



2010 Air Quality Detailed Assessment of SO₂

for

North West Leicestershire District Council

In fulfilment of

Part IV of the Environment Act 1995

Local Air Quality Management

Date: December 2010

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Executive Summary

The update and screening assessment published October 2009 [8] found that a detailed assessment for SO₂ was required in some areas of the district in relation to the burning of solid fuel, This Detailed assessment was undertaken to further assess the likelihood of an exceedance of one of the SO₂ air quality objectives in one or more of the areas outlined in Section 3.1.

The assessment involved a postal survey of the areas in question asking what the main source of heating in domestic properties was.

In total 4620 properties were surveyed. 2173 were returned, 2 of which had been spoiled, 3 were unmarked. This means 46.9% valid returns were received. The overall error level for a confidence interval of 95% is $\pm 1.5\%$. The results are presented in Table 3 and Figure 9

The results of the survey show that the majority of properties are using fuels other than coal or smokeless solid fuel, therefore no further action is required by the Council.

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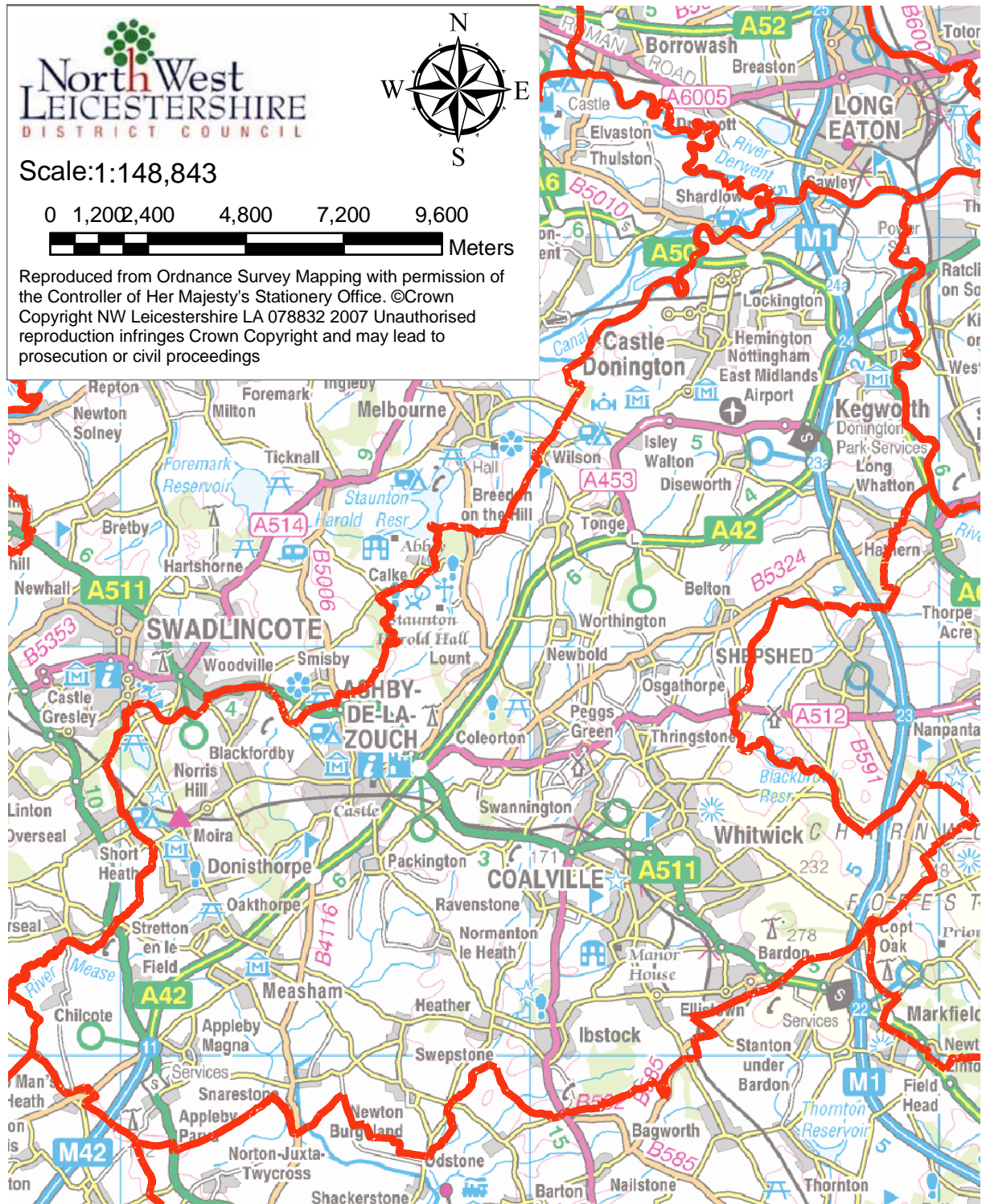
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1 Introduction

1.1 Description of Local Authority Area

Figure 1 Map of North West Leicestershire District



North West Leicestershire lies in the East Midlands Region and is both the name and geographical location. The district is situated in the heart of the National Forest and lies between Leicester, Burton-on-Trent, Derby and Nottingham, covering 105 square miles. The district is mostly rural with a large extent of industry historically from coal mining, but more recently with Nottingham East Midlands Airport and large quarries. The population of 90,600 people (June 2009) [28] live mainly in the principle towns of Coalville and Ashby-de-la-Zouch; and the large villages of Castle Donington, Kegworth and Ibstock. Three established main roads run through the district, the M42/A42 between Birmingham and Nottingham, the M1 and the A50/A511 from Leicester to Burton-on-Trent.

1.2 Purpose of Detailed Assessment Report

The update and screening assessment published October 2009 [8] found that a detailed assessment for SO₂ is required in some areas of the district in relation to the burning of solid fuel, This report is designed to further assess the likelihood of an exceedance of one of the SO₂ air quality objectives in one or more of the areas assessed.

1.3 Air Quality Objectives

The air quality objectives applicable to Local Air Quality Management (LAQM) in England are set out in the Air Quality (England) Regulations 2000 (SI 928) [11], and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043) [12]. They are shown in Table 1 the table includes the number of permitted exceedences in any given year (where applicable).

Table 1. Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16.25 μgm^{-3}	Running annual mean	31.12.2003
	5.00 μgm^{-3}	Running annual mean	31.12.2010
1,3-Butadiene	2.25 μgm^{-3}	Running annual mean	31.12.2003
Carbon monoxide	10.0 μgm^{-3}	Running 8-hour mean	31.12.2003
Lead	0.5 μgm^{-3}	Annual mean	31.12.2004
	0.25 μgm^{-3}	Annual mean	31.12.2008
Nitrogen dioxide	200 μgm^{-3} not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 μgm^{-3}	Annual mean	31.12.2005
Particles PM ₁₀ (gravimetric)	50 μgm^{-3} , not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 μgm^{-3}	Annual mean	31.12.2004
Particles PM _{2.5} (gravimetric) (not currently included in regulations)	25 μgm^{-3} (target)	Annual mean	2020
Sulphur dioxide	350 μgm^{-3} , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 μgm^{-3} , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 μgm^{-3} , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

Six AQMAs were designated in North West Leicestershire during the first round of review and assessment for the level of nitrogen dioxide concentrations. After Further Assessments it was determined that only two of these locations required AQMA designations and the remaining four were revoked. The Update and Screening Assessment undertaken in 2006 [1] concluded that these two sites should remain AQMAs and identified three additional locations where Detailed Assessments should be undertaken to determine whether new AQMAs were required for nitrogen dioxide concentrations. The two AQMAs designated during the first round are presented in Figure 2 and Figure 3.

The Detailed Assessment [2] undertaken in September 2007 of the three locations identified as possible areas for AQMAs in the USA 2006 [1], the three locations were High Street/Bondgate in Castle Donington, Broom Leys Road, Coalville and Bardon Road, Coalville, found that exceedences of the nitrogen dioxide objective were occurring in Castle Donington at properties located next to the carriageway along High Street and Bondgate due to traffic emissions. Monitoring at both locations in Coalville identified nitrogen dioxide concentrations that exceeded the mean annual objective during 2005, 2006 and 2007. The Detailed Assessment concludes that AQMAs should be designated at all three locations. As a result, two additional AQMAs were designated; the first in Castle Donington, presented in Figure 4, and the second covering Broom Leys Road and Bardon Road in Coalville, presented in Figure 5.

The Air Quality Progress Report conducted in April 2008 [3] recommended that a detailed assessment of the village of Copt Oak and the area surrounding East midlands airport be undertaken to determine if AQMA's should be determined at these locations.

The Detailed Assessment of Copt Oak published in January 2009 [5] found that an AQMA should be declared and that the area should cross the district boundary to include an area within the borough of Hinckley and Bosworth as shown in Figure 6.

The Detailed assessment of East midlands airport published in March 2009 [4] concluded that the Air quality objective for NO₂ would not be exceeded within 1000m of the airport as a result of air traffic emissions.

The further assessment of Bardon Road, Coalville published in February 2009 [6] supported the original declaration of the AQMA comprising the four residential properties at Broom Leys Junction and the one hundred and seventy two residential properties on Bardon Road.

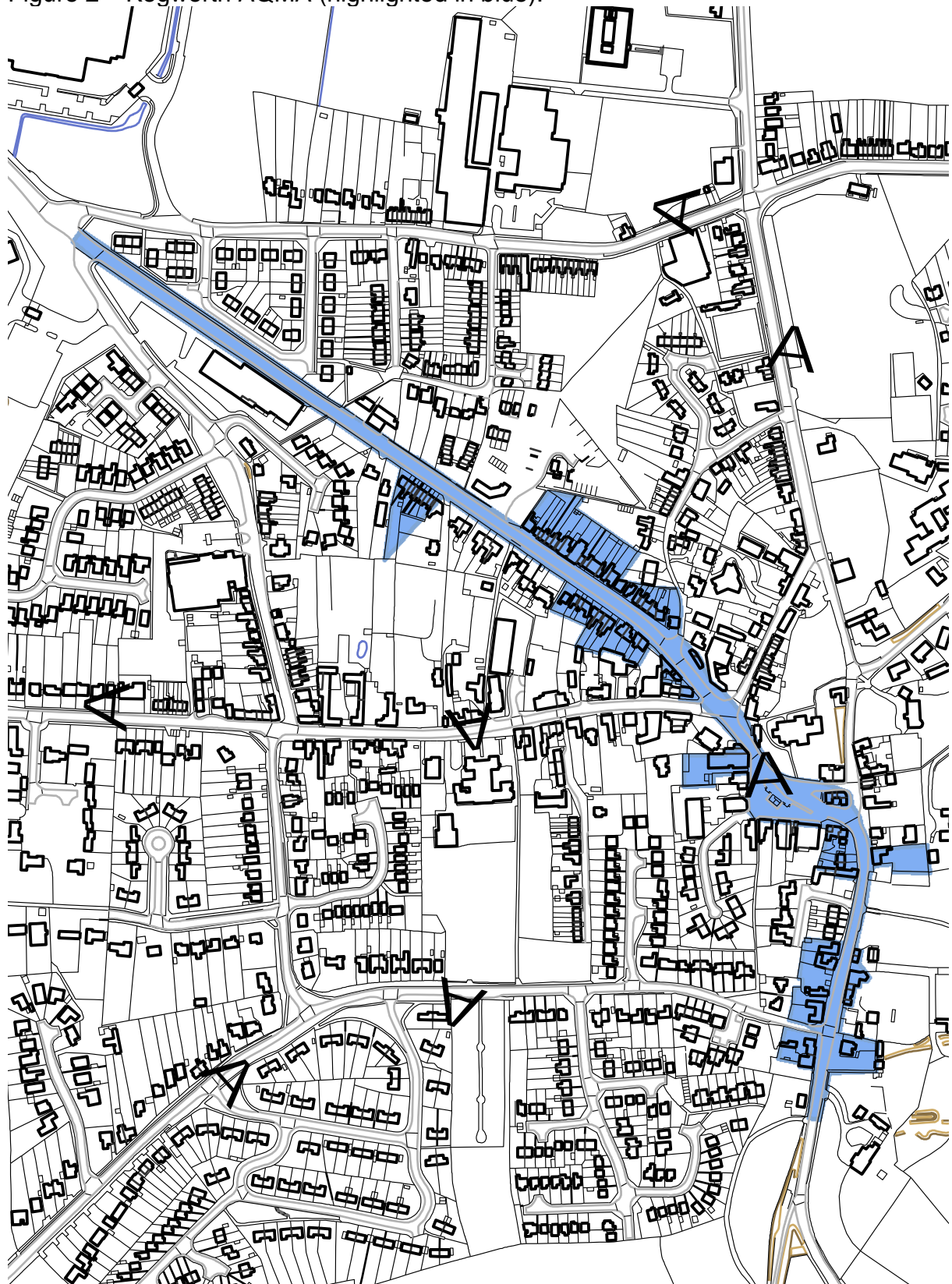
The further assessment of High street castle Donington published in April 2009 [7] supported the original declaration of the AQMA comprising ninety one residential properties on High Street and Bondgate, Castle Donington.

