

Lower Thames Crossing

7.7 Combined Modelling and Appraisal Report – Appendix D – Economic Appraisal Package: Distributional Impact Appraisal Report

APFP Regulation 5(2)(q)

Infrastructure Planning (Applications:
Prescribed Forms and Procedure)
Regulations 2009

Volume 7

DATE: October 2022

Planning Inspectorate Scheme Ref: TR010032
Application Document Ref: TR010032/APP/7.7

VERSION: 1.0

Lower Thames Crossing

7.7 Combined Modelling and Appraisal Report – Appendix D – Economic Appraisal Package: Distributional Impact Appraisal Report

List of contents

	Page number
1 Executive summary	1
2 Introduction	9
2.1 Purpose of this document	9
2.2 Document structure	10
3 Scope of the distributional impact appraisal	11
3.1 Introduction	11
3.2 Scope	11
3.3 Overview of the distributional impact appraisal process	12
4 Project overview and objectives	16
4.1 Introduction	16
4.2 Project overview	16
4.3 Scheme Objectives	17
5 Screening	19
5.1 Introduction	19
5.2 Screening	19
5.3 Screening results	19
6 Socio-demographic overview and area assessment	20
6.1 Introduction	20
6.2 Socio-demographic overview	20
6.3 Assessment area	22
7 Impacts appraisal	26
7.1 Introduction	26
7.2 User benefits methodology	26
7.3 User benefits appraisal	29
7.4 Noise methodology	35
7.5 Noise appraisal	37
7.6 Air quality methodology	54
7.7 Air quality appraisal	56
7.8 Accidents methodology	61

7.9	Accidents appraisal.....	64
7.10	Severance methodology	69
7.11	Direct severance appraisal	72
7.12	Traffic related severance appraisal.....	72
7.13	Personal affordability methodology.....	82
7.14	Personal affordability appraisal.....	83
8	Conclusions.....	86
8.1	Introduction.....	86
8.2	Conclusions	86
	References	91
	Glossary	92
	Annex A Screening stage.....	106
	Annex B Socio-demographic assessment	109
	Annex C Accidents	118
	Annex D Severance	121

List of plates

	Page number
Plate 4.1 Lower Thames Crossing route.....	18
Plate 6.1 Local study area	24
Plate 6.2 Regional and Local study areas	25
Plate 7.1 User Benefits Impact area	28
Plate 7.2 Distribution of user benefits compared to distribution of population for the User Benefits Impact area	32
Plate 7.3 Distribution of user benefits compared to distribution of population for the Local study area	33
Plate 7.4 Geographical distribution of user benefits per head of population	34
Plate 7.5 Location of care home and education noise receptors	36
Plate 7.6 Change in noise levels at residential receptors with Lower Thames Crossing, 2030.....	40
Plate 7.7 Change in noise levels at schools with the Project, 2030	48
Plate 7.8 Change in noise levels at care homes with the Project, 2030.....	52
Plate 7.9 Location of air quality education receptors	55
Plate 7.10 Change in NO ₂ levels with Lower Thames Crossing, 2030.....	60
Plate 7.11 Impact area for accidents appraisal	61
Plate 7.12 Accident analysis impact area and links with more than 50 casualties	63
Plate 7.13 LTAM Fully Modelled Area	70
Plate 7.14 Location of links affected by traffic related severance	79
Plate 7.15 Indices of Deprivation (Income Domain) Gravesham	85
Plate B.1 Indices of Deprivation by Income Domain, 2019	109
Plate B.2 Proportion of children (aged under 16 years), comparison with England and Wales.....	110
Plate B.3 Proportion of children (aged under 16 years), comparison with regional study area	111
Plate B.4 Proportion of older people (aged 70 and over), comparison with England and Wales.....	112
Plate B.5 Proportion of older people (aged 70 and over), comparison with regional study area	113
Plate B.7 Proportion of households with people of day-to-day limited activity, comparison with England and Wales	114
Plate B.8 Proportion of households with people of day-to-day limited activity, comparison with regional study area.....	115
Plate B.9 Proportion of non-car-available households, comparison with England and Wales.....	116
Plate B.10 Proportion of non-car-available households, comparison with regional study area	117
Plate D.1 Potential traffic related severance locations and amenities.....	121
Plate D.2 Potential traffic related severance locations and open space	122
Plate D.3 Potential traffic related severance locations and bus stops.....	123

List of tables

	Page number
Table 1.1 Scope of socio-demographic analysis for distributional impacts	2
Table 1.2 Distributional impact appraisal assessments and scores.....	7
Table 3.1 Distributional impact appraisal methodology.....	12
Table 3.2 Scope of socio-demographic analysis for distributional impacts	13
Table 3.3 Criteria for determining the distributional impacts summary scores.....	15
Table 4.1 Scheme Objectives.....	17
Table 7.1 Distributional analysis of user benefits against income for the User Benefits Impact area.....	30
Table 7.2 Distributional analysis of user benefits against income for the Local study area	31
Table 7.3 Distributional impacts of noise by income: 2030	38
Table 7.4 Average population percentage for children under 16 and people 70 and over.	41
Table 7.5 Distributional impacts of noise by population under 16, 2030	42
Table 7.6 Distributional impacts of noise by population aged 70 and over, 2030	43
Table 7.7 Change in noise levels with the Project at schools: north of the River Thames.	44
Table 7.8 Change in noise levels with the Project at schools: south of the River Thames	45
Table 7.9 Change in noise level with Project at care homes: north of the River Thames ..	49
Table 7.10 Change in noise levels with the Project at care homes: south of the River Thames.....	50
Table 7.11 Distributional impacts of NO ₂ by income, 2030	58
Table 7.12 Distributional impacts of NO ₂ by population under 16, 2030.....	59
Table 7.13 Comparison of accident casualty statistics by vulnerable group (2015–2019).	65
Table 7.14 Changes in accidents by link (With Project compared to Without Project).....	66
Table 7.15 Percentage distribution of accidents and casualties by road type, severity of accident and casualty vulnerable group, 2015–2019, selected roads.....	68
Table 7.16 Comparison of social characteristics for links potentially impacted by traffic related severance	73
Table 7.17 Distributional analysis for links potentially impacted by traffic related severance: regional study area	75
Table 7.18 Distributional analysis for links potentially impacted by traffic related severance: England and Wales.....	77
Table 7.19 Amenities potentially impacted by traffic related severance.....	81
Table 7.20 Personal affordability distributional analysis of Gravesham user charge discount	84
Table 8.1 Distributional impacts output summary	88
Table 8.2 Distributional impact appraisal findings and scores	89
Table A.1 Screening Stage Proforma	106
Table C.1 Worksheet for assessing accidents.....	118
Table C.2 Distribution of accidents and casualties by road type, severity of accident and casualty vulnerable group, 2015–2019, regional study area.....	120

1 Executive summary

- 1.1.1 This report describes the methodologies used to appraise the distributional impacts of the A122 Lower Thames Crossing (the Project) across vulnerable people groups and presents the distributional impact appraisal results for the Project. Summary scores for these distributional impacts are reported in the Project's Appraisal Summary Table (AST) and inform its value for money (VfM) assessment.
- 1.1.2 This Distributional Impact Appraisal (DIA) report is part of Appendix D: Economic Appraisal Package within the Lower Thames Crossing Combined Modelling and Appraisal Report (ComMA). This is part of the Project's Development Consent Order (DCO) application. Appendix D of the ComMA also includes an Economic Appraisal Report (EAR), an Appraisal Summary Table Report and a report on Level 3 Wider Economic Impacts.
- 1.1.3 The impacts of the Project in a With Project scenario have been compared against a Without Project scenario in line with the Department for Transport's (DfT) Transport Analysis Guidance (TAG). The DIA presented in this report has been carried out using the guidance in TAG Unit A4.2, Distributional Impact Appraisal (Department for Transport, 2020).
- 1.1.4 The DIA is closely linked with the appraisal of the Project's social impacts which looks at the overall impact on a range of social indicators that are not included in the economic or environmental assessments. The appraisal of distributional impacts relates to the extent to which impacts may not uniformly affect socially vulnerable groups. It is important to give due consideration to the distribution of the Project's impacts across vulnerable social groups and understand whether any groups receive a disproportionately low share of the benefits or high share of disbenefits. The DIA compares the distribution of the Project's benefits and disbenefits against the distributions of the different vulnerable groups, relevant for a range of topics, within the general population, in order to assess the extent to which the Project results in distributional impacts. The vulnerable groups relevant for each potential benefit or disbenefit according to TAG Unit A4.2 guidance are set out in Table 1.1, which shows the scope of the socio-demographic analysis. The table shows the eight topics that are screened for assessment in the DIA. In the case of accidents, an analysis of casualties by vulnerable groups, rather than the population as a whole, was carried out.

Table 1.1 Scope of socio-demographic analysis for distributional impacts

	User benefits	Noise	Air quality	Accidents	Security	Severance	Accessibility	Affordability
Income distribution	✓	✓	✓	–	–	–	✓	✓
Children: proportion <16	–	✓	✓	✓	✓	✓	✓	–
Young adults: proportion aged 16–25	–	–	–	✓	–	–	✓	–
Older people: proportion aged 70+	–	✓	–	✓	✓	✓	✓	–
Proportion of population with a disability	–	–	–	–	✓	✓	✓	–
Proportion of population of BAME origin	–	–	–	–	✓	–	✓	–
Proportion of households without access to a car	–	–	–	–	–	✓	✓	–
Proportion of households with dependent children	–	–	–	–	–	–	✓	–

Source: TAG Unit A4.2

- 1.1.5 Following TAG guidance, a screening exercise was carried out to consider whether the Project was likely to have a distributional impact for any of the vulnerable groups for each topic area.
- 1.1.6 The topic groups taken forwards to full DIA comprise user benefits, noise, air quality, accidents, severance and personal affordability.
- 1.1.7 The Project is not expected to have a distributional impact on personal security indicators as set out in TAG Unit A4.2 and the distributional impact appraisal of security has also been screened out.
- 1.1.8 The distributional impact appraisal of accessibility is not required for the Project because it is a road and TAG guidance on accessibility for DIA relates to public transport projects only.
- 1.1.9 A series of maps were produced to show the difference in the distribution of vulnerable groups based on five measures relevant for the Project: income, the proportion of children under 16, people aged 70 and over, the population with a disability (restricting daily activity) and the proportion of non-car-available households. The maps were created using Census 2011 data, the Office for National Statistics (ONS) Indices of Deprivation (IOD) by Income Domain for 2019 and ONS Mid-Year Population Estimates (2020). Census 2021 does not yet provide the required disaggregation of data. The geographical distribution of young adults was not mapped as this is only relevant for the distributional impact assessment of accidents for the Project, which is based on the demographic details of the accident casualties themselves, rather than the resident population.

- 1.1.10 The most income deprived areas (quintiles 1 and 2) are located around Basildon, to the north-east of the Project, with pockets of high income deprivation in Dartford (north-east of the town), Gravesham (Gravesend and North Fleet), Medway (Chatham and Gillingham), Havering (north-east of Romford) and Thurrock (Chadwell St Mary, South Ockendon and Tilbury).
- 1.1.11 There are clusters of above average proportions of children under 16 compared to England and Wales. These include Medway and along the River Thames in Gravesend and Dartford, Basildon, Chatham and Gillingham.
- 1.1.12 Higher concentrations of people aged 70 and over are seen in parts of Essex, including Brentwood, Basildon, Canvey Island and Rayleigh and some rural areas, compared to the England and Wales average of 13.7%.
- 1.1.13 There are areas which have an above average proportion of people with restrictions on their daily activity in North-East and South Thurrock, Romford, Gravesend and along the River Medway.
- 1.1.14 Key areas of higher than average number of households that do not have access to a car include Basildon, North Fleet, Gravesham, Chatham and Gillingham.
- 1.1.15 The area of assessment for the DIA is defined for each impact depending upon the nature of the impact, with the focus being on areas where material changes are likely. The assessment is summarised in Table 1.2 which presents the distributional appraisal scores.

User benefits

- 1.1.16 The distributional appraisal of user benefits for the Project is based on a comparison of the spatial distribution of user benefits against the distribution of income.
- 1.1.17 User benefits reflect the change in travel time costs, fuel and non-fuel operating costs and user charges, for commuter and other transport users. Reductions in travel costs result in user benefits and increases in travel costs lead to user disbenefits.
- 1.1.18 The areas in receipt of the greatest benefits per head are mainly near to the Project, particularly in Thurrock and Gravesham, although more areas are also forecast to benefit, including Chelmsford and part of the Medway towns. Locations which receive an overall disbenefit include areas adjacent to the A228 in south-west Medway, Sevenoaks in Kent, west of Epping Forest and Braintree.
- 1.1.19 There is an overall net user benefit as a result of the Project across all income quintiles for both the User Benefits Impact area and the Local study area (Brentwood Borough Council, Dartford Borough Council, Gravesham Borough Council, the London Borough of Havering, Medway Council and Thurrock Council).
- 1.1.20 The lowest income quintile net benefits are in line with the population proportions in the User Benefits Impact and Local study areas and assessed as even. Overall, the distributional impact of user benefits is assessed as Moderate Beneficial.

Noise

- 1.1.21 The distributional appraisal of noise impacts for the Project is based on a comparison of those impacts against:
- The distribution of income
 - The vulnerable groups of children under 16 and people aged 70 and over
- 1.1.22 The DIA for noise has been undertaken using the predicted road traffic noise level in the opening year of 2030 for both the Without Project and With Project options. The road traffic noise levels represent average daily levels and have been derived from 18-hour Annual Average Weekday Traffic (AAWT) flows which are taken from the Lower Thames Area Model (LTAM). Forecast changes in noise levels greater than or equal to 1dB(A) were identified at residential, school and care home noise receptors.
- 1.1.23 The noise assessment in the Environmental Statement (ES) is carried out in accordance with the Design Manual for Roads and Bridges (DMRB) LA 111: Noise and Vibration (formerly HD213/11) (Highways England, 2020a). The DIA uses 1dB in the opening year because this is when people first become aware of the noise impact. The aim of the DIA is to assess how noise impacts on different segments of the population and only 1dB in the opening year provides enough data points to undertake the segmented analysis required. Therefore, the DIA provides a more precautionary noise assessment than the ES, noting that 1dB does not indicate a perceptible impact in all contexts.
- 1.1.24 The most deprived quintile has a 12.7% share of the total population in the Defined Impact area and around 1 in 5 of all properties with increased noise are in this quintile. The noise DIA score with respect to income is assessed as Large Adverse because the most deprived income quintile is disproportionately adversely impacted.
- 1.1.25 There is a greater proportion of noise disbenefits than expected in Lower Layer Super Output Areas (LSOAs) with an above average percentage of children under 16, compared with the regional study area and England and Wales and also for people aged 70 and over, compared to England and Wales. Overall, it is concluded that the distribution of changes in noise for the proportion of children under 16 is uneven and Large Adverse and for those aged 70 and over is uneven and Moderate Adverse.
- 1.1.26 There would be no major benefits or disbenefits experienced by schools or care homes within the noise impact study area because of the Project, resulting in an assessment score of Neutral.

Air quality

- 1.1.27 The distributional appraisal of air quality impacts for the Project is based on a comparison of those impacts against:
- The distribution of income
 - The vulnerable groups of children under 16

- 1.1.28 The most deprived quintile has a net decrease in NO₂ of 0.1%. A total of 11.2% of the study area population is in this quintile. The DIA air quality score with respect to income has been assessed as Large Beneficial because the proportion of the benefit in the deprived income quintiles is greater than the proportion of the population.
- 1.1.29 Households with an above average proportion of children under 16 have a net improvement in NO₂ levels compared with both the regional study and England and Wales. It is concluded that the distribution of change in air quality for the proportion of children under 16 is Large Beneficial.
- 1.1.30 There would be no major benefits or disbenefits experienced by schools in the air quality impact area because of the Project, resulting in an assessment score of Neutral.

Accidents

- 1.1.31 An accident appraisal was carried out for the Project using DfT's COBALT (Cost and Benefit to Accidents – Light Touch) software appraisal program. COBALT was used to forecast the total number of personal injury accidents (PIAs) and casualties within the impacts appraisal area. The analysis was carried out for 2030, which is the assumed year of opening as modelled by the LTAM. While the number of accidents and casualties over the Project's 60-year operational phase is predicted to rise due to the increased volume of traffic on the road network, the accident rate per vehicle km is forecast to reduce.
- 1.1.32 Fourteen locations are predicted to have over 50 casualties over a five-year period with the Project. Five of these locations are predicted to have a change in the expected number of casualties of greater than 5%, compared to the Without Project scenario. There are two locations which are predicted to have a decrease in casualties and three locations which are predicted to have an increase in casualties, due to changes in traffic flows with the Project. An analysis was undertaken of the accident data to identify casualties by vulnerable group for the affected links, that is motorcyclists, young male drivers and drivers aged over 70.
- 1.1.33 There is no distributional effect for any vulnerable user group, compared with the regional study area or Great Britain. The assessment score is Neutral.

Severance

- 1.1.34 Severance concerns people using non-motorised modes, primarily pedestrians. The Project has the potential to affect severance in the following ways:
- Direct severance caused by the new highway infrastructure
 - Traffic related severance – an increase in severance on existing roads due to changes in traffic flows arising from the Project
- 1.1.35 The Project would cross several public rights of way (PRoW) and other designated paths. A design aim for the Project is that, as far as reasonably practicable, all routes severed during the construction phase would be re-instated by means of bridges or underpasses, as appropriate, once it is opened. The assessment therefore assumes that all PRoW paths would be re-provided without additional hindrance or additional length for non-motorised

user journeys and that there would be no direct severance for any vulnerable groups due to the operation of the Project. Hornsby Lane in Thurrock would be permanently stopped up but there would be no additional journey distance for non-motorised modes.

- 1.1.36 The extent of traffic related severance was investigated by identifying forecast traffic flow changes greater than 10% for roads. The traffic flow changes were taken from the 2030 LTAM traffic forecasts. The number of people affected in each severance location was estimated by calculating the population within an 800m buffer area proximity. The percentage of the following vulnerable characteristics was then calculated for the relevant LSOA for each severance location and compared against the regional study area and England and Wales total populations:
- a. Children under 16 and people aged 70 or over
 - b. Proportion of people with a disability
 - c. Proportion of households without access to a car
- 1.1.37 Having identified the severance locations, conclusions were drawn on the impact of severance by considering any distributional bias for the vulnerable groups within the local population and in relation to the location of facilities.
- 1.1.38 There are six locations where traffic related severance is forecast to increase and 12 locations where traffic related severance is forecast to decrease with the Project. The Section 106 agreement – Heads of Terms (Application Document 7.3) includes proposals for a number of pedestrian crossing improvements to mitigate these impacts. This is not being factored into the assessments presented here on a precautionary basis. The proportion of population under 16, 70 and over, and with a life limiting illness are in line with both the regional study area and England and Wales for each of the affected links.
- 1.1.39 Overall, the percentage of non-car owning households in the proximity of each affected link is lower than for both the regional study area and England and Wales. This impact is assessed as Slight Beneficial. The distributions of traffic related severance on children aged under 16, people aged 70 and over and for people with a limiting long-term illness are even and are assessed as Neutral as they are similar to the regional study area and England and Wales.
- 1.1.40 Amenities potentially impacted by a decrease in traffic related severance include care homes, GP surgeries, hospitals, schools and supermarkets.

Personal affordability

- 1.1.41 The River Thames is a barrier to movement and a deterrence for cross-river trips. There is an existing personal affordability issue for residents in the Lower Thames area who must pay a user-charge to use the Dartford Crossing, although residents who live in the local authority areas of Dartford and Thurrock are eligible for a residents' discount.
- 1.1.42 TAG states that a personal affordability assessment is required where there is a change in monetary transport charges. The DIA analysis for the Project considered road user charges. The personal affordability appraisal assumes that the principles of the charging regime for the Project are consistent with

those currently applied at the Dartford Crossing. It has therefore been assumed that the residents of Gravesham Borough would benefit from a similar discount for using the Project as residents of Dartford and Thurrock do currently when using the Dartford Crossing. This would mean that journeys involving the Project by Gravesham Borough residents to and from destinations north of the River Thames would be proportionately cheaper than without the Project as cross-river road user charges would be reduced. The cost of journeys across the River Thames would reduce for around 106,900 people (population of Gravesham Borough, 2020 mid-year population statistics). The residents of Thurrock will also qualify for a discount using the Project, but this is not counted as a benefit in the affordability appraisal because of their existing eligibility for a Dartford Crossing residents' discount.

- 1.1.43 The distributional analysis of personal affordability has been assessed against the spatial distribution of income. The analysis of LSOAs in Gravesham shows more households in the lowest income quintile compared with the regional study area and more households in quintile 2 compared with England and Wales. Overall, the distribution of changes in personal affordability is Large Beneficial for Gravesham residents.
- 1.1.44 Spatial analysis from the mapping shows that the lowest income households who would make the most relative gain in personal affordability are located in the centre of Gravesend, near to Northfleet station and west of Whitehill Road.
- 1.1.45 It should be noted that the conclusions relate to the extent to which the vulnerable groups benefit or disbenefit across the social indicator, rather than the general level of impact for that indicator.

Table 1.2 Distributional impact appraisal assessments and scores

Indicator	Assessment	Scores
User benefits	Overall, there is a net beneficial impact from the Project on user benefits. There are net user benefits across all income quintiles. The distribution of user benefits is within 5% of the population for each income quintile and assessed as even.	Moderate Beneficial for each income quintile
Noise	Overall, there is a net adverse impact of the Project on residential noise levels. The distribution of noise against income quintiles is assessed as uneven. Adverse noise impacts are higher than expected in the most deprived (20%) income quintile groups. There is a net increase in properties with an increase in noise greater than 1dB in areas with higher than average proportions of children under 16 and people aged 70 and over. There are more net increases in noise greater than 1dB in areas with higher than average proportions of children under 16, compared with both the regional study area and with England and Wales. There are more net increases in noise greater than 1dB in areas with higher than average proportions of people aged 70 and over, compared with both the regional study area and England and Wales, although the net increases are lower compared with the England and Wales proportions.	Income: Large Adverse Children aged under 16: Large Adverse People aged 70 and over: Moderate Adverse

Indicator	Assessment	Scores
	However, there is a neutral impact of changes in noise levels on schools and care homes as the majority of schools and care homes would receive no change in noise level.	
Air quality	<p>Overall, there is a net beneficial impact of the Project on air quality. The distribution of air quality against income quintiles is assessed as uneven as the two most deprived income quintiles benefit more than the other income quintiles.</p> <p>There is a net decrease in NO₂ in areas with higher than average proportions of children under 16, compared with both the regional study area and with England and Wales.</p> <p>No schools would experience a change in air quality levels resulting in an assessment score of Neutral.</p>	<p>Income: Large Beneficial for NO₂</p> <p>Children aged under 16: Large Beneficial for NO₂</p>
Accidents	There is no distributional impact by any of the vulnerable user groups analysed, that is pedestrians and cyclists (for A-roads), motorcyclists, under 16, 16 to 25 males, over 70 for any location, compared with regional study area and Great Britain.	Neutral for all vulnerable groups.
Severance	<p>A design aim for the Project is that as far as reasonably practicable all routes severed by the Project during the construction phase would be re-instated by means of bridges or underpasses as appropriate, with no additional impediment. There is therefore likely to be limited direct severance.</p> <p>Hornsby Lane in Thurrock would be permanently closed but there is no increase in distance for the alternative route.</p> <p>Overall, there is likely to be a small net decrease in traffic related severance in a small number of locations, potentially affecting less than 1% of the population within the regional study area. The distribution of decreased traffic related severance is uneven with respect to car-ownership and there is likely to be a smaller than expected impact of traffic related severance on non-car owning households, compared with the regional study area and England and Wales.</p> <p>The distributions of traffic related severance on children aged under 16, people aged 70 and over and for people with a limiting long-term illness are even as they are similar to the regional study area and England and Wales.</p>	<p>Car ownership: Slight Beneficial</p> <p>Children under 16: Neutral</p> <p>People aged 70 and over: Neutral</p> <p>People with a limiting long-term illness: Neutral</p>
Personal Affordability	<p>Generally, personal affordability would not be affected by the Project as the Without Project travel routes and operating costs would still be available. There is therefore no overall impact of the Project on personal affordability.</p> <p>Journeys by Gravesham residents to and from destinations north of the River Thames would be proportionately cheaper than in the Without Project scenario as cross-river road user charges would be reduced through a residents' user charge discount.</p> <p>Around 106,900 Gravesham residents would benefit from a reduction in the cost of travel across the River Thames. The distribution of personal affordability impacts is uneven across income quintiles as there is a higher proportion of Gravesham residents within the lowest income quintiles compared with the regional study area and England and Wales.</p>	Large Beneficial for Gravesham residents

2 Introduction

2.1 Purpose of this document

- 2.1.1 This Distributional Impact Appraisal Report (DIA) describes the methodologies used to appraise the distribution across vulnerable people groups of some of the economic, environmental and social impacts of the A122 Lower Thames Crossing (the Project). It also presents the results of this distributional appraisal. These results are summarised in the Project's Appraisal Summary Table (AST) and contribute to its value for money (VfM) assessment.
- 2.1.2 The Project's appraisal has been developed to support its application for a Development Consent Order (DCO). The appraisal is presented in the Economic Appraisal Report (EAR) and summarised in the Appraisal Summary Table Report. These documents, along with this report and the Level 3 Wider Economic Impacts Report, comprise Appendix D: Economic Appraisal Package of the Combined Modelling and Appraisal Report (ComMA) (Application Document 7.7).
- 2.1.3 The ComMA also provides information about the traffic data, transport model and traffic forecasts which are used as inputs for the appraisal:
- Appendix A – Transport Data Package – this includes the transport data collected and used within the traffic modelling and forecasting as part of the evidence base for the Project's appraisal.
 - Appendix B – Transport Model Package – this describes the development of the Lower Thames Area Model (LTAM) transport model.
 - Appendix C – Transport Forecasting Package – this includes traffic forecasts produced using LTAM, upon which this appraisal is based.
- 2.1.4 The Project has been appraised based on the assumption that construction begins in 2025 with the Project opening by the end of 2030.
- 2.1.5 The traffic impacts of the Project have been forecast using the LTAM which is used to model the Without Project scenario and the With Scheme scenario. The DIA presented in this report is based on the guidance in DfT's Transport Appraisal Guidance Unit A4.2 (Department for Transport, 2020).
- 2.1.6 A distributional impact appraisal does not assess the Project's overall levels of social, environmental and economic impacts. Those assessments are presented in the EAR (Appendix D: Economic Appraisal Package of the ComMA (Application Document 7.7)). Rather the Distributional Impact Appraisal assesses whether particular impacts are felt disproportionately by particular vulnerable sectors of the population.
- 2.1.7 Numbers included in tables in this report do not necessarily all sum exactly to their respective table totals due to rounding.

2.2 Document structure

2.2.1 The remaining chapters of this document are structured as follows:

- a. Chapter 3 sets out the scope of the DIA and summarises the appraisal process.
- b. Chapter 4 provides a summary of the Project and its objectives.
- c. Chapter 5 describes the screening stage process and screening results undertaken to assess whether a DIA of the Project should be undertaken.
- d. Chapter 6 includes a socio-demographic overview and assessment of the Lower Thames area.
- e. Chapter 7 describes each of the appraisal approaches and presents the appraisal of distributional impacts.
- f. Chapter 8 sets out the conclusions from the appraisal.
- g. Annexes provide more detail about some of the impact appraisals.

3 Scope of the distributional impact appraisal

3.1 Introduction

3.1.1 This chapter explains the scope of the distributional impact appraisal of the Project and provides an overview of the three-step DIA process.

3.2 Scope

3.2.1 An appraisal of the distribution of impacts from a transport project across vulnerable groups is part of the Transport Analysis Guidance (TAG) transport appraisal process. A summary of the distributional impact appraisal scores is presented in the AST for the Project. The AST is an annex to Appendix D: Economic Appraisal Package of the ComMA (Application Document 7.7).

3.2.2 The DIA is closely linked with the appraisal of social impacts. Guidance on the appraisal of social impacts is provided by the Department for Transport (DfT) in TAG Unit A4.1 (Department for Transport, 2022). In a DIA both positive or beneficial and negative or adverse distributional impacts of transport interventions are considered along with the identification of any vulnerable groups likely to be affected. The DIA is carried out for 60-years from scheme opening and does not consider distributional impacts during the Project's construction period.

3.2.3 Distributional impacts relate to the extent to which impacts disproportionately affect socially vulnerable groups. These groups are:

- a. Low income households
- b. Children under 16
- c. Young adults aged between 16 and 25
- d. Older people aged 70 and over
- e. People with an illness or disability that limits their daily lives
- f. People of black, Asian or minority ethnic origin (BAME)
- g. Households without access to a car

3.2.4 Accidents are also appraised with regard to their impacts on:

- a. Pedestrians
- b. Cyclists
- c. Motorcyclists
- d. Young male drivers

3.2.5 The benefits and disbenefits of the Project may be experienced to varying degrees by the different vulnerable groups. The DIA compares the distribution of the Project's benefits and disbenefits received by the different vulnerable

groups against the distributions of the different vulnerable groups within the general population. This is done to understand whether the benefits and disbenefits received by people in these vulnerable groups represent, respectively, disproportionately low and high shares of the Project’s benefits and disbenefits, or are at least in line with their share of the general population.

3.2.6 There are eight impact topics that are assessed in the distributional impact appraisal:

- a. User benefits
- b. Noise
- c. Air quality
- d. Accidents
- e. Security
- f. Severance
- g. Accessibility
- h. Personal affordability

3.3 Overview of the distributional impact appraisal process

3.3.1 Table 3.1 provides an overview of the three step DIA methodology. This involves:

- a. Screening to determine the likelihood of positive and negative distributional impacts
- b. For those impacts where there are positive and negative distributional impacts, assessing the area impacted by the Project and determining the vulnerable groups and amenities in the impacted area
- c. Appraising the distributional impacts

Table 3.1 Distributional impact appraisal methodology

Step	Description	Output
1	Screening process Identification of the likelihood of potential positive and negative impacts on specific vulnerable groups for each indicator	Screening Proforma
2	Assessment Confirmation of the area impacted by the transport intervention (impacted area) Identification of vulnerable groups in the impacted area Identification of amenities in the impacted area	Vulnerable groups statistics and amenities affected within the impacted area

Step	Description	Output
3	Appraisal of impacts Core analysis of the impacts Full appraisal of DIs and input into AST	Appraisal worksheets and AST scores

3.3.2 Table 3.2 shows the vulnerable groups that the TAG guidance indicates should be appraised for each impact.

Table 3.2 Scope of socio-demographic analysis for distributional impacts

	User benefits	Noise	Air quality	Accidents	Security	Severance	Accessibility	Affordability
Income distribution	✓	✓	✓	–	–	–	✓	✓
Children: proportion <16	–	✓	✓	✓	✓	✓	✓	–
Young adults: proportion aged 16–25	–	–	–	✓	–	–	✓	–
Older people: proportion aged 70+	–	✓	–	✓	✓	✓	✓	–
Proportion of population with a disability	–	–	–	–	✓	✓	✓	–
Proportion of population of BAME origin	–	–	–	–	✓	–	✓	–
Proportion of households without access to a car	–	–	–	–	–	✓	✓	–
Proportion of households with dependent children	–	–	–	–	–	–	✓	–

Source: TAG Unit A4.2 (Department for Transport, 2020)

3.3.3 Following the screening exercise to remove distributional impact topics that are not relevant to the Project, summary scores on a seven-point scale are derived for each relevant vulnerable group for each distributional impact topic. Table 3.3 presents the criteria for determining the summary scores. In accordance with TAG, the assessment scores are derived taking the following into consideration:

- a. If the percentage of the benefits/disbenefits for a vulnerable group are within 5% of the percentage of that vulnerable group in the population, then the impact is scored as Moderate Beneficial / Adverse.
- b. If the benefits/disbenefits for a vulnerable group are more than 5% higher than the percentage of that vulnerable group in the population, then the impact is scored as Large Beneficial / Adverse.
- c. If the benefits/disbenefits for a vulnerable group are less than 5% lower than the percentage of that vulnerable group in the population, then the impact is scored as Slight Beneficial / Adverse.

- 3.3.4 For example, if a vulnerable group accounts for 25% of the population but receives more than 30% of the Project's benefits for a particular impact, then the impact, for that vulnerable group, is scored as Large Beneficial. However, if a vulnerable group accounts for 25% of the population but receives less than 20% of the benefits, then the impact for that group is scored as Slight Beneficial.
- 3.3.5 The results of the DIA are set out for each impact in turn in the remainder of this report.
- 3.3.6 The summary scores are included in the Distributional column of the AST, which is presented in the Appraisal Summary Table Report (Appendix D of the ComMA (Application Document 7.7)).

Table 3.3 Criteria for determining the distributional impacts summary scores

Impact	Assessment
Beneficial and 5% or more greater than the proportion of the group in the total population	Large Beneficial
	✓✓✓
Beneficial and in line (+/-5%) with the proportion of the group in the total population	Moderate Beneficial
	✓✓
Beneficial and 5% or more smaller than the proportion of the group in the total population	Slight Beneficial
	✓
There are no significant benefits or disbenefits experienced by the group for the specified impact	Neutral
A disbenefit which is 5% or more smaller than the proportion of the group in the total population	Slight Adverse
	x
A disbenefit which is in line (+/-5%) with the proportion of the group in the total population	Moderate Adverse
	x x
A disbenefit which is 5% or more greater than the proportion of the group in the total population	Large Adverse
	x x x

Source: TAG Unit A4.2 (Department for Transport, 2020)

4 Project overview and objectives

4.1 Introduction

4.1.1 This chapter provides a brief overview of the Project and sets out its objectives.

4.2 Project overview

4.2.1 The Project would provide a connection between the A2 and M2 in Kent and the M25 south of junction 29, crossing under the River Thames through a tunnel. The Project route is presented in Plate 4.1.

