Farnham Traffic Management and Low Emission Feasibility Study – Stage 2

Air quality impacts

Report for Waverley Borough Council

AEA/R/ED58209
Issue Number 1
Date 21/10/2014

Customer:

Waverley Borough Council

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Contact:

Beth Conlan
Ricardo-AEA
Gemini Building, Harwell, Didcot, OX11 0QR
t: 01235 753480
e: beth.conlan@ricardo-aea.com

Ricardo-AEA is certificated to ISO9001 and ISO14001

Author:

John Abbott and Beth Conlan

Approved By:

Beth Conlan

Date:

21 October 2014

Signed:

Ricardo-AEA reference:

Ref: ED58209- Issue Number 1

Executive summary

Waverley Borough Council has a responsibility under Part IV of the Environment Act 1995 to monitor and identify sources of air pollution within its area. In particular, the Council considers where people are living and where air quality standards are not being met. Where these standards are not being met the local authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan to tackle the pollution identified in these areas.

Waverley Borough Council declared an AQMA to cover much of Farnham Town Centre because measured concentrations of nitrogen dioxide exceeded the air quality limit value of 40 µg m^{-3} as an annual mean. The designated area incorporates all parts of The Borough; parts of East Street and South Street; The Woolmead; Union Street; Downing Street; and part of West Street. The boundaries incorporate a wider area than simply where concentrations exceeded the limit so that a holistic approach to tackle air quality issues can be taken. Waverley Borough Council prepared an Air Quality Action Plan (AQAP) in July 2008.

This project is the second stage of a low emissions strategy feasibility study where the main objective of this project was to assess the effectiveness of existing and proposed traffic management options included in Waverley's AQAP, to determine which would deliver satisfactory reductions in emissions to produce lower concentrations of nitrogen dioxide and attain the Nitrogen dioxide (NO_2) Limits Value by 2015. The first stage of the project also evaluated the implementation and acceptability of further low emission measures including heavy goods vehicle (HGV) or other vehicle restrictions and 20 mph speed limits. It concluded that the second stage of the project should focus on the implementation of a traffic management scheme for Farnham town centre and a car parking strategy to encourage diesel cars to park on the outskirts of the town, as emissions of NOx from diesel cars are significantly higher than petrol cars.

The highest concentrations in Farnham town centre, up to 68 µg m^{-3} in 2010, occur on The Borough. These are predicted to decrease to 54 µg m^{-3} by 2016 as the result of changes in the vehicle fleet. The nitrogen dioxide concentrations are thus expected to remain substantially above the objective of 40 µg m^{-3}.

The AQAP noted proposed changes to the traffic circulation in the town centre, including partial pedestrianization of The Borough east of Castle Street. The analysis indicates that removing all non-bus traffic from The Borough would reduce concentrations to levels well below the objective.

Diesel cars provide a substantial part of the emissions of oxides of nitrogen emissions in the Farnham AQMA. They emit substantially more oxides of nitrogen than the equivalent petrol car. The analysis indicates that restricting access for diesel cars, for example by restricting access to town centre car parks, would reduce roadside concentrations but in some locations these would increase. There were a number of locations where the air quality standards would still be exceeded.

An economic cost benefit analysis and health impact assessment of the traffic management option concluded that the costs far outweighed the monetary benefit and the quantified benefits to mortality, coronary and respiratory disease were low.

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1 Outline of brief

The main objective of this project is to assess the effectiveness of existing and proposed traffic management options included in Waverley Borough Council's Air Quality Action Plan (AQAP), to determine which would deliver satisfactory reductions in emissions to produce lower concentrations of nitrogen dioxide and attain the air quality standards by 2015.

To fulfil the above objective, Waverley Borough Council requested a project to facilitate the management of air quality in Farnham be undertaken by appointed consultants. The project outline was submitted to Defra for Air Quality Grant funding and was awarded funds following the acceptance of a detailed project plan.

The aim of this project is to conduct a feasibility and emission reduction study with traffic management strategies proposed for Farnham, in order to achieve compliance of UK Air Quality standards within Farnham AQMA. These standards are set for the protection of human health.

This is the second stage in the project. The first stage assessed a number of traffic management options and low emission options. This concluded that of the measures considered, it has been demonstrated that the changes in traffic circulation deliver the best air quality outcome across the town. Assumptions were made in that study and it was recommended that detailed traffic modelling of this measure is undertaken to provide a better insight to the likely impact of such a proposal. However, this alone may not meet the annual average NO_2 objective in all locations and a further recommendation that it should be considered in conjunction with congestion reducing measures to ensure compliance and best local health protection.

The work programme for the second stage of the project includes:

1. An air quality impact assessment of the traffic management proposals is to be provided based on an updated traffic model from Surrey County Council.

