Air Quality Plan for tackling roadside nitrogen dioxide concentrations in Belfast Metropolitan Urban Area (UK0028)

July 2017

Contents

1 Introduction

1.1 This document

This document is the Belfast Metropolitan Urban Area agglomeration zone (UK0028) updated air quality plan for tackling roadside nitrogen dioxide (NO_2) concentrations. This is an update to the air quality plan published in December 2015 (https://www.gov.uk/government/collections/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2015).

This plan presents the following information:

- General information regarding the Belfast Metropolitan Urban Area agglomeration zone

- Details of NO_2 exceedance situation within the Belfast Metropolitan Urban Area agglomeration zone

- Details of local air quality measures that have been implemented, will be implemented or are being considered for implementation in this agglomeration zone

This air quality plan for the Belfast Metropolitan Urban Area agglomeration zone should be read in conjunction with the separate UK Air Quality Plan for tackling roadside nitrogen dioxide concentrations (hereafter referred to as the overview document) which sets out, amongst other things, the authorities responsible for delivering air quality improvements and the list of UK and national measures that are applied in some or all UK zones. The measures presented in this zone plan, and the accompanying UK overview document show how the UK will ensure that compliance with the NO_2 limit values is achieved in the shortest possible time.

This plan should also be read in conjunction with the supporting UK Technical Report which presents information on assessment methods, input data and emissions inventories used in the analysis presented in this plan.

1.2 Context

Two NO_2 limit values for the protection of human health have been set in the Air Quality Directive (2008/50/EC). These are:

- The annual mean limit value: an annual mean concentration of no more than 40 μgm^{-3}

- The hourly limit value: no more than 18 exceedances of 200 μgm^{-3} in a calendar year

The Air Quality Directive stipulates that compliance with the NO_2 limit values will be achieved by 01/01/2010.

1.3 Zone status

The assessment undertaken for the Belfast Metropolitan Urban Area agglomeration zone indicates that the annual limit value was exceeded in 2015 but is likely to be achieved by 2022 through the introduction of measures included in the baseline. When combined with the measures outlined in the overview document for the UK we expect this zone to be compliant by 2021.

1.4   Plan structure

General administrative information regarding this agglomeration zone is presented in Section 2.

Section 3 then presents the overall picture with respect to NO_2 levels in this agglomeration zone for the 2015 reference year of this air quality plan. This includes a declaration of exceedance situations within the agglomeration zone and presentation of a detailed source apportionment for each exceedance situation.

An overview of the measures already taken and to be taken within the agglomeration zone both before and after 2015 is given in Section 4.

Baseline modelled projections for each year from 2017 to 2030 for each exceedance situation are presented in Section 5. The baseline projections presented here include, where possible, the impact of measures that have already been taken and measures for which the relevant authority has made a firm commitment to implement. However, it has not been possible to quantify the impact of all the measures. This section therefore also explains which measures have been quantified, and hence included in the model projections, and which measures have not been quantified.

2   General Information About the Zone

2.1   Administrative information

Zone name: Belfast Metropolitan Urban Area
Zone code: UK0028
Type of zone: agglomeration zone
Reference year: 2015
Extent of zone: Figure 1 shows the area covered by the Belfast Metropolitan Urban Area agglomeration zone. Local Authorities within the zone: Figure 2 shows the location of Local Authorities within the agglomeration zone. A list of these Local Authorities is also given below. The numbers in the list correspond to the numbers in Figure 2.

1. Antrim and Newtownabbey

2. Belfast City Council

3. Lisburn and Castlereagh

4. Mid and East Antrim

5. North Down and Ards

(Note: Local Authority boundaries do not necessarily coincide with zone boundaries. Hence Local Authorities may be listed within more than one zone plan.)

Figure 1: Map showing the extent of the Belfast Metropolitan Urban Area agglomeration zone (UK0028).
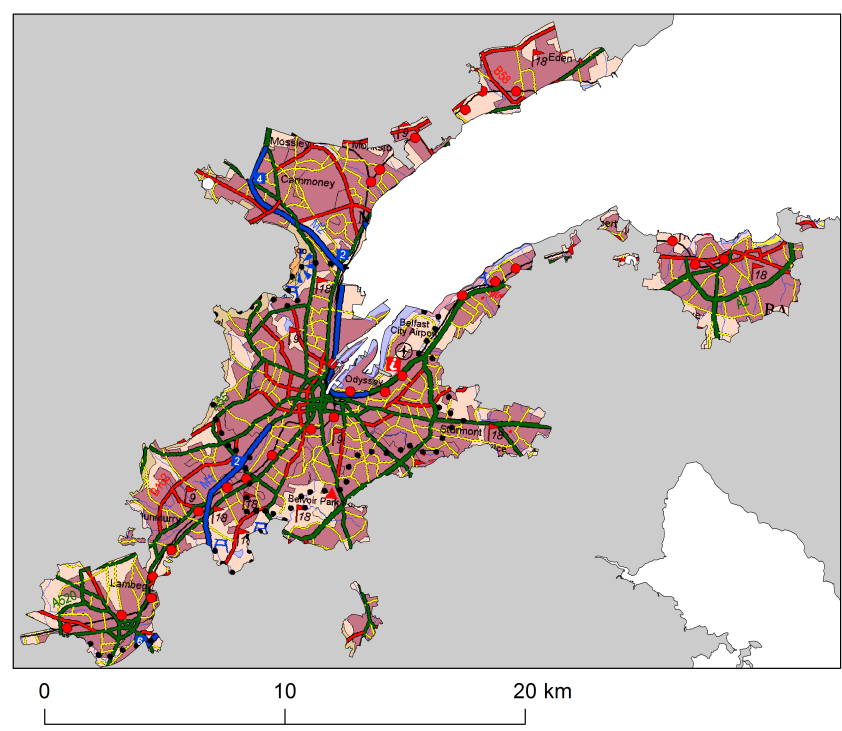
Figure 2: Map showing Local Authorities within the Belfast Metropolitan Urban Area agglomeration zone (UK0028).

2.2 Assessment details

Measurements

NO_2 measurements in this zone were available in 2015 from the following national network monitoring stations (NO_2 data capture[1] for each station in 2015 shown in brackets):

1. Belfast Centre GB0567A (92%)

2. Belfast Stockman's Lane GB1036A (99%)

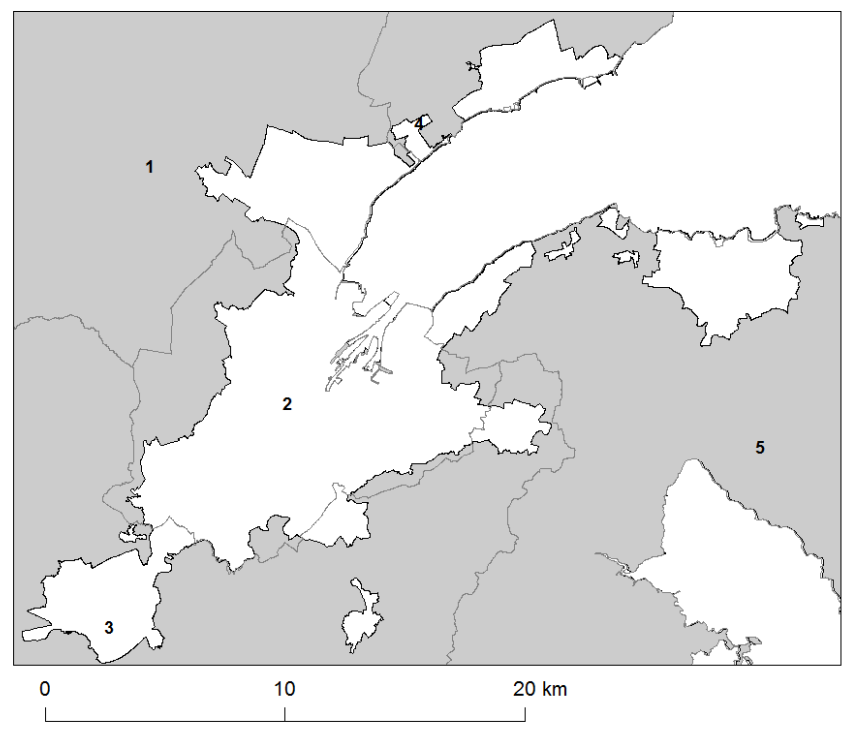Full details of monitoring stations within the Belfast Metropolitan Urban Area agglomeration zone are available from http://uk-air.defra.gov.uk/networks/network-info?view=aurn.

