Before the Independent Comissioner Hearing Panel

Under	the Resource Management Act 1991 (**RMA**)
In the matter of	an application by **Dunedin City Council** to develop a landfill at Smooth Hill, Dunedin.

Statement of Evidence of Peter Warwick Stacey

29 April 2022

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Qualifications and experience

1 My full name is **Peter Warwick Stacey**. My qualifications are a Bachelor of Science from The University of Auckland and a Graduate Diploma in Business from Auckland University of Technology.

2 I am a Member of the Clean Air Society of Australia and New Zealand and a Certified Air Quality Professional.

3 I am a Managing Director at Air Quality Consulting NZ Limited, based in Auckland. I have over 18 years of experience in the field of air quality.

4 I have experience with assessing odour and dust from various activities. My work experience relevant to this application includes:

(a) Expert witness for Northland Waste for the proposed construction and operation of a Refuse Transfer Station. This project involved an assessment of odour and dust associated with the facility's construction and operation (2019);

(b) I am responsible for undertaking the annual independent peer review of Redvale landfill's odour management practices (2017-2021);

(c) I have undertaken various odour assessments and investigations associated with the following landfills: Hampton Downs, Porirua, Bonny Glen and Greenmount;

(d) Expert witness for Agrifeeds, Glencore and ADM NZ Limited (s127 parties) as part of an appeal to the Environment Court regarding Bay of Plenty Regional Council's Plan Change 13. As part of this project, I undertook an independent assessment of the dust effects from bulk handling of stockfood material. This information was then presented as evidence before the Court (2020-2022);

(e) I have also prepared odour assessments for the following wastewater treatment plants: Whangarei, Te Puke, Kerikeri, Cambridge and Paeroa;

(f) Air quality delivery work plans for various stages of the City Rail Link works, including the design and implementation of a monitoring programme to determine whether works are causing significant nuisance dust effects (2018-2020);

(g) Air quality assessment of emissions from Ballance Agri-Nutrient's fertiliser manufacturing plant in Mount Maunganui. This project

required a detailed study of emissions using atmospheric dispersion modelling and empirical analysis of monitoring results (2015-2019);

(h) Air quality assessment for Wellington International Airport's Runway Extension Project and development of appropriate dust mitigation measures (2017);

(i) Air quality assessment to support the application to expand the Brookby Quarry, where fugitive dust emissions were the primary pollutant of concern (2013-2014);

(j) Expert witness for Doug's Opua Boatyard, presenting evidence before the Environment Court as part of an appeal against Northland Regional Council's decision to decline to grant an air discharge consent. As part of this work, I assessed dust and odour emissions from boatyard activities and determined the potential effects on the adjacent reserve, public walkway and nearby residential properties; and

(k) I am skilled in using a range of atmospheric dispersion models, such as CALPUFF/CALMET, TAPM, AERMOD, GRAL, CALROADS, LandGEM and AUSPLUME) and have applied these skills to air quality assessments for a broad range of clients.

5 In addition to the above, over the past thirteen years, I have been responsible for obtaining air discharge consents for a large number of different activities within New Zealand (2010-2022).

Code of Conduct for Expert Witnesses

6 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it, and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

7 My brief was to identify the various air discharges associated with landfilling activities, assess the potential to cause some form of effect beyond the proposed Smooth Hill landfill site (the Site) boundary, and recommend measures to mitigate those effects.

8 A detailed description of the proposed activities is provided in the Application and the Evidence of the planner, Mr Dale and others. My evidence instead focuses on the air quality effects associated with the construction and operation of the landfill.

9 Therefore, my evidence is structured as follows:

(a) Executive summary;

(b) The existing environment;

(c) Mitigation measures;

(d) Assessment of discharges to air;

(e) Response to ORC peer review comments;

(f) Comments on the section 42A report; and

(g) Response to matters raised in submissions.

Executive summary

10 I have undertaken an assessment to determine the potential air quality effects associated with the construction and operation of the proposed landfill. As part of undertaking my assessment, I have concluded the following.

The existing environment

11 There are thirteen (13) residential receptors and three (3) commercial receptors located within 3.5 km of the Site. In addition, two further parcels of land where residential receptors could be located in the future were also identified.

12 The prevailing winds are from the west and west southwest wind directions, with wind speeds typically of low to moderate strength.

13 The topography and meteorology are not particularly conducive to frequently carrying undiluted air pollutants toward neighbouring residences and businesses.

14 The landfill is relatively well-sited from the perspective that there are a limited number of receptors located close to the Site. However, it remains important to address potential issues for the receptors that are located near the Site.

Mitigation measures

15 Odour, dust and landfill gas mitigation measures are provided in the Draft Landfill Management Plan Framework (LMP) attached to Mr Dale's Evidence.

16 A range of specific mitigation measures have been developed to reduce the likelihood of nuisance effects associated with highly odorous waste types.

Assessment of discharges to air

17 On account of my review of the Green Island Landfill odour complaint history, the site-specific considerations applicable to the recommended separation distances, the results of the Frequency, Intensity, Duration, Offensiveness, Location (FIDOL) assessment and the results of the odour dispersion modelling, I consider that provided the mitigation measures specified in the Draft LMP are implemented, nearby receptors are unlikely to experience odour nuisance effects.

18 Considering the distance from the Site to sensitive receptors and the local meteorology, provided the proposed mitigation measures are undertaken, it is unlikely that off-site receptors will experience adverse nuisance effects in relation to dust.

19 Predicted off-site concentrations of air pollutants associated with the landfill gas flare are well below the relevant assessment criteria. I, therefore, consider that flare emissions have limited potential to cause adverse effects beyond the Site boundary.

20 Negligible effects are anticipated from vehicle emissions and diesel generator emissions.

Response to any issues in Otago Regional Council (ORC) peer review (Matters for Further Discussion, February 2022, paragraphs 38 to 44)

21 I have reviewed the additional recommendations suggested by Mr Chilton, in relation to the additional odour mitigation measures and consent conditions and consider these to be useful additions to the suite of odour controls already proposed. These additional measures will help provide a greater level of assurance that odours from "highly odorous waste" will be appropriately controlled.

22 Furthermore, I also agree with the amendment to Consent Condition 34 outlined by Mr Chilton, as follows: "There shall be no noxious, dangerous, offensive or objectionable odour or dust to the extent that it causes an adverse effect at or beyond the boundary of the Site." The proposed wording better aligns with the recommended consent condition provided in the Ministry for the Environment Good Practice Guide for assessing and managing odour (2016) (GPG Odour).

23 I note that Mr Chilton was concerned that a complete and comprehensive LMP had not been prepared at the time of his review. The Draft LMP has subsequently been updated and includes all of the mitigation measures that I recommended in my Air Quality Assessment (2021), along with Mr Chilton's additional measures.

Response to any issues in section 42A report

24 I have reviewed the relevant sections of the s42A report and note the Council's planner has recommended some minor amendments to the consent conditions and LMP. I have no specific issue with any of these amendments.

Response to matters raised in submissions

25 There were 35 submissions in opposition and one neutral submission concerning air quality (namely, odour and dust). Of the sensitive receptors located within 3.5 km of the Site, the only submissions received in relation to air quality were from R11 (Big Stone Forest Limited – S & A Ramsay located at 691 Big Stone Road, Dunedin), R12 (S & C Rampe located at 513 Big Stone Road, Dunedin), and R16 (S & B Judd located at 389 Big Stone Road)[1].

