Appendix H

H1 Bus Stop Review Methodology

H2 Bus Stop Review Analysis

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Bus Stop Review
Methodology

Bus Stop Review Methodology (REV 3)

Project name	Date	Prepared by
Bus Connects Core Bus Corridor	21 June 2020	Joe Seymour - AECOM

1.0 Introduction

The location and design of bus stops will be critical to the success of the operation of BusConnects Dublin. Bus stop catchment areas and safety will need to be maximised, the size of the stop needs to be sufficient to meet the expected passenger and bus demand, and the bus stop itself must not become a bottle neck to the operation of the corridor. This methodology outlines how each corridor shall be assessed so as the location and operation of bus stops can be optimised.

This Note does not relate to the physical layout of the bus stops which is addressed in Chapter 11 of the Preliminary Design Guidance Booklet, although spatial considerations are discussed in section 5.4. Standard details for bus stop layouts are to be included in the next draft of the Design Guidance Booklet.

It is important to note that existing bus stops located along the Core Bus Corridors will have been subject to considerable thought by Bus Operators, An Garda Siochana, and the Local Authority. For this reason, it is imperative that each location is closely examined before it is considered for relocation or removal.

For avoidance of doubt this manual assumes the standard bus is a twin axle double decker bus (10 to 11m in length) with a front and middle doors. Other vehicles, such as 3-axle double decker, are in use by Dublin Bus and should be considered when undertaking the Geometric Design.

Figure 1.2 Standard Bus being used on the CBC's.

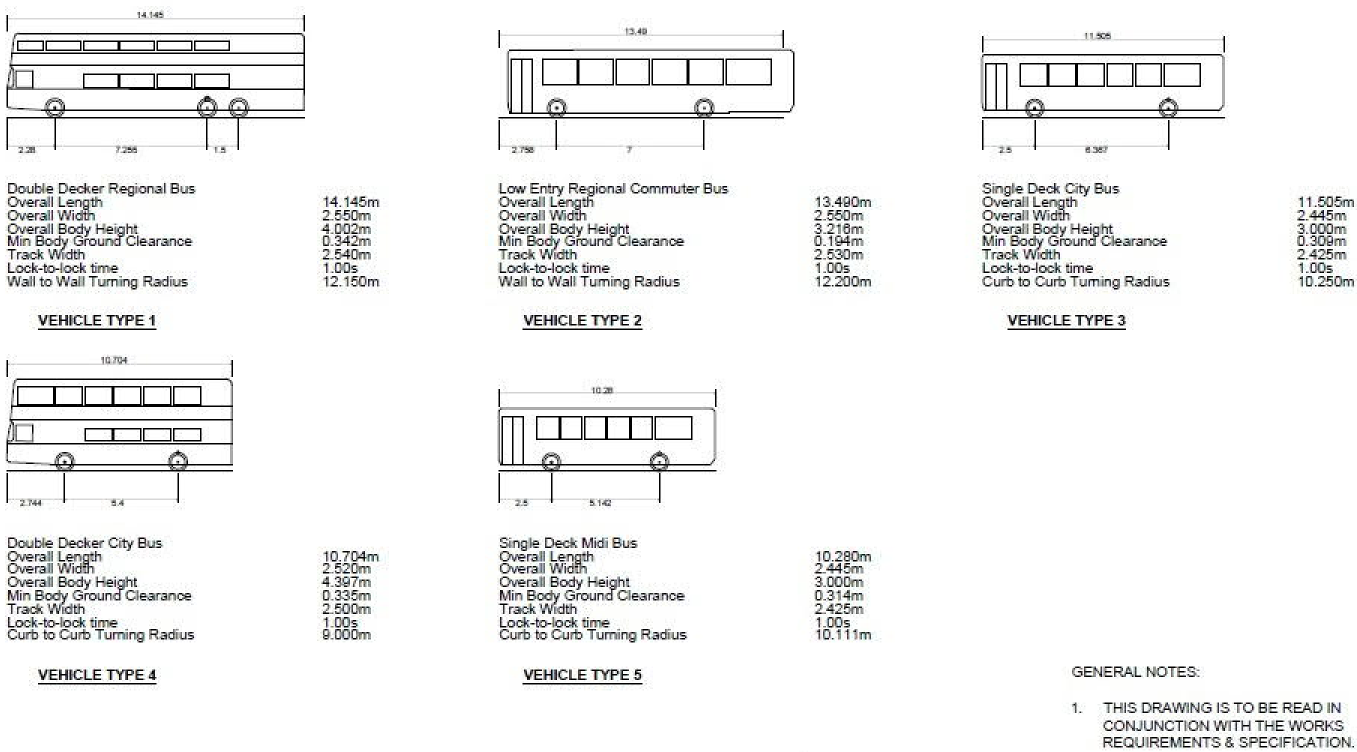


Figure 1.3 Standard Transport for Ireland Bus Specifications.

Considerations for Bus Stop Locations

The basic criteria for consideration when locating a bus stop:

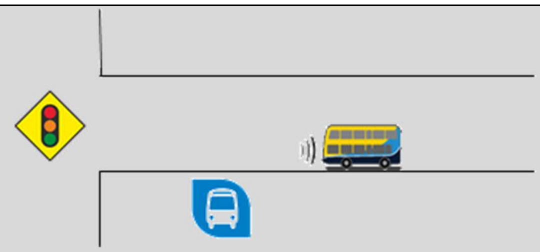
- Driver and waiting passengers are clearly visible to each other;
- Located close to key local facilities;
- Located close to main junctions without affecting road safety or junction operation;
- Located to minimise walking distance between interchange stops;
- Where there is space for a bus shelter;
- Located in pairs, 'Tail to tail' on opposite sides of the road;
- Close to (and on exit side of) pedestrian crossings;
- Away from sites likely to be obstructed; and
- Adequate footway width.

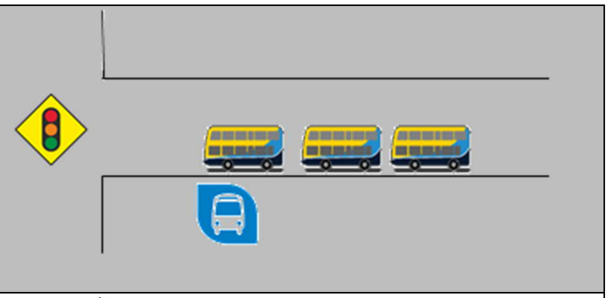
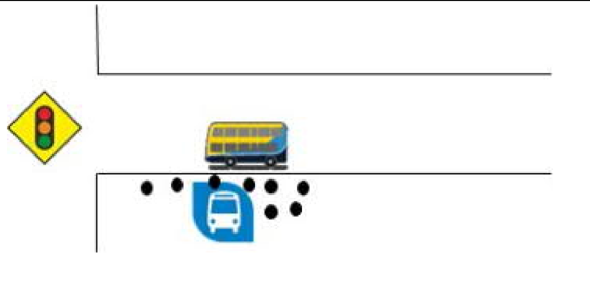
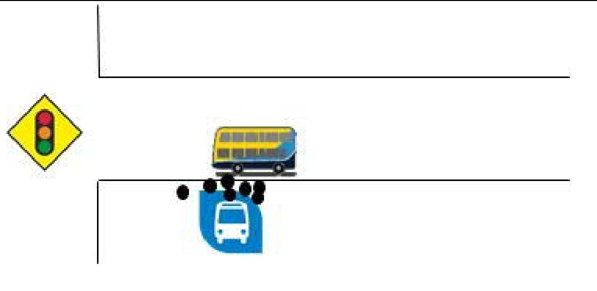
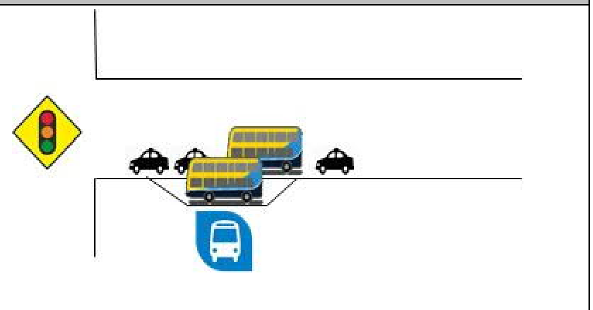
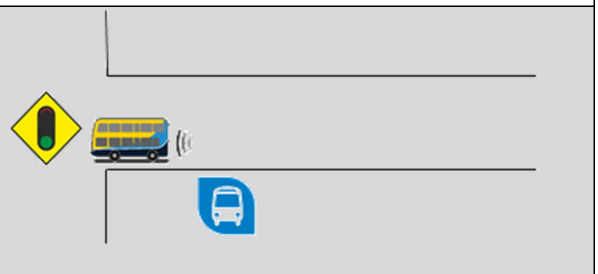
Principals of Bus Stop on high capacity Bus Systems.

The Core Bus Network Report (2015) noted that the distances between bus stops influences the efficiency of the bus network. In general, the lower the distances between stops along a corridor, the higher the delay that is incurred for buses. This delay is caused through acceleration and deceleration and delays associated with pulling in and out of bus stops with some estimates suggesting that stopping at bus stops makes up in excess of 20% of the journey times along the QBC corridors. International literature on bus stop spacing recommends a distance of 300 to 500m (NTA Report on Core Bus Network Infrastructure Network, February 2015) between stops in suburban areas is optimum, whereas in Dublin many routes have bus stops located at far lower spacing. The Core Bus Network Report concluded that increasing spacing between bus stops was part of the solution to reduce delays along the corridors.

The following indicates where delay materialises when accessing bus stops.

Table 1.1 Sources of Bus Delay associated with Bus Stops (TCQoSM, TRB)

1 Deceleration Time spent slowing to serve the stop.	

2 Bus stop failure Waiting for other buses to clear the stop	
3 Boarding lost time Waiting for passengers to reach the bus	
4 Passenger service time (dwell time) Opening the doors, boarding and alighting passengers, and closing the doors	
5 Traffic signal (traffic control) delay Waiting for the signal to turn green, or other traffic control delay	
6 Re-entry delay Waiting for a gap in traffic	
7 Acceleration Time spent getting back up to speed	

Boarding of passengers, layout of stations are not being examined as they are either not relevant in this case or dealt with elsewhere as part of the overall BusConnects Programme.

The acceleration and deceleration will be similar at all stops and clearly the overall impact is dependent on the number of bus stops along a route; this will be dealt with by examining the number of bus stops along a corridor.

Bus Stop failure is linked to the amount of time buses are stopped and the frequency of buses along the route and has a significant impact on the overall corridor capacity and efficiency, particularly where non stopping buses are present (Express or Regional Buses). A situation where a bus arrives at a bus stop to find all loading areas full:

- The bus must wait until space becomes available;
- Slows down the bus and creates schedule reliability issues; and
- Delay can also increase further as bus bunching occurs and bus dwell and traffic control delay times will increase.

The proximity of a bus stop to signalised junctions has an impact on bus speeds with far-side stops having the least negative impact on speed and capacity, and also favored as passengers cross the road behind the bus which increases safety.

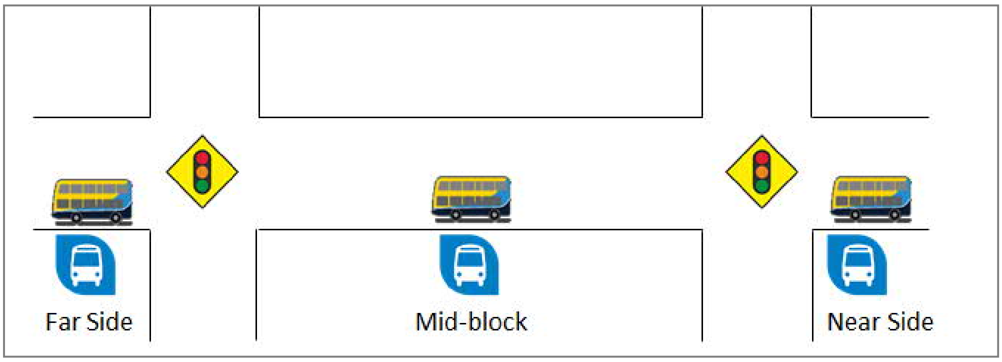


Figure 1.4 Typical Location of Bus Stops.

Ability to overtake slower buses is an important parameter where the route is made up of both express (rarely stopping) and slower (stopping at all stops) buses. For example, on the N11 QBC lay-bys (or passing lanes) were introduced after the original QBC was built to increase the capacity and allow express buses to pass the slower vehicles. On some of the BusConnects schemes this will need to be considered particularly on those routes that include regional and intercity services.

Figure 1.5 Stillorgan QBC with high bus flows and no bus laybys resulted in bus bunching/ platooning; bus lay-by's provided at key locations to allow express buses to pass slower buses. (Source: Google Maps)

Figure 1.6 A typical bus lay-by adjacent to a bus lane; note concrete surface for additional durability.

Consideration should also be given to locations where coaches stop along the Corridors, particularly those serving the airport which could require longer dwell time to allow passengers to load/unload their luggage. In these cases, a layby separate to the CBC Bus Stop maybe desirable (Figure 1.7).

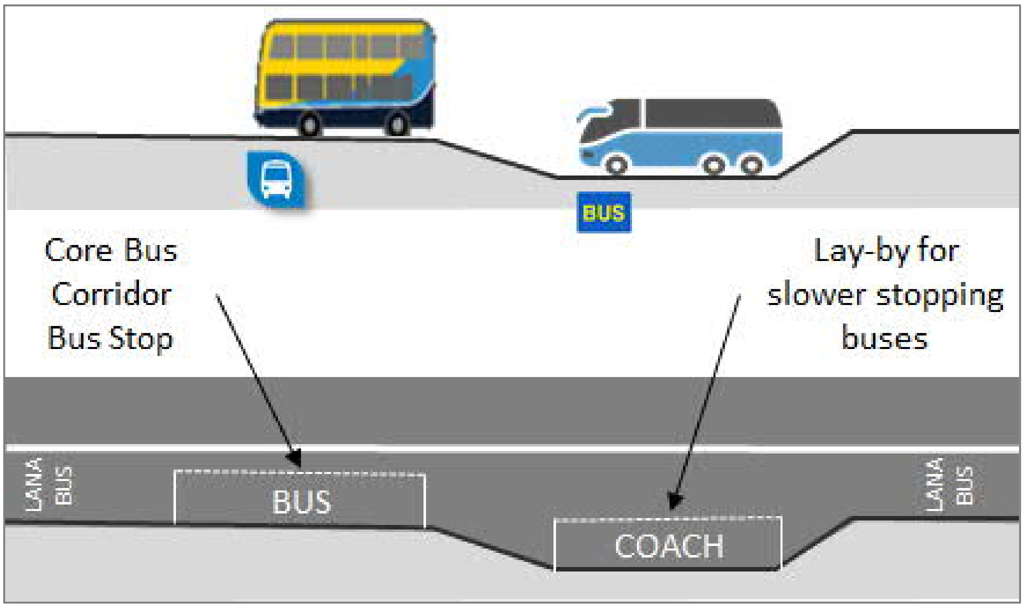


Figure 1.7 Double Bus Stop (in-line for BusConnects routes) concept for locations with buses requiring different dwell times.

