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Wellbeing Appraisal for Low Traffic Neighbourhoods. Underpinning evidence and assumptions

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Abstract
Low Traffic Neighbourhoods (LTNs) are a series of measures to reduce traffic volumes and increase active modes of travel in residential areas. They typically restrict cars from certain streets and can include bollards or planters to redirect cars, as well as cameras to monitor and enforce restrictions. In some areas their implementation is controversial, with outspoken opposition. Evidence suggests they can increase wellbeing mainly through active travel and improvements in physical health, but evidence also points to a reduction in injuries, an improvement in neighbourhood interactions and improvement in air quality in the neighbourhood. Wellbeing losses are likely to come from increases in driving time as well as feelings of restriction. This paper evaluates whether, given these pros and cons, they offer good value for money.

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Sara MacLennan, Centre for Economic Performance at LSE.

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Wellbeing Appraisal for Low Traffic Neighbourhoods. Underpinning evidence and assumptions[1]

Background

Low Traffic Neighbourhoods (LTNs) are a series of measures to reduce traffic volumes and increase active modes of travel in residential areas. They typically restrict cars from certain streets and can include bollards or planters to redirect cars, as well as cameras to monitor and enforce restrictions.

Theory of Change

Evidence points to a number of changes stemming from low traffic neighbourhoods (LTNs) which can, in turn, impact on wellbeing:

- Low traffic neighbourhoods **increase the amount of walking and cycling**[2], which has been shown to directly improve wellbeing when there is an increase in the amount of walking or cycling or a switch from driving[3]. The best available evidence for the impact of LTNs on resident physical activity comes from LTNs with associated cycling infrastructure. We assume that the LTNs modelled here are supported with high quality cycling and walking infrastructure.[4]
- An increase in walking and cycling has been shown to **improve physical health**, which has links to overall wellbeing as well as impacts on estimated mortality.[5]
- In these spaces, **perceptions improve as to how safe and pleasant it is to cycle,** and how safe it is for a child to walk.[6]
- LTN introduction is generally associated with a **drop in street crime** inside the LTN. This may in part be due to more 'eyes on the street' via increased walking and cycling
- Low traffic neighbourhoods have been shown to **reduce** road traffic crashes / collisions. Police injury data showed that casualty numbers reduced after the implementation of LTNs in London, with even a reduction in cyclist and motorcyclist crashes / collisions on boundary roads[7]. Separate to LTNs, high quality cycling infrastructure has been shown to decrease accidents and fatalities.[8]

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[1] We are grateful to Anna Goodman for her significant contributions to this paper and sharing her expertise in the evidence surrounding low traffic neighbourhoods.

[2] Aldred et al (2024) use 6 years of longitudinal data from Outer London, and find that changes in active travel behaviour were largest and had the strongest evidence for those living in low traffic neighbourhoods. Most of the increase in absolute terms was in time spent walking, although the increase in cycling was larger in relative terms and cycling also showed the strongest evidence of increased participation.

[3]For example, after accounting for potentially-confounding area-level and individual-level socioeconomic and commute-related variables, walking commutes in London (but not other modes) were associated with significantly higher life satisfaction compared to driving.
Chng et al (2016)

[4]We take the evidence directly from the introduction of LTNs in London. This is backed up by review evidence which suggests that changes in the physical environment can encourage walking and cycling, through: (i) improving accessibility and connectivity; (ii) improving traffic and personal safety; and (iii) improving the experience of walking and cycling, all which are a focus of LTNs with high quality infrastructure.

[5] Which in turn increases total lifetime wellbeing

[6] Aldred and Goodman, 2021

[7] Furlong et al (2025, in press)

[8] Evidence from the US: Wesley et al, (2019) and from London: Adams and Aldred (2020)

- Evidence has shown **reduced traffic on LTN streets**[9]. Separate research has shown that reduced traffic load is associated with a greater social network, which in turn has a positive association with wellbeing and mental health.[10] The associated cycling and walking paths may also lead to better street connectivity, which has also been shown to be positively correlated with a **greater social network**[11].
- This reduction in car volumes inside LTNs also means that those in the neighbourhood benefit from improvements in **air quality**[12] and reductions in **noise**[13].
- On boundary roads, evidence is more mixed. One systematic review of London schemes found little average change in traffic volumes on LTN boundary roads[14] but other analysis has suggested an average increase in congestion on boundary roads in the first year of operation (although not subsequently)[15] which could have impacts on air pollution and noise. For air quality, studies have shown a mix of minimal reductions, no reductions and some increases in emissions of air pollutants in boundary areas.[16]
- For car-owning residents living inside LTNs, the total annual distance travelled by car decreases.[17] This may reflect some car trips shifting to another mode (e.g. cycling rather than driving to the supermarket); other car trips shifting to a nearer destination (e.g. a local supermarket not a more distant supermarket); and still other car trips not being made (e.g. driving to the supermarket only once per week not twice). However, for those trips that residents do still drive, some journeys by car are expected to become more circuitous and take longer.
- LTNs are often controversial. The restrictions that LTNs impose on car travel may be perceived by some as a nuisance, or as an unfair policy intervention, which deprioritises their mode of transport or their street in favour of other modes or other streets. This is a "real" subjective wellbeing impact, independent of objective effects, due to people's perceptions.