Modelling

Modelling for the 2015 reference year has been carried out for the whole of the UK. This modelling covers the following extent within this zone:

- Total background area within zone (approx): 216 km^2

- Total population within zone (approx): 545,493 people

Zone maps

Figure 3 presents the location of the NO_2 monitoring stations within this zone for 2015 and the roads for which NO_2 concentrations have been modelled. NO_2 concentrations at background locations have been modelled across the entire zone at a 1 km x 1 km resolution.

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[1]Annual data capture is the proportion of hours in a year for which there are valid measurements at a monitoring station, expressed in this document as a percentage. The Implementing Provisions on Reporting (IPR) guidance requires that a minimum data capture of 85% is required for compliance reporting (that is 90% valid data, plus a 5% allowance for data loss due to planned maintenance and calibration). Monitoring stations with at least 75% data capture have been included in the modelling analysis to ensure that a greater number of operational monitoring sites have been used for model calibration and verification purposes. For more information on compliance reporting under European Directives see Section 2.3.

Figure 3: Map showing the location of the NO₂ monitoring stations with valid data in 2015 and roads where concentrations have been modelled within the Belfast Metropolitan Urban Area (UK0028) agglomeration zone.
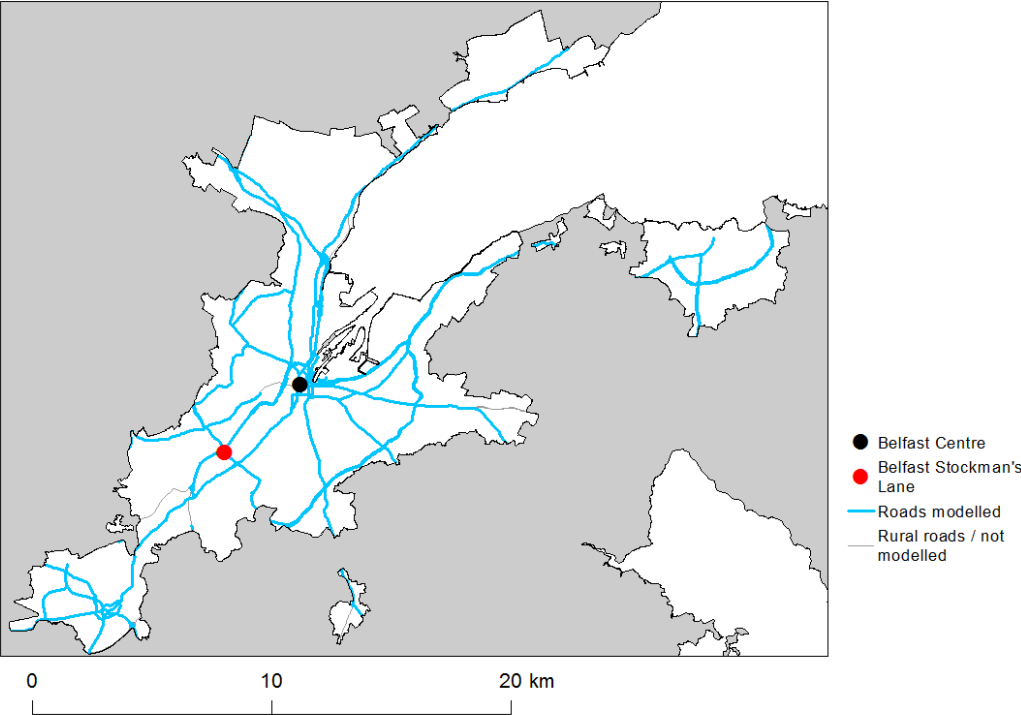
2.3 Air quality reporting

From 2001 to 2012 the UK has reported annually on air quality concentrations using a standard Excel questionnaire (Decision 2004/461/EC). These questionnaires are available online from http://cdr.eionet.europa.eu/gb/eu/annualair. Since 2013 reporting has been via an e-reporting system (Decision 2011/850/EU) http://cdr.eionet.europa.eu/gb/eu/.

In addition, the UK has reported on air quality plans and programmes (Decision 2004/224/EC) since 2003. The most recent previous UK air quality plan for nitrogen dioxide was published in 2015. The plan and supporting documents are available at https://www.gov.uk/government/collections/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2015 and the submission of this plan via e-reporting is published at http://cdr.eionet.europa.eu/gb/eu/aqd/h/envvryhbq/. Historic plans and programmes are available on http://cdr.eionet.europa.eu/gb/eu/aqpp.

3   Overall Picture for 2015 Reference Year

3.1 Introduction

There are two limit values for the protection of health for NO_2. These are:

- The annual limit value (annual mean concentration of no more than 40 μgm^{-3})

- The hourly limit value (no more than 18 hourly exceedances of 200 μgm^{-3} in a calendar year)

Within the Belfast Metropolitan Urban Area agglomeration zone the annual limit value was exceeded in 2015. Hence, one exceedance situation for this zone has been defined, NO_2_UK0028_Annual_1, which covers exceedances of the annual limit value. This exceedance situation is described below.

3.2 Reference year: NO_2_UK0028_Annual_1

The NO_2_UK0028_Annual_1 exceedance situation covers all exceedances of the annual mean limit value in the Belfast Metropolitan Urban Area agglomeration zone in 2015.

Compliance with the annual limit value in this exceedance situation has been assessed using a combination of air quality measurements and modelling. Table 1 presents measured annual concentrations at national network stations in this exceedance situation since the 1st Daughter Directive (1999/30/EC) came into force in 2001. This shows that there were measured exceedances of the annual limit value at Belfast Stockman's Lane (GB1036A) in 2015.

Table 2 summarises the maximum modelled annual mean NO_2 concentrations in this exceedance situation for the period 2001 to 2014. For 2015, there were seven locations across the UK where the measured NO_2 concentration exceeded the annual mean limit value of 40 μgm^{-3} and the measured concentration was greater than the modelled concentration for the road link adjacent to the monitoring station. In these situations, the measured 2015 annual mean concentration is used as the reference year value. This is a precautionary approach taking the higher NO_2 concentration out of the modelled and measured concentration at the location of monitoring stations in 2015. Where these measured concentrations correspond to the maximum concentration in the zone, the measured 2015 concentrations are included in Table 2 in place of modelled concentrations, for consistency with the projections (see Section 5.3). For years prior to 2015 only modelled results are presented in Table 2.

In the Belfast Metropolitan Urban Area agglomeration zone the measured concentration at one monitoring station, Belfast Stockman's Lane (GB1036A; 50 μgm^{-3}), exceeded the annual mean limit value in 2015 and was greater than the modelled concentration at the adjacent road link (traffic count point 902795 on the A55) of 39 μgm^{-3}. The road length in exceedance presented in Table 2 includes the length of road associated with traffic count point 902795 of 3.5 km.

The discrepancy between the measured and modelled concentration was likely to have been as a result of some specific local conditions that are not well represented in the national model.

Table 2 shows that, in 2015, 42.7 km of road length was modelled to exceed the annual limit value. There were no modelled background exceedances of the annual limit value. The models are updated each year to take into account the most up-to-date science, so the modelled results for different years may not be directly comparable. Maps showing the modelled annual mean NO$_2$ concentrations for 2015 at background and at roadside locations are presented in Figures 4 and 5 respectively (note that Figure 5 also includes the measured exceedance at Belfast Stockman's Lane). All modelled (and measured) exceedances of the annual limit value are coloured orange or red in the maps.

The modelling carried out for this exceedance situation has also been used to determine the annual mean NO$_X$ source apportionment for all modelled locations. Emissions to air are regulated in terms of oxides of nitrogen (NO$_X$), which is the term used to describe the sum of nitrogen dioxide (NO$_2$) and nitric oxide (NO). Ambient NO$_2$ concentrations include contributions from both directly emitted primary NO$_2$ and secondary NO$_2$ formed in the atmosphere by the oxidation of NO. As such, it is not possible to calculate an unambiguous source apportionment specifically for NO$_2$ concentrations; therefore the source apportionment in this plan is presented for NO$_X$, rather than for NO$_2$ (for further details please see the UK Technical Report). Table 3 summarises the modelled NO$_X$ source apportionment for the section of road with the highest NO$_2$ concentration in this exceedance situation in 2015. This is important information because it shows which sources need to be tackled at the location with the largest compliance gap in the exceedance situation.

Figure B.1 in Annex B presents the annual mean NO$_X$ source apportionment for each section of road within the NO$_2$_UK0028_Annual_1 exceedance situation (i.e. the source apportionment for all exceeding roads only) in 2015.

Table 1: Measured annual mean NO$_2$ concentrations at national network stations in NO2_UK0028_Annual_1 for 2001 onwards, μgm^{-3} (a). Data capture shown in brackets.

