

Bus Network Redesign Choices Report

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1 Introduction

What is BusConnects Cork?

BusConnects is the NTA's programme of bus service improvement in Irish metropolitan areas. It is funded by Project Ireland 2040. It includes nine measures (shown at right) which will transform Cork's bus system, making public transport more useful to more people.

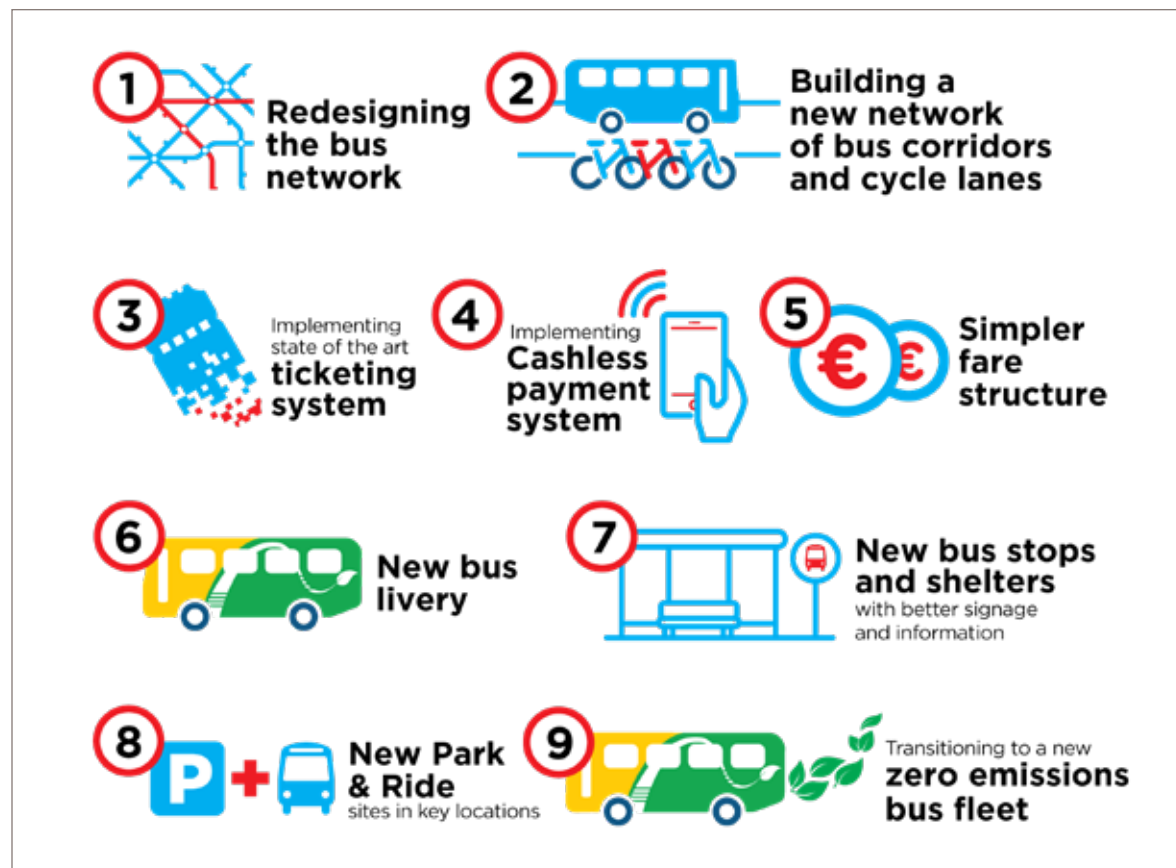
BusConnects is included in, and will help realise, these Government policy strategies within the Cork Metropolitan Area (CMA):

- The National Development Plan 2018-2027
- The Climate Action Plan 2019
- The Cork Metropolitan Area Transport Strategy (CMATS) 2040

The latter, CMATS, is an integrated land use and transport strategy. A key principle of CMATS is to reduce dependency on the private car whilst increasing the appeal of sustainable public transport. Another fundamental principle of the Strategy is to support future growth in the CMA with an efficient public transport network.

Bus Network Redesign

This report describes choices that will arise in redesigning the bus network for the CMA, which is the first measure shown above. The network will be redesigned



in collaboration with Bus Éireann (the operator), NTA, Cork City Council and Cork County Council.

The input gathered during this first phase of public consultation will inform the design of a Draft New Network. That Draft will be presented to the public for review and comment. The second phase of consultation is currently foreseen for October 2021.

Public input in response to the Draft will inform the Final New Network. It will also inform the second measure shown above, the development of fast and reliable Core Bus Corridors.

The Final New Network and the Core Bus Corridors are currently planned for implementation in 2023, with full operation reached in 2024.

What is the Network Redesign?

Cork's bus network has gradually evolved over many years, as the city and the metropolitan area have grown and changed. While some routes have been running a similar pattern since the founding of Bus Éireann, some routes have been improved and adapted as the area has grown and changed.

With Cork's expected population growth and the urgent need to develop more sustainably, it is time to reevaluate the design of the Cork area bus network and invest in its success.

This network redesign will be a collaboration between:

- NTA
- Cork City Council
- Cork County Council
- Bus Éireann

This project is an opportunity to design the Cork network around today's needs rather than continue with the network inherited from the past.

Which roads buses run on, times and days of service, frequencies, stop locations, and how passengers interchange could be revised as part of this redesign, which is starting with a "blank slate."

In the redesigned network, some or many routes may resemble those in today's network. If so, it will be because they support present and future conditions—not because of history or tradition.

Every detail of the existing network is something somebody is used to, and they may object to it being changed. One of the key choices presented in this report is whether it is worth causing inconvenience for some people in order to improve public transport service for most people.

This is an opportunity to design a new network around today's needs rather than continue with the network inherited from the past.

Routes Under Study

All publicly-funded bus routes in the CMA are under study and may be revised. This includes local routes within Cork City, and routes that connect towns and rural areas of County Cork.

The list of routes under study is below. Some of these routes were not operating in 2019, the year for which representative public transport patronage data is available, and as a result they are not included in every part of this report. Some routes that were operating in 2019 no longer operate today, yet do appear in this report.

201	215	261
202	216	202A
203	219	207A
205	220	209A
206	223	215A
207	225	220X
208	226	223X
209	240	225L
212	241	226A
213	248	226X
214	260	

Planning During a Pandemic

The timing of this study relative to the COVID-19 pandemic is both advantageous and awkward.

It is advantageous in that this study can adjust the bus network to any pandemic-related changes in public transport demand that seem lasting, and can help Cork move forward out of the pandemic with momentum towards implementing the CMA Transport Strategy.

The awkwardness of this study's timing arises from the pandemic and its effect on public transport patronage. Normally such a study would use recent, detailed patronage data in order to inform service and network design. Yet it is impossible to collect relevant patronage data at present. Schools and universities have been closed, many people have worked from home, and many retail and hospitality businesses have been shut. Patronage data collected during this period would not be representative of the post-pandemic future for which the network is being redesigned.

There is general data available regarding the patronage and service levels on each Cork route, from 2019 and earlier. That is

the data referenced in this report, and it will be used until it becomes possible to collect new patronage data that reflects greater levels of travel in the CMA.

Just as the COVID-19 pandemic limits peoples' use of public transport today, it limits the study team's ability to reach people in-person or gather people together into large meetings. As a result, the first phase of consultation for the network redesign will be held virtually, through online meetings and an interactive website and survey.

More information on next steps and later phases of this study is provided at the end of this report.

Recent Developments in Cork

Transport patronage has been growing faster in Cork than anywhere else in Ireland. The number of journeys on the Cork bus network increased by 51% from 2013 to 2019,¹ surpassing the area's growth in population, employment or bus service over the same period.

While some of this passenger growth is likely due to greater economic activity and more residents moving to Cork, there has also been a concerted effort by Bus Éireann and NTA to simplify the network, make routes in the most populated areas more useful, and improve connections among towns in the CMA.

Investments in All-Day, All-Week Service

Many metropolitan areas have recently observed that there is potential to grow patronage by investing in service at times other than weekday rush hours. Travel patterns have changed over the past decades and more people now travel for work or leisure outside of weekday rush-hours. Whether the COVID-19 pandemic will permanently reduce rush-hour commutes, relative to travel during the rest of the

week, remains to be seen.

Cork has been keeping up with other places in this regard, as new investments in bus service have been focused on frequent, all-day and all week routes.

NTA and Bus Éireann have been evolving a core network that people can rely on for many different types of trips. As in many other places, the patronage response has been very positive. For example:

- In 2016, all-day weekday, Saturday and Sunday frequencies were improved on Route 202 (between Mahon Point and Hollyhill). Patronage on this route grew by 22% over the next two years.
- In 2017, daytime service on Route 220 (between Ovens and Carrigaline via Cork) was made frequent, and service was added overnight. Patronage on this route increased by 70% in the first year.

Anticipated Growth

Cork is planned to grow by 50-60% in the next two decades. This growth is a major impetus for the CMA Transport Strategy, BusConnects Cork and this network redesign.

High public transport patronage can

help Cork City and the towns of County Cork welcome new residents and workers without some of the negative effects of growth such as congestion, longer journey times and larger car parks.

High public transport use can also support more abundant and affordable housing, by allowing many households to go without a car. This reduces the amount of space that must be provided for parked cars within housing developments, and thereby reduces the cost of building new housing. It also allows families to save money on transport and use that money instead for better housing, or other things they value.

¹ Bus & Rail Services for Ireland – State Funded Services, 2020.

Public Transport Goals in Tension

Public transport can be designed to achieve different goals.

One of the goals for public transport that gets a lot of attention is high patronage. High patronage is necessary to meet Cork's climate, development and livability goals.

But patronage is not public transport's only goal. Nearly all public transport providers are expected to serve areas where few people live or work, even if patronage is low in those areas. This type of service is pursuing a coverage goal, which has its own value.

Within any limited budget, these two goals are in tension. The more a public transport provider concentrates service into frequent, all-day routes, in the places with the most residents and activities, the less service is available to cover many roads and serve areas with fewer people.

The tension between pursuing high **patronage** and providing wide **coverage** exists in every public transport system.

In the redesign of the Cork network, some routes will be designed for high patronage, while others will be designed to provide coverage without an expectation of high patronage. The high-patronage services will help meet climate and development goals, while the coverage services help meet

Reasons people care about high patronage include:

- Serving more passengers.
- Combatting congestion.
- Reducing vehicle emissions.
- Supporting dense and walkable development.
- Improving job access for large numbers of workers.
- Using public resources efficiently.

Reasons people care about high coverage include:

- Promoting social and economic inclusion for all people, regardless of where they live.
- Serving people with a severe need for transport.
- Offering transport in all parts of the geographic area.

goals for social inclusion.

NTA and Bus Éireann expect to add a modest amount to the budget for bus service as part of this redesign, but the budget will still be limited and this trade-off will still exist. Input from the public on how to balance patronage and coverage goals will inform the design of the new Cork bus network.

Why Buses?

Urban areas are where people go to access the opportunities that arise from being *close to other people*. Every successful urban place hits physical limits on how many people can get close to one another if they travel in separate vehicles:

- **Road space limitations.** There is a limit to how much roads can be widened as travel demand increases, especially in urban places.
- **Parking limitations.** Storing private cars and hired cars when they are not in use

is costly, compared to the other ways a growing city or town can use land.

- **Intensification of land use and economic growth.** Growth in Cork's population and economy will cause congestion and degrade the area's attractiveness, unless public transport and other space-efficient modes absorb the growth in travel demand.

The photos below illustrate how much space is required to transport people in cars, as opposed to on a bus, on bicycles or on foot.



There simply isn't room in dense cities and towns for everyone to come in their own car. Hired cars (like Ubers) and autonomous cars cannot change this basic geometric problem. They take up nearly as much space as privately-owned cars – plus they make driving so much easier and more attractive that they increase congestion.

Carpools are helpful, but no car-based solution can get close to the space efficiency of people walking, cycling or using public transport.

On-demand public transport, in which passengers get picked up and dropped off at the place and times they request, can work in low-demand areas. But moves far fewer people per vehicle than a fixed-route bus.

Rail is even more space-efficient than buses, but it is expensive to build and operate and can therefore be justified only on the highest-patronage lines. In every global city with a high-patronage rail system, there is an even bigger high-patronage bus network.

Wherever big cities need to be really efficient with public space, there is no replacement for high-patronage, big-vehicle public transport.

Photo credit: The Cycling Promotion Fund of Canberra, Australia

Access to Opportunity

Throughout this project we will measure the benefits of public transport services in terms of their affect on **access**.

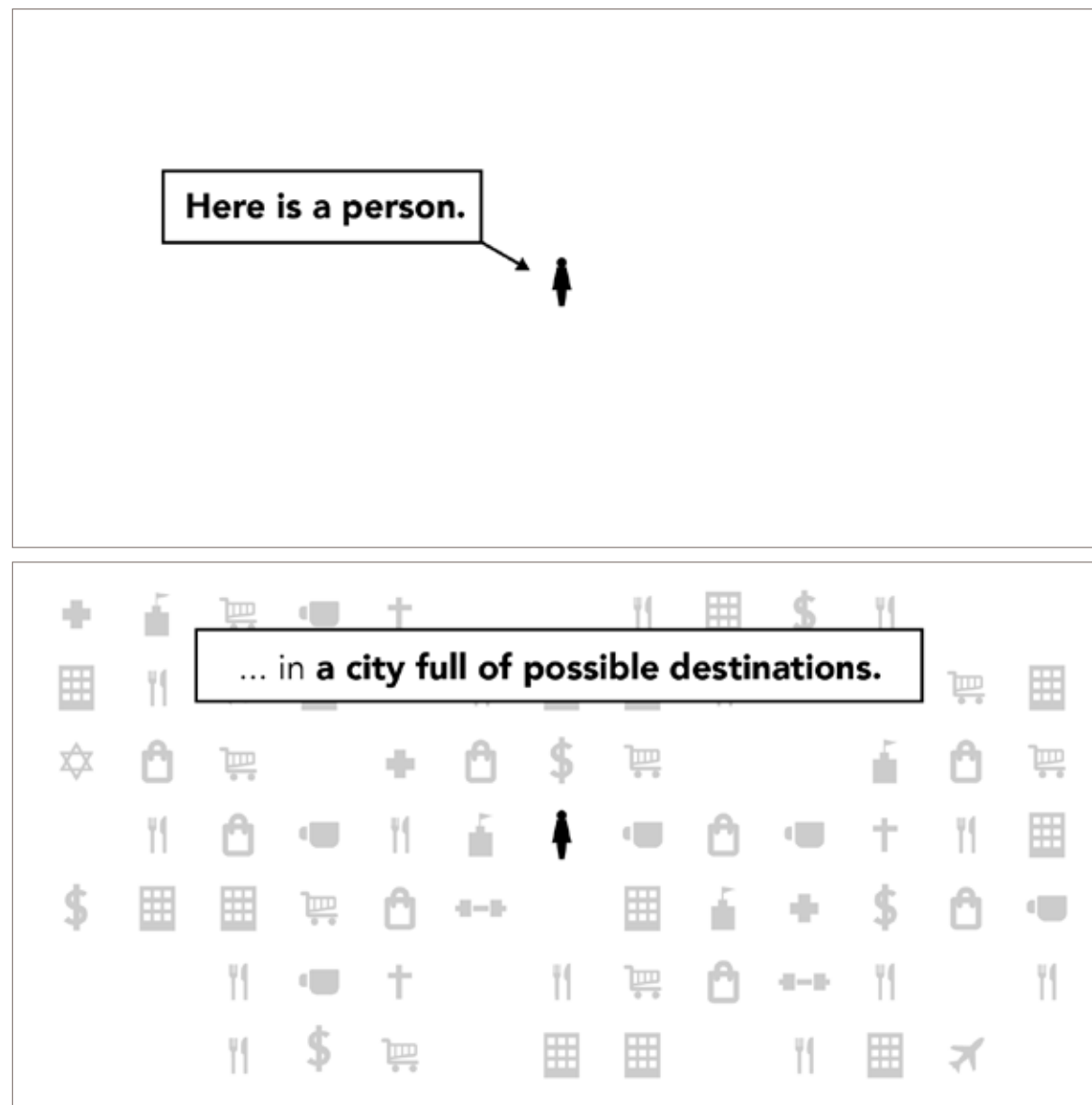
The word “access” means different things in different contexts. In this report it means *the number of opportunities someone can reach through the public transport network, in a given amount of time.*

Why does access matter? Expanding access for as many people as possible:

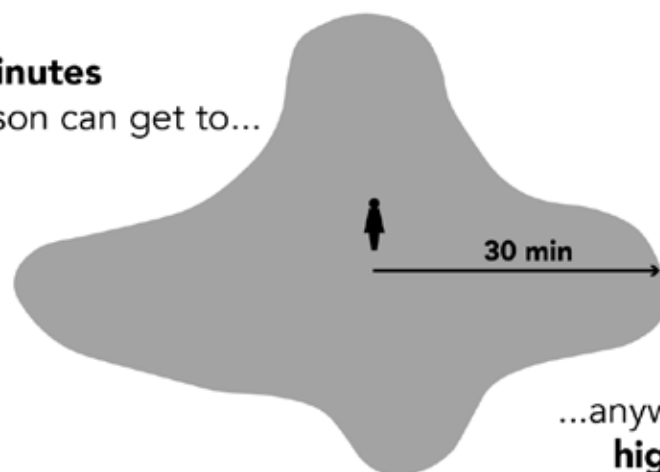
- Increases patronage potential, because more people find public transport useful.
- Brings more opportunities and services within reach for more people.
- Fights carbon emissions and other types of pollution from roads and cars.
- Allows for economic growth without growth in congestion.
- Gives people more freedom to choose how to live their lives.

Access has a remarkable sweep of relevance. When we improve access for large numbers of people, we improve all of those things.

The pictures at right and on the next page illustrate public transport access.



In **30 minutes**
this person can get to...



...anywhere in the
highlighted area.

Her access to destinations
is the **number of
destinations
in that
area.**



What factors affect a person's public transport access?

- **How many destinations are near public transport.**
- **How long she has to walk** to and from service.
- **How long she has to wait** for the service.
- **How far she has to travel** on public transport.
- The **speed** of the service.
- **How long she has to wait to interchange** between services.

Public transport providers have control over some of these factors: waiting time, interchange, route directness, where service is provided.

They have less control or no control over other factors: public transport speed, travel distances, where jobs and housing are located. These factors are generally controlled by City and County Councils as they manage land use, development and roadways.

2 How Networks Work

What Leads to High Patronage?

Access, described on the previous pages, is the way that public transport network design can affect **patronage**.

Access describes the likelihood that any person's trip, when looked up in a journey planner, will be possible *in a reasonable amount of time*.

There are many factors that affect patronage which have nothing to do with access or public transport network design, such as fuel prices, the economy, the price of a hired-car ride and the cost of buying or leasing a car.

In this report, we focus on the factors that the NTA, Bus Éireann, Cork City Council or Cork County Councils can each influence, and that contribute to high patronage:

- **Frequency** and **hours of service**.
- The **ease of interchange** among public transport services.
- **Land use** and **development patterns**.
- **Street design, distance** and **walkability**.
- **Demographics**, and where people with particular needs are located.

As mentioned on page 9, high patronage is not public transport's only goal. The

best public transport network for the CMA may include services that attract few users, and provide little access, but do serve coverage goals.

Productivity

Almost every time we use the word "patronage" in this report, we mean *patronage relative to cost*. The word for this is "**productivity**."

Productivity tells us how much people have been responding to a given level of public transport investment and a certain route or network design. It can be an indicator of greater patronage potential, even if *total* patronage isn't high, for example if a route with poor frequency is highly productive nonetheless.

The productivity of individual routes is discussed starting on page 39.

A well-connected network is key to high patronage. Interchange must be easy and reliable so that people can reach many destinations in a reasonable amount of time, at a reasonable cost.

Frequency

One of the most powerful ways to increase access across a network is to shorten waiting times by improving frequency.

