



ENVIRONMENT REPORT

# ASSESSMENT OF THE POTENTIAL FOR METHANE GAS MOVEMENT FROM VICTORIAN LANDFILLS

Publication 1270 February 2009



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## 1 EXECUTIVE SUMMARY

The Environment Protection Authority (EPA Victoria) has completed an assessment of methane gas at Victorian landfills in response to the issues identified at the former Stevenson's Road (Cranbourne) landfill.

### Aim

The aim of the assessment was to report on the status of landfill methane management across Victoria, in order to provide community confidence that the issue has been systematically assessed and landfill methane is being adequately managed.

### Objectives

This report provides information on the status of landfill methane management at Victorian landfills. The report includes;

1. a review of methane management at 260 operating and former landfills
2. identification of landfills requiring improved methane management controls and the status of works undertaken by the operators/managers of those landfills
3. identification of opportunities to enhance landfill methane management practices.

### Findings

Two hundred and fifty-two landfills (97 per cent of those assessed) were assessed as being unlikely to have any methane effects on adjacent communities.

At six landfills (two per cent of those assessed) methane from landfill gas was detected at the landfill boundary, above investigation trigger levels. Subsequent investigations show that methane from these landfills is unlikely to have any effects on adjacent communities. However, the landfill operators/managers are now adopting improved methane management controls. The landfills are located in Clayton South, Springvale South and Lyndhurst.

Two other landfills also had methane detected above EPA's investigation level at the landfill boundary. Subsequent investigations suggest this methane is likely to be naturally occurring and is unlikely to have any effects on adjacent communities.

Key management enhancement practices identified:

- Siting, design, construction and management, along with appropriate buffer distances between landfills and sensitive land uses, are all important tools in effectively managing landfills.
- Where suitable siting, design or buffers are not in place landfill operators/managers should conduct periodic assessments of methane management controls at their landfills.
- Landfill management and commercial extraction and energy generation from landfill gas need to be more closely integrated to enable best landfill gas management from an environmental and community protection standpoint.

### Conclusion

Methane gas movement is primarily a legacy of landfilling practices over many decades, typically in larger metropolitan landfills and particularly where siting and design standards predate EPA's current best practice guidelines.

Victorian communities can be confident that no residential estates have been affected in the same way as the development adjacent to the former Stevensons Road landfill in Cranbourne.

EPA will continue regulating and monitoring landfill operator/manager progress to ensure continued safe management of methane gas at landfills.

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## 2 INTRODUCTION

EPA Victoria has completed an assessment of methane gas at Victorian landfills in response to the issues identified at the former Stevensons Road (Cranbourne) landfill<sup>1</sup>.

This report details the assessment outcomes, including the potential for methane gas movement from eight licensed landfills. The assessment was conducted by EPA from September 2008 to January 2009.

## 3 PROJECT SCOPE

The aim of the assessment was to report on the status of landfill methane management across Victoria, in order to provide community confidence that the issue has been systematically assessed and landfill methane is being adequately managed.

This assessment report includes:

- a review of methane management at 260 operating and former landfills
- identification of landfills requiring improved methane management controls and the status of works undertaken by those landfill operators/managers
- identification of opportunities to enhance landfill methane management practices.

All licensed and formerly licensed landfills recorded in EPA's current database were included in the assessment. A list of the 260 landfills can be viewed in Appendix 1.

## 4 PROJECT BACKGROUND

### What is methane?

Methane is a natural gas that is produced by the decay of organic wastes such as food and garden wastes in conditions where there is no oxygen. Degradation of organic waste, such as household food scraps, paper and garden waste, produces high volumes of methane within landfills as it decomposes<sup>2</sup>.

Methane is flammable, and can explode if its concentration reaches between five and 15 per cent within air and an ignition source is present. When concentrations are very high, methane also has the potential to cause asphyxiation in enclosed spaces, through lack of oxygen in the air.

1 A range of measures have been implemented in Cranbourne to help ensure the safety of residents, to reduce the concentration of gas moving from the former landfill and to determine the direction and extent of gas movement. More information is available at [www.epa.vic.gov.au/waste/StevensonsRoad-Cranbourne-Landfill-gas-migration.asp](http://www.epa.vic.gov.au/waste/StevensonsRoad-Cranbourne-Landfill-gas-migration.asp)

2 'Putrescible waste' is the technical term used by EPA for biodegradable wastes that can produce landfill gas.