26 The main issues raised in the submissions included general landfill odour affecting amenity, dust generation from unsealed roads, odour and dust generation from trucks, and general air pollution concerns.

27 I have reviewed the submitter's concerns, and none of the information provided in the submissions changes the outcome of my assessment, other than emphasising the need for the landfill to rigorously implement the proposed control measures to minimise the potential for off-site odour nuisance.

Introduction

28 I was first engaged by the applicant in August 2020 to prepare an air quality effects assessment in relation to the proposed Smooth Hill Landfill. I have also been involved in preparing various responses to the additional information requests by ORC.

29 Specifically, my involvement in this project has included:

[1] This receptor was not included in the Air Quality Assessment (2020/2021) as the property had only recently been constructed and was not visible on aerial photographs at the time of the assessment.

(a) Preparation of an Air Quality Assessment in August 2020 – Principal Author (Air Quality Assessment (2020);

(b) Undertaking a review of ORC's s92 Request in October 2020;

(c) Updating my Air Quality Assessment in May 2021 in response to the s92 request. (Air Quality Assessment (2021));

(d) Undertaking a review of ORC's second s92 Request in June 2021;

(e) Preparing a technical memorandum entitled Smooth Hill Landfill – Additional s92 Question responses – Air Quality in July 2021; and

(f) Reviewing "Tonkin & Taylor's Technical Review for the ORC to Inform Notification Decision: Smooth Hill Landfill in August 2021".

The existing environment

30 Firstly, it is important to understand that the potential for adverse effects from air discharges is significantly influenced by the existing environment. By way of example, the same activity may pose different health risks depending on whether it is in a remote location or a residential setting.

31 Therefore, it is essential for this assessment to have a sound understanding of the environment surrounding the landfill. I consider aspects such as nearby sensitive land uses, local topography, meteorology, and background air quality to be of particular importance.

Sensitive receptors

32 The Site is located in a rural area with a low density of sensitive receptors. Thirteen (13) residential receptors and three (3) commercial receptors are located within 3.5 km of the Site. Of these receptors, two (both residential) are located within 1 km, with the closest being 380 m (R10) and the other 605 m (R11) from the landfill footprint.

33 I identified two further parcels of land where residential receptors could perceivably be located in the future. The closest of these receptors (where a property for a dwelling would logically be placed) is 810 m to the north northeast of the landfill footprint.

34 Furthermore, Big Stone Road is located within 50 m of the southeast boundary of the landfill footprint. While the road is close to the landfill, I consider public roads to have a low sensitivity to adverse effects, as road users typically only experience discharges for very short periods of time.

This view is supported by the guidance provided in GPG Odour[2]. Consequently, I have not undertaken any further assessment of the effects of the landfill on road users.

35 The existing and potential sensitive receptors described above are presented in Appendix A.

Meteorology and topography

36 The local meteorology significantly affects the dispersion of air pollutants and, consequently, the frequency and duration that off-site receptors could experience effects. Furthermore, in the case of dust emissions, meteorology can also directly influence the amount of material discharged to air, such as from exposed surfaces prone to wind erosion.

37 One of the first steps associated with undertaking my assessment was to review data from local meteorological stations and determine if it could be used to provide representative information on the meteorology at the Site.

38 Based on my review, the nearest station was Dunedin Airport (Dunedin Automatic Weather Station (AWS)), located 5 km to the northwest of the Site. However, I did not consider the data from this station to provide a good representation of conditions at the Site due to significant differences in land use and topography at the two locations. Namely, Dunedin AWS is located in a broad valley (Taieri Plains), whereas the Site is surrounded by complex terrain.

39 Consequently, I undertook meteorological modelling using CALMET to understand the Site's specific conditions and have used this data to inform the air quality assessment. At the same time, I arranged for an AWS to be installed at the Site, with the long-term view of using the data collected to validate the meteorological modelling results. The AWS measures wind speed and direction (at the height of 6 m), temperature, relative humidity and rainfall at the height of 2 m.

40 The AWS was established on 16 June 2020 and is still operational. The station is located in the northeast corner of the landfill footprint.

41 Given that over a year of meteorological data has now been collected, I have taken the opportunity as part of preparing this brief of evidence to update my assessment to ensure that the best available data has been considered.

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[2] Refer to Table 4 on page 20 of the guide.

42 I have used onsite data for 2021 (01 January to 31 December) to refine my assessment. While more than one year of data is available, I decided to exclude the 2020 and 2022 data to avoid an uneven weighting of seasons. The windrose associated with this data is provided in Appendix B. By way of explanation, the windrose shows the frequency of winds by direction and strength. The segments correspond to the 16 cardinal directions, i.e. N, NNE, NE, and the length of the segments represents the frequency that these winds occur, expressed as a percentage.

43 In general, the windrose shows the following:

(a) The highest frequency of light winds (< 3 m/s) are from the **west** and **west-southwest** directions. Noting that light winds provide the worst-case scenario for ground-based odour sources (as mechanical mixing and odour dilution is higher with increasing wind speeds); and

(b) The highest frequency of strong winds (> 5 m/s) are from the same directions, namely **west** and **west-southwest**. Strong winds provide the worst-case scenario for dust sources (as strong winds allow for the uplift/erosion of dust particles, causing them to become airborne).

44 I have compared the modelled wind data with the onsite AWS measurements by visually inspecting the windroses. These are provided alongside each other for comparison in Appendix C. The main differences between the wind data are summarised as follows:

(a) Onsite data has a slightly higher frequency of westerlies (17% vs 13%) and a lower proportion of winds from the west southwest (14% vs 17%);

(b) The average wind speed measured by the onsite AWS was 2.9 m/s (corrected to a height of 10 m) which compares with the average wind speed from the CALMET data of 3.1 m/s;

(c) Calm conditions (wind speeds < 0.5 m/s) were recorded 1.5 % of the time, which compares well with the CALMET value of 1.3%; and

(d) The onsite data shows a slightly higher proportion of strong winds (> 5 m/s) from the west and west southwest.

45 While there are some differences between the modelled and onsite wind data, overall, I consider that the modelled data provides a good representation of wind conditions at the Site. Furthermore, given that the modelled data incorporates three years of data (instead of the single year of onsite data) and, therefore, more potential worst-case conditions, I have

not updated the results of my modelling assessment to include the onsite data.

46 Instead, I have commented on the potential differences that could be expected if onsite data were to be used. The only exception is the frequency analysis I have presented as part of the FIDOL analysis, where I used the onsite data, as the results of this analysis are a direct result of the meteorological data used. It is also more conservative as the dataset has a higher frequency of westerly winds, i.e. winds blowing from the landfill to the direction of nearby receptors.

47 The Site and surrounding topography consist of various ridgelines and valleys. However, of particular importance is that the majority of the future filling operations at the Site will be at a significantly lower elevation than the nearby receptors (shown in Appendix A), which are located on various ridgelines.

48 As the receptors are located at higher elevations than the landfill filling operations, this will aid in mitigating odours, as odours tend to stay close to the ground and will flow downslope (i.e., away from the receptors), particularly during low wind speed/katabatic conditions. Consequently, any odours detected at the nearby receptor locations are likely to be diluted in strength.

49 Overall, I consider that the topography and meteorology are not particularly conducive to carrying undiluted air quality pollutants toward neighbouring residences and businesses.

