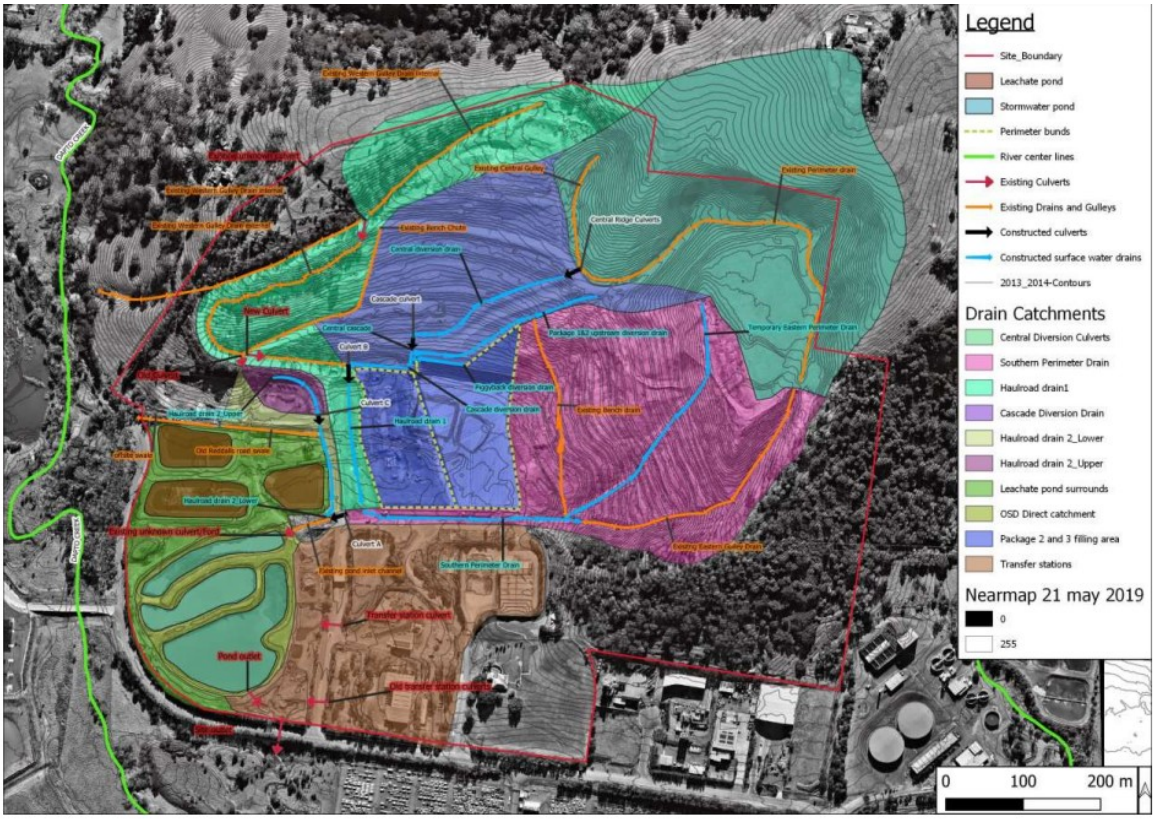
2. Overview of Stormwater Management at Whytes Gully

The site surface water management infrastructure encompasses open channel drains, pipes, culverts and various energy dissipation structures. In general, the surface water management encompasses:

- 'Clean' stormwater. Runoff from areas of the site where soil and vegetation have not been disturbed or final capped areas vegetation has been established is considered to be 'Clean'.
- 'Dirty' stormwater. Run off from areas of the site where soils have been disturbed and are likely to generate sediment are considered to be 'Dirty', including areas of immediate cover or final capping that has not fully vegetated.
- 'Leachate': comprises run off from areas of waste or daily cover material as well as leachate generated by the landfill.

Clean surface water is generally diverted around disturbed areas of the site where possible. Dirty surface water is conveyed to the surface water pond system for sediment treatment, storage and eventual discharge. Surface water that comes into contact with waste (leachate) is collected in the leachate collection system.

3. Current Stormwater Management System



The current main drainage infrastructure is shown in Figure 1. These are briefly described below and discussed in full in Appendix One (Site -wide Stormwater Review (Golder 2021).

3.1 Existing Western Gully External Drain

This is only one clean stormwater drain that discharges directly into Dapto Creek from the site. All other drains shown in Figure 1 drain dirty stormwater into the pond system.

3.2 Central Diversion Drain

The Central Diversion Drain was constructed during the Stage 1 landfill expansion cell works. Reporting catchments include the area north of the Eastern Gully, as well as small northern catchment within the Western Gully. This Drain is connected to the Central Cascade via culverts under a haul road and is designed to convey up to the 1:20 AEP peak flow stormwater event. It was not designed for larger events as it will be removed in the future stages of landfill construction.

3.3 Central Cascade

During the development of Stage 1, a gabion cascade structure was constructed at the end of the Central Diversion Drain designed to cope with 1:20 AEP peak flows. This was primarily an energy dissipation structure and was upgraded recently with the further development of Stage 1 and 2A phase plans. Resulting in a 1:100 AEP peak flow capacity.

3.4 Cascade Diversion Drain

With the development of Package 2 and 3 phase of the landfill, drainage modifications resulted in the flows from the gabion cascade being directed westward into the Cascade Diversion Drain which confluences with a smaller channel which flows in an eastward direction. This drain is designed to convey the 1:100 peak storm event flows.

3.5 Culvert B

Three existing 1.2 metre culverts north of the haul road channel receives flows from the Cascade Diversion Drain as well as existing drains from the west. Flows from both east and west channels were designed to turn 90 degrees for energy dissipation and has been designed for 1:100 AEP peak storm event flows.

3.6 Haul Road Drainage Infrastructure

The Haul Road Drains 1 and 2, which rum parallel on the east and west side of the Haul Road respectively, were designed for construction prior to Package 2 and 3 landfill cells to convey peak flows during major storm events. A dissipation basin was designed for Haul Road Drain 1 to reduce flow energy prior to being directed through Culvert A. Culverts A and C have been sized to convey major storm events (1:100 AEP) without overtopping the Haul Road.

3.7 Southern Drain

The Southern Drain is a permanent open channel drain on the southern edge of the landfill. It has a gabion mattress lined portion and an inverted box culvert portion. The drain has been sized with capacity for major storm events (1:100 AEP) considering the expanded catchments in future stages.

3.8 Surface Water Ponds

All site surface water is currently directed into the Surface Water Pond system located on the south-western portion of the site. The Surface Water Pond system is comprised of three Reed Beds and two Polishing Ponds. The total capacity is approximately 40 000 $m^{3.}$ The polishing ponds discharge through a concrete culvert overflow and then a culvert under Reddalls Road after combining with treated surface water from the transfer stations. The flows then drain through a series of creeks and wetlands before entering Dapto Creek.

3.9 Rainsheds

To divert clean runoff away from the landfill cell leachate collection system, a system of channels and pipes (known as the 'Rainshed') was designed. The Rainshed consists of an impermeable surface supported by aggregate, creating channels and bunds to divert clean runoff to the temporary eastern drain via outlet pipes. This is a temporary structure in place until the filling of the cell occurs.

4. Issues Identified for Improvement in the Existing Stormwater Management System

A site walkover was conducted by Golder and Waste Services staff on the 10th December 2020 to assess the condition and efficiency of stormwater infrastructure at Whytes Gully. The following areas were identified for improvement:

4.1 Confluence of Southern Drain and Drain 1

The proposed bund at the southern edge of the basin located at the confluence of the Southern Drain and New Haul Road Drain 1 is not in place. Consideration should be given to bunding as designed.

Rip Rap within the confluence of the basin is not visible. Consideration should be given to installing as per design requirements.

4.2 Package 1 Filling Plan – Upstream stormwater diversion

Channel erosion and overtopping has recently occurred along the drainage alignment that exists at the north western perimeter of the Package 1 and Package 2 landfill cell, south of the Western Gully Haul Road. These issues are believed to be related to increased catchment draining through this alignment compared to that assumed in the initial design which incorporated the bund mentioned above. This diversion bund should be implemented as per design requirements.

4.3 Drainage Channels

Various sections of the drainage channels have sediment accumulation within the interstitial spaces of the aggregate. This sediment has the potential to be eroded and carried during elevated channel flows which can result in elevated sediment load of surface water. There is also vegetation growth in some areas within the drainage channels including grasses, shrubs and trees that may result in reduced channel capacity and increased potential for channel overtopping.

Some areas have evidence of shifting rip rap aggregate and it appears that the Temporary Eastern Drain has collapsed and is in need of repair.

Accumulation of waste materials was noted to occur in the gabion and reno mattress lined portion of the Southern Drain. This area should be cleaned and maintained regularly.

The TRM lined stormwater drainage channels also require regular maintenance. Some areas were noted to not have grass establishment and have signs of erosion. There was some signs of liner damage evident.

4.4 Culverts

The main Culverts at Whytes Gully appeared to be functional and free of blockages. Some erosion appears to be occurring at the minor culverts including the accessway to Old Reddalls Road and the western intersection of the Western Gully Haul Road.

4.5 Stormwater Ponds

The Ponds are currently being operated via a manual pump out following confirmation of water quality within the pond being compliant with discharge criteria. It is recommended that the operations be reviewed and automated if possible.

Evidence of sedimentation of the ponds and channels was noted and desilting if the system is recommended. A bathymetric survey should be conducted at the same time to accurately measure storage capacity.

4.6 Potential Sediment Source Areas

The following areas have the potential to increase sedimentation risk on site:

- Borrow Excavation Areas
- Western Gully Stockpile Area
- Operational Areas
- Landfill Intermediate Cover Batters

5. Recommended Preliminary Actions

The following actions are recommended to improve performance of the stormwater management system:

- Development of Sedimentation and Erosion Control Plans for all disturbed and operational areas of the Site.
- Implementation of an inspection and maintenance program for all stormwater drainage infrastructure once upgrade works are undertaken.
- Investigate the suitability of lining at confluence of Southern and Access Road Drain 1 and the need for the proposed bund in the New Haul Road design.
- Implement Diversion Drain as proposed for the Access Ramp Connection design.
- Reconstruction of degraded areas of Rip Rap and TRM lined drains to original design.
- Develop and implement rectification for collapsed section of Temporary Eastern Drain.
- Further review of condition and operation of Stormwater Ponds (e.g. desilting and bathymetric survey).

6. Improvement and Maintenance Program

A list of actions to improve performance and reliability of the stormwater management system has been developed based on short, intermediate and long-term strategies. These are discussed below and summarised in Table One with appropriate timeframes for completion.

