

Bristol City Council

**Western Harbour Feasibility
Study**

Final Transport Feasibility Report

Final | 2 September 2019

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 260233

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Executive Summary

The Commission

BCC commissioned Arup, Alec French and JLL to produce “*a feasibility study to look at detailed options for realigning traffic movement across the basin, while also freeing up land for potential development*”.

The purpose of this study is to formally assess the feasibility of the opportunity from a multidisciplinary perspective, with a particular focus on transport.

The Context

The Western Harbour area is rich in historic and environmental significance, forming the western end of the unique harbourside experience. It is also a key transport node and strategic link, providing one of only a handful of crossing points of the Harbour and the River Avon.

It is home to many people, businesses and a number of listed structures. It is also crossed by Metrobus, the Portishead freight line, and a number of strategically important cycle routes.

The abundant heavy road system built in the 1960s covers large parts of this area. Both bridges and much of the elevated highway infrastructure are now considered life expired. This infrastructure currently enforces severance in terms of noise, air quality and accessibility and contributes towards negative outcomes such as poor health and community integration and damage of historic features.

Scheme Objectives and Assessment Methodology

Project Objectives and Success Measures have been set in order to reflect BCC policy aspirations, and to guide the option selection process towards delivering an outcome that is positive for the whole of Bristol. These are set as challenges to the design, to ensure that the selected option has a degree of ambition and excellence which is commensurate with the scale of the opportunity.

Through stakeholder review and evaluation in the project inception workshop in February 2018, this produced 10 Project Objectives and comprehensive Success Measures that a successful solution will deliver.

These Objectives and Measures formed the basis of the Assessment Methodology and the 12 feasibility parameters devised to assess each option against in Option Development.

Option Development

A number of ambitious and forward-thinking transport concepts have been developed, which take into account the impact on their surroundings, as well as the opportunity to release land for development. Proposals were developed for the rationalisation and simplification of the elevated sections of existing highway and bridge crossing. As an output of this process, nine options have been identified to be appraised and sifted within this report.

Each of the nine options represent a slight reduction in highway capacity compared with the existing scenario, but include improvements to the walking, cycling and bus networks throughout the study area.

Options were examined through a two stage approach; initial sifting and a more detailed option refinement of the shortlisted options.

Option Sifting and Refinement

The Initial Sifting Process discounted options that had attributes which were considered to make them undeliverable.

The two strongest options (Option 2 and Option 8) which performed best against the scoring parameters were progressed to the next stage of feasibility assessment, Option Refinement.

The two options were refined to better understand their land-take, their ability to cater for pedestrians, cyclists and buses, and their capacity for motor-traffic. The option designs were drafted to outline-design level, illustrating the potential horizontal alignment of each option. Both options were compared to the 'Do Minimum' scenario of retaining the existing highways arrangement, to measure interventions against a fixed baseline.

Preferred Options

Both Option 2 and Option 8 were both found to have the potential to deliver significant positive outcomes to the Western Harbour area and Bristol in general, with Option 8 scoring slightly more highly than Option 2 on the parameters included within this study.

Given the strength of these two options, it was considered beneficial to formulate a 'hybrid option' which combines the strongest design elements of Option 2 with those of Option 8.

The Hybrid Option provides significant benefits through the combination of two very positive schemes, therefore it is recommended that it is given greater consideration through further study, as a follow-on from this commission.

Conclusion

In overall summary, Option 8 achieves similar benefits to Option 2 but with less great challenges in terms of funding and buildability. While both Options represent a great improvement on the current arrangement, Option 8 is considered to be the strongest choice and should be progressed for further study. There are considerable strengths associated with the Hybrid Option and this should also be the subject of further study.

1 Introduction

1.1 Commission Overview

Cumberland Basin is part of Bristol's Western Harbour, at the western extremity of the city's Floating Harbour. It is currently dominated by highway infrastructure, the Plimsoll swing-bridge, and Junction swing-bridge at the eastern extent of the basin.

Both bridges and much of the elevated highway infrastructure are now considered life expired. The infrastructure needs renewal and this provides the opportunity to re-think the highway network and to release land which can realise new residential and commercial developments, enabling hundreds of new and affordable waterside homes to be constructed establishing a vibrant community. In short, the creation of a new high-quality waterfront place. Transforming a place for cars to a place for people.

The Brief

"We would like to commission a feasibility study to look at detailed options for realigning traffic movement across the basin, while also freeing up land for potential development. The main purpose of the commission is to determine whether there is a feasible way to deliver the improvement works in a manner that can both be built with limited disruption and be self-funding"

Bristol City Council

Bristol City Council, Arup and Alec French Architects have developed proposals for the rationalisation and simplification of the elevated sections of existing highway and bridge crossing. These options unlock land on both sides of the Basin for development, with the potential to extend development on the south bank of the River Avon. Arup has partnered with property consultant JLL to provide market insight to help to identify the scale of development opportunity.

The purpose of this study is to formally assess the feasibility of the opportunity from a multidisciplinary perspective. In undertaking this assessment, several highway options have been developed along with the associated regeneration opportunity to unlock the potential of the basin as an asset.

The study has given detailed consideration to nine scheme options, from which one option (Option 8) has been identified as the preferred choice to be subject to further study. In addition, a further hybrid option (Option 10) has been generated which seeks to deliver wider regional benefits in parallel with the release of development land at Western Harbour and south of the river. The hybrid option would also benefit from further study.

This transport feasibility study highlights the challenges, opportunities and benefits to help guide BCC and stakeholders in the realisation of the best possible solution for Western Harbour. We also set out some potential next steps for

consideration where we recommend that a wider lens for assessing the highway and rail interventions may generate greater benefits for Bristol and the region.

1.2 Report in Context

The purpose of this report is to answer a specific brief set out by Bristol City Council (BCC). However, Arup is aware of ongoing discussions within BCC with regard to the broader objectives for Western Harbour in terms of the quantity and quality of development and how highways access facilitates this. As such Arup has invested its own resources to develop further the ideas of what may be delivered in this area.

The horizontal alignment drawings presented in this report reflect established highway design practice and guidelines. This is based on an appraisal of capacity against demand scenarios agreed with BCC. Reduced highway infrastructure would be possible should BCC, as highway authority, be willing to consider acceptance of greater peak time queuing or the fact that road users change their behaviour in response to queues and congestion, e.g. peak spreading whereby drivers travel earlier or later. Acceptance of such behavioural change would allow the amount of highway infrastructure to be reduced. This would then offer opportunities to develop a new city quarter with less impact resulting from highway infrastructure.

The assessment work assumes that all the north/south strategic traffic is routed through this area. Should proposals for a significant revision to regional transport infrastructure, for example a new connection to Bristol Airport from the M5, be developed, the level of strategic traffic in the Cumberland Basin area would be greatly reduced, allowing further reductions in the amount of highway infrastructure provided around Western Harbour.

This study has been undertaken in two stages:

- The first stage involves understanding existing conditions, and generating initial scheme options for assessment against agreed objectives, and feasibility parameters. Two initial options are then selected for further study in the next stage;
- The second stage involves the refinement of two options supported by a greater level of assessment work. Following this stage, it is possible to more fully evaluate their performance against scheme objectives and compare them in terms of feasibility. A preferred option has been selected at the conclusion of this stage, while a hybrid option has also been identified as a suitable for further consideration by BCC.

From this process, a preferred option is rationalised and recommended, with any suggestion of further study.

1.3 Report Structure

This report is structured as to demonstrate the sifting and refinement process of the options, to illustrate the bespoke methodology applied to this commission.

1.3.1 The Context and Project Objectives

This report discusses the existing context of Western Harbour and the wider Bristol area in Section 2. Given the strategic importance and civic value of the study area, a set of objectives have been defined which will guide the project to a positive outcome. These objectives are set out in Section 3.

1.3.2 Stage 1 – Initial Sifting

The rationale, process, and methodology of developing initial scheme options is described in Section 4. These options are assessed according to a set of detailed feasibility parameters, the process for which is described in Section 5 and 6.

1.3.3 Stage 2 – Option Refinement

Having assessed the initial scheme options, the two strongest options are selected for further study. The process for selecting these two options is summarised in Section 7. The scope of further study or ‘option refinement’ is defined in Section 8, with the refined highways arrangements described in Section 9.

The option refinement process comprises the following elements:

- Junction modelling – described in Section 10;
- Provision for bus services – Section 11;
- Provision for pedestrians and cyclists – Section 12;
- Integration with flood defences – Section 13; and
- Discussion of bridge operations – Section 14.

The results of the option refinement process are discussed in Section 15, which includes a comparison of the two options and an evaluation of their ability to meet the scheme objectives.

1.3.4 Summary and Conclusion

The closing sections of the report outlines the potential hybrid option, option 10, and modified scheme options, providing an overall summary of the study. Section 17 selects two ‘preferred options’ and highlights a series of recommendations and next-steps for the project.

2 Site Baseline

2.1 Introduction

Bristol's Western Harbour, including Cumberland Basin, is at the far western end of the city's Floating Harbour. Cumberland Basin forms part of the broader Western Harbour which encompasses the areas of Hotwells on the north side of the basin, Spike Island and the areas south of the New Cut. It is a large area with significant infrastructure including multiple roads, former railway lines, the new Metrobus route, waterways, bridges and historic buildings.

Cumberland Basin and the broader Western Harbour is currently dominated by highway infrastructure, notably the Plimsoll swing bridge and associated elevated highways, which are now considered life-expired and which prevent the area reaching its full potential.

The study area is included in Appendix B.

2.2 Wider Context

Bristol is a city in south west England with a population of around 450,000. The population of the wider Bristol metropolitan area is around 1,040,000. It is located close to the mouth of the River Avon, and to the east of the Mouth of the Severn. Its location has contributed to a rich history of maritime and trading activity, the effects of which are reflected in the built environment in the city – the historic floating harbour and its surroundings.

The Bristol area falls largely within Bristol City Council's administration boundaries, with some areas falling within North Somerset and some within South Gloucestershire. Bristol has an elected city mayor, and, falling within the West of England Combined Authority, a 'metro-mayor'.

Bristol is one of the country's economic success stories. It has grown faster than any other core city in the UK. Bristol's population has grown by 4.5% between 2011 and 2015, which is the fastest growth after the Greater London area¹, and between 2009 and 2014 the economy of Bristol grew by 19.2% (GVA), second only to London². It has many promising opportunities that, if grasped now, could deliver sustained economic benefits for residents and businesses both today and in the future. Alongside these opportunities are a set of challenges; principally to make sure that economic growth and prosperity is shared across all of society.

With all of the city's successes, there are still challenges. There are areas of entrenched deprivation, educational attainment gaps for disadvantaged children and skills and employment gaps. This indicates that the benefits of growth enjoyed by many Bristolians are not shared by all.

¹ ONS 2016 population estimates

² ONS bulletin, 9 December 2015

Bristol is one of the most productive cities in the country³. It has highly skilled jobs and higher wages than other cities: Bristol's 2017 average weekly workplace earnings are higher than most UK cities with the exception of London, Oxford and Cambridge⁴.

Bristol is known for innovation, ranking 3rd out of the core cities for number of patent applications per capita⁵; high tech industries⁶, and; the arts, Bristol has more than 2.5 times more jobs in visual arts (programming and broadcasting activities) than the English average⁷.

The city is also celebrated as one of the most liveable cities⁸ in the country with excellent green credentials, access to open space and cultural amenity. Additionally, it offers some of the best higher education in the country through the University of Bristol and the University of West England, with a high performing further education institution at the City of Bristol College. Contributing to its success is the retention of its higher education graduates (Bristol ranks 4th after London, Manchester and Leeds⁹) and the number of graduates it attracts from other institutions from around the country.

The Small and Medium Enterprise (SME) community in Bristol is strong, accounting for 50% of businesses in city. Supporting and nurturing SMEs and innovation is fundamental to Bristol's ongoing growth story.

The excellent assets and attributes as described above provide a very strong foundation to build.

However, there are also many challenges to address including persistent deprivation¹⁰, which is reflected in the large gap in attainment levels for children from disadvantaged backgrounds and other children, which is higher than the UK average. Poor access to employment for the under-skilled, significant increases in house prices and a local transport system which needs improving so it can effectively link residents to jobs and training are also key issues.

³ Bristol is in the top quintile of the most productive UK cities in terms of GVA per worker in 2016 (10th out of 62 UK cities and towns). Centre for Cities from ONS, Regional Gross Value Added (Income Approach) NUTS3 Tables; NOMIS, Business Register and Employment Survey; NOMIS, Mid-year population estimates

⁴ ONS, Annual Survey of Hours and Earnings (ASHE), average gross weekly residence based earnings.

⁵ Centre for cities from PATSTAT; Intellectual Property Office, Patent published by postcode, 2015 data.

⁶ The Bristol and Bath Tech City supports 35,924 Digital jobs according to Tech City 2017.

<https://technation.techcityuk.com/cluster/bristol-and-bath/>

⁷ Source: ONS Business Register and Employment Survey 2016

⁸ In 2016, Bristol was ranked 1st for 'City Conditions' by the Happy City Index, incorporating work, health, education, place and community factors. It was also ranked 1st for sustainability.

Source: Happy City Index 2016

⁹ Centre for Cities

¹⁰ 42 LSOAs in the city are in the most deprived 10% of England. That amounts to 16% of residents in Bristol, almost 70,000 people. Since the 2010 IMD, an additional 10 wards have fallen within the lowest decile. Source: Index of Multiple Deprivation 2015 (Source: DCLG, Indices of Deprivation Explorer)

2.3 Growth & Housing

Bristol's status as a Smart City Capital, green capital and reputation for excellent quality of life attract people to live here. In recent years, demand for housing has outpaced supply, leading to a shortage of homes and impacting prices and affordability.

Secure and good quality housing is important to achieving a good quality of life and can often act as a springboard to improving health, education and employment outcomes. For Bristol to grow in a sustainable and inclusive manner people must have a safe and secure place to live which they can afford.

Despite Bristol's strengths, there are inequalities within the city, and these inequalities are also apparent within the housing market. These include persistent health and wellbeing inequalities, a shortage of affordable housing and frequently these inequalities are reinforced by poor quality homes.

Currently, the average (median) house price is 10 times the average (median) salary. Bristol is ranked 10th in terms of affordability when compared to other comparable cities (making Bristol more affordable than London but less affordable than most of the UK's largest cities). However, Bristol has seen the largest increase in this ratio between 2011 and 2016 indicating that the impact of this affordability challenge will have been felt severely in recent years.

The city has a critical role in delivering homes to accommodate growth, in particular providing affordable homes in the right places for residents. The Bristol Housing Strategy identifies the role for the Mayor and other agencies in meeting this challenge in particular:

- Proactively looking for opportunities for additional housing land and site assembly, making best use of land available; and
- Creating value from brownfield land and sites and reviewing existing land and property assets.

Need for new homes. Bristol requires 1,300-1,400 homes to be built per year through 2026 (according to the Bristol Core Strategy), but recent house building rates are at about 750 homes per year between 2008 and 2016. There has been a recent uplift in housing completions with nearly 2,000 homes being completed in 2016-17. However, there is a considerable challenge to keep up this rate.

Rising home prices. Growth in house prices in Bristol since 2012 has outstripped the UK and South West.

Less home ownership, more private renting. Bristol has seen growth in private renting of housing and a decline in home ownership (either outright or with a mortgage), and a higher increase in private renting compared to England.

Affordability. The average house price is 10.4 times the average wage in Bristol in 2016, making it one of the most unaffordable cities for housing in the UK.

As well as creating new homes and communities there is a need to continue investment in existing areas. The existing communities in Hotwells and Spike Island have for generations tolerated the intrusion of significant highway infrastructure and the associated dis-benefits.

Taking a community-wide approach is critical to delivering successful regeneration and there is much already happening within Bristol. Empowering local communities, registered providers, charities and developers to deliver the right type of new homes for their areas will be critical in the success of the wider project and should be a focus of future project stages.

2.4 Western Harbour Profile

2.4.1 Policy Context

The study area is covered by policy SA105 Site Allocation of the Bristol Local Plan – Bristol Central Area Plan, which was adopted March 2015. With respect to City Centre site allocations within the Harbourside Neighbourhood, including specifically the land and buildings south of Brunel Lock Road, including A-Bond Warehouse, development considerations state that developers should:

- Explore the opportunities for rationalisation of the existing highway infrastructure and deliver significant public realm improvements, including providing the proposed Primary Pedestrian Route between Avon Crescent and Ashton Avenue as shown on the Policies Map;
- Accommodate the route of the proposed Metrobus system; Retain suitable access and turning provision for service vehicles to the former bonded warehouses;
- Take account of the City Docks conservation area;
- Reuse the existing bonded warehouse building;
- Respond to the green infrastructure linkages and assets in the surrounding area and integrate existing green infrastructure where possible;
- Explore the potential for habitat creation on the River Avon New Cut;
- Address noise and pollution issues from the Cumberland Basin road system;
- Be supported by a Flood Risk Assessment.

Proposals that take account of the Hotwells and Cliftonwood Community Traffic Strategy (CHASE/HCCA) will be encouraged.

Bristol's Mayor stated in the *State of the City Address 2017* that a scheme at Cumberland Basin which reduces the level of highway infrastructure in the area, can bring more affordable housing to the city, and extend the harbour as a residential area – would be highly beneficial to the whole city and its prospects.

2.4.2 Socio-Economic

A review of economic activity and general health across the study area shows there to be high levels of economic activity and good levels of health across the study area, with only minor differences between the north side and south side of the harbour. Illustrations drawing on data from the 2011 Census are presented in Figure 1 and Figure 2.

Figure 1: Economically Active Residents in Vicinity of Study Area

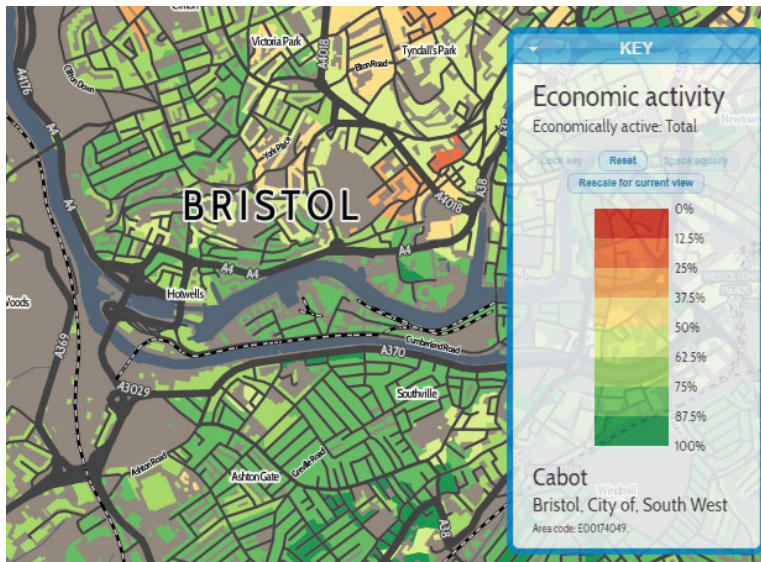
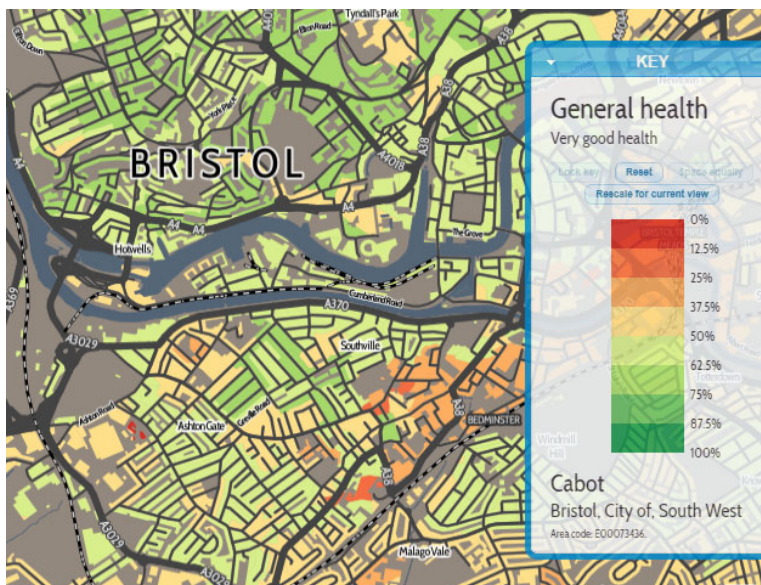


Figure 2: Residents in 'Very Good Health' in the vicinity of the study area



Despite the relatively modest differences shown in the figures above, Cumberland Basin and the broader study area sits in a key location between north and south Bristol and their distinctive urban and social characters. As such, any scheme that is brought forward within the study area should be sensitive to its location and the role it plays in linking different areas of Bristol.

2.4.3 Harbour Operations

Under the existing arrangement, the Plimsoll and Junction bridges are not supposed to be opened Mondays to Fridays (except public holidays) between 7.30am to 9am and 4.30pm to 6pm, to allow for peak traffic, however it is believed that exceptions have occurred.

Typically, each bridge operation takes the following:

- Plimsoll Bridge tends to close to traffic for 15-20 minutes per time
- Junction Bridge tends to close to traffic for 10-15 minutes per time

The Maritime Act supersedes the Highways Act, meaning that should a vessel wish to pass through the locks at Cumberland Basin during the high-tide period, then it must be allowed to do so. As high tide lasts for a longer period than the highway peak hour, both functions can occur.

The most recent data available for bridge swings of Plimsoll and Junction bridges received from the Bristol Harbour Master shows considerable seasonal and daily variation, as presented in Figure 3 and Figure 4. The weekly profiles in Figure 4 include the week containing Bristol Harbour Festival 2017; from Friday 21 July until Sunday 23 July. It should be noted that multiple vessels can pass through per swing.

Figure 3: Bridge swings per month in 2016

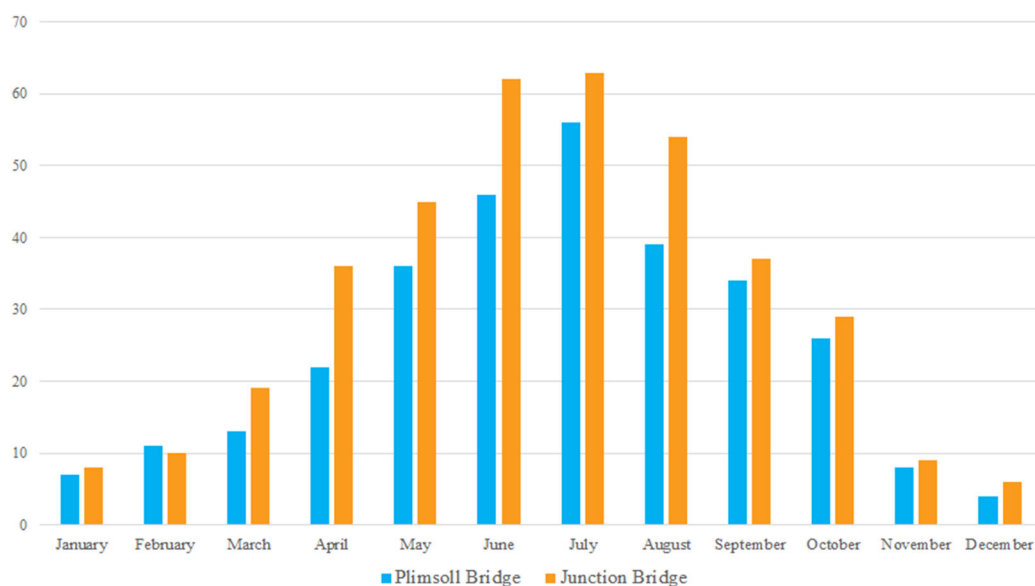
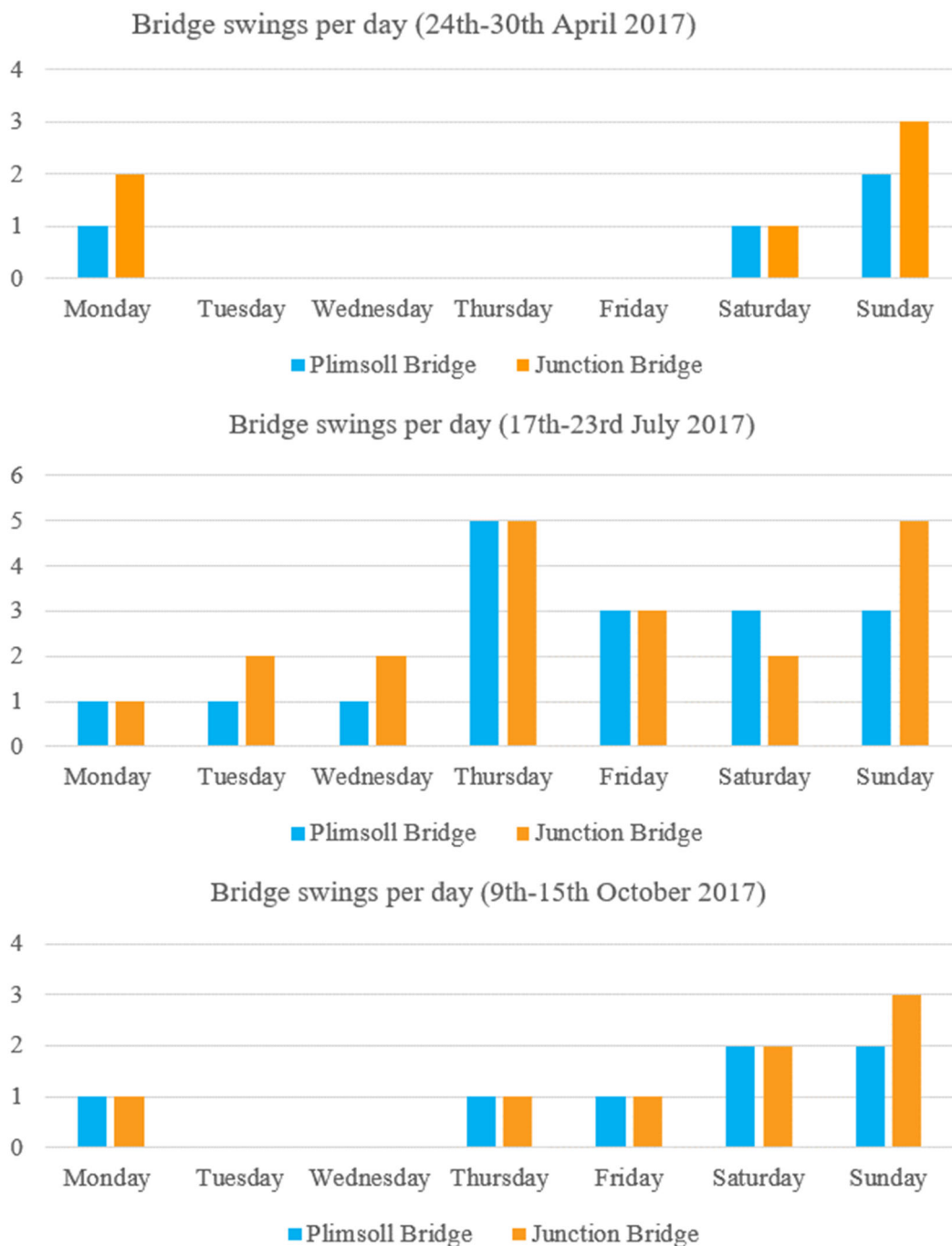


Figure 4: Weekly profile of bridge swings in 2017



2.4.4 Flood Defences

Cumberland Basin forms the western extent of the Floating Harbour and as such its lock gates harbour walls are critical to the management of water levels within and near to the harbour. The lock gates retain a normal water level of approximately 6.2m Above Ordnance Datum (AOD) in the harbour (between low and high tide levels in the River Avon adjacent). Tidal stop gates prevent high tide levels, higher than the normal water level in the harbour, forcing the lock gates open and gaining access to the harbour. The floating harbour and other adjacent areas of Central Bristol have long been identified as being at risk of tidal flood

events and as such a Tidal Flood Risk Management strategy has been developed to provide a reasonable standard of protection to the existing development in the area and cater for future increased risk arising from expected sea level rise.

Bristol City Council, in partnership with the Environment Agency, is developing a long-term plan setting out what needs to be done to manage tidal flood risk to the city centre over the next 100 years. This is known as the Tidal Flood Risk Management Strategy.

The Strategy proposes the implementation of new flood defences at Cumberland Basin, as well as at many other locations along the River Avon in Bristol. There are two design levels which will be implemented in a phased 'adaptive managed' approach to cater for the progressive onset of sea level rise in the future. The initial 'low defence' of 9.65m AOD is an interim level of defence (1:200yr in 2030), and the 'high defence' of 10.3m AOD provides protection to an estimated 1:200yr level in 2115. The latter can be considered as a baseline assumption for this scheme, as in the long term this degree of infrastructure will be required regardless of the land development proposals considered by this study.

Appendix C shows the proposed defence highest above existing ground level, calculated by subtracting existing ground level from the 'high defence' level of 10.3m AOD. It should be noted that the alignment of these defences has been developed outside of the scope of this study, and as such assumed the highway network as it exists today. Even so, the figure shows the likely concept of flood defences that must be constructed in the long term at Cumberland Basin to ensure the acceptable management of tidal flood risk to the city.

2.4.5 Environmental and Heritage

This is an area intimately linked to heritage, notably Brunel's history. The area presents a variety of views; the Bonded warehouses, the Clifton Suspension Bridge, the terraces, crescents and streets that rise from Hotwells and the Ashton Court estate.

Any solution must also consider the impact on the setting of the Clifton Suspension Bridge and Gorge, which is located to the north-west of the basin.

In addition, the area is rich in environmental value. There are areas of ancient woodland and sites of special scientific interest at Avon Gorge, and there are a number of receptors to effects such as noise and air quality.

An Environment and Heritage Constraints Map of the study area is included in Appendix D.

2.4.6 Transport

2.4.6.1 Traffic Flows

The road network surrounding Cumberland Basin comprises key strategic and local vehicular movements, with multiple 'A roads' providing access to the motorway network via A369 and A4 for the western side of the city.

The most strategically significant vehicular movement through the road network in the study area is the strategic link between A4 Portway to the north and A370 to the south, via A3029 Brunel Way and across Plimsoll Bridge. This route allows traffic to avoid travelling through Bristol city centre and this is the signed route from the M5 towards Bristol Airport.

The strategic flow between the A4 Portway and the A3029 Brunel Way is around 800-900 vehicles in each direction in the AM peak, and around 900-1000 vehicles in the PM peak. There is little opportunity to reduce these traffic volumes through modal shift. Over a typical 24-hour period, the total traffic flow crossing the Plimsoll Bridge is around 51,000 vehicles per day.

Local traffic flows to / from city centre in contrast, provide a better opportunity to achieve a meaningful modal shift towards more sustainable modes through a package of measures explored as part of the emerging West of England Joint Spatial Plan.

A strategy has therefore been assumed whereby strategic traffic volumes are assumed to remain at current levels, while traffic flows in/out of the city centre can potentially sustain a reduction in capacity.

2.4.6.2 Bus Services

A range of city and longer distance bus routes serve the study area. Most North Somerset services, including the Long Ashton Park and Ride, enter and exit the city via the A370 and serve bus stops along Merchants Road (exiting city only) and Hotwell Road, both on the northern side of Cumberland Basin. These routes enter the city the northbound lane of A3029 Brunel Way, across Plimsoll Bridge and exit the city via Merchants Road and McAdam Way, across Junction Bridge. This routing is the product of the one-way Hotwells gyratory. The Portway Park and Ride service also serves the Merchants Road (exiting city only) and Hotwell Road bus stops. This cumulative combination of services makes the Hotwells area on the northern side of the Basin highly sustainable in terms of public transport access.

Spike Island, on the southern side of Cumberland Basin, is only served by one bus service, the 506 – a shuttle between the Harbour and Broadmead with half hourly services.

The Metrobus link from Ashton Vale to Temple Meads and Bristol City Centre is currently under construction and will have a bus stop, Butterfly Junction, in the study area, on the northern side of the A Bond building.

A plan showing the existing bus services operating in the study area is appended to this report, as Appendix E.

2.4.6.3 Walking and Cycling

Positioned at the western edge of Bristol, Cumberland Basin is a key gateway in accessing recreational areas on the edge of the city and popular walking and cycling routes.

National Cycle Network (NCN) route 33 runs along the southern edge of Spike Island, across Ashton Ave bridge and westwards into Ashton Court. NCN route 41 runs underneath Brunel Way and turns northwards along the western side of the River Avon, following its course towards Pill.

Walking and cycling movements north/south across the Basin are heavily influenced by the highway infrastructure, with grade separated footbridges, underpasses and footways along multiple lanes of traffic often creating incoherent and unpleasant environments.

Images and plans showing the existing walking and cycling provision in the vicinity of the study area are appended to this report, as Appendix F.

3 Scheme Objectives

3.1 Introduction

The brief for this study focuses on the identification of potential highway solutions which meet the transport needs of the city while releasing land for development in this highly sustainable and attractive location. Creating places for community, walking, cycling, ease of access to public transport, a liveable neighbourhood as opposed to a place for cars.

In developing options and appraising their relative merits, the study team has been conscious of a wider opportunity to deliver a new district of the city. This is a once in a generation opportunity to evolve the story of Bristol's historic Floating Harbour and create a place of outstanding quality for people to live, work and visit this unique part of the city.

Following analysis of the context discussed in Section 2 of this report, and informed by a project workshop, a definition of 'what success will look like' has been determined.

3.2 Success Measures

Key measures have been defined in order to establish what a successful solution will look like. The success measures have been devised by Arup and reviewed and supplemented in the stakeholder workshop on Wednesday 28th February 2018. A full attendance list of the workshop is provided below, with the agreed Success Measures listed in the Table 1.

- Bristol City Council:
 - Adam Crowther, Head of Strategic Transport
 - Howard Swift, Head of Service – Economic Development
 - Shaun Taylor, Highway Maintenance Manager
 - Richard Goldthorpe, Placemaking Manager
- Business West:
 - David Mellor
- Arup:
 - Andrew Jenkins, Project Director
 - David Watkins, Project Manager
 - Andrew Gibbins, Associate Director, Placemaking Lead
- Alec French Architects:
 - Mark Osborne, Director
- JLL:

- James Petherwick, Director – Residential Development

Table 1: Success Measures Agreed at Stakeholder Workshop

A successful solution will:
Be deliverable, with risks that can be adequately mitigated.
Facilitate and enable the coherent development of the site.
Deliver socioeconomic benefits and contribute to a better-connected city.
Minimise disruption during construction and be readily buildable without insurmountable challenges.
Improve links between communities and reduce severance
Maintain harbour operations, minimising and mitigating any disruption.
A successful solution will not:
Result in significant negative impact on highway network resilience, including flows and delay.
Negatively impact on public transport services and operation.
Negatively impact on walking and cycling provision.
Generate an unsustainable maintenance revenue burden for BCC.
Result in significant negative impacts on the environment, including at Avon Gorge.
Result in negative impacts on heritage assets, which should be enhanced as part of the scheme.

3.3 Project Objectives

The Success Measures listed above have been considered through the evolution of this scheme. They have been used to help inform a list of Project Objectives.

The Project Objectives have been set in order to reflect the policy aspirations described in a Section 2.4.1, and to guide the option selection process towards a delivering an outcome that is positive for the whole of Bristol, and which delivers on the promise and potential of the area. In short, the objectives are set as a challenge to ensure that the selected option has a degree of ambition and excellence which is commensurate with the scale of the opportunity. The project objectives are listed below.

1. To create a new residential quarter with affordable¹¹ homes in the heart of the city which connects and integrates with existing development.
2. To extend the Harbour visitor destination experience and connections to the Brunel legacy, creating an inclusive place for all.
3. To enable high quality urban and landscape design reflecting the city gateway and historic significance of this location.
4. To promote outstanding contemporary architecture.
5. To fully exploit the connectivity delivered by Metrobus.

¹¹ As defined by the National Planning Policy Framework, and delivered in compliance with Core Strategy Policy BCS17: Affordable Housing Provision.

6. To animate waterside spaces, walkways and water space through lively and imaginative uses and opportunities for employment land uses and independent traders.
7. To establish new pedestrian and cycle links through and across the area linking adjoining communities.
8. To improve and facilitate access to the Avon Gorge, noting its importance as a Natura 2000 site.
9. To phase development through an incremental approach to implementation, managing knock-on impacts.
10. To realise a significant capital receipt for the city council.

The project objectives are considered in more detail in Section 5 and 6 of this Report.

We would recommend that wider input and further definition of the project objectives is gained from representatives of the West of England Combined Authority (WECA) and other key stakeholders, to inform and define a detailed list of measurable value-outcomes.

4 Option Development

Both Bristol City Council, Arup and Alec French Architects have developed proposals for the rationalisation and simplification of the elevated sections of existing highway and bridge crossing. As an output of this process, nine options have been identified to be appraised and sifted within this report.

The nine options are appended to this report as Appendix A.

The options have been developed with the aim of maximising high-quality traffic-free development frontage to historic waterfront, suitable for mixed residential development. Some options are more ambitious than others, with implications on the environment, cost and buildability. This is reflected in the assessment in the later sections of this report.

The options can be broadly split into three key families that share similar design ideologies.

- Options 1, 2, 3 and 9 show the splitting of the strategic road off from local movements, taking the main strategic road away from the development parcels and existing residential areas. Options 1 and 2 site the A3029 strategic road onto the western site of the River Avon and connect into A4 Portway via a two-lane roundabout over the River Avon. Option 2 proposes significant reconstruction online of the A3029 to eliminate the elevated sections and to redesign the junction with the A370 at Ashton Gate. Option 3 places the A3029 strategic road at the western of Spike Island, connecting to the A4 via an all movements signalised junction. Option 9 shows a dual carriageway tunnel beneath the River Avon, connecting A370 Brunel Way to A4 Portway, carrying the key strategic route.
- Options 4, 5 and 6 show broadly similar proposals to the present arrangement, with updated infrastructure. All three of these options remove the one-way movement on the Hotwells gyratory, and propose two-way vehicular movements on A4 Hotwell Road and Merchants Road. Oldfield Place is only accessible from the east, with vehicular access stopped up with Faraday Road.
- Options 7 and 8 combine strategic and local vehicular movements into one vehicular crossing via an upgraded provision at the location of Junction bridge.

5 Assessment Methodology

5.1 Introduction

Each of the nine options has been assessed against both the project objectives and a series of feasibility parameters. The methodology that has been employed to assess and score the options is discussed in the paragraphs that follow.

5.2 Assessment Against Objectives

Section 3 of this report sets out the objectives against which project outcomes will ultimately be considered. Table 2 details which objectives can be employed in the current level of assessment, and which objectives will follow on at a later stage.

Table 2: Inclusion of Project Objectives within Initial Sift Analysis

#	Objective	Included	Comment
1	To create a new residential quarter with affordable homes in the heart of the city which connects and integrates with existing development	Yes	
2	To extend the Harbour visitor destination experience and connections to the Brunel legacy, creating an inclusive place for all	Yes	Reflected by 'Environment and Heritage' Feasibility Parameter outlined in Section 5.3.
3	To enable high quality urban and landscape design reflecting the city gateway and historic significance	Yes	
4	To promote outstanding contemporary architecture designed to respond to the local context	Yes	Reflected by 'Desirability of Development' Feasibility Parameter outline in Section 5.3.
5	To fully exploit the connectivity delivered by Metrobus	Yes	
6	To animate waterside spaces, walkways and water space through lively and imaginative uses and opportunities for independent traders	Yes	Reflected by Walk and Cycle Feasibility Parameter outlined in Section 5.3, and Objective 7.
7	To establish new pedestrian and cycle links through and across the area linking adjoining communities	Yes	
8	To improve and facilitate access to the Avon Gorge, noting its status as a Natura 2000 site	Yes	
9	To phase development through an incremental approach to implementation, managing knock-on impacts	Yes	Reflected by Buildability Feasibility Parameter outlined in Section 5.3.
10	To realise a significant capital receipt for the city council	Yes	

5.3 Feasibility Parameters

This section of the report sets out an assessment of each of the nine options against the feasibility parameters that were established and used to aid assessment at the stakeholder workshop on Wednesday 28th February 2018.

This describes the 12 criteria and the approach used to inform the assessment of each option. There is inevitably some overlap between parameters and whilst a fixed weighting has not been applied across the parameters, the intention of the sifting process is that the key strands of multidisciplinary review are captured and considered.

The full list of feasibility parameters is set out below:

1. Estimated cost
2. Buildability
3. Maintenance Cost
4. Harbour Operations
5. Highway Capacity
6. Public Transport
7. Cycling and Walking
8. Environment and Heritage
9. Stakeholder Views
10. Potential Quality of Development
11. Land Value
12. Meeting Housing Needs

5.3.1 Estimated Construction Cost

Construction costs have been estimated by a combination of highways and structures cost assessments, with indicative costs identified for both. Structural demolition costs have not been included in this assessment and would be considered as part of a follow-on commission. Table 3 details the construction cost estimates associated with the options.

It should be noted that the construction costs presented are indicative, outline estimates and are not for reliance. A more detailed Bill of Quantities approach would be undertaken as part of a follow-on commission.

Table 3: Initial Construction Cost Estimates

Option	Construction Cost Estimate (central cost, no margin of error)
Option 1	£228m
Option 2	£308m
Option 3	£262m
Option 4	£111m
Option 5	£333m
Option 6	£295m
Option 7	£133m
Option 8	£180m
Option 9	£1900m

Figure 5 compares of the construction cost estimates across the nine options, with Option 9 removed in Figure 6, so to see the other options in better detail.