Figure 1.8 Multiple bus operators may be using bus stops along the Corridors.

In general, most bus stops along corridors will be in-line (bus stops within the bus lane), as a result re-entry delays will not impact the operation of buses. However, on busier corridors where lay-bys are used re-entry may delay buses. ED's need to consider the flow of buses and taxis passing lay-by's, and where there is increased risk of delay additional measures may be required to generate gaps in traffic (far-side) or the installation of a yellow box to allow buses to renter the traffic queue (near-side).

Pedestrian accessibility

Another important aspect of bus stop positioning is proximity to pedestrian crossings. Failure to provide high quality pedestrian facilities on the pedestrian desire line may lead to a higher accident risk associated with a bus stop. Therefore, designers need to consider how passengers are going to cross the road to get access to the stop, in general this will require bus stops to be located close to safe crossing points.

2.0 Methodology

This section outlines the process for examining each BusConnects Corridor and assessing and reporting on the bus stops along each route. The flow chart summarises the process and this is followed by a more detailed description of the tasks to be undertaken.

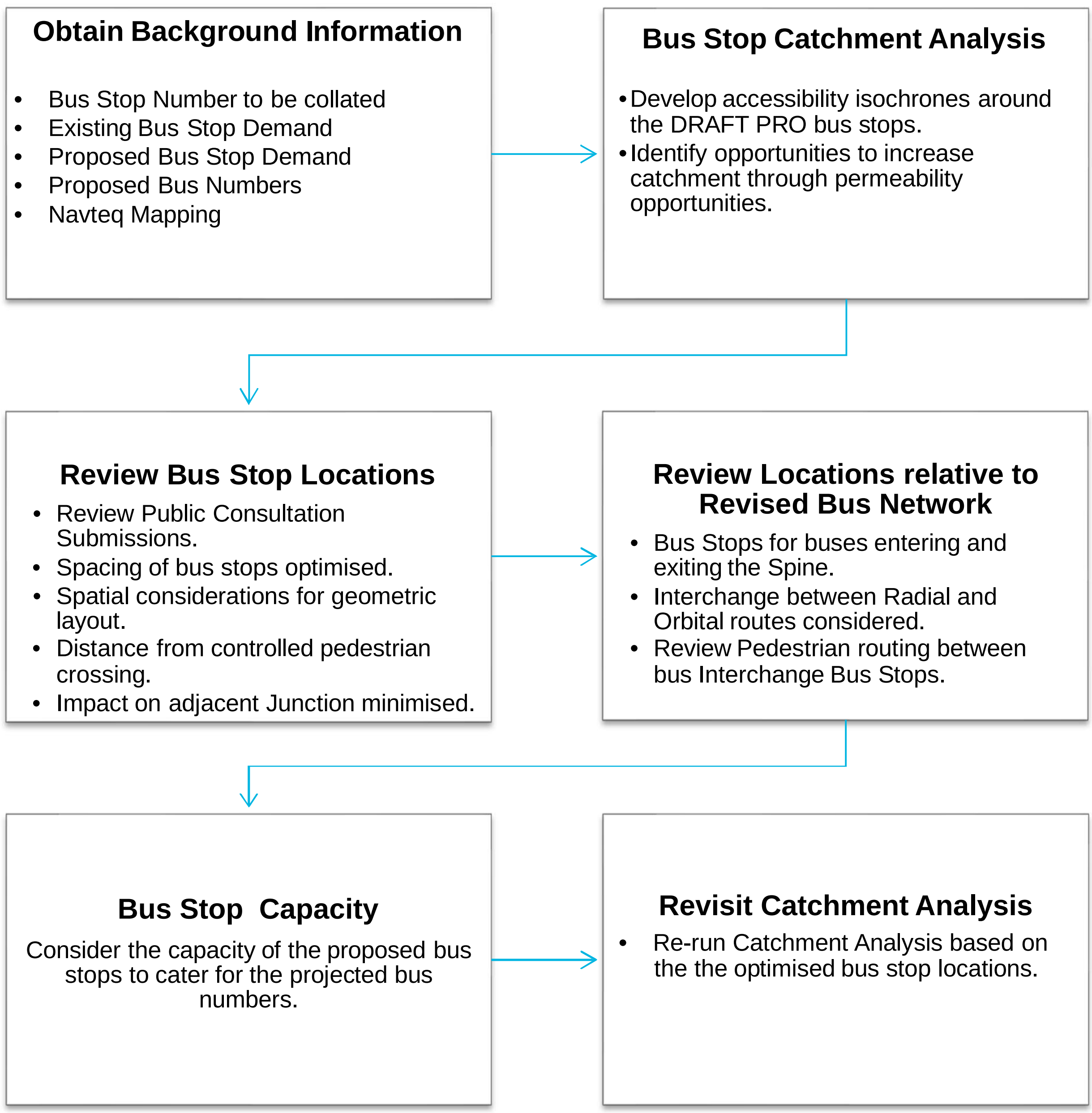
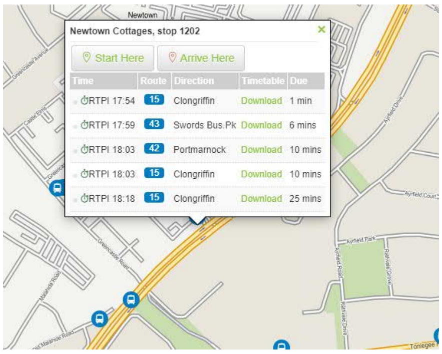


Figure 2.1 Flow Chart for proposed Bus Stop Review.

3.0 Background Information

In order to undertake the review of the bus stops along each corridor background information must be gathered. The following section outlines this information and how to obtain it.

Table 3.1 Information to be gathered to undertake the Bus Stop Review

Item	Description	Location/Contact
Bus Stop Number	Bus Stop Numbers can be obtained from a number of online sources.  	https://www.transportforireland.ie/plan-a-journey/
Existing Bus Stop Demand	Estimated boarding and alighting figures are available from NTA Business Intelligence Unit. Using Leap Card Data and Machine Learning the NTA has recently developed a tool for estimating where passengers are alighting buses along each route. The format that this will be available in is currently under development. This information can include details on use of Free Travel Pass which may help in identifying locations which are a higher priority for the elderly and those with accessibility issues.	**NTA Business Intelligence Unit**
Proposed Bus Stop Demand	Obtain future passenger demand for each corridor, this will come from the ERM. This will not be linked to specific bus stops, but zonal. The bus stop demand will then be linked to bus stops by using the existing bus stop data and factoring up existing boarding and alighting figures.	TIAR Consultant
Proposed Bus Numbers	The number of buses on each corridor is available from the BusConnects Network Redesign Team. This information has already been issued to each ED. It is the ED's responsibility to confirm that these figures are correct at this time.	Confirm that the numbers provided are the revised network data.
Navteq Mapping	The GIS Mapping is required to understand permeability in the area surrounding bus stops. NTA has this information and will provide it to each ED. Note that this base data will need to be reviewed thoroughly as from experience there will be many permeability routes that are missing.	NTA to issue mapping to all teams.

4.0 Bus Stop Catchment Analysis

Bus stop passenger catchment areas are critically important to the success of a high-quality bus corridor. The catchment at each bus stop needs to be maximised so as each stopping movement collects sufficient passengers to justify the loss in journey speed; a bus stopping at each bus stop to pick up one passenger will result in a very slow journey time, the ideal scenario is to stop less often and collect more passengers at each stop. Clearly too few bus stops could also be detrimental to the success of the scheme. To assess if bus stops are optimally spaced to maximise the passenger catchment area it is recommended that a catchment analysis using the NTA Navteq data(or similar process) is undertaken.

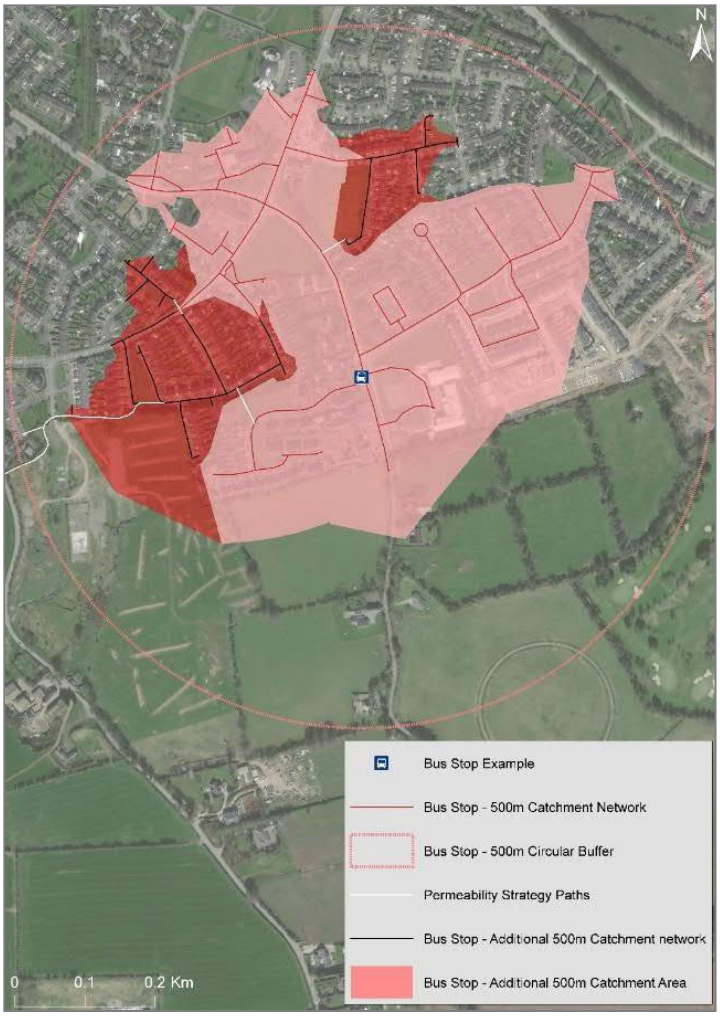


Figure 4.1 Passenger catchment analysis for a bus stop indicating the existing and possible catchment areas assuming permeability improvements can be undertaken.

Figure 4.1 indicates the area that is within a standard walking distance of a bus stop (400m for BusConnects CBC's) based on the actual walking distance rather than "as crow flies" analysis which can be misleading particularly where there are long sections of blank, inaccessible, wall along corridors. The number of people living within this area can be obtained from GeoDirectory data. In addition, permeability solutions can be identified and the impact of making these changes can be quickly assessed in terms of increased catchment area. The process of undertaking this analysis is outlined below:

Task 1: Enhancing the Navteq network using OpenStreetMap to add footpaths, greenways, cut throughs which are accessible to most people, paths over greens or parks, etc., this is required as the network supplied by the NTA is a primarily a driving network not a pedestrian network.

To do this you will add walk links extracted from OpenStreetMap's data clearly coding these into the Navteq supplied by the NTA. Google Streetview should be used as a check to ensure any link added to the Navteq exist on the ground and are accessible to all. Informal walk links should not be added at this stage.

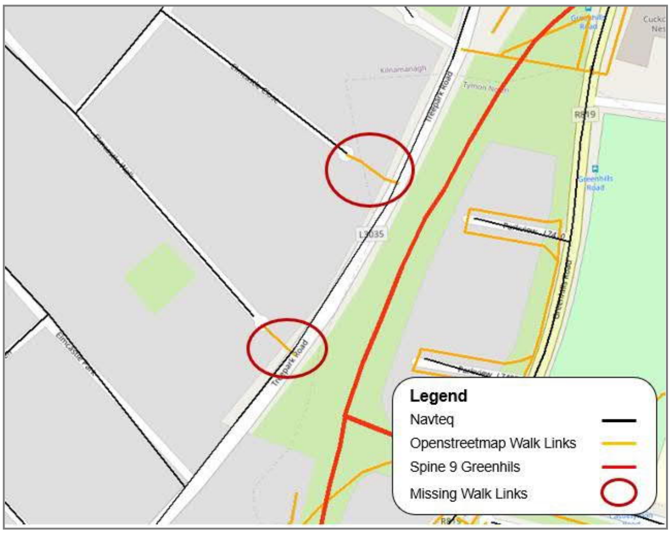


Figure 4.2 Example of permeability link missing from Navteq mapping on Tallaght/Clondalkin Cor Bus Corridor.

Task 2: Once the Navteq has been enhanced to the required level to capture all major pedestrian movement within bus stop catchment areas, catchment analysis shall be run for the proposed and existing bus stops. Using the Network Analyst Extension in ArcGIS generating 400m and 800m walking bands to reflect 5 and 10-minute walking catchments of bus stops.

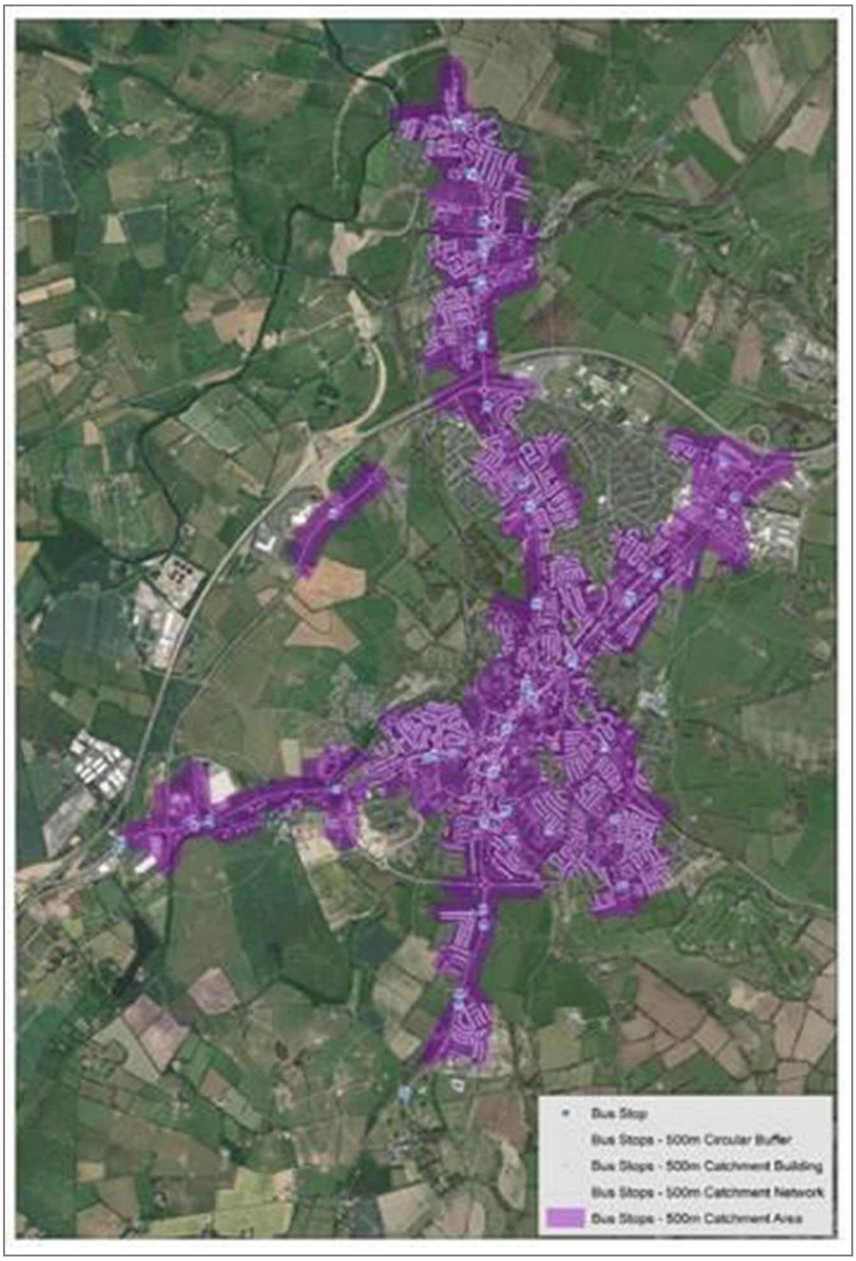


Figure 4.3 Example of catchment analysis run for all bus stops in Naas

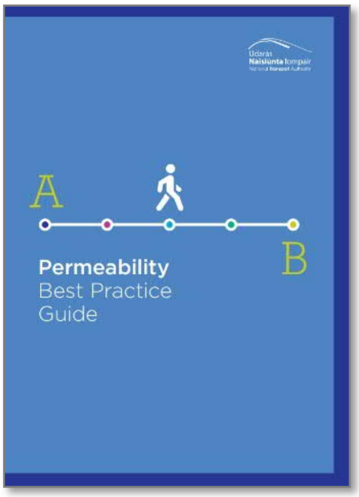
Task 3: Production of catchment tables identifying number of households using Geo Directory or population estimate using census 2016 and Geo Directory to apportion sections of Census Small Area within 400m and 800m catchments of each bus stop. Catchments will be non-overlapping to avoid double counting between stops along the same alignment.