2. An economic and health impact assessment is to be undertaken to examine the feasibility of such measures.

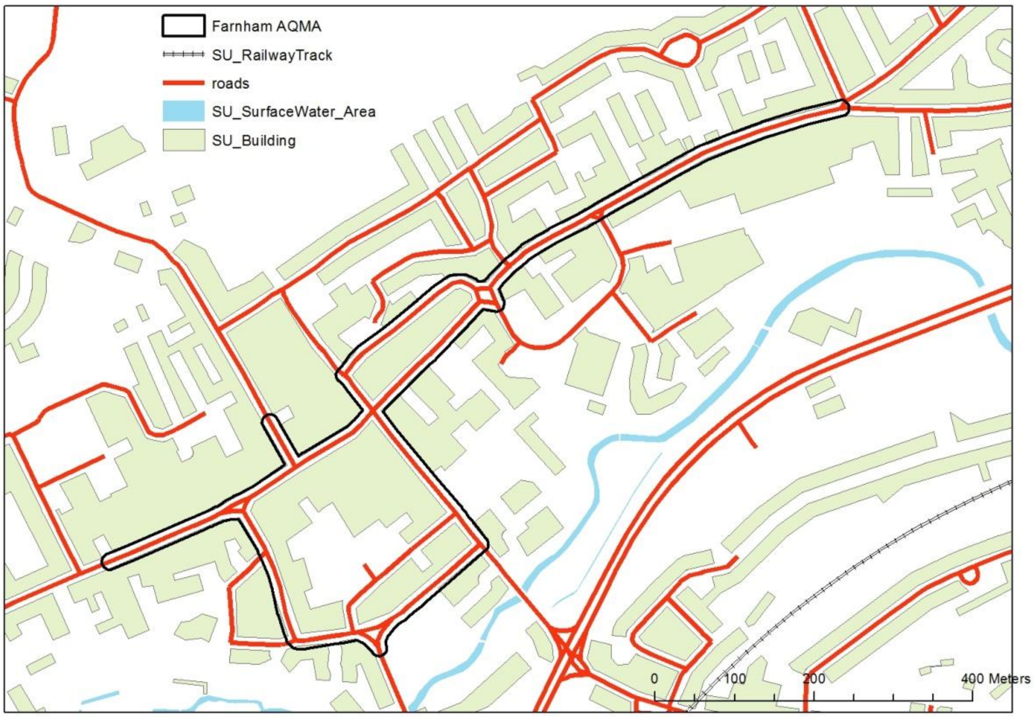
3. Restricting diesel vehicles going into Farnham also delivers significant air quality benefit. While this is not a well established measure, it does focus on those responsible for the higher sources of emission that leads to the air pollution i.e. diesel vehicles. An assessment is to be undertaken on the air quality impact of a car parking strategy to encourage diesel vehicle owners to park on the outer town centre car parks.

2 Introduction

Waverley Borough Council has a responsibility under Part IV of the Environment Act 1995 to monitor and identify sources of air pollution within its area. Where air quality standards, which are set for the protection of human health, are not being met the local authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan to tackle the pollution identified in these areas.

Waverley Borough Council declared 3 such areas, including an AQMA to cover much of Farnham Town Centre because measured concentrations of nitrogen dioxide exceeded the air quality standard of 40 µg m^{-3} as an annual mean. Fig. 1 shows the boundaries of the AQMA. The AQMA was further reviewed in 2007 and the designated area incorporates all parts of The Borough; parts of East Street and South Street; The Woolmead; Union Street; Downing Street; and part of West Street. The boundaries incorporate a wider area than simply where concentrations exceeded the limit so that a holistic approach to tackle air quality issues can be taken.

Fig. 1: Farnham Air Quality Management Area



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The main source of pollution in the AQMA is road vehicles and therefore measures to reduce road vehicles need to be considered to improve the quality of the air in Farnham. Emissions from heavy goods vehicles and buses are significantly higher than from passenger cars, although the numbers of cars outweigh the number of HGVs in most urban roads. Also emissions of nitrogen oxides from diesel cars are significantly higher than for petrol cars, although diesel cars have lower carbon emissions.

Traffic movement and congestion have been of concern in Farnham for some years. In June 2013 Surrey County Council undertook a traffic modelling assessment of four traffic management schemes. The model took into account national, regional and local policies including the Surrey Local Transport Plan objectives to:

- Tackle congestion
- Increase accessibility to key services
- Improve road safety and security
- Enhance environment and quality of life
- Improve management and maintenance of the road network

Details of each traffic management scheme are described below.

2.1 2010 Base year

The Farnham traffic model was reviewed and updated to a 2010 base for the AM and PM peak to enable the assessment of traffic management options within Farnham town centre for this study. To enable the impact of the car park diesel cost strategy (Option 2) to be assessed, the base model was developed to represent car petrol and car diesel vehicle types separately. In total, four matrix levels relating to vehicle types were constructed: car petrol, car diesel, LGV and HGVs (OGV1, OGV2 and coach).

2.2 2016 Do minimum

This scenario was developed as a future base year for comparison with the two future options. This scenario takes into account the committed East Street development in the town centre. This is a large multi land use development which has been granted planning permission and construction is anticipated to be completed by 2016.

The committed East Street development has a number of related highway alterations:

Implementation of a bus-only street on A325 East Street between Dogflud Way and South Street with the direction of travel reversed from westbound to eastbound;

- A325 Woolmead Road converted from one-way (eastbound) to bi-directional travel;
- Existing one-way entrance to Dogflud Way car park converted to bi-directional travel to become entrance and exit;
- Brightwells Road (existing entrance to South Street car park) converted from one-way to bi-directional travel facilitating entrance to South Street car park as well as entrance and exit for future service vehicles;
- New signal controlled toucan crossing at junction of A325 East Street and Dogflud Way;
- New signal controlled junction at A325 East Street with Dogflud Way and Woolmead Road;
- New signal controlled junction at A287 Union Road with Longbridge and Downing Street with pedestrian facilities; and
- Amended layout and signal timings at junction of A325 East Street, A287 South Street, A325 The Borough and Bear Lane.