Figure 5: Construction cost estimates for nine options including indicative cost bands

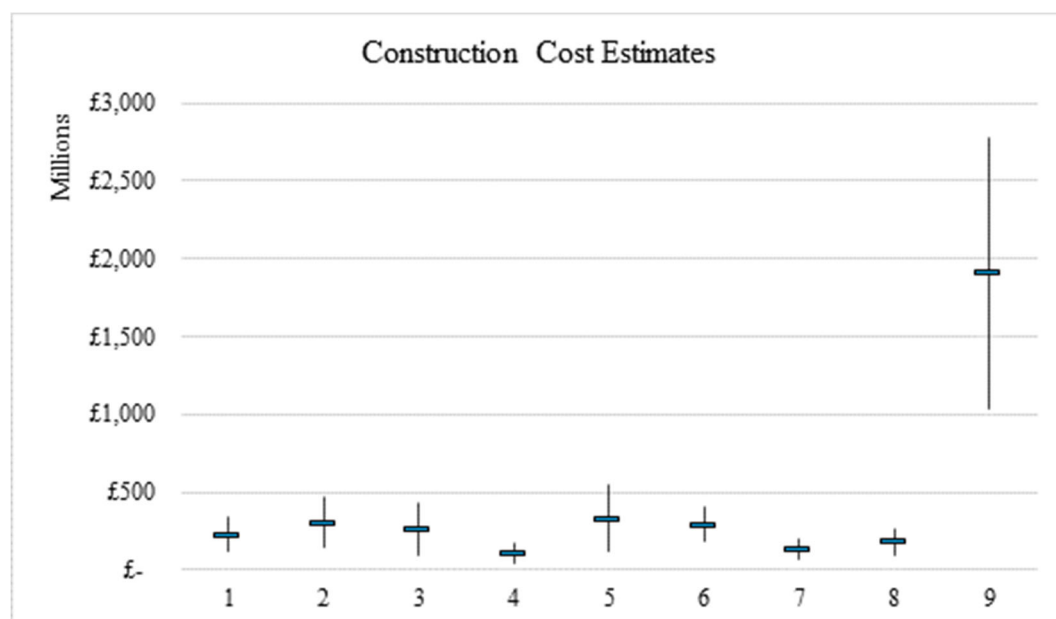
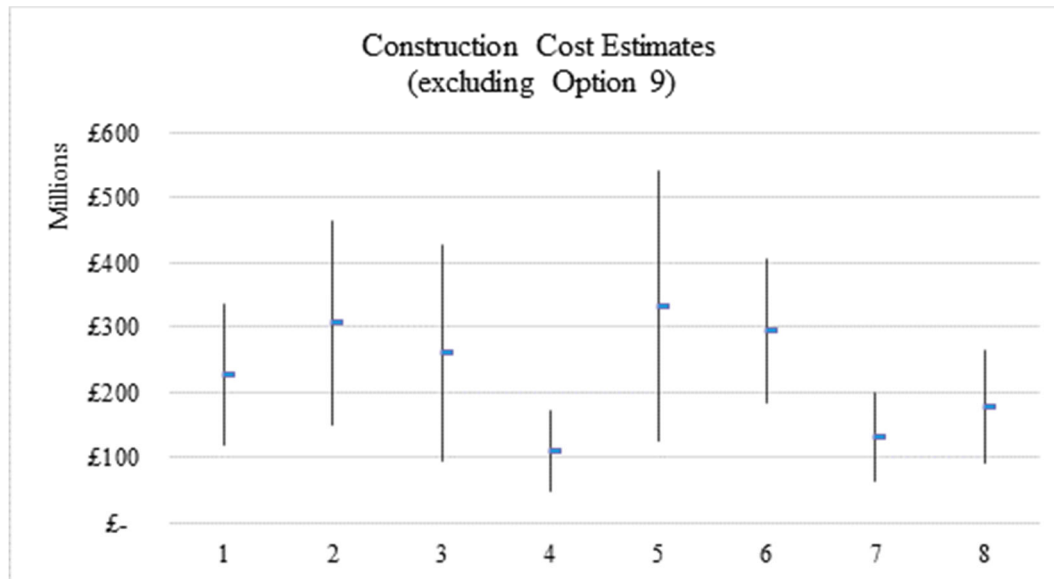


Figure 6: Construction cost estimates for eight options (excluding option 9) including indicative cost bands



5.3.2 Buildability

Buildability comprises a qualitative description relating to complexity of construction phase, traffic disruption and any likely political / public opposition.

5.3.3 Maintenance Cost

There is a need to spend significant funding on maintenance of the highway structures in and around the Cumberland Basin. The main costs relate to the elevated, grade separated structures but all elements require some degree of expenditure. In the scenario in which none of the proposed options are taken forward, the estimated cost for these works is around £40m.

The Maintenance Cost parameter provides an initial assessment of the likely annual maintenance cost increase/decrease on the existing situation associated with the proposed highways and structures in each option, presented as a percentage increase/decrease compared existing annual maintenance costs. The percentage uplift / decrease does not take account of the £40m renewal works identified above.

5.3.4 Impact on Harbour Operations

This parameter assesses how changes to the highway network and rearrangements to the swing/lifting bridges will impact on access to the Harbour.

5.3.5 Highway Capacity Impact

At this initial stage no detailed highway modelling has been undertaken. Instead the study's review has considered the number and type of new junctions, free-

flow lanes versus priority or signalised arrangements and the potential resilience of the network with respect to bridge operations.

5.3.6 Public Transport Impact

This parameter considers how each option will impact upon bus service provision including Metrobus, identifying any opportunities to enhance services or support them through increased patronage.

5.3.7 Cycling and Walking Impact

The impacts of the reconfiguration of the road network on walking and cycling has been assessed. This includes a view on the physical connections between different communities. It considers the “barrier effect”, which happens when the transport system limits people’s mobility, instead of facilitating it. Motorways and roads with high traffic levels or speeds, create physical and psychological barriers that separate communities, with effects on walking and cycling mobility and possible negative effects on individual health and social cohesion.

Impacts on the two National Cycle Network routes 41 and 33 are also considered.

All options show the reinstatement of Brunel’s Other Bridge as a walking and cycling link and each option shows a minimum of two walking/cycling facilities to cross the New Cut (River Avon).

5.3.8 Environmental and Heritage Impact

The key environmental topics considered are consistent with the standard environmental topic areas typically considered in the appraisal of options for transport and mixed-use developments (and as required by the Environmental Impact Assessments and Strategic Environmental Assessment directives), namely:

- Air Quality;
 - Air Quality Management Areas (AQMAs)
 - Sensitive receptors e.g. Residential areas, Schools, care homes, parks etc. as identified through the BCC mapping tool – Know your place¹²
- Ecology;
 - Sites of Special Scientific Interest
 - Special Areas of Conservation
 - Special Protection Areas
 - Sites of Nature Conservation Interest
 - Priority habitats and wildlife corridors
- Landscape and Visual;
 - Long distance views
 - Local views

¹² <http://maps.bristol.gov.uk/knowyourplace/>

- Noise and Vibration;
 - Sensitive receptors e.g. Residential areas, Schools, care homes etc. as identified through the BCC mapping tool – Know your place
- People and Communities
 - Community facilities as identified through the BCC mapping tool - Know your place including public rights of way, cycle paths, open space, allotments and amenity space. Assessment based on potential for direct loss, severance or interruption to operations of a community facility (including non-motorised routes and consequently impacts on connectivity for pedestrians and cyclists).
- Water Environment
 - Flood zones
- Cultural Heritage;
 - Scheduled monuments
 - Listed buildings;
 - Conservation areas;
 - Registered parks and gardens;
 - Local historic parks and gardens; and
 - Heritage assets at risk.

5.3.9 Stakeholder Views

The Stakeholder Views parameter combines the likely concerns of local residents, business owners, societies and groups. Whilst some of these are likely to have been captured by other parameters, stakeholder views are worth reviewing separately to identify proposals likely to receive support or opposition. It should be noted that stakeholder views can vary and conflict on any single issue.

No stakeholders have been consulted on any of options produced for this study. Instead, each option has been reviewed from a high-level planning basis. Local groups, such as the Hotwells and Cliftonwood Community Association, Avon Industrial Buildings Trust, BS3 Community, Greater Bedminster Community Partnership and Friends of Greville Smyth Park will have a significant interest in the proposals.

Listed below are views that would likely be consistent across all nine options:

- One-way southbound-only movements for vehicles has recently been implemented at Avon Crescent. Bringing two-way movements back onto Avon Crescent would be viewed negatively by local residents. Drawing GAV TMR-0200-111 appended to this report as Appendix G shows the plans for Ashton Crescent as part of the Metrobus proposals.
- Vehicular access from/to residential properties fronting onto Ashton Avenue needs to be considered.

- Any impact on existing provision of on-street permit parking on Christina Terrace / Merchants Road or Hotwell Road would likely be viewed negatively by residents.

5.3.10 Potential Quantity and Quality of Development

This parameter appraises the quality of the development parcels released by each of the options. The estimated quantity of land released is indicated on each plan and listed in the table below:

Table 4: Estimated area of land released by each option

Option	Released land (sqm)
Option 1	90,000
Option 2	110,000
Option 3	93,000
Option 4	75,000
Option 5	85,000
Option 6	89,000
Option 7	87,000
Option 8	105,000
Option 9	89,000

The following was consistently identified across the nine options:

- The areas either side of Cumberland Basin would be suitable for high density residential development.
- The area south of the New Cut would be suitable for variety of house types.
- All options provided an opportunity for retail and commercial uses adjacent to the Metrobus route.

5.3.11 Land Value

Each option is expected to increase the monetary value of the land¹³ in and around Cumberland Basin. To calculate an initial value for each development option return, the following assumptions have been made by JLL based on their market experience:

- The net developable area is assumed to be 75% of the total area;
- Residential densities have been applied to net developable area, reflecting the likely development of the site;
- Whilst the scheme will be mixed use, for this exercise it is assumed that all development is residential;

¹³ 'Land value' in this report refers to the monetary value that the present landowner could sell the land for to a developer, assuming that it is granted planning permission.

- Land value per unit is based on an appraisal of the quality of land area released; and
- Land value is then based on the corresponding rate per plot which assumes 40% affordable housing.

Table 5 shows the land value uplift associated with each option.

Table 5: Estimated Land Value Uplift associated with each option

Option	Land Value Uplift
Option 1	£36m
Option 2	£42m
Option 3	£33m
Option 4	£24m
Option 5	£28m
Option 6	£27m
Option 7	£23m
Option 8	£36m
Option 9	£34m

5.3.12 Health and Wellbeing

The health and wellbeing impacts of the options has been assessed by gauging their effect on people's propensity to engage in active travel, and the extent to which their environment is affected by motor traffic. As such, this measure is calculated by combining the score for Cycling and Walking, with a score for Noise and Air Quality impacts, which was produced in support of the wider 'Environment and Heritage' parameter.

The majority of the options are expected to result in strongly positive impacts in terms of walking and cycling, but this positive impact is counterbalanced by the potential for disbenefits arising from the routing of traffic in proximity to existing and potential residential areas. For that reason, the majority of options are expected to produce a balanced, or medium-positive effect, with the exception of Option 3 which provides benefits from active travel with only minor disbenefits from traffic impact. Option 4 is expected to produce limited benefits in terms of active travel and its impact on noise and air quality is not positive.

5.3.13 Meeting Housing Needs

As identified in Section 3.2 of this report, Bristol requires 1300-1400 homes to be built per year through 2026 (according to the Bristol Core Strategy), but recent house building rates are at about 750 homes per year between 2008 and 2017. There has been a recent uplift in housing completions with nearly 2,000 homes being completed in 2016-17. However, there is a considerable challenge to keep up this rate.

Therefore, one of the key opportunities associated with the options under consideration is their ability to help meet housing needs in Bristol.

The land-value assessment described in 5.3.11 was partially based on the quantity of land released by each option, as well as a high-level estimate of the number of dwellings that could be delivered within each option given reasonable density assumptions. This information has been used to determine the ability of each option to help meet the housing needs of the city, albeit as a ‘full development’ scenario only – the phasing of housing construction has not been considered in relation to targets within the Local Plan.

6 Option Assessment Results

6.1 Introduction

This section of the report details the option assessment results both in terms of their performance against project objectives and their performance against the feasibility parameters.

6.2 Scoring

The Option Assessment process has been undertaken with a single scoring system. Options are assigned a score based on their relative strength, taking into account their performance against the other options and also their outcome in comparison with the present scenario¹⁴.

A simple scale of 1 – 5 has been employed, which is listed and explained below.

1. Very Weak
2. Weak
3. Medium
4. Strong
5. Very Strong

Each Option is then given an overall score both for feasibility and for option compliance.

6.3 Scoring Against Project Objectives

The outcome of the project objective assessment is summarised in Table 6.

Scoring against the objectives relating to housing, urban setting, and pedestrian links, are informed by the work undertaken in support of the assessment against the feasibility parameters, described in Section 5.3.

¹⁴ Assessments relating to environmental impact have a particular focus on scoring against the existing scenario, as this is the convention within the discipline and is the approach that would be taken during the consenting process.

Table 6 – Project Objectives Scoring

Scoring Against Objectives*	Options								
	1	2	3	4	5	6	7	8	9
To create a new residential quarter with affordable homes in the heart of the city	4	5	3	1	3	2	1	5	3
To Enable high quality urban and landscape design reflecting the city gateway and historic significance	5	5	3	2	2	2	3	4	5
To fully exploit the connectivity delivered by Metrobus	3	3	3	3	3	3	3	3	3
To establish new pedestrian and cycle links through the area linking adjoining communities	4	4	4	2	4	4	5	5	2
To improve and facilitate access to the Avon Gorge	2	2	3	2	3	3	4	4	5
To realise a significant capital receipt for the city council	4	5	3	1	2	2	2	4	4
Score	22	24	19	11	17	16	18	25	22

*The scale is from 1 (Very Weak) to 5 (Very Strong)

Table 6 shows that Options 1, 2 and 8 most closely meet the project objectives. This is largely through their higher scoring relating to the creation of residential areas, the enablement of high quality urban space, and their ability to realise a capital receipt for BCC.

Option 4 scores poorly as it releases less land for residential use, and, in its retention of a large proportion of existing highway infrastructure, realises lower capital receipts and is less able to provide for a high quality urban setting. The remaining options vary in their scoring but appear to have reasonable compliance with the project objectives.

There is no variance around connecting with the Metrobus because each option incorporates the existing route through the released land parcels, but without further enhancing provision. As such each Option is scored with a ‘medium’ 3.

6.4 Scoring Against Feasibility Parameters

A summary of the options’ scoring against the feasibility parameters is provided in Table 7.

Table 7 – Feasibility Parameters Scoring

Summary of Feasibility Assessment*	Options:								
	1	2	3	4	5	6	7	8	9
Estimated Cost	3	2	3	4	2	3	4	4	1
Buildability	3	3	2	5	1	1	3	3	1
Maintenance Cost	4	4	4	4	4	3	5	5	2
Harbour Operations	2	2	2	3	3	2	4	4	5

Highway Capacity	2	2	2	3	3	3	4	4	5
Public Transport	2	2	3	2	3	3	3	3	1
Cycling and Walking	4	4	4	2	4	4	5	5	2
Environment and Heritage	1	1	4	3	3	2	3	3	5
Stakeholder Views	2	2	2	3	3	3	3	2	4
Potential Quality of Development	5	5	4	3	3	4	4	5	5
Land Value	4	5	3	1	2	2	2	4	3
Health and Wellbeing	3	3	4	2	3	3	3	3	3
Meeting Housing Need	4	5	4	1	3	2	1	5	3
Score	39	40	41	36	37	35	44	50	40

*The scale is from 1 (Very Weak) to 5 (Very Strong) Table 7.

Table 7 reflects the project objectives' scoring in that Option 1, Option 2 and Option 8 are strongest at meeting housing needs and increasing land value. The desirability of the development is strong across most options, but is strongest in Option 1, Option 2, Option 8 and Option 9.

Highway capacity varies across the options, and is perhaps expected to be most constrained in options 1-3. However, none of the options are considered to be unfeasible in transport operational terms – including the operation of the harbour, which retains a reasonable level of functionality in all scenarios. Options 7 – 9 are strongest in terms of harbour operations as there are fewer harbour bridges in these scenarios.

In terms of environment and heritage, there are concerns that Option 1 and 2 may disbenefit the setting and natural environment of the gorge and the green areas to its south and west. At this high level, and without detailed design it is not possible to establish what mitigation may be required to offset any potential disbenefits.

Buildability is of critical importance to the viability and feasibility of the options. Discussions taking place in the Stakeholder Workshop, and assessment work undertaken in support of this report has found that Options 5, Option 6 and Option 9 would result in very great levels of transport operations disruption, and as such may be considered undeliverable.

Similarly, the very high capital costs associated with Option 9 renders the option very difficult to deliver, as this level of funding would be very challenging to secure.

A detailed breakdown of the scoring of each option against the 12 parameters, along with a justification of the scoring, is detailed in the tables that follow.

Table 8: Option 1 (CH-101)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £120,912,000 – Mid estimate: £227,611,000 – High estimate: £334,310,000	3
Buildability	Tie-ins with existing A3029 (S) and A4 (N) difficult to construct due to land constraints at both tie-in points. The two T-junctions to the A4 can be constructed online but there is little/no room to the north or south of the river for the temporary construction areas required to build and lift the two bridges into place. Construction of route to the south of the river and north of the railway line is difficult due to lack of land availability and road will need to be constructed on new banks reducing river width - including construction from floating barges or similar. A3029 section joins an elevated highway section - ideally this would come further south to an at-grade section but this increases the potential length of replacement highway and will increase construction time and disruption. Demolition relatively simple as area is reduced to local highways and existing lift bridge is retained. The potential for increased traffic along Oldfield Place is likely to be an issue for local residents.	3
Maintenance Cost	Maintenance cost is marginal for highways. In terms of structures, on the basis of scale, new structure, new M&E, design coordinated with existing maintainer to design out some of the current maintenance issues, the proposed swing bridge could require 50% of the existing maintenance effort.	4
Impact on Harbour Operations	Option requires the construction of two new bridges across the Avon to the west of the existing lock gates. These bridges represent an additional barrier to passage along the Avon and into the floating harbour. As the Avon is tidal there is little capacity to anchor vessels and the bridges will therefore need to be raised to accommodate vessels on demand. Demand is expected to be focussed on hightide periods as this is when vessels presently navigate the Avon.	2
Highway Capacity Impact	<p>This proposes a simplified road network in comparison to the existing arrangement. The provision of a two-lane one-way gyratory to the west of Hotwells would remove the dominant west-south strategic traffic flows to the new dedicated link away from existing residential areas and proposed development areas. This reduces interaction between local and strategic traffic and reduces junction capacity requirements.</p> <p>The strategic A4-A370 movement is provided for via a dual carriageway and largely segregated from local traffic and this could be a net benefit over the existing arrangement. There is a net reduction in capacity around Hotwells gyratory with Oldfield Place to be formed into a two-way road linking to Hotwell Road by way of a left in/left out junction and to Merchants Road by way of a three-arm junction. Oldfield Place would experience an increase in traffic flows, associated with the rerouted trips from Spike Island, following the closure of the Cumberland Basin Road. Oldfield Place would provide access to the local residential area bounded by Hotwell Road and Merchants Road.</p> <p>Option 1 ties into the existing grade separated Jessop interchange.</p> <p>Overall the proposal has a slight reduction in capacity on the A4-A370 movement associated with two new signalise junctions. The route from Spike Island to the A370 is also less direct. There is less redundancy as although there are two bridges there is insufficient connectivity between them to provide an alternative route for traffic.</p>	2
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depends on the final junction form. The loss of the bus lane on McAdam Way would likely have some negative impact on	2

Parameter	Narrative	Score
	journey times for routes exiting the city. Removal of McAdam Way slip also removes future opportunities for North Somerset routes to serve Spike Island via Hotwell Road entrance to city.	
Cycling and Walking Impact	The diversion of section of NCN Cycle Route 41 along off-carriageway facility on the western side of River Avon reduces the character and recreational appeal of the route, however design measures can protect its accessibility. The removal of highway infrastructure from Spike Island increases the attractiveness of north-south walking and cycling movements along car free routes and no grade separation.	4
Environmental and Heritage Impact	Option results in adverse effects on views to and from, and the setting of the Grade 1 listed Clifton Suspension Bridge and some views towards the Clifton Conservation Area. There are also adverse landscape effects through the introduction of new dual carriageway on the southern bank of the River Avon and a crossing further towards the Avon Gorge. Increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells. Increased adverse noise and visual effects on recreational users of the Pill Path, Leigh Woods, users of amenity land to the west of the railway and the Ashton Court Grade II* Registered Park and Garden. Impacts on a large number of ecological receptors including sensitive estuarine habitat and loss of habitat on the southern bank of the Avon, and the extension of urban activities and disturbance in proximity to SNCI / SSSI / SAC/ ancient woodland. Imposition of at-grade dual carriageway in flood plain, and crossing may require a marine license. Loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut and along the gorge (The Pill Path). The main benefits / opportunities include improvements to the views across, and immediate setting of, the Grade II listed Cumberland Basin and an opportunity to enhance the setting of listed buildings, particularly A and B Bond Warehouses, and also the immediate setting of the City Docks Conservation Area.	1
Stakeholder Views	Sustrans and local cycling groups would view the rerouting of NCN Route 41 negatively. Network Rail could take a negative view on the proximity of road to proposed Metrowest route and existing freight railway line. The positioning of the junction would have a negative impact on residents along A4 Hotwell Road, to the east of the junction, facing onto the road. The removal of Plimsoll Swing Bridge allows for the re-appreciation of Brunel's Other Bridge and surrounding area. There are numerous negative impacts on Ashton Court – both the setting of conservation area and listed buildings. Positive impact on stakeholders would be the removal of the majority of grade separated infrastructure on both sides of Cumberland Basin, away from existing communities.	2
Potential Quality of Development	This option provides maximum high-quality traffic-free development frontage to Cumberland Basin and River Avon (New Cut) and end of the peninsula looking west and north to the Gorge. Developable land to the south of the New Cut is restricted and compromised by existing elevated Brunel Way to south. This area would be suitable for variety of house types. Developmental land to the north of Cumberland Basin restricted by limited width to the east. With segregation of A4-A370 traffic there are opportunities to provide high quality connections to integrate the new development and existing communities. There is opportunity to improve setting of Holy Trinity Church, Rownham Meads and Bonded Warehouses. New highway on west bank of Avon will impact on the peninsula but could be screened with a new 'green edge' to improve aspect from the peninsula and reduce noise. The Hotwell Road frontage will continue to be dominated by traffic.	5
Land Value	£36,000,000: Waterside development maximised and main road removed from development area. Good connectivity to rest of Harbourside and Hotwells/Clifton/City. Very attractive development parcel.	4

Parameter	Narrative	Score
Meets Housing Need	Potential provision of 700-800 units.	4

Table 9: Option 2 (CH-102)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £150,912,000 – Mid estimate: £307,611,000 – High estimate: £464,310,000	2
Buildability	As with Option 1, however Option 2 proposes significant reconstruction online of the A3029 to eliminate the elevated sections and to redesign the junction with the A370 at Ashton Gate. With this work being online there are potential major disruptions to the A370 and A3029 during these works, with diversion routes resulting in traffic passing through Bristol city centre - or diverting to the M5.	3
Maintenance Cost	Maintenance cost is likely to be 5% less for highways than under existing arrangements. In terms of structures, on the basis of scale, new structure, new M&E, design coordinated with existing maintainer to design out some of the current maintenance issues, the proposed swing bridge could require 50% of the existing maintenance effort.	4
Impact on Harbour Operations	Option requires the construction of two new bridges across the Avon to the west of the existing lock gates. These bridges represent an additional barrier to passage along the Avon and into the floating harbour. As the Avon is tidal there is little capacity to anchor vessels and the bridges will therefore need to be raised to accommodate vessels on demand. Demand is expected to be focussed on hightide periods as this is when vessels presently navigate the Avon.	2
Highway Capacity Impact	<p>This proposes a simplified road network in comparison to the existing arrangement. The provision of a two-lane one-way gyratory to the west of Hotwells would remove the dominant west-south strategic traffic flows to the new dedicated link away from existing residential areas and proposed development areas. This reduces interaction between local and strategic traffic and reduces junction capacity requirements. The strategic A4-A370 movement is provided for via a dual carriageway and largely segregated from local traffic and this could be a net benefit over the existing arrangement.</p> <p>There is a net reduction in capacity around Hotwells gyratory with Oldfield Place to be formed into a two-way road linking to Hotwell Road by way of a left in/left out junction and to Merchants Road by way of a three-arm junction. Oldfield Place would experience an increase in traffic flows, associated with the rerouted trips from Spike Island, following the closure of the Cumberland Basin Road. Oldfield Place would provide access to the local residential area bounded by Hotwell Road and Merchants Road.</p> <p>New simplified at-grade signalised roundabout replacing the Ashton Gate Interchange. Currently there is a high proportion of U-turners during both the AM and PM peak associated with access to Winterstoke Road. Provision of a simplified junction would better accommodate these trips. A simplified junction may result in a net reduction in highway capacity albeit with significant benefits in terms of highway intrusion.</p> <p>Overall the proposal has a slight reduction in capacity on the A4-A370 movement associated with two new signalise junctions, plus further delays at the redesigned Ashton Gate interchange. The route from Spike Island to the A370 is also less direct. There is less redundancy as although there are two bridges there is insufficient connectivity between them to provide an alternative route for traffic.</p>	2
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depends on the final junction form. The loss of the bus lane on McAdam Way would likely have some negative impact on journey times for routes exiting the city. Removal of McAdam Way slip also removes future opportunities for North Somerset routes to serve Spike Island via Hotwell Road entrance to city.	2

Parameter	Narrative	Score
Cycling and Walking Impact	The diversion of section of NCN Cycle Route 41 along off-carriageway facility on the western side of River Avon significantly reduces the character and recreational appeal of the route, however design measures can protect its accessibility. The removal of highway infrastructure from Spike Island increases the attractiveness of north-south walking and cycling movements along car free routes and no grade separation.	
Environmental and Heritage Impact	<p>Option results in adverse effects on views to and from, and the setting of the Grade 1 listed Clifton Suspension Bridge and some views towards the Clifton Conservation Area and adverse landscape effects through the introduction of new dual carriageway on the southern bank of the River Avon and a crossing further towards the Avon Gorge. Increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells. Increased adverse noise and visual effects on recreational users of the Pill Path, Leigh Woods, some existing residential buildings such as at Paxton Drive, users of amenity land to the west of the railway (including allotment and sports ground and nursery off Clanage Road) and the Ashton Court Grade II Registered Park and Garden. Impacts on a large number of ecological receptors including sensitive estuarine habitat and loss of habitat on the southern bank of the Avon, and the extension of urban activities and disturbance in proximity to SSSI / SAC/ ancient woodland. Imposition of at-grade dual carriageway in flood plain, and crossing may require a marine license. Loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut and along the gorge (The Pill Path).</p> <p>The main benefits / opportunities include improvements to the views across, and immediate setting of, the Grade II listed Cumberland Basin and potential improvements to views to and from Greville Smyth Park. An opportunity to enhance the setting of listed buildings, particularly A and B Bond Warehouses, and also the immediate setting of the City Docks Conservation Area.</p>	1
Stakeholder Views	Similar concerns to Option 1. Significant impact on residents of Paxton Drive with roads on east and western sides and grade separated junction. This proposal brings the highway along eastern boundary of Bedminster Cricket Club and Bright Horizons Bristol Day Nursery and Preschool, immediately parallel to the railway line.	2
Potential Quality of Development	<p>This option provides maximum high-quality traffic-free development frontage to Cumberland Basin and River Avon (New Cut) and end of the peninsula looking west and north to the Gorge.</p> <p>Developable land to the south of the New Cut is restricted and compromised by existing elevated Brunel Way to south. Developmental land to the north of Cumberland Basin restricted by limited width to the east.</p> <p>With segregation of A4-A370 traffic there are opportunities to provide high quality connections to integrate the new development and existing communities.</p> <p>Opportunity to improve setting of Holy Trinity Church, Rownham Meads and Bonded Warehouses.</p> <p>New highway on west bank of Avon will impact on the peninsula but could be screened with a new 'green edge' to improve aspect from the peninsula and reduce noise.</p> <p>Hotwell Road frontage will continue to be dominated by traffic.</p> <p>Opportunity to extend development into Homes England site benefitting from semi-rural aspect to south and west, if new highway is screened by planting. Opportunity to connect development to existing residential neighbourhood on east side of Metrobus route.</p>	5
Land Value	£42,000,000: Waterside development maximised and main road removed from development area. Good connectivity. Land released to the south of the Avon Cut will provide for lower density housing to create a more balanced area attractive to a range of developers.	5

Parameter	Narrative	Score
Meets Housing Need	Potential 800-900 units	5

Table 10: Option 3 (CH-103)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £94,881,000 – Mid estimate: £261,888,000 – High estimate: £428,895,000	3
Buildability	A3029 to A4 connection will require the construction of a new four lane highway consisting of elevated section over the River Avon and new four lane bridge. The route as shown passes over the listed harbour walls and will require the removal of the A3029 eastbound off slip to Spike Island - alternative route would be viable via Hotwells gyratory, however construction of the new junction with the A4 will temporarily remove any option for access from A3029 eastbound, north of Jessop Underpass until junction is complete. Demolition will be taking place close to new highway. Potential issue with operations of new and old bridges depending on design. New bridge impacts on length of lock gate - potential stakeholder issue. Tie in with A3029 is along an elevated section - potential delays during construction of tie-in - with increased difficulty due to over the river construction being required for new highway. The potential for increased traffic along Oldfield Place is likely to be an issue for local residents.	2
Maintenance Cost	Maintenance cost is likely to be 5% less for highways than under existing arrangements. In terms of structures, on the basis of scale, new structure, new M&E, design coordinated with existing maintainer to design out some of the current maintenance issues, the proposed swing bridge could require similar maintenance effort to the existing.	4
Impact on Harbour Operations	Existing four-lane swing bridge is replaced further west by a new four-lane bridge which shortens the lock gate length. The bridge position also results in a need to coordinate lock gate and bridge operation in order for ships to pass. There is no means to anchor ships approaching the bridge from the Avon and the bridge will need to operate as ships approach. Ships exiting from the floating harbour could be accommodated in the lock gate.	2
Highway Capacity Impact	<p>This proposes a simplified road network in comparison to the existing arrangement. New dual-carriageway bridge crossing linking the western-most point of Spike Island directly to Hotwell Road, catering for the dominant west-south traffic movements. This reduces interaction between local and strategic traffic and reduces junction capacity requirements. The strategic A4-A370 movement is provided for via a dual carriageway and largely segregated from local traffic and this could be a net benefit over the existing arrangement.</p> <p>There is a net reduction in capacity around Hotwells gyratory with Oldfield Place to be formed into a two-way road linking to Hotwell Road by way of a left in/left out junction and to Merchants Road by way of a three-arm junction. Oldfield Place would experience an increase in traffic flows, associated with the rerouted trips from Spike Island, following the closure of the Cumberland Basin Road. Oldfield Place would provide access to the local residential area bounded by Hotwell Road and Merchants Road.</p> <p>In comparison to Options 1 and 2, Option 3 provides a large three-arm signalised junction rather than a signalised roundabout and so is thought to provide less capacity. As with the other two options in this family there is a reduction in redundancy as although there are two bridges there is insufficient connectivity between them to provide an alternative route for traffic.</p>	2
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. The loss of the bus lane on McAdam Way would likely have some negative impact on journey times for routes exiting the city. Removal of McAdam Way slip also removes future opportunities for North Somerset routes to serve Spike Island via Hotwell Road entrance to city. Less diversion for buses than via new gyratory in Options 1 and 2.	3

Parameter	Narrative	Score
Cycling and Walking Impact	The removal of highway infrastructure from Spike Island increases the attractiveness of north-south walking and cycling movements along car free routes and no grade separation. One of the two key north-south links is still an off-carriageway facility immediately parallel to the Brunel Way dual carriageway.	4
Environmental and Heritage Impact	<p>The main risks or potential adverse effects include increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells. Potential to impact features of the City Docks Conservation Area although this would be balanced against wider improvement through the relocation of the carriageway to the western end of the Conservation Area. This option shows loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut.</p> <p>The main benefits / opportunities include Oldfield Place traffic flows likely to be low – stronger opportunity for physical/visual links to new development site to the south and potential improvement in noise and air quality and the creation of three substantial, coherent development blocks with potential for a range of development scenarios and landscape treatments that are likely to better facilitate the enhancement to the setting of the Cumberland Basin and City Docks. Improvements to the views across, and immediate setting of, the Grade II listed Cumberland Basin (although not to the extent of Options 1 and 2) and an opportunity to enhance the setting of listed buildings, particularly A and B Bond Warehouses, and the immediate setting of the City Docks Conservation Area.</p>	4
Stakeholder Views	Likely to be significant opposition to negative impact on historic lock gates and harbour buildings, with proposed road crossing over heritage assets at the north-western tip of Spike Island. Restricted vehicular access to Cumberland Basin, via longer route around Hotwell Road if approaching from south Bristol may be viewed negatively by SS Great Britain owners and residents of this area.	2
Potential Quality of Development	<p>This option provides high quality traffic-free frontage to historic waterfront along Cumberland Basin and River Avon (New Cut) which is suitable for high density residential development. With segregation of A4-A370 traffic there are opportunities to provide high quality connections to integrate the new development and existing communities.</p> <p>Development potential at end of the peninsula and the development to the north of the basin is compromised by the proximity of highways at the western end. Developable land to the south of the New Cut is restricted and compromised by existing elevated Brunel Way to south. This area would be suitable for variety of house types</p> <p>The small site to the west of the realigned dual carriageway and south of the cut may be difficult to develop.</p> <p>Opportunity to improve setting of Holy Trinity Church, Rownham Meads and Bonded Warehouses.</p> <p>Hotwell Road frontage will continue to be dominated by traffic.</p>	4
Land Value	£33,000,000: Good waterside development area although main road will hamper values of the 'prime' units with views to the Suspension Bridge. Improves connectivity to City and Harbourside.	3
Meets Housing Needs	Potential 700-800 units	4

Table 11: Option 4 (CH-104)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £48,950,000 – Mid estimate: £111,275,000 – High estimate: £173,600,000	4
Buildability	Option 4 retains significant amount of existing elevated highways and both existing bridges. Minimal highway works required to deliver this option. Some difficulties associated with demolition of existing highway structures next to retained highways. There is no impact on Metrobus bar an internal site connection.	5
Maintenance Cost	No change or marginal for highways maintenance costs. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	4
Impact on Harbour Operations	Existing bridges retained in existing locations. No impact on harbour operations.	3
Highway Capacity Impact	Cross-Avon traffic movements would utilise the re-configured existing grade-separated junctions – there is no impact on the strategic A4-A370 movements. Hotwell Road would be modified to run two-way with a resulting reduction in capacity. The road could operate using a tidal arrangement to maintain two lanes in the priority direction in peak hours. The exiting junction configuration with Merchants Road and Rownham Mead is maintained. Spike Island is accessed direct from the dual carriageway with a priority three-arm junction provided with Brunel Lock Road, which is proposed to be upgraded to a two-way road. A new stop line is proposed to control and facilitate traffic movements on occasions when the Cumberland Basin bridge is closed. Overall the changes are not considered significant in terms of capacity of redundancy.	3
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. The loss of the bus lane on McAdam Way would likely have some negative impact on journey times for routes exiting the city. Buses entering the city could be routed via the two-way Brunel Lock Way but could not service Spike Island on exiting the city.	2
Cycling and Walking Impact	No major change on existing provision, albeit the reinstatement of Brunel's other bridge. One of the two key north-south links is still an off-carriageway facility immediately parallel to the Brunel Way dual carriageway.	2
Environmental and Heritage Impact	The main risks or potential adverse effects include increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells and the introduction of a two-way road way on Brunel Lock way, potentially increasing impact on City Docks Conservation Area and setting of the Basin. Reduced improvements to B Bond Warehouse - setting remains marred by bridge/flyover but opportunity to improve environs to north and east and loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut. The main benefits / opportunities include road infrastructure simplified and reduced in overall massing. Oldfield Place traffic flows likely to be low – stronger opportunity for physical/visual links to new development site to the south and potential improvement sin noise and air quality. There is potential for improvements to the views across, and immediate setting of, the Grade II listed Cumberland Basin (although not to the extent of Options 1,2 and 3), although overall benefits are limited due to the retention of existing bridge. There is potential for significant improvements to setting of A	3

Parameter	Narrative	Score
	Bond Warehouse and the opening up of views across the river/ Floating Harbour between new development sites, and from dwellings along Hotwell Road and Oldfield Place.	
Stakeholder Views	Similarities to existing situation with retention of much of the road network. Improvements for some residents, such as those fronting onto Oldfield Place, but likely increase in traffic onto other routes e.g. Merchants Road. Few impacts from the proposal for stakeholders as little changes from the existing arrangement.	3
Potential Quality of Development	<p>The development site north of the basin is severely compromised by extensive highway infrastructure (existing retained and extended) splitting the site into two plots with limited scope for development on the western plot.</p> <p>The development potential at end of the peninsula is severely limited by retention of existing highways, however there is an opportunity to provide high-quality frontage to historic waterfront along Cumberland Basin and River Avon (New Cut).</p> <p>Development south of the new cut has mainly traffic-free frontage to waterfront, compromised at west end by proximity to existing elevated road and bridge. The developable land is also restricted and compromised by existing elevated Brunel Way. The small west end site may be difficult to develop. Opportunities for connection to the existing Hotwells residential neighbourhood and east end of Cumberland Basin.</p> <p>Hotwell Road frontage will be dominated by traffic and highway infrastructure.</p> <p>Some opportunity to the improve setting of Holy Trinity Church and Rownham Meads. There is a good opportunity to improve the setting of Bonded Warehouse (A Bond) which has development potential for residential use, while B Bond is compromised by its proximity to the elevated road bridge.</p>	3
Land Value	£24,000,000: Development areas significantly hampered by main roads - hampering views, values and connectivity.	1
Meets Housing Needs	Potential 500-600 units	1

Table 12: Option 5 (CH-105)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £126,048,000 – Mid estimate: £333,085,000 – High estimate: £540,122,000	2
Buildability	Option 5 retains some of the existing highway infrastructure, however the A3029 crossing is a new bridge which is located to the east of the existing bridge. There are significant potential issues associated with the construction at height of the new highway sections and junctions, whilst retaining operation of the A3029. The potential diversion route would see all vehicles travelling east and routing across the Junction swing bridge - but this will result in significant delays due to insufficient capacity. Construction of a new four lane highway bridge above the lock could cause issues with tall ship access. Construction of the new A3029/Hotwell Road junction is also problematic and will result in significant reductions in highway capacity due to use of alternative diversion routes. Demolition will need to be undertaken adjacent/below/above new highway infrastructure presenting significant issues around timing and safety. No impact on Metrobus. This Option is considered to have major buildability issues.	1
Maintenance Cost	No change or marginal for highways maintenance costs. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	4
Impact on Harbour Operations	Junction swing bridge is retained and the Plimsoll Bridge is replaced with a new four-lane bridge to the east. No impact on harbour operations.	3
Highway Capacity Impact	Simplified road network in comparison to existing with two major three-arm signalised junction replacing the existing grade-separated junctions. Hotwell Road extended as a two-way road (single lanes), with the possibility of a tidal arrangement. The junction between Hotwell Road and Merchants Road simplified to a three-arm signalised junction, incorporating pedestrian crossings New three-arm priority junction to be created between Merchants Road/Oldfield Place, with no through movements to Hotwell Road. Provision of this junction allows the Merchants Road priority junctions with Charles Place and Oldfield Road to be stopped up. The new junction would form a gateway to this residential area, without encouraging through traffic movements, resulting in minimal changes to traffic levels on the local streets. It is proposed that McAdam Way would connect to the new bridge by way of a simplified at-grade three-arm signalised junction and a three-arm priority junction with Merchants Road. Overall there is a net reduction in capacity on the A370-A4 movement due to new signalised junctions, however this impact can be mitigated through appropriate junction design and the option retains redundancy between the two bridges.	3
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. Positive for routing of North Somerset buses as more options are available with the two-way McAdam Way and the removal of the one-way around Hotwells gyratory. Depending on capacity, one of the westbound lanes on McAdam Way could be provided as a bus lane, as per existing arrangements.	3
Cycling and Walking Impact	Similarities to existing situation but with removal of majority of grade separated infrastructure, making for a more pleasant environment for walkers and cyclists. One of the two key north-south links is still an off-carriageway facility immediately parallel to the Brunel Way dual carriageway.	4

Parameter	Narrative	Score
Environmental and Heritage Impact	<p>New development land is less substantial and more difficult to build out coherently compared with other options. The openness of views across the Basin could decrease through the new location of the bridge to the east of the existing bridge. Increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells and Brunel Lock Road dividing two areas of released land. The loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut.</p> <p>The main benefits / opportunities include new infrastructure is partly lowered and significantly simplified, reducing visual impact compared to existing higher level network and Oldfield Place traffic flows likely to be low – stronger opportunity for physical/visual links to new development site to the south and potential improvement in noise and air quality. At-grade junction adjacent to B Bond Warehouse could result in a slight improvement to setting. Potential for significant improvements to setting of A Bond Warehouse. An opportunity exists for a strong viewing corridor from the tip of Spike Island towards the Suspension Bridge. Improvement to the setting of the North Entrance Lock through the removal of existing bridge.</p>	3
Stakeholder Views	Similar to Option 4, few impacts from the proposal for stakeholders as little changes from the existing arrangement.	3
Potential Quality of Development	<p>The development to the north of the Basin is compromised by new highway splitting the site and creating an awkward corner opposite rose of Denmark. The opportunity on the peninsula is compromised by retention of existing ramp (McAdam Way), but high-quality frontage is created along the historic River Avon (New Cut) waterfront.</p> <p>Development to the south of the New Cut has mainly traffic-free frontage to waterfront, compromised at west end by proximity to existing elevated road and bridge, with the small western site difficult to development. Developable land is also restricted and compromised by existing elevated Brunel Way.</p> <p>Opportunities for connection to the existing Hotwells residential neighbourhood and east end of Cumberland Basin and a good environment along Oldfield Place. Hotwell Road frontage will be dominated by traffic.</p> <p>Limited opportunity to the improve setting of Holy Trinity Church and Rownham Meads. There is a good opportunity to improve the setting of Bonded Warehouse (A Bond) which has development potential for residential use, while B Bond is compromised by its proximity to the elevated road bridge.</p>	3
Land Value	£28,000,000: Significant impact on development areas by main roads. Development parcels are awkward in shape and lack connectivity. Despite this some good waterside development parcels are created.	2
Meets Housing Needs	Potential 600-700 units	3

Table 13: Option 6 (CH-106)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £184,829,000 – Mid estimate: £294,793,000 – High estimate: £404,757,000	3
Buildability	Option 6 has significant new highway in the form of realignment of the A3029 with new four-lane bridges over the River Avon and lock. The proposed route results in a need to demolish a significant amount of existing highway in order to create space to construct the proposed route which will need to be supported through temporary diversions. The proposed new signalised junction with the A4 will require all traffic to come off at Spike Island in order to make the A3029-A4 movement and as this passes over a two-lane bridge there is insufficient capacity to accommodate this manoeuvre for any significant period of time. Construction and demolition will be difficult due to the need to proximity of new and outdated infrastructure as well as the need to keep major highways open through demolition areas. There is negligible impact on the Metrobus associated with this proposal. This Option is considered to have major buildability issues.	1
Maintenance Cost	Highways costs are likely to increase by +20% to manage ITS kit. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	3
Impact on Harbour Operations	Junction Road Bridge is retained and Plimsoll Bridge is replaced with a new four-lane bridge to the east. The capacity of the Cumberland Basin is reduced very slightly.	2
Highway Capacity Impact	<p>Simplified road network in comparison to existing with two major three-arm signalised junction replacing the existing grade-separated junctions.</p> <p>Hotwell Road extended as a two-way road (single lanes), with the possibility of a tidal arrangement. The junction between Hotwell Road and Merchants Road simplified to a three-arm signalised junction, incorporating pedestrian crossings.</p> <p>New three-arm priority junction to be created between Merchants Road/Oldfield Place, with no through movements to Hotwell Road. Provision of this junction allows the Merchants Road priority junctions with Charles Place and Oldfield Road to be stopped up. The new junction would form a gateway to this residential area, without encouraging through traffic movements, resulting in minimal changes to traffic levels on the local streets.</p> <p>It is proposed that McAdam Way would connect to the new bridge by way of a simplified at-grade three-arm signalised junction and a three-arm priority junction with Merchants Road.</p> <p>Overall there is a net reduction in capacity on the A370-A4 movement due to new signalised junctions, however this impact can be mitigated through appropriate junction design and the option retains redundancy between the two bridges.</p>	3
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. Positive for routing of North Somerset buses as more options are available with the two-way McAdam Way and the removal of the one-way around Hotwells gyratory. Depending on capacity, one of the eastbound lanes on McAdam Way could be provided as a bus lane, as per existing arrangements.	3
Cycling and Walking Impact	Similarities to existing situation but with removal of majority of grade separated infrastructure, making for a more pleasant environment for walkers and cyclists. Additional walking/cycling bridge across New Cut to continue provision where Brunel Way has been relocated eastwards.	4

