



Local Air Quality Management

Pembrokeshire Air Quality Management Area's Action Plan 2017



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

February 2018

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Executive Summary

This Air Quality Action Plan (AQAP) 2017 details the development and effect that Pembrokeshire County Council's AQAP has had in its attempt to improve air quality within two Air Quality Management Areas (AQMA) declared within the County of Pembrokeshire in July 2012. The AQMA's are located within the main shopping streets in the towns of Haverfordwest and Pembroke. Both AQMA's were declared because the annual mean objective for nitrogen dioxide (NO₂) of 40 µg/m³ has been exceeded at some monitoring points within these locations.

Nitrogen dioxide arises primarily from emissions of a mixture of nitrogen dioxide and nitric oxide from combustion processes such as vehicle engines. When mixed with ambient air nitric oxide is converted to the pollutant nitrogen dioxide. Combined, nitrogen dioxide and nitric oxide are referred to as oxides of nitrogen (NO_x). This draft AQAP suggests a range of actions aimed at reducing NO_x emissions in order to achieve the air quality objective for NO₂.

A reduction in NO_x emissions of 30% for Haverfordwest and 22% for Pembroke has been identified to meet the air quality objective. The compliance date for NO₂ objectives is 31 December 2005 and although it has never been a requirement that the objective has had to be achieved by that date it is a requirement that AQAP's are developed to identify proposed actions and timescales for implementation in an attempt to achieve the relevant objective.

The main source of the pollution in the AQMA's is from road traffic with a greater than 80% component of that traffic comprising of cars at both the AQMA's. The affected areas are the main commercial streets passing through the town centres and possess the physical characteristics that conform to the "street canyon" effect where high sided buildings either side of narrow roads inhibit the dispersion of pollutants within the local air.

The action plan measures will attempt to improve local air quality and also maintain the level of access and development needed for the economic growth of the town centre areas.

Pembrokeshire County Council has a statutory duty to review and assess air quality; and improvements in the AQMA's will continue to be assessed against air quality data collated and linked to road traffic emissions.

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1 Introduction

1.1 Background

The Environment Act 1995 places a statutory duty on Local Authorities to carry out a programme of Local Air Quality Management (LAQM) including the periodic review and assessment of air quality in their area. The LAQM process carried out within Pembrokeshire to date is summarised in Appendix 1.

The review and assessment is made against air quality objectives adopted in the UK and are defined in the latest [Air Quality Strategy for England, Scotland, Wales and Northern Ireland](#), published on 17th July 2007 and are also contained at Appendix 2. Those which are limit values required by EU Daughter Directives on Air Quality have been transposed into UK law through the [Air Quality Standards Regulations 2007](#) which came into force on 15th February 2007.

Appendix 2 shows the relationship between the objectives and the relevant exposure to the public. If the review and assessment indicates that an air quality objective is not likely to be met by the target date, then the Local Authority must declare an Air Quality Management Area (AQMA) for the affected area. AQMA's are therefore pollutant specific and an Air Quality Action Plan (AQAP) must then be produced for each and every AQMA setting out actions and projects in an attempt to improve the air quality within the affected area/s.

In July 2012 Pembrokeshire County Council designated two AQMA's within the towns of Haverfordwest and Pembroke within the main road network accessing the central commercial areas of both towns as detailed at Figures 1 and 2 below.

The AQMA's were declared due to the assessment of the local air quality within both areas which has indicated that the annual mean objective for nitrogen dioxide of $40\mu\text{g}/\text{m}^3$ is being exceeded.

The annual mean is the average concentration measured over a period of one calendar year. For an air quality objective not to be met members of the public must be regularly exposed over the averaging period of the objective, as both the AQMA's are the main commercial areas for both towns with a combination of residential and commercial properties this exposure is thought to take place for local residents and the general public when utilising these high street areas.

Figure 1: Map of Haverfordwest AQMA Boundaries

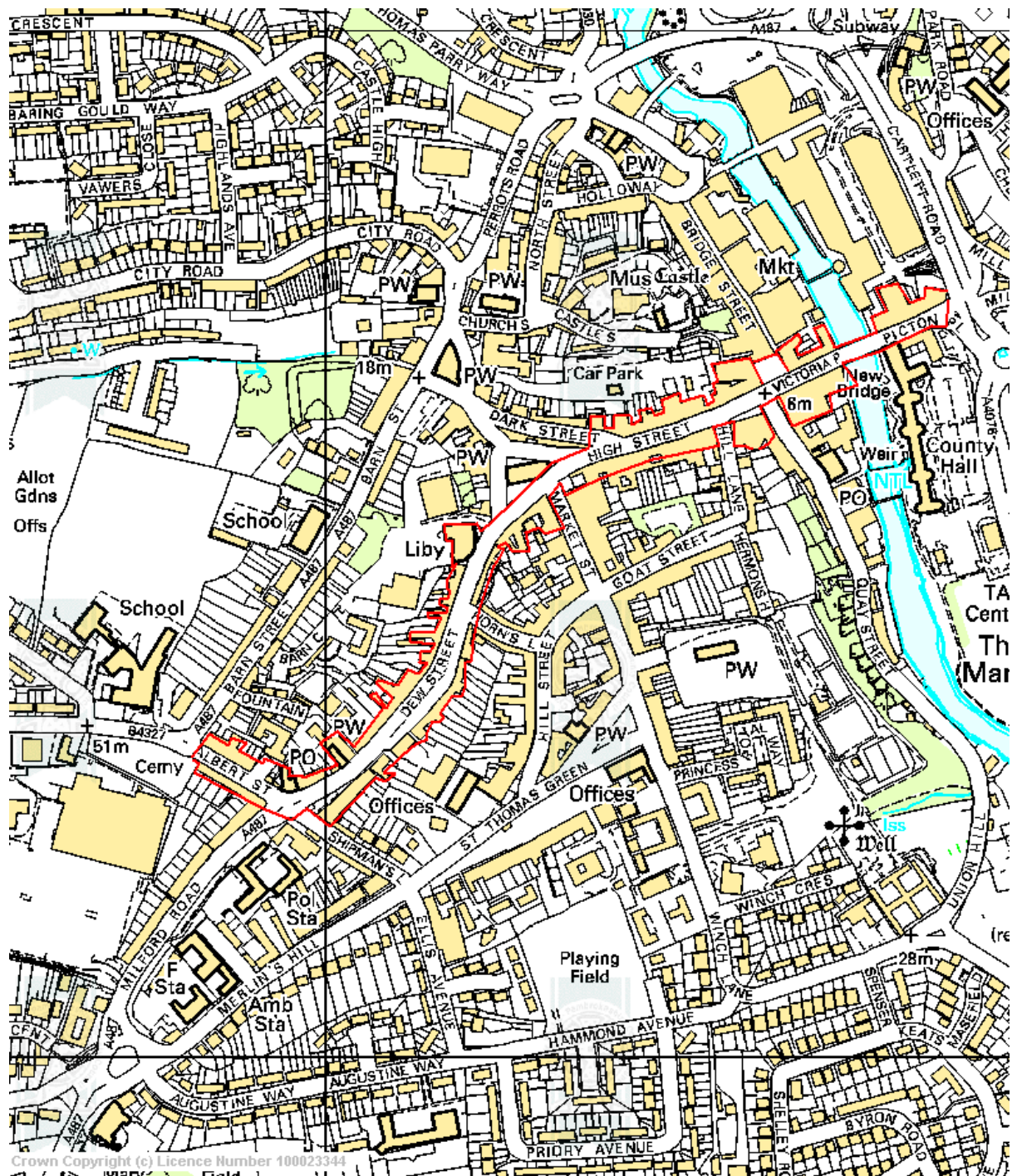
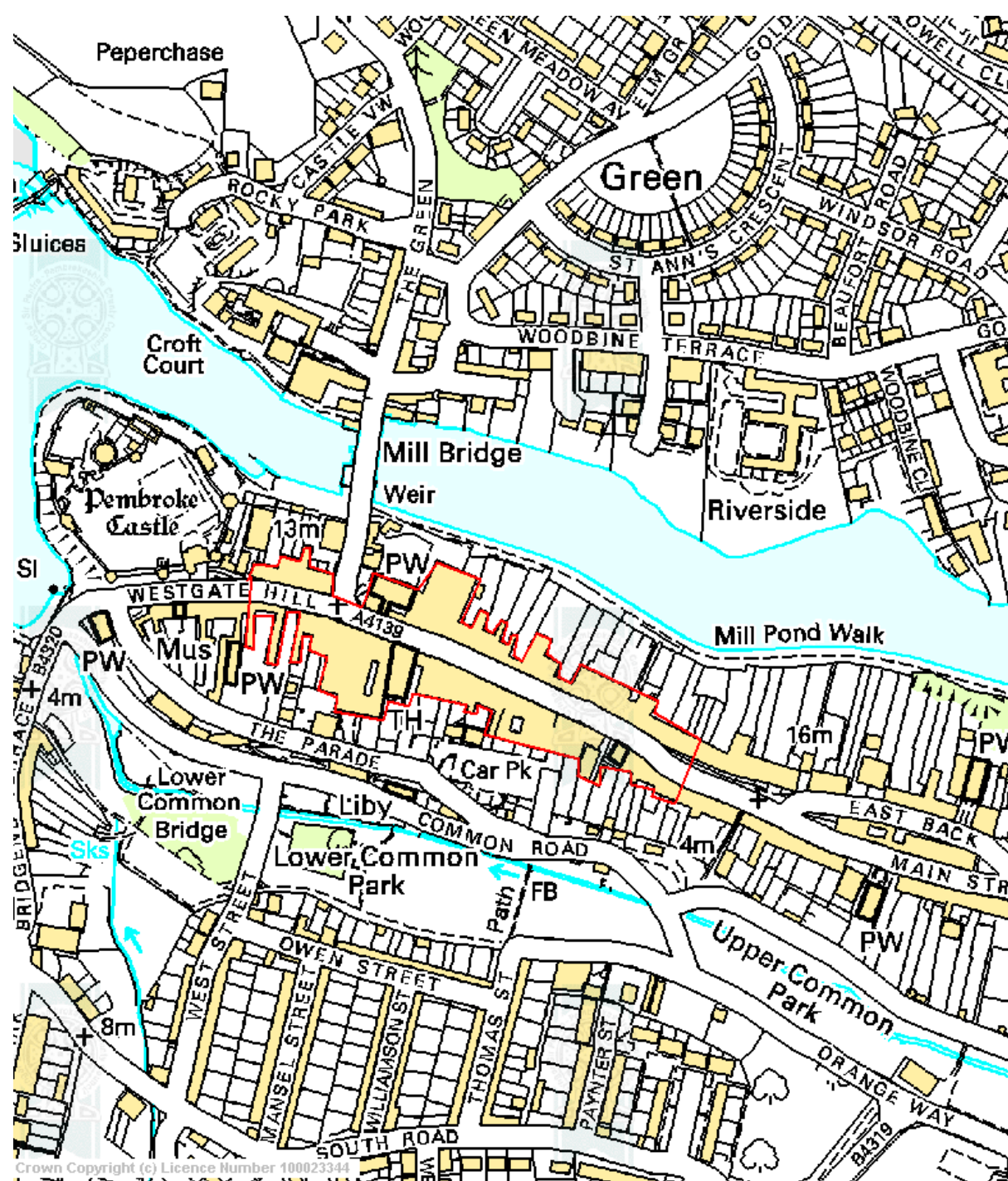