There are a number of distributional impacts:

- Location: Residents within LTNs benefit, but those in boundary roads and surrounding area may suffer from additional traffic in the first year(s). This is modelled in the analysis.
- Disability: people with a disability who use their cars as a mobility aid are a group where the costs could potentially fall more heavily. However, these journey time costs are typically mitigated with blue badge exemptions[18]. In addition, people with a disability are also a group with five times the injury rate when travelling as pedestrians[19] , so may also benefit particularly[20].
- Underrepresented groups: interim analysis by Fevyer et al. suggests that as well as total cycling volumes increasing inside LTNs, the share of cyclists that are women and children also increases, (from a baseline where cycling in London is very dominated by adult males)

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[9] Thomas and Aldred (2024)
[10] Leslie & Cerin (2008)
[11] Leslie & Cerin (2008)
[12] Yang, X., McCoy, E., Hough, K., & de Nazelle, A. (2022).
[13] Leach et al (2024)
[14] Thomas and Aldred (2024)
[15] Forthcoming analysis
[16] IPSOS (2024)
[17] Goodman et al (2023)
[18] E.g. details from Haringey Council [Exemptions from low traffic neighbourhoods | Haringey Council]
[19] Aldred (2018) https://doi.org/10.1016/j.jth.2018.03.006
[20] This means that both the cost and the benefit may be magnified on average for disabled people. See e.g. https://www.transportforall.org.uk/wp-content/uploads/2023/11/Pave-The-Way-full-report.pdf
Different disabled people have different mobility needs so the costs and the benefits are likely to be unequally distributed within disabled people.

- Income: car owners on average have higher incomes[21]. This is the group who are likely to disproportionately face the wellbeing costs of disruption. In comparison all residents, across all income levels, gain the wellbeing benefits from a safer and more pleasant surrounding. Concurrently, improved surroundings *may* increase house prices and rent: there is no evidence for LTNs, but a study of low emissions zones[22] suggests they increased rent by 2%,[23] which may offset any improvements in wellbeing for those renting[24].

In this analysis, we present two scenarios. In one scenario, these LTNs are supported with high quality cycle and walking infrastructure in the surrounding area, as was done for the LTNs created in Waltham Forest in London; in another there is no further supporting infrastructure in the surrounding areas.

Assumptions: Benefits

Analysis is done per 'example modelled' LTN network of 1km^2 [25], with 5,000 residents[26] and 7,900 people living in areas surrounding LTNs and touching on boundary roads.[27] This is a lower density compared to the LTNs which were introduced in, for example, London in the past year. However, since the costs and benefits are on a per person basis, the overall analysis holds where the density is higher.

We assume that:

- **On average, residents walk almost 10mins more every day**. Using controlled longitudinal data from London, Aldred et al (2024) estimate that residents in LTNs with active travel infrastructure walk an additional 67minutes per week, on average[28]. For the wellbeing evidence, Martin et al (2014) use a linear fixed effects model and find that (compared to a baseline of driving) walking for an additional 10mins per day improved GHQ-12 scores by 0.083. This can be roughly translated into a life satisfaction increase of 0.02 WELLBYs, [29] using a conversion of 0.21 (Parkes, 2025).
- **5% of people in the neighbourhood start to walk or cycle.** The increase in numbers cycling and walking is broadly based on the impact of LTNs with high quality cycling and walking infrastructure. Using controlled longitudinal data from London, Aldred et al (2024) also

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[21] Percentage of households with cars by income group, tenure and household composition: Table A47 - Office for National Statistics (ons.gov.uk)
[22] a policy which also restricts traffic with the aim of improving air quality
[23] Gruhl et al (2025)
[24] A group with on average lower income
[25] Note that, of the 105 LTNs analysed in London, the mean was 0.35km^2, with only 16% above 0.5km^2 and only 6% over 1km^2. However, many councils put multiple LTN next each other to create an LTN network. Since we are often drawing from evidence from such larger programmes (e.g. Waltham Forest, Lambeth), we assume this larger 1km^2 size.
[26] Priority for LTNs is in urban areas with higher population density, therefore this is roughly based on relevant ONS LSOA population density. Population density for "inner city cosmopolitan" is 10,747.;. However, average urban population density is 3,500. 5,000 was chosen as a reasonable middle ground. Islington, an area with implemented LTNs in London has a population density of 16,321 people per km2.
[27] Matching the proportions in within and boundary areas which were calculated in analysis by Aldred et al (2021a) see table 2.
[28] Plus an additional 21minutes of cycling, but this is not included since the wellbeing evidence from Martin et al (2014) is for walking
[29] Martin et al (2014): linear fixed effects model
0.48 from Chng et al (2016) based on evidence from London, but cross sectional

found a 38% increased likelihood of cycling and a 7% increased likelihood of walking[30] when living in an LTN with high active travel infrastructure compared to a control group with no changes. This means just over 5% of the adult population start walking or cycling.[31] Martin et al (2014) also estimate that cycling or walking to work (compared to a baseline of driving) improved GHQ-12 scores by 0.185 (significant at 1%). This can be roughly translated into an increase of 0.04 life satisfaction points (on a 0-10 scale), which is 0.04 WELLBYs when we assume no adaptation. Switching from car travel to active travel was estimated to increase GHQ-12 scores by 0.479, which can be roughly translated to 0.1 WELLBYs. We take the lower figure (i.e. 0.04 WELLBYs) to be more conservative.

- To avoid double counting, we exclude the additional minutes walking for those who are assumed to switch to active travel. We include only the 80% of the average population who are aged 16+, since the analysis of change in active travel was based on those aged 16+. However, this may be an underestimate, given that many children may also start to walk or cycle to school.
- **Calculation**:
  5,000 x (100%-5%) x (80%) x 0.02 WELLBYs per year (wellbeing benefit of walking 10mins extra per day)
  \+ 5,000 x 5% x 0.04 WELLBYs per year (wellbeing benefit of initiating active travel)

For the surrounding area, we have two scenarios.
Where we assume there is no further supporting infrastructure, we are conservative and assume there are no changes in active travel.
Where LTNs are implemented as part of a wider active travel investment, such as cycle lanes and walking infrastructure in the surrounding area, we take the findings from Aldred et al (2024) of the average change in active travel in non-LTN areas with high quality cycling infrastructure[32]. Based on this increase of 30mins walking per week compared to control areas, we assume a 5min increase in walking per day on average across all residents (minus the 2% who switch, below) and a linear relationship with length of time walking and wellbeing impact, a wellbeing increase of around 0.02 WELLBYs per adult resident on average.

2% of the adult residents are assumed to start to cycle or walk, based on the evidence from Aldred et al (2024) of the %s of those doing any walking or cycling in the past week (adjusted rate ratios) [33]. Due to the assumptions required, these figures need to be understood only as illustrative estimates of the scale of likely wellbeing benefit.

