Falkirk Council

Detailed Assessment of PM_{10} in Banknock

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

December 2010

Local Authority Officers	Author: Jon Flitney. Reviewed by: Graeme Webster, Stuart Henderson and Alf Hillis.
Department	Environmental Health, Development Services.
Address	Abbotsford House, David's Loan, Falkirk, FK2 7YZ.
Telephone	01324 504950
E-mail	envhealth@falkirk.gov.uk
Report Reference	Detailed Assessment of PM_{10} in Banknock.
Date	December 2010

Executive Summary

Falkirk Council proceeded to a Detailed Assessment for particulate matter (PM_{10}) in the Banknock area of Falkirk, in proximity to Cowdenhill Quarry, as a result of local resident complaints in respect of dust and other screening criteria required by the technical guidance. PM_{10} monitoring commenced in the area in October 2009. The monitoring was carried out in the grounds of a dwelling in Coneypark Place, Banknock, Falkirk. An Osiris monitor was used. The site is named Banknock 1.

The number of daily PM_{10} exceedances recorded in the year of monitoring was 30. This is greater than the number of daily exceedances permitted by the Scottish PM_{10} daily objective but is within the 35 daily exceedances permitted by the UK PM_{10} daily objective. The annual concentration recorded was 23.5 $\mu g/m^3$. This is greater than the Scottish PM_{10} annual objective of 18 $\mu g/m^3$ but is below the UK PM_{10} annual objective of 40 $\mu g/m^3$. A correction factor of 1.3 was used, this is discussed in detail in the report.

As Banknock 1 is located at relevant receptors for both the annual (residential building façade) and daily objectives (garden of residential property) an Air Quality Management Area (AQMA) is required. The AQMA declaration will need to include the Scottish PM_{10} objectives and it is recommended that it should also include, due to the potential to breach, the two UK PM_{10} objectives. This is due to the 90.4th percentile concentration being “close to“ breaching the UK PM_{10} daily objective. The monitoring was not conducted in the “worst case” modelled location due to the need to be representative of a greater number of receptors and due to limitations on issues such as power supply.

An analysis of the monitoring data has also been carried out. This highlights differences in the PM_{10} concentrations between the Banknock 1, the background Grangemouth and the roadside Falkirk West Bridge St monitoring sites which were used as a comparison. For example, the number of daily exceedances recorded at the Banknock 1 site was greater in the summer than in the winter months and the ratio of $PM_{2.5}$ to PM_{10} suggests that the particles at Banknock 1 are in the larger size fraction (2.5 to 10 µm in diameter).

The monitoring and analysis of the data adds evidence to the theory that a possible contributor to the PM_{10} concentrations at Banknock 1 relate to the activities of the nearby Cowdenhill Quarry.

Contents

List of Figures

List of Tables

Abbreviations

ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network (UK monitoring network)
DEFRA	Department for Environment, Food and Rural Affairs (UK Government)
DMRB	Design Manual for Roads and Bridges
FDMS	Filter Dynamics Measurement System (for measuring PM_{10})
LAQM	Local Air Quality Management
NAEI	National Atmospheric Emissions Inventory
NAQS	National Air Quality Strategy
PM_x	Particulate matter, less than x µm in diameter
PPC	Pollution Prevention and Control (Regulations)
SAQN	Scottish Air Quality Network
SEPA	Scottish Environment Protection Agency
TEOM	Tapered Element Oscillating Microbalance (for measuring PM_{10})
USEPA	United States Environment Protection Agency
VCM	Volatile Correction Model
WBS	Falkirk West Bridge Street (monitoring site).

1 Introduction

Falkirk Council is a unitary authority located in Central Scotland (Figure A1). Falkirk Council area encompasses 290 square kilometres with a population of approximately 151,000, the Council area extends from Banknock in the west to Blackness in the east and from South Alloa in the North to Limerigg in the south. It is bordered by the local authorities of North Lanarkshire, Stirling and West Lothian, with Clackmannanshire and Fife located on the north side of the Firth of Forth.

The Council area contains the port of Grangemouth and depends for its prosperity on a broad industrial base which includes sizeable industrial areas in Falkirk and Grangemouth. These industrial areas include an oil refinery, associated chemical industry and dockland in Grangemouth. The main towns and population base in the area are Bo'ness, Denny, Falkirk, Grangemouth and Larbert with the area around Slamannan in the south being more rural in nature.

Three motorways pass through the area, the M80, M876 and M9, in addition to the main rail line connecting Glasgow and Edinburgh and the rail lines connecting Glasgow / Edinburgh with Stirling and the north. The area also contains the Falkirk wheel which connects the Union and Forth and Clyde canals.

Local authorities are required to review and assess air quality in their area for seven pollutants. The air quality objectives applicable to Local Air Quality Management (LAQM) in Scotland are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97) and the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish SI 2002 No 297).

Table 1 shows the objectives and, where applicable, the number of exceedances in each year that are permitted. The PM_{10} objectives relevant to this report are highlighted in bold. Local authorities are required to work towards achieving the objectives set out in Table 1. There is currently no requirement on local authorities to achieve the objectives. This report fulfils the requirements of the LAQM process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance (LAQM.TG(09)) documents.

Table 1: Air Quality Objectives included in Regulations for Local Air Quality Management in Scotland.

Pollutant	Concentration	Measured as	Compliance date
Benzene	16.25 ug/m^3	Running annual mean	31/12/2003
	3.25 µg/m^3	Running annual mean	31/12/2010
1,3-Butadiene	2.25 µg/m^3	Running annual mean	31/12/2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31/12/2003
Lead	0.5 µg/m^3	Annual mean	31/12/2004
	0.25 µg/m^3	Annual mean	31/12/2008
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31/12/2005
	40 µg/m^3	Annual mean	31/12/2005
Particles (PM_{10}, gravimetric)	**50 µg/m^3, not to be exceeded more than 35 times a year**	**24-hour mean**	**31/12/2004**
	40 µg/m^3	**Annual mean**	**31/12/2004**
	50 µg/m^3, not to be exceeded more than 7 times a year	**24-hour mean**	**31/12/2010**
	18 µg/m^3	**Annual mean**	**31/12/2010**
Sulphur dioxide	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31/12/2005
	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31/12/2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31/12/2004

Particles can be classified by their diameter. In this report the focus is on PM_{10}, these are defined as particles that are less than 10 µm in diameter. **See below: [a]** Fine particles, such as PM_{10}, can be carried deep into the lungs where they can cause inflammation and a worsening of conditions suffered by people with heart and lung diseases. **Ref: 1** Larger particles are more likely to be filtered out by the nose and the body's defence mechanisms, although larger particles have the potential to cause nuisance as they are visible.

The smaller particles, such as $PM_{2.5}$ (particles less than 2.5 µm in diameter), are not currently covered by the LAQM process.

The PM_{10} objectives have different compliance dates. To avoid confusion between these and monitoring dates, the objectives with a 2010 compliance date will be referred to as the objectives applicable to Scotland (7 exceedances and 18 µg/m^3) and those with a 2004 compliance date will be referred to as UK wide objectives (35 exceedances and 40 µg/m^3). All objectives are stated in Scottish legislation but the UK objectives are included in relevant legislation in the other parts of the UK as they have their origins from EU Directives.

Detailed Assessment

A Detailed Assessment is designed to identify whether an air quality objective of any of the pollutants listed in Table 1 is being breached (or has the potential to be breached) for a particular area.

Falkirk Council originally proceeded to a Detailed Assessment for the area in proximity to Cowdenhill Quarry in respect of local resident complaints about dust and other screening criteria that are required by the technical guidance. This resulted in a modelling study being completed. The Discussions and Conclusions section from this report are reproduced in the Appendix (Figure A2). The modelling study recommended that monitoring should be carried out in the area. Additional modelling may be carried out in the future, but currently this report is concentrating on reporting and analysing the monitoring data. In addition, there were significant uncertainties in the modelling, particularly for re-suspended dust. As stated in the Technical Guidance (LAQM.TG(09)) "due to the uncertainties associated with defining emissions from uncontrolled and fugitive sources, it is likely that the Detailed Assessment with need to focus

[a] The strict definition relates to the size selection of the analyser in terms of a 50% efficiency cut off point, which is at 10 µm for PM_{10}.

upon a detailed monitoring programme". Fugitive sources can include, for example, construction and re-suspended dust.

Air Quality Management Areas (AQMAs)

If the Detailed Assessment shows that an objective has been breached (or has the potential to be breached) and there are also relevant receptors in the area, then an Air Quality Management Area is required. An AQMA declaration leads to the formation of an Action Plan which aims to implement measures so that the objectives are met. When the objectives are met an AQMA can be revoked.

