BASELINEGROUP

Appendix 10: Air Quality Report

AIR QUALITY ASSESSMENT

Canterbury Clay Bricks Furnace Operation

6 July 2018

AIR QUALITY ASSESSMENT

Canterbury Clay Bricks Furnace Operation

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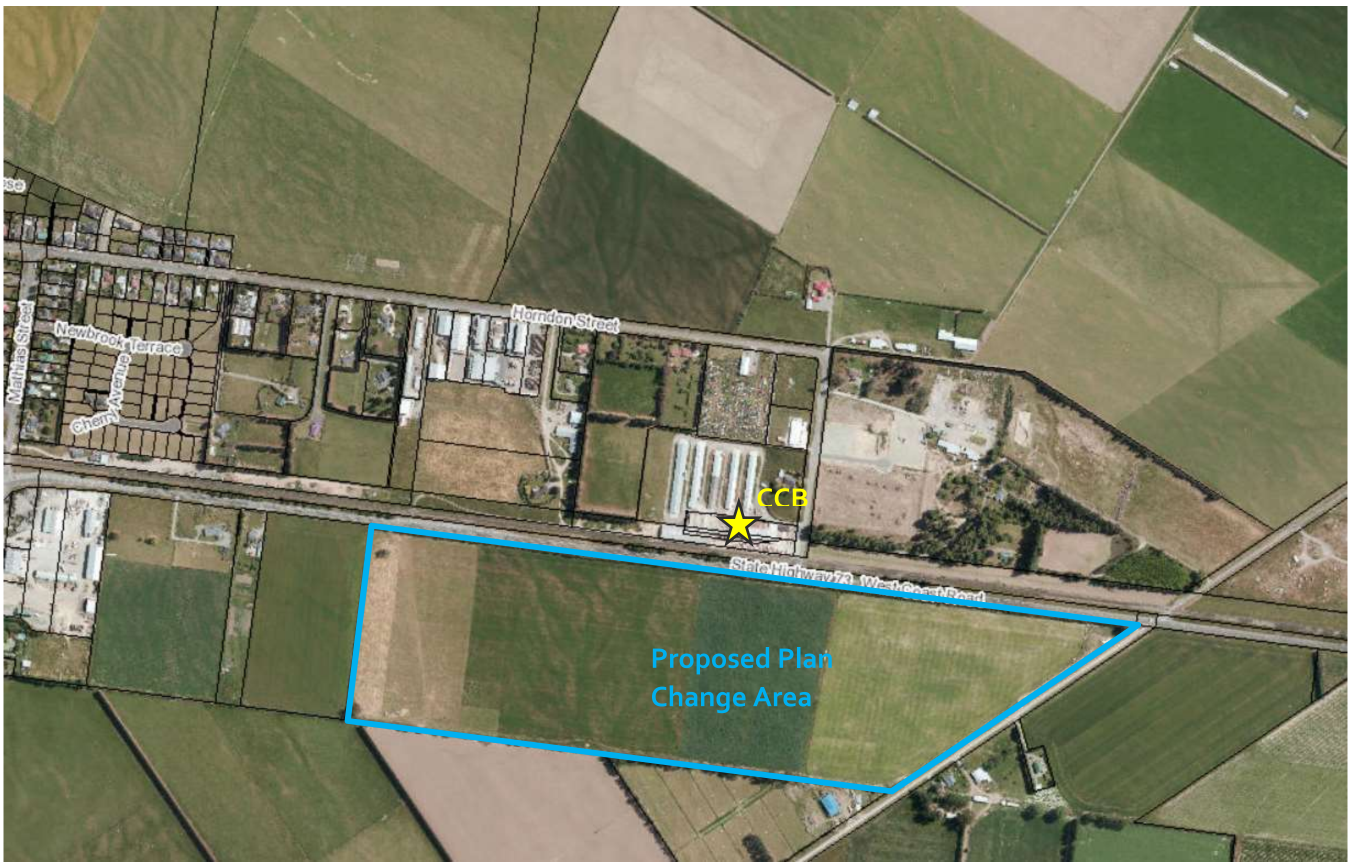
NZ Air is an air quality consultancy specializing in expert evidence, air discharge consent applications, odour assessments, nuisance dust assessments, air quality monitoring and air dispersion modelling

1. Introduction

Baseline Group Limited (**BGL**) have a client whom is proposing to undertake a private plan change to land located south of the Canterbury Clay Bricks (**CCB**) factory on Horndon Street, Darfield (see **Figure 1**). As a part of this process BGL would like to identify any potential adverse air quality effects that may exist within the proposed plan change area as a result of the brick works discharges to air.

NZ Air Limited (**NZ Air**) has obtained a copy of the assessment of environmental effects (**AEE**) which supported the application for air discharge consent held by CCB. This AEE produced by Glasson Potts Fowler in 2005 (attached as **Appendix A**) is now 13 years old. BGL has requested that NZ Air supply an updated air dispersion modelling assessment, which uses current assessment techniques, and compare the assessment results against the current regulatory requirements.

FIGURE 1 SITE



CCB holds an air discharge consent (CRC921703.1) for its current discharges to air. Within this consent there is authorisation to burn coal, diesel or re-refined oil in two brick kilns.

NZ Air has used air dispersion modelling to assess the potential peak concentrations of pollutants in the environment surrounding the CCB facility, with a particular emphasis on potential effects within the proposed plan change area.

2. Assessment Criteria

Sources of Air Quality Assessment Criteria

The Ministry for the Environment's (**MFE**) Good Practice Guide (**GPG**) on Assessing Emissions to Air from Industry[1] recommends an order of priority when reviewing air quality assessment criteria. This order of priority is as follows:

- Ministry for the Environment, Resource Management (National Environmental Standards for Air Quality) Regulations, 2004 (**NES**)[2];
- Ministry for the Environment, Ambient Air Quality Guidelines (2002 update) (**AAQG**)[3];
- Regional Air Quality Targets (**RAQT**); and,
- World Health Organisation air quality guideline (**WHO AQG**) Global Update 2005[4].

National Environmental Standards

The MfE promulgated National Environmental Standards for Air Quality (**AQNES**)[5] as regulations under the Resource Management Act (**RMA**) on 6 September 2004 which are based on the potential for health effects. These health effects are described in the MfE New Zealand Ambient Air Quality Guidelines (**AAQG**)[6]. The AQNES applies standards to five air pollutants; particulate matter less than 10 µm in diameter (**PM_{10}**), carbon monoxide (**CO**), nitrogen dioxide (**NO_2**), sulfur dioxide (**SO_2**), and ozone (**O_3**). The AQNES also places restrictions on home heating appliances, hazardous waste combustion, etc.

Table 1 presents the AQNES ambient air quality assessment criteria relevant to this assessment.

TABLE 1 AQNES AMBIENT AIR QUALITY STANDARDS RELEVANT TO ASSESSMENT

Pollutant	Threshold Concentration (µg/m³)	Averaging Period	Number of Exceedances Allowed Each Year
NO_2	200	1-hr	Nine 1-hr periods
SO_2	350	1-hr	Nine 1-hr periods
	570*	1-hr	None
CO	10,000	8-hr	One 8-hr period
PM_{10}	50	24-hr	One 24-hr period

*not to be exceeded

[1] Ministry for the Environment Good Practice Guide for Assessing Discharges to Air from Industry, 2016
[2] Ministry for the Environment, Resource Management (National Environmental Standards for Air Quality), Regulations 2004
[3] Ministry for the Environment, Ambient Air Quality Guidelines (2002 update)
[4] Air quality Guidelines for Europe Second Edition, 2000
[5] Ministry for the Environment, Resource Management (National Environmental Standards for Air Quality), Regulations 2004
[6] Ministry for the Environment, Ambient Air Quality Guidelines (2002 update)

Ambient Air Quality Guidelines

The AAQG were published by the MfE in 2002 following a comprehensive review of international and national research, and are widely accepted among New Zealand air quality practitioners. The AAQG criteria provide the minimum requirements that ambient air quality should meet in order to protect human health and the environment.

AAQG levels for pollutants and averaging periods not superseded by the AQNES are still relevant and should be considered as part of any assessment. The AAQG criteria set for the protection of human-health are presented in **Table 2**.

TABLE 2 AMBIENT AIR QUALITY GUIDELINES RELEVANT TO ASSESSMENT

Pollutant	Threshold Concentration (µg/m³)	Averaging Period
NO_2	100	24-hr
SO_2	350	1-hr
	120	24-hr
CO	30,000	1-hr
PM_{10}	20	Annual
Lead	0.2	3-month moving average*
Arsenic	0.0055	Annual
Chromium VI	0.0011	Annual

*Calculated monthly

There is a potential for Cadmium to be present in the re-refined oil, however there is no New Zealand ambient air quality criteria for this pollutant. Therefore, for the purposes of this assessment NZ Air have used the conservative long term exposure Texas Effects Screening Level (**Texas ESL**) of 0.0033 µg/m^3 as an annual average criteria for Cadmium.

Regional Air Quality Targets

Canterbury Regional Council (**CRC**) have recently made the Canterbury Air Regional Plan (**CARP**) fully operative. Within the CARP there are no longer regional air quality targets.

Ecosystem Based Guidelines

In addition to effects on human health there is also the potential for air pollutants to have effects on ecosystems. However, these effects are generally only noticed when concentrations reach high levels, higher than those used as assessment criteria for determining adverse health effects. Levels of air pollution in New Zealand rarely reach these ecosystem effect levels and therefore it is reasonably assumed that providing pollutants are below the health based effects assessment criteria then there are unlikely to be effects on the environment or ecosystems.

Summary of Assessment Criteria

The air quality standards and guidelines relevant to this assessment are summarised in **Table 3**.

TABLE 3 SUMMARY OF RELEVANT AIR QUALITY CRITERIA

Pollutant	Averaging Period	AQNES (μg/m³)	NZAAQG (μg/m³)
NO_2	1-hr	200	-
	24-hr	-	100
SO_2	1-hr	350	
		570*	
	24-hr		120
CO	1-hr	-	30,000
	8-hr	10,000	-
PM_{10}	24-hr	50	-
	24-hr	Increase <2.5 within a gazetted airshed	
	Annual	-	20
Lead	3-month moving average**		0.2
Arsenic	Annual		0.0055
Chromium VI	Annual		0.0011
Cadmium	Annual		0.0033***

*Not to be exceeded
**Calculated monthly
*** Texas ESL

3. Assessment Methodology

Identification of Sensitive Receptors

A desktop study was undertaken to identify discrete receptors for the purposes of assessing potential off-site effects resulting from the CCB discharges. The nearest sensitive receptors assessed are summarised in **Table 4**.

The Site and surrounding sensitive receptors are illustrated in **Figure 2**.

FIGURE 2 SITE AND LOCATION OF BOILERS AND SENSITIVE RECEPTORS

Aerial imagery sourced from Google Earth June 2018

TABLE 4 LOCATION OF RECEPTORS LOCATED CLOSE TO THE PROJECT SITE

Receptor Name	Receptor Type	Distance from stacks (m)	Direction Relative to the Site
Proposed plan change area	Residential	70 - 635	South
R1	Residential	110	Northeast
R2	Residential	300	Northeast
R3	Residential	270	Northwest

4. Discharges to air

The CCB factory is consented to operate two brick making kilns, referred to as the “batch kiln” and the “tunnel kiln”.

