Paeriwa Application No APP143988 Additional Information

The following information is in response to items listed in the Waikato Regional Council Notification Decision document dated 3/12/2021 that suggests that further information would be useful in assessing the application APP143988 by Global Contracting Solutions (GCS) for consent to discharge to air.

Specific items listed in the decision document are in italics followed by the GCS response.

1 FLUE GAS COOLING AND RECIRCULATION

The flue gas treatments largely resemble EU BAT guidelines, however some details are missing that are relevant to likely emission rates such as use of rapid flue gas cooling, or use of flue gas recirculation. While there is no requirement in the RMA to comply with the EU BAT guidelines, applicants do need to demonstrate that the emission limits can be complied with, particularly for a large installation that would not be easy to mitigate or modify once built.

RESPONSE

There is no rapid flue gas cooling employed in this application, but flue gas recirculation is used to reduce the discharges of carbon monoxide and nitrogen oxides and other species including dioxins and furans. A schematic (*Boiler-Filter-Stack Diag 2.pdf*) showing the FGR in green is attached to this report.

2 SUPPORTING EMISSION DATA

While the applicant has indicated that the manufacturer has guaranteed the emissions will be complied with, there is no supporting stack emission data from a reference plant to support the manufacturer's emission guarantees, despite this being requested in the section 92 request.

RESPONSE

Emission data for installations in Germany are required to continuously report the data from the emission monitoring instruments as well as report annual test results. Stack emission concentration data for a Lambion RDF plant in Korbach that is similar to the proposed Paeriwa units and uses the same technology for emission control is summarised in Table 1 below in mg Nm^{-3} @ 11% O_2. Note that for NOx emissions, the site operates under a legacy limit of 200 mg Nm^{-3}.

Although no particulate measurements have been reported, the manufacturers guarantee of 10mg Nm^{-3} for TSP at 11% O_2 or 15 mg Nm^{-3} at 6% O_2 is readily attainable using commonly available filtration media and experience shows that emission concentrations of less than 5 mg Nm^{-3} can also be achieved if required using specialist fabric material installed in standard baghouses. However, this lower limit is not considered to be necessary because the existing proposed discharges already meet the appropriate ambient air quality standards.

The proposed limits for Paeriwa are for the mass emission rates rather than the stack emission concentration that is still used in the EU and other jurisdictions.

Table 1 Korbach RDF Emission Test Data and Proposed Paeriwa Limits***

	Limit*	Measured 2019	Measured 2020	Measured 2021	Paeriwa Concentration	Proposed Paeriwa kg hr^{-1}
Particulate TSP	(20) 5	0	0	0	10	0.47
Particulate PM_{10}	5	-	-	-	10	0.47
Particulate $PM_{2.5}$	5	-	-	-	10	0.47
SO_2	(200) 50	4	5	4	50	2.33
NOx as NO_2	(400) 200**	181	181	183	150	7.00
HCl	(60) 10	9	9	9	10	0.47
HF	(4) 1	<1	<0.3	<0.1	1	0.05
Hg	(0.05) 03	0.000	0.000	0.000	0.03	0.0014
CO	(100) 50	3	3	5	50	2.33
NH_3	(15) 10	0	0	0		-
Cd+Tl	0.05	0.0	<.0.01	0.01	0.005	0.00023
Sum of Sb, As, Pb, Cr, Co	0.01	0.0	0.0		.01	0.00047
Cu, Mn, Ni, V, Sn						-
Benzo(a)pyrene	.005	0.000	0.000	0.000	-	-
PCDD/PCDF ng I-TEQ	0.1	0.0	0.0	0.0	0.0	0.0047

* Values in parentheses are for half-hour averages, and the second value is for daily average
** Limit is greater than current EU (2019) reference value as plant was established prior to 2019
*** All values in mg Nm^{-3} @ 11% O_2 except for PCDD/PCDF that is in ng Nm^{-3}
Values listed as - indicate not measured
Flue gas flow rate = 31122 Nm^3 hr^{-1} dry 6% O_2 or 46683 Nm^3 hr^{-1} dry 11% O_2

3 OZONE LIMITING METHOD SENSITIVITY

The AQ assessment should consider the sensitivity of the selected NOx-to-NO_2 assessment method. Is the "5% as NO2" rule-of-thumb appropriate after SNCR, and is the assessment sensitive to this assumption? Stack emission data from a similar reference site would really be helpful here.

RESPONSE

Maximum potential NO_2 levels assuming a 10% NO_2 fraction in the flue gases are summarised as below. As described in the Assessment document, the analysis for NO_2 uses the conservative ozone limiting method[1] (OLM) with the longer term O_3 levels taken from Patumahoe as there is no 24 hr nor annual average reported for the Baring Head ozone data.

One-hour Averages

For maximum predicted 1-Hour off site NOx levels of 75 to 100 µg m^{-3} that are close to or at the proposed site boundary (Figure 6-10 of the assessment) the maximum NO_2 assuming 10% in the flue gases is determined from Equation (1).

$$[NO_2] = 72 + [NOx]_{tot} \times 10\% \quad (1)$$

This yields a predicted maximum NO_2 of between 79.5 and 82 µg m^{-3}. Assuming a constant background of 41 µg m^{-3} results in maximum potential NO_2 of between 120.5 and 123 µg m^{-3} close to or at the Paeriwa boundary and significantly less for other locations. As with the original assessment, the

[1] Ministry for the Environment. Good Practice Guide for Atmospheric Dispersion Modelling. June 2004 Wellington, New Zealand

expected levels comply with the New Zealand Ambient Air Quality Standard (NZAAQS) of 200 µg m^{-3} for a 1 hour average.

