



TLCCG Questions and Answers  
Tullamarine Landfill Aftercare  
Environment Audit  
1 July 2018 to 30 June 2019

EPA CARM's No. 62139-4

4 March 2021 Meeting

# Question No. 1

Could the Auditor please elaborate on how she concluded that the set leachate level was unachievable? What is the new level set in the 28/2/21 PCMP? Can you offer any reason why this “impossible to achieve” level was not noticed before?

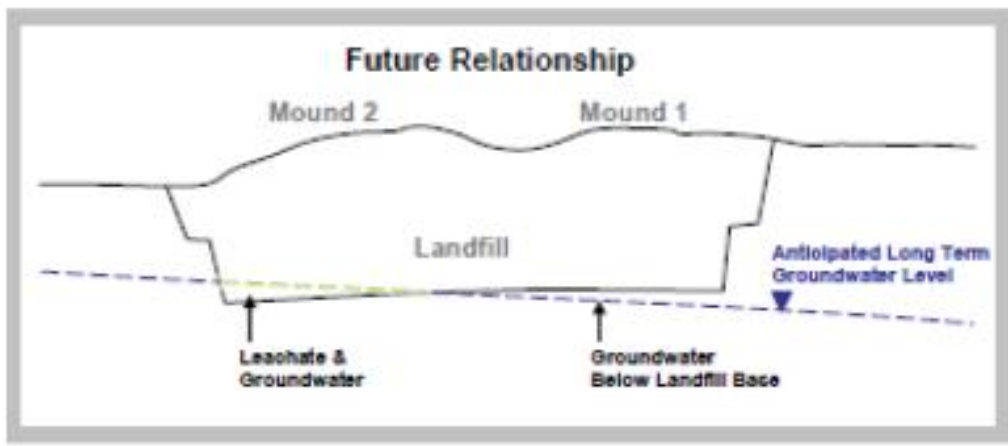
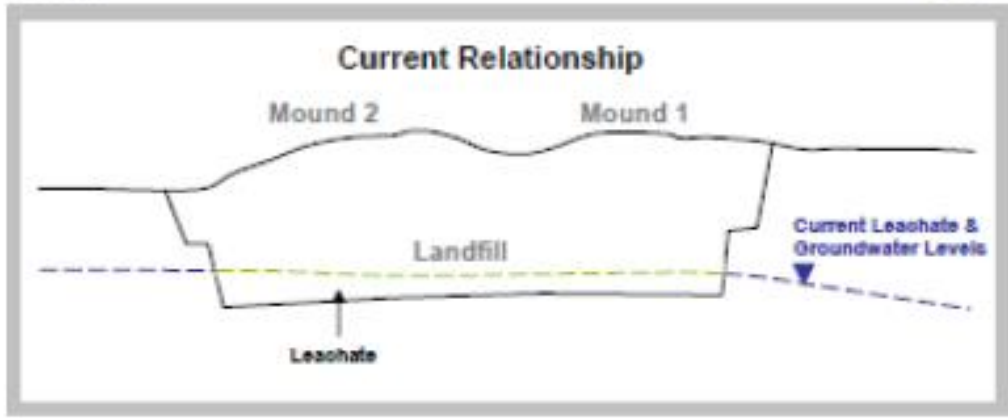
- The set leachate level of 86.95 m AHD is unachievable because:
  - The base of the waste in Mound 1 and Mound 2 sits at approx. 88 AHD (1.05 m above the set leachate target level).
  - Base of waste in Mound 3 is approx. 92 m AHD (5.05 m above the set leachate target level). Mound 3 received solid waste only, and is reported to be dry i.e. there is no “leachate” in Mound 3.
  - The historical (pre-landfilling) groundwater elevation within Mound 2 is approx. 89 mAHD (2.05 m above the set leachate target level). Continuous extraction of leachate and groundwater would be required within Mound 2, indefinitely, to draw the leachate down to 86.95 mAHD.
  - The historical (pre-landfilling) groundwater elevation within Mound 1 is approx. 87 mAHD.
  - Refer to the following slide.

Information sourced from the 2007 Hydrogeological Conceptual Model and Numerical Groundwater Model prepared by Golder Associates.

