APPENDIX MA1 – REFERENCE DOCUMENTS

DEPARTMENT FOR TRANSPORT

DfT Circular 01/2008
Department for Transport
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POLICY ON SERVICE AREAS AND OTHER ROADSIDE FACILITIES ON MOTORWAYS AND ALL-PURPOSE TRUNK ROADS IN ENGLAND

INTRODUCTION

1. Circular 01/2008 sets out policy on the provision, standards and signing of roadside facilities on the Strategic Road Network (SRN), including motorway service areas (MSAs), motorway rest areas (MRAs), truckstops, and services and lay-bys on all-purpose trunk roads (APTRs). It also sets out the role of the Highways Agency in relation to such facilities. This supersedes previous guidance contained in Roads Circular 01/94, the MSA Policy Statement of 1998, and Annex J to Circular Roads 04/94 (in respect of the SRN).

2. The provisions described in this policy would all have effect in England only.

3. This policy applies in respect of all signed roadside facilities on the SRN that do not have a planning application registered with the relevant Local Planning Authority (LPA) prior to 2 April 2008. The policy will also apply to the redevelopment of existing roadside facilities that do not have a planning application registered with the LPA prior to this date, when the gross floor area of a facility increases by 50 per cent or more.

4. Additionally, the relevant section of this policy will apply when any specific element of an existing facility is redeveloped, such as parking or toilets.

5. However, it is recognised that constraints on land availability at some existing sites may mean that it is not possible to meet all of the requirements of the policy when redevelopment of the whole site or a given element takes place. In such circumstances, compliance will become a subject of negotiation with the Highways Agency.

6. MSAs and other roadside facilities perform an important road safety function by providing opportunities for the travelling public to stop and take a break in the course of their journey. Government advice is that motorists should stop and take a break of at least 20 minutes every two hours. Drivers of heavy goods vehicles (HGVs) are subject to a regime of statutory breaks, and such facilities offer the opportunity for this.

7. The Government's objective is to encourage greater choice in the provision of service facilities for all road users, thereby encouraging drivers to take breaks more frequently and so reducing the number of fatigue-related accidents. The Government aims to work with the private sector to increase public satisfaction with roadside facilities in terms of their quality and value for money.

8. Operators of both new and existing roadside facilities in England are required to ensure that their sites are fully accessible to all members of the travelling public regardless of ability, race, gender, faith, age or sexual orientation. MSAs and other roadside facilities are required to comply with all existing and future equality legislation.

9. New and existing roadside facilities are subject to the provisions of the Town and Country Planning Act 1990 and the Planning and Compulsory Purchase Act 2004, which together set the framework under which local planning authorities are to consider applications for such developments. The Secretary of State for Transport is designated as a statutory consultee, and the Highways Agency exercises this function on his or her behalf, giving advice on applications in respect of road safety and traffic

management issues. Power to grant access from the highways to all roadside facilities is given under Section 62 of the Highways Act 1980. The provision of traffic signs for service areas is governed by the Road Traffic Regulation Act 1984.

10. Until 1992, the Department for Transport was responsible for developing MSAs: acquiring land, funding construction and leasing the completed sites to operating companies. Since 1992, government policy has been that the private sector should take the initiative in identifying and acquiring MSA sites and seeking planning consent from local planning authorities. When completed, these MSAs are owned by the private sector rather than the Government. The Government, through the Highways Agency, continues to have an interest in these (new and existing) privately owned sites, in relation to motorway safety and traffic management.

11. Operators of both new and existing MSAs, whether leased from the Government or privately owned, must comply with the requirements of government policy. These provisions are reflected in the Traffic Signs Agreements into which they enter with the Highways Agency. If they do not observe these conditions, action can be taken which could ultimately lead to the closure of sites. However, operators have responsibility for all other operational matters at MSAs, including pricing and staffing levels.

12. The development of roadside facilities on APTRs has traditionally been led by the private sector, with the Highways Agency providing advice on road safety and traffic management issues.

DESTINATION IN ITS OWN RIGHT

13. MSAs, MRAs, all-purpose trunk road service areas (TRSAs) and on-line truckstops should only provide facilities needed to serve people using the SRN in the course of a journey.

14. The primary function of the SRN is to facilitate long-distance transportation of people and goods. Service areas are signed from the SRN on the basis that they will provide essential services to road users. The potential risk to safety that is created by additional accesses and egresses is balanced by the improvement to safety resulting from refreshed and alert drivers.

15. Government policy is to discourage service areas and other roadside facilities from becoming destinations in their own right. A destination in its own right would be created if drivers were attracted onto the SRN solely to visit the service area. This is likely to involve short, local trips onto the SRN which would not otherwise be taken and might therefore interfere with the safety and flow of long-distance traffic.

16. Allowing a service area to become a destination in its own right can have a negative impact on road safety. Firstly, traffic on the road would increase and junctions would become more congested (and therefore potentially more dangerous). Secondly, increased patronage by local customers might place pressure on capacity at service areas, which could discourage drivers from stopping there to take a break during a long journey.

17. Furthermore, to permit a service area, or similar site, to become a destination for local customers would be contrary to government planning policy on retail and town centres as set out in *Planning Policy Statement 6: Planning for Town Centres*.[1] The consequence of this would be to threaten the viability of businesses in cities, towns or other local centres.

18. For these reasons it is important that the Highways Agency is consulted on any proposal affecting an existing or proposed service area.

IMPACT ASSESSMENT

19. If operators wish to make changes to their sites, they should first seek confirmation from the Highways Agency's Spatial Planning Team (or any successor) that their proposals conform to standards laid down in this circular as well as DfT Circular 02/2007 *Planning and the Strategic Road Network*.[2]

20. To safeguard the interests of all users of the SRN, operators of existing MSAs, MRAs and TRSAs and promoters of new MSAs, MRAs and TRSAs will be required to carry out Impact Assessments in respect of any proposed activity that is not specifically permitted under this policy or in respect of a permitted activity on a scale greater than that allowed for by this policy. Impact Assessments will enable the operator/promoter to detail how an activity will impact upon the SRN and service-area customers. This will allow the Highways Agency to give full consideration to proposed activities and their potential impact on the delivery of policy objectives. This mechanism cannot be applied in respect of activities prohibited by this policy.

21. Impact Assessments will enable the Highways Agency to make informed, evidence-based decisions on the impact these activities will have at facilities on the SRN.

22. Early consultation with the Highways Agency to discuss the scope of the Impact Assessments is encouraged. However, operators will still need to ensure that their proposal is fully compliant with national planning policy and equality legislation and seek planning approval in the normal manner.

23. The Impact Assessment will be evidence-based and its scope should first be agreed with the Highways Agency. As a minimum, operators will be expected to provide:

- a detailed explanation of what is proposed;
- a scale plan showing where the proposed facility will be located and its size;
- an account showing how current activities at the service area will be affected by the proposal (for example, the impact on parking spaces of a coach interchange);
- an assessment to demonstrate that the proposal would not result in the facility becoming a 'destination in its own right';

1 Planning Policy Statement 6 'Planning for Town Centres', can be found online at www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement11
2 www.dft.gov.uk/pgr/regional/strategy/policy/circular207planningandstrategic

- a breakdown of current and forecast customer numbers;
- a breakdown of any proposed enhancement of facilities (e.g. number of toilets, amount of indoor seating provided);
- details of the anticipated benefits that the activity will provide to the service area user;
- details of any potential adverse impact on normal use of the service area;
- details of measures to mitigate any adverse impacts;
- details of the monitoring proposed to ensure that the impact of the development is consistent with the Impact Assessment.

24. Operators/promoters will be required to demonstrate that their proposal does not have a potential to generate new vehicle trips on the SRN or, if new trips will be generated, how overall vehicle mileage will be reduced. They must also be able to show that the activity will cause no detriment to the safety or convenience of road users or those wishing to use the essential facilities.

25. If any of the above could occur, the operators will be required to demonstrate how the undesirable effects will be mitigated to the Highways Agency's satisfaction.

26. Proposals that provide overall benefits and otherwise meet with the Highways Agency's approval will be allowed, subject to a licensing regime agreed between the Highways Agency and the operator.

27. This approach cannot be used to attempt to justify activities that are prohibited under this policy.

DETERMINING THE NEED FOR ROADSIDE FACILITIES ON THE STRATEGIC ROAD NETWORK

28. DfT Circular 02/2007 *Planning and the Strategic Road Network*[3] endorses the Highways Agency's role as a consultee in the planning system. Any roadside facility proposal will need to comply with the policy set out in that Circular. The Highways Agency will provide input to local development frameworks (LDFs), assisting LPAs to consider whether there is sufficient provision of roadside facilities on the SRN by taking account of traffic flows and the need for motorists to stop and take a break at regular intervals. Developers can expect that proposals which are in accordance with the LDF will, in most cases, be granted approval, unless material considerations indicate otherwise.

29. As a statutory consultee to LDFs, the Highways Agency will provide advice to LPAs on a range of issues, including the need for the provision of additional roadside facilities. The Highways Agency will also, when asked, provide input on the need for new roadside facilities to assist in the review of Regional Spatial Strategies.

3 www.dft.gov.uk/pgr/regional/strategy/policy/circular207planningandstrategic

30. In assessing any application for a new roadside facility, the Highways Agency will consider the impact of development on the SRN alongside the needs of road users. The Highways Agency will need to be satisfied that the access and egress to the roadside facility can be provided safely, that it conforms to Departmental standards and that it will not have a materially adverse effect on the capacity or performance of the SRN, in addition to considering the potential road safety benefit of a service area in reducing driver fatigue.

31. The Highways Agency will continue to assess the impact of any roadside facility proposal on traffic flow and safety. It may oppose particular developments when the location is considered unsuitable, where, for instance, there are existing capacity or infrastructure constraints. Roadside facility proposals must also be weighed against the achievement of other policy objectives for the SRN. However, the LPA will continue to determine the planning merits of any proposal.

ACCESS TO THE STRATEGIC ROAD NETWORK

32. As outlined in DfT Circular 02/2007, there is a general presumption against additional accesses to the motorway and other routes of strategic national importance other than for '*service areas, facilities for the travelling public, maintenance compounds and, exceptionally, other major transport interchanges*'.

33. Therefore, the Highways Agency will not agree to the provision of accesses to the SRN from private developments for the purpose of service provision other than for facilities that meet the standard range of minimum requirements set out in this circular, nor will it permit the development of activities at service area sites which are unconnected with the immediate needs of the travelling public and which would therefore lead to the site becoming a destination in its own right.

34. LPAs and developers are encouraged to discuss with the Highways Agency at the earliest opportunity any proposals to develop new roadside facilities to extend existing facilities or to sign existing facilities. The Highways Agency is particularly interested in facilities located wholly or partly within 400 metres of the motorway boundary, or developments exceeding 2 hectares in area that include the provision of fuel and refreshments and are situated within 1 kilometre of a motorway junction.

CHANGE OF USE OF REDUNDANT ROADSIDE FACILITIES

35. The Agency will oppose any change in permitted land use in respect of any roadside facility with direct access to the SRN if it ceases to operate. If any alternative use were to be allowed other than one that serves the immediate needs of the travelling public, there is a risk that additional, unnecessary trips might be generated on the network. Through its role in the planning system, the Highways Agency will seek to restrict alternative developments.

36. To prevent sites becoming derelict, the Highways Agency will seek the imposition of planning conditions that require sites to be landscaped, returned to agricultural use or otherwise rendered compatible with the surrounding landscape. All accesses to the SRN will be removed and the former highway boundary restored.

REAR ACCESS/ACCESS TO OTHER DEVELOPMENTS

37. Under normal circumstances, rear access roads connecting a roadside facility to the local road network will not be acceptable. Where, exceptionally, an access is agreed, the Highways Agency will expect developers to enter into arrangements to ensure its use is restricted to staff, deliveries, emergency services and agents and staff of the Highways Agency acting on behalf of the Secretary of State for Transport. If a connection to the local road network is needed to facilitate deliveries and staff access, the associated service yard and parking area normally should be physically segregated from the main MSA parking areas and circulatory roads by the provision of a permanent vehicular barrier.

38. Access to other developments through roadside facilities is not permitted.

39. All sites should be provided with a secure boundary fence to prevent unauthorised access by pedestrians and/or vehicles from adjacent roads and/or land.

DESIGN STANDARDS

40. In considering issues affecting the SRN, traffic flow and safety considerations are of great importance. Any access provided direct to the SRN would need to conform fully to the *Design Manual for Roads and Bridges* (DMRB) and any other relevant Departmental standard. At all roadside facilities, it will be particularly important to avoid significant adverse impacts upon the effective functioning of the SRN, such as the risk of congestion or slowing on the main carriageway. Proposals for new roadside facilities should not unduly conflict with meeting the objective of improving road performance through better network management. Advice on these aspects should be sought from the relevant regional office of the Highways Agency.[4]

41. The Government believes that good design should be the aim of all those involved in the development process. Those promoting service-area schemes will therefore be expected to demonstrate that they have taken account of the need for high standards of design in formulating their proposals.

42. In design terms, roadside facilities schemes should:

- respond sensitively to both the site and its setting, including the existing landscape and other physical features, and take account of the purposes of any designation that may cover the site or the surrounding area; create character and identity within the site by the careful design of spaces and buildings and the relationship between them; and minimise the visual impact of the development on its surroundings;

- incorporate vehicle accesses and means of circulation that are safe, clear to motorists and minimise vehicle congestion: with this in mind, developers will be required to apply the relevant Departmental standards when designing service area accesses and internal layouts; to submit the resulting proposals for processing through the formal road safety audit procedures set out in the DMRB;

4 Relevant contact details may be found at www.highways.gov.uk

- ensure that all traffic signing (including road markings) for drivers using the site complies with the Traffic Signs Regulations and General Directions 2002 (TSRGD);

- be able to show that the proposal will cause no detriment to the safety or convenience of road users or those wishing to use the facility;

- achieve building designs that take account of the needs of all users,

- incorporate buildings that are safe, environmentally friendly and energy efficient so as to maximise sustainability and minimise environmental damage and waste;

- ensure the sensitive design and siting of lighting schemes with the aim of minimising light pollution and light-spill onto adjacent roads, whilst ensuring that public areas are well lit;

- in preparing the design for their lorry parking facilities, operators should give due consideration to the need for security, ensuring that there is adequate lighting and taking account of lines of sight from occupied buildings.

43. Future customer demand/capacity should be an early consideration within the design process.

44. Under normal circumstances, a bridge or underpass connecting facilities on opposite sides of a motorway or trunk road will not be permitted.

45. The internal layout of new service areas and proposed amendments to existing layouts must be subjected to a full Road Safety Audit carried out in accordance with the DMRB.

46. The access/egress arrangements for new and redeveloped roadside facilities must accommodate all types of vehicle permitted to enter the site, including abnormal loads (see paragraphs 86 to 88 below).

FUNDING OF WORKS

47. The full cost of any works within the motorway or trunk road boundary (including traffic management), will be met by the developer by means of an agreement with the Secretary of State under Section 278 of the Highways Act 1980.[5]

STANDARDS OF FACILITIES

48. Roadside facility operators should endeavour to provide high-quality facilities at all times. This will instil confidence in road users that, when they stop at a facility, their essential needs will be met. It is in the interests of operators to encourage drivers to use their facilities for as long as they require to rest. By ensuring consistently high standards of hygiene, service, catering, seating and other facilities, operators are likely to increase both customer numbers and lengths of stay. The consequence will be better-rested and more-alert drivers, and this is likely to have a positive impact on road safety.

5 Guidance on S278 Agreements can be found at www.dft.gov.uk/pgr/regional/strategy/policy/guidancesection278highwaysact

49. Roadside facilities can provide an important first impression for visitors to England. Thus it is vital that facilities can offer all road users a clean, safe and welcoming environment in which to rest during the course of their journey.

50. Improved standards at MSAs and MRAs will be promoted through the mechanism of an independent quality award scheme based on a cyclic inspection regime. Participation is voluntary, but the operators are encouraged to take part and assist in defining the framework for the system. However, it is expected that the scheme will include access and other equality issues as a consistent factor.

51. Advice on equality issues should be sought from national access and equality groups. Quality awards based on the outcome of the inspections should be displayed prominently within the amenity building; one 'star' will be the lowest rating possible, as it is necessary to distinguish participating and non-participating sites. Results may also be displayed on sign 2917 of the Traffic Signs Regulations and General Directions (TSRGD) (see Annex A).

SPACING OF ROADSIDE FACILITIES ON MOTORWAYS

52. Policy on the spacing of roadside facilities on motorways needs to balance the road safety benefit of allowing drivers regular access to services with the potential detriment to safety, traffic flow and the environment of development alongside motorways and at motorway junctions.

53. Drivers are encouraged to stop and take a break of at least 20 minutes every two hours. Drivers of HGVs are required by drivers' hours' legislation to take a break at specified intervals. Research has shown that up to 20 per cent of accidents on monotonous roads (especially motorways) are caused by tiredness. However, roadside facilities introduce new on- and off-motorway movements that have their own safety implications, and may disrupt the free flow of traffic.

54. There is also a need to limit development alongside motorways and motorway junctions to mitigate the impact of strategic roads on the environment. This applies particularly, though not exclusively, to open countryside and areas of planning restraint such as National Parks, Areas of Outstanding National Beauty (AONBs), the Green Belt and sites that either are themselves, or may affect, Sites of Special Scientific Interest (SSSIs). Finally, any development accessed from a motorway (including roadside facilities) risks the creation of additional local journeys that would not previously have been made.

55. The existing network of MSAs has evolved around a long-standing spacing criterion of 30 miles. This was based on the premise that drivers should be given the opportunity to stop at intervals of approximately half an hour. However, at peak hours, on congested parts of the network, travel between MSAs can take longer than 30 minutes. Further, 90 km/h (56 mph) speed limiters for HGVs limit the distance they can travel in 30 minutes to a maximum of 28 miles (45 km). Any new application for a core MSA should therefore be considered on the basis of a 28 mile (45 km) distance, or 30 minutes' travelling time,[6] from the previous core MSA, whichever is the lesser.

6 Median average inter-peak travelling time.

56. The absolute minimum acceptable distance between facilities on the same route is 12 miles.

57. All existing MSAs, and new facilities that have been registered in the planning systems prior to the date of publication of this document (which subsequently receive planning consent) and any future sites that fill existing gaps in the core network must provide the required features of a site having that status.

58. Where a clear and compelling need and safety case can be demonstrated, applications for an infill service area may be considered. Individual cases will need to be treated on their merits, and it is not possible to prescribe a comprehensive list of the factors which it might be appropriate to consider in every case. There are, nevertheless, a number that are likely to be of importance in virtually all cases. Planning authorities therefore will be expected to have considered at least:

- the distance to adjoining roadside facilities;
- evidence (such as queuing on the roadside facility approach roads or lack of parking spaces at times of peak demand) that nearby existing roadside facilities are unable to cope with the need for services;
- evidence of a genuine safety-related need for the proposed facilities (such as, for example, a higher than normal incidence of accidents attributable to driver fatigue);
- whether the roadside facility is justified by the type and nature of the traffic using the road; the need for services may, for example, be lower on motorways used by high percentages of short-distance or commuter traffic than on those carrying large volumes of long-distance movements.

59. Where infill sites are proposed, the Government's preference will be that they should be located roughly halfway between MSAs, unless it can be shown that an off-centre location is more suitable in either operational, safety or spatial planning terms or in its ability to meet a particular and significant need. The Government will not agree to more than one infill site between any two core MSAs. Where the spacing between two existing MSAs is 40 miles or greater, any infill site that might be permitted will also be designated as a Core site and must provide the required range of facilities (see paragraphs 67 to 71 below).

60. Where the spacing between existing Core sites is less than 40 miles, any infill site that might be permitted may take the form of a Rest Area.

61. Rest Areas will provide some though not necessarily all of the range of facilities of a Core MSA.

PICNIC AREAS AT MSAS AND MRAS

62. Picnic areas are attractive to many drivers who would like to stop and take a break without leaving the motorway but who prefer to bring their own food rather than purchase it. All new MSAs and MRAs are required to provide picnic areas.

63. Operators of existing core MSAs are encouraged to invest in picnic areas at their own sites. The availability of a picnic area will increase the likelihood that drivers will stop and take a break at the MSA.

64. Provided the criteria set out in paragraphs 65 and 66 are met, MSA operators may indicate the availability of their picnic area to motorway users by the addition of a 'picnic area' symbol to diagram 2919.1 of the TSRGD (normally situated half a mile before the MSA).

65. The picnic area must be equipped with a minimum of ten tables, each with seating for six. Properly covered rubbish bins must also be provided within picnic areas. These are to be regularly emptied to avoid any spillage. Operators are encouraged to provide cover for the picnic area when possible.

66. The picnic areas provided at MSAs and MRAs should be laid out in an attractive setting. If the picnic area is segregated from the amenity building and the main car park by a circulatory carriageway, dedicated parking for motorcycles, cars and caravans/motorhomes as well as toilet facilities shall be provided at 0.1 of the figures set out at Annex B (rounded up) so as to avoid the need for pedestrians to cross the traffic flow.

67. The Highways Agency will work with the operators to increase the quality and availability of picnic area facilities at existing sites.

MANDATORY FEATURES OF AND LEVELS OF PROVISION FOR ROADSIDE FACILITIES ON MOTORWAYS

Requirements for motorway service areas

68. All MSAs (including the network of Core sites defined at paragraph 57 above) must provide as a minimum the following facilities for 24 hours a day, 365 days a year:

- free parking for up to two hours for all types of vehicle (see Annex B);
- free toilets and hand-washing facilities for all road users, with no obligation to make a purchase (see Annex C);
- parent/carer and child facilities containing baby-changing amenities;
- access to a signed, free, private breastfeeding area;
- a free picnic area (meeting the criteria set out at paragraphs 65 and 66 above);
- access to a cash-operated telephone (card phones alone will not suffice);
- fuel;
- snacks and hot drinks;

- free play area for children;
- the site must also comply with all current and future equality legislation.

69. There must also be hot substantial food and hot drinks available between the hours of 6 am and 10 pm.

70. Under the Licensing Act 2003, any premises that provide late-night refreshment (i.e. hot food and drink) between 11.00 pm and 5.00 am for sale to the public require appropriate permission from the local licensing authority.

71. Access must be permitted for up to two hours for those carrying out emergency repairs to broken-down vehicles.

72. Access must be permitted for parties carrying out duties for and on behalf of the Secretary of State for Transport.

Requirements for motorway rest areas

73. A facility designated as a Rest Area must be open for 24 hours a day, 365 days a year and provide the following facilities:

- free parking for up to two hours for all types of vehicle at half the level required for MSAs (see Annex B);
- free toilets and hand-washing facilities for all road users, with no obligation to make a purchase (see Annex B);
- parent/carer and child facilities containing baby-changing amenities;
- access to a signed, free, private breastfeeding area;
- access to a cash-operated telephone (card phones alone will not suffice);
- a free picnic area (meeting the criteria set out at paragraphs 64 and 65 above);
- free play area for children;
- the site must also comply with all current and future equality legislation.

74. Access must be permitted for up to two hours for those carrying out emergency repairs to broken down vehicles.

75. Other facilities provided would be at the discretion of the operator, but in every case these must be in full compliance with the other requirements of this policy.

76. Access must be provided for parties carrying out duties for and on behalf of the Secretary of State for Transport.

LEVELS OF PROVISION AT ROADSIDE FACILITIES ON MOTORWAYS

Parking general requirements

77. MSAs, and MRAs must provide free short-term parking for all classes of vehicle. Annex B sets out the method for calculating how many parking spaces must be provided for certain classes of vehicle and users at MSAs and MRAs.

78. The operator/designer of the MSA or MRA should reach agreement with the Highways Agency on the most appropriate method of controlling traffic and the layout of parking areas within the site (see 'Design Standards').

Parking for disabled travellers

79. Parking bays for disabled users of all types of vehicle should be located in close proximity to the main entrance of the amenity building. The number of bays dedicated for use by disabled travellers is set out in Annex B.

Facilities for motorcyclists

80. Operators should provide dedicated signed parking spaces for motorcyclists, enabling the rider to secure the bike to a sound structure. They should be located close to the amenity block for security reasons. A number of free lockers should be provided for storage of helmets and clothing, so that riders may rest comfortably. However, a deposit charge may be levied to ensure the return of keys.

Parking for caravans, motorhomes and other light vehicles towing trailers

81. Parking for caravans/motorhomes and other light vehicles towing trailers should not be located within the HGV parking area. A safe walking route from the parking area to the amenity building should be provided. Further, the parking area should not be situated such that manoeuvres cause a safety issue for other customers (see paragraphs 45 and 46). Parking bays should be laid out in a drive-through pattern so that caravan, motorhome and light vehicle trailer towing drivers are not required to reverse to exit.

82. A minimum of two parking bays suitable for caravans/motorhomes and other light vehicles towing trailers should be situated close to the amenity building for the convenience of disabled users of such vehicles (see Annex B).

83. Operators may provide overnight parking facilities for caravans and motorhomes. Facilities for the supply of fresh water, electrical hook-up and the disposal of foul and grey water may also be provided. However, caravans and motorhomes should not be permitted to stay on site for more than a maximum of twelve hours.

84. Operators are also expected to provide parking for vehicles towing all types of trailer (including horseboxes and trailer tents).

Coach parking

85. Coach parking should be segregated from the HGV parking area and a safe walking route to the amenity building should be provided.

Provision for abnormal loads

86. At MSAs, parking facilities suitable to accommodate abnormal-load vehicles should be provided for the purpose of statutory rest breaks or escort handover.

87. The minimum requirement is for the provision of a single bay capable of accommodating abnormal loads that are covered by the Road Vehicles (Authorisation of Special types) (General) Order 2003. This covers loads up to 30 m rigid length, 6.1 m wide and 150,000 kg total weight (maximum 16,500 kg axle weight). An allowance should also be made for a tractor unit for tractor/trailer combinations, so the bay should have a minimum length of at least 47.5 m.

88. However, the promoter of a new MSA should liaise with the Highways Agency's Abnormal Load Team regarding any need for enhanced provision, such as multiple bays or provision for larger 'Special Order' categories of vehicle.

HGV parking

89. In addition to the minimum parking spaces for HGVs, operators are required to provide shower and toilet facilities within the HGV parking area (for numbers see Annex B). A snack bar located within the HGV parking area providing hot food and drinks is permitted. A safe walking route to the amenity building should also be provided.

90. Operators are required to permit self-propelled horse boxes (as opposed to trailers – see paragraph 77) to park in the HGV parking area.

Toilets

91. Annex C indicates how the number of toilets should relate to the number of parking spaces. If an operator believes that the calculation will lead to overprovision of facilities, the Highways Agency will consider requests for derogation from these requirements, based on an impact assessment.

92. The standards laid down in the Charter of the British Toilet Association are commended, and the Highways Agency strongly advises all operators to meet its requirements.

Parent/carer and child rooms

93. Parent and child facilities should be provided at the levels laid down in Annex B.

94. Such facilities should be separate and not combined with toilets. Parent and child facilities must be fully accessible to disabled users.

95. The female parent/carer and child room must contain a screened area with seating, where women who do not wish to breastfeed in public can do so in private. This facility should be clearly signed.

96. However, operators are encouraged to adopt breastfeeding-friendly policies and should consider displaying the international breastfeeding symbol prominently in their amenity buildings.

ON-LINE AND JUNCTION SITES

97. Although an MSA situated at a junction may be signed from the motorway, there is a presumption in favour of on-line sites. Junction MSAs are more likely to generate undesirable trips from the surrounding area if the facilities are attractive to local residents. In addition, sites that are located further away from the motorway network might discourage drivers from stopping to rest. Where drivers do make use of such facilities, there is a need to leave the motorway, negotiate the junction and later rejoin the motorway. All of these manoeuvres increase the risk of accidents occurring and may cause congestion at the junction or exacerbate an existing congestion problem.

98. However, a junction site may be considered in circumstances where it can clearly be demonstrated that the construction of an on-line MSA would have an adverse impact or could not be delivered due to planning, operational or environmental constraints.

SIGNING OF ROADSIDE FACILITIES

Signing on road network

99. Annex A details the criteria for signing all types of roadside facilities on the road network and the signs that should be used.

Signing within roadside facilities

100. All traffic signs and markings within roadside facilities should conform to the standards laid down in the TSRGD 2002 as amended or replaced from time to time.

Advertising within roadside facilities on the motorway

101. Advertisements situated within roadside facilities on motorways that are visible from the motorway are not permitted. This includes advertisements mounted internally or externally on footbridges or connecting road bridges.

TRAFFIC INFORMATION POINTS AT MSAS

102. To help the travelling public make informed travel decisions and plan their onward journeys, MSA operators are encouraged to provide traffic information to customers. Operators are also encouraged to provide sufficient space to support the installation of a Traffic Information Point.

103. Where a Traffic Information Point is installed, the Highways Agency will be happy to advise on its location and size, on a case-by-case basis.

RETAIL ACTIVITIES AT MSAS AND MRAS

Retail general requirements

104. The Government is committed to the principle of discouraging MSAs and MRAs from becoming destinations in their own right. A modest degree of retail development is permitted, so that MSAs and rest areas may serve the needs of road users, but not so

that they attract customers from the local area. Creating a destination in its own right would generate additional trips on the motorway network and may have an adverse impact on local retail trade.

105. The maximum retail sales floorspace permitted at an MSA or MRA is 500 m^2. Additional areas may be used for retail storage, but there shall be no public access and sales shall not be permitted from these areas. Where an MSAs amenities are split between two distinct sites on either side of the motorway, it will be permitted to have up to 500 m^2 of retail space at each site, provided customers are not required to cross the motorway to reach essential facilities. Where floorspace provision in excess of 250 m^2 per side is proposed, the provisions in paragraphs 106–108 shall apply:

- any existing footbridge or underpass connecting the sites must be taken out of normal public use with a view to removal at an appropriate time;

- a full range of services (including toilets, and hot substantial meals between 6 am and 10 pm) must be available and open at each site.

106. Trading will not be permitted on bridges connecting two sides of an MSA or MRA.

107. The floorspace restriction is set at a level to allow MSAs and MRAs to provide an adequate range of facilities to serve the travelling public. It has no direct correlation with traffic flows. Therefore, an MSA or MRA situated at a junction and which serves traffic using both carriageways is permitted only 500 m^2 of retail floorspace.

108. Operators are encouraged to provide a range of alternative catering outlets that would increase the choice available to road users.

Games area

109. MSAs and MRAs are permitted, in addition to retail space, a modest games/gaming machine/exercise machine area not exceeding 100 m^2 to provide drivers and passengers with an opportunity to relax during long trips.

TOURIST INFORMATION CENTRE

110. Operators are encouraged to develop and promote tourist information services by participation in the Enjoy England Official Partner programme promoted by Visit Britain. Space should be allocated within MSAs to undertake this activity, which will not be counted against the 500 m^2 retail limit. In order to provide an income stream to support the delivery of this service, an accredited tourist information centre located within an MSA may be accompanied by an additional 50 m^2 of retail floorspace (over and above the 500 m^2 limit as per paragraph 105) for the sale of products originating from the region.

111. Tourist information facilities may also be provided at MRAs.

FUEL FORECOURT

112. The petrol filling station is permitted a retail facility that is limited in scale and genuinely ancillary to the sale of fuel.[7]

113. Operators are encouraged to provide basic safety facilities such as air and water at no cost to customers.

114. Operators are encouraged to provide a wide range of fuels, including LPG and bio-fuels.

115. Operators are expected to provide assistance at pumps for disabled travellers.

SALE OF ALCOHOL

116. There is to be no sale or consumption of alcohol anywhere on the premises of a MSA or MRA.

LODGES

117. Service areas are permitted to provide a lodge offering overnight accommodation for drivers/passengers.

118. When located at an on-line MSA MRA or TRSA, lodges are expected to only serve traffic using the side of the carriageway on which the lodge is sited, unless a dedicated link road to the other side of the facility is provided.

119. The overnight accommodation is to serve road users on the way to their destination, and will not be permitted to become a destination in its own right.[8] The lodge will be allowed to provide dining facilities.

120. There is to be no sale or consumption of alcohol within MSA or MRA lodges.

121. The lodge will be required to provide one parking bay per two lodge bedrooms in addition to the parking provision required for the service facilities.

122. Impact Assessments will be required for any proposal that exceeds the above criteria[9] or where operators seek to deviate from the minimum criteria. Early discussions with the Highways Agency will enable the scope of the Assessment to be agreed.

CONFERENCE FACILITIES AND BUSINESS CENTRES AT MSAS

123. MSAs can offer a sustainable location at which to hold business meetings by reducing the overall distance that delegates need to travel. Operators may therefore be permitted to develop a modest conference facility or business centre at an MSA, where the proposal is supported by an acceptable Impact Assessment.[10] This would need to demonstrate either that no new trips would be generated on the SRN, or, if there would be, that overall vehicle mileage would be reduced.

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7 See Planning Policy Statement 6: Planning for Town Centres
www.communities.gov.uk/publications/planningandbuilding/planningpolicystatement11
8 See paragraphs 13–18.
9 See paragraphs 19–27.
10 See paragraphs 19–27.

124. Approval could only be granted if the MSA was shown to be an appropriate location for such a facility. It is unlikely that an MSA located close to a major settlement would be granted approval for a conference facility or business centre, as it would be likely to attract business from established centres and draw traffic onto the motorway from the local area.

125. Any conference facility or business centre should have additional parking spaces (approximately 0.75 spaces per delegate) and dedicated toilet facilities in adequate numbers.

126. The Highways Agency will not approve any proposal that would cover a floor area of greater than 200 m^2.

127. There is to be no sale or consumption of alcohol at conference facilities and business centres.

COACH INTERCHANGE/PARK-AND-RIDE/PARK-AND-SHARE AT ROADSIDE FACILITIES

General

128. The Highways Agency recognises that, because of their location between major settlements, MSAs can in certain circumstances be appropriate locations from which to promote or facilitate alternative sustainable means of travel. The benefit would be a reduction in overall vehicle mileage, leading potentially to reduced congestion and pollution, and improved road safety.

129. The construction/operation of park-and-ride/coach interchange or park-and-share facilities at an MSA or MRA would be subject to the production of an Impact Assessment, approved by the Highways Agency, which demonstrated that there would be an overall reduction in vehicle mileage.

Coach interchanges

130. Coach interchanges allow coach operators to increase the overall efficiency of coach movements. Feeder coaches bring passengers to the interchange, from where they can then be taken to a variety of destinations. By permitting an interchange at an MSA, it might be possible to reduce the need for coaches to leave the motorway to exchange passengers at a facility on the local road network. Provided that no extra trips are likely to be generated, the Highways Agency has no 'in principle' objection to the establishment of this type of facility at an MSA. Proposals will be judged on their merit, based on an Impact Assessment.

131. Any benefits of a coach interchange must be balanced with the needs of other motorway users to stop and take a break. Therefore operators should discuss their proposals with the Highways Agency at the earliest opportunity to agree the scope of the Impact Assessment. If a coach interchange is permitted, the operator will need to provide appropriate infrastructure (for example a parking area, a canopy and additional toilets) to ensure that customer safety and convenience are not compromised. No MSA will be permitted to operate a coach depot or otherwise to become a destination in its own right.

Park-and-ride

132. Park-and-ride schemes have the potential to reduce overall vehicle mileage and/or urban congestion. Where a scheme would link an MSA to a nearby city centre, additional parking spaces (over and above the minimum requirements defined in Annex B) would need to be provided at the MSA to meet demand. The scale of the additional parking would be determined through the Impact Assessment. For this form of park-and-ride, a relatively long car journey would be followed by a short bus ride, contributing to a reduction in the number of vehicles joining the local road network from the SRN.

133. An alternative form of park-and-ride would involve relatively short trips by car prior to a medium- to long-distance coach journey. To reduce the number of short trips on the motorway, wherever possible the car park/drop-off point should be located outside the MSA area and accessed from the local road network, with passengers provided with a safe walkway to board the coach from within the MSA. Operators would be required to demonstrate that this arrangement could not be achieved, before the Highways Agency would give any consideration to allowing the car-park/drop point to be built within the MSA.

134. Any park-and-ride proposal must be supported by an Impact Assessment, the scope of which should be agreed in advance with the Highways Agency. The risk with park-and-ride schemes is that travellers will switch from public transport to the private car for the early stage of their journey. The Impact Assessment will need to demonstrate that this would not occur.

Park-and-share

135. To promote sustainable travel, operators might wish to encourage drivers to park at an MSA and share the remainder of their journey. This would help to reduce overall vehicle mileage. Any park-and-share facility would have to provide long-stay parking in addition to existing minimum parking provision (as defined in Annex B), and there should be no detriment to drivers using the MSA to stop and take a break in the course of their journey. Any park-and-share facility must be agreed with the Highways Agency and will be considered subject to an acceptable Impact Assessment.

TRUCKSTOPS SIGNED FROM THE MOTORWAY NETWORK

136. In order to be signed from the motorway, a truckstop must meet the following criteria:

- Signing should normally be limited to truckstops within 2 miles of the motorway that provide a minimum of 30 HGV parking spaces.

- Truckstops should provide as minimum facilities: fuel; hot drinks and food; showers; adequate parking to cater for expected demand; free short-term parking (minimum two hours); free flush toilets together with hand-washing facilities of sufficient number to cope with demand, and access to a cash-operated telephone (card phones alone will not suffice).

- These minimum facilities must be available 24 hours a day every day except Christmas Day, Boxing Day and New Year's Day.

137. Signing will not be provided where, in order to reach the truckstop, HGVs would be required to pass through residential areas.

SIGNED SERVICE AREAS ON ALL-PURPOSE TRUNK ROADS (TRSA)

Spacing

138. There is a clear need at intervals along trunk roads for fuel, parking, toilet and refreshment facilities, including picnic areas. From the point of view of both the safety and convenience of travellers there is advantage in the grouping of such facilities at appropriately sited and spaced locations, without the need (or opportunity) to cross traffic flows or use the local highway to reach them.

139. Half-an-hour's driving time should be regarded as the maximum that any driver should have to travel without the availability of fuel, refreshments, toilets and parking facilities, including parking for HGVs. It is considered that signed service areas should be sited at distances apart of approximately 30 minutes[11] or 14 miles (whichever is the lesser).

140. However, in determining applications for TRSAs, it will be necessary to consider the availability of existing provision nearby which, although not adequate by itself to secure traffic signs, is likely to reduce the overall demand for service facilities. In general, the aim should be to avoid the need for travellers to divert into by-passed communities to reach facilities that they require. Where there are significant barriers to developing new facilities on the trunk road and where there is a clear road safety need for services, it may be appropriate to sign traffic off to existing facilities on bypassed roads.

141. Responsibility for identifying sites, acquiring land, seeking planning permission and developing service areas rests with the private sector. To encourage the provision of services at appropriate intervals, the Highways Agency will seek to identify stretches of trunk road between settlements where there is a clear road safety need for a TRSA and will provide LPAs and developers with this information.

Facilities

142. To be signed from the SRN (see Annex A), the facilities must be:

- open at least between the hours of 8 am and 8 pm every day except Christmas Day, Boxing Day and New Year's Day;
- limited to a single or two adjoining or interconnected premises;
- accessed directly from on the road or directly accessible from a junction on the road;
- the facilities must also comply with all existing and future equality legislation.

11 Median average inter-peak travelling time.

143. To be signed from the SRN. the facilities must provide:

- fuel;
- hot drinks and hot food;
- adequate indoor tables and chairs to cater for expected demand (subject to a minimum provision for eight persons);
- free short-term parking (minimum two hours);
- free toilets available to all road users, together with hand-washing facilities in sufficient number to cope with demand;
- parent/carer and child facilities containing baby-changing amenities;
- access to a cash-operated telephone (card phones alone will not suffice);
- two car and caravan/motorhome/light vehicle towing trailer parking spaces.

144. The following criteria will also apply:

- Signing should normally be limited to service areas on 'A' numbered roads.
- Where services are provided on one side of the road only, signing will be limited to the nearside direction of approach unless adequate provision has been made for right-turning vehicles. Where facilities are split between two sites on opposite sides of the road, and connected by a footbridge or subway and with petrol and parking available at both sides, signing from both directions will be permissible.
- Only service areas that are accessed directly from the road or have direct access from a junction on the road can be signed. It is not acceptable to sign drivers *along* a route to remotely located facilities; the road must pass the service area. Where a service area is located at a roundabout, it will be for the traffic authority to decide on which approaches, if any, signs can be provided.
- Direct access to and egress from service areas should be provided either by diverging and merging lanes or other dedicated arrangements in accordance with Department for Transport Technical Document 41. Where flow exceeds 500 vehicles per day, then the appropriate full junction standard should be adopted – see Technical Document 42 or Technical Document 16.

145. Signs will ***not*** be provided:

(a) in urban areas – subject to speed restrictions of 40 mph or less – as services are generally frequently available therein;

(b) where discrimination would occur, ie two or more services establishments of a similar type on the same side of the road located within 1 mile of each other.

146. Operators are also encouraged to provide tourist information points.

147. Under the Licensing Act 2003, any premises that provide late-night refreshment (i.e. hot food and drink) between 11.00 pm and 5.00 am for sale to the public require appropriate permission from the local licensing authority.

148. Operators are encouraged to adopt breastfeeding-friendly policies and should consider displaying the international breastfeeding symbol prominently in their amenity buildings.

LOCAL SERVICES IN BY-PASSED COMMUNITIES

149. In order to receive signing, qualifying criteria must be met. ***All*** the following services must be available at least during normal shop opening hours, 9.30 am to 5.30 pm Monday to Saturday (half-day closing excepted), but excluding public holidays throughout the year:

(a) Adequate public parking and public toilets with hand-washing facilities (both clearly signed within the community); public cash-operated telephone; fuel; refreshments. (Where fuel is not available within the community, but is available on the main road, a special variant of the sign may be authorised by the Highways Agency).

(b) The community must be within 3 miles of the main (all-purpose) road from which its services would be signed, and must be the first town or village reached after leaving the road signed with the 'facilities' sign. Adequate confirmatory and return route signing must be provided.

(c) The community should not be so large that the provision of a full range of services would reasonably be assumed to be available by the majority of travellers. As a guide, towns with a population of over 10,000 would not normally be signed, but this figure is not to be taken as a rigid criterion.

(d) No equivalent (or better) roadside services are available on the main road ahead within the total detour distance plus 1 mile of the local facilities.

(e) No detriment to road safety, sound traffic management or local amenity should result from the encouragement of 'facilities-seeking' traffic.

(f) Encouragement of traffic is acceptable to the local community as a whole (to be determined by the district council).

(g) The cost of providing, erecting and maintaining the signs will normally be borne by local traders likely to benefit from their existence. Promoting local authorities may offer financial assistance.

TRADING FROM LAY-BYS

150. Lay-bys are provided on all-purpose trunk roads to enable motorists to stop in the course of their journey. This may be to take a brief rest, to use a mobile phone or, in the case of HGV drivers, to comply with drivers' hours regulations. However, lay-bys should not be considered substitutes for full service areas and are not satisfactory locations to rest

for more than a short period. Drivers should be encouraged to use service areas wherever these are available, using lay-bys only when stopping is an urgent necessity or where provision of services is inadequate.

151. Although lay-bys generally do not have any facilities, they are attractive to mobile traders serving refreshments to motorists. However, many lay-bys are unsuitable for this purpose, neither being large enough nor designed to standards that will accommodate the safe movement of a large number of vehicles. The availability of refreshments in lay-bys also has the potential to cause environmental and hygiene problems if traders and customers do not act in a responsible manner. Vehicle overrun damage to kerbs and verges also occurs and adjacent land may be subject to trespass.

152. Under Schedule 4 of the Local Government (Miscellaneous Provisions) Act 1982, with the Highways Agency's consent, local authorities may designate stretches of all-purpose trunk road as 'licensed streets' and issue licences to trade in lay-bys. Trading without a licence would be illegal where this provision is applied. The Highways Agency will seek to work proactively with local authorities to identify lay-bys where trading may safely be carried out.

153. It is expected that traders will be required, as a condition of being granted a licence, to provide adequate litter disposal, toilet and hand-washing facilities (that are maintained and kept clean) so as to mitigate the negative environmental and hygiene impacts of their operation. The payment for the issue of a licence is intended to be used to fund a regime of regular inspections of the operation. If facilities are not kept to the required standard or if the presence of the canteen gives rise to environmental, safety, maintenance or operational problems that cannot be resolved, traders may expect to have their licence withdrawn.

154. Licences should be granted only in circumstances where:

- the lay-by in question is suited in terms of size and layout to accommodate anticipated demand safely;
- there is no signed service area in close proximity;
- the products on sale are intended to serve the immediate needs of the road user (i.e. drinks and snacks);
- the trader undertakes to provide adequate litter disposal and toilet and hand-washing facilities;
- the lay-by is suitable for the provision of the required facilities or will be adapted to achieve suitability prior to the operation commencing.

155. If the Highways Agency does not agree with the proposal, the local authority will not issue a licence.

156. If traders wish to provide hot food and drink between 11.00 pm and 5.00 am, they must hold appropriate permission from their local licensing authority under the 2003 Licensing Act.

157. A typical layout for a 'trading lay-by' is included in the DMRB and a copy of the drawing is attached at Annex D.

SOCIAL AND ENVIRONMENTAL RESPONSIBILITY

158. The Highways Agency expects operators of roadside facilities to conduct business in a socially and environmentally responsible manner and to act in the best interest of their customers, staff and the wider community. Operators should encourage their customers and staff to behave in an environmentally responsible manner by providing adequate recycling litter bins where appropriate, promoting sustainable waste practices, and ensuring the premises and surrounding environment are clean, safe and secure. Customers should be able to choose from a range of healthy food options, with products sourced from local providers wherever possible.

ANNEX A: POLICY ON THE DESIGN AND USE OF TRAFFIC SIGNS TO SERVICES AND FACILITIES ON THE STRATEGIC ROAD NETWORK IN ENGLAND

A1 INTRODUCTION

A1.1 This policy covers the provision of traffic signs to roadside facilities from the Strategic Road Network (SRN) in England. It should always be read in conjunction with the Traffic Sign Regulations and General Directions (TSRGD), S.I.2002 No. 3113, or any succeeding document.

A1.2 In order to be lawfully placed on or near roads in England, Scotland and Wales, traffic signs must either be prescribed by the TSRGD or be specially authorised by the Secretary of State in accordance with section 65 of the Road Traffic Regulation Act 1984.

A1.3 This document supersedes the provisions of Annex J to Roads Circular 04/94 (Revision of the TSRGD) in respect of the SRN.

A1.4 Detailed guidance on the design and use of traffic signs can be obtained in the *Traffic Signs Manual*, which is available from The Stationery Office or on the Department for Transport (DfT) website at www.dft.gov.uk/roads/signs. Working drawings for most of the signs described in this annex are also available at this location.

A1.5 For non-prescribed signs on the SRN or non-prescribed variants to prescribed signs on the SRN, site-specific authorisation must be sought from the Highways Agency, who will act on behalf of the Secretary of State. For other roads, authorisation must be sought from the DfT centrally.

A2 MOTORWAY SERVICE AREAS

A2.1 Traffic Signs Agreement

A2.1.1 Provided that a proposed motorway service area (MSA) or an existing MSA seeking to upgrade its facilities meets the criteria set out by Circular 01/2008, operators will be required to enter into a Traffic Signs Agreement. Only when such an agreement has been concluded may signing to an MSA be erected on the SRN. Funding for such signing will be secured by means of an agreement under section 278 of the Highways Act 1980.

A2.2 Sign design and use

A2.2.1 *Signing from motorways*

A2.2.1.1 At each entry to a motorway (space permitting), there will be a sign to diagram 2918, indicating the distance to the next MSA along that motorway. It should normally follow the route confirmatory sign. This sign is not provided where the MSA is sited before the next junction. If there are no services on the motorway, or on any intersecting motorway, then diagram 2918.1 "No services on motorway" should be used.

Diagram 2918

A2.2.1.2 Only if the motorway intersects another one *before* the next MSA should a different sign, with distances to more than one MSA, be provided. This will then be a variant of diagram 2917, with only one MSA per route (up to a maximum of three routes) and *no* operators' names. A permitted variant allows the legend "No services" to be shown against a particular motorway on this sign.

Diagram 2917 variant

A2.2.1.3 On the approach to an on-line MSA, at its simplest, the signing should be as follows:

- 1 mile before a MSA, there should be a sign to diagram 2917;
- half a mile before the MSA, there should be a sign to diagram 2919.1;
- at the start of the diverge into the MSA, there should be a sign to diagram 2920.1; and
- on the exit nosing, there should be a sign to diagram 2921 or 2921.1, depending on the road layout.

No other site-specific signing is permitted, and these standard signs should not be varied, other than as permitted by the TSRGD. For example, the sign at the start of the diverge must *not* include the pictograms indicating the range of services.

A2.2.1.4 Diagram 2917 includes the distance to the next two MSAs and names the operators. Where only one motorway route is shown, the motorway number should be omitted. However, other MSAs reached on other routes can be included if they are the next but one MSA when following a particular route. Where appropriate, "No services" can be substituted next to the motorway number in place of the operator's name and distance. No more than three motorway routes should be indicated on this sign. Where the sign is located on a motorway of four lanes or more, it may be sensible to vary the distance to 2 miles. The results of an independent inspection scheme may also be displayed on this sign.

Diagram 2917 – single route

A2.2.1.5 Diagram 2919.1 includes provision for the addition of a header board displaying the operator's name and logo in their house style. Height restrictions apply to this header board, and the width is governed by the width of the main sign below when designed in accordance with the normal design rules. It is not permitted to alter the layout of the main sign to increase the overall width. All lettering on the header board must at least as large as the transport alphabet used on the main sign. Where the petrol price panel is included, the numerals should be the size shown on the DfT working drawings and the display panel should be remote-operated. Where the petrol price panel is omitted, the white petrol pump symbol should be added to the beginning of the top row of symbols. Where the sign is located on a motorway of four lanes or more, it may be sensible to vary the distance to 1½ miles.

A2.2.1.6 All MSAs are required to meet the strict requirements for disabled access laid down in primary legislation; therefore signs to diagram 2919.1 will no longer display the symbol indicating that the MSA is accessible to disabled users. The omission of this symbol has been authorised until such time as it is prescribed. Where appropriate, a symbol denoting the availability of a picnic area (shown on diagram 2305) may be used in its place.

Diagram 2919.1

A2.2.1.7 Diagram 2920.1 also includes provision for the addition of an operator's header board. As with diagram 2919.1, height restrictions apply to this header board, and the width is governed by the width of the main sign below when designed in accordance with the normal design rules. It is not permitted to alter the layout of the main sign to increase the overall width. All lettering on the header board must be at least as large as the transport alphabet used on the main sign.

Diagram 2920.1

A2.2.1.8 On the diverge nosing at the entrance to a MSA, there will normally be a sign to diagram 2921.1. Exceptionally, diagram 2921 might be appropriate. It is not permitted to vary these signs in any way, i.e. neither a header board nor symbols should be included.

A2.2.1.9 Where the MSA is at a standard junction, the 1 mile sign is replaced by one at 2 miles, the half-mile sign is replaced by one at 1½ miles, and the word "Services" is added below the route number on the standard nose-exit sign to diagram 2910 (with a five-stroke width vertical space between the exit route number and "Services"). Where possible, the destination "Services" should be added to the standard directional signing approaching the junction. However, where this would lead to overload on these signs, a separate sign to diagram 2920.1 should be provided between the half-mile and final ADSs. This should be sited at least 200 metres, and more if possible, from any other directional signing.

A2.2.1.10 Where the access to an MSA is from a non-motorway route, continuity signing should be provided by means of diagrams 2311.1 and 2311.2, as appropriate. The geographical name may be omitted from these signs, in which case "services" should be varied to "Services".

A2.2.1.11 In the unlikely event that the MSA is some distance from the motorway, the distances given on the motorway signing should be those to the turn-off for the MSA. It is important not to give the overall distance to the MSA, as this could mislead drivers into passing the junction, seeking a later turn-off for the MSA.

A2.2.2 *Signing from all-purpose roads*

A2.2.2.1 The TSRGD now prescribes signs for use on non-motorway roads approaching a local road from which a named MSA is accessed. These indicate the distance and, where required, the direction. Like motorway signs, these are blue background signs with white lettering, but unlike motorway signs they may *not* include either header boards or petrol price panels.

A2.2.2.2 On the approach, a sign to diagram 2310.1 should be used. Signs to diagram 2310.1 must include the geographical name as well as the word "services". This sign is normally provided at half mile, but, where this would interfere with standard directional signing, other distances may be shown. Permitted variants are set out in Schedule 16, item 8, to the TSRGD, and the maximum distance is 2 miles. Note that, unlike the motorway sign to diagram 2919.1, this sign may *not* include a panel showing the price of unleaded petrol. As with signs to diagram 2919.1, signs to diagram 2310.1 will no longer display the symbol indicating that the MSA is accessible to the disabled. The omission of this symbol has been authorised until such time as it is prescribed. On non-trunk roads authorisation for this change is required from DfT. Where appropriate a symbol denoting the availability of a picnic area (shown on diagram 2305) may be used in its place.

Diagram 2310.1

A2.2.2.3 Continuity signing should be provided in the form of signs to diagram 2311.1 and 2311.2 as appropriate. Alternatively, Schedule 16, item 35 lists those standard directional signs to which a blue panel with the legend "Services" may be added. "Services" may be varied to a geographical name and "services".

Diagram 2311.1

Diagram 2311.2

A2.2.2.4 Signs to diagram 2330 may be used on all-purpose roads to indicate that there are no services available on a motorway.

A2.2.2.5 Alternatively, signs to diagram 2917 (without operators' names) may be placed on all-purpose roads near a motorway. They can be particularly helpful on the approaches to a motorway junction, where the distance to the first MSA along one or all of the motorway routes accessed from the junction is greater than drivers would reasonably expect.

A2.3 Financial arrangements

A2.3.1 Signs to diagrams 2917, 2918 and 2921/ 2921.1 should be erected and maintained at the Highways Agency's expense and will remain the property of the Highways Agency.

A2.3.2 The faces of diagram 2919.1, diagram 2920.1 and diagram 2310.1 signs must be paid for by the MSA operator and will remain their property and responsibility. The support posts, safety fences and any lighting are the Highways Agency's responsibility but shall be funded by the MSA operator. The MSA operator will pay for any surveys by the Highways Agency's Regional Office to determine the work necessary for the erection of the diagram 2919.1 sign, including in relation to cabling for any remote control of the petrol price display.

A2.3.3 For signs to diagrams 2919.1 and 2920.1, a commuted sum should be charged to recover costs incurred in maintenance that will be the responsibility of the Highways Agency. This sum should include an allowance for administration and maintenance. The operator should be given an estimate of the costs and be asked to pay in advance. The costs of future replacement of these signs must also be borne by the MSA operator. It will be acceptable for an MSA operator to arrange the manufacture and erection of these signs, provided their contractor is approved by the Highways Agency for working on the motorway and that written agreement from the Highways Agency's Regional Office is provided in advance for the work to be done. For those signs for which the MSA operator is responsible, the operator must sign a Traffic Signs Agreement.

A2.3.4 All other MSA signs are the financial responsibility of the Highways Agency, which will meet all maintenance and replacement costs. However, where an MSA operator changes its operating name, any costs associated with changes to signs for which the Highways Agency is responsible will be met by the MSA operator provided no other changes are needed to the signs. Operators will also be required to submit a revised signing agreement to reflect changes to the sign permitted. Where changes are required to existing signs to reflect the opening of a new MSA, this cost must be met by the operator of the new facility.

A3 MOTORWAY REST AREAS

A3.1 Traffic Signs Agreement

A3.1.1 Provided that a proposed motorway rest area meets the criteria set out in Circular 01/2008, operators will be required to enter into a Traffic Signs Agreement. Only when such an agreement has been concluded may signing to a rest area be erected on the trunk road network. This applies to all of the SRN. Funding for such signing will be secured by means of an agreement under section 278 of the Highways Act 1980.

A3.1.2 Because they do not provide all of the facilities of an MSA (in particular, fuel may not be available) rest areas will *not* be included on any advance direction signs (ADS) to diagram 2917 or standard signs to diagram 2918 at motorway entries.

A3.2 Sign design and use

A3.2.1 *Signing from motorways*

A3.2.1.1 On the approach to an on-line rest area, the signing should be as follows:

- One mile before a rest area, there should be a sign to diagram NP2918.2 (non-prescribed sign). In some circumstances, it may be appropriate to vary the distance on this sign.

Non-prescribed sign NP2918.2

- Half a mile before the rest area, there should be a sign to diagram NP2919.3 (non-prescribed sign) indicating the facilities available at the rest area.

Non-prescribed sign NP2919.3

  – This diagram does *not* include provision for a header board to be added. However, it should include the name of the rest area to help driver identification.

  – The pump, LPG fuel, and "***i***" symbols may be omitted as appropriate. The spoon and fork symbol (denoting restaurant facilities) may be substituted for the cup symbol. The remaining facilities may be shown on a single row.

  – Where a lodge is provided at a rest area, its availability may be indicated by the inclusion of a bed symbol on this diagram. The bed symbol should be shown after the symbols illustrated above.

- At the start of the diverge into the rest area, there should be a sign to diagram NP2920.2 (non-prescribed sign).

Non-prescribed sign NP2920.2

- On the exit nosing, there should be a sign to diagram NP2921.2 or NP2921.3 (non-prescribed signs), depending on the road layout.

Non-prescribed sign NP2921.2

Non-prescribed sign NP2921.3

No other site-specific signing is permitted, and these standard signs should not be varied.

A3.2.2 Rest areas at junctions

A3.2.2.1 Where a rest area is located at a motorway junction and the same slip roads are being used by other traffic, special arrangements should be followed to avoid a conflict between the rest area signs and the standard advance direction sign on the approach to the junction.

A3.2.2.2 Where the rest area is at a standard junction, the 1 mile sign (on diagram NP2918.2 non-prescribed sign) is replaced by one at 2 miles in advance of the junction exit and the half-mile sign (diagram NP 2919.3 non prescribed sign) is replaced by one at 1½ miles. The distances on both signs are changed accordingly.

A3.2.2.3 At the junction, a nose exit sign to diagram NP2910.2 (non-prescribed sign), which has the words "Rest area" added below the route number on the standard nose-exit sign (with a five-stroke width vertical space between the exit route number and "Rest area").

Non-prescribed sign NP2910.2

A3.2.2.4 A sign to diagram NP2920.2 (non-prescribed sign), should be provided between the half-mile and final advanced direction sign for the ordinary junction signing. It should be sited at least 200 metres, and more if possible, from any other directional sign. Once on the slip road and on the route to the services, continuity signing using the legend "Rest area" should be provided to direct drivers. These signs should be white on blue throughout, irrespective of the status of the road. Where appropriate, they may be integrated into the advance direction signs.

A3.2.2.5 Where the access to a rest area is from a non-motorway route, continuity signing should be provided by means of diagrams NP2311.3 and NP2311.4 (non-prescribed signs), as appropriate. The geographical name may be omitted from these signs, in which case "rest area" should be varied to "Rest area".

Non-prescribed sign NP2311.3

Non-prescribed sign NP2311.4

A3.2.3 Signing from all-purpose roads

A3.2.3.1 Non-prescribed signs may be used on non-motorway roads approaching a local road from which a named rest area is accessed. These indicate the distance and, where required, the direction. Like motorway signs, these are blue background signs with white lettering.

A3.2.3.2 On the approach, a sign to diagram NP2310.2 (non-prescribed sign) should be used and must include the geographical name as well as the words "rest area". This sign is normally provided at half-mile, but, where this would interfere with standard directional signing, other distances may be shown. The symbols may be varied as appropriate to the facilities available at the rest area and the maximum distance is 2 miles.

Non-prescribed sign NP2310.2

A3.2.3.3 Continuity signing should be provided in the form of signs to diagram NP2311.3 and NP2311.4 (non-prescribed signs) as appropriate.

A3.2.3.4 Alternatively, the words "Rest area" may be added to those standard direction signs identified in Schedule 16, item 35 as being signs to which a blue panel with the legend "Services" may be added. However, such variations are non-prescribed and authorisation will be required. "Rest area" may be varied to a geographical name and "rest area". On non-trunk roads, authorisation for this is required from DfT.

A3.3 Financial arrangements

A3.3.1 Signs to diagram NP2918.2 (non-prescribed sign) should be erected and maintained at the Highways Agency's expense and will remain the property of the Highways Agency.

A3.3.2 The faces of diagram NP2919.3 and diagram NP2310.2 signs (non-prescribed signs) must be paid for by the rest area operator and will remain their property and responsibility. The support posts, safety fences and any lighting are the Highways Agency's responsibility. The rest area operator must also pay for signs to diagram NP2920.2 (non-prescribed sign), but they will be the property of the Highways Agency, who will bear the maintenance costs. The rest area operator will pay for any surveys by the Highways Agency's Regional Office to determine the work necessary for the erection of the signs to diagram NP2919.3 (non-prescribed sign).

A3.3.3 For signs to diagrams NP2919.3 and NP2920.2 (non-prescribed signs), a commuted sum should be charged to recover costs incurred. This should include an allowance for administration and maintenance. The operator should be given an estimate of the costs and be asked to pay in advance. The costs of future replacement of these signs must also be borne by the rest-area operator. It will be acceptable for a rest-area operator to arrange the manufacture and erection of these signs, provided their contractor is approved by the Highways Agency for working on the motorway and that written agreement from the Highways Agency's Regional Office is obtained in advance for the work to be done. For those signs for which the rest-area operator is responsible, the operator must sign an Operating Agreement covering the maintenance and replacement.

A3.3.4 All other rest-area signs are the financial responsibility of the Highways Agency, which will meet all maintenance and replacement costs.

A4 MOTORWAY TRUCKSTOPS

A4.1 Traffic Signs Agreement

A4.1.1 Since the introduction of the 2002 TSRGD, it has been possible to sign various HGV destinations and routes from motorways using diagram 2929.1. Now, subject to the standards laid out in Circular 01/2008 being met, specialist HGV facilities (generally known as truckstops) can receive signing more akin to standard MSA signing. In light of this change, a non-prescribed sign design has been developed that requires site-specific authorisation.

A4.1.2 Provided that a truckstop meets the criteria set out in the main body of Circular 01/2008, operators will be required to enter into a Traffic Signs Agreement. Only when such an agreement has been concluded may signing to a truckstop be erected on the SRN. Funding for truckstop signs, as for MSA signs, should be secured by means of an agreement under section 278 of the Highways Act 1980.

A4.2 Sign design and use

A4.2.1 Truckstops are generally located on the local road network adjacent to a motorway junction. The sequence of signing, therefore, should be as follows:

- One and a half miles before the junction from which the truckstop can be accessed, there should be a sign to diagram NP 2919.2 (non-prescribed sign) indicating the distance to the junction. It is important that it is this distance, rather than the overall distance to the truckstop, that is given, or drivers might pass the turn-off, believing that there was an access further along the motorway. This sign is, as yet, non-prescribed, and must be authorised on a site-specific basis. It is similar in appearance to other services signing,

but, in keeping with the standard convention for HGV route signing, it has a black background with white lettering. No header board is permitted.

Non-prescribed sign NP2919.2

- Between the half-mile and final ADSs for the junction, there should be a sign to diagram 2929, with legend "Puddleworth truckstop" and an inclined arrow. This is a permitted variant of the prescribed sign and does not require site-specific authorisation.

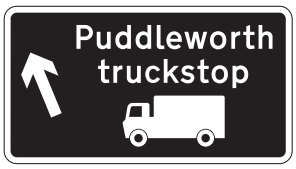


Diagram 2929 for truckstop

- On the motorway slip road, signing may be provided either by a further variant of diagram 2929, or by incorporating a black panel into the standard direction signing. Again, this is permitted by the TSRGD.

A4.2.5 Continuity signing on local roads should be provided either by means of signs to diagrams 2805, 2806 and/or 2806.1, varied as necessary, or by adding black panels to standard directional signing. This, too, is permitted by TSRGD.

A4.3 Financial arrangements for truck stops signed from the motorway

A4.3.1 All signs should be erected and maintained at the operator's expense, but will remain the property of the Highways Agency.

A4.3.2 Where sites do not comply with policy, the operator of the site will be responsible for the costs of removing any signs.

A5 SERVICE AREAS ON ALL-PURPOSE ROADS

A5.1 Traffic Signs Agreement

A5.1.1 Provided that a proposed service area or an existing service area seeking to upgrade its facilities meets the criteria set out by Circular 01/2008, operators will be required to enter into a Traffic Signs Agreement. Only

when such an agreement has been concluded may signing to an all-purpose trunk road service area be erected on the SRN. Funding for such signing will be secured by means of an agreement under section 278 of the Highways Act 1980.

A5.2 Sign design and use

A5.2.1 The TSRGD 2002 introduced a new signing regime for service areas on all-purpose roads. Black and white signs are now prescribed for all service areas other than named MSAs. A deadline of 1 January 2015 has been set for replacing existing green background signs on primary routes.

A5.2.2 In advance of services that are open 24 hours of those days required by the eligibility criteria (laid down in paragraphs 144 and 145 in the main body of this policy), a sign to diagram 2313.1 may be provided. The normal distance is half a mile, but, where this would interfere with standard directional signing, this may be varied in accordance with Schedule 16, item 8. "Services" may be varied to a geographical name and "services". Symbols should be varied according to available facilities, but should always be used in the order shown on the drawings, and must always include the WC, petrol pump and cup or fork and spoon (but not both). If LPG fuel is available, the symbol should be placed after the petrol pump. The "*i*" symbol may be omitted if no tourist information is available and the bed symbol may be added.

Diagram 2313.1

Diagram 2313.1 variant

A5.2.3 Where services are not open 24 hours, the advance signing should be to diagram 2313.3. The lower panel may read either "not 24 hrs" or "Fuel only 24 hrs" as appropriate. Additionally, the same permitted variants apply as for diagram 2313.1.

Diagram 2313.3

A5.2.4 Where services are not open to HGVs, the advance signing should be to diagram 2313.5, with the lorry symbol varied to the lorry symbol with the red bar through it, and the words "Lorries only" omitted. Again, the same permitted variants apply as to diagram 2313.1.

Diagram 2313.5 – no HGVs

A5.2.5 Where required, final advance direction signs to service areas should be designed to diagrams 2313.2, 2313.4 or 2313.6 as appropriate. These signs may also include the range of symbols shown on the half-mile advance direction signs, and the symbols should be the same on both signs. Signs of this type, incorporating symbols, should only be used where drivers are required to turn off the main road in order to reach services accessed from a minor road. They should not be used as final signs at the entrance to a service area.

A5.2.6 At the entrance to the service area itself, either diagram 2314.1 or diagram 2314.2 should be used, as appropriate for the road layout. Signs to diagram 2314.2 may also be used at slip road nosings. The direction to a service area may also be indicated by adding the destination "Services" to standard directional signing, either directly in the case of non-primary route signs, or in a panel in the case of green primary route signs. Schedule 16, item 35 indicates those sign diagrams to which this permitted variant applies.

Diagram 2314.1

Diagram 2314.2

A5.3 Financial arrangements

A5.3.1 All signs should be erected and maintained at the operator's expense but will remain the property of the Highways Agency.

A6 TRUCKSTOPS ON ALL-PURPOSE ROADS

A6.1 Traffic Signs Agreement

A6.1.1 Provided that a facility meets the criteria set out in the main body of Circular 01/2008, operators will be required to enter into a Traffic Signs Agreement. Only when such an agreement has been concluded may signing to a truckstop be erected on the SRN. Funding for truckstop signs, as for MSA signs, should be secured by means of an agreement under section 278 of the Highways Act 1980.

A6.2 Full standard services – sign design and use

A6.2.1 Fully qualifying services that cater only for HGVs should be signed in advance using diagram 2313.5, with symbols varied as appropriate.

Diagram 2313.5

A6.2.2 Where required, final advance direction signs to lorry only service areas should be designed to diagram 2313.6, varied to omit the lorry with the red diagonal line and add the lorry symbol plus "Lorries only". These signs may also include the range of symbols shown on the half-mile advance direction signs, and the symbols should be the same on both signs. Signs of this type, incorporating symbols, should only be used where drivers are required to turn off the main road in order to reach services accessed from a minor road. They should not be used as final signs at the entrance to a service area.

Diagram 2313.6 – lorries only

A6.2.3 At the entrance to the service area itself, either diagram 2314.1 or diagram 2314.2 should be used, as appropriate for the road layout. Signs to diagram 2314.2 may also be used at slip road nosings. The direction to a service area may also be indicated by adding the destination "Services" to standard directional signing, either directly in the case of non-primary route signs, or in a panel in the case of green primary route signs. Schedule 16, item 35, indicates those sign diagrams to which this permitted variant applies.

A6.3 Special lorry facilities

A6.3.1 Where facilities are provided for HGVs, but do not meet the signing criteria for all-purpose road services, variants of diagrams 2502, 2505 and 2507 may be used on all-purpose roads. It is for the route manager to decide whether signing is appropriate. However, an HGV driver should not be expected to follow such signs unless overnight parking is available.

A6.3.2 The signs would include the blue "**P**" symbol plus the black lorry symbol on a white background, with no legend, and certain other permitted symbols where appropriate.

Diagram 2502

Diagram 2505

Diagram 2507

6.4 Financial arrangements

A6.4.1 All signs should be erected and maintained at the operator's expense but will remain the property of the Highways Agency.

7 LOCAL FACILITIES IN OFF-LINE COMMUNITIES

7.1 Restrictions on use

A7.1.1 These signs are for use where a range of basic services are available in a small town or village lying off the main road, which will often but not necessarily be a purpose-built bypass. These signs are *not* to be used on motorways. Neither are they to be used for towns or cities large enough for the traveller to assume that a full range of services is available (see paragraphs 151 and 152 of main policy body).

7.2 Sign design and use

A7.2.1 Advance signing to local facilities should be by means of diagram 2308.1. This sign should be positioned so as to avoid last minute manoeuvring by drivers.

Diagram 2308.1

A7.2.2 The WC, petrol pump and cup symbols should appear on all signs, as these represent the minimum qualifying criteria for signing. The spoon and fork (denoting a restaurant), bed or tourist information "***i***" symbol shall be omitted where these facilities are not provided.

A7.2.3 Tourist attraction and camping site/caravan park symbols should ***not*** be added, as these would make the sign too complicated. These are tourist facilities and should be signed separately in accordance with TD 52/04.

A7.2.4 Normally, drivers will be able to obtain the name of the community shown on the local facilities sign from the standard directional signing at the junction and on the continuation of the route. However, a flag-type sign to diagram 2309.1 is prescribed for use at any junction on the route where the existing local directional signing is not adequate.

Diagram 2309.1

A8 LAY-BYS

A8.1 Lay-bys are an essential element in highway design, giving frequent opportunities for drivers of all types of vehicle to take a short break. Lay-bys are signed by means of an advance sign to diagram 2501, plus a sign at the start of the lay-by to diagram 801.

Diagram 2501

Diagram 801

A8.2 Where there is a WC and/or telephone in a lay-by, advance signing should be to diagram 2502. The "i" symbol, indicating general information not associated with tourist attractions, may be added. This sign may also be used to indicate a parking area reserved for commercial vehicles, by incorporating the lorry symbol (see paragraph 6.3.2)

Diagram 2502 variants

ANNEX B: STANDARDS FOR PARKING AT MOTORWAY SERVICE AREAS AND MOTORWAY REST AREAS

The calculations below set out the requirements for MSAs. The requirement in respect of facilities for MRAs will be half that required for MSAs, and rounded to the higher number where clear division can not be made.

	Calculation[12]	**Variable**	**Notes**
Traffic flow (vehicles per day)[13]			
Light vehicle		A	Advice on traffic flows is available from the Highways Agency
HGV and coach		B	
No. of parking spaces required[14]			
Cars	0.5% of A	C	
HGV	0.5% of B	D	
Abnormal load	Minimum of 1		
Coach	0.1% of B	E	
Coach interchange[15]	No. of bays provided	E1	
Caravan/ motorhome/ vehicle & trailer	0.015% of A	F	
Motorcycle	0.015% of A (where the percentage falls below 10 a minimum of 10 should be provided)	G	Dedicated motorcycle bays for securing bikes
Additional spaces for lodges	One space per 2 bedrooms		

12 The Highways Agency's Spatial Planning Team can assist with these calculations.
13 Where the necessary information exists operators may wish to increase the number of parking spaces for particular types of vehicle to recognise the particular demographics of the road served by the facility.
14 Parking for disabled travellers should be clearly signed at the entrance to the MSA.
15 Where such a facility has been permitted.

No. of parking spaces required continued		
Spaces for disabled users	5% of C (where the percentage falls below 5 a minute, 5 should be provided)	
Spaces for disabled users caravan/motorhome/ vehicle and trailer	5% of F (where the percentage falls below 2 a minute, 2 should be provided)	Located adjacent to the front entrance
Spaces for disabled lodge users	5% of F (where the percentage falls below 2 a minute, 2 should be provided)	

ANNEX C: STANDARDS FOR TOILETS AT MOTORWAY SERVICE AREAS AND MOTORWAY REST AREAS

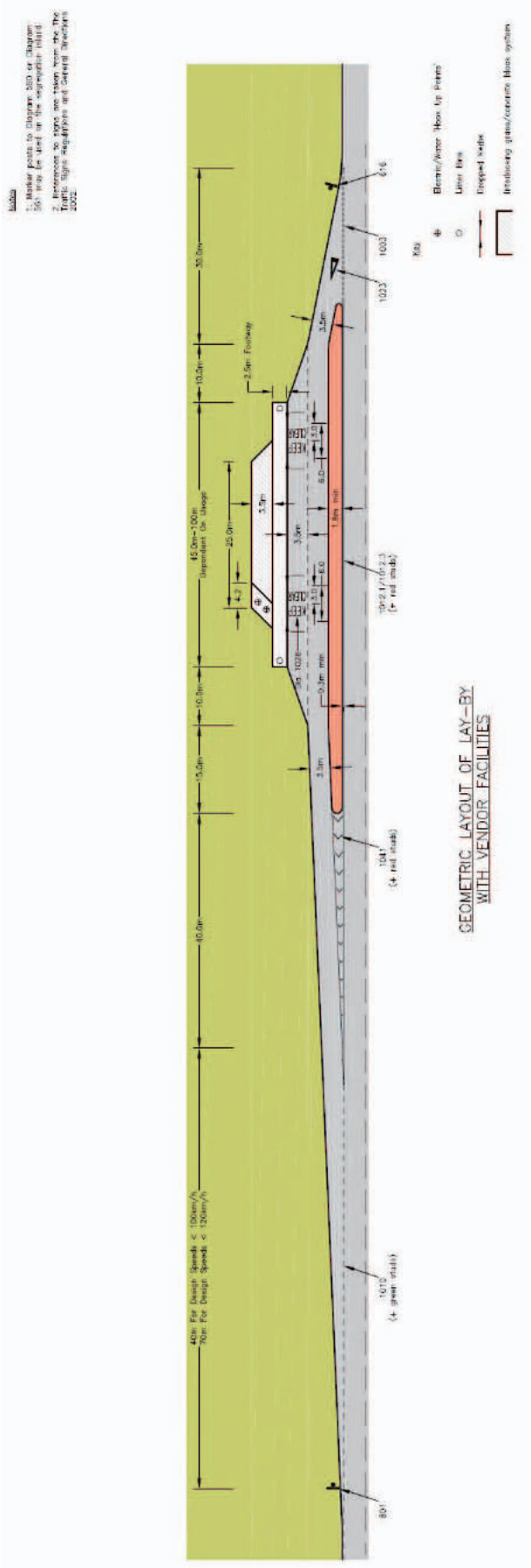
The calculations below set out the requirements for MSAs. The requirement in respect of facilities for MRAs will be half that required for MSAs, and rounded to the higher number where clear division can not be made. The variables used are the same as those used in Annex B.

No. of passengers requiring use of toilets		
Light vehicles	2.3 x (C+F)	H
HGV	1.2 x D	I
Coach	30 x (E + E1)	J
Total	H + I + J	K

No. of toilets required			
Average length of toilet use	3 minutes		
Hourly turnover	60 ÷ 3 = 20		
No. of toilets required	K ÷ 20 =	L	
Distribution of toilets and parent/ carer and child room			
Female	60% of L = (minimum of 10)	M	
Female and child room	minimum of 2		Located within the female toilet block
Female disabled users	5% of M = (minimum of 2)	N	
Male	40% of L Minimum of 10		Two-thirds urinals, one-third WCs
Male and child room Male disabled user	Minimum of 2 Minimum of N		Located within the male toilet block
Disabled user independent unit	Minimum of 1		Independent unit to allow for male/female access

Dedicated facilities for lorry drivers	
Male toilets	1% of I (minimum 2)
Female toilets	1% of I (minimum 2)
Independent disabled user	Minimum of 1
Male showers	Minimum of 2
Female showers	Minimum of 2
Independent disabled user shower	Minimum of 1

ANNEX D: DESIGN FOR A TRADING LAY-BY



GLOSSARY

ADS	Advance direction signs
AONB	Area of Outstanding Natural Beauty
APTR	All-purpose trunk roads
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges and any subsequent revision.
HGV	Heavy goods vehicle
LPA	Local Planning Authority
MRA	Motorway rest area
MSA	Motorway service area
SRN	Strategic Road Network – network of trunk roads, including motorways, for which the Secretary of State for Transport is the highway authority
SSSI	Site of Special Scientific Interest
TRSA	Trunk road service area
TSRGD	Traffic Signs Regulations and General Directions

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DRIVER FATIGUE AND ROAD ACCIDENTS

A LITERATURE REVIEW
and
POSITION PAPER

FEBRUARY 2001

THE ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS
DRIVER FATIGUE AND ROAD ACCIDENTS
A LITERATURE REVIEW AND POSITION PAPER
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1 INTRODUCTION

1.1 Driver fatigue ('falling asleep at the wheel') is a major cause of road accidents, accounting for up to 20% of serious accidents on motorways and monotonous roads in Great Britain[1]. The Government's Road Safety Strategy, "Tomorrow's Roads: Safer for Everyone"[2], identifies driver fatigue as one of the main areas of driver behaviour that needs to be addressed if the target for reducing the number of people killed and seriously injured in road accidents by 40% by 2010 is to be achieved.

1.2 The purpose of this paper is to review published research and data concerning:

a) the scale of the sleep related road accident problem

b) the causes of driver fatigue

c) potential measures to reduce accidents caused by sleepy drivers.

1.3 This literature review is part of a DETR grant-in-aid project to develop a "Journey Planner for Drivers" and to investigate the feasibility of electronic route planners automatically prompting drivers to take rest stops on long journeys and, where possible, providing other safety-related information.

1.4 The literature research was conducted through RoSPA's Information Centre, a Transport 2000 CD-ROM and the internet. The main UK research considered in this report is the various studies into sleep related road accidents by Professor Horne at the Sleep Research Centre at Loughborough University, and TRL research. International studies, particularly from the USA, Australia, New Zealand and Canada, have also been considered.

1.5 For the purposes of this report the terms "sleepiness", "tiredness", "drowsiness" and "fatigue" are used interchangeably, unless otherwise stated.

2 SLEEP

2.1 Human beings need to sleep. Sleep is not a matter of choice; it is essential and inevitable. The longer someone remains awake, the greater the need to sleep and the more difficult it is to resist falling asleep. Sleep will eventually overpower the strongest intentions and efforts to stay awake.[3]

2.2 The need for sleep varies between individuals, but sleeping for 8 out of 24 hours is common, and 7 to 9 hours sleep is required to optimise performance. Sleep patterns are governed by the circadian rhythm (the bodyclock) that completes a full cycle approximately once every 24 hours. Humans are usually awake during daylight and asleep during darkness. There are two peaks of sleepiness: the early hours of the morning and the middle of the afternoon.[4]

2.3 The loss or disruption of sleep results in sleepiness during periods when the person would usually be fully awake. The loss of even one night's sleep can lead to extreme short term sleepiness, and continual disrupted sleep can lead to chronic sleepiness. The only effective way to reduce sleepiness is to sleep. Sleeping less than four hours per night impairs performance. The effects of sleep loss are cumulative, and regularly losing one or two hours of sleep a night can lead to chronic sleepiness over time.[5, 6]

2.4 Sleep loss and sleep disruption can be caused by a wide range of factors, some of which are beyond the individual's control, but some of which are personal choices:

- hours of work, including long hours and shift work
- family responsibilities
- social activities
- illness, including sleep disorders[3]
- medication
- stress.

2.5 Today's "24 hour society" seems to pressurise many people to sacrifice sleep in favour of other activities, without realising the negative effects this has on their health and ability to perform a wide range of tasks, including driving.

2.6 **Sleepiness and Impairment**
Sleepiness reduces reaction time (a critical element of safe driving). It also reduces vigilance, alertness and concentration so that the ability to perform attention-based activities (such as driving) is impaired. The speed at which information is processed is also reduced by sleepiness. The quality of decision-making may also be affected.[3]

3 DRIVER FATIGUE AND ROAD ACCIDENTS

3.1 There are difficulties in determining the level of sleep related accidents because there is no simple, reliable way for an investigating police officer to determine whether fatigue was a factor in an accident, and if it was, what level of fatigue the driver was suffering. This results in varying estimates of the level of sleep related accidents, and in particular, evidence based on accident reports usually produces lower estimated levels than research based on in-depth studies.

UK

3.2 A recent study by the Sleep Research Centre[1] indicates that driver fatigue causes up to 20% of accidents on monotonous roads. This suggests that there are several thousand casualties each year in accidents caused by drivers falling asleep at the wheel.

3.3 An earlier study[7] of road accidents between 1987 -1992 found that sleep related accidents comprised 16% of all road accidents, and 23% of accidents on motorways.

3.4 Research by the TRL[8] found slightly lower proportions of sleep related accidents: 9% - 10% of accidents on all roads, and 15% of accidents on motorways involved driver sleepiness. In this study, 29% of drivers reported having felt close to falling asleep at the wheel at least once in the previous twelve months.

3.5 An earlier (1984) TRL study[9], of 2,000 HGV and PSV drivers involved in accidents, found that driver fatigue was a factor in 11% of these accidents.

USA

3.6 In the USA, several studies[3,10-15] in recent years have produced various estimates of the level of sleep related road accidents. The National Highway Traffic Safety Administration (NHTSA) estimate that there are 56,000 sleep related road crashes annually in the USA, resulting in 40,000 injuries and 1,550 fatalities[3].

3.7 One study[10] calculated that 17% (about 1 million) of road accidents are sleep related. A 1995 study suggested that 2.6% of accidents caused by driver inattention were due to fatigue[11].

3.8 A study[12] of road accidents on two of America's busiest roads indicated that 50% of fatal accidents on those roads were fatigue related. Another study[13] claims that 30% - 40% of accidents involving heavy trucks are caused by driver sleepiness.

3.9 An analysis of road accidents between 1990 and 1992 in North Carolina[14] found 5,104 accidents in which the driver was judged to have fallen asleep. This was about 0.5% of all road accidents during that period. A survey[15] of 205 drivers in another State found that 31% admitted having dozed off at least once while driving during the preceding twelve months. Younger drivers were especially prone to doze off, and men were twice as likely as women to fall asleep at the wheel.

3.10 **Australia**
VicRoads, an Australian road safety organisation, estimates that 25% - 35% (and possibly up to 50%) of road crashes are sleep related[16]. A 1994 study[17], estimated that driver sleepiness accounts for 6% of road accidents, 15% of fatal accidents and 30% of fatal crashes on rural roads.

3.11 **Germany**
A study of motorway accidents in Bavaria[18] estimated that 35% of fatal motorway crashes were due to reduce vigilance (driver inattention and fatigue).

3.12 **New Zealand**
Between 1996 and 1998, 114 fatal road crashes (8% of all fatal crashes) and 1,314 injury road crashes (5% of injury accidents) were thought to be fatigue related.[19] A study[20] of 370 heavy motor vehicle crashes in 1997, found that driver fatigue was listed as a contributing factor in 7% of accidents.

3.13 **Norway**
A questionnaire survey[21] of 9,200 accident-involved drivers found that 3.9% of the accidents were sleep related, but almost 20% of night-time accidents involved driver drowsiness.

3.14 **Israel**
An assessment of road accidents between 1984 and 1989[22] found that up to 1% were recorded as sleep related, but the real figure was likely to be much higher as many accidents recorded as other types of driver error were likely to have been related to driver fatigue.

4 ACCIDENT PATTERNS AND RISK FACTORS

4.1 Type of Driver

4.1.1 Several studies have identified young male drivers, aged under 30 years, as one of the groups most at risk of being involved in sleep related road accidents. Horne[7] found that about half of the drivers involved in sleep related accidents were males aged below 30 years, with the peak age being 21 - 25 years.

