Definition of Activity Classes for Industrial Boilers

Part 2: Setting Limits

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Executive summary

Environment Southland is in the process of reviewing its air plan to incorporate measures to achieve the NES for PM_{10} and intends to update the plan for the whole region, including a review of the rules relating to industry. At present the air plan includes a permitted activity limit for external combustion of 5MW for all fuels other than refuse or trade wastes. A re-evaluation of the combustion activity classifications for permitted activities is required to manage localised impacts of discharges more effectively.

Atmospheric dispersion modelling was carried out during stage 1 of this project for a range of fuels, emission rates and chimney heights using selected model input parameters. A schedule of chimney heights was developed here from that modelling for diesel, liquid petroleum gas (LPG), coal, light fuel oil (LFO), heavy fuel oil (HFO), wood, pellets (custom) and pellet conversions for a range of emission rates indicative of different heat outputs. The chimney height schedule provides an indication of the heights required to disperse emissions to achieve ground level concentrations of 2.5 µg m^{-3} for PM_{10}, 70 µg m^{-3} for SO_2 and 40 µg m^{-3} for NO_2.

To determine the most appropriate heat output limits, chimney height was used to provide equitable limits for different fuels for permitted activity status. A height of 12 metres was selected after evaluating the chimney height criteria as well as existing air plan limits. The following heat output limits were recommended for permitted activities for external combustion in the Southland Region: 10MW for diesel and LPG, 40kW for LFO and HFO, 40kW for wood, 100kW for coal, 500kW for pellet conversions and 1.3 MW for custom built pellet boilers. A suite of permitted activity “conditions” for external combustion including chimney height specifications were also identified.

1 Introduction

Concentrations of PM_{10} exceed national environmental standards (NES) in Invercargill and Gore. Environment Southland is reviewing its air plan to incorporate measures to achieve the NES for PM_{10} in these towns and in the process, intends to update the plan for the whole region including a review of the rules relating to industry.

This review requires a re-evaluation of the combustion activity classifications for permitted or controlled activities to manage localised impacts of discharges more effectively. This requires an understanding of the expected maximum ground level concentrations (GLCs) of contaminants based on different heat outputs (impacting on emission rates) and chimney height and diameter (key variables impacting on dispersion).

Historically, a number of air plans have used an unnamed chimney height specification, derived overseas, as a condition for permitted or controlled activities to specify the required chimney height. The basis for the chimney height specification including assumptions (such as target GLCs) underpinning the heights are not specified in the plan and appear largely unknown. Many parameters have changed since this specification would have been developed and more importantly, the "acceptable" GLCs, as targets or standards for a number of contaminants have been revised downwards. Continued reliance on this specification may result in unacceptable ground level concentrations of contaminants.

This report provides the analysis of data obtained in stage one of the project which included assessment of ground level concentrations of contaminants from industrial boilers for different heat outputs and stack heights (Somervell & Wilton, 2012). The analysis includes determination of appropriate heat outputs levels and stack heights for permitted, controlled, restricted discretionary and discretionary activities. These can be found in section 5.

2 Summary of Stage I: Assessment of Effects

Stage one of this project involved atmospheric dispersion modelling of a range of emission rates to determine the chimney heights required to mitigate the impacts of discharges to air from external combustion sources. Effective mitigation was assessed against ground level concentrations of 2.5 µg m^{-3} (24-hour average) for PM_{10}, 70 µg m^{-3} (hourly average) for SO_2 and 40 µg m^{-3} (hourly average) for NO_2. The fuels included in the assessment were coal, wood, diesel and pellets for PM_{10}, light fuel oil (LFO) and heavy fuel oil (HFO) for SO_2 and LPG for NO_2. For coal PM_{10} was identified as the main contaminant for coal sulphur contents of less than 2%. Emission rates and fuel consumption were calculated based on Table 1.

Table 1: Summary data for fuel consumption and emission rate calculations.

