REPORT

Tonkin+Taylor

Bluegums Landfill

Odour Modelling Assessment

Prepared for
Marlborough District Council
Prepared by
Tonkin & Taylor Ltd
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1 Introduction

1.1 General

Tonkin & Taylor Ltd (T+T) has been engaged by Marlborough District Council (MDC) to prepare a baseline odour modelling assessment for Bluegums Landfill ("Bluegums"), in accordance with our letter of engagement (reference 85158.012) dated 17 September 2020.

Bluegums is owned and operated by MDC and has recently received odour complaints from nearby residences at and around Taylor Pass Road near Blenheim. Accordingly, MDC is undertaking investigation of odour mitigation measures to reduce the odour effects from Bluegums. To this end, T+T has been engaged by MDC to undertake an odour modelling assessment to achieve the following objectives:

- Identify existing locations/receptors at greatest risk of experiencing odours from Bluegums.
- Predict baseline odour concentrations arising from the main odour source (i.e. active working face) at Bluegums during normal routine operations.

Establishing baseline odour concentrations allow characterisation of current levels of potential odour impacts based on operational conditions at the time of assessment. The impacts of any future changes in operational conditions or odour mitigation options upon ambient odour concentrations can then be tracked by comparing against the baseline concentrations.

Findings of this odour assessment may be used to inform MDC's consideration of odour mitigation options relating to installation of odour suppressant system near or at the working face.

2 Site description

2.1 Overview

Bluegums is located off Taylors Pass Road, approximately five kilometres south of Blenheim's town centre which is situated on the Wairau Plains (Figure 2.1). The landfill was developed in 1996 and will eventually consist of 13 staged developments to optimise use of the site. The current stage of operations is Stage 7 (Figure 2.2), but at the time of writing waste is being filled above Stage 6 .

Bluegums receives mixed waste from the entire Marlborough district, sourced from the Blenheim waste sorting facility, a further five refuse transfer stations located throughout the district and waste directly from industrial and commercial sources. Normal operation hours at Bluegums are as follows:

- Monday to Friday 7:30 am and 5.00 pm
- Saturdays 7:30 am and 12 noon

The operation of the Landfill is subject to the requirements of the Resource Management Act (1991), and the Landfill Resource Consent U000950 ("Consent") as detailed in Table 1.1. Under this Consent, MDC is required to take all practicable measures to avoid discharge of odour beyond the site boundary.

Table 2.1: Landfill resource consents

Number	Type	Issue date	Expiry date
U000950	Disposal of contaminants to land, Air discharge, Discharge of stormwater to land and water, Dam and divert, to erect, place and maintain structures in the stream beds, Disturbance to land.	14th March 2001 Note: Corrigendum issued by Commissioner 17th Sept 2001	30 November 2030

2.2 Waste streams

2.2.1 Acceptable waste

Wastes acceptable for disposal at Bluegums without special disposal procedures are as follows:

- Household refuse which is normal domestic refuse in bagged or other form as delivered by contract collection.
- Refuse generally accepted as household or domestic refuse.
- Trade refuse arising from commercial or industrial premises, but excluding special wastes as defined in the following sections.
- Clean soil wastes.
- Putrescible wastes, but excluding special wastes as defined in the following sections.
- Garden wastes, including weeds, pruning's etc (although composting operations may remove this waste from the waste stream).
- Sewage sludge that has been stabilised over six months can be accepted at the landfill for disposal without further mixing or treatment. This permission is based on the assumption that the sludge moisture content is reduced to a satisfactory level during the stabilisation period.
- Bagged sewage plant screenings.

2.2.2 Special waste

Special wastes are also accepted at Bluegums, but subject to specific disposal management due to their physical and/or chemical nature (some of which may result in odour impacts if not adequately managed). These may include the following:

- Sludge and animal waste (such as offal, animals and animal parts, winery wastes, raw sewage sludge).
- Controlled waste (such as contaminated soil, asbestos-containing waste, medical waste).
- Difficult waste – waste which presents no significant health, environmental or nuisance issues but which by their physical nature are difficult to handle and which cannot be spread and compacted by the trash compactor in the manner that general refuse is handled (such as vineyard posts, salmon nets, concrete demolition rubble).
- Liquid waste (such as wet sludge and bulk liquid emulsion waste).

2.3 Odour sources

2.3.1 Working face

Incoming waste is placed at the tipping face in as small an operational area as possible. A maximum area of exposed refuse at any time of 900 m^2 (30 m x 30 m) will be targeted under normal operational conditions with a maximum limit of up to 2,500 m^2 (50 m x 50 m) when required (e.g. transitioning to a new filling area). Any area beyond this size is required to be covered with daily or intermediate cover as appropriate. Daily cover is placed to a minimum depth of 200 mm at the conclusion of each day's operations. Daily cover is required to be of sufficient standard to provide a continuous coverage over the waste such that control of vermin, dust and odours is achieved. At the completion of waste placement in areas where no further refuse is planned to be placed for a period of three months or more, intermediate cover is placed over the surface to provide a minimum total cover thickness of 300 mm.

During normal operations, the active working face is considered by T+T to most likely be the main odour source of Bluegums Odours from the working face can result from activities such as waste tipping, waste spreading and some level of fugitive landfill gas (LFG) emissions from underlying waste. As such, the working face is the subject of odour dispersion modelling presented in Section 4.4.

At the time of writing, the location of the active working face is at Stage 6 as shown on the latest quarterly drone survey (September 2020) undertaken at the landfill (shown in Figure 2.3). As the filling progresses to further stages until the last Stage 13 (closure anticipated to be July 2054[1]), the active cell working face will move further eastwards away from the majority of sensitive receptors located towards the north and west of Bluegums (see Section 3.4).

2.3.2 Landfill gas system

LFG is generated from the decomposition of organic waste materials by bacteria within a landfill. It consists mainly of methane and carbon dioxide with trace amounts of odorous reduced sulphur compounds (including hydrogen sulphide) and other volatile organic compounds.

Untreated LFG can be odorous depending on the concentration of odorous components and atmospheric dilution. If uncaptured and untreated, fugitive LFG emissions have the potential to result in off-site odour impacts. The LFG generated at Bluegums is extracted from wells to a landfill gas flare. Odour compounds are substantially destroyed during flare combustion. Consequently, the

[1] Bluegums Landfill Development Plan 2019, T+T, October 2019. Note, new consents are required for operation beyond 2030.

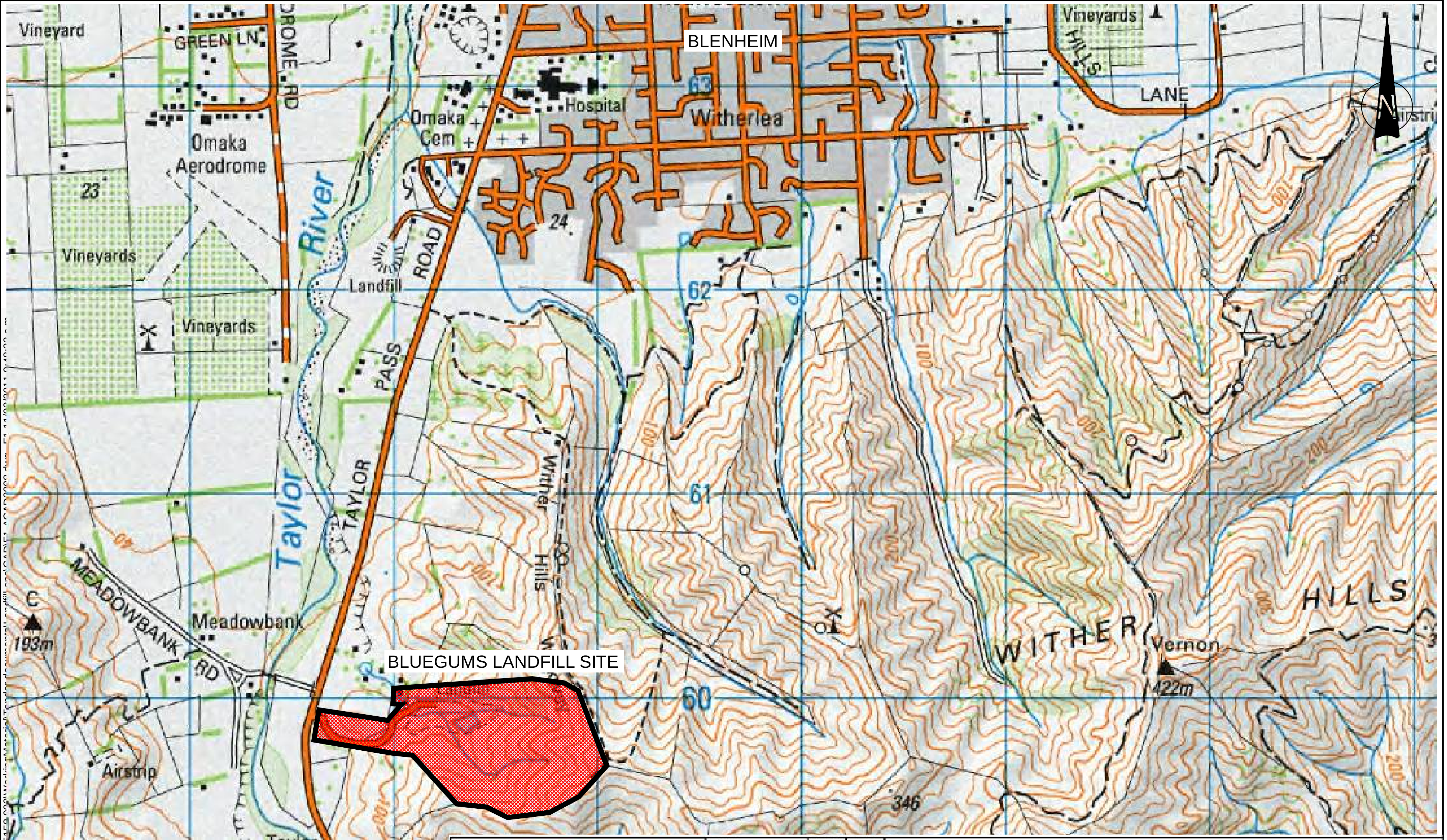
extraction and flaring of LFG largely avoids odour effects of LFG at and beyond site boundary. No untreated gas is vented within 200 m of the site boundary in compliance with Air Discharge Condition 7.