At the time of writing there are 12 Scottish Local Authorities and 230 Local Authorities in the remainder of the UK that have declared AQMAs. An AQMA can vary in size from a single house or footpath to the total area of a Council. The vast majority of AQMAs are for road traffic tailpipe emissions. Falkirk Council has four AQMAs: One in Grangemouth (SO_2, industrial emissions), two in Falkirk Town Centre (NO_2, road traffic emissions) and one in Haggs (NO_2, road traffic emissions).

Further Assessment

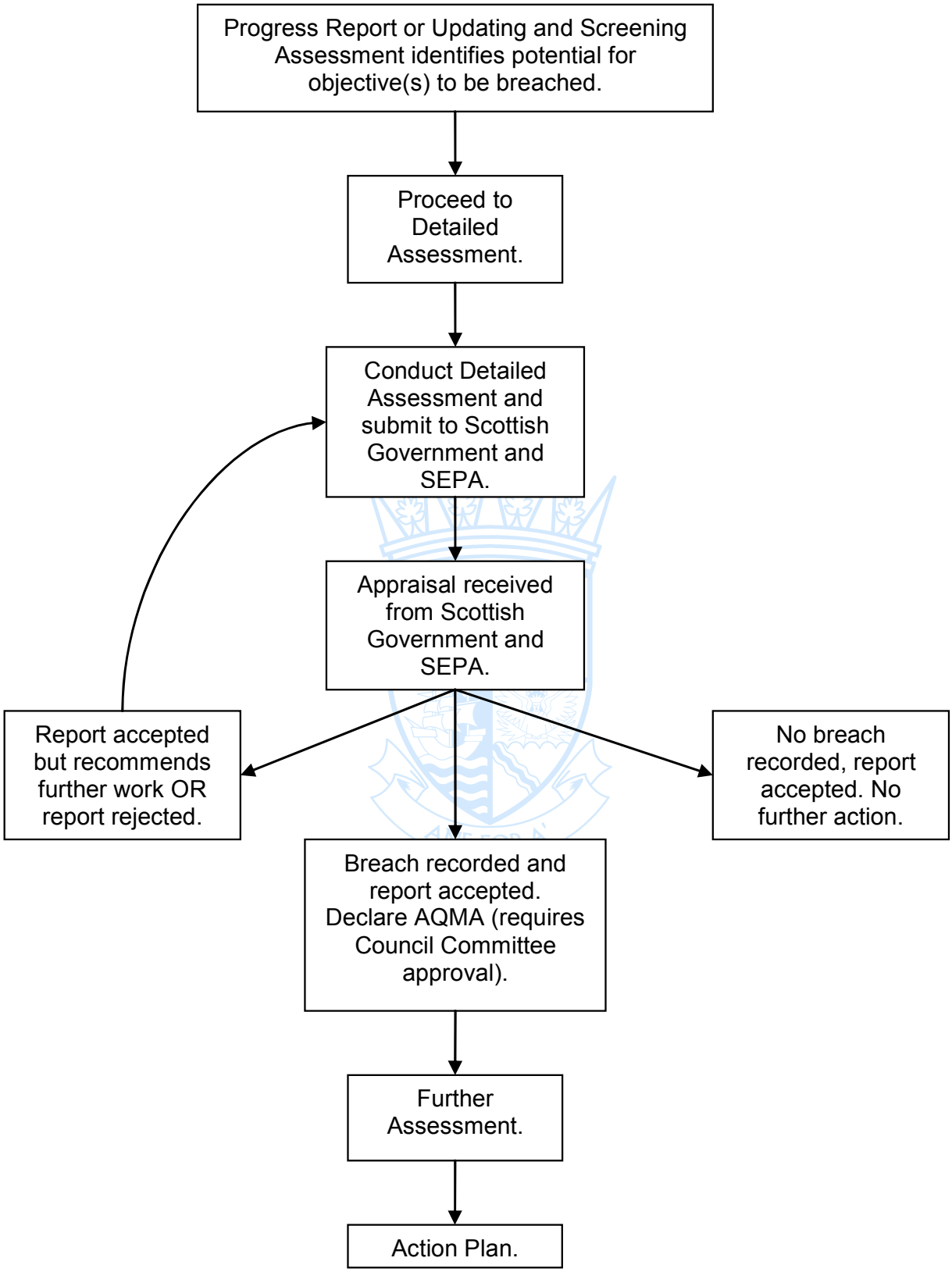
If an AQMA is declared then the Council is currently required to submit a Further Assessment. The aim of the Further Assessment is to identify the sources of the pollutant. This is known as source apportionment. If this Detailed Assessment shows that an objective is being breached the Council aims to, at least partially, discuss the potential sources in this report through analysis of the monitoring data.

Action Plan

In addition to the Further Assessment the Council is required to submit an Action Plan. This Plan will contain measures that are designed to reduce the pollutant concentrations such that the objective(s) that are being breached are met, with the focus and priority on measures that are effective, feasible, proportionate and quantifiable. The development of this Action Plan usually runs parallel with the Further Assessment.

A simplified summary of the Review and Assessment process is shown in Figure 1.

Figure 1: Simplified Summary of the Review and Assessment Process.



2 Details of Monitoring

The monitoring commenced on the 21st October 2009 in the grounds of a dwelling in Coneypark Place in Banknock, Falkirk. The location of the monitor is shown in Figures 2a and 2b with four pictures of the monitoring site shown in the Appendix (Figure A3). The site is called Banknock 1.

The full grid reference of the analyser is 277348 / 679037 thus the OS grid reference is: NS77348 79037. The entrance to the track that connects the A803 road and Cowdenhill Quarry is on the western edge of Figure 2a. The A803 road is immediately to the south of the monitor. The western limit of the Falkirk Council area is shown by the black line in the mid to north-western edge of Figure 2b. The area west of this line is within the North Lanarkshire Council area.

Figure 2a: Map showing the location of the Banknock 1 Analyser, scale 1:1500.