6.1 Relocation of Stormwater Monitoring Point 1

Stormwater Monitoring Point 1 was located opposite side of the stormwater discharge outlet on Reddalls Road, Kembla Grange. This point was considered representative of Whytes Gully stormwater discharge quality when the EPL was first issued due to the rural land use surrounding the site. In recent years, there have been significant changes to the catchment, including. an increase in light industrial development. An application to amend the EPL to include this alternate sampling location was submitted and accepted in February 2021 as part of this preliminary assessment.

6.2 Desilting of Stormwater Ponds

The ponds currently contain silt, resulting in less than optimum storage and settling volume. It is planned to stage desilting of the three stormwater ponds progressively over the rest of this year. All ponds will have excess sediment removed and stockpiled for reuse on the site. Where possible, the re-established wetland system will be kept to maintain water quality treatment. Siltation control measures will be put in place and all works will be monitored to ensure no water leaves the site during work. The contracting company has been engaged and the first pond works are underway (this will

include a bathymetric survey component). Unfortunately, COVID 19 restrictions have impacted project delivery timeframes and as a result desilting and survey works are approximately three months behind schedule.

6.3 Stabilisation of Pond Water Quality

The unusually heavy rainfall event of February 2020 (156.5 mm recorded) resulted in leachate migrating into the stormwater management system and impacting water quality. This resulted in a number of treatment methods being put in place based on stormwater analysis results and specialist advice. The methods used were based on a multifaceted approach using a combination of:

- Aeration
- Addition of microorganisms
- Flocking (calcium chloride)

This treatment methodology will continue to be used to maintain and stabilise water quality after rainfall events.

6.4 Water Balance Model for Whytes Gully Waste Facility

Consultants have been engaged by Wollongong City Council to address the issues triggered by the February stormwater contamination event. The consultants will review the original water balance (used in the original designs for the site); and develop an updated comprehensive water balance based on the existing site conditions and future planned landfill expansion. This will incorporate leachate, groundwater as well as stormwater. This water balance development is currently underway and is scheduled to be completed by December 2021.

6.5 Stormwater Harvesting and Reuse

As part of Wollongong City Council's commitment to sustainable site management, a number of water reuse strategies are being implemented. This will result in reducing pressure on the stormwater management system, reducing operational costs and assist in improving site safety.

Council is currently establishing a rapid fill tank station on site, which will utilise treated stormwater for dust suppression, emergency management (e.g. firefighting), road cleaning and other site maintenance requirements.

6.6 Automation of Stormwater Management System

Currently, stormwater is discharged via gravity flow or manual pumping. It is also recirculated via manual placing of hoses and pumps as required. This practice is inefficient and requires at least 3 staff to move the heavy equipment, potentially posing an environmental and safety risk. It is planned to automate this system in the near future to allow for flexibility and improved management.

Water quality monitoring was previously conducted through physical sample collection and field analysis as required.

At the beginning of 2021, an insitu monitoring system was installed to automatically collect environmental data including standard water quality parameters and weather data. This has allowed Council to monitor pond quality in real time and improve timely water quality management.

6.7 Drainage Correction and Maintenance based on results of site review of stormwater system.

The site wide stormwater review identified several areas that would improve management on site and alleviate some of the pressure on the pond system. These are detailed in the previous sections and will be prioritised as part of the operations works plan to ensure that best practice design is followed, and optimal drainage performance is maintained.

6.8 Off-site swale Investigation and Rectification

The Golder Sitewide Stormwater Review identified an off-site swale that directed 'dirty' stormwater to an off-site drain. After detailed review of the report; and a ground truthing exercise by Council staff, the swale was confirmed to be located on the northwester portion of the site (Stage 4a). See Figure 3 in the attached Golder Site-wide Stormwater Review (12 August 2021).

The swale directs water to Haulroad Drain 2 (Lower), however it had been temporarily impaired by a bank of soil disturbed on site during some contractor works in the past. There was existing silt fencing and hay bales downstream of the bank that ensured 'dirty' stormwater did not leave the site. This was immediately rectified to ensure stormwater drains into the Haulroad Drain 2(Lower) catchment.

Further erosion/sedimentation controls were placed around the perimeter of the area as recommended in the review.

7. Improvement and Maintenance Plan

Strategy	Actions	Timeframe
Relocation of Stormwater Monitoring Point 1	Move sampling point onto the site	Complete
Desilting of Ponds	Scoping Works Bathymetric Survey Silt removal Reed Bed Establishment	Underway October 2021 October/November 2021 November 2021
Development of a water balance model	Model the stormwater/leachate/ hydrological system at Whytes Gully	Underway December 2021 completion
Stormwater Harvesting and Reuse	Hardstand preparation Installation of 2 Tanks Installation of pipe, pump infrastructure	Complete Underway February 2022
Automation of Stormwater Management System	Water Quality Monitoring Network Development of Council real time database Installation of automated pumping/recirculation/discharge system	Complete Complete April 2022
Drainage Correction and Maintenance	Desilting/Clean up of site drains Repair of Damaged Infrastructure (Business Case Development based on site review findings) Litter Removal Maintenance of drainage infrastructure	Underway Underway Weekly & Ongoing Quarterly & Ongoing
Off- site Swale Investigation	Undertake Drainage Assessment Redirect water into Haul Road 2 Drain (Lower) Establish Silt and Sediment Control Measures	Underway Complete Complete

8. Conclusions

The detailed site-wide review (preliminary assessment) and site inspection report are provided in Appendix One and Two respectively. The recommendations from this preliminary assessment have begun to be implemented as outlined in the table above and will be funded initially through the following programs:

- $350 000 allocated toward leachate treatment system upgrade.
- $400 000 allocated to leachate pond upgrades.
- $100 000 allocated to stormwater pond upgrades.
- $50 000 allocated to landfill cover upgrades.
- An enclosed Small Vehicle Transfer Station to be constructed in 2021/2022.
- A comprehensive water balance by the end of 2021.
- Trialling of Biocover to decrease erosion and sedimentation
- Vegetation Management Plan implementation – enhancing vegetation plantings to control erosion.

Wollongong City Council is committed to working with the EPA to continue to move forward in the sustainable management of our Waste Operations.

DOC20/1041375 -04

Mr Greg Doyle
General Manager
Wollongong City Council
Locked Bag 8821
WOLLONGONG DC NSW 2500
Email: council@wollongong.nsw.gov.au

Attention: Christopher Brown

1 March 2021

Dear Mr Doyle

Draft Licence Variation Notice No. 1604123 for comment
Whytes Gully Landfill – EPL 5862

I am writing to you about the Whytes Gully Landfill which operate under Environment Protection Licence 5862 (licence), including the leachate seep in February 2020 and Wollongong City Council's (Council) correspondence to the Environment Protection Authority (EPA) received on 1 February 2021 in relation to Leachate and stormwater management.

We reviewed the information provided and have since held a meeting with Council to discuss the variation proposals. During this meeting Council proposed to vary the licence as follows:

1. complete a preliminary review of the existing stormwater management system;
2. prepare a comprehensive water balance assessment; and
3. conduct an independent assessment of the revised stormwater management system.
4. vary a stormwater monitoring location point on the licence.

During the meeting, Council informed the EPA that it proposed to undertake an odour assessment which would be finalised in late April 2021. Council has since provided further correspondence to the EPA including further details, a scope of works and proposed timeframe for the assessment.

Draft Licence Variation Notice

We have reviewed the information provided and have prepared draft Licence Variation Notice No. 1604123 (draft Notice) which includes a Pollution Reduction Program requiring Council to submit reports in relation to the management of stormwater at the premises. We have also amended the stormwater monitoring point location as requested by Council.

The EPA has also added special conditions upon the licence requiring Council to undertake a detailed odour assessment and provide a copy of this assessment to the EPA by the 30 April 2021.

A copy of the draft Notice is attached with this letter for your review and comment. Please provide any comments you have on the proposed variation to Unit Head Regulatory Operations by **5pm on Friday 12 March 2021** to EPA.Southopsregional@epa.nsw.gov.au.

Ongoing Stormwater Management

You must ensure that you continue to maintain all aspects of the stormwater management system to ensure that you comply with your licence. This may include, but not necessarily be limited to, the actions outlined in your correspondence.

Leachate Seep – February 2020

We also refer to the leachate seep that occurred during the rainfall event on 9 February 2020 where leachate was detected running into the stormwater system from the base of the capped landfill cell 1B. The monitoring results showed that ammonia levels were below the freshwater guideline trigger value of 1.18 mg/L outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).

We note that Council acted promptly to rectify the issue and monitored any potential environmental impact by testing for ammonia at the stormwater discharge point. The EPA advises that we do not propose to take any further action in relation to this incident.

Legal Obligations

You are reminded that condition O1.1 of the Licence requires you to carry out licensed activities in a competent manner. Condition O2.1 requires you operate and maintain all plant and equipment in a proper and efficient manner. You must comply with the conditions of the Licence at all times.
It is an offence under section 64 of the *Protection of the Environment Operations Act 1997* (the Act) to fail to comply with a condition of a licence. It is also an offence under section 120 of the Act for a person to pollute waters.

If you have any questions about this matter, please contact Marc Cooper on (02) 4224 4126 or email marc.cooper@epa.nsw.gov.au

Yours sincerely

LARA BARRINGTON
Unit Head
Regulatory Operations - South

Phone 131 555 **TTY** 133 677 Locked Bag 5022 4 Parramatta Square **info@epa.nsw.gov.au**
Phone +61 2 9995 5555 **ABN** 43 692 285 758 Parramatta 12 Darcy St, Parramatta **www.epa.nsw.gov.au**
(from outside NSW) NSW 2124 Australia NSW 2150 Australia

Section 58(5) Protection of the Environment Operations Act 1997

Licence Variation

Licence - 5862

WOLLONGONG CITY COUNCIL
ABN 63 139 525 939
LOCKED BAG 8821
WOLLONGONG DC NSW 2500

Attention: Mr Christopher Brown

Notice Number	1604123
File Number	EF13/4863
Date	

NOTICE OF VARIATION OF LICENCE NO. 5862

BACKGROUND

A. WOLLONGONG CITY COUNCIL (licensee) holds Environment Protection Licence No. 5862 (licence) issued under the *Protection of the Environment Operations Act 1997* (Act). The licence authorises the carrying out of activities at REDDALLS ROAD, KEMBLA GRANGE, NSW, 2526 (premises).

B. On 17 November 2020 the Environment Protection Authority (EPA) provided correspondence to the licensee requesting information on how it intends to address numerous exceedences of the licence limit for total suspended solids (TSS) during overflow events.

C. On 4 December 2020 the licensee provided a response outlining a number of measures it intends to take to address the issue.