For locations close to Fonterra the maximum predicted NOx is between 100 and 200 µg m^{-3}. For 10% NO_2 in the flue gases the maximum potential NO_2 is between 82 and 92 µg m^{-3}. Assuming a constant background level of 41 µg m^{-3} gives a maximum NO_2 of between 123 and 133 µg m^{-3}. However it is important to note that these higher levels close to Fonterra are dominated by the existing discharges from Fonterra, not the proposed RDF plant.

24-hour Averages

As described in Section 6.3 of the Assessment document, the OLM equation for 24-hour averages is given in Equation 2.

$$[NO_2] = 68 + [NOx]_{tot} \times 10\% \qquad (2)$$

For 24-hr total NOx of 50 to 75 µg m^{-3} close to the RDF plant, the NO_2 concentration can be estimated[2] to be 50 to 76.1 µg m^{-3}. For locations closer to the Fonterra plant the total NOx of 100 to 150 µg m^{-3} yields a predicted NO_2 level of 79 to 84 µg m^{-3}.

The addition of the assumed 24-hr background of 16 µg m^{-3} results in a total NO_2 of 66 to 92.1 µg m^{-3} close to the RDF plant and lower for other locations. Predicted levels are 95 to 100 µg m^{-3} closer to the Fonterra plant that are dominated by its own discharges not the proposed RDF plant.

Annual Averages

For annual averages the highest off-site predicted total NOx is about 15 µg m^{-3} that is less than the lower limit of 47 µg m^{-3} where it is all assumed to be converted to NO_2 (see Appendix H). Therefore the total NO_2 is determined to be 15 µg m^{-3} plus the assumed annual background of 4 µg m^{-3} results in 19 µg m^{-3} for locations very close to the both the RDF and Fonterra plant boundaries but much less for more distant locations. This is less than the Regional Council guideline of 30 µg m^{-3} and the effects are considered to be no more than minor.

Summary

The original assessment modelled the potential off-site effects assuming that the flue gas NOx contained 5% NO_2. Using an upper range of 10% instead increases the predictions from 117 - 118 µg m^{-3} to 123 - 133 µg m^{-3}, that still complies with the NZAAQ of 200 µg m^{-3}. The 24-hour and annual average predictions are also greater than those using the 5% NO_2 ratio, but remain compliant with the Regional Council guidelines. It is also important to remember that these predictions are conservative[3] and that they are considered to be screening level over-estimates1 of those that could occur in practice even for the higher predictions that use the 10% NO_2 ratio in the flue gas NOx.

4 FLUE GAS TEMPERATURE

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[2] The lower value of 50 is less than the limit value of 76 for a 24 hour average. See Appendix H of the assessment document.

[3] U.S. Environmental Protection Agency Office of Air Quality Planning and Standards. Technical support document (TSD) for NO2-related AERMOD modifications. EPA- 454/B-15-004 July 2015.

Discharge temp of 175 ℃ is quite high compared to our experiences in Victoria (where 140 ℃ is typical) and implies incomplete heat recovery which could end up different in the final design. Modelling should consider sensitivity to discharge temp as this affects the plume buoyancy.

RESPONSE

Flue gas temperatures from most combustion sources are typically in the range of 200 to 250 °C, but heat losses due to passage of the flue gas through cleaning and duct work reduce the temperature to a nominal 175 °C and as was noted in the S92 response to the same query lower temperatures can cause corrosion of the economiser, flue gas ducts and the baghouse as well as blinding of the filters due to condensation.

The manufacturer (Lambion Energy Solutions) has specified the stack flue gas temperature to be between 170 and 180 °C and nominally 175 °C. A copy of the specification is shown below in Table 2.

Table 2. Boiler flue gas specification

LAMBION
ENERGY SOLUTIONS

Flue gas data (per line)

flue gas volume incl. recirculation	:		56,600	Sm³/h
flue gas temperature, approx.	:		175	°C
flue gas rate at stack	:		33,910	Sm³/h
flue gas rate at stack, operation	:		55,420	Am³/h

Lambion also advise that a reduction in temperature of the final flue gas discharge is possible with the addition of a low grade heat recovery system after the baghouse filter, for example to provide warm water or for condensate pre-heating.

We are not familiar with the Victorian plant cited by the Jacobs reviewer but it is very likely that it employs low grade heat recovery after flue gas cleaning that is not being considered for the Paeriwa installation at this time but, if it were to be considered in the future, then notification to the council would be required and a variation to the consent would likely be required.