More frequent service:

- Reduces waiting time (and thus overall travel time).
- Lets you travel whenever you want.
- Improves reliability, because if you miss your bus another one is coming soon.
- Makes interchange (between two frequent services) fast and reliable.

When frequency is improved in places with large numbers of people, jobs and other opportunities, that improves average access for the population.

Better frequency increases potential for high patronage...but it isn't enough on its own to cause high patronage.

A high-patronage network is useful for most people. And most people are in a hurry.

How Frequent is Frequent enough?

In small mid-sized cities and towns, such as Cork or Carrigaline, peoples' trips tend to be quite short. Public transport must be very frequent to compete with alternatives for short trips, since waiting time can easily dwarf public transport journey time.

In order to think about whether any frequency is "frequent enough," imagine waiting one-half of the frequency, on average (since statistically, you will) and ask yourself whether you could tolerate waiting that long as part of an everyday trip.

NTA and Bus Éireann are investing in the infrastructure to offer real-time arrival information and real-time trip planning on the Cork public transport network. Some people may imagine that with this new technology, nobody needs to wait for a bus anymore, and frequency therefore doesn't matter. If a bus only comes once an hour, that's fine, because your phone will tell you when it is a few minutes away and you should walk to the stop.

Despite this new technology, frequency still matters enormously, because:

- Waiting doesn't just happen at the start of your journey, it also happens at the

end. You may not spend much time waiting at the stop in the morning, but if your bus is infrequent, you'll probably have to wait at your destination.

- o If you start work at 8:00 am but the once-hourly bus passes your workplace at 8:10 am, you must choose between being 50 minutes early or 10 minutes late. (Or consider an alternative mode of transport for commuting, including purchasing a car).
- We can choose when to leave home based on the bus schedule, but we don't decide what time we get off work, or when a cinema screening finishes, or when a doctor's appointment ends. When our departure time isn't entirely flexible or entirely up to us, poor frequency often means we spend a lot of time waiting.

Real-time arrival information doesn't make the bus more reliable, but frequency does. Your phone can tell you when your bus is arriving, but it cannot prevent your bus from having a problem and being severely delayed. Only frequency—which means that another bus is always coming soon—can offer this kind of reliability.

Distance, Speed and the Cost of Frequency

Within a limited public transport budget, longer routes trade-off against higher frequencies, as illustrated to the right.

This doesn't mean that a high-patronage network is all short routes. But it means that the more people a route serves per kilometer, the more likely it is that the public transport authority can justify frequent service there.

Slower speeds have the same effect, increasing the cost of providing frequent service over any distance.

As public transport slows down, the cost of operating it increases. A public transport provider can either reduce frequencies or come up with additional funding, funding which could have been used to *improve* service rather than run slower service at a higher cost.

This is why **bus priority** is so essential to public transport success in a growing metropolitan area like Cork.



One bus can provide 30-minute frequency service over a short distance...



...but double the distance means half the frequency. Now the bus comes every 60 minutes.

As routes get longer, their frequency must get worse, or the transport agency must spend more to add buses and drivers to the route.

When congestion slows down public transport, it becomes more costly to operate. This consumes funding that could have been spent making the service better.

Designing for Connections

A public transport network should be greater than the sum of its parts. One bus route can take people only so many places – but if that route makes useful connections with many other bus routes and rail lines, vastly more places become reachable.

Interchange

A connected network offers people greater access to jobs, housing and other opportunities, but it relies on interchange.

Interchange can present a barrier if:

- Bus arrival times are unreliable.
- An extra fare is charged to change buses.
- Finding the correct bus stop or bus is difficult.
- More than a short walk between stops is required.
- Waiting at the bus stop is uncomfortable.

The second fare charged for interchange between buses today is a barrier to providing a highly connected network in the CMA. The second fare naturally leads to people requesting single bus routes that take them directly to where they need to

go. The reliability of Cork buses is also a challenge, though it should improve in the coming years as the locating technology on-board buses is replaced.

As part of the BusConnects Cork measures related to fares, there will be **no additional fare to interchange**, neither between buses nor between bus and rail. This makes it possible to design the bus network for greater access and greater patronage, if more interchange is tolerable.

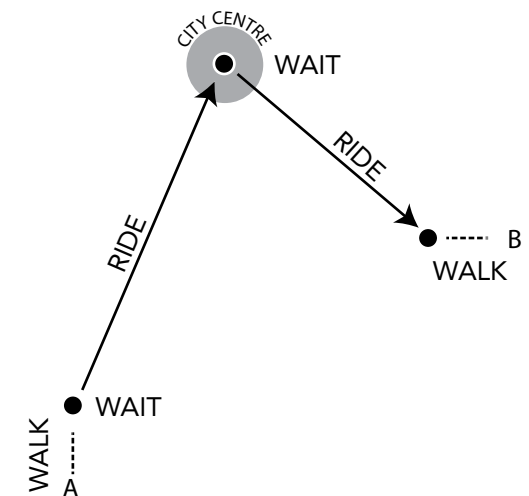
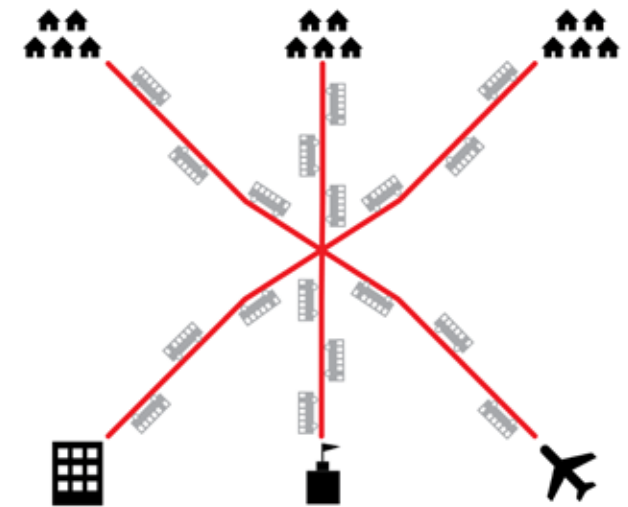
Radial Networks

The basic shape of the Cork bus network is **radial**.

In a purely-radial network, as illustrated at right, above, every route connects with every other route at the center; only one interchange is needed to reach every point in the system.

But as a system grows large, trips from one outlying area to another can require much out-of-direction travel through the center, as illustrated at right, below. This is why purely-radial transport networks are mostly found in small cities and towns.

In Cork, nearly all routes connect at the centre (though, as we discuss later in this report, the centre of the network is made

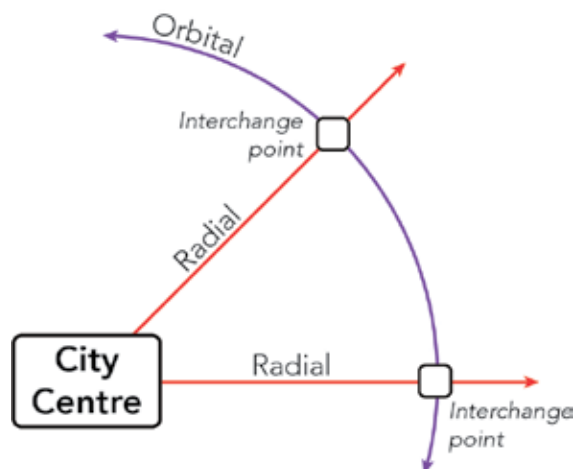


complex by the many one-way splits in routes).

As Cork grows, trips from one outer location to another will become longer if they must all be routed through the centre. At some point in the city's growth, the addition of routes which circle or traverse the city outside of the center become a natural consideration.

Orbital routes can be added to a radial network to allow for cross-city travel without going through the centre, as illustrated below. When a radial network gains orbital lines, it looks a bit like a spider web.

There are two orbital routes in the Cork network today, which can be seen in the maps starting on page 34. One traverses the southern side of Cork City, from



Loughmahon to MTU. The other orbits the northern side, from MTU to Lotabeg.

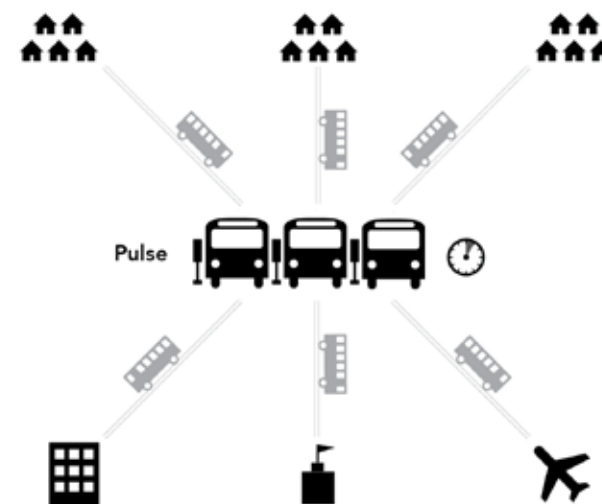
For most trips along the orbital routes within Cork City, if someone can't choose when to travel and doesn't have ample time to wait, then using two radial routes and interchanging in the centre would actually offer a shorter journey. This is because the orbital routes are so infrequent that they require a great deal of waiting for any trips that people can't time to the bus schedule, like trips to work or school.

Some people may prefer the orbital routes because interchange is a hassle for reasons besides the fare—perhaps they are traveling with children, or don't want to walk between stops in the centre in the rain. But it's also possible that the additional fare for interchange has discouraged people from using two radial routes to reach their destination. If they could interchange, reliably, for no extra charge, they might be happy to get where they are going sooner.

Pulses

Connective networks depend on interchange, and there are two ways that interchange can be made fast and reliable for passengers.

One way is high frequency. When two



frequent routes cross, an interchange from one to another will require a short wait, as long as both routes are reliable. But high frequency is costly to provide, and cannot be provided on all routes.

In a radial network, a different type of fast interchange is possible. Bus arrivals at a centre can be timed to "pulse" with one another in a recurring pattern throughout the day.

In a pulse, buses meet and dwell together for a few minutes, as illustrated above. People can interchange among them with a reliably short wait.

Infrequent routes that don't pulse don't add up to a connective network. If two

routes coming every 60 minutes cross, the untimed interchange between them will require a wait of up to 59 minutes—on average, the wait will be 30 minutes, one-half the frequency. But if two routes are designed to pulse, the interchange can take just 5-10 minutes, every time.

One of the challenges of pulsing routes is that they must arrive *on time*. Passengers on a bus that misses the pulse would face a long wait for their interchange.

Some transport providers aspire to offer pulse connections among infrequent routes but are unable to because buses are subjected to so much unpredictable congestion. The BusConnects Cork measures to improve speed, reliability and operating technology suggest that this may be a good time to consider pulses for some routes in the bus network.

Recognising Areas with High Patronage Potential

Public transport authorities can attract more passengers by offering service that more people find useful.

However, many factors outside the control of transport authorities affect patronage, regardless of how objectively useful their service may be. Free parking, low fuel costs and low costs to hire a car (such as an Uber) can all erode public transport patronage by making other options cheaper and easier.

Also beyond the control of the public transport authority are land use patterns and street designs, though they have a huge impact on how many people public transport can reach, and at what cost.

Five geographic factors are especially suggestive of high patronage potential:

- Density
- Walkability
- Linearity,
- Proximity, and
- Mix of Uses.

The way these factors affect public transport patronage and cost are described on the following pages, and illustrative examples are given from the Cork CMA.

As the illustration on the following pages show, the way that development patterns affect patronage potential is a matter of **geometry**.

By pointing out these geometric facts, we are not saying anything about the importance of any particular area, nor about the people who live or work there.

We are only describing the ways that the physical layout of development interacts with geometric facts of transport. This determines whether public transport can efficiently provide access to large numbers of people, which in turn determines patronage potential.

As described on page 9, high patronage is one of public transport's major goals, but it is not the *only* goal, and it must be balanced against the goal of spreading service out widely and into numerous routes. To the extent the Cork bus network is designed for high patronage, the five geographic factors on the following pages will help us recognise areas with potential for high patronage.

Density

A place with many residents, employees, shoppers, students, and customers has a high density of activities.

The graphic on the right shows two identical bus routes. The route on the top is travelling in an area that has twice as many homes as the route on the bottom.

All else being equal, the route on top will attract more users because there are simply more people travelling to and from the area.

How many people, jobs and activities are near each transport stop?



+ Many people and jobs are within walking distance of public transport.

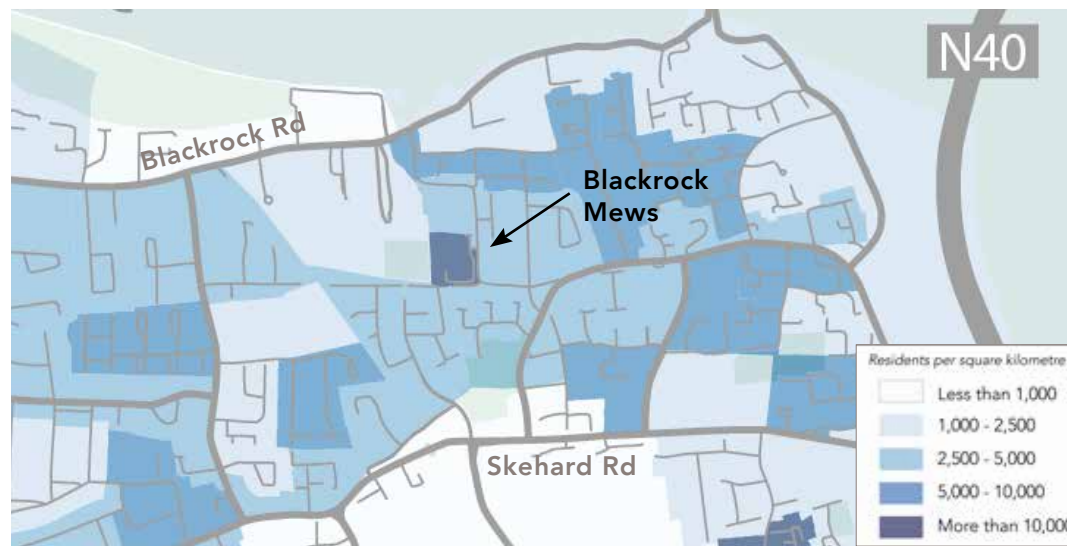


- Fewer people and jobs are within walking distance of public transport.

The maps at right provide an example of high residential **density** in Cork.

The Blackrock Mews apartments stand out in a map of residential density. They are set about halfway between Blackrock Road to the north and Skehard Road to the south.

This dense housing development is located rather far from the main road and its frequent service (Skehard Road, where the 202/202A comes by every 10 minutes), and the street network would suggest a circuitous walk to Skehard Road. However, walkability is improved by the provision of footpaths both directly south to Skehard and north to Blackrock.



Satellite Photo Credit: Open Street Maps

Walkability

To use a bus route, people need to be able to get to the stop, and the vast majority of people will start their trip by walking.

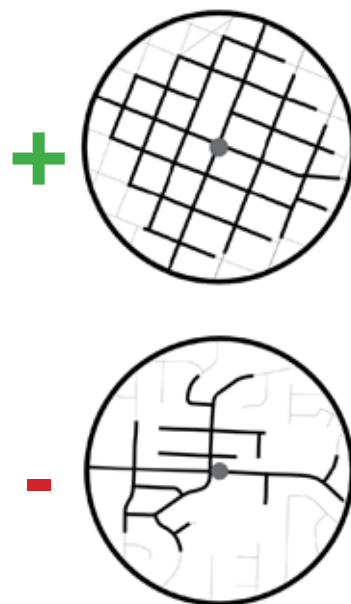
The street network, footpaths and crossings around a bus stop affect how many people are willing and able to walk to the stop.

If a street network is disconnected, the bus stop on a main road may be close as-the-crow-flies but quite far away by walking.

Large intersections and roundabouts can mean that bus stops are not at or close to intersections. This adds extra distance to the walk to a stop, for people on an intersecting street.

If a road is unpleasant or dangerous to cross, people won't be able to use public transport in both directions. Or they might ask the public transport provider to drive a bus into their car park or down their street, so that people don't have to walk across the main road. This makes the route longer and less useful to everyone else.

Is it easy to walk between the stop and the activities nearby?



The dot at the center of these circles is a transport stop, while the circle is a 400 metres radius.

The whole area is within 400 metres, but only the black-shaded streets are within a 400 metre *walk*.



+ It must also be safe to cross the street at a stop. You usually need the stops on both sides for two-way travel!

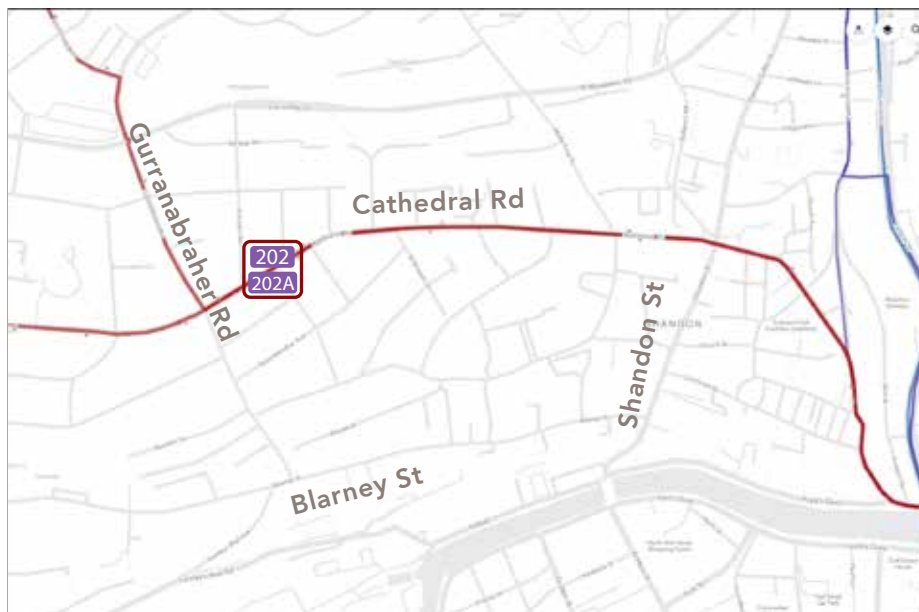
The maps on this page and the next contrast a **walkable**, well-connected street network in Shandon (south of Cathedral Road) with a disconnected street network south of Shanakiel Road.

In Shandon, the streets are well-connected. Aside from a few cul de sacs, nearly all streets connect with multiple other streets, and as a result people have many ways to walk out to multiple main roads—Cathedral Road to the north, Blarney Street to the south, Shandon Street to the east.

This high street connectivity means that nearly all of the homes and businesses that are within 400 m of frequent service on Cathedral Road as-the-crow-flies are also within a 400 m walk, or about five minutes. It is a simple matter to provide frequent, linear service to many people by operating on Cathedral Road, because buses can simply drive along it and get close to nearly everyone.



Satellite imagery from Open Street Maps



The housing south of Blarney Street, shown on the right, is on a disconnected street network. Roads are curvy and some of them dead end. This makes the walking routes to Blarney Street circuitous from many homes.

Very few roads connect between Blarney Street and Harbor View Road, so a walk to Harbor View Road from a home south of Blarney Street would be even more circuitous.

There is frequent service to the north on Harbor View Road, with Route 202 or 202A coming every 10 minutes. Most of the homes in the development south of Blarney Street are within 400 m of Harbor View Road as-the-crow-flies, but few homes are actually within a 400 m walk.

