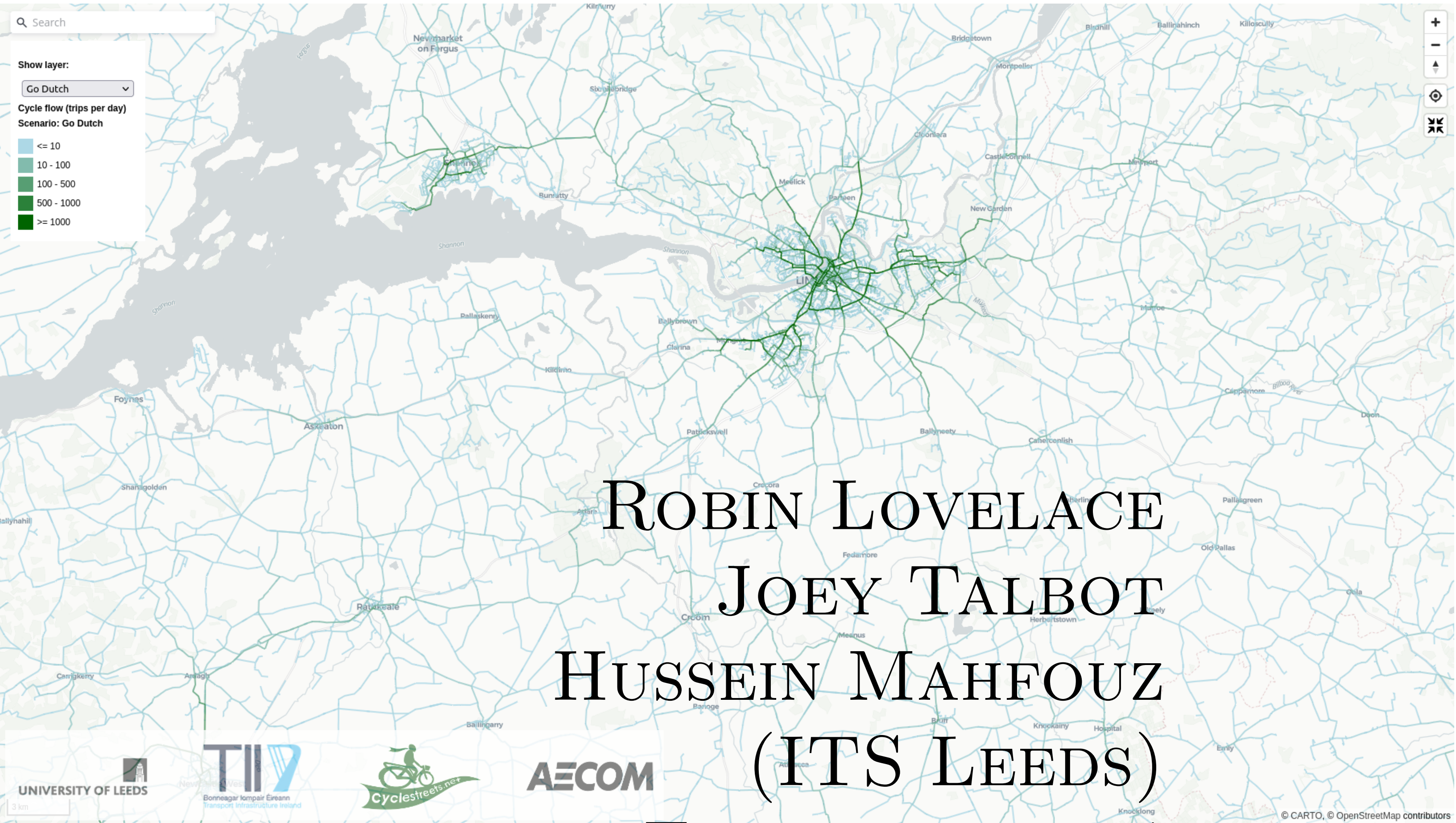
CRUSE Tool project: Extension report



Robin Lovelace
Joey Talbot
Hussein Mahfouz
(ITS Leeds)

Exectutive summary

This report outlines the work undertaken and the outputs produced for the extension work of the Cycle Route Uptake and Scenarios Estimation (CRUSE) Tool project, funded by Transport Infrastructure Ireland (TII) and developed by the University of Leeds' Institute for Transport Studies (ITS), with project management support from AECOM. The project builds on the Propensity to Cycle Tool and subsequent Rapid tools developed by the University of Leeds. The main purpose of the extension work was to add recreational and cycle tourism trips to the CRUSE Tool, in addition to improving the user interface and documentation. The results of this extension work are now available on the CRUSE website, which contains the recreational results in Everyday trips and the cycle tourism results in a separate map.

