IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of an application to the **HAWKES BAY REGIONAL COUNCIL** by **THE TE MATA MUSHROOM COMPANY LTD** under the Resource Management Act 1991 for a resource consent to discharge contaminants to air

STATEMENT OF EVIDENCE OF DUNCAN BACKSHALL

1. INTRODUCTION

1.1 My full name is Duncan Thomas Backshall. I am currently a director of Air Quality NZ, a company that provides air quality consulting and technical services.

1.2 This evidence is given in respect of the application by The Te Mata Mushroom Company Ltd under the Resource Management Act 1991 for a resource consent to discharge contaminants to air from a composting and mushroom growing operation and associated activities at 174-176 Brookvale Road, Havelock North.

Qualifications and experience

1.3 I am an Air Quality Consultant and hold the qualification of Master of Science (Hons) from Auckland University in 1982.

1.4 I have 37 years' experience in environmental science and have been primarily involved in environmental air quality for 25 years. I have gained experience in many aspects of this field, including atmospheric dispersion modelling, assessment of effects of emissions to air, ambient air monitoring and source emission testing. I am a member of the Clean Air Society of Australia and New Zealand.

1.5 I have been involved in a variety of work with regard to the effects of odour. These include odour monitoring, atmospheric dispersion modelling, assessment of effects and consultancy services for various

operations, including composting, wastewater treatment plants, and packaging and flooring manufacturing.

Involvement

1.6 I was engaged by the Hawkes Bay District Health Board (HBDHB) in May 2019 to provide air quality advice on the application by The Te Mata Mushroom Company (TMM) to discharge contaminants to air from their mushroom growing operation at Havelock North. I participated in the air quality expert witness conferencing held in Auckland during May this year as presented in appendix 6 of the Regional Council section 42a report.

Purpose and scope of evidence

1.7 The purpose of my evidence is to summarise and discuss the review of the application that was prepared for the Hawkes Bay DHB. This was prepared after submissions closed and is included in the appendix to my evidence.

1.8 I will also discuss the changes to the timetable for the proposed mitigation measures presented in the 9 July section 92 response, and comment on the HDC and HBRC section 42a reports.

1.9 I have also read the evidence prepared on behalf of the applicant regarding the application to discharge contaminants to air and will comment on this.

1.10 My evidence is structured as follows:

(a) Summary and discussion of the technical report (Section 2);

(b) Comments on the section 42a reports and recommended consent conditions (Sections 3 and 4);

(c) Comments on the evidence prepared on behalf of the applicant (Section 4);

(d) Discussion (Section 6);

(e) Conclusions (Section 7);

(f) DHB technical report (Appendix).

Expert Witness Code of Conduct

1.11 I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's 2014 Practice Note. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

2. SUMMARY AND DISCUSSION OF TECHNICAL REPORT

2.1 I have prepared a review of the consent application by TMM for the Hawkes Bay District Health Board which is included in the appendix to my evidence. This review was prepared in May this year and does not consider the 9 July section 92 response from TMM.

2.2 The review summarises the information on odour sources presented in the Air Quality Professionals (AQP) report and assesses the likely effectiveness of the key mitigation measures proposed. The 2017 Armatec report, odour complaints and meteorology at the site were also reviewed.

2.3 The distance to the closest houses of under than 200 m is less than the 500 to 1000 m separation recommended by the Western Australia EPA. This is a consequence of the residential development to the west of Arataki Road during the last 10 to 15 years.

2.4 The review includes the following recommendations:

(a) The use of odour assessment tools in addition to complaint records,

(b) implement odour mitigation measures on all main sources before any increase in production,

(c) engage appropriate engineering services to design the extended eaves and ventilations systems,

(d) installation of a suitable weather monitoring station, and

(e) establishing community consultation.

2.5 Emissions to air other than odour were considered. While bioaerosols will be discharged when compost is disturbed, there appears to be limited information on possible off-site health effects. An investigation by the DHB did not find increased hospitalisation rates due to pneumonia.

2.6 I concluded that while the proposed mitigation measures should result in a significant reduction in odour emissions, it is difficult to assess whether this will eliminate adverse effects from odour in the nearby residential areas. It is also likely that complaints will continue even if this is achieved as I expect many residents are now sensitised to mushroom compost odour.

2.7 The following part of my evidence presents additional information and discussion regarding the report.

2.8 In addition to the residential development that has already occurred, the old campground on Arataki Road has been subdivided, which will result in a further increase in dwellings within 500 metres of the TMM site.

2.9 No further analysis of odour complaints has been carried out by the applicant since 2016, although I note that an analysis of odour complaints is presented in the Regional Council section 42a report. I will comment on this later in my evidence.

2.10 Section 2 of my report reviews the odour assessment by Air Quality Professionals (AQP) included in the application. A key part of the assessment is the ranking of odour sources at the site, which was used as the basis for the proposed odour mitigation measures.

