Kent Transport Network Gap Analysis – VIA Study

Purpose and Need

As Kent recovers from the COVID-19 pandemic and starts to move again, public transport will be as important as ever. However, public transport authorities are increasingly finding that older, less adaptable network designs of fixed-route buses widely distributed across sprawling suburban and rural areas, are failing to deliver either high-quality service to passengers or good value for their investment. In the Maidstone area of Kent, these issues are particularly relevant in the outer suburban and rural areas to the south, west, and east of the town centre. The area's rapid suburbanisation has resulted in a patchwork of communities with a fragmented road network and, often, poor public transport access. The subsidised bus services in these areas typically operate with short hours of operation on weekdays, little or no weekend service, and limited frequency, with often just a handful of daily round trips. In some growing areas such as Hermitage Park and Leybourne Chase, residents and workers may find themselves beyond walking distance to the nearest bus stop of any kind. The Council aims to achieve the following objectives with the public transport alternatives evaluated in this study:

- Provide public transport service more consistently throughout the day, with more reliable passenger wait times or headways
- Improve the quality of public transport service, with shorter wait times, shorter journey times to key destinations, and shorter walking distances to/from bus stops
- Expand public transport coverage to rural communities that either have limited bus service or lack bus service entirely
- Offer an equitable solution for people with disabilities, elderly residents, and people from disadvantaged backgrounds

Kent County Council initiated this Transport Network Gap Analysis study to address these critical challenges as well as to evaluate innovative transport service delivery models that may offer superior quality of service to areas of the network where fixed-route service has struggled to operate effectively. **The primary goal of the study is to improve and expand mobility in the Maidstone area**, in particular for the rural communities located beyond the more frequent, commercial bus lines. KCC asked Via, the world's leading operator of public mobility systems, to evaluate the feasibility of a range of multimodal transport solutions to improve public transport in Maidstone and its rural environs. **The purpose of this analysis is solely to determine the feasibility of these preliminary alternatives and should not be interpreted as a prescriptive forecast of KCC's upcoming plans.** These preliminary strategies include the following potential changes to the public transport network:

- Route changes along subsidised routes to reduce journey times and improve route directness
- Expansion of subsidised fixed-route service to suburban areas with higher levels of social deprivation or those undergoing new development, with longer hours of operation, increased frequency of service, or both

- Enhancements of community transport options, such as the Kent Karrier Dial-a-Ride and dynamic carpool platforms (e.g., LiftShare)
- Exploration of demand-responsive transport (DRT) to improve rural and suburban transport

While each of these strategies have merits that warrant further investment, the Council has fiscal constraints that preclude implementing every viable alternative. Fixed-route bus services work best in higher-density, compact, and direct corridors in urban and suburban areas, where the high costs of providing fast, frequent, and reliable service on larger buses are offset by the high patronage and efficiency of these corridors. In more rural or suburban settings with more car-oriented development patterns, as in much of Maidstone, improvements to fixed-route bus services often chase diminishing returns, with fragmented networks and high operating costs required to serve relatively low patronage. Community transport options, such as Dial-a-Ride or volunteer driver programmes, have limited capacity and are typically neither designed to or capable of serving the general public or more than a narrow range of prescribed journey types. The project team finds that in the Maidstone area **demand-responsive transport (DRT) is the strategy most suitable to fulfill this study's core objectives of expanding broad-based public transport coverage, whilst improving quality of service at a low cost per passenger relative to more resource-intensive enhancements to fixed-route services.** Moreover, implementing DRT to provide broader service coverage would enable the Council to make significant improvements to the current subsidised bus network. These changes could include the potential simplification of route geometries - limiting coverage-oriented deviations from primary corridors - and the potential discontinuation of low-patronage services.

The following summary describes **key findings from the Via's evaluation of DRT solutions in the Maidstone area**.