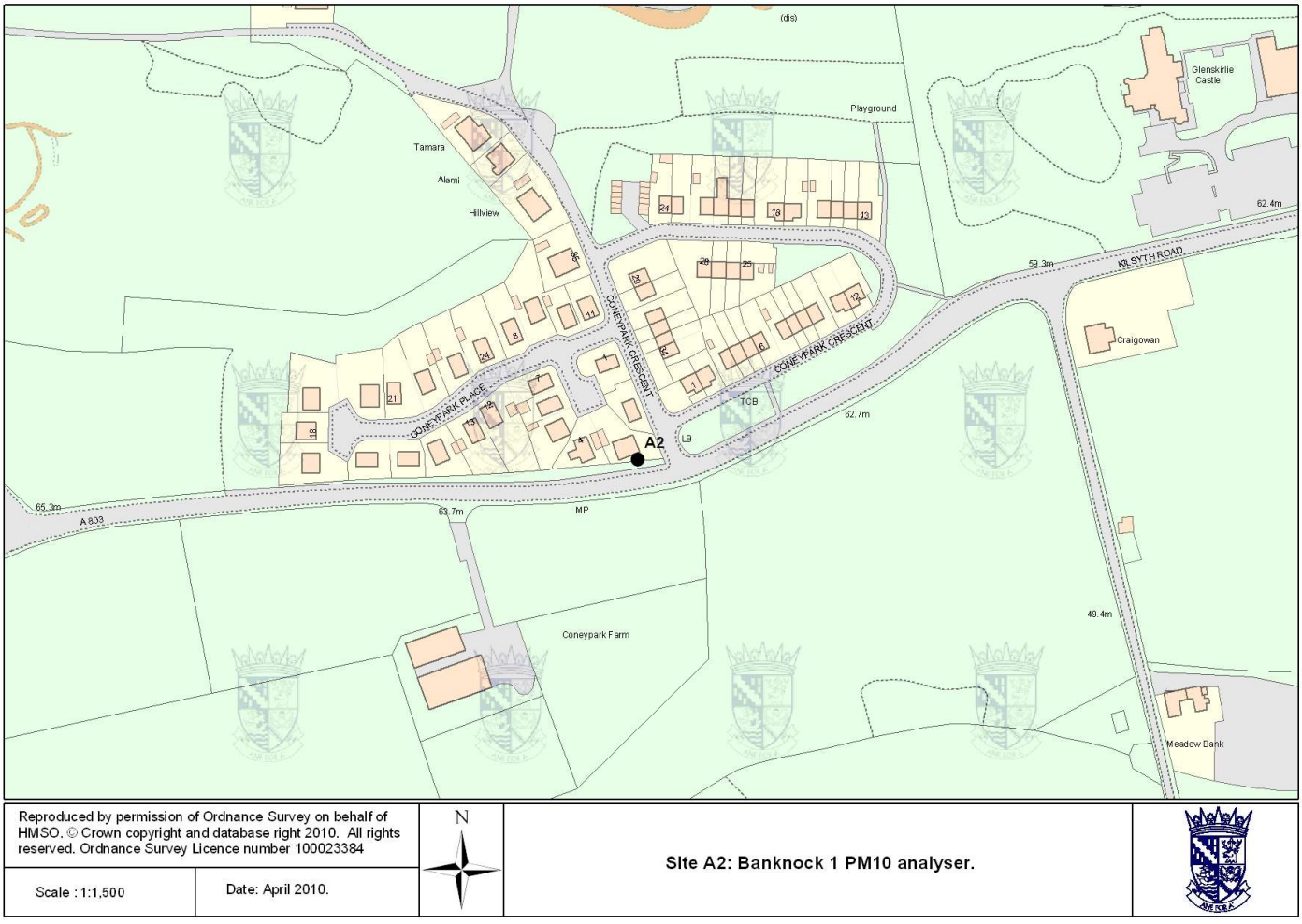
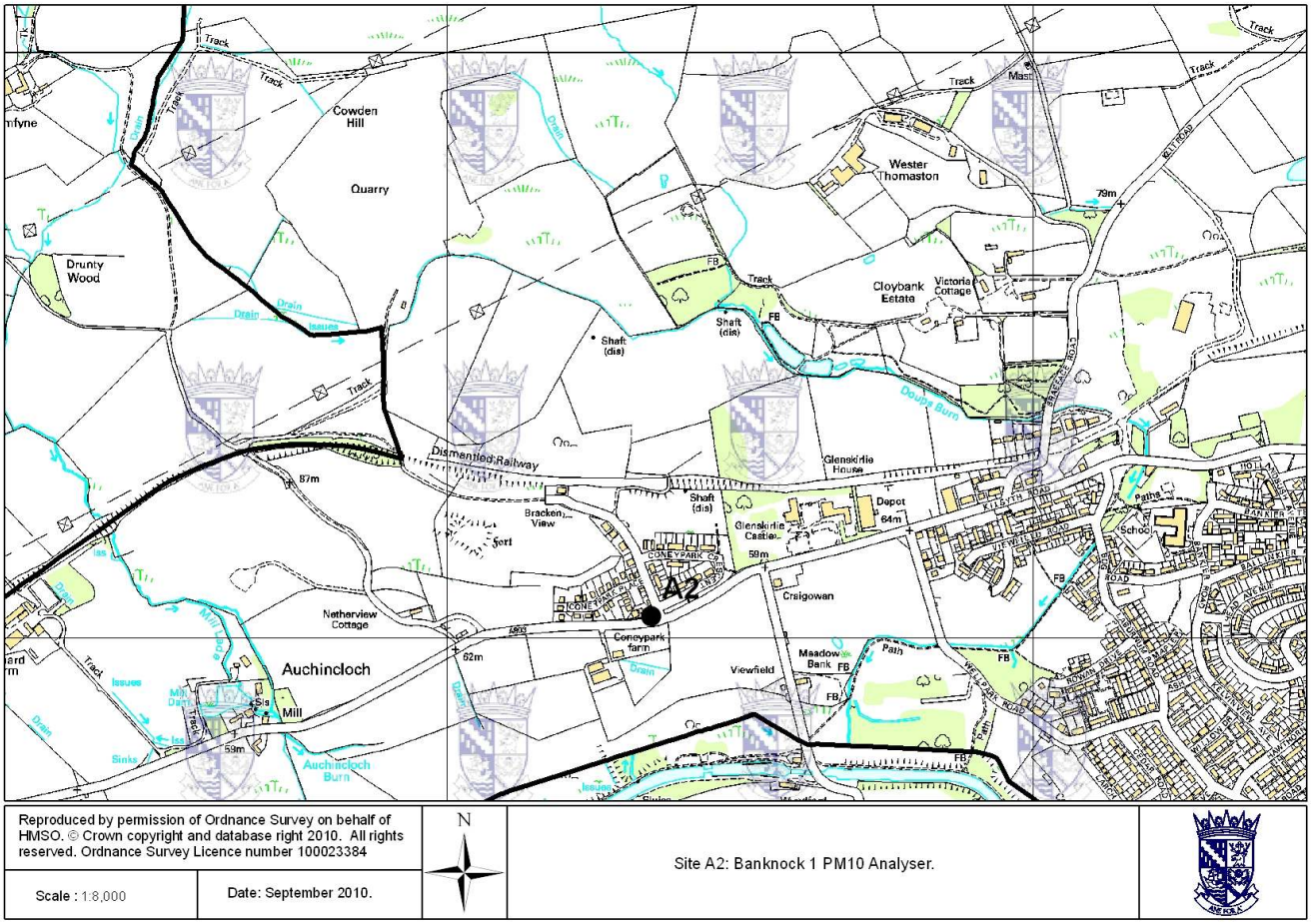


Figure 2b: Map showing the location of the Banknock 1 Analyser, scale 1:8000.



Note: In addition to the name Banknock 1, this site is labelled as A2 as identified in Falkirk Council's 2010 Progress Report.

A Turnkey Osiris direct reading airborne particle monitor has been used for monitoring. While the technical guidance recommends that light scattering devices, like an Osiris, should not be used for Detailed Assessment work, the Scottish Government and SEPA are aware that this type of monitor is being used in relation to this work and to date have raised no objections. An Osiris monitor was utilised for the following reasons:

- The Council was also investigating dust complaints in the area. The Osiris will be useful for this investigation.
- The monitor was available for use.

- The only Council based electricity supply in the area was a supply used for a road traffic speed limit sign. This was connected to the mains supply in August 2009.

The monitoring location was chosen for the following reasons:

- The residents were happy for the monitor to be located within the grounds of their dwelling.
- The monitor is as close as possible to the A803 road. The analyser has been located to minimise the vegetation between it and the A803 road. The distance from the analyser to the kerb of the A803 road is 6 metres and to the centre of the road is 9 metres.
- The monitor is in a location that is relevant for both the annual mean objective (residential building façade) and the daily mean objective (garden of residential property).

The inlet height is 1.35 metres above the ground level. This is slightly below the recommended minimum of 1.5 metres but still gives a good representation of the receptors in the area. The analyser was used with the heated inlet switched on. The data from the analyser has had an adjustment factor of 1.3 applied. The issue of correction factors is discussed in Section 4. Details of the site visits and handling of the data are described in the Appendix (Figure A4).

The modelling for the original Detailed Assessment showed that under all scenarios the location with the highest predicted concentrations was Netherview Cottage. This dwelling is adjacent to the track that leads from the A803 road to Cowdenhill Quarry. Thus the analyser is not in the “worst case” location, but it is located in an area where a greater number of properties are represented.

3 Monitoring Results for Banknock 1

Table 2 shows the monitoring data results from the analyser at the Banknock 1 site for the period from 22nd October 2009 to 21st October 2010. Monitoring is continuing.

Table 2: Summary of the Monitoring Data at the Banknock 1 Site.

Site	Annual mean, µg/m^3	Number of daily exceedances	90.4th percentile, µg/m^3	98th percentile, µg/m^3	Data capture, %
Banknock 1	23.5	30	48.6	68.1	87.2

As Table 2 shows the number of daily exceedances recorded during the monitoring period was 30. [b] The number of daily exceedances was above the 7 permitted by the Scottish PM_{10} daily objective but below the 35 permitted by the UK PM_{10} daily objective. [c]

The hourly data capture across the year was 87.2%. This is slightly below the ideal level of 90% but is above 75%, below which data should be treated with caution. [d] Thus the appropriate percentiles need to be considered and are also shown in Table 2. These should be compared to the concentration in the daily objective of 50 µg/m^3. As the number of exceedances is greater than the number permitted in the Scottish PM_{10} daily objective, the 98th percentile is, as expected, also above the objective concentration at 68.1 µg/m^3.

For the UK PM_{10} daily objective the 90.4th percentile needs to be considered, this was 48.6 µg/m^3. This is below the objective concentration of 50 µg/m^3 and so it is considered that the UK PM_{10} daily objective has been met at the Banknock 1 monitoring site.

The annual mean recorded was 23.5 µg/m^3. This is greater than the Scottish PM_{10} annual objective of 18 µg/m^3 but is below the UK PM_{10} annual objective of 40 µg/m^3.

[b] A day is defined by the technical guidance as being from midnight to midnight.
[c] All concentrations used for this report have been rounded to one decimal place.
[d] The data capture does not need to be greater than either 75% or 90% to record a breach of either daily objective. However, achieving these levels aids comparison with other sites and changes from year to year.