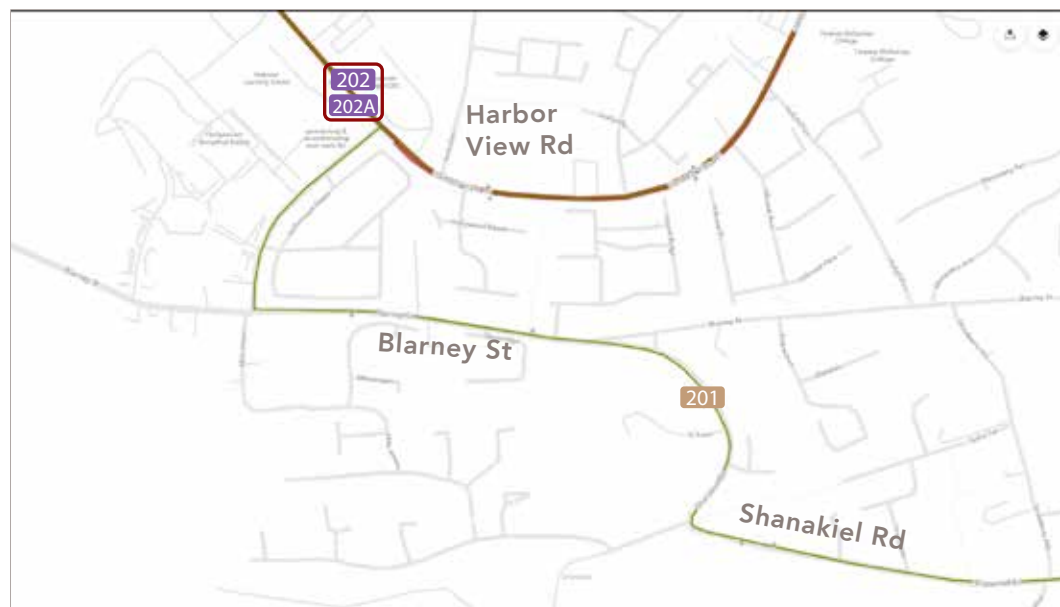
A disconnected street system makes public transport less useful and efficient.

The route on the main road isn't close to potential users on either side. More parallel routes must be run to get closer to more residents—but dividing service into more routes means offering poorer frequencies.

High density is not enough to generate high patronage. Good footpaths and crossings are also not enough, if development is far from main roads and made even farther by circuitous and disconnected streets.



Satellite imagery from Open Street Maps



Linearity

Exactly where development is allowed determines how *linear and direct* public transport routes can be.

The graphic on the right shows destinations aligned in two different ways. In the town on the top, the destinations are on the main road. Public transport can serve all destinations with a straight line. If you are travelling through this area, you're always travelling towards your destination, and never feel that you're being taken out of your way.

The town on the bottom has the same four destinations, but has permitted them to build far from the main road. To serve these places, a bus needs to drive away from the main road, get to the front door, and then drive back to the main road. If this is your destination, this is nice for you...but if you are travelling between any other places, you are taken out of your way and your trip is longer.

Can public transport run in reasonably straight lines?

+ A direct path between any two destinations makes transport appealing.

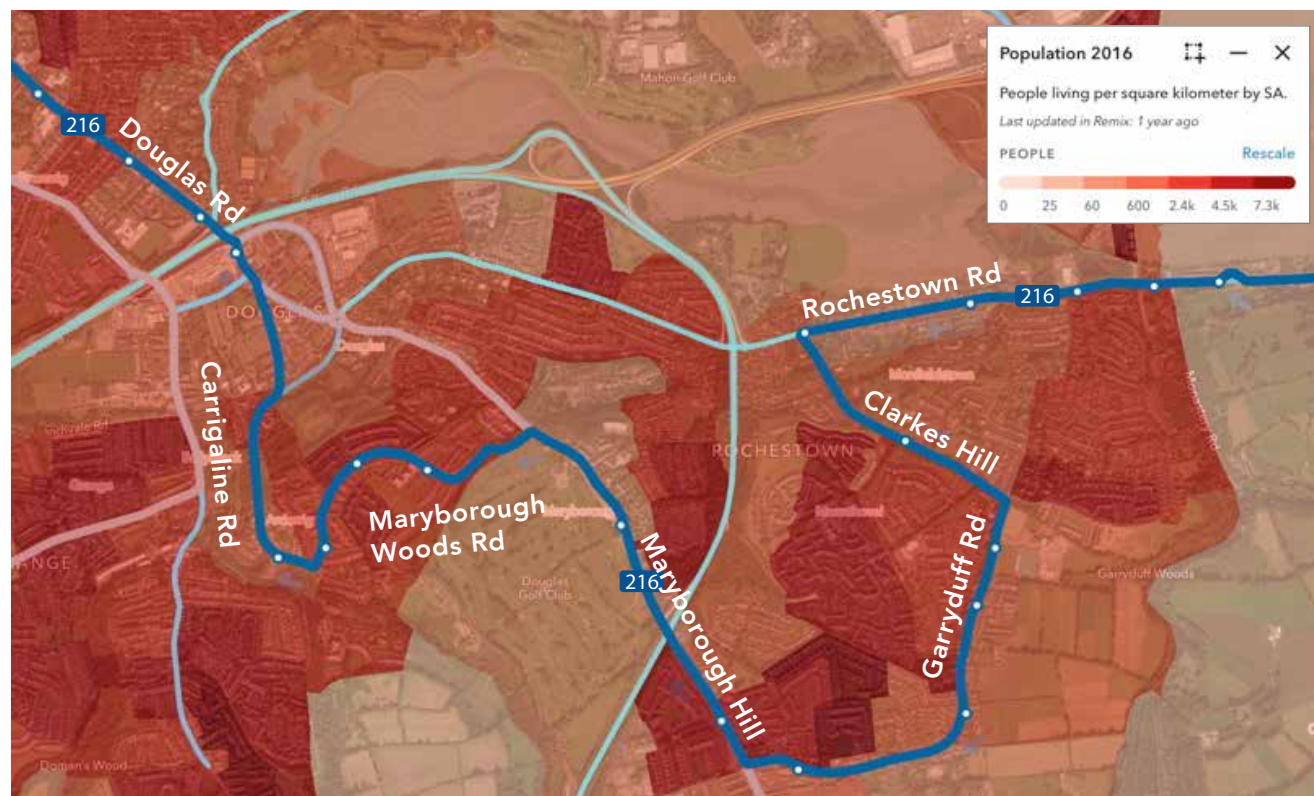


In the two maps on this page and the next, development patterns that affect public transport **linearity** are compared.

To the right, the Rochestown area has some moderately dense housing, but the way it is arranged causes circuitous bus routing. Some of the densest developments are located away from the major roads, so a bus route must meander in order to get close to a large number of people. As a result, Route 216 follows a deviating path which is much slower than a direct route through the area could be.

For people living east of Rochestown – such as in Passage West – a meandering route means longer journeys. The meandering also causes more operating expense, which reduces the budget available for other useful service improvements like frequency, long hours of service, or routes covering more places.

Once a neighborhood is built there may be little choice but to meander. In future developments, however, Cork City and Cork County can support efficient, high-patronage transport by organising dense housing into linear patterns.



Satellite imagery from Open Street Maps, Remix

***Poor street connectivity
can also result in circuitous
bus routes, which are time-
consuming for passengers and
costly to operate.***

In contrast, the businesses lining Main Street in Carrigaline are very well oriented to efficient transport. The map at right shows Carrigaline centre, with Route 220 running along Main Street.

The buildings in Carrigaline centre are mostly located close to Main Street, without large car parks separating them from transport.

Main Street is straight and is *on the way* to other major destinations. Buses can run through Carrigaline on the most direct path whilst getting close to many businesses and services, without meandering.



Satellite imagery from Open Street Maps

Proximity

With transport, distance is a major contributor to the cost of service.

The greater the distance Bus Éireann has to drive to serve 100 people, the fewer people it can serve within any particular operating budget. For this reason, places that have *continuous density and activities* along a road, will generate higher patronage relative to costs.

Another way to describe this factor is *proximity*. Connecting places that are far away is more expensive than connecting places that are close by, and – as described on page 16 – longer routes require more spending or poorer frequencies.

Does transport have to cross long gaps?

- + Short distances between many destinations are faster and cheaper to serve.
- Long distances between destinations means a higher cost per patron.

Mix of Uses

The mix of uses along a road affects how many people public transport can attract, relative to cost. A mix of uses tends to generate patronage *in both directions, at many times of day and week*.

Transport in purely residential areas tends to be used mostly in one direction – away from the residences, towards jobs – and mostly at rush hours.

There are three ways that mixed-use development patterns can support productive transport:

- Transport vehicles can be full in both directions, rather than being empty half the time.
- If people board and alight all along the route, then the route is used for many short trips. Each seat on the vehicle is useful to multiple people.
- Vehicles can be full all day and all week, so the cost of buying and maintaining the vehicles is supporting more passengers in total.

Do people travel in both directions, all day?



+ A mix of land uses means buses are ridden in both directions, more times of the day and week.



- Transport serving purely residential areas tends to fill up in one direction, but not in the other.

Transport-Oriented Development

The relationship between development and transport success is two-way.

Transport can be provided efficiently when development is walkable, linear, proximate and dense with a mix of uses.

Where transport can be provided efficiently, it's more likely to offer frequent service all day and all week. That high level of service allows people to live full lives without a car, which supports growth and development with less added car parking and car traffic.

Places that are very dense, with jobs or residents, can be in completely different transport situations depending on how proximate they are to *other* dense places.

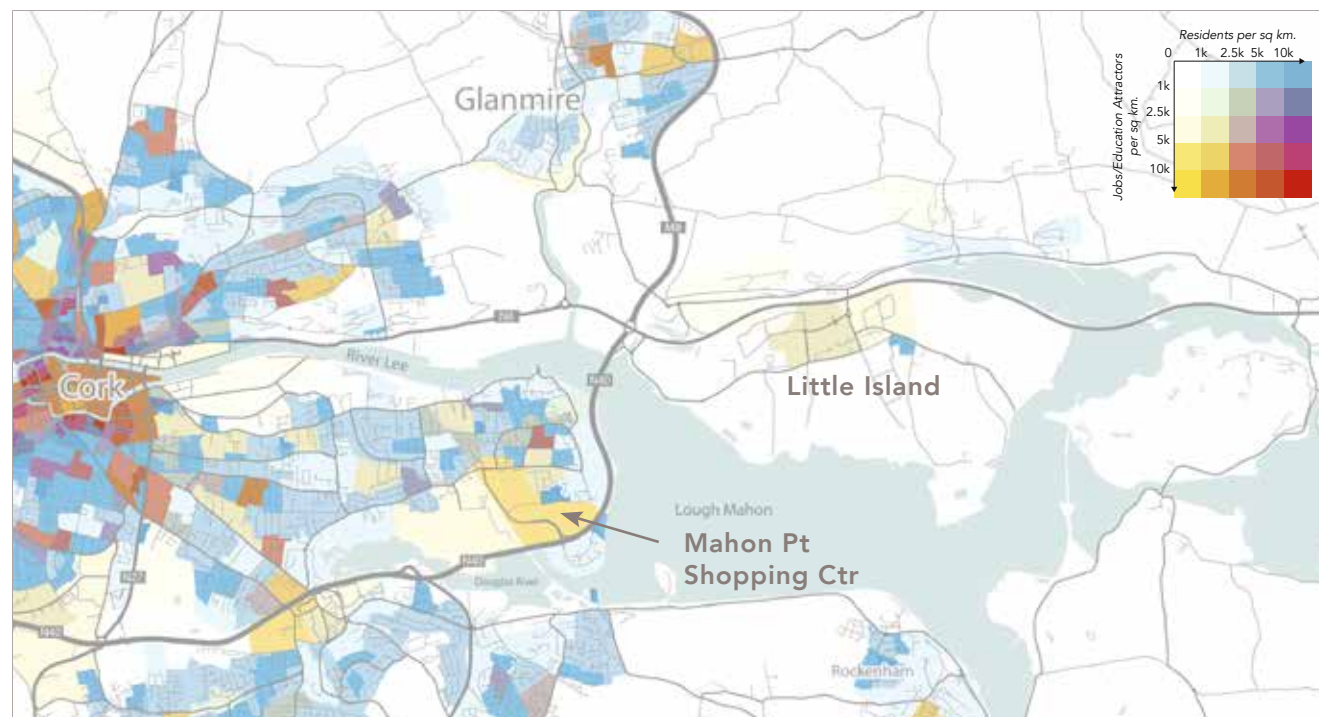
Mahon Point Shopping Centre is close to other dense places. Any bus route serving Mahon Point will pass by moderately dense homes, apartments, services and businesses on its way. This means that a bus serving Mahon will pick up passengers continuously between there and the centre.

As a result, a large number of passengers can be moved relative to the cost of the service.

High patronage and productivity on any service helps a transport authority justify higher investments in frequency or span of service, and helps a city or town justify investments in public transport priority measures and pedestrian improvements.

In this way Mahon Point's proximity to other development, and the mix of uses nearby, justify and reinforce good public transport to and from Mahon Point.

Little Island is dense with jobs like Mahon Point, and has grown quite a bit larger since the data shown on this map was collected (in 2016). Yet it is isolated, with a lot of distance between it and other dense places. It is across both the rail line and the dual



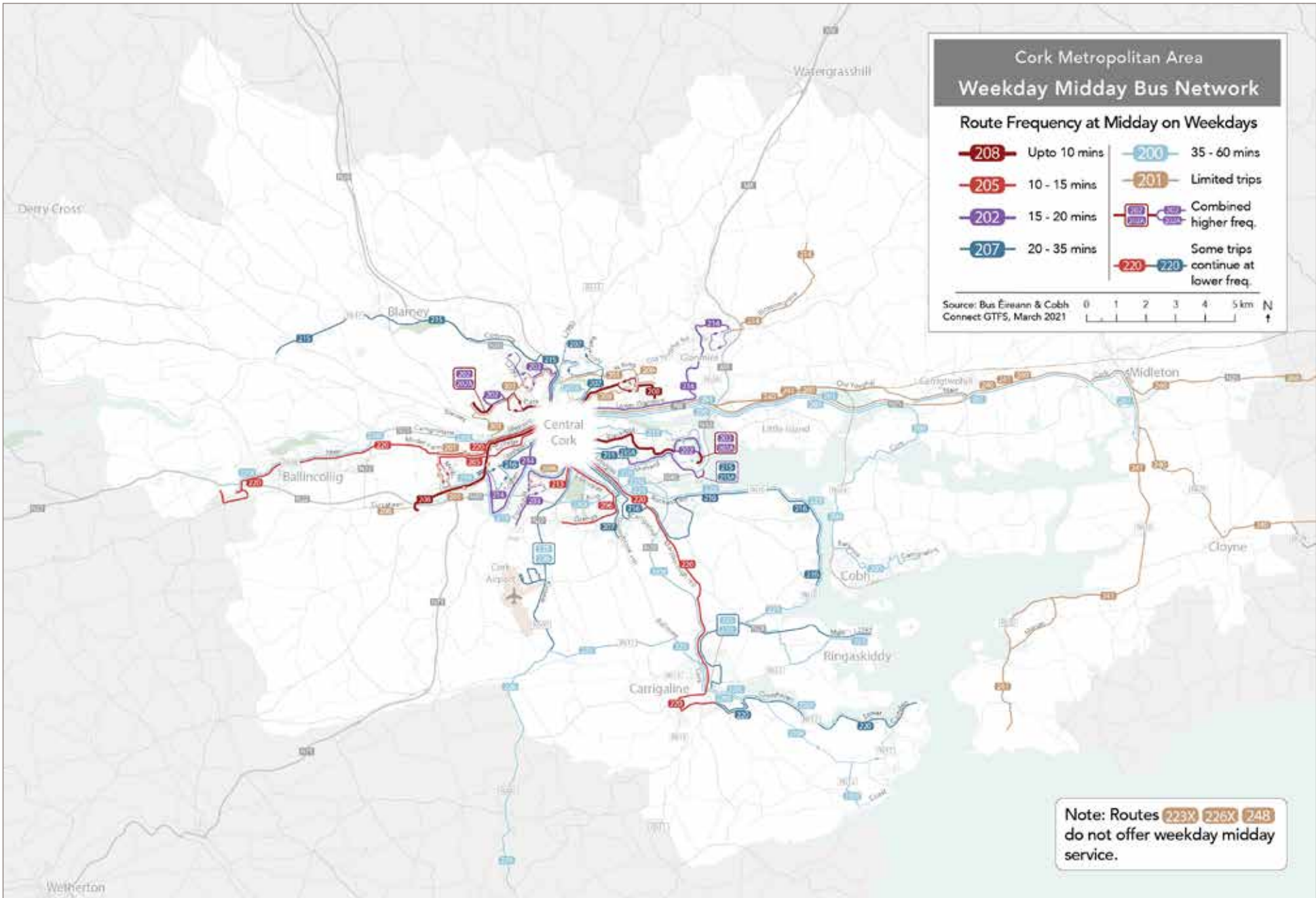
carriageway from other developed areas, and a bus route could not serve one side of those barriers without deviating away from the other. There is little housing on Little Island at present, so transport would be used mostly in one direction each morning and evening, with emptier buses running the other direction.

In transport, covering distance is costly. The greater distance a transport network needs to cover, and the more routes it is divided into, the less can be spent on high frequencies or other improvements.

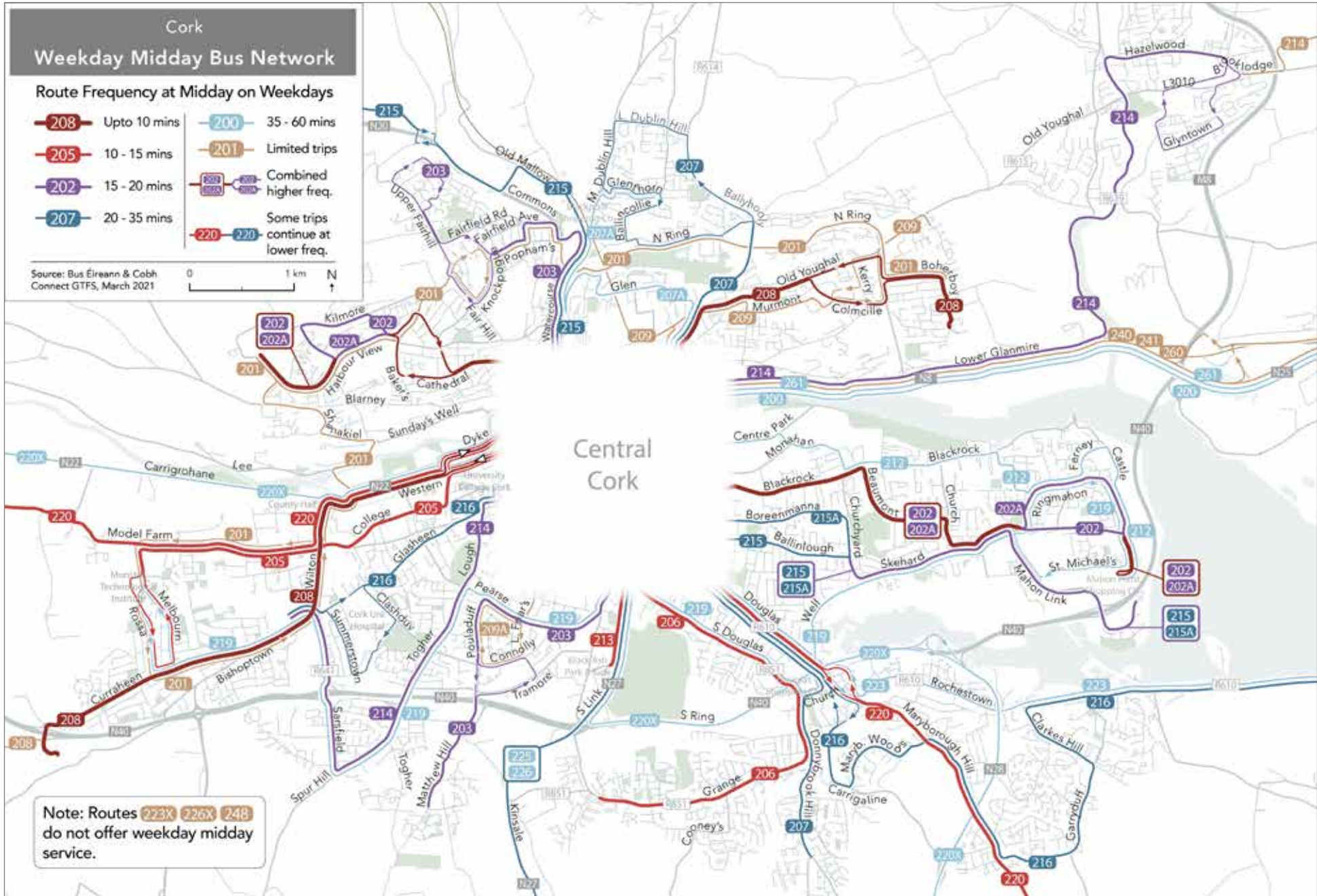
This doesn't mean that Little Island should not have service. It means that the service level on Little Island will be justified entirely by the activity on Little Island. It is not *on the way* for a bus heading elsewhere, and so it cannot be the beneficiary of service that is also justified by neighbouring, proximate developments.