### Landfilling in Victoria

Under the *Environment Protection Act 1970* ('the Act') many landfills in Victoria do not require licensing, as they are small, service fewer than 5000 people and represent a very low risk to the environment and the community. Unlicensed landfills are managed by local governments. Landfills servicing more than 5000 people or receiving certain types of prescribed waste require a licence from EPA under the current regulatory regime.

### Landfill regulatory framework in Victoria

The design, development and operational standards set by EPA for landfills have become more stringent over time. Key documents are:

- *Best practice environmental management for the siting, design, operation and rehabilitation of landfills* (EPA Publication 788, October 2001) ('EPA's best practice guidelines').
- *Waste management policy (siting, design and management of landfills)*, 14 December 2004 ('the WMP').

EPA's best practice guidelines and the WMP ensure that best practice standards are applied to the siting, design and management of new landfills, to prevent impacts on the environment and community. However, most of Victoria's landfills date back to the 1970s, 1980s and 1990s, when waste management practices were less sophisticated.

EPA's best practice guidelines incorporate international standards for landfill gas management. Under these guidelines, landfill gas management controls need to ensure the methane component of landfill gas does not exceed one per cent by volume in bores or confined spaces at the landfill boundary (meaning methane accounts for one per cent or less of the air content, which is well below the lower explosive limit of five per cent methane). Further investigation and improvement of methane management controls is required if methane exceeds one per cent by volume at the landfill boundary (this is EPA's 'investigation level').

## 5 ASSESSMENT METHOD

The assessment method used by EPA had three stages. Each stage shortlisted landfills for further assessment. That is, failure to meet one or more criteria led to Stage 2 assessment.

### Stage 1

All landfills were assessed against three separate and independent criteria. These criteria were as follows:

1. Had the landfill received waste in the last 10 years? (Criterion 1)

2. Had the landfill a buffer distance less than 500 m from buildings<sup>3</sup>? (Criterion 2)
3. Had the landfill received significant quantities of biodegradable waste? (Criterion 3)

Any landfills meeting any of the above criteria were shortlisted for Stage 2 assessment.

### Stage 2

This stage considered a range of landfill siting, design and operational characteristics (such as cell type and geology) to determine the potential for methane gas movement from the landfill. This stage provided a further shortlist requiring Stage 3 assessment.

### Stage 3

This stage included an initial detailed review of the landfills concerned (including additional site files, audit reports and formal telephone interviews with landfill operators/managers) to determine whether methane monitoring was required. EPA identified a number of sites requiring preliminary field monitoring of methane at the landfill boundary, to complete the assessment. Environmental consultant GHD was engaged to undertake field testing.

EPA's assessment method is explained in Appendix 2. GHD's method for bore construction and testing is described in its report in Appendix 3.

## 6 RESULTS

### Summary of outcomes

A total of 252 landfills (97 per cent of those assessed) were considered unlikely to have any methane effects on adjacent communities.

Eight landfills tested for methane were identified as having a methane concentration above one per cent at the landfill boundary. At six of these landfills the methane is from the landfill; at the other two, the detected methane may be occurring naturally. Whilst improved methane control is being undertaken at these six sites, they are considered unlikely to have any methane effects on adjacent communities.

EPA is confident that no residential estates have been affected in the same way as the development adjacent to the former Stevensons Road (Cranbourne) landfill.

### Results of assessment method

**Stage 1** determined 182 landfills as unlikely to have methane beyond the landfill boundary or buffer zone, including:

- 115 landfills that passed Criterion 1, as they had not been operational for at least 10 years

<sup>3</sup> This does not include all buildings. For instance, methane is unlikely to accumulate in open storage sheds or in warehouses that are not fully enclosed and are hence well ventilated.

- 47 landfills that passed Criterion 2, as they had operated within the last 10 years, but had a complete buffer distance of 500 metres from building developments
- 20 landfills that passed Criterion 3, as they had operated within the last 10 years, had a buffer distance of less than 500 metres, but had never received significant quantities of biodegradable waste.

**Stage 2** assessed the remaining 78 landfills and categorised 50 as unlikely to have methane beyond the landfill boundary. As the Stevensons Road Cranbourne landfill has a dedicated EPA project team, this landfill also did not require further investigation.