1 Introduction

The Cycle Route Uptake and Scenarios Estimation (CRUSE) Tool is a research and data science/web development project funded by Transport Infrastructure Ireland (TII) and developed by the University of Leeds' Institute for Transport Studies (ITS), with project management support from AECOM. The project builds on the Propensity to Cycle Tool and subsequent Rapid tools developed by the University of Leeds in collaboration with CycleStreets Ltd and others (Lovelace et al. 2017, 2020; Goodman et al. 2019; Lovelace, Félix, and Carlino 2022).

Phase 1 of the project ran from September 2021 to September 2022. The extension work described here was undertaken from June to December 2023. As shown in Figure 1, the main element of the extension work was addition of recreational trips, in addition to improving the UI and documentation.

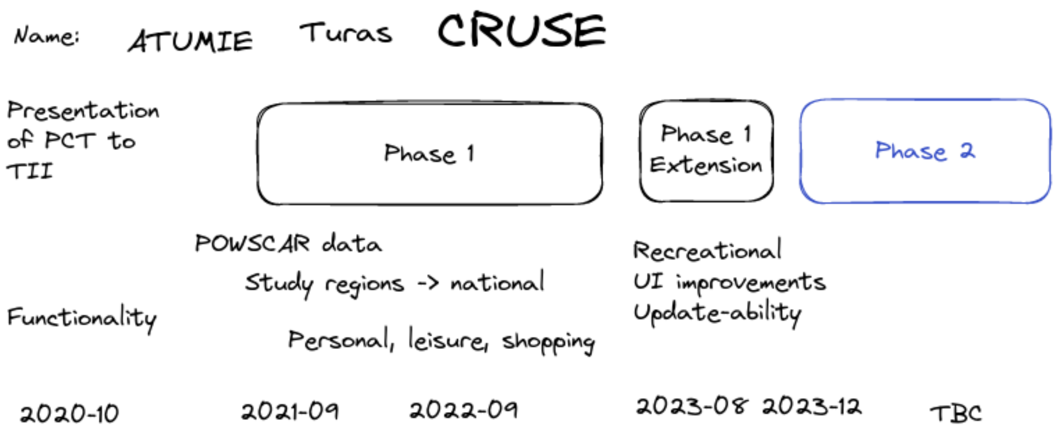


Figure 1: Schematic timeline of the CRUSE Tool project, showing the main phases of work and the extension work described in this report.

The main tasks were to:

1. Import greenways into CRUSE codebase
2. Website ready for launch
3. Integration of recreational and touring trips into CRUSE
4. Deliver webinar

This end of project report outlines the work undertaken and the outputs produced for each of these tasks.

2 Import greenways into CRUSE codebase

The greenways are now included in the CRUSE codebase and feed into the estimation of recreational trips. As illustrated in Figure 2, we analysed the spatial distribution of the Sports Ireland cycling trails and the Eurovelo routes, compared with OpenStreetMap data. The results showed that the additional datasets added value to the CRUSE tool and improved our ability to estimate recreational and cycle tourism trips, when compared with the imperfect proxy of Strava flows, as illustrated in Figure 7 and Figure 9.