Figure 2: Map of Pembroke AQMA Boundaries



1.2 Air Quality Action Plan

This Air Quality Action Plan (AQAP) details actions that are considered to be the most appropriate way to attempt to reduce nitrogen dioxide within the two AQMA's declared within Pembrokeshire. Such initiatives may also assist in the reduction of other pollutants including the greenhouse gas carbon dioxide.

Within Pembrokeshire cars have been identified as accounting for >80% of nitrogen dioxide (NO₂) emissions within the two AQMA's. Where road transport emissions are the largest single contributor to the pollution within an AQMA it is recommended that the AQAP is integrated into a Local Authorities Local Transport Plan. Pembrokeshire County Council is the authority responsible for transport planning and development of the LTP within the county. The Environment Act 1995 places a duty on this authority to propose actions that works towards meeting the air quality objectives within the AQMA's.

1.3 Regional Transport Plan

The Regional Transport Plan for South West Wales 2010 to 2015 aspires to improve transport and access within and beyond the region to facilitate economic development and the development and use of more sustainable and healthier modes of transport.

The RTP has seven objectives as follows;

1. improving access to services and facilities
2. sustainability by improving the range and quality of transport
3. efficiency and reliability of movement of people and freight
4. improve integration between policies
5. improvements to air quality and reduce adverse impacts of transport on health and climate change
6. reduce negative impact upon natural and built environments
7. improve road safety

2 Air Quality and Transport

2.1 What is Nitrogen Dioxide?

Nitrogen dioxide arises primarily from emissions of a mixture of nitrogen dioxide and nitric oxide from combustion processes such as vehicle engines. When mixed with ambient air nitric oxide is converted to the pollutant nitrogen dioxide. Combined, nitrogen dioxide and nitric oxide are referred to as oxides of nitrogen (NO_x).

2.2 Nitrogen Dioxide and Public Health

The World Health Organisation (WHO) Fact Sheet No313 Air Quality and Health, updated September 2011, details the following information;

As an air pollutant, NO₂ has several correlated activities.

- *At short-term concentrations exceeding 200 µg/m³, it is a toxic gas which causes significant inflammation of the airways.*
- *NO₂ is the main source of nitrate aerosols, which form an important fraction of PM_{2.5} and, in the presence of ultraviolet light, of ozone.*

The major sources of anthropogenic emissions of NO₂ are combustion processes (heating, power generation, and engines in vehicles and ships).

Health effects

Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO₂. Reduced lung function growth is also linked to NO₂ at concentrations currently measured (or observed) in cities of Europe and North America.

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. Continued and/or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children.

2.3 Short Term Health Effects of Nitrogen Dioxide

Short term “acute” symptoms can be irritation to the eyes, nose and throat and an increase in existing symptoms of respiratory conditions such as asthma, bronchitis or emphysema. See Appendix 2 for short term hourly air quality objective.

2.4 Long Term Health Effects of Nitrogen Dioxide.

The long term “chronic” effects of nitrogen dioxide are associated with a gradual deterioration in the health of people who already suffer from lung diseases and an increased susceptibility to respiratory infections. Due to the debilitating health effects of long term exposure an annual average objective for nitrogen dioxide exists as detailed at Appendix 2.

It is the annual average objective for nitrogen dioxide that is being exceeded within the two Pembrokeshire AQMA's and could be having an adverse impact upon the long term health of the more susceptible members of the population within the affected areas. Both AQMA's comprise commercial and residential elements to the properties and relevant exposure is recognised for both the localities.

2.5 Where does the Pollution come from?

Within the two Pembrokeshire AQMA's traffic count data has indicated that 89% in Haverfordwest and 84% in Pembroke represent the proportion of cars as detailed at Figures 3 and 4 respectively.

Figure 3

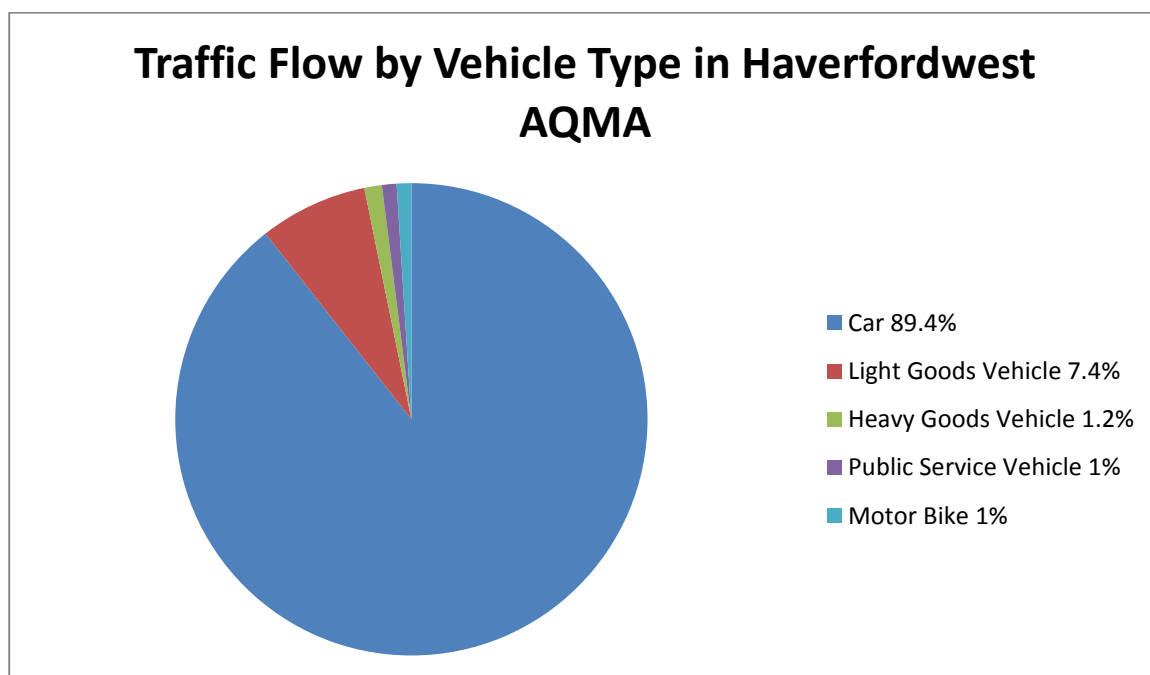
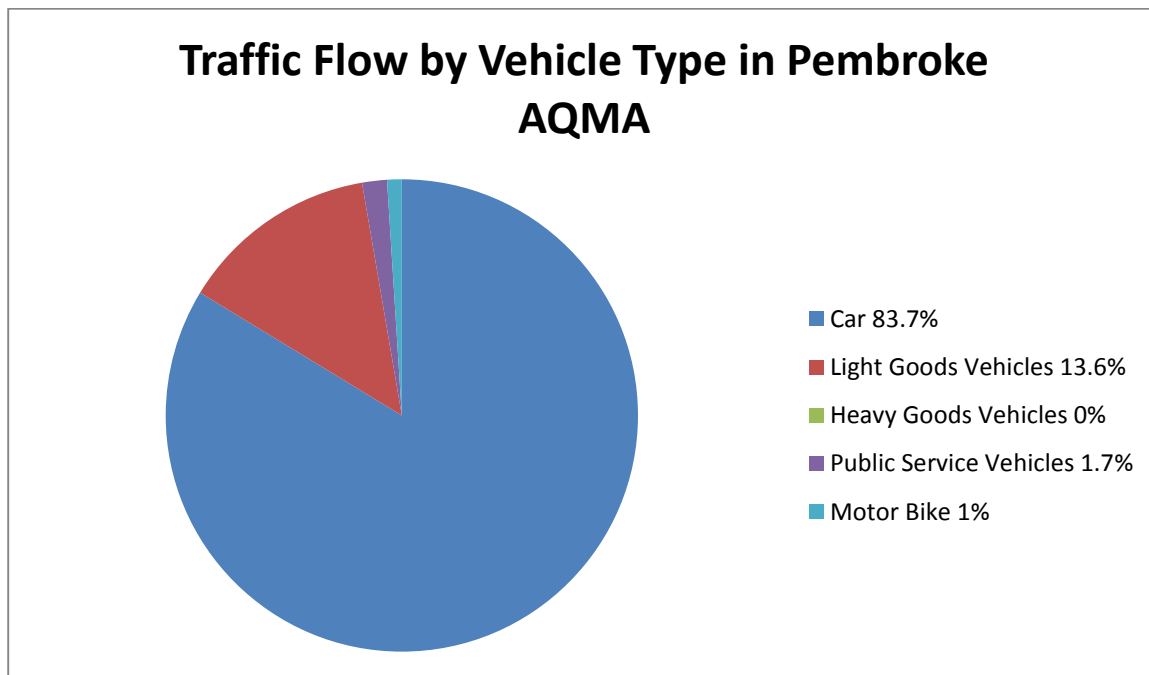