4 Analysis and Discussion

A summary of the statistics from the monitoring data was shown in Table 2. This section analyses and discusses the monitoring data in greater detail.

Banknock 1 Data

As a consequence of the monitoring results obtained an Air Quality Management Area will be necessary. The declaration of an AQMA will be required for the breach of the Scottish PM_{10} objectives and its area will need to include the Banknock 1 site. The monitoring indicated that the UK PM_{10} objectives were met at the Banknock 1 site. However, as the number of exceedances and the 90.4th percentile can be considered to be "close to" the UK PM_{10} daily objective and the monitor was not located at the "worst case" modelled location, it is recommended that the declaration should also include the UK objectives as a precaution.

The Osiris monitor is typically used as a screening tool for PM_{10} concentrations. The Osiris monitor is not the EU reference method for measuring PM_{10} and is not equivalent to the reference method. However, as discussed in Section 2 the monitor was used for a variety of reasons and the Scottish Government and SEPA are aware of its use for this work.

The data collected from the Osiris monitor requires to have a correction factor applied. This is due to the analyser using a heated inlet to prevent moisture interference with its operation. However, a disadvantage is that some particulate matter is driven off. An enquiry was submitted to King's College London to ascertain whether the Volatile Correction Model (VCM) [e] could be applied to Osiris PM_{10} data similar to TEOM PM_{10} data. Unfortunately King's College stated that the VCM could not be applied to Osiris data. **Ref: 2**

The Council asked the DEFRA and DA run Helpdesks as to which correction factor should be used for Osiris data and was directed to the frequently asked question on the Air Quality Archive website, see Reference 3. The information in this FAQ suggests the use of a 1.3 correction factor. This could be seen as conservative (i.e. higher concentrations are being reported) bearing in mind the previous use of a 1.14 factor for TEOM equipment in Scotland. This is a different analyser and the FAQ information was provided by SEPA (and after a time when the 1.14 factor was in use). As it would be considered a

[e] See www.volatile-correction-model.info

precautionary approach the Council has remained with the 1.3 correction factor for this report. This is in-line with the small amount of 2009 monitoring data presented in the 2010 Progress Report.

It should be noted that a breach of the Scottish PM_{10} objectives occurs whether a 1.14 correction factor is applied or there is no adjustment.

Analysis of Monitoring Data

Openair [Ref 4, 5] and Excel have been used to provide an analysis of the monitoring data. In addition, data from other sites has been used to provide a comparison to the Banknock 1 data. The closest AURN or SAQN site to Banknock is the North Lanarkshire Council site in Croy. However, due to low data capture since June 2010 for this site, two of Falkirk Council's sites have been chosen. One is the Grangemouth AURN site which is in an urban background location and the second a roadside site on West Bridge Street, Falkirk (WBS). [f]

Table 3 shows that the majority of the data loss for the Banknock 1 site occurred in the winter months (October to March). It is therefore accepted that the annual mean PM_{10} concentration may have been affected slightly by this, but it is otherwise noticeable that summer (April to September) PM_{10} concentrations are greater than winter concentrations at the Banknock 1 site.

Table 3: Winter and Summer Concentrations and Data Capture for the Banknock 1 Site.

Banknock 1	Winter	Summer
Mean concentration, $\mu g/m^3$	16.3	29.4
Data capture, %	79.3	95.0

The median PM_{10} concentration of the Banknock 1 site is 14.0 $\mu g/m^3$. This is much lower than the average concentration. This suggests peak concentrations are an issue rather than elevated concentrations over longer time periods.

Figure 3 shows the average PM_{10} concentrations at the Banknock 1, Grangemouth and WBS sites according to the hour of day, the day of week

[f] Site locations can be viewed at www.scottishairquality.co.uk Grangemouth AURN data is measured using FDMS, no adjustment made. Falkirk West Bridge Street uses a TEOM: VCM corrected for 2009, 1.3 corrected for 2010. Significant amount of this data is provisional.

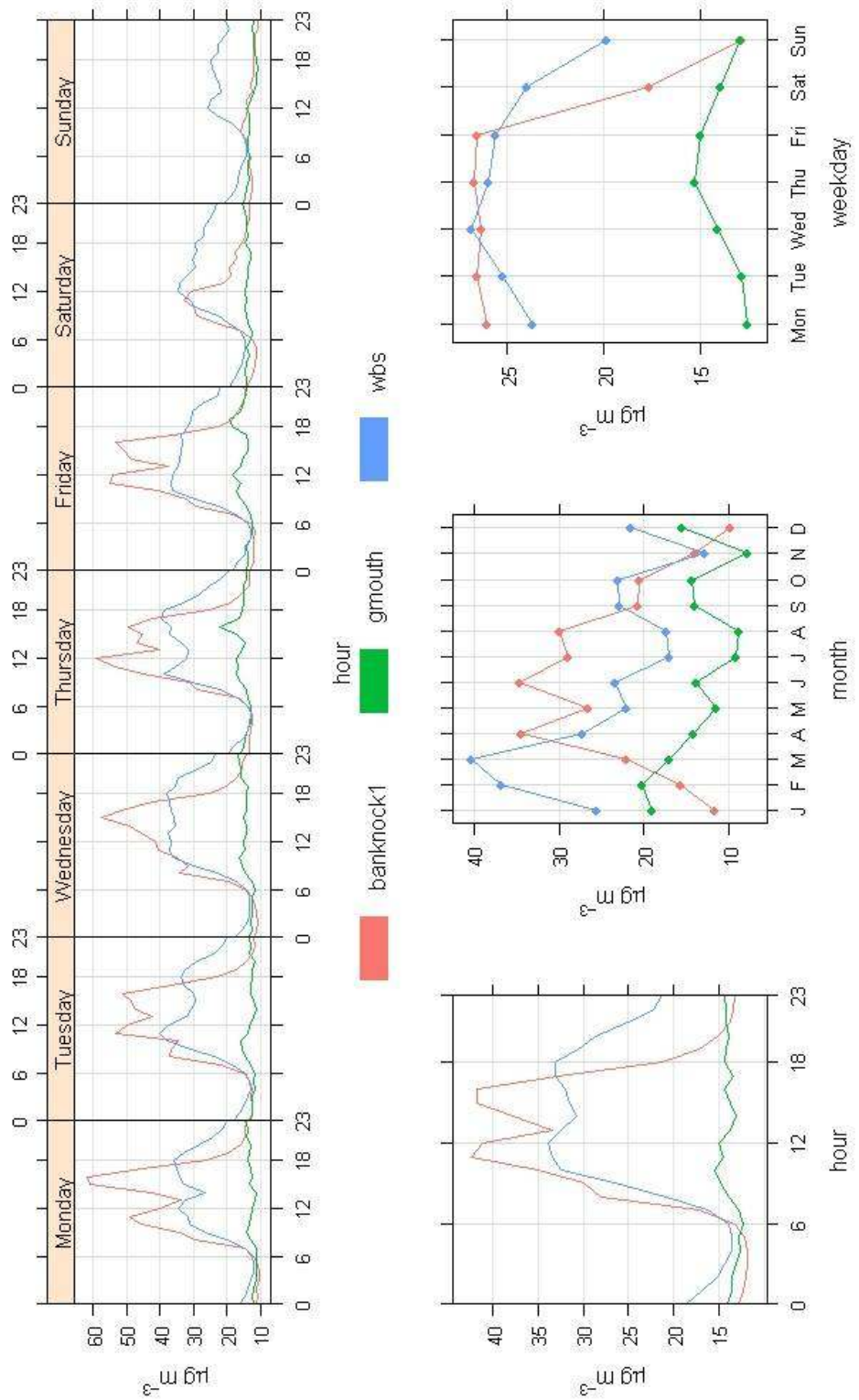
and the month. Figure A5 in the Appendix shows graphs of the daily PM_{10} concentrations for the three sites.

As expected the Grangemouth background monitoring site records a relatively small variation in PM_{10} concentrations throughout the day. This is in contrast to WBS and Banknock 1 where there is an increase in PM_{10} concentrations during the daytime at both sites. This would be expected where road traffic is a significant source. However, there is a difference between the Banknock 1 and WBS data. The PM_{10} concentrations are higher at Banknock 1 during the daytime compared to WBS, but there is then a greater decrease during the weekday and Saturday afternoons resulting in concentrations being lower at Banknock 1 at night. There is also no daytime peak on Sundays at the Banknock 1 site as there is at the WBS site. This would suggest that there is, in terms of potential sources of PM_{10}, a difference between WBS and Banknock 1 site.