Site name (EOI code)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Belfast Centre (GB0567A)	32 (85)	30 (95)	32 (95)	28 (92)	33 (55)	34 (91)	32 (91)	32 (92)	33 (89)	35 (92)	28 (99)	29 (99)	31 (95)	31 (92)	29 (92)
Belfast Stockman's Lane (GB1036A)														59 (56)	50 (99)

(a) Annual Mean Limit Value = 40 μgm^{-3}

Table 2: Annual mean NO$_2$ model results in NO$_2$_UK0028_Annual_1 for 2001 onwards.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015(b)
Road length exceeding (km)	37.2	46.0	53.8	67.6	35.0	35.0	35.0	36.4	57.9	63.4	36.4	34.3	51.8	39.6	42.7
Background exceeding (km^2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum modelled concentration (μgm^{-3}) (a)	60.0	49.9	60.5	56.6	72.9	73.9	67.8	70.4	65.6	77.0	68	65	64	65	57

(a) Annual Mean Limit Value = 40 μgm^{-3}

(b) For 2015 the road length exceeding includes the road length associated with the traffic count point located adjacent to Belfast Stockman's Lane monitoring station (traffic count point 902795 on the A55). See text for more detail. For years prior to 2015, model results only are presented.

Table 3: Modelled annual mean NO$_X$ source apportionment at the location with the highest NO$_2$ concentration in 2015 in NO2_UK0028_Annual_1 (μgm^{-3}) traffic count point 999345 on the A12; OS grid (m): 145596.25, 529935.6) (d).

Spatial scale	Component	Concentration at highest road link (a)
Regional background sources NOx (i.e. contributions from distant sources of > 30 km from the receptor).	Total	3.0
	From within the UK	1.4
	From transboundary sources (includes shipping and other EU member states)	1.6
Urban background sources NOx (i.e. sources located within 0.3 - 30 km from the receptor).	Total	37.1
	From road traffic sources	22.2
	From industry (including heat and power generation)	2.5
	From agriculture	NA
	From commercial/residential sources	8.7
	From shipping	1.0
	From off road mobile machinery	1.9
	From natural sources	NA
	From transboundary sources	NA
	From other urban background sources	0.7
Local sources NOx (i.e. contributions from sources < 0.3 km from the receptor).	Total	108.7
	From petrol cars	8.1
	From diesel cars	54.2
	From HGV rigid (b)	24.0
	From HGV articulated (b)	13.6
	From buses	0.8
	From petrol LGVs (c)	0.0
	From diesel LGVs (c)	7.6
	From motorcycles	0.4
	From London taxis	0.0
Total NOx (i.e. regional background + urban background + local components)		148.8
Total NO$_2$ (i.e. regional background + urban background + local components)		57

(a) Components are listed with NO$_X$ concentration of NA when there is no source from this sector.

(b) HGV = heavy goods vehicle

(c) LGV = light goods vehicle

Figure 4: Map of modelled background annual mean NO$_2$ concentrations 2015. Modelled exceedances of the annual limit value are shown in orange and red.
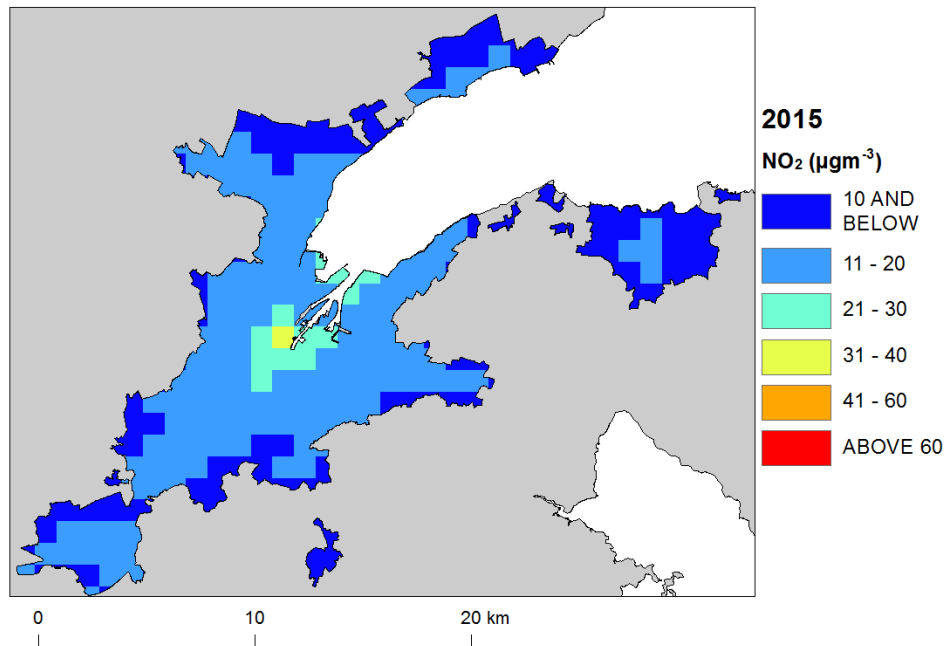
Figure 5: Map of roadside annual mean NO$_2$ concentrations 2015. Modelled exceedances of the annual limit value are shown in orange and red.[2]
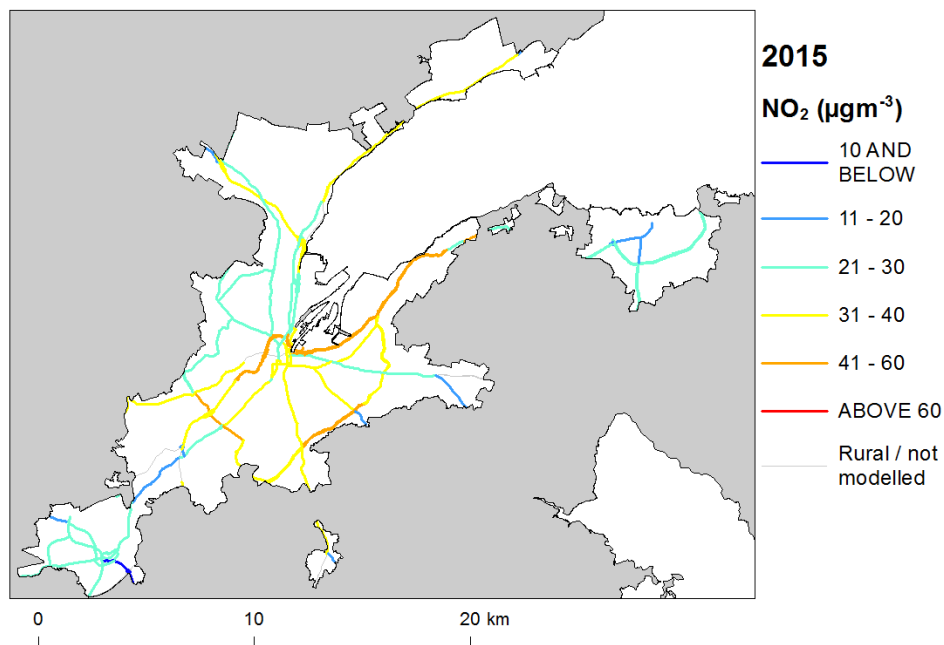
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[2]The NO$_2$ concentration presented for the traffic count point located adjacent to Belfast Stockman's Lane monitoring station (traffic count point 902795 on the A55) is the measured annual mean NO$_2$ concentration at Belfast Stockman's Lane monitoring station. See text for more detail.

4 Measures

4.1 Introduction

This section gives details of measures that address exceedances of the NO_2 limit values within Belfast Metropolitan Urban Area agglomeration zone. This includes both measures that have already been taken and measures for which there is a firm commitment that they will be taken.

Section 5 then explains the extent to which it has been possible to incorporate the impacts of these measures into the baseline modelling carried out for this assessment.

4.2 Source apportionment

It is important to understand which sources are responsible for causing the exceedance in order to most effectively tailor measures to address the NO_2 exceedance situation described in Section 3 above. This can be achieved by considering the source apportionment for the exceedance situation, also presented in Section 3. A summary of what the source apportionment shows and the implications for which measures would therefore be appropriate is given here.

Local road traffic was the dominant source in this exceedance location in the reference year. The largest contribution was from diesel cars at the location of maximum exceedance with a contribution of 54.2 μgm^{-3} of NO_X out of a total of 148.8 μgm^{-3} of NO_X. Diesel cars and on some roads rigid and articulated HGVs were important sources on the primary roads with the highest concentrations.

This indicates that appropriate measures should impact on local road traffic sources in this zone. Other measures to address the urban background sources may also be beneficial.