Background on DRT

Demand-Responsive Transport (DRT), also known as "on-demand transport" features flexible routing and/or flexible scheduling of vehicles, typically booked through a smartphone application. DRT providers design services to match demand (journey) and supply (driven vehicle) and extend the efficiency and accessibility of the transport service. Possible pick-up/drop-off stops are restricted to maximise the efficiency of service, usually within a geofenced area, known as the "service zone." Vehicle type can vary, but DRT is often operated by a van or minibus, typically with capacity for 6 - 15 passengers. Conceptually, DRT blends the convenience of private transport (e.g., private cars or taxis) and public transport buses operating along fixed routes. Passenger fares are typically kept low (often equivalent to other public buses) and subsidised by a local government or public transport authority, as many services are offered in hard-to-serve areas and therefore do not serve a patronage high enough to operate commercially. Typically, customers request a ride using a smartphone app or by calling a dispatcher, and a vehicle is dynamically routed to pick them up near their location and take them to their destination, while picking up and dropping off other passengers traveling in a similar direction and balancing passenger convenience and overall service efficiency. To limit vehicle detours

and improve service efficiency, passengers are typically asked to walk to the intersection nearest their desired origin, or from the drop-off point to their desired destination. Passengers' total walking distance is seldom more than 400 meters.

To book a ride, a passenger starts by indicating the number of passengers in their party and their desired pickup and drop-off locations. When booking using the app, passengers will clearly see the geofenced service zone in which service is offered. Requesting a journey beyond this zone is not possible, so passengers always know where the DRT service is available. Once the passenger submits a journey request, they are given a proposal that tells them when the vehicle will arrive and where to meet it. Typically, **passengers will wait between 10 and 25 minutes for a trip**, although this may vary depending on service design, as well as the level of demand and the number of vehicles available.

Passengers can track the vehicle in real-time using the app. The passenger is provided with vehicle information—for example: license plate, driver name, driver photo, and vehicle ID number. Passengers can usually cancel a ride at any time before pickup, but as cancellations may negatively affect other passengers, a small fee is often charged to discourage cancellations.

Once the vehicle arrives, the driver confirms the passenger's details using the driver app. Passengers can pay using credit and debit cards, fare cards issued by the local transport authority, cash, vouchers, and more. Most DRT providers take care to include payment options for people without credit cards or bank accounts to ensure that the service is accessible to all. The passenger is then taken to their destination. Along the way, the vehicle will pick up and drop off other passengers heading in the same direction, but care is taken to avoid lengthy detours for passengers already on board. The passenger can track their journey's progress using the app.

DRT often supports passengers making intermodal connections to other public transport, such as regional/express bus or train service. Passengers who live or work beyond walking distance from stations or hubs along a trunk corridor can use DRT to bridge the "first / last mile" gap to reach the longer-distance service. In rural settings, DRT's primary application is to improve mobility in lower-density settings by offering high-quality service where fixed-route buses cannot operate efficiently. In other settings with more frequent fixed-route services, DRT can also be used to provide supplemental service during hours when fixed-route buses are no longer operating, such as weekends, late-night, or off-peak periods.

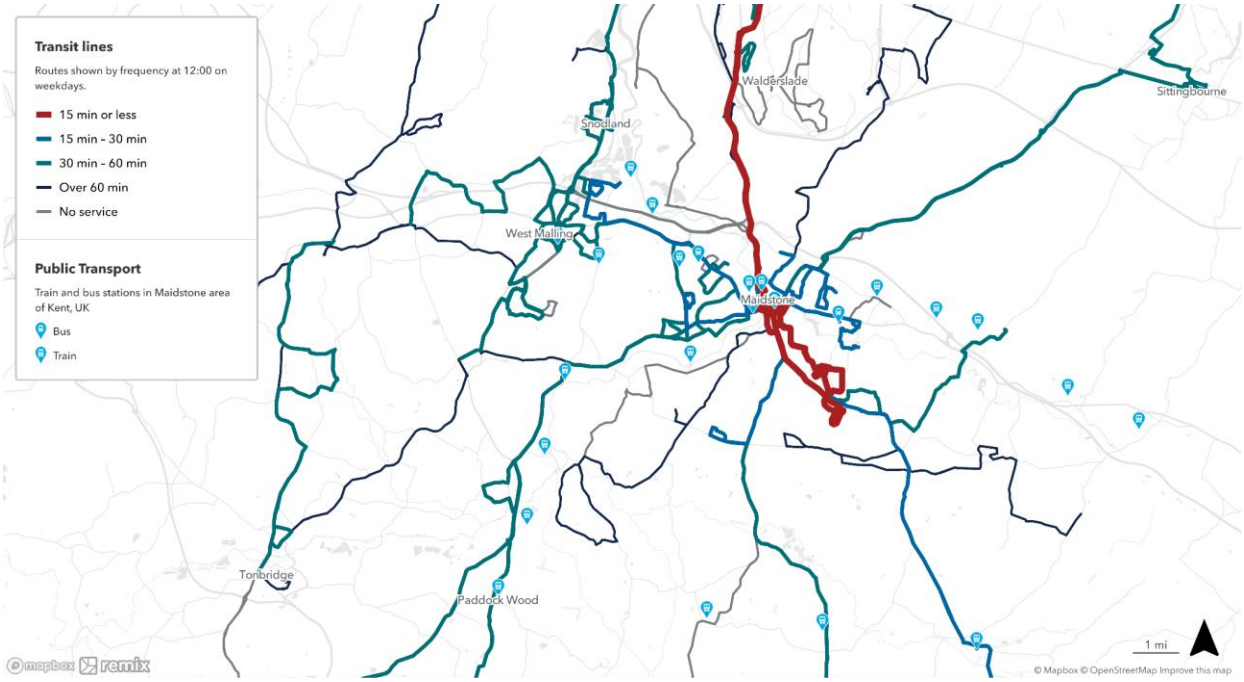
DRT can have a transformative impact in Maidstone by expanding the reach of the public transport network, allowing it to serve broader populations in rural, suburban, or hard-to-serve areas where fixed-route buses have struggled to operate efficiently in the past. DRT is a proven approach to achieving a wide range of DfT's strategic objectives, including:

- Encourage modal shift from private cars to public transport

- Grow public transport patronage in lower-density, rural, or hard-to-serve areas by facilitating both point-to-point journeys and “first/last-mile connections” to train and bus stations
- Improve the quality of service and customer satisfaction, with shorter passenger wait times and walking distances to pickup locations
- Replace underperforming or coverage-oriented fixed bus routes
- Reduce greenhouse gas emissions from transport

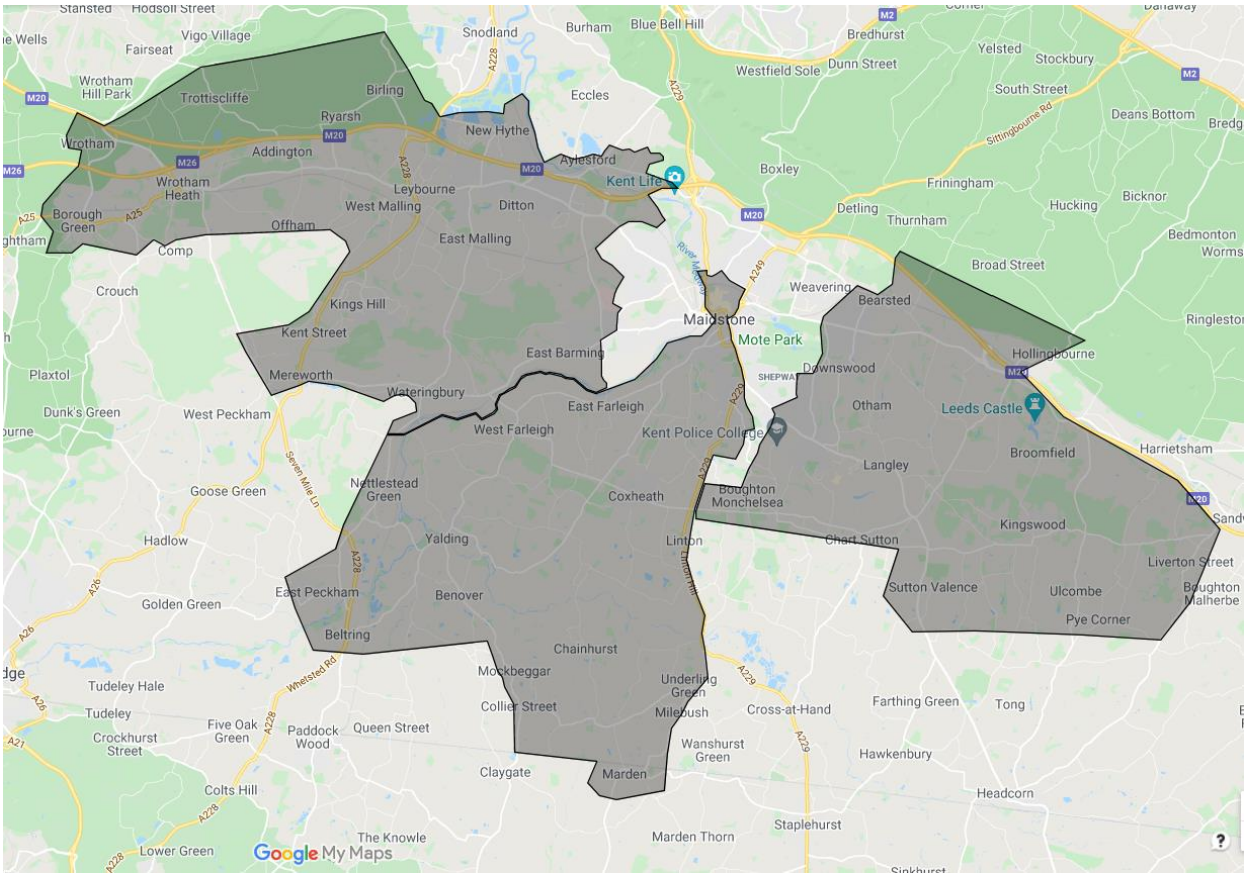
DRT Feasibility in Maidstone