4.2.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel portals would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

4.2.3 Junctions are proposed at the following locations:

- a. New junction with the A2 to the south-east of Gravesend
- b. Modified junction with the A13/A1089 in Thurrock
- c. New junction with the M25 between junctions 29 and 30

4.2.4 To align with National Policy Statement for National Networks (Department for Transport, 2014) policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied in line with the Dartford Crossing. Vehicles would be charged for using the new tunnel.

4.2.5 The Project route would be three lanes in both directions, except for:

- a. link roads
- b. stretches of the carriageway through junctions
- c. the southbound carriageway from the M25 to the junction with the A13/A1089, which would be two lanes

4.2.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. The A122 design outside the tunnel would include emergency areas. The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

4.2.7 The A122 would be classified as an ‘all-purpose trunk road’ with green signs. For safety reasons, walkers, cyclists, horse riders and slow-moving vehicles would be prohibited from using it.

4.2.8 The Project would include adjustment to a number of local roads. There would also be changes to a number of Public Rights of Way, used by walkers, cyclists and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas pipelines, overhead electricity powerlines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

4.2.9 The Project has been developed to avoid or minimise effects on the environment. The measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

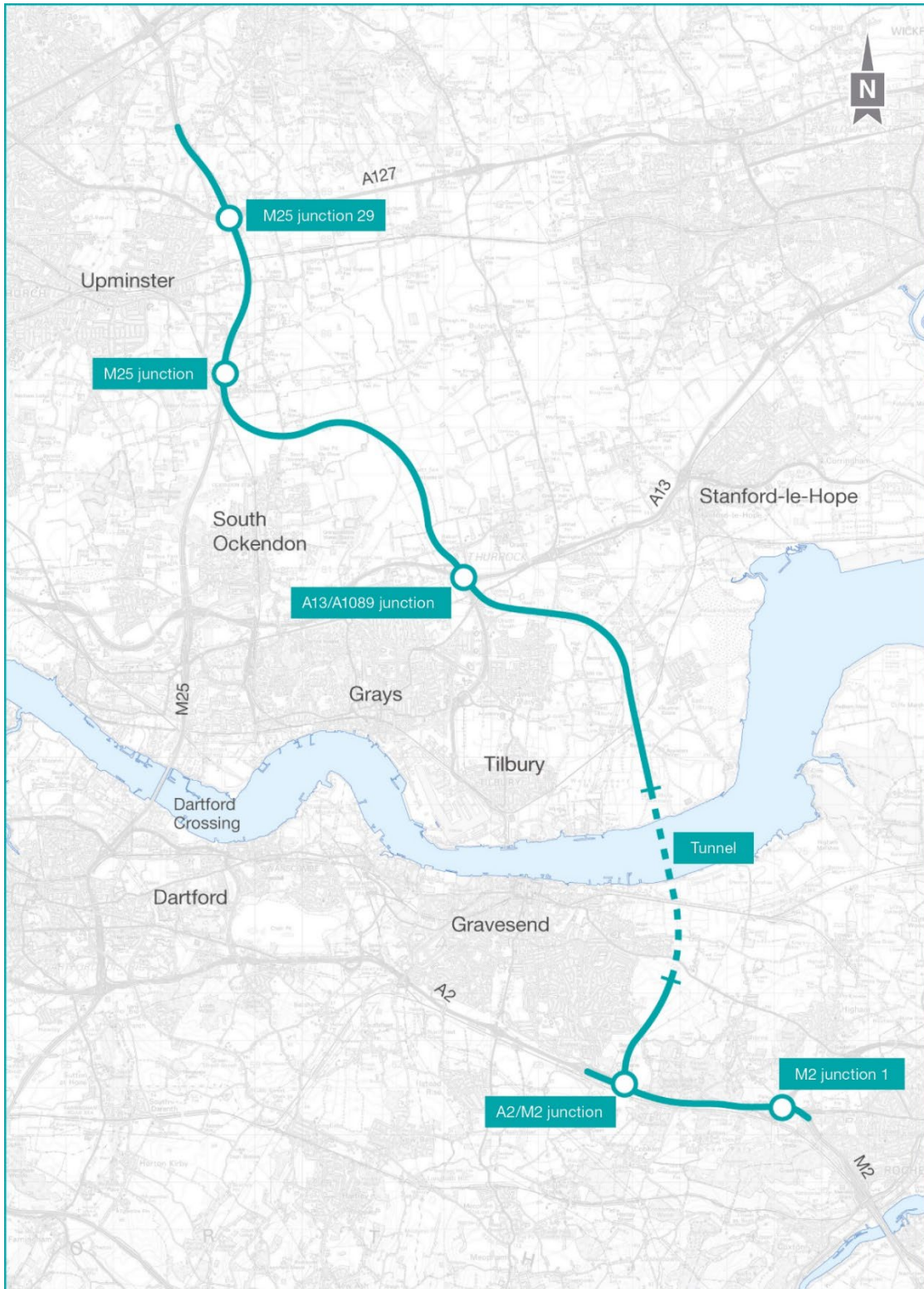
4.3 Scheme Objectives

4.3.1 The Scheme Objectives, which comprise three principal categories of Economic, Community and environment, and Transport, were developed by National Highways and endorsed by the DfT, after the Government commissioned National Highways (formerly Highways England) to identify and assess options for a new road crossing in the Lower Thames area in 2014. The objectives are shown in Table 4.1.

Table 4.1 Scheme Objectives

Type of objective	Objectives
Economic	<ul style="list-style-type: none"> To support sustainable local development and regional economic growth in the medium to long term To be affordable to government and users To achieve value for money
Community and environment	<ul style="list-style-type: none"> To minimise adverse impacts on health and the environment
Transport	<ul style="list-style-type: none"> To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free-flowing north-south capacity To improve the resilience of the Thames crossings and the major road network To improve safety

Plate 4.1 Lower Thames Crossing route



5 Screening

5.1 Introduction

5.1.1 This chapter describes the first step in the DIA process, which is the screening of impacts. This was undertaken to assess whether there are likely to be any positive or negative distributional impacts on any of the vulnerable social groups and therefore which impacts should be subject to a more detailed distributional impacts appraisal. The chapter also presents the screening results.

5.2 Screening

5.2.1 Following TAG guidance, a screening exercise was carried out to consider whether, for each impact, the Project was likely to have any positive or negative distributional impacts for the vulnerable groups. The screening proforma for the Project is shown in Table A.1 in Annex A of this report.

5.2.2 The key findings from the screening exercise were as follows:

- a. The Project is not expected to have a distributional impact on personal security.
- b. The distributional impact appraisal of accessibility is not required for the Project because it is a road and TAG guidance on accessibility for DIA only relates to public transport projects.
- c. There are potential positive and negative impacts on specific vulnerable groups for the other impacts (user benefits; noise; air quality; accidents; severance; and personal affordability) and these are included in the DIA.

5.3 Screening results

5.3.1 With the exception of security and accessibility, all impacts were carried forward for detailed assessment. Table A.1 in Annex A sets out the conclusions from the screening exercise.

6 Socio-demographic overview and area assessment

6.1 Introduction

- 6.1.1 The second step in the DIA process involves undertaking a socio-demographic overview and assessment of the Lower Thames area. This assessment is described in this chapter.
- 6.1.2 The population characteristics used in the DIA are:
- a. Income distribution
 - b. The proportion of children under 16
 - c. People aged 70 and over
 - d. The proportion of the population with an illness or disability
 - e. Non-car available households
- 6.1.3 A series of maps is provided in Annex B which compare the data for each of these population characteristics in the local area against the regional average and the average for England and Wales. The local study area consists of Brentwood Borough Council, Dartford Borough Council, Gravesham Borough Council, the London Borough of Havering, Medway Unitary Authority and Thurrock Unitary Authority and is shown in Plate 6.1. The regional study area is shown in Plate 6.2.

6.2 Socio-demographic overview

- 6.2.1 The maps provided in Annex B were created using Census 2011 data, Office for National Statistics (ONS) Indices of Deprivation (IOD) Income Domain data (2019) and ONS Mid-Year Population Estimates (2020). The data is mapped at the Lower Layer Super Output Area (LSOA) level and at property levels using Ordnance Survey (OS) Address Point data. Census 2021 does not yet provide the required disaggregation of data.
- 6.2.2 The purpose of producing the maps is to show the difference in the distribution of vulnerable groups across the local study area, compared to either the regional study area average and the average for England and Wales.

Income distribution

- 6.2.3 Plate B.1 shows the distribution of the 2019 household IOD (Income domain) across the Local study area. Households in quintile 1 are measured to be the most deprived areas, while those in quintile 5 are the least deprived. Quintiles are based upon rankings in England.

- 6.2.4 The most income deprived areas (quintiles 1 and 2) are located around Basildon, to the north-east of the Project, with pockets of high income deprivation seen across the map notably in Dartford (to the north-east of the town), Gravesham (Gravesend and North Fleet), Medway (Chatham and Gillingham), Havering (north-east of Romford) and Thurrock (Chadwell St Mary, South Ockendon and Tilbury).
- 6.2.5 The highest concentration of least income deprived households (quintiles 4 and 5) is located around Brentwood, north of Basildon and south-east of Romford (Havering). Typically, rural areas tend to have low measured income deprivation across the mapped area, for example in Dartford, Gravesham, Medway and Thurrock.
- 6.2.6 As the IOD (income domain) is a relative measure, comparing incomes against the national average, no comparison maps are required.

Proportion of children aged under 16 years

- 6.2.7 Plate B.2 shows the variation in the total population aged under 16 within each LSOA compared to the average for England and Wales of 19.1%. Plate B.3 shows the variation in the total population aged under 16 within each LSOA compared to the average for the regional study area of 20.1%.
- 6.2.8 Plate B.2 highlights clustering of above average proportions of children aged under 16 years in areas to the south of the Project in Medway and along the River Thames in Gravesend and Dartford. There is also clustering in Basildon, Chatham and Gillingham. There are pockets of areas with below average proportions of children under 16 years which are typically in rural locations or on the edge of the urban areas. Plate B.3 shows a similar picture to Plate B.2.

Proportion of older people aged 70 and over

- 6.2.9 Plate B.4 and Plate B.5 show the variation in the total population aged 70 and over within the LSOAs compared to the England and Wales average of 13.7% (Plate B.4) and the regional study areas average (Plate B.5) which is lower at 11.6%.
- 6.2.10 Plate B.4 shows higher concentrations of older people in Brentwood, rural areas, and areas of Essex (including Basildon, Canvey Island and Rayleigh) compared to the England and Wales average. Lower concentrations are seen in west Thurrock, along the southern bank of the River Thames and in the Medway towns of Chatham and Gillingham.
- 6.2.11 Plate B.5 shows that there are more locations with above average populations of older people compared to the regional study area average, including Havering, Brentwood, Rayleigh and South Gravesham and slightly fewer locations where the proportions of older people are lower than the regional study area average, particularly around Rochester.

Proportion of the population with a disability

- 6.2.12 As a proxy for people with a disability, Census 2011 data relating to people with some limitations in day-to-day activity has been used. Plate B.6 and Plate B.7 show the variation in the proportion of population within the LSOAs with day-to-day limited activity compared to the England and Wales average of 17.9% and the regional study area average which is lower at 15.1%.
- 6.2.13 There are areas which have an above average proportion of people with day to day limited activity in North-East and South Thurrock, Romford, Gravesend and Rochester.

Proportion of non-car-available households

- 6.2.14 Plate B.8 and Plate B.9 respectively show the variation in the total number of households who do not have access to a car (from Census 2011 data) compared to the England and Wales average (26.7%) and regional study area average (30.9%).
- 6.2.15 Clusters of above average non-car owning households can be seen across the mapped area and this shows a strong correlation with the IOD (income) patterns. Key areas of higher than average non-car owning households are seen in Basildon, North Fleet, Gravesham, Chatham and Gillingham.

6.3 Assessment area

- 6.3.1 The area of assessment for the DIA is defined for each impact topic depending upon the nature of the impact, with the focus being on areas where material changes are likely.

User benefits

- 6.3.2 The user benefits have been assessed over the User Benefits Impact area shown in Plate 7.1 and the Local study area shown in Plate 6.1.

Noise

- 6.3.3 The assessment area has been defined based upon standards in the Design Manual for Roads and Bridges (DMRB) LA 111: Noise and Vibration (formerly HD213/11) (Highways England, 2020a). The noise assessment area extends for 600 metres on either side from the road centreline of the Project, together with the existing highway extents that would be by-passed, including the Dartford Crossing. The noise assessment area is shown in Plate 7.5 in Chapter 7.

Air quality

- 6.3.4 The assessment area for air quality has been defined based on standards in the DMRB LA 105: Air Quality (Highways England, 2019). The air quality assessment area is termed as the Affected Road Network (ARN). It includes links where:
- Annual average daily traffic (AADT) $\geq 1,000$; or
 - Heavy duty vehicle (HDV) AADT ≥ 200 ; or

- c. A change in speed band; or
- d. A change in carriageway alignment by ≥ 5 metres

6.3.5 The air quality assessment area is shown in Plate 7.9 in Chapter 7.

Accidents

6.3.6 The study area for accidents was defined in line with TAG Unit A4.2 Distributional Impact Appraisal (Department for Transport, 2020). This specifies that an assessment should be undertaken where:

- a. There are significant changes ($>10\%$) in vehicle flow, speed, heavy duty vehicle (HDV) use; or
- b. There is a significant change ($>10\%$) in the number of pedestrians, cyclists or motorcyclists using the road network.

6.3.7 For this study the appraisal area was based on the study area used in the appraisal of accidents, undertaken using DfT's COBALT (Cost and Benefit to Accidents – Light Touch version 2.3, May 2022) software appraisal programme. The area includes road links where the AADT flow with the Project is forecast to change by a more refined criterion (more than 5% and more than 200 vehicles), compared with the Without Project scenario. The COBALT study area is shown in Plate 7.11 in Chapter 7.

Severance

6.3.8 The study area for physical severance covers all locations that could potentially be severed by the Project or its junctions.

6.3.9 Traffic related severance was considered for all roads included in the LTAM Fully Modelled Area (FMA) The FMA is shown in Plate 7.13 in Chapter 7.

Personal affordability

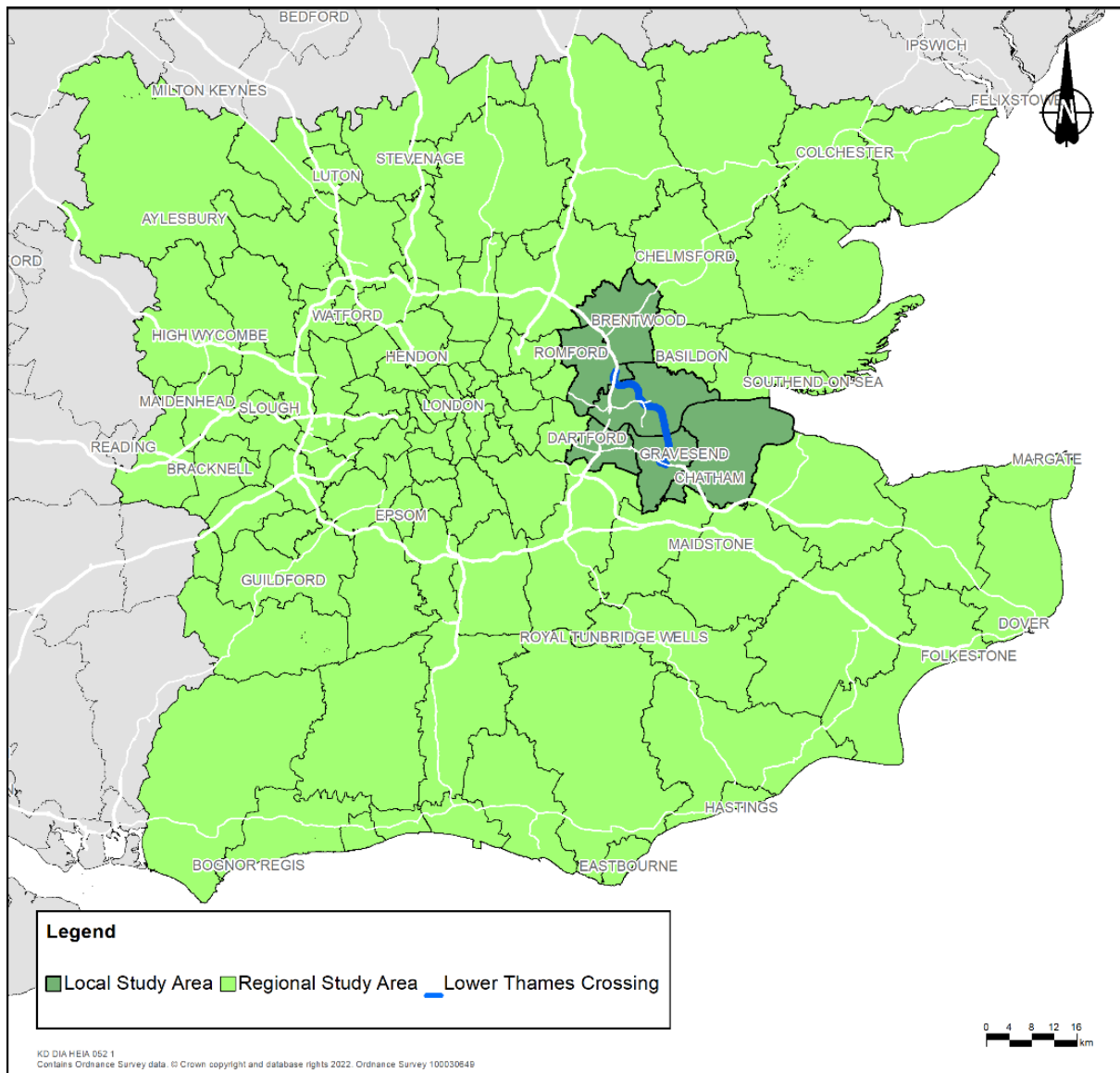
6.3.10 The analysis for personal affordability involved looking at changes to user charges within the Gravesham Borough Council area.

6.3.11 TAG Unit A4.2 recommends that personal affordability is also assessed for the Defined Impact area and Local study area, using available model information, if available (Department for Transport, 2020). However, this involves potentially double-counting changes in fuel and non-fuel operating costs which form part of user benefits. Therefore, this impact on personal affordability was not included and the personal affordability assessment was only based on changes to user charges in the Gravesham area.

Plate 6.1 Local study area



Plate 6.2 Regional and Local study areas



7 Impacts appraisal

7.1 Introduction

- 7.1.1 The third step in the DIA process involves undertaking the appraisal of those impacts that were identified as being positive or negative based on the results of the screening exercise.
- 7.1.2 This chapter describes, in turn, the DIA methodology, the assessment area and the results for each of the following indicators:
- a. User benefits
 - b. Noise
 - c. Air quality
 - d. Accidents
 - e. Severance
 - f. Personal affordability
- 7.1.3 The appraisal has been undertaken in accordance with the DIA methodologies contained in TAG Unit A4.2 (Department for Transport, 2020).
- 7.1.4 The DIA analyses use outputs from the Without Project (or Do Minimum) and With Project (or Do Something) traffic forecast model runs produced using the LTAM for the 2030 opening year.

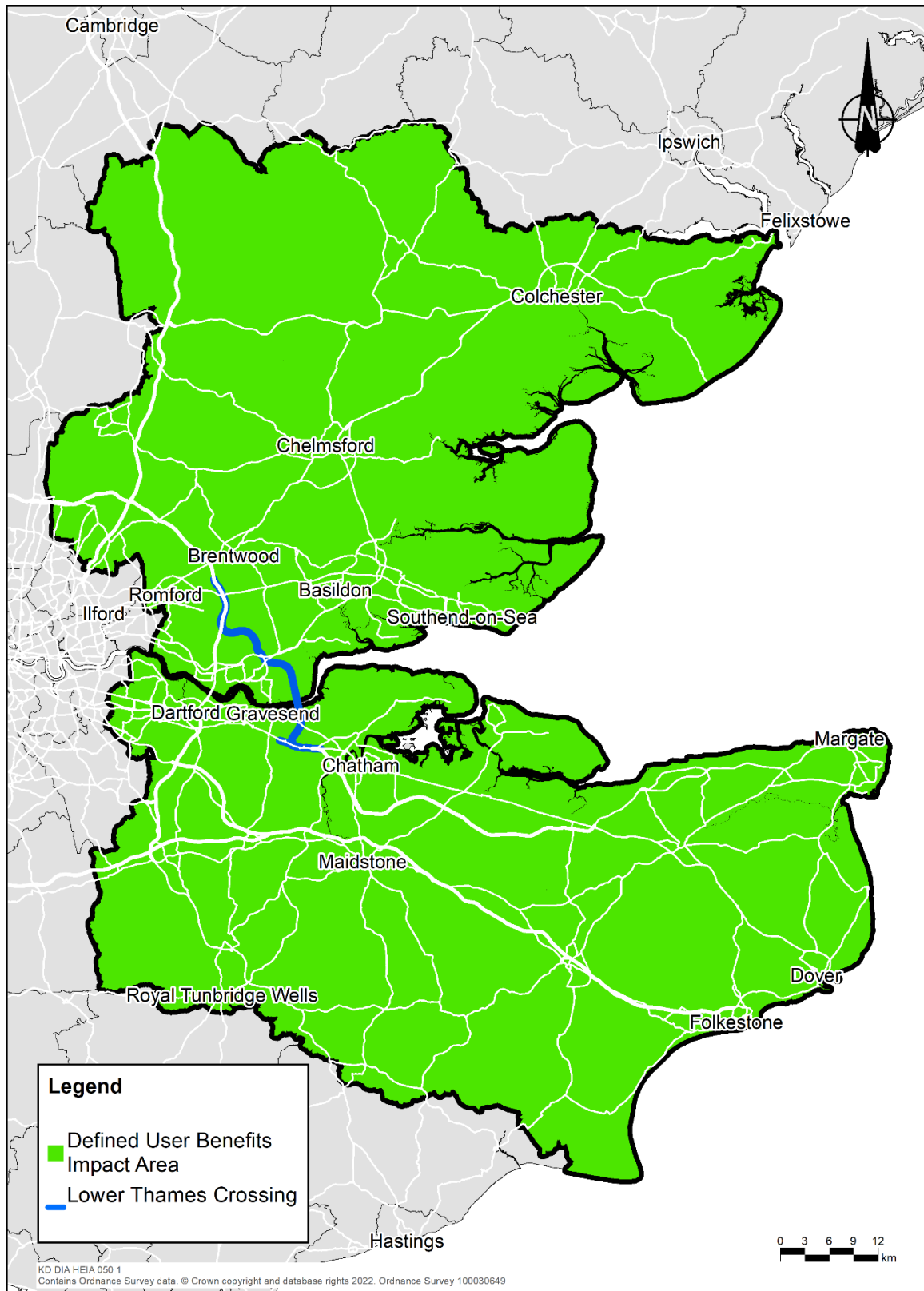
7.2 User benefits methodology

- 7.2.1 The DIA of user benefits for the Project is based on a comparison of the spatial distribution of user benefits against the distribution of income.
- 7.2.2 User benefits reflect the change in the cost of travel, which comprise travel time costs, fuel and non-fuel operating costs and user charge impacts for commuter and other transport users. Reductions in travel costs result in user benefits and increases in travel costs lead to user disbenefits. These impacts have been valued using DfT's TUBA appraisal software and installer v1.9.17 but with the TUBA Economic Parameters file v1.9.18 (May 2022) which is consistent with the TAG data book v1.18 (Department for Transport, n.d.). For simplicity, references hereafter will simply be to TUBA v1.9.18. The number of trips and cost information was taken from the LTAM. The full user benefits analysis is presented in the EAR (Appendix D of the ComMA (Application Document 7.7)).
- 7.2.3 The DIA of user benefits differs from the appraisal of user benefits reported in the EAR in two aspects:
- a. User benefits for the DIA were analysed for each zone in the User Benefits Impact area for non-business journeys (that is for commuting and other trips) for the Core traffic growth scenario. It is inappropriate to conduct a DIA for business journeys because user benefits and disbenefits for these journeys are experienced by businesses and not individuals.

- b. User benefits for the DIA are based on monetised user benefits calculated for the AM peak (07:00–09:00), inter-peak (09:00–15:00) and PM peak (16:00–18:00) periods only. The AM and PM peak period benefits and total inter-peak hour benefits were derived by applying factors to the LTAM modelled hour time periods (07:00–08:00, average between 09:00–15:00, and 17:00–18:00) and annualised within TUBA v1.9.18. The benefit values reported in the DIA analysis therefore differ from the full TUBA v1.9.18 analysis in the EAR which includes benefits from non-modelled time periods. The user benefits reported are discounted present values, expressed in 2010 prices and values, that have been calculated over the 60-year appraisal period from scheme opening.

- 7.2.4 User benefits were only calculated for journeys with either an origin or destination within the User Benefits appraisal area (see Plate 7.1). This was to avoid unrepresentative impacts being forecast from small changes in travel costs to remote locations.
- 7.2.5 User benefits were estimated for commute and other non-business trips made by car and light goods vehicles based on the following assumptions:
 - a. AM benefits were accrued to the origin LTAM zones
 - b. PM benefits were accrued to the destination LTAM zones
 - c. Inter-peak benefits were split 50% to origin zones and 50% to destination zones
- 7.2.6 The distribution of user benefits has been compared against the spatial distribution of income levels based on the national IOD for LSOAs. The impact area over which the Project leads to changes in travel costs was defined within the LTAM and is shown in Plate 7.1.
- 7.2.7 User benefits were also calculated for income quintiles for the Local study area which includes the local authorities of Brentwood, Dartford and Gravesham and the unitary authorities of Thurrock and Medway, and the London Borough of Havering.
- 7.2.8 An assessment score was then assigned to each income quintile using the criteria set out in Table 3.3.

Plate 7.1 User Benefits Impact area



7.3 User benefits appraisal

- 7.3.1 Table 7.1 and Table 7.2 present and compare the distribution of user benefits and disbenefits and the population for each income quintile for the User Benefits impact area and Local study area, respectively. This enables an assessment to be made with comparisons to both the local area and further afield. The level of benefits is substantially greater than the level of disbenefits across all income quintiles. The proportions of benefits, disbenefits and population in each quintile are also shown in the graphs in Plate 7.2 and Plate 7.3.
- 7.3.2 Plate 7.4 shows the geographical distribution of user benefits per head of population. Most locations have a decrease in costs and therefore receive a beneficial impact from the Project. The areas in receipt of the greatest benefits per head are mainly near the Project, particularly in Thurrock and Gravesham, although other areas are also forecast to benefit, including Dartford, the London Borough of Havering, Chelmsford and parts of the Medway towns. Locations which receive an overall disbenefit include areas adjacent to A228 in south-west Medway, Sevenoaks in Kent, Rainham in Kent and Braintree.
- 7.3.3 There is an overall net user benefit as a result of the Project across all income quintiles for both the User Benefits Impact area (Table 7.1) and the Local study area (Table 7.2). The benefits for all income quintiles were assessed to be Moderate Beneficial for both areas because the proportion of the population experiencing a net benefit within each quintile is in line with the proportion of the population of the group overall, within a range of +/-5%. The proportion of net benefits in quintiles 1, 2 and 3 are slightly higher than the proportion of the population in those categories for both the User Benefits Impact area and the Local study area.
- 7.3.4 For the User Benefits Impact area, the proportion of disbenefits for quintile 1 is lower than the population distribution (8.1% disbenefit compared to 12.5% population distribution).
- 7.3.5 For the Local study area, the proportion of disbenefits in the lowest quintile is marginally above the proportion of the population in that category. For quintile 2, the proportion of disbenefit is also above the proportion of the population (31.6% compared with 24.9% of the population).
- 7.3.6 Overall, the distributional impact of the Project on user benefits is assessed to be Moderate Beneficial.

Table 7.1 Distributional analysis of user benefits against income for the User Benefits Impact area

User Benefits Impact area	Indices of Multiple Deprivation (Income Domain)					Total
	Most deprived areas <-----> Least deprived areas					
	0%–20%	21%–40%	41%–60%	61%–80%	81%–100%	
Benefits	£81,550,271	£146,521,976	£139,718,939	£108,360,743	£96,809,303	£572,961,231
Disbenefits	-£1,218,653	-£3,460,474	-£3,217,738	-£3,628,945	-£3,428,678	-£14,954,487
Total net benefits	£80,331,618	£143,061,502	£136,501,201	£104,731,798	£93,380,625	£558,006,744
Proportion of benefits	14.2%	25.6%	24.4%	18.9%	16.9%	100%
Proportion of disbenefits	8.1%	23.1%	21.5%	24.3%	22.9%	100%
Proportion of net benefits (a)	14.4%	25.6%	24.5%	18.8%	16.7%	100%
Population	470,938	801,072	862,474	869,101	774,179	3,777,764
Proportion Population (b)	12.5%	21.2%	22.8%	23.0%	20.5%	100.0%
(a) – (b)	2%	4%	2%	-4%	-4%	
Assessment (total)	✓✓	✓✓	✓✓	✓✓	✓✓	

Table 7.2 Distributional analysis of user benefits against income for the Local study area

Local study area	Indices of Multiple Deprivation (Income Domain)					Total
	Most deprived areas <-----> Least deprived areas					
	0%–20%	21%–40%	41%–60%	61%–80%	81%–100%	
Benefits	£55,413,077	£114,497,873	£103,690,687	£71,087,385	£64,478,176	£409,167,198
Disbenefits	-£554,347	-£1,259,886	-£757,913	-£1,053,590	-£359,638	-£3,985,374
Total net benefits	£54,858,731	£113,237,986	£102,932,774	£70,033,795	£64,118,538	£405,181,824
Proportion of benefits	13.5%	28.0%	25.3%	17.4%	15.8%	100%
Proportion of disbenefits	13.9%	31.6%	19.0%	26.4%	9.0%	100%
Proportion of net benefits (a)	13.5%	27.9%	25.4%	17.3%	15.8%	100%
Population	101,720	204,819	171,356	170,374	175,279	823,548
Proportion Population (b)	12.4%	24.9%	20.8%	20.7%	21.3%	100%
(a) – (b)	1%	3%	5%	-3%	-5%	
Assessment (total)	✓✓	✓✓	✓✓	✓✓	✓	

Plate 7.2 Distribution of user benefits compared to distribution of population for the User Benefits Impact area

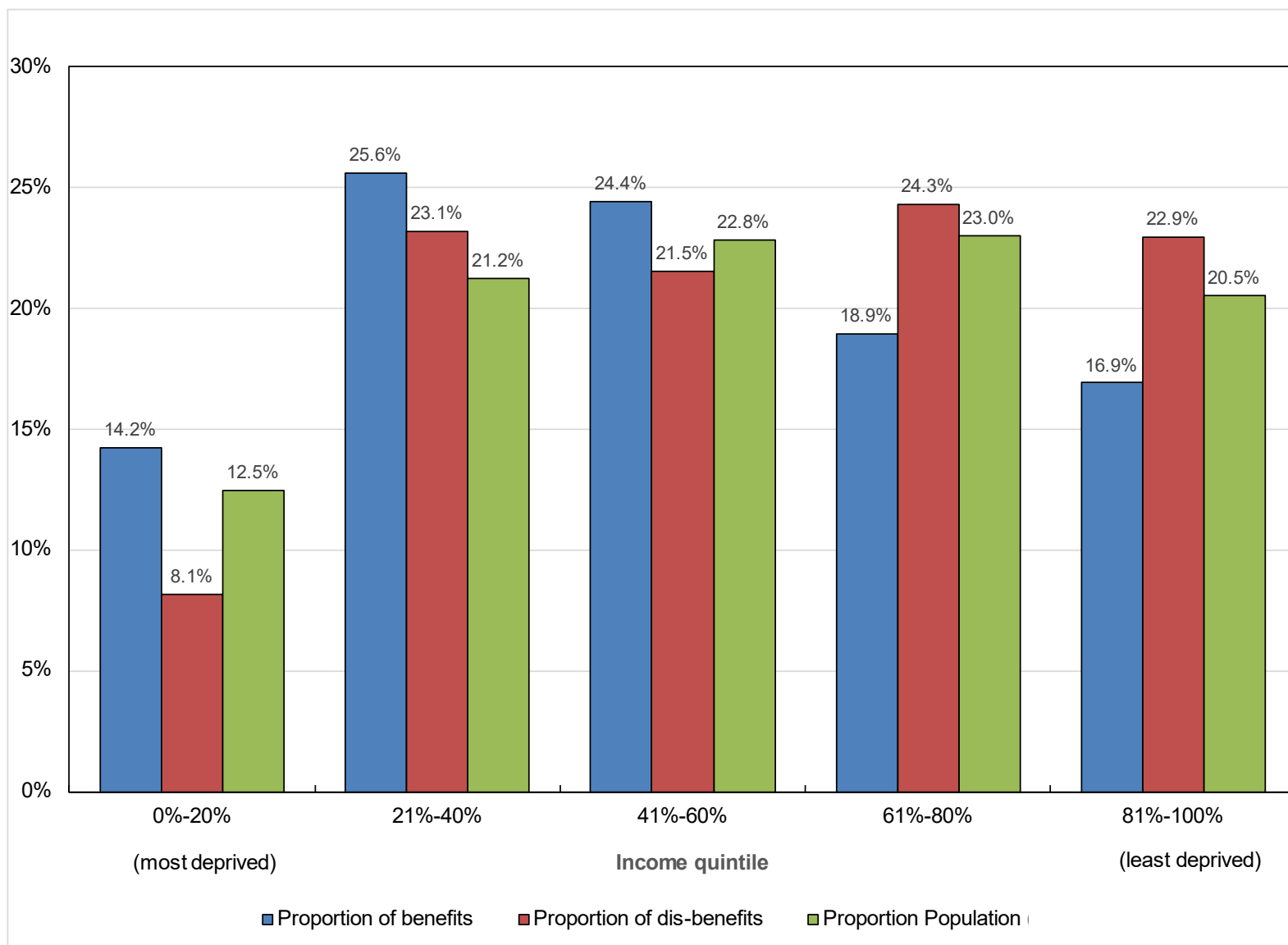


Plate 7.3 Distribution of user benefits compared to distribution of population for the Local study area