D. This Notice varies the licence to include a Pollution Reduction Program (PRP) to require the licensee to prepare and submit reports investigating the overflow TSS exceedance issue and providing recommendations.

E. The Notice also updates and includes reporting conditions regarding notification to the EPA of elevated surface and subsurface gas monitoring results to be consistent with the E*nvironmental Guidelines:Solid Waste Landfills* (EPA, 2016).

F. On 22 February 2021, EPA Officers met with representatives from Wollongong City Council to discuss the proposed conditions within the variation. During this meeting, Wollongong City Council representatives indicated that Council was proposing to undertake a detailed odour assessment to address ongoing complaints in Farmborough Heights

G. Licence conditions have been added to incorporate the proposed odour assessment.

H. On 24 February 2021, the licensee provided an email to the EPA confirming an odour assessment had been proposed and would be completed by the 30 April 2021and a final report prepared. The scope of works for the proposed odour assessment was attached to this email and is held under EPA record [DOC21/141915

Licence Variation

I. This Notice varies the licence to add special conditions to require the licensee to prepare and submit a copy of the final report to the EPA. Also included within these conditions is the proposed scope of works, which have been provided by Council.

J. On 24 February 2021, the licensee provided the EPA with an email containing a new proposed stormwater monitoring location point. Attached to this email was a photograph depicting the new location along with eastings and northings. (A copy of this email and photograph is held under EPA record DOC21/136523)

K. On 1 March 2021 the EPA provided the licensee with a draft Notice of Licence variation for review and comment.

VARIATION OF LICENCE NO. 5862

1. By this notice the EPA varies licence No. 5862. The attached licence document contains all variations that are made to the licence by this notice.

2. The following variations have been made to the licence:

   - R2.3 updated to be consistent with the *Environmental Guidelines: Solid Waste Landfills (EPA, 2016)*:

     Current:

     R2.3: The licensee must notify the EPA within 24 hours in accordance with condition R2.1 if surface monitoring detects methane above 1.0 % (v/v), and increase the frequency of monitoring to daily, until the EPA determines otherwise.

     Amended to:

     R2.3 The licensee must notify the EPA within 24 hours by telephoning Environment Line on 131 555 if surface gas monitoring required by the licence detects methane of 500 ppm (volume/volume) or greater.

   - Added condition R2.4 to require notification of elevated subsurface gas monitoring results.

     R2.4 The licensee must notify the EPA within 24 hours by telephoning Environment Line on 131 55 if subsurface gas monitoring required by the licence detects methane of 1% (volume/volume) or greater. Inclusion of PRPs to address overflows and exceedences of TSS from the stormwater management system, and to provide assessment reports to the EPA.

   - Amendment of condition P1.2 - Point 1 - location description for the stormwater monitoring point has changed due to the relocation of this monitoring point.

     Current:

Licence Variation

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Stormwater monitoring and discharge point	Stormwater monitoring and discharge point	Outlet at Reddalls Road - Monitoring point labelled 1 on Figure 13 titled "Proposed Surface Water Monitoring Locations" dated 26 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297777 N6183972

Amended to:

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Stormwater monitoring and discharge point	Stormwater monitoring and discharge point	Outlet at Reddalls Road - Monitoring point identified at E297772 N6184025.

- Inclusion of special conditions E1.4 and E1.5 to undertake an odour assessment and provide a copy of the final report to the EPA.

E1.4 The licensee must engage a suitably qualified and experienced odour specialist to assess odour emissions from the premises and on the performance and effectiveness of the odour mitigation measures. Provide the EPA with a copy of this assessment by 30 April 2021.

E1.5 The licensee is required to undertake a detailed risk assessment of the premises including the following:

a) The risk assessment must identify all significant odour-generating sources at the premises.

b) The risk assessment must be informed by site-specific odour monitoring. All monitoring must be undertaken in accordance with the NSW EPA's Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.

c) Where measured site-specific odour emission rates are significantly different to t hose previously adopted in the odour modelling report by Pae Holmes (June 2012), the modelling must be revised to include site specific data.

d) The Licensee must undertake a detailed feasibility study to consider and evaluate options to reduce odour emissions from the highest ranked odour generating sources.

e) The feasibility study should evaluate the expected change in offsite odour impacts via a revised odour impact assessment.

Licence Variation

.....

(by Delegation)

INFORMATION ABOUT THIS NOTICE

- This notice is issued under section 58(5) of the Act.
- Details provided in this notice, along with an updated version of the licence, will be available on the EPA's Public Register (http://www.epa.nsw.gov.au/prpoeo/index.htm) in accordance with section 308 of the Act.

Appeals against this decision

- You can appeal to the Land and Environment Court against this decision. The deadline for lodging the appeal is 21 days after you were given notice of this decision.

When this notice begins to operate

- The variations to the licence specified in this notice begin to operate immediately from the date of this notice, unless another date is specified in this notice.
- If an appeal is made against this decision to vary the licence and the Land and Environment Court directs that the decision is stayed the decision does not operate until the stay ceases to have effect or the Land and Environment Court confirms the decision or the appeal is withdrawn (whichever occurs first).

Environment Protection Licence

Licence - 5862

Licence Details	
Number:	5862
Anniversary Date:	29-May

Licensee

WOLLONGONG CITY COUNCIL

LOCKED BAG 8821

WOLLONGONG DC NSW 2500

Premises

WHYTES GULLY WASTE DISPOSAL FACILITY

REDDALLS ROAD

KEMBLA GRANGE NSW 2526

Scheduled Activity

Waste disposal (application to land)

Fee Based Activity	Scale
Waste disposal by application to land	Any capacity

Region

Regional South - Wollongong

Level 3, NSW Govt Offices, 84 Crown Street
WOLLONGONG NSW 2500

Phone: (02) 4224 4100

Fax: (02) 4224 4110

PO Box 513

WOLLONGONG EAST NSW 2520

Environment Protection Licence

Licence - 5862

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Environment Protection Licence

Licence - 5862

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence

Licence - 5862

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

WOLLONGONG CITY COUNCIL
LOCKED BAG 8821
WOLLONGONG DC NSW 2500

subject to the conditions which follow.

Environment Protection Licence

Licence - 5862

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Waste disposal (application to land)	Waste disposal by application to land	Any capacity

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
WHYTES GULLY WASTE DISPOSAL FACILITY
REDDALLS ROAD
KEMBLA GRANGE
NSW 2526
LOT 2 DP 240557, PART LOT 52 DP 1022266, PART LOT 53 DP 1022266, PART LOT 501 DP 1079122, PART LOT 502 DP 1079122
THE PREMISES BOUNDARY IS DEPICTED BY THE AREA BOUNDED IN GREEN ON THE DRAWING LABELLED "WHYTES GULLY WASTE DISPOSAL FACILITY SITE BOUNDARY PLAN - 2 JULY 2014" (EPA REF DOC14/116147)

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

A3.2 The Whytes Gully Landfill Environmental Management Plan (LEMP), dated March 2012 is not to be taken as part of the documentation in A3.1, other than those parts specifically referenced in this licence.

Environment Protection Licence

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

Air

EPA identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
3	Surface gas monitoring		Areas where intermediate or final cover has been placed.
4	Gas accumulation monitoring		Inside all buildings within 250 metres of deposited waste.
21	Subsurface gas monitoring		Monitoring point labelled LFG MW1 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298084 N6184278
22	Subsurface gas monitoring		Monitoring point labelled LFG MW2 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298202 N6184228
23	Subsurface gas monitoring		Monitoring point labelled LFG MW3 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298297 N6184244
24	Subsurface gas monitoring		Monitoring point labelled LFG MW4 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298376 N6184303
25	Subsurface gas monitoring		Monitoring point labelled LFG MW5 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298438 N6184381
26	Subsurface gas monitoring		Monitoring point labelled LFG MW6 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298376 N6184303
27	Subsurface gas monitoring		Monitoring point labelled LFG MW7 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298470 N6184553
28	Subsurface gas monitoring		Monitoring point labelled LFG MW8 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298376 N6184303

Environment Protection Licence

29	Subsurface gas monitoring	Monitoring point labelled LFG MW9 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298465 N6184645
30	Subsurface gas monitoring	Monitoring point labelled LFG MW10 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298448 N6184684
31	Subsurface gas monitoring	Monitoring point labelled LFG MW11 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298400 N6184695
32	Subsurface gas monitoring	Monitoring point labelled LFG MW12 on Figure 14 titled "Proposed Landfill Gas Monitoring Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298351 N6184701

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Stormwater monitoring and discharge point	Stormwater monitoring and discharge point	Outlet at Reddalls Road - Monitoring point identified at E297772 N6184025.
5	Groundwater quality monitoring		Monitoring point labelled GABH02 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297754.9 N6184377
9	Groundwater quality monitoring		Monitoring point labelled GMW102 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297952.6 N6184807
10	Groundwater quality monitoring		Monitoring point labelled GMW103 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298470.2 N6184603
11	Groundwater quality monitoring		Monitoring point labelled GMW104 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297597.9 N6184508

Environment Protection Licence

Licence - 5862

12	Groundwater quality monitoring	Monitoring point labelled GMW105 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298433.3 N6184397
13	Groundwater quality monitoring	Monitoring point labelled GMW106 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E298356.8 N6184294
14	Groundwater quality monitoring	Monitoring point labelled GMW108S on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297870.2 N6184262
15	Groundwater quality monitoring	Monitoring point labelled GMW108D on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297871.4 N6184262
16	Groundwater quality monitoring	Monitoring point labelled GMW109S on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297605.7 N6184068
17	Groundwater quality monitoring	Monitoring point labelled GMW110 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297572.6 N6184266
18	Groundwater quality monitoring	Monitoring point labelled GMW111 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297588.6 N6184385
19	Groundwater quality monitoring	Monitoring point labelled GMW109D on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297604.9 N6184068
20	Groundwater quality monitoring	Monitoring point labelled BH6 on Figure 15 titled "Current Site Investigation Locations" dated 6 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297807.4 N6184052

33	Stormwater monitoring point	Downstream monitoring point labelled 4 on Figure 13 titled "Proposed Surface Water Monitoring Locations" dated 26 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297767 N6183396
34	Stormwater monitoring point	Upstream monitoring point labelled 6 on Figure 13 titled "Proposed Surface Water Monitoring Locations" dated 26 March 2012 (Whytes Gully New Landfill Cell EA - Volume IV). E297495 N6184504

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L1.2 There must be no discharge of contaminated stormwater to waters under dry weather conditions (less than 10 mm of rainfall within a 24 hour period) or a storm event/s of less than 1:10 year, 24 hour recurrence interval (less than 297.4 mm of rainfall within a 24 hour time period).