# Question No. 1

## Current and Inferred Future Leachate and Groundwater Levels

West East



Source: Golder 2007b, page 52

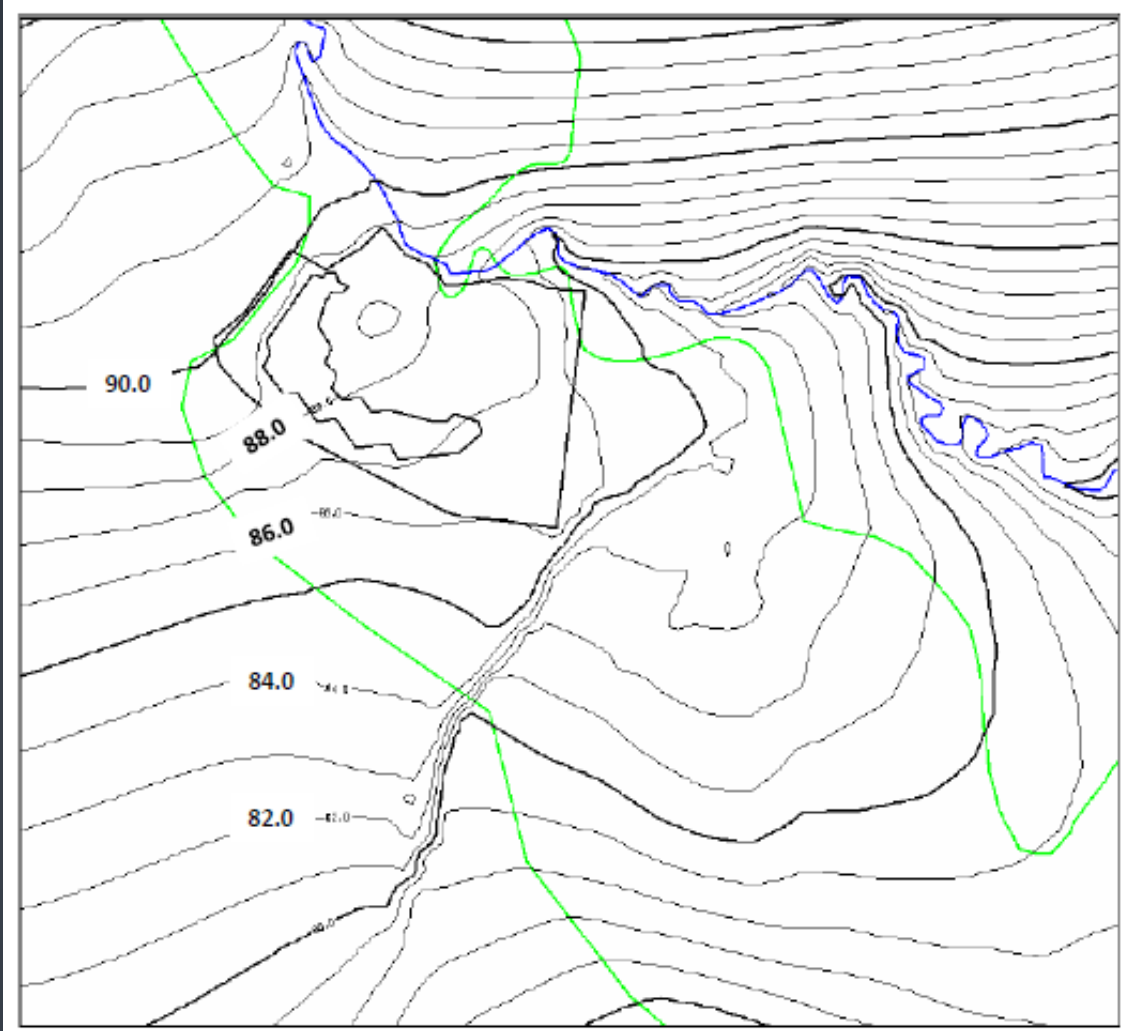


Figure 13: Pre-landfilling Groundwater Levels

Source: Golder 2007c

## Question No. 2

How many of the outstanding recommendations from the previous audit would it have been reasonable to expect to be completed in time for this audit? Of the 11 partially and the 26 not completed at the time of this audit, how many are still outstanding?

- 11 of the actions assessed as not complete were related to the PCMP not being updated, as well as 1 partial action.
- Four of the actions assessed as partially complete were near complete (11, 35, 36a, 45) and it was additional recommendations from this audit to improve the action taken that led to the decision to record them as partial.
- Good progress was made on investigating the landfill gas risks in detail, as these were the risks that were least understood at the completion of the previous GHD audit.
- The in-depth investigation and assessment of landfill gas risks during this audit indicates a low risk to beneficial uses with two outstanding actions to close knowledge gaps in potential pathways.
- To date, 27 recommendations completed and 16 partially completed.

## Question No. 3

Has the Environmental Risk Assessment to inform the PCMP objectives and priorities been completed? Who conducted it? How has its finding influenced the PCMP? Is the document available as a public document?

- The auditor understands Cleanaway has commissioned this process, including:
  - an initial tidy up of the PCMP to incorporate some of the smaller changes, and then
  - a major update incorporating the outcomes of the larger outstanding investigations.
  - The Environmental Risk Assessment would be attached to the next audit report.

## Question No. 4

Does the amended PCMP of 28/2 now comply with BPEM standards of EPA publication 1490.1?

- The amended PCMP will reflect all requirements of landfill aftercare management as detailed within EPA publication 1490.1.

## Question No. 5

Is the Auditor confident that the seven high priority tasks can be completed within the recommended time frame of either the next three months or the next relevant monitoring round? Which tasks fall into the latter category?

- The audit makes recommendations based on the risks and data gaps identified, and does not take into consideration the resources required to complete them.
- The completion of the seven high priority tasks within three months or next monitoring round was challenging but possible.
- Items in next 3 months were:
  - A1 – risk assessment to inform PCMP priorities
  - A2 – update the PCMP – to reflect EPA 1490.1, plus Audit report Table 6-1 items.
  - GW4 – update the HA target leachate levels
  - SW3 – MPC monitoring during low flow conditions
- Items before next monitoring round:
  - GW1 – detailed bore condition assessment
  - GW3 – low flow sampling / master field sheets
  - GW8 – quarterly gauging plus off-site bores

# Question No. 6

When can we expect a report on Monitored Natural Attenuation?

- The auditor does not expect a report to be available within the next 12 months:
  - Further leachate and LNAPL characterisation is required.
  - Groundwater recommendation 8 (quarterly gauging for a year) should be completed, including a search for usable state observation wells further out.
  - Most of groundwater recommendation 6 should be completed i.e. establishing the edge of the groundwater plume to assess whether it is shrinking, stable or otherwise.



## Question No. 7

Is the auditor confident that Cleanaway's current skill set can ensure GW 3 recommendation is implemented?

- Groundwater recommendation 3 is mandating a consistent sampling methodology i.e. all groundwater bores should be monitored using low flow sampling techniques, and from the same depth relative to bore screen level each time. This is normal industry practice and in line with EPA guidelines.

## Question No. 8

How long does the Auditor think it will take to complete a systematic assessment of the groundwater monitoring well network?

- The auditor expects an assessment of the groundwater monitoring network could take at least a month.
- Implementing corrective actions would follow from that.

## Question No. 9

Has the review of the geology and potential for outcropping of LFG to the south and west of the landfill been conducted? What implications does it have? If it's not completed when can we expect to get the results?

- The auditor understands this has not been completed yet.
- Landfill gas recommendation 3 was assigned a medium priority (complete within the next six months).
- The risk off-site is expected to be low, however this recommendation provides additional assurance and gap closure.