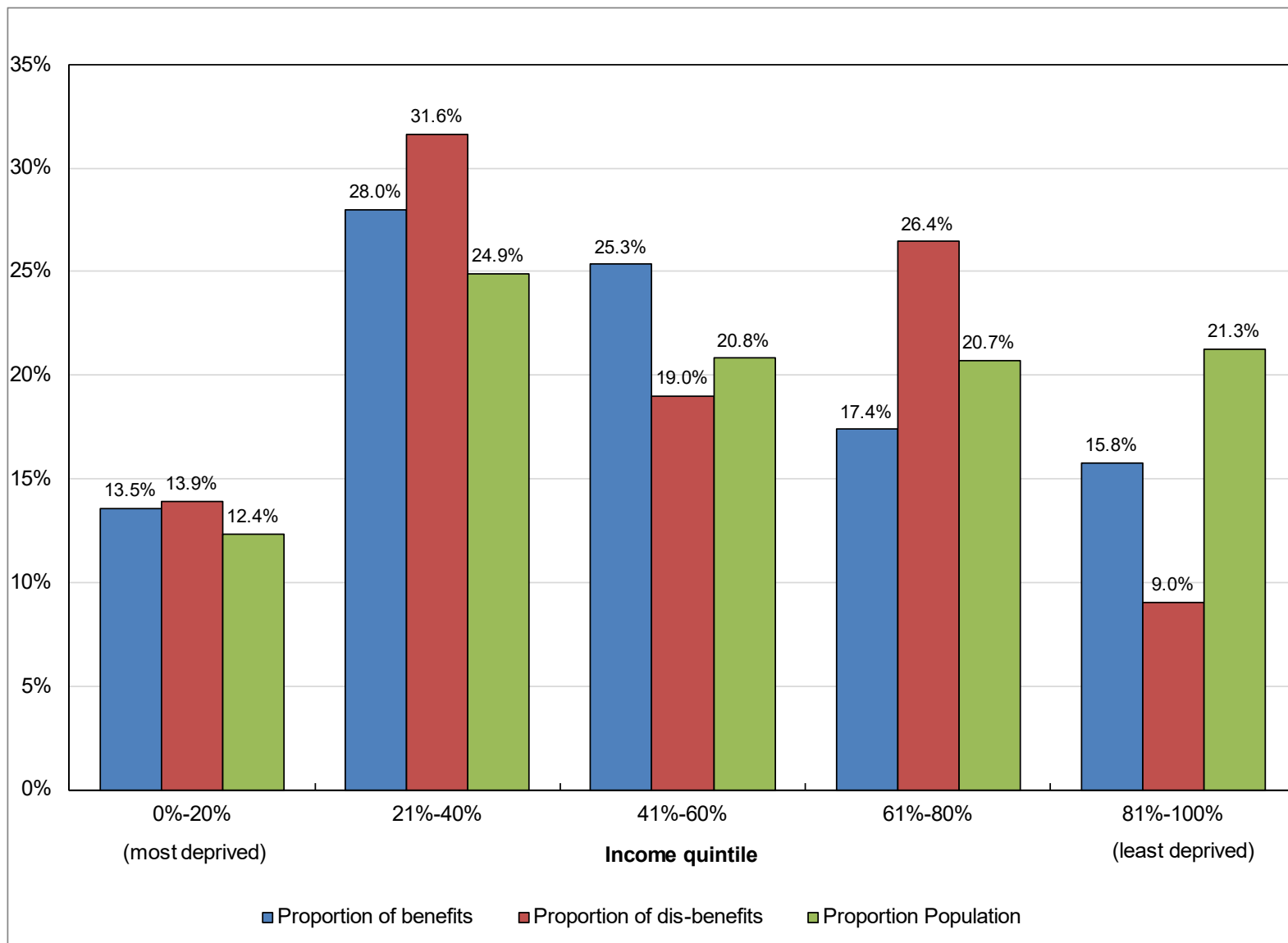
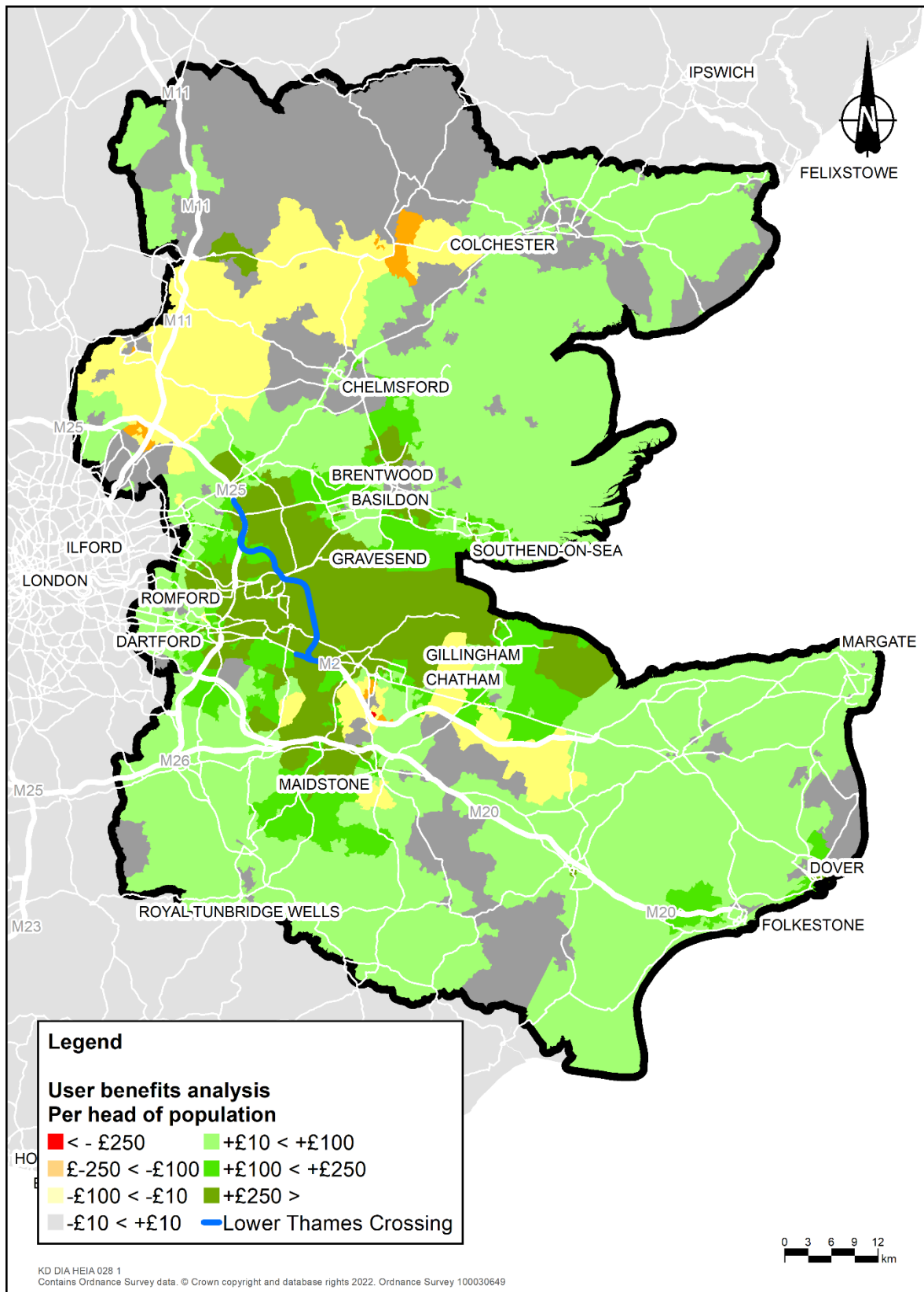


Plate 7.4 Geographical distribution of user benefits per head of population



7.4 Noise methodology

- 7.4.1 The distributional appraisal of noise impacts for the Project is based on a comparison of those impacts against:
- The distribution of income
 - Two vulnerable groups – children under 16 and people aged 70 and over
- 7.4.2 The DIA for noise has been undertaken using the predicted road traffic noise level in the future opening year of 2030 for both the Without Project and With Project options. The road traffic noise levels represent average daily levels and have been derived from the 18-hour Annual Average Weekday Traffic (AAWT) flows which have been calculated from the LTAM.
- 7.4.3 The forecast change in road traffic noise levels for the Without Project and With Project scenario was calculated for each receptor. Forecast changes greater than or equal to 1dB(A) were identified, which is the smallest change in noise considered perceptible to the human ear. Forecast changes in noise levels greater than or equal to 1dB(A) were identified at residential, school and care home noise receptors. The noise assessment area and location of receptors is shown in Plate 7.5.
- 7.4.4 The noise assessment in the Environmental Statement (ES) is carried out in accordance with LA 111 (Highways England, 2020a). The DIA uses 1dB in the opening year because this is when people first become aware of the noise impact. The aim of the DIA is to assess how noise impacts on different segments of the population and only 1dB in the opening year provides enough data points to undertake the segmented analysis required. Therefore, the DIA provides a more precautionary noise assessment than the ES, noting that 1dB does not indicate a perceptible impact in all contexts.

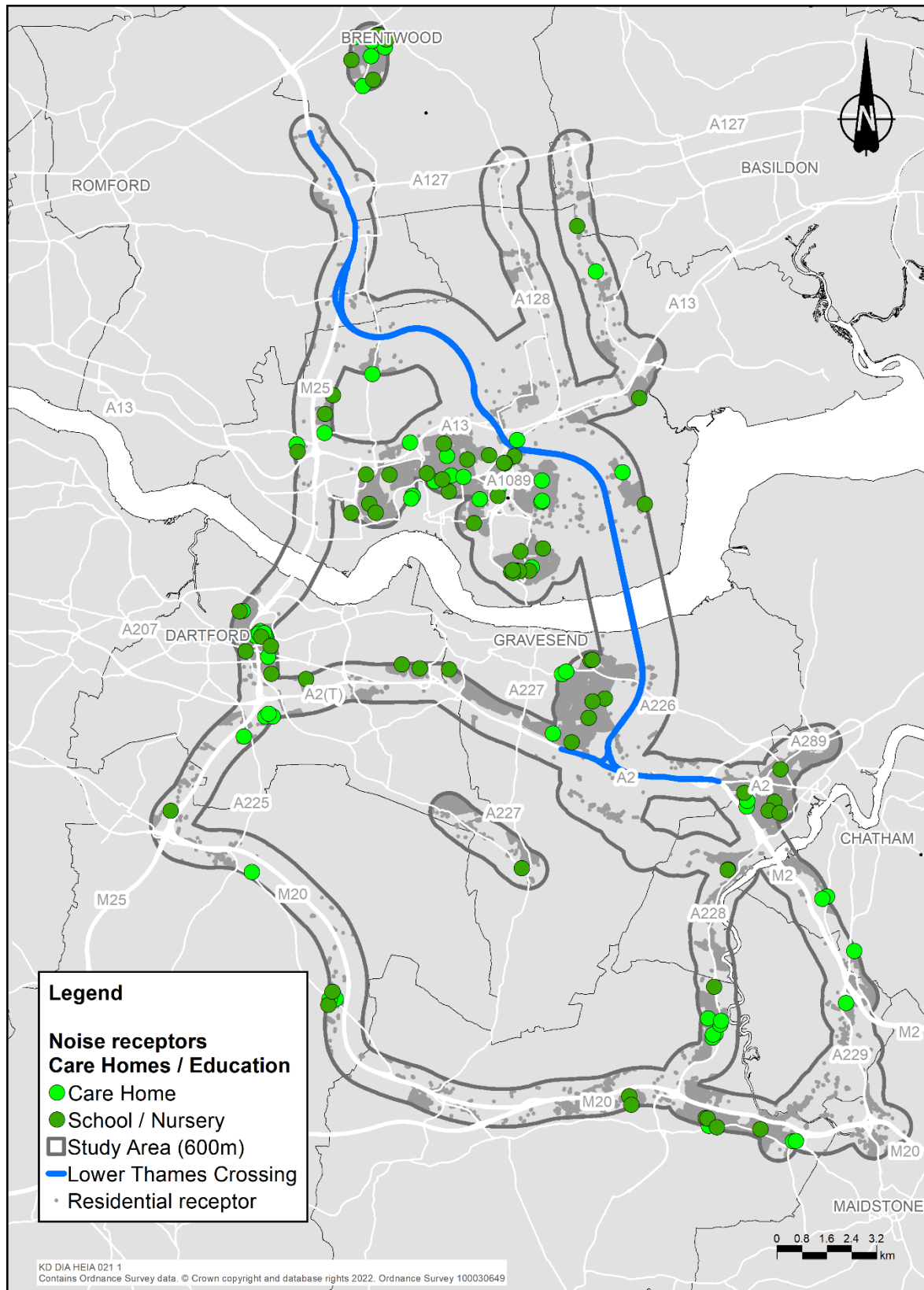
Income

- 7.4.5 The appraisal of noise impacts of the Project against the distribution of income involved assigning each residential noise sensitive receptor within the study area to its relevant LSOA. Then, using IOD Income Domain data, the analysis of noise impacts experienced by households with different levels of income was undertaken.
- 7.4.6 An assessment score was assigned to each income quintile using the criteria set out in Table 3.3.

Vulnerable groups

- 7.4.7 The appraisal also looked at the distributional impacts by LSOA across two vulnerable groups – children under 16 years and people aged 70 and over. The overall impact takes account of the populations of these vulnerable groups in the impact areas and the noise impacts on amenities used by these groups, namely schools (for children) and care homes (for older people).

Plate 7.5 Location of care home and education noise receptors



7.5 Noise appraisal

Geographical distribution of noise changes

- 7.5.1 The geographical distribution of noise changes of greater than or equal to 1dB(A) for the Without Project and With Project options in 2030 is shown in Plate 7.6.

Income

- 7.5.2 The DIA for noise impacts requires the identification of the number of properties within each income quintile which experience an increase, decrease or no change in road traffic noise level.
- 7.5.3 In accordance with the TAG guidance, the DIA has been undertaken using the predicted road traffic noise levels in the 2030 modelled future year at identified dwellings within the noise assessment study area. The assessment only considers day-time noise.
- 7.5.4 The change in road traffic noise level has been based upon a change of greater than or equal to 1dB. A change in road traffic noise of 1dB is the smallest that is considered perceptible to the human ear.
- 7.5.5 Table 7.3 presents the numbers of properties that experience an increase, no change or a decrease in road traffic noise levels in 2030. The study area consists of a total of 101,464 properties. Beneficial and adverse changes in noise levels are defined in DMRB as those levels changing by +/-1dB(A), which is consistent with significant effects from short-term noise changes (Highways England, 2020a Version 2).

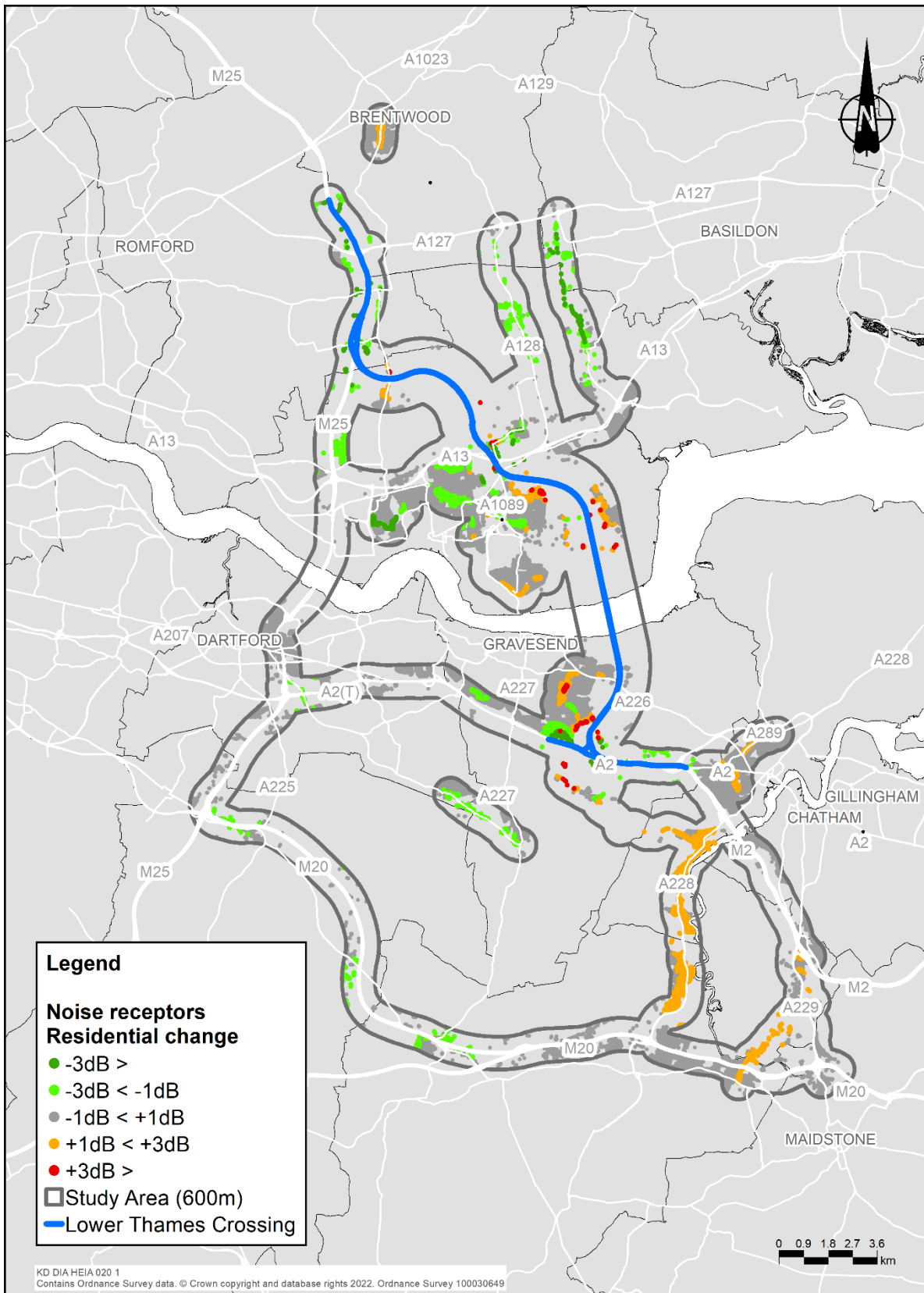
Table 7.3 Distributional impacts of noise by income: 2030

Indices of Deprivation	IMD Income Domain					Total
	Most deprived areas <-----> Least deprived areas					
	0%–20%	21%–40%	41%–60%	61%–80%	81%–100%	
Properties with reduced noise [A]	70	824	1,709	1,442	739	4,784
Properties with no change in noise [B]	11,469	21,617	18,879	21,574	15,652	89,191
Properties with increased noise [C]	1,388	2,245	1,437	1,432	987	7,489
Number of net winners/losers [D] = [A] – [C]	-1,318	-1,421	272	10	-248	
Total number of winners/losers across all groups [E] = Σ[D]						-2,705
Net winners/losers in each area as percentage of total [F] = [D] / [E]	48.7%	52.5%	-10.1%	-0.4%	9.2%	100.0%
Share of total population of study area (i.e. number of properties)	12.7%	24.3%	21.7%	24.1%	17.1%	100.0%
Assessment	Large Adverse	Large Adverse	Slight Beneficial	Slight Beneficial	Slight Adverse	-
	xxx	xxx	✓	✓	x	

Note: As defined in TAG A4.2 (Department for Transport, 2020), winners are properties that are forecast to have a reduction in noise and losers are properties that are forecast to have an increase in noise

- 7.5.6 From the data presented in Table 7.3, the following can be concluded:
- a. 7,489 properties are forecast to have an increased noise level of 1dB(A) or more, while 4,784 properties are forecast to have reduced noise levels of 1dB(A) or more, in 2030, for the With Project scenario, compared to the Without Project scenario, leading to a net adverse noise impact.
 - b. The most deprived quintile has a 12.7% share of the total population and 18.5% of all properties with increased noise are in this quintile (1,388). The impacts are mainly adverse and the population impacted is greater than the proportion of this group in the total population. This results in an assessment score of Large Adverse.
 - c. Quintile 2, the next most deprived quintile, also contains a larger proportion of properties with increased noise, compared with the proportion of the properties with reduced noise and the impact is assessed as being Large Adverse.
 - d. Quintiles 3 and 4 are forecast to have a greater number of properties with reduced noise levels than properties with increased noise levels. The impacts are marginally beneficial and the population impacted is less than the proportion of this group in the total population. This results in an assessment score of Slight Beneficial.
 - e. The least deprived quintile (Quintile 5) is forecast to have a greater number of properties with increased noise levels than properties with reduced noise levels. The impacts are marginally adverse and the population impacted is less than the proportion of this group in the total population. This results in an assessment score of Slight Adverse.
 - f. The percentage of properties in quintiles 3, 4 and 5 with increased noise is within 5% of the proportion of the population in the relevant categories.
 - g. As shown in Plate 7.6, most of the receptors which are adversely affected by the Project are situated within the 600m buffer along its route, the A228 and A229 between the M2 and M20 and along the M2/A2 interchange. There are clusters of noise decreases in Thurrock, along the A128, Lower Dunton Road, the A2 west of the Project, along the M20 in Kent and B260 Longfield Road.
 - h. The distributional impact of the Project on noise by income is uneven because 48.7% of net noise impacts are in the most deprived quintile but only 18.5% of the properties. Overall, the noise DIA score with respect to income is assessed as Large Adverse because the most deprived income quintile is disproportionately adversely impacted.

Plate 7.6 Change in noise levels at residential receptors with Lower Thames Crossing, 2030



Vulnerable groups

Populations

- 7.5.7 Table 7.4 shows the average population, by LSOAs, for the regional study area and for England and Wales, for children under 16 and people aged 70 and over.
- 7.5.8 Table 7.5 and Table 7.6 show the distributional impact of noise against children under 16 and people aged 70 and over respectively, using population information for LSOAs. The properties have been categorised by the level of forecast change in noise levels and cross-tabulated with whether the LSOA in which they are located has average, below average or above average proportions of children or people aged over 70, compared with either the regional study area or England and Wales. This analysis assumes that LSOAs with a proportion of children under 16 years or older people equal to five percentage points above or below average were accepted to be in line with the regional or England and Wales averages. The DIA for children under 16 and people aged 70 and over was carried out for 2030.
- 7.5.9 Table 7.5 shows that there is a greater proportion of noise disbenefits than expected in LSOAs in the impacted area which have an above average percentage of children under 16, compared with both the regional study area and England and Wales. It is concluded that the distribution of changes in noise for the proportion of children under 16 is uneven and Large Adverse.
- 7.5.10 Table 7.6 shows that there is a greater proportion of noise disbenefits than expected in LSOAs in the impacted area which have an above average percentage of people aged 70 and over, compared to the regional study area but below average percentage compared to England and Wales as a whole. Overall, it is concluded that the distribution of changes in noise in relation to the proportion of the population aged 70 and over is uneven and Moderate Adverse.

Table 7.4 Average population percentage for children under 16 and people 70 and over

Area	Children under 16 years	People over 70 years
Regional study area	20.1%	11.6%
England and Wales	19.1%	13.7%

Source: Population ONS statistics, Mid-Year population estimates 2020

Table 7.5 Distributional impacts of noise by population under 16, 2030

Aged under 16: regional study area	Below average	Average	Above average	Total
Properties with reduced noise [A]	35	3,997	752	4,784
Properties with no change in noise [B]	445	61,150	27,596	89,191
Properties with increased noise [C]	24	5,271	2,194	7,489
Number of net winners/losers [D] = [A] – [C]	11	-1,274	-1,442	
Total number of winners/losers across all groups [E] = Σ[D]				-2,705
Net winners/losers in each area as percentage of total [F] = [D] / [E]	-0.4%	47.1%	53.3%	100%
Share of total population of study area (i.e. pop = number of properties)	0.5%	69.4%	30.1%	100%
Assessment	Moderate Beneficial ✓✓	Slight Adverse x	Large Adverse xxx	– –
Aged under 16: England and Wales	Below average	Average	Above average	Total
Properties with reduced noise [A]	580	3,690	514	4,784
Properties with no change in noise [B]	2,663	65,158	21,370	89,191
Properties with increased noise [C]	28	5,887	1,574	7,489
Number of net winners/losers [D] = [A] – [C]	552	-2,197	-1,060	
Total number of winners/losers across all groups [E] = Σ[D]				-2,705
Net winners/losers in each area as percentage of total [F] = [D] / [E]	-20.4%	81.2%	39.2%	100%
Share of total population of study area (i.e. pop = number of properties)	3.2%	73.7%	23.1%	100%
Assessment	Large Beneficial ✓✓✓	Large Adverse xxx	Large Adverse xxx	– –

Note: As defined in TAG A4.2 (Department for Transport, 2020), winners are properties that are forecast to have a reduction in noise and losers are properties that are forecast to have an increase in noise

Table 7.6 Distributional impacts of noise by population aged 70 and over, 2030

Aged 70 and over: regional study area	Below average	Average	Above average	Total
Properties with reduced noise [A]	669	3,622	493	4,784
Properties with no change in noise [B]	28,535	48,952	11,704	89,191
Properties with increased noise [C]	1,776	4,598	1,115	7,489
Number of net winners/losers [D] = [A] – [C]	-1,107	-976	-622	
Total number of winners/losers across all groups [E] = Σ [D]				-2,705
Net winners/losers in each area as percentage of total [F] = [D] / [E]	40.9%	36.1%	23.0%	100%
Share of total population of study area (i.e. pop = number of properties)	30.5%	56.3%	13.1%	100%
Assessment	Large Adverse xxx	Slight Adverse x	Large Adverse xxx	– –
Aged 70 and over: England and Wales	Below average	Average	Above average	Total
Properties with reduced noise [A]	470	2,947	1,367	4,784
Properties with no change in noise [B]	17,814	53,813	17,564	89,191
Properties with increased noise [C]	156	5,656	1,677	7,489
Number of net winners/losers [D] = [A] – [C]	314	-2,709	-310	
Total number of winners/losers across all groups [E] = Σ [D]				-2,705
Net winners/losers in each area as percentage of total [F] = [D] / [E]	-11.6%	100.1%	11.5%	100%
Share of total population of study area (i.e. pop = number of properties)	18.2%	61.5%	20.3%	100%
Assessment	Slight Beneficial ✓	Large Adverse xxx	Slight Adverse x	– –

Note: As defined in TAG A4.2 (Department for Transport, 2020), winners are properties that are forecast to have a reduction in noise and losers are properties that are forecast to have an increase in noise

Amenities

Schools

7.5.11 The predicted changes in road traffic noise levels that are forecast for schools located within the assessment impact area are presented in Table 7.7 and Table 7.8 and Plate 7.7. The location of the school receptors is shown in Plate 7.5. It includes receptors within a 600m buffer of the Project, together with any roads that would be seen as alternative route-choices.

**Table 7.7 Change in noise levels with the Project at schools:
north of the River Thames**

Local authority	Name	Type	Predicted change in opening year
Basildon	Essex Wildlife Trust	Other Educational Establishment	No change
Brentwood	Brentwood County High School	School	No change
Brentwood	Brentwood Ursuline Convent High School	School	No change
Brentwood	Clever Clogs Day Nursery	Nursery	No change
Brentwood	Holly Trees Primary School	School	No change
Brentwood	Warley Primary School	School	No change
Thurrock	Aveley Primary School	Nursery	No change
Thurrock	Beacon Hill Academy	Special Needs Establishment	Reduced
Thurrock	Chafford Gorges Visitor Centre	Other Educational Establishment	No change
Thurrock	Creche at Ikea	Nursery	No change
Thurrock	Deneholm Primary School	Other Educational Establishment	No change
Thurrock	Dilkes Academy	School	Reduced
Thurrock	East Tilbury Primary School & Nursery	Nursery	No change
Thurrock	Great Child Day Nursery	Nursery	Increased
Thurrock	Harris Academy Ockendon and Sixth Form	School	No change
Thurrock	Harris Primary Academy	Primary School	Reduced
Thurrock	Harris Primary Academy Mayflower	School	No change
Thurrock	Hathaway Academy	School	No change
Thurrock	Just Learning Ltd	Nursery	No change
Thurrock	Lansdown Primary Academy	School	No change

Local authority	Name	Type	Predicted change in opening year
Thurrock	Little Angels Day Nursery	Nursery	No change
Thurrock	Little Pirates Nursery	Nursery	No change
Thurrock	Oak Tree Resource Centre	Nursery	No change
Thurrock	Orsett Heath Academy	School	Reduced
Thurrock	St Clare's School	School	No change
Thurrock	St Mary's Catholic Primary School	School	Increased
Thurrock	St Mary's Church Nursery	Nursery	No change
Thurrock	St Thomas's Catholic Junior School	Primary School	No change
Thurrock	Stifford Clays Primary School	School	No change
Thurrock	The Sunshine Centre Civic Square	Special Needs Establishment	No change
Thurrock	Tilbury Pioneer Academy	School	No change
Thurrock	Treetops School	Special Needs Establishment	Reduced
Thurrock	USP College. Palmer's Campus	Other Educational Establishment	No change
Thurrock	William Edwards School	School	Reduced
Thurrock	Willow Garden Day Nursery	Nursery	No change

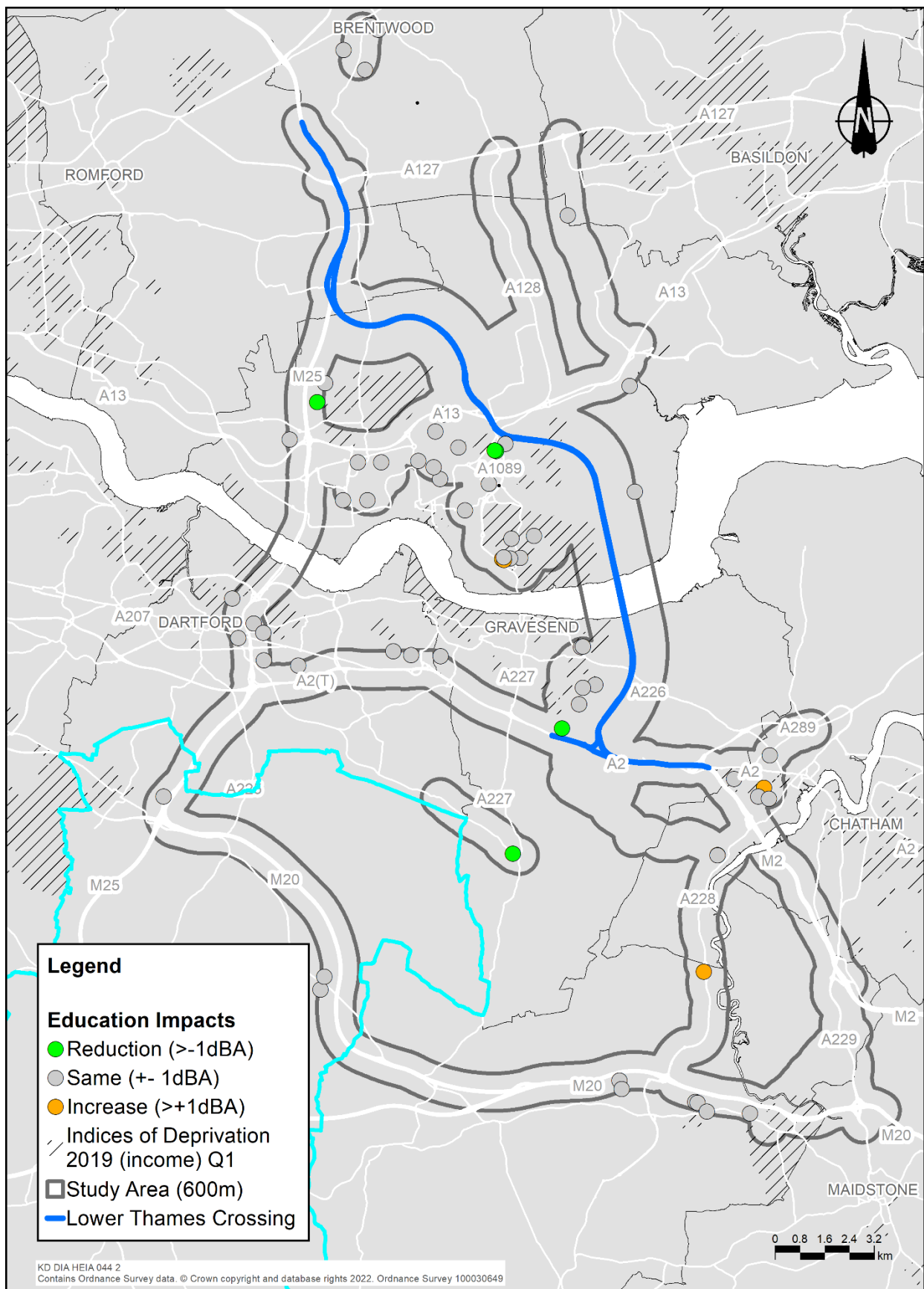
**Table 7.8 Change in noise levels with the Project at schools:
south of the River Thames**

Local authority	Name	Type	Predicted change in opening year
Dartford	Acorn House	Residential Education	No change
Dartford	Cherry Orchard Primary Academy	Nursery and School	No change
Dartford	Ebbsfleet Green Primary School	School	No change
Dartford	Fleet Day Nursery	Nursery	No change
Dartford	Hesketh Park Day Care Centre	Nursery	No change
Dartford	Temple Hill Community Primary School and Nursery	School	No change
Dartford	The Brent Primary School	School	No change
Dartford	The Gateway Community Primary School	School	No change

Local authority	Name	Type	Predicted change in opening year
Gravesham	Helen Allison School	Special Needs Establishment	Reduced
Gravesham	Little Explorers Kindergarten & Nursery	Nursery	No change
Gravesham	Riverside Community Resource Trust	School	No change
Gravesham	Riverview Infant School	Infant School	No change
Gravesham	Singlewell Primary School	School	Reduced
Gravesham	Springhead Park Primary School	School	No change
Gravesham	Thamesview School	Nursery	No change
Gravesham	Tymberwood Academy	School	No change
Medway	2J's Pre-School	Nursery	No change
Medway	Abbey Court School	School	No change
Medway	Beehive! And Buzz!	Nursery	Increased
Medway	Bligh Primary School	School	No change
Medway	Cedar Children's Academy	School	No change
Medway	Cuxton Community Infant School	School	Increased
Medway	St Francis' Pre-School	Nursery	Increased
Sevenoaks	Parkwood Hall School	Special Needs Establishment	No change
Sevenoaks	West Kingsdown CE Primary School	School	No change
Sevenoaks	West Kingsdown Pre-School	Nursery	No change
Tonbridge and Malling	Brookfield Infant School	Infant School	No change
Tonbridge and Malling	Dawn to Dusk Day Nursery	Nursery	No change
Tonbridge and Malling	Kent Health Needs Education Service	Special Needs Establishment	No change
Tonbridge and Malling	Little Stars	Nursery	No change
Tonbridge and Malling	Pippins Preschool	Nursery	No change
Tonbridge and Malling	Valley Invicta Primary School	School	No change
Tonbridge and Malling	Zoe Evans Childcare	Nursery	Increased

- 7.5.12 From the data presented in Table 7.7 and Table 7.8, the following can be concluded:
- a. Eight schools or nurseries within the impact area would experience a decrease in road traffic noise level.
 - b. Six schools or nurseries within the impact area would experience an increase in road traffic noise level.
 - c. The remaining 54 schools and nurseries out of the 68 within the noise impact area would experience no change in road traffic noise level.
- 7.5.13 Plate 7.7 shows the location of schools with a change in noise level compared with the most deprived income quintile. The map shows there is one nursery (St Francis' Pre-School in Medway) that experiences an increase in noise and is within the most deprived income quintile Major Super Output area.
- 7.5.14 Of the schools within the impact area assessed, the majority would experience no change and it is therefore concluded that there would be no major benefits or disbenefits experienced by the group as a result of the Project, resulting in an assessment score of Neutral.