This difference is also illustrated by the higher concentrations and the majority of the daily exceedances being recorded during the summer months at the Banknock 1 site. This is most notable in April and June (Table 4, Figure A5). The lowest concentrations are then recorded in the winter months. This is in contrast to the Grangemouth and WBS monitoring sites where higher concentrations are mostly recorded during the winter months.

A comparison with other monitoring sites enables region wide exceedances or elevated concentrations to be potentially identified. There is one exceedance at the Banknock 1 site that was possibly caused by elevated regional concentrations. This was recorded on the 4th March, and can be identified due to an exceedance being recorded at WBS with the Grangemouth site recording its highest concentration of the year of 42 $\mu g/m^3$. This is the only Banknock 1 exceedance that was recorded outwith the summer months.

Figure 3: Average concentrations by hour of day, day of week and by month at Banknock 1, Falkirk West Bridge Street and Grangemouth AURN. [g]



[g] Local time function used for this plot.

In addition, the numbers of daily exceedances by day of week and by month for the Banknock 1 site are shown in Table 4. These reflect the hourly concentrations shown in Figure 3, with more exceedances in the summer and only one (marginal) exceedance being recorded over a weekend, on Saturday 10th April.

Table 4: Banknock 1 Daily Exceedances by Month and Day of Week.

Month	No. of exceedances
January	0
February	0
March	1
April	7
May	2
June	9
July	5
August	5
September	1
October	0
November	0
December	0

Day of week	No. of exceedances
Monday	5
Tuesday	6
Wednesday	7
Thursday	5
Friday	6
Saturday	1
Sunday	0

The $PM_{2.5}$ to PM_{10} ratio at several sites is shown in Table 5. The ratio at Banknock 1 is much lower than at the AURN sites in Scotland where both PM_{10} and $PM_{2.5}$ are measured. [h] This means that more of the particulate matter at the Banknock 1 site consists of the larger particles that are between 2.5 µm and 10 µm in diameter. Typically, road traffic tailpipe emissions exhibit a higher $PM_{2.5}$ to PM_{10} ratio.

Table 5: $PM_{2.5}$ to PM_{10} ratio at four AURN sites in Scotland and Banknock 1.

Site	Ratio PM2.5/10
Aberdeen Errol Place	0.52
Edinburgh St Leonards	0.64
Glasgow Kerbside	0.80
Grangemouth	0.75
Banknock 1	0.30

[h] Auchencorth Moss and Glasgow Centre not included as data capture less than 75%. All data used from AURN sites is FDMS data and is provisional from beginning of July 2010.

Source Apportionment

The background PM_{10} concentration in 2010 for the 1km by 1km grid square at the monitor location (277, 679) is 9.37 µg/m^3. [Ref: 6]

The Figures in the original Detailed Assessment suggested the maximum contribution from road traffic tailpipe emissions concentrations was 1.8 µg/m^3 and this coincided with the area in proximity to the Banknock 1 site. This was based on 2007 road traffic data. A DMRB run (Appendix A6), suggests a similarly small value of 1.32 µg/m^3 of PM_{10} and no daily exceedances caused by tailpipe emissions for the Banknock 1 site. [i] This reduction is partly due to the expected reduction in tailpipe emissions. In-line with previous air quality reports this suggests that road traffic tailpipe emissions are not a significant issue in this area.

This leaves a difference of 12.8 µg/m^3 at the Banknock 1 site between the measured concentration (23.5 µg/m^3) and the expected concentration (10.7 µg/m^3, i.e. background added to tailpipe emissions from road traffic). Although a precautionary 1.3 correction factor has been used for the monitoring data, this still leaves a gap between the background added to tailpipe concentration and the measured concentration.

As an update to the sources in the area, the following are unlikely to be significant:

- PPC regulated processes close to the monitoring site. The R&A process has not highlighted any PPC processes in this area as being of concern for PM_{10}. Those currently within five km of the site are listed in the Appendix (Figure A7).
- The Glasgow to Edinburgh (via Falkirk High) rail line is 800 m and Cumbernauld airport is 1.3 km to the south of the monitoring site. Given the distance to and nature of the sources they are unlikely to be significant. The rail line will be electrified by 2016.
- Emissions from sources such as brake and tyre wear are included in the national 1 km grid square modelling (0.145 µg/m^3).
- The area is partly rural in nature and thus there is the potential for some agricultural and field dust but this is unlikely to be significant.

[i] This used the latest traffic data (2009) with 2010 selected as the year as this represents a greater percentage of the monitoring period. Background concentration has had the 'primary road in' concentration deducted.

- The analyser is located within a smoke control area so domestic fuel burning should not make a significant contribution to PM_{10} concentrations. This is shown to be the case with little elevation in PM_{10} concentrations recorded during evenings or winter months.
- There is potential for a few daily exceedances to be recorded as a result of bonfire night. There was no data for 2009 but any exceedances in future years can usually be identified quite easily.

The evidence presented in this and previous reports have identified emissions as a result of the activities at Cowdenhill Quarry as a potential source of PM_{10}. The monitoring and analysis in this report can be added to this evidence. In terms of the quarry there are likely to be two principle sources.

- Direct emissions.

Direct emissions occur from the quarry operations itself and include screening, crushing and blasting carried out on site. The distance between the monitoring site and quarry operations is approximately 675 metres, which in terms of the larger particles expected from these processes is a significant distance to travel. This was reflected by the modelling which suggested concentrations due to direct emissions were low. There have been fewer complaints of dust further away from the A803. These points suggest that direct emissions are unlikely to be a significant issue. This could be confirmed by future background monitoring at a greater distance from the A803, eg. In the residential area to the north of the Banknock 1 site.

- Indirect emissions.

These would include those occurring off-site, for example via re-suspended dust from both the A803 and the unmade quarry road.

Future Concentrations

The end of 2010 is the compliance date for the Scottish PM_{10} objectives, therefore no projection for the future has been carried out. This is in-line with the technical guidance that states a prediction should not be made where there is likely to be a strong influence from fugitive or industrial sources of the remaining PM_{10}.

In addition, based on the DMRB run the objectives will not be met through a reduction in PM_{10} from tailpipe emissions.

Other Issues

The Council has retained the filters from the Banknock 1 site for analysis if necessary. Although it should be noted that the filters do not specifically collect PM_{10}.

The Council has also noticed that part of the track connecting the quarry with the A803 runs through the North Lanarkshire Council area. There does not appear to be any relevant receptors in proximity to this part of the track. However, as this is outside the Falkirk Council area this would be a matter for North Lanarkshire Council and the Scottish Government.

5 Conclusions and Future Proposals

The monitoring of PM_{10} in Banknock between October 2009 and October 2010 has shown that at the Banknock 1 monitoring site two of the four PM_{10} objectives applicable to Local Air Quality Management in Scotland were breached. As this monitoring site is representative of relevant receptors for both the daily and annual objectives an Air Quality Management Area is required. The use of the 1.3 correction factor for the monitoring data is not ideal but it does represent a precautionary approach.

It is recommended that the declaration should include the UK PM_{10} objectives. This is because the number of daily exceedances can be considered to be "close to" the objective. In addition, the monitor was not located at the "worst case" modelled location, although it represented a greater number of receptors. For the area around the monitoring site this declaration would be seen as precautionary but would nevertheless be justified.

The analysis of the monitoring data gives additional weight to previous evidence that has suggested that activities attributable to Cowdenhill Quarry are a possible contributor to the PM_{10} concentrations in the area. The most notable result is that most of the daily exceedances occur during the summer months. At other Falkirk Council sites elevated concentrations tend to occur in the winter months.

The Council makes the following proposal for the Further Assessment report. The Osiris at the Banknock 1 site is to continue operating. Additional, short term monitoring at a background comparison site may be conducted, ideally in the residential area to the north of the Banknock 1 site. This would help to confirm whether direct or indirect emissions from the quarry are an issue and whether the PM_{10} objectives are being met distant to the A803 road.

Once monitoring is complete at this background location a further monitoring site would be identified, for example to the east of the Banknock 1 site along the A803 road. This would enable the boundaries of any AQMA to be confirmed. The proposed monitoring at these two potential locations would take priority over installing a replacement to the Osiris (TEOM etc) at a location close to the Banknock 1 site. However, this is subject to change depending on the availability of analysers.