# Question No. 10

Given numerical modelling assist in understanding trends how long will it take to update the Numerical Modelling?

- Numerical model:
  - Set up and input data to be defined/selected as close to original model as possible. Note the model used before is specialised and not in common usage.
  - Run scenarios through the model.
  - Calibrate the model.
- Two scenarios:
  - 1<sup>st</sup>: Update now using groundwater levels and TDS concentrations from existing groundwater bores (~ 2 months).
  - 2<sup>nd</sup>: Update after **a year** of quarterly gauging including off-site bores, has been completed (GW 8).
- The second scenario may produce more credible predictions as calibration of the model using groundwater levels and TDS concentrations from off site bores will reduce model uncertainty.

# Question No. 11

With particular reference to Steele Creek and the Maribyrnong River and given that we still don't know the extent of the plume: what state ground water monitoring bores are available, at a suitable depth, from which a groundwater samples could be collected for analysis, so we can

- a. *compare their characteristics to the dump's leachate?*
- b. *continue to use them as a sentinel bores to ensure that neither Maribyrnong river and Steele creek are not being polluted by this dump?*

- Groundwater recommendation 8 requires a search of state observation bores be conducted. If they do not exist or are not suitable, and usable off-site bores in the landfill monitoring network do not provide enough coverage, then new wells will need to be installed. The search was assigned a High (1) priority i.e. within the next three months.
- The overall objective is to identify the extent of the groundwater plume attributable to the landfill, as noted in the question.

# Question No. 12

Given that all waterways in Victorian Volcanic Plains are groundwater dependent, and our deep pools are critically needed habitat refuge pools especially in dry times, the Auditor was not able to assess the risk to water dependent eco systems because of missing data; when will be given an accurate assessment of the risk?

- Prior to assessing the risk to water dependent ecosystems:
  - The Chemicals of Interest (Cols) to be analysed in groundwater and the Moonee Ponds Creek need to be reviewed.
  - The Moonee Ponds Creek should be sampled during low flow conditions, possibly in March 2021.
- Some assessment of the risk may be possible within the next audit, but may not be conclusive.
- It should be noted that the risk profile of the landfill has not suddenly changed, just the specific nature of the data gap has changed.

# Question No. 13

Reference - Para 2.4 - page 8 – (p 24 of 176) G1: A database of all historical and current monitoring data for the Tullamarine landfill should be developed and maintained by Cleanaway, to ensure that data is preserved in a usable format and enable future auditors and assessors to have confidence in the assessments being made.

***Given that this Toxic Waste Dump has been passed through several owners/operators since it opened what guarantee does anyone have the records dating from 1972 are accurate or even complete? (1)***

- There has been considerable focus on improving record keeping for the site.
- Historic records would be extracted from laboratory certificates in previous reports where available.
- Data trends are assessed over a period of time. It's quite likely that some monitoring data will be missing, however with data spanning a 10-20 year period a suitable picture can be established for assessment purposes.
- Laboratories can issue data in a requested format for import into customised database systems such as ESDAT. This is the preference for recent and ongoing water quality monitoring data (groundwater, leachate, LNAPL, surface water).

# Question No. 14

Reference - Para 2.5 – Potential Conflict of Interest – page 8 – (p 24 of 176)  
Further details of audit team member past involvement and Senversa involvement at neighbouring sites is provided in the letter to Cleanaway attached in Appendix F. The letter was also provided to EPA Audit Unit by email on 28 February 2020, with no response received.

***It is to be expected there will be movement of people within waste and waste related industries. Being familiar with the concept of “fire walls” the electronic lock out is noted but how does Senversa ensure physical separation such that there is not an exchange of information on an informal basis? (2)***

- The risk of conflict for MAB and APAM related to confidentiality of those entities information, as they are not subject to a public audit process. Meetings and other discussions of a confidential nature are held in meeting rooms. COVID -19 restrictions also helped.



# Question No. 15

Reference - 3.7.4 - Site Hydrogeology- page 22 – (p 38 of 176) Since the completion of initial capping works in 1990s, groundwater levels have been decreasing due to a reduction in rainfall infiltration and therefore recharge (Golder 2007). The groundwater mounding has produced localised reversals in flow, mainly to the north east and south east, as shown in Figure 7. This is superimposed on a regional, northerly groundwater flow direction, towards MPC. There is also a lesser, southerly flow component towards Maribyrnong River (Golder 2007).

- **Comment 1:** The index in the main report has no reference to figure 7, only figure 16. However, upon examination the index referencing figures 16-1 to 16-8 are in fact figures 1 to 8 contained at the end of the report and in the front of the Appendices document.

Incorrect

## Figures

Figure 16-1: Site Location and Audit Boundary

Figure 16-2: On and Off-Site Groundwater, Leachate, Landfill Gas and Surface Water Monitoring Locations (Site Close Up)

Figure 16-3: On and Off-Site Groundwater, Leachate, Landfill Gas and Surface Water Monitoring Locations (Site and Surrounding Properties)

Figure 16-4: Registered Groundwater Bores within a 3km Radius

Figure 16-5: Extent of Onsite LNAPL, June 2020

Figure 16-6: South-North Landfill Cross-Section Through Mound 1 and Mound 3

Figure 16-7: Indicative Groundwater Contours (Upper Aquifer), February 2020

Figure 16-8: Indicative Groundwater Contours (Lower Aquifer), February 2020

Correct

## Figures¶

Figure-1:-Site-Location-and-Audit-Boundary¶

Figure-2:-On-and-Off-Site-Groundwater,-Leachate,-Landfill-Gas-and-Surface-Water-Monitoring-Locations-(Site-Close-Up)¶

Figure-3:-On-and-Off-Site-Groundwater,-Leachate,-Landfill-Gas-and-Surface-Water-Monitoring-Locations-(Site-and-Surrounding-Properties)¶

Figure-4:-Registered-Groundwater-Bores-within-a-3km-Radius¶

Figure-5:-Extent-of-Onsite-LNAPL,-June-2020¶

Figure-6:-South-North-Landfill-Cross-Section-Through-Mound-1-and-Mound-3¶

Figure-7:-Indicative-Groundwater-Contours-(Upper-Aquifer),-February-2020¶

Figure-8:-Indicative-Groundwater-Contours-(Lower-Aquifer),-February-2020¶

# Question No. 16

Reference - 4.3.3 - Consultation with Hume City Council – page 28 – (p 44 of 176) No contact was made with Council. Cleanaway's Stakeholder and Community Engagement Manager advised on 23 July 2020 that Cleanaway no longer had a contact at Hume Council. It was noted that Council had not sent a representative to the previous October 2018 and October 2019 community meetings.