A number of speed limit reductions on the A31 Farnham Bypass and A325 have recently been approved by local committee and have been included in the 2016 do minimum scenario.

2.3 Option 1

The traffic modelled network in Option 1 is a continuation of the 2016 do minimum scenario but includes the following proposed highway alterations:

- Implementation of bus-only streets on A325 The Borough (between Castle Street and South Street), A287 Downing Street (between Church Lane and West Street) and A287 South Street (between East Street and Victoria Way);
- Conversion of one-way streets to two way on A325 The Borough (between Downing Street and Castle Street), A287 South Street (between Victoria Way and Union Street), A287 Union Road (between South Street and Longbridge) and A287 Downing Street (between Church Lane and Lower Church Lane);
- Amended layout and signal timings at junction of A325 East Street, A287 South Street, A325 The Borough and Bear Lane;
- Amended layout and signal timings at junction of A287 South Street and Victoria Way to include signal control of Brightwells Road;
- New signal controlled junction of A287 South Street and Union Road; and
- New mini-roundabout at junction of A287 Union Road, Longbridge and Downing Street, with puffin pedestrian facilities remaining on A287 Union Road and Longbridge.

2.4 Option 2

Diesel cars emit substantially more oxides of nitrogen than modern petrol cars, which are fitted with catalysts to reduce pollutant emissions. Diesel cars also emit a higher proportion of their emissions as nitrogen dioxide than petrol cars. Restricting access to the town centre for diesel cars, for example by restricting access to car parks, has the potential to reduce emissions. The proportion of NO_2 concentration due to diesel cars at various locations in Farnham can be compared to that due to other vehicle types in figure 2.

Much of the traffic in the town centre is travelling to and from the town car parks. Access to the Waggon Yard, Central and South Street car parks is obtained via the South Street/ Union Road/ Downing Street/ The Borough one way system in the centre of town: access to the Maltings, Upper Hart, Lower Hart, East Street, Dogflud, St James and Riverside car parks can be obtained without driving through the town centre. One way of discouraging diesel car drivers from driving through the one way system would be to restrict access to the car parks in the centre of the town.