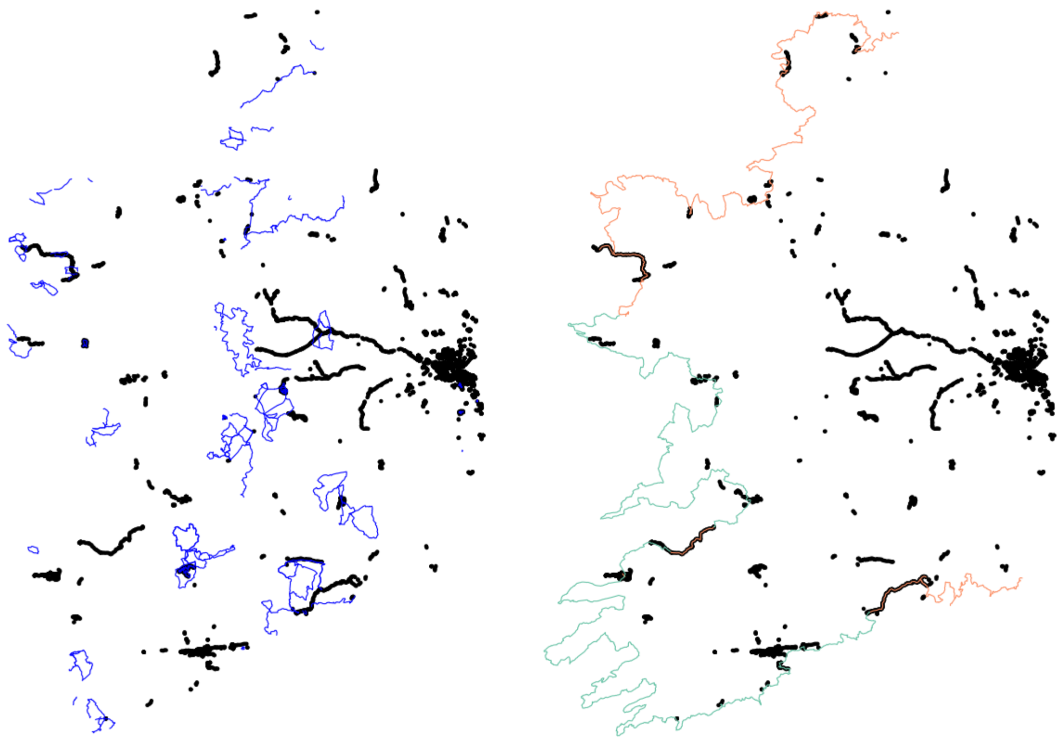


Figure 2: Spatial distribution of Sports Ireland cycling trails (left) and Eurovelo routes (right) in Ireland. The left hand result show that Sports Ireland cycling trails (blue) are not well represented in OpenStreetMap (black). The right hand result shows that the same is true for Eurovelo routes, for both the completed ("signage in place") routes (orange) and especially for the proposed ("in development") routes (green).

We undertook sense checking, validation and quality checking of the other input datasets used in the CRUSE project, and sense checked the outputs with reference to local knowledge during workshops.

3 Website ready for launch

The updated website content has been deployed at https://cruse.bike/ and is ready for an official launch.

As shown in Figure 3, there is a new tab with the cycle tourism network. The website also includes the following improvements:

- Search bar: people can now search for a county, town or even a specific road name to view cycling potential locally
- Full screen mode: it's now easier to see the full map
- New layer visualisations: we now allow the user to visualise the results for any scenario (Go Dutch is shown by default), hilliness, or quietness
- New popup functionality: a new popup appears when you click on a route segment, showing potential cycling uptake, quietness, and hilliness

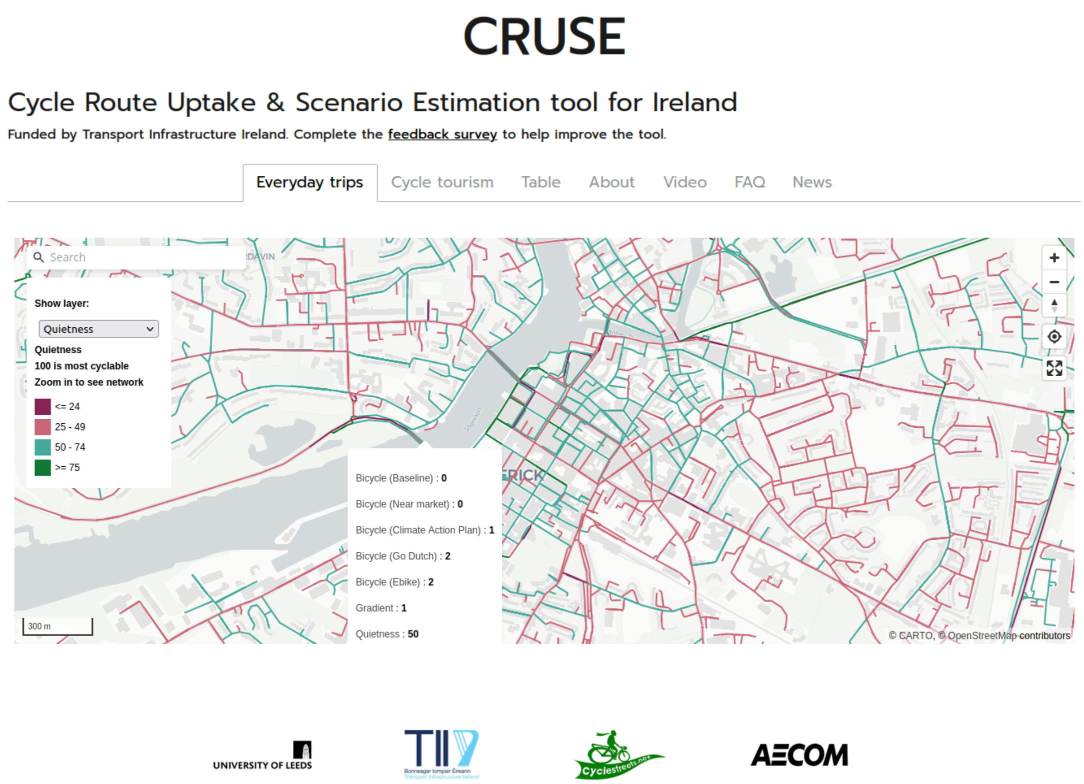


Figure 3: Updated CRUSE Website

Following feedback from TII the following additional improvements were made:

- New 'flow legend' that shows when the user zooms in, in addition to the county level views that show when the user is zoomed out, as illustrated in Figure 4
- Updated breaks for the Gradient legend, as illustrated in Figure 5
- New descriptions of the Everyday and Cycle tourism maps to ensure people understand what they are seeing

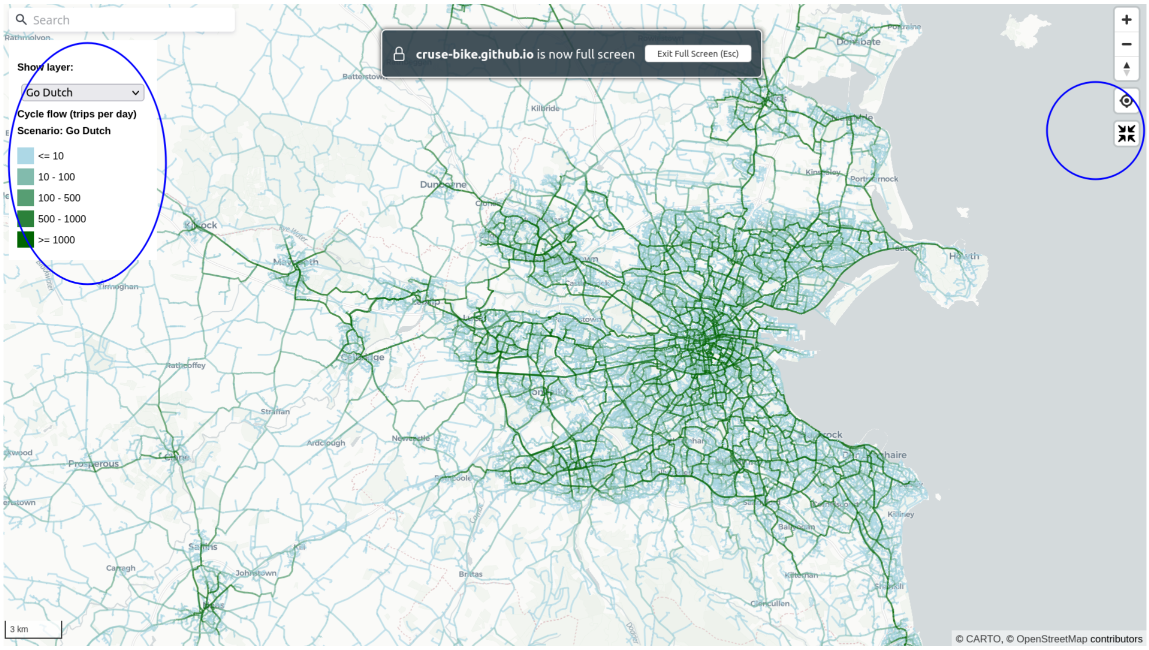


Figure 4: Updated CRUSE Website: flow legend, highlighted in the left of the map. Also highlighted is the new Full Screen mode allowing better use of the landing page map.

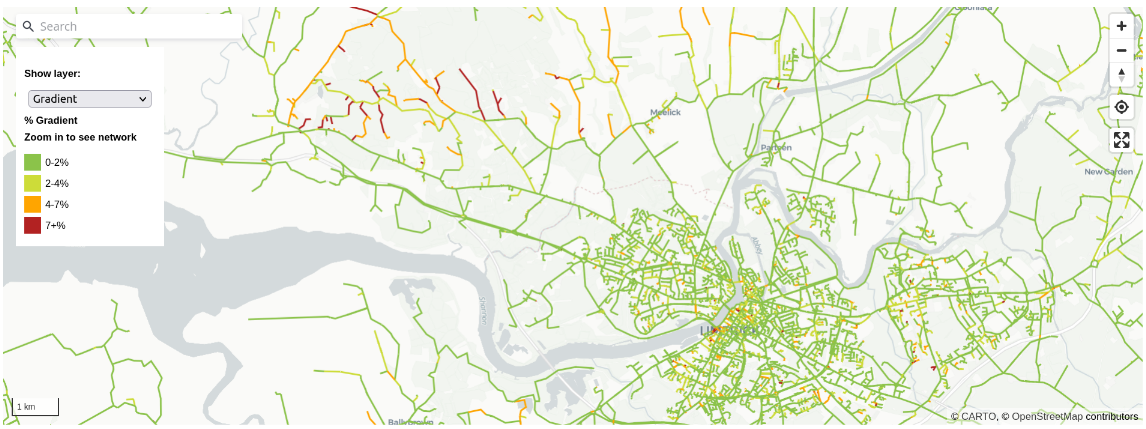


Figure 5: Updated CRUSE Website: gradient legend

4 Integration of recreational and touring trips into CRUSE

As outlined in our previous report focussing on Recreational trips, we estimated the total number of recreational cycle trips using the assumption from Table 5.2 in PAG Unit 13 that there are a mean of 5 daily recreational trips per 100 people.