3 The Existing Bus Network

Bus Network Map: Cork Metropolitan Area



Bus Network Map: Cork City



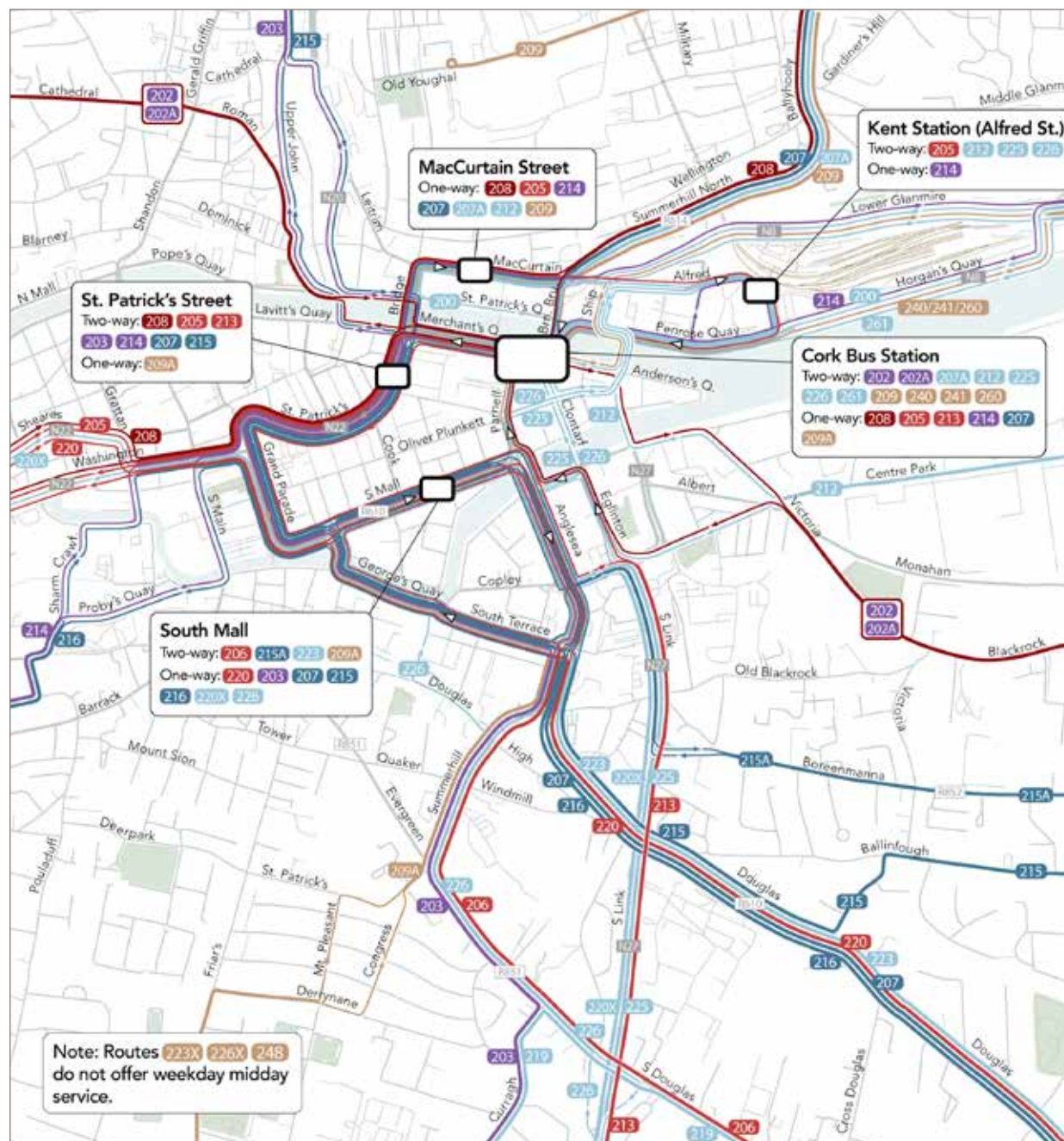
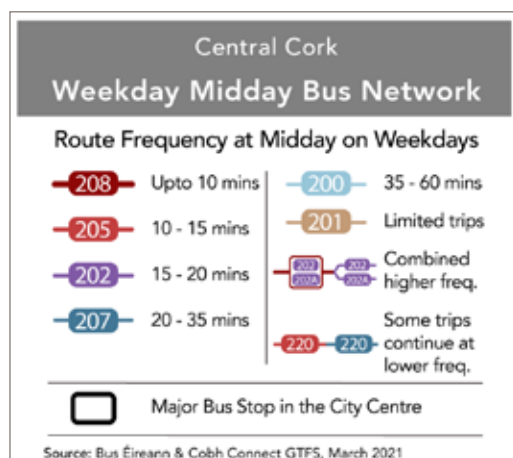
Bus Network Map: Cork City Centre

The map to the right shows the bus network in the centre of Cork, where it becomes very complex. It is surely challenging for newcomers to Cork to decipher the network and quickly learn where they can go by transport.

The complexity is caused in part by some one-way streets, which force transport to offer different patterns and go to different stops for the two directions of travel.

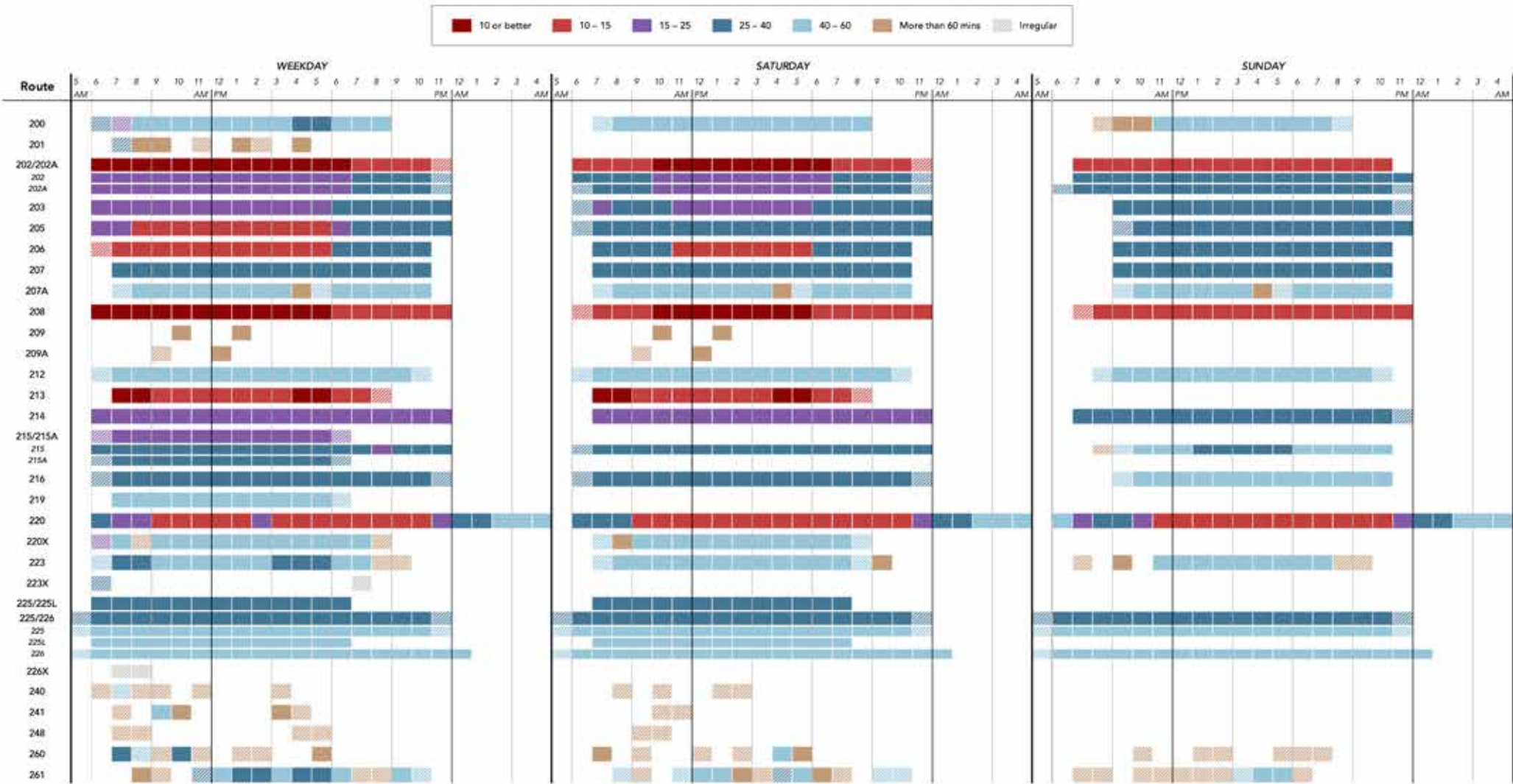
Many routes end in large one-way loops in the centre. One-way loops require people to spend extra time travelling around the loop, or they can get off and walk farther.

The effects of one-way loops and one-way splits on people's journeys are described further starting on page 42.



Bus Route Frequencies and Spans

Cork Bus Route Frequencies, March 2021



Proximity to Any Service, and Frequent Service

The graph to the right shows an estimate of many people and jobs are with about **five minutes' walk** of a bus route.¹ Proximity to bus service of varying frequencies is shown using different colors on the graph.

This graph can be used to describe progress towards both patronage and coverage goals.

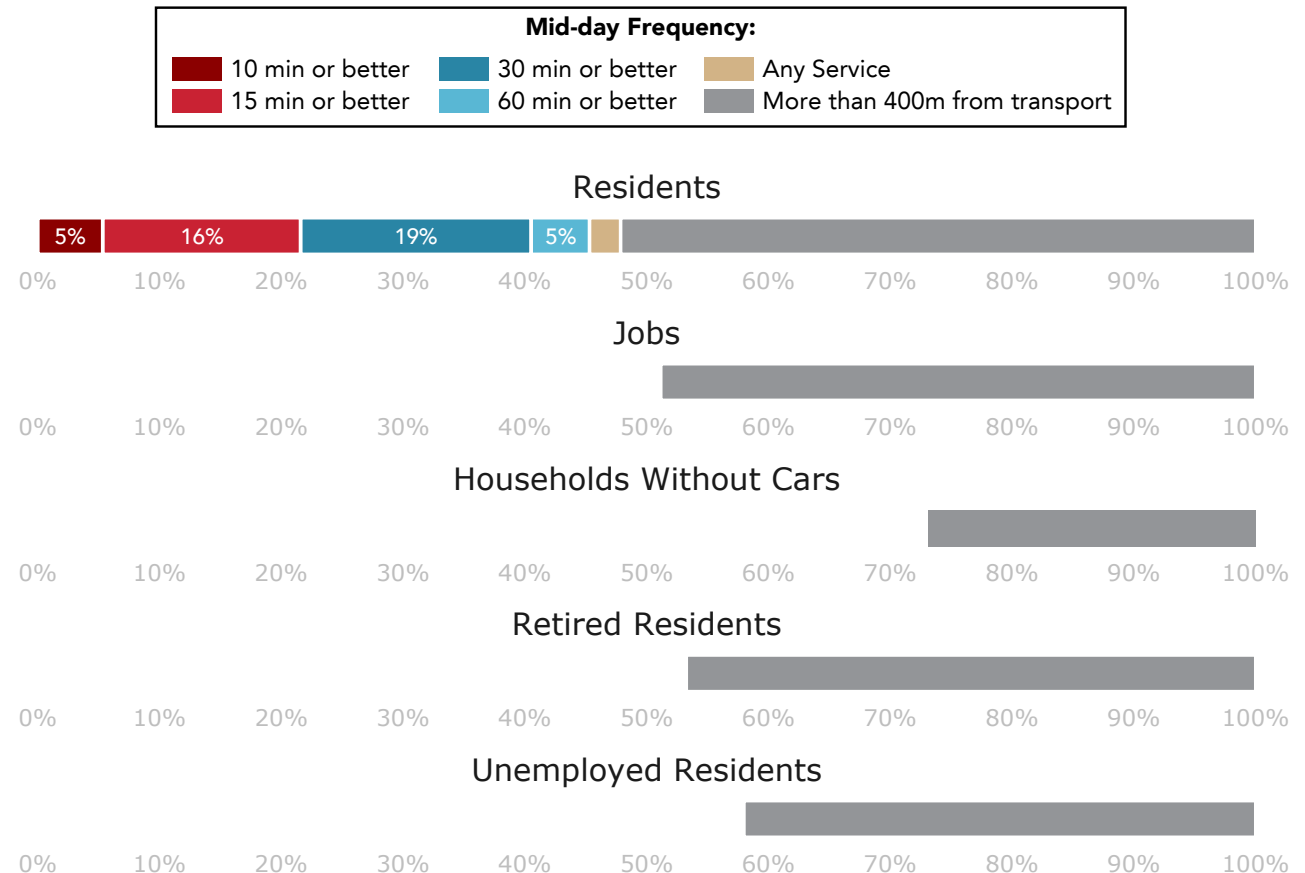
Increasing the percentage of residents and jobs near **any service** speaks to coverage goals such as social inclusion.

Increasing the percentage of people near **frequent service** speaks to patronage goals such as reducing vehicle emissions.

Once a Draft New Network has been developed, a similar measurement will be provided for that Draft, so that the public can compare how it would change people's proximity to service.

¹ Note that this analysis uses Census data for "Small Areas," some of which are in fact quite large. It is therefore only an estimate, as people living in rural Small Areas may be closer to transport than we can know from this data source. More precise data about the locations of residences and jobs may allow for a finer measurement at a later stage of this project.

Proximity to Transport at Midday *How many people in the Cork Metropolitan Area are near transport?*



Note: Proximity is measured as being located within a 400 m walk of a transport stop.

Frequency and Productivity Are Related

Productivity means patronage relative to the cost of providing service. A highly productive route is attracting many users relative to its operating cost.¹

More frequent routes are likely to be more productive. Not only do they attract more passengers, they attract *disproportionately more passengers* relative to the higher cost of providing the better frequency.

The scatterplot at right shows route-by-route data from the Cork bus network in late 2019 (pre-pandemic). More frequent routes are towards the left, and more productive routes are higher.

As the upward-leftward curve shows, more frequent routes are, on average, more productive.

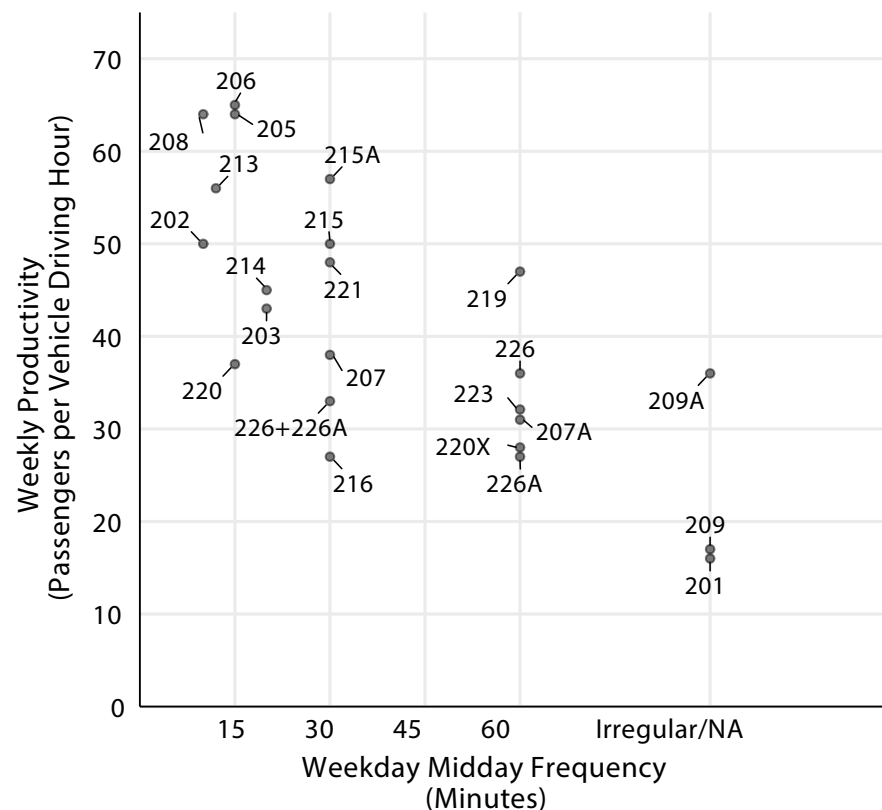
This same pattern appears for nearly every bus network of at least moderate size. This is because, in pursuit of higher patronage, public transport planners tend to increase frequency on routes that are already very productive, or routes serving areas with high patronage potential. When they increase route frequency in such public-transport-oriented places, the average

result is that the growth in patronage exceeds the increased cost of the frequency.

Public transport in places where the geometry of the development pattern is not conducive to high public transport access tends to have low productivity. But it can serve important coverage goals regardless, if the *availability* of the service is what matters most. In such areas, transport providers typically offer infrequent service because the cost of better frequency is difficult to justify for a small number of passengers.

We cannot increase the frequency of just any route and expect productivity to increase as well. The geographic and geometric conditions must be in place as well: density, walkability, linearity, proximity and a mix of land uses.

Cork Bus Route Productivity and Frequency
November 2019



¹ A common way to represent operating cost for transport is "vehicle hours" or "revenue hours," which are the hours a vehicle and its driver are on the road, available to passengers.

The table to the right shows the quantity of service provided on each route, the total patronage, and the resulting productivity, in 2019. Numbers are coloured based on their relative value, from orange for the highest values to brown for the lowest.

The far right column shows the midday frequency on each route in 2019, coloured according to frequency as on the maps in this report.

If increasing patronage is important, then we must look at routes' **productivities** as well as total patronage. No authority can spend infinite amounts of money to pursue each additional passenger, so it is important to understand how efficiently existing routes attract each passenger they serve.

For example, if a route currently offers little service, yet is fairly productive, that sometimes indicates high potential for growth in patronage. This may be the case for parts of routes 215A and 219, which are infrequent and represent relatively low service investment, but attract a fair number of passengers nonetheless.

Conversely, if a route offers a high level of service but attracts few passengers, that is sometimes suggestive of low patronage potential. This may be the case for Route 216, which offers 30-minute frequency, and

Route	Name	Service Provision (Weekly vehicle-driving hours, Nov 2019)	Total Patronage (Weekly, Nov. 2019)	Productivity (Users per vehicle-driving hour)	Frequency (Weekdays, midday, Nov. 2019)
206	Grange-South Mall	267	17,275	65	15
208	Lotabeg-Marymount Hosp.	790	50,734	64	10
205	MTU-Kent Sta.	360	22,976	64	15
213	Black Ash P&R-St. Patrick St.	147	8,850	60	12
215A	Jacobs Isl.-South Mall	89	5,057	57	30
215	Jacobs Isl.-Cloghroe	456	23,005	50	30
202	Hollyhill-Mahon Pt.	942	47,174	50	10
221	Knockraha-Merchants Quay	182	8,675	48	30
219	MTU-City Gate	103	4,842	47	60
214	Knockraha-CUH	345	15,433	45	20
203	Manor Farm-Fairhill	440	18,745	43	20
207	Donnybrook-Glenheights	410	15,544	38	30
220	Carrigaline-Ovens	1426	52,582	37	15
226	Kinsale-Airport-Kent Sta.	261	9,448	36	60
209A	Friar's Walk-Merchants Quay	7	246	36	90
226+226A	Airport-Kent Sta.	384	12,837	33	30
223	Ringaskiddy-South Mall	238	7,624	32	60
207A	Glenthorne-Merchants Quay	84	2,590	31	60
220X	Ovens-Crosshaven	220	6,190	28	60
226A	Airport-Kent Sta.	123	3,389	27.47	60
216	Monkstown-CUH	462	12,619	27	30
209	Lotamore-St. Patrick's St.	12	203	17	90
201	MTU-Lotabeg	50	796	16	90

operates seven days per week, but attracts fewer passengers relative to its costs than routes offering much less service.