Background air quality

50 I have reviewed the range of activities associated with Site operations and consider the anticipated air discharges to be as follows:

(a) Odour from landfill gas and refuse;

(b) Dust from both the construction and operation of the landfill;

(c) Combustion emissions associated with vehicle movements;

(d) Emissions associated with the landfill gas flare ((oxides of nitrogen (NO_X), carbon monoxide (CO), sulphur dioxide (SO_2), fine particulate matter (PM_{10}, $PM_{2.5}$), and trace amounts of volatile organic compounds (VOC)); and

(e) Combustion emissions (NO_X, CO, PM_{10} and $PM_{2.5}$) associated with the operation of backup diesel generators to power the leachate extraction pumps.

51 To understand the potential for cumulative effects (background + Site contributions), I first looked for any publicly available background air quality monitoring data collected near the Site. However, I could not find any representative information, which is not unexpected given the lack of any significant activities that generate air discharges and would be a cause of concern.

52 In the absence of suitable local air quality monitoring data, I have estimated background concentrations for all the pollutants of concern, except for odour, using the guidance found in the following two documents as is considered good practice: MfE *Good practice guide for Assessing Discharges to Air from Industry* (GPG ID) and Auckland Council *Use of Background Air Quality Data in Resource Consent Applications*. The adopted background concentrations are detailed in Section 2.3.4 of my Air Quality Assessment (2021).

53 Of the anticipated discharges to air, it is my experience that odour is the key pollutant associated with the operation of the landfill that will require the greatest focus in terms of day-to-day management to minimise the potential for adverse effects.

54 I undertook a review of existing odour sources in the area surrounding the Site and did not identify any significant odorous land uses which could result in cumulative effects.

Mitigation measures

55 Section 5 of my Air Quality Assessment (2021) provides a summary of the odour, dust and landfill gas management practices, which are set out in the Draft Landfill Management Plan Framework (LMP). My assessment is therefore based on the assumption that these measures are implemented.

56 Operational practices at the Site will be based on those currently used at Green Island Landfill and amended where necessary to represent best practice operation standards for landfills in New Zealand.

57 A range of measures will be implemented to reduce the risk of causing off-site odour nuisance, these include:

(a) Having stringent controls regarding the acceptance and placement of waste;

(b) Designing and installing an appropriate system to collect and destroy landfill gas (LFG);

(c) Storing leachate in enclosed tanks; and

(d) Implementing a range of industry best practice operational odour mitigation measures to minimise the frequency and intensity of odour discharges.

58 I consider that disposing of highly odorous waste such as biosolids or offal to have some of the greatest potential to cause odour nuisance. Therefore, specific mitigation measures have been developed to deal with these types of waste to reduce the potential for off-site odour nuisance effects. These measures are outlined in LMP and Section 5.1.4 of my Air Assessment Report (2021).

59 The conditions of consent and Draft LMP measures to achieve these mitigation measures are addressed further in the Evidence of Mr Dale. I have reviewed the proposed resource consent conditions and the mitigation measures provided in the LMP and consider that these are appropriate to manage the potential effects associated with air discharges from the landfill.

Assessment of discharges to air

Odour

60 In my experience, the principal sources of odour from the Site will include:

(a) Refuse odours from tipped waste or material awaiting tipping;

(b) Storage of leachate;

(c) Odour from highly malodorous specific wastes;

(d) Excavation activities into previously placed waste; and

(e) Fugitive landfill gas.

61 To assess the potential for adverse odour off-site effects, I have based my assessment on the following:

(a) A review of the odour complaint register for the Green Island Landfill;

(b) A separation distance assessment;

(c) A FIDOL assessment;

(d) Odour dispersion modelling; and

(e) Taking into consideration the existing environment and the odour mitigation measures as specified in the LMP.

Complaints analysis

62 Given that Green Island Landfill is comparable to the Site in terms of the relative scale of the activity, it is likely to provide an indication of the odour potential associated with the Site. Notwithstanding that cleanfill and bulk green waste are not intended to be accepted at the Site, the majority of putrescible waste will be removed from the waste stream, and the total amount of waste received is estimated to be lower than what Green Island has received historically.

63 I have therefore undertaken an analysis of the complaint data for Green Island and have used this information to inform my assessment. A summary of my complaint analysis is set out below.

64 I undertook a review of the odour complaint register for the period August 2017 to January 2021. This analysis is presented in Section 9 of my Air Quality Assessment (2021) and summarised as follows:

(a) Complaints were recorded at various locations within 2,000 m of Green Island Landfill. The majority of the complaints were from a number of repeat complainants on Clariton Avenue (within 500 m) and Brighton Road (500-1,000 m). Complaints recorded at distances between 1,000 m and 2,000 m from the Green Island Landfill were infrequent;

(b) The most common cause of odour complaints was wastewater treatment plant sludge/grit, frequently received at Green Island Landfill without warning. Therefore, effective management of the delivery of this type of waste has been challenging;

(c) I anticipate that this is unlikely to be an issue at Smooth Hill, with the effective implementation of mitigation measures, including specific measures in relation to the receipt of wastewater treatment plant sludge/grit (as detailed in Section 5.1.4 of my Air Assessment Report); this includes this type of waste having priority over other waste types combined with the expeditious mixing/covering at the tip head;

(d) Furthermore, as of December 2019, improvements to the Green Island Landfill operational procedures and infrastructure have been implemented;

(e) I reviewed the odour complaints received after these improvements for the period 01 January 2020 to 28 March 2021, the details of which are provided in my s92 response. During 2020 no complaints were received regarding "general landfill/no abnormal conditions", and only one was received between 01 January 2021 and 28 March 2021;

(f) While my review of complaints undertaken as part of the s92 request showed a decrease in complaints, I have been made aware that there has been a significant increase in complaints over the most recent period, particularly within the last three months. I have therefore undertaken another review of the complaint records capturing this latest period, 29 March 2021 to 9 March 2022;

(g) Over this period, there have been 31 odour related complaints, with 19 of these being received within the last three months. Based on investigations undertaken by site staff, the potential cause of the complaints has been attributed to the following (ordered from most common to least common cause):

(i) Acceptance of highly odorous waste;

(ii) There is no specific reason/complaints not received promptly to allow an investigation;

(iii) Drainage maintenance;

(iv) Uncovering old refuse;

(v) Engine/Flare offline;

(vi) Turning of compost; and

(vii) High ambient temperatures;

(h) As can be seen above, a variety of potential causes for the odour complaints have been identified. However, in my view, a number of these reasons are specific to Green Island and are unlikely to be the cause of similar effects at Smooth Hill for the following reasons:

(i) Smooth Hill will have more stringent controls regarding the acceptance of highly odorous waste;

(ii) Smooth Hill will have a backup flare, and therefore the frequency of periods during which the gas extraction system will be offline will be much lower, and the duration will be shorter; and

(iii) No composting activities will be undertaken at Smooth Hill;

(i) Some of the other potential causes of odour complaints, such as high ambient temperature and non-routine site works, will be applicable at Smooth Hill. However, additional mitigation measures have been proposed for the Site to reduce the intensity and frequency of odour associated with these events;

(j) In terms of comparing the two landfills, another important factor is that Green Island is surrounded by residential properties, with over 500 homes within 1 km of the Site. This contrasts with Smooth Hill, where there are only two existing properties and limited permitted opportunities for new homes within 1 km of the Site. The greater density of housing surrounding Green Island means that there is almost always the possibility of receptors being downwind of the Site. Therefore, the potential for complaints to occur at Green Island is significantly higher than at Smooth Hill;