The update and screening assessment published October 2009 [8] found that a detailed assessment for SO₂ is required in some areas of the district in relation to the burning of solid fuel, to which this report relates. The report also recommended that the M1 AQMA is expanded to include an exceedance of the 1-hour mean objective for NO₂ as the yearly mean has exceeded 60µgm⁻³.

The Progress Report published in April 2010 [9] found no significant change in the district.

A Further Assessment for the AQMA declared at Copt Oak is currently being undertaken.

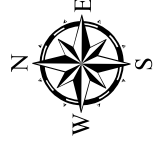
Figure 2 Kegworth AQMA (highlighted in blue).



0 50 100 200 300 400
1:4,928 Meters

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Figure 3 M1 AQMA (outlined in dark blue)



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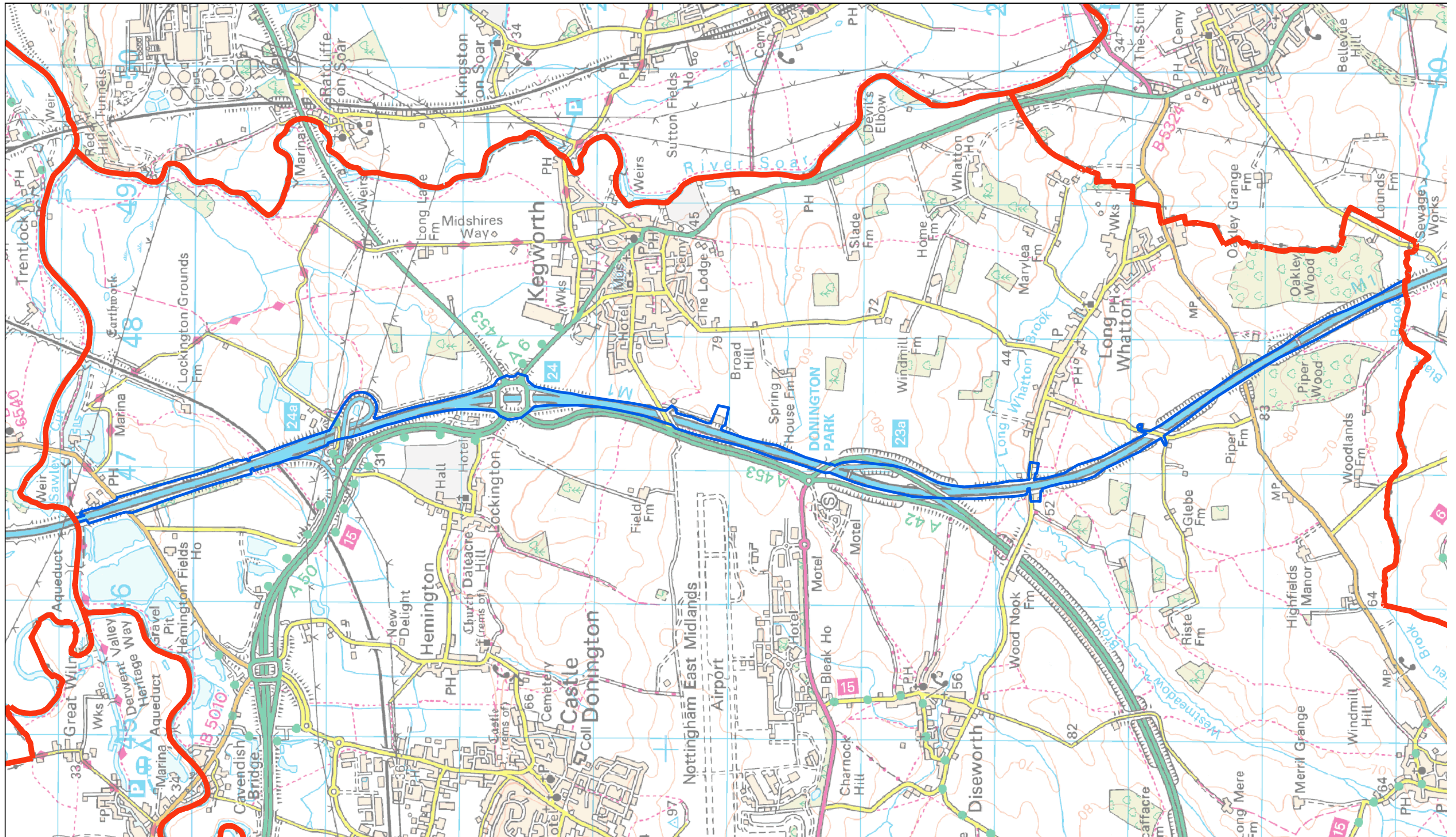
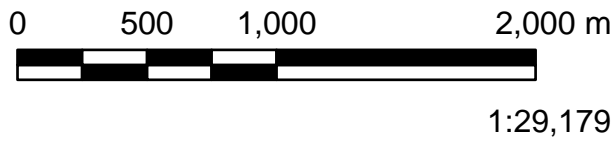
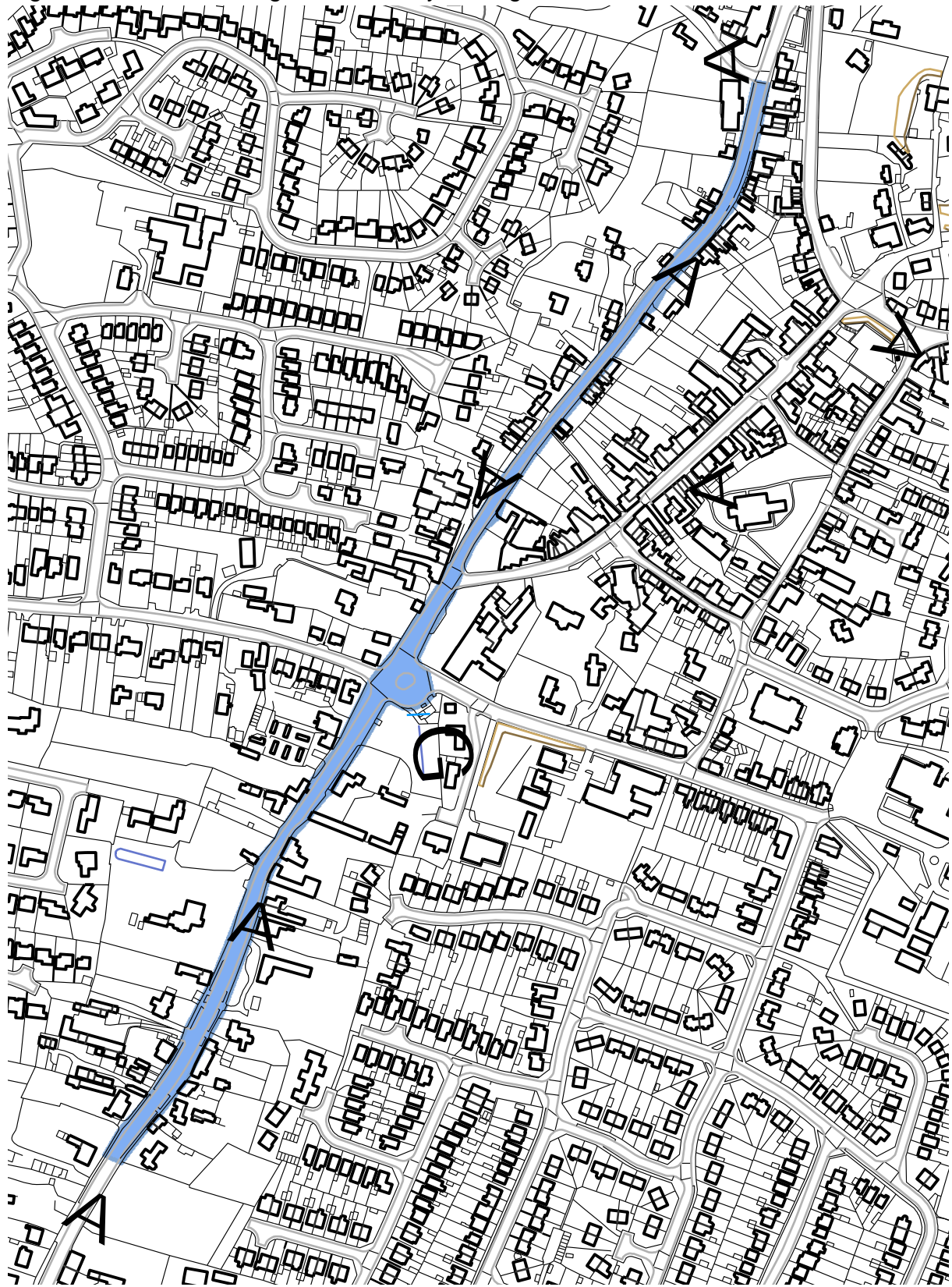