Fuel	Efficiency	Calorific Value mg/kg	Emission factor g/kg
LPG *	80%	45.65	3.07
LFO	78%	41.2	40
HFO	78%	40.5	60
Diesel	78%	42.86	0.28
Wood	72%	15.8	1.6
Pellets	75%	19.2	0.8
Coal	72%	28.03	2

The emission rate for PM_{10} was assumed to be constant over the 24-hour period. This is likely to result in an overestimate of PM_{10} concentrations and therefore increases the conservatism around the PM_{10} ground level concentration estimates.
The model used was Ausplume version 5.4. Model input parameters used were:

- Meteorological data from the Invercargill Airport for 2004 and 2007
- Chimney diameters of 20 cm (heat outputs < 1MW), 30 cm (1-5 MW) and 40 cm (>5MW)
- Exit velocities based on Winflue calculations (Brady, 2004)
- An exit temperature of 200 degrees C
- One building of 30m width and 5m high.

Results were reported for the second highest modelled concentration for a range of emission rates and chimney heights and are shown in Tables 2 to 8.

Table 2: Maximum modelled 24 hr PM_{10} GLC (µg m^{-3}) for diesel emissions (Limit = 2.5 µg m^{-3})

DIESEL	6 m	7 m	8 m	9 m	10 m	11 m	12 m
40 kW							
100 kW	1.0						
500 kW	2.5	1.5					
1MW	3.6	1.9	1.3				
3 MW		3.4	2.3	1.6			
4 MW		3.4	2.3	1.8			
5 MW		3.6	2.4	1.98			
10 MW			3.2	**2.6**	2.0		

Table 3: Maximum modelled 24 hr PM_{10} GLC (µg m^{-3}) for wood emissions (Limit = 2.5 µg m^{-3})

WOOD	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m	16 m	17 m	18 m
40kW	3.3	2.3	1.9	1.5							
100 kW			3.9	3.1	2.5						
200 kW						2.9	2.6				
300 kW							3.2	2.8	2.6		
500 kW									3.2	2.9	2.7

Table 4: Maximum modelled 24 hr PM_{10} GLC (µg m^{-3}) for pellet emissions (Limit = 2.5 µg m^{-3})

PELLET	6 m	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m	16 m
40 kW	3.7	1.9	1.3								
100 kW		3.5	2.5								
500 kW					3.4	2.8	2.3				
700 kW							3.1	2.2			
>1MW								3.0	2.7	2.4	

Table 5: Maximum modelled 24 hr PM_{10} GLC (µg m^{-3}) for coal emissions (Limit = 2.5 µg m^{-3})

COAL	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m	16 m	17 m	18 m	19 m	20 m
40 kW	3.5	2.3	1.6											
100 kW			3.7	2.9	2.4									
200 kW					3.5	2.9	2.3							
300 kW							2.8	2.5						
500 kW								3.1	2.8	2.5				

Table 6: 2nd highest modelled hourly SO_2 GLC (µg m^{-3}) for LFO emissions (Limit = 70 µg m^{-3})

LFO	7 m	8 m	9 m	10 m	11 m	12 m	13 m	14 m	15 m	16 m	17 m	18 m	19 m
40 kW	138	111	87.2	68.0	56.7								
100 kW					133	110	51.3						
200 kW						177	74.4	67.4					
500 kW								89.0	82.7	76.8	72.2	68.2	64.3

Table 7: 2nd highest modelled hourly SO_2 GLC (µg m^{-3}) for HFO emissions (Limit = 70 µg m^{-3})

HFO	11 m	12 m	13 m	14 m	15 m	16 m	17 m	18 m	19 m	20 m
40 kW	82.0	67.3								
100 kW			74.4	65.3	59.1					
200 kW							73.5	67.7		
500 kW								101	94.8	89.2

Table 8: 2nd highest modelled hourly NO_2 GLC (µg m^{-3}) for LPG emissions (Limit = 40 µg m^{-3})