2.11 Ms Freeman describes this process in more detail in her evidence. For an operation such as the mushroom farm, I agree that the qualitative assessment described is a reasonable approach. It would be impractical to quantify odour emission rates from the existing operations, and dispersion modelling would be unlikely to provide a reliable indication of the comparative effects of odour from the various sources.

2.12 This method has been used to assess odour effects for three stages of development at the site, which are presented in section 10 of the report. The "future upgraded and expanded" scenario incorporates the increased production with the proposed mitigation measures fully implemented. This requires the effectiveness of these measures to be

included in the assessment, which shows the odour impact of all sources as either Low or Low-Moderate.

2.13 However, as agreed by the expert witnesses, there are uncertainties regarding the effectiveness of the proposed measures. It is unclear whether this has been allowed for in the assessment for the "future upgraded and expanded" scenario. If some measures are less effective than assessed, then odour impacts may be greater than indicated.

Odour capture by extended eaves

2.14 The basis for the proposed odour control measures for the main sources is to enclose these processes as far as considered practicable. The Phase 1 bunkers would be extended to better contain odours during compost transfer and turning, with extended eaves and drop curtains above the entrances to capture odour when the doors are open.

2.15 Phase I to Phase II transfer would be modified to enclose part of the process in a new building beside the Phase II tunnels, with ventilation air treated by a biofilter. The hopper receiving Phase I compost would be covered by an extended eave, which would have a ventilation system to capture odour. Similarly, the proposed bale breaking line outside of the Phase I bunkers would be covered by a similar extended eave and ventilation system.

2.16 Efficient odour collection from the extended eaves is a critical component of these measures. It is difficult to estimate the proportion of the odour emissions that will need to be captured by these systems, but they will need to reasonably efficient to reduce the possibility of effects from residual odour.

2.17 Two reports have been provided by Armatec regarding the extended eaves over the Phase 1 bunker entrances. While Armatec consider that the majority of the evolved gas will be captured, the 2017 report concludes "*Machinery movement in and out of the bunkers and on-site winds will affect gas behaviour at the bunker entrances, and reduce the effectiveness of the extraction system.*"

2.18 The applicant has not provided similar information for the other applications of the extended eaves on Phase I to II transfer or the compost blending line, although this was not requested by HBRC. I consider that these systems are also likely to be key mitigation

measures and their design and implementation will also be critical to the overall success of the proposed odour controls.

2.19 Apart from complete enclosure of all composting operations, which was rejected for practical reasons, it is unclear whether other alternatives were considered to those proposed, for example a method of Phase I bunker to bunker transfer that does not require a front-end loader.

2.20 Most of the movement of compost at present is carried out using a front-end loader. Residual odour from this activity could become more significant as the odour emissions from the main sources are reduced.

2.21 The timetable presented in my review has been superseded by the proposed changes to the implementation of odour controls described in the July 9 section 92 response. An updated flow chart is in the appendix to Ms Freeman's evidence.

2.22 The expert witnesses agreed that implementing the bale breaking system should be a high priority, although there was some disagreement on the timing of this measure. This will not occur for 30 months from granting of the consent according to the updated timetable.

2.23 Mr Whittaker states in his evidence that this is the time required to have the system manufactured in the Netherlands, transported to the site, installed and commissioned. While this delay appears unavoidable, I note that a bale dunking system has been implemented recently. This should reduce the risk of odour resulting from the bale wetting phase, although the construction of the aerated concrete pad to drain water to the existing sump is now scheduled to occur 30 months from consent being granted.

2.24 Mr Whittaker has presented a list of odour mitigation measures that have been implemented recently, including a conveyer system to transfer Phase I compost to the Phase II bunkers. This should reduce odour from this operation, especially once the conveyor is enclosed as indicated by Ms Freeman in her evidence.

3. SECTION 42a REPORTS

3.1 The Hastings District Council section 42a report covers the application for a land use consent by TMM and concludes that the proposal "*will not*

be contrary to the objectives and policies of the Proposed District Plan." However, after considering the requirements of section 104, 104B and 104D of the RMA, the report recommends that consent be refused because "*potential adverse odour effects associated with the proposed activity will not be appropriately avoided, remedied or mitigated*". The report predates the section 92 response provided by the applicant on 9 July.

3.2 The Regional Council also recommends that the consent be refused unless the applicant is able to provide further information on the efficacy of the proposed Phase I bunker hoods and extraction system to reduce odours from this source to an acceptable level. If this is addressed, then consent could be granted subject to conditions which would include implementation of odour mitigation measures before increases in production.

3.3 I generally support the assessment of air quality issues in the HBRC report and the recommended consent conditions. Comments on the report and consent conditions follow.

3.4 Existing air discharge consent, 57: HBRC consider that TMM has failed to comply with conditions 12 and 13 of the 2011 consent, which require all Phase I composting and turning operations to be fully enclosed by 1 March 2017. It is likely that odour complaints would be lower if these measures had been implemented.

3.5 Section 9, Complaints: The analyses for the period from 2013 - 19 are presented graphically in appendix 4, and provide useful information on complaint patterns. `While complaints since December 2015 have not been verified by Council, this remains the only odour assessment information available.