4.1.2 Maycock[8] also found that young male drivers were at greater risk. This study identified company car drivers as having a high probability of falling asleep at the wheel because they tend to drive high mileage, on monotonous roads and have tight schedules.

4.1.3 A Danish study[23] found that tiredness was common among young male drivers who were driving at night.

4.1.4 American studies[3] have identified three main risk groups among drivers:

- male drivers aged 16 - 29 years
- shift workers
- people with sleep problems.

4.1.5 Another American study[15] found that 55% of sleep related crashes involved drivers aged 25 years or younger, with the peak age being 20 years.

4.1.6 Untreated sleep apnea (brief interruptions of air flow and loss of oxygen while sleeping, resulting in poor and fragmented sleep) and narcolepsy (a disorder of the sleep-wake mechanism which can cause excessive daytime sleepiness) increase the risk of sleep related driving accidents. Many people with these conditions are undiagnosed and untreated, and are unaware of their increased risk.[3]

4.2 Time of Day

4.2.1 Sleep related accidents peak in the early hours of the morning, between 2:00 and 6:00 am, and in the mid afternoon, between 3:00 and 4:00 pm, due mainly to circadian rhythms. Horne[24] calculated that drivers are 50 times more likely to fall asleep at the wheel at 2:00 am than at 10:00 am. The risk is three times as great between 3:00 - 4:00 pm than at 10:00 am.

4.2.1 There appears to be a link between the age of the driver and the peak fatigue time.[25] Younger drivers are more prone to fatigue in the early hours of the morning, whereas older drivers are more likely to fall asleep at the wheel during the afternoon sleep period. For drivers aged 70 years or more, the peak time period was between 10:00 and 11:00 am.

4.2.2 Maycock[8] also found a link between sleep related accidents and time of day, again with the highest risk period being the early hours of the morning.

4.2.3 American research[15] also shows the same time pattern of sleep related accidents related to the age of the driver. Those aged up to 45 years were more at risk in the early hours, those aged between 45 and 65 years were most at risk around 7:00 am, and those aged over 70 years the peak period was 3:00 pm.

4.3 Type of Journey

4.3.1 Journeys involving long periods of driving on monotonous roads, such as motorways, are more likely to result in a driver falling asleep at the wheel[25]. Journeys that are for work purposes, especially ones involving truck drivers or company car drivers, are also a high risk type of journey.

4.3.2 As discussed above, there is a clear relationship between time of day and the likelihood of falling asleep while driving. Therefore, journeys which involve driving in the early hours, and to a lesser extent in the middle of the afternoon, are likely to generate more risk.

4.3.3 Boredom; people who are under-stimulated tend to feel drowsy and more likely to fall asleep. [26]

4.4 Type of Road

4.4.1 As noted above, roads which involve sustained, monotonous driving, with little visual stimulus for the driver, and where drivers are not required to attend to either the vehicle's controls or respond to multiple road users and junctions, are more likely to have sleep related accidents. Urban roads are less prone to fatigue crashes because the level of activity is so much greater, and helps to keep drivers active and alert.[12]

4.4.2 Horne[7] found two-thirds of sleep related accidents occurred on A roads, 9% on motorways, 16% on B roads and 9% on minor roads.

4.4.3 Maycock[8] found higher rates on motorways (20%) and non built-up roads (14%) than on built-up roads (5%).

4.5 Other Impairment Factors

4.5.1 Lack of sleep is not the only cause of sleepiness. General health, alcohol, drugs, medicines and illness also cause tiredness, in addition to their other impairment effects. Most studies about driver fatigue exclude accidents where other impairment factors have been identified in order to isolate the effects of fatigue. However, sleepiness caused by alcohol or other drugs is still influenced by the circadian rhythm, so that the effects of the alcohol or drug are likely to be greater during peak periods of sleepiness (the early hours and mid afternoon).[3]

4.5.2 Research at Loughborough University shows that drinking alcohol in the early afternoon is about twice as likely to make a driver sleepy than the same amount drunk in the early evening.

4.5.3 Recent research[27] in Australia and New Zealand suggests that staying awake for 17 - 19 hours results in the same level of impairment as drinking around 50 mg of alcohol, and produces much slower response speeds.

4.6 Type of Accident

4.6.1 Sleep related accidents tend to be more severe, possibly because of the higher speeds involved and because the driver is unable to take any avoiding action, or even brake, prior to the collision[3]. Horne[7] describes typical sleep-related accidents as ones where the driver runs off the road or collides with another vehicle or an object, without any sign of hard braking before the impact.

4.6.2 Horne[7] also suggests that the risk of death or serious injury to drivers may be greater in sleep related accidents than in other types of accident. A study of accidents in North Carolina also concluded that sleep related accidents tended to have more severe consequences.[14]

4.6.3 Zomer[22] found that the number of casualties in sleep related accidents was 50% higher than in all accidents, and sleep accidents had three times as many fatalities, and twice as many serious injuries, than non sleep related accidents.

4.6.4 Indications that an accident is sleep related are that :

- a single vehicle left the road
- the accident occurred on a high speed road
- the driver did not attempt to brake or swerve to avoid the accident
- the driver was alone in the vehicle
- the accident occurred in the early hours of the morning, or between 3:00 and 4:00 pm.

5 WORK RELATED FATIGUE ACCIDENTS

5.1 Truck Drivers

5.1.1 Driver fatigue is a particular problem for truck drivers. A 1998 American study[28] found that about 20% of all fatal crashes and fatalities and 10% of all injuries involving a long-haul truck, occurred between midnight and 6 a.m, the peak period for driver fatigue. These crashes tended to be more severe than crashes during other parts of the day. Truck driver fatigue was a particular problem in single-vehicle fatal crashes, but in crashes involving other vehicles, fatigue was coded more often for the other driver than for the truck driver.

5.1.2 In another study, 593 truck drivers were interviewed at rest areas on New York's interstate highways[29]. Nearly two-thirds reported episodes of drowsy driving within the previous month, and almost 5% said that they drove when drowsy on most, if not all, days. Nearly half had fallen asleep at the wheel at some point in their driving career, and about one-quarter reported doing so at least once during the previous year.

5.1.3 Truck driver fatigue may be a contributing factor in as many as 30% to 40% of all heavy truck accidents.[30]

5.1.4 For a two year period large truck crashes on the interstate system in Washington State were investigated using a case-control method[31]. For each large truck involved in a crash, three trucks were randomly selected for inspection at the same time and place as the crash. Driving in excess of eight hours increased the risk of crash involvement by a factor of two; drivers with log book violations, young drivers, and interstate drivers also had increased crash risks.

5.1.5 Similar evidence in relation to those who operate and/or manage other modes of transport, such as trains, ferries and aircraft indicates a correlation with the research into trucks and driving.

5.2 Drivers' Hours

5.2.1 In most countries, HGV and PSV drivers are subject to regulations that set limits on the amount of time they can drive without a break, the amount of time they can drive in a day, the amount of time they can be on-duty and for minimum rest periods. These regulations are designed to prevent drivers from driving for unreasonably long periods and consequently falling asleep at the wheel. However, they still allow drivers to drive for very long periods (E.U. Drivers Hours Rules, for instance, allow drivers to drive up to 4.5 hours without a break, and even this can be extended).

5.2.2 Driver Hours regulations are flawed in other respects. In America, they have been criticised for actually increasing risk because they do not take account of circadian rhythms and so sometimes require a driver to rest when wide awake, and to drive when sleepy.[32] Horne[25] points out that the EU Drivers Hours do not appear to be based on any evidence of safe driving times.

5.2.3 One of the studies by Horne[7] found that all of the sleep related HGV accidents occurred within two hours of the start of the journey. An analysis[33] of more than one thousand commercial vehicles in Europe found that most truck accidents take place in the first seven hours of the driving time.

5.2.4 Discussions are underway in the EU on the possibility of extending the Working Time Directive (which sets limits on the amount of working, as opposed to driving, time) to cover drivers and operators who are currently covered by the Drivers Hours Rules. In its Road Safety Strategy[2], the British Government states that once the results of the EU discussions are known, it will consult on repealing the UK Domestic Drivers Hours Rules in favour of the EU Rules.

5.2.5 Even the limits set by the Drivers Hours Regulations are often flouted by operators and drivers. And many classes of drivers are not covered by these regulations. Van, taxi and company car drivers do not have legal limits on their driving time. An Australian survey[34] showed that about 38% of truck drivers exceeded 14 hours of driving in a work day, and another 5% exceeded 14 hours of work (including non-driving work). About 5% of drivers reported having not slept and 7.5% reported less than four hours of sleep on at least one work day of the preceding seven days. Overall, about one third of drivers obtained less than six hours of sleep on at least one working day.

5.2.5 In America, almost 20% of drivers reported that they "always or often" exceeded the 10-hour driving limit in the Federal Highway Administration Hours-of-Service (HOS) regulations. Close to one-fifth were usually off-duty for fewer than eight hours, and just over 21% drove longer than their records indicated.[29]

5.2.6 Another study[35] found significantly higher fatigue accident rates for drivers who drove for longer than 9.5 hours per day without rest, for driving at night, and for driving in remote areas. These factors were found to have a cumulative effect on fatigue-related truck accident rates.

5.2.7 A New Zealand study[36] compared a group of heavy vehicles involved in crashes (for which details of drivers' hours were known from their log-books) with a matched control group of similar vehicles. There was an increased crash risk when driving hours since the driver's last compulsory 10 hour off-duty period exceeded about eight hours.

5.2.8 The Australian study referred to above (5.2.5)[34] found that 67% of truck drivers with irregular schedules had been involved in fatigue-related accidents, compared to 38% of drivers with regular schedules. 82% of the drivers who admitted to having exceeded the number of permissible driving hours had had a fatigue-related accident. The most important measures in predicting a fatigue-related accident in the sample were the duration of the last sleep period, the total hours of sleep obtained during the 24 hours prior to the accident, and the split sleep patterns.

5.2.9 A study[32] of schedules of 498 long-distance drivers found that, assuming average legal speed limits of 55 mph, 26% of the drivers had schedules that required them to exceed speed limits in order to meet the schedule. Assuming average travelling speeds of 50 mph, the vast majority of long distance drivers would have to work more than 40 hours a week, half would work more than 65 hours and a quarter over 81 hours a week.

5.2.10 An informal truck driver 'Pooling' system is known to operate in UK, in which (usually self-employed) drivers are 'called-off' by large operators as and when required. It is understood that this enables individual drivers to work far longer than would be legally possible if they were employed by a single employer. Such practice, while obviously attractive to commercial operators because it enables them to pay only for the hours or trips they need, leaves much to be desired in safety terms, since the drivers may well have already worked a full quota of hours for other companies before they start the next job.

5.3 Shift Work

5.3.1 Shift workers are more likely to have less sleep, and sleep disturbances, than non shift workers. Disruptions to the circadian rhythm are associated with impaired attention and performance and slower reaction times.[3]

5.3.2 An investigation[37] of the rate of road accidents related to sleep duration in 448 shift nurses found that road accidents occurred more frequently on the way home from morning and night shifts. Those nurses who reported accidents generally slept less than their colleagues. Another study compared nurses on rotating shifts with nurses on other schedules and found that those on rotating shifts reported more accidents (including driving accidents).[38]

5.3.3 A USA survey[39] of rotating shift and straight day workers at a manufacturing plant found an increased incidence of motor vehicle accidents or 'near misses' in which sleepiness was cited as a cause: 22% of rotating shift workers compared to 7% of day-only workers. Complaints of poor sleep and increased sleepiness during hours of wakefulness were also significantly more common in shiftworkers than day workers. Shiftworkers reported higher caffeine and alcohol consumption, and were more likely to use alcohol as a sleep aid.

5.3.4 Another study[40] found that there were few differences in alertness during work hours, but that 12 hour shift workers were significantly more sleepy at the end of the shift, especially at 7:00 am., than eight hour shift workers. Such workers were particularly at risk when driving home after their shift.

5.4 Passenger Carrying Vehicles

5.4.1 Taxi and private hire car drivers also often work very long hours, although they are more likely to drive in urban environments where the risk of falling asleep at the wheel is less. However, they often work shifts, and in the early hours of the morning which increases their risk.

5.4.2 An Australian study[41] examined fatigue-related variables and their relationship with accident involvement in a group of 42 Sydney metropolitan taxi drivers over a two-year period. The authors found that driver time-on-the-road is often considerable: 67% of those surveyed drove at least 50 hours per week, yet time off in long shifts (up to 12 hours) was often short (as low as 3 minutes, with an average of 37 minutes).

5.4.3 Bus and coach drivers often drive for long distances on monotonous roads, work long shifts, all of which are high-risk factors as far as fatigue-related accidents are concerned. Although the hours of work associated with this activity take account of periods when the driver is not driving, it may not always be possible for the driver to 'rest' properly during these driving breaks and this casts doubt over the drivers' hours regime. However, no studies focusing on bus and coach drivers were identified.

5.4.4 The informal 'driver pooling' system referred to in 5.2.10 is also understood to operate in this field. Bus and coach drivers sometimes work for more than one transport company, and it is understood that some are engaged in other types of work as well (such as taxi/private hire vehicle driving or night-shift work).

5.4.5 Drivers (other than professional drivers), who drive (usually) smaller vehicles, such as minibuses or people carriers, do not fall within the regulations even though they may be carrying passengers who are dependent upon their ability to drive safely over extended distances and periods of time. Examples of such drivers include teachers, youth workers' people working in the youth uniformed organisations, churches and community centres. No regulations cover this type of driving, nor are there yet guidelines from Government on this issue.

5.5 Managing Occupational Road Risk

5.5.1 It is clear that many types of vocational drivers have driving patterns that are associated with sleep related accidents. Therefore, employers have a major role to play in reducing the risk of their employees falling asleep at the wheel while driving for work. The adoption and implementation of the principles of the Management of Occupational Road Risk[42] provide many opportunities for employers to reduce this risk, principally by ensuring that they assess which drivers and journeys are at risk and set schedules that do not require drivers to exceed driver hours, and speed limits.

5.5.2 Principally, employers should:

- Manage the safety of their employees who drive
- Consider and implement the most suitable system of risk assessment and re-assessment for the road safety needs of the company and its employees
- Choose the right vehicle and the safest specification for the needs of the job
- Ensure that work practices, journey schedules, appointments and routes enable drivers to stay within the law
- Provide sensible guidelines about driving and for the use of the vehicles for all employees who may drive for the company.

6 DRIVER AWARENESS

6.1 Drivers are normally aware when they are feeling sleepy, and therefore make a conscious decision about whether to stop and rest or to continue driving while trying to fight off sleepiness and stay awake.

6.2 Horne has demonstrated that most drivers involved in sleep related accidents, deny having fallen asleep. This may be due to embarrassment, fear of prosecution or loss of insurance indemnity, or to a genuine belief that they did not fall asleep. Laboratory studies have shown that if people are woken within a few minutes of falling asleep, they will have no knowledge of having fallen asleep. [24]

6.3 However, even if drivers are genuinely unaware of having fallen asleep, they are fully aware of feeling sleepy beforehand. Horne used a driving simulator on which subjects whose sleep had been restricted to five hours the night before, drove for two hours in the afternoon on a monotonous road, to assess awareness of sleepiness while driving, awareness of the likelihood of falling asleep during the drive and the level of incidents due to sleepiness while driving. The study showed that drivers were well aware when they were feeling sleepy, and generally were aware that this meant they might fall asleep.

6.4 The number of incidents increased as drivers grew more sleepy, and all the major incidents (where the car drifted out of the lane completely) occurred after a lengthy period in which the driver was aware of increasing sleepiness, and usually after a period of fighting sleepiness.

6.5 Some drivers did not seem to realise that feeling very sleepy meant that they were likely to actually fall asleep.

6.6 Another study[25] by Horne suggested that people often fall asleep more quickly than they realise or expect.

7 DRIVERS' TACTICS TO AVOID FALLING ASLEEP

7.1 Given that drivers are usually aware that they are feeling sleepy, many employ a range of strategies to help themselves fight sleep and to stay awake. Maycock[8] asked drivers to list the tactics they use.

Open windows/turn up air conditioning	68%
Stop and go for a walk	57%
Listen to radio/cassette	30%
Talk to a passenger	25%
Drink coffee	14%
Other	15%

7.2 A series of studies at the Loughborough University Sleep Research Centre assessed the effectiveness of these measures, and found that the only ones that had any effect (beyond a very short term 10 - 15 minutes) were an intake of caffeine of at least 150 mg and a nap of around 15 minutes.

7.3 **Listening to the Radio**
Subjects who had been restricted to five hours sleep the night before drove on a driving simulator for 2.5 hours on monotonous roads. Listening to the radio had no significant effect in reducing sleepiness or in reducing 'incidents' (i.e. drifting out of lane), other than for an initial, very short, 10 to 15 minutes.[43]

7.4 **Air Conditioning**
The same study[43] assessed the effects of air conditioning, but also found no significant benefit.

7.5 **Exercise**
A study[44] examining whether exercise can help to reduce sleepiness compared the effects of 10 minutes light, 10 minutes moderate and 10 minutes heavy exercise. Light and moderate exercise made some of the subjects feel less sleepy, but only for about 10 minutes. Heavy exercise produced better results, and the effects lasted for about 30 minutes. However, it does not seem feasible for people to take heavy exercise during breaks from journeys, or indeed as preparation for a journey. Therefore, exercise is not a practical way of avoiding or reducing driver sleepiness.

Caffeine

7.6 A trilogy of studies[45-47] assessed the effects of caffeine intake on driver sleepiness using a driving simulator. The first[45] found that it takes around 30 minutes for caffeine to take effect but that taking 150mg of caffeine in the early afternoon was effective in reducing sleepiness, and sleep related 'incidents', for up to one hour.

7.7 A second study[46] found that combining 150 mg of caffeine with a nap of around 15 minutes significantly reduced sleep related incidents for up to two hours, compared to subjects who had taken a placebo (decaffeinated coffee).

7.8 The third study[47] examined the effects of taking 200 mg of caffeine on a group of drivers who had only slept five hours the night before, and on a group who had no sleep the previous night. Again, for the group who had restricted sleep, the caffeine took around 30 minutes to take effect, but then significantly reduced sleep related incidents for the next two hours. However, there was no such effect for the group who had no sleep. In fact, the driving of this group was so impaired that they were unable to continue driving on the simulator for more than one hour. The caffeine had some effect for the first 30 minutes, but this deteriorated markedly thereafter.

Naps

7.9 Horne[46] reports that various studies have shown that taking a nap can reduce impairment caused by sleepiness, and that the minimum nap time required to gain any benefit is 4 minutes, but naps of 20 minutes or more tend to be counter-productive. The optimum nap period is 15 minutes.

7.10 Two of the studies [46-47] referred to above also examined the benefits of taking a nap, (in addition to examining the benefits of caffeine intake) and found that taking a 15 minute nap was as effective as taking 150 mg of caffeine. The second study found that combining a nap and caffeine was particularly effective.

Conclusion

7.11 Most of the things that drivers do to fight off sleepiness when driving are ineffective for more than around 10 minutes. They are only useful in an emergency to provide time for the driver to find somewhere safe to stop and rest.

7.12 The only measures that have an effect in reducing sleepiness when driving are taking a nap of around 15 minutes and taking at least 150 mg of caffeine. However, even these measures are no substitute for sleep. And there is some concern that drivers may use these tactics to enable themselves to continue driving when they should really stop.

7.13 It is clear that while drivers are aware that they are becoming sleepy, and that this increases their risk of having an accident, many will persevere with their driving, and employ a number of measures to fight off sleepiness.

7.14 Education and publicity measures are required to raise awareness amongst drivers of the dangers of driver fatigue. Such measures could focus on:

- the dangers of driving when tired and the consequences of falling asleep
- the signs that a driver is becoming too tired to continue driving
- the ineffectiveness of common tactics (such as listening to the radio)
- the relative effectiveness of caffeine and naps
- the need to plan journeys
- the need to rest well before long journeys
- the increased risk that illness, alcohol, drugs and medicines generate
- the types of journeys that carry the highest risk.

8 HIGHWAY ENGINEERING

8.1 Much of the research into driver fatigue has identified that dull, monotonous roads increase the risk of sleep related accidents. Unfortunately, it is not feasible to design roads, such as motorways, that are stimulating to drive along. However, there are some highway design and engineering measures that can be used successfully.

Hard Shoulder Rumble Strips

8.2 As sleep related accidents often involve a vehicle drifting out of lane, it is thought that rumble strips along the edge of a road, and particularly along the hard shoulder of motorways, may wake up a drowsy driver and so avoid an accident.

8.3 In the USA, an innovative rumble strip called the Sonic Nap Alert Pattern (SNAP) was developed and installed on the highway shoulder of the Pennsylvania Turnpike[48]. A distinct warning sound and vibration are produced when drowsy or inattentive drivers' vehicles drift to the right and their tyres roll on the strips. After installation of SNAP, drift-off-road accidents per month decreased by 60% - 70%.

8.4 A 1994 study[15] of continuous shoulder rumble strips (CSRS) in 34 states that used CSRS along at least parts of their freeway systems, and some other roads, concluded that CSRS can reduce run-off-road accidents by 20% to 50%.

8.5 Concern in Japan about accidents, particularly involving truck drivers, caused by the driver falling asleep resulted in the development of a striped road surface design to help keep drivers awake at the wheel. This was used at locations where accidents probably caused by drowsy drivers were frequent. Accidents in these locations were reduced to zero where previously there had been two or three per month[49].

8.6 In the UK, the use of continuous raised rib markings is governed by the Traffic Signs and General Directions regulations 1994, and the DETR provide advice and guidance on their use in Traffic Advisory Unit leaflets[50].

9 IN-VEHICLE TECHNOLOGY

9.1 Devices to detect when drivers are falling asleep and to provide warnings to alert them of the risk, or even to control the vehicle's movement, have been the subject to much research and development. Some are designed to monitor the driver and detect changes in, for example, blink rates or head position. Others detect changes in vehicle movement, such as drifting out-of-lane. However, there are concerns about the reliability of such devices and that drivers may rely on them to warn them when the situation becomes particularly dangerous rather than consider and plan when they should take rest breaks. It has been shown that drivers are normally well aware that they are sleepy, so why is a device necessary to tell them so?

9.2 An analysis of collision warning devices[51] found that a system which only alerted a driver to a potential accident due to an unintentional lane change or roadway departure was not likely to be cost effective. However, a system which could also warn of potentially hazardous situations when other manoeuvres were being made could be very beneficial.

9.3 One study[52] assessed whether degradation in driver performance could be detected from controlled inputs of drowsy drivers. A test was developed to replicate the kind of driving environment associated with single vehicle run-off-the-road type crashes. Physiological measures of drowsiness were recorded on a closed-circuit track. Driving sessions were conducted when test subjects were both alert and sleep deprived. The results indicated that lane departure, arising from a loss of alertness due to fatigue, may be predicted by monitoring movements of the steering wheel.

9.4 An evaluation of the Safe-T-Cam System[53], where passive image processing has been used to monitor the movement of heavy vehicles indicated that on average such a system could reduce excessive driving hours by over 3%, and excessive speed by over 2%. Additional morale benefits were improvements to company image, driver education and awareness of safety, and to vehicle on-road/time efficiency.

9.5 A variation on devices to detect drowsiness is a device to help maintain alertness. An experiment[54] was conducted using a driving simulator to assess whether drivers' alertness could be maintained in drowsiness-inducing conditions by a 'gamebox'. When driving with the gamebox, drivers reported a lower degree of drowsiness and fewer instances of sleep episodes as compared to a control condition. Driving with the device resulted in fewer incidents and accidents, and those that did happen, occurred later in the session. The quality of vehicle control deteriorated progressively over the course of the session, but less so in the gamebox condition.

9.6 An evaluation[55] of three fatigue monitors (an eye closure monitor, a head nodding monitor and a reaction time monitor) suggested that the devices showed an ability to detect fatigue in some cases but were not able to maintain alertness and thus prevent performance deterioration. There were a few instances of the audible alarms startling the driver.

9.7 Evidence from the field of rail transport indicates that the use of a stimulus/ action response system is likely to improve driver attentiveness and thus safety. In further refinements, when it was linked to existing vehicle systems (viz. the brakes) so that when the driver failed to respond to the stimulus, or responded inappropriately, the brakes were applied, it proved 'fail-safe'.

10 CONCLUSION

10.1 Driver fatigue is a serious problem resulting in many thousands of road accidents each year. It is not currently possible to calculate the exact number of sleep related accidents because of the difficulty in detecting whether fatigue was a factor and in assessing the level of fatigue. However, research suggests that up to 20% of accidents on monotonous roads in Great Britain are fatigue related. Research in other countries also indicates that driver fatigue is a serious problem.

10.2 Young male drivers, truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. However, any driver travelling long distances or when they are tired, is at risk of a sleep related accident. The early hours of the morning and the middle of the afternoon are the peak times for fatigue accidents, and long journeys on monotonous roads, particularly motorways, are the most likely to result in a driver falling asleep.

10.3 It is clear that drivers are aware when they are feeling sleepy, and so make a conscious decision about whether to continue driving or to stop for a rest. It may be that those who persist in driving are either unaware of the risk they are taking, or underestimate the risk of actually falling asleep while driving. Or it may be that some drivers choose to ignore the risks (in the way that drink drivers do). However, this awareness at least provides a foundation on which to build educational messages.

10.4 Most of the things that drivers do to try to keep themselves awake and alert when driving are ineffective, and should only be regarded as emergency measures to allow the driver time to find somewhere safe to stop. Drinking at least 150 mg of caffeine and taking a nap of around 15 minutes are the only measures that help to reduce sleepiness. But even these are temporary measures; sleepiness will return if the driver does not stop driving within a fairly short period of time.

10.5 The safest option is for drivers to avoid driving when sleepy, when they would normally be sleeping or when they are ill or taking medication which contra-indicates driving or using machinery. It is crucial that drivers plan journeys, especially long ones involving driving on motorways or other monotonous roads. Drivers should:

- Try to ensure they are well rested, and feeling fit and healthy (and not taking medication which contra-indicates using machinery), before starting long journeys
- Plan the journey to include regular rest breaks (a break of at least 15 minutes at least every two hours)
- If necessary, plan an overnight stop
- Avoid setting out on a long drive after having worked a full day
- Avoid driving into the period when they would normally be falling asleep
- Avoid driving in the small hours (between 2am and 6am)
- Be extra careful when driving between 2pm and 4pm (especially after having eaten a meal or drunk any alcohol)
- If feeling sleepy during a journey, stop somewhere safe, take drinks containing caffeine and take a short nap.

10.6 Employers have a vital role to play in managing the risks involved in their employees who drive for work purposes. As part of their health and safety policies and practices, employers should adopt and implement the principles of managing occupational road risk, with particular reference to reducing the risk of their employees being involved in a sleep related driving accident. Principally, employers should:

- Manage the safety of their employees who drive
- Consider and implement the most suitable system of risk assessment and re-assessment for the road safety needs of the company and its employees
- Choose the right vehicle and the safest specification for the needs of the job
- Ensure that work practices, journey schedules, appointments and routes enable drivers to stay within the law
- Provide sensible guidelines about driving and for the use of the vehicles for all employees who may drive for the company.

10.7 **Holiday and Travel Companies**

One of the times when individual drivers may drive in the early hours of the morning is when they are catching, or returning from, an early flight or ship/ferry journey. Drivers returning from long haul flights, or coming off ships and ferries also often drive home after having had very little sleep in the previous 24 hours. Holiday companies, airlines and shipping lines should consider what advice and information they could offer to their customers, particularly as they sell alcohol to their passengers, which exacerbates the risk.

10.8 **Enforcement**

It can be difficult for the Police to detect a fatigue-impaired driver. However, some Police Forces are currently trialling general impairment roadside tests, which may prove effective in detecting sleepy drivers, as well as drivers affected by alcohol, drugs or medicines.

10.9 The regulation and enforcement of driver hours rules is obviously important. However, these rules do not cover many drivers who drive for work (e.g. company car drivers) and who do very high mileages. Even some of those drivers and operators who are governed by the Rules, sometimes find way of circumventing them. It would be difficult to include non-vocational drivers within the regulations because their vehicles are not currently required to have tachographs. However, it may be that technological advancements in the long term would enable motor vehicles (with a few exemptions) to have some form of system that records and maintains a record of an individual's driving hours, no matter what vehicle they are driving. Whether this would be publicly or politically acceptable is another issue. In the meanwhile, guidance could be developed for employers on drivers' hours that mirrored the existing regulations.

10.10 **Technical Devices**

Technical devices to detect when drivers are feeling sleepy and provide warnings to them, or even to take control of the vehicle, are being researched and developed. Such devices may prove beneficial, but there are concerns that drivers would rely on them instead of managing themselves for safety.

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RoSPA
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Road Safety Information

June 2011

DRIVER FATIGUE AND ROAD ACCIDENTS

Introduction

Driver fatigue is a serious problem resulting in many thousands of road accidents each year. It is not possible to calculate the exact number of sleep related accidents but research shows that driver fatigue may be a contributory factor in up to 20% of road accidents, and up to one quarter of fatal and serious accidents.

These types of crashes are about 50% more likely to result in death or serious injury as they tend to be high speed impacts because a driver who has fallen asleep cannot brake or swerve to avoid or reduce the impact.

Sleepiness reduces reaction time (a critical element of safe driving). It also reduces vigilance, alertness and concentration so that the ability to perform attention-based activities (such as driving) is impaired. The speed at which information is processed is also reduced by sleepiness. The quality of decision-making may also be affected.

It is clear that drivers are aware when they are feeling sleepy, and so make a conscious decision about whether to continue driving or to stop for a rest. It may be that those who persist in driving underestimate the risk of actually falling asleep while driving. Or it may be that some drivers choose to ignore the risks (in the way that drink drivers do).

Crashes caused by tired drivers are most likely to happen:

- on long journeys on monotonous roads, such as motorways
- between 2am and 6am
- between 2pm and 4pm (especially after eating, or taking even one alcoholic drink)
- after having less sleep than normal
- after drinking alcohol
- if taking medicines that cause drowsiness
- after long working hours or on journeys home after long shifts, especially night shifts

Drivers most at risk

Young male drivers, truck drivers, company car drivers and shift workers are most at risk of falling asleep while driving. However, any driver travelling long distances or when they are tired, is at risk of a sleep related accident.

Young male drivers are most commonly involved in sleep-related road accidents, but this may be because they are more likely to drive in situations which are likely to lead to fatigue rather than because they are more susceptible to falling asleep at the wheel. Similarly, shift workers and commercial vehicle drivers may have a higher risk of sleep-related crashes due to work-related factors.

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Many professional drivers, especially HGV drivers report increased levels of sleepiness and are involved in a disproportionately high number of fatigue-related accidents. However, two thirds of drivers who fall asleep at the wheel are car drivers. Most (85%) of the drivers causing sleep-related crashes are men, and over one third are aged 30 or under.

Sleep Disorders

Anyone who suffers from a sleep disorder that prevents them from getting sufficient sleep is likely to be excessively tired during their waking hours, and so to be at higher risk of falling asleep when driving. Those most at risk of suffering from a sleep disorder, such as sleep apnoea, include professional drivers. It has been estimated that such drivers are between 6 and 15 times more likely to have a road traffic accident than those without the condition.

This type of medical condition is often undiagnosed, and some drivers may be unwilling to seek help because they fear losing their driving licence. However, there are established treatments for sleep apnoea which allow drivers to retain their licence, and therefore, their livelihood. Anyone suspecting that they have a sleep disorder is strongly advised to contact their GP.

How To Avoid Falling Asleep at the Wheel

The Highway Code (Rule 91) gives the following advice:-

Driving when you are tired greatly increases your accident risk. To minimise this risk

- Make sure you are fit to drive. Do not begin a journey if you are tired. Get a good night's sleep before embarking on a long journey.
- Avoid undertaking long journeys between midnight and 6am, when natural alertness is at a minimum
- Plan your journey to take sufficient breaks. A minimum break of at least 15 minutes after every two hours of driving is recommended
- If you feel sleepy, stop in a safe place. Do not stop on the hard shoulder of a motorway
- The most effective ways to counter sleepiness are to drink, for example, two cups of caffeinated coffee and to take a short nap (up to 15 minutes).

Most of the things that drivers do to try to keep themselves awake and alert when driving are ineffective, and should only be regarded as emergency measures to allow the driver time to find somewhere safe to stop. Drinking at least 150 mg of caffeine and taking a nap of around 15 minutes are the only measures that help to reduce sleepiness. But even these are temporary measures; sleepiness will return if the driver does not stop driving within a fairly short period of time.

The safest option is for drivers to avoid driving when sleepy, when they would normally be sleeping or when they are ill or taking medication which contra-indicates driving or using machinery. It is crucial that drivers plan journeys, especially long ones involving driving on motorways or other monotonous roads.

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Drivers should:

- Try to ensure they are well rested, and feeling fit and healthy (and not taking medication which contra-indicates using machinery), before starting long journeys
- Plan the journey to include regular rest breaks (at least 15 minutes at least every two hours)
- If necessary, plan an overnight stop
- Avoid setting out on a long drive after having worked a full day
- Avoid driving into the period when they would normally be falling asleep
- Avoid driving in the small hours (between 2am and 6am)
- Be extra careful when driving between 2pm and 4pm (especially after having eaten a meal or drunk any alcohol)
- If feeling sleepy during a journey, stop somewhere safe, take drinks containing caffeine and take a short nap.

RoSPA produces a free guide, "Safer Journey Planner" (PDF 535kb) which gives advice to drivers on how to avoid the risk of falling asleep at the wheel.

Alcohol and Medicines
Even small amounts of alcohol, well below the legal drink drive limit, will exacerbate driver sleepiness, so that a tired driver who has had some alcohol will be even more impaired and likely to crash.

Many over-the-counter medicines, including remedies for coughs, colds, flu and hay fever, cause unwanted drowsiness which might impair driving. Warnings about drowsiness are not always clear so, for example, if the label says "may cause drowsiness", assume that it will do so.

Fatigue Detection and Warning Devices
There are devices to detect when drivers are feeling sleepy and to warn them. However, RoSPA is concerned that would rely on them, and may even be tempted to drive when they are tired, believing that the device will prevent an accident. It is far better for drivers to avoid driving when too tired, to plan their journeys safely and follow the advice in the Highway Code and RoSPA's guides.

Employers

Driving is the most dangerous work activity that most people do. It is estimated that around 150 people are killed or seriously injured every week in crashes involving someone who was driving, riding or otherwise using the road for work purposes. The majority of these tragedies can be prevented. HSE Guidelines, "Driving at Work", state that *"health and safety law applies to on-the-road work activities as to all work activities and the risks should be effectively managed within a health and safety system".* Therefore, employers must assess the risks involved in their staff's use of the road for work and put in place all 'reasonably practicable' measures to manage those risks.

One of the most important things employers must do is ensure that their drivers are not at risk of falling asleep at the wheel.

RoSPA's free guide, "Driving for Work: Safer Journey Planner" gives advice to employers on how they can do this.

Holiday and Travel Companies

One of the times when individual drivers may drive in the early hours of the morning is when they are catching, or returning from, an early flight or ship/ferry journey. Drivers returning from long haul flights, or coming off ships and ferries also often drive home after having had very little sleep in the previous 24 hours. Holiday companies, airlines and shipping lines should consider what advice and information they could offer to their customers, particularly as they sell alcohol to their passengers, which exacerbates the risk.

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MIND sets




A New Vision on European Mobility



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MIND-SETS Deliverable 2.1a


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MIND-SETS: A new vision on European mobility

Date: October 2015 Version: 1

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Project partners

MIND-SETS. Mobility Innovations for a New Dawn in Sustainable (European) Transport Systems

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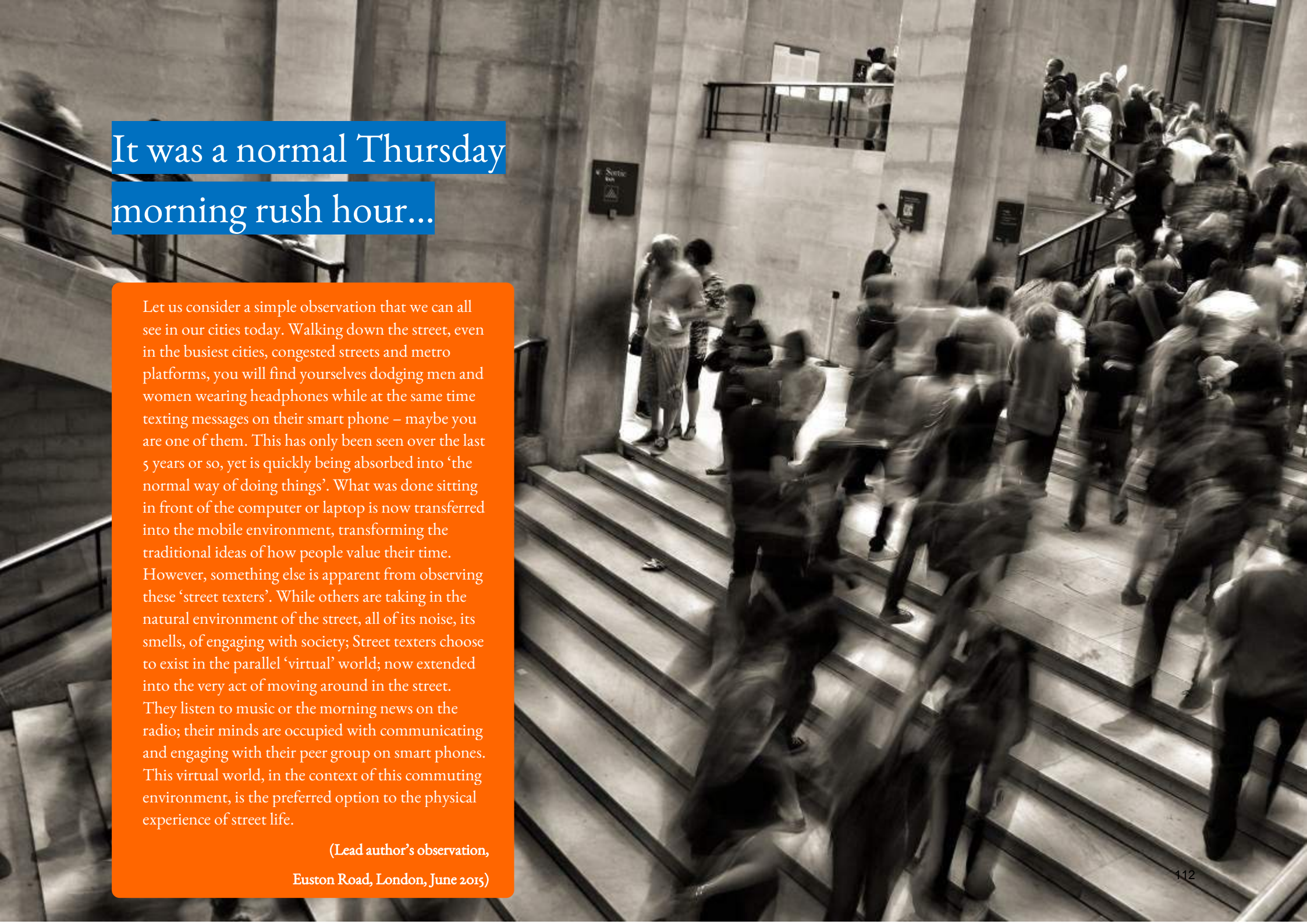

It was a normal Thursday morning rush hour...

Let us consider a simple observation that we can all see in our cities today. Walking down the street, even in the busiest cities, congested streets and metro platforms, you will find yourselves dodging men and women wearing headphones while at the same time texting messages on their smart phone – maybe you are one of them. This has only been seen over the last 5 years or so, yet is quickly being absorbed into 'the normal way of doing things'. What was done sitting in front of the computer or laptop is now transferred into the mobile environment, transforming the traditional ideas of how people value their time. However, something else is apparent from observing these 'street texters'. While others are taking in the natural environment of the street, all of its noise, its smells, of engaging with society; Street texters choose to exist in the parallel 'virtual' world; now extended into the very act of moving around in the street. They listen to music or the morning news on the radio; their minds are occupied with communicating and engaging with their peer group on smart phones. This virtual world, in the context of this commuting environment, is the preferred option to the physical experience of street life.

(Lead author's observation,

Euston Road, London, June 2015)

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Preface

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The MIND-SETS project (Mobility Innovations for a New Dawn in Sustainable (European) Transport Systems) is funded by the Directorate General for Research of the European Commission, under the Horizon 2020 Programme. Horizon 2020 is the financial instrument implementing the 'Innovation Union', a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness - the means to drive economic growth and create jobs.

The MIND-SETS project is a completely new perspective on mobility. Mobility is the largest industry in the world and an industry experiencing rapid growth on all transport modes, an unceasing desire for mobility in European society and a vibrant economic sector full of new ideas, concepts and services for keeping Europe moving. The key to success is economic growth - while fully respecting the requirements to ensure 'growth with sustainability' and 'growth with inclusion'. In this way, advances in mobility will proceed in harmony with European environmental and energy goals; and with the objectives to achieve greater social inclusion in European society and greater individual and social well-being.

In achieving these higher goals, it is important that those target groups responsible for the mobility means we all enjoy, understand which mobility innovations will be 'game changing' and grow economies; which ones will be accepted by different generations of the European public – and which one could be rejected and why. This requires a full understanding of the underlying value of mobility in people's lives; whether they are making local journeys, national or trans-European: Whether they are on foot, cycle, by public transport on land, sea, by air. In addition, physical and virtual mobility (via the internet) are now fully integrated and one cannot understand one without understanding the other. Mind-sets centrally addresses this issue in 3 basic objectives:

- How to better understand mobility (to better influence and change it)
- How to predict the likely future attitudes to, and patterns of, mobility
- What forms of mobility policies, products and services will best meet these future mobility needs

In developing the MIND-SETS approach, the goal is to synthesise and coordinate current intelligence as building blocks for the new approach; and then to use the approach (through guidelines and a 'Knowledge Centre') to advise and support the key stakeholders in the wider European mobility industry.

One of the Commission's important justifications for launching the MIND-SETS project was that, while we have good knowledge of mobility patterns, we still lack the basic understanding of mobility and how travel patterns may be influenced and changed. An important element of MIND-SETS is that it takes a step back from current professional analysis of mobility and travel patterns, to more fully understand how mobility is placed in the everyday lives of

Europeans; using and approach which embrace a wide range of intelligence from many disciplines.

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This deliverable (**D2.1A**) forms the synthesis report from two linked reports (**D2.1B** and **D2.1C**) produced within the MIND-SETS project under its second workpackage. The objective of this report is to provide a new perspective to understanding mobility through coordinating the intelligence from a wide range of disciplines: breaking down academic language barriers to identify common themes in thinking and approach.

This report combines with two sister reports (**D2.1B**) that brings together perspectives on understanding mobility from a wide range of disciplines, including economics, psychology, sociology, spatial analysis and social networking among others; and a further report, **D2.1C**, that develops an approach based on the analysis of the common values and mind-sets within different generations of European society. Both of these reports are then synthesized in this 'top report'.

Details of the 3 reports and their citations are as follows:

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KONINGS, H and S, VAN DIST (2015). MIND-SETS: A generational perspective on mobility. **Deliverable 2.1C of the MIND-SETS project.** European Commission Directorate General for Research, Covent Garden, Brussels.

It is hoped that this report, and its two sister documents, will spark a new line of thought and debate among mobility specialists and, through the forthcoming MIND-SETS guidelines and Knowledge Centre, provide the intelligence and support that stakeholders need in developing new mobility products and services that will meet future mobility aspirations in Europe and drive sustainable economic growth to the benefit of all.

Professor **Laurie Pickup**

MIND-SETS Technical Coordinator
October 2015

RATV A–

Understanding mobility in a wider context

1. Introduction

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Whether for land, air, sea or through the internet, mobility is the biggest industry in the world. The MIND-SETS project will try to understand mobility. Not mobility as seen from within the traditional, narrow perspective of the transport planner, but to understand mobility from a much wider perspective.

Only by taking a step back and trying to understand mobility in this wider context can we hope to fully appreciate the rapidly changing mobile world in which we live. How do we understand the opportunities and dangers mobility can pose and the acceptance or rejection of the plethora of new 'mobility policies, products and services' that are being planned and offered to us.

To increase our understanding of mobility, the project has needed a new type of consortium which mixes those trained in conventional transport social science, to those trained in the broad set of disciplines that encompass the wider view of mobility – from neo classical to behavioural economics, from cognitive psychology and psycho-analysis to behavioural psychology, from the traditional

‘vertical mobility’ of sociologists to the ‘Mobilities’ perspective, from social geography and mental maps. Importantly the project includes expertise assessing future visions, such as the increasing mix of physical and virtual mobility in our lives, automation, customisation and personalisation.

Each of these disciplines brings a new vision of mobility, each with its own language and concepts; but each one providing important pieces of an evolving jigsaw of how mobility defines us as individuals, families and neighbourhoods; and how this will shape the future.

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MIND-SETS was born from a realisation that the current passage of mobility research was increasingly becoming a ‘progress trap’; and that – to make innovative steps forward – there was a need to take a step back and re-examine the fundamental roots of mobility from all perspectives. In doing this, the hope is to find a new, accelerated understanding and direction for mobility policy makers (in their broadest definition), and innovators in the mobility industry seeking to penetrate new markets among populations where the hunger for more mobility is unceasing.

This realisation was not only the view of the MIND-SETS consortium but also of the transport and research policy making arms of the European Commission in Brussels. Underlining the fact that the mobility industry is the world’s largest industry, there was an increasing need to harness a new and fuller understanding of mobility: in order for European industry to grow its economy within expanding world mobility markets. In achieving this it is essential that mobility growth happens in a sustainable way, and in a way that is fully inclusive to all sections of society. The overriding objective of MIND-

SETS is based around the 3 guiding principles of planet (sustainability), people (inclusion) and profit (growth). The project mission statement is:

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At any one moment in Europe, there are thousands of travel behaviour studies ongoing in municipal authorities, universities, consultancies and from within the transport industry. Over the last 40 years, much has been learned from these studies about the travel behaviour of different groups of society. We know, for example, the social distribution of the types of journeys made their mode, timing, length and duration. We have knowledge of the impacts that greater mobility and accessibility have had on the volume of mobility in recent decades, and the nature of that growth. We have knowledge of the impacts of mobility deprivation on individuals. However, we still understand little of the underlying processes that drive mobility decisions – what factors affect people’s propensity to change their behavior?

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What are the underlying ‘mobility genes’? Is it possible to identify a ‘mobility DNA’ that manifests itself in different people, in different places and times; but

a mobility DNA where the genetic roots are more fully understood in a way that can enable us to appreciate it, to plan for it, to harness its opportunities, and to guard against the adverse impacts it can have.

In this context, the MIND-SETS journey has a simple logic:

- To absorb and digest the wealth of intelligence on mobility: combining ideas to create new innovation.
- To produce a new approach to understanding mobility; and to encompass this approach in guidelines which are tailored to meet the needs of the primary target groups.
- To actively exploit the approach, through the guidelines, by developing an interactive 'MIND-SETS Knowledge Centre', which policy makers, product, systems and service suppliers can use to make more informed decisions in growing their markets, and to achieve more sustainable and inclusive living.
- To use MIND-SETS to provoke further research and development in the field.

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This report is the first stage of the MIND-SETS story. It draws on the impressive range of multi-disciplinary skills within the consortium to identify the building blocks of the MIND-SETS approach – the ideas and concepts, backed up by high quality research. This has, by the very nature of the task, produced a wealth of information. Each member of the consortium had sought to digest the ideas and concepts on mobility from their own disciplinary backgrounds, producing innovative ideas. In turn, the important interplay between consortium members has sought to further this innovation through seeking common and supportive elements in the thinking; overcoming the barriers of disciplinary languages into a single coherent form.

2. What is mobility?

Mobility is a fundamental freedom – it is one of the most fundamental freedoms we have; whether we choose to use it or not. As a result, mobility plays an important role in defining social status and power relationships between individuals, communities and countries. It defines the ability people have to move about in time and space to satisfy their activity needs; and thus plays an important role in influencing their life chances. It influences the possibility and course of personal relationships and social interaction. It dominates conversation; as people reflect on the wider experiences they have had from increased mobility and of the travel experience itself. It happens quite often that when two people meet for the first time that some comments are made to establish the relative mobility level (and thus expected respect) of each person. It is an important defining element in a person's self-esteem and self-achievement through the course of their lives; and an important factor defining their projected personality to others. In summary, mobility is a central feature of our identity; both as we feel it and how others see it. It also explains why measures to restrict mobility meet with the strongest opposition.

While mobility freedoms bring to individuals greater feelings of control and social advantage, it is important to underline that mobility does not have to be fully expressed; particularly where most activities are easy to reach in the local area – there is a difference between mobility potential and mobility use. In this context, it is important to remember that most societies do not support the

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unlimited expression of freedoms; but the practice of moderation and self-control – relegating freedom to the background. This feature underpins most of current mobility policy. Psycho-analysts have found that levels of 'excessive freedom' can lead to boredom, in its most positive form; and to disorders and addiction in its worst form. Sigmund Freud underlined the importance of social norms in placing 'an innate internal break on pleasure' (*Freud, 1920*).

Mobility is about freedom. Accessibility is about meeting needs. These two factors are frequently mixed and misinterpreted. In highly mobile dependent societies such as in Europe, mobility has a large influence on access. However, it is perfectly possible to have highly mobile people living, for the most part, local accessible lives. Also to have people with low mobility suffering the disadvantages of the need to access distant activities with limited means.

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lrfoywsr ehfsphwdr lp tsvxdrxtsdf2 jsdookhr
h1tos1xlrj xkhehrhilxwsirho p seldxlhw

The mobility horizons of 2020 and beyond will reflect quite different lifestyles to those experienced in the late 20th century. At the macro scale, the migration of European (and World) populations between countries continues to accelerate for economic and lifestyle reasons. On an annual basis business and leisure mobility is now the largest economic sector in the world. People now have the ability to live and work in several countries; whether they are professional workers or low income economic migrants. All of this will influence the social development of European society. The mobility industry is also a major employer in the European economy; in primary manufacture, systems supply, on the ground operations, or people working within communities providing mobility advice and support. It is essential in meeting future mobility needs that the opportunities of mobility growth take account of the living and working conditions of workers in the industry.

Nseldx2 lwlrfvhdwrj o2 ehfsplrj diyrgdphrxdodvthfx
ghilrlrj xkhfkdvdfxhvdrg dihwx2dhwsi Eyvsthdrw
fkdrjlrj xkhglzhvwkx2 si Eyvsthdr fyoyvh

While the overall numbers of journeys that people make at the regional and urban level have not increased significantly in recent decades, the length of journeys has increased markedly. The volume of daily mobility has placed

heavy demands on urban and sub-regional transport networks. Urban Europe has grown rapidly over the last half century and will continue to grow; though the rate of growth is expected to slow towards 2050. In addition, we cannot simply think of mobility in terms of transport networks any more. The internet and social media channels are transforming traditional concepts of mobility. All of the important factors listed above that people value in their travel mobility are now being transferred to the new 'virtual mobility'. For every purpose for which a trip can be made, there is now a virtual substitute; be it space for the development of relationships and friendship networks, gaming for leisure activities and so on. To many experts, this is not a process of substitution, but a broadening of mobility options, leading to a further expansion in the volume of both physical and virtual mobility. Virtual mobility is now the primary driver of lifestyle development in Europe, having profound impacts on how we travel to meet activity needs; and how we receive the goods and services we need.

What is of growing concern to experts in many fields, from environmental psychology and psycho-analysis, through sociology to economics and the planning arena, is whether the pace of mobility growth and innovation is happening too fast for individuals and society at large to absorb. This is something observed in the 1970s (the pre-internet age) by the American author Alvin Toffler in the book 'Future Shock'.

Cdp dxh fkdrj h lwidwx eyxv fldoevhdngs o r lv p yfk idwhv

Mobility can have diverse impacts within society. People's identities and the growing gap between those who have high mobility, and those who do not, are becoming threatened by the power of the mobility explosion: leading to defensive actions in the form of xenophobic types of behaviour and community unrest in the neighborhoods' of many European cities.

Wlvxydop seldx2 lwrs o xkh t vlp dv2 gvlzhv si dihwx2dh ghzhos t p hr xlr Eyvs t h

The continuing mobility revolution, by its very nature, will have differing impacts on different groups in society. Most people in society suffer some form of mobility disadvantage (either permanent or transitory) as they pass through the life cycle. This will be due to dependency (among the very young and old), frailty (as a result of age or physical disability), gender role, low income, faith or ethnicity or sensory and mental impairment. These factors are not limited to mobility but affect the whole lifestyles of people afflicted with these conditions. Mobility disadvantage is most acute when these factors combine in any one individual, family or community. Where these mobility disadvantages become compounded in particular neighbourhoods, then they can give rise to social breakdown (The very definition of the word 'the mob').

Hs o p yfk p seldx2 lwxkhvh

3. How much mobility is there?

Quite apart from the scale of mobility in people's minds, the expression of mobility across Europe has reached explosive proportions, putting further pressure on already congested transport networks from urban to international, and increasing the demands for new types of mobility products and services. Work within the MIND-SETS consortium has assessed the scale and nature of this growth, which is presented in detail in the sister document. As a result of this work, we can identify the key dimensions to physical mobility in Europe.

- N seldx2 gsp lr dxhwdihwx2 dh. In 2012, there were 6,391 billion passenger kilometers undertaken in Europe, 82.4% of them being made by road. The level of road transport in 2012 was at the same level as in 2004. European citizens travelled an average distance of 34.7km per day. Private households in the EU spent 13.0 % of their total consumption on transport-related items, and the transport sector accounted for 4.8% of the EU GDP (EUROSTAT 2014).

- Msf doxvlt wgsp lr dxh szhvosr j glwdr fh xvlt w Road trips over three hours in duration represent only 12% of the total trips made between 'NUTS3' regions in Europe. Roughly 70% of all of the road trips made in Europe take less than 2 hours to complete (TEN-CONNECT 2009).

- Rhst dh dvh xvdz hodr j iyvxkhvdr g iyvxkhv Communication technologies are already impacting on mobility both by substituting trips (e.g. because of email, teleconferencing) and by inducing new trips (e.g. due to enlarged relations supported by ICT). The net impact is difficult to assess, isolated from other social, economic and technologic drivers but on

a long-time perspective this may increase personal and business mobility patterns (COMPASS 2013).

- N seldx2 dnz howfsyog fkdrjhlrghthrghrxo2 si hfsrsplf thvisvp drfho lxk yvedr p seldx2 ehfsplrj p svh wxdech The aggregate demand for passenger travel developed roughly in line with per capita GDP and population growth in the past, but there are signs that this trend could be weakening in advanced economies, especially in relation to passenger mobility in urban areas (OECD ITF 2013). Mobility policy is proving more efficient in urban areas (for example in response to policies for road pricing, vehicle taxation and parking regulation).

- Edwx o hwxp lj vdxlsr wo lxk EWhr odvj hp hr xo loofsr xlr yh Between 2004 and 2011, after enlargement of the EU to Eastern European countries, about 1,8% of the population in new Member States moved to western European countries, raising the host country population by 0,3%. Thirty million eastern Europeans moved to other European countries between 1997 and 2008. Transitional restrictions in place diverted workers away from traditional destinations like Germany towards more easily accessed labour markets in the UK, Ireland and the Mediterranean (Holland et at, 2011).

- Usyxk Osvxk p lj vdxlsr kdwlr fvhdwhg gyh xs xkh hfsrsplf fvlwhwivsp 644/ Over one million have emigrated from Mediterranean countries to other European countries. For example, in 2014, of all immigration into the UK from other EU member states, the predominant flow was from Italy and Spain; not from Eastern Europe (EUROSTAT 2015). Despite the extent of the 2008 crisis, south-north migrations have been generally one order of magnitude lower that east-west migrations in the 2000s, indicating low levels of labour mobility within western European countries (CEPS 2014).

- Osvxk vsyxk p lj vdxlsr wdr nhg xs vhwlghr xldoxsyvlvp dr g vhxlvhp hr xo loofsr xlr yh xs j vso The proportion of elderly people in Europe is expected to continue rising to 20% of the overall EU population in 2020 and to 30% by 2060 (EUROPOP2013). The older generation has become keen and frequent travellers, having both purchasing power and leisure time (Frye 2015). For example, in 2009, there were almost 0.5 million foreign residents under the age of 55 years living along the Spanish Mediterranean coast and in the island regions. Most of this migration has been from North West Europe, plus Norway and Switzerland. This older niche European immigration represents 1.6% of the total overall population in these regions (Rodríguez et al, 2010).

- Osvxk Usyxk xsyvlvp sr xkh vlwh The leading tourist economies in Europe are France with 84.7 million visitors in 2013 (the global leader), Spain with 60.7 million, Italy 47.7 million, Turkey 37.7 million, and Germany and the UK with 31 million each (UNWTO 2015). The expanding numbers of tourists are a challenge both for transport networks (especially airports) and for social accommodation of larger volumes of tourists concentrated into the top tourist destinations. Northern European countries have a larger trend towards international tourism within the EU, whereas Mediterranean countries, to a much higher extent, take vacations within their own countries (Torkington, 2012).

- N lj vdxlsr wivsp syxwhgh xkh EW 33.5 million people who resided in the EU in January 2014 had been born outside of the EU (6.6%). The largest numbers were found in Germany (7.0M, 8.7%), the UK (5.0M, 7.8%), Italy (4.9M, 8.1%), Spain (4.7M, 10.1%) and France (4.2M, 6.4%). Main routes into the EU have moved eastwards from Spain in the 2000s to Italy and the Eastern Mediterranean currently. However, most migrants living illegally in the EU originally entered with valid documents via EU

airports but then overstayed on a visa. On the other hand, emigrants from the EU outnumbered immigrants in 2014 in 12 countries: Bulgaria, Ireland, Greece, Spain, Croatia, Cyprus, Poland, Portugal, Romania and the three Baltic States (Eurostat 2015).

- Dhfvhdwr j fdvso rhwklt lr Y hwxhvr Eyvst h After rising almost continuously since the end of the Second World War, the rate of increase in car ownership in Western-European countries has started to decline, especially in cities. This trend of 'Peak Car' started before the onset of the crisis in 2008. To many professionals, this new trend suggests that it was being caused by lifestyle changes, rather than economic stringency (EUROSTAT 2015). To others, it is still uncertain as to whether the Peak Car phenomenon denotes a fundamental change in people's value sets toward their mobility. In some countries, the economic crisis and extremely high youth unemployment have played a role in postponing the purchase of cars. Also, deliberate policy measures to discourage car use in urban areas are also thought to have played a role in decreasing car ownership where it has been observed.

- Ir xkh isvp hvfsp p yr lwxfsyr xdhwsi Edwxhvr Eyvst h car ownership is increasing rapidly, albeit from a lower base than in Western European countries. The drive to purchase a car mirrors the increase in post-war mobility freedoms that characterized Western Europe in the 1950s and 1960s. As a consequence, public transport patronage is falling from the high level of use that it had prior to the 1990s. High status is given to personal car ownership and to company car ownership.

- Ir f vhdwhg t vhihvhr f h isv vdloxdz ho The proportion of all trips undertaken by rail is generally greater in central Europe than in other parts of Europe; Switzerland 18%, Czech Republic 17%, Austria 15% and Hungary 13%. At the other end of the spectrum, peripheral countries, especially smaller ones or countries with geographical constraints rely less on rail to meet mobility needs: Greece 2%, Ireland 3%, Portugal 5%, Finland 6% and Spain 7% (EUROSTAT 2014).

- Wkh si wkdvhg sv dffhwwhedh p seldx2 whvzlfhwEconomics is becoming less about ownership and more about access. Younger generations are becoming less interested in purchasing their mobility and more interested in renting and sharing it (Hajkowicz, 2012). Across Europe in 2014 there were almost 5 million members of car-sharing schemes, popularity being significantly higher in Germany, followed by France and the United Kingdom (STATISTA 2015).

- Wkh si wkdvhg p seldx2 wsoyxdsr w elnh wkdvlr j There are currently more than 500 cities in 50 countries hosting bike-sharing programs. Prominent cases in Europe include Paris, London and Barcelona, with more than 6000 bikes available in each city (Wikipedia 2015).

- Ir xhvr dxlsr dop seldx2 ehxo hhr Eyvst hdr fsyr xdhwlwwdoozhv2 dp lxhg Less than 5% of all trips and less than of 10% of all trip kilometers are for trips that cross European member state borders. Cross-border mobility between neighboring regions on 2 sides of a political border is even more limited; below 1% of all trip kilometers made (TEN-CONNECT, 2009). Low border permeability also affects economic activities, despite the European single market for goods being in place already for 30 years. Services represent 75% of the aggregate GDP of the EU, estimated at approximately 9 trillion Euros in 2011; but less than 0.7 trillion of this is traded across EU internal borders, 7.4% of the trade in services (Santagostino, 2012).

- Ir xhvr dxlsr doxdz holr Eyvst h lwwdogsp lr dxhg e2 ksdgd2wJust over 1 in 5 of the passenger kilometers travelled for holidays are

international. Of all passenger kilometers travelled for business, 13.3% are international. Trips to visit friends and relatives between member states represent only 5% of the total passenger kilometers travelled for that purpose; and only 2% of commuting passenger kilometers travelled in Europe was across international borders (ETISplus 2014). Visiting families is expected to increase with the number of economic migrants making more frequent trips to the home country; taking advantage of cheaper air travel for example.

- Alvxvdr wt svxlwgsp lr dxhg lr Eyvst he2 gsp hwxlf fsr r hfxlsr w For equivalent trip lengths, domestic flight are likely to have up to 50% more demand than international flights of equivalent distances within the Union (for example, despite Lyon and Bilbao having similar demographics and both being located 600km from Barcelona, air passenger flows between Barcelona and Lyon are only 60% of the size of air flows between Barcelona and Bilbao) (EUROSTAT 2015). This effect is caused by the "cost of European borders" and/or the "cost of gaps in European integration".

- Ddlo2 fvswvesvghvp seldx2 lwj vhdxhvlr fhr xvdoEyvst h klj kdj kxlr j odr j ydj h fyoxyvdodr g klvwsvlf dokhvlxdj h Approximately 40% of the formal cross-border regions in Europe in 2003 were German speaking (Perkmann, 2003). Mobility between these regions is more prominent than between other regions. The 'hot spots' of cross-border mobility in Europe (that is, the number of people working in a neighboring region of another EU country) mainly concentrate around German borders: such as the Benelux countries, France, Switzerland, Austria, and in other central European countries like the Czech Republic or Slovakia). The largest cross-border flows are into Luxemburg, Basel, and the city cluster of Aachen-Liège-Maastritch, Saarbrüken, Strasbourg, Geneva, Lille, Copenhagen-Malmö and Vienna-Bratislava (ESPON METROBORDER 2010).

- Ir fvhdwlr j t hvp hdeldx2 isvh1 xvd EWesvghvw Passenger flows between cities within the EU and elsewhere in the World are growing faster in many cases than are the flows between cities in different European countries. Within Europe, the largest flows remain the primary domestic inter-city movements within countries: Barcelona-Madrid, Paris-Lyon or Milano-Rome. However, out of the 10 busiest international city-pairs, 6 of them are between European cities and cities outside the continent (mostly between London and American or Asian cities). Proportionally by distance, Asiatic and American traffic is larger from London airports than traffic to EU destinations; African traffic is larger from Paris, and Latin American traffic from Madrid (MIND-SETS based on EUROSTAT 2015).

Europeans are hungrier to realize and take advantage of their mobility freedoms. The growth in mobility in the last 20 years has been of explosive proportions and the projections are for this to continue on all transport modes; from international to urban movements. We can identify 4 dimensions to the increase in European mobility:

- Inter-city and international business and leisure mobility is underpinning economic growth in Europe. The reliance of the Mediterranean economies on annual flows of tourists from Northern Europe and wider afield is marked. This has boosted the growth and capacity of regional airports and seaports. The continued expansion of the single European market has increased movements between the major European cities. This accelerated growth in business travel has, in turn, increased the demands on the major airport hubs and high speed rail networks.

- Trans-European economic and retirement migrations are producing a new level of regular international mobility from the adopted to the home country. This has been assisted by the expansion of 'low cost' flights in the air sector; although it has increased mobility on all Trans-European networks, road, railway and sea crossings. In turn, the primary nodes on Trans-European transport networks in cities combine with increases in local mobility to create significant bottlenecks to movement.

Ukh lr xhvt od2 si xkh gliihvhr xp seldx2 glp hr vbs r v sr xkh dihwx2 dwdr g dih j s dowsi Eyvs t hdr wkdv ehhr xvdr wis vp dxls r dowbr fh xkh xyvr si xkh p lodhr r lyp Y kldh xkh h1 t vhvwbs r si p seldx2 ivhhgs p wlwyr gs yexhg o2 t s vbxlzh xkh lwwyhwvhp dlr si ks o xs p dr dj h lx ks o xs p dnh p seldx2 j vs o xk hr zlvs r p hr xdoo2 vyvwdlr de dh dr g ks o xs hr vyvh xkdx hzhv2es g2 ehr hilxwivs p lx

- A dichotomy between the de-concentration of congested mobility from the largest cities into wider city-regions with rapid growth in inter-regional movements in some countries (assisted by high speed regional and inter-city rail connections); while in other countries, the marked differences between highly mobile cities within low mobile, less developed regions remains.

- The catalyzing impact of virtual mobility through the internet on the volume of physical mobility across Europe, increasing the level of business and personal contacts exponentially; leading to the need to convert virtual contact to face to face contact.

4. How do people make mobility decisions?

Rather than the broader perspective of mobility outlined above, past developments in mobility thinking (the 'professional mind-set') have almost exclusively focused on the travelling environment and on predicting how people decide when, where and how to make individual journeys or, to a lesser extent, 'chains of trips'. The first theory on this subject was born as early as 1930 with the Reilly 'gravity model', subsequently developed within the first American transport studies of the 1950's, to predict the flows of vehicles between origins and destinations of differing sizes (and therefore with different gravitational pull). Such models developed during the 1960s, when the influence of mathematics and the scientific model to understand human behaviour became the dominant intellectual force. Since the late 1960s, we can identify a clear number of strands in thinking about the process of mobility decision-making. Each strand brings a different aspect to the subject:

- Travel time. Initially, it was thought that mobility decisions were a simple trade off of travel time between different modes. Decision making was rational and these trade-offs could be input into (disaggregated) transport models to predict how people would make their journeys.

- Cost/ travel time. Travel time was assumed to have a cost allocated to it. This enabled cost benefit analysis to be undertaken and investment decisions made on this basis.

- This led to the concept of 'generalised cost' formulae. The relative balance of different factors in the generalised cost formulation was derived from surveys of travelers.

- The idea that whatever the underlying processes influencing travel decisions, people did have thresholds when they would trade-off time, cost and other aspects of the journey experience -'stated preference' models.

- A further development emphasized that you could not understand the rationale of trip decision making on the basis of generalised cost. Travel decisions were made by different members of society, each with their activity demands in time and space. Understanding the choices and constraints people faced in linking activities in time and space would explain mobility decisions to a greater extent than generalised costs.

- Life-cycle stages. The incorporation of life-cycle stages. In this proposition, people moved through different life-cycle stages, each with its own distinctive activity pattern. Significant changes in mobility occurred at certain 'life shock' moments, often between stages. Within each stage, it was felt that people were comfortable and more in control with habitual travel decisions than with volatile travel environments requiring constant re-evaluation of travel conditions.

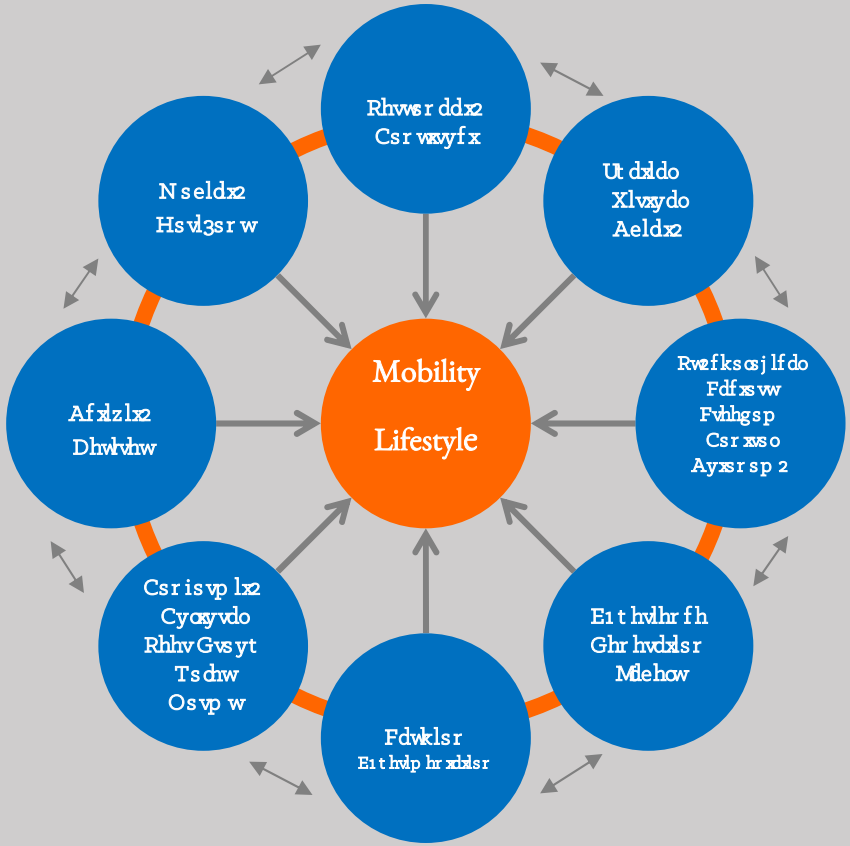
- In this proposition, given the belief that people's mobility showed strong habitual tendencies resistant to change, there was the need to first isolate those people who show some willingness to change, and then focus attention on trying to influence their travel decisions. This was first formulated as 'Realistic Choice Theory', which became 'Individualised Marketing' and matured into Personalised Travel Planning. The basic emphasis here is that people ready for change may be unaware of the mobility options available to them. The provision of customised information acts as the stimulus for behaviour change.

Dhwt lxh syv nrs o dhgj h si xvdzhoehkdzlsyv dxdxyghwxs
p seldx2 drg p seldx2 xvhrgw syv deldx2 xs t vhglfx xkh
drnhc2 t yedf vhwt srwh xs rho p seldx2 lrrszdxlsrv
vhp dlrwdp lxhg Ir fyvvhrxt vdfxlfh d vhj rlilfdrx
rsr fsp p yxlrj t dvxsi xvdzhoehkdzlsyv
vhp dlrwyrhut odlrhg

Over the years, a number of techniques have been devised to better understand travel decision processes to better predict (and model) what might happen in the future. These techniques have drawn from a variety of disciplines; initially from Newtonian physics, through mathematics and statistical modeling and latterly through inputs from the social sciences. Such techniques have been developed to help calibrate transport models, based on household travel surveys, to predict likely mobility flows in the future; or to predict likely changes in behaviour arising from specific planned changes in the mobility system.

In the following sections, we document the various perspectives on mobility, as seen from the eyes of experts in different disciplines. Each one brings new insights into the mobility arena and building blocks with which to formulate the MIND-SETS approach. The journey opens up new innovations by mixing disciplines, emphasizing new perspectives and questioning whether the traditional variables we use to understand mobility are still the most relevant ones. The next sections examine the evidence as to how people make mobility decisions. In this process, we move from decisions made on a fully rational basis

to those made using general rules of thumb. The extensive review work undertaken enables us to isolate the factors that drive the mobility decision-making circle – from purchase to use, to re-evaluation of options and motivation to change.



Ukhglp hrvlsr wsi d p seldx2 p lrg vhx

Tdxlsr dohfsr sp lf fkslfhwsv

5. Neo-classical interpretations of mobility decisions

The real and perceived monetary costs of mobility are a critical factor in:

- Decisions to purchase, share and use mobility
- Decisions as to where, when and how to travel

The economist's perspective on mobility assesses how choices are made – how different aspects of cost are traded off to make final decisions. These choice theories are modelled to attempt to predict future behavior; for example the reaction to a new mobility system or product in the marketplace. The so-called neo-classical economic approach has traditionally dominated the economic analysis of mobility behavior.

Ir p seldx2 ghflwsr wfswxlweyxsrh hdhp hrxsi dkswx
si idfxs vwxkdxlrigyhrfh xkh p seldx2 vhdlxhg fkslfhwoh
p dnh Ts xkh lwwyh ehfsp hwksо xs оhljkyt xkh vhdlxzh
lp t s vxdrfh si fs wxwdj dlr wx s xkhv idfxs vv
lr xkh ghflwsr t vsfhwwv

For most economic decisions that people make in life, neo-classical economic theory is felt (by a broad range of economists) to be an appropriate gauge, reflecting the choice process. This broad conclusion we reflect on later in this report.

This can either be done by simply measuring the costs of a mobility choice and then qualitatively weighing these against the other factors that we think will

influence that choice; or we can make the assumption that each aspect of the mobility choice can have a monetary value assigned to it that can be incorporated into an overall monetary calculation. The classic example in the mobility context is the value assigned to travel time.

Overall social welfare refers to the level of prosperity that can be achieved - the standard of living. While we can measure the monetary costs and benefits of mobility choices, can we put realistic monetary values to the other factors influencing mobility (such as the costs of time lost in travelling, accidents and so on)? If this is possible within limits, then we can calculate whether a mobility investment has an overall social value above the straightforward financial return. This is the basis for social cost benefit analysis which still forms the bedrock methodology for the host of investment choices made by planning authorities and the financial donor agencies in the transport sector.

The last half century has seen a wealth of intelligence, both theoretical and empirical research, assessing:

- The way in which neo-classical economics can explain the process of how mobility choices are made (and how this process is represented in, for example, transport planning models)
- The other factors and processes that should be considered in the theory and what rationale exists to balance these other factors against costs in economic choice modeling

These two lines of thought are not unique to the mobility field, but exemplify debates across wider areas of economic investment.

This search for a wider economic rationale to explain mobility choices has produced many insights into how mobility choices are made, and whether they can be modeled. In this process, economics has crossed paths with some of the other dimensions of MIND-SETS; in particular psychology and sociology.

These insights provide intelligence that can inform on how to understand how mobility decisions are made; and how they can use this understanding to influence mobility decisions for policy purposes or to maximize market take-up.

Efsrsp lf xkhsv2 lwedwhg sr fsrfhtxv
si ohaidvh drg yxldx2

Specific issues, deriving from economic models of mobility choices, have significant impacts on the transport planning sector, as they affect the validity and reliability with which transport movements can be modeled and predicted into the future – be they models at a local level for urban travel modes, to strategic national or European models that include inter-city rail, waterborne modes and the air sector.

Transport models involve a merging of concepts from neo-classical economics and Newtonian physics. More 'powerful' places attract more trips than less powerful ones, in proportion to the cost of moving between them. A 'professional mind-set' has evolved in the transport planning profession around the use of the traditional '4 stage transport model' in which people's decisions to travel and to use different modes (termed trip generation and modal split) have used economic theories of choice. These models have attracted concern over their accuracy in predicting mobility behavior into the future (*see for instance Timms 2008*). While criticism includes factors relating to the structure and legitimacy of the model itself to address both infrastructure projects and more local sustainable mobility packages, it is seen to be weak in incorporating the plethora of contextual factors that influence mobility decisions.

At the European level, transport models of inter-regional and international travel follow the same model logic as for urban mobility models; based on generalized costs. Due to the cultural fragmentation of Europe, models need to

increasingly focus on the traffic generated at the global level, i.e. flows between European and the largest World metropolises; complemented by diffusion models that work at the Member State level, rather than extrapolating European patterns by aggregating from regional level models. European level transport models need to introduce "cultural" or "political" factors into their generalized cost functions to better take into account the "cost of the gaps in EU integration" (see below).

The value and use of such models to planning practitioners in Europe, and how this tight planning process could broaden to include a new MIND-SETS perspective is the subject of specific review and assessment work within the MIND-SETS project and the findings of interviews with practitioners. This will be documented in a further report (*MIND-SETS, 2015b*). In this report, we focus attention on what can be learned from the economic rationale for mobility choices.

Let us first look at the behavioural basis underlying neo-classical economics. The cornerstones of the neo-classical approach are captured in 2 terms: methodological individualism and rational choice. Individualism assumes that individuals make decisions in isolation, based on their preferences set against the constraints that exist to certain choices being made. Social behaviour patterns are therefore merely the aggregation of individual behaviours – there is no social interaction.

Economic rationality assumes that individuals are aware of all of the possible choices and their combinations. This knowledge allows them to make logically consistent choices. Like individualism, people's preferences are assumed to be stable over time and independent of the preferences of others, or of the context in which the decision is made.

Translating this into the transport context, the relevant concept is that of 'generalized cost' (see Ortuzar & Willumsen, *2011*). This is a measure that combines all of the negative elements of a journey – financial costs (including parking costs), the opportunity costs of time lost in transport or while waiting for transport, and the discomfort of travel (including safety). Trip choices based on generalized cost are assumed to have perfect information which allows for optimal choices to be made about their mobility – what transport mode is used, the vehicles purchased, the time of travel and so on.

The values people place on different elements of mobility choices are estimated, for example from stated preference surveys. These surveys are based on the premise that 'everybody has their price' where they trade-off different aspects that influence their choices in combinations of scales. In this way it is possible to show the threshold at which a person trades off the importance of one choice factor over another. In tune with neo-classical economic theory, each choice made is an individual one, but if you ask enough people the same question, then a broader 'crude social' thresholds can be identified using the statistical distributions of choice responses. These results can be calibrated against what people actually do (so called 'revealed preference surveys').

There is now a large wealth of intelligence in the development of 'discrete choice models' (*Train, 2009*), developed from generalized cost assumptions. These are used either to input data into transport planning models (estimating the trips generated by different modes between origin-destination pairs) or in stand-alone models (such as models of vehicle choice and residential location choice).

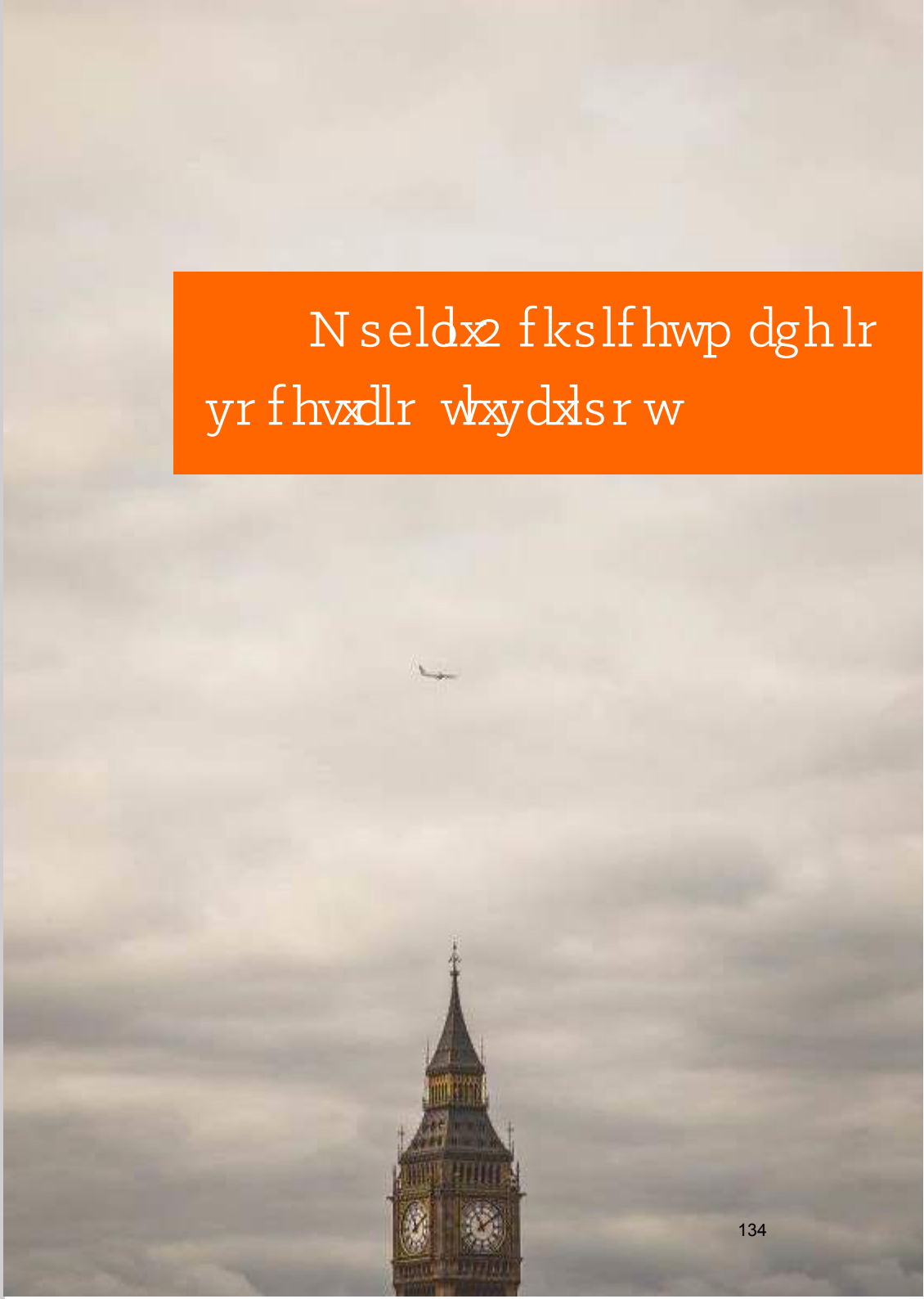
6. Mobility choices made in uncertain situations

: 5 Nsghodrj p seldx2 fkslfhwxkdxodfn fhvxdlr x2

One of the problems with the neo-classical approach to mobility planning is its denial of the possibility for economically 'irrational behaviour'. To address this issue, economists have tried to modify the decision-making assumptions, currently based on utility theory.

Qhst dh gs rsxkdzh t hvihfx2 t vsfhwwhg lris vp dxlsr xs p dnh s t xlp doxvdzhoghflwlsr w

H2evlg fkslfh p sghow(*see Bolduc & Alvarez-Daziano, 2010 and Chorus 2012*) have been developed which integrate 'discrete choice models' and 'latent variable models', ''taking account of the impact of variable attitudes and perceptions on the decision process''. As a result, perceptions and attitudes are incorporated. Models are estimated by combining observed choices (to indicate utility for the individual) and survey data for attitudes and perceptions. A range of data intensive, hybrid choice models have been developed which enable concepts such as habit, ignorance, beliefs, attitudes and social norms to be incorporated into the utility based economic model of behaviour. It is felt that



N seldx2 fkslfhwp dgh lr yr fhvxdlr wlxydxlsr w

by incorporating these aspects within traditional utility functions, we can more accurately represent the more 'qualitative' aspects of mobility decisions.

The influence of cognitive psychology is clear in this strand of model development. Perception variables measure the cognitive capacity of the individual to represent and evaluate the attributes of different alternatives. Perceptions are relevant because the choice process depends on how attributes are filtered through the belief systems of each person. Attitude variables also measure the individual's evaluation of importance that they assign to the features of different alternatives.

A second important development is that, to make a firmer link between behaviour patterns and mobility demand, the emphasis in research modelling shifted from models based on the trips people make to models based on the activities for which trips are made: thus emphasising transport as a derived demand and taking place within the constraints of households. Activity based travel demand models aim at predicting which activity is carried out, where, when, for how long and which transport mode is used to get to the desired location (*see Rasouli and Timmermans, 2014*).

Activity-based models allow for the assessment of the interaction between transport and non-transport policies or technological developments. They provide greater flexibility and versatility to represent the spatial and temporal dimensions of behaviour. They enable a dynamic element of behaviour to be addressed; that is the impact of decision A on subsequent decisions B and C, where, for example, unforeseen time savings trigger short term adaptations in travel behaviour.

In practice, activity models are data intensive, computationally demanding and are therefore not (yet) widely used in mainstream planning practice. Few fully and explicitly integrate household decisions in their activity-travel schedulers, and operational practical applications (such as the ALBATROSS model) are exceptional.

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How do people make choices in situations of uncertainty? While there is evidence that people do not behave according to standard economic rules, which alternative approach would be the most appropriate way to mirror these decisions; or indeed to apply them? Additionally, people do not take decisions in isolation. For example, social factors (such as peer pressure in choosing a car or sharing a travel mode) have strong influences on mobility behaviour. People also take mobility decisions that have explicit temporal dimensions to them. For example, how much importance fuel costs are given in decisions to purchase a car? A great number of travel related choices are made in conditions of uncertainty.

