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Consulting Engineers Limited

SUEZ RECYCLING AND RECOVERY UK LIMITED

BINNEGAR QUARRY

AIR QUALITY CONSTRAINTS

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TABLE OF CONTENTS

1 Introduction

1.1 Background

The proposed Site is within the former Binnegar Quarry, near Wareham. The site is set into the side of a valley with the base of the quarry 26 m below the level of the public road to the north. The area is rural with the closest residential properties an isolated farm house 500 m to the south east and 750 m to the east. A review of the local area has also identified a number of ecological sites of European importance, the closest of which is located immediately to the south-west of the Site. These receptors are identified on Figure 1. When developing a facility in this area the effect of terrain will need to be considered. Figure 2 shows the terrain file compiled from freely available OS50 data. The extent in the z direction is exaggerated for effect. As shown the terrain data captures the elevated ridge to the south, the valley in which the site is located, and the elevated land towards the north. In addition, it appears that the disused quarry is captured.

A review has shown that there is little local monitoring, as expected due to the rural nature of the area. In this instance it is appropriate to use the DEFRA mapped background dataset. This shows that background concentrations are relatively low, as would be expected in such a rural area.

The APIS database shows that the surrounding ecological sites include bog habitats which are extremely sensitive to nitrogen and acid deposition. Although the mapped background shows that concentrations are relatively low, the very stringent Critical Load is currently exceeded.

2 Assessment criteria

A waste gasification plant will require both planning permission and an Environmental Permit (EP) to operate. The following section detailed the assessment criteria which will need to be applied for both applications.

2.1 Environmental Permit

When determining the EP application, the Environment Agency an impact can be screened out as 'insignificant' if:

- The long term process contribution is <1% of the long term environmental standard; and
- The short term process contribution is <10% of the short term environmental standard.

The environmental standard refers to the Air Quality Assessment Level (AQAL), Critical Level or Critical Load.

The long-term 1% process contribution threshold is based on the judgement that:

- it is unlikely that an emission at this level will make a significant contribution to air quality; and
- the threshold provides a substantial safety margin to protect health and the environment.

The short-term 10% process contribution threshold is based on the judgement that:

- spatial and temporal conditions mean that short-term process contributions are transient and limited in comparison with long-term process contributions; and
- the threshold provides a substantial safety margin to protect health and the environment.

2.2 Planning

The Institute of Air Quality Management (IAQM) released a guidance document in 2015 which details a recommended approach to assessing the impact of a development on air quality. This has been developed for professionals operating within the planning system. It provides them with a means of reaching sound decisions, having regard to the air quality implications of development proposals. This is not intended to replace the guidance that exists for industrial developments which require a permit but the guidance notes that the Environment Agency guidance has not been developed for conducting an assessment to accompany a planning application. Therefore, when applying for planning permission the IAQM guidance should be applied. The IAQM guidance provides a matrix to described the magnitude of an impact which the assessor should then use as a basis when determining the significance of the effect. The magnitude of change can be described as 'negligible' if:

- the overall concentration (the process plus baseline known as the PEC) is less than 75% of the AQAL and the process contribution is less than 5% of the AQAL; or
- the PEC is less than 94% of the AQAL and the process contribution is less than 1% of the AQAL.

For short term process contributions, the impact can be described as 'negligible' if the process contribution is <10% of the AQAL.

Both the EA and IAQM guidance has been considered as part of this analysis.

3 Discussion

We have undertaken dispersion modelling to determine the impact of a typical waste gasification plant on the local environment. For the purpose of this analysis, as requested, we have modelled two different sized facilities:

(1) An approximately 49ktpa facility – equivalent to Charlton Lane – based on a MCR feed rate of 5.59 tph and a fuel with an NCV of 10.3 MJ/kg – all emissions data extracted from the EP application for Charlton Lane; and

(2) An approximately 93ktpa facility – based on a feed rate of 10.7 tph and a fuel with an NCV of 15.5 MJ/kg – all emissions data extracted from the EP application for the Hoddeston facility.

All model inputs can be found in Appendix A. It is possible to scale up the emissions from a smaller to larger scale plant if the fuel specification is the same. However, as discussed it is likely that the NCV of the fuel would be much higher than expected at the Charlton Lane and as such we have analysed a larger plant with a higher NCV and the emissions data for this plant has been extracted from the relevant EP application.

For the purpose of this analysis we have focussed on emissions of oxides of nitrogen, sulphur dioxide and particulate matter. It is noted that other pollutants will be regulated but from experience it is normally these pollutants which drive the stack height and are the main constraint for a development of this nature.

The dispersion model uses the terrain file to generate a modified flow field, which takes into account the changes to the airflow patterns expected when air flows over / around a hill, rather over flat terrain. The emissions from the stack are then emitted into this modified flow field. For any application on this Site the second effect which needs to be captured in any model is the difference in ground level between the plant and the local area. The site is located within a quarry with a ground level approximately 26 m below the local road. It appears that the terrain file captures this. From the plans provided and a review of aerial imagery it does not appear that the Site is located within a steep sided quarry. If this was the case the building height and stack height would need to be modified to account for differences this is explained graphically in Figure 3. From this analysis it is considered that the models terrain module is suitable and the stack height / building height does not need to be artificially changed to reflect the real world. However, this would need to be clarified as part of any detailed assessment.

When determining a suitable stack height, it is best practice to identify the stack height where the rate of reduction in maximum ground level concentration with increased height slows down. This can be identified on a graph as a step change in the slope. As part of this analysis we have also taken into consideration the guidance outlined in Section 2 which will need to be applied as part of the planning and permit applications. All heights specified are taken from the base of the stack based on a flat development platform with a 20 m high building.

3.1 49ktpa facility – fuel mix NCV 10.3MJ/kg - Charlton Lane

The graphs in Appendix B show the ground level concentration at the point of maximum impact as a percentage of the relevant AQAL for the range of stack heights. This analysis shows that for annual mean concentrations there is a change in the angle of the slope at 35 m and again at 65 m; beyond 65 m, the decrease in impact with increased stack height is significantly reduced. For short term impacts the graphs clearly show a step change at 55 m for 15-minute sulphur dioxide, and a less pronounced change at 55 m for 1-hour nitrogen dioxide. From this analysis we would recommend that the minimum stack height is 55 m. However, increasing the stack to 65 m would still have some benefit and may be required to ensure a successful outcome of the planning and EP applications.