**Stage 3** assessed 27 landfills. A detailed information review determined that seven landfills were unlikely to have methane beyond the boundary. Twenty were assessed as requiring methane testing at the boundary. EPA engaged GHD consultants to construct bores and undertake methane testing at these landfills. A number of landfill operators provided testing data to assist EPA's Stage 3 assessment.

Methane testing identified seven landfills with no detectable methane and five with methane levels below EPA's investigation level in bores at the landfill boundary. Eight landfills had detectable levels of methane above the investigation level at the landfill boundary, though at two of these the methane may be of natural origin. These eight landfills are discussed further in section 6 below.

**Table 1: Results of the landfill assessment method**

Assessment stages	Number of landfills
<b>Stage 1 assessment</b>	
Criterion 1: Closed more than 10 years	115
Criterion 2: Existing buffer of 500m	47
Criterion 3: Solid inert waste landfills	20
<b>Subtotal</b>	<b>182</b>
<b>Stage 2 assessment</b>	
Detailed Information Review	50
Stevensons Road Cranbourne Landfill	1
<b>Subtotal</b>	<b>51</b>
<b>Stage 3 assessment</b>	
Methane testing not required after detailed information review	7
No methane detected	7
Methane found below investigation level	5
Possible natural methane found above investigation level	2
Landfill methane found above investigation level	6
<b>Subtotal</b>	<b>27</b>
<b>TOTAL</b>	<b>260</b>

The location of the 260 landfills is listed in Appendix 1. The results of GHD's investigation are detailed in Appendix 3. The methane monitoring results provided by landfill operators is detailed in Appendix 4.

## 7 LANDFILLS REQUIRING METHANE MANAGEMENT WORKS BY OWNERS

This section of the report provides further information on the eight landfills where methane was detected above EPA's investigation level. At two of these the methane detected may be derived from natural sources (local peat soils or 'swamp gas'). At the remaining six the methane detected is considered to have originated from the landfill.

The landfills where methane gas was detected all contain older, closed landfill cells that are a legacy of siting and design standards predating EPA's best practice guidelines. It is mostly the older cells that are associated with methane gas movement from the landfills.

Appendix 5 of this report contains the technical detail of the methane management works being carried out at the eight landfills. One step in this process will be for operators to engage an EPA-approved environmental auditor to conduct an audit of the site. This is a statutory environmental audit conducted in accordance with section 53V of Part IXD of the *Environment Protection Act 1970*.

### Landfills with possible natural methane detected

#### Hallam Road landfill, Hampton Park

This landfill is operating under EPA licence ES33144. The operator installed 18 bores along the landfill boundary at this landfill and methane was not detected in 17 of the bores. A methane concentration above EPA's investigation level was detected by the operator adjacent to a small reed pond, at approximately eight metres depth, within one monitoring bore only. This bore was located within 50 metres of adjacent residential properties.

The methane detected may be derived from local swampy/peat deposits and not the landfill, for the following reasons:

- monitoring bores adjacent to the landfill cells do not have detectable levels of methane
- shallow monitoring bores closer to the residential properties do not have detectable levels of methane, indicating that methane is not present within surface soil
- the operator has compared the gas composition in the monitoring bore with that of the landfill gas from the landfill. The results were not conclusive but indicated that the gas within the bore has a different composition to the landfill gas.

As a precaution this landfill is being audited to confirm the source of the detected methane. The audit will identify if any further gas management actions are warranted.

#### Bosworth Road landfill, Bairnsdale

This is a closed and capped landfill that used to operate under EPA licence LS169. EPA installed six shallow bores along the boundary at this landfill and methane was not detected above EPA's investigation level in five of the bores. Methane was initially detected above EPA's investigation level in one bore only, located in an area of peaty soil not adjacent to any buildings.

The detected methane may be derived from these peat deposits and not the landfill. Over time, the methane concentration in this bore has decreased to less than one per cent by volume (in other words, below EPA's investigation level), suggesting decay of organic matter produced the methane, rather than being landfill gas. Methane concentrations would be expected to rise and fall with air pressure if the source of the methane was landfill gas.

As a precaution this landfill is being audited to confirm the source of the detected methane. The audit will identify if any further gas management actions are warranted.

### Landfills with landfill methane gas detected

The following six pages provide community information for three areas of greater Melbourne where landfill methane was detected above one per cent concentration, with no immediate methane effects on surrounding buildings being identified.

