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*under:* the Resource Management Act 1991

*in the matter of:* the proposed Canterbury Air Regional Plan

*and:* **Fonterra Co-operative Group Limited**  
*Submitter 63146*  
*Further submitter C15C/102825*

## Statement of evidence of Richard Leslie Chilton

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Dated: 18 September 2015

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## STATEMENT OF EVIDENCE OF RICHARD LESLIE CHILTON

- 1 My full name is Richard Leslie Chilton.
- 2 I am a Senior Air Quality Scientist employed by Golder Associates (NZ) Limited (*Golder*), a ground engineering and environmental consulting firm. I have been employed by Golder since January 2006 and have 16 years of experience in air quality management.
- 3 I hold the qualifications of a Bachelor of Science (Canterbury University) and a Master of Science degree (Honours) in Environmental Science (Canterbury University), specialising in air pollution meteorology.
- 4 I am a member of the Clean Air Society of Australia and New Zealand and the Resource Management Law Association.
- 5 In my current role at Golder, I manage air quality assessments for a wide range of industrial, agricultural, regulatory and transport sector clients. This includes evaluating effects related to odour, dust and hazardous air pollutants. It also includes recommending air contaminant control systems and management practices, and preparing air quality management plans. I have worked in both the New Zealand and United Kingdom regulatory sectors, being involved in consenting and compliance reviews of industrial air discharges, regional air quality policy development, regional emissions inventory preparation, and ambient air quality monitoring programmes.
- 6 I have managed a large number of air quality assessments for a range of industrial, agricultural, and transport related projects. These have included the manufacturing, printing, metallurgical, power generation, dairy industry, fertiliser manufacture, metal refining, mining, land-filling, composting, hazardous waste treatment, wastewater treatment, intensive agricultural and forestry sectors. Some examples include the Mangatangi Coal Mine for Glencol, several Fonterra milk processing sites (Darfield, Studholme, Clandeboye, Kaikora, Edendale, Pahiatua, Takaka and Stirling), NZ Starch's operation in Penrose and more recently the first stage of the City Rail Link project.
- 7 A more detailed list of my experience in air quality management is contained in **Appendix A** to this evidence.
- 8 In preparing this evidence I have read the evidence of **Mr Tim Keir, Mr Roger Cudmore, Mr Jason Pene, and Ms Justine Ashley**. I have also reviewed the proposed Canterbury Air Regional Plan (*pCARP*), and Fonterra's submission and other industry submissions with respect to the pCARP.

## SCOPE OF EVIDENCE

- 9 In my evidence I provide a case study outlining some of the key implications of the pCARP in relation to Fonterra Co-operative Group Limited's (*Fonterra*) Studholme site. Many of the issues that I will highlight in relation to the Studholme site will be common to Fonterra's other manufacturing sites in Canterbury that I have direct experience with, including the Clandeboyne and Darfield sites. Accordingly, my evidence will provide:
  - 9.1 a description of the existing Studholme site (and relationship with the Waimate airshed);
  - 9.2 a description of the proposed future discharges from the Studholme site; and
  - 9.3 comment on the extent to which certain provisions in pCARP would be able to be met.
- 10 I have read the Expert Witness Code of Conduct set out in the Environment Court Practice Note 2014. I have complied with the code in preparing this evidence and I agree to comply with it while giving oral evidence. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

## SUMMARY OF EVIDENCE

- 11 The main findings of my case study examination of the Fonterra Studholme site are as follows:
  - 11.1 Policy 6.2, as well as 6.21 and Rules 7.17 and 7.18 do not recognise or distinguish between localised and airshed wide ambient air quality effects.
  - 11.2 Policy 6.2, as well as 6.21 and Rules 7.17 and 7.18 are not effects based, as they do not recognise whether persons will be exposed to contaminants for the relevant time averaging periods of the ambient air quality standards and guidelines. Instead, the provisions seek to apply to all locations irrespective of whether an adverse effect would occur or not.
  - 11.3 Policy 6.22 and Rule 7.14 seek to incorrectly, and in my view unnecessarily, implement the provisions of Regulation 17 of the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (*NES-AQ*), with policy and rule wording that does not correctly reflect Regulation 17 and

which has significant implications for industry in its application.

- 12 I consider that these issues will in many cases be common to Fonterra's other manufacturing sites in Canterbury, of which I have direct experience of.

### **EXISTING STUDHOLME SITE**

- 13 Fonterra operates a milk processing facility at Studholme, at the intersection of Packers Road and State Highway 1 (SH1), which is approximately 5 km east of Waimate Township (**Figure 1**).
- 14 The site is surrounded by rural pastoral land, which includes a small number of rural residences. The nearest residence on land not owned by Fonterra is approximately 600 m from the nearest boiler stack and 700 m from the nearest dryer. The rural setting of the site is typical of milk processing facilities, for the reasons described in **Mr Keir's** evidence.
- 15 The Studholme site currently operates a single milk powder dryer with a production capacity of 5.5 tonnes per hour (t/h). The energy requirement of the existing dryer is met by the operation of two coal fired boilers – with a consented maximum combined thermal output of 15 MW.
- 16 An air discharge permit was first granted to New Zealand Dairies Limited for the establishment of a dairy factory at the Studholme site in 2006. Fonterra purchased the site in 2012 and discharges to air are currently authorised under air discharges permit CRC140320, which expires on 15 December 2026.
- 17 The milk powder dryer gives rise to a relatively large, moderately hot and humid air exhaust streams that discharge to air through two stacks on top of the dryer building. The main contaminant discharge to air from the dryer exhausts is particulate matter emissions, in the form of residual milk powder that escapes the dryer emission control system. Particulate emissions from the dryer are minimised using a baghouse, which is consistent with current industry practice.
- 18 The boilers are consented to be fired on either wood or biomass. The boilers give rise to hot air exhaust streams containing combustion products (particles and gases). The main air contaminants are PM<sub>10</sub>, oxides of nitrogen (NO<sub>x</sub>) and sulphur dioxide (SO<sub>2</sub>). The boilers also use baghouse technology to minimise particulate emissions.
- 19 Fonterra also operates a wastewater treatment plant to the south of the main manufacturing site that is used to treat the wastewater prior to discharge.