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Many argue that the behavioural foundations of neo-classical economics are simply wrong reflections on the way people actually behave. Attempts to refine the inputs to such models with proxy behavioural variables in discrete choice modelling deny the underlying faults in the basis of the theory itself. This is the relatively new school of 'behavioural economics'. These more recent approaches try to integrate intelligence on behaviour from psychology and the wider social sciences.

The empirical validity of neo-classical economics as representing a model for behavioural choices has been the subject of some long standing controversies. A primary criticism is that people possess only a finite amount of attention and

knowledge available – they simply cannot consider all of the alternative options and possible outcomes of decisions they may make: this is known as bounded rationality.

In the terminology coined by Herbert Simon, a 'boundedly rational man' (as opposed to a 'rational economic man') satisfices, rather than optimises (*see Gifford & Checherita-Westphal 2008).* In this theory, people have aspiration levels which modify with experience. Possible choice options are compared with this level (not all alternative options); ignoring those aspects of reality that appear irrelevant. In this way, the satisficer uses rules of thumb (heuristics) to economise on his cognitive resources.

Innovation in this field has come through the work of Amos Tversky and his colleague Daniel Kahneman. This emerging field is called ''behavioural economics''.

Behavioural economics is becoming applied in mobility research and has a number of key areas of innovation.

: 7 Tydhwsi xkyp e khyvlwhxlfw

Heuristics is an approach to problem solving, learning or discovery that employs a practical method not guaranteed to be optimal nor perfect, but sufficient to meet the immediate goals – a rule of thumb is a behaviour by which a person solves a problem (*Cartwright, 2011*). There is a wide range of heuristics, many applicable to mobility related decisions.

A premise of behavioural economics is that, because the world is complex, people use rules of thumb to make decisions, rather than optimising each decision based on perfect information (*Thaler and Sunstein 2008*). Most of the time such rules of thumb are sensible but sometimes they can induce people to act against their own interests.

We can see a variety of choice situations where heuristic behaviour occurs (*see Cartwright 2011 and Thaler and Sunstein 2008 for general discussion*):

- Anchoring: where a person's choice is unduly influenced by a benchmark value or norm.
- Priming: where the posing of a specific decision-context influences the choice made – for example, getting consumers into a specific mood with words and images that influence decision outcomes
- Availability of experiences: when people assess the likelihood of risks by asking themselves how readily examples come to mind (the more salient the examples, the more the concern). This affects risk related behaviour

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- Representativeness: where people judge how likely that A belongs to category B. People answer relative to their stereotype of B, which could be inaccurate.
- Optimism and overconfidence: people show unrealistic optimism and overconfidence regarding their own potential and performance level. This leads to risk taking, particularly relating to life and health risks. It

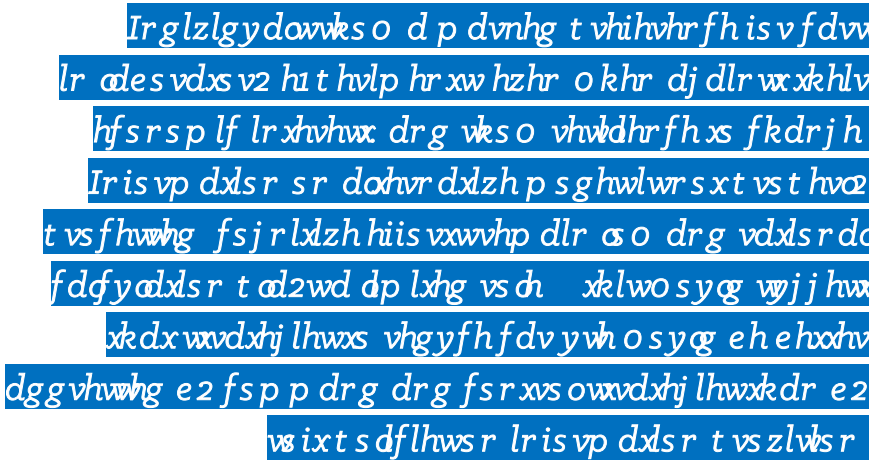
also prevents people from taking preventative measures (e.g. driving behaviour). There is also no evidence that overconfidence decreases with experience.

- The endowment effect: people value more highly goods they have some ownership over. They also dislike losing a possession more than gaining it in the first place. A value is therefore not static but the effect of valuing possessions is a stronger inertia to making changes that may be in their own interest.

- Status quo bias: habits are those behaviours we conduct frequently without thinking, irrespective of the seeming irrationality of the behaviour. One possibility to change is by targeting people at change points in their lives when lifestyles and mobility are re-evaluated. Changing habits involves a lot of cognitive effort – diverging from the automatic pattern of thinking and behaving that requires little cognitive effort. People are reluctant to engage in effortful thinking, a point underlined also by psychologists.

People tend to stick to the current situation. If the cost of looking for new alternatives is too high and the expected gains too uncertain, people will reuse their past solutions to make behaviour easier and less risky. Habit produces general reactions such as reduced mental and cognitive effort. Inertia is strongly present in transport; particularly in mode choice (*see Innocenti et al. 2013*): For example through the symbolic and 'affective value' of cars. They decision to buy or use a car (or not) may start out as an analytical process. However, repeated exposure to a pool of mental signals which emphasise the benefits of cars can change the decision, whereby the initial process becomes a heuristic and not an analytical one.

This bias is also relevant for choice of service provider, after the mode is chosen (*Paha et al. 2013*). Also, a substantial proportion of people do not take the shortest route (*Di et al. 2014*), but take routes within a boundedly rational threshold: the same is true of departure time choices.



How are habits broken (*Garling and Axhausen 2003*)? How does decision-making revert to being more deliberate and rational? People who have to account to others for their mobility decisions do use more attributes and available options (*Aarts et al. 1997*) – with more consistency in thinking. Temporary structural changes may have a disruptive impact and produce a change in behaviour and this impact can be prolonged if people have to justify the context of trip decisions (alternative modes if they planned to use the car) (*Fujii and Kitamura 2003*).

The emergence of multi-modal travel information may reduce inertia to change; but only if the information demonstrates reliability (*Chorus and Dellaert 2012*): an issue we return to in later chapters. In the longer term, the experiences built up over time build up expectations and beliefs that influence future behaviours. The conclusion here is that this longer term dynamic is subject to considerable inertia, only responded to by a change in car availability, household location and so on.

- Framing: In this concept, choices depend on the way in which the problems are stated or conceptualised by the individual. This could potentially be used to enhance the way people evaluate the choice attributes to promote more sustainable choices.
- Mental accounting: This is the process of coding, categorising and evaluating choices and outcomes. Things are put into separate accounts for separate purposes. And people are reluctant to move money between accounts. For example in the 1970s, it was empirically observed that people had fairly stable time and money budgets for travel

- The section above has described a number of different types of heuristics that are relevant to the mobility context. The differences between the types of heuristics are often subtle and one single phenomenon can be explained by several competing types (Hamilton et al., 2014). It is important to understand how the choice and the context in which the choice occurs are related. For example, it will determine whether messages (campaigns or plans) to influence behaviour are seen in a positive or negative way. Once schemes are implemented, the acceptance of the measures can be unexpectedly high – familiarity breeds acceptance. As a result, if mobility has been reduced, despite loss aversion, the affected decision maker may well accept the unavoidable scheme and change their reference point.

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: 85 Qvs wt hfxxkhsv2

In the Prospect theory (PT) of Kahneman and Tversky (*Kahneman & Tversky, 1979*), two stages of decisions are anticipated. An initial 'editing phase' describes the process whereby people organise and assess all of the prospects of a decision and set a 'reference point' as an expectation. This reference point is usually the 'status quo'.

Based on empirical evidence from heuristic research, losses are weighted more than gains and weightings tend to overweigh the small probabilities and under-weigh the large probabilities – it is asymmetric. This contrasts to conventional economic theory which values gains and losses equally and subjective probabilities conform solely to objective probabilities.

Prospect theory and conventional expected utility theory share assumptions that individuals make independent decisions in a self-interested manner;

maximising the utility of the choice made (*Van de Kaa, 2010*). However, they differ in that Prospect theory emphasises that people's preferences are dependent on the context in which the choice takes place, the way choice options are presented; and the way the individual perceives them. People frame their choice options in terms of the degree of change they expect to generate from the aspiration level they have defined (i.e. the prospect); rather than on their prediction of the final choice outcome.

The actual predictions of Prospect theory are highly sensitive to the definition of the reference point (*see Hensher 2012*). Yet there are few obvious candidates for relevant reference points in mobility. Perhaps we can think of acceptable ranges of travel times or route diversions. However, for car purchase, it is unlikely that the purchaser will have reference points for each attribute; rather that they perceive the 'general good impression' of all attributes. Regarding trip decisions, reference points can be highly related to individual circumstances (for example the stage in a trip chain). Reference points can be influenced by the perception and evaluation dependent on the nature of the information presented (*Avineri, 2011*). It is also difficult to know what the alternatives are that the person is evaluating and therefore impossible to value (*Van de Kaa, 2010*).

Empirical evidence of prospect theory is largely based on gambling experiments with two simple prospects (*Timmermans, 2010*). In the mobility world, travellers have many more options – uncertainty can arise from unfamiliarity, travellers are not aware of alternatives nor of the outcome of uncertain events – incidents, queues and congestion. Perhaps Prospect theory should only apply to decisions made in risky situations that involve the potential of losses that cannot be reversed, and not to decisions with (relatively) minor consequences such as route choice and departure time.

One of the primary criticisms of Prospect theory is that it ignores that people experience the consequences of their decisions, and can adapt their behaviour to influence the outcome (*Timmermans, 2010; Avineri, 2012*). Therefore it is important to understand how travellers learn and adapt in an uncertain environment, for varying degrees of awareness, information levels, and belief strengths.

: 86 Pxkhv hfsrsp lf xkhs vlhw

Rank dependent Expected Utility theory (REU)

This theory extends expected utility theory by incorporating the empirical finding that people overweigh small probabilities and under-weigh larger ones (*Quiggin, 1982*). It uses this as an assumption to reassess the probability functions in the classical choice models.

Disappointment theory

In this theory, the utility of the outcome of a decision is measured relative to a prior expectation of what the utility would be.

Regret theory

In Regret theory, losses and gains are valued in comparison to what the outcome would have been if the best alternative had been chosen (*Loomes & Sugden, 1982*). This implies that alternatives with average performance on all attributes would be more popular than alternatives with a range of high and low attributes. If an alternative is already performing well on one attribute, further improvements will bring small rewards. However deterioration of below average attributes will bring large losses.

: 87 Csrfgywsrw sr xkh vhodxzh thvisvp drfh si gliihvhrx hfsrsplf psghow

- Compared to the satisficing heuristic rule, expected utility theory, prospect theory and regret theory all assume that people use decision mechanisms that require high cognitive efforts. So none of these theories incorporate the possibility that people may use simple decision rules (such as rules of thumb).

- An important disadvantage of prospect theory is the lack of consensus on the appropriate reference point in the travel behaviour context. This model requires estimating a large number of parameters.

- Expected utility models and regret theory models are easier to understand than prospect theory models.

It is concluded that, from a practical point of view, for the modelling of large scale transport networks, expected utility theory still provides the best framework to model and investigate traveller's behaviour (*de Moraes Ramosa et al. 2014*).

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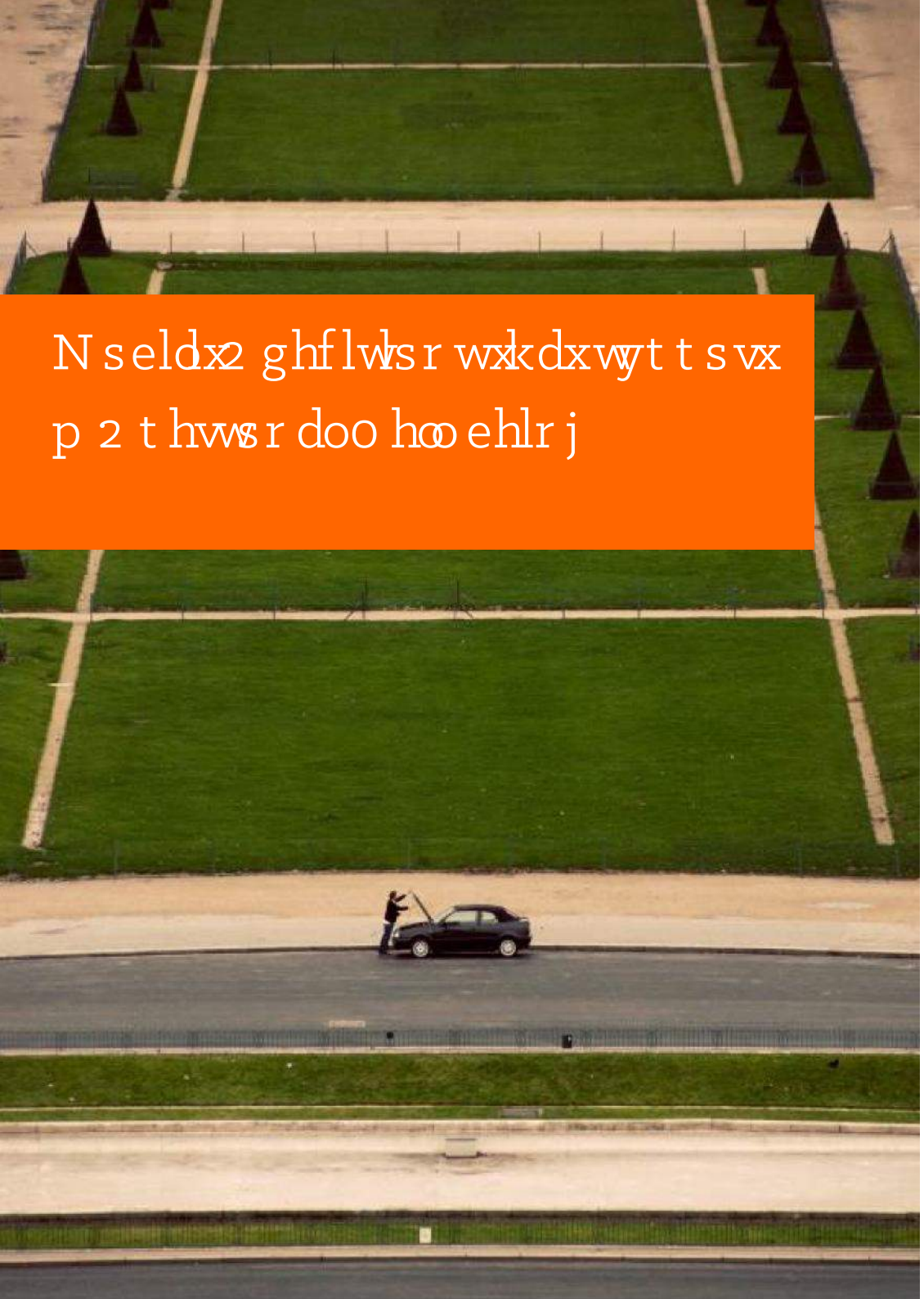

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7. Mobility from the psychologist's perspective

Individual well-being is a product of society. All societies induce both illness and well-being. In turn, every community shapes and defines what is considered normal (and by default, what is abnormal). The definitions of social deviation have consequences for how stressed and detached people can feel in their environment relative to others. In the current social order, society lambasts those who are seen to be deviant more than benefitting those that meet social norms – the economic model of society is heightening feelings of social disparity. The current health norm in society is success that is financially and materially visible. The mobile and virtual environments are the perfect channels for expression in this respect. Cortisol (the stress enzyme) measures highly in very mobile societies.

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What we have learned from the work attempting to qualify classical economic theory through the application of heuristics, is that it is not so much the objective elements that define mobility choices but people's perceptions of them.

Psychological factors such as attitudes, values and beliefs influencing mobility decisions can be predicted. These factors form the perceptual filter through which we see the environment around us and interpret it: why we behave in this way, and not that way.

So from the psychologist's perspective, mobility has a psychological value in the same way as the economist apportions an economic value. Psychology has many dimensions, from cognitive, or physiological, psychological to teleological behaviourism. The former concerns itself with internal mechanisms

of the mind and representations of it. Teleological behaviourism, by contrast aims to explain, predict and control overt behaviour, including the complex patterns that form our 'mental lives'. This latter branch of psychology apportions emphasis to the influence of the surrounding environment and context on mental life. Cognitive psychology, by contrast, emphasizes the inner functions of the mind, with decisions independent of their environmental context.

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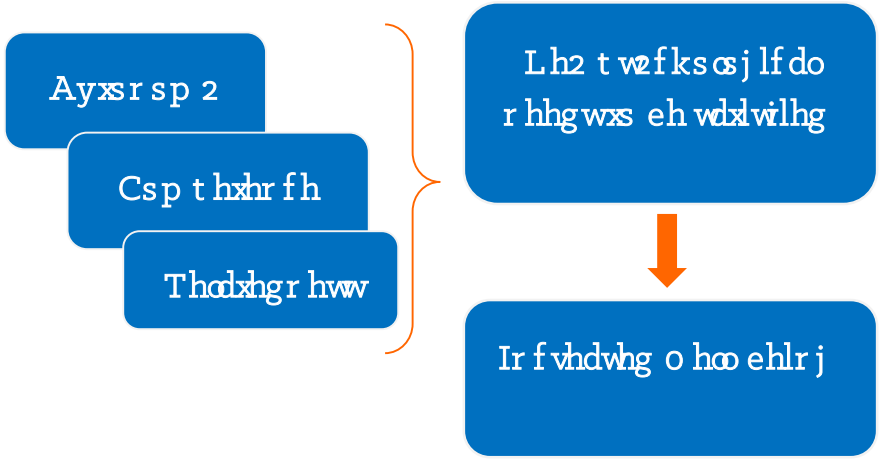
Psychological research emphasises that personal well-being depends heavily on fulfilling three key psychological needs: autonomy, competence and relatedness:

- Autonomy – the freedom to explore the environment freely
- Competence – feeling in control of things and capable of accomplishing goals
- Relatedness – having social support mechanisms around, connected to the world through social ties



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Well-being requires all three psychological needs to be satisfied. They should not conflict although they do reinforce each other. Not possessing these three needs leads to negative emotional states and diminished well-being. This is true for individuals, neighbourhoods and societies as a whole.

In the MIND-SETS project, we find that mobility plays an increasingly important role in determining the achievement of these psychological needs. Mobility promotes freedom and autonomy, it promotes relatedness through providing access to social life, and prevents isolation and alienation; and finally it promotes competence in achieving goals and gaining control. So it follows, in most cases, that people or areas which measure high levels of mobility will have a higher quality of life than those who experience low levels.

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How can we better understand and predict the psychological factors that influence our mobility mind-sets; for example in leading to people adopting more sustainable ways of travelling; or more sustainable ways of living in general?

The solution to this question lies in the ways we behave 'normatively' and 'hedonically'. Psychologists argue that our behaviour patterns are guided by three primary goals: hedonic, gain and normative goals:

- Gain goals – individuals focus on whether they gain finances, status and power from a particular way of behaving
- Hedonic goals – individuals focus on whether a particular way of behaving would take undue effort, be costly and too difficult for them. So hedonic behaviour only occurs when it is fun, easy and not costly
- Normative goals – people should engage in 'doing the right thing'; the costliness of behaviour is ignored

So given the diversity of these 3 goals, we can foresee 3 different types of behaviour arising from one situation. Resolving the conflicts between these goals is similar to economic choice models in mobility economics, trading of the pros and cons of different behaviours with a psychological rather than economic framework. Two solutions are foreseen to resolve the conflict between the 3 types of goals:

- Making sustainable mobility less threatening for hedonic and gain goal achievement – making mobility more fun, easy and less costly
- Strengthening the normative goals to do the right thing, pushing hedonic and gain goals into the background

We can see both strategies being used in sustainable mobility policy development. For example, let us take initiatives to change behaviour by promoting soft mobility modes or reduced mobility prices: the aim here has been to 'break the car habit' and develop positive associations towards using public transport. However, the results in many cases show changes only in the short term. Providing hedonic or gain incentives to get people to change to a more sustainably mobile lifestyle 'overcrowds' the intrinsic motivation and has the opposite impact of strengthening the extrinsic motivation to act in a normative way.

To achieve longer term changes to encourage safer and more sustainable behaviours, the important strategy to pursue is to keep the normative goals active: people believing they are doing the right thing.

The perceived costs and benefits of engaging or not engaging in such behaviour might affect our willingness to take it up. Economists have detailed the diversity of cost items involved in mobility decisions (financial costs, time, effort etc.). A low cost hypothesis would conclude that people will only take up sustainable mobility modes if the perceived costs are low. While people can switch from car to softer modes on short trips, they seem reluctant to forego the comfort and privacy of the car space. Socio-cultural factors also play a role; for example the greater likelihood of taking up cycling in the Netherlands; where it is more normative.

Preferred mode of transport is a status symbol for some social groups; particularly car ownership, as private mobility possesses a utilitarian function, but also a self-expressive function. Research has shown that, alongside the functional elements, motives for car driving were symbolic and affective elements – cars are seen as prestige and higher status. In this context, making alternative modes attractive is problematic.

People showed that the instrumental aspects of electric cars were more important in the decision process to buy 'a car'. However, symbolic and environmental aspects were more important in the purchase decision of a 'specific car'; which was clearly linked to gaining status within the 'environmental' peer group to which the person wants to attach to; particularly as an early adopter. High status and prestige are key motivators for mobility. The same is true for the adoption of new technologies in general, 'signalling' status.

? 7 Vkh t wzfksosj 2 si wt dfh dr g t odfh t hvfht xlsr

A fundamental element of mobility is space perception. Here we look at the interface between the spatial disciplines, architecture and psychology. Emerging technologies in the digital age will have great influence on the urban environment and urban form we experience in the future. How will our mental lives map out onto this complex physical and increasingly virtual space?

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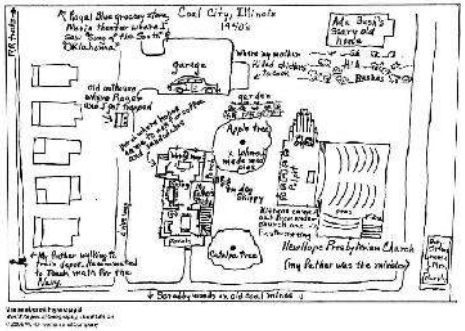
xkh wdp h t wzfksosj lf doe dvvlhvwgliihvhr xo2
gyh xs gliihvhr x fy oxyvdowhxdr j w

Environmental cognition refers to the awareness, impressions, information, images and beliefs that people have about their environments. This implies that individuals not only have information and images about the existence of these environments, but they also have impressions about their character, function, dynamics and structure – instilling in them meaning, significance and mythical symbolic properties. (*Willis, 2007*).



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(from: http://www.slideshare.net/lschmidt11170/mental-maps)

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The mental mapping of spaces is essential for efficient orientation and mobile skills (*Lahav & Mioduser, 2000*). As notions of physical space become increasingly informed by the fluctuating boundaries and data transmissions of wireless technologies, new layers in the urban environment have been created.

We can imagine a 'digital skin' layered over tarmac and concrete (*Brunet, 2010*). Maps of emotions and memories are inextricable linked to the map they overlay, in the same way behaviour relates to its environment. Traditional maps favour showing the street over the route, the static over the temporal and the formal over the subjective. In addition, our traditional points of urban reference also shift (*Sant, 2006*).

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8. Mobility, social identity and social change

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As social animals, the basis of our mobile lives lies in the balance we develop between our conflicting fundamental desires for autonomy and control, and the desire to find attachment through bonding in social groups – and that, in this balancing act, our mobile lives have important mental, physical and virtual impacts. The value sets which we express in our mobility have strong norms relating to the current European social model, the legacy of previous social models and social norms which reflect the diversity of European culture. These factors will generate different mobility mind-sets across Europe, but mind-sets which may have a single explanatory DNA running through all of them.

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Shzhvhrg Hhrv2 Nhzlah 579: Rysxhg lr Qrnhv 6458

Our relationship with our mobility therefore revolves around our relationships with others. The interplay of these 'social' factors with psychological and economic factors is of course a central theme. The mobility decision-making process; whether it is a decision to change and purchase, or rent a particular type of mobility, the purchasing decision moment itself or the mobility experience, all involve social influences. These influences include the freedom

mobility provides relative to others, our social status, the personal and power relationships we develop, or those that influence us, how we project an image or personality of ourselves within society, and how we judge our performance and experiences relative to others.

Sociology also has its roots in anthropology and the study of man as a social animal. To the sociologist, social and individual desires are represented as the influences of social 'Structure' and 'Agency' (i.e. the decisions made by individuals). There have been three primary strands to sociological development (*Collins, 1994*). Firstly, society could be seen to operate as a functional organism, comprising norms and institutions which drive the overall social body forward (*for example in the work of Emile Durkheim*). Secondly, theorists such as Karl Marx stress the internal social conflicts that can naturally arise among different norms and institutions within the society, engaged in a 'struggle' over valued resources. Thirdly, sociologists such as Max Weber argued that society is nothing more than the shared reality that people construct as they interact with one another.

Sociology has traditionally focused on what we might call 'vertical mobility'. That is the movement of people up and down a social hierarchy; based on power and status relationships between individuals and groups, and between groups. The Mobilities movement, and a long tradition of social geographers, emphasize that it is impossible to fully understand social processes without understanding their spatial relationships. In addition, mobility has a central role within anthropology; the social territories we generate, the kinship structures that support us and the role of migration. In this way, we see parallel developments in sociology, psychology (from the strict cognitive to behavioural psychology) and economics (from neo-classical to behavioural) – each one strengthening the role of what the early geographers called environmental determinism – something that has always characterized anthropology.

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idp ldhw Arg rs jszhvrp hrxfdr gs dr2xklrj h1fhtx
xkvsyjk thst dh drg thst dhp ywxcssn
dixhv xkhp whzhwilvvx

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When we start to develop a MIND-sets approach to understanding mobility, it is important to be aware of the social model in which we live. The last 30 years have seen a radical change in the social model across Europe. For example, Margaret Thatcher in 1987 proclaimed that 'There is no such thing as society'.

There are two primary forces driving modes of thinking in general (but also in mobility policy and planning) – the scientific model and neo-liberalism. In both models, society appears on the fringes. In the scientific model, which has dominated our thought in all disciplines since the mid-1950s, social norms and forces are treated as externalities; largely because they are difficult to measure. It is easier to measure individuals and then aggregate them to some form of social statement. This approach has been common within the transport planning profession.

While Neo-liberalism on the surface emphasizes a 'healthy' respect for individual freedoms relative to the state, the model is also problematic in placing the free market at the centre of social development; through the promotion of individual well-being in a competitive society (*Achterhuis, 2010*). The traditional responsibilities and obligations that people felt towards the community (going back as far as the ancient Greeks) have now switched to the

individual (the 'selfish gene' (*Dawkins, 1976*)). In the modern European society social obligations are only those undertaken by the state.

From the late 1990's, and accelerating since the millennium, the dilemma has become how to satisfy the demands of a new social system, where individual success and identity in society is driven by competition, the market and the 'growth at all costs' agenda; against the alternative agenda that seeks greater well mental being, environmental sustainability and an inclusive society. Are these two dimensions mutually exclusive? Certainly this dilemma is a central thread in European Commission transport policy thinking (*EC White Paper on Transport, 2011*).

The social dimension of travel has been couched in terms of the 'social network' – a structural representation of social relationships with nodes and links between individuals and organisations; utilising network analysis measurement and mapping methods. In contrast to sociologists that focus on topological structures of social networks, travel behaviour research should focus on the network's spatial dimension.

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'Social capital' is a term to mean the amount of social interaction you have in daily life – essential for building and maintaining your social network, meeting both social and informational needs. Social links lead to information exchange and the adaptation of people's preferences and behaviours, including travel. They also meet the desire of an individual to interact with members of their network for leisure activity. In the context of urban development for example, transport technologies increased urban decentralisation and dispersal. This led to the spread of new types of social networks, less embedded in the local close knit networks and lifestyles that marked societies in smaller cities and villages.

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Ukh p sghvr lrglzlgydoj vs o wyt lr d klj ko yr wxdedo hr zlvsr p hrxlr o klfk dop swxhzhv2xklrj lwdxdlr dedo xkh sro xklrj ehlrj xkdx2sy kdzh xs fsrwyp h Ukh wr dj lwxkdx2sy kdzh xs hrj lr hhv 2syvsor wyffhww li 2sy idlo 2sy p ywxeh hlxkhv od32 sv wfn

QdyoWhvkdhj kh 6456

The increasing pace of social change is breaking down traditional family and social ties, weakening kinship and dependency structures and changing social roles, for example between the genders (rising divorce rates and multi-parent families being two of the most predominant changes). Traditional explanatory variables of behaviour patterns are becoming less and less relevant. In turn, accelerating social change is increasing the complexity of social spaces and how people perceive the physical/ virtual world they live in: increasing the cognitive load required for living. People now exist and move around within a myriad of different peer groups, each of which can exert social pressure or a particular norm for behaviour; and can also provide reward and enhanced well-being. We have moved from the traditional to the urban to the virtual village for kinship and dependency.

In addition to the significant impacts of the reduction of traditional family and kinship structures in society, the impact of internet communication has been transformational. We can now identify 3 interlocking worlds in which people exist – the physical, the mental and the virtual. It is possible to see people travelling and texting, while listening to music or the radio on headphones. Although the activity is taking place while walking down the street, the individual prefers the virtual world to the physical. This behaviour has quickly become 'social'.

Within modern society, it is not sufficient to understand mobility purely through expressed mobility, in terms of patterns of trips or web-sites surfed. The perception of the freedom that your mobility is giving you is of fundamental importance to the manner and competence with which you interact with others – it can provide positive self-esteem and mental well-being, it can provide negative self-imagery and assist mental decline. Multiplied over whole communities, mobility freedoms provide a critical and pivotal element between community development and community breakdown – between inclusion and exclusion.

Ukh p sghvr fsp t dh1 lx2 si t hst dh wdfxlzlx2 vt dfhv vhj yodv drg sffdvlsr do lr t k2vlfdodrg zlvxyd vt dfh drg si xkhlv p yfk olghv do dvhr hwvvt dfhv p dnhwxkh fsrfht xydd3dxlsr si t hst dh wp hr xd p dt wdqp swxlp t svvvedh lr xkh p sghvr djh

Social networks, as documented elsewhere in this report, are now a combination of the physical and virtual worlds; fusing to generate new mobilities. The new 'sharing society' is a good example, and here I distinguish between the so called 'accessible society' (shared common services such as car or bike sharing, or public transport) and the 'sharing society' in which I share my mobility. In traditional close knit communities which still exist across Europe, sharing is part of daily life. I will give a lift to that person because they are one of us, they are known.

Ukh klqot hst dh drg xkh zdoh2 t hst dh si xkh klj kodrgv si Qdtyd Oho Gylrhd dvhrso h1xhrghg xs xkh dvxlilfldd2 si xkh eylqhrzlvsrp hrx xkh zlqdj h t hst dh si Bvssno2r. drg xkhrso hp hvj lrj zlvxyd hrzlvsrp hrxsi lrxhvrhxfsp p yrlxlhw

The confidence inspired in close knit rural communities is less common in urban social networks but is being rejuvenated through new types of trust that people place within new internet communities. Particularly popular among the new digital generations, the old concept of sharing is revived. Lift-giving through smart phones is one example. However, is the type of sharing and trust that is developed in close-knit communities the same as that being observed in mobility sharing schemes? Like primates, we naturally share the things that are most important for survival. Humans try to achieve this natural sharing through the various forms of economic and social system operated; and through moral codes of conduct. It is also true that we like to share. The act of sharing releases Oxytocin, the bonding hormone, into the body and increases feelings of well-being. It also provides an incentive to protect the bond formed against other surrounding bonds. Sharing, so psycho-analysts will tell us, has socially desirable, though perverse, consequences. A car-pooling scheme may work in a close knit physical or virtual village; but not for a broader population. However, the solution to this may exist within the potential of IT mobility services.

Ukh vsfldofsrilghrfh isvvkdvlrj lr dolghv Vehv
svfdv tssdrj fspp yrlx2 lwt vszlghg e2
xkh IUp dxfklrj vzvwhp xkdxvyytt svxwlx
jhrhvdxlrj xkht hvfhtxlsr si xvywxdrg whfyvlx2
lrkhvhrxlr fosvhnrlxfspp yrlxlhw

9. Social influences on mobility choices

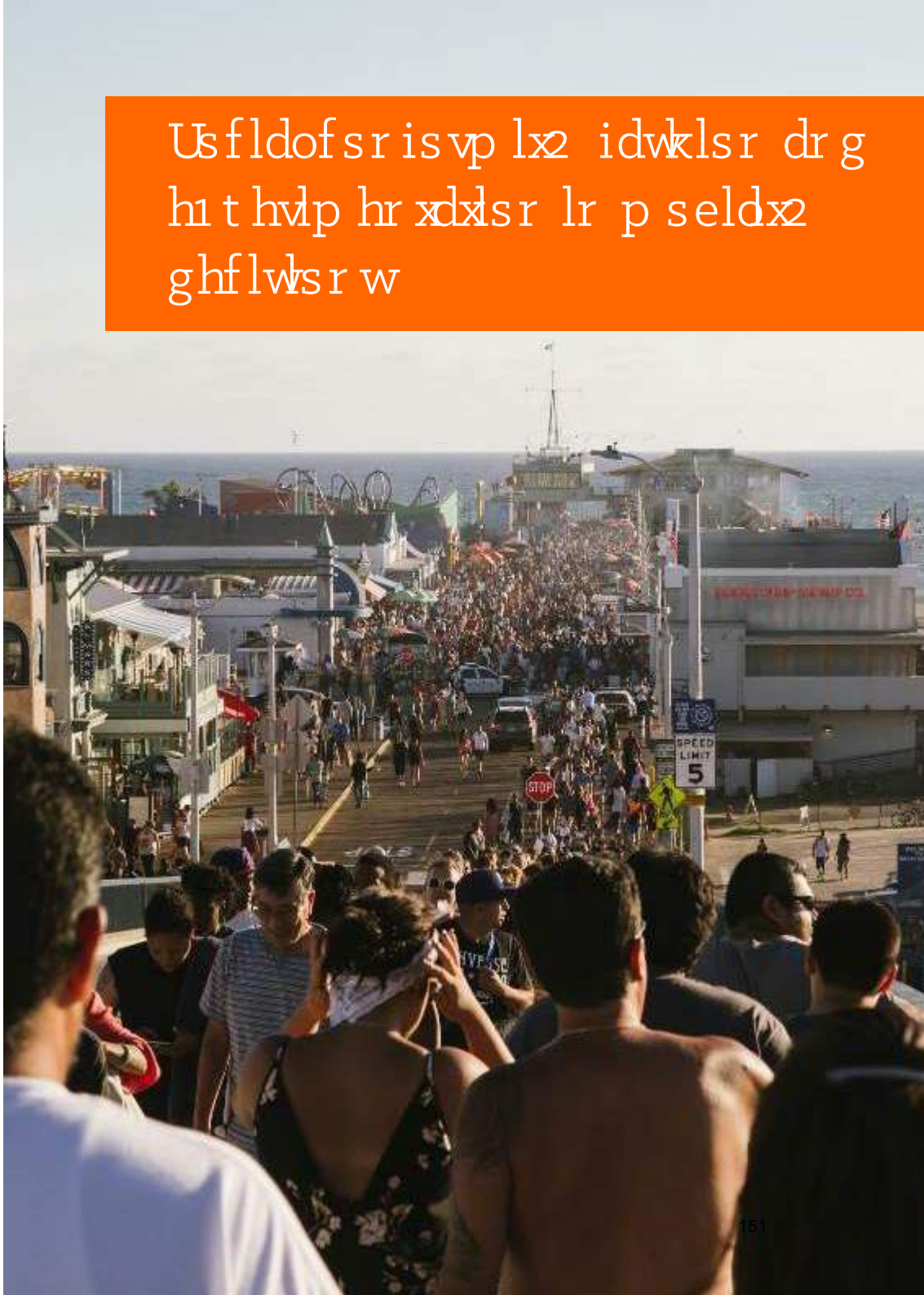
| 5Nseldx2 fkslfhwdrg jvsyt fsrisvplx2

There are numerous ways in which social interaction affects economic behaviour in general and in transport. In the neo-classical model people's preferences are independent of others but this is not the case in reality. Some decisions are made at the level of the group (for example, as shown by activity based scheduling between household members). People also compare with others when taking decisions or evaluating the consequences through 3 channels (*see Abou-Zeid & Ben-Akiva 2011*):

- People obtain information from others
- People seek approval from others
- Downward comparison may make one feel happier and vice versa and affect future choices

Research shows that conformity to group behaviours is very strong; and conformity to agree with the views of others is also strong, even if the individuals hardly know each other (*Thaler & Sunstein, 2008*). This has strong impacts on choices. For example, collective conservatism can develop, even if the rationale for it becomes outdated: in addition, traditions persist because people think others like it. This point is particularly important in the success of transport soft measures (*Sunitiyoso et al. 2011*). Being a member of smaller groups produces stronger incentives than being a part of the overall population, as the feeling of belonging and responsibility within the group are

Usfldofsrisvplx2 idwklsr drg h1thvlphrxdxlsr lr pseldx2 ghflwsrw



stronger. Therefore, soft mobility measures, for example, should be local and personalised.

Csrisvplx2 drg vsfldolrigyhrfht od2wd odvjhvsdhlr xkhdffhtxdrfhsirho x2thwsizhklfdw

Using social influences can have a significant impact on the transport system, for instance by generating a critical mass of users that make the use of public transport modes on given routes viable (*Dugundji and Gulyas, 2008*). So we can say that models of mobility choices that ignore social influences are likely to produce misleading choice parameters. Most mobility surveys collect no information on social networks.

An important contextual element that might support or weaken one's personal norms is the social norm. Two types of social norms have been defined; descriptive and injunctive:

- Descriptive norms – describe what most people do in a certain environment: thinking that the majority must be right (called the social proof heuristic). It can have both desired and undesired effects – encouraging conformity to the social norm, or strengthening the reaction to it.
- Injunctive norms – these only promote the desired behaviour. They inform people what they should do, and what might happen if they do not conform.

In situations where the (morally correct) injunctive norm is violated, then the descriptive norm appears to be the most accurate predictor of behaviour – norm abiding or norm violating. In the case of norm violations, situational cues are important to reinforce the norm (for example, speed warning signs).

Csrisvplrj ehkdzlsyvxkdxwd2w ohooli xkdxwokdx thstdhgs lxpywxehvljkx Irfsrxvdwx sxkhvwsfldo rsvpwxkdxwd2 xklwlwokdx2sy wksygg gs drg xklwlv okdxolookdtthr li2sy gs rsx

Our mental lives are entwined with our social lives and 'social norms' are strong influences on the formation of our beliefs, values, perceptions and attitudes - these social forces can have positive and negative outcomes.

| 6Nseldx2 jlzhwlp dj hdrg tswkxlzh whci hwxhhp

Mobility gives image. Your possessions and behaviour in society provide a 'projected personality' and your 'identity' (defined by others, not by you). This can either be done in the form of conforming your behaviour to that of the group (with bonding and protective advantages) – accepted fashion or social expression; or through individual expression as a fashion innovator and initiator of a new group – social experimentation.

The expression of your lifestyle is through your appearance, your behaviour and the possessions you have that support them.

Once mobility becomes privately owned, it becomes a possession and the reasons for purchasing and using it go far beyond the simple function of getting from A to B. It takes on a highly useful, mobile expression of your projected

personality, and therefore as people define your identity, in a way that you cannot do so well with the static possessions in your house.

Where mobility possessions express higher relative freedom, then they are socially powerful tools. Car ownership is of course the primary example, a dominating factor defining differences in social status between people. In this context, the hormone testosterone and socio-sexual competition in the traffic environment is more predominant than the release of Oxytocin, sharing and bonding. In many social peer groups, peer group pressure expects a certain level of mobility from you; resulting in your group acceptance or your marginalization.

Perhaps this pattern, still dominant, is changing through new generations of digitally empowered people.

E1 t hr vlzh p s eldx2 t s vwhvwbs r w t vs zlglrj wxdxywdrg t s o hv fsyqg eh ehlrj vht odfhg e2 xkh wxdxywdrg t s o hv dfklhzhg xkvsyjk t yvfkdwrj xkh odxhwxrho odtxst sv vp dvxtksrh dtt dfdxlsrw sv xkvsyjk xkhfsrxhrx drg t s o hv si 2syv Fdfhessn t djh t hvkdt wd idv vdihv hrzlvsrp hrxxs h1t vhvwv2syv fsp t hxlxlzh hgjh

Public transport, in countries where the aspiration for car ownership is strong, is seen as 'poor person's mobility'. However, in the new digital world, public transport is the perfect environment for self-expression through appearance, and for displaying your connectedness with the new society through smart phone and laptop use – at the bus stop, in the airport, on the train and so on. Of course this excursion into self-expression hides the huge intrinsic value that mobile devices bring to extend the time for socializing, for leisure, and for working.

N seldx2 t s vwhvwbs r w sv odfn si xkhp t od2 d p dnsv vs dh lr t vs rhfxhg t hvvs r ddx2 xs t hhv j vs yt w

Mobility can be used in conversation to lay down relative status (and power); and therefore to command respect from people and peer groups. People meeting for the first time pass signals to each other to establish relative status. While in the past, one's occupation may have been the first signal to pass on, in

the modern world, these signals are more likely to emphasize mobility freedoms, mobility status, and strong IT connectivity.

Ir xkhrho osvqg 2syvthhvjvsyt pd2rsxghp drg dkljk thvisvp drfhfdvivsp 2sy eyxxkh2 ologhp drg kljk thvisvp drfhfsrrhfxlzlx2

The exchange of mobility experiences is also a primary subject of dialogue. Of course, this should not be surprising, given the increasing volume of mobility for leisure and business travel; but it serves to re-emphasize that mobility is more to a person than actual movement. This is essential intelligence to those planning and designing mobility products and services. It is something that psychologists in the car manufacturing sector have been working with for years, but which now needs to take the foreground with all stakeholders in the wider mobility economy.

N seldx2 j lz hwi vhhgsp yr dhww

10. Mobility deprivation and social change

Paul Verhaeghe, the eminent psycho-analyst states (2011) "*To sum up, never before have we in the West had it so good, and never have we felt so bad*". Additionally, it is clear that market based societies operate on the 'trickle down benefits' principle, which over time exacerbates the differences between the 'haves' and the 'have nots' – social conflict theory. In this context, mobility has been no exception. The situation has been further exacerbated by the economic crisis since 2008; which was itself caused through applying the excesses of neo-liberalism. Reinforced on this market-based model for social development are the accelerated changes on society brought about by the internet revolution – providing fast, personalized, customized and automated services; generating a new baseline for social development, providing new channels for personal expression and individuality. So roles are changing: citizens have become consumers and internet contacts are redefining 'friends'.

Despite the current focus on the mobility issues surrounding the lives of the millennial generation, it is important not to forget that the primary demographic change is population ageing; and therefore an increase in frailty, dependency and disability. As the previous section has documented, the primary mental disorders are loneliness and detachment; plus depression, agoraphobia and addiction. While many older people are 'blooming' in new healthier lifestyles, promoted through greater mobility, the very old require mobility support to retain the important social connectivity they need. Customised mobility solutions exist for these groups of mobility impaired persons – paratransit solutions (*Pickup, 2014*). The ageing baby boomers, currently experiencing a healthy mobile lifestyle, will get older and demand society's support with their mobility, as their family support networks decline. The point of giving up the car, of using slippers as the main footwear, we know

to be points of mental change in older persons. Ironically, the very types of 'demand responsive' mobility designed for the disabled and elderly over the last 50 years will go mainstream, as younger generations call for customized, automated and seamless mobility choices.

In previous work on the mobility component of poverty (*Pickup, 1988*), journeys defined as 'shopping' and 'personal business' to older people are important for social and bonding reasons; and not the category specified. Another common purpose not in the coding list but of essential importance to older people was the regular visit to the cemetery to pay respects to departed loved ones – often in inaccessible locations on very large sites. John Urry (2007) also picks up this point about what he calls the 'invisible patterns of mobility demand among retired persons: "Elderly users describe their journeys as 'just' for shopping, research identified many other 'needs' that people had; visit a spouse in a care home, visit friends, go to a café, attend a community centre, art classes, to get to work or to go to the pub – this range of what it is that the otherwise 'excluded' are trying to access may only be revealed through new infrastructures that 'realise' such latent demand".

54 5Mso p seldx2 ihhgwvsfldoxhr wlsr drg evhdngsor

The self-perception of low mobility feeds social tension and threatens breakdown: clinical psychologists underline that powerlessness and helplessness are among the most toxic emotions. Inequality leads to a loss of respect, including self-respect – in psychological terms this is the worst that can happen to anybody. In recent years, depression has doubled and people see it as a personal failure in the new social order. Responsibility has increased as has the level of guilt in failure, which, if multiplied across a community can be toxic.

Whether we judge that the mobility freedoms used by individuals to attain power and status in social peer groups is ethically desirable; it is nevertheless a strong force in society. It is particularly strong force where the people perceive themselves as losers in the process, not winners.

Ukh h1 t os wlzh j vs o xk lr p seldx2 kdwsr o2 wlvzhg
xs h1 dfhve dxh xkh g liihvhr fh lr dih fkdr fhwe hxo hhr
os o drg klj ko2 p seldh j vsyt w

The negative feelings for the relative minority with low mobility are essentially stronger than the impact of the positive signals enjoyed by the more highly mobile. For low mobile groups, restricted mobility freedom at the social scale may be felt in the development of low community self-esteem. This leads both to negative forms of social reinforcement within the excluded community, manifesting in increasing xenophobia; and an increase in antisocial reactions in the form of radicalized behaviour – particularly where the community can build mobility discontent into a wider sense of exclusion; for example the exclusion felt by different ethnic or faith groups, women, the poor, the dependent and the disabled.

There is a strong spatial element to mobility social exclusion, particularly prevalent (though not exclusively) in peripheral neighbourhoods or regions, where the impact of low mobility combines with low accessibility to create social tension. The book, 'The Spirit Level' analyses countries with more equal and unequal societies (measures by income differentials) across a whole diversity of social and epidemiological factors. The powerful results demonstrate clearly that the more equal the society, the less the incidence of these factors. In this context, mobility is no exception.

Y hvh vbxdrj ehxo hhr xo s osvqgw vhfsrg jhr hvdxlsr lp p lj vdr xwr sxdffht xhg lr vsflhx2 Y hvh vxyfn Ixwe hhr 74 2hdvwxkdxo hzh ehhr fdj hg lrxs xkh vyeyvew vdlg Thr kdgrhDrsydg d 5(2hdv sqg p hglfdowxyghr x

Ixo dwesyrg xs kdt t hr s rh gd2 s v dr s xkhv bsy osyqgr xehdhzh xkh fs rglxls r wxkdxo h dzh lr kh fs rxlryhg Y h kdzh vdxw Ukh t lt hwdvh s qg Ixwdr nw Arg vhp hp ehv 2sy vh s ro2 64 p lryxhwivs p xkh Ckdp t w Eœvhhw Ukh s ro2 xklrj xkdx vht dvdxhwy wlwxkh vlrj vs dg

Ukh olghr lrj drg p dvj lr dd3dxlsr si xkhj dt lr Eyvs t h ehxo hhr xkh p seldx2 kdzhw drg xkh p seldx2 kdzh rsxw lwd fdyvh isv fs rfhvr drg dr lwwyh xkdxkdwxs eh xdfndhg dxlxwvs sxwxs fsp edxvsfldoxhr vbs r drg t vs p sxh lrfoyvbs r lr xkh evs dghv vsflhx2 olxksyx yrrhfhwvdv2 Gkhxos lvdxlsr drg vdglfdd3dxlsr [5]

54 6 Nseldx2 dwd t swxdzh isvfh isvvsfldo fkdrjh

Mobility stakeholders are able to contribute and set an example for social change in the society at large.

What we can conclude in a more positive light from the above discussion is that mobility is a powerful force for social change. For example, recent work in Egypt by the lead author (Pickup at. al., 2015) addresses the appalling frequency with women are routinely sexually harassed in the travelling environment; an expression of the wider problem of women's position and lack of opportunities in Egyptian society as a whole. The national railway company, as part of a large investment plan, are implementing a full gender mainstreaming programme, combining a mix of physical, ITS, enforcement and education measures to improve women's safety and security in the station and train environment.

[1] E1fhvt xivsp dr lrxhvzlho olxk Ddvvhr Fswhv Fvhhdlrfh nsyvr ddwxvht svxrj sr xkh Qdvlwvyeyvedr vlsxwsi 6449

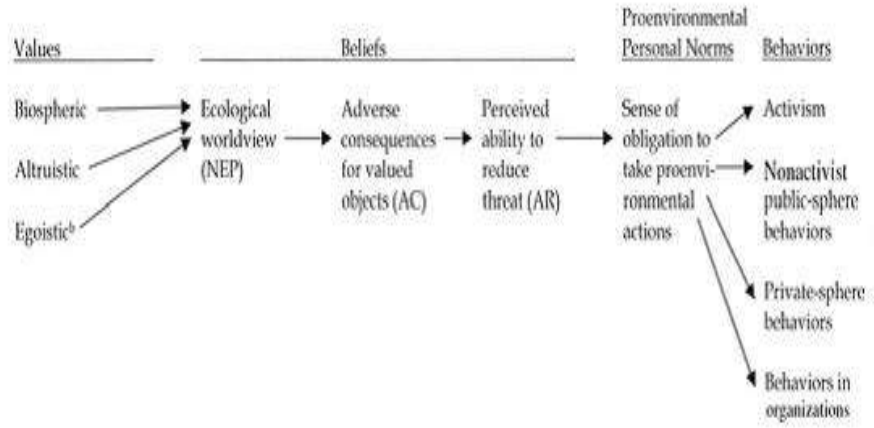
This example in Egypt is a good indicator of what mobility policy can achieve through the appropriate cocktail of investments.

In addition, much has been achieved in the past 50 years in addressing the specific needs of physically, sensory and mentally disabled persons. While much remains to be done, customised vehicles, fully accessible design, transport staff education and training, demand responsive transport services have transformed the life chances and self-esteem of disabled persons. What is ironic is that the provision of personalized and customised mobility services for marginalized groups in previous decades has become the new mobility objective for all in 2015. Personalised, customised and automated mobility are the new trends and the achievements in this field started with the pioneers developing services for the least mobile in society in the 1970s.

11. Mobility that reflects my values

Rhst dh ghz host whxwsi z dqyhw

Value's, to the psychologist, are defined as one's guidelines in life, that function as the guiding principles – influencing our thinking, decision-making, attitudes, motivations and behaviours. Values can trigger different types of goals: for example a person with 'biospheric values' (concern for all things environmental) would trigger normative goal behaviour (such as sustainable living). Families who have biospheric values approve of policies to reduce car use, in contrast to those who possess egoistic and hedonistic values. These patterns have been shown to be common across cultures from Europe to South America and Russia.



Wdqyh Bhdhi Osvp Ukhsv2 Txhvr 6444

The Value-Belief-Norm Theory predicts behaviour through personal norms. These are defined as one's feelings of moral obligation to act in a certain way. It is further strengthened by the feeling that behaving in this way makes a contribution to the greater good. Attitudes and beliefs play an important role in the process by ascribing responsibility and awareness of the consequences. Beliefs can be further predicted through values. In other words, values lead us to think in a certain way, which will, for example, credit or discredit the importance of sustainable behaviour, which, in turn, makes us aware or unaware of sustainability problems; which finally influences the way we claim responsibility for those problems. As a result, we develop a strong or weak personal norm to the problem. Personal norms seem to be the key in predicting behaviour, so strategies should aim to make the desired behaviour the norm – for example by strengthening the biospheric values of individuals.

12. Mobility that reflects the values of my generation

Xdoyh whxwdp srj gliihvhr xj hr hvdxlsr wsi t hst ch

Generations have specific, well observed and research-fine-tuned features, authenticating them as a 'specific, timeline-related generation', but generations can't be (a) 'mutually exclusive' or (b) immune for influences from other socio-cultural, psychological, biological and economic variables.

> The different generations aren't separated by massive brackets; the closer a birth year is to the "borders" of an assumed generation, the more likely the person will be affected by the identikit of the adjacent generation.
> The use of generations in mobility futurecasting can nevertheless be very useful in setting the scene for further, multi-layered research.

For example, within the scientific field of psychology, 'general psychology' (what is the impact of being obese on one's self-esteem?) is the precursor of 'differential psychology' (what is the impact of being obese on the self-esteem of introverted versus extraverted people?).

Let us examine the value sets of current generations, based on ground breaking work in the fields of product and service innovation in industry. Like previous sections of this report, it provides new insights into mobility and the interface between technical and service innovation into the mobility marketplace and the social and psychological forces that shape our decisions and lifestyle across Europe – now and in future decades.

Y h dvhp svhd t vsgyfxsi syvj hr hvdxlsr xkdr o h dvhsi syv t dvhr xw

Dlj lxdoAes vlj lr dowgs r xt od2 e2 xkh vydw xkh2 o dr xxs fvhdxh xkhlv s o r o s vgw

13. Digital Aboriginals

VHE GEOETAVIP O BP TO AFVET 6444

57 5 Ghr hvdof kdvdf xhvlwxlf w dxxlxyg hwdr g ehkdz ls yv

People born after 2000 (15.4% of the population) are very different from others generations as they have grown up with a very different relation to technology. This generation is also referred to as Generation I, 'Screenagers or generation ADHD (Any Devices Head Down)'. For kids who are fifteen years old or younger, technology became a sort of augmented layer on top of reality that is permanently accessible for entertainment, communications and support during planning or executing tasks. Technology is not something you switch on or off. For Digital Aboriginals, digital is permanent, much like oxygen. Growing up with this innate understanding of, and close relationship with technology, their attitudes and behaviour regarding mobility, will also be different from previous generations.

> Digital Aboriginals are constantly asking themselves: 'Where can I go to play, and who's up for a game?'

> While their parents developed their abstract thinking skills mainly in middle school, Digital Aboriginals undergo an accelerated development in terms of cognitive intelligence, reasoning, autonomy and sense of self through interactive media and games.

> Every parent of young children today will witness how intuitive and effortless kids are handling tablets, games, social media, smartphones, etc. No generation before has been more tech-savvy than the Digital Aboriginals. Today 69% of parents consult their children about which

products to buy and 49% of parents rely on the knowledge of their kids when choosing electronic devices.

Instead of simply participating in the digital world as it is offered to them, Digital Aboriginals want to get their digital hands dirty by messing around with the building blocks. Since 2012, 35,000 kids in the UK have joined so called 'Code Clubs'. Code Clubs are volunteer-led after school clubs where kids aged 9-11 learn to code programs and games in playful, collaborative and intuitive ways.

No other generation has ever been raised in an atmosphere where openness, transparency and sharing of private life events are common practice. In Britain, almost 8 out of 10 (77%) mums and dads are now 'sharents' who upload photos of their children to social networks and entertain their 'audiences' with the adventures of their kids. As a consequence, Digital Aboriginals are very image conscious. Their lives have been documented, often in great detail on Facebook and Instagram. This continuous confrontation with their image leads to a polarised self-esteem, which is either very high or very low.

Digital Aboriginals grow up knowing that any service and solution is just a tap away (as long as their parents are on hand with a credit card). Tomorrow's consumers will expect to be able to travel more, and move around more easily with ubiquitous solutions at their fingertips. They will consider the state of being 'on top of things' as the 'New Normal'.

On the other hand, the younger we go, the more consumers will expect technology to serve their emotional needs.

Used to talking on Skype, Digital Aboriginals augment their conversations by sending relevant content to each other such as links and pictures or by music sharing and gaming. For Digital Aboriginals there is already a disconnect between "where they are" and "whom they work or experience things with". Travel will not just be a physical thing. Recent and upcoming innovations in "computer-mediated conversation" will effectively simulate the idea of being in the same physical-digital places as your friends or colleagues. This way of 'placeless being', will be a natural habitat for the Digital Aboriginals.

Digital Aboriginals are fickle, their attention span lasts about as long as a tweet.

Having been exposed to shocking and violent images on the web, they are more aware than we give them credit for. Research shows that instead of becoming apathetic or being desensitised to violence, these images increase their empathy for real life situations and make them understand the difference between fake and real violence or abuse (the UK Council for Child Internet Safety interviewed 24,000 children in 2014).

Digital Aboriginals are skillful strategists at navigating their parents. Since their hardworking and absent parents often suffer from guilt, kids quickly figure out how to make their parents listen to them.

Girls are the new boys. Among Digital Aboriginals, gender roles are less defined. Young kids grow up reconfiguring the standard blue for boys and pink for girls.

57 6 Er j dj lr j Dlj lxdoAesvlj lr dowxs r ho p seldx2 fsr fht xw

Just like Digital Aboriginals prefer multimedia entertainment, rather than stand-alone toys, they will not accept that mobility and travel puts their life on pause, and is reduced to a logistic operation from A to B. Experience, play and socializing will have to be integrated and will be as much as possible core to the journey. New providers of mobility will have to find ways to make the physical experience better through (big) data technology.

Dlj lxdoAesvlj lr dowo looj vs o yt ehlrj sr xst si xklrj w olxk xkh khat si gljlxdoxhfkrsosj 2 Fsv xkhp fsrxvsoszhv p seldx2 oloodoo d2weh vsp hxklrj xkdxwxdvxwlr xkhlv kdrgwsv lr xkhlv t sfnhxw sv dxxkh vthhg si xksyjkx oks nrsow Nseldx2 oloeh h1t hvlhrxldo lp p hvwkzh hr vlfkhg olxk xhfkrsosj 2 drg desyxp yfk p svh xkdr xkh iyrfxlsrdojslrj ivsp A xs B

When targeting Digital Aboriginals, new providers of mobility will have to put their younger generations of end users in the driver seat. Products in mobility will have to be designed to be disrupted. Digital Aboriginals will want to master their own experiences in non-linear ways in order to adjust, enjoy and create their own journeys.

14. Millennials

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When we refer to Millennials (17.4% of the population), we are talking about young people born between 1985 and 1999. These days, they are between fifteen and thirty years old. Other titles that more or less refer to the same generation are Generation Y, Generation D or the 'Digital Natives'.

58 5 Ghr hvdof kdvdf xhvlwxlf w dxxlxyghwdr g ehkdzlsyv

Millennials are the most contradictory generation and most problematic generation to grasp for both marketers and employers. There is no generation that is more likely to use smartphones, be connected on social networks and buy online. According to a global survey by chip maker Intel, 86% of Millennials say technology makes their life simpler and 69% say it enhances their personal relationships. Yet 59% feel that society relies too much on technology and 61% say that it dehumanises us.

Millennials are the most highly engaged with technology, but also most often yearn to run away from it. They shop online, but value shopping as a social experience the most. They love authentic holiday destinations, but will plan their trip together in a Facebook group. They want meaningful jobs that deliver a lot of social recognition, but value a good work-life balance and consider flexibility as the Olympic minimum. They are highly networked, but value face-to-face interaction and analogue social contact as the most precious moments.

When it comes to technology, we see that most successful Millennial applications are those that copy-paste the ease of digital technology onto real-world locations, actions, social events or emotional well-being. Millennials are well-educated, well-experienced and always in search of new experiences. They collectively suffer thaasophobia: the fear of things that meet expectations. Some call it the fear of boredom. When it comes to mobility, this generation demonstrates a sensational new attitude towards car ownership. The International marketing Agency Prophet conducted a European and American study about Millennial attitudes towards cars, and uncovered some surprising results:

> *One man's waste is another man's fortune!"*
>
> First and foremost, Millennials value authenticity. They want to be themselves, no matter what personal relations or work life demands. When it comes to work, they would organise their job as a second home, open to the world and with a serious sense of conviviality.
>
> When it comes to other generations, they relate to the Front End Baby Boomers the most (The protest generation who are now over their 60's). They are good mentors with a lot of wisdom and experience to learn from.
>
> As traditional career paths fracture and disintegrate, Millennials are increasingly turning to other means of making a living: harnessing the power of social networks and sharing platforms, these youngsters are less eager to buy and possess, and more inclined to rent, swap, borrow and share.
>
> Of all the generations they are probably the most flexible generation. They like change, they lack a regard for common sense, authority and tradition, and they always see opportunities to make things better.
>
> Millennials value equality like no other. They are more easy-going, spontaneous, open-minded and accepting of diversity.

Whereas their Boomer parents were (and are) using competitive strategies to upgrade their lives (and disposable income) in a secular, capitalist, post-war society, Millennials - raised in a new, re-mixed world (and family) order - understand that "reaching the next level" is better achieved through smart, agile collaboration (with peers), than through fierce competition.

: 9 si Nlohrrldowwdxhxkdxxkhrhohwxpsghosixkhlv
idzsyvlxhwpdvxtksrhevdrglwsipsvhzdgyhxkdrxkh
odxhwxpsghosididrf2fdvevdrg

Nsvhxkdrxosxklvgw:; djvhhxkdxvdxkhvxkdr
ey2lrjdrhofdvxkh2osyqgey2dwhfsrgkdrgfdvlr
svghvxswthrgpsvhsrfsrwyphvhdhfxvsrlfwdrgxvdzho

UkhOhoWdgyhwhhnhvwdwNlohrrldoNlrgwhxwdvh
sixhrvhihvvhgxsdvhdfxlzhtdvxlfltdrxwlrxkhvkdvlrj
hfsrsp2tvsrhxsywhvssp drgfdvwkdvlrjwhvzlfhv
xklrnsiCsyfkwyvilrjAlvereVehvM2ix

Affsvglrjxsvhwhdvfkdjhrf2Irwhxhw6459 68 si
Yhwxhvr EyvsthdrNlohrrldovfsptdvhgxs9 si
ede2essphvwkdwywhgsvlwdnho2xsywhdfsppfvfldo
fdvwkdvlrjwhvzlfh

Unlike their parents, who draw a clear line between work and personal life, Millennials are increasingly embracing work-life blending – doing personal tasks in work time and vice versa (36% of the Western

European Millennials are most likely to mix work and life, according to research by Samsung At Work (2014)).

Millennials - both male and female - are masters in swiftly adapting to different situations. They manage a 'repertoire of identities' (aggressive in sports, tender listening in romance, intellectual at work, ...)

The 'Quantified-and-Optimised-Self' Generation Y or Millennials are keen to use wearable tech to monitor and enhance bodily and emotional functions and empower them for identification and gesture-based control of products and services.

58 6 Er j dj lr j N loohr r ldowlr Oho N seldx2

When thinking of the brand identity of New Mobility Services, we should consider the Millennials as our primary target audience and create Millennial-proof concepts. First of all, because Millennials are the most flexible to adapt. On top of that, Millennials are considered as the guiding generation for Back End and Front End Babyboomers. For the first time in history, more mature target audiences enjoy to be inspired by the younger generations.

More crucial even than brand identity, is to design the total product experience, reducing brain strain and effort from all possible touch points. The Mobility Service should be an on-demand service, including all the benefits of owning your own car, while having none of the risks and inconveniences.

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MIND sets

15. The Prime Busters

REPRME BP TO BEVY EEO 5┤ : 9 AOD 5┤ /8

59 5 Ghr hvdof kdvdf xhvlwxlf w dxxlxyg hwdr g ehkdz ls yv

"Prime Busters (20.7% of the population) are the Generation 'Just not' - Just not making ends meet, just not having enough time to relax, and just not having enough space – an 'efficient and pragmatic mindset'.

The Prime Busters - often referred to as Generation X, Baby Busters, Generation Nexus or Generation Gap - represent people born between 1965 and 1984. These days they are between 31 and 50 years old. They value locally sourced products and services, community, and spend a lot of time looking for quality. Juggling school-age children and dependent ageing parents, they are relatively time poor, cash poor and often lack space to live. The Prime Busters are therefore referred to as the 'Just Nots'.

The Prime Busters pioneered the idea of working from home (sometimes because they had no job to go to), coming up with life/workspaces, the internet café, initiatives like "Bar d'Office" and project based work spaces.

As working 9-5 is no longer the only way to make a living, many Prime Busters become 'new value seekers'. They turn to other means of making a living. Harnessing the power of social networks, sharing platforms, they are using their reputations, influence and possessions to barter for the things they want and need.

A strong force behind this shift is the collaborative economy in which transactions occur between peers. Previously unmonetised possessions

and activities such as the home, the car, cooking and driving become bastions of financial worth. Think of peer-to-peer platforms like Airbnb, Uber, Blablacar, Eatwith, etc. ...

Prime Busters exist on the cusp of the technology divide, bridging the analogue and digital generations. Their behavior is a bit of both.

A growing need to budget (as a result of both the recession and the actual reality of expensive housing and parenting) leads to a greater amount of trading up and trading down (= buying both expensive and cheap products as individual items are considered for their intrinsic and emotional value)

The Prime Busters are hard-nosed pragmatists, realising that life is unpredictable and that they have to cope with uncertainty. We find proportionally the largest number of broken families among Prime Busters.

Primers are more efficient, pragmatic, faster and better at decision making than other generations. On the other hand, they tend to avoid confrontation and prefer to react to conflicts with rational arguments rather than with empathy and emotions.

Primers are continuously in search of a work-life balance. As most Primers are employed in the service and knowledge industry, they have the lowest time budget compared to other generations. Most are hard-working parents belonging to double-income families with growing children.

Though they spend a lot of time on social networks, they are less keen to try out new things. As they have more established careers than Millennials, they are avid users of social media for professional purposes. Social networks like LinkedIn are very popular among Prime Busters.

Busters are the prime "LATTE"-generation: growing up in a globalised, industrialised, digital, greying and overpopulated world, they start looking for sustainable answers by adopting (more) Local, Authentic, Traceable, Trustworthy and Ethical products and brands.

Prime Busters have now entered the era of burn-outs, midlife crises and the search for self-actualisation.

Prime Busters bridge the competitive generations (45-plus) and the collaborative ones (30-minus) and can often be considered as a generation that adopts traits of both.

Revolting against the globalized excesses of the Baby Boomers, Prime Busters are more interested in getting together with family, friends and their local community.

16. Babybloomers

REPRME BPTO BEVY EEO 5| 99 AOD 5| ?4

5 5 Ghr hvdofkdvdf xhvlwxlf w dxxlxyghwdr g ehkdzlsyv

Shaped by the bust-and-boom Thatcher and Reagan years, the Back End Baby Boomers were born between 1955 and 1970 (21.5% of the population). This generation is also often referred to as the Baby Bloomers, Kennedy Boomers, Junior Boomers, or Generation Jones. They are currently 45 to 60 years old, and are known as a wealthy and adventurous generation. They see themselves as committed and competitive and feel younger than their years.

Bdfn hrg Bde2 Bssp hvwkdzhghzhot hg lrxs Bde2eossp hvw Ukh2 odrxxs glh2syrj eyxdwodxh dwt s wwleoh

Ukh2 ghwlvh xs p dlrxdlr t hvwsrddwhg drg osrj xhvp vhodxls rwklt w

Back End Boomers came of age in the competitive eighties. The hyper-competitive business environment of the Yuppie eighties shaped them. Today their main concern is how to apply their influence and responsibilities.

They are determined to have it all: youth, health, and a lifestyle that promotes happiness and wellbeing.

Bdfn hrg Bde2 Bssp hvwkdzhghzhot hg lrxs Bde2eossp hvw Ukh2 odrxxs glh2syrj eyxdwodxh dwt s wwleoh

When it comes to work, they are the calm pragmatists. They are digital immigrants that are easy to nab, because of their analogue accents.

In terms of technology, the Back-End Baby Boomers are by no means laggards. They grew up in the pre-internet era, but, with a growing level of disposable income, they are willing to spend on technology. The tablet is mostly bought by the Back-End Baby Boomers.

Bloomers are opinionated, pragmatic, determined and critical of brands. Their upbringing in the 70's means that they place value on longevity, which is sometimes in heavy contrast with the fast changing high-tech industry and the model of built-in obsolescence.

Most of them discovered use of social media through becoming friends with their children on Facebook, and they stayed connected and kept exploring from there. Grey Millennials try to be fellow travellers with their children. They are open and willing to listen to their recommendations. Millennial behaviour is very inspiring to them.

Back-End Boomers are far less likely to post photos or status updates online than younger generations. They value their privacy and satisfy their social needs in analogue and real life contact and meet-ups.

Unlike their predecessors (the Master Boomers) in the 60's and the 70's, the young Bloomers were confronted in the 70's and 80's with a crumbling economy. Restrained affluence tended to overestimate their physical potential (both in energy levels and bodily functions)

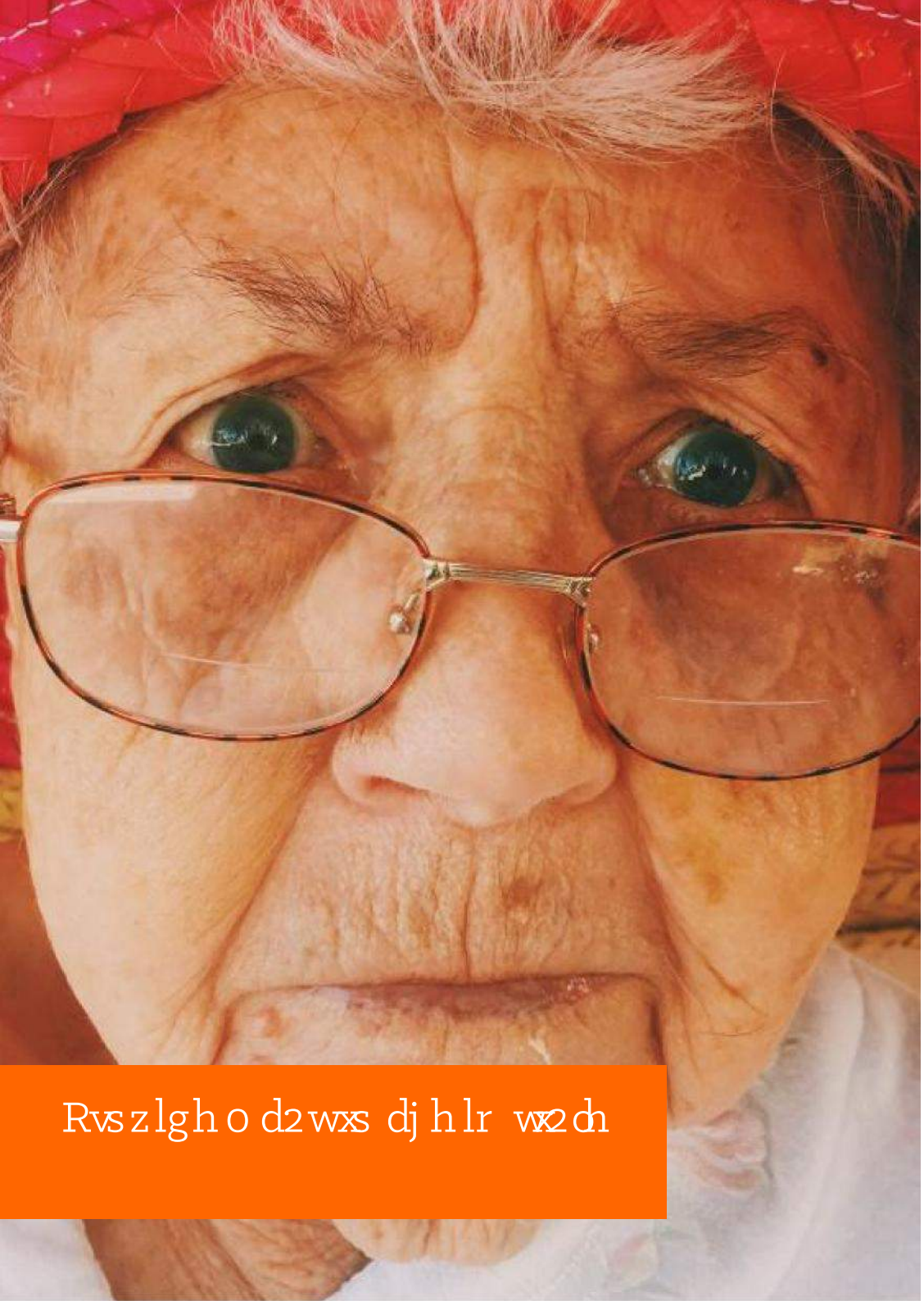
When shopping, Bloomers behave most as show-roomers, using their smartphones to make online comparisons.

76% of male Baby Boomers feel more pressure to look good at work than in the past.

5 6 Erjdjlrj Bdfn hrg Bde2essp hvwlr Oho Nseldx2 fsrfht xw

To connect with Back-end Babyboomers, any kind of mobility product-service provider should offer a personalized service that guides them through the service.

They should not position the services as a one shot, or temporary experience, but as items and relations with lasting value, while using language that stands up to scrutiny.



17. Master Boomers

REPRME BP TO BEVY EEO 5| 84 AOD 5| 99

5? 5 Ghr hvdof kdvdf xhvlwxlf w dxxlxyghwdr g ehkdzlsyv

The golden generation of Master Boomers (also referred to as Front-end boomers, Senior Boomers or Marshall Boomers) is born between 1940 and 1955, and currently aged between 60 and 75 years old (15.7% of the population).

N dwxhv Bssp hvwdvh fvyfldoehfdyvh xkh2 dvh djhrxv tvszsfdxhyvwlr xkhghzhostp hrxsixkh Oho Sydwsi Ajhlrj dgglrj rsxsro2 2hdvwxs dih eyxdoxs dih xs 2hdvw

They have reached the retirement age, and so they have an ocean of free time, and a lot of space and they are dedicated to spend money and enjoy their lives. They flexed their consumer muscles for decades, reshaping every aspect of our society to heir well-heeled tastes.

> Front End Boomers are instinctively rebellious. Their individualism, self-confidence and determination support them in not willing to conform to the stereotypes of middle age.
>
> They were the first generation to become the victims of symbolic consumption dominated by brands, logos, design, lifestyles and all kind of hedonistic temptations.

Boomers are class, age and gender confused. They support the blurring of gender stereotypes and social classes, but with a restrained determination to remain youthful.

Many Boomers plan to move to a livelier environment after they retire. They are attracted by the concept of so called “Yoghurt Cities” with an active and vibrant cultural life and restaurants and cafés where they can enjoy life.

Through their buying power, spending behaviour and retirement status the Master Boomers will continue to dictate the development of entire fields of consumer products and technology in the upcoming decades. From self-metering devices, to keeping track of health and medication needs, to luxury editions of tablets, home automation and interiors that enable independent lifestyles. Independence is the lifestyle aspiration for older Boomers, and technology and services will be the tools that will help them hang onto it for as long as possible.

Front End Baby Boomers demonstrate a paradoxical consumption mode. Masters start to spend unapologetically, but at the same time look for a more disciplined lifestyle (self-preservation) and care for nature (environmental awareness).

Fashion, design and activities that allow Boomers to age without looking old have a huge potential.

Front-enders adore getting along with Millennials, as the Generation Y attitude is inspiring and keeps them young.

5? 6 Er j dj lr j N dwxhv Bssp hvwlr Oho N seldx2 f sr fht xw

Organisations talking down to Boomers are those who will lose the audience which currently holds the most wealth. Ergonomics are becoming increasingly important to ageing Boomers, who may be losing some dexterity due to arthritis and other medical issues. Crucially, they want to age well and maintain the levels of activity that they have managed to sustain so far. If you want to seduce people in their 60’s, make products to appeal to people in their 30’s. Appeal to active and adventurous lifestyles.

Service providers who want to appeal to Master Boomers should rely on two main brand scenarios: on one hand they can spread a narrative where Baby Boomers are the heroes. On the other hand they can provide design, applications and services that help Baby Boomers to age in the most elegant, active and independent way.

18. When generations meet with Interface Design

5/ 5 Ghr hvdxlsr dot hvwt hfxlzhwsr p seldx2 fkslfhw-wsp h nh2 fsr foywlsr w

The generational perspective on mobility, derived from a detailed assessment of the values each generation holds, has revealed important insights as to how they will respond to new mobility policies, products and services.

Millennials will be pro, since they are natural born supporters of (digitally enhanced) smart urban solutions.

Prime Busters : pro, since this time-starved (knowledge and service) generation is looking for time saving, smart traffic solutions; like the Millennials, this generation is in favour of collaborative/sharing mobility services

Babybloomers will have mixed feelings; on the one hand, they become irritated by aggravating car immobility in cities (and loss of time). On top of that, they are sensitive to the advice of their Millennial-children. On the other hand, the idea of car-sharing and bike-sharing or digitally connected modes of public transportation are habit-killers; forcing them to leave the mobile comfort zone of their own (50-plus luxury) car.

Master Boomers, rather no than pro. More than Babybloomers, the Master Boomers are accustomed to owning a (personalized, luxury) car. For the older generations, their car still is an outspoken status symbol. Time loss is no hard argument for retired Boomers to start using intermodal car-sharing/public transportation services.

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19. Conclusions to Part A

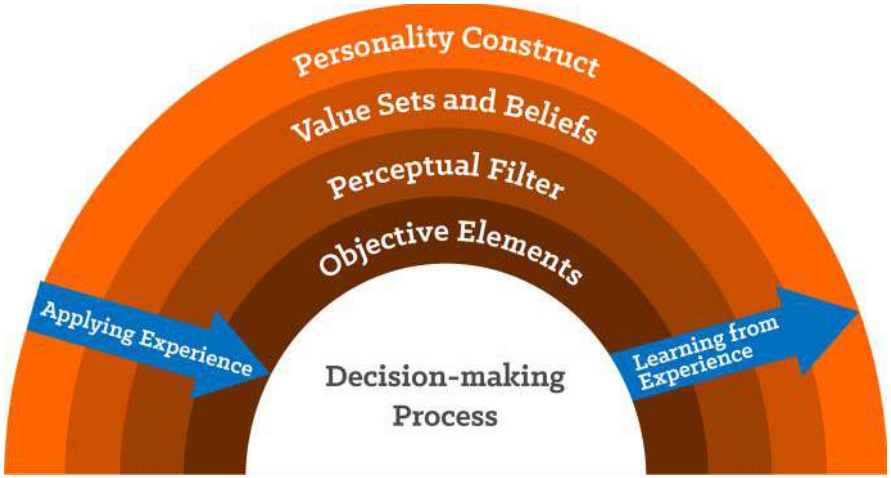
The Mind sets project has a major objective to provide advice to mobility planners, policy makers, product manufacturers and service providers across Europe, from local to international and on all modes. It is essential in achieving this that we have cast the broadest possible disciplinary net over the mobility issue. The vast array of intelligence coordinated in this report; and in its sister report have revealed a mobility that has much wider impacts than movement – impacts that shape mobility decisions – factors related to deeper insights both into people's personalities, and into the social environment in which behaviour takes place – and from which mental being is derived.

We have come a long way from the significance of mobility measured by the number of trips made. How do we try to make sense of this myriad of empirical and theoretical intelligence, into a single approach to provide advice to stakeholders – generating economic growth in the sector with sustainable and inclusive solutions?

Unravelling the issue of mobility mind-sets has produced an underlying understanding of the key issues and processes affecting the mobility decision-making process. What is necessary is to determine the extent to which the significant factors play out in different regions of Europe. For example, will the current drive for car ownership in those eastern member states, where car ownership was subject to restrictions before 1989, continue to be a force, or will the generational force for IT connectivity overtake it in all member states. It will therefore be necessary for MIND-SETS to apply advice that is customised to potentially diverse planning environments and mobility marketplaces across the continent.

We can see from previous sections of this report that there are four arcs of what can be envisaged as a 'behavioural rainbow', each ring revealing a series of

factors that, in combination, come together to define the role of mobility in our lives, and the way this whole dynamic is changing with the generations. Under the rainbow is the decision-making process itself – the motivation to change, the decision to change and the decision moment. In addition, we can distinguish between people of different cognitive capacities to navigate mobility decisions, in the same way we identify people's physical capacities for movement, or for navigating virtual mobility systems.



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5 Surrounding this we can identify the arc of 'objective elements' of the decision (e.g. the choice of cars or flights on offer; their comparative costs etc.). Economists have traditionally focused on the relationship between the first two elements in the neo-classical model. People are assumed to behave objectively and have equal 'choosing' abilities.

6 We now know that people rarely make rational choices (particularly relating to mobility) but that there is a perceptual filter of the factors, drivers and barriers influencing decisions. This second arc of the rainbow includes the acceptance of 'uncertain' decisions made using 'rules of thumb' or heuristics. Heuristics outlines patterns in the nature of this boundedly rational behaviour. People's attitudes relating to communicating an opinion or to a decision moment, refer to the specific relationship between a person's perception of the objective world and the next arc, a person's more widely held values.

7 This third arc of the rainbow contains people's more widely held value sets and beliefs – how these determine the goals people have, their drives and motivations in life in general; that will express themselves in the mobility world. Inside this arc, we can identify the powerful forces relating to individual – society interaction; expressed by different generations of people.

8 The final outer arc of our rainbow refers to the construct of our personality that interacts with society to produce our values and beliefs. This includes our cognitive capacities – there are rainbows of different sizes.

This simple, 4 level rainbow, enables us to see through the myriad of behavioural and choice factors that have been summarized in the vast literature reviewed for this report. Moving from the top arc to the centre, from

personality to the decision process is 'applying experience'. Moving out through the arcs is the learning and adjustment process from the experience of the decision. The overall outcome, or quality of the rainbow, is economic, physical and mental well-being.

We can see social influences on mobility within the third ring – shaping our values, goals and preferences in the world and, in turn, defining our personality - our identity as perceived by us or, more accurately, as defined by others in the society around us. There can be many models that could be suggested of this process, but we see the rainbow concept as simple to understand and communicate; and encompassing all of the material processed.

In Part B of the report, we look to the future, to the innovations in mobility and other items in lifestyle that will impact on it. We examine the pace at which industry is innovating products and services; and the rapid rate at which novel ideas are being absorbed by the generations.

RATV B–

Mobility mind-sets in a rapidly changing Europe

20. Physical, mental and now virtual mobility

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The last 10 years have seen a rapid acceleration of internet based communication into everyone's' lives; having major social impacts. This is not just an accelerating trend but should be underlined as an explosive change on an historical scale – it will define future mobility. Information and communication technologies (ICT) have generated a shift from social groups defined through a specific neighbourhood or workplace to individually-based social networks – 'networked individualism' – personalised social networks and social ties (Wellman, 2002).

As a result, social networks have become less coherent and have less spatial definition – this will continue into the future. People will have more active social contacts than in the past; requiring more time for communication and these contacts transverse many social networks; which the technology will provide for.

It is important that we also recognise the relationships and impact of non-mobile technologies in homes, workplaces and other facilities on our mobility freedoms. We will no longer be able to think simply in terms of 'trip related' and non-trip related' activities; they will act in unison with mobility as a defining feature of individuals, families, social groups and of national identities.

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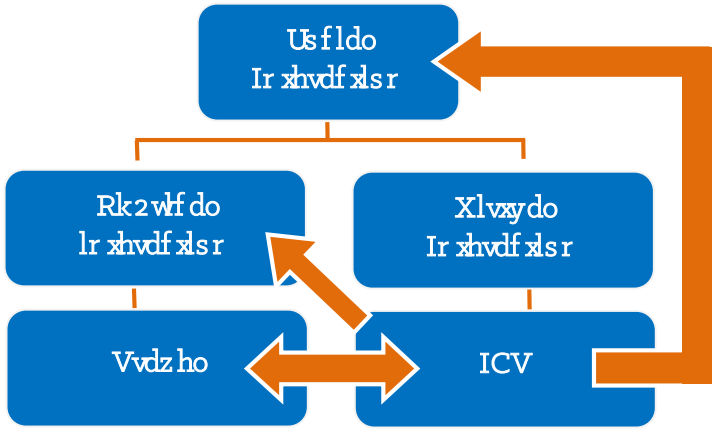
At the same time, the rapid transport networks are enabling long distance mobility and multi-localities to develop in more people's lives – holiday homes, economic migration, long distance relationships and social ties. The appearance of virtual social networks such as Facebook, on the one hand and the changes in working patterns on the other hand have led to the mixing of leisure activities with other daily routines. All of these developments have an impact upon mobility behaviour. Personal mobility today therefore involves not just the movement of persons, but also of the objects they need; and the imaginative and virtual travel using ICT (Urry, 2000).