The two kilns can be fired on three different fuel types; diesel, re-refined oil and coal. Each of these fuel types has differing potential emission parameters. The burning of each fuel types will produce products of combustion. The products of combustion which are relevant to this assessment and controlled through New Zealand legislation are; PM_{10}, NO_2, CO, and SO_2. In addition, the combustion of re-refined oil may discharge trace concentrations of metals present in the oil.

NZ Air has gathered the required air dispersion modelling input information primarily from the 2005 AEE and the existing consent. Where required information has not been available, NZ Air has made conservative estimates of various input factors.

NZ Air have used the air dispersion model AERMOD in the assessment. AERMOD is a steady-state dispersion model designed for short-range dispersion of air pollutant emissions from stationary industrial sources.

On 9 November 2005 the model was adopted by the US Environmental Protection Agency (**EPA**) and promulgated as its preferred regulatory model for both simple and complex terrain and as of the 1 January 2014 the model replaced Ausplume as EPA Victoria regulatory model.

Even though the kilns don't run 24 hours a day 7 days a week, to be conservative, NZ Air have assumed that both kilns are running every hour of every day modelled. This will demonstrate very conservative worst case potential impacts associated with the current consented operation.

Additionally, NZ Air have modelled the emissions based on each kiln operating at its maximum consented fuel burning rate as stipulated in the consent. The calculated emission rates of PM_{10}, NO_2, CO, and SO_2 are highest when burning coal. Therefore NZ Air have only modelled the predicted worst case off-site concentrations of these pollutants for the operation of the kilns at peak coal burning rates. The predicted off-site concentrations for burning diesel or re-refined oil in the kilns will be significantly lower, due to the lower calculated emission factors.

The SO_2 emission rates have been conservatively estimated based on the maximum consented coal sulfur content of 1.8%. The coal fuel burn rate for each kiln has been estimated to be proportional to the consented peak fuel burn rates for diesel/re-refined oil, i.e. the batch kiln has a burn rate of 27.4 kg/hr and the tunnel kiln has a burn rate of 122.6 kg/hr (total equals consented coal burn max of 150 kg/hr).

The modelled stack locations and dimensions for the two kilns on-site have been based on the information provided in the 2005 AEE, available aerial imagery, and Google Street View images. The modelled exit velocities and temperatures were estimated based on stoichiometric calculations assuming the burning of bituminous coal.

Coal burning emissions have been based on published emission factors within Chapter 1.1 of the USEPA AP42 emission factors. It has been conservatively assumed that the emission factors from a spreader stoker coal combustion device are representative of worst case emission from the CCB kilns. These emission factors are elevated in comparison with other coal burning devices. As NZ Air is not aware of the actual coal burning devices on-site, these higher emission factors have been conservatively assumed.

The modelling inputs for the coal burning scenario are included in **Table 5**.

Table 5 Coal Burning Modelling Inputs

Kiln	Fuel burn rate (kg/hr)	Stack height (m)	exit diameter (m)	exit velocity (m/s)	exit temp (deg C)	NO_2 (g/s)	CO (g/s)	PM_{10} (g/s)	SO_2 (g/s)
Batch Kiln	27.4	21.3	0.6	1.22	503	0.042	0.019	0.050	0.260
Tunnel Kiln	122.6	15.5	0.5	7.84	503	0.187	0.085	0.225	1.165

To estimate the potential increase in metal concentrations off-site, NZ Air have also modelled a conservative re-refined oil burning scenario. This modelling scenario was based on the maximum consented concentrations of pollutants in the re-refined oil (i.e. the specification listed in Section 279.11 of the United States Federal Regulation for the Management of Used Oil).

The re-refined oil burning rates were also based on the maximum burn rates within the existing consent. The exit temperatures and velocities were based on the information supplied in the 2005 AEE.

The modelling inputs for the re-refined burning scenario are included in **Table 6**.

Table 6 Re-Refined Oil Burning Modelling Inputs

Kiln	Fuel burn rate (l/hr)	Stack height (m)	exit diameter (m)	exit velocity (m/s)	exit temp (deg C)	Arsenic (g/s)	Cadmium (g/s)	Chromium (g/s)	Lead (g/s)
Batch Kiln	22	21.3	0.6	0.6	300	0.000031	0.000012	0.000061	0.00061
Tunnel Kiln	99	15.5	0.5	15.3	300	0.000137	0.000055	0.000275	0.00275

Deposition rates of the various metals were also modelled utilising the ‘total deposition’ tool in AERMOD. For the purposes of the deposition modelling all particles were assumed to be PM_{10} or less. It has been conservatively assumed that re-refined oil with the maximum content of metals is burned at maximum consented fuel burn rates to ascertain the annual off-site maximum deposition rates.

Meteorological Data

Given the lack of measured representative meteorological data, NZ Air has obtained a three year (2015 – 2017 inclusive) meteorological data file representative of the project site generated in MM5 (5th-generation Mesoscale Model). MM5 is a prognostic meteorology model developed by Pennsylvania State University and the U.S. National Centre for Atmospheric Research (**NCAR**). The model is a limited-area, non-hydrostatic, terrain-following sigma coordinate model designed to simulate or predict mesoscale and regional-scale atmospheric circulation. The MM5 data was used to generate surface output data and upper air output data for input into the dispersion modelling study discussed below.

The modelled meteorological data is presented as a wind rose in **Figure 3**. A wind rose displays wind speed and wind direction data in a graphic form. The percentage of wind blowing from 16 wind directions are annotated by the length of the bars in the rose. The proportion of wind speeds within this wind direction category is illustrated by the coloured segments within the bars. The wind frequency data for the MM5 generated data is presented in **Table 7**.

FIGURE 3 AERMET DATA OUTPUT FOR 2015 TO 2017

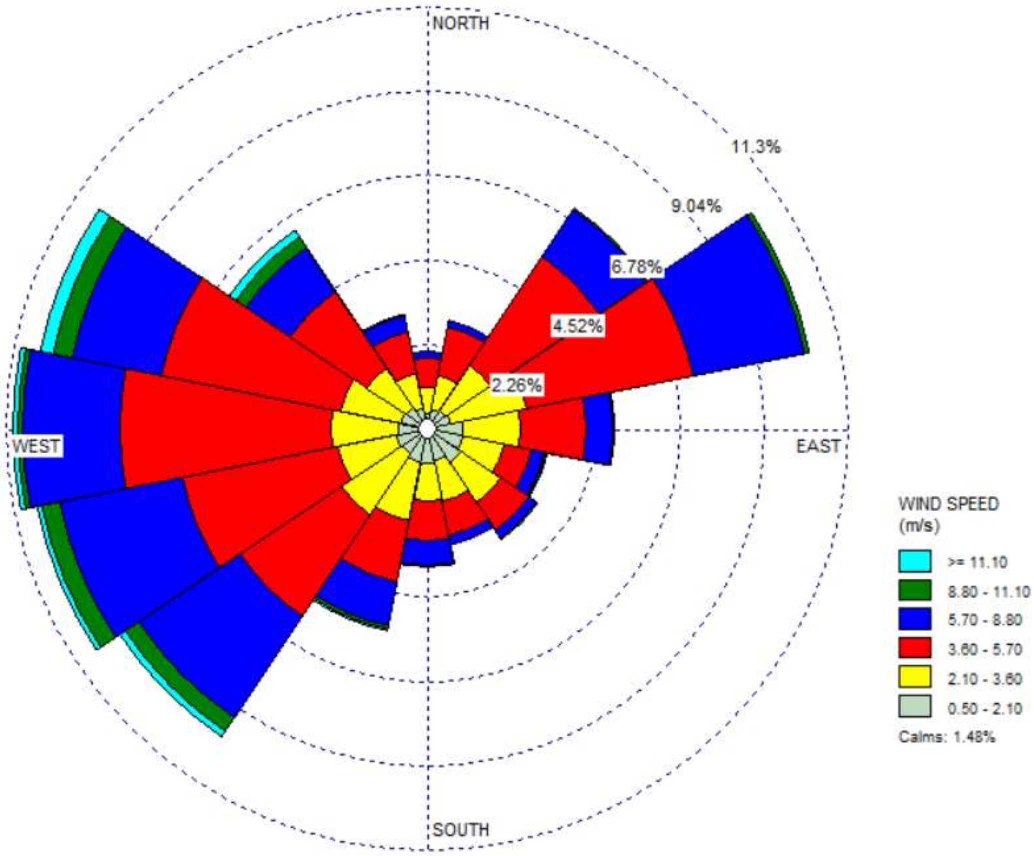


TABLE 7 MM5 2015 - 2017 WIND FREQUENCY DISTRIBUTION PERCENTAGES

Wind Direction	Percentage of Winds from Wind Speed Bands						Total
	0.5 – 2.1 m/s	12.1 – 3.6 m/s	3.6 – 5.7 m/s	5.7 – 8.8 m/s	8.8 – 11.1 m/s	>11.1 m/s	
North	0.94	1.52	1.89	0.40	0.02	0.00	**4.77**
Northeast	1.27	2.96	6.89	3.26	0.10	0.01	**14.49**
East	1.83	3.20	4.09	2.32	0.07	0.01	**11.53**
Southeast	2.05	2.28	1.68	0.41	0.09	0.03	**6.54**
South	1.92	2.28	2.13	1.33	0.06	0.05	**7.76**
Southwest	1.75	3.75	6.22	5.73	0.85	0.28	**18.58**
West	1.62	3.36	10.76	5.25	0.53	0.32	**21.84**
Northwest	1.35	2.52	5.04	2.97	0.70	0.43	**13.01**
Sub Total	**12.74**	**21.87**	**38.70**	**21.67**	**2.43**	**1.12**	**98.52**
Calms							**1.48**
Missing Data							0
Total							**100**

AERMOD Atmospheric Dispersion Model

The AERMOD modelling domain was centred on the project site at UTM 591541 m East (E), 5184054m South (S), zone 59 south. A 4 km by 4 km Nested grid was used at resolutions of 50, 100 and 200 m. Discrete receptors were used to represent the sensitive receptor locations.

AERMOD was run utilising default settings. The parameters used in the AERMOD modelling are summarised in **Table 8**.