3.6 Figure A4.2 in the appendix presents odour complaints by month from 2013 onwards. This shows much higher complaint numbers during summer than winter, which I would expect as the higher temperatures will increase odour emissions from the compost during Phase I transfer operations. However, the stable, low wind speed conditions considered in the AQP report to result in poor dispersion of odour would be ess frequent in summer.

3.7 Ms Freeman presents wind roses in the appendix to her evidence, and notes that low wind speeds from the northeast towards the residential area are very uncommon. This suggests to me that high odour levels

are occurring during other meteorological conditions, possibly light winds and neutral conditions.

3.8 With regards to odour complaints by days of the week, Figure A4.4 shows that high numbers of complaints occur on the days when Phase I odour is being turned (Monday and Friday), transferred to the Phase II tunnels (Tuesday) and during bale breaking (Thursday).

3.9 The partial enclosure of Phase I turning operations since August 2015 does not appear to have reduced odour complaints on Monday and Friday. This measure may have reduced odour emissions from the operation, but there is no significant reduction in complaints. However, this upgrade occurred a few months before HBRC stopped investigating odour complaints and the data from December 2015 onwards may not be directly comparable to the earlier complaint record.

3.10 I also note a spike in complaints on Thursdays during 2018, which increased the average complaints for this day of the week to third highest over the analysis period. This would suggest that bale breaking and mixing is a significant source of odour and based on this analysis, ranks alongside bunker to bunker transfer on Mondays.

3.11 The report notes that the majority of complaints are from within 500 m of the site. If this had been maintained as a separation distance from sensitive activities, then I would not expect the current level of complaints.

4. Recommended consent conditions

4.1 I have reviewed the draft conditions provided in appendix 2 of the HBRC section 42a report. In general, I support these and note that the recommendations in my report to the DHB have been covered by the draft conditions. Further comments are included below along with some suggested changes.

4.2 Condition 9 (a): I support this condition as it would enable all transfer operations to be carried out on one side of the building once the third bunker is commissioned. This could also enable the design of the extended eaves and ventilation to be optimised for a single side of the bunkers and would avoid the possibility of air movement through the bunkers during transfer operations.

4.3 Condition 9: This does not include the extended eaves over the compost hopper outside the proposed Phase II transfer building as proposed in section 8.6 of the AQP odour assessment. I understand that TMM are now using a conveyer to transport Phase I compost to the Phase II tunnels, which should also be included along with a requirement that this be enclosed.

4.4 Condition 12 (b) (i): It appears that bale dunking may be an interim measure until the bale breaker blending line is commissioned as the completion of the aerated pad is proposed 30 months after consent is granted.

4.5 Condition 36: I would recommend that there be two temperature sensors on the mast to give an indication of low-level inversion conditions.
It appears condition 36 (b) should refer to condition 35.

4.6 Conditions 37 – 41: While I support the requirement for odour monitoring, it is likely that this will change over time as mitigation measures are implemented and hopefully, odour levels beyond the site boundary reduce. For example, a higher frequency of monitoring than weekly may be appropriate initially. My suggestion would be to include the details of the monitoring programme in the OMP so that these can be reviewed annually and revised as necessary.

4.7 I have reservations about whether it is appropriate for the consent holder to investigate odour complaints where there may be an adverse effect. My suggestion would be to limit this to complaints received by TMM.

4.8 Condition 43 (e): Actual wind speed and direction should be available from the meteorological station.

5. Te Mata Mushroom Company expert witness evidence

5.1 My comments below refer to the paragraph numbers in the statements of evidence.

5.2 Mr Whittaker, 24: He refers to Thursday as the fourth highest day for odour complaints based on the AQP complaints analysis. The analysis for 2013 to 2019 presented in the HBRC section 42a report shows Thursday is the third highest day. This suggests that the rate for

Thursday and Monday are similar, which indicates that bale breaking should be considered one of the main odour source.

5.3 Ms Freeman, 14: I agree that objective odour monitoring will be required rather than complaints to determine the effectiveness of the planned mitigation measures because of the degree to which the community is likely to be sensitised to mushroom compost odour.

5.4 Ms Freeman, 27: The only further mitigation measure discussed for Phase I composting is full enclosure. However, there may be other options to improve the odour mitigation.

5.5 Mr Holyoake, 11.5: Much detail is provided on the configuration of the ventilation system and flow rates, which should provide flexibility for adjustment to optimise ventilation of the extended eaves and bunkers. However, I am unsure how the system would be controlled and whether there would this would be automatic when the bunker doors are opened and closed, or require manual setting each time.

5.6 Mr Holyoake, 30: I note that the flow rate of 9.2 m^3/s represents an increase of 260% on the maximum that can be treated by the current biofilter. This is for the Phase I bunkers and extended eaves alone and does not include the air flow from other planned extraction systems, such as the extended eaves for the bale breaker and the Phase II tunnels. This suggests that more than 2 additional biofilters may be required.