Applying the EA's criteria for impacts to be screened out as insignificant:

- All short term impacts – for all stack heights above ~45 m
- Annual mean PMs – for all stack heights above ~30 m
- Annual mean NO2 – for all stack heights above ~65 m
- Annual mean NO2 – if SCR used – for all stack heights above ~55 m

Applying the IAQM criteria for impacts to be described as negligible irrespective of baseline concentrations:

- All short term impacts – for all stack heights above ~45 m
- Annual mean PMs – for all stack heights above ~40 m
- Annual mean NO2 – not possible unless stack height is well in excess of 80 m
- Annual mean NO2 – if SCR used – for all stack heights above ~65 m

Applying the IAQM criteria for impacts to be described as negligible taking into account the existing baseline concentrations:

- All short term impacts – for all stack heights above ~45 m
- Annual mean PMs – for all stack heights
- Annual mean NO2 – for all stack heights above ~35 m
- Annual mean NO2 – if SCR used – for all stack heights above ~30 m

If a 55 m stack height is used the all impacts will be able to be screened out as insignificant, with the exception of annual mean nitrogen dioxide impacts. Annual mean nitrogen dioxide impacts would be approximately 2% of the AQAL. When applying for planning permission all impacts would be able to be described as negligible irrespective of the baseline concentrations with the exception of annual mean nitrogen dioxide impacts. However, as the baseline concentrations are relatively low the magnitude of change would be described as negligible.

This analysis is based on the minimum stack height. Increasing the stack from 60 m to 65 m would decrease concentrations by ~37% whereas increasing from 65 m to 70 m concentrations would decrease by a further ~14%. Therefore, a stack height of 65 m could be argued to be the most appropriate stack height. At this height the impact would be approximately 0.9% of the AQAL for nitrogen dioxide and can be screened out as insignificant.

3.2 93ktpa facility – fuel mix NCV 15.5MJ/kg

The graphs in Appendix C show the ground level concentration at the point of maximum impact as a percentage of the relevant AQAL for the range of stack heights. This analysis shows that for annual mean concentrations there is a change in the angle of the slope at 30 m and again at 65 m; beyond 65 m the decrease in impact with increased stack height is significantly reduced. For short term impacts the graphs clearly show a step change at 55 m for 15-minute sulphur dioxide, and a less pronounced change at 55 m for 1-hour nitrogen dioxide. This is the same conclusion reached for the smaller facility. From this analysis we would recommend that the minimum stack height is 55 m. However, increasing the stack to 65 m would still have some benefit and may be required to ensure a successful outcome of the planning and EP applications. This conclusion is driven by the mass of the building and therefore the same conclusion has been reached for both plant capacities analysed, although the overall impact is greater with the larger capacity plant.

Applying the EAs criteria for impacts to be screened out as insignificant:

- All short term impacts – for all stack heights above ~55 m
- Annual mean PMs – for all stack heights above ~42 m

- Annual mean NO2 – not possible unless stack height is well in excess of 80 m
- Annual mean NO2 – if SCR used – for all stack heights above ~65 m

Applying the IAQM criteria for impacts to be described as negligible irrespective of baseline concentrations:

- All short term impacts – for all stack heights above ~55 m
- Annual mean PMs – for all stack heights above ~55 m
- Annual mean NO2 – not possible unless stack height is well in excess of 80 m
- Annual mean NO2 – if SCR used – not possible unless stack height is well in excess of 80 m

Applying the IAQM criteria for impacts to be described as negligible taking into account the existing baseline concentrations:

- All short term impacts – for all stack heights above ~55 m
- Annual mean PMs – for all stack heights
- Annual mean NO2 – for all stack heights above ~52 m
- Annual mean NO2 – if SCR used – for all stack heights above ~37 m

If a 55 m stack height is used the all impacts will be able to be screened out as insignificant, with the exception of annual mean nitrogen dioxide impacts. Annual mean nitrogen dioxide impacts would be approximately 4.2% of the AQAL. When applying for planning permission all impacts would be able to be described as negligible irrespective of the baseline concentrations with the exception of annual mean nitrogen dioxide impacts. However, as the baseline concentrations are relatively low the magnitude of change would be described as negligible.

This analysis is based on the minimum stack height. Increasing the stack from 60 m to 65 m would decrease concentrations by ~30% whereas increasing from 65 m to 70 m concentrations would decrease by a further ~14%. Therefore, a stack height of 65 m could be argued to be the most appropriate stack height. At this height the impact would be approximately 2.1% of the AQAL.

3.3 Impact at ecological receptors

In addition to the point of maximum impact, the impact at the sensitive ecological receptors has been considered. This has shown that any plant on site would have the potential to impact a number of European designated sites. An Appropriate Assessment would be required where the background exceeds the Critical Level or habitat specific Critical Load and if the impact is greater than 1%. The APIS database shows that the closest ecological site includes bog habitats which are extremely sensitive to nitrogen and acid deposition and current levels exceed the Critical Loads.