The three main types of recreational trips identified for the extension work were recreational (leisure), recreational (sport), and cycle tourism (touring). We simulated two of these trip types: recreational (leisure) and cycle tourism (touring). The recreational (leisure) trips are now incorporated into the 'Everyday trips' layer which can be accessed in the main map view of the CRUSE website. As oulined in the previous section, cycle tourism results are presented in a separate tab on the website.

The approach to integrating recreational and touring trips into CRUSE was as follows:

- Classify recreational and touring trips
  - We identified 3 main types of recreational trips: recreational (leisure), recreational (sport), and cycle tourism (touring)
  - Due to the relative importance of leisure trips, we focussed on these; the recreational layer does correlate with sport cycling, as confirmed by comparisons with Strava data, but the main emphasis is on leisure trips to green spaces and other recreational destinations, as outlined below
  - Cycling touring trips were classified as trips that start and end in different locations, typically between counties
- To generate trips for recreational trips starting at residential locations, we used the following approach:
  - Origins were generated using the same approach as for commuter trips, with the amount of travel starting in each zone proportional to its population
  - Destinations were generated as follows, based on three types of recreational trip attractor:
    * Green spaces: we used the green space layer from OSM, with weights based on the area of the green space and its type (e.g. parks are more important than other green spaces)
    * Cycleways: we used three sources of cycleway data: greenways, data from the Eurovelo Dashboard, and data from OSM
    * Tourism nodes: we used the tourism node layer from OSM
  - We then used a gravity model to generate OD pairs, with the amount of travel between each pair proportional to the population of the origin zone and the weight of the destination zone, with weights based on the type of destination, area of green space and cycleway length

4.1 Validation of recreational and cycle tourism layers

To ensure the estimated number of trips is accurate, we also validated the recreational and non-recreational trip data against two independent sources - –cycle counter data from a set of Dublin count points, and estimates of total km cycled in the Dublin Metropolitan Area from the Bikelife 2019 report. As part of the extension work with also validated flows against Strava data.

The figure below shows the Waterford Greenway has around 10-35 Strava user trips per day (5000-

12,000 per year), and is much more popular than surrounding roads.

Figure 6: Waterford Greenway flows from Strava

This corresponds with the cycle tourism layer, where we estimate around 150 cycle trips per day on the Waterford Greenway.

In County Limerick, there are a set of popular Sports Ireland cycle trails in the south of the county at Ballyhoura, as seen as in the Strava data. The roads leading towards these trails are picked out strongly in our cycle tourism layer, as illustrated in the figure below.

4.2 Validation using cycle counter data

To validate the number of recreational and non-recreational trips, we have obtained cycle count data from a set of counter locations in Dublin. For the year from 12th October 2021 to 11th October 2022, there are 9 cycle counters providing reliable data that can be cross-referenced with the corresponding segments on the recreational and non-recreational trip route networks. Here, non-recreational trips means both POWSCAR (travel to work / school) and other utility trips. The only recreational layer we have attempted to validate so far is the Strava data.

The count data correlates very strongly with our estimates of the number of POWSCAR and other utility trips on these route segments, with an R squared of 0.89. This is slightly higher than the R squared for POWSCAR trips alone (0.88), suggesting that the spatial interaction model we used to model the other utility trip purposes (social, personal and shopping trips) is providing a realistic representation of these trips. As shown by the dotted line in Figure @ref(fig:utility), there is almost a 1:1 match between the count data and the route network trip numbers at many of these points.