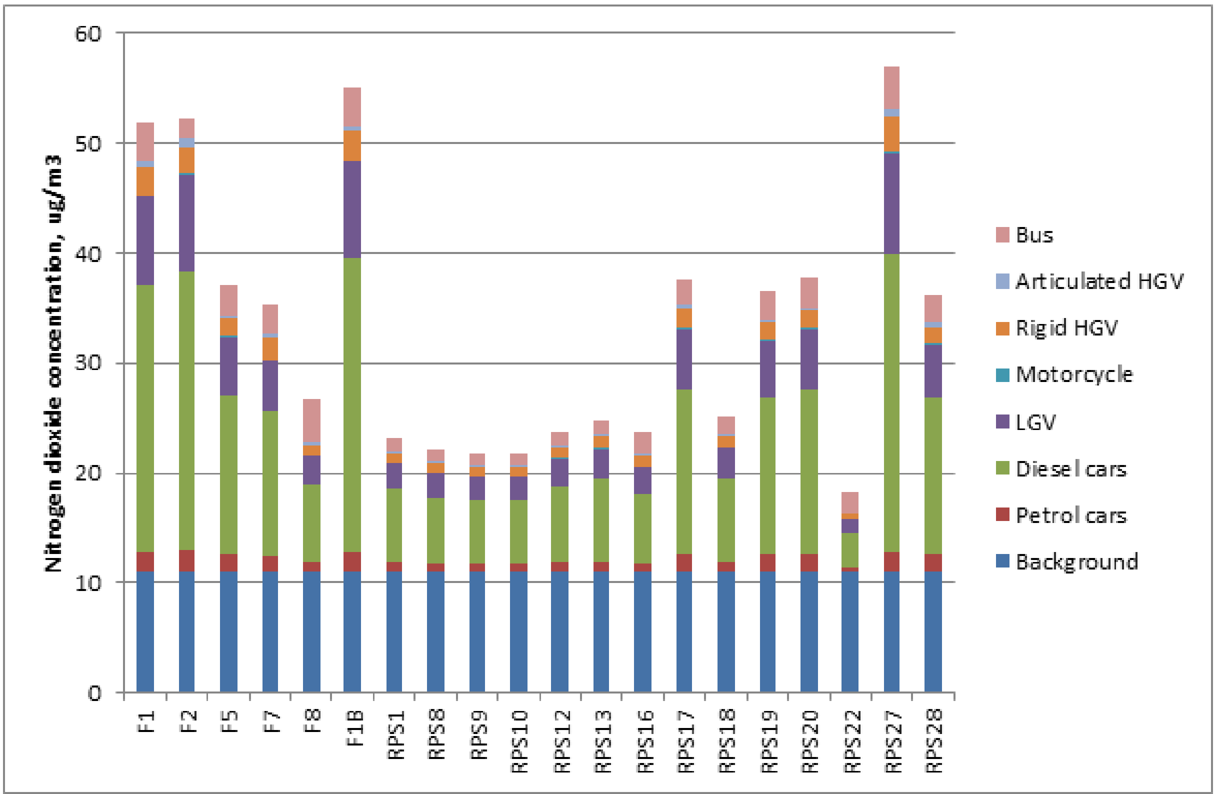


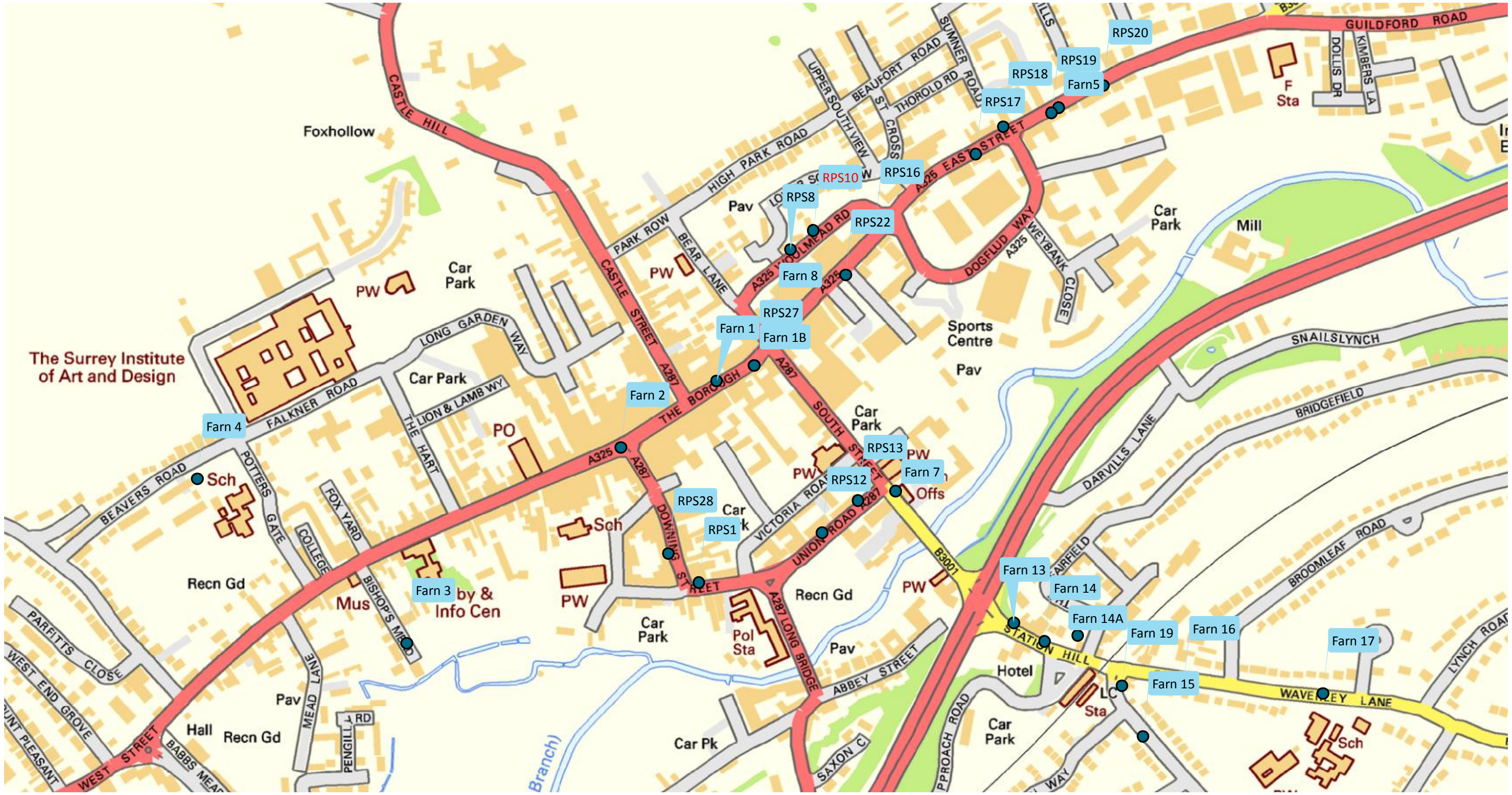
Fig 2: Source apportionment of NO_2 at selected receptors for 2015 with planned development. The location of the selected receptors are given in Fig 3.

Option 2 represents the diesel car park cost strategy. This strategy proposed discouraging diesel cars from the town centre. Car parks in the town centre will charge a higher cost for a parking space for a diesel car than compared to a petrol car. However, car park spaces on the edge of the town would cost much less for diesel cars. This would thereby indirectly influence driver behaviour. The traffic assessment made the following assumptions:

- 15% of diesel cars parking in all of the car parks to be replaced by petrol cars
- 5% of diesel cars parking in all the car parks to be replaced by electric and hybrid cars
- 80% of the remaining diesel cars parked in the car parks with a high charge for diesel cars will relocate to car parks with a low cost for diesel cars.

This scenario does not include any highway alterations but only changes to the number, distribution and vehicle composition originating from and destined to Farnham's ten public car parks. Five car parks were defined as having a high charge rate for diesel and the other five a lower charge rate for diesel cars.

Figure 3 Specified Receptors



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3 Effects on air quality

3.1 Introduction

This Section presents the results of predicted air quality levels for emissions reduction scenarios set out in Section 3.