Via’s methodology and approach for evaluating DRT services is informed by an examination of the local physical environment, including roadway hierarchy, land use-type, the development pipeline, and key travel demand generators. We also draw upon the existing bus network and its performance indicators, such as patronage of subsidised services, and coverage and frequency patterns of existing services. These steps are essential to designing DRT service zones with legible boundaries that make sense to customers and operators and match local travel flows while also capturing sufficient passenger demand for a cost-effective service.



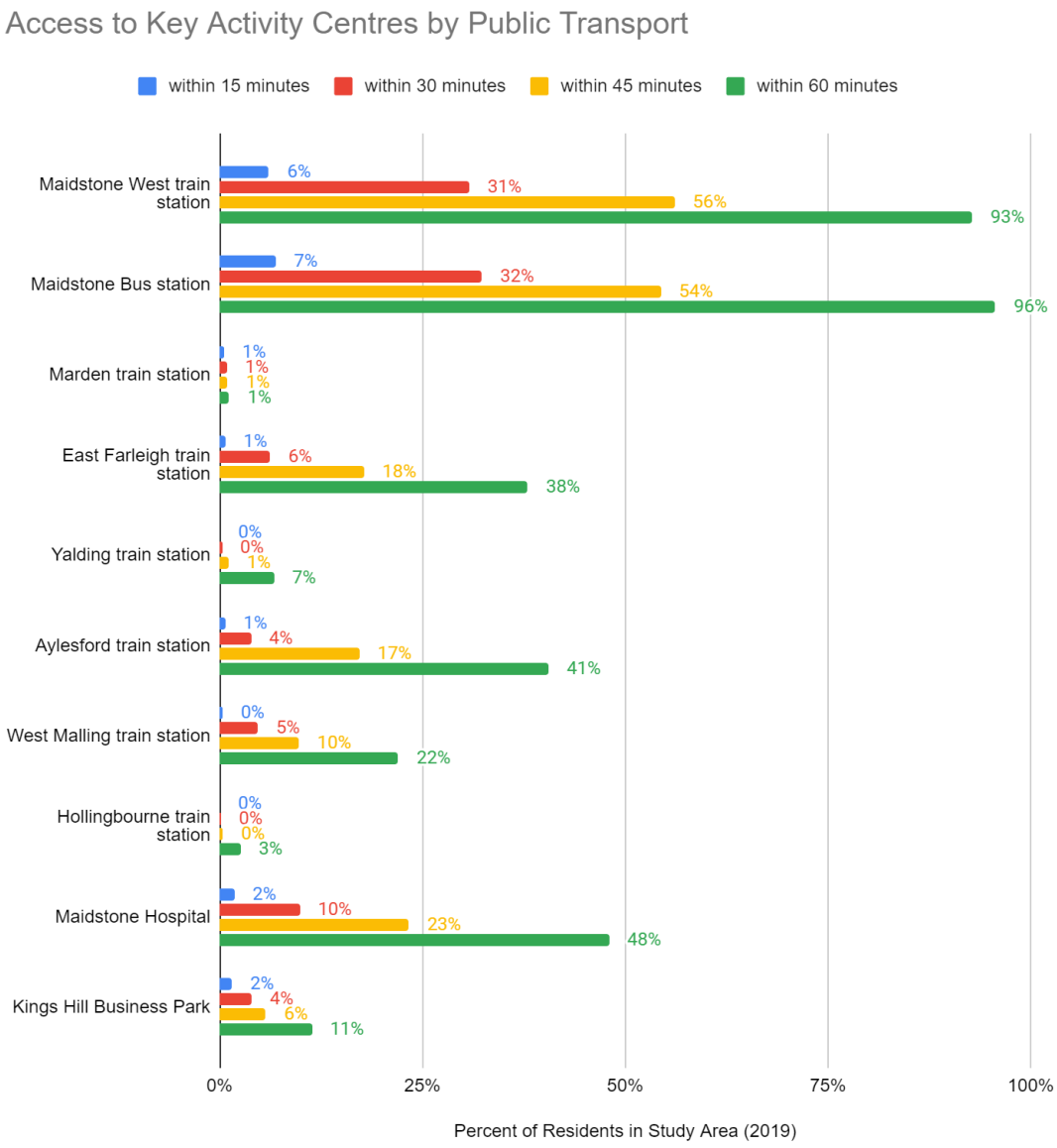
Map of Maidstone area bus network with service frequency and train stations shown