Task 4: Maps will be generated for each stop along each of the alignment, or stops can be grouped together to reflect particular study areas. Maps can be generated in any particular format to match the theme of previous reports (EPR Reports).

Task 5: Quality Assurance and Checking of catchments is critical as missing, or additional, links will be easily identified by the public and could discredit the analysis if there are errors.

Having developed a detailed understanding of the catchment areas consideration should then be given to how the catchments can be widened through identification of permeability opportunities along the corridors. Permeability describes the extent to which an urban area permits the movement of people by walking or cycling. Such an approach is known as "filtered permeability". Barriers to filtered permeability can include:

- Boundary walls around estates and within residential areas that prevent movement along natural desire lines, being usually the shortest and most direct route connecting two points;
- Cul-de-sacs which prohibit through movement;
- Poorly designed linkages that are difficult or unattractive to use; and
- Connections which require much longer travel distances than direct linkages.



The NTA Permeability Best Practise Guide should be followed for the identification and assessment of these opportunities. Careful consideration should be given to whether or not these proposals should form part of the Bus Connects scheme or if they should be identified to the Local Authority for actioning. Only those linkages that are directly linked to the corridor should be considered as part of this application.

An example from the Clongriffin to City Centre CBC can be seen in Figure 4.4 where a very large housing estate which is located immediately adjacent to the proposed bus corridor has a continuous boundary wall that runs for over 800m preventing easy access to the bus routes and requiring a walk of almost 1km to access the bus routes. Opening a pedestrian access on the boundary wall could create a much shorter route to the buses and substantially increase the bus passenger catchment area.

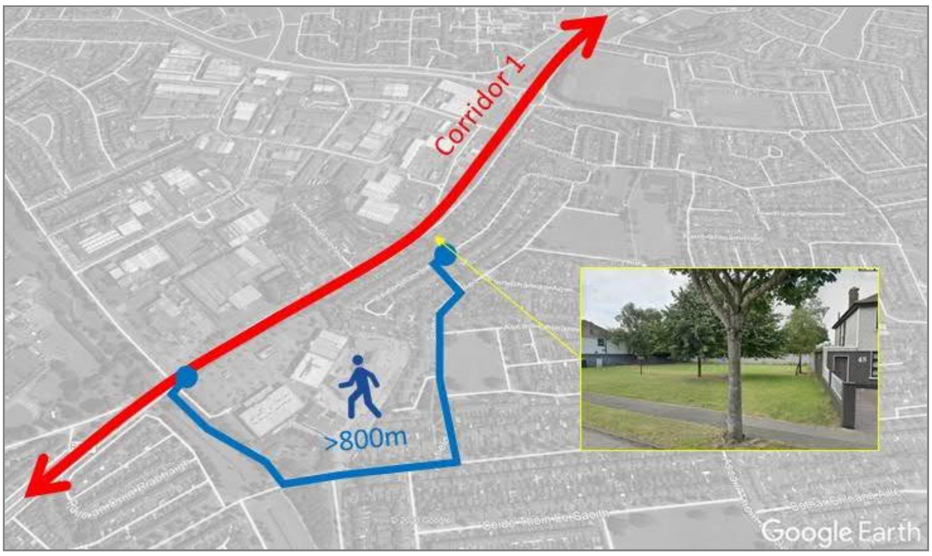


Figure 4.4 Permeability option on the Malahide Road (Source: Google Maps).

Figure 4.5 Boundary wall along Malahide Road (Corridor 1) where local residents have opened up individual doors to access the existing QBC route.

5.0 Review Bus Stop Locations

5.1 Public Consultation Feedback.

An important aspect of the bus stop review is to review feedback received from the general public in relation to the position of an existing, or proposed, bus stop along the corridor. This may identify a specific issue that the reviewer should be aware of before beginning the review. For example, the relocation of a bus stop away from a destination for people with mobility impairments may not have been identified during the preliminary design process and should now be considered. It is also important to review these comments against commitments that may have been given during the "one to one" meetings held during the initial, and subsequent, consultation stages.

Please note that some bus stops were relocated after the EPR public consultation as a result of public consultation comments, if a bus stop is being considered for relocation please also check whether it had been relocated previously by checking the EPR drawings and discussing with the NTA IPO.

5.2 Usage of Bus Stops.

In order to help the reviewer, understand the passenger movements at a bus stop it is recommended that the existing Boarding and Alighting Data is reviewed at this early stage and is used as an approxi for future passenger movements. This will provide an indication of the numbers using a bus stop in an area and would indicate the number of pedestrians movements having to be catered for. It will also indicate those bus stop locations that are relatively lightly used and could be considered for amalgamation with a nearby bus stop, relocation to a more convenient location, or removal completely.

5.3 Spacing of Bus Stops.

The spacing of bus stops has a significant impact on the average speed of a bus corridor, clearly the more times a bus stops the slower the overall journey time will be. A bus incurs a minimum of 15 seconds delay with each stop on an urban street just to decelerate, open and close the bus doors, and accelerate back to speed (25 seconds on a busway). Table 5.1 uses information extracted from the Transit Capacity and Quality of Service Manual (TRB) and indicates the estimated average speed on an 80kph busway. This clearly indicates that bus stop spacing, and dwell time have a large impact on average speed on bus corridors.

Table 5.1 Average Bus Speed (km/h) in Bus Priority Corridors, 80km/h running speed.

Average Stop Spacing (km)	Average Dwell Time (s)				
	0	15	30	45	60
0.8	50	37	32	27	24
1.6	61	51	45	40	37
2.4	68	58	53	48	45

For BusConnects it is proposed that bus stops should be spaced approximately **400m** apart on typical suburban sections of the route, dropping to approximately **250m** in urban centres (CIHT Buses in Urban Developments, January 2018). This spacing should be seen as a recommended spacing rather than an absolute minimum spacing.

The ability to increase stop spacing depends in part on the quality of the pedestrian connectivity in the area and also the availability of safe crossing points in the vicinity of the proposed bus stop. It may also depend on the characteristics of the passengers using the stop, e.g. persons with limited mobility may find it difficult to walk to the next stop. It is therefore recommended that for locations that may generate high number of elderly or mobility impaired bus passengers (health facilities, local businesses) consideration should be given to locating the bus stop within **100m** of the location if spatial considerations permit.

5.4 Spatial considerations for geometric layout.

The provision of high-quality bus stop infrastructure that is customer orientated is considered an essential part of the BusConnects offering, including:

- Being fully accessible for all bus passengers;
- Having a bus shelter for waiting passengers;
- Having both timetable and real time passenger information (RTPI) available to passengers;
- Having sufficient footpath space to allow the free movement of pedestrians passed the bus stop;
- Continuous cycle lane past the bus stop; and
- Provision of Cycle Parking at, or close to, the bus stop.

All of which requires significant space along the already congested radial routes that the Core Bus Corridors run along. Therefore, an important aspect of locating bus stops is identifying locations that have sufficient space to accommodate all, or most, of these elements.

The BusConnects Design Guide suggests that an Island Bus Stop (Figure 34) is the preferred bus stop option to be used as standard on the CBC project where space constraints allow. The **minimum footpath width within which an island bus stop can be implemented is 5.4m** (1.8m footpath + 1.2m cycle track + 2.4m island with shelter). This option assumes a shelter with half bay end panels. Should full panels (as seen on Figure 5.2) be required the width requirement will increase to approximately 6.3m.

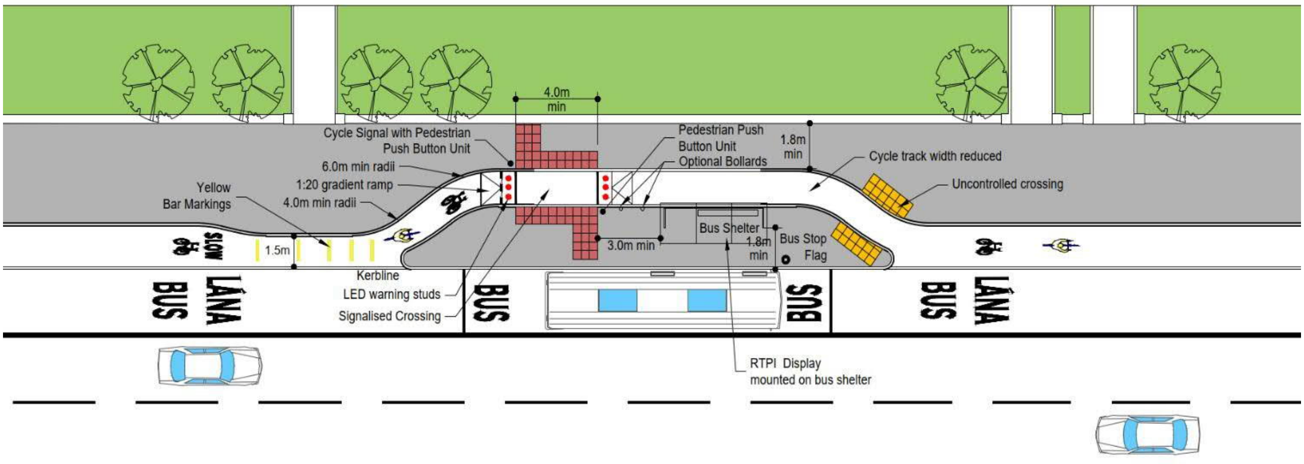


Figure 5.1 Typical Island Bus Stop Arrangement (Bus Connects Design Guideline).

Figure 5.2 Standard 3 Bay Reliance Mark Shelter with full width advertising panel.

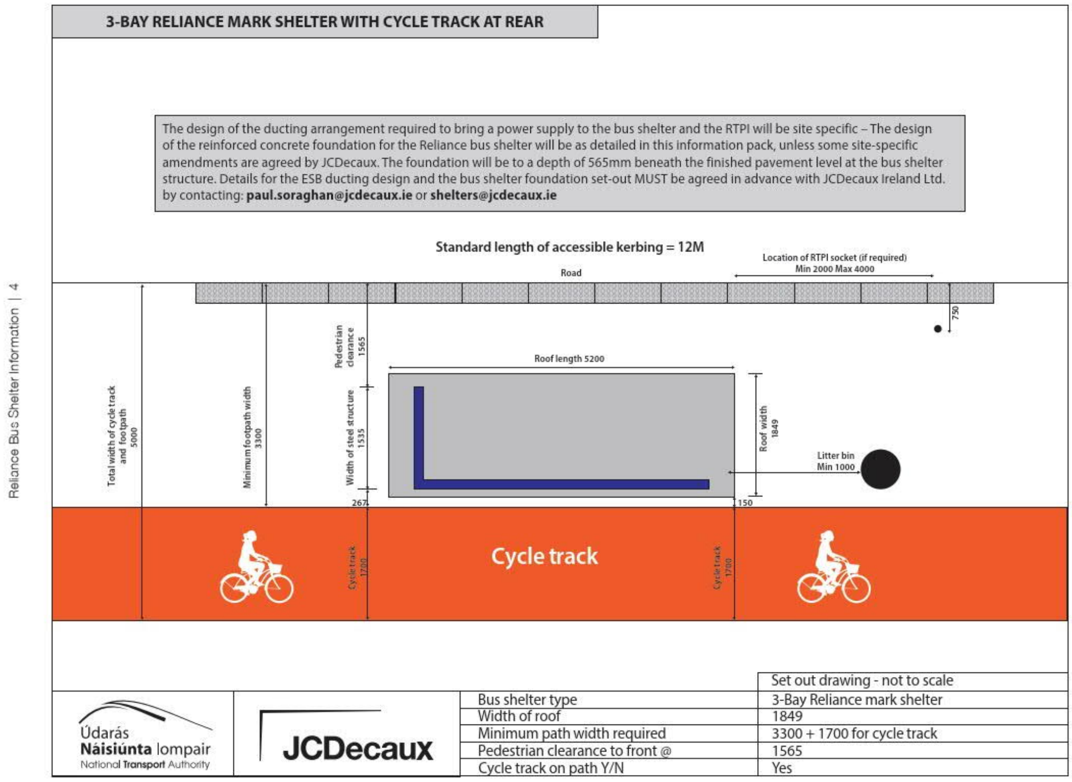


Figure 5.3 Standard layout for a 3 Bay Reliance Mark Shelter with full width advertising panel and cycle lane to the rear (note cycle lane width is to be determined by designers).

For locations where space is constrained an option consisting of a shared bus stop landing zone can be considered. This option is indicated in Figure 5.4 and should only be considered on a case-by-case basis to ensure suitability with particular attention paid to the volume of cyclists and volumes of boarding and alighting passengers. **Using the narrowest non-standard bus shelter this would require a minimum width of approximately 4.0m** (1.9m footpath with shelter + 1.2m cycle track + 0.75m island).