- ***It would have been a simple matter for the Auditor to contact Hume City Council using the freely available email address: [contactus@hume.vic.gov.au](mailto:contactus@hume.vic.gov.au). A phone call to 03 9205 2200 would have directed the Auditor to the relevant area. Why is it the auditor did not make the attempt to contact or consult with Hume? (3)***

- The auditor consulted with the EPA and Southern Rural Water in relation to some of the risks identified in the audit.
- No issues were identified during the audit that required further information from Council.
- The auditor did not pursue consultation with the City of Hume as she was of the opinion that Council's input would not have changed the audit outcomes.

# Question No. 17

Reference - Maintenance of a monitoring database – page 41 (p 57 of 176) A monitoring database is currently not being maintained by Cleanaway. Previous databases maintained by Golder Associates, Hydroterra and Kleinfeder no longer exist.

- *In the case of a toxic waste dump the records need to be kept for as long as the site is being actively managed and beyond. Some would argue the records need to be kept in perpetuity given the longevity of the toxic chemicals dumped. Is there no requirement within EPA that records are to be retained for a number of years after the event? What systems exist for private companies to archive data such that it is not lost through buyouts, mergers, sale of business or anything else that could lead to loss of corporate memory? Note that the same applies to public bodies. (4)*

- The Post Closure Pollution Abatement Notice requires records to be maintained for seven years.
- It is in Cleanaway's interest to retain records longer than seven years, while a Financial Assurance is still held for the site by EPA.

# Question No. 18

Reference - Table 5-2 - Beneficial Uses  
Considered for the Audit – page 31 – (P  
47 of 176)

- ***This table appears to refer to the offsite bores within a 3 km radius – see Figure 4. Has any attempt been made to test the groundwater from any of these bores in the path of the plume? If not, why not? At the very least it may assist in determining the extent of the plume.***  
***(5)***

- Groundwater recommendation 8 requires a search of state observation bores be conducted. If they are not suitable and additional off-site data is needed, then new wells will need to be installed. The search was assigned a High (1) priority i.e. within the next three months.
- Existing bores identified in Figure 4 which are privately owned cannot be monitored by Cleanaway.

# Question No. 19

Reference - 7.1.2 - Leachate Characterisation – page 47 (p 63 of 176) It is noted that monitored natural attenuation (MNA) is normally used as a management strategy for stable or shrinking dissolved plumes, while natural source zone depletion (NSZD) is more appropriately used for LNAPL.

- ***LNAPL is a general term applying to non-water soluble less dense than water liquids floating on water. It appears that the NSZD concept arises from a relative non fatal perspective. However, where the LNAPL contains known carcinogens natural depletion is unacceptable especially to a nearby community and where the LNAPL can find its way into the groundwater flow. Given that community requests for the LNAPL to be removed and treated when it was freely mobile were not agreed what processes and procedures are in place for the next 100 – 200+ (refer Anthony Lane Preliminary Risk Assessment 2004) years to ensure the LNAPL will not pose a risk the nearby communities while it, hopefully, depletes naturally? How can the community be assured that somewhere in the next 100 - 200 + years the corporate (and public) memory will not be lost and the Dump becomes a disaster in waiting? (6)***

- The LNAPL footprint under and around the landfill has not changed.
- The LNAPL continues to be detected in the same groundwater bores under Mound 3 and to the east of Mound 3 and Mound 1.
- The LNAPL has not moved off site since it was deposited at the site (pre 1990), even when leachate hydraulic gradients within the landfill were much higher i.e. when greater leachate mounding in the landfill could have mobilised it.
- The LNAPL present on leachate in Mounds 1 and 2 and on groundwater under Mound 3 has been sitting below the extent of the clay side liner for some time and off site movement has not been detected.
- Natural source zone depletion of the LNAPL is occurring approximately 20 m below ground level, hence the risk of exposure to the LNAPL or its degradation by-products is low.
- The site will remain on EPA's priority sites register.
- The Financial Assurance for the site will be in place until the site no longer poses a risk to the environment.
- Refer to the following slides.



**senversa**  
 Address: Level 6, 15 William Street  
 Melbourne VIC 3000  
 Phone: (03) 9506 0070  
 Website: www.senversa.com.au