Figure 4



2.6 How much does pollution need to be reduced?

In this instance nitrogen dioxide is the pollutant of concern and the following calculations utilise the highest concentration monitored within the AQMA during 2012 as the worst case focus point as it is assumed that the other monitoring locations will require less of a reduction.

Required Reduction in Nitrogen Dioxide Concentration.

Reduction Required = Measured Mean Value (2012) – AQS ($40\mu\text{g}/\text{m}^3$)

Air Quality Management Area 1: Haverfordwest PCC8

Reduction Required = $57.2\mu\text{g}/\text{m}^3 - 40\mu\text{g}/\text{m}^3$

= $17.2\mu\text{g}/\text{m}^3$ reduction required

As a percentage;

$\frac{\text{Measured Value} - \text{Required Value}}{\text{Measured Value}} \times 100 = \% \text{ Reduction Required}$

% Reduction Required = $\frac{57.2 - 40}{57.2} \times 100$

= **30% reduction required**

Air Quality Management Area 2: Pembroke PCC46

Reduction Required = $51.5\mu\text{g}/\text{m}^3 - 40\mu\text{g}/\text{m}^3$

= $11.5\mu\text{g}/\text{m}^3$ reduction required

As a percentage;

$$\frac{\text{Measured Value} - \text{Required Value}}{\text{Measured Value}} \times 100 = \% \text{ Reduction Required}$$

$$\% \text{ Reduction Required} = \frac{51.5 - 40}{51.5} \times 100$$

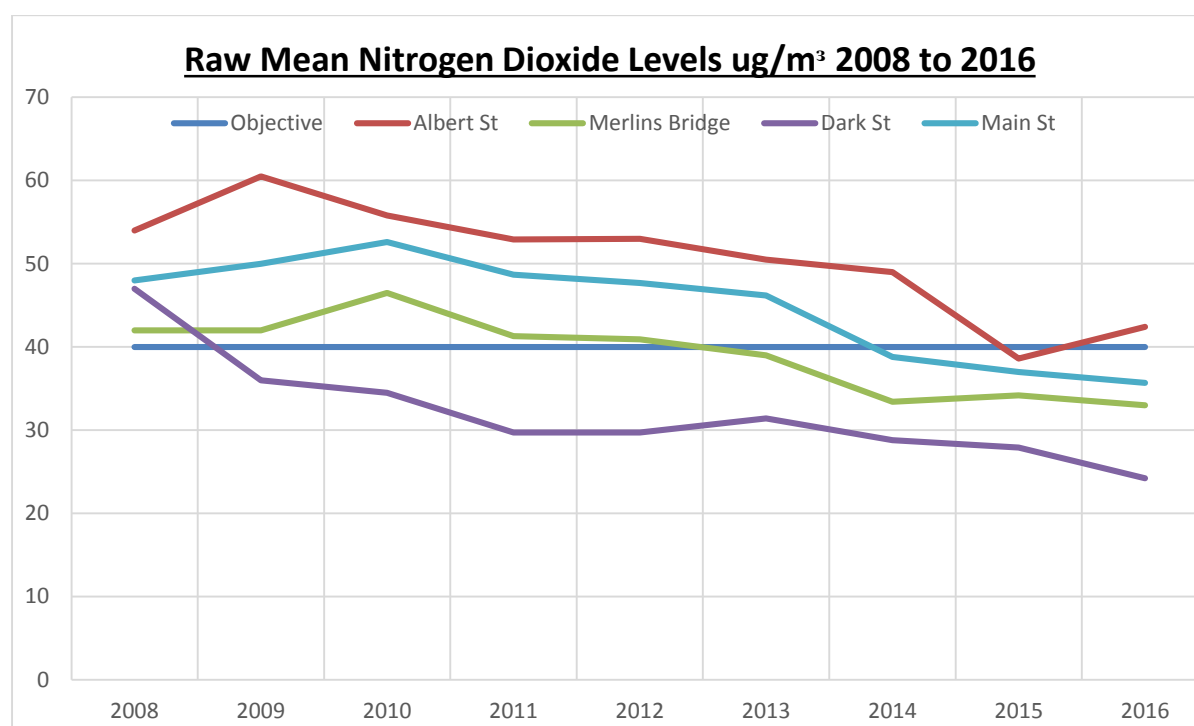
= **22% reduction required**

3 Trends in Air Quality

3.1 Local Monitoring

Diffusion Tube data from roadside locations within Haverfordwest and Pembroke have been used to examine the concentrations of nitrogen dioxide over the years as detailed at Figure 5 below.

Figure 5



Objective	40	40	40	40	40	40	40	40	40
Albert St, H,West PCC 27	54	60.5	55.8	52.9	53	50.5	37.3	27.7	29
Merlins Bridge, H,West PCC 31	42	42	46.5	41.3	40.9	39	33.4	34.2	31.7
Dark St, H,West PCC 9	47	36	34.5	29.7	29.7	31.4	28.8	27.9	24.2
Main St, Pembroke PCC 44	48	50	52.6	48.7	47.7	46.2	33.7	37	36.6

Through the 2007 to 2009 period nitrogen dioxide levels were identified as increasing and an increase in the use of passive monitoring via diffusion tubes took place to identify the extent of the affected areas.

Continued monitoring has taken place as recommended in the Defra (Department for Environment Food and Rural Affairs) Technical Guidance LAQM.TG(09) (now LAQM. TG(16)) document as a Further Assessment to establish that the exceedance was ongoing and not a short term episode. Since that time the areas have been identified, as detailed at Figures 1 and 2 above, and designated as AQMA's respectively.

Nitrogen dioxide is and continues to be the greatest challenge for local authorities with regard to compliance with the NO₂ annual mean air quality objective. It comprises the highest number of failures for any one objective and Defra details the following current number of NO₂ AQMA's declared as follows;

Table 1.

Pollutant	Objective	England	Wales	Scotland	N. Ireland	London
NO ₂	Annual Mean	452	27	19	21	26

The full table of AQMA's can be viewed at <http://aqma.defra.gov.uk/aqma/tables.php>

Table 2 Bias adjusted annual mean NO₂ levels 2011 - 2013

Location	Bias A adjusted annual mean NO ₂ level µg/m ³ (Bias A x Raw Mean) Red indicates result exceeding objective level (Number of months in brackets, bold indicates adjustment as per LAQM.TG09 as less than 9 months data).					
	2011 Bias A = 0.83		2012 Bias A = 0.79		2013 Bias A = 0.80*	
	Raw Mean	Bias A 0.83	Raw Mean	Bias A 0.79	Raw Mean	Bias A 0.80
Haverfordwest AQMA						
High St Hwest PCC3	52.1 (12)	43.2	36.4 (12)	28.7	31 (11)	24.8
High St Hwest PCC4	48.1 (11)	39.9	42.5 (12)	33.6	43.2 (11)	34.6
High St Hwest PCC5	52.3 (11)	43.4	51.3 (11)	40.5	48.8 (12)	39
High St Hwest PCC6			48.4 (10)	38.2	46 (12)	36.8
High St Hwest PCC7			57.2 (9)	45.2	50.2 (12)	40.2
High St Hwest PCC8			45.8 (9)	36.2	50.2 (7)	40.4
Dark St Hwest PCC9	29.7 (11)	24.7	29.7 (12)	23.5	31.4 (12)	25.1
Dew St Hwest PCC11	40.2 (9)	33.4	41.5 (10)	32.8	44.8 (6)	35.8