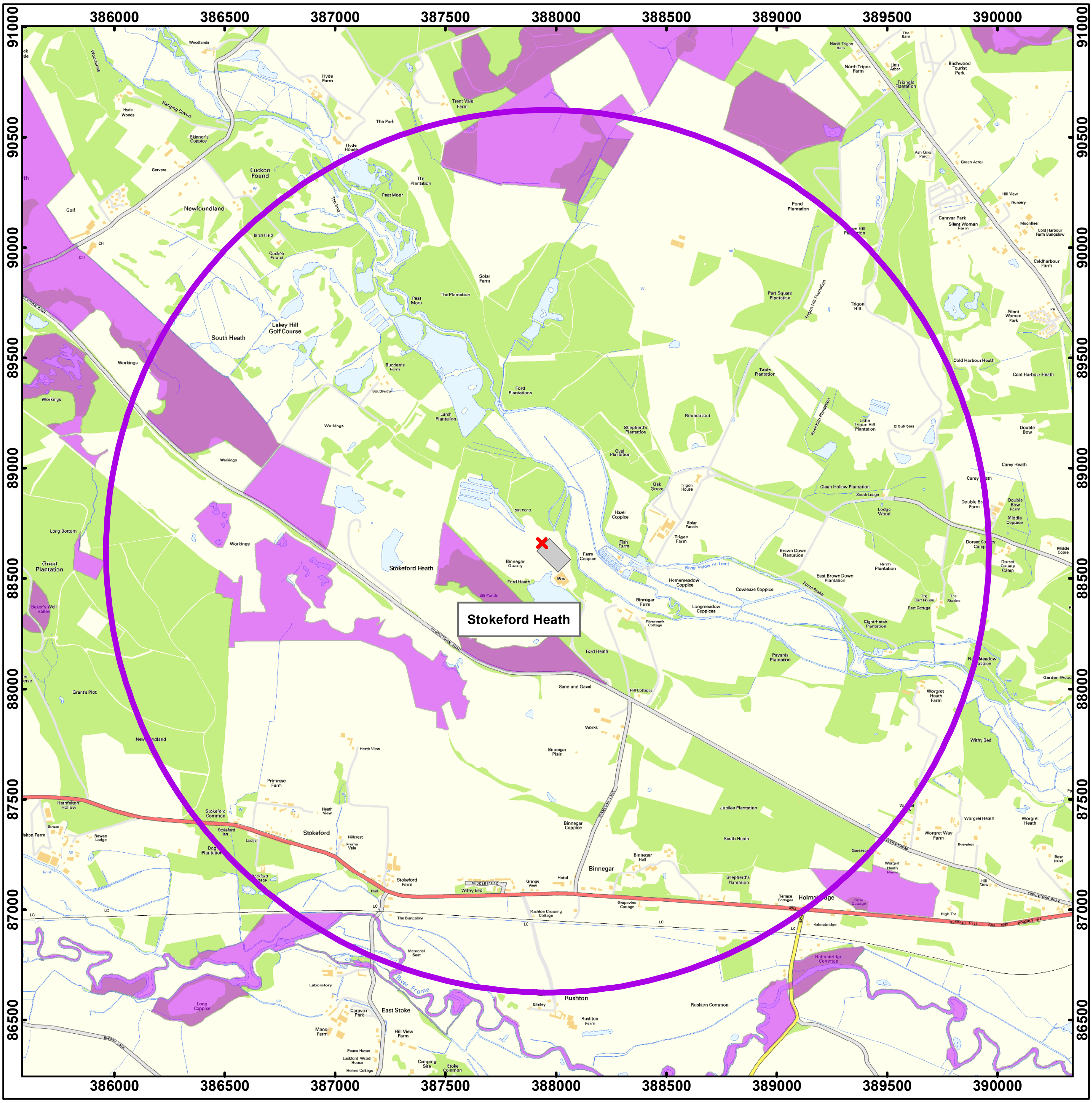
This analysis has shown that with both sizes of plants the impact of annual mean ammonia and impact of nitrogen deposition would exceed 1% of the Critical Level and Load for the most sensitive habitat even if the stack is greater than 80 m. Therefore, an allowance for undertaking an Appropriate Assessment should be made when developing the application. This should identify the habitats of concern and if the Critical Level or Load is currently exceeded and what the effect of any additional pollution loading would be on the designation. As part of this process it may be that more stringent control of ammonia emissions and additional abatement of NOx emissions is required to minimise the impact on the local habitat features.

4 Conclusions and Recommendations

The proposed Site is located within the former Binnegar Quarry, near Wareham. The site is set in the side of a valley with the base on the quarry 26m below the level of the public road. A review of the terrain data has shown that this captures the local topographical features. However, when any detailed work the exact location of the facility within the quarry and relation to the local area will need to be considered. It is not expected that the facility would be located within a steep sided quarry and therefore the terrain module in the ADMS dispersion model performs well. If the facility is to be located within a steep sided quarry careful consideration should be made of the height of the building in relation to the local area and how this is represented in the modelling.

It is possible to scale up the emissions from a smaller to larger scale plant if the fuel specification is the same. However, as discussed it is likely that the NCV of the fuel would be much higher than expected at the Charlton Lane and as such we have analysed a larger plant with a higher NCV and the emissions data for this have been extracted from the relevant EP application. The analysis has shown that a plant with a larger capacity than that currently being constructed at Charlton Lane would be possible on the Site. The analysis shows that the stack height is driven by the massing of the buildings. Therefore, it is likely if the building remains the same the stack height would be very similar following clarification of the anticipated fuel specification. This analysis has shown that the minimum stack height would be 55 m but there is a benefit of increasing the stack to 65 m, and if possible this should be considered.

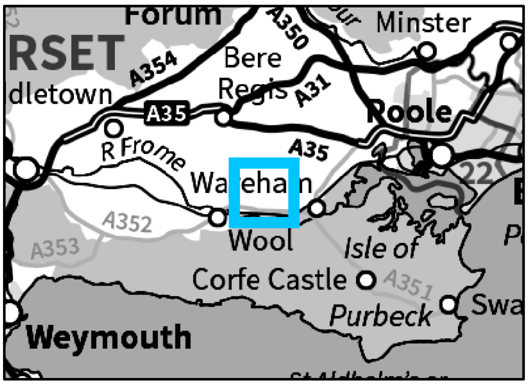
The Site is not located in close proximity to an AQMA as was the case for the Charlton Lane facility. However, any facility on the site will have the potential to impact upon a number of European designated ecological sites. The closest ecological sites, are European designated sites and bog habitats are present. These are highly sensitive to ammonia, nitrogen and acid deposition. An Appropriate Assessment would be required where the background exceeds the Critical Level or habitat specific Critical Load and the impact is greater than 1%. This analysis has shown that for either size plant it is likely that an Appropriate Assessment will be needed. As part of this process it may be determined that additional abatement of NOx emissions and / or more stringent control of ammonia emissions would be required to minimise the impact on the local habitat features.



Legend

- Stack
- Building
- Site Buffer 2km
- Ecological Site

Notes:



0 220 440 880 m

N

Scale: 1:24,000 @ A4

Drawn by: Rosalind Flavell	Date: 14/10/2016
Checked by: Stephen Othen	Date: 14/10/2016

Client:	Suez Recycling and Recovery UK Limited
Site:	Binnegar Quarry
Project:	Air Quality Constraints

Title:

Figure 1:
Site and Sensitive Receptors

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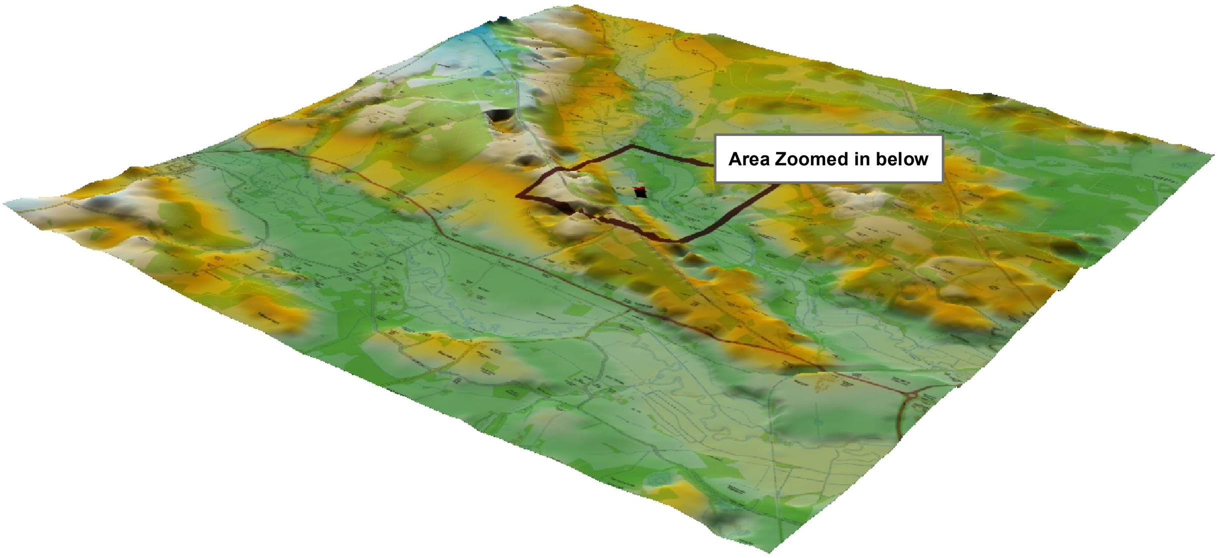
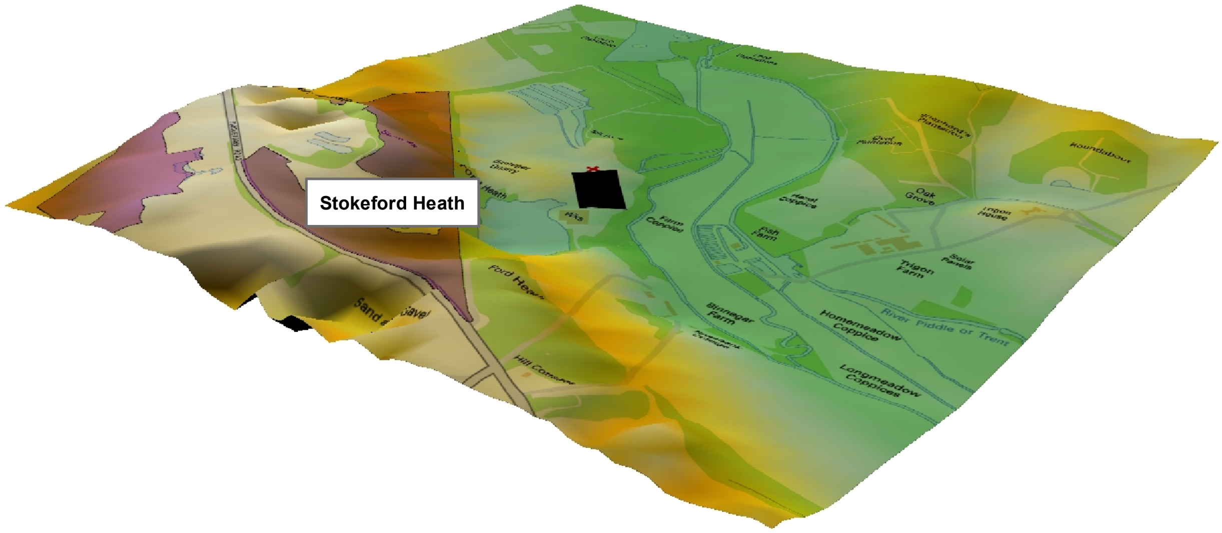
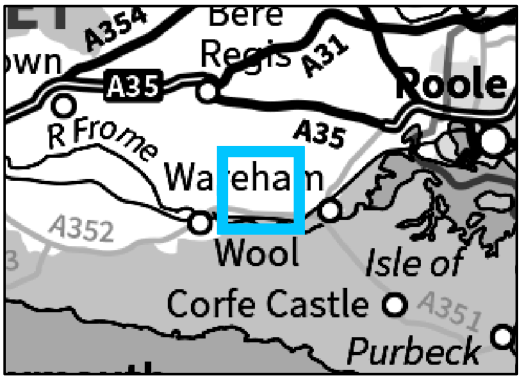
Drawing No: 1	Revision: A





Notes:
Different Z extents have been used on each figure for visualisation purposes

Legend



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Drawn by: Rosalind Flavell	Date: 14/10/2016
Checked by: Stephen Othen	Date: 14/10/2016

Client:	Suez Recycling and Recovery UK Limited
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Project:	Air Quality Constraints

Title:

Figure 2:
Site and Terrain

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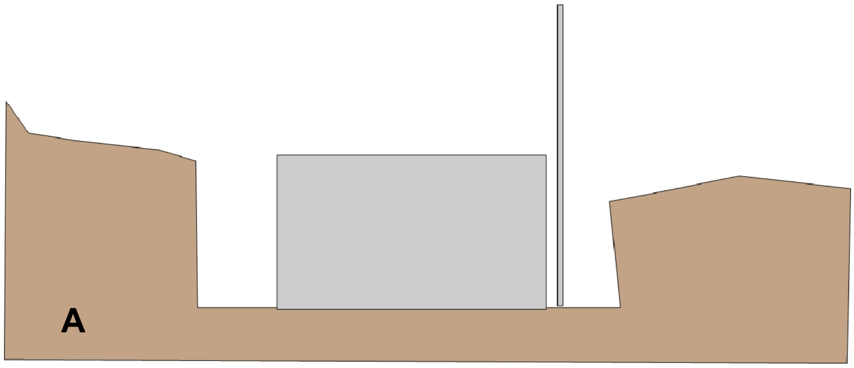
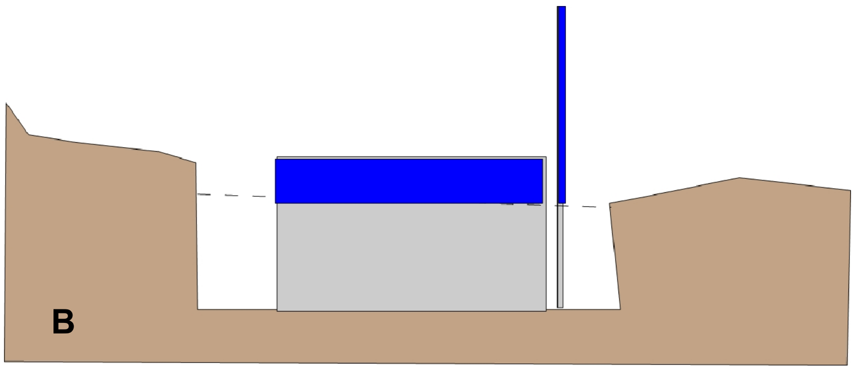
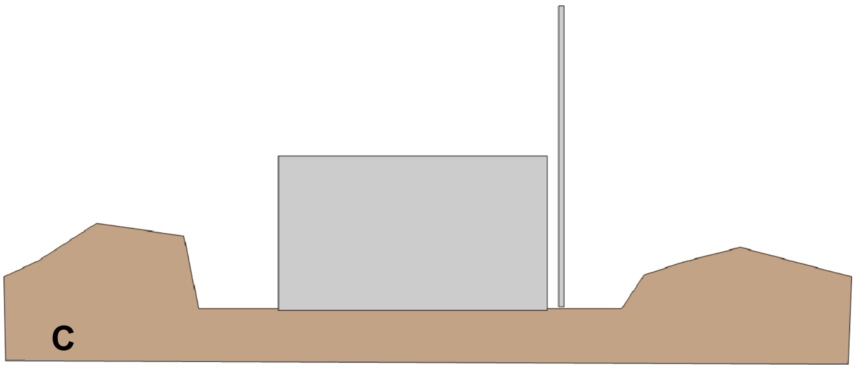
Drawing No: 2	Revision: A