(k) The key changes between the Site and Green Island Landfill that will reduce the potential for complaints are as follows:

(i) Changing from a manual process (currently used at Green Island Landfill) to a manifest waste acceptance procedure. This will allow site staff time to prepare and, in some cases, pre-emptively act on incoming odorous loads;

(ii) The Site will receive significantly reduced quantities of putrescible waste through initiatives such as kerbside collection of food and garden waste;

(iii) No greenwaste acceptance at the Site;

(iv) Reduced population density surrounding the Site;

(v) Stabilising of the biosolids (not currently undertaken at Green Island Landfill), such as mixing with lime or using some other suitable method to reduce the odour potential;

(vi) No composting operations at the Site;

(vii) Lack of any other significant odour sources which could cause cumulative effects, such as an adjacent WWTP or estuary, i.e. Green Island WWTP and Kaikorai Estuary are both close to Green Island;

(viii) Improvements at the Site associated with the design of a modern landfill, which is not constrained by historic design issues. This includes an efficient landfill gas collection system and a reduction in the frequency of old waste excavation (most commonly to install leachate drainage or retrofit gas laterals) at the Site compared to Green Island Landfill. The extraction system will also include the use of lateral wells to enable early access to landfill gas; and

(ix) Using a backup (secondary) flare provides redundancy during scheduled maintenance periods or failure of the primary flare and therefore minimises periods where landfill gas is not being collected; and

(l) While the recent increase in odour complaints at Green Island suggests that odour mitigation measures need to be reviewed and potentially further improvements need to be implemented, in my opinion the increase in complaints does not raise any additional concerns regarding the required level of odour management required at Smooth Hill. The increase in complaints serves as a further reminder of the importance that the landfill operator and site staff need to effectively and continuously implement the proposed range of odour control measures to prevent nuisance effects.

65 In my view, the key changes outlined above, and the very small number of close residential dwellings will likely reduce the occurrence of off-site odour from normal operations to a level well below that of Green Island. Consequently, I expect that odours generated by Smooth Hill from the normal operation of the landfill will not cause odour nuisance effects at the nearest receptor locations.

Separation distance analysis

66 A separation distance is a land-use planning tool that can help mitigate nuisance effects on occasions when standard mitigation measures cannot be entirely effective (for example, under non-routine operations or adverse weather events). In relation to Smooth Hill Landfill, I note the following:

(a) The Auckland Council discussion document on Separation Distances for Industry prepared by Emission Impossible recommends a separation distance of 1,000 m;

(b) Environment Protection Authority (EPA). Victoria recommends a separation distance of 500 m. However, I understand that there is the potential for this value to be increased in the near future;

(c) Two (2) existing (R10 and R11) and two (2) potential (P1 and P2) receptors are located within 1,000 m of the centre of the Site, and one (1) receptor (R10) is located within 500 m of the centre of the Site;

(d) I note that the separation distances outlined above are generic, and in my experience, it is common to vary a separation distance based on site-specific factors (such as mitigation measures, local meteorology and likelihood of emissions). This approach is supported by the Auckland Council document, GPG ID and EPA Victoria Publication 1518;

(e) I consider the following criteria to be applicable to the Site:

(i) Size of the landfill:

Table 1 Classification of landfills based on throughput

Landfill	Approximate throughput (tonnes per annum)
Smooth Hill Landfill	60,000 (estimated)
Green Island Landfill	100,000 (consented)[3]
Kate Valley Landfill	300,000
Hampton Downs Landfill	Estimated 800,000 (Consented for 30Mm³ over 25 years)
Redvale Landfill	Estimated 800,000

(ii) **Table 1** above provides the annual throughput for a number of New Zealand landfills;

(iii) The data shows that the throughput at the Site will be significantly lower than larger landfills operating in New Zealand (60,000 tonnes per annum (tpa) compared to 800,000 tpa – i.e.

[3] It is noted that recent annual tonnages have been well less than the consented volume, in the order of 60,000 tonnes per annum.

eight (8) times smaller). Hence, given that the separation distance was likely developed to include amenity protection for large landfills, I consider that the recommended separation distance can reasonably be reduced;

(iv) Topography and meteorology: As previously highlighted, the majority of the proposed future filling operations will be at a lower elevation than nearby receptors, which are located on ridgelines. Therefore, the topography will aid in mitigating odours, as odours tend to stay close to the surface and flow downslope, particularly during low wind speeds and cold air drainage flows. Consequently, any odours detected at these locations are likely to be diluted in strength. I, therefore, consider the local topography to assist with carrying strong odour (i.e. undiluted) away from neighbouring residences; and

(v) Plant equipment and operation: Smooth Hill will be a modern lined landfill with an efficient LFG collection system. The Site will also incorporate a range of best practice mitigation measures to reduce off-site odour.

67 Based on the above, it is my opinion that the circumstances at Smooth Hill support a departure from the recommended separation distances.

Qualitative Odour Assessment (FIDOL)

68 I have used the FIDOL assessment tool to determine the potential for odours to be considered offensive or objectionable by off-site receptors. GPG Odour recommends this approach. The following summarises the findings of the FIDOL odour assessment:

(a) I re-analysed the frequency of light/calm wind speeds (required to carry undiluted odour) blowing from the Site towards receptors using the onsite AWS data, following the same methodology as my original assessment;

(b) I note that individuals are more susceptive to experiencing odour effects during the day (i.e. times when they are working outside and not indoors asleep). Therefore, I have only considered the wind conditions recorded during the proposed waste receipt hours of 8:00 am through 5:30 pm (rounded to 6:00 pm). Furthermore, waste will be covered with daily and other cover material outside of these hours, and therefore, the odour associated with refuse should be low. My frequency analysis is presented in **Table *2*** below:

Table 2 Frequency of low-speed winds (< 3 m/s)

Receptor ID	% of low wind speed winds		
	Between 8:00 am and 6:00 pm – expressed as a percentage of the daytime hours	Between 8:00 am to 6:00 pm – expressed as a percentage of the year	All hours
R1	2	1	2
R2	2	1	2
R3	4	2	3
R4	4	2	3
R5	9	4	5
R6	5	2	5
R7	5	2	5
R8	2	1	2
R9	2	1	2
R10	3	1	4
R11	3	1	6
R12	5	2	5
R13	4	2	6
R14	2	1	2
R15	2	1	2
R16	5	2	5
P1	2	1	2
P2	2	1	2

69 Based on the data provided in **Table *2***, it is expected that:

(a) Receptor R5 will experience light winds from the Site for approximately 9% of the time during hours when waste is received (4% expressed as a percentage of the year). While this may appear to be a relatively high proportion of the time, R5 is located further than 2.5 km from the centre of the Site, and so I expect that any odours would be well dispersed (i.e., diluted) by the time they reached this receptor. Consequently, I consider the risk of this receptor experiencing offensive and objectionable odour to be low;

(b) Receptors R6, R7, R12 and R16 will experience light winds from the direction of the Site for approximately 5% of the time during hours when waste is received (2% expressed as a percentage of the year). All of these receptors are located further than 1 km from the centre of

the Site, and so again, I expect that any odours would be well dispersed (i.e., diluted) by the time they reach these receptors. Therefore, and similar to R5, I consider the risk of these receptors experiencing offensive and objectionable odour to be low; and

(c) Receptors R10 and R11 (located closest to the Site) will experience light winds from the Site for approximately 3% of the time during hours where waste is received (1% expressed as a percentage of the year). I consider this to be a low proportion of the time and therefore consider the risk of these receptors experiencing offensive and objectionable odour to be low.

