Glasgow City Centre Transport Plan

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DETAILED OPTIONS APPRAISAL

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Glasgow CITY COUNCIL

SYSTRA

GLASGOW CITY CENTRE TRANSPORT PLAN

DETAILED OPTIONS APPRAISAL

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1. EXECUTIVE SUMMARY

1.1 Aims of the Project

1.1.1 SYSTRA Limited, in conjunction with Ironside Farrar, Urban Movement and Logistics UK have been commissioned by Glasgow City Council (GCC) to help prepare the Glasgow City Centre Transport Plan (CCTP). The Plan will sit under the new, 10 year Glasgow Transport Strategy.

1.1.2 The CCTP will help:

- Re-allocate city centre road space for active travel and green infrastructure;
- Deliver improved public transport and support/encourage a shift to more sustainable modes, particularly walking, cycling and public transport;
- Improve access for the mobility impaired;
- Achieve a 30-40% reduction in peak-hour private car traffic by 2030;
- Deliver improvements for servicing (e.g. goods deliveries and waste collection) to improve the vitality of the city centre;
- Support a doubling of the city centre population to 40,000 by 2035; and
- Support City's aim to be carbon neutral by 2030.

1.2 Summary of the Appraisal

1.2.1 The study is being undertaken in accordance with the Scottish Transport Appraisal Guidance (STAG). The process provides a framework to assess the performance of different transport options to address the identified problems and opportunities, and presents the results in a consistent manner to decision makers. The STAG process comprises four stages as follows and this stage is the **Detailed Options Appraisal**. This report details the performance of the packaged options against the TPOs and the emerging updated STAG approach. The options will be considered against the following criteria:

- Environment;
- Climate Change;
- Health, Safety and Wellbeing;;
- Economy; and
- Equality and Accessibility

1.2.2 As part of the Case for Change a long list of interventions was developed and sifted. The interventions were grouped into ten broad themes and assessed qualitatively against the Transport Planning Objectives and STAG criteria:

- Theme 1a: Repurposing road space (public transport);
- Theme 1b: Repurposing road space (active travel/place);
- Theme 2: Sustainable transport connectivity;
- Theme 3: Accessible, inclusive, safe and quality public spaces;
- Theme 4: Improved pedestrian and cycle facilities and infrastructure;
- Theme 5: Increased physical activity and health;
- Theme 6: Sustainable, affordable and integrated transport system;
- Theme 7: Minimised adverse environmental impacts of traffic;
- Theme 8: Network of carbon neutral infrastructure; and
- Theme 9: Demand Management

1.2.3 The interventions were then allocated to four packages of options. This process was informed by a high level assessment of 'deliverability' of each intervention and its alignment with the four packages.

1.2.4 The four appraised packages were as follows:

Package 1 – Do Minimum – Low Investment Measures. Focus on Public Transport interventions and completion of existing programmes and projects;

Package 2 – Incentive Base Measures. Focus on measures that extend, incentivise and promote travel behaviour change

Package 3 - Incentive and Demand Management measures. A balance of demand management measures that extend, incentivise and promote altered travel behaviour

Package 4 - Focus on demand management measures that would reduce vehicular access and thus promote altered travel behaviour.

1.2.5 The packages were tested within the Strathclyde Regional Transport Model to understand the impacts associated with each package and this informed the appraisal against the TPOs and STAG criteria.

1.3 Conclusions/Recommendations

1.3.1 Each of the packages are considered to contribute to the study TPOs to varying degrees with reduction in private car trips coming into the city centre of between 13-25% and corresponding increases in walking and cycling of 10-43% and 5-31% respectively. CO_2 emission reductions were also identified alongside benefits associated with climate change vulnerability, improved equality and accessibility and health benefits.

1.3.2 Throughout the appraisal process and across all criteria Package 3, which contains a mixture of incentive and demand management measures, performs the strongest with a 23% reduction in vehicle person trips, 43%

increase in walking and 31% increase in cycling. The proposed public realm improvements and improved connectivity to surrounding communities would also contribute to achieving the TPOs and delivering improved equality, accessibility and health benefits.

1.3.3 Following the identification of Package 3 as the best performing package the interventions and themes were refined to develop the CCTP which would be presented to the public for consultation. The CCTP was produced based on outcomes of the appraisal of Package 3 and presented in an accessible, concise plan which explains the process, the aims and the actions. To achieve this, some of the aspects of the STAG report have been refined and summarised, including the themes presented in this report. The ten themes used in the STAG process have been refined to the following in the CCTP, with interventions allocated to each of the themes:

- Accessible Glasgow
- Walk Glasgow
- Cycle Glasgow
- Public Transport Glasgow
- Streets for Glasgow Servicing for Glasgow
- Greener Glasgow

1.3.4 In addition to the refined themes, catalyst areas were also identified in the CCTP. Delivery and getting interventions on the ground was identified in the consultation as a key issue. Catalyst areas reflect this desire for change and outline key activity and projects which have the potential to be 'catalysts of change' and be significant enablers in creating new place-based opportunity to accelerate change and the delivery of the transport strategy objectives.

1.3.5 The proposals are at varying stages of development and reflect emerging ideas and thinking which have been included in Package 3 and include:

- City Centre People First Zone — People friendly low vehicular access zone
- Broomielaw & Clyde Waterfront — Re-connecting the city with its waterfront
- George Square — Putting 'Great Spaces' in the heart of the city
- Cowcaddens Gateway — Re-connecting the centre with neighbourhoods
- High Street Corridor — Promoting liveable places
- M8 Garden Cap & Charing Cross — Mitigating the impact of an urban motorway

- People Friendly Streets — Reduced traffic within Local Neighbourhoods

2. INTRODUCTION

2.1 Background

2.1.1 SYSTRA Limited, in conjunction with Ironside Farrar, Urban Movement and Logistics UK have been commissioned by Glasgow City Council (GCC) to help prepare the Glasgow City Centre Transport Plan (CCTP). The Plan will sit under the current 10-year Glasgow Transport Strategy which was developed in 2022.

2.1.2 The CCTP will help:

- Re-allocate city centre road space for active travel and green infrastructure;
- Deliver improved public transport and support/encourage a shift to more sustainable modes, particularly walking, cycling and public transport;
- Improve access for the mobility impaired;
- Achieve a 30-40% reduction in peak-hour private car traffic by 2030;
- Deliver improvements for servicing (e.g. goods deliveries and waste collection) to improve the vitality of the city centre;
- Support a doubling of the city centre population to 40,000 by 2035; and
- Support City's aim to be carbon neutral by 2030.

2.2 Purpose of this report

2.2.1 The purpose of this report is to present the findings of the Detailed Appraisal. This is the third stage of the CCTP transport appraisal, and provides a detailed appraisal of the transport options recommended from the preceding Preliminary Options Appraisal stage.

2.3 Scottish Transport Appraisal Guidance (STAG)

2.3.1 The study is being undertaken in accordance with the Scottish Transport Appraisal Guidance (STAG). The process provides a framework to assess the performance of different transport options to address the identified problems and opportunities, and presents the results in a consistent manner to decision makers. The STAG process comprises four stages as follows:

- **Pre-Appraisal (Initial Appraisal: Case for Change):** where the problems, opportunities, issues and constraints are identified and scoped, if possible. Study-specific Transport Planning Objectives (TPOs) are then identified and a list of possible options to address the problems and opportunities generated;

- **Initial Appraisal (Preliminary Options Appraisal):** where the potential options are appraised against the TPOs, five STAG criteria, Established Policy Directives and factors concerning feasibility, affordability and public acceptability, to ensure they are likely to fulfil the study's requirements;
- **Detailed Appraisal (Detailed Options Appraisal):** which involves more detailed consideration of potential options taken forward following the Initial Appraisal (Preliminary Options Appraisal), and where the outcomes to inform investment decision makers are presented. The Detailed Options Appraisal also includes proposals for monitoring and evaluation; and
- **Post-Appraisal:** which involves the application of the monitoring and evaluation proposals developed as part of the appraisal.

2.3.2 This stage is the **Detailed Options Appraisal**. This report details the performance of the packaged options against the TPOs and the emerging updated STAG approach. The options will be considered against the following criteria:

- Environment;
- Climate Change;
- Health, Safety and Wellbeing;;
- Economy; and
- Equality and Accessibility

2.3.3 In addition the deliverability, cost to government and risks associated with the options will be considered.

2.4 Pre-Appraisal (Initial Appraisal: Case for Change)

2.4.1 The Pre-Appraisal (Initial Appraisal: Case for Change) stage was completed and approved in September 2021. It collated relevant socio-demographic and transport information for the study area and identified the key problems, opportunities, issues and constraints for Glasgow city centre. A set of four Transport Planning Objectives (TPOs) were then developed, and a long list of potential interventions that could help address the identified problems and opportunities generated. The interventions were identified from a comprehensive review of existing commitments and plans within the city centre and a wide-ranging consultation with stakeholder groups. The interventions were then grouped into broad themes for further consideration in the Preliminary Options Appraisal.

2.4.2 A summary of the identified problems, opportunities, issues and constraints, key policies and the set out TPOs are presented in Figure 1.

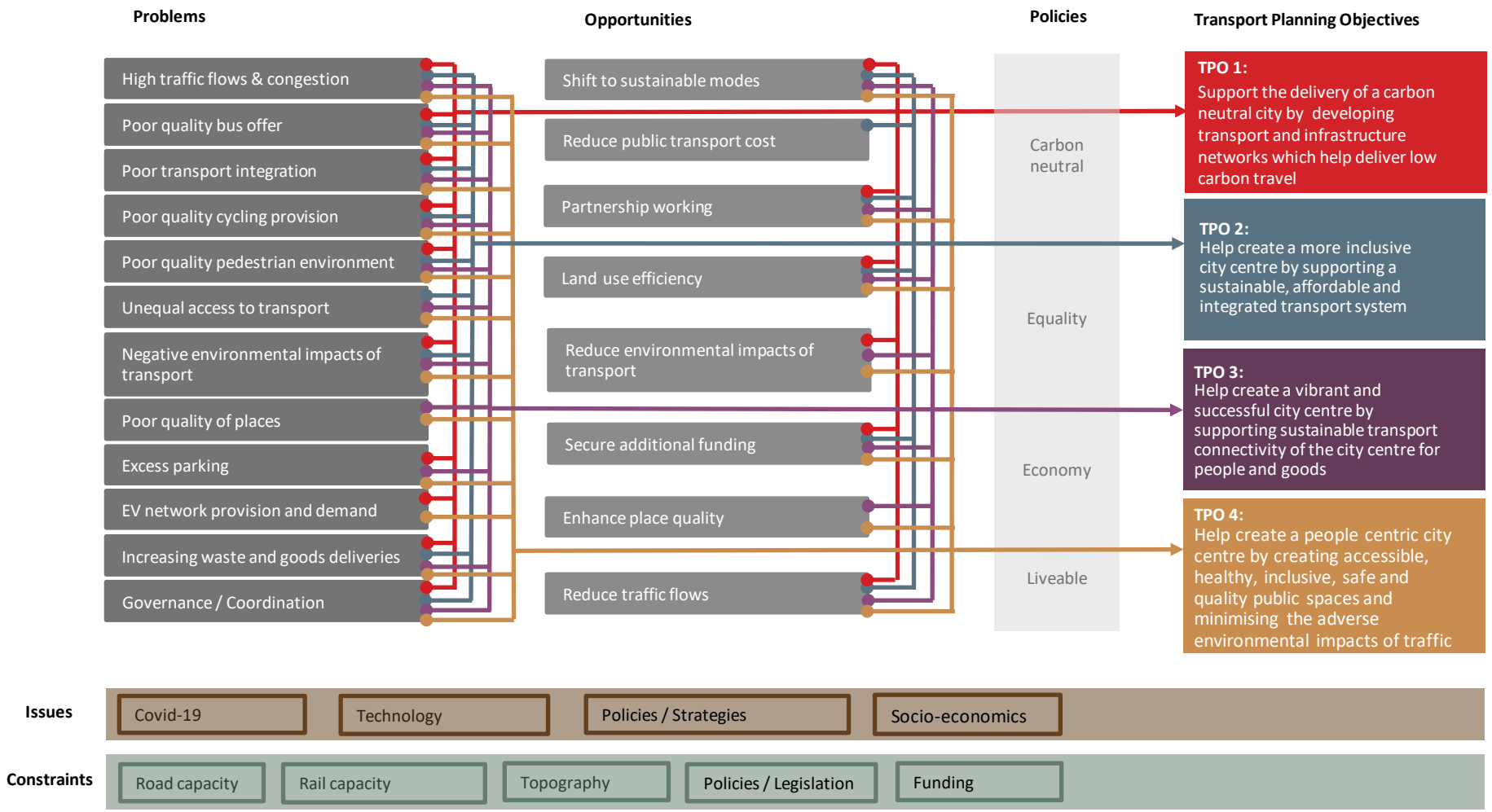


Figure 1. Mapping of Problems, Opportunities, Issues and Constraints, Policies and Transport Planning Objectives

2.5 Preliminary Options Appraisal

Sifting and packaging of interventions

2.5.1 The long list of interventions, identified during the Case for Change stage, was further developed and sifted, as ongoing stakeholder feedback was provided. The interventions were grouped into ten broad themes, as follows:

- Theme 1a: Repurposing road space (public transport);
- Theme 1b: Repurposing road space (active travel/place);
- Theme 2: Sustainable transport connectivity;
- Theme 3: Accessible, inclusive, safe and quality public spaces;
- Theme 4: Improved pedestrian and cycle facilities and infrastructure;
- Theme 5: Increased physical activity and health;
- Theme 6: Sustainable, affordable and integrated transport system;
- Theme 7: Minimised adverse environmental impacts of traffic;
- Theme 8: Network of carbon neutral infrastructure; and
- Theme 9: Demand Management

2.5.2 The individual interventions within each theme were then appraised qualitatively against the Transport Planning Objectives and STAG criteria of Environment, Security, Economy, Accessibility and Social Inclusion and Integration (this stage was undertaken prior to the STAG refresh of criteria). The deliverability, which includes feasibility, public acceptability and affordability was also considered for each option. Based on this appraisal, each intervention was aligned to a package to develop the four packages appraised in the Preliminary Options Appraisal, and, subsequently, the Detailed Appraisal. Note: interventions could be included in more than one package.

2.5.3 The individual interventions within each theme were then allocated to four packages of options. This process was informed by a high level assessment of ‘deliverability’ of each intervention and its alignment with the four packages.

2.5.4 The resulting four alternative packages of measures are summarised below.

2.5.5 These packages have been refined further since the Preliminary Options Appraisal. For example, reducing through traffic has been included within the People First Zone (PFZ) as that is one of the aims of the PFZ and extending the Air Quality Management Zone (AQMZ) has been removed based on consultation with the Sustainable Glasgow team.

2.5.6 To simplify the presentation of the interventions, those which apply to more than one theme are now only listed once.

2.5.7 The STAG process has been followed to provide an objective, evidenced-based study to understand the problems which need to be addressed and appropriate interventions. This report provides the evidence base for the plan. The emerging CCTP has been produced based on outcomes of this report, to present an accessible, concise plan which explains the process, the aims and the actions. To achieve this, some of the aspects of the STAG report have been refined and summarised, including the themes presented in this report.

2.5.8 The ten themes outlined above have been refined to the following in the CCTP:

- Accessible Glasgow
- Walk Glasgow
- Cycle Glasgow
- Public Transport Glasgow
- Streets for Glasgow Servicing for Glasgow
- Greener Glasgow

2.5.9 Section 12 of this report provides further details of how this Detailed Appraisal has informed the final version of the CCTP.

2.6 Package One

2.6.1 Package One was designed to include measures focusing on public transport interventions and the completion of existing programmes and projects. The interventions included are detailed in the table below.

Table 1. Package 1 Description

REF	PACKAGE 1 - SCHEME	THEME 1A	THEME 1B	THEME 2	THEME 3	THEME 4	THEME 5	THEME 6	THEME 7	THEME 8	THEME 9
101	Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (incl Ballater Street, Norfolk Street Jamaica Street, Bridge Street, High Street etc)	✓									
102	High vehicle occupancy lanes including information in the city centre	✓									
103	Effective waste and recycling management to improve the urban realm and create more effective bus lanes and active travel space	✓	✓	✓	✓						
106	Parking distribution, restrictions and increased enforcement - to	✓			✓						✓

	manage demand, provide more bus lanes and more quality public spaces										
156	Improved traffic signal control systems- to prioritise active travel		✓								
157	Traffic-calming (including High Street and the Broomielaw), speed management and enforcement		✓								
205	Connecting train stations for better pedestrian provision			✓				✓			
215	Implement the Lanes Strategy and integrate with Avenues/Avenues Plus			✓							
313	Require all developments to comply with Secure by Design with Animated/Activated Frontages				✓						
318	Develop City Centre Public Realm Strategy				✓						
319	Street cleansing improvements – identify, assess and prioritise street cleansing				✓						

320	Licensing of pavement areas / street trading				✓						
324	Improved connections through St. Enoch Shopping Centre and Buchanan Galleries				✓						
326	Apply the safe systems approach, including education, training and publicity to prevent casualties				✓						
327	Create safe junctions and crossing places (e.g. including around Cowcaddens Subway Station, Cowcaddens Road and Port Dundas junction)				✓	✓					
328	Safe and car free school zones				✓						
403	Active travel hubs					✓					
404	Improve existing bike hire offer, with more affordable access to cycling and bike hire including electric bikes					✓					
405	More cycling parking and storage					✓					

503	Promote public awareness of health benefits of outdoor lifestyles, activity and active travel						✓				
607	Shared mobility including public taxi, private hire and ride-hailing (including taxi ranks locations)							✓			
608	Coach parking - consider enforcement/charging and location/safety/integration							✓			✓
610	Bus Stop rationalisation							✓			
701	Low emission vehicle lanes, including information in the city centre								✓		
330	Play streets and more green space								✓		
705	Route traffic to minimise impacts								✓		
706	Undertake resurfacing using Low Noise Pavements								✓		
707	Surface water management strategy								✓		

708	Regulate waste collection to minimise the AQ & GHG emissions and noise from waste collection								✓		
709	Regulate freight deliveries to minimise the AQ & GHG emissions and noise from goods deliveries (including. e-cargo bikes, low carbon freight, freight hubs/consolidation centres at strategic locations etc)								✓		
710	People First Zone								✓		
802	Low Carbon Council fleet									✓	
803	Electric Bike charging									✓	
804	Carbon Audit / Capital Carbon Assessment (Operations/Development)									✓	
805	Require all Taxi and Public Transport Vehicles to be LEZ compliant and transition towards zero emission fleets									✓	

908	Waste vehicles restrictions to manage demand (e.g. xx am-xx pm)										✓

2.7 Package Two

2.7.1 Package Two includes measures that focus on extending, promoting and incentivising travel behaviour change. The measures included in this package are presented in the table below.

Table 2. Package 1 Description

REF	PACKAGE 2 - SCHEME	THEME 1A	THEME 1B	THEME 2	THEME 3	THEME 4	THEME 5	THEME 6	THEME 7	THEME 8	THEME 9
101	Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (incl Ballater Street, Norfolk Street Jamaica Street, Bridge Street, High Street etc)	✓	✓		✓						
103	Effective waste and recycling management to improve the urban realm and create more effective bus lanes and active travel space	✓	✓	✓	✓						
104	Smart 'tartan' grid of streets for car-only or car-free traffic management		✓		✓						

106	Parking distribution, restrictions and increased enforcement - to manage demand, provide more bus lanes and more quality public spaces		✓		✓						
156	Improved traffic signal control systems- to prioritise active travel		✓								
157	Traffic-calming (including High Street and the Broomielaw), speed management and enforcement		✓								
158	Accelerate the Avenues Programme		✓	✓							
204	Long continuous and connected walking and cycling routes (including new routes through St Enoch, Buchanan Galleries etc)			✓							
205	Connecting train stations for better pedestrian provision			✓				✓			

206	Dynamic Buchanan Bus Station - better /new connections & integration with city centre, Queen Street rail station and Buchanan Galleries. Improved/new bus station layout and improved place/modes integration in front of bus station.			✓				✓			
207	Masterplans – e.g. Broomielaw, River Park (including possible Custom House Quay extension) and Tradeston			✓	✓						
208	Complete a network of safe, high quality, segregated cycling arterial routes connecting the city centre to suburbs and peripheral neighbourhoods			✓							
210	Reconnecting and activating the railway undercroft			✓	✓						
212	Expansion of Avenues Plus Project		✓	✓							

215	Implement the Lanes Strategy and integrate with Avenues/Avenues Plus			✓							
304	Modify/remove slip roads to/from the motorway and reconnect historic streets/links that have been severed				✓						
305	Reduce and simplify the current junction arrangement around Junction 15		✓		✓						
309	Create street play / active sport & piloting play streets for child-friendly city				✓						
312	Develop SMART-City and enhanced CCTV and active security				✓						
313	Require all developments to comply with Secure by Design with Animated/Activated Frontages				✓						
314	St. Enoch Highline (focus on quality places)				✓						

315	Streets and public space improvements (including lighting, seating, signage, greening & associated user infrastructure) – e.g St Vincent Street, West George Street, Blythswood Square, Glorious Argyle Street, Sauchiehall Street, Buchanan Street, George Square, High Street, Improved Glasgow Cross / Trongate, Lively and safe Ballater Street, St. Enoch event Square, enhanced public realm and spaces in Calton/Barras, Cowcaddens Road and Port Dundas junction				✓						
316	New Anderston Cross - refurbishment of the M8 (Junction 19) and night-time strategy				✓						
318	Develop City Centre Public Realm Strategy				✓						
319	Street cleansing improvements – identify,				✓						

	assess and prioritise street cleansing										
320	Licensing of pavement areas / street trading				✓						
321	Public art, Street festival/light festival, Design for rain				✓						
322	Planned quay wall extension and new public realm walkway at Windmillcroft Quay (south of river between Tradeston and Kingston Bridge)				✓						
323	Active, attractive promenades & riverfront				✓						
324	Improved connections through St. Enoch Shopping Centre and Buchanan Galleries				✓						
325	Updated access to the St. Enoch Car Park including re-development of King Street parking				✓						

326	Apply the safe systems approach, including education, training and publicity to prevent casualties				✓						
327	Create safe junctions and crossing places (e.g. including around Cowcaddens Subway Station, Cowcaddens Road and Port Dundas junction)				✓	✓					
328	Safe and car free school zones				✓						
329	Safe and attractive underpasses and vennels				✓						
330	Play streets and more green space				✓		✓		✓		
402	Introduce segregated cycle lanes where possible (including around Cowcaddens Road, Port Dundas Junction)					✓					
403	Active travel hubs					✓					

404	Improve existing bike hire offer, with more affordable access to cycling and bike hire including electric bikes					✓					
405	More cycling parking and storage					✓					
501	Create quiet, low use streets, activity zones and street gyms						✓				
503	Promote public awareness of health benefits of outdoor lifestyles, activity and active travel						✓				
504	Access points to River Clyde – Active Leisure						✓				
604	Mobility hubs (including places to hire mobility scooters and other shared use provision)							✓			
605	Improve existing car club offer							✓			
606	Scottish Accessible Travel Framework - Support disabled people's rights by							✓			

	removing barriers and improving access to travel; and ensuring they are fully involved in work to improve all aspects of travel										
607	Shared mobility including public taxi, private hire and ride-hailing (including taxi ranks locations)							✓			
608	Coach parking - consider enforcement/charging and location/safety/integration							✓			✓
609	Bus Partnership Fund improvements							✓			
610	Bus Stop rationalisation							✓			
611	Travel information and apps							✓			
701	Low emission vehicle lanes, including information in the city centre								✓		
705	Route traffic to minimise impacts								✓		

706	Undertake resurfacing using Low Noise Pavements								✓		
707	Surface water management strategy								✓		
708	Regulate waste collection to minimise the AQ & GHG emissions and noise from waste collection								✓		
709	Regulate freight deliveries to minimise the AQ & GHG emissions and noise from goods deliveries (including. e-cargo bikes, low carbon freight, freight hubs/consolidation centres at strategic locations etc)								✓		
710	People First Zone								✓		✓
801	Enhanced private/residential electric vehicle charging points/hubs									✓	
802	Low Carbon Council fleet									✓	
803	Electric Bike charging									✓	

804	Carbon Audit / Capital Carbon Assessment (Operations/Development)									✓	
805	Require all Taxi and Public Transport Vehicles to be LEZ compliant and transition towards zero emission fleets									✓	
806	EV Charging Points for Taxis									✓	
901	Variable demand parking charges										✓
902	Workplace Parking Levy										✓
903	Smarter parking										✓
905	Policies to /support reduced need to travel, low traffic neighbourhoods and low car ownership										✓
907	Freight/delivery vehicles restrictions to manage demand(e.g. xx am-xx pm)										✓

908	Waste vehicles restrictions to manage demand (e.g. xx am-xx pm)										✓
101	Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (incl Ballater Street, Norfolk Street Jamaica Street, Bridge Street, High Street etc)	✓	✓		✓						

2.8 Package Three

2.8.1 Package three includes a balance of demand management measures and measures that extend, promote and incentivise travel behaviour change. The measures included in this package are detailed in the table below.