5.7 Mr Holyoake, 35. He suggests that the extended eaves will be of most benefit to mitigating odour from compost in the loader bucket once the third bunker is completed. I agree with this and suggest that the 3rd bunker should be considered part of the odour mitigation measures for bunker to bunker transfers.

5.8 Mr Holyoake, 44: He notes that there will be some losses of steam and odour from the bunkers when winds are higher. While dispersion will be better during meteorological conditions when the atmosphere is less stable and wind speeds are higher, it is unclear how whether will be offset by a reduction in odour capture efficiency.

6. DISCUSSION

6.1 The applicant in their 9 July section 92 response has revised the schedule for implementation of odour mitigation and production increases. Although most of the mitigation measures remain unchanged, the timing of their implementation and production increases is different to that proposed in the 2016 consent application. Maximum compost production would remain at 120 tons per week until the extended Phase I bunkers and eaves are completed in 12 months, plus the time to obtain building consent. Following this, production would increase to 160 tons per week. After completion of the other key odour mitigation measures, including the semi-enclosed bale breaking line after 30 months, production would then increase in stages to a maximum of 350 tons per week.

6.2 While this removes the uncertainties in the 2016 proposal, there will still be a 33% production increase without full implementation of the key mitigation measures.

6.3 Mr Curtis in his evidence recommends that the key mitigation measures should be completed before any increase in compost production above the currently consented maximum of 120 tons per week. This is reflected by conditions (9) to (11) in the recommended consent conditions, which I support.

6.4 Some mitigation measures have been implemented, such as dunking the bales to wet them. However, these measures are part of the package of measures proposed for each of the odour sources and their effectiveness individually has not been assessed.

6.5 A number of the main odour sources will not be fully enclosed, including the bale breaking line, Phase I bunker to bunker transfer and Phase I to Phase II transfer. Extended, vented building eaves are proposed to capture odour from these processes. The efficiency of odour capture is not known, and it is also unclear the degree to which residual odour emissions will need to reduce to prevent adverse odour effects.

6.6 Given that the partial enclosure of Phase I compost turning in 2015 has not reduced the number of complaints, I consider that there remains uncertainty as to the effectiveness of the proposed mitigation measures.

6.7 I would recommend that consideration be given to improving the odour mitigation measures for the main sources or investigating alternative

control measures if practicable. This should reduce the risk that adverse odour effects will continue.

6.8 A further issue is the meteorological conditions when adverse odour effects occur. If these do happen during higher wind speeds than expected, then the efficiency of the extended eaves to contain odour could be reduced.

6.9 Odour from compost preparation, which includes bale wetting and breaking, appears to be one of the main odour sources based on complaints analysis. TMM has proposed installing a bale breaking line to improve this process and reduce odour emissions. However, this would require 30 months to commission. While bale wetting has been improved by dunking the bales instead of spraying them with water, I would suggest that further measures be considered in the interim, including bringing forward the aerated pad for draining the wetted bales.

7. CONCLUSIONS

7.1 I have reviewed the odour assessment by TMM, which identifies the key odour sources at the site and proposes a number of mitigation measures to reduce odour emissions. Minor odour sources have been considered, with appropriate controls recommended for these also. A complicating factor is the separation distance of less than 200m to the closest houses.

7.2 The odour control measures generally involve enclosure of composting activities to varying degrees with capture of as much odour as practicable followed by treatment in biofilters. While odour emissions will be reduced, it is difficult to estimate how efficient the mitigation measures will be, and more importantly, whether the residual odour will result in adverse effects beyond the site boundary.

7.3 Even if adverse effects are eliminated, nearby residents are sensitised to mushroom compost odour and a significant level of complaints may continue.

7.4 If the panel does choose to grant consent, I would support the draft consent conditions recommended by the Regional Council.

Duncan Backshall
24 July 2019

Appendix A

Review of application for resource consent prepared for the Hawkes Bay DHB

Nicholas Jones
Public Health Unit
Napier Health Centre
PO Box 447
Napier 4140

9 July 2019

Dear Nicholas,

TE MATA MUSHROOM COMPANY: REVIEW OF APPLICATION FOR RESOURCE CONSENT

The Te Mata Mushroom Company Ltd operates a facility at 174 – 176 Brookvale Road, Havelock North for the commercial production of mushrooms. Following a period of increased complaints from the local community and a decision by the Environment Court, Te Mata Mushroom Company has applied for new Resource Consents for land use and discharges to air. The proposal is a staged implementation of controls to reduce odour emissions accompanied by an increase in mushroom production from 25 to 100 tons per week.

The Hawkes Bay District Health Board (DHB) has requested a review of the application with specific emphasis on the following aspects:

- Whether the application adequately characterises the risks or the adequacy of the odour control measures.
- The possibility of airborne transmission of pathogens from the composting process.

Section 1 presents a brief description of the background to the Consent application, followed by a description and assessment of the proposal in Section 2. Odour issues are discussed and recommendations presented in Section 3, and other emissions to air are considered in Section 4.