70 All remaining receptors will likely experience light winds from the Site for less than 4% of the time during hours where waste is received (2% expressed as a percentage of the year). Which I consider to be a low frequency, especially considering that various forms of odour mitigation will be used to minimise odour discharges.

71 While there is the potential for nearby receptors to experience odour from the landfill from time to time, given the above factors in addition to the landfill being constructed in accordance with best practice engineering designs; and the implementation of appropriate mitigation measures, I considered it unlikely that any odours detected at the nearby receptors would be regarded as 'offensive or objectionable'.

72 In addition to the FIDOL assessment, I undertook odour dispersion modelling as part of my Air Quality Assessment (2021), as detailed in Section 9.4.7. Given the relatively close alignment between the modelled data and onsite AWS, I have not re-run the model using this data. I anticipate that the inclusion of the onsite AWS meteorology would slightly alter the shape of the predicted odour contours (shown in Figure 9-6 of my Air Assessment report 2021) to extend more to the east and west than the northeast and southwest. However, I expect the overall predicted concentrations would remain similar.

73 Based on the odour dispersion modelling results, I concluded the following:

(a) The tipping face and daily cover emission rates would need to be approximately 40 times greater than those modelled (based on measurements undertaken at Redvale Landfill in 2016) before the 5 OU criterion (MfE Criteria for rural locations) is exceeded at the nearest receptor; and

(b) In my opinion, the findings from the odour modelling assessment support the FIDOL assessment findings that, provided the proposed

mitigation measures are implemented appropriately, the nearest sensitive receptors are unlikely to experience odour nuisance effects.

74 On account of my review of the Green Island Landfill odour complaint history, the Site-specific considerations applicable to the recommended separation distances, the findings of the FIDOL assessment and the results of the odour dispersion modelling, I consider that, provided the mitigation measures specified in the LMP are implemented, the operation of the landfill is unlikely to cause adverse odour nuisance effects.

Dust

75 Based on my experience, dust emissions from the Site are expected to predominantly consist of coarse particles, which typically results in concerns related to impacts on amenity, visibility and effects on structures (nuisance). The likely sources of dust from the Site would include:

(a) Construction dust:

(i) Earthworks for upgrades to McLaren Gully Road and Big Stone Road;

(ii) Earthworks for construction of the facility areas, vehicle access, toe embankment, attenuation basin, and perimeter drainage;

(iii) Earthworks associated with the construction of the stage one landfill cell;

(iv) Vehicle movements on unpaved surfaces; and

(v) Stockpiling of fill or aggregate;

(b) Operational dust:

(i) Disturbance of dry soils on internal roads as a result of wind or traffic movements;

(ii) Earthworks, such as placing of cover material during dry periods;

(iii) Receiving, placing and compacting dry material during windy conditions; and

(iv) There is also the potential for there to be short periods of time when there are more vehicles onsite as new cells are developed or when final capping is being placed. Consequently, during

these periods, there may be additional wheel generated dust from these vehicles.

76 My Air Quality Assessment (2021) used the FIDOL assessment tool to determine the potential for the activities to generate nuisance dust that might affect the neighbouring community. This approach is recommended by the MfE Good Practice Guide for Assessing and Managing Dust (GPG Dust). The assessment of potential effects from dust discharges is detailed in Section 10 of my Air Assessment report 2021.

77 In my experience, nuisance dust typically becomes a problem when the wind speed exceeds 5 m/s (also noted in MfE GPG as the speed at which dust pickup occurs) and is unlikely to cause significant adverse effects beyond 300 m of an unmitigated dust source. With appropriate mitigation, these effects are typically localised to 100 m from the dust source.

78 To mitigate dust nuisance effects, I have recommended a range of control measures provided in the LMP. However, for convenience, the key measures include:

(a) Watercarts or fixed sprinklers will be used to control dust generated from haul roads;

(b) During high-wind speeds (wind speeds above 5 m/s), delay/reduce the rate of works and/or further increase the watering rate;

(c) Establish vehicle speed limits (typically less than 15 km/hour) to reduce wheel generated dust emissions;

(d) If the material being excavated is very dry, using water sprays to increase surface moisture; and

(e) Installation of appropriate temporary wheel wash facilities in advance of the permanent wheel wash being available to reduce impacts to local roads.

79 Considering the nearest receptor is more than 350 m from the landfill boundary, I do not anticipate that there will be any discernible dust at the identified receptor locations providing the proposed dust mitigation measures are implemented.

80 I conclude that overall, providing the proposed mitigation measures are undertaken, it is unlikely that off-site receptors will experience adverse effects in relation to dust discharges.

Vehicle emissions

81 In practice, the total number of heavy vehicles will fluctuate across any given day. I have assumed truck movements could be up to a worst-case maximum of 25 per day. In addition to heavy vehicles, there will be light vehicles associated with staff vehicles.

82 In my experience, adverse effects associated with vehicle/machinery emissions in New Zealand are only found in urban areas with high traffic volumes combined with traffic congestion. However, I consider that the trucks and heavy machinery should be appropriately maintained. If the landfill operator observes visible emissions from any operational vehicle's exhaust, the identified vehicle should be required to undergo immediate servicing.

83 Overall, the expected traffic volumes at any given time will be very low and have a negligible effect on local air quality.

Combustion gases

84 I have undertaken atmospheric dispersion modelling using CALPUFF (an advanced non-steady-state meteorological and air quality modelling system) to assess the effects associated with emissions from the flare, as detailed in Section 11 of my Air Assessment Report (2021).

85 In my assessment, I have compared predicted off-site concentrations against the health-based assessment criteria outlined in Section 7.2 of my Air Quality Assessment (2021) to determine the potential for adverse effects. A summary of my findings is provided as follows:

(a) As the predicted concentrations at the receptor locations may change slightly with the use of the onsite AWS data, in my evidence, I have instead considered the maximum off-site predicted concentrations for each pollutant and relevant averaging period (instead of at specific receptor locations);

(b) When I compared the predicted maximum off-site concentrations (including background concentrations) with the relevant criteria, I found that the predicted concentrations ranged between 5% (SO_2 99.9th percentile 1 hour average) and 60% (PM_{10} annual average) of the relevant assessment criteria; and

(c) Given that predicted concentrations are well below the assessment criteria, I consider there is limited potential for adverse off-site effects associated with flare discharges.

Diesel generator emissions

86 Small backup diesel generators will be required to power the leachate extraction pumps. It is estimated that the total capacity of the diesel generators for this purpose would be 200 kW.

87 This amount of generation is comparable to a generator that could be hired or purchased by a member of the general public without the expectation that resource consent would be required. The exhaust discharges are also likely to be less than that generated from some of the heavy vehicles used on Site.

88 Providing that the generators are appropriately tuned and maintained and that stack discharges are orientated vertically to improve dispersion, I consider that given the small size of the generator(s), the limited period of operation and the significant distance to the nearest boundary, the off-site effects from this activity are likely to be negligible.

Assessment conclusions

Odour

89 On account of my review of the Green Island Landfill odour complaint history, the Site-specific considerations applicable to the recommended separation distances, the results of the FIDOL assessment and the results of the odour dispersion modelling, I consider that, provided the mitigation measures specified in the Draft LMP are implemented, any odour at or beyond the boundary is unlikely to be considered offensive or objectionable.