Figure 7: Waterford Greenway flows from the new Tourism layer in CRUSE

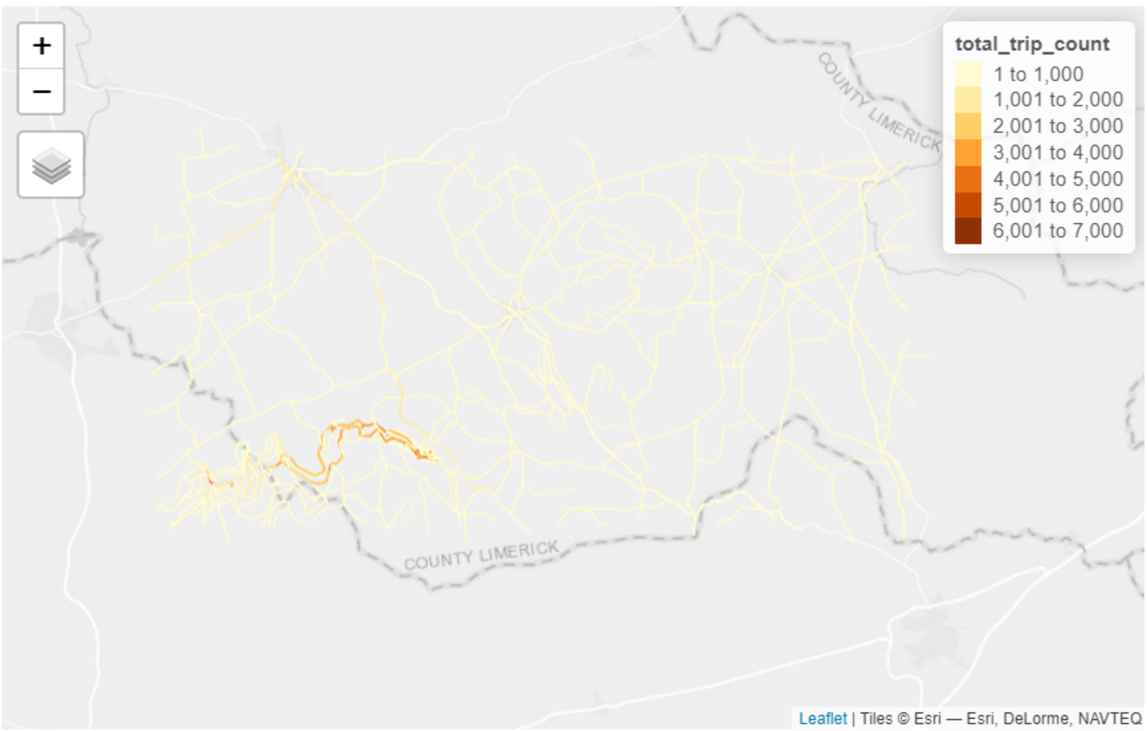


Figure 8: Popular Sports Ireland cycle trails to the South of Limerick flows from Strava

Figure 9: Popular Sports Ireland cycle trails to the South of Limerick flows from the Tourism layer

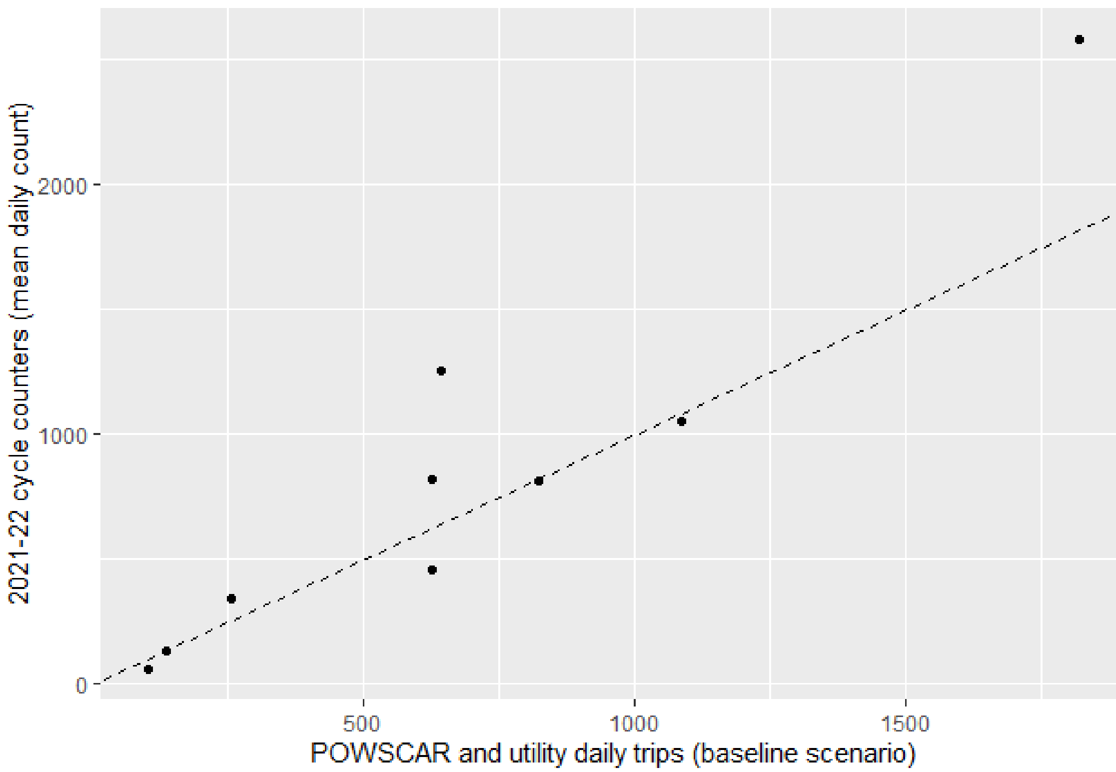


Figure 10: Correlation between cycle count data and POWSCAR/utility baseline cycle route network. Dotted line represents a 1:1 correspondence.