Dew St Hwest PCC12	39.8 (10)	33	38.9 (10)	30.7	38.4 (9)	30.7
Dew St Hwest PCC13	37.8 (12)	31.4	39.5 (11)	31.2	36 (10)	28.8
Dew St Haverfordwest PCC14	34.7 (11)	28.8	35.8 (10)	28.3	33.6 (12)	26.9
Dew St Hwest PCC15	42.2 (12)	35	40.4 (12)	31.9	38.5 (12)	30.8
Albert St Hwest PCC17	52.9 (12)	43.9	53 (11)	41.9	50.5 (12)	40.4
Albert St Hwest PCC18	26.4 (12)	21.9	26.9 (11)	21.2	31.6 (11)	25.3
Albert St Hwest PCC19	42 (12)	34.9	43.1 (12)	34	42 (12)	33.6
Albert St Hwest PCC20	34.6 (12)	28.7	33.3 (12)	26.3	34.5 (12)	27.6
Albert St Hwest PCC21	58.6 (10)	48.6	56.9 (12)	45	48.4 (11)	38.7
Albert St Hwest PCC22	38.6 (12)	32	32.9 (10)	26	39.2 (8)	31.4
Albert St Hwest PCC23	53.3 (12)	44.2	54.4 (12)	43	50.7 (11)	40.6
Albert St Hwest PCC24	24.4 (10)	20.2	24.9 (12)	19.7	22 (12)	17.6
Albert St Hwest PCC25	32.5 (12)	27	33.8 (10)	26.7	32.2 (12)	25.8
Albert St Hwest PCC26	54.4 (12)	45.2	53.2 (7)	42	46.9 (12)	37.5
Albert St Hwest PCC27	51.6 (12)	42.8	53.5 (12)	42.3	41.2 (12)	33
Albert St Hwest PCC28	34.5 (10)	28.6	35.2 (11)	27.8	41.9 (6)	33.5
Pembroke AQMA						
Main St Pembroke PCC40	48.7 (12)	40.4	47.7 (12)	37.7	46.2 (11)	37
Main St Pembroke PCC41	34.4 (11)	28.5	34.2 (12)	27	30.8 (12)	24.6
Main St Pembroke PCC42	17.2 (11)	14.3	17.7 (12)	14	19.5 (10)	15.6
Main St Pembroke PCC43	33.5 (12)	27.8	27.1 (12)	21.4	26.2 (11)	21
Main St Pembroke PCC44	41.3 (12)	34.3	39.6 (6)	31.3	39.5 (12)	31.6
Main St Pembroke PCC45	30.3 (12)	25.10	45.7 (12)	36.1	40.9 (11)	32.7
Main St Pembroke PCC46	54.2 (5)	45	51.5 (12)	40.7	53.9 (12)	43.1
Main St Pembroke PCC47	59.7 (9)	49.5	35.2 (12)	27.8	30 (11)	24

Main St Pembroke PCC48	50 (10)	41.5	42.5 (11)	33.6	40.9 (11)	32.7
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3.2 National Monitoring

The Air Pollution in Wales annual reports produced by Ricardo – AEA on behalf of the Welsh Government and Welsh Air Quality Forum can be accessed via the following link;

http://www.welshairquality.co.uk/documents/reports/471141002_AQ_wales_2013_Final_in_English.pdf

The report details at Figure 4.1 on page 7 a downward trend for ambient pollutants in Wales from 1990 to 2013, including NO₂.

4 Options for reducing NO₂ emissions

4.1 Introduction

It is not a requirement that the objective for nitrogen dioxide is achieved by the target date of December 2005. It is however a requirement that the AQAP identifies proposed actions, with associated timescales for their implementation, with the aim of improving air quality and achieving the relevant objective.

4.2 Proposed Actions

The following proposed actions have been detailed as options for Pembrokeshire County Council in an attempt to create a strategy to improve air quality within the designated AQMA's. The actions have been subject to public consultation by providing all relevant stakeholders within the affected areas with a copy of the proposals in the format of a tick box appraisal form with five options for each proposal ranging from strongly agree to strongly disagree. The completed responses have been returned and assessed as a percentage per action indicated by a tick from the AQMA's occupants. The Action Plan Proposals related to the following topics.

1. Signage
2. Emissions testing
3. Restriction to commercial vehicle
4. Idling policy
5. Parking policy
6. Enforcement
7. Speed Controls
8. Improved visibility
9. Low emission zones
10. Increased vegetation
11. Engage with local transport operator's
12. Pedestrianisation
13. Review crossing facilities
14. Promote cycling
15. Promote walking
16. Bypass
17. Regeneration

4.3 Public Consultation

Action Plan Proposals were posted to 655 residential and commercial properties within the Haverfordwest and Pembroke AQMA's. There were 79 responses where the documents were completed and returned to the Authority equating to a 12% response rate.

A copy of the questionnaire follows on this and the preceding pages and the response rates are detailed at each tick box as a percentage of the 79 responder's preference to the proposals.

Action Plan Proposals

79 of 655 Returned Equates to 12% of Total

Please tick only one of the options for each proposal. Personal details are **not** required.

AQMA Action Plan Proposal	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1. Signage introduced to the affected area; e.g. "You are entering a designated Air Quality Management Area"	17%	30%	15%	18%	19%
2. Emissions testing; Implementation of powers for vehicle exhaust systems testing within AQMA's by the Local Authority.	16%	29%	18%	25%	11%
3. Restriction to commercial vehicles; e.g. specified delivery times.	29%	31%	6%	14%	19%
4. Idling policy; no stationary vehicles waiting with engines running within AQMA.	37%	39%	5%	14%	5%
5. Parking policy; no parking within AQMA.	6%	9%	14%	11%	54%
6. Enforcement; designated/contracted wardens for AQMA's issuing fixed penalty notices for parking and idling	6%	25%	5%	24%	35%

vehicles, etc.					
7. Speed controls; e.g. 20mph, lights, speed humps etc.	24%	30%	7%	11%	26%
8. Improved visibility; e.g. mirrors to assist visibility at difficult junctions to avoid rapid acceleration, etc.	32%	32%	18%	11%	6%
9. Low Emission Zone initiatives; HGV restriction, only Euro III or Euro IV compliant vehicles permitted.	30%	25%	19%	11%	14%
10. Increased vegetation; plants are able to absorb some pollutants, annual variation with deciduous plants.	56%	33%	7%	1%	1%
11. Engage with local public transport operators (buses and taxis) to; <ul style="list-style-type: none"> Promote the procurement of vehicles with cleaner engine technologies; and Promote the use of cleaner fuels. 	53%	39%	2%	5%	0%
12. Pedestrianisation; removal of vehicles other than for deliveries to premises.	18%	18%	9%	11%	44%
13. Review pedestrian and vehicle movements particularly within the vicinity of the Pelican Crossings to ensure timing adjustments are at optimum to reduce vehicle	24%	48%	13%	2%	6%

emissions.					
14. Contra-flow cycling facility; to promote cyclists into the town areas.	32%	19%	20%	8%	19%
15. Measures to encourage uptake of more walking and cycling under the proposed Active Travel (Wales) Act 2013.	37%	35%	13%	5%	9%
16. Bypass; re-route vehicles to provide the above and/or reduce traffic volume.	33%	30%	8%	8%	19%
17. Establish regeneration teams to prepare actions plans to identify measures which will assist in regenerating the town centres.	33%	33%	8%	8%	11%

Other: Pembrokeshire Council would welcome your thoughts and recommendations in relation to air quality improvement strategies. Please write your comments on the following page.

Comments on the Action Plan Proposal

Topics raised are summarised in no particular order as follows;

- Illegal vehicle parking and enforcement
- More traffic wardens
- Interest from local action group; www.transitionhaverfordwest.org.uk
- Speed control, reductions, speed bumps
- Enforcement in relation to idling vehicles
- Bypass initiatives
- Re-directing traffic flows
- Tourism initiatives
- Parking configuration to accommodate more vehicles at kerb side
- Vehicles having to mount pavements due to narrowing of road from illegally parked vehicles
- How long will improvements take
- One side of road parking only
- Introduce parking meters
- Specific delivery times
- No parking in AQMA's
- Introduction of vegetation
- More public transport, re-introduce Sunday service
- Pedestrianisation of areas
- Restricted vehicular access during certain times of day
- Improved bus parking areas, more, larger

4.4 Public Consultation Results

Ignoring the Neither option within the public consultation document and combining the Strongly Agree and Agree option and Disagree and Strongly Disagree option provides an indication of the level of agreement with the 17 Action Plan Strategies detailed within the questionnaire as follows;

1. Signage	47% For
2. Emissions testing	45% For
3. Restriction to commercial vehicle	60% For
4. Idling policy	76% For
5. Parking policy	65% Against
6. Enforcement	59% Against
7. Speed Controls	54% For
8. Improved visibility	64% For
9. Low emission zones	55% For
10. Increased vegetation	89% For
11. Engage with local transport operator's	92% For
12. Pedestrianisation	55% Against
13. Review crossing facilities	72% For
14. Promote cycling	51% For
15. Promote walking	72% For
16. Bypass	63% For
17. Regeneration	66% For

The written comments submitted on some of the returned forms, in contradiction to the tick box results, was strong for enforcement due to parking infringements e.g. double parking, parking on yellow lines etc. With mitigation ideas relating to increase in traffic wardens, one sided parking, improved parking as angled areas, use of roadside parking meters

5 Which Options to Introduce to Local AQMA's

It would appear from the survey that a preferred method of mitigation would relate to the use of parking restrictions via control of commercial vehicles to specific delivery time constraints and the control of parked vehicles with idling engines.

These preferred options are then contradicted in that a strong opposition to enforcement and parking restrictions are evident within the percentage of responses received.

Vehicle parking and control of idling engines would undoubtedly require enforcement to ensure compliance, indeed it has been noted that the convenience parking of vehicles in restricted areas to enable access to banks and shops is a main feature associated with impeding traffic flow within the AQMA's.

Expenditure is also a consideration as some strategies, for example hard construction in the form of physical changes in the form of a bypass, pedestrianisation, road humps etc would be very costly and could well be above and beyond the level of mitigation required considering the level of exceedance being experienced.

Parking control measures via the designation of strictly no parking road markings within the areas presently utilised for convenience parking would be a far more cost effective method of attempting to restrict and remove the obstructions that can generate stationary tail backs of vehicles within the AQMA's.

This technique would undoubtedly have to be supported by enforcement of the parking restrictions by the use of traffic wardens and the issuing of fines, a strategy that is already in place. Though the introduction of such measures would have to be made public and submitted for consultation prior to their execution providing a period where the local community can become aware of the penalty that will be received should the traffic management control be contravened.