Table 3. Package 3 Description

REF	PACKAGE 3 - SCHEME	THEME 1A	THEME 1B	THEME 2	THEME 3	THEME 4	THEME 5	THEME 6	THEME 7	THEME 8	THEME 9
101	Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (including Ballater Street, Norfolk Street Jamaica Street, Bridge Street, High Street etc)	✓	✓								
102	High vehicle occupancy lanes including information in the city centre	✓									
103	Effective waste and recycling management to improve the urban realm and create more effective bus lanes and active travel space	✓	✓	✓	✓						

106	Parking distribution, restrictions and increased enforcement - to manage demand, provide more bus lanes and more quality public spaces	✓	✓		✓						✓
156	Improved traffic signal control systems- to prioritise active travel		✓								
157	Traffic-calming (including High Street and the Broomielaw), speed management and enforcement		✓								
158	Accelerate the Avenues Programme		✓	✓	✓						
201	Connect neighbourhoods with under/over pass connections (across the M8) - includes retention and enhancement of existing bridges; adding new high-quality contemporary bridges. These would include the new crossing over M8			✓							

	connecting Sighthill with the City Centre; widening of the existing bridge crossings over the M8 at St Vincent Street and Bath Street; reconnecting William St and Bothwell St, and Kent Rd with Elmbank Crescent										
202	Connect neighbourhoods with/across the river Clyde - includes retention and enhancement of existing bridges			✓							
204	Long continuous and connected walking and cycling routes (including new routes through St Enoch, Buchanan Galleries etc)			✓							
205	Connecting train stations for better pedestrian provision			✓				✓			
206	Dynamic Buchanan Bus Station - better /new connections & integration			✓				✓			

	with city centre, Queen Street rail station and Buchanan Galleries. Improved/new bus station layout and improved place/modes integration in front of bus station.										
207	Masterplans – e.g. Broomielaw, River Park (including possible Custom House Quay extension) and Tradeston			✓	✓						
208	Complete a network of safe, high quality, segregated cycling arterial routes connecting the city centre to suburbs and peripheral neighbourhoods			✓							
209	Glasgow City Region Metro			✓							
210	Reconnecting and activating the railway undercroft			✓	✓						
212	Expansion of Avenues Plus Project		✓	✓	✓						

213	St. Enoch Highline (focus on creating/improving connectivity)			✓							
215	Implement the Lanes Strategy and integrate with Avenues/Avenues Plus			✓							
309	Create street play / active sport & piloting play streets for child-friendly city				✓						
312	Develop SMART-City and enhanced CCTV and active security				✓						
313	Require all developments to comply with Secure by Design with Animated/Activated Frontages				✓						
315	Streets and public space improvements (including lighting, seating, signage, greening & associated user infrastructure) – e.g St Vincent Street, West George Street, Blythswood Square, Glorious Argyle				✓						

	Street, Sauchiehall Street, Buchanan Street, George Square, High Street, Improved Glasgow Cross / Trongate, Lively and safe Ballater Street, St. Enoch event Square, enhanced public realm and spaces in Calton/Barras, Cowcaddens Road and Port Dundas junction										
316	New Anderston Cross - refurbishment of the M8 (Junction 19) and night-time strategy				✓						
317	Develop Feasibility for new City Square at Mitchell Library including the M8 Garden Cap				✓						
318	Develop City Centre Public Realm Strategy				✓						
319	Street cleansing improvements – identify, assess and prioritise street cleansing				✓						

320	Licensing of pavement areas / street trading				✓						
321	Public art, Street festival/light festival, Design for rain				✓						
322	Planned quay wall extension and new public realm walkway at Windmillcroft Quay (south of river between Tradeston and Kingston Bridge)				✓						
323	Active, attractive promenades & riverfront				✓						
324	Improved connections through St. Enoch Shopping Centre and Buchanan Galleries				✓						
325	Updated access to the St. Enoch Car Park including re-development of King Street parking				✓						
326	Apply the safe systems approach, including education, training and				✓						

	publicity to prevent casualties										
327	Create safe junctions and crossing places (e.g. including around Cowcaddens Subway Station, Cowcaddens Road and Port Dundas junction)				✓	✓					
328	Safe and car free school zones				✓						
329	Safe and attractive underpasses and vennels				✓						
330	Play streets and more green space				✓		✓		✓		
402	Introduce segregated cycle lanes where possible (including around Cowcaddens Road, Port Dundas Junction)					✓					
403	Active travel hubs					✓					
404	Improve existing bike hire offer, with more affordable access to cycling and bike hire including electric bikes					✓					

405	More cycling parking and storage					✓					
501	Create quiet, low use streets, activity zones and street gyms						✓				
503	Promote public awareness of health benefits of outdoor lifestyles, activity and active travel						✓				
504	Access points to River Clyde – Active Leisure						✓				
601	Updated and improved PT nodes and gateways (focus on place quality, improved approaches, environments & modes integration to improve legibility, passenger experience and increase patronage), for example rail and subway stations, including Charing Cross railway station, Glasgow Central, Anderston Station, Argyle Street railway station, High Street station; Cowcaddens							✓			

	Subway Station, Bus interchange at Cathedral St & southern bus hub; connecting Queen St station with Cathedral St										
604	Mobility hubs (including places to hire mobility scooters and other shared use provision)							✓			
605	Improve existing car club offer							✓			
606	Scottish Accessible Travel Framework - Support disabled people's rights by removing barriers and improving access to travel; and ensuring they are fully involved in work to improve all aspects of travel							✓			
607	Shared mobility including public taxi, private hire and ride-hailing (including taxi ranks locations)							✓			

608	Coach parking - consider enforcement/charging and location/safety/integration							✓			✓
609	Bus Partnership Fund improvements							✓			
610	Bus Stop rationalisation							✓			
611	Travel information and apps							✓			
701	Low emission vehicle lanes, including information in the city centre								✓		
705	Route traffic to minimise impacts								✓		
706	Undertake resurfacing using Low Noise Pavements								✓		
707	Surface water management strategy								✓		
708	Regulate waste collection to minimise the AQ & GHG emissions and noise from waste collection								✓		

709	Regulate freight deliveries to minimise the AQ & GHG emissions and noise from goods deliveries (including. e-cargo bikes, low carbon freight, freight hubs/consolidation centres at strategic locations etc)								✓		
710	People First Zone								✓		✓
801	Enhanced private/residential electric vehicle charging points/hubs									✓	
802	Low Carbon Council fleet									✓	
803	Electric Bike charging									✓	
804	Carbon Audit / Capital Carbon Assessment (Operations/Development)									✓	
805	Require all Taxi and Public Transport Vehicles to be LEZ compliant and transition towards zero emission fleets									✓	

806	EV Charging Points for Taxis									✓	
901	Variable demand parking charges										✓
902	Workplace Parking Levy										✓
903	Smarter parking										✓
905	Policies to /support reduced need to travel, low traffic neighbourhoods and low car ownership										✓
907	Freight/delivery vehicles restrictions to manage demand(e.g. xx am-xx pm)										✓
908	Waste vehicles restrictions to manage demand (e.g. xx am-xx pm)										✓

2.9 Package Four

2.9.1 Package Four include measures that focus on demand management in order to reduce vehicular access and thus promote travel behaviour change. The measures included in this package are detailed in the table below.

Table 4. Package 4 Description

REF	PACKAGE 4 - SCHEME	THEME 1A	THEME 1B	THEME 2	THEME 3	THEME 4	THEME 5	THEME 6	THEME 7	THEME 8	THEME 9
101	Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (including Ballater Street, Norfolk Street Jamaica Street, Bridge Street, High Street etc)	✓	✓								
102	High vehicle occupancy lanes including information in the city centre	✓									
104	Smart 'tartan' grid of streets for car-only or car-free traffic management	✓	✓								
105	Managed Motorways	✓									
106	Parking distribution, restrictions and increased enforcement - to manage demand, provide more bus lanes and more quality public spaces	✓	✓		✓						✓

152	Effective waste and recycling management to improve the urban realm and create more effective bus lanes and active travel space	✓	✓	✓	✓						
156	Improved traffic signal control systems- to prioritise active travel		✓								
157	Traffic-calming (including High Street and the Broomielaw), speed management and enforcement		✓								
158	Accelerate the Avenues Programme		✓	✓	✓						
201	Connect neighbourhoods with under/over pass connections (across the M8) - includes retention and enhancement of existing bridges; adding new high-quality contemporary bridges. These would include the new crossing over M8			✓							

	connecting Sighthill with the City Centre; widening of the existing bridge crossings over the M8 at St Vincent Street and Bath Street; reconnecting William St and Bothwell St, and Kent Rd with Elmbank Crescent										
202	Connect neighbourhoods with/across the river Clyde - includes retention and enhancement of existing bridges			✓							
204	Long continuous and connected walking and cycling routes (including new routes through St Enoch, Buchanan Galleries etc)			✓							
205	Connecting train stations for better pedestrian provision			✓				✓			
206	Dynamic Buchanan Bus Station - better /new connections & integration			✓				✓			

	with city centre, Queen Street rail station and Buchanan Galleries. Improved/new bus station layout and improved place/modes integration in front of bus station.										
207	Masterplans – e.g. Broomielaw, River Park (including possible Custom House Quay extension) and Tradeston			✓	✓						
208	Complete a network of safe, high quality, segregated cycling arterial routes connecting the city centre to suburbs and peripheral neighbourhoods			✓							
209	Glasgow City Region Metro			✓							
210	Reconnecting and activating the railway undercroft			✓	✓						
212	Expansion of Avenues Plus Project		✓	✓	✓						

213	St. Enoch Highline (focus on creating/improving connectivity)			✓							
215	Implement the Lanes Strategy and integrate with Avenues/Avenues Plus			✓							
305	Reduce and simplify the current junction arrangement around Junction 15		✓								
309	Create street play / active sport & piloting play streets for child-friendly city				✓						
312	Develop SMART-City and enhanced CCTV and active security				✓						
313	Require all developments to comply with Secure by Design with Animated/Activated Frontages				✓						
315	Streets and public space improvements (including lighting, seating, signage, greening & associated user				✓						

	infrastructure) – e.g St Vincent Street, West George Street, Blythswood Square, Glorious Argyle Street, Sauchiehall Street, Buchanan Street, George Square, High Street, Improved Glasgow Cross / Trongate, Lively and safe Ballater Street, St. Enoch event Square, enhanced public realm and spaces in Calton/Barras, Cowcaddens Road and Port Dundas junction										
316	New Anderston Cross - refurbishment of the M8 (Junction 19) and night-time strategy				✓						
317	Develop Feasibility for new City Square at Mitchell Library including the M8 Garden Cap				✓						
318	Develop City Centre Public Realm Strategy				✓						

319	Street cleansing improvements – identify, assess and prioritise street cleansing				✓						
320	Licensing of pavement areas / street trading				✓						
321	Public art, Street festival/light festival, Design for rain				✓						
322	Planned quay wall extension and new public realm walkway at Windmillcroft Quay (south of river between Tradeston and Kingston Bridge)				✓						
323	Active, attractive promenades & riverfront				✓						
324	Improved connections through St. Enoch Shopping Centre and Buchanan Galleries				✓						
325	Updated access to the St. Enoch Car Park including re-development of King Street parking				✓						

326	Apply the safe systems approach, including education, training and publicity to prevent casualties				✓						
327	Create safe junctions and crossing places (e.g. including around Cowcaddens Subway Station, Cowcaddens Road and Port Dundas junction)				✓	✓					
328	Safe and car free school zones				✓						
329	Safe and attractive underpasses and vennels				✓						
330	Play streets and more green space				✓		✓		✓		
402	Introduce segregated cycle lanes where possible (including around Cowcaddens Road, Port Dundas Junction)					✓					
403	Active travel hubs					✓					

404	Improve existing bike hire offer, with more affordable access to cycling and bike hire including electric bikes					✓					
405	More cycling parking and storage					✓					
501	Create quiet, low use streets, activity zones and street gyms						✓				
503	Promote public awareness of health benefits of outdoor lifestyles, activity and active travel						✓				
504	Access points to River Clyde – Active Leisure						✓				
604	Mobility hubs (including places to hire mobility scooters and other shared use provision)							✓			
605	Improve existing car club offer							✓			
606	Scottish Accessible Travel Framework - Support disabled people's rights by							✓			

	removing barriers and improving access to travel; and ensuring they are fully involved in work to improve all aspects of travel										
607	Shared mobility including public taxi, private hire and ride-hailing (including taxi ranks locations)							✓			
608	Coach parking - consider enforcement/charging and location/safety/integration							✓			✓
609	Bus Partnership Fund improvements							✓			
610	Bus Stop rationalisation							✓			
611	Travel information and apps							✓			
701	Low emission vehicle lanes, including information in the city centre								✓		
705	Route traffic to minimise impacts								✓		

706	Undertake resurfacing using Low Noise Pavements								✓		
707	Surface water management strategy								✓		
708	Regulate waste collection to minimise the AQ & GHG emissions and noise from waste collection								✓		
709	Regulate freight deliveries to minimise the AQ & GHG emissions and noise from goods deliveries (including. e-cargo bikes, low carbon freight, freight hubs/consolidation centres at strategic locations etc)								✓		
710	People First Zone								✓		✓
801	Enhanced private/residential electric vehicle charging points/hubs									✓	
802	Low Carbon Council fleet									✓	
803	Electric Bike charging									✓	

804	Carbon Audit / Capital Carbon Assessment									✓	
805	Require all Taxi and Public Transport Vehicles to be LEZ compliant and transition towards zero emission fleets									✓	
806	EV Charging Points for Taxis									✓	
901	Variable demand parking charges										✓
902	Workplace Parking Levy										✓

3. DETAILED APPRAISAL METHODOLOGY

3.1 Transport Planning Objectives

3.1.1 The interventions and the Options packages are appraised against the TPOs, which were developed during the Pre-Appraisal (Initial Appraisal: Case for Change) stage. The TPOs are:

Net Zero Carbon
TPO1 – Support the delivery of a net zero carbon city by developing transport and infrastructure networks which help deliver low-carbon travel;

Metrics to appraise options - Change in walk trips, change in cycling trips, change in CO_2(e) (non-traded and traded emissions from regional road transport inc. grid emissions from charging light-duty vehicles) and change in car trips in the city centre.

Inclusive
TPO2 – Help create a more-inclusive city centre by supporting a sustainable, affordable and integrated transport system;

Metrics to appraise options - Change in public transport journey times and change in mode share.

Economy
TPO3 – Help create a vibrant and successful city centre by supporting sustainable transport connectivity of the city centre for people and goods;

Metrics to appraise options – qualitative appraisal of potential economic benefits for the city centre

Liveable
TPO4 - Help create a people-centric city centre by creating accessible, healthy, inclusive, safe and quality public spaces and minimising the adverse environmental impacts of traffic.

Metrics to appraise options – qualitative appraisal of sense of place

3.2 STAG Criteria

3.2.1 The interventions as well as the Options packages were also appraised against the updated STAG criteria of Environment; Climate Change; Health, Safety and Wellbeing; Economy; Equality and Accessibility; as well as a number of sub-criteria, as follows:

Environment

- Air Quality
- Noise and vibration;
- Biodiversity and habitats;
- Geology and soils;
- Land Use (including Agriculture and Forestry)
- Water quality, drainage and flood defence;
- Agriculture and soils;
- Historic Environment; and
- Landscape

Climate Change

- Greenhouse Gas Emissions
- Vulnerability to Effects of Climate Change
- Potential to Adapt to Effects of Climate Change

Health, Safety and Wellbeing

- Accidents;
- Security;
- Health Outcomes;
- Access to Health and Wellbeing Infrastructure and
- Visual amenity.

Economy

- Transport Economic Efficiency (TEE); and
- Wider Economic Impacts.

Equality and Accessibility

- Public Transport Network Coverage;
- Active Travel Network Coverage;

- Comparative Access by People Group;
- Comparative Access by Geographic Location; and
- Affordability.

3.2.2 The performance of an option against each of these criteria follows the seven-point scale of assessment as recommended in STAG:

- **Major benefit (✓✓✓):** these are benefits or positive impacts which, depending on the scale of benefit or severity of impact, the practitioner feels should be a principal consideration when assessing an option's eligibility for funding;
- **Moderate benefit (✓✓):** the option is anticipated to have only a moderate benefit or positive impact. Moderate benefits and impacts are those which taken in isolation may not determine an option's eligibility for funding, but taken together do so;
- **Minor benefit (✓):** the option is anticipated to have only a small benefit or positive impact. Small benefits or impacts are those which are worth noting, but the practitioner believes are not likely to contribute materially to determining whether an option is funded or otherwise.
- **No benefit or impact (-):** the option is anticipated to have no or negligible benefit or negative impact.
- **Small minor cost or negative impact (×):** the option is anticipated to have only a moderate cost or negative impact. Moderate costs/negative impacts are those which taken in isolation may not determine an option's eligibility for funding, but taken together could do so.
- **Moderate cost or negative impact (××):** the option is anticipated to have only a moderate cost or negative impact. Moderate costs/negative impacts are those which taken in isolation may not determine an option's eligibility for funding, but taken together could do so; and
- **Major cost or negative impacts (×××):** these are costs or negative impacts which, depending on the scale of cost or severity of impact, the practitioner should take into consideration when assessing an option's eligibility for funding.

3.3 Cost to Government

3.3.1 To understand the benefits associated with an option the net cost of an option from a public spending perspective is required. This allows an overall value for money assessment to be made. The Cost to Government consists of investment costs, operating and maintenance costs, grant/subsidy payments, revenues, and taxation impacts, adjusted for Optimism Bias.

3.4 Risk and Uncertainty

3.4.1 Assumptions made as part of the appraisal carry an element of risk in terms of the costs associated with the interventions and the benefits potentially generated. Please see Section 3.5 of this report for further details for the modelling assumptions. The Risk and Uncertainty section considers the risks and identifies potential mitigations (Section 10). In addition, this section also considers the uncertainty associated with COVID-19 and the impact it may have on the benefits and disbenefits associated with the proposed interventions.

3.5 Appraisal Tools

3.5.1 To support the appraisal of the options a number of tools have been employed which allow for options to be quantitively appraised against the TPOs and STAG criteria:

- Strathclyde Regional Transport Model
- ENEVAL (Traffic emissions – CO_2, NO_X and particulate matter)
- HEAT for walking and cycling
- Glasgow City Centre Paramics model

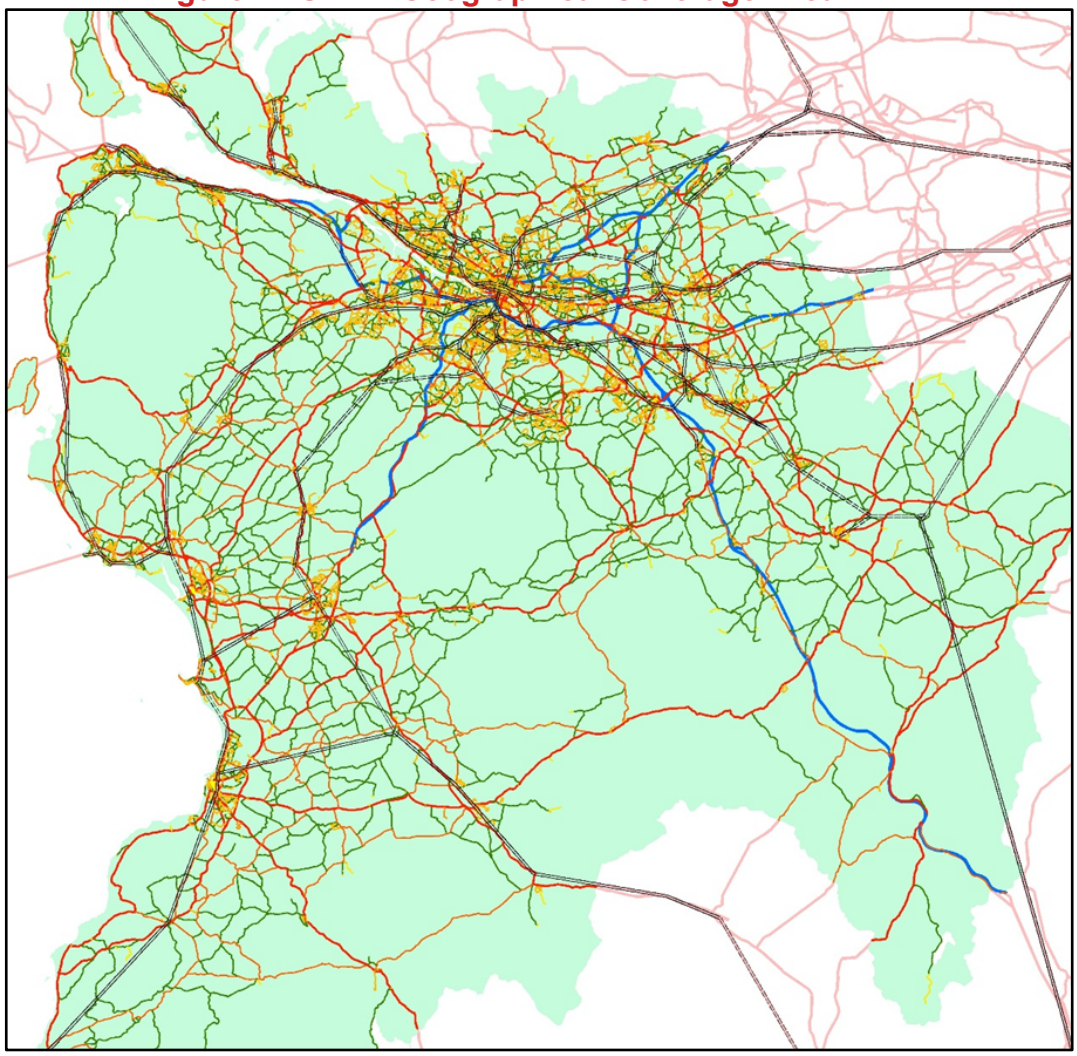
3.5.2 An overview of each of these four modelling tools is provided below.

3.6 Strathclyde Regional Transport Model

3.6.1 To understand the impact of the potential interventions and develop key performance indicators against which the options can be appraised, the appraisal has made use of the Strathclyde Regional Transport Model (SRTM). This allows us to examine the scale of change that may be realised across the city and wider region as a result of these interventions and also allows for consistency against the Glasgow Transport Strategy which also uses the SRTM.

3.6.2 SRTM covers the full Strathclyde area and models travel choice, road and public transport assignment. The SRTM Base Reference year was 2017 and forecasts are available at 5-year intervals. The effective appraisal year was 2027.

Figure 2. SRTM Geographical Coverage Area



3.6.3 The following forecast year assumptions SRTM were agreed during the development of the Base Model and Forecast Model with Transport Scotland, including Network changes, PT services and fare changes:

- Transport Schemes. In total 23 transport schemes SRTM (either full city deal project or sub-projects) have been included within the Reference Case Do-Minimum forecasting model. The model also includes 17 Glasgow City Deal schemes.
- Public transport services enhancements are taken directly from the TMfS 2037 forecast year, and included 10 schemes.
- The model also includes the Glasgow City Deal PT schemes, which all incorporate increased Park and Ride capacities:
  - Robroyston (2022) Capacity 231 spaces
  - East Kilbride (2022) Capacity 437 spaces
  - Airdrie (2022) Capacity 219 spaces
  - Uddingston (2022) Capacity 348 spaces
  - Lenzie (2022) Capacity 249 spaces

3.6.4 The four GCCTP option packages modelled in SRTM were as follows:

Package 1 – Do Minimum – Low Investment Measures. Focus on Public Transport interventions and completion of existing programmes and projects;

Package 2 – Incentive Base Measures. Focus on measures that extend, incentivise and promote travel behaviour change

Package 3 - Incentive and Demand Management measures. A balance of demand management measures that extend, incentivise and promote

Package 4 - Focus on demand management measures that would

3.6.5 Each package proposed a wide range of interventions and measures (over 150 measures in total) which focused on public transport, completion of existing programmes/projects, promoted change in travel behaviour, balance incentive and demand management measures, and reduce vehicular access.

3.6.6 The proposed interventions that incentivise travel behaviour change in GCCTP cannot be explicitly modelled within SRTM in all cases. For example, the detailed design for some measures such as complex traffic management measures and public transport service enhancements will be undertaken following consultation and detailed design review and cannot be represented in a strategic model.

3.6.7 The impact of the proposed interventions in each package was modelled in SRTM by undertaking an assessment of the level of impact of each intervention. For ease of reporting, the individual interventions are grouped together by 'theme', as follows:

THEME 1a - Repurposing road space (PT).

THEME 1b - Repurposing road space (Non-motorised travel/Place)

THEME 2 - Sustainable transport connectivity

THEME 3 - Accessible, inclusive, safe and quality public spaces

THEME 4 - Improved pedestrian and cycle facilities and infrastructure

THEME 5 - Increased physical activity and health

THEME 6 - Sustainable, affordable and integrated transport system

THEME 7 - Minimised adverse environmental impacts of traffic

THEME 8 - Network of carbon neutral infrastructure

THEME 9 - Demand management

3.6.8 Within the SRTM model a range of parameters and measures were identified to model the different level of impact of each theme. The SRTM model parameters selected to model the above themes included: parking costs, number of parking spaces, cycle/walk speeds, travel demand, vehicle occupancy factors, public transport speeds, and car ownership.

3.6.9 The Reference Case network coding was updated to reflect committed schemes within the City Centre and public transport service enhancement where they were at an advanced stage of design and appraisal, as follows:

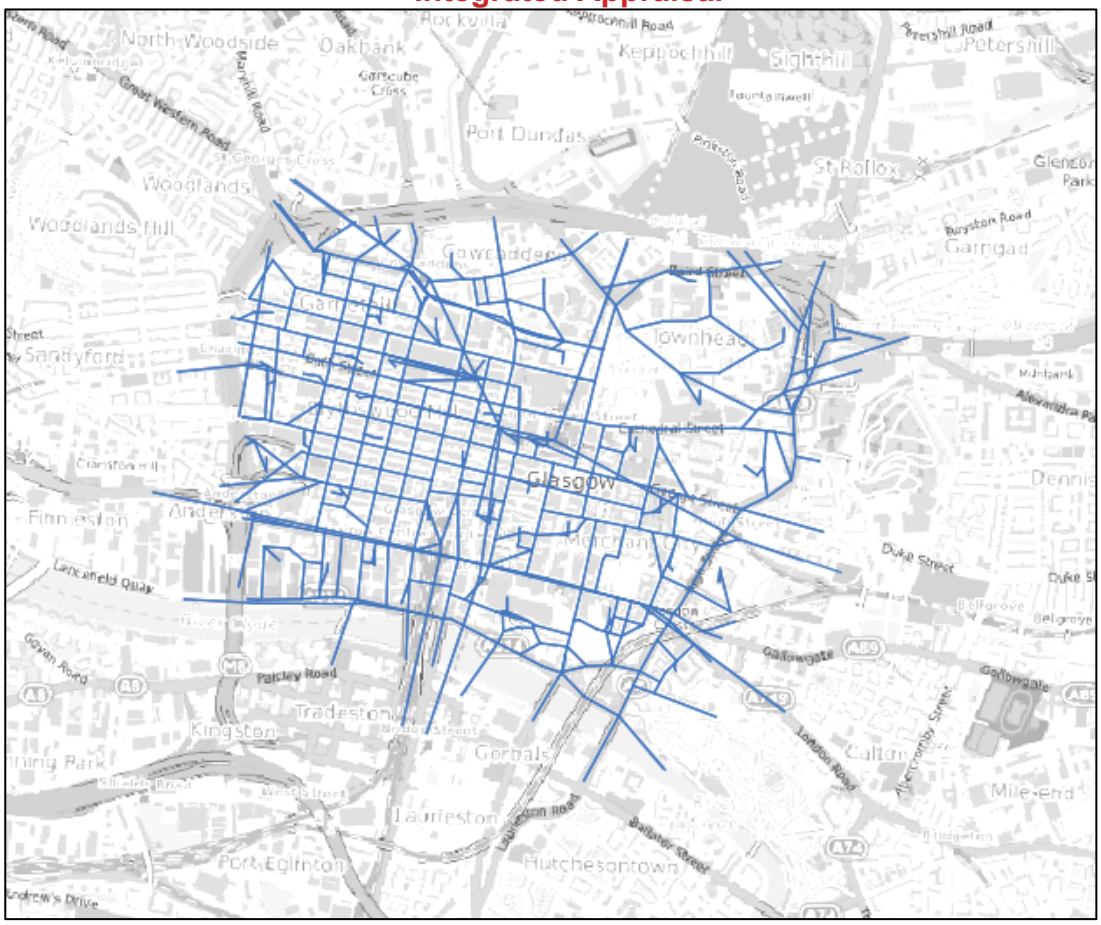
- The Avenues;
- Queen Street- Central Station connectivity (pedestrian); and
- Argyle Street-Howard Street pedestrian link

3.6.10 The extent of the area of the City Centre SRTM model network and the highway network included within the modelled area is shown in the following figure.

3.6.11 Cycling and walking modes were included separately within the development of the calibrated base model of the SRTM. However, it should be noted that the mode choice model within SRTM does not fully reflect all of the features which influence levels of active travel, including the benefits of segregated cycle paths/lanes.

3.6.12 The base number of cycling trips within the model is relatively low when compared to recent Glasgow City Council cordon counts which showed almost 14,000 daily counts in September 2021 (a proportion of which may be through cordon counts and resulting in double counting). SRTM shows a conservative estimate of change in trips and mode share and is expected to generate a greater change than reflected in these outputs. Further work could be undertaken to enhance the forecast level of mode shift to cycling by undertaking a study of the propensity to cycle to/from/within Glasgow city centre.

Figure 3. Network coverage – City Centre sector consistent with Glasgow Integrated Appraisal



Person Trips and Modal Split – 12-hour

3.6.13 Summary outputs from the modelled scenarios are included in this section. For further detail please refer to Appendix D. Table 5 shows the total demand (person trips) to, from and within the city centre by mode (through trips are excluded) and the modal split over the 12-hours period. The growth in trips between the 2017 Base year and the 2027 Do Minimum is from 698,000 trips to 798,000 trips (14%). Growth varies by mode, with the most significant growth in active modes.

3.6.14 There is a reduction in vehicle trips across all four packages, particularly Package 3 and 4 (20% and 23% reduction respectively), both of which include demand management measures. The most significant increase in demand is associated with active modes, and the greatest increase is Package 3, which includes both incentive based and demand management measures (increase of 78,000 trips or 42%).

3.6.15 Figure 4 shows the relative change in the mode split for each Package relative to the 2027 Do Minimum, from which it can be seen that Package 3 has the highest proportion of travel by Active Modes, and the largest level

of increase in active travel. The level of reduction in vehicular person trips is similar in Packages 2-4.

3.6.16 There is a reduction in PT person trips within the city centre in all packages except Package 1 (Low Investment) due to the significant improvement in the urban environment and associated measures to prioritise and improve walking and cycling, and increases the attractiveness of walking for short trips compared with PT and the level of trip chaining (drive/walk or PT/walk trips) .