Complexity

The Cork network is complex considering its relatively small size. The complexity arises from a few factors:

1. Service is divided into many routes in order to run on many nearby streets.
2. One-way streets cause routes to differ for the two directions of travel.
3. Many routes are specialised around specific kinds of journeys, offering just a handful of trips per day, or connecting only a few bus stops. (The three least-productive routes in the table on the last page are like this.)
4. Many routes have, within their daily schedule, special trips only made at certain times of day.
5. Interchange is discouraged by the charging of a second fare whenever someone boards a second bus during their journey. This leads to a network designed to minimise the need for interchange, which results in more routes at poorer frequencies.

What does this mean for public transport users, and especially for people who have just moved to Cork, whether for university, work or other reasons?

1. There are numerous routes to learn and remember, relative to the size of the metropolitan area and the amount of transport provided.
2. If someone is travelling to the centre, the stop where they alight is often blocks away from the stop where they should re-board for their return journey.
3. If someone wants to travel outside of the times when a highly-specialised route operates, they may wait a long time in order to use the bus or they may decide transport just doesn't work for them.
4. If a route has variations in its pattern throughout the day, people who don't know the system will occasionally get on the wrong bus, and end up somewhere they didn't expect.
5. A network designed for little interchange is more complex, and actually makes most peoples' journeys longer.

The fifth point, regarding interchange, is discussed starting on page 69.

The overall complexity of the bus network is not good for passenger growth. Some of the most successful changes to the network over the past decade have made it simpler, by investing in routes that run all day and all week, and by providing frequent service on clear, linear corridors. The BusConnects Cork network redesign is an opportunity to make the network simpler and easier-to-use for existing and future passengers alike.

Cork is expecting major economic and population growth in the future. This means many new residents will come to Cork and, upon arrival, make decisions about where to live, where to apply for jobs, and whether to purchase a car (and a home that necessitates a car commute).

If new arrivals cannot understand the transport network, and don't quickly see its value, then that will affect the choices they make as individuals. These individual choices add up, and affect the success of the CMA Transport Strategy in reducing auto emissions and not increasing congestion while welcoming new residents.

One-Way Splits

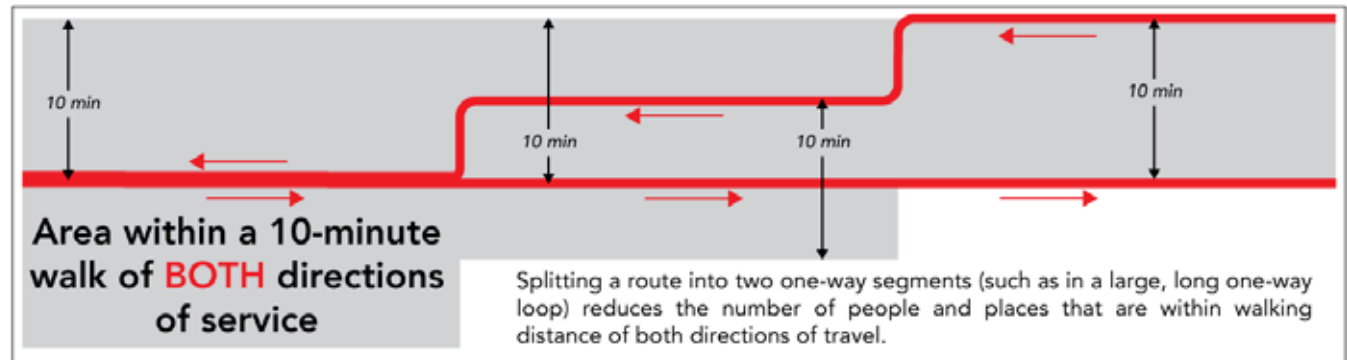
One source of complexity in the existing Cork bus network is when the two directions of service are on different streets. These one-way splits cause the area served by a route to be *smaller* even as it appears on a map to be larger. This is illustrated to the right, at top.

Transport needs to be useful in *both* directions. When the two directions of a route are split, people take different walking routes for their two journeys (which adds to the complexity of their journey planning), and they also must walk different distances.

The wider the split between two directions of a route, the more people will find that their walk, for one direction of travel, is uncomfortably long. This is true for any assumed walking distance, whether 5, 10 or 20 minutes, and its true even though individuals have diverse preferences about walk distance.

The map to the right provides an example of a one-way split in a route, and how it affects someone's maximum walking distance to a bus stop. Routes 202/202A—which together offer high frequency service between Mahon Point and Hollyhill in Cork—split by direction in Gurranabraher. Westbound buses follow Cathedral and Bakers Roads, and eastbound buses follow

A route split by direction appears to cover more, actually covers less.

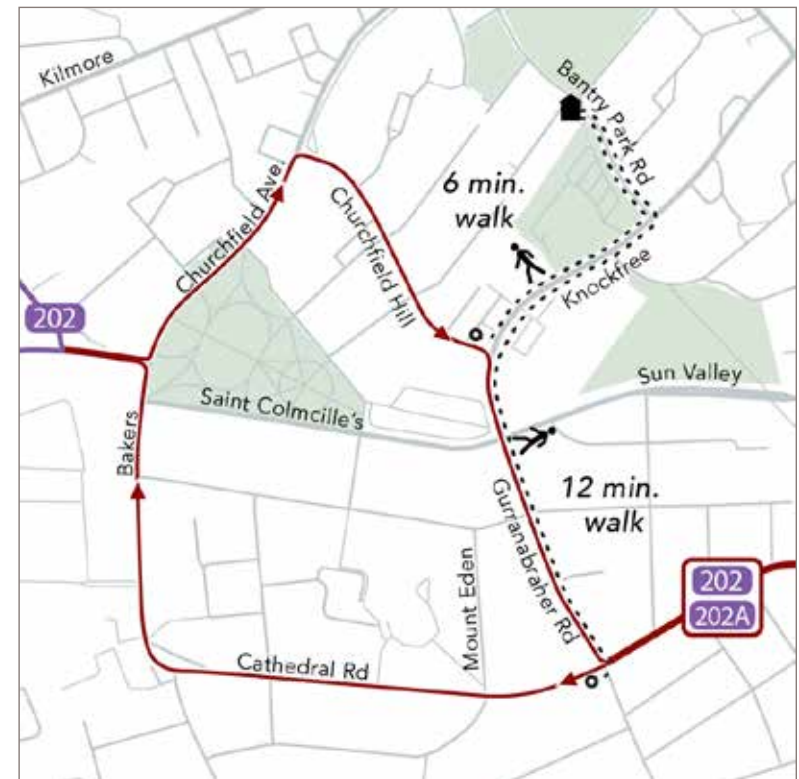


Churchfield Ave and Gurranabraher Road, as shown above.

While on a map it appears as though a greater number of people have access to frequent service because of the split, that is only true for people who can tolerate a walk to the *more distant* side of the split.

In this example, a resident on Bantry Park Road has a walk of just 6 minutes to reach the eastbound bus stop at Churchfield Hill. But when returning home, westbound buses turn away from this person's home. They must get off on Cathedral Road, and their walk home takes 12 minutes.

This reduces the number of people who consider themselves close



enough to the 202/202A to use it.

Nearly every route divides into one-way splits or loops in Cork City centre, due in part to one-way streets that have been designed for the flow of car traffic. The map above, to the right, uses Route 214 as an example to illustrate how a person's walking time varies when they are going to work and returning home.

Moving the stops for each direction of public transport farther away from one another makes walking distances for the two directions of travel more different. While the average walk may be acceptable, some people are sensitive to the *longest* walk they are asked to make.

The difference in walking time in this Cork City centre example may seem small, but nearly every route operates this way in the centre. Not only does it make walking times more extreme, it also makes the network more complex and confusing for new residents. The effect on each individual's experience is small, but it is compounded over tens of thousands of people. A small nudge or disincentive, if it affects a whole population, will have an effect on overall outcomes.



When two directions of a route are far apart, some people will find that the walk, either going or returning, is too long for them.

4 Population and Land Use Maps

Patronage Potential and Need

In this chapter, we present data that inform two different types of considerations in transport planning:

- *Where are the strongest markets for transport, with potential for high patronage and low operating costs?*
- *Where are there moderate or severe needs for transport, where services may be important even if they do not attract high patronage?*

The maps draw on 2016 Census data and other sources.

The maps on the following pages show:

- Activity, which combines residents and jobs and therefore also shows where land uses and mixed
- Residents
- Jobs
- No-Car Households
- Transport Commuters
- Unemployed Residents
- Retired Residents
- Youths

These maps show the density of each population group across the metropolitan

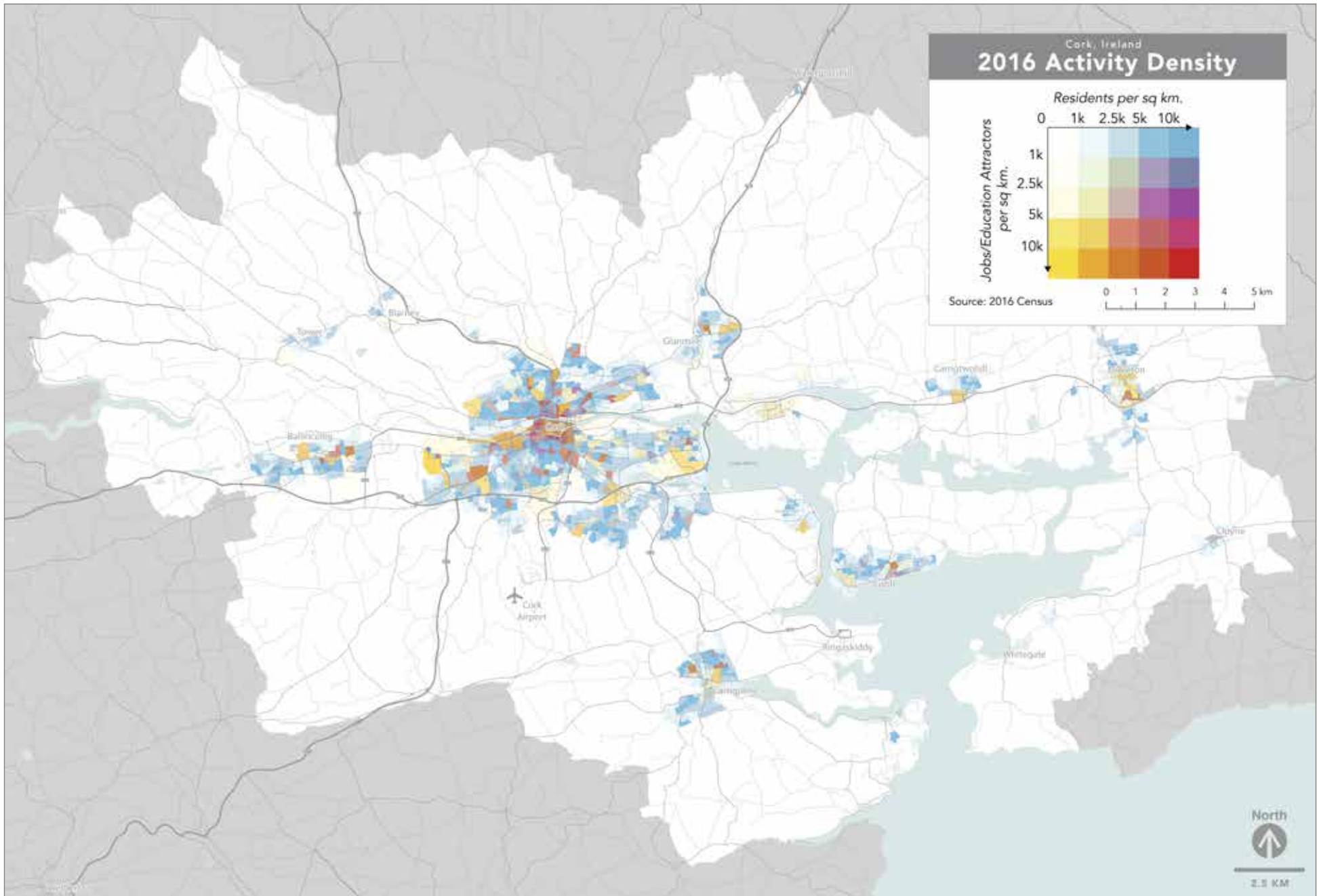
area.

Density on its own is not enough to support high access and high patronage. We must examine these maps for all of the geographic qualities that indicate potential for high access and patronage:

- **Walkability.** The last map in this series shows how conducive the local street and path network is to providing short walks to bus stops.
- **Linearity.** These maps, especially when viewed in combination, reveal where transport can run in reasonably straight lines, without deviating or following circuitous patterns, while getting close to large numbers of people and activities.
- **Proximity.** Crossing rural areas and open space takes time and therefore consumes operating budget, which means that the farther apart destinations are the greater the cost to connect them, or the worse frequency can be offered across that distance.
- **Mix of Uses.** This is best visualised in the first map in the series, which shows Activity. When places are dense with both residents and jobs, transport service can be used more efficiently: in both directions, all day and all week.

These factors and their geometric effect on public transport access and efficiency are illustrated starting on page 20.

Activity (Residents + Jobs)

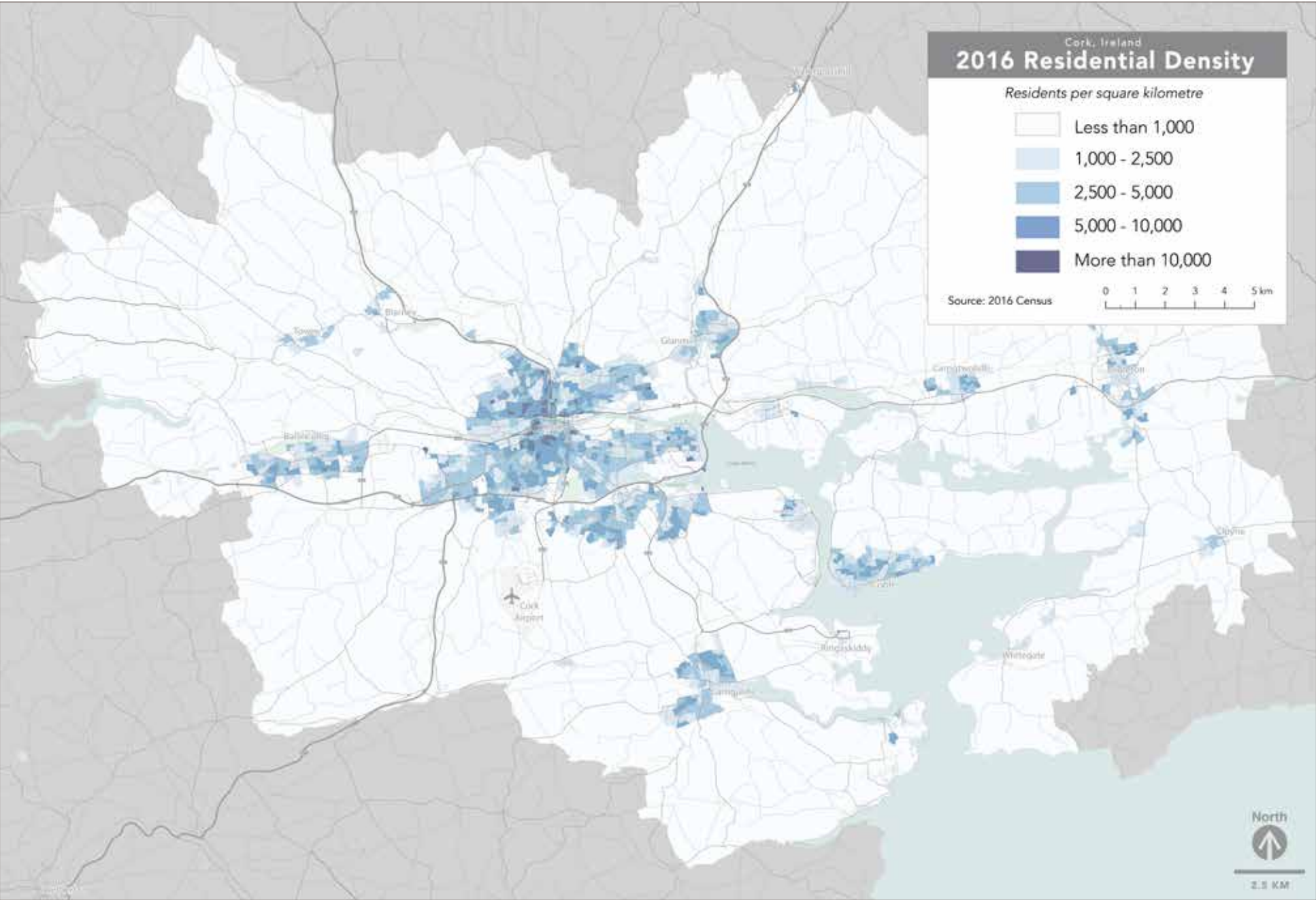


The map of **activity density** on the previous page shows job and residential density together. This allows us to identify areas that are dense with either use, as well as areas with a high mix of residents and jobs.

Areas with many jobs and residents are likely to have many potential transport users and destinations. Areas with mixed use are likely to generate trips in all directions, at many times of the day and week. This makes it possible to attract high patronage efficiently, as service and vehicles are useful in both directions of each route.

The activity map identifies (in yellow) areas that are primarily job centres and (in blue) areas that are primarily residential centres. Large portions of central Cork City are dense with a mix of uses (shown in orange, red and dark pink). To a lesser degree, the centres of towns in the County also stand out as having a mix of uses.

Residents



Many journeys start and end at home, so places where many people live have potential for high patronage. They also serve as destinations for other people's trips such as for visiting, caring for family, or receiving services someone provides from home. Understanding where many people live close together can help us see where there is a greater market for transport.

The largest area of concentrated residential density in the CMA centres around Cork City. Much of the central Cork City area has more than 5,600 residents per square kilometre. There is slightly more residential density south of the river than north.

Outside the central Cork area, there are several other medium-sized pockets of residential density such as Ballingcollig, Carrigaline, Carrigtwohill, Coolbawn and Cobh. There are small pockets of residential density in smaller towns such as Ballygarvan, Ballyvoreen, Blarney, Cloyne, Killeens Cross, Noonans Field, Ringaskiddy, Passage West, Tower and Whitegate.

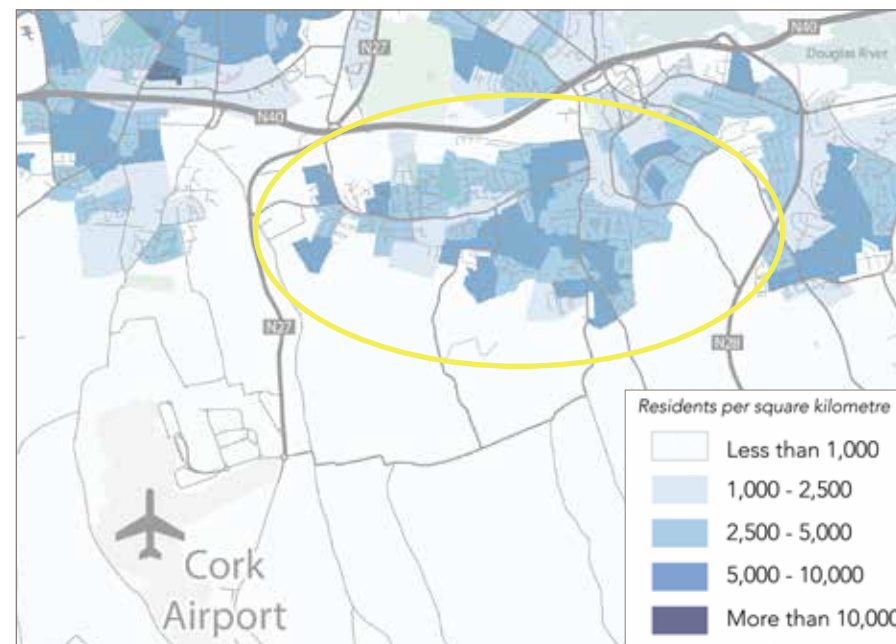
A pattern of development that is problematic for transport is visible on this map, and that is the placement of dense housing developments away from main roads. Some of the darker-blue areas around the periphery of Cork and in the suburbs are at the edges of the urbanised areas, not along a

main road, and separated from other dense places by less-dense development or dual carriageways.