1 Background

Te Mata Mushroom Company (TMMC) has been growing mushrooms at the Brookvale Road site since 1967. As discussed in the application, the site was originally some distance from Havelock North, but residential development of land to the south-west of the site has resulted in a significant number of houses within 500 m. The closest houses on Arataki Road are about 200 m from site activities, which can be compared to the minimum separation distance of 500 m recommended by the Western Australia EPA[1].

[1] West Australia EPA, (2005). *Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) Separation Distances between Industrial and Sensitive Land Uses No. 3*, Western Australia Environmental Protection Authority, June 2005.

The most recent Resource Consent was issued in 2012. This included a number of conditions requiring plant upgrades to reduce odour, which suggests that there were adverse odour effects from operations at the site at this time. It should be noted that not all mitigation measures have been implemented. For example, condition 13 of the 2012 consent requires all Phase I turning to be undertaken in a fully enclosed building, which is not the case at present.

HBRC has received many complaints regarding odour from the site in recent years. The application notes that 273 complaints were received during the 24-month period from September 2014 to August 2016. As many of the activities on site take place on a weekly cycle, the complaints were analysed by day of the week in order to relate these to site activities. This information was used as an input to the odour assessment.

Large numbers of complaints continue to be received, with over 550 since August 2016. HBRC stopped investigating complaints in December 2015 and are unable to supply the addresses of the complainants, which makes the information of limited value for assessing odour effects.

TMMC applied for new consents in 2017 to allow for a fourfold increase in production together with a staged approach to reduce odour emissions by implementing a number of mitigation measures as production increases. The rationale for this is that implementation of the odour controls would be uneconomic at current production rates. The consent process has been delayed due to issues regarding the land use consent and was notified in March 2019.

1.1 Information reviewed

The following document was downloaded from the Hastings District Council (HDC) website on 13 May 2019:

> *Resource Consent Application for Land Use, 174 to 176 Brookvale Road, Hastings, The Te Mata Mushroom Company Limited.* Stradegy, 26 September 2018

This document includes the following odour assessment as an appendix:

> *Odour Assessment – Te Mata Mushroom.* Air Quality Professionals, 19 December 2016.

Two letters were prepared by Stradegy dated 17 December 2018 and 5 February 2019 as responses to the Section 92 requests for further information by HDC. These were also downloaded from the HDC website.

Information downloaded from the Hawkes Bay Regional Council (HBRC) website included the Section 92 response to the Regional Council and a report by Armatec on the proposed bunker eave design.

> *DP162209A: Response to request for further information.* cheal, 27 March 2017.

> *Bunker eave extension design.* Armatec Environmental, 5 May 2017.

Reviews of the Air Quality Professionals (AQP) odour assessment were carried out by AECOM for HBRC dated 26 January 2017, and Tonkin and Taylor for HDC dated 12 June 2017. AECOM also reviewed the Section 92 response to HBRC regarding odour issues. Copies of these documents were supplied by the authors, Andrew Curtis and Jenny Simpson.

Additional background information was obtained from media reports and other documents on the HBRC website.

2 Description of Application

The applicant is proposing to increase the rate of mushroom production from 25 to 100 tons per week, which will require a corresponding increase in compost production from the present 80 - 120 tons per week to a maximum of 500 tons. This will require several changes to the existing plant, both to accommodate the increased production and also to mitigate odour emissions from the processes.

Section 3 of the odour assessment prepared by AQP describes activities at the site. The odour sources are described in detail in Section 8. The odour sources were rated for the 3 stages of development (pre-2015, current, and future expansion and upgrades) and the results presented in Section 10.

Odour is the only discharge to air considered in the application.

2.1 Process summary and odour sources

Although the AQP odour assessment contains a comprehensive and detailed assessment of the odour sources, it may be helpful to discuss the hierarchy of the main sources as a background to the assessment and proposed upgrades.

The strongest odours result from the composting activities, with Phase I composting being more odorous than Phase II. The compost is contained within bunkers during both phases, with the Phase I bunkers maintained at a negative pressure inside and the ventilation air treated by a biofilter. The Phase II bunkers are presently vented directly to the atmosphere.

High levels of odour emissions will occur when the compost is disturbed, which occurs twice when it is turned in the Phase I bunkers and again when removed from these bunkers before being turned and moved to the Phase II bunkers. Turning the Phase I compost cannot be done completely inside the bunkers at present, and these are opened at both ends during the operation.

There is less odour during the Phase II composting with only minor odours expected when it is removed from the bunker.

Another potentially significant odour source is the preparation of the compost material, which involves wetting hay bales, breaking them open, and combining with the gypsum / chicken litter mixture. This process is currently carried out in the open and could result in significant odour emissions if the bales or chicken litter have started to decompose.