Many of the terms for physical mobility are applied to communications – traffic on networks, the information highway etc. The internet has changed radically our perceptions of accessibility by weakening the traditionally strong links between activity, distance place and time – this in turn is influencing the structure of our cities and regions.



64 6 Rk2wlfdodr g zlvxydop seldx2 lr xhvdfxlsr w

Much work has been conducted into the possible substitution of ICT for travel, a possible complementary growth; or simple neutrality (Hjorthol, 2002; Mok and Wellman, 2007; Mokhtarian, 1990; Niles, 1995; Plaut 1997). Recent development are showing that the concept of a possible demise of transportation were premature. A 'complementarity' relationship has emerged whereby the increasing importance of telecommunications contacts may signal the growth in transportation needs and services. People who have more contacts travel more to translate virtual contacts to face to face contacts and therefore the social network grows spatially, requiring greater physical mobility.

The initial prospects for trip substitution have not happened. Relatively minor amounts of trip substitution have been lost in the overall aggregate increase in travel: stimulation has had the greater effect compared to substitution. The pace of technological change is making it difficult to unravel the dynamics of the process (Aguillera et al., 2012).

Mobile communications disconnect activities from specific locations, leading to increasing flexibility in location and timing and location of activities: mobility patterns are less structured and less predictable. This has made it even more difficult to assess travel decision processes; adding a strong new dimension (Couclelis, 2004; Dal Fiore et al., 2014; Kwan, 2007; Lenz & Nobis, 2007; Schwanen & Kwan, 2008).

There are two primary interrelationships between telecommunications and travel which complement each other.

- Trips that would not have taken place without the stimulus of telecommunications
- Where one increases the efficiency of the other (for example the impact of ICT on goods mobility and smart warehousing).

One major influence of ICT is the ability to manage and interact with the transport system in real time. Initially there was strong 'top down' development of sophisticated traveller information systems, using on-line journey planners – using what can be called 'formal information'. However, the emergence of smart phones has led to technological developments from 'bottom up' user generated 'informal' information; for example combining cellphones with GPS technology.

The impact of all of this rapid change is more complex travel patterns embodied in new lifestyles with mobility mind-sets that emphasize personalised

and customised requirements. The spatial spreading of social networks is further stimulated by telecommunications affecting:

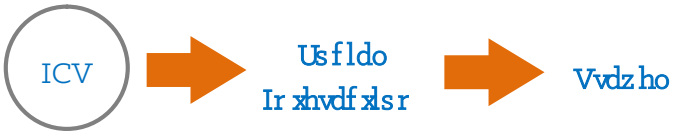
- The quality of contact could have been reduced – fewer strong ties and more superficial ties
- The number of active contacts will have increased through the ability to maintain remote relationships, increasing the amount of free time available for social interaction; stimulated by the falling costs of telecommunications.
- People can be more selective and gain greater satisfaction from their social networks, as they are less dependent on where you live, work and play; and are more personalised.

The spatial spread of social networks is having marked impacts on the increase in leisure travel: telecommunications generating travel. However, the increase in the number of contacts and the decreasing strength of ties due to spatial separation may have affected the information flow through social networks. In the 'weak ties theory', weak ties generate novel sources of information. Greater selectivity in people choosing their social networks through ICT will lead to reinforced perceptions, attitudes and behaviours among network members. Selectivity may also reflect the desire to acquire new knowledge. All of this process has a vigorous dynamic over time as links are dissolved or reinforced and changing life circumstances influences social needs.

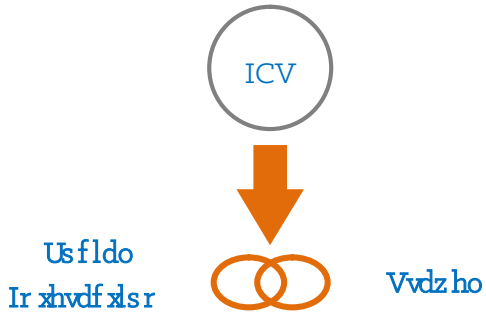
We can identify 3 impacts of social networks and ICT on travel behaviour:

- Direct impact of ICT – travel behaviour is changed as ICT is used to maintain social networks (Arentze & Timmermans, 2008; Axhausen, 2006; Larsen et al., 2008; Line et al., 2011).

- Indirect effect of ICT1 – ICT influences the amount of social interaction which, in turn, influences travel patterns (Axhausen, 2003; Carrasco and Miller, 2006; Schwanen & Kwan, 2008).



- Indirect effect of ICT2 – Travel patterns are changed by ICT use impacting on the relationship between social interaction and physical mobility (complementarity) (Tillema et al., 2010; Van den Berg et al., 2012)



Virtual mobility is mobility facilitated by networked computers. Virtual environments exist within computers. Individuals today and in the future will live in 'multiple spaces', incorporating, physical, electronic and virtual spaces – which will create numerous new socio-economic opportunities and challenges. Socially, the new virtual worlds represent the frontier of social media and social computing. In this context, every activity has a virtual substitute (Arora, 2012):

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Os	V2t hwsi wt dfh–gvlzhvw	Rodfh dwd p hxdt ksv	Xlvxydowt dfh
1	Utilitarian	Roads	Information infrastructures, digital divide, online traffic, virtual communities, shared space, convergence
2	Aesthetic	Residences	Customisation, personalisation, ownership, taste, private versus public space
3	Context	Parks	Cyberleisure, social network sites, situated activity online, gendering online space, online pluralism.
4	Play	Playgrounds	Engagement, interactivity, corporate blogging, work-play, hard play, gaming
5	Value	Museums	Emotion, affective spaces, nationalism and online tourism, digital flaneur and browsing, politics of information.

21. Seamless mobility, third places and vending machines

N IOD UEVUAOD VHE OEY NPBIMVb PFFET

The concept of mobility has evolved in recent years into a 'holistic mobility lifestyle'. At the heart of the drive for human mobility is the desire to live, think and act individually.

Technology is opening up new innovation in products and services in the mobile environment. Outside of the immediate mobile environment, technology in buildings is also having major indirect impacts on our mobility needs. Technology development in the ITC sector is transforming our virtual lives and having profound impacts on our physical and mental mobility. In this section we discuss the interface between the wider mobility marketplace and our understanding of mobility mind-sets from the previous part of the report.

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The objective to achieve complete seamless mobility between modes of transport for urban, regional or international travel is a primary objective of transport planners, whether they are urban planners, airport or port authorities, or the managers of rail interchanges: effectively taking the skills of logistics planning into the realm of human behaviour. In the description of the objectives for the air, rail and waterborne sectors in the EC Horizon 2020 Programme for research and innovation, it is stressed that, while there will be future generations of planes, vessels and trains, the primary problem will be the quality and management of the door to door journey – from the house to the

interchange, the rail hub, landside airport or port experience at origin and destination, and the journey to the destination. A majority of these mobility experiences involve journeys in and around major cities.

Seamless mobility is advancing at a pace, inspired by innovation in IT systems. Rather than the futile attempts in the past to benchmark seamless public transport against the private car in urban areas, new seamless mobility systems are now seen as involving all modes of mobility – public and private, formal and informal.

Part of the new seamless mobility is linked to two other mobility desires; the need for personalised and customised mobility. In the past, seamless mobility options were supplied and complex search engines provided advanced, real time multi-modal traveller information systems for people to use. In the smart phone age, seamless travel is being taken to a new level; particularly among the more digitally empowered generations. In the mind-set of these travellers the integration is achieved on their smart phone. This has an important psychological component as the locus of control and responsibility for the integration of the trip has switched from the mobility provider to the individual traveller. Individual preferences are programmed in so that the trips are within the person's 'comfort zone'.

656 Nseldx2 o loolr zsoch Vklvg t odfhw

Transit zones – next to the home and factory/office – are the new fluid working areas. In a highly mobile and networked era, an individual's home or workplace is just is just one node in this Small World Network. So living, working and socialising branches out to third places. These are public spaces between the home and traditional workplace – they could be railway stations, airports, shopping malls and cafes. Third places can enrich the way we live and can be important to the way society functions.

Decentralised spaces and services:

This is a throw-back to traditional forms of social organisation. Co-cooking space, co-working places or living rooms like clubs – specialised and active nodes made readily available in the neighbourhood. Time being the most valuable asset, outsourcing is seen as improving one's quality of life. From laundry to grooming, people will turn to professionals while they work, relax or socialise. It is the 20 to 30 year olds that are the main consumers of these services.

Redefining urban space

With the increasing importance of third places and outsourcing, new urbanisation requirements emerge: Mobility hotspots – attractive spaces with readily available accommodation. Sleepbox, for example offers small boxes with beds, shower, TV and Wi-Fi on an area of 2.8 square metres. We can see the growth of smaller living units and small room apartments, reflecting our more decentralised way of living. In this context, mobility interchanges will need to offer multiple functions and services, ranging from work spaces to shopping malls. On transport vehicles, the traditional division into classes will become functional separation – silent spaces – work spaces – entertainment and even health spaces.

Flexible co-working spaces

The world of work will increase in its flexibility in the years to come. The buzzword is 'mobile workers'. Our personal mobility increasingly determines whether we can obtain certain jobs, unite professional or private goals, reconcile demands and demands to improve our quality of life. Already today, professional jobs are not bound to specific locations. An increasing number of employees conduct work 'on the move'. This location independence will only increase in the future. From 3rd wave coffee bars and bistro terraces to co-

working spaces and shared offices, these new job nomads want to be flexible and individually seek out and adapt their own mobile working worlds.

Sharing and collaboration is the mantra of the new generation. It finds a particular expression in trending co-working spaces: large office spaces in which different entrepreneurs pursue their respective activities alongside each other. Today more than 1,000 co-working spaces are distributed as international chains across the globe.

Entrepreneurial mobility

Co-working offices attract young, open-minded people who understand physical proximity results in positive synergies. They want to be successful entrepreneurs with their own business. At the same time they acknowledge that the future lies in project-oriented collaborations between the individual independently operating companies. Thus, co-working is not only spatial but also spiritual cooperation, enabling both concentrated work, as well as stimulating discussions and cross-pollination.

Young freelancers and start-ups

The typical co-worker is active in knowledge areas such as IT, marketing and communication, design or counselling. Co-workers tend to be in their mid-twenties to late thirties, with an average age of 34. Two-thirds are men, one third are women - the same ratio generally found in the wider entrepreneurial and small business statistics across Europe and the U.S.

Reducing the ecological footprint?

With co-working, people possibly still partake in fossil fuel driven traffic. However, it allows employees of companies based in mayor employment areas to work from decentralized co-working hubs nearer their homes, thus reducing traffic jams and CO_2 emissions.

A 2015 poll by Mobileiron among 3,400 full- and part-time professionals across six countries, including France, Germany and the UK, discovered the rise of Generation M (for mobile Millennials), a growing demographic of hyper-connected professionals mixing work with pleasure. Members of Generation M conduct 26% of their work on mobile devices (compared to non-Generation M at 17%). 95% of Generation M plan to use 'wearables' for work tasks such as phone calls, emails and other activities

The communal work hotel

The Hotel Shani goes beyond bedrooms to meet with new nomadic lifestyles. According to the principle of the 'sharing economy', Viennese hotel 'Shani' provides different rooms and lounges for different uses, such as work, communications, recreation and dining, living the new lifestyle. Like the painters, Klimt and Schiele, or authors, Hugo von Hofmannsthal and Arthur Schnitzler, who would sit in a coffee house to exchange ideas and find inspiration in past times, both Viennese and guests can encounter each other at Hotel Schani. The special thing about Hotel Schani Wien is the opportunity for local and global cooperation. Thus, people, professional groups and friends from all around the world can communicate with each other and work together, in the spirit of the shared office principle.

When generations meet with Third places

Millennials are natural born supporters of (digitally enhanced) fluid working. Fixed working schemes and sites (offices or proper seats) kill their creativity and eagerness to create added value in their work. Millennials were raised in the Nineties and Zeroes, when the rate of change started to accelerate exponentially and a wealth of new, interesting innovation and events were about to challenge their attention span. As a result, the concept of different working areas - including transit zones, third places - is very attractive to this change-oriented generation.

Prime Busters will also support Third places, since this time-starved (knowledge and service) generation is looking for time saving, and smart working space solutions. Like the millennials, this generation is attracted to collaborative and sharing space services. Having young children, flexible working at (or near to) home is an important plus.

Baby Bloomers will rather have mixed feelings. On the one hand, their Millennial-children are positive about using third (working) spaces and fifty-somethings are eager to express a younger lifestyle (disregarding their real age as a ' survival strategy'). On the other hand, the 'fluid' working style ("wherever I lay may iPad, that's my office") may be natural and axiomatic for a digital led 'tablet' generation, but is likely to make Bloomers (and Masters) feel disabled or inhibited in their natural flow and working system.

Master Boomers will respond no rather than pro. More than Baby Bloomers, the Master boomers are accustomed to a fixed working space. Most of the Masters are retired, so there is no longer a need for a third 'working' space?

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Foraging for commuters:

In a society promoting healthy lifestyles, vending machines were long frowned upon. Impersonal, often fed with junk food or designed to solve emergencies at most they seem relics of a bygone era. But in this new mobile service economy, the vending machine culture is experiencing a phenomenal comeback. Not only does it blend in perfectly with our 24/7 functioning society, its new offer also meet the increasing demands of mobile consumers.

Healthy lifestyles for people on the move

The new vending culture brings forth new concepts satisfying the need for convenience and freshness for the modern work nomad. As the need for quick solutions increases, vending machines will start offering healthier food options in addition to flexibility and mobility. Machines already supply fresh fruit, milk, or even organic, vegan or gluten-free foods. One machine evens *grows* heads of lettuce using fluorescent light bulbs. But it needn't stop there - vendors could promote healthier lifestyles: in the run-up to the Olympics of 2013, machines dispensed subway tokens in exchange for 30 squats in Moscow metro stations.

Infotainment machines

The new vending solutions are individual and tailored to specific locations or situations. They cater to our high standards of health, pleasure and time sovereignty: from personalized postcards or umbrellas in areas with high probability of rain to iPads in airports. Machines equipped with LCD screens could also function as bulletin boards, dispensers of (nutritional) information or as entertainment medium for the user waiting for his fresh meal to be prepared.

Food as a service

One of the hottest topics in the food business today is home food delivery.

Home grocery delivery is nothing new. Grocers began experimenting with that in the 19th century. More recently, Schwan's has been successfully doing home delivery for 60-plus years.

Using the Internet to order and pay for groceries to be delivered to one's door has been happening as well. Early efforts in this direction by the likes of Peapod, Webvan and HomeGrocer generated considerable enthusiasm, interest

and investor capital before falling victim to the dot-com collapse in the early 2000s. But there is now a sense that grocery home delivery may finally become a bigger business proposition, capable of generating the growth and returns many have long predicted.

What remains to be agreed upon, however, is how it will work. When people go to a shop, buy shopping and carry it home; this is now seen as a (rather inefficient) goods trip.

Whether simply browsing the Internet for meal and recipe ideas, or undertaking a major grocery shop, the fit between in-home, and now mobile, behaviours and the relatively complex task of in-store grocery shopping has developed positive synergies with today's online grocery business models. One simple reason for this lies in the fact that shopping itself has progressively gone virtual, and while food (especially perishables) remains one of the last few remaining categories of consumer products to "go digital," there is growing evidence that several aspects of grocery shopping are trending to online.

Food trucks

Food trucks sell prepared food in public settings from motorized vehicles, from which food is prepared and stored and customers purchase and eat. They operate as quasi-portable restaurants, serving customers on public streets, private property, and designated lots. The paper presents Los Angeles, California, USA as an example of how local governments address food and urban culture trends and how this regulation defines public space. Pro-regulation forces argue that food trucks unfairly compete with restaurants, congest sidewalks and streets, are unsanitary, and diminish urban quality of life. Anti-regulation forces argue that food trucks provide affordable and quality food, rejuvenate public space, fairly compete with size and open-air limitations, serve innovative and fusion cuisines, and represent Mexican, Mexican-American, Latino, foodie, and migrant culinary cultures. There are now over 100 food trucks, carts, and vendors permitted to sell healthy, interesting, convenient, culturally diverse, and delicious food on Vancouver streets. You can locate Vancouver's food trucks and food carts by smartphone app.

Mobile food vendors have risen in popularity. New wave trucks sell fusion Mexican, Korean and Vietnamese items, barbeque, cupcakes, vegan, and other gourmet cuisine. Food and Wine magazine recently named Roy Choi of Kogi BBQ, a fusion Korean taco truck and emblematic of new trends, "best new chef."

When generations meet with the New Vending Culture

Since Millennials are very digitally enhanced, keen on convenience and favor a 24/7 orientation, they will probably be very receptive.

As Prime Busters are a time starved, time saving cohort, smart vending solutions, close to work, home or daily routine will be very relevant, especially when they come together with working hubs or transit zones.

Baby Bloomers will be rather pro than no. Like their Millennial-children, Bloomers are time starved and are looking for time saving, smart vending solutions. Vending machines, food trucks and similar smart vending services don't require high tech skills; on the other hand, Bloomers (and Masters even more) are fans of a personal (human, not digital) vending service, but when time becomes precious, functional shopping wins.

Master Boomers will react rather no than pro. Master Boomers - digital immigrants - are accustomed to a personal, non-digitized retail experience; most of the Masters are retired, so there is no longer a need for mechanized or 'smart' (digitized) vending services.

Future mobility for flexible living: digital neighbourhoods and yoghurt cities

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In the context of a 24/7 society and a dynamically changing working and living environment, finding a new, intelligent balance between work and private life will be one of the major challenges of the 21st century.

Operational work-life balance measures will be aimed to facilitate successful professional careers while honouring private, social, cultural and health needs. Integrated work-life balance concepts include specifically configured working time models, an adapted work organization, flexible places of work, management directives and other supportive health and preventive services for employees.

Smart work-life balance concepts should be understood as a critical issue, affecting our society and economy. A well thought-out balance between the private and professional life of active citizens is not only beneficial for the individual, but also for the companies employing them, and for society as a whole. As the members of communities move more and more to the rhythm of their very own agendas and work-life schedules, traditional family ties dissolve into a loosely patchworked togetherness. People no longer derive their happiness from the core family but from a broader social environment, and from the activities they perform with this community.

Just as the distinction between inner and outer social circles slowly fade, so do the borders between work and life gradually crumble and make way for a new perception of work/life and work/hobby. At its core is a multi-faceted lifestyle, which is fed by the many passions of an individual and his experiences and networks. Rather than climbing the corporate ladder in no time, people will focus on recognizing and exploiting one's potential. A surgeon is no longer just a doctor, but a doctor/pianist. A unique, personality-forming lifestyle of the slash / slash generation is more important than a classical career.

Among the generations:

For Digital Aboriginals these applications are not relevant, however they will easily consider them as usual and normal.

Millennials will be rather no than respond pro. Although they love novelty and smart (digitized) services and products, Generation Y can handle their work/study-life-balance. Most of the Millennials have no children to raise. A substantial number of them are still living at their parents' or - at least - make use of services (and finance), provided by their Bloomer parents.

Prime Busters will definitely respond with enthusiasm. Primers are time starved (knowledge and service) and look for ways to control a time consuming (young) family life while working harder. Their agendas are often challenged by traffic congestion.

Babybloomers are still time starved and are starting to put more focus on an optimal divide between controlling their career (entering the last stage before retirement), controlling their physical abilities and energy levels, and the upcoming drive to invest more time in personal relations and self-actualisation.

Most of the Master Boomers on the other hand are retired, so the 'survival need' for a work-life balance has become redundant.

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In the 21st century, labour markets are transforming drastically, adopting hyper flexible structures and concepts. The Fordism of the previous century is becoming more and more obsolete. This contract-based employment concept with fixed, 9-to-5 working hours, collectively agreed salaries, health insurance, allowances and dismissal protection is increasingly being replaced by a temporal and spatial flexibilisation of labour.

Temporary labour, freelancing, tele- or co-working – enhanced by an ever innovating technology, mobile working has become a matter of course – especially for managers. 73% of executives use a laptop and at least 45% own a smartphone, 49% work at least once a week away from the office or are on the road; 23 % even two or three times or even more often. The non-managerial workforce has adapted to the new requirement of the labour market, bringing forth new and more erratic mobility patterns.

Families in motion

Also socially, the traffic of individuals no longer moves punctual and linearly – from work to home, from home to school or sports club. Families move in all directions at all times of the day. Mobility is a prerequisite for social participation, social progress, economic growth, self-realisation and individual success.

Meeting the need for flexible service

As people are perpetually on the move, businesses need to tailor their services to today's demands of flexibility – even if this means involving people who are not on the company's pay roll to do so. Tuning in on the sharing economy concept, Deutsche Post DHL managed to creatively meet his customer's need for flexibility. With its MyWays-program in Stockholm, it offered customers the option for a hyper-flexible delivery when buying online. They simply had to specify the exact location and time they'd like the package to be delivered, along with a bid of how much they're willing to pay. At the package arrival at a nearby DHL centre, MyWays-participants could retrieve the package, deliver it to its destination and pocket the fee of the customer.

Flexible future generations?

As the most connected and tech-savvy generation, Millennials not only expects technology to be used intuitively, but all facets of life have to be managed in an effortless, flexible way.

> Prime Busters will adopt this since this time starved (knowledge and service) generation is looking for ways to control a time consuming (young) family life while working harder (and their agendas being often challenged by traffic congestion); flexible mobility management is a (stress and time loss reducing) must.
>
> Babybloomers will be pro. Like the Busters, also coined Generation X, Bloomers are still time starved, longing for flexible mobility services.
>
> Master Boomers will be pro. Masters want to control (their) mental, social and physical life as long as possible, so they are asking for easy-to-understand, low threshold and flexible (technology and) mobility solutions.

Masters have more (easily access to) financial resources to adopt e-mobility.

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Section 7.3 in this report examined the changing nature of people's perceptions of space and place; the link between man and the environment. That work not only stressed the multi-layered nature of space perception but also highlighted that, in the future, architects predict that the spaces between buildings (in the socially mobile environment) will be more important that the spaces within them.

Whether rented, owned or built homes and their interiors offer a deep insight into one's personality. Conversely, studying socio-cultural changes and trends enables us to draw conclusions on how society will live tomorrow. Social megatrends such as individualization, mobility and health have a decisive influence on architecture and home design. But also economic crises, technological advances, collective needs and changing family structures influence the way we live.

Creative professionals, young and mobile, are conquering urban areas and driving new food and lifestyle concepts. More and more cities become sustainable places, where (environmentally friendly and noise avoiding) electric cars, connected vehicles, bike sharing (and fixing) stations, etc. are about to make the city behave more like a village. An interesting phenomenon are 'Yoghurt cities'. Yoghurt cities, or neighbourhoods, are places (within cities) like yoghurt, with 'active cultures'; vital museums, shopping, terraces, theatre, urban sportainment, tai chi-sessions in the park, downtown neighborhoods with throbbing street life, etc. Retiring Babyboomers are insisting on moving to (open, multi-generational) Yoghurt cities rather than (segregated) retirement communities.

When it comes to Digital Aboriginals, young urban children learn to re-connect with the (healthy, sustainable, safe, joyful, social and educational) outdoor. More and more cities are being re-conceived and redesigned as healthy, green and safe work-life-play zones (so-called 'rurbanization'), where the prime digital generation can meet and understand real life.

Millennials are an outspoken high-tech-high-touch generation, happy to mix the magic efficiency (and efficient magic) of high tech with the beauty of yesteryear, 'hipster' design (high touch). They are the prime 'collaborative' generation, longing for co-creativity, not only by means of social media, but also by meeting up with peers in low tech co-creation caves (like coffee bars or co-working living rooms), where traditional craftsmanship and high tech tools go hand-in-hand.

Prime Busters look for a stimulating environment, where everything they need is - more and more - on hand (24/7 shopping, neighbourhood supermarkets, bike/car sharing ...).

Both Babybloomers and Master Boomers are rather pro. Like their Boomer counterparts (the Master Boomers), the Bloomers are attracted to the idea of a slow city, where slow and smart mobility has its place. Sharing vehicles though is a bridge too far for them as it is difficult to disconnect car usage from car ownership.

22. Mobility with a buzz

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The development of e-mobility is primarily taking place in industrial and industrialising nations. In 2012, the USA owned 38% of the global electric car stock, Japan 24%, the EU 11% and China 6%. As prices for electric vehicle batteries drop, the overall purchase price for electric vehicles will decrease. Together with the rising fuel prices, improved battery ranges and growing charging infrastructure, electro-mobility will become more attractive. The number of electric cars is expected to grow from 20 to 30 million by 2030 to around 25 to 50 million vehicles by 2050 due to technological developments.

New business opportunities

Car manufacturers, railways, public transport, airlines and other suppliers of traditional mobility need to rethink their role and function within the mobility grid. In the slipstream of e-mobility, products and services will need to be created to support and enhance connected e-driving, not in the least creation and use of an intelligent charging infrastructure for electric vehicles and new billing models. New technologies stir up the market to create new opportunities and approaches for related industries. New players will emerge, establishing themselves in a cross-innovations market.

New e-lifestyles

With an electric vehicle, a quick stop at a service station is a thing of the past. Charging an e-driven motor happens while the vehicle is parked: overnight at home, or while the driver is working or enjoying leisure time. E-charging will drive the need for new 'third places'-concepts: hotspots that combine living, working and relaxing spaces with docking stations for e-bikes and e-cars.

Everyone is an energy supplier

E-mobility will shift the energy provider landscape profoundly, decentralising it into a network of many small energy suppliers: homeowners with solar panels, farmers with a biogas plant or companies with small, private wind turbines. Current users will supply energy to a power grid that is increasingly intelligent, the so-called smart grid.

Smart grids and energy highways

In the future e-mobility could be completely self-sustaining: we could use roads as energy highways. E-vehicles charge the smart grid, with batteries serving as a buffer, and overcapacity from the smart grid is redirected into the car, charging the battery. Thus, electric cars trigger the birth of another logic concerning energy and mobility.

The missing mobility link

Especially the e-bike will change the way people address their daily individual transport. Electric bikes extend the urban biking radius and function as the preferred mobility mode - especially in regions with underdeveloped infrastructure. It allows overcoming long distances, regardless of a sparse infrastructure of public transport.

The generational response to E-mobility

Millennials will respond with mixed feelings. They are natural born supporters of electronics and electric mobility is an attractive novel way of transportation, but the prices are too high (even for e-bikes)

Prime Busters will be pro, but concerned about the (still) high prices of e-cars; regarding e-bikes, the interest grows for this time-starved and traffic-jam-bullied generation: e-bikes - often sponsored by their employer and the tax authorities - are speeding up the commuting (plus, there is less need for a shower at work, since electric biking doesn't make you break a sweat)

Babybloomers will be pro as well. Front-end Boomers are becoming aware of the need for "LOHAS" (a lifestyle of health (self) and sustainability (environment). E-mobility will provide a fair share in solving (urban and global) environmental and health problems.

Master Boomers: pro - forced by their progressing age, Back-end Boomers are (even more) conscious of the need for "LOHAS" (lifestyles of health and sustainability). Master Boomers have the time to contemplate the consequences of their 'fossil fuel lifestyle' of the last decades. The declining physical condition and vitality of Master Boomers are making them adopt/buy e-bikes at a rapid rate. Bloomers and Masters have more (easily access to) financial resources to adopt e-mobility

Hands free mobility

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Glen Hiemstra, creator of futurist.com

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According to innovation and mobility experts we talked to, like Johan Peter Paludan (Copenhagen Institute for Future Studies) and Erik Van den Heuvel (Daimler Group), autonomous cars will be probably for sale in the year 2020 and will start to become commonplace by 2025 or 2030.

Automated cars could solve large portions of our environmental problems, prevent tens of thousands of deaths per year, save millions of hours with increased productivity, and create entire new industries that we cannot even imagine from our current vantage point.

The beginning is in fact already there. Tesla Motor's declares that their 2020 models will be able to self-drive 90% of the time. From Morgan Stanley's research we know that cars are driven just 4% of the year, which is an astonishing waste considering that the average cost of individual car ownership.

Maarten Kooiman, founder of car sharing scheme Tapazz argues that next to a house, an automobile is the second-most expensive asset that most people will ever buy — it is no surprise that ride sharing services like Uber and car sharing services like Zipcar, Car2go and Tapazz are quickly gaining popularity as an alternative to car ownership. But what is even more amazing is that the self-driving car will alter our attitudes and behaviours towards mobility in a never seen way:

Broad societal and environmental potential:

> Morgan Stanley estimates that a 90% reduction in crashes would save one million lives a year worldwide. Driverless cars do not need to park — vehicles cruising the street looking for parking spots account for an astounding 30% of city traffic, not to mention that eliminating curbside parking adds two extra lanes of capacity to many city streets.
>
> Traffic jams will become non-existent, saving the average commuter 38 hours every year—nearly a full work week.
>
> As parking lots and garages, car dealerships, and bus stations become obsolete, tens of millions of square feet of available prime real estate will spur explosive metropolitan development.
>
> The environmental impact of autonomous cars has the potential to reverse the trend of global warming and drastically reduce our dependence on fossil fuels. As most autonomous cars are likely to be electric, estimates are that 134 billion gallons of gasoline will be saved a year in the US alone.

Borrowing is the new owning

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The opportunity to enjoy a car without actually owning one is now a reality. As a result of growing eco-consciousness, resource shortages, skyrocketing gasoline prices, and parking scarcity in urban areas, the car is losing its importance as a status symbol. Car sharing offers an ideal mobility alternative. The promising development in the professional market has caused many providers of the car industry to market for potential part-time drivers. This will in the future lead to even better conditions in price and service.

The young and the carless

However fragmented the publicly available demographic data, car sharing users are predominantly well-educated, male young adults between ages 25 and 45. Living in urban areas, they are either single or childless couples, and tend to belong to middle and middle-upper income household. They do not own a car since, for these urban mobility users, there is no good reason for owning one: they tend to rely on non-car forms of urban transport – be it public transport, walking or cycling.

The structural downward trend in 'auto-mobility' amongst this demographic group can be explained by a new rational of everyday meaningfulness: this younger generation prefers using to owning. Another plausible interpretation is that the downward trending incomes for Millennials have constrained their use of private cars, while at the same time new technologies have made car sharing services more accessible and practical.

Corporate car sharing

The business world also greedily adopts new concepts to reduce or alternatively employ their car fleet. With the Alpha City car sharing program for companies, employees use fleet cars professionally, and – when needed - in their private time. In the latter case, the use is settled privately.

Car sharing as a pioneer of e-Mobility

Electric vehicles are increasingly used in corporate e-car sharing fleets. According to Frost & Sullivan, 20 % of car-sharing fleets will be battery-powered by 2016, which might drive corporate users to also consider an electric vehicle in their everyday life.

Car sharing in numbers

Car sharing schemes have been established in many cities (e.g. Car2go from Daimler, Drivenow! from BMW & Sixt) and are used by 2.5% of the urban population. While car sharing providers registered almost 50,000 drivers in 1997, the number jumped to around 500,000 in 2013. During this same time period, the car sharing car fleet grew from around 500 to just under 11,000 vehicles.

Future mobility: flexible, borrowed

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Future intermodality – public transport and car sharing are becoming increasingly important. Intermodal mobility, which is switching (repeatedly) between modes of transport such as cars, public transport, cycling or going by foot, is clearly increasing. Cars in particular are experiencing a loss of importance compared to other modes of transport – they are increasingly seen less as a status symbol or expression of individual freedom but, rather, as a transport option among many and, therefore, are used more pragmatically. In this context, the desire for car ownership, particularly in cities and especially among young adults, is decreasing.

Car sharing concepts are becoming very popular. The number of car owners in the age group 18 to 24 decreased by 44% between 2000 and 2010. In the age group of 18 to 39, 36% more car sharing is attainable by 2020. At the same, existing public transport, cycling and footpath networks will be expanded and improved, so that inter- and multimodality will be possible and fostered. Public transport will be multi-modally anchored and converted to electro-mobility, in order to lessen the loss of importance compared to electric cars and to act as the backbone in intermodal transport.

Our 24/7 society today is characterized not only by a growing demand for mobility, but also by an increasing variety of mobility forms. Whether commuting to work, going to school, family or doctor visits, shopping and leisure activities, we are traveling to more places than ever before. More than ever, our lives are happening in between places.

MIND sets

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Today we face challenges such as sustainability, new energy infrastructure and post-fossil mobility concepts. And there's a need to find solutions for more efficiently networked cities, intelligent transport systems and services, and end-to-end solutions for personal transport.

Mixing and matching different means of transport will increase the security, speed and flexibility of road users. The future will see an increase of combined mobility, which today already exists in these forms:

Park + Ride = car / motorcycle and bus or train

Bike + Ride = bicycle and public transport

Kiss + Ride = drop-of zones for passengers at public transport hubs

Park + Pool = carpooling with start / end on a car park nearby the motorway

Car-Sharing = organized community use of one or more cars

Whether combining motorized with public transport or a bicycle with a bus ride - a seamless transition between different means of transport is of vital importance in order for mixed mobility to become a success. To create functioning mobility chains and thus improve the framework conditions for combined mobility, all interested parties need to coordinate their traffic and spatial development.

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(Johan Peter Paludan. The Copenhagen Institute for Future Studies)

Combined mobility services are a smart alternative to car ownership in a rapidly urbanising world, as they are more tailored to customer needs and better suited to metropolitan environments. For those public transport operators who are able to innovate and turn public transport services into combined mobility services, these developments offer a real opportunity to deliver sustainable growth over the next decades.

The importance of infrastructure

Ageing urban infrastructure limits the adaptive capacity to the impact of mobility. The infrastructure in many cities in Germany (and worldwide) is out-dated due to insufficient investment funds. This restricts the capacity of cities to adequately adapt to the mobility needs in the field of multi-modal mobility concepts and electric mobility.

At the same time, the obligation to modernise infrastructure offers the chance to take new mobility requirements into account during construction. Today, competition for innovative and sustainable mobility concepts is on the rise, fuelled by European and national funding. The results, for example, have been the use of physical models for planning the flow of traffic in cities, which reduces congestion as well as fuel consumption.

Intermodal mobility, which is switching (repeatedly) between modes of transport such as cars, public transport, cycling or going by foot, is clearly increasing. Cars in particular are experiencing a loss of importance compared to other modes of transport – they are increasingly seen less as a status symbol or expression of individual freedom but, rather, as a transport option among many and, therefore, are used more pragmatically

The end of boundless freedom

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23. The 'Arrival' cities of the future

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From rural migration to social mobility

Today cities are home to more than half of humanity. By 2050 more than 70 % of the global population will be living in urban environments. An unprecedented number of people will move from rural areas to the metropolis, creating new urban spaces in its core or outskirts. In these *Arrival Cities,* migrants struggle to integrate themselves socially and economically in order to establish a better future for their children.

Integrative mobility

The success or failure of Arrival Cities will have profound implications for local, national, and international economies. Cities where migrants are allowed to integrate in and contribute to urban society, create prosperous middle classes and thriving economies. Failed arrival cities create poverty and social problems with ensuing conflicts, revolutions and political crises. By providing citizenship, a chance to own property, good education, transport linking the arrival cities to the main city, and security, governments will successfully integrate their migrants.

Creativity and innovation

It is of critical importance to see and treat Arrival Cities as urban hotspots of social advancement, opportunity and innovation. Megacities need to tap in to the impressive creativity that new city dwellers collectively and individually develop to get ahead in life - even under the most adverse circumstances.

Commuting between communities

Migration between rural and urban areas is not one linear migratory movement from the country to the city. It often performs a pendulum motion: Arrival City dwellers continue to maintain links with their rural networks, returning to get married and transferring money to relatives. Rural migrants of the first generation often vacillate between a rural and urban lifestyle all their lives, until the next generation really arrives in the city.

24. Slow food - Slow mobility

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Transport use will continue to significantly transform. People increasingly refrain from using or owning cars and engage in other forms of transport: combining modes of traffic, car sharing, public transport, and ... slow traffic. Slow or non-motorized traffic is mainly synonymous to cycling and walking. But also skating or moving with vehicle-like devices fall in this category.

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Globally, individual mobility is still very much determined by the use of cars with internal combustion engines. Motorised individual transport makes up nearly 50% of the global mobility market which - in terms of expenditures - amounts to EUR 6.4 trillion in 2010 or around 1,000 EUR per person.

Top efficiency

While mobility expenses continues to rise, the mobile society of tomorrow is not determined by top speed but by the mode of transportation that allows us to arrive best at our destination. Traffic tends to be so bad that at rush hour cars hardly move at all. Especially in (mega) cities and metropolitan areas like London or Berlin the average speed of auto-mobility tends to decrease.

To our good health

Slow traffic has a significant, still untapped potential to improve a city's transport system, while at the same time protecting the environment, improving the air quality, reducing noise and CO^2 emission. In addition, it reinforces sustainable tourism, leading to savings in the public and private expenditure for mobility.

The bike rules

In a slow traffic culture, the bicycle gains importance to move across the city. Apart from being practical, innovations have made cycling more attractive and safer. Therefore, in coming years the market will experience a sustained boom. Today there are 70 million bikes in Germany alone, more than 4 million of them were sold here in 2011 - worth 2 billion Euros. 15 % of all roads in Germany are already accessible to biking. In comparison, leading bicycle nations Denmark and the Netherlands can only boast a little over 18 %.

Even more so than renting cars, renting a bicycle is far better than owning one. From free rental for short distances of up to half an hour to user-friendly registered use for people who need a bike for a longer period of time, the success of the municipal projects worldwide shows that innovative and flexible bicycle rental initiatives have yet to reach their full market potential. The boom of the bike in the public space will bring a diverse service and lifestyle culture with them. Urban planners must also react to the new cyclists, as well as the tourism industry, hospitality or leisure industry.

25. Mobility Mind-sets

When consulting research and experts, there is a broad consensus that the diversity of new mobility concepts that we face today (car sharing, ride sharing etc.) will lead to a landscape that is best described as 'mobility as a service'. Vehicles – like aircraft, vessels, cars, bikes, trains - are not any longer at the heart of the mobility. Instead there is digital information based on 'Big data', that is accessible in real time.

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Gilles Vesco calls it 'The New Mobility'. It is a vision in which citizens are no longer dependent on their cars to get along – or worse – on public transport as we know it, but dependent on real-time data on their smartphones. Gilles Vesco argues that the real acceleration towards this new mobility behaviour will be brought by cities aiming to rebalance the public space and create a city reclaimed by people and is no longer occupied by cars.

Apart of Lyon, many other European cities lead the way forward in the same direction. Birmingham is now embarking on its own 20-year plan called 'Birmingham Connected', to reduce dependence on cars. For a city so associated in the public mind with car manufacturing, this is quite a step. The initiative is being driven by the veteran leader of Birmingham city council, Sir Albert Bore, who talks airily about imposing a three-dimensional transport plan on the two-dimensional geography of the city: "French and German cities all have an infrastructure which has a far better understanding of how you need to map the city with layers of travel."

"Multi-modal" and "interconnectivity" are now the words on every urban planner's lips. Also in Munich, bikes and more efficient public transport would be the norm; for occasional trips out of the city, citizens could hire a car or join a car club that facilitated inter-city travel. The statistic everyone trots out is that your car sits outside, idle and depreciating, for 96% of its life. There has to be a more efficient way to provide for the average of seven hours a week when you want it.

And when it comes to the user, professor emeritus Henk A. Beckers argues that it matches perfectly with the current rise of Generation Z. Z stands for Zero tolerance towards substandard strategies. This generation goes beyond age cohorts and corresponds maybe best with the Millennial mindset: wanting everything right here and now.

Babyboomers as the biggest active age group: We're about to enter a people and purpose economy says Geertrui Jacobs, former researcher and strategist at Synnovate.

When it comes to mobility mind-sets, not all people have the same attitudes and motivations at every single moment. Depending on context, means, social status, psychological make-up, gender and age, their culture and geographical location, people may adopt different 'mind-sets' for navigating the world of (new) mobility. Above all, context defines mindset. Day-to-day commuting is a different context than having a trip during the weekend.

In the upcoming segmentation, we consider Mobility mind-sets as the different fundamental human drivers that define our behavior and determine our choices in how we use transportation.

26. Different mind-sets towards future mobility

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The motivational grid builds on the work reported in earlier sections of this report. It may provide a useful way to visualize mind-sets for the forthcoming MIND-SETS approach (MIND-SETS 2015b). In this approach, mind-sets are mapped onto two uncorrelated axes.

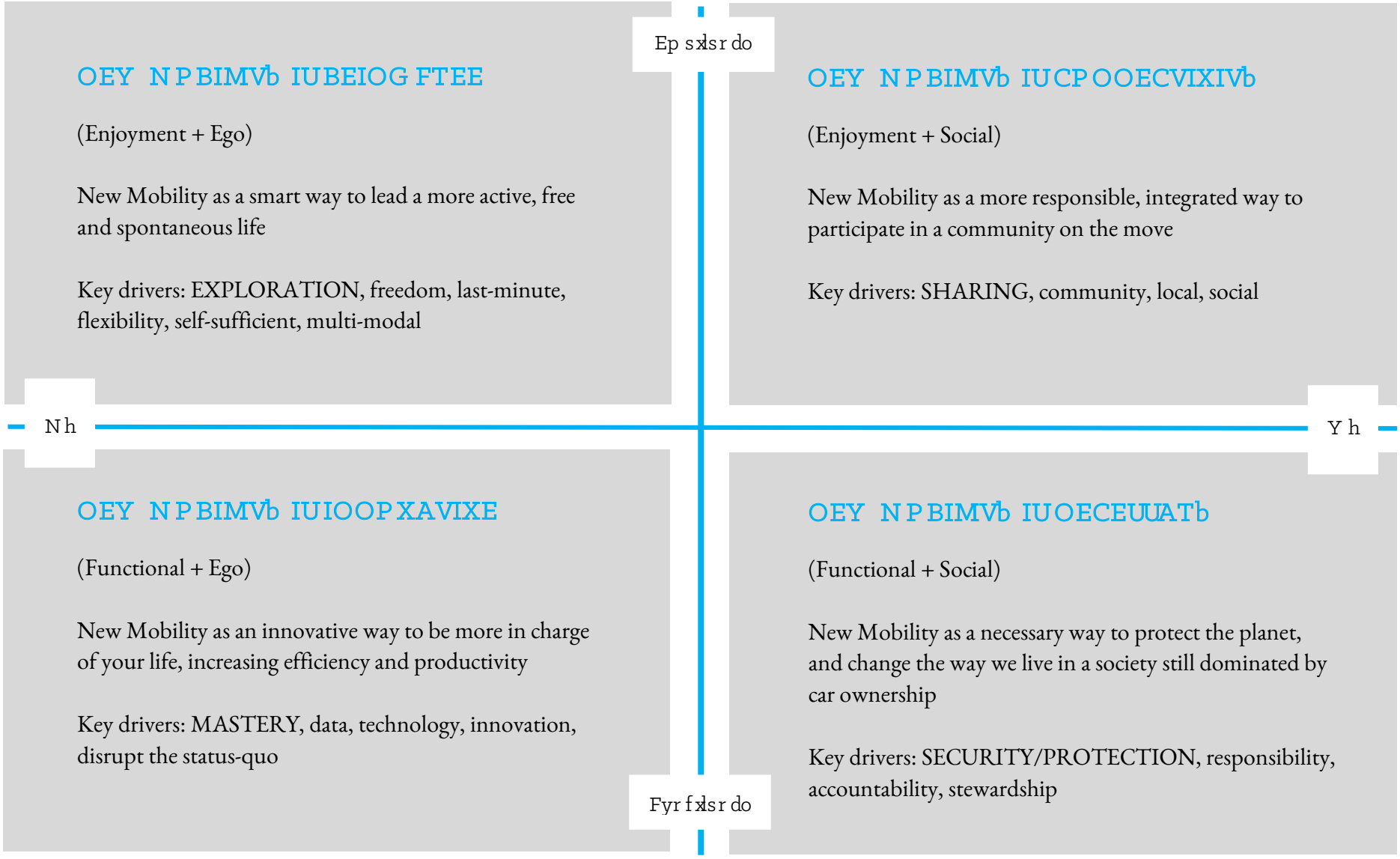
The vertical axis defines the way in which mobility has gains for the individual: people have an emotional, open, accepting attitude to mobility and vehicles, versus people who take a more rational, controlling approach to mobility and who view it as a functional solution of getting from point A to point B.

The horizontal axis denotes the way in which mobility gains social meaning – it is a social act, either you feel connected to the world around you (the US at the right), or you try to reinforce your ego (the ME on the left).

When making a motivational segmentation in the spirit of Synovate, we define "the new Mobility" as a vision of regions, neighborhoods and cities in which residents no longer rely on their cars but on public transport, shared bikes, car clubs and - above all - on real-time data on their smartphones. The New Mobility will result in a new set of attitudes we can cluster and depict in a motivational segmentation.

Four kinds of mobility are defined:

- New mobility is being free (Enjoyment + Ego). In this group, New Mobility is a smart way to lead a more active, free and spontaneous life. The key drivers for this are: exploration, freedom, last-minute, flexibility, self-sufficient, multi-modal
- New mobility is connectivity (Enjoyment + Social). In this group, new Mobility as a more responsible, integrated way to participate in a community on the move. The key drivers: SHARING, community, local, social
- New mobility is innovative (Functional + Ego). Here we see new Mobility as an innovative way to be more in charge of your life, increasing efficiency and productivity. The key drivers: mastery, data, technology, innovation, disrupt the status-quo
- New mobility is necessary (Functional + Social). In this final group, new Mobility as a necessary way to protect the planet, and change the way we live in a society still dominated by car ownership. These key drivers: security/protection, responsibility, accountability, stewardship



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When making a motivational segmentation in the spirit of Synovate, we define “the new Mobility” as a vision of regions, neighbourhoods and cities in which residents no longer rely on their cars but on public transport, shared bikes, car clubs and – above all – on real-time data on their smartphones. The New Mobility will result in a new set of attitudes we can cluster and depict in a motivational segmentation.

6: 6 Ep hvj lr j p lr g whxw

(i) From A TO B

The overall and default mindset of the New Mobility is about getting from point A to B in the most logical, no-nonsense, cost-effective way. Mobility has become a commodity. The A to B mindset has no emotional preference for car, train, bike, sharing programs etc... they just evaluate the pros and cons of the mode of transportation in a rational manner. They are willing to give up some personal freedom. People are supported by apps and big data to decide what journey to take. In this mind-set, mobility has become a commodity. In every country you see multi-modal applications coming up, allowing people to plan their route over the frontiers of vehicle types and suppliers of mobility. This mindset is about having basic control over travel time, connections, and price, preferably based on real time data.

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(ii) UBER everything

Uberization is not necessary Uber taking over all kind of mobility services. It means "digital platforms" enabling citizens find providers for analog services. With the mainstreaming of the on- demand economy and life in an always-on culture, consumers' expectations for speed and ease are rising exponentially. They want more experiences and more information and they want it faster, easier, better, in small chunks, easier to digest, Bite Size. Today, there is an Uber for everything, and more are up to come. 9% of Millennials in the EU have already made use of Uber, as opposed of 2% of Babyboomers. There is an Uber for Asian food (Bento), for cheese and wine (Lasso) for marihuana (Meadow, Eaze, Canary,) Via Blade you can book a helicopter flight and via Blackjet, you can have an open seat in a private jet.

There is Uber for massages, tow trucks, cleaning, grocery, food delivery, computer repairs, laundry services, etc. There is even an Uber for Uber Services: a software platform for developers of Uber software: Mowares. Even for buying cars, there are Ubers. Shift, Carvana, Carlypso and Beepi lets you test drive any second hand car sold in San Franscisco in less than 45 minutes. Luxe is a service that links you up with someone to park your car, or provide other services - Instantly.

With the mainstreaming of the on-demand economy and life in an always-on culture, consumers' expectations for speed and ease are rising exponentially. They want more experiences and more information and they want it easier, better, faster, instantly.

(iii) METOPIAN mobility

As more and more people have access to luxury products and brands, people are looking for different ways to stand out and get the applause. What makes me powerful and determines my status is the story I create and tell about the products, services and brands I select.

Mobility and social status are so intertwined that even when mobility gets commoditized, citizens (and companies) will cater people on their need to stand out.

Nowadays we see that Uber or Uber-like applications allow users to distinguish themselves with Luxury cars. Apart of UberPOP (the cheaper variant of Uber), there is UberBLACK and UberLUX. During the Cannes Lions Week 2015 (The World's most prestigious Advertising Festival in Cannes), Uber hosted helicopter flights with Uber Chopper. Also in the context of Car Sharing schemes, we see how one distinguishes itself from the other. In Belgium e.g. there is e clear differentiation form Bolides (stylish, upmarket) versus Cambio (average).

(iv) Wetopian Mobility

Trust in big authorities is crumbling. Yet there is a belief in real people, a belief that together we can achieve more. A lot of people have taken advantage of crowd- sourcing, start organizing local initiatives and support local products and P2P partnership. They are taking the economy back into their own hands. When it comes to mobility, citizens organize

When it comes to mobility, citizens organize car clubs with their own cars, enabled by platforms like Tappaz. A typical and promising Wetopian solution is Blablacar, enabling intra-city mobility by ridesharing. Trust is key in this new economy. Peer reviews and rating are vital to make the market flourish where individuals offer and demand bikes, cars, rides, even motorcycles for rent. This market is not only driven by price, but also by conviviality and the pleasure of meeting new friends. Mobility enables social encounters, and this is nowadays enables by apps.

(v) Revitalising Mobility

We also call this 'decompressive commuting'. Most people who commute every day, are employed in the service or knowledge industry. This requires a lot of communication with different people, all day long. When coming home, the time pressure and intensive communication starts all over again. That's way sometimes some people want to switch off, and miss out during commuting. They want to refresh their minds, and consider their journeys as moments of meditation, tension release or just enjoy me-time in a car as media rich environment or even a high tech cinema capsule. They furnish their car with their favorite CD's, make phone calls with loved ones, or sing along with their favorite songs.

When the truly fully self-driving car hits the mainstream, cars will make the switch to enable moments of distress for 100% not requiring you to hold the steering wheel.

(vi) Vehicle petting

Today 18% of families in the UK give their car a nickname. On top of that, is seems that cars with a nick name are better taken care of than others. With the always faster evolution of robotization and integration of intuitive technology in cars, a group of car 'fanboys' will rise. Big box movies like Real Steal and Ex Machina explore this relation between artificial intelligence, robots and

humans and explore how deep humans can establish emotional relationships with machines.

They will see the world of mobility as a world full of opportunities and crave the new as it represents advancement, excitement and experiences. As much as possible, car fanboys will enhance their seamless interaction with cars and will always keep trying out different modes of transport. Relations with vehicles are great expressions of keeping re-inventing the self.

(vii) Integrated living

As people live in smaller places, and are constantly on the move, they want full access to everything in the neighborhood they live in. They make use of Third places to meet, and cater all of their needs.

Neighborhoods become more pleasant to live in and density with services is increasing. Many services are dedicated to avoid mobility and wasting time. “Lifehacks” are the new business icons: solutions that are easily accessible, intuitive and full integrated with each other so they can ease life and achieve balance: Everything available at the push of a button. When it comes to mobility, this mobility mindset is rather about avoidance of mobility, or creating certainty that life, work and play goes on.

(viii) On top of the flow

New technologies mean that people can now gain insights into their own behavior, allowing them to better manage, monitor, control & adapt their daily lives and activities. Control over drive time, cost and comfort is key. These intelligent apps prove that there is no longer an excuse not to reclaim one's own responsibility for what happens in life.

We will see the rise of a new breed of intelligent apps that prove that there is no longer an excuse not to reclaim one's own responsibility for what happens in life. Not less in the field of mobility. Years ago Toyota came up with the ‘Glass of water’ application. This iPhone app allowed drivers to monitor their driving behavior. A virtual glass of water was simulated standing on the dashboards. Drivers were challenged not to spill a drop while driving, and driver performance could be compared with other drivers in the network. Other applications will help people control their blood alcohol concentration (or that of others), their concentration capacity, road congestion, etc...

(ix) Up-smart Mobility

Important aspects of life that seem separated like mobility, commuting, groceries, dating, exercise, work etc... will find seamless connections in order to get in tune with people’s attempt to manage their time in effective ways. Apart of Amazon’s Prime Air (a futuristic delivery system with multi-rotor Miniature Unmanned Air Vehicles technology intended to utilize GPS to autonomously fly individual packages to customers’ doorsteps within 30 minutes of ordering) there are many other smart tech solutions on the go. The internet-of-things makes it possible that different services talk with each-other. Bringme is a Belgian start-up providing intelligent boxes connected to the smartphone for home delivery.

Some people are consciously looking to manage their lives much better in order to rise above the mass and stay ahead. Smart sensor-connected devices help you to continuously improve your quality of life, even on the go: Smarter, better, leaner, meaner, more efficient - more up-smart.

27. The road goes on and on...

Er gr sxh

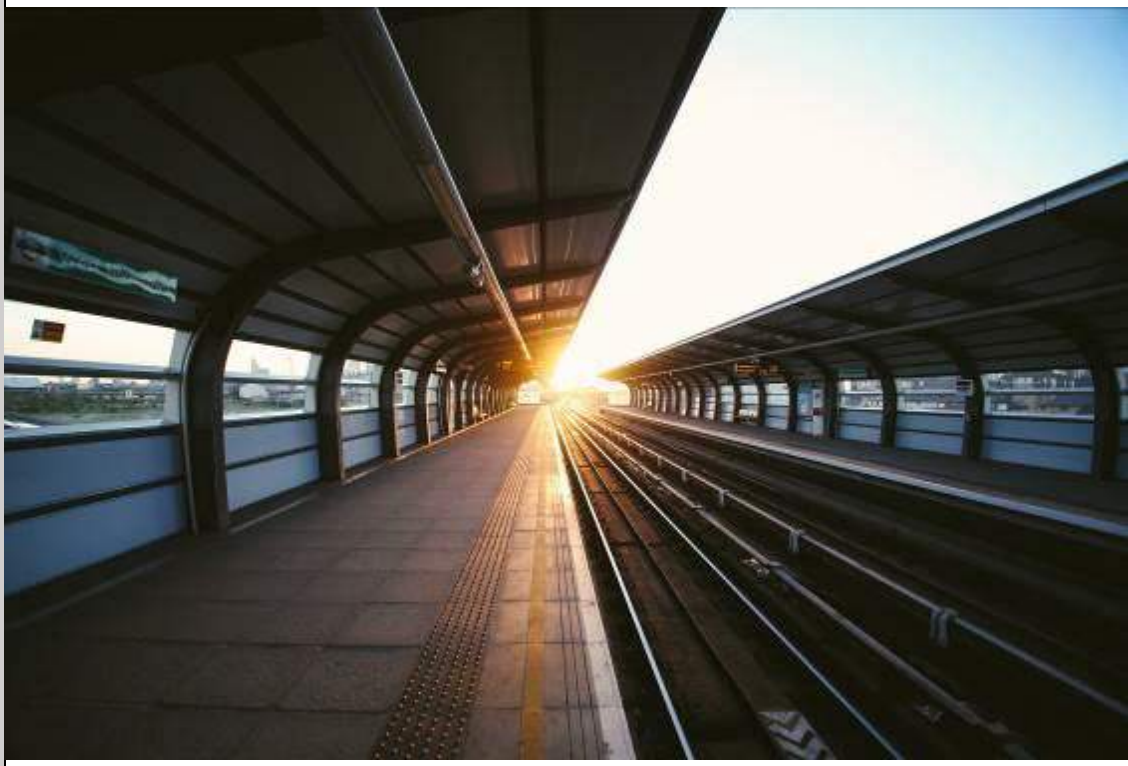
This report has travelled a long road, absorbing intelligence, coordinating it, generating new ideas and innovation on how we should view mobility in the modern and future world. For example, we can see that mobility is itself moving – it is more and more migrating to a 'service centred' concept, rather than a 'product centred' concept.

Our journey has taken us through many disciplines and modes of thought; each with its own language. The list is long: anthropology, architecture, economics, geography, Newtonian physics, philosophy and psychology and sociology. What we have discovered along the way is that the disciplines share some common ground on how to view mobility and at the same time, bring fresh insights and innovation.

We started this work at the baseline of current transport planning – individual trip decisions, only focusing on trips made – on getting from A to B. As we stated at the beginning, the work has taken us on a journey to discover the complexity and depth of mobility, and its profound impacts on personality, identity, image and (importantly) mental and social well being. Only by this full understanding of mobility can we provide accurate advice to policy makers and to all those innovating products and services in the mobility marketplace.

We are confident that the reader of this report will come to this point, looking at mobility with a clearer, wider vision – and maybe some self reflection and reflection on others.

The challenge now is to process the intelligence in this report into the MIND-SETS approach; and then to provide guidelines to our target groups to provide concrete advice to European policy makers and those in the wider mobility economy.



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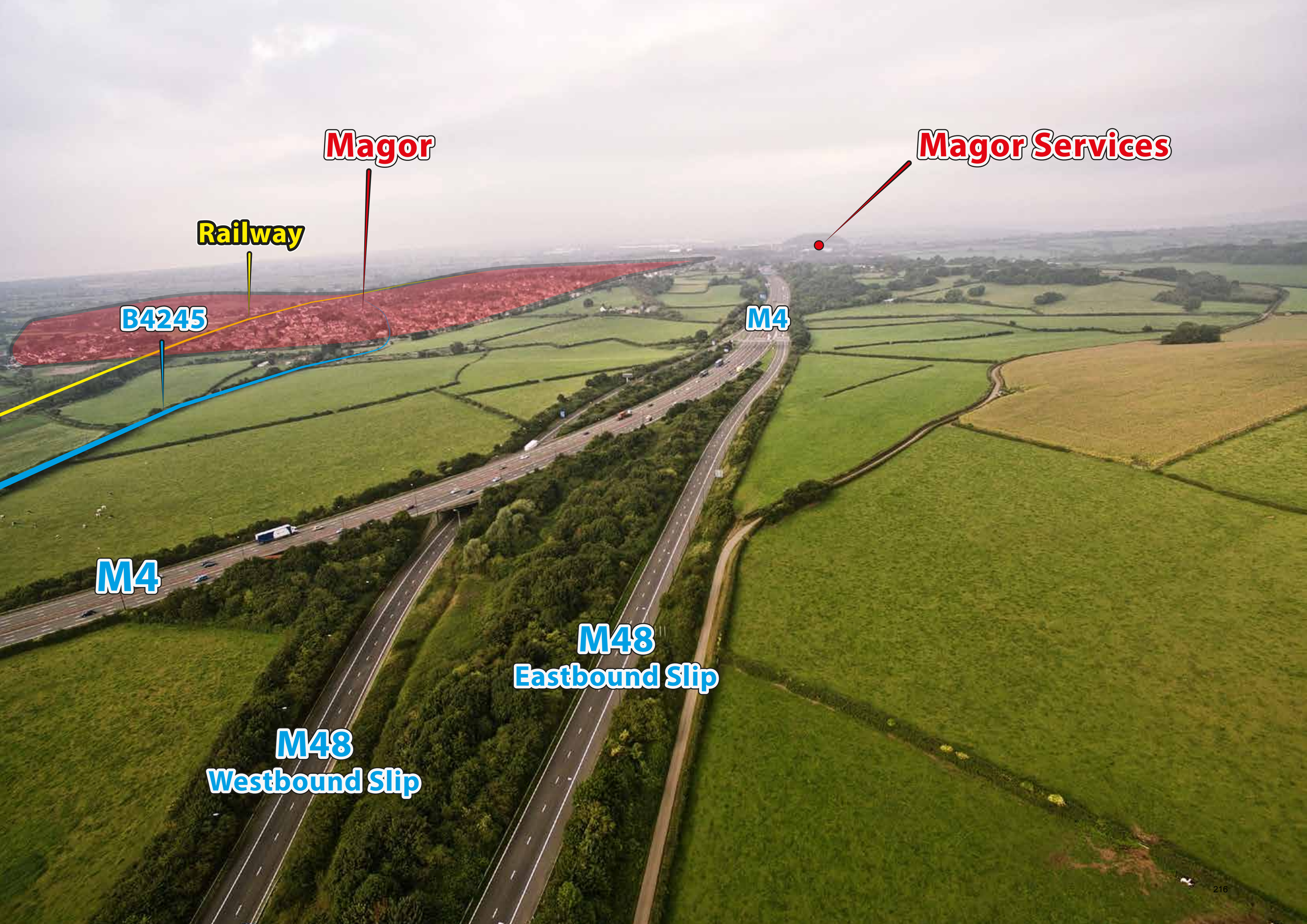
APPENDIX MA2 – CONTEXT OF MAGOR MSA


Magor Services


Magor
Magor Services
Railway
B4245
M4
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M48
Eastbound Slip
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Westbound Slip


Magor Services
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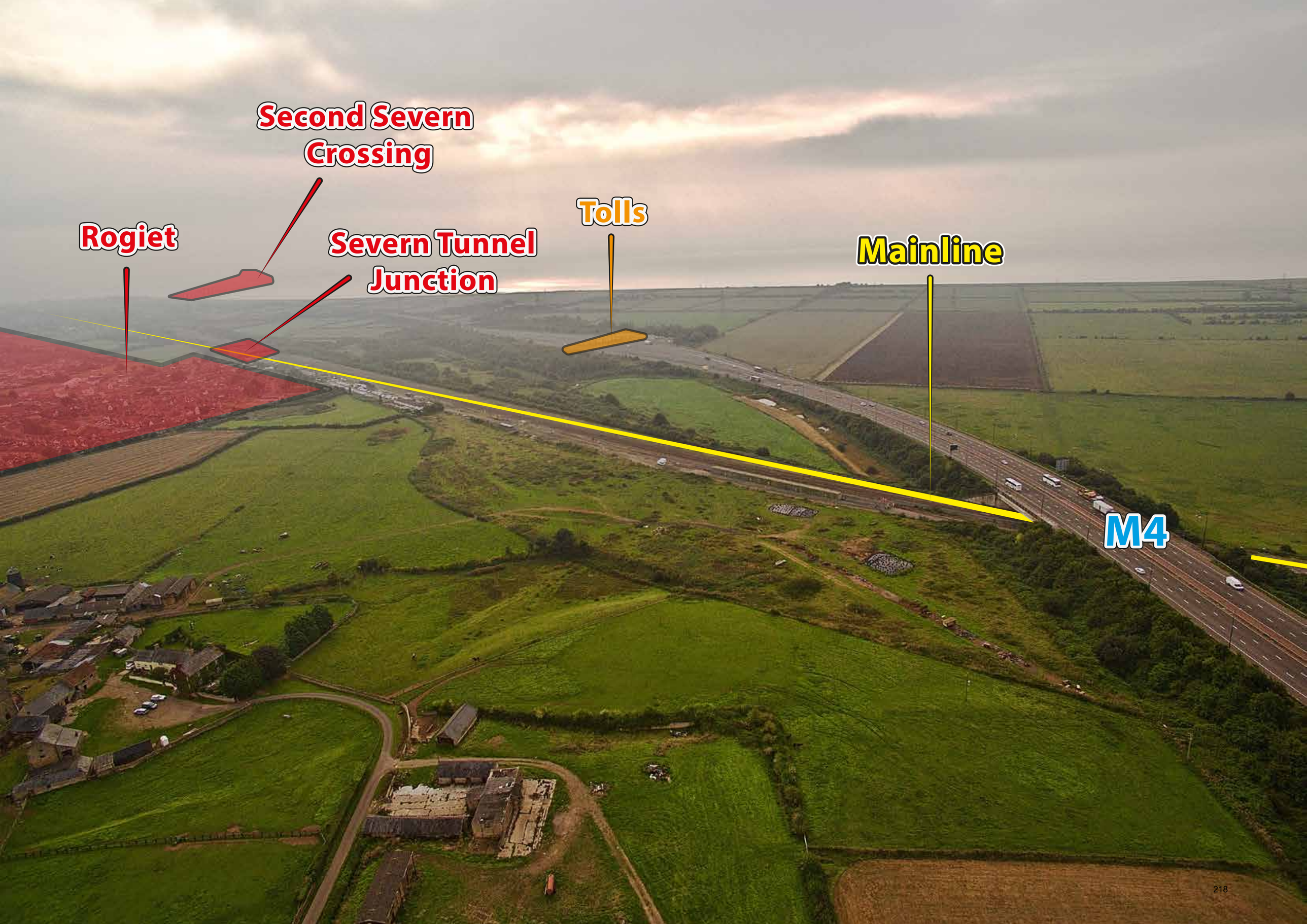
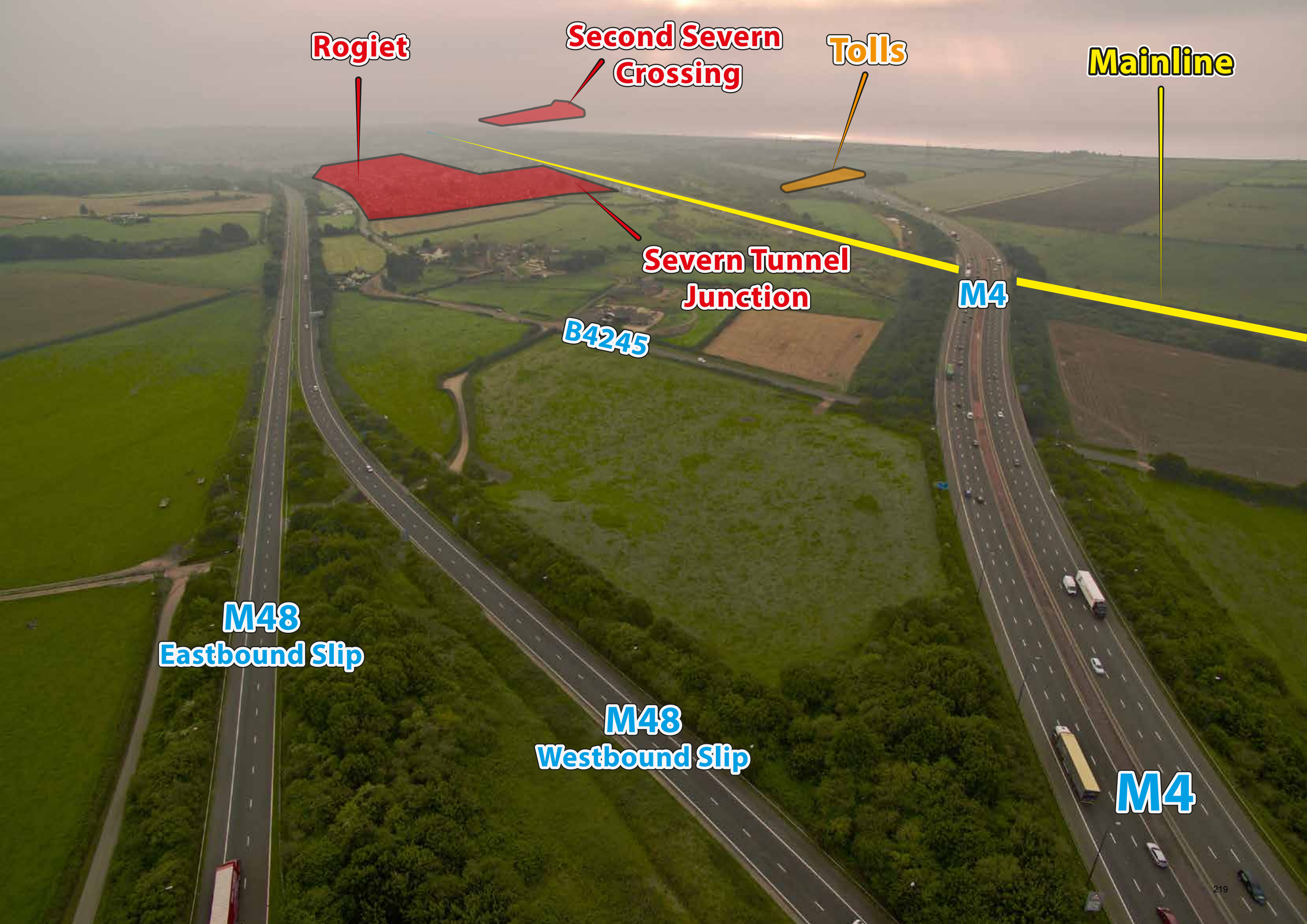

Second Severn Crossing
Rogiet
Severn Tunnel Junction
Tolls
Mainline
M4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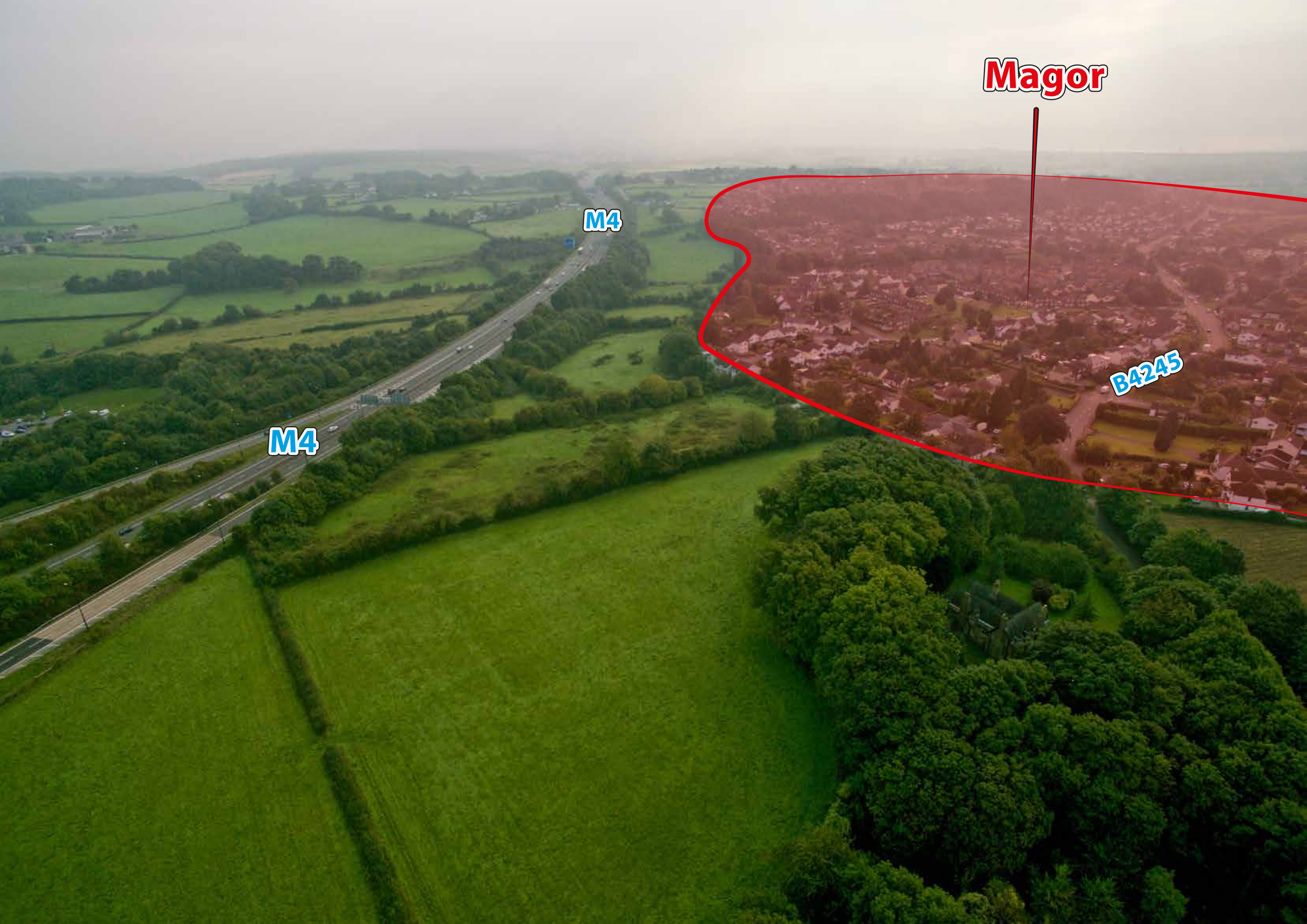
Second Severn Crossing
Tolls
Mainline
Severn Tunnel Junction
M4
B4245
M48
Eastbound Slip
M48
Westbound Slip
M4


Magor
Wales One
Magor Services


Magor
M4
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Wales One
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Magor Services

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Wales One

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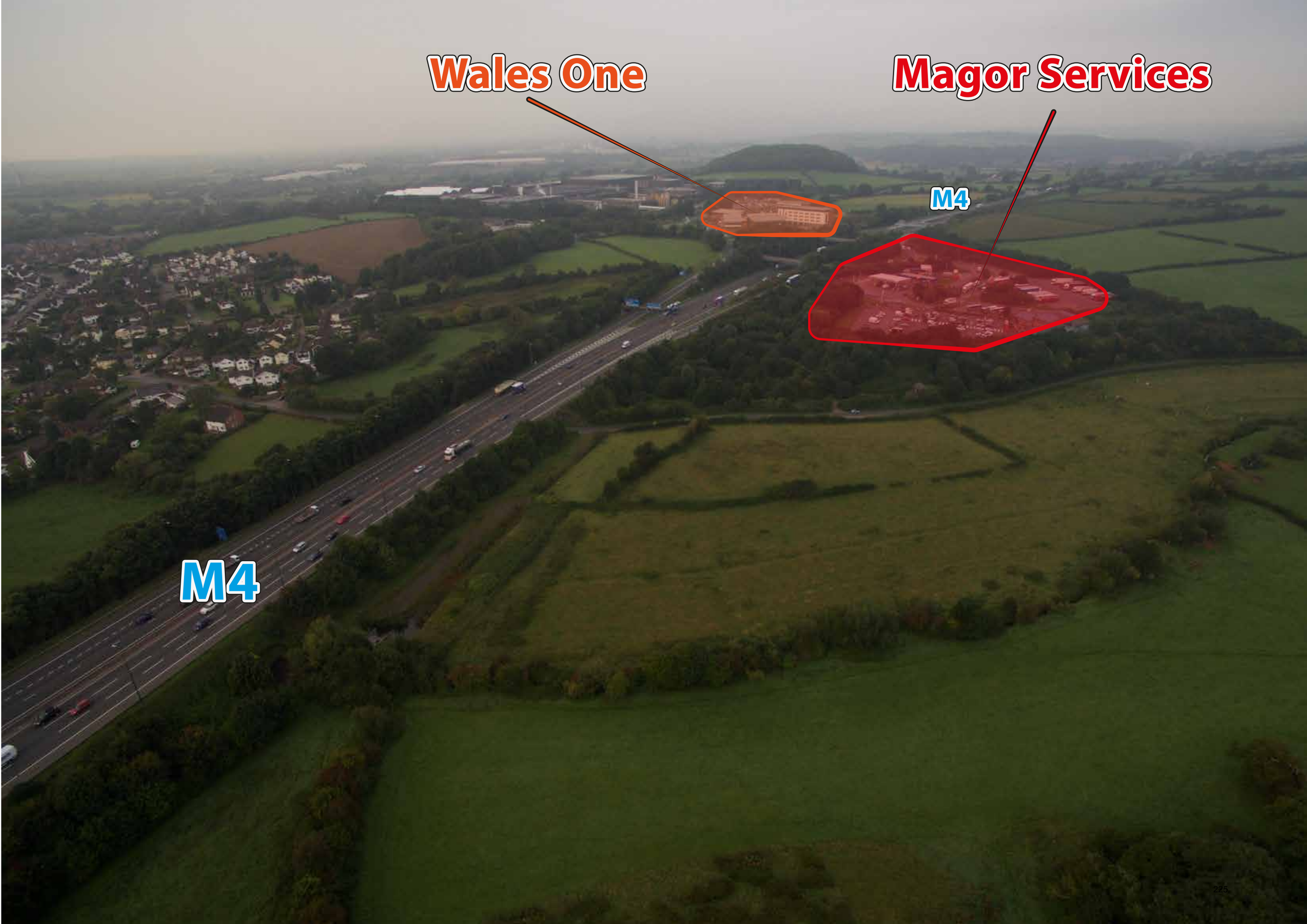
Glan Lyn
Inbev (UK) Ltd
A4810


Wales One
Magor Services
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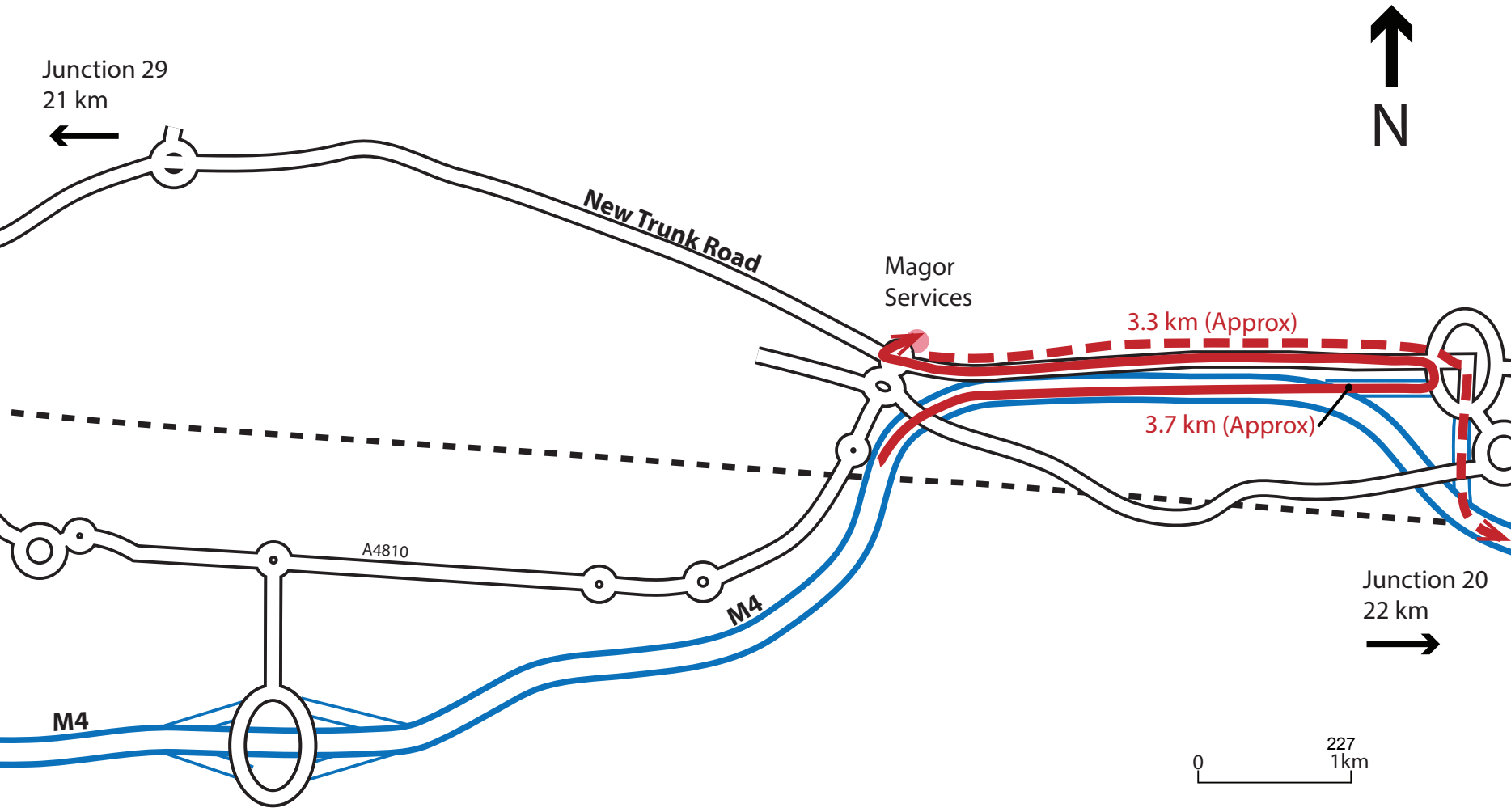
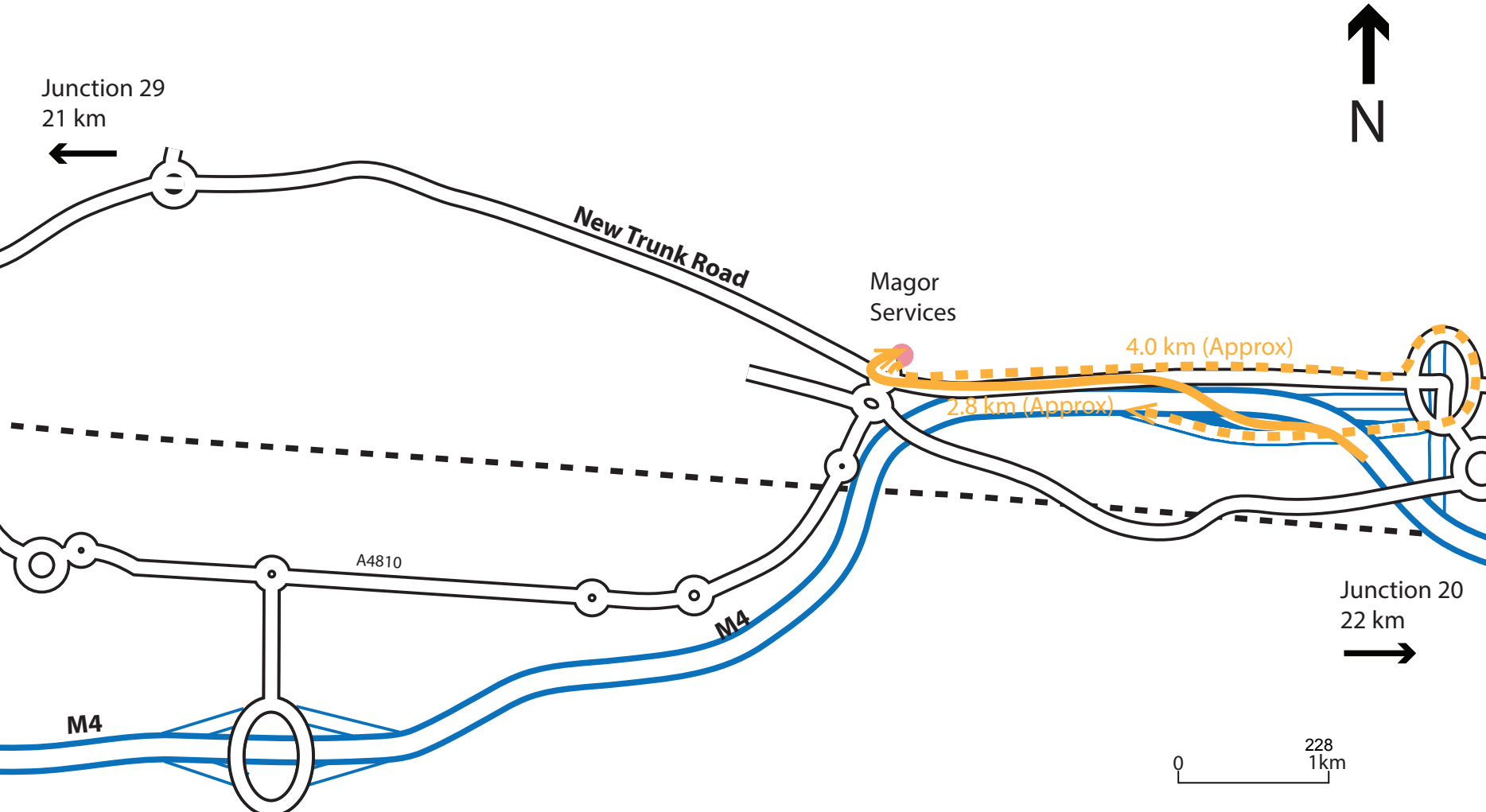
APPENDIX MA3 – WG SCHEME – ACCESS TO MAGOR MSA