**Legend**

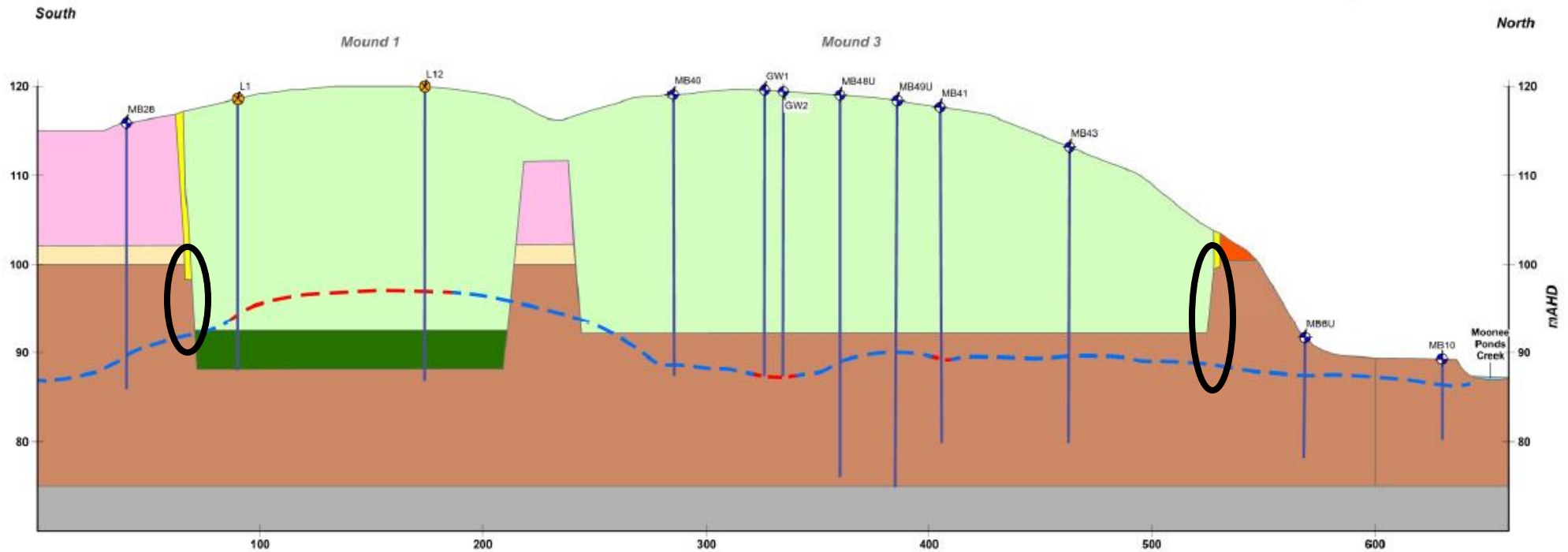
- Site Boundary
- DTM Boundary
- Major Contours
- Minor Contours
- LNAPL Present
- Groundwater Monitoring Well
- Leachate Extraction Well

Notes:  
 Cadastre and road data sourced from land.vic.gov.au (DELWP)  
 Aerial imagery sourced from Neemap Pty Ltd  
 Contours: Tullamarine Site Survey 02-12-19

Designed:	V. Rigoli	Date:	20/11/2020
Drawn:	C. Smith	Revision:	0
Checked:	N. Verga	Scale:	1:3,100 (A3)
File:	M17865_Post Closure Audit		

0 25 50 100 150 200 Metres  
 Datum/Projection: GDA 1994 MGA Zone 55

**Figure No:** 5  
**Title:** Extent of Onsite LNAPL  
**Project:** Tullamarine Landfill Post Closure Audit 2018-2019  
**Location:** 206-300 Western Avenue, Melbourne Airport, VIC 3045  
**Client:** Cleanaway Solid Waste



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Legend	
+	X and Y Axis
⊕	GW Bore
⊗	Loachate Bore
—	Well Info
—	Axis
—	Inferred Groundwater/Loachate Elevation
—	Intermittent LNAPL Elevation
—	Brighton Group
■	Compacted Clay Side Liner
■	FILL
■	LNAPL - Leachate - Groundwater
■	Newer Volcanics
■	Older Volcanics
■	Silt/clay Bedrock
■	Dry Unsaturated Waste
■	Moonee Ponds Creek

Notes:  
Groundwater/Leachate/LNAPL elevations taken in Feb 2020 (Resolve Environmental)  
Crosshairs and road data sourced from land.vic.gov.au (DELWP)  
Aerial imagery sourced from Neasmap Pty Ltd

Designed:	N. Verga	Date:	19/11/2020
Drawn:	C. Smith	Revision:	0
Checked:	S. Harvey	Scale:	(A3)
File:	F006		
NOT TO SCALE			
Datum GDA 1994, Projection MGA Zone 55			

Figure No:	6
Title:	South-North Landfill Cross-Section Through Mound 1 and Mound 3
Project:	Tullamarine Landfill Post Closure Audit 2018-2019
Location:	206-300 Western Avenue, Melbourne Airport, VIC 3045
Client:	Cleanaway Solid Waste

# Question No. 20

Reference - LL1: The 2018 PCMP does not include any specific leachate quality monitoring, and no LNAPL monitoring for Mounds 1 and 2. The Auditor identifies this as a significant gap, and therefore has recommended a program to assist with determining the efficacy of monitored natural attenuation (refer to Section 8.4.4), and to provide up to date information on impacts from LNAPL contaminants of interest

- Comment 2: The Auditor confirms what the community has been expressing for several years, namely that the monitoring of the leachate is inadequate.

- The comment is acknowledged.



# Question No. 21

Reference - 7.4 Gauging Results.

Throughout the report the auditor refers to “gauging” of the wells. Gauging means a number of things to different people in different industries.

- ***Can you provide a definition and explanation of what is meant by “gauging” in the sense used in the report? (7)***

- Gauging in the context of the audit report means measuring a liquid level in a well or bore, either being leachate, groundwater or LNAPL.
- The depth to the liquid is measured, usually as metres below top of casing. If the top of casing elevation is surveyed, the liquid level or depth to liquid can be converted to a reduced level in metres, referenced to the Australian Height Datum (m AHD).

# Question No. 22

Reference - 8.2 - Site Observations – Page 70 – (p 86 of 167) The order for sampling wells for the last few rounds has been based on geographic location (generally starting upgradient and working across), rather than aiming to sample known ‘clean’ wells first.

- ***The auditor appears to be promoting a “clean wells” approach over a geographical approach. Is there a reason for the auditor’s preference and may we have that reason? Should the reason form part of the report? (8)***

- The inference to sample clean wells first is a precautionary measure.
- Sampling cleaner wells first reduces the risk of cross-contamination between wells during sampling, and is usually done as an additional control measure. Decontamination of sampling equipment between wells and/or using disposable equipment for each well is the primary means to prevent cross-contamination.