3.6.17 Table 6 shows absolute change in level of mode share, with car model share falling from 27% in the Do Minimum to between 21% and 23% in the Packages, with the lowest mode share associated with Packages 3 and 4 (21%). Similarly the Active Mode share increases from the Do Minimum (22%) to 29-31% in Packages 2-4. Package 3 is predicted to generate the highest increases in walking (+43%) and cycling (+31%) trips.

Table 5. Model Summary - 12 hr comparison of person trips (excluding through trips)

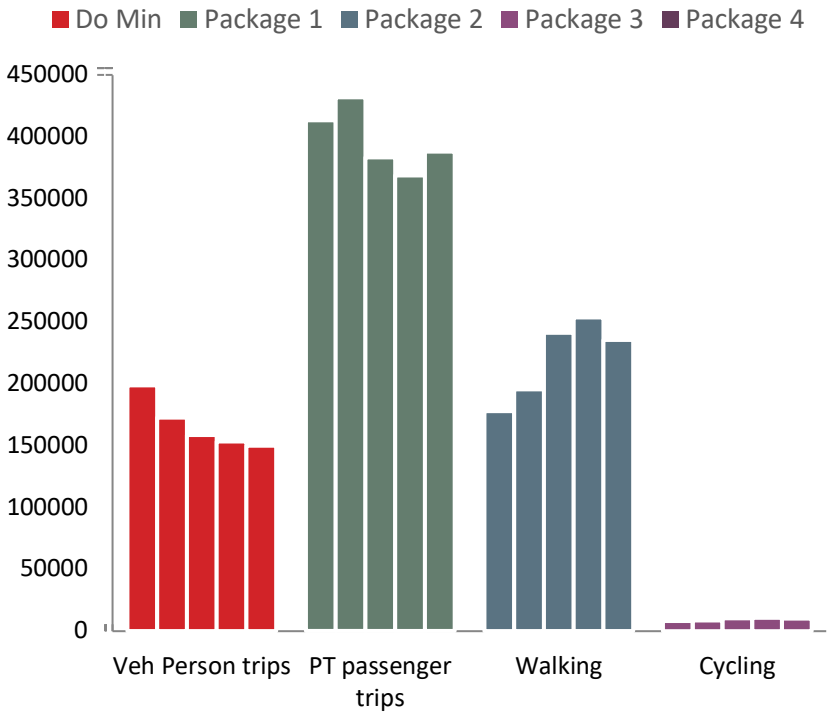
PERSON TRIPS	2017 BASE	2027 DO MIN	2027 PACKAGE 1	2027 PACKAGE 2	2027 PACKAGE 3	2027 PACKAGE 4
Veh Person trips	176,981	198,836	172,759 (-13%)	158,674 (-20%)	153,439 (-23%)	150,023 (-25%)
PT passenger trips	365,450	413,262	431,864 (+5%)	383,262 (-7%)	368,644 (-11%)	387,947 (-6%)
Walking	148,041	177,996	195,609 (+10%)	241,362 (+36%)	253,785 (+43%)	235,593 (+32%)
Cycling	7,422	8,223	8,655 (+5%)	10,401 (+26%)	10,809 (+31%)	10,188 (+24%)
Total trips	697,894	798,317	808,887 (+1%)	793,699 (-1%)	786,677 (-1%)	783,751 (-2%)

Table 6. Model Summary - 12 hr comparison of modal split

MODE SHARE	2017 BASE	2027 DO MIN	2027 PACKAGE 1	2027 PACKAGE 2	2027 PACKAGE 3	2027 PACKAGE 4

Car mode share	27%	27%	23%	22%	21%	21%
PT mode share	56%	56%	57%	53%	51%	54%
Walking Mode share	21%	22%	23%	29%	31%	29%
Cycling Mode share	1.1%	1.0%	1.1%	1.3%	1.4%	1.3%

Figure 4. 12H Mode Share Comparison



Public Transport Journey Times

3.6.1 The proposed city centre measures reduce public transport journey times along corridors in the city by doubling service frequency, halving fares and

increasing bus priority through a series of sub-measures which include bus priority at junctions, additional bus lanes and improved technology

3.6.2 The level of reduction in public transport journey times by bus will be affected by a number of factors such as the flow of general traffic (cars and good vehicles) along the corridor, relative priority when crossing competing public transport corridors; the relative priority for other road users such as active travel (walking and cycling), the city centre traffic management and urban space measures, as well as extent of bus priority at junctions, dedicated, segregated bus lanes along the route. The delay due to conflicts with other traffic within the city centre are reduced due to the reduction in traffic flows.

3.6.3 The detailed design for the bus lane measures are not yet available and at present it is not possible to model the impact on journey times along individual corridors. To reflect the overall increase in the attractiveness in public transport bus services. the model parameters were adjusted to reflect the higher bus speeds and lower journey times. An appraisal has been undertaken at a strategic level which is consistent with the current modelling of the city centre measures and themes within each packages and indicates the level of overall journey times savings across all PT services within the city centre.

3.6.4 Table 7 and Table 8 show the total saving in journey times within the city centre by public transport for each Package, relative to the Reference Case network in the morning and evening peak periods respectively. When the preliminary designs of bus priority measures are available, an appraisal of the increase in speed and reduction in journey times along the major public transport corridors could be undertaken to indicate the benefits of the above measures for each corridor.

3.6.5 The journey times savings in the inter-peak period will be lower due to the lower level congestion and delays.

3.6.6 The tables show that between 2017 and 2027 journey times are predicted to increase by 3%. The proposed range of incentive based and demand management measured are forecast to reduce journey times by 10-12% in the morning peak period and 9-13% in the evening peak period. The greatest journey time savings are predicted for Package 3, with benefits of 12% and 13% in the morning and evening peak periods respectively

Table 7. AM Public Transport Journey Times

AM	2017 BASE	2027 DO MIN	2027 PACKAGE 1	2027 PACKAGE 2	2027 PACKAGE 3	2027 PACKAGE 4

Journey Times (Min)	19,324	19,982 (3%)	18,019 (-10%)	17,817 (-11%)	17,521 (-12%)	17,582 (-12%)

Table 8. PM Public Transport Journey Times

PM	2017 BASE	2027 DO MIN	2027 PACKAGE 1	2027 PACKAGE 2	2027 PACKAGE 3	2027 PACKAGE 4
Journey Times (Min)	19,424	19,965 (3%)	18,145 (-9%)	17,721 (-11%)	17,391 (-13%)	17,434 (-13%)

City Centre Link Flow Differences - 2027 (12-hour PCUs)

3.6.7 The predicted change in 12-hours traffic flows (PCUs) within the city centre for the four packages are shown in Figure 5 to Figure 8. Reductions in flows are shown in green, with the bandwidth and the brightness of the green increasing with the level of reduction, with the greatest reduction in flow being around 11,000 PCU's. Similarly, local increases in flow are shown in red, and the maximum increase in flow is predicted to be about 5,000 PCUs during the 12-hour peak period. In each case the width of the line is proportional to the overall level of change (-11,000 to +5,000 CUs). The change in flows shown in the figures are directional, with the direction of travel consistent with left hand drive.

3.6.8 The figures shown that in general there is a significant decrease in flows (green) along the M8, major radial routes to and from Glasgow and throughout the city centre. Along a small number of roads within the city centre, an increase in flow is predicted. This arises where the capacity along existing routes have been reduced (for example, to provide bus lanes) or links have been closed and despite the general reduction in traffic flows within the city centre, and traffic reassigning to alternative routes gives rise to a local increase in traffic flows.

3.6.9 Traffic flows have generally reduced as the result of incentive based and demand management measures associated with the four packages. These reflect a number of measures, including the reduction in parking spaces, changes in the permitted car ownership within the city centre, environmental measures and improvements to the urban streetscape, capacity constraints arising from the introduction of pedestrianisation, by bus lances and

increased active travel measures and prioritisation (walking and cycling) and the increased levels of public transport and reduction in fares.

3.6.10 The figures show that the predicted level of reduction in flows in the city centre is highest along the main traffic corridor to and from the city centre, which is located in the northeast sector of the city centre, running along Alexander Parade, Stirling Road, Cathedral Street and Cochrane Street. Small changes in flow are shown as grey lines.

3.6.11 The change in traffic flows across all four Packages during the peak 12-hour period is broadly similar, although local differences can be seen when the change in traffic flows are examined in detail. The majority of the changes are due to the Avenues programme, which involves a large package of traffic management measures that extends across a wide area of the city centre and is included within all four packages.

Figure 5. Package 1 12-hour flow differences (PCUs) relative to Base 2027

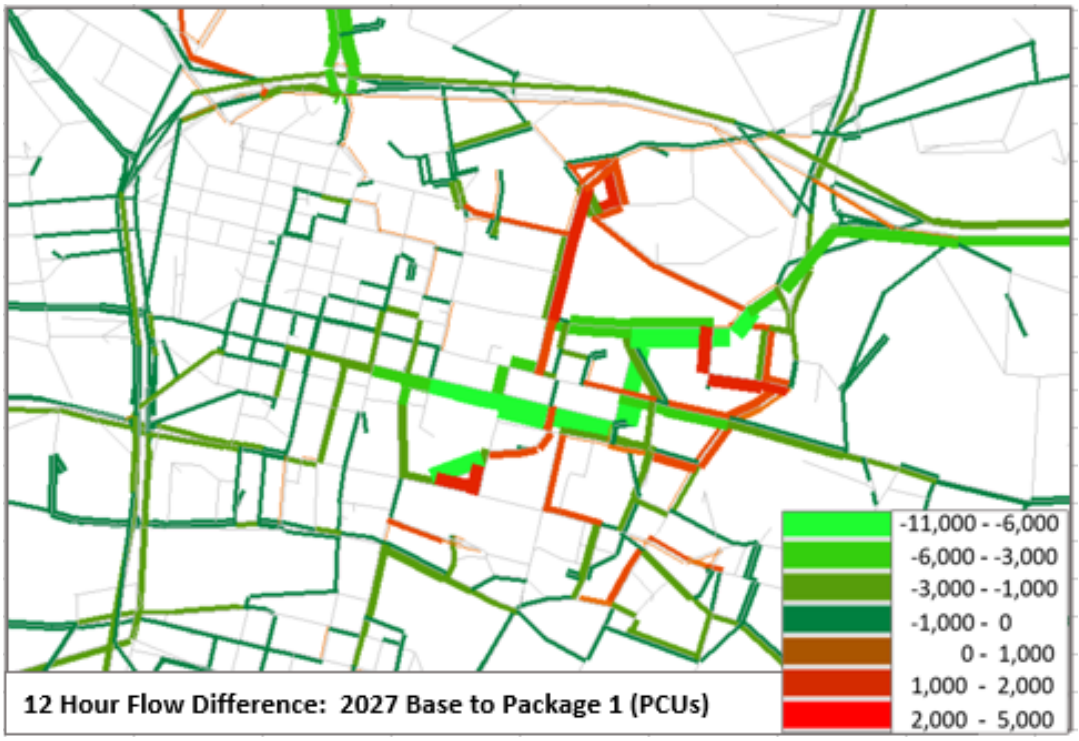


Figure 6. Package 2 12-hour flow differences (PCUs) relative to Base 2027

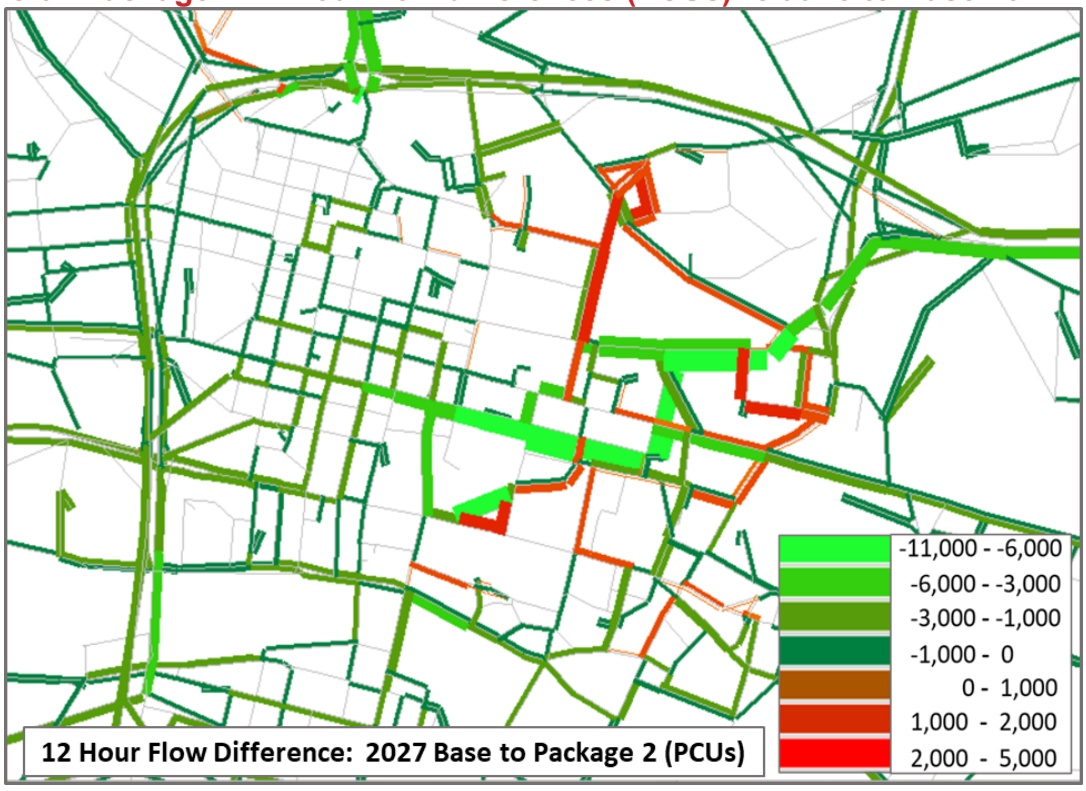


Figure 7. Package 3 12-hour flow differences (PCUs) relative to Base 2027

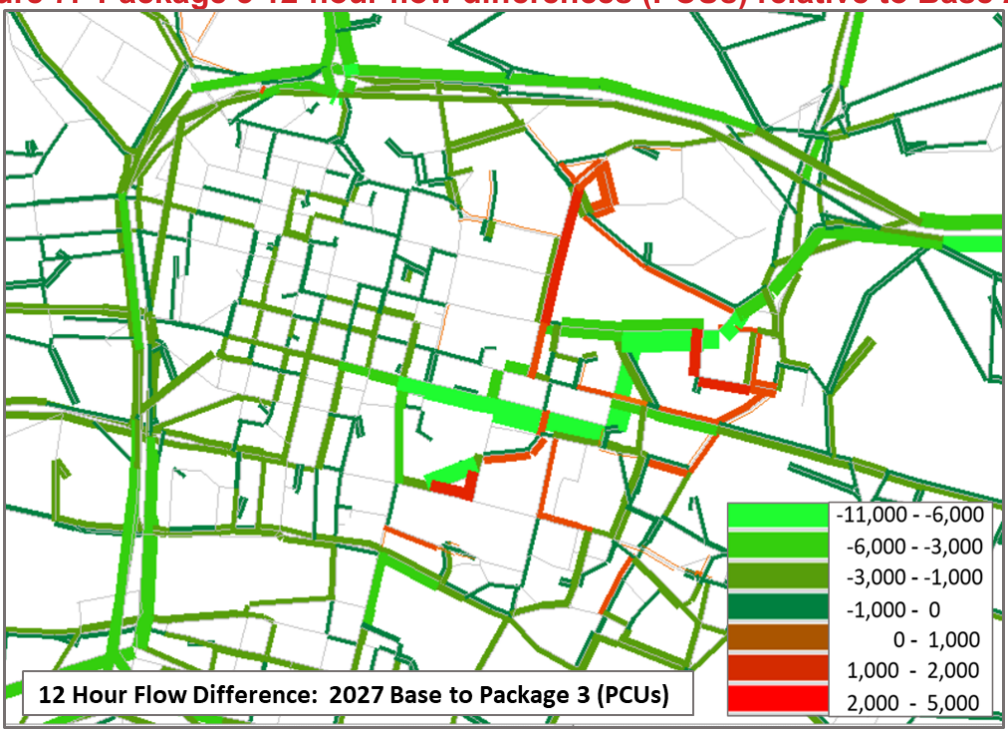
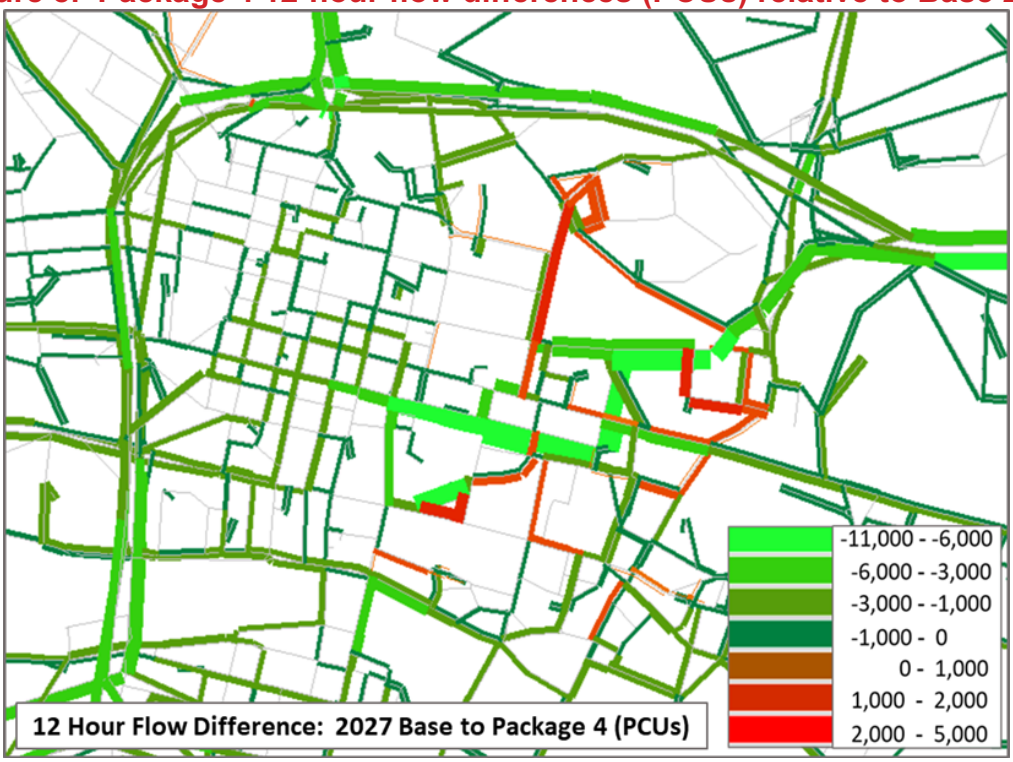


Figure 8. Package 4 12-hour flow differences (PCUs) relative to Base 2027



Change in Cycle Demand – 2027 (12-hour)

3.6.12 The predicted change in 12-hours cycle flows (PCUs) within the city centre for the four packages are shown in Figure 9 to Figure 12. The reductions in flows are shown in green and increases in red, with deeper shades to show larger changes. The figures show changes in total demand by model zones as it would be misleading to show small change in bicycle flows on a link basis as route finding is complex and new route choices are likely to become available in future as bicycle priority routes are confirmed. Overall, the figures show that the proposed city centre measures give rise to increases in flows across the majority of the city centre (the reduction in cycling shown is some zones is very low and may not be statistically significant within the context of the strategic SRTM model).

3.6.13 SRTM predicts the growth and changes in active travel, including walking and cycling. However, the factors taken into account within a strategic model when predicting change in cycling is limited and it is recommended that further appraisal is undertaken to increase the level of confident in the forecast increased level of cycling. A further assessment could be undertaken to determine the propensity to cycle within the city centre and the likely level of change associated with the proposed measures within each Package.

Figure 9. Package 1 Cycle flow differences relative to Base 12-hour 2027

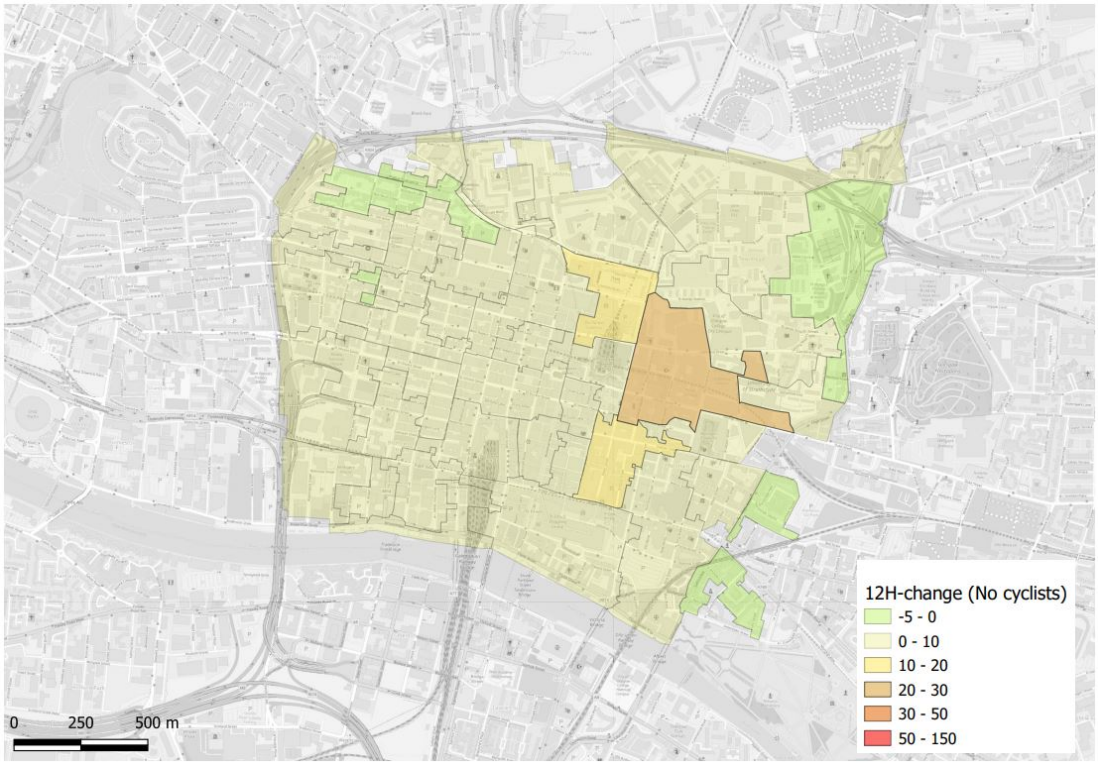


Figure 10.Package 2 Cycle flow differences relative to Base 12-hour 2027

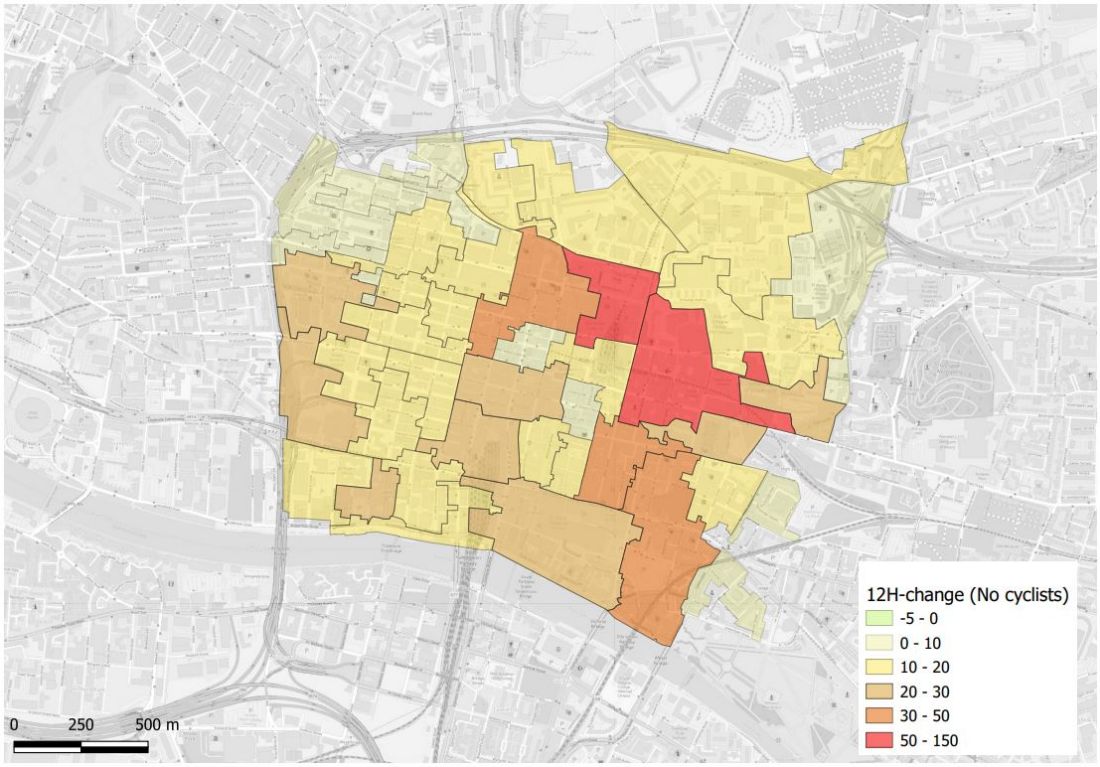


Figure 11.Package 3 Cycle flow differences relative to Base 12-hour 2027

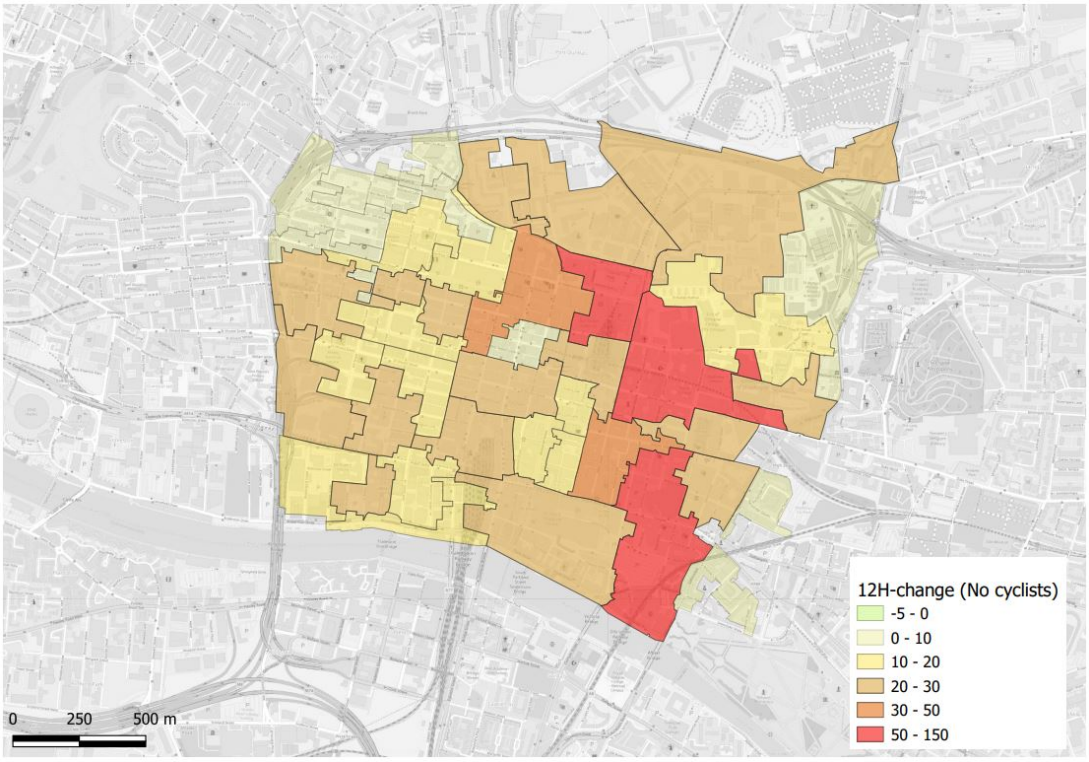
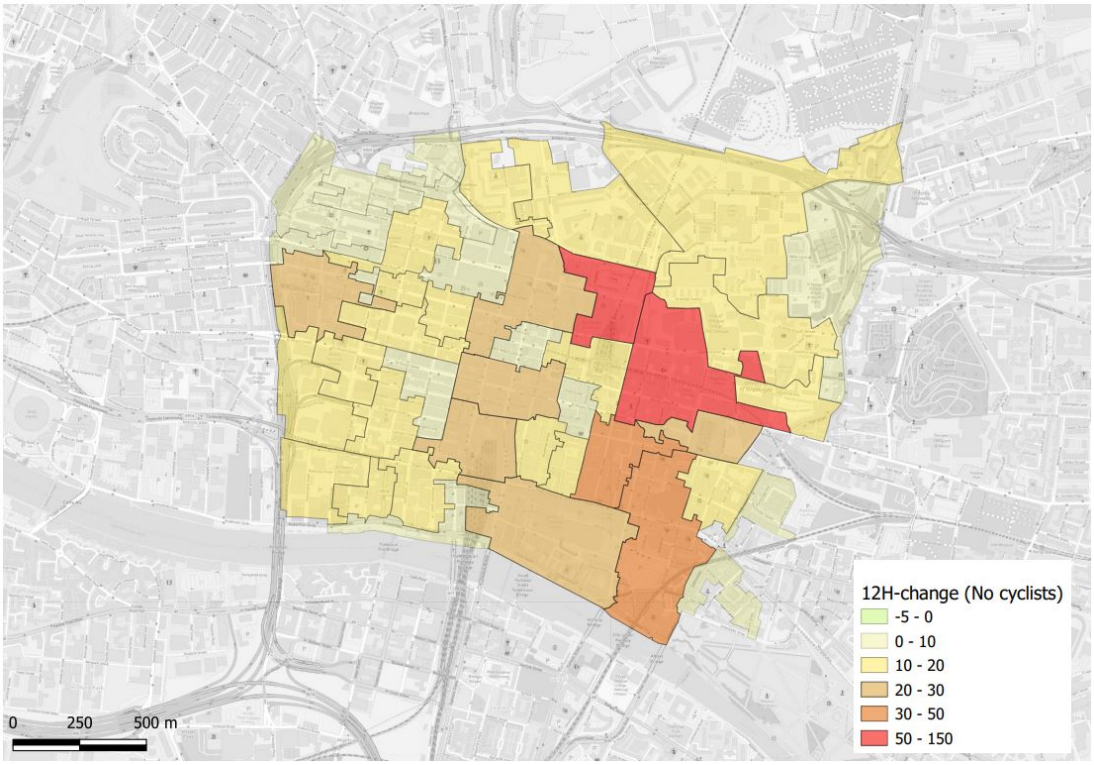


Figure 12.Package 4 Cycle flow differences relative to Base 12-hour 2027



Traffic Emissions

3.6.14 The forecast emissions for trips within the city centre in the Base Year 2017 and 2027 are shown in the table below, along with the forecasts for the 4 transformation packages.