Eastbound WG1 to WG1



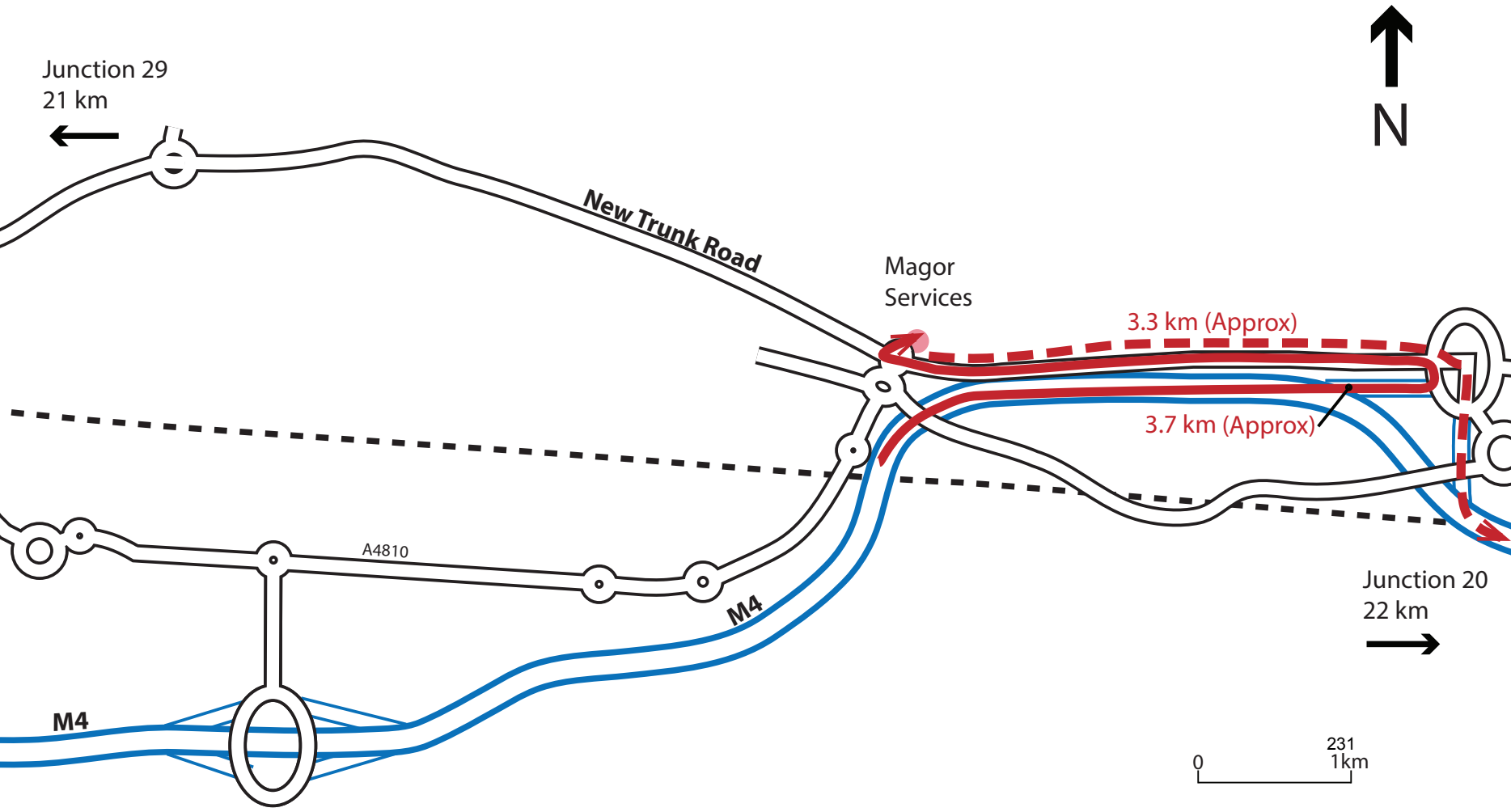
Westbound WG1 to WG1



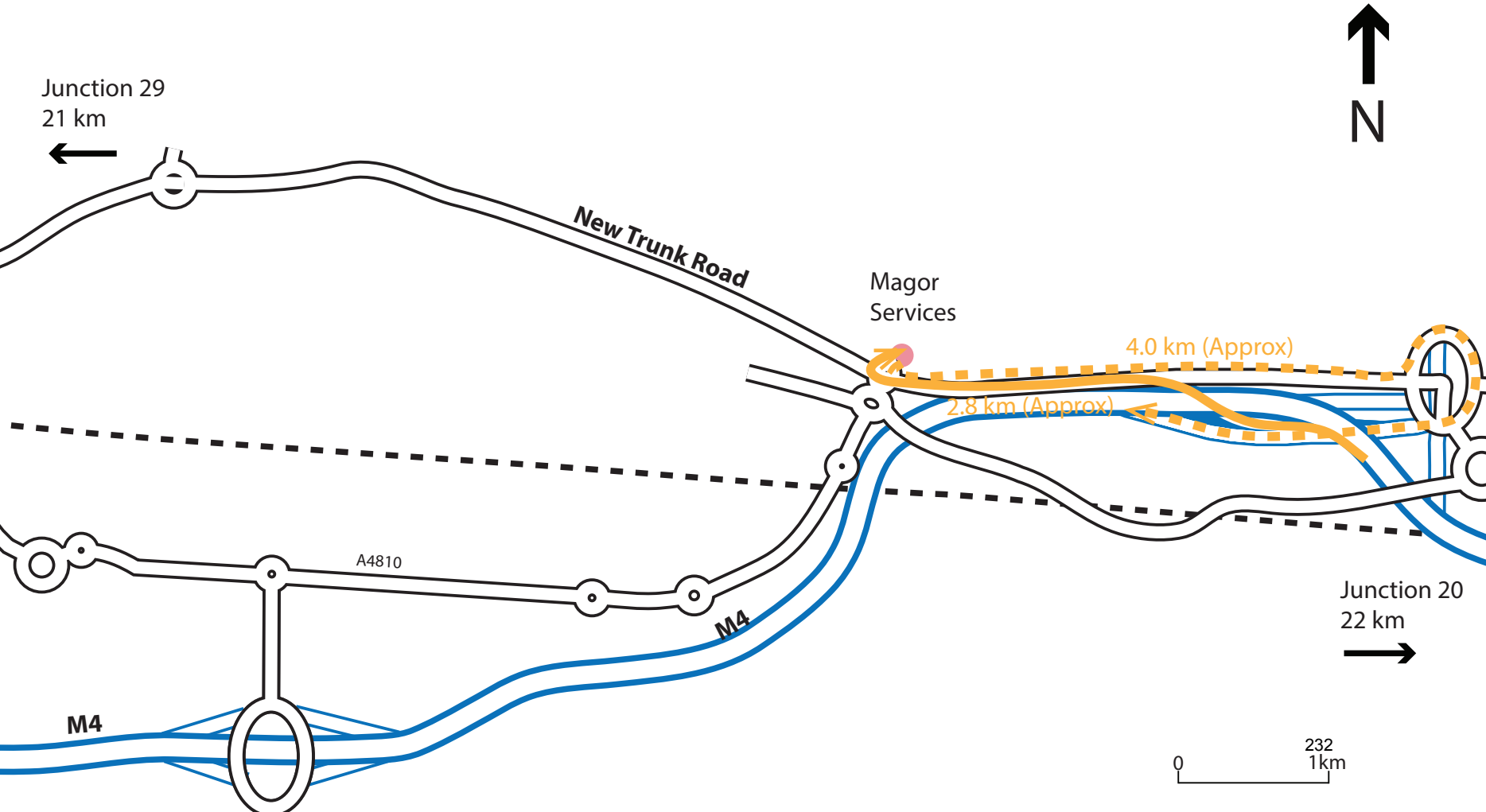

A48
N
A48
M48
23.8 km
Severn View
Services
M4
Magor
Services
B4461
M4
20.9 km
A4810
River Severn
M49
A403
B4055
M5
A38
M4
A4018
229

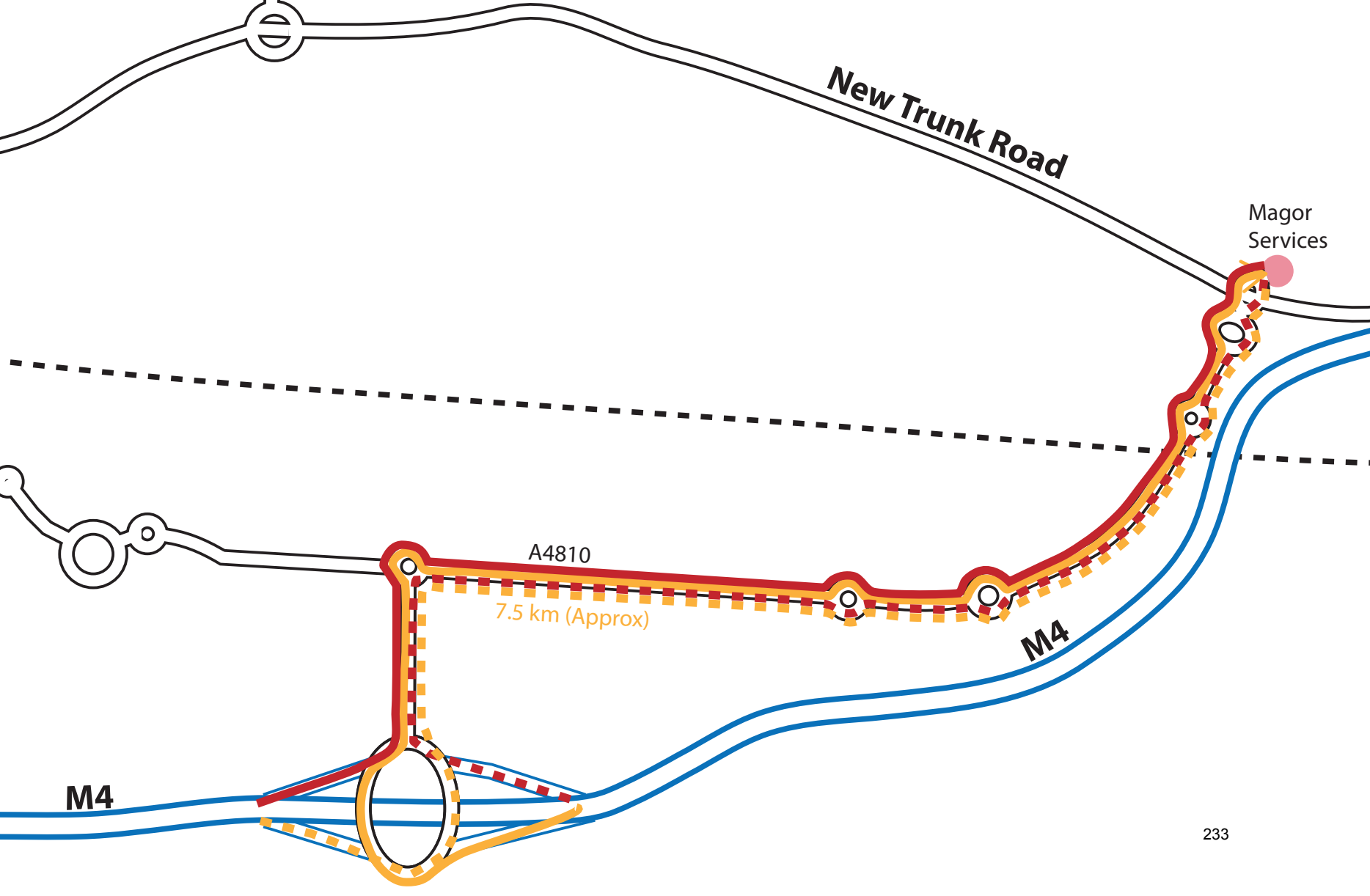
APPENDIX MA4 – WG SCHEME – ACCESS OPTIONS TO MAGOR MSA

Eastbound WG1 to WG1

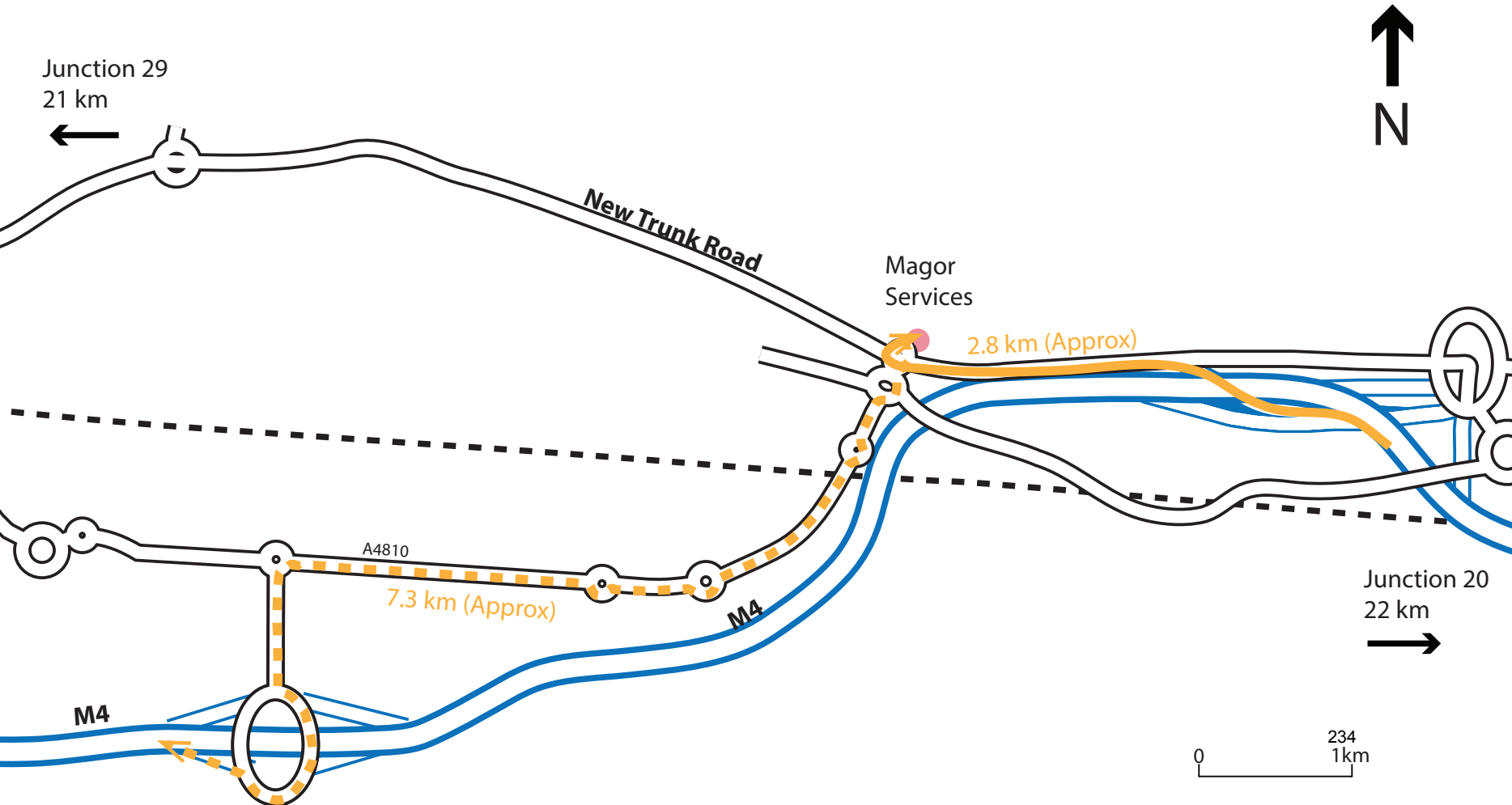


Westbound WG1 to WG1

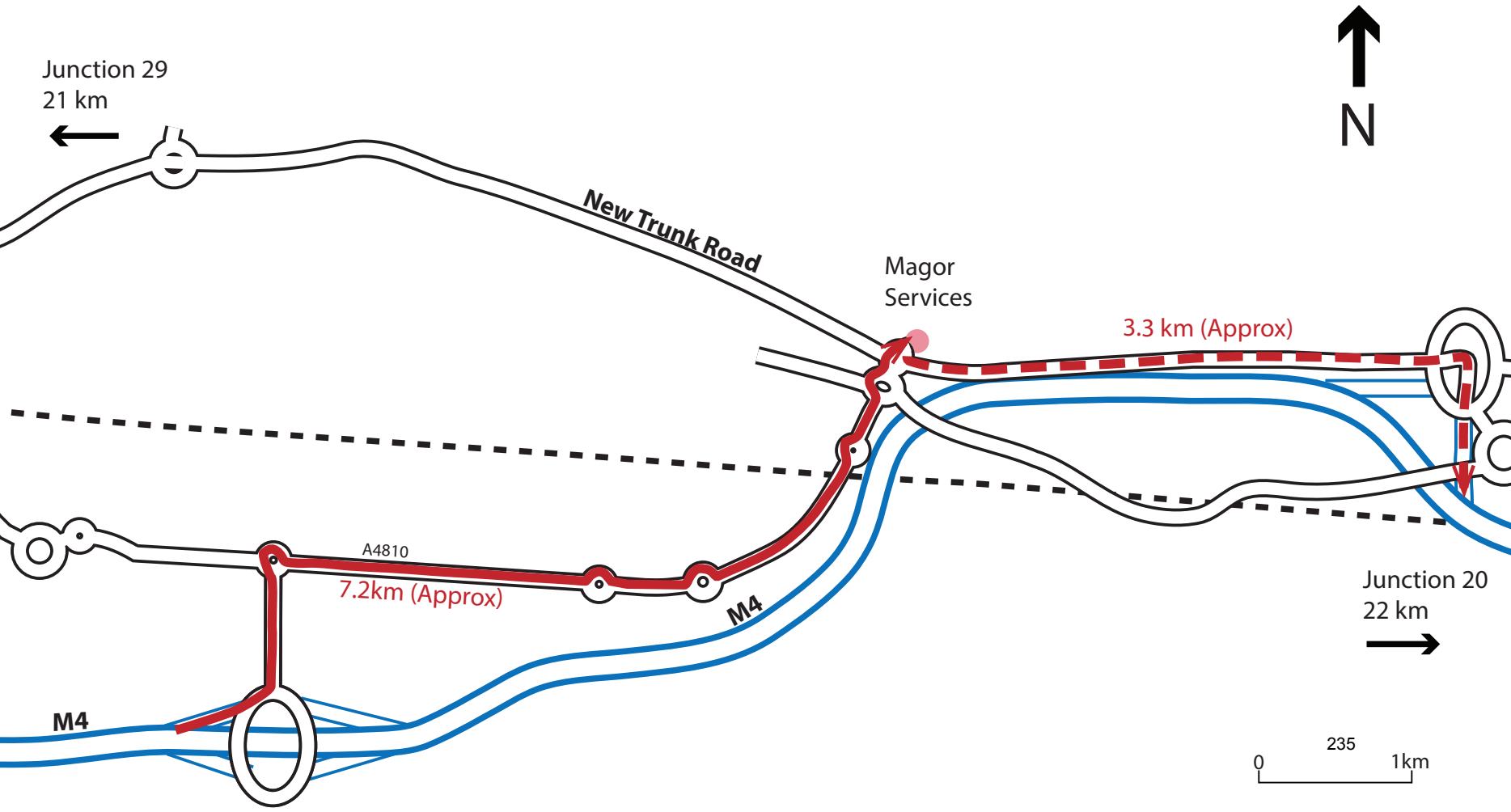



New Trunk Road
Magor
Services
A4810
7.5 km (Approx)
M4
M4

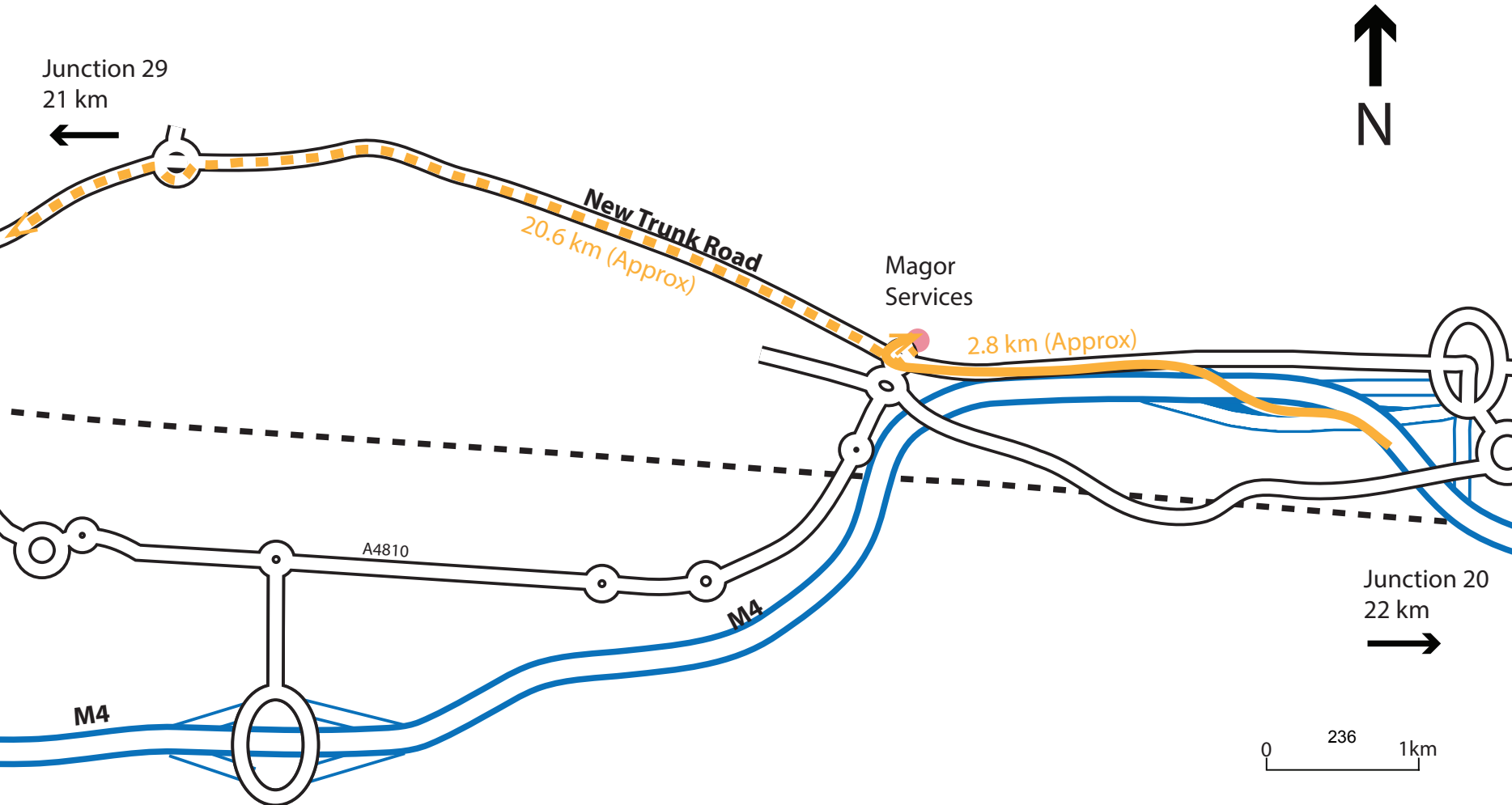
Westbound WG1 to WG2



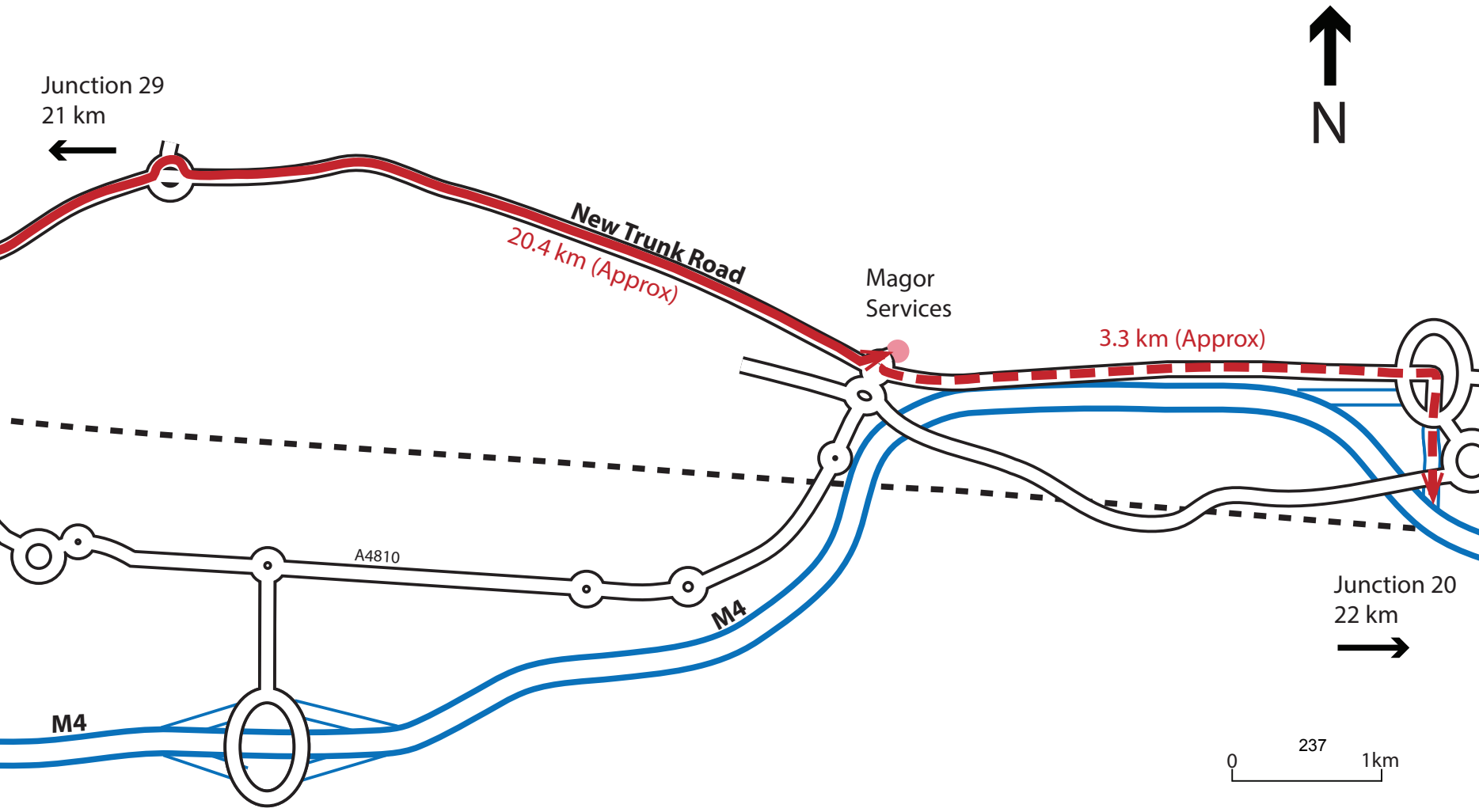
Eastbound WG2 to WG1



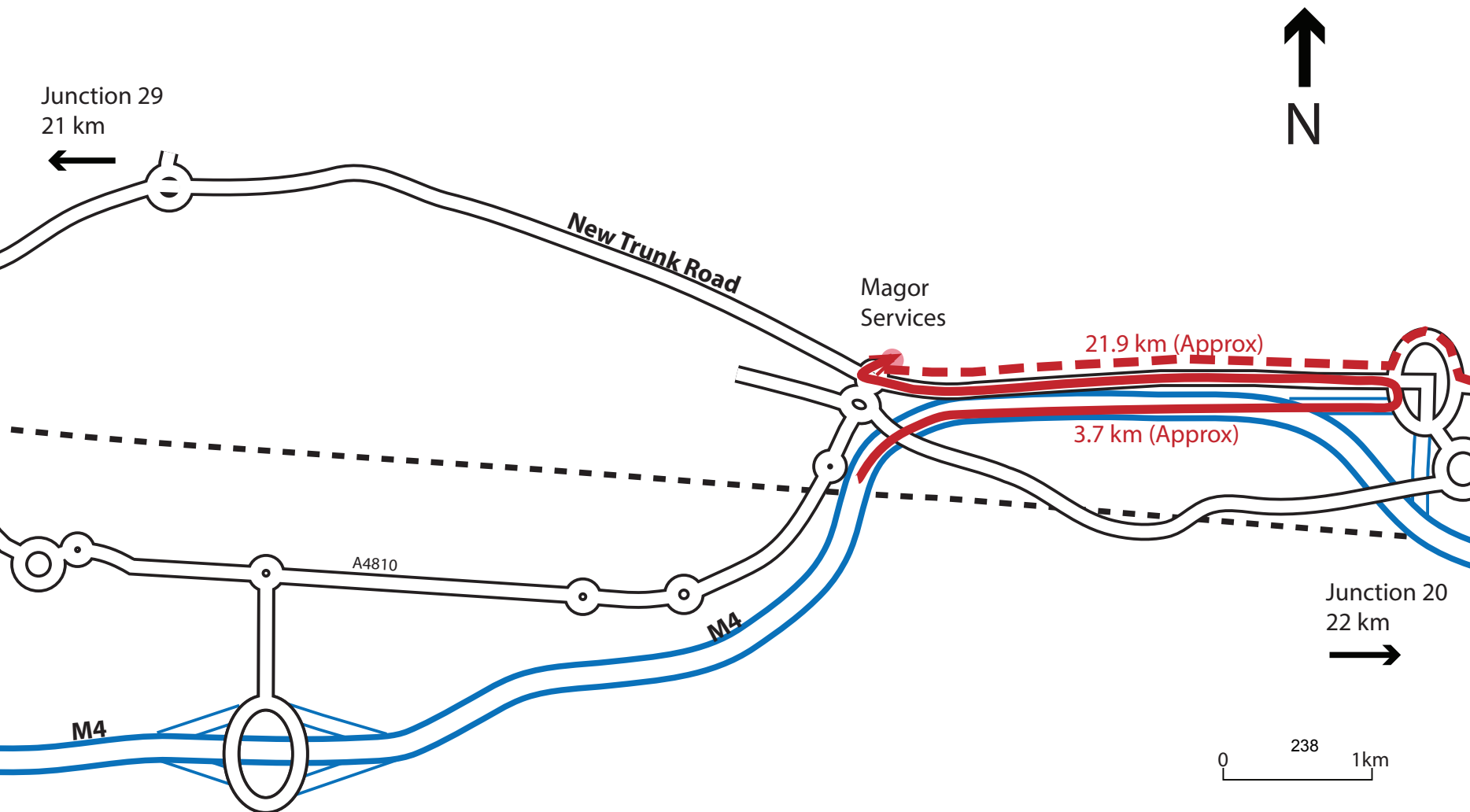
Westbound WG1 to WG3



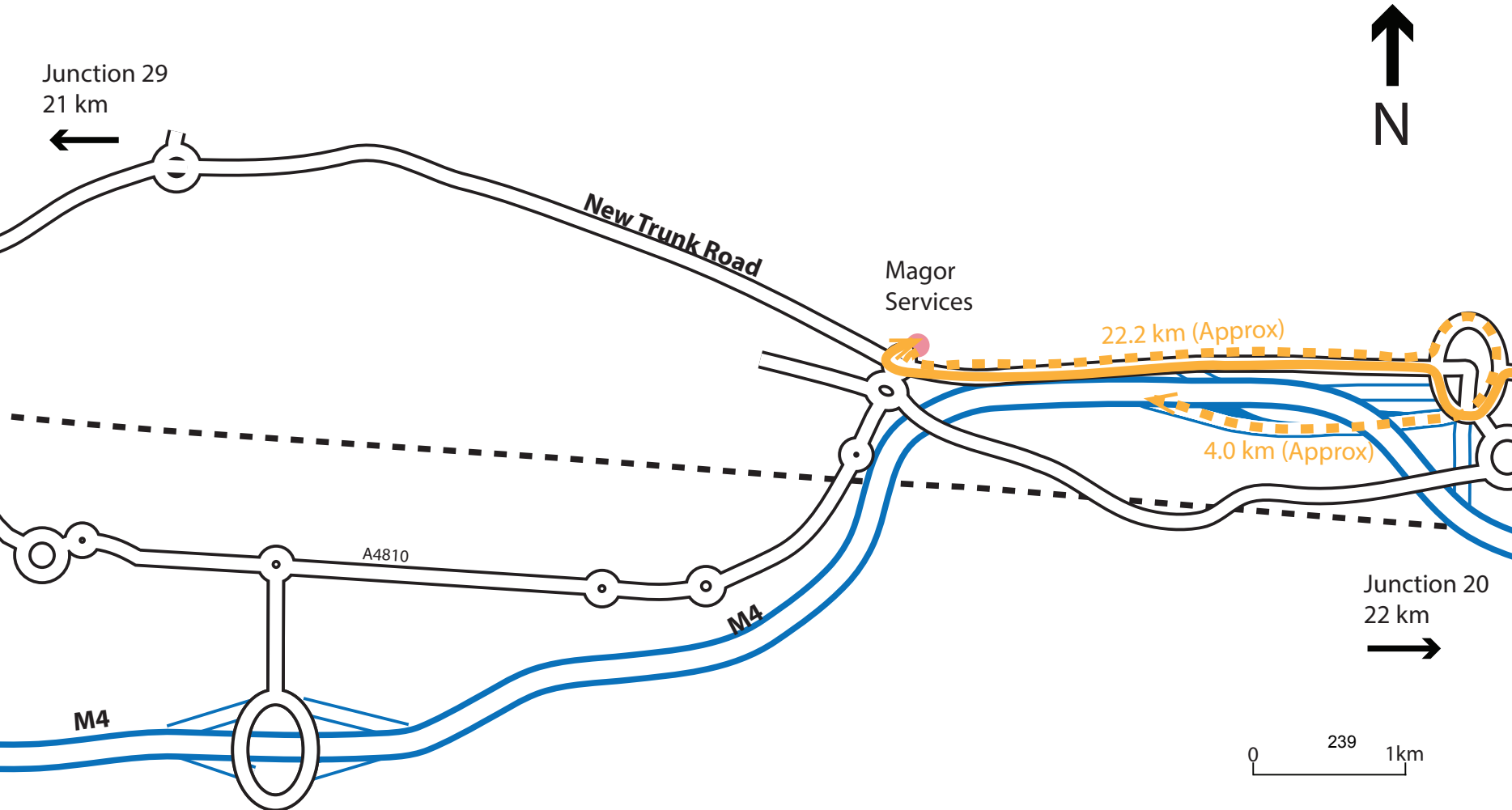
Eastbound WG3 to WG1



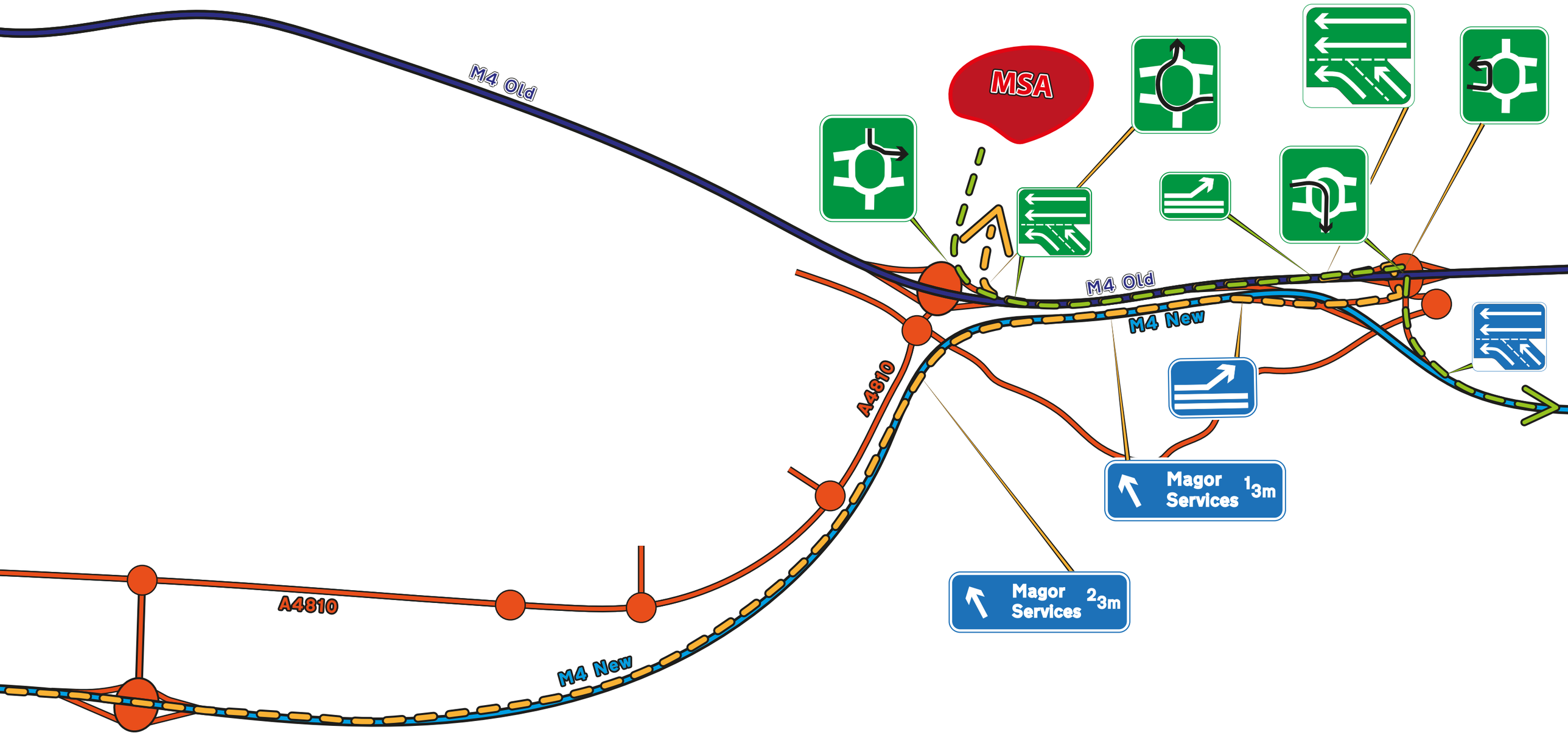
Eastbound WG1 to Option 2



Westbound WG2 to WG1



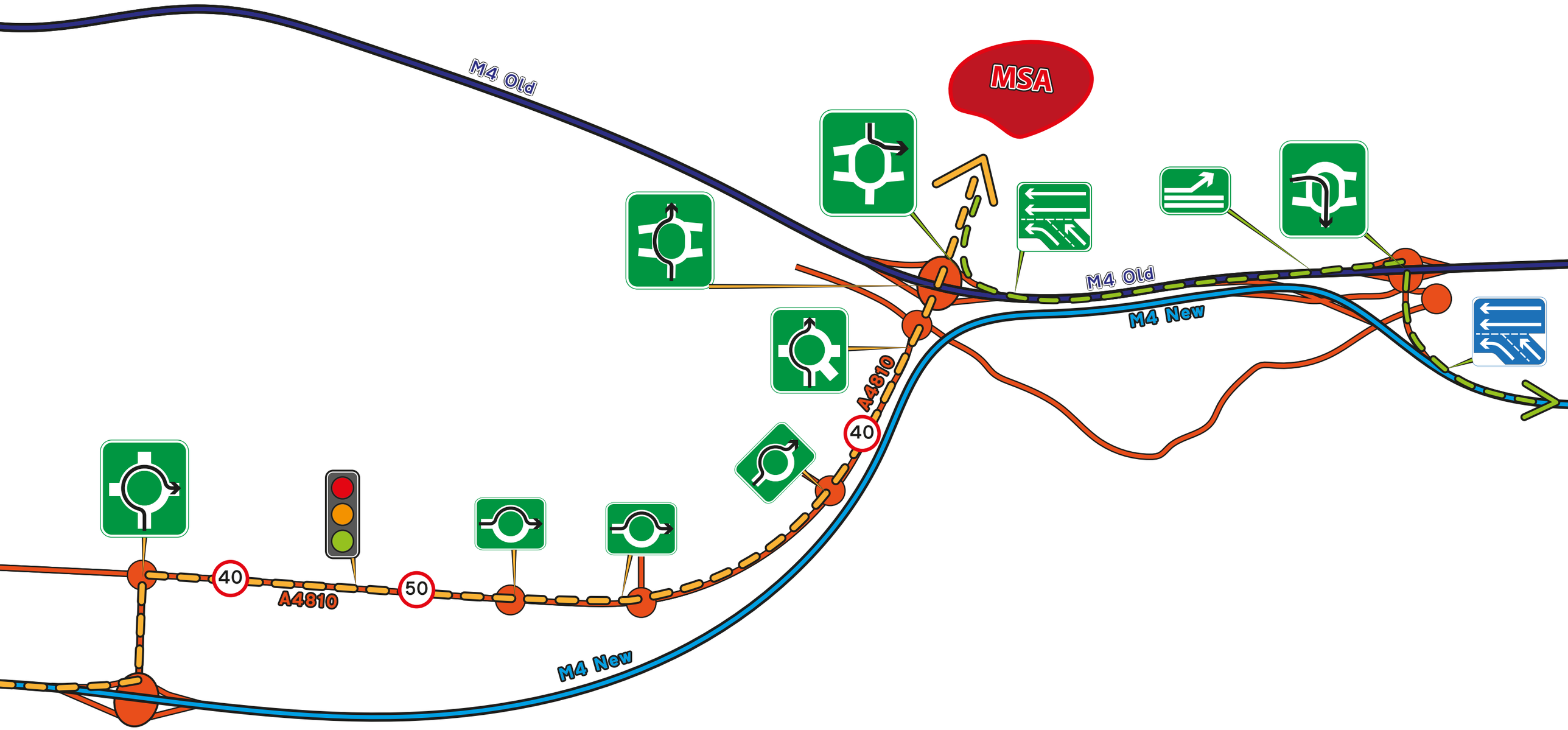
Magor MSA - Proposed Welsh Goverment Access Arrangements



Eastbound Entry Option 1

Eastbound Exit Option 1

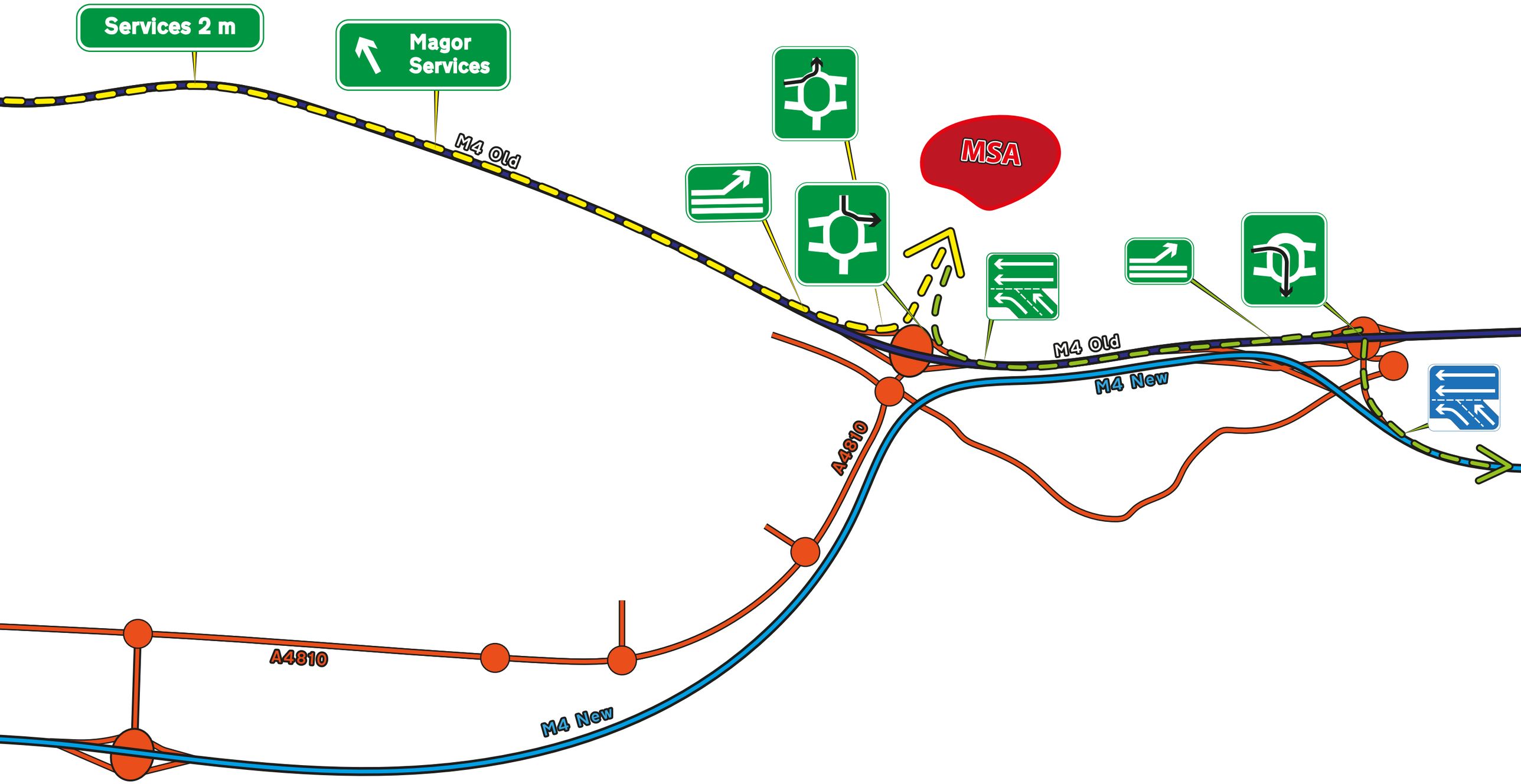
Magor MSA - Proposed Welsh Goverment Access Arrangements



Eastbound Entry Option 2

Eastbound Exit Option 1

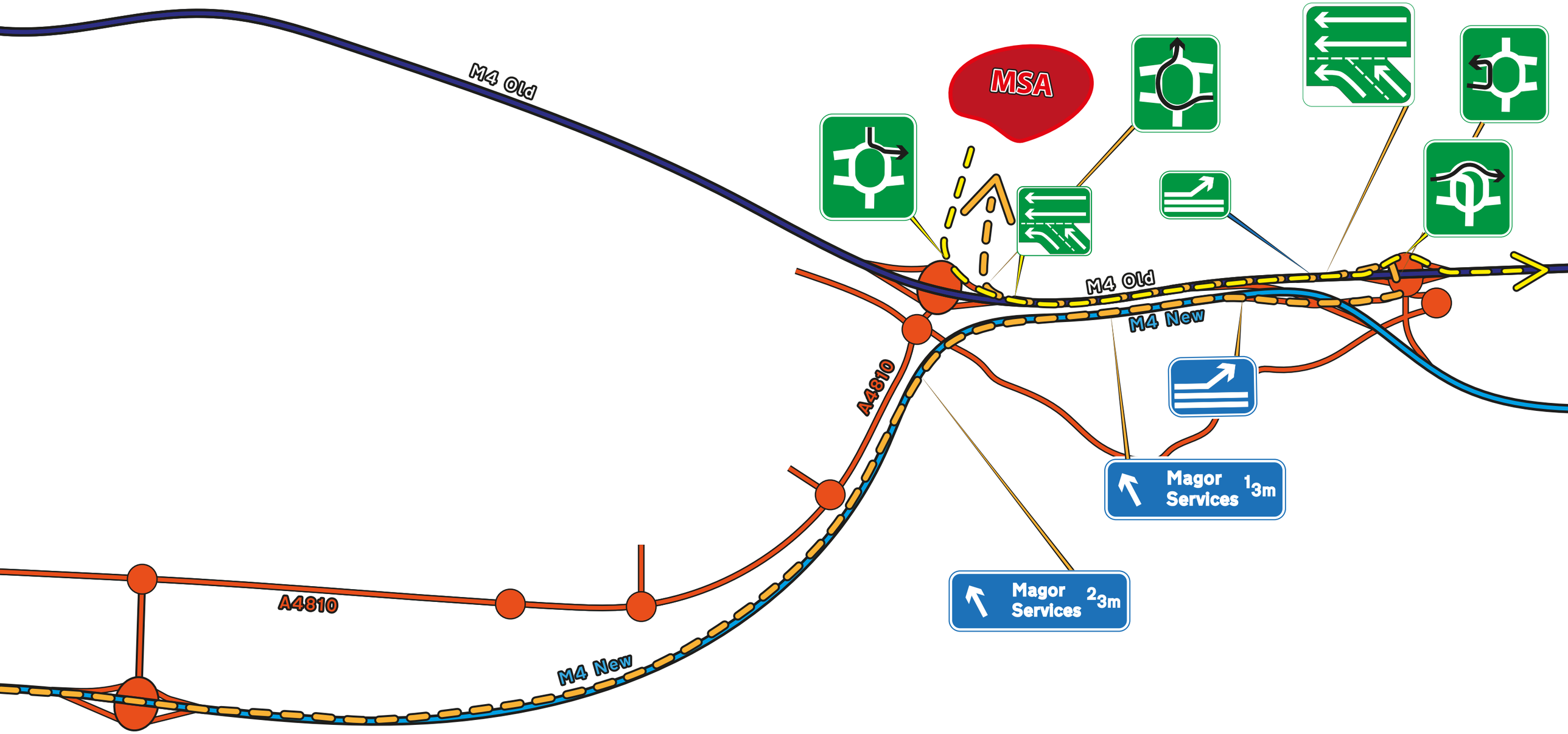
Magor MSA - Proposed Welsh Goverment Access Arrangements



Eastbound Entry Option 3

Eastbound Exit Option 1

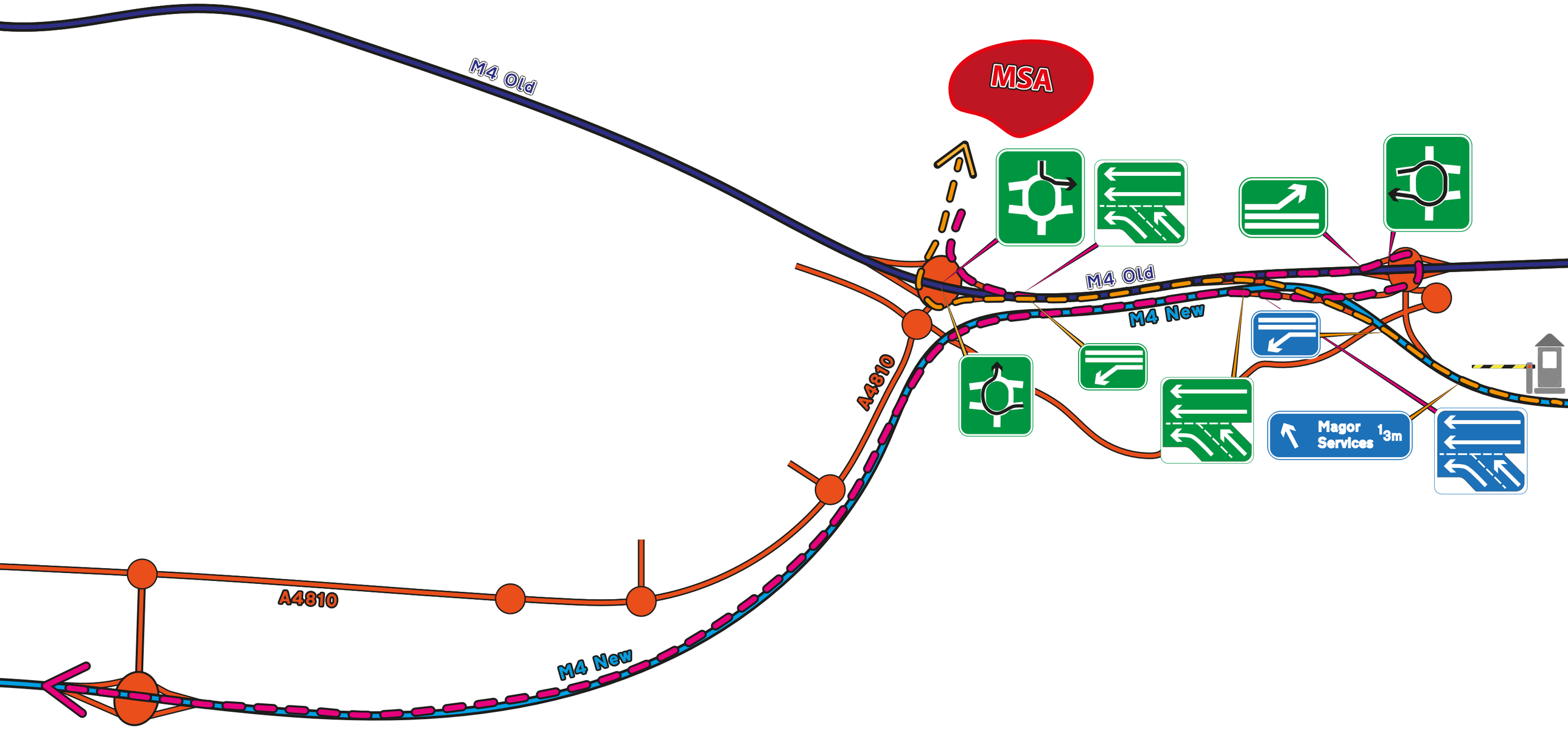
Magor MSA - Proposed Welsh Goverment Access Arrangements



Eastbound Entry Option 1

Eastbound Exit Option 2_{243}

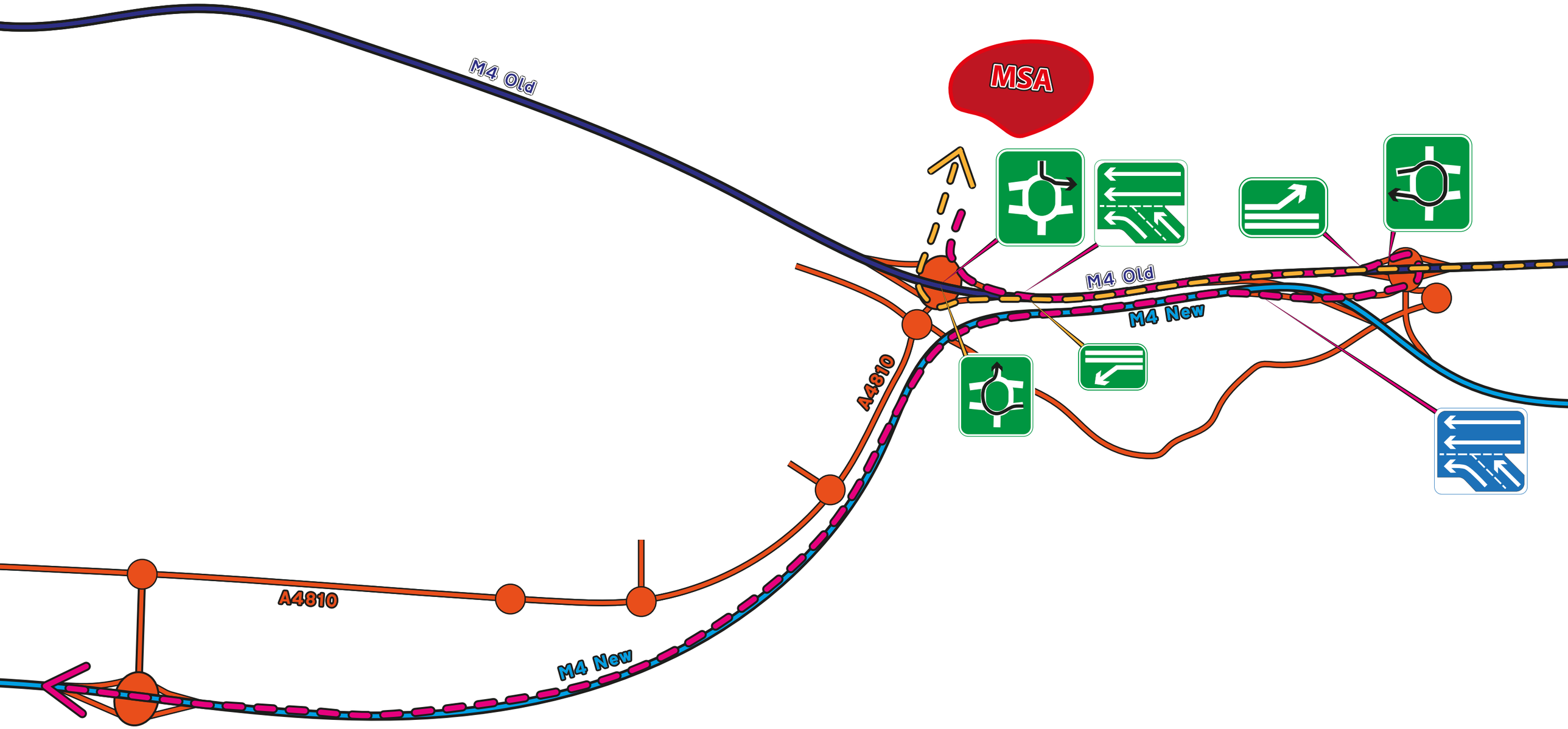
Magor MSA - Proposed Welsh Goverment Access Arrangements



Westbound Entry Option 1

Westbound Exit Option 1

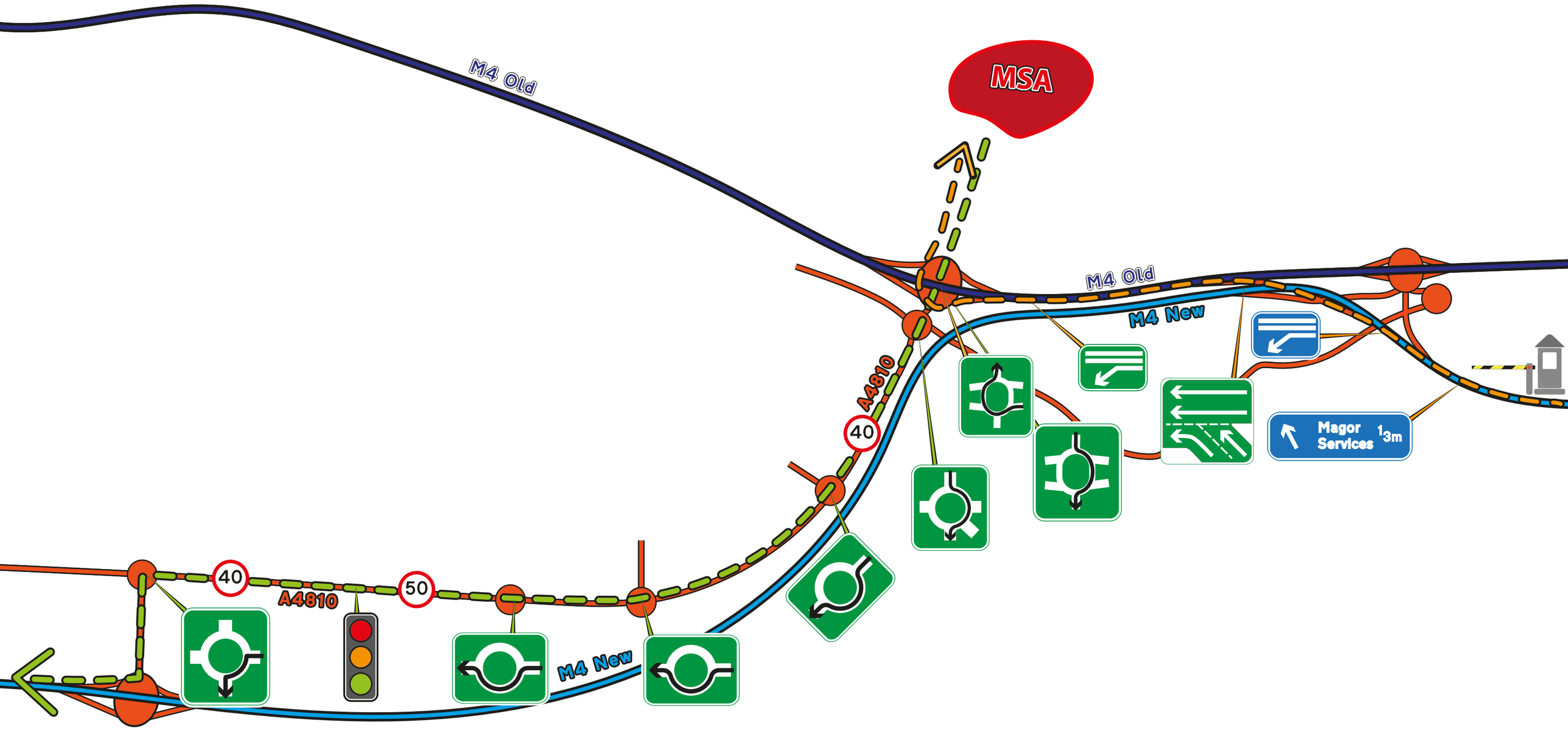
Magor MSA - Proposed Welsh Goverment Access Arrangements



Westbound Entry Option 2

Westbound Exit Option 1

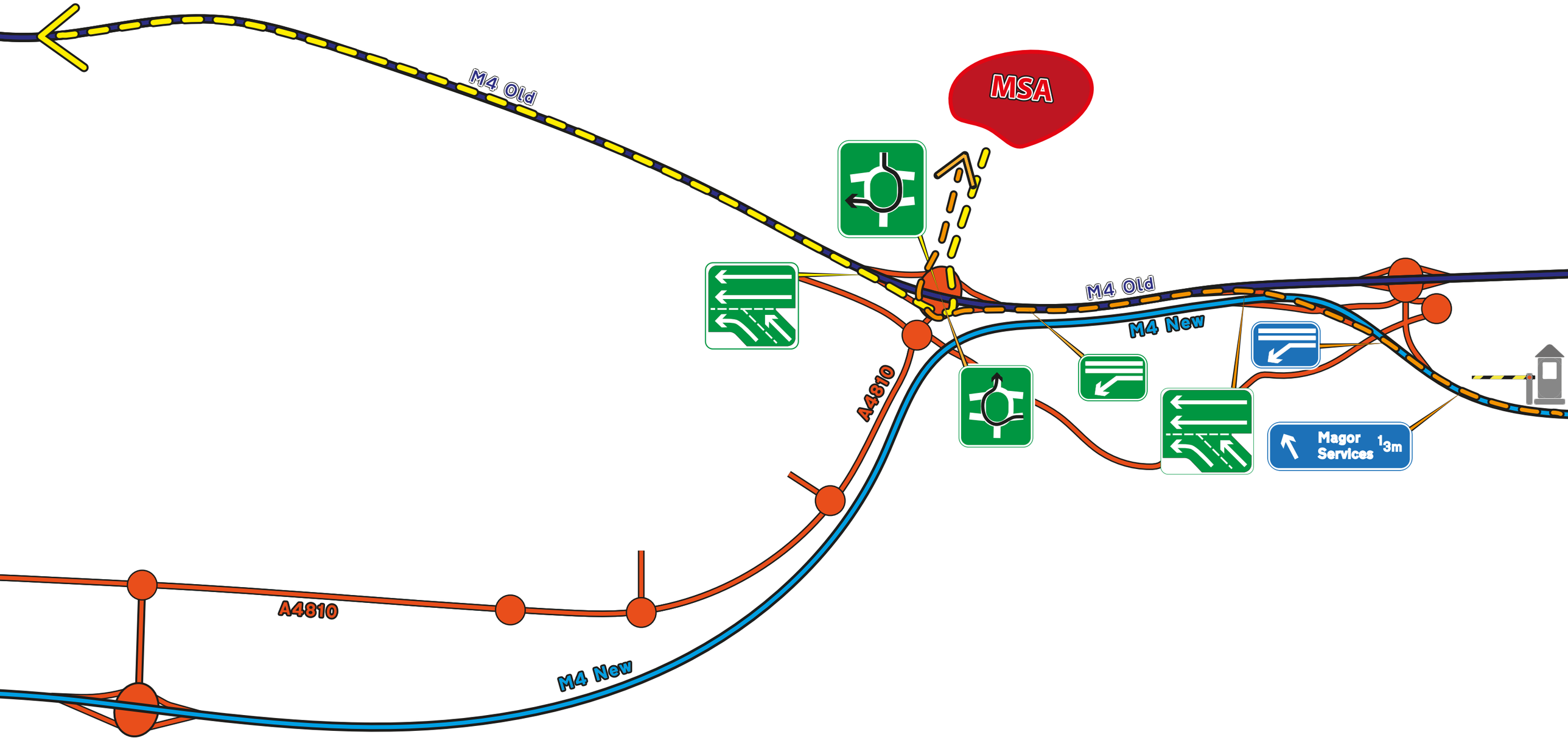
Magor MSA - Proposed Welsh Goverment Access Arrangements



Westbound Entry Option 1

Westbound Exit Option 2

Magor MSA - Proposed Welsh Goverment Access Arrangements



Westbound Entry Option 1

Eastbound Exit Option 3

APPENDIX MA5 – VIRTUAL DRIVE THROUGHS

Magor MSA – Existing Access Arrangements

Eastbound Entry – Travel Distance (from the motorway) = 620 metres

A 'Services 2m' sign informs drivers they are approaching Magor MSA. There are also 'Services' signs 2/3 mile and 1/3 mile from the turn-off. Drivers exit the M4 at Junction 23a via a slip road, and take the first exit at Junction 23a Roundabout to access Magor MSA.

Eastbound Exit – Travel Distance = 650 metres

Drivers exit Magor MSA, take the first exit at Junction 23a Roundabout and join the M4 via a slip road from Junction 23a. Appropriate directional signage is provided at Junction 23a.

Existing Eastbound Journey Distance from the Motorway = 1,270 metres

Westbound Entry – Travel Distance = 890 metres

A 'Services 2m' sign informs drivers they are approaching Magor MSA. There are also 'Services' signs 2/3 mile and 1/3 mile from the turn-off. Drivers exit the M4 at Junction 23a via a slip road, and take the third exit at Junction 23a Roundabout to access Magor MSA.

Westbound Exit – Travel Distance = 880 metres

Drivers exit Magor MSA, take the third exit at Junction 23a Roundabout and join the M4 via the slip road from Junction 23a. Appropriate directional signage is provided at Junction 23a.

Existing Westbound Journey Distance from the Motorway = 1,770 metres

Magor MSA – Proposed Welsh Government Access Arrangements

Eastbound Entry – WG Option 1 – Travel Distance = 3,700 metres

'Services 2/3 mile' and 'Services 1/3 mile' will need be provided on the M4 to sign drivers passed Magor MSA to Junction 23. Drivers will leave the motorway at Junction 23, where they will undertake a u-turn (which will need to be signed) at the signal controlled Junction 23 Roundabout to travel back along the declassified M4. Drivers will merge onto the declassified M4 where further non-motorway signage will be required, in the form of 'Services 1/3 mile' to direct drivers to Magor MSA. Drivers then exit the declassified M4 at Junction 23a, take the third exit at Junction 23a Roundabout, and access Magor MSA.

Eastbound Entry – WG Option 2 – Travel Distance = 7,200 metres

'Services 2/3 mile' and 'Services 1/3 mile' will need to be provided in advance of the Glan Lyn Junction on the M4 (which is 7,200 metres west of Magor MSA). Drivers will exit the M4 at the new Glan Lyn Junction, take the first exit at the Glan Lyn Roundabout, and join the A4810 via another roundabout, taking the second exit. Drivers will then travel for a distance of 5,960 metres along the A4810, through one signal controlled junction and four further roundabout junctions, before reaching Junction 23A. This section of the A4810 is subject to 40mph in some places, and 50mph in other places, and 'Services' signs will be required at regular intervals and at all junctions to direct drivers to Magor MSA. Upon arriving at Junction 23a, drivers will take the second exit at the roundabout to access Magor MSA.

Eastbound Entry – WG Option 3 – Travel Distance = 20,400 metres

An advanced 'Services' sign will need to be provided in advance of Junction 29, some 20,400 metres west of Magor MSA, to inform drivers of route choices to access Magor MSA, and the option of travelling along the declassified M4. Drivers who choose to travel along the declassified M4 will exit the M4 at Junction 29, travel along the declassified M4 for 20,200 metres, through six motorway junctions (28, 27, 26, 25a, 25 and 24) before exiting the declassified M4 at Junction 23a. Drivers will leave the declassified M4 at Junction 23a and take the first exit at Junction 23a to access Magor MSA.

Eastbound Exit – WG Option 1- Travel Distance = 3,300 metres

Drivers exit Magor MSA, take the first exit at Junction 23a Roundabout, travel for a distance of approximately 2,400 metres along the declassified M4, before turning right via a signal controlled hamburger junction at Junction 23 to re-join the M4 and merge with M4 traffic.

Eastbound Exit – WG Option 2 - Travel Distance = 7,300 metres

Drivers exit Magor MSA, take the first exit at Junction 23a Roundabout, and travel along the declassified M4 to Junction 23. At Junction 23, drivers travel around the roundabout (via a dedicated lane) onto the M48, and across the Severn Crossing, before re-joining the M4 at Junction 21, 7,200 metres east of Magor MSA.

WG Eastbound Journey Distance from the Motorway = 7,000 metres

Westbound Entry – WG Option 1 - Travel Distance = 2,800 metres

Advanced signage to Magor MSA will need to be provided in advance of the toll booths on the Second Severn Crossing. Drivers will be required to keep left at the toll booths, and 900 metres after the toll booths leave the M4 via a slip road approximately which connects to the declassified M4. Drivers will then join the declassified M4 for 1,200 metres, where further non-motorway signage will be required on the declassified M4 to inform drivers of the correct route. Drivers will then exit the declassified M4 at Junction 23a. At Junction 23a drivers will take the third exit at Junction 23a Roundabout to access Magor MSA.

Westbound Entry – WG Option 2 - Travel Distance = 22,200 metres

An advanced 'Services' sign will need to be provided in advance of Junction 21, some 22,000 metres east of Magor MSA, to inform drivers of route choices to access Magor MSA. Drivers who choose to travel along the M48 will leave the M4 at Junction 21, travel across the Severn Crossing, through the toll booths, to Junction 23. At Junction 23, which will be signal controlled, drivers will pass through three sets of traffic lights and take the 4th exit at the roundabout and then join the declassified M4 for 2,600 metres, before exiting the declassified M4 at Junction 23a. At Junction 23a drivers will take the third exit at Junction 23a Roundabout to access Magor MSA.

Westbound Exit – WG Option 1 - Travel Distance = 4,000 metres

Drivers will exit Magor MSA and take the first exit at Junction 23a and join the declassified M4. Drivers will then leave the declassified M4 at Junction 23, and undertake a u-turn at Junction 23, passing through three sets of traffic lights and taking the third exit to the M4. Drivers will then join the M4 via a slip road.

Westbound Exit – WG Option 2 - Travel Distance = 7,300 metres

Drivers will exit Magor MSA and take the second exit at Junction 23a onto the A4810. Drivers will then travel through four roundabout junctions and one set of traffic lights on the A4810. This section of the A4810 is subject to 40mph in some places, and 50mph in other places, and 'M4' signs will be required at regular intervals and at all junctions to direct drivers back to the M4. At the fifth roundabout junction on the A4810 drivers will take the first exit to the Glan Lyn Junction on the M4. At the Glan Lyn Junction drivers will take the second exit, and then merge onto the M4 via a slip road.

Westbound Exit – WG Option 3 - Travel Distance = 20,400 metres

Drivers will exit Magor MSA and take the third exit at Junction 23a Roundabout to the declassified M4. Drivers will then join the declassified M4 and travel through six motorway junctions (24, 25, 25a, 26, 27 and 28) before exiting the declassified M4 at Junction 29, some 20,200 metres to the west, at which point they will merge back onto the new M4.

WG Westbound Journey Distance from the Motorway = 6,800 metres

Magor MSA – Roadchef Proposals

Eastbound Entry – Travel Distance = 1,000 metres

'Services 2/3 mile' and 'Services 1/3 mile' will be provided on the M4 prior to the slip road providing access to Magor and Magor Services. Drivers will leave the M4 via the slip road, take the second exit at a new roundabout on the A4180 and the second exit at Junction 23a to access Magor MSA.

Eastbound Exit – Travel Distance = 2,600 metres

Drivers will exit Magor MSA and take the first exit at Junction 23a to access the declassified M4. Drivers will then leave the declassified M4 via a slip road, and merge back onto the M4..

Roadchef Eastbound Journey Distance from the Motorway = 3,600 metres

Westbound Entry – Travel Distance = 2,800 metres

This arrangement is the same as proposed under the WG Scheme. Advanced signage to Magor MSA will need to be provided in advance of the toll booths on the Second Severn Crossing. Drivers will be required to keep left at the toll booths, and 900 metres after the toll booths leave the M4 via a slip road approximately which connects to the declassified M4. Drivers will then join the declassified M4 for 1,200 metres, before exiting the declassified M4 at Junction 23a. At Junction 23a drivers will take the third exit at Junction 23a Roundabout to access Magor MSA.

Westbound Exit – Travel Distance = 1,000 metres

Drivers will exit Magor MSA and take the second exit at Junction 23a Roundabout onto the A4810. Drivers will then take the second exit at a new roundabout on the A4180 to join the M4 via a slip road.

Roadchef Westbound Journey Distance from the Motorway = 3,800 metres

Magor MSA – Roadchef Compromise

Eastbound Entry – Travel Distance = 1,000 metres

'Services 2/3 mile' and 'Services 1/3 mile' will be provided on the M4 prior to the slip road providing access to Magor and Magor Services. Drivers will leave the M4 via the slip road, take the second exit at a new roundabout on the A4180 and the second exit at Junction 23a to access Magor MSA.

Eastbound Exit – Travel Distance = 3,300 metres

This arrangement is the same as proposed under the WG Scheme. Drivers exit Magor MSA, take the first exit at Junction 23a Roundabout, travel for a distance of approximately 2,400 metres along the declassified M4, before turning right via a signal controlled hamburger junction at Junction 23 to re-join the M4 and merge with M4 traffic.

Roadchef Eastbound Journey Distance from the Motorway = 4,300 metres

Westbound Entry – Travel Distance = 2,800 metres

This arrangement is the same as proposed under the WG Scheme. Advanced signage to Magor MSA will need to be provided in advance of the toll booths on the Second Severn Crossing. Drivers will be required to keep left at the toll booths, and 900 metres after the toll booths leave the M4 via a slip road approximately which connects to the declassified M4. Drivers will then join the declassified M4 for 1,200 metres, before exiting the declassified M4 at Junction 23a. At Junction 23a drivers will take the third exit at Junction 23a Roundabout to access Magor MSA.

Westbound Exit – Travel Distance = 1,000 metres

Drivers will exit Magor MSA and take the second exit at Junction 23a Roundabout onto the A4810. Drivers will then take the second exit at a new roundabout on the A4180 to join the M4 via a slip road.