A map of the three potential DRT service zones evaluated in this study —titled Western, Southern, and Eastern — is shown in the map below. Each of the proposed DRT zones are designed to improve first/last-mile connections to train and bus stations, enhance rural mobility, and improve access to key destinations such as hospitals, shopping centres, schools, business and industrial parks, and high streets.



Map of proposed Western, Southern, and Eastern DRT Zones

The proposed DRT zones are also intended to improve access to key destinations by public transport. Using the Remix “Jane” isochrone tool, the team calculated the shares of residents able to reach key destinations by public transport within set time thresholds. These results helped to prioritise areas for improved access via DRT. The rural areas of East Farleigh, Marden, and Yalding were each prioritised for accessibility improvements in the Southern Zone because of this analysis.



The Western Zone focuses on improving mobility in the communities of Aylesford, Borough Green, East Barming, East Malling, Leybourne, Wateringbury, and West Malling. Its key destinations for locally oriented travel include Maidstone Hospital, Aldi, Tesco (multiple locations), South Aylesford Retail Park, Morrison's, ASDA, and Aylesford High Street. The zone also serves business and industrial parks at Kings Hill, Aylesford, and New Hythe. The zone facilitates first/last-mile connections to train stations at Wateringbury, West Malling, and Barming, as well as to more frequent bus service at Maidstone Hospital via Service 3. It also serves new residential development at Leybourne Chase, Barming, and Hermitage Park. This zone would also enable the potential replacement of under-performing fixed-route services 58, 70, and 88 (operated by Nu-Venture).

The Eastern Zone would improve mobility in the communities of Bearsted, Boughton Monchelsea, Grafty Green, Hollingbourne, Kingswood, Langley, and Sutton Valence. This zone also includes some of the more socially deprived areas of Maidstone, such as Parkwood, making connections between this neighbourhood and more suburban and rural areas not easily accessible by the existing bus network. Its key destinations for locally oriented travel include Aldi, Newnham Court, Marks & Spencer, and Morrisons. First/last-mile connections are available to train stations at Bearsted and Hollingbourne or Service 82, a high-frequency bus line, at the transfer point at Morrisons. This DRT zone would also enable the potential replacement of under-performing fixed-route services 13 (operated by Nu-Venture) and 59 (operated by Arriva).

The Southern Zone is described in more detail in the **case study** in the following section.

We **estimate passenger demand for DRT service** in these zones based on the ratios of underlying population and employment with observed patronage of other DRT services in the region, such as those operating in Sevenoaks, Ebbsfleet, and Milton Keynes. We also include the patronage from existing subsidised bus services located within these zones whose low patronage and vehicle requirements enable it to be fully replaced by a DRT service.[1] The Council engaged Via to **analyse the likely performance of DRT service in each of the three zones evaluated using the company's proprietary, agent-based microsimulation software**. The results of this analysis are shown in the table below.