Parameter	Narrative	Score
Environmental and Heritage Impact	<p>The main risks or potential adverse impacts include openness of views across the Basin could decrease through the new location of the bridge to the east of the existing bridge. Increased adverse noise and air quality impacts on residential receptors through the introduction of two way movements in Hotwells and the realigned Brunel Way passing through the centre of land released for development. Possible imposition of structures (e.g. Piers between Spike Island and the southern connection) within the river channel;</p> <p>Potential adverse impacts on the listed B Bond warehouse. The new crossing from Spike Island to the north runs centrally across the Basin, with potential adverse effects to the fabric and structure of the listed Cumberland Basin. The new bridge immediately adjacent to the existing Ashton Swing Bridge will negatively impact on setting of the listed swing bridge and loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut.</p> <p>The main benefits / opportunities include new infrastructure lowered and significantly simplified and road network pulled further away from the Gorge, reducing impact on views of the Suspension Bridge. Oldfield Place traffic flows likely to be low – stronger opportunity for physical/visual links to new development site to the south and potential improvements in noise and air quality. An opportunity exists for a strong viewing corridor from the tip of Spike Island towards the Suspension Bridge. Improvement to the setting of the North Entrance Lock through the removal of existing bridge.</p>	2
Stakeholder Views	The relocation of the bridge means that there is less impact on the heritage assets, such as Brunel's Other Bridge. Some impact on setting of Ashton Ave Bridge.	3
Potential Quality of Development	<p>The development to the north of the Basin is compromised by new highway splitting the site and creating an awkward corner opposite rose of Denmark. The opportunity on the peninsula is compromised by new four lane highway but high-quality frontage is created along the historic River Avon (New Cut) waterfront and at the end of the peninsula looking west and north to the Gorge</p> <p>Development to the south of the New Cut has mainly traffic-free frontage to waterfront, compromised by proximity to new at-grade 4 lane highway rising to join existing elevated highway, and new road bridge. The site is also split by the new highway alongside the Metrobus route, making connection to the east plot very challenging</p> <p>Opportunities for connection to the existing Hotwells residential neighbourhood and east end of Cumberland Basin and a good environment along Oldfield Place. Hotwell Road frontage will be dominated by traffic.</p> <p>Opportunity to the improve setting of Holy Trinity Church and Rownham Meads. There is a very good opportunity to improve the setting of Bonded Warehouse (A Bond) which has development potential for residential use, while B Bond is compromised by its proximity to new highway.</p>	4
Land Value	£27,000,000: Main road will impact in terms of visuals and noise. Development parcels released are mostly of a regular size and some good waterfront areas created.	2
Meets Housing Need	Potential 600-700 units	2

Table 14: Option 7 (CH-107)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £65,546,500 – Mid estimate: £132,276,000 – High estimate: £199,005,500	4
Buildability	Option 7 lends itself to construction in a phased manner with the new four lane lifting bridge constructed first, the modifications to Spike Island conducted second and works to the A4/Hotwell Road area being undertaken third. This option requires the construction of two new four-lane bridges - over the River Avon and a replacement for Junction swing bridge. There is negligible impact on the Metrobus associated with this proposal. Opposition is likely from residents of Avon Crescent and Oldfield Place due to increased traffic along these Streets. Residents of Ashton Avenue are likely to object as their street becomes isolated at the centre of a two-lane gyratory.	3
Maintenance Cost	Maintenance cost is likely to be 10% less for highways than under existing arrangements. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	5
Impact on Harbour Operations	The number of bridges is reduced to one in this option. Therefore, it is considered beneficial to vessels and harbour operations.	4
Highway Capacity Impact	There is a net reduction in the number of bridges and number of trafficked lanes crossing the Cumberland Basin. This simplifies the road network into a “dumbbell” arrangement either side of a new four-lane bridge replacing the existing Junction Road Bridge. The existing gyratory in Hotwells is maintained and upgraded along Oldfield Place. Traffic demand on the gyratory will increase as all A365 traffic must use the new bridge. All existing residential junctions around Hotwells Gyratory are maintained, despite the increase in the volume of traffic. Second gyratory introduces further signalised junctions along A4-A370 route. The new bridge link across the New Cut would connect into the existing Brunel Way alignment priority to the Jessop Underpass. The reconfigured road network would be less resilient than earlier options due to the limitation of a single bridge crossing across the Cumberland Basin, and the mixture of strategic and local traffic over a single crossing point. Overall a reduction in capacity and a significant number of new junctions on the A4-A370 route. Significant mixing of local and strategic traffic and less resilience due to a single bridge option.	4
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. This layout allows for future bus routes to access Spike Island for accessing city via Hotwells.	3
Cycling and Walking Impact	The removal of highway infrastructure from western side of Spike Island increases the attractiveness of north-south walking and cycling movements along car free routes and no grade separation. Additional walking/cycling bridge across New Cut to continue provision where Brunel Way has been relocated eastwards. The quality of the walking/cycling facility across the proposed dual carriageway in the location of Junction Bridge would decrease with the increase in no. of lanes and traffic.	5
Environmental and Heritage Impact	The main risks or potential adverse impacts include that the only route west along the Portway passes along Oldfield Place closer to a residential area than at present and introducing new development to the immediate south, and several parcels of land are enclosed on four sides by busy roads, with the	3

Parameter	Narrative	Score
	<p>potential to increase noise and air quality impacts. New development land less coherent than for some other options and more difficult to build out coherently. Possible imposition of structures (e.g. Piers between Spike Island and the southern connection) within the river channel. The new bridge immediately adjacent to the existing Ashton Swing Bridge will negatively impact on setting of the listed swing bridge and loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut. Loss of some of the attractive but unlisted terraced properties on Ashton Avenue.</p> <p>The main benefits / opportunities include new infrastructure significantly simplified – reduced massing compared to existing higher level network. Road network pulled further away from the Gorge, reducing impact on views of the Suspension Bridge. Improvement to the setting of the North Entrance Lock through the removal of existing bridge, and reduction in road infrastructure will improve City Docks Conservation Area. Narrowing of Hotwell Road gives room for public realm enhancements and improvements to settings of listed buildings. This represents the considerable landscape benefits and positive impacts on the Suspension Bridge and the Cumberland Basin overall, balanced against increased adverse noise and air quality impacts, impacts on the setting of a number of listed buildings and structures, and the potential need for new structures within the river channel.</p>	
Stakeholder Views	There is reduced potential for public opposition and political opposition as proposal removes crossing point of basin without adding crossing point on River Avon. Widening and increased traffic across Junction swing bridge would have negative impact on Underfall Yard and the properties on Ashton Ave would be surrounded on all four sides by multiple lanes of traffic. Increased traffic around the Hotwell Road / Merchants Road / Oldfield Place residential area. Negative impact on setting of Ashton Ave Bridge.	3
Potential Quality of Development	<p>North development is mostly traffic free high-quality development frontage to historic waterfront however the eastern end of site is limited by the width between new road and waterfront.</p> <p>On the peninsula, there is partially traffic-free frontage to historic waterfront along Cumberland Basin and end of the peninsula looking west and north to the Gorge. Frontage to New Cut is constrained by new highway</p> <p>Development to the south of the New Cut has mainly traffic-free frontage to waterfront, compromised by proximity to new at-grade 4 lane highway rising to join existing elevated highway, and new road bridge. The site is also split by the new highway alongside the Metrobus route, making connection to the east plot very challenging.</p> <p>Opportunities for connection to the existing Hotwells residential neighbourhood is compromised by widened Oldfield Road (one way route) and new highway and bridge to east of the Basin. Highway connections sever part of the Speke island development and isolate the development from the historic neighbourhood at the eastern end. Hotwell Road frontage will continue to be dominated by traffic. Opportunity to improve setting of Holy Trinity Church and Rownham Meads and create a good setting for both of the Bonded Warehouses which have potential for residential use.</p>	4
Land Value	£23,000,000: Two very good waterfront plots created. Traffic and noise will remain an issue and de-value parts of the site.	2
Meets Housing Needs	Potential 500-600 units	1

Table 15: Option 8 (CH-108)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £93,566,500 – Mid estimate: £179,636,000 – High estimate: £265,705,500	4
Buildability	Largely offline construction except the Spike Island and Swing Bridge section which will require temporary closure and diversion via existing grade separated sections. Limited impact on Metrobus as route retained. Demolition of grade-separated sections can be undertaken largely without impacting on routing once alternatives put in place. Tie-ins required on northbound ramp onto A4, Metrobus crossing and with the at-grade section of A3029. Construction of new A3029/A370 roundabout could result in significant delays to traffic. Potential opposition associated with significant increases in traffic in close proximity to Avon Crescent and Oldfield Place and with replacement of existing Junction swing bridge with larger four-lane structure. The route also requires the demolition of some residences along Ashton Avenue.	3
Maintenance Cost	From highways perspective, there would likely be a 10% decrease in maintenance costs on the existing arrangement, related to significant reduction in highway network. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	5
Impact on Harbour Operations	The number of bridges is reduced to one in this option. Therefore, it is considered beneficial to vessels and harbour operations.	4
Highway Capacity Impact	<p>There is a net reduction in the number of bridges and number of trafficked lanes crossing the Cumberland Basin. This simplifies the road network into a “dumbbell” arrangement either side of a new four-lane bridge replacing the existing Junction Road Bridge.</p> <p>The existing gyratory in Hotwells is maintained and upgraded along Oldfield Place. Traffic demand on the gyratory will increased as all A365 traffic must use the new bridge.</p> <p>All existing residential junctions around Hotwells Gyratory are maintained, despite the increase in the volume of traffic. Second gyratory introduces further signalised junctions along A4-A370 route.</p> <p>The new bridge link across the New Cut would connect into the existing Brunel Way alignment priority to the Jessop Underpass. A new roundabout junction is shown as replacement for the existing Jessop interchange. This will result in a net reduction in capacity with the existing arrangement.</p> <p>The reconfigured road network would be less resilient than earlier options due to the limitation of a single bridge crossing across the Cumberland Basin, and the mixture of strategic and local traffic over a single crossing point.</p> <p>Overall a reduction in capacity and a significant number of new junctions on the A4-A370 route. Significant mixing of local and strategic traffic and less resilience due to a single bridge option.</p>	4
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. This layout allows for future bus routes to access Spike Island for accessing city via Hotwells.	3

Parameter	Narrative	Score
Cycling and Walking Impact	The removal of highway infrastructure from western side of Spike Island increases the attractiveness of north-south walking and cycling movements along car free routes and no grade separation. Additional walking/cycling bridge across New Cut to continue provision where Brunel Way has been relocated eastwards.	5
Environmental and Heritage Impact	<p>The main risks or potential adverse impacts include that the only route west along the Portway passes along Oldfield Place closer to a residential area than at present and introducing new development to the immediate south, and the rerouting of the main flow across Merchants road brings the main flow of traffic into close proximity to residential development on the Cumberland Road, with the potential to increase noise and air quality impacts. Loss of some of the attractive but unlisted terraced properties on Ashton Avenue. Poor relationship between C Bond Warehouse and new road/roundabout impacting on setting. Part of Greville Smyth Park (Local Historic Park and Garden) lost to create roundabout and new road. Loss of informal park / recreational space on either side of the adapted BRT bridge to the south of the New Cut. Possible imposition of structures (e.g. Piers between Spike Island and the southern connection) within the river channel.</p> <p>The main benefits / opportunities include new infrastructure lowered and significantly simplified – reduced massing compared to existing higher level network. Reduction in road infrastructure will improve City Docks CA and positively impact the Cumberland Basin Listed Structure overall. Improvements to setting of B Bond Warehouse. Road network pulled further away from the Gorge, reducing impact on views of the Suspension Bridge. Narrowing of Hotwell Road gives room for public realm enhancements and improvements to settings of listed buildings.</p> <p>This represents the considerable landscape and heritage benefits including positive impacts on the Suspension Bridge and the Cumberland Basin overall, balanced against some adverse heritage impacts, increased adverse noise and air quality impacts and the potential need for new structures within the river channel.</p>	3
Stakeholder Views	Addition of new roundabout over Jessop Underpass encroaches onto Grenville Smyth park, more so than the existing highway arrangement. This would be viewed negatively by local residents and groups.	2
Potential Quality of Development	<p>North development is mostly traffic free high-quality development frontage to historic waterfront however the eastern end of site is limited by the width between new road and waterfront.</p> <p>On the peninsula, there is high quality traffic-free frontage to historic waterfront along Cumberland Basin and end of the peninsula looking west and north to the Gorge with uninterrupted views, suitable for high density residential development. Frontage to New Cut is locally constrained by new highway to east of A Bond.</p> <p>Opportunities for connection to the existing Hotwells residential neighbourhood is compromised by widened Oldfield Road (one-way route) and new highway and bridge to east of the Basin. Highway connections sever part of the Speke island development and isolate the development from the historic neighbourhood at the eastern end. Hotwell Road frontage will be dominated by traffic. Opportunity to improve setting of Holy Trinity Church and Rownham Meads and create a good setting for both of the Bonded Warehouses which have potential for residential use.</p> <p>Development to the south of the New Cut has high quality traffic-free frontage to waterfront, locally compromised at east end by proximity to new highway and bridge.</p>	5

Parameter	Narrative	Score
	There are opportunities to extend development where Brunel way interchange is removed, and also into Homes England site benefitting from semi-rural aspect to south and west. There is also an opportunity to connect development on the Homes England site to the existing residential neighbourhood on east side of Metrobus route.	
Land Value	£36,000,000: Very good waterside development parcels plus potential for some lower density housing south of the Cut. Traffic and main road will have some impact, but less than other proposals. Connectivity to rest of Harbourside will need to be ensured for best values.	4
Meets Housing Needs	Potential 700-800 units	5

Table 16: Option 9 (CH-109)

Parameter	Narrative	Score
Estimated Construction Cost	Low estimate: £1,039,493,000 – Mid estimate: £1,910,609,000 – High estimate: £2,781,725,000	1
Buildability	Tunnel construction likely to be difficult due to local geotechnics and hydrology. Tie-ins with existing A3029 (S) and A4 (N) difficult to construct due to land constraints at both tie-in points. The A4 connection in particular will require significant widening of the northern river bank to create a junction with the existing A4 and is also likely to require long term closure of the A4 during construction. A3029 section joins an elevated highway section - ideally this would come further south to an at-grade section but this increases the potential length of replacement highway and will increase construction time and disruption. Demolition relatively simple as area is reduced to local highways and existing Junction swing bridge is retained. Potential impact on Metrobus depending on the final solution for the A3029 tie-in. Potential opposition associated with increased traffic along Oldfield Place. This Option is considered to have major buildability issues. Issues relating to the construction and footprint of a highways tunnel within the study are summarised in the slides found at Appendix H.	1
Maintenance Cost	From highways perspective, there would likely be a minimum of a 15% increase in maintenance costs on the existing arrangement, related to tunnel operations. Plus additional maintenance required for the portals. Highways Authority may need to amend routine maintenance schedules and draw on additional expertise to undertake it. Maintenance effort compared with existing swing bridges is likely to be a 10% decrease in costs.	2
Impact on Harbour Operations	The number of bridges is reduced to one in this option. Therefore, it is considered beneficial to vessels and harbour operations.	5
Highway Capacity Impact	Tunnel proposed to link Jessop Interchange to Hotwell Road (west of Cumberland Basin), reducing the interaction of the traffic with more local-based trips along the residential sections of Hotwell Road and to a lesser degree Merchants Road. Assuming a grade separated rather than signalised connection with the A4 this would likely result in an increase in capacity compared to the existing situation. However, there is no means of accessing the A370 from Spike Island or Hotwells – traffic would need to divert south of the River Avon with impacts on Bedminster Bridge and other routes across the city centre and west of centre. Two-way flows permitted along entire length of Merchants Road. Priority junctions of Charles Place and Oldfield Road with Merchants Road would be stopped up. Access to these streets would be provided via Oldfield Place. Overall while the A4-A370 movement is well provided for there are significant issues with access to the A370 from other routes which are likely to result in changes in traffic flows outside of the study area - most likely on congested city centre highways.	5
Public Transport Impact	Potential impacts of the Metrobus route intersecting with an internal site road within the released land south of the New Cut could be politically problematic, however this depending on the final junction form. The addition of the tunnel and removal of a local vehicular link across the New Cut majorly limits routes for buses to/from North Somerset and routes other than the Metrobus to serve Spike Island.	1
Cycling and Walking Impact	The removal of strategic traffic and majority of highway infrastructure will improve the environment for walkers and cyclists. The quality of the walking/cycling facility across the proposed continuation as a single carriageway crossing in the location of Junction Bridge would decrease with the increase traffic, subject to traffic modelling outputs.	2

Parameter	Narrative	Score
Environmental and Heritage Impact	<p>The main risks or potential adverse impacts include potential adverse air quality and noise impacts arising at Oldfield Place and through the introduction of two way movements in proximity to residential dwellings on Hotwell Road. Views and setting of the Suspension Bridge could be impacted by structures around the tunnel's northern portal – this would need to be sensitively designed and integrated into the landscape. A tunnel solution has the potential to affect ground water flows and would generate a significantly greater volume of excavated material which would likely require additional vehicle trips during construction and may increase costs for disposal of materials depending on the nature of the material excavated.</p> <p>The main benefits / opportunities include trunk road network largely removed from view including to and from the suspension bridge. This creates three substantial, coherent development blocks with potential for a range of development scenarios and landscape treatments. Reduction in road infrastructure will improve City Docks Conservation Area. Setting of Bond Warehouses significantly improved. Setting of listed lock and sluice structures improved. Reduction in road infrastructure means views opened up across the river/ Floating Harbour including between new development sites, and dwellings along Hotwell Road, Oldfield Place, and Cumberland Road. Noise and air quality impacts for a large section of the development will be contained within the tunnel, with impacts focussed at portal locations which are not determined at this stage.</p>	5
Stakeholder Views	Whilst this alleviates many of the existing negative impacts associated with the current road network, there is potential for stakeholder concerns due to the high cost and longer timescale of construction.	4
Potential Quality of Development	<p>Provides maximum high-quality traffic-free development frontage to Cumberland Basin and River Avon (New Cut) and end of the peninsula looking west and north to the Gorge - with largely uninterrupted views.</p> <p>Developable land to the south of the New Cut is restricted and compromised by existing elevated Brunel Way.</p> <p>Developmental land to the north of Cumberland Basin restricted by limited width to the east.</p> <p>With segregation of A4-A370 traffic there are opportunities to provide high quality connections to integrate the new development and existing communities.</p> <p>Hotwell Road frontage will continue to be dominated by traffic. Opportunity to greatly improve setting of Holy Trinity Church, Rownham Meads and Bonded Warehouses, which have potential for residential use.</p>	5
Land Value	£34,000,000: Excellent development sites created. Views will not be impacted by new bridge and traffic/noise will be minimised.	3
Meets Housing Needs	Potential 600-700 units	2

7 Initial Sifting Summary

7.1 Initial Sifting Assessment Summary

Nine distinct options have been developed which seek to rationalise the transport network in the vicinity of Cumberland Basin, while releasing land for development and providing an opportunity to provide betterment to the area in terms of its urban setting and its sense-of-place. Each option has been considered against both a set of project objectives and also some more detailed feasibility parameters.

Table 17 indicates the overall scoring of the options in terms of project objectives and also feasibility assessment. It discounts options which have attributes which are considered to make them undeliverable, as discussed in Section 6.4. This has the effect of removing Option 5, Option 6 and Option 9 from consideration.

Table 17: Option Assessment Summary Table

Option	Feasibility	Project Objectives	Objectives + Feasibility	Significant Issue**	Discount	Ranking
Option 1	39	22	61			4th
Option 2	40	24	64			2nd
Option 3	41	19	60			5th
Option 4	36	11	47			6th
Option 5	37	17	54	Buildability	Yes	n/a
Option 6	35	16	51	Buildability	Yes	n/a
Option 7	44	18	62			3 rd
Option 8	50	25	75			1 st
Option 9	40	22	62	Cost and Buildability	Yes	n/a

** Significant issues are those issues which were highlighted through the stakeholder workshop as ‘show stoppers’. Other major issues, such as environmental issues, will be reviewed at a later time in terms of their suitability once mitigation is taken into account.

Table 17 shows that in overall summary, the assessment process has shown that Option 8 is the strongest in terms of both meeting objectives and feasibility. Option 7 and Option 2 also perform well and could be considered candidates for further consideration.

7.2 Selection of Options for further Detail

The purpose of the sifting exercise was to select two options to be progressed to a more detailed level of feasibility analysis.

On the basis of the evidence presented in this report it is clear that Option 8 performs most strongly against the various criteria and has no significant issues in

any topic area. Option 8 is therefore selected to be progressed to a greater level of detail.

Option 2 and Option 7 score similarly overall, however the detailed scoring shows that they have quite distinct strengths and weaknesses. Option 2 releases a greater quantity of land, yet requires a higher level of capital expenditure. It may carry a greater risk in terms of environmental impact and may be more complex to construct. However, in terms of its ability to provide a high-quality waterfront place with a coherent urban environment, it is stronger. On that basis, Option 2 is progressed to a greater level of detail.

An additional benefit of progressing Option 2 over Option 7 is that Option 7 has a number of commonalities with Option 8 – including its similar alignment and land release. Therefore, there is benefit to exploring Options that are quite dissimilar and would produce very distinct outcomes.

In overall summary, Option 2 and Option 8 are the strongest options and are progressed to the next stage of feasibility assessment, which is described in the following Section of this report.

8 Option Refinement Process

Option 2 and Option 8 have been selected for ‘Option Refinement’. The Option Refinement process comprises the below elements and is summarised in the Chapters that follow:

1. Outline design of junction layouts, including bus lanes, line markings, and turning radii. This enables a detailed junction capacity modelling exercise for all of the significant junctions included within the two options. This element of the refinement process is discussed in Section 9, with junction modelling results discussed in Section 10;
2. Consideration of the provision for bus services and any opportunities for bus priority measures and improved bus stops / layover space. This element of the refinement process is discussed in Section 11;
3. A discussion of the level of provision for pedestrians and cyclists is presented in Section 12;
4. A description of how each option might interact and be compatible with the flood defence measures that are being developed by Bristol City Council is discussed in Section 13; and
5. A description and illustration of how the moving bridges included within each option might operate is presented in Section 14.
6. Revised revenue estimates are presented and discussed in 15.

Having refined the Options in the manner described above, the scoring process presented in Section 6 is refined, before both options are compared with the ‘Do Minimum’ scenario of retaining the existing highways arrangement. This process is described in more detail in Section 15.

9 Highways Refinement

The highways arrangements associated with Option 2 and Option 8 have been refined to better understand their land-take, their ability to cater for pedestrians, cyclists and buses, and their capacity for motor-traffic. The option designs have been drafted to outline-design level, illustrating the potential horizontal alignment of each option. The design approach is summarised below:

- The overall footprint and land-take of junctions have been of key consideration throughout the design process. It is recognised that there is trade-off between a junction's capacity and its impact on land-take and its surroundings. Junctions have been designed in order to deliver adequate levels of capacity for traffic and pedestrians, while also not being 'over-designed' and requiring too much land which could be put to other use.
- The design process has adopted an approach which encompasses both DMRB and Manual for Streets design principles. Some junctions and links within the study area are expected to fulfil a strategic purpose and as such DMRB has been applied. In other locations, it is expected that the public highway will predominantly serve local traffic and as such have the potential to create a 'sense of place'. In these instances, Manual for Streets has been employed. Traffic lanes are in general either 3.65m or 3.5m in width.
- Bus Lanes have been provided where geometric constraints allow, in order to reduce delays to bus services as they approach junctions. Given the significant rearrangement of highway links through the study area, the potential for large-scale development, and a design year of 2036, it is not possible to know the exact routing or frequency of bus services within the study area. However, bus stop locations have been selected to reflect the potential routes of long-distance and local bus services through the area, while maintaining a connection of inbound and outbound services. The incorporation of buses into the design is discussed in more detail in Section 11.
- Off-road cycle facilities have not been designed in detail, as they would necessarily interact with the proposed development areas, the masterplans of which are not yet defined. 'Advanced Stop Lines' (ASL) are included in locations where cyclists can reasonably be expected to use the main carriageway. Cycle routes through the study area are presented in Appendix M and Appendix N which is appended to this report.
- Pedestrian crossing locations have been identified at all junctions. All pedestrian crossings shown in the proposals are formal signalised at-grade crossings, and at 3m in width are wide enough for cyclists and pedestrians to use together. Pedestrian routes through the study area are presented in Appendix M and Appendix N which is appended to this report.
- The alignment of the Metrobus link on Spike Island and at the A370 / A369 junction has been incorporated into the design.

- It is assumed that public highway and public rights of way should not be aligned to be within 5m of the railway line known as the 'Portishead Line'. This offset has been assumed based on experience from other locations.
- It is assumed that a slight reduction in the quantity of formal on-street parking spaces is acceptable. This is in line with the BCC Parking Strategy which seeks to encourage alternative modes of transport and reduce unnecessary use of private cars in the city.

The highways element of Option 2 and Option 8 are presented in Appendix I and Appendix J which are appended to this report. The junction arrangements associated with each option are summarised in the paragraphs below.

9.1 Option 2

As described in Section 2 of this report, Option 2 converts the existing gyratory at Hotwells to a two-way system. The A370 connects with land to the north of the river and Cumberland Basin via a new link running along the south and west of the river Avon, and crossing the Avon at a point around 150m west of the western lock of Cumberland Basin (this link will henceforth be referred to as 'the New Link'). As such, this arrangement requires a new junction at its Avon crossing, (which will henceforth be referred to as New Avon Bridge). It will also require a rearrangement of the junction of the A370 / A3029 / A369, and rearrangement of all junctions at the Hotwells gyratory.

The various junctions comprised within this arrangement are described in the paragraphs that follow.

In setting out the necessary junction arrangements described below, it should be noted that the potential land release associated with Option 2 has been calculated at 107,000sqm.

9.1.1 A370 / A3029 / A369 Junction

The existing junction of the A370, A3029 and A369 is a complex partially grade-separated junction. It passes over a Metrobus-only route and also the Portishead Line. It is considered that the existing alignment is not fully compliant with DMRB standards for horizontal curvature.

Option 2 proposes to connect a new crossing of the River Avon with the A370 / A3029 / A369 junction. This proposal therefore results in a 5-arm junction, which must be separated from Metrobus and the Portishead Line.

A number of options were considered for this location:

- Junction Option A - 'Throughabout' – Five arm roundabout with a 'throughabout' lane from the proposed link to the River Avon to the A370 southbound. The junction is elevated from the Metrobus route and Portishead Line, and all traffic movements meet at the same grade. Utilisation of existing slips. Route from the A369 to the roundabout passes underneath the A370, utilising the existing Ashton Road slip road.

- Junction Option B - ‘Single roundabout with Flyover to New Avon Link’ – Four arm roundabout, elevated from the Metrobus route and Portishead Line. Grade separated (elevated) crossing of junction from the existing A370 South arm to the proposed New Link to the River Avon crossing. The elevated section is designed in compliance with DMRB standards for horizontal and vertical curvature. The junction functions as an all-movements junction.
- Junction Option B1 – ‘Single Roundabout with Flyover to New Avon Link – Further East’ – As Option B, but with the circulatory located further east around 50m to the east, which should reduce the difficulty
- Junction Option C – ‘Dumbell Roundabout’ – Two roundabouts, one in the location of the existing roundabout of Blackmoors Lane / A369, and one at the confluence of the A3029 and the A370 Brunel Way. The western roundabout provides the connection to the New Avon Link. Both junctions are connected by a single traffic bridge which is elevated over the Portishead Line and the Metrobus route.
- Junction Option C1 – ‘Dumbell Roundabout with Flyover to New Avon Link’ as Option C but with the movement from the A370 South to the New Avon Link elevated over the western roundabout.

All options are illustrated in Appendix K.

Option A is considered to represent the lower-cost, lower-capacity option. It reduces the overall footprint of the junction and simplifies the road network. Even so, it would require significant structural works and thus consideration within this project has been at a high-level.

The other options are considered to represent higher-cost, higher-capacity options. They each increase the overall footprint of the junction, and do little to simplify the road network. They would require significant structural works and in some cases, works to the A370 as far south as its junction with the B3128.

A full discussion of the options for this junction is included at Appendix K. In summary however, Option B/B1 has been selected to be included as the preferred arrangement for Option 2. Option A and C are discounted for capacity reasons, while Option C1 is expected to be more expensive and more challenging to construct than Option B/B1.

Appendix K also discusses two off-junction improvements which have the potential to simplify the junction by reducing the amount of movements which pass through it.

9.1.2 A370 / A4 ‘New Avon Bridge’ Junction

The proposed junction of the New Link and the A4 takes the form of a signalised three-arm roundabout. All three arms are provided with three approach arms, and there are three lanes on most of the circulatory carriageway. Pedestrian crossings are provided at all stop lines, with a crossing on the exit from the circulatory to the A4 North.

The carriageway has been set-back a distance of 10m from the Portishead railway line, which enables the provision of a 5m wide pedestrian / cycle facility, while meeting Network Rail setback requirements¹⁵.

9.1.3 Merchants Road / Oldfield Place Junction

The proposed arrangement for Merchants Road / Oldfield Place is an all-movements priority controlled 'T' junction, with Oldfield Place forming the minor arm of the junction.

9.1.4 Hotwell Road / Oldfield Place Junction

The junction of Hotwell Road and Oldfield Place takes the form of a signal controlled 'T' junction with right turns prohibited. There are two lanes for Oldfield Place traffic to turn left onto Hotwell Road, and two lanes for Hotwell Road eastbound traffic. A single lane provides for all westbound traffic on Hotwell Road, which can either go ahead or turn left onto Oldfield Place. A loading bay is provided on the eastern side of Oldfield Place to enable loading operations for the Rose of Denmark pub. The junction is provided with pedestrian crossings on all arms.

9.1.5 Hotwell Road / Merchants Road Junction

It is proposed to simplify the existing arrangement by introducing one right turn lane for Hotwell Road eastbound traffic and two ahead lanes for eastbound traffic. One ahead and left lane is provided for Hotwell Road westbound traffic.

The movement from Clifton Vale to Merchants Road is retained, although the movement from Ambra Vale to Merchants Road is not facilitated by the junction; instead it would travel east to the Anchor Road junction before U-turning and returning to Merchants Road.

Pedestrian crossing facilities are provided across all arms of the junction.

9.2 Option 2B Variant

It should be noted that there is an alternative arrangement for this Option, whereby traffic from Hotwell Road to Spike Island is not routed along Oldfield Place, but is instead routed along Merchants Road. This would result in a reduced footprint of highway infrastructure along what is currently Oldfield Place. However, in order to deliver all flows for Spike Island along Merchants Road, the junction of Merchants Road / Hotwell Road junction would need to be larger than in the main Option 2 arrangement. It would require a mini-gyratory junction at the northern extent of Merchants Road with two ahead lanes on all three approaches.

¹⁵ As understood from previous studies elsewhere in the UK.

9.3 Option 8

As described in Section 4 of this report, Option 8 retains the one-way gyratory system of Hotwell Road, Merchants Road and Oldfield Place, running in a clockwise direction. The A370 connects with the gyratory, and by extension the A4, by crossing the River Avon to the east on the A Bond Warehouse, and then continuing north on that alignment, crossing the harbour in the location that Junction Swing Bridge currently does. As it does so, it connects with Clift House Road, in the vicinity of Greville Smyth Park, and Cumberland Road, in the vicinity of the A Bond Warehouse, the 'Chocolate Path' and Avon Crescent.

The various junctions comprised within this arrangement are described in the paragraphs that follow.

In setting out the necessary junction arrangements described below, it should be noted that the potential land release associated with Option 2 has been calculated at 95,500sqm.

9.3.1 A370 / Clift House Road Junction

The junction has been designed as a large signal controlled crossroads. It is provided with three ahead lanes for northbound traffic and three ahead lanes for southbound traffic. Two right turn lanes are provided for the movements from A370 South to Clift House Road. The western arm of the junction leads to the potential development site and is provided with one lane in each direction.

The junction and its approach arms have been aligned such that it does not require physical alterations to the existing bonded warehouse on Clift House Lane or the Pumping Station to its west.

Pedestrian crossings are provided on three of the four sides of the junction.

Consideration has been given to alternative junction types. Given the heavy through-traffic flow of the A370, the optimal arrangement purely in terms of traffic operation may be a grade-separated junction, similar to the junction of the A4044 and A420 at Old Market, Bristol. However, this junction type would require lengthy on-slips and off-slips, considerable earthworks, and require a greater land-take. Furthermore, the aspiration identified through the Workshop was to simplify the road network in this location. As such, a signalised crossroads option has been selected as demonstrating the best balance between traffic operation and land-take.

9.3.1.1 Further Development

There is an opportunity to amend the design for Clift House Road junction to reduce its footprint and increase operational performance. This is achieved through:

- Provision of a dedicated right turn expressway for traffic from the south arm to Clift House Road, following the alignment of the slipway at the western extent of Greville Smyth Park.

- Provision of an egress from the development area to the A370 on a left-out basis only, remote from the Clift House Road junction.
- Prohibiting right turns from the A370 North arm into the development area, at the Clift House Road junction.

9.3.2 A370 / Cumberland Road / Metrobus Junction

This junction is designed as a signal controlled crossroads. It is provided with three southbound lanes and two northbound lanes. This is because the traffic flows derived from strategic modelling (and discussed in Section 10) indicate a heavier flow in the southbound PM than the northbound flow in the AM. Cumberland Road is provided with two approach lanes. The junction provides for Metrobus which runs through the crossroads on an east-west orientation and is provided with its own distinct stage.

At-grade pedestrian crossings are provided on all sides of the junction. Given the proximity of the junction to the 'Chocolate Path' and improvements along the 'Greenway', both of which run on the north bank of the River Avon, it is considered that a grade separated pedestrian and cycle crossing could be provided over the southern arm of the junction, in addition to the signalised crossing of this arm.

9.3.2.1 Further Development

There is an opportunity to amend the design to reduce footprint and increase operational performance of the Cumberland road / Metrobus junction in Option 8. This would be achieved though prohibiting the left turn movement from Cumberland Road, and prohibiting right turns from the southern arm. This enables the Cumberland Road phase to run concurrently with the Metrobus Phase.

9.3.3 Merchants Road / Oldfield Place Junction

The junction is provided with two traffic lanes for both Merchants Road approaches. The movement from Merchants Road North to Oldfield Place runs as a give-way merge as it is lightly trafficked.

9.3.4 Hotwell Road / Oldfield Place Junction

Hotwell Road is a one-way road to the east of Oldfield Place, and as such its carriageway is allocated to three eastbound lane to the east. To the west it is provided with two westbound lanes. There is no right turn from Hotwell Road into Oldfield Place. Oldfield Place is provided with two general traffic approach lanes, which flare out into four lanes, two of which turn left onto Hotwell Road, the other two turn right. A loading bay is provided on the eastern side of Oldfield Place to enable loading operations for the Rose of Denmark pub.

Pedestrian crossings are provided on all sides of the junction.

9.3.5 Hotwell Road / Merchants Road Junction

It is proposed to simplify the existing arrangement by introducing two right turn lanes for Hotwell Road eastbound traffic and two left turn lanes for Hotwell Road westbound traffic. One ahead-lane is provided for Hotwell Road westbound traffic.

The movement from Clifton Vale to Merchants Road is retained, although the movement from Ambra Vale to Merchants Road is not facilitated by the junction; instead it would travel east to the Anchor Road junction before U-turning and returning to Merchants Road.

Pedestrian crossing facilities are provided across all arms of the junction.

9.4 Option 8B Variant

A variant of Option 8 has been conceptualised whereby the east-west route from Junction Bridge to Hotwell Road is aligned along the northern harbour wall of Cumberland Basin. This has the benefit of moving highways infrastructure away from what is currently Oldfield Place. However, it results in a lower quantity of developable land than that released by Option 8, and proposes a busy highway link in the immediate vicinity of the waterside setting of Cumberland Basin. The layout of Option 8B is appended to this Report.

9.5 Summary

This section describes the outline junction design incorporated into each option. All junctions have been designed with pedestrian, cycle and bus provision in mind, and land-take has been reduced to a minimum.

The option refinement process has established that the proposed arrangement at the A369 / A370 / A3029 is likely to be a complex grade separated junction. The buildability score for Option 2 is therefore amended as below.

The Initial Sifting Score presented in Table 7.

Table 7 gave the following scores:

- **Option 2:** 2 out of 5 – ‘Weak’

Following the refinement exercise this score is reduced:

- **Option 2:** 1 out of 5 – ‘Very Weak’

10 Junction Capacity Assessment

This section of the report describes the junction assessments that have been undertaken to assess the alignments described in Section 9. The assessments provide a basis for determining the extent to which future traffic movements can be accommodated by the scheme options.

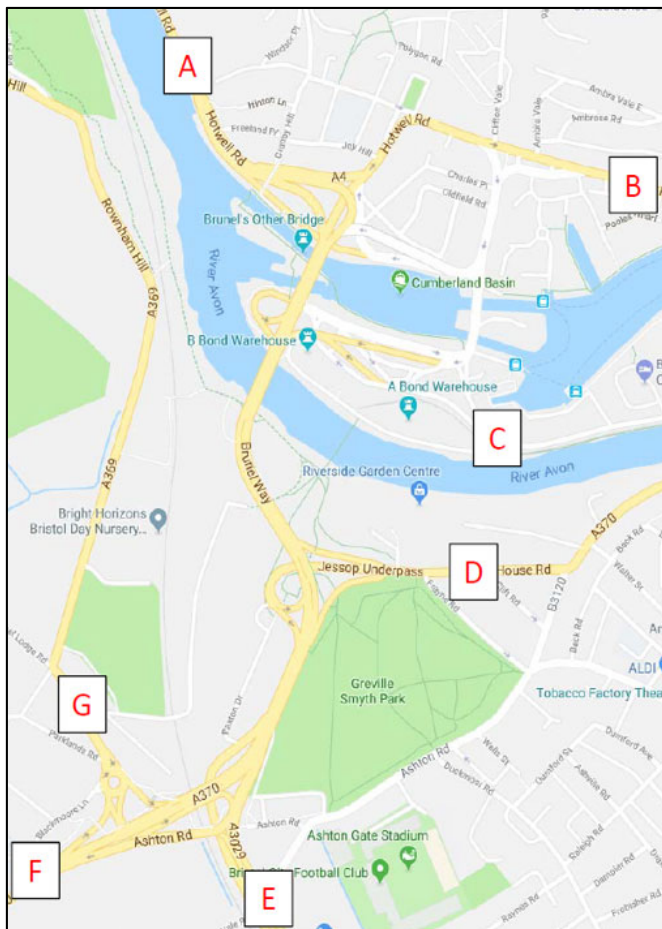
10.1 Traffic Flows

10.1.1 Extraction of Flows

Traffic flows have been acquired from the Greater Bristol Area Transport Study model (the GBATS model) for the year 2036 in both a weekday AM peak hour and a weekday PM peak hour.

A cordon was applied to the model so that origin and destination flows could be extracted for the seven zones indicated in Figure 7. Flows were provided in PCUs.

Figure 7: GBATS Model Zones



10.1.2 Reduction in Flows

During discussions with BCC it was established that some of the traffic movements through the study area can be considered to ‘strategic’ in nature, while others are considered ‘local’.

Strategic movements are those movements that cannot easily be reduced by sustainable transport initiatives. An example of such a strategic movement is between the A4 at Avonmouth and the A370 towards Long Ashton.

For local movements, it is expected that sustainable transport measures will be implemented across the city which will have the effect of improving alternative modes of travel, thus reducing traffic volumes. Flows are therefore reduced between the city centre and Avonmouth, Spike Island and Southville.

Using these assumptions, flows have been reduced across the study area by the percentages indicated in Table 18. Origin-Destination pairs (OD pairs) that are left blank are not reduced.

Table 18: Percentage Flow Reductions by Origin-Destination Pairs

OD pairs	A	B	C	D	E	F	G
A		33%					
B	33%		33%	33%	20%	20%	
C		33%		20%	20%	15%	
D		33%	20%		20%	15%	
E		20%	20%	20%			
F		20%	15%	15%			
G							

It should be noted that further flow reductions may be achieved through other wider transport interventions, such as improvement of the route between the M5 and the South Bristol Link Road. This would have the effect of reducing the volume of the strategic movement from the A4 to the A370 within the Western Harbour study area. Such flow reductions have not been formally included within the assessment, however the results of the modelling exercise should be read in the context of such potential improvements.

10.1.3 Modelling Methodology

All of the modelled junction arrangements comprised within the options are signal controlled. As such the junctions have been modelled using LinSig V3.2.31.

Junction capacity in LinSig is measured using Practical Reserve Capacity (PRC) and Degree of Saturation (DoS). It also estimates the Mean Maximum Queue (MMQ).

- DoS measures the proportion of capacity that is utilised by an arm- and can be understood as the ratio of flow to capacity.

- PRC is calculated from the maximum degree of saturation on a Lane and is a measure of how much additional traffic could pass through a junction whilst maintaining a maximum degree of saturation of 90% on all lanes.
- MMQ represents the maximum queue within a typical cycle averaged over all the cycles within the modelled time period.

These parameters have been used to summarise the operational effectiveness of individual junction approaches in accordance with the following pre-determined thresholds:

	Within Practical Capacity – <i>DoS below 90%</i>
	Over Practical Capacity, Approaching Theoretical Capacity <i>DoS between 90% and 100%</i>
	Over Theoretical Capacity - <i>DoS above 100%. Such junctions have been deemed to operate over theoretical capacity with substantial queuing delays.</i>

In building the various junction models, the following assumptions have been made:

- Saturation flows have been determined based on geometric parameters according to principles set out in TRL RR67;
- Pedestrian phases are called once per cycle. This is considered to be a robust assumption as it is possible that pedestrian movements would not be so great in highway peak hours so as to require pedestrian phases every two minutes in the peak hour;
- A maximum cycle time of 120 seconds has been applied;
- Flows have been input to the model based on PCUs as opposed to vehicles with percentage HGV allowance;
- Stage sequences have been reviewed to ensure that there is adequate time in the sequence for pedestrian crossing phases to run unopposed by traffic phases. Where the sequences do not naturally enable sufficient time for a pedestrian phase, a specific pedestrian phase has been built into the sequence; and
- Stages and phases have been included where appropriate for the proposed development. However, as the quantum of the proposed development has not been determined, no development flows have been added to the model.

10.2 Option 2 Results

10.2.1 A370 / A3029 / A369 Junction

The junction modelling results associated with Option A ‘Throughabout’ and Option B ‘New Link Flyover’ arrangements for this junction in Option 2 are discussed in the paragraphs below.

10.2.1.1 Option A – ‘Throughabout’

The ‘Throughabout’ option was found to suffer from such high levels of queuing on its circulatory carriageway that it would not function adequately.

In the AM peak, queues of around 175m were produced at one circulatory stop-line, which is far in excess of the amount of queuing that can be stored internally at a roundabout.

In the PM peak, operational issues are present on the approach to the roundabout from the New Link, exceeding 110% DoS. Circulatory queues exceeded those of the AM peak and would have the effect of preventing the junction from operating properly.

For these reasons, the Option A ‘Throughabout’ was not explored further, rather it is recorded that it is a low capacity option that would require significant enhancement (or a reduced flow scenario) in order to be acceptable in traffic terms. Detailed modelling results can be provided on request.

10.2.1.2 Option B – ‘Single Roundabout with Flyover to New Avon Link’

The modelling results associated with Option B – ‘New Link Flyover’ in Option 2 are presented in Table 19.

Table 19 – A370 / A3029 / A369 Option A ‘New Link’ Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Existing A370 North Approach	16	28	89%	11	21	82%
A3029 Approach	14	27	81%	16	39	93%
A370 South Approach	24	87	99%	17	53	96%
New Link Sliproads	11	27	78%	10	22	80%
Worst Performing Circulatory Arm	11	13	64%	10	13	78%

Table 19 indicates that through the addition of a flyover between the A370 South and the New Link, the junction operates adequately and largely within capacity. The most significant pinch point is between the circulatory carriageway and the A370 South arm, which results in queues of around 10 PCUs on the circulatory carriageway. There is sufficient storage space within the junction for this queue to be accommodated without blocking-back to its upstream stopline.