Plate 7.7 Change in noise levels at schools with the Project, 2030



Care homes

7.5.15 The predicted changes in road traffic noise level that are forecast for care homes located within the 600m assessment impact area is presented in Table 7.9 and Table 7.10 and Plate 7.8. The location of the care home receptors is shown in Plate 7.5.

**Table 7.9 Change in noise level with Project at care homes:
north of the River Thames**

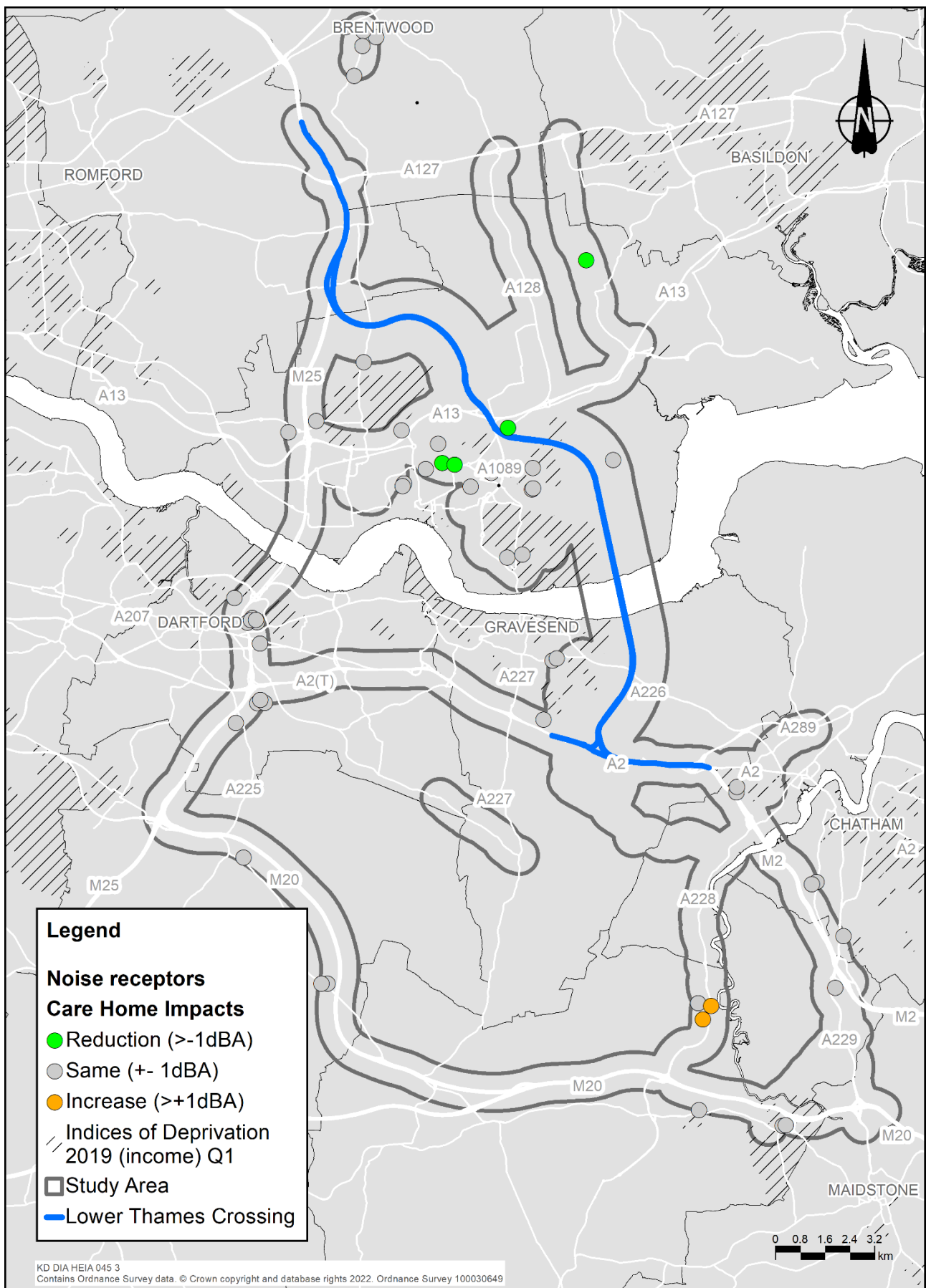
Local authority	Name	Predicted change in opening year
Brentwood	Seven Arches Nursing Home	No change
Brentwood	Signature Of Brentwood (Operations) Ltd	No change
Brentwood	Sunshine Care Homes Ltd	No change
Brentwood	Tara Residential Home	No change
Brentwood	Winifred Dell Care Centre	No change
Thurrock	A M Care Home	Reduced
Thurrock	Allens Mead Care Home	No change
Thurrock	Avalon Care Home	No change
Thurrock	Aveley House Care Home	No change
Thurrock	Bennett Lodge	No change
Thurrock	Bradd Close Nursing Home	No change
Thurrock	Caroline House	No change
Thurrock	Dexter Close Care Home	No change
Thurrock	Emmanuel House	No change
Thurrock	Gallimore Lodge	No change
Thurrock	Grapecroft Nursing Home	No change
Thurrock	Hollyrose House	Reduced
Thurrock	Honeywood Care Choices	No change
Thurrock	Larwood Care Home	No change
Thurrock	Long Lane Care Home	No change
Thurrock	Meesons Lodge Care Home	No change
Thurrock	Merrie Loots Farm Rest Residential Home	No change
Thurrock	Mosaic Housing	No change
Thurrock	St. Luke's Hospice	Reduced
Thurrock	The Barn & Coach House	No change
Thurrock	The Whitecroft Nursing Home	Reduced

**Table 7.10 Change in noise levels with the Project at care homes:
south of the River Thames**

Local authority	Name	Predicted change in opening year
Dartford	Archery House	No change
Dartford	Beechcare Care Home	No change
Dartford	Broad Oak Manor Care Home	No change
Dartford	Darenth Grange	No change
Dartford	Greenacres, Little Brook Hospital	No change
Dartford	Kentwood House Care Home	No change
Dartford	Little Brook Hospital	No change
Dartford	New Life Christian Community	No change
Dartford	Priory Mews	No change
Dartford	Rainbow Lodge	No change
Dartford	Yew Tree Centre	No change
Gravesham	Hever Court Residential Home	No change
Gravesham	Orchard Cottage Care Home	No change
Gravesham	Sheringham House Care Home	No change
Medway	Aquarius Residential Care Home	No change
Medway	Bridge Reach	No change
Medway	Copper Beeches Care Home	No change
Medway	Curlew Crescent Care Home	No change
Medway	Voyage Care	No change
Sevenoaks	Abbey Court Nursing Home	No change
Sevenoaks	Charton Manor Care Home	No change
Sevenoaks	Manordene	No change
Tonbridge and Malling	Appleton Lodge Care Home	No change
Tonbridge and Malling	Avenues South East	No change
Tonbridge and Malling	Birling House	Increased
Tonbridge and Malling	Gavin Astor House	No change
Tonbridge and Malling	Headra House	No change
Tonbridge and Malling	Lawson House	No change
Tonbridge and Malling	The Melanie Ann Trust Residential Home Building 1	Increased

- 7.5.16 From the data presented in Table 7.9 and Table 7.10, the following can be concluded:
- a. Four care homes within the impact area would experience a decrease in road traffic noise level.
 - b. Two care homes would experience an increase in road traffic noise level.
 - c. The remaining 49 care homes within the noise impact area would experience no change in road traffic noise level.
- 7.5.17 Plate 7.8 shows the location of care homes with a change in noise level compared with the most deprived quintile. There are care homes which would experience an increase in noise levels. These are in Tonbridge and Malling.

Plate 7.8 Change in noise levels at care homes with the Project, 2030



- 7.5.18 As the majority of care homes within the impact area would experience no change and it is concluded that there would be no major benefits or disbenefits experienced by the group because of the Project, this results in an assessment score of Neutral.

Overall impact

- 7.5.19 The distributional impact of the Project on noise for children is assessed to be Large Adverse based upon the 2030 analysis. The distributional impact of the Project on noise for people aged 70 and over is assessed to be Moderate Adverse based upon the 2030 analysis.

7.6 Air quality methodology

- 7.6.1 The distributional appraisal of air quality impacts for the Project is based on a comparison of those impacts against:
- The distribution of income
 - The vulnerable group of children under 16
- 7.6.2 The DIA for air quality has been undertaken using the predicted annual mean concentrations of NO₂ (microgrammes per m³, i.e. µg/m³) in the opening year of 2030 for both the Without Project and With Project options. The air quality levels have been predicted using the DMRB Air Quality model to predict pollution concentrations in the bands required as part of the TAG Assessment (20m, 70m, 115m and 175m) (Highways England, 2019). Properties are allocated a concentration depending on what distance band they reside within. There are four distance bands: 0m to 50m, 50m to 100m, 100m to 150m and 150m to 200m. The 20m predicted concentration for example is allocated to all properties which reside within the 0m to 50m band, the 70m to the 50m to 100m and so on. The analysis has used a threshold of a perceptible change greater than 0.4µg/m³. There has been no DIA of PM_{2.5} levels as perceptible changes of 0.4µg/m³ were identified at only 23 properties (0.02%).
- 7.6.3 The study area for the DIA assessment is consistent with the air quality assessment and the following traffic change criteria set out in the DMRB LA 105 have been used to define the ARN for the local air quality assessment (Highways England, 2019):
- Change in 24 hour AADT of 1,000 vehicles or more
 - Change in 24 hour AADT of 200 HDV vehicles or more
 - Change in speed band
 - Change in the road alignment of 5 metres or more
- 7.6.4 The AADT levels have been calculated from the LTAM. The location of receptors is shown in Plate 7.9.

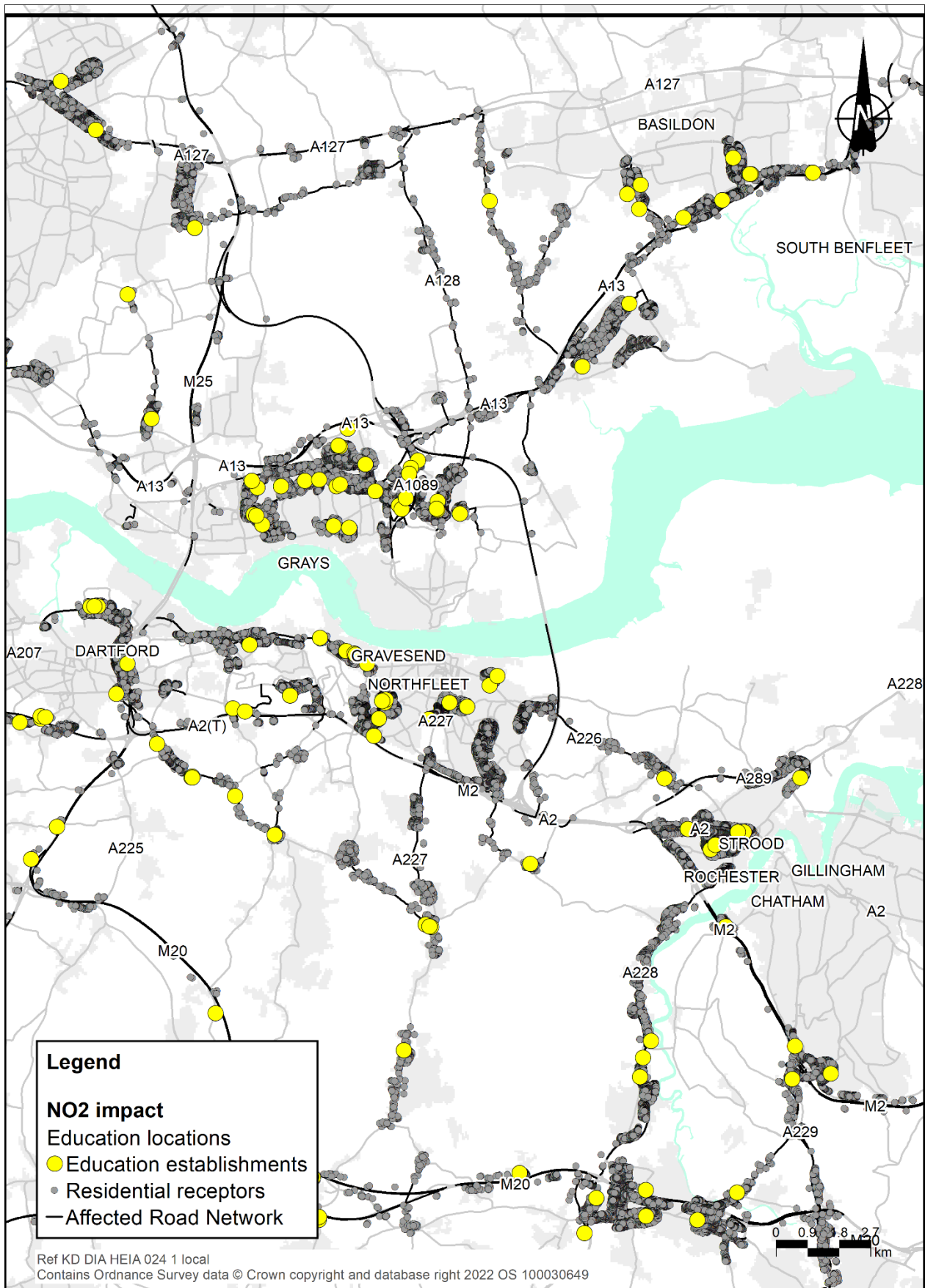
Income

- 7.6.5 The appraisal of air quality impacts of the Project against the distribution of income involved assigning each residential receptor within the study area to its relevant LSOA. Then, using the IOD Income Domain data, the analysis of air quality impacts experienced by households with different levels of income was undertaken.
- 7.6.6 An assessment score was assigned to each income quintile using the criteria set out in Table 3.3.

Vulnerable groups

- 7.6.7 The appraisal also looked at the distributional impacts by LSOA across the vulnerable group of children under 16 years. The overall impact takes account of the populations of these vulnerable groups in the impact areas and the impacts on amenities used by these groups, namely schools.

Plate 7.9 Location of air quality education receptors



7.7 Air quality appraisal

Geographical distribution of air quality changes

7.7.1 The geographical distribution of NO₂ changes is shown in Plate 7.10 for the Without Project and With Project options in the 2030 opening year. The Plate shows clusters of improvement in air quality in Thurrock, along the A128 and adjacent to the Dartford Crossing. There is a deterioration in air quality along the A13 east of the Project, along the A228, and in the Medway area.

Income

- 7.7.2 The DIA for air quality impacts requires the identification of the number of properties within each income quintile which experience an increase, decrease or no change in air quality levels.
- 7.7.3 In accordance with the TAG guidance, the DIA has been undertaken using the predicted air quality levels in the 2030 modelled future year, which represents the worst-case scenario, at identified dwellings within the air quality assessment study area.
- 7.7.4 Table 7.11 presents the numbers of properties that experience an improvement, no change or a deterioration in NO₂ levels in 2030. The study area consists of a total of 93,129 properties. From the data presented in the table, the following can be concluded:
- 134 (0.1%) properties are forecast to have a deterioration in NO₂ levels, while 373 (0.4%) properties are forecast to have improved NO₂ levels, for the With Project scenario, compared with the Without Project scenario. There is a net improvement in NO₂ for all income categories apart from those households in quintile 4, with above average income, where there are three more households with worse air quality than the number with improved air quality and in quintile 5, where the number of households with worse air quality is equal to the number of households with improved air quality.
 - Quintiles 1 and 2 have the fewest properties forecast to have worse air quality in NO₂ levels with the Project, with only two receptors having a worse air quality. The impacts are beneficial. Since the populations impacted are higher than the proportion of these groups in the total population within the air quality impact area, the assessment score is Large Beneficial for both quintiles.
 - Quintile 3 also has more properties forecast to have improved NO₂ levels than worse air quality. It has a net NO₂ impact that is assessed as Slight Beneficial as 5% of the net improvement in air quality is in this income category, compared with 25% of the population.
 - Quintile 4 has a slight net increase in NO₂ levels though the proportion of the properties impacted is lower than the proportion of the population in this category. It therefore has an assessment score of Slight Adverse.
 - Quintile 5 has no net change in NO₂ levels and is assessed as neutral.

Vulnerable groups: children

Population

- 7.7.5 Table 7.12 shows the distributional impact of NO₂ against children under 16 using population information for LSOAs set out in Table 7.4. As in the case of the noise impact analysis, the air quality analysis assumes that LSOAs with a proportion of children under 16 years equal to five percentage points above or below average were accepted to be in line with the regional or England and Wales averages. The DIA for children under 16 was carried out for 2030 forecast pollutants.
- 7.7.6 Table 7.12 shows that there is a net improvement in NO₂ levels for LSOAs that have above average percentages of children under 16, compared with the regional study area and with England and Wales. Overall, it is concluded that the distribution of changes in NO₂ for the proportion of children under 16 is uneven and Large Beneficial.

Schools

- 7.7.7 The predicted changes in NO₂ levels that are forecast for schools located within the assessment impact area were calculated, but no schools were found to have a change above 0.4µg/m³, the level above which any change is considered perceptible. The location of the school receptors is shown in Plate 7.9.
- 7.7.8 It should be noted that the assessment area for air quality includes only receptors within a 200m buffer of the ARN. There are 158 schools within the assessment area for air quality.

Overall impact

- 7.7.9 The distributional impact of the Project on air quality for children is assessed to be Large Beneficial based upon 2030 analysis because households with an above average proportion of children under 16 have a net improvement in NO₂.

Table 7.11 Distributional impacts of NO₂ by income, 2030

	IMD Income Domain					Total
	Most deprived areas <-----> Least deprived areas					
	0%–20%	21%–40%	41%–60%	61%–80%	81%–100%	
Number of properties with improved air quality [A]	69	162	83	41	18	373
Number of properties with no change in air quality [B]	10,357	21,191	22,869	21,274	16,931	92,622
Number of properties with worse air quality [C]	2	0	70	44	18	134
Number of net winners/losers [D] = [A] – [C]	67	162	13	-3	0	
Total number of winners/losers across all groups [E] = $\sum[D]$						239
Net winners/losers in each area as percentage of total [F] = [D] / [E]	28.0%	67.8%	5.4%	-1.3%	0.0%	100.0%
Share of total population of study area	11.2%	22.9%	24.7%	22.9%	18.2%	100.0%
Assessment	Large Beneficial ✓✓✓	Large Beneficial ✓✓✓	Slight Beneficial ✓	Slight adverse x	Neutral	–

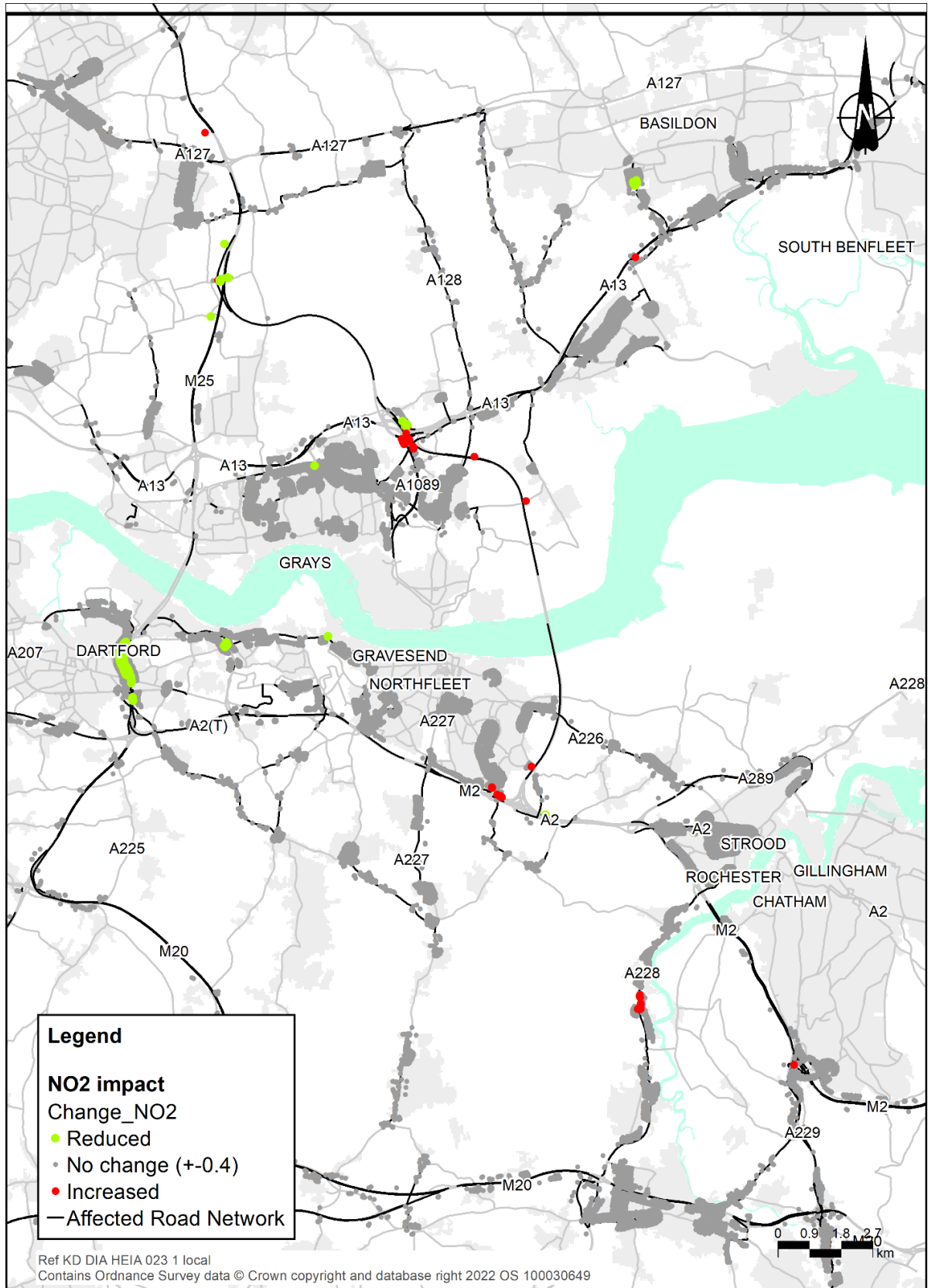
Note: As defined in TAG A4.2 (2022), winners are properties that are forecast to have an improvement in air quality and losers are properties that are forecast to have a deterioration in air quality

Table 7.12 Distributional impacts of NO₂ by population under 16, 2030

Aged under 16: Regional Study Area	Below average	Average	Above average	Total
Number of properties with improved air quality [A]	0	302	71	373
Number of properties with no change in air quality [B]	5,568	72,765	14,289	92,622
Number of properties with worse air quality [C]	0	132	2	134
Number of net winners/losers [D] = [A] – [C]	0	170	69	
Total number of winners/losers across all groups [E] = Σ[D]				239
Net winners/losers in each area as percentage of total [F] = [D] / [E]	0.0%	71.1%	28.9%	100%
Share of total population of study area (i.e. number of properties)	6.0%	78.6%	15.4%	100%
Assessment	Neutral	Slight beneficial ✓	Large beneficial ✓✓✓	– –
Aged under 16: England and Wales	Below average	Average	Above average	Total
Number of properties with improved air quality [A]	0	298	75	373
Number of properties with no change in air quality [B]	1,865	70,140	20,617	92,622
Number of properties with worse air quality [C]	0	132	2	134
Number of net winners/losers [D] = [A] – [C]	0	166	73	
Total number of winners/losers across all groups [E] = Σ[D]				239
Net winners/losers in each area as percentage of total [F] = [D] / [E]	0.0%	69.5%	30.5%	100%
Share of total population of study area (i.e. number of properties)	2.0%	75.8%	22.2%	100%
Assessment	Neutral	Slight beneficial ✓	Large beneficial ✓✓✓	– –

Note: As defined in TAG A4.2 (2022), winners are properties that are forecast to have an improvement in air quality and losers are properties that are forecast to have a deterioration in air quality.

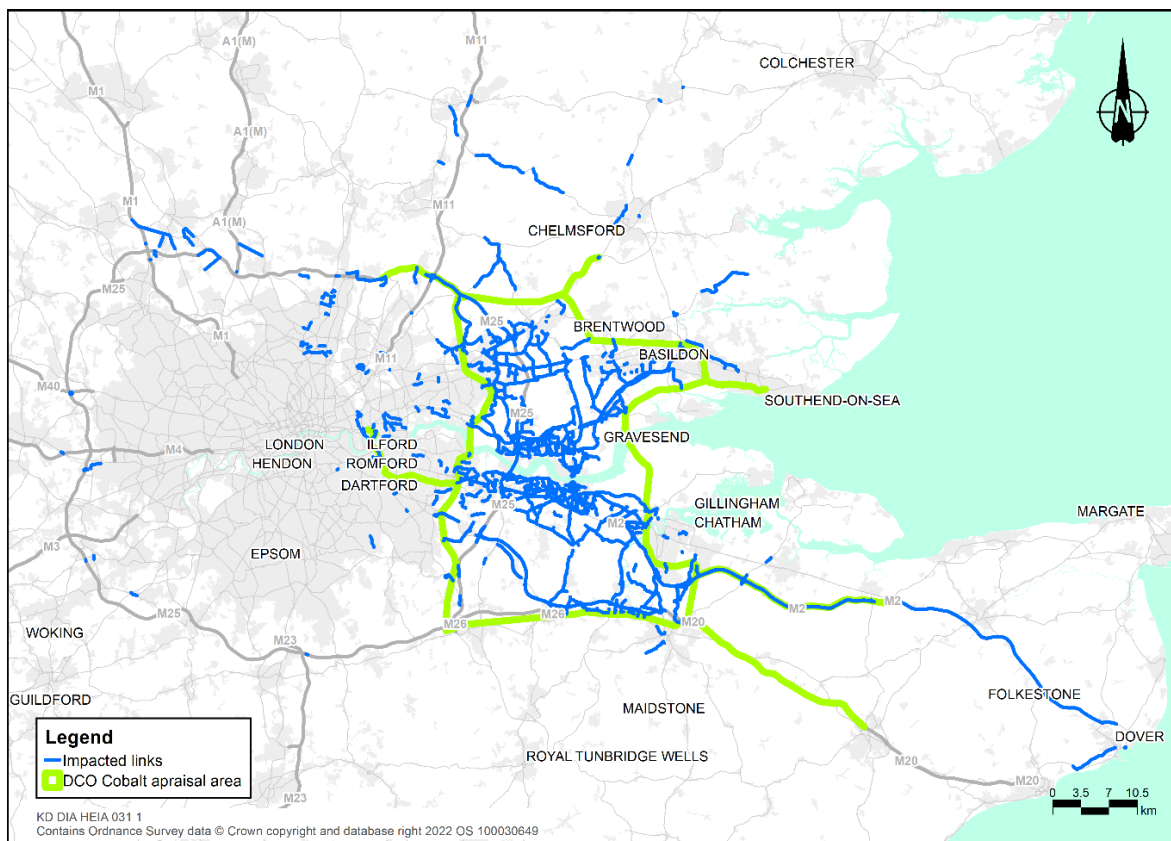
Plate 7.10 Change in NO₂ levels with Lower Thames Crossing, 2030



7.8 Accidents methodology

- 7.8.1 The appraisal involves taking forecast changes in accident rates and analysing whether there is any distributional impact across vulnerable user and mode group categories.
- 7.8.2 An accident appraisal was carried out for the Project using DfT’s COBALT software programme. As a new transport corridor, the Project is forecast to result in large changes in traffic flows and speeds and Heavy Goods Vehicle (HGV) use. The criteria are shown in the Screening Proforma in Table A.1 in Annex A.
- 7.8.3 Plate 7.11 below shows the impact appraisal area used for the accidents appraisal.

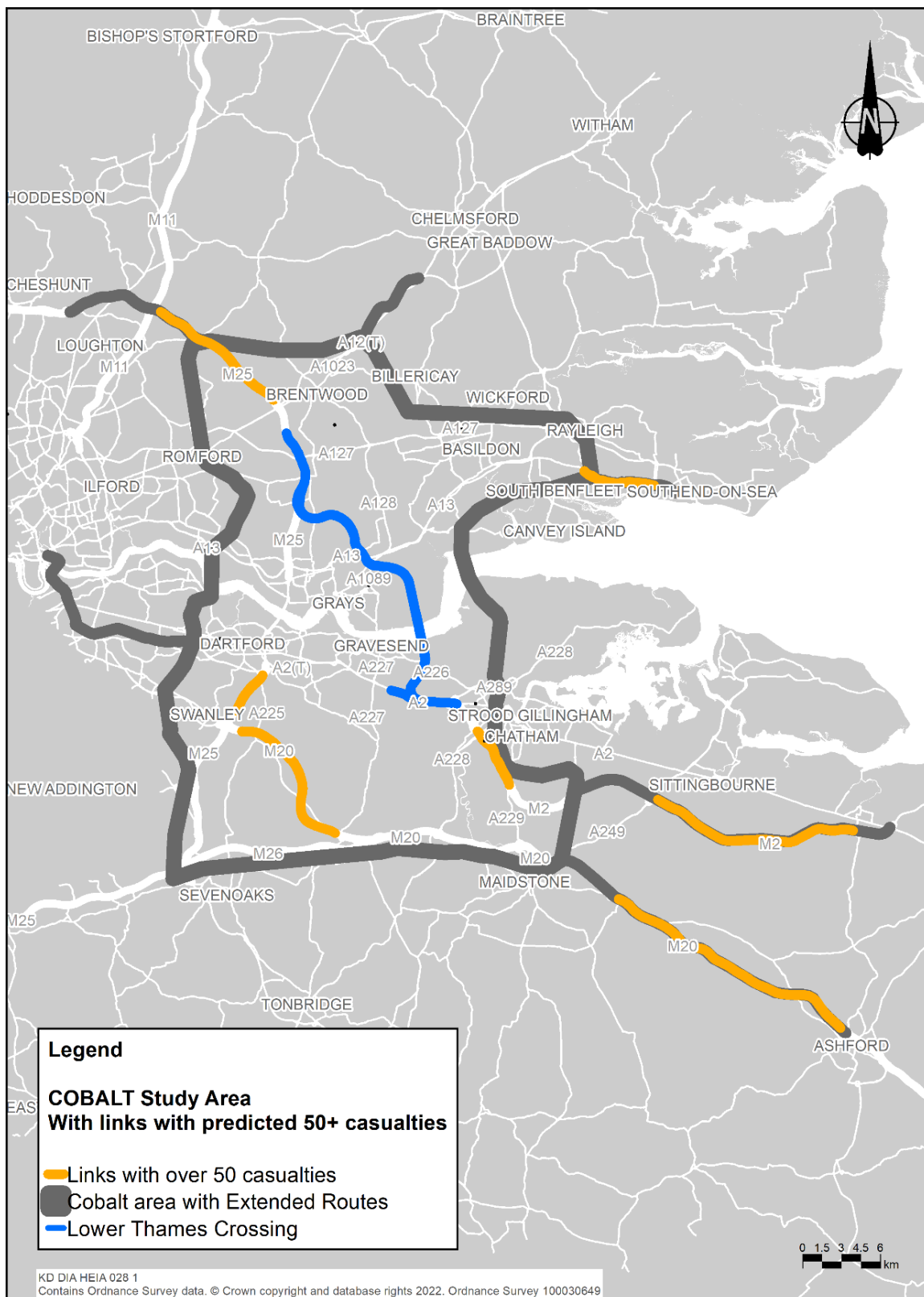
Plate 7.11 Impact area for accidents appraisal



- 7.8.4 The appraisal area was determined by identifying the links with flow changes of 5% or more, and a flow change of above 200 vehicles AADT, when comparing the With Scheme and Without Scheme scenarios. The forecast changes in modelled flows were obtained from the LTAM.