3.2 Option 1: Changes in traffic circulation

The predicted concentrations under Option 1 indicate that the maximum air quality benefit could be a reduction in the annual mean NO_2 concentration of 31 µg m^{-3}at The Borough (Table 1). The main reason for this reduction is due to a reduction in road traffic as this location changes to a bus lane only.

The annual mean NO_2 concentration was predicted to reduce at all specified receptors within the AQMA with the exception of East Street South Street-Woolmead Road, where an increase of 0.6 µg m^{-3} was predicted.

The predicted annual mean NO_2 concentrations at all specified receptors indicate that traffic management scheme Option 1 would result in a decrease in the annual mean across the AQMA. The predicted concentrations indicate that there would be no exceedences of the annual mean objective within the study area.

3.3 Option 2: Restrictions on diesel cars

Modelling predictions under Option 2 indicates that there would be a decrease in the annual mean concentrations at the majority of specified receptor location within the AQMA. However three sites, namely Junction Downing Street/West Street/The Borough; Junction South Street/Union Road and Woolmead Road indicate an increase in annual mean NO_2 concentrations greater than 2 µg m^{-3}.

The modelling predictions indicate that under Option 2 there would still be exceedences of the annual mean NO_2 objective within the AQMA. Consequently, further feasibility of Option 2 was not undertaken.

Table 1: Predicted annual mean NO_2 µg m^{-3}

Receptor	Location	In AQMA	Annual Mean NO2 µg m-3				
			Measured 2010	2010 Base	2016 Do Minimum	2016 Option1	2016 Option 2
Farn 1	The Borough	Y	**57.5**	**62.1**	**54.5**	23.3	**51.9**
Farn 1B	The Borough	Y	**67.9**	**65.1**	**53.2**	22.8	**50.6**
Farn 2	Junction Downing Street/West Street/The Borough	Y	**54.9**	**50.4**	**40.0**	27.8	**42.1**
Farn 3	Bishops Mead	N	21.2	16.7	16.0	15.8	16.2
Farn 4	Junction East Street/Bear Lane	N	21.5	15.6	15.3	15.3	15.4
Farn 5	East Street, east of Dogflud Way	Y	**42.3**	**45.6**	34.2	22.7	35.2
Farn 7	Junction South Street/Union Road	N	39.5	**42.5**	35.0	31.9	38.2
Farn 8	Woolmead Road	Y	**40.3**	**42.7**	27.1	18.3	27.7
Farn 13	Woolmead Road	N	**41.4**	**42.9**	35.7	31.4	35.3
Farn 14	Woolmead Road	N	**48.2**	**42.5**	34.4	32.8	36.9

Receptor	Location	In AQMA	Annual Mean NO2 µg m-3				
			Measured 2010	2010 Base	2016 Do Minimum	2016 Option1	2016 Option 2
Farn 16	Union Street	N	36.9	29.0	24.1	21.7	23.1
RPS1	Downing Street	Y	N/A	**44.7**	38.3	19.4	36.9
RPS8	Woolmead Road	Y	N/A	25.0	25.7	16.8	22.4
RPS9	Woolmead Road	Y	N/A	23.9	24.5	16.9	22.3
RPS12	Union Street	Y	N/A	30.1	27.0	20.7	28.4
RPS13	Union Street	Y	N/A	29.5	26.2	21.3	27.5
RPS16	Junction East Street/Woolmead Road	Y	N/A	28.9	24.8	20.2	23.7
RPS17	East Street Woolmead Road-Dogflud Way	Y	N/A	36.7	22.1	21.8	22.4
RPS18	Junction East Street/ Dogflud Way	Y	N/A	25.3	21.4	18.5	21.6
RPS19	East Street, east of Dogflud Way	Y	N/A	**41.7**	32.1	20.7	32.8
RPS20	East Street, east of Dogflud Way	Y	N/A	**40.7**	31.0	19.9	30.9
RPS22	East Street South Street-Woolmead Road	Y	N/A	29.7	19.0	19.6	18.8

Receptor	Location	In AQMA	Annual Mean NO2 µg m-3				
			Measured 2010	2010 Base	2016 Do Minimum	2016 Option1	2016 Option 2
RPS27	The Borough	Y	N/A	**61.9**	34.3	22.4	32.8
RPS28	Downing Street	Y	N/A	22.9	21.3	17.0	20.2

The data has been further analysed to determine the air quality benefit between the future year scenarios and the 2016 do minimum scenario. The results are presented in Table 2.

Table 2: Predicted change in annual mean NO_2 µg m^{-3}

Receptor	Location	In AQMA	Change in Annual Mean NO_2 µg m^{-3}	
			2016 Option 1	2016 Option 2
Farn 1	The Borough	Y	-31.2	-2.6
Farn 1B	The Borough	Y	-30.4	-2.6
Farn 2	Junction Downing Street/West Street/The Borough	Y	-12.2	2.1
Farn 3	Bishops Mead	N	-0.2	0.2
Farn 4	Junction East Street/Bear Lane	N	0	0.1
Farn 5	East Street, east of Dogflud Way	Y	-11.5	1
Farn 7	Junction South Street/Union Road	N	-3.1	3.2
Farn 8	Woolmead Road	Y	-8.8	0.6
Farn 13	Woolmead Road	N	-4.3	-0.4
Farn 14	Woolmead Road	N	-1.6	2.5
Farn 16	Union Street	N	-2.4	-1
RPS1	Downing Street	Y	-18.9	-1.4
RPS8	Woolmead Road	Y	-8.9	-3.3
RPS9	Woolmead Road	Y	-7.6	-2.2
RPS12	Union Street	Y	-6.3	1.4
RPS13	Union Street	Y	-4.9	1.3