Roadchef Westbound Journey Distance from the Motorway = 3,800 metres

Eastbound Journey

Eastbound Entry

Existing Arrangement	WG Option 1	WG Option 2	WG Option 3	Roadchef Option 1	Roadchef Option 2	Roadchef Option 3	Roadchef Compromise
Sign	Sign	Sign	Sign	Sign	Sign	Sign	Sign
Diverge	Diverge	Diverge	Trunk Road (variable speed limit)	Diverge	Diverge	Diverge	Diverge
Roundabout (give-way)	Roundabout (signals)	Roundabout	Junction	Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)
Services	Sign	Roundabout	Junction	Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)
	Opposite Direction of Travel	A Road (40mph)	Junction	Services	Services	Services	Services
	Trunk Road (variable speed limit)	Junction (signals)	Junction				
	Sign	A Road (50 mph)	Junction				
	Diverge	Roundabout (give-way)	Junction				
	Roundabout (give-way)	Roundabout (give-way)	Sign				
	Services	Roundabout (give-way)	Diverge				
		A Road (40mph)	Roundabout (give-way)				
		Roundabout (give-way)	Services				
		Roundabout (give-way)					
		Services					

Eastbound Exit

Existing Arrangement	WG Option 1	WG Option 2	WG Option 3	Roadchef Option 1	Roadchef Option 2	Roadchef Option 3	Roadchef Compromise
Roundabout	Roundabout	Roundabout		Roundabout	Roundabout	Roundabout	Roundabout
Merge	Merge	Merge		Merge	Merge	Merge	Merge
Motorway	Trunk Road (variable speed limit)	Trunk Road (variable speed limit)		Trunk Road (60 mph)	Trunk Road (60 mph)	Trunk Road (60 mph)	Trunk Road (variable speed limit)
	Roundabout (signals, signals) - Hamburger Arrangement	Diverge (by-pass roundabout)		Diverge	Diverge	Diverge	Roundabout (signals, signals) - Hamburger Arrangement
	Merge	Merge		Merge	Merge	Merge	Merge
	Motorway	Motorway		Motorway	Motorway	Motorway	Motorway
		Merge					
		Motorway					

Westbound Entry

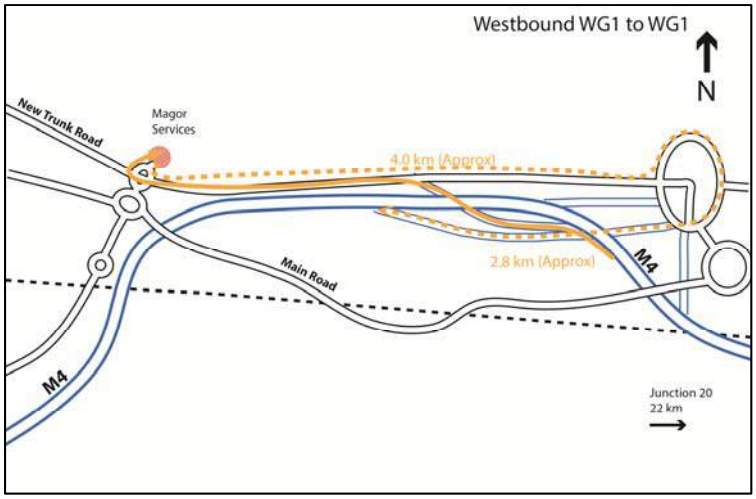
Existing Arrangement	WG Option 1	WG Option 2	WG Option 3	Roadchef Option 1	Roadchef Option 2	Roadchef Option 3	Roadchef Compromise
Sign	Sign	Sign		Sign	Sign	Sign	Sign
Diverge	Tolls	Diverge		Tolls	Tolls	Tolls	Tolls
Roundabout	Sign	Tolls		Sign	Sign	Sign	Sign
Services	Diverge	Sign		Diverge	Diverge	Diverge	Diverge
	Merge	Roundabout (signals, signals, siganls)		Merge	Merge	Merge	Merge
	Trunk Road (variable speed limit)	Merge		Trunk Road (variable speed limit)	Trunk Road (variable speed limit)	Trunk Road (variable speed limit)	Trunk Road (variable speed limit)
	Diverge	Trunk Road (variable speed limit)		Diverge	Diverge	Diverge	Diverge
	Roundabout (give-way)	Diverge		Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)	Roundabout (give-way)
	Services	Roundabout (give-way)		Services	Services	Services	Services
		Services					

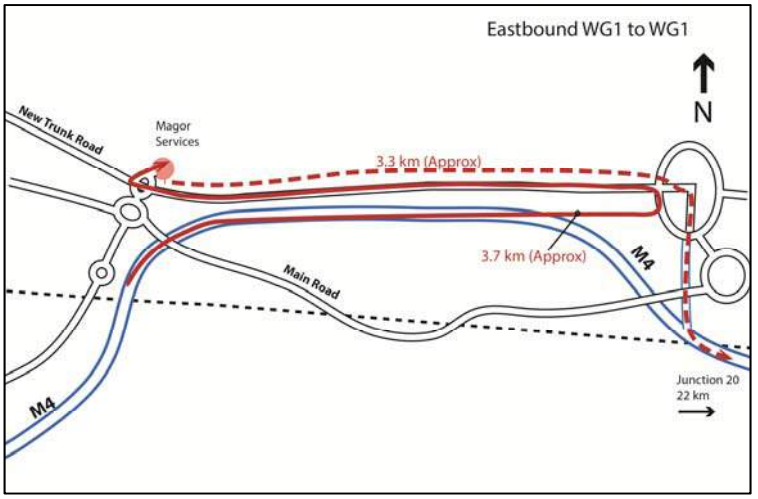
Westbound Exit

Existing Arrangement	WG Option 1	WG Option 2	WG Option 3	Roadchef Option 1	Roadchef Option 2	Roadchef Option 3	Roadchef Compromise
Roundabout	Roundabout	Roundabout	Roundabout	Roundabout	Roundabout	Roundabout	Roundabout
Merge	Merge	Roundabout	Merge	Roundabout	Roundabout	Roundabout	Roundabout
Motorway	Trunk Road (variable speed limit)	A Road (40mph)	Trunk Road (variable speed limit)	Merge	Merge	Merge	Merge
	Opposite Direction of Travel	Roundabout	Junction	Motorway	Motorway	Motorway	Motorway
	Roundabout (signals, signals, signals)	Roundabout	Junction				
	Merge	Roundabout	Junction				
	Motorway	A Road (50mph)	Junction				
		Junction (signals)	Junction				
		A Road (40mph)	Junction				
		Roundabout	Diverge				
		Roundabout	Merge				
		Merge	Motorway				
		Motorway					

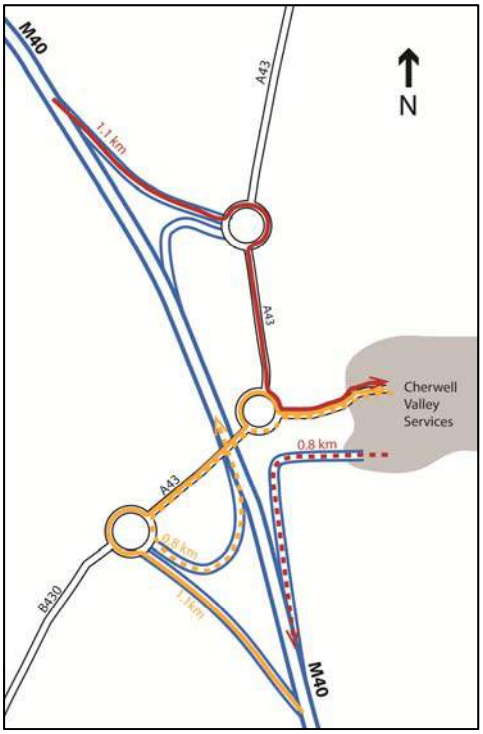
APPENDIX MA6 – ACCESS ARRANGEMENTS TO WG REFERENCE MSAS

WG Access to Magor MSA

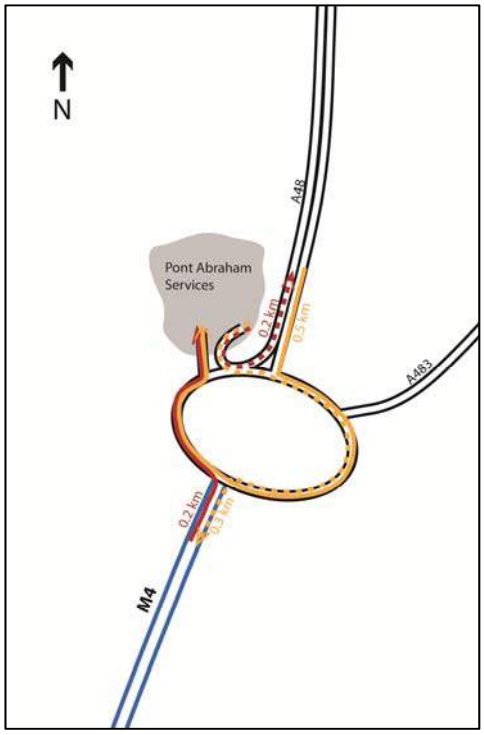




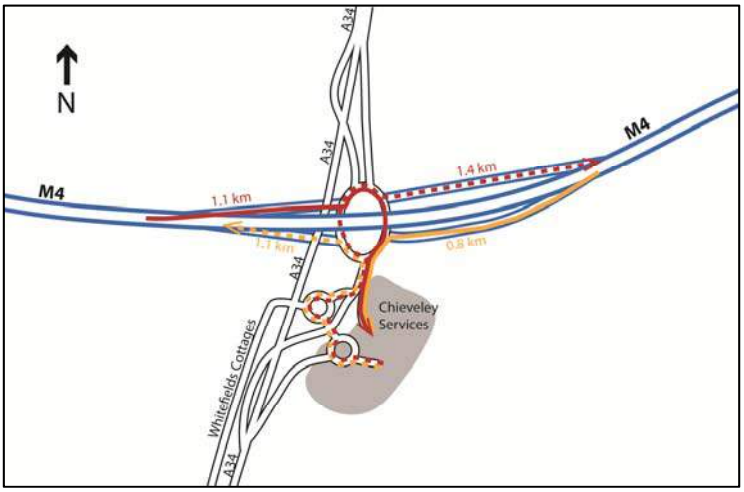
Cherwell Valley (M40)



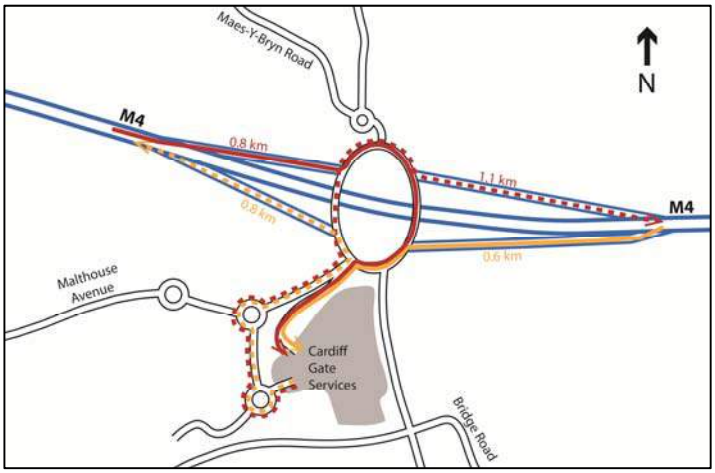
Pont Abraham (M4, J49)



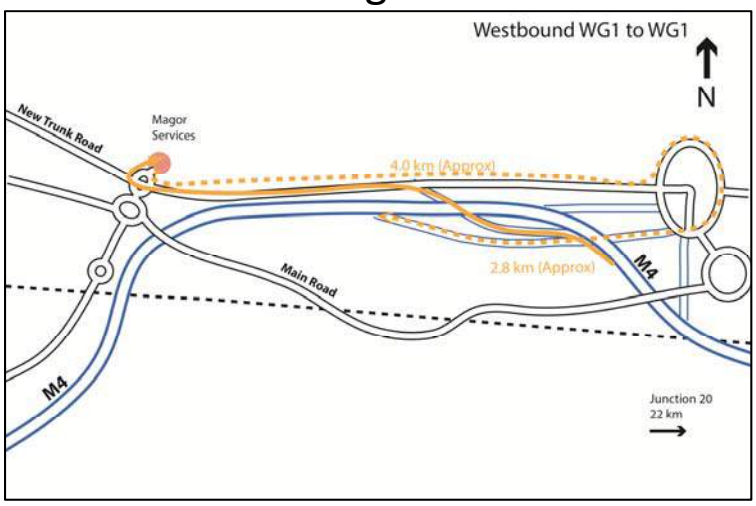
Chievely (M4, J13)

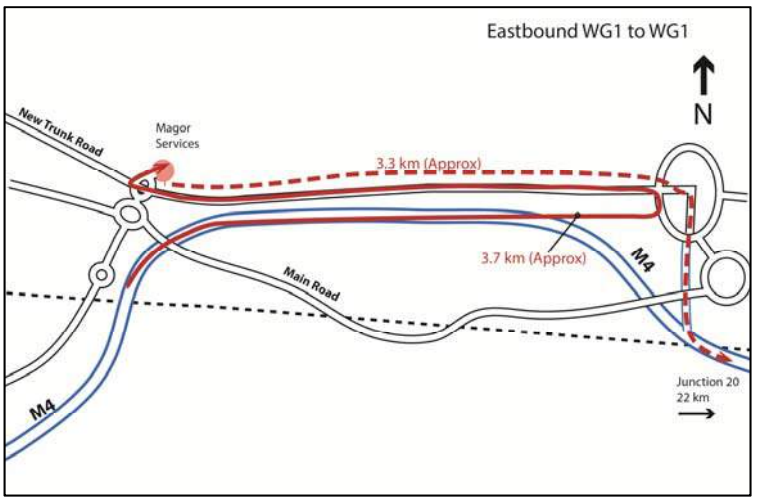


Cardiff Gate (M4, J30)

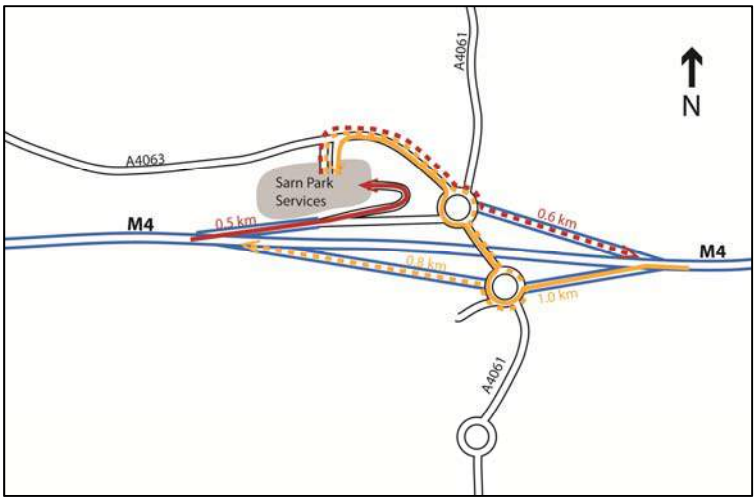


WG Access to Magor MSA

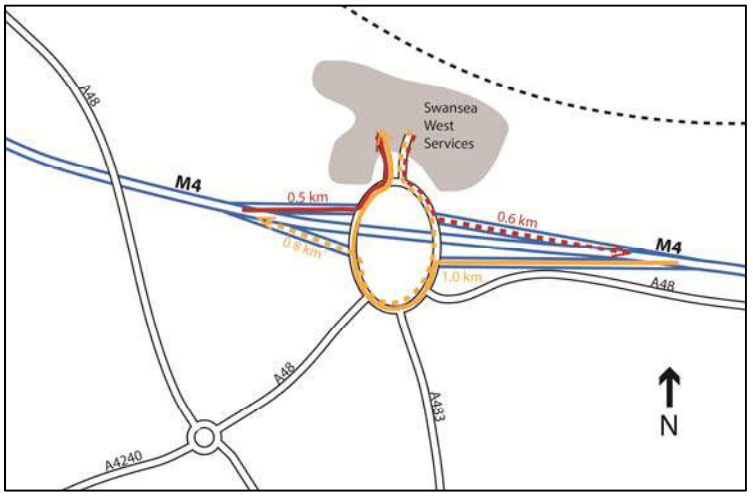


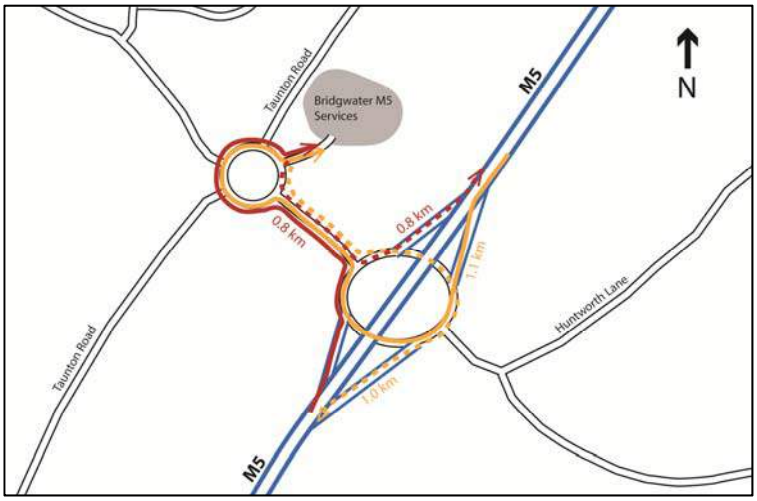


Sarn Park (M4, J36)



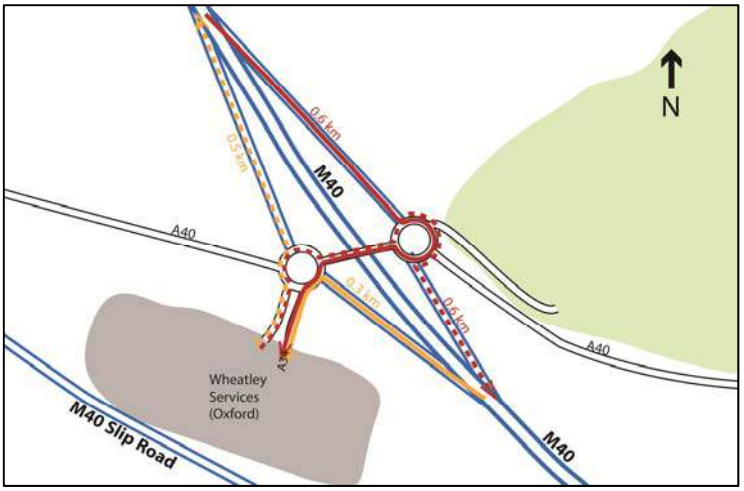
Swansea West (M4, J47)

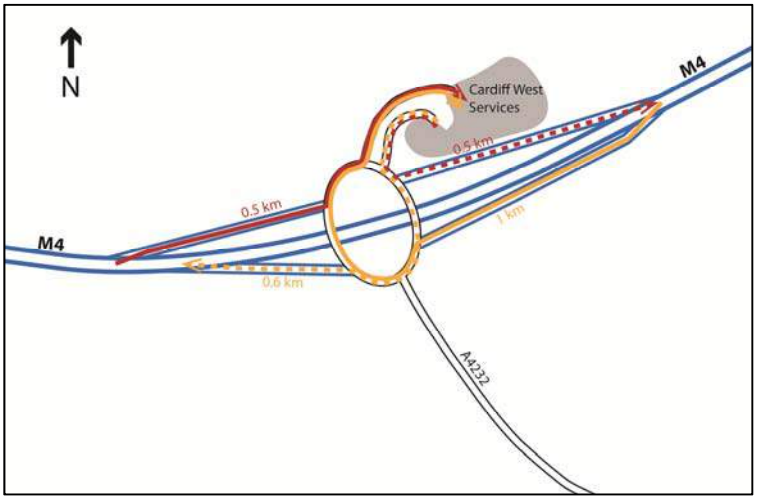




Bridgwater (M5, J24)

Oxford (M40)

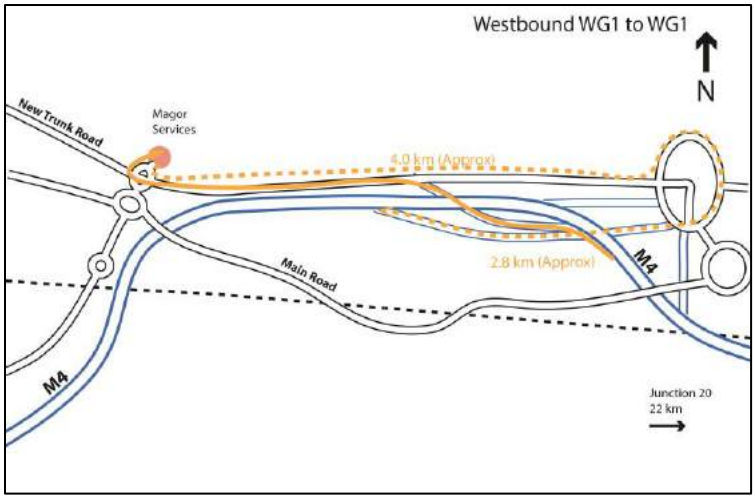


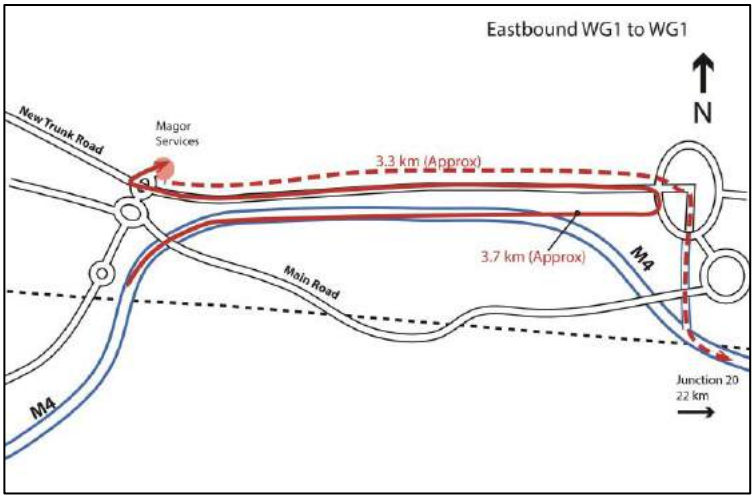


Cardiff West (M4, J33)

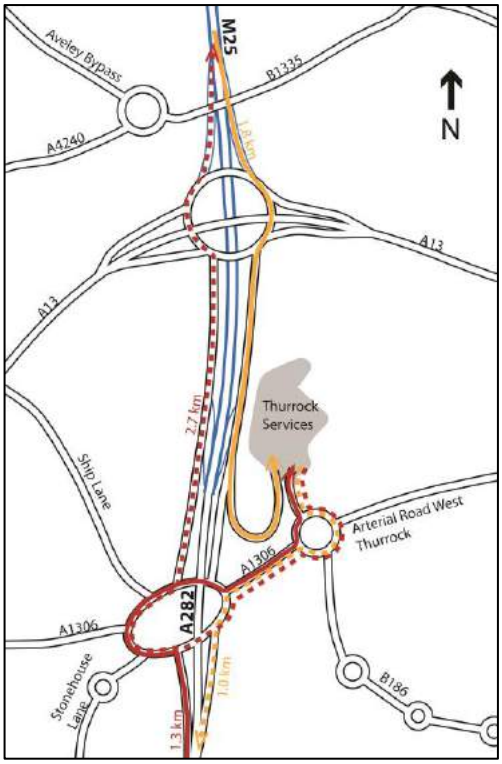
APPENDIX MA7 – MSA WITH INDIRECT ACCESS

WG Access to Magor MSA

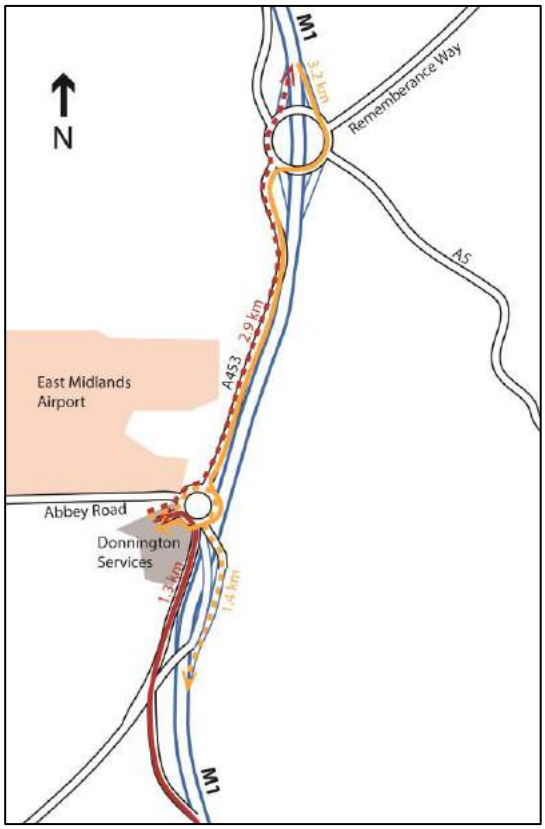




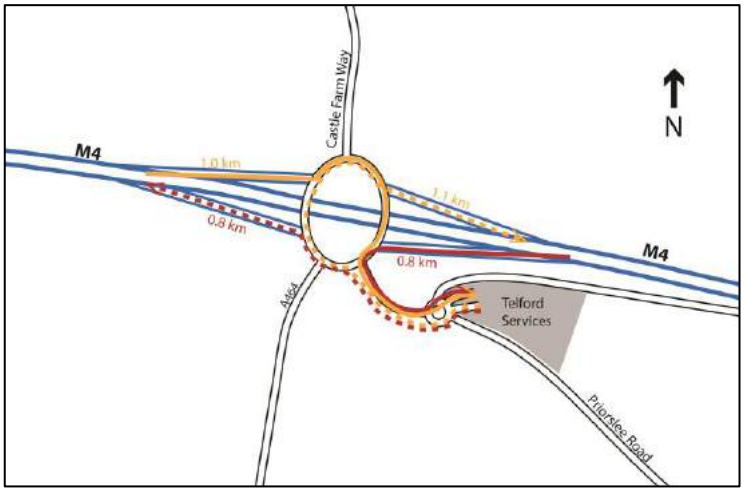
Thurrock (M25, J30, J31)



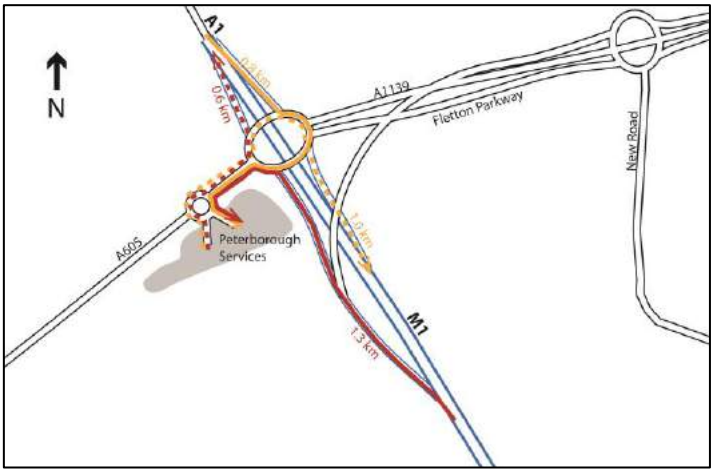
Donnington Park (M1, J23A)



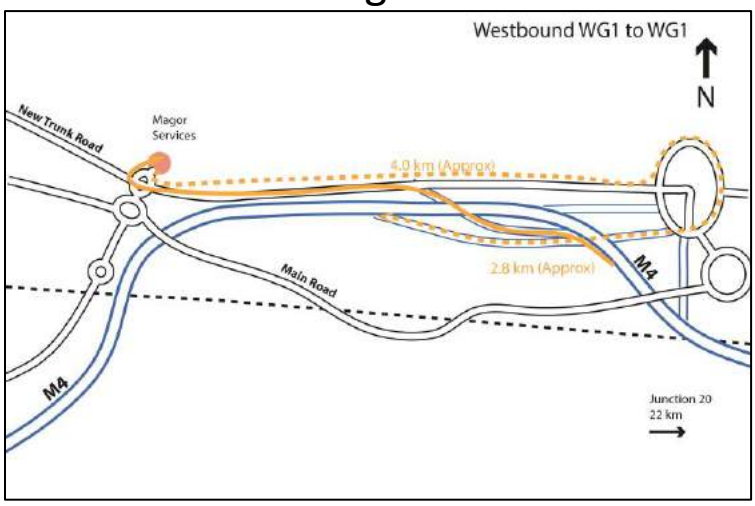
Telford (M54, J4)

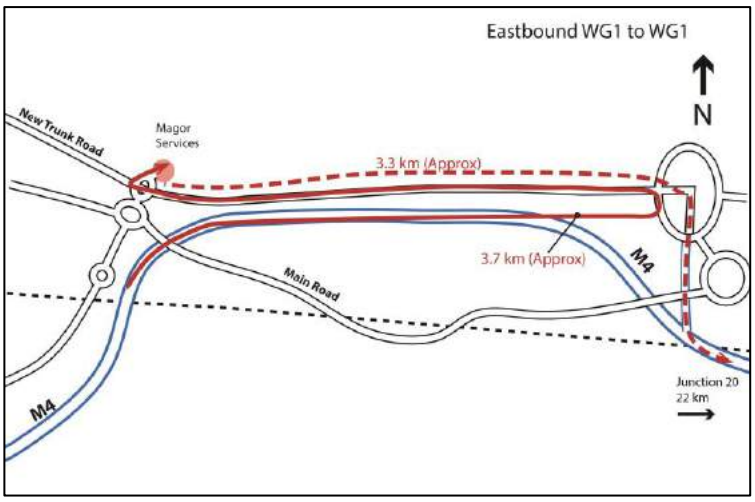


Peterborough (A1 (M) J17)



WG Access to Magor MSA





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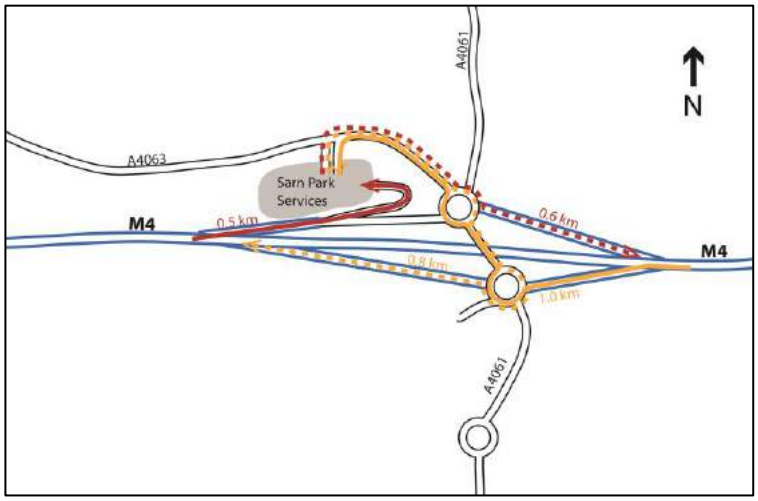
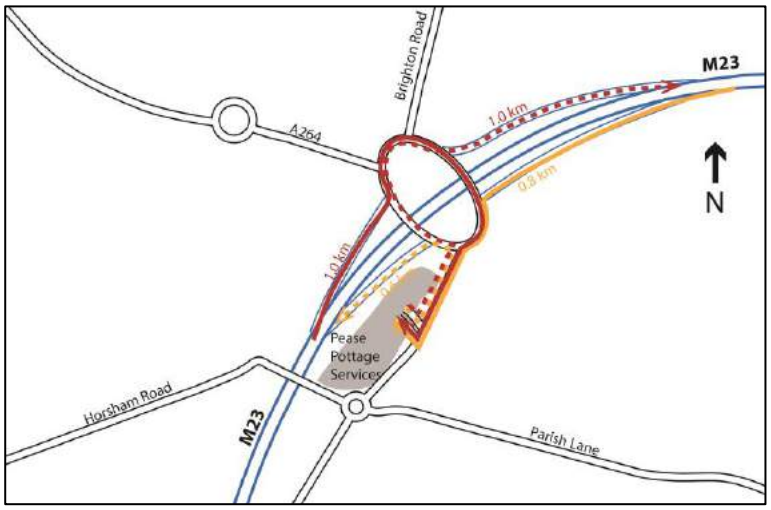
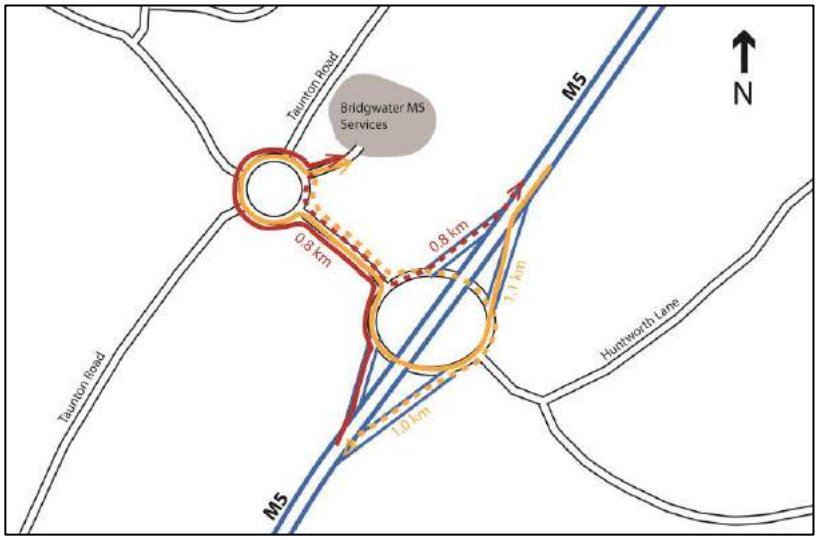


Pease Pottage (M23, J11)



Bridgwater (M5, J24)



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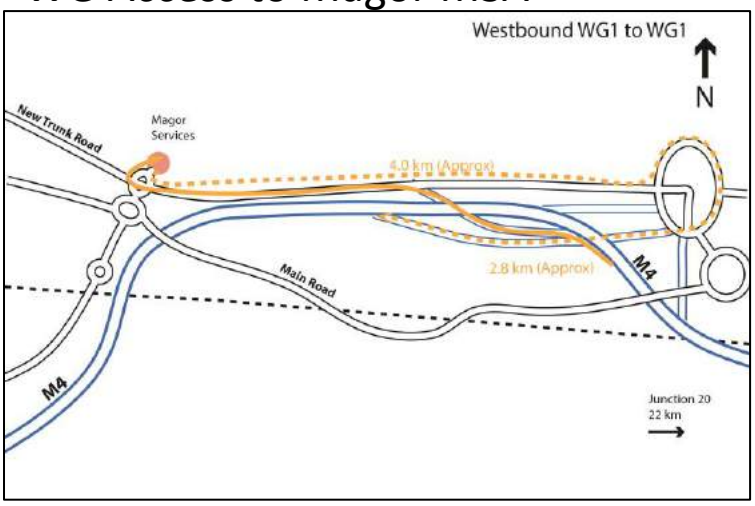

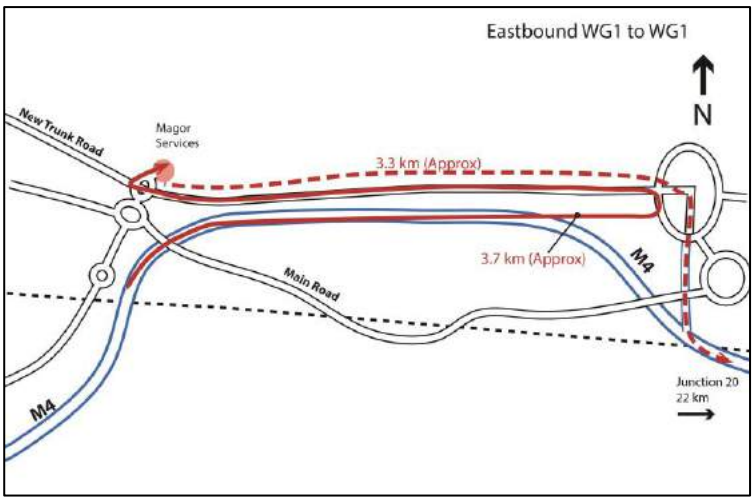

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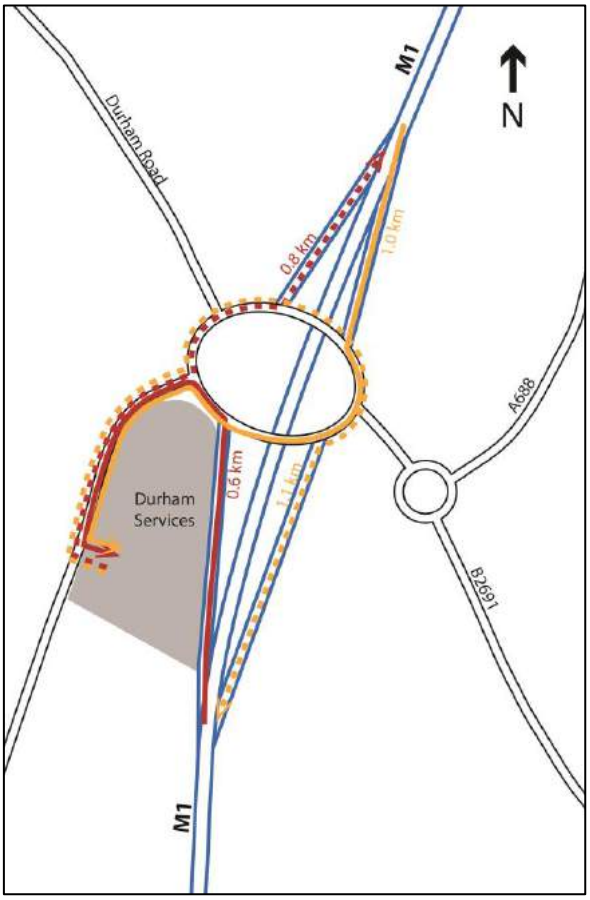
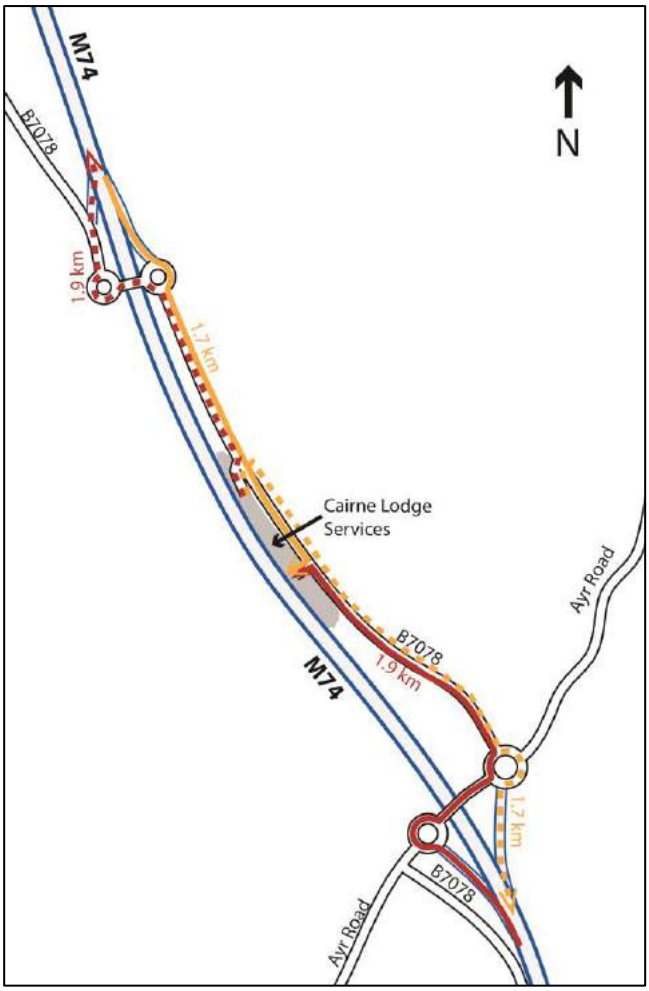
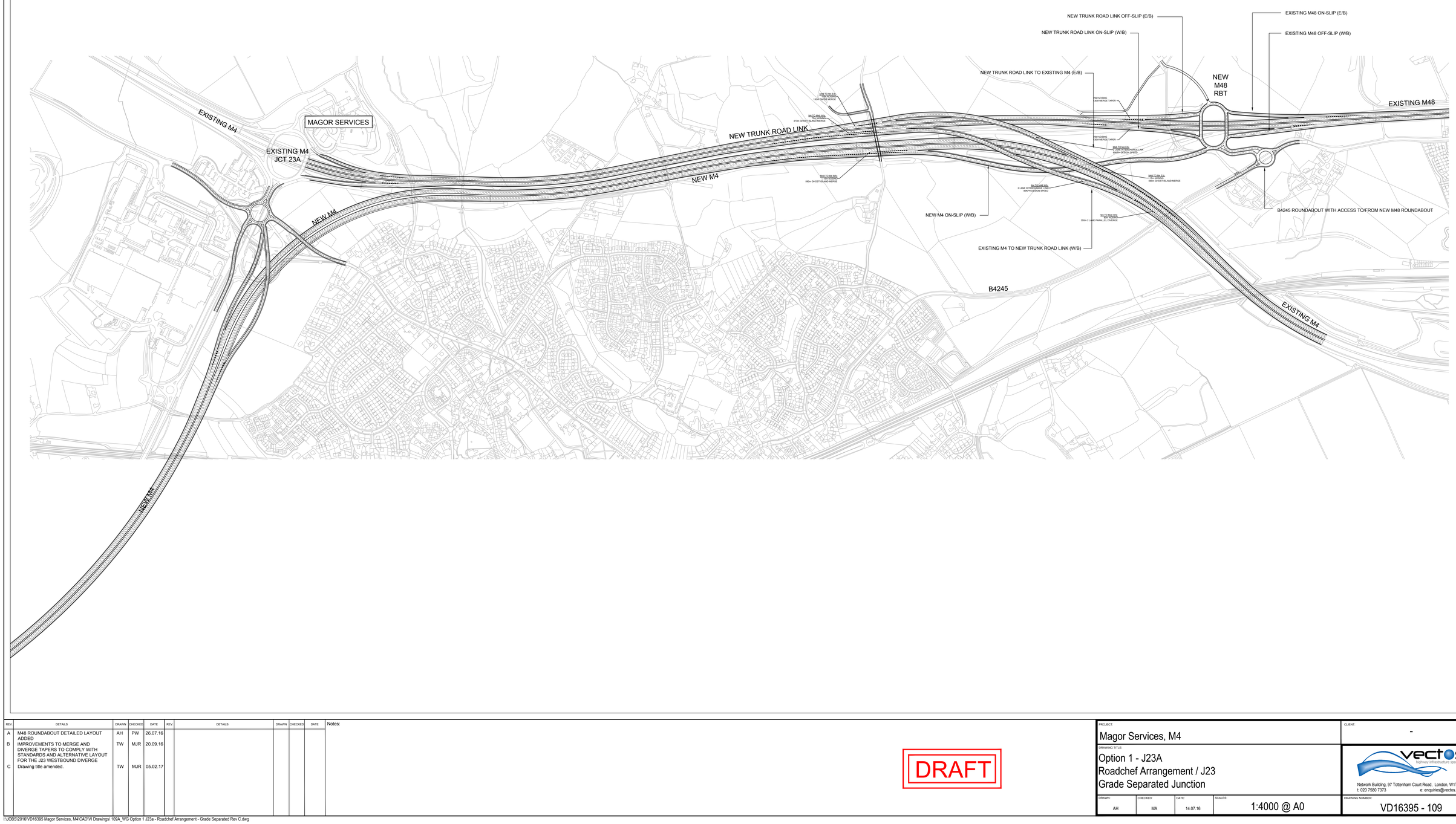




Happendon (A47 (M)
J11 and J12)

APPENDIX MA8 – ROADCHEF OPTIONS



REV	DETAILS	DRAWN	CHECKED	DATE
A	M48 ROUNDABOUT DETAILED LAYOUT ADDED	AH	PW	26.07.16
B	IMPROVEMENTS TO MERGE AND DIVERGE TAPERS TO COMPLY WITH STANDARDS AND ALTERNATIVE LAYOUT FOR THE J23 WESTBOUND DIVERGE	TW	MJR	20.09.16
C	Drawing title amended.	TW	MJR	05.02.17

Notes:

DRAFT

PROJECT: Magor Services, M4

CLIENT: -

DRAWING TITLE:
Option 1 - J23A
Roadchef Arrangement / J23
Grade Separated Junction

vectos
highway infrastructure specialists
Network Building, 97 Tottenham Court Road, London, W1T 4TP
t: 020 7580 7373 e: enquiries@vectos.co.uk

DRAWN:	CHECKED:	DATE:	SCALES:	DRAWING NUMBER:	REVISION:
AH	MA	14.07.16	1:4000 @ A0	VD16395 - 109	C

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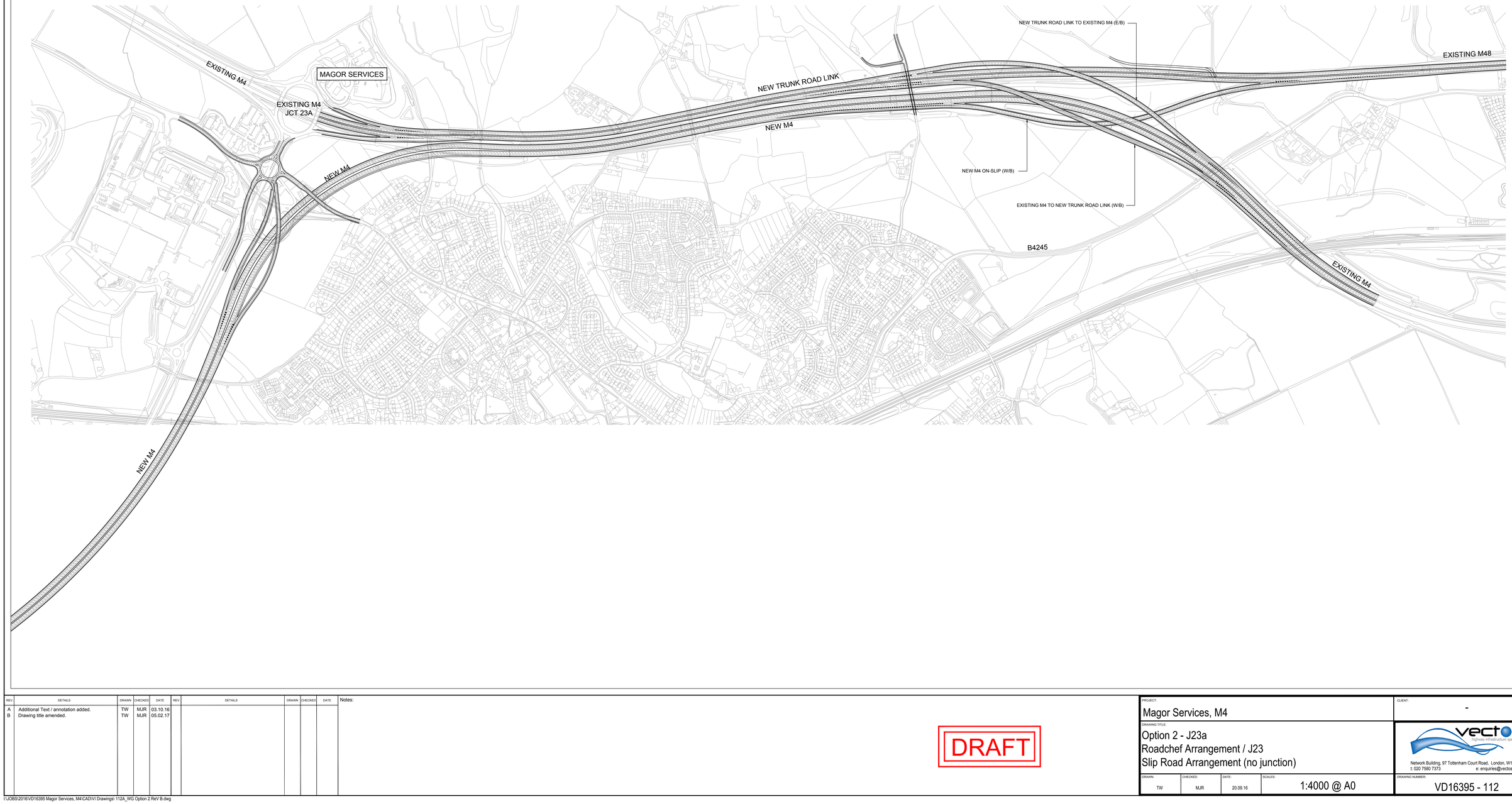

REV	DETAILS	DRAWN	CHECKED	DATE
A	Additional Text / annotation added.	TW	MJR	03.10.16
B	Drawing title amended.	TW	MJR	05.02.17

Notes:

DRAFT

PROJECT: Magor Services, M4

CLIENT: -

DRAWING TITLE:
Option 2 - J23a
Roadchef Arrangement / J23
Slip Road Arrangement (no junction)

vectos
highway infrastructure specialists
Network Building, 97 Tottenham Court Road, London, W1T 4TP
t: 020 7580 7373 e: enquiries@vectos.co.uk

DRAWN:	CHECKED:	DATE:	SCALES:	DRAWING NUMBER:	REVISION:
TW	MJR	20.09.16	1:4000 @ A0	VD16395 - 112	B

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A	Drawing title amended.	TW	MJR	05.02.17

REV.	DETAILS	DRAWN	CHECKED	DATE

Notes:

DRAFT

PROJECT: Magor Services, M4

CLIENT: -

DRAWING TITLE:
Option 3 - J23A
Roadchef Arrangement / J23
At-Grade Junction

vectos
the way infrastructure specialists
Network Building, 97 Tottenham Court Road, London, W1T 4TP
t: 020 7580 7373 e: enquiries@vectos.co.uk

DRAWN:	CHECKED:	DATE:	SCALES:
TW	MJR	20.09.16	1:4000 @ A0

DRAWING NUMBER: VD16395 - 113

REVISION: A

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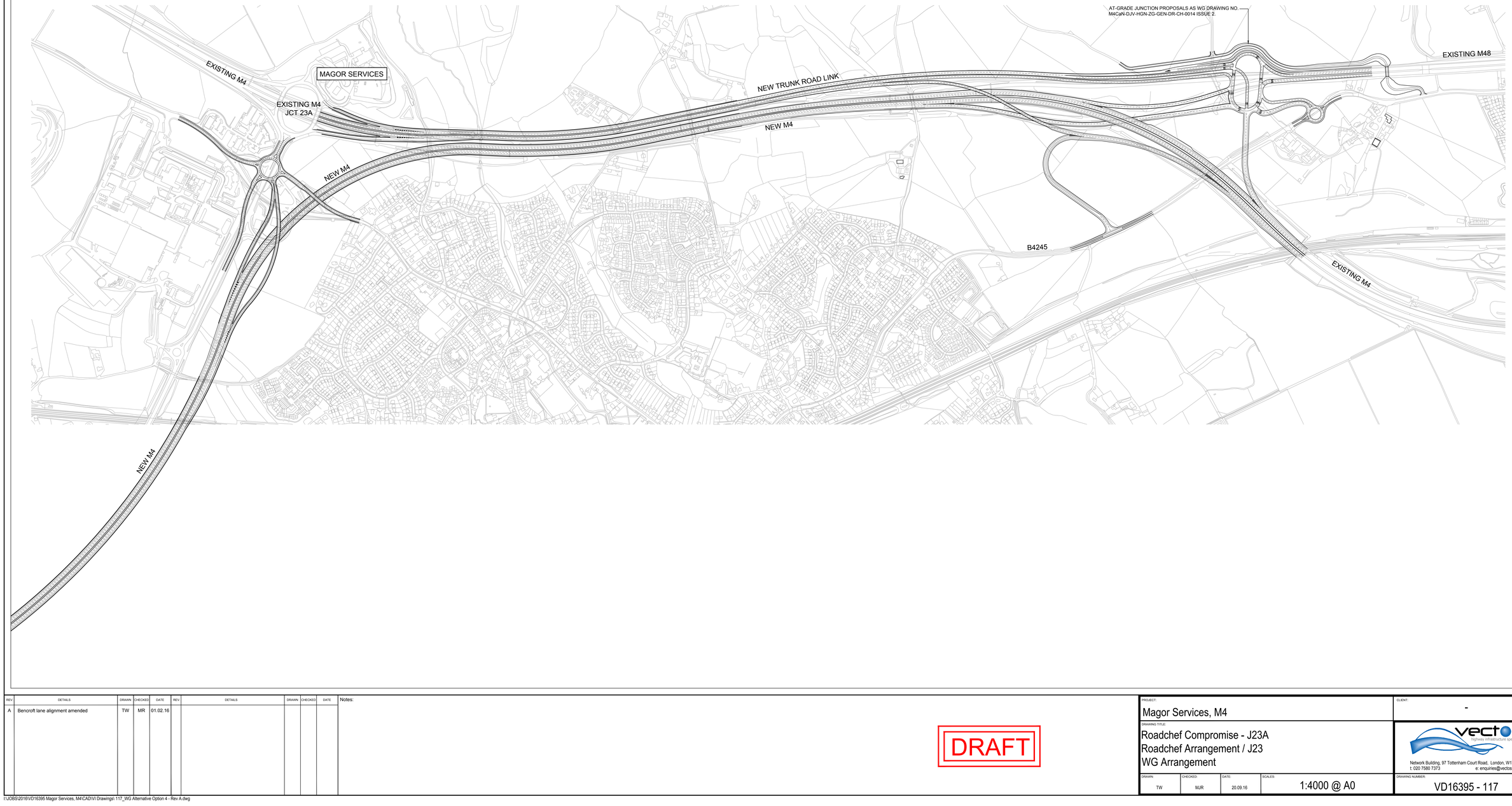

REV.	DETAILS	DRAWN	CHECKED	DATE	REV.	DETAILS	DRAWN	CHECKED	DATE
A	Bencroft lane alignment amended	TW	MR	01.02.16					

Notes:

DRAFT

PROJECT: Magor Services, M4

DRAWING TITLE: Roadchef Compromise - J23A
Roadchef Arrangement / J23
WG Arrangement

CLIENT: -

vectos Highway infrastructure specialists
Network Building, 97 Tottenham Court Road, London, W1T 4TP
t: 020 7580 7373 e: enquiries@vectos.co.uk

DRAWN:	CHECKED:	DATE:	SCALES:	DRAWING NUMBER:	REVISION:
TW	MJR	20.09.16	1:4000 @ A0	VD16395 - 117	A

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M4 Corridor Around Newport

Alternative Layout Options for Junction 23 and Junction 23A East of Newport

Three alternative options have been identified in concept to provide suggested improvements to the Welsh Government proposals for the M4 Corridor centred on Junctions 23 and 23A at Magor, east of Newport. The alternative proposals offer solutions to improve access for all road users to Junction 23A and particularly Magor Services.

In order to develop the concepts and ensure that the alternative options are feasible both the horizontal and vertical alignments have been developed to present a concept that is believed to satisfy current design standards and provide a compliant alternative to the Welsh Government proposals.

The alignment works have been undertaken using Lidar survey data, which provides data of sufficient accuracy to identify the proposed highway alignment as the Welsh Government design and ground survey models was not available for review.

The Alignment Proposals have been developed to current standards. Both the main lines and interchange links are compliant with current standards and therefore are not considered to contain any Departures from Standards, however permitted relaxations have been proposed.

Specific areas of concern are noted where proposals do not confirm to recommendations for merge and diverge layouts, however these are recommendations only and typically there is strong justification to take forward an alternative proposal.

One area of the proposed works does appear to constitute a Departure from Standard. This issue applies to the original Welsh Government Proposals and all three proposed alternatives. This is the proximity of the proposed A4810 roundabout to the existing Junction 23A. It is not possible to provide compliant visibility at this location to TD16 / TD9. The alternative options have looked to maximise the distance, however it remains sub-standard and would be the subject of a departure.

Each option identified has been costed for all additional elements of work over and above those identified on the Welsh Government Proposals. New lengths of carriageway and new structures have been identified and their costs estimated and where appropriate deductions have been made to remove superceded elements from the original Welsh Government proposals. Therefore the costs identified are a total extra over cost to deliver the alternative proposals.

The estimated costs have been developed from Spon's Civil Engineering and Highway Works Priced Book with costs identified from the Approximate Estimating Rates Section. The Estimates are based upon the concept design.

A signing strategy has also been considered to identify the potentially signing requirements for Magor Services from each element of the route. As minimal gantries were indicated on the original Welsh Government proposals, the sign plates have been designed for verge mounted positions, rather than a gantry position, however the proposals can be altered to suit gantry mounting as required. A wider look at the services signing along the M4 / M48 was also considered, which has resulted in additional proposals being suggested along the M4 corridor as part of the proposals.

A further signing strategy has been developed to identify a solution to sign Magor Services off the M4 from the current Welsh Government proposals. This strategy utilises the A4810 to the proposed Llanwern junction of the M4.

The signing proposals effectively replicate the current provision of advanced signing to each direction of travel and dedicated confirmatory signing at the diverge points. Advanced distance signs will require amendment as indicated to reflect the proposed alignment supported by additional signing suggesting motorists should "Take a Break".

Option 1 -

Option 1 indicated on Drawing D109 provides an alternative to the Welsh Government proposals including the following amendments;

- A simplified Grade Separated Interchange to Junction 23, with direct access to the adjacent farm,
- A dedicated interchange link from the A48 Eastbound to the M4 eastbound
- A diverge from the eastbound M4 to a larger roundabout to the A4810 and Junction 23A
- A merge to the M4 westbound from the A4180.
- Improvements to the Merge and diverge proposals to comply with recommendations within design guidance.
- The omission of the Lane drop and lane gain arrangement on the eastbound M4
- The removal of the dedicated slip road from M4 eastbound to Junction 23,
- The omission of the Link from M4 Westbound to the B4245 (Although this can be provided)
- The omission of the link from Junction 23 to the M4 Eastbound
- An alternative to the Bencroft Lane proposals by stopping up access from the B4245 from Bencroft Lane.

Specific issues of note regarding the Welsh government scheme are the merge and diverge proposals at a number of locations, which do not follow the recommendations within TD22/06 - the Layout of Grade Separated Junctions. Where two lane merges or diverges are proposed the design guidance recommends a ghost island arrangement. These were not incorporated in the Welsh Government Design, however have been proposed where appropriate in Option 1.

The WG scheme incorporates a lane drop from the M48 / Junction 23 Interchange Link and a lane gain at the Merge with the Eastbound M4. Effectively 2 lanes only on the M4, and providing cross sectional width to cross the Rail Bridge. However the merge lengths of the WG scheme are not compliant with Standards, and we believe that to accommodate the requirements without departures will necessitate the widening of the structure. The Option 1 alternative looks to reposition the merge point further west to enable the Ghost Island merge to be included with minimal impact to the railway structure. It is believed that works will be required to the structure to ensure minor realignment to the hardened verge over the structure will accommodate the loadings imposed.

The Westbound Diverge from the M4 to the A48 would require a Ghost Island Diverge in order to comply with TD22. This would necessitate widening of the Railway Structure, which is not included on the Welsh Government scheme. However, however the proximity of the M4 Severn Bridge Toll less than a kilometres to the east of the diverge gives justification to deviate from the recommended Ghost Island Layout. A ghost island proposals was considered, however this resulted in the Ghost Island diverge taper starting 542 metres from the toll booths, and 130 metres from the end of the Tool Booth Ghost Island Merge (Departure Zone) where the 11 lanes merge to 3 lanes.

The exit to the Toll Booth (Recovery Zone) is initially 30 mph, increasing to the National Speed Limit within 300 metres of the Toll Booth moving into the Departure Zone where traffic is funnelled down to the Departure Carriageway Cross Section. Fast Tag Traffic is limited to lane 11 only, therefore there is a potential swooping movement from the outside lane to the nearside lane to diverge onto the link to the A48. There is no specific guidance on the proximity of a diverge beyond a Toll Booth, and TA98/08 suggests proximity to a junction is a concern, but there is no guidance on exact distance requirements.

Therefore in order to maximise the distance between the Toll Booth and the Diverge point, the auxiliary lane proposal is proposed. The auxiliary lane will assist with the flow of diverging traffic, and the interchange link is two lanes plus hard shoulder to the A48.

The Bencroft Lane realignment and the access to the adjacent farm adjacent to J23 within the Welsh Government proposals includes four separate structures to connect to the B4245. Option 1 includes a proposals to provide access to the Farm directly from the circulatory carriageway of J23 roundabout. This would permit direct access to the Trunk Road, B4245 and M4/M48. Bencroft Lane is indicated as being stopped up at the B4245 to remove the requirement to

construct the 4 separate structures. Access would be from Rockfield Lane with minor accommodation works for landowner access to provide dedicate and convenient access to the fields adjacent to Bencroft Lane.

With regards to the Signing requirements for Services Signs off the main lines, the requirements are identified on the immediate approaches to the diverge points, with signs at 2/3s and 1/3s mile, a confirmatory sign at the nosing of each diverge followed by a standard ADS sign on approach to the give way to each slip road / interchange link. Therefore effectively 4 signs to each diverge, with additional signage to the local road network to identify the services. The proposed services signs covering the area generally will be at the approximate locations as they are currently, on the M4 / M48, with additional signs to the New M4 west of Newport where the new and old routes diverge. As discussed within the introduction, it is unknown if there will be the Gantry signing therefore the position and sign plate information is proposed as verge mounted at this time.

Option 1 Cost Summary Sheet

Description	Cost of proposals
Cost estimate for Additional Length of Highway to Deliver Option 1 over and above Welsh Government preferred scheme.	£22,714,000.00
Estimates Structures Costs associated with above	£20,158,700.00
Deduction of Civils and Structural costs for elements of Welsh Government scheme superceded by the Alternative Proposals	-£11,119,000.00
Total Estimated Construction Costs Associated with the increased proposals to deliver Option 1.	**£31,753,700.00**

Option 2

Option 2 is identified on Drawing D112 and removed Junction 23 from the proposals, whilst retaining the majority of the other suggested alternatives from Option 1.

- The Omission of the Junction 23 Interchange
- A dedicated interchange link from the A48 Eastbound to the M4 eastbound
- A diverge from the eastbound M4 to a larger roundabout to the A4810 and Junction 23A
- A merge to the M4 westbound from the A4180.
- Improvements to the Merge and diverge proposals to comply with recommendations within design guidance.
- The omission of the Lane drop and lane gain arrangement on the eastbound M4
- The omission of the Link from M4 Westbound to the B4245 (Although this can be provided)

This alternative effectively replicates the current M4 / M48 layout, albeit supplemented with addition interchange links to improve connectivity between the two routes.

In removing Junction 23, the access to the B4245 from both the M4 and M48 is removed.

Specific issues identified regarding the Merge and Diverge proposals as Option 1 have been applied to Option 2 to ensure compliance with the recommendations within the Design Standards. The same arrangement is also proposed for the diverge from the M4 immediately beyond the Toll Booth Departure Zone with an Auxiliary Lane Diverge proposed to maximise the distance between the Toll Departure Zone and start of the diverge Taper.

The horizontal and vertical alignment has been developed in concept and is found to be compliant with current standards for the design speed.

A cost estimate has been developed based upon Option 2 and represents a considerable saving over Option 1 due to the significant reduction in works associated with the removal of Junction 23.

The signing strategy is effectively identical to Option 1, as the principle route remains unchanged. AS identified, all service route signing has been priced based upon verge mounting.

Option 2 Cost Summary Sheet

Description	Cost of proposals
Cost estimate for Additional Length of Highway to Deliver Option 2 over and above Welsh Government preferred scheme.	£14,425,600.00
Estimates Structures Costs associated with above	£15,982,700.00
Deduction of Civils and Structural costs for elements of Welsh Government scheme superceded by the Alternative Proposals	-£14,073,900.00
Total Estimated Construction Costs Associated with the increased proposals to deliver Option 2	**£16,334,400.00**

Option 3

Option 3 is identified on Drawing No. D113 and incorporates an At-Grade junction to Junction 23, whilst retaining all other suggested alternatives within Option 2.

- A simplified At-Grade Interchange to Junction 23, with three lane approached to the A48 / M48 and direct access to the adjacent farm,
- A dedicated interchange link from the A48 Eastbound to the M4 eastbound
- A diverge from the eastbound M4 to a larger roundabout to the A4810 and Junction 23A
- A merge to the M4 westbound from the A4180.
- Improvements to the Merge and diverge proposals to comply with recommendations within design guidance.
- The omission of the Lane drop and lane gain arrangement on the eastbound M4
- The removal of the dedicated slip road from M4 eastbound to Junction 23,
- The omission of the Link from M4 Westbound to the B4245 (Although this can be provided)
- The omission of the link from Junction 23 to the M4 Eastbound
- An alternative to the Bencroft Lane proposals by stopping up access from the B4245 from Bencroft Lane.

Specific issues identified regarding the Merge and Diverge proposals as Option 1 have been applied to Option 3 to ensure compliance with the recommendations within the Design Standards. The same arrangement is also proposed for the diverge from the M4 immediately beyond the Toll Booth Departure Zone with an Auxiliary Lane Diverge proposed to maximise the distance between the Toll Departure Zone and start of the diverge Taper.

The horizontal and vertical alignment has been developed in concept and is found to be compliant with current standards for the design speed.

A cost estimate has been developed based upon Option 2 and represents a considerable saving over Option 1 due to the significant reduction in works associated with the removal of Junction 23.

The signing strategy is effectively identical to Option 1, as the principle route remains unchanged. AS identified, all service route signing has been priced based upon verge mounting.

Option 3 Cost Summary Sheet

Description	Cost of proposals
Cost estimate for Additional Length of Highway to Deliver Option 3 over and above Welsh Government preferred scheme.	£20,395,600.00
Estimates Structures Costs associated with above	£15,982,700.00
Deduction of Civils and Structural costs for elements of Welsh Government scheme superceded by the Alternative Proposals	-£17,053,500.00
Total Estimated Construction Costs Associated with the increased proposals to deliver Option 3.	**£19,324,800.00**

Magor Services Signing Strategy for Welsh Government Proposals

The current Welsh Government proposals provide no direct link to the Magor Area from the proposed M4 particular for traffic heading to and from west Wales. Therefore access to Magor and particularly Magor Services to and from the west will be via the Llanwern Junction.

In order to demonstrate the signing requirements for Magor from the Llanwern Junction, Drawing No D115-01 and D115 02 have been created. As with the previous proposals, the signs are verge mounted only, however M4 signing could be gantry mounted as required.

The proposals included advanced signing to the new M4 Eastbound and dedicated confirmatory signing at the diverge points. Advanced distance signs will require amendment as indicated to reflect the proposed alignment supported by additional signing suggesting motorists should "Take a Break".

Once vehicles reach to Local Road Network, signing is proposed at each junction location along the A4810 running parallel to the M4 continuing up to the Magor Services Roundabout at Junction 23a. Traffic Leaving Magor Services heading west will be signposted to the M4 along the A4810 in the alternative direction to the proposed Llanwern Junction.

Roadchef Compromise – J23A Roadchef Arrangement

The Roadchef Compromise is identified on Drawing No. D117 and incorporates the updated Welsh Government proposals to Junction 23 including the revised proposals to Bencroft Lane as indicated on Drawing No. M4CaN-DJV-HGN-ZG-GEN-DR-CH-0014 Issue 2 and including the Roadchef Arrangement for Junction 23A which incorporates the following;

- A diverge from the eastbound M4 to a larger roundabout to the A4810 linking to Junction 23A
- A merge to the M4 westbound from the A4180 roundabout.

The compromise proposes a larger 5 arm roundabout to the A4810 / Newport Road to enable the provision of a dedicated merge and diverge from the M4. The larger roundabout proposed requires the realignment of the A4810 and the reconfiguration of the Newport Road Junction Arrangements. The realignment of the B4245 and the land take requirements for the Roadchef Compromise are the same as the Welsh Government Proposals

The proposed M4 merge and diverge are a single lane provision with hard shoulder which are fully compliant with current design standards. The M4 Diverge passes through the current highway maintenance depot, which would require relocation. The M4 merge would pass over the M4 on a new structure and additional land would be required between the proposed M4 corridor and the residential properties on the outskirts of Magor.

The compromise provides the ability for Eastbound M4 traffic to access the Industrial Area north of Llandevenny and the existing J23a / Roadchef Services area directly. It also permits westbound traffic to merge with the M4 immediately south of the Roadchef services. The merge and diverge proposals are fully compliant with the DMRB and the alternatives proposals with a minimal requirement for additional land take to deliver the proposals.

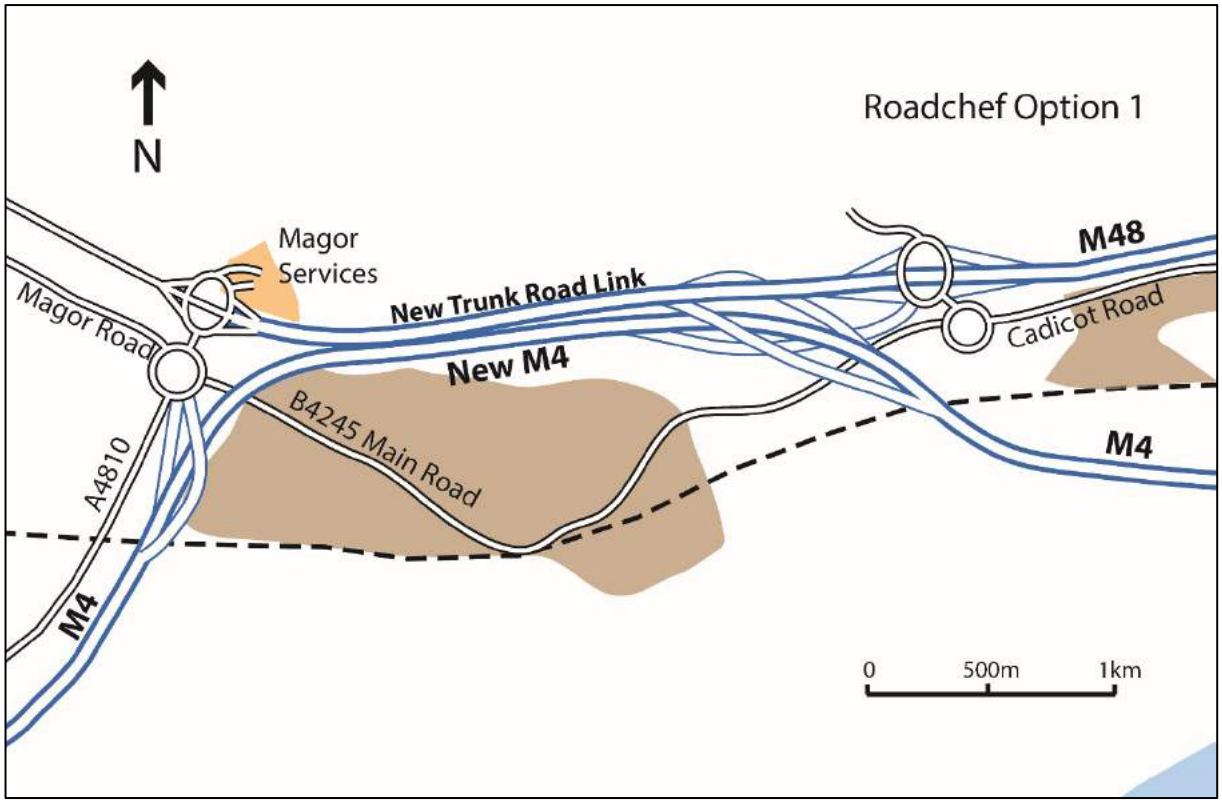
Roadchef Compromise Cost Summary Sheet

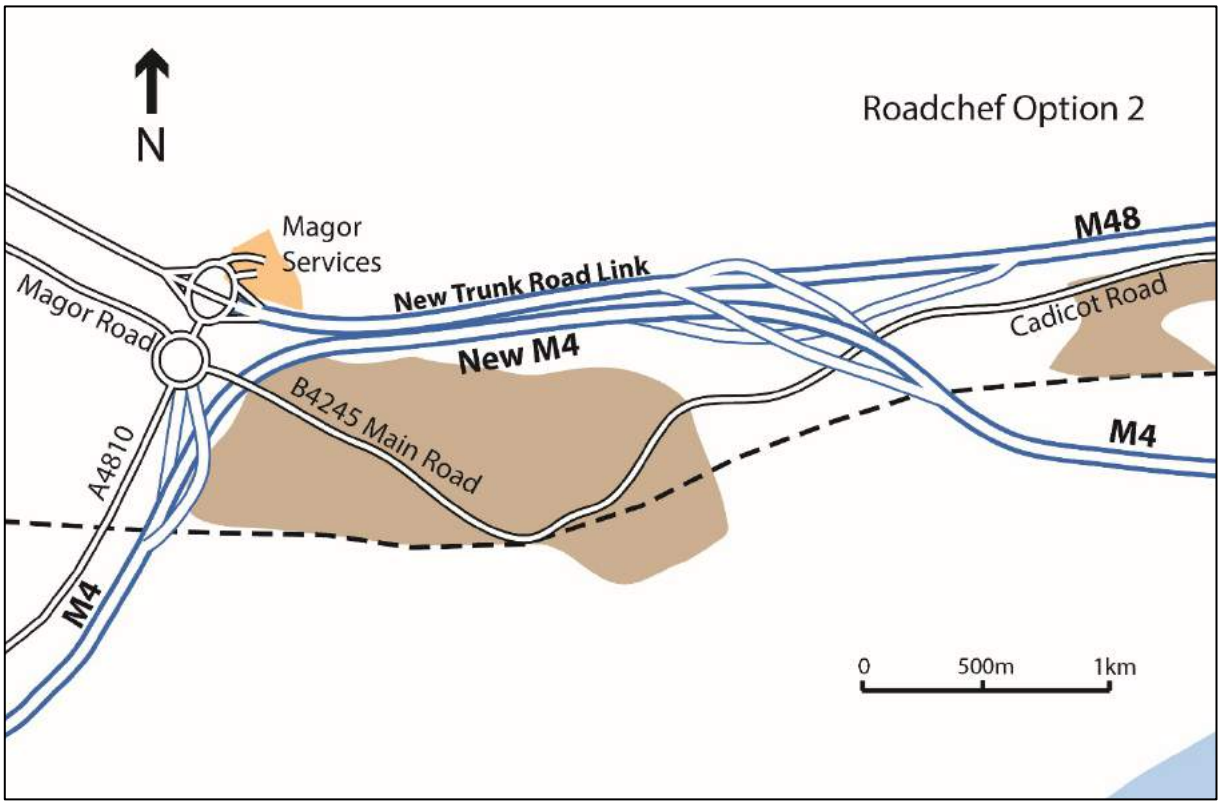
Description	Cost of proposals
Cost estimate for Additional Length of Highway to Deliver the Roadchef Compromise over and above Welsh Government scheme.	£3,400,000
Estimates Structures Costs associated with above	£2,552,000
Total Estimated Construction Costs Associated with the increased proposals to deliver the Roadchef Compromise	**£5,952,000**

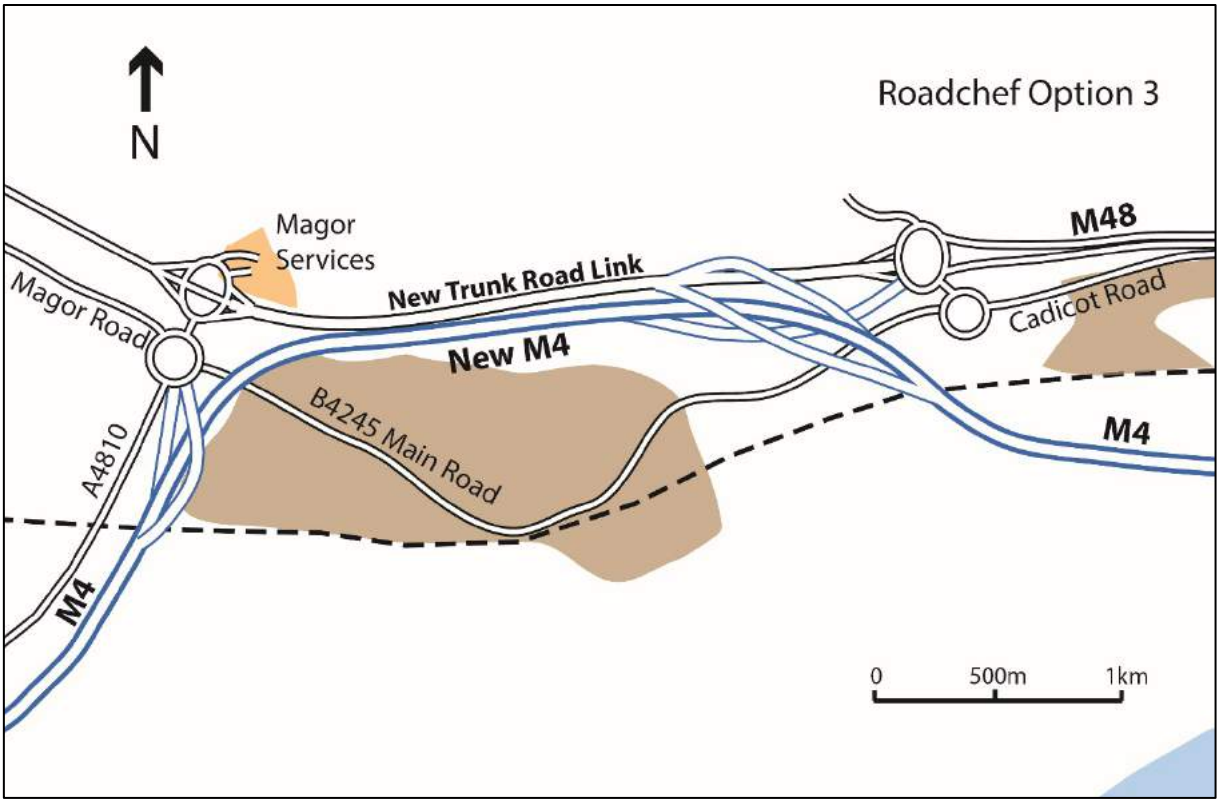
For information purposes, an Estimated Works Costs to deliver the improvements identified at Junctions 23 and Junction 23A have been estimated as identified below. The above figures are based on the Approximate Estimating Rates from SPON's Civil Engineering and Highway Works Price Book 2016.

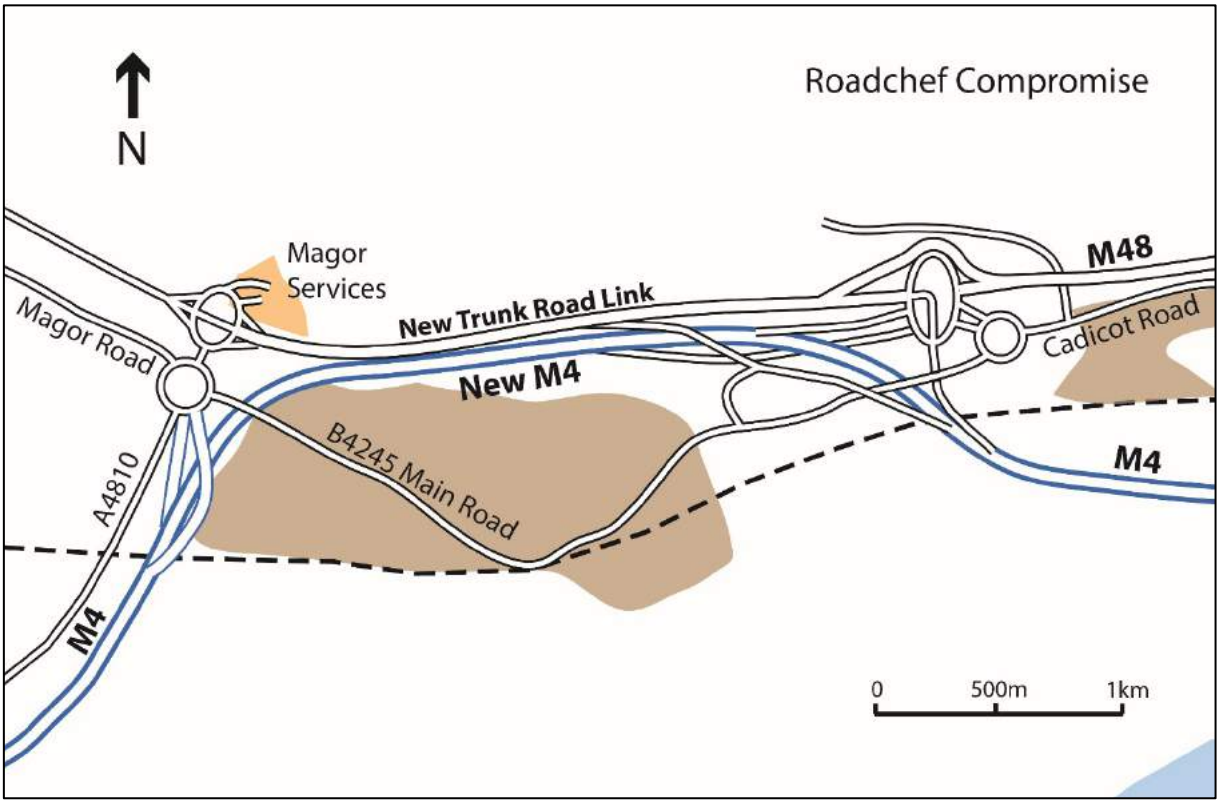
Welsh Government Cost Summary Sheet Junction 23 to Junction 23A

Description	Cost of proposals
Cost estimate for Highway Works - Welsh Government scheme.	£44,500,000
Estimates Structures Costs associated with above	£28,500,000
Total Estimated Construction Costs Associated with the Welsh Government Proposeds excluding the Roadchef Compromise.	**£73,000,000**


Roadchef Option 1
N
Magor Services
New Trunk Road Link
M48
Magor Road
Cadicot Road
New M4
B4245 Main Road
A4810
M4
M4
0
500m
1km


Roadchef Option 2
N
Magor Services
New Trunk Road Link
M48
Magor Road
Cadicot Road
New M4
B4245 Main Road
A4810
M4
M4
0
500m
1km


Roadchef Option 3
N
Magor Services
New Trunk Road Link
M48
Magor Road
Cadicot Road
New M4
B4245 Main Road
M4
A4810
M4
0
500m
1km


Roadchef Compromise
N
Magor Services
New Trunk Road Link
M48
Magor Road
Cadicot Road
New M4
B4245 Main Road
M4
A4810
M4
0
500m
1km

APPENDIX MA9 – WG CORRESPONDENCE

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Date: 1 February 2017
Our ref: MDEM/27177.00072
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Mr Matthew Jones
Project Engineer
Department for Economy, Science and Transport
Welsh Government,
Cathays Park,
Cardiff CF10 3NQ

By e-mail & post

Dear Mr Jones

M4 Corridor around Newport ("the Scheme")

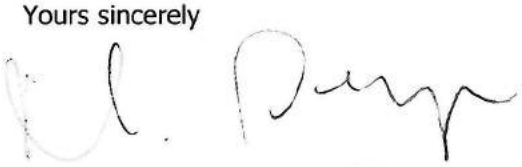
Outstanding/further information required by Roadchef

Further to the second Pre-Inquiry Meeting concerning the Scheme on 27 January 2017, we enclose, as agreed, a list of the outstanding/further information required by Roadchef.

In accordance with the timetable agreed between our respective Counsel and endorsed by the Inspector in the Pre-Inquiry Meeting, we understand that the Welsh Government will respond to this request for information at the beginning of next week.

We therefore look forward to hearing from you shortly.

Yours sincerely



Michael Dempsey

M4 Corridor Around Newport

Roadchef's Outstanding Questions and Questions in Response to Information Provided by Welsh Government (as at 1 February 2017)

1. The flow diagrams in 'Traffic Forecasting Report, July 2014' indicate increased traffic levels on B4245 to / from Rogiet following the construction of the new link. There is not the same detail in the 2016 Traffic Forecasting Report. In light of this:

    a. please can you provide detailed flow projections for the Do Minimum and Do Something (Core Scenario) by time of day for traffic through Rogiet, Magor and the surrounding local area; and

    b. please can you tell us whether or not you have analysed the environmental effects of these changes in traffic, and is so please can we see the analysis, the judgements and the reasons leading to those judgements.

2. Please can you set out the extent, detail and outcome of the discussion with Highways England regarding the Second Severn Crossing the toll booths? Are these still outstanding matters?

3. Please could you direct us to:

    a. the sections of the two reports (TFR and LMVR) which sets out how the judgement has been made that nearly half of all traffic passing through J23a will continue to do so; and

    b. the sections which show the workings and calculations undertaken to determine the distribution?

4. We understand from your advice that, the primary function of J23 is be to deal with traffic U turning from the M48 to the M4 to head to England when the M48 Severn Bridge is shut, and then secondly, to provide relief to traffic movement through Magor (i.e. Local environmental benefit). Please will you provide us with the dates and times of closure of the M48 Severn Bridge for the last five years.

5. Closure of the M48 Bridge is widely publicised when it occurs. People undoubtedly alter their travel patterns in light of that, beyond simply trying to travel at the same time by the same mode (for instance, getting the train over the river, working from home, altering the time of their journey). Accordingly:

    a. Please can you provide us with the travel data (by time, mode and route) across the day on the M48 westbound to M4 eastbound when the M48 bridge is open, and then the data on how this currently changes when the bridge is closed.

    b. Please can you then let us have your forecasts.

c. Please can you let us have (or point us to the location in the reports) your analysis (traffic and environmental) of the degree and longevity of congestion in Magor, and any other part of the network which is of concern to you, as a result of your forecasts on the basis of no U turn facility at Jct 23, and which has led you to the conclusion that you need such a U turn facility to mitigate that impact.

6.

a. We understand that there are environmental reasons why a single junction at J23a has not been pursued. Please can you clarify what these environmental reasons are?

b. Please can you let us have (or point us to the location in the reports) your analysis of the traffic related environmental disbenefit in Magor that this proposal seeks to mitigate, and your analysis of the degree of mitigation (in environmental terms) that this proposal is forecast to achieve?

c. A second local access also generates local traffic movement. Please can you isolate this, letting us know how much induced traffic this creates in your forecast, what assumptions you have made to get to this, and what your analysis of the environmental effects of this traffic is?

7. What proportion of Magor MSA visitors do you forecast will access and egress via the existing M4 and the new M4? Please can you direct us to, or let us have, your analysis behind your judgements about this, what the split is between eastbound and westbound traffic and your estimate of the degree of confidence that you have in these projections.

8. Please can you direct us to your calculations and workings to determine that there will be a 35% - 45% reduction in flows through the Brynglas Tunnels, and the origin-destination data for traffic travelling through the Brynglas Tunnels?

9. In previous work there were a number of scenarios tested, with variations on the Do Something scenario based on, for instance, whether or not the toll booths are included, differential charging at the toll booths and varying growth assumptions. It appears that these alternative scenarios are no longer being assessed. Please can you confirm this, and if this is correct please can you explain how you have distilled these scenarios, and why, into one Do Something scenario. Please can you give us your method, analysis and judgements of the degree of risk associated with making judgements on this single scenario compared with the previous multiple scenarios.

10. Please can you supply the origin-destination matrix for J23 and J23a for the Do Minimum and Do Something (Core) scenarios.

11. Turning counts for the Do Something scenario (Core Scenario) have been provided in the updated 2016 reports for J23a, but only link flows for the same scenario at J23. Please can

you supply turning count forecasts for the Do Minimum and Do Something (Core scenario) for both Junction 23A and Junction 23.

12. We understand that the latest data assumes no material change in traffic entering and leaving the Magor MSA as a result of the M4 CaN. Please can you explain this and let us have the assumptions and analysis that led to this judgement.

13. Please can you provide the CAD files, topographical data and the traffic models which have informed WG's assessments.

14. Please can you provide us with (or point us to the location in the updated reports) the assumptions and analysis that you have made in respect of how traffic will access Magor MSA. In particular, please can you explain how you have taken into account driver psychology and associated behaviour. Please can you let us know whether your assumptions have changed as a result of the updated work and in the recent issue of information.

15. In the 'Alignment and Junctions Report Supplement 2' dated 9th December 2016, the traffic flows and distribution for traffic travelling to and from Magor MSA appears to be different to the turning count information you issued to us via e-mail last year. Please can you advise which is correct in your view, and please could you confirm what judgements have been made which have changed the flow of vehicles travelling to and from Magor MSA?

Vectos

(on behalf of Roadchef Limited)

1 February 2017

53672590v1

vectos
transport planning specialists

31st March 2016

Edwina Hart
Minister for Economy, Science and Transport
Welsh Government
5th Floor
Tŷ Hywel
Cardiff Bay
CF99 1NA

Our ref: MA/162191/L02

Dear Ms Hart,

M4 Corridor Proposals and Magor Motorway Service Area

Thank you for your letter dated 1st March 2016, addressed to Simon Turl (Chief Executive, Roadchef).

Following receipt of your letter Vectos has been appointed by Roadchef to review the proposals for the M4 Corridor, particularly in relation to access to Magor Motorway Service Area, and further to the points raised in your letter we would to like to request the following information:

1. We would like to understand the detail of the road layout in respect to Junction 23 and Junction 23A, and the proposed arrangement at the toll booths. Please could you send through the latest and most detailed highway design drawings for this section of the proposals?
2. Your letter states that the proposed junction arrangement would provide a beneficial new connection between the M4, M48 and B4245 and would provide relief to the busy Junction 23A. What level of benefit would this provide, and how has this been measured?
3. You reference the Park and Ride proposals at Severn Tunnel. What are the proposals for the Severn Tunnel Park and Ride site, what degree of certainty is attached to these, and what benefit do they provide?
4. With respect to the toll booths, and the arrangement which will separate the new free flow link to the existing M4, please can you provide clarity of how this will operate, what it will look like to users of the M4, how the toll booths may be rearranged or signed, and how the free flow link will interact with users of the M48 continuing on to the existing M4?
5. Please could you supply all traffic data which has informed the design of J23 and J23A, including baseline data and forecast data, and confirm the scenarios which have been assessed and the judgements which have been made to inform each scenario, including judgements in relation to distribution, reassignment, traffic growth, and mode shift (including the Park and Ride)? You state that nearly half of the traffic currently passing through J23A and using the existing M4 will continue to do so with the project in place. Can you share the assessment work undertaken to reach this conclusion?
6. Your letter states that J23A is a 'busy' junction. What do you mean by 'busy'? How has this been measured?

Helmont House, Churchill Way, Cardiff CF10 2HE
Tel: 02920 720860 www.vectos.co.uk

7. You state that a single new junction at J23A has been considered at previous stages of development, but it is considered unachievable. Please can you confirm what criteria Welsh Government has applied in making this judgement, the outcome for each criteria, and the weight placed on each criteria, including noise, air, driver delay, driver convenience, highway safety, cost? Please could you also send on details of the previous designs which have been considered, and the assessments of these designs which informed the decisions to discard them?
8. In terms of the attractiveness of Magor Service Area, you reference travel time, travel distance, and journey reliability. Please can you issue your assessment of each of these factors and confirm how they have been considered in the balance of assessments about design, convenience and safety?

The provision of the information listed above will allow us to understand the process which Welsh Government has gone through in its assessment of the M4 Corridor Proposals and how the current position has been reached.

Roadchef's current position, whilst supportive of the concept of the M4 Corridor Proposals, remains an objection to the Draft Orders, as set out in a letter dated 30th March 2016.

We look forward to hearing from you shortly.

Yours sincerely

Mike Axon
Director
Vectos
02920 720860
mike.axon@vectos.co.uk

Adran yr Economi, Gwyddoniaeth a Thrafnidiaeth
Department for Economy, Science and Transport

Llywodraeth Cymru
Welsh Government

Mr Michael Dempsey
Berwin Leighton Paisner
Adelaide House,
London Bridge,
London
EC4R 9HA

Your Ref: MDEM/27177.00072
Our Ref: qA1174612/OBJ0026
Date: 18 05 2016

Dear Mr Dempsey

M4 Corridor around Newport – Magor Services

I refer to correspondence received as follows:

- Letter from Mr Simon Turl, Chief Executive, RoadChef Ltd, dated 30th March 2016 to Ms Edwina Hart in relation to the draft statutory Orders associated with the Welsh Government's proposals for the M4 Corridor around Newport.
- Letter from consultants, Vectos, dated 31st March to Ms Edwina Hart and email dated 18th April to Martin Bates requesting for information and containing a proposed alternative.
- Your letter dated 29th April address to the Orders Branch, raising basis of objection from RoadChef and four proposed alternatives.

The letter from Mike Axon of Vectos, dated 31 March 2016, referred to Martin Bates' letter of 1st March 2016 and requested eight items of information. I shall address each of these requests using the same numbering provided in that letter with additional point 9 responding to the draft alternative layout included with the email of 18th April 2016, points 10 to 18 responding to your points 4.2 to 4.7 and point 19 responding to the four further alternatives in BLP letter dated 29th April.

1. Request for detailed plans for J23 and J23A

1.1 Please find attached the plan and profile drawings (M4CaN-DJV-HGN-ZG_GEN-DR-CH-0084, 0085, 0101, 0102, 0103, 0105 & 0106) and general arrangement drawings (M4CaN-DJV-HGN-ZG_GEN-DR-CH-0013, 0014 & 0015) relevant for J23 and J23A.

2. What level of benefit/relief would the proposed new junction arrangement east of Magor and Undy provide?

2.1 Currently, M4 traffic travelling to/from Undy, Rogiet and Caldicot is required to travel via the B4245 through Magor and Junction 23A. The introduction of a new connection between the M4, M48 and B4245 at the proposed Junction 23 would shorten journey times for these movements, reduce traffic flows along the B4245 through Magor and reduce traffic flows at Junction 23A. This connection is also included as a complementary measure in the M4 Corridor and Newport Plan announced in 2014.

3. What are the proposals for Severn Tunnel Park and Ride?

3.1 The proposed M4/M48/B4245 junction arrangement would improve access to the surrounding area of Magor, Undy, Rogiet and Caldicot, including to Severn Tunnel Junction station.

3.2 Monmouthshire County Council has recently completed a public survey (16th May 2016) regarding access and parking facilities at Severn Tunnel Junction station. It will be for them to take forward Park and Ride proposals in that location, and the Welsh Government's proposal will complement Monmouthshire's scheme, should it proceed.

4. With respect to the toll booths and the arrangement which will separate the fee flow link to the existing M4, please can you provide clarity on how this will operate?

4.1 When approaching the toll booths at the Second Severn Crossing from the east and travelling west, advance signs would be provided to advise drivers wishing to exit for the B4245 and the existing M4 to use the booths on the left/near side of the toll plaza.

4.2 TAG facilities are currently provided both at the right and left side of the toll plaza and at each manned booth at the Second Severn Crossing. Those on the left would be the most suitable for drivers wanting to take the diverging link or slip road at Junction 23 and as above there will be signs indicating this. Discussions are also planned with the operator of Second Severn Crossing and Highways England to ascertain what additional measures may be required taking into account the uncertainty as to if and when tolls might be removed.