Dust

90 Considering the distances from the Site to sensitive receptors and the local meteorology, provided the proposed mitigation measures are undertaken, it is unlikely that dust nuisance effects will occur at off-site locations.

Flare

91 Predicted off-site concentrations of pollutants associated with the flare(s) are all predicted to be well below the relevant assessment criteria. I, therefore, consider that flare emissions pose limited potential to cause adverse effects beyond the Site boundary.

Combustion emissions – vehicles/generators

92 Negligible impacts are anticipated from vehicle emissions and diesel generator emissions.

Response to ORC peer review comments

93 Tonkin & Taylor undertook a review of a former version of my Air Quality Assessment (2020), the outcomes of which have been responded to and incorporated in the latest revision of my Air Quality Assessment (2021). Overall, I consider that the additional information requested by Mr Chilton has served to strengthen the findings of my assessment and has made for a more robust assessment of effects.

94 I understand that there are a small handful of residual items raised by Mr Chilton, which are summarised as follows:

(a) Limit the time of day when highly odorous loads can be received to avoid early mornings when winds can be very light or calm which is a worst case for odour dispersion;

(b) Include a definition of what constitutes highly odorous wastes;

(c) Require the management plan to include specific procedures for the pre-acceptance, handling and placement of highly odorous wastes, including contingency measures in the event of an unexpected odorous load; and

(d) Specify the key requirements of the procedures for the receipt of highly odorous wastes (for example immediate burial, availability of odour suppressant sprays, etc.).

95 I have reviewed the recommendations suggested by Mr Chilton[4], in relation to the additional odour mitigation measures/consent conditions and consider these to be useful additions to the suite of odour controls already proposed and will help provide a greater level of assurance that odours from "highly odorous waste" will be appropriately controlled.

96 Furthermore, I agree with the amendment to the following condition of consent outlined by Mr Chilton, as the proposed wording better aligns with the recommended consent condition provided in the Ministry for the

[4] *Technical Review to inform Notification Decision: Smooth Hill Landfill Appendix 10 - Air quality Assessment, dated 27 August 2021*

Environment Good Practice Guide for assessing and managing odour (2016) (GPG Odour).

97 The amended condition is as follows:

> "There shall be no noxious, dangerous, offensive or objectionable odour or dust to the extent that it causes an adverse effect at or beyond the boundary of the Site."

98 I note that Mr Chilton was concerned that a complete and comprehensive LMP had not been prepared at the time of his review. The Draft LMP has subsequently been updated and includes all of the mitigation measures that I recommended in my Air Quality Assessment (2021), along with Mr Chilton's additional measures.

99 The specific changes to the conditions and Draft LMP measures are addressed further in the Evidence of Mr Dale.

Response to any issues in section 42A report

100 I have reviewed the relevant sections of the s42A report and note the Council's planner has recommended some minor amendments to the consent conditions and LMP. I have no specific issue with any of these amendments.

Response to matters raised in submissions

101 I have reviewed the submissions received by ORC in response to the consent application and noted 35 opposed and one neutral submission in relation to air quality (namely, odour and dust). The main issues raised include:

(a) General landfill odour affecting amenity in residential locations and Brighton Beach;

(b) Dust generation from unsealed roads;

(c) Odour and dust generation from trucks;

(d) Contamination of drinking water with lead from vehicle exhausts; and

(e) General air pollution concerns.

102 Furthermore, of the sensitive receptors incorporated into my assessment (i.e. those located within 3.5 km of the Site), I note there were three submissions concerning air quality, with these being received from:

(a) R12 (S & C Rampe located at 513 Big Stone Road, Dunedin). The submission states that due to the predominant wind directions, odour will be experienced from the landfill up to and including Brighton. The Submitter states that the odour will be similar to the odour which can allegedly be experienced when passing Green Island Landfill. The Submitter also states that the rubbish trucks will leave a distinct "diesel cloud" in the area;

(b) R11 (Big Stone Forest Limited – S & A Ramsay located at 691 Big Stone Road, Dunedin). The submission raises concerns in relation to:

(i) odour nuisance effects from highly odorous waste types and how this will be managed by the Site;

(ii) landfill gas odour and how this will be monitored and regulated at the Site;

(iii) commitment to avoiding the receipt of putrescible waste not reflected in the application; and

(iv) dust from the Site, the unsealed haul routes, and requests further details on the dust mitigation measures in the LMP; and

(c) (R16) S and B Judd (389 Big Stone Road) also cited similar concerns regarding odour nuisance at their property and odour generated by Green Island.

103 In response to issue (a), the results of the odour assessment indicate that, provided the mitigation measures specified in the Draft LMP are implemented, general landfill odour is unlikely to cause offensive or objectionable odour at the nearby receptor locations. I further note that Brighton Beach is located over 7 km from the Site, and in my experience, it is very unlikely that any odour would be experienced at such a distance and be sufficiently strong to be considered offensive and objectionable.

104 In response to issue (b) following the initial construction phase, it is expected that the Site access road will be sealed as far into the Site as the wheel wash, and all public roads leading to the Site will be sealed. Furthermore, water-carts or an irrigation system will be used on sealed and unsealed roads as required during dry periods. Refer to Section 10 of my Air Assessment Report (2021), where it was concluded that dust emissions will not cause any adverse effects beyond the site boundary.

105 In response to issue (c), refer to the above response in relation to dust from trucks. In relation to odour, refuse will be placed in sealed truck and trailer units or bins while transported to the Site (no open bin trucks); therefore, odour from this source should be limited and unlikely to cause adverse nuisance effects.

106 In response to issue (d), lead was effectively banned in New Zealand in 1996; therefore, emissions of this nature from motor vehicles are considered negligible.

107 In response to issue (e), air pollutants associated with site discharges have been assessed and predicted to be well below levels that can cause off-site effects.

108 In response to the submission made by R12 (S & C Rampe located at 513 Big Stone Road, Dunedin):

(a) An assessment of the predominant wind directions was undertaken with respect to the identified receptors. All receptors located within 1 km of the Site would likely experience light winds from the direciton of the Site for less than 5% of the time that waste is being received. I, therefore, consider the frequency that odours have the potential to affect this property to be low, particularly considering that mitigation measures will be used to reduce the frequency and duration of odour discharges;

(b) As stated above, Brighton Beach is located over 7 km from the Site, and in my experience, it is very unlikely that offensive and objectionable odour would be experienced at such a distance. In addition, I reviewed the Green Island complaint records and noted that the furthest distance from which a complaint was received was 2 km from the landfill;

(c) Furthermore, when comparing Smooth Hill Landfill and Green Island Landfill, Smooth Hill Landfill will:

(i) Operate under a manifest waste acceptance procedure;

(ii) Pretreat biosolids;

(iii) Receive reduced quantities of putrescible waste; and

(iv) Have expected improvements associated with the design of a modern landfill;

(d) As such, the potential for off-site odour nuisance from normal operations at Smooth Hill will likely be at a level below that of Green Island Landfill; and

(e) In my experience, combustion-related odours from diesel waste trucks are localised and short-lived (i.e., will disperse (dilute) and become unnoticeable within minutes), and given the low number of truck movements per day (typically less than 25), I consider odour from this source is unlikely to cause nuisance effects beyond the boundary. Furthermore, I note that trucks will access the landfill via McLaren Gulley Road, unless there is an emergency and the route is impassable, and will therefore not travel past 513 Big Stone Road on their way to the landfill.