Receptor	Location	In AQMA	Change in Annual Mean NO_2 µg m^{-3}	
			2016 Option 1	2016 Option 2
RPS16	Junction East Street/Woolmead Road	Y	-4.6	-1.1
RPS17	East Street Woolmead Road-Dogflud Way	Y	-0.3	0.3
RPS18	Junction East Street/ Dogflud Way	Y	-2.9	0.2
RPS19	East Street, east of Dogflud Way	Y	-11.4	0.7
RPS20	East Street, east of Dogflud Way	Y	-11.1	-0.1
RPS22	East Street South Street-Woolmead Road	Y	0.6	-0.2
RPS27	The Borough	Y	-11.9	-1.5
RPS28	Downing Street	Y	-4.3	-1.1

Table 3 shows the projected nitrogen dioxide concentrations for the Do Minimum case for the years 2016-2020. The projections indicate that nitrogen dioxide concentrations at the most affected sites in Farnham will fall to the limit value of 40 µg m^{-3} in 2020 for the Do minimum scenario.

Table 3: Projected nitrogen dioxide concentrations, µg m^{-3}

Site	2016	2017	2018	2019	2020
Farnham 1	55	50	47	43	40
Farnham 1B	53	49	46	42	39

4 Cost benefit analysis

4.1 Introduction

Air pollution has a number of important impacts on human health, as well as on the natural and built environments. Government provides guidance[1] on assessing the value for the impacts of exposure to air pollution on health – both chronic mortality effects (which consider the loss of life years due to air pollution) and morbidity effects (which consider changes in the number of hospital admissions for respiratory or cardiovascular illness) – in addition to damage to buildings (through building soiling) and impacts on materials. The monetary value of these impacts is called “Damage Costs”. The following data were used to determine the damage costs in Farnham:

- The first year of the measure (option 1) implementation which may or may not be the first year where emissions change. This is also important as a different base year has a different level of damage cost associated with it. For this assessment, the base year was 2014, so that all damage costs are expressed at 2014 prices.
- The number of years of the impact of the measure . For this assessment the policy was appraised over the period 2016-2030, because the damage costs saved resulting from the change in the traffic circulation will extend for many years after implementation
- Data on annual emission changes (in tonnes, by each pollutant)

In addition, Government also provides guidance on the calculation of “abatement costs” which is the monetary estimate of the potential supply of abatement at a national scale. To achieve compliance of the European Air Quality Directive limit values, the UK Government will incur a pollution abatement cost. The abatement potential and cost for a range of different abatement technologies are available. Wider impacts on society are incorporated, including: impacts on other pollutants; energy and fuel impacts, and health impacts (damage costs). Should Option 1 achieve compliance with the air quality standard then this abatement cost is avoided. (Option 2 was not considered for economic assessment as this did not achieve compliance with the air quality standard and in some areas air quality deteriorated).

4.2 Benefits

Table 4 shows the total benefit of the scheme, calculated as the sum of abatement costs and the damage costs saved. The calculated values include double counting of part of the damage costs for nitrogen dioxide for the period 2016-2020: however, this contribution is small compared to the overall uncertainty. The costs are calculated with an upper and lower sensitivity bound. Detailed designs for the Option 1 scheme have not been developed yet. Surrey County Council provided initial estimates of the upper and lower limits for the cost of the scheme for scoping purposes. The upper and lower limits produce a very large range. When calculating costs, ideally there would be a scheme drawing and an idea of materials that would be used. At this initial concept stage this information is not yet available, and hence risk and optimism bias are very high.

[1] https://www.gov.uk/air-quality-economic-analysis#damage-costs-approach

Table 4: Total benefit of scheme, NPV (2014 base)

Estimate	Area	NPV, 2014 base
Central estimate	Study Area	1,237,957
	AQMA	892,792
Lower bound	Study Area	1,009,376
	AQMA	695,754
Upper bound	Study Area	2,305,659
	AQMA	1,504,233

4.3 Costs

Table 5 lists the upper and lower bound cost estimates for the main components of the development. It also shows the total cost. For the purposes of this report it is anticipated that the development will take place during 2015. Table 14 also shows the Net Present Value of the total cost at the 2014 base year, assuming a discount rate of 3.5%.