Given the above, the LFG is not expected to be an appreciable source of odour except in non-routine events such as a pipework leak or immediately following a flare outage (before the auto shutoff valve closes). As such, LFG has not been included in odour dispersion modelling.

2.3.3 Leachate system

Under normal operating circumstances, leachate is discharged by gravity to a 110 mm discharge line to the Blenheim sewerage system. However, this line has limited capacity and under large flows the line backs up and the leachate pond fills. An automatic pumping system then pumps leachate from the pond to a storage pond on the landfill for release after the high flow event has passed.

During normal operations, leachate ponds are typically not a significant source of odour (although they can have a localised ammonia-type smell). As such, this source is not included in odour dispersion modelling.



SCALE 1: 25,000

0 500 1000 1500 (m)

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DRAWN	HEC	2019
DRAFTING CHECKED		
APPROVED		
CADFILE :		
SCALES (AT A3 SIZE) AS SHOWN		
PROJECT No. 85158.012 (from 85158.009)		

MARLBOROUGH DISTRICT COUNCIL
BLUEGUMS LANDFILL
TAYLOR PASS ROAD, BLENHEIM
Site location plan

FIG. No. Figure 2.1

REV. B

697800 mN
311000 mE
311200 mE
311400 mE
311600 mE
311800 mE

Northern access road

STAGE 2B
STAGE 3
STAGE 7
STAGE 10
STAGE 2
STAGE 4
STAGE 11
STAGE 5
STAGE 6
STAGE 8
STAGE 12
STAGE 9
Access to Stage 13
STAGE 13

Southern access road

697600 mN
697400 mN
697200 mN

LEGEND

- Stage boundary
- Existing contours (1.0m Interval)
- 100 Existing contours (5.0m Interval)
- 100 Proposed Basegrade contours (5.0m Interval)

SCALE 1: 2,500

0 50 100 150 (m)

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DRAWN	HEC	2019
DRAFTING CHECKED		
APPROVED		
CADFILE :		
SCALES (AT A3 SIZE)	AS SHOWN	
PROJECT No.	85158.012 (from 85158.009)	

MARLBOROUGH DISTRICT COUNCIL
BLUEGUMS LANDFILL
TAYLOR PASS ROAD, BLENHEIM
Landfill layout and development phases

FIG. No. Figure 2.2
REV. C

Figure 2.3: Location of active working face (assumed maximum 50 m by 50 m) at Stage 6 based on drone survey data overlaid on base map.

3 Receiving environment

3.1 Topography

Blenheim town is mostly flat with only its southernmost fringe rising to the base of the Wither Hills (Figure 3.1), close to where Bluegums is located. The immediate area surrounding Bluegums has complex steep topography, which will strongly influence localised wind and air flow patterns and therefore the dispersion of odour emissions. During calm or low wind conditions, surface winds will generally follow the topography of slopes from the highest to lowest elevation.

Bluegums is located within an incised valley with steep slopes. Based on the terrain, the winds across the site are expected to have a tendency to drain during relatively calm conditions either in the general northerly direction towards Blenheim town, or flow westwards down from the landfill valley to the point where the winds meet the wider Wairau Valley winds which would then transport odours northwards. Wind flows around and across Bluegums are highly influenced by the surrounding valleys and ridgelines of the Wither Hills.

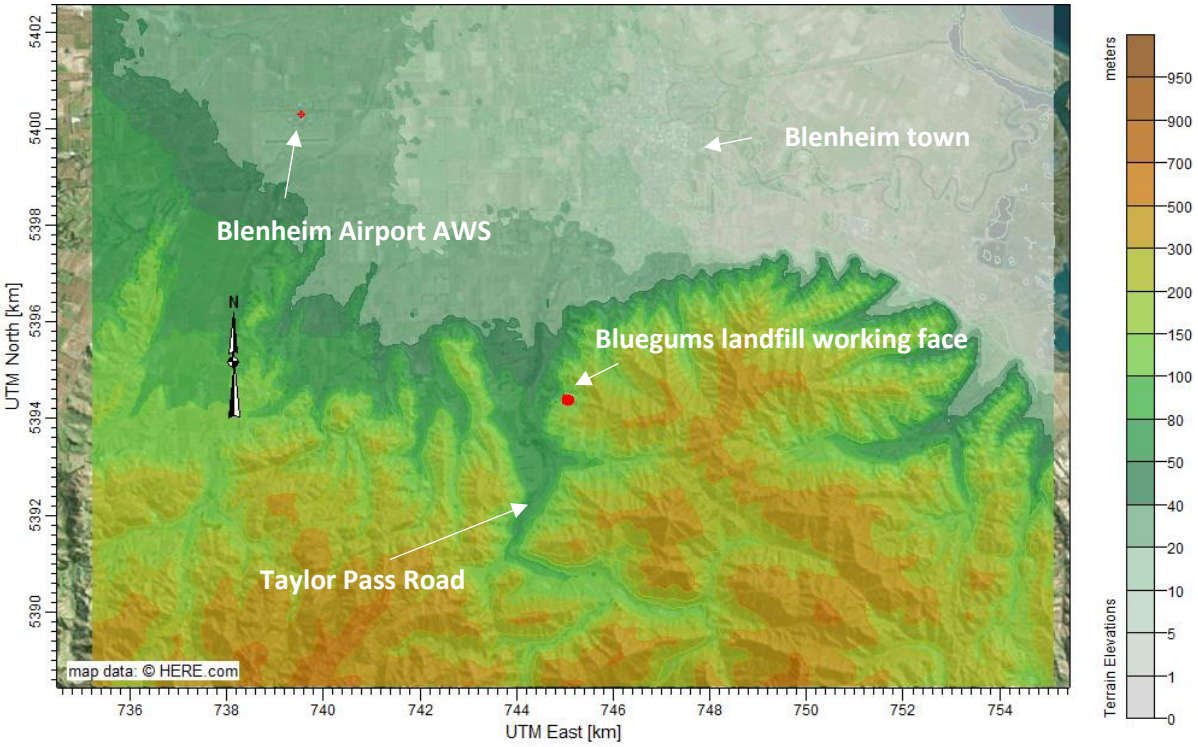


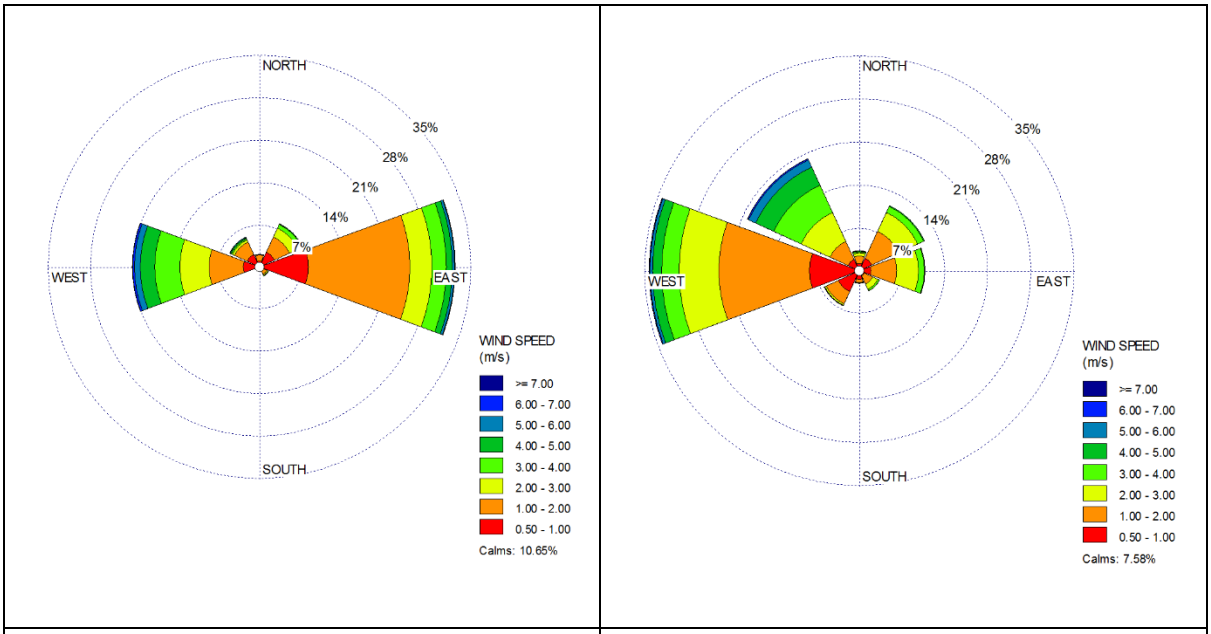
Figure 3.1: Topography of Bluegums and surroundings.

3.2 Meteorology (wind conditions)

There is a wind monitor at Bluegums which measures onsite wind speed and wind direction. However, the monitor is mounted at approximately 2 m above ground level, which is lower than the typical height of 10 m above ground level recommended for wind monitoring for dispersion modelling purposes that require applicability to a broader area for definition of wind fields. In addition to onsite monitoring, an automatic weather station (AWS) is located at Blenheim Airport, operated by Metservice and approximately 8 km northwest of Bluegums (see Figure 3.1). Wind roses for both locations are shown in Figure 3.2.