# Question No. 23

Reference 8.3 - Monitoring Network –  
page 70 – (p 86 of 176)

- **23a. The auditor noted difficulty in locating some of the wells. Did the auditor locate Well MB89U/L in Wright Street? The last time I looked I could not locate the concrete marker/cap. It seems to have been covered by soil. (9)**
- **23b. The auditor notes there are number of wells where the monitoring event was not scheduled within the current audit period. Would it be reasonable to include when the last monitoring event occurred, when the monitoring should have occurred and/or the next monitoring event due? (10)**

- 23a – the auditor was unable to locate bore MB89U/L, however, Cleanaway has advised it was found during the bore condition survey conducted recently.
- 23b – the audit report documents monitoring rounds that were missed. It was not within the audit scope to record the last monitoring event and next due date for every monitoring well.
- The audit report has addressed this by requiring the review of Chemicals of Interest in all monitoring bores and their consistent monitoring over twelve months (groundwater recommendation 5) so that ongoing monitoring trends and risks can be better understood.

# Question No. 24

8.4.1 - Groundwater Elevations – page 75 (p 91 of 176) Groundwater level contours have been prepared by the Auditor and are attached as Figures 7 and 8. They have been prepared using elevations measured by Resolve in February 2020.

- Comment 3. Refer Comment 1.

- Figure 16-7 is Figure 7 and Figure 16-8 is Figure 8 in the audit report.

## Question No. 25

Can you confirm the Landfill Gas Perimeter Monitoring Bores are connected to the gas collection system?  
(11)

- Extraction does not occur from the perimeter landfill gas monitoring bores.
- Landfill gas extraction should generally occur from within landfill waste, not outside it.
- Landfill gas extraction from outside of the source could promote outward movement of gas i.e. subsurface gas migration outside the landfill perimeter.
- Refer to the following slide.



Plan: S01, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32, S33, S34, S35, S36, S37, S38, S39, S40, S41, S42, S43, S44, S45, S46, S47, S48, S49, S50, S51, S52, S53, S54, S55, S56, S57, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69, S70, S71, S72, S73, S74, S75, S76, S77, S78, S79, S80, S81, S82, S83, S84, S85, S86, S87, S88, S89, S90, S91, S92, S93, S94, S95, S96, S97, S98, S99, S100, S101, S102, S103, S104, S105, S106, S107, S108, S109, S110, S111, S112, S113, S114, S115, S116, S117, S118, S119, S120, S121, S122, S123, S124, S125, S126, S127, S128, S129, S130, S131, S132, S133, S134, S135, S136, S137, S138, S139, S140, S141, S142, S143, S144, S145, S146, S147, S148, S149, S150, S151, S152, S153, S154, S155, S156, S157, S158, S159, S160, S161, S162, S163, S164, S165, S166, S167, S168, S169, S170, S171, S172, S173, S174, S175, S176, S177, S178, S179, S180, S181, S182, S183, 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Address: Level 6, 15 William Street  
 Melbourne VIC 3000  
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 Website: www.senversa.com.au

**Legend**

- Groundwater Monitoring Well
- Landfill Gas Bore
- Leachate Well
- Surface Water Sample - Moonee Ponds Creek
- Surface Water Sample - Rockpond
- Watercourse - Tributary
- Watercourse - Main
- Property Boundary

Notes:  
 Cadastre and road data sourced from land.vic.gov.au (DELWP)  
 Aerial imagery sourced from Naaman Pty Ltd

Designed: N. Verga	Date: 23/11/2020
Drawn: C. Smith	Revision: 0
Checked: S. Harvey	Scale: 1:3,000 (A3)
File: F002	

Datum GDA 1994, Projection MGA Zone 56

**Figure No:** 2

**Title:** Groundwater, Leachate, Landfill Gas and Surface Water Monitoring Locations (a)

**Project:** Tullamarine Landfill Post Closure Audit 2018-2019

**Location:** 206-300 Western Avenue, Melbourne Airport, VIC 3045

**Client:** Cleanaway Solid Waste

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## Question No. 26

The base of all three mounds sits above the final target leachate level of 86.95 m AHD. How is it that previous audits did not detect that the final target leachate level was set below the base of the site?  
(12)

- The target leachate level was set within the Hydrogeological Assessment (HA) prepared by Kleinfelder in 2015.
- There has only been one audit since then, completed by GHD in 2019.
- The GHD audit report noted the HA set the leachate level to protect groundwater and the Moonee Ponds Creek. It does not comment on the impracticalities achieving it. A recommendation was made to update the HA.
- We cannot comment on what other auditors may or may not have considered in their assessment, or why.

# Question No. 27

Reference - 10.5.1 - Gas Sources – page 112 (p 128 of 176) The degradation of hydrocarbons from an LNAPL source will usually generate gas volumes consistently, year after year, for decades.

- ***Are you able to advise the estimated number of years the degrading LNAPL will continue to produce methane and other gases please? This community needs to be aware of the risks to the environment and human health. (13)***

- LNAPL degradation will continue to occur and could exceed 100 years.
- The LNAPL at the site is a mixture of oils and fuels disposed from multiple sources and not all of its components can be identified.
- Without understanding all the components that make up the LNAPL, it is difficult to predict its ongoing degradation rate.
- Characterisation of all components of the LNAPL will be difficult.



# Question No. 28

Reference - 10.5.2 - Gas Exposure Pathways - page 113 – (p 129 of 176)  
Installation of the best practice cap over Mound 3 in 2006 and Mounds 1 and 2 in 2011 is also likely to have accelerated lateral migration through potential cracks in the clay side liner.

- Comment 4. Referring to the cap as a best practice cap is disputed by the community.
- According to the March 2011 Report, INDEPENDENT EXPERT GROUP REVIEW OF THE TULLAMARINE LANDFILL MANAGEMENT AND CAP DESIGN by Edward Kavazanjian Jr, PHD. PE, Consulting Engineer and Richard Theil, PE, President, Theil Engineering:

- Refer to the following slide.