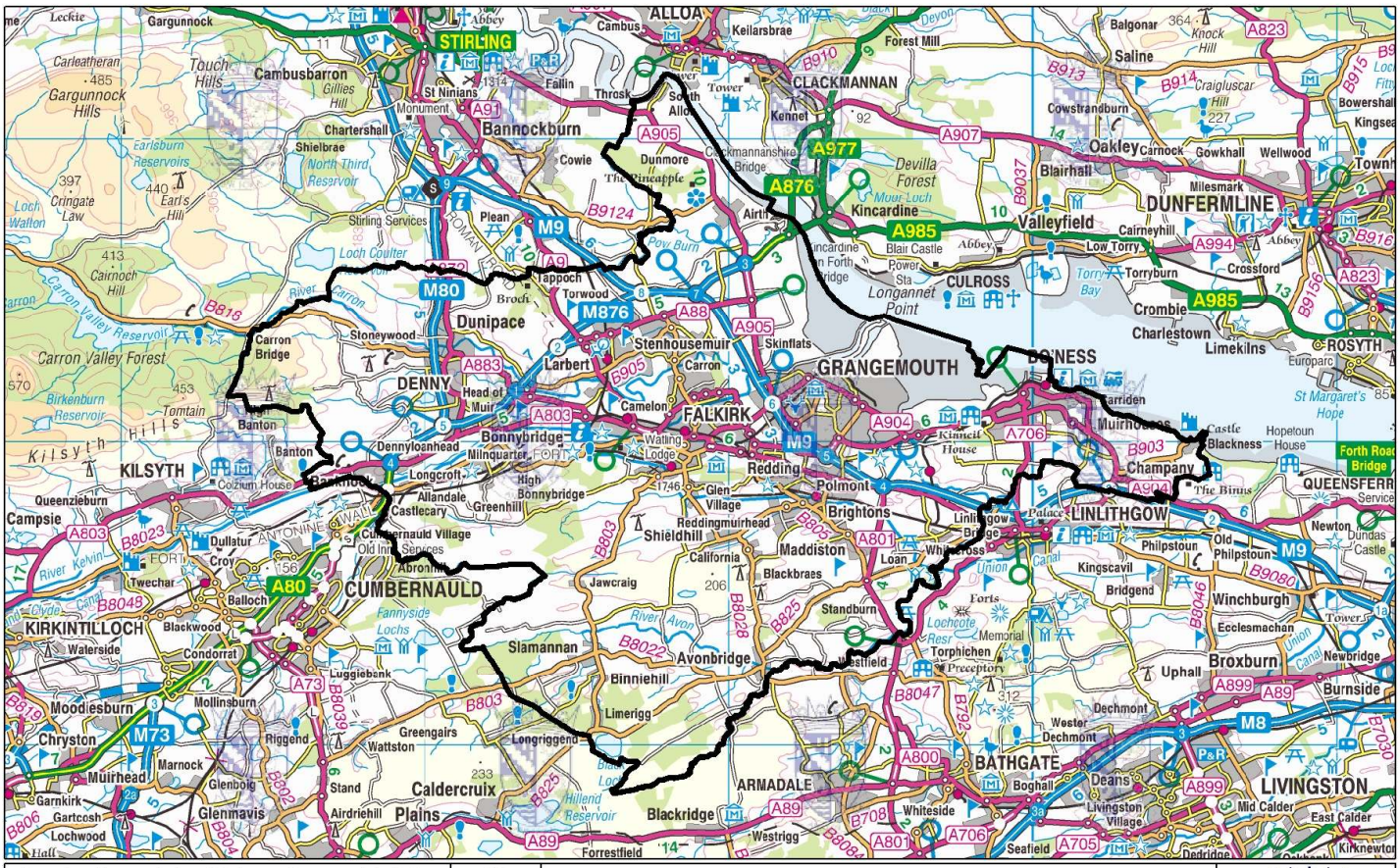
6 References

1. Local Air Quality Management, Technical Guidance LAQM.TG(09), DEFRA and DAs, February 2009.
2. Personal Communication, Environmental Research Group, King's College London, November 2009.
3. Air Quality Archive, Frequently Asked Question: http://www.airquality.co.uk/kb.php?action=showpost&question_id=1385
4. D.C Carslaw and K.Ropkins (2010), Openair: Open-source tools for the analysis of air pollution data. R package version 2.11.1 and Openair version 0.3-10. www.openair-project.org
5. R Development Core Team (2010). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org
6. DEFRA LAQM website, http://www.defra.gov.uk/environment/quality/air/airquality/local/support/
7. Chapter 7 (Discussions and Conclusions) of original Detailed Assessment, ref: BMT Cordah, September 2007, E_FAL_026/Report 3, September 2007.

All websites listed in this section were accessible in October 2010.

7 Appendix

Figure A1: Map showing boundaries of the Falkirk Council area, scale 1:120000.



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N

Falkirk Council Area.

Scale : 1:120,000

Date: July 2010.

Figure A2: Chapter 7 (Discussions and Conclusions) of Original Detailed Assessment.
(Reference 7)

"The dispersion modelling undertaken of the area around Cowdenhill Quarry has determined that, potentially, ambient PM10 concentrations are high, and may exceed NAQS objectives at residential properties. There remain, however, a number of important issues that result in uncertainty with the results. These uncertainties particularly concern the methods and assumptions used to calculate PM10 emission factors for quarry emissions and from resuspended PM10 emissions.

The emission factor used to calculate emissions from the quarry came directly from the NAEI, and depends on the quantity of rock quarried. Data on the quantity of rock quarried was supplied by the Skene Group, and is assumed to be accurate. An estimate was also made of the volume over which PM10 emissions would be spread. This was done using GIS and a site-visit, and while it is unlikely to be precise, it is considered that the estimate is reasonable. Despite the uncertainties in deriving the emission factor, the modelling of PM10 emissions has indicated that fugitive PM10 emissions from the quarry have a minimal effect on ambient PM10 concentrations at the closest residential properties.

Exhaust PM10 emissions were calculated using the emissions factors built into ADMS-Roads. These emission factors were based on numerous field tests undertaken by the NAEI and the Department for Transport, and as such there is a greater degree of confidence in the quality of these factors. It is considered, therefore, that the model predictions of exhausts PM10 emissions are more accurate than emissions from other sources. The highest PM10 concentrations were predicted to occur at the residential properties closest to the A803 on Coneypark Place. These concentrations were predicted to reach levels of up to 1.8µg/m3.

Predicted PM10 concentrations as a result of resuspended emissions were determined to be the most significant source of PM10, but also had the highest degree of uncertainty surrounding them. The uncertainties arise as a result of the assumptions that were made to estimate emissions. Predictions using the USEPA AP-42 method are based on vehicle weight and silt content/silt loading of the road, over which there was a high degree of

uncertainty. The NAEI emission factor was the lowest factor used, although it is unclear how appropriate it is in specific cases, since the factor is used in the NAEI to predict resuspended PM10 emissions across the entire UK road network.

It is considered that the emission factors used for the elevated emissions scenario are unrealistic given the predicted PM10 concentrations. Use of these factors overestimates likely PM10 emissions and hence ambient concentrations. It is considered that the conservative and NAEI emission factors are more realistic, although these still lead to a large variation in predicted PM10 concentrations.

Establishing which is more accurate is crucial when trying to determine whether PM10 objectives are exceeded. Without the availability of measured PM10 data to compare model predictions to, there is no way to verify the model performance. It is noted that Falkirk Council plan to undertake particulate monitoring in Banknock, and once available it will be possible to compare model predictions to establish how accurate they have been."

Figure A3: Pictures of the Banknock 1 Monitoring Site.

Figure A4: Site Visit Log for Banknock 1 Site.