The Blenheim Airport windrose shows general bi-directional east-west tendencies, with also frequent occurrences of northwesterlies and northeasterlies. Blenheim Airport is located on open land centrally within the Wairau Plains, directly downstream of the flows being channelled through Wairau Valley. As the Wairau Plains are surrounded by mountains on all but the eastern flank (which is open to Cook Strait), it is relatively well protected from the frequent southerly weather fronts occurring during winters. However, the area does experience some high wind events during the course of the year, especially from the west where the wind is funnelled down the Wairau Valley, and winds blowing inland from Cook Strait from the east. Average wind speeds tend to be low (<2 m/s) with corresponding high incidences of calm winds (<0.5 m/s) of 8% (which are generally not conducive to odour dispersion).

The onsite wind rose shows similarly strong bi-directional east-west tendencies. Compared to winds measured aloft at 10 m, the onsite winds measured at about 2 m have a potential to be strongly influenced by factors such as ground surface type and roughness, soil moisture, localised topography and obstructions, thereby recording wind speeds that are considerably lower. The measured wind directions may also be different. As such, the data from onsite wind monitoring has not been incorporated into dispersion modelling (see Section 4.3).



Onsite (January 2018 – October 2020)	Blenheim Airport AWS (January 2016 – December 2017)
Average wind speed – 1.60 m/s	Average wind speed – 1.84 m/s
Calms (<0.5 m/s) – 10.65%	Calms (<0.5 m/s) – 7.58%

Figure 3.2:Onsite and Blenheim Airport AWS wind roses.

3.3 Other activities in the area

Bluegums is located in a rural area. The immediate surroundings of the Wither Hills area is largely uninhabited. MDC administers much of the Wither Hills as a working farm and recreational park (Wither Hills Farm Park, see Figure 3.3) and has constructed a network of walking and cycle tracks (Figure 3.4) and implemented a conservation and restoration programme for the remaining bush remnants.

The main activities in Wairau Plains relate to agriculture (mainly pastoral, viticultural and horticultural in nature). Significant odour sources are generally not expected for the activities undertaken in these surroundings.

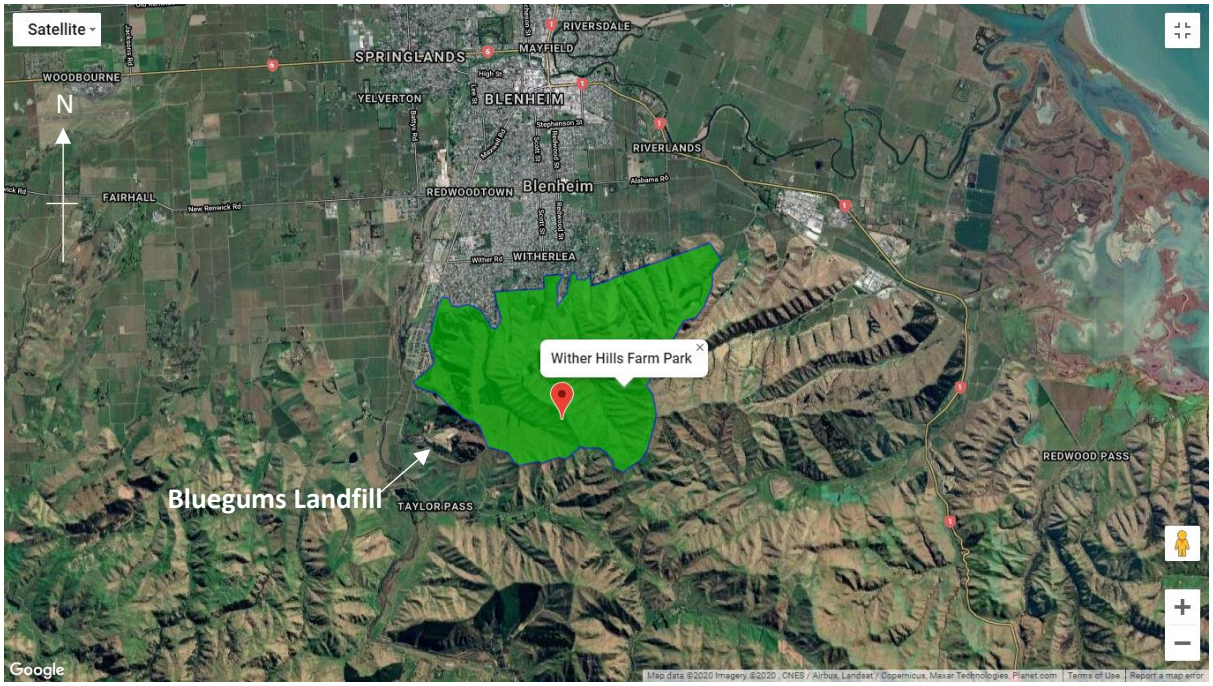


Figure 3.3:Wither Hills Farm Park.

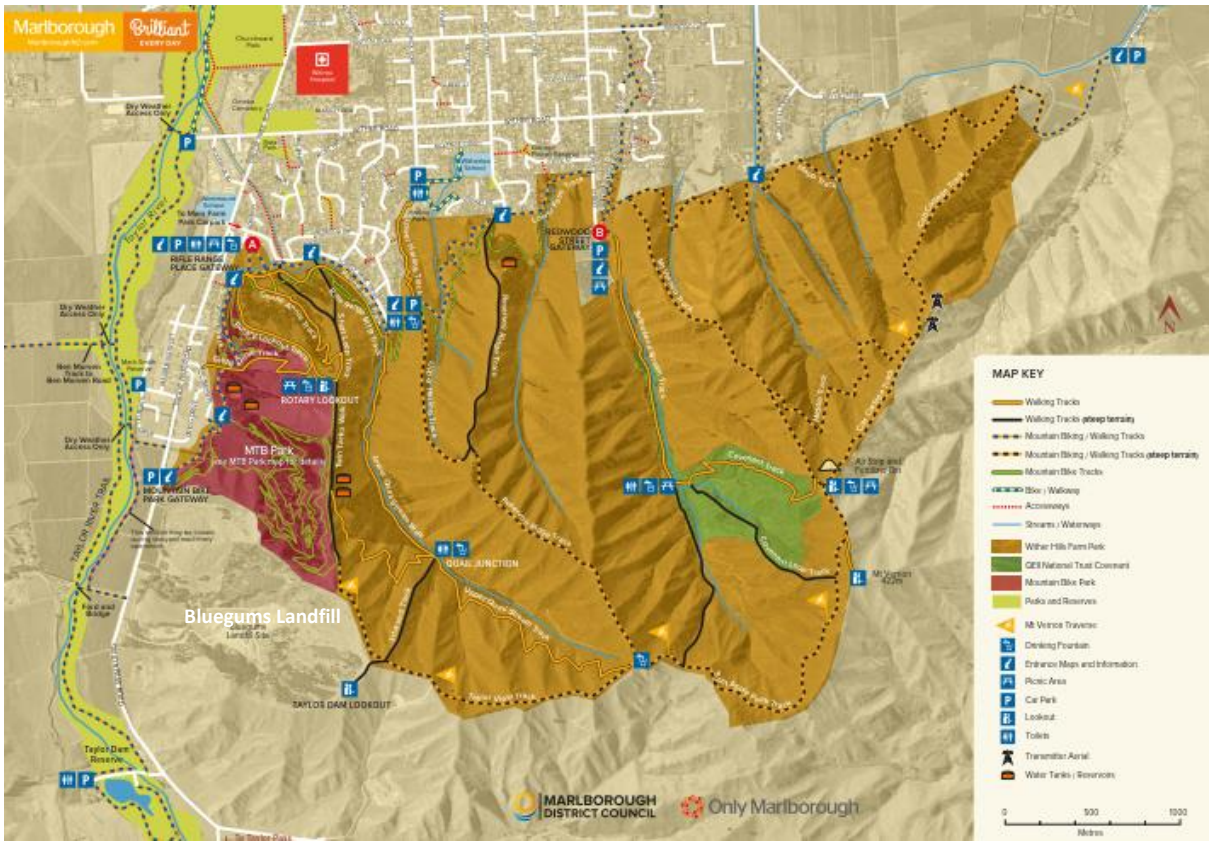


Figure 3.4:Wither Hills Farm Park – walking and mountain biking tracks.

3.4 Sensitive receptors

The nearest sensitive receptors to Bluegums have been identified as follows:

- Northeast of Bluegums is the Wither Hills Farm Park, which is a working farm and recreational park which include a number of walking/ mountain biking tracks which tend to follow the ridgelines/roads (Figure 3.4).
- Dwellings along and off Maxwell Pass Road, Taylor Pass Road and Meadowbank Road (Figure 3.5).