Figure 4 Castle Donington Air Quality Management Area



0 25 50 100 150 200
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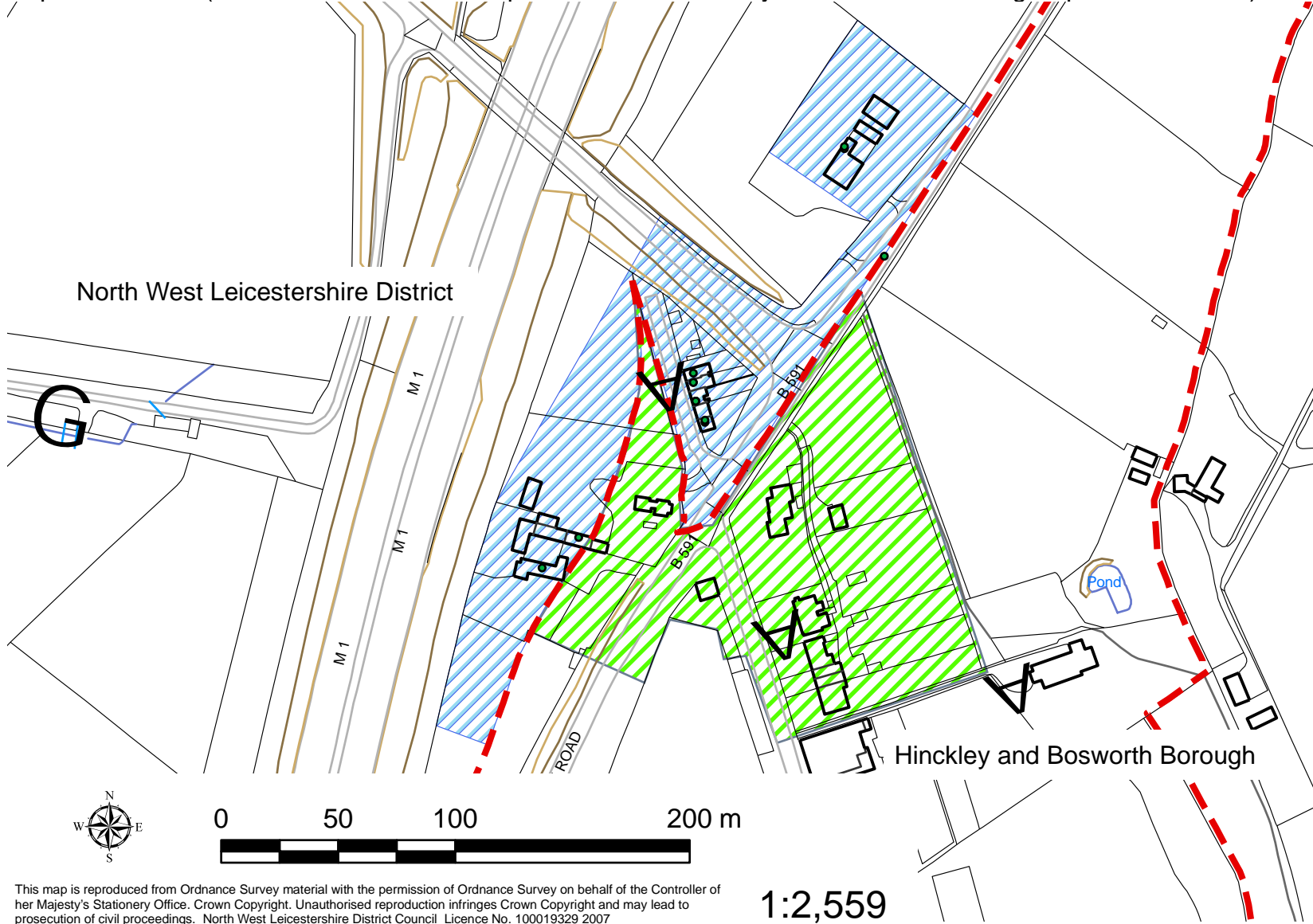
Figure 5 Coalville Air Quality Management Area (Bardon Road and Broom Leys Junction)



1:9,149 0 95 190 380 570 760 Meters

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Figure 6 Copt Oak AQMA (North west Leicestershire portion in Blue Hinckley and Bosworth Borough's portion in Green)



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1:2,559

2 Methodology

The 2009 Update and Screening Assessment [8] chapter 6 sub-section 3 attempted to ascertain the impact of solid fuel burning on SO₂ levels within the district. This was done in line with Box 5.8 D2 in the LAQM technical guidance TG09 [17] (for ease of reference it has been reproduced in Table 2).

Table 2. Box 5.8 D2 taken from LAQM technical guidance TG09 [17] chapter 5 page 5-51

D.2 Domestic solid-fuel burning (Sulphur dioxide emissions)		
Relevant pollutants	Steps that must be taken to complete the assessment	Notes relevant to each step
Overview		
The previous rounds of Review and Assessment have identified areas where domestic solid fuel burning gives rise to exceedences of the objective for SO ₂ . PM ₁₀ from domestic solid fuel burning is covered under D.1b Biomass combustion – combined impacts.		
Sulphur dioxide	Approach	
	Identify areas where significant coal burning takes place. Smokeless fuel has a similar sulphur content to coal and so should be treated in the same way	“Significant” is defined as any area of about 500x500 m with more than 50 houses burning coal/smokeless fuel as their primary source of heating If necessary use professional judgment to identify such areas, including experience of smoke hanging over the area on a winter’s evening. Further guidance is provided in Annex 2.
	Collect information on the actual use of coal/smokeless fuel in these areas.	Do not count houses with occasional use of solid fuels.
	Question	
	Does the density of coal burning premises exceed 100 per 500x500 m area?	
Action		
	If the answer is YES, it will be necessary to proceed to a Detailed Assessment for SO ₂ at these locations.	

The USA was unable to rule out a solid fuel impact on air quality in several areas of the district (see section 3 for details) as the type of fuel usage in those areas was unknown.

Therefore, inline with Box 5.8 D2 in LAQM technical guidance TG09 [17] (Table 2), it was necessary to collect detailed information on the use of coal and smokeless fuel in those areas.

To ensure a good return it was decided that a postal survey consisting of a prepaid postcard with a multiple choice question asking what the main source of heating within the property is was the most likely method to receive a good return rate.

It was decided that instead of asking what type of fuel is used in a property that we would ask what kind of system that fuel was used with as well, this has made the survey data useful in combating fuel poverty and improving the energy efficiency of the housing sector within the district.

Figure 7 Example of fuel survey postcard

North West LEICESTERSHIRE DISTRICT COUNCIL

FUEL SURVEY Ref. No. 200003511340

What is the Main source of heating in your property?
(Mark 1 of the following)

<input type="checkbox"/> Electric Storage heaters	<input type="checkbox"/> Bottled Gas Burning fire places
<input type="checkbox"/> Electric Central heating	<input type="checkbox"/> Oil fired central heating
<input type="checkbox"/> Ground Source heat pump	<input type="checkbox"/> Coal fired central heating
<input type="checkbox"/> Air Source heat pump	<input type="checkbox"/> Coal burning fire places
<input type="checkbox"/> Mains Gas Fired Central Heating	<input type="checkbox"/> Biomass (e.g. wood) fired central heating
<input type="checkbox"/> Mains Gas Burning fire places	<input type="checkbox"/> Wood Burning fire places
<input type="checkbox"/> Bottled Gas Fired Central Heating	

The postcards were marked with a property specific reference number. This meant that residents did not need to fill in any address information, an example of a postcard is shown in Figure 7. A cover letter was included with the postcard explaining what was meant by main source of heating and gave examples.

For the purposes of this report smokeless fuel has been counted as coal

3 Locations Being Assessed in this Report

The 2009 Update and Screening Assessment (USA) found that Measham, Donisthorpe, Breedon on the Hill, Lount, Belton, Newton Burgoland, and Oakthorpe are either within “gas-free” zones or have large off-gas estates and would require assessment.

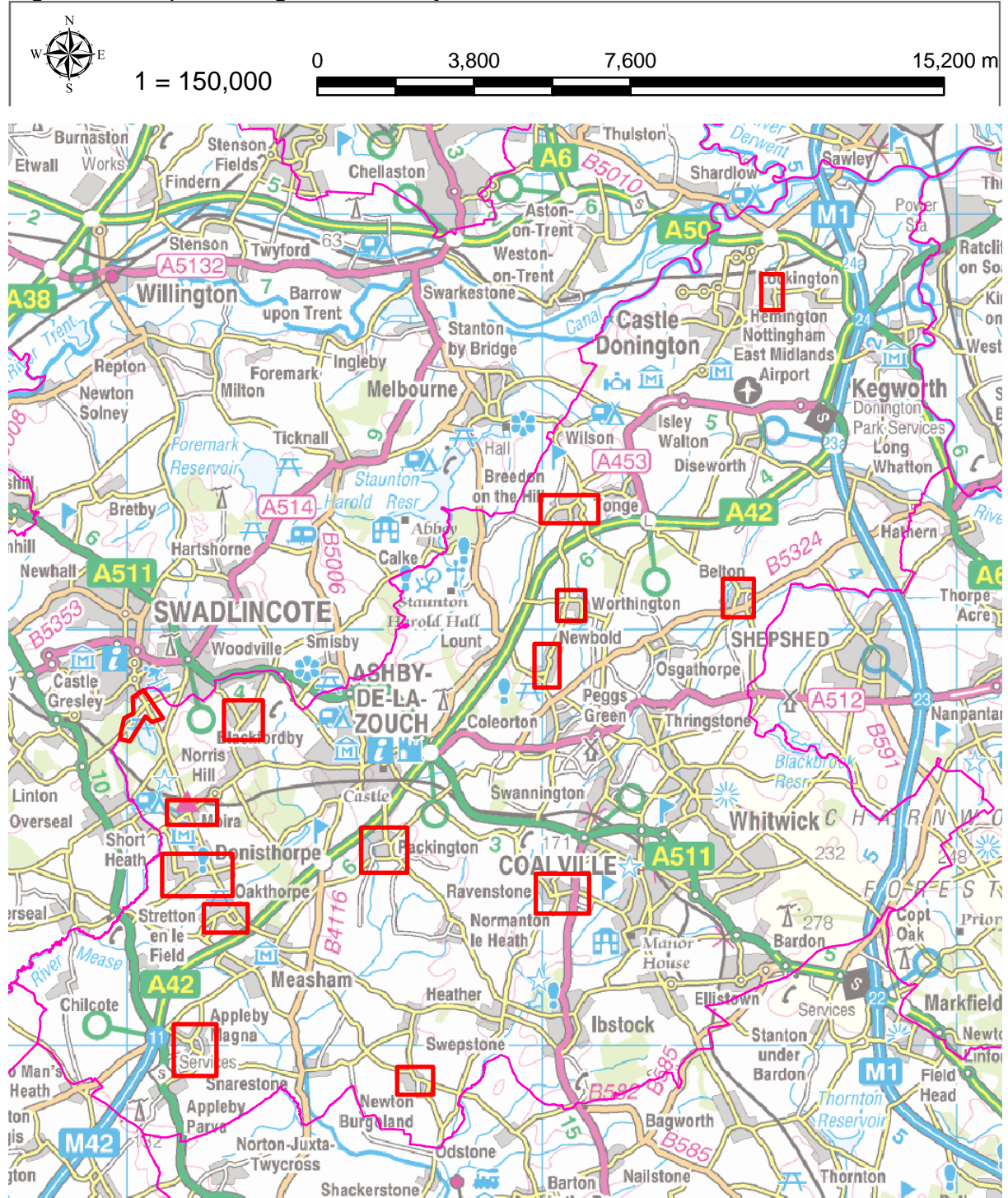
Information received since the writing of the USA shows that Measham now has mains gas to the whole village, therefore Measham will not be assessed in this report.

Improvements in the housing data since the publishing of the USA show that the housing density in Lount does not have a housing density great enough to require assessment. However housing density in Hemington, Worthington, Newbold, Moira, Ravenstone, Packington, Appleby Magna, Albert village and Blackfordby has increased therefore these are now included in the survey area.