## EPA ASSESSMENT OF LICENSED LANDFILLS: LYNDHURST AREA

### Background to Taylors Road, Lyndhurst landfill

This landfill has received large volumes of organic waste from municipal waste since the 1990s, which will produce a significant volume of methane.

After the closure of the Tullamarine landfill in 2008, the Taylors Road landfill became the only remaining landfill in Victoria licensed to receive Category B prescribed industrial waste. The operator is continually improving the site to meet or exceed best practice design standards. The prescribed industrial waste is unlikely to generate significant volumes of methane.

The EPA licence for this landfill requires that no more than 35 per cent of the waste deposited is prescribed waste. Hence biodegradable waste is the dominant waste type in the landfill.

### What was found at the Lyndhurst landfill?

This landfill has an extensive network of 28 monitoring bores on the landfill premises, maintained by the landfill operator, with five shallow bores constructed by EPA for this assessment at the landfill boundary.

Twenty-six monitoring bores have not detected methane above EPA's investigation level.

Seven monitoring bores detected methane above the investigation level around the boundary. Methane was detected in three locations, on the northern, western and southern boundaries, outside of landfill cells but within the landfill boundary. In one of these locations, methane was also detected outside the boundary. The landfill cells adjacent to where methane was detected are all closed organic (municipal waste) cells that have a clay liner predating EPA's best practice guidelines. Methane movement at this site is a legacy of historical landfill design methods.

### Northern landfill boundary

High levels of methane were detected in four bores established on, and one bore just outside of, the northern landfill boundary. A cut-off trench has been constructed in this area to intercept the methane. Shallow monitoring bores further beyond the boundary have not detected methane, indicating methane in surface soils does not extend to industrial buildings further north.

### Western and southern landfill boundaries

Methane was detected in one bore on the western boundary and one bore on the southern boundary. These bores may be located in historical landfill areas, explaining the methane detected. Adjacent bores constructed just outside the landfill boundary did not detect any methane. This suggests that methane is

unlikely to have moved beyond the landfill boundary at these locations.

### What is being done at Lyndhurst now?

- Additional monitoring bores have been established outside the northern boundary of the landfill.
- The onsite gas extraction system has been improved by the operator to increase landfill gas extraction.
- Boundary gas monitoring bore networks are being expanded by the operator.
- The operator has installed a landfill gas cut-off trench along part of the northern landfill boundary.
- An EPA-approved environmental auditor has been engaged to conduct an environmental audit.
- EPA has required a gas management plan from the operator, with regular updates reported to EPA.

### Are homes and neighbourhoods safe?

Yes. Methane has only moved a short distance beyond the landfill at a section of the northern boundary. No residential premises or other buildings have been affected by methane. The operator has installed a gas cut-off trench to control the gas movement.

### How will the community be kept informed?

Further information is available on EPA's website and information will be updated periodically ([www.epa.vic.gov.au/waste/landfill-assessments.asp](http://www.epa.vic.gov.au/waste/landfill-assessments.asp)).

For further information, please call the site operator or EPA on the numbers listed below:

**SITA Lyndhurst**  
9554 4554

**EPA Victoria**  
9695 2722

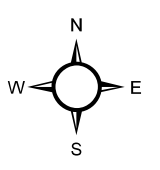




**Taylors Road Landfill  
ES511**

1:5,000 (at A3)  
0 30 60 120 180  
Meters

Map Projection: Vicgrid 94  
Datum: Geocentric Datum of Australia 1994



- |                             |                |
|-----------------------------|----------------|
| Sealed Road                 | Freeway        |
| Unsealed Road               | Highway        |
| Sealed Walking/Bike Trail   | Rail Lines     |
| Unsealed Walking/Bike Trail | Land Fill Site |
| Unsealed Track              | Parcel         |



# Taylors Road Landfill

Licence No. ES 511      Data Source: State of Victoria and GHD

Disclaimer: Only EPA licensed (and former licensed) landfills where methane was detected >1% v/v adjacent to the site are shown. The landfill site boundary reflects the boundary of the site itself; waste deposits will be present within these boundaries, commonly distributed in zones. Other landfills may be present in this area but are not shown on this plan. The extent of the plan is for context only, and should not be interpreted as the extent of methane gas movement. Suburbs surrounding these landfill sites have not been affected by methane.