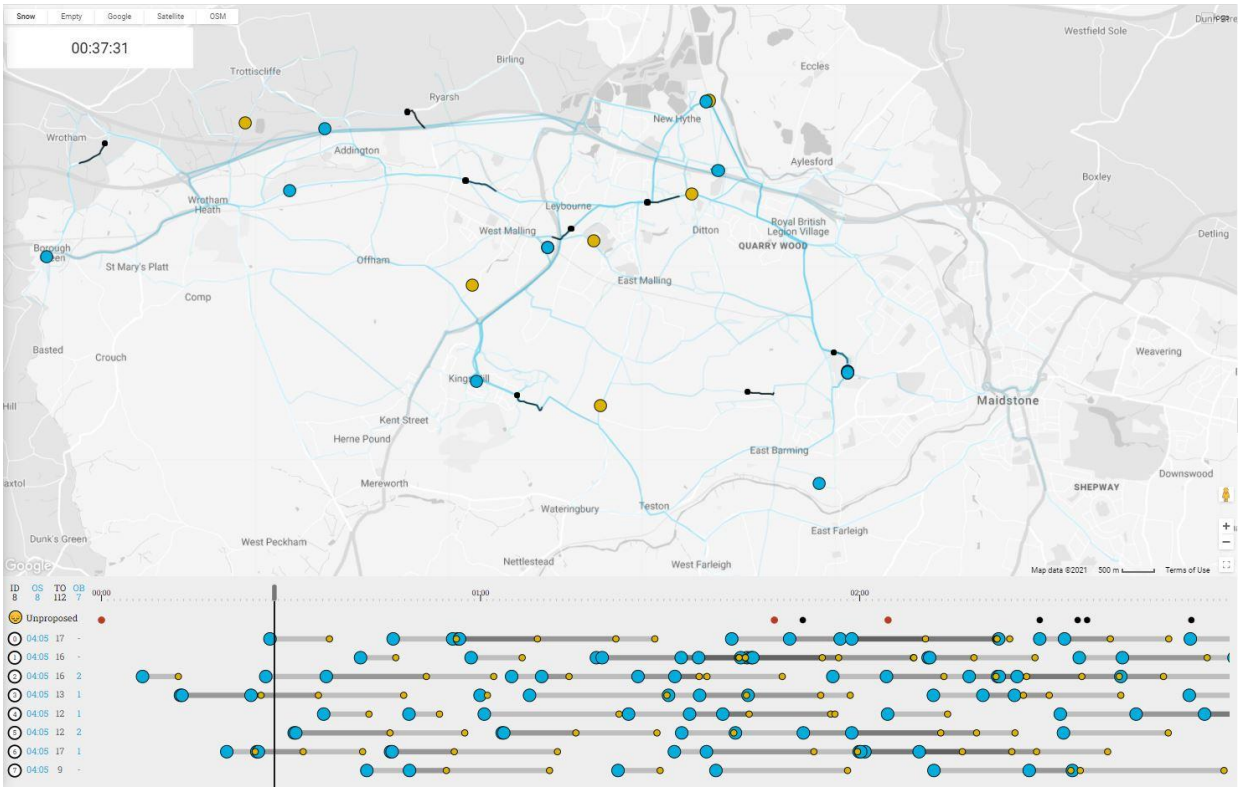
Potential DRT Zone	Zone Size (sq. km.)	Daily Demand	Peak Vehicles Required *	Peak Productivity of Service (pax per vehicle-hour)*	Avg. passenger wait time (mins.)
Western Zone	75.6	206 - 619	6 - 9	3.1 - 4.0	21 - 27
Southern Zone	68.6	273 - 475	6 - 7	3.1 - 4.6	23 - 26
Eastern Zone	62.4	206 - 320	4 - 5	3.1 - 3.9	22 - 25

Ranking table of potential on-demand zones showing their simulated performance across various quantitative evaluation criteria.

Based on our estimates of patronage and our proprietary microsimulation of DRT service, we find that the Southern Zone achieves the highest likely productivity of service, at

[1] School transport services, both dedicated routes and school runs within general-public bus lines, are excluded from this analysis.

between three and four passenger boardings per vehicle-hour, though only slightly higher than either the Western or Eastern Zones. A snapshot of the proprietary simulation tool is shown below.