## **PROPOSED FUTURE STUDHOLME DISCHARGES**

- 20 Fonterra has lodged applications for resource consents (August 2015 - CRC160871 and others) to expand operations at its Studholme plant, near Waimate. This will increase the milk powder drying capacity from the existing 5.5 tonnes per hour (t/h) capacity to 65.5 t/hr. The expansion will also involve increasing the thermal output of the site's solid fuel fired boilers from 15 MW to 115 MW of steam generation at any given time.
- 21 The expansion will be in two stages. Each stage will involve the installation of a milk powder dryer with a production capacity of 30 t/hr. The energy demands of the new dryers will be provided for by a new 65 MW boiler for Stage 1 and a new 50 MW boiler for Stage 2. The two new boilers will discharge to air through a common stack that has a height of 68 m above ground level.
- 22 The new dryers and boilers will use baghouse filter systems to control particulate emissions. The new boilers may be of a fluidised bubbling bed design that is capable of providing significant reductions in SO<sub>2</sub> emissions when burning coal. I consider the emission controls associated with the new plant would effectively set current industry best practice.
- 23 The resource consent applications for the site expansion were lodged with the Canterbury Regional Council (ECan) following the notification of the pCARP. Consequently, the assessment of effects on the environment (AEE) regarding air discharges that accompanied the application considered the relevant provisions of the pCARP. For this reason, the Studholme site expansion provides a useful and relevant case study in relation to Fonterra's submission to consider the implications of the proposed provisions of the pCARP against.
- 24 The main contaminant discharges to air from the site will remain unchanged from those currently consented, however, the overall quantity of emissions will increase.
- 25 Inland from the site (approximately 5 km) is the town of Waimate. ECan has gazetted Waimate as an airshed, and it is classified as a 'polluted airshed' in accordance with Regulation 17 of the NES-AQ. The airshed boundary for Waimate Township approximately aligns with the existing urban limits of the township.
- 26 The pCARP includes a proposed Clean Air Zone (CAZ) over Waimate Township. Of note, is that the CAZ extends significantly beyond the current urban limits of the township, covering rural land.
- 27 Although Waimate is reasonably far from the Studholme site, it was necessary to assess the air quality impacts on Waimate arising from the proposed site expansion in order to demonstrate compliance

with the new provisions of the pCARP as well as the provisions of Regulation 17 of the NES-AQ.

- 28 As part of the site expansion, the existing wastewater treatment plant will be significantly upgraded with treated wastewater to be discharged via a new ocean outfall.

## **IMPLICATIONS OF THE PCARP FOR STUDHOLME**

### **Overview**

- 29 The key policies and rules that have particular relevance to the expansion of Fonterra's Studholme site, and which I will discuss in detail, are:

29.1 Policy 6.2

29.2 Policy 6.21 and Rules 7.17 and 7.18

29.3 Policy 6.22 and Rule 7.14

### **Policy 6.2 – localised versus airshed wide ambient air quality**

- 30 Policy 6.2 of the pCARP states:

"Minimise adverse effects on air quality where concentrations of contaminants are between 66 % and 100 % of the guideline values set in the Ambient Air Quality Guidelines 2002 Update, so that concentrations do not exceed 100 % of these guideline values."

- 31 This policy is relevant to the assessment of the expanded Studholme site as some predicted contaminant concentrations exceed 66% of the Ambient Air Quality Guidelines (AAQG) beyond the site boundary. By way of example, I refer to **Figure 2** and **Figure 3** which provide contour plots showing the predicted 24-hour average PM<sub>10</sub> and SO<sub>2</sub> ground level concentrations arising from the proposed expansion of the Studholme site. These two plots figures were included in the application for the expansion of the Studholme site. In each of these figures, the area where cumulative impacts might exceed 66% of the relevant guideline value is shown as a dashed red line.

- 32 The land underneath the footprint of the dashed red line in **Figure 2** and **Figure 3** is pastoral farm land where I would not expect a person to be present for a period of 24-hours (the relevant time exposure period of AAQG values for PM<sub>10</sub> and SO<sub>2</sub> as given in the two figures). The predicted concentrations over locations where exposure is relevant (i.e., the nearest residences shown as white circles in the two figures) are well below 66% of the AAQG values in each case.

- 33 In my view, these two figures provide a clear example of localised air quality impacts, in that they occur over small areas of land

located immediately adjacent to the site. The predicted concentrations reduce rapidly with increasing distance from the site and impacts further afield are very low.

- 34 The areas where predicted impacts in the two figures go above 66% of the guideline values occur over land where people are very unlikely to be exposed to the relevant 24-hour average exposure periods of the AAQG values and there is a negligible risk of other sources (other than the site) that could result in those impacts exceeding the AAQG values. Given this, I consider that there is a negligible risk of significant adverse air quality effects relative to the AAQGs.
- 35 Because Policy 6.2 does not distinguish between localised impacts and ambient impacts that occur over a wider airshed, I consider there is the potential for this policy to be applied inappropriately in a manner that would seek to control impacts over land where human exposure and air quality effects are not a concern. I also consider that this policy if applied to localised impacts would have no tangible benefit in terms of managing air quality trends across a wider airshed, where wide-spread poor air quality is predominantly driven by emission from the domestic heating and motor vehicle sectors.

#### **Policy 6.21 and Rules 7.17 and 7.18**

- 36 Rules 7.17 and 7.18 are closely related to one another and provide for the implementation of Policy 6.21.
- 37 Rule 7.18 was a relevant consideration when assessing the future discharges to air from the Studholme site. This is because the rule prohibits discharges that will likely result in guideline values being exceeded. The rule, however, makes no distinction regarding whether the exceedence of the guideline value will give rise to an adverse effect. For example, if a predicted exceedence occurs over land where no person will reasonably be exposed for the averaging period of the guideline then an adverse effect is not expected to occur. I note that the concept of exposure is integral to both the NES-AQ and the AAQG.
- 38 For the Studholme site, the initial assessment of the expanded site identified that emissions of SO<sub>2</sub> from the proposed new boiler stack (60 m high) could give rise to an exceedence of the 24-hour average ambient air quality guideline value of 120 µg/m<sup>3</sup> at locations very close to the site boundary. Importantly from an adverse effects perspective, concentrations at the nearest location where exposure is relevant (i.e., rural residences) were well below the guideline values. However, because of Rule 7.18, it was necessary to consider measures to further reduce SO<sub>2</sub> impacts over unoccupied land in order for the discharge to not be categorised as a prohibited activity. This was achieved by evaluating the reduced

SO<sub>2</sub> impacts for boiler stack design heights above 60 m. The analysis determined that a further 8 m in height would be needed to provide model predictions that did not exceed the ambient air quality guideline of 120 µg/m<sup>3</sup>.