4.3 Once through the Second Severn Crossing toll booths, those vehicles wishing to remain on the new section of motorway would continue ahead on any of the three mainline westbound lanes. Those wishing to exit for the B4245 and the existing M4 would do so via a parallel diverge. Following this diverge, vehicles could either continue ahead onto the free-flow link or exit via another taper diverge onto a slip road connecting to the B4245.

4.4 Vehicles using the free flow link would join the westbound J23 to J23A Trunk Road link, and ultimately the existing M4, via a ghost island merge.

5. Request for all traffic data for J23 and J23A including baseline, forecasts and scenarios considered.

5.1 Information about the base year transport model and its subsequent validation can be found here: http://gov.wales/docs/det/report/160310-m4-local-model-validation.pdf

5.2 Traffic forecasts have been produced to inform the operational, economic and environmental evaluations of the new section of motorway to the south of Newport. The following scenarios have been tested:

- A 'Do Minimum' scenario, in which committed transport improvement schemes have been added to the base year network; and

- A 'Do Something' scenario, which includes the proposed new section of motorway to the south of Newport and reclassification of the existing M4 around Newport to an all-purpose road.

5.3 Forecasts are provided within the Traffic Forecasting Report, which can be found here: http://gov.wales/docs/det/report/160310-m4-traffic-forecasting.pdf

5.4 Please see attached junction turning movements for the roundabouts at J23a and J23 for the 'with' and 'without' scheme scenarios.

6. Clarification on what is meant by J23A being 'busy' and how this has been measured.

6.1 Presently, when the M48 Severn Bridge is closed, all traffic joining the M48 at junction 2 is required to divert westwards to the M4 junction 23A in order to join the M4 east bound and to cross the Severn using the Second Second Severn Crossing. Similarly, traffic which would normally use the M48 Severn Bridge and exist at junction 2 is required to divert to junction 23A before then proceeding eastwards along the M48.

6.2 This causes traffic congestion at junction 23A which also affects the ability of traffic from the B4245 through Magor to join the M4.

7. Confirm criteria which ruled out a single new junction at J23A and details of previous designs, including assessments.

7.1 Chapter 4 of the Environmental Statement outlines the main alternatives considered during the development of the Scheme. In addition, it sets out the main reasons for the selection of the key elements of the Scheme.

7.2 The preparation of the original TR111 preferred route, published in 1995 and modified in 1997, considered junction options in the Magor area and concluded that, for the route options to the north of Magor, the only viable location for the interchange was that arranged around junction 23.

7.3 The April 2006 TR111 preferred route, maintained the principle of the junction strategy at Magor and additionally included west facing slip roads to connect the proposed new motorway to a new roundabout on the A4810 south of the Junction 23A roundabout. Interchange link roads provided for connection of the proposed new motorway to the existing motorway immediately to the west of junction 23A, affording the use of the existing junction 23A east facing slip roads. This arrangement was thus operating similar to a single junction at junction 23A.

7.4 The conclusion of the June 2013 WelTAG appraisal was that additional strategic options should be included in the draft Plan including connections between the M4, the M48 and the B4245 between Undy and Rogiet.

7.5 The junction layouts in Magor/ Undy/ Rogiet area were re-assessed during the development of The Plan between 2013 and 2014. I refer you to the July 2014 Junction Strategy Report for information regarding assessment of junction options and a copy of this report is enclosed for you as it was not published on the m4newport.com web site at the time of publishing The Plan in July 2014.

7.6 The addition of the connections between the M4/M48/B4245 to improve motorway resilience between Undy and Rogiet necessitated a change to the April 2006 TR111 junction layout and the recommended option arising from this report, option 4, became the layout chosen for the 2014 TR111 Preferred Route.

7.7 Further background to the selection of the 2014 Preferred Route can be found in the following reports which are available on m4newport.com:

a) The Weltag Stage 1 Appraisal (Strategy Level) Report
b) Weltag Stage 1 & 2 Appraisal (Scheme Level) Report
c) Design Manual For Roads And Bridges Stage 2 Report Volume i
d) Design Manual For Roads And Bridges Stage 2 Report Volume ii

7.8 During the development of the preliminary design and draft Orders between March 2015 and March 2016, the layout of Junction 23 was further modified from the preferred route to provide a westbound free-flow link road between M4 and D2AP link to existing Junction 23A; a new signalised junction and roundabout at the proposed western end of the M48 to provide access to the M4; Eastbound off, eastbound on and westbound on slip roads connected to M48 "throughabout" (Westbound on slip makes use of existing M48 to M4 link road.)

7.9 The 1:2500 scale draft Orders engineering layout plans are included in the Environmental Statement as Figure 2.4 and can be viewed at http://gov.wales/topics/transport/roads/schemes/m4/corridor-around-newport/environmental-info/?lang=en

8. Assessment of each of the factors of travel time, travel distance and journey reliability and how these have been considered in the balance of assessments about design, convenience and safety.

8.1 Please refer to our response to points 11.5 to 11.12.

9. Draft alternative for Discussion.

9.1 The email from Mike Axon of Vectos to Martin Bates of 18th April 2016 provide plan VD16395-100 showing an alternative proposal for Junction 23A of the proposed motorway as a draft for discussion purposes. After reviewing this information it is our understanding that this drawing is the same as VD16395-100 (Option 2) which was sent as part of the four further alternatives within the BLP letter dated 29th April. Therefore, refer to point 19.3 below for more detail on preliminary comments and matters for consideration for this option.

10. BLP objection letter 29 April 2016

10.1 We note the points made by BLP in their letter to Welsh Government dated 29 April 2016, providing a summary of RoadChef's background and relevant highways policy in points 1 to 3.

10.2 For completeness, whilst you refer to DfT Circular 02/2013 Paragraphs B4, B5 and B6, it should be noted that B7 sets out that: "Speed limits on the strategic road network vary and therefore, applying the same principles, the maximum distance between signed services on trunk roads should be the equivalent of 30 minutes driving time."

10.3 Point 4 sets out RoadChef's objection and referring to the BLP paragraph references, our responses are provided below

10.4 We understand the points of objection to be:

1. Accessibility of Magor services to users of the new section of motorway.
2. Highway Safety: Reduced use of the services.
3. Highway Safety: Signage from Tolls
4. Sustainability / environmental implications
5. Impact on the services and local economy
6. Equalities impacts
7. Why RoadChef land is required for the scheme.
8. Stopping up of public highway.
9. RoadChef proposes alternatives junction arrangements for J23A and J23. Four options are proposed with direct access from the M4, Option 1 being RoadChef's preference.

11. Accessibility of Magor services to users of the new section of motorway.

11.1 We note your description and calculations of the proposed access and egress from the M4 for two options. We do however dispute the suggestion that for each option "the inconvenience for travellers heading eastbound on the M4 is the same", as we will demonstrate under 11.10 below. Whilst we do acknowledge and appreciate Roadchef's concerns about the potential for reduced visits to Magor services as a result of increased trip lengths, we would welcome your evidence behind your statement that "up to 80% of long haul traffic on the realigned M4 will by-pass the Magor MSA". Like Magor services, other UK services continue to operate successfully as services without benefiting from direct access arrangements, such as Chieveley (M4 J13), Cardiff Gate (M4 J30), Cardiff West (M4 J33), Sarn Park (M4 J36), Swansea West (M4 J47), Pont Abraham (M4 J49), Bridgwater (M5), Oxford (M40) and Cherwell Valley (M40) , the latter being notably remote from the motorway. Taking into account available traffic data, and the intention of advanced clear signage, it remains our view that Magor would continue to operate as a services, with the proposed access arrangements from the new section of motorway.

11.2 The safety concerns you raise with regard to a 49 mile distance between Leigh Delemere and Cardiff Gate services would be addressed by appropriate traffic signs.

11.3 Traffic forecasts developed for the Scheme are based on 'typical' conditions without delays and disruption caused by frequent incidents. As traffic volumes increase on the

existing M4 without the proposed new section of motorway in place, conditions are likely to become more unstable leading to a higher frequency of incidents and long periods of recurrent congestion. The effects of incidents on the existing M4 have been seen to result in stop-start conditions, and on occasions bringing traffic to a standstill. It is likely that traffic would benefit even more from the Scheme when there is an incident on the existing motorway/ reclassified trunk road network around Newport.

11.4 Journeys travelling between the Second Severn Crossing toll plaza and J29 (Castleton) using the new motorway would be 2.8km shorter than using the existing M4 route. The traffic forecasts indicate that all through traffic travelling between the toll plaza and J29 would use the new section of motorway, under typical operating conditions.

11.5 Traffic forecasts indicate that on an average weekday, the journey times on the new section of motorway to the south of Newport would provide time savings of between three and nine minutes in 2037 compared to travel along the existing M4 without the Scheme, depending on time of day and direction of travel.

11.6 The volume of traffic wishing to access Magor services is small compared to the volume of through traffic on the M4 that would greatly benefit from the Scheme. However, traffic forecasts show that with the Scheme in place, journey times on the existing M4 route would improve by up to around 4 minutes.

11.7 For those wishing to use Magor services, accessibility would be improved for westbound traffic continuing to use the existing reclassified M4 route compared to the situation without the Scheme.

11.8 With the Scheme in place, access to Magor services for eastbound M4 traffic using the new section of motorway would be less direct than at present. Access via the existing M4 would remain as at present. There would be two route options for those wishing to access Magor services using the new section of motorway. Both involve indirect access, with associated increases in travel distances and journey times, compared to passing straight along the new section of motorway without accessing the services.

1. Via a U-Turn movement at the proposed Junction 23, with an increase of around 6.5km / 5.5-7.5 minutes; and

2. Via proposed Glan Llyn junction using the A4810, with an increase of around 1km / 5-6 minutes.

11.9 The quickest route for those wishing to access Magor services is forecast to be the existing M4 route, which would benefit from improved journey times when compared to the without scheme scenario. However, for those wishing to use the new section of motorway and access Magor services, it would take around 5-7.5 minutes longer depending on the route selected. It should again be noted that these forecasts are under average conditions on a typical weekday, and that there would be further benefits in the event of an incident or delay on the road network.

11.10 It remains our view that the proposed arrangement would provide a safe solution, whilst advanced signage would help make any journey to the services 'easily understandable', whether from the trunk road network or proposed new section of motorway.

12. **Highway Safety: Reduced use of the services**

12.1 The scheme proposals provide for access to the services at Magor.

12.2 Traffic signs would clearly direct those requiring a safe rest break to access the Magor services from the motorway and trunk road network.

13. Highway Safety: Traffic Signs from Tolls

13.1 It should be noted that the Severn Bridges Act 1992 enables the Secretary of State, once in public ownership, to retain tolls on the Severn Crossings until 2022 and no later than 2027. The opening year for the Scheme and completion of the reclassification works to the existing M4 is 2022, such that unless new legislation is agreed between the Department for Transport and the Welsh Government, the collection of Severn Crossing Tolls could cease by the opening year, but could feasibly be in place for first five years of the Scheme's completion.

13.2 Advanced signing would be provided to ensure that drivers would be clearly signed to get into the correct lane in advance of the tolls, in order to safely access Magor Services.

13.3 Please also refer to point 4.2.

14. Sustainability / environmental implications

14.1 A Sustainability Report and a Carbon Report included as part of the Environmental Statement (ES) as Appendix 2.4 have been produced for the Scheme.

14.2 Analysis sets out that the South Wales road network contributes approximately 4.3% of the total carbon emissions in Wales each year. With the Scheme the total user carbon emissions on the South Wales network would reduce (albeit by a negligible amount – less than 1%), even though the number of vehicle trips would increase. This is due the Scheme being approximately 2.8km shorter than the existing M4, the reduction of the 'stop-start' traffic and smoother, more efficient traffic flow.

14.3 Future user carbon emissions are difficult to project beyond 2037 due to uncertainties in future technological improvements in the UK/Welsh vehicle fleet, energy generation and fuel mix.

14.4 Future user carbon emissions are difficult to project beyond 2037 due to uncertainties in future technological improvements in the UK/Welsh vehicle fleet, energy generation and fuel mix.

15. Impact on the services and local economy

15.1 As stated in 11.3 and 11.4, examples of other successful services on the highway network suggest that Magor services would continue to operate successfully following completion of the proposed scheme.

15.2 Magor services would remain an important facility along the highway network, especially considering the 49 mile / 45 minute alternative, between Cardiff Gate and Leigh Delemare.

16. Equalities impacts

16.1 A Health and Equalities Impact Assessment for the Scheme has been carried out and is available to view here: http://gov.wales/docs/det/policy/160310-m4-es-a5-4-health-impact-assessment.pdf. It has been based on the assumption that Magor services would continue to operate.

17. Why RoadChef land is required for the scheme.

17.1 All land within the published draft Compulsory Purchase Order (CPO) is essential for the Scheme to be constructed, maintained and operated. The proposed use of the land is as follows.

17.2 The land adjacent to the existing Junction 23A slip road owned by Rontec and leased by RoadChef, labelled 15/23, 15/23a, 15/23b to 15/23j, on Sheet 15 draft CPO are required for the construction of the new eastbound on slip of the Magor junction, provision of a new Public Right of Way along the highway boundary and an easement for the future maintenance of the Scheme.

17.3 The land to the north of the Magor Service Area, labelled plots 19/2 and 19/2a on Sheet 19 of the draft Compulsory Purchase Order, is required for the provision of a temporary diversion of St. Brides Road to allow a new St Brides Road bridge structure to be constructed. The land would be returned to the land owner after construction. Although the draft CPO indicates that the Welsh Ministers would take title to these plots, their current intention is to negotiate the acquisition of lesser rights by agreement, i.e. a licence. If such a licence can be negotiated then there would be no need to proceed to implement the CPO and ownership would remain with the landowner. However the Welsh Ministers reserve the right to implement the CPO should negotiations prove unsuccessful.

18. Stopping up of public highway.

18.1 The Eastbound on-slip and Westbound off-slip of the existing M4 motorway are stopped up through the 'THE M4 MOTORWAY (JUNCTION 23 (EAST OF MAGOR) TO WEST OF JUNCTION 29 (CASTLETON) AND CONNECTING ROADS) AND THE M48 MOTORWAY (JUNCTION 23 (EAST OF MAGOR) CONNECTING ROAD) AND THE LONDON TO FISHGUARD TRUNK ROAD (EAST OF MAGOR TO CASTLETON) (SIDE ROADS) ORDER 201-' which is currently published in draft. The reason for this is that the alignment of the slip roads would be changed as part of the tie-in of the new trunk road to the existing M4 (to be reclassified as trunk road). The slip roads are then reprovided as part of the Line Order 'THE LONDON TO FISHGUARD TRUNK ROAD (EAST OF MAGOR TO CASTLETON) ORDER 201-' along the proposed alignments.

18.2 The Eastbound off-slip and Westbound on-slip remain on their current alignment. Under the 'THE M4 MOTORWAY (WEST OF MAGOR TO EAST OF CASTLETON) AND THE A48(M) MOTORWAY (WEST OF CASTLETON TO ST MELLONS) (VARIATION OF VARIOUS SCHEMES) SCHEME 201-' also currently published in draft, they are reclassified as Trunk Road.

19. BLP objection letter 29 April 2016 and proposed alternative arrangements

19.1 The letter from BLP of 29th April 2016 provides four plans VD16395-100 (Rev B), and VD16395-101 to 103 showing alternative proposals, Options 1 to 4 respectively, for Junction 23A of the proposed motorway as a draft for discussion purposes. It is noted

that Option 1 is your preferred solution. It may be beneficial to arrange a meeting between our technical teams to discuss the four alternatives in more detail. In the mean time I have reviewed the draft proposals in these plans and offer the following preliminary comments and matters for consideration:

19.2 Option 1 - drawing number VD16395-100, Revision B.

a) Both the A4810 and Magor appear to be not connected to the motorway network as there is no direct access to J23A. This would have a serious impact on the area as the only access would be via the Glan Llyn Junction. This would also provide a significant disbenefit to the residents of Magor.
b) At the proposed J23A there would be more impact on residents in Magor with respect to noise, air quality and visual impact due to the alignment/ slip roads being closer and elevated.
c) In order to implement the proposed M4 westbound diverge to Magor Services it would be necessary to construct an embankment which would have a greater impact on land at Upper Grange Farm and the Private Means of Access to the north-west of Magor Services. The westbound diverge also passes through a flood plain which could create more flooding of Mill Reen and Upper Grange Farm land.
d) The proposed M4 westbound diverge to Magor Services would impact Grange Road and Knollbury Bridge.
e) There would be no connection to the B4245 at J23 which would mean that there would be no traffic or social improvements to the Magor/ Undy local network, which are proposals included in The Plan, 2014.
f) Designation of the existing M4 would need to be a Motorway (Special Road) as there is no opportunity for unauthorised vehicles to exit to the trunk or local road network.
g) There would be three additional large skewed structures for the slip roads and widening to two structures where crossing the railway and B4245.
h) The proposed amendments to A4810 would have an impact on the Inbev Brewery.
i) Review of the traffic capacity of your proposed J23A is required as this solution provides no improvements to the current traffic arrangements.
j) There are no advantages to the network resilience as traffic would need to go to J23A if the M48 Severn Bridge was closed.

19.3 Option 2 - drawing number VD16395-101, Revision -.

a) As per points b, e, g, h, i and j raised in Option 1 above.
b) There could be potential traffic delay and congestion as traffic travelling along A4810 to J23A would need to go through a tee junction and roundabout before reachingJ23A. More work is required to assess this.

19.4 Option 3 - drawing number VD16395-102, Revision A.

a) We would need to understand from you the vertical alignment of your proposed J23. We assume the proposed roundabout is elevated so is it possible to get down to join the B4245?
b) Bencroft Lane appears to be impacted and an alternative solution to provide access would be required.
c) As per points b, g, h and i, j raised in Option 1 and b raised in Option 2 above.

19.5 Option 4 - drawing number VD16395-103, Revision -.

a) There would be an additional large skewed structures for the slip roads and widening to Railway Bridge.
b) As per points b, g, h and i raised in Option 1 and b raised in Option 2 above.

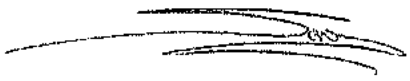
If you wish to promote alternative Option 1 for access to Magor Services then I will instruct my technical advisors to prepare a diagram for your agreement to be known as "Objectors' Alternative Access for Magor Services" and following your agreement, and the event that a decision is taken to hold a Public Local Inquiry, a booklet would be produced containing summary information on your alternative, any other alternatives promoted and the proposed scheme. This booklet would then be circulated in the area of both the proposed scheme and the alternative(s), and anybody wishing to comment would be invited to do so. All comments received would be passed to the Public Local Inquiry independent Inspector for his consideration.

Whilst the Welsh Government would not be promoting or supporting your alternative, it would be obliged to consider it so that an Inspector conducting the Public Local Inquiry could report on its merits in his report to the Welsh Ministers. The Inspector could not recommend in his report that any alternative proposal be adopted, but he could advise the Welsh Ministers that an alternative warrants further investigation. In such an event, and if such investigations were undertaken that conclude the alternative be adopted, it would then be the subject of new statutory Orders which themselves would be open to formal objection.

I would be grateful if you would confirm by return whether or not you wish the matters you have raised to be formally treated as an alternative proposal and an objection to the draft Orders.

Should you require clarification, or wish to discuss the above prior to responding, please do not hesitate to contact me or the project public liaison officer Brian Greaves on info@m4-can.com or 0845 600 2664.

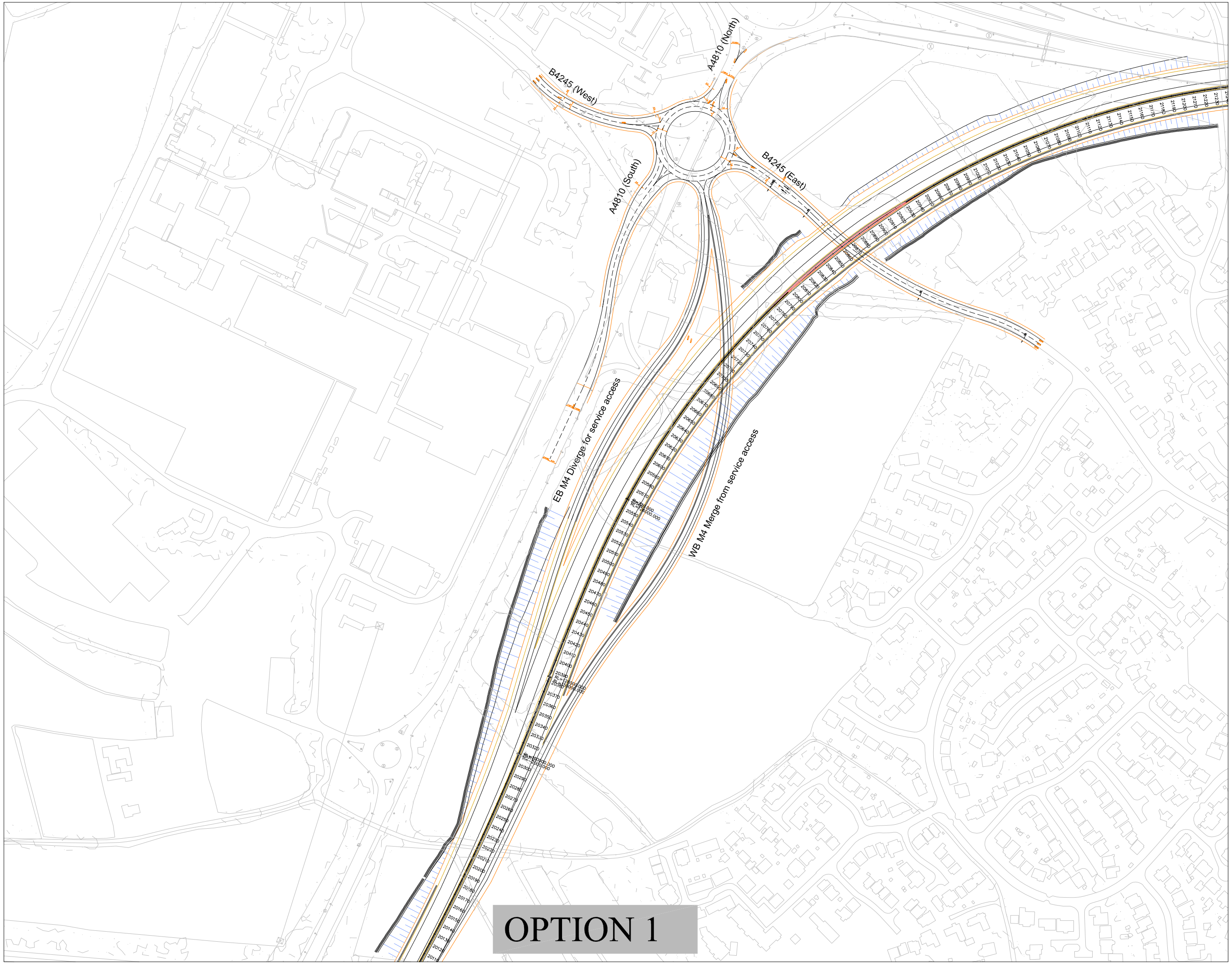
Yours sincerely



Matthew Jones
Project Engineer

CC Mr Simon Turl, Chief Executive, RoadChef Ltd. By email.
CC Mr Mike Axon, Director, Vectos. By email.

Attachments
Drawings M4CaN-DJV-HGN-ZG_GEN-DR-CH-0084, 0085, 0101, 0102, 0103, 0105 & 0106
Drawings M4CaN-DJV-HGN-ZG_GEN-DR-CH-0013, 0014 & 0015
Junction Strategy Report, July 2014
Junction turning movements for the roundabouts at J23a and J23 for the 'with' and 'without' scheme scenarios


B4245 (West)
A4810 (North)
A4810 (South)
B4245 (East)
EB M4 Diverge for service access
WB M4 Merge from service access

OPTION 1

BERWIN LEIGHTON PAISNER

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Geldards LLP
Dumfries House
Dumfries Place
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CF10 3ZF

For the attention of Charles Felgate (charles.felgate@geldards.com)

By post & by e-mail

Dear Sirs

M4 Corridor around Newport ("the Scheme")

We write on behalf of our client, Roadchef Limited, further to the recent exchange of e-mails between your Charles Felgate and our Michael Dempsey concerning our client's previous requests for information (copies of relevant correspondence enclosed for completeness).

We are surprised and disappointed that, in the context of the public inquiry concerning the Scheme, your client is continuing to withhold information on which it is relying for the purposes of the inquiry. This is continuing to disadvantage the preparation of our client's case for the inquiry and we have clear advice from Leading Counsel that we are entitled to such information. Accordingly, the purpose of this letter is to formally request that this information is provided forthwith and so avoid the need to trouble the Inspector with this matter at the start of the Inquiry.

With reference to Mr Felgate's e-mail of 21 September 2016:

1 Roadchef's highways consultants, Vectos have revisited the published documents referred to by Mr Felgate as already containing some of the information that our client is seeking (i.e. the published Traffic Forecasting Report, etc). Regretfully these documents do not provide the relevant information. However, as a result of their review of these documents, Vectos have compiled a list of further questions/information that our client requires, which we attach and would be grateful if you treat as part of this request for information.

2 Regarding the Welsh Government's reasons for not releasing the requested information, please will you explain what these are in detail. We do not understand your current position and, as stated above, we are advised by Leading Counsel that your client is obliged to release any information on which your client is relying for the purposes of the inquiry (which we presume includes the modelling information that we have previously requested).

3 There is no mystery as to why our client is requesting the information that it is requesting; plainly it is being requested in the context of the above inquiry and our client's objection to the Scheme. For the avoidance of doubt our client requires the requested information to

enable it to fully understand why the Scheme has been designed in the way that it has and to enable a like-for-like assessment to be carried out in respect of our client's alternative proposals.

4 With regard to the financial information that your client is seeking from our client, as previously indicated, we do not understand why your client requires this information at this stage or why it is apparently a pre-cursor to further discussions between our clients on potential alternative junction arrangements. It is also unfortunate that your client is linking the provision of this information from our client with the information that our client has requested when the two are unrelated and our client is under no obligation to provide such information.

In light of the above we therefore write in order to formally request that the following information is provided forthwith:

(1) the information referred to in Mr Dempsey's e-mail of 20 September (and previously requested by Vectos); and

(2) the additional information in the attached list of questions from Vectos.

We look forward to hearing from you as a matter of urgency, particularly in view of the forthcoming deadline for the submission of evidence.

Yours faithfully

Berwin Leighton Paisner LLP

Berwin Leighton Paisner

ADDITIONAL INFORMATION REQUIRED

Traffic Forecasting Report (TFR) (2014)

1 Paragraph 2.8 of the TFR refers to the 'Zone System'. There are 443 zones. Which zone contains Magor MSA, and please can we have the traffic flows for this zone for each scenario?

2 Paragraph 4.2 of the TFR notes that the 'Core Scenario' is the most realistic scenario. Is the limited turning count data provided by WG (attached) from the 'Core Scenario'?

3 Paragraph 7.3 of the TFR states that with the new section of motorway in place traffic flows on the existing route would reduce by 35% – 45%, and in 2037 in the DS scenario 45,000 vehicles (AADT) will use the Brynglas Tunnels, compared to 95,000 vehicles in the DM scenario. How has this been calculated? Please can you detail the judgements and assumptions which led to this level of flow change?

4 Paragraph 7.5 states that in the DM scenario, 45% of the 93,500 (AADT) vehicles passing through the Brynglas Tunnels would be through trips, with 41% of trips either joining or leaving the motorway between Junctions 23 and 29, with the remaining 13% (14%) joining and leaving the motorway between Junctions 23 and 29. How has this been calculated?

5 Appendix E of the TFR contains turning counts for the junctions close to Magor. However, the layout of the network (and the junctions) is not that same as the route now being promoted. Is the same information available for the proposed layout i.e. the two junctions at Junction 23 and two junctions at Junction 23A, and the through flow through Magor? Also, is an origin-destination matrix available for this section of the network (the extent of the network shown in Figure E12 of the TFR)?

Local Model Validation Report (LMVR) (2014)

1 Please could we have the traffic data for Junction Ref 46 – 51 in Table 3.1 of the LMVR, Junction Ref 60 – 61 in Table 3.2 of the LMVR, and Link Ref L2 – L4 in Table 3.3 of the LMVR, and

2 The LMVR also references the 'Zone System' (at paragraph 5.1). Please can we have the traffic flows for the zone within which Magor MSA is contained for each scenario?

3 The 'Assignment Methodology' (Section 6) seems to refer primarily to costs in determining route choice. What other factors have been taken into account in determining route choice? Is it simply PPM and PPK? In discussion the WG has agreed that a 'generalised cost' basis for making judgements about individual decision making is clearly crude and inaccurate. In that respect, since traffic models find it easier to use 'generalised cost' basis for forecasting, have these models have been set up in that way (i.e., are they based on 'generalised cost'), and what interventions have been manually introduced by the modellers to better reflect reality? In particular, what judgements have been made in the forecasts about how the change in accessibility to Magor Services affects the attractiveness of the Services to travellers on the M4, and in turn the conduciveness of travellers to use the Services?

4 Have the models forecast accident rates and accident severity proportions for the motorway, in particular in light of accidents related to driver fatigue related to the change in accessibility of the services?

Junction Strategy Report (JSR) (2014)

1 The JSR considers 4 options for Magor. Please could we have the CAD files for Option 1?

2 In Section 3 (at the bottom of Page 10) the report notes differences in traffic capacity. Please could we see the inputs (traffic flows) and outputs (modelling results) of each of the four options, and please could we have the traffic models themselves?

3 Appendix A of the JSR references a now superseded layout around Magor. Therefore, has the 2014 report been superseded? Is this the 2016 report, due to be released on 4th October 2016?

Miscellaneous

Please could we also request the traffic models for the proposed layout, together with turning count data and origin-destination data for the proposed layout? It appears to us from the information that has been released that the second access to the local Magor area (Junction 23) has caused an increase in movement between that local area and the motorways. If this is not correct please can we have the flow data sets (including local movement through Magor, and on the B4245 and A48 to and from Chepstow, taking into account also the flows to and from Junction 2 on the M48) with and without that second local access so that we can understand what the models are doing in this respect?

On 14th July, WG issued Option 1 and Option 2 as potential alternative layouts for Junction 23a. Please could we have the dwg files for these layouts, and any associated modelling work which informed them?

Vectos

(on behalf of Roadchef Limited)

Adran yr Economi, Gwyddoniaeth a Thrafnidiaeth
Department for Economy, Science and Transport

Llywodraeth Cymru
Welsh Government

Mr Michael Dempsey
Berwin Leighton Paisner
Adelaide House
London Bridge
London
EC4R 9HA

Your Ref: MDEM/27177.00072
Our Ref: qA1174612/OBJ0026
Date: 13 December 2016
By email

Dear Mr Dempsey

M4 Corridor around Newport

Thank you for your letter of 30th September 2016.

I apologise for the delay in responding. You will appreciate that shortly after your correspondence was received the Welsh Ministers decided to delay the start of the public inquiry, due to the release of revised traffic growth forecasts by the Department for Transport. The implication of this information on the published proposal is being considered and, subject to the Welsh Ministers confirming that they do wish to continue with the scheme, the inquiry will be rearranged to start next year. The start date is, as yet unidentified, as are the dates for exchange of evidence, as you would expect given the current review.

However, notwithstanding the current review, and without prejudice to the outcome, the Welsh Ministers do wish to continue an ongoing dialogue with your client and its consultants in relation to the impacts of the scheme on Magor Services.

I note your suggestion that the Welsh Government is withholding information that it is relying on for the public inquiry from your client. This is strongly refuted. Our respective clients have been in an ongoing dialogue for quite some time now and the flow of information between them has been ongoing. The Welsh Government believe they have provided all information requested of them to date, with the exception of provision of the computerised transport model used to forecast traffic flows. There is of course a distinction between information on how the model operates and the results it generates and the model itself. The Welsh Government is happy to share information on how the model operates and its results. However, as stated previously, the model itself is not generally released.

Turning now to the list of questions attached to your letter, you will appreciate that the Welsh Government's traffic experts are currently involved in considering the implication of

updated Tempro growth factors, much of the model output is being revisited. So far as model outputs are concerned, we propose that responses on those await the completion of the remodelling exercise and publication of the updated reports. I trust you agree that the previously published results are now to some extent outdated and will accept that these are not currently proposed to be relied upon at the inquiry. We would thus propose to respond using the latest data. Furthermore, the Welsh Government will not be issuing CAD or traffic model files.

However a number of your questions relate to the way in which the model operates and the local model validation exercise, which was used to confirm the model was operating correctly. Questions on these matters can be addressed now and I attach responses as Appendix A and enclosures, using the numbering on your list.

Your summary of the request for information in the closing paragraphs of your letter also refers to information requested by your email of 20th September, but apparently not supplied. The Welsh Government's response to your email of 20th September was contained in our email of 21st September. You have said that the documents provided did not provide the requested information, but we are assuming that the information your client and its consultants believe is outstanding is as set out in the list of questions attached to your letter, as referred to above, and we are not proposing a separate response. If however there is something else outstanding, we would be grateful if you could clarify, in order that the Welsh Government can consider the request.

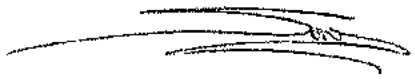
Lastly, it has never been suggested either verbally or in writing that the provision of any information by the Welsh Government is in any way linked to or contingent upon the provision of financial information by your client. That allegation is strongly refuted.

Your client's refusal to disclose such information is noted and disappointing, the request for this information was to enable the most accurate assessment of economic impacts on Magor Services to take place, but absent its provision, the Welsh Government will have to rely on other methodologies. These do not show the extent of economic impacts alleged by your client. The Welsh Government will only be able to reconsider its position on the current proposals if accurate financial information is provided on behalf of your client that shows a different magnitude of impact.

Notwithstanding the lack of progress on the economic impact on Roadchef and the pending decision from the Welsh Ministers on whether to proceed to a Public Local Inquiry, the Welsh Government would like to seek a statement of common ground on matters of fact in order that the information presented at any Public Local Inquiry is made as easy as possible for the inspector to consider. The Welsh Government has prepared an analysis of the journey distances and times between rest areas on the motorway network within 50 miles/ 80km of Magor, both with and without the proposed scheme. This analysis is presented on the documents enclosed which are draft for review and comment.

I would be grateful if Roadchef and your advisors could review this information and advise whether you would be prepared to reach agreement on the data so that we may present this at the inquiry as a statement of common ground.

Yours sincerely



Matthew Jones
Project Engineer

CC Mr Simon Turl, Chief Executive, RoadChef Ltd. By email
CC Mr Mike Axon, Director, Vectos. By email

Encls:

Name	Title Line 1	Title Line 2
M4CaN-DJV-GEN-ZG_GEN-FN-TR-0004	SCHEDULE OF FREQUENCIES	OF MOTORWAY REST AREAS
M4CaN-DJV-HGN-ZG_GEN-SK-CH-0043.pdf	EXISTING REST AREAS ALONG THE M4/M5	
M4CaN-DJV-HGN-ZG_GEN-SK-CH-0044.pdf	REST AREAS ALONG THE M4/M5	WITH THE PROPOSED SCHEME

Name	Description
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0006	Link Counts_2012
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0005	Jct Counts 3_2012
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0004	Jct Counts 2_2012
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0003	Jct Counts 1_2012
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0002	Link Counts
M4CaN-DJV-GEN-Z5_GEN-FN-TR-0001	Junction Turning Counts

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Appendix A - Response to Queries on Local Model Validation Report (LMVR) (2014)

To clarify, the two versions of the LMVR:

The 2014 version, published in July 2014 to support The Preferred Route, which is now superseded, but can nevertheless be found at this location: http://m4newport.com/assets/model-validation-report.pdf

The current, 2015 LMVR which supports the March 2016 published draft Orders, which can be found at this location: http://gov.wales/docs/det/report/160310-m4-local-model-validation.pdf

Question 1. Please could we have the traffic data for Junction Ref 46 – 51 in Table 3.1 of the LMVR, Junction Ref 60-61 in Table 3.2 of the LMVR, and Link Ref L2 – L4 in Table 3.3 of the LMVR?

Response:

The traffic data, as requested, is as published in the 2014 version of the LMVR, using counts undertaken in 2012. Additionally, the current (2015) version of the LMVR lists updated survey data, with all of the count sites being re-surveyed during 2014. The change in site references is as follows:

1.1 2014 LMVR	1.2 2015 LMVR
Table 3.1 – junction refs 46-51	Table 3.3 – junction refs 57-62
Table 3.2 – junction refs 60-61	Table 3.3 – junction refs 8-9
Table 3.3 – link refs L2-L4	Table 3.1 – RSI ref 2 Table 3.2 – link refs L1, L2

The original survey data containing the requested count data as listed in the 2014 and the 2015 LMVR data is appended to this letter.

Question 2: The LMVR also references the "Zone System" (at paragraph 5.1). Please can we have the traffic flows for the zone within which Magor MSA is contained for each scenario?

Response:

The base (2014) model contains the following vehicle trips to/from the Magor MSA zone:

	From MSA	To MSA
AM Peak Hour	263	207
Average Interpeak Hour	215	220
PM Peak Hour	185	216

Question 3: The 'Assignment Methodology' (Section 6) seems to refer primarily to costs in determining route choice. What other factors have been taken into account in determining route choice? Is it simply PPM and PPK? In discussion the WG has agreed that a 'generalised cost' basis for making judgements about individual decision making is clearly crude and inaccurate. In that respect, since traffic models find it easier to use 'generalised cost' basis for forecasting, have these models been set up in that way (i.e., are they based on 'generalised cost'), and what interventions have been manually introduced by the modellers to better reflect reality? In particular, what judgements have been made in the forecasts about the change in accessibility to Magor Services affects the attractiveness of the Services to travellers on the M4, and in turn the conduciveness of travellers to use the services?

Response:

The assignment methodology for the M4 CaN model follows the guidance set out in the Department for Transport's Transport Analysis Guidance (WebTAG). TAG Unit M3.1 – Highway Assignment Modelling defines this sort of model, representing average conditions over a modelled period, as a 'steady state assignment model', and states that the aim of the assignment model is to *"reach an equilibrium such that costs and traffic flows are in balance, under the assumption that individual users will seek to minimise their own travel costs of travel through the network". It further goes on to say that 'in principle, the basis for route choice in a highway assignment model should be generalised cost, with everything converted to equivalent minutes' Within the SATURN assignment model, it takes the form:*

> *Generalised cost = (time) + PPK/PPM * Distance + Toll/PPM where PPM=pence per minute and PPK=pence per kilometre*

In the case of the M4 CaN model, the toll charges in operation at the Severn crossings are included in the generalised cost under 'road user charges'.

Different values of time apply to different trip purposes, and vehicle operating costs vary by type of vehicle. But – in accordance with WebTAG guidance – route choice is determined by the cost of travel in terms of time and distance. There is no scope within a mathematical

model to introduce subjective travel choices, and so no manual interventions have been introduced in the assignment method, even if it was possible to demonstrate that such interventions better reflect reality.

The forecasting methodology, which also follows the advice set out in WebTAG, uses the concept of variable demand modelling, in which the demand for travel between any two zones varies in accordance to the change in travel costs. In principle, if travel costs for trips accessing the MSA increase (for example through increased congestion or trip length), then it is possible that some of these trips to be suppressed in the model. But it should be stressed that this process is again based solely on travel costs, and that it is not possible to apply any subjective judgements within the model on the attractiveness of the destination.

Question 4: Have the models forecast accident rates and accident severity proportions for the motorway, in particular in light of accidents related to driver fatigue related to change in accessibility of the services?

Response:

The M4 CaN model does not predict accident rates. A separate prediction is made of accident predictions for the purpose of economic assessment. This uses the Department for Transport's COBALT computer software, which utilises the traffic forecasts produced by the M4 CaN model. In general, this examines these forecasts in relation to average accident rates for the types of road, although we have included the observed accident rate for the M4 motorway around Newport in this analysis. But this analysis does not have the facility to identify those accidents related to driver fatigue or the change in accessibility of the services, and we are not aware of any data on which such identification might be based.

Adran yr Economi, Gwyddoniaeth a Thrafnidiaeth
Department for Economy, Science and Transport

Llywodraeth Cymru
Welsh Government

Mr Michael Dempsey
Berwin Leighton Paisner
Adelaide House
London Bridge
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EC4R 9HA

Your Ref: MDEM/27177.00072
Our Ref: qA1174612/OBJ0026
Date: 21st December 2016

By email only

Dear Mr Dempsey

M4 Corridor around Newport – Magor Services Alternative Proposals

I write further to my letter of 18th May 2016 which responded to your letter of 29th April 2016. You will be aware that the Cabinet Secretary for Economy and Infrastructure has announced that, following his review, the Project shall proceed to be considered by Independent Inspectors at an Inquiry determined by the Planning Inspectorate to commence on 28th February 2017, with a pre-inquiry meeting held on 27th January.

Since the announcement I have received, direct from Mr Axon, an email on 14th December wishing to continue dialogue with Welsh Government to which I am agreeable. With his email was a without prejudice draft copy of his Proof of Evidence, dated October 2016. Mr Axon also requested a meeting in early January 2017 to discuss "*ways of narrowing the gap between us*" to which I am again agreeable.

In advance of any meeting I would appreciate being advised as to the status of the four alternative proposals which accompanied your letter of 29th April to which I responded with comments at Section 19 of my letter of 18th May 2016 in which I also offered a technical meeting between our respective technical teams. Further to their meetings on 14th June and 7th July 2016 there has been no response to the comments made on the then four alternatives nor information whether your client wishes to formally propose them as alternatives to the published proposals.

From my initial perusal of Mr Axon's draft Proof of Evidence, I note that in Section 5 headed "The Roadchef Scheme" there are three suggested alternative options. In advance of any meeting I would appreciate being advised as to whether these three options supersede the previous four alternative proposals. It is also noted that within the draft Proof of Evidence at Appendix MA9 there are drawings and descriptions of the three options. Whilst I appreciate that it is a draft document I would be grateful if you would clarify an apparent anomaly between the included drawings and the descriptive text.

For ease of reference I have tabulated below the three drawings provided in the draft Proof of Evidence.

Roadchef Scheme Options - received 14/12/16

Drawing No.	Revisio n	Date	Drawing Title
VD16395-SK001	-	14/07/16	WG Alternative Option Merge/Diverge with M48 Roundabout Option
VD16395-112	A	20/09/16	WG Alternative Option 2 – M4 Service Access Merge/Diverge with no Junction 23 Option
VD16395-113	-	20/09/16	WG Alternative Option 3 – M4 Service Access Merge/Diverge with At-Grade Junction 23 Option

However in the draft Proof of Evidence Appendix MA9 text, reference is made to:

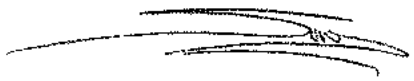
A. Option 1 indicated on Drawing D109 – is this the same as Drg SK001?
B. Option 2 identified on Drawing D112 – Is this the same as Drg 112 rev A?
C. Option 3 identified on Drawing No D113 – Is this the same as Drg 113?

A prompt response would be appreciated on this aspect in advance of any meeting.

Accompanying the announcement of the 14th December 2016, Welsh Government published revised traffic and economic reports as a result of our review of new Department for Transport traffic growth forecasts. I will therefore be writing separately to respond to the questions on the Traffic Forecasting Report raised in your letter of 30th September 2016, further to my response to the Local Model Validation Report questions on 13th December 2016.

I would like to propose that a meeting is convened early in January between the Welsh Government, our technical team and your technical team, to seek clarity on your client's intentions and responses to the comments raised on your draft alternatives. I propose the following dates in January 2017 of Tuesday 10th, Wednesday 11th or Thursday 12th. A prompt acceptance of one of these dates would be appreciated because I am trying to arrange other meetings as well.

Yours sincerely



Matthew Jones
Project Engineer

CC Mr Simon Turl, Chief Executive, RoadChef Ltd. By email
CC Mr Mike Axon, Director, Vectos. By email

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Mr Matthew Jones
Project Engineer
Department for Economy, Science and Transport
Welsh Government,
Cathays Park,
Cardiff CF10 3NQ

By e-mail & post

Dear Mr Jones

M4 Corridor around Newport ("the Scheme")

Magor Services Alternative Proposals

Thank you for your letter of 21 December 2016 concerning the above matter.

Plainly we welcome your positive response to Mr Axon's request for a meeting to discuss the above. Unfortunately Mr Axon is unavailable on any of the meeting dates that you have suggested; he has, however, suggested 3rd or 18th January. Would either of these dates work for you?

Otherwise picking up the other points in your letter:

Roadchef's position regarding the alternative proposals for Magor Services

We note that you set out a chronology of correspondence/contact between Roadchef and the Welsh Government regarding the alternative proposals for Magor Services. However, your chronology overlooks two important aspects that explain why Roadchef has yet to settle and formally propose any alternatives to the Scheme, namely:

1 As summarised in our letter of 30 September to Geldards (copy attached for ease of reference), Roadchef has repeatedly requested further technical information regarding the design/modelling of the Scheme. This was to enable it to fully understand why the Scheme has been designed in the way that it has and to enable a like-for-like assessment to be carried out in respect of Roadchef's alternative proposals. As you know, by your letter dated 13 December, we only recently received a partial response to our letter of 30 September and even now the majority of the requested information remains outstanding.

2 The Pre-Inquiry Meeting was 18 July 2016 and the Inspector set a specific deadline for any alternatives to be submitted to the inquiry (18 October). This was the deadline that Roadchef was working to before the inquiry was postponed; it was no under obligation to confirm its position to the Welsh Government before this date and we fail to see how it could have sensibly done so when it was waiting for technical information from the Welsh Government that could influence the design of those alternative options.

As it remains the case that we are still waiting for technical information to be provided (and we note that your letter of 21 December 2016 indicates that a further response to our letter of 30 September is to follow), Roadchef obviously remains in the same position. Of course, this is one of the reasons why Mr Axon has approached you on behalf of Roadchef to set up the meeting referred to above.

In the meantime, in the absence of the requested information regarding the design/modelling of the Scheme and ahead of the proposed meeting, the alternative options set out in Mr Axon's draft proof of evidence represent Roadchef's current position. Since Roadchef has not had sight of the modelling information it cannot express which of these three options is its preferred option at this stage. However, all three options referred to in Mr Axon's draft proof represent viable options from Roadchef's perspective.

As you will appreciate, this position remains subject to any further information that is provided by the Welsh Government, as well as the proposed discussions between the technical teams, and this is ultimately why Mr Axon can only provide his draft proof of evidence on a without prejudice basis at this stage.

Drawing reference numbers

Regarding your query concerning the drawing reference numbers, we confirm that the correct drawing numbers for each option are as you have set out in your letter.

Going forward

Given that the proposed meeting is to be between the two parties' respective technical teams and in view of the forthcoming Christmas period and Pre-Inquiry Meeting, going forward I suggest that you liaise directly with Mike Axon and Ian Southwell of Vectos to organise the same. For your ease of reference their respective contact details are as follows:

	Phone	Mobile	E-mail
Mike Axon	020 7580 7373	07875 760 770	mike.axon@vectos.co.uk
Ian Southwell	029 2072 0865	07825 792 830	Ian.Southwell@vectos.co.uk

For the avoidance of doubt, however, any formal correspondence in this matter should continue to be addressed to me.

Yours sincerely

Michael Dempsey

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Mr Matthew Jones
Project Engineer
Department for Economy, Science and Transport
Welsh Government,
Cathays Park,
Cardiff CF10 3NQ
By e-mail & post

Dear Mr Jones

M4 Corridor around Newport ("the Scheme")

Magor Services Alternative Proposals

We write further to our letter of 23 December 2016 concerning the above matter and your two subsequent meetings with Vectos, Roadchef's transport consultant, on 3 and 9 January 2017.

Roadchef's position regarding the alternative proposals for Magor Services

Since it remains the case that Roadchef is still waiting for technical information to be provided by the Welsh Government (as to which please see below), Roadchef's position regarding alternative proposals for access to/from Magor MSA remains as set out in our letter of 23 December 2016.

However, whilst the final design of Roadchef's preferred option is dependent upon this outstanding technical information, we are able to confirm that Roadchef's preferred option must include the following elements in order to meet the substance of Roadchef's objection:

(i) An east-bound off-slip from the new M4 into Magor MSA;

(ii) A west-bound on-slip to the new M4 from Magor MSA; and

(iii) A direct on-slip from Magor MSA for east-bound traffic.

Following Vectos' meetings with the Welsh Government, we understand from Martin Bates' e-mail of 21 January that consideration is being given to the provision of an additional eastbound off slip from the new section of motorway in the vicinity of the Services. This is (i) above. Whilst Roadchef obviously welcomes this, unfortunately this amendment to the Scheme alone would not resolve Roadchef's objection, as Vectos have previously indicated.

Accordingly, we write to confirm that Roadchef will be maintaining and pursuing its current objection to the Scheme and seeking an alternative option which secures (i) to (iii) above.

Roadchef's outstanding request for information concerning the Scheme

As you know, Roadchef has repeatedly requested further technical information regarding the design/modelling of the Scheme in order to enable it to fully understand why the Scheme has been designed in the way that it has and to enable a like-for-like assessment to be carried out in respect of Roadchef's alternative proposals. We refer in particular to Roadchef's letter of 30 September 2016.

Whilst your letter of 13 December provided a partial response to our letter of 30 September and explicitly denied that the Welsh Government is withholding information that it is relying on for the public inquiry, your letter of 21 December 2016 indicated that a further response would follow. At the time of writing, this further response still remains outstanding.

We do not understand why the Welsh Government has not provided any further information since the aforementioned correspondence and, unless the position changes, we intend to raise this issue with the Inspector at the Pre-Inquiry Meeting on 27 January 2017.

Roadchef's financial information

We welcome the confirmation in your letter of 13 December that the provision of the outstanding information detailed above is not in any way linked to or contingent upon the provision of financial information by Roadchef. That is, of course, as things should be. However, we do not understand the related explanation in your letter as to why such information is required from Roadchef.

Specifically you indicate that, in absence of further information from Roadchef, the Welsh Government has relied on other methodologies to assess economic impact on Magor MSA and that the Welsh Government cannot reconsider its position until accurate financial information has been provided. Having reviewed the publicly available documents, we have not seen any assessment of the economic impact on Magor MSA and so are unclear as to what you are referring to here and how this is relevant to the Welsh Government's stance in relation to Roadchef's objection.

In light of this, please will you explain:

(a) where/how you have assessed impact on Magor and what your conclusions are (supplying any relevant documents);

(b) what financial information you actually require from Roadchef; and

(c) why/how the Welsh Government's position opposite Roadchef could change if Roadchef provides the relevant financial information.

In view of the forthcoming Pre-Inquiry Meeting, we look forward to hearing from you on the above points as soon as possible.

Yours sincerely

Michael Dempsey

Mdem/53531291

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Llywodraeth Cymru
Welsh Government

Your Ref: MDEM/27177.00072
Our Ref: qA1174612/OBJ0026
Date: 26 January 2017
By email only

Dear Mr Dempsey

M4 Corridor around Newport

Thank you for your letters of 23 December 2016 and 25 January 2017. I will respond to any remaining issues from your latest letter in due course.

Technical information
As stated in your letter of 23 December 2016, our letter of 13 December 2016 provided a response to the queries made in your letter of 30 September 2016 on the Local Model Validation Report (LMVR). As stated in our letter, the previously published results were to some extent outdated as a result of changes to the guidance governing traffic forecasting. As a result, we stated that a response to the queries made in your letter on the Traffic Forecasting Report (TFR) and Junction Strategy Report (JSR) should await until Welsh Government had revisited the traffic modelling as a result of this.

The traffic modelling and assessments were completed in December 2016 and the relevant reports were updated and/or supplemented. The documents were published week commencing 12 December 2016 and can be found at this location: http://gov.wales/topics/transport/roads/schemes/m4/corridor-around-newport/reports/?lang=en

Responses to the remaining queries in your letter dated 30 September 2016 are provided in the following Appendices of this letter.

- Appendix A - Traffic Forecast Report (TFR)
- Appendix B - Junction Strategy Report (JSR)

Welsh Government again met Roadchef's technical advisors, Vectos, in meetings on 3 and 9 January 2017 and were able to respond to clarification requests made at those meetings as recorded in the notes contained in Appendix C and D of this letter.

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Economic impact on Magor Services

As recorded in several previous correspondences, Welsh Government has repeatedly requested information from your client to enable the most accurate assessment to be undertaken for the potential economic impacts to Magor Services. Your client's refusal to disclose such information is again noted and continues to be disappointing.

We note that the draft Proof of Evidence received without prejudice from Mr Axon on 14 December 2016 included some information on potential financial impact but little or no accounting evidence was provided to support this. This was discussed at the meeting with Vectos on 9 January 2017 and further information requests were made by Welsh Government at that meeting. Please refer to Appendix D in this letter for a copy of the meeting notes.

In the absence of evidence-based information from Roadchef, the Welsh Government had to rely on other methodologies to undertake its assessment. These do not show the same extent of potential economic impacts alleged by your client.

For the record, requests for information on this matter were made in the following correspondence and meetings:

1. Meeting with Vectos on 14 June and 7 July 2016
2. Letter from WG to BLP 14 July 2016
3. Meetings with Vectos on 3 and 9 January 2017

Welsh Government's assessment of the potential impact on Magor Services is contained in the Proofs of Evidence which will be published imminently with copies issued to you directly.

Alternatives

Your letter dated 23 December 2016 stated that the alternative options set out in Mr Axon's draft proof of evidence (received without prejudice on 14 December 2016) represented Roadchef's position at that time. You also stated that all three options referred to in Mr Axon's draft proof of evidence represented viable options from Roadchef's perspective. You did qualify this by stating that Roadchef could not express which of these three options its preferred option at that stage was, until they had seen the modelling information. It is noted that the traffic modelling and assessments were completed in December 2016 and the relevant reports were updated and/or supplemented. The documents were published week commencing 12 December 2016 and could/can be found at this location: http://gov.wales/topics/transport/roads/schemes/m4/corridor-around-newport/reports/?lang=en

In the meeting with Vectos on 9 January 2017 (refer Appendix D), Welsh Government noted that seven different potential alternatives had been proposed by Roadchef, albeit some were similar to others. Welsh Government stated at the meeting that it would be helpful if the status of these seven potential alternatives could be clarified. Vectos stated that they would respond to Welsh Government on the alternatives following liaison with their client Roadchef.

As discussed at the meeting on 9 January, the Public Local Inquiry (PLI) Rules requires that alternative proposals with sufficient detail can be required to be submitted at least two weeks before the PLI. The PLI is scheduled for 28 February. Welsh Government also noted that the Inspector is likely to request an update on the number of alternatives at the Pre-Inquiry meeting scheduled for 27 January.

We await confirmation from RoadChef as to which of the seven potential alternatives are to be considered by the Inspector at the PLI. A booklet will be produced containing summary information on the alternative(s), any other alternatives promoted and the proposed scheme. The booklet would then be circulated in the area of both the proposed scheme and the alternative(s).

Eastbound offslip

As stated in Martin Bates' email to you on 21 January, the following statement has been included in my Proof of Evidence under the Section on Magor Services. This may be of interest to your client and its designers in the preparation of evidence.

> *"Further consideration is being given to provision of an additional eastbound offslip from the new section of motorway in the vicinity of the Services. This would improve access to the Services for users travelling eastbound on the new section of motorway. Should the decision be taken to promote this measure, supplementary draft Orders and an Environmental Statement Supplement would be published to inform the Inquiry."*

Statement of Common Ground

Notwithstanding the lack of progress on the economic impact on Roadchef, the Welsh Government would like to seek a statement of common ground on matters of fact in order that the information presented at the Public Local Inquiry is made as easy as possible for the Inspectors to consider. Your views are this are sought.

Yours sincerely

Matthew Jones
Project Engineer

CC Mr Simon Turl, Chief Executive, RoadChef Ltd. By email
CC Mr Mike Axon, Director, Vectos. By email

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Appendix A - Response to Queries on Traffic Forecasting Report (2014)

It should be noted that the questions below raised by Roadchef are from the letter dated 30 September 2016 and were related to the 2014 TFR.

To clarify, details of the superseded and current versions of the TFR are provided below:

- The 2014 version, published in July 2014 to support The Preferred Route is now superseded, but can nevertheless be found at this location: http://m4newport.com/assets/traffic-forecasting-report.pdf
- The subsequent March 2016 TFR (M4CaN-DJV-HTR-ZG_GEN-RP-TR-0001) which supported the March 2016 published draft Orders, is now superseded, but can nevertheless be found at this location: http://gov.wales/docs/det/report/160310-m4-traffic-forecasting.pdf
- The TFR Supplement issued in September 2016 (M4CaN-DJV-HTR-ZG_GEN-RP-TR-0002), which is now superseded, documented the highway design changes to the draft orders M4CaN Scheme and the resultant effect on the traffic forecasts that were presented in the March 2016 TFR. This can nevertheless be found at this location:http://gov.wales/docs/det/publications/160905-traffic-forecasting-report-supplement.pdf
- The current, Revised TFR published in December 2016 (M4CaN-DJV-HTR-ZG_GEN-RP-TR-0003) was prepared as a result of changes to the guidance governing traffic forecasting and considered material to the future year traffic forecast. The M4CaN transport model was also updated to reflect the UK Government's announcement, contained within the Budget 2016, on the future of the Severn Crossing tolls following the end of the current concession arrangement. The Revised TFR December 2016 can be found at this location: http://gov.wales/docs/det/publications/161214-revised-traffic-forecasting-report.pdf

Question 1: *Paragraph 2.8 of the TFR refers to the 'Zone System'. There are 443 zones. Which zone contains Magor MSA, and please can we have the traffic flows for this zone for each scenario?*

Question 1 Response: This response is based on the Revised TFR published in December 2016.

The spatial representation of zones was refined in the latest traffic model. The traffic model now has 1196 zones, of which zone number 30011 contains Magor Services Area. Traffic entering and exiting this zone in the 'Do Minimum' and 'Core Scenario' is shown in the table below.

		Traffic Flows in Year 2037 (in vehicles per hour)	
	Time Period	**Exiting Magor Services Area**	**Entering Magor Services Area**
Do Minimum	AM Peak Hour	291	208
	PM Peak Hour	189	233
Core Scenario	AM Peak Hour	292	221
	PM Peak Hour	197	230

Question 2: *Paragraph 4.2 of the TFR notes that the 'Core Scenario' is the most realistic scenario. Is the limited turning count data provided by WG (attached) from the 'Core Scenario?*

Question 2 Response: We confirm that the J23a and J23 junction turning volumes provided by WG were extracted from the 'Core Scenario' that was current at the time. This has now been superseded by the 'Core Scenario' reported in the Revised TFR published in December 2016.

Question 3: *Paragraph 7.3 of the TFR states that with the new section of motorway in place traffic flows on the existing route would reduce by 35% - 45%, and in 2037 in the DS scenario 45,000 vehicles (AADT) will use the Brynglas Tunnels, compared to 95,000 vehicles in the DM scenario. How has this been calculated? Please can you detail the judgements and assumptions which led to this level of flow change?*

Question 3 Response: The forecast year traffic model scenarios were created to represent a 'Do Minimum' scenario (without the proposed Scheme) and a 'Core Scenario' (with the proposed scheme). The processes given in Welsh Transport Planning and Appraisal Guidance (WelTAG) and Department for Transport's Transport Analysis Guidance (WebTAG) were followed to create the traffic models. Full details of the creation of the base year and forecast traffic models were provided in the Local Model Validation Report (LMVR) and the Traffic Forecasting Report (TFR). The traffic model represents average weekday traffic conditions during a morning and evening peak hour, as well as an inter-peak hour representing conditions during the middle of the day. Section 3.10 of the TFR (December 2016) details how these were converted to annual average daily traffic (AADTs).

Question 4: *Paragraph 7.5 states that in the DM scenario, 45% of the 93,500 (AADT) vehicles passing through the Brynglas Tunnels would be through trips, with 41% of trips either joining or leaving the motorway between Junctions 23 and 29, with the remaining 13% (14%) joining and leaving the motorway between Junctions 23 and 29. How has this been calculated?*

Question 4 Response: Trip patterns contained within the trip matrix of the traffic model were collected using mobile phone data and roadside interview surveys in May / June 2014. The traffic model was validated to ensure that modelled traffic volumes show a good match against observed traffic counts. These processes are detailed within the Local Model Validation Report (LMVR). Traffic growth was then applied to project the travel demand into the future. Forecast traffic models were created to represent a road network without the proposed Scheme and with the proposed Scheme. These processes were detailed within

the Traffic Forecasting Report. The analysis presented in the TFR was extracted directly from these traffic model scenarios.

Question 5: *Appendix E of the TFR contains turning counts for the junctions close to Magor. However, the layout of the network (and the junctions) is not that same as the route now being promoted. Is the same information available for the proposed layout i.e. the two junctions at Junction 23 and two junctions at Junction 23A, and the through flow through Magor? Also, is an origin-destination matrix available for this section of the network (the extent of the network shown in Figure E12 of the TFR)?*

Question 5 Response: The forecast year junction turning movements in the vicinity of Junction 23a and Junction 23 taken from the latest Do Minimum and Core Scenario (December 2016) are contained within Appendix B of the Alignment and Junctions Report Supplement 2 published in December 2016. A copy of the report can be found at this location: http://bailey.persona-pi.com/Public-Inquiries/M4%20-%20Revised/6.2.34.pdf.

An origin-destination matrix separating out the trips in the requested section of the network is not readily available.

Appendix B - Response to Queries on Junction Strategy Report (JSR)

Question 1: *The JSR considers 4 options for Magor. Please could we have the CAD files for Option 1?*

Question1 Response: Please advise what elements of design information are requested, and for what reason, and Welsh Government will give further consideration to their release. We note that Welsh Government will be undertaking appropriate design of objectors' suggested alternatives in due course.

Question 2: *In Section 3 (at the bottom of Page 10) the report notes differences in traffic capacity. Please could we see the inputs (traffic flows) and outputs (modelling results) of each of the four options, and please could we have the traffic models themselves?*

Question 2 Response: The 2014 Traffic Forecasting Report provides information on the traffic at that time, although noting as in other responses that this data is now superseded. The 2014 TFR can nevertheless be found at this location: http://m4newport.com/assets/traffic-forecasting-report.pdf.

Please advise what further elements of traffic information are requested, and for what reason, and Welsh Government will give further consideration to their provision.

Question 3: *Appendix A of the JSR references a now superseded layout around Magor. Therefore, has the 2014 report been superseded? Is this the 2016 report, due to be released on 4th October 2016?*

Question 3 Response: The plan in Appendix A was that at the stage of publishing the Plan in July 2014. Since that stage, the layout of Junction 23 has been developed from that layout during the development of the preliminary design for draft Orders. The revision provided a westbound free flow link and an amended gyratory layout.

The highway layout at J23 includes a signalised gyratory providing connection between the proposed new motorway, the reclassified M4, the M48 and the B4245 between Undy and Rogiet.

The Supplement to the draft Orders published in September 2016 made changes to the J23 M48 Roundabout. These changes included a revised vertical alignment to lower part of the roundabout, achieved by realigning Bencroft Lane, removing Bencroft Lane underpasses and providing an overbridge to the east over the M48.

The current layout is shown in the draft Orders plans in Chapter 2 of the Environmental Statement Supplement, September 2016, which can be found at this location: http://gov.wales/topics/transport/roads/schemes/m4/corridor-around-newport/?lang=en

Appendix C – Notes from meeting with Vectos 3 January 2017

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Meeting Notes

Project title	M4CaN		
Meeting name and number	Meeting with Vectos Re: Roadchef Objection (OBJ026)	File reference OBJ0026-035-XXX	
Location	Longcross Court	Time and date 1.30pm	3 January 2017
Purpose of meeting	To discuss alternatives proposed		
Attendance	Mike Axon, Vectos (MA) Ian Southwell, Vectos (IS) Martin Bates, Welsh Government (MB) Matt Jones, Welsh Government (MJ) Ben Sibert, AAR (BS) Gary Davies, AAR (GD)		
Apologies			
Circulation	Attendees		

	(Action)
1. Notes 1.1 MB – Welsh Government continue to have an open mind to suggested alternatives but must remain mindful of statutory process, budget and implications of any changes on other stakeholders and the environment. 1.2 MA - Roadchef are supportive of the principle of the new motorway. They just want what they consider to be appropriate access. 1.3 MA – MA explained their approach to considering alternatives to the Scheme layout at J23 and J23A. They could not understand why J23 was configured the way it was. Their aim was stated to provide improved access/egress alternatives suggested at J23A (to/from Services) and other alternatives proposed at J23 to reduce the costs of the published Scheme and consequently to cover the additional costs of additional access to the Services, potentially providing an overall cost saving. 1.4 MB – The Scheme provides improved connectivity between the M4 and M48 and would reduce traffic flow on B4245 through Magor and Undy. The alternatives proposed by Vectos would give less reduction in traffic through Magor and Undy. They would also have less connectivity with M4/M48/B4254. The connectivity provided at J23 has been set out in The Plan, which has also been the subject of a Judicial Review. No changes to the connectivity principles set out in The Plan would be considered by the WG (although acknowledged that the Inspectors could probe this at PLI). 1.5 MA – Impact on local roads should not be a primary consideration for strategic	

	(Action)
trunk roads. 1.6 MA – The level of traffic alleviation achieved in Magor is limited with a proposed Scheme cost of £60m cost for the proposed J23. 1.7 MB – The M48 connection to the M4 Second Severn Crossing through J23 is important to provide relief to J23A at times when the M48 Severn Bridge is shut due to high winds, other weather or for maintenance. Otherwise, J23A suffers operational difficulties at such times, causing disruption to the residents of Magor gaining access to the motorway. This is also part of The Plan. 1.8 MA queried how many occasions is the M48 subject to closure annually. No one had the definitive answer at the meeting. 1.9 MB – Questioned how Vectos would achieve M48 termination for learner drivers etc. No response provided. 1.10 MB – Has sympathy with journey length increases to use services on new M4 in Eastbound direction. Potential eastbound offslip at J23A discussed. This would need a supplementary Order but WG would need views of Monmouthsire CC and Roadchef in advance of any potential change to current Scheme. 1.11 MA – Doesn't think Roadchef will drop objection for an eastbound offslip but will discuss with them this afternoon. 1.12 MA - Would this then be included in the promoted Scheme at the PLI? 1.13 MB – Yes, if WG decide to promote it, it would be a Supplement to the draft Orders and would be included in the WG's Scheme. 1.14 MB - Requested Roadchef's view by Monday next week. 1.15 MA – stated that they were meeting Roadchef later in the afternoon and would seek to provide a response by Monday 9 January. 1.16 MA – Would WG go any further than just consider providing an eastbound offslip i.e. provide a westbound onslip? 1.17 MB – No. The provision of a westbound onslip would have significant cost implications as well as increased impacts on residential areas. 1.18 MA: What measures are proposed for the old (existing) M4 west of J23A? 1.19 MB/MJ/BS: The existing M4 would be maintained as trunk road and improvement works undertaken to junctions including re-opening of accesses at J25. No NMUs proposed on old M4. Speed limit on reclassified M4 trunk road would be national speed limit with the exception of the tunnels which would be 60mph.	
2. Date of Next Meeting TBC.	

Appendix D – Notes from meeting with Vectos 9 January 2017

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Meeting Notes

Project title	M4CaN		
Meeting name and number	Meeting with Vectos Re: Roadchef Objection (OBJ026)	File reference OBJ0026-036-XXX	
Location	Longcross Court	Time and date 1100	9 January 2017
Purpose of meeting			
Attendance	Mike Axon, Vectos (MA) Ian Southwell, Vectos (IS) Martin Bates, Welsh Government (MB) Matt Jones, Welsh Government (MJ) Gary Davies, AAR (GD)		
Apologies			
Circulation	Attendees + Ben Sibert		

	(Action)
1. Notes 1.1 MA – Following the meeting on 3 January, MA stated that they had discussed the potential WG proposal of providing an eastbound offslip with their client (Roadchef) and their legal team. Under Roadchef's instruction, MA tabled a counter proposal which included all of the following: eastbound offslip, westbound onslip and direct access to M4 eastbound through J23. Roadchef would remove their objection to the WG M4J23 proposals if these were provided. 1.2 MB – The counter offer is not acceptable. 1.3 MA – Does the westbound onslip have environmental implications? 1.4 MB – Environmental implications are one of the reasons why the westbound onslip is not being considered. 1.5 MA – Is there any further information available to inform consideration of this? 1.6 MB – The published environmental statement provides baseline information for the J23A and the western Magor area. 1.7 MB – Vectos on behalf of their client have currently proposed seven different potential alternatives albeit some are similar. It would be helpful if Vectos could clarify their position on these. The PLI Rules requires alternative proposals with sufficient detail be submitted at least two weeks before the PLI. The PLI is scheduled for 28 February. It should be noted that the Inspector will probably	

	(Action)
want an update on the number of alternatives at the Pre-Inquiry meeting scheduled for 27 January. 1.8 MA – Vectos will respond to WG on the alternatives and will rationalise the information requested from WG. 1.9 MA – When will Vectos receive responses to the queries made in the letter dated 30 September 2016 on the Junction Strategy Report and Traffic Forecasting Report queries? 1.10 MJ – Responses to the queries are in progress and will be issued shortly. 1.11 MJ – WG still awaiting financial information from Roadchef. Vectos will chase. WG would also like full data on turn-in rate claim in evidence and any other raw data from draft Vectos evidence. 1.12 MA – asked for a status of the supplementary Order for the eastbound offslip. 1.13 MB – stated that no decision had been made whether to include the eastbound offslip but the opportunity was going to be taken to informally seek the view of Monmouthsire CC. 1.14 MA – Suggested that a Statement of Common Ground should be developed by both parties. 1.15 MB – Agreed. WG were intending to propose this too. 1.16 MA – asked whether WG had appointed professionals experienced in Service Station operations. 1.17 MB – said that the highways design team and the transport consultants had undertaken a review of the Scheme proposals. WG (as previously requested) were awaiting further information on the potential commercial impact stated by Vectos which forms part of their objection. More details of the following were also requested: • Details of the Roadchef survey (paras 3.9 & 4.6 in draft PoE) • how Roadchef has measured the turn in rate under the existing and future situations. • how the estimate of an 80% reduction has been determined. 1.18 MB – asked Vectos to provide a response before Thursday this week to enable progress to be made.	
2. Date of Next Meeting TBC.	

APPENDIX MA10 – DRIVER ROUTE CHOICE BEHAVIOUR: EXPERIENCES, PERCEPTIONS AND CHOICES

2010 IEEE Intelligent Vehicles Symposium
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Driver Route Choice Behavior: Experiences, Perceptions, and Choices

Aly M. Tawfik, Hesham A. Rakha, *Member, IEEE*, and Shadeequa D. Miller

Abstract— **Within the context of transportation modeling, driver route choice is typically captured using mathematical programming approaches, which assume that drivers, in attempting to minimize some objective function, have full knowledge of the transportation network state. Typically, drivers are assumed to either minimize their travel time (user equilibrium) or minimize the total system travel time (system optimum). Given the dynamic and stochastic nature of the transportation system, the assumption of a driver's perfect knowledge is at best questionable. While it is well documented in psychological sciences that humans tend to minimize their cognitive efforts and follow simple heuristics to reach their decisions, especially under uncertainty and time constraints, current models assume that drivers have perfect or close to perfect knowledge of their choice set, as well as the travel characteristics associated with each of the choice elements. Only a few of the many route choice models that are described in the literature are based on observed human behavior. With this in mind the research presented in this paper monitors and analyzes actual human route choice behavior. It compares actual drivers experiences, perceptions and choices, and demonstrates that (a) drivers perceptions are significantly different from their actual experiences, and that drivers' choices are better explained by their perceptions than their experiences; (b) drivers perceive travel speeds better than travel times (c) perceived travel speeds seem to influence route choice more than perceived travel times, and (d) drivers' route choice behavior differs across different driver groups.**

I. Introduction

In an effort to mitigate the impacts of traffic congestion, transportation engineering research is rich in literature directed towards understanding driver travel behavior. Because to the wide application of driver route choice models in transportation engineering and planning, dynamic traffic assignment, advanced area-wide signal control, advanced traveler information and electronic route guidance systems, among others, driver route choice models probably rank among the most influential models [1, 2]. This paper attempts to extend this wealth of research by observing actual driver route choices and evaluate the interactions between drivers' experiences, perceptions and choices.

Some studies show that most commuters use only one route to get to work or school [3], other research efforts show that most drivers select more than one route to get to their destination to avoid congestion and minimize travel time. A recent study concluded that 40 percent of the commuters used only one route for their commute and the remaining 60 percent of commuters used at least two routes [4]. Accordingly, assuming that around half of the drivers use only one route for their commute seems a reasonable assumption.

Modeling human route choice can be complicated. The number of available alternative routes from an origin to a destination can be vast, and the cognitive task of route choice is not easy and requires decisions about how to reach a destination while satisfying various limitations and obligations. Also, the experience of earlier route choices can affect the probability of the route being selected again. Furthermore, the characteristics of each alternative route do not have the same importance in a driver's final decision [4]; how commuters select their routes may be affected by many other factors such as age, gender, time, distance, special events, bad weather, and the behavior of other drivers [5].

Although in all route choice models drivers are assumed to behave rationally and to have a certain level of knowledge about their travel network, little has been done to investigate the actual cognitive abilities and rational behavior of drivers. Studies performed to measure route choice and driving performance can be categorized into different groups, such as: mathematical network models [2, 6] and evolving psychological driver behavior models [7, 8]; simulator-based, closed-course, and on-road studies [9, 10]; time-of-day, day, and trip purpose models; survey-, simulation-, and GPS- based studies [11-13], and with and without information provision [14]. Yet, there remains no perfect model available to explain the way drivers make route choice decisions. All techniques are characterized with strengths and weaknesses. Data collection and real-life validation of proposed models, nonetheless, significantly add to the challenge.

Most route choice models assume that drivers constantly evaluate and remember the travel times on the routes they travel, and use this information to select the travel route that maximizes some utility function. It assumes that drivers are

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constantly conscious and rational of their route choices. According to the HOT cognition theories, however, human behavior and decisions are highly dependent on humans' personal perceptions. For example, it is rather common for humans to behave irrationally based on erroneous personal perceptions, or beliefs. It is well documented in human psychological behavior that humans tend to minimize their cognitive efforts, and follow simple heuristics to reach their decisions, especially under uncertainty and time constraints, and with repetition, cognitive activities become habitual and could reach automaticity. Hence, minimizing the required cognitive resources [15].

Unlike most route choice research that is based on rational behavior assumptions, and is primarily focused on the end product of route choice, this research attempts to investigate the validity of these assumptions. It explores the accuracy of drivers' perceptions and examines the reasons for route choice based on drivers' perceptions. Drivers' perceptions are compared to their choices, In an attempt to weigh the fidelity of drivers' perceptions, this work also captures the drivers' actual experiences and cross examines them with their perceptions. To the best of the authors' knowledge, no previous research has examined the extent of validity of rational route choice behavior. The authors anticipate that this work could provide insights into driver route choice behavior and that more unexplained variation in modeling driver route choice behavior can be uncovered. For example, drivers' compliance to disseminated traffic information has been reported to vary according to age, gender, driving experience, and other factors [16, 17]. Although unexplained variation still exists, the authors believe that incorporating drivers' cognitive characteristics can improve route choice models [18].

In the following sections, the authors present the objectives of the study, followed by a detailed explanation of the study approach: participants, instruments and materials, procedures, and limitations. In the third section, the authors present the experimental results and discussion, and in the fourth section the paper ends with the conclusions of the study and recommendations for further research.

II. OBJECTIVES

The objectives of this study are to demonstrate that: (a) drivers perceptions can be significantly different from their actual experiences, and that drivers' choices are better explained by their perceptions than their experiences; (b) drivers can perceive travel speeds better than travel times (c) perceived travel speeds seem to influence route choice more than perceived travel times, and (d) drivers' route choice behavior differs across different driver groups.

III. METHODOLOGY

A. Participants

The research involved a total of fifty participants. All participants had valid driver's licenses, a normal or corrected-to-normal vision and perfect color vision. As presented in Table 1, participants were selected from different groups to ensure variability in their personal attributes.

TABLE I
BREAKDOWN OF PARTICIPANTS BY GROUP

Criteria	Groups	Count
Age	Age1: 17 – 25 years	32
	Age2: 26 – 56 years	18
Gender	Gen1: Males	33
	Gen2: Females	17
Ethnicity	Eth1: European/American (White)	28
	Eth2: Non European/American (Non-White)	22
Education	Ed1: Bachelor Degrees	26
	Ed2: Graduate Degrees	24
Driving Years	Yrs1: < 4 years	25
	Yrs2: > 4 years	25
Annual Miles*	Mil1: <12,000 miles/year	31
	Mil2: >12,000 miles/year	18

* One participant did not report his/her annual driven miles.

B. Instruments and Materials

Driving Performance: The experiment was conducted using the STISIM driver simulator software that was developed by Systems Technology Inc. (STI). STISIM Drive is an interactive program that is capable of recording numerous performance measures. The program offers the investigator control over development of driving scenarios, ensuring that all participants encounter the same events and conditions while driving. It also offers the investigator with possible partial randomization in the simulated scenario and events. The simulated driving program operates on a vehicle-similar structure with a 48 cm (19 in.) monitor. The vehicle-similar structure is equipped with a vehicle chair, a steering wheel, and gas and brake pedals. Software limitations are discussed in the limitations section.

Driving Network: As depicted in Figure 1, the research used a network composed of two geometrically-identical routes with nearly identical (but statistically biased) routes, with mean travel times of 3 to 4 minutes with an average speed of approximately 56 to 40 km/h (35 to 25 mph), respectively. Although all intersections were priority controlled by four-way stop signs, for clearer presentation the stop signs are not shown on Figure 1. As discussed later in the limitations, no landmarks were placed at any location.

Initial Questionnaire: Participants were asked to fill a short questionnaire before performing the driving tasks. The questionnaire collected information about their age, gender, ethnicity, education, vision problems, driving years, and average number of miles driven per year.

Final Questionnaire: Participants were asked to fill a short questionnaire after performing all the driving runs. The questionnaire was designed to capture the participants' cognition of the different sections of this study. The questionnaire collected information about their perceptions of differences in travel characteristics between the two routes, and reasons for their route choice.

C. Experiment Procedure

After participants read and signed the consent forms, they were asked to fill an initial questionnaire, which collected their general information (as described earlier). Then, participants were given a 15-minute drive on practice routes. The practice routes were characterized by different terrains and driving schemes, with the objective of allowing the drivers to be familiar with the simulator driving motor skills.

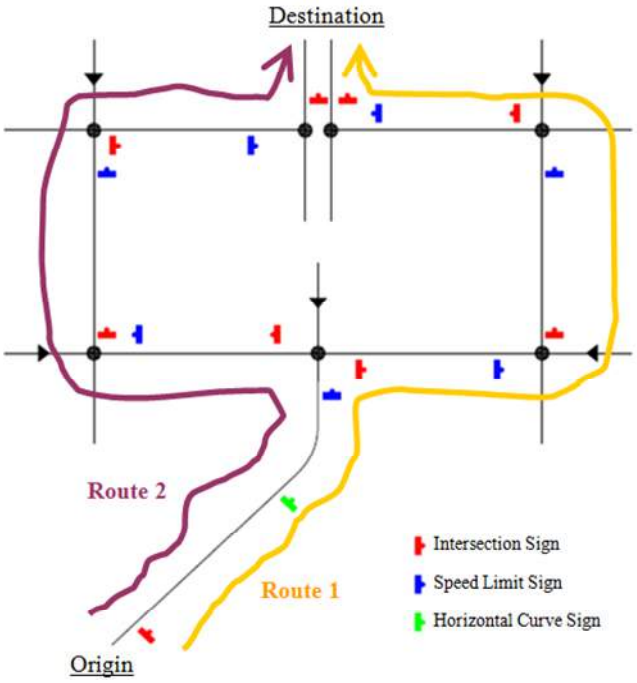

Fig. 1. Sketch of the simulated network

Afterwards, participants were introduced to the research route. They were handed a draft sketch showing the network and the points of origin and destination. The participants were asked to drive from the point of origin to the point of destination. They were asked to imagine moving to a new city, where the origin point was home, and the destination point was work/school. They were asked to drive similar to how they would drive in the real world. Participants were asked to repeat driving from home to work many times, and most participants ended up driving twenty times from origin to destination. Participants were allowed as many intermediate breaks as they liked, and were instructed to report any signs of nausea or fatigue.

At the end, participants were asked to fill a post-task questionnaire where they were asked to report their route choices and network perceptions (as described earlier).

D. *Study Limitations*

To place the results of this study in context, the limitations of this research effort are summarized. The STISIM driver simulator dynamics lacked some realism. A noticeable difference was observed between real-life steering and breaking, and in the simulator experience. As an example, Modeling of T-intersections was not possible using the STISIM software; so, construction cones were placed to prevent participants from continuing through at the 4-leg intersections. However, although participants' vehicles would crash if driven into a construction cone, other simulated vehicles were not smart enough to recognize construction cones and drove into the cones with no harm.

Also, the STISIM software does not support "If, Then" logic. Accordingly, it was not possible to build a different scenario based on "If" the participant turned right or left at the different intersections, and as a result, no landmarks were added to the network. Due to lack of landmarks, a small number of participants made wrong turns and got lost a few times. The total number of trials that involved crashes or missed turns, however, was less than 10% of total runs.

IV. RESULTS

A. *Drivers Experiences*

Figure 2 presents a cumulative distribution of experienced travel times by the fifty participants. On average, the right route was 5% shorter in travel time than the left one. Based on a t-test and an F-test, both travel time means and standard deviations, respectively, were significantly different (p-value<0.01). Based on a Monte-Carlo simulation, probability of the right route having a shorter travel time was 60%.

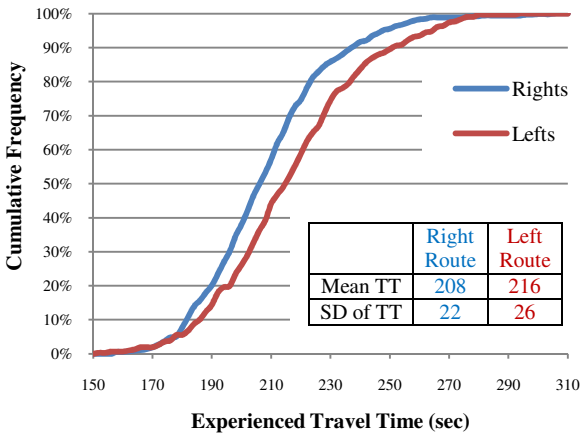

Fig. 2: Cumulative Frequency Distributions of Experienced Travel Times on Each Route

Table 2 shows the average experienced values of traffic conditions encountered by drivers on both routes. Three measures were selected to reflect experienced traffic conditions; namely, the number of vehicles encountered, the closest experienced car-following distance, and the average car-following distance experienced per trial. T-tests and F-tests indicated significant mean and variance differences for all three measures. As presented in Table 2, although, on average, the left route was characterized with slightly lighter traffic, vehicles were following at closer distances than the right route. Due to this discrepancy, drivers' perceptions of traffic volumes were more erroneous than their travel time and speed perceptions. Therefore, in the following sections less focus is placed on drivers' traffic volume perceptions.

TABLE 2
DRIVERS' EXPERIENCED TRAFFIC VOLUMES ON THE TWO ROUTES

Route	Average Number of Vehicles Encountered	Average Min. Experienced Car Following Distance (m)	Average Avg. Experienced Car Following Distance (m)
Left	8.5	23	237
Right	9.0	27	296

B. *Drivers Perceptions*

Figures 3.a and 3.b show drivers' perceptions of travel times, and travel speeds, respectively. Differences between drivers' travel time and travel speed perceptions are

particularly interesting, because since distances were equal, perceptions of travel times and speeds should have been the same. Given that humans allocate more attention to more important events [19], this difference in perception can be useful in identifying the more important route choice factor.

Two possible alternative explanations for the obvious bias in travel speed perceptions favoring the left route over the right route are the primacy effect and the short gains strategy; because in order to choose the left route, drivers had to cross oncoming traffic at the first intersection.

Perception differences between driver groups, observable from Figures 3.a, and 3.b, should be noted. Although differences between driver groups have been repeatedly reported in many driving related areas, they still have not been fully incorporated in route choice models.