4.3 Measures

Measures potentially affecting NO_2 in this agglomeration zone have been taken and/or are planned at a range of administrative levels. These are:

- European Union

- National (i.e. England, Scotland, Wales, Northern Ireland or whole UK)

- Local (i.e. UK Local Authorities)

Details of European Union measures (e.g. Euro Standards, Fuel Quality Directives, Integrated Pollution Prevention and Control) can be found on the European Commission's website (http://ec.europa.eu/environment/air/index_en.htm). Details of national measures are given in the UK overview document.

Relevant Local Authority and Department for Infrastructure measures within this exceedance situation are listed in Table C.1 (see Annex C). Table C.1 lists measures which a local authority or Department for Infrastructure has carried out or is in the process of carrying out, plus additional measures which the local authority or Department for Infrastructure is committed to carrying out or is investigating with the expectation of carrying out in the future.

Overview

The Area Plan contains details of a range of measures put forward by Northern Ireland central and local government. The Plan encourages increased provision for walking and cycling facilities together with policies

which seek to provide an alternative to travel by car. The measures set out in the Plan are linked to the overall policy aim of reducing car travel and emissions from road transport, as this offers the greatest potential for reducing levels of nitrogen dioxide on major routes. Also, improved facilities for public transport, walking and cycling provide greater choice of travel.

There are a number of initiatives that are being undertaken. A bicycle strategy for Northern Ireland is intended to improve and extend cycle networks. This was launched in 2015. The strategy will contribute to reduced congestion and improve air quality. It will be followed by a bicycle network plan for the area to guide the development and operation of bicycle infrastructure for the next ten years. A public bike hire scheme was launched by Belfast City Council in April 2015 and has 300 bicycles and 30 bike docking stations within the city centre area.

There are also installations of electric charging points across Northern Ireland with approximately 30 charge point locations within the Greater Belfast area. The network will help the development of the growing ultra-low emission vehicle sector within Northern Ireland. Bus fleets are also being replaced with newer, lower polluting vehicles.

At a local authority level, options will be explored concerning voluntary fleet recognition and an advice scheme that encourages operators to move towards a cleaner fleet and improve fuel efficiency. This would result in greener and modern delivery vehicles in the city centre and so reduce emissions.

Northern Ireland central government is also currently committed to introducing a number of measures which will encourage walking and use of public transport instead of private cars, reduce single occupancy car use and improve air quality. These include the following:

- Belfast Rapid Transit - an urban public transport system with two primary arterial routes from the east and west of the city which will connect with a city centre loop. Work has already commenced on the scheme which is projected to cost £98.5m. Operation of the scheme is forecast to result in a significant shift away from private car journeys into and within the Greater Belfast/city centre area.

- Belfast Transport Hub - this flagship project (currently at planning/consultation stage) will develop and construct a new and modern public transport facility, which will integrate rail and coach services with new commercial developments and car-parking to provide "best in class" public transport access to the city centre.

- Enhanced bus priority on Metro routes and improved car parking controls - draft Programme for Government identifies these two initiatives which are expected to reduce private car commuting and encourage greater use of public transport in the Greater Belfast / city centre area.

- The Department for Agriculture, Environment and Rural Affairs is working on an air quality strategy for Northern Ireland that will examine issues of air pollutants from all sectors, including nitrogen dioxide from road traffic. This measure forms part of the Delivery Plan for the air quality (nitrogen dioxide) indicator in the draft NI Programme for Government.

4.4   Measures timescales

Timescales for national measures are given in the UK overview document.

Local Authorities report on progress with the implementation of their action plans annually and review action plan measures regularly. Information on local measures was collected in February/March 2015. Local authorities were asked to review and, where necessary, provide updates to measures in March/April 2017. Hence, any Local Authority action plans and measures adopted by Local Authorities after this time have not been included in this air quality plan, unless additional information was provided during the consultation process.

The reference year for this air quality plan is 2015. Where measures started and finished before 2015, then the improvement in air quality resulting from these measures will have already taken place before the reference year and the impact of these measures will have been included in the assessment where the measure has had an impact on the statistics used to compile the emission inventory. Many measures started before the reference year and will continue to have a beneficial impact on air quality well beyond the reference year. Measures with a start date before 2015 and an end date after 2015 may have an impact on concentrations in the reference year and a further impact in subsequent years. Where the Status column in Annex C is 'Implementation', this shows that this measure is already underway or that there is a commitment for this measure to go ahead. Where the Status is 'Planning', 'Preparation' or 'Other' the level of commitment is less clear and it is possible some of these measures may not go ahead.

5 Baseline Model Projections

5.1 Overview of model projections

Model projections for each year from 2017 to 2030, starting from the 2015 reference year described in Section 3, have been calculated in order to determine when compliance with the NO_2 limit values is likely to be achieved on the basis of EU, regional and local measures currently planned. Details of the methods used for the baseline emissions and projections modelling are provided in the UK technical report.

For national measures, it has not been possible to quantify the impact of all measures on emissions and ambient concentrations. The impact for all quantifiable measures has been included in the baseline projections.

The impacts of the individual Local Authority and Department for Infrastructure measures have not been explicitly included in the baseline model projections. However, measures may have been included implicitly if they have influenced the traffic counts for 2015 (used as a basis for the compilation of the emission inventory) or in the traffic activity projections to 2020 and beyond (used to calculate the emissions projections). It should be recognised that these measures will have a beneficial impact on air quality, even if it has not been possible to quantify this impact here.

5.2 Baseline projections: NO_2_UK0028_Annual_1

Table 4 presents summary results for the baseline model projections for each year from 2017 to 2030 for the NO_2_UK0028_Annual_1 exceedance situation. At locations where the measured NO_2 concentration in 2015 exceeded the annual mean limit value of 40 μgm^{-3} and the measured concentration was greater than the modelled concentration for the road link adjacent to the monitoring station, projections have been calculated using the measured concentration in 2015 as the starting point. The trend in concentration reductions shown by the modelled projection for the adjacent traffic count point has been used to project the 2015 measured concentrations forward. This is a precautionary approach to provide the best prediction of future concentrations and the corresponding year that compliance with the NO_2 limit values is projected to be achieved for the measured 2015 exceedance. For all other locations the modelled projections of NO_2 and NO_X concentrations start from the modelled concentration for the base year 2015. In the Belfast Metropolitan Urban Area agglomeration zone the measured concentration at one monitoring station, Belfast Stockman's Lane (GB1036A, 50 μgm^{-3}), exceeds the annual mean limit value and is greater than the modelled concentration at the adjacent road link (traffic count point 902795 on the A55) of 39 μgm^{-3}. At this location concentration projections start from the measured concentration of 50 μgm^{-3}.

Table 4 shows that the maximum modelled annual mean NO_2 concentration predicted for 2020 in this exceedance situation is 43 μgm^{-3}. By 2022, the maximum modelled annual mean NO_2 concentration is

predicted to drop to 38 μgm^{-3}. Hence, the model results suggest that compliance with the NO$_2$ annual limit value is likely to be achieved by 2022 under baseline conditions.

Figure 6 and 7 presents maps of projected annual mean NO$_2$ concentrations at background and roadside locations respectively in 2022, the year at which compliance is achieved. For reference Figures 8 and 9 show maps of projected annual mean NO$_2$ concentrations in 2020, 2025 and 2030 for background and roadside locations respectively.

It should be noted that the baseline projections presented here include the impacts of some measures, where they can be quantified, that have already been or will be implemented.

Table 4: Annual mean NO$_2$ model results in NO$_2$_UK0028_Annual_1. (c, d)

|	2015	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Road length exceeding (km)	42.7	30.6	30.6	30.6	9.2	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Background exceeding (km^2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum modelled concentration NO$_2$ (μgm^{-3}) (a)	57	51	48	46	43	41	38	37	35	33	32	31	30	29	28
Corresponding modelled concentration NOx (μgm^{-3}) (b)	149	127	117	110	101	93	86	81	76	72	69	65	62	60	58

(a) Annual Mean Limit Value = 40 μgm^{-3}

(b) NO$_X$ is recorded here for comparison with the NO$_X$ source apportionment graphs for 2015 presented in Annex B of this plan. Limit values for EU directive purposes are based on NO$_2$.