109 In response to the submission made by R11 (Big Stone Forest Limited S & A Ramsay located at 691 Big Stone Road, Dunedin):

(a) Specific mitigation measures have been developed to reduce the likelihood of highly odorous waste types causing nusiance effects. This includes identifying customers that may have transported odourous loads to site that resulted in odour complaints. If this was to occur then waste from this customer will no longer be accepted until it can be demonstrated that the level of odour from the waste has been reduced to acceptable levels. Furthermore, with the inclusion of additional consent conditions (as outlined by Mr Chilton) specifically relating to highly odorous waste types, I anticipate that odour from highly odorous waste types should be controlled (or suspended until such time that the odour can be appropriately controlled);

(b) Regarding the concerns raised regarding the potential for odour nuisance from vehicles transporting highly odorous waste, I note there is a requirement in the LMP for loads to be sealed and for highly odorous waste to be treated before being transported to the Site. In my view, these measures should be sufficient to minimise the potential for odour nuisance while the material is being transported;

(c) The Submitter has suggested that a covered area could be constructed to assist with mitigating odour from waste being placed. While I understand that this is not practicable for the main working face, given its size and the need for this area to move as the landfill develops, I have been involved with other Landfills where this was discussed as a potential option to help control odours from the placement of highly odorous waste;

(d) For these projects, it was ultimately discovered that this was unnecessary as the odour could be managed using standard handling procedures, such as the immediate burial of the waste/use of odour sprays. Therefore, for Smooth Hill, I don't consider that it will be necessary to create a covered area for the placement of this type of waste. However, if this type of waste is found to be the cause of off-site odour nuisance, then I agree it is one (of many) options that could be considered to reduce odour;

(e) An efficient landfill gas collection system will be installed at the Site. This will include a primary and a backup flare to allow for gas to be continuously collected and flared. With the proper use of the landfill gas collection system and the flare(s) (one primary and one backup flare), I don't anticipate that off-site landfill gas odour will be an issue;

(f) The Submitter is also concerned about the lack of any form of hydrogen sulphide monitoring required as a requirement of consent. While not specified by the consent or LMP, the H_2S concentration in the LFG will be recorded as part of routine gas well tuning, typically undertaken monthly. This information is not used specifically as part of the well tuning process, however, wells identified to have high H_2S concentrations are noted, and additional controls are often implemented when working in these areas;

(g) There are no specific standards that I am aware of limiting the concentration of H_2S in the LFG, as the amount of H_2S generated is primarily a function of the composition of the waste and the conditions within the landfill;

(h) Regarding fugitive emissions of H_2S associated with the LFG, I have recommended regular Instantaneous surface monitoring (ISM) and regular walkovers to identify any areas of the landfill where high concentrations of methane are being emitted through the capping. Furthermore, I have also recommended that boundary odour observations are made once a week to assess the level of odour and the effectiveness of controls;

(i) Methane is most commonly measured to identify fugitive emissions as it typically comprises at least 50% of the LFG and is relatively easy to measure. Whereas, because H_2S is present at much lower concentrations (<0.05%) and is more difficult to measure, it is not typically used to identify the presence of LFG as part of a surface monitoring survey. However, given that the ratio between methane and H_2S remains fairly constant, in my experience, if fugitive LFG

emissions can be appropriately managed, then the same will apply to H_2S emissions in terms of minimising the likelihood of discharges which could cause odour nuisance effects;

(j) The concern raised regarding DCC's commitment to avoiding the receipt of putrescible waste is outside the scope of my assessment. However, I understand that both Mr Henderson and Mr Shaw have addressed this issue in their evidence; and

(k) As stated above, following the initial construction phase, it is expected that the Site access road will be sealed as far into the Site as the wheel wash, and all public roads leading to the Site will be sealed. Furthermore, water-carts or an irrigation system will be used on unsealed roads as required during dry periods. Refer to Section 10 of my Air Assessment (2021), where it was concluded that dust emissions will not cause any adverse effects beyond the Site boundary.

110 In response to the submission made by S and B Judd (389 Big Stone Road):

(a) An assessment of the predominant wind directions was undertaken with respect to the identified receptors. Based on the meteorological data, this receptor will likely experience light winds from the Site for less than 5% of the time that waste is being received. I therefore consider that the frequency that odours have the potential to affect this property to be low, particularly considering that mitigation measures will be used to reduce the frequency and duration of odour discharges. The property is also located over 2 km from the landfill footprint, and in my opinion, a sufficient distance that any odours experienced at this location are unlikely to be of sufficient strength they would be considered offensive or objectionable;

(b) In response to the Submitter's concern regarding experiencing odour from Green Island at locations approximately 4 km from the landfill (Brighton/Waldronville), I am not aware of any recorded odour complaints associated with Green Island beyond a distance of 2 km. Therefore, while odours may be detectable from Green Island over a large distance on occasions, it appears that nuisance effects have not occurred beyond 2 km of the Site; and

(c) While noting that odours from Green Island have led to complaints, as mentioned previously, there are a number of improvements that will occur at Smooth Hill, when compared to Green Island, and therefore the potential for off-site odour nuisance from normal

operations at Smooth Hill will likely be a level below that of Green Island Landfill.