## Question No. 28 (cont.)

Review of the proposed final cover designs for the Tullamarine Landfill indicates that the caps as constructed for Mound 3 and as designed for Mounds 1 and 2 meet international best practice standards for hazardous waste final cover (cap) design, construction, and management with four exceptions: absence of a biotic barrier, absence of a free-draining drainage layer, absence of a blanket gas collection layer beneath the entire area covered by the caps, and lack of a comprehensive post-closure Operations, Maintenance, and Monitoring Plan for the site. Absence of a biotic barrier in the Tullamarine cap mandates that appropriate institutional controls be put in place to mitigate the potential for inadvertent intrusion through the cap. These controls should include restricting access to the site and restricting and controlling activities on top of the cap. These controls should be memorialized in a Post-Closure Operations, Maintenance, and Monitoring plan and in deed restrictions.

The community notes the cap is less than that required for a putrescible landfill and given the toxic nature of the chemicals in this landfill and the extremely lengthy time (100 – 200+ years) for the chemicals and other nasties to breakdown into relatively harmless products the faith of the community in cap longevity and performance remains very low. The community would like to see cap integrity and performance included under a separate heading in future audits.

- Cap integrity and performance is addressed in the PC PAN, see condition LC11 which requires the incorporation of landfill cap maintenance in the PCMP.
- Aftercare management recommendation A2 requires ongoing inspection and maintenance of the landfill cap be included in an updated PCMP.
- The international best practice design that the Thiel study compared the Tullamarine cap to was for low-level radioactive waste or hazardous waste.
- The Thiel study report was dated March 2011. The Construction Audit report for Mounds 1 and 2 cap was issued in February 2013, and concluded the cap complied with BPEM 788.1. Construction Audit report for Mound 3 cap was issued in May 2010 and concluded the works met the EPA approved design and works approval.

# Question No. 29

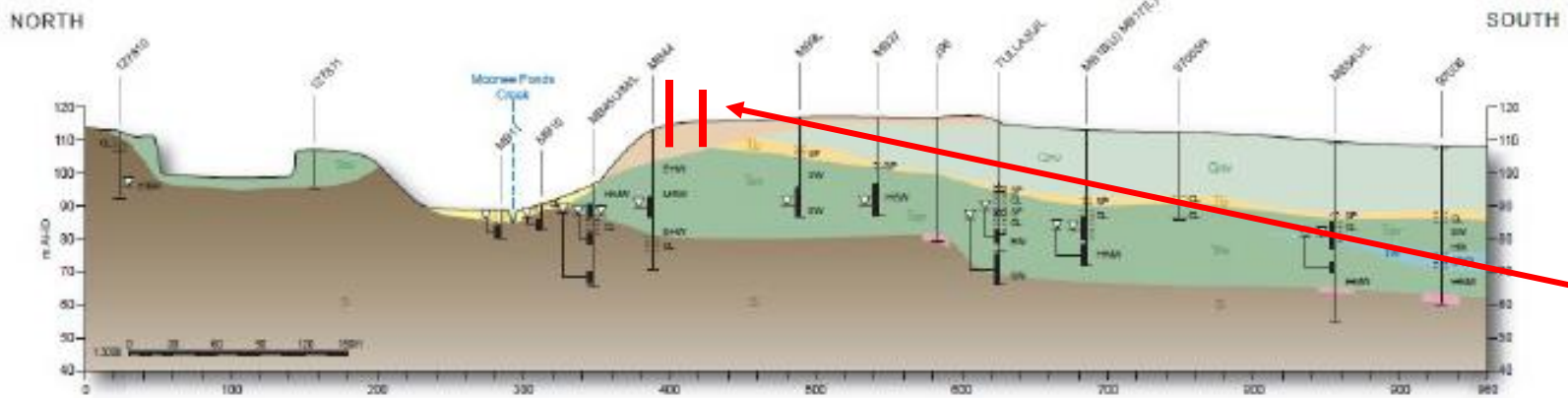
Reference - Table - 10-1: Landfill Gas Perimeter Bore Groups (original wells) - page 105 - (p 121 of 176)

- ***It is presumed the heading FILL in the table refers to soil placed between the finished cap and the surrounding undisturbed ground. Is this correct? (14)***

Fill comprises imported material placed over natural soil or rock. It is not specifically related to the cap.

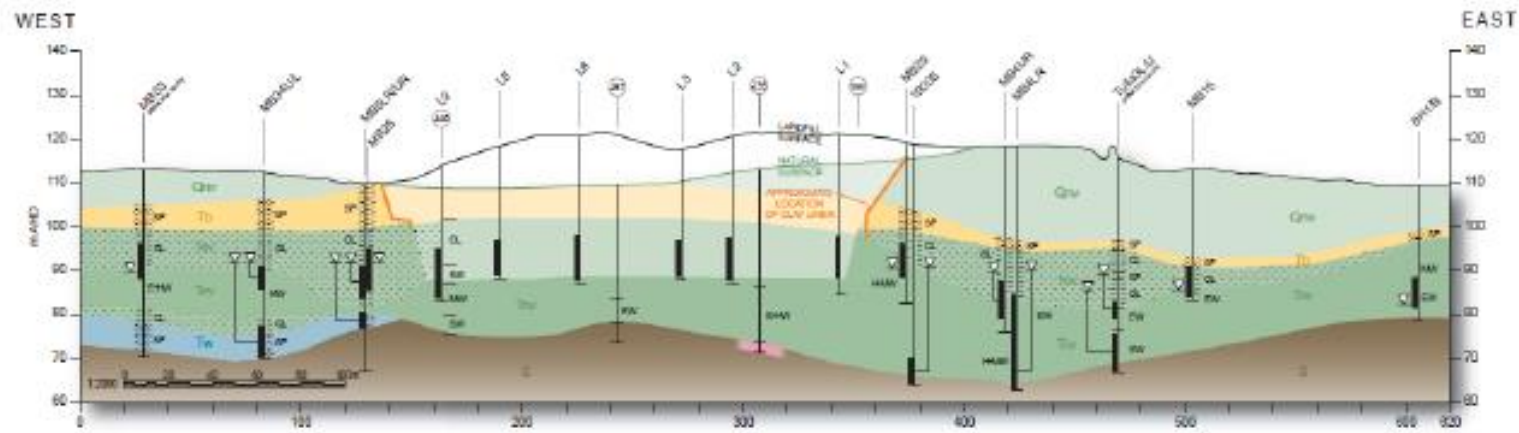
Some shallow perimeter landfill gas monitoring bores are located in the fill that is present outside the landfill cap extent.