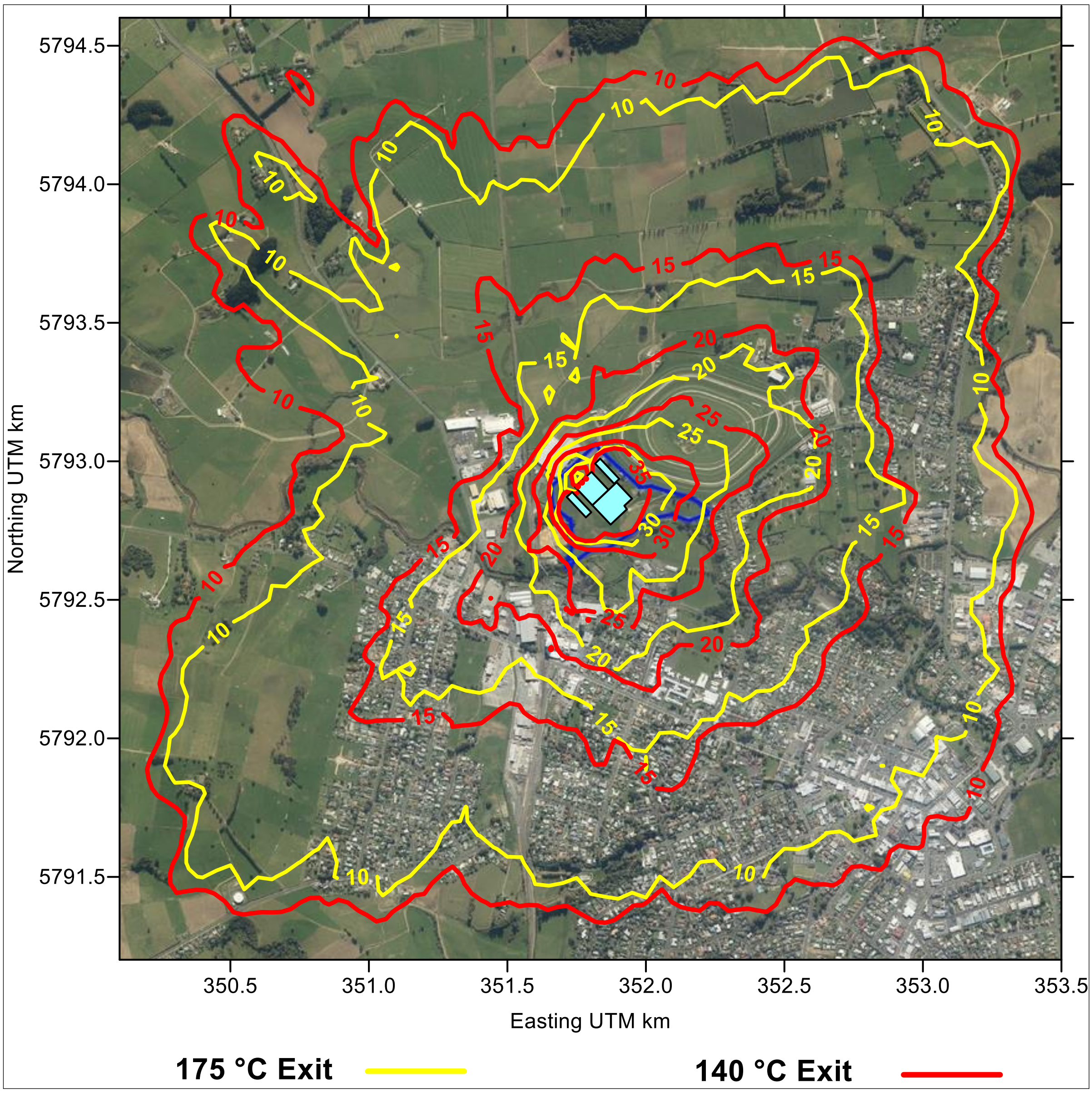

Figure 1. 99.9%ile SO_2 levels variation with flue gas exit temperature. Background levels and Fonterra discharges are not included

While the flue gas temperatures are never expected to be as low as 140 °C for the Paeriwa plant, as suggested by the council's reviewer, as there is no low grade heat recovery, the effect of a 140 °C flue gas discharge is shown in Figure 1 for SO_2 and only small differences to the predicted 1-hour off-site levels are expected.

However again, we reiterate that the design and operation of the boilers is such that this will not occur unless GCS choose to install low grade heat recovery in the future.

The plots in Figure 1 should be regarded as purely of academic interest only as a lower temperature from heat recovery is not being proposed.

5 ALTERNATIVE STACK HEIGHTS

Given all the above, taller stacks may be needed. There is no serious consideration of this and this should be included in a "consideration of alternatives". There is a small amount of discussion on this in the S92 response, but it needs more detailed assessment.

RESPONSE

Further increases in stack height will, in general, result in incremental reductions in predicted off site impacts, but at the expense of visual amenity and additional engineering requirements. The Section 92 response demonstrated the relatively small benefits obtained from increasing the stack heights to 45m. An additional analysis below demonstrates the effects of increasing the height to 60m as well as how there are diminishing benefits, as expected, for longer time averages.

For simplicity, SO_2 has been chosen to demonstrate the changes, but the changes apply to any of the species modelled and considered in the application.