3.1 Summary of areas assessed

- Donisthorpe,
- Breedon on the Hill,
- Belton,
- Newton Burgoland,
- Oakthorpe
- Hemington,
- Worthington,
- Newbold,
- Ravenstone,
- Packington,
- Moira
- Appleby Magna,
- Albert village, and
- Blackfordby

Figure 8 Map showing areas surveyed



4 Survey Data

Where

n is the sample size

N is the population size

p and q are the population proportions. (If you don't know what these, are set them each to 0.5.

z is the value that specifies the level of confidence you want in your confidence interval when you analyze your data. Typical levels of confidence for surveys are 95%, in which case z is set to 1.96.

z	confidence level
2.58	99%
1.96	95%
1.65	90%

E is the level of error as a decimal.

$$n = \frac{Nz^2 pq}{E^2(N-1) + z^2 pq} \quad \text{Equation to calculate survey size}$$

$$n \times (E^2(N-1) + z^2 pq) = Nz^2 pq$$

$$E^2(N-1) + z^2 pq = \frac{Nz^2 pq}{n}$$

$$E^2(N-1) = \frac{Nz^2 pq}{n} - z^2 pq$$

$$E^2 = \frac{\left(\frac{Nz^2 pq}{n} - z^2 pq \right)}{N-1}$$

$$E = \sqrt{\frac{\left(\frac{Nz^2 pq}{n} - z^2 pq \right)}{N-1}} \quad \text{Equation to calculate error level}$$

4.1 Summary of Monitoring Undertaken

In total 4620 properties were surveyed. 2173 were returned, 2 of which had been spoiled, 3 were unmarked. This means 46.9% valid returns were received. The overall error level for a confidence interval of 95% is $\pm 1.5\%$. The results are presented in Table 3 and 0.

4.1.1 Albert village

284 properties were surveyed. 115 were returned, 1 of which was unmarked. This means 40.1% valid returns were received. The error level for a confidence interval of 95% is $\pm 7.1\%$ The results are presented in Table 3 and Figure 10.

4.1.2 Appleby Magna

394 properties were surveyed. 222 were returned. This means 46.9% valid returns were received. The error level for a confidence interval of 95% is $\pm 4.4\%$ The results are presented in Table 3 and Figure 11.

4.1.3 Belton

276 properties were surveyed. 127 were returned, 2 of which had been spoiled, 3 were unmarked. This means 46.0% valid returns were received. The error level for a confidence interval of 95% is $\pm 6.4\%$ The results are presented in Table 3 and Figure 12.

4.1.4 Blackfordby

391 properties were surveyed. 215 were returned. This means 55.0% valid returns were received. The error level for a confidence interval of 95% is $\pm 4.5\%$ The results are presented in Table 3 and Figure 13.

4.1.5 Breedon on the Hill

315 properties were surveyed. 156 were returned. This means 42.0% valid returns were received. The error level for a confidence interval of 95% is $\pm 5.6\%$ The results are presented in Table 3 and Figure 14.

4.1.6 Donisthorpe

753 properties were surveyed. 316 were returned. This means 46.9% valid returns were received. The error level for a confidence interval of 95% is $\pm 4.2\%$ The results are presented in Table 3 and Figure 15.

4.1.7 Hemington

170 properties were surveyed. 69 were returned. This means 40.6% valid returns were received. The error level for a confidence interval of 95% is $\pm 9.1\%$ The results are presented in Table 3 and Figure 16.

4.1.8 Moira

234 properties were surveyed. 107 were returned, 1 of which was unmarked. This means 44.9% valid returns were received. The error level for a confidence interval of 95% is $\pm 7.1\%$ The results are presented in Table 3 and Figure 17.

4.1.9 Newbold

215 properties were surveyed. 106 were returned. This means 49.3% valid returns were received. The error level for a confidence interval of 95% is $\pm 6.8\%$ The results are presented in Table 3 and Figure 18.

4.1.10 Newton Burgoland

168 properties were surveyed. 79 were returned. This means 47.0% valid returns were received. The error level for a confidence interval of 95% is $\pm 8.0\%$ The results are presented in Table 3 and Figure 19.

4.1.11 Oakthorpe

291 properties were surveyed. 114 were returned. This means 39.2% valid returns were received. The error level for a confidence interval of 95% is $\pm 7.2\%$ The results are presented in Table 3 and Figure 20.

4.1.12 Packington

320 properties were surveyed. 166 were returned. This means 51.9% valid returns were received. The error level for a confidence interval of 95% is $\pm 5.3\%$ The results are presented in Table 3 and Figure 21.

4.1.13 Ravenstone

598 properties were surveyed. 280 were returned. This means 46.8% valid returns were received. The error level for a confidence interval of 95% is $\pm 4.3\%$ The results are presented in Table 3 and Figure 22.

4.1.14 Worthington

211 properties were surveyed. 100 were returned, 1 of which was unmarked. This means 46.9% valid returns were received. The error level for a confidence interval of 95% is $\pm 7.2\%$ The results are presented in Table 3 and Figure 23

Table 3. Total Fuel Survey result

Fuel Type	Total No.	Albert Village	Appleby Magna	Belton	Blackfordby	Breedon On The Hill	Donisthorpe	Hemington	Moira	Newbold	Newton Burgoland	Oakthorpe	Packington	Ravenstone	Worthington
Electric	246	15	20	15	3	48	42	6	16	9	19	18	4	8	23
Gas	1209	67	178	98	200	9	100	62	72	12	7	14	159	226	5
oil	442	2	10	11	2	68	118	0	9	64	43	45	1	32	37
coal / smokeless fuel	259	30	12	3	10	28	55	1	7	19	10	35	2	14	33
biomass	12	0	2	0	0	3	1	0	1	2	0	2	0	0	1
not returned / no answer marked	2452	170	172	149	176	159	437	101	129	109	89	177	154	318	112
total sent	4620	284	394	276	391	315	753	170	234	215	168	291	320	598	211
95% confidence error level (±%)	1.5%	7.1%	4.4%	6.4%	4.5%	5.6%	4.2%	9.1%	7.1%	6.8%	8.0%	7.2%	5.3%	4.3%	7.2%

Figure 9 Pie chart of total results of survey (%)