Discharges of contaminated stormwater from the stormwater ponds caused by a 1:10 year, 24 hour recurrence interval storm event or greater do not constitute a breach of this licence.

L1.3 There must be no discharge of leachate to waters under dry weather conditions (less than 10 mm of rainfall with a 24 hour period) or storm event(s) of less than 1:25 year, 24 hour recurrence interval (less than 371.5 mm of rainfall within a 24 hour time period).

Discharges of leachate from the leachate pond caused by a 1:25 year, 24 hour recurrence interval storm event or greater do not constitute a breach of this licence.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

Environment Protection Licence

POINT 1

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
pH	pH				6.5 - 8.5
TSS	milligrams per litre				50

L3 Waste

L3.1 The licensee must not cause, permit or allow any waste to be received at the premises, except the wastes expressly referred to in the column titled “Waste” and meeting the definition, if any, in the column titled “Description” in the table below.
Any waste received at the premises must only be used for the activities referred to in relation to that waste in the column titled “Activity” in the table below.
Any waste received at the premises is subject to those limits or conditions, if any, referred to in relation to that waste contained in the column titled “Other Limits” in the table below.
This condition does not limit any other conditions in this licence.

Code	Waste	Description	Activity	Other Limits
T140	Tyres	As defined in Schedule 1 of the POEO Act, in force from time to time	Waste storage Waste disposal (application to land)	NA
NA	General solid waste (non-putrescible)	As defined in Schedule 1 of the POEO Act, as in force from time to time	Waste disposal (application to land)	NA
NA	General solid waste (putrescible)	As defined in Schedule 1 of the POEO Act, as in force from time to time	Waste disposal (application to land)	NA
NA	Asbestos waste	As defined in Schedule 1 of the POEO Act, as in force from time to time	Waste disposal (application to land)	NA

L3.2 The licensee must not dispose of any tyres on the premises which;
a) have a diameter of less than 1.2 metres; and
b) are delivered at the premises in a load containing more than 5 whole tyres; and
c) became waste in the Sydney Metropolitan Area.

Note:

This condition does not apply where:
i) The tyres received comply with the EPA Tyre Disposal Specifications; or
ii) The premises have the capacity, at the time of unloading the tyres, to comply with the EPA Tyre Disposal Specifications; or
iii) The premises have the capacity, at the time of unloading the tyres, to recycle or reprocess the tyres into a saleable product, including retreading the tyres.

L3.3 Tyres stockpiled on the premises must:
a) not exceed fifty (50) tonnes of tyres at any one time; and
b) be located in a clearly defined area away from the tipping face; and
c) be managed to control vermin; and
d) be managed to prevent any tyres from catching fire.

L4 Potentially offensive odour

L4.1 The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O3.2 All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.

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O4 Emergency response

O4.1 The licensee must extinguish fires at the premises as soon as possible.

O5 Processes and management

O5.1 The licensee must take all practicable steps to control entry to the premises.

O5.2 The licensee must ensure that all gates are locked whenever the premises is unattended.

O6 Waste management

O6.1 The licensee must have in place and implement procedures to identify and prevent the disposal of any waste not permitted by this licence to be disposed of at the premises.

O6.2 The licensee must ensure that the local amenity is not degraded by litter from the premises.

O6.3 The licensee must only dispose of waste in the Upper Eastern Gully Tipping Face, Cell 1B, Package 3 or Package 2.

O6.4 The surface of filled areas must have a minimum slope of one per cent with suitable design to prevent ponding of water. Any surface depressions that develop must be restored, graded and compacted to prevent further ponding of water.

O6.5 The licensee must apply cover material to landfilled waste in accordance with this condition. This cover material must be either Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM - as defined and characterised by the Excavated Natural Material Order, as in force from time to time), Road Asphalt Profilings (RAP), Steel Furnace Slag (SFS), Steel Framed Fabric or Metal Covered Landfill Lids or an alternative cover approved in writing by the EPA.
a) Daily cover must be applied to a minimum depth of 150mm over all exposed landfilled waste prior to ceasing operations at the end of each day.
b) Intermediate cover must be applied to a depth of 300mm over surfaces of the landfilled waste at the premises which are to be exposed for more than 90 days.
c) Cover material stockpile: at least two weeks cover material must be available at the premises under all weather conditions. This material may be won on site, or alternatively a cover stockpile may be maintained adjacent to the tip face.
d) Excavated Natural Material used as cover material must be managed in accordance with the practices detailed in the licensee's letter dated 21 March 2017 (Z17/70390).

O6.6 The licensee must ensure that landfill cells are capped progressively during operations and specifically at times when the level of waste reaches final heights.

O6.7 Vehicles leaving the premises must not track materials to external surfaces.

O6.8 The licensee must not exhume any landfilled waste unless approved in writing by the EPA.

O6.9 The licensee must obtain approval from the EPA prior to constructing any landfill cells at the premises.

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O6.10 The licensee must provide a report to the EPA which details the design, construction, operation and rehabilitation of any new landfill cell. This report must be submitted to the EPA at least six months before the licensee intends to construct the cell, and it must include details on a QA/QC program which can demonstrate that the cell was constructed to meet its design specifications.

O6.11 Any report prepared in accordance with condition O6.10 must consider the recommendations made in the document titled "Wollongong Waste and Resource Recovery Park - Slope Stability Re-Assessment For Package 2 and Package 3" prepared by Golder Associates and dated 27 June 2018.

O6.12 The licensee must prepare and maintain a detailed filling plan for each active landfill cell at the premises.

O6.13 The last licensee must prepare and submit to the EPA within six months prior to the last load of waste being landfilled, a closure plan in accordance with section 76 of the Protection of the Environment Operations Act 1997.

O7 Other operating conditions

O7.1 Drainage from areas not subject to waste disposal activities must be directed away from the existing leachate collection pond(s).

O7.2 The licensee must maintain a leachate management system to collect and direct all leachate to a point for treatment and disposal to sewer.

O7.3 Disturbed areas must be provided with separate water quality controls for the treatment of runoff containing suspended or turbid pollutants.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

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M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 3

Pollutant	Units of measure	Frequency	Sampling Method
Methane	percent by volume	Special Frequency 2	Special Method 1

POINT 4

Pollutant	Units of measure	Frequency	Sampling Method
Methane	percent by volume	Special Frequency 2	Special Method 2

POINT 21,22,23,24,25,26,27,28,29,30,31,32

Pollutant	Units of measure	Frequency	Sampling Method
Methane	percent by volume	Special Frequency 2	Special Method 3

M2.3 Water and/ or Land Monitoring Requirements

POINT 1,33,34

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	milligrams per litre	Special Frequency 1	Grab sample
Ammonia	milligrams per litre	Special Frequency 1	Grab sample
Calcium	milligrams per litre	Special Frequency 1	Grab sample
Chloride	milligrams per litre	Special Frequency 1	Grab sample
Conductivity	microsiemens per centimetre	Special Frequency 1	Grab sample
Dissolved Oxygen	milligrams per litre	Special Frequency 1	Grab sample
Filterable iron	milligrams per litre	Special Frequency 1	Grab sample
Fluoride	milligrams per litre	Special Frequency 1	Grab sample
Magnesium	milligrams per litre	Special Frequency 1	Grab sample
Nitrate	milligrams per litre	Special Frequency 1	Grab sample
pH	pH	Special Frequency 1	Grab sample
Potassium	milligrams per litre	Special Frequency 1	Grab sample

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Sodium	milligrams per litre	Special Frequency 1	Grab sample
Sulfate	milligrams per litre	Special Frequency 1	Grab sample
Temperature	degrees Celsius	Special Frequency 1	In situ
Total organic carbon	milligrams per litre	Special Frequency 1	Grab sample
Total Phenolics	milligrams per litre	Special Frequency 1	Grab sample
Total suspended solids	milligrams per litre	Special Frequency 1	Grab sample

POINT 5,9,10,11,12,13,14,15,16,17,18,19,20

Pollutant	Units of measure	Frequency	Sampling Method
Alkalinity (as calcium carbonate)	milligrams per litre	Quarterly	Grab sample
Aluminium	milligrams per litre	Yearly	Grab sample
Arsenic	milligrams per litre	Yearly	Grab sample
Barium	milligrams per litre	Yearly	Grab sample
Benzene	milligrams per litre	Yearly	Grab sample
Cadmium	milligrams per litre	Yearly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample
Chromium (hexavalent)	milligrams per litre	Yearly	Grab sample
Chromium (total)	milligrams per litre	Yearly	Grab sample
Cobalt	milligrams per litre	Yearly	Grab sample
Conductivity	microsiemens per centimetre	Quarterly	Grab sample
Copper	milligrams per litre	Yearly	Grab sample
Ethyl benzene	micrograms per litre	Yearly	Grab sample
Fluoride	milligrams per litre	Yearly	Grab sample
Lead	milligrams per litre	Yearly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample
Manganese	micrograms per litre	Yearly	Grab sample
Mercury	milligrams per litre	Yearly	Grab sample
Nitrate	milligrams per litre	Yearly	Grab sample
Nitrite	milligrams per litre	Yearly	Grab sample
Nitrogen (ammonia)	milligrams per litre	Quarterly	Grab sample
Organochlorine pesticides	milligrams per litre	Yearly	Grab sample
Organophosphate pesticides	milligrams per litre	Yearly	Grab sample
pH	pH	Quarterly	Probe
Polycyclic aromatic hydrocarbons	milligrams per litre	Yearly	Grab sample
Potassium	milligrams per litre	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample
Standing Water Level	metres	Quarterly	In situ
Sulfate	milligrams per litre	Quarterly	Grab sample
Toluene	milligrams per litre	Yearly	Grab sample

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Total dissolved solids	milligrams per litre	Quarterly	Grab sample
Total organic carbon	milligrams per litre	Quarterly	Grab sample
Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample
Total Phenolics	milligrams per litre	Yearly	Grab sample
Xylene	milligrams per litre	Yearly	Grab sample
Zinc	milligrams per kilogram	Yearly	Grab sample

Note: Special frequency 1 means annually and whenever overflows occur.

Note: Special frequency 2 means monthly if an initial survey indicates significant gas.

Note: Special method 1 means in accordance with surface gas emission monitoring procedures described in Section 5.2 Landfill Gas Surface Emission Monitoring of the Environmental Guidelines: Solid Waste Landfills (2016).

Note: Special method 2 means in accordance with gas accumulation monitoring procedures described in Section 5.4 Gas Accumulation Monitoring in Enclosed Structures of the Environmental Guidelines: Solid Waste Landfills (2016)

Note: Special method 3 means in accordance with subsurface gas monitoring procedures described in Section 5.3 Landfill Gas Sub-Surface Monitoring of the Environmental Guidelines: Solid Waste Landfills (2016).