Calculation:
7,900 x (100%-2%) 80% x 0.02 WELLBYs per year (assumed estimated wellbeing benefit of walking 5mins extra per day)
+ 7,900 x 2% x 80% 0.04 WELLBYs per year (wellbeing benefit of initiating active travel)

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[30]And a 107minute increase in active travel per person per week. 95% CI: 52.7minutes to 161.9minutes of additional active travel, in comparison to control area with no changes in infrastructure. This improvement is also backed up by further, forthcoming analyses in Oxford and London.

[31] Since 16% of people currently cycle at least once a week in England and 78% of people currently walk for 20mins or more 'more than once a week' and 58% more than 3 times a week. National Travel Survey 2021: Active travel - GOV.UK (www.gov.uk) this represents an increase of 6% and 5% respectively

[32] Compared to the control areas.

[33] Average across waves 1 to 5, Table 3 From Aldred et al (2024). Since 16% of people currently cycle at least once a week in England and 78% of people currently walk for 20mins or more 'more than once a week'. National Travel Survey 2021: Active travel - GOV.UK (www.gov.uk) an increase of 22% in cycling and 2% walking represents an increase of 3% and 2% respectively of the total resident group.

- **An increase in physical activity also reduces premature death**. This has been calculated using DfT's methodology,[34] and inputs of 21.5 additional minutes cycling and 66.6 additional minutes walking from Aldred et al's (2024) analysis of London's active travel infrastructure[35]. This estimates per year per 'average' modelled area: **1.16 deaths avoided** and thus around 21.8 avoided Years of Life Loss (YLL) due to the reduction in premature deaths. See Annex 1 for further detail of the calculation.

  Calculation: On total across all age groups, this leads to: 21.8 avoided YLL which we monetise using the value of a QALY / statistical life year of £70k[36]

  Since we assume no change in physical activity in the surrounding area, there are no changes to premature death. In the supporting scenario where there are high quality cycle lanes in the surrounding area, the increases of 31 extra minutes walking and 10 extra minutes cycling per week from Aldred et al (2024)[37] would lead to 16.1 avoided YLL.

  Calculation: On total across all age groups, this leads to: 16.1 avoided YLL which is monetised as above.

  An increase in physical activity has also been shown to reduce absenteeism, with implications for GDP. This is not included in these wellbeing-focussed calculations. [38]

- **Road traffic crashes reduce.** We use evidence from Furlong, J et al. (in press) of 5.24 injuries averted per km2 per year inside LTNs, of which 0.86 are KSIs. In recent years a 3% around KSIs in London have been fatalities[39], which is used to estimate deaths avoided. The wellbeing impact of injuries is calculated using QALYs. Specifically, using estimates of the QALY loss for a non-hospitalised road crash injury to a lower or upper extremity injury of around 0.1 QALYs in total and a conservative estimate of 1.5 QALYs in total for KSIs[40]

  Calculation: Avoided fatalities: 0.86 avoided KSIs x 3% of KSIs fatal =0.026 avoided fatalities per year. This can be converted to years of life lost through multiplying by the 45 average years of life lost for age group

[34] See details https://www.gov.uk/government/publications/tag-unit-a5-1-active-mode-appraisal and TAG Unit A4.1 - Social-impact-appraisal_Nov 2022_Accessible_v1.0 (publishing.service.gov.uk)
[35] See Impacts of active travel interventions on travel behaviour and health: Results from a five-year longitudinal travel survey in Outer London - ScienceDirect Directly using the downloadable spreadsheet in Appendix 2, amending to the population numbers in this example
[36] For the purposes of this project, we use the UK Gov't monetary values for impacts which already have a monetised value, such as a QALY / statistical life year and e.g. tonne of Co2e. WELLBYs are assessed and monetised for impacts which do not have an existing method of monetisation.
For a focus on wellbeing cost effectiveness, i.e. measuring everything in wellbeing, these impacts could also be converted to WELLBYs. This alternative calculation would apply the average of 7.5 WELLBYs per adult per year, the average level of life satisfaction for adults in the UK.
[37] Of an additional 30mins of walking, additional 10mins of cycling on average across the waves
[38] See e.g. Table 4 of TAG Unit A2.1 wider economic impacts appraisal, May 2025
TAG unit A2-1 wider economic impacts - GOV.UK
[39] Casualties in Greater London during 2023 – Data Release [online]. London: TfL; 2024.
https://content.tfl.gov.uk/casualties-in-greater-london-2023.pdf (accessed: 10 October 2024).
(95 fatalities) / (95 fatal + 3615 serious) injuries in London in 2023 = 2.6%
[40] See table 5 Spicer et al (2011) Quality-Adjusted Life Years Lost to Road Crash Injury: Updating the Injury Impairment Index - PMC Overall QALYs in this paper have been discounted at 3%

Injuries (QALYs): (5.24-0.86) avoided non hospitalised injuries x 0.1 QALYs = 0.44 QALYs
(0.86 x 97%) avoided hospitalised injuries x 1.5 QALYs = 1.25 QALYs

For the surrounding area, we use evidence from the same paper which found 0.32 averted cyclist and motorcyclist injuries on LTN boundary roads, per km2 per year, of which 0.08 were KSIs. Injuries and fatalities are calculated using assumptions as above.
Calculation: Avoided fatalities: 0.08 x 3km2 (assumed boundary area) x 3% = 0.01 avoided fatalities. Years of life lost: 0.01 deaths avoided x 45 average years of life lost for age group 20 to 49 x 7.5 WELLBYs per year (average LS in the UK) = **2.4 WELLBYs per year**
Injuries (QALYs): (5.24-0.86) avoided non hospitalised injuries x 0.1 QALYs=0.1 QALYs
(0.86 x 97%) avoided hospitalised injuries x 1.5 QALYs=0.47 QALYs