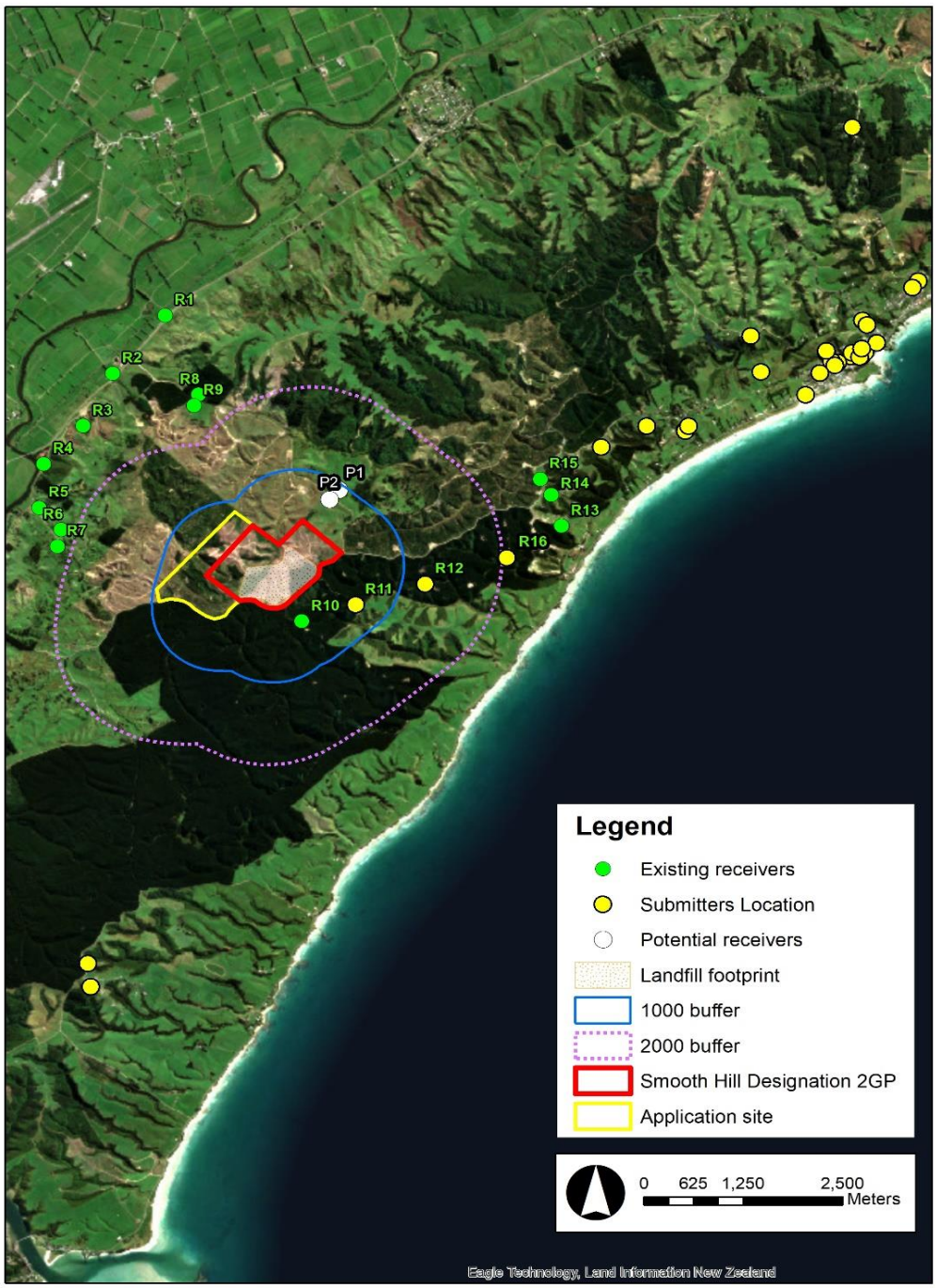
Conclusion

111 I have assessed the effects of the potential air quality impacts arising from the construction and operation of the proposed Landfill. I find that, providing appropriate mitigation measures are implemented, air quality effects on nearby receptors are likely to be minor.

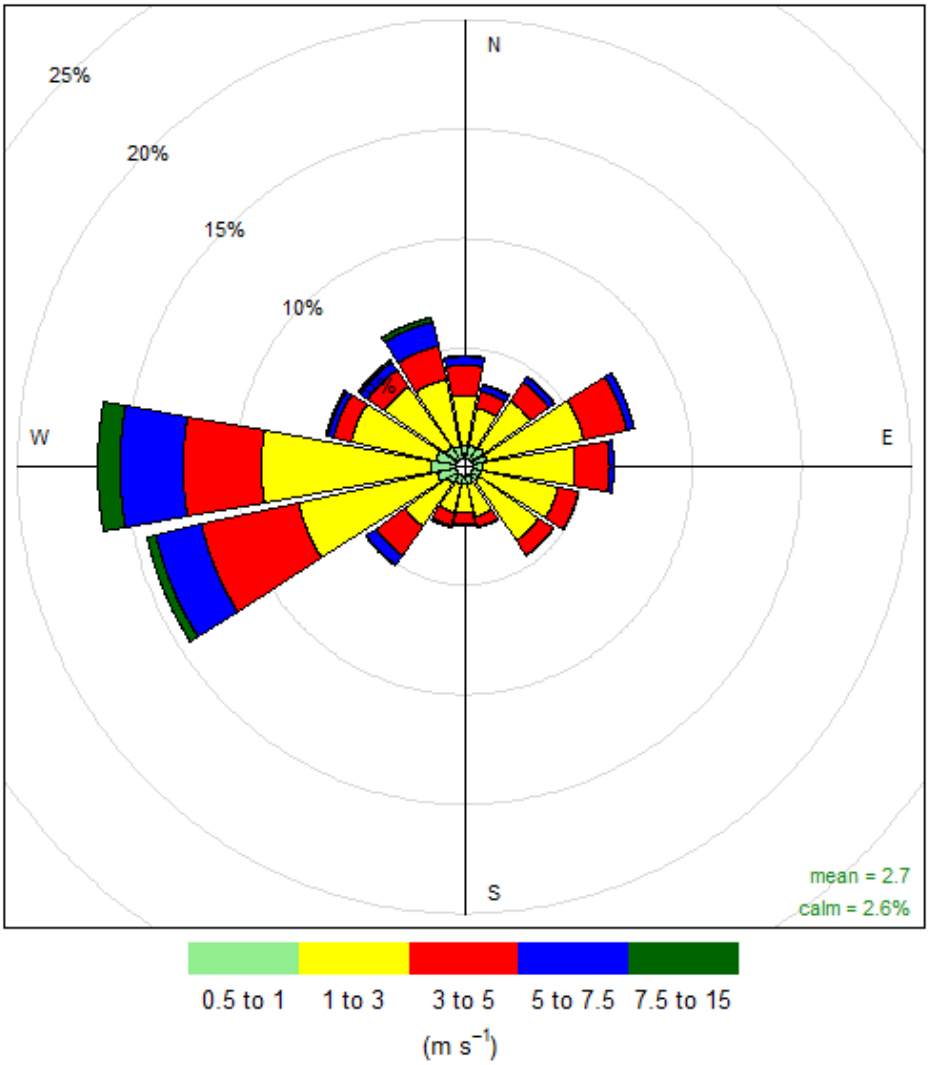
Peter Warwick Stacey

29 April 2022

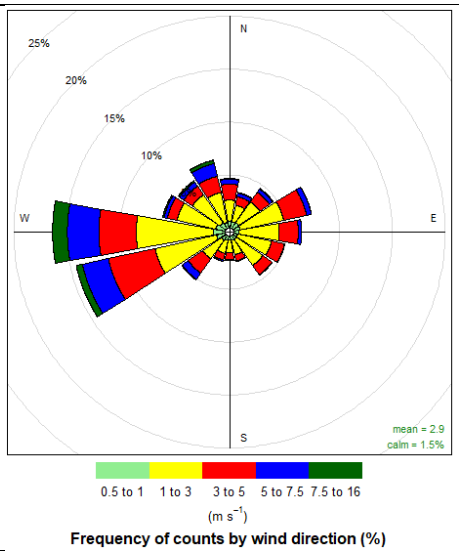
Appendix A: Identified sensitive receptors



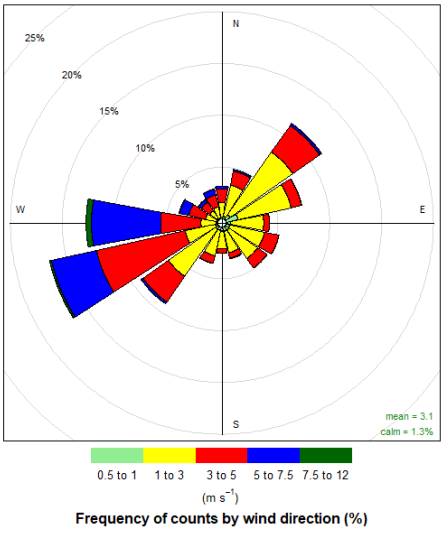
Appendix B: Onsite AWS windrose (2021)



Appendix C: Comparison of modelled vs onsite wind data



a) Onsite AWS Data 2021 (data adjusted from the measured height of 6 m to 10 m)



b) CALMET Data 2017-2019 (extracted at a height of 10 m)