M3 Testing methods - concentration limits

M3.1 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

Note: The *Protection of the Environment Operations (Clean Air) Regulation 2010* requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

M3.2 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:
a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or
b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or
c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

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M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until 3 months after: the date of the issue of this licence.

M6 Other monitoring and recording conditions

M6.1 The licensee must maintain a record of all events involving the removal of any waste that was brought to the facility and which is not permitted to be disposed of at the facility.

M6.2 The licensee must make available to the EPA the results of monthly Trade Waste monitoring of leachate and include these results in the Annual Report.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,

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3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee notification that the Annual Return is due.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R1.8 The Annual Return must be accompanied by/or include an Annual Report which must contain an assessment of environmental performance relevant to licence conditions including:
a) tabulated results of all monitoring data required to be collected by this licence;
b) a graphical presentation of data from at least the last three years (if available) in order to show variability and/or trends. Any statistically significant variations or anomalies should be highlighted and explained;
c) an analysis and interpretation of all monitoring data;
d) an analysis of and response to any complaints received;

e) identification of any deficiencies in environmental performance identified by the monitoring data, trends or incidents and of remedial action taken or proposed to be taken to address these deficiencies; and
f) recommendations on improving the environmental performance of the facility.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R2.3 The licensee must notify the EPA within 24 hours by telephoning Environment Line on 131 555 if surface gas monitoring required by the licence detects methane of 500 ppm (volume/volume) or greater.

R2.4 The licensee must notify the EPA within 24 hours by telephoning Environment Line on 131 55 if subsurface gas monitoring required by the licence detects methane of 1% (volume/volume) or greater.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not

satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

R4 Other reporting conditions

R4.1 The licensee must maintain a daily log and record the following data of fires at the site:
a) Time and date when the fire was deliberately started or reported.
b) Whether the fire was authorised by the licensee, and, if not, the circumstances which ignited the fire.
c) The time and date that the fire ceased and whether it burnt out or was extinguished.
d) The location of fire (eg. clean timber stockpile, putrescible garbage cell, etc).
e) Prevailing weather conditions.
f) Observations made in regard to smoke direction and dispersion.
g) The amount of waste that was combusted by the fire.
h) Action taken to extinguish the fire.

R4.2 The licensee or its employees or agents must notify the EPA in accordance with conditions R2.1 and R2.2 of all fires at the premises immediately after becoming aware of the incident.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

8 Pollution Studies and Reduction Programs

U1 Stormwater Improvement Plan

U1.1 By no later than 28 August 2021 the licensee must submit a preliminary assessment and update of the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater management system and develop an improvement and maintenance plan.

U1.2 By no later than 3 December 2021 the licensee must prepare a comprehensive water balance based on current and future landfill operations. The water balance must consider leachate, groundwater and stormwater at the premises.

U1.3 By no later than 31 March 2022 the licensee must submit an independent assessment of the revised stormwater management system prepared by a suitably qualified and experienced independent person. The assessment must include recommendations for improvements to the management of the system to prevent overflow events and ensure compliance with relevant licence limits.

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9 Special Conditions

E1 Environmental Obligations of Licensee (Works & Programs)

E1.1 While the licensee's premises are being used for the purpose to which the licence relates, the licensee must:
a) Clean up any spill, leak or other discharge of any waste(s) or other material(s) as soon as practicable after it becomes known to the licensee or to one of the licensee's employees or agents.
b) In the event(s) that any liquid and non-liquid waste(s) is unlawfully deposited on the premises, such waste(s) must be removed and lawfully disposed of as soon as practicable or in accordance with any direction given by the EPA.
c) Provide all monitoring data as required by the conditions of this licence or as directed by the EPA.

E1.2 In the event of an earthquake, storm, fire, flood or any other event where it is reasonable to suspect that a pollution incident has occurred, is occurring or is likely to occur, the licensee (whether or not the premises continue to be used for the purposes to which the licence relates) must:
a) make all efforts to contain all firewater on the licensee's premises,
b) make all efforts to control air pollution from the licensee's premises,
c) make all efforts to contain any discharge, spill or run-off from the licensee's premises,
d) make all efforts to prevent flood water entering the licensee's premises,
e) remediate and rehabilitate any exposed areas of soil and/or waste,
f) lawfully dispose of all liquid and solid waste(s) stored on the premises that is not already securely disposed of,
g) at the request of the EPA monitor groundwater beneath the licensee's premises and its potential to migrate from the licensee's premises,
h) at the request of the EPA monitor surface water leaving the licensee's premises; and
i) ensure the licensee's premises is secure.

E1.3 After the licensee's premises cease to be used for the purpose to which the licence relates or in the event that the licensee ceases to carry out the activity that is the subject of this licence, that licensee must:
a) remove and lawfully dispose of all liquid and non-liquid waste stored on the licensee's premises; and
b) rehabilitate the site, including conducting an assessment of and if required remediation of any site contamination.

E1.4 The licensee must engage a suitably qualified and experienced odour specialist to assess odour emissions from the premises and on the performance and effectiveness of the odour mitigation measures. Provide the EPA with a copy of this assessment by 30 April 2021.

E1.5 The licensee is required to undertake a detailed risk assessment of the premises including the following:

a) The risk assessment must identify all significant odour-generating sources at the premises.
b) The risk assessment must be informed by site-specific odour monitoring. All monitoring must be undertaken in accordance with the NSW EPA's Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.
c) Where measured site-specific odour emission rates are significantly different to those previously adopted in the odour modelling report by Pae Holmes (June 2012), the modelling must be revised to include site specific data.
d) The Licensee must undertake a detailed feasibility study to consider and evaluate options to reduce odour emissions from the highest ranked odour generating sources.
e) The feasibility study should evaluate the expected change in offsite odour impacts via a revised odour

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impact assessment.

Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder describe d at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

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TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non-putrescible), special waste or hazardous waste

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End Notes

1	Licence varied by notice 1004923, issued on 28-Mar-2001, which came into effect on 19-Apr-2001.
2	Licence varied by notice 1006649, issued on 15-Jun-2001, which came into effect on 10-Jul-2001.
3	Licence varied by notice 1010783, issued on 22-Oct-2001, which came into effect on 16-Nov-2001.
4	Licence varied by notice 1013124, issued on 19-Mar-2002, which came into effect on 13-Apr-2002.
5	Licence varied by notice 1018823, issued on 11-Jul-2002, which came into effect on 05-Aug-2002.
6	Licence fee period changed by notice 1027159 on 07-May-2003.
7	Licence varied by notice 1040733, issued on 15-Mar-2005, which came into effect on 21-Mar-2005.
8	Licence varied by notice 1046062, issued on 11-Oct-2005, which came into effect on 05-Nov-2005.
9	Licence varied by change to DEC Region allocation, issued on 17-Mar-2006, which came into effect on 17-Mar-2006.
10	Licence varied by change to EPA Region, issued on 07-Aug-2006, which came into effect on 07-Aug-2006.
11	Licence varied by notice 1080328, issued on 20-Nov-2007, which came into effect on 20-Nov-2007.
12	Licence varied by notice 1092800, issued on 17-Oct-2008, which came into effect on 17-Oct-2008.
13	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>
14	Licence varied by notice 1095240, issued on 28-Nov-2008, which came into effect on 28-Nov-2008.
15	Licence varied by Correction to EPA Region data record., issued on 28-Jun-2010, which came into effect on 28-Jun-2010.
16	Licence varied by notice 1502805 issued on 16-Apr-2012
17	Licence varied by notice 1506302 issued on 23-Aug-2013
18	Licence varied by notice 1522234 issued on 08-Jul-2014
19	Licence varied by notice 1525454 issued on 28-Oct-2014
20	Licence varied by notice 1532651 issued on 01-Sep-2015

Environment Protection Licence

Licence - 5862

21	Licence varied by notice	1544472 issued on 14-Oct-2016
22	Licence varied by notice	1546335 issued on 23-Nov-2016
23	Licence varied by notice	1547871 issued on 20-Jan-2017
24	Licence varied by notice	1549078 issued on 06-Jun-2017
25	Licence varied by notice	1553778 issued on 05-Jul-2017
26	Licence varied by notice	1566693 issued on 05-Jul-2018
27	Licence varied by notice	1572784 issued on 20-Dec-2018
28	Licence varied by notice	1576255 issued on 19-Feb-2019
29	Licence varied by notice	1579764 issued on 23-May-2019

WHYTES GULLY STORMWATER MANAGEMENT: INSTALLATION OF RAPID FILL WATER STATION FOR WATER RECYCLING ON SITE
10/11/2021

INTRODUCTION

Wollongong City Council (Waste Services) is seeking endorsement from the NSW Department of Planning, Infrastructure and Environment (DPIE) under Major Project Approval MP 11_0094 for the installation of a Rapid Fill Water Station at Whytes Gully. The endorsement is required by Council Certifiers to provide a construction certificate for the proposed works (including the hardstand area).

Council's role as a certifier requires them to be able to directly link the proposed construction works to a set of plans or approved document that specifies the exact nature of the works proposed. In this case, DPIE endorsement has been requested by Council's Certification Manager to show the link between the installation of the Rapid Fill Water Station and the Major Project Approval.

This document defines this link, allowing DPIE to provide a written endorsement of regulatory compliance to Council for the construction of this water recycling project to proceed.

LEGISLATIVE CONTEXT

In February 2020, over two years of drought conditions were broken by catastrophic rains resulting in leachate entering the stormwater management system at Whytes Gully Landfill. This triggered a pollution incident and a subsequent regulatory review of water management practices at the landfill. A license variation was put in place by the EPA to include a Pollution Reduction Program (Stormwater Improvement Plan) as outlined below:

Condition 8 Pollution Studies and Reduction Programs

U1 Stormwater Improvement Plan

U1.1 By no later than 28 August 2021 must submit a preliminary assessment and update the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater system and develop an improvement and maintenance plan.

U1.2 By no later than 3 December 2021 the licensee must prepare a comprehensive water balance based on current and future landfill operations. The water balance must consider leachate, groundwater and stormwater at the premises.

U1.3 By no later than 31 March 2022 the licensee must submit an independent assessment of the revised stormwater management system prepared by a suitably qualified and experienced independent person. This assessment must include recommendations for improvements to the management of the system to prevent overflow events and ensure compliance with relevant limits.

DPIE Independent Environmental Audit (IEA) Response (2020)

The Independent Environmental Audit (IEA) Report and Response to Audit Recommendations (RAR) for the Whytes Gully Waste Project's Independent Environmental Audit 2020 was submitted last year to the Department of Planning, Industry and Environment (DPIE), as required under Schedule 5 condition 9 of project approval MP11_0094 (Approval, as modified).