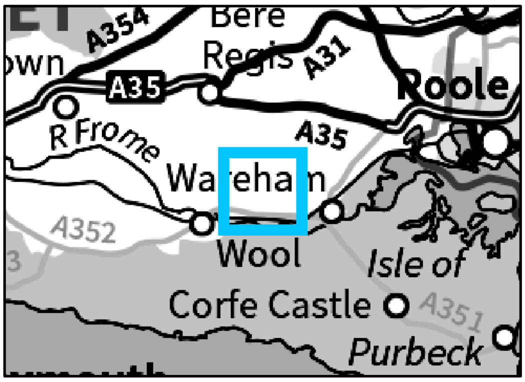
Building is within a quarry. Emissions from the stack will be most effected by terrain modified flow.
Very limited effect of building.
Should consider using a small building and stack height in realtion to surrounding ground level as per figure B





Building protruding from local landscape. Emissions from the stack will be effected by terrain modified flow and building downwash. This should be modelled in the standard approach.

Legend



Drawn by: Rosalind Flavell	Date: 14/10/2016
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Figure 3:
Buildings in Quarry

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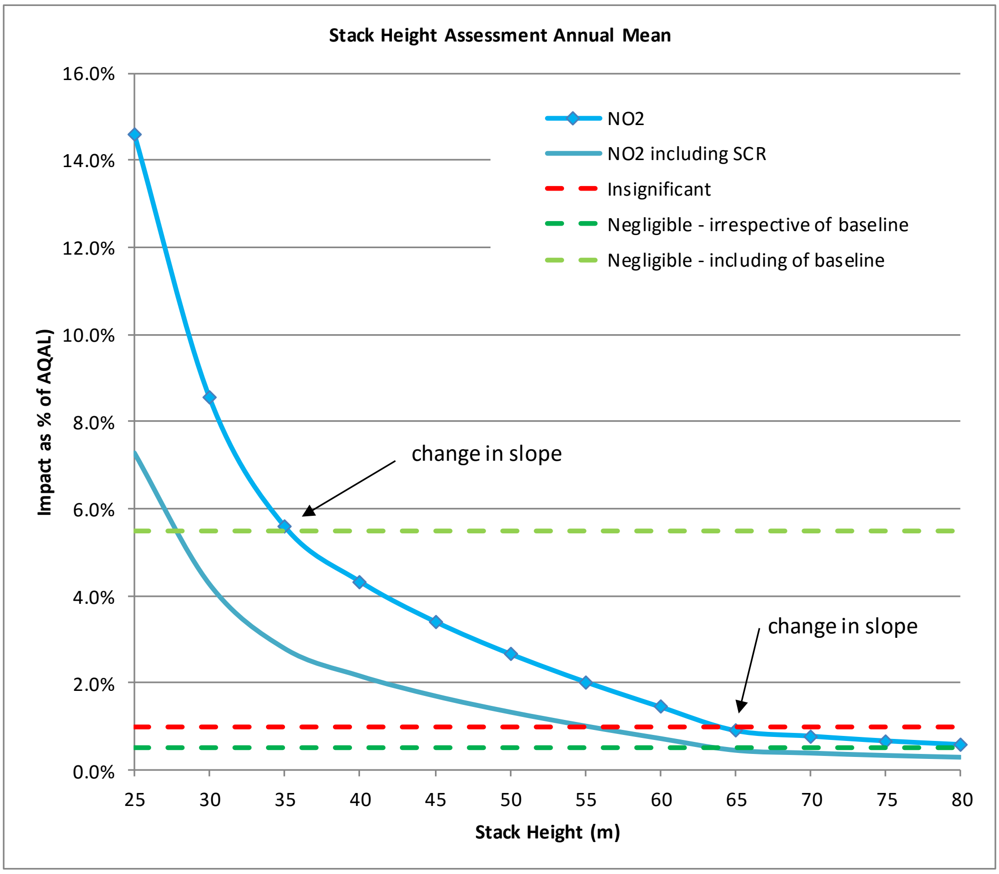
Drawing No: 3	Revision: A