This may be an underestimate given that a 2002 study from London estimated that approximately 30% of serious and slight injuries are not captured in Stats19, alongside around 15% of fatalities.[41]

- These early deaths avoided also avoid the wellbeing loss to partners and families associated with widowhood, a wellbeing loss on average of 0.86[42] reducing by 0.1 every year.[43]

  Calculation: 1.16 deaths avoided from physical activity (0.86 in surrounding areas) + 0.026 deaths (0.01 in surrounding areas) avoided from reduced road crashes x 61% of people with a partner x 0.86 WELLBYs, reducing each year by 0.1 WELLBYs

- **That air quality improves in line with the findings from areas in London which introduced traffic calming areas**, reducing NO2 within intervention areas by 5.7%[44]. Taking the average No2 urban concentrations[45] and findings from Knight and Howley (2017)[46] on the potential wellbeing impacts represents an improvement of 0.002 WELLBYs per resident inside the LTN. We assume that this also holds for children.
  Calculation: 5,000 residents x 0.002 WELLBYs per year (LTN area) = 8.5 WELLBYs per year

  For boundary areas, evidence shows a mix of reductions, no reductions and some increases in emissions of air pollutants, as summarised in a recent review[47]. We take the assumption that on average over the 10 years of the appraisal, there are no statistically significant increases in air quality.
  Calculation: 7,900 residents in boundary areas x 0 WELLBYs per year = 0 WELLBYs per year

[41] Ward et al (2002)
[42] Lucas et al (2003)
[43] There could be a wider group of family and friends who would have otherwise been impacted by the death of a loved one, which is avoided through these avoided deaths.
[44] Yang, X., McCoy, E., Hough, K., & de Nazelle, A. (2022). Evaluation of low traffic neighbourhood (LTN) impacts on NO2 and traffic. Transportation Research Part D: Transport and Environment, 113, 103536.
[45] 15.6 µg/m3 in 2022 Nitrogen dioxide (NO2) - GOV.UK (www.gov.uk) Average roadside concentrations were of 23.6µg/m3 in 2022. **Taking roadside concentrations as the value would amend the WELLBY per person per year to 0.003 in the LTNs and 0.004 in boundary areas**
[46] -0.003 per µg/m3 in the fixed effects model for Life Satisfaction on a 1-7 scale.
Calculation: 0.003 x 7/11 (translation to 0-10 scale) x roadside concentrations of 23.6 x improvement of 5.7% = 0.003 WELLBYs/ person/year
MacKerron and Mourato (2009) also find NO2 concentration is significant, with a negative impact on LS ratings of -0.042 points per 10 µg/m3 in the OLS model. This would represent a WELLBY impact of 0.006 per person per year
[47] PISOS (2024)

- Evidence shows that LTNs reduce traffic noise.[48] However, the study we have used to estimate the WELLBY benefits of air quality did not control for noise, meaning that the positive impacts of noise may also be partially captured in the above estimates for air quality. We do not include the wellbeing benefits of **lower levels of traffic noise** in addition to avoid double counting.

- **That crime reduces in these neighbourhoods in line with the findings from the roll-out of LTNs in London[49]**: although these papers show 10% reduction for Waltham Forest compared to the adjacent area and a 7% decrease compared to other areas for the wider roll out, we take the most conservative assumption in the literature, which is a 4.9% drop[50] compared to other comparable non LTN areas. Given a starting crime rate of 10% in the relevant analysis of LTNs[51], this leads to a reduction of around half a point in the crime rate. Dustmann and Fasani (2016) find that a 1% increase in crime reduces LS by 0.0025[52] [53] and we assume that the inverse (a decrease in crime) has the same relationship. We assume that this only holds for adults, since there is no evidence of the relationship between crime rate and wellbeing for children.
  Calculation*:* 5,000 residents x 80% x 0.0025WELLBYs for 1% x 0.5 (half a percentage point change)

- **That neighbours begin to talk to each other more, with an increased sense of community.** In a survey of those living in LTNs across the UK, 22% agreed with the statement that LTNs had helped to create a sense of community in my local neighbourhood[54]. Wellbeing evidence suggests that an improved sense of community, or greater social interactions, is positive for wellbeing. Compared to a baseline of never speaking to your neighbours, Powdthavee (2008) finds that speaking to them 'once or twice a week' improves life satisfaction by 0.045. We assume that 6.7% of adult residents start to talk to neighbours once or twice a week. This is as assumption, based on initial evidence[55] of adult residents' response to the question "I regularly stop and talk to people in my local area" and the change over time following the introduction of an LTN (4.9% had a net positive change[56]), compared to the difference in a control group (-1.8% net positive change – i.e. a negative

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[48] Leach et al (2024)

[49] Aldred and Goodman (2021) [The Impact of Introducing a Low Traffic Neighbourhood on Street Crime, in Waltham Forest, London | Published in Findings (findingspress.org)](#)
[Short-Term Association between the Introduction of 2020 Low Traffic Neighbourhoods and Street Crime, in London, UK | Published in Findings (findingspress.org)](#)

[50] Goodman et al (2021) using only data from inner London, compared to inner London non-LTN control areas during the same time period. Note that this paper used data during years of the covid19 pandemic, when crime was down in general, which is a limitation. In the same paper, outer London areas showed larger effects than this, as did Waltham Forest, which was data collected pre-Covid 19 pandemic. 4.9% relative change is the most conservative choice from the published literature.

[51] Number of reported street crimes per population. Calculated from Table 2 in Goodman et al (2021a) using the rate per 1000 population

[52]See Crime chapter. They concluded that a 1% increase in the crime rate raised average score on the GHQ 12 by 0.0119 points. From our own research we know that a 1 point increase in GHQ produces a 0.21 point fall in life-satisfaction (see annex 2) Thus a 1% increase change in crime produces a 0.0025 fall in life-satisfaction

[53] Alternatively, in addition to the impact on victims, evidence from Hanselmaier (2013) has shown that a doubling of fear of crime is associated with -0.3 drop in SWB. We could assume that fear of crime drops e.g. for 10% of the residents.