TABLE 8 PARAMETERS USED IN AERMOD FOR THIS PROJECT

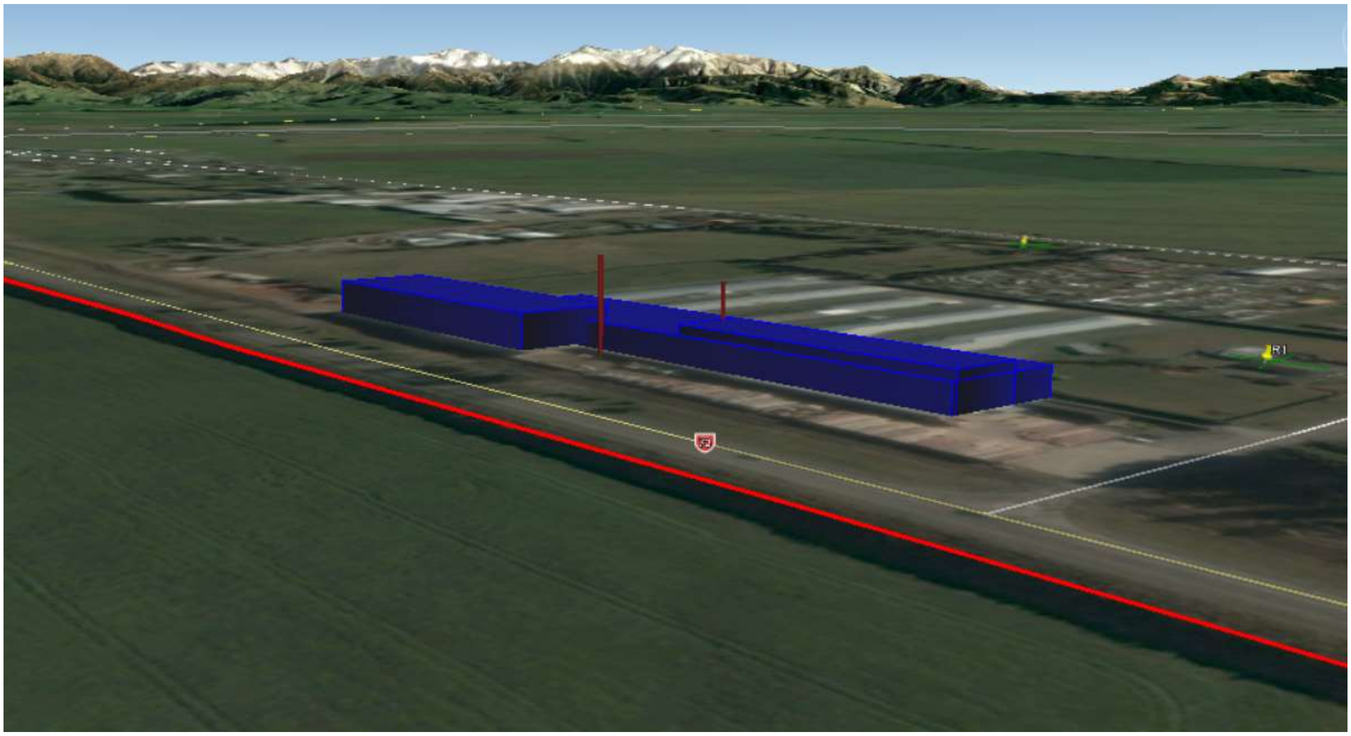
AERMOD	
Model version	9.5.0
Grid size	4.0 km x 4.0 km
Number of grid points	1084
Grid Spacing (m)	50, 100 and 200 m.
Year(s) of analysis	2015 to 2017
Centre of grid	UTM 591541 m East (E), 5184054m South (S), zone 59 south
Terrain Data	Elevated
Dispersion Co-efficient	Rural

Building downwash or building wake effects are generated because airflow around buildings is very complicated and can create zones of strong turbulence and downward mixing on the lee side of a building. This effect is known as building downwash or a building wake effect. In such cases, the entrainment of exhaust gases released by short stacks or rooftop vents in the wake of a building can result in much higher ground-level concentrations close to the source than the model would otherwise predict. It is generally accepted that if a stack is 2.5 times higher than any nearby building, then building downwash is unlikely to occur.

Within AERMOD a building input tool called Building Profile Input Programme (**BPIP**) is used to input all of the building dimensions close to the stack. Then a building wake effect model called Plume Rise Model Enhancements (**PRIME**) is used to calculate the resulting building wake effects on stack emissions.

As the stacks are not 2.5 times the height of a number of nearby buildings BPIP and Prime were used in the modelling approach. The largest/nearest buildings surrounding the proposed stacks were entered into the model and are illustrated in blue on **Figure 4**.

FIGURE 4 BUILDING PROFILES AND STACK LOCATIONS



The modelling input files are available from NZ Air on request.

5. Modelling Results

Background Concentrations

A search of the CRC records shows that there are only two air discharge consents in close proximity to the CCB factory. Approximately 400 m to the north west is a consent for a seed cleaning operation which is only likely to produce nuisance dust emissions. No combustion based activities are consented from this seed cleaning facility. The other consented air discharge is approximately 1.3 km to the west. It is a spray painting booth consented to discharge solvents and isocyanates. It is not expected that any of these discharges will result in cumulative impacts with the CCB emissions.

Home heating and vehicle emissions are likely to be the primary contributors to background levels of PM_{10}, NO_2 and CO in the surrounding environment. However, given that CCB is on the fringe of Darfield and traffic volumes on State Highway 73 are not very high, it is expected that these background concentrations will be relatively low.

NZ Air is not aware of any publicly available ambient air quality monitoring data for the Darfield region and therefore estimation of actual background concentrations of criteria pollutants surrounding the CCB factory is difficult.

Results

Coal Burning Scenario

The maximum predicted off-site pollutant concentrations associated with the modelled coal burning scenario are presented in **Table 9** and compared to the relevant air quality criteria. **Figure 5** presents a contour plot of the predicted PM_{10} concentrations associated with the modelled coal burning operation.

Table 9 Predicted peak concentrations: Coal combustion

	PM_{10} µg/m^3		SO_2 µg/m^3		NO_2 µg/m^3		CO µg/m^3	
Averaging period	**24 hour**	**Annual**	**1 hour 99.9%ile**	**24 hour**	**1 hour 99.9%ile**	**24 hour**	**1 hour 99.9%ile**	**8 hour**
Max off-site	29.3	4.5	279.9	151.6	45.0	24.4	20.46	15.5
Max in proposed plan change area	14.4	1.5	182.2	73.3	29.3	11.8	13.32	9.46
R1	19.7	3.0	164.3	102.3	26.4	16.5	12.01	10.66
R2	9.6	1.0	158.8	49.7	25.5	8.0	11.61	6.2
R3	7.7	0.3	86.6	39.8	13.9	6.4	6.33	4.38
Criteria	50	20	350	120	200	100	30,000	10,000

Note all NOx emitted from the kilns has been conservatively assumed to be NO_2.

The very conservative predicted increase in maximum 24 hour PM_{10} concentration off site (29.3 µg/m^3) and within the proposed plan change area (14.4 µg/m^3) are within the relevant ambient air quality criteria. However, within a number of Canterbury airsheds the PM_{10} NES standard (50 µg/m^3) is regularly exceeded in winter months, primarily due to home heating emissions. The peak CCB contribution to PM_{10} concentrations in the proposed plan change area only exceeds 10 µg/m^3 in a relatively small portion of the site. For the vast majority of the time it is expected that the contribution of the CCB emissions will be much lower than this and relatively minor in comparison to other potential background contributions (i.e. home heating emissions from Darfield or outdoor burning).

The conservatively predicted SO_2 concentrations do not exceed the 1 hour average criteria, and only exceed the 24 hour criteria in a very small area just off-site (see **Figure 6).** It is anticipated in this semi rural environment that the background concentrations of SO_2 will be very low. Although the conservative modelling does indicate that the CCB factory may under the worst case coal burning scenario contribute to elevated levels of SO_2 within the proposed plan change area, it is unlikely that these will exceed the relevant ambient air quality criteria, even with a conservative background level added.

The peak concentrations of CO and NO_2 within the proposed plan change area are well below criteria.

Figure 5 Predicted PM10 24 hour average concentrations (μg/m³): Coal burning

FIGURE 6 PREDICTED PEAK SO2 24 HOUR AVERAGE CONCENTRATIONS (µG/M^3): COAL BURNING

The modelled results are very conservative, it is unlikely that CCB is burning coal 24/7 at the maximum consented burn rates. Additionally, it is unlikely that CCB is burning coal with the maximum sulfur content continuously. Furthermore, it is unlikely that the actual emissions from the stacks are as high as the conservatively high emission factors which NZ Air has utilised in this modelling assessment. Therefore, it is considered that these modelling results will overpredict the potential off-site impacts beyond the site boundary.

The modelled off-site impacts from the very conservatively assessed coal burning scenario demonstrate that there is a potential for degraded air quality within the proposed plan change area as a result of the CCB operation, however the levels are unlikely to result in exceedances of any of the relevant health based New Zealand air quality criteria.

Re-refined Oil Burning Scenario

The maximum predicted annual concentrations of Arsenic, Cadmium, Chromium and Lead in air have been conservatively modelled and the results are presented in **Table 10**. Note that for Lead, monthly concentrations have been modelled as there is no capacity for modelling three month rolling averages in AERMOD. Utilising peak monthly Lead averages is considered conservative.

TABLE 10 PREDICTED PEAK CONCENTRATIONS IN AIR: RE-REFINED OIL COMBUSTION

	Arsenic		Cadmium		Chromium VI*		Lead	
Averaging period	**Annual**	**Annual total deposition**	**Annual**	**Annual total deposition**	**Annual**	**Annual total deposition**	**Month**	**Annual total deposition**
Units	µg/m3	g/m2	µg/m3	g/m2	µg/m3	g/m2	µg/m3	g/m2
Max predicted	0.0033	0.0125	0.0013	0.0052	0.0020	0.0077	0.14	0.27
Max in proposed plan change area	0.0007	0.0030	0.0003	0.0010	0.0003	0.0018	0.03	0.07
R1	0.0010	0.0100	0.0008	0.0030	0.0012	0.0030	0.06	0.01
R2	0.0005	0.0030	0.0003	0.0005	0.0003	0.0006	0.02	0.03
R3	0.0001	0.0008	0.0001	0.0003	0.0001	0.0003	0.01	0.01
Guideline	0.0055		0.0033		0.0011		0.2**	

*based on 2005 AEE assumption that 30% of total Chromium discharged is Chromium VI

** 3 month moving average

All of the very conservatively predicted concentrations of metals in air are below the relevant guidelines except for Chromium VI levels in a very small area surrounding the CCB factory. It is noted that this predicted exceedance is extremely unlikely to occur given the conservatism in the modelling approach. Moreover, this exceedance does not extend to land within the proposed plan change area, which is the subject of this report.

The maximum predicted annual deposition rates of Arsenic, Cadmium, Chromium and Lead have been conservatively modelled and the results are presented in **Table 11.**

For the purposes of this assessment and associated calculations, NZ Air have assumed that the top 0.1 m of soil is the area of most likely impact. Also assumed is a soil density of 1,000 kg/m^3, as presented in the 2005 AEE.

Table B2 in the 'Ministry for the Environment. 2012. Users' Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.' (reproduced below) contains the New Zealand NES soil contaminant standards for health.

NZ Air have conservatively compared the deposition rates against the rural residential/lifestyle block standards, which are the strictest within this Table.

Table B2: Soil contaminant standards for health ($SCSs_{(health)}$) for inorganic substances

	Arsenic	Boron	Cadmium (pH 5)[1]	Chromium III	Chromium VI	Copper	Inorganic lead	Inorganic mercury
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Rural residential / lifestyle block 25% produce	17	>10,000	0.8	>10,000	290	>10,000	160	200
Residential 10% produce	20	>10,000	3	>10,000	460	>10,000	210	310
High-density residential	45	>10,000	230	>10,000	1,500	>10,000	500	1,000
Recreation	80	>10,000	400	>10,000	2,700	>10,000	880	1,800
Commercial / industrial outdoor worker (unpaved)	70	>10,000	1,300	>10,000	6,300	>10,000	3,300	4,200

Notes: All concentrations refer to dry weight (ie, mg/kg dry weight).