DPIE considered that the IEA report generally satisfied the reporting requirements of the approval. The non-compliances identified in the IEA were assessed in accordance with the Department's Compliance Policy, with breaches being recorded, however no enforcement action being taken.

The IEA also identified the leachate pollution incident as an issue of concern and Council subsequently committed to updating Soil, Water and Leachate Management Plan for a November 2021 submission. This will include the EPA Condition U1.1 submission (*Preliminary assessment and update the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater system and develop an improvement and maintenance plan)* that was recently approved in October 2021.

PROJECT OUTLINE

To improve water use efficiency in the short term, Council proposed the installation of a Rapid Fill Water Station. This was presented in the approved EPA Report submission (see Attachment One: Whytes Gully Landfill Preliminary Assessment: Stormwater Management System (EPL 5862)). In Section 6.5, the Report states:

> *'As part of Wollongong City Council's commitment to sustainable site management, a number of water reuse strategies are being implemented. This will result in reducing pressure on the stormwater management system, reducing operational costs and assist in improving site safety. Council is currently establishing a rapid fill tank station on site, which will utilise treated stormwater for dust suppression, emergency management (e.g. firefighting), road cleaning and other site maintenance requirements.'*

The Station consists of 2 x 26,000 litre tanks mounted on a hardstand area. Photograph One shows the proposed layout to be constructed. Figure A and B provide the specifications for the hardstand area.

Photograph One: Rapid Fill Water Tanks.

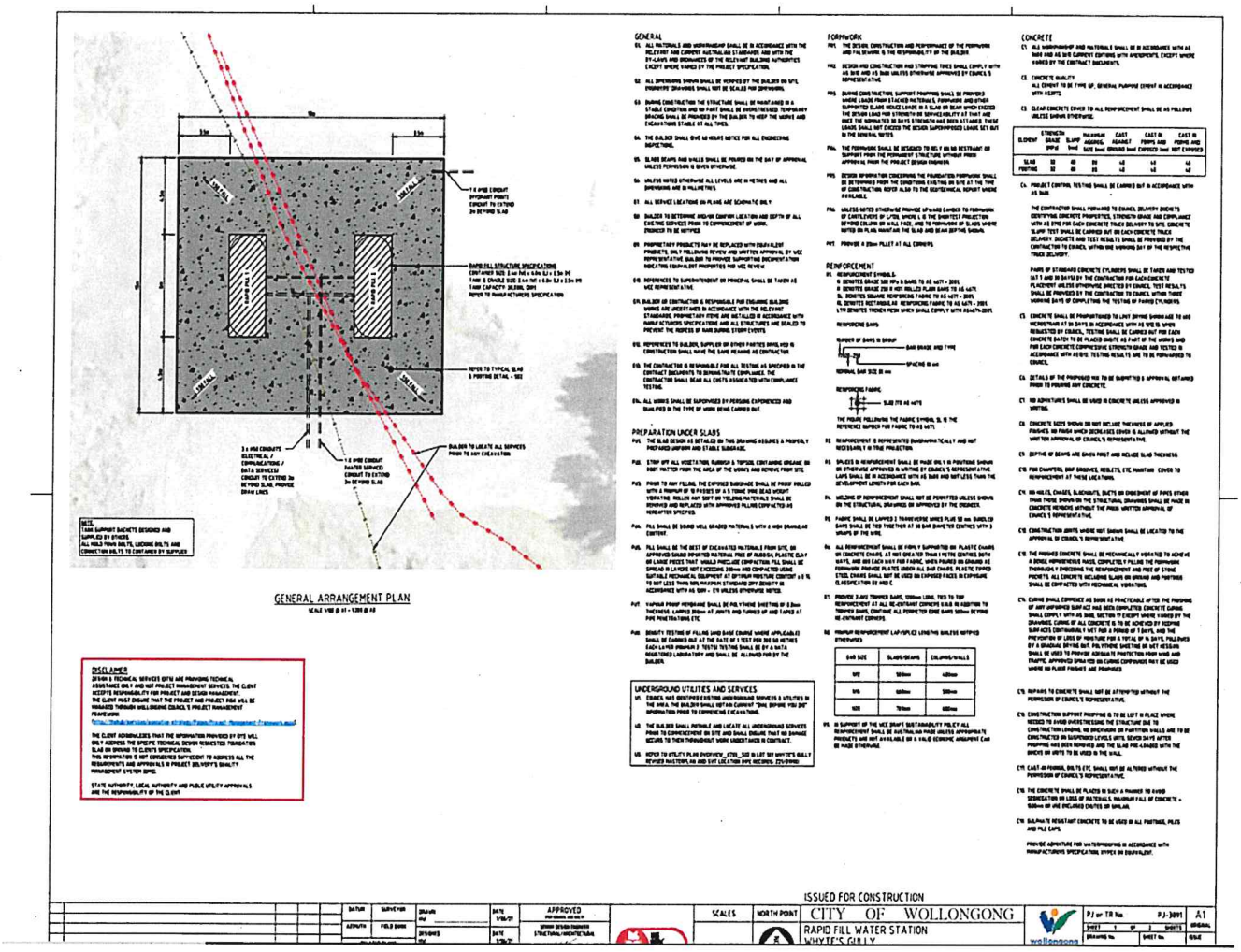

Figure A: General Arrangement Plan

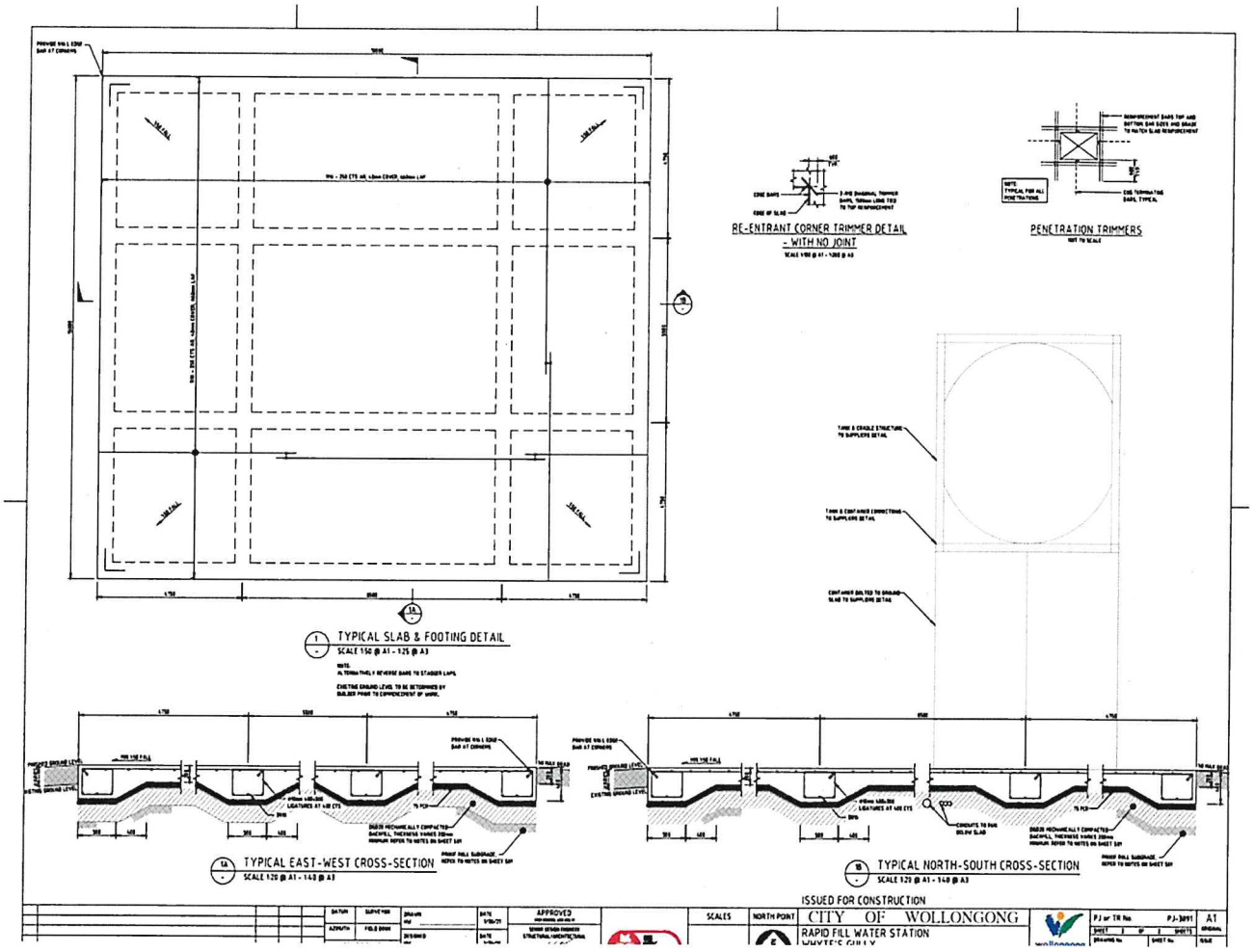

Figure B: Hardstand Specifications

APPLICABILITY TO MAJOR PROJECT APPROVAL MP 11_0094

The following table outlines how the Rapid Fill Water Station directly addresses the relevant Conditions outlined in the Project Approval.

Schedule	Condition	Applicability
Schedule 4: Dust Minimisation	25 During Construction, the Proponent shall ensure that: c). All loaded vehicles leaving the site are cleaned of dirt, sand and other materials before they leave the site, to avoid tracking these materials on public roads.	The Station will be in close proximity to the weighbridge and will allow for cleaning of large commercial vehicles both entering and leaving the site, ensuring that they do not track material on or off the property.
Schedule 4: Operating Conditions	26 The Proponent shall: (a) Implement best management practice including all reasonable and feasible dust and odour mitigation measures to prevent and minimise dust and odour emissions from operation.	At the beginning of 2021, a new water cart was purchased for Whytes Gully to improve dust and odour suppression. The cart has a larger capacity and improved efficiency. The nearest fill point for the cart is currently off site, resulting in valuable use time being lost driving the vehicle to and from the filling point. In line with best practice, the rapid fill tanks will provide a constant reliable source of water (recycled from the site's stormwater supply) on site that can be accessed to fill the larger vehicle.
Schedule 4: Soil, Water and Leachate Management Plan	18 The Proponent shall implement and prepare a Soil, Water and Leachate Management Plan for the project in consultation with Council, NOW and the EPA and to the satisfaction on the Director-General. This plan must be prepared and implemented by a suitably qualified and experienced person and be approved by the Director-General prior to the commencement of operation. The plan must include: a). a site water balance that describes measures that will be implemented to minimise water use on site.	As part of the updated Soil, Water and Leachate Management Plan the EPA Approved Improvement and Maintenance Plan will be implemented. One of the first stages is the Rapid Water Fill Station as this is a simple and effective mechanism to reuse water on site.
Schedule 4: Fire Management	46. The Proponent shall: a) implement suitable measures to minimise the risk of fire on site, including in the landfill area; b) extinguish any fires on site promptly; and	A Rapid Fill Water Station on site will mean there will be a permanent water supply for fire management located on site in close proximity to the tip face and other high use areas.

	c) maintain adequate firefighting capacity on site.	Currently, the nearest source is located off site at Keevers Place, approximately 1 km from the site entrance.