3.6.15 These traffic emission forecasts were produced using SYSTRA's ENEVAL software, which is compatible with the DfT's Emissions Factor Toolkit.

3.6.16 The highest level of reduction in emissions is for Package 3, closely followed by the reductions generated by Package 4.

Table 9. Impact of the Packages on Traffic Emissions in the City Centre

	EMISSIONS (TONNES PER ANNUM)			% CHANGE (FROM 2017)			% CHANGE (FROM REFERENCE CASE)		
	CO_2	NO_X	PM_{10}	CO_2	NO_X	PM_{10}	CO_2	NO_X	PM_{10}
2017	36,876	111.2	5.0						
2027	38,773	46.0	4.0	+5%	-59%	-19%			
GCCTP 1	35,538	41.7	3.75	-4%	-62%	-25%	-8%	-9%	-7%

GCCTP 2	34,239	40.2	3.6	-7%	-64%	-27%	-12%	-13%	-10%
GCCTP 3	30,810	35.6	3.3	-16%	-68%	-34%	-21%	-23%	-18%
GCCTP 4	30,884	35.7	3.3	-16%	-68%	-34%	-20%	-22%	-18%

3.6.17 Further details of the modelling methodology and outputs are presented in Appendix D.

3.7 Glasgow City Centre Paramics Model

3.7.1 Glasgow City Council has a Paramics model which covers the Glasgow City Centre and extends from the M8 motorway in the north to the river Clyde in the south and models the interaction of private and public transport both on the M8 motorway and the city centre surface streets.

3.7.2 Paramics is a micro-simulation modelling package which can be used to test the impact of transport schemes. A 2027 Reference Case Model was developed by SYSTRA to inform the development of the CCTP and consider specific interventions which may impact on traffic operations in the city centre. Reference Case changes included updating George Sq proposals, King Street Car Park removed and Ingram Street Car Park removed. For further details on the changes to the Reference Case please refer to Appendix C.

3.7.3 In addition to testing the operations of specific interventions the final CCTP package was also tested using Paramics.

3.7.4 The final package included the following interventions:

- People First Zone - To reflect the proposals, bus/taxi/goods vehicle gates were added on approach to the zone;
- Avenue Completions - The 2027 Reference Case reflects the committed Avenues proposals and in addition to these the GCCTP Model represents the completion of the remaining Avenues.
- Cycle Network Completions - The cycle network completions reflect the inclusion of cycle lanes as part of the GCCTP measures.
- Proposed Bus Gates and Lanes
- Car Park Closures - The GCCTP model also assumes that the car parks at Buchanan Galleries and the St Enoch Centre are removed. To reflect this, the demands associated with the following zones have been reduced to zero:

- Demand Reduction to reflect the PFZ intervention and car parking changes

Paramics modelling outputs

3.7.5 The Reference Case and GCCTP models were run five times for the AM and PM periods and results extracted that reflected the average of the five runs.

3.7.6 A comparison of general network operation between the Reference Case and GCCTP models was carried out using network wide average speed. The results for the AM (07:00-10:00) and PM (16:00-19:00) periods are shown in Table 10.

Table 10. General Network Statistics

	REF CASE AM	CCTP AM	REF CASE PM	CCTP PM
Total distance (km)	241,331	219,036	256,125	230,823
Total time (hrs)	8,355	6,823	9,993	7,299
Avg Speed (kph)	28.89	32.10	25.63	31.62

3.7.7 Table 10 shows that the GCCTP model operates with an overall increase in average journey time in both time periods when compared to the Reference Case. The reduction in demands between the two models leads to a general reduction in congestion which is reflected in the increased average speed in the GCCTP model.

3.7.8 A comparison of general traffic journey times was carried out along selected routes in the model. The average journey time in seconds along these routes for the AM (08:00-09:00) and PM (17:00-18:00) peak hours is shown in Table 11. It should be noted that these journey times reflect the journey times for all vehicles and on some paths this will be all traffic and some this may be bus or taxi only.

Table 11. General Traffic Journey Times

	AM Peak Hour Journey Time			PM Peak Hour Journey Time		
	Ref Case	GCCTP	Diff.	Ref Case	GCCTP	Diff.
Bothwell St	77	80	3	112	119	7
Broomielaw Ebd	160	158	-3	214	197	-16
Broomielaw Wbd	141	142	2	137	133	-3
Cathedral St Ebd	125	134	8	121	119	-2
Cathedral St Wbd	144	128	-16	124	107	-17
Clyde St Ebd	93	96	3	124	118	-6
Clyde St Wbd	80	92	12	147	146	0
Cowcaddens Rd Ebd	184	169	-16	188	169	-18
Cowcaddens Rd Wbd	161	135	-27	258	145	-113
Dobbies Loan Nbd	140	106	-35	85	81	-4
Dobbies Loan Sbd	76	69	-7	83	79	-5
George St Ebd	81	86	6	63	216	153
High St Nbd	100	114	14	96	122	25
High St Sbd	112	121	9	94	171	77
Ingram St Ebd 2	75	78	3	106	75	-32
Ingram St Wbd 1	40	32	-8	36	30	-6
Ingram St Wbd 2	297	122	-175	112	77	-34
Jamaica St	139	135	-4	122	137	15
King George V	91	86	-5	94	93	-1
Oswald St	45	46	2	46	50	4
Phoenix Ebd	225	232	7	189	188	-1
Phoenix Wbd	215	197	-18	169	167	-2
Renfield St	171	174	3	184	192	8
Saltmarket Nbd	176	184	8	163	167	4
Saltmarket Sbd	88	174	86	95	172	77
St Vincent St Wbd	191	154	-36	155	141	-14
St Vincent Wbd Central	177	150	-27	216	217	1
Trongate Wbd	200	169	-31	150	192	42
Union St	47	47	0	44	48	4
West Graham Nbd	61	63	1	61	60	-1
West Graham Sbd	68	65	-3	68	67	-1

3.7.9 Table 11 shows a range of differences in journey time, the locations with a lower journey time in the GCCTP model are a result of the reductions in traffic demand associated with the GCCTP model.

3.7.10 The locations with the most significant increases in journey times in the GCCTP model are on Saltmarket southbound which has been reduced to one lane, on High Street southbound in the PM which has also been reduced to one lane and on George St Eastbound which has increased queueing on approach to the congested High St/Castle Street corridor.

3.8 Bus Journey Times

3.8.1 A comparison of bus journey times was carried out along selected routes in the model. The average journey time in seconds along these routes for the AM (08:00-09:00) and PM (17:00-18:00) peak hours is shown in Table 12.

Table 12. Bus Journey Times

	AM Peak Hour Journey Time			PM Peak Hour Journey Time		
	Ref Case	GCCTP	Diff.	Ref Case	GCCTP	Diff.
Bothwell St	109	118	10	133	134	1
Cathedral St Ebd	159	154	-5	124	130	6
Cathedral St Wbd	197	172	-24	183	168	-15
Cowcaddens Rd Wbd	226	233	6	359	218	-141
Dobbies Loan Nbd	132	110	-22	93	94	2
George St Ebd	201	190	-11	169	269	100
Hope St	405	413	8	447	465	18
Jamaica St	168	166	-2	142	149	7
King George V	167	168	1	186	184	-2
Oswald St	130	131	2	146	145	-1
Phoenix Ebd	304	286	-18	277	266	-11
Phoenix Wbd	268	245	-23	238	216	-21
Renfield St	281	292	11	366	374	8
St Vincent St Wbd	248	199	-49	235	204	-31
Trongate Wbd	185	150	-35	150	178	27
Union St	86	86	0	98	100	2
West Graham Nbd	138	137	-1	121	120	-1
West Graham Sbd	112	113	0	112	112	0

3.8.2 Table 12 shows a range of differences in journey time, the locations with a lower journey time in the GCCTP model are a result of the reductions in traffic demand associated with the GCCTP model. At some locations, for example Hope Street the removal of the traffic demand is balanced by the inclusion of cycle stages which removes green time for the traffic movements.

3.8.3 On St Vincent Street, Phoenix Road and Cathedral Street the bus priority measures included lead to a reduction in journey times.

3.8.4 On George Street eastbound the increase in journey time in the PM is linked to the increase in journey time for the general traffic which is caused by an increase in congestion on the High Street/Castle Street corridor.

3.8.5 In summary, the modelling results show that in general the CCTP network operates better for both general traffic and buses in the AM and PM periods this is largely a result of the reduction in traffic in the CCTP model. There

are some locations which show increased congestion, most notably the Castle Street/High Street/Saltmarket corridor in the PM and this can also lead to delays for vehicles on approach to this corridor.

3.9 Stakeholder and Public Consultation

3.9.1 The list of potential interventions, themes and the options packages have been informed by stakeholder workshops held during September and October 2021. Stakeholder engagement and consultation is an ongoing process and continued throughout the appraisal of the options and the options were refined further through these stages.

3.9.2 During summer 2022 a public consultation exercise will be held to presented the outcomes of the emerging City Centre Transport Plan. Further details of this consultation process will be presented in Appendix B of this report.

4. APPRAISAL USING THE TRANSPORT PLANNING OBJECTIVES

4.1 Introduction

4.1.1 The Transport Planning Objectives (TPOs) identified as part of the Case for Change were strengthened to ensure each option could be appraised against the TPOs in an objective manner. This section presents the results of this appraisal against each TPO.

Net Zero Carbon
TPO1 – Support the delivery of a net zero carbon city by developing transport and infrastructure networks which help deliver low-carbon travel;

Inclusive
TPO2 – Help create a more-inclusive city centre by supporting a sustainable, affordable and integrated transport system;

Economy
TPO3 – Help create a vibrant and successful city centre by supporting sustainable transport connectivity of the city centre for people and goods;

Liveable
TPO4 - Help create a people-centric city centre by creating accessible, healthy, inclusive, safe and quality public spaces and minimising the adverse environmental impacts of traffic.

4.2 Performance Against TPO1

Net Zero Carbon
TPO1 – Support the delivery of a net zero carbon city by developing transport and infrastructure networks which help deliver low-carbon travel;

4.2.1 A climate (and ecological) emergency was declared Glasgow City Council in May 2019. An action plan has subsequently been developed, covering key issues such as transport, to increase the rate of action towards reducing Glasgow's carbon emissions to achieve neutrality by 2030. Transport is a significant contributor of emissions directly linked to climate change, as well as those harming human health through local air pollution.

4.2.2 TPO1 supports the delivery of a net zero carbon city by developing transport and infrastructure networks which help deliver low carbon travel.

4.2.3 Package 1 would support the delivery of a zero carbon, its networks and infrastructure through the provision of a wide range of measures including strategic repurposing of the road network and parking redistribution to prioritise public transport (Ref 101 and 106) and improving the facilities and connections for active travel through the following interventions: traffic calming to prioritise active travel (157), improved traffic signal control systems to prioritise active travel (156), safer crossings and junctions (327), cycle storage (405) and cycle hire (404), and the introduction of active travel hubs (403). Further positive impacts are anticipated through the provision of the People First Zone (710), regulated and managed servicing and freight deliveries to reduce carbon during peak hours (908) and a low carbon council fleet (802). More benefits are constrained by the extent of schemes and not having a fuller focus on demand reduction.

4.2.4 Package 1 modelling outputs indicates that there would be a reduction of 13% in vehicle person trips in the city centre over a 12 hour period compared to the Do Minimum with a corresponding 10% increase in walking and 5% increase in cycling. In terms of mode share this represents a 2% increase in walking mode share and no change in cycling mode share. As discussed previously, there are limitations to the SRTM's ability to model active travel modes and modal shift to walking and cycling in particular. The base number of cycling trips is also relatively low when compared to recent Glasgow City Council cordon counts which showed almost 14,000 daily counts in September 2021 (a proportion of which may be through cordon counts and resulting in double counting).[1] SRTM therefore shows a conservative estimate of change in trips and mode share and is expected to generate a greater change than reflected in these outputs. These changes represent a 3.6% decrease in CO_2 emissions when compared to 2017 data.

4.2.5 In addition to the benefits generated by Package 1, Package 2 also has a focus on motorised traffic demand reduction which helps to provide a more notable overall benefit for this TPO. This is coupled with a more comprehensive package of active travel measures, such as segregated cycling and more-car free space (159), and a more complete package of measures to help decarbonise transport, such as resident and taxi EV charging (801).

4.2.6 Package 2 modelling outputs indicates that there would be a reduction of 20% in vehicle person trips in the city centre over a 12 hour period compared to the Do Minimum with a corresponding 36% increase in walking and 26% increase in cycling. In terms of mode share this

[1] https://www.ubdc.ac.uk/news-media/2022/january/up-and-down-cycling-and-walking-trends-in-glasgow-city-centre/

represents a 8% increase in walking mode share and no change in cycling mode share however it is anticipated that the step change in cycling infrastructure including increased segregated routes and road space and parking redistribution to prioritise active travel would generate a greater increase in cycling mode share. These changes represent a 7.1% decrease in CO_2 emissions when compared to 2017 estimates.

4.2.7 The benefits identified in Package 1 are also in Package 3 with further positive impacts anticipated through the re-routing of traffic from the centre, enhanced provision of EV charging points for private cars, taxis and bikes (801 and 806) and a focus on motorised traffic demand reduction helps to provide a major overall benefit for this TPO. Package 3 also supports increased connectivity within and to the city centre with the Clyde Metro (209), improved connections across the Clyde (202) and over the motorway/at motorway junctions (201 and 316) which would support low carbon travel.

4.2.8 Package 3 modelling outputs indicates that the measures would result in a reduction of 23% in vehicle person trips in the city centre over a 12 hour period compared to the Do Minimum with a corresponding 43% increase in walking and 31% increase in cycling. In terms of mode share this represents a 10% increase in walking mode share and no change in cycling mode share. The increase in cycling trips in Package 3 is the greatest of each of the Packages and it is therefore assumed that the measures introduced including improved connectivity and segregated routes would generate a greater increase in cycling and walking mode share. These changes represent a 16.4% decrease in CO_2 emissions when compared to 2017 estimates.

4.2.9 In addition to the measures and benefits identified in Packages 1-3, Package 4 has a number of measures which manage demand and support Glasgow's net zero ambitions. These packages include managed motorways (105) and tartan grid of streets for car-free or car-only traffic management (104).

4.2.10 Package 4 modelling outputs achieve the greatest reduction in vehicle person trips at 25% due to the managed demand, however the change in walking and cycling is lower than Package 2 and 3 at 32% and 24% respectively. These changes represent a 16.2% decrease in CO_2 emissions when compared to 2017 estimates.

Table 13. TPO1 Appraisal Summary/KPIs

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Change in cycling trips: +5% Change in walking trips: +10% Change in vehicle person trips: -13% Carbon saving 3.6% in CO_2 No interventions were considered to have a negative impact on TPO1	Change in cycling trips: +26% Change in walking trips: +36% Change in vehicle person trips: -20% Carbon saving 7.1% in CO_2 No interventions were considered to have a negative impact on TPO1	Change in cycling trips: +31% Change in walking trips: +43% Change in vehicle person trips: -23% Carbon saving 16.4% in CO_2 No interventions were considered to have a negative impact on TPO1	Change in cycling trips: +24% Change in walking trips: +32% Change in vehicle person trips: -25% Carbon saving 16.2% in CO_2 No interventions were considered to have a negative impact on TPO1
✓	✓✓	✓✓✓	✓✓✓

4.3 Performance Against TPO2

Inclusive
TPO2 – Help create a more-inclusive city centre by supporting a sustainable, affordable and integrated transport system;

4.3.1 Packages 1 and 2 will improve inclusivity through sustainability, affordability and integration through improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), which will open up cycling to more users; providing better connections with train stations (205), and creating active travel hubs (403). Each of these measures will improve access both to active travel modes, including opening up cycling to more users through the e-bike measures, and also connections between travel hubs.

4.3.2 In addition to the measures identified in Packages 1 and 2, packages 3 and 4 also include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). These measures would increase both the attractiveness of walking/cycling as a mode of transport to access the city centre in a sustainable and affordable way but also improves the integration of the existing transport system. The repurposing of road space to public transport (106) and the introduction of the metro (209) would also improve journey times and reliability in the city centre. Furthermore, a general shift away from car, encouraged by a more extensive range of measures to reduce demand for car use will benefit sustainable transport users overall. Master-planning (207), and improved connectivity to areas outside of the city centre will also help produce a more integrated and inclusive transport network.

4.3.3 The modelling outputs for Packages 3-4 show that public transport mode share has reduced with a corresponding increase in walking, and, to a smaller degree, cycling (as shown in TPO1). This is in response to the marked improvement in walking and cycling environment and infrastructure and results in a reduction in both car use and public transport use as there is a shift towards active travel. When appraised at a qualitative level, and individually, the interventions are expected to represent an improved inclusive and sustainable integrated transport system however, when combined with improved active travel this results in a switch to active travel. This is further evidenced by the reduction in public transport journey times in packages 3 and 4 of 13% in the PM for both Packages.

Table 14. TPO2 appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Change in public transport trips: +5% Change in public transport journey times (PM): -9% See TPO1 for change in active travel trips.	Change in public transport trips: -7% Change in public transport journey times (PM): -11% See TPO1 for change in active travel trips.	Change in public transport trips: -11% Change in public transport journey times (PM): -13% See TPO1 for change in active travel trips.	Change in public transport trips: -6% Change in public transport journey times (PM): -13% See TPO1 for change in active travel trips.
✓	✓	✓✓	✓✓

4.3.4 Each of the packages help to create a more-inclusive city centre by supporting a sustainable, affordable and integrated transport system through improved cycling infrastructure and bike and e-bike hire and charging. In addition, Packages 3 and 4 include improved connectivity into and within the city centre and the introduction of the Clyde Metro which would provide an increased benefit for TPO2 through improved integration and reliability of public transport.

4.4 Performance Against TPO3

Economy
TPO3 – Help create a vibrant and successful city centre by supporting sustainable transport connectivity of the city centre for people and goods;

4.4.1 The Case for Change considered the level of footfall in the city centre and how it has changed in recent years. Data from the city centre permanent count sites (Figure 44) shows pedestrian footfall from the start of 2018 to May 2021. The data indicates a footfall of nearly six million pedestrians per month in the city centre pre-Covid-19, with a substantial reduction in city centre footfall following the beginning of the Covid-19 pandemic. A slight recovery is observed in the summer of 2020, but this is followed by a further downturn due to renewed lockdown.

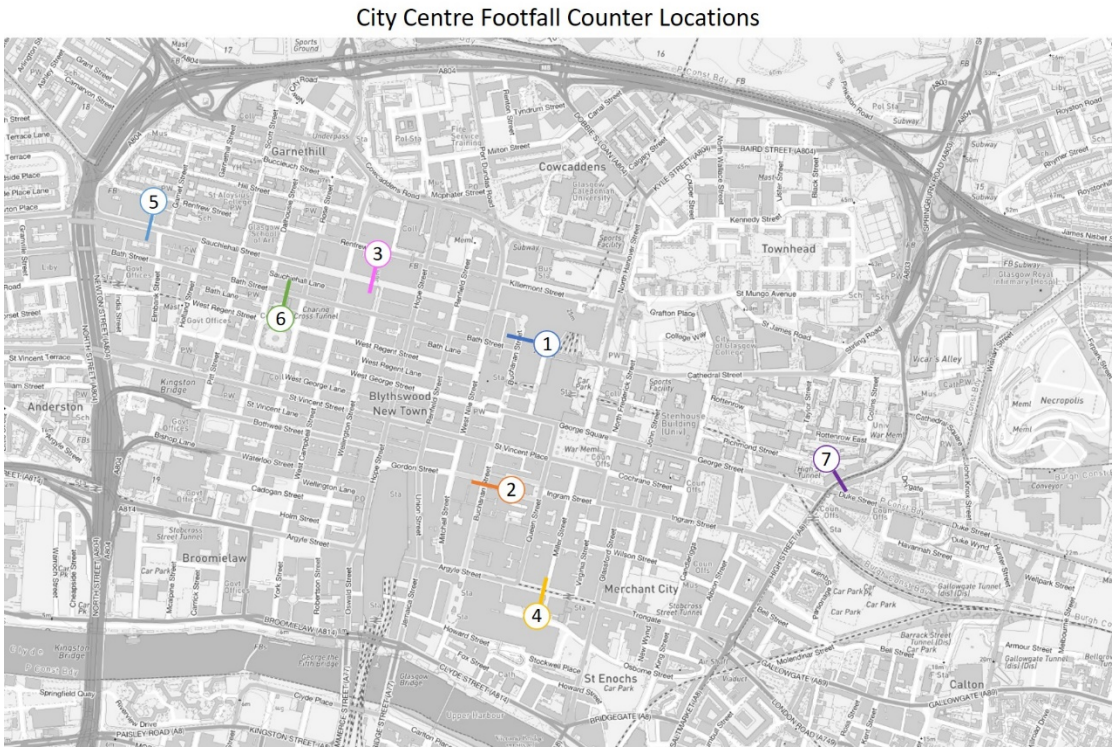


Figure 13.City Centre permanent footfall counter locations

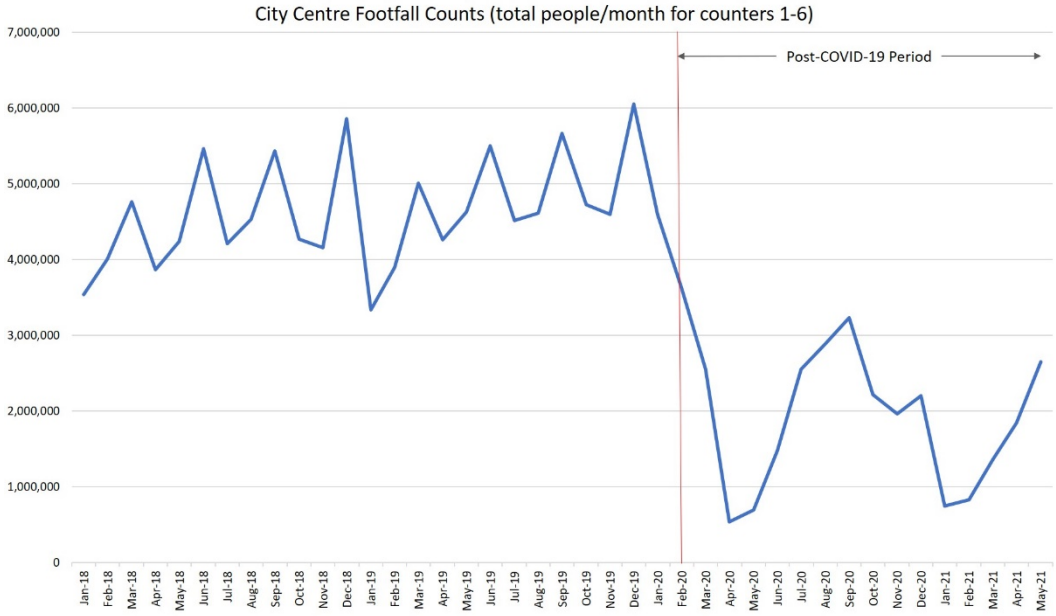


Figure 14.City Centre monthly footfall totals from six permanent counters, Jan 2018-May 2021

4.4.2 Any predictions as to future trends need to be undertaken with caution. Prior to 2020, it can be seen that the gradual trend was upwards, but there also seemed to be a repeated pattern of peaks and troughs within the two years 2018 and 2019. There may be specific factors behind some troughs (such as the effect of two major fires on closing different sections of Sauchiehall Street), but the chart points to the possibility of there being underlying seasonal patterns. Since May 2021 however there have been steady increases in footfall in the city centre (excluding the period of December 2021-January 2022 when Scotland had further restrictions introduced following the increase in cases associated with the Omicron Covid variant).

4.4.3 Helping to create a vibrant and successful city centre by supporting sustainable transport connectivity of the city centre for people and goods is a key objective of the CCTP following the Covid pandemic which reduced footfall and the viability of the city centre. Throughout the lifespan of this project the redevelopment plans for St Enoch Centre and Buchanan Galleries have taken shape and evolved. Each of the options would support these redevelopments to varying degrees, with the Options 3 and 4 representing the greatest shift towards walking and cycling infrastructure and public realm improvements, which would complement the planned redevelopments.

4.4.4 The increase in walking and cycling trips associated with each option is discussed in TPO1 and is also presented in Table 15. These represent trips within the origin/destination matrices of the SRTM and do not reflect

the assessment of any increase in leisure related walking trips, this is considered to be additional. To understand the benefits generated by interventions for TPO2, Transport for London's *Walking & cycling: the economic benefits* and Living Streets *Pedestrian Pound* 2018 have been considered and highlight the following evidence and case studies:

- High street walking, cycling and public realm improvements can increase retail sales by up to 30%
- Cycle parking delivers five times the retail spend per square metre than the same area of car parking
- Retail vacancy was 17% lower after high street and town centre improvements
- 13:1 is the average "Benefit Cost Ratio" for walking and cycling projects
- Retailers have been shown to over-estimate the importance of the car for customer travel. In these studies, more people walked, cycled or came by bus.
- Piccadilly, Stoke-on-Trent, a £10 million investment to make the area more pedestrian-friendly led to 30% more footfall.