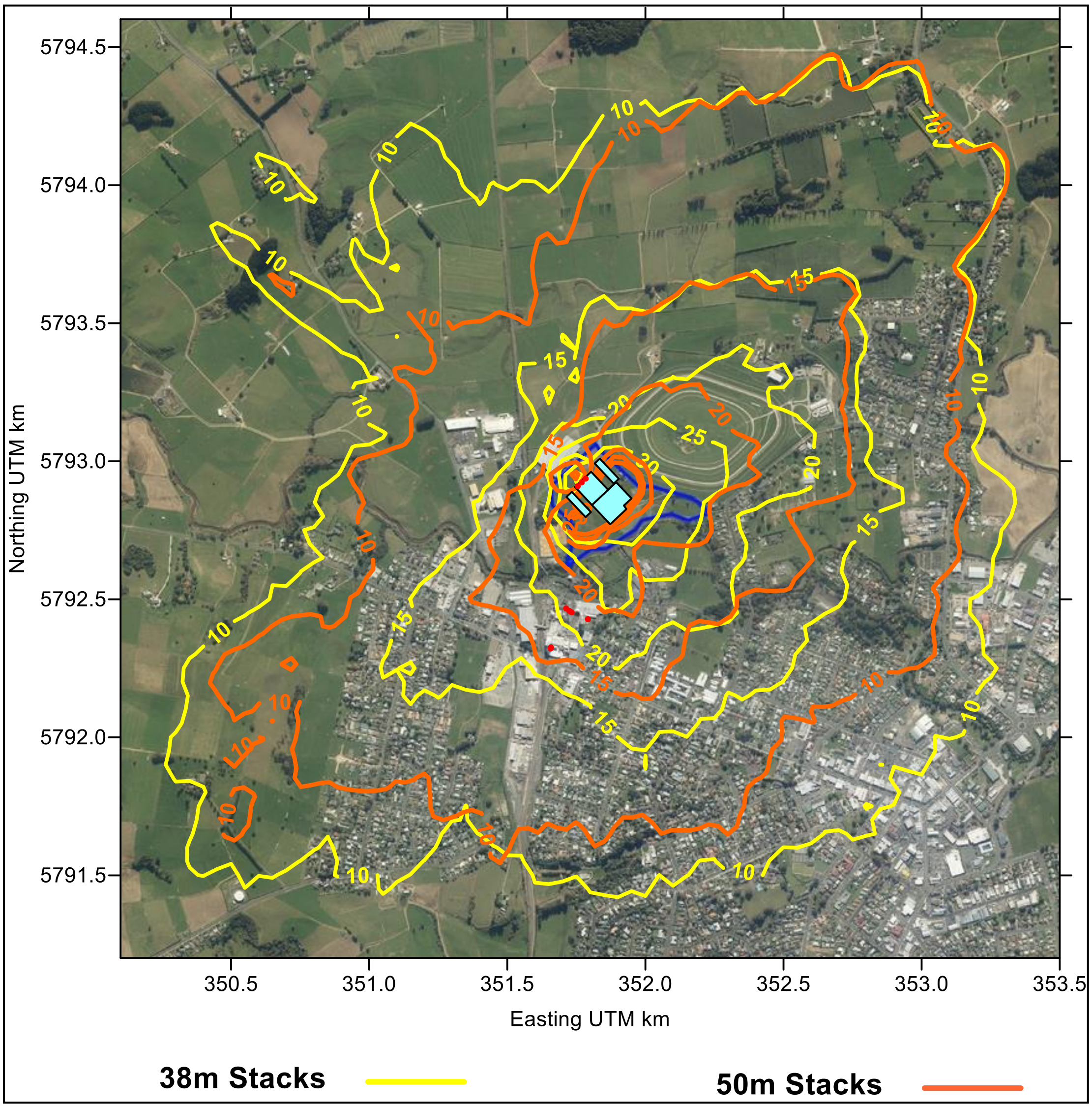

Figure 2. 99.9%ile SO_2 levels variation with stack height for 38m and 50m high stacks. Background levels and Fonterra contributions are not included

