CRUSE Tool project: Milestone 3 Report

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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). The project builds on and extends the methods underlying the Propensity to Cycle Tool, an open access strategic cycle network planning tool that has transformed the practice of cycle network design in England and Wales (Lovelace et al. 2017; Morgan and Lovelace 2020; Lovelace, Parkin, and Cohen 2020).

The output will be an open source web application for Local Authorities and others across the Republic of Ireland to guide cycling infrastructure development. The CRUSE Tool project is undertaken by the University of Leeds and managed by AECOM.

2 Current state of progress

Progress on the project is divided into four milestones:

- Milestone 1: establishment of regional baseline networks
- Milestone 2: generation of mode shift scenarios and route networks for additional trip purposes
- Milestone 3: completion of a prototype tool for the pilot counties
- Milestone 4: scaling-up, refinement and deployment of a national tool

During this milestone we have:

- Refined the results
- Improved the user interface
- Implemented a Near Market scenario
- Tested the build process in non-pilot counties
- Implemented methods to support route prioritisation

3 Refinement of results

We have worked closely with routing service provider CycleStreets to improve the route results for our work. Based on tests in Longford, we identified a bug that led to large detours: cycle trips were not being calculated on trunk roads, meaning that busy and wide roads that may be strong candidates for new infrastructure (with physical separation from the road on fast roads) were being missed. This is now fixed.

Another issue was that some line widths were very thin under the baseline scenario. We fixed this but that caused another issue: the minimum line widths in scenarios of high cycling uptake became too thick, as shown in Figure 3.1 (left). The solution was to set a fixed minimum line width for all route network maps, as illustrated in Figure 3.1.

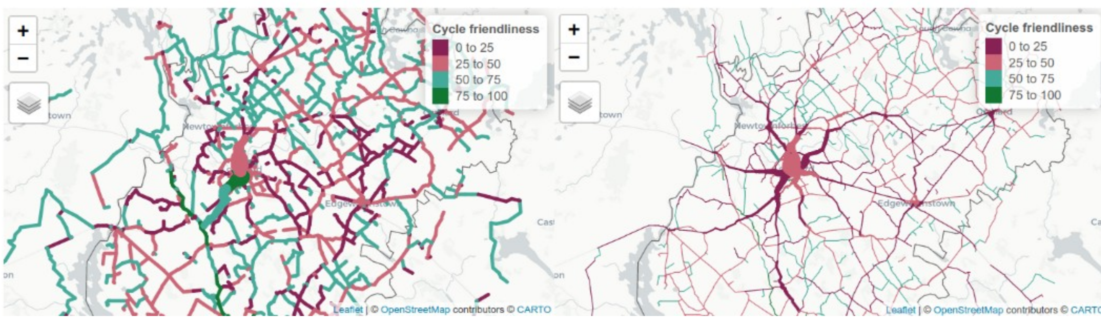


Figure 3.1: Illustration of fix to line width issues.

4 Improvements to the user interface

We have created an updated statically hosted interactive map-based user interface. This is now available at https://jazzy-elf-95a68a.netlify.app/ with an overview map of Ireland allowing users to select counties of interest, and an interactive table allowing users to select the county of interest.

The landing page for each county displays:

- route network results by scenario type
- an interactive graph with cycling trips by distance and scenario type, and
- links to more detailed results on:
  - trips and cycling trips statistics at the county level
  - route network types (based on the type of users/levels of cycle-friendliness), and
  - the identification of ‘priority’ route segments on which new cycling infrastructure improvements would likely be highly cost-effect

The overview map for Kildare is shown in Figure 4.1. An issue with the prototype overview route network results is that there is a trade-off between level of detail (and number of layers) and performance. When full route network results are presented for large counties such as Kildare, the first map is slow to load because it contains the data for many route segments. We dealt with this issue in Milestone 3 and the associated web app by capping the number of segments visualised. In Phase 4 we will explore alternative solutions to tackle these issues.