1 Default value is for soil that is pH 5. Concentrations increase with increasing pH (see *Methodology*).

TABLE 11 PREDICTED PEAK TOTAL ANNUAL DEPOSITION: RE-REFINED OIL COMBUSTION

	Arsenic		Cadmium		Chromium VI		Lead	
Averaging period	**Annual total deposition**	**Annual increase in soil**	**Annual total deposition**	**Annual increase in soil**	**Annual total deposition**	**Annual increase in soil**	**Annual total deposition**	**Annual increase in soil**
Units	g/m2	mg/kg	g/m2	mg/kg	g/m2	mg/kg	g/m2	mg/kg
Max off-site	0.0125	0.1250	0.0052	0.0524	0.0077	0.0770	0.27	2.7
Max in proposed plan change area	0.0030	0.0300	0.0010	0.0100	0.0018	0.0180	0.07	0.7
R1	0.0100	0.1000	0.0030	0.0300	0.0030	0.0300	0.01	0.1
R2	0.0030	0.0300	0.0005	0.0050	0.0006	0.0060	0.03	0.3
R3	0.0008	0.0080	0.0003	0.0030	0.0003	0.0030	0.01	0.1
NES Standard		**17**		**0.8**		**290**		**160**
Background*		**2.37**		**0.5**		**30**		**23**
Years to reach guideline in plan change area		**488**		**30**		**14,444**		**196**

*as presented in the 2005 AEE

The very conservative results presented in **Table 11** demonstrate a low level potential maximum impact in the proposed plan change area. Additionally, the number of years that it would take for cumulative deposition of the assessed metals to generate potentially hazardous levels in the soils inside the proposed plan change area is significant. Note, that in reality the deposition rates used in the modelling are likely to be much higher than those actually emitted from the site, as re-refined oil with the maximum consented metal concentrations is unlikely to be burnt 24/7. Additionally, as outlined in the 2005 AEE a portion of these metals are likely to be deposited on the bricks themselves and not emitted from the stacks.

6. Conclusion

NZ Air have undertaken an assessment of potential air quality impacts associated with the operation of the existing CCB factory. In particular NZ Air have focussed on the potential for adverse health effects within the proposed plan change area. NZ Air has adopted a very conservative approach in the assessment based on available information.

The results of the conservative air dispersion modelling assessment, demonstrate that the maximum predicted off-site concentrations of controlled pollutants are below the relevant air quality criteria within the proposed plan change area. Although some of the SO_2 modelled results are elevated, it is anticipated that the actual peak off-site concentrations will be well below the peak levels presented in this report, primarily due to the fact that other consented fuels have a much lower maximum sulfur content than coal, and therefore much lower emission factors.

Appendix A – Glasson Potts Fowler 2005 AEE

GLASSON POTTS FOWLER

8700CCB
04 July 2005

EC - CHCH
FILE REF: CO6C/2289
DOCUMENT No.
40604 - 5 JUN 2005
ACTION INFO
L. Davidson

The Chief Executive
Environment Canterbury
P O Box 345
CHRISTCHURCH

Dear Sir

RESOURCE CONSENT VARIATION APPLICATION – W D BOYES & SONS LIMITED

Please find enclosed an application for a variation to an existing resource consent (CRC921703) which permits the discharge contaminants into the air from clay brick manufacturing (including combustion processes) on a site at Darfield owned and operated by W D Boyes & Sons Limited.

A cheque for the deposit amount ($1,125 incl. GST) is enclosed. Please forward a receipt for this amount through to us at the above address.

Yours sincerely
GLASSON POTTS FOWLER LIMITED

Sarah Smith

Sarah Smith
Senior Environmental Scientist
sarah.smith@gpf.co.nz

Enc:

GLASSON POTTS FOWLER

W D BOYES & SONS LIMITED

Horndon Street
Darfield

Resource Consent Variation Application & Assessment of Environmental Effects

July 2005
8700CCB-1C

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W D BOYES & SONS LIMITED

Horndon Street
Darfield

Resource Consent Variation Application & Assessment of Environmental Effects

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Version No.	**1C – final**
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Reviewer	R J Potts
Approved for Issue	R J Potts
Date	**04 July 2005**

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Form 9

APPLICATION FOR RESOURCE CONSENT UNDER SECTION 127 OF THE RESOURCE MANAGEMENT ACT 1991

TO: Environment Canterbury

W D Boyes & Sons Limited applies for a variation to an existing resource consent as described below.

1. **THE NAME AND ADDRESS** of the owner of the land to which the application relates is:

Owner: W D Boyes and Sons Limited
Main West Road
Darfield

Occupier: As above (trading as Canterbury Clay Bricks)

2. **THE LOCATION** of the proposed activities is as follows:

Horndon Street
Darfield

Legal Description: Sec 24 Pt Sec 22 Darfield Village Settlement BLK VII Hawkins SD
Map Reference: NZMS 260 L35: 398-460

3. **THE TYPE** of resource consent sought from Environment Canterbury is:

- Variation to an existing resource consent (CRC921703) that permits discharge of contaminants into the air.

4. **A DESCRIPTION** of the activities to which the application relates is:

Discharges into the air from combustion sources, to be fuelled with a mixture of diesel and re-refined oil (currently consented to be fuelled with coal).

5. **AN ASSESSMENT** of environmental effects in the detail that corresponds to the scale and significance of the effects that the proposed activities may have on the environment, in accordance with the Fourth Schedule to the *Resource Management Act 1991*, is attached.

6. **THAT ASSESSMENT** also contains other such information required to be included in the application by the district plan, the regional plan, the *Resource Management Act 1991* or any regulations made under that Act.

Signed on behalf of applicant

Sarah Smith
Glasson Potts Fowler Limited

Dated this 4th day of July 2005.

ADDRESS FOR SERVICE of Applicant:

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P O Box 13-875
CHRISTCHURCH

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All correspondence relating to this consent application should sent to W D Boyes & Sons Limited, c/- Glasson Potts Fowler Limited at the above address. All contact and correspondence relating to this resource consent variation application should be sent <u>only</u> to the above address.

1. INTRODUCTION

W D Boyes & Sons Limited, trading as Canterbury Clay Bricks, ("*the applicant*") owns and operates a clay brick and pipe manufacturing business on the corner of West Coast Road and Horndon Street, Darfield.

The applicant currently holds a resource consent which permits discharges into the air from the site, as follows:

- Consent CRC921703, which permits discharges into the air from brick and pipe manufacture, including contaminants from burning of up to 150 kg/hour of coal for kiln firing and heating purposes. This consent was granted on 15 September 1993 with various special conditions attached to it.

A copy of the current resource consent is included in Appendix A. The consent is currently being exercised. It has an expiry date of 30 August 2028.

The applicant has recently decided to modify the kiln burners to allow them to be fuelled with a mixture of diesel and re-refined oil.

Accordingly, W D Boyes & Sons Limited is making application to Environment Canterbury (ECan) for a variation to the resource consent, to permit this change in discharges to air.

1.1 Project Scope

Glasson Potts Fowler Ltd (GPF) were engaged to prepare a resource consent application and Assessment of Environmental Effects (AEE) for the proposed discharges to air from the kiln burners running on diesel and re-refined oil, to support an application for variation to the current resource consent being made to Environment Canterbury (ECan).

2. SITE DESCRIPTION

2.1 Location

The site is located on the corner of West Coast Road and Horndon Street, Darfield. The topography of the site and locality is flat.

2.2 Receiving Environment

The receiving environment details around the proposed discharge locations are shown in Table 1.

Table 1 Receiving Environment Details

Direction	Land Use	Approx. Distance from Stack Location metres
North	Dwelling	115
	Farmhouse	200
	Public road (Horndon Street)	290
East	Plantation forestry	150
	Public road (Horndon Street)	135
South	Railway line	35
	Public road (West Coast Road)	50
	Plantation forestry	60
West	Pasture farmland	65

2.3 Wind Conditions

A windrose, generated from wind data gathered at the Rangiora EWS meteorological station from 1999 - 2003, indicates prevailing winds expected in the environment would be from the west and north-east. A copy of the windrose is included in Appendix B.

Given the site's location (which is inland and south-west of Rangiora), local wind directions may be slightly different. Given the proximity of the location to the Southern Alps foothills, katabatic drainage may also occur at night.

2.4 Local Air Quality

The ECan GIS database was reviewed to establish the location of discharge consents granted for discharges into the air in the environment surrounding the discharge stack location on the applicants site.

The database review indicated that there are three air discharge consents currently granted within a one kilometre radius of the applicant's site location.

There is one consent that permits discharges into the air from combustion processes. This is the consent granted to the applicant for the activities on its site.

The other two consents are for discharges into the air from a spray-painting booth and a seed and grain handling, cleaning and packaging business.

There will be discharges into the air from home heating appliances in nearby Darfield township. These could be fuelled with coal, wood, diesel or other organic fuels.

3. STATUTORY ASSESSMENT

3.1 Overview

The operative regional plan is the *Transitional Regional Plan* (TRP), constituted under section 368 of the *Resource Management Act 1991*. This plan includes rules governing the discharges of contaminants into the air. ECan has also released its *Proposed Canterbury Natural Resources Regional Plan, Chapter 3: Air Quality* (NRRP).

3.2 Transitional Regional Plan

The TRP includes provisions governing the discharges of contaminants into the air, via the *Clean Air Act 1972* (CAA).

The Second Schedule of the CAA is part of the TRP. This schedule defines various industrial and commercial activities, and classes them according to the requirement for discharge permits.

In terms of the proposed activity, the Second Schedule of the CAA defines any combustion process involving fuel burning equipment, not otherwise specified or described in the Schedule, having a heat release exceeding 40 kW as a Part C process (subsection 1).

Based on the activity the applicant proposes to undertake on the site (as detailed in the consent application), the proposed activity falls under the jurisdiction of Part C of the Second Schedule of the CAA. The TRP does not mention the burning of diesel or re-refined oil as a specific activity.

It is therefore considered that a resource consent for air discharges from the proposed combustion of diesel and re-refined oil in the kiln burners would be required under the TRP.

3.3 Proposed Natural Resources Regional Plan

Discharges into the air from the proposed activity are addressed in the *Proposed Natural Resources Regional Plan* (NRRP) *Chapter 3: Air Quality*, which ECan released on 01 June 2002 for public submissions. Submissions closed in 2004 and hearings on the submissions started in October 2004. ECan have indicated (via their website) that the hearings will probably conclude in August 2005. Decisions on the submissions will likely be released several months later, so this chapter is unlikely to become fully operative for some time.

Chapter 3 has, as its focus, the maintenance and improvement of ambient air quality and the reduction of nuisance effects. Policies seek the avoidance, remediation, or mitigation of adverse effects resulting from discharges of contaminants into air.

A review of the maps accompanying Chapter: 3 indicates that the applicant's location is outside the Christchurch Clean Air Zones 1 and 2.

Chapter 1: Overview of the NRRP defines a large scale fuel burning device as:

> *...any boiler, furnace, engine or other device designed to burn fuel for the primary purpose of energy production having a net heat or energy output of more than 40 kilowatts, but excluding motor vehicles, boats and aircraft.*

The applicant's units are considered to fall within this definition.

The relevant NRRP rule, in terms of the applicant's proposed activity, is:

- AQL27 – this makes the discharge of contaminants into the air from burning, outside the Christchurch Clean Air Zones 1 and 2, any fuels in any large scale fuel burning device which is not classed as a permitted or controlled activity under rules AQL22 to AQL26 (which govern large scale fuel burning appliances outside the Christchurch Clean Air Zones 1 and 1) a discretionary activity.

  One of the applicant's proposed fuels would fall under the jurisdiction of rules AQL22 to AQL26 (diesel), but the other proposed fuel (re-refined oil) would not. Therefore, the applicant's proposed activity falls under the jurisdiction of rule AQL27.