- 7.8.5 Additionally, links on the strategic road network (SRN) which extend outside the defined area were included to fully capture the benefits/disbenefits on key strategic routes in the area, including:
- a. M2 south to junction 7
 - b. M20 south to junction 9
 - c. M25 north to junction 26
 - d. A2 west to A102 Blackwall Tunnel
 - e. A12 north to junction 15
 - f. A13 east to Southend-on-Sea
- 7.8.6 In line with TAG, COBALT was used to forecast the total number of personal injury accidents (PIAs) and casualties by severity of injury (fatal, serious and slight) within the impact appraisal area. The analysis was carried out for 2030, which is the assumed year of opening as modelled by the LTAM. The forecast change in accident rates was then analysed against vulnerable user groups to assess whether there were any distributional impacts.
- 7.8.7 Accident rates are expressed as personal injury accidents (PIA) per million vehicle kilometres. TAG provides default accident rates for various types of roads for project appraisal. However, it is preferable to use study area-specific accident rates when such local data for a project's area is available. This is because local accident rates provide a more robust estimate of accident benefits compared to the default rates which are based on national averages.
- 7.8.8 Local accident rates for the COBALT analysis were calculated based on STATS19 personal injury accident data and AADT data from National Highways' TRIS system of continuous traffic count sites, which are mainly located on the SRN. The methodology for carrying out the COBALT accident analysis is provided in the EAR report, alongside a figure demonstrating on which links local accident rates were used.
- 7.8.9 TAG Unit A4.2 advises that where there are modelled links with over 50 casualties in a five-year period as a result of the Project (the difference between the With Project and Without Project options) then a quantitative assessment of the distributional impacts of accidents should be carried out. COBALT was used to identify locations with over 50 casualties over a five-year period, and then to identify predicted changes in accident rates for those links comparing the With Project option with the Without Project option.
- 7.8.10 STATS19 data was used to identify casualties by vulnerable group for the affected links, that is those with over 50 casualties and a predicted change in accident rates greater than 5%. The profile of local transport vulnerable users was then compared across the region and Great Britain to assess whether there was likely to be any distributional impact for these categories for the affected links.
- 7.8.11 Plate 7.12 below shows the affected links used in the accident DIA appraisal.

Plate 7.12 Accident analysis impact area and links with more than 50 casualties



- 7.8.12 The following vulnerable user and mode group categories were considered:
- a. Pedestrians
 - b. Cyclists
 - c. Motorcyclists
 - d. Children under 16
 - e. 16–25 males
 - f. People over 70

7.9 Accidents appraisal

- 7.9.1 Table 7.13 compares the proportion of accident casualties for each vulnerable group within the COBALT appraisal area, the regional study area and Great Britain. It shows that the proportion of pedestrian and cycle casualties is slightly lower within the accident appraisal area than both the regional study area and Great Britain. This is likely to reflect the dominance of strategic roads within the COBALT appraisal area.
- 7.9.2 Overall, the COBALT analysis predicted an increase in the number of accidents and casualties with the Project but a decrease in the number of accidents and casualties per million vehicle kilometres driven.
- 7.9.3 A total of 14 links are predicted to have over 50 casualties over a five-year period with the Project. These links are shown in Table 7.14. Where the predicted change in accidents with the Project is forecast to be less than 5%, the impact of the Project is considered to be neutral. Where the predicted change in accidents is between 5% and 15%, the impact is considered to be Slight. Where the predicted change is greater than 15% but less than 30%, the impact is considered to be Moderate.

Table 7.13 Comparison of accident casualty statistics by vulnerable group (2015–2019)

	Category	Great Britain		Regional study area		COBALT appraisal area	
		Total	Percent	Total	Percent	Total	Percent
Mode	Pedestrians	115,617	13.6	43,574	14.9	1,615	8.3
	Cyclists	90,076	10.6	35,368	12.1	895	4.6
	Motorcyclists	88,920	10.4	40,737	13.9	1,869	9.6
	Other	557,709	65.4	173,254	59.1	15,013	77.4
	Total casualties	852,322	100.0	292,933	100.0	19,392	100.0
Age	Under 16	75,638	8.9	21,870	7.5	1,695	8.7
	16 to 25, male	119,533	14.0	40,608	13.9	2,545	13.1
	Over 70	37,879	4.4	10,947	3.7	676	3.5
	Other	619,272	72.7	219,508	74.9	14,476	74.6
	Total casualties	852,322	100.0	292,933	100.0	19,392	100.0

Source: STATS19 All accident casualties, 2015–2019, DfT

Table 7.14 Changes in accidents by link (With Project compared to Without Project)

Link	Without Project	With Project	% change in casualties	Impact
A13 London Road between A129 and A1158 (westbound)	9.7	9.6	-1	Neutral
A13 London Road between A129 and A1158 (eastbound)	12.4	12.3	-1	Neutral
M2 between junction 2 and junction 3 (southbound)	6.1	7.2	17	Moderate Adverse
M2 between junction 3 and junction 2 (northbound)	5.6	7.1	25	Moderate Adverse
M2 between junction 6 and junction 5 (westbound)	11.3	11.9	5	Neutral
M2 between junction 5 and junction 6 (eastbound)	11.7	12.0	2	Neutral
M20 between junction 2 and junction 1 (northbound)	13.2	10.3	-22	Moderate Beneficial
M20 between junction 1 and junction 2 (southbound)	9.8	8.8	-10	Slight Beneficial
M20 between junction 8 and junction 9 (southbound)	11.9	12.0	1	Neutral
M20 between junction 9 and junction 8 (northbound)	11.2	11.4	1	Neutral
M25 between junction 2 and junction 3 (southbound)	7.7	7.7	-1	Neutral
M25 between junction 27 and junction 28 (southbound)	10.0	10.4	3	Neutral
M25 between junction 28 and junction 27 (northbound)	9.6	10.5	10	Slight Adverse
M25 between junction 3 and junction 2 (northbound)	8.3	7.9	-5	Neutral

Source: COBALT analysis for modelled 2030 opening year

- 7.9.4 Table 7.14 shows the forecast percentage change in accidents without the Project, compared to the Project Scheme option for each of the links where the change in accidents is considered to be adverse or beneficial.
- 7.9.5 The distribution of accidents was not considered across the social population groups by residence because motorway users would not necessarily be from the local areas and therefore the analysis would not be representative.
- 7.9.6 Five links are forecast to experience a change of over 50 casualties over a five-year period and a greater than 5% change in the number of accidents compared to that forecast in the Without Project scenario in the 2030 opening year. These are:
- a. M2 between junction 2 and junction 3 (southbound) which is forecast to have an increase in casualties of 17%
 - b. M2 between junction 3 and junction 2 (northbound) which is forecast to have an increase in casualties of 25%
 - c. M20 between junction 2 and junction 1 (northbound) which is forecast to have a decrease in casualties of 22%
 - d. M20 between junction 1 and junction 2 (southbound) which is forecast to have a decrease in casualties of 10%
 - e. M25 between junction 28 and junction 27 (northbound) which is forecast to have an increase in casualties of 10%
- 7.9.7 Table 7.15 compares the percentage of casualties in each of the vulnerable groups for these five links, between 2015 and 2019. The impacted links are all motorway links and therefore the distributional analysis of pedestrians and cyclists was not considered.
- 7.9.8 The percentage of casualties for all motorway links forecast to experience a change in over 50 casualties is within 12% of that for motorways for both the regional study area and Great Britain for all vulnerable groups. All links are therefore assessed as a medium impact with no distributional impact for vulnerable user groups, using the criteria set out in TAG guidance (30% lower to 30% higher for the class of road).
- 7.9.9 Overall, the Project was assessed as having a Neutral impact on the distributional impact of accidents for vulnerable groups.

Table 7.15 Percentage distribution of accidents and casualties by road type, severity of accident and casualty vulnerable group, 2015–2019, selected roads

Casualties by vulnerable group for motorways		Motorcyclists	Under 16	Male 16–25	Over 70
% casualty rate, motorways, by vulnerable group	Region	3.5%	7.1%	20.6%	1.8%
	GB	2.9%	6.5%	20.4%	2.1%
M2 between junction 2 and junction 3 (southbound)	Casualties for selected link	3	5	10	1
	% casualties by vulnerable group	6%	10%	20%	2%
	Difference casualty rates: region	3%	3%	0%	0%
	Difference casualty rates: GB	3%	4%	0%	0%
M2 between junction 3 and junction 2 (northbound)	Casualties for selected link	2	4	13	2
	% casualties by vulnerable group	5%	10%	33%	5%
	Difference casualty rates: region	1%	3%	12%	3%
	Difference casualty rates: GB	2%	3%	12%	3%
M20 between junction 2 and junction 1 (northbound)	Casualties for selected link	3	4	18	2
	% casualties by vulnerable group	4%	5%	22%	2%
	Difference casualty rates: region	0%	-2%	2%	1%
	Difference casualty rates: GB	1%	-2%	2%	0%
M20 between junction 1 and junction 2 (southbound)	Casualties for selected link	0	5	6	0
	% casualties by vulnerable group	0%	17%	20%	0%
	Difference casualty rates: region	-4%	10%	-1%	-2%
	Difference casualty rates: GB	-3%	10%	0%	-2%
M25 between junction 28 and junction 27 (northbound)	Casualties for selected link	0	4	12	1
	% casualties by vulnerable group	0%	6%	19%	2%
	Difference casualty rates: region	-4%	-1%	-1%	0%
	Difference casualty rates: GB	-3%	0%	-1%	0%

Source: STATS19 All accident casualties, 2015–2019, DfT

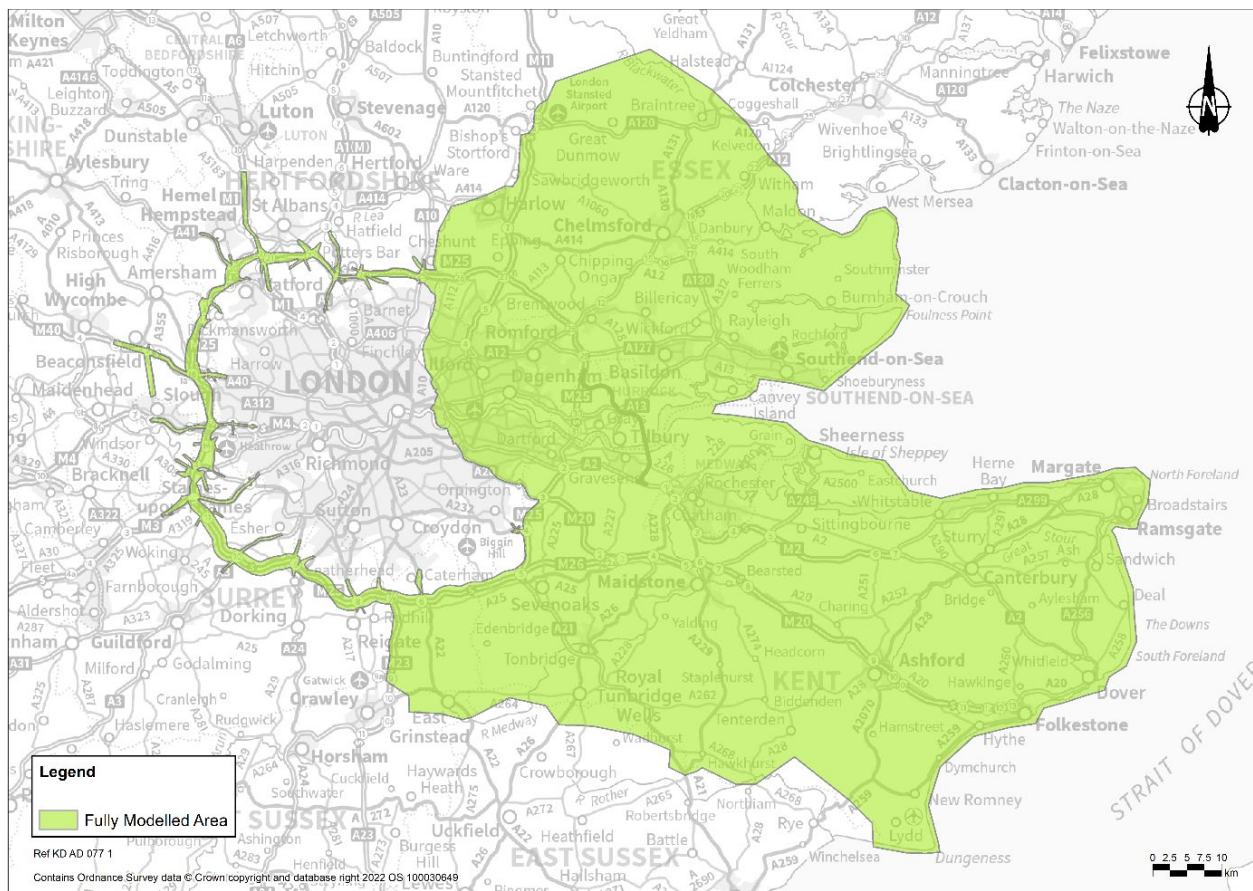
7.10 Severance methodology

- 7.10.1 The distributional appraisal of severance impacts for the Project is based on a comparison of those impacts against the proportion of:
- Children under 16
 - People aged 70 and over
 - People with a disability
 - People without access to a car
- 7.10.2 Community severance, as defined by TAG, is the separation of residents from community facilities and the services they use within their community caused by substantial changes in transport infrastructure or by changes in traffic flows. Severance concerns people using non-motorised modes, primarily pedestrians. Cyclists and equestrians can be less susceptible to severance because they are generally able to travel more quickly than people on foot, although they may have more limited alternative routes available to them.
- 7.10.3 The Project has the potential to affect severance in the following ways:
- Direct severance caused by the new highway infrastructure
 - Traffic related severance – an increase in severance on existing roads due to changes in traffic flows arising from the Project
- 7.10.4 The methodology for assessing community severance involved identifying locations of severance, the number of people likely to be affected and the location of amenities. A DIA was then carried out by analysing the approximate proportion of people in each of the vulnerable groups listed above. TAG Unit A4.1 Social Impact Appraisal defines severance as below (Department for Transport, 2022):
- None – little or no hindrance to pedestrian movement.
 - Slight – all people wishing to make pedestrian movements would be able to do so, but there would probably be some hindrance to movement.
 - Moderate – pedestrian journeys would be longer or less attractive; some people are likely to be dissuaded from making some journeys on foot.
 - Severe – people are likely to be deterred from making pedestrian journeys to an extent sufficient to induce a reorganisation of their activities.

Confirmation of areas impacted

- 7.10.5 The area considered in the severance appraisal covered the whole of the FMA in the Lower Thames Area Model. This area is shown in Plate 7.13 below.

Plate 7.13 LTAM Fully Modelled Area



- 7.10.6 Direct severance impacts have been considered for the Core traffic growth scenario, based on the guidance set out in DMRB LA 112: Population and human health (Highways England, 2020b). This examines changes to non-motorised user journey lengths greater than 50m.
- 7.10.7 The extent of traffic related severance was investigated by identifying the forecast combined two-way traffic flows both with and without the Project for the AM, inter-peak and PM periods identifying those links that meet both of the following traffic flow criteria:
- In any one of these peak periods, there is a greater than 10% change (increase or decrease) in two-way traffic flows on the link between the Without Project and With Project scenarios.
 - For the same peak periods, the change in two-way traffic flow on the link between the Without Project and With Project scenarios is more than a 180 PCU reduction or increase. Such a change in flow equates to an average PCU reduction or increase of 20 seconds. The purpose of this second criteria is to filter out links where the change in flow is small, but the percentage change is large and exceeds 10%.

- 7.10.8 The analysis was carried out for the 2030 opening year and only considered roads included in the LTAM. Only single carriageway roads, likely to be crossed at grade, were assumed to be within the scope of the analysis as non-motorised users would not normally cross other road types. Roads considered not to be affected by traffic related severance, either because non-motorised users would be unlikely to want to cross the road, or crossing facilities would be present, were excluded from the analysis.
- 7.10.9 An assessment of the change in the level of severance was then carried out which considered the flow changes, together with an estimation of the number of people affected and the location of amenities.
- 7.10.10 It should be noted that the traffic related assessment methodology used does not consider the desire for the residents of the impacted areas to reach the impacted amenities, nor the location of alternative amenities that may be accessible. However, it does highlight potential severance locations for consideration of any distributional bias within particular vulnerable groups.

Identification of vulnerable groups

- 7.10.11 The number of people affected by each severance location was estimated by calculating the population within an 800m buffer area proximity. TAG Unit A4.2 guidance advice is to use an 800m walk journey along established routes and not crow-fly distances (Department for Transport, 2020). The percentage of the following vulnerable social groups was then calculated for the relevant LSOA for each severance location and compared against the regional study area and England and Wales total populations:
- a. Non-car owning households
 - b. Population under 16
 - c. Population aged 70 and over
 - d. Population with a limiting long-term illness
- 7.10.12 An assessment score was then assigned to each severance location using the criteria set out in Table 3.3 to understand whether there was a potential distributional effect for each vulnerable group.

Identification of amenities

- 7.10.13 Severance would have an impact if the local population is hindered in its access to amenities. In this assessment any of the following amenities located within an 800m buffer boundary of the severance location were considered:
- a. Bus stops
 - b. Care homes
 - c. GPs
 - d. Hospitals
 - e. Primary schools

- f. Secondary schools
- g. Other schools
- h. Community centres
- i. Supermarkets

7.10.14 The location of bus stops within a 400m buffer of the severance locations was also analysed.

7.10.15 Having identified the severance locations, conclusions were drawn on the impact on severance by considering any distributional bias by vulnerable group within the local population and the location of facilities.

7.11 Direct severance appraisal

7.11.1 The Project would cross several public rights of way (PRoW) and other designated paths. A design aim for the Project is that, as far as reasonably practicable, all routes severed during the construction phase would be re-instated by means of bridges or underpasses, as appropriate, once it is opened. The assessment therefore assumes that all PRoW paths would be re-provided without additional hindrance or additional length for non-motorised user journeys and that there would be no direct severance for any vulnerable groups due to the operation of the Project. Hornsby Lane in Thurrock would be permanently stopped up but there would be no additional journey distance for non-motorised modes.

7.12 Traffic related severance appraisal

7.12.1 The population estimated to be impacted by a change in traffic related severance is estimated to be less than 1% of the population in the regional study area.

7.12.2 Table 7.16 and Plate 7.14 show the road links that are likely to be affected by traffic related severance based on changes in flow derived from the 2030 LTAM forecasts. There are six locations where traffic related severance is forecast to increase and 12 locations where traffic related severance is forecast to decrease with the Project. Table 7.17 and Table 7.18 contain the distributional analysis for the social characteristics of the population within the 800m catchment area of each link with the regional study area and England and Wales, respectively. The actual percentages for each of the social groups are contained in Table 7.16 below.

Table 7.16 Comparison of social characteristics for links potentially impacted by traffic related severance

Road name	Highway Authority	Non car owning households	Population aged 16 under	Population 70+	Population with limiting long-term illness
England and Wales		26.7%	19.1%	13.7%	17.9%
Regional study area		30.9%	20.1%	11.6%	15.1%
Increase in severance					
Valley Drive, Gravesend	Gravesham	16.5%	20.7%	13.9%	16.0%
Forstal Road, Aylesbury	Tonbridge and Malling	12.4%	19.2%	11.9%	15.3%
Wrotham Road	Gravesham	8.1%	17.1%	20.7%	15.1%
Elaine Avenue, Strood	Medway	19.2%	22.7%	11.4%	15.9%
Springhouse Lane, Stanford-Le-Hope	Thurrock	19.4%	19.4%	18.6%	19.8%
Brennan Road, Tilbury	Thurrock	26.9%	27.3%	7.2%	16.4%
Decrease in severance					
New Barn Road, Longfield	Dartford	4.5%	14.6%	21.4%	15.5%
The Street, Cobham	Gravesham	9.0%	16.7%	24.3%	15.6%
Stanford Road, Grays	Gravesham	16.4%	20.1%	16.1%	19.4%
Warren Lane, Chafford Hundred	Thurrock	9.0%	25.1%	3.9%	6.7%
Station Road, West Horndon	Brentwood	12.9%	16.1%	16.8%	19.0%
Singlewell Road, Gravesend	Gravesham	21.3%	20.8%	12.0%	16.7%
Cross Lane West, Gravesend	Gravesham	22.3%	20.1%	12.1%	17.0%
Dover Road East, include to train track	Gravesham	25.3%	23.6%	9.3%	15.6%
Dover Road	Gravesham	25.4%	26.2%	7.7%	15.3%
Northcote Road, Rochester	Medway	24.9%	22.7%	9.0%	16.3%
Lodge Lane, Chafford Hundred	Thurrock	18.4%	22.3%	11.9%	16.5%
Blackshots Lane, Little Thurrock	Thurrock	17.7%	20.4%	15.4%	17.4%

- 7.12.3 The percentage of non-car owning households in the proximity of each affected link is lower than for both the regional study area and England and Wales for all locations experiencing an increase in severance, apart from Brennan Road in Tilbury. For links experiencing a decrease in severance, the percentage of non-car owning households in the proximity of each affected link is lower than in the regional study area for all links and for the majority of links for England and Wales.
- 7.12.4 The proportion of the population of children under 16 years affected by traffic related severance is in line with both the regional study area and England and Wales for the majority of the road links. The increase in severance on Wrotham Road, Gravesham has a larger than expected impact on the proportion of the population under 16 years, for the regional study area and England and Wales. The decrease in severance on Station Road, West Horndon and Lodge Lane, Chafford Hundred affects a larger than expected proportion of the population of children under 16 years, for the regional study area and England and Wales.
- 7.12.5 The proportion of the population aged 70 years and older affected by traffic related severance is in line with both the regional study area and England and Wales for the majority of the road links. The proportion of population aged 70 years and older affected by an increase in severance is larger than the regional study area for Forstal Road, Aylesford, Elaine Avenue, Strood and Brennan Road, Tilbury. The proportion of older people forecast to experience a decrease in severance for Stanford Road, Grays and Singlewell Road, Gravesend, is greater than the regional study area average, although the proportion of older people forecast to experience a decrease in severance on Station Road, West Horndon is less than the regional study area average.
- 7.12.6 The proportion of people with a life limiting illness affected is in line with the regional study area and England and Wales for all links with an increase in traffic related severance. Similarly, the proportion of people with a life limiting illness affected by a decrease in severance is in line with the regional study area and England and Wales apart from Station Road, West Horndon, where it is smaller than the regional study area average.

Table 7.17 Distributional analysis for links potentially impacted by traffic related severance: regional study area

Road name	Road type	Highway Authority	All social groups score	Non car owning households	Population aged 16 under	Population 70+	Population with limiting long-term illness
				Regional percentage			
				30.9%	20.1%	11.6%	15.1%
Increase in severance							
Valley Drive, Gravesend	Minor Road	Gravesham	xx	x	xx	xx	xx
Forstal Road, Aylesbury	Minor Road	Tonbridge and Malling	xx	x	x	xxx	xx
Wrotham Road	A-Road (A227)	Gravesham	xx	x	xxx	xx	xx
Elaine Avenue, Strood	Local Street	Medway	xx	x	xx	xxx	xx
Springhouse Lane, Stanford-Le-Hope	Minor Road	Thurrock	xx	x	xx	xx	xx
Brennan Road, Tilbury	Minor Road	Thurrock	xx	xx	xx	xxx	xx
Decrease in severance							
New Barn Road, Longfield	Minor Road	Dartford	✓✓	✓	✓✓	✓✓	✓✓
The Street, Cobham	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓	✓✓
Stanford Road, Grays	A-Road (A1013)	Gravesham	✓✓	✓	✓✓	✓✓✓	✓✓
Warren Lane, Chafford Hundred	Minor Road	Thurrock	✓✓	✓	✓✓	✓✓	✓✓
Station Road, West Horndon	Minor Road	Brentwood	✓✓	✓	✓✓✓	✓	✓
Singlewell Road, Gravesend	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓✓	✓✓
Cross Lane West, Gravesend	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓	✓✓
Dover Road East, include to train track	B-Road (B261)	Gravesham	✓✓	✓	✓✓	✓✓	✓✓

Road name	Road type	Highway Authority	All social groups score	Non car owning households	Population aged 16 under	Population 70+	Population with limiting long-term illness
				Regional percentage			
				30.9%	20.1%	11.6%	15.1%
Dover Road	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓	✓✓
Northcote Road, Rochester	Minor Road	Medway	✓✓	✓	✓✓	✓✓	✓✓
Lodge Lane, Chafford Hundred	Minor Road	Thurrock	✓✓	✓	✓✓✓	✓✓	✓✓
Blackshots Lane, Little Thurrock	Minor Road	Thurrock	✓✓	✓	✓✓	✓✓	✓✓

Key:

*	slight adverse	✓	slight beneficial
**	moderate adverse	✓✓	moderate beneficial
***	large adverse	✓✓✓	large beneficial

Table 7.18 Distributional analysis for links potentially impacted by traffic related severance: England and Wales

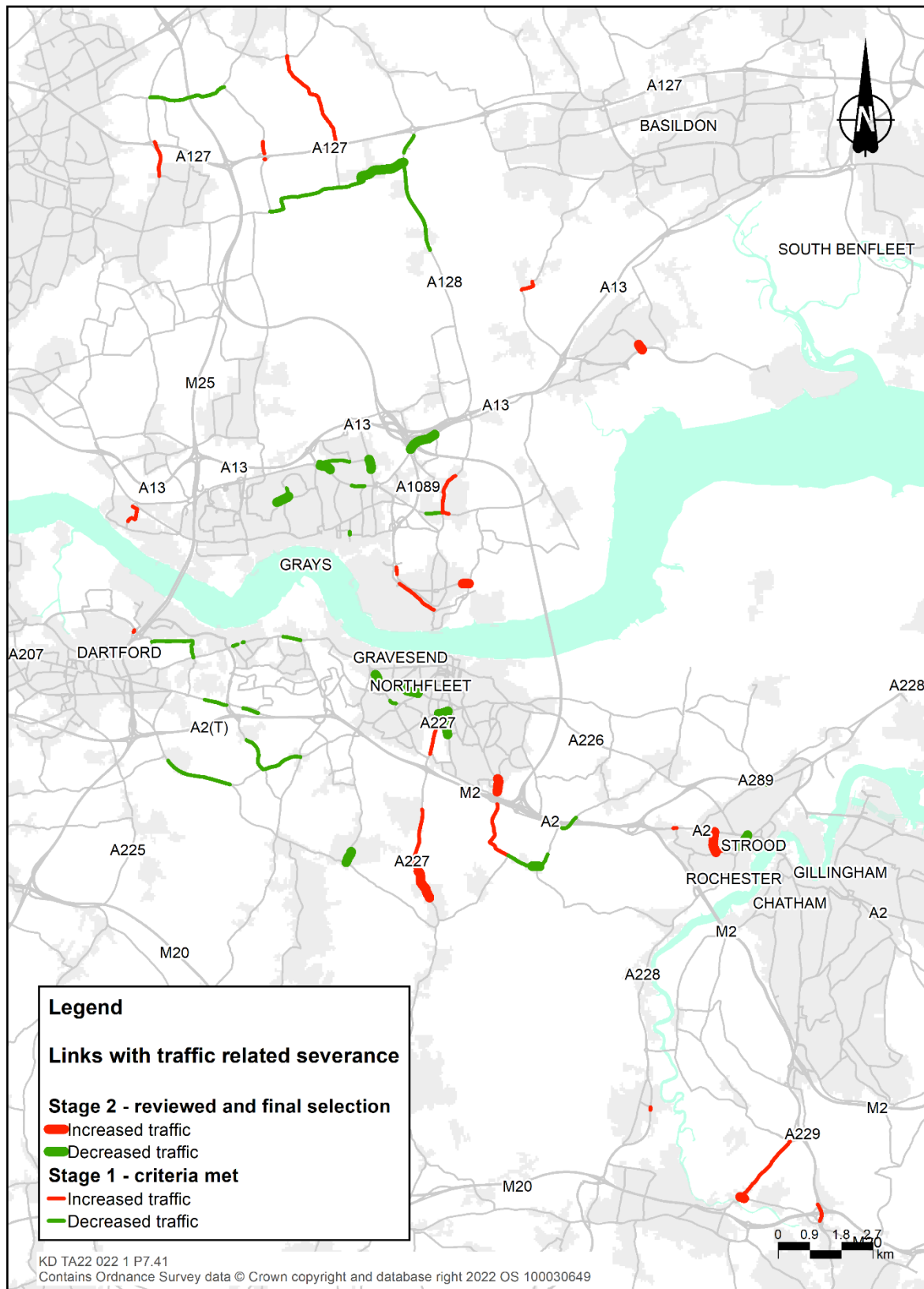
Road name	Road type	Highway Authority	All social groups score	Non car owning households	Population aged 16 under	Population 70+	Population with limiting long-term illness
				England and Wales percentage			
				26.7%	19.1%	13.7%	17.9%
Increase in severance							
Valley Drive, Gravesend	Minor Road	Gravesham	xx	x	xx	xx	xx
Forstal Road, Aylesbury	Minor Road	Tonbridge and Malling	xx	x	xx	xxx	xx
Wrotham Road	A-Road (A227)	Gravesham	xx	x	xxx	x	xx
Elaine Avenue, Strood	Local Street	Medway	xx	x	xx	xxx	xx
Springhouse Lane, Stanford-Le-Hope	Minor Road	Thurrock	xx	x	xx	xx	xx
Brennan Road, Tilbury	Minor Road	Thurrock	xx	xx	xx	xx	xx
Decrease in severance							
New Barn Road, Longfield	Minor Road	Dartford	✓✓	✓	✓✓	✓✓	✓✓
The Street, Cobham	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓	✓✓
Stanford Road, Grays	A-Road (A1013)	Gravesham	✓✓	✓	✓✓	✓✓✓	✓✓
Warren Lane, Chafford Hundred	Minor Road	Thurrock	✓✓	✓	✓✓	✓✓	✓✓
Station Road, West Horndon	Minor Road	Brentwood	✓✓	✓	✓✓✓	✓	✓
Singlewell Road, Gravesend	Minor Road	Gravesham	✓✓	✓	✓✓	✓✓	✓✓
Cross Lane West, Gravesend	Minor Road	Gravesham	✓✓	✓✓	✓✓	✓✓	✓✓
Dover Road East, include to train track	B-Road (B261)	Gravesham	✓✓	✓✓	✓✓	✓✓	✓✓
Dover Road	Minor Road	Gravesham	✓✓	✓✓	✓✓	✓✓	✓✓

Road name	Road type	Highway Authority	All social groups score	Non car owning households	Population aged 16 under	Population 70+	Population with limiting long-term illness
				England and Wales percentage			
				26.7%	19.1%	13.7%	17.9%
Northcote Road, Rochester	Minor Road	Medway	✓✓	✓✓	✓✓	✓✓	✓✓
Lodge Lane, Chafford Hundred	Minor Road	Thurrock	✓✓	✓	✓✓✓	✓	✓✓
Blackshots Lane, Little Thurrock	Minor Road	Thurrock	✓✓	✓	✓✓	✓✓	✓✓

Key:

x	slight adverse	✓	slight beneficial
xx	moderate adverse	✓✓	moderate beneficial
xxx	large adverse	✓✓✓	large beneficial

Plate 7.14 Location of links affected by traffic related severance



- 7.12.7 Table 7.19 and Plates D.1, D.2 and D.3 show the location of amenities within the impact area of those links forecast to experience a change in traffic related severance. It should be noted that the analysis is limited in that it records the location of the impacted amenities and not the extent to which the local population wish to cross the road, nor whether an alternative amenity is available. It is therefore considered a precautionary assessment. Nevertheless, a key point from the analysis is that there are more amenities affected by a decrease than an increase in severance. Amenities potentially impacted by a net decrease in traffic related severance include care homes, GP surgeries, hospitals, schools and supermarkets.
- 7.12.8 Plate D.3 shows that the number of bus stops that have a decrease in severance tend to be concentrated in Thurrock and Gravesham whereas the number of bus stops that have an increase in severance tend to be more localised, apart from in the south Gravesham area and Medway.