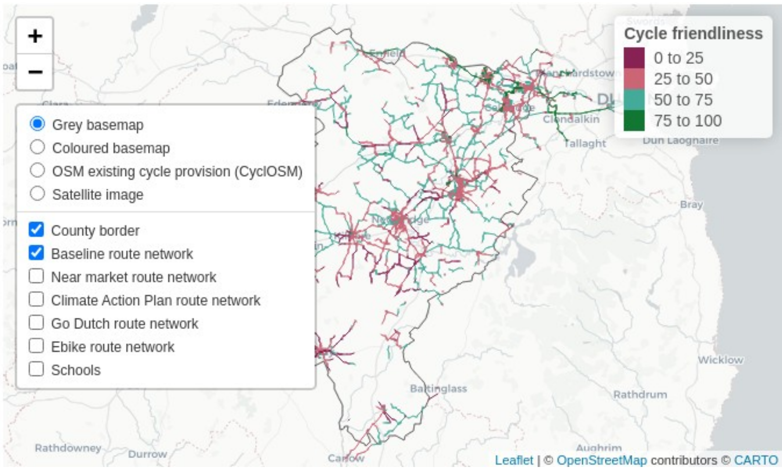


*Figure 4.1: Interactive overview map for Kildare. Note the range of layers that can be selected by the user from the drop-down menu. *The quietest and fastest route networks will be provided as a separate page.*

Following feedback on the Milestone 2 report, we have made numerous changes to the visualisations of the results. We have refined the colour blind-friendly palettes in all visualizations, which are easier to interpret. Two examples of this are the colour schemes used to represent the different scenarios in Figure 4.2, and the cycle friendliness level of each segment in the the route networks illustrated in Figure 4.3. We have also updated the distance-cycling graph in the county page (Figure 4.2) so that it reports the proportion of trips made by bike rather than number of cycling trips; this should be easy to understand and interpret.

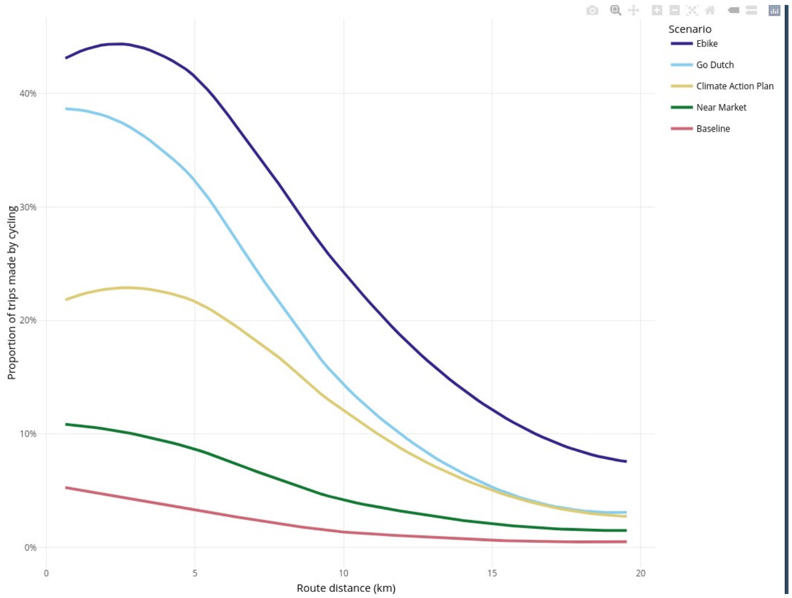


Figure 4.2: Distance-frequency graph used to communicate the different scenarios.