It is therefore considered that a resource consent for air discharges from the proposed combustion of diesel and re-refined oil in the kiln burners would be required under the NRRP.

4. ACTIVITY DESCRIPTION

4.1 Unit Specifications

The two units are:

- A tunnel kiln for continuous brick firing, rated at 820 kW; and
- An intermittent kiln, rated at 176 kW, which is used for batch brick runs.

The applicant has indicated that the units will be run on a mixture of diesel and re-refined oil, with diesel percentages varying from 30 - 80% and re-refined oil percentages varying from 20 - 70%. The percentages vary depending on the brick appearance required (some brick colours and effects need a higher percentage of re-refined oil, to achieve the required colour/effect).

The details of the two units are shown in Table 2.

Table 2 Individual Unit Details

Unit	Tunnel kiln	Batch kiln
Rating, kW	820	176
Max diesel usage rate, L/hour (calculated maximum)	103	23
Max re-refined oil usage rate, L/hour (calculated maximum)	99	22

4.2 Discharge Nature

4.2.1 Diesel

When run on a fuel mixture that is primarily made up of diesel, the appliances are likely to discharge:

- Particulate matter;
- Nitrogen oxides, including nitrogen dioxide (NO_2);
- Sulphur oxides, mainly sulphur dioxide (SO_2);
- Carbon monoxide (CO); and
- Unburned organic compounds.

Diesel is included in the fuel category known as *distillate oils*. The United States Environmental Protection Agency (USEPA) describes distillate oils as relatively volatile, having negligible nitrogen and ash content and generally less than 0.3% sulphur by weight.

Diesel combustion results in contaminant discharges that depend on the fuel quantity burned, fuel contaminant concentrations, and combustion conditions.

- Heat

Heat will be released from the combustion process.

- Odour from Fuel Burning

Odour associated with diesel combustion will be released as part of the proposed activity.

- Organic Compounds

Organic compounds are discharged into the atmosphere when some fuel remains unburned or is partially burned during combustion. The quantities of total organic compounds (TOC) discharged can be extremely variable.

4.2.2 Re-refined Oil

When run on a fuel mixture that is primarily made up of re-refined oil, the appliances are likely to discharge:

- Particulate matter;
- Sulphur oxides (SO_x);
- Nitrogen oxides (NO_x);
- Carbon monoxide (CO);
- Metals and metalloids (present in the re-refined oil fuel);
- Organic compounds (present in the re-refined oil fuel); and
- Hydrogen chloride (HCl) (as a result of halogens present in the re-refined oil fuel).

Burning re-refined oil as a fuel in a combustion appliance produces emissions that reflect the compositional variation inherent in such a product.

4.3 Contaminant Emission Rates

4.3.1 General Comments

Emission rate calculations allow contaminant computer dispersion modelling and ground level concentration prediction.

The United States Environment Protection Agency (USEPA) publishes emission factors for many activities emitting contaminants to atmosphere. These emission factors are generally regarded as being robust and applicable. Diesel-fuelled combustion appliance emission factors (*Chapter 1.3 – Fuel Oil Combustion*) were published in 1998. Emission factors for burning waste and re-refined oils (*Chapter 1.11- Waste Oil Combustion*) were published in 1996.

In Chapter 1.11, the emission factors presented are indicated as being suitable for use where waste (or re-refined oil) comprises the majority of the fuel combusted. The chapter indicated that if virgin oil comprised the majority of the fuel combusted, the emission factors presented in Chapter 1.3 should be used instead.

So the approach taken in this assessment is:

- For the scenario where re-refined oil comprises the majority of the fuel being combusted, emission rates based on Chapter 1.11 emission factors were used; and
- For the scenario where diesel comprises the majority of the fuel being combusted, emission rates based on Chapter 1.3 emission factors were used.

This approach is considered conservative, as the real situation is likely to be somewhere in between the two cases assessed in this report.

4.3.2 High Percentage Diesel Emission Rates

The contaminants of primary concern were assessed as:

- Inhalable particulate less than ten microns in diameter (PM_{10});
- Sulphur oxides, principally sulphur dioxide (SO_2); and
- Carbon monoxide (CO).

Assumptions made when calculating contaminant emission rates for this scenario were:

- All fuel used is diesel;
- Maximum diesel burning rates were as given in Table 2;
- A diesel sulphur content of 0.05%; and
- Diesel specific gravity was 0.83.

Emission factor calculations were undertaken using the 1998 USEPA emission factors and kiln burner kilowatt rating.

Calculated emission rates are shown in Table 3.

Table 3 Calculated Emission Rates - Diesel

Contaminant	Calculated Emission Rate Tunnel kiln g/s	Calculated Emission Rate Batch kiln g/s
PM_{10}	0.003	0.001
Sulphur dioxide	0.026	0.006
Carbon monoxide	0.017	0.004

4.3.3 High Percentage Re-refined Oil Emission Rates

The contaminants of primary concern were assessed as:

- Inhalable particulate less than ten microns in diameter (PM_{10});
- Sulphur oxides;
- Heavy metals and metalloids (arsenic, cadmium, chromium, lead);
- Hydrogen chloride; and
- Carbon monoxide (CO).

Assumptions made when calculating contaminant emission rates for this scenario were:

- All fuel used is re-refined oil;
- Maximum re-refined oil burning rate were as given in Table 2;
- The applicant's fuel supplier has indicated that the heavy metal/metalloid and halogen levels in the fuel are those specified in the United States federal regulations governing the management of used oil. A copy of the applicable limits is included in Appendix C;
- All sulphur oxides emitted are assumed to be sulphur dioxide;
- An ash content of 0.5%, based on re-refined oil data;
- A sulphur content of 0.8% (maximum sulphur content specified by the applicant's fuel supplier); and
- Re-refined oil specific gravity was 0.9 (specified by applicant's fuel supplier).

Emission factor calculations were undertaken using the USEPA emission factors, the US federal regulations contaminant limits (for heavy metals and metalloids) and kiln burner kilowatt rating. Calculated emission rates are shown in Table 4.

The US federal regulations did not indicate if the chromium value specified was total chromium, or one of the two chromium species (Cr III or Cr VI). For this assessment, it was assumed to be total chromium.

Table 4 Calculated Emission Rates – Re-refined Oil

Contaminant	Calculated Emission Rate Tunnel kiln g/s	Calculated Emission Rate Batch kiln g/s
PM_{10}	0.09	0.02
Sulphur dioxide	0.39	0.09
Carbon monoxide	0.02	0.004
Hydrogen chloride	0.022	0.005
Arsenic	0.00014	0.00003
Cadmium	0.0001	0.00001
Chromium	0.0003	0.0001
Lead	0.003	0.0006

4.4 Stack Details

4.4.1 Tunnel Kiln

The tunnel kiln stack extends above the roof of the main factory building. It is 15.5 metres high and has a diameter of 0.5 metres. The tip of the stack is 9.5 metres above the roof of the factory building.

4.4.2 Batch Kiln

The batch stack is free standing next to the south side of the factory building. It is 21.3 metres high and has a diameter of 0.6 metres. The tip of the stack is 15.3 metres above the roof of the adjoining factory building.

4.5 Efflux Velocities

4.5.1.1 Tunnel Kiln

The stack diameter, at the exit point, is 0.5 metres and the stack discharge area was calculated as 0.196 m^2. The applicant advised that the gas flowrate is 3 m^3/s (due to air volumes injected into the tunnel kiln for firing and cooling purposes), so the calculated efflux velocity is 15.3 m/s.

4.5.1.2 Batch Kiln

The stack diameter, at the exit point, is 0.6 metres and the stack discharge area was calculated as 0.28 m^2. The gas flowrate, when the batch kiln is fuelled with diesel, was calculated as 0.17 m^3/s, so the calculated efflux velocity is 0.9 m/s.

4.6 Discharge Method

The kiln burners will discharge contaminants into the air via two existing stacks, which have no devices that would obstruct the vertical movement of exhaust gases (like a "Chinaman's hat"). The tips of the stacks are between 9 - 15 metres higher than the factory building.

4.7 Building Dimensions

Literature indicates that buildings that are greater than 40% of the stack height within a radius of five times the stacks height will influence the stack discharges (by causing downwash effects).

An assessment of the surrounding buildings found that the factory building was the only building that could influence the stack discharges, when assessed against the above criteria. A map showing the location of the building relative to the stacks is included in Appendix D.

4.8 Air Quality Modelling

The atmospheric dispersion model AUSPLUME v6 (with the PRIME building downwash algorithm activated) was used to assess the effects of the additional contaminant discharges. This Gaussian plume dispersion model is commonly used in New Zealand to predict contaminant ground level concentrations (GLCs) discharged from stack sources in cases with simple terrain (which is the case here).

Conservative assumptions were used when calculating emission rates and selecting model parameters. As a result the model is more likely to over-predict than under-predict peak concentrations.

A review indicated no site-specific meteorological data was available for the Darfield area. A standard screening meteorological data set was considered (METSAMP) but averaging periods longer than one hour were unable to be generated, rendering it useless for this application.

A set of real meteorological data was used (Christchurch 1997-98; Release 2; 2000), which was obtained from ECan. Even though it is not strictly applicable to Darfield, it contains a full set of meteorological conditions likely to be experienced, so it was used in this assessment as a "best-fit" data set (allowing for it not being site specific).

5. ALTERNATIVES ASSESSMENT

The applicant considers that the use of the proposed fuels is itself an alternative to the current use of coal, which can emit significantly higher levels of some contaminants.

There are positive benefits accruing from recovery, refining and re-use of waste lubricating and hydraulic oils which could otherwise be potentially disposed of into local council wastewater or stormwater networks, or into the Canterbury Waste Services Kate Valley landfill.

The discharges will be through existing stacks on the site. The applicant considers that there are no alternatives to this discharge method and considers it 'best practice' for contaminant dispersion at the location.

6. ASSESSMENT OF ENVIRONMENTAL EFFECTS

6.1 Contaminant Nature

The contaminants considered in this assessment are combustion products, metals and halogen compounds. The effects of these contaminants on the receiving environment are discussed below.

In terms of comparisons of predicted values with guidelines, the Ministry for the Environment (MfE) (MfE, 1997) notes that ambient air quality guidelines should not be seen as a limit to pollute up to, but should be regarded as minimum requirements for air quality.

6.2 Receiving Environment Sensitivity

The receiving environment around the proposed site has mixed land uses, with rural, commercial and extensive forestry uses present. ECan aerial photography indicated that the closest residential dwelling was about 115 metres to the north, with the main residential area of Darfield township about one kilometre to the west of the site. The area is considered to have low to moderate sensitivity, given the nature of surrounding activities.

The receiving environment uses downwind under the prevailing winds (as shown on the wind rose) are:

West	Plantation forestry (Selwyn Plantation Board) Public road (Horndon Street)
North-east	Railway line Public road (West Coast Road) Plantation forestry

6.3 Ground Level Contaminant Effects

6.3.1 General Comments

Ground level contaminant concentrations arising from the two scenarios detailed in section 4.3.1 will be assessed.

The cumulative effects from the discharges were assessed using monitoring information obtained from the ECan air quality monitoring station in Rangiora for the period 27 February-31 December 2004. ECan does not routinely monitor ambient air quality in Darfield township. The Rangiora station was considered to have the closest similarity to Darfield, in terms of land uses and potential impacts on air quality.