[54] [Low Traffic Neighbourhoods research report (publishing.service.gov.uk)](#) 27% disagreed

[55] From https://doi.org/10.32866/001c.21390 .

[56] moved from 'disagree' or 'strongly disagree' to 'agree' or 'strongly agree' minus the proportions who moved from 'strongly agree' or 'agree' to 'strongly disagree' or 'disagree'

change). This is supported by qualitative evidence demonstrating that changes in public realm can change community interactions[57]. We apply this only to adult residents.
Calculation: 5,000 residents x 80% x 6.7% x 0.045 WELLBYs per year

- **There is additional travel time for those who remain driving cars, due to journeys requiring more circuitous routes.** Evidence from LTNs demonstrated that the increase in journey time during the first year of operation tended to reduce in year 2 or 3 after introduction.[58]
  We assume they suffer a wellbeing drop of 0.0054 WELLBYs per additional minute per day (one way), from Stutzer and Frey (2008). The estimate of the additional time spent driving is based on Laverty et al's analysis[59] of travel time in English LTNs. This used data on estimated journey duration from Google direction API. A "basket" of journeys from: i. inside the planned LTN, ii. near the LTN and iii. inside and iv. near control areas were randomly selected and the increased travel time from inside and near the LTN was compared to the change in travel time from inside and near the control group.

  For the first year after LTN introduction, this showed an average increase of +2.0 minutes at peak time and +1.5minutes at off-peak times for journeys that started or ended inside new LTN areas <1km, +1.5minutes and +1.3minutes for peak and off peak respectively for those >1km. This change in driving time compared to walking or cycling time for small trips influences behaviour change in the following years: year 2 and 3 demonstrated a drop to no significant increase for journeys <1km, a reduction to 0.7 additional minutes for those >1km. To estimate the wellbeing impact, we assume that additional minutes of driving for all purposes (including e.g. shopping, visiting friends) has a wellbeing disbenefit equivalent to that found for commuting, we multiply the estimated additional minutes per journey by the total number of journeys made by car per person per year[60] estimate the additional minutes per day and divide by 2, to apply the 'one way' commuting time wellbeing disbenefit from Stutzer and Frey. This gives an average value of 0.004 WELLBYs per person living in the LTN for year 1; 0.001 WELLBYs for year 2 onwards.
  Calculation: Assumption of 4,000 adult residents in LTN[61] x 0.004 WELLBYs for year 1, x 0.001 WELLBYs for year 2 onwards

  For those in the surrounding area, ie. journeys starting or ending near to an LTN, there was little impact on driving duration. The pooled estimate was +0.5minutes at peak and off-peak times, a relative increase of 3-4%, which reduced to 0 by year 2. The calculation above gives 0.001 WELLBYs per person living 'near' the LTN in year 1, dropping to 0 by year 2.

  Calculation: Assumption of 6,300 adult residents in 500m surrounding area[62] x 0.001 WELLBYs per year for year 1 only

  There will also be further people who may have previously travelled through the LTN area as

[57] Systematic review of community infrastructure (place and space) to boost social relations and community wellbeing: Five year refresh - What Works Wellbeing
[58] Personal communication based on Laverty et al (Forthcoming).
[59] Laverty et al (Forthcoming).
[60] Splitting by those <1mile and >1mile as a conservative approximation for 1km. We include journeys made by car as a driver and as a passenger. We do not differentiate between peak and non-peak time but rather take the conservative assumption that the peak journey difference is observed for all journeys
[61] Since the journeys are based on average per person, this is calculated for each resident, not just the 78% of people living in a household with a car
[62] As above, since the journeys are based on average per person, this is calculated for each resident, not just the 78% of people living in a household with a car

part of a longer journey and now have to take a slightly more circuitous route. In reality, longer distances will have so many different options for navigation that the route will adjust for this. However, as set against this, there may be an increase in congestion in the first year that delays some of these journeys. We therefore assume that the additional journey time associated with journeys starting or ending near an LTN would apply.

Calculation: average number of cars passing per day x 0.001 WELLBYs for year 1 (i.e. assuming that these cars pass every day and have the additional 0.5minutes)
=4,500[63] x 0.001 WELLBYs per year for year 1 only

- **Lack of reliability** is an additional source of disbenefit. The above analysis of estimated google maps journey times[64] also demonstrated a **decrease in reliability,** for journeys <1km. For some journeys drivers would need to factor in a further additional 2-4 minutes of travel time to be confident of arriving by a given time.

  We do not directly have the number of WELLBYs associated with (lack of) reliability, but we can use evidence of life satisfaction measured 'in the moment' in various activities and locations. Krekel and MacKerron (2023) estimate the negative wellbeing impact of waiting during commuting is double that of commuting. Exploiting the randomised timing of surveys for identification, they arrive at a Value of Time (VOT) of £12.2 per hour of waiting, £8.4 per hour of commuting, and £17.2 per hour of waiting during commuting (e.g. due to congestion). We add this to the disbenefit calculated above.

  Based on the monetary value of time from Krekel and MacKerron's paper, the calculation above of additional journey time would be would be £85 in £ equivalent per average person[65]. Using the evidence from Laverty et al and including what could be interpreted to be 3minutes of waiting per journey for the proportion of journeys with reduced reliability[66] would be an additional £25 in £ equivalent per average person living in the LTN. Based on this ratio, we can roughly assume that there could be an additional 30% of disbenefit for those living in LTNs, in addition to the additional time.