Table 7.19 Amenities potentially impacted by traffic related severance

Facility	Distance (from impacted link)	Increase in severance	Decrease in severance	Net impact	Source
Bus stops	400m	56	156	100	Naptan (May 2020)
Care homes	800m	8	35	27	Naptan (May 2020)
GPs	800m	10	32	22	NHS Direct (May 2020)
Hospitals	800m	9	26	17	NHS Direct (May 2020)
Primary schools	800m	10	34	24	Department for Education (May 2020)
Secondary schools	800m	1	5	4	Department for Education (May 2020)
Other schools	800m	4	17	13	Department for Education (May 2020)
Community centres	800m	1	0	1	OS AddressBase 2020
Supermarkets	800m	9	14	5	Geolytix Open Data (May 2020)

- 7.12.9 The overall conclusion is that the Project would have a neutral impact on traffic related severance as there are both increases and decreases in traffic related severance and the proportion of vulnerable groups impacted is similar for roads that have both a beneficial and adverse impact.

7.13 Personal affordability methodology

- 7.13.1 The distributional appraisal of personal affordability impacts for the Project needs to be assessed against the distribution of income.
- 7.13.2 The monetary costs of travel can be a major barrier to mobility for certain groups of people, with particularly acute effects on their ability to access key destinations.
- 7.13.3 Personal affordability impacts may arise as indirect consequences of an intervention. Personal affordability is closely linked to the other social impact topics of user benefits and accessibility. Changes in travel costs contribute to user benefits which are assessed quantitatively as a separate impact. Personal affordability is also an aspect that affects accessibility to transport, although TAG advises that this impact only relates to public transport projects.
- 7.13.4 Where there are few travel alternatives, transport costs can have a disproportionate effect on personal affordability, especially where income levels preclude car ownership and use. The latter is particularly relevant for households with low income which are non-car owning. The River Thames is a barrier to movement and a deterrence for cross-river trips. There is an existing personal affordability issue for residents in the Lower Thames area who must pay a user-charge to use the Dartford Crossing, although those residents who live in the local authority areas of Dartford and Thurrock are eligible for a residents' discount.
- 7.13.5 TAG states that a personal affordability assessment is required where there is a change in monetary transport charges. For the Project, the analysis considered road user charges. The personal affordability appraisal assumes that the principles of the charging regime for the Project are consistent with those currently applied at the Dartford Crossing. It has therefore been assumed that the residents of Gravesham would benefit from a similar discount for using the Project as residents of Dartford and Thurrock do currently in using the Dartford Crossing. The residents of Thurrock would also be eligible for a discount for using the Project. This would mean that journeys involving the Project by Gravesham residents to and from destinations north of the River Thames would be proportionately cheaper than in the Without Project scenario as cross-river road user charges would be reduced. The cost of journeys across the River Thames would reduce for up to 107,000 people (2020 mid-year population of Gravesham).
- 7.13.6 A DIA of personal affordability for Gravesham has been carried out by analysing the IMD Income Domain data, as set out in Table 3.2. The proportion of the population in each income quintile for LSOAs in Gravesham was compared against both the regional study area and England to determine whether there is a distributional effect. This assumes that all households within Gravesham would receive the same benefit from the user charge discount.

- 7.13.7 TAG recommends the consideration of potential TUBA cost changes for non-business users in the assessment of personal affordability. However, changes in vehicle operating costs are already considered in the analysis of user benefits for non-business users, which is appraised as a separate social impact category. In addition, the TUBA forecasts of increased operating costs for some road users and the resultant impact on personal affordability is oversimplistic as the LTAM on which the TUBA appraisal is based assumes road users would choose their routes to minimise overall generalised cost. They could therefore incur increased operating costs in order to benefit from reduced journey times. Although the Project may provide a new route option for some road users, they would retain the option to travel via their previous route to prioritise reduced travel costs, if desired.
- 7.13.8 Therefore, this DIA report does not report a TUBA based personal affordability analysis and this is excluded from the DIA output summary in Table 8.1 and the Project's AST.

7.14 Personal affordability appraisal

Impact of user charge discount in Gravesham

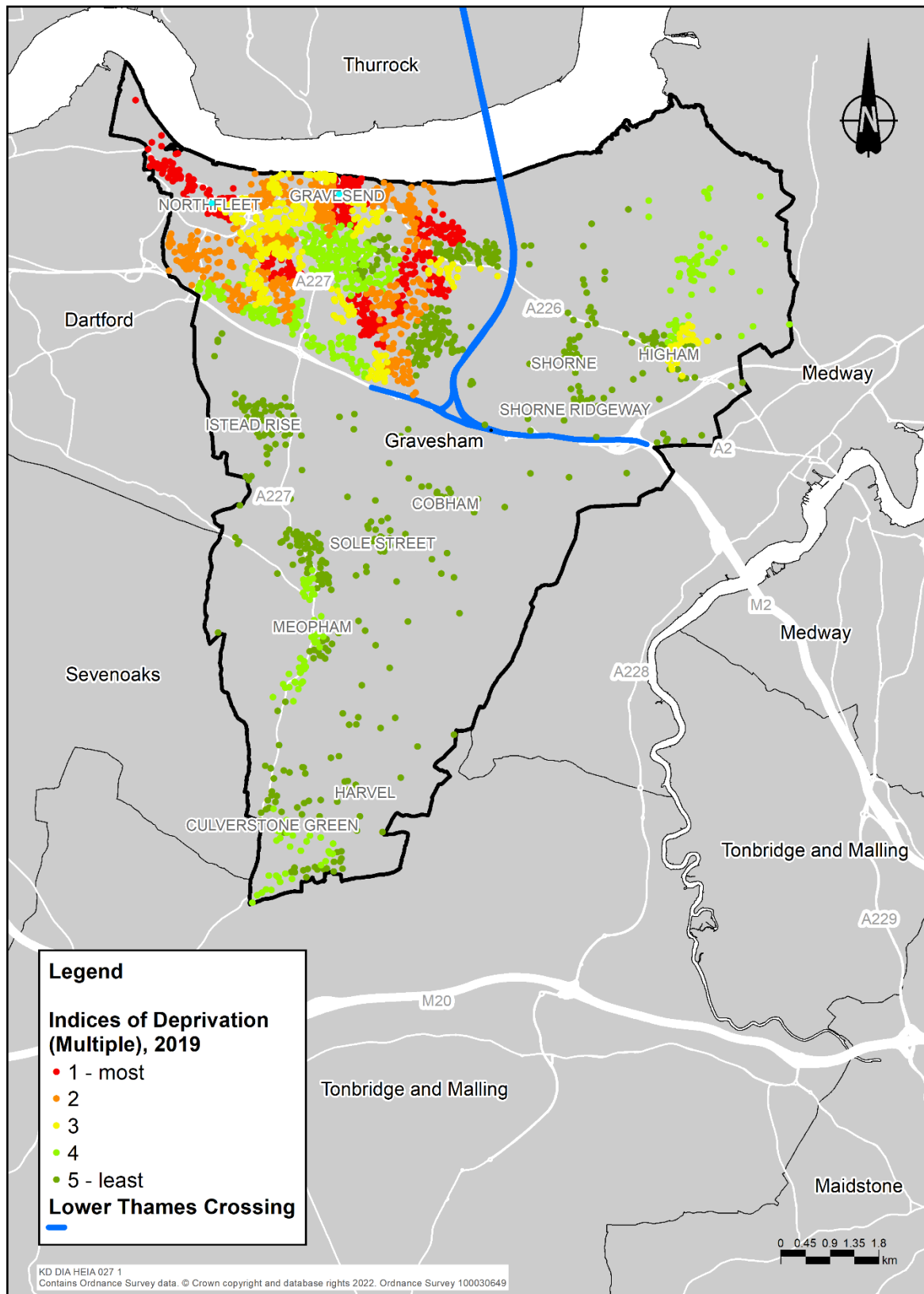
- 7.14.1 The analysis of LSOAs in Gravesham in Table 7.20 generally shows an even distribution of user charge discount benefits by income quintile compared to the regional study area, although the benefit for the lowest quintile income group is higher than expected. This is because there are more households in the lowest income quintile in Gravesham, compared to the regional study area. The comparison against England shows that there are more households in quintile 2 in Gravesham. Overall, there is a Large Beneficial impact as the percentage of households in Gravesham in the most deprived quintiles is higher than with both the regional study area and England.
- 7.14.2 The geographical distribution by income for Gravesham is shown in Plate 7.15. This shows that the lowest income households who would make the most relative gain in personal affordability are located in the centre of Gravesend, near to Northfleet station and west of Whitehill Road. The area along the A2 and the rural areas to the south of the A2 are dominated by higher income households.

Table 7.20 Personal affordability distributional analysis of Gravesham user charge discount

Indices of Deprivation		IMD Income Domain					Total
		Most deprived areas <-----> Least deprived areas					
		0%–20%	21%–40%	41%–60%	61%–80%	81%–100%	
Gravesham	Population	22,931	28,285	18,764	22,473	14,437	106,890
Regional study area	Population	2,230,867	4,456,004	4,112,552	3,684,782	3,946,007	18,430,212
England and Wales	Population	11,301,143	11,629,843	11,485,024	11,177,974	10,956,154	56,550,138
Gravesham	Percentage	21.5%	26.5%	17.6%	21.0%	13.5%	100%
Regional study area	Percentage	12.1%	24.2%	22.3%	20.0%	21.4%	100%
England and Wales	Percentage	20.0%	20.6%	20.3%	19.8%	19.4%	100%
Compared to regional study area	Difference	9.3%	2.3%	-4.8%	1.0%	-7.9%	
Compared to England	Difference	1.5%	5.9%	-2.8%	1.3%	-5.9%	
Assessment (regional)		Large Beneficial ✓✓✓	Moderate Beneficial ✓✓	Moderate Beneficial ✓✓	Moderate Beneficial ✓✓	Slight Beneficial ✓	
Assessment (national)		Moderate Beneficial ✓✓	Large Beneficial ✓✓✓	Moderate Beneficial ✓✓	Moderate Beneficial ✓✓	Slight Beneficial ✓	

Source: Indices of Deprivation from Department for Communities and Local Government, 2019, Mid population estimates 2020

Plate 7.15 Indices of Deprivation (Income Domain) Gravesham



8 Conclusions

8.1 Introduction

8.1.1 This chapter sets out the conclusions of the DIA. It should be noted that the conclusions relate to the extent to which the vulnerable social groups benefit or disbenefit in relation to each social indicator, rather than the general level of impact for the indicators.

8.2 Conclusions

- 8.2.1 Table 8.1 summarises the distributions for each topic across the income distribution and vulnerable populations. Table 8.2 summarises the outputs from the distribution impact appraisal by topic and the overall appraisal scores that are included in the AST for the Project. The general conclusions are:
- a. There is an even distribution of net user benefits across each income group, resulting in a Moderate Beneficial effect for each quintile.
 - b. There is an uneven distribution of noise impacts against household income, with a Large Adverse impact for the most deprived income quintile.
 - c. There is an uneven distribution of residential noise impacts with a Large Adverse effect for locations with above average numbers of children under 16 years and a Moderate Adverse effect for locations with above average numbers of people aged 70 and over, compared with the regional study area and England and Wales.
 - d. There is an uneven distribution of NO₂ air quality impacts against household income, with a Large Beneficial impact for the most deprived income quintile.
 - e. Households with an above average proportion of children under 16 have a net improvement in NO₂ levels compared with both the regional study area and England and Wales. It is concluded that the distribution of change in air quality for the proportion of children under 16 is Large Beneficial.
 - f. There are two locations which are predicted to have a decrease in casualties and three locations which are predicted to have an increase in casualties, due to changes in traffic flows with the Project. The locations are all motorway links. The distributional impact is even for all vulnerable groups, resulting in a Neutral score.
 - g. There is assumed to be no physical severance as a result of the Project because the aim is to reinstate all routes that would be potentially physically severed, which results in a Neutral score. There would be an increase in traffic related severance for less than 1% of the population of the regional study area.

- h. To avoid double-counting of operating costs and user benefits, it has been assumed that the only effect on personal affordability would be for Gravesham residents who would receive a user charge discount. The distribution of personal affordability impacts is uneven as the proportion of Gravesham residents in the lowest income quintiles is higher compared with the regional study area and England and Wales, resulting in a Large Beneficial score.

Table 8.1 Distributional impacts output summary

Social group and amenities indicators			User Benefits	Noise	Air quality NO ₂	Accidents	Security	Severance	Accessibility	Affordability (Population Gravesham)	Fully modelled area	Local study area	Regional study area	England and Wales
Resident population in the impact area	Income distribution quintiles	0–20%	13%	13%	11%	–	–	–	–	22%	12.5%	12.4%	12%	20%
		20–40%	21%	24%	23%	–	–	–	–	27%	21.2%	24.9%	24%	21%
		40–60%	23%	22%	25%	–	–	–	–	18%	22.8%	20.8%	22%	20%
		60–80%	23%	24%	23%	–	–	–	–	21%	23.0%	20.7%	20%	20%
		80–100%	21%	17%	18%	–	–	–	–	14%	20.5%	21.3%	21%	19%
	Children (<16)		–	22%	21%	–	–	22%	–	–	–	–	20%	19%
	Young people		–	–	–	–	–	–	–	–	–	–	–	–
	Aged 70 over		–	12%	–	–	–	11%	–	–	–	–	12%	14%
	People with a disability		–	–	–	–	–	16%	–	–	–	–	15%	18%
	Black Minority Ethnic		–	–	–	–	–	–	–	–	–	–	–	12%
	No car households		–	–	–	–	–	23%	–	–	–	–	31%	27%
Households with dependent children		–	–	–	–	–	–	–	–	–	–	–	–	
Indicator population in the impact area		–	101,464	93,129	19,308	–	112,580	–	–	3,777,764	823,548	18,430,212	56,550,138	
Amenities present within the impact area	Schools/nurseries		–	✓	✓	✓	–	✓	–	–	–	–	–	–
	Playgrounds		–	–	–	–	–	✓	–	–	–	–	–	–
	Parks and open spaces		–	–	–	–	–	✓	–	–	–	–	–	–
	Hospitals		–	–	–	–	–	✓	–	–	–	–	–	–
	Care homes/day centres		–	✓	–	✓	–	✓	–	–	–	–	–	–
	Community centres		–	–	–	–	–	✓	–	–	–	–	–	–

Table 8.2 Distributional impact appraisal findings and scores

Indicator	Assessment	Scores
User benefits	Overall, there is a net beneficial impact from the Project on user benefits. There are net user benefits across all income quintiles. The distribution of user benefits is within 5% of the population for each income quintile and assessed as even.	Moderate Beneficial for each income quintile
Noise	<p>Overall, there is a net adverse impact of the Project on residential noise levels. The distribution of noise against income quintiles is assessed as uneven. Adverse noise impacts are higher than expected in the most deprived (20%) income quintile groups.</p> <p>There is a net increase in properties with an increase in noise greater than 1dB in areas with higher than average proportions of children under 16 and people aged 70 and over.</p> <p>There are more net increases in noise greater than 1dB in areas with higher than average proportions of children under 16, compared with both the regional study area and with England and Wales.</p> <p>There are more net increases in noise greater than 1dB in areas with higher than average proportions of people aged 70 and over, compared with both the regional study area and England and Wales, although the net increases are lower compared with the England and Wales proportions.</p> <p>However, there is a neutral impact of changes in noise levels on schools and care homes as the majority of schools and care homes would receive no change in noise level.</p>	Income: Large Adverse Children aged under 16: Large Adverse People aged 70 and over: Moderate Adverse
Air quality	<p>Overall, there is a net beneficial impact of the Project on air quality. The distribution of air quality against income quintiles is assessed as uneven as the two most deprived income quintiles benefit more than the other income quintiles.</p> <p>There is a net decrease in NO₂ in areas with higher than average proportions of children under 16, compared with both the regional study area and with England and Wales.</p> <p>No schools would experience a change in air quality levels resulting in an assessment score of Neutral.</p>	Income: Large Beneficial for NO ₂ Children aged under 16: Large Beneficial for NO ₂
Accidents	There is no distributional impact by any of the vulnerable user groups analysed, that is pedestrians and cyclists (for A-roads), motorcyclists, under 16, 16 to 25 males, over 70 for any location, compared with regional study area and Great Britain.	Neutral for all vulnerable groups.
Severance	A design aim for the Project is that as far as reasonably practicable all routes severed by the Project during the construction phase would be re-instated by means of bridges or underpasses as appropriate, with no additional impediment. There is therefore likely to be limited direct severance. Hornsby Lane in Thurrock would be permanently closed but there is no increase in distance for the alternative route.	Car ownership: Slight Beneficial Children under 16: Neutral People aged 70 and over: Neutral

Indicator	Assessment	Scores
	<p>Overall, there is likely to be a small net decrease in traffic related severance in a small number of locations, potentially affecting less than 1% of the population within the regional study area. The distribution of decreased traffic related severance is uneven with respect to car-ownership and there is likely to be a smaller than expected impact of traffic related severance on non-car owning households, compared with the regional study area and England and Wales.</p> <p>The distributions of traffic related severance on children aged under 16, people aged 70 and over and for people with a limiting long-term illness are even as they are similar to the regional study area and England and Wales.</p>	<p>People with a limiting long-term illness: Neutral</p>
<p>Personal Affordability</p>	<p>Generally, personal affordability would not be affected by the Project as the Without Project travel routes and operating costs would still be available. There is therefore no overall impact of the Project on personal affordability.</p> <p>Journeys by Gravesham residents to and from destinations north of the River Thames would be proportionately cheaper than in the Without Project scenario as cross-river road user charges would be reduced through a residents' user charge discount.</p> <p>Around 106,900 Gravesham residents would benefit from a reduction in the cost of travel across the River Thames. The distribution of personal affordability impacts is uneven across income quintiles as there is a higher proportion of Gravesham residents within the lowest income quintiles compared with the regional study area and England and Wales.</p>	<p>Large Beneficial for Gravesham residents</p>

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Glossary

Term	Abbreviation	Explanation
100-year appraisal period	n/a	A sensitivity test used to appraise benefits and costs of the Project over a 100-year appraisal period.
2010 prices and values	n/a	The price base and present value year used to present and compare monetised costs and benefits of a transport project.
2030 opening year	n/a	A modelled year in the Project's LTAM traffic model in which traffic flows and costs are estimated when the Project is opened.
2045 design year	n/a	A modelled year in the Project's LTAM traffic model in which traffic flows and costs are estimated on which the Project design is based.
A-weighted decibel	dB(A)	An expression of the relative loudness of sounds as perceived by the human ear. A-weighting gives more value to frequencies in the middle of human hearing and less value to frequencies at the edges of human hearing.
A122 Lower Thames Crossing	Project	A proposed new crossing of the Thames Estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
AM peak hour	n/a	The hour between 07:00–08:00 in in the Project traffic model LTAM.
AM peak period	n/a	The period between 06:00–09:00 in in the Project traffic model LTAM.
Acute Myocardial Infarction	AMI	Commonly known as a heart attack, this occurs when blood flow decreases or stops to the coronary artery of the heart, causing damage to the heart muscle.
Active Mode Appraisal Toolkit	AMAT	A DfT toolkit for appraising the physical activity impacts of transport projects.
Adjusted Benefit Cost Ratio	Adjusted BCR	The ratio of the sum of Level 1 and 2 PVBs to PVC
Affected Road Network	ARN	In air quality assessment, the network of roads to be considered within the air quality model (selection of the roads within the model depends on a number of criteria such as changes in Heavy Duty Vehicle flows).
Agglomeration	n/a	In traffic and economics assessment, benefits which come when firms and/or people locate near one another in geographical clusters
Air quality management area	AQMA	An area, declared by a local authority, where air quality monitoring does not meet Defra's national air quality objectives.
Air Quality Strategy Objective	AQSO	An objective set by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland to improve air quality in the UK in the medium term. Objectives are focused on the main air pollutants to protect health.
Analysis of Monetised Costs and Benefits	AMCB	In transport and economic assessment, the conversion of changes due to a project into an estimated monetary value.
Ancient Semi-Natural Woodland	ANSW	A type of ancient woodland, acknowledged as non-statutory designated sites and protected under the National Planning Policy Framework.

Term	Abbreviation	Explanation
Annual Average Daily Traffic	AADT	An estimate of the average daily traffic along a defined segment of roadway. This value is calculated from short-term counts taken along the same section, which are then factored to produce the estimate of AADT. Because of this process, the most recent AADT for any given roadway will always be for the previous year.
Annual Average Weekday Traffic	AAWT	The average weekly flow of vehicles on a road or section of a road
Appraisal	n/a	The process of defining objectives, examining options and weighing up the relevant costs, benefits, risks and uncertainties.
Appraisal period	n/a	The period of time over which benefits, costs and revenues are appraised. For a road scheme this includes benefits and costs before scheme opening and all impacts for 60 years from scheme opening.
Appraisal Summary Table	AST	A table that appraises the performance of each option against economic, environmental, social and distributional sub-impacts and is used to directly inform the Value for Money assessment for the economic case.
Appraisal year	n/a	The year in which an appraisal is undertaken and is used to determine when changes to the discount rate are applied
Area of Outstanding Natural Beauty	AONB	Statutory designation intended to conserve and enhance the ecology, natural heritage and landscape value of an area of countryside.
Balance of payments	BoP	The difference between all money flowing into a country in a particular period of time (e.g. a quarter or a year) and the outflow of money to the rest of the world.
Base cost	n/a	A category of project costs that covers the material and labour inputs.
Benefit	n/a	An increase in the welfare of society from a project, programme or policy.
Benefit Cost Ratio	BCR	The ratio of a project's benefits to its costs.
Biodiversity Action Plan	BAP	National, local and sector-specific plans established under the UK Biodiversity Action Plan, with the intention of securing the conservation and sustainable use of biodiversity.
Black, Asian and Minority Ethnic	BAME	A collective term for the minority ethnic population.
Building Cost Information Service	BCIS	A provider of cost and price information for the UK construction industry and part of RICS.
CM45	n/a	Core traffic growth without scheme scenario used to appraise noise, air quality and greenhouse gases.
CM49	n/a	Core traffic growth without scheme scenario used to appraise all impacts except noise, air quality and greenhouse gases.
Capital expenditure	CAPEX	The cost of developing or providing non-consumable parts of the product or system.
Carbon Budget	CB	Carbon budgets are a simplified way to measure the additional emissions that can enter the atmosphere, whilst limiting global warming to defined levels, such as 1.5°C. Carbon budgets are based on the fact that the amount of warming that will occur can be approximated by total CO2 emissions

Term	Abbreviation	Explanation
Carbon dioxide equivalent	CO₂e	A standard unit for measuring carbon footprints that describes, for a given amount of greenhouse gas emissions, the amount of CO ₂ that would have the same Global Warming Potential (GWP) when measured over a timescale of 100 years.
Central case appraisal	n/a	The expected benefits and costs of the Project being submitted for development consent
Closed Circuit Television	CCTV	National Highways CCTV cameras are used to monitor traffic flows on the English motorway and trunk road network primarily for the purposes of traffic management.
Combined Modelling and Appraisal Report	ComMA	The purpose of the Combined Modelling and Appraisal Report is to inform decision makers and stakeholders on how the evidence underpinning the business case has been developed, from the initial identification of the underlying problem through the collection of data and the production of any supporting traffic models and forecast impacts of the Project on traffic to the eventual economic appraisal.
Compensation of employees	COE	A statistical measure of the total gross (pre-tax) wages paid by employers to employees for work done in an accounting period, such as a quarter or a year.
Conservation area	n/a	An area of special environmental or historic interest or importance, of which the character or appearance is protected by law against undesirable changes (Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990).
Consumer Price Index	CPI	A measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food and medical care. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them.
Consumer Prices Index including owner occupiers' housing costs	CPIH	A price index that measures the price of a weighted average market basket of consumer goods and services purchased by households including owner occupiers housing costs.
Core traffic growth	n/a	The central traffic growth forecast
Cost and Benefit to Accidents – Light Touch	COBALT	DfT's software used to appraise the change in accidents due to a transport project.
CS67	n/a	Core traffic growth with scheme scenario used to appraise noise, air quality and greenhouse gases
CS72	n/a	Core traffic growth with scheme scenario used to appraise all impacts except noise, air quality and greenhouse gases
Day to day variability	DTDV	The daily variability in travel times excluding the impact of incidents
Decibel	dB	The unit of measurement used for sound pressure levels and noise levels.
Department for Business, Energy and Industrial Strategy	BEIS	A department of the UK government, with responsibility for business, industrial strategy, and science and innovation with energy and climate change policy.

Term	Abbreviation	Explanation
Department for Environment, Food and Rural Affairs	Defra	The government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland.
Department for Transport	DfT	The government department responsible for the English transport network and a limited number of transport matters in Scotland, Wales and Northern Ireland that have not been devolved.
DfT Value for Money Framework	n/a	Outlines the Department's approach to Value for Money assessments and provides guidance on how the outputs of these assessments should be communicated to decision-makers.
Design Manual for Roads and Bridges	DMRB	Design Manual for Roads and Bridges: A comprehensive manual which contains requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (National Highways, Transport Scotland, the Welsh Government or the Department for Regional Development (Northern Ireland)) is the highway authority. For the A122 Lower Thames Crossing, the Overseeing Organisation is National Highways.
Development Consent Order	DCO	Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIPs) under the Planning Act 2008.
Disbenefits	n/a	Negative benefits.
Discounting	n/a	A technique used to compare costs and benefits occurring at different points of time
Displacement	n/a	An increase in employment in one firm, locality or region which is offset by reductions elsewhere
Distributional impact	DI	The variance of transport intervention impacts across different social groups. The appraisal of DIs is mandatory in the appraisal process and is a constituent of the Appraisal Summary Table (AST)
Distributional Impact Appraisal	DIA	An appraisal of Distributional Impacts.
Dynamic clustering		Benefits come when firms and/or people locate near one another in geographical clusters by changing their spatial location
Dynamic Integrated Assignment and Demand Model	DIADDEM	DfT software for finding equilibrium between demand and supply in a transport model
Economic Appraisal Report	EAR	A report that presents the appraisal methods and results for a transport project
Emissions Factor Toolkit	EFT	The Emissions Factors Toolkit (EFT) is published by Defra and the Devolved Administrations to assist local authorities in carrying out review and assessment of local air quality as part of their duties under the Environment Act 1995.

Term	Abbreviation	Explanation
Environment Agency	EA	A non-departmental public body of Defra, established under the Environment Act 1995. It is the leading public body for protecting and improving the environment in England and Wales. The organisation is responsible for wide-ranging matters, including the management of all forms of flood risk, water resources, water quality, waste regulation, pollution control, inland fisheries, recreation, conservation and navigation of inland waterways.
Environmental Impact Assessment	EIA	A process by which information about environmental effects of a proposed development is collected, assessed and used to inform decision making. For certain projects, EIA is a statutory requirement, reported in an Environmental Statement.
Environmental Quality Standards	EQS	The standards set out in the Environmental Quality Standards Directive (2008/105/EC) which concern the presence in surface water of certain pollutants and substances or groups of substances identified as priority or 'priority hazardous', on account of the substantial risk they pose to or via the aquatic environment.
Environmental Statement	ES	A document produced to support an application for development consent that is subject to Environmental Impact Assessment (EIA), which sets out the likely impacts on the environment arising from the proposed development.
Essex Red Data List	ERDL	Endangered species in Essex included in the Red Data Book which is a public document created to record endangered and rare species of plants, animals, fungi as well as some local subspecies which are present in a particular region.
Foreign Direct Investment	FDI	Investment into the UK economy by overseas companies and governments.
Fully Modelled Area	FMA	
GDP deflator	n/a	A measure of the level of prices of all new, domestically produced, final goods and services in an economy in a year.
Geographic Information System	GIS	An integrated collection of computer software and data used to view and manage information about geographic places, analyse spatial relationships and model spatial processes.
Great Crested Newt	GCN	Great crested newts are a European protected species. The animals and their eggs, breeding sites and resting places are protected by law.
Greenhouse gas	GHG	Gases able to absorb infrared radiation emitted from Earth's surface and reradiate it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases.
Green Belt	n/a	A policy and land use zone designation used in land use planning to retain areas of undeveloped land surrounding urban areas.
Green Book	n/a	HM Treasury's guidance on how publicly funded projects, programmes and policies should be appraised and evaluated.
Gross Disposable Household Income	GDHI	The standard measure of household income
Gross Domestic Product	GDP	Total value of all goods and services produced within an economy in one year.

Term	Abbreviation	Explanation
Gross Domestic Product per worker	n/a	A measure of productivity.
Gross Value Added	GVA	The measure of the value of goods and services produced in an area, industry or sector of an economy.
Groundwater and Groundwater Dependent Terrestrial Ecosystems	GWDTE	A wetland that critically depends on groundwater flows and chemistries to support sensitive ecosystems.
Habitat of Principal Importance	HoPI	Habitats listed in section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, considered to be the UK's most important habitats for wildlife.
Hectare	ha	The hectare is an SI unit of area primarily used in the measurement of land as a metric replacement for the imperial acre. An acre is about 0.405ha and 1ha is about 2.47 acres.
Herfindahl–Hirschman Index	HH index	An economic measure of market concentration.
Heavy Duty Vehicle	HDV	Freight vehicles of more than 3.5 tonnes (e.g. lorries) or passenger transport vehicles of more than 8 seats (e.g. buses).
Heavy Goods Vehicle	HGV	A large, heavy motor vehicle used for transporting cargo.
High Speed 1	HS1	A 109km high-speed railway between London and the UK end of the Channel Tunnel. The line carries international passenger traffic between the UK and continental Europe; it also carries domestic passenger traffic to and from stations in Kent and east London, as well as Berne gauge freight traffic.
Highways England Water Risk Assessment Tool	HEWRAT	A water risk assessment tool produced by National Highways
HM49	n/a	High traffic growth without scheme scenario
HM Treasury	HMT	The government's economic and finance ministry which maintains control over public spending, setting the direction of the UK's economic policy.
HS72	n/a	High traffic growth with scheme scenario
Income Domain	n/a	One of components of the Index of Multiple Deprivation that measures the proportion of the population in an area experiencing deprivation in terms of low income
Index of Multiple Deprivation	IMD	Official measure of relative deprivation for 32,844 small census areas in England. A rank of 1 is the most deprived area.
Indices of deprivation	IOD	A measure of the relative levels of deprivation. In England this considers 32,844 small areas or neighbourhoods, called Lower Layer Super Output Areas. The IOD 2019 is based on 39 separate indicators, organised across seven distinct domains of deprivation; these relate to income, employment, education, health, crime, living environment and barriers to housing and services.

Term	Abbreviation	Explanation
Indirect tax revenue	n/a	Revenues from indirect taxes, such as fuel duty, paid by road users
Industrial structure	n/a	The categorisation of industries with an economy
Inflation	n/a	A measure of the increase in prices within the economy
Initial BCR	n/a	The BCR that includes Level 1 benefits
Inter-peak	IP	An average hour within LTAM to represent an hour within the period 09:00–15:00
International Union for Conservation of Nature	IUCN	The International Union for Conservation of Nature is the global authority on the status of the natural world and the measures needed to safeguard it.
International Territorial Level	ITL	A geocode standard for referencing the subdivisions of the United Kingdom for statistical purposes, used by the Office for National Statistics (ONS). Within the UK it replaced the EU's NUTS system after Brexit.
Journey time reliability	JTR	The variation in journey times that travellers are unable to predict due to incidents and other factors
Krugman Specialisation Index	KSI	An economic measure of regional industrial specialisation
Land Use Transport Interaction model	LUTI	An economic model used to estimate the wider economic impacts based on variable land uses
Landscape Character Area	LCA	The discrete geographical areas of a particular landscape type. Also referred to as Local Landscape Character Area (LLCA)
Level 1 benefits	n/a	Monetised benefits estimated using established methodologies that are included in the Level 1 PVB when calculating the Initial and Adjusted BCRs
Level 2 benefits	n/a	Monetised benefits estimated using less established methodologies that are included in the Level 2 PVB when calculating the Adjusted BCR
Level 3 benefits	n/a	Either monetised or qualitatively appraised benefits that are not included in BCRs but which are taken into account in assessing a project's Value for Money
Light Goods Vehicle	LGV	Vehicles meeting the Department for Transport VEH04 criteria.
LM49	n/a	Low traffic growth without scheme scenario
Local authority areas	LAA	Several local authorities
Local Nature Reserve	LNR	Locally designated nature site protected through the planning system.
Local Planning Authority	LPA	A local planning authority is the local authority or council that is empowered by law to exercise statutory town planning functions for a particular area of the UK. May also be referred to as 'local authority'.
Local North	n/a	The Lower Thames local authorities of Havering, Thurrock and Brentwood

Term	Abbreviation	Explanation
Local South	n/a	The Lower Thames local authorities of Dartford, Gravesham and Medway
Local Wildlife Site	LWS	Locally designated nature site protected through the planning system.
Location Quotient	LQ	An economic concept used as a relative measure of industry concentration
Lower Layer Super Output Area	LSOA	A geographical area defined by the ONS used to produce neighbourhood statistics for small areas with a typical population of around 1,500 people
Lower Thames Area Model	LTAM	Transport model designed to forecast impacts of providing additional road based capacity across the River Thames at locations at or east of the existing Dartford Crossing.
LS72	n/a	Low traffic growth with scheme scenario
M25 motorway	n/a	Orbital motorway that encircles most of Greater London
Marginal external costs	MEC	The additional cost imposed on third parties by producing an extra unit of a good or service. In the case of transport projects it includes congestion, air pollution, noise, infrastructure impacts and accidents.
Market failure	n/a	A situation where the allocation of goods and services is inefficient resulting from a divergence between the private costs and benefits experienced by individuals, businesses and society.
Monte-Carlo simulation	n/a	A computational algorithm based on repeated random sampling to obtain cost estimates.
Most Likely	n/a	The expected level of CAPEX costs expressed as a probability (P) level.
Motorway Reliability Incidents And Delays	MyRIAD	Motorway Reliability Incidents And Delays appraisal software.
Moves to more or less productive jobs	M2MLPJ	A Level 3 wider economic impact that reflects the distortionary effect of taxes on the labour market and is measured by the change in tax revenues to Government due to a transport scheme
National Character Area	NCA	NCAs divide England into 159 distinct natural areas. Each NCA is defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity. Their boundaries follow natural lines in the landscape rather than administrative boundaries.
National Highways Carbon Valuation Toolkit v1.4.2	n/a	National Highways appraisal tool used to present and value in monetary terms all greenhouse gas emissions of a road project.
National Highways Commercial Services Division	CSD	National Highways division responsible for commercial services.