4.4.5 The benefits generated by the packages vary based on the interventions included. Package one would generate positive impacts for sustainable connectivity through the range of transport measures proposed in this package which promote active travel and public travel, as well as improved public spaces. Some measures will represent a shifting away from private motorised vehicle access to the city centre which may be considered as having a negative impact on the viability of businesses within the city centre however the evidence presented about highlights the increased retail sales and footfall generated by walking and cycling schemes and the over-estimation of the importance of car parking for shoppers. The restriction of some motorised service vehicles to certain time periods may negatively impact businesses however this is countered by the reduction in private vehicle trips in the city centre which would improve journey times and reliability for service/delivery vehicles. This may mean that the benefits are only minor, at least at first, as the economy reshapes to a more sustainable delivery model.

4.4.6 Packages 2-4 include a greater number of public realm and active travel measures including the expansion of the Avenues (158), the Lanes Strategy (215) and the feasibility of the M8 Garden Cap (Packages 3 and 4 only).[2] The more extensive placemaking proposed is considered to help create a more vibrant city by increasing footfall and retail spend and reducing vacancy rates. As with Package 1, The restriction of some

[2] The M8 Garden Cap was not modelled in SRTM however the public realm and active travel measures are considered to represent a benefit for TPO3.

motorised service vehicles to certain time periods may negatively impact businesses however this is countered by the reduction in private vehicle trips in the city centre which would improve journey times and reliability for service/delivery vehicles. This may mean a restriction to the benefits at first as the economy reshapes to a more sustainable delivery model.

Table 15. TPO3 Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Change in walking trips: +10% with a further increase in footfall associated with the active travel and public realm improvements	Change in walking trips: +36% with a further increase in footfall associated with the active travel and public realm improvements	Change in walking trips: +43% with a further increase in footfall associated with the active travel and public realm improvements	Change in walking trips: +32% with a further increase in footfall associated with the active travel and public realm improvements
✓	✓✓	✓✓✓	✓✓✓

4.4.7 Each package performs positively by improving walking and cycling and increasing footfall in the city centre to varying degrees with Packages 3 and 4 representing the greatest benefits due to the greater number of public realm and active travel measures including the expansion of the Avenues, the Lanes Strategy and the feasibility of the Garden Cap over the M8, which would represent a step change in public realm environment in the Charing Cross area.

4.5 Performance Against TPO4

Liveable
TPO4 - Help create a people-centric city centre by creating accessible, healthy, inclusive, safe and quality public spaces and minimising the adverse environmental impacts of traffic.

4.5.1 TPO4 supports Glasgow City Council's ambitions to double the city centre population over a 15 year period and to create accessible, healthy, inclusive, safe and quality public spaces whilst minimising the adverse environmental impacts of traffic.

4.5.2 Package 1 proposes measures which help to reduce emissions in the city centre by removing and redistributing traffic, encouraging the use of more sustainable transport modes, and regulating waste, freight, and taxis (805 and 908). Some spaces currently used for traffic and parked vehicles will be redefined as those for sustainable and more efficient movement, both making them more accessible for the majority by increasing the perceived and actual safety of the cycling, and helping to minimise the impacts of traffic (101 and 106). Measures aimed at making spaces safer, including improved walking connections between stations (205), will also help make the city centre more people-centric. Benefits are constrained by their extent, and a focus on environmental factors rather than fuller demand management.

4.5.3 Package 2 represents measures that focus on extending, promoting and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. In addition, Package 2 includes additional active travel and public realm improvements such as the Avenues extension, more-car free space (159), and a more complete package of measures to help decarbonise transport, such as resident and taxi EV charging (801). The increased number of walking trips associated with Package 2 (36%) would also improve perceived safety in the city centre through informal surveillance and formal surveillance through enhanced CCTV and active security (312). The improved public realm, connectivity and sense of safety in the city centre is considered to support GCC's ambition to double the residential population in the city centre. An expansion of the extent of measures, and a focus on demand reduction helps to create a strong moderate benefit.

4.5.4 Packages 3 and 4 represent further public realm improvements including the M8 Garden Cap (317) and the Lanes Strategy (215) which would provide the same positive benefits associated with Package 2 with an improved public realm offering at Charing Cross and safety associated with

the Lanes Strategy. The extent of demand reduction measures, balanced with behavioural change helps to create a major overall benefit.

Table 16. TPO4 appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Measures would encourage the use of more sustainable transport modes improve the actual and perceived safety of walking and cycling providing a minor benefit .	Measures would encourage the use of more sustainable transport modes improve the actual and perceived safety of walking and cycling providing a moderate benefit.	Measures would encourage the use of more sustainable transport modes improve the actual and perceived safety of walking and cycling and increase the attractiveness of the city centre providing a major benefit.	Measures would encourage the use of more sustainable transport modes improve the actual and perceived safety of walking and cycling and increase the attractiveness of the city centre providing a major benefit.
✓	✓✓	✓✓✓	✓✓✓

4.5.5 Each of the packages help to create a more-inclusive, safer and attractive city centre by supporting sustainable transport modes and improving the safety of walking and cycling. In addition, Packages 3 and 4 include improved public realm areas which would provide additional benefits.

5. FIT WITH ESTABLISHED POLICY

5.1 Policy Integration

5.1.1 The Transport Planning Objectives and options were developed in line with established policy which was reviewed within the Case for Change. National, Regional and City policies and plans were considered with a focus on objectives, methodology and relevant proposals. Of particular importance to the CCTP are the following policies:

- Climate Change Plan – the CCTP will help deliver Scottish Governments' commitment to delivering a 20% reduction in car Kms (relative to 2019 levels) by 2030;
- National Transport Strategy 2 – the Sustainable Travel Hierarchy is at the heart of each of the packages proposed;
- Strategic Transport Project Review 2 – scenario and package based approach to appraisal including proposals of relevance to the CCTP;
- Glasgow Transport Strategy – alignment of policy framework across Glasgow city centre and the wider Glasgow area; and
- Active Travel Strategy – incorporation of proposals contained within the Active Travel Strategy

5.1.2 Each of the packages proposed reflects that they are integrated with existing and emerging transport and land use policy which support transport integration as active travel and public transport becomes better integrated. Land-use and transport integration is also strengthened by improving public transport and active travel links with key services and public spaces. The introduction of the People First Zone (710) will have a positive impact on reducing car trips and kilometres into the city centre and highlights the commitment to the sustainable travel hierarchy and the 20 minute neighbourhood concept. In addition, the extensive improvements and transformational projects within Packages 2-4 will create new quality public spaces connected to sustainable transport infrastructure. The packages and their interventions support key policies as they support low carbon infrastructure and networks, climate change resilience, accessibility and inclusivity.

Table 17. Policy Integration appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Minor positive impact based on the interventions within Package 1. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158) and parking redistribution to manage demand and reallocate space to active travel and public transport (106).	Moderate positive impact based on the interventions within Package 2. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207) and Workplace Parking Levy (902).	Moderate positive impact based on the interventions within Package 3. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207), Workplace Parking Levy (902), Clyde Metro (209) and the M8 Garden Cap Feasibility (317).	Moderate positive impact based on the interventions within Package 4. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207), Workplace Parking Levy (902), Clyde Metro (209) and the M8 Garden Cap Feasibility (317).
✓	✓✓	✓✓	✓✓

6. ENVIRONMENTAL APPRAISAL

6.1 Introduction

6.1.1 The environmental sub-criteria considered in detail during this Detailed Appraisal include:

- Biodiversity and Habitats;
- Land Use (including Agriculture and Forestry), Geology and Soils;
- Water, Drainage and Flooding;
- Air Quality;
- Historic Environment;
- Landscape and Visual; and
- Noise and Vibration.

6.2 Methodology

Baseline Data Collation and Early Constraints Mapping

6.2.1 We collated a range of baseline data to inform the assessment from early constraints mapping through development of early options and themes and packages:

- NatureScot website and Scotland's Environment Web – information of natural heritage designations, landscape character etc;
- SEPA website - information regarding flooding, water quality, groundwater, pollution prevention etc.;
- Historic Environment Scotland website – Listed Buildings, Scheduled Ancient Monument Records etc.;
- OS Maps, Plans, Data;
- Glasgow Biodiversity Action Plan;
- Glasgow Local Development Plan with accompanying supplementary guidance;
- Glasgow's Climate Plan, 2021;
- Glasgow City Council – Glasgow's Open Space Strategy, 2019; and
- Consultation with Glasgow City Council officers – Biodiversity, Contaminated Land, Flood Risk and Environmental Health.

Consultation and Engagement

6.2.2 Consultation and engagement has been undertaken with the following consultees during the SEA Screening process and as part of the Case for Change stage and Preliminary Options Appraisal:

- NatureScot;
- Historic Environment Scotland;
- SEPA; and
- Glasgow City Council officers – Biodiversity, Contaminated Land, Flood Risk and Environmental Health.

Impact Assessment

6.2.3 When considering the nature of the impacts upon the environment the STAG guidance states the importance of considering the type of impact, likely duration of impact and scale of impact.

6.2.4 Each specialist topic within the STAG has different criteria for predicting environmental impacts and their magnitude but each records impact on a seven point scale as shown below. The assessment methods used will be described in greater detail within each of the sections of this report.

- Negative Major
- Negative Moderate
- Negative Minor
- Neutral
- Positive Minor
- Positive Moderate
- Positive Major

6.2.5 We progressed an individual assessment of each sub-option under the 9 themes against the environmental criteria to allow an informed assessment of each package as set out in the following section and in the Appraisal Summary Tables (ASTs) in Appendix A.

6.3 Option appraisal

General Study Area

6.3.1 The study area comprises the communities of Garnethill, Blythswood (in the west of the City Centre), Anderston, Broomielaw (covering the north and south banks of the river Clyde west of Central Station), Cowcaddens (the northern part of the city centre, including Glasgow Caledonian University), Townhead, Collegelands, Merchant City (the south eastern part of the City Centre), St. Enoch (to the east of Central Station), and the Central Business District. The predominant land uses are high density commercial and leisure and mixed-use developments and much of the area falls within the City Centre Conservation Area.

6.3.2 There is a clear difference in the architectural style of the buildings in the study area. The city's commercial district has a modern style and generally taller office and hotel building located to the south and south east of the study area. The eastern portion of the study is composed of 19th century four to six storey Victorian buildings following the grid iron pattern. To the west, the M8 motorway and A804 act as a clear and impermeable edge to the city centre.

6.3.3 Environmental designations within the area include the following biodiversity, landscape and heritage designations which fall either wholly or partly within the plan area:

- Site of Importance for Nature Conservation (SINC)
- Garden and designated landscapes
- Conservation Areas
- Designated Cultural Heritage Assets

Biodiversity and Habitats

6.3.4 Glasgow is known as the 'dear green place' due to its large number of parks, cemeteries and other greenspaces. Glasgow's open spaces, wild plants and native animal species are important to the health and well-being of residents and contribute to 'place quality'. The plan area includes road, woodland, river, squares, boundary features and the built environment. Tree planting through the city centre includes linear avenue-style planting which form an incomplete and interspersed thread throughout the study area.

6.3.5 Glasgow was the first Scottish City to declare an ecological emergency in May 2019 with 25 recommendations committed to reverse declines in wildlife and restore nature in Glasgow. Biodiversity is an important consideration in the management of the city's greenspace, openspace and park. Management is informed by monitoring of habitats and species with the Glasgow Museums Biological Records Centre recording c. 6000 species.

Table 18. Biodiversity and habitats appraisal

BIODIVERSITY AND HABITATS		
Option	**Performance**	**Score**
1	There is potential for localised benefits to biodiversity in the city centre through individual measures such as design guides	-

	(106), the Avenues Plus programme (215), Play streets and more green space (330) which will provide opportunities for green 'threads' and a habitat network through the plan area. Overall, Package 1 is assessed to have neutral impacts on Biodiversity and Habitats. Opportunities to enhance biodiversity will be integrated into individual projects as they are brought forward.	
2	There is potential for localised benefits to biodiversity in the city centre through individual measures such as design guides (106), accelerating the Avenues Plus programme (158), play streets and more green space (330), and St Enoch Highline (213) etc which will provide opportunities for green 'threads' and a habitat network through the plan area. Overall, Package 2 assessed to have neutral impacts on Biodiversity and Habitats. Opportunities to enhance biodiversity will be integrated into individual projects as they are brought forward.	-
3	Package 3 represents further improvements in the public realm to Package 2, including Masterplans (207), play streets and more green space (330), and accelerate and expand the Avenues Plus program (158, 159) will enhance ecological corridors and biodiversity. The cumulative effect of Package 3 on Biodiversity and habitats is a minor benefit. Surveys would be undertaken as part of detailed route design and recommended mitigation integrated into the designs if a series of ecological enhancement measures are included to increase the biodiversity of the site, suitable to its urban context. For example, incorporating a rain gardens, green walls, and wildlife-friendly plant species is incorporated into the layout and design. Bat and bird nesting boxes and new invertebrate habitats will be created with an ecologically sensitive lighting strategy and biodiversity measures through hard and soft landscaping. Further assessment is required once details are known.	✓
4	There is potential for beneficial impacts to enhance the biodiversity in the city centre through the Avenues Plus programme (159), Masterplans (207), redevelopment of the riverfront and play streets and more green space (330) will enhance ecological corridors and biodiversity. The cumulative effect of package 4 on Biodiversity and habitats is a minor benefit. Surveys would be undertaken as part of detailed route design and recommended mitigation integrated into the designs if a series of ecological enhancement measures are included to increase the biodiversity of the site, suitable to its urban context. For example, incorporating a rain gardens,	✓

	green walls, and wildlife-friendly plant species is incorporated into the layout and design. Bat and bird nesting boxes and new invertebrate habitats will be created with an ecologically sensitive lighting strategy and biodiversity measures through hard and soft landscaping. Further assessment is required once details are known.	

Land Use, Geology and Soils

6.3.6 There are no local, national, or internationally designated sites of geological importance within 500m of the plan area. Historical map evidence has shown that site and surrounds have been part of a typical urban setting from earliest editions through to the current time. In areas which have previously seen past industrial activity, particularly former railway depots and sidings, there is likely to be contamination. Made Ground can be anticipated throughout the plan area.

Table 19. Land Use, Geology and Soils

LAND USE, GEOLOGY AND SOILS		
Option	**Performance**	**Score**
1	Significant infrastructure is not anticipated for Package 1, as the options would use the existing routes and interchange facilities. Therefore, no significant effects on land use, geology or geological/mineral resources are predicted for this option.	-
2	Significant infrastructure is not anticipated for Package 2, as the options would use the existing routes and interchange facilities. Therefore, no significant effects on land use, geology or geological/mineral resources are predicted for this option.	-
3	The measures in Package 3 are in an already established transport corridor in the city centre with upgrades to walking and cycling routes and public realm improvements. It is anticipated that some options, e.g. Expansion of Avenues Plus Program project will cover areas which have historically seen rail infrastructure, tram infrastructure, subway infrastructure and post office tunnels as well as maintenance buildings associated with the transport and other localised contaminating industry including mills, printing works, oil and soap works, foundries, coal and coke works and shipping related works along the Clyde. Minor ground disturbance will be required to redevelop the roads however provided works are contained within the existing road corridor and relatively superficial the impact is likely to be minor. Ground investigation is likely required to determine the contamination position, this could	✓

	highlight remedial measures which are required and if implemented this would represent a minor benefit. As the areas are brownfield no further impacts to soils and geology are anticipated. Overall significant impacts on land use, geology and mineral resources are not expected.	
4	The measures in Package 4 are in an already established transport corridor in the city centre with upgrades to walking and cycling routes and public realm improvements. It is anticipated that some options, e.g. Feasibility of the new M8 Garden Cap (317), Planned quay wall extension and new public realm walkway at Windmillcroft Quay (322) will cover areas which have historically seen rail infrastructure, tram infrastructure, subway infrastructure and post office tunnels as well as maintenance buildings associated with the transport and other localised contaminating industry including mills, printing works, oil and soap works, foundries, coal and coke works and shipping related works along the Clyde. Minor ground disturbance will be required to redevelop the roads however provided works are contained within the existing road corridor and relatively superficial the impact is likely to be minor. Ground investigation is likely required to determine the contamination position, this could highlight remedial measures which are required and if implemented this would represent a minor benefit.	✓

Water, Drainage and Flooding

6.3.7 The River Clyde is located in the south of the plan area. Information obtained from the SEPA indicative flood map shows that small areas across the site are at high risk from surface water flooding. More concentrated areas of high surface water flooding are located around Merchant City in the south east quadrant and Cowcaddens in the north east quadrant of the study area. The Clyde Estuary is at high risk for coastal flooding, generally confined to the channel of the river, with the east end of the Clyde recorded as a High risk of river flooding. Small areas up to a High risk of river flooding are shown in discrete areas north of Glasgow Green with additional Low risk in the St Enoch's area. On the south side of the Clyde SEPA's flood maps record flooding in the area may be influencing groundwater flooding, affecting the duration and extent of flooding from other sources. Scottish Water records show a large amount of sewer and water infrastructure within the development area, as would be expected within a city centre location. Groundwater has an overall status of 'poor' due to pressures from water abstraction, legacy mining and quarrying pollution and past land contamination point source discharges.

Table 20. Water, drainage and flooding

WATER, DRAINAGE AND FLOODING		
Option	**Performance**	**Score**
1	Package 1 is focused on the best possible management of existing resources (including road space and public realm) within the City Centre. Despite city growth, the package assumes that there will be no net growth in traffic levels in the city centre. A wide range of measures to discourage private vehicle use to and through the city centre with priority being given instead to active travel and public transport, resulting in the potential for minimal improvement of water runoff quality from roads and urban areas. Package 1 includes a Surface Water Management Strategy (707). Further options such as parking and quality public space (106), the Avenues Plus programme (215), and Play streets and more green space (330) are assumed to include interventions specific to the water environment such as Sustainable drainage system (SuDs), implementation of rain gardens, permeable pavements etc. are likely to yield positive outcomes with regards to the water environment.	✓
2	Package 2 represents measures that focus on extending, promoting, and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. Package 2 includes a Surface Water Management Strategy (707). In addition, Package 2 includes additional active travel and public realm improvements such as the Avenues extension (159), Masterplans (207), Planned quay wall extension and a new public realm walkway at Windmillcroft Quay (322) and play streets and more green space. SEPA flood maps record coastal flooding, and therefore a new quay wall could displace a small amount of flood water should it be constructed within the existing channel. Options in proximity to Clyde are at risk of contamination. Ground investigation would be required to determine the contaminated land position and whether any remedial measures are required. Remediation could provide a slight benefit if carried out. Individual options include interventions specific to the water environment, e.g. sustainable drainage systems, rain gardens, permeable pavements, etc. Minor benefits with regard to run-off and if there is more permeable green space covering the impermeable road surfaces will assist with runoff, rainfall, and surface water management. The scale of potential impacts will	✓

	depend on the final design but will be subject to detailed assessment and approvals from SEPA.	
3	Package 3 represents further public realm improvements, including the M8 Garden Cap and the Lanes Strategy, which would provide the same positive benefits associated with Package 2 with an improved public realm offering. Package 3 would result in a more significant reduction in vehicle person trips and increased walking and cycling mode share through measures including improved connectivity and segregated routes. Package 3 modelling outputs indicate that the options within Package 3 would reduce 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in cycling. A move towards active travel would further reduce the reliance on vehicle transport in the city—minor benefits concerning run-off. Ground investigation would be required to determine the contaminated land position and whether any remedial measures are required. Remediation could provide a slight benefit if carried out. Individual options that include interventions specific to the water environment, e.g. sustainable drainage systems, rain gardens, permeable pavements will produce minor benefits with regard to with runoff, rainfall, and surface water management. The scale of potential impacts will depend on the final design. Further assessment is required once details are known. Detailed flood risk assessments will be required to understand the potential impacts further of specific options e.g quay wall extension and new public realm walkway (322). Significant impacts are not anticipated with appropriate design and associated mitigation/ compliance with SEPA and Scottish Water guidance and authorisations.	✓
4	Package 4 has measures and benefits associated with Packages 1 to 3, plus additional measures which manage demand and support Glasgow's net-zero ambitions. These packages include managed motorways (105) and a tartan grid of streets for car-free or car-only traffic management (104). Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. A move towards active travel would further reduce the reliance on vehicle transport in the city—minor benefits concerning run-off and with measures that play streets and more green space, etc., benefits regarding rainfall and surface water management. would further reduce the reliance on vehicle	✓

	transport in the city—minor benefits concerning run-off. SEPA flood maps record coastal flooding, and therefore a new quay wall could displace a small amount of flood water should it be constructed within the existing channel. A flood risk assessment would require considering the impact of any development and adjacent land. Ground investigation would be required to determine the contaminated land position and whether any remedial measures are required. Remediation could provide a slight benefit if carried out. Individual options that include interventions specific to the water environment, e.g., sustainable drainage systems, rain gardens, permeable pavements will produce minor benefits with regard to with runoff, rainfall, and surface water management. The scale of potential impacts will depend on the final design. Further assessment is required once details are known. Detailed flood risk assessments will be required to understand the potential impacts further of specific options e.g., quay wall extension and new public realm walkway (322). Significant impacts are not anticipated with appropriate design and associated mitigation/ compliance with SEPA and Scottish Water guidance and authorisations.	

Air Quality (Local)

6.3.8 The CCTP plan area is located within the Glasgow City Centre (GCC) Low Emission Zone (LEZ). In 2002, an Air Quality Management Area (AQMA) was declared in the city centre due to exceedances of the annual mean Air Quality Objectives (AQOs) for NO_2 and PM_{10}. A further AQMA was declared at Byres Road/Dumbarton Road in 2007, also due to exceedances of the annual mean AQOs for NO_2 and PM_{10}.

Table 21. Air Quality (Local)

AIR QUALITY (LOCAL)		
Option	**Performance**	**Score**
1	Package 1 aims to gradually remove the dominance of vehicles in the city centre with a comprehensive package of active travel measures, such as segregated cycling and more-car free space, decarbonising transport, better connections with train stations, and creating active travel hubs etc. However, reallocation of road space may result in displaced impacts on vehicle emissions due to redirecting traffic elsewhere. Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a reduction of 13% in vehicle person trips with a corresponding 10% increase in walking	✓

	and a 5% increase in cycling. Analysis of road traffic data shows that Package 1 will lead to a reduction in annual average daily traffic (AADT) flows on the majority of roads in the city centre, including those adjacent to Glasgow Central Station where the highest NO_2 concentrations have been measured, however there are also some city centre roads on which AADT flows will increase. Both the increases and decreases in traffic flows could have potentially significant impacts on air quality in the immediate vicinity. Some city centre roads will experience an increase in the numbers of heavy duty vehicles (HDVs), which could also significantly affect air quality, although in many cases the increase in HDVs occurs on roads on which the AADT flows decrease overall. Package 1 is expected to result in an overall minor benefit to local air quality.	
2	Package 2 represents measures that focus on extending, promoting, and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. In addition, Package 2 includes additional active travel measures, such as segregated cycling and more-car free space, and a complete package of measures to help decarbonise transport. Public realm improvements include the Avenues extension and more car free space. Package 2 modelling outputs indicate that there would be a reduction of 20% with a corresponding 36% increase in walking and 26% increase in cycling. However, reallocation of road space may result in displaced impacts on air quality due to redirecting traffic elsewhere. Analysis of road traffic data shows that Package 2 will lead to a reduction in AADT flows on the majority of roads in the city centre, including those adjacent to Glasgow Central Station where the highest NO_2 concentrations have been measured, however there are also some city centre roads on which AADT flows will increase. Both the increases and decreases in traffic flows could have potentially significant impacts on air quality in the immediate vicinity. Some city centre roads will experience an increase in the numbers of HDVs, which could also significantly affect air quality, although in many cases the increase in HDVs occurs on roads on which the AADT flows decrease overall. Package 2 is expected to result in an overall minor benefit with regard to Local Air Quality.	✓
3	Package 3 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 3 modelling outputs indicate a reduction of 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in	✓✓

	cycling. Reducing road space available for vehicles would limit the number of vehicles that can be in the city centre and alongside road closures, reduce the release of tailpipe emissions. This would be beneficial for addressing the exceedance issues in the Air Quality Management Area (AQMA) in the city centre. However, road closures on key arterial routes and reallocation of road space may result in displaced impacts on air quality as a result of redirecting traffic elsewhere. Analysis of road traffic data shows that Package 3 will lead to a reduction in annual average daily traffic AADT flows on more roads in the city centre than Package 1 and Package 2, including those adjacent to Glasgow Central Station where the highest NO_2 concentrations have been measured, however there are still some city centre roads on which AADT flows will increase. Both the increases and decreases in traffic flows could have potentially significant impacts on air quality in the immediate vicinity. Some city centre roads will experience an increase in the numbers of HDVs, which could also significantly affect air quality, although in many cases the increase in HDVs occurs on roads on which the AADT flows decrease overall. Package 3 is expected to result in an overall moderate benefit to Local Air Quality.	
4	Package 4 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. Reducing road space for vehicles would limit the number of vehicles in the city centre and alongside road closures on key arterial routes. Reallocation of road space may result in displaced impacts on air quality due to redirecting traffic elsewhere. Reducing road space available for vehicles would limit the number of vehicles that can be in the city centre and alongside road closures, reduce the release of tailpipe emissions. This would be beneficial for addressing the exceedance issues in the Air Quality Management Area (AQMA) in the city centre. However, road closures on key arterial routes and reallocation of road space may result in displaced impacts on air quality as a result of redirecting traffic elsewhere. Analysis of road traffic data shows that Package 4 will lead to a reduction in annual average daily traffic AADT flows on more roads in the city centre than Package 1 and Package 2, including those adjacent to Glasgow Central Station where the highest NO_2 concentrations have been measured, however there are still	✓✓

	some city centre roads on which AADT flows will increase. Both the increases and decreases in traffic flows could have potentially significant impacts on air quality in the immediate vicinity. Some city centre roads will experience an increase in the numbers of HDVs, which could also significantly affect air quality, although in many cases the increase in HDVs occurs on roads on which the AADT flows decrease overall. Package 4 is expected to result in an overall moderate benefit to Local Air Quality.	

Cultural Heritage

6.3.9 Glasgow is an important historic city with many listed buildings by notable architects. Work by Charles Rennie Mackintosh, Alexander "Greek" Thomson and Robert Adam are among the individuals which have contributed to the city's listed heritage, with many contributing to Glasgow's position of pioneering building materials and techniques in past centuries.

6.3.10 The grid street plan of Central Glasgow has had various extensions from the 18th century to accommodate the city's economic growth and expanding population. In 1949 the Clyde Valley Report assigned large areas as Comprehensive Development Areas and people moved from central Glasgow to the periphery. However, the grid-iron street plan established in the City Centre at the close of the 18th century has remained essentially intact to the present day.

6.3.11 Statutory listing began to be implemented from the mid-1960s. However, Frank Worsdall described 1971 as 'The Black Year of Destruction' due to notable losses of historic buildings. It was not until November 1972 that a comprehensive survey was instructed, and greater recognition given to the legacy of historic buildings in the City Centre.

Table 22. Historic Environment

HISTORIC ENVIRONMENT		
Option	**Performance**	**Score**
1	Glasgow city centre contains many historic, listed and scheduled buildings and structures and public places as well as the potential for as yet undiscovered artefacts buried below street level. Package 1 contains a number of measures which would lead to minor positive effects on the historic environment. The effects would be largely indirect, with traffic reduction and improved public realm leading to an improved appearance and public appreciation of the historic townscape	✓

	and buildings. It is also assumed that any measures requiring significant construction works will be carried out in accordance with best practice in relation to the protection of the historic environment, thereby leading to no adverse effects. The overall impact would be minor positive.	
2	Package 2 has a significantly wider range of traffic reduction and public realm improvement measures than Package 1. However, the majority of the impacts on the historic environment would be indirect, leading to minor positive improvements through better appearance and public appreciation of the historic townscape and buildings. The overall impact across all the measures would be slightly more positive than Package 1, but essentially at a similar, minor positive level.	✓
3	Package 3 has a similar number of traffic reduction and public realm improvement measures to Package 2. Similarly, the majority of the impacts on the historic environment would be indirect, leading to minor positive improvements through better appearance and public appreciation of the historic townscape and buildings. The overall impact would be at a similar level to that of Packages 1 and 2.	✓
4	Package 4 has a similar number of traffic reduction and public realm improvement measures to Packages 2 and 3. Similarly, the majority of the impacts on the historic environment would be indirect, leading to minor positive improvements through better appearance and public appreciation of the historic townscape and buildings. The overall impact would be at a similar level to that of Packages 1-3.	✓

Townscape and Visual

6.3.12 The plan area lies within the shallow bowl of the Clyde's flood plain (6-12m), the ground level rising gently northwards to the higher ground of Blythswood Hill (42m) to the west and the Cathedral (40m) to the east. The Cathedral and the Necropolis drumlins (54m) are bisected by the valley of the Molendinar Burn. North-west of Blythswood Hill, Garnethill (52m) have steeper gradients.