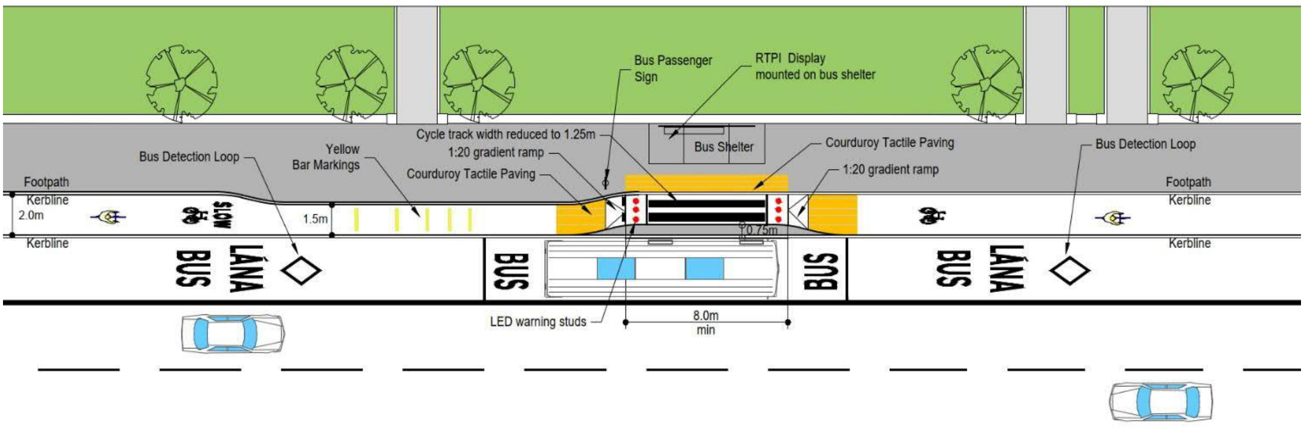


Figure 5.4 Shared Bus Stop Landing Zone Arrangement (Bus Connects Design Guideline).

Figure 5.5 Cantilever narrow roof Bus Shelter

It is important that ED's do not immediately choose the minimum sized shelter as this will impact on the weather protection provided to bus passengers and potentially advertising revenue share received by the NTA. Where there are a substantial number of bus stops using the nonstandard bus shelter it is recommended that the NTA IPO are consulted prior to finalising the proposals.

Providing cycle parking at bus stops has the potential to increase the catchment area of a bus corridor by providing a safe place for cyclists to secure their bike for the duration of their trip. ED's should look to provide cycle parking at all bus stops along the BusConnects Corridors where space permits. The **minimum provision is 3 Sheffield Stands** (accommodating 6 bicycles) in the vicinity of a bus stop. Where larger numbers of cyclists can be expected consideration should be given to providing a larger covered area of approximately 10 Sheffield Stands (accommodating 20 bicycles).

Figure 5.6 Sheffield Bicycle Stands provided at a Bus Stop on the N11.

Figure 5.7 Covered Sheffield Bicycle Stands provided at a Bus Stop on the N11.

5.4 Distance from controlled pedestrian crossing.

Pedestrians by their nature often take the quickest route to their destination rather than the safest route, particularly if they feel the safety risk is low. This results in bus passengers leaving buses stepping out in front of, or behind, buses and crossing the road in a hazardous manner. The placement of bus stops near safe pedestrian crossing points is therefore a critical aspect of bus stop design. Providing a bus stop where there is no, or an indirect, pedestrian crossing will lead to “jaywalking” and pedestrians making higher risk movements.

There are many examples of bus stop located immediately outside a pedestrian opening into a housing estate which makes it easy for passengers to access the bus stop in the morning, however on the return journey the passenger can often be isolated on the other side of the road with no safe crossing point available. While this may be satisfactory on some roads, it may not be on others, and how is a person with a mobility impairment to cross a busy radial route? **All bus stops along the CBC’s should be located within a short distance of a controlled crossing point.**

The optimum location to locate a bus stop is adjacent to junctions which have signalised pedestrian crossings provided on all desire lines. Much research has been undertaken in relation to the optimum location for a bus stop adjacent to a junction, either before (near-side) or after a junction (far-side), while there are advantages and disadvantages of both, all guidance recommends that locating the bus stop on the **far-side of a junction is the optimum solution**. While this may be theoptimum location in terms of the operation of a corridor a near-side bus stop may still be appropriatewhen spatial constraints, routing, or distance from junction are considered.

Figure 5.8 indicates various locations for bus stops at junctions with particular consideration for interchange between Spine and Orbital Core Bus Corridors. This indicates that all options which require passengers to interchange will require passengers to cross at least one arm of a junction (on average over both legs of their journey), emphasizing the importance of locating bus stops at junctions and providing controlled crossings on all desire lines between interchanging bus stops.

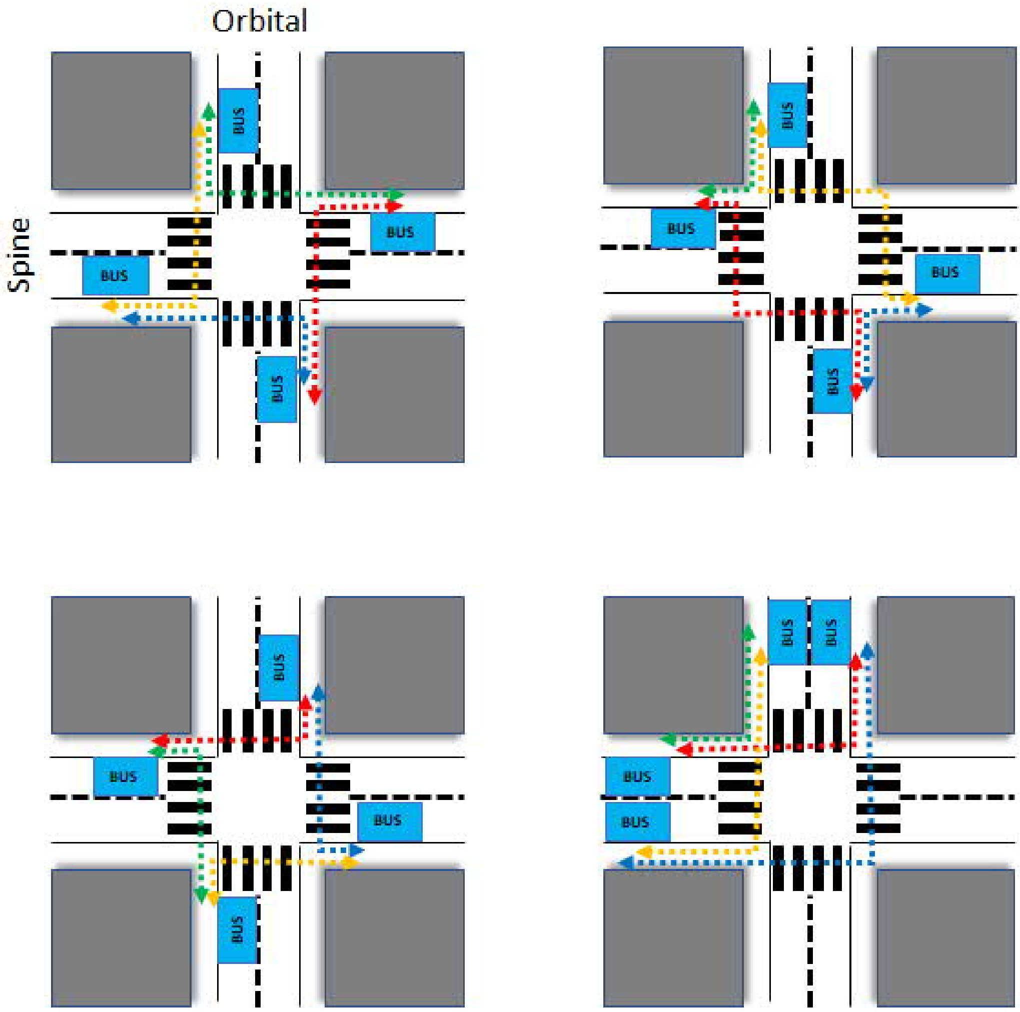


Figure 5.8 Bus stop locations and passenger interchange routes between them.

The DfT document Inclusive Mobility (2005) suggests recommended distance limits without rest for various Mobility Impaired Groups that ranges from 50 to 150m, which limits the distance between interchanging bus stops significantly. It is therefore recommended that the distance between the key interchange bus stops is limited to approximately **100m walking distance** where possible to enable all impaired groups to be able to interchange, consideration must be given to providing a rest spots at approximately 50m between the bus stops to cater for those that will not make this distance without a rest.

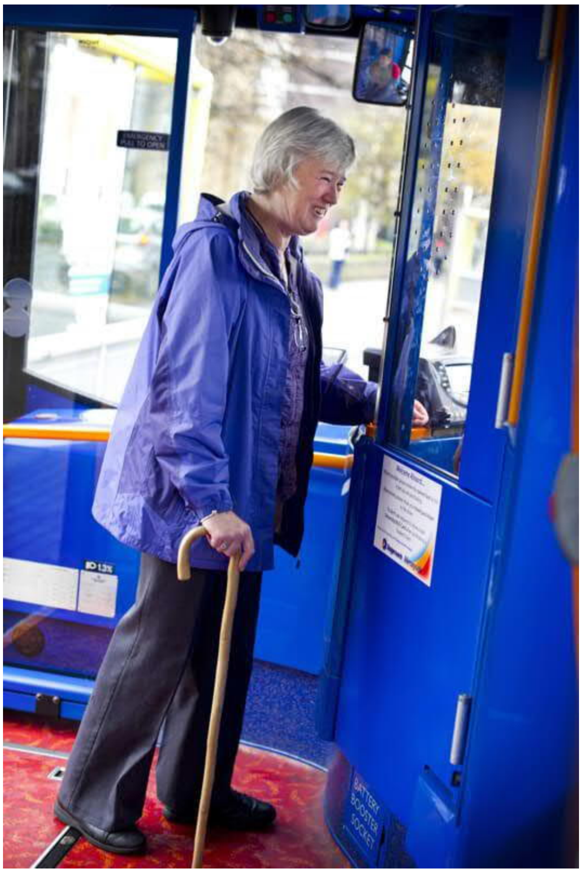


Figure 5.9 Pedestrians using sticks have a limited range of 50m before needing a rest.

For mid-block (between junctions) bus stops it is important that consideration is given to the location of a safe crossing point. It is recommended that a signalised crossing is located in close proximity to these stops to allow all passengers to cross the road safely. It is also recommended that bus stops are positioned upstream of this crossing to avoid buses blocking visibility to the crossing and that passengers walk to the back of the bus where they are more visible to oncoming traffic.

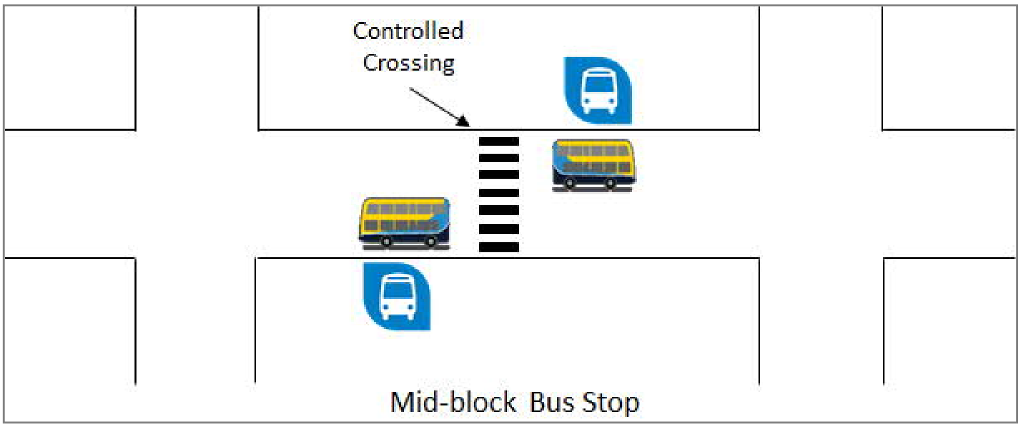


Figure 5.10 Mid-block bus stop optimum layout.

5.5 Impact on Adjacent Junction.

Locating bus stops close to junctions is optimum for pedestrian connectivity and safety, however it clearly can impact on the capacity of a junction and may result in increased congestion. Designers will need to review the location of the bus stops in order to minimise the impact on the operation and capacity of the junctions; things to consider include:

- Distance from the far-side bus stop to the junction. Buses will be running at headways of approximately 2 minutes at peaks on some corridors, while every effort will be made to avoid bunching it is likely that buses will end up meeting each other as they wait for a green signal. As a result, it is important that sufficient space for a bus to wait behind a stopped bus is provided at all junctions. Importantly this offset should start beyond the pedestrian crossing point in order to avoid blocking the crossing. Table 2.2 provides guidance on offset distance from key features.

- For near-side bus stops it is important that the location is reviewed in the context of visibility to the traffic signals for general traffic (bus, or the bus stop infrastructure, impacting on visibility to primary traffic signals) and also interaction with left turning traffic. Reference DMRB DN-GEO-03044 and DTTaS Traffic Signs Manual Chapter 9.

- Where a bus is joining a Spine from a side road it is important that the bus stops are fully accessible by the turning vehicle and sufficient space is provided to allow the bus to pull in flush with the bus stop so as the gap between the kerb and the bus is minimised (both doors). It is also important to ensure that the manoeuvring bus does not require the bus to sweep over the kerb line.

Figure 5.11 Tracking of a turning bus entering a bus stop.

Figure 5.12 Having buses flush with the bus stop is important to allow the ramp to lower correctly, but also to speed up the boarding and alighting of all passengers as gaps slow this down.

Table 5.2 Indicative Distances of Features from Bus Stops

(DRAFT NTA Bus Stop Design Guidance)

Feature	Distance (m) to bus stop sign
Prior to isolated pedestrian crossing signals or Zebra	18m
After pedestrian crossing signals or Zebra	10m + bus length*
Prior to signalised junction	20-30m
After signalised junction	20m + bus length*
Prior to or after a side road	20m
After a side road	10m + bus length*
Prior to a roundabout (no diverge)	20-30m
After a roundabout (no merge)	20m + bus length*

***the bus length should be the longest bus using the stop**

6.0 Review Locations relative to Revised Bus Network

The revised BusConnects Network is based on the Connective Network Principle which will rely on some interchange between routes to reduce journey times across the City. This Interchange will primarily occur in the City Centre where the spines overlap rather than along the Spines. However, some interchange will occur between the High Frequency Spines and the Frequent Orbital routes and also between the routes before Branches peel off the spine. Seamless interchange between these bus routes will be critical for the successful operation of this system.