When dense residential developments are permitted far from main roads, and especially when local street networks do not make it easy for those residents to walk to the main roads, this leads to less useful transport and lower transport patronage.

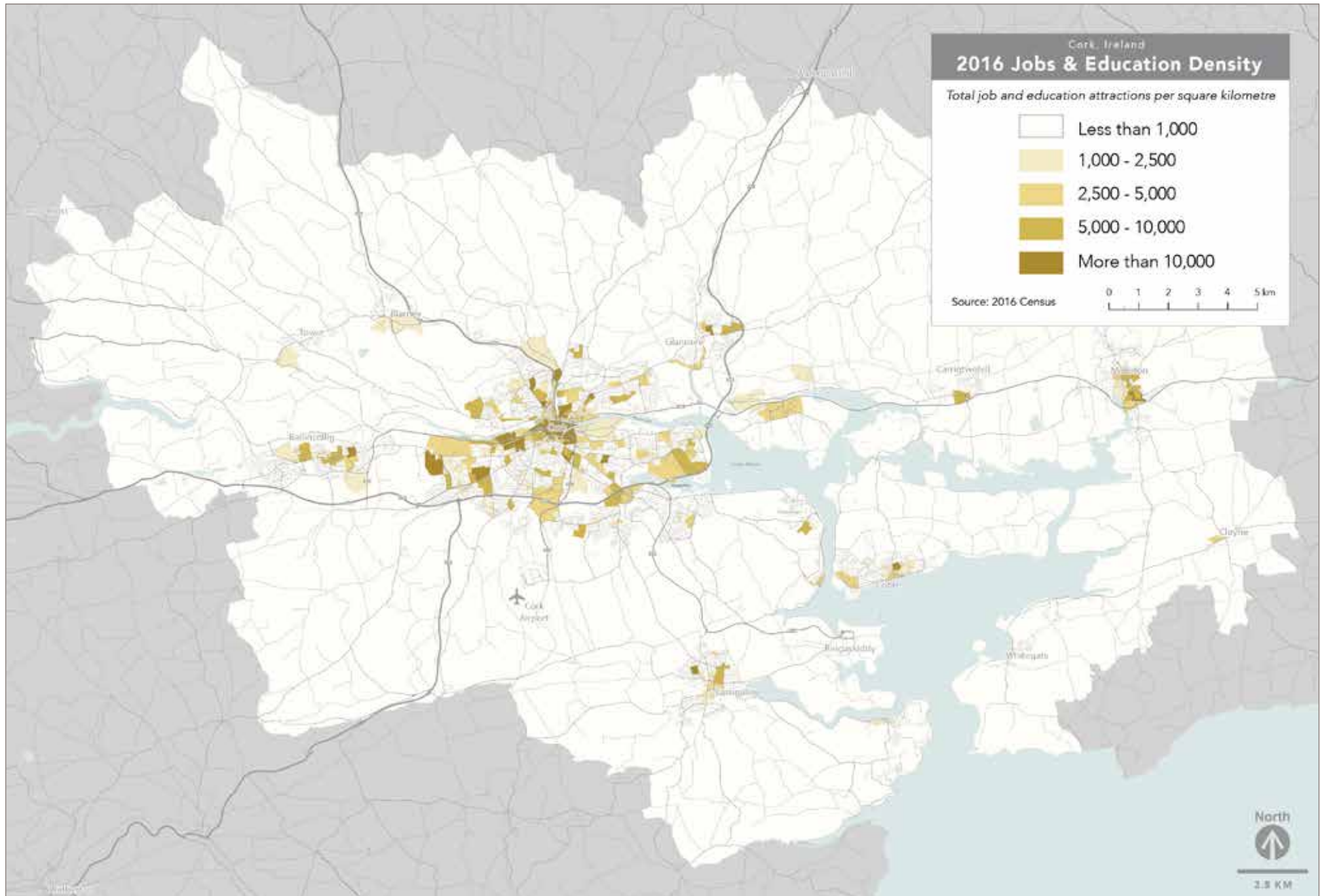
- Residents, and their public officials, will naturally request that buses be deviated off the main road to get closer to them. Yet this makes service less useful for everyone else, as described on page 26.
- The transport provider may deviate a route into the development, or even run a second route through it. In either case, transport is spread over more kilometres, which means that the frequency of service that can be afforded within any particular budget is less.

An example is the subdivisions south of the N40 in Cork, circled on the map above. Moderately-dense housing is scattered



onto many roads, rather than being organised into a centre or along a corridor that could be served efficiently.

Jobs & Educational Opportunities



Job and education density can show us where the important destinations are that people travel to daily, for work or school.

Some areas that are dense with jobs attract more than just commuters. Commercial and retail job locations represent places people go to regularly throughout the day for shopping, medical care, socialising, fitness, and all of the other activities that make a full life.

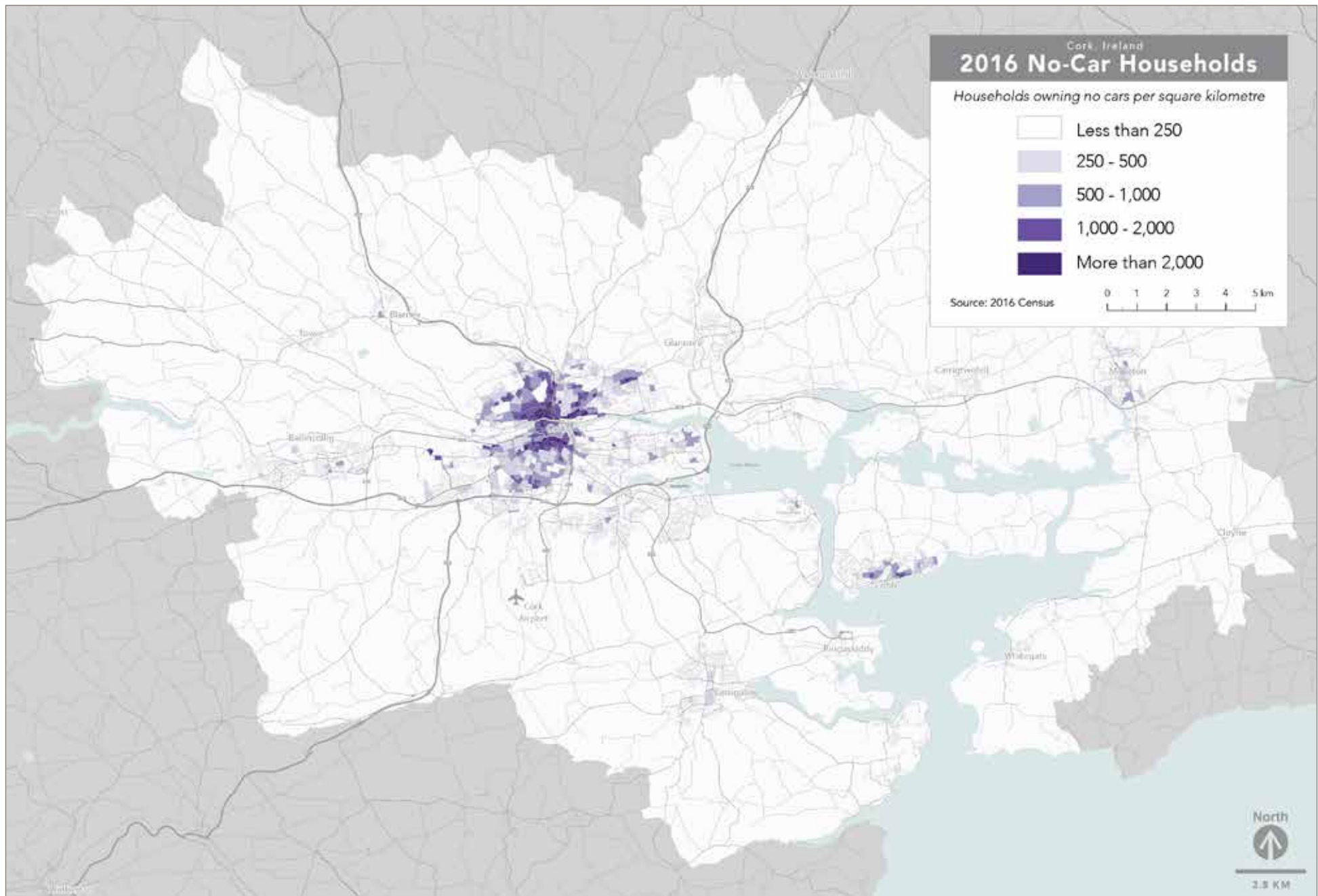
In Cork City, a high density of jobs and educational opportunities are located in and around central Cork City, as well as at universities, hospitals and schools. There are also job centres in Ballincollig to the west, Loughmahon Technology Park to the east, and Kilnap Business & Technology Park to the north.

There are dense jobs in the centres of towns in County Cork such as Carrigaline, Cobh, and Midleton, and in the Eastgate Retail Park on Little Island.

At lower densities, there are also jobs spread around the Cork Airport, in Ringaskiddy, in Carrigtwohill and in the industrial park south of Carrigaline. While Ringaskiddy is particularly well-known as offering a great many jobs, the jobs are dispersed over such large areas that they barely appear on this map.

That wide dispersal is typical of modern industrial development patterns. It makes those jobs harder to reach with public transport, especially when buildings are placed at the ends of cul-de-sacs or behind walls. The low-density of jobs in such areas sometimes means that workers have to walk a long distance from the bus stop to their actual job site.

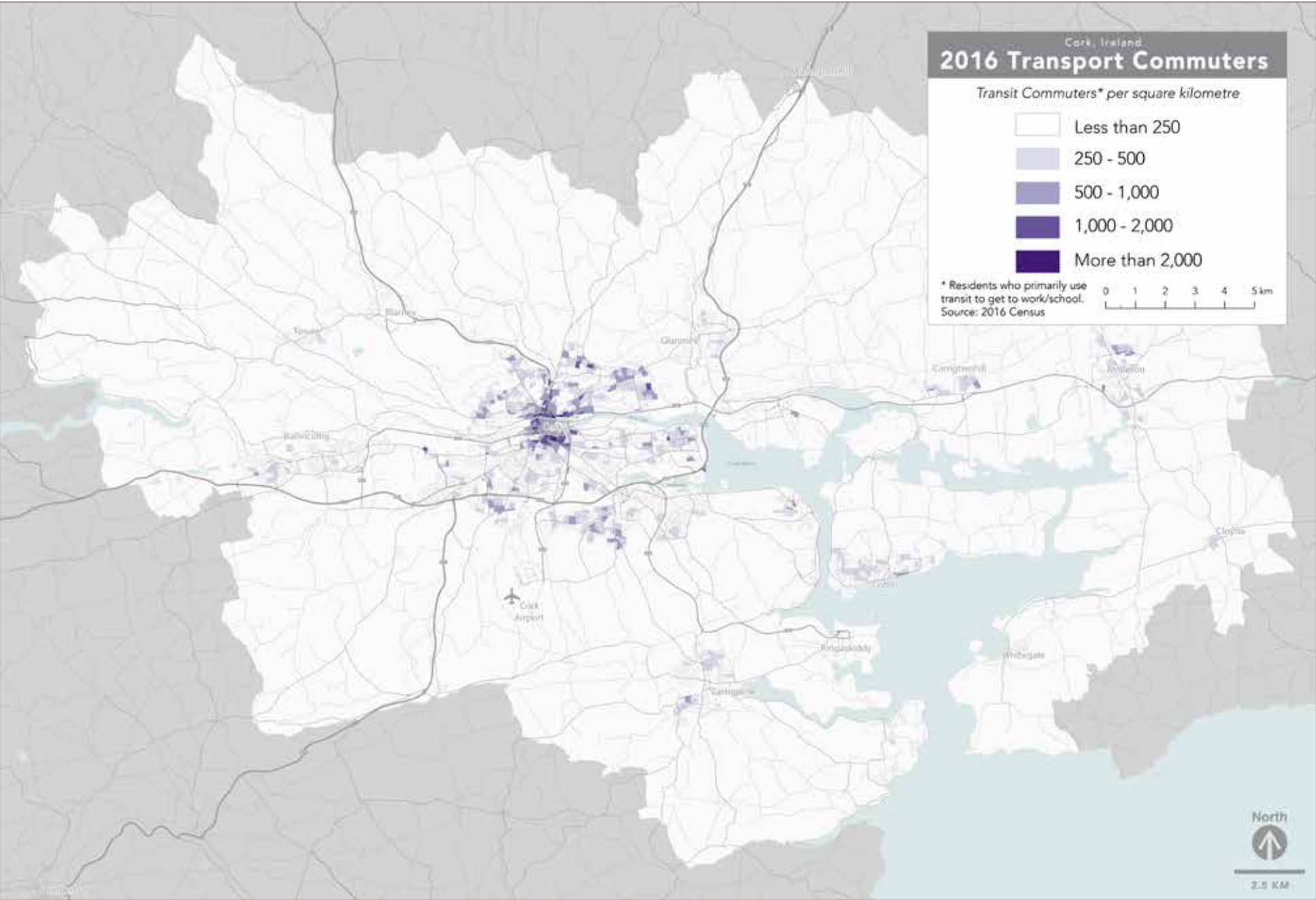
No-Car Households



The map on the previous page shows where **no-car households** are concentrated in the CMA. There are high densities of no-car households in central Cork City, especially north of the river, as well as in Cobh.

No-car households indicate both potential for high patronage and a need for transport service. In places that are far from Cork City Centre and local town centres, households without cars may have few options besides transport for reaching jobs and services beyond their neighbourhood or their town.

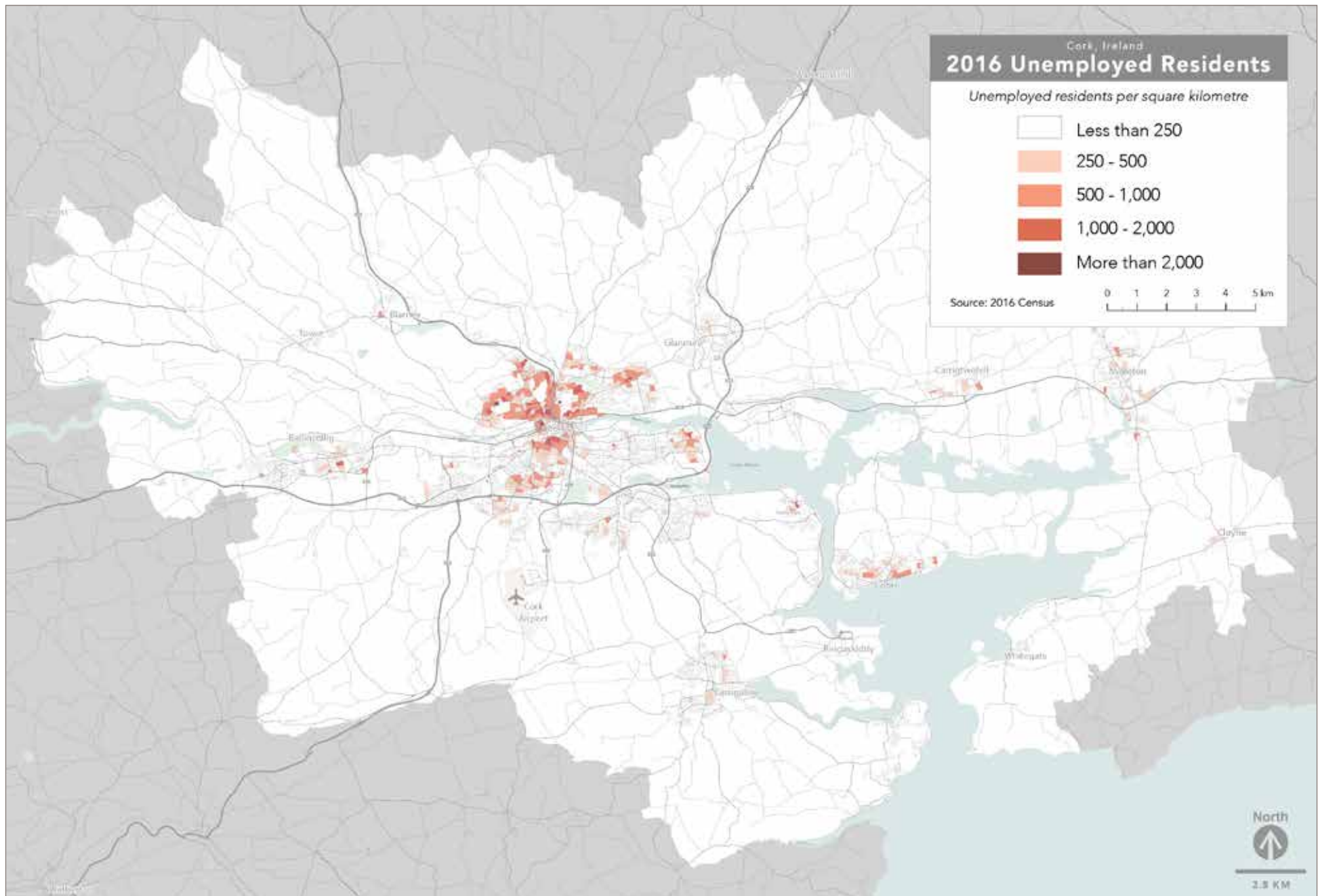
Public Transport Commuters



The map of **transport commuters** on the previous page shows where people who were relying on transport for a work or school commute in 2016 were then residing.

Unlike the previous map of no-car households, this map shows where people rely on transport but also where transport existed in 2016. There may be potential for more transport commutes beyond where the network allowed in 2016 or even today.