- 39 The model results for 24-hour average SO<sub>2</sub> impacts for a 60 m stack and a 68 m stack are provided in **Figure 4** and **Figure 5** respectively. The red shaded area in **Figure 4** shows the area where the SO<sub>2</sub> concentrations were predicted to go above the guideline value, and helps illustrate how close and localised to the site that these exceedences are. These are clearly localised impacts and do not affect the wider area. Furthermore, the predicted concentrations at the nearest residences where exposure is relevant (white circles) are all below the guideline value. **Figure 5**, which represents the 24-hour average impacts achieved with a 68 m high stack, shows that off-site concentrations are predicted to be within the ambient air quality guideline at all locations. However, I consider it noteworthy that the predicted concentrations further afield from the site remain relatively similar despite the increase in stack height.
- 40 I understand from discussions with **Mr Keir** that the cost implications of increasing the boiler stack from 60 m to 68 m are potentially significant. This is despite there being little environmental benefit in terms of exposure relative to the AAQGs at the most impacted residences or changes in SO<sub>2</sub> concentrations further afield.
- 41 While I appreciate that the Officer's report has recommended removing Rules 7.17 and 7.18 and replacing those rules with some alternative rules (albeit undefined), I am mindful that that the recommendation regarding Policy 6.21 does not address this matter. The Officer's report only recommends that "*Policy 6.21 is amended to provide clear guidance as to what is to be achieved in applying the BPO in different receiving environments and to refer to the NESAQ as well as Ambient Air Quality Guidelines.*"
- 42 Policy 6.21 as notified states:
- "Avoid the discharge of contaminants into air from any large scale burning device of industry or trade premises, where the discharge will result in the exceedance, or exacerbation of an existing exceedence, of the guideline values set out in the Ambient Air Quality Guidelines 2002 Update."
- 43 I consider that Policy 6.21 fails to account for whether a discharge results in an exposure that could give rise to an adverse effect. Put simply, if the exceedence of the guideline occurs over a location where no one will be exposed then an adverse effect is very unlikely to occur and given this, I consider that the policy is not effects



based. Additionally, I note in his evidence, **Mr Cudmore** states that even if a moderate exceedance of many of the AAQGs occurs– that minor effects can still be achieved, even for locations where people may be exposed.

**Policy 6.22 and Rule 7.14 – PM<sub>10</sub> offsets**

44 Policy 6.22 and Rule 7.14 seek to implement the provisions of Regulation 17 of the NES-AQ.

45 Policy 6.22 states:

“Within Clean Air Zones, significant increases of PM<sub>10</sub> concentrations from discharges of contaminants are to be offset in accordance with the Resource Management (National Environmental Standards for Air Quality) Regulations 2004.”

46 Rule 7.14 as notified states.

“Within a Clean Air Zone, the discharge of PM<sub>10</sub> into air from a large scale burning device, where concentrations of PM<sub>10</sub> will likely equal or exceed 2.5 µg/m<sup>3</sup> at ground level at or beyond the boundary of the property of origin, is a restricted discretionary activity provided that following condition is met:

- (1) 100% of the discharge will be off-set within the gazetted airshed in accordance with Regulation 17 of the Resource Management (National Environmental Standards for Air Quality) Regulations 2004.

The exercise of discretion is restricted to the following matters:

- (1) The proposal to off-set 100% of the emissions within the gazetted airshed to ensure that there is no net increase of PM<sub>10</sub> emissions; and
- (2) The matters set out in Rule 7.2.”

47 The Officer’s report recommends no change to Policy 6.22 but that Rule 7.14 is deleted and replaced with the following rule in order to be more consistent with Regulation 17 of the NES-AQ:

“Any discharge of PM<sub>10</sub> into air that would be likely, at any time, to increase the concentration of PM<sub>10</sub> (calculated as a 24-hour mean) by more than 2.5 µg/m<sup>3</sup> in any part of a polluted airshed other than the site on which the discharge occurs, is a restricted discretionary activity provided the following condition is met:

- (1) 100% of the discharge will be off-set within the polluted airshed in accordance with Regulation 17 of the Resource Management (National Environmental Standards for Air Quality) Regulation 2004.

The exercise of discretion is restricted to the following matters:

(1) The proposal to off-set 100% of the emissions within the polluted airshed to ensure that there is no net increase of PM<sub>10</sub> emissions; and

(2) The matters set out in rule 7.2."

48 While the intention of the recommended change was to more correctly align the rule with Regulation 17 of the NES-AQ, I consider that this objective has not been met. Most notably the Officer's recommended change to Rule 7.14 fails to recognise the provisions of Regulation 17 that exempt lawfully established discharges of PM<sub>10</sub> from the requirement to offset emissions.

49 I also note that, unlike Rule 7.14, Regulation 17 does not require that 100% of emissions be offset. Instead, Regulation 17 requires that offset be applied to the "... *amount of PM<sub>10</sub> that is likely to be discharged into the relevant airshed...*" by an activity. This distinction is particularly relevant for those activities located outside of a polluted airshed (such as the Studholme site). In those circumstances Regulation 17 only requires the amount of PM<sub>10</sub> discharging into the relevant airshed be offset and this does not necessarily mean 100% of the PM<sub>10</sub> discharge from a site when it is located outside of a polluted airshed.

50 Rule 7.14 is relevant to the Fonterra Studholme site given its relatively close proximity to both the gazetted Waimate Airshed and the proposed Waimate CAZ. The proposed changes to Rule 7.14 as recommended in the Officers Report seek to align the rule with Regulation 17 of the NES-AQ. This change means that that the requirement to offset PM<sub>10</sub> emissions under the pCARP is no longer based on impacts within a CAZ but is instead based on impacts within a gazetted polluted airshed. This change is appropriate in my view.

51 Despite the changes to Rule 7.14, I note that the Officer's Report has not made consequential changes to Policy 6.22, as that policy still refers to significant increases in PM<sub>10</sub> within CAZ's rather than polluted airsheds.

52 There is a significant consequent for the Fonterra Studholme site arising from the officer's recommended change in Rule 7.14 combined with the retention of Policy 6.22 as proposed. This consequence arises from the original wording of Rule 7.14 which:

52.1 only related to PM<sub>10</sub> emissions from "large scale burning devices", as opposed to any emission of PM<sub>10</sub> (such as from a milk powder dryer); and

52.2 the significant difference in the spatial extent of the Waimate CAZ compared to that of the Waimate Airshed.

- 53 Unlike the notified wording of Rule 7.14, Policy 6.22 does not make the distinction regarding the source of PM<sub>10</sub>, meaning that it could be taken to apply to all sources of PM<sub>10</sub> giving rise to a significant increase in concentrations within a CAZ, rather than just those sources that are derived from combustion processes. However, in my view the original wording of Rule 7.14 helped to clarify the intent of Policy 6.22, in that it was only to apply to PM<sub>10</sub> emissions derived from large scale fuel burning devices (or combustion emissions). With the change now recommended by the Officer's to Rule 7.14 this distinction no longer exists, meaning that Policy 6.22 applies to all sources of PM<sub>10</sub>.
- 54 To illustrate the consequences of this issue, I present **Figure 6** and **Figure 7**, which provide contour plots of predicted 24-hour average PM<sub>10</sub> from the expanded Studholme site over both the Waimate CAZ and the Waimate Air Shed. **Figure 6** shows the results for all discharges from the site (both dryers emissions and combustion emissions from the boilers), whereas **Figure 7** presents the model results for combustion emissions only. As can be seen from **Figure 6**, PM<sub>10</sub> emissions from the site are expected to be below the 2.5 µg/m<sup>3</sup> threshold of the NES-AQ within the Waimate Airshed. However, it would exceed 2.5 µg/m<sup>3</sup> over the Waimate CAZ boundary – albeit over rural land outside of the urban limits of Waimate Township where PM<sub>10</sub> levels are unlikely to exceed the NES for PM<sub>10</sub> (50 µg/m<sup>3</sup>).
- 55 By comparison **Figure 7** shows that combustion derived emissions from the site (i.e., excluding emissions from the milk powder dryers) remain well below the 2.5 µg/m<sup>3</sup> threshold over the Waimate Airshed and over the Waimate CAZ.
- 56 I consider that if Policy 6.22 is not amended to reflect the changes made to Rule 7.14 by applying to an Airshed boundary rather than the boundary of a CAZ, then discharges from the expanded Fonterra site would not meet requirements of Policy 6.22. This is despite the discharge meeting Regulation 17 of the NES-AQ and also having minor impact, in my opinion, over the rural land within the CAZ.
- 57 In my view, a better approach to amending Policy 6.22 and Rule 7.14 would be to delete both the policy and the rule as sought in line with the relief requested by Fonterra. In my view the pCARP does not need to include provisions that reflect Regulation 17 of the NES-AQ, given that the NES-AQ takes precedence and would apply irrespective of whether such provisions were in the pCARP or not.