New Zealand guideline literature (MfE, 2004) suggests the most sensible approach, when assessing cumulative impacts, is to add the maximum or 99.9th%tile predicted concentration to the average background concentration. This is the approach used here, which has been accepted by ECan for previous applications for combustion activities.

6.3.2 Contaminant Guideline Values

Particles

Deposited particulate matter constitutes larger-sized particles (greater than 20 µm diameter) that are rapidly removed from the atmosphere by gravity. Total suspended particulate (TSP) is the fraction less than 20 µm diameter. Particles less than ten microns in diameter (known as PM_{10}) are able to be inhaled into the lungs.

The MfE *Ambient Air Quality Guidelines* (AAQG) (MfE, 2002) value for inhalable particles is given in terms of PM_{10}, as this fraction is known to cause health effects. The relevant guideline value is 50 $\mu g/m^3$ (24-hour average).

Sulphur Oxides

Sulphur oxide emissions (primarily sulphur dioxide, SO_2) generated during combustion depend on fuel sulphur content and fuel quantity burnt.

Inhalation of high ambient SO_2 concentrations can cause nerve stimulation in the air passages, resulting in a reflex cough, irritation, and chest tightness. Airway resistance increases with increasing SO_2 concentration, over an extremely large range of sensitivity. The effect is heightened by exercise. It can also cause air passage narrowing, particularly in people with asthma and chronic lung diseases.

The New Zealand AAQG (MfE, 2002) SO_2 value is based on World Health Organisation (WHO) measurements of the lowest SO_2 concentration at which adverse effects were observed. The relevant SO_2 AAQG value is 350 $\mu g/m^3$ (one-hour average).

Carbon Monoxide

Carbon monoxide (CO) is formed when combustion conditions do not allow full oxidation of hydrocarbons to carbon dioxide (CO_2). This can occur when there is not enough oxygen near the burning fuel or when combustion temperatures are too low.

The presence of CO in the blood reduces its oxygen carrying capacity by binding to the haemoglobin molecules inside each red blood cell. Cumulative CO exposure can produce substantial CO levels in the bloodstream.

The relevant MfE AAQG value (MfE, 2002) is 30 mg/m^3 (one-hour average).

Hydrogen Chloride

In terms of hydrogen chloride guideline values, the MfE guideline document contains no values. ECan air quality investigating officers have previously indicated that, in the absence of appropriate guideline values in the MfE document, they would then seek suitable guideline values from the State of Victoria (SoV) *State Environment Protection Policy (Air Quality Management)*[1] document. The guideline values are referred to as *Design Ground Level Concentrations* (DGLCs) in the SoV document.

The SoV document lists one guideline value for hydrogen chloride. The SoV guideline value (toxicity-based) is 250 µg/m^3 (three minute average).

Longer term hydrogen chloride guideline values were then sought from other suitable guideline documents. The Standards Development Branch of the Ontario Ministry of the Environment has published Point of Impingement Limit (POI) and Ambient Air Quality Criteria (AAQC) values for various contaminants. The POI values are equivalent to the DGLC values in the SoV document.

The Ontario document lists two hydrogen chloride guideline values. The POI value is 100 µg/m^3 (30 minute average), which is based on corrosion as the limiting effect. The AAQC value is 20 µg/m^3 (24 hour average), based on health as the limiting effect.

Heavy Metals/Metalloids

In terms of heavy metals and metalloid guideline values, several different documents were consulted, to find short and longer term guideline values.

- Arsenic

  The SoV document lists one guideline value which covers arsenic and its compounds. The guideline value is based on arsenic's classification as an IARC Group I carcinogen. The SoV DGLC value is 0.00017 mg/m^3 (0.17 µg/m^3) (three minute average).

[1] State of Victoria (2001): *State Environment Protection Policy (Air Quality Management).*

The MfE document lists two longer-term arsenic guideline values. The inorganic arsenic value is 0.0055 μg/m³ (annual average) and the arsine (formula AsH_3) value is 0.055 μg/m³ (annual average).

- Cadmium

The MfE document does not list any cadmium guideline values.

The SoV document lists one short-term guideline value which covers cadmium and its compounds. The SoV DGLC value is 0.000033 mg/m³ (0.033 μg/m³) (three minute average).

The Ontario document lists two guideline values for cadmium and its compounds. The POI value is 5 μg/m³ (30 minute average) and the Ambient Air Quality Criteria value is 2 μg/m³ (24 hour average).

- Chromium

The SoV document lists two guideline values for the two chromium valency states.

The SoV DGLC value for trivalent chromium (Cr III) is 0.017 mg/m³ (17 μg/m³) (three minute average). The guideline value is toxicity-based.

The SoV DGLC value for hexavalent chromium (Cr VI) is 0.00017 mg/m³ (0.17 μg/m³) (three minute average). The guideline value is based on it's classification as an IARC group I carcinogen.

The MfE document lists two longer-term chromium guideline values, also based on valency states. The Cr III value (which also includes chromium metal) is 0.11 μg/m³ (annual average) and the Cr VI value is 0.0011 μg/m³ (annual average).

- Lead

The SoV DGLC value for lead is 0.003 mg/m³ (3 μg/m³) (three minute average). The guideline value is toxicity-based.

The Ontario document lists two guideline values for lead. The POI value is 6 μg/m³ (30 minute average) and the Ambient Air Quality Criteria value is 2 μg/m³ (24 hour average)

The MfE document lists a longer-term lead guideline value. The lead value is 0.2 μg/m³ (three month moving average, calculated monthly).

6.3.3 High Diesel Scenario

Concentrations of various contaminants generated during the combustion of fuel which is predominantly diesel within the two kilns (so-called "high diesel" scenario) was modelled using the atmospheric dispersion modelling program AUSPLUME v6 (with the PRIME building downwash algorithm activated) and the 1997-1998 Christchurch meteorological data set.

The following conservative assumptions were used:

1. The burners operate at 100% of their Maximum Capacity Ratings (MCRs) throughout the 24 hour averaging period;
2. The kilns operate 24 hours a day, seven days a week. This is conservative, as the batch kiln processes discrete batches of bricks, so it is not a constant emission source;
3. The emission rates were as given in section 4.3.2;
4. The efflux velocities were as given in section 4.5;
5. The discharge from the stack occurs as detailed in section 4.4;
6. As <50% of surrounding area (a three kilometre radius around proposed activity's location) is high-density urban, following examination of aerial photography, *Irwin Rural* wind profile exponent values were used. This is consistent with New Zealand dispersion modelling guideline literature (MfE, 2003));
7. The surface roughness height category selected was *Flat rural* (0.1 metres), given the surrounding land profile;
8. The PRIME building downwash algorithm was activated;
9. Emissions are constant over the various averaging periods used;
10. The minimum distance selected for the Cartesian receptor grid was ten metres;
11. For longer-term averaging periods (24 hours or greater), the Maximum Ground Level Concentration (MGLC) values were used for comparative purposes;
12. For shorter-term averaging periods (i.e. three minutes) the 99.9^{th}%tile ground level concentration was used for assessment against the relevant guideline value. This is so any rogue or errant meteorological conditions could be excluded, and a comparison made to a more realistic concentration; and
13. The main factory building is considered to potentially cause downwash effects (as explained in section 4.7).

The predicted values for the high diesel scenario, and likely background contaminant values, are shown in Table 5.

Table 5 Predicted Ground Level Concentrations – High Diesel Scenario

Contaminant	Predicted GLC µg/m³	Average Ambient Background Value µg/m³	Predicted + Background µg/m³	Guideline Value µg/m³
PM_{10} [1]	0.074	16	16.1	50
Sulphur dioxide[3]	1.1	0.82	1.9	350
Carbon monoxide[3]	0.69	170	171	30,000

Notes:

1. Maximum ground level concentration
2. µg – microgram
3. 99.9th%tile value

The modelling assumed that the batch kiln operates 24 hours a day, every day of the year. In reality, the batch kiln will operate only as required (to produce custom brick batches) so the modelling assessment is considered conservative. The temperature of the batch kiln discharge was assumed to be constant but in reality, it increases as the batch of bricks inside the kilns is processed, up to a maximum of 300°C (the temperature used in the modelling assessment).

The applicant has indicated that the batch kiln only runs for 50% of the time, as for 50% of the time it is cooling down from processing a batch of bricks.

It is considered that the impacts from running the two kilns on diesel would result in less impacts than the impacts from the current operations (coal fuel used in both kilns), as the diesel proposed for use has a lower sulphur content and will result in less inhalable particulate emissions than coal.

Given the predicted values (when considered in combination with typical background levels already present in the airshed) are significantly less than the relevant guideline values and given the sensitivity of the receiving environment, it is considered that the cumulative effects of discharges from both kilns running on fuel that is predominantly diesel should be less than minor at ground level.

6.3.4 High Re-refined Scenario

Concentrations of various contaminants generated during combustion of fuel which is primarily re-refined oil within the two kilns (referred to as the "high re-refined oil" scenario) was modelled using the atmospheric dispersion modelling program AUSPLUME v6 (with the PRIME building downwash algorithm activated) and the 1997-1998 Christchurch meteorological data set.

The assessment used the same conservative assumptions as the diesel assessment.

The predicted ground level concentrations for the high percentage re-refined scenario, and likely background values are shown in Tables 6 and 7. An isopleth plot showing predicted ground level PM_{10} concentrations is included in Appendix D. This plot indicates that the level of inhalable particles decreases with distance from the stacks, with low PM_{10} levels predicted in the surrounding environment.

Table 6 Predicted Ground Level Concentrations – High Re-refined Scenario

Contaminant	Predicted GLC µg/m³	Average Ambient Background Value µg/m³	Predicted + Background µg/m³	Guideline Value µg/m³
PM_{10} [1]	2.01	16	18.01	50
Sulphur dioxide[3]	15.8	0.82	16.6	350
Carbon monoxide[3]	0.78	170	171	30,000
Hydrogen chloride[3]	1.47	-	-	250 (3 min av.)
	1	-	-	100 (30 min av.)

Notes:
1. MGLC – maximum ground level concentration
2. µg – microgram
3. 99.9th%tile value

Table 7 Predicted Ground Level Metal Concentrations – High Re-refined Scenario

Contaminant	Predicted GLC µg/m³	Guideline Value µg/m³
Arsenic	0.009	0.17 (3 min av.)
	0.0008	0.0055 (annual av.)
Cadmium	0.0059	0.033 (3 min av.)
	0.0041	5 (30 min av.)
Chromium[4]	0.015	Cr III - 17 (3 min av.)
	0.0013	Cr III – 0.11 (annual av.)
	0.007	Cr VI – 0.17 (3 min av.)
	0.0006	Cr VI – 0.0011 (annual av.)
Lead	0.19	3 (3 min.av.)
	0.13	6 (30 min av.)

Notes:
1. GLC – ground level concentration
2. µg – microgram
3. 99.9th%tile value
4. In order to assess chromium impacts, it was conservatively assumed that 70% of total chromium emissions released will be in Cr III form and 30% will be in Cr VI form (this assumption is derived from Australian national pollutant inventory data).

The modelling assumed that the batch kiln operates 24 hours a day, every day of the year. In reality, the batch kiln will operate only as required (to produce custom brick batches) so the modelling assessment is considered conservative. The temperature of the batch kiln discharge was assumed to be constant but in reality, it increases as the batch of bricks inside the kilns is processed up to a maximum of 300°C (the temperature used in the modelling assessment).