6.3.13 The street pattern of Glasgow city centre is dominated by the rectilinear grid that runs broadly east-west and north-south forming almost square city blocks. Road widths are generous (approx. 22m width from building lines for the east-west streets and 18m for the north-south streets), narrow east-west lanes service the blocks. The grid street plan results in dramatic

controlled views, or vistas, to terminating buildings such as the Gallery of Modern Art.

6.3.14 Numerous views are provided by the hilly topography of the area. The high points of the Necropolis (out with the study area), Blythswood Square and Garnethill permit fine long panoramic views to the Campsie Hills in the north and south to the Cathkin Braes.

6.3.15 The density of building is highest in the commercial centre of the study area. Building density decreases further west towards Blythswood and Garnethill, where building heights are generally in the 3-storey to 5-storey range.

6.3.16 Areas of significant tree cover within the study area are Blythswood Square and Garnethill Park. Pockets of open space are found in formal squares with soft landscaping such as George Square and Blythswood Square.

6.3.17 Recent public realm schemes with linear avenue-style planting form an incomplete but interspersed thread throughout the study area. Other notable public green spaces within the study area are St Mungo's Museum Japanese garden and the Children's Memorial park. These green spaces are comprised of amenity grass and trees. Groves, tree avenues, street trees and squares with amenity grass can also be found throughout the study area.

6.3.18 A broad variety of roof details define the character of the Conservation Area. Steeples, spires, towers, turrets, chimneys, and domes appear across the City Centre.

Table 23. Landscape and visual

LANDSCAPE AND VISUAL		
Option	**Performance**	**Score**
1	Package 1 provides the most limited suite of options. There are a handful of infrastructure improvement measures aimed at improving the quality of the public realm that would lead to moderate positive impacts on townscape and visual amenity. However, the majority of options, aimed at traffic reduction or improved use of available street space, would have a more indirect, slight effect. Some options, such as localised safety improvements, would not have any appreciable effect on townscape and visual amenity, adding nothing to the level of improvement in townscape and visual amenity that would result from implementing measures across the package.	✓

2	Package 2 has a far wider range of options than Package 1. This includes many more incentivising infrastructure improvement measures, such as infrastructure for active travel, reconnecting streets and creation of a new public space over the M8, that would lead to a moderate or strong positive impact on townscape and visual amenity. While there are also many more indirect measures with a slight or neutral impact, the number of measures having a moderate positive effect would result in an appreciable, moderate overall improvement in townscape and visual amenity.	✓✓
3	Package 3 has a similar number of measures to Package 2, although the emphasis in this case is a balance between incentivising measures and demand management. Nevertheless, as both approaches contain significant physical infrastructure measures, the resulting impact on townscape and visual amenity is very similar to Package 2. A similar number of moderate and strong positive effects would result in a moderate overall improvement in townscape and visual amenity.	✓✓
4	Package 4 has a similar number of options to Packages 2 and 3, but with more emphasis on demand management measures. Nevertheless, this includes many active travel infrastructure and public realm measures, such as the St Enoch Highline, that could have a moderate positive effect. The overall impact on townscape and visual amenity would be at a very similar, moderate, level.	✓✓

Noise and Vibration

6.3.19 Glasgow is a major Scottish transport node with a comprehensive internal transport network including motorways (M8, M73, M74, M77 and M80), the UK's second largest suburban commuter rail network, subway system and an extensive network of bus routes.

6.3.20 The dominant environmental noise source in the study area is road traffic movements from cars, HGVs and buses. There are several one-way streets in the study area that will carry sporadic intermittent traffic. Local topography also means that roads gradients will increase traffic noise levels in some areas. The massing of buildings can also create street canyons which further elevate noise levels. The grid system layout of the roads in combination with traffic signalling has the potential to result in stop start traffic, resulting in acceleration and deceleration.

6.3.21 Scottish Government Round 3 strategic noise modelling carried out in response to the European Parliament and Council Directive for Assessment

and Management of Environmental Noise 2002/49/EC show that there is a complex distribution of noise exposure within the study area.

Table 24. Noise and vibration

NOISE AND VIBRATION		
Option	**Performance**	**Score**
1	Measures in Package 1 aim to gradually remove the dominance of vehicles in the city centre with a comprehensive package of active travel measures, such as segregated cycling and more-car free space, decarbonising transport, better connections with train stations, and creating active travel hubs etc. However, reallocation of road space may result in displaced impacts on noise impacts due to redirecting traffic elsewhere. Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a reduction of 13% in vehicle person trips with a corresponding 10% increase in walking and a 5% increase in cycling. There are a range of measures which would address road traffic noise including (706) Use of low noise paving, (708 and 709) Regulation of waste and freight moments and (805) move to electric / zero emission taxi and public transport. Based on analysis of road traffic data the majority of road links towards the west of the city centre show negligible change or minor beneficial impacts. Towards the east of the city centre there is a larger variation in links showing beneficial and adverse change in approximately equal measure but with the majority showing a negligible change. Overall, neutral impacts.	-
2	Package 2 represents measures that focus on extending, promoting, and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. In addition, Package 2 includes additional active travel measures, such as segregated cycling and more-car free space, and a complete package of measures to help decarbonise transport. Public realm improvements include the Avenues extension and more-car free space. Package 2 modelling outputs indicate that there would be a reduction of 20% in vehicle person trips with a corresponding 36% increase in walking and 26% increase in cycling. There are a range of measures which would reduce road traffic noise including (2) Smart tartan grid, (157) Traffic Calming, (501) Quiet / Low Use Streets with (708 and 709) regulation of waste and freight deliveries as well as (801 and 806) EV charging. Based on analysis of road traffic data the majority of road links towards the west of the city centre show minor	✓

	beneficial impacts or negligible change. Towards the east of the city centre there is a larger variation in links showing beneficial and adverse change in approximately equal measure but with the majority showing a negligible change. Minor benefit with regard to noise impacts in the city centre.	
3	This package aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 3 modelling outputs indicate a reduction of 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in cycling. Reducing road space available for vehicles would limit the number of vehicles in the city centre and alongside road closures on key arterial routes, and reallocation of road space may result in displaced impacts on noise due to redirecting traffic elsewhere. The range of measures with benefits in relation to noise environment are similar to those in Package 2 and include Traffic Calming, (501) Quiet / Low Use Streets with (708 and 709) regulation of waste and freight deliveries as well as (801 and 806) EV charging. Based on analysis of road traffic data the majority of road links towards the west of the city centre show minor to moderate beneficial impacts or negligible change. Towards the east of the city centre there is a larger variation in links showing beneficial and adverse change in approximately equal measure but with the majority showing a negligible change. Minor benefit with regard to noise impacts in the city centre.	✓
4	This package aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. Reducing road space available for vehicles would limit the number of vehicles in the city centre and alongside road closures on key arterial routes, and reallocation of road space may result in displaced impacts on noise due to redirecting traffic elsewhere. Specific options will require further assessment once details are known. The measures with noise environment benefits are similar to those in Package 2, including Traffic Calming, (501) Quiet / Low Use Streets with (708 and 709) regulation of waste and freight deliveries as well as (801 and 806) EV charging. Based on analysis of road traffic data the majority of road links towards the west of the city centre show minor to moderate beneficial impacts or negligible change. Towards the east of the city	✓

	centre there is a larger variation in links showing beneficial and adverse change in approximately equal measure but with the majority showing a negligible change. Minor benefit with regard to noise impacts in the city centre.	

Table 25. Environment appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Package 1 aims to use the existing material assets better and reduce the need to construct new infrastructure. Interventions including traffic calming, quiet streets and removing parked cars and traffic has the potential to gradually remove the dominance of vehicles in the city centre to make it safer and more accessible for pedestrians and cyclists. Reducing road space available for cars would limit the number of cars in the city centre, and alongside traffic calming measures could reduce vehicle emissions. Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a	Package 2 has similar benefits to Package 1, which will gradually remove the dominance of vehicles in the city centre to make it safer and more accessible for pedestrians and cyclists, alongside traffic calming measures to reduce vehicle emissions. Providing more space for pedestrians and cyclists and segregation from road traffic could improve public confidence in using active travel means. Travel hubs would increase the likelihood of a modal shift to active travel. The cumulative effect of Package 2 would be a reduction of 20% of private cars, with a corresponding 36% increase in walking and 26% increase in cycling. This would be beneficial for addressing the	Package 3 represents the most robust package with further public realm and safety measures, including the M8 Garden Cap (317) and the Lanes Strategy (215), with an improved public realm offering Charing Cross. It is assumed that any redevelopment will include interventions specific to the environment, such as ground investigations, remediation (if required), sustainable drainage system (SuDs), rain gardens, permeable pavements, etc. The scale of potential impacts will depend on the final design. Further assessment is required once details are known. Options which positively	Cumulatively, package 4 represents includes a more significant number of the public realm and active travel measures, including the expansion of the Avenues (158), the Lanes Strategy (215), the feasibility of the M8 Garden Cap over the M8, strategic repurposing of the road network to prioritise people-friendly public spaces, public transport, and active travel (101), Traffic-calming, speed management and enforcement - to prioritise active travel (157) and St. Enoch Highline (213). It is anticipated that these measures will improve the walking and cycling environment and infrastructure and reduce both car use and

reduction of 13% in vehicle person trips with a corresponding 10% increase in walking and a 5% increase in cycling. This would be beneficial for addressing the exceedance issues in Air Quality Management Area (AQMA) in the city centre. Providing more space for pedestrians and cyclists and segregation from road traffic could improve public confidence in using active travel means. Travel hubs would increase the likelihood of a modal shift to active travel. Reallocating more space to pedestrians would enhance the experience for pedestrians and cyclists in the city centre. Further options such as design guides (106), the Avenues Plus programme (215), and Play streets and more green space (330) are assumed to include interventions specific to the environment such as	exceedance issues in Air Quality Management Areas (AQMAs) in the city centre. Better usage also aims to use the existing material assets better and reduce the need to construct new infrastructure. Interventions including traffic calming, quiet streets and removing parked cars and traffic would positively impact the setting of proximate listed buildings and localised parts of Conservation Areas. Further options such as design guides (106), the Avenues Plus programme (215), and Play streets and more green space (330) the Avenues extension (159), Masterplans (207), Planned quay wall extension and a new public realm walkway at Windmillcroft Quay (322) are assumed to include interventions specific to the environment such as Sustainable drainage system (SuDs), implementation of rain	contribute toward safety include the People First Zone (710), the Avenues programme (158) and expansion (212), and the creation of safe junctions and crossing points (327). In addition, there are direct security interventions in Packages 3, which include enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements, including improved lighting (315) and implementing the Lanes Strategy (215) and build on Glasgow's Public Realm Design and Maintenance Guide. Package 3 modelling outputs indicate that the measures would reduce 23% vehicle person trips with a corresponding 43% increase in walking and 31% increase in cycling. This represents a 10%	public transport use as there is a shift towards active travel. It is assumed that any redevelopment will include interventions specific to the environment, such as ground investigations, remediation (if required), sustainable drainage system (SuDs), rain gardens, permeable pavements, etc. The scale of potential impacts will depend on the final design. Further assessment is required once details are known. Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. This represents a 16.2% reduction in CO2 when compared to 2017 data. Minor to moderate benefits for environment and physical fitness.

Sustainable drainage system (SuDs), implementation of rain gardens, permeable pavements etc. are likely to yield positive outcomes with regards to the water environment. Minor benefits with regard to local air quality, water environments, townscape, visual amenity, cultural heritage and physical fitness.	gardens, permeable pavements etc. The scale of potential impacts will depend on the final design. Further assessment is required once details are known. It is anticipated that the interventions would encourage a modal shift to more sustainable modes of traffic to achieve these benefits with a minor benefit to noise, global & local air quality, water, and physical fitness.	increase in walking mode share. The cumulative effect of options in Package 3 is anticipated to reduce traffic in the city centre. The interventions are expected to encourage a modal shift to more sustainable modes of traffic and achieve moderate benefits for the environment and physical fitness.	
✓	✓	✓✓	✓ / ✓✓

7. CLIMATE CHANGE

7.1 Introduction

7.1.1 Climate is generally defined as the average weather (e.g. temperature, rainfall) experienced over a long period of time[3]. It is clear from a wide range of data sources[4] that Scotland's climate is changing due to anthropogenic activity. In Glasgow, changes mean that there will be increased extreme weather events, more intense winter rainfall and drier summers, higher average temperatures, and an increased level of flooding[5]. The Met Office's State of the UK Climate report for 2021 shows the ten hottest years in the UK since 1884 have all happened since 2002.

7.1.2 Climate projections indicate that this change will continue, with more severe weather events becoming more common. These changes have the potential to cause significant disruption to Scottish transport infrastructure and there is a need to ensure that current and future infrastructure within the study area is resilient to changing conditions.

7.1.3 A climate (and ecological) emergency was declared Glasgow City Council in May 2019. An action plan has subsequently been developed, covering key issues such as transport, to increase the rate of action towards reducing Glasgow's carbon emissions to achieve neutrality by 2030. Transport is a significant contributor of emissions directly linked to climate change, as well as those harming human health through local air pollution.

7.1.4 Although CO_2 emissions from transport have slightly reduced in Glasgow since 2005, the share from transport as a proportion of all CO_2 emissions within the local authority area have not seen the reductions as seen in other sectors.

7.2 Methodology

7.2.1 The latest Scottish Transport Appraisal Guidance Managers Guide sets out the three criterion that should be assessed under the Detailed Options Appraisal including:

- Greenhouse Gas Emissions
- Vulnerability to Effects of Climate Change
- Potential to Adapt to Effects of Climate Change

[3] https://www.metoffice.gov.uk/weather/climate-change/what-is-climate-change#:~:text=Climate%20change%20refers%20to%20a,greenhouse%20gases%20into%20the%20air
[4] https://www.environment.gov.scot/our-environment/climate/changing-climate/
[5] https://www.adaptationscotland.org.uk/why-adapt/climate-trends-and-projections

7.2.2 The Climate Change Scotland Act (2019) includes a target date of 2045 for achieving net zero carbon as well as a target of 75% reduction against 1990 emissions levels by 2030. The effect of each option on our ability to meet net zero targets should be assessed. This section covers emissions for each options, vulnerability and the potential of each option to adapt to the effects of climate change.

7.3 Option Appraisal

Greenhouse Gases

7.3.1 According to data under the State of the Environment Reporting, Scotland has almost halved its greenhouse gas emissions since 1990[6]:

- In 2019, Scottish greenhouse gas emissions were estimated to be 47.8 million tonnes carbon dioxide equivalent ($MtCO_2e$). This is 1.1 $MtCO_2e$ less than 2018 (a 2.3 % reduction), and 37.3 $MtCO_2e$ less than 1990 (a 43.8 % reduction).
- Since 1990, the power sector has contributed most to the overall reduction (71.8 %) as coal fired power stations have closed and renewable energy generation has increased. The top 3 emitters now are transport, business and agriculture.
- Carbon dioxide is the largest contributor to Scottish greenhouse gas emissions (70 %) followed by methane and nitrous oxide. Transport is now the biggest source of CO_2 emissions.

Table 26. Greenhouse gases

GREENHOUSE GASES		
Option	**Performance**	**Score**
1	Package 1 aims to gradually remove the dominance of vehicles in the city centre with a comprehensive package of active travel measures, such as segregated cycling and more-car free space, decarbonising transport, better connections with train stations, and creating active travel hubs etc. Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a reduction of 13% in vehicle person trips with a corresponding 10% increase in walking and a 5% increase in cycling. Analysis of road traffic data shows that Package 1 will lead to a reduction in AADT flows on the majority of roads in the city centre, however there are also some city centre roads on which AADT flows	✓

[6] https://www.gov.scot/publications/scottish-greenhouse-gas-statistics-1990-2019/

	will increase. As vehicle person trips will reduce overall, Package 1 is expected to result in an overall minor benefit to Global Air Quality.	
2	Package 2 represents measures that focus on extending, promoting, and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. In addition, Package 2 includes additional active travel measures, such as segregated cycling and more-car free space, and a complete package of measures to help decarbonise transport. Public realm improvements include the Avenues extension and more-car free space. Package 2 modelling outputs indicate that there would be a reduction of 20% with a corresponding 36% increase in walking and 26% increase in cycling. Analysis of road traffic data shows that Package 2 will lead to a reduction in AADT flows on the majority of roads in the city centre, however there are also some city centre roads on which AADT flows will increase. As vehicle person trips will reduce overall, Package 2 is expected to result in an overall minor benefit to Global Air Quality.	✓
3	Package 3 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 3 modelling outputs indicate a reduction of 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in cycling. Analysis of road traffic data shows that Package 3 will lead to a reduction in annual average daily traffic AADT flows on more roads in the city centre than Package 1 and Package 2, however there are still some city centre roads on which AADT flows will increase. As vehicle person trips will reduce overall, Package 3 is expected to result in an overall moderate benefit to global air quality.	✓✓
4	Package 4 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. Analysis of road traffic data shows that Package 4 will lead to a reduction in annual average daily traffic AADT flows on more roads in the city centre than Package 1 and Package 2, however there are still some city centre roads on which AADT flows will increase.	✓✓

	As vehicle person trips will reduce overall, Package 4 is expected to result in an overall moderate benefit to global air quality.	

Vulnerability to Effects of Climate Change

7.3.2 Vulnerability is defined by the International Panel on Climate Change (IPCC) in 2001 as 'Vulnerability: the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate vulnerability and extremes'.

7.3.3 Vulnerability is the degree to which infrastructure is impacted, depending on the sensitivity of the system and its ability to cope with a significant event e.g. flood, heatwave, storm. This section therefore considers the following:

- The risk posed to the options under the package - how often the transport network and systems will be subject to a flood event, winter storm etc and if this is becoming more frequent
- The sensitivity of the system – what is the impact on operation of the package and options e.g. is there potential for increased flood vulnerability and would that cause significant disruption to travel time / closure / increased accidents etc
- The adaptive capacity of each package to cope with a significant event / increased frequency and intensity of events

7.3.4 The plan area is covered by SEPA's Glasgow City north (Potentially Vulnerable Area 11/15) which identifies flooding as a key issue. According to SEPA Flood Maps[7], the River Clyde corridor is affected by coastal, river and surface flooding, and experiences periodic flood events which, with future climate change are anticipated to increase in severity and frequency.

7.3.5 The Glasgow City Region Climate Adaptation Strategy and Action Plan[8] also indicates that the plan area is subject to periodic extremes of heavy rainfall and storms which also increase the risk of flooding. These events are projected to increase in future together with other extremes, such as increased heat which are a particular issue in urban centres. Adaptation Scotland highlighted some key events affecting the transport network in Glasgow[9]:

- Heatwave disruption, June and July 2018 and summer 2022 – led to significant rail disruption and deterioration of road surfaces

[7] https://www.sepa.org.uk/environment/water/flooding/flood-maps/
[8] http://climatereadyclyde.org.uk/gcr-adaptation-strategy-and-action-plan/
[9] https://www.adaptationscotland.org.uk/news-events/stories/adaptation-roads-and-transport

- Severe flooding after storm event August 2020 – led to significant problems on the roads with main routes impassable and parts of the subway system closed and rail services disrupted
- Severe flooding in October 2021 – led to impassable roads significant disruption to train services

7.3.6 The Metropolitan Glasgow Strategic Drainage Partnership[10] was formed in 2002 by Glasgow City Council, Scottish Water and SEPA due to a need for co-ordinated action which has led to the implementation of schemes and works to protect properties from river and surface water flooding across Glasgow City and wider region.

7.3.7 Vulnerability to climate change is addressed through tackling emissions to lessen the impacts of climate change and design of the city centre and its infrastructure to be more resilient to impacts.

Table 27. Vulnerability to effects of climate change

VULNERABILITY TO EFFECTS OF CLIMATE CHANGE		
Option	**Performance**	**Score**
1	Package 1 includes some measures that address vulnerability to effects of climate change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. The plan area has been subject to travel disruption in the past due to surface water flooding following storm events, including notably during COP26. Package 1 commits to a Surface Water Management Strategy (707).	-
2	Package 2 includes measures which are primarily Incentive based to look to extend user choice and incentivise behaviours around active travel and reducing car trips but with limited change to city centre access, road-space or parking restrictions that would support change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. Package 2 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, (330) Play streets and more green space, (207) Masterplans for key parts of the plan area and (322) Quay wall extension for Windmillcroft Quay	✓

[10] https://www.mgsdp.org/index.aspx?articleid=21077

	(south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	
3	Package 3 includes further measures that address vulnerability to effects of climate change through a combination of Incentive and Demand Management which look to extend user choice and incentivise behaviours around active travel and reducing car trips aligned with changes to city centre access, road-space and parking that supports change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. Package 2 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, Play streets and more green space (330), Masterplans for key parts of the plan area and (322) Quay wall extension for Windmillcroft Quay (south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	✓
4	Package 4 is primarily demand management based with a series of measures that focuses on restricting city centre car trips, access to the city centre and reduced parking space availability but without significant investment in extending choice based on sustainable modes and public transport.	**x**

Potential to Adapt to Effects of Climate Change

7.3.8 The Glasgow City Region Climate Adaptation Strategy and Action Plan was produced in June 2021 by Climate Ready Clyde (CRC), a cross-sector initiative funded by fifteen member organizations and supported by the Scottish Government to create a shared Vision, Strategy, and Action Plan for an adapting Glasgow City Region (GCR).

7.3.9 Adaptation Scotland[11] defines adaptation as working to address impacts of climate change *'through design, management and use of land, buildings, services and infrastructure'.*

[11] https://www.adaptationscotland.org.uk/what-adaptation/concept-adaptation

7.3.10 Transport infrastructure can be impacted by extremes of temperature, flooding and increased storm intensity. Options under the CCTP packages can mitigate for these changes through sustainable drainage and surface water design, increased greenspace within the plan area and addressing the cause of climate change – emissions reduction.

Table 28. Adaptation to climate change

ADAPTATION TO CLIMATE CHANGE		
Option	**Performance**	**Score**
1	Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a reduction of 13% in vehicle person trips with a corresponding 10% increase in walking and a 5% increase in cycling. This represents a 3.6% decrease in CO_2 when compared to 2017 data. The plan area has been subject to travel disruption in the past due to surface water flooding following storm events, including notably during COP26. Package 1 commits to a Surface Water Management Strategy (707).	-
2	Package 2 modelling outputs indicate that there would be a reduction of 20% with a corresponding 36% increase in walking and 26% increase in cycling. This represents a 7.1% reduction in CO_2 when compared to 2017 data. Package 2 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, Play streets and more green space (330), Masterplans for key parts of the plan area and (322) Quay wall extension for Windmillcroft Quay (south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	✓
3	Package 3 modelling outputs indicate a reduction of 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in cycling. This represents a 16.4 % reduction in CO_2 when compared to 2017 data. Like Package 2, Package 3 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, Play streets and more green space (330), Masterplans for key parts of the plan area and (322) Quay wall extension for Windmillcroft Quay (south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	✓✓

4	Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. This represents a 16.2 % reduction in CO_2 when compared to 2017 data. Like Packages 2 & 3, Package 4 includes a commitment to a Surface Water Management Strategy (707) with some wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, Play streets and more green space (330), Masterplans for key parts of the plan area. Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	✓✓

Table 29. Climate Change Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Package 1 aims to gradually remove the dominance of vehicles in the city centre with a comprehensive package of active travel measures, such as segregated cycling and more-car free space, decarbonising transport, better connections with train stations, and creating active travel hubs etc. However, reallocation of road space may result in displaced impacts on vehicle emissions due to redirecting traffic elsewhere. Package 1 modelling outputs show a conservative estimate of the change in modal share. They indicate that there would be a reduction of 13% in vehicle person trips with a corresponding 10% increase in walking and a 5% increase in cycling. This represents a	Package 2 represents measures that focus on extending, promoting, and incentivising travel behaviour change by removing and redistributing traffic as described in Package 1. In addition, Package 2 includes additional active travel measures, such as segregated cycling and more-car free space, and a complete package of measures to help decarbonise transport. Public realm improvements include the Avenues extension and more-car free space. Package 2 modelling outputs indicate that there would be a reduction of 20% with a corresponding 36% increase in walking and 26% increase in cycling. This represents a 7.1% reduction in CO_2 when compared to 2017	Package 3 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 3 modelling outputs indicate a reduction of 23% vehicle person trips in the city centre with a corresponding 43% increase in walking and 31% increase in cycling. This represents a 16.4 % reduction in CO_2 when compared to 2017 data. Package 3 includes further measures that address vulnerability to effects of	Package 4 aims to remove the dominance of vehicles more significantly in the city centre and make it safer and more accessible for pedestrians and cyclists to travel to and within the city centre. Package 4 modelling outputs achieve the most significant reduction in vehicle person trips at 25% due to the managed demand. However, the change in walking and cycling is lower than Package 2 and 3 at 32% and 24%, respectively. This represents a 16.2 % reduction in CO_2 when compared to 2017 data.

3.6% decrease in CO_2 when compared to 2017 data. Package 1 includes some measures that address vulnerability to effects of climate change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. The plan area has been subject to travel disruption in the past due to surface water flooding following storm events, including notably during COP26. Package 1 commits to a Surface Water Management Strategy (707).	data. Package 2 includes measures which are primarily Incentive based to look to extend user choice and incentivise behaviours around active travel and reducing car trips but with limited change to city centre access, road-space or parking restrictions that would support change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. Package 2 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, (330) Play streets and more green space, Masterplans for key parts of the plan area and	climate change through a combination of Incentive and Demand Management which look to extend user choice and incentivise behaviours around active travel and reducing car trips aligned with changes to city centre access, road-space and parking that supports change. Green networks including parks and street trees create more pleasant places to live and bring important environmental benefits through reducing temperatures, pollution and help manage surface water drainage. Package 2 includes a commitment to a Surface Water Management Strategy (707) with wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, (330) Play streets and more	Package 4 is primarily demand management based with a series of measures that focuses on restricting city centre car trips, access to the city centre and reduced parking space availability but without significant investment in extending choice based on sustainable modes and public transport. Package 4 includes a commitment to a Surface Water Management Strategy (707) with some wider options that would enable surface water drainage to be re-designed including (158 and 159) acceleration and expansion of avenues projects, (330) Play streets and more green space, (207) Masterplans for key parts of the plan area. Options which upgrade infrastructure will be

	(322) Quay wall extension for Windmillcroft Quay (south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	green space, (207) Masterplans for key parts of the plan area and (322) Quay wall extension for Windmillcroft Quay (south of river between Tradeston and Kingston Bridge). Options which upgrade infrastructure will be informed by best practice guidance on natural flood management, SuDS and blue-green networks.	informed by best practice guidance on natural flood management, SuDS and blue-green networks.
-	✓	✓✓	✓

HEALTH, SAFETY AND WELLBEING APPRAISAL

7.4 Introduction

7.4.1 This section considers the appraisal of each of the identified options against the health, safety and wellbeing criteria. The emerging sub-criteria includes:

- Accidents - relate to those taking place on all modes, but the advice set out in STAG only effectively requires consideration of accidents taking place on the road network;
- Security - relates to how safe the transport system is for users, and takes into account the impact of such initiatives as CCTV, help points, lighting, etc.
- Health Outcomes – relates to the impact transport options can have on the health of the general population
- Access to Health and Wellbeing Infrastructure
- Visual Amenity – relates to the impact options can have on the quality of panoramas, specific views and the visual environment of sensitive receptors

7.5 Accidents

7.5.1 As part of the Safety criteria the impact of an option on the number of transport related accidents and/or severity should be considered. The need to provide a positive impact on accidents was identified at the Case for Change stage and is supported by the interventions included in the packages.