  Calculation: Assumption of 4,000 adult residents in LTN[67] x 0.004 WELLBYs year 1 (0.001 WELLBYs for year 2 onwards) x 30% estimate of additional negative impact
  For surrounding areas: 7,900 residents in surrounding area x 0.004 WELLBYs year 1 (0.001 WELLBYs for year 2 onwards) x 30% estimate of additional negative impact

- **We assume that some people have a wellbeing drop from feelings of "unfairness".** This may be due to the perceptions of their mode of transport being deprioritised – i.e. cyclists and walkers being prioritised at the "expense" of cars. Or, a drop in wellbeing due to feelings of their mobility being restricted. Overall, a survey completed for the DfT[68] showed 77% of respondents in England supported the reduction of road traffic in towns and cities in

[63] Based on average data for minor roads in Camden Road traffic statistics - Local authority: Camden
[64] Ibid, REF
[65] £68 when calculated using the value of a WELLBY
[66] *From **Table Error! Main Document Only.: Pooled estimates across LTNs of the percentage difference between LTN and Control areas in the proportion of 'after' journeys where the longest journey exceeded by a given amount the typical (median) duration.***

[67] Since the journeys are based on average per person, this is calculated for each resident, not just the 78% of people living in a household with a car
[68] 2020 Public Opinion Survey on Traffic and Road Use - Phase 1 (publishing.service.gov.uk)

England, 78% supported it in their local area, and two-thirds supporting reallocating road space to walking and cycling.[69]
The choice of streets could also be perceived as unfair, for those who are outside the LTNs and end up on boundary roads, missing the positive impacts and with potential negative impacts. [70][71]

There is no specific evidence of the scale of this wellbeing drop for those in and around LTNs. This means we apply a switching point analysis – what scale would this drop in wellbeing have to be, to cancel out the estimated positive wellbeing impacts. This drop would have to be -0.1 WELLBYs for all adult residents in the LTN, for 5 years[72]. This is almost equivalent to the drop in life satisfaction which was experienced[73] by those living in Low Emissions Zones in Germany, a policy with much greater restrictions on car travel[74] and without the active support for walking or cycling, as is the aim of LTNs.[75]
If this feeling of unfairness only applied to the 24% of adults people who are opposed[76] to road space being reallocated to cycling and walking, the wellbeing drop would need to be around 0.5 per year, the equivalent wellbeing loss associated with unemployment. In the LTN area, the drop in wellbeing would have to be equivalent to that of Low Emissions Zones in Germany over 5 for all residents to outweigh the wellbeing benefits outlined above.

Assumptions: costs

For the government net costs, we assume:

- Costs of LTNs with long-term, high dosage cycle infrastructure, as established in London: £121 per resident[77] and a total of £560,000 per example modelled area
- Costs of maintenance are assumed at £2,000 per area per year[78]

For the scenario where the LTN is embedded in a surrounding area with cycle lanes, we assume costs of £1.8m in the surrounding area[79].
These are discounted at 3.5%, consistent with the Green Book.

[69] Specifically on LTNs, a poll in London showed 10% strongly opposed and 7% opposed LTNs. (https://redfieldandwiltonstrategies.com/plurality-of-londoners-support-expanding-londons-ultra-low-emissions-zone-ulez/). However we use the more general findings from DfT since although it is not focussed on LTNs, it is wider than London.
[70] A poll from London Steady Support for for Low Traffic Neighbourhoods in London - Redfield & Wilton Strategies suggested that **support for the introduction of Low Traffic Neighbourhoods is higher among respondents who say they currently live in an LTN (57%),** compared to 47% among those who do not live in one – even though specific analysis is lacking, it is likely that support is lower and opposition is higher specifically in boundary areas
[71] qualitative account of support and opposition in Birmingham https://doi.org/10.1016/j.tbs.2024.100800
[72] -0.13 for 5 years if all impacts are quantified in WELLBYs, -0.10 if including WELLBYs and QALYs
[73] See Sarmiento et al (2023) This analysis from Germany found a negative impact of -0.13 on life satisfaction for those living in LEZs in the first year, slightly weaker in the second year, before reverting to insignificance some five years after the treatment.
[74] restricting vehicles from entering specific geographical areas based on their emission intensity
[75] This same study found that the wellbeing drop was much smaller where there was greater public transport quality and accessibility, which could be interpreted as a proxy for alternatives.
[76] Or strongly opposed, see page 9
[77] Calculations from Aldred et al (2024)
[78] For some councils using speed cameras, the LTNs may raise more in fines than was cost to implement and maintain
[79] £600,000 per km for 3km

We also consider potential cost savings to government:

- Reduced costs to the NHS associated with physical inactivity, estimated with Sport England's MOVES tool[80] and with assumptions based on Aldred et al's (2024) longitudinal evidence from London active travel infrastructure. We only have averages and do not have the starting levels of physical activity, so we take central, conservative assumptions. This results in estimated cost savings of £2,328 per year within LTNs and £4,000 in the scenario where there is supporting active travel infrastructure in the surrounding area.
- There would also likely be reduced costs to the NHS through reduced casualties, for which we use the DfT estimates for medical and ambulance costs[81]. This gives a saving of £21.7k in LTNs and £5.3k in the surrounding area, using the figures of reduced injuries discussed above from Furlong et al (in press).
- Reduced costs of crime of £30,303 from 25 fewer crimes in the LTN area[82]

Combined totals and value for money assessment

This gives an overview of monetised wellbeing impacts as set out in the following tables. Due to the assumptions required[83], these figures need to be understood as illustrative estimates of the scale of potential wellbeing benefit stemming from each of the changes brought about by LTNs. This approach monetises years of life and QALY impacts from injuries directly and monetises WELLBYs for the remaining impacts. An alternative approach would be to assess all impacts in WELLBYs, with each year of life lost or gained valued with 7.5 WELLBYs, the average level of life satisfaction in the UK.