## CONCLUSION

- 58 I conclude Policy 6.20, Policy 6.21 and Rules 7.17 and 7.18, and Policy 6.22 and Rule 7.14 are likely to have significant implications for discharges to air from Fonterra's Studholme site. These issues

will in my view be common to Fonterra's other key manufacturing sites in Canterbury (e.g. Clondeboye and Darfield). Overall I consider that these provisions of the pCARP:

- 58.1 do not recognise or distinguish between localised and airshed wide ambient air quality effects;
- 58.2 are not effects based, as they fail to recognise where persons will be exposed to contaminants for the relevant time averaging periods of the ambient air quality standards and guidelines. Instead, the provisions seek to apply to all locations irrespective of whether an adverse effect would occur; and
- 58.3 seek to incorrectly, and in my view unnecessarily, implement the provisions of Regulation 17 of the NES-AQ, with policy and rule wording that does not correctly reflect Regulation 17 and which have significant implications for industry in its application.

Dated: 18 September 2015

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Richard Leslie Chilton

## **APPENDIX A - EXPERIENCE**

### **QUALIFICATIONS AND AFFILIATIONS**

I hold a Bachelor of Science (Geography) gained from University of Canterbury in 1997

I hold a Masters of Environmental Science with honours gained from the University of Canterbury in 2000.

My professional affiliations include the following:

- Resource Management Law Association of NZ (RMLA)
- Clean Air Society of Australia and New Zealand (CASANZ)

### **EMPLOYMENT**

Senior Air Quality Consultant  
Golder Associates (NZ) Limited (Christchurch, NZ) – 2007 to present

Senior Air Quality Consultant  
Kingett Mitchell Limited (Christchurch, NZ) – 2006 to 2007

Air Quality Consultant  
Bureau Veritas (London, UK) – 2004 to 2005

Technical Officer – Air Quality  
London Borough of Greenwich (London, UK) – 2004

Air Quality Officer  
Auckland Regional Council (Auckland, NZ) – 1999 to 2004

### **REGULATORY SECTOR**

In addition to being employed as an air quality officer for the Auckland Regional Council for several years, I have also undertaken a number of air quality management related projects and acted an expert advisor for the regulatory sector in New Zealand and the United Kingdom since the early 2000's. Examples are listed below.

Technical review of resource consent applications on behalf of Auckland, Wellington and Canterbury Regional Council: Astley Leathers (Auckland), New Zealand Breweries – East Tamaki plant (Auckland), Synlait Dairy Factory (Canterbury), Ministry of Justice Precinct earthworks (Canterbury), Computer Concepts (Canterbury), Unilever (Wellington), Southern Landfill (Wellington).

Revision of PARP:ALW poultry activity rules: Review of poultry activity rules in relation to odour discharges for the Proposed Auckland Regional Plan: Air, Land and Water. The project also sought to provide technical

advice for council staff when processing air discharge consents for poultry farms. For the Auckland Regional Council. 2007 to 2008.

Revision of PARP:ALW combustion activity rules: Project manager. Revision of combustion rules for the Proposed Auckland Regional Plan: Air, Land and Water. This involved dispersion modelling of a wide range of boiler types and sizes to evaluate appropriate permitted activity thresholds and rule requirements. For the Auckland Regional Council, 2009-2012.

Auckland regional meteorological datasets: Joint project manager and author. Development of official Auckland Regional high-resolution three-dimensional CALMET meteorological datasets single-point steady state datasets (for Ausplume and CALINE) covering key industrial and transport routes for the Auckland Region. For the Auckland Regional Council and New Zealand Transport Agency, 2007-2009.

### **ASSESSMENTS OF EFFECTS ON THE ENVIRONMENT - AIR QUALITY**

I have completed numerous assessments of effects on the environment (AEEs) in New Zealand, the United Kingdom, Fiji, Australia, Armenia, Bulgaria and Greenland, mainly in support of air discharge permit applications. The AEEs have covered a wide range of sectors including transport, industrial, manufacturing and mining sectors.

Example projects are listed below.

Air quality consent applications for Fonterra Co-operative Group Limited: Preparation of air discharge assessments and resource consent application for a various Fonterra sites, including the Clandeboye, Darfield, Pahiatua, Edendale, Kaikora, Hautapu, Waitoa, Te Awamutu, Takaka, Stirling and Studholme sites. These all included CALMET meteorological and CALPUFF dispersion modelling to predict potential air quality impacts, evaluating effects against relevant national guidelines and standards, and included attending consultation meetings and presentation of expert evidence at Council Hearing. For Fonterra Limited (2006 to 2015).

City Rail Link- Britomart to Wyndham Section: Air Quality Technical Lead. Prepared the air technical assessment for the construction of the Britomart to Wyndham section of the City Rail Link project. Aurecon/Auckland Transport (2014-2015)

New Zealand Starch: Project Manager: Preparation of an air discharge assessment for the continued operation of the NZ Starch plant in Auckland. This included dispersion modelling using CALPUFF to predict contaminant ground level concentrations and the development of a probabilistic assessment approach using Monte Carlo simulations to establish the likelihood of contaminants exceeding national air quality standards. For NZ Starch, 2013.

Mahinerangi Coal Mine – Air Quality Assessment: Preparation of an air quality assessment relating to potential air quality impacts associated with a proposed open cast coal mine in the Waikato Region. This involved CALMET meteorological modelling and probability analysis of exposure of sensitive locations to coal dust. It included a detailed air emission estimation and CALPUFF dispersion modelling to determine potential offsite contaminant impacts. The project involved presentations at a community consultation day, and providing expert evidence at the consent hearing. For Glencoal (subsidiary of Fonterra) (2012 - 2013).

Waisoi Gold Mine feasibility environmental and social impact assessment, Fiji: Assistant discipline project manager. Preparation of an air quality environmental impact assessment for the proposed Waisoi gold mine. This involved the preparation of CALMET meteorological dataset, detailed calculation of hour-varying emissions from mining operations, power generation and transport emissions. Dispersion modelling was used to model the potential impacts of mine site discharges on communities, including consideration of particulate matter, dust, sulphur dioxide, nitrogen dioxide and acid deposition. The project also included modelling of the impacts of non-tailpipe and tailpipe emissions on communities along the transport route to Suva. For Namosi Joint Venture (2011).