(c) Model results presented for 2015 include the measured concentration at Belfast Stockman's Lane (GB1036A) in place of the modelled concentration for traffic count point 902795 on the A55 (the road link adjacent to Belfast Stockman's Lane monitoring station). Therefore, the road length exceeding may differ from that derived solely from modelling. See Section 3.2 for more information.
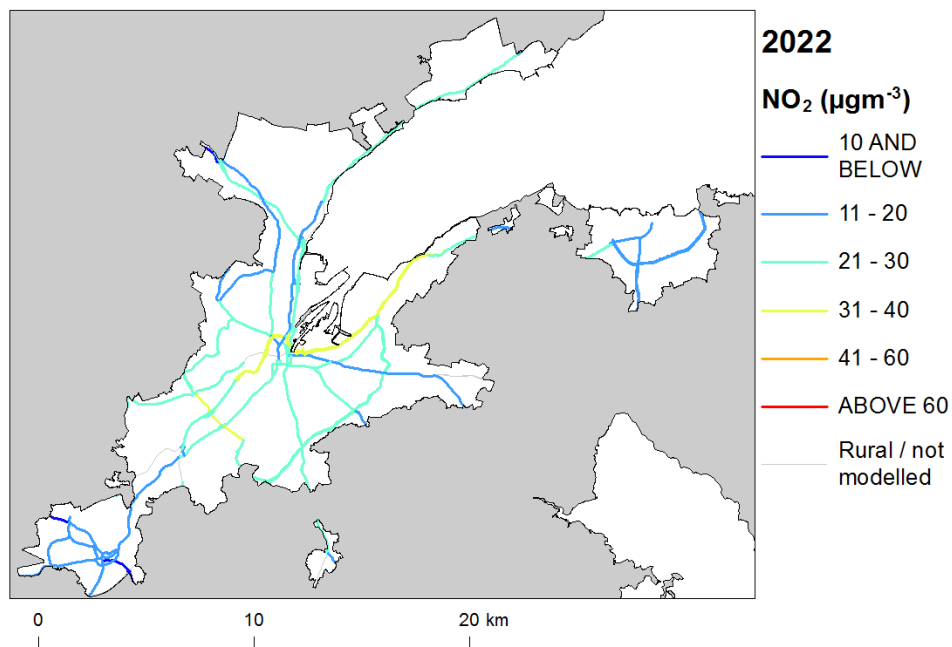
(d) Projected concentrations of NO$_2$ and NO$_X$ at traffic count point 902795, the road link adjacent to Belfast Stockman's Lane(GB1036A) monitoring station, are projected from the 2015 measured annual mean concentrations of NO$_2$ and NO$_X$, respectively. See main text for more details.

Figure 6: Background baseline projections of annual mean NO$_2$ concentrations in 2022, the year at which compliance is achieved under baseline conditions. Modelled exceedances of the annual limit value are shown in orange and red.
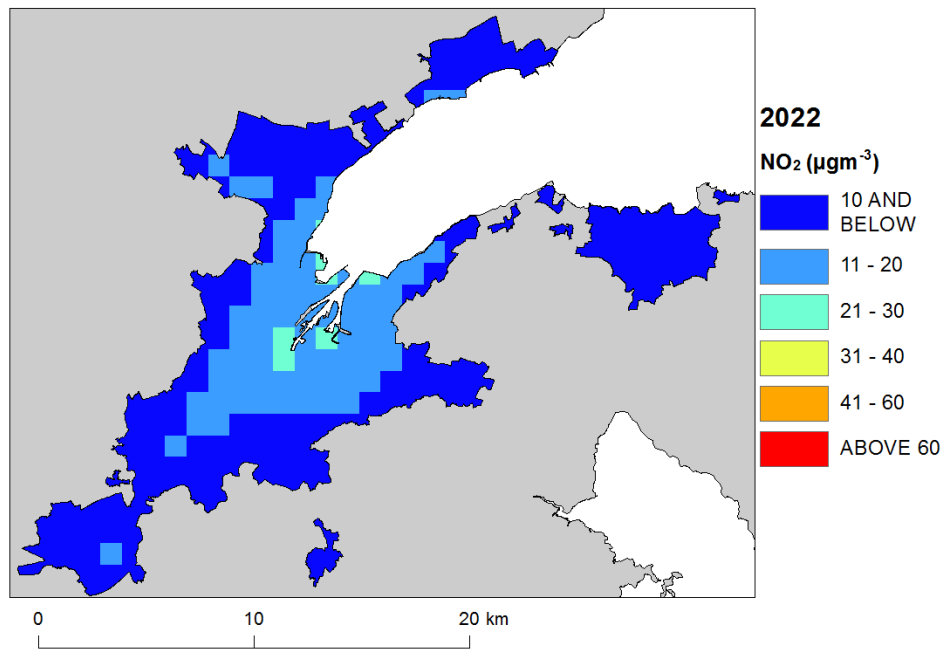
Figure 7: Roadside baseline projections of annual mean NO$_2$ concentrations in 2022, the year at which compliance is achieved under baseline conditions. Modelled exceedances of the annual limit value are shown in orange and red.[3]

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[3]The projected concentration of NO$_2$ at traffic count point 902795, the road link adjacent to Belfast Stockman's Lane (GB1036A) monitoring station, is projected from the 2015 measured annual mean concentration of NO$_2$. See main text for more details.

Figure 8: Background baseline projections of annual mean NO₂ concentrations in 2020, 2025 and 2030. 2015 is also included here for reference. Modelled exceedances of the annual limit value are shown in orange and red.

Figure 9: Roadside baseline projections of annual mean NO$_2$ concentrations in 2020, 2025 and 2030. 2015 is also included here for reference. Modelled exceedances of the annual limit value are shown in orange and red.[4]