Such a mitigation strategy would be very low cost and of low infrastructure change basically requiring the introduction of road marking's via the use of road paint to designate the specific control measures.

6 Continued Monitoring for NO₂ emissions within AQMA's

Diffusion tube monitoring has continued through 2013, 2014, 2015 and 2016 as detailed within Table 3 below.

A noticeable downward trend is in effect as can be seen by the reduction of exceedances highlighted in red within the Detailed Assessment data contained in Table 3 compared to the previous Table 2 and also detailed within the graphing of the historic single diffusion tube data at Figure 6 below.

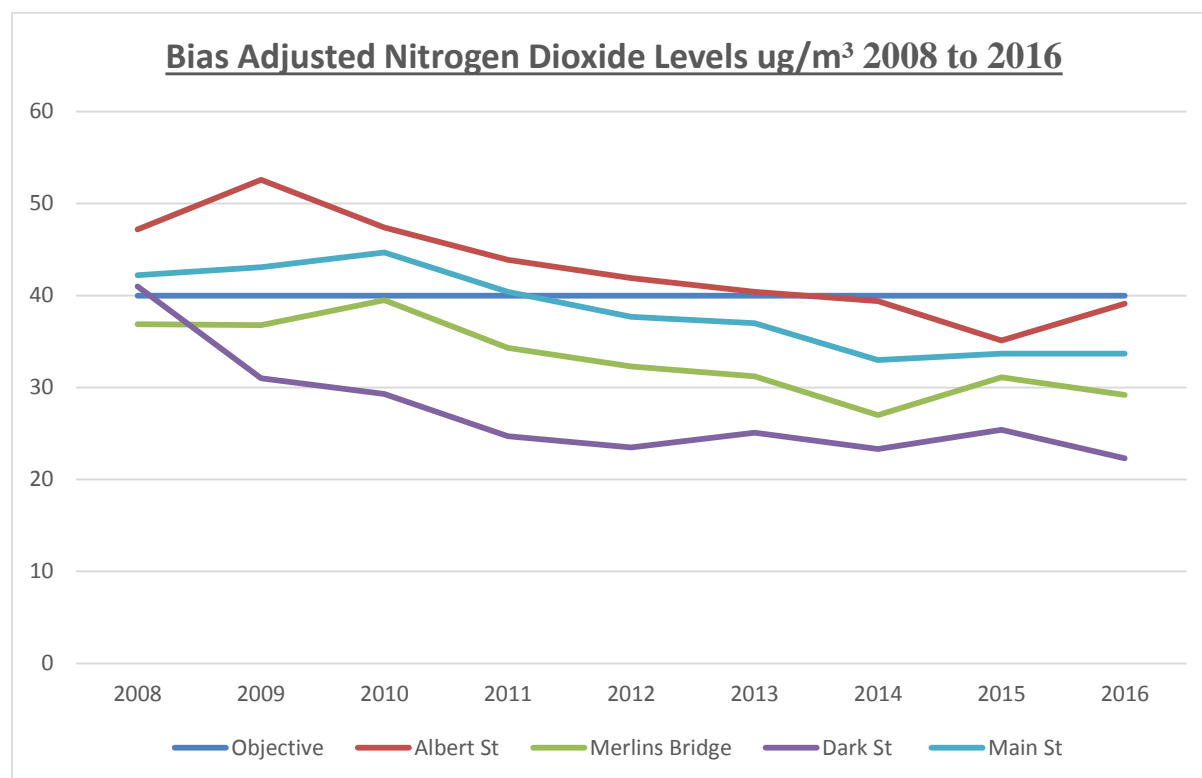
Table 3 Bias A adjusted annual mean NO₂ levels 2015 - 2017

Location	Bias A adjusted annual mean NO ₂ level µg/m ³ (Bias A x Raw Mean) Red indicates result exceeding objective level (Number of months in brackets, bold indicates adjustment as per LAQM.TG09 as less than 9 months data).					
	2014 Bias A = 0.81		2015 Bias A = 0.91		2016 Bias A = 0.92	
	Raw Mean	Bias A	Raw Mean	Bias A	Raw Mean	Bias A
Haverfordwest AQMA						
High St Hwest PCC3	31.9 (10)	25.8	29.3 (12)	26.7	26.4 (11)	24.3
High St Hwest PCC4	37.9 (11)	30.7	37.1 (12)	33.8	36.1 (12)	33.2
High St Hwest PCC5	47.5 (11)	38.5	43.4 (11)	39.5	42.3 (12)	38.9
High St Hwest PCC6	45.6 (9)	36.9	37.7 (12)	34.3	37 (11)	34
High St Hwest PCC7	46.5 (10)	37.7	43 (11)	39.1	41.8 (12)	38.5
High St Hwest PCC8	42.3 (5)	34.3	34.5 (12)	31.5	33.8 (12)	31.1
Dark St Hwest PCC9	28.8 (11)	23.3	27.9 (12)	25.4	24.2 (12)	22.3
Dew St Hwest PCC11	38.4 (10)	31.1	34.2 (11)	31.1	33 (9)	30.4
Dew St Hwest PCC12	41.7 (11)	33.8	34 (11)	30.9	31.4 (11)	28.9
Dew St Hwest PCC13	37.2 (11)	30.1	33.9 (12)	30.8	31.9 (12)	29.3
Dew St Hwest PCC14	31.4 (9)	25.4	28.2 (12)	25.7	26.8 (12)	24.6
Dew St Hwest PCC15	38 (10)	30.8	33.1 (12)	30.1	32 (11)	29.5
Albert St Hwest PCC17	31.2 (11)	25.3	33.3 (11)	30.3	33.5 (12)	30.8
Albert St 2 Hwest PCC18	49 (11)	39.4	38.6 (12)	35.1	42.4 (12)	39.1
Albert St Hwest PCC19	22.2 (11)	18	27.3 (12)	24.8	28.6 (12)	26.3
Albert St Hwest PCC20	34.2 (9)	27.7	42.5 (12)	38.7	43.8 (12)	40.3
Albert St Hwest PCC21	33.1 (11)	26.8	20.1 (12)	18.3	19.3 (11)	17.8

Albert St Hwest PCC22	31.1 (8)	25.2	40.2 (12)	36.6	42 (12)	38.7
Albert St Hwest PCC23	49.2 (9)	39.8	32.1 (11)	29.2	27.9 (10)	25.7
Albert St Hwest PCC24	45.8 (11)	37	43 (11)	39.1	41.5 (11)	38.2
Albert St Hwest PCC25	49.6 (11)	40.2	30.9 (12)	28.1	26.7 (12)	24.6
Albert St Hwest PCC26	54 (10)	43.7	41.5 (12)	37.8	41.9 (12)	38.6
Albert St Hwest PCC27	37.3 (11)	30.2	27.7 (10)	25.2	29 (6)	26.7
Albert St Hwest PCC28	31.4 (9)	25.4	24.1 (10)	21.9	22.4 (10)	20.6
Pembroke AQMA						
Main St Pembroke PCC40	28.3 (10)	22.9	22.2 (11)	20.2	21.9 (12)	20.1
Main St Pembroke PCC41	37.9 (9)	30.7	25 (12)	22.7	25.4 (12)	23.4
Main St Pembroke PCC42	41 (9)	33.2	25.3 (12)	23	22.4 (11)	20.6
Main St Pembroke PCC43	47.8 (11)	38.7	32.2 (8)	29.3	34.2 (12)	31.5
Main St Pembroke PCC44	33.7 (7)	33	37 (12)	33.7	36.6 (12)	33.7
Main St Pembroke PCC45	29 (11)	23.5	41 (12)	37.3	44 (11)	40.5
Main St Pembroke PCC46	26.3 (9)	21.3	33.5 (10)	30.5	36.4 (12)	33.5
Main St Pembroke PCC47	26.8 (10)	21.7	24.6 (12)	22.4	26.4 (12)	24.3
Main St Pembroke PCC48	16.2 (9)	13.1	14.3 (12)	13	14.2 (12)	13

Bias A adjustment calculated via use of relevant annual spreadsheet on the defra website.

Figure 6



Objective	40	40	40	40	40	40	40	40	40
Albert St, H,West PCC 27	47.2	52.6	47.4	43.9	41.9	40.4	39.4	35.1	39.1
Merlins Bridge, H,West PCC 31	36.9	36.8	39.5	34.3	32.3	31.2	27	31.1	39.1
Dark St, H,West PCC 9	41	31	29.3	34.3	32.3	31.2	27	31.1	29.2
Main St, Pembroke PCC 44	42.2	43.1	44.7	40.4	37.7	37	33	33.7	33.7

The Figures 7, 8, 9 and 10 below details the specific site locations and associated annual average NO₂ levels recorded for 2013.

Map of a residential area in Cardiff, Wales, showing streets and landmarks. The map includes a grid of yellow and green squares, and a red line indicating a specific route or boundary. Key features include:

- Streets:** Castle Street, North Street, South Street, Castle Park, North Street, South Street, North Street, South Street, North Street, South Street.
- Landmarks:** Museum, Castle Park, New Bridge, The William Owen (PH), Club, Job Centre, Remains Hill House, Recreation Ground, St Thomas's Bede's Church.
- Speed Limits:** 40.2 (red), 30.6 (black), 25.1 (black), 18.5 (black), 24.8 (black), 34.6 (black), 39 (black).
- Other Labels:** JEEN'S HUARE, Castle Hill, Castle Collage, Car Park, PC, Bank, Skille Hall, Club, HPO, Club, Job Centre, Remains Hill House, Recreation Ground, St Thomas's Bede's Church.