While there is a possible value-engineering exercise to establish the optimum iteration of a 'Flyover'-type solution, the modelling has demonstrated that the New Link can connect with an all-movements junction and operate adequately.

10.2.2 New Link / A4 'New Avon Bridge' Junction

The junction modelling results associated with the proposed New Avon Bridge at the A370 / A4 in Option 2 are presented in Table 20 below.

Table 20 – A370 / A4 'New Avon Bridge' Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
New Link Approach	23	15	90%	12	11	80%
A4 West Approach	16	20	77%	8	11	69%
A4 East Approach	7	34	68%	9	22	83%
Worst Performing Circulatory Arm	17	40	87%	7	26	87%

The results presented in Table 20 show that the proposed arrangement at the New Avon Bridge performs within practical capacity on all arms in both peaks, with the exception of the A4 East Arm, which experiences queues of around 16 PCUs and delays of around 34 seconds per vehicle.

10.2.3 Merchants Road / Oldfield Place Junction

The junction modelling results associated with the proposed priority controlled junction of Merchants Road and Oldfield Place in Option 2 are presented in Table 21 below.

Table 21 – Merchants Road / Oldfield Place Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	RFC	Queue (PCU)	Delay (s / pcu)	RFC
Merchants Road North	1	7	0.1	1	1	0.1
Oldfield Place	1	9	0.1	1	1	0.1

The results presented in Table 21 show that the proposed arrangement at the priority controlled junction of Merchants Road / Oldfield Place performs within capacity on all arms in both peaks. The strong performance of this junction is due to very limited flows which pass through it, which is itself a result of the fact that it is only trafficked by local movements to Oldfield Place and the relatively light movement to / from Spike Island.

10.2.4 Hotwell Road / Merchants Road Junction

The modelling results associated with the proposed signalised junction of Hotwell Road and Merchants Road in Option 2 are presented in Table 22 below.

Table 22 – Hotwell Road / Merchants Road Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Hotwell Road West	9	9	50%	7	65	51%
Merchants Road	1	70	10%	1	71	15%
Hotwell Road East	8	8	42%	24	14	76%

The results presented in Table 22 demonstrate that the proposed signalised junction of Hotwell Road and Merchants Road operates within practical capacity on all arms and in both peaks, with the exception of Hotwell Road East, which operates close to its theoretical capacity and experiences a queue of around 48 vehicles and around 35 seconds of delay per vehicle. It is worth noting that at less than 100% DoS, the queue is expected to dissipate entirely once per phase.

The Hotwell Road East arm is provided with only one ahead lane and thus in the PM peak, when flows exiting Bristol City Centre are highest, delays and queue lengths extend to a degree not experienced in the AM peak.

10.2.5 Hotwell Road / Oldfield Place Junction

The modelling results associated with the proposed signalised junction of Hotwell Road and Oldfield Place in Option 2 are presented in Table 23 below.

Table 23 – Hotwell Road / Oldfield Place Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Hotwell Road West	7	4	43%	2	3	19%
Oldfield Place	4	57	48%	11	76	88%
Hotwell Road East	9	11	41%	34	28	87%

The results presented in Table 23 show that the proposed signalised junction of Hotwell Road and Merchants Road operates well within capacity in the AM peak hour. In the PM peak hour however, when flows exiting Bristol City Centre are highest, the single lane westbound approach is less able to deliver the flows that arrive at the junction without queues or delays and this has an impact on its opposing flow, the left turn from Oldfield Place. It is worth noting that queues on both arms dissipate to close-to-zero on during each green phase, and that, were the pedestrian crossing not to be called once per cycle then delay per vehicle would be reduced significantly.

10.3 Option 8 Results

10.3.1 A370 / Clift House Road Junction

The junction modelling results associated with the proposed signalised junction of the A370 and Clift House Road in Option 8 are presented in Table 24.

Table 24 – A370 / Clift House Road / Potential Development Access – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
A370 North Arm	11	24	45%	47	106	101%
Clift House Road	17	78	92%	31	150	103%
A370 South Arm (ahead)	31	40	93%	15	32	75%
A370 South Arm (right)	12	83	85%	30	146	101%

The results presented in Table 24 indicate that the proposed junction is approaching capacity in the AM peak. It exceeds capacity on three of the four arms in the PM peak, due to generally higher flows in this time period. Delay per vehicle exceeds one minute on all but one of the approach arms in the PM peak.

Overall, the junction is sub-optimal in traffic terms, but it is not significantly over capacity and would be expected to function adequately. While queue lengths are not inconsiderable it should be noted that queues will dissipate to close to zero once per cycle.

The results reflect the very high flows that pass through the junction. The existing junction of the A370 and Clift House Lane provides an uninterrupted grade-separated link which passes over the River Avon, while the proposed arrangement introduces a signalised option which has a less significant footprint, and which enables access to the proposed development area to the west. On that basis, the operational sub-optimalities associated with the proposed signalised junction should be weighed against the benefits of the potential development it helps to unlock.

Furthermore, it should be noted that were the pedestrian phase to be called less frequently than once per cycle then the junction's performance would increase. Similarly, were the proposed development to produce very few vehicle trips in the peak hour and the signals were run on a demand basis, then the junction's performance would increase.

10.3.2 A370 / Cumberland Road / Metrobus Junction

The junction modelling associated with the proposed signalised junction of the A370 and Cumberland Basin in Option 8 are presented in Table 25.

Table 25 – A370 / Cumberland Road / Metrobus Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
A370 North Arm	12	10	70%	55	57	99%
Cumberland Road	9	118	92%	28	154	103%
A370 South Arm	43	28	93%	30	28	86%

The results presented in Table 25 indicate that the proposed junction is expected to approach capacity in both its AM peak. It exceeds capacity in the PM peak on the Cumberland Road arm, due to high flows generally in the PM peak. Cumberland Road experiences queues and delays which would be considered not insignificant.

It should be noted that the results of the Metrobus approach arms of the junction are not presented. However, the Metrobus arms are given one stage per cycle and as such there is sufficient capacity within the junction for the bus stage to be called 30 times per hour, for services running in both directions. Were services to be run with a lower frequency, or for their arrival profile to be distributed unevenly, then the junction would perform with a lower degree of saturation.

Similarly, the pedestrian facilities on the southern arm of the junction may be called less frequently than once per cycle, given that it is proposed to also provide a pedestrian and cycle bridge over the carriageway. On that basis the results, in terms of their modelling of pedestrian movements and Metrobus demand, should be considered a 'worst case'.

10.3.3 Merchants Road / Oldfield Place Junction

The junction modelling associated with the proposed signalised junction of Merchants Road and Oldfield Place in Option 8 are presented in Table 26.

Table 26 – Merchants Road / Oldfield Place Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Merchants Road North	10	5	59%	22	9	80%
Merchants Road North (RT to Oldfield Place)	1	5	11%	1	4	7%
Merchants Road South	24	9	81%	14	6	66%

The results presented in Table 26 show that the junction operates well within capacity on all arms in both the AM and the PM peak. This is to be expected given that the only conflicting flow is from vehicles wishing to turn from Merchants Road onto Oldfield Place, a movement which gives way to northbound traffic from Junction Bridge.

10.3.4 Hotwell Road / Merchants Road Junction

The junction modelling associated with the proposed signalised junction of Hotwell Road and Merchants Road in Option 8 are presented in Table 27.

Table 27 – Hotwell Road / Merchants Road Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Hotwell Road West Ahead	16	12	89%	38	39	96%
Hotwell Road West Right Turn	20	15	73%	33	49	93%
Hotwell Road East	12	53	76%	37	66	98%

The results presented in Table 27 show that the junction operates at full capacity in both the AM and PM peak. The only conflicting movement to the Hotwell Road West Ahead arm is the pedestrian crossing from the refuge to the north side of Hotwell Road and so it should be noted that were the crossing phase to be called less than once per cycle then the performance of this arm would improve significantly.

One key constraint on both arms of the Hotwell Road is the provision of bus lanes. The removal or shortening of the proposed bus lanes would improve the operation of the junction by converting 'short lane' in lane 1 to 'long lanes', with the effect that the junction would operate entirely within capacity. However, bus priority measures are a key factor in sustainable travel initiatives in the city and on that basis the proposed bus lanes are retained.

Consideration was given to widening the junction such that it is provided with two eastbound ahead lanes, however this requires a significant narrowing of the footway

widths, or the removal of one of the west arm right-turn lanes. The west arm right-turn lanes are too heavily trafficked to be reduced in number and as such this measure has not been employed.

10.3.5 Hotwell Road / Oldfield Place Junction

The junction modelling associated with the proposed signalised junction of Hotwell Road and Oldfield Place in Option 8 are presented in Table 28.

Table 28 – Hotwell Road / Oldfield Place Junction – 2036 Reduced Flows

Link	AM			PM		
	Queue (PCU)	Delay (s / pcu)	Deg of Sat	Queue (PCU)	Delay (s / pcu)	Deg of Sat
Hotwell Road West	30	66	96%	15	18	72%
Oldfield Place Right Turn	46	71	99%	13	48	80%
Oldfield Place Left Turn	10	9	87%	11	10	88%

The results presented in Table 28 show that the junction operates well within capacity on all arms in PM peak, but approaching capacity in the AM peak. While queues are not inconsiderable, average delay does not significantly exceed one minute per vehicle and queues are expected to dissipate to zero during each green phase.

As with other junctions in the study area, it should be noted that were the pedestrian phase to be called less than once per cycle then the junction's operation would be improved.

10.4 Summary of Junction Modelling

The key junctions included within Option 2 and Option 8 have been assessed using junction modelling software. Traffic flows have been extracted from the existing GBATs strategic traffic model for the year 2036, and reduced based on assumptions around sustainable travel measures in the city over the coming decades.

The results of the modelling exercise undertaken for Option 2 and Option 8 are summarised in Table 29, which shows the worst degree of saturation across both peaks and across all approach arms.

Table 29 – Summary of Junction Modelling

Junction	Option 2 – Worst Degree of Saturation	Option 8 – Worst Degree of Saturation
A370 / A3029 / A369 / 'New link'	99%	n/a
A370 / A4 'New Avon Bridge'	90%	n/a

Junction	Option 2 – Worst Degree of Saturation	Option 8 – Worst Degree of Saturation
Merchants Road / Oldfield Place	10%	81%
Hotwell Road / Merchants Road	76%	98%
Hotwell Road / Oldfield Place	88%	99%
A370 / Clifthouse Road	n/a	103%
A370 / Cumberland Road / Metrobus Link	n/a	103%

Table 29 shows that on balance, Option 2 experiences less great issues in terms of traffic operation than Option 8. However, it should be noted that this is in part due to the inclusion of larger junction solutions in Option 2, such as at the A370 / A4 New Avon Bridge and at the A370 / A3029 / A369 junction. Furthermore, both of the junctions which operate over capacity in Option 8 are situated in areas which have considerable room for expansion of the junctions' footprint, should that be considered strategically desirable, and acceptable in terms of land-take. It should also be noted also that the Clift House Road / A370 junction incorporates staging for potential development. This is not the case with any of the Option 2 junctions.

Overall therefore, the modelling shows that both Option 2 and Option 8 are feasible in terms of their impact on traffic – although they both represent a reduction of capacity when compared with the existing arrangement.

Further work could be undertaken as part of a follow-on study to enhance and optimise the junction arrangements. However, this study has found that there is strong potential for Option 2 and Option 8 to both release land for development and provide adequate facilities for local and strategic traffic movements up to the year 2036.

10.4.1 Refinement of Feasibility Assessment Scoring

Following the option refinement process, the Highways Capacity scores for Option 2 and Option 8 are revised to reflect the outcome of the junction modelling.

The Initial Sifting Score presented in Table 7.

Table 7 gave the following scores:

- Option 2: 2 out of 5 – 'Weak'
- Option 8: 4 out of 5 – 'Strong'

On the basis of the junction modelling results the score for this feasibility parameter is amended to:

- Option 2: 3 out of 5 – 'Medium'
- Option 8: 3 out of 5 – 'Medium'

11 Provision for Bus Services

It is important to consider provision for buses for the proposed options and to highlight opportunities for bus priority and bus connectivity within the study area.

Due to the significant rearrangement of the highway network and the potential for large-scale residential development, it is not possible to be certain about how buses might route through the area, and how their patronage might be impacted. However, it is fair to assume that the potential residential development at Western Harbour, combined with ongoing investment in sustainable travel initiatives over the coming years across Bristol will have the effect of making the buses an increasingly important mode of travel. As such, it is assumed that bus services will continue to route through the study area and that they should be provided with bus priority measures wherever possible.

Indeed, it is noted that in order to achieve the flow reductions discussed in Section 10.1.2, there will have to be a mode shift away from the private car and towards other modes of travel, such as the public bus.

Appendix M and Appendix N illustrate the various bus routes and priority measures that are included within Option 2 and Option 8.

11.1 Option 2

Option 2 retains the Metrobus route, and does not propose any interactions between associated buses and the public highway, apart from the potential for a crossing of the Metrobus route within the potential development site south of the River Avon.

It is expected that services between the City Centre and the Portway would travel west along Hotwell Road towards the proposed New Avon Bridge, pass through this junction and continue on the A4 in the direction of Avonmouth. Bus lanes are provided in advance of the Merchants Road junction, and the New Avon Bridge. For their return route, buses from the Portway are provided with bus lanes in advance of the junction with Oldfield Place and with Merchants Road. There are bus stops located on Hotwell Road near to Dowry Square and to the east of Merchants Road.

Services between the City Centre and North Somerset may travel south along Merchants Road, turning right onto Oldfield Place before re-joining Hotwell Road. This section of the route will be lightly trafficked and there are minimal queues at both junctions that services will pass through. As such, there is no requirement for bus lanes. However, bus laybys have been provided on both Merchants Road and Oldfield Place.

Services for North Somerset would then continue to the New Avon Bridge, passing along the westbound bus lane in advance of the junction, before joining the New Link in a southbound direction, which is provided with a bus layby, reflecting the potential for land development to the east of the New Link. Bus laybys are also provided on the south western arm of the junction of the A369, reflecting the fact that there is an additional bus stop at the existing junction.

The return route for North Somerset services, bound for the City Centre, would be the reverse of the outbound route, and as with the Portway services are provided with bus lanes in advance of the Oldfield Place junction and the Merchants Road junction.

11.2 Option 8

Option 8 retains the Metrobus route, and has incorporated its route within the design. In particular, a Metrobus-only approach arm is provided to the west and the east of the junction at Cumberland Road. The Metrobus route is provided with its own link and its own traffic stage and in this sense is given a comprehensive form of priority.

It is expected that services between the City Centre and the Portway would use all four sides of the one-way gyratory system at Hotwells. Bus lanes are provided along each of these links, and bus stops are provided either in laybys or in bus lanes on Oldfield Place, Merchants Road and Hotwell Road.

Services between the City Centre and North Somerset would travel south along Merchants Road and cross the proposed bridge crossing of Cumberland Basin and the River Avon. Their return route would utilise the western and northern sides of the Hotwells Gyratory in order to return to the City Centre. A bus layby for northbound services is provided to the north of the proposed Cumberland Road junction, and a layby for southbound services is provided to the south. Bus lanes have not been provided between the A370 / Cumberland Road junction and the A370 / Clift House Road junction but these could be added, should it be determined that additional delays to general traffic are acceptable or that the land-take of the A370 link could be increased.

11.3 Intelligent Transport Systems

All of the key junctions within Option 2 and Option 8 have been designed to be controlled by traffic signals. This presents an opportunity to install Intelligent Transport Systems (ITS) which give further priority to buses. ITS works through the detection of buses, either through roadside detectors, or through GPS, which detect the approach of a bus, before communicating to downstream signals to switch to a green phase or extend a green phase, in time for the bus's arrival. ITS requires that buses are fitted with devices which can be detected by roadside equipment or by GPS.

It is understood that such measures are already present in Bristol, which were implemented as part of the Greater Bristol Bus Network (GBBN), which includes a corridor-level bus priority ITS comprising over 100 junctions. The extension of this system to the junctions comprised within Option 2 and Option 8 would build-in bus priority measures which complement the physical measures provided within the designs and limit delays to bus services and their passengers.

11.4 Summary

In summary it has been demonstrated that there is significant scope within both Option 2 and Option 8 to provide both physical and non-physical bus priority measures at key pinch points through the study area. There is sufficient room to provide bus stops on what are expected to be key bus routes, although confirmation of how buses might pass through the arrangements of Option 2 and Option 8 should be determined through further study and consultation with relevant bus operators and stakeholders.

11.4.1 Refinement of Feasibility Assessment Scoring

Following the option refinement process, the Public Transport scores for Option 2 and Option 8 are revised following the introduction of the design elements described above.

The Initial Sifting Score presented in Table 7 gave the following scores:

- **Option 2:** 2 out of 5 – ‘Weak’
- **Option 8:** 3 out of 5 – ‘Medium’

On the basis of the consideration of the public transport facilities described above, the score for this feasibility parameter is amended to:

- **Option 2:** 4 out of 5 – ‘Strong’
- **Option 8:** 4 out of 5 – ‘Strong’

12 Provision for Pedestrians and Cyclists

12.1 Introduction

Pedestrian and cycle movements have been considered in the development of Option 2 and Option 8. This section of the report describes the facilities that could be provided within each option to provide safe, convenient and direct pedestrian and cycle routes that reflect both existing and potential desire lines.

This study has noted the emergence of the 'Greenway' project, which seeks provide an enhanced pedestrian and cycle route along the route of the tidal flood defences described in Section 2.4.4. In addition, National Cycle Routes and key walking routes have been incorporated into the designs of both Option 2 and Option 8.

Appendix M and Appendix N indicate the provision for pedestrians and cyclists within both of the options, highlighting sections of footway, cycleway, at-grade crossings and grade-separated crossings.

12.2 Option 2 and Option 8

Both Options have been designed to include footways which are 3m in width or wider across the vast majority of the study area. This width is sufficient to enable the footway to act as a shared footway / cycle way. In many places, particularly alongside the potential development site, and along the western side of the New Link, there is sufficient space for both a footway and a dedicated off-carriageway cycle facility.

All of the pedestrian crossings are 3m in width and as such are wide enough to support a toucan arrangement, which is suitable for pedestrians and cyclists to share.

The only sections of footway which are less than 3m in width are in the vicinity of the proposed bus layby on Merchants Road, and over the existing Junction Bridge. The former still represents an improvement over the existing arrangement, while Junction Bridge cannot be widened for pedestrians without significant structural works.

Advanced cycle stoplines could be provided at each of the proposed junctions within the study area. They have been included within the designs at the four junctions at Hotwells gyratory. Road widths are generally sufficient to enable the introduction of nearside advisory cycle lanes throughout the majority of the study area, where bus lanes are present it is assumed that on-road cyclists would cycle within bus lanes.

Both options include the refurbishment and reinstatement of 'Brunel's Other Bridge', for use by pedestrians and cyclists. It also includes the construction of a walking and cycling bridge to the west of B Bond Warehouse which would connect Spike Island to the potential development area south of the River Avon.

In Option 2, The National Cycle Route 41 would run between the Portishead Line and the proposed New Link. Allowance has been made for this link to be up to 5m in width. A formal signalised crossing is proposed at the point where the cycle route intersects with the proposed New Link.

The proposed alignment of the A370 in Option 8 intersects with the existing National Cycle Route 33 'Chocolate Path' at its junction with Cumberland Road. In this location it is proposed to provide an at-grade toucan crossing, and also a grade separated cycle / footbridge over the southern arm of the junction.

In Option 8, the A370 south of the River Avon also intersects with a local cycle route which currently passes between the existing pumping station and the bonded warehouse at Clift House Lane. It is proposed to provide a formal road-crossing for pedestrians and cyclists at the A370 / Clift House Road junction, as well as a grade separated footbridge further to the north.

12.3 Summary

In summary Option 2 and Option 8 include comprehensive provision for pedestrian and cycle movements throughout the study area.

Cycles can be provided for with a blend of both on-street and off-street facilities, and it is proposed that formal road crossing points are provided at intersections and by way of footbridges. Both Options include dedicated pedestrian and cycle bridges over the River Avon and over Cumberland Basin.

High-level consideration has been given to how Option 2 and Option 8 intersect with the national cycle route network. The location and form of road-crossing points has been identified.

The proposals for pedestrian and cycle movements within Option 2 and Option 8 could be refined further through consideration of pedestrian and cycle data, and following the development of proposals for the potential development areas.

Following the option refinement process, the Walking and Cycling scores for Option 2 and Option 8 are revised following the introduction of the design elements described above.

12.3.1 Refinement of Feasibility Assessment Scoring

On the basis of the consideration of the pedestrian and cycling facilities described above, the score for this feasibility parameter in the initial sift is considered to be appropriate:

- **Option 2:** 4 out of 5 – 'Strong'
- **Option 8:** 4 out of 5 – 'Strong'

13 Integration with Flood Defences

13.1 Introduction

Consideration has been given to how the layouts for Option 2 and Option 8 might be integrated with the flood defence measures described in Section 2.4.4. No flood modelling or flood risk assessment has been undertaken in support of this exercise. Rather, a combination of engineering judgement and an understanding of existing BCC proposals have been combined to produce a high-level commentary flood defences within the study area.

13.2 Option 2

Option 2 does not restrict the possibility for the routing of defences over reconstructed, dual action (lock and flood defence) gates at the entrance to Cumberland Basin and over Brunel's second lock, as originally presented in the Strategic Flood Defence and Greenway proposals.

In Option 2, new flood defences would be provided along the south side of the River Avon New Cut, tying into the New Link south of the river and with a flood gate to cover the remaining low point at the Metrobus crossing at Ashton Avenue Bridge.

13.3 Option 8

Within Option 8 there are at least two options relating to flood defence alignment at Cumberland Basin. One option is to provide flood defences over the dual action gates at the entrance to Cumberland Basin as described above for Option 2. An alternative arrangement would be to construct flood defences along the northern and southern side of Cumberland Basin, tying into the new road infrastructure at Merchants Road. Existing flood defence infrastructure adjacent to Merchants Road would be modified and tied into the new road infrastructure with the level of protection continued onto the development area south of Cumberland Basin and north of the New Cut. This level of protection would be maintained around the peninsula by peripheral defences or general ground level raising in the area. It is unclear which of these options would be most beneficial in terms of costs, and impact on the potential development area located on Spike Island.

Similarly to Option 2, new flood defences would also be required to the south of the River Avon, in order to protect the potential development area in this location. It is understood that such measures have previously been considered by BCC as part of a wider flood risk strategy.

13.4 Summary

It has been determined that both options, as currently designed, appear to be compatible with existing aspirations within BCC relating to flood defences. There would be different options for the provision of flood defences both at Cumberland

Basin and the land to the south of the River Avon, which should be determined at a later time when the highways schemes are more developed and the quantum of development has been defined.

14 Swing Bridges and Bascule Bridges

14.1.1 Introduction

This study has given high-level consideration to the form, visual impact and operation of the moving bridges comprised within Option 2 and Option 8.

14.1.2 Opening and Closing Sequence

The current convention within the design of moving bridges is that their opening and closing sequence should be 90 seconds in duration. However, the period of time allocated to the process of closing the road, and commencing the opening / closing sequence, would be determined by local factors such as the traffic management and operational / staffing arrangement. It is considered that there is no design constraint inherent within either swing bridges or bascule bridges that would mean the opening / closing mechanism in one is faster than the other. However, it should be noted that the cost of the lifting / swinging mechanism increases exponentially with its speed. This cost / speed relationship is more pronounced with bascule bridges than with swing bridges.

14.1.3 Option 8 - Junction Bridge

Option 8 proposes to remove the existing Junction Bridge. Junction Bridge is a swing bridge which is two traffic lanes in width (plus footways) and is located at the eastern extent of Cumberland Basin.

A four lane wide bridge would be constructed to the west of the existing Junction Bridge. It would be designed with the same air-draft for vessels and there is no proposal to amend the width of the lock gate passage. The proposed bridge could therefore have a similar elevation to the existing bridge. However, it is expected that the span of the bridge would be extended due to the pivot point being further back from the front of the quay wall.

An initial review of the setting of this bridge suggests that were it to be designed as a swing bridge, the pivot would be to the south of the lock, as it is in the current arrangement. Assuming that the proposed bridge would be balanced by way of having equal carriageway weighting on either side of the pivot, then the swept path of the bridge would require the demolition of properties to the south of the lock.

However, were the bridge to have less moving-carriageway to the south, and was balanced by other means – such as a counterbalance, then the junction's swept path would be reduced and there would be no requirement for the demolition of properties. Such an arrangement is considered to be less efficient than a naturally balanced option, requiring counterweights which can be below deck or at deck-height.

It should be noted that bascule bridges do not require counter weights to be located above-ground. Rather they can be housed within the bridge pier or underground.

It is recommended that in order to establish the optimum form and design parameters for the bridge, a separate feasibility study should be undertaken with a specific focus on bridge structures and operations.

14.1.4 Option 2 – New Avon Bridge

For the New Avon Bridge included with Option 2 it is considered likely that piers would be required to be constructed within the watercourse of the River Avon in order to house either the pivot system of a swing bridge, or the counterweight of a bascule bridge, assuming that it is a double-opening bascule bridge. Again, there is no requirement for counterweights to be above ground, rather they can be housed within piers or underground.

The provision of two moving structures as proposed within Option 2 is considered to be a greater risk in terms of operational soundness, as there is twice the chance that a bridge mechanism will fail. Furthermore, the construction of piers within the watercourse may be a consenting issue and would require further study.

Given the setting of the proposed New Avon Bridge it would be of critical importance that it be designed to have aesthetic value and to be visually pleasing. A selection of ‘architecturally designed’ bridges which incorporate lifting or swinging mechanisms is included at Appendix OAppendix N of this report.

As with Option 8, it is considered that a separate feasibility study is undertaken with a specific focus on bridge structures and operations.

15 Refined Revenue Estimates and Capital Impact

As part of the Options Refinement process, the land value uplift estimates included within the Initial Sifting exercise have been revisited in order to better understand the capital impact of the delivery of Option 2 and Option 8. The resulting refined revenue estimates are thus the product of a more detailed appreciation of the opportunity at Western Harbour.

The revenue estimates have been refined in the following ways:

- ‘Development potential plans’ were produced for each option, which show the scale, massing, and layout of each development area. For the purposes of this exercise the plans function as high level illustrative masterplans. This enables a more granular approach to estimating the pricing of various elements of the quantum, and is more accurate than applying aggregate densities to development areas;
- The development potential plans predict that a more dense development could be delivered at Western Harbour. Much of land north of the River Avon is shown to be developed to six stories in height;
- The quantum for each option includes mixed uses, such as commercial, retail and leisure uses. In addition, the bonded warehouses have been included as residential conversions;
- The land south of the River Avon is developed more intensively, albeit at a lower density than land north of the cut. Residential development north of the River Avon is assumed to comprise 40% affordable homes, while to the south it is expected to be 30% affordable homes; and
- Land value is calculated to be 20% of gross development value.

The refined revenue estimates are calculated to be:

Option 2 Land Value Uplift = £214m

Option 8 Land Value Uplift = £181m

The revenue estimates can be compared against the construction cost estimates presented in Section 5.3.1. This comparison is made in Table 30.

Table 30 – Comparison of Refined Revenue Costs with Initial Construction Cost Estimates

Option	Construction Cost Estimate (initial)	Land Value Uplift	Net Impact
Option 2	£308m	£214m	-£94m
Option 8	£180m	£181m	£1m

It should be noted that Table 30 does not take into account the one-off maintenance renewal scheme required to refresh the highway infrastructure at Western Harbour, which is expected to cost around £40m.

The costs and revenues presented are high-level indicative estimates, and are not for reliance.

16 Final Options Comparison

16.1 Introduction

The option refinement process set out in Sections 8 - 15 of this report has increased the level of detail associated with Option 2 and Option 8, and in some instances, changed the feasibility scoring that should be attributed to them. As such it is useful to summarise the final scoring of Option 2 and Option 8 reflecting the outcome of the refinement process.

Furthermore, it is important to consider the options in the context of a 'Do Minimum' option – the retention of the existing arrangement and its support through maintenance activities.

16.2 Project Objectives

Table 31 shows the scoring of Option 2 and Option 8 against the project objectives. These scores are unchanged from the Initial Sifting score. It also shows the scoring of the 'Do Minimum' scenario and a justification of the score for the Do Minimum scenario.

It should be noted that as the Do Minimum scenario does not meet some of the objectives even in a minor way, it is considered appropriate to allocate a score of zero in some instances.

Table 31: Project Objectives - Comparison of Option 2, Option 8 and DM

Objectives*	Option 2	Option 8	Do Min	Rationale of Do Minimum Score
To create a new residential quarter with affordable homes in the heart of the city	5	5	0	No opportunity to create residential development area
To enable high quality urban and landscape design reflecting the city gateway and historic significance	5	4	1	Existing arrangement considered to be a very poor environment and a detriment to the city gateway and its history
To fully exploit the connectivity delivered by Metrobus	3	3	3	The existing arrangement ties in with Metrobus to an adequate degree
To establish new pedestrian and cycle links through the area, linking adjoining communities	4	5	0	Poor pedestrian and cycle links in both north-south and east-west directions. Zero provision of new links.
To improve and facilitate access to the Avon Gorge	2	4	1	Access to the wider gorge area is enabled for motor vehicles and there are limited delays. However this limits the ability to experience the gorge on a human scale.
To realise a significant capital receipt for the city council	5	4	0	No capital receipt from land release.
Total	24	25	5	

*The scale is from 1 (Very Weak) to 5 (Very Strong)

Table 31 illustrates the ability of Option 2 and Option 8 to meet broad objectives for the improvement of the study area across a number of different sectoral issues. As expected, it is clear that the Do Minimum option fails to deliver on any of the objectives beyond compatibility with Metrobus.

16.3 Feasibility Parameters

Table 32 shows the scoring of Option 2 and Option 8 against the various feasibility parameters. The scores take into account the findings of the Option Refinement exercise, incorporating an improved score for both options against the Public Transport measure, and an equalisation of their performance in terms of walking and cycling, and highways capacity.

The Do Minimum scenario has also been scored against each of the feasibility parameters. It should be noted that as this option does not achieve some of the characteristics measured by the parameters – such as meeting housing needs - it has been allocated a score of zero in some instances.

Table 32: Feasibility Parameters Scoring - Comparison of Option 2, Option 8 and DM

Feasibility Parameters*	Option 2	Option 8	Do Min	Description of DN Score
Estimated Cost	3	4	5	No Capital Expenditure beyond maintenance costs.
Buildability	1	3	5	No construction required.
Maintenance Cost	4	5	2	Significant maintenance required at both bridges.
Harbour Operations	2	4	2	Majority of ships must wait for both bridges to swing open.
Highways Capacity	3	3	5	Grade separated junctions and resilience of two bridges
Public Transport	4	4	3	Limited bus-priority. However, limited delays.
Cycling and Walking	4	4	1	Undesirable area to walk and cycle through. Poor legibility of routes. Dominance of intimidating structures.
Environment and Heritage	1	3	1	Historic area dominated with highway infrastructure
Stakeholder Views	2	2	5	‘No change’ does not require stakeholder consultation
Desirability of Development	5	5	0	Zero development opportunity.
Land Value	5	4	0	Zero land value up-lift
Health and Wellbeing	3	3	2	Existing arrangement frustrates aspirations for increased health and wellbeing in the area.
Meetings Housing Need	5	5	0	No increase in housing stock in DM option
Total	37	44	31	

*The scale is from 1 (Very Weak) to 5 (Very Strong)

Table 32 illustrates that Option 8 performs most strongly against the feasibility parameters – as it did in the initial sift, prior to the refinement process.

The Do Minimum scenario only performs well in that it requires less capital expenditure, and it delivers a good level of service for motor vehicles. However, the Do Minimum option does little for pedestrians and cyclists and does not produce any benefits in terms of land value or housing and as such scores less well than Option 2.

16.4 Summary

Table 33 combines the Objectives Scoring with the scoring against feasibility parameters for Option 2, Option 8 and the Do Minimum scenario.

Table 33: Overall Comparison of Option 2, Option 8 and the Do Minimum Scenario

Option	Score against Objectives	Score against Feasibility Parameters	Total
Option 2	24	37	61
Option 8	25	44	69
Do Minimum	5	31	36

Table 33 shows that Option 8 is the strongest option is the strongest in terms of meeting project objectives and in terms of feasibility.

The Do Minimum scenario performs very poorly overall. This is to be expected as the existing scenario only delivers notable positive outcomes in terms of motor traffic and shipping traffic, at the expense of other measures such as land value, housing, and pedestrian and cycle connectivity.

The information presented in Table 33 clearly makes the case that there are very significant benefits associated with progressing with options to improve the study area, and that the Do Minimum scenario represents a missed opportunity and a sub-optimal use of land. It is thus the least preferred option when compared with Option 2 and Option 8.

Option 2 performs less well than Option 8 at meeting Project Objectives, and when scored against various Feasibility Parameters. Its principle benefit is in moving traffic away from the historic harbour location and away from the potential development areas. This generates positive outcomes in terms of the quality of development, walking and cycling links, and land value. However, it carries a delivery risk in terms of objections and environmental consenting. Its proposed New Avon Bridge over the River Avon in the setting of the Clifton Suspension Bridge would be key – it would have to be of the highest visual and aesthetic quality in order to avoid public disapproval. Option 2 is likely to require a large grade separated junction at Ashton Gate which would be complex and high cost.

Option 8 has the potential to unlock a development area of similar size and quality to that of Option 2, providing high quality walking, cycling and bus links, and reducing maintenance costs. However it would require significantly less capital expenditure than Option 2 to construct, and it is expected to have a greater degree of buildability. While Option 2 does represent a radical change to the study area,

and there would be challenges associated with consenting and public opinion, it carries less risk in terms of environmental consenting than Option 8.

In summary therefore it is considered that Option 8 is the strongest option for the improvement of the Western Harbour area.

17 Development of a Hybrid Option (Option 10)

Option 2 and Option 8 have both been found to have the potential to deliver significant positive outcomes to the Western Harbour area and Bristol in general, with Option 8 scoring slightly more highly than Option 2 on the parameters included within this study. Given the strength of these two options, it is considered sensible to formulate a ‘hybrid option’ which combines the strongest design elements of Option 2 with those of Option 8. The hybrid option thus includes a new bridge over the River Avon, to the west of the harbour, with a new bridge crossing connecting the A370 and Clift House Road, with land on Spike Island to the east of A Bond Warehouse.

The highway layout associated with the Hybrid Option is included in Appendix L. The form and layout of its junctions and road links have been developed on the basis of a high level assessment, which assumes a slightly greater reduction of flows than those described in Section 10.1.2. The hybrid option thus represents a more positive vision for the Western Harbour area, in which sustainable travel and rail travel feature prominently across an area which allocates even less land to the private car. The flow reductions for the hybrid options are presented in Table 18.

Table 34: Percentage Flow Reductions by Origin-Destination Pairs – Hybrid Option

OD pairs*	A	B	C	D	E	F	G
A		33%					
B	33%		33%	33%	33%	33%	
C		33%		33%	33%	33%	
D		33%	33%		33%	33%	
E		33%	33%	33%			
F		33%	33%	33%			
G							

** Origins and Destinations are as per Figure 7.

The key design features of the Hybrid Option are listed below:

- Through providing road bridges both to the west of the harbour (as in Option 2) and from the A370 to Junction Bridge (as in Option 8), each of these routes requires a lower level of highway capacity and thus requires less land-take. In particular:
 - The New Avon Bridge is a single bridge with one lane in each direction. This compares with a three-lane roundabout as proposed in Option 2. The connection of the New Avon Bridge and the A4 Hotwell Road is not an all movements junction and could be provided with high-quality grade separated pedestrian links, which connect with an enhanced public realm area on the north side of the

Hotwell Road, in the vicinity of the wharves around 250m north west of Cumberland Basin.

- The A370 Bridge over the River Avon (in the vicinity of the C Bond warehouse) is provided with two lanes in each direction, which is a reduction from the proposal in Option 8.
- The junction of the A370 and Clift House Road is simplified and reduced in scale. It is provided with two ahead lanes from each direction (as opposed to three in Option 8), and a single right turn lane from the south (as opposed to two in Option 8). The junction does not provide a point of access to the potential development site to the south of the cut – access is instead provided from the New Avon Link.
- The Cumberland Road junction is reduced in scale, with the removal of one approach lane from the east as compared with Option 8.
- A new bridge is proposed to cross the eastern lock in place of Junction Bridge, which is two lanes northbound and one lane southbound. It should be noted that the bridge would be less lightly trafficked than in the Option 8 arrangement.
- The Hybrid Option could be considered to be more resilient to harbour operations. Ship movements along the River Avon and the Harbour would require the closure of the crossings to motor traffic, however these closures would not take place concurrently and as such there would be less upstream impact to traffic in the vicinity of the Western Harbour area.
- The potential development sites on Spike Island and north of Cumberland Basin are accessed as in Option 2 and Option 8. The potential development site to the south of the River Avon is accessed from a junction on the New Link, which takes the form of a signal controlled ‘T’ junction.
- The hybrid option is provided with a similar level of provision in terms of public transport facilities. Provision for pedestrians and cyclists is improved through lower traffic flows through the study area and a greater degree of choice in terms of crossing locations

Land release has been calculated to be 101,500sqm, which compares well against both Option 2 (103,000sqm) and Option 8 (95,500sqm). Based on ‘development potential plans’ produced by Alec French, it is considered that Option 10 has the potential to deliver a land value uplift to £193m.

It should be noted that the Hybrid Option has not been subject to the same scoring process that other options were, as it emerged as a concept following completion of the initial sifting process. However, the highways arrangement has been developed using the same robust quantitative methods that were employed in the development of Option 2 and Option 8. The results of this modelling exercise can be provided upon request.

Given that the Hybrid Option provides significant benefits through the combination of two very positive schemes, it is recommended that it is given greater consideration through further study, as a follow-on from the present commission.

Including Option 10 alongside the cost and revenue data presented in Section 15 gives the final net financial data in the table below.

17.1 Potential for Further Development

There is the potential to deliver Option 10 as a phased option, whereby part of the eastern crossing (passing across Spike Island) is constructed before the western crossing of the River Avon. This may have the benefit of greater compatibility with funding and delivery streams, and enable the flexible reallocation of highways land to other uses, once the whole scheme is open. In addition, the New Avon Link comprised within the Option 10 drawings connects the A4 Portway with the A369 Blackmoors Lane roundabout, broadly following the alignment of the Portishead Line.

There is the potential to develop an alternative alignment for this link, connecting it with the A370 in the vicinity of the existing A370 / Clift House Road junction. Both of these concepts could form the basis of further study, and it is anticipated that they would be discussed in any subsequent reporting on Option 10.

18 Summary, Recommendation and Next Steps

18.1 Summary

This study has assessed a number of options which seek to rationalise the transport network in the vicinity of Cumberland Basin, while releasing land for development and providing an opportunity to provide betterment to the area in terms of its urban setting and its sense-of-place. Each option has been considered against both a set of project objectives and also some more detailed feasibility parameters.

The initial sifting exercise found that Option 2 and Option 8 were found to be the strongest performing options and that they should be the subject of additional refinement. Option 2 and Option 8 were thus designed in outline, giving consideration to bus, cycle and walking provision.

Following the option refinement exercise, both Option 2 and Option 8 were compared with the Do Minimum scenario in terms of their ability to meet project objectives, while being able to perform well against feasibility parameters.

This study concludes that there is a strong case for the delivery of an option which radically alters the existing arrangement at Cumberland Basin. The Do Minimum scenario – which retains the existing arrangement - is found to represent a missed opportunity and a suboptimal use of land.

Option 8 is found to be the strongest option for the improvement of the Western Harbour area, when measured against both project objectives and feasibility parameters. It has less great challenges in terms of funding and buildability than Option 2, while delivering similarly positive outcomes.

A hybrid option (Option 10) has been formulated which combines the strongest design elements of Option 2 with those of Option 8. The hybrid option represents an even more positive vision for the Western Harbour area, in which sustainable travel and rail travel feature prominently across an area which allocates even less land to the private car. While it has not been subject to the same scoring process as Option 2 and Option 8, it is considered that the hybrid option (Option 10) is worthy of more detailed consideration through a subsequent commission.

18.2 Report in Context

The purpose of this report is to answer a specific brief set out by Bristol City Council (BCC). However, Arup is aware of ongoing discussions within BCC with regard to the broader objectives for Western Harbour in terms of the quantity and quality of development and how highways access facilitates this.

The horizontal layout drawings presented in this report reflect established highway design practice and guidelines. This is based on an appraisal of capacity against demand calculations. Reduced highway infrastructure would be possible should BCC, as highway authority, be willing to consider acceptance of greater peak time queuing or the fact that road users change their behaviour in response to queues and congestion, for example travelling earlier or later. Acceptance of such

behavioural change would allow the amount of highway infrastructure to be reduced further. This would then offer opportunities to develop a new city quarter with less impact resulting from highway infrastructure.

This report also assumes that all the north/south strategic traffic is routed through the study area. Should proposals for a large-scale revision of regional transport infrastructure be developed, the level of strategic traffic in the Cumberland Basin area would be greatly reduced, allowing further reductions in the amount of highway infrastructure provided around Western Harbour.

18.3 Recommendation

In overall summary, Option 8 achieves similar benefits to Option 2 but with less great challenges in terms of funding and buildability. While both Options represent a great improvement on the current arrangement, Option 8 is considered to be the strongest choice and should be progressed for further study. There are considerable strengths associated with the Hybrid Option and this should also be the subject of further study.