## EPA ASSESSMENT OF LICENSED LANDFILLS: CLAYTON SOUTH AREA

### Background to the Clayton South area

Much of the Clayton South area was used for sand quarrying dating back to the 1890s. This was followed by intermittent landfilling, which became more prevalent in the 1960s. There are numerous closed and several operating landfills in this area. Older landfill cells are a legacy of historical design standards that required only limited methane controls. Most of the landfills in this area have extraction systems that use gas to generate electricity. The sandy soils in the area do not create a secure barrier to offsite methane gas movement.

### What was found in the Clayton South area?

In the Clayton South area (see map), EPA identified three landfills that require methane management works by the operators to monitor and stop methane movement. These landfills are located on Fraser Road, Heatherton Road and Clayton Road respectively. Methane was detected at the boundary of each of these landfills at concentrations above one per cent.

Three isolated homes (situated away from other residential developments), two plant nurseries and a small number of industrial or commercial buildings are located relatively close to where methane was detected.

Monitoring within one of the commercial buildings found no methane. Additional monitoring next to the plant nursery buildings indicated that methane is present at very low levels (below one per cent concentration). The bores closest to the three homes have also found only very low levels of methane (below one per cent concentration). Monitoring in stormwater drains, along which methane could move, also showed very low levels.

In summary, monitoring on landfill boundaries in this area found high levels of methane outside of landfill cells. However, monitoring around nearby buildings to date indicates the methane does not extend to buildings at concentrations greater than one per cent.

### What is being done in the Clayton South area now?

- Landfill operators have offered methane monitors or onsite gas monitoring bores to the occupiers of the homes, plant nurseries and other industrial buildings while gas management works are completed.
- Onsite gas extraction systems are being improved by operators.
- Boundary gas monitoring bore networks are being either upgraded or installed by operators.
- Operators are installing landfill gas cut-off trenches to intercept gas escaping the landfill.

- Operators have engaged EPA-approved environmental auditors to conduct an environmental audit.
- EPA has required a gas management plan from the operators, with regular updates reported to EPA.

### Are homes and neighbourhoods safe?

Yes. Methane has not been detected in homes. Monitoring close to buildings (including monitoring in stormwater drains and fibre optic cable pits) showed methane gas concentrations were very low (less than one per cent concentration, which is below the EPA investigation level). Landfill operators are undertaking works to improve control of landfill gas from their sites.

### How will the community be kept informed?

Further information is available on EPA's website and this information will be updated periodically ([www.epa.vic.gov.au/waste/landfill-assessments.asp](http://www.epa.vic.gov.au/waste/landfill-assessments.asp)).

For further information, please call the site operators or EPA on the numbers listed below:

**TPI Landfills (Heatherton Rd & Fraser Rd)**  
9552 1718

**Clayton Road Joint Venture Landfill**  
9558 7220

**EPA Victoria**  
9695 2722





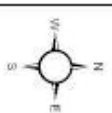
# Landfill Sites in the Clayton South Area

Licence Nos. EM 28818, ES 20872 & ES 49849

Data Source: State of Victoria and GHD



- Sealed Road
- Unsealed Road
- Sealed Walking/Bike Trail
- Unsealed Walking/Bike Trail
- Freeway
- Highway
- Rail Lines
- Land Fill Site
- Parcel
- Unsealed Track



1:7,500 (at A3)  
 0 45 90 180 270  
 Meters

Map Projection: Vicgrid 94  
 Datum: Geocentric Datum of Australia 1984

Disclaimer: Only EPA licensed (and former licensed) landfills where methane was detected >1% v/v adjacent to the site are shown. The landfill site boundary reflects the boundary of the site itself, waste deposits will be present within these boundaries, commonly distributed in zones. Other landfills may be present in this area but are not shown on this plan. The extent of the plan is for context only, and should not be interpreted as the extent of methane gas movement. Suburbs surrounding these landfill sites have not been affected by methane.

## EPA ASSESSMENT OF LICENSED LANDFILLS: SPRINGVALE SOUTH AREA

### Background to the Springvale South area

Much of the Springvale South area was used for sand quarrying dating back to the 1890s. This was followed by intermittent landfilling, which became more prevalent in the 1960s. All of the landfills in this area are closed landfills. All of the landfill cells are a legacy of historical design standards that required only limited methane controls. The landfills in this area have extraction systems that use gas to generate electricity. The sandy soils in the area do not create a significant barrier to offsite methane gas movement.