White City Development, London: Undertook a detailed monitoring programme for nitrogen dioxide and fine particulate matter (PM<sub>10</sub>) to determine the air quality development constraints and advising on mitigation measures for an under-utilized area of White City, London. For Halical Bar Ltd (2004).

## APPENDIX B - FIGURES

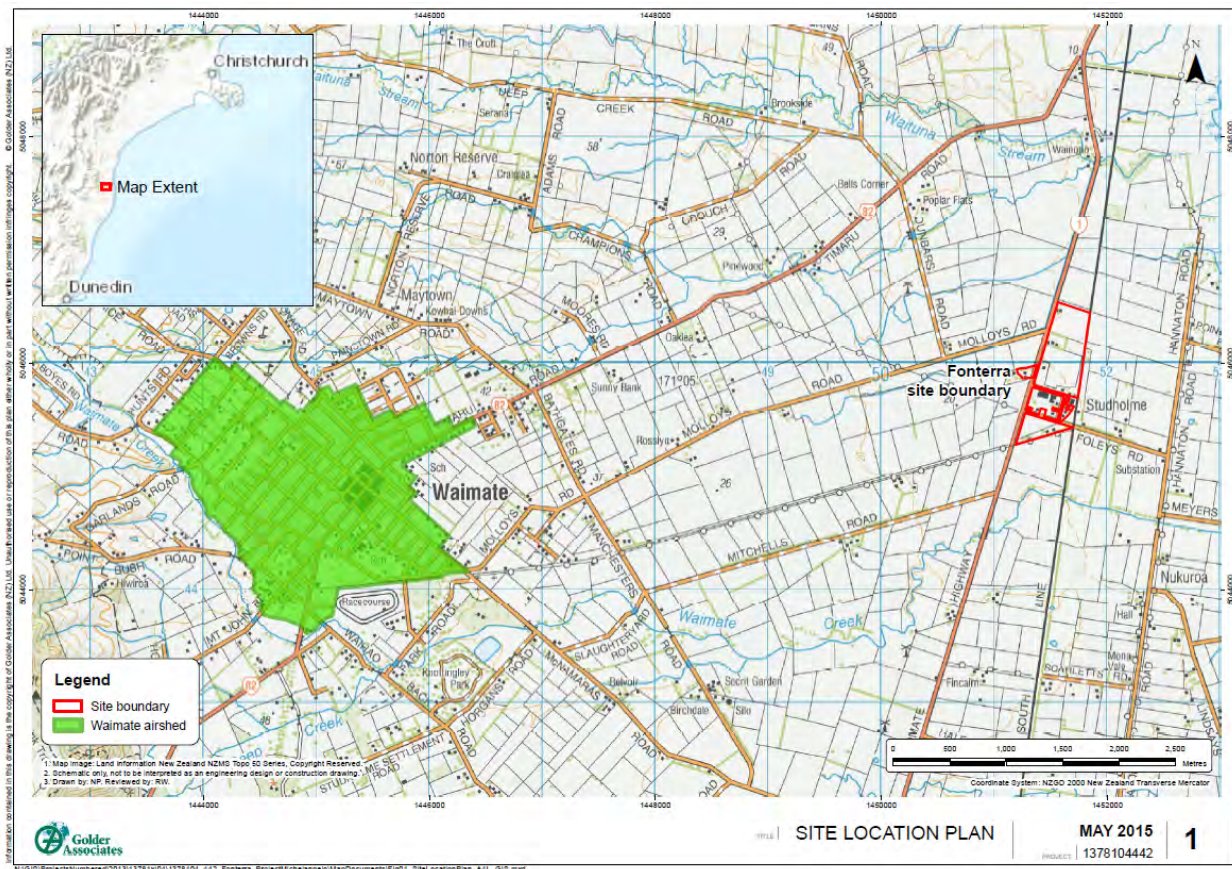


Figure 1: Fonterra Studholme site location (red), showing the location of the Waimate Airshed (green).