18.4 Next Steps

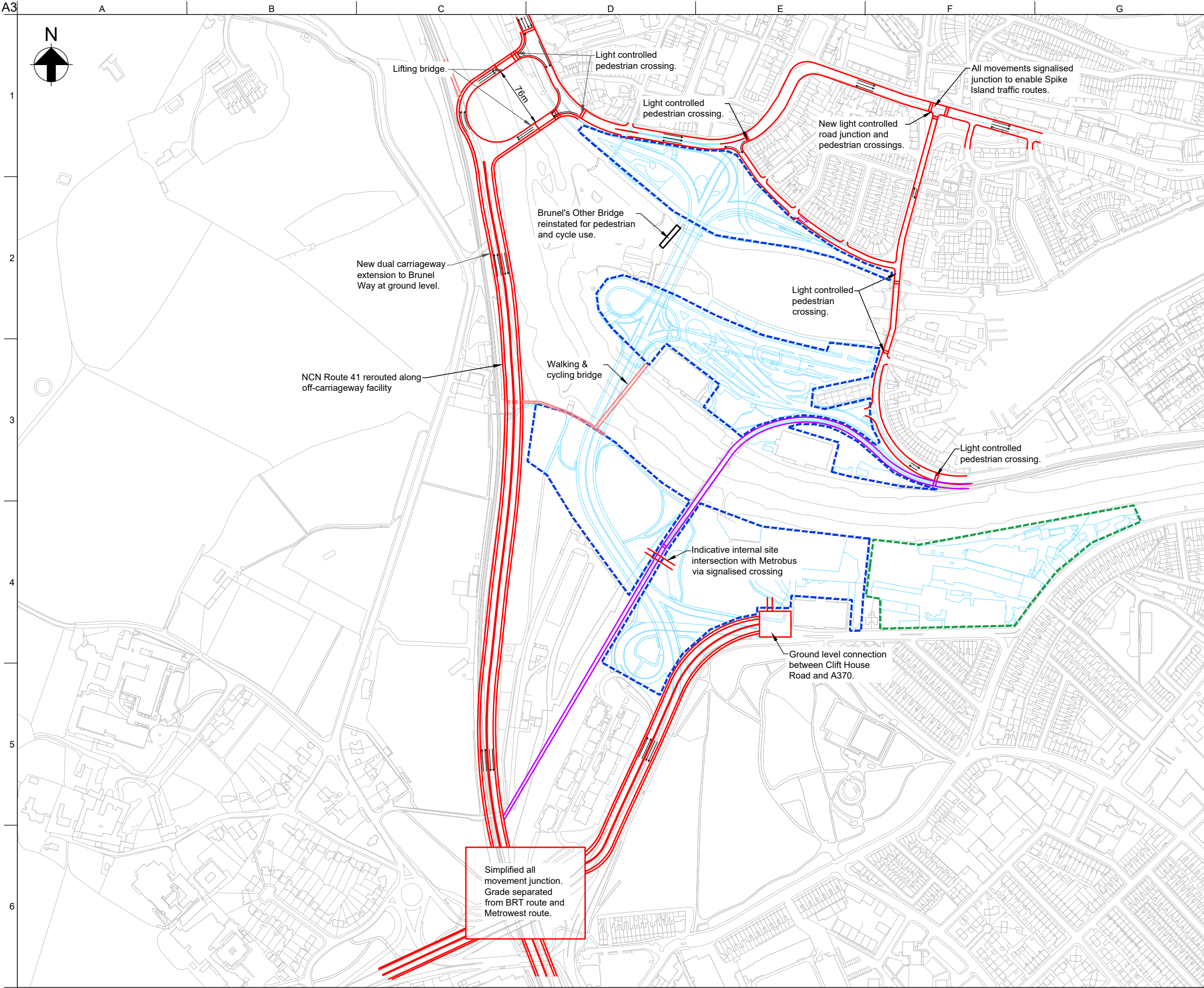
Bristol City Council is invited to consider the arguments and conclusions presented within this report and to discuss its findings with the study team and any internal stakeholders. Should it be confirmed that Option 8 is the preferred option, then the following activities are recommended as next steps:

- Short Term Actions:
 - Give consideration to different land development mixes within the potential development areas. Define the value-outcomes that BCC and others aspire to unlock through developing the land. Discuss with BCC internal planning representatives and with other parties such as WECA, the Mayor of Bristol and the Metro Mayor.
 - Identify potential funding streams which could be used to finance the highways construction element of the scheme. Undertake economic impact analysis to estimate the full monetary impact of the scheme.
 - Further liaison with key stakeholders, such as WECA, Bristol Harbour Authority, Sustrans, Historic England, Natural England, EA and others.
- Medium Term Actions:
 - Once the possible development opportunity is defined, and a quantum is estimated, estimate development traffic associated with the development and add into traffic modelling.
 - Commence formal highways design incorporating vertical alignment and elevation. Structural feasibility study to be undertaken. Further refine cost estimates.

- Prepare a Planning Strategy Document which outlines the detailed steps required to take the opportunity through planning and into construction.

Appendix A

Nine Schematic Options Plans



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (110,000 m²)

01	06/04/18	MK	BS	EW
Rev	Date	By	Chkd	Appd

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Client
Bristol City Council

Project Title
Cumberland Basin
Feasibility Study

Drawing Title
Option 2

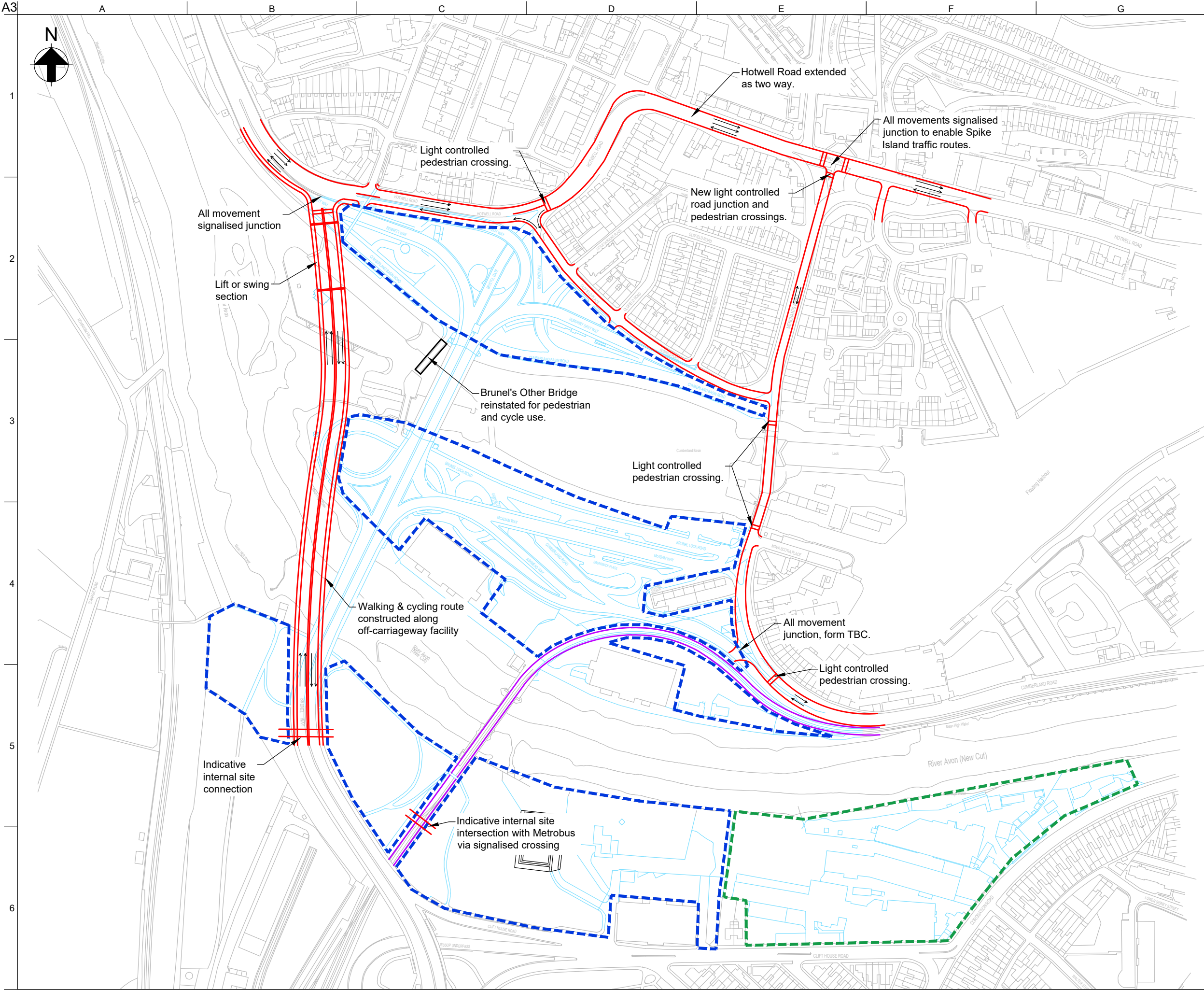
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Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-102



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (93,000 m²)

01	06/04/18	MK	BS	EW
Rev	Date	By	Chkd	Appd

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Client
Bristol City Council

Project Title
Cumberland Basin
Feasibility Study

Drawing Title
Option 3

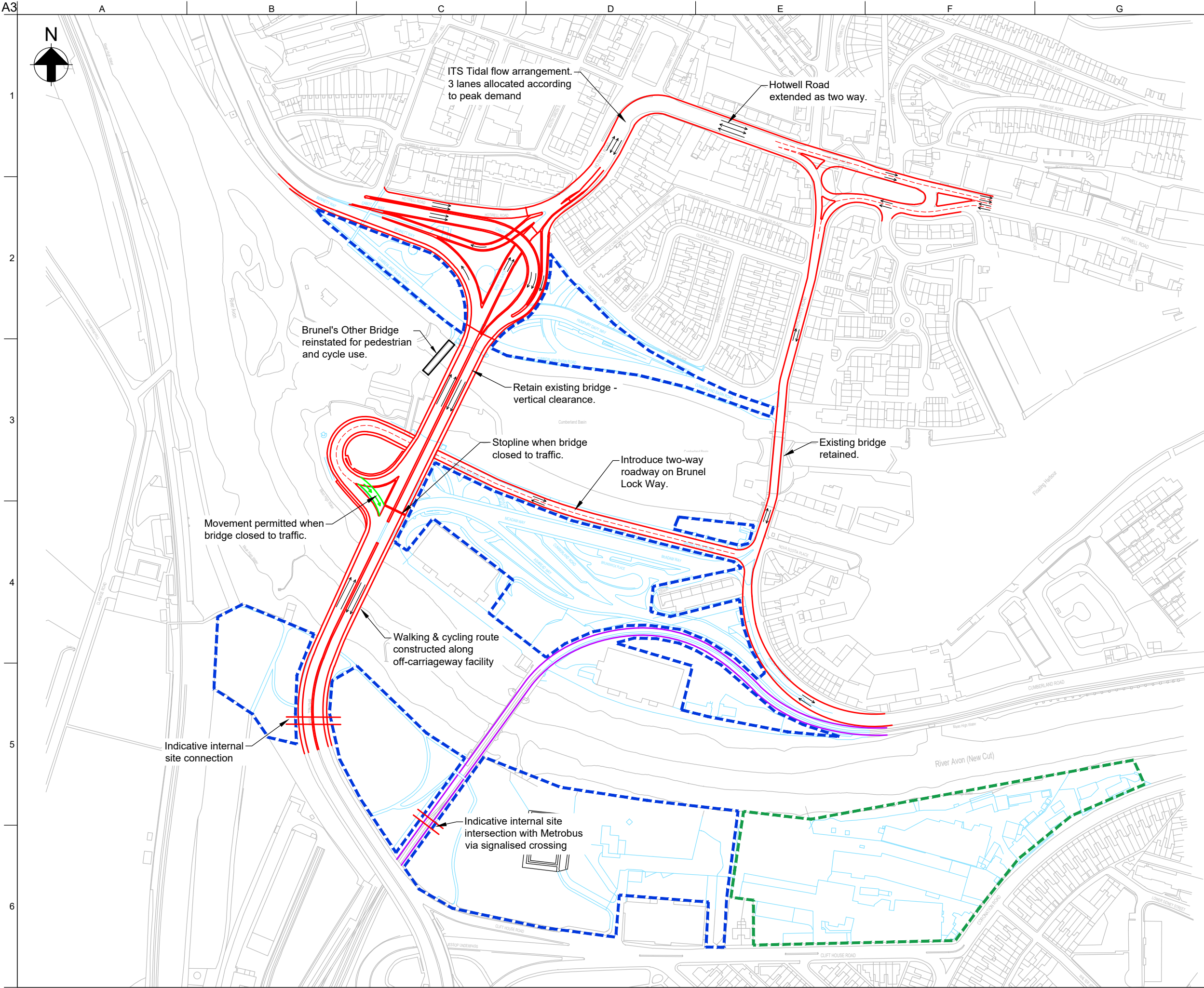
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Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-103



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (75,000 m²)

01	06/04/18	MK	BS	EW
Rev	Date	By	Chkd	Appd

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Client
Bristol City Council

Project Title
Cumberland Basin
Feasibility Study

Drawing Title
Option 4

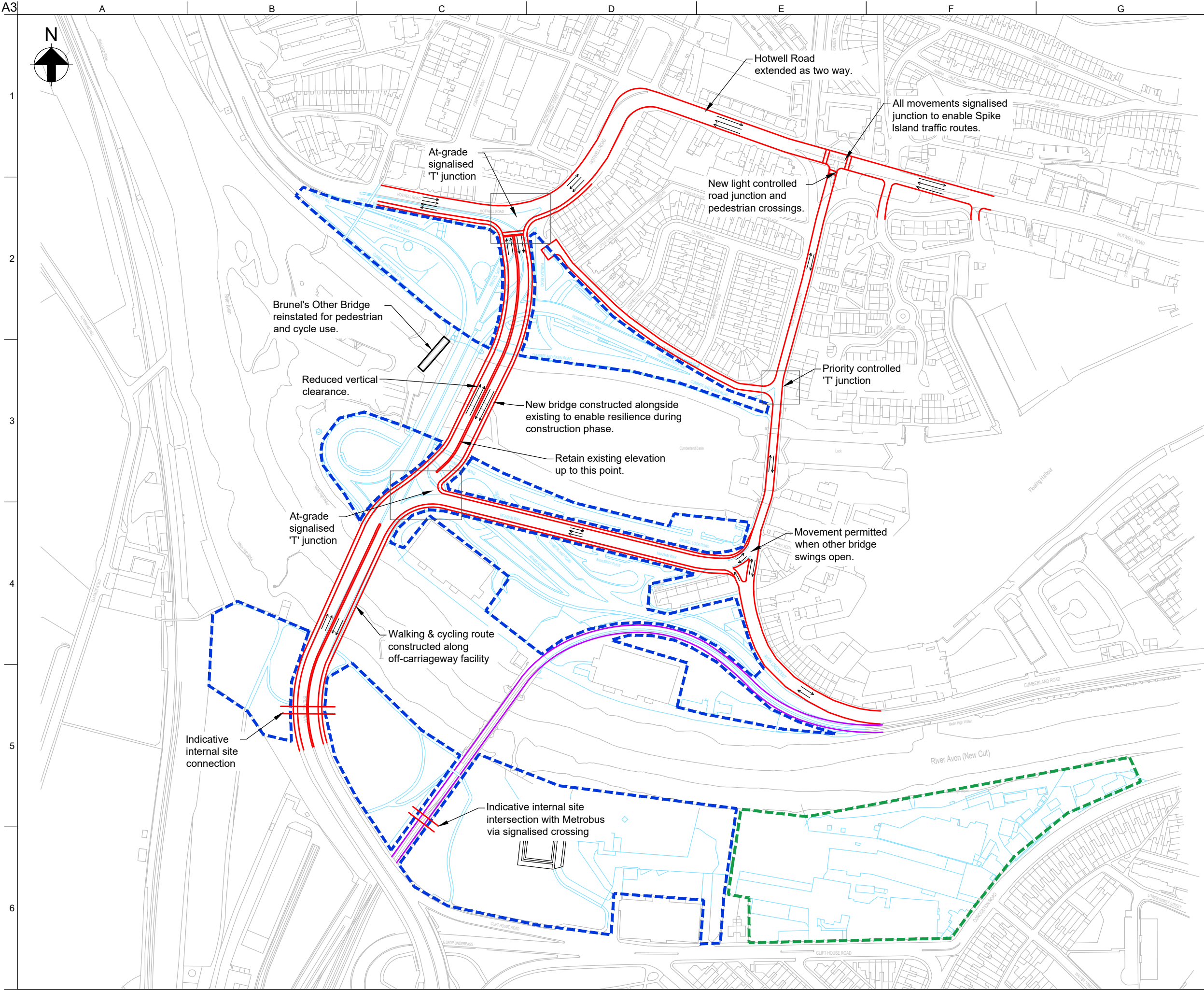
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Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-104



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (85,000 m²)

01	06/04/18	MK	BS	EW
Rev	Date	By	Chkd	Appd

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Client
Bristol City Council

Project Title
Cumberland Basin
Feasibility Study

Drawing Title
Option 5

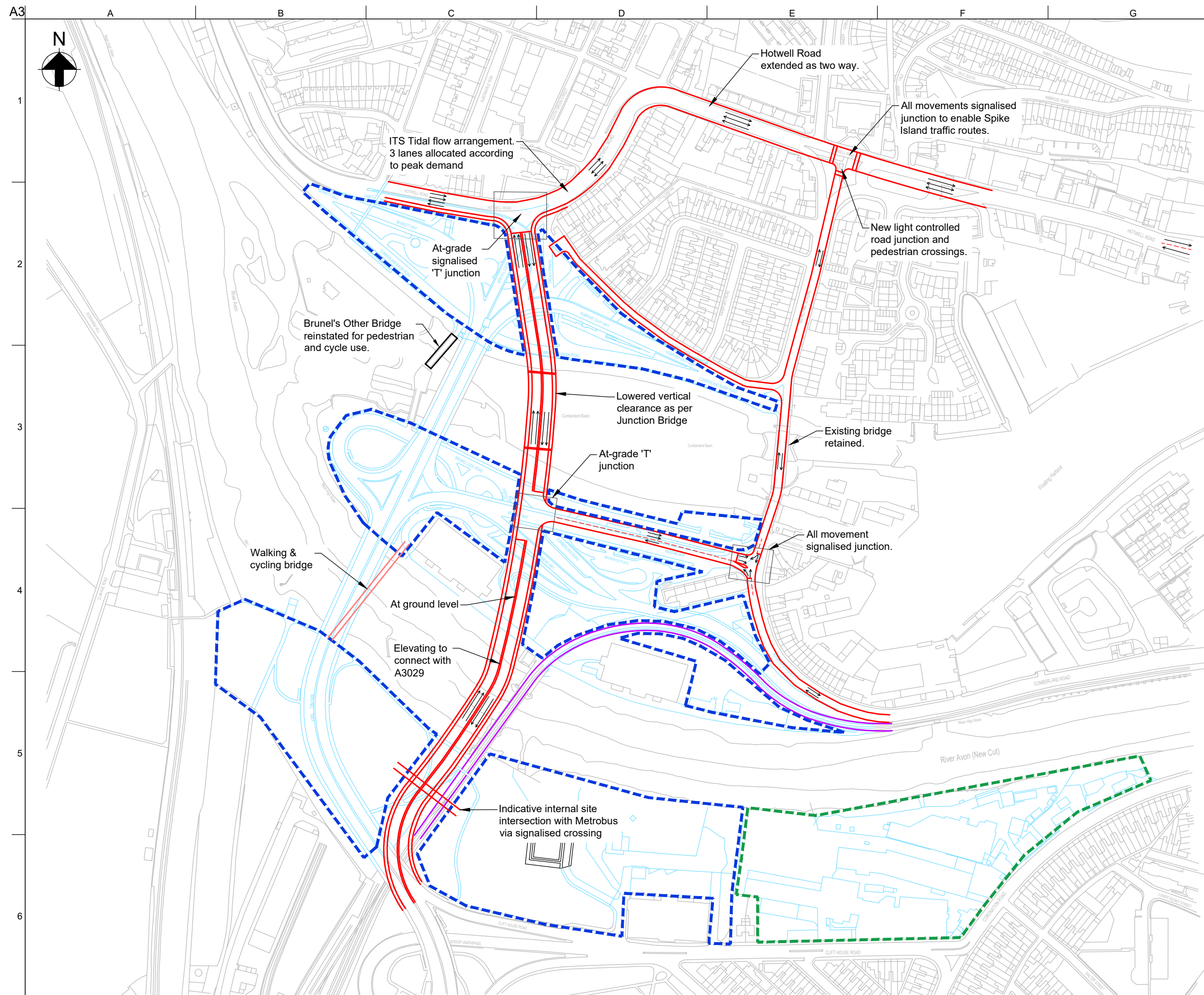
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Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-105



Do not scale

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Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (89,000 m²)

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Rev	Date	By	Chkd	Appd

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Client

Bristol City Council

Project Title

Cumberland Basin Feasibility Study

Drawing Title

Option 6

Scale at A3 1:3000

Role	Transport Planning
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Suitability

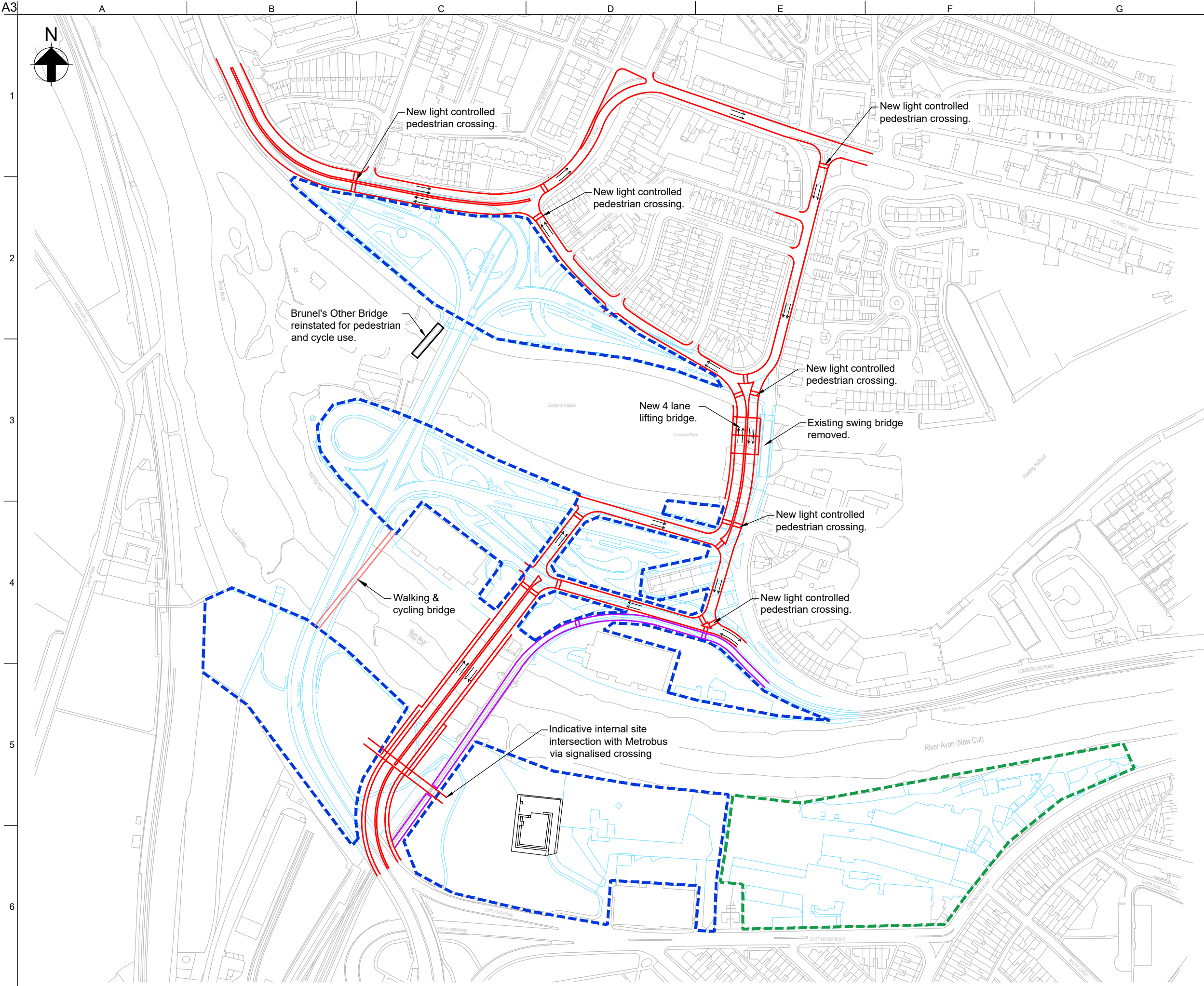
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Drawing No
CH-106

Rev	01
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Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (87,000 m²)

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Rev	Date	By	Chkd	Appd

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Project Title
**Cumberland Basin
Feasibility Study**

Drawing Title
Option 7

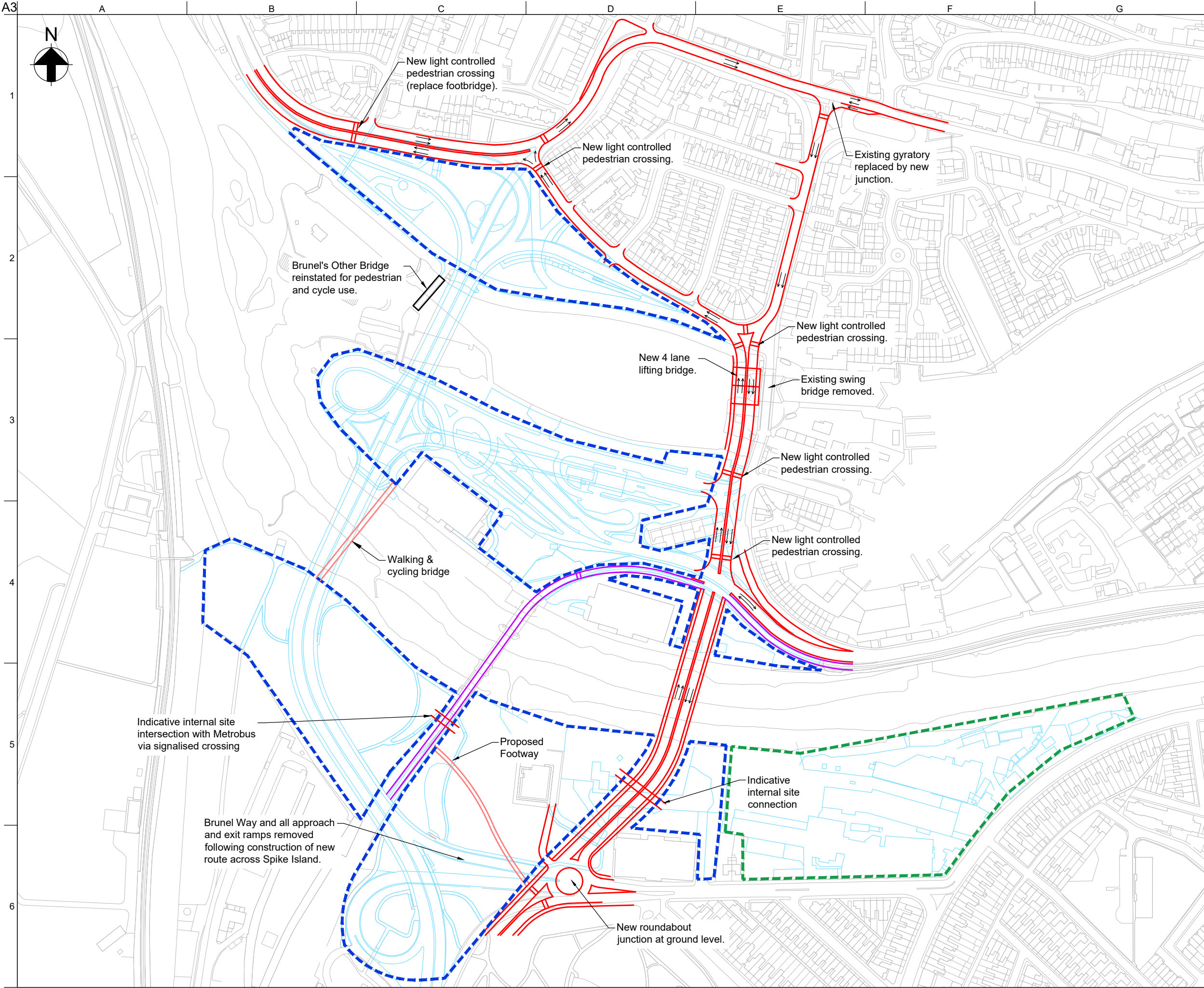
Scale at A3
1:3000

Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-107



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (105,000 m²)

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Rev	Date	By	Chkd	Appd

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Project Title
Cumberland Basin
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Drawing Title
Option 8

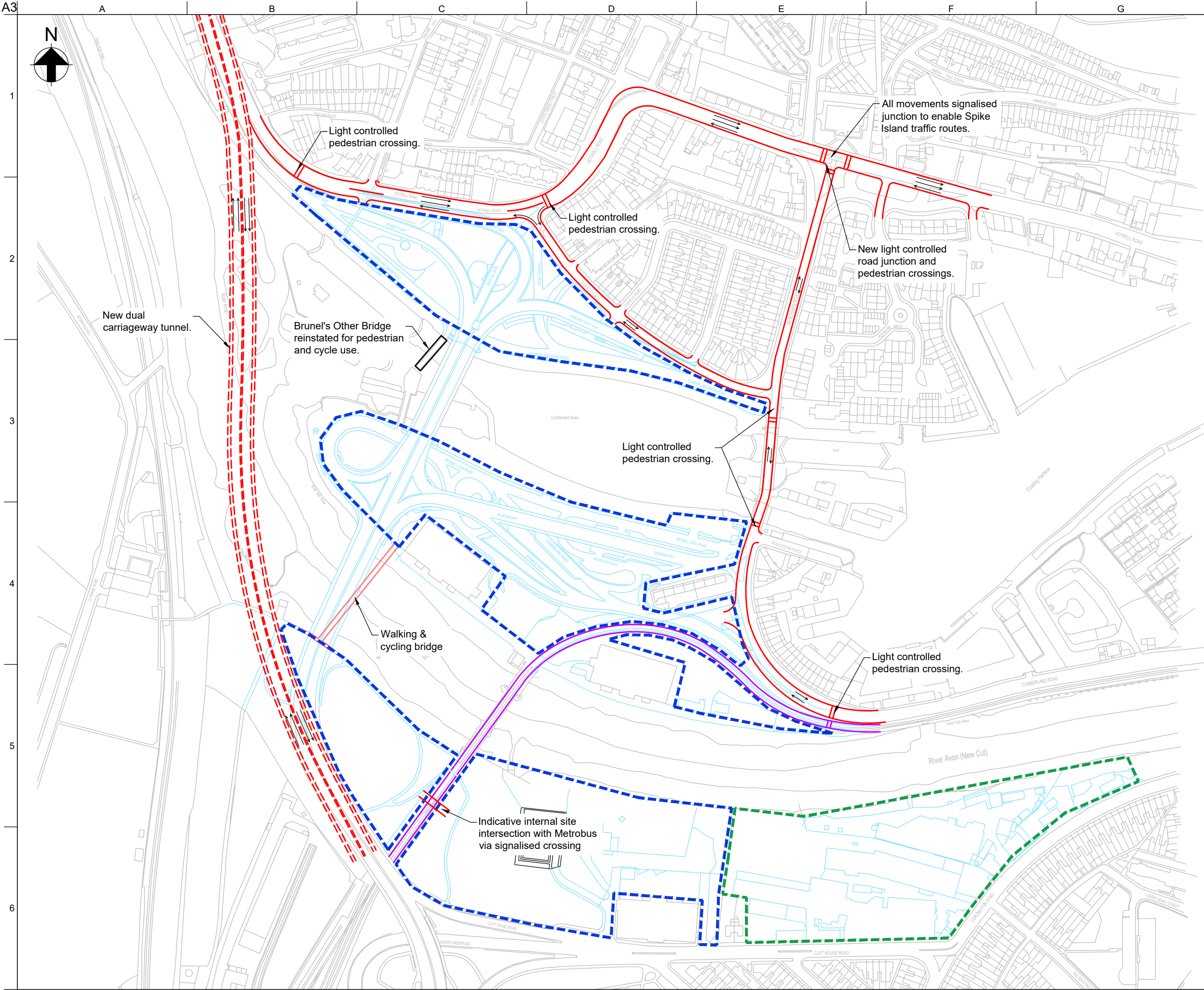
Scale at A3 1:3000

Role
Transport Planning

Suitability
Draft

Arup Job No 260233-00	Rev 01
---------------------------------	------------------

Drawing No
CH-108



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Metrobus Route
- Third Party Land
- Released Land (89,000 m²)

01	06/04/18	MK	BS	EW
Rev	Date	By	Chkd	Appd

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Client
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Project Title
Cumberland Basin Feasibility Study

Drawing Title
Option 9

Scale at A3 1:3000

Role
Transport Planning

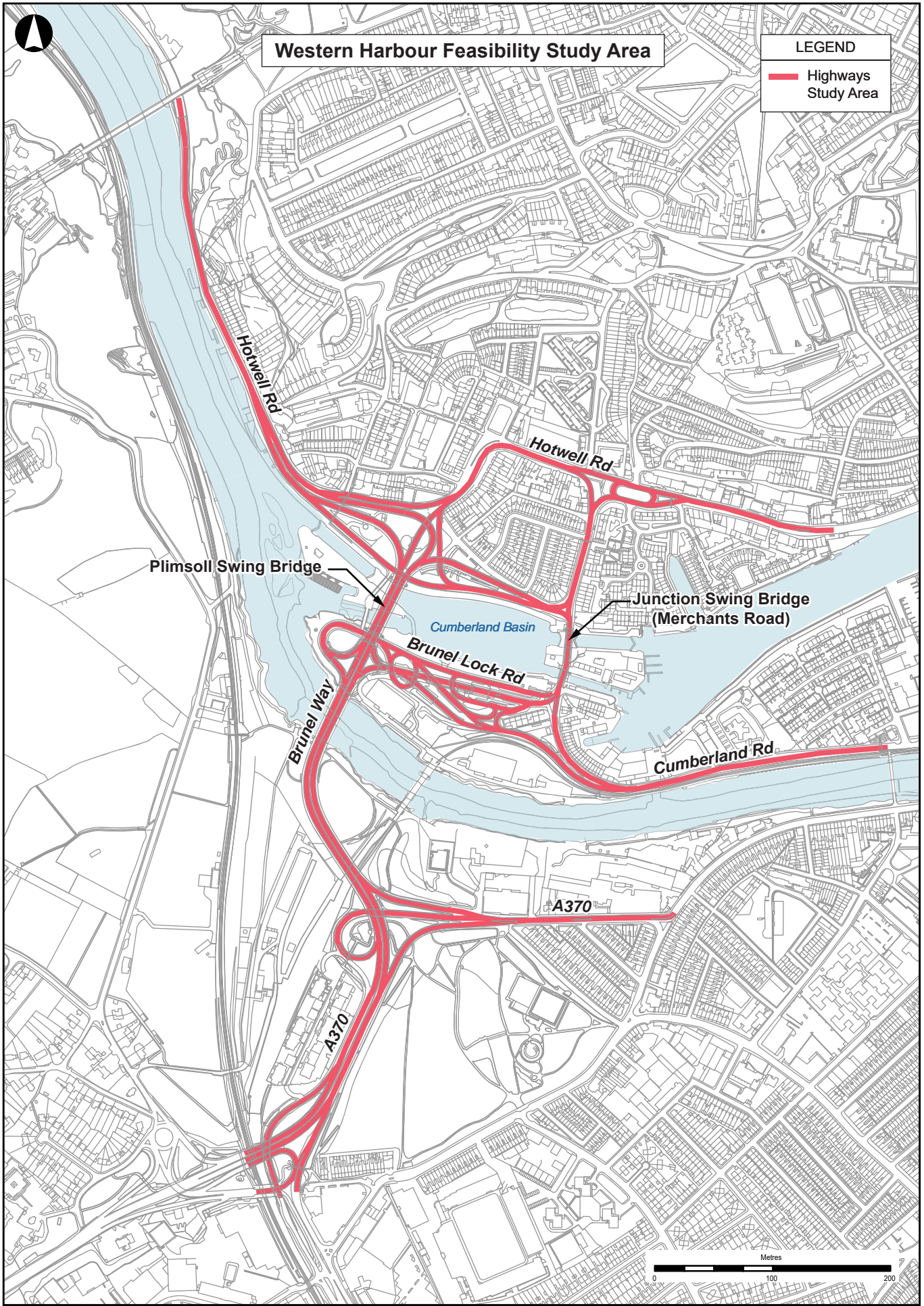
Suitability
Draft

Arup Job No 260233-00	Rev 01
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Drawing No
CH-109

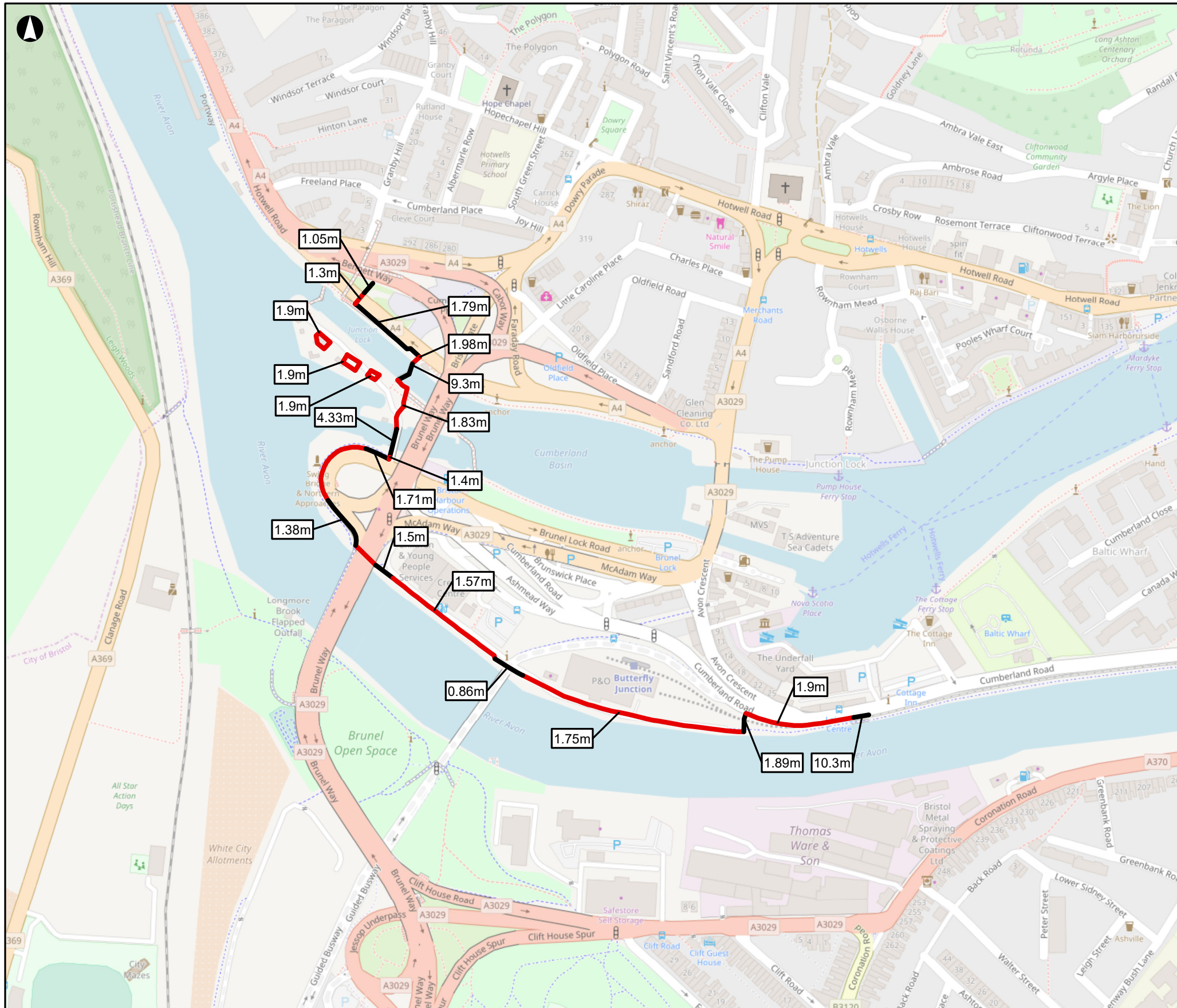
Appendix B

Western Harbour Study Area Plan



Appendix C

Potential Flood Defence Measures Plan



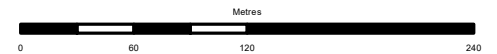
Legend

Note:
Defence heights shown are 'average high defence heights' above existing ground level. Calculated by subtracting ground level from 10.3m above datum.