Table 5: Upper and lower bound cost estimates for Option 1

Development	Cost estimates, £	
	Upper bound	Lower bound
Town Centre		
Bus only street A325 The Borough (between Castle Street and South Street)	1,000,000	50,000
Bus only street A287 Downing Street (between Church Lane and West Street)	1,000,000	50,000
Bus only street A287 South Street (between East Street and Victoria Way)	1,000,000	50,000
Conversion of A325 The Borough (between Downing Street and Castle Street) one-way street to two-way	500,000	50,000
Conversion of A287 South Street (between Victoria Way and Union Street) one-way street to two-way	500,000	50,000
Conversion of A287 Union Road (between South Street and Longbridge) one-way street to two-way	500,000	50,000
Conversion of A287 Downing Street (between Church Lane and Lower Church Lane) one-way street to two-way	500,000	50,000
Amended layout and signal timings at junction of A325 East Street, A287 South Street, A325 The Borough and Bear Lane	500,000	250,000
Amended layout and signal timings at junction of A287 South Street and Victoria Way to include signal control of Brightwells Road	500,000	250,000
New signal controlled junction of A287 South Street and Union Road	700,000	300,000
New mini-roundabout at junction of A287 Union Road, Longbridge and Downing Street, with puffin pedestrian facilities remaining on A287 Union Road and Longbridge	200,000	20,000
Outskirts of Town		
Improvements to Coxbridge Roundabout (A31 j/w A325) - not specific	1,000,000	1,000,000
Improvements to Shepherd and Flock Roundabout (A31 j/w A325) - not specific	1,000,000	1,000,000
Total cost	**8,900,000**	**3,170,000**
Net present value, 2014 base	**8,600,000**	**3,100,000**

Surrey County Council indicated that the cost of a successful scheme, in terms of both delivering air quality benefits as well as minimising the impact from traffic, is most likely to be at the upper than the lower level. Although the scheme offers benefit in the town centre, the diversion of traffic, resulting in increased travel time and distance, is a dis-benefit in traditional transport economic terms. Thus to mitigate against the additional traffic and change of travel patterns at the key external junctions (notably Coxbridge and Shepherd & Flock roundabouts), improvement works will need to be undertaken at these major junctions. A scheme of this scope and causing such significant barriers to vehicle movements will also require good pedestrian and cycle connectivity. These matters and the required supporting infrastructure have yet to be considered in detail. The development will also need to be supported by behavioural measures (such as marketing) to improve the success of these routes and reduce car dependency for short trips. In addition it would be sensible to improve the attractiveness of car parks, particularly those situated to the east of the town to further reduce car trip lengths and reduce congestion. As a result of these concerns, Surrey County Council suggested that the total upper limit should be used to calculate the health benefit to cost ratio for the scheme.

4.4 Comparison of costs and benefits

The net present value of the upper bound cost of the scheme was estimated to be £8.1 million. This may be compared with net benefits within the AQMA of £0.89 million. The estimated costs thus substantially exceed the calculated benefits of the scheme.

The costs of the scheme are higher than the calculated benefits even if the most optimistic estimate of the cost (£3.1 million) is compared with the most optimistic estimate of the benefits (£2.3 million). It may be robustly concluded that the costs outweigh the economic benefits.

5 Health impact assessment

5.1 Introduction

5.1.1 General health and life expectancy

Public Health England provides the following summary of the health of people in Waverley.

- The health of people in Waverley is generally better than the England average. Deprivation is lower than average, however about 1,800 children live in poverty. Life expectancy for both men and women is higher than the England average.
- Life expectancy is 6.1 years lower for men and 7.2 years lower for women in the most deprived areas of Waverley than in the least deprived areas.
- Over the last 10 years, all cause mortality rates have fallen. Early death rates from cancer and from heart disease and stroke have fallen and are better than the England average.

Life expectancy at birth in Waverley (2007-2009) is 80.7 years for males and 84.9 years for females (Neighbourhood Statistics): these are slightly higher than the average for the southeast of England.

Poor air quality is known to have a detrimental impact on circulatory disease, coronary heart disease, stroke and respiratory disease. The sections below indicate the comparative levels of such disease in Waverley.

5.1.2 Mortality

Table 6 shows Public Health England's estimates of the numbers of deaths 2006-2010 in relevant wards in Farnham.

Table 6: Number of deaths 2006-2010.

Cause	Farnham Firgrove	Farnham Castle	Farnham Moor Park	Waverley	England
All causes	197	228	264	5,596	2,337,068
All circulatory disease	63	69	79	1,908	774,501
Coronary heart disease	23	25	28	796	354,814
Stroke	21	22	26	573	213,324
Respiratory disease	26	38	40	704	322,420

Table 7 presents these data as mortality rates per thousand usual residents

Table 7: Mortality rates per thousand

Cause	Farnham Firgrove	Farnham Castle	Farnham Moor Park	Waverley	England
All causes	8.99	10.84	10.53	9.21	8.82
All circulatory disease	2.87	3.28	3.15	3.14	2.92
Coronary heart disease	1.05	1.19	1.12	1.31	1.34
Stroke	0.96	1.05	1.04	0.94	0.80
Respiratory disease	1.19	1.81	1.59	1.16	1.22

5.1.3 Emergency hospital admissions

Table 8 shows Public Health England's estimates of the numbers of emergency hospital admissions 2006/7-2010/11 in relevant wards in Farnham. Table 9 shows these admissions as the admission rate per 100,000 usual residents.

Table 8: Emergency hospital admissions, 2006/7-2010/11

Cause	Farnham Firgrove	Farnham Castle	Farnham Moor Park	Waverley	England
All causes	1,630	1,860	2,066	44,424	24,482,768
Coronary heart disease	36	47	49	1,256	733,521
Stroke	28	25	31	826	343,972
Mycardial infarction (heart attack)	20	30	31	732	318,883
Chronic obstructive pulmonary disease	33	37	36	696	530,197

Table 9: Emergency hospital admission rates per 100,000 usual residents, 2006/2007-2010-2011

Cause	Farnham Firgrove	Farnham Castle	Farnham Moor Park	Waverley	England
All causes	7,436	8,847	8,238	7,308	9,237
Coronary heart disease	164	224	195	207	277
Stroke	128	119	124	136	130
Mycardial infarction (heart attack)	91	143	124	120	120
Chronic obstructive pulmonary disease	151	176	144	115	200

5.1.4 Fraction of mortality attributable to particulate air pollution

The Public Health Outcomes Framework[2] provides an estimate of the fraction of mortality in Waverley attributable to particulate air pollution of 5.2% for 2011. This may be compared with 5.5% for the southeast of England and 5.4% for England as a whole. It is estimated that particulate air pollution had an effect on mortality equivalent to 5.2% of 5,596= 291 deaths at typical ages over the period 2006-2010 in Waverley or 58 deaths per year.