### What was found in the Springvale South area?

In the Springvale South area (see map), EPA identified two former landfills that require, and are having undertaken, gas management works by the managers to control methane gas movement. These former landfills are located on Spring Road and Clarke Road.

At the Spring Road former landfill, high levels of methane were detected in bores adjacent to two isolated homes situated away from other residential developments. It is possible that the former landfill extends up to the boundary of these two properties, hence these monitoring results may reflect methane within the waste. Further monitoring around and within one of the homes did not detect methane above the EPA investigation level of one per cent concentration.

At the Clarke Road former landfill, high levels of methane were detected in bores adjacent to a community building and residences on the southern boundary. However, monitoring under buildings and in electrical pipes and stormwater drains (which act as potential pathways for methane) has shown very low levels of methane, below the EPA investigation level of one per cent concentration. One stormwater drain, not located near the community building or residences, showed high levels of methane, but this has since been fitted with grated lids to allow gas venting. Subsequent monitoring of this drain has shown significantly reduced levels of methane.

### What is being done in the Springvale South area now?

- Landfill managers will offer methane monitors to the occupiers of nearby houses whilst gas management works are completed.
  - Boundary gas monitoring bore networks are either being upgraded or installed by managers.
  - A cut-off trench is being installed at the southern boundary of the Clarke Road former landfill.
  - Onsite gas extraction systems are being improved by managers.
- Managers have engaged EPA-approved environmental auditors to conduct an environmental audit.
  - EPA has required a gas management plan from the managers, with regular updates reported to EPA.

### Are homes and neighbourhoods safe?

Yes. Methane has not been detected in homes. Only a small number of homes and a community building are located near areas where methane was detected in bores. Methane was only detected at very low concentrations (well below the EPA investigation level of one per cent concentration) beneath the community building and around houses. Landfill managers are undertaking works to improve control of landfill gas from their sites.

### How will the community be kept informed?

Further information is available on EPA's website and this information will be updated periodically ([www.epa.vic.gov.au/waste/landfill-assessments.asp](http://www.epa.vic.gov.au/waste/landfill-assessments.asp)).

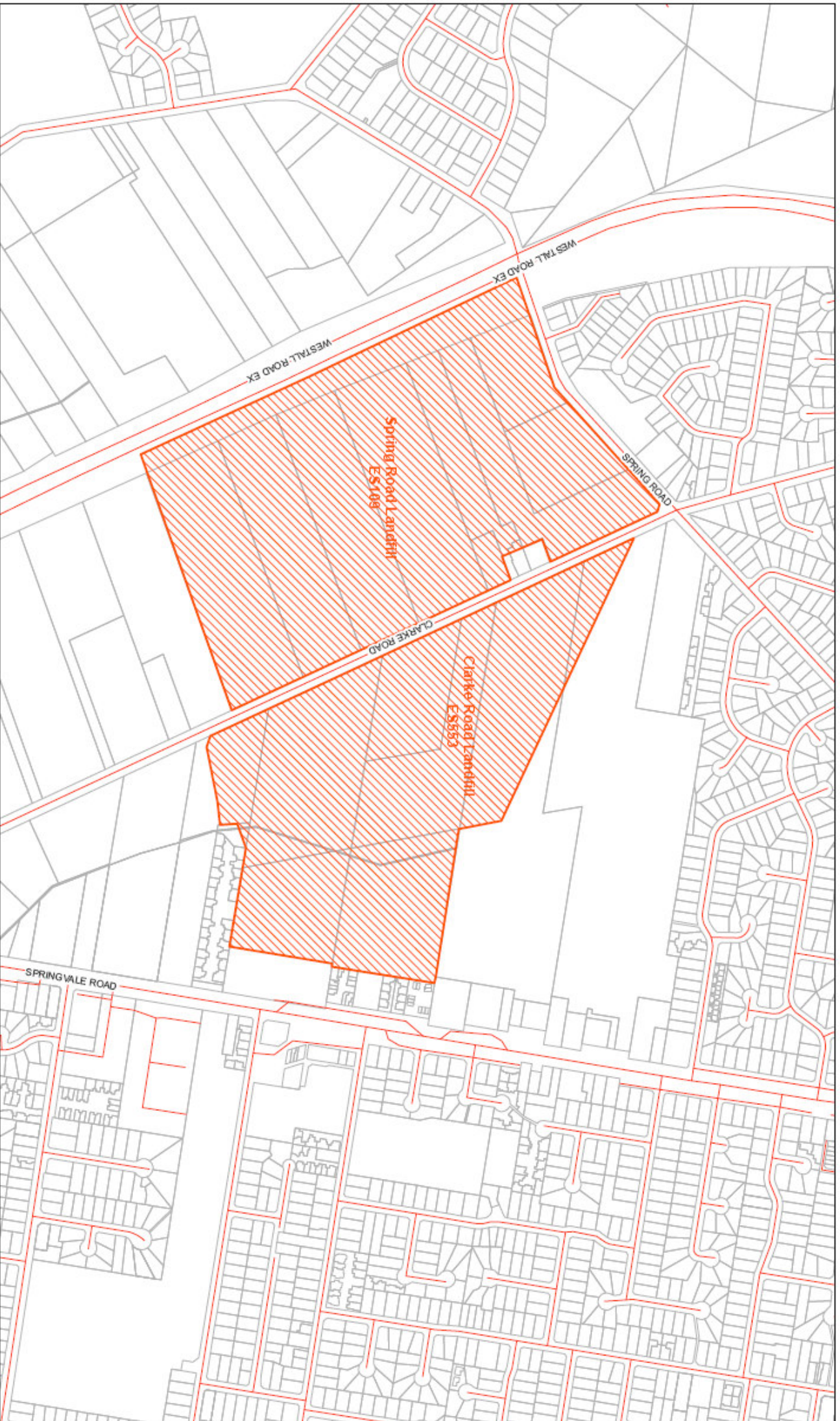
For further information, please call the site owners or EPA on the numbers listed below:

