TODOROSKI AIR SCIENCES

DRAFT REVIEW OF GOLDER AIR DISPERSION MODELLING

OF METHYL BROMIDE FOR DECISION-MAKING COMMITTEE

New Zealand Environmental Protection Authority on behalf of Decision-Making Committee

6 May 2021

Job Number 21041270

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DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	06/05/2021	A Todoroski	

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1 INTRODUCTION

Todoroski Air Sciences (TAS) has been engaged by the New Zealand (NZ) Environmental Protection Authority (EPA) on behalf of the Decision-making Committee (DMC) to review the report and air dispersion modelling by Golder Associates (New Zealand) Limited ("Golder") referred to as the 'Fumigation Mitigation Options Investigation', dated 29 January 2021.

1.1 Objectives

This report responds to the Direction & Minute WGT032 of the DMC on 14 April 2021. The relevant directions are set out below;

"...

6. The DMC note that the SEC and Golder reports have not been independently reviewed by other experts, unlike the other available modelling reports.

7. The DMC direct that the Golder report is independently reviewed by TAS and Atmospheric Science Global (ASG).

8. The DMC understand from previous reports that being able to look at the modelling files in conjunction with the report is an important aspect in the review process. The DMC, therefore, direct Golder to provide the modelling files directly to TAS and ASG.
..."

2 REVIEW OF GOLDER REPORT AND MODELLING

2.1 Outline of Golder approach

Section 2.0 of the Golder report outlines that Golder utilises the previously peer reviewed modelling by TAS to determine the mass emission rate of methyl bromide that can be used to fumigate log stacks without causing impact at a nominal 100m distance. The strategy adopted for controlling impact from log stack fumigation is by controlling both the mass emissions of methyl bromide released in any hour, and varying the time of day of the release.

For the ships, Golder ran new modelling based on the TAS ship modelling, by modelling a one-hour interval between opening ship holds instead of the two-hour interval modelled by TAS. The strategy for controlling ship emissions is the time of day, i.e. there is typically better air dispersion in daytime hours than at night for example, or it may be impractical to control the mass emissions rate.

2.2 Consideration of wind conditions

Section 2.2 of Golder correctly points out that modelling results for times with wind speeds less than 0.5m/s are less reliable and nominates to not undertake ventilation under such conditions. Golder also notes that further research into low wind speed conditions may be warranted.

This is consistent with the findings in Section 4.1.2 of TAS report "Air Dispersion Modelling of Methyl Bromide for Decision-Making Committee" dated 1 December 2020 (**TAS, 2020**), where the analysis of wind conditions indicates most risk at low wind, but low risk for wind speeds above 2m/s, and concluded that the TAS *"...analysis indicates that the required buffer distance is significantly affected by the wind conditions, and .... show that there may be value in the Operator evaluating ... whether ventilation activities can be adjusted according to the weather conditions in order to minimise impacts."*

It is considered appropriate to reiterate the advice in (**TAS, 2020**) that it may be useful for the operator to take steps to evaluate in more detail if it is able to utilise wind conditions (e.g. wind speed and direction) as factors to better mitigate potential impacts from ventilation of methyl bromide.

This requires more information on operational specifics than a third party like the EPA or TAS can reasonably garner and analyse, (and thus impose on the operator). However, as the TAS modelling is focussed on the upper range of potential impacts but at the same time also indicates that there is low risk of any impact when wind speeds above 2m/s, (such wind speeds occur most of the time), it would seem to be an important issue for the operator to evaluate in more detail than is provided in Section 2.2 of Golder. For example, is would seem to be useful to determine the mass emission rate for log stacks that is needed to keep impacts within 100m during wind speeds of >1, 1.5, 2, 2.5 m/s …etc.

2.3 Assessment of log stack ventilation

Section 2.3 of Golder provides more detail as to how the TAS modelling was used to determine the mass emission rate and time of day controls to prevent impacts beyond approximately 100m from the log stacks being ventilated.

Reviewing this section led to identifying an error in the TAS modelling of the scenarios used by Golder. The error arises primarily due to an error in the equation in Section 3 of (**TAS, 2020**) that led to an underestimation of impacts by a factor of approximately 2.4-fold in the two scenarios (2 and 12) relied on by Golder. In essence there were excess emission reductions made for the lower impacting scenarios in (**TAS, 2020**).

As a consequence, the calculated acceptable mass emission rates in Golder would need to be reduced by a factor of approximately 2.4-fold to correspond with Golder's conclusions and recommendations in Section 3.0 of Golder. As a guide, the area of maximum potential impact calculated by Golder in Figures 1 and 2 would be a little smaller than the 1,500 $\mu g/m^3$ isopleth line at the proposed mass emission rates, but at mass emission rates approximately 2.4 times lower than proposed it would match the blue 3,900 $\mu g/m^3$ line shown in the figures. The blue line is an approximate 100m distance from the log stacks.