LPG	6 m	7 m	8 m	9 m	10 m	11 m	12 m
100 kW	26.4	21.0					
500 kW	52.1	39.6	31.3				
1 MW			45.7	35.3			
2 MW					52.2	38.9	30.5
3 MW						46.8	35.6
4 MW					50.7	36.6	
5 MW					50.0	30.1	
7.5 MW					68.0	39.8	27.1
10 MW						41.5	23.2

3 Schedule of Chimney Heights

Tables 9 and 10 show the schedule of chimney heights derived using the GLC outputs detailed in Tables 2 to 8. The chimney heights were selected based on the modelled maximum GLCs being less than 2.5 µg m^{-3} for PM_{10}, 70 µg m^{-3} for SO_2 and 40 µg m^{-3} for NO_2. In the case of PM_{10} a number of GLCs came out at 2.5 µg m^{-3}. In these cases an additional half a metre was added to the chimney height in the schedule.

The tables have been derived for boilers less than 10 MW for diesel and LPG, 500 kW for wood, coal, LFO and HFO, 1MW for pellets (conversions) and 1.3 MW for custom built pellet boilers. The following list indicates how these tables can be used to determine an appropriate chimney height that will disperse contaminants from boilers so that "acceptable" GLCs are obtained. Note these apply only to external combustion for the fuels specified.

1. Estimate the emission rate in grams per hour (g/hr) of the appropriate contaminant.
2. Select the appropriate chimney height schedule for the fuel being used.
3. Find the corresponding emission rate on the table (left hand column) if the exact emission rate was modelled or if not, go to the next highest emission rate.
4. Trace across to the chimney height column that matches the emission rate.
5. This is the chimney height that should be adequate to disperse contaminants from the boiler for similar combustion conditions to those modelled.

Because of the potential for variability from the conditions modelled (e.g., different chimney diameters) a limit needs to be established above which site specific modelling of discharges is required. Chapter four of this report considers the impact of variability in input parameters and identifies a level below which variability in input parameters is unlikely to significantly influence chimney heights.

Note: It was beyond the resources available to model all potential emission rates and chimney height combinations. In most instances chimney heights indicated in Tables 9 and 10 are based on the actual modelling conducted. However in a few instance extrapolations have been made between modelling done for different emission rates, which is appropriate because of the linear nature of the model with respect to emission values. These values are highlighted in the tables in blue/grey.

Table 9: Chimney height schedules for diesel, coal, wood and pellet boilers.

DIESEL			COAL			PELLET (conversions)		
PM_{10} Emission Rate g hr-1	Indicative Heat output	Chimney Height Metres	PM_{10} Emission Rate g hr-1	Indicative Heat output	Chimney Height Metres	PM_{10} Emission Rate g hr-1	Indicative Heat output	Chimney Height Metres
1	40 kW	6.0	14	40 kW	8.0	8	40kW	7.0
3	100 kW	7.0	36	100 kW	10.5	20	100 kW	8.5
6	200 KW	7.0	72	200 kW	13.0	40	200 kW	10.5
9	300 kW	7.0	107	300 kW	14.5	60	300 kW	11.5
12	400 kW	7.0	178	500 kW	16.5	80	400 kW	12.0
15	500 kW	7.0	357	1MW	20.0	100	500 kW	12.0
30	1MW	8.0				152	700 kW	13.0
45	2MW	8.0				253	1MW	15.0
90	3 MW	8.0	Wood			PELLET (custom)		
121	4 MW	8.0	PM_{10} Emission Rate g hr-1	Indicative Heat output	Chimney Height Metres	PM_{10} Emission Rate g hr-1	Indicative Heat output	Chimney Height Metres
151	5 MW	8.0	20	40kW	9.0	8	100 kW	7.0
181	6 MW	9.5	51	100 kW	12.5	15	200 kW	8.5
211	7 MW	9.5	100	200 kW	15.0	23	300 kW	8.5
241	8 MW	10.0	152	300 kW	17.0	30	400 kW	10.5
271	9 MW	10.0	203	400 kW	>18	38	500 kW	10.5
302	10 MW	10.0	253	500 kW	>18	63	700 kW	11.5
						75	1 MW	12.0
						98	1.3 MW	12.0

Table 10: Chimney height schedules for LFO, HFO and LPG.