7.5.2 The Case for Change identified that road traffic accidents in the city centre are numerous with data from Crashmap.co.uk presented in Figure 15 illustrating the change in accident frequency over the latest available eight years of full data, for all casualty types.

7.5.3 The data shows that overall, accident levels have been declining, although there has been an increase in serious accidents in 2019. On average, approximately 44% of all accidents per year involve pedestrian or cyclist casualties.

Figure 15.City Centre Accidents

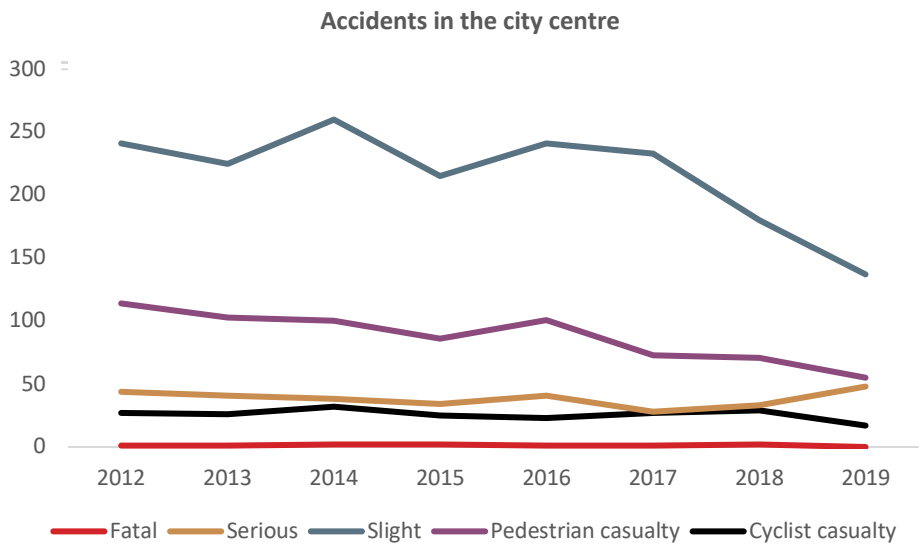


Table 30. City Centre Accidents

YEAR	FATAL	SERIOUS	SLIGHT	PEDESTRIAN CASUALTY	CYCLIST CASUALTY
2012	1	44	241	114	27
2013	1	41	225	103	26
2014	2	38	260	100	32
2015	2	34	215	86	25
2016	1	41	241	101	23
2017	1	28	233	73	27
2018	2	33	180	71	29
2019	0	48	137	55	17

7.5.4 The locations of accidents were also identified, as illustrated in the maps below. Between 2017 and 2019 there were three fatal accidents, one involving motorcyclist and two involving pedestrians. There were no cyclist fatalities in the city centre in this time period.

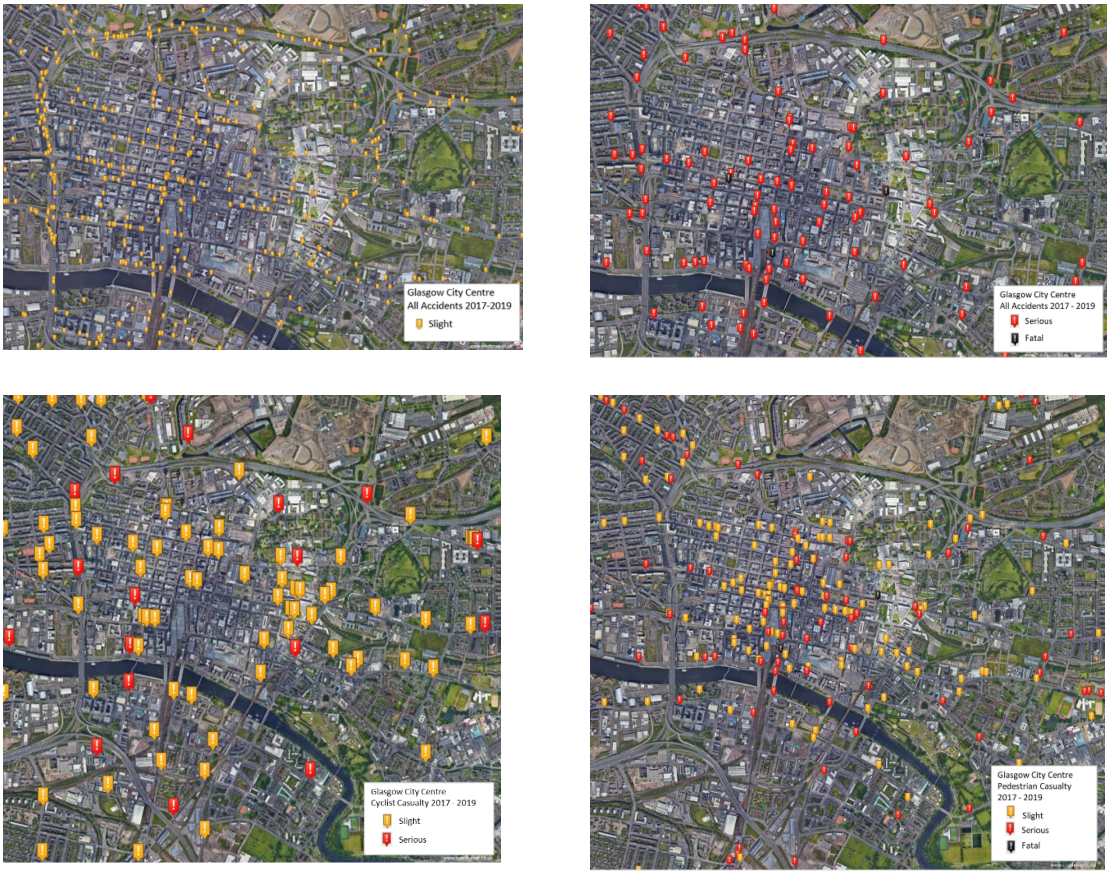


Figure 16.Location of accidents in the city centre 2017 – 2019, Crashmap.co.uk

7.5.5 COBALT (COst and Benefit to Accidents – Light Touch) is conventionally used to assess changes in accidents and calculate monetised accident costs and benefits of road- related options. COBALT compares the predicted numbers of accidents for each link and calculates the monetised accident costs and benefits of road related options. Given that 44% of accidents involved a pedestrian or cyclist and that the focus of the interventions is on demand management to varying degrees within the city centre and prioritising active travel and segregated cycle routes COBALT was not considered an appropriate tool as it only assesses general traffic and not the impact on cyclists and pedestrians.

7.5.6 As part of the option development and through discussions with stakeholders and reviews of recent accident data the location of junction improvements and segregated cycle lanes were identified. Junction improvement locations include Buchanan Street/Bath Street junction, Union Street/Argyle Street, Broomielaw/Jamaica Street and Cowcaddens Subway (327).

7.5.7 Within each package there are a number of interventions which would have a positive impact on accidents. The People First Zone (710) and other

demand management interventions including parking redistribution (106), WPL (902) and waste/delivery vehicle management (907 and 152) would reduce vehicle movements in the city centre which would reduce the number of accidents and conflicts between pedestrian and cyclists and between vehicles. The Avenues completion and expansion (212 and 158) will further reduce conflict with vehicles due to the segregation of cyclists. The improved active travel infrastructure and other interventions which increase the number of pedestrians and cyclists in the city centre would, however, likely increase the number of pedestrian/cyclist conflicts. Conflicts could be mitigated through considered design to reduce the likelihood of accidents.

Table 31. Accidents Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Minor positive impact based on the interventions within Package 1. Policies which positively contribute towards Accidents include the People First Zone (710), the Avenues programme (158) and creating safe junctions and crossing points (327).	Moderate positive impact based on the interventions within Package 2. Policies which positively contribute towards Accidents include the People First Zone (710), the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327) and the introduction of WPL (902).	Moderate positive impact based on the interventions within Package 3. Policies which positively contribute towards Accidents include the People First Zone (710), the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327) and the introduction of WPL (902).	Moderate positive impact based on the interventions within Package 4. Policies which positively contribute towards Accidents include the People First Zone (710), the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327) and the introduction of WPL (902).
✓	✓✓	✓✓	✓✓

7.6 Security

7.6.1 The aim of the Security sub-criterion is to assess and reflect changes in security arising from a particular transport option and the likely number of users affected. The Case for Change identified a number of problems related to safety within the city centre including user satisfaction surveys showing that Glasgow bus users (city wide) do not feel as safe as the Scottish average (92% compared to 94% feel personally safe and secure on the bus during the train and 61% compared to 69% during the evening. In contrast, Glasgow train users report a higher perception of safety compared to the rest of Scotland (82% compared to 76% in the evening). The number of lanes in the city centre that are underutilised and present community safety and public health concerns was also identified.

7.6.2 The packages identified seek to improve real and perceived security in the city centre by increasing the viability and vibrancy of the city through measures which increase the residential population within the city and increase the number of people walking and cycling through the city (Avenue completion, segregated cycle routes and the People First Zone). These measures would improve informal surveillance within the city centre. In addition there are direct security interventions in Packages 2-4 which include enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215) and build on Glasgow's Public Realm Design and Maintenance Guide. There are also measures to improve the attractiveness of public transport measures including improvements to Buchanan Bus Station and greater road space allocation to buses. The modelling currently shows that the improvements to active travel result in mode shift from public transport to active travel (see TPO2 for further details) however as the public transport improvements are improved further and with the introduction of the Metro (Package 3 and 4) it is likely that public transport usage will increase and result in increased perceptions of safety on public transport.

Table 32. Security Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Minor positive impact based on interventions within Package 1. The packages which positively contribute towards security include the People First Zone (710) and the Avenues programme (158).	Moderate positive impact based on interventions within Package 2 The packages which positively contribute towards security include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).	Moderate positive impact based on interventions within Package 2 The packages which positively contribute towards security include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).	Moderate positive impact based on interventions within Package 2 The packages which positively contribute towards security include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).
✓	✓✓	✓✓	✓✓

7.7 Health Outcomes

7.7.1 The World Health Organisation's Health Economic Assessment Tool (HEAT) had been used to understand some of the health benefits associated with the increase in active travel due to the interventions. The outputs are predominantly related to premature mortality associated with increased walking and cycling levels but also provide an indication of the scale of general improvement in health resulting from the packages.

7.7.2 In addition to reduced premature mortality increased cycling levels are considered to improve general health within the city centre and wider Glasgow area which was highlighted in the Case for Change. In the wider Glasgow City area 77% of the population report that day-to-day activities are not limited compared to the Scottish average of 80% and 85% in Glasgow city centre.[12] Health benefits associated with active travel not only provide benefits to the population in terms of quality of life but also for the local economy with employees who travel actively using 27% fewer sick days than colleagues.[13]

7.7.3 Table 33 shows that Package 3 generates the greatest health benefits which is due to the significant active travel improvements including include the People First Zone (710), the Avenues programme (158).

7.7.4 HEAT uses outputs from SRTM to derive the health outcome data and it should be noted that, as discussed previously, the level of cycling is under-represented in SRTM, however HEAT uses the step change in mode which is captured by SRTM. Also, the assessment of premature death has been based on the city centre resident population which may underestimate the benefits as residents from beyond the city centre are expected to benefit from the Options.

Table 33. Premature deaths prevented per annum

	PREMATURE DEATHS PREVENTED PER ANNUM
Package 1	0.5
Package 2	1.5
Package 3	1.9
Package 4	1.4

[12] Census 2011
[13] TfL Walking and Cycling Economic Benefits Summary Pack

Table 34. Health Outcomes Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Measures which will positively impact health outcomes include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), and creating active travel hubs (403).	Measures which will positively impact on health outcomes include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), and creating active travel hubs (403).	Measures which will positively impact on health outcomes include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), , creating active travel hubs (403) and repurposing of road space to public transport and active travel (106).	Measures which will positively impact on health outcomes include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), creating active travel hubs (403), repurposing of road space to public transport and active travel (106) and the introduction of the metro (209).
✓	✓✓	✓✓	✓✓

7.8 Access to Health and Wellbeing Infrastructure

7.8.1 The healthcare provision in the area includes the Glasgow Royal Infirmary, the Princess Royal Maternity Unit and the Glasgow Dental Hospital. These are key health destinations for residents in Glasgow and the surrounding area as they offer specialised care. The interventions proposed do not seek to improve the end to end journeys to these healthcare facilities, which is instead covered by Glasgow-wide policies and proposals in the Glasgow Transport Strategy, however there are a number of proposals which will provide benefits to access to health and wellbeing infrastructure

7.8.2 The option packages 1 and 2 support affordable and sustainable travel to healthcare facilities through improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), which will open up cycling to more users; providing better connections with train stations (205), and creating active travel hubs (403).

7.8.3 Healthcare users have a variety of complex needs and active travel may not always be appropriate so packages 3 and 4 also include the repurposing of road space to public transport (106), improved transport connections and hubs including at Cathedral Street (601) and the introduction of the metro (209) which would improve journey times and reliability in the city centre. The People First Zone (710) will improve journey times in the city centre but will not impact on accessibility to/from the healthcare facilities by car.

Table 35. Access to Health and Wellbeing Infrastructure Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Change in public transport journey times (PM): -7% Measures which will positively impact on access to health and wellbeing infrastructure include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), and creating active travel hubs (403).	Change in public transport journey times (PM): -9% Measures which will positively impact on access to health and wellbeing infrastructure include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), and creating active travel hubs (403).	Change in public transport journey times (PM): -9% Measures which will positively impact on access to health and wellbeing infrastructure include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), creating active travel hubs (403), repurposing of road space to public transport (106), improved transport connections and hubs including at Cathedral Street (601) and the introduction of the metro (209).	Change in public transport journey times (PM): -9% Measures which will positively impact on access to health and wellbeing infrastructure include improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), providing better connections with train stations (205), creating active travel hubs (403), repurposing of road space to public transport (106), improved transport connections and hubs including at Cathedral Street (601) and the introduction of the metro (209).
✓	✓	✓✓	✓✓

7.9 Visual Amenity

7.9.1 The townscape and traffic in Glasgow city centre affects the everyday experience of visual amenity for those who live in, visit, pass through and work in it. Transport improvement measures can have an effect on visual amenity: directly through physical interventions such as infrastructure improvements; or indirectly through longer term reductions in traffic resulting from changes in transport modes. Improvements in townscape and visual amenity can be integral to achieving the transport or other environmental objective, or a by-product of a measure whose main objective is transport-related.

7.9.2 The four packages can be assessed on the degree to which the measures are likely to lead to direct or indirect improvements in townscape and visual amenity. Generally, direct physical interventions of a scale and type that can improve the appearance of an area or corridor as well as achieving other environmental objectives have the highest positive score. These would include improvements related to active travel or significant public realm projects. Smaller interventions likely to lead to localised improvements have a lower positive score, but this could be higher if repeated many times across an area. Measures such as traffic reduction are given a lower positive score, reflecting the more indirect nature of the effect on visual amenity. Many measures which have limited or no obvious relationship to townscape, such as vehicle emissions controls or changes to waste collection times are given a neutral assessment. Occasional measures are given negative scores if the physical intervention has potential for adverse effect on townscape and visual amenity, although the measure may be beneficial to other aspects of the environment or traffic management.

7.9.3 The table below indicates that Options 2 – 4 include more direct physical measures most likely to benefit townscape and visual amenity. Option 3 would be the most beneficial, as it includes a high proportion of incentivisation measures leading to physical improvements (e.g. M8 Cap at Charing Cross - to provide a new 'quality place' (306); Updated access to the St. Enoch Car Park and Re-develop King Street parking (325)) as well as demand control measures leading to more indirect effects, reducing vehicular traffic. Option 4, while including some of these measures, has a higher proportion of demand control measures less obviously connected to physical improvements, but intent on reducing traffic (e.g. Traffic-calming, speed management and enforcement - to prioritise active travel (157)), would be slightly less beneficial than Option 3. Option 2, although focusing

an incentivisation, has fewer overall landscape-related measures than Option 3 so would also be slightly less beneficial.

Table 36. Visual Amenity Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Overall minor improvement to townscape and visual amenity. Many measures would have indirect benefits through traffic reduction including Parking distribution, restrictions and increased enforcement (106). Measures with the most direct positive effects include implementing the Lanes Strategy and integrating with Avenues (215) or Play streets and more green space (330). Some measures such as Require all Taxi and Public Transport Vehicles to be zero emission (805) would have no or little effect on townscape and visual amenity.	Overall moderate improvement to townscape and visual amenity through a variety of significant infrastructure improvements. Measures include improving streets for active travel and increasing public realm provision: e.g. Complete a network of safe, high quality, segregated cycling arterial routes (208); M8 Cap at Charing Cross - to provide a new 'quality place' (306); Updated access to the St. Enoch Car Park and Re-develop King Street parking (325). Measures with a more indirect effect on townscape and visual amenity include Smart 'tartan' grid of streets for	Overall moderate improvement to townscape and visual amenity through a wide variety of significant infrastructure improvements also included in Options 3 and 4, relating to both promoting travel behaviour change and managing demand. This option contains the widest variety of measures with potential to enhance townscape and visual amenity and would be slightly more beneficial than Options 2 or 4.	Overall moderate improvement to townscape and visual amenity through a variety of significant infrastructure restricting traffic and managing demand. Measures include: Strategic repurposing of the road network to prioritise people friendly public spaces, public transport and active travel (101), Traffic-calming, speed management and enforcement - to prioritise active travel (157) and St. Enoch Highline (213). Potential for direct negative townscape effects from high profile infrastructure measures including Glasgow City Region Metro (209).

	car-only or car-free traffic management (104) or Connecting train stations - better pedestrian provision (205).		
✓	✓✓	✓✓	✓✓

8. ECONOMY

8.1 Introduction

8.1.1 In accordance with STAG, assessment of the economic impact takes into consideration:

- Transport Economic Efficiency (TEE) – the benefits ordinarily captured by standard cost-benefit analysis – the transport impacts of a proposal;
- Wider Economic Impacts – impacts which are not captured by the TEE but are of importance from a policy or distributional perspective. They relate to the notion of wider economic benefits derived from the impact of transport upon agglomeration, and the underlying relationship of impacts of agglomeration upon productivity.

8.1.2 As part of the STAG appraisal the economic benefits and disbenefits of the options are considered. This is based on the concept of Transport Economic Efficiency which is the benefits ordinarily captured by standard cost benefit analysis – the transport impacts of a proposal.

8.1.3 The transport costs and benefits captured by the TEE are intended to represent an acceptable approximation of the full economic impacts of a project. Journey time benefits and disbenefits form a key component of the transport user benefits in addition to the change in the monetary cost of travel. This is informed by the strategic modelling outputs.

8.1.4 The Wider Economic Impacts are not captured by the TEE and have been considered separately by assessing the economic benefits based on benchmarking against the outcomes for similar strategies in European and the TfL Walking and Cycling: Economic Benefits.

8.2 Transport Economic Efficiency

8.2.1 As described in Appendix D, the modelling of the various packages of city centre measures involved various changes to (perceived) walking & cycling speeds & car availability, in addition to the representation of the various changes to city centre road capacity and parking space availability. These changes in mode behaviour cannot be applied to subsets of the demand and have therefore been applied across the modelled area.

8.2.2 In addition, the decrease in car ownership which was used to reflect the predicted reduction in residential parking in the city centre generates TUBA benefits (due to the reduction in traffic congestion), but with no offsetting disbenefits from the reduced access to a private car.

8.2.3 As a result, the standard TUBA outputs from the modelling will significantly over-estimate the user benefits of the four packages and therefore cannot be used here.

8.2.4 Instead, we restrict the appraisal of the economic benefits to a monetisation of the benefits of the decreased car use (health benefits of active travel and reduction in damage costs from traffic emissions in the city centre), the impacts on parking revenue and the wider economic benefits which we predict will be generated by the four packages of measures.

8.3 Monetising the Emissions Reduction Benefits

8.3.1 The table below shows the results of applying TAG damage costs (and carbon pricing) to the reduction in emissions of CO_2, NO_X and PM_{10} in the city centre in 2027.

Table 37. Change relative to Reference Case (Tonnes per Annum in 2027)

CHANGE RELATIVE TO REFERENCE CASE (TONNES PER ANNUM IN 2027)	CO_2	NO_X	PM_{10}	TOTAL
Package 1	-3,325	-4.3	-0.3	
Package 2	-4,533	-5.9	-0.4	
Package 3	-7,962	-10.4	-0.7	
Package 4	-7,889	-10.3	-0.7	
Benefits (£K, 2018 prices)				
Package 1	£249.1K	£100.8K	£32.4K	£382.3K
Package 2	£349.1K	£138.0K	£48.0K	£535.1K
Package 3	£613.1K	£245.3K	£87.6K	£945.9K
Package 4	£607.4K	£242.5	£86.7K	£936.7K

8.4 Monetising the Health Benefits

8.4.1 Transport Economic Efficiency (TEE) takes into account the economic impacts in terms of transport benefits from the investment in a particular option. The TEE analysis here includes the consideration of the net benefit to transport users.

8.4.2 Using the World Health Organisation's Health Economic Assessment Tool (HEAT), described further in section 7.7, the health benefits associated with the increase in active travel due to the interventions have been monetised. The outputs are predominantly related to premature mortality associated with increased walking and cycling levels but also provide an indication of the scale of general improvement in health resulting from the packages.

8.4.3 Mortality is monetised using value of statistical life (VSL) of £2,410,800 . Table 38 presents the benefits over the full assessment period of 10 years adjusted to 2022 values.

Table 38. Monetisation of Health Benefits

PACKAGE	£K
Package 1	£1,059K
Package 2	£30,171K
Package 3	£38,804K
Package 4	£28,391K

8.5 Wider Economic Impacts

8.5.1 Wider economic impacts are impacts which are not captured by the TEE but are of importance from a policy or distributional perspective. They are not transport related but do represent benefits to society associated with a transport intervention. TPO3 captures many of the potential benefits associated with each package including increased retail sales, retail spend, lower retail vacancy and increased footfall. In addition, many of the interventions proposed are considered to have positive benefits associated with attracting investors to the city.

8.5.2 Below are three case studies of similar transformational public realm and active travel improvements which have attracted businesses and investment which reflect the possibilities for Glasgow and the CCTP[14]:

- Connecting Leicester is the successor to 'Streets and Spaces' initiative which improved routes through the city centre for pedestrians and cyclists, and make the city centre more attractive to investors and developers. Connecting Leicester has considered to have attracted £30 million of private sector investment in retail, restaurants, bars, new businesses and residential developments in the city centre;
- A $4.5 million investment in streetscape and pedestrian improvements in Lodi, California, combined with economic development incentives, were credited with attracting 60 new businesses; and
- Washington DC, improvements to Barrack's Row (new patterned sidewalks, more efficient public parking and new traffic signals) attracted 44 new businesses and 200 new jobs.

[14] Sustrans, Pedestrian Pound, 2018

Table 39. Economy Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Measures which will have positive Wider Economic Impacts include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). The repurposing of road space to public transport (106) and the introduction of the metro (209) would also attract investors to the city.	Measures which will have positive Wider Economic Impacts include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). The repurposing of road space to public transport (106) and the introduction of the metro (209) would also attract investors to the city, as would master-planning (207).	Measures which will have positive Wider Economic Impacts include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). The repurposing of road space to public transport (106) and the introduction of the metro (209) would also attract investors to the city, as would master-planning (207) and the M8 Garden Cap.	Measures which will have positive Wider Economic Impacts include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). The repurposing of road space to public transport (106) and the introduction of the metro (209) would also attract investors to the city, as would master-planning (207) and the M8 Garden Cap.
✓	✓✓	✓✓✓	✓✓✓

9. EQUALITY & ACCESSIBILITY

9.1 Public Transport Network Coverage

9.1.1 Public transport network coverage considers any improvements to the public transport network which improves access to services. There are a number of measures proposed which will directly improve public transport services: road space reallocation to buses (101 and 106), improved connections between train stations (205) and bus stop rationalisation (610) for example. These interventions, along with those directed at demand management to reduce private vehicles in the city centre will improve the reliability and journey times for bus services and this is demonstrated in the bus journey time changes for each package presented in Table 40. These journey times will increase the destinations which are accessible within a limited time period (eg. 30 minutes) but do not directly impact on public transport network coverage.

Table 40. Bus journey time changes (PM)

PACKAGE	BUS JOURNEY TIME CHANGE
Package 1	-9%
Package 2	-11%
Package 3	-13%
Package 4	-13%

9.1.2 The Clyde Metro proposed in Package 3 and 4 (209) seeks to directly improve public transport coverage. The Metro would bring major benefits for public transport coverage and will extend coverage to areas with poor or no public transport currently. This would provide connections to key services including hospitals and higher education as well as better connections for employment.

Table 41. Public Transport Network Coverage Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Minor positive impact based on the interventions within Package 1. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158) and parking redistribution to manage demand and reallocate space to active travel and public transport (106).	Moderate positive impact based on the interventions within Package 2. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207) and Workplace Parking Levy (902).	Moderate positive impact based on the interventions within Package 3. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207), Workplace Parking Levy (902), Clyde Metro (209) and the M8 Garden Cap Feasibility (317).	Moderate positive impact based on the interventions within Package 4. Policies which positively contribute towards Policy Integration include the People First Zone (710), the Avenues programme (158), parking redistribution to manage demand and reallocate space to active travel and public transport (106), Masterplans (207), Workplace Parking Levy (902), Clyde Metro (209) and the M8 Garden Cap Feasibility (317).
✓	✓✓	✓✓	✓✓

9.2 Active Travel Network Coverage

9.2.1 Active travel network coverage captures the benefits to the walking and cycling network. Each of the packages directly improves walking and cycling infrastructure within the study area to varying degrees which the strategic modelling has indicated sees a modal shift towards active travel.

9.2.2 Package 1 would improve the active travel network through the strategic repurposing of the road network and parking redistribution to prioritise active travel (101) and improving the facilities and connections for active travel through the following interventions: traffic calming to prioritise active travel (157), improved traffic signal control systems to prioritise active travel (156), safer crossings and junctions (327), cycle storage (405) and cycle hire (404), and the introduction of active travel hubs (403). While 'new' coverage is limited, the quality of the access is expected to be improved and this is considered a minor benefit. Package 1 modelling outputs indicates that there would be a 10% increase in walking and 5% increase in cycling. In terms of mode share this represents a 2% increase in walking mode share and no change in cycling mode share. As discussed previously, there are limitations to the SRTM's ability to model active travel modes and modal shift to walking and cycling in particular. SRTM therefore shows a conservative estimate of change in trips and mode share and is expected to generate a greater change than reflected in these outputs.

9.2.3 In addition to the benefits generated by Package 1, Package 2 has a more comprehensive package of active travel measures, such as segregated cycling and more-car free space (159) and the expansion of the Avenues Plus project (212). Modelling outputs show that over a 12 hour period compared to the Do Minimum there is a 36% increase in walking and 26% increase in cycling. In terms of mode share this represents a 8% increase in walking mode share and no change in cycling mode share however it is anticipated that the step change in cycling infrastructure including increased segregated routes and road space and parking redistribution to prioritise active travel would generate a greater increase in cycling mode share.

9.2.4 Packages 3 and 4 are likely to have moderate benefits for active travel network coverage in terms of improvements to the ability to walk or cycle to services in the area. Effective Master-planning (207) and new routes, coupled with improved quality will produce a moderate benefit. The Packages may provide greater benefits than Packages 1 and 2, due to the additional neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).

9.2.5 Package 3 modelling outputs indicates that the measures would result in a 43% increase in walking and 31% increase in cycling. Package 4 shows increases in walking and cycling of 32% and 24% respectively. The increase in cycling trips in Package 3 is the greatest of each of the Packages and it is therefore assumed that the measures introduced including improved connectivity and segregated routes would generate a greater increase in cycling and walking mode share.