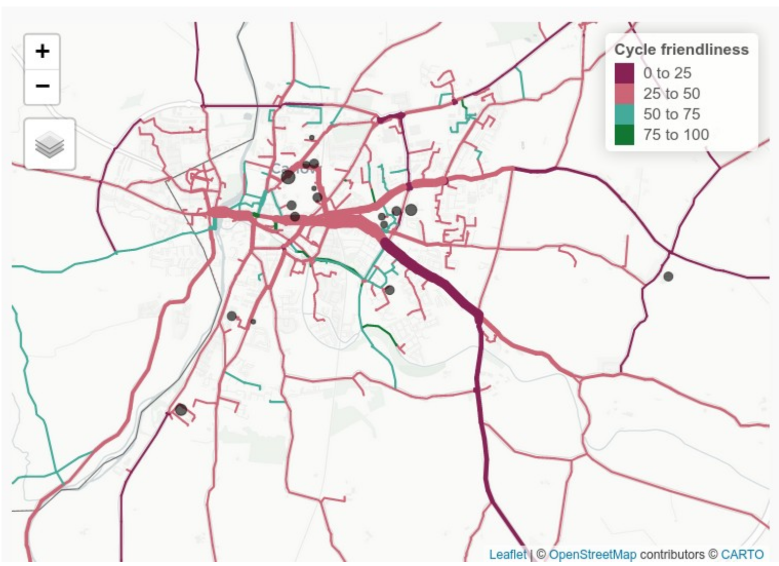


Figure 4.3: Illustration of new route network results in Carlow. The fastest network under the Climate Action Plan scenario is shown.

We changed the name of the ‘Decabonise’ scenario to Climate Action Plan, as whilst this is aligned with the Climate Action Plan (10% reduction in vkm policy) it was confusing as many believed it to indicate the delivery of “net zero” target. With the similarity to the next scenario it was decided to drop the Demand Reduction scenario from the public facing results to reduce information overload. Note the new “intermediate” Near Market scenario, described in the next section.

5 Near Market scenario

Following feedback on the large gap between the baseline and the Climate Action Plan plan we developed an intermediate scenario. The Near Market scenario approximates the level of cycling that would be achieved if levels of cycling uptake observed in areas of Ireland with high levels of cycling according to the 2016 Census were achieved everywhere, accounting for differences in trip distances and hilliness levels. The scenario is implemented as follows:

- Calculate distance decay curves for Dublin for the base year (2016, using POWSCAR data) by fitting a model to the relevant OD data after it has been converted to a route network datasest
- Apply the Near Market model to the hilliness and distance values for each county during the build process
- Add the current level of cycling to the Near Market model

An illustration of the level of cycling under various scenarios in the county of Kildare is shown in Figure 4.2. The results will vary from place-to-place. A possibility we can explore in Phase 4 is to show the percentage of trips made by cycling by distance for each county, in addition to or instead of the number of trips (see Section 8). This highlights how the Near Market scenario is based on a moderate scenario of cycling uptake approximating current levels of cycling in Dublin, in addition to levels of cycling from the latest available datasets at the origin-destination level (2016, the year for which POWSCAR datasets were provided). At the route network level, this scenario will place roughly equal emphasis on future cycling potential and existing demand, with more emphasis placed on future potential than current cycling levels in places with low levels of cycling currently.

6 Build process in non-pilot counties and deployment

We tested the build process for the following counties, beyond the case study counties of Limerick and Kildare

- Longford
- Kerry
- Carlow
- Offaly
- Galway
- Dublin

The results have been deployed in a prototype statically hosted web application which can be found here: https://jazzy-elf-95a68a.netlify.app/

You can see results for Dublin here, for example: https://jazzy-elf-95a68a.netlify.app/dublin/

7 Route prioritisation

The aim of this task was to identify the route segments that would potentially benefit most from cycle infrastructure improvements, or at least the level of intervention that may be appropriate. This is not a definitive prioritisation but can be used to inform decision-making on the relative priority for a route in comparison to others in a county. We use road names derived from OpenStreetMap. Named roads are further divided into shorter segments according to their cycle friendliness and cycling potential. These segments are then mapped and ranked in order of priority for potential investment in new cycle infrastructure: 1 to 4.

Segments that have high cycling potential and low cycle friendliness are identified as being the top priority for improvement (1). Each segment can be plotted on a simple scatter plot and assigned to one of 4 priority groups, as shown in Figure 7.1:

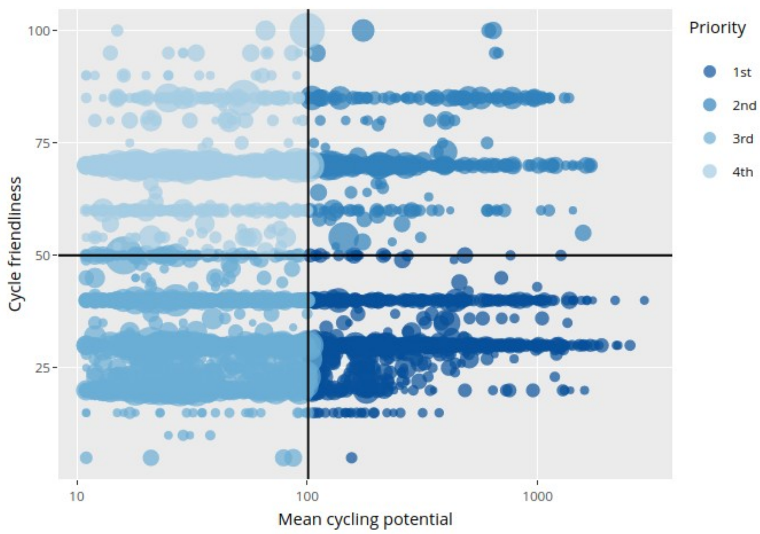


Figure 7.1: Scatter plot of the 4 priority groupings for route segments in Limerick city centre, under the quietest routing plan

The prioritisation results will differ depending on the routing plan. For Limerick city centre, maps of priority routes according to the quietest and fastest route networks show some interesting differences, due to the different route choices made (Figure 7.2).

Figure 7.2: Maps of the 4 priority groupings for route segments in Limerick city centre, using (left) the quietest and (right) the fastest routing plans.

We calculate the priority ranking as:

$$sqrt(cyclingpotential)/sqrt(cyclefriendliness)$$

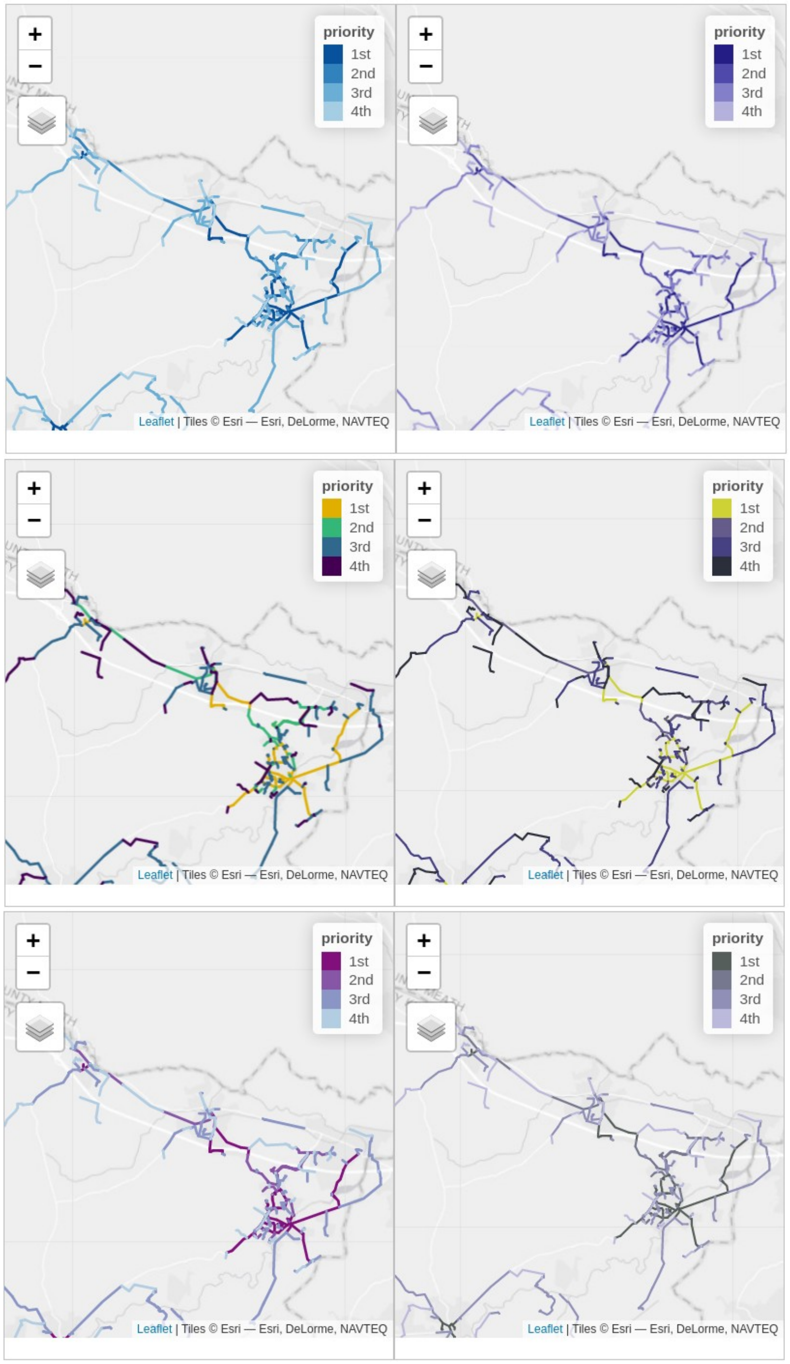
Table 7.1 shows the top ranked route segments. The segment length is provided, but doesn’t affect the calculation of priority. This was deliberate: some of the most important links are short. Prioritising long links, as we did in the Rapid tool Lovelace et al. (2020), could lead to important links being missed. Multiple segments may be identified along the same roads, if their mean cycling potential differs by >100 or if their mean cycle friendliness differs by >10. The interactive table only includes segments that have unique and ‘meaningful’ names, which we define as unique road segment names at least 8 characters in length. Segments that lack a unique and meaningful name, e.g. ‘Unnamed Link’, will still be included in the map results and in the data that can be downloaded and imported into GIS software.