LFO			LPG		
SO_2 Emission Rate	Indicative Heat output	Chimney Height	NO_2 Emission Rate	Indicative Heat output	Chimney Height
g hr-1		Metres	g hr-1		Metres
179	40 kW	10.0	30	100KW	6.0
448	100 kW	13.0	75	250 kW	6.5
896	200 kW	14.0	151	500 KW	7.0
2240	500 kW	18.0	225	750 kW	8.0
	HFO		302	1MW	9.0
SO_2 Emission Rate	Indicative Heat output	Chimney Height	605	2MW	11.0
			907	3MW	12.0
			1209	4MW	11.0
g hr-1		Metres	1512	5MW	11.0
259	40 kW	12.0	2116	7.5MW	11.0
649	100 kW	14.0	3023	10MW	12.0
1297	200 kW	18.0			
3243	500 kW	0.0			

4 Establishing Limits

Based on the table produced in the stage one assessment, it might be argued that discharges could be permitted for very high heat output levels provided chimney height specifications are met. This approach is not recommended, however, because the modelling contains significant assumptions about input parameters which will not always be consistent with actual site details. The impact of these parameters may increase with heat output. The following process was used to determine limits for permitted, controlled, discretionary and prohibited activity classes for external combustion sources:

- Evaluate modelled ground level concentrations for different stack heights – the outputs from stage one.
- Consider model uncertainties and potential variations.
- Evaluate limits set by other Councils and any underlying technical basis.
- Identify an appropriate approach to determining the limit classifications that is, if possible, equitable across different fuels.
- Identify appropriate conditions for different activity statuses.

4.1 Modelling Results

The modelling results indicate that a chimney height of 10 metres should be sufficient to adequately disperse emissions from a reasonable sized diesel boiler (10MW). For LPG the chimney is required to be slightly higher (12 metres). For the more polluting fuels (wood, coal, LFO and HFO) chimney heights in excess of 12 metres are required to disperse emissions at significantly lower heat outputs (e.g., 200 kW or less). These fuels typically require a chimney height increase of at least one metre per 100 kW increase in heat output. Greater care is required when setting limits for these fuels as a small increase in heat output can have a big impact on maximum GLCs.

4.2 Modelling Uncertainties

Model uncertainties arise because of the need to select generic model input parameters. The input parameters used have been conservatively selected so that they err on the side of producing higher GLCs. An example of this is the assumption that all sites will have some building downwash impact. Other factors with reasonable influence on GLCs include chimney diameter and exit temperature and velocity. Table 11 shows the impact of changing some of these assumptions on maximum GLCs for a 100kW and 300kW coal fired boiler.

Table 11: Sensitivity of modelling to input parameters.

Efflux Velocity Calculations	100 kW	100 kW	100 kW	100 kW	100 kW	100 kW
Fuel use(kg/hr)	18	18	18	18	18	18
Exhaust gas flow (m^3/hr)	316.044	316.044	316.044	382.84	382.84	382.84
Exhaust gas flow (m^3/s)	*0.09*	*0.09*	*0.09*	*0.11*	*0.11*	*0.11*
Exhaust diameter (m)	**0.2**	**0.3**	**0.4**	**0.2**	**0.3**	**0.4**
Exhaust area (m^2)	*0.03*	*0.07*	*0.13*	*0.03*	*0.07*	*0.13*
Efflux Velocity (m/s)	*2.79*	*1.24*	*0.70*	*3.39*	*1.50*	*0.85*
0.66 of efflux Velocity (m/s)	*1.84*	*0.82*	*0.46*	*2.23*	*0.99*	*0.56*
Temperature (^oC)	**200**	**200**	**200**	**300**	**300**	**300**
Emission rate (g/hr)	36	36	36	36	36	36
Maximum GLC with 12m chimney	**1.87**	**1.89**	**1.92**	**1.69**	**1.72**	**1.73**