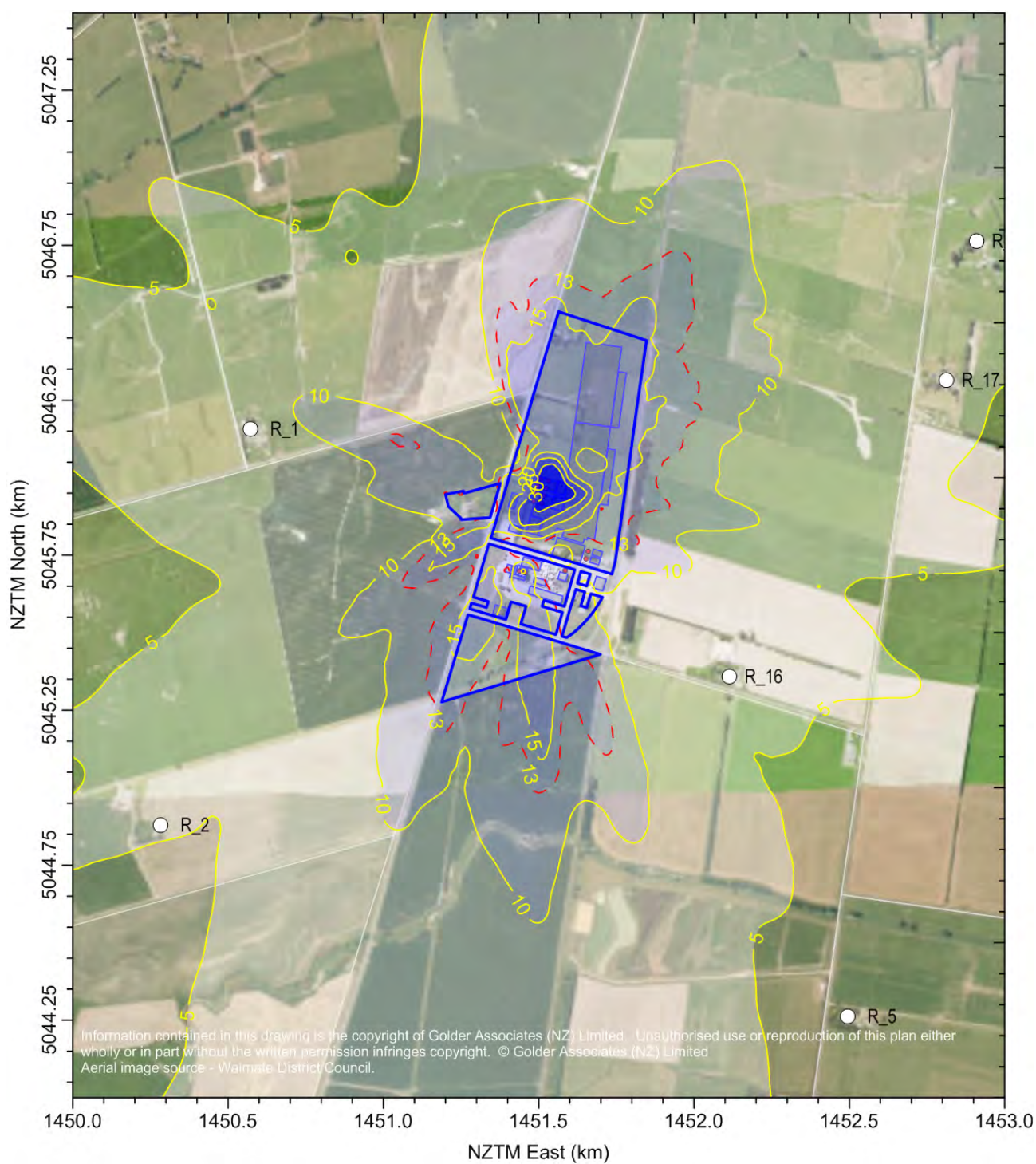


Figure 2: Predicted maximum 24-hour average  $PM_{10}$  ground level concentrations, excluding background. Red dashed contour shows the area where the cumulative concentration would exceed 66 % of the NES (equivalent to a site-only concentration of  $13 \mu g/m^3$ ).

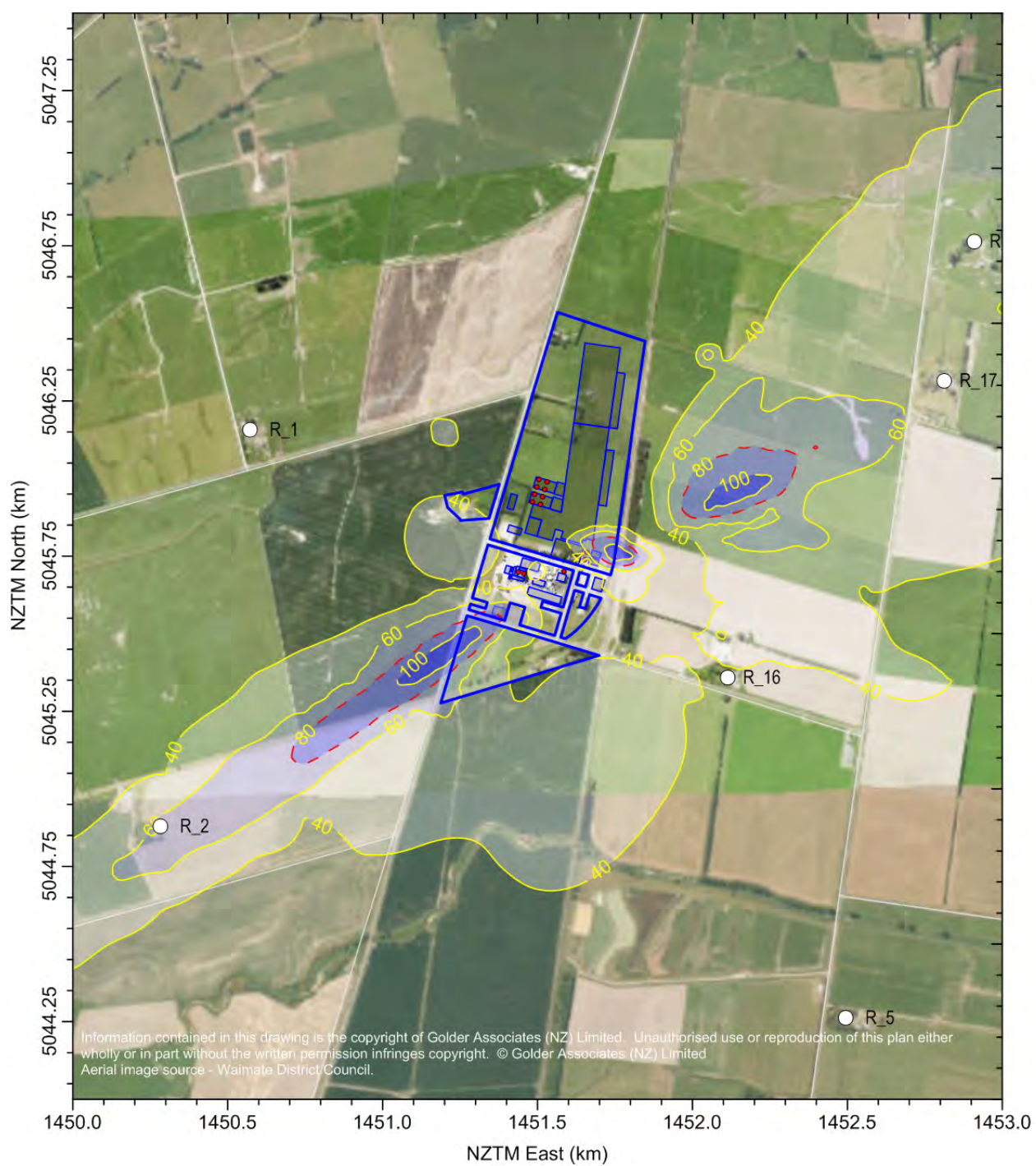


Figure 3: Predicted maximum 24-hour average SO<sub>2</sub> ground level concentration, excluding background. Red dashed contour shows the area where predicted concentrations exceed 66 % of the AAQG.