There are a number of other odour sources on the site, but at present the 3 main sources would be:

1. Turning the Phase I compost.
2. Phase I to Phase II bunker transfer
3. Preparing the mixture for Phase I composting.

2.2 Proposed odour control measures

Evaluation of proposed odour controls is complicated by their implementation during the same period as production increases. This could give rise to the following issues:

1. The first stage is to increase compost production to 200 tons per week while implementing some of the odour controls. This will complicate evaluation of the new controls and may result in increased odour from some sources as a result of production increases without upgrading mitigation measures.
2. The remaining measures are proposed when production reaches 200 tons per week. These would be implemented before increasing production to 500 tons per week, although the timing of production increases relative to the upgrades is unclear. This could also complicate evaluation of the odour controls unless there are defined periods while the production is stable after commissioning the new control measures.

One of the questions in the HDC Section 92 request related to this issue. The response by the applicant did include additional odour analyses (pages 8 – 14 of Part 1 of the Section 92 response), but the staging of the production increases and odour controls remains unclear.

The following sections present an assessment of the key odour control measures and a timeline for the production increases and odour control implementation based on the application and Section 92 responses.

2.3 Effectiveness of proposed odour controls

The proposed odour mitigation measures are described in Section 8 of the AQP odour assessment with the key controls summarised in Section 9. The assessment[2] below follows the order in Section 9.

1. Pre-wetting of the bales

   This is currently carried out by spraying the bales with recycled water over a 7-day period for a total of 30 hours, which is done in the open. There can be odour from the recycled water if this is not well aerated, and the bales can begin to decompose depending on their condition.

   The proposed controls are to wet the bales by dunking them in water and then draining them over an aerated pad. This should reduce odour from the recycled water and result in the bales staying in better condition.

2. Phase I mixing upgrade

   At present, the bales are laid out on a concrete pad and the chicken litter mixture applied to them. The bales and chicken litter are mixed by a turning machine, with the mixture loaded into the Phase I hoppers using a front-end loader. The mixing is done in the open.

   The proposal is to break up the bales prior to adding the chicken litter mixture. This would still be done outside, although the eaves of the Phase I bunker building would

[2] As the AECOM review for HBRC contains a comprehensive assessment of all odour controls, only the key mitigation measures in Section 9 of the AQP odour assessment have been considered here.

be extended to cover the blending line. An air extraction system would be installed above this. The mixture would then be loaded into the bunkers.

This is expected to result in a significant reduction in odour emissions compared to the current procedure. However, there will still be some odour emissions as the extraction system will not capture all of the odour from the mixing process. There may also be odour from moving the mixture into the bunker using a front-end loader.

3. Additional Phase I bunker capacity and odour capture

The analysis of complaints in Section 7 of the AQP odour assessment indicates that this is one of the main causes of complaints. An upgrade was completed during August 2015 although the effects are unclear from the complaints analysis.

2015 upgrade

Improvements to Phase I turning were made by dividing the existing bunkers in half and transferring the material from one side to the other using a front-end loader. Prior to this, the operation was carried out by removing the compost from the bunker, forming a windrow in the open, turning the material and loading it back into a bunker.

While an improvement, odour emissions from the movement of compost by front-end loader will continue. Some odour from operations at the bunker entrance are expected as the building ventilation system will be less effective at the openings.

Application

The proposed upgrade is to extend the bunkers by 10 m so that the entire turning operation is carried out inside the bunkers. A canopy would then be constructed over the extended bunker entrances to enable odour from these to be captured. The Section 92 response to HBRC states that canopies will be built over the bunker entrances on both sides of the building.

While this should reduce odour emissions from the process, there will still be some odour from the bunker entrances as the ventilation system will not capture all of the odour.

Also, the bunkers will remain split in half until the third bunker is constructed. This means that the compost will continue to be moved from one side of the bunkers to the other using a front-end loader. Once the third bunker is commissioned then all transfers will occur on the same side of the building.

There should be a significant reduction in odour emissions compared to the current operations, but these will not be eliminated. Phase I compost odour is very unpleasant, and odour is likely to be detectable downwind of the plant at times. Whether this continues to be offensive or objectionable in the residential area is difficult to assess.

This could be considered a compromise solution, and other options such as an automated turning system contained within the bunkers, or full enclosure of the process would reduce odour further.

4. Phase I to Phase II transfer

   The complaints analysis indicates that this is the other main cause of odour complaints.

   At present the transfer of compost from the Phase I to Phase II bunkers is carried out as follows:

   - The compost is removed using a front end loader and a windrow formed in the open.
   - Water is added and the compost turned.
   - The compost is moved into the Phase II bunker using a front-end loader.

   The proposed upgrade is to change the process so that the compost is removed from the bunker, turned, and loaded into the Phase II bunkers as a continuous process. A new building would be constructed adjacent to the bunkers to contain this operation, with a loading hopper outside covered by an extended eave. Air extracted from the new building and eave would be treated by a biofilter.

   This should significantly reduce the odour emissions as the turning operation will no longer be carried out in the open. However, there will still be odour emissions resulting from the emptying of the Phase I bunkers and filling the proposed hopper that are not captured by the extraction system.

   As with the upgrades to the Phase I turning operation, this can be regarded as a compromise solution as not all odour from this process will be captured.