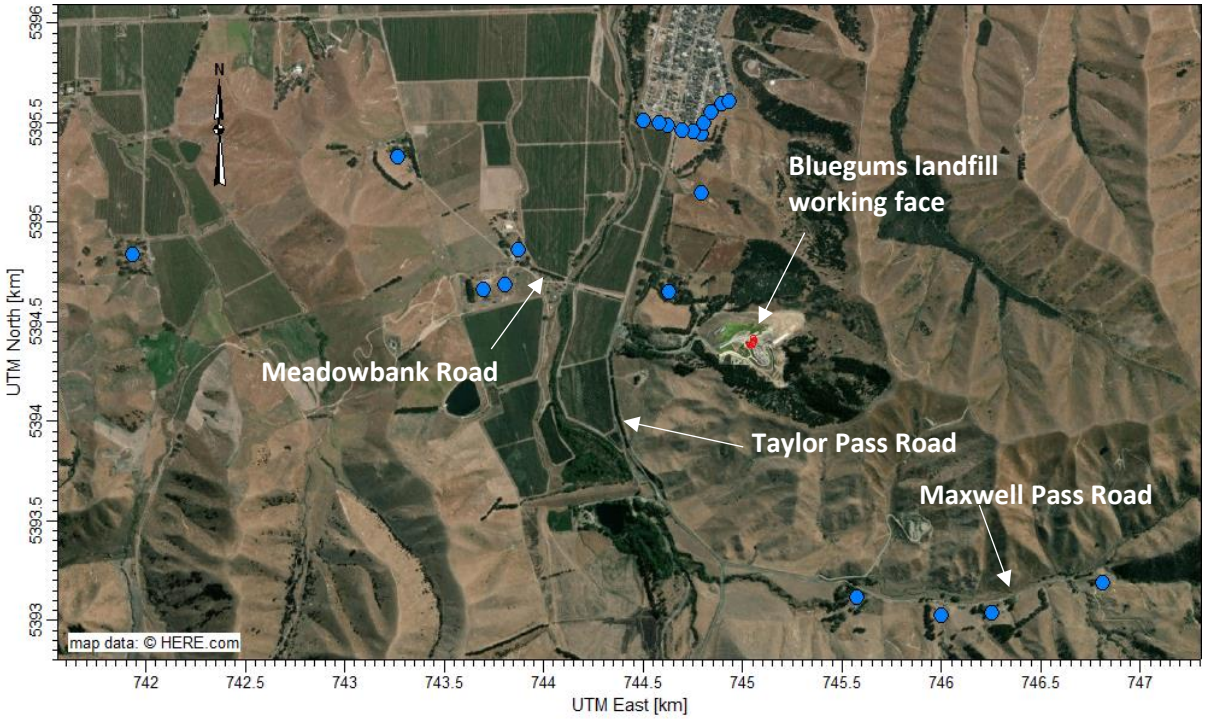


Figure 3.5: Nearest sensitive receptors (dwellings marked as blue circles).

The Ministry for Environment's (MfE) Good Practice Guide for Assessing and Managing Odour[2] (Odour GPG) describes the sensitivity to odour for different land use types. The sensitivity depends on various factors including the characteristics of the land use, the time of day and the reason people are at a particular location. The sensitivity of these differing land uses is described in Table 3.1. The activities with the highest sensitivity to odour are residential dwellings and schools, as well as outdoor recreational activities that will occur in the recreational areas of Wither Hills. However, unlike at dwellings, the presence of members of the public along walking/biking tracks at Wither Hills are comparatively intermittent. As such, if odour exceedances are predicted along any tracks, the likelihood of such odours occurring while people are there also need to be taken into account.

[2] Ministry for the Environment. 2016. Good Practice Guide for Assessing and Managing Odour. Wellington.

Table 3.1: General sensitivity of the receiving environment to odour

Land use	Sensitivity	Reasons for sensitivity
Residential	High	People of high sensitivity (including children and the elderly) are exposed. People expect a high level of amenity in their home and immediate environs (i.e., curtilage). People may be present all times of the day and night, both indoors and outdoors. Visitors to the area are unfamiliar with any discharges and are more likely to be adversely affected (which can cause embarrassment to residents and raise awareness of the problem).
Hospitals, schools, childcare facilities, rest homes, marae	High	People of high sensitivity (including children, the sick and the elderly) are exposed, and/or People are likely to be exposed continuously (up to 24 hours, seven days a week).
Tourist, cultural, conservation	High	These areas may have high environmental values, so adverse effects are unlikely to be tolerated.
Open space recreational	Moderate to high	These areas are used for outdoor activities and exercise, in circumstances where people tend to be more aware of the air quality. People of all ages and sensitivity can be present.
Commercial, retail, business	Moderate to high	These areas have a similar population density to residential areas as people of all ages and sensitivity can use them. Commercial activities may also be sensitive to other uses (e.g. food preparation affected by volatile organic compounds emissions from paint manufacture). There can be embarrassment factors for businesses with clients on their premises. Note: Need to consider the time of day, nature of activity, and likelihood of exposure (people are typically present less than 24 hours per day).
Rural	Low for rural activities moderate or high for other activities	A low population density means there is a decreased risk of people being adversely affected. People living in and visiting rural areas generally have a high tolerance for rural activities and their associated effects. Although these people can be desensitised to rural activities, they may still be sensitive to other types of activities (e.g., industrial activities).
Public roads	Low	Roads users will typically be exposed to adverse effects from air discharges for only short periods of time.

3.5 Odour complaints history

The latest 2019/2020 odour complaints history has been reported in T+T's *Bluegums Regional Landfill: Annual monitoring report, July 2019 – June 2020* (dated August 2020). Records of complaints received are kept at MDC.

During the 2019/20 period, the landfill received odour complaints from five separate complainants. Whilst seven reported incidents were recorded in the current reporting system, it is acknowledged that two of these complainants had multiple exchanges with council via phone or text related to

ongoing discussions on potential landfill odour. In response to this narrow scope of reporting, MDC has developed a community reporting platform referred to as PONG (Prevailing Odour Not Good) which is intended to be rolled out across the region during 2020. The purpose of this reporting platform is to widen the opportunity for residents to register odour issues on an ongoing basis. The platform follows a similar format to that taken by Environment Canterbury (ECAN) and should provide a broader community reporting opportunity to any objectionable, persistent odours. MDC will receive daily updates on reports related to their severity or a pre-set reporting period.

The following complaints were recorded by MDC:

- The complaint in August 2019 was related to odour from Bluegums and was associated with a prevailing wind direction from the east-northeast. The complainant's locations were unable to be determined. It was noted that there had been a delivery of organic material at the landfill on the day of the complaint.
- The complaint from December 2019 related to an odour event at Taylor Pass Road. A delivery of waste from Cloudy Bay Clams was noted to be odorous, however, this was buried and covered. Cloudy Bay Clams was contacted by MDC to address the issue of odorous waste inputs to the landfill and the issue is deemed to have been resolved going forward. The predominant wind direction in the week leading up to the complaint was from the east-southeast.
- A complaint in March 2020 was made relating to an odour event at 10 Grigg Drive where the predominant wind direction at the time was from the east. There were no adverse activities occurring onsite at the time of the complaint. When a compliance officer visited the location no objectionable odour was detected.
- A complaint in April 2020 was made relating to an odour event at Maxwell Pass Road where the predominant wind direction at the time was from the west-northwest and east-northeast. The complainant visited the landfill to witness operations and no objectionable odour was noted at the time of visit or complaint.
- A complaint in May 2020 was made relating to an odour event at Grigg Drive where the predominant wind direction at the time was from the east, west and south-southeast. The complainants address was visited at between 8:20 am and 8:50 am and no objectionable odour was detected.

4 Dispersion modelling methodology

4.1 Overview

The odour effects from Bluegums have been assessed using dispersion modelling, utilising the CALPUFF modelling suite (with CALMET as its meteorological pre-processor). The CALMET/CALPUFF modelling suite was selected over other available dispersion models because of its enhanced ability to deal with complex terrain and calm conditions.

The predicted ground level concentrations (GLCs) of odour were then compared with relevant assessment criteria to assess relative odour impacts. The model results are not intended to be used to access the acceptability of the odours in place of community feedback or actual observations. Instead, the purpose of the model results is to help identify locations at greatest risk to being exposed to odour impacts and provide a model baseline for evaluating mitigation measures.

4.2 Selection of model period

In accordance with good practice, multiple calendar years (2016 and 2017) have been selected to encompass the range of meteorological conditions that are encountered on-site and in the surrounding area.

The selection of the period 2016 to 2017 was made based on a consideration of the following:

- Use of recent monitoring data (i.e. within the last 10 years) so that the data is representative of recent climate conditions.
- Comparison of wind speed direction patterns (wind-roses) and frequency of calms at the nearest local meteorological stations to understand inter-year variability (there was relatively minor variability between years).
- Consideration of phases of the El Niño Southern Oscillation. Over the recent period, 2017 best represented La Niña conditions and 2015 best represented El Niño conditions.