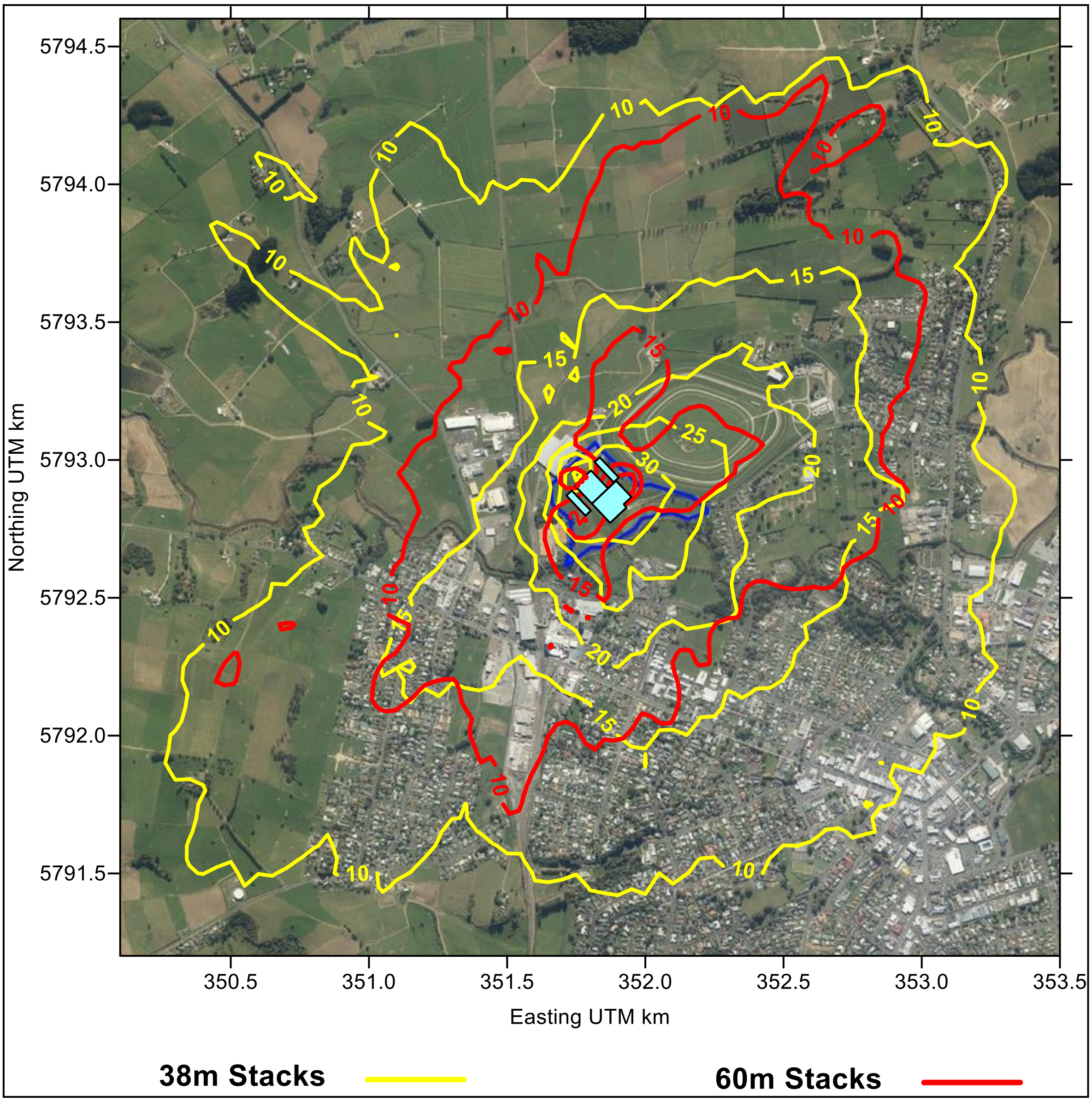

Figure 3. 99.9%ile SO_2 levels variation with stack height for 38m and 60m high stacks. Background levels and Fonterra contributions are not included

Short Time Averages

The 99.9%ile 1-hour predicted SO_2 levels for 38m, 50m and 60m high stacks are shown in Figures 2 & 3.

There is an incremental reduction in ground level concentrations very close to the plant for the increase stack height going from 38m to 50m stacks, but the differences at greater distances vary from moderate to negligible. The greatest reduction amounts to about 20% for some locations immediately adjacent to the plant boundary for a 50m height compared to the proposed 38m, but other locations that are also on the boundary, there is no significant change e.g. the SW boundary. There is also no change for some locations 600 to 1500m to the SW of the RDF plant and 500 to 1600m to the NW. While not shown, the effects for 55m stacks are similar to those of 50m.

For 60m high stacks there is a reduction in off site effects for some locations close to the RDF plant boundary but minimal change for more distant locations as for the 50m stack option.

Note also that these modest improvements apply only to short term 1-hour impacts that are only relevant to SO_2 and NO_2 which already comply with appropriate NZAAQS's for the 38m stacks and extended stacks of 50 to 60m high are not considered to be warranted.

Longer Time Averages

Both the 24-hour and annual predictions likewise show only minimal improvement in potential off-site levels for stack heights up to 50m as shown in Figures 4 & 5. Again, the improvements for 55m stack are similar but not shown.

For 60m stacks there is a reduction in predicted levels for some locations close to the RDF plant boundary for both the 24-hour and annual averages but those reductions are not universal for all locations and there is virtually no significant change for some that are to the immediate north and south of the RDF plant.