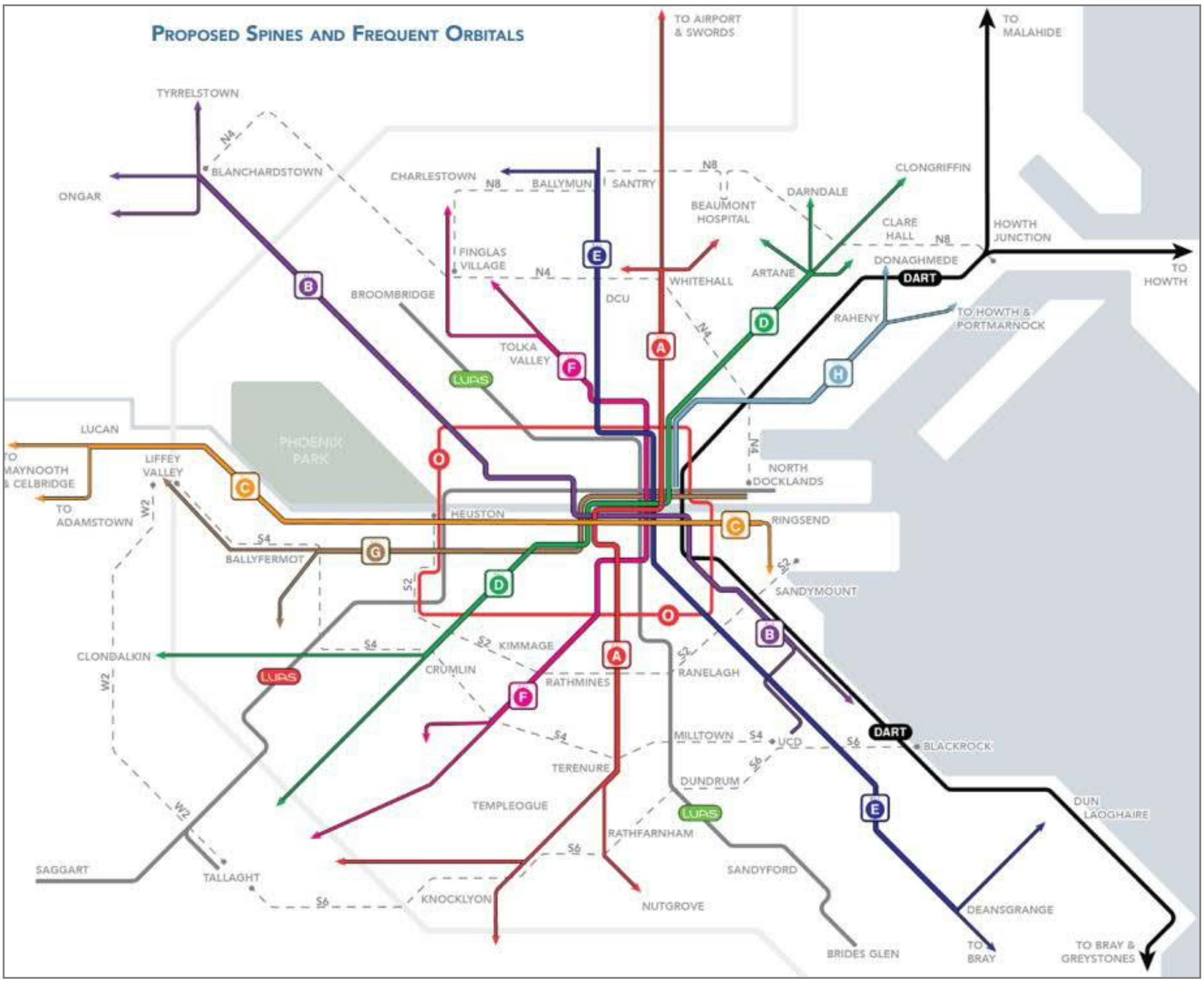


Figure 6.1 Simplified diagram of spines and frequent orbitals in the proposed network

The latest maps need to be obtained by each ED from the NTA IPO. In addition, the ED's can make use of the NTA's Remix system, which is an on-line route and stop information system for the proposed bus network.

6.1 Buses entering and exiting the Spine.

For buses entering and exiting the Spine, consideration should be given to how passengers may switch from one branch to another branch route. While this can happen anywhere along the Spine it will most regularly occur at the last stop before the branch route peels off the Spine. An existing example of this can be seen at Foxrock Church where two high frequency routes (46A/145) deviate at this point. At the last stop before the 46A deviates to Kill Avenue significant numbers switch from one route to the other.

Figure 6.2 Foxrock Church Bus Stop on the N11 QBC

For the Core Bus Corridors consideration should be given to the size and location of the stops before branch routes leave the main Spine. The optimum location of stops at this location will allow all routes to overlap prior to the junction thus removing the necessity for passengers to walk to anotherbus stop.

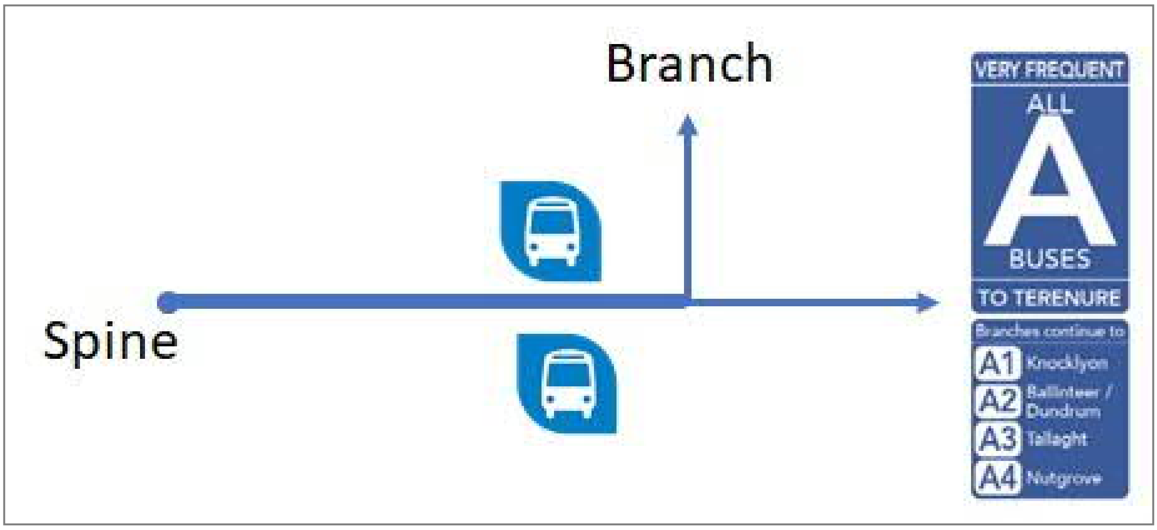


Figure 6.3 Location of Bus Stops Immediately before Branch Route Peels Off Spine

6.2 Interchange between Radial and Orbital routes.

The movement of passengers from one corridor to another is critically important to make Dublin more accessible by public transport. Making this interchange as easy as possible is thus critical to the successful delivery of the BusConnects Programme. Figure 3.4 indicates two typical scenarios that will arise on this project; the crossing movement (D/N4) and the overlapping movement (D/N2).

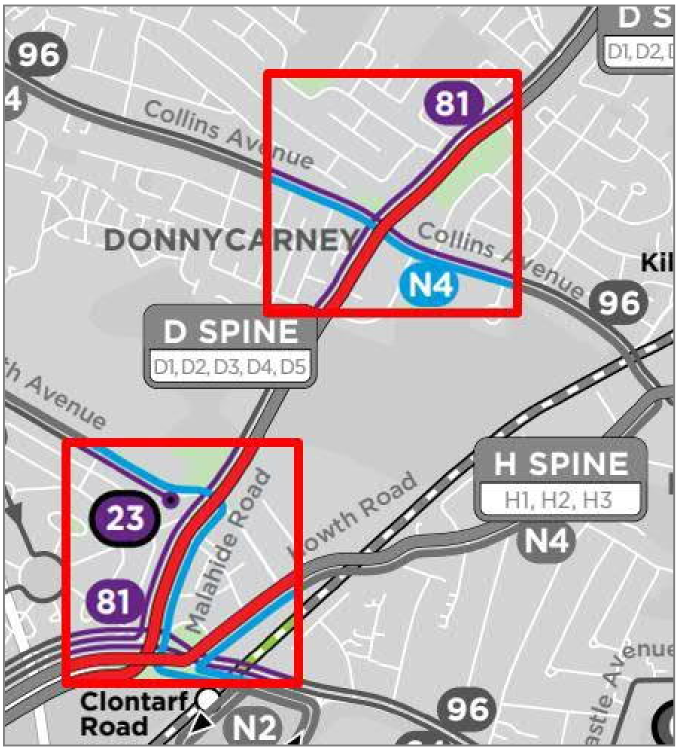


Figure 6.4 Two Different Scenarios for Interchange between orbital and radial corridors.

The optimum solution, but the less likely one, is the overlapping of routes which will allow passengers to leave one route and access another one via the same bus stop (or the opposite pair) making it a very easy interchange. For this option it is important that the designer considers the location of bus stops in a similar manner to the previous section on peeling off of branch lines.

For the more common crossing of routes the location of the bus stops needs to be carefully considered to minimise the distance passengers have to walk and to ensure there is a safe crossing location to facilitate this movements. This was outlined in section 5.4. **For locations where interchange is expected it is recommended that the desirable maximum distance between the interchanging bus stops is 100m,** with rest stops provided at 50m for those with impairments that restrict the maximum walking distance to below 100m.

7.0 Bus Stop Capacity

The capacity of bus stops is a complex and dependent on many variables which may constantly vary throughout a typical peak hour. For this reason it is proposed to undertake a high level assessment of bus stop capacity at this time and a more detailed assessment at a later stage when the Microsimulation Models are available for each corridor which can include the interaction between junctions and bus stops (potential bunching of buses), taxi numbers on the corridor, and the number of express or stopping coaches. Information on the calculation of capacities is available in the TRB, Transit Capacity and Quality of Service Manual, 3rd Edition and for complex locations it is recommended that the designer review applicable sections of this document to gain an understanding of the critical parameters.

7.1 Number of Bus Bays

The TFL Bus Stop Design Guidance states that bus stop capacity is a function of bus length, service frequency, the number of serving routes and their average dwell time. The BusConnects Dublin Corridors will generally carry between 15 to 20 buses per hour at peak times, which equates to a bus every 3 minutes. Assuming a maximum dwell time of 1 minute it could be assumed that one bus stop will be sufficient in most cases. However, the spine corridors will have multiple branches joining at different points with buses running at different frequencies resulting in buses not running at a constant headway. Figure 7.1 below indicates a bus arrival scenario from the TFL Bus Stop Design Guideline which shows how buses may arrive at a stop. This shows the estimated volume of buses at a single bus stop, depending on the frequency of the respective services. For example, Scenario C shows that although there is a frequency of 26 buses per hour, the stop, would theoretically operate well below capacity, however the arrival pattern of buses means that at times more than one bus will be on the stop. For this reason, it would be recommended that this bus stopshould have sufficient space to board and alight two buses at once.

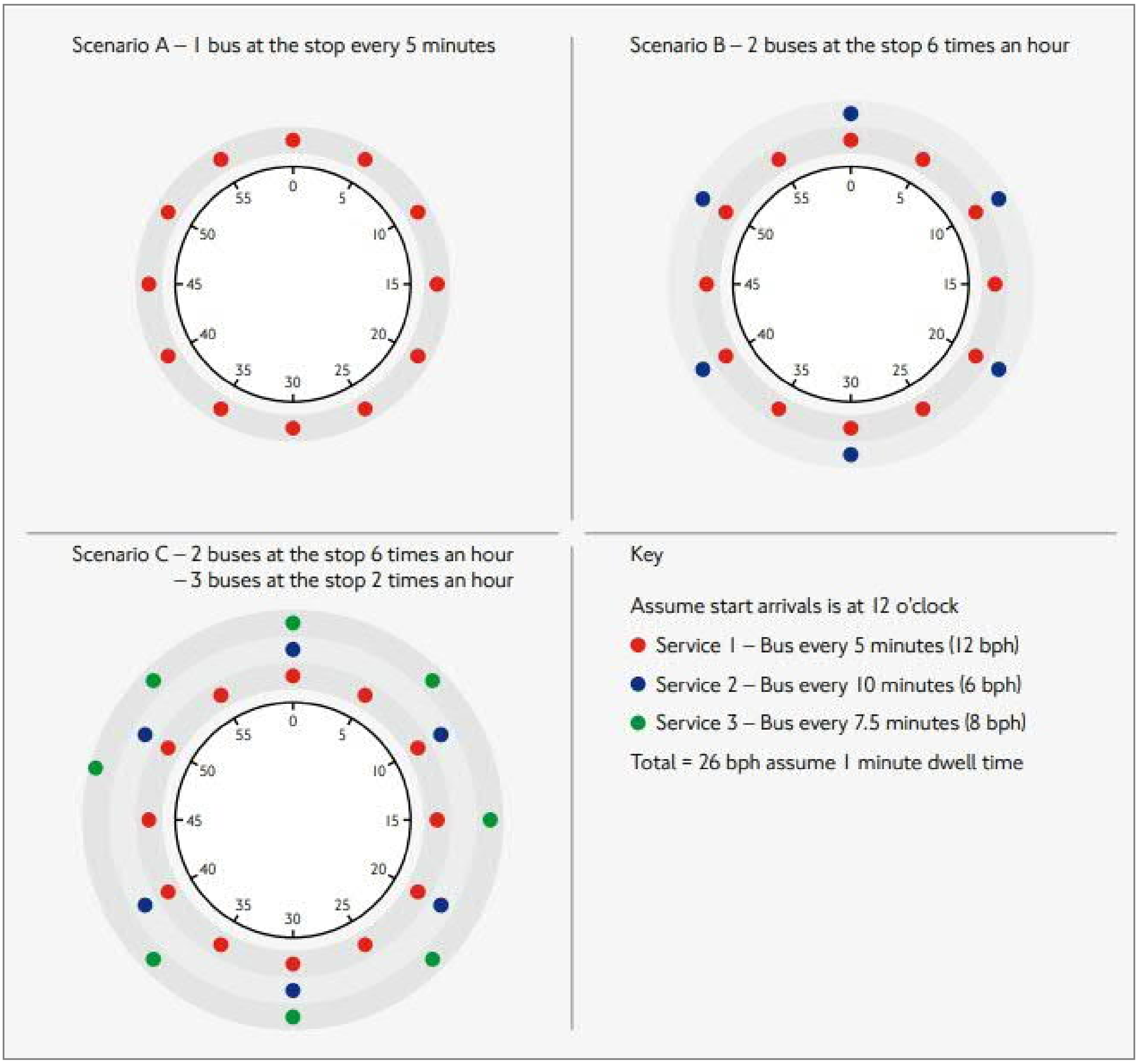


Figure 7.1 Bus Arrival Pattern at a Bus Stop (Source: TFL Bus Stop Design Guidance)

Detail on the buses using each corridor can be obtained from the NTA Remix site (obtain access from NTA IPO), or the frequency information from the BusConnects website. This can be used to make an estimate of the number of bays required at a bus stop by generating scenarios for the stops based on the headways for each route similar to Figure 7.1 above. These assessments will be superseded on completion of the micro-simulation analysis of each route, for this reason it is proposed to undertake this initial assessment based on the assumption that 2 bus bays will likely be required where there are between 25 and 30 buses on the route. This would require a longer bus cage that will accommodate two buses stopped simultaneously, approximately 24m in length (end to end bus), with Kassel Kerbs provided over its length to assist passengers, particularly those with a mobility impairment, to board and alight with ease from both buses.