4.3 Meteorological modelling

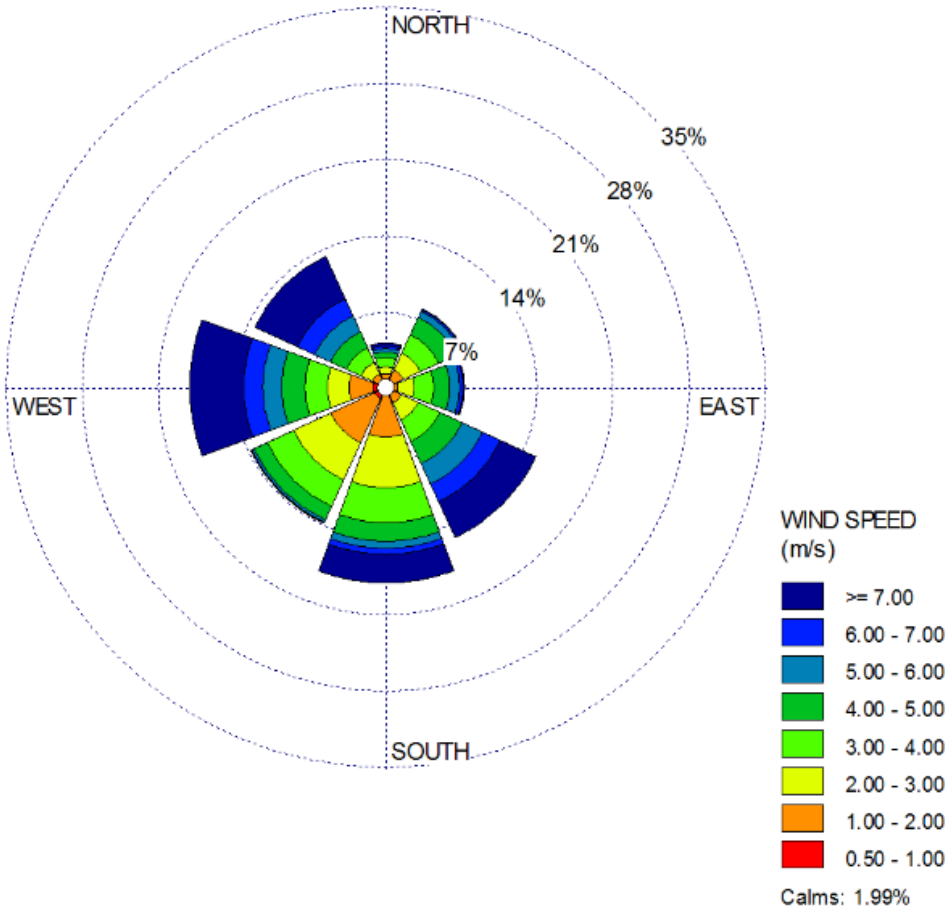
Meteorological information is one of the key inputs for dispersion modelling. Meteorological inputs to the CALPUFF model are generated using the CALMET model (latest version 6.5.0). The CALMET model generates hourly, three-dimensional fields of meteorological parameters that are used by CALPUFF.

The CALMET configuration details are as follows:

- The prognostic meteorological model, Weather Research and Forecasting Model (WRF) was used to generate upper air data. The WRF model outputs were purchased from Lakes Environmental Inc. (Canada), with a resolution of 4 km × 4 km and a domain of 50 km × 50 km centred on NZS.
- Surface data from the Blenheim Airport AWS was used.
- The CALMET model covers an area that is 20 km x 20 km centred at Bluegums and extends up from the surface to the atmospheric boundary layer. It has been run at horizontal grid resolution of 100 m, which is considered sufficiently high to capture variations in the meteorology caused by the complex terrain in the area.
- Terrain data used in the CALMET and CALPUFF model was derived from LINZ NZ 8 m Digital Elevation Model (2012) data and exported as a 30 m resolution grid over the CALMET domain.

- Land cover used in the CALMET model was derived from the Ministry for the Environment LUCAS database (v006) for the 2016 year and exported as a 100 m resolution grid over the CALMET domain.
- Radius of influence of terrain features (TERRAD) = 1 km.
- Maximum radius of influence – over land surface (RMAX1) = 5 km, over land aloft (RMAX2) = 5 km.
- Minimum radius of influence (RMIN) = 0.1 km.
- Relative weighting of Step 1 field versus observations – surface layer (R1) = 1.9 km, layers aloft (R1) = 1.9 km.
- Thirteen cell face heights = 0, 20, 30, 40, 50, 70, 90, 100, 250, 500, 1000, 1500, 2000 m.

CALMET wind predictions at 10 m elevation is shown in Figure 4.1 and overlaid on terrain in Figure 4.2. The effects of local wind channelling by the valleys at Taylor Pass Road and Maxwell Pass Road are seen in the southerlies and southeasterlies, which disperse odour plumes from Bluegums towards the directions of sensitive receptors shown in Figure 3.5.



CALMET model (January 2016 – December 2017)
Average wind speed – 4.19 m/s
Calms (<0.5 m/s) – 1.99%

Figure 4.1:CALMET wind rose.

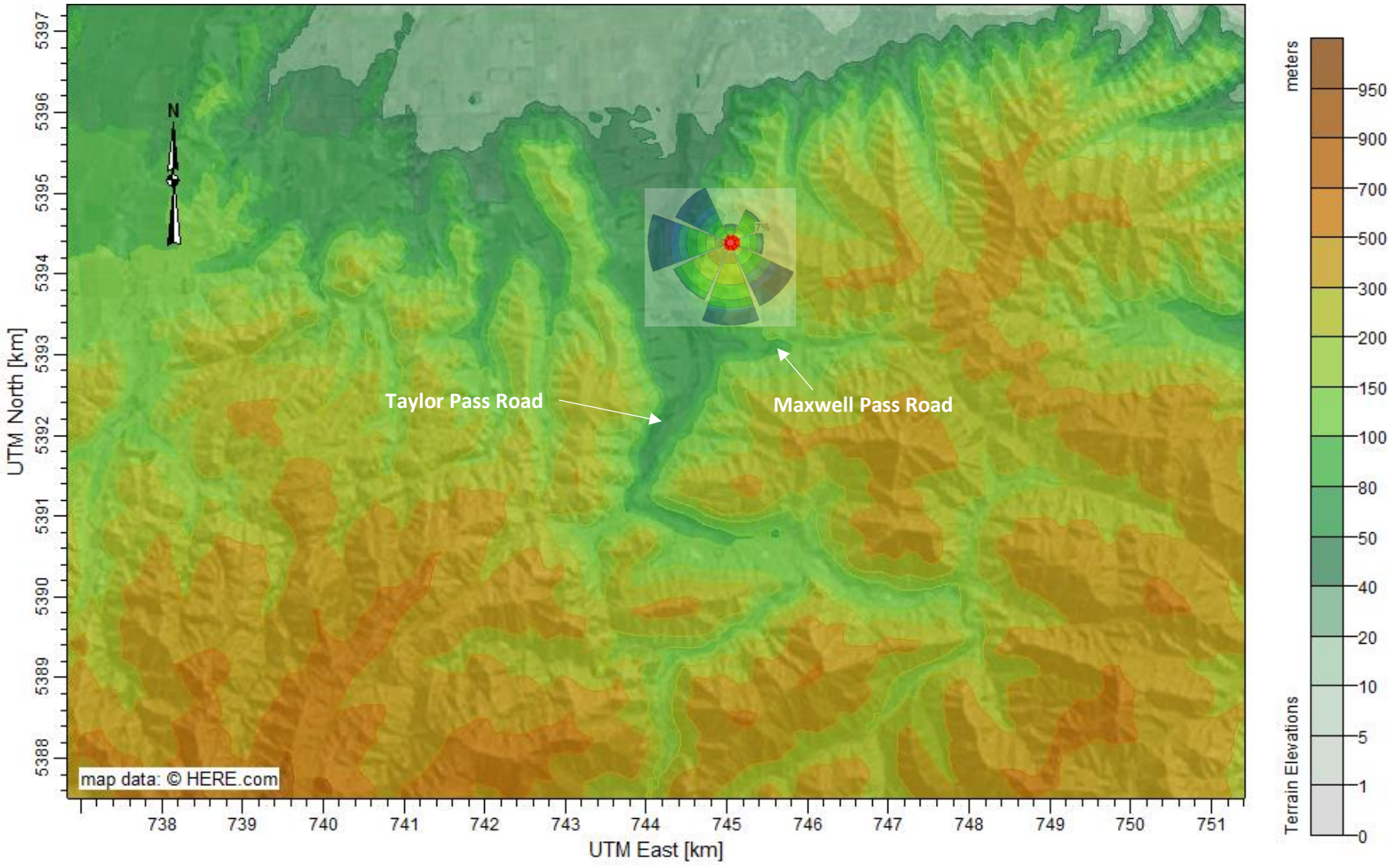


Figure 4.2: CALMET wind rose and terrain.

4.4 Dispersion modelling

Dispersion modelling of contaminant emissions has been conducted using CALPUFF (v. 7.2.1) software. Predictions have been made over an area of 8 km x 8 km grid of receptors. Nested grids of 100 and 200 m spacing have been centred extending 2 and 4 km respectively from the working face. In addition to the gridded receptors, discrete receptor points have also been placed at the nearest sensitive receptors to the site (Figure 3.5).

4.4.1 Odour emission rates from other landfills

Odour emission rates have not been measured at Bluegums, and as a result reference has been made to other operating Australasian landfills to derive a reasonable estimate of the odour emission rate for the working face at Bluegums.

The unit for odour emission rate is expressed in units of 'odour units' per square meter per second ($OU/m^2/s$). The odour concentrations derived using olfactometry are expressed in 'odour units' (OU). An OU is defined as the volume of odour-free air required to dilute a unit volume of a sample of odorous air until the detection threshold of the odour is reached. For example, if an odour sample needs to be diluted 100-fold to reach the point where the odour is just detectable, then it is described as having an odour concentration of 100 OU. An odour concentration of 1 OU means that the odour can be detected by 50% of the population (and is not detectable to 50% of the population).

Table 4.1 sets out published measured odour emission rates from some Australasian landfills. Where available, the odour emission rates are presented for the open working face and areas of intermediate and final cover. Intermediate cover describes areas of the landfill that have a relatively thick layer of cover in place, but not yet the final capping system. There is typically at least an order of magnitude difference between the odour emission rates from the open working face and areas of intermediate cover. For this reason, areas of intermediate cover have not been included in the dispersion modelling. If the predicted odours were close to the assessment criteria, then refinement of the model would need to be considered through inclusion of these areas in the modelling, where appropriate. Areas of final cover are not a source of odour. The measured odour emissions are representative of the naturally occurring odours that would be measured above grassed areas (such as pasture).