	300 kW	300 kW	300 kW	300 kW	300 kW	300 kW
Fuel use(kg/hr)	54	54	54	54	54	54
Exhaust gas flow (m^3/hr)	948.133	948.133	948.133	1148.52	1148.52	1148.52
Exhaust gas flow (m^3/s)	*0.26*	*0.26*	*0.26*	*0.32*	*0.32*	*0.32*
Exhaust diameter (m)	**0.2**	**0.3**	**0.4**	**0.2**	**0.3**	**0.4**
Exhaust area (m^2)	*0.03*	*0.07*	*0.13*	*0.03*	*0.07*	*0.13*
Efflux Velocity (m/s)	*8.38*	*3.73*	*2.10*	*10.16*	*4.51*	*2.54*
0.66 of efflux Velocity (m/s)	*5.53*	*2.46*	*1.38*	*6.70*	*2.98*	*1.68*
Temperature (^oC)	**200**	**200**	**200**	**300**	**300**	**300**
Emission rate (g/hr)	107	107	107	107	107	107
Maximum GLC with 12m chimney	**3.49**	**3.80**	**3.90**	**2.89**	**3.08**	**3.12**

4.3 Existing Air Plans

The existing limit for external combustion in the Southland Region is 5MW for all fuels other than refuse or trade wastes. A single heat output limit across all fuels is not effects based as it does not take into account the different impacts associated with different fuel types. Table 12 shows the cut off limits for external combustion of fuel from selected Councils throughout New Zealand. Existing limits, particularly those from more modern air plans and areas where the NES is breached (e.g., Nelson, Christchurch, and Hawkes Bay) are important to consider as they typically reflect current expert judgement on the magnitudes of impact for different activities.

Table 12: Summary of regulated levels for external combustion from selected Councils.

FUEL	Permitted	Controlled	Restricted/Discretionary	Discretionary	Prohibited
Environment Canterbury – Christchurch Clean Air Zones 1 & 2					
Diesel	100kW	2MW			
LPG & natural gas	5MW	20MW			
Kerosene	100kW	2MW			
Solid fuel - existing			1MW		
Pellet – new or replacing non solid fuel			500kW		
Pellet – conversion, replacement of existing solid fuel	40kW	500kW	1MW		
All fuels					Large scale fuel burning devices with total suspended particulate (TSP) emissions greater than 250 mg/m^3
Nelson City Council					
Diesel	5MW				
LFO		200kW			
HFO		100kW			
Coal & Wood			200kW		
LPG	4MW				
Kerosene	2MW				
Pellet	220Kw (custom only)	All heat outputs and custom or conversions.			

FUEL	Permitted	Controlled	Restricted/Discretionary	Discretionary	Prohibited
Tasman District Council – Richmond Airshed					
Diesel, LPG, LFO, natural gas, wood pellets	2MW (existing activities at 13 Jan 2007) 1MW (new activities)				
Wellington Regional Council					
All fuels	2MW	2MW – 5MW			
Environment Waikato					
Diesel, oil, kerosene	5MW for TSP <250mg/m3				
Coal	5MW for TSP <250mg/m3	50MW - existing			
Wood	5MW – existing and TSP <250mg/m3 2MW – new and TSP <250mg/m3		5MW – existing and TSP >250mg/m3 2MW – new and TSP >250mg/m3		
LPG & natural gas	10MW	50MW			
Auckland Regional Council					
Diesel, LFO, HFO	10MW				
LPG & natural gas	22MW				
Coal	5MW (S content <0.5% & bagfilter or similar emissions control)		20 MW (S content <0.5% & bagfilter or similar emissions control)		
Wood	5MW (bagfilter or similar emissions control)		20 MW (bagfilter or similar emissions control)		
Any other fuel			5MW		
Otago Regional Council – Air Zones 1 & 2					
Oil	5MW (S content <1%)				
Other fuels	1MW				
Hawkes Bay Regional Council					
Coal, wood, LFO, HFO	100 kW				
LPG and natural gas	5MW	50MW			
Diesel	2MW	between 2MW and 5MW			
Kerosene	2MW				