**City of Greater Dandenong (Clarke Rd)**  
9239 5359

**Glynlee Pty Ltd (Spring Rd)**  
9789 1693

**EPA Victoria**  
9695 2722





1:5,000 (at A3)

0 30 60 120 180

Meters

Map Projection: Vicgrid g4

Datum: Geocentric Datum of Australia 1984



- |  |                             |  |                |
|--|-----------------------------|--|----------------|
|  | Sealed Road                 |  | Freeway        |
|  | Unsealed Road               |  | Highway        |
|  | Sealed Walking/Side Trail   |  | Rail Lines     |
|  | Unsealed Walking/Side Trail |  | Land Fill Site |
|  | Unsealed Track              |  | Parcel         |



## Landfill Sites in the Springvale South Area

Licence No's. ES 109 & ES 553

Data Source: State of Victoria and GHD

Disclaimer: Only EPA licensed (and former licensed) landfills where methane was detected > 1% v/v adjacent to the site are shown. The landfill site boundary reflects the boundary of the site itself. Waste deposits will be present within these boundaries, commonly distributed in zones. Other landfills may be present in this area but are not shown on this plan. The extent of the plan is for context only, and should not be interpreted as the extent of methane gas movement. Surrounding these landfill sites have not been affected by methane.

## 7 CONCLUSIONS

EPA assessed 260 operating and closed licensed landfills across Victoria for potential methane gas movement.

Victorian communities can be confident that no residential estates have been affected in the same way as the development adjacent to the former Stevensons Road (Cranbourne) landfill.

In summary, the assessment found:

- 252 landfills (97 per cent of those assessed) were considered unlikely to have any effects on adjacent communities
- eight landfills had detectable levels of methane above the EPA investigation level at the landfill boundary, but at two of these sites the methane may be naturally occurring.

The operators/managers of these eight landfills are deploying monitoring and mitigation strategies for each landfill and are working in close collaboration with EPA. Operators/managers have already begun gas management works. A landfill gas audit is being conducted at each of these landfills by an independent, EPA-approved environmental auditor. The landfill operators/managers must provide regular monitoring updates to EPA until management actions are complete and the environmental auditor has confirmed that offsite movement of methane is no longer occurring.

A small number of houses or commercial/industrial buildings are located near areas of the landfills where methane was detected in bores. However, monitoring close to these buildings (including monitoring bores, monitoring underneath buildings and in stormwater drains) showed methane gas concentration was below the EPA investigation level.

Siting, design, construction and management, along with appropriate buffer distances between landfills and sensitive land uses, are all important tools in effectively managing landfills. The landfills where methane gas was detected all contain older, closed landfill cells that were designed to standards predating EPA's best practice guidelines.