Table 4.1: Odour emission measurements from Australasian landfills

Location[1]	Measured odour emission rate by source ($OU/m^2/s$)		
	Active cell	Intermediate cover	Final cover
Southern Landfill, Wellington (Stage 3)[2]	0.99	-	-
Melbourne Regional Landfill, VIC	3.3[4]	0.16	0.04
Wyndham Refuse Disposal Facility, VIC	9 - 16.7[5]	-	-
Nambour Landfill, QLD	2.6	0.51	-
Summerhill Waste Disposal Facility, NSW	0.35	-	-
Lucas Heights Landfill, NSW	2.05	0.08	-
Kimbriki, NSW	0.08	0.004	-
Eastern Creek, NSW	1.97	0.04	0.04
Woodlawn, NSW	0.7	-	0.3

Location[1]	Measured odour emission rate by source (OU/m^2/s)		
	Active cell	Intermediate cover	Final cover
Sita Waste Treatment Facility, NSW	0.2	0.1	0.047
Redvale Landfill, Auckland, NZ[3]	0.36	0.016	0.023
Levin Landfill, Levin, NZ[4]	0.15 - 1.56	-	-

Notes:

1. Odour emission rates for Australian landfills sourced from Pacific Environment Ltd. 2016. "Melbourne Regional Landfill Air Quality Assessment".
2. Sourced from Tonkin & Taylor Ltd data. Job number 85635.5000.
3. Sourced from Tonkin & Taylor Ltd. May 2019. "Auckland Regional Landfill Air Quality Assessment". Job number 1005069.
4. Sourced from MWH. February 2015. "Levin Landfill Odour Assessment".
5. Estimated using an ambient sampling transect method rather than direct flux measurement.

4.4.2 Odour emission scenarios

The active cell working face emission source has been simulated as an area source (representing the surface of the source). For the purposes of this assessment, the area source has been assumed to have the following characteristics:

- Flat, i.e. of a single elevation across the source.
- Existing terrain height used (i.e. terrain does not account for changing landfill height).
- Ground level height release and initial vertical dimension (sigma-z) to be 0 to simulate a plume that essentially "hugs" the ground with minimal vertical plume rise (as a worst-case assumption).
- A maximum 50 m x 50 m (2,500 m^2) in area size as a worst-case assumption.
- Located at Stage 6 based on the latest drone survey (September 2020) undertaken at the landfill (Figure 2.3).

To determine peak short-term odour levels, odour emissions have been assumed to occur constantly (i.e. 24 hours per day). This will overstate the effect of emissions from the active cell as this area is under daily cover overnight, which will reduce emissions compared to the emission rate assumed in this assessment.

Without direct source testing at Bluegums, there is some uncertainty regarding the magnitude of odour emission rate of the working face. To account for a range of reasonable potential odour emission rates, two odour emission scenarios have been assessed by referencing landfills in Table 4.1 which handle similar waste types:

- Scenario A with a reasonable lower range odour emission rate of 0.99 OU/m^2/s based on Southern Landfill.
- Scenario B with a reasonable upper range odour emission rate of 3.3 OU/m^2/s based on Melbourne Regional Landfill.

The odour dispersion model input parameters are summarised in Table 4.2.

Table 4.2: Source odour discharge parameters

Parameter	Unit	Active cell working face
Source area	m^2	2,500 (50 m by 50 m)
Effective height	m	0
Initial sigma Z	m	0
Odour emission rate	$OU/m^2/s$ Note 1	Scenario A – 0.99 Scenario B – 3.3

Notes:

1. Odour units are described in CALPUFF as European odour units (OU/m^3) therefore the odour emission concentration measurements in units of $OU/m^2/s$ are described in units of OU.m/s in CALPUFF.

4.4.3 Odour modelling assessment criteria

The MfE Odour GPG sets out odour modelling guideline values that can be used for assessing odour effects. Odour concentrations are expressed in terms of odour units per cubic meter (OU/m^3, which is sometimes simply expressed as OU)).

The odour modelling guidelines are expressed as a combination of an odour concentration and a percentile value (i.e. whether the criteria apply to the 99.9^{th} or 99.5^{th} percentile of the hourly modelled odour concentrations), as shown in Table 4.3. These criteria are intended to be used as design ground-level concentrations for comparison with one-hour average modelling results.

Table 4.3: Odour modelling assessment criteria (reproduced from MfE, 2016)

Sensitivity of the receiving environment	Concentration	Percentile
High (worst-case impacts during unstable to semi-unstable conditions)	1 OU/m^3	0.1% and 0.5%
High (worst-case impacts during neutral to stable conditions)	2 OU/m^3	0.1% and 0.5%
Moderate (all conditions)	5 OU/m^3	0.1% and 0.5%
Low (all conditions)	5–10 OU/m^3	0.5%

The 'baseline' percentile that is used in all assessments is 0.5%[3]. Additional consideration of the 0.1% value is only recommended in specific cases, such as when the source operates intermittently and less than 50% of the time. This is because the infrequent peak impacts of odour in such cases can be the main driver of nuisance. In this instance, both the 0.5% and 0.1% results are presented to better understand locations at risk of odour exposure.

The concentration component of the odour modelling assessment criterion is selected based on the sensitivity of the receiving environment, which takes into account the presence (or absence) and density of sensitive receptors (which relates to the likelihood of more sensitive individuals being present). Urban areas are considered more sensitive to odour effects than rural areas because of the higher population density, even though rural areas include sensitive receptors such as dwellings. The sensitivity of different land uses is set out in Table 3.1**.**

[3] A 99.5^{th} percentile odour concentration indicates this value will be exceeded 0.5% of the time.

An odour modelling assessment criterion of 5 OU/m^3 is typically adopted for odour assessments of moderately offensive odours in rural areas. However, we conservatively consider 2 OU/m^3 to be an appropriate criterion (for both percentiles) to be adopted for this assessment due to the following:

- Landfill-type odours can be considered as offensive in nature. People who reside in nearby dwellings, be it in a rural or urban setting, expect a high level of amenity in their homes.
- Similarly, the Wither Hills Farm Park covering a relatively large part of Withers Hill area is popular for walking and mountain biking. This area has high environmental values, and recreational visitors to the area are more likely to expect a high level of amenity and likely to be intolerant of any offensive odours.
- The emissions from a landfill are released at a low height and the worst-case dispersive conditions are neutral to stable atmospheric conditions (unlike releases from tall stacks where the worst-case dispersive conditions are unstable atmospheric conditions).

The assessment criterion mainly applies to discrete locations where receptors are reasonably expected to be present (dwellings and walking tracks), rather than all locations at and beyond the site boundary.

4.5 Odour modelling results and assessment

The 99.5th and 99.9th percentile 1-hour average odour concentrations at sensitive receptors are set out in the following tables. Contour plots illustrating the spatial distribution of peak odour concentrations for the two modelled scenarios are provided in Figure 4.3 to Figure 4.6.

Table 4.4: Highest predicted 99.5th percentile odour concentrations at any dwelling

Scenario	Predicted odour concentration (OU/m^3, 99.5th percentile, 1 hour)	Predicted odour concentration (OU/m^3, 99.9th percentile, 1 hour)
Scenario A – 0.99 OU/m^2/s	0.03	0.05
Scenario B – 3.3 OU/m^2/s	0.1	0.17
Criterion	2	

Table 4.5: Highest predicted 99.5th percentile odour concentrations at any walking track (Wither Hills Farm Park)

Scenario	Predicted odour concentration (OU/m^3, 99.5th percentile, 1 hour)	Predicted odour concentration (OU/m^3, 99.9th percentile, 1 hour)
Scenario A – 0.99 OU/m^2/s	0.03	0.05
Scenario B – 3.3 OU/m^2/s	0.1	0.17
Criterion	2	

The predicted odour concentrations at any dwelling and at any walking track (Taylor View Track at Wither Hills Farm Park, immediately bordering Bluegums to the northeast) are below the odour modelling assessment criterion for highly sensitive receptors of 2 OU/m^3 (1-hour average, 99.5th and

99.9th percentiles), when assessed across a range of low to high odour emission rates during routine operations.

Based on the spatial distribution profiles of the contour plots in Figure 4.3 to Figure 4.6, there is a tendency for the odour concentration contours to extend northwards toward Blenheim. As such, when Blenheim is downwind from Bluegums and if a non-routine malodorous event was to occur at the landfill, there is potential risk for odour to flow down the valley towards the dwellings along and off Taylor Pass Road.