FUEL	Permitted	Controlled	Restricted/Discretionary	Discretionary	Prohibited
Pellets - conversions	200 kW	500 MW			
Pellets - custom	200 kW	1.2 MW			

4.4 Proposed approach

The approach used to determine the cut off limits for permitted and controlled activities in existing plans have typically relied on expert judgement. In most cases inter-fuel equity (i.e., allowing higher heat outputs for lesser polluting fuels) has been integrated into the cut off limits. In the absence of extensive modelling however, quantification of these differences has at best been based on differences in emission rates. Modelling carried out during stage one of this project allows for a more comprehensive assessment (e.g., including different fuel flow characteristics and differences in average efficiencies between fuels). This information allows the approach of selecting a cut off limit based on a single chimney height across all fuels. Chimney height is the logical criteria because a single chimney height represents the approximately the same magnitude of impacts across all fuels. For example, using the modelling outputs from section two, a 9 metre high chimney is sufficient to disperse emissions from a 5MW diesel boiler, a 40kW wood boiler, a 40kW coal boiler and a 1MW LPG boiler to the extent that the threshold GLCs for each are not exceeded.

Comparison of the model results with the more modern air plans limits in areas where the NES is breached (e.g., Christchurch, Nelson and the Hawkes Bay) show that for most fuels limits for permitted or controlled activities have been selected near to the point at which a 12 metre high chimney would disperse contaminants. The main exception is diesel fuel which has historically been considered based on a higher sulphur content. There are some discrepancies that occur as a result of inconsistencies between fuels within these plans, and differences between the plans, but when considered collectively selecting a chimney height of 12 metres provides the greatest consistency with existing limits whilst providing equity between fuels.

A heat output limit for different fuels based on a chimney height of 12 metres would give the following limits: diesel and LPG up to10MW, LFO & HFO up to 40 kW, wood and coal up to 100 kW, pellet conversions up to 500kW and custom built pellets up to 1.3 MW for permitted or controlled activity classes. Above these heat output limits activities could be classified as restricted discretionary or discretionary.

If applying this criterion is indicating that the impact of the activity is such that it requires a chimney of more than 12 metres to disperse impacts then it is sufficient to warrant site specific investigation.

4.5 Use of the Chimney Height Schedule

The chimney height schedule for coal is only applicable for sulphur contents of 2% or less. With a higher sulphur content, SO_2 becomes the main contaminant (for the selected threshold GLCs) and site specific modelling of both SO_2 and PM_{10} should be carried out. Emission rates for coal are based on an average emission rate for an underfeed stoker. This is the most common small scale coal fired boiler in New Zealand and has an average emission rate of around 2 kg/tonne for PM_{10} (Wilton & Baynes, 2010). There is potential for significant variation in PM_{10} emission rates if other coal fired boiler types are used. It is

recommended that boiler specific emission rates are calculated for each fuel (rather than using the indicative heat output indicated on the tables). This is particularly important for coal fired boilers because of the greater propensity for variation in emission rates with boiler types and emissions control equipment.

Neighbouring buildings, or the building to which the chimney is attached, can result in building downwash whereby the plume from the chimney is brought to ground level sooner than would otherwise occur, resulting in higher ground level concentrations of contaminants. The modelling integrates some building downwash by the inclusion of a building of 30m width and 5m high. Generally it has been accepted that if the criteria in the Good Engineering Practice is met (i.e. chimney height 2.5 times higher than any nearby building) then building downwash is unlikely to occur (US EPA, 1985). However, further examination of this document indicates that the rule relates primarily to chimneys around 65m high and that for small scale boilers "application of the 2.5 times rule may yield answers which have little or no meaning." The absence of any general condition to account for building downwash for small scale industry means that a height limit of 5 metres is a necessary condition on the chimney height schedule. This may be overly restrictive and further work examining the impact of building downwash is recommended.