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P1	2018-03-19	EB		
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Issue	Date	By	Chkd	Appd
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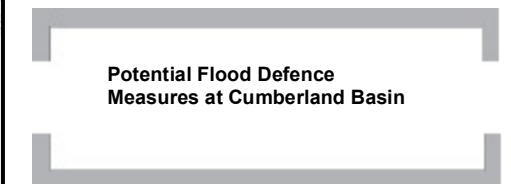


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Job Title
Cumberland Basin Feasibility



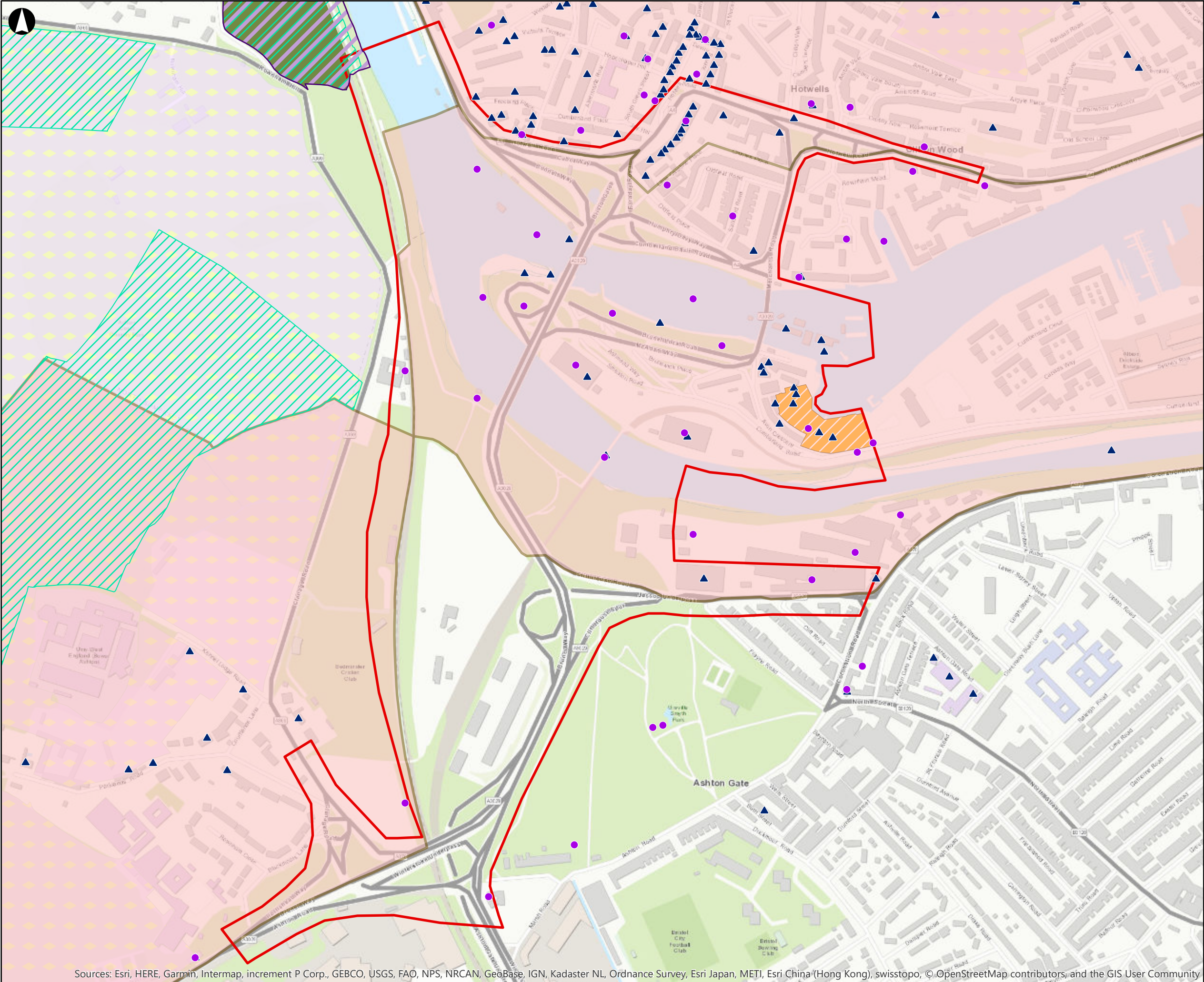
Scale at A4

1:5,000

Job No 260233-00	Drawing Status Preliminary	Issue P1
Drawing No 001		

Appendix D

Environment and Heritage Constraints Map

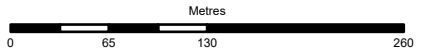


- Legend
- Historic Environmental Records (HER) Monuments
 - ▲ Listed Buildings
 - ▭ Cumberland Basin Study Area
 - ▭ Special Area of Conservation
 - ▨ Sites of Special Scientific Interest
 - ▨ Scheduled Monument
 - ▭ Park and Garden
 - ▭ Ancient Woodland
 - ▭ Conservation Area

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contained in this material was obtained in 2016. The most publicly available up to date Historic England GIS
Data can be obtained from HistoricEngland.org.uk
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P2	26-04-10	FG	PI	EW
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Issue	Date	By	Chkd	Appd
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Job Title
Cumberland Basin

**Environmental and Heritage
Constraints Map**

Scale at A3
1:5,000

Job No 260233-00	Drawing Status For Information
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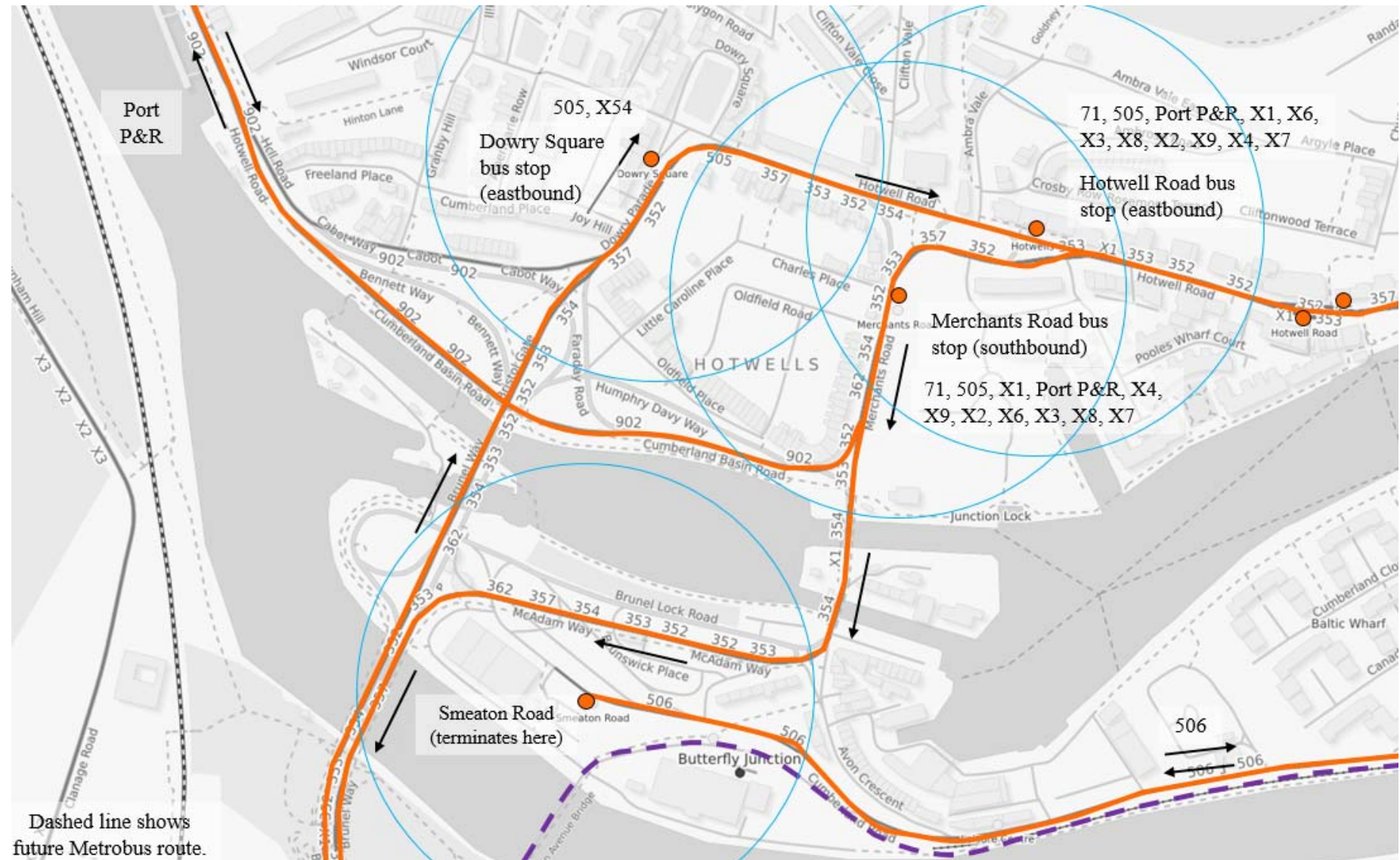
Drawing No 001	Issue P2
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Appendix E

Existing Bus Services Plan

Existing Bus Services, with isochrones showing 200m bus stop catchments



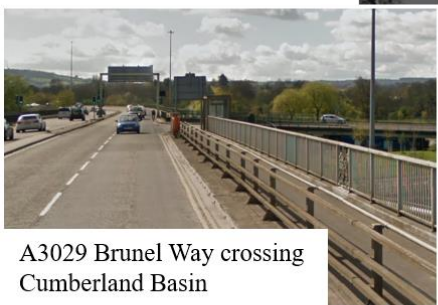
Appendix F

Existing Walking and Cycling Provision Plan

Existing Walking Routes



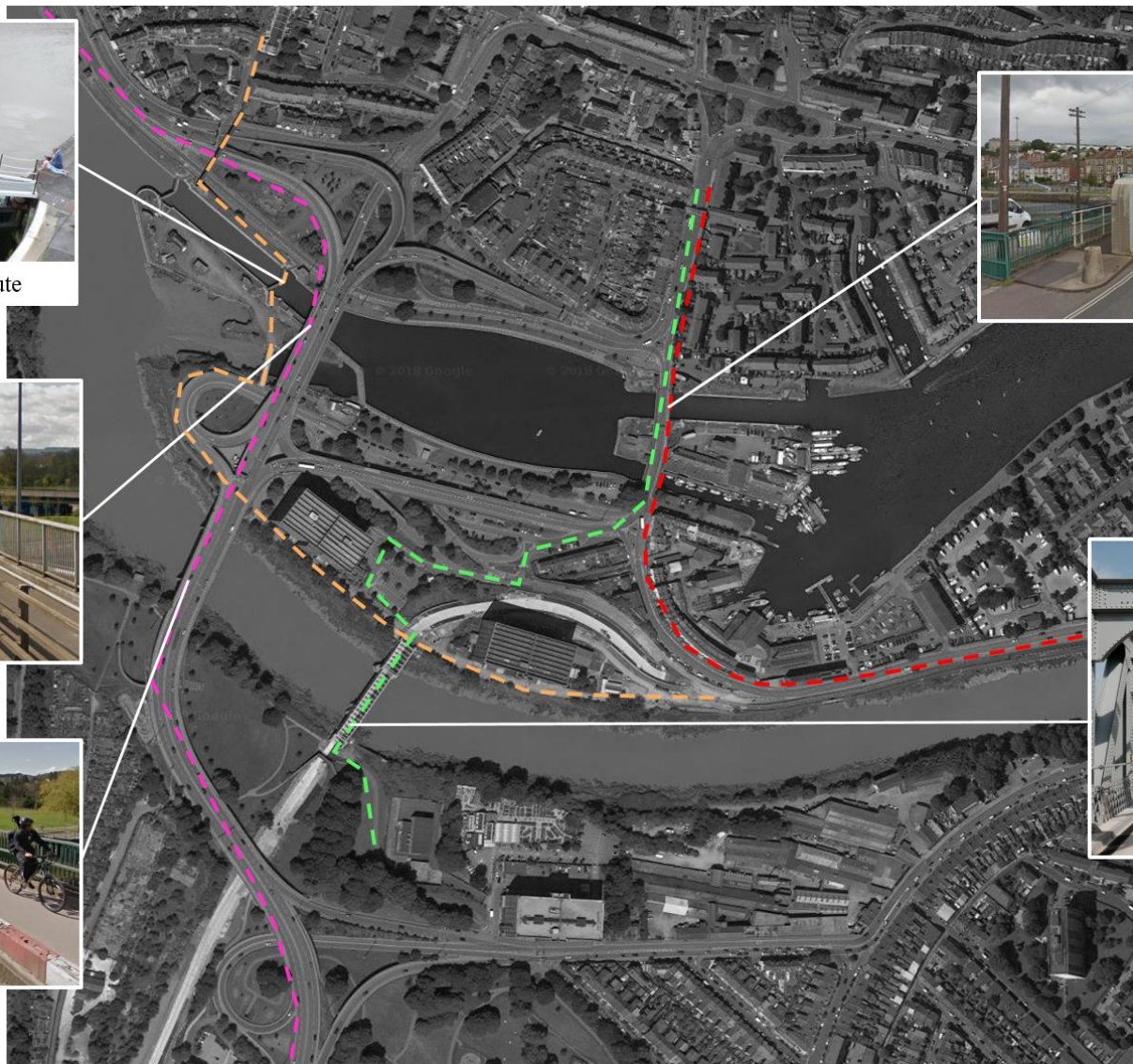
Lock gates with pedestrian route



A3029 Brunel Way crossing
Cumberland Basin



A3029 Brunel Way
crossing River Avon

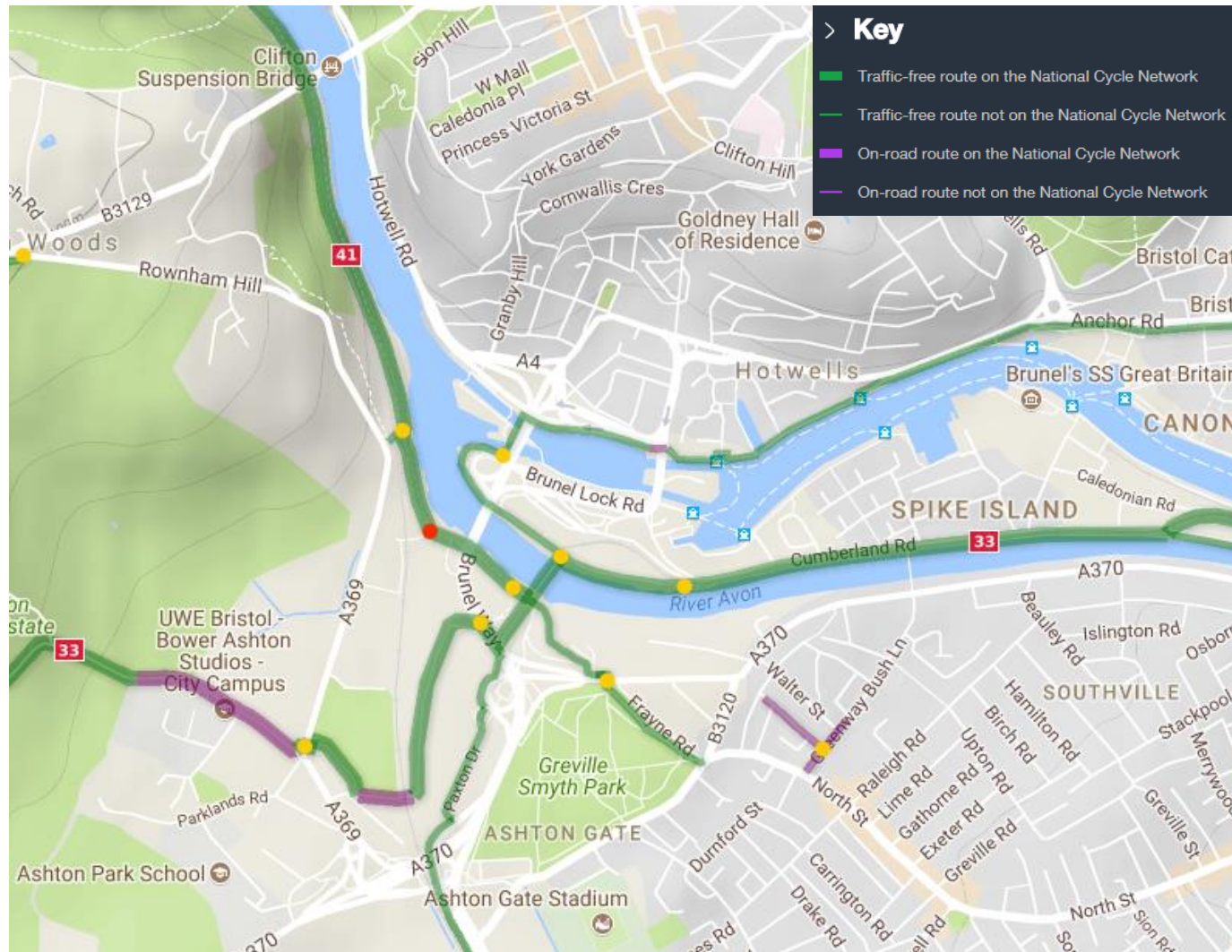


Merchants Road bridge



Ashton Ave bridge

Existing Cycle Routes

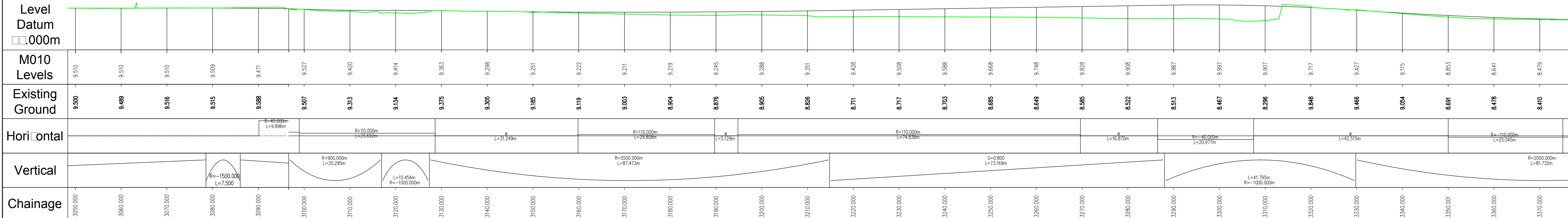
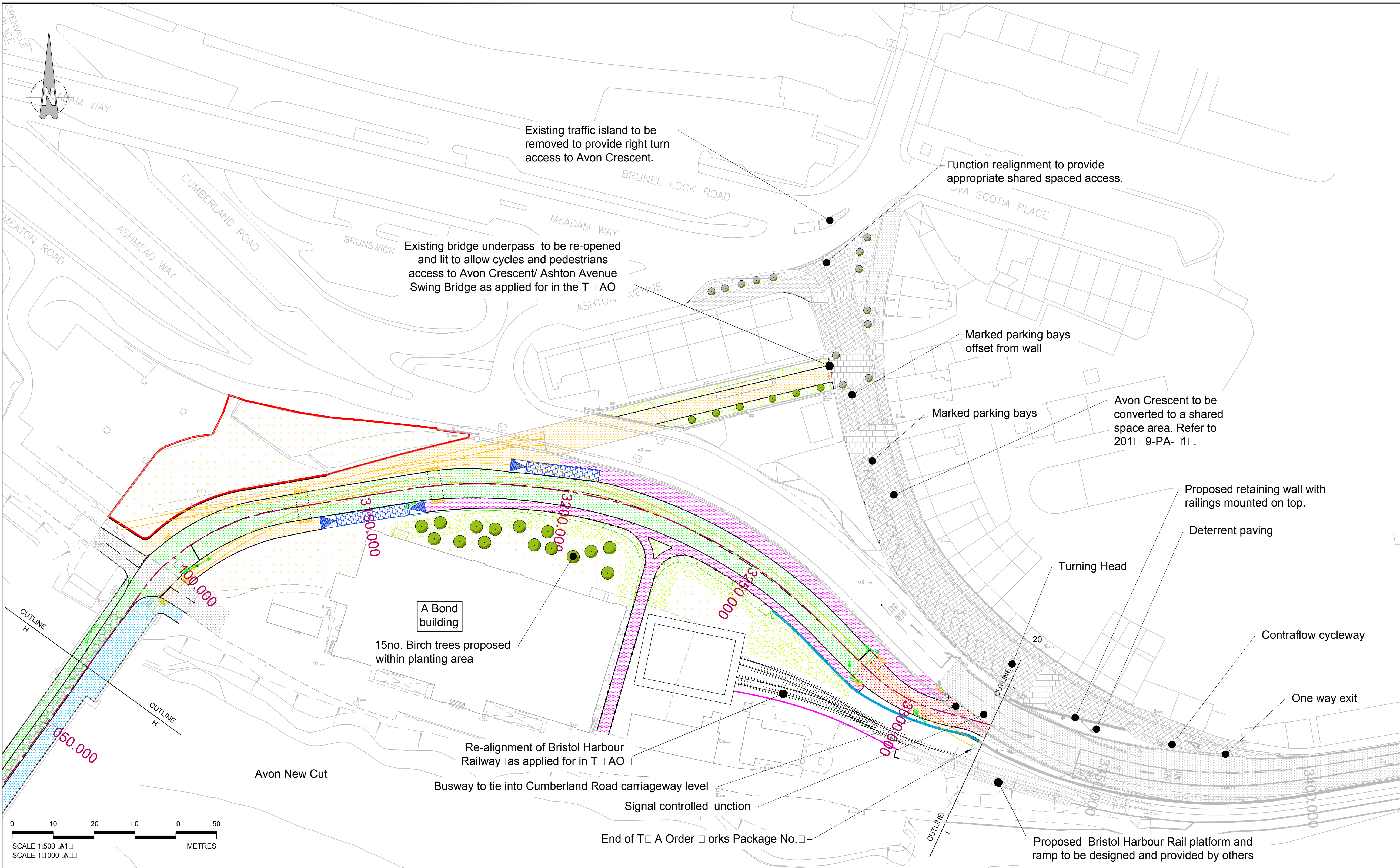


Extract from sustrans.org.uk

Appendix G

Metrobus Proposals at Avon Crescent Plan

Note: Scheme not fully delivered as part of Metrobus scheme; decision pending regarding final layout of Avon Crescent.



Notes:

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General Notes

- All dimensions are in metres, unless specified
- Do not scale from this drawing
- Horizontal and vertical alignment is based upon Topographical Survey dated October 2009
- All long section levels both proposed and existing refer to near side channel edges for Busway and the centre line for unguided Busway sections

Drainage

- Busways will be drained by the use of linear filter system with either glued material or grass depending on location
- Non-Busways will have conventional gully which will be linked into existing drainage network where possible

Street Lighting

- All proposed footways, cycleways and maintenance tracks to be lit in accordance with BS5:89 and BCC standards

Existing/Proposed Cycle Links

- Upgraded and proposed cycle links from the route are shown for information only and are not a part of this scheme

LEGEND:

- Guided Busway with grass central strip
- Guided Busway with glued granular central strip
- Guided Busway on a bridge
- Unguided Busway
- Maintenance track
- Bus Lane
- Vehicle restraint / flood wall
- Bridge parapet or retaining wall
- Re-aligned carriageway
- Shared footway/cycleway
- Re-aligned footway
- Re-aligned cycleway footway
- Planting areas
- Butterfly Habitat to be protected permanently
- Trees to be planted

Rev	By	Chkd	Apprvd	Date	Description
E	PGF	BS	BS	2/11/11	Design Freeze F
D	PGF	BS	BS	05/09/11	Design Freeze E
C	PGF	BS	BS	1/10/11	Design Freeze D Route Change
B	PGF	BS	BS	10/12/12	Design Freeze C
A	PGF	BS	BS	2/08/12	Model adjustments to vertical and horizontal alignment

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West of England

travel

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BRISTOL METROBUS
ASHTON VALE to TEMPLE MEADS
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Drawing

ORIGINAL CORRIDOR SECTION
PLANS FOR INFORMATION
DESIGN FREEZE F

Drawn by: ADS	Date: 15/03/2012
Checked by: BS	Date: 16/03/2012
Approved by: BS	Date: 16/03/2012

Drawing No.	Revision
GAV TMR-0200-111	E

Drawing Scale: 1:500 @ A1

Drawing File Path & Name:
User and Plot Date

Appendix H

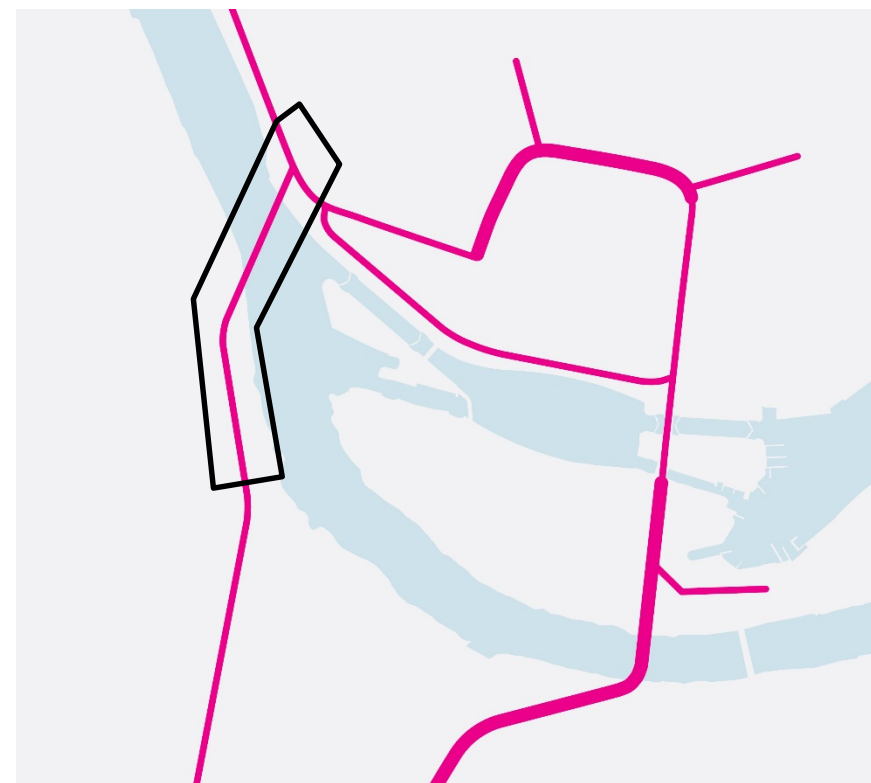
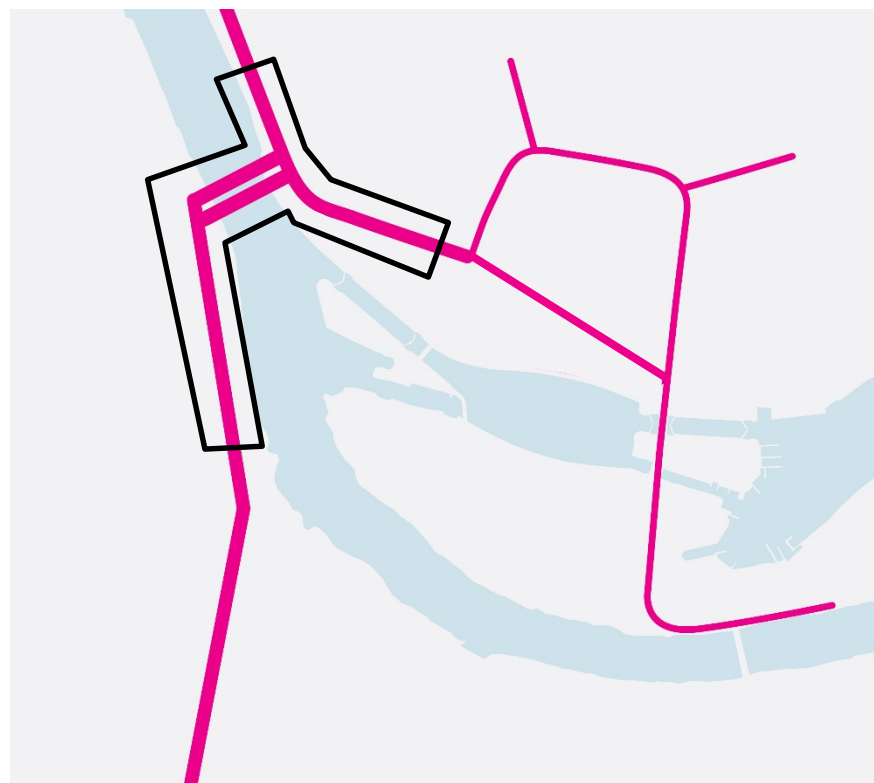
Tunnel Options

Tunnel Options

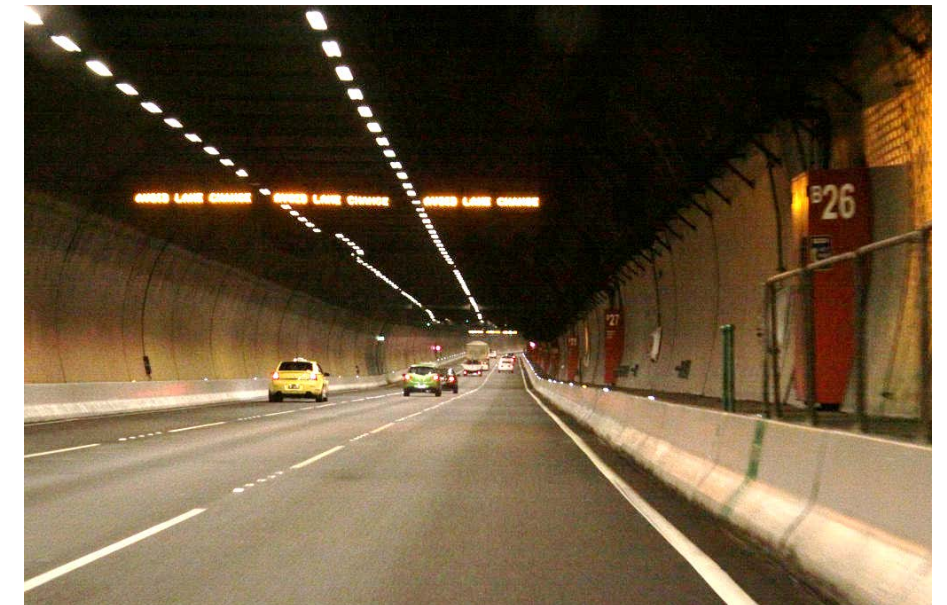
For the Western Link we need 2-3 lanes in each direction based on junction capacity at the A4 Portway junction.

For the Hybrid there is less traffic and a simpler junction form, so a single lane in each direction is required.

Construction would be open cut, drop in boxes, pump out water and seal.



Western Link Hybrid



Three lane cut and cover tunnel, Australia



Two lane bored tunnel, Austria

Tunnel Depth and Ramping

Assuming a ground level of around 9.0mAOD for A4 Portway



Bottom of channel can be assumed to be 0.0-1.0AOD

With 2m cover to the top of the tunnel gives ~3.0mAOD

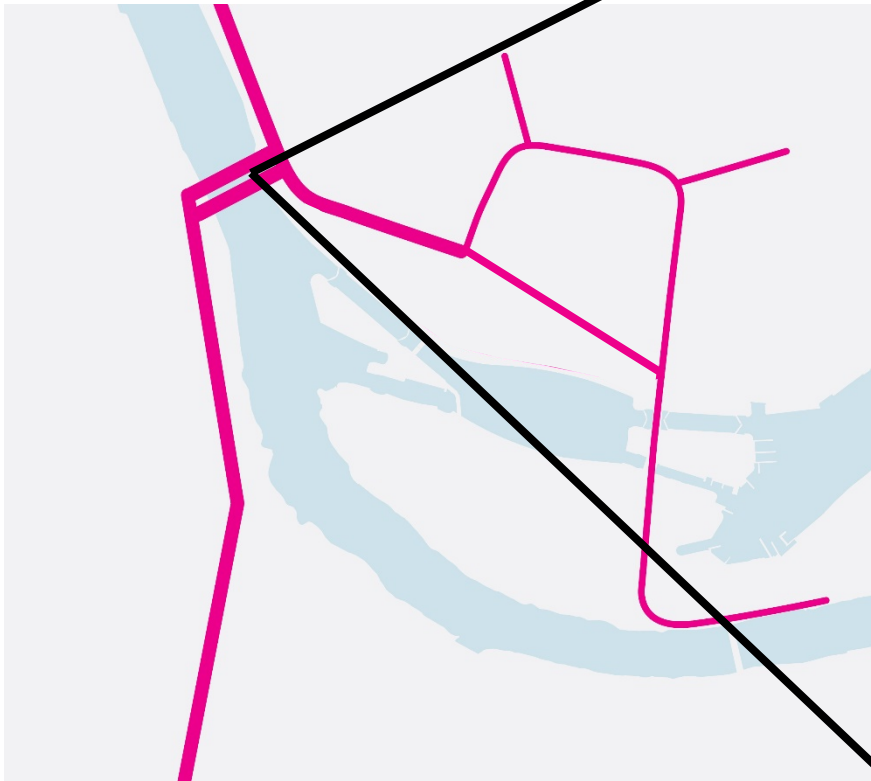
A 5m deep tunnel would give a road level of ~8.0mAOD



The highway would therefore need to transition 17m of depth. At a 1:5 Gradient this would be equivalent to a ramp length of 340m.

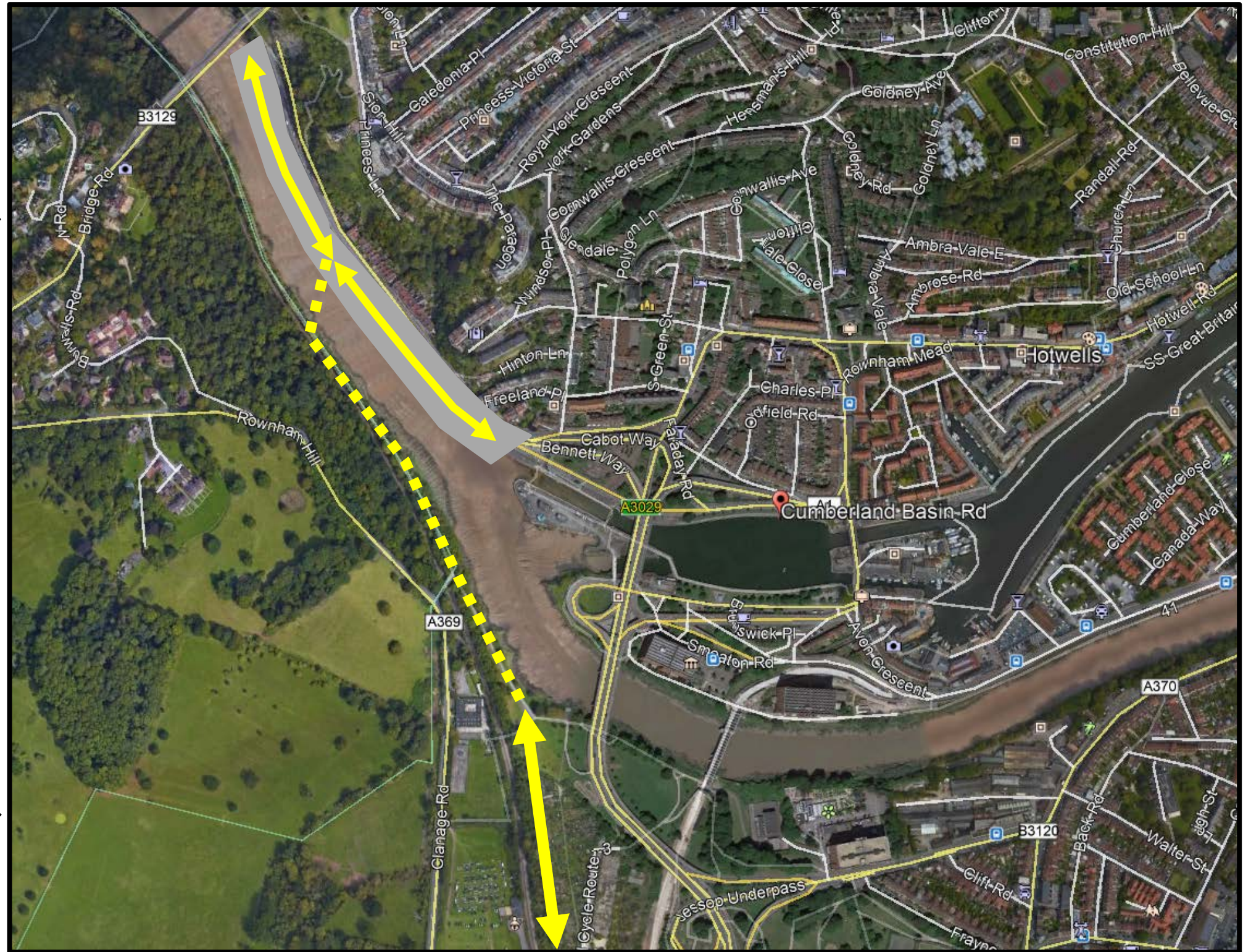
Transport Concepts - Tunnelling

Construction of a tunnel would require portals and ramps at either end to enable the change in height required to pass under the River Avon.



The space required to provide adequate ramps and portals is indicated in the sketch to the right.

Western Link



Sketch assumes a change in height of 10m. At 5% (1:20) = 200m ramp.

Transport Concepts - Tunnelling

Construction of a tunnel would require portals and ramps at either end to enable the change in height required to pass under the River Avon.

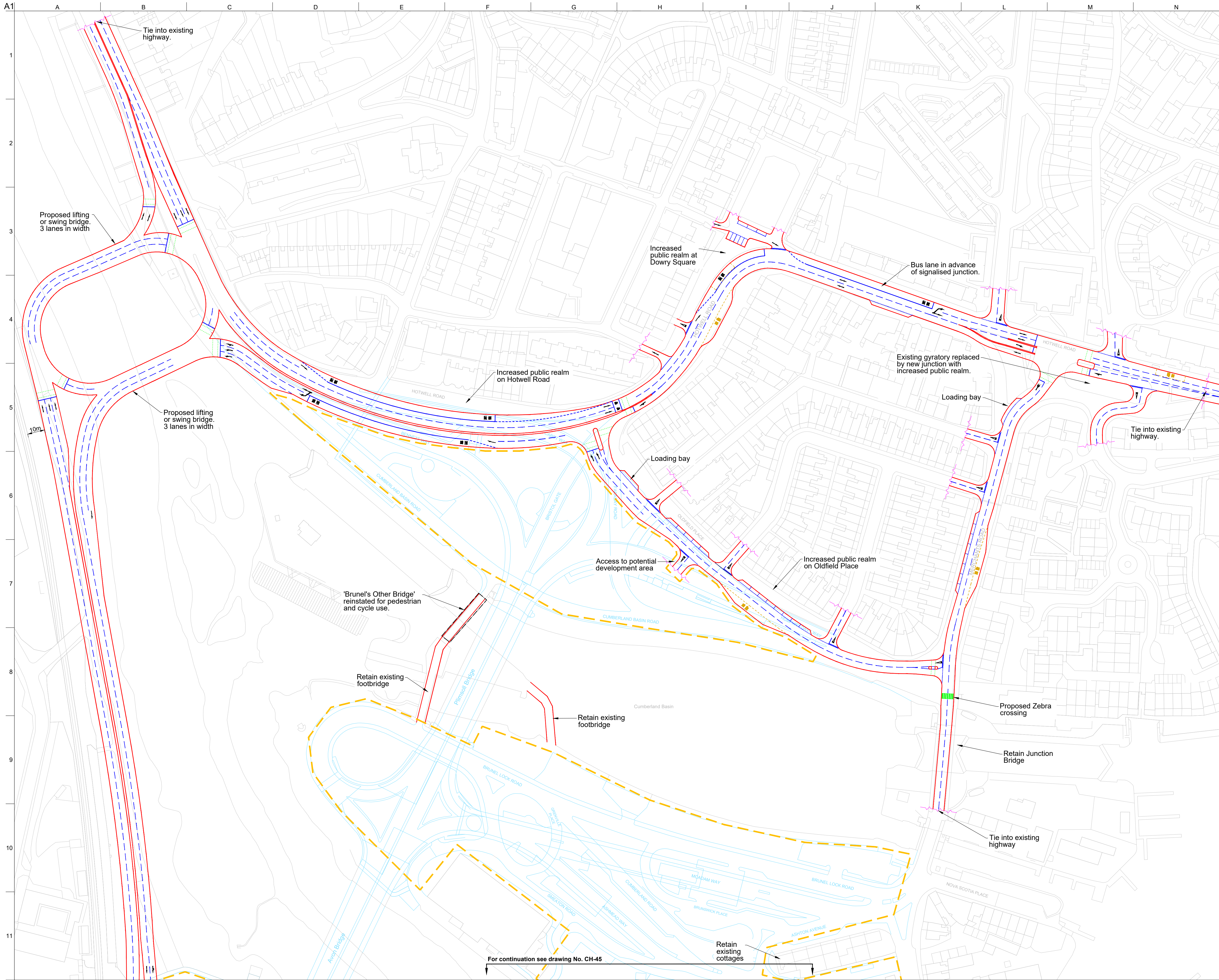


Sketch assumes a change in height of 10m. At 5% (1:20) = 200m ramp.

Western Link

Appendix I

Option 2 Outline Highway Layout Drawing



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (107,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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Issue	Date	By	Chkd	Appd

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Bristol City Council

Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 2
Sheet 1 of 3**

Scale at A1
1:1000

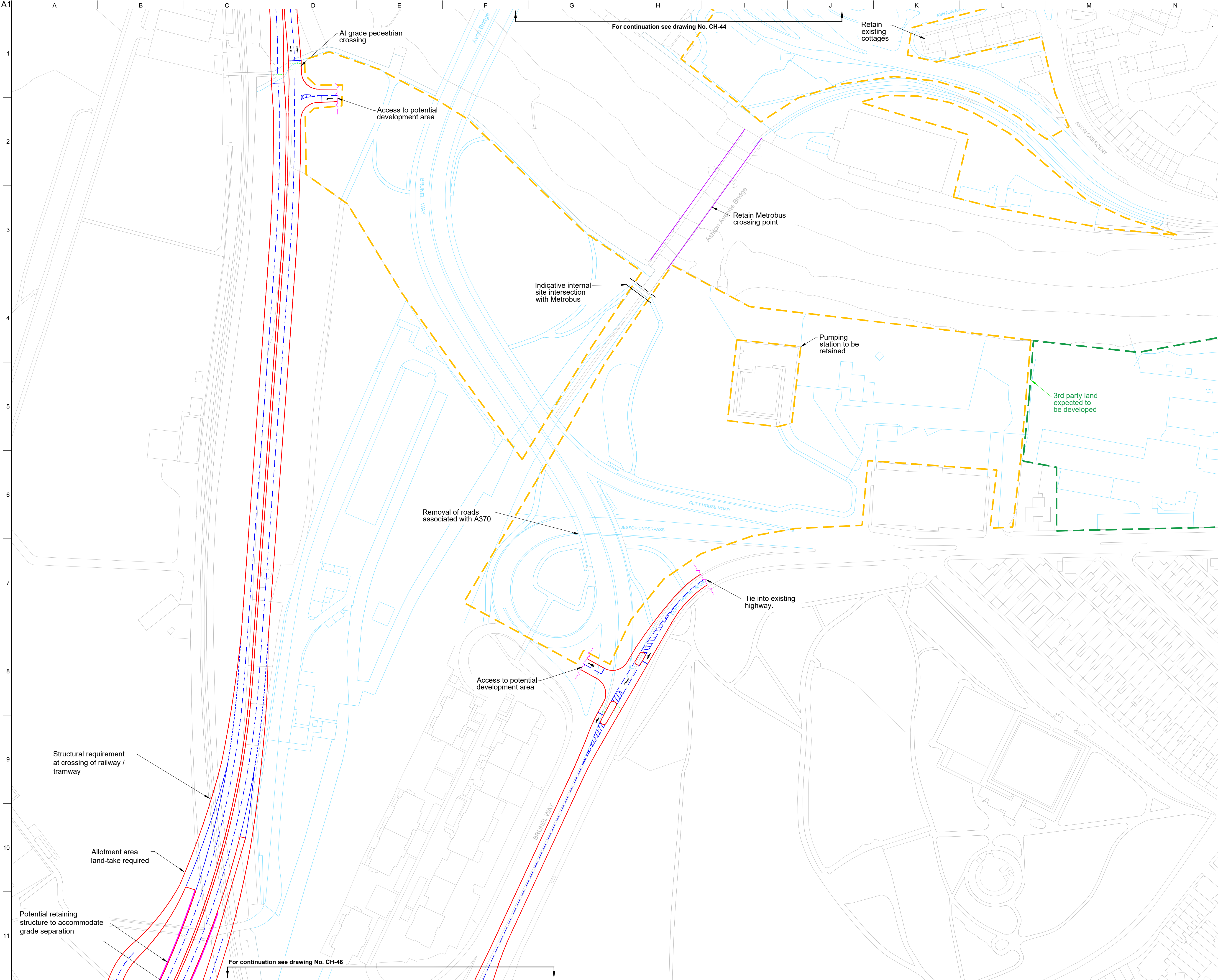
Discipline
Transport Planning

Job No
260233-00

Drawing No
CH-044

Drawing Status
Information

Issue
01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (107,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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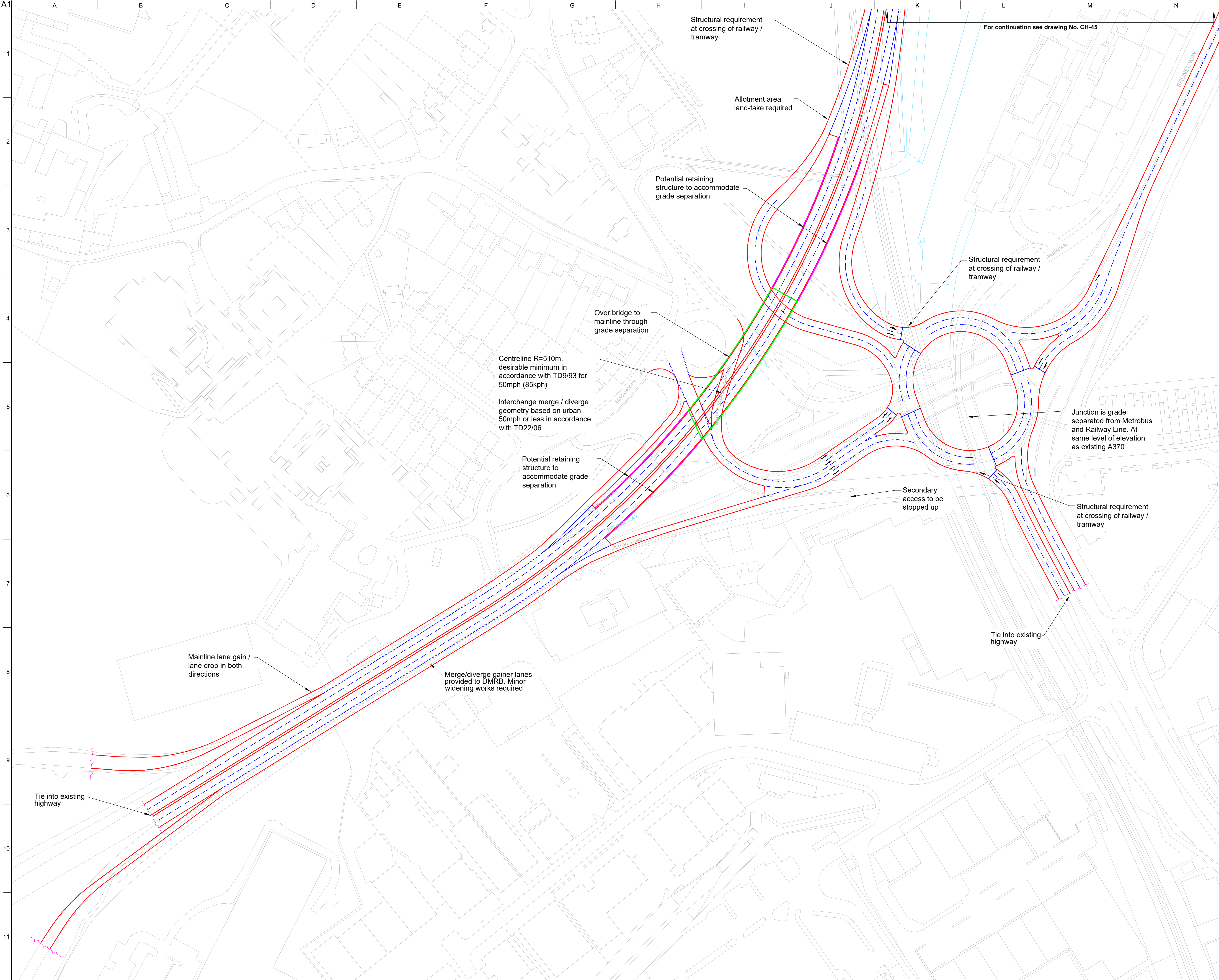
Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 2
Sheet 2 of 3**

Scale at A1 1:1000

Discipline **Transport Planning**

Job No	Drawing Status
260233-00	Information
Drawing No	Issue
CH-045	01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (107,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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Issue	Date	By	Chkd	Appd

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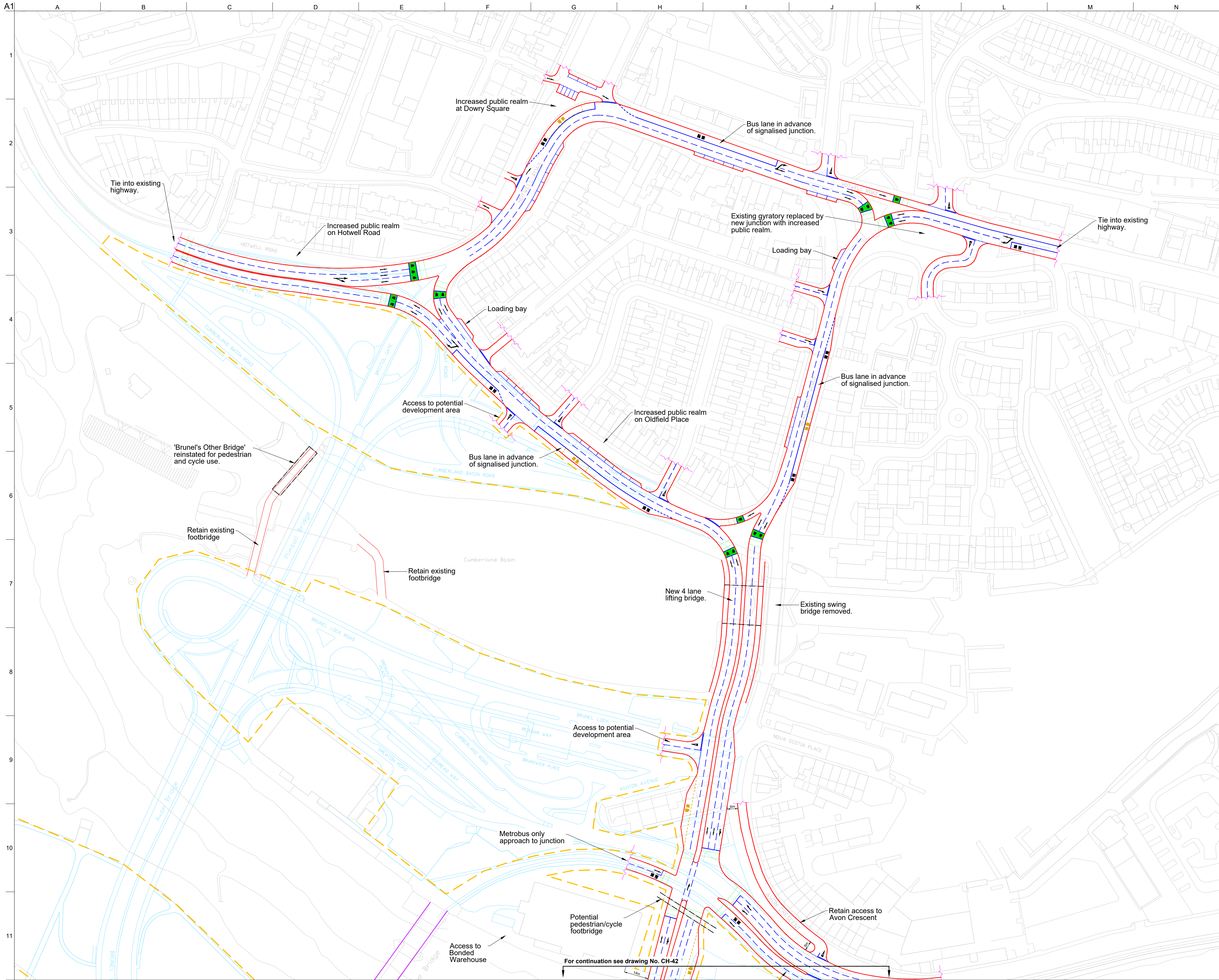
Job Title
 Western Harbour Feasibility Study

Drawing Title
 Highway General Arrangement
 Option 2
 Sheet 3 of 3

Scale at A1		1:1000	
Discipline		Transport Planning	
Job No		Drawing Status	
260233-00		Information	
Drawing No		Issue	
CH-046		01	

Appendix J

Option 8 and 8B Outline Highway Layout Drawings



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (95,500 m²)

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Note: Footways and off road cycleways not shown.