When Strava data are added together with the POWSCAR and utility data, the R squared falls slightly to 0.85. At some locations, the combined POWSCAR/utility/Strava flows are higher than the cycle counter data, even though the cycle counter data is from 2021-22, while other data is from 2016-2019. Perhaps there is some duplication, for example with Strava being used for non-recreational trips.

4.3 Validation using Bikelife 2019 data

The Sustrans Bikelife 2019 report provides a range of statistics related to cycling in the Dublin Metropolitan Area (DMA). This is a slightly different geographical area from County Dublin: it excludes the northern part of the county but includes parts of Kildare, Meath and Wicklow, as shown in Figure 11. In particular, the report provides estimates of the number of trips and total km cycled in the DMA, broken down by trip purpose. Trip purposes include commuting, travel to school by children, travel to school or college by adults (including adults accompanying children), other utility journeys, and recreational journeys.

We used this report for validation because it provides the best quality data that was available. However, we recognise that the Dublin Metropolitan Area is not necessarily representative of Ireland as a whole. Therefore there may be some bias, for example, cycle touring trips will likely comprise a higher proportion of total cycle trips in rural parts of the Atlantic Coast than they would in and around Dublin City.

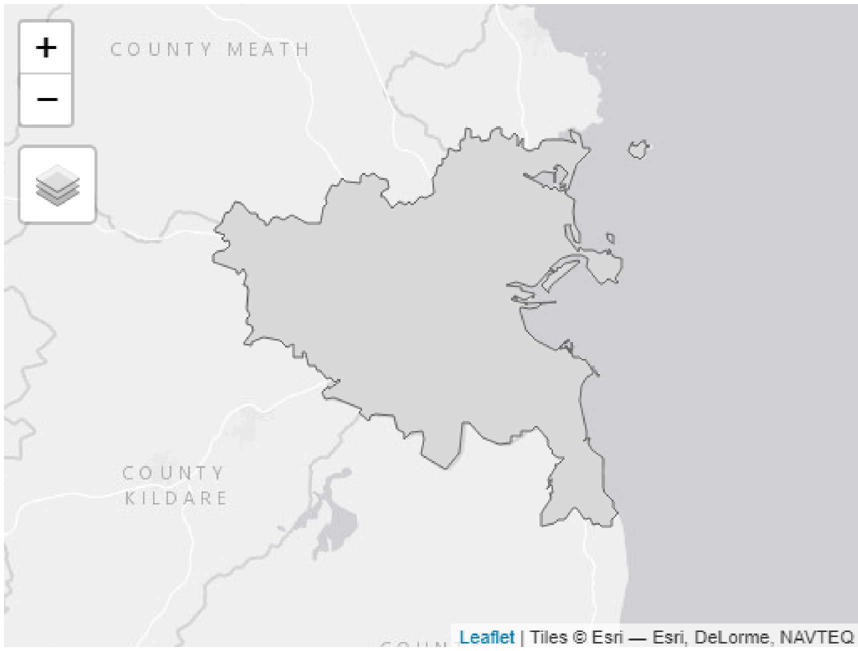


Figure 11: The Dublin Metropolitan Area

Bikelife 2019 reports a total of 375.1 million km cycled per year in the DMA, of which 163.3 million km are for recreational trips, with 120.8 million km for travel to work, 27.1 million km for travel to school (by both children and adults), and 63.6 million km for other utility journeys.

The data in Bikelife 2019 is based mainly on a survey of 1,106 residents aged 16 and above, conducted in June to July 2019. The number of trips for each purpose apart from children's travel to school is taken from the survey responses, with corrections for seasonal variation and trip chaining and to infer recreational trips by children, and validation using Dublin counter data. Children's travel to school is taken from the 2016 census. Respondents provide an estimate of the distance of each journey, and the median trip distances are multiplied by the total number of trips to get the km cycled for each trip purpose.