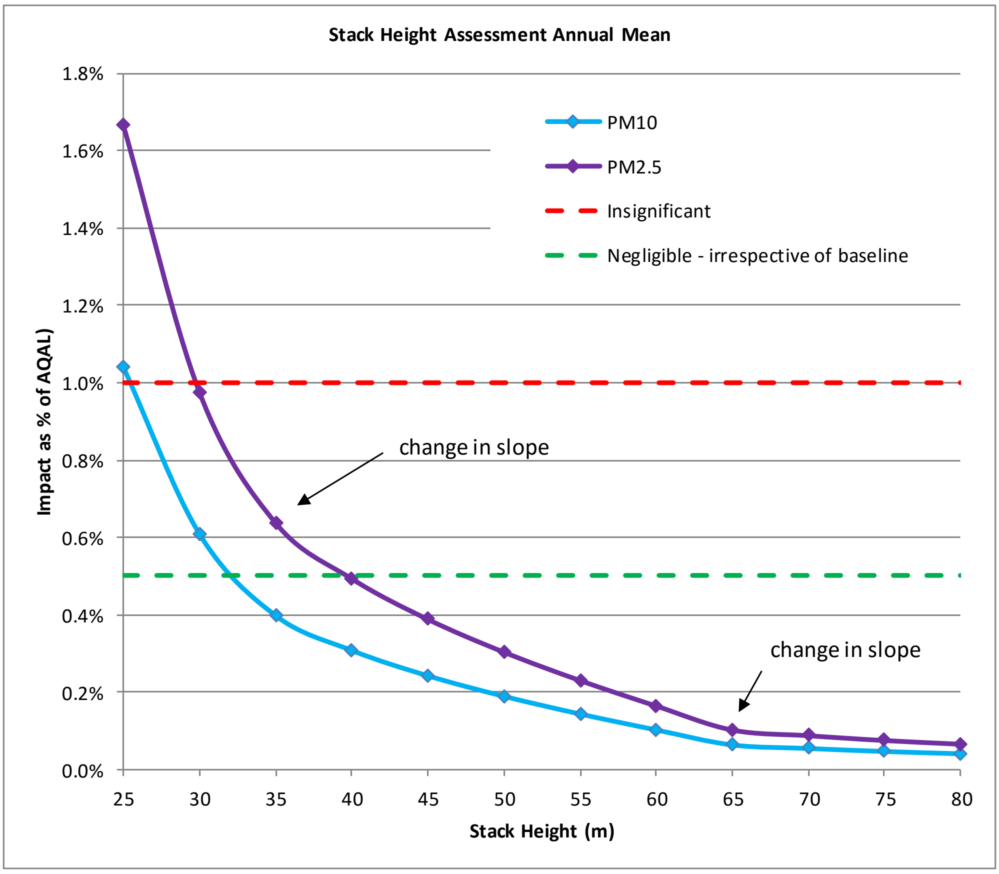
Appendix A – Model Inputs

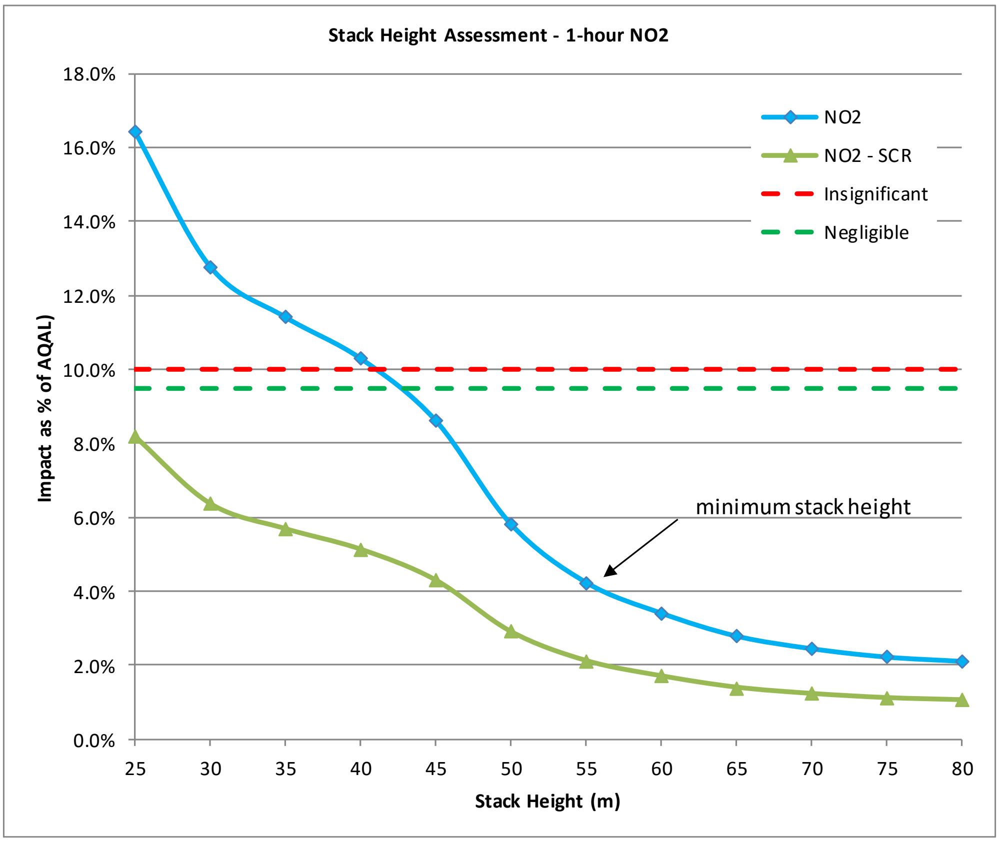
Source Data			
Item	**Unit**	**49ktpa**	**93ktpa**
Fuel feed rate	tph	5.59	10.7
NCV	MJ/kg	10.3	15.5
Stack data			
Internal diameter	m	1.2	1.4
Flue gas exit velocity	m/s	16.5	20.66
Flue Gas Conditions			
Temperature	°C	138	155
Exit moisture content	% v/v	16.8%	13.6%
Exit oxygen content	% v/v dry	11.8%	6%
Reference oxygen content	% v/v dry	11%	
Volume at reference conditions (dry, ref O2)	Nm^3/s	9.28	26.30
Volume at actual conditions	Am^3/s	18.26	31.80
Emissions	**IED Limit (mg/Nm^3)**	**Emission Rate (g/s)**	
Oxides of nitrogen (as NO_2)	200	1.856	5.260
Sulphur dioxide	50	0.464	1.315
Particulate matter	10	0.093	0.263
NOTES: All other regulated pollutants also considered but not presented here as not detailed in this analysis.			

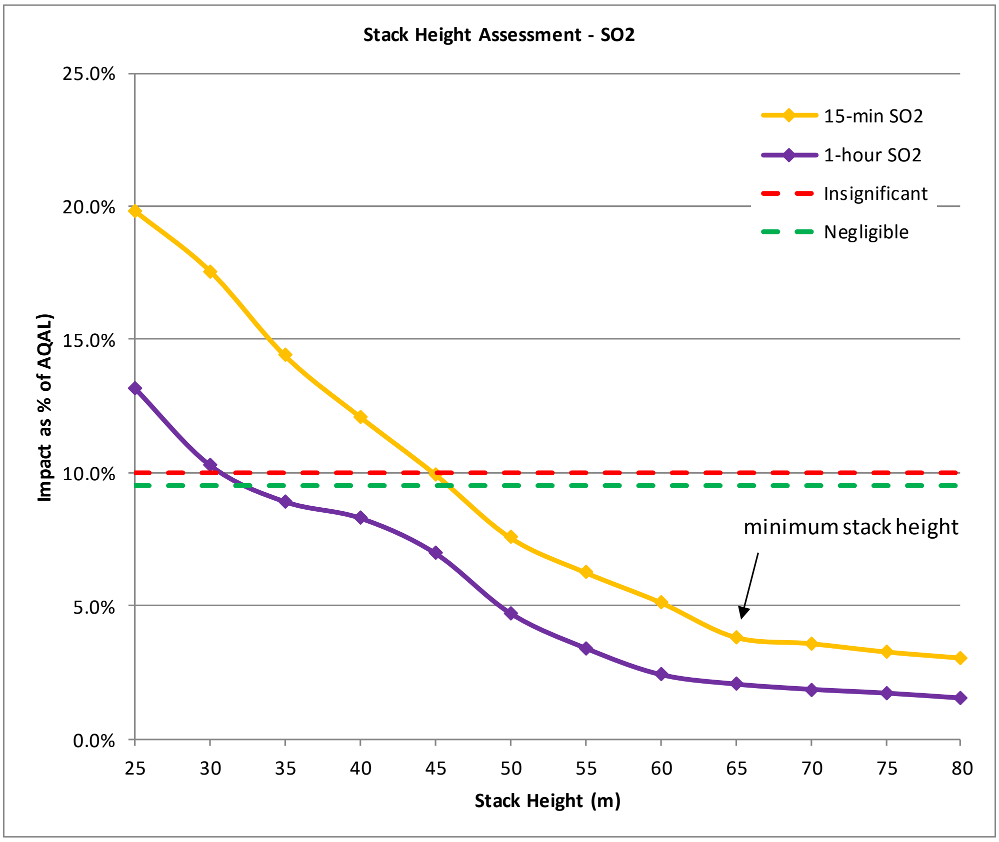
Building						
Buildings	**Centre Point**		**Height (m)**	**Length (m)**	**Width (m)**	**Angle (°)**
	X (m)	**Y (m)**				
Main building	387990	88605	20	80	135	45