CONCLUDING COMMENTS

The Annual DPIE Report (2021) and the Annual EPA Return (2021) both highlight the urgent need to implement practical measures to reduce pressure on the stormwater management system at Whytes Gully Landfill. The Rapid Fill Water Station will address the shortfalls in sustainable site management by establishing a reliable water supply onsite.

Wollongong City Council (Waste Services) would like to request written endorsement of this project in order to gain a Construction Certificate enabling construction as soon as practicable.

Attachment One

EPA ref: DOC21/878411

Mr Greg Doyle
General Manager
Wollongong City Council
By email at: council@wollongong.nsw.gov.au

12 October 2021

Attention: Nicole Diatloff

Dear Mr Doyle

Whytes Gully Waste Disposal Depot – EPL 5862 – Preliminary stormwater assessment

I refer to Environment Protection Licence No 5862 (Licence) issued to Wollongong City Council (Council) for the Whytes Gully Waste Disposal Depot (Premises) and your email of 5 October 2021 in which you provided the report titled "*Preliminary Assessment: Stormwater Management System (EPL 5862), October 2021*" in response to condition U1.1 of the Licence.

A range of improvement and maintenance works designed to rectify some shortcomings in the current stormwater management system at the Premises was provided. These should continue to be implemented until the remaining conditions of the pollution reduction program (condition U1 of the Licence) are completed.

I note that Council is undertaking a comprehensive water balance at the Premises, as required by condition U1.2 of the Licence and following that, Council is also required to submit an independent assessment of the stormwater management system, as required by condition U1.3 of the Licence. The ongoing stormwater management system will be determined and implemented following the submission of these assessments.

Off-site swale

Thank you for investigating the off-site swale drain issue that had been identified at the Premises. Council has indicated the issues was caused by an impairment in the drainage channel meaning that water was not correctly draining into the Haulage Drain 2. Council has indicated that this has been rectified and water is now correctly draining into the stormwater management system. Please note that Council must continue to ensure that all untreated stormwater is captured by the stormwater management system and meets Licence discharge limits prior to discharge from the Premises.

If you have any questions about this matter, please contact Greg Frost on (02) 4224 4113.

Yours sincerely

LARA BARRINGTON
Unit Head Regulatory Operations

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Whytes Gully Landfill

Preliminary Assessment: Stormwater Management System (EPL 5862)

Waste Services

WOLLONGONG CITY COUNCIL (OCTOBER 2021)

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Whytes Gully Preliminary Assessment: Stormwater Management System (EPL 5862)

1. Introduction

This Preliminary Assessment provides a review of the current stormwater management system, how it is performing and how it can be improved to address Special Condition U1.1 in EPL 5862. This is in accordance with correspondence from the EPA dated 1st March 2021 and ongoing discussions following on from the leachate seepage/stormwater overflow events of February 2020.

The assessment also provides a supporting Improvement and Maintenance Program to prioritise Works to ensure compliance and sustainability in stormwater management at Whytes Gully in the future.

The Pollution Studies and Reduction Program conditions in EPL 5862 relating to stormwater management (and this preliminary assessment) are as follows:

8 U1.1 By no later than 28 August 2021 the licensee must submit a preliminary assessment and update of the existing stormwater management system with the aim of understanding the effectiveness of the current stormwater management system and develop an improvement and maintenance plan.

8 U1.2 By no later than 3 December 2021 the licensee must prepare a comprehensive water balance based on current and future landfill operations. The water balance must consider leachate, groundwater and stormwater at the premises.

8 U1.3 By no later than 31 March 2022 the licensee must submit an independent assessment of the revised stormwater management system prepared by a suitably qualified and experienced independent person. The assessment must include recommendations for improvements to the management of the system to prevent overflow events and ensure compliance with relevant licence limits.

This Assessment looks at the current stormwater management system, areas that can be improved and how this can be addressed via a proposed actions. Supporting information from Golder is provided based on a study and detailed site inspection conducted earlier this year Appendix One and Two respectively). This will form the basis of **8 U1.3 (independent assessment of the revised stormwater management system).**

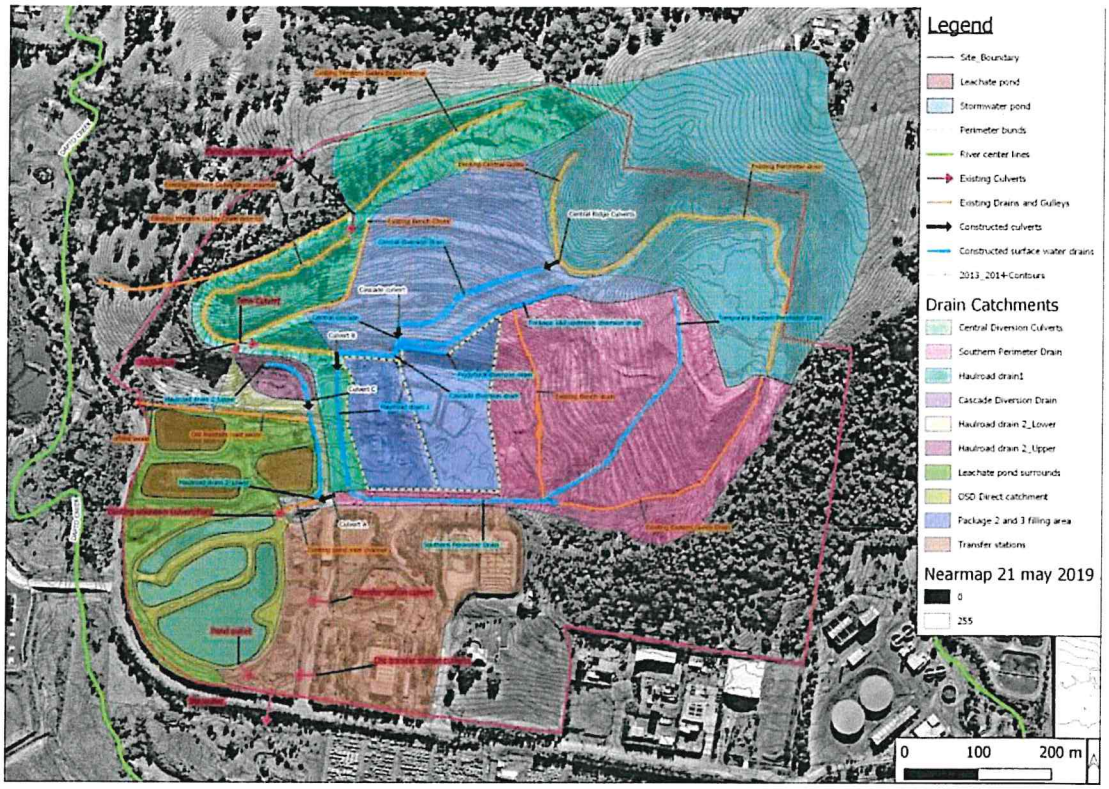
2. Overview of Stormwater Management at Whytes Gully

The site surface water management infrastructure encompasses open channel drains, pipes, culverts and various energy dissipation structures. In general, the surface water management encompasses:

- 'Clean' stormwater. Runoff from areas of the site where soil and vegetation have not been disturbed or final capped areas vegetation has been established is considered to be 'Clean'.
- 'Dirty' stormwater. Run off from areas of the site where soils have been disturbed and are likely to generate sediment are considered to be 'Dirty', including areas of immediate cover or final capping that has not fully vegetated.
- 'Leachate': comprises run off from areas of waste or daily cover material as well as leachate generated by the landfill.

Clean surface water is generally diverted around disturbed areas of the site where possible. Dirty surface water is conveyed to the surface water pond system for sediment treatment, storage and eventual discharge. Surface water that comes into contact with waste (leachate) is collected in the leachate collection system.

3. Current Stormwater Management System



The current main drainage infrastructure is shown in Figure 1. These are briefly described below and discussed in full in Appendix One (Site -wide Stormwater Review (Golder 2021).

3.1 Existing Western Gully External Drain

This is only one clean stormwater drain that discharges directly into Dapto Creek from the site. All other drains shown in Figure 1 drain dirty stormwater into the pond system.

3.2 Central Diversion Drain

The Central Diversion Drain was constructed during the Stage 1 landfill expansion cell works. Reporting catchments include the area north of the Eastern Gully, as well as small northern catchment within the Western Gully. This Drain is connected to the Central Cascade via culverts under a haul road and is designed to convey up to the 1:20 AEP peak flow stormwater event. It was not designed for larger events as it will be removed in the future stages of landfill construction.

3.3 Central Cascade

During the development of Stage 1, a gabion cascade structure was constructed at the end of the Central Diversion Drain designed to cope with 1:20 AEP peak flows. This was primarily an energy dissipation structure and was upgraded recently with the further development of Stage 1 and 2A phase plans. Resulting in a 1:100 AEP peak flow capacity.

3.4 Cascade Diversion Drain

With the development of Package 2 and 3 phase of the landfill, drainage modifications resulted in the flows from the gabion cascade being directed westward into the Cascade Diversion Drain which confluences with a smaller channel which flows in an eastward direction. This drain is designed to convey the 1:100 peak storm event flows.

3.5 Culvert B

Three existing 1.2 metre culverts north of the haul road channel receives flows from the Cascade Diversion Drain as well as existing drains from the west. Flows from both east and west channels were designed to turn 90 degrees for energy dissipation and has been designed for 1:100 AEP peak storm event flows.

3.6 Haul Road Drainage Infrastructure

The Haul Road Drains 1 and 2, which rum parallel on the east and west side of the Haul Road respectively, were designed for construction prior to Package 2 and 3 landfill cells to convey peak flows during major storm events. A dissipation basin was designed for Haul Road Drain 1 to reduce flow energy prior to being directed through Culvert A. Culverts A and C have been sized to convey major storm events (1:100 AEP) without overtopping the Haul Road.