Number of Bays at a Bus Stop	Where a Corridor is carrying approximately **25 to 30 buses** or more per hour, consideration be given to lengthened the bus stop cage and kerbing to provide space for 2 buses stopping simultaneously. Independent arrival and departure is not required.

Figure 7.2 Where space permits double bus bay should be provided where more than one bus is expected to arrive at a bus stop simultaneously (source: Google)

7.2 Passing Lanes

For corridors with large number of buses, particularly express buses that are not stopping at bus stops it may be necessary to provide a passing lane, or to indent the bus stop in a lay-by, to allow these faster moving buses to overtake the slower ones. This is likely to be particularly important on high capacity corridors where Regional Buses are accessing the City Centre. The TIAR Consultant has undertaken an initial assessment of this and have concluded that where the **hourly bus numbers exceed 40 the addition of a bus stop layby** will help maintain bus capacity and reliability along the corridor. The specific number for each corridor will be obtained from detailed microsimulation analysis at a later date.

Requirements for passing Lanes	Where a section of corridor is carrying approximately **40 to 50 buses** or more an hour**,** consideration should be given to providing passing lanes at bus stops.

Figure 7.3 In-line bus stops on a heavily used bus corridor can lead to express, or non-stopping buses, being delayed or making overtaking manoeuvres. (source: Dublin Bus Stuff).

8.0 Revisit Catchment Analysis

On completion of the review of bus stops along each corridor the catchment analysis for each corridor should be undertaken. The process was detailed in Section 4.0. The analysis should be undertaken and presented on a corridor basis with both Residential and Employment/Education population within 5 and 10 minutes presented.

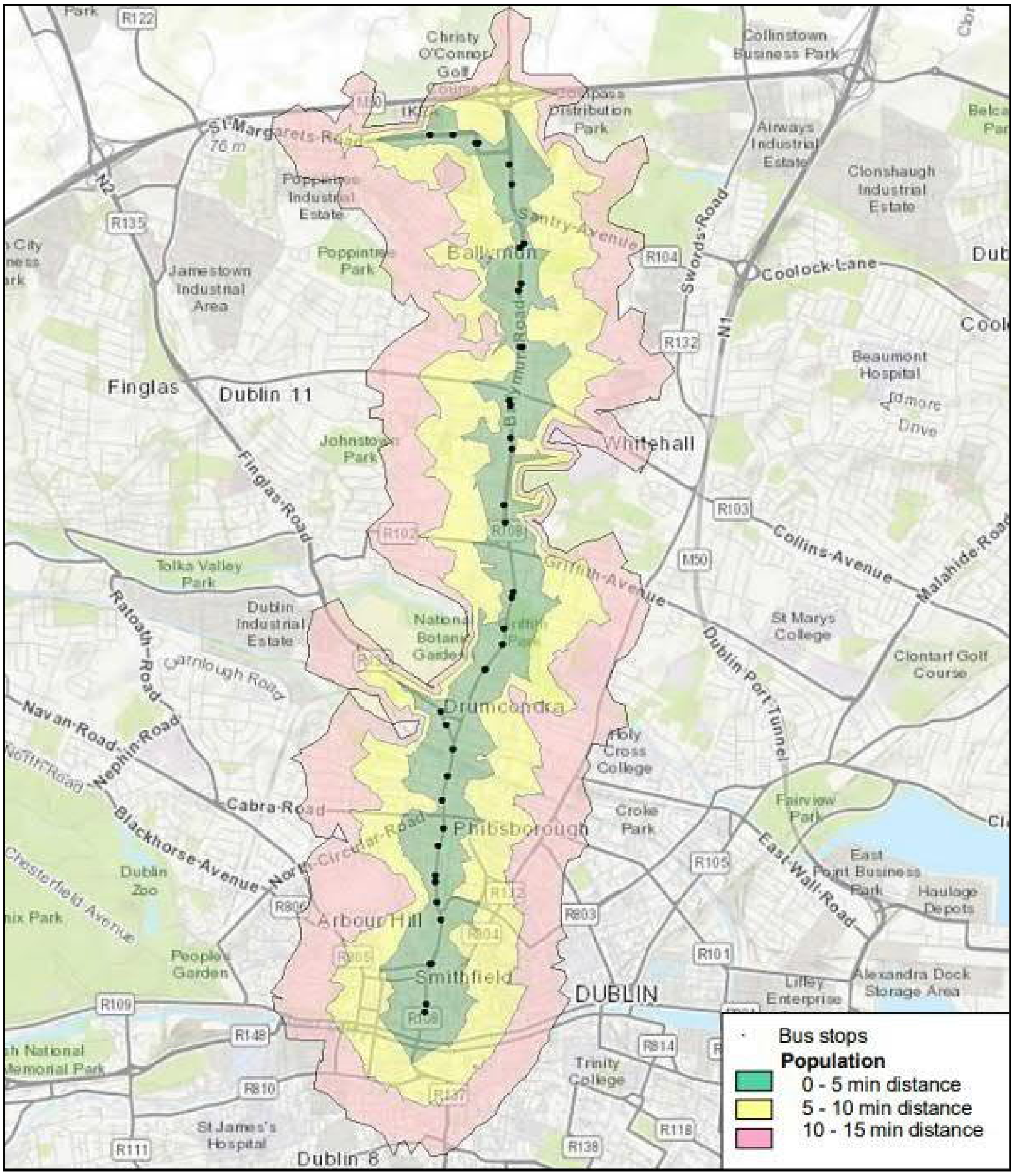


Figure 8.1 Typical map of bus corridor catchment areas

8.1 Presentation of Review

For consistency it is recommended that this review is undertaken, and presented, on the PRO drawings. High-level comments can be listed against each stop with distance between stops also noted (Document 1).

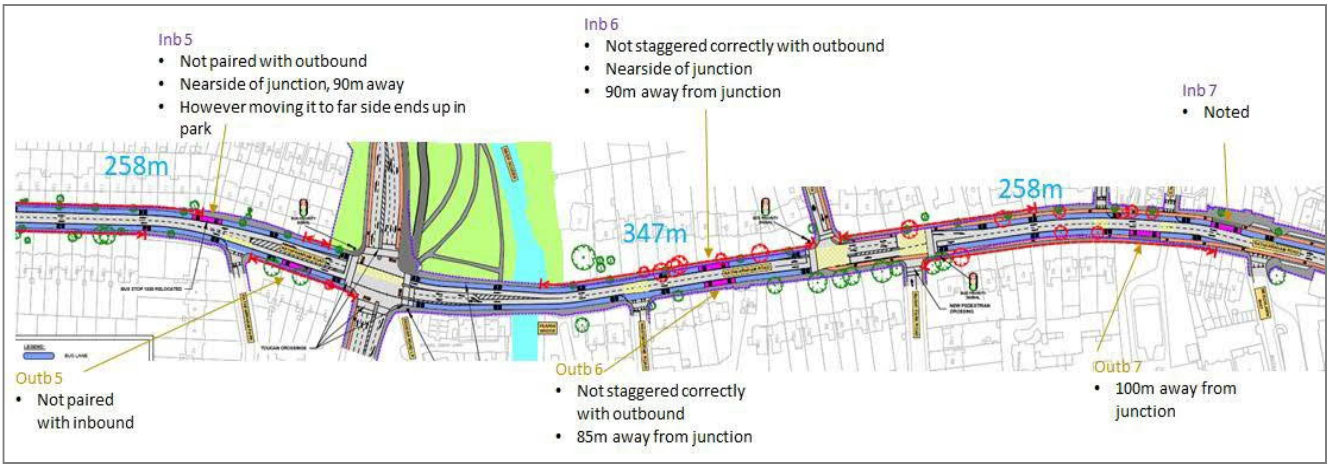


Figure 8.2 Example Review of Bus Stop Locations (Source: ARUP, Rathfarnham CBC).

This document should then be followed by a recommended bus stop strategy (Document 2) for each corridor indicating where bus stop are to be located and that all variables have been considered for each stop. This should be in a similar drawing to the review drawing in Figure 8.2, but focused on those stops that have been altered from the original PRO drawings. A summary table for each corridor should be placed on the front drawing of the recommendations summarising the existing and proposed bus stop strategy:

Corridor Name			
Number of Existing Bus Stops		**Length (KM)**	
	Existing	**Proposed**	**Comment**
Average Spacing of Bus Stops (m)			
All stops located adjacent to a controlled crossing?	Y/N	Y/N	
Have all accessibility / spatial requirements and consultation suggestion been accommodated?	-	Y/N	

Document 2 shall include a report providing specific details of each bus stop along a corridor and detailing the results of the catchment analysis for the optimised bus stops.

Appendix H2

Bus Stop Review
Analysis

Clongriffin to City Centre Core Bus Corridor Scheme

Bus Stop Review

January 2022

Bus Stop Summary, Clongriffin Scheme - Existing vs Proposed

Inbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
1	4563	A3375	N/A	1	4563	A3375	N/A
2	1218	A3675	300	2	1218	A3675	300
3	1270	A4100	425	3	1270	A4025	350
4	1272	A4600	500	4	New	A4440	415
5	1201(1273 GA)	A4925	325	5	1272	A4790	350
6	1274	A5225	300	6	1274	A5225	435
7	1199	A5675	450	7	New	A5475	250
8	1276	A5825	150	8	1276	A5805	330
9	1277	A6125	300	9	1277	A6125	320
10	1219	A6350	225	10	New	A6575	450
11	1220	A6725	375	11	1221	A7025	450
12	1221	A7025	300	12	664	A7375	350
13	664	A7375	350	13	665	A7675	300
14	665	A7675	300	14	666	A7975	300
15	666	A7975	300	15	667	A8275	300
16	667	A8275	300	16	668	A8700	425
17	668	A8700	425			Average Distance:	355
		Average Distance:	333				

Outbound							
Existing				Proposed			
No.	Bus Stop No.	Chainage	Distance between Stops (meters)	No.	Bus Stop No. / Location	Chainage	Distance between Stops (meters)
1	1205	A3425	N/A	1	1205	A3550	N/A
2	6115	A3650	225	2	New	A3925	375
3	1203	A4075	425	3	New	A4375	450
4	1202	A4725	650	4	1202	A4820	445
5	1201	A4975	250	5	1201	A5100	280
6	4385	A5300	325	6	1200	A5525	425
7	1200	A5525	225	7	1199	A5775	250
8	1199	A5775	250	8	1198	A6175	400
9	1198	A6175	400	9	New	A6500	325
10	1197	A6650	475	10	1196	A6950	450
11	1196	A6950	300	11	4382	A7375	425
12	4382	A7375	425	12	New	A7800	425
13	672	A7575	200	13	671	A8000	200
14	671	A8000	425	14	New	A8300	300
15	670	A8175	175			Average Distance:	365
16	669	A8500	325				
		Average Distance:	338				

No.	Direction	Bus Stop		Existing Stop (Yes / No)	Proposal (Retained / Removed / New)	Boarding	Alighting	Boarding	Alighting	Demand (AM peak) 2028		Bus Lay-by or Onstreet	
		Name	No.			AM (08:00 - 09:00)	AM (08:00 - 09:00)	PM (17:00 - 18:00)	PM (17:00 - 18:00)	Services	Passengers	Existing	Proposed
1	Inbound	Clongriffin	6318	Yes	Retained	N/A	N/A	N/A	N/A	13	17	onstreet	onstreet
2		Grange Lodge Avenue	6319	Yes	Removed							onstreet	N/A
3		Park Avenue	7246	Yes	Retained/Relocated	0	0	0	0	16	31	onstreet	onstreet
4		East of The Hole in the Wall Junction	New	No	New	New	New	New	New	16	30	N/A	onstreet
1		Clare Hall	4563	Yes	Retained	21	18	13	29	17	1231	onstreet	onstreet
2		Belcamp Lane	1218	Yes	Retained	18	7	5	8	17	1231	onstreet	onstreet
3		Newtown Road	1270	Yes	Retained	25	6	9	12	16	1231	layby	onstreet
4		Ayrefield Drive		No	New								
5		Newtown Cottages	1272	Yes	Retained	3	4	1	10	16	1231	layby	onstreet
6		Brookville Cresent	1201	Yes	Removed	13	5	11	24	16	1231	onstreet	onstreet
7		St Brendans Church	1274	Yes	Retained	15	10	6	11	20	1917	layby	onstreet
8		North of St. Brendan's Drive Junction	New	No	New	New	New	New	New	20	2113	N/A	onstreet
9		Mask Avenue	1199	Yes	Removed							onstreet	
10		Mask Park	1276	Yes	Retained	7	2	1	3	20	2113	onstreet	onstreet
11		Mornington Grove	1277	Yes	Retained	21	12	18	38	21	2113	onstreet	onstreet
12		Danieli Road	1219	Yes	Removed							onstreet	
13		South of Kilmore Rd Junction	New	No	New	New	New	New	New	30	2618	N/A	onstreet
14		Beaumont, Malahide Road (Killester Avenue)	1220	Yes	Removed							onstreet	
15		Mayfield Park	1221	Yes	Retained	28	7	5	5	30	2618	onstreet	onstreet
16		Donnycarney Church	664	Yes	Retained	32	15	10	13	30	2847	layby	onstreet
17		Casino Park	665	Yes	Retained	10	8	3	11	30	2924	onstreet	onstreet
18		Mount Temple School	666	Yes	Retained	11	13	3	8	30	2981	layby	onstreet
19		Marino, Malahide Road (Griffith Avenue)	667	Yes	Retained	15	25	4	8	30	3250	onstreet	onstreet
20		Marino Crescent Park	668	Yes	Retained	23	16	0	0	30	3244	onstreet	layby