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Figure 8: Map of Non-Automatic Monitoring Sites Dew Street, Haverfordwest. Bias Adjusted NO₂ levels (Red indicates result exceeding objective level)

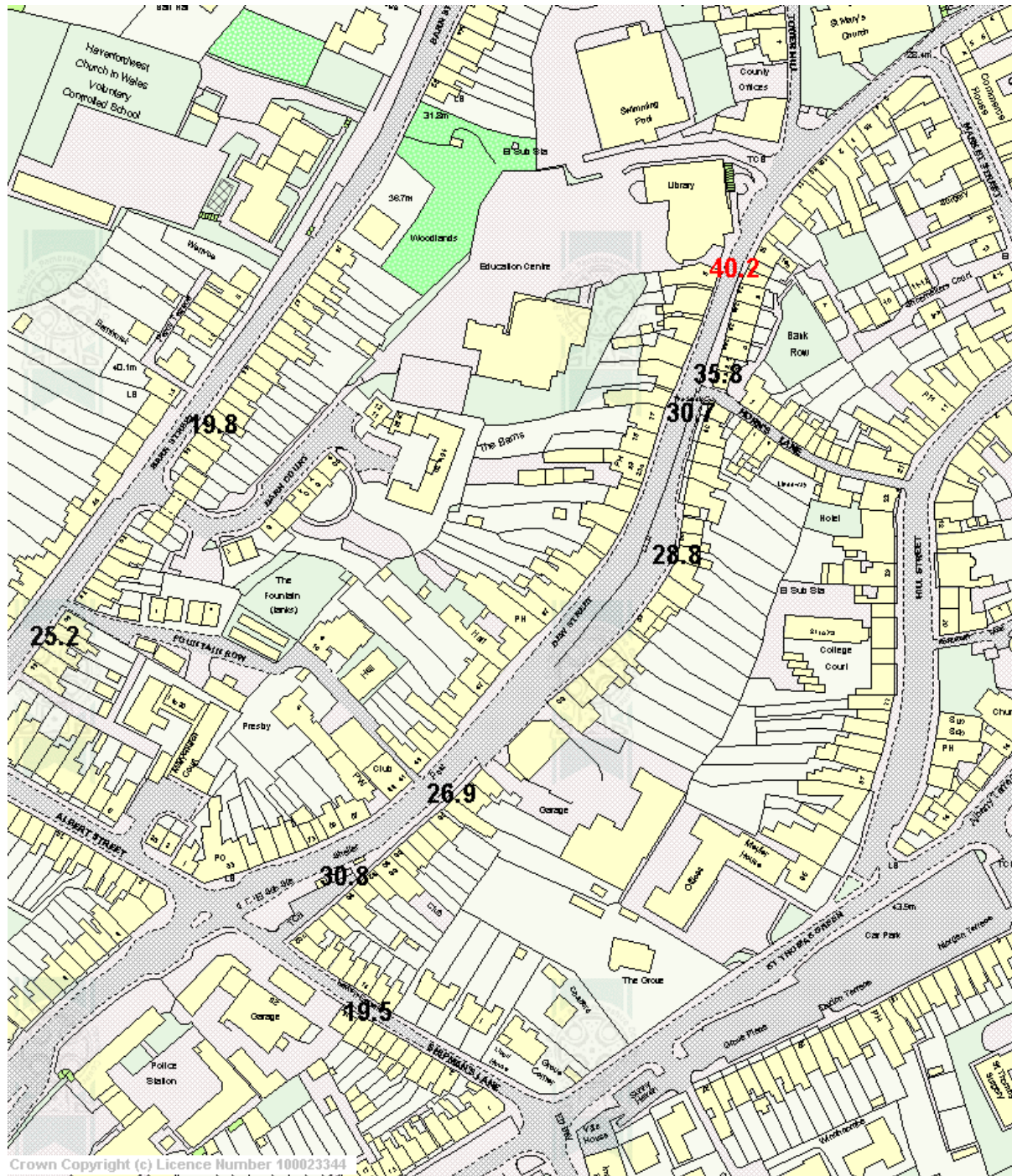
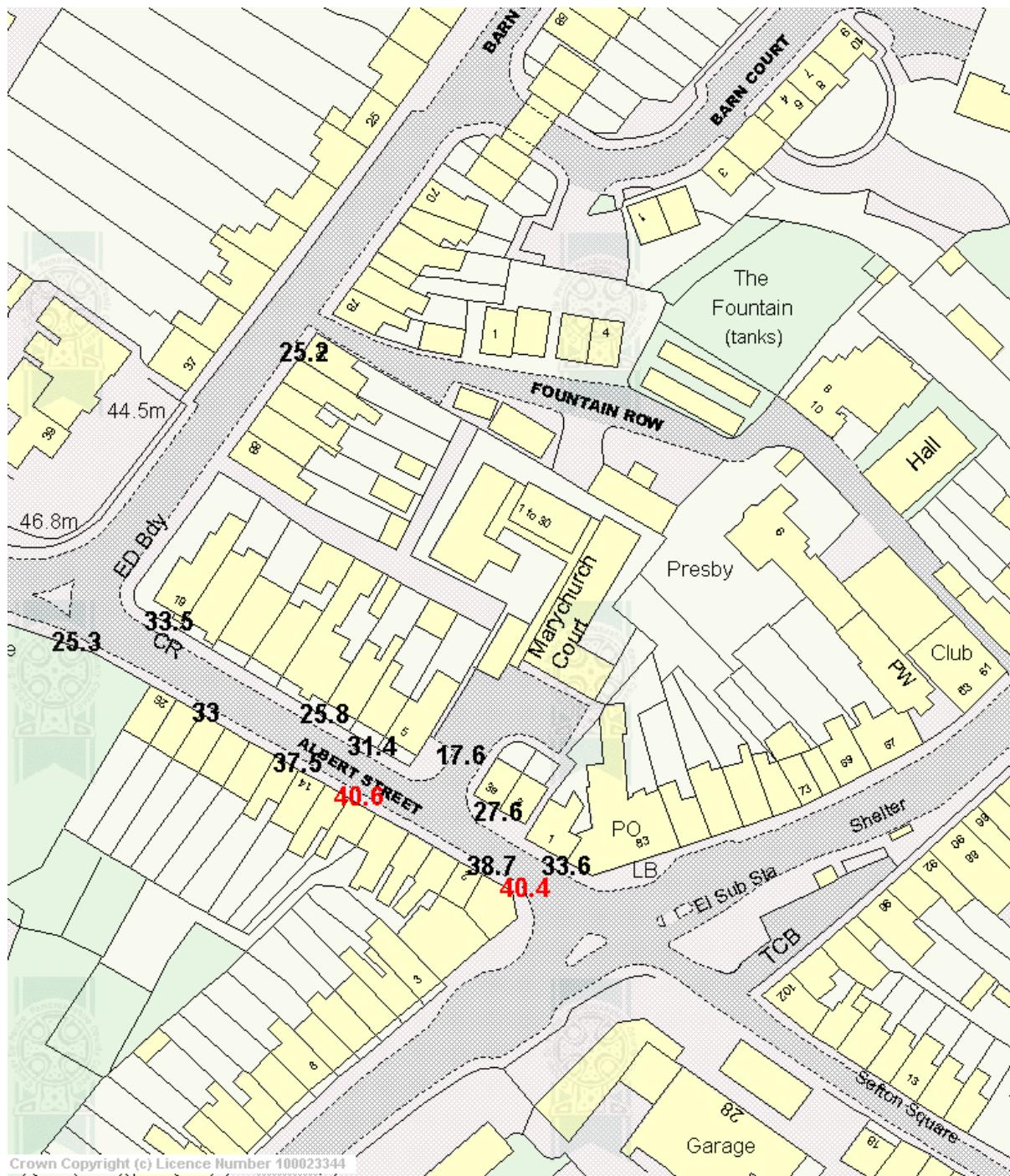


Figure 9: Map of Non-Automatic Monitoring Sites Albert Street, Haverfordwest. Bias Adjusted NO₂ levels (Red indicates result exceeding objective level)



**Figure 10: Map of Non-Automatic Monitoring Sites Main Street, Pembroke.
Bias Adjusted NO₂ levels (Red indicates result exceeding objective level)**



7.0 Action Plan

7.1 Haverfordwest AQMA

As detailed through Figures 1, 6, 7, 8 and 9 the affected area within Haverfordwest is contained within the one way system that passes through the town centre area.

The annual mean objective for nitrogen dioxide of $40\mu\text{g}/\text{m}^3$ through 2013 is only fractionally being exceeded at the various monitoring locations within the designated AQMA. Bias adjusted levels of 40.2, 40.4 and $40.6\mu\text{g}/\text{m}^3$ have been recorded through 2013 with a downward trend recorded throughout the preceding years as detailed within Figures 5 and 6 and Table3.

This downward trend in NO_2 has also been recorded within *The Air Pollution in Wales 2013 Annual Report* produced by Ricardo – AEA on behalf of the Welsh Government and Welsh Air Quality Forum.

Table 2 above provided the specific exceedances taking place within the Haverfordwest AQMA through the last three years, nine for 2011, seven within 2012 and four for 2013.

A traffic study has been carried out in relation to the Haverfordwest AQMA the results of which is detailed within Figure 3 and indicates that cars provide the majority of the vehicle types accessing the area as they comprise 89.4% of the total number of vehicles counted.