Table 42. Active Travel Network Coverage Appraisal Summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Minor positive impact based on the interventions within Package 1. Policies which positively contribute towards active travel network coverage include the Avenues programme (158) and strategic repurposing of the road network and parking redistribution to prioritise active travel (101).	Moderate positive impact based on the interventions within Package 2. Policies which positively contribute towards active travel network coverage include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327).	Moderate positive impact based on the interventions within Package 3. Policies which positively contribute towards active travel network coverage include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).	Moderate positive impact based on the interventions within Package 4. Policies which positively contribute towards active travel network coverage include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).
✓	✓✓	✓✓	✓✓

9.3 Comparative Access by People Group and Geography

9.3.1 Comparative accessibility is the distribution of accessibility impacts and recognises that some options may discriminate against particular groups in society, and that the geographical distribution of transport investment has not always reflected policy aims. This section identifies those who stand to benefit from an individual transport project and policy and any potential disbenefits for some people or areas.

9.3.2 The Case for Change identified that the study area has a number of socio-economic characteristics which should be taken into consideration at this stage of the appraisal as they determine the most appropriate interventions. The following characteristics were explored in the Case for Change:

- The city centre is predominantly comprised of 16-34 year olds. The combination of the two age groups together (16-24 and 25-34) make up more than 70% of the population for 12 out of 36 city centre datazones with the highest concentration of the 16-24 year age group is around the Caledonian and Strathclyde Universities, suggesting a large student population in these areas. This population is less likely to have access to a car. They are also less likely to hold a driving license, and are more likely to walk or travel by bus to work.[15]
- Most of the city centre datazones are more than 50% male, with "Laurieston and Tradeston – 02" to the south of the river being 73% male. Conversely, only nine of the 36 datazones has a female proportion between 50-55% and all remaining areas have less than 50%.
- Data presented in the GTS Equality impact assessment suggests that women are less likely to have access to a driver's license than men, and use buses more frequently than men. They are also less likely to travel by bike than men[16].
- The city centre has a higher than average proportion of population from a variety of ethnic backgrounds in comparison to Glasgow City and Scotland as a whole. 16% of the population includes Asian communities, particularly concentrated in areas of Garnethill, Woodlands, George Street, High Street, Broomielaw and Tradeston. Evidence from the GTS Equality Impact Assessment suggests that households from Chinese or African households are more likely to not have access to a car in Glasgow compared to other ethnic groups. In addition, in Glasgow, black and minority ethnic communities are under-represented when it comes to riding a bike.[17]

[15] GTS Equality Impact Assessment Screening Form, June 2020, page 13
[16] GTS Equality Impact Assessment Screening Form, June 2020, page 7
[17] GTS Equality Impact Assessment Screening Form, June 2020, page 9 https://www.glasgow.gov.uk/CHttpHandler.ashx?id=50282&p=0

9.3.3 Census 2011 data shows that 63% of households in Glasgow city centre do not have access to a car or van, which is higher than for Glasgow City (51%) and Scotland as a whole (31%).

- There are nine datazones in the city centre which are ranked in the 20% most deprived datazones in Scotland according to the Scottish Index of Multiple Deprivation.[18] These are (in order of decreasing deprivation):
- Gorbals and Hutchesontown;
- City Centre West;
- Calton and Gallowgate;
- Anderston (2 datazones);
- City Centre South;
- Woodside;
- Laurieston and Tradeston; and
- City Centre East.

9.3.4 The data presented above highlights that there varying travel needs for the resident population in the city centre with below average access to car, an increased reliance on public transport and also a lower propensity to travel for some of the population. In addition to these characteristics, given the importance of the Glasgow city centre for the wider Glasgow area the needs of the wider population to access the centre should also be considered.

9.3.5 Packages 1 and 2 will benefit the resident population with low car ownership levels through improved cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), which will open up cycling to more users; providing better connections with train stations (205), and creating active travel hubs (403). Each of these measures will improve access both to active travel modes, including opening up cycling to more users through the e-bike measures, and also connections between travel hubs. In addition public transport services will be directly improved through road space reallocation to buses (101 and 106), improved connections between train stations (205) and bus stop rationalisation (610). These interventions, along with those directed at demand management to reduce private vehicles in the city centre will improve the reliability and journey times for bus services. The improvements to bus services, when considered alongside free bus travel for under 22s will see a step change in public transport access for the young residential population. Security and safety are also aspects which influence mode choice and section 7.6 discusses further the benefits associated with each package including increased informal and formal surveillance within the city centre and on public

[18] https://simd.scot/#/simd2020/BTTTFTT/9/-4.0000/55.9000/

transport, which will positively impact on groups identified (women and ethnic minority groups).

9.3.6 In addition to the measures identified in Packages 1 and 2, Packages 3 and 4 also include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). These measures would increase both the attractiveness of walking/cycling as a mode of transport to access the city centre in a sustainable and affordable way but also improves the integration of the existing transport system. The repurposing of road space to public transport (106) and the introduction of the metro (209) would also improve journey times and reliability in the city centre.

Table 43. Comparative access appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Moderate positive impact based on interventions within Package 1. The packages which positively contribute towards comparative access include the People First Zone (710) and the Avenues programme (158).	Moderate positive impact based on interventions within Package 2 The packages which positively contribute towards comparative access include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).	Major positive impact based on interventions within Package 2 The packages which positively contribute towards comparative access include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).	Major positive impact based on interventions within Package 2 The packages which positively contribute towards comparative access include the People First Zone (710), the Avenues programme (158) enhanced CCTV and active security (312), improvements to underpasses and vennels (329), streets and public realm improvements including improved lighting (315) and implementing the Lanes Strategy (215).
✓✓	✓✓	✓✓✓	✓✓✓

9.4 Affordability

9.4.1 To understand the impact of affordability on mode choice and the ability to travel bus fares were reviewed in the Case for Change and concluded that First Bus and McGills daily tickets are priced similarly and are comparable to Lothian in Edinburgh with Xplore Dundee and Stagecoach Glasgow are slightly cheaper. In terms of weekly and monthly tickets, the Glasgow operator tickets are comparable to those in Edinburgh and are more expensive than Dundee.

9.4.2 Although the fares have been found to align with the rest of Scotland, the SPT RTS Public Survey found that residents of the SPT region identified the cost of public transport fares as one of their top transport-related challenges when accessing work, education, and hospitals by public transport and in the take up of new employment opportunities. Additionally, a recent survey of young people by the Scottish Youth Parliament found that many young people felt that the cost of fares was too high in relation to the wages they earn.[19]

9.4.3 Bus fare rises in particular have a disproportionate impact on women, younger people, disabled people and black and ethnic minority people as people in these groups are more likely to use buses to meet a large proportion of their travel needs.

9.4.4 The National Entitlement Card scheme seeks to address this issue by providing holders with free bus travel in Scotland at any time of day, whilst the Strathclyde Concessionary Travel Scheme offers reduced fares on trains and Subway in the Strathclyde area during inter-peak and off-peak hours. Those under 22 are now entitled to the NEC scheme.

9.4.5 The interventions proposed for each of the packages do not directly address public transport affordability, as this would be addressed at a national or GTS level. However, improvements to the public transport network and service will positively impact on those with no access to a car and who rely on public transport.

9.4.6 In addition to public transport improvements, walking and cycling improvements in the city centre will directly improve the affordability of transport.

9.4.7 The option packages 1 and 2 will benefit affordability through improving cycle parking, storage (405), and e-bike charging (803); improving cycle hire to make it more affordable and to include electric bicycles (404), which

[19] Scottish Youth Parliament; All Aboard Campaign Survey Results

will open up cycling to more users; providing better connections with train stations (205), and creating active travel hubs (403). Each of these measures will improve access both to active travel modes, including opening up cycling to more users through the e-bike measures, and also connections between travel hubs.

9.4.8 In addition to the measures identified in Packages 1 and 2, packages 3 and 4 also include improved connectivity across the motorway and River Clyde (201, 202 and 316) as well as updated and improved public transport key arrival points and connectivity (206 and 601). These measures would increase both the attractiveness of walking/cycling as a mode of transport to access the city centre in a sustainable and affordable way but also improves the integration of the existing transport system.

Table 44. Affordability appraisal summary

OPTION 1	OPTION 2	OPTION 3	OPTION 4
Moderate positive impact based on interventions within Package 1. The packages which positively contribute towards affordability include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).	Moderate positive impact based on interventions within Package 2 The packages which positively contribute towards affordability include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).	Major positive impact based on interventions within Package 2 Policies which positively contribute towards affordability include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).	Major positive impact based on interventions within Package 2 Policies which positively contribute towards affordability include the Avenues programme (158) and expansion (212), creating safe junctions and crossing points (327), effective master-planning (207) neighbourhood connections, under/overpass links across the M8 and over the Clyde (201, 202 and 316).
✓	✓	✓✓	✓✓

10. ANALYSIS OF RISK AND UNCERTAINTY

10.1 Introduction

10.1.1 Risk and uncertainty should be taken into account as part of the appraisal. This helps to ensure that the best possible estimate of the costs and benefits associated with each option is presented. To capture all aspects of risk and uncertainty this chapter includes the following sections:

- Feasibility, affordability and public acceptability – to inform the Risk Register;
- Uncertainty Analysis – including the impact of COVID-19; and
- Risk Register.

10.1.2 Feasibility, affordability and public acceptability considerations are identified as part of the Preliminary Appraisal. A number of major considerations were identified at that stage and have been presented below to inform the Risk Register.

10.2 Feasibility

10.2.1 Overall, there are moderate technical and operational consideration for the delivery of Package 1 as it focuses on existing and/or committed programmes. The package uses existing infrastructure (i.e. bus stops and roads), and an established mode/technology. The People First Zone (710) represents the intervention with the greatest consideration required for feasibility. An initial feasibility of the People First Zone is provided in Appendix E. At a high level this addresses the legal and operational feasibility of introducing the intervention including the method of monitoring compliance and the impacts on residents and users of the city centre. There are expected to be further operational considerations relating to re-routing of traffic, servicing and freight management.

10.2.2 Package 2 is estimated to have moderate to major technical and operational considerations. In addition to the points identified for the People First Zone, major considerations are expected from the transformational projects such as; modifications to the motorway junctions, re-design of the city centre streets to create new public spaces, and resolving issues with the active St Enoch freight line to create a new active travel walkway and a public space. Moderate operational considerations are anticipated for measures such as car parking redistribution, new active travel routes, master-planning and servicing and freight management.

10.2.3 Packages 3 and 4 are estimated to have moderate to major technical and operational considerations. In addition to the points identified for the People

First Zone there are anticipated to be wider potential impacts, including traffic re-routing, street re-design, car parking re-distribution, enhanced river crossings and the re-development of lanes due to third party ownerships. Additional considerations include space availability to support improvements at public transport nodes and city centre public spaces, traffic free active travel routes including across the motorway, resolving the live freight operation at St Enoch to create a new active travel walkway and a public space, effectively managing servicing and freight, and developing SMART city centre. The M8 cap is a major consideration and an initial feasibility of the option has been undertaken from an engineering perspective. There are precedents for similar scale projects in Dallas, Atlanta and Pittsburgh however the study identified some key risks which need to be addresses relating to the planning process and approvals and design/construction.

10.3 Affordability

10.3.1 Overall Package 1 is estimated to have minor to moderate financial considerations, depending on whether the particular interventions within the package has an allocated funding or whether an additional capital expenditure is required. Moderate financial considerations include measures such as junction and crossing improvements, improvements to bike hire offer and related EV infrastructure, creating more green parks and public spaces, and car free zones. Measures that relate to the repurposing or removal of car parking may be impacted by the loss of car parking revenue and the proposed method of administering the People First Zone will have capital and revenue costs associated with it.

10.3.2 Costs associated with Package 2 are estimated to have minor to major financial considerations. Measures with major considerations for which major capital expenditure is likely to be required include, street improvements, expansion of the Avenues, new river-front and associated walkways and the transformational projects noted above. Measures that relate to the repurposing or removal of car parking may be impacted by the loss of car parking revenue and the proposed method of administering the People First Zone will have capital and revenue costs associated with it.

10.3.3 Packages 3 and 4 include measures with estimated minor to major financial considerations. Measures with major considerations for which major capital expenditure is likely to be required include, street and public transport nodes improvements, expansion of the Avenues, lanes redevelopment, improved connections over the M8 and the river Clyde (including the M8 cap), new riverfront and associated walkways, St Enoch highline. Measures that relate to the repurposing or removal of car parking may be

impacted by the loss of car parking revenue for options including the People First Zone.

10.3.4 As part of the Delivery Plan and additional costing exercise has been undertaken which reflects committed schemes where funding has been secured and schemes which are yet to secure funding. The total cost for the delivery of Package Three is approximately £600m, excluding the Metro and other heavy rail investment.

10.4 Project Risk Register

10.4.1 At this stage, an initial Risk Register has been developed that highlights the key risks that could affect the appraisal, delivery and operation of the options. This has been provided alongside the probability of their occurrence and the magnitude of their potential impact. The Risk Register is presented in Table 45 and should be continuously reviewed and updated throughout the risk management process as the detailed design of options taken are taken forward progressed.

10.4.2 The Risk Register has been informed by consultation with key stakeholders, previous professional experience within the project team and the preceding feasibility, affordability and public acceptability section.

Table 45. Risk Register

OPTION	Risk Description	Risk Mitigation	RISK ASSESSMENT		
			Risk Likelihood (1 – 5)	Risk Impact (1 – 5)	Risk Rating
All options	**Funding** – Some options are committed and have funding sources identified however uncertainty over future budgets and increasing costs may impact on and delay potential options being brought forward. Those options without commitment may not be able to secure funding sources.	Decision makers will consider which options to progress and discuss potential funding with relevant parties.	5	5	25
All options	**Public –** significant objection to the final option.	Public consultation has shown general wide spread support for the interventions proposed as part of the final option.	2	3	6
All options	**Public transport operators –** potential risk regarding an agreed approach to bus operations and commitment to provide service improvements identified in the plan.	GCC is engaging with the local bus operators through the Glasgow Bus Partnership and SPT and are developing the plans collaboratively.	4	4	16
All options	**Modelling change –** The SRTM does not accurately reflect the	The proposed interventions that incentivise travel behaviour change in GCCTP cannot be explicitly modelled	3	3	9

	change in behaviour and detail associated with the options.	within SRTM in all cases. For example, the detailed design for some measures such as complex traffic management measures and public transport service enhancements will be undertaken following consultation and detailed design review and cannot be represented in a strategic model. The modelling approach reflects the high level concepts associated with each of the packages to understand the benefits and disbenefits. Travel and land use has changed and continues to evolve and the modelling reflects that this will continue to evolve. The CCTP captures the total package however for individual schemes further modelling and analysis would be required.			

10.5 Public acceptability

10.5.1 Glasgow has been involved in an extensive and ongoing public engagement to inform the City Vision, the City Development Plan (CDP), City Centre Strategic Development Framework (CDF) City Centre Strategy and District Regeneration Frameworks (DRF's). The engagement identified key issues to be addressed in the City Centre to improve it's social, environmental and economic performance over the next 30 years.

10.5.2 'Connecting Communities: A Public Conversation on Glasgow's Transport Future' was undertaken in September and October 2020 by Glasgow City Council and had 2899 Survey Responses, 23 Online Conversations, 29 Stakeholder organisations and 11 Community Councils added to awareness and thinking, and recorded:

- Broad support for the analysis of the Problems
- Agreement on the key Draft Outcomes and specific objectives
- Support for a Transformation Plan including:
  - Liveable Neighbourhoods
  - Re-balancing Road Space
  - Support for more sustainable transport modes
- Clear indication of a transportation system not addressing need with 50%+ advising transport system did not meet their needs

10.5.3 In addition, as part of the Case for Change targeted engagement was carried out with key stakeholders and representatives. For further details please refer to the Case for Change.

10.5.4 As part of the Detailed Appraisal a comprehensive public consultation exercise was undertaken. This consultation focused on the emerging CCTP rather than presenting the four options.

10.5.5 The draft CCTP was presented for public consultation over a seven-week period from Wednesday 27th July until Monday 12th September 2022. The public consultation exercise consisted of three main strands:

- A number of online meetings/workshops with key stakeholders
- An online survey on Glasgow City Council's Consultation Hub
- A public drop-in session at a City Centre venue

10.5.6 These activities were supported by social media activity from Glasgow City Council's Corporate Communications team and further backed up by online promotion by a number of key internal and external partners and stakeholders. A5 promotional flyers were distributed to a range of

venues/organisations across Glasgow, with 'toblerone' signs and banners placed at key locations in the City Centre with a high footfall.

10.5.7 Several Consultation Workshops were arranged with key stakeholder to discuss several themes in the CCTP. This was an opportunity to gain valuable feedback from key stakeholders on the priority actions under each theme of the CCTP.

10.5.8 An online survey was hosted on Glasgow City Council's Consultation Hub and included questions about the key aims, strategic planning objectives, various themes and action points (with a few additional socio-demographic questions). Questions in the survey were posed to gauge the amount of support for the CCTP, each theme and the priority actions put forward. 722 responses were received to the survey.

10.5.9 The results from the consultation survey show broad support for the key aims and strategic planning objectives of the draft CCTP, as well as the themes and priority actions put forward.

Table 46. Survey responses – key aims

PLEASE INDICATE WHETHER YOU AGREE OR DISAGREE THAT THE KEY AIMS THAT THE CCTP IS LOOKING TO ACHIEVE ARE THE RIGHT ONES.				
			Response Percent	**Response Total**
1	Strongly Agree		64%	465
2	Slightly Agree		20%	145
3	Slightly Disagree		6%	41
4	Strongly Disagree		10%	70

DO YOU THINK THE KEY AIMS ARE REALISTIC AND ACHIEVABLE?				
			Response Percent	**Response Total**
1	Yes		63%	457
2	No		22%	157
3	Not sure		15%	107

PLEASE INDICATE WHETHER YOU AGREE OR DISAGREE THAT THE CORE STRATEGIC PLANNING OBJECTIVES OF THE CCTP ARE THE RIGHT ONES.				
			Response Percent	**Response Total**
1	Strongly Agree		71%	510
2	Slightly Agree		17%	121
3	Slightly Disagree		4%	31
4	Strongly Disagree		8%	59

10.5.10 Within the survey, a number of closed questions asked respondents whether they agreed with the overall approach of each of the themes in the CCTP. The results from these closed questions in the consultation survey were as follows:

Table 47. Survey responses - themes

QUESTION: DO YOU AGREE OR DISAGREE WITH THE AIM OF THIS THEME:	AGREE/ STRONGLY AGREE TOTAL % OF RESPONDENTS	DISAGREE/ STRONGLY DISAGREE TOTAL % OF RESPONDENTS
Theme 1 – ACCESSIBLE Glasgow	94%	6%
Theme 2 – WALK Glasgow	83%	17%
Theme 3 – CYCLE Glasgow	82%	18%
Theme 4 – BUS Glasgow	92%	8%
Theme 5 –TRAIN / SUBWAY / METRO Glasgow	96%	4%
Theme 6 – STREETS for Glasgow	94%	6%
Theme 7 – SERVICING of Glasgow	96%	4%
Theme 8 – GREENER Glasgow	92%	8%

10.5.11 Similarly, there were closed questions in the survey that asked respondents whether they agreed or disagreed with the priority actions under each theme. The results from these questions on the priority actions are as follows:

Table 48. Survey responses – priority actions

	AGREE/ STRONGLY AGREE TOTAL % OF RESPONDENTS	DISAGREE/ STRONGLY DISAGREE TOTAL % OF RESPONDENTS	NEITHER AGREE OR DISAGREE TOTAL % OF RESPONDENTS
Theme 1 – ACCESSIBLE Glasgow	89%	7%	4%
Theme 2 – WALK Glasgow	83%	13%	4%
Theme 3 – CYCLE Glasgow	79%	16%	5%
Theme 4 – BUS Glasgow	84%	10%	6%
Theme 5 – TRAIN / SUBWAY / METRO Glasgow	92%	4%	4%
Theme 6 – STREETS for Glasgow	85%	11%	4%
Theme 7 – SERVICING Glasgow	83%	7%	10%
Theme 8 – GREENER Glasgow	82%	13%	5%

10.5.12 Additional details of the consultation, including a summary of the suggested changes to the CCTP, can be found in the detailed consultation report (Appendix B).

10.5.13 The outputs of the public survey have given confidence that there is widespread support for the plan's implementation. In addition to the closed questions there were over 3,000 comments received in response to individual questions. The comments were collated, where possible and are also reported in the Appendix. These comments, alongside those which were made at the in-person and online workshops have led to amendments being made to the final plan. These amendments include:

- Changes to names of interventions to more clearly identify the areas;
- City Centre Transformation Plan changed to City Centre Transport Plan to reflect the focus on movement;

- Refocus and strengthening of aspects which were identified by many respondents relating to bus service provision and accessibility; and
- Updates to the delivery plan to reflect support to move the plan forward and deliver.

11. ADDITIONAL DESIGN AND FEASIBILITY CHECKS

11.1 Feasibility Study for the People First Zone

11.1.1 As part of the CCTP, the People First Zone was identified as a key intervention which would drive modal shift and support the CCTP TPOs. SYSTRA and Ironside Farrar have undertaken a feasibility study of this concept, to help understand the implications from a technical delivery and operational perspective.

11.1.2 The long-term objective of the People First Zone is to deliver a solution which restricts non-essential vehicular access and through-traffic in the city centre core, to create a more pleasant and healthy environment for people living, working and visiting the centre.

11.1.3 The focuses of the study were: a review of the current legislation regarding vehicular access restrictions, the identification of restrictions types and their management (informed by precedent examples), the identification of high level options, an assessment of the options against the different user groups of the city centre, a consideration of 'Deliverability' and identification of 'Next Steps'.

11.1.4 The 'People First Zone' (PFZ) is proposed to cover the central area of the city centre, where vehicular access would be limited to essential users only, such as people with disabilities, buses, taxis, emergency services etc. This intervention would greatly reduce vehicle numbers in the core of the City Centre, creating opportunities to re-allocate road space for active travel, public realm and green spaces. On-street parking would also be significantly reduced.

11.1.5 The feasibility study identified a number of factors to be considered in further detail including legislation, monitoring and enforcement and the levels of access for all users in the city centre. Two options for delivery and enforcement were proposed and the report concluded that the proposed scheme is, indeed, feasible and deliverable.

11.1.6 The enforcement methods and restriction types currently available allow for the delivery of the People First Zone in Glasgow. A number of examples exist across the UK which illustrate that a variety of approaches have been taken to reduce, restrict and/or manage vehicular access in a specific area. The examples also illustrate that schemes such as this often include a wide range of intervention types and enforcement mechanisms.

11.1.7 The overarching conclusions of the report were that:

- The delivery of a People First Zone is feasible and;
- That a cell approach (Option 2) is the preferred option. This is because it can be anticipated to have lower capital and revenue costs and could be delivered incrementally. This would build on existing controls and allow the scheme to be 'flexed' as it is delivered, building up to a significant change incrementally. Option 2 could also 'build up' to Option 1 over time.

11.1.8 A set of principles have also been identified that should be considered when developing the option further:

- A number of user groups will still require access to the PFZ by vehicle, although access can be limited to specific routes and to specific times.
- A layered (family of measures) and incremental delivery approach is recommended to respond to the city centre complexities as well as building public consensus. In this context starting with Option 2 does not rule out eventual delivery of a scheme which has boundary controls as per Option 1.
- To reduce costs and deliverability risks it is important to simplify the management and enforcement of measures as much as possible (e.g. minimise number of exceptions required).
- There will never be full compliance with the PFZ and therefore consideration should be given to the approach taken to non-compliance with Traffic Orders.

11.1.9 For further details of the study, including next steps, please refer to Appendix E.

Figure 17.Option 2 – Cell approach

12. RECOMMENDATIONS

12.1 The Recommended CCTP

12.1.1 Following the STAG process, the performance of each of the options has been appraised against the Transport Planning Objectives, STAG criteria and an analysis of the costs, benefits, risks and uncertainties.

12.1.2 The four appraised packages were as follows:

Package 1 – Do Minimum – Low Investment Measures. Focus on Public Transport interventions and completion of existing programmes and projects;

Package 2 – Incentive Base Measures. Focus on measures that extend, incentivise and promote travel behaviour change

Package 3 - Incentive and Demand Management measures. A balance of demand management measures that extend, incentivise and promote altered travel behaviour

Package 4 - Focus on demand management measures that would reduce vehicular access and thus promote altered travel behaviour.

12.1.3 Each of the packages are considered to contribute to the study TPOs to varying degrees with reduction in private car trips coming into the city centre of between 13-25% and corresponding increases in walking and cycling of 10-43% and 5-31% respectively. CO_2 emission reductions were also identified alongside benefits associated with climate change vulnerability, improved equality and accessibility and health benefits.

12.1.4 The findings of the Detailed Options Appraisal are summarised in Table 49 below.

12.1.5 Throughout the appraisal process and across all criteria package 3, which contains a mixture of incentive and demand management measures, performs the strongest with a 23% reduction in vehicle person trips, 43% increase in walking and 31% increase in cycling. The proposed public realm improvements and improved connectivity to surrounding communities would also contribute to achieving the TPOs and delivering improved equality, accessibility and health benefits.

12.1.6 Following the identification of Package 3 as the best performing package the interventions and themes were refined to develop the CCTP which would be presented to the public for consultation. The CCTP was produced based on outcomes of the appraisal of Package 3 and presented in an accessible, concise plan which explains the process, the aims and the

actions. To achieve this, some of the aspects of the STAG report have been refined and summarised, including the themes presented in this report. The ten themes used in the STAG process have been refined to the following in the CCTP, with interventions allocated to each of the themes:

- Accessible Glasgow
- Walk Glasgow
- Cycle Glasgow
- Public Transport Glasgow
- Streets for Glasgow Servicing for Glasgow
- Greener Glasgow

12.1.7 In addition to the refined themes, catalyst areas were also identified in the CCTP. Delivery and getting interventions on the ground was identified in the consultation as a key issue. Catalyst areas reflect this desire for change and outline key activity and projects which have the potential to be 'catalysts of change' and be significant enablers in creating new place-based opportunity to accelerate change and the delivery of the transport strategy objectives. The proposals are at varying stages of development and reflect emerging ideas and thinking which have been included in Package 3 and include:

City Centre People First Zone	People friendly low vehicular access zone
Broomielaw & Clyde Waterfront	Re-connecting the city with its waterfront
George Square	Putting 'Great Spaces' in the heart of the city
Cowcaddens Gateway	Re-connecting the centre with neighbourhoods
High Street Corridor	Promoting liveable places
M8 Garden Cap & Charing Cross	Mitigating the impact of an urban motorway
People Friendly Streets	Reduced traffic within Local Neighbourhoods

12.2 Next steps

12.2.1 The Glasgow City Centre Transport Plan has been developed to be presented to the Environment, Sustainability and Carbon Reduction City Policy Committee and has passed the Committee. A Delivery Plan has been developed as part of the CCTP suite of documents and includes next steps for the CCTP.

12.2.2 The Delivery Plan sets out a range of activities to deliver the plan over the period 2022-2032 and ensure the strategy can be delivered in an effective, coordinated and cost-efficient way. A key purpose of the Delivery Plan is to set out the strategy to facilitate stronger partnership working and promote engagement on the detail of implementation and delivery and identifies that integration and coordination of activity across Council services and with partners and stakeholders is key to delivery.

12.2.3 The Delivery Plan also includes details of the potential funding sources, governance and the monitoring programme to be implemented to assess the success of the plan to meet the TPOs.

Table 49. Summary of Detailed Appraisal

	TPO1	TPO2	TPO3	TPO4	ENVIRONMENT	CLIMATE CHANGE	HEALTH SAFETY AND WELLBEING	ECONOMY	EQUALITY AND ACCESSIBILITY
Package 1	✓	✓	✓	✓	✓	-	✓	✓	✓
Package 2	✓✓	✓	✓✓	✓✓	✓	✓	✓✓	✓✓	✓✓
Package 3	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓✓
Package 4	✓✓✓	✓✓	✓✓✓	✓✓✓	✓/✓✓	✓	✓✓	✓✓	✓✓✓

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