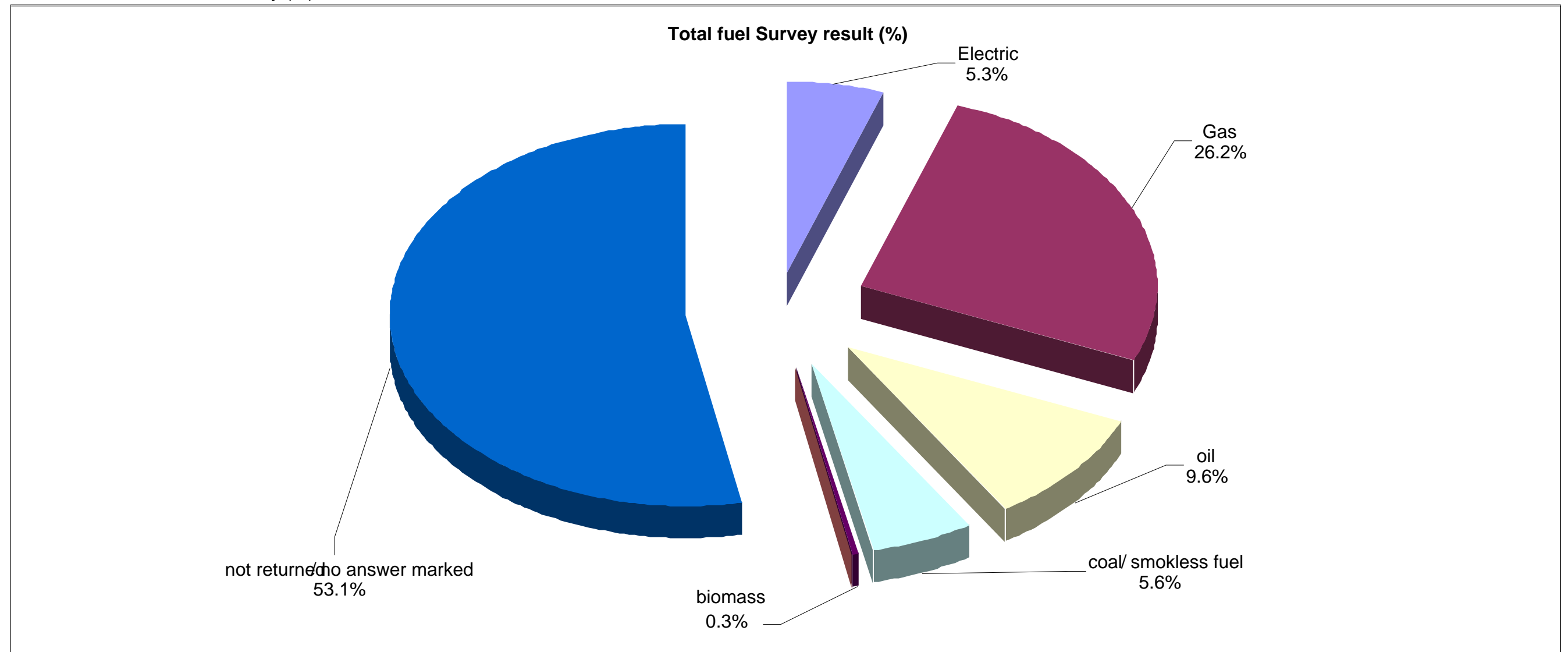


Figure 10 Albert Village Fuel Survey

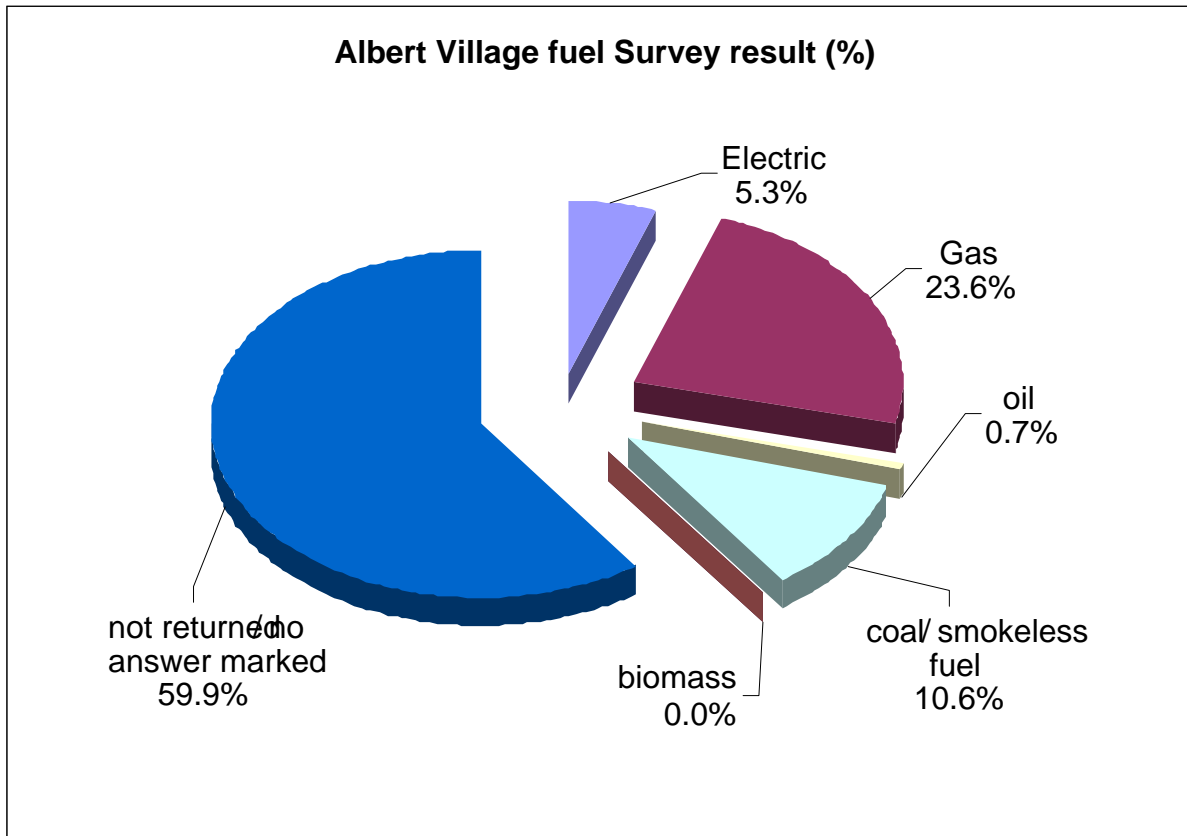


Figure 11 Appleby Magna Fuel Survey

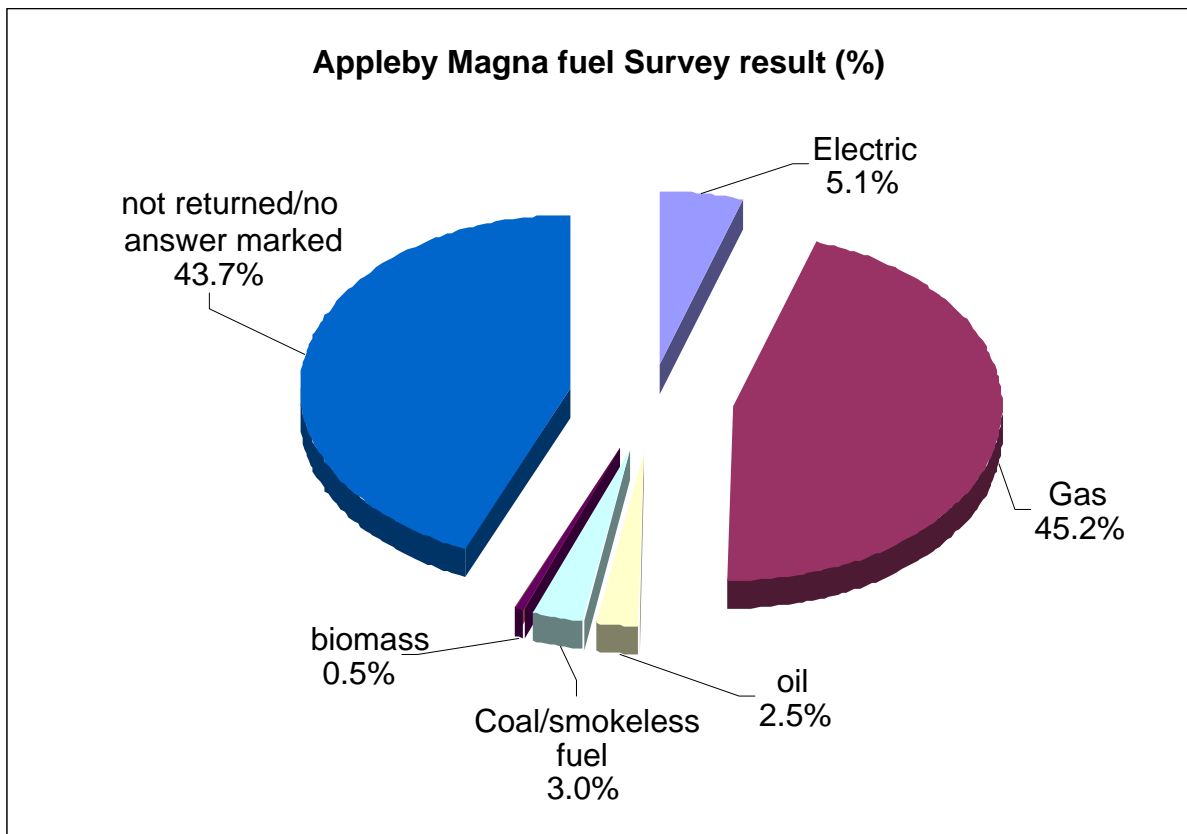


Figure 12 Belton Fuel Survey

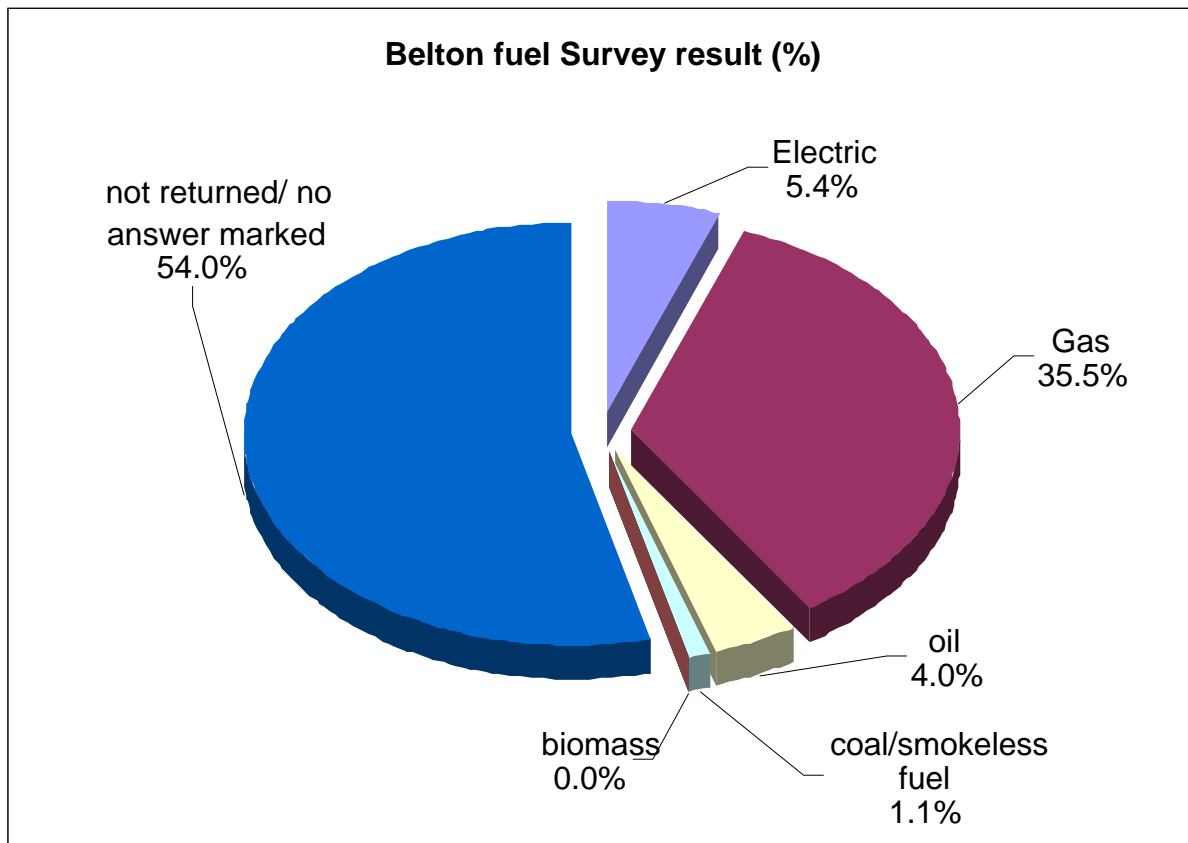


Figure 13 Blackfordby Fuel Survey

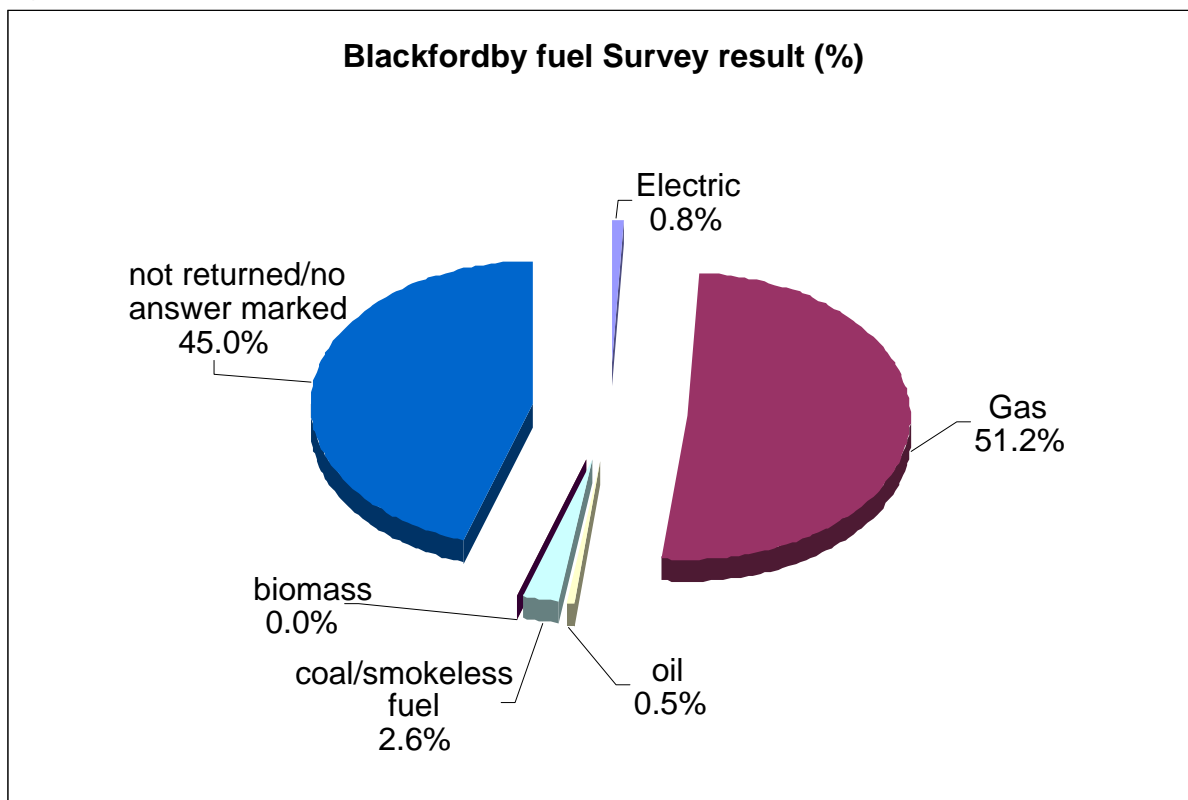


Figure 14 Breedon on the Hill Fuel Survey

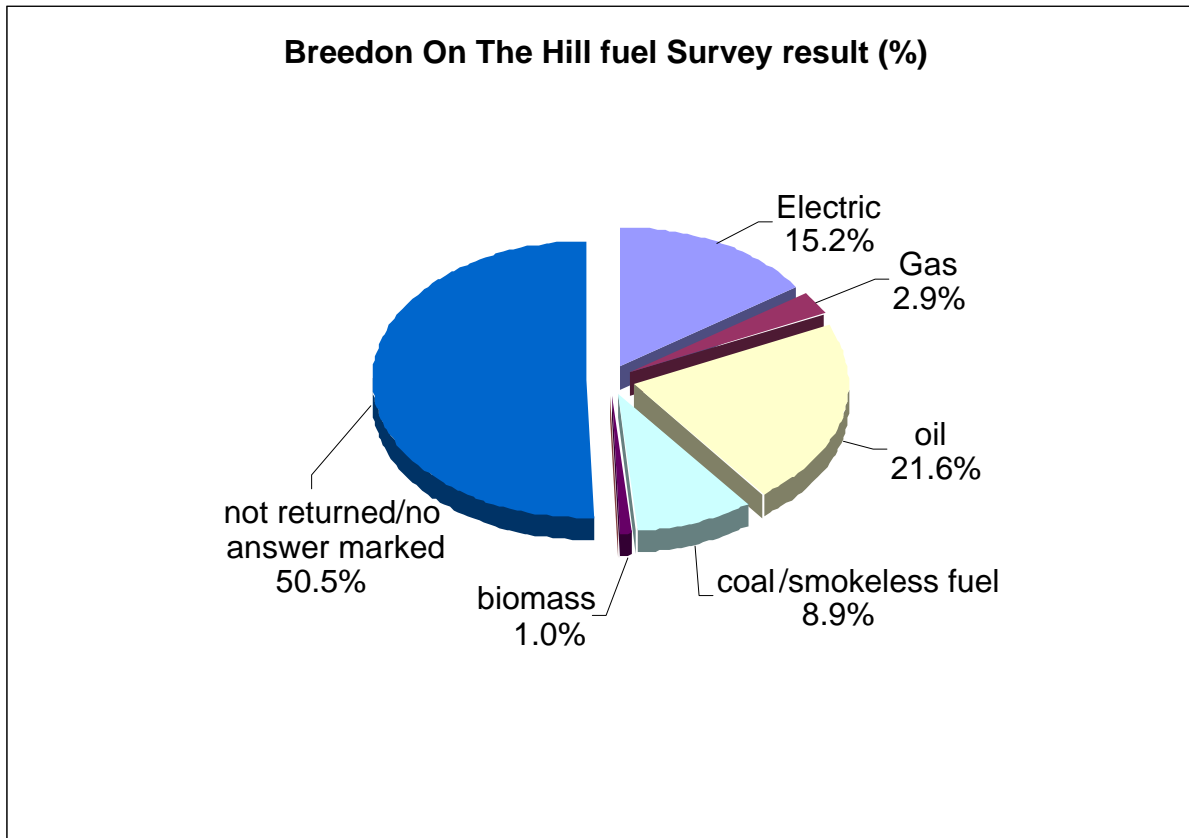


Figure 15 Donisthorpe Fuel Survey

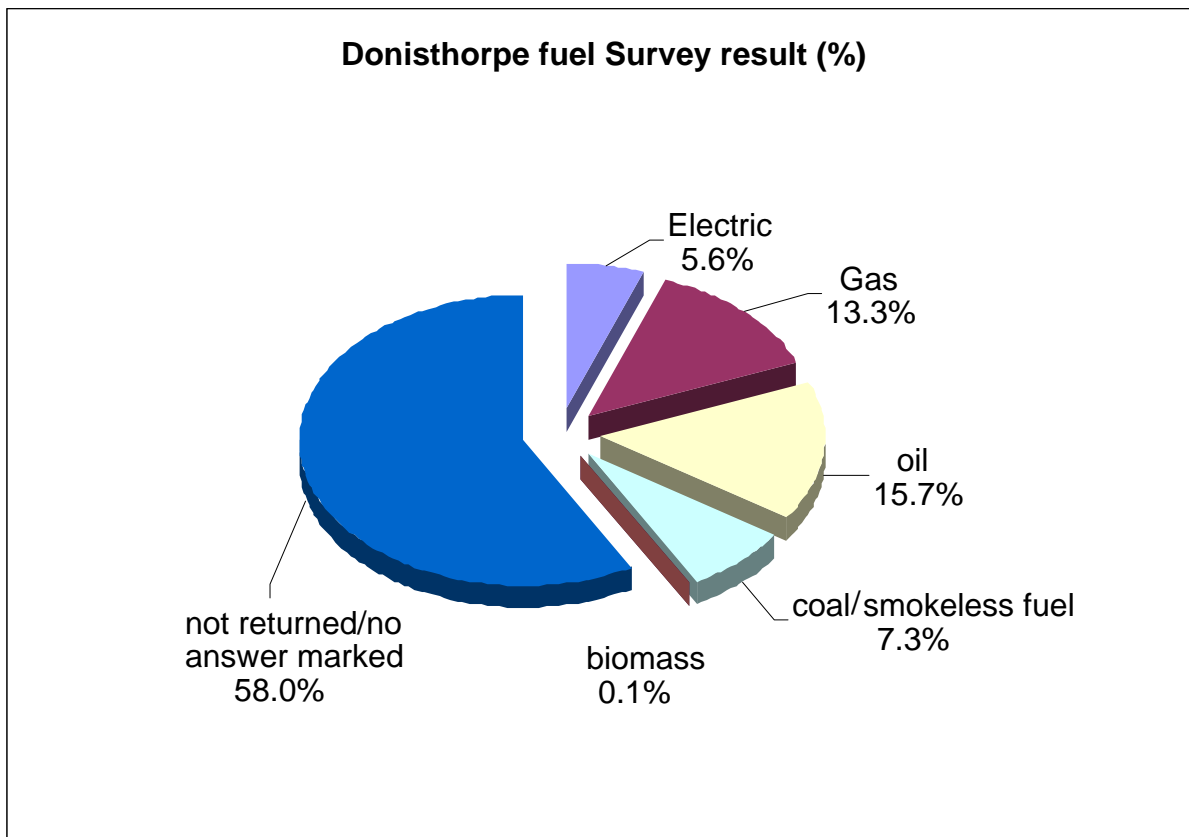


Figure 16 Hemington Fuel Survey

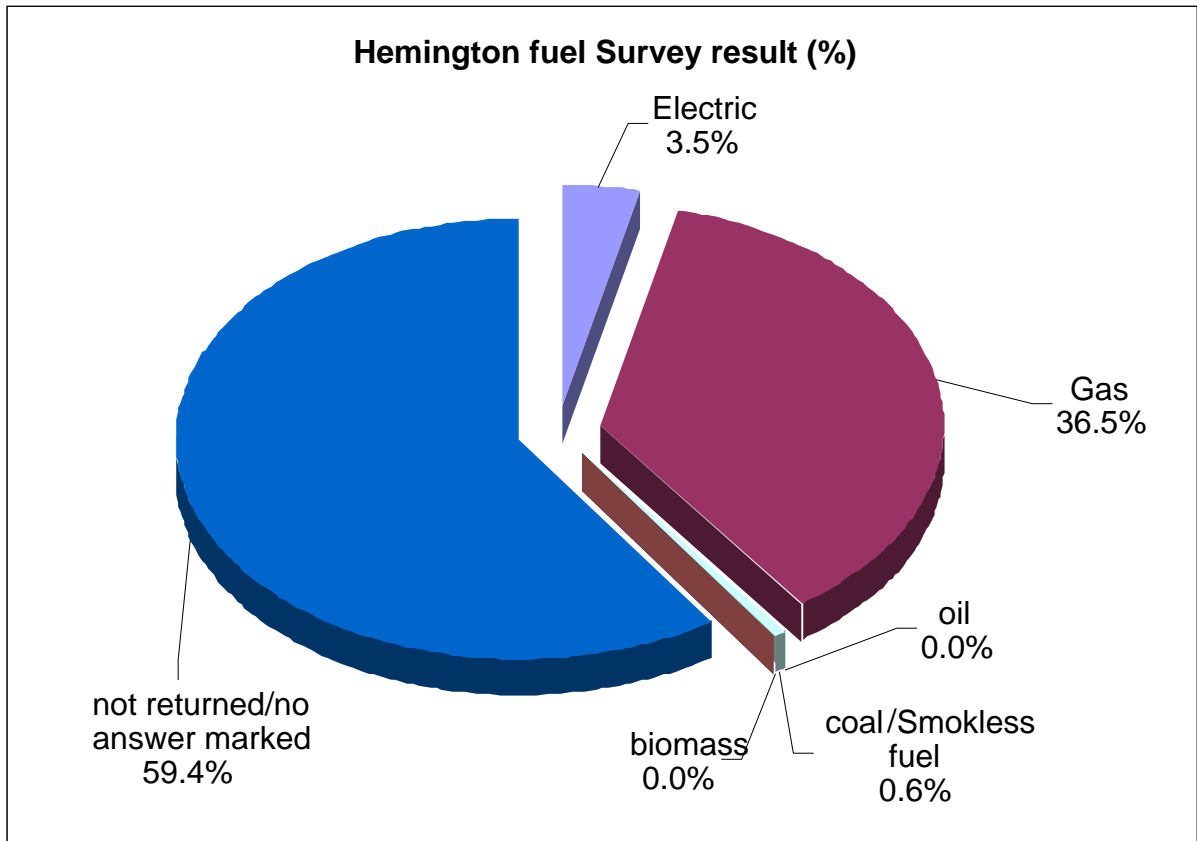


Figure 17 Moira Fuel Survey

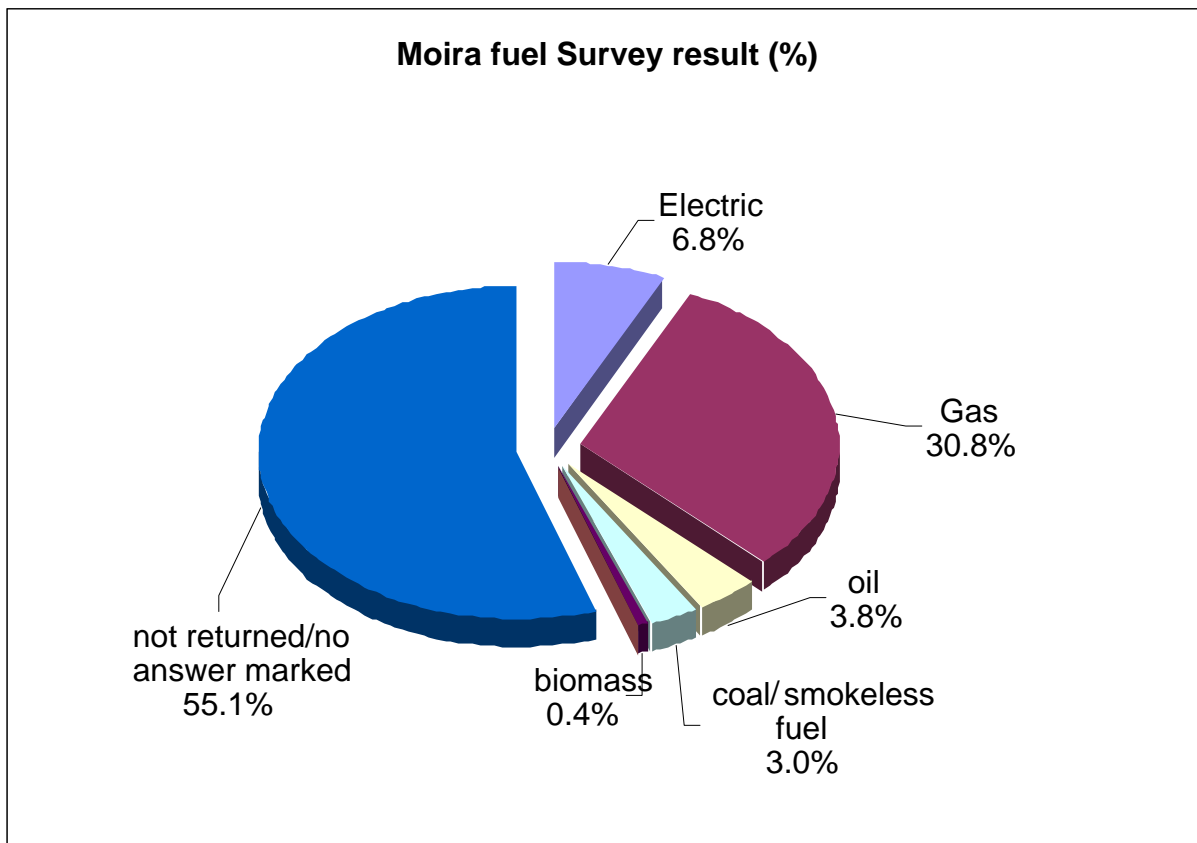


Figure 18 Newbold Fuel Survey

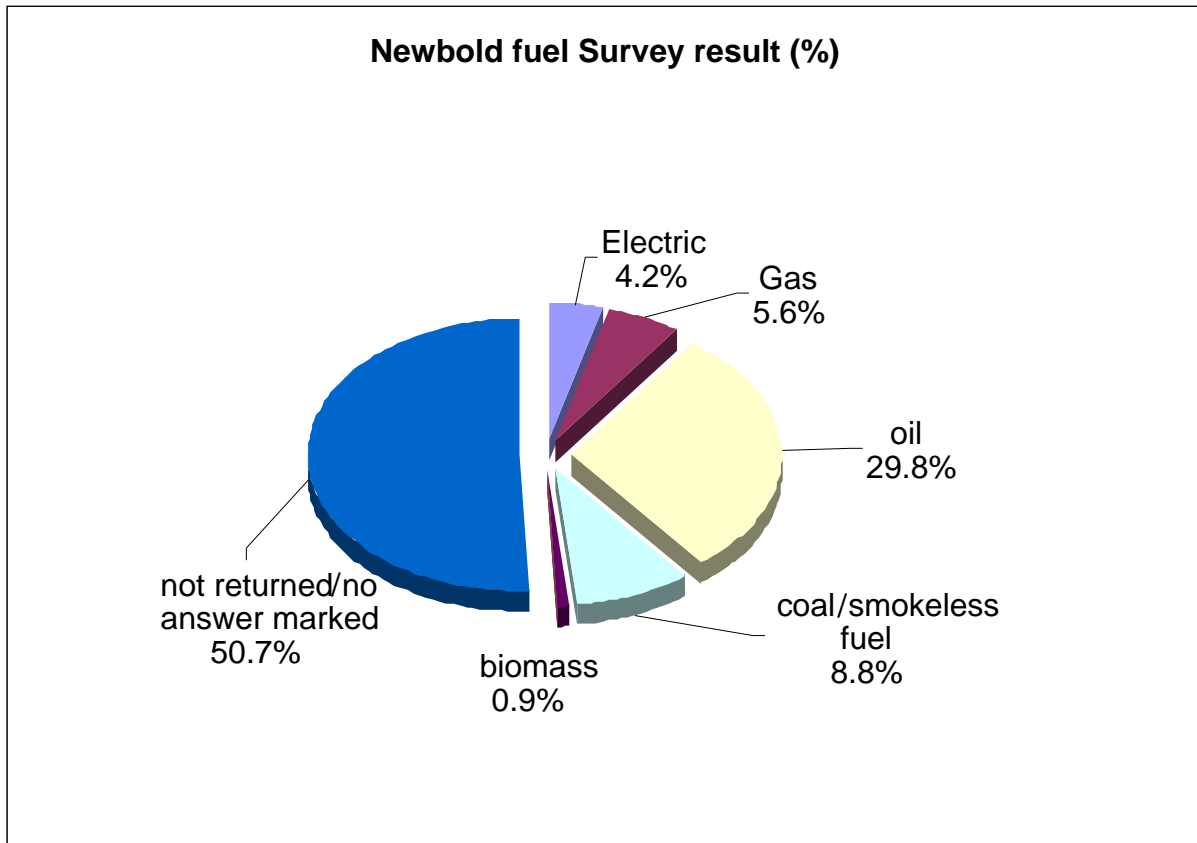


Figure 19 Newton Burgoland Fuel Survey

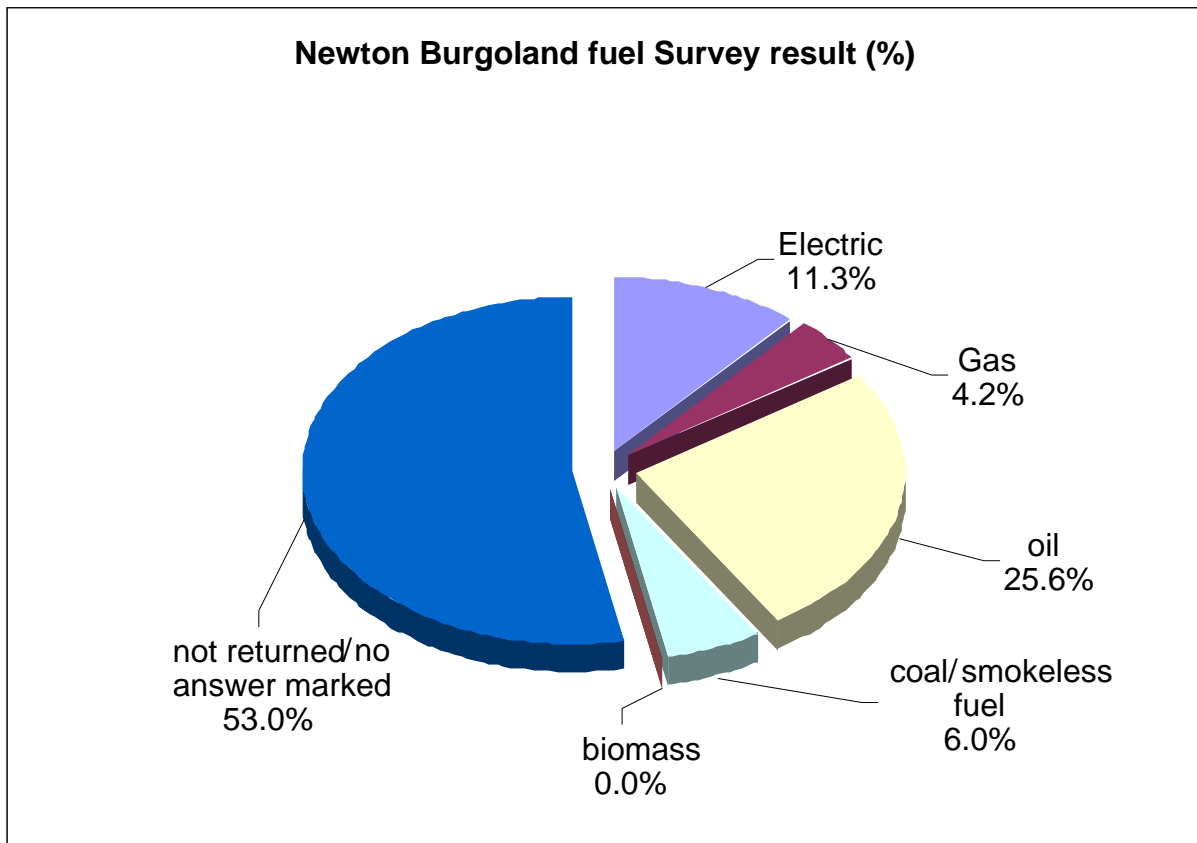


Figure 20 Oakthorpe Fuel Survey

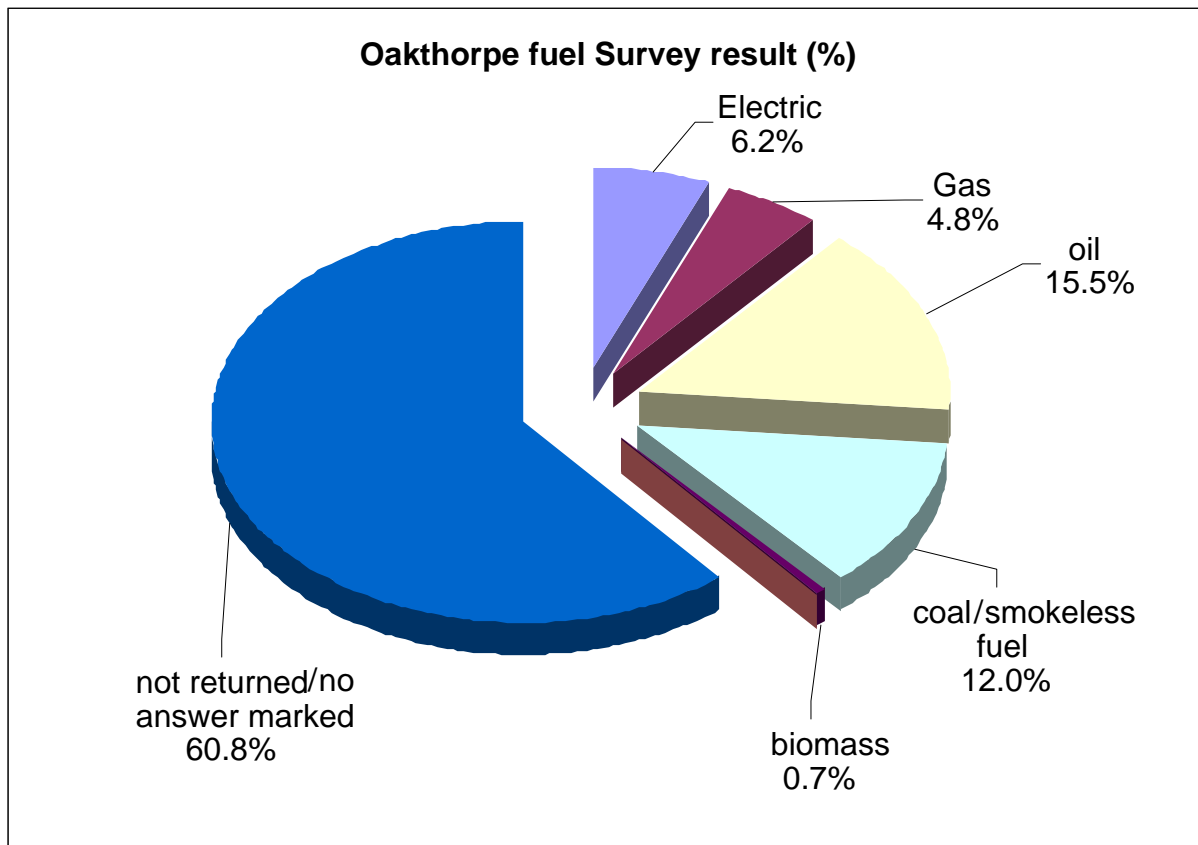


Figure 21 Packington Fuel Survey