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Drawing Title
**Highway General Arrangement
Option 8
Sheet 1 of 2**

Scale at A1
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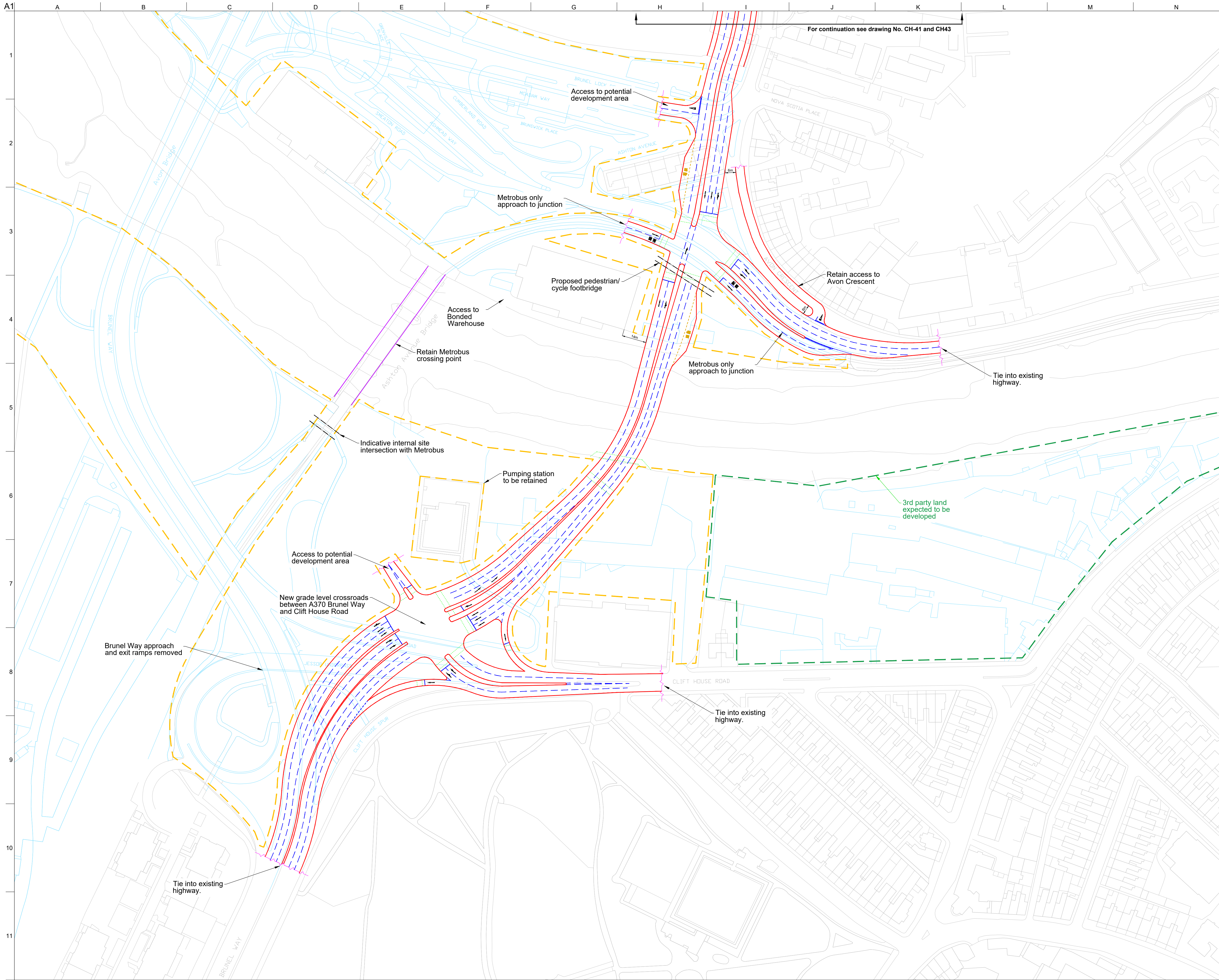
Discipline
Transport Planning

Job No
260233-00

Drawing Status
Information

Drawing No
CH-041

Issue
01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (95,500 m²)

Keyplan

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Issue	Date	By	Chkd	Appd

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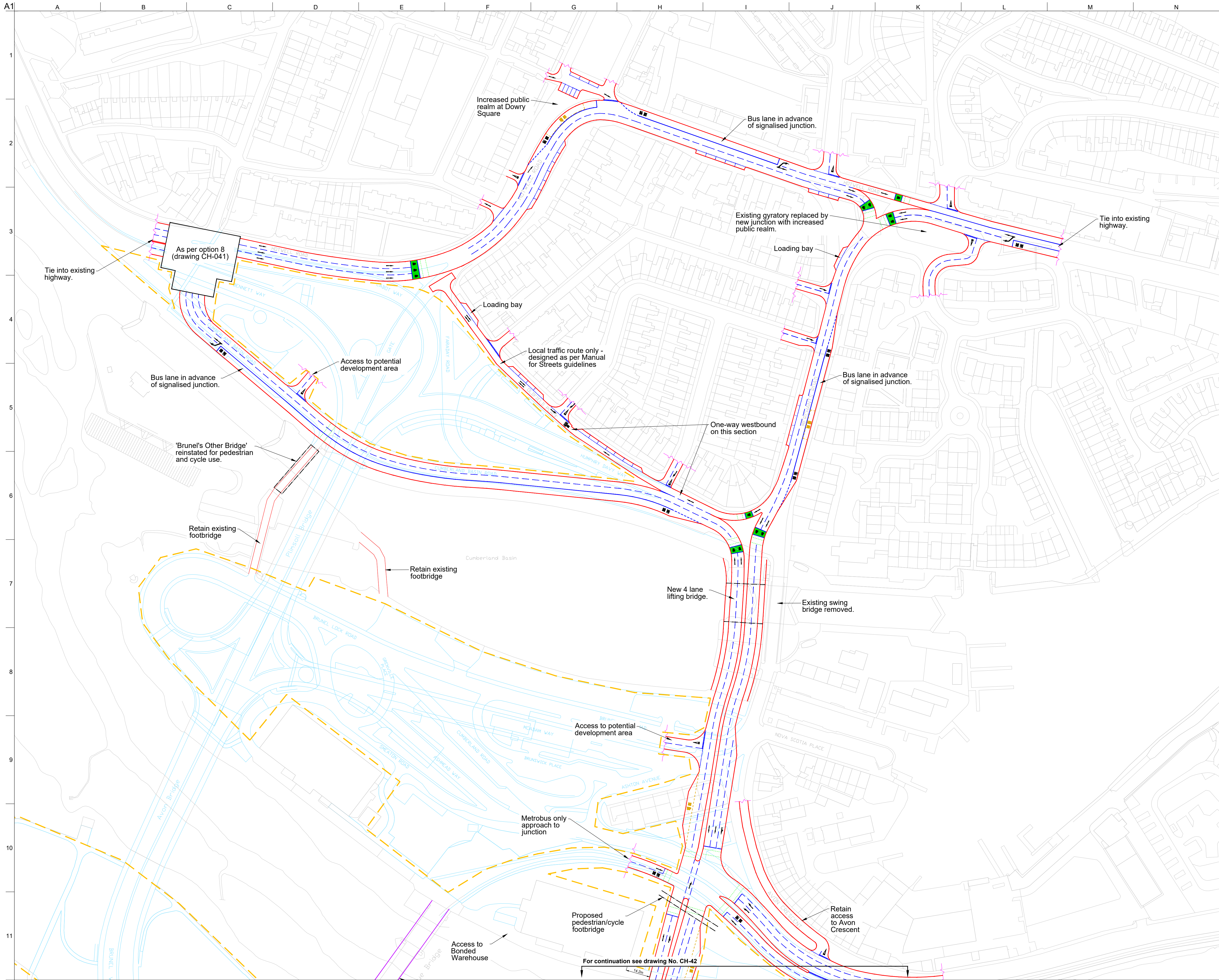
Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 8
Sheet 2 of 2**

Scale at A1
1:1000

Discipline
Transport Planning

Job No 260233-00	Drawing Status Information
Drawing No CH-042	Issue 01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (95,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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Drawing Title
**Highway General Arrangement
Option 8B
Sheet 1 of 2**

Scale at A1
1:1000

Discipline
Transport Planning

Job No
260233-00

Drawing Status
Information

Drawing No
CH-043

Issue
01

Appendix K

Option 2 – Potential Junction for
A370 / A3029 / A369 / New
Avon Link

Option 2 – Potential Junction Arrangements for A370 / A3029 / A369 / New Avon Link

All Movements Junction Options

Consideration has been given to the following all-movements junction arrangements, each of which provide for all of the traffic movements, plus Metrobus and the Portishead Line, in one location.

Option A – Throughabout

Option B – Single Roundabout with Flyover to New Avon Link

Option B1 – Single Roundabout with Flyover to New Avon Link - Eastern

Option C – Dumbell Roundabout

Option C1 – Dumbell Roundabout with Flyover to New Avon Link

The junctions are assessed to a very high level in Section 1 of this Appendix.

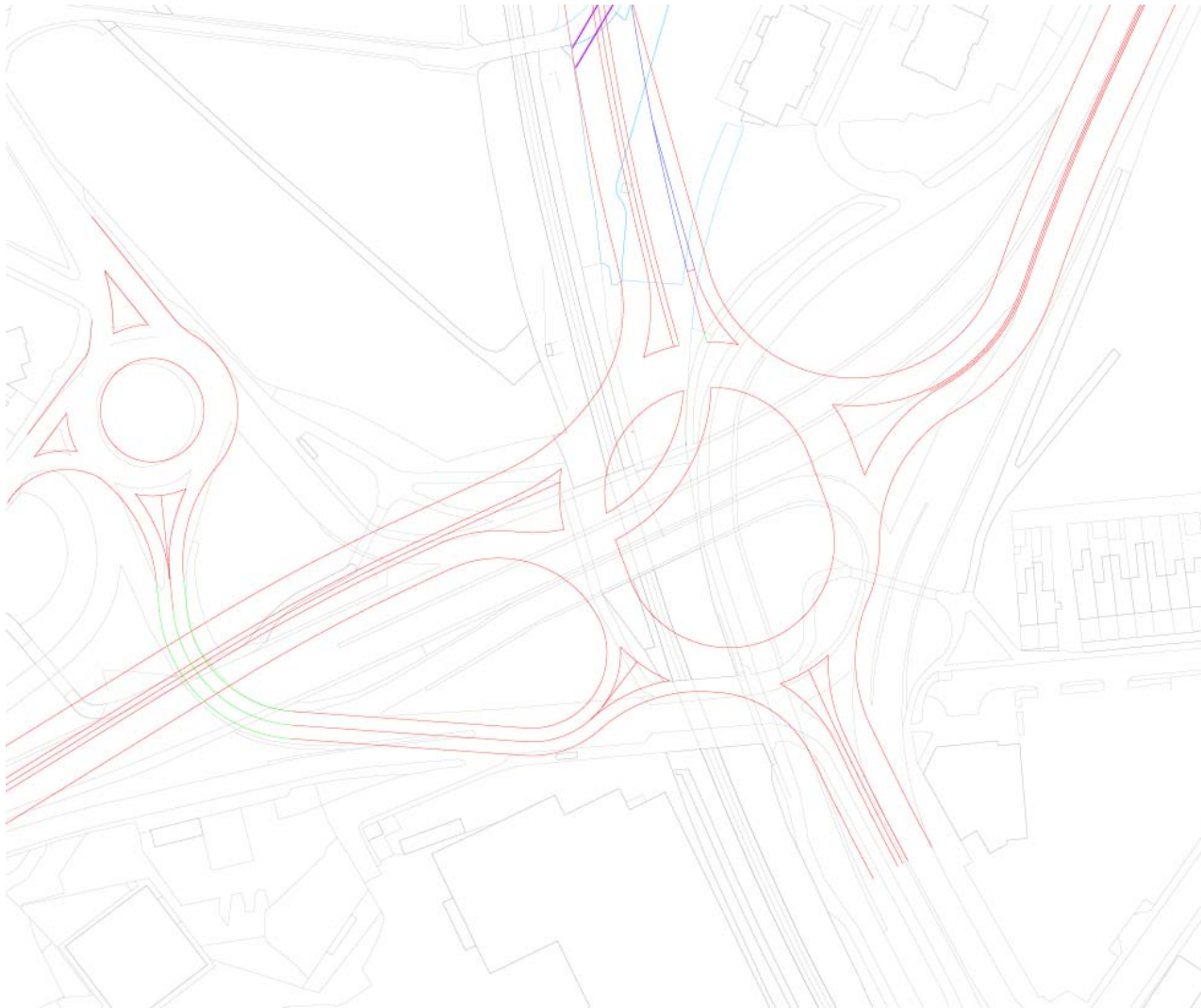
Off-Junction Improvements

Through a combination of existing conditions, and the proposed New Avon Link, the junction is highly complex and represents a confluence of 4 significant road routes, 2 transit routes, local roads, and residential / commercial properties. On that basis, this study has given high level consideration to three options which would reduce the amount of movements taking place at this one location.

These off-junction improvements are presented to a very high level in Section 2 of this Appendix.

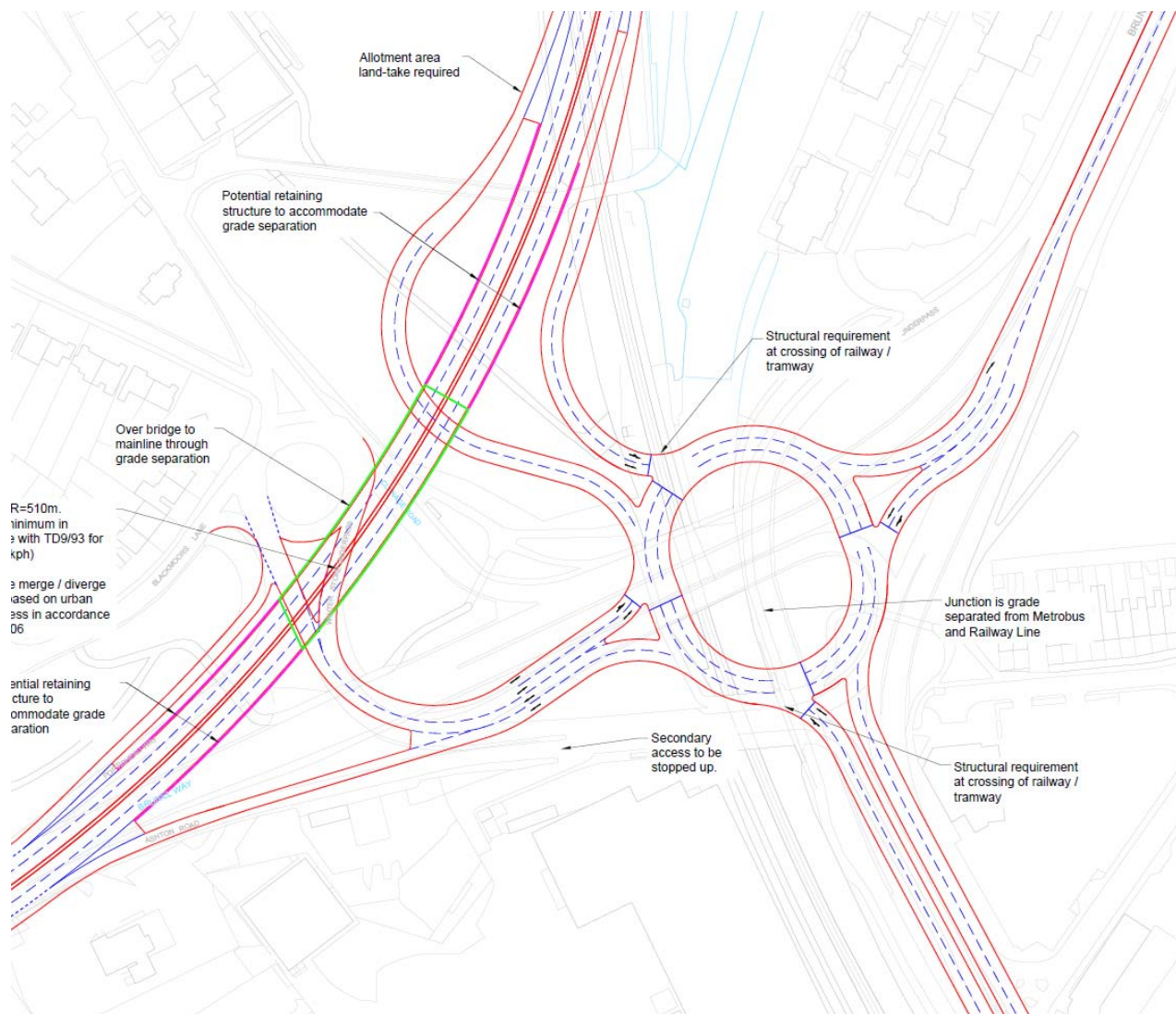
Section 1 - All Movements Junction Options

Option A – ‘Throughabout’



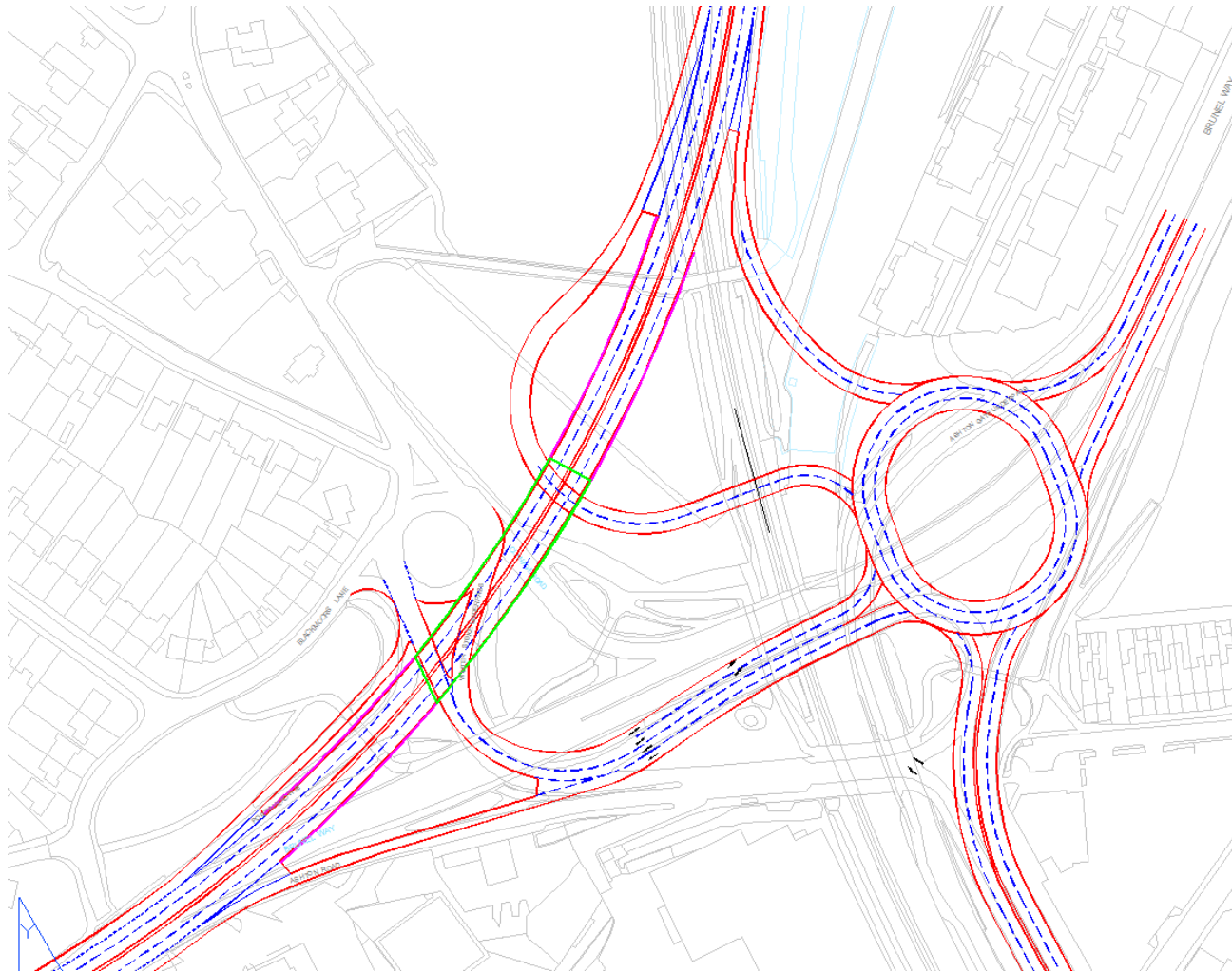
Criteria	Score
Capacity	
Footprint	
Complexity	
Potential Cost	
Buildability	

Option B – ‘Single Roundabout with Flyover to New Avon Link’



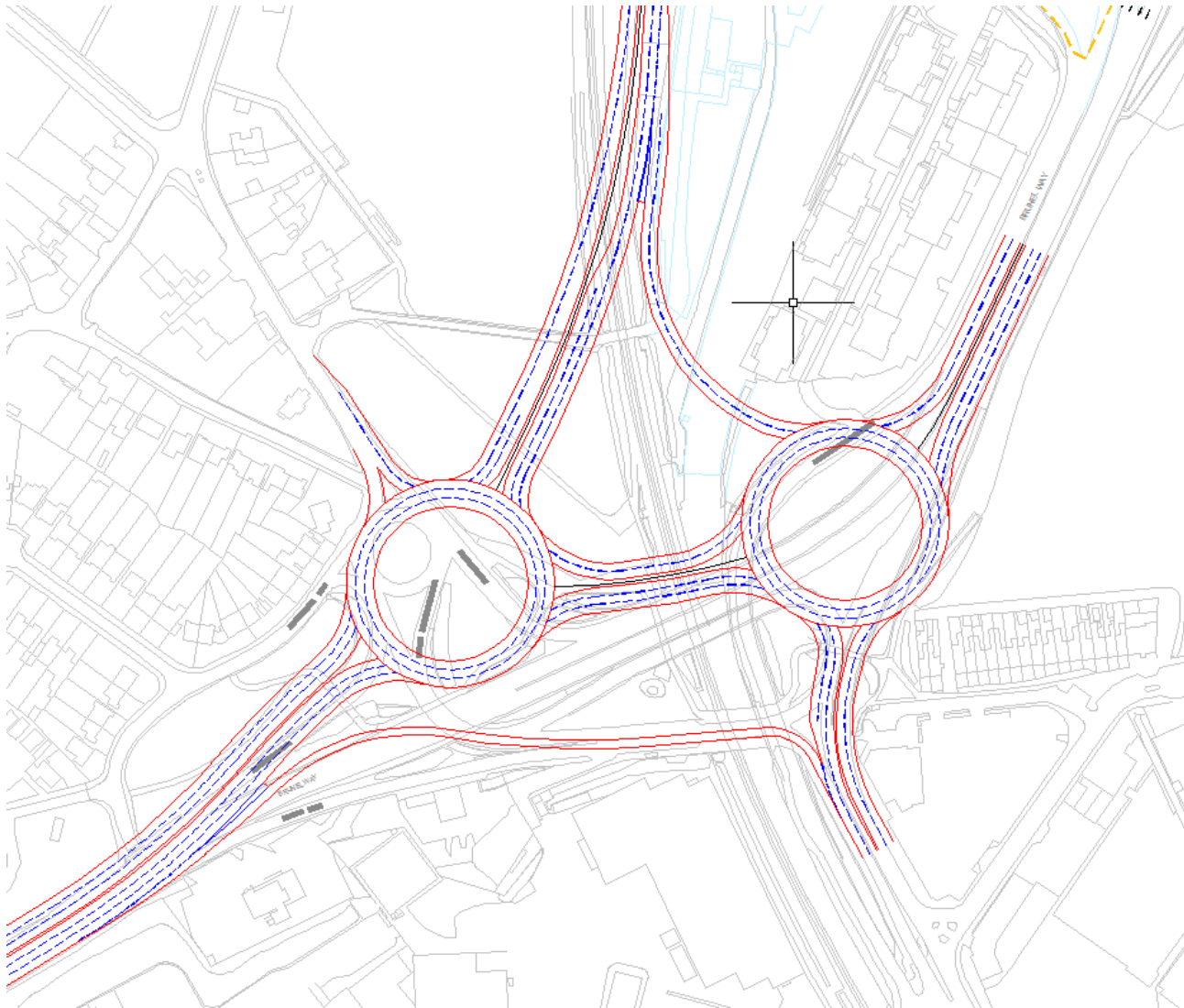
Criteria	Score
Capacity	
Footprint	
Complexity	
Potential Cost	
Buildability	

Option B1 – Single Roundabout with Flyover to New Avon Link – Further East



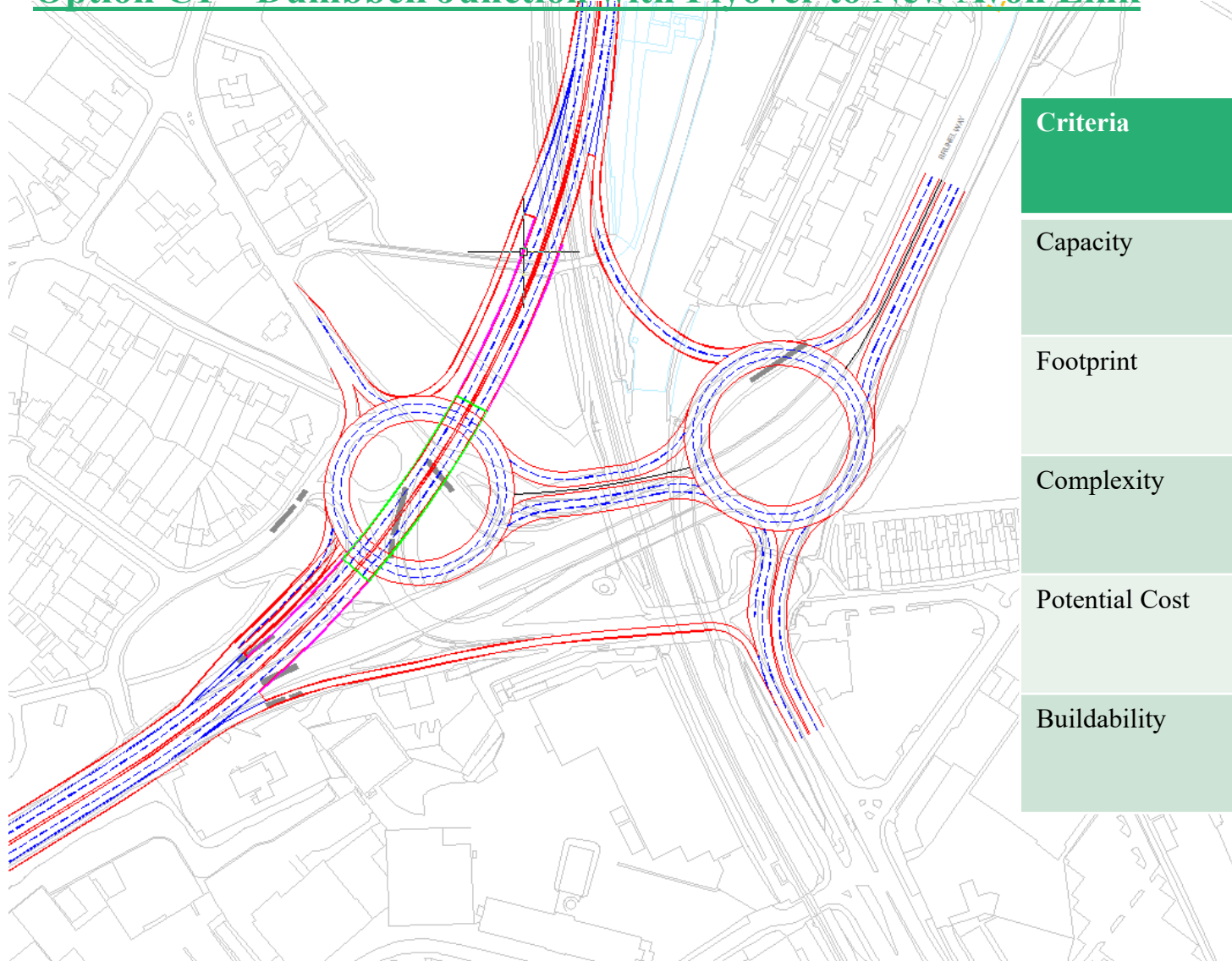
Criteria	Score
Capacity	
Footprint	
Complexity	
Potential Cost	
Buildability	

Option C – Dumbbell Junction



Criteria	Score
Capacity	
Footprint	
Complexity	
Potential Cost	
Buildability	

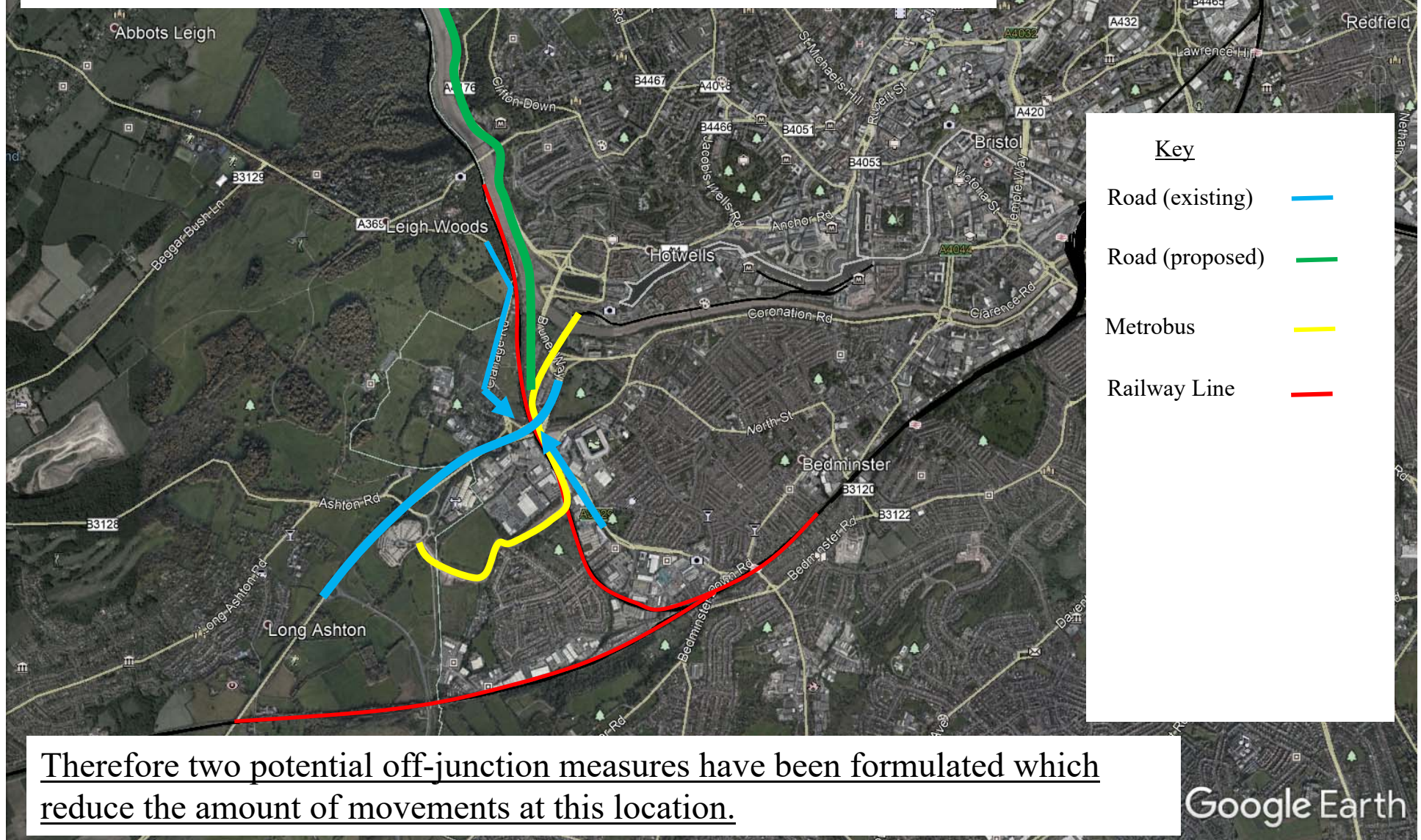
Option C1 – Dumbbell Junction with Flyover to New Avon Link



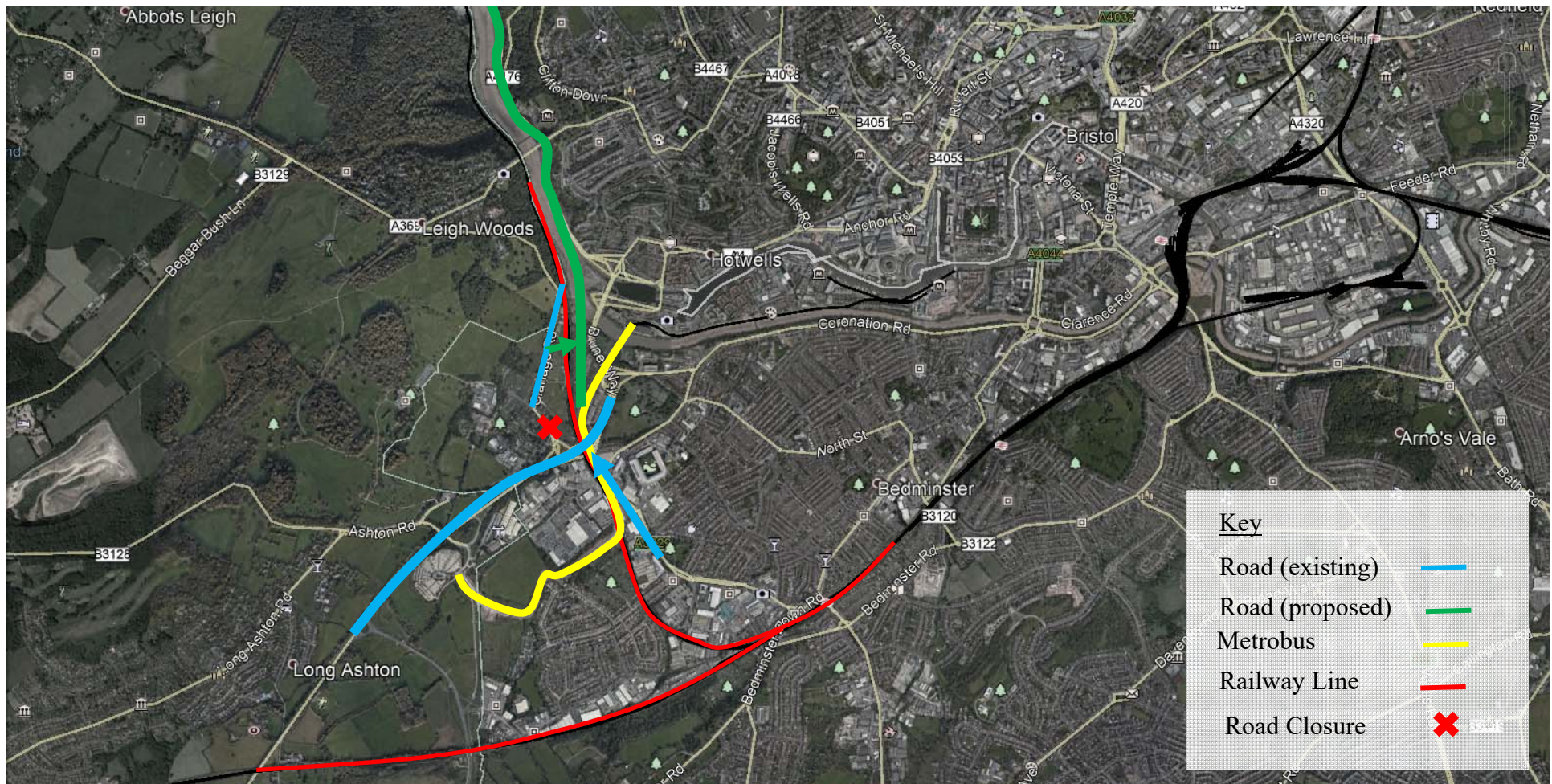
Criteria	Score
Capacity	
Footprint	
Complexity	
Potential Cost	
Buildability	

Section 2 – Off-junction Improvements

The junction is a confluence of existing constraints and the proposed New Avon Link.