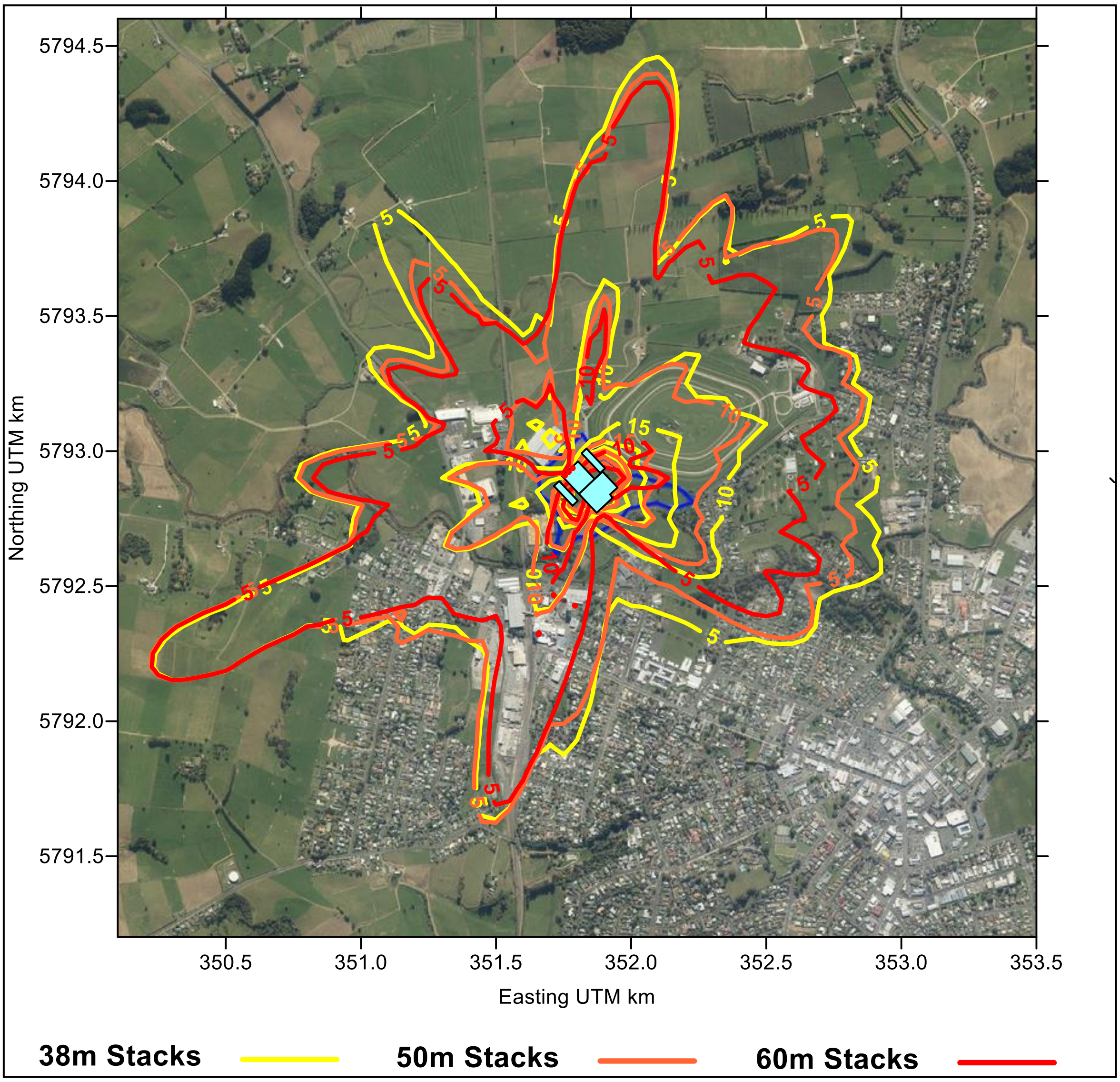

Figure 4. Predicted Maximum 24-Hour SO_2 predictions for different stack heights. Background levels and Fonterra contributions are not included.

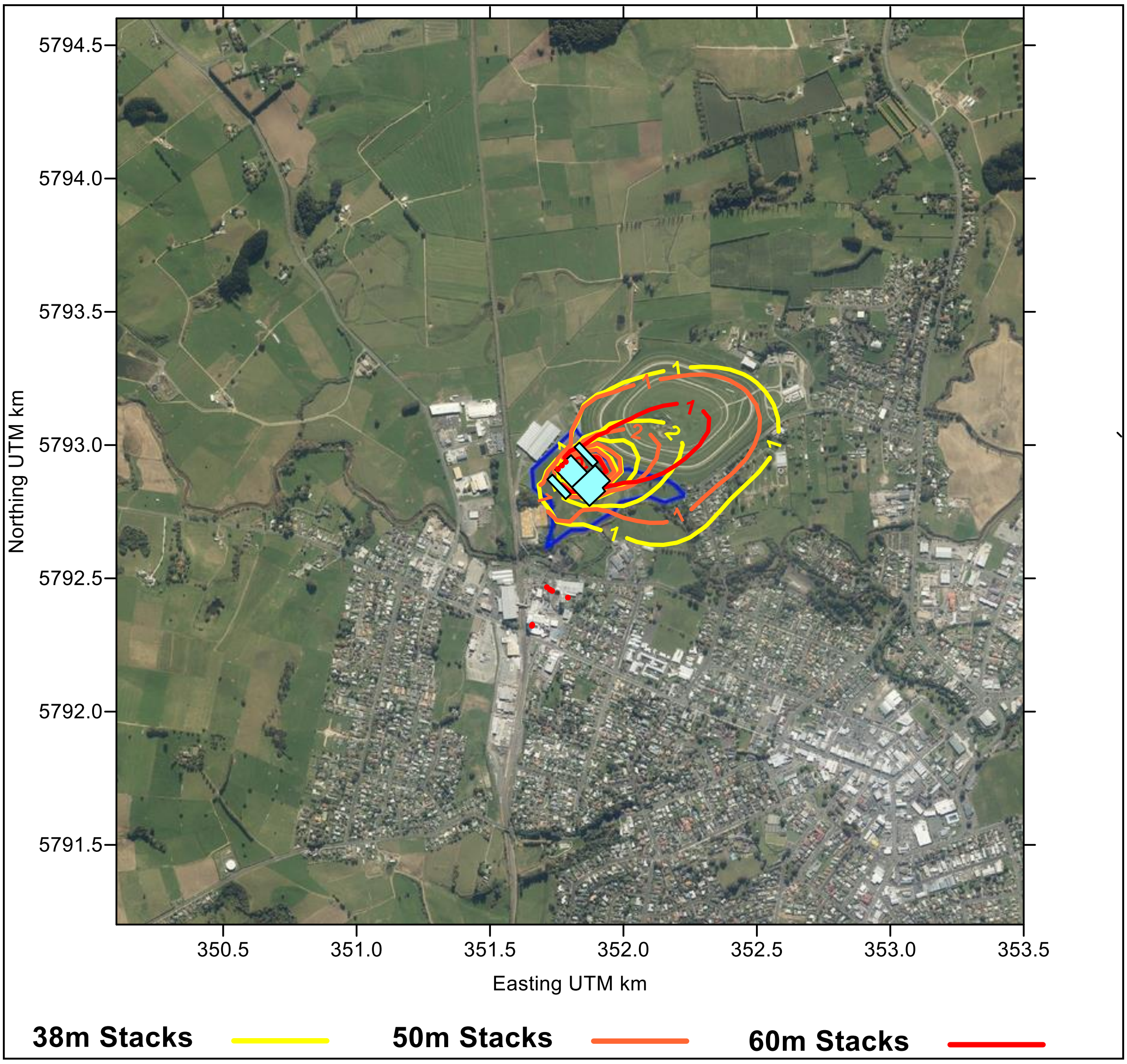

Figure 5. Predicted Maximum Annual SO_2 predictions for different stack heights. Background levels and Fonterra contributions are not included.