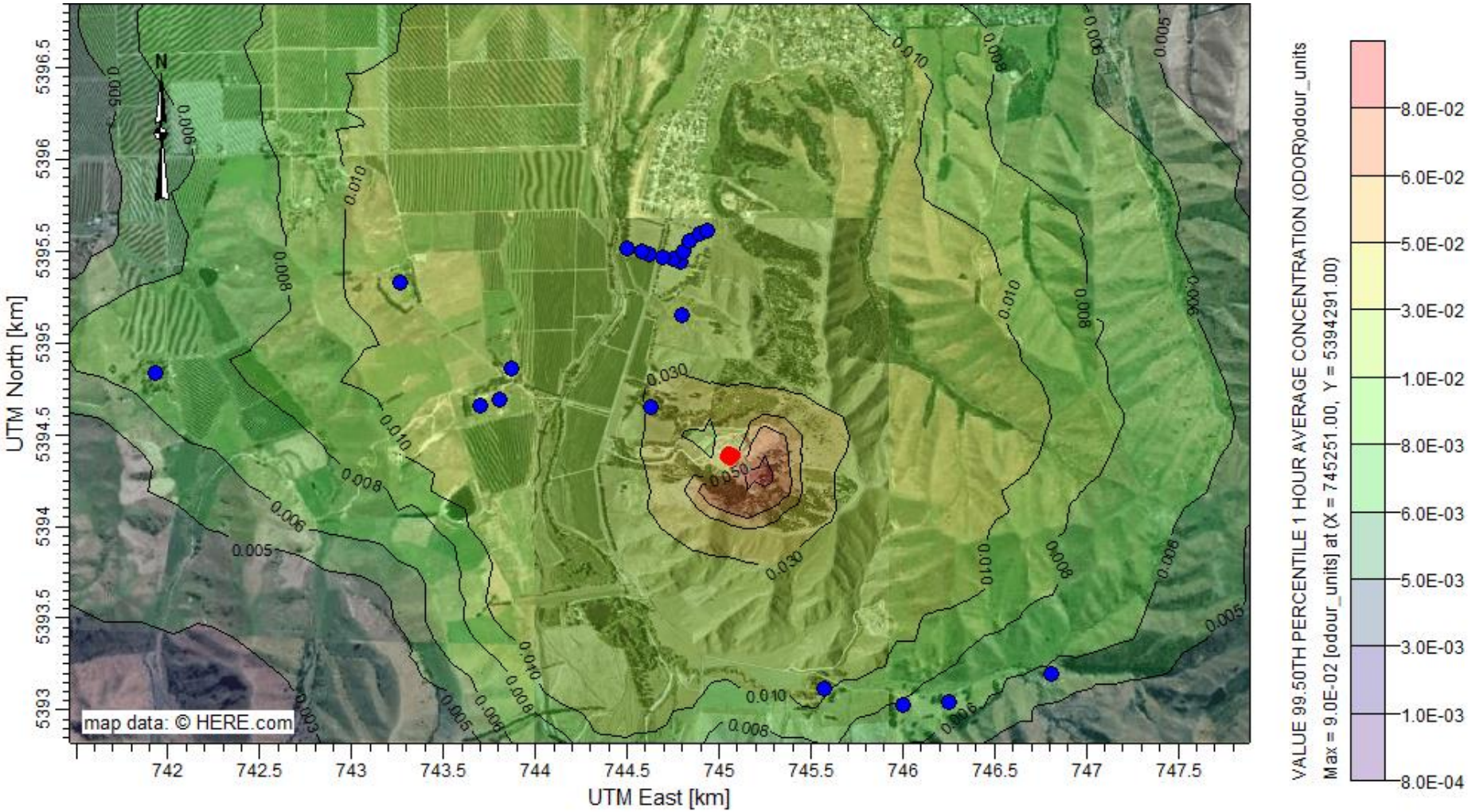


Figure 4.3: Scenario A (0.99 OU/m^2/s) odour GLCs (99.5th percentile, 1 hour) contour plot (dwellings marked as blue circles, working face marked as red box).

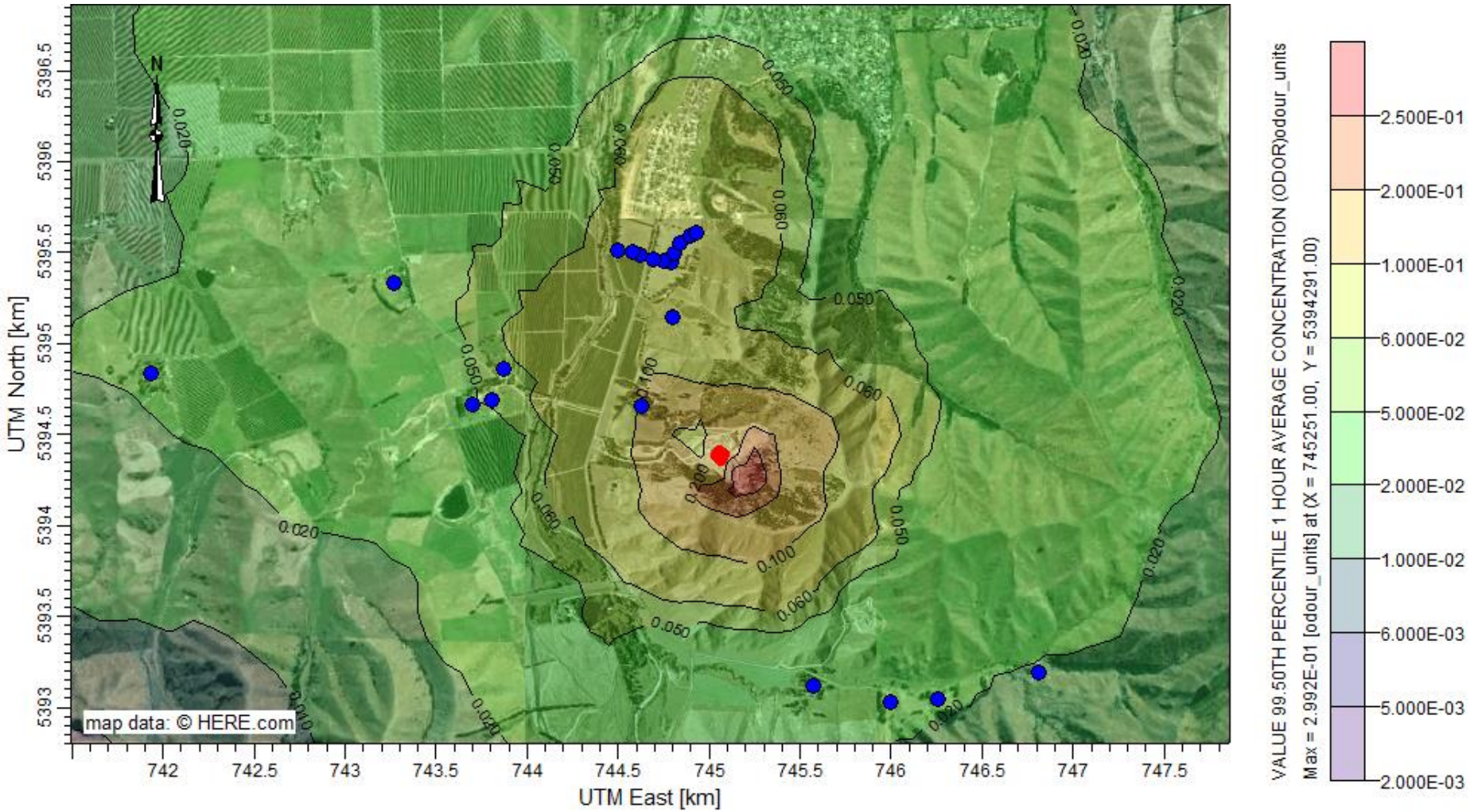


Figure 4.4: Scenario B (3.3 OU/m^2/s) odour GLCs (99.5th percentile, 1 hour) contour plot (dwellings marked as blue circles, working face marked as red box).

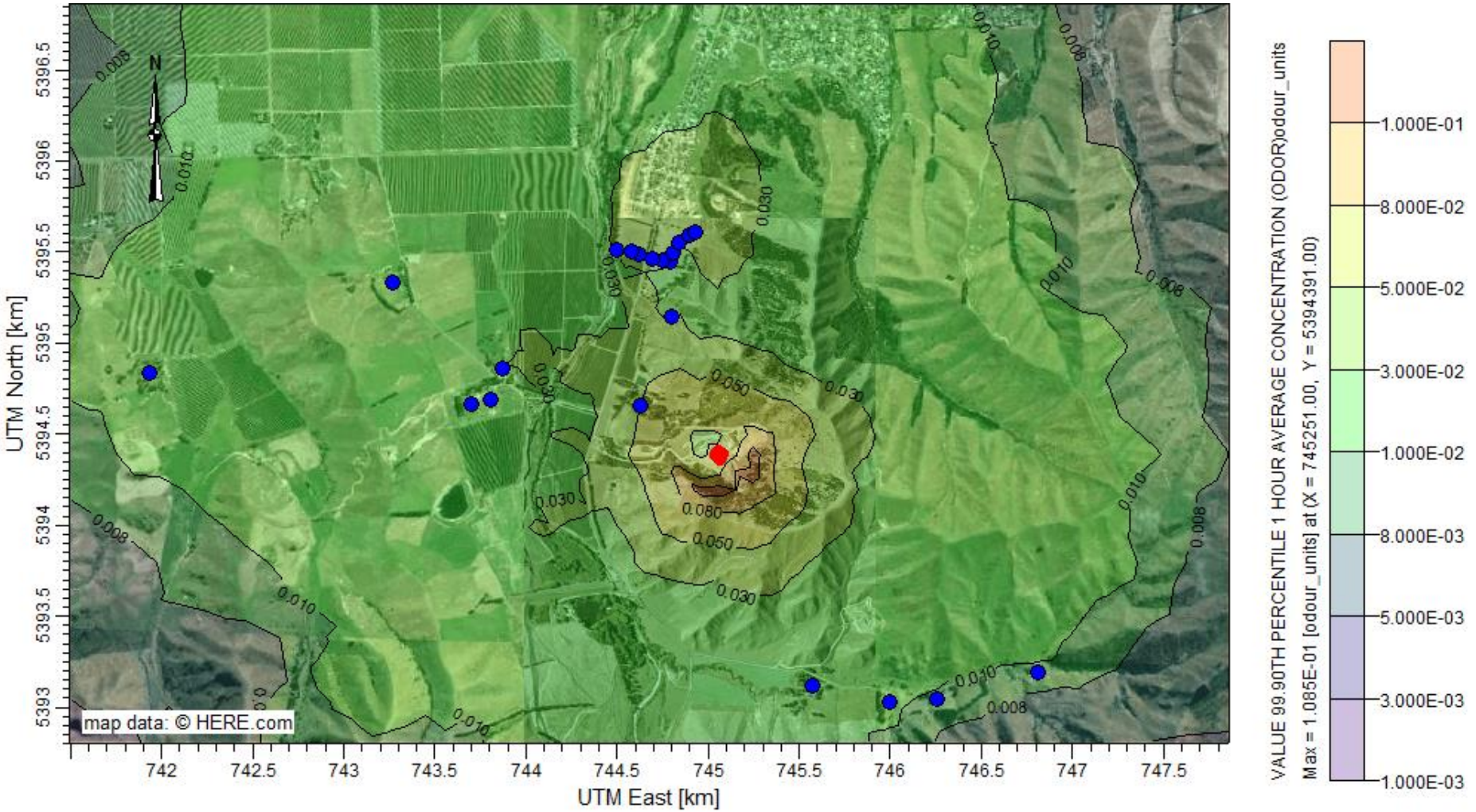


Figure 4.5: Scenario A (0.99 OU/m^2/s) odour GLCs (99.9th percentile, 1 hour) contour plot (dwellings marked as blue circles, working face marked as red box).