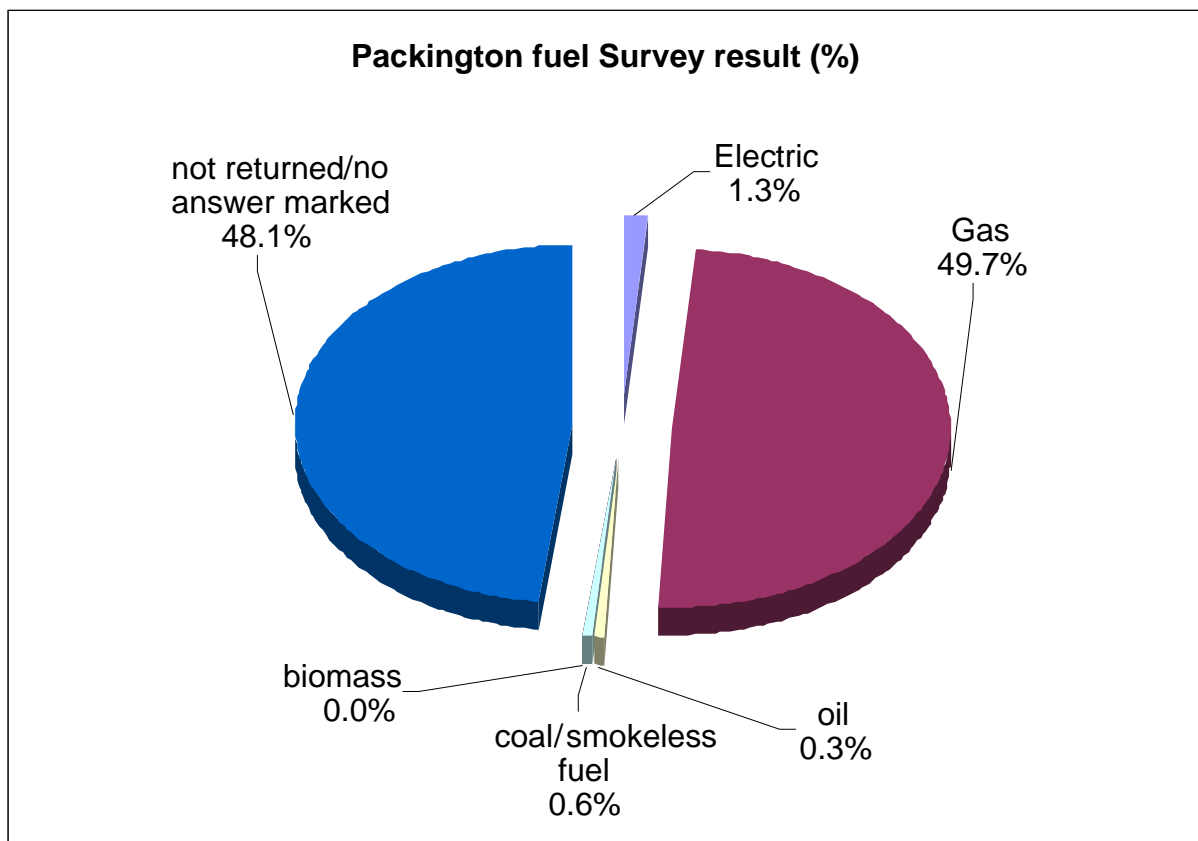


Figure 22 Ravenstone Fuel Survey

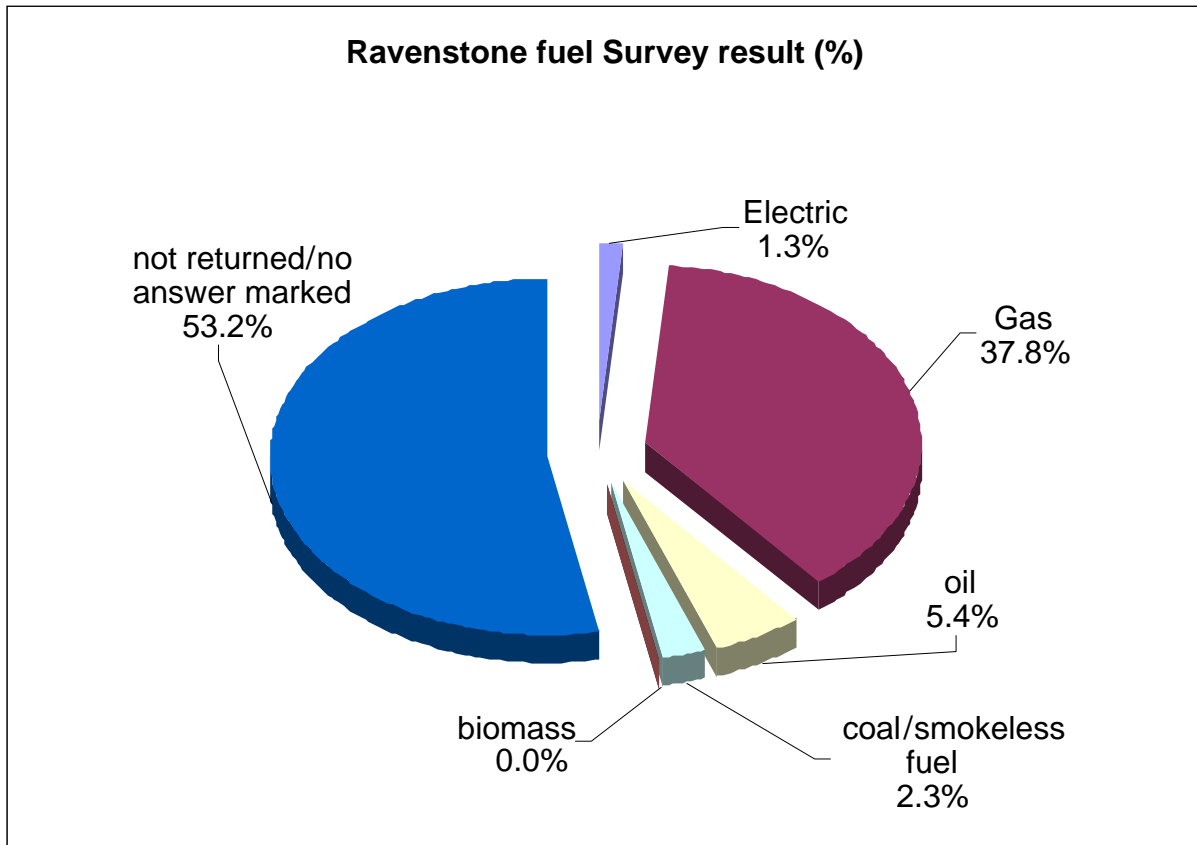
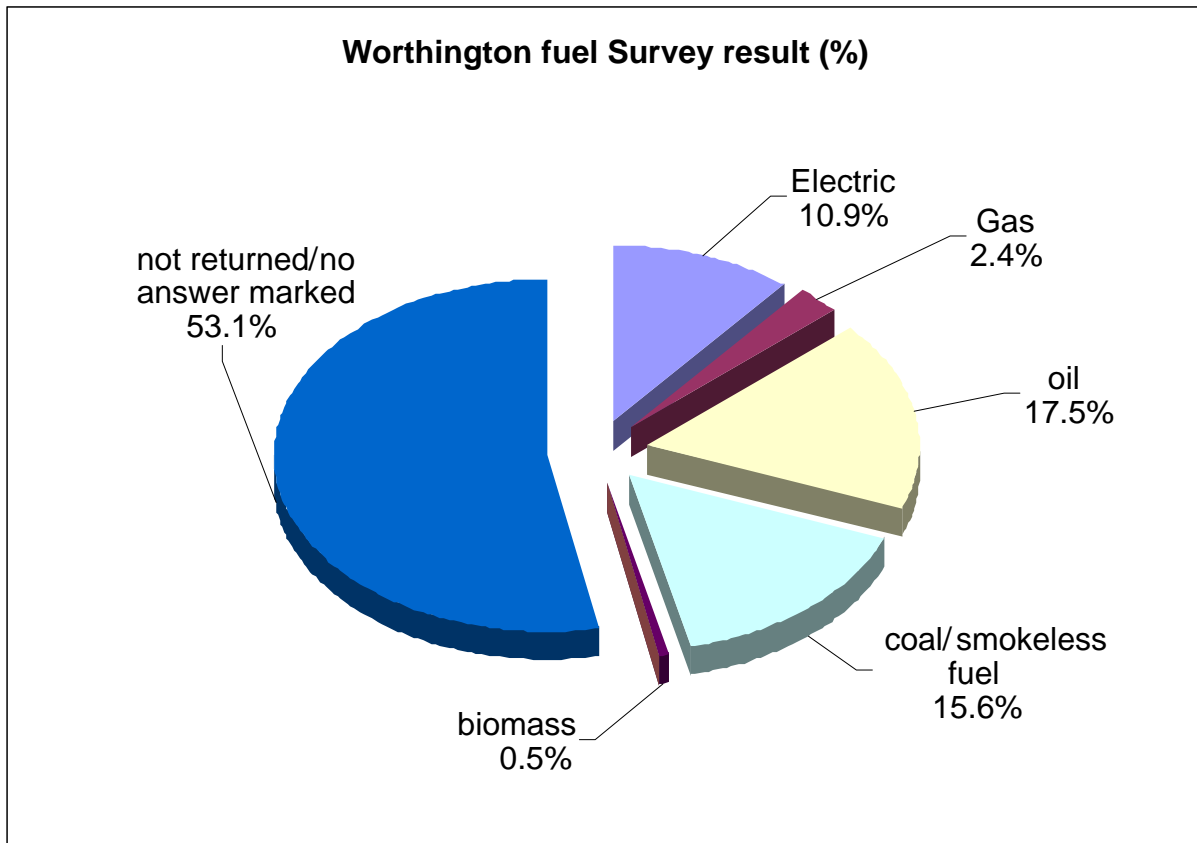


Figure 23 Worthington Fuel Survey



5 Analysis of Results

In order to be conservative in our estimate of the true number of properties using coal / smokeless fuel as their primary source of heating the 95% confidence error level will be added to the estimated number of people using Coal / smokeless fuel.

Where

- x = total confirmed using coal in survey
- n = total valid returns from survey
- N = Total population
- z = estimated number of people in total population using coal / smokeless fuel
- z_{95} = estimated number of people in total population using coal / smokeless fuel 95% confidence
- c = 95th percentile confidence interval
- $\hat{\rho}$ = proportion of survey using coal / smokeless fuel

$$\hat{\rho} = \frac{x}{n}$$

$$z = N \hat{\rho}$$