However those potential improvements for the longer time averages only apply if the RDF plant were to exist in isolation, and the relatively small improvements are even less apparent once the existing discharges from the Fonterra plant are also included. Figures 6 & 7 shows the combined PM_{10} 24-hour and annual averages for the proposed 38m stacks and 60m stacks with the discharges from Fonterra included where the benefits for the increased stack heights are shown to be quite minor and do not warrant the additional stack heights.

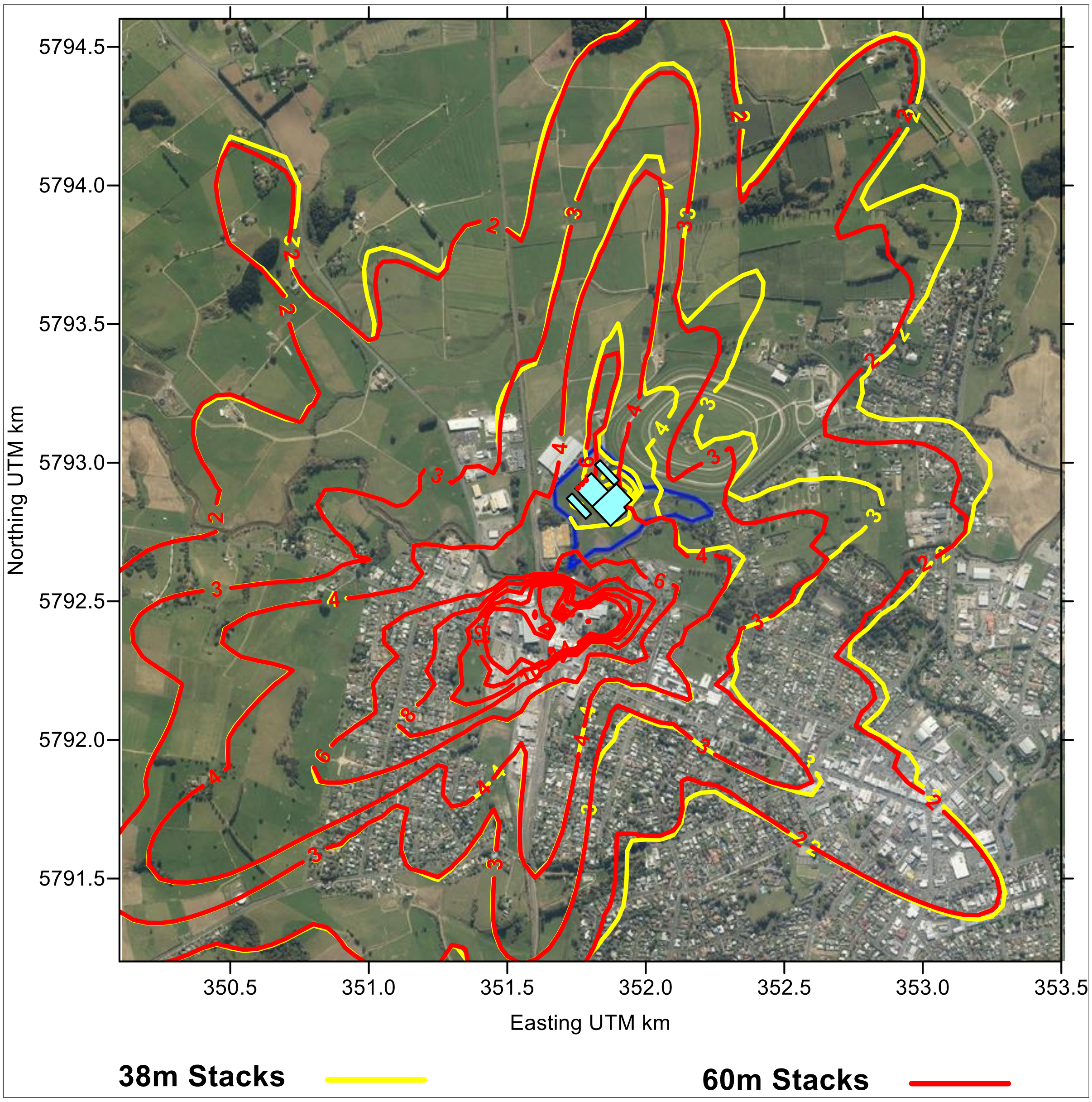

Figure 6. Combined Predicted Maximum 24-Hour PM_{10} predictions for different stack heights including Fonterra discharges. Background levels are not included.