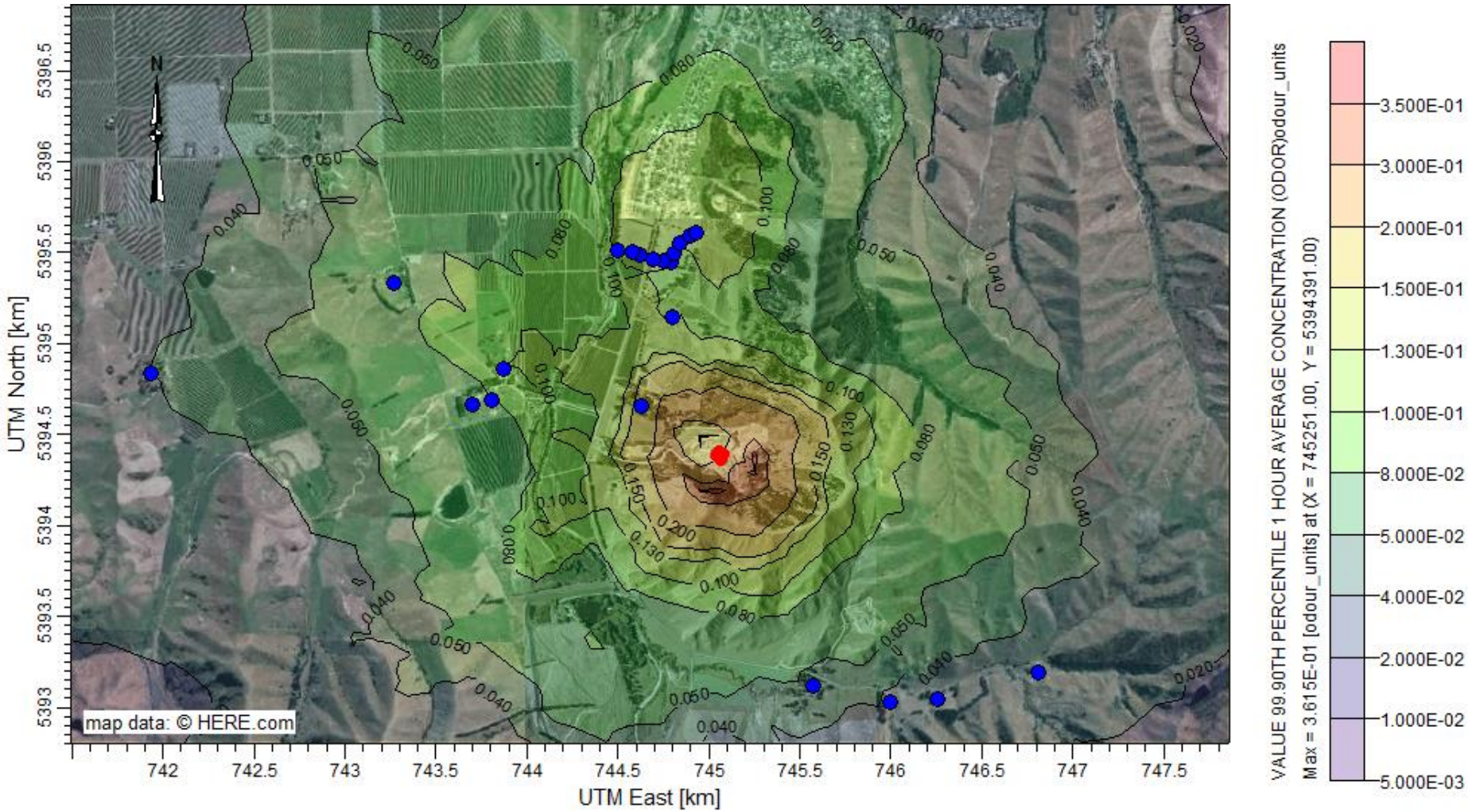


Figure 4.6: Scenario B (3.3 OU/m2/s) odour GLCs (99.9th percentile, 1 hour) contour plot (dwellings marked as blue circles, working face marked as red box).

4.5.1 FIDOL assessment

The potential for odour nuisance, and the potential for objectionable or offensive effects in particular, is assessed by considering what are termed the FIDOL factors (frequency, intensity, duration, offensiveness/character and location). The potential for objectionable or offensive odour effects from the site has been assessed through the consideration of the FIDOL factors as discussed in Table 4.6. The overall findings of the FIDOL assessment are that the occurrence of detectable odours at sensitive receptors around Bluegums under normal operating conditions is expected to be infrequent and of short duration.

Table 4.6: FIDOL assessment for discharges of odour

FIDOL factor	Assessment
Frequency Intensity	The frequency and intensity of exposure to odour within the receiving environment is dependent on the strength of emissions and meteorological conditions. These factors have been assessed for normal operating emissions from Bluegums (working face at Stage 6) by quantifying the odour emissions and using atmospheric dispersion modelling to predict odour concentrations in the receiving environment. The odour modelling assessment shows that while there is no significant risk of odour nuisance effects in the surrounding area as a result of normal operational odour emissions at the landfill, during a non-routine malodourous event there is a risk of odours being observed at dwellings north of Bluegums. This appears to be consistent with the recorded low level of complaints that have been received (Section 3.5). Such a finding is also consistent with our experience, where odour complaints from well managed landfills are generally related to an identifiable event resulting in unexpected waste-related odours (such as from an odorous load of waste) or increased fugitive LFG emissions (such as from a pipework leak). The risk of odour nuisance due to abnormal odour emission events occurring is minimised through the use of stringent controls in relation to acceptance and placement of waste as well as the integrity of the landfill cover and gas collection system and efficient operation of the flare.
Duration	In terms of the overall duration of the proposed activity, at the currently anticipated rates of filling, it is expected that Bluegums will have a remaining filling 'life' of approximately 34 years (until 2054). Waste placement activities occur during the daytime, with working faces covered by daily soil cover, or alternative daily cover, overnight. Provided the landfill gas extraction system is operating well and other controls related to the integrity of the cover are in place to minimise fugitive emissions of LFG, the potential for odour emissions to occur at night-time when there is no active filling is low.
Offensiveness (character)	Waste and LFG odours are intrinsically offensive in character.
Location	The sensitivity of the immediate environment surrounding the site that is not part of the Wither Hills walking/biking tracks, is considered low. Residential dwellings in nearby Blenheim and isolated residential dwellings on Taylor Pass Road/ Maxwell Pass Road/Meadowbank Road to the north/west/south of the site, as well as the walking/biking tracks have a high sensitivity to odour effects. The Environment Protection Authority Victoria recommends a buffer distance of 500 m between the edge of the landfill footprint to the nearest sensitive locations (Landfill BPEM[4]). The nearest sensitive receptor is located around 500 m from the nearest point of the proposed landfill footprint. The active landfill working face will shift during the landfill

[4] Siting, design, operation and rehabilitation of landfills, Publication 788.3, August 2017, Environment Protection Authority Victoria.

FIDOL factor	Assessment
	lifecycle and will be at distances greater than 500 m during the majority of the remaining operating life of the landfill.

4.6 Existing odour mitigation/management measures

We understand that MDC currently uses the following measures to mitigate the impacts of odour at Bluegums. This information is relevant in the context of this modelling assessment being used as a baseline for which future evaluations may be compared with:

- Limiting the size of the working area where waste is being landfilled to no more than 50 m by 50 m.
- Covering odorous wastes when they arrive on site – these tend to be organic or "wet" type waste.
- Covering the working area at the end of each day with daily soil cover (or alternative daily cover).
- Operating an LFG collection system.
- Operating a leachate collection system.
- Managing odorous waste through pre-treatment where required.
- Controlling the timing of loads to ensure that waste can be received and adequately covered.
- Restricting or rejecting odorous waste that could be treated at the industrial waste water treatment ponds.
- Operating an odour suppressant system (high pressure irrigation style spray system) along the top of the litter fence system.
- Installing an appropriate final capping layer when waste has reached the final fill level.

5 Summary

The odorous discharges to air from landfilling activities principally comprise:

- Odour from the active cell working face.
- Fugitive emissions of LFG.
- Odour from the leachate pond.

The effects of the main odorous emissions from the working face have been modelled using dispersion modelling. During routine normal operations, the predicted off-site concentrations are below the relevant odour assessment criterion of 2 OU/m^3 (99.5th and 99.9th percentiles, 1 hour). Overall, if there are occurrences of detectable odours at sensitive receptors during normal operations, it is expected to be infrequent and of short duration.

Based on the spatial distribution from the contour plots generated from the dispersion model, the sensitive receptors north of the landfill (along Taylor Pass Road and surroundings) have the highest potential risk of being impacted during non-routine malodourous events, which appears to be consistent with the low level of historic complaints that have been received. Odour management/ mitigation measures are in place to reduce such odour impacts to as low as reasonably practicable (ALARP).

6 Applicability

This report has been prepared for the exclusive use of our client Marlborough District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

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