The assessment assumed that all metals present in the re-refined oil were emitted to atmosphere. This is considered conservative, as the applicant has indicated that most of the metals present in the oil will be absorbed as a visible colouring on the surface of the finished bricks.

The predicted values are all below relevant guideline values. No ambient monitoring for metals and metalloids have been undertaken in the Darfield area, but given the lack of heavy industries and other major potential sources of such contaminants in the area, it can be concluded that the levels of heavy metals and metalloids in the Darfield airshed would be low.

Given that predicted values (when considered in combination with expected background levels already present in the airshed) are less than the relevant guideline values, it is considered that the cumulative effects of discharges from both kilns running on fuel that is predominantly re-refined oil should be less than minor at ground level.

6.4 Effects on Local Air Quality

The discharges from the proposed fuel changes in the two kilns will include odour and combustion products. The effects on local air quality beyond the boundary will be minor, given the low contaminant levels being emitted. The low contaminant levels anticipated in the discharges are not considered to cause adverse effects on the local air quality surrounding the site.

6.5 Effects on People and Community

All the guideline values used for comparative purposes were developed on a health protection basis. Given that the predicted contaminant concentrations are below these guidelines, it is anticipated that the effect of the proposed combustion of diesel and re-refined oil in the two kilns on the health of people, flora and fauna in the surrounding receiving environment should be minor.

6.6 Specific Cumulative Effects

6.6.1 Metals

Soils under and around the applicant's site are classified as *Chertsey sub-hygrous yellow-grey earths*. Relevant literature was consulted which listed heavy metal and metalloid levels present in such soils in the Canterbury region at various depths. It is considered that the surface depths (<0.1 m) would be of most relevance when discussing deposition from the applicant's proposed discharge.

The above literature did not give any specific values for arsenic in Canterbury soils. Other literature indicated that New Zealand rural soils belonging to the *Yellow grey* *earth* soil type category have arsenic concentrations in the range 0.73-7.33 mg/kg, with a mean arsenic concentration of 2.37 mg/kg (at a soil depth of 7.5 cm).

Relevant data is presented in Table 8.

Table 8 Soil Heavy Metal/Metalloid Levels

Contaminant	Depth m	Range mg/kg	Mean Value mg/kg
Arsenic	0.075	2 - 30	2.37
Cadmium	<0.1	-	0.5[1]
Chromium	<0.1	15 - 40	30
Lead	<0.1	18 - 29	23

Notes:
1. No range given for less than four samples determined.

In order to assess the impact of metal deposition from the proposed discharge, the following conservative assumptions were made:

- Deposition was based on the maximum or 99.9th%tile predicted values given in Table 7;
- It was assumed that at each location, the total predicted metal mass at that location was deposited onto an area of one metre by one metre;
- It was considered that the topsoil would be of most interest in terms of potential impact, so a soil depth of 0.1 metres was assumed for calculation purposes;
- A soil density of 1,000 kg/m^3 was assumed;
- Deposition over a period of one year was assessed; and
- Background heavy metal/metalloid concentrations in soils given in Table 8 were used.

Predicted maximum annual increases in soil metal/metalloid concentrations are shown in Table 9. Relevant guideline values for various metals and metalloids are also shown for comparison.

Table 9 Predicted Annual Metal/Metalloid Concentration Increases in Soil

Metal	Mean Background Concentration mg/kg	Assumed Background Mass mg	Predicted Annual Deposited Mass mg	Background + Predicted Deposited mg	% Increase	Conc. mg/kg	Guideline Value mg/kg	Time to reach Guideline years
Arsenic	2.37	237	1.6	239	0.68	2.4	30[1]	1,727
Cadmium	0.5	50	0.07	50.07	0.14	0.51	1[2]	714
Chromium	30	3,000	3.9	3010	0.13	30.1	600[3]	14,615
Lead	23	2,300	2.3	2,303	0.1	23.3	300[4]	12,043

Notes:
1. *Combined exposure pathways* guideline value, human health protection basis, MfE Health and Environmental Guidelines for Selected Timber Treatment Chemicals, 1997.
2. *All pathways* guideline value, human health and ecological receptors protection basis, NZ Biosolids Guidelines 2003.
3. *All pathways* guideline value, assumes all chromium is present as Cr III, human health and ecological receptors protection basis, NZ Biosolids Guidelines 2003.
4. *Residential with garden/soil access* guideline, human health protection basis, NZ Biosolids Guidelines 2003.

The results show that, even with the addition of deposited metals from the proposed discharge, the concentration of various heavy metals and metalloids in the soil does not exceed relevant guideline values.

Cadmium levels are likely to be elevated in Canterbury soils, as a result of widespread superphosphate application (phosphate rocks used in New Zealand superphosphate production have elevated cadmium content).

It is therefore concluded that the deposition of metals from the proposed discharge should not cause adverse effects.

7. MITIGATION

The applicant will ensure that regular maintenance is undertaken, to ensure that contaminant discharges are minimised and fuel efficiency maximised.

Monitoring is also proposed as outlined below in Section 8.

8. MONITORING

The following monitoring measures are proposed by the applicant:

- A record of all fuel volumes used in the kilns, for both diesel and re-refined oil, to be supplied to ECan once per year;
- An analysis of a sample from a typical re-refined oil delivery, for sulphur, total halogens, metals and arsenic, with reporting of the results (including a comparison to the relevant United States federal regulations) to ECan once per year;
- A record of all complaints received about the running of the units, including details of measures undertaken to minimise any effects, following a complaint being received. This complaints record would be made available to ECan staff upon reasonable request, and a copy of the complaints record would be forwarded to ECan once per year; and
- Implementation of a regular maintenance programme. Records of all maintenance undertaken would be retained and made available to ECan staff for viewing upon reasonable request.

9. SUMMARY

W D Boyes & Sons Limited is applying for the variation of an existing resource consents, to permit the discharge of contaminants into the air from the proposed fuelling of two existing brick production kilns on a combination of diesel and re-refined oil, at their brickworks site near Darfield.

The units are used to provide heat for the production of kiln-fired bricks for the building industry.

To permit the discharges from the two kilns when running on a mixture of diesel and re-refined oil, variation to the existing resource consent is required.

An assessment of the discharges into the air from the two units, when fuelled with diesel and re-refined oil, was undertaken using dispersion modelling techniques.

The results of the assessment showed that the predicted contaminant levels were below relevant guideline values, both singly and when considered in combination with background levels, in the general receiving environment around the applicant's site.

Given the modelled predictions for contaminants, the low level of contaminants anticipated in the receiving environment, the sensitivity of the receiving environment and the proposed operating scenario (batch kiln only operating intermittently), the effects of the discharge of contaminants from the kilns, when fuelled with a mixture of diesel and re-refined oil, are anticipated to be minor.

The modelled results show that, even with the addition of deposited metals from the proposed discharge using very conservative assumptions, the concentration of various heavy metals and metalloids in the surrounding soil will not exceed relevant guideline values for many years. Cadmium levels are likely to be elevated in Canterbury soils, as a result of widespread superphosphate application.

The expiry date for the variation is requested to be consistent with the existing expiry date for the current consent (30 August 2028).

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Percival H J , Webb T H and Speir T W (1996): *Assessment of background concentrations of selected determinands in Canterbury soils.* Manaaki Whenua - Landcare Research contract report LC9596/133 prepared for Canterbury Regional Council.

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United States Environmental Protection Agency (1996): *Compilation of Air Pollutant Emission Factors; Volume 1 – Stationary Point and Area Sources; Chapter 1.11 - Waste Oil Combustion.* Publication AP-42.

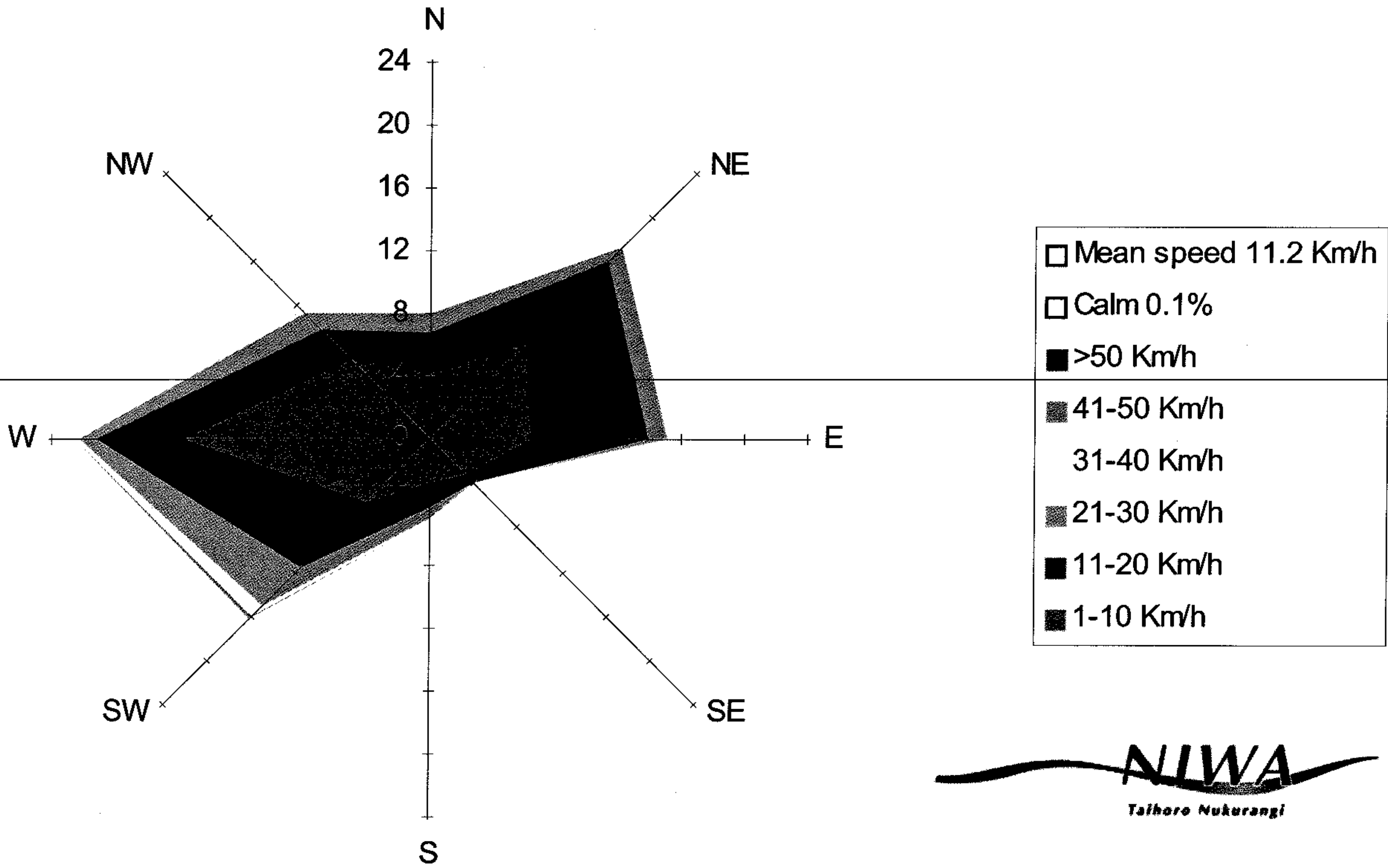
Resource Consent Details

Record No CRC921703
Consent Summary
Client Name W D Boyes & Sons Limited
To discharge contaminants to air associated with the manufacture of bricks and pipes, at or about map reference L35:398-440.
Location Horndon Street, Darfield
LegalDesc SEC 24 PT SEC 22 DARFIELD VILLAGE SETTLEMENT BLK VII HAWKINS SD
Status Current
Events
15 Sep 1993 Consent Commenced
15 Sep 1993 Consent Issued
15 Sep 1995 Lapse Date if consent not given effect to
30 Aug 2028 Consent Expires