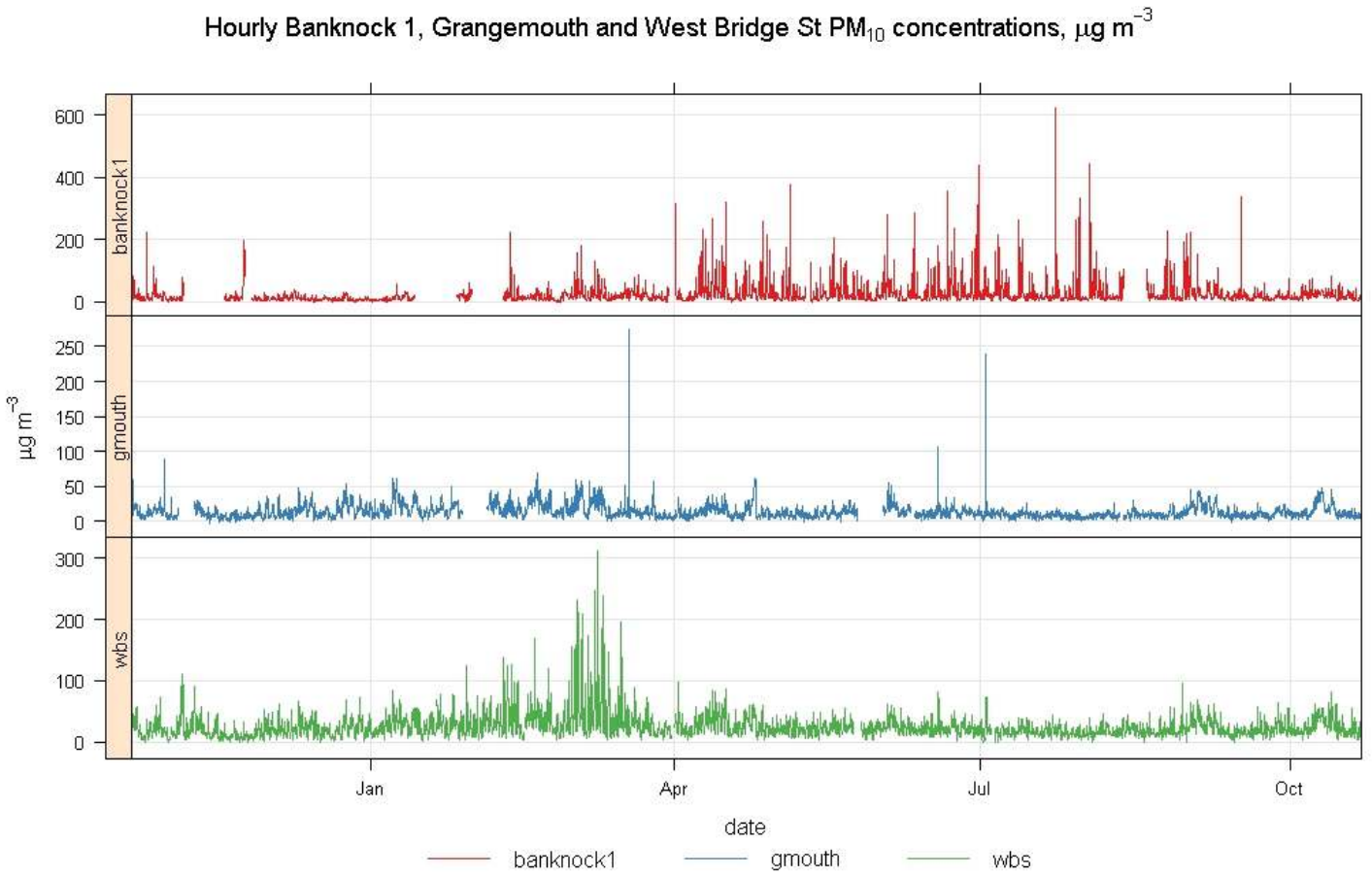
Date	Time, GMT	Filter time, mins	Filter time, hrs	Filter mass, mg	Pump hours	Flow up or down	Flow after	Comments
21/10/2009	15:00							Machine on and tried to setup, menus not quite as instructions, left running.
22/10/2009	14:30							Confirmed with Turnkey phone support that machine set up correctly.
02/11/2009	15:00	17331	289	0.38	295	Up	>6	Note no indicators on flow meter except 6.
18/11/2009	09:55	23106	385	2.22	391	OK	>6	Monitor off on arrival, power tripped off. Time set to GMT. Filter changed.
03/12/2009	10:45	18737	312	0.35	703	OK	>6	
17/12/2009	11:50	38975	650	0.7	1040	OK	>6	Filter changed.
14/01/2010	11:00	40256	671	0.65	1711			Analyser removed and sent away for service.
26/01/2010	14:00							Analsyer returned after service.
29/01/2010	15:00							Data downloaded to ensure correct operation after re-installation.
10/02/2010	10:00							Analyser off on 09/02/10 so just downloaded data.
26/02/2010	10:30	31034	517	0.64	2231	Up	>6	
11/03/2010	11:15	49798	830	1.16	2544	OK	>6	Filter changed.
25/03/2010	11:30	4373	73	1.61	2879	OK	>6	
08/04/2010	10:25	21846	364	1.98	3170	OK	>6	Filter changed.
22/04/2010	10:10	20123	335	0.83	3506	OK	>6	
11/05/2010	11:45	45574	760	1.69	3930	OK	>6	Filter changed.
19/05/2010	09:45	11382	190	0.36	4120	OK	>6	
03/06/2010	11:55	33052	551	1.03	4481	OK	>6	Clock adjusted slightly.
15/06/2010	09:15	50283	838	1.53	4768	OK	>6	Filter changed.
06/07/2010	08:45	30207	503	1.27	5272	OK	>6	
14/07/2010	15:30	42116	702					Slightly wet, only download data.
29/07/2010	09:30	63361	1056	2.35	5824	OK	>6	Filter changed.
19/08/2010	09:00	18171	303					Download data only.
27/08/2010	11:30	29847	497	3.49	6358	OK	>6	Filter changed.
09/09/2010	12:15	18741	312			OK	>6	
23/09/2010	08:55	38699	645	1.08	7003	OK	>6	Spare inlet head installed (other cleaned), filter changed.
01/10/2010	08:45	11492	192			OK	>6	
22/10/2010	08:35	41726	695					Heavy rain, download data only.

Site visits were carried out on a fortnightly basis. At each visit the analyser operation, software and instrument were checked for any status faults. Data was downloaded from the analyser, the inlet condition and flow rate were checked. The filter was changed approximately every four weeks, although this was weather dependent. The data is manually checked with suspicious data being identified and removed if necessary. Additional site visits took place if an officer was in the area to ensure the analyser was operating as a remote connection is not currently used. The analyser was serviced in January 2010. This is conducted off-site rather than on-site and accordingly there is a slight reduction in data capture. The next service is due in January 2011. The analyser is covered by a comprehensive service agreement.

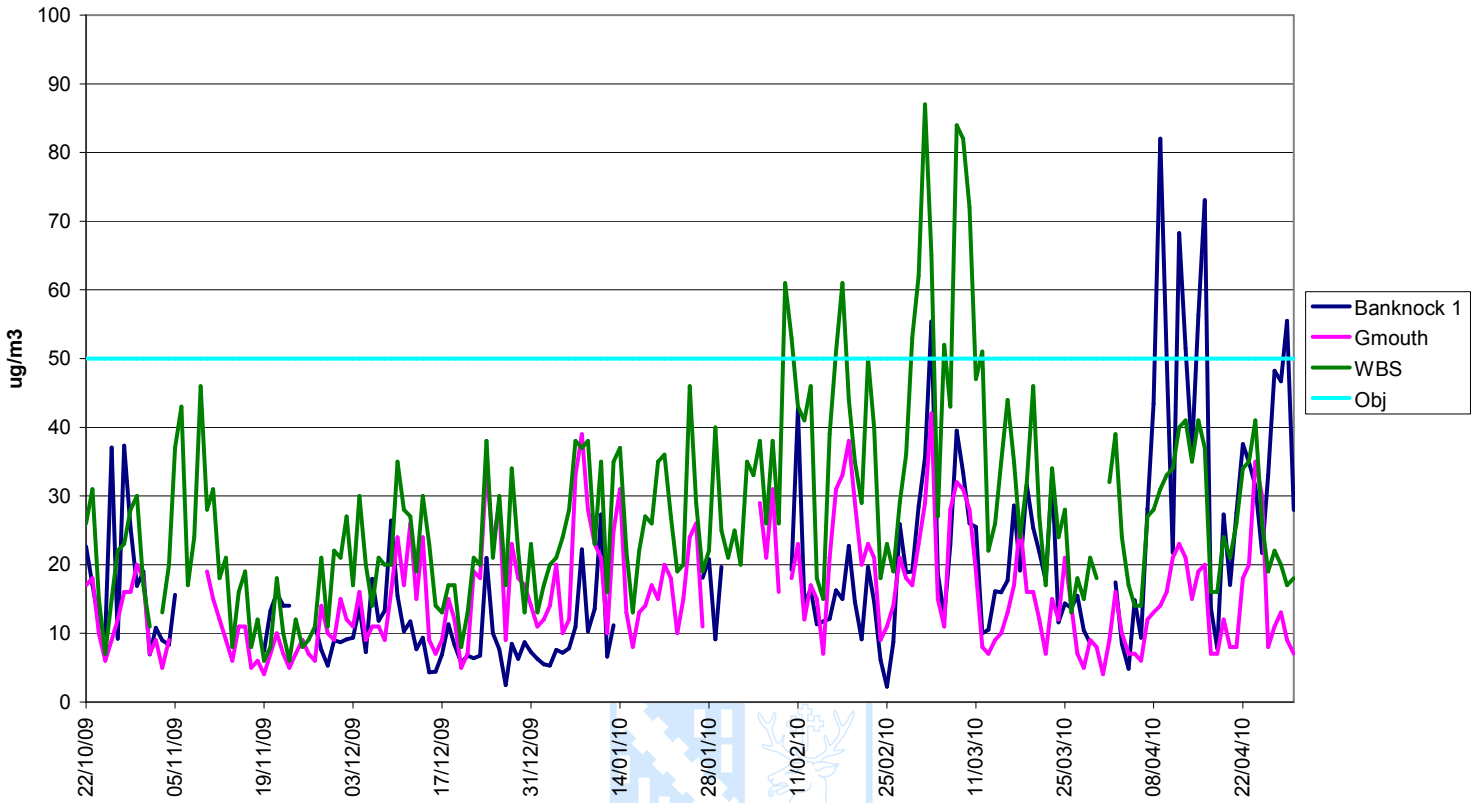
As detailed in the technical guidance, three 15-minute periods were required to make an hour of data valid and 18 hours of data was required to make a day of data valid. The analyser has remained on GMT for the duration of the monitoring. Some minor adjustment of the times for the data has taken place.