Table 1: Overview of monetised impacts per year (year 1) £millions – no modelling of wellbeing loss from opposition

Benefit or disbenefit		Inside LTN	Near LTNs – no cycle lanes	Near LTNs – with cycle lanes
Active travel - improvement in wellbeing	WELLBYs	£1.14	-	£0.83
Active travel - reduction in mortality	QALYs	£1.53	-	£1.13
Reduction in traffic deaths	QALYs	£0.08	£0.02	£0.02
Widowers	WELLBYs	£0.02	£0.00	£0.01
Reduction in injuries	QALYs	£0.12	£0.03	£0.03
Crime	WELLBYs	£0.07	0	0
Neighbourhood interactions	WELLBYs	£0.18	0	0
Air Quality	WELLBYs	£0.13	0	0
Noise				0
Increase in journey time for car drivers	WELLBYs	-£0.27	-£0.19	-£0.19
Increase in congestion	WELLBYs	-£0.08	-£0.03	-£0.03

[80] Measuring impact | Sport England
[81] £1,006 for fatal accident, £13671 for serious, £1,012 for slight, all in 2012 prices https://assets.publishing.service.gov.uk/media/60d057fbd3bf7f4bd842e3de/rrcgb-valuation-methodology.pdf
[82] Calculation: 4.9% reduction x 10% crime rate x 5,000 residents x cost of an average crime of £1,213 in 2023 values, from GMCA unit cost database
[83] and using extrapolations from studies rather than directly evaluating the wellbeing impacts

Total		**£2.92**	**-£0.17**	**£1.79**
Total combined LTN plus surrounding area			**£2.74**	**£4.71**

The above table highlights that, even though there is a positive wellbeing outcome overall, there are 'winners' and 'losers'. Without modelling the potential wellbeing losses from opposition, the estimated improvements in wellbeing are greatest in the LTN area, as would be expected, mainly driven by the wellbeing and mortality improvements from active travel. In the surrounding area, there are net wellbeing improvements estimated where there are investments in cycling and walking infrastructure in this wider area which supports active travel. Without these investments, we estimate that there could be a net wellbeing loss in the surrounding area, mainly driven by an increase in journey time and congestion for car drivers in the first year. The combined wellbeing benefit for the LTN plus surrounding area in the first year is positive overall, which masks the likely "losers" in the surrounding area.

However, an important omission is the feelings of opposition or unfairness which have been experienced through the implementation of LTNs in the UK. Since we do not have wellbeing evidence for the change in question, we carry out break even analysis, to assess how high these negative feelings would need to be, to outweigh the estimated positive wellbeing benefits. We assume that these negative feelings would last for 5 years, i.e. as was observed in Germany, that there would be adaptation or relocation of residents which would reduce this negative impact to 0.

Table2: Break even point for "feelings of opposition" within LTNs

Total discounted WELLBYs over 10 years[84]	2668
Number of residents: all adults in LTN	4,005 residents
Negative WELLBY impact for this group over 5 years to outweigh wellbeing benefits	0.13 life satisfaction points
Number of residents: those opposed to LTNs (24%, based on survey)	961 residents
Negative WELLBY impact of this group over 5 years to outweigh wellbeing benefits	0.6 life satisfaction points (comparison: 0.5 points negative impact of unemployment)

For residents inside the LTN, the wellbeing losses of the 24% on average opposed to LTNs would have to be equivalent to the wellbeing losses associated with unemployment – for 5 years – for these to outweigh the wellbeing benefits estimated to come from improved physical activity and a more pleasant environment. If we expand this to all residents, the losses in life satisfaction would have to be maintained for 5 years at the level estimated in Germany in the first year of Low Emissions Zone restrictions.

There is a time dimension: opposition will likely be experienced in the first years whereas the positive health benefits from active travel will be experienced over a longer time period.

[84] Excluding wellbeing reduction from congestion and increase in journey time, since this will partly be incorporated in the 'feelings of opposition'

Table 3: **Total costs and benefits, present value over 10 years, BCRs. Net benefits including illustrative estimates of unfairness**

£ millions PV, 10 years, 2023 prices	**Combination of LTN with no cycle lanes in surrounding area**	**Combination of LTN with cycle lanes in surrounding areas**
Net monetised benefits (QALYs and WELLBYs)	**£28.5**	**£47.0**
Total government costs	£0.6	£2.4
Cost savings from reduced fatalities, injuries and crimes	£0.5	£0.5
Net government costs	£0.1	£1.8

Adding cycle lanes in the surrounding areas can lead to a higher net wellbeing benefit in the over the 10 years, if it does increase active travel in this surrounding area, as has been suggested by initial evaluations. There are higher costs associated with this, as demonstrated in Table 3.

Conclusions:

- LTNs have been in places controversial, with outspoken opposition. Evidence suggests benefits to wellbeing mainly through increases in wellbeing from active travel and improvements in physical health, but evidence also points to a reduction in injuries, an improvement in neighbourhood interactions and improvement in air quality in the neighbourhood. Wellbeing losses are likely to come from increases in driving time as well as feelings of restriction.
- In short, there are wellbeing winners and losers, with this determined mostly by people's uptake of walking and cycling as well as psychological attitude towards restrictions on car driving (as opposed to, for example, determined by which road they live on)
- The potential overall wellbeing loss of those in surrounding areas could be mitigated where there is infrastructure to support active travel, so that residents there could also benefit from the associated health and wellbeing improvements. This is associated with higher costs.[85] It is also worth noting that as one rolls out a network of LTNs the number of people 'inside' a scheme increases relative to the number of people in surrounding areas.
- There is likely to be a wellbeing "transition" with initial losses, followed by gains. Over 10 years there are wellbeing gains when summed across all areas, representing good value for money. However, this could involve a few early years with net wellbeing losses, depending on the level of wellbeing loss from opposition. This overall wellbeing loss in the initial years could illustrate why LTNs have been challenging to maintain as a policy. However, the value for money over 10 years demonstrates that such policies are valuable for long term wellbeing.
- Low Traffic Neighbourhoods may be one of the more controversial changes to encourage active travel and improve neighbourhoods. Existing DfT analysis typically shown that investments in active travel are high value for money, with an average of a BCR of around 5[86].

[85] which has implications for the illustrative benefit cost ratio. It should be clear that these comparisons are only illustrative. In the scenario where there is further active travel infrastructure in the surrounding area, there are likely to be further benefits for those who live outside of the area, but travel through and can benefit from use of these cycle lanes. These benefits have not been calculated.

[86] Analysis of the value for money of active travel schemes, based on evaluations of funded projects, from Investing in cycling and walking: the economic case for action (publishing.service.gov.uk). Literature review BCR of 5.6 for UK projects DfT. Investing in Cycling and Walking: The economic case for action. 2015; & Impact of the Local Sustainable Transport Fund Summary Report. 2017.