Appendix B – Stack Height Analysis – 49ktpa facility – NCV 10.3MJ/kg

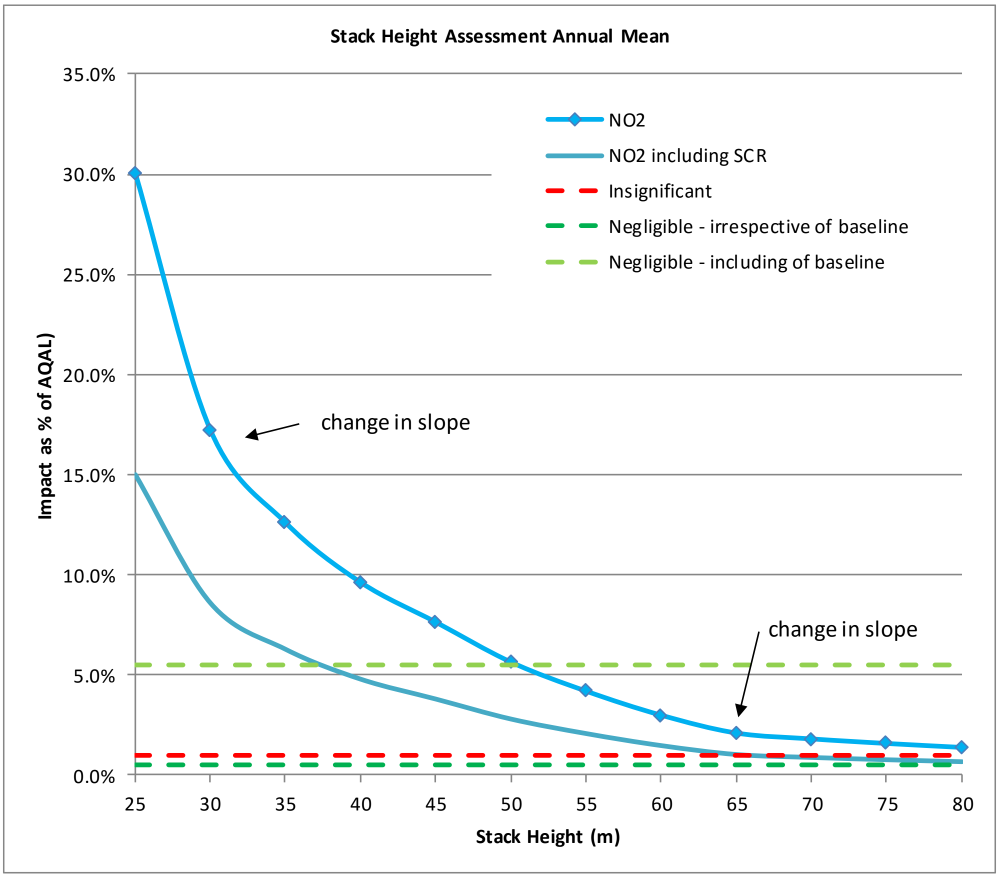


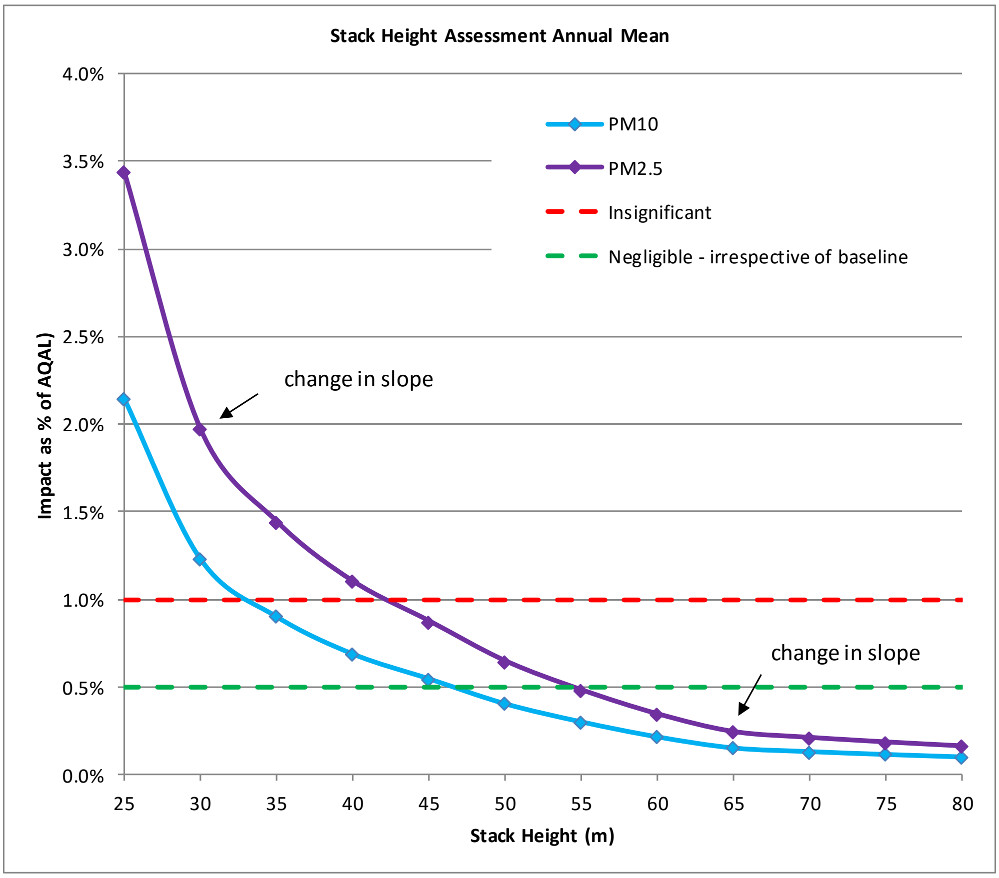


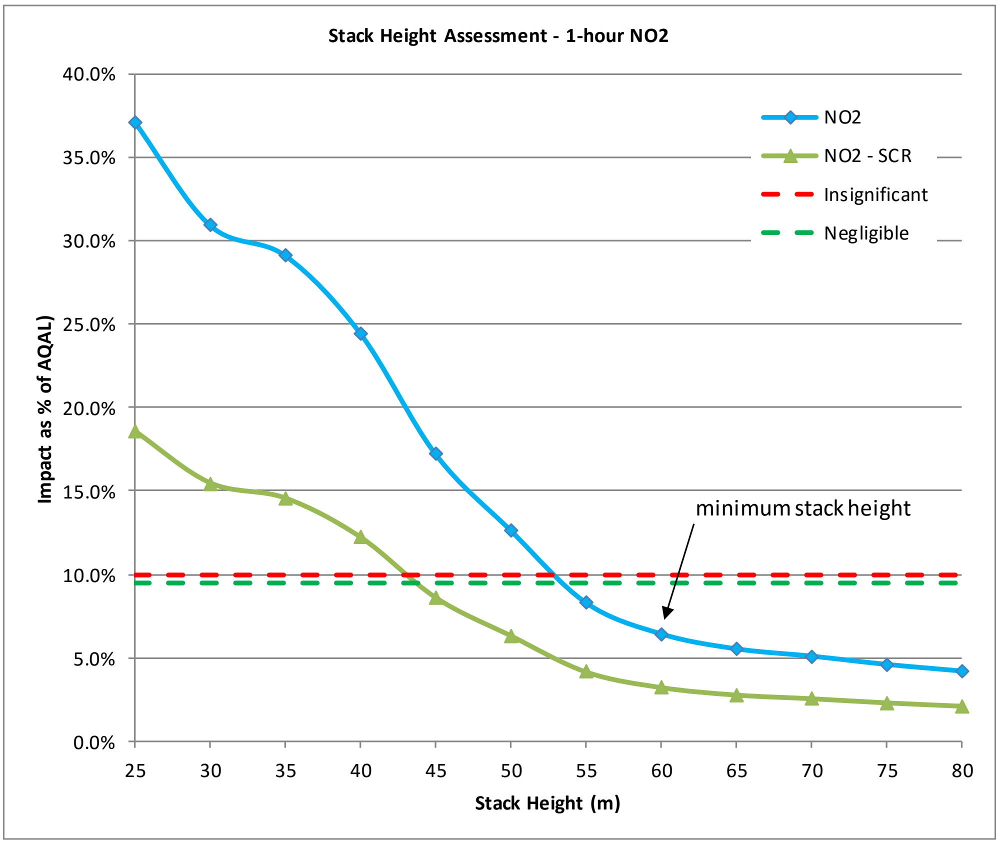

Stack Height Assessment - 1-hour NO2
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
Impact as % of AQAL)
NO2
NO2 - SCR
Insignificant
Negligible
minimum stack height
25
30
35
40
45
50
55
60
65
70
75
80
Stack Height (m)

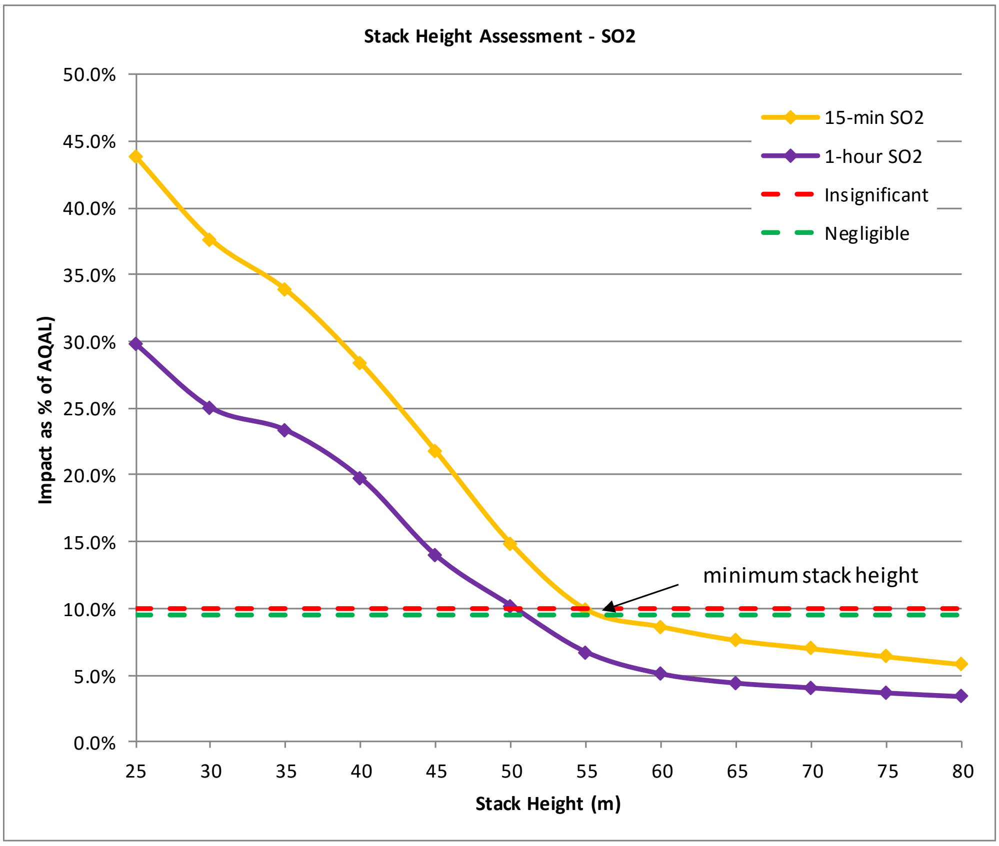

Stack Height Assessment - SO2
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Impact as % of AQAL)
15-min SO2
1-hour SO2
Insignificant
Negligible
minimum stack height
25
30
35
40
45
50
55
60
65
70
75
80
Stack Height (m)

Appendix C – Stack Height Analysis – 93ktpa facility – NCV 15.5MJ/kg






Stack Height Assessment - 1-hour NO2
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Impact as % of AQAL)
25
30
35
40
45
50
55
60
65
70
75
80
Stack Height (m)
NO2
NO2 - SCR
Insignificant
Negligible
minimum stack height


Stack Height Assessment - SO2
50.0%
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Impact as % of AQAL)
25
30
35
40
45
50
55
60
65
70
75
80
Stack Height (m)
15-min SO2
1-hour SO2
Insignificant
Negligible
minimum stack height

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