Subject to the following conditions:

1 The coal and clay delivery, storage and conveyance procedures, and combustion processes shall be operated; and the operations and plant maintained by the consent holder either using dust and particulate control processed in place at the time of application for this consent, or using methods which produce at least an equivalent level of control.
2 The amount of coal burned shall not exceed 1250 tonnes per annum, with a maximum consumption rate of 150 kg/hr. The sulphur content of the coal shall be less than or equal to 1.8%.
3 The chimney height shall be greater than 10 metres above ground level.
4 There shall be no visible emissions from the coal fired kiln (visible smoke is defined as smoke with an opacity of greater then 10% except i) For a continuous period not exceeding 2 minutes in any one hour. ii) In the case of intermittent emissions, an aggregate period not exceeding 4 minutes in any one hour. iii) For the purpose of lighting up from cold, a period not exceeding thirty minutes.
5 The Canterbury Regional Council may annually, on or about the last working day of March each year, serve notice of its intention to review the conditions of this consent for the purposes of:i) Dealing with adverse effect on the environment which may arise from the exercise of the consent: or ii) requiring the adoption of the best practicable option to prevent or minimise any adverse effect on the environment: or iii) complying with the requirements of a regional plan for air quality management. iv) ensuring that condition (3) related to chimney height is adequate.
6 Charges, set in accordance with section 36(2) of the Resource Management Act 1991, shall be paid to the Regional Council for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under section 35 of the Act.

Station: H32364 - Rangiora EWS
Lat: 43° 20' S **Long:** 172° 37' E **Alt:** 12m AMSL
Data period: Feb 1999 to Nov 2003



279.11 Used oil specifications.

Used oil burned for energy recovery, and any fuel produced from used oil by processing, blending, or other treatment, is subject to regulation under this part unless it is shown not to exceed any of the allowable levels of the constituents and properties in the specification shown in Table 1. Once used oil that is to be burned for energy recovery has been shown not to exceed any specification and the person making that showing complies with §§279.72, 279.73, and 279.74(b), the used oil is no longer subject to this part.

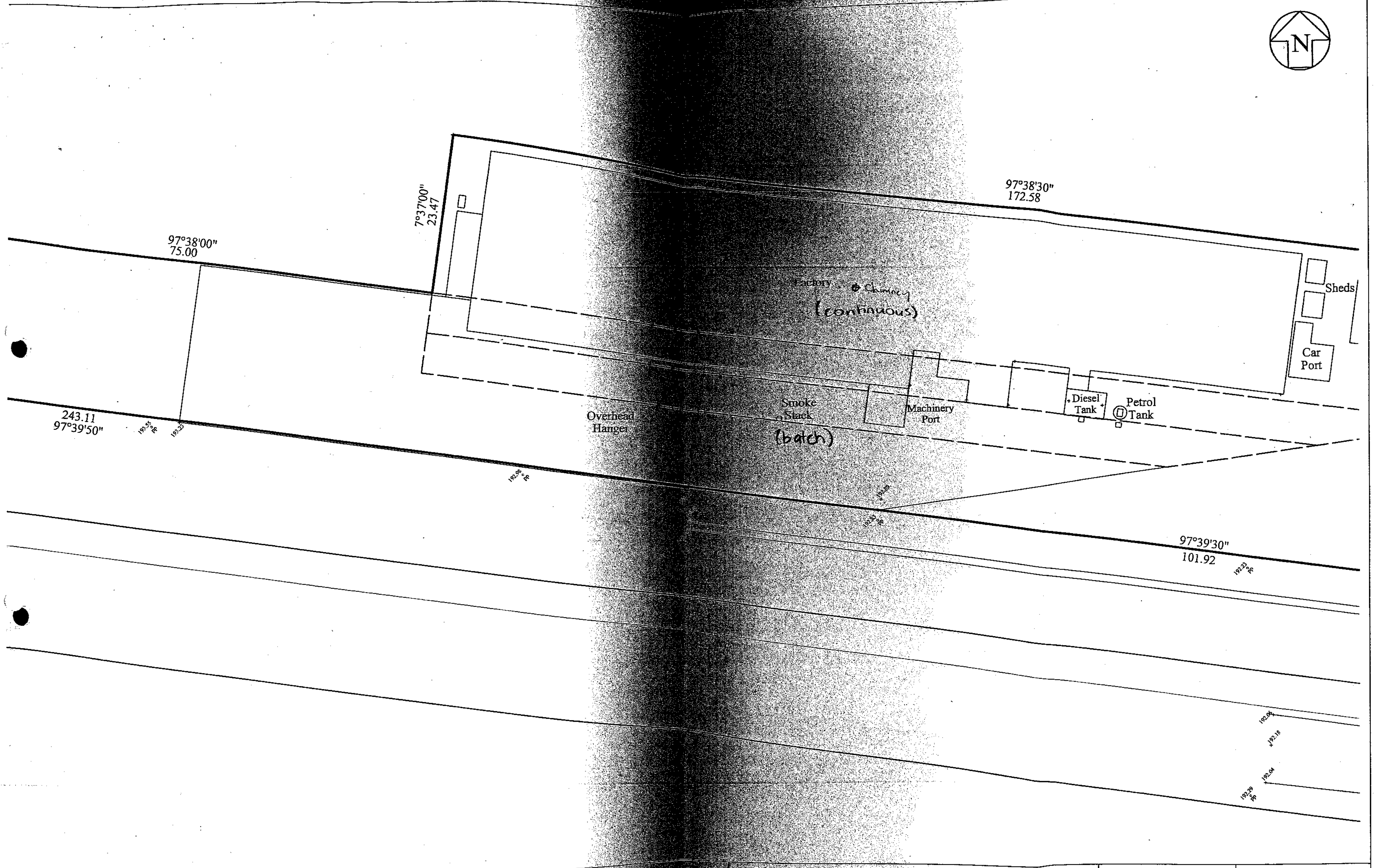
Table 1_Used Oil Not exceeding Any Specification Level Is Not Subject to This Part When Burned for Energy Recovery \1\

Constituent/property	Allowable level
Arsenic	5 ppm maximum.
Cadmium	2 ppm maximum.
Chromium	10 ppm maximum.
Lead	100 ppm maximum.
Flash point	100 °F minimum.
Total halogens	4,000 ppm maximum.\2\

Note: Applicable standards for the burning of used oil containing PCBs are imposed by 40 CFR 761.20(e).

\1\ The specification does not apply to mixtures of used oil and hazardous waste that continue to be regulated as hazardous waste (see § 279.10(b)).

\2\ Used oil containing more than 1,000 ppm total halogens is presumed to be a hazardous waste under the rebuttable presumption provided under § 279.10(b)(1). Such used oil is subject to subpart H of part 266 of this chapter rather than this part when burned for energy recovery unless the presumption of mixing can be successfully rebutted.



Rev	Date	By	Amendments
k	16/05/05	PTC	Preliminary

Site Survey
Horndon Street, Darfield
Canterbury Clay Bricks

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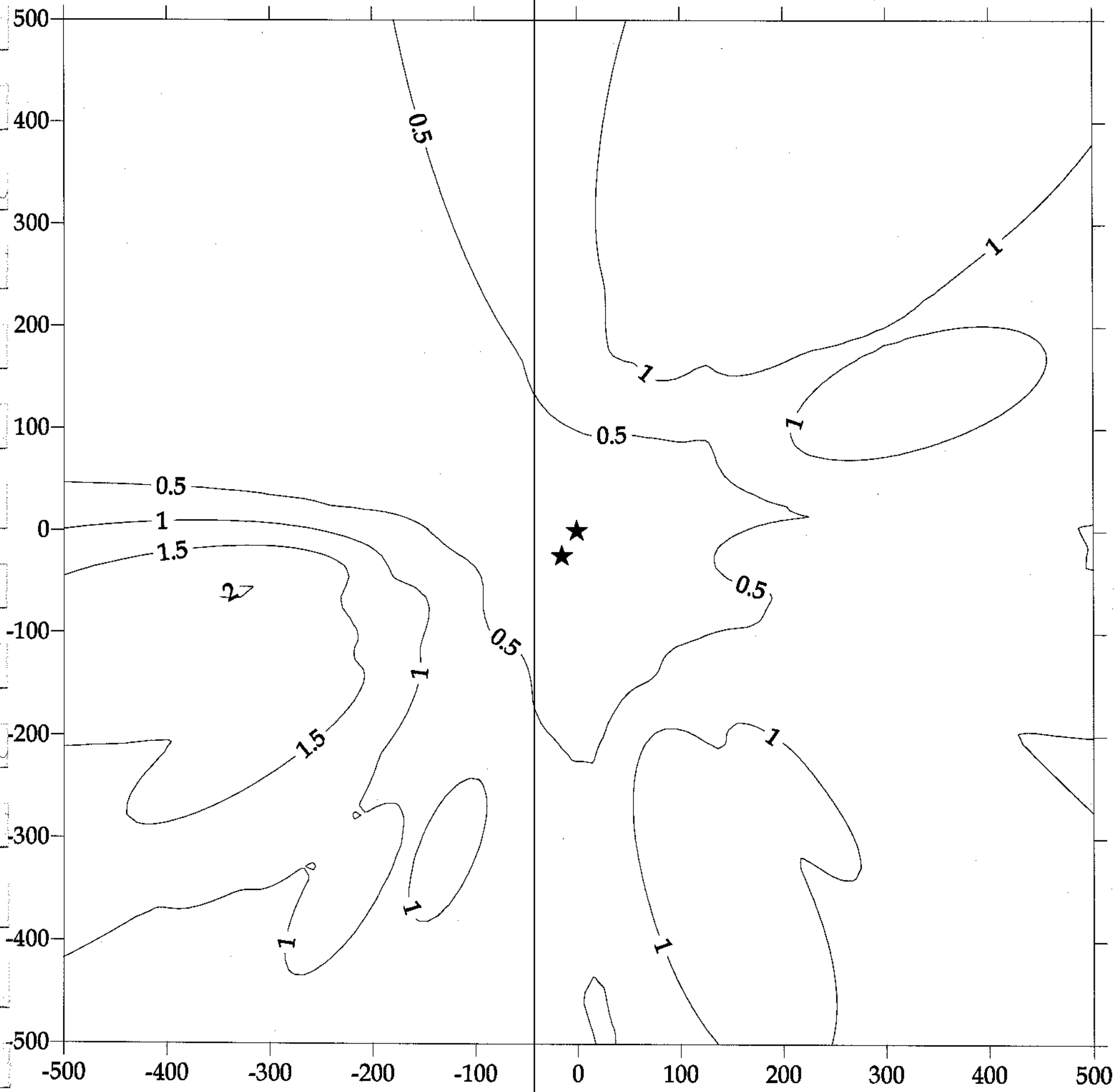
Scale	Job Ref	Date	Sheet	Revision
1:500	1898/30	May 2005	2 of 2	sk A3



Rerefined Scenario - Predicted Ground Level PM10 Concentrations

Units: micrograms/m^3

Key: ★ emission source