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Annex 1: Calculations for active travel leading to changes in mortality

Methodology and tables below where reproduced are from TAG Unit A4.1 - Social-impact-appraisal Nov 2022 Accessible v1.0

Detail: WHO analysis sets out the dose-response type effect where greater levels of activity yield greater benefits to individuals, especially those induced to active modes from a relatively inactive lifestyle.[87]
This time is converted to Metabolically Equivalent Tasks (MET) hours using the Compendium of Physical Activities[88], where cycling is 6.8 METs and walking is 3.3 METs. METs provide a standard metric for physical exertion.
The mortality impact is calculated using log-linear relative risks (RRs) for all cause mortality for regular walkers and cyclists, relative to the presence of mortality in the population as a whole, based on Kelly et al 2014[89]).
The number of deaths avoided (or incurred) by age and gender is then estimated by multiplying the change in background mortality with the background mortality for that age and gender group. This is based on the Global Burden of Disease 2015 study results for England, as shown in table 3.4 below. It assumes that cycling and walking will not decrease mortality in the youngest age group (0-19).

[87] The World Health Organisation has produced the Health Economic Assessment Tool (HEAT) to conduct an economic assessment of the health benefits of walking and cycling, to support its inclusion in appraisal figures (WHO, 2007, 2011 & 2014). It estimates the value of reduced mortality risk that results from specified amounts of walking or cycling.
[88] Compendium of Physical Activities – Quantifying Physical Activity Energy Expenditure
[89] Kelly, P. et al (2014): Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship

Table 3.4: Background mortality rates by age and gender

Age group	Male	Female
0-19	0.00042	0.00032
20-49	000118	0.00071
50-64	0.00627	0.00419
65-80	0.02459	0.01669
80+	0.11471	0.09948

Source: 2015 Global Burden of Disease (GBD) Results for England

The number of deaths is then converted to Years of Life Lost (YLLs) by age and gender, using the same GBD 2015 study.

Table 3.5: Average discounted and undiscounted YLL loss per death.

	Discounted YLLs		Undiscounted YLLs	
Age group	**Male**	**Female**	**Male**	**Female**
0-19	47.7	48.0	81.7	82.8
20-49	34.1	33.6	47.2	45.9
50-64	23.7	23.7	28.9	29.0
65-80	15.1	14.3	16.6	16.3
80+	5.8	5.8	6.4	5.7

Source: calculation based on GBD 2015 results for England

Calculation: Applying this for the age group 20-49:

- An increase of cycling of 21minutes per week = 6.8METs x 21/60 = 2.4 METhours
- An increase of walking of 67minutes per week = 3.3 METs x 67/60 = 3.7METhours
- Total of 6.1 METhours a week.
- Reduced risk of around 0.9 corresponding to an exposure of 11.25 MET hours per week (i.e. 10% lowered likelihood of death), with a dose response relationship. Based on graphs of dose response relationship[90], 6 additional MET hours per week would roughly lead to reduced risk of around 0.94 (6% reduced likelihood of death). These RRs are assumed to sufficiently take into account other forms of physical activity so that we can estimate health benefits of cycling and walking directly, without taking other forms of physical activity into account.
- Background mortality rate is around 0.001 for age 20-49 (on average across males and females)
- 0.001 x (1-0.95) x 2,060 residents aged between 20 and 49 = **0.103 reduced deaths**
- A death in the age range of 20 to 49 leads to 34 Years of Life Lost on average (discounted YLL). 0.103 deaths x 34 YLL = **3.5 YLL for the age group 20 to 49.**
- This calculation is repeated for each of the other age categories, with 0.28 and 0.77 deaths avoided for the 50-64 and 65-80 age categories respectively, with 6.7 and 11.5 associated YLL.

On total across all age groups, this leads to: 21.8 avoided YLL

[90] Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship | International Journal of Behavioral Nutrition and Physical Activity | Full Text figures 4 and 5

Since we assume no change in physical activity in the surrounding area, there are no changes to premature death. In the supporting scenario where there are high quality cycle lanes in the surrounding area, a 2% increase in physical activity using evidence from Aldred et al (2024) would lead to 16.1 avoided YLL.

Annex 2: Distributional analysis of wellbeing impacts

We do not have sufficient information to provide a full distributional wellbeing analysis. However, we can examine the starting levels of wellbeing for those who gain wellbeing and those who lose wellbeing, to understand if the policy will increase or decrease existing wellbeing inequalities:

Group with potential wellbeing loss	Initial wellbeing level	Notes
Car owners	Higher	Car owners have higher average income than non-car owners. Higher incomes are associated with higher wellbeing.
Those in LTN boundary areas	Average	No characteristics in particular which would lead to this group having a higher or lower wellbeing
People with a disability who use their cars as mobility aids	Lower	Negative impacts typically mitigated with exemptions[91]

Group with potential wellbeing gain	Initial wellbeing level	Notes
Inactive group who switch to active travel (specifically, the 5% who report no walking and cycling to some walking and cycling)	Lower	The **lifetime wellbeing** of people who are inactive is lower, due to lower risk of morbidity and mortality through physical activity
Those in LTN area	Average	No characteristics in particular which would lead to this group having a higher or lower wellbeing.
People with a disability	Lower	People with a disability have five times the injury rate when travelling as pedestrians[92] , so may benefit particularly.

Overall, there is no clear pattern of the wellbeing losses falling to those with higher than average nor lower than average wellbeing; nor a clear pattern that all the wellbeing gains fall to those with starting lower or higher wellbeing. We can conclude, given the current evidence available, that the policy is unlikely to exacerbate wellbeing inequalities nor focus on those with starting low levels of wellbeing.

[91] E.g. details from Haringey Council [Exemptions from low traffic neighbourhoods | Haringey Council]

[92] Aldred (2018) https://doi.org/10.1016/j.jth.2018.03.006