Via's Proprietary Simulation Tool creates a virtual simulation of on-demand transport services, clarifying complex trade-offs between quality of service and efficiency. It allows to quickly test different zone boundaries, fleet sizes, and parameters, such as walking distance, trip durations and pickup wait times, and service models—including first/last mile, general coverage, and late-night/weekend coverage. Simulation process begins by uploading potential service zones for analysis. Next, an underlying road map is generated by pulling data within the service zone boundaries from OpenStreetMap. Traffic speeds specific to the time of day during which service is being simulated are determined for each different road type in the zone by querying Google's Maps API. "Terminals"—staging areas for vehicles without an active ride assignment—are specified, and a list of "virtual bus stops," or safe places for pickup and drop-off, is generated. The simulations produce hundreds of different metrics for analysis.

Value for Money of DRT in Maidstone

Via estimates that DRT will require gross operating costs of between £10 and £14 per passenger journey, before accounting for the cost savings generated by the potential replacement of low-patronage, subsidised services within each DRT zone (school runs excluded). In the Western Zone, these services potentially replaced include Services 58, 70, and 88, with an average of 103 daily passengers. In the Southern Zone, they include services 23, 23A, 25, and 26, with 144 daily passengers on average. In the Eastern Zone, services 13 and 59 could be replaced by DRT, along with 133 average daily passengers.[2] **While DRT's gross costs per passenger journey may exceed those of the subsidised services considered for replacement, this is primarily due to the significant expansion of service hours and coverage areas that DRT would offer.** For example, while the 23/23A/25/26 services in the Southern Zone total about 8,000 annual service-hours, compared to at least 22,000 annual service-hours that the DRT service would offer.

This cost-benefit analysis assumes that DRT software and operations (drivers, vehicles, and operations support) are procured separately, at £55 per vehicle-hour, a typical benchmark for DRT in the UK. It likewise assumes a DRT software licence fee of £3,500 per vehicle per year.

Fixed-Route Solutions

This study explored a series of route changes to improve the quality of service on subsidised routes by improving route simplicity and directness. Route changes typically involve discontinuing service deviations from primary corridors intended to provide coverage to smaller villages and activity centres. As described below, coverage-oriented service to smaller villages and activity centres may be more effectively provided by a broader DRT service that offers passengers more consistent service availability throughout the day, shorter wait times, and shorter walking distances to pickup points and from drop-off points. This approach of route simplification shortens passenger journey times and reduces operating costs by reducing the vehicle miles traveled (VMT) required to operate these routes along their primary corridors. These changes are shown in the table below, with the corresponding reduction in annual fixed-route service-hours and mileage:

Service	Route Change Description	Percent Change in Annual Vehicle-Hours	Percent Change in Annual VMT
27	Redirect Service 27 to operate between Goudhurst and Coxheath (where passengers	-40%	-21%

[2] These patronage figures are based on operator-provided data from November 2019.

	transfer to Service 89), if Southern DRT zone is implemented		
151	Truncate Service 151 between Mereworth and Kings Hill, if Western DRT zone is implemented	-1%	-1%
222	Simplify Service 222 in Tonbridge near Tonbridge School, if Western DRT zone is implemented	-2%	-2%
59	Service 59 in Parkwood - if the Eastern Zone is *not* implemented, consider a more direct route to serve Boughton Monchelsea	-15%	-14%
6	Remove deviation in East Peckham is Southern DRT Zone is implemented	-2%	-3%
306	Truncate service between Bluewater Shopping Centre and Ebbsfleet International (to be served by Ebbsfleet ArrivaClick DRT Zone)	-8%	-8%
308	Streamline service in St. John's, Sevenoaks, with coverage areas served by Sevenoaks Go2 DRT service from Go-Coach	-2%	-1%

Via also explores increasing service frequency and lengthening hours of operation on selected subsidised fixed-route bus lines. These improvements are intended to improve access to consistent, reliable bus service capable of serving multiple journey types throughout the day. Most of the proposed changes listed here involve routes serving longer-distance, intermunicipal journeys, such as for services with cycle times of longer than one hour. Fixed-route services are preferable to DRT in serving longer, regional, or cross-County journeys due to the longer cycle times required, whereas DRT is more suitable for shorter, locally oriented journeys within a zone. Increasing frequency and hours of operation on longer-distance and more frequent, but still partially subsidised corridors such as Services 5, 6, and 12 is therefore likely the more cost-effective approach of the two. These changes are shown in the table below, with the corresponding reduction in annual fixed-route service-hours and mileage:

Service	Route Change Description	Percent Change in Annual Vehicle-Hours	Percent Change in Annual VMT
155	Increase service frequency to 120 minutes on weekdays and extend hours of operation between 06:00 and 21:00 and 07:00 to 21:00 on Saturdays (at 120-minute headways), so it can be operated with one vehicle throughout the day. This service would provide much-needed coverage to Aylesford industrial park and new development areas of Eccles, Burnham, Scarborough, and Wouldham	394%	393%
12	Extend Sunday evening service (Council-supported portion) from 17:30 to 21:30, and extend Sunday morning service start from 10:30 to 7:30	5%	5%
5	Extend Sunday evening service (Council-supported portion) from 17:00 to 22:00 and extend Sunday morning service start from 9:30 to 7:30	3%	5%
6	Extend Sunday service from 08:45 to 10:45 and 16:45 to 17:45, with route change described above	2%	2%
306	Extend hourly service to between 08:15 and 19:00 on weekdays and 08:15 to 20:15 on Saturdays, with route change described above	111%	99%
B150	Extend hours of operation to 07:00 and 19:00, from 12:15 to 16:00, and increase frequency to 60 minutes	72%	103%

Community Transport Solutions

Several community transport programmes operate in the Maidstone area, which the Council should consider strengthening to improve multimodal transport options for disadvantaged groups. The most significant of these is the Council's **Kent Karrier** service, a membership-based Dial-a-Ride service offering wheelchair-accessible, door-

to-door DRT service to members on weekdays, from 9 AM to 4 PM, between rural communities in the Maidstone area and Maidstone Town Centre. Members must have a qualifying mobility impairment, live in a rural area more than 500 metres away from a bus stop or train station, or be 85 years of age or older. Passengers can book journeys by calling a dispatcher up to seven days in advance. Kent Karrier serves a different range of rural villages depending on the day of the week, with pickups in rural locations starting at 10 AM and return journeys from Maidstone Town Centre scheduled at 1 PM. The range of rural communities by day of the week are shown below:

- **Monday**: Allington, Barming, Collier Street, East Farleigh, Laddingford, Nettlestead, Teston, West Farleigh, Yalding
- **Tuesday**: Bearsted, Eythorne Street, Grove Green, Harrietsham, Hollingbourne, Leeds, Lenham, Otterden, Platts Heath, Shepway. Vinters Park, Warren Street
- **Wednesday**: Bicknor, Boxley, Bredhurst, Detling, Hucking, Penenden Heath, Ringlestone, Sandling, Stockbury, Thurnham
- **Thursday**: Boughton Monchelsea, Chainhurst, Coxheath, Dean Street, Hunton, Linton, Loose, Marden, Staplehurst, Tovil
- **Friday**: Chart Sutton, Grafty Green, Headcorn, Kingswood, Langley Heath, Otham, Park Wood, Senacre, Sutton Valence, Ulcombe

Due to the relatively small passenger volumes on the Kent Karrier service, it may be feasible to consolidate some portions of its service geography within a broader DRT service. For example, a DRT service operating in rural communities to the south of Maidstone Town Centre may be able to fully absorb passengers who currently use the Kent Karrier service on Mondays. Alternatively, if the Eastern DRT Zone is implemented, the service could effectively absorb Kent Karrier patronage served by Dial-a-Ride on Tuesdays, Thursdays, and Fridays. The broader DRT service, described in the following section, would offer these passengers longer hours with consistent service availability, a wider range of eligible destinations, and improved customer communications tools such as real-time vehicle tracking and a mobile app to offer journey reservations and fare payment.

Another community transport option the Council promotes, but does not currently subsidise, is the carpool scheme operated by **LiftShare**. LiftShare is a journey-matching software platform that matches commuting drivers in private vehicles with other fellow passengers traveling who share similar origins and destinations. Typically, peer-to-peer carpool platforms struggle to achieve significant rates of carpooling in areas like Maidstone due to the low probability of matching in rural and suburban areas. Participation is likely to remain low if commuters are not offered targeted incentives to participate on the platform, as many would-be participants may hesitate to share journeys in private vehicles with a stranger. The Council can encourage higher participation on LiftShare by offering commuters with targeted subsidies to the larger employers in Maidstone. This will make journey-matching more likely, improving the efficacy of the service, as well as reducing car journeys during the most congested hours of the day. The Council should consider offering the non-driving passengers discounted rates for

commute journeys, such as £2 flat rate per journey, while offering drivers and LiftShare the remaining difference.