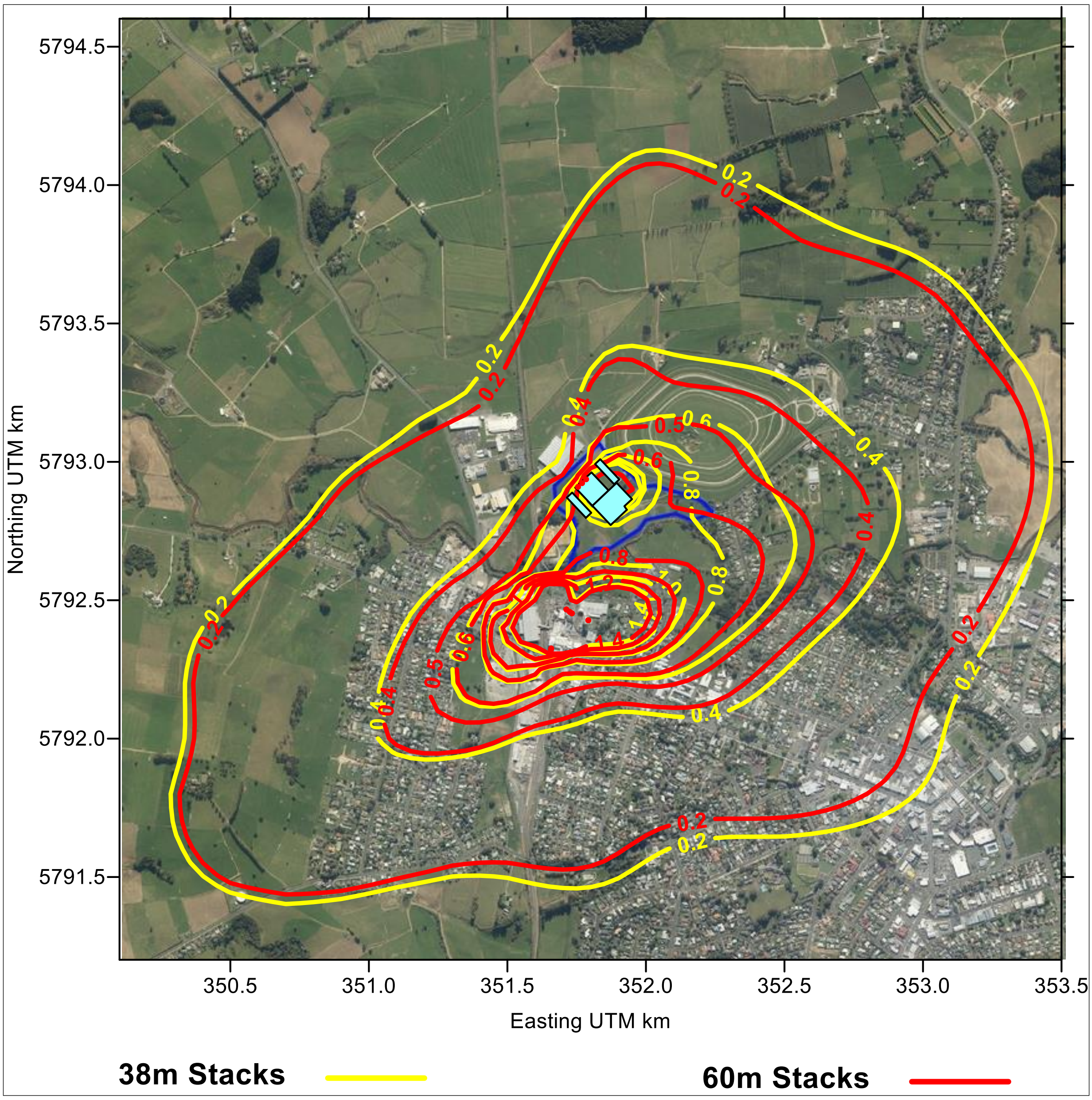

Figure 7. Combined Predicted Maximum Annual PM_{10} predictions for different stack heights including Fonterra discharges. Background levels are not included.

Summary

Increasing stack heights comes with additional engineering requirements and these must be balanced with the potential improvements in off site effects that result. Those improvements are considered to be minor for stack heights up to 55m. For 60m high stacks there are noticeable reductions for short time averages for some off site locations, but not others. However those improvements are not apparent once the effects of the discharges from the nearby Fonterra plant are included. The additional engineering that would be required for 60m high stacks is not considered to be warranted.

6 BAGHOUSE FAILURE

Air emissions during "other than normal operating conditions" (OTNOC) are not discussed. For example – what happens to odour emissions from the building air space if the burners aren't operating. And, how long does it take to shut down a furnace if there is a bag filter failure and what are the potential emissions during this shut down.

RESPONSE

Building Air Space During Shutdown

The function of the boilers is to provide steam to the steam turbines that generate electricity, but steam turbines are not designed to be operated on an intermittent or modulated basis. In other words, both the turbines, and by default the boilers, are expected to operate continuously at relatively constant loads. GCS expect that at least one boiler will be operating at all times, and this will be sufficient to maintain negative pressure in the boiler room and fuel bunker.

Bag Filter Failure

The proposed baghouses will be partitioned into either 2 or 3 separate sections per baghouse and each of those partitions will be separately monitored internally for pressure drop and particulate (using tribo-electric sensors). In the event of a bag failure in one of the sections, that section will be isolated and the filter will continue to operate with the remaining one or two sections. At the same time the boiler load will be temporarily reduced to between about 60 to 75% MCR to minimise the short term increase in the filter air to cloth ratio. The air to cloth ratio will, at all times, remain low at less than 1.8 m min^{-1} that is a typical normal operating setting for most fabric filters and no significant change in filtration performance particulate emission is expected when the filter is operated with one section taken off line to repair the bag filter elements.

Boiler shutdown is therefore not required for routine bag filter replacement if the failure occurs in a single section, but in the very unlikely event that all sections are signalled as having a filter failure then the boiler will be shut down as soon as is practicable for filter repairs.

If a sole operating boiler is required to be shut down then one of the remaining two boilers can be started up so that there will be no accumulation of fuel in the bunkers.

Boiler shutdown for the proposed installation will conform to the same general procedures that apply to any boiler but the supplementary oil burners can be employed to prevent smoke discharge if necessary if it occurs during shutdown.