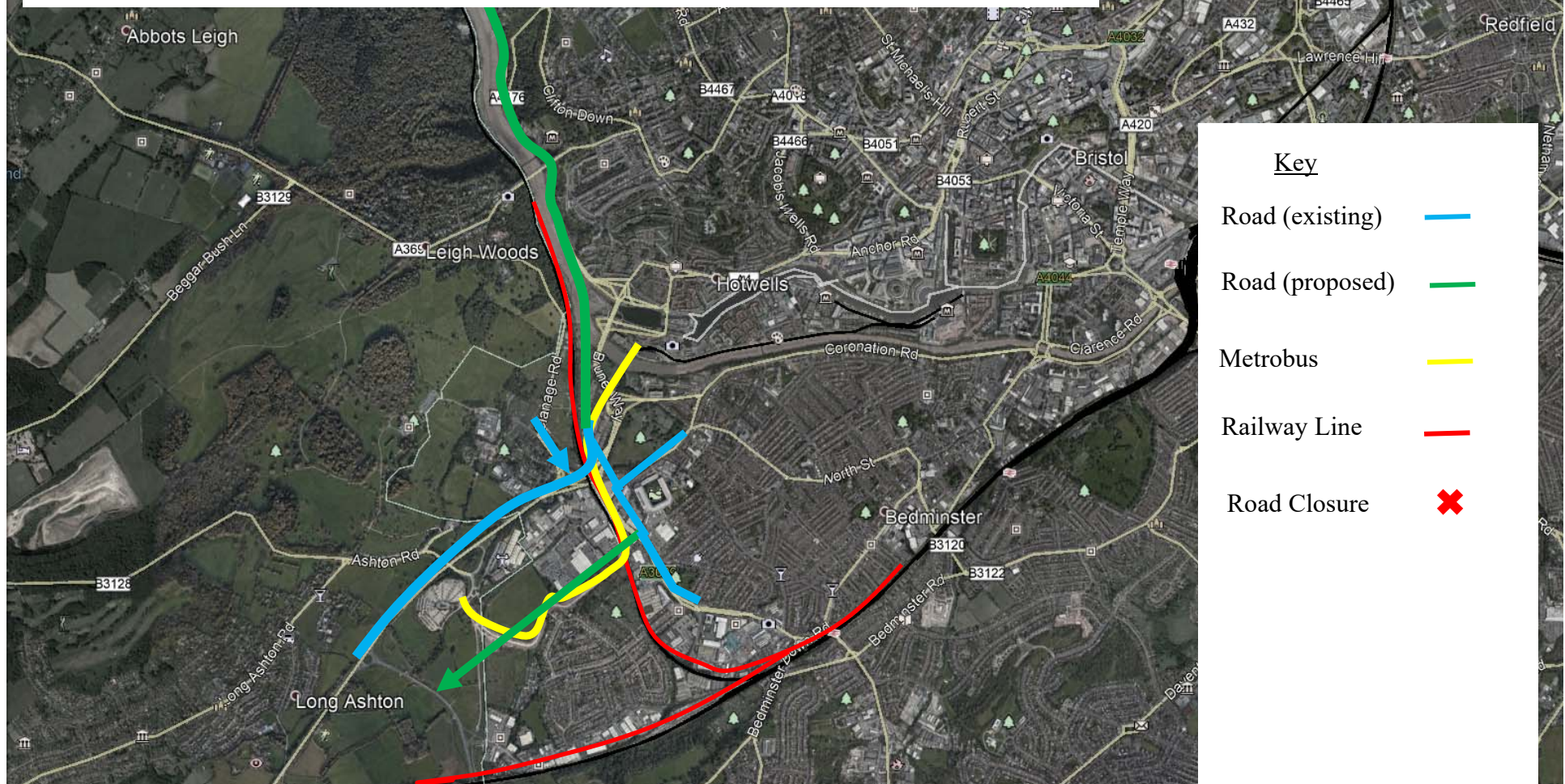


Off-Junction Measure 1: Provide a Direct Connection between the A369 and the New Avon Link

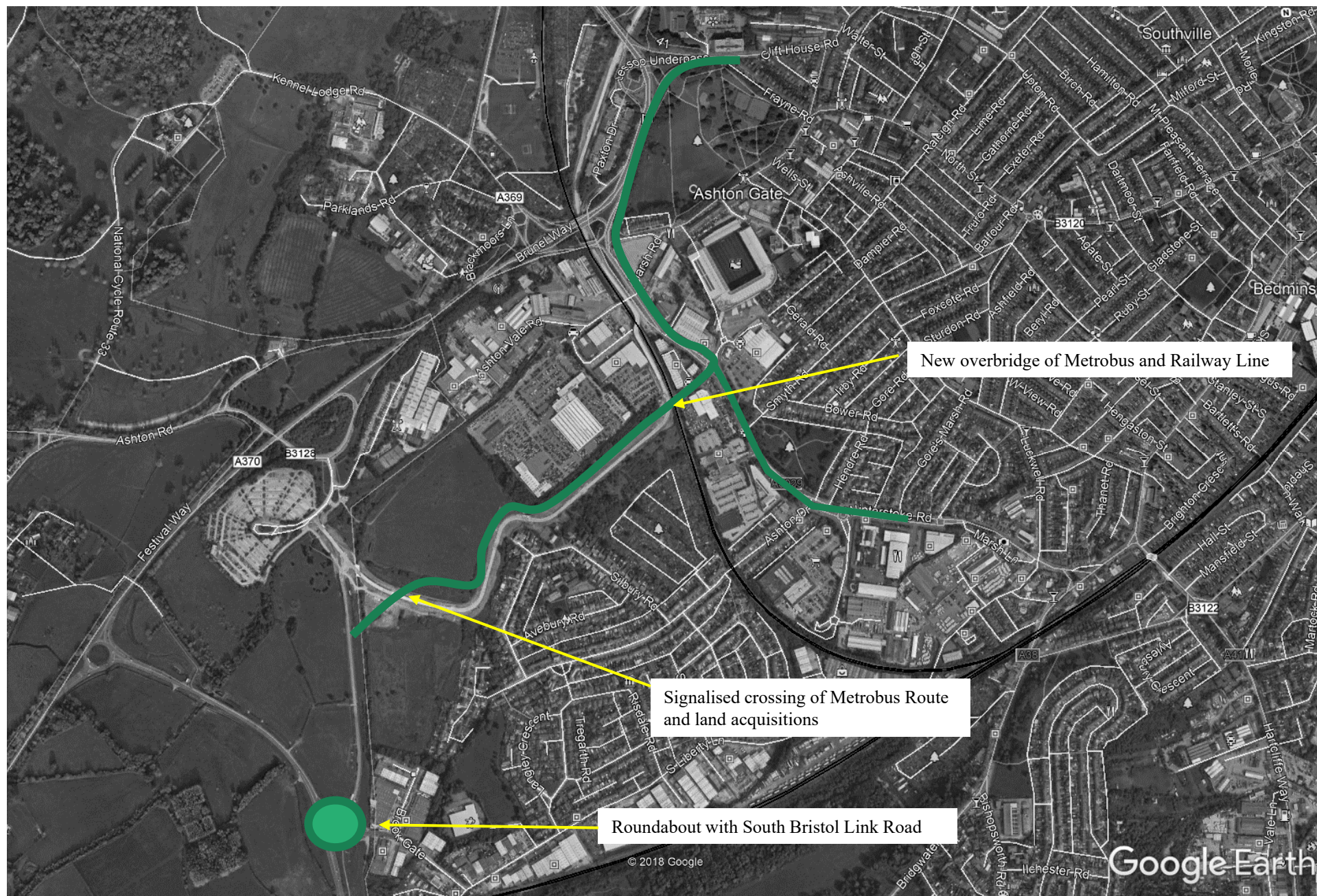


This would reduce the amount of traffic passing through the junction, and the amount of infrastructure required at this location. However, it would require an additional crossing of the Portishead Line, and the acquisition of land at Clanage Road. A connection across the railway line would require sufficient vertical clearance to allow potential overhead electrification and also connect onto a bridge across the Avon.

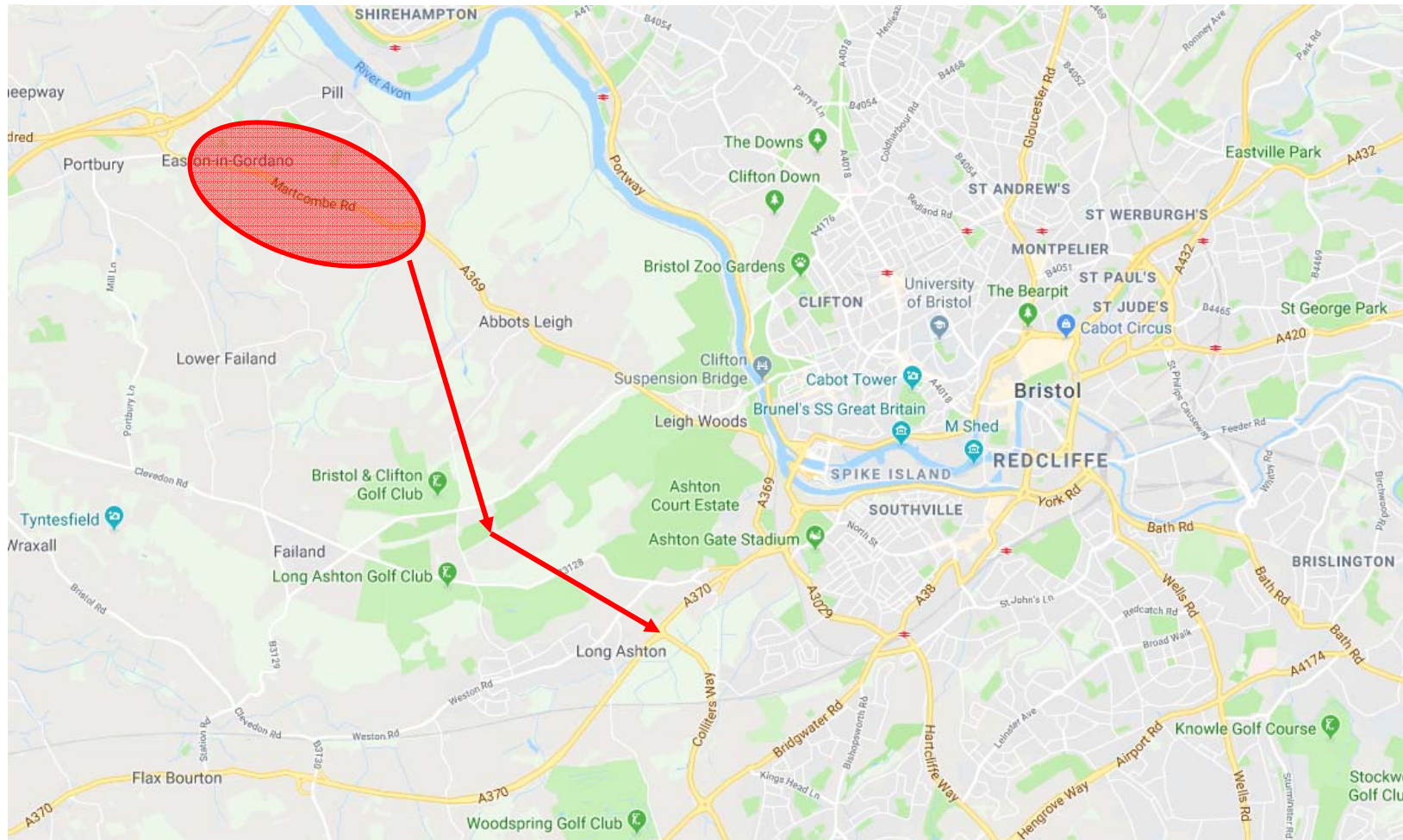
Off-Junction Measure 2: Divert Movement from A370N and A3029 along proposed link, following route of Metrobus.



This would reduce the amount of traffic passing through the junction, and the amount of infrastructure required at this location. However, it would require an additional crossing of the Railway Line, Metrobus Route, the acquisition of land at Longmoor Brook and the construction of an additional new road link. It would also result in significant increases to journey distance and journey time for some movements. Detail provided overleaf.



Off-Junction Measure 3: Improve link from M5 J19 to South Bristol Link Road



This would significantly reduce the amount of traffic passing through the junction, and the amount of infrastructure required at this location. It would also reduce the quantity of strategic traffic using the Portway, and passing through the Western Harbour area.

However, it would require the construction of a new road link which better connects the A369 south of M5J19 and the South Bristol Link Road.

ARUP

Option 2 – Potential Junction Arrangements for A370 / A3029 / A369 /

New Avon Link

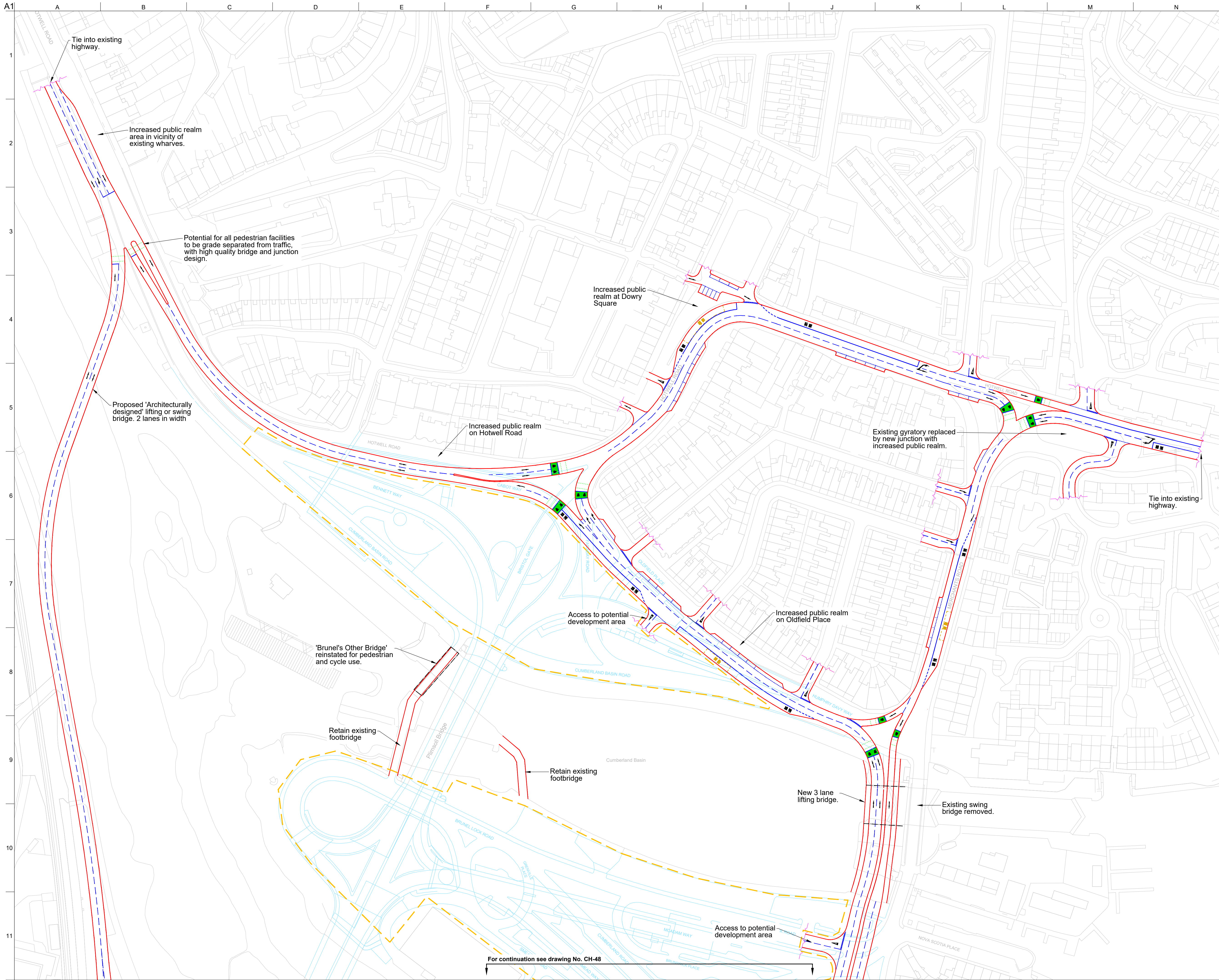
Summary

Options for proposed an all-movements junction at this location are all non-standard, complex, and require a degree of grade separation. Based on a high level comparison, Option B and B1 are preferred as they provide adequate capacity for the land-take they require.

Consideration has also been given to three off-junction improvements which would reduce the amount of movements passing through the junction. Neither option is without challenges, but the connection of the A369 with the New Avon Link appears to be the most feasible.

Appendix L

Option 10 'Hybrid' Outline Highway Layout Drawing



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (101,500 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 10
Sheet 1 of 3**

Scale at A1
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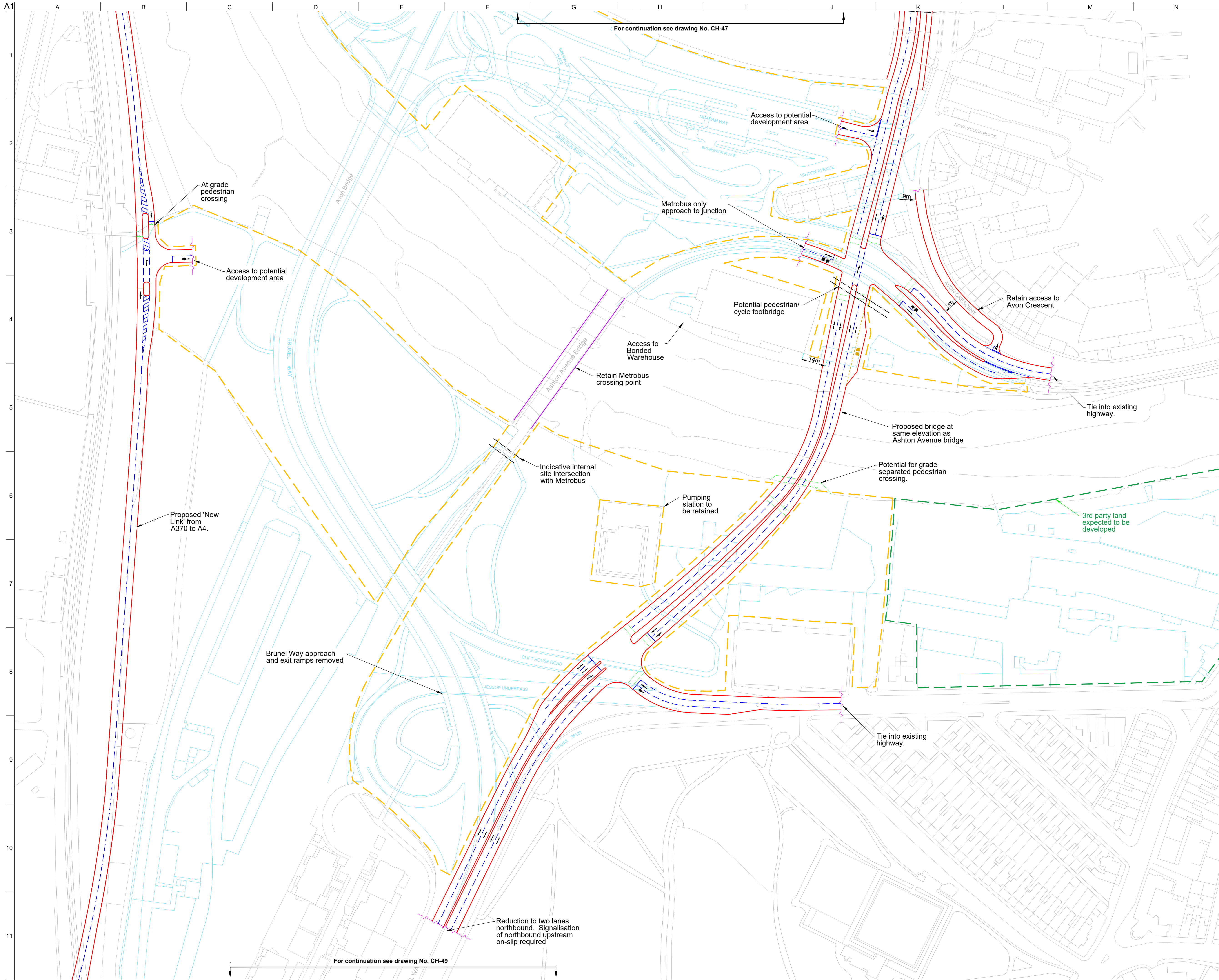
Discipline
Transport Planning

Job No
260233-00

Drawing Status
Information

Drawing No
CH-047

Issue
01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (101,500 m²)

Keyplan

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Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 10
Sheet 2 of 3**

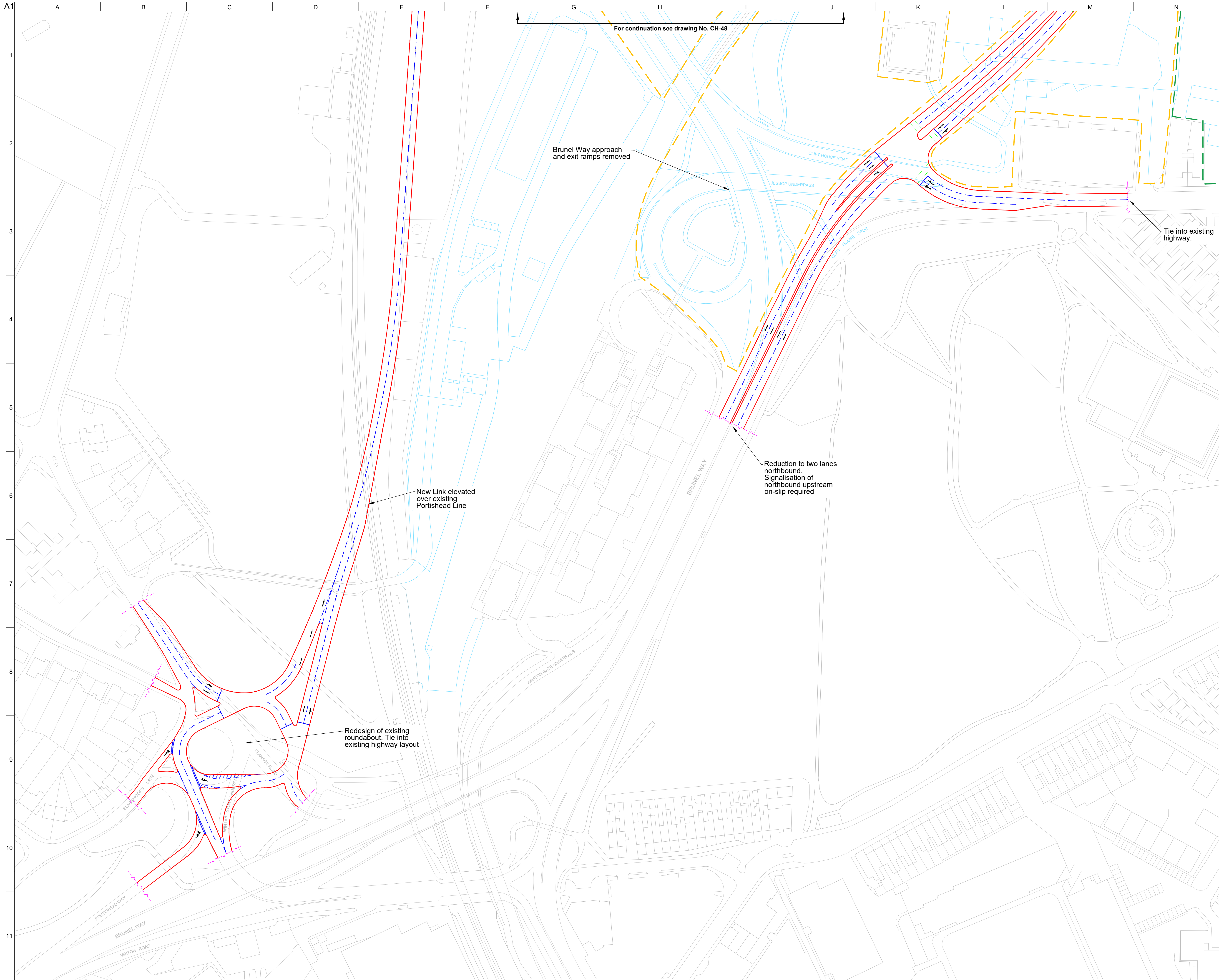
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Discipline
Transport Planning

Job No	Drawing Status
260233-00	Information

Drawing No
CH-048

Issue
01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (101,500 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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**Highway General Arrangement
Option 10
Sheet 3 of 3**

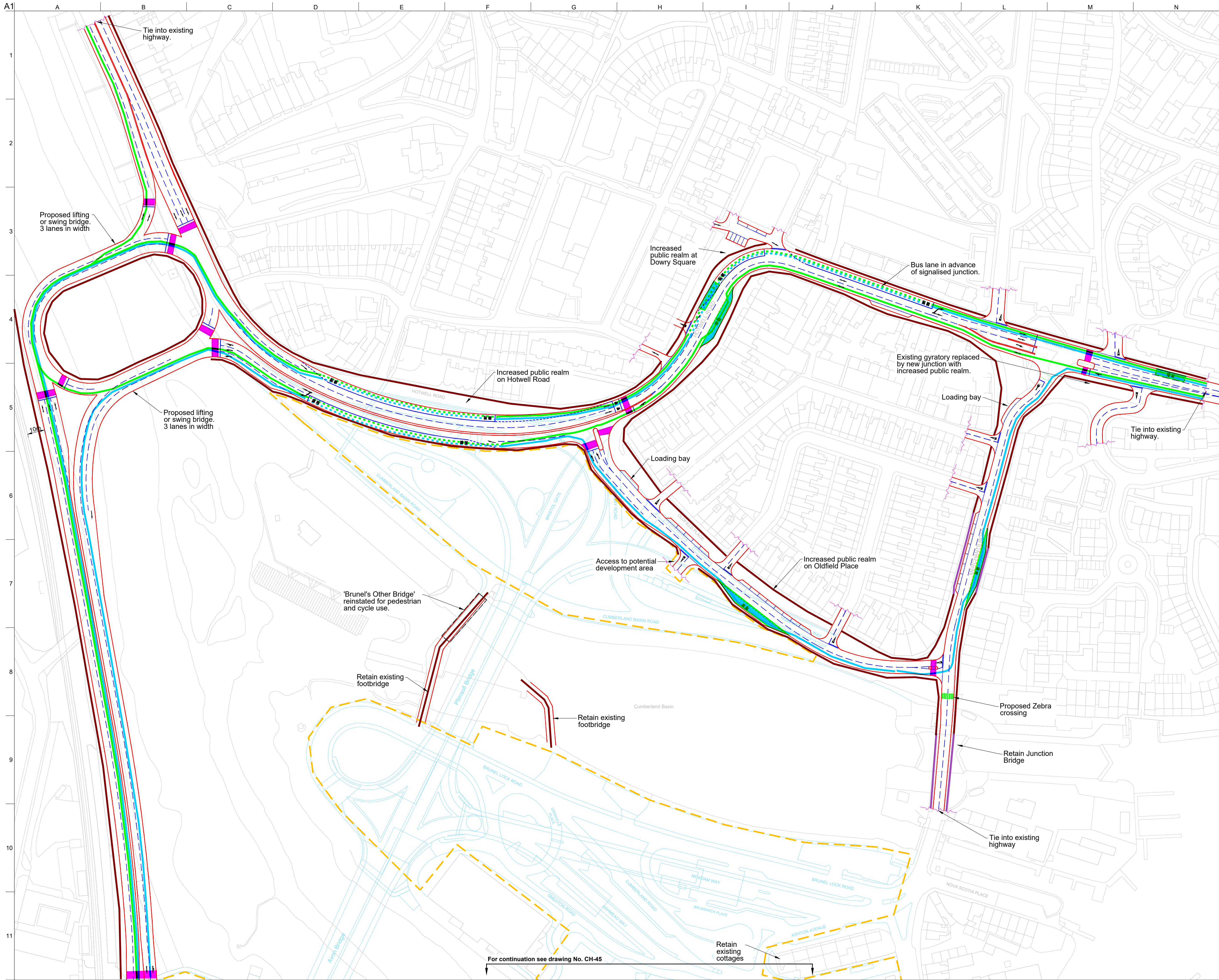
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Discipline **Transport Planning**

Job No 260233-00	Drawing Status Information
Drawing No CH-049	Issue 01

Appendix M

Option 2 Bus and Cycle Provision Plan



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (107,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

- Section in excess of 3m, enabling shared footway / cycleway as a minimum
- Footway section between 2m - 3m
- North Somerset bus services utilising general traffic lanes
- North Somerset bus services utilising bus lanes
- Portway bus services utilising general traffic lanes
- Portway bus services utilising bus lanes
- Bus stop
- Signalised pedestrian and cycle crossing

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**Highway General Arrangement
Option 2
Sheet 1 of 3**

Scale at A1
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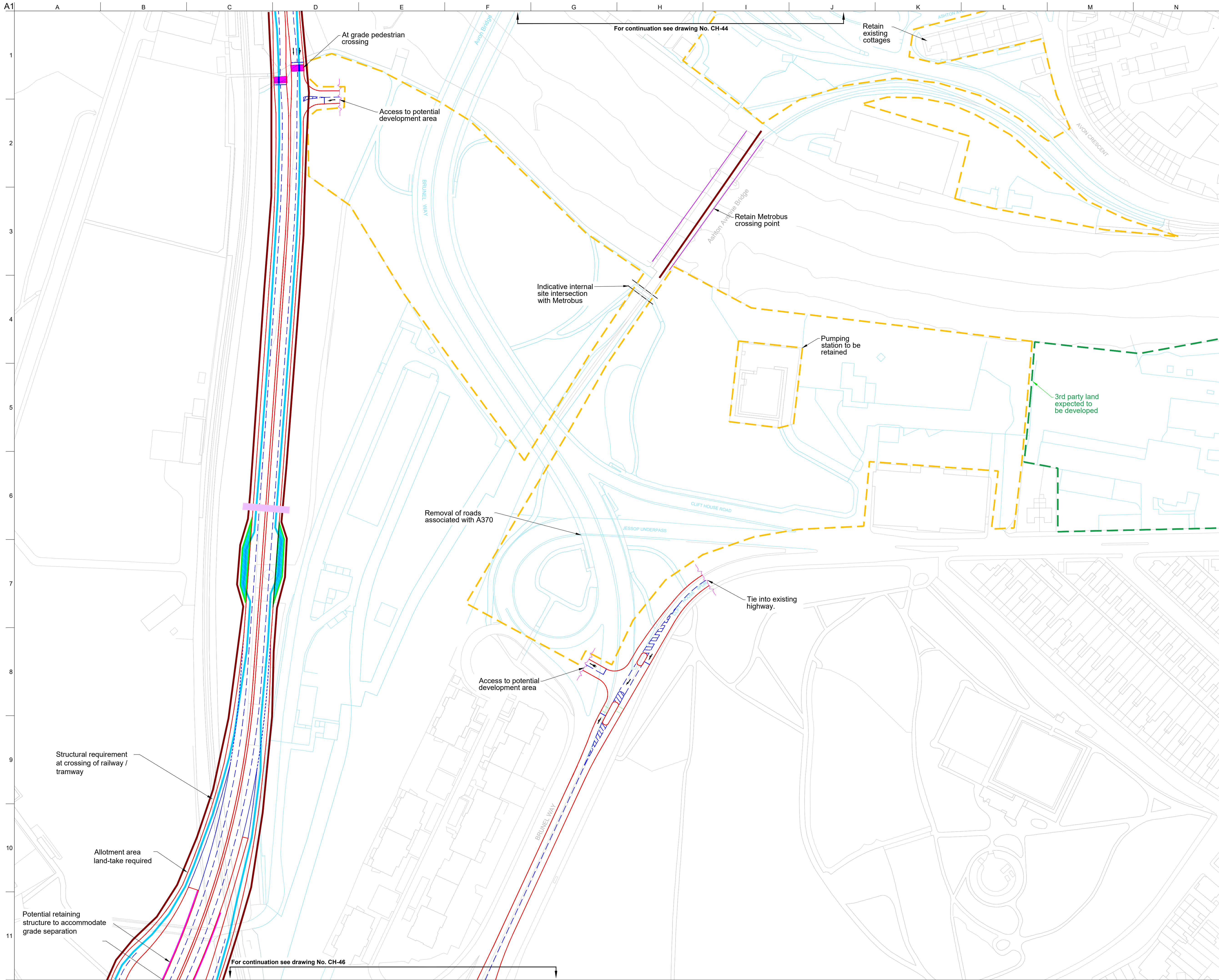
Discipline
Transport Planning

Job No
260233-00

Drawing No
CH-044

Drawing Status
Information

Issue
01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (107,000 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

- Section in excess of 3m, enabling shared footway / cycleway as a minimum
- North Somerset bus services utilising general traffic lanes
- Bus stop
- Signalised pedestrian and cycle crossing
- Grade separated pedestrian and cycle crossing

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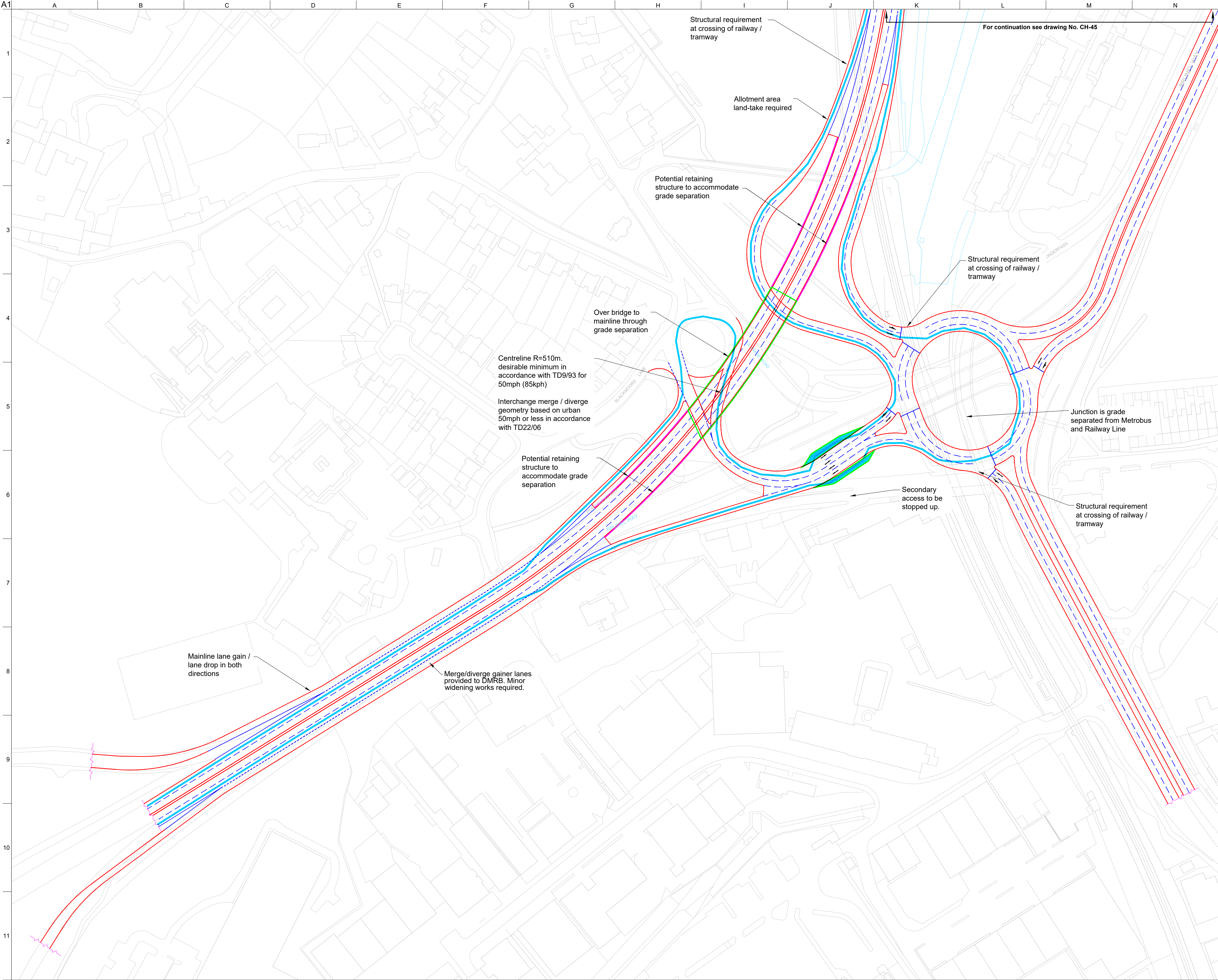
Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 2
Sheet 2 of 3**

Scale at A1 1:1000

Discipline **Transport Planning**

Job No 260233-00	Drawing Status Information
Drawing No CH-045	Issue 01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (99,000 m²)

Keyplan

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North Somerset bus services utilising general traffic lanes

Bus stop

N.B. Plan does not include buses, cycle and pedestrian routes through potential development sites, or walk and cycle routes parallel to the carriageways.

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Drawing Title
**Bus routes
Option 2
Sheet 3 of 3**

Scale at A1
1:1000

Discipline
Transport Planning

Job No
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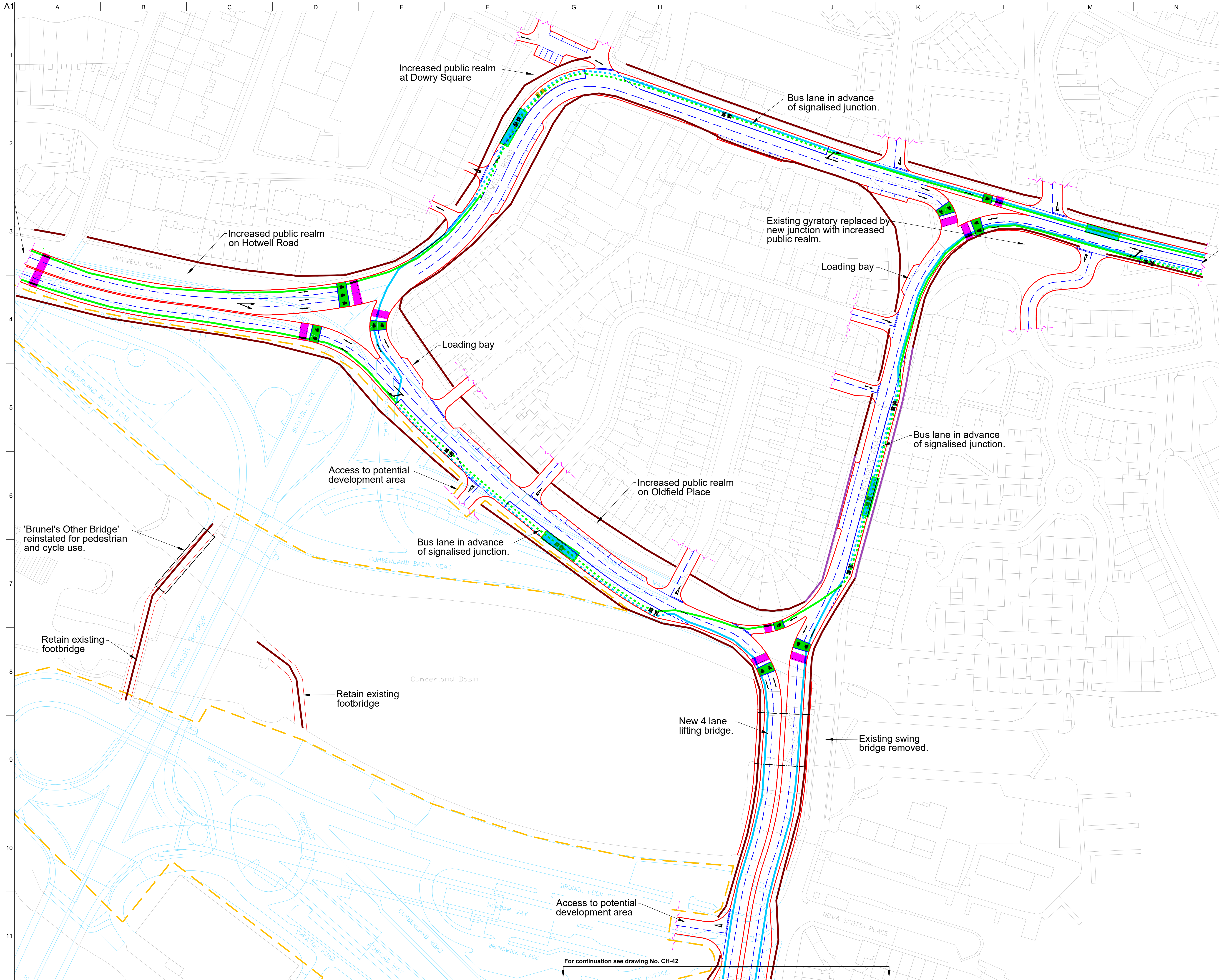
Drawing No
CH-046

Drawing Status
Information

Issue
01

Appendix N

Option 8 Bus and Cycle Provision Plan



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (95,500 m²)

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Note: Footways and off road cycleways not shown.

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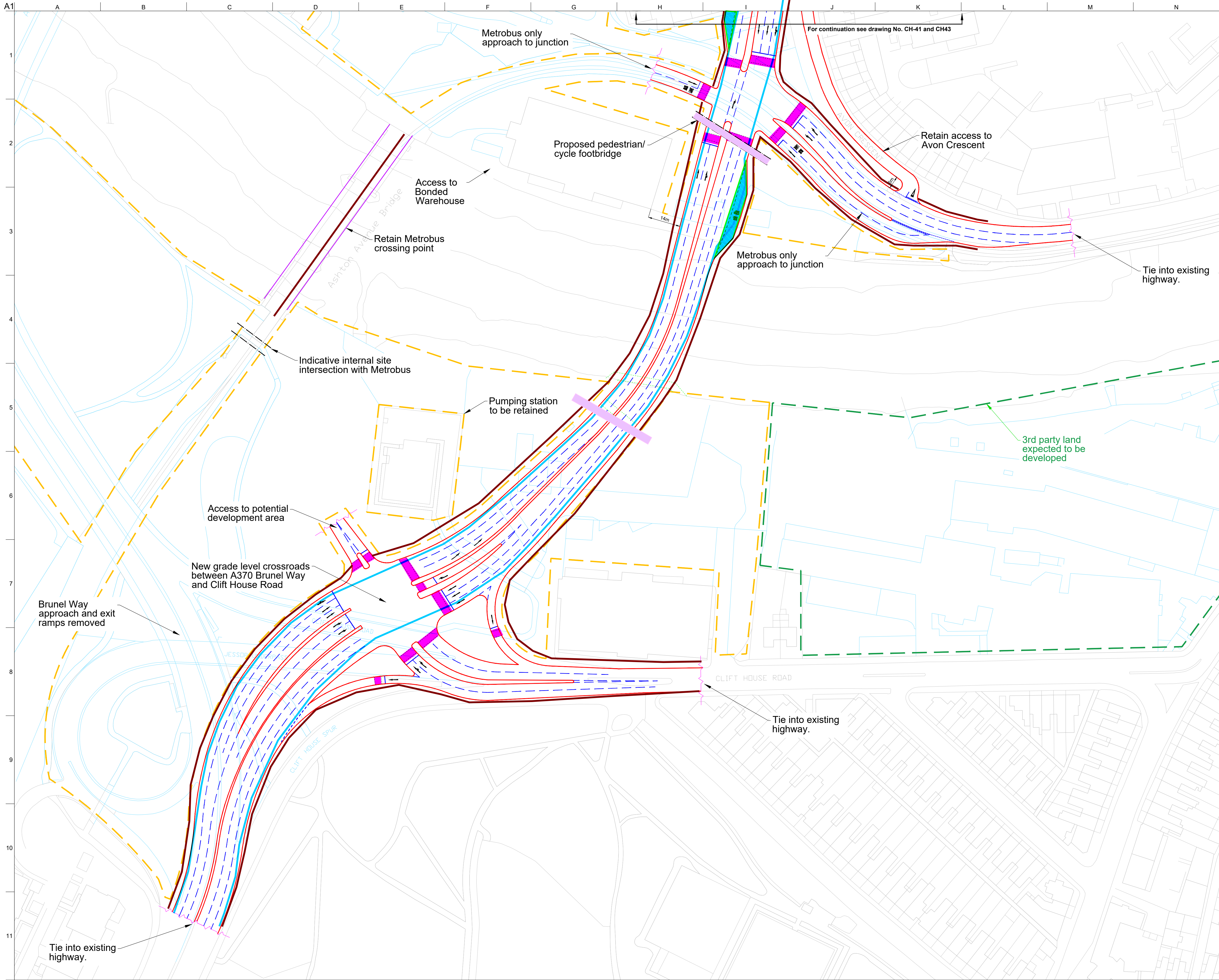
Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 8
Sheet 1 of 2**

Scale at A1 1:750

Discipline **Transport Planning**

Job No 260233-00	Drawing Status Information
Drawing No CH-041	Issue 01



Legend:

- Proposed Roads
- Removed Highway Infrastructure
- Released Land (95,500 m²)

Keyplan

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Note: Footways and off road cycleways not shown.

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Job Title
Western Harbour Feasibility Study

Drawing Title
**Highway General Arrangement
Option 8
Sheet 2 of 2**

Scale at A1	1:750
Discipline	Transport Planning
Job No	Drawing Status
260233-00	Information
Drawing No	Issue
CH-042	01

Appendix O

Examples of Moving Bridges

Examples of Moving Bridges

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Scale Lane Bridge, Hull,



Prins Clausburg, Dordrecht



Palace Bridge, St Petersburg



Pont Jacques Chaban-Delmas, Bordeaux



Twin Sales Bridge, Poole