5. Upgraded main biofilter

   This will be required to treat the much higher volumes of ventilation air from the measures described above, and also the air from the Phase II bunkers which is currently untreated. There will also be additional air from the new Phase I and 2 bunkers required for the production increase, and a significant increase in biofilter capacity will be required.

2.4 Timeline

The following table summarises the odour mitigation measures and additional plant required for the production increase. It is based on the application, AQP odour assessment and the Section 92 response to HBRC.

It should be noted that the first 4 items are unlikely to be completed until near the end of the 8 months, therefore no significant mitigation of odour emissions will occur until then. However, compost production could be increased during this period using the existing plant, so it is possible that emissions could increase until the odour controls are commissioned.

Time after consent granted	Compost production	Required for production increase	Odour mitigation measures
0 – 8 months	Increase from 120 to 200 tons per week		1. Extend Phase I bunkers and construct canopy over bunker entrance. Item 3 above 2. Construct new building for Phase I to Phase II transfer. Item 4 above. 3. Construct new biofilter for (2) Item 5 above. See note below. 4. Treat Phase II ventilation air in new biofilter. 5. Upgrade spent compost storage.
Not specified	Upon increasing to 200 tons	1. Construct a third Phase I bunker similar to existing, upgraded bunkers. 2. Construct additional Phase II bunkers.	1. Upgrade bale wetting process. Item 1 above. 2. Phase I mixing upgrade. Item 2 above. 3. Upgrade or construct new biofilter. See note below.
Not specified	Increase production to 500 tons		

Note: No timing is given for a new biofilter, although it appears this will be required in the first 8 months.

2.5 Armatec report on eave odour collection

A report was commissioned by TMMC on the proposed odour collection system under the extended eaves in response to a request for further information by HBRC. The report concludes that:

- When the bunker doors are open, it is not possible to capture all gases evolved from the bunkers.
- When the compost is outside the bunkers and eaves, evolved gas is not captured.
- The majority of the evolved gas will be captured by the combination of appropriately designed and constructed extended eaves, curtains and roof design coupled with appropriately sized and designed gas extraction systems.
- Machinery movement in and out of the bunkers and on-site winds will affect gas behaviour at the bunker entrances, and reduce the effectiveness of the extraction system.

This confirms that the extraction system will not be completely effective, and the performance will depend on appropriate design and implementation. The report also notes that odour treatment (biofilter) is “a very important element of the overall design”.

2.6 Odour complaints

As discussed previously, the odour complaints from September 2014 to August 2016 were analysed to inform the AQP odour assessment. It appears that no further analysis of the complaints since then has been carried out although the HBRC has received more than 550 complaints since then.

However, HBRC has not responded to complaints since December 2015 and the location of the complaints is either not recorded or withheld. This reduces the value of the complaint data for odour assessment, and also hinders the evaluation of new odour controls that have been implemented in recent years such as the changes to Phase I compost turning.

2.7 Meteorology

As noted in Section 7 of the AQP odour assessment, the most important meteorological conditions affecting odour dispersion are wind speed and direction, and atmospheric stability. Although there is wind monitoring equipment at the site, the data was considered unsuitable because the low height of the mast. Deficiencies were also noted in the data from a wind monitor in Arataki Road due to the low mast height, and data from the weather station at Whakatu was considered to not represent Havelock North wind patterns.

Given the importance of meteorological data to odour assessment, it is unfortunate that representative wind data of an acceptable quality has not been collected.

3 Discussion and recommendations

3.1 Odour assessment methodology

The standard procedure when assessing the effects of discharges to air is to identify the sources, quantify the emissions, and use atmospheric dispersion modelling to predict ground level concentrations. The procedure with odour assessments is different, as quantifying source odour emissions is often difficult and atmospheric dispersion modelling of odour has limitations. Accordingly, some method(s) of determining the community response to odour is a key part of the assessment process for existing operations.

The MfE Good Practice Guide (GPG) for Assessing and Managing Odour recommends a number of tools for odour assessment in the community. Of those listed in Appendix 2 of the GPG, the only one used in the AQP odour assessment is complaint records. While this has been of value in determining the major odour sources at TMMC, the use of other tools such as an odour annoyance survey could have been of assistance in understanding the effects on the community, especially with regard to chronic effects.

The recommendation is that appropriate tools as recommended in the Odour GPG be used for odour assessments in the future.

3.2 Implementation of odour controls

Although the community response is limited to complaint records, the major odour sources have been identified, and mitigation measures proposed. However, the implementation of these as described in the application will occur along with a quadrupling of production. As

the timing of the mitigation measures and production increases is unclear, evaluating the effectiveness of the odour reduction strategy may be compromised.

Because operations at TMMC result in adverse odour effects in the community, it is recommended that the proposed control measures be applied to at least the key sources and the community response be evaluated over an appropriate period before any increase in production. This should establish whether the controls have reduced odour below the objectionable and offensive threshold and identify whether any source(s) require additional mitigation.

Only once it is determined that the odour control strategy has succeeded should production be increased. It is recommended that this be done in stages, for example an increase to 250 tons of compost followed by a period of evaluation, then to full production.