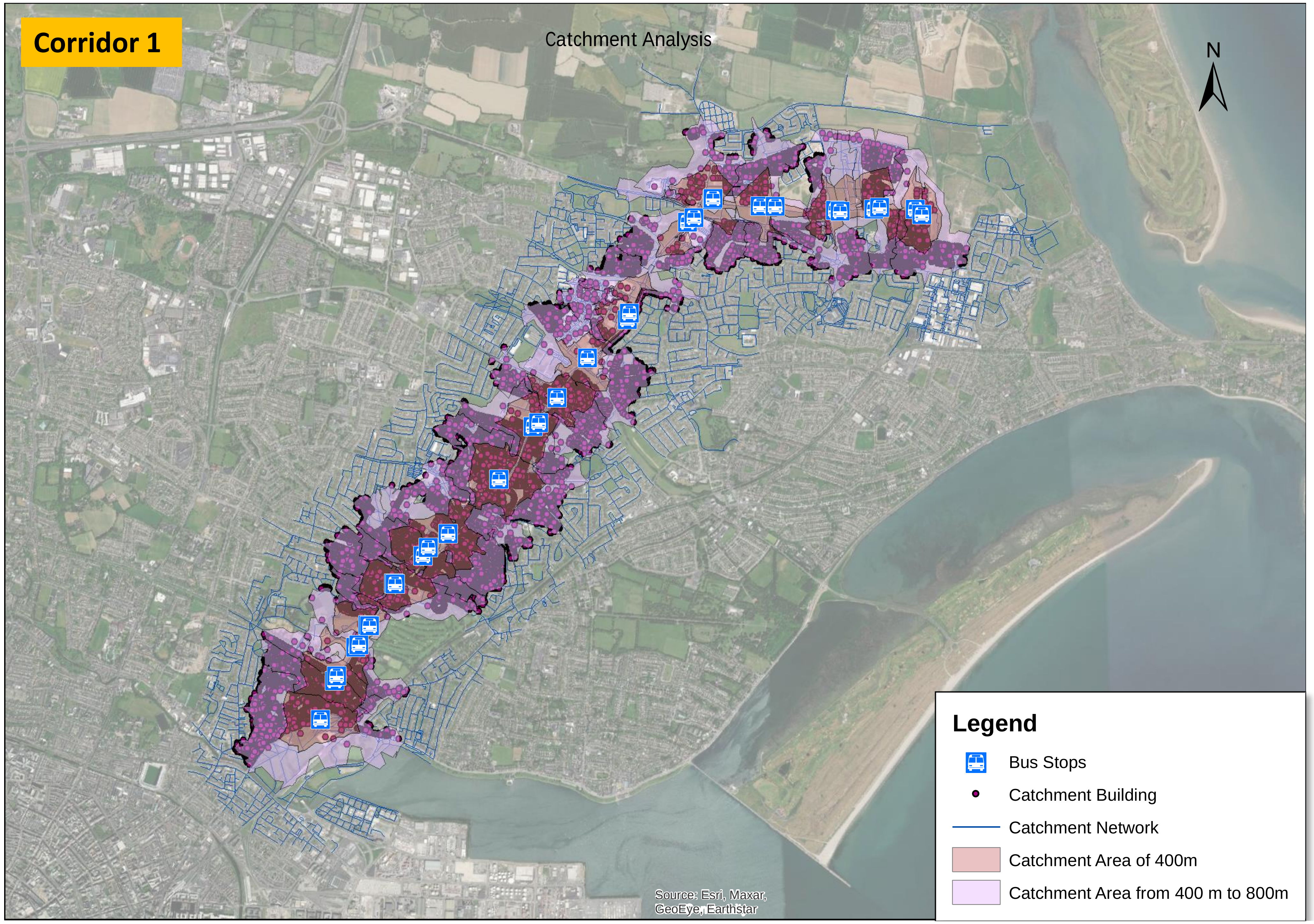
No.	Direction	Bus Stop	Proposed Bus Stop Capacity	Spacing of Bus Stops (meters)	Distance from Controlled Pedestrian Crossing	Permeability Issue (Yes / No)	(I) Interchange Stop (i.e. stops both serving orbital and radial routes)	(II) If Yes, which Services	Cycle Parking Proposed	Bus Shelter Proposed	Notes (e.g. permeability issues, land constraints)
		Name	No. of Bays		(meters)				(Yes / No)	(With or Without Panel)	
1	Inbound	Clongriffin	1	Start of the Scheme	16	No	No	N/A	tbc	tbc	
2		Grange Lodge Avenue							tbc	tbc	
3		Park Avenue	1	385	320 (pedestrian crossing required)	No	No	N/A	tbc	tbc	
4		East of The Hole in the Wall Junction	1	285	53	No	No	N/A	tbc	tbc	
1		Clare Hall	2	Tie in to DCC Scheme	70	No	Yes	D2 (Branch Route)	tbc	tbc	
2		Belcamp Lane	1	265	7	No	Yes	D2 & D5(Branch Route)	tbc	tbc	
3		Newtown Road	1	320	7	No	No	N/A	tbc	tbc	
4		Ayrefield Drive							tbc	tbc	
5		Newtown Cottages	1	405	20	Yes	No	N/A	tbc	tbc	Permeability Issues: wall adjacent to the bus stop
6		Brookville Cresent	1	325	45	Yes	Yes	D2 (Branch Route)	tbc	tbc	Permeability Issues: wall adjacent to the bus stop
7		St Brendans Church	1	410	32	No	Yes	N8 (Orbital)	tbc	tbc	
8		North of St. Brendan's Drive Junction	1	250	30	No	No	N/A	tbc	tbc	
9		Mask Avenue							tbc	tbc	
10		Mask Park	1	300	10	No	No	N/A	tbc	tbc	
11		Mornington Grove	1	315	58	No	Yes	D4 & D5(Branch Route)	tbc	tbc	
12		Danieli Road							tbc	tbc	
13		South of Kilmore Rd Junction	1	430	24	No	No	N/A	tbc	tbc	
14		Beaumont, Malahide Road (Killester Avenue)							tbc	tbc	
15		Mayfield Park	1	420	15	No	No	N/A	tbc	tbc	
16		Donnycarney Church	1	325	35	No	Yes	N4 (Orbital)	tbc	tbc	
17		Casino Park	1	290	49	No	No	N/A	tbc	tbc	
18		Mount Temple School	1	275	24	No	No	N/A	tbc	tbc	
19		Marino, Malahide Road (Griffith Avenue)	1	290	17	No	Yes	N2 (Orbital)	tbc	tbc	
20		Marino Crescent Park	1	395	14	No	Yes	N2 (Orbital)	tbc	tbc	

No.	Direction	Bus Stop Name	Design Rationale
1	Inbound	Clongriffin	1) Existing stop at the start of the corridor retained
2		Grange Lodge Avenue	1) Existing stop proposed to be removed due to proximity of the Clongriffin stop (less than 200m). The rationalisation of stops at this location will assist to improve bus journey times at this location.
3		Park Avenue	1) Existing stop proposed to be retained. 2) Stop shown in PC2 previously located immediately opposite Dermot Street. Stop location shown in PC2 has been marginally relocated to existing location to ensure stop is not located on top of ramp. 3) New pedestrian crossing shown on PC3 to enhance pedestrian accessibility
4		East of The Hole in the Wall Junction	1) New stop proposed at cater for the existing and future catchment
1		Clare Hall	1) Length of the Bus Stop to be reduced to ~20m (Standard Stop)
2		Belcamp Lane	1) Existing stop proposed to be retained 2) Stop situated near to pedestrian crossing
3		Newtown Road	1) Existing stop proposed to be relocated closer to the controlled pedestrian crossing and Blunden Junciton
4		Ayrefield Drive	1) Proposed new stop to serve the surrounding residential and employment catchment 2) New formal pedestrian link proposed into Ayrefield Drive 3) New controlled pedestrian crossing
5		Newtown Cottages	1) Existing stop proposed to be relocated south near to Greencastle Road
6		Brookville Cresent	1) Existing stop proposed to be removed, given the proximity of the relocated Newtown Cottages stop
7		St Brendans Church	1) Existing stop proposed to be retained
8		North of St. Brendan's Drive Junction	1) Proposed new stop located north of Brendans drive. Stop proposed to serve the surrounding residential catchment. 2) Stop proposed near pedestrian crossing
9		Mask Avenue	1) Existing stop proposed to be removed, due to the proximity of the new St Brendans Drive stop and also the existing Mask Park stop (which is proposed ot be relocated closer to Mask Avenue).
10		Mask Park	1) Existing stop proposed to be retained
11		Mornington Grove	1) Existing stop proposed to be retained, bus stop island introduced
12		Danieli Road	1) Existing stop proposed to be removed due to the proximity of the Mornington Grove and the new Kilmore Road stop.
13		South of Kilmore Rd Junction	1) New stop proposed to serve the surrounding catchment
14		Beaumont, Malahide Road (Killester Avenue)	1) Existing stop proposed to be removed due to the proximity of the Kilmore Road and Elm Mount Road junctions.
15		Mayfield Park	1) Existing stop proposed to be retained, with the stop relocated closer to the signal controlled crossing
16		Donnycarney Church	1) Existing stop proposed to be retained, bus stop island introduced.
17		Casino Park	1) Existing stop proposed to be retained
18		Mount Temple School	1) Existing stop proposed to be retained given proximity to the existing schools
19		Marino, Malahide Road (Griffith Avenue)	1) Existing stop retained, minor relocation south to tie in with pedestrian crossing facilities, and greater area for bus stop waiting facilities
20		Marino Crescent Park	1) Existing stop proposed to be retained

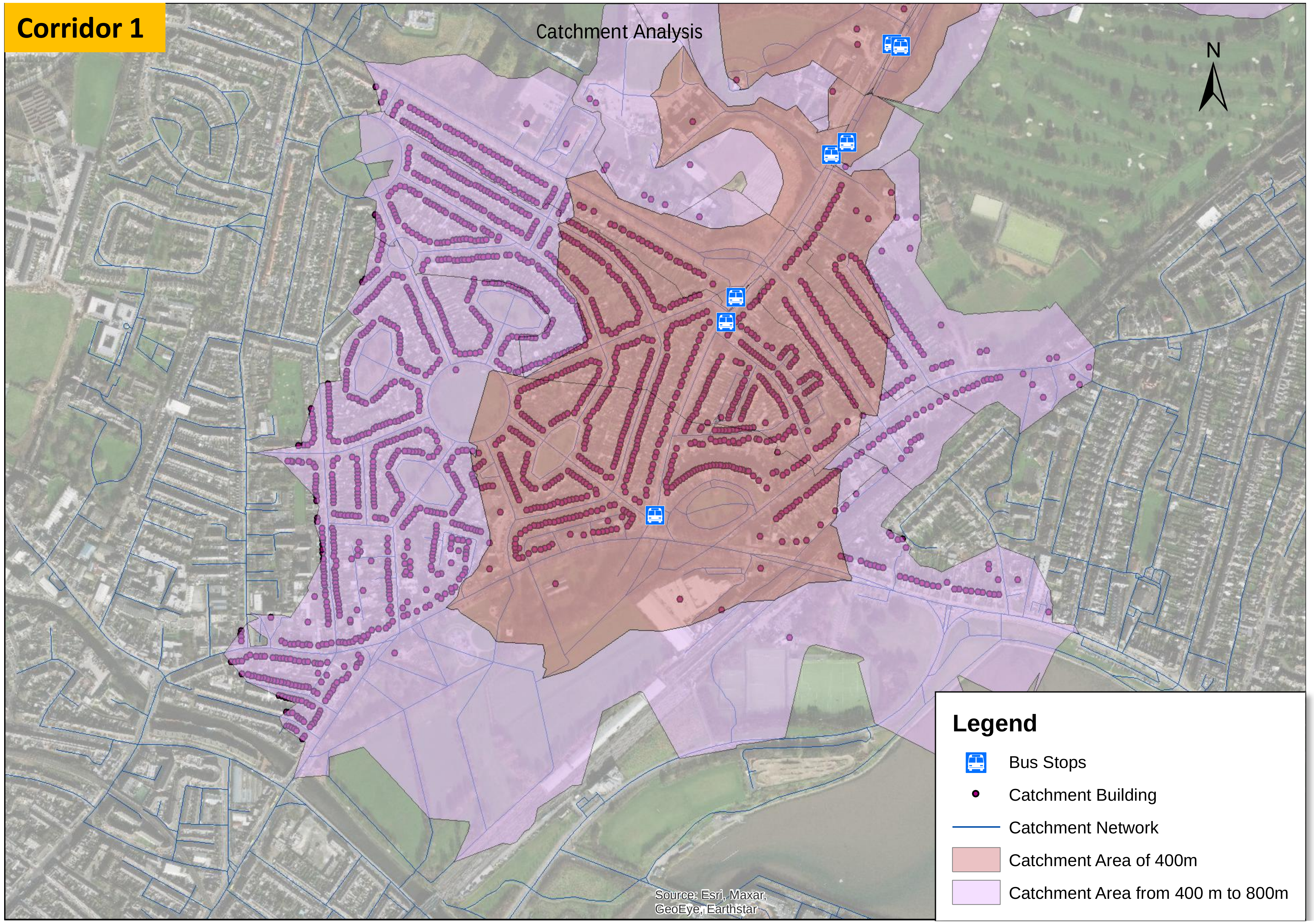
No.	Direction	Bus Stop		Existing Stop (Yes / No)	Proposal (Retained / Removed / New)	Boarding	Alighting	Boarding	Alighting	Demand (AM peak) 2028		Bus Lay-by or Onstreet	
		Name	No.			AM (08:00 - 09:00)	AM (08:00 - 09:00)	PM (17:00 - 18:00)	PM (17:00 - 18:00)	Services	Passengers	Existing	Proposed
1	Outbound	Malahide Road	669	Yes	Removed							onstreet	
2		North of Brian Rd Junction	New	No	New	New	New	New	New	27	833	N/A	onstreet
3		Mount Temple School	670	Yes	Removed							onstreet	
4		North of Mount Temple School	New	No	New	New	New	New	New	27	833	N/A	onstreet
5		Nazareth House	671	Yes	Removed							onstreet	
6		South of Casino Park Junction	New	No	New	New	New	New	New	27	698	N/A	onstreet
7		Donnycarney Road	672	Yes	Removed							onstreet	
8		Donnycarney Church	4382	Yes	Retained	15	8	11	26	27	609	layby	onstreet
9		Elm Mount Road	1196	Yes	Retained	4	7	4	16	27	609	onstreet	onstreet
10		Killester Avenue	1197	Yes	Removed							onstreet	
11		North of Kilmore Rd Junction	New	No	New	New	New	New	New	27	564	N/A	onstreet
12		Mornington Grove, Artane	1198	Yes	Retained	21	12	18	38	20	564	layby	onstreet
13		Malahide Road / Mask Avenue	1275	Yes	Retained	New	New	New	New	20	346	N/A	onstreet
14		Chanel College	1200	Yes	Retained	4	3	6	10	20	346	layby	onstreet
15		St Brendans Church											
16		St'Brendan's Church - Coolock	New	Yes	Retained/Relocated	New	New	New	New	20	153	onstreet	onstreet
17		Newtown Cottages	1202	Yes	Retained/Relocated closer to the junction	7	2	4	15	20	153	onstreet	onstreet
18		Entrance at the Retail Park	New	No	New	New	New	New	New	20	130	N/A	onstreet
19		Newtown Road	1203	Yes	Removed							layby	
20		North of Blunder Drive Junction	New	No	New	New	New	New	New	21	85	N/A	onstreet
21		Belcamp Lane	6115	Yes	proposed to be removed	6	3	4	10	15	85	onstreet	onstreet
22		Clare Hall	1205	Yes	Retained/Relocated closer to the junction	TBC	TBC	TBC	TBC	15	85	onstreet	onstreet
23		The Hole in the Wall	New	No	New	New	New	New	New	15	20	N/A	onstreet
24		Park Avenue	6316	Yes	Retained/Relocated east of Dermont St	0	0	0	0	13	56	onstreet	onstreet
25		Grange Lodge Avenue	7236	Yes	Removed							layby	
26		Clongriffin Stop	7245										
27		Clongriffin Station	6317	Yes	Retained	N/A	N/A	N/A	N/A	13	56	layby	onstreet