Therefore, considering the noticeable downward trend and significant reduction of NO_2 levels over preceding years both locally and nationally there are no mitigation strategies planned to be incorporated into the Haverfordwest AQMA. Monitoring will continue to assess the levels of NO_2 within the AQMA and appropriate actions will be taken should levels of NO_2 be found to be on the increase and the annual air quality objective exceeded.

7.2 Pembroke AQMA

Figures 2 and 10 detail the affected area within Pembroke is contained within part of the one way system that passes through the town centre area.

The annual mean objective for nitrogen dioxide of $40\mu\text{g}/\text{m}^3$ continues to be exceeded for 2013 at a monitoring location within the designated AQMA. A bias adjusted level of $43.1\mu\text{g}/\text{m}^3$ has been recorded as a 2013 annual figure though the Pembroke AQMA is experiencing a downward trend as recorded throughout the preceding years as detailed within Figures 5 and 6 and Table3.

This downward trend in NO_2 has also been recorded within *The Air Pollution in Wales 2013 Annual Report* produced by Ricardo – AEA on behalf of the Welsh Government and Welsh Air Quality Forum at Figure 4.1.

Table 2 above provided the specific exceedances taking place within the Pembroke AQMA through the years, four for 2011, one within 2012 and one for 2013.

A traffic study has been carried out in relation to the Pembroke AQMA the results of which is detailed within Figure 4 and indicates that cars provide the majority of the vehicle types accessing the area as they comprise 83.7% of the total number of vehicles counted.

The area affected within the Pembroke AQMA has been found to be an area where traffic tails back and can become stationary due to convenience parking taking place. This area is currently and has been for some considerable time an area designated with double yellow lines prohibiting the parking of vehicles. As this practice appears to be continuing unabated and a causal effect would appear to be taking place in relation to the detriment of the local air quality a mitigation strategy is to be incorporated into the Pembroke AQMA in an attempt to achieve compliance with the relevant air quality objective.

To this end it was proposed to further incorporate parking control measures and increase parking restriction by the introduction of double yellow stripes on the kerbstone alongside the double yellow lines indicating that no parking and or unloading is allowed on the road areas in question at any time.

The diffusion tube regime has been maintained to enable collation of air quality data of NO₂ levels and thereby enable assessment of the effectiveness of the strategy.

The Highways and Construction Department of Pembrokeshire County Council introduced the relevant marking indicators for the parking control within 2014 and have confirmed that prior consultation took place with the County Councillors, Pembroke Town Council, notices on the street, notification within local papers and within the County Hall Offices reception area.

8.0 Outcomes

8.1 Action Plan Results

The vehicle composition study within section 2 detailed that a reduction of NO₂ within the two AQMA's of 30% within Haverfordwest AQMA and 22% within the Pembroke AQMA were required respectively.

Table 3 and Figure 6 above both detail a downward trend in monitored NO₂ within the two AQMA's. The reduction equates to the following at both monitoring areas where the largest exceedance's took place in 2012.

Table 4

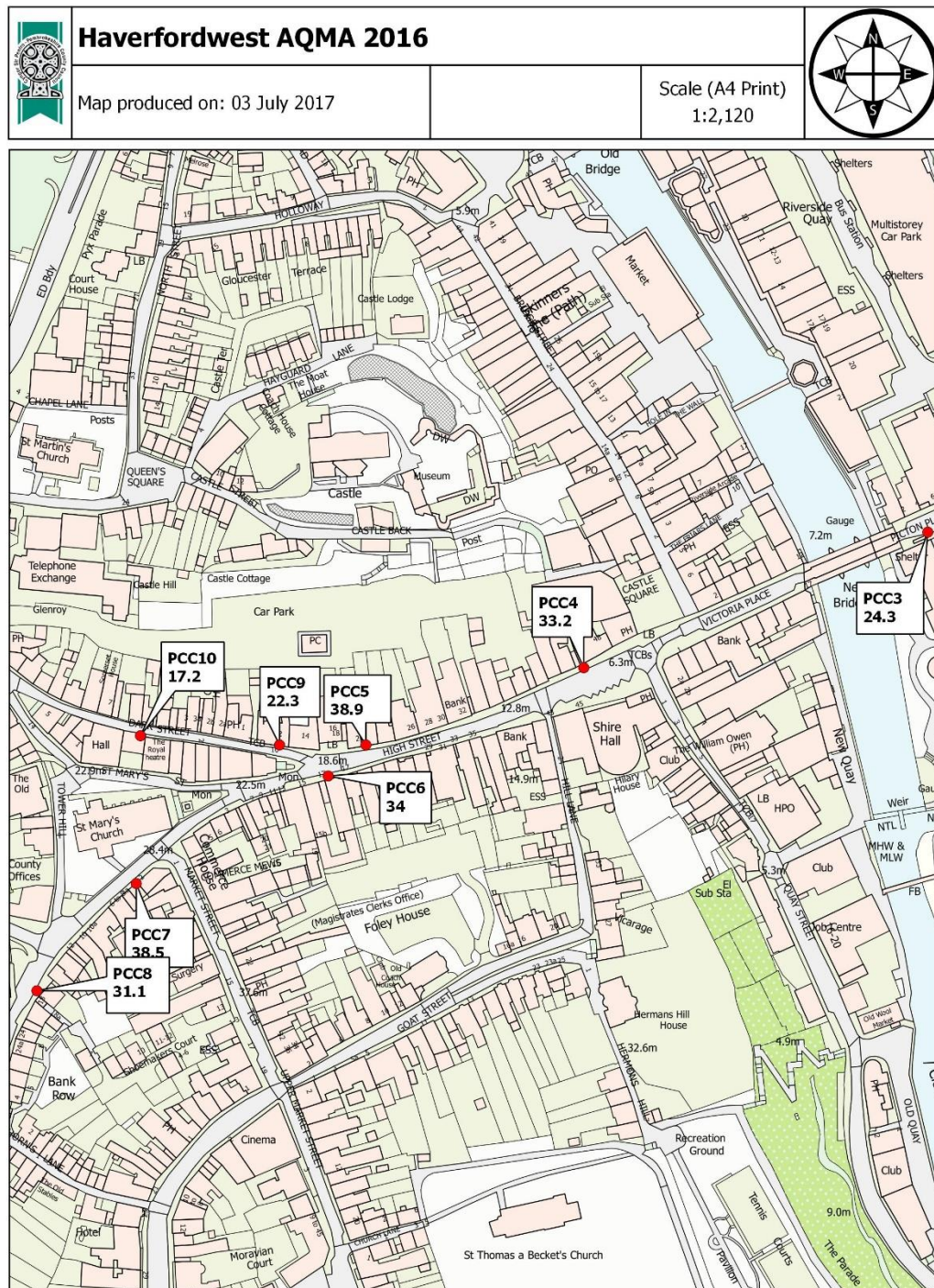
AQMA	Year	Mean NO₂	Required Reduction	Actual Reduction
Haverfordwest PCC7	2012	57.2µg/m ³	30%	
	2016	41.8µg/m ³		27%
Pembroke PCC46	2012	51.5µg/m ³	22%	
	2016	36.4µg/m ³		29%

The 2016 annual mean NO₂ levels within both AQMA's has reduced significantly in relation to 2012 results with one objective not quite achieved and the other significantly overachieved. The greater reduction relates to the Pembroke AQMA where an actual mitigation method was incorporated in an attempt to reduce NO₂ within the AQMA in the form of increased parking restrictions as detailed above.

The NO₂ concentrations detailed within the assessment are the annual mean averages and as part of the air quality reporting process these results are calculated for bias adjustment to correct the mean results for precision and accuracy purposes. The bias adjustment factors are derived from this Authority's participation with the National Bias Adjustment NO₂ Co Location Study via the DEFRA questionnaire and data submission process and use of a combined bias factor has been determined as per the guidance at Box 7.11 within LAQM (TG16).

The resulting bias adjusted figures are further reduced and for 2016 the final NO₂ concentration for the assessment areas are 38.5µg/m³ at PCC7 Haverfordwest and 33.5µg/m³ at PCC46 Pembroke. The bias adjusted figures are the results used to assess compliance with the relevant air quality objective for NO₂ which is 40µg/m³ as an annual mean. Therefore, the subject areas are compliant with the relevant air quality objective and the associated AQMA's are presented graphically below.