Table 7.1: The 10 top ranked route segments in Limerick city centre according to their potential need for improved cycle infrastructure, using the quietest routing plan.

Name	Mean cycling potential	Mean cycle friendliness	Length (m)	Rank	Potential...Length
Sarsfield Street, R857	1,343	20	78	4	5
Ballykeefe Roundabout, R526	937	15	86	6	6

Name	Mean cycling potential	Mean cycle friendliness	Length (m)	Rank	Potential...Length
Ballinacurra Road, R526	1,494	30	798	11	56
Quinlan Street, R526	1,356	30	76	13	5
Shannon Bridge, R527	1,353	30	193	14	14
Sarsfield Bridge, R857	1,347	30	186	15	13
Sarsfield Street, R527	1,298	30	117	17	8
Saint Paul's Roundabout, R526	703	17	72	18	5
R463 (roundabout)	615	15	81	19	6
Mulgrave Street, R527	1,122	28	513	21	36

We have explored various palettes for the route network prioritisation results, as shown in Figure 7.3. On the left side of the figure are shown each of the palettes tested and on the right side their colour-blind interpretation. Of the palettes tested so far, our preferred one is the blue sequential colour scheme shown at the top of Figure 7.3.



8 Next steps

Following feedback and sign-off of the Milestone 3 report, the next steps focus on preparing to deploy the tool at a national level. This will include:

- Include summary tables on the scenarios and trip purposes covered (and % cycle trips accounted for) in the FAQ, possibly in the limitations section

- Getting more feedback on the prototype tool from TII and users from other counties. We have set-up test deployment at https://jazzy-elf-95a68a.netlify.app/ that can be kept up-to-date to solicit feedback.
- Explore alternative ways to present cycling uptake levels building on the trip distance-frequency graph in the landing page for each county: we will explore presenting cycle uptake results as the percentage of trips made by cycling by distance for each county, in addition to or instead of the number of trips (see Section 8).
- Include a limitations section in the CRUSE tool's FAQ
- Developing a multi-county build workflow to automate the build and deployment of new counties
- Implement new 'batch' methods to speed-up the routing, the slowest part of the 'build' process
- Testing approaches to speed-up the computation of interactive route network maps, another bottleneck in the build process
- Generating results for a random sample of counties and sanity check, ideally with feedback from local practitioners
- Developing a user guide and planning future work to train people in the use of the tool and data resulting from the CRUSE Tool project
- Undertaking a dry run of the national build and orchestrating the national build
- Exploring and visualising the national map
- Explore ways to include safety monitoring/crash data
- Suggest potential improvements in user experience from the landing page, which can be undertaken later

By the end of the project we will handover the tool and the codebase to TII. To ensure the codebase is future-proof we will provide detailed documentation on how to reproduce the build and seek to provide support for regular re-builds to ensure results respond to new infrastructure.

References

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