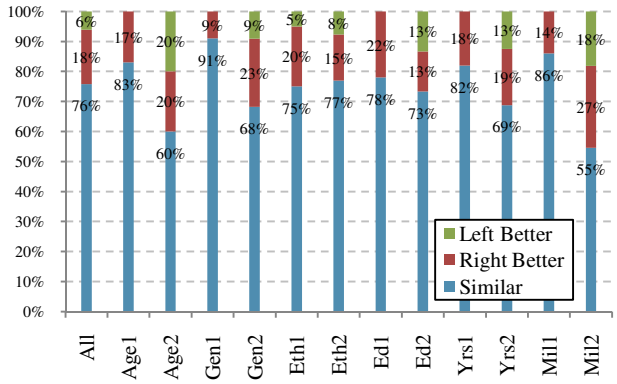

Fig. 3.a: Drivers Perceptions of Experienced Travel Times on Both Routes; Broken Down by Driver Groups

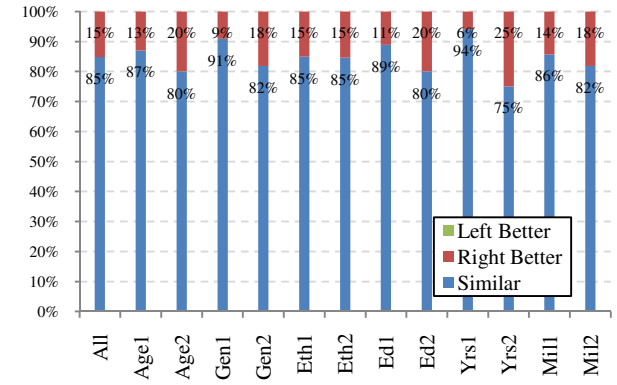

Fig. 3.b: Drivers Perceptions of Experienced Travel Speeds on Both Routes; Broken Down by Driver Groups

Table 3 shows drivers perceptions of the three traffic parameters on both routes. It is noted that while perceptions of travel time and speed were close, traffic perceptions were a little different. Because several research efforts concluded that travel speed could be a better indicator of route choice than travel time, the difference between travel time and travel speed perceptions are studied further.

TABLE 3
DRIVERS' PERCEPTION OF TRAFFIC CONDITIONS ON THE TWO ALTERNATIVE ROUTES

Perception	Travel Time	Speed	Traffic
No Difference	76%	85%	55%
Right Better	18%	15%	30%
Left Better	6%	0%	15%

C. *Drivers Experiences vs. Perceptions*

Table 4 shows a comparison between drivers' perceptions and experiences. It can be seen that while 76% of the drivers were unable to perceive travel time differences, only 12% of the drivers were able to correctly perceive their experienced travel times, and conversely, 12% perceived the opposite of their experience. While this result signifies the usefulness of traveler information systems, the small difference between the two travel times should be noted. The experienced travel time was calculated as the average travel time per participant on all trials. Table 4 also shows that, as expected, average signal strength (experienced travel time difference) was stronger for correct than for opposite perceptions.

TABLE 4
BREAKDOWN OF PARTICIPANTS' TRAVEL TIME PERCEPTIONS BASED ON THEIR ACTUAL EXPERIENCES

			Travel Time Experiences		
			Left Faster	Right Faster	All Drivers
Travel Time Perceptions	Left Faster	% of Drivers	***0%***	6%	6%
		% Avg. $Left_{TT} - Right_{TT}$	***N/A***	5%	5%
	Right Faster	% of Drivers	6%	***12%***	18%
		% Avg. $Left_{TT} - Right_{TT}$	-5%	***8%***	4%
	No Differ.	% of Drivers	33%	43%	76%
		% Avg. $Left_{TT} - Right_{TT}$	-4%	8%	3%

* Bold Italic Cells: Correct Perception, Underline Cells: Incorrect Perception, Highlighted Cells: Opposite Perception.

D. *Drivers Choices*

Two different measures of choices were observed. First the drivers' reported choices in the post-task questionnaire, referred to as declared choices, and second, the observed choices on each individual trial, referred to as trial choices. Results of both measures were the same; therefore, only declared choices are presented in Figure 4.

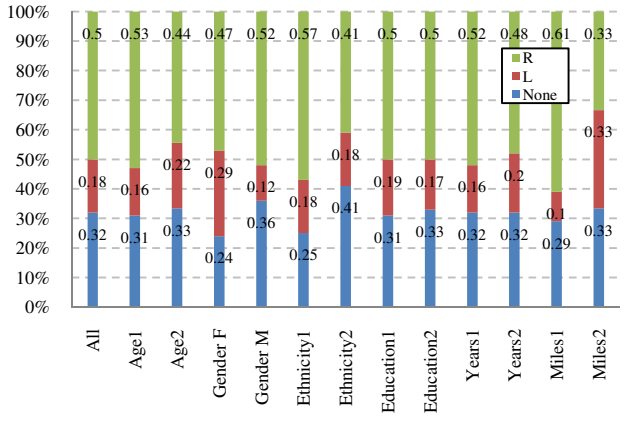

Fig. 4: Percentage of Drivers Choosing Right Route, Left Route and not Making a Decision; Broken Down by Driver Groups

E. *Drivers' Experiences vs. Choices*

Table 5 compares trial choices (Table 5.a) and declared choices (Table 5.b) to experienced travel times. It is shown that in either case about 50% of the drivers did not choose the minimum experienced travel time route. Again, this result demonstrates the potential benefits of traveler information systems.

TABLE 5
DRIVERS EXPERIENCES VERSUS CHOICES*

TABLE 5.A
ROUTE TRIAL CHOICES VERSUS TRIAL EXPERIENCES

Trial Choices	Left Driven	Right Driven
Right Faster	66%	67%
Left Faster	34%	33%

TABLE 5.B
ROUTE REPORTED CHOICES VERSUS ROUTE EXPERIENCES**

Reported Choices	Left Chosen	Right Chosen
Right Faster	60%	64%
Left Faster	40%	36%

* Highlighted Cells: drivers choosing longer travel time routes.
** Driver experience calculated as average travel time of all trials per driver.

F. *Drivers' Perceptions vs. Choices:*

Table 6 compares perceptions of travel time (Table 5.a), travel speed (Table 5.b), and traffic volume (Table 5.c) to reported choices. Three types of behaviors were identified in the table: logical behavior reflects drivers choosing better perceived routes, cognitive behavior reflecting drivers choosing a route in spite of not perceiving a difference between both routes, and irrational behavior reflecting drivers choosing worse perceived routes. Cognitive behavior is in line with human psychology hypotheses postulating that humans always minimize their cognitive loads.

TABLE 6: DRIVERS PERCEPTIONS VERSUS REPORTED CHOICES*

TABLE 6.A: REPORTED CHOICES VS. TRAVEL TIME PERCEPTIONS

Choice	Perception of Travel Time			Sum
	No Differ.	Right Faster	Left Faster	
None	*33%*	6%	3%	42%
R	36%	*12%*	0%	48%
L	6%	0%	*3%*	9%
Sum	76%	18%	6%	100

TABLE 6.B: REPORTED CHOICES VS. TRAVEL SPEED PERCEPTIONS

Choice	Perception of Travel Speed			Sum
	No Differ.	Right Faster	Left Faster	
None	*39%*	3%	0%	42%
R	36%	*12%*	0%	48%
L	9%	0%	*3%*	9%
Sum	85%	15%	0%	100

TABLE 6.C: REPORTED CHOICES VS. TRAFFIC VOLUME PERCEPTIONS

Choice	Perception of Traffic Volume			Sum
	No Differ.	Right Lower	Left Lower	
None	*30%*	6%	6%	42%
R	21%	*24%*	3%	48%
L	3%	0%	*6%*	9%
Sum	55%	30%	15%	100

* Italic Cells: Logical Behavior, Underlined Cells: Cognitive Behavior, Highlighted Cells: Irrational Behavior

Figures 5.a and 5.b show the breakdown of drivers reported choices versus perceptions of travel time, and travel speed, respectively, by driver group. Again, differences between driver groups are evident and incorporating these differences in route choice models seems a promising arena.

Figure 5 implies that travel speed is a better variable in predicting driver choices in comparison to travel time, since it is characterized with a clear reduction in the percentage of irrational decisions; in total and across all driver groups.

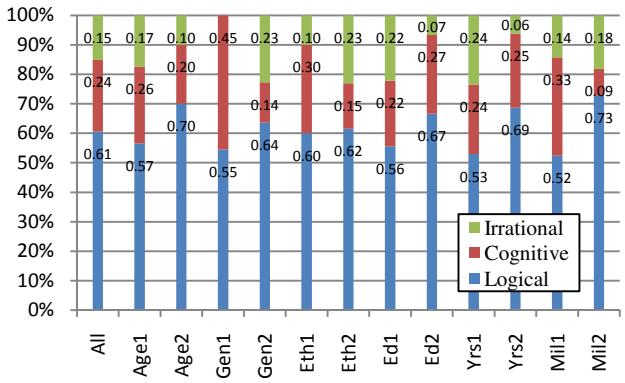

Figure 5.a: Percentage of Drivers Making Logical, Cognitive, and Irrational Choices Based on Travel Time Perceptions; Broken Down by Driver Groups

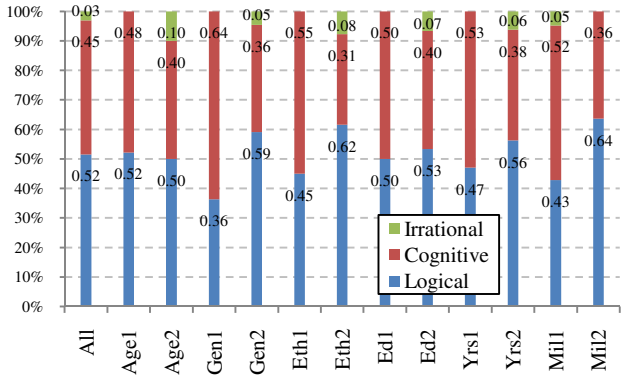

Figure 5.b: Percentage of Drivers Making Logical, Cognitive, and Irrational Choices Based on Travel Speed Perceptions; Broken Down by Driver Groups

V. CONCLUSIONS AND FURTHER WORK

While the results of this experiment should not be considered conclusive for all driver populations; because of limitations in the sample size and experiments, the results do demonstrate that driver choices are not necessarily identical to their perceptions and that modeling route choice based on driver experiences invokes errors in route choice models. Accordingly, incorporating drivers' perceptions to route choice models rather than experiences, if possible, could improve model accuracy.

About half of the drivers did not choose their minimum experienced travel time routes. This finding may be attributed to the small travel time difference between both routes (5%) and the high travel time variance. This difference, however, could reflect real life situations; even in longer trips where on many occasions as part of a longer trip drivers may be faced with the option of choosing between two short alternative travel legs. It is documented in wayfinding literature that drivers may consider short segments sequentially, instead of the entire travel route [20].

It appears that drivers can perceive travel speeds better than travel times and route choice decisions are more influenced by travel speeds than travel times. Hence, it might be useful to include travel speed variables including the number of stop signs and traffic signals along a route in

route choice models. Nevertheless, even when considering both travel speed and travel time perceptions, irrational route choice behavior, although small, continues to exist. This implies the existence of other unidentified variables (e.g. reliability).

In accordance with current research standings, in this work, differences between driver groups were observable, and incorporating these differences in route choice models could improve model accuracy.

Finally, a few possible future research directions include: modeling route choice with different signal strengths and in more complicated networks and analyzing the effect of each variable on the driver route choice task; investigating the possible effects of primacy and recency on route choice behavior, use of better driving simulators with higher fidelity levels to overcome the earlier mentioned limitations; examining route choice behavior in real environments; and comparing the differences between simulator and real-life results, with respect to drivers' experiences, perceptions and route choices.

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[20] R. Golledge and T. Garling, "Cognitive maps and urban travel.," University of California Transportation Center2003.

APPENDIX MA11– PLAN OF MSA DISTANCES

Hopwood Park

M5

24 - 30 mins 36.7 km

Worcester

Warwick North

M40

22-30 mins 38.5 km

Strensham

M50

26-35 mins 39.5 km

Cheltenham

Cherwell Valley

16-22 mins 28.4 km

Gloucester

Wheatley

Oxford

18- 24 mins 29.2 km

40.7 km

28-45 mins

M4

Swansea West

Michaelwood

Beaconsfield

22 - 30mins

37 km

Swansea

30-40 mins

41.6 km

20-26 mins

Magor

25.8 km

Newport

M40

Sarn Park

16-20 mins

Bridgend

20.3 km

12-16 mins

Cardiff West

15.1 km

Cardiff Gate

Cardiff

M4

24-30 mins

Swindon

Leigh Delamere

45.2 km

M25

30 - 45 mins

Membury

Reading

16 - 22 mins

Bristol

53 km

12-16 mins

14-28 mins

25.6 km

19.2 km

Chieveley

22.2 km

Reading

Gordano

M4

20 -26 mins 31km

Fleet

M3

Sedgemoor

20- 26 mins

37.5km

28-40 mins 43.2 km

Winchester

Bridgewater

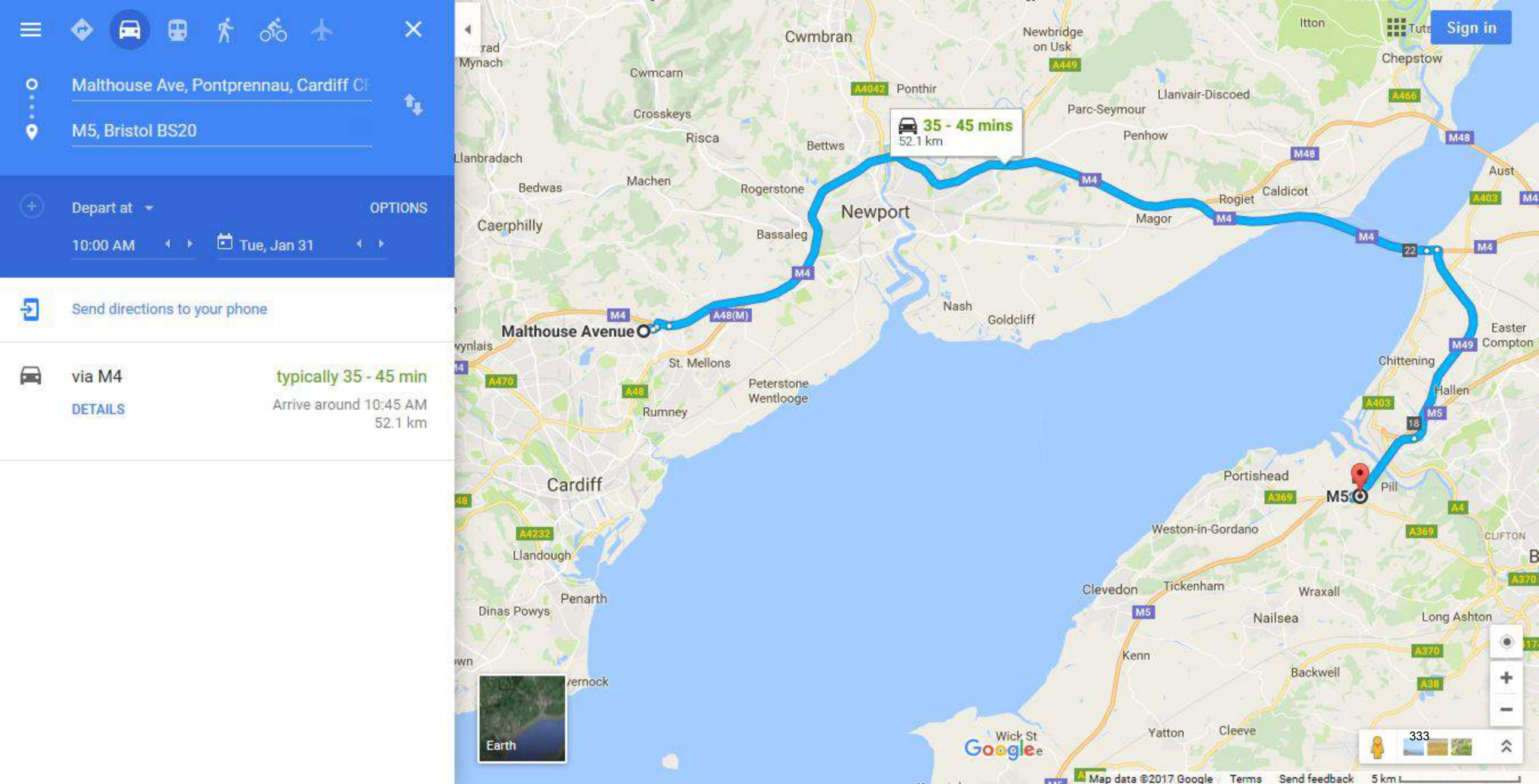
20 -26 mins 25.9 km

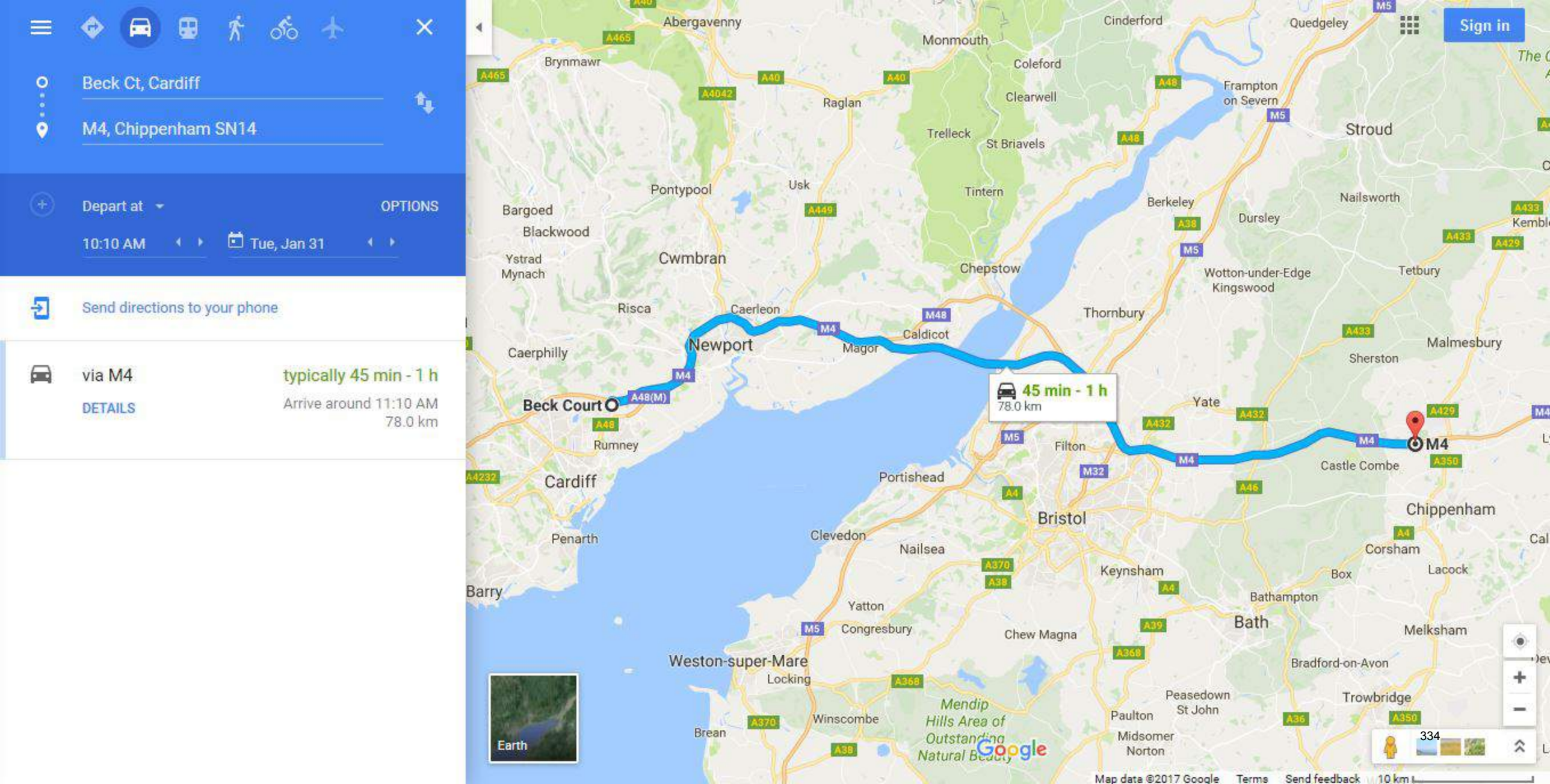
Taunton Deane

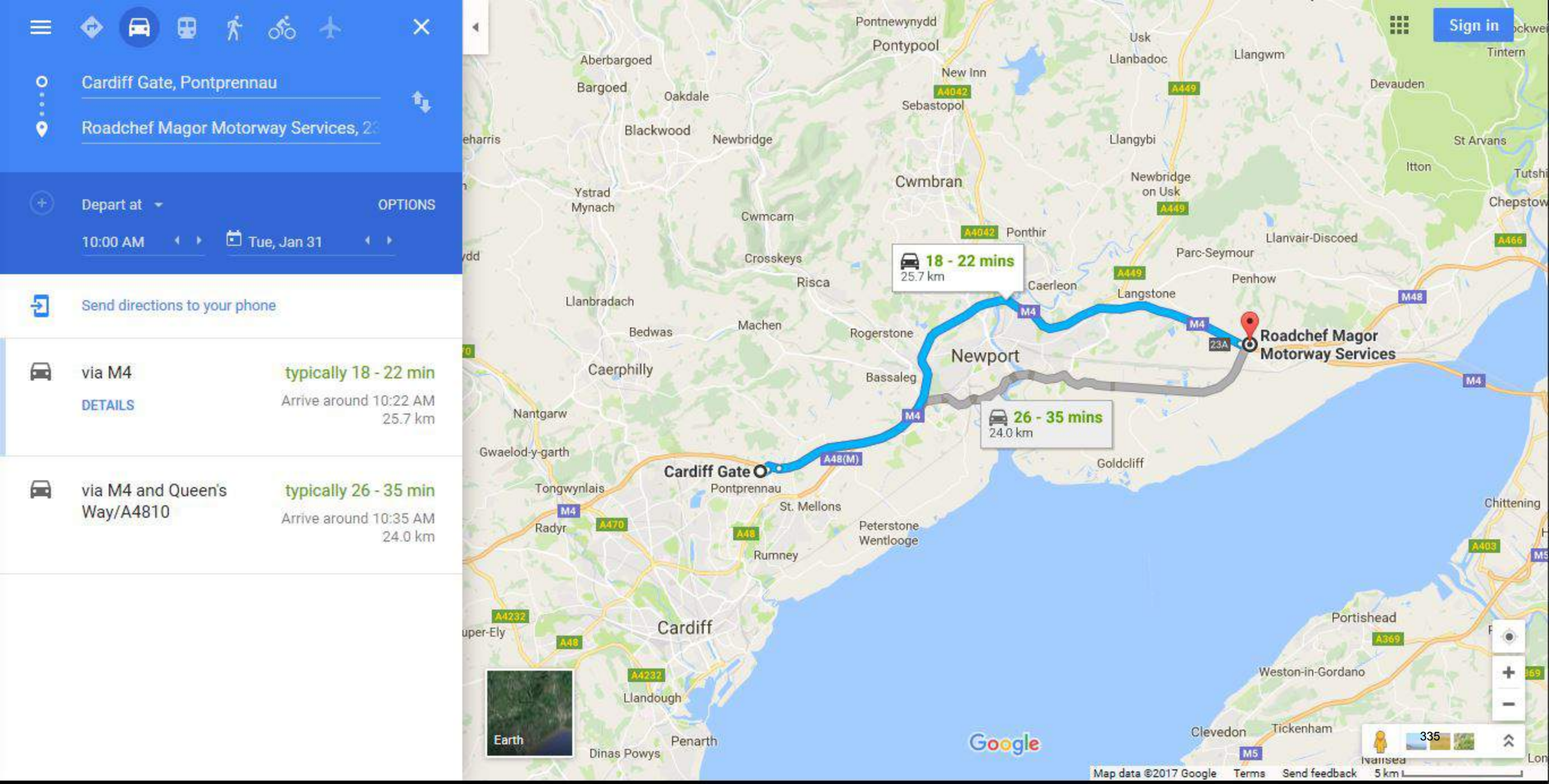
M27

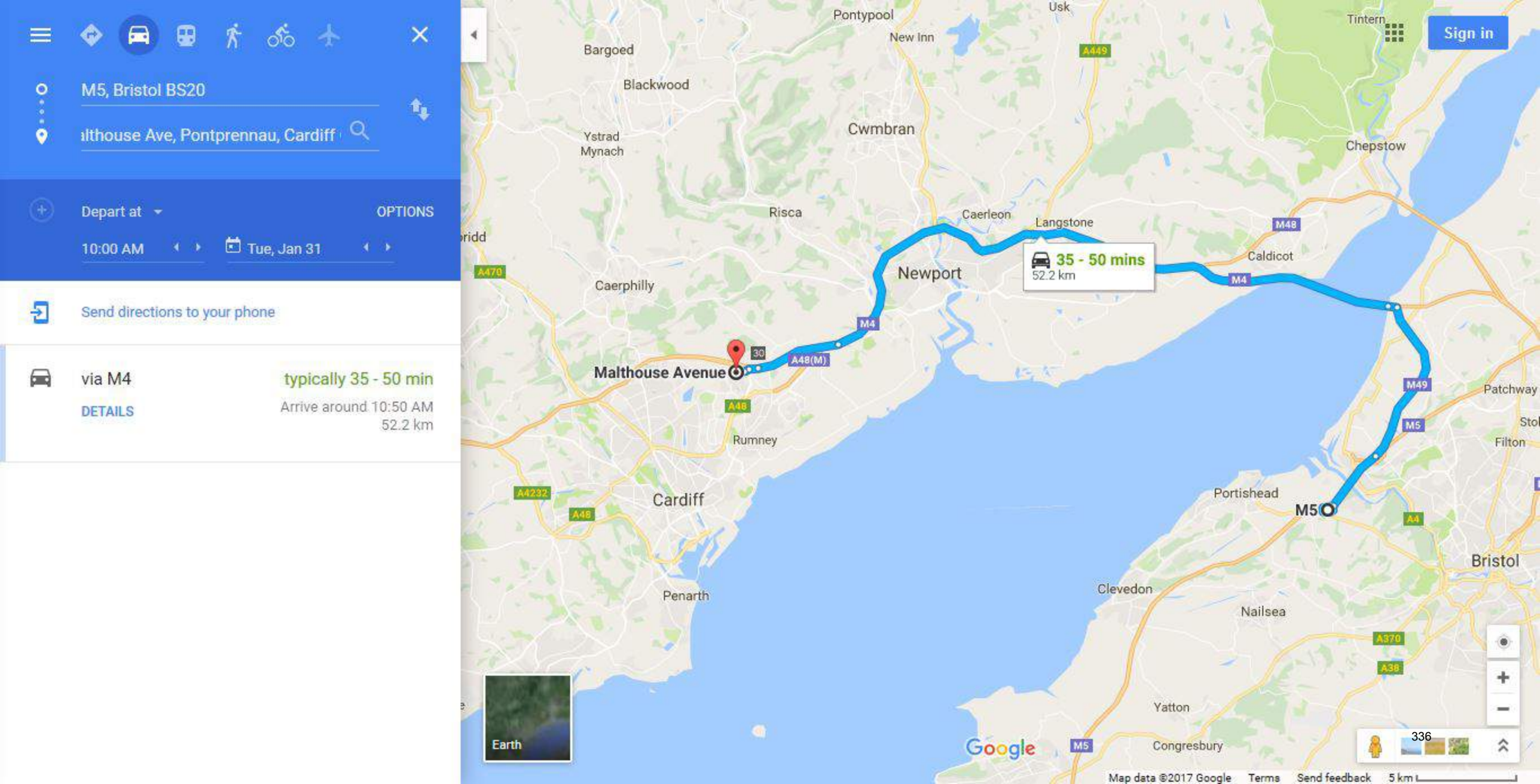
M5

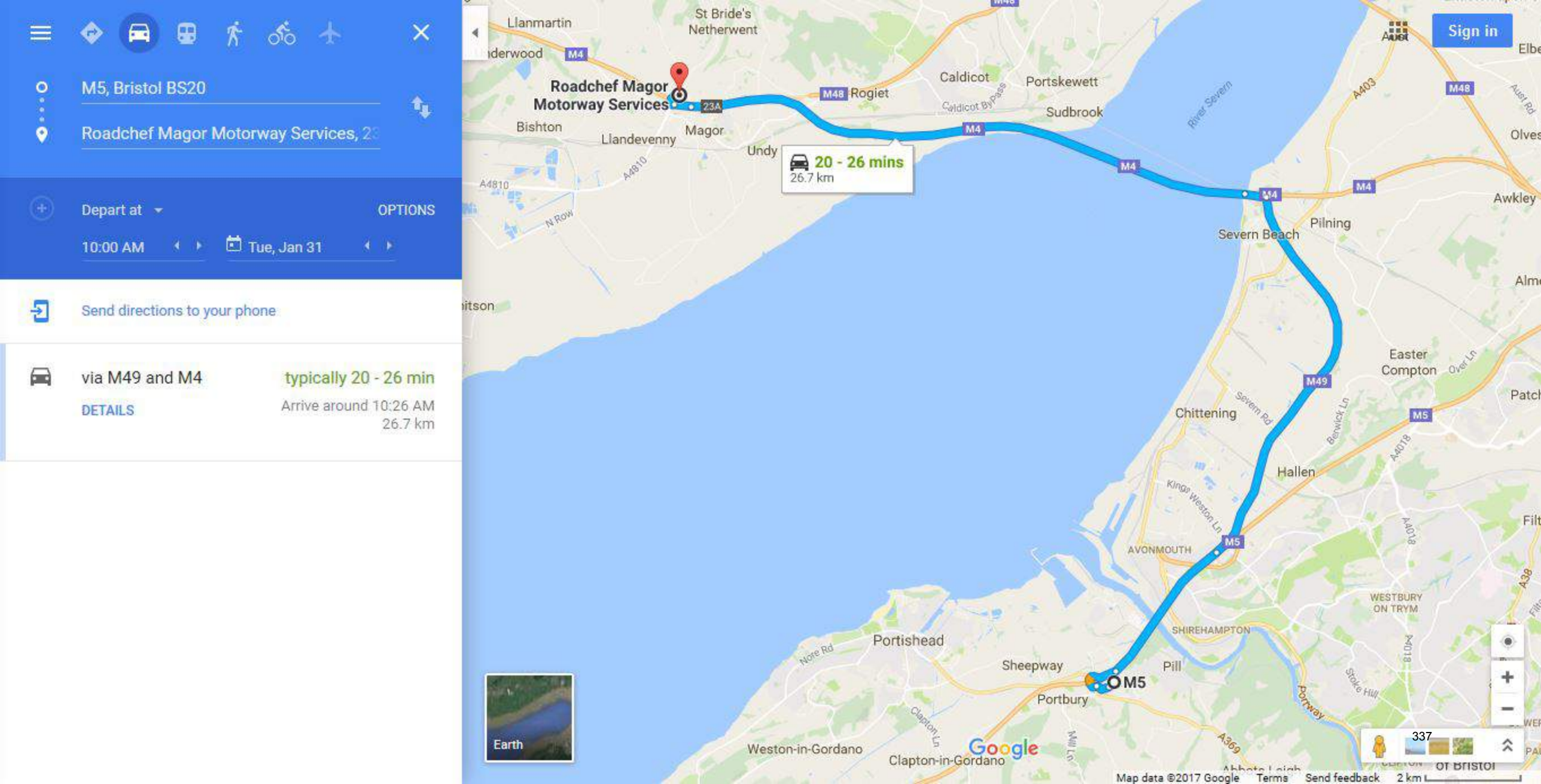
Time taken from 08:00 AM on a Monday

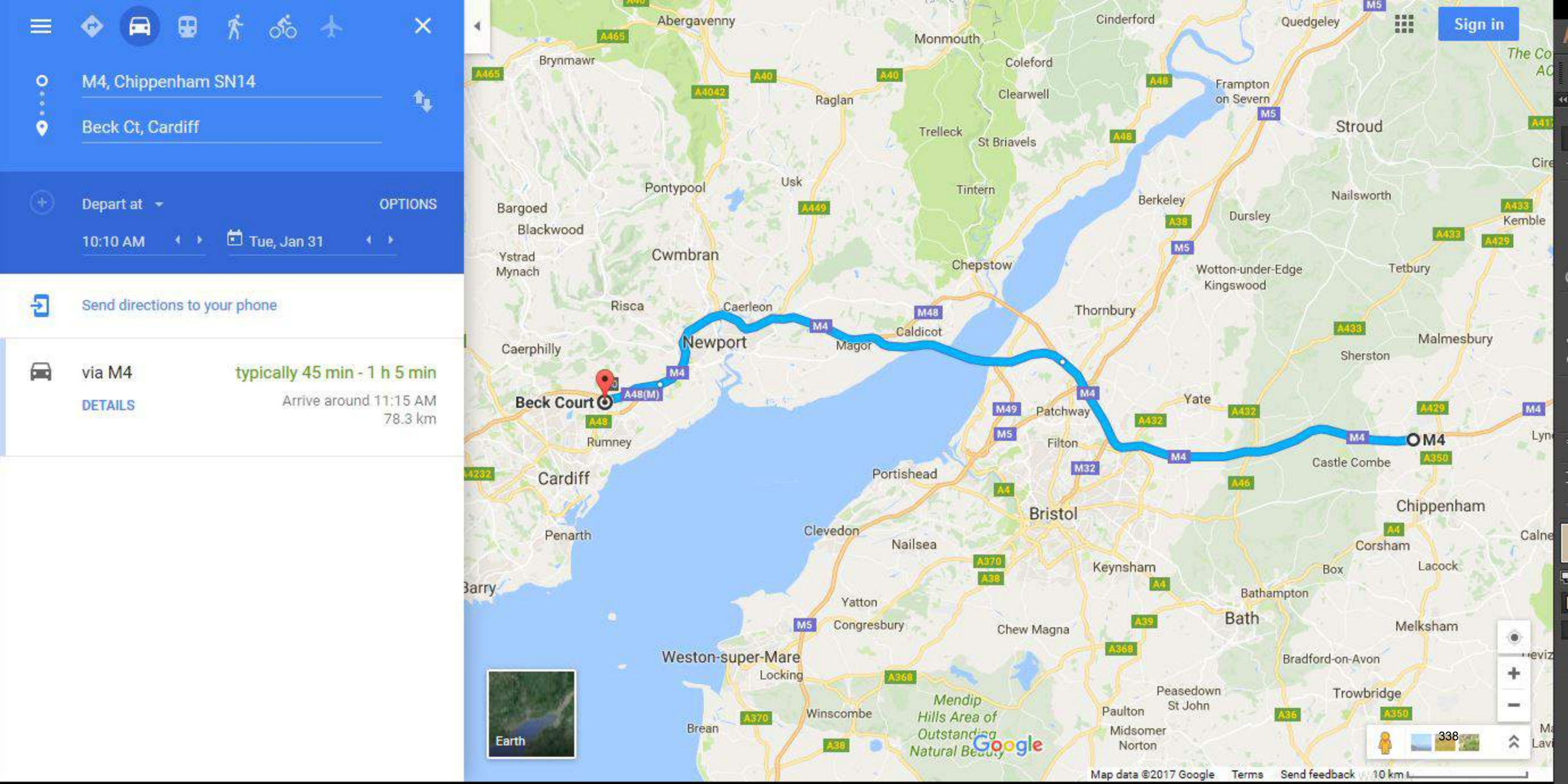

Malthouse Ave, Pontprennau, Cardiff CF
M5, Bristol BS20
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 35 - 45 min
DETAILS
Arrive around 10:45 AM
52.1 km
35 - 45 mins
52.1 km
Malthouse Avenue
M5
Newport
Cardiff
Sign in
Earth
Map data ©2017 Google
Terms
Send feedback
5 km

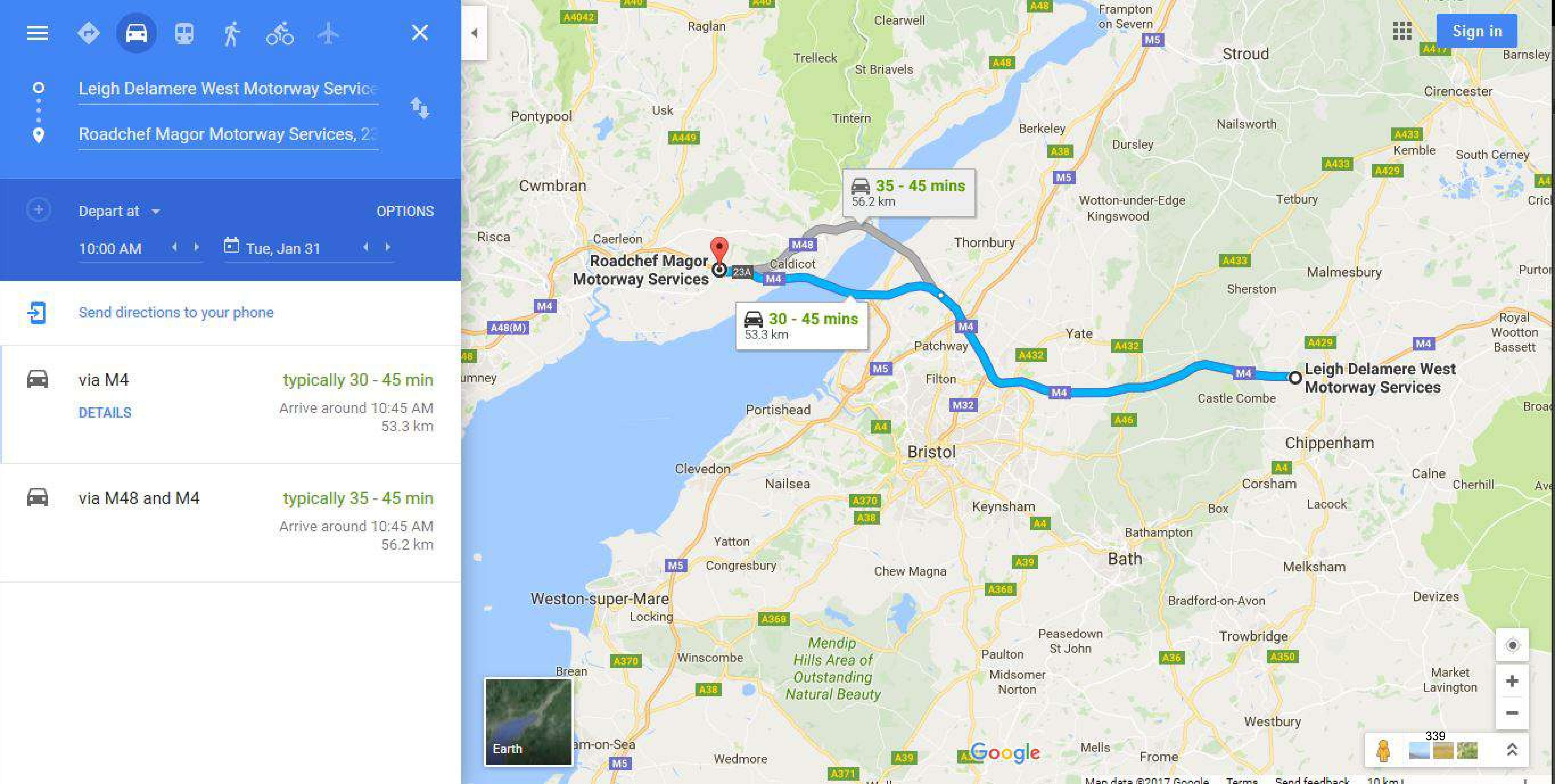

Beck Ct, Cardiff
M4, Chippenham SN14
Depart at
OPTIONS
10:10 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 45 min - 1 h
DETAILS
Arrive around 11:10 AM
78.0 km
Sign in
45 min - 1 h
78.0 km
Beck Court
M4
Abergavenny
Monmouth
Cinderford
Quedgeley
Brynmawr
Coleford
Clearwell
Frampton on Severn
Stroud
Raglan
Trelleck
St Briavels
Tintern
Pontypool
Usk
Bargoed
Blackwood
Ystrad Mynach
Cwmbran
Berkeley
Dursley
Nailsworth
Chepstow
Wotton-under-Edge
Kingswood
Tetbury
Risca
Caerleon
Newport
Caerphilly
Magor
Caldicot
Thornbury
Sherston
Malmesbury
Rumney
Cardiff
Filton
Yate
Castle Combe
Portishead
Bristol
Chippenham
Penarth
Clevedon
Nailsea
Keynsham
Corsham
Lacock
Box
Barry
Yatton
Congresbury
Chew Magna
Bathampton
Bath
Melksham
Weston-super-Mare
Locking
Winscombe
Bradford-on-Avon
Peasedown St John
Trowbridge
Brean
Paulton
Midsomer Norton
Mendip Hills Area of Outstanding Natural Beauty
Earth
Google
Map data ©2017 Google
Terms
Send feedback
10 km
334

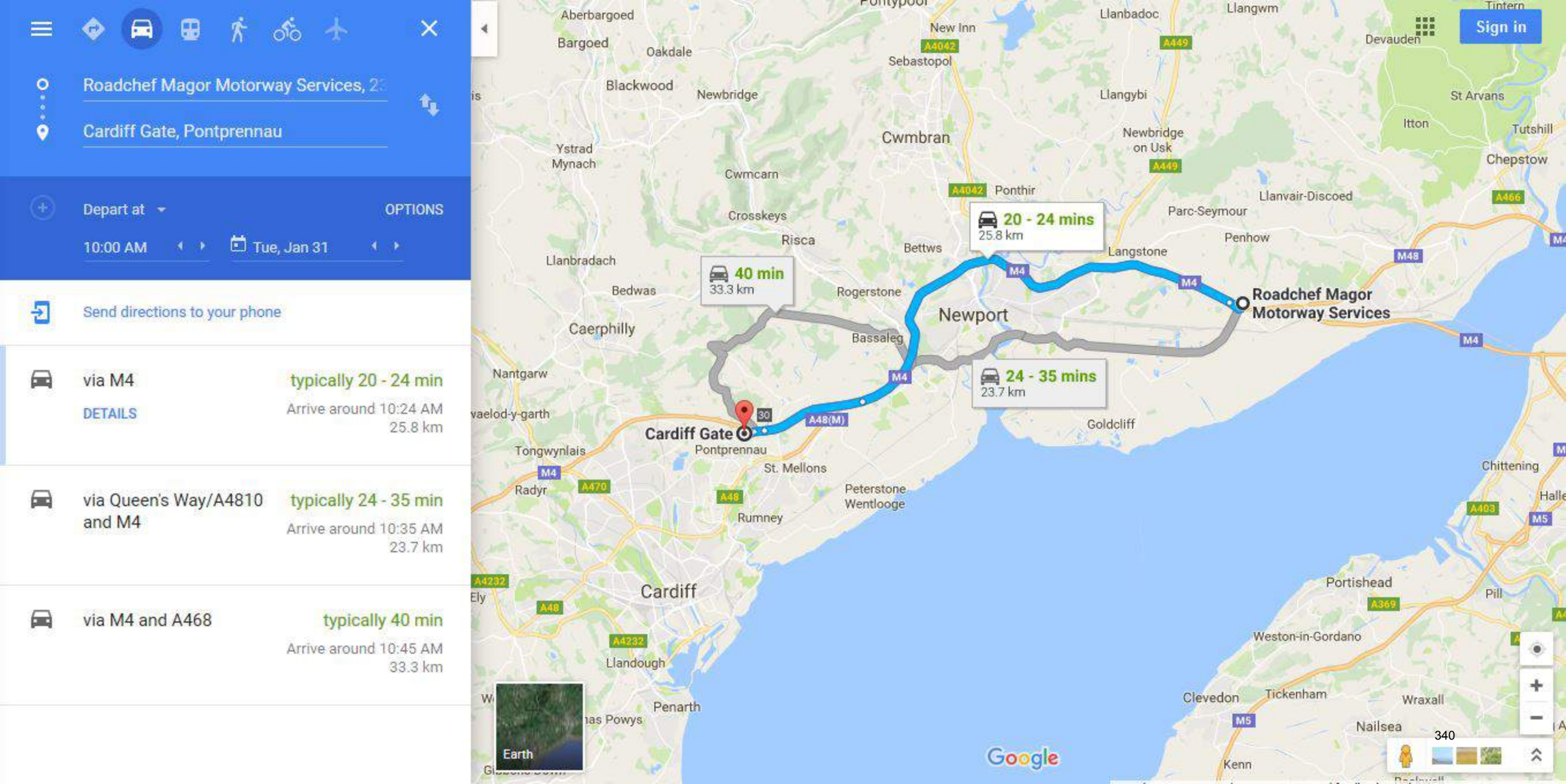

Cardiff Gate, Pontprennau
Roadchef Magor Motorway Services, 23
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 18 - 22 min
DETAILS
Arrive around 10:22 AM
25.7 km
via M4 and Queen's Way/A4810
typically 26 - 35 min
Arrive around 10:35 AM
24.0 km
18 - 22 mins
25.7 km
26 - 35 mins
24.0 km
Roadchef Magor Motorway Services
Cardiff Gate
Newport
Cardiff
Pontypool
Cwmbran
Caerphilly
Sign in
Earth
Google
Map data ©2017 Google
Terms
Send feedback
5 km
335

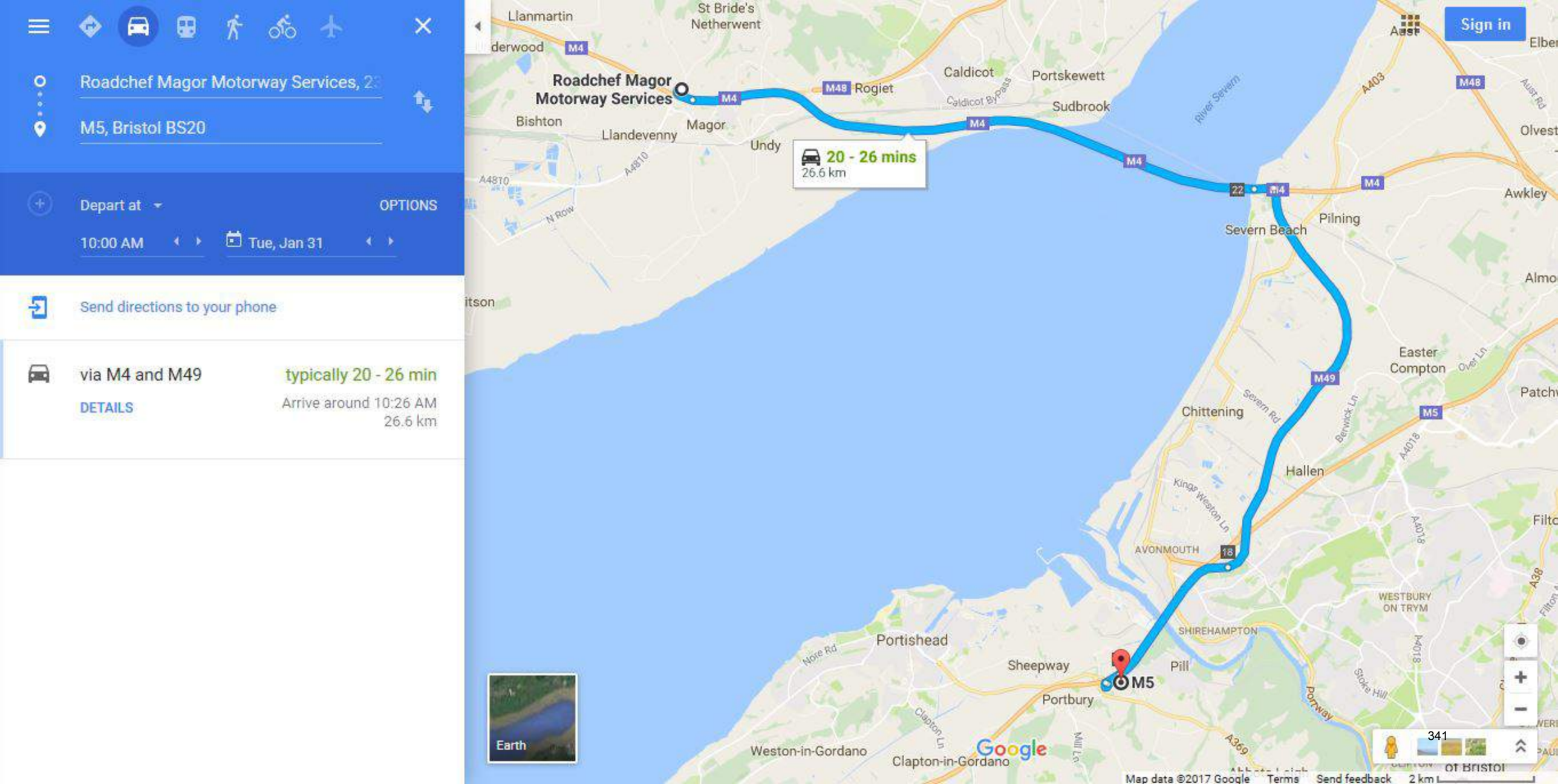

M5, Bristol BS20
althouse Ave, Pontprennau, Cardiff
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 35 - 50 min
DETAILS
Arrive around 10:50 AM
52.2 km
35 - 50 mins
52.2 km
Malthouse Avenue
M5
Sign in
Pontypool
New Inn
Usk
Tintern
Bargoed
Blackwood
Ystrad Mynach
Cwmbran
Chepstow
Risca
Caerleon
Langstone
Caldicot
Newport
Caerphilly
Rumney
Cardiff
Penarth
Portishead
Clevedon
Nailsea
Bristol
Yatton
Congresbury
Patchway
Filton
A449
M48
M4
A470
A48(M)
A48
A4232
M49
M5
A4
A370
A38
Earth
Google
Map data ©2017 Google
Terms
Send feedback
5 km

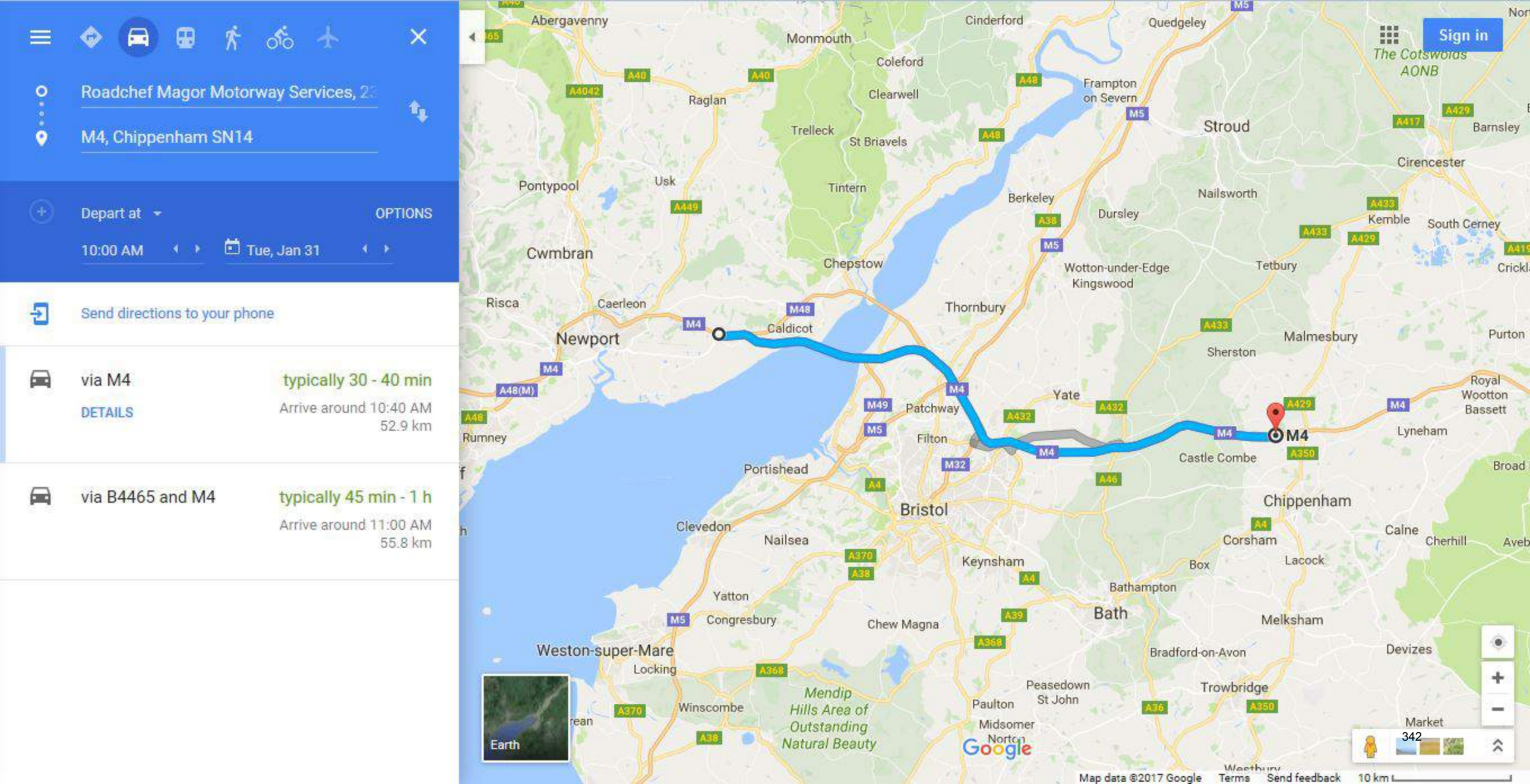

M5, Bristol BS20
Roadchef Magor Motorway Services, 23
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M49 and M4
typically 20 - 26 min
DETAILS
Arrive around 10:26 AM
26.7 km
Sign in
Roadchef Magor Motorway Services
20 - 26 mins
26.7 km
Llanmartin
St Bride's Netherwent
Caldicot
Portskewett
Rogiet
Sudbrook
Bishton
Llandevenny
Magor
Undy
Severn Beach
Pilning
Awkley
Chittening
Easter Compton
Hallen
AVONMOUTH
SHIREHAMPTON
WESTBURY ON TRYM
Portishead
Sheepway
Pill
Portbury
Weston-in-Gordano
Clapton-in-Gordano
Earth
Google
Map data ©2017 Google
Terms
Send feedback
2 km

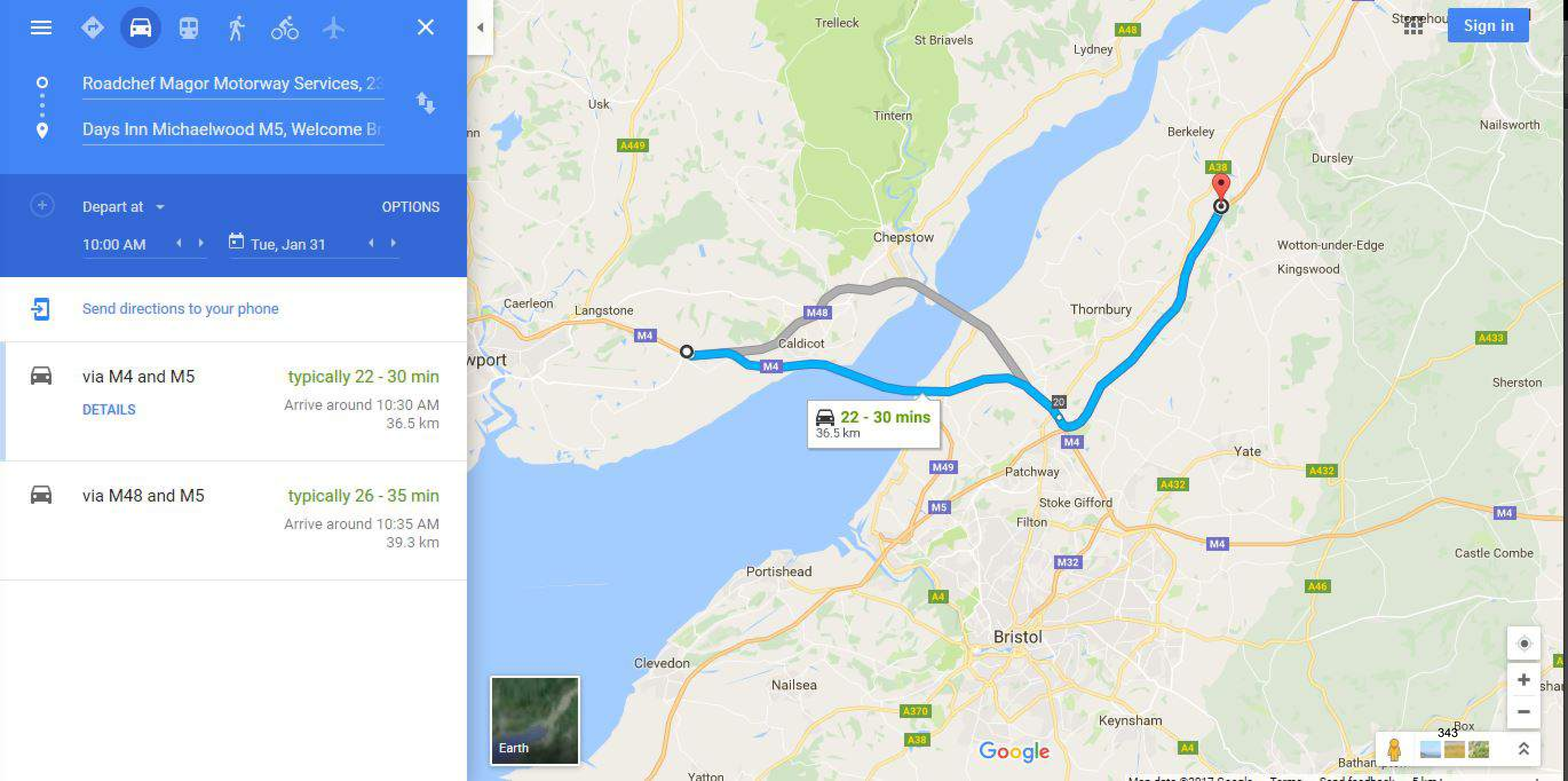

M4, Chippenham SN14
Beck Ct, Cardiff
Depart at
OPTIONS
10:10 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 45 min - 1 h 5 min
DETAILS
Arrive around 11:15 AM
78.3 km
Sign in
Beck Court
M4
Earth
Map data ©2017 Google
Terms
Send feedback
10 km
Google

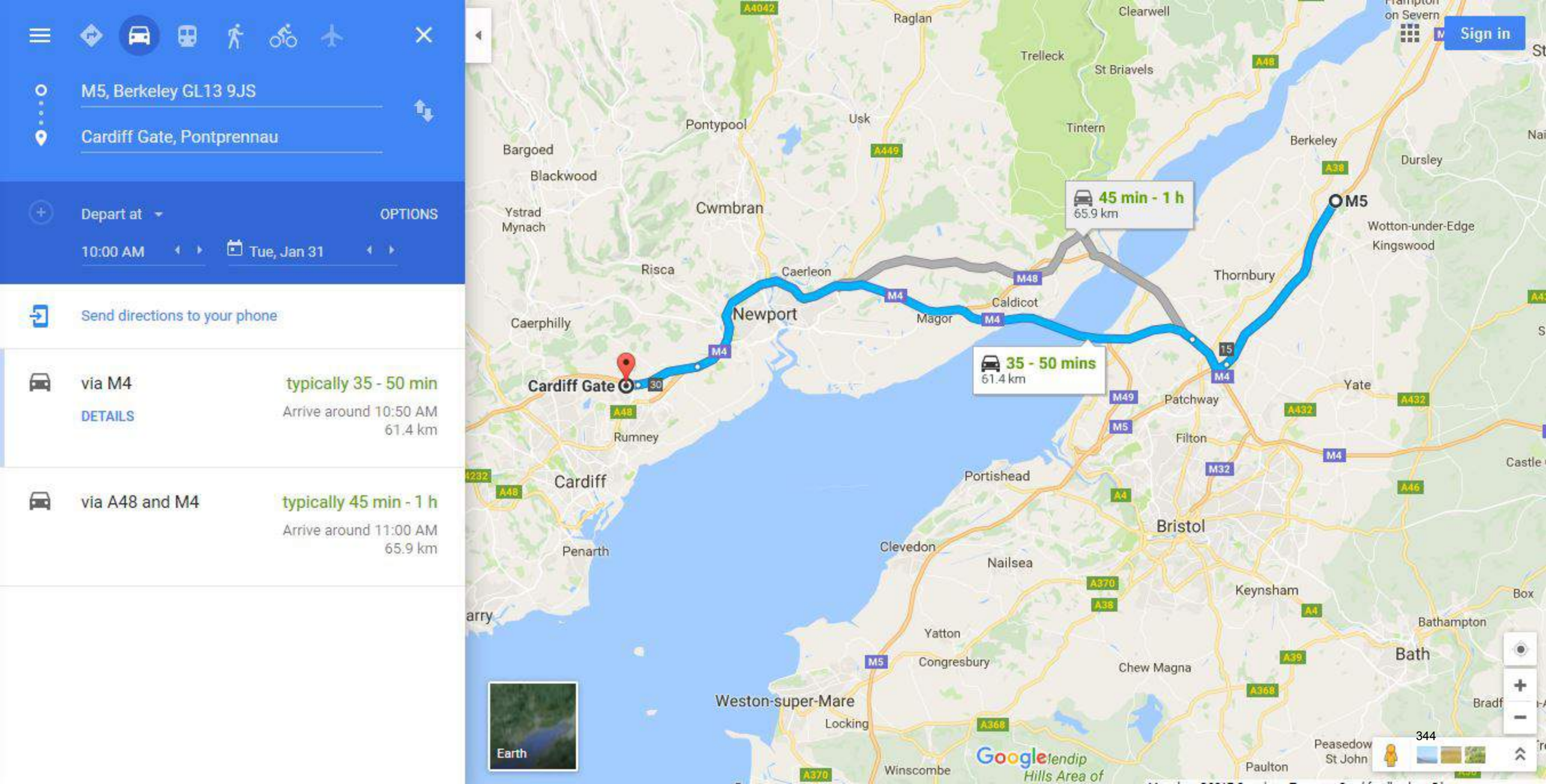

Leigh Delamere West Motorway Servic
Roadchef Magor Motorway Services, 2
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 30 - 45 min
DETAILS
Arrive around 10:45 AM
53.3 km
via M48 and M4
typically 35 - 45 min
Arrive around 10:45 AM
56.2 km
Sign in
35 - 45 mins
56.2 km
30 - 45 mins
53.3 km
Roadchef Magor Motorway Services
Leigh Delamere West Motorway Services
Bristol
Bath
Chippenham
Stroud
Cwmbran
Weston-super-Mare
Mendip Hills Area of Outstanding Natural Beauty
Earth
Google
Map data ©2017 Google

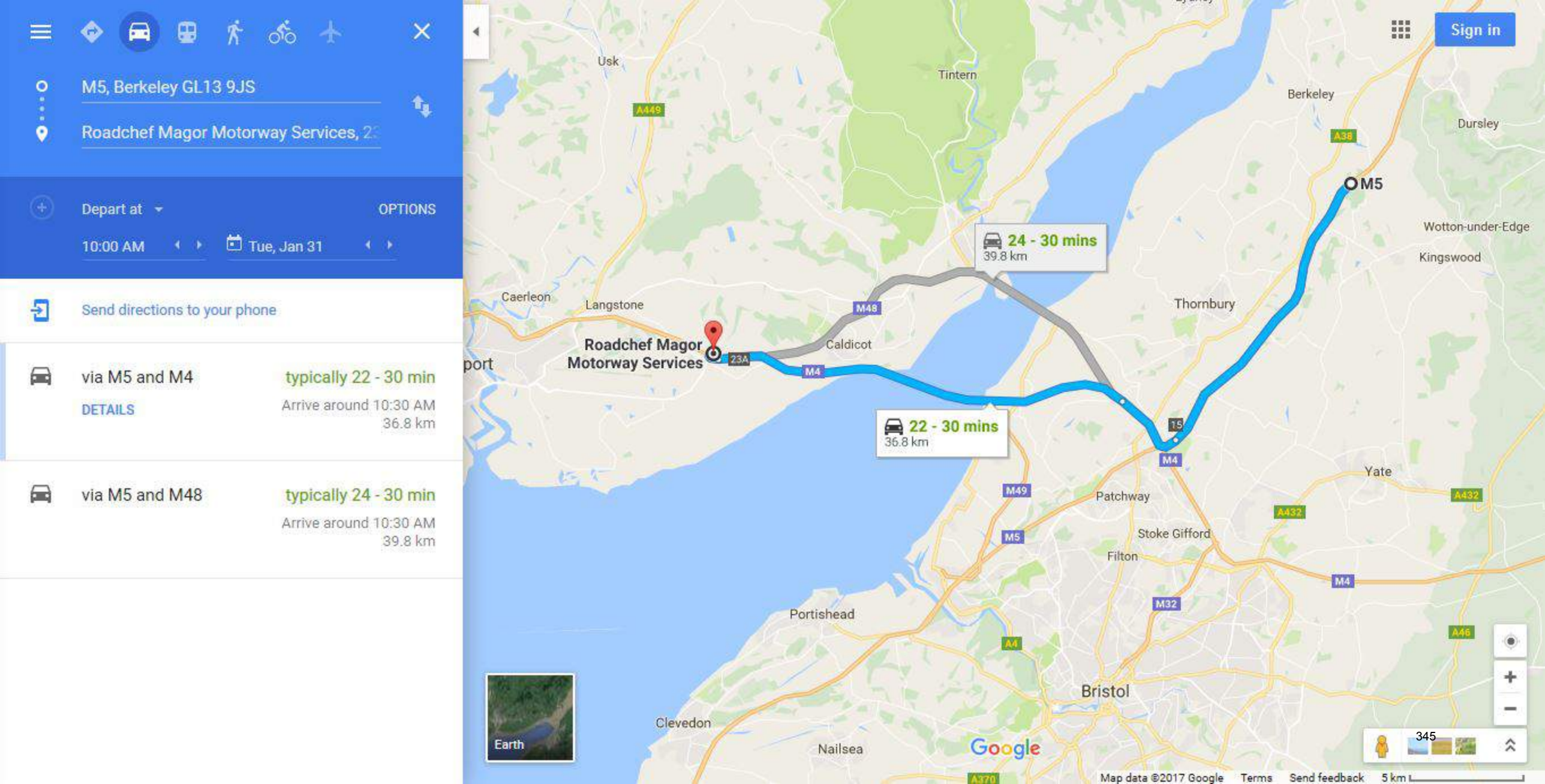

Roadchef Magor Motorway Services, 2
Cardiff Gate, Pontprennau
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 20 - 24 min
DETAILS
Arrive around 10:24 AM
25.8 km
via Queen's Way/A4810 and M4
typically 24 - 35 min
Arrive around 10:35 AM
23.7 km
via M4 and A468
typically 40 min
Arrive around 10:45 AM
33.3 km
20 - 24 mins
25.8 km
40 min
33.3 km
24 - 35 mins
23.7 km
Roadchef Magor Motorway Services
Cardiff Gate
Newport
Cardiff
Sign in
Earth
Google
340


Roadchef Magor Motorway Services, 2
M5, Bristol BS20
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4 and M49
typically 20 - 26 min
DETAILS
Arrive around 10:26 AM
26.6 km
Roadchef Magor Motorway Services
20 - 26 mins
26.6 km
Sign in
Earth
M5
Google
Map data ©2017 Google
Terms
Send feedback
2 km


Roadchef Magor Motorway Services, 2
M4, Chippenham SN14
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 30 - 40 min
DETAILS
Arrive around 10:40 AM
52.9 km
via B4465 and M4
typically 45 min - 1 h
Arrive around 11:00 AM
55.8 km
Sign in
Abergavenny
Monmouth
Cinderford
Quedgeley
The Cotswolds AONB
Coleford
Clearwell
Frampton on Severn
Stroud
Barnsley
Raglan
Trelleck
St Briavels
Cirencester
Pontypool
Usk
Tintern
Berkeley
Dursley
Nailsworth
Kemble
South Cerney
Cwmbran
Chepstow
Wotton-under-Edge
Kingswood
Tetbury
Risca
Caerleon
Thornbury
Newport
Caldicot
Malmesbury
Sherston
Purton
Yate
Royal Wootton Bassett
Patchway
Filton
Lyneham
Rumney
Portishead
Castle Combe
M4
Broad
Bristol
Chippenham
Clevedon
Nailsea
Corsham
Calne
Cherhill
Keynsham
Box
Lacock
Yatton
Bathampton
Congresbury
Chew Magna
Bath
Melksham
Weston-super-Mare
Locking
Bradford-on-Avon
Devizes
Winscombe
Peasedown St John
Trowbridge
Paulton
Midsomer Norton
Market
Mendip Hills Area of Outstanding Natural Beauty
Earth
Google
Map data ©2017 Google
Terms
Send feedback
10 km


Roadchef Magor Motorway Services, 2
Days Inn Michaelwood M5, Welcome B
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4 and M5
typically 22 - 30 min
DETAILS
Arrive around 10:30 AM
36.5 km
via M48 and M5
typically 26 - 35 min
Arrive around 10:35 AM
39.3 km
22 - 30 mins
36.5 km
Sign in
Trelleck
St Briavels
Lydney
Usk
Tintern
Berkeley
Nailsworth
Dursley
Chepstow
Wotton-under-Edge
Kingswood
Caerleon
Langstone
Thornbury
Caldicot
Yate
Patchway
Stoke Gifford
Filton
Sherston
Castle Combe
Portishead
Bristol
Clevedon
Nailsea
Keynsham
Earth
Google


M5, Berkeley GL13 9JS
Cardiff Gate, Pontprennau
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M4
typically 35 - 50 min
DETAILS
Arrive around 10:50 AM
61.4 km
via A48 and M4
typically 45 min - 1 h
Arrive around 11:00 AM
65.9 km
45 min - 1 h
65.9 km
35 - 50 mins
61.4 km
Sign in
Cardiff Gate
M5
Newport
Cardiff
Bristol
Weston-super-Mare
Bath
Earth
Raglan
Clearwell
Trelleck
St Briavels
Pontypool
Usk
Tintern
Berkeley
Dursley
Bargoed
Blackwood
Ystrad Mynach
Cwmbran
Risca
Caerleon
Caerphilly
Magor
Caldicot
Thornbury
Wotton-under-Edge
Kingswood
Rumney
Patchway
Yate
Filton
Portishead
Clevedon
Nailsea
Keynsham
Bathampton
Yatton
Congresbury
Chew Magna
Locking
Winscombe
Paulton
Peasedown St John
Penarth
344


M5, Berkeley GL13 9JS
Roadchef Magor Motorway Services, 2
Depart at
OPTIONS
10:00 AM
Tue, Jan 31
Send directions to your phone
via M5 and M4
typically 22 - 30 min
DETAILS
Arrive around 10:30 AM
36.8 km
via M5 and M48
typically 24 - 30 min
Arrive around 10:30 AM
39.8 km
Sign in
24 - 30 mins
39.8 km
22 - 30 mins
36.8 km
Roadchef Magor Motorway Services
M5
Usk
Tintern
Berkeley
Dursley
Wotton-under-Edge
Kingswood
Thornbury
Caerleon
Langstone
Caldicot
Yate
Patchway
Stoke Gifford
Filton
Portishead
Bristol
Clevedon
Nailsea
Earth
Google
Map data ©2017 Google
Terms
Send feedback
5 km

Cardiff Gate, Pontprennau

Days Inn Michaelwood M5, Welcome Br

Depart at OPTIONS

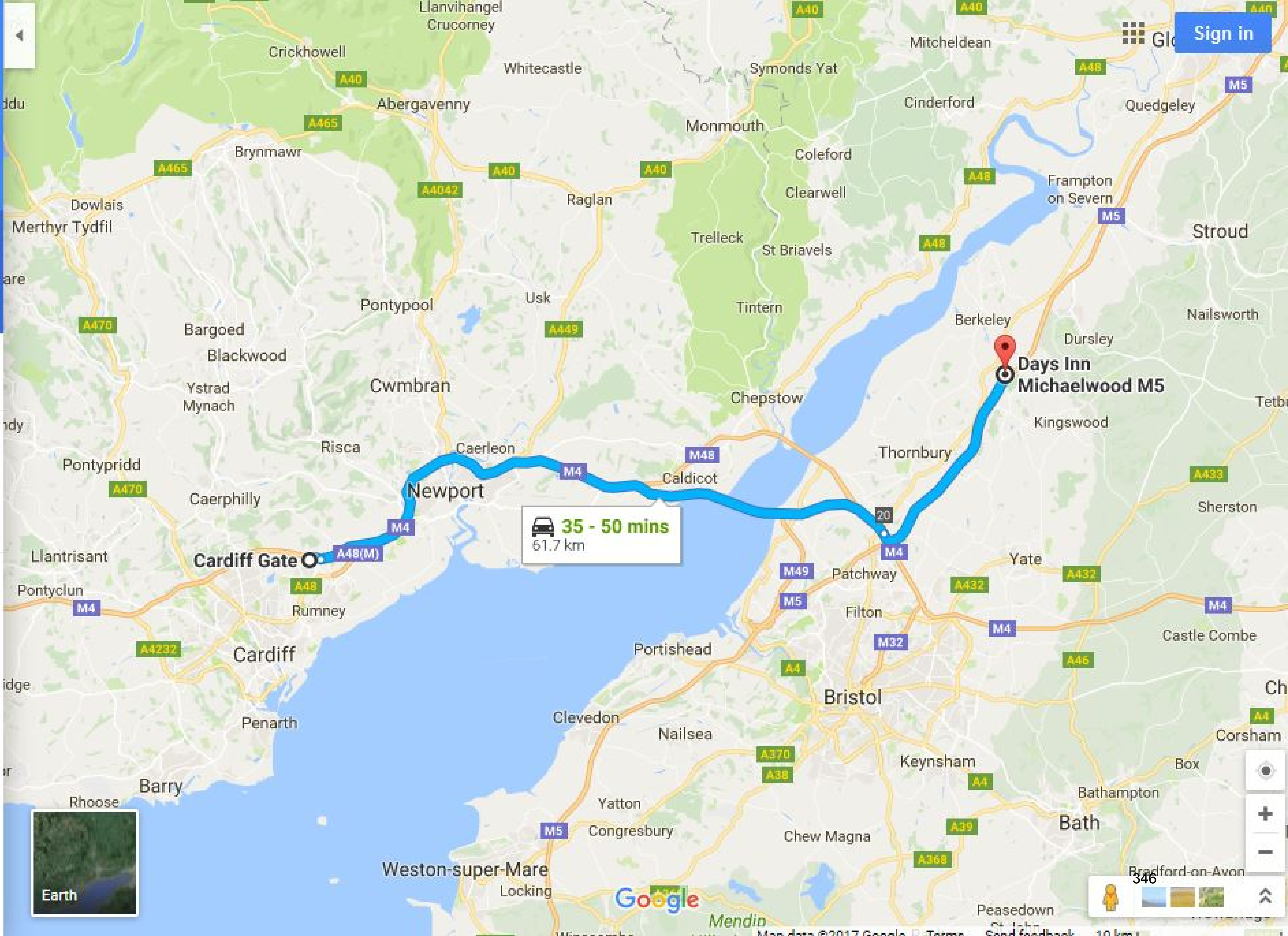
10:00 AM Tue, Jan 31

Send directions to your phone

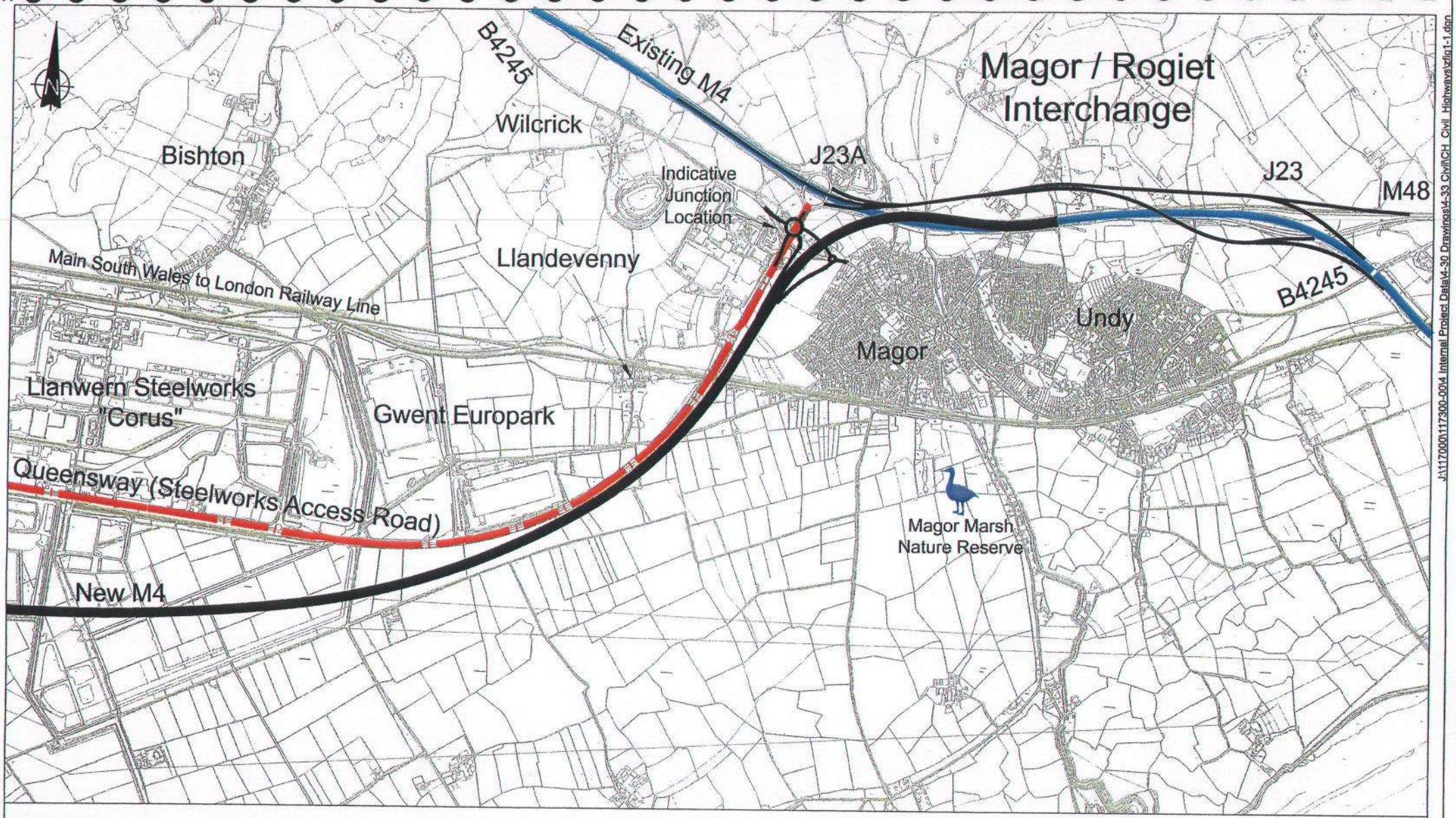
via M4 typically 35 - 50 min

DETAILS Arrive around 10:50 AM

61.7 km



APPENDIX MA12 – EXTRACT FROM APRIL 2006 JUNCTION STRATEGY REVIEW



ARUP

4 Pierhead St. Capital Waterside
Cardiff, CF10 4QP
Tel 44(0)029 20473727 Fax +44(0)029 20 472277
www.arup.com

Client

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Uned M4 Newydd
Yr Is-adran Rhaeffyrdd a Ffyrdd Newydd 10
Trafnidiaeth Cymru
Parc Cathays
Caerdydd
CF10 3NQ

New M4 Unit
Rail and New Roads Division 10
Transport Wales
Cathays Park
Cardiff
CF10 3NQ

Job Title

New M4 Project Magor (J23) to Castleton (J29)
Prosiect yr M4 Newydd Magwyr (C23) i Gas-bach (C29)

Drawing Title

Illustrative Magor/Rogiet Interchange and Magor Junction

Scale at A4 1:25000

Plot ID

Drawing Status

Job No	Drawing No	Issue
117300	Figure 1.1	

APPENDIX MA13 – MCC CORRESPONDENCE

Clara Evans

From: Schmidt, Christian A. <ChristianSchmidt@monmouthshire.gov.uk>
Sent: 04 July 2016 17:23
To: Ian Southwell
Subject: RE: Severn Tunnel Park and Ride

Follow Up Flag: Follow up
Flag Status: Completed

Ian,

Sewta undertook a Severn Tunnel Interchange study in 2011. This can be found at http://sewta.gov.uk/other-documents/studies/. There was a subsequent public consultation on the plans, I can send you the report if you wish.

The proposals included a link road to the M48 along the east side of Rogiet, at a cost of £25m, and did not get anywhere – mainly through lack of funding. Subsequently MCC did some work. Firstly some spaces were created on the south side – these are well visible on google maps (satellite view). This is quite informal and free. Secondly this spring MCC constructed a 70-space car park extension on the north side next to the playing fields – roughly the brown strip next to the trees. This was funded with the help of Welsh Government and GWR grants. There will be a charge of £2.60 / day (i.e. £1 less than the main car park) once we got the car parking order approved and implemented.

There is though still a problem, demand is clearly out stripping supply, leading to lower passenger numbers commuters parking on local streets in Rogiet. (And this will get worse between September and April when the road overbridge is closed for electrification work and thus the south side spaces out of action.)

MCC is currently looking at plans to develop STJ further. Firstly we are looking at improved walking & cycle access to the STJ, which I would hope would lead to some passengers from the local Severnside area (Magor-Caldicot) using alternative means to access the station. Specifically, we are looking at upgrading the track along the railway between STJ station and Caldicot, a pavement/footpath for Station Approach/Station Road (where it is missing), and a safe footpath along the B4245 between Rogiet and Magor/Undy. The last one is mixed up a bit with the new M4 proposal – MCC believes WG should provide this if the motorway junction is moved to the east of Magor/Undy.

We are also looking at further car park extensions around the station, but there is no absolute certainty where this could go. The original plans suggested to the north of the station, but this would require some of the playing fields / adjacent fields, and I understand this was not popular when last looked at. There is quite a bit land to the north west (north of the railway, west of the roadbridge), but this is Network Rail's who have stated they require a base for accessing the tunnel (in case of emergencies, or works). Again note that the new M4 proposals may enable a new access to STJ station to be provided along the west side of Rogiet. The land to the south is council owned, some is currently temporary leased to network Rail (some of which they needed to construct the new accessible pedestrian bridge, some of which they will need to reconstruct the road overbridge), I understand the rest is part of a country park. If we could get 100-200 spaces, then I would also be looking to slightly reduce the number of spaces in the current car park to improve station facilities (e.g. more cycle parking, a café, a better bus stop).

As to station users, together with the Severn Tunnel Action Group we have undertaken a passenger survey during April. I'm currently trying to get the report ready, and would be able to send you a copy once this is done.

Regards,

Christian

Christian Schmidt

Transport Planning & Policy Officer / Swyddog Polisi a Chynllunio Trafnidiaeth
Monmouthshire County Council / Cyngor Sir Fynwy
Tel / Ffôn: 01633 64 (4727)
Mobile / Symudol: 07471 479238
Email / Ebos: christianschmidt@monmouthshire.gov.uk
Website / Gwefan: www.monmouthshire.gov.uk

Follow us on Twitter / Dilynwch ni ar Twitter: www.twitter.com/monmouthshirecc

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From: Ian Southwell □mailto:Ian.Southwell□vectos.co.uk□
Sent: 28 June 2016 11:43
To: Schmidt, Christian A.
Subject: Severn Tunnel Park and Ride

Christian,

I understand that you may be the best person to contact in relation to possible proposals for a Park and Ride at Severn Tunnel Junction.

Have any proposals been worked up, and if so, are they available to view?

I believe you undertook a consultation exercise recently in relation to the possible Park and Ride proposals. Is there any feedback available in relation to this?

A few more quick questions which may be easier to answer:

- Where will the Park and Ride be located and how will it connect to the road network and the rail network?
- How many parking spaces are proposed?
- What is the catchment of the Park and Ride?
- Which trips is it hoped it will remove from the network – westbound (in the AM) car trips of the M4, eastbound (in the AM) car trips on the M4, other local car trips?

Any information which you can provided in relation to any of the above would be greatly appreciated.

Thanks,

Ian

Ian Southwell
Associate Director

vectos
transport planning specialists

029 2072 0865 (T) 07825 792 830 (M)
Ian.Southwell@vectos.co.uk

10th Floor Helmont House, Churchill Way, Cardiff, CF10 2HE