$$z_{95} = z + (zc)$$

The estimated number of properties burning coal in each surveyed area is presented in Table 4. Only Donisthorpe is estimated to have more than 100 properties burning coal as its primary source of heating. The area surveyed is 3 times the 500m×500m area mentioned in the guidance it is therefore unlikely that more than 100 properties in a 500m×500m area are burning coal as their primary source of heating.

Table 4. Data analysis of each area surveyed.

Place	total return using coal / smokeless (n)	proportion of return using coal / smokeless $\hat{\rho}$	estimated number of properties using coal z	estimated number of properties using coal +95% error level Z ₉₅
Albert Village	30	0.263	74.74	80.05
Appleby Magna	12	0.054	21.3	22.22
Belton	3	0.024	6.52	6.94
Blackfordby	10	0.047	18.19	19
Breedon On The Hill	28	0.179	56.54	59.7
Donisthorpe	55	0.174	131.06	136.57
Hemington	1	0.014	2.46	2.69
Moira	7	0.067	15.6	16.71
Newbold	19	0.179	38.54	41.16
Newton Burgoland	10	0.127	21.27	22.98
Oakthorpe	35	0.307	89.34	95.75
Packington	2	0.012	3.86	4.06
Ravenstone	14	0.050	29.9	31.18
Worthington	33	0.333	70.33	75.39
Total No.	259	0.1190	551.93	560.39

6 Conclusions and Proposed Actions

The results show that none of the areas identified, as potentially exceeding the Sulphur Dioxide Air Quality Objectives (AQO), are likely to exceed the AQO as they do not meet the criteria set out in Box 5.8 D.2 in the Local Air Quality management technical guidance TG09 [17] (Box 5.8 D.2. has been reproduced in section 2).

6.1 Proposed Actions

No further action is required.

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- [16] British Standards Institution 2007. *BS ISO 4226:2007 - Air quality. General aspects. Units of measurement*. Milton Keynes: BSI

7.4 Technical guidance

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