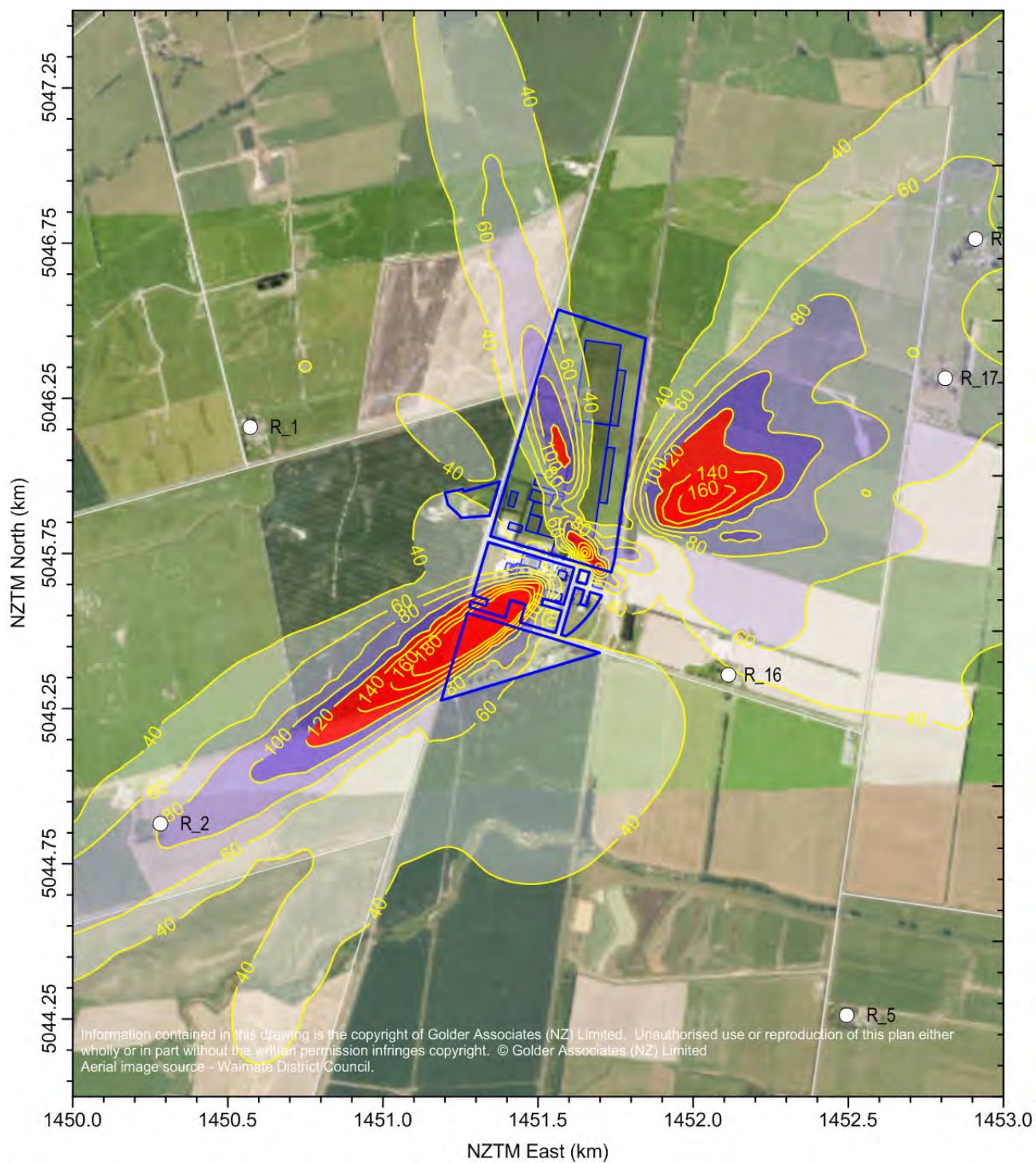


Figure 4: Predicted 24-hour average  $\text{SO}_2$  concentrations ( $\mu\text{g}/\text{m}^3$ ) - 60 m boiler stack – red shaded area indicates GLC that are above the AAQG of  $120 \mu\text{g}/\text{m}^3$ .

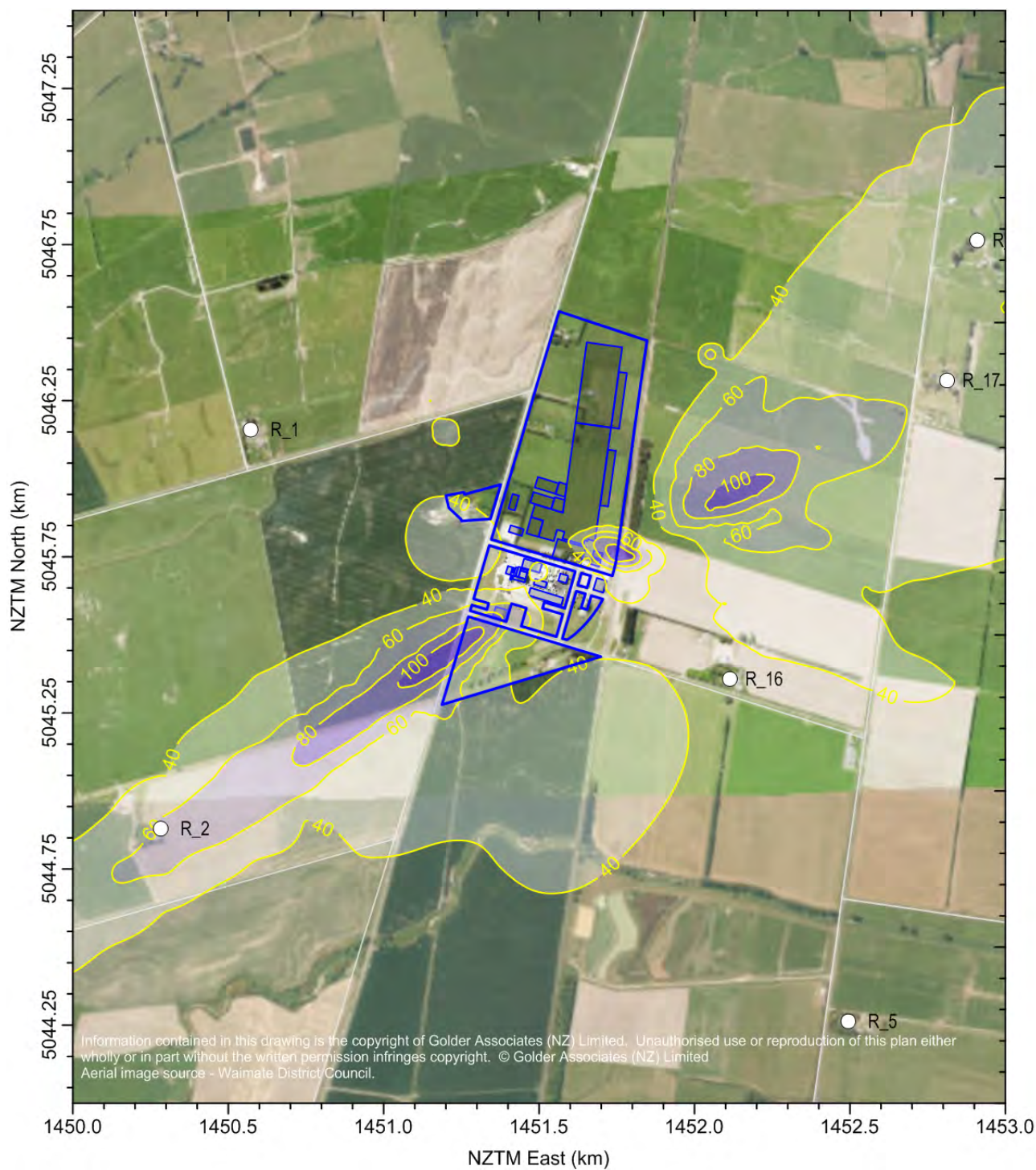


Figure 5: Predicted 24-hour average  $\text{SO}_2$  concentrations ( $\mu\text{g}/\text{m}^3$ ) - 68 m boiler stack.