3.3 Implementation of odour controls

A further issue regarding the odour mitigation is that some of the measures proposed for the main sources should significantly reduce odour emissions but will not eliminate them. The degree of reduction is difficult to determine and even with appropriate engineering advice and design, the effectiveness in reducing odour effects offsite will not be known until the extraction systems are implemented. This proviso applies in particular to the use of extended eaves and canopies to capture odour from sources such as the Phase I bunker entrances during compost turning.

The recommendations are that appropriate engineering services be engaged to design the extended eaves and canopies including air extraction and odour treatment, and off-site odour effects be assessed using appropriate methods following commissioning.

3.4 Meteorological monitoring

A weather monitoring station should be installed at or near the site. As a minimum, this should measure wind speed and direction and measure temperature at 2 heights to determine when there is a temperature inversion. An alarm system should be implemented to ensure that plant operators are aware of low wind speeds and/or inversion conditions so that odour emissions from plant operations can be avoided at these times.

3.5 Community consultation

It appears from the AQP odour assessment that there is no formal community consultation in place. *The recommendation is that regular meetings with community representatives be established.*

4 Other emissions to air

The effects from emissions to air other than odour were not assessed in the application. While odour emissions are usually the main cause of adverse effects from mushroom production, there may be the potential for effects from other discharges to air in this case due to the following:

1. The closest houses are about 200 m from operations on the site, which is less than the recommended separation distance from sensitive activities.

2. At present, some compost turning and transfer operations are carried out in the open. The proposed upgrades will not result in complete enclosure of these activities.

3. Very stable meteorological conditions can occur in the area overnight, resulting in poor dispersion of contaminants until the inversion conditions break up after sunrise. This could increase levels downwind of the site at these times

4.1 Emissions to air other than odour

Mushroom growing at Te Mata Mushroom is carried out indoors with the spent compost sterilised before removal from the growing sheds to covered storage. There are unlikely to be any significant emissions to air from these operations. However, composting operations are carried out wholly or partially in the open at present and possible emissions to air are discussed below.

While gases such as ammonia result from compost production, any effects beyond the site boundary are likely to be due to odour. Emissions of microorganisms are expected to be bioaerosols rather than dust because of the high moisture content of mushroom compost.

The pattern of bioaerosol emissions are expected to be similar to the odour discharges from composting operations, with the highest emission rates during compost turning and transfer. At present, some of these operations are carried out in the open, which increases the potential for bioaerosols to be transported off site.

There is little information in the literature regarding off-site health effects from mushroom compost production. However, there are publications covering occupational health risks for workers that can give an indication of potential health effects. The HSE in the UK has published a fact sheet on the respiratory risks from mushroom production, which indicates that the main health risks to workers are from allergic reactions to thermophilic microorganisms in the compost (Mushroom worker's lung) and to spores of the mushrooms or contaminating fungi (Mushroom picker's lung / asthma). There is no mention of risks from human pathogens, probably because most commercial production in the UK is carried out using Phase III compost from specialist producers.

Phase I and 2 composting result in high temperatures inside the compost, and a study of pathogen inactivation during Phase II compost production[3] found that this "*can be an effective control measure for eliminating risks associated with the use of composted animal manures during mushroom production.*" However, Phase I composting was not found to be as effective, possibly due to temperature variations in the compost.

4.2 Effects of emissions to air

The potential for effects from emissions to air other than odour was not considered by the applicant. While there can be risks to workers at mushroom farms from airborne microorganisms, it is unclear whether these could be present beyond the site boundary at

[3] Weil, J. D., Cutter, C. N., Beelman, R. D., & Laborde, L. F. (2013). Inactivation of Human Pathogens during Phase II Composting of Manure-Based Mushroom Growth Substrate. *Journal of Food Protection,* 76(8), 1393–1400.

concentrations that would result in adverse health effects. However, it is important to note that effective odour control measures will also minimise the emissions of bioaerosols.

5 Conclusions

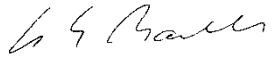
The odour assessment by TMM identifies the main odour sources at the site and proposes a number of mitigation measures to reduce odour emissions. Minor odour sources have been considered, with appropriate controls recommended for these also. A complicating factor is the separation distance of less than 200m to the closest houses.

The odour control measures generally involve enclosure of composting activities to varying degrees with capture of as much odour as practicable followed by treatment in biofilters. While odour emissions will be reduced, it is difficult to estimate how efficient the mitigation measures will be, and more importantly, whether the residual odour will result in adverse effects beyond the site boundary. Even if adverse effects are eliminated, some nearby residents will be sensitised to mushroom compost odour and a significant level of complaints may continue.

The applicant did not assess emissions to air other than odour. There will be some bioaerosol emissions during turning and transfer of the Phase 1 compost, but it is unclear whether these could result in off-site health effects. The proposed mitigation measures for odour would also reduce bioaerosol emissions.

I hope that this information is of assistance to you. Please contact me if you have any questions or require further information.

Yours sincerely,



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