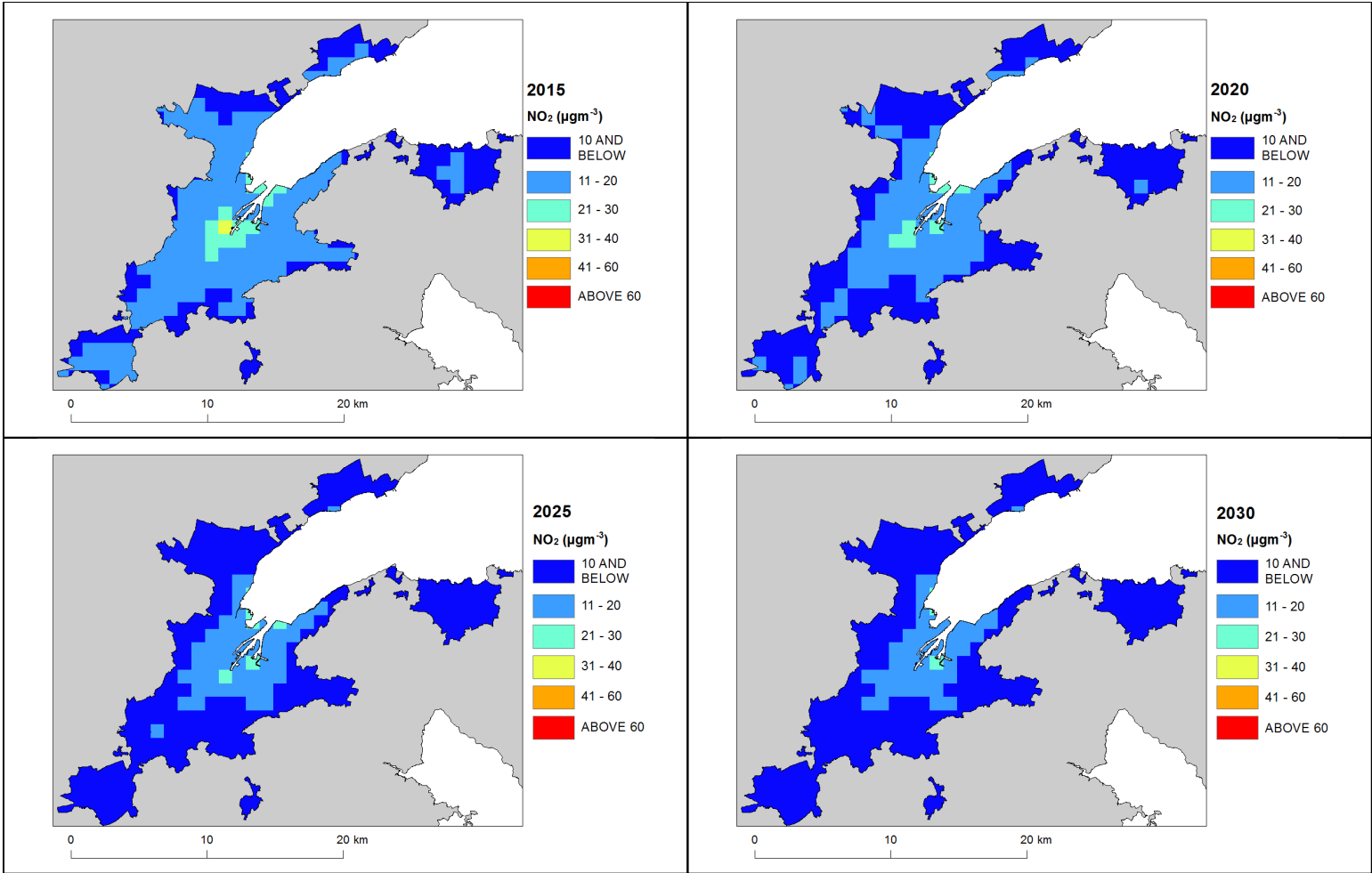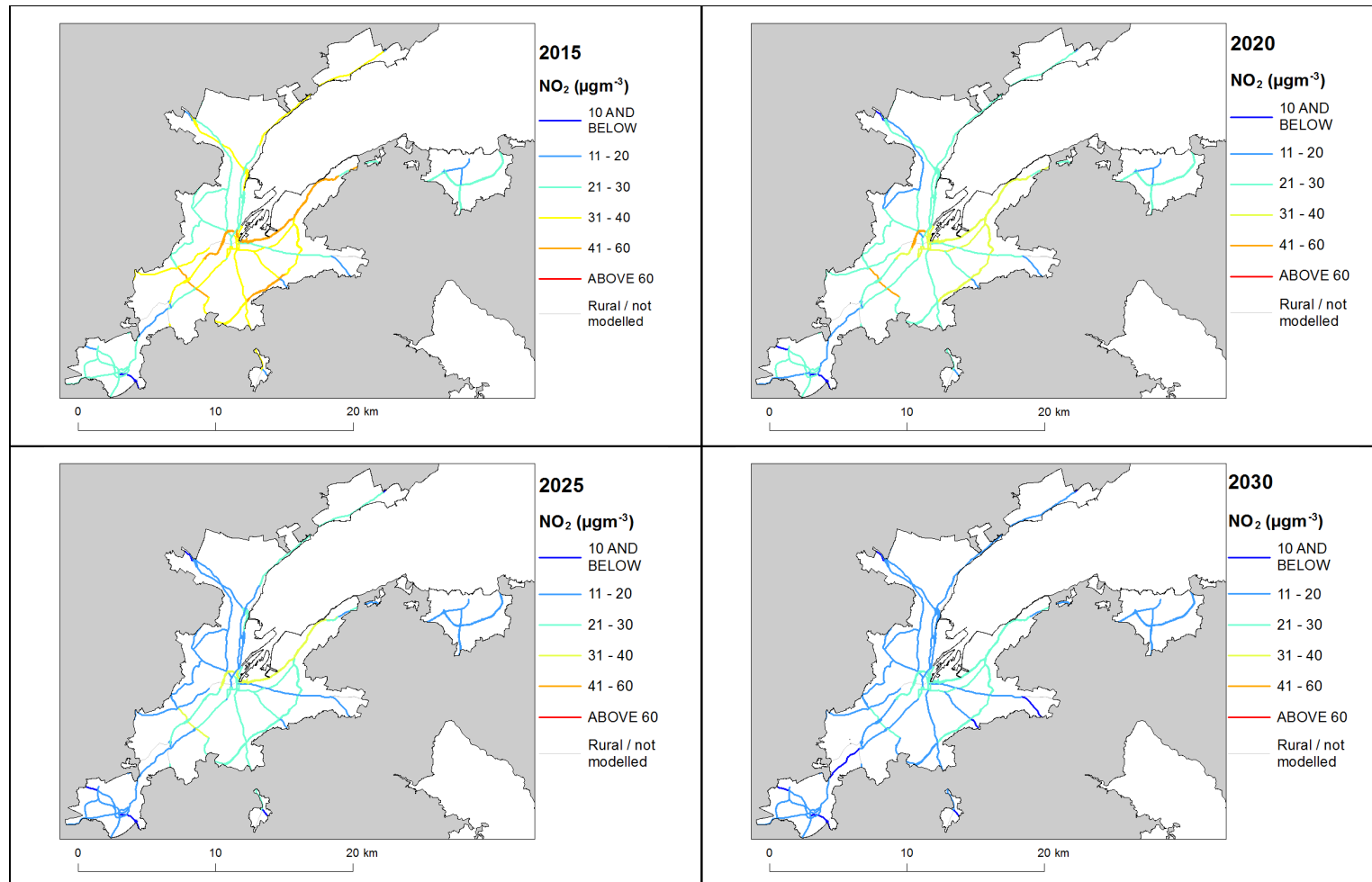[4] The projected concentration of NO$_2$ at traffic count point 902795, the road link adjacent to Belfast Stockman's Lane (GB1036A) monitoring station, is projected from the 2015 measured annual mean concentration of NO$_2$. See main text for more details.

Annexes

A References

1st Daughter Directive 1999/30/EC. Council Directive 1999/30/EC, of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air (The First Daughter Directive). From the Official Journal of the European Communities, 29.6.1999, En Series, L163/41.

Air Quality Directive 2008/50/EC. Council Directive 2008/50/EC, of 21 May 2008. On ambient air quality and cleaner air for Europe. From the Official Journal of the European Union, 11.6.2008, En Series, L152/1

Air Quality Expert Group (AQEG, 2004). Nitrogen Dioxide in the United Kingdom. http://uk-air.defra.gov.uk/library/aqeg/publications

CDR Central Data Repository. http://cdr.eionet.europa.eu/

Decision 2004/224/EC. Commission Decision of 20 February 2004 laying down arrangements for the submission of information on plans or programmes required under Council Directive 96/62/EC in relation to limit values for certain pollutants in ambient air. From the Official Journal of the European Union, 6.3.2004, En Series, L68/27

Decision 2004/461/EC. Commission Decision of 29 April 2004 laying down a questionnaire to be used for annual reporting on ambient air quality assessment under Council Directives 96/62/EC and 1999/30/EC and under Directives 2000/69/EC and 2002/3/EC of the European Parliament and of the Council. From the Official Journal of the European Union, 30.4.2004, En Series, L156/78

Decision 2011/850/EU. Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality. From the Official Journal of the European Union, 17.12.2011, En Series, L335/86

IPR 2013. Guidance on the Commission Implementing Decision laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air (Decision 2011/850/EU). http://ec.europa.eu/environment/air/quality/legislation/pdf/IPR_guidance1.pdf

UK Air Quality Plan for tackling roadside nitrogen dioxide concentrations and the UK technical report are available at: http://www.gov.uk/defra.

B Source apportionment graphs

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Figure B.1: Annual mean roadside NO$_X$ source apportionment plots for all roads exceeding the annual mean NO$_2$ limit value in 2015.

Belfast Metropolitan Urban Area (UK0028): 2015

Legend:
- London taxis
- Motorcycles
- LGVs diesel
- LGVs petrol
- Buses
- HGVa
- HGVr
- Cars diesel
- Cars petrol
- UB: Traffic
- UB: Non traffic
- Regional background

Modelled NO$_X$ concentration (NO$_X$ as NO$_2$, μgm^{-3})