This is because between a flow check or filter change and the next midnight hour, the Osiris records data in 15-minute blocks at say 12, 27, 42, 57 mins past the hour rather than the usual 15, 30, 45 and 00. This should have little effect on the results and permits the data to fit into the Council's monitoring database which it otherwise would not.

Figure A5: Additional Openair and Excel Graphs.



Banknock 1, Grangemouth AURN and Falkirk West Bridge St daily PM_{10} concentrations, October 2009 to April 2010.



Banknock 1, Grangemouth AURN and Falkirk West Bridge St daily PM_{10} concentrations, May to October 2010.

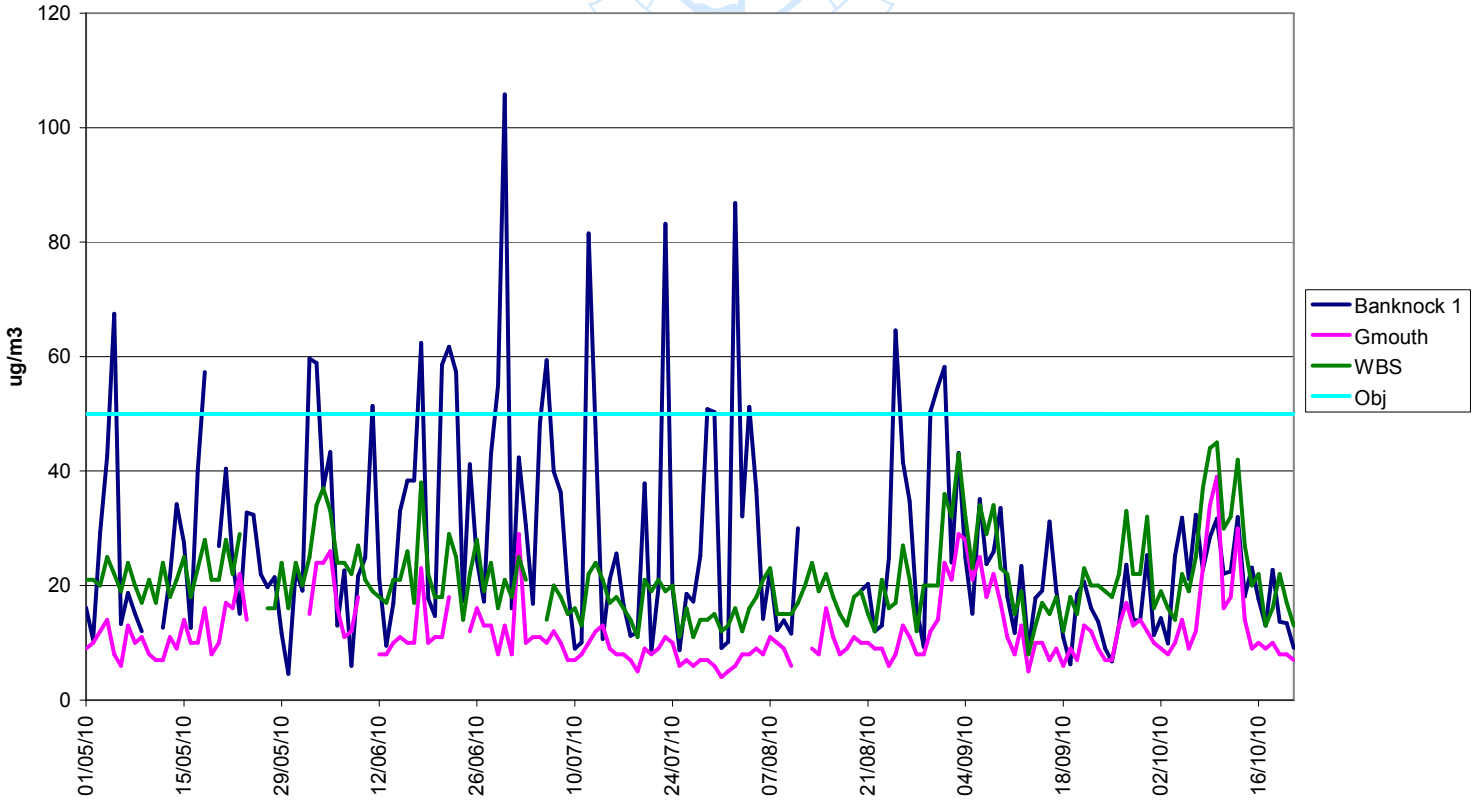


Figure A6: DMRB Sheet for run using 2009 Traffic Data.

DMRB: Assessment of Local Air Quality — INPUT SHEET

Step 1	Receptor name	Banknock 1	Receptor number	1	Step 6
Step 2	Year	2010			Step 7
Step 3	Number of links	1			

Step 4 — Background concentrations for 2010

CO (mg/m³)	Benzene (µg/m³)	1,3-butadiene (µg/m³)	NO_x (µg/m³)	NO_2 (µg/m³)	PM_{10} (µg/m³)
0	0	0	0	0	9.351242

Step 5

Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition							
		AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Vehicles <3.5t GVW (LDV)			Vehicles>3.5t GVW (HDV)			
					% passen-ger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV	Total % HDV
1	9	8070	50	A			88				12
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

DMRB: Assessment of Local Air Quality — OUTPUT SHEET

Current receptor

Receptor Name	Banknock 1	Receptor number	1
Assessment year	2010		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
CO	0.00	0.04	0.04	mg/m³	Annual mean*	0.04	mg/m³
Benzene	0.00	0.04	0.04	µg/m³	Annual mean	0.04	µg/m³
1,3-butadiene	0.00	0.06	0.06	µg/m³	Annual mean	0.06	µg/m³
NO_x	0.0	15.1	15.1	µg/m³	Not applicable		
NO_2	0.0	5.2	5.2	µg/m³	Annual mean*	5.2	µg/m³
PM_{10}	9.4	1.32	10.67	µg/m³	Annual mean	10.7	µg/m³
					Days >50µg/m³	0	Days

* See Footnote 32 in DMRB Volume 11 Chapter 3

Contribution of each link to annual mean

Link number	CO (mg/m³)	Benzene (µg/m³)	1,3-butadiene (µg/m³)	NOx (µg/m³)	PM_{10} (µg/m³)
1	0.04	0.04	0.06	15.07	1.32
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

All receptors

Receptor number	Name	Year	Pollutant concentrations at receptor						
			CO *	Benzene	1,3-butadiene	NO_x	NO_2 *	PM_{10}	
			Annual mean mg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Days >50µg/m³
1	Banknock 1	2010	0.04	0.04	0.06	15.07	5.19	10.67	0.00

Figure A7: PPC Sites within 5 km of Banknock 1.

YEAR	SITE NAME	SITE ADDRESS	SITE POST CODE
2009	M & D Russell (Haulage) Ltd. Drumbowie Farm Denny	Drumbowie Farm Denny FK6 5LZ	FK6 5LZ
2009	SRCL Limited. SRCL Ltd Cumbernauld	South Wardpark Court Waste Treatment & Transfer Facility Cumbernauld Glasgow G67 3EH	G67 3EH
2009	Scottish Water. Broadside Landfill	Broadside Landfill, Denny, FK6 5JE	FK6 5JE
2009	Scottish Water. Dunnswood STW Dunswood Rd Wardpark Ind Est	Dunnswood Road Wardpark Industrial Estate Cumbernauld North Lanarkshire G67 3EN	G67 3EN
2009	Scottish Water. Carron Valley WTW Broadside Denny Stirling	Carron Valley WTW Broadside Denny Stirlingshire FK6 5JE	FK6 5JE