3.7 Southern Drain

The Southern Drain is a permanent open channel drain on the southern edge of the landfill. It has a gabion mattress lined portion and an inverted box culvert portion. The drain has been sized with capacity for major storm events (1:100 AEP) considering the expanded catchments in future stages.

3.8 Surface Water Ponds

All site surface water is currently directed into the Surface Water Pond system located on the south-western portion of the site. The Surface Water Pond system is comprised of three Reed Beds and two Polishing Ponds. The total capacity is approximately 40 000 m^3. The polishing ponds discharge through a concrete culvert overflow and then a culvert under Reddalls Road after combining with treated surface water from the transfer stations. The flows then drain through a series of creeks and wetlands before entering Dapto Creek.

3.9 Rainsheds

To divert clean runoff away from the landfill cell leachate collection system, a system of channels and pipes (known as the 'Rainshed') was designed. The Rainshed consists of an impermeable surface supported by aggregate, creating channels and bunds to divert clean runoff to the temporary eastern drain via outlet pipes. This is a temporary structure in place until the filling of the cell occurs.

4. Issues Identified for Improvement in the Existing Stormwater Management System

A site walkover was conducted by Golder and Waste Services staff on the 10th December 2020 to assess the condition and efficiency of stormwater infrastructure at Whytes Gully. The following areas were identified for improvement:

4.1 Confluence of Southern Drain and Drain 1

The proposed bund at the southern edge of the basin located at the confluence of the Southern Drain and New Haul Road Drain 1 is not in place. Consideration should be given to bunding as designed.

Rip Rap within the confluence of the basin is not visible. Consideration should be given to installing as per design requirements.

4.2 Package 1 Filling Plan – Upstream stormwater diversion

Channel erosion and overtopping has recently occurred along the drainage alignment that exists at the north western perimeter of the Package 1 and Package 2 landfill cell, south of the Western Gully Haul Road. These issues are believed to be related to increased catchment draining through this alignment compared to that assumed in the initial design which incorporated the bund mentioned above. This diversion bund should be implemented as per design requirements.

4.3 Drainage Channels

Various sections of the drainage channels have sediment accumulation within the interstitial spaces of the aggregate. This sediment has the potential to be eroded and carried during elevated channel flows which can result in elevated sediment load of surface water. There is also vegetation growth in some areas within the drainage channels including grasses, shrubs and trees that may result in reduced channel capacity and increased potential for channel overtopping.

Some areas have evidence of shifting rip rap aggregate and it appears that the Temporary Eastern Drain has collapsed and is in need of repair.

Accumulation of waste materials was noted to occur in the gabion and reno mattress lined portion of the Southern Drain. This area should be cleaned and maintained regularly.

The TRM lined stormwater drainage channels also require regular maintenance. Some areas were noted to not have grass establishment and have signs of erosion. There was some signs of liner damage evident.

4.4 Culverts

The main Culverts at Whytes Gully appeared to be functional and free of blockages. Some erosion appears to be occurring at the minor culverts including the accessway to Old Reddalls Road and the western intersection of the Western Gully Haul Road.

4.5 Stormwater Ponds

The Ponds are currently being operated via a manual pump out following confirmation of water quality within the pond being compliant with discharge criteria. It is recommended that the operations be reviewed and automated if possible.

Evidence of sedimentation of the ponds and channels was noted and desilting if the system is recommended. A bathymetric survey should be conducted at the same time to accurately measure storage capacity.

4.6 Potential Sediment Source Areas

The following areas have the potential to increase sedimentation risk on site:

- Borrow Excavation Areas
- Western Gully Stockpile Area
- Operational Areas
- Landfill Intermediate Cover Batters

5. Recommended Preliminary Actions

The following actions are recommended to improve performance of the stormwater management system:

- Development of Sedimentation and Erosion Control Plans for all disturbed and operational areas of the Site.
- Implementation of an inspection and maintenance program for all stormwater drainage infrastructure once upgrade works are undertaken.
- Investigate the suitability of lining at confluence of Southern and Access Road Drain 1 and the need for the proposed bund in the New Haul Road design.
- Implement Diversion Drain as proposed for the Access Ramp Connection design.
- Reconstruction of degraded areas of Rip Rap and TRM lined drains to original design.
- Develop and implement rectification for collapsed section of Temporary Eastern Drain.
- Further review of condition and operation of Stormwater Ponds (e.g. desilting and bathymetric survey).

6. Improvement and Maintenance Program

A list of actions to improve performance and reliability of the stormwater management system has been developed based on short, intermediate and long-term strategies. These are discussed below and summarised in Table One with appropriate timeframes for completion.

6.1 Relocation of Stormwater Monitoring Point 1

Stormwater Monitoring Point 1 was located opposite side of the stormwater discharge outlet on Reddalls Road, Kembla Grange. This point was considered representative of Whytes Gully stormwater discharge quality when the EPL was first issued due to the rural land use surrounding the site. In recent years, there have been significant changes to the catchment, including. an increase in light industrial development. An application to amend the EPL to include this alternate sampling location was submitted and accepted in February 2021 as part of this preliminary assessment.

6.2 Desilting of Stormwater Ponds

The ponds currently contain silt, resulting in less than optimum storage and settling volume. It is planned to stage desilting of the three stormwater ponds progressively over the rest of this year. All ponds will have excess sediment removed and stockpiled for reuse on the site. Where possible, the re-established wetland system will be kept to maintain water quality treatment. Siltation control measures will be put in place and all works will be monitored to ensure no water leaves the site during work. The contracting company has been engaged and the first pond works are underway (this will

include a bathymetric survey component). Unfortunately, COVID 19 restrictions have impacted project delivery timeframes and as a result desilting and survey works are approximately three months behind schedule.

6.3 Stabilisation of Pond Water Quality

The unusually heavy rainfall event of February 2020 (156.5 mm recorded) resulted in leachate migrating into the stormwater management system and impacting water quality. This resulted in a number of treatment methods being put in place based on stormwater analysis results and specialist advice. The methods used were based on a multifaceted approach using a combination of:

- Aeration
- Addition of microorganisms
- Flocking (calcium chloride)

This treatment methodology will continue to be used to maintain and stabilise water quality after rainfall events.

6.4 Water Balance Model for Whytes Gully Waste Facility

Consultants have been engaged by Wollongong City Council to address the issues triggered by the February stormwater contamination event. The consultants will review the original water balance (used in the original designs for the site); and develop an updated comprehensive water balance based on the existing site conditions and future planned landfill expansion. This will incorporate leachate, groundwater as well as stormwater. This water balance development is currently underway and is scheduled to be completed by December 2021.

6.5 Stormwater Harvesting and Reuse

As part of Wollongong City Council's commitment to sustainable site management, a number of water reuse strategies are being implemented. This will result in reducing pressure on the stormwater management system, reducing operational costs and assist in improving site safety.

Council is currently establishing a rapid fill tank station on site, which will utilise treated stormwater for dust suppression, emergency management (e.g. firefighting), road cleaning and other site maintenance requirements.

6.6 Automation of Stormwater Management System

Currently, stormwater is discharged via gravity flow or manual pumping. It is also recirculated via manual placing of hoses and pumps as required. This practice is inefficient and requires at least 3 staff to move the heavy equipment, potentially posing an environmental and safety risk. It is planned to automate this system in the near future to allow for flexibility and improved management.

Water quality monitoring was previously conducted through physical sample collection and field analysis as required.

At the beginning of 2021, an insitu monitoring system was installed to automatically collect environmental data including standard water quality parameters and weather data. This has allowed Council to monitor pond quality in real time and improve timely water quality management.

6.7 Drainage Correction and Maintenance based on results of site review of stormwater system.

The site wide stormwater review identified several areas that would improve management on site and alleviate some of the pressure on the pond system. These are detailed in the previous sections and will be prioritised as part of the operations works plan to ensure that best practice design is followed, and optimal drainage performance is maintained.

6.8 Off-site swale Investigation and Rectification

The Golder Sitewide Stormwater Review identified an off-site swale that directed 'dirty' stormwater to an off-site drain. After detailed review of the report; and a ground truthing exercise by Council staff, the swale was confirmed to be located on the northwester portion of the site (Stage 4a). See Figure 3 in the attached Golder Site-wide Stormwater Review (12 August 2021).

The swale directs water to Haulroad Drain 2 (Lower), however it had been temporarily impaired by a bank of soil disturbed on site during some contractor works in the past. There was existing silt fencing and hay bales downstream of the bank that ensured 'dirty' stormwater did not leave the site. This was immediately rectified to ensure stormwater drains into the Haulroad Drain 2(Lower) catchment.

Further erosion/sedimentation controls were placed around the perimeter of the area as recommended in the review.

7. Improvement and Maintenance Plan

Strategy	Actions	Timeframe
Relocation of Stormwater Monitoring Point 1	Move sampling point onto the site	Complete
Desilting of Ponds	Scoping Works Bathymetric Survey Silt removal Reed Bed Establishment	Underway October 2021 October/November 2021 November 2021
Development of a water balance model	Model the stormwater/leachate/ hydrological system at Whytes Gully	Underway December 2021 completion
Stormwater Harvesting and Reuse	Hardstand preparation Installation of 2 Tanks Installation of pipe, pump infrastructure	Complete Underway February 2022
Automation of Stormwater Management System	Water Quality Monitoring Network Development of Council real time database Installation of automated pumping/recirculation/discharge system	Complete Complete April 2022
Drainage Correction and Maintenance	Desilting/Clean up of site drains Repair of Damaged Infrastructure (Business Case Development based on site review findings) Litter Removal Maintenance of drainage infrastructure	Underway Underway Weekly & Ongoing Quarterly & Ongoing
Off- site Swale Investigation	Undertake Drainage Assessment Redirect water into Haul Road 2 Drain (Lower) Establish Silt and Sediment Control Measures	Underway Complete Complete

8. Conclusions

The detailed site-wide review (preliminary assessment) and site inspection report are provided in Appendix One and Two respectively. The recommendations from this preliminary assessment have begun to be implemented as outlined in the table above and will be funded initially through the following programs:

- $350 000 allocated toward leachate treatment system upgrade.
- $400 000 allocated to leachate pond upgrades.
- $100 000 allocated to stormwater pond upgrades.
- $50 000 allocated to landfill cover upgrades.
- An enclosed Small Vehicle Transfer Station to be constructed in 2021/2022.
- A comprehensive water balance by the end of 2021.
- Trialling of Biocover to decrease erosion and sedimentation
- Vegetation Management Plan implementation – enhancing vegetation plantings to control erosion.

Wollongong City Council is committed to working with the EPA to continue to move forward in the sustainable management of our Waste Operations.