PU,A12,999345,57
PU,A12,999290,53
PU,A55,902795,50
PU,A2,902209,49
PU,A2,902501,47
PU,A12,902213,44
PU,A2,902502,41
PU,A55,902221,41
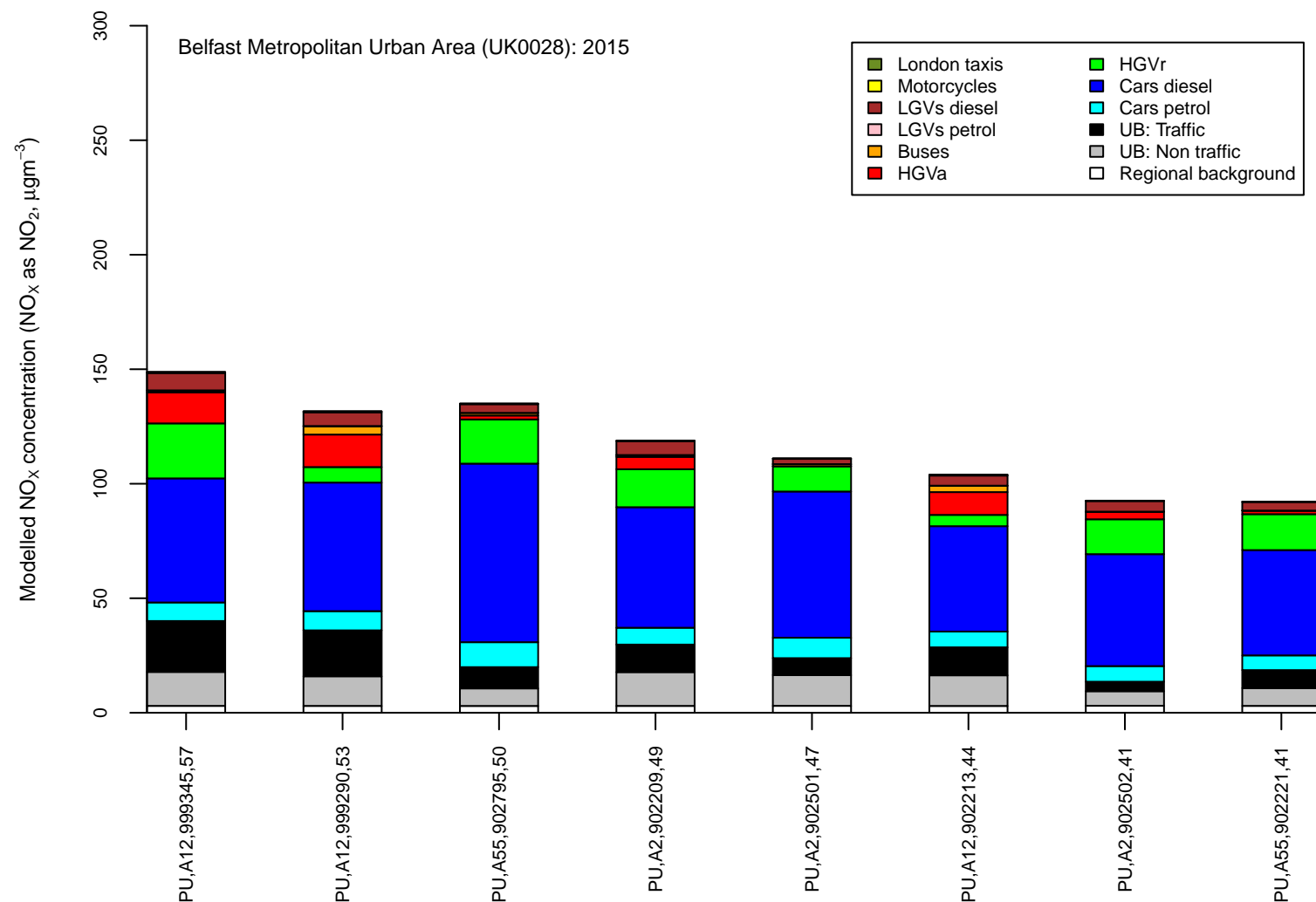
Road class (MU = motorway, PU = primary road, TU = trunk road), road number, census id 15 and modelled NO$_2$ concentration (μgm^{-3})

C   Tables of measures

Local authorities measures were collected in February/March 2015 and local authorities were asked to review and, where necessary, provide updates to measures in March/April 2017. Please note that local government in Northern Ireland was reformed in April 2015, therefore local authority boundaries have changed since this assessment was originally undertaken. The Local Authorities in the Belfast Metropolitan Urban Area agglomeration zone are now: Belfast City Council, Antrim and Newtownabbey Borough Council, Ards and North Down Borough Council, Lisburn and Castlereagh City Council, and Mid and East Antrim Borough Council. Prior to 11th April 2015 the Local Authorities in the Belfast Metropolitan Urban Area agglomeration zone were: Belfast City Council, Carrickfergus Borough Council, Castlereagh Borough Council, Lisburn Borough Council, Newtownabbey Borough Council and North Down Borough Council. The measures in Table C.1 contain updated measures for Belfast City Council which were provided in 2017. The measures for Castlereagh Borough Council were collected in Februrary/March 2015 under the old LA boundaries.

Table C.1 Relevant Local Authority and Northern Ireland central government measures within Belfast Metropolitan Urban Area (UK0028)

Measure code	Description	Focus	Classification	Status	Other information
Department for Infrastructure_1	Belfast Multi-Modal Transport Model	Development of a computer-based multi-modal transport model and support services in order to assist the Department for Infrastructure and its partners to plan and prioritise transport investment in the Greater Belfast area and across Northern Ireland. The model will be applied to test impacts of potential new highways, public transport, walking and cycling schemes at the planning and prioritisation stage. The model will forecast how travellers will change their routes, mode of travel, time of travel and destinations in response to the new choices and network conditions created.	Traffic planning and management: Other measure	Implementation	Start date: 2015 Completed: 2017 Spatial scale: Whole town or city Source affected: Transport Indicator: This model will provide the capability to estimate the likely change in air quality arising from different transport investment options. Target emissions reduction: Med
Department for Infrastructure_2	Belfast Rapid Transit	Belfast Rapid Transit (BRT) is public transportation (PT) by bus that is intended to provide a faster more reliable and more comfortable journey for passengers than conventional bus services. In order to provide a faster journey time, road space is allocated to give priority to BRT vehicles. The objective is to improve accessibility and service for existing PT users and attract new PT users / trips from car based work and leisure travel.	Traffic planning and management: Improvement of public transport	Implementation	Start date: 2014 Expected end date: 2018 Spatial scale: Whole town or city Source affected: Transport Indicator: Increase in the usage of Public Transport could contribute to reduced congestion and improved air quality. Target emissions reduction: Med
Department for Infrastructure _3	Belfast Transport Hub	Translink and the Department for Regional Development in conjunction with the Strategic Investment Board have identified the potential to create a class leading integrated Public Transport Hub in Belfast. The Hub is set to be located on the 20-acre site of the existing Europa Bus centre and Great Victoria Street Train Station. The new hub will offer customers a fully integrated transport solution: a destination catering for rail, bus and coach, taxi, car and bicycle users.	Traffic planning and management: Improvement of public transport	Planning	Start date: 2017 Expected end date: 2022 Spatial scale: Local Source affected: Transport Indicator: Experience in Great Britain and Europe shows that investing in public transport infrastructure, particularly this type of project, improves the public transport. Increase in the usage of the Public Transport generally contributes to reduced congestion and improved air quality Target emissions reduction: Med

Measure code	Description	Focus	Classification	Status	Other information
Department for Infrastructure _4	Bicycle Strategy for NI	To significantly increase the number of people using the bicycle for everyday journeys by: building a comprehensive network for the bicycle made up of traffic-free and properly segregated routes; providing better cycle parking facilities and cycle training; and promoting the bicycle as a sensible way to travel for everyday journeys.	Traffic planning and management: Expansion of bicycle and pedestrian infrastructure	Implementation	Start date: 2015 Expected end date: 2025 Spatial scale: Whole town or city Source affected: Transport Indicator: The Bicycle Strategy will contribute to significant improvements in the physical environment. An increase in the level of cycling has the potential to deliver significant improvements in health and wellbeing, reductions in congestion, improvements in air quality, reductions in noise pollution and a cleaner environment. The Bicycle Strategy will be followed with a Bicycle Network Plan for Belfast to guide the development and operation of bicycle infrastructure in the city for the next 10 years. Target emissions reduction: Low - Med
Department for Infrastructure _5	Ecarni	The ecar project continues to provide support to the emerging market for plug in electric vehicles and to develop an Ultra Low Emission Vehicle Strategy for Northern Ireland.	Other measure: Other measure	Implementation	Start date: N/A Expected end date: N/A Spatial scale: Whole town or city Source affected: N/A Indicator: Increasing the market share for plug in electric and hybrid vehicles for both personal use and in the business and freight sectors Target emissions reduction: Med

Measure code	Description	Focus	Classification	Status	Other information
Department for Infrastructure _6	Park and Ride (Bus & Rail)	Park & Ride schemes aim to reduce traffic travelling and parking within the city centre by establishing an out of town car park and using buses (or trains) to travel into the centre. The objective is to improve accessibility and service for existing PT users and attract new PT users / trips from car based work and leisure travel.	Traffic planning and management: Improvement of public transport	Implementation	Start date: 2013 Expected end date: 2020 Spatial scale: Whole town or city Source affected: Transport Indicator: DRD considering the options of delivering additional P&R schemes. This would have positive effect on reducing air quality in Belfast by providing alternative transport for commuters coming into the city rather than private car. There is currently a total of 7, 600 P&R spaces throughout NI, the 2013-2015 delivery programme resulted in an increase of over 30% in the number of spaces available. Improvements to P&R facilities along the Belfast Metropolitan Transport Corridor have resulted in a 17% increase of cars using the facilities between 2012-2014. Target emissions reduction: Med
Department for Infrastructure _7	York Street Interchange	The York Street Interchange will provide full grade separation for traffic travelling on the strategic network between the Westlink, the M1 and M2. These proposed improvements to this key junction will provide continuous links between three of the busiest roads in Northern Ireland; the M2, M3 and A12 / Westlink. This project is a high priority within the DRD Programme.	Traffic planning and management: Other measure	Planning	Start date: 2018 Expected end date: 2021 Spatial scale: Local Source affected: Transport Indicator: As a result of modification of the existing road layout and associated traffic re-distributional effects, changes in NO2 are estimated as small Target emissions reduction: Low