Term	Abbreviation	Explanation
National Planning Policy Framework	NPPF	The National Planning Policy Framework was published in March 2012 by the UK's Department of Communities and Local Government, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Practice Guidance Notes (PPG) for use in England. The NPPF was updated in February 2019 and again in July 2021 by the Ministry of Housing, Communities and Local Government.
National Policy Statement for National Networks	NPSNN	The NPSNN sets out the need for, and Government's policies to deliver, development of Nationally Significant Infrastructure Projects on the national road and rail networks in England. It provides planning guidance for promoters of Nationally Significant Infrastructure Projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
National Trip-End Model	NTEM	A DfT model that forecasts the growth in trip origin-destinations (or productions-attractions) up to 2051 for use in transport modelling. The forecasts take into account national projections of population, employment, housing, car ownership and trip rates.
National Vocational Qualifications (NVQ) Level 4	NVQ4	National Vocational Qualifications are work-based awards in England, Wales and Northern Ireland that are achieved through assessment and training. NVQ level 4 is equivalent to a degree level education.
Net Present Value	NPV	A measure of the total impact of a scheme upon society, in monetary terms, expressed in 2010 prices.
New Economic Geography	NEG	A theoretical framework for locational decisions in the context of imperfectly competitive markets.
Nitrogen dioxide	NO₂	A reactive gas introduced into the environment by natural causes, including entry from the stratosphere, bacterial respiration, volcanos, and lightning. It is also introduced by the emissions of internal combustion engines burning fossil fuels.
NOMIS	n/a	An ONS web site that publishes official census and labour market statistics for the UK
NOMIS Business Register and Employment Survey	BRES	An employer survey of the number of jobs held by employees at the location of their workplace broken down by full/part-time and detailed industry classification using five digit SIC codes
Nomenclature of Territorial Units for Statistics	NUTS	A standard for referencing the subdivisions of countries for statistical purposes. The standard is developed and regulated by the European Union, and thus only covers the member states of the EU in detail.
Non-Motorised Users	NMU	Users of non-motorised vehicles (eg cyclists, horse riders) and pedestrians.
Non-recoverable VAT	NR VAT	Value added tax that has been paid but cannot be reclaimed by a business.
Non-traded carbon	n/a	Carbon emissions in sectors not included in Emission Trading Systems such as those from road vehicles
O&M model	n/a	National Highways model for estimating operating, maintenance and renewals costs of road projects

Term	Abbreviation	Explanation
Office for National Statistics	ONS	The executive office of the UK Statistics Authority, a non-ministerial Government department responsible for the collection and publication of statistics related to the economy, population and society of the UK
Off-peak period	OP period	The hours between 18:00-06:00 within the Project traffic model (LTAM).
Operating, maintenance and renewals expenditure	OMR	Operating, maintenance and renewal expenditure.
Ordnance Survey	OS	The national mapping agency of Great Britain.
Origin-destination	OD	Origin-destination data (also known as flow data) includes the travel-to-work and migration patterns of individuals, cross-tabulated by variables of interest (for example occupation).
OSPAR	n/a	The mechanism by which 15 governments (including the UK) and the EU cooperate to protect the marine environment of the North-East Atlantic.
Other Goods Vehicle 1	OGV1	All rigid vehicles over 3.5 tonnes gross vehicle weight including all large vehicles on a single frame: trucks, tow trucks, campers, motor homes, large ambulances, etc.
Other Goods Vehicle 2	OGV2	All articulated vehicles including multi-unit goods-carrying vehicles with a tractor or straight truck power unit, including goods-carrying rigid trucks pulling trailers and rigid vehicles with four or more axles.
P10	n/a	Costs for which there is a 10% chance that they will not be exceeded.
P90	n/a	Costs for which there is a 90% chance that they will not be exceeded.
PM peak hour	n/a	The hour between 17:00–18:00 within LTAM
PM peak period	n/a	The hours between 15:00–18:00 within LTAM
Particulate matter	PM_{2.5}	Particulate matter with a diameter smaller than 2.5 micrometres
Passenger car unit	PCU	A metric to allow different vehicle types within traffic flows in a traffic model to be assessed in a consistent manner. PCU factors used within the Project's transport model are: 1 for a car or Light Goods Vehicle; 2 for a bus, 2.5 for a Heavy Goods Vehicle.
Pence per hour	PPH	Travel cost per hour
Pence per kilometre	PPK	Travel cost per kilometre
Pence per minute	PPM	Travel cost per minute
Personal Injury Accident	PIA	An accident that involves personal injury occurring on the public highway (including footways) in which at least one road vehicle or a vehicle in collision with a pedestrian is involved and which becomes known to the police within 30 days of its occurrence.
Present Value	PV	The result of discounting a stream of benefits or costs
Present Value of Benefits	PVB	The sum of discounted benefits

Term	Abbreviation	Explanation
Present Value of Costs	PVC	The sum of discounted costs
Public Accounts table	PA table	A TAG appraisal table that reports the impacts of the Project on the public finances
Public Rights of Way	PRoW	A right possessed by the public, to pass along routes over land at all times. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. The mode of transport allowed differs according to the type of Public Right of Way which consist of footpaths, bridleways and open and restricted byways
Public Transport	PT	A system of vehicles such as buses and trains that operate at regular times on fixed routes and are used by the public
Quantitative Risk Assessment	QRA	A formal and systematic risk analysis approach to quantifying the risks associated with the operation of an engineering process.
Quarter 1	Q1	The first three month period in a financial year.
Queen Elizabeth II bridge	QEII bridge	Queen Elizabeth II Bridge, part of the Dartford-Thurrock crossing.
QUEues And Delays at Roadworks maintenance delays appraisal software	QUADRO	A National Highways sponsored computer program to estimate the effects of roadworks in terms of time, vehicle operating and accident costs on the users of the road
Quality Index	QI	A measure of the robustness of TRIS traffic data
RAMSAR site	n/a	A wetland of international importance, designated under the Ramsar convention
Real terms	n/a	A data series for costs and benefits excluding the effect of the general level of price increases
Reliability ratio	n/a	A ratio used to calculate Journey Time Reliability benefits
Retail Prices Index	RPI	A price index that measures the change in the cost of a representative sample of retail goods and services. No longer classified as a national statistic in the UK
Revenue	n/a	Income from road users that are included in the PVC
Risk (costs)	n/a	A category of costs associated with events that may arise or may not arise due to a road project
River Basin Management Plan	RBMP	A planning document published by the Department for Environment, Food and Rural Affairs and the Environment Agency which sets out how organisations, stakeholders and communities will work together to improve the water environment.
Road user charging	RUC	A road user fee for the use of the tunnel.
Roll on – roll off	Ro-ro	Freight that can be driven on and off ships using their own wheels or a platform vehicle such as a self-propelled modular transporter
Sensitivity test	n/a	A test carried out to investigate the dependency in the model outputs to the values input into the model. Often a single input value is changed in turn and the resulting model outputs examined.

Term	Abbreviation	Explanation
Simulation and Assignment of Traffic to Urban Road Networks, software	SATURN	Software used to build transport models
Site of Importance for Nature Conservation	SINC	Locally designated nature site protected through the planning system.
Site of Special Scientific Interest	SSSI	A conservation designation denoting an area of particular ecological or geological importance
Social cost benefit analysis	CBA	A technique used to assess and compare the costs and socio-economic benefits of different options
Social impact appraisal	n/a	Social impacts cover the human experience of the transport system and its impact on social factors, not considered as part of economic or environmental impacts
South East Local Enterprise Partnership	SELEP	The business-led, public-private body established to drive economic growth across East Sussex, Essex, Kent, Medway, Southend and Thurrock
South East Regional Traffic Model	SERTM	National Highways South East Regional Traffic Model
Spatial Computable General Equilibrium model	SCGE	A methodology that can be used in the appraisal of the wider economic impacts of a transport intervention.
Special Area of Conservation	SAC	A designation under EU Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, also known as the Habitats Directive.
Special Protection Area	SPA	A designation under EU Directive 2009/147/EC on the Conservation of Wild Birds.
Standard Industrial Classification	SIC	A system used to classify business establishments and other statistical units by the type of economic activity in which they are engaged.
Strategic Road Network	SRN	The core road network in England managed by National Highways
Static clustering	n/a	Benefits that come when firms and/or people locate near one another in geographical clusters but do not change their spatial location
STATS19	n/a	A database of all road traffic accidents that resulted in a personal injury and were reported to the police within 30 days of the accident. The data are collected by the police at the roadside or when the accident is reported to them by a member of the public in a police station.
Teletrac	n/a	DfT traffic dataset
Tender Price Index	TPI	An index of the prices for which contractor offer to carry out projects

Term	Abbreviation	Explanation
Thames Estuary 2100	TE2100	An Environment Agency project (formed November 2012) to develop a comprehensive action plan to manage flood risk for the Tidal Thames from Teddington in West London, through to Sheerness and Shoeburyness in Kent and Essex.
Transport Analysis Guidance	TAG	Transport Analysis Guidance published by DfT which provides methods to model and appraise the impacts of transport projects
TAG data book	n/a	The data book of appraisal parameters used in transport appraisals for DfT
Transport Decarbonisation Plan	TDP	The government's commitments and actions needed to decarbonise the entire transport system in the UK
Transport Economic Efficiency	TEE	An appraisal table used to report the Level 1 benefits that measure the impact of a transport scheme on the efficiency of the transport system
Transport User Benefits Appraisal	TUBA	DfT's transport user benefits appraisal software
TRIS	n/a	National Highways Traffic Count Database
Traded carbon	n/a	Carbon emissions in the traded sectors covered by Emission Trading Systems such as the power and industrial sectors
Travel time variability	TTV	The daily variation in travel times not due to incidents
Tunnel Boring Machine	TBM	A large machine used to excavate tunnels with a circular cross-section.
Uncertainty (costs)	n/a	A category of project costs that are unpredictable
User class	UC	Categorisation of different transport users based on their journey purposes
Value Added Tax	VAT	A consumption tax levied in the UK which was introduced in 1973. It is administered and collected by HM Revenue and Customs. VAT is levied on most goods and services provided by registered businesses in the UK and some goods and services imported from outside the European Union. The default VAT rate is the standard rate, 20% since 4 January 2011. Some goods and services are subject to VAT at a reduced rate of 5% (such as domestic fuel) or 0% (such as most food and children's clothing).
Value for Money	VfM	Value for Money, being the optimum combination of whole-life costs and quality to meet the user requirement.
Value of time	VOT	The opportunity cost of the time that a traveller spends on their journey and would be the amount that a traveller would be willing to pay in order to save time
Variable demand model	VDM	A transport model that represents how people respond to changes in travel times and costs
Vehicle operating costs	VOC	Costs that vary with vehicle usage, including fuel, tyres, maintenance, repairs, and mileage-dependent depreciation costs.
VISUM	n/a	Strategic car and rail modelling software

Term	Abbreviation	Explanation
Volume over capacity	V/C	The ratio of a road's current or projected traffic volumes to its saturation flow or capacity
Water Framework Directive	WFD	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. The Directive establishes a framework for the protection of inland surface waters, estuaries, coastal waters and groundwater. The framework for delivering the WFD is through river basin management planning. The UK has been split into several river basin districts. Each river basin district has been characterised into smaller management units known as water bodies. The surface water bodies may be rivers, lakes, estuary or coastal.
Weekend	WE	A time period included in the transport model that covers travel on Saturdays and Sundays
Wider Economic Impacts	WEI	Land use-related economic consequences of transport interventions, not directly related to impacts on users of the transport network, such as increased productivity. There are two Levels of Wider Economic Impacts, Level 2 and Level 3 benefits, that vary depending on whether land use is assumed to change.
WITA v2.2	n/a	DfT Wider Impacts Transport Appraisal Version 2.2 software used to appraise Level 2 wider economic impacts
With Scheme	n/a	Appraisal scenario that includes a proposed intervention such as a project, programme or policy. Also referred to as With Project
Without Scheme	n/a	Appraisal scenario that excludes a proposed intervention such as a project, programme or policy. Also referred to as Without Project
World War II	WWII	World War 2

Annex A Screening stage

Table A.1 Screening Stage Proforma

Distributional Impact Appraisal Screening Proforma				
Project description: Lower Thames Crossing				
Indicator	(a) Appraisal output criteria	(b) Potential impact (yes/no, positive/negative if known)	(c) Qualitative comments	(d) Proceed to Step 2
User benefits	The TUBA user benefit analysis software or an equivalent process has been used in the appraisal; and/or the value of user benefits Transport Economic Efficiency (TEE) table is non-zero.	Yes. The TUBA software has been used to appraise user benefits on a zonal basis for the LTAM fully modelled area.	TUBA user benefits and disbenefits are spread over a wide geographical area with different socio-economic characteristics.	Yes. A detailed assessment of the non-business user benefits should be carried out for trips originating from and destinating to the LTAM fully modelled area and a more local study area.
Noise	Any change in alignment of transport corridor or any links with significant changes (>25% or <-20%) in vehicle flow, speed or %HDV content. Also note comment in TAG Unit A3.	Yes. The Project would introduce traffic to new locations. Changes in traffic flows indicate that there would be potential noise impacts.	A TAG noise assessment was undertaken which sets out the locations experiencing changes in noise levels > 1dB(A) as a result of the Project in 2030.	Yes. An assessment of noise should be carried out across a refined study area depending on changes in vehicle flow, speed or %HDV content.
Air quality	Any change in alignment of transport corridor or any links with significant changes in vehicle flow, speed or %HDV content: <ul style="list-style-type: none"> Change in 24 hour AADT of 1000 vehicles or more Change in 24 hour AADT of 200 HDV vehicles or more 	Yes. The Project would introduce traffic to new locations. Changes in traffic flows indicate that there would be potential air quality impacts.	A TAG air quality assessment was undertaken which sets out the locations experiencing changes in NO ₂ as a result of the Project in 2030.	Yes. An assessment of air quality should be carried out across a refined study area.

Distributional Impact Appraisal Screening Proforma				
Project description: Lower Thames Crossing				
Indicator	(a) Appraisal output criteria	(b) Potential impact (yes/no, positive/negative if known)	(c) Qualitative comments	(d) Proceed to Step 2
	<ul style="list-style-type: none"> Change in daily average speed band Change in road alignment of 5m or more 			
Accidents	Any change in alignment of transport corridor (or road layout) that may have positive or negative safety impacts, or any links with significant changes in vehicle flow, speed, %HGV content or any significant change (>10%) in the number of pedestrians, cyclists or motorcyclists using road network.	Yes. The Project is a new corridor which would introduce changes in traffic flows, speeds or %HGV across the road network.	A COBALT analysis was carried out to forecast the change in accidents with the Project.	Yes. An assessment of accidents should be carried out across a refined study area, the COBALT study area, together with an analysis of STATS19 accident data.
Security	Any change in public transport waiting/interchange facilities including pedestrian access expected to affect user perceptions of personal security.	There is no impact on public transport or pedestrian security.	The design is not expected to have an impact on personal security.	No.
Severance	Introduction or removal of barriers to pedestrian movement, either through changes to road crossing provision, or through introduction of new public transport or road corridors. Any areas with changes (>10%) in vehicle flow, speed, %HGV content.	Yes. Changes in traffic flows indicate that there would be potential severance impacts.	A design aim for the Project is that all existing PRow crossed by the Project would be reinstated. There would be some increased traffic flows on some assessment area links.	Yes. Analysis should be carried out across a refined study area.

Distributional Impact Appraisal Screening Proforma				
Project description: Lower Thames Crossing				
Indicator	(a) Appraisal output criteria	(b) Potential impact (yes/no, positive/negative if known)	(c) Qualitative comments	(d) Proceed to Step 2
Accessibility	Changes in routings or timings of current public transport services, any changes to public transport provision, including routing, frequencies, waiting facilities (bus stops/rail stations) and rolling stock, or any indirect impacts on accessibility to services (for example demolition and re-location of a school).	No. There would be no change in public transport provision or public transport accessibility to employment, services and social networks.		No.
Affordability	In cases where the following charges would occur; Parking charges (including where changes in the allocation of free or reduced fee spaces may occur); Car fuel and non-fuel operating costs (where, for example, rerouting or changes in journey speeds and congestion occur resulting in changes in costs); Road user charges (including discounts and exemptions for different groups of travellers); Public transport fare changes (where, for example premium fares are set on new or existing modes or where multi-modal discounted travel tickets become available due to new ticketing technologies); or Public transport concession availability (where, for example concession arrangements vary as a result of a move in service provision from bus to light rail or heavy rail, where such concession entitlement is not maintained by the local authority).	Yes. The Project includes a road user charge (toll) for the Lower Thames Crossing tunnel.	It is proposed that the Project would have a charge, consistent with that applied at the Dartford Crossing and that Gravesham residents would benefit from a local residents discount for travel across the River Thames. TUBA fuel and non-fuel operating cost changes are spread over a wide geographical area with different socio-economic characteristics.	Yes. Analysis should be carried out across Gravesham. Changes in vehicle operating costs should also be considered.

Annex B Socio-demographic assessment

Plate B.1 Indices of Deprivation by Income Domain, 2019

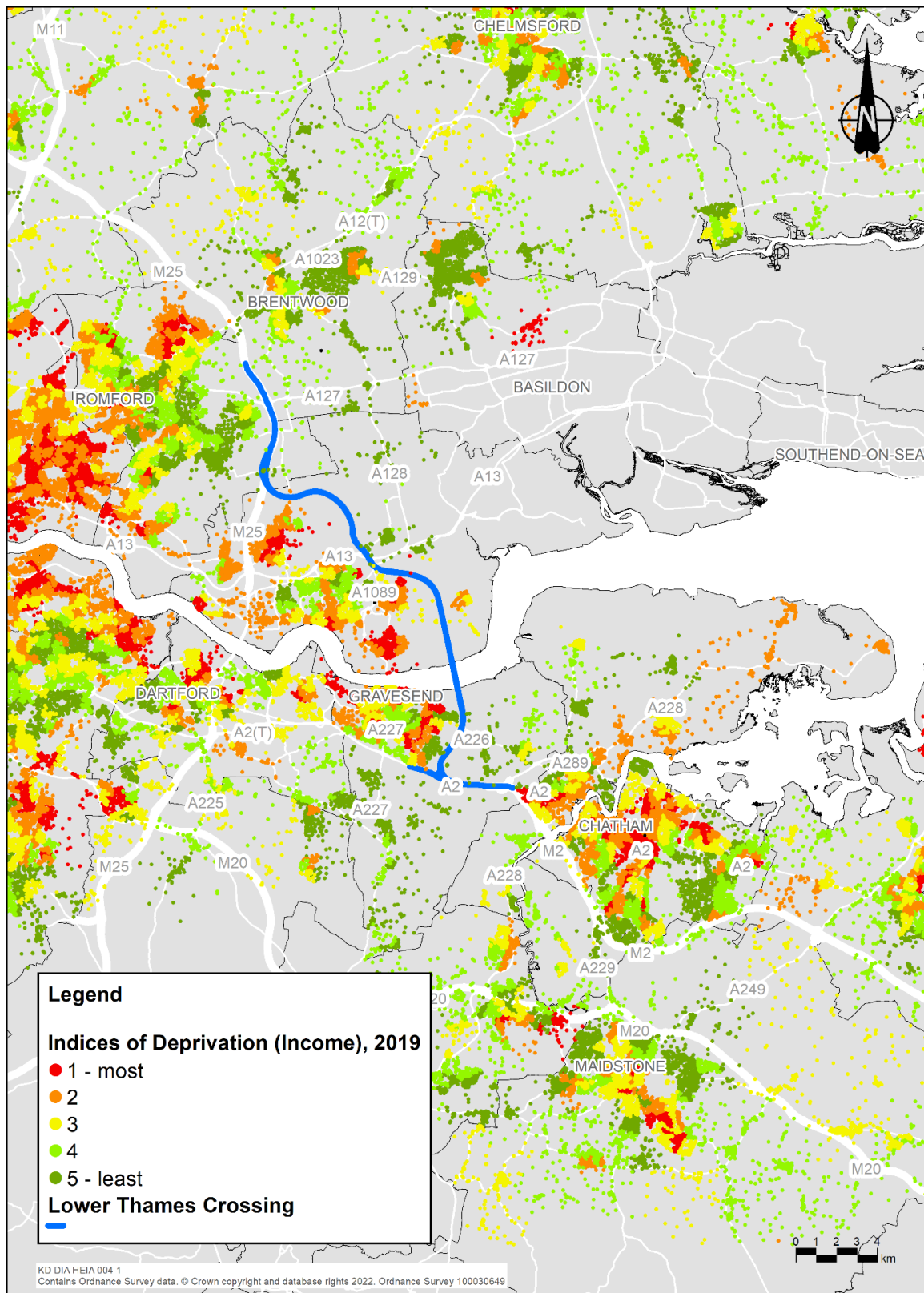


Plate B.2 Proportion of children (aged under 16 years), comparison with England and Wales

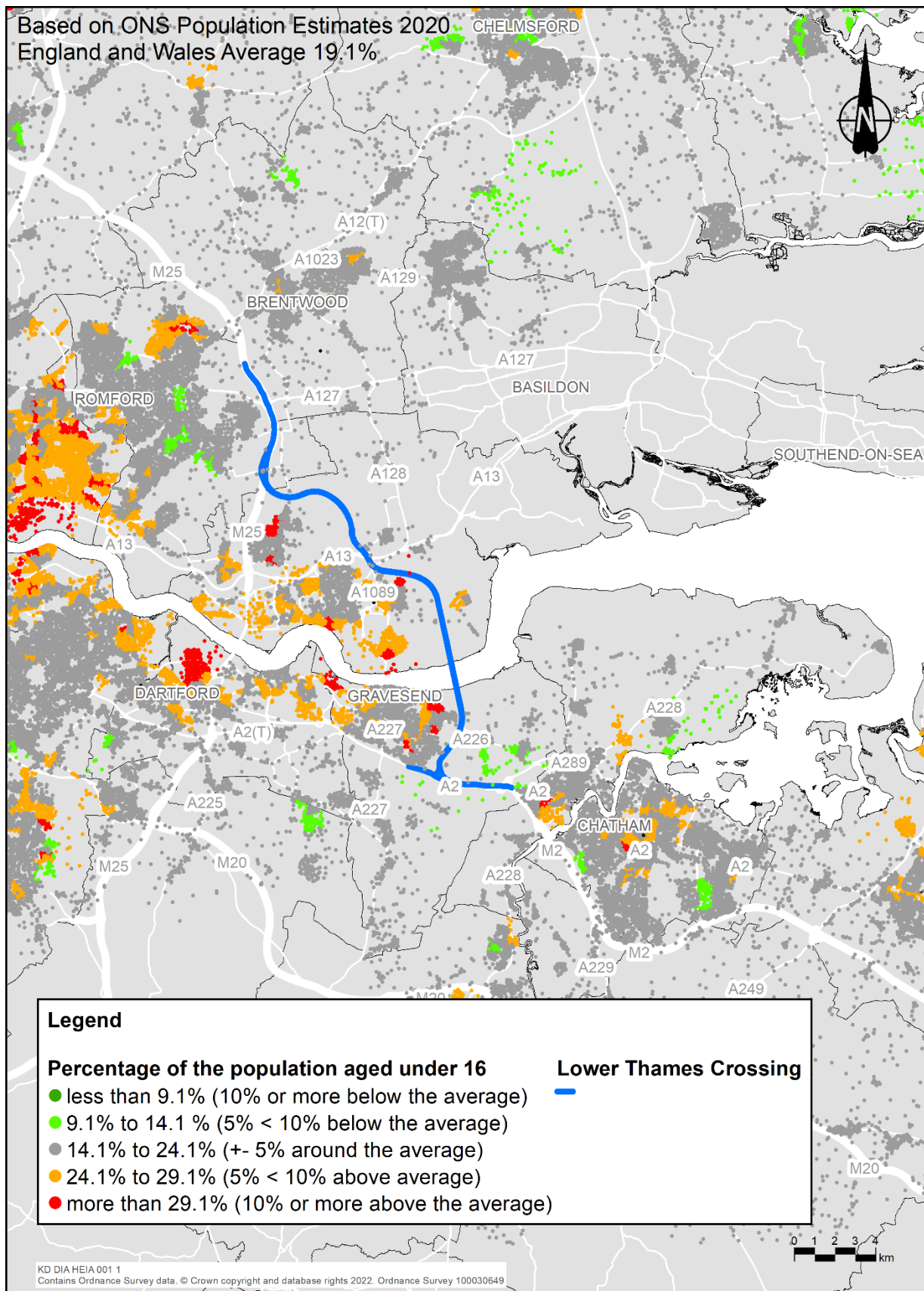


Plate B.3 Proportion of children (aged under 16 years), comparison with regional study area

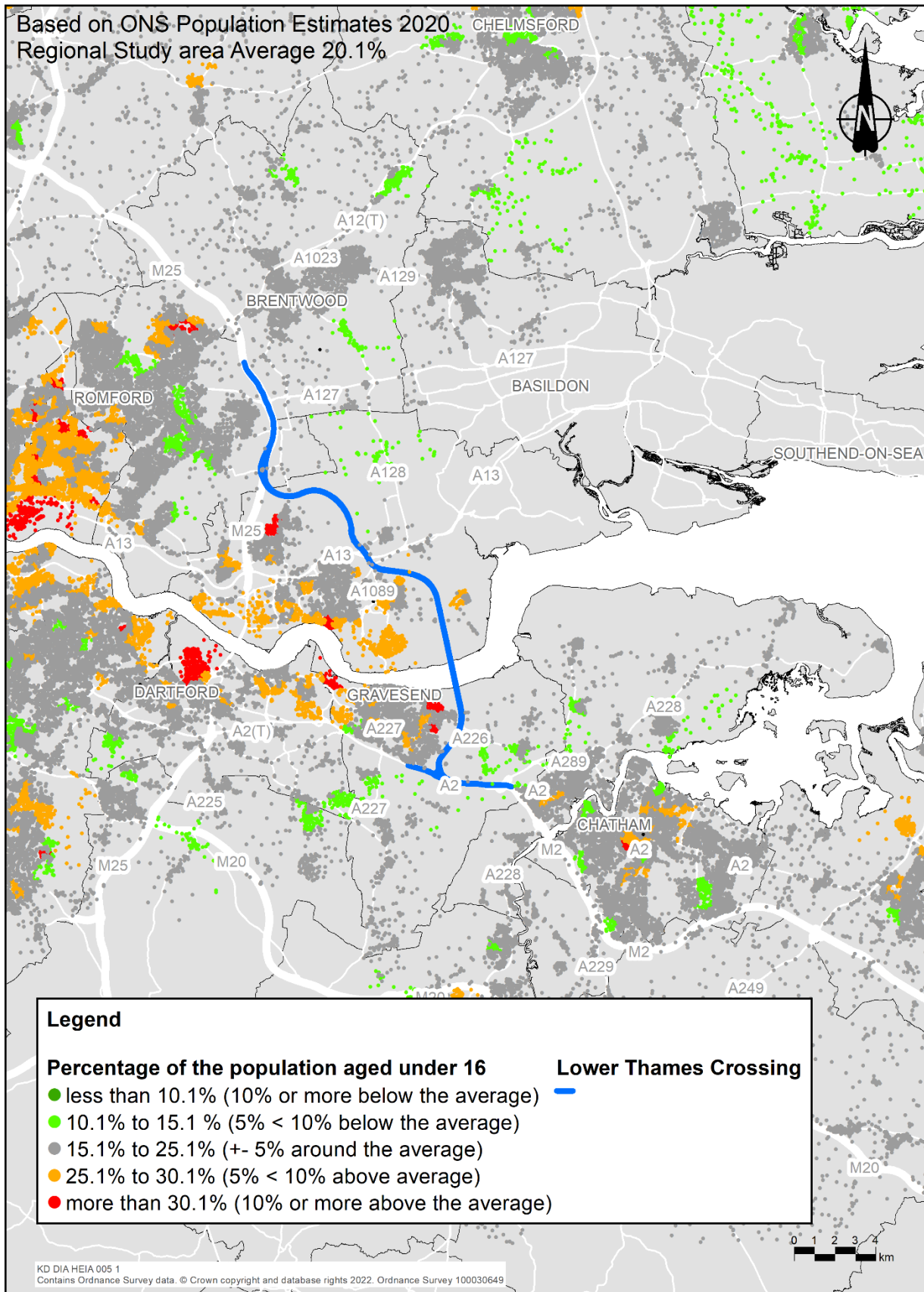


Plate B.4 Proportion of older people (aged 70 and over), comparison with England and Wales

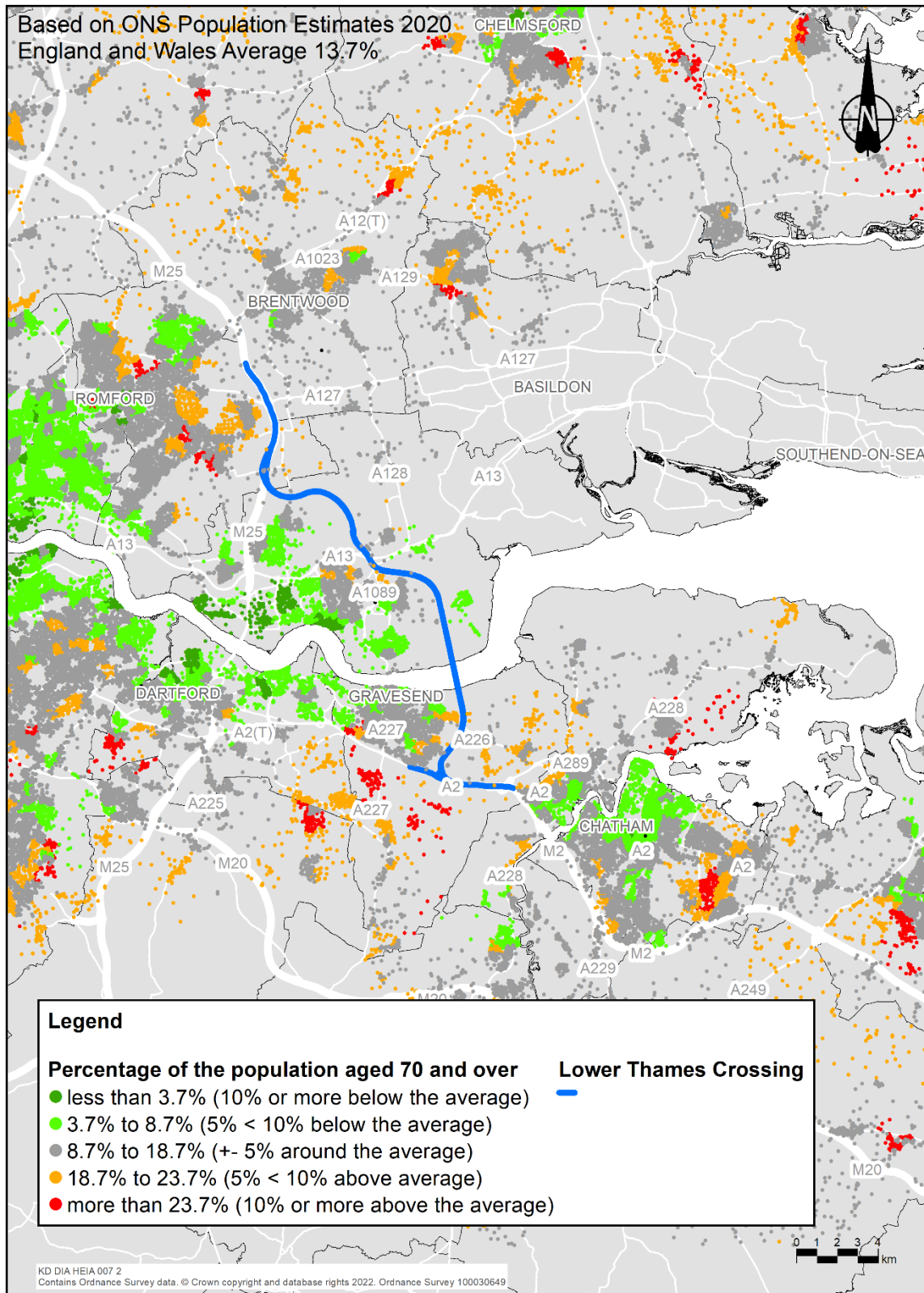


Plate B.5 Proportion of older people (aged 70 and over), comparison with regional study area