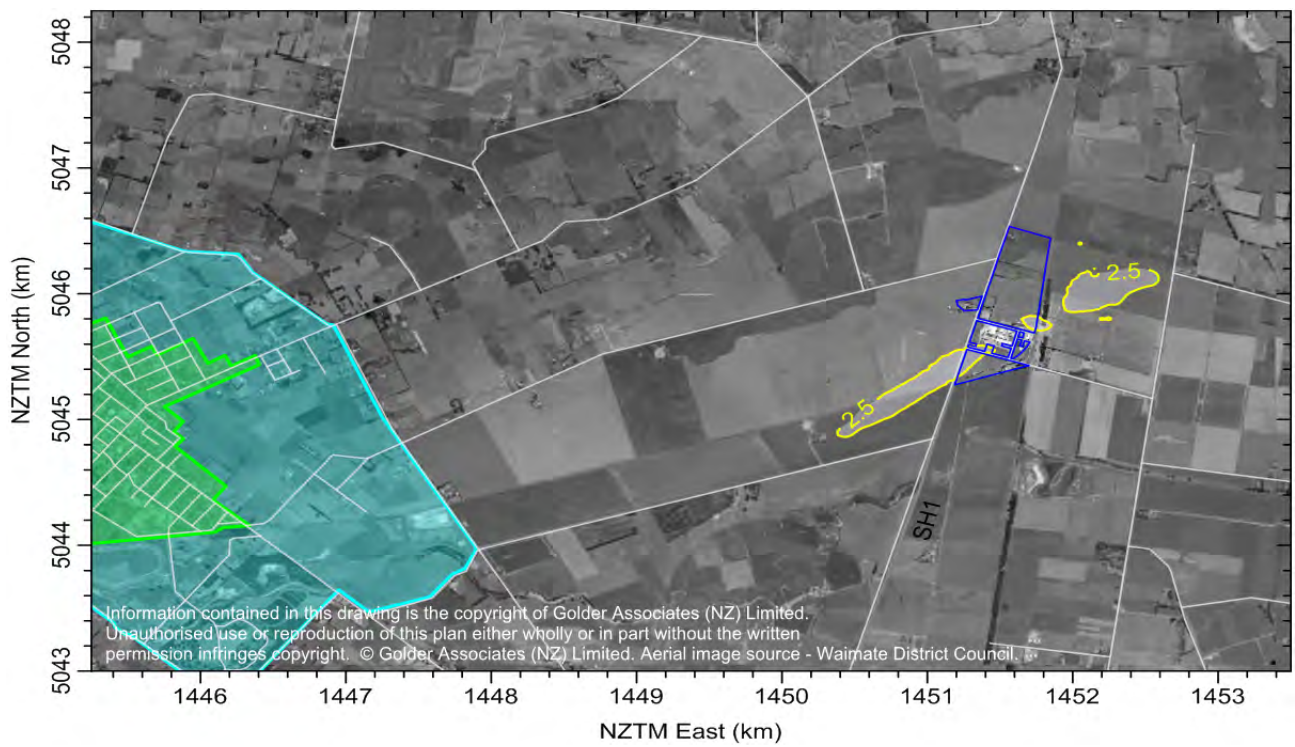


Figure 6: Predicted 24-hour average  $PM_{10}$  ground level concentrations from combustion sources only, excluding background (Waimate airshed is shown as a green shaded area; the proposed Waimate Clean Air Zone is shown as a turquoise shaded area; the site boundary is shown in blue).

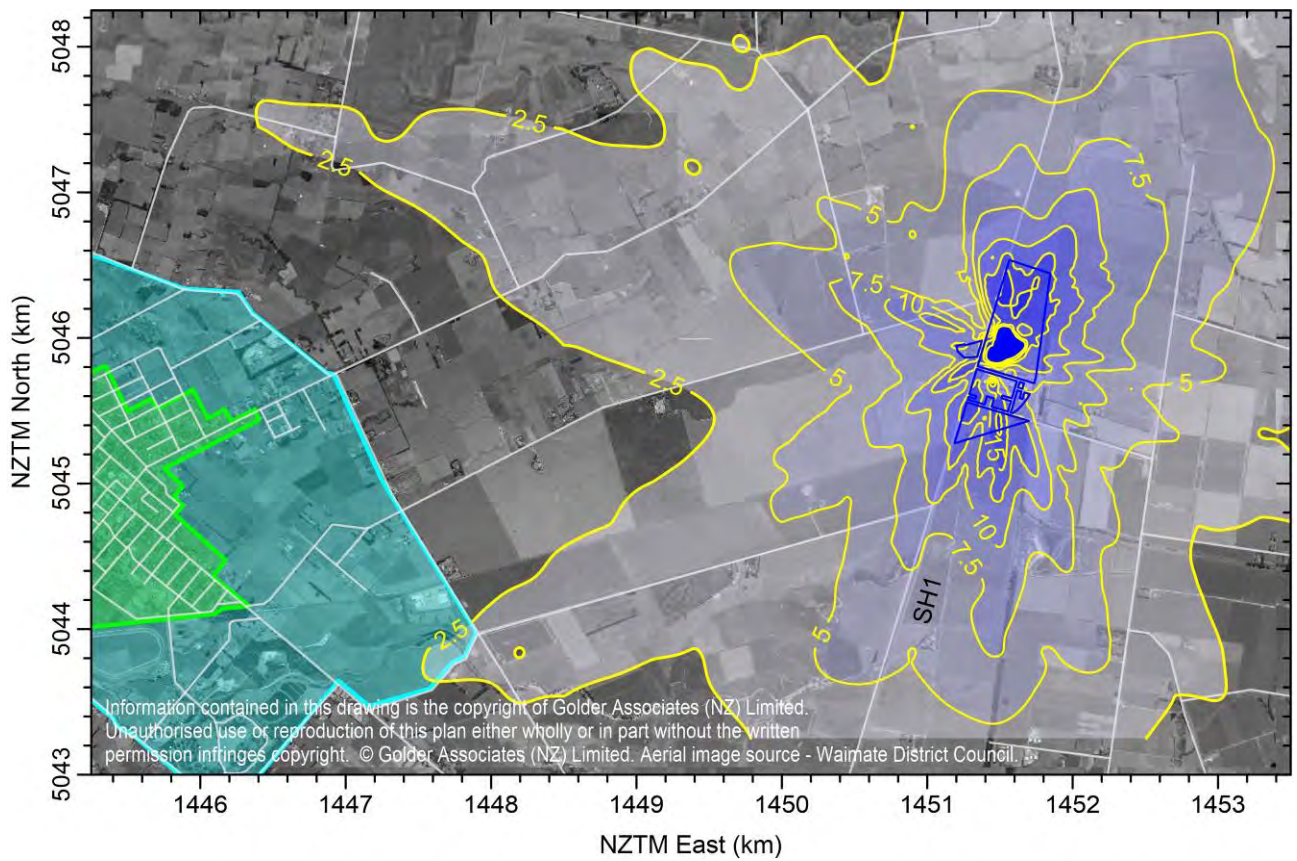


Figure 7: Predicted 24-hour average  $PM_{10}$  ground level concentrations from all sources, excluding background (Waimate airshed is shown as a green shaded area; the proposed Waimate Clean Air Zone is shown as a turquoise shaded area; the site boundary is shown in blue).