It is these older cells that are the sources of most methane gas movement from the landfills. This highlights the legacy of past landfill siting and design practices that now require a higher standard of ongoing monitoring and management by landfill operators to ensure they do not have an adverse effect on the community and the environment. Accordingly, EPA is requiring the operators/managers of these landfills to apply current best practice standards for rehabilitation, monitoring and gas extraction to these older landfill cells. This is required to control methane and thus protect the community and environment.

## 8 RECOMMENDATIONS

Conducting this methane gas assessment has provided EPA with an opportunity to gauge the evolution of best practice in landfilling, within the context of changing development and land use around landfills.

The assessment findings will help inform further refinement of EPA landfill programs and policy. A number of recommendations are detailed below.

### Biodegradable waste to landfill

The assessment supports the view that landfilling biodegradable waste may pose a long-term liability to both the environment and the community. Under the Act the waste hierarchy suggests biodegradable waste should be reused where possible rather than deposited to landfill. The findings of this assessment reinforce the need to adopt the waste hierarchy to maximise biodegradable waste reuse, and therefore minimise methane generation.

EPA will continue to implement and support initiatives that lead to sustainable waste management solutions, thereby reducing long-term liabilities associated with landfilling.

### Landfill siting, design and construction

In many cases there are closed or operating landfills that are a legacy of outdated siting and construction methods. At some of these landfills methane movement has not been totally controlled.

To address these issues EPA will require landfill operators to adhere more closely to EPA's best practice guidelines for siting, design, operation and rehabilitation of landfills. Where necessary, landfill operators will need to take additional actions to address any legacy issues caused by historical landfill siting and construction methods.

This review also highlights that sandy soil areas are not ideal locations in which to construct landfills, because sandy soils do not secure methane from moving beyond the landfill cell in all cases. Sandy soils in coastal areas are also often associated with high groundwater levels, which can inhibit gas extraction if groundwater is able to enter the landfill cells.

### Landfill gas management

The assessment has highlighted that many landfills in Victoria currently have passive (venting) gas extraction systems. Some of these landfills may require active (pumped) gas extraction systems for enhanced gas management.

Some landfills do not have sufficient boundary gas monitoring bores, with limited buffer distances to surrounding buildings. EPA will require gas management plans to be prepared (or revised) for



these landfills to ensure that gas management is of an even higher standard in future.

It has also been found that commercial landfill gas extraction systems do not always ensure landfill gas does not move off-site. Optimal gas extraction at the landfill boundary is preferred to ensure landfill gas does not move offsite. However, methane gas at the landfill boundary is usually less concentrated and therefore less suitable for commercial energy generation. Thus, extraction systems that focus on maximising energy generation alone may not have sufficient bores at the boundary to control gas movement.

EPA will be conducting a further review of this matter, in collaboration with landfill operators/managers and commercial gas extraction operators/managers, to determine how integrated landfill management and gas extraction systems can better protect the environment and communities.

As a result of this assessment EPA will review guidelines and, where needed, strengthen the regulatory regime for landfill operators/managers regarding methane monitoring, management and assessment. Any changes to guidelines or regulations will:

- address the need to install sufficient monitoring bores and gas management infrastructure to control gas movement, relative to the landfill size and adequacy of buffers to surrounding land uses
- ensure that landfill gas risks from landfills are regularly reviewed and updated by the operator in the context of landfill age and surrounding land use.

### Planning guidelines

EPA's best practice guidelines recommend a 500-metre buffer distance between dwellings and landfills accepting biodegradable wastes. A 200-metre buffer distance is required between dwellings and landfills accepting only solid inert waste.

EPA intends to work with planning authorities to ensure that planning controls do establish and maintain buffer distances (in other words, so that they are not relaxed or bypassed). Where full buffer distances never existed, or no longer exist, landfill operators/managers will need to conduct a periodic assessment and review of methane generation from their landfill.

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### APPENDICES (AVAILABLE SEPARATELY FROM [WWW.EPA.VIC.GOV.AU](http://WWW.EPA.VIC.GOV.AU))

**Appendix 1: List of assessed landfills**

**Appendix 2: EPA assessment method**

**Appendix 3: Methane monitoring data provided by GHD consultants**

**Appendix 4: Methane monitoring data provided by landfill operators**

**Appendix 5: Gas management works undertaken by landfill operators**