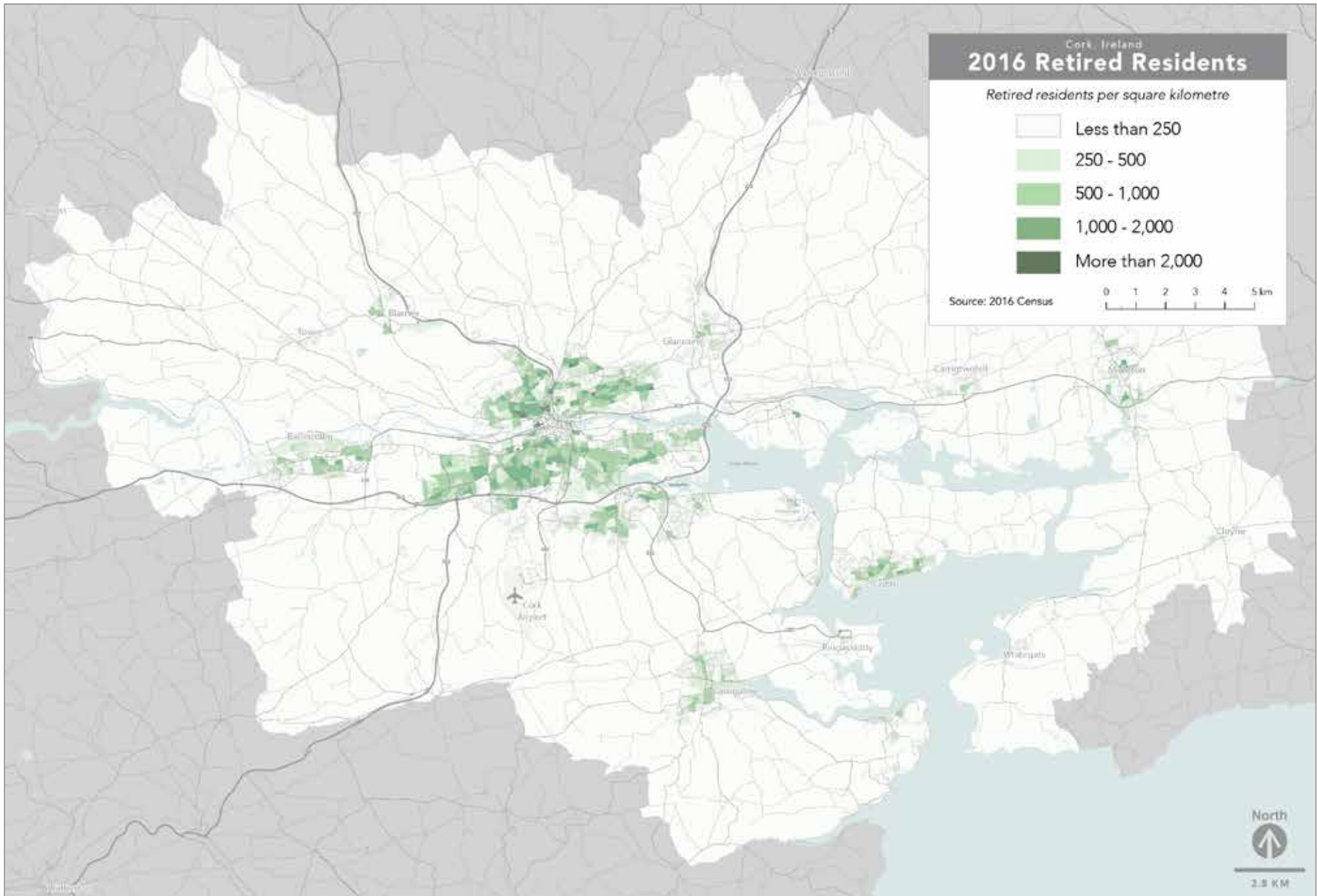
Unemployed Residents



The map of **unemployed residents** on the previous page shows where people who were in not in employment in 2016 were residing. Unemployment is but one measure of deprivation, but it can help us identify areas where transport would be valuable for social reasons, even if it does not attract high patronage.

There are high concentrations of unemployed residents around central Cork City and a few outlying parts of the City, as well as notably in Cobh. There is a greater density of unemployed residents north of the river in Cork than south of the river.

Retired Residents



The density of **retired residents** generally follows the patterns of overall residential density.

Retirees live at high densities in Laharn and near the Cork University Hospital. There are some very dense retiree residences and nursing homes in Cork north of the river.

Among all of the fares paid on board Cork publicly-subsidised buses in 2019, 29% of them were DSP Free Travel Passes, which are available to people over the age of 65 and people with certain disabilities.

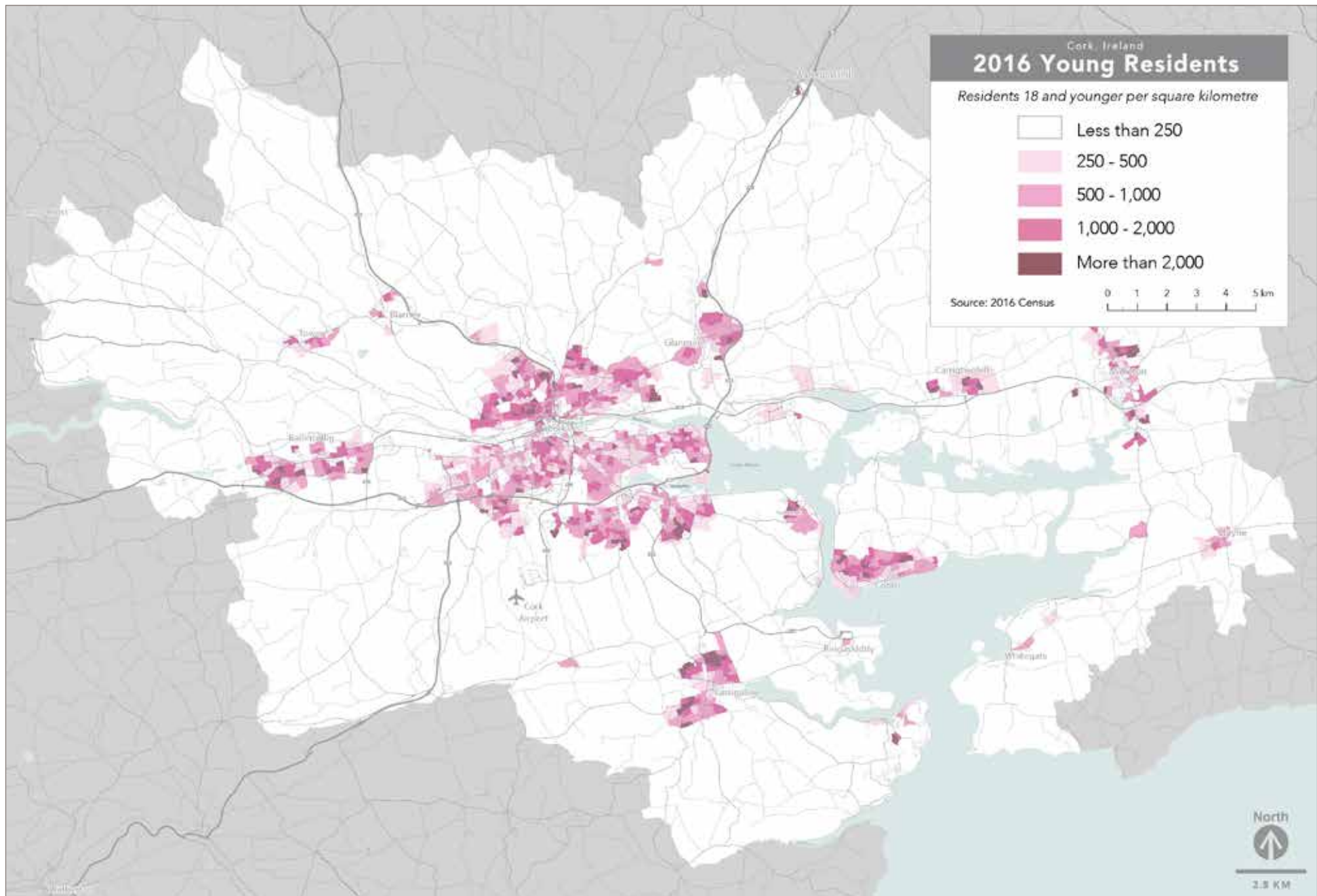
Retirees and seniors are known to have a high propensity for using public transport. As a group, they tend to have different preferences for transport service design than younger people and working people:

- They often prefer a shorter walk to and from the bus stop.
- They often have more time to plan their journey and make their journey.
- They are somewhat less likely to make trips for which they do not control the timing (such as to a job or school) and therefore are a bit more able to time their trips around the bus schedule.

For these reasons, retirees and seniors are sometimes more concerned that transport

routes get close to their homes and destinations, and less concerned about whether the service is frequent or fast.

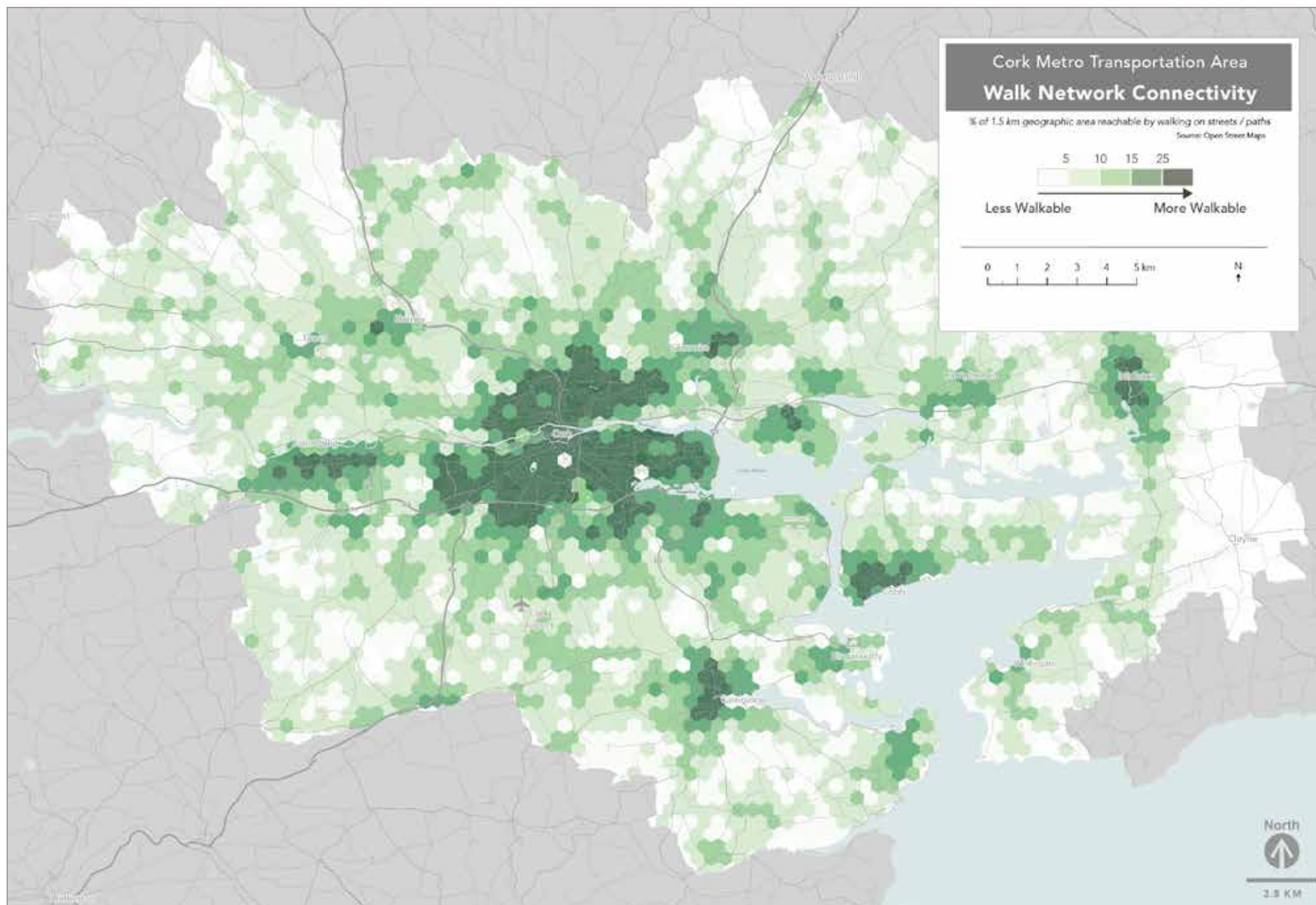
Youths



Concentrations of young residents (those 18 years and younger) generally follow patterns of high residential concentration. However, in central Cork City, there are fewer concentrations of young residents, even in densely populated areas. This is likely because the smaller housing units that are common in the centre city are less likely to be occupied by families with children.

Of the fares paid on Cork buses in 2019, 9% were for a child 18 years or younger.

Walk Network Connectivity



The map on the previous page shows one measure of walkability: the portion of the nearby area that can be reached by walking up to 1.5 km on streets or paths.

Places with few street or path connections will require people to walk longer distances to reach destinations that are nearby as-the-crow-flies, as illustrated on page 23. Such places appear on this map in light green or white. Places where many connected streets or paths allow people to reach most nearby places quickly appear in dark green.

Central Cork City is generally has higher walk network connectivity than other places in the CMA.¹ Other towns have high walkability in their centres, but their centres tend to be quite small.

¹ Areas near water show lower walkability by this measure because reaching destinations on the other side of the river might require a diversion to a bridge.

4 Key Choices

The purpose of this report is to invite members of the public to provide their opinion on certain choices about the future Cork bus network.

There are certain transport choices about which reasonable people will disagree. Understanding how people in the Cork Metropolitan Area would make these choices will us design the Draft New Network for public consideration.

The first phase of public consultation is therefore focused on these choices:

- How much change is desirable and tolerable, given that *any* change is disruptive?
- Should the redesigned network prioritise giving people short walks to transport, or short waits?
- Soon, interchange will come with no additional cost. Should routes be designed for more interchange, if this results in faster journeys for most people?

Tolerance for Change

The biggest choice facing the Cork Metropolitan Area in this study is whether changing the network is worthwhile.

Every detail of the existing network is something somebody is accustomed to, and they will object to it being changed.

The value of a familiar network is that it continues serving existing passengers in a familiar way. People have built habits and lives around the existing network.

Network redesigns are controversial in proportion to how much the network changes. ***How much change is desirable and tolerable given that even a change that benefits the larger population will be disruptive to some people?***

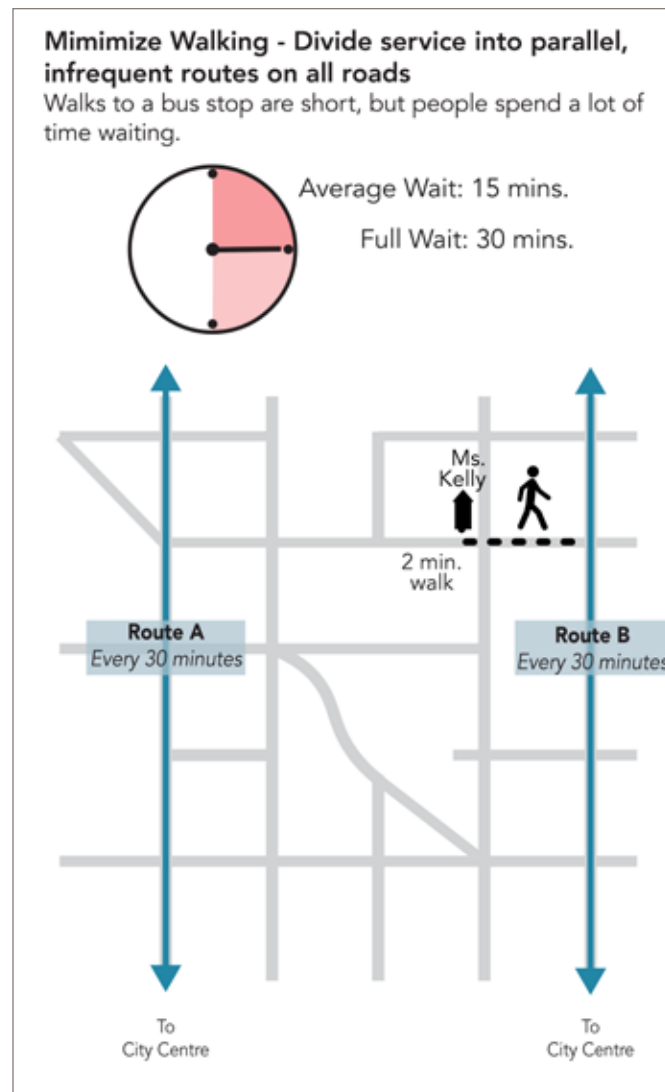
Shorter Walks or Shorter Waits?

There are some parts of the Cork network in which transport operates on nearby parallel roads, with the result that many people are close to two routes that are heading in the same direction.

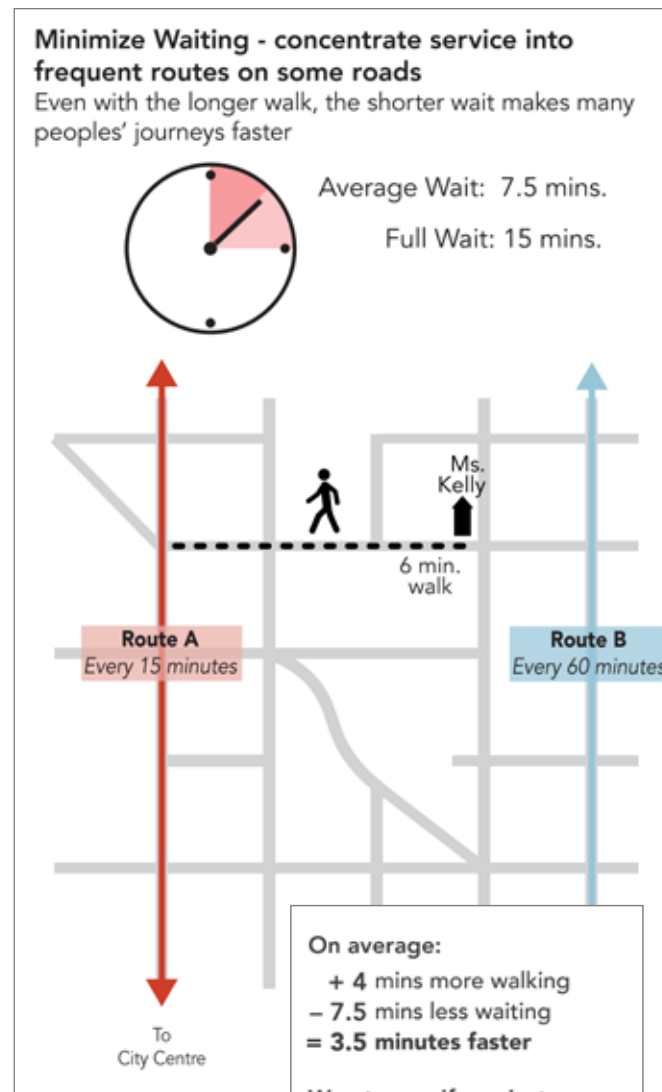
BusConnects Cork is an opportunity to ask people whether short walks to a stop are more important than short waits for the bus. The illustrations to the right show two different ways that a network can be designed: to provide short walks (at left) or to provide short waits (at right).

In areas with good street connectivity and footpaths, focusing service investment on key corridors in order to make those routes more frequent can actually make people's trips *faster*. This increases access to opportunity within a reasonable travel time, getting people where they are going sooner. It typically leads to higher patronage.

Local conditions affect peoples' willingness to walk: if the walk is noisy, unsafe or hilly, then people may prefer longer waits at a stop closer to them. People in different life situations will have different abilities and preferences: someone who is transporting multiple children, or who is elderly, may prefer a short walk even if it means more time waiting and a longer journey.



Focusing service on key corridors can shorten waits more than it lengthens walks. This gives people access to more places within a reasonable amount of time.



This page presents one theoretical example from Cork. Routes 215 and 215A operate on nearby, parallel Boreenmanna and Ballinlough Roads, as shown below at left. Many people have a short walk to one (or both) of these routes. But for journeys that can't be timed to the bus schedule (such as journeys to work), people will spend up to 35 minutes waiting.

If more service were concentrated on one or the other of the roads, then shorter waits would be available in this area. So much

shorter, in fact, that walking *further* to the frequent route would shorten overall journeys for most people.

In the example below, instead of a 19.5 minutes spent walking and waiting (below left), this resident would spend 13.5 minutes (below right). Journey times for people living nearer to the frequent route would improve by even more.