4.5.1 Process

The purpose of the chimney height schedule is to identify a chimney height for boilers meeting permitted or controlled activity status. The following process is recommended for using the chimney height schedule:

1. Check that the heat output of the boilers is consistent with the permitted or controlled activity status as defined in the Council's Air Plan.
2. Estimate the emission rate in grams per hour (g/hr) of the appropriate contaminant (see section two for contaminants).
3. Select the appropriate chimney height schedule for the fuel being used.
4. Find the corresponding emission rate on the table (left hand column) if the exact emission rate was modelled or if not go to the next highest emission rate.
5. Trace across to the chimney height column that matches the emission rate.
6. This is the chimney height that should be adequate to disperse contaminants from the boiler for similar combustion conditions to those modelled.
7. Check that the conditions specified in Chapter 4 of this report are met, including the surrounding building height and distance criteria.
8. If so, the activity may be permitted at the specified chimney height.

4.6 Conditions for Permitted Activities

1. These limits apply to the total heat output from a site. Where more than one fuel type is used on the site, the combined heat output shall not exceed the lowest MW threshold of any of the fuel types used.
2. The fuel shall be burned using fuel burning equipment, and the discharge shall be from a chimney or exhaust structure designed so that the emission is effectively dispersed upwards.
3. The opacity of the discharge when measured at the point of entry to the atmosphere shall not exceed 20%, except that a discharge in excess of this shall be allowed for a period of not more than 2 minutes continuously or for an aggregate of 4 minutes in any 60 minute period.
4. The fuel burning equipment is maintained in accordance with the manufacturer's specifications at least once every year by a person competent in the maintenance of that equipment.
5. For external combustion sources the chimney height shall comply with the requirements in the chimney height schedule.
6. No buildings within a 25 metre radius of the discharge are higher than 5 metres.
7. The terrain on which the discharge is located and the surrounding terrain is flat.
8. The sulphur content of any coal burnt shall be less than 2%.
9. For custom built pellet fired boilers the emission rate for PM_{10} for the boiler type must be 0.3 g/kg or less.
10. Discharges to air do not adversely affect visibility on any road or in any aircraft flight path.
11. There is no objectionable odour at or beyond the property boundary.
12. There is no objectionable deposition of particulate matter onto any land or structure at or beyond the property boundary.

5 Recommended limits

The recommended limits for external combustion from industrial boilers are detailed in Table 13. The biggest discrepancy relative to most existing air plan limits is allowing diesel boilers up to 10 MW as permitted activities, although the Auckland air plan does include this limit for diesel boilers. The reduction in the sulphur content of diesel is the reason for the bigger discrepancy with this fuel.

No evaluation has been done for natural gas for Southland because this fuel is not currently available in the Region. However, LPG and natural gas (CNG) have been classified together in all existing plans because emissions and dispersion characteristics are similar between these fuels. It is recommended that the LPG limits also apply to CNG to enable use of this fuel in the Region should it become available in the future.

Kerosene has not been included in the modelling and is not similar enough to any one modelled fuel to be able to be classified accordingly. Kerosene does not appear to be a commonly used fuel in Southland and was therefore not included in this evaluation. Based on other air plans and a technical evaluation by Bluett (2004), an appropriate limit for a permitted activity for this fuel would be around 2MW.

Recommended limits only apply to the fuels specified, although it is recommended that in addition permitted activity limits of 10MW be applied to CNG and 2MW to kerosene. These are not included in Table 13 because assessment of impacts from those fuels was beyond the scope of this work. Any other fuels are recommended as discretionary activities unless listed as prohibited fuels in the air plan

Table 13: Recommended activity classifications for external combustion of fuels.

	Diesel	LPG	LFO	HFO	Wood	Coal	Pellet - conversion	Pellet - custom
Permitted	10MW	10MW	40 kW	40kW	40kW	100kW	500kW	1.3 MW
Controlled								
Discretionary	>10MW	>10MW	>40 kW	>40 kW	>40W	>100kW	>500kW	>1.3 MW
Prohibited	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

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