No.	Direction	Bus Stop	Proposed Bus Stop Capacity	Spacing of Bus Stops (meters)	Distance from Controlled Pedestrian Crossing	Permeability Issue (Yes / No)	(I) Interchange Stop (i.e. stops both serving orbital and radial routes)	(II) If Yes, which Services	Cycle Parking Proposed	Bus Shelter Proposed	Notes (e.g. permeability issues, land constraints)
		Name	No. of Bays		(meters)				(Yes / No)	(With or Without Panel)	
1		Malahide Road							tbc	tbc	
2		North of Brian Rd Junction	1	Start of the Scheme	0	No	Yes	N2 (Orbital)	tbc	tbc	
3		Mount Temple School							tbc	tbc	
4		North of Mount Temple School	1	285	13	No	No	N/A	tbc	tbc	
5		Nazareth House							tbc	tbc	
6		South of Casino Park Junction	1	190	26	No	No	N/A	tbc	tbc	
7		Donnycarney Road							tbc	tbc	
8		Donnycarney Church	1	405	41	No	Yes	N4 (Orbital)	tbc	tbc	
9		Elm Mount Road	1	405	45	No	No	N/A	tbc	tbc	
10		Killester Avenue							tbc	tbc	
11		North of Kilmore Rd Junction	1	435	50	No	No	N/A	tbc	tbc	
12	Outbound	Mornington Grove, Artane	1	305	69	No	Yes	D4 & D5(Branch Route)	tbc	tbc	
13		Malahide Road / Mask Avenue	1	375	10.5	No	No	N/A	tbc	tbc	
14		Chanel College	1	235	8	No	No	N/A	tbc	tbc	
15		St Brendans Church									
16		St'Brendan's Church - Coolock	1	250	69	No	Yes	N8 (Orbital)	tbc	tbc	
17		Newtown Cottages	1	415	12	No	Yes	D2 (Branch Route)	tbc	tbc	
18		Entrance at the Retail Park	1	415	24	No	No	N/A	tbc	tbc	
19		Newtown Road							tbc	tbc	
20		North of Blunder Drive Junction	1	430	14	No	Yes	D2 & D5(Branch Route)	tbc	tbc	
21		Belcamp Lane	1	270	14	No	Yes	N/A	tbc	tbc	
22		Clare Hall	1	310	80	No	Yes	D2 (Branch Route)	tbc	tbc	
23		The Hole in the Wall	1	Tie in to DCC Scheme	18	No	No	N/A	tbc	tbc	
24		Park Avenue	1	340	320 (pedestrian crossing required)	No	No	N/A	tbc	tbc	
25		Grange Lodge Avenue						N/A	tbc	tbc	
26		Clongriffin Stop									
27		Clongriffin Station	1	330	23	No	No	N/A	tbc	tbc	

No.	Direction	Bus Stop Name	Design Rationale
1	Outbound	Malahide Road	Stop proposed to be removed given the proximity of stops along Marino Mart and also the Brian Road stop (along Malahide Road)
2		North of Brian Rd Junction	1) New stop proposed to serve the surrounding catchment 2) Stop will be 'tailed' with the inbound stop
3		Mount Temple School	1) Existing stop to be removed. New stop is proposed immediately north of Brian junction, which will serve the secondary school and also cater for the surrounding residential catchement.
4		North of Mount Temple School	New outbound stop proposed located immediately adjacent to Mount Temple School. Stop is proposed near a controlled pedestrian crossing, across Malahide Road.
5		Nazareth House	Existing stop proposed to be removed due to the proximity to the new 'Mount Temple School' stop, also the proximity to the new Casino Park stop. The removal of this stop will assist to facilitate rationalisation to enhance bus journey times at this location
6		South of Casino Park Junction	1) New stop proposed at Casino Park to cater for the surrounding residential catchment. Stop is located adjacent to a controlled pedestrian crossing at the Casino Park Junction.
7		Donnycarney Road	1) Existing stop proposed to be removed, due to the proximity of the (new) Casino Park stop and also the existing Donnycarney Church stop.
8		Donnycarney Church	1) Existing stop proposed to be retained, due to the surrounding residential catchment.
9		Elm Mount Road	1) Existing stop proposed to be retained, due to the surrounding residential catchment.
10		Killester Avenue	1) Existing stop to be removed, due to the distance to a controlled pedestrian crossing. A new stop is proposed at Kilmore junction to cater for the surrounding residential catchment
11		North of Kilmore Rd Junction	1) New stop proposed at Kilmore Road junction to serve the surrounding residential catchment. Stop is proposed adjacent to a controlled pedestrian crossing at the Kilmore Road junction. New stop will be paired with an inbound stop
12		Mornington Grove, Artane	1) Existing stop proposed to be retained to serve the surrounding catchment. Stop is paired with the inbound stop
13		Malahide Road / Mask Avenue	1) Existing stop proposed to be retained to serve the surrounding catchment. Stop is paired with the inbound stop
14		Chanel College	1) Existing stop serving the college and the surrounding catchment is proposed to be retained.
15		St Brendans Church	1) Existing stop proposed to be removed due to rationalisation of stops. The existing stop is located within 200 of the previous and next stop at Chanel College and the new stop at Tonlegee junction.
16		St'Brendan's Church - Coolock	1) New stop is proposed at the Tonlegee Road junction to serve the surrounding catchment. Stop is proposed to be located adjacent to controlled crossing.
17		Newtown Cottages	1) Existing stop to be relocated south, to be adjacent to Greencastle Road, to serve the surrounding catchment, and to be located near to controlled pedestrian crossings.
18		Entrance at the Retail Park	New stop proposed to serve the retail park and the surrounding residential catchment. Proposal to introduce controlled pedestrian crossing, to ensure the outbound stop is linked with the proposed inbound stop.
19		Newtown Road	1) Ecisting stop proposed to be removed. A new stop is proposed north of the Blunden Road junction. The rationalisation of this stop will assist to improve journey times along the corridor at this location.
20		North of Blunder Drive Junction	New stop proposed to cater for the surrounding catchment Stop is proposed to be located near new controlled crossings across Malahide Road and Priorswood Road.
21		Belcamp Lane	Existing stop is proposed to be removed. Stop is located between nearby Blunden Drive stop and (New) Clarehall SC stop. The rationalisation of this bus stop will assist to improve bus journey times at this location.
22		Clare Hall	Existing stop proposed to be retained but relocated closer (~30m) to Malahide / Clarehall Avenue Junction, where controlled crossing facilities are located.
23		The Hole in the Wall	New stop is proposed to be located to the east of The Hole in the Wall junction, to serve the surrounding existing and projected catchment.
24		Park Avenue	Existing stop proposed to be retained. New raised pedestrian crossing proposed across Main Street to facilitate pedestrian crossing between the outbound and inbound stops.
25		Grange Lodge Avenue	The existing stop is proposed to be removed due to the proximity of the Park Avenue and Clongriffin Stops. The rationalisation of this stop will assist to improve bus journey times along the corridor.
26		Clongriffin Stop	Existing stop proposed to be removed due to the proximity of Clongriffin Station stop (approx 60m). The rationalisation of stops at this location will assist to improve bus journey times.
27		Clongriffin Station	Existing stop at the end of the corridor proposed to be retained.



Corridor 1
Catchment Analysis
N
Legend
Bus Stops
Catchment Building
Catchment Network
Catchment Area of 400m
Catchment Area from 400 m to 800m
Source: Esri, Maxar, GeoEye, Earthstar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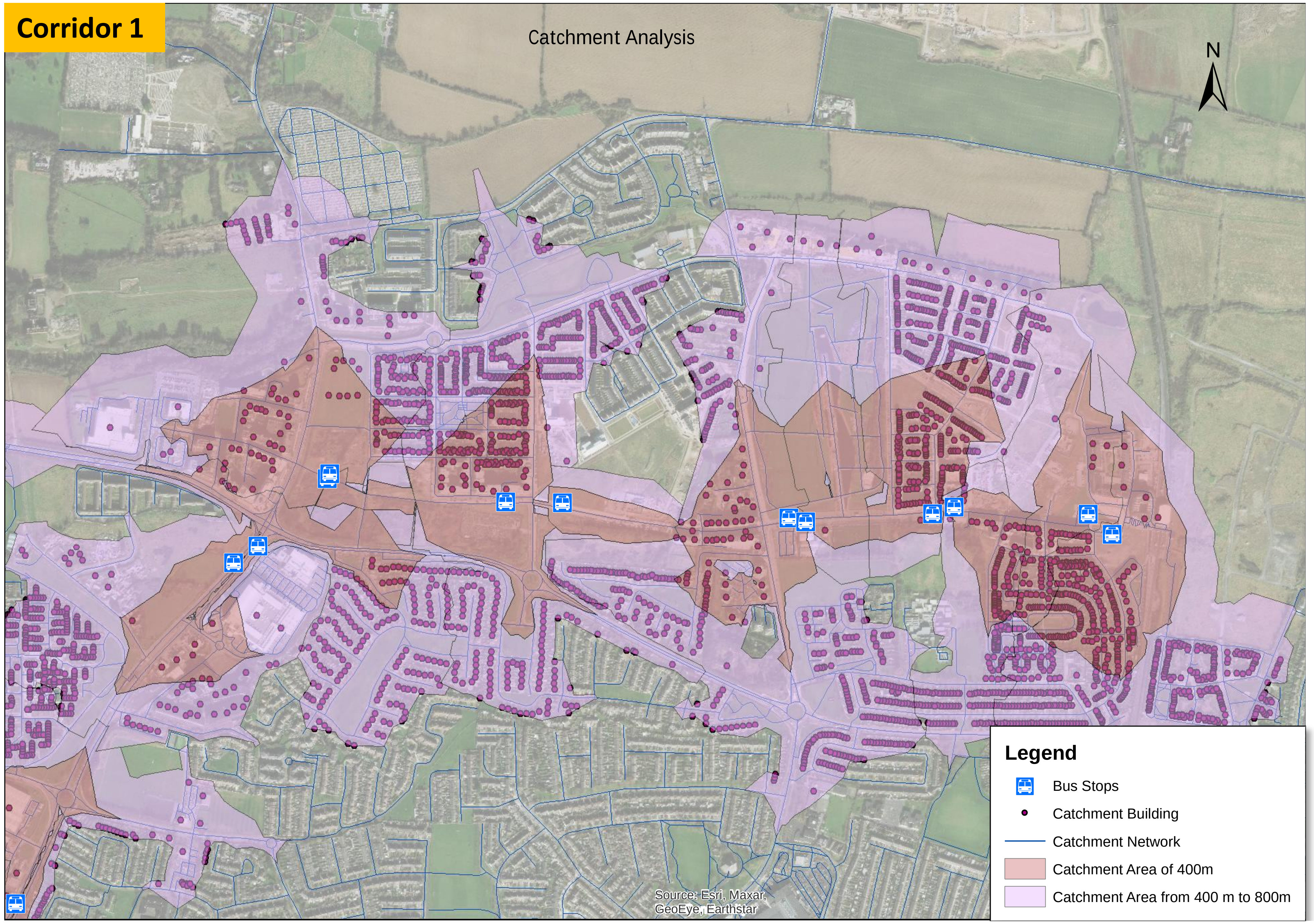

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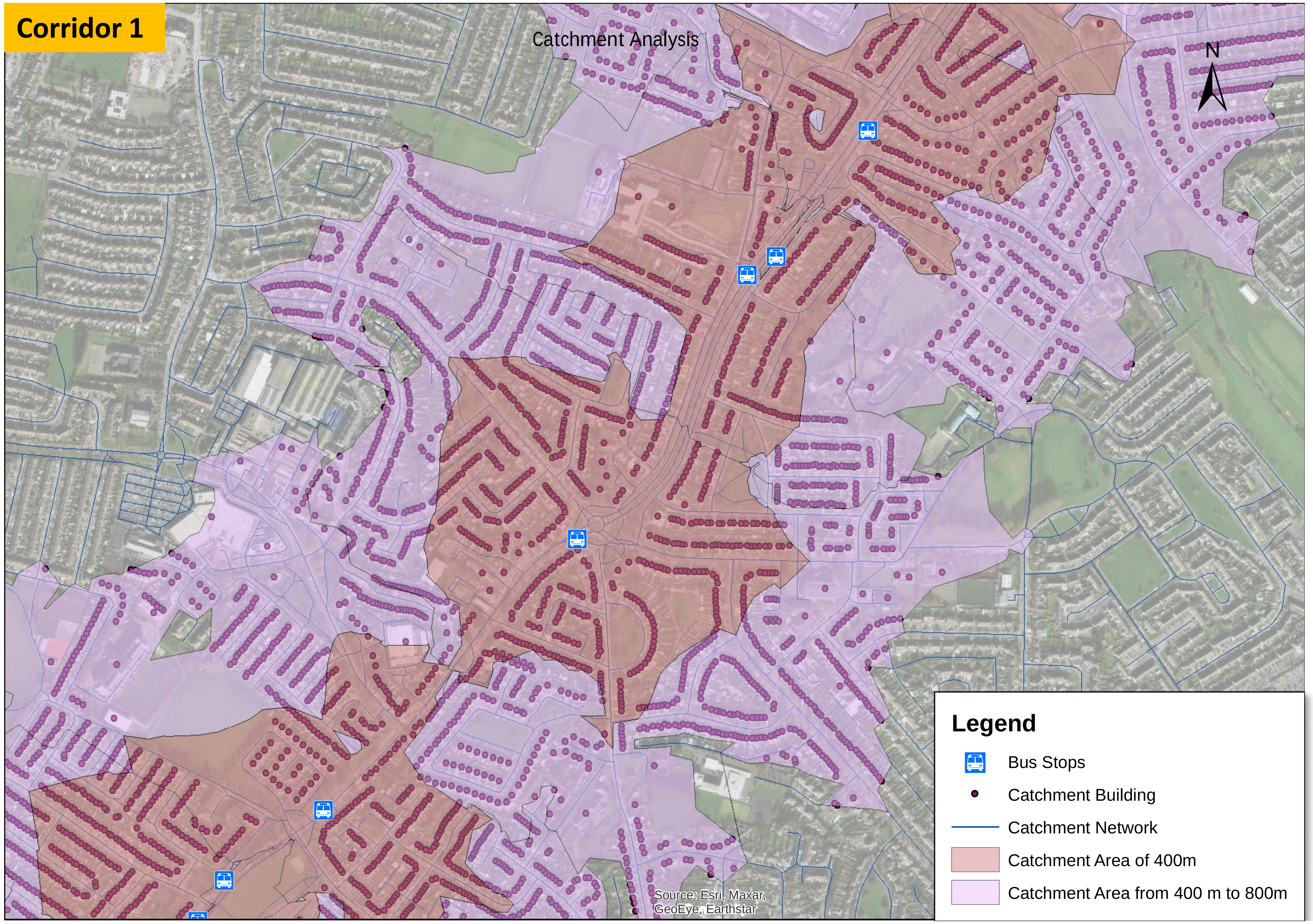
Corridor 1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NTA
Údarás Náisiúnta Iompair
National Transport Authority

National Transport Authority
Dún Scéine
Harcourt Lane
Dublin 2
D02 WT20

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