It is important to note that the error does not affect the worst-case scenarios in (**TAS, 2020**), and there is no underestimation of the maximum upper impacts predicted in (**TAS, 2020**).

Review of the Golder modelling files, which are essentially a re-scaling of the TAS modelling found no technical issues in how this was done by Golder. There would be some minor imprecision arising from such scaling, but this would be well within any uncertainty in the modelling or in the variability that would arise from year to year due to weather conditions. Overall, we did not find any technical issues with the approach, except of course that it relied on TAS modelling files which are incorrect for the scenarios used, as noted above.

2.4 Assessment of ship ventilation

Section 2.4 of Golder outlines in more detail how the ship holds were re-modelled. The modelling is essentially the same as TAS except that only a one-hour instead of a two-hour interval between the opening of successive ship holds was used.

It is noted that the issue outlined in **Section 2.3** does not affect any of the ship modelling.

2.4.1 Two-hour interval between successive ship holds opening

Section 2.4.1 of Golder outlines fumigation (control) options based on the TAS modelling with two-hour intervals between successive ship hold openings.

No issues were identified in this section. Similarly, no technical issues were identified in the modelling approach used. It is noted that the issue outlined in **Section 2.3** does not affect any of the ship modelling.

2.4.2 One-hour interval between successive ship holds opening

Section 2.4.2 of Golder outlines fumigation (control) options based on the TAS modelling set up re-run by Golder with a one-hour interval between successive ship hold openings.

No significant issues were identified in this section. Similarly, no significant technical issues were identified in the modelling approach used. It is noted that the issue outlined in **Section 2.3** does not affect any of the ship modelling.It is noted that the blue "buffer" line in Golder Figure 3 to Figure 5 covers areas of water to the west of the site, and under easterly wind conditions it may require control of watercraft to manage impacts in this area.

3 REVIEW OF PROPOSED CONTROL MEASURES

Section 3.0 of Golder describes the equivalent volume of log stacks that can be treated in one-hour and also the mass emissions in the first hour needed to prevent impacts beyond 100m exceeding the one-hour average criteria from methyl bromide of 3,900 µg/m^3.

However, due to the issue outlined in **Section 2.3**, the values in all of the tables in Section 3.0 of Golder need to be reduced by a factor of approximately 2.4.

This degree of reduction may not be achievable whilst meeting fumigation volumes and timelines. STIMBR/ Golder may need to re-evaluate the proposed mitigation measure to determine if they are still practical, or to develop alternative and complementary management measures, for example more detailed consideration of wind conditions, rather than just the time of day may assist.

4 DISCUSSION AND CONCLUSIONS

This report has reviewed the report and modelling by Golder.

The review did not identify any technical issue of consequence in the technical approach and work by Golder, however it found that there was an error in the TAS results for log stacks that the Golder work is based on.

Consequently, the mitigation strategy for log stacks set out in Section 3.0 of Golder would need reduce the volume and mass rates in all of the tables in Section 3.0 of Golder by a factor of approximately 2.4 in order to achieve the outcomes presented in the Golder report.

This may not be readily achievable, and STIMBR/ Golder may need to re-evaluate the proposed mitigation strategy in more detail.

As set out in (**TAS, 2020**), …"*the following five key factors were found to have a significant bearing on the potential for compliance with TEL criteria:*

- *the number of timber log stacks (or ship holds) ventilated per hour;*
- *the initial dose;*
- *the capture rate (or final concentration);*
- *wind conditions; and,*
- *distance to the nearest receptor location.*

For ventilation of timber log stacks on the dock; with careful attention to these five key factors the results indicate that it is possible to ventilate log stacks on the dock without excessive risk of impacts on workers or bystanders.

The brief analysis presented indicates that there may be scope for potentially significant reductions in impact if ventilation activities can be adjusted under certain more adverse weather conditions. Other technical or planning options may also be available to alleviate or minimise the potential risk of impacts.

The results indicate that with attention to the key factors that affect the potential impacts the activity can achieve compliance with the TEL criteria, but the results also show that impact can arise, for example is if due care is not taken. "

We thus re-iterate that more detailed examination of control options which consider the last two factors; wind conditions, distance to the receptor (e.g. factoring in the spatial spread and size of log stacks upwind of a receptor) may be warranted to adequately control impacts in this case.

We would add that utilising weather and plume predictive systems may also assist. For example, such systems are used by large pollutant emitters, and whilst these systems are not known to be used by fumigators, there appears to be scope to achieve significantly lower impact in this case with such strategies.

5 REFERENCES

TAS (2021)

"*Air Dispersion Modelling of Methyl Bromide for Decision-Making Committee*", prepared for New Zealand Environmental Protection Authority on behalf of Decision-Making Committee by Todoroski Air sciences December 2021.