Refer to the following slide.



Landfill gas monitoring bores in "Fill".

Source: Golder 2007c, Figure 14



Source: Golder 2007c, Figure 13

- Fill
- Alluvial/Colluvial Sediments
- Newer Volcanics (Qnv)
- Brighton Group (Tb)
- Older Volcanics (Tov)
- Werrabee Formation Equivalent (Tw)
- Silcrete
- Silurian Bedrock (S)

# Question No. 30

Reference - Table 10-2: Landfill Gas Perimeter Bore Groups – New Gas Bores 2020 - page 111 – (p 127 of 176)

- ***It is noted the Table 10.1 uses the prefix TU before each bore identifier whereas Table 2 except for one occasion does not yet the TU prefix is used in the following text. Is this because “sometimes the sampling programs are aligned with other programs, resulting in different naming conventions” as explained by P. Fennelly of Cleanaway at the TLCCG meeting of 15 October 2020? (15)***

- Cleanaway uses the “TU” prefix in front of the bore names so they are not confused with other bores at other Cleanaway sites.
- When discussing the landfill gas results, the audit team tended to leave the “TU” prefix out as the discussions relate to the one Cleanaway site i.e. Tullamarine. On occasion, the audit report used SG, rather than TUSG.

# Question No. 31

Reference - 10.5.3 - Gas Receptors – page 113 – (p 129 of 176) Off-site receptors to the south and south-west of the landfill, including the childcare centre and other buildings on Airport land, beyond the freeway.

**a. The auditor references off site gas receptors which include a childcare centre and Airport buildings. Why are the residents in Wright Street not considered as receptors? What about people working and living on the buffer land should there be building on the buffer, surely they would be off site gas receptors especially as the prevailing winds are from the west and the north? (16)**

**b. Why has no consideration been given to off-site flora and fauna? (17)**

- Section 10.5.2 of the audit report describes gas exposure pathways, all of which are below the ground i.e. subsurface migration of landfill gas.
- Landfill gas will not travel above the ground through ambient air as once it reaches the ground surface, it disperses immediately.
- The heavier components of landfill gas like carbon dioxide can accumulate in underground service pits or structures, just below the ground surface (note this is not occurring in pits /site buildings).
- The landfill migration risk (below the ground) towards the east of the landfill was assessed as low because landfill gas migration was not detected in the outer eastern bores (along Victoria Street boundary).
- Landfill gas subsurface migration is greatest to the south west, at depth, within the Brighton Group and Older Volcanics geological formations, between 10 m and 15 m below ground level.
- Depth to gas off-site is deeper than plant root zones or burrowing depths.

# Question No. 32

Reference - Table 10-5 - Severity Likelihood Matrix (Source - LFTGN 03) – page 115 – (p 131 of 176)

**• Whilst the use of the UK document LFTGN 03 as a Risk Evaluation authority is acknowledged, classifying the consequence of a Catastrophic event however unlikely as Insignificant (refer Table 10.5) is unacceptable to this community. In other industries any event which has a Severity assessment of Catastrophic and that risk cannot be eliminated must be addressed in the Risk Management Plan. Will Cleanaway ensure that, as a minimum, any Risk of Severity Rating of Significant and above regardless of Likelihood is addressed in their Risk Management Plan? (18)**

- Risk = Consequence x Likelihood
- The risk of a “consequence” cannot and should not be assessed without consideration of its “likelihood”.
- For example, it may be considered unjustified for any site owner to plan for a “catastrophic” event in any detail, if its likelihood of occurring is “extremely unlikely”. Risk mitigation measures should be commensurate with the level of risk posed.
- Risk management at the site includes regular monitoring of landfill gas and maintenance of the gas extraction system.

# Question No. 33

Reference - Table 10-7 - Risk Evaluation  
– page 117 - (p 133 of 175)

- ***Both on-site workers and on-site vegetation (flora) are considered as Receptors. Why has on-site fauna been ignored? Native animals are known to frequent the covered portion of the site. Consideration should be given to people living in Wright Street and potentially living and working to the east of the site on the buffer land. (19)***

- The landfill gas risk to onsite fauna is not considered due to the following:
  - Landfill gas risk to workers onsite generally exists when people work within buildings and landfill gas can potentially accumulate within the buildings. Risk to outdoor workers may be present if they attempted to enter subsurface services or conduct works that could ignite flammable landfill gas, like drilling of a leachate well or gas extraction well.
  - Landfill gas risk to onsite fauna is considered negligible as animals generally remain outdoors, and any landfill gas emissions through the cap will dissipate immediately.
  - Landfill gas risk to flora is considered with respect to potential root zone impacts.
- Landfill gas risk to residents living in Wright Street – refer to Question 31 response.



# Question No. 34

Reference - LFG7 (P) – page 121 - (p 137 of 176) The following recommendations are made for the conduct and reporting of LFG monitoring. This is to be detailed in the PCMP: Target all LFG monitoring to coincide with periods of decreasing pressure. As a minimum, avoid monitoring during days of increasing pressure.

- ***This recommendation is not understood. Why decreasing pressure and which pressure is being referenced, atmospheric or landfill gas? (20)***

- Atmospheric pressure is referred to in this section of the audit report.
- Subsurface landfill gas in the ground will most likely rise up out of the ground when atmospheric pressure is low or decreasing. This is a common trend noted in landfill gas monitoring at and around most landfill sites.