The estimated average loss of age-specific life-expectancy associated with attributable deaths was approximately 12 years. On this basis, it is estimated that the local burden of particulate air pollution in Waverley is 698 life-years lost per year.

5.2 Health impact from pollution reductions

The concentrations of particulate matter and nitrogen dioxide in Farnham are expected to decrease as the result of improvements in vehicle technology and the effects of Low Emission Scheme measures. This section assesses the health impacts of these reductions. It assesses the reduction in:

- Mortality attributable to particulate air pollution
- Respiratory hospital admissions
- Cardiovascular hospital admissions

[2] http://www.phoutcomes.info/public-health-outcomes-framework#gid/1000043/pat/6/ati/101/page/1/par/E12000008/are/E07000216

5.2.1 Mortality attributable to particulate air pollution

The all cause mortality rate in Waverley was 9.21 per thousand (Table 7). It is not appropriate to use the ward level data because of the uncertainties introduced by the relatively small sample size. Table 10 shows the change in the annual number of deaths attributable to particulate air pollution and the change in the number of life years lost with respect to the 2010 base case. Option 1 reduces the number of attributable deaths by 0.029 per year and the number of life years lost by 0.35 per year in the area within 100 m of the AQMA. The reduction is greater than that for the do minimum case.

Table 10: Changes in the annual numbers of deaths attributable to particulate air pollution and life-years lost from the 2010 baseline

Area	Change in the number of attributable deaths			Change in the number of life years lost		
	Do minimum	Option 1	Option2	Do minimum	Option 1	Option2
Within 100 m of AQMA	-0.016	-0.029	-0.015	-0.19	-0.35	-0.18
Within 200 m of AQMA	-0.024	-0.040	-0.021	-0.28	-0.48	-0.25
Within 100 m of study area	-0.046	-0.065	-0.037	-0.55	-0.78	-0.45
Within 200 m of study area	-0.047	-0.067	-0.039	-0.57	-0.80	-0.46

5.2.2 Respiratory hospital admissions

The coefficient for hospital admissions for respiratory disease associated with short-term exposure to particulate matter, PM_{10} is 0.8% per 10 µg m^{-3}. The rate of emergency hospital admissions in Waverley for chronic obstructive pulmonary disease was 115 per 100,000 in 2006/7-2010/11. The change in the number of hospital admissions for COPD within 200 m of the study area resulting from reductions in PM_{10} concentrations between 2010 and 2016 is estimated on this basis to be less than 0.01 per year for all scenarios.

The coefficient for hospital admissions for respiratory disease associated with short-term exposure to nitrogen dioxide is 2.5% per 50 µg m^{-3} but it is acknowledged that there are uncertainties about the relationship between exposure to nitrogen dioxide and effects on health. The rate of emergency hospital admissions in Waverley for chronic obstructive pulmonary disease was 115 per 100,000 in 2006/7-2010/11. The change in the number of hospital admissions for COPD within 200 m of the study area resulting from reductions in nitrogen dioxide concentrations between 2010 and 2016 (assuming all oxides of nitrogen) is present as nitrogen dioxide) is estimated on this basis to be less than 0.01 per year for all scenarios.

5.2.3 Coronary hospital admissions

The coefficient for hospital admissions for coronary disease associated with short-term exposure to particulate matter, PM_{10} of 0.8% per 10 µg m^{-3}. The rate of emergency hospital admissions in Waverley for coronary heart disease, strokes and mycardial infarction was 463 per 100,000 in 2006/7-2010/11. The change in the number of hospital admissions for COPD within 200 m of the study area resulting from reductions in PM_{10} concentrations between 2010 and 2016 is estimated on this basis to be less than 0.01 per year for all scenarios.

While these quantified impacts appear low, it is important to point out that the World Health Organisation undertook an extensive review of the medical impacts of poor air quality in 2013. The expert groups have suggested much more stringent coefficients which would show a higher benefit on health from the proposed traffic management scheme. However, these are still suggestions and have not as yet been incorporated into government guidance.

6 Conclusions

The traffic management scheme has a significant improvement to air quality in the centre of Farnham and would result in compliance with the air quality standards set for the protection of health. However, this scheme is costly to implement and would greatly outweigh the estimated monetary benefits. In addition, the quantified health impacts to mortality and coronary and respiratory hospital admissions appear low. However, it should be noted that a detailed review of these methods of calculating monetary value and health impact was undertaken in 2013 during the European Commission's `Year of Air'. Suggestions were that the current government guidance under-estimates the impact. Should this be widely accepted the cost benefit and health impact case would need to be updated prior to any policy decision making.

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR

Tel: 0870 190 6440
Fax: 0870 190 6318