4.4 Comparison with POWSCAR and utility data

Using CRUSE route network results for the Dublin Metropolitan Area, we estimated km cycled under the baseline scenario as follows:

For commute and school trips:

km_cycled_per_rnet_segment = segment_length_km * powscar_bicycle_trips

total_daily_powscar_km = sum(km_cycled_per_rnet_segment) * 2 annual_powscar_km = total_daily_powscar_km * 252

For other utility trips:

km_cycled_per_rnet_segment = segment_length_km * non_powscar_bicycle_trips

total_daily_non_powscar_km = sum(km_cycled_per_rnet_segment) * 2

annual_non_powscar_km = total_daily_powscar_km * 365

We multiplied by two to include both outward and return trips. For annual commute and school trip totals, we assumed there were 252 working days per year. With these calculations, we estimated there were 127.7 million km cycled per year for trips to work and school (POWSCAR data), which is 86% of the equivalent work and school journeys in Bikelife 2019. We estimated there were 60.2 million km cycled per year for non-POWSCAR utility trips (shopping/social/personal), which is 95% of the equivalent in Bikelife 2019.

It makes sense that the proportional coverage of POWSCAR trips is lower, because the Bikelife school category includes trips made by adults accompanying children to school, which are not included in the POWSCAR school data, and would come under other utility trips. In total, the CRUSE estimate of all non-recreational km cycled in the Dublin Metropolitan Area is 89% of the equivalent Bikelife 2019 estimate.

The CRUSE estimates of km cycled are based on 2016 Census data, so the fact that these are 11% lower than the estimates from the Bikelife 2019 report suggests that cycling uptake in the DMA has increased between 2016 and 2019.

4.5 Comparison with recreational data

The number of km cycled in the DMA according to the Strava data (which is from 2019) is 5% of the recreational km cycled according to Bikelife 2019. This suggests that in 2019, around 5% of cyclists used the Strava app.

Across the DMA, Bikelife 2019 gives a mean estimate of 3.2 daily recreational trips per 100 people, when we divide the number of recreational trips by the total population aged 4 and above. This is similar to the PAG Unit 13 assumption of 5 daily recreational trips per 100 people, suggesting that it is reasonable for us to use this PAG estimate to determine the number of recreational trips by residents of each Electoral Division.

We cannot assume that the Dublin Metropolitan Area is representative of Ireland as a whole. However, the use of DMA data is justified by the fact that more datasets are available for the DMA than for other parts of Ireland. As illustrated by the Walking and Cycling Index 2021 by Sustrans and the NTA, the DMA's population of 1.4 million people includes more rural areas up to Donabate in the North, Kilcock in the West, and Greystones in the South.

We have less information about how recreational trips are likely to be divided between sport cycling (as represented by Strava), cycle touring/tourism, and dispersed short trips. This is important in terms of the overall geographical distribution of recreational trips. Dispersed short trips will be more likely to originate from close to people's homes, while tourism will be biased towards more scenic and rural areas, especially gravitating towards trip attractors such as greenways. The sport cycling represented by Strava could be halfway between these two extremes.

5 Deliver webinar

We delivered a webinar to TII and Local Authority staff and the wider community on 7th December 2023. The audience was engaged and asked many questions. A recording of the video is available and could be edited and published as a video on the CRUSE website.

6 Next steps

There are many ways that the tool could be improved. We have built a foundation that is modular and designed to be extended. The direction of future work on the the tool should be decided by the users and TII, but the following are some suggestions:

- Regular updates to the data: a major limitation with the Propensity to Cycle Tool is that it's out of date. There are three main ways that the tool can be updated:
  - Updated routing: the transport network and its representation in OSM is evolving all the time (Seto 2022). It would make sense to automate the build process so that the routes update regularly, for example every month or every quarter.
  - Updated demand models: based on continuously collected cycle counters, the gravity models on which the non-POWSCAR trips are based could be updated regularly (e.g. annually).
  - Updated POWSCAR data: the POWSCAR data is based on the 2016 census. It would be possible to update this using the 2022 census data when it becomes available.
- Further improvements to the user interface:
  - Currently we only show the balanced network on the landing page. This could be updated to show the fastest and quietest networks as well via a dropdown menu.
  - Improvements of county level pages: it would be possible to re-write the county level maps so that they show the full networks (only the landing page map shows the full network due to limitations with the Leaflet library used in the county networks). This could build on work done by Active Travel England in the Active Travel Infrastructure Platform (see https://acteng.github.io/atip/browse.html)
  - 'Quality of life' improvements, such as zoom dependent legends (the current legends do not update when you zoom in and out), only finding placenames in Ireland, accessibility improvements, improved mobile experience and documentation.
- Estimation of benefits: we could integrate with recent updates to the HEAT tool to estimate the health benefits of cycling, and with reference to collision data, estimate the safety benefits of cycling investment.
- Network simplification: in collaboration with researchers at Network Rail and ESRI, we have developed new methods to simplify networks. This can result in much clearer network maps. This could be integrated into the CRUSE tool.
- Prioritised layers: we could revisit some of the cohesive and prioritised network work done in Phase 1, and integrate this into the tool, with reference established methods (Szell et al. 2021) which we have explored and would like to refine.

References

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