Measure code	Description	Focus	Classification	Status	Other information
Department for Infrastructure _8	Fleet improvement	Upgrading current bus fleet by replacement and renewal to bring in greater proportion of newer, lower polluting vehicles, and reducing the average age of the fleet. Proposed procurement process for Metro Fleet (subject to funding): 2015/2016 - purchase 15 hybrid double decks, 2016/2017 - purchase 15 hybrid double decks, 2019/2020 – purchase 15 hybrid double decks	Public procurement: New vehicles, including low emission vehicles	Implementation	Start date: 2013 Expected end date: 2020 Spatial scale: Whole town or city Source affected: Transport Indicator: Fleet improvement will reduce emissions from buses and consequently improve air pollution especially along the busy roads. Our test results suggest a ~3% reduction in the annual mean NO2 (and <1% reduction in PM10) would accrue from upgrading buses to Euro VI compared to the existing baseline (Ormeau Rd). However, routes operating a greater number of bus services would, in practice, produce higher emission savings. Additional test results: 20% Metro fleet improvement led to reduction in NOx emission from Buses by: 13% -Upper Newtownards Rd, 16% - Belfast City Centre (average from Howard St, May St and ChichesterSt) Target emissions reduction: High
Department for Infrastructure _9	Promote Public Transport	Annual programme of publicity campaigns and events – encouraging commuters to use public transport instead of private cars.	Traffic planning and management: Encouragement of shift of transport modes	Implementation	Start date: 2014 Expected end date: 2030 Spatial scale: Whole town or city Source affected: Transport Indicator: The impact of this measured will be low initially, but should increase over time as further marketing campaigns encourage greater usage of public transport. How people choose to travel is measured through annual cordon survey. A comparison of the data from 2011 and 2013 cordon survey for Belfast indicates the following: 36.6% increase in the number of people entering the city centre by train, 17.6% increase in the number of people entering the city centre by bus. Target emissions reduction: Low

Measure code	Description	Focus	Classification	Status	Other information
Belfast City Council_10	FCC	Goods / deliveries moved into centre from edge of town warehouse, for example at a site close to the city Port.	Traffic planning and management: Freight transport measure	Planning	Start date: 2015 Expected end date: 2020 Spatial scale: Whole town or city Source affected: Transport Indicator: FCC combined with the use of low emission vehicles would have a significant impact on emissions level. Our test suggests that consolidation of goods into the City centre with a 100% uptake can bring about significant reductions in emissions and subsequent improvement in AQ (~20% reduction in annual mean road NO2 compared to the base case). The voluntary uptake does not appear as attractive (i.e. ~5% reduction in the annual mean NO2) but would nevertheless provide a foundation to promoting a greater uptake. Target emissions reduction: Low-Med
Belfast City Council_11	ECO Stars	Voluntary fleet recognition and advice scheme that encourages operators to move towards a cleaner fleet and improve fuel efficiency. A sufficient number of operators would need to sign up to deliver emission benefits.	Traffic planning and management: Freight transport measure	Planning	Start date: 2015 Expected end date: 2020 Spatial scale: Whole town or city Source affected: Transport Indicator: Uptake of this scheme would result in greener and modern delivery vehicles in the city centre (reductions in emissions). Target emissions reduction: Low

Measure code	Description	Focus	Classification	Status	Other information
Belfast City Council_12	Servicing and Loading Bays	Allocating current on-street car parking spaces at strategic points as HGV Loading Bays for specific periods such as 07.00 - 11.00 Monday to Friday. This would ease the flow of traffic in the city and persuade some commuters to avoid taking car into the city centre at morning peak hours	Traffic planning and management: Freight transport measure	Planning	Start date: 2015 Expected end date: 2017 Spatial scale: Whole town or city Source affected: Transport Indicator: More loading bays in the city would reduce engine idling caused by vehicles having to wait for suitable parking space. It would also reduce the occurrence of double parking therefore reducing traffic congestion. Target emissions reduction: Low
Belfast City Council_13	Public Bike Hire Scheme	Public cycle scheme in city centre - 300 bikes and 30 docking sites in public places including Titanic Quarter, the Gasworks, Queen's University and York Street.	Traffic planning and management: Expansion of bicycle and pedestrian infrastructure	Implementation	Start date: 2015 Expected end date: 2015 Spatial scale: Whole town or city Source affected: Transport Indicator: Using the bikes for shorter city centre journeys will cut congestion and improve air quality. Target emissions reduction: Low
Belfast City Council_14	BCC Fleet Improvement	BCC developed Fleet Improvement Programme in 2013. This includes updating fuelling infrastructure, developing GPS fleet-tracking system and disposal method.	Other measure: Other measure	Implementation	Start date: 2013 Expected end date: 2030 Spatial scale: Whole town or city Source affected: Transport Indicator: This will reduce overall emissions from council fleet. Target emissions reduction: Low - Med
Department for Infrastructure_15	Active Travel Plan	Encourage walking, cycling and use of public transport instead of private car.	Traffic planning and management: Encouragement of shift of transport modes	Implementation	Start date: 2015 Expected end date: 2018 Spatial scale: Whole town or city Source affected: Transport Indicator: Increasing use of public transport and active travel such as walking and cycling should reduce single occupancy car use improve air quality and result in a beneficial effect on health. Target emissions reduction: Med

Measure code	Description	Focus	Classification	Status	Other information
Department for Infrastructure _16	Bus Priority	Enhance bus priority on Metro routes	Traffic planning and management: Encouragement of shift of transport modes	Planning	Start date: 2018 Expected end date: 2021 Spatial scale: Whole town or city Source affected: Transport Indicator: Increasing use of public Transport should reduce single occupancy car use, improve air quality and result in a beneficial effect on health Target emissions reduction: Med
Department for Infrastructure _17	Car Parking Controls	Improved car parking controls including extending the Belfast City Centre Controlled Parking Zone and increased enforcement, review of urban parking Policy and work with council to ensure charging regimes discourage all-day commuter parking and introducing residents' parking schemes in areas of greatest need	Traffic planning and management: Encouragement of shift of transport modes	Planning	Start date: 2018 Expected end date: 2021 Spatial scale: Whole town or city Source affected: Transport Indicator: reduce single occupancy car use, improve air quality and result in a beneficial effect on health
Department for Agriculture, Environment and Rural affairs_18	Air Quality Strategy	Develop air quality strategy for Northern Ireland	Air quality strategy for Northern Ireland to examine and propose measures for air pollutants from all sectors, including nitrogen dioxide from road transport. Air quality strategy is proposed measure in Delivery Plan for air quality indicator for draft NI Executive Programme for Government.	Planning	Start date (development) March 2017 Expected end date March 2018.
Lisburn and Castlereagh Council_19	LCBC to investigate using cleaner more sustainable vehicles	N/A	Other measure: Other measure	Implementation	Start date: 2009 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: N/A Target emissions reduction: N/A

Measure code	Description	Focus	Classification	Status	Other information
Lisburn and Castlereagh Council_20	Continue to provide eco bus driver training	N/A	Other measure: Other measure	Implementation	Start date: 2009 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: All drivers to be trained Target emissions reduction: N/A
Lisburn and Castlereagh Council_21	Continue to purchase Euro 5 classified vehicles and sustainable transport methods	N/A	Other measure: Other measure	Implementation	Start date: 2009 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: Purchase of Euro 5 vehicles on replacement Target emissions reduction: N/A
Lisburn and Castlereagh Council_22	LCBC to introduce/encourage sustainable travel	N/A	Traffic planning and management: Encouragement of shift of transport modes	Implementation	Start date: 2013 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: Promotion of green travel Target emissions reduction: N/A
Department for Infrastructure_23	Park and Ride scheme	N/A	Traffic planning and management: Improvement of public transport	Evaluation	Start date: 2014 Expected end date: 2016 Spatial scale: Whole town or city Source affected: Transport Indicator: Reduction of traffic on main arterial route into city centre Target emissions reduction: N/A
Lisburn and Castlereagh Council_24	Promote sustainable initiatives in conjunction with Travelwise NI	N/A	Traffic planning and management: Encouragement of shift of transport modes	Implementation	Start date: 2014 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: N/A Target emissions reduction: N/A
Lisburn and Castlereagh Council_25	LCBC to introduce the use of electric vehicles into their fleet/ and supply charging point.	N/A	Other measure: Other measure	Implementation	Start date: 2013 Expected end date: 2030 Spatial scale: Local Source affected: Transport Indicator: N/A Target emissions reduction: N/A