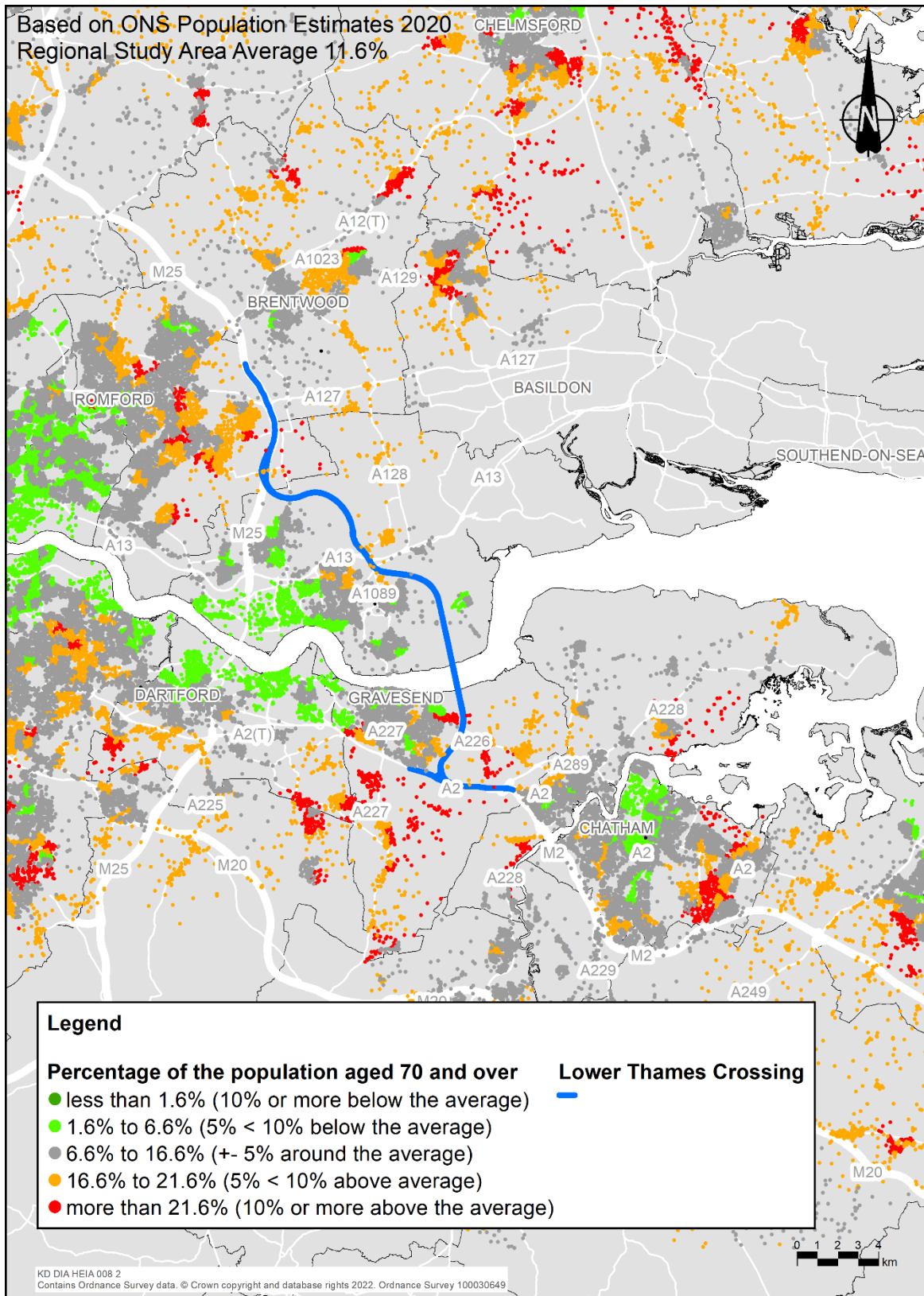


Plate B.7 Proportion of households with people of day-to-day limited activity, comparison with England and Wales

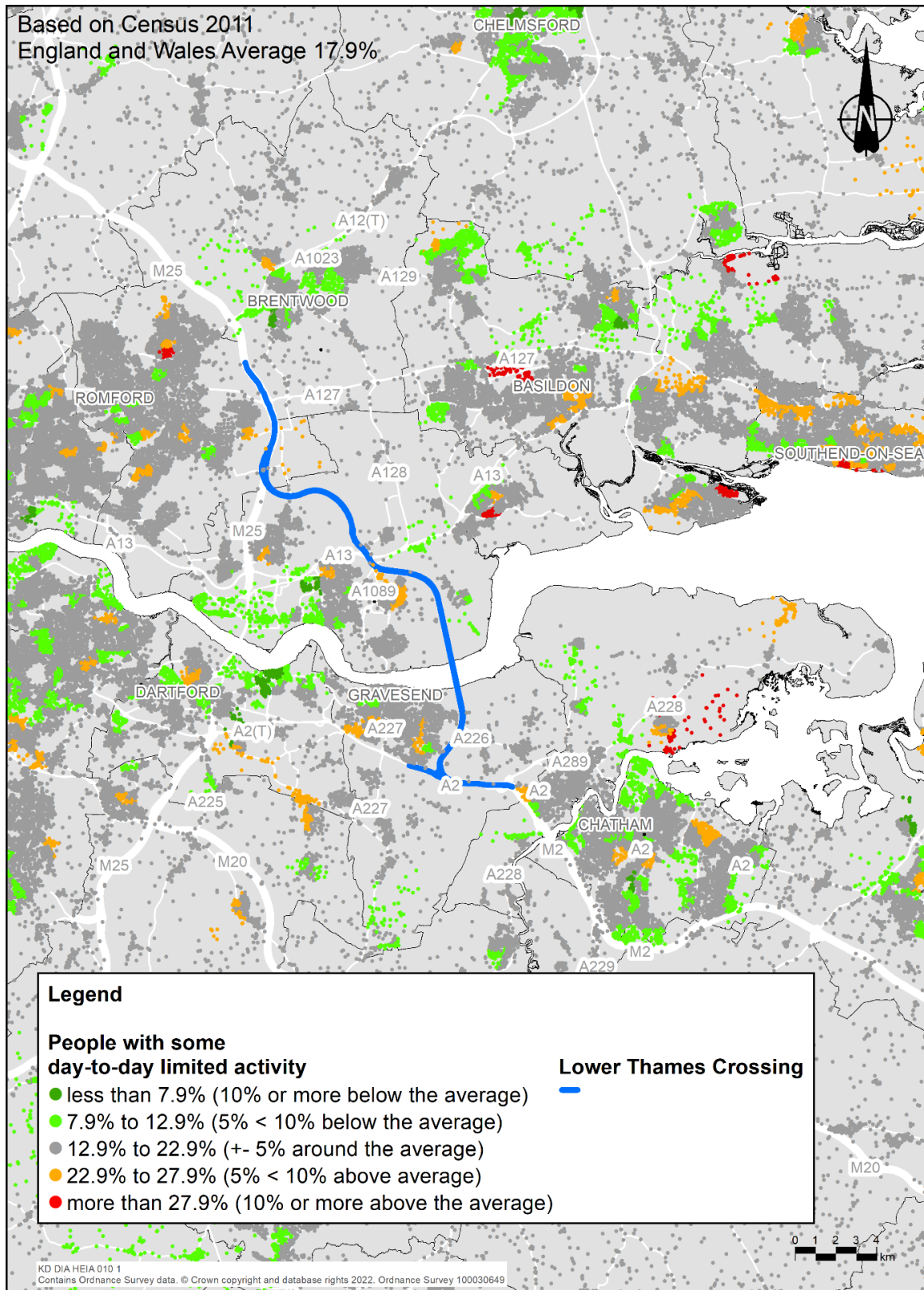


Plate B.8 Proportion of households with people of day-to-day limited activity, comparison with regional study area

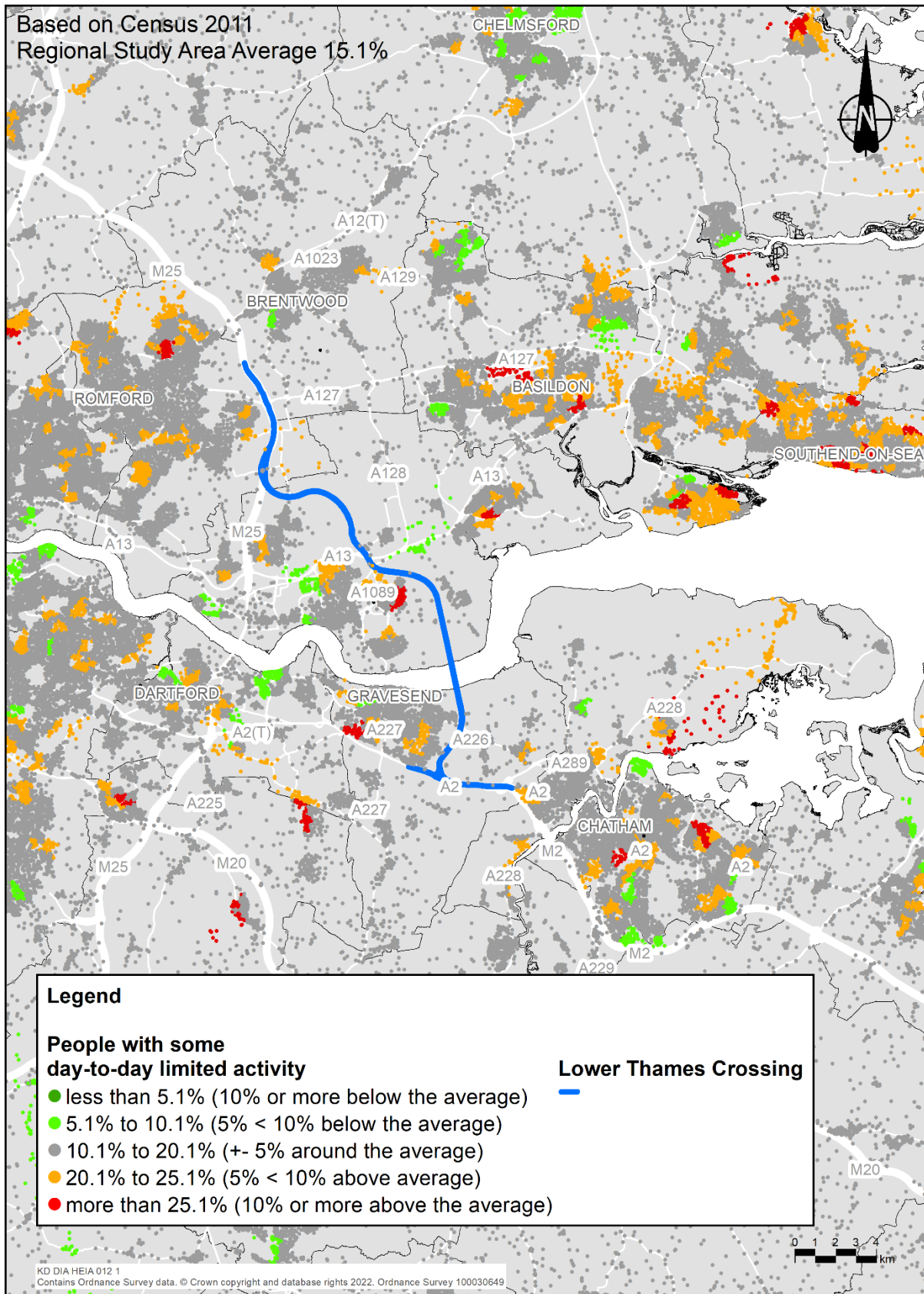


Plate B.9 Proportion of non-car-available households, comparison with England and Wales

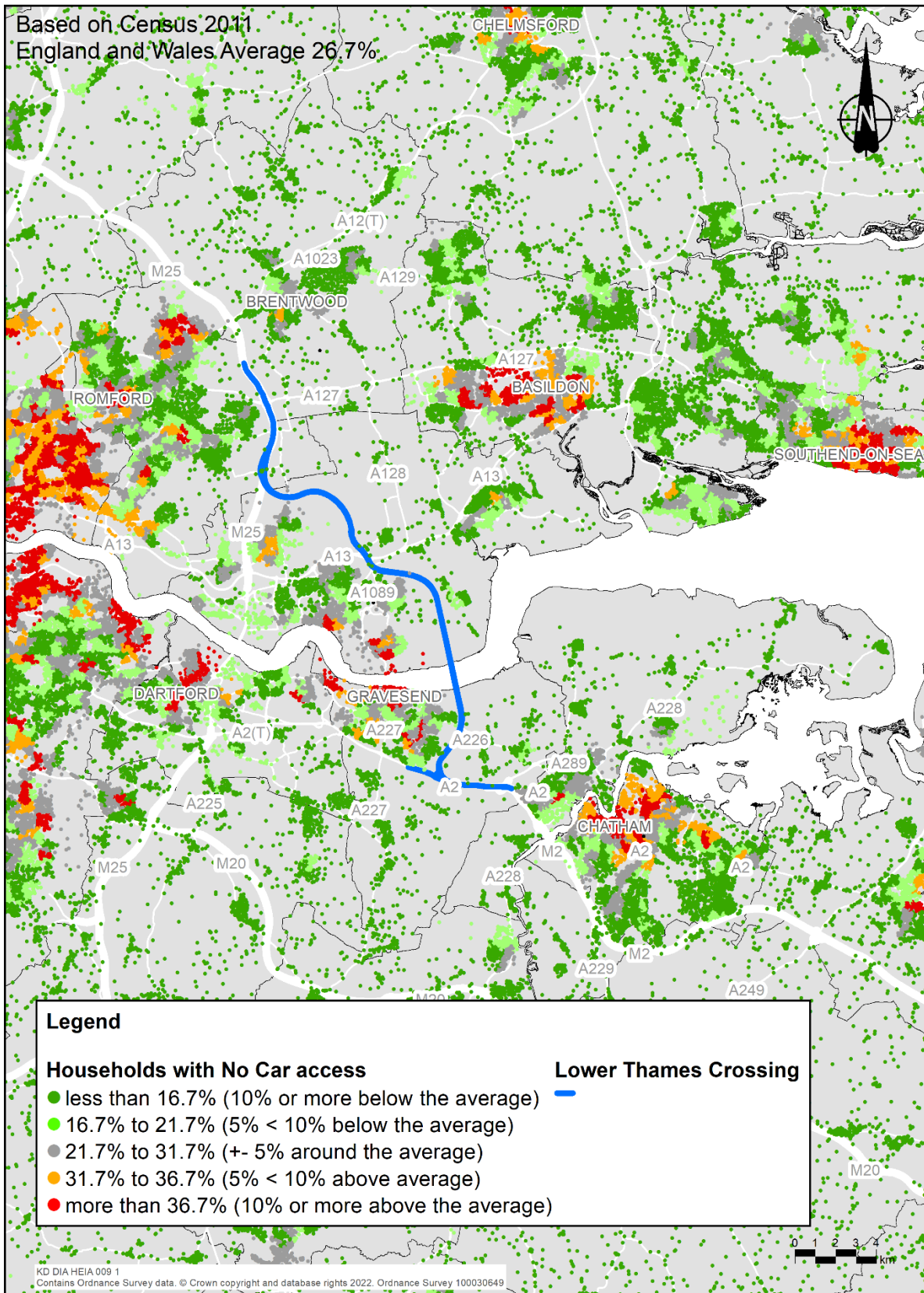
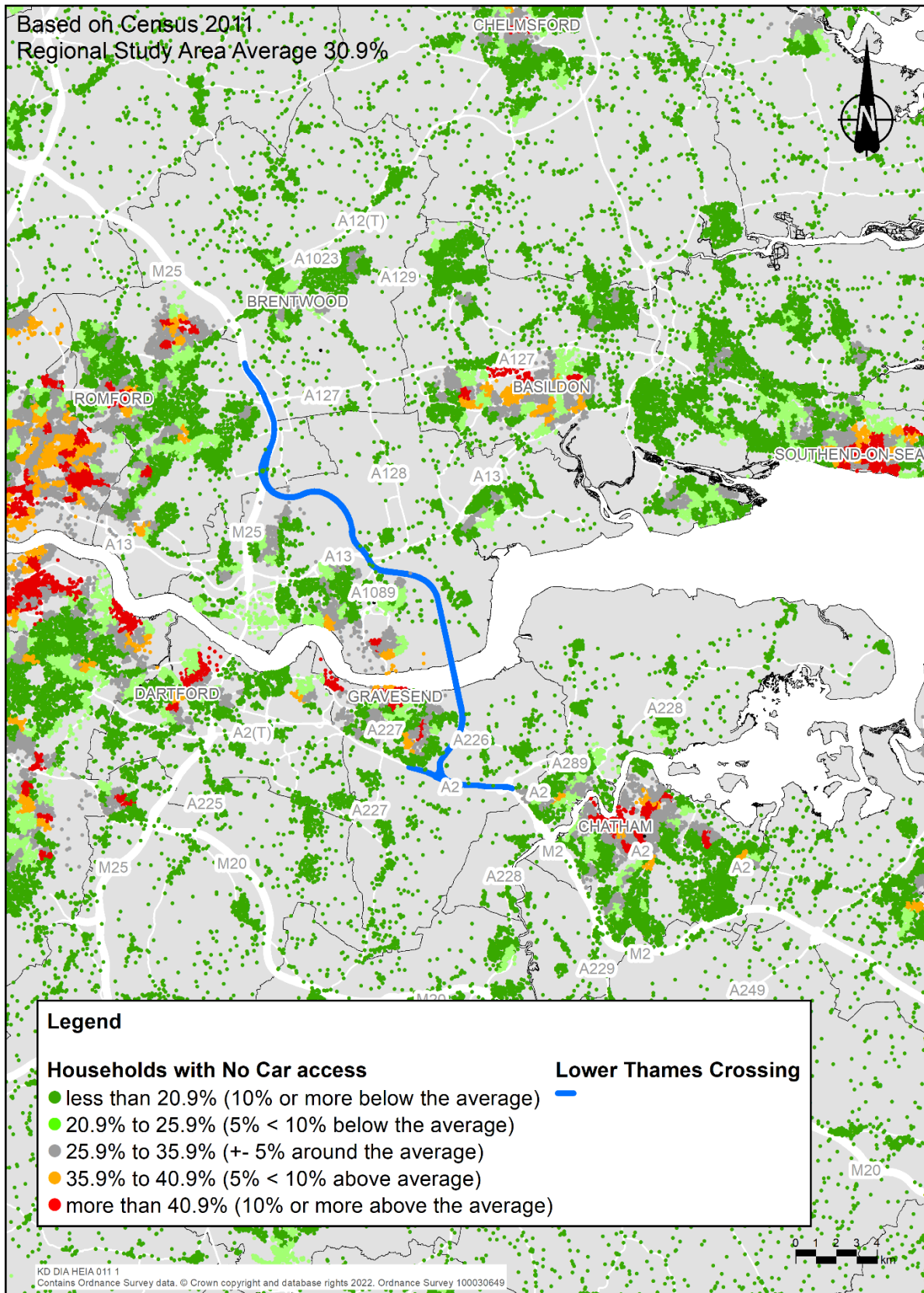


Plate B.10 Proportion of non-car-available households, comparison with regional study area



Annex C Accidents

Table C.1 Worksheet for assessing accidents

	Existing casualty rate for vulnerable users		
	Defined vulnerable casualty group		
	Low (more than 30% of average rate for class of road)	Medium (<30% lower to <30% higher than average rate for class of road)	High (more than 30% higher than average rate for class of road)
1. Change in physical layout that could impact on defined vulnerable group			
Significant improvement	Moderate Beneficial	Moderate Beneficial	Large Beneficial
Slight improvement	Slight Beneficial	Slight Beneficial	Moderate Beneficial
Neutral	Neutral	Neutral	Neutral
Slight worsening	Slight Adverse	Slight Adverse	Moderate Adverse
Significant worsening	Moderate Adverse	Moderate Adverse	Large Adverse
2. Change in traffic flow OR speed			
Significant reduction (>15% decrease)	Moderate Beneficial	Moderate Beneficial	Large Beneficial
Slight reduction (>5%, <15% decrease)	Slight Beneficial	Slight Beneficial	Moderate Beneficial
Neutral (<5% increase or decrease)	Neutral	Neutral	Neutral
Slight increase (>5%, <10% increase)	Slight Adverse	Slight Adverse	Moderate Adverse
Significant increase (>10% increase)	Moderate Adverse	Moderate Adverse	Large Adverse

	Existing casualty rate for vulnerable users		
	Defined vulnerable casualty group		
	Low (more than 30% of average rate for class of road)	Medium (<30% lower to <30% higher than average rate for class of road)	High (more than 30% higher than average rate for class of road)
3. Change in numbers of pedestrians, cyclists and motorcyclists			
The percentage of casualties that are pedestrians and cyclists for links that are forecast to have more than 50 casualties or more over a five year period and are not motorways is within the average for the affected links. The percentage of casualties that are motorcyclists is within the average for the affected links.			
Overall assessment for link, based on criteria 1, 2 and 3 above			
There is no distributional impact by vulnerable user group.			
Qualitative commentary			

Table C.2 Distribution of accidents and casualties by road type, severity of accident and casualty vulnerable group, 2015–2019, regional study area

Road type	Casualties						
	Total	Pedestrians	Cyclists	Motorcyclists	Under 16	16 to 25, male	Over 70
Motorway	12,654	62	2	449	903	2,603	228
A(M)	754	4	2	38	50	149	14
A	149,723	19,610	18,125	24,855	12,773	36,855	4,554
B	28,954	4,257	3,815	4,019	2,777	6,245	1,244
C	22,607	4,314	3,152	3,159	2,628	5,267	727
Unclassified	78,109	15,310	10,259	8,216	10,578	15,446	3,243
Total	292,801	43,557	35,355	40,736	29,709	66,565	10,010
Road type	Percentage						
	Total	Pedestrians	Cyclists	Motorcyclists	Under 16	16 to 25, male	Over 70
Motorway	100%	0%	0%	4%	7%	21%	2%
A(M)	100%	1%	0%	5%	7%	20%	2%
A	100%	13%	12%	17%	9%	25%	3%
B	100%	15%	13%	14%	10%	22%	4%
C	100%	19%	14%	14%	12%	23%	3%
Unclassified	100%	20%	13%	11%	14%	20%	4%
Total	100%	15%	12%	14%	10%	23%	3%

Annex D Severance

Plate D.1 Potential traffic related severance locations and amenities

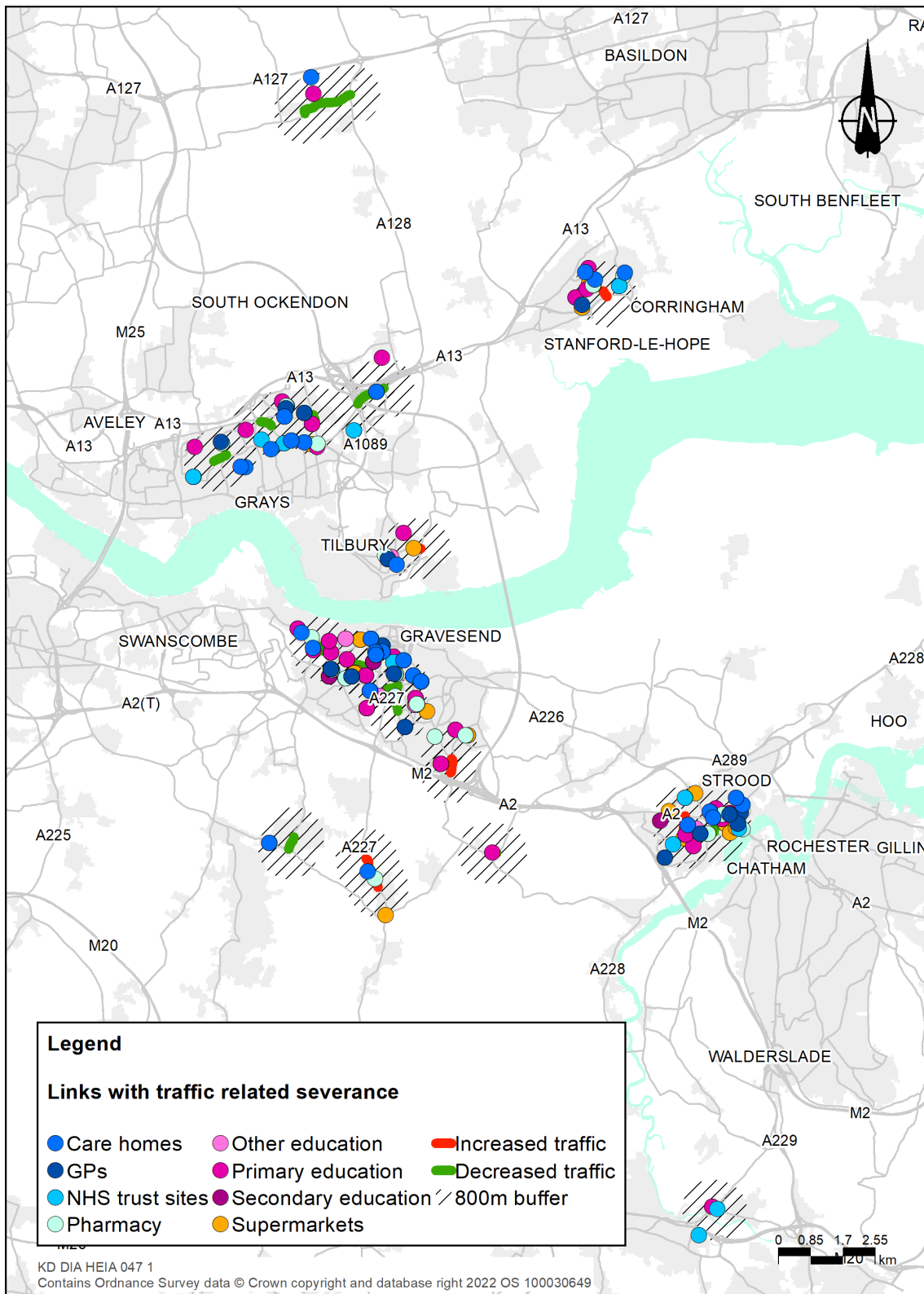


Plate D.2 Potential traffic related severance locations and open space

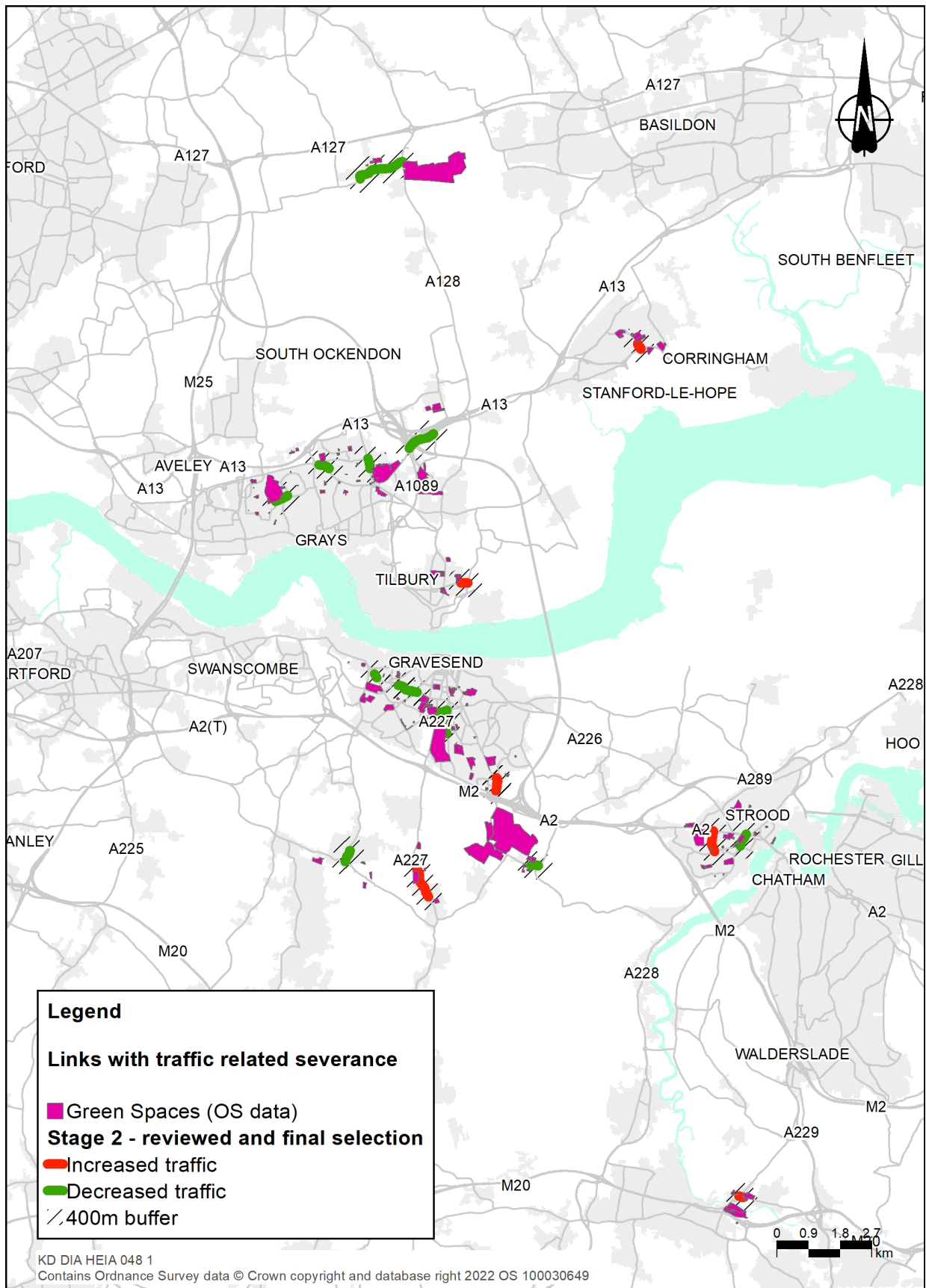
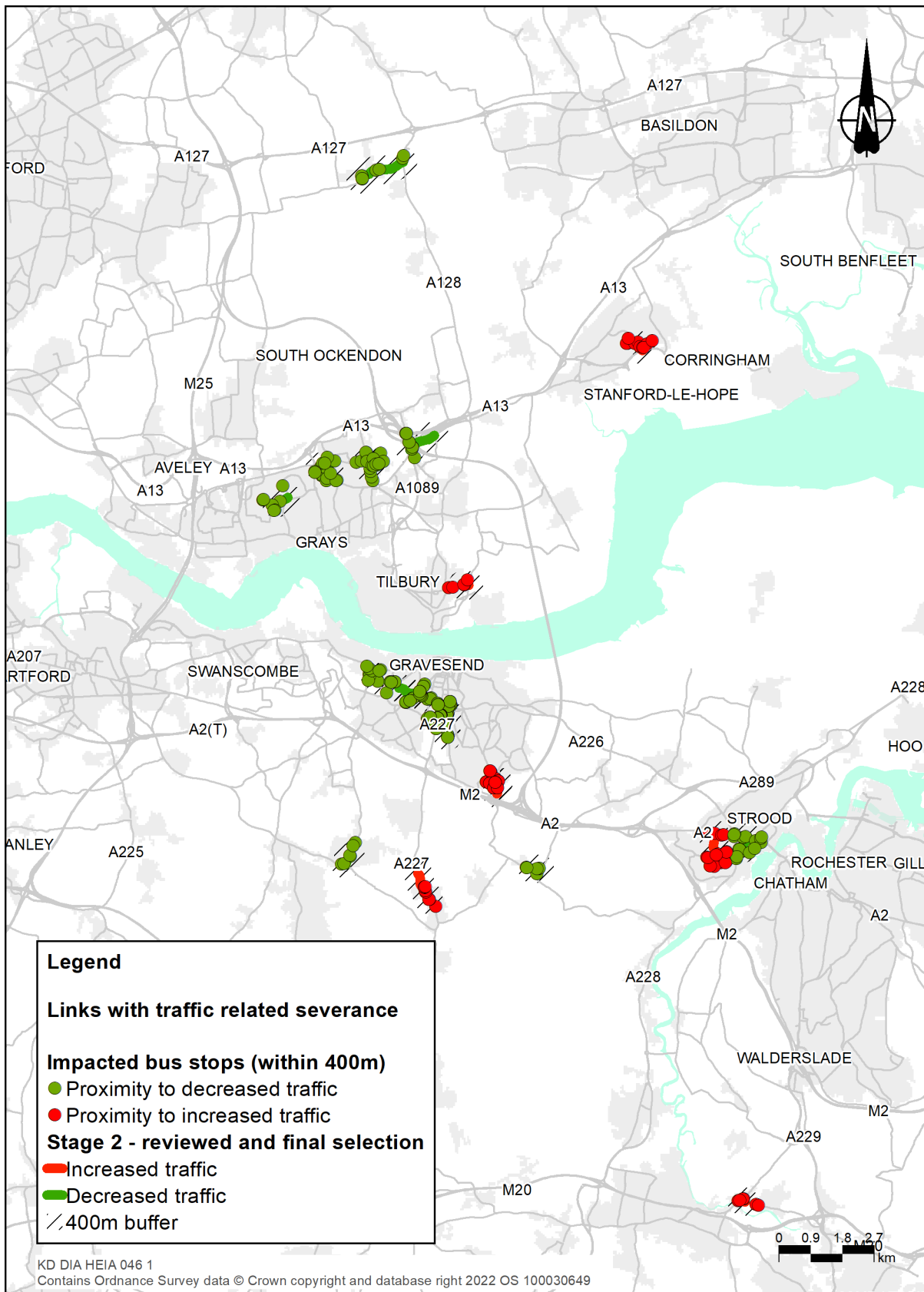


Plate D.3 Potential traffic related severance locations and bus stops



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Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

National Highways Company Limited registered in England and Wales number 09346363