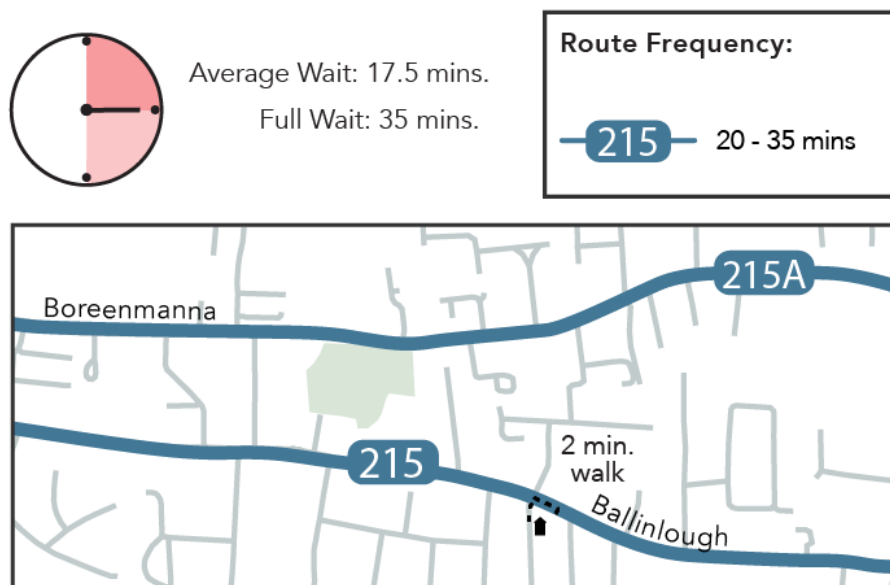
This would be true whether the service were concentrated on Boreenmanna or

on Ballinlough, and either is a possibility—this arrangement was picked purely as an illustration.

Some people are sensitive to walking distance and might not walk further in order to get where they are going sooner. On average, enough people are in a hurry that focusing service into frequent routes tends to increase patronage. ***Should the new Cork bus network be designed to prioritise short walks, or short waits?***

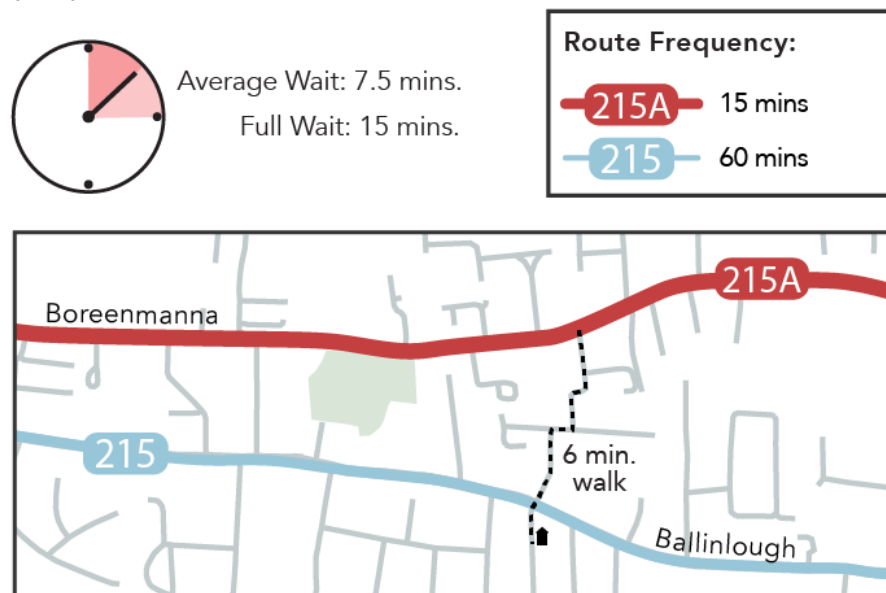
Mimimize Walking - Divide service into parallel, infrequent routes on all roads

Walks to a bus stop are short, but people spend a lot of time waiting.



Mimimize Waiting - Concentrate service into frequent routes on some roads

Even with the longer walk, the shorter wait makes many peoples' journeys faster.



Interchange or Complexity?

There is a trade-off between interchange and complexity that arises in many transport networks, because it arises from the simple math and geometry of transport. The more a transport network is designed to avoid interchange, the more complex it will be, and the poorer the frequency of many routes.

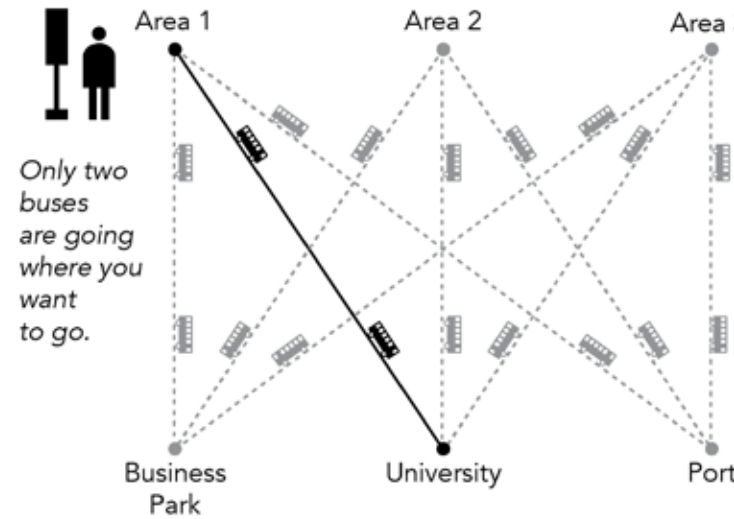
Obviously we would all prefer a one-seat-journey, rather than a second wait for a second bus. But making that wish come true for all would spread service thin, and thereby make it less useful.

The illustration to the right shows why designing for some interchange allows for shorter waits and a simpler network.

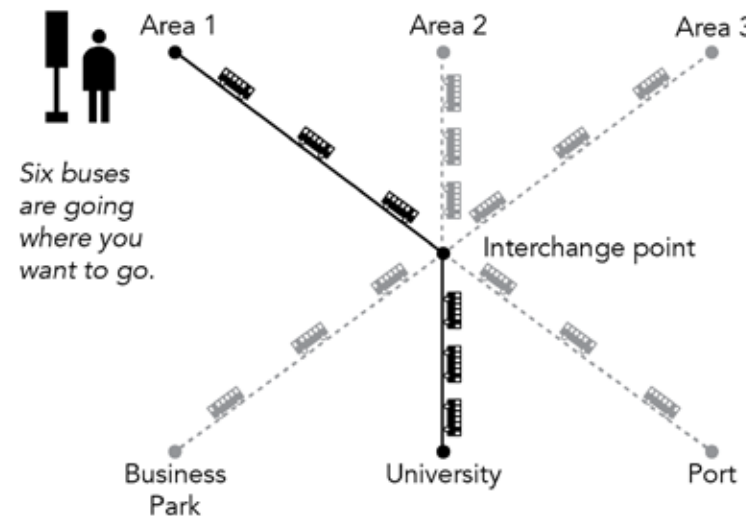
The network at top is made of direct routes, one from each of three neighbourhoods to each of three major destinations. There are a total of nine routes, but each is only operated by two buses, so the frequencies are poor. A person travelling from home to the city centre gets a direct journey, but they can't depart when they want to—they have to time their departure to the bus schedule.

The network at bottom connects the same six places but with fewer routes. Each route offers much better frequency. In order to make this high frequency service possible,

Direct Routes, Long Waits, Complexity



Interchange, Short Waits, Simplicity



there must be interchange for some trips—but the high frequencies make those interchanges fast.

In the network at bottom, a person travelling from home to the city centre can depart at the right time for their work shift, because a bus is always coming soon. They needn't get to the work excessively early just because that's when the bus schedule dictates. They spend less time waiting for the bus and in other places they don't to be—despite the interchange.

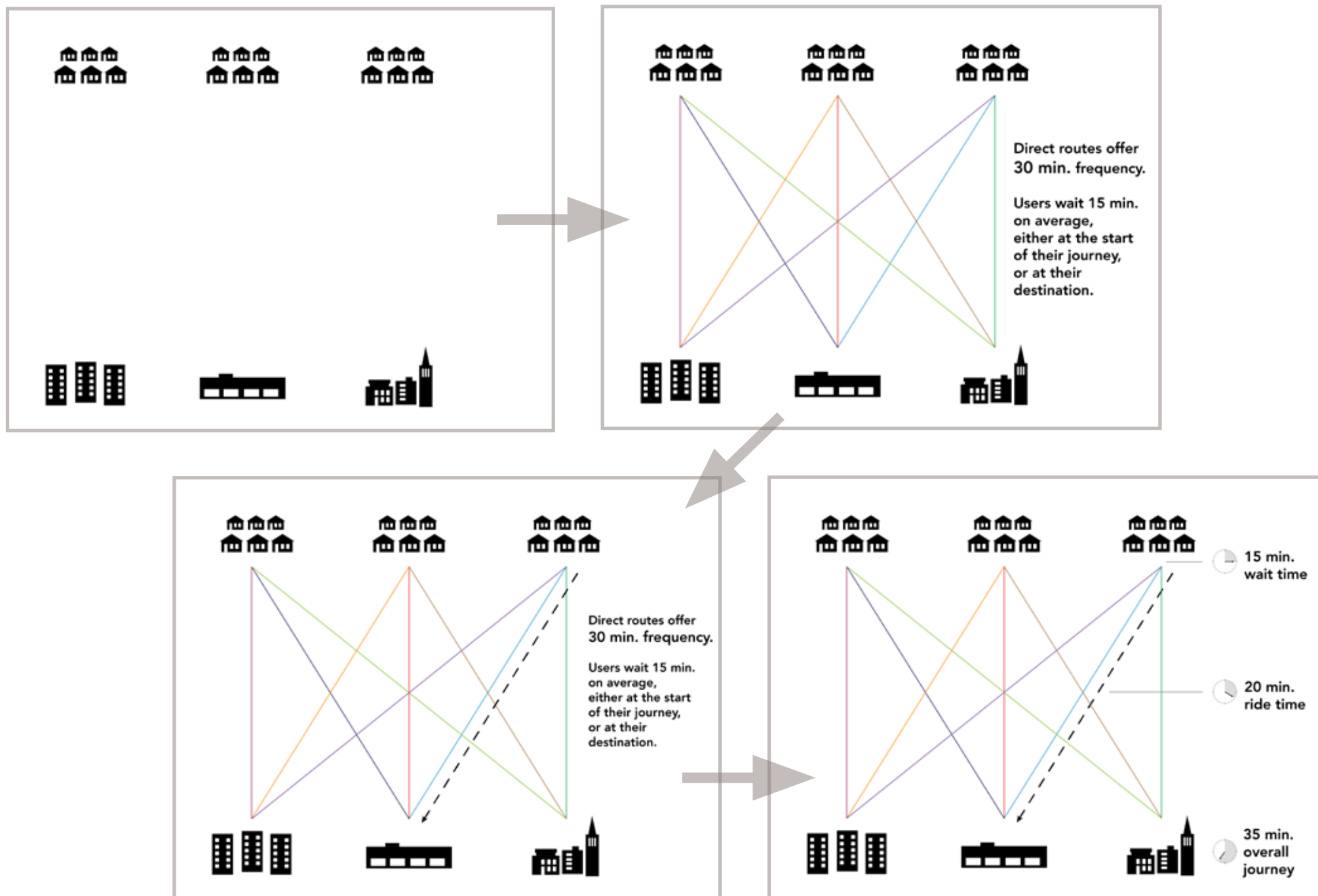
The illustrations on the next two pages show how it is possible that, for the same number of buses and operating cost, a network that involves some interchange could actually make peoples' journeys shorter.

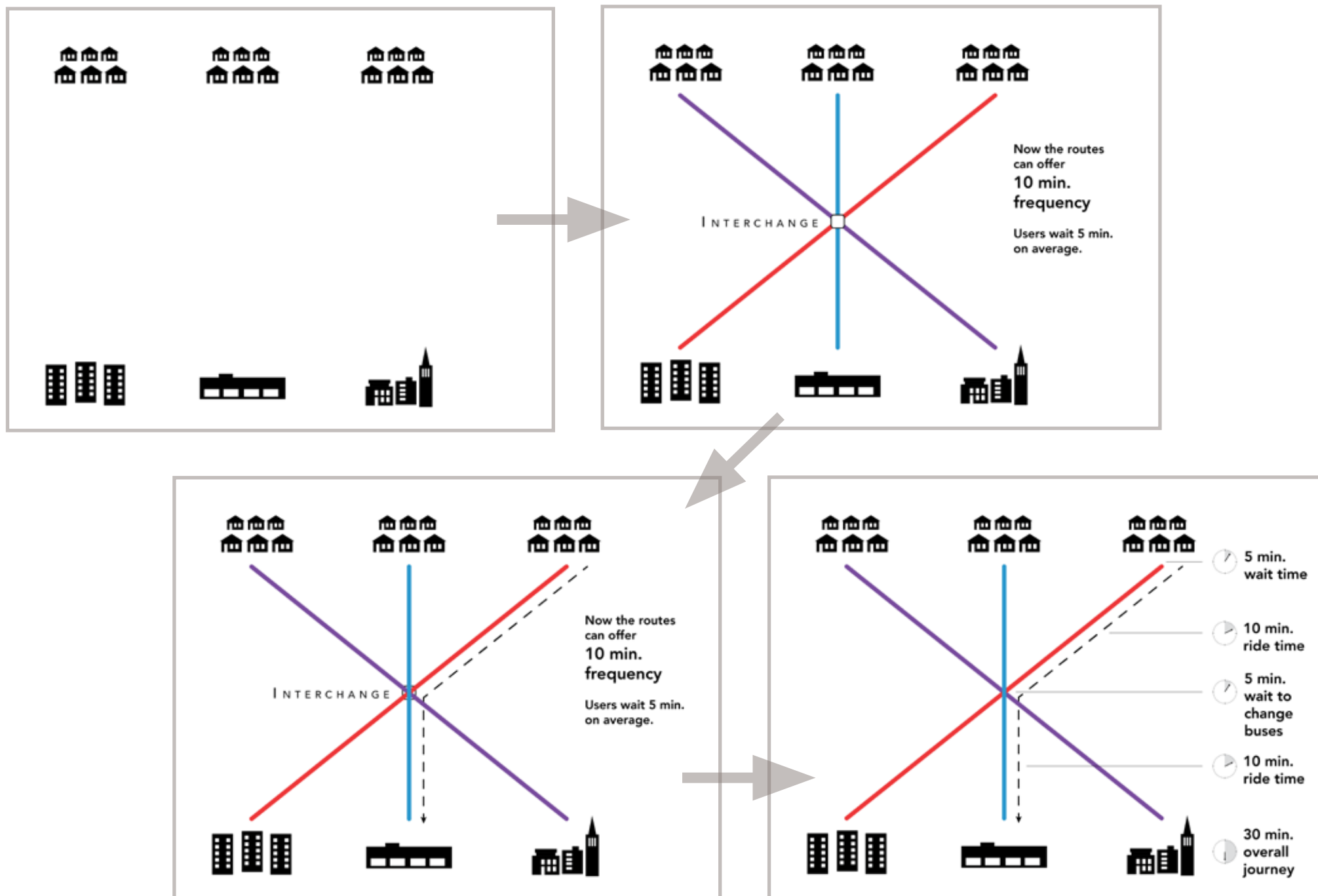
An important thing to note about the two networks contrasted on the following pages is that **they cost the same to operate**:

- The network shown on the very next page **divides 18 buses onto 9 routes**. Each route, operated by just two buses, offers **30 minute frequency**.
- The network on the following page **divides the same 18 buses onto just three routes**. As a result, each route is operated by 6 buses, and can offer **10 minute frequency**.

- While this is a fictional example, the geometry and arithmetic is no different in real life.

The next two pages illustrate how people's journeys can be made faster on a more connected, frequent network, even for trips that require a new interchange. But many trips can still be made *without* interchange, and these trips become even faster thanks to the higher frequencies.





Introducing more (free) interchange isn't the only way to improve the connectivity of the Cork network, but it is a choice about which we wish to consult the public.

Other changes can improve access and shorten peoples' journeys, by allowing more routes to work together in a connected network. They have been described earlier in this report, and include:

- **Simplifying route patterns in the centre city** (which may require changes to street operations) so that connections between bus routes, and between buses and trains, are easier to learn and understand.
- **Focusing higher frequency on key corridors**, so that interchange is available among more frequent routes across the network.
- **Designing some infrequent routes to pulse together** (as described on page 18), to offer a consistently short wait to interchange between them.
- **Investing in reliability**, so more interchange involves a reliably short wait, whether as part of a pulse or between frequent routes.

Interchange, Access and Patronage

A network designed for higher access and patronage would necessarily include some interchange. It is not possible to design for high access and patronage *without* interchange, because interchange makes it possible to give people faster journeys efficiently.

The redesign of the Cork bus network is not strictly limited to the existing budget for bus service. Some modest additional investment can be made in order to support the CMA's Transport Strategy and provide an optimal network.

But even with an increase in service, there is a low limit to how many routes can run at high frequency if avoiding interchange remains important. This will tend to limit the amount of access that the network provide in the future, and reduce its potential to attract high patronage.

As part of the BusConnects improvements to public transport fares, the additional charge to interchange will be eliminated in Cork. This, plus planned improvements to bus stops and reliability, make it possible to present the choice:

Once interchange is free, should the network still be designed to help people avoid it?

If some additional interchange would result in greater access and faster journeys for most people, would that be worthwhile?

What is the Most Important Definition of Success?

In this study, we are asking the public to tell us what it would mean for a new Cork bus network to be “successful.”

Transport can serve many different goals, and some of these goals are in tension with one another, as described on page 9. Within any limited budget for transport—even if that budget is growing—we cannot maximise the pursuit of every goal at once.

Given that mathematical reality, ***which of these goals are most important for the transport network serving the Cork Metropolitan Area?***

- High patronage.** Large numbers of people using transport.
- Reducing vehicle travel and carbon emissions.** Fewer people travelling fewer kilometers by car, with the resulting reduction in harmful emissions.
- Limiting congestion.** Continued growth of Cork’s population and economy *without* more growth in congestion.
- Inclusion of people with severe needs or disadvantages.** Provision of transport in places and in ways that help people in situations of disadvantage be independent and participate in society.
- Inclusion of all developed areas.** Provision of transport in all developed areas of the CMA, regardless of the needs of people in each area and regardless of patronage.

5 Next Steps

This report and the public consultation phase that accompanies it are the first step in the BusConnects Cork network redesign.

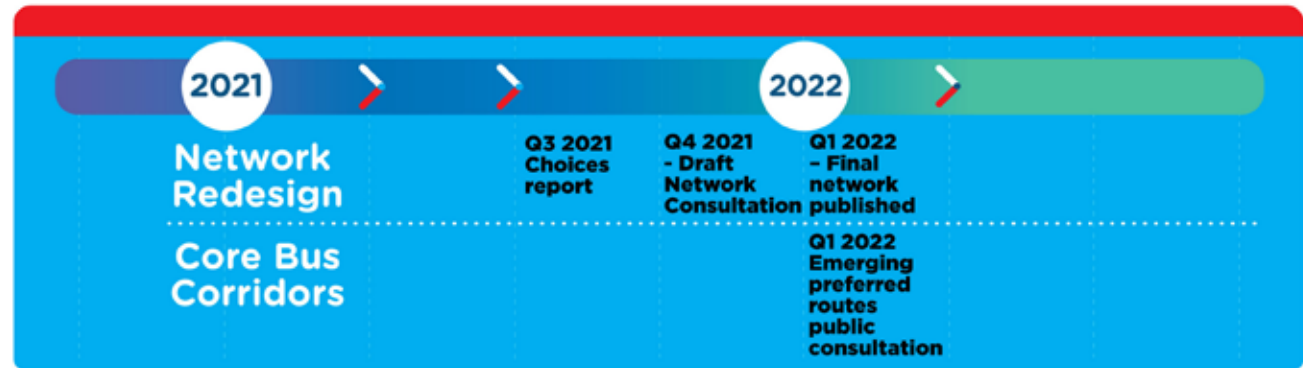
After consideration of public input from this first phase of consultation, a Draft New Network will be developed by NTA, Bus Éireann, Cork City Council, Cork County Council and consultants.

The Draft New Network will be presented to the public for review and comment, currently foreseen for October 2021.

Public input in response to the Draft will inform the Final New Network. It will also inform a parallel BusConnects programme, the development of Core Bus Corridors.

The Final New Network and the Core Bus Corridors are currently planned for implementation in 2023 with full operation reached in 2024.

If you wish to be kept informed of the progress of this study and opportunities for public comment, send an email to corknetwork@busconnects.ie and you will be added to the announcement list.



To join the announcement list for this study, send an email to corknetwork@busconnects.ie

Visit the [BusConnects Cork website](#) for more information and updates.