**Figure 11: Map of Non – Automatic Monitoring Sites High St, Haverfordwest.
Bias Adjusted NO₂ Levels.**



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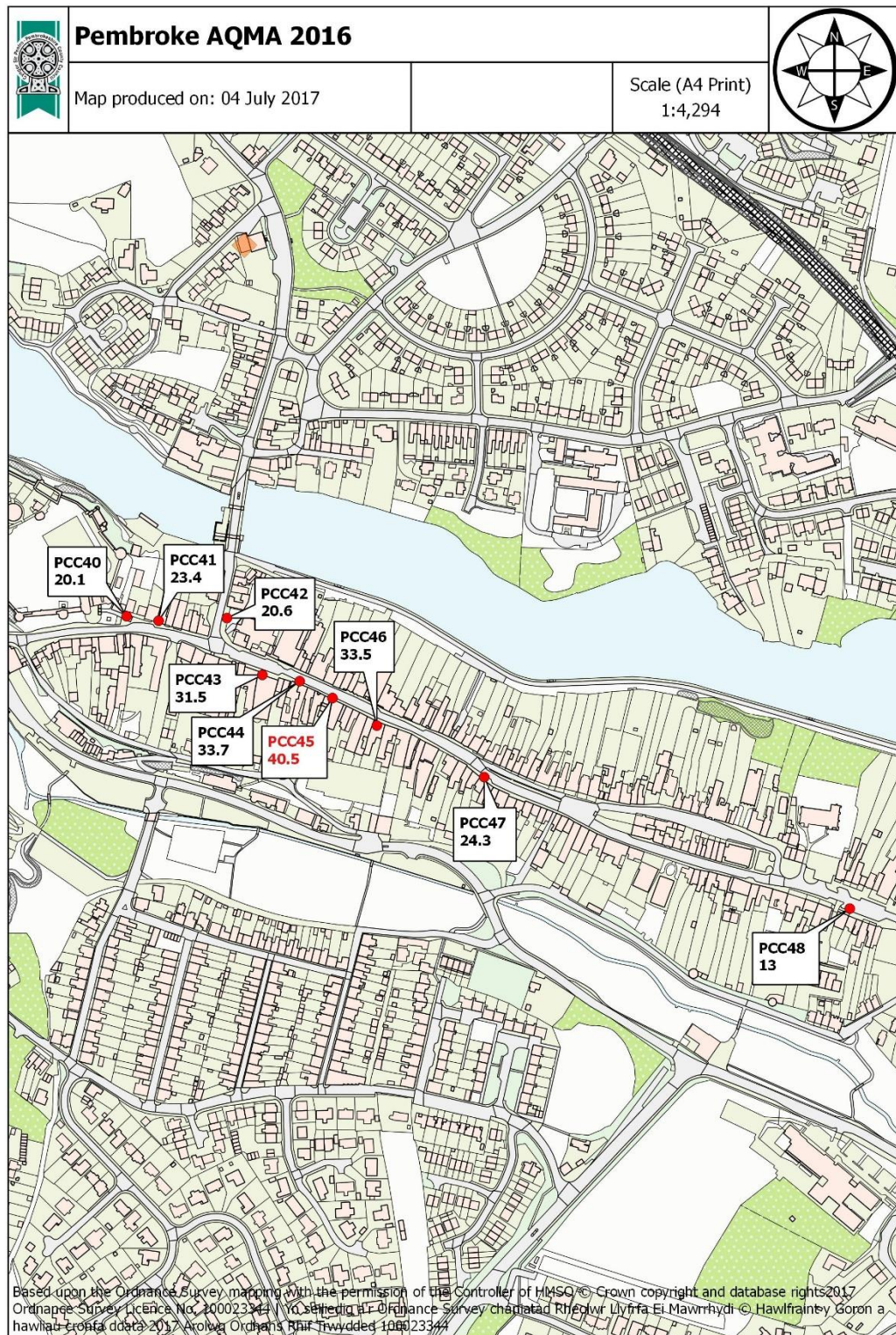
Figure 12: Map of Non-Automatic Monitoring Sites Dew St, Haverfordwest.
Bias Adjusted NO₂ levels.



Figure 13: Map of Non-Automatic Monitoring Sites Albert St, Haverfordwest.
Bias Adjusted NO₂ levels.



**Figure 14: Map of Non-Automatic Monitoring Sites Main St, Pembroke.
Bias Adjusted NO₂ levels.**



9.0 Conclusion

Previous air quality reporting has identified the source of the NO₂ affecting the Haverfordwest and Pembroke town centres as road traffic resulting in the need to declare two Air Quality Management Areas. The physical constraints of the town centre areas, narrow high sided streets with low air flow and poor dispersion enables NO₂ concentrations to accumulate and exceed the annual NO₂ air quality objective of 40µg/m³.

As part of this Action Plan traffic count data has identified that cars are the main form of traffic found within the town centre areas.

An assessment of the reduction of NO₂ required to comply with the air quality objective has taken place. The continual monitoring of air quality and collation of associated results has identified a marked downward trend in NO₂ levels over the previous years to date.

It has been found that this reduction in NO₂ has been sufficient to significantly reduce the exceedances within the Haverfordwest and Pembroke AQMA's to require no further direct intervention but that continuation of the present monitoring regime shall continue and actions taken if an exceedance is found to take place.

In relation to Pembroke it is difficult to confirm whether the mitigation in the form of increased parking restrictions to prevent the occurrence of convenience parking has contributed to the reduction of NO₂ levels considering the overall downward trend for both AQMA's.

This report will be forwarded to statutory consultees for their attention in relation to this Authorities ongoing work on air quality monitoring and the associated results obtained. Future reporting will update upon the Haverfordwest and Pembroke AQMA's and the compliance with the NO₂ air quality objective which presently appears to becoming compliant with the NO₂ air quality objective.

Initially AQMA's were declared for Haverfordwest and Pembroke as exceedances were taking place at individual locations. An increase of monitoring locations established the extent of the affected areas but the individual tubes were generally compliant with the NO₂ air quality objective. The monitoring points that were exceeding would not necessarily represent the "relevant exposure" criteria for the AQMA designation as it is not thought likely that a member of the public would spend an hour or more at these individual locations.

Having said that the Pollution Control function were of the opinion that as the affected areas are the main high street shopping locations within both towns that potentially a member of the public could spend an hour or more within the overall locality of the individual AQMA's. The responsible option was thought to be to declare AQMA's for Haverfordwest and Pembroke due to the aforementioned reasons.

The affected AQMA's continued monitoring has indicated a steady downward trend and it is starting to appear that this reduced level of NO₂ , if it continues through

2017 and 2018, would provide a strong indication that the NO₂ level is unlikely to rise and so a revocation of both AQMA's would be forthcoming from Pembrokeshire County Council if this situation is the case.

Appendices

Appendix 1 Summary of Previous Review and Assessments.

Appendix 2 Air Quality Objectives.

Appendix 1: Summary of Previous Review and Assessments

A summary of the reports produced on air quality by Pembrokeshire County Council to date is detailed below.

- 1998 First Stage Review, an initial benchmark for local air quality, recognised that further detail was required in relation to nitrogen dioxide and particles.
- 2000 Second Stage Review concentrating on nitrogen dioxide and particulates. The report concluded that the two pollutants would meet the objectives set out in Regulations.
- 2003 Updating and Screening Assessment produced. This report recommended a Detailed Assessment of benzene in relation to the petrochemical facilities and fugitive emissions from a specified quarry.
- 2005 Progress Report followed and detailed that benzene levels were already well within the 2010 objective levels. Introduction of permanent dust suppression had been introduced to the specified quarry and a re-assessment of the situation was taking place.
- 2006 Updating and Screening Assessment submitted, the assessment of particles which concluded that the declaration of any Air Quality Management Area within Pembrokeshire is not necessary at this time but that a Detailed Assessment of particles associated with the quarry operation is still required.
- 2007 Progress Report concluded that all air quality objectives would be met and that a Detailed Assessment of the fugitive dust emissions associated with a specific quarry was presently underway.
- 2008 Progress Report and a Detailed Assessment for particles submitted. The Progress Report concluded that all reported air quality parameters would not exceed the relevant objective but that nitrogen dioxide monitoring at one road side location had exceeded the bias corrected annual objective of 40 µg/m³ by 0.5 µg/m³. The location in question was undergoing changes to the road network including infrastructure improvements, introduction of traffic lights and the diversion of traffic volume due to improved access at a local supermarket. A reduction in levels at the monitoring site was therefore expected and the results would be examined in the 2009 Updating and Screening Assessment. The Detailed Assessment relating to fugitive dust emissions from a local quarry concluded that declaration of an Air Quality Management Area was not necessary for particles.

- 2009 Updating and Screening Assessment conclusion identified an increasing upward trend of nitrogen dioxide at roadside locations associated with vehicle emissions. The report recommended a Detailed Assessment be carried out for three specific locations. The number of diffusion tubes has been significantly increased to identify the extent of the areas affected and the associated report is to be submitted in 2010.
- 2010 Progress Report did not identify potential exceedance of the Air Quality Objectives but did recognise the upward trend of nitrogen dioxide emissions at roadside locations associated with vehicle emissions. This has necessitated a Detailed Assessment of nitrogen dioxide for publication in 2011 in conjunction with the annual Progress Report.
- 2011 Progress Report and combined Detailed Assessment recognised the exceedance of the nitrogen dioxide objective requiring the declaration of two Air Quality Management Areas within the County as detailed in Figures 1.1 and 1.2 respectively. No other parameters were found to be in breach of their respective objective concentrations.
- 2012 Updating and Screening Assessment detailed the continuing monitoring of nitrogen dioxide encompassing the full extent of the affected areas as identified within 2011 and resulting in the proposal to declare two Air Quality Management Areas for Haverfordwest and Pembroke.

These AQMA's for Haverfordwest and Pembroke were declared in July 2012 and the boundary of each AQMA is detailed within Figures 1.1 and 1.2. Public consultation has taken place with local stakeholders including local residents and business premises, prior to the declaration and continues through the process in the development of the Air Quality Action Plan.

- 2013 Progress Report focused on the continued exceedance of nitrogen dioxide within the declared AQMA's and detailed the intention to also submit a Further Assessment as part of the air quality reporting regime required as Part IV of the Environment Act 1995.

A Further Assessment is a distinct and separate report the purpose of which is to confirm the original conclusions reached in relation to nitrogen dioxide levels to review the accuracy of the AQMA boundaries, calculate more accurately the improvement needed to comply with the relevant objective by a source apportionment study, refine knowledge on the sources of pollution so that Air Quality Action Plan measures can be identified and targeted. The purposes of which is to improve the Action Planning process and to involve the relevant agencies who have a definite role to play.

Both reports were submitted to and accepted by the Welsh Assembly Government.

**Appendix 2 Air Quality Objectives included in Regulations for the purpose of
LAQM in Wales.**

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a	15-minute mean	31.12.2005