A82 Tarbet to Inverarnan Upgrade

DMRB Stage 1 Assessment Report

Transport Scotland

February 2014

Volume 1

TRANSPORT SCOTLAND

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DMRB Stage 1 Assessment Report – Volume 1

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1. Introduction

1.1 Background

In June 2013, Transport Scotland commissioned the 'A82 Tarbet to Inverarnan, Single-Supplier Framework Agreement for Provision of the Design, Investigative and Environmental Services', to carry out the necessary works to complete a Design Manual for Roads and Bridges (DMRB) Stage 1 and Stage 2 Assessment for the proposed upgrade of a section of the A82 Trunk Road between Tarbet and north of Inverarnan. The framework agreement, being undertaken by CH2M HILL Fairhurst JV (CFJV), allows for further stages to be undertaken pending availability of funding and appropriate commitment from Scottish Ministers.

The requirements of the Scheme Brief are as follows:-

- review of existing information;
- conduct a problems and opportunities validation consistent with Scottish Transport Appraisal Guidance (STAG) appraisal procedures, assess traffic and economics and prepare a Strategic Business Case;
- deliver an Inception Report;
- assist in the preparation and maintenance of a Project Execution Plan and a Risk Register;
- deliver a DMRB Stage 1 Assessment Report;
- undertake an Environmental Assessment of the baseline condition over the area which could be significantly affected by any route corridors;
- undertake the procurement, supervision and reporting of any topographical, bathymetric, ground and pavement investigations, traffic and environmental surveys as required;
- deliver a DMRB Stage 2 Scheme Assessment Report;
- deliver a Stage 2 Environmental Assessment and Record of Determination;
- give presentations to Key Investment Decision Makers;
- procure Road Safety Audits;
- arrange and attend a public exhibition for the scheme as required;
- assess and report on responses to consultation exercises;
- assist in the preparation and publication of impact assessments as required;
- assist with workshops as required; and
- undertake the duties of Construction Design Management (CDM) Co-ordinator.

There will be a specific hold point in the scheme development following submission of the Scheme Brief requirements listed above. Progress beyond this stage will depend on the receipt of approval from Transport Scotland to proceed to the next

stage in the scheme development. Following this specific hold point, the requirements of the Scheme Brief are as follows:-

- provide a DMRB Stage 3 Scheme Assessment Report for the preferred scheme option and prepare a Record of Determination to determine whether or not an Environmental Statement is required;
- prepare appropriate preliminary or detailed designs, and prepare and update cost estimates as necessary;
- prepare all necessary consultation documentation required in connection with any Scottish Statutory Instruments (SSIs) for the scheme;
- assist in the preparation and publication of the SSIs;
- assist with all aspects of the Public Local Inquiry;
- assist with the preparation of Tender and Contract documents;
- assist with the procurement and award of the construction contract;
- carry out site supervision activities during the construction of the scheme; and
- undertake post construction monitoring and evaluation of the scheme.

Initially the brief was to consider the section of A82 from a point just to the north of Tarbet (end of 30mph speed limit) to just north of Inverarnan. However, following a query from stakeholders about the extent of the study, Transport Scotland subsequently confirmed that the study will extend to the south of the A82/A83 junction at Tarbet. The data on the existing route gathered to date is predominantly for the section of A82 covered by the original brief. However, updates to include Tarbet have been provided where possible. More detailed engineering alignments in this vicinity will be considered as part of the DMRB Stage 2 Assessment.

The revised study area therefore covers a length of approximately 17 kilometres from a point just south of Tarbet (start of 30mph speed restriction) to a point north of Inverarnan where the carriageway cross-section widens to 7.3 metres with near standard verge widths.

Figure 1.1 indicates the extents of the study area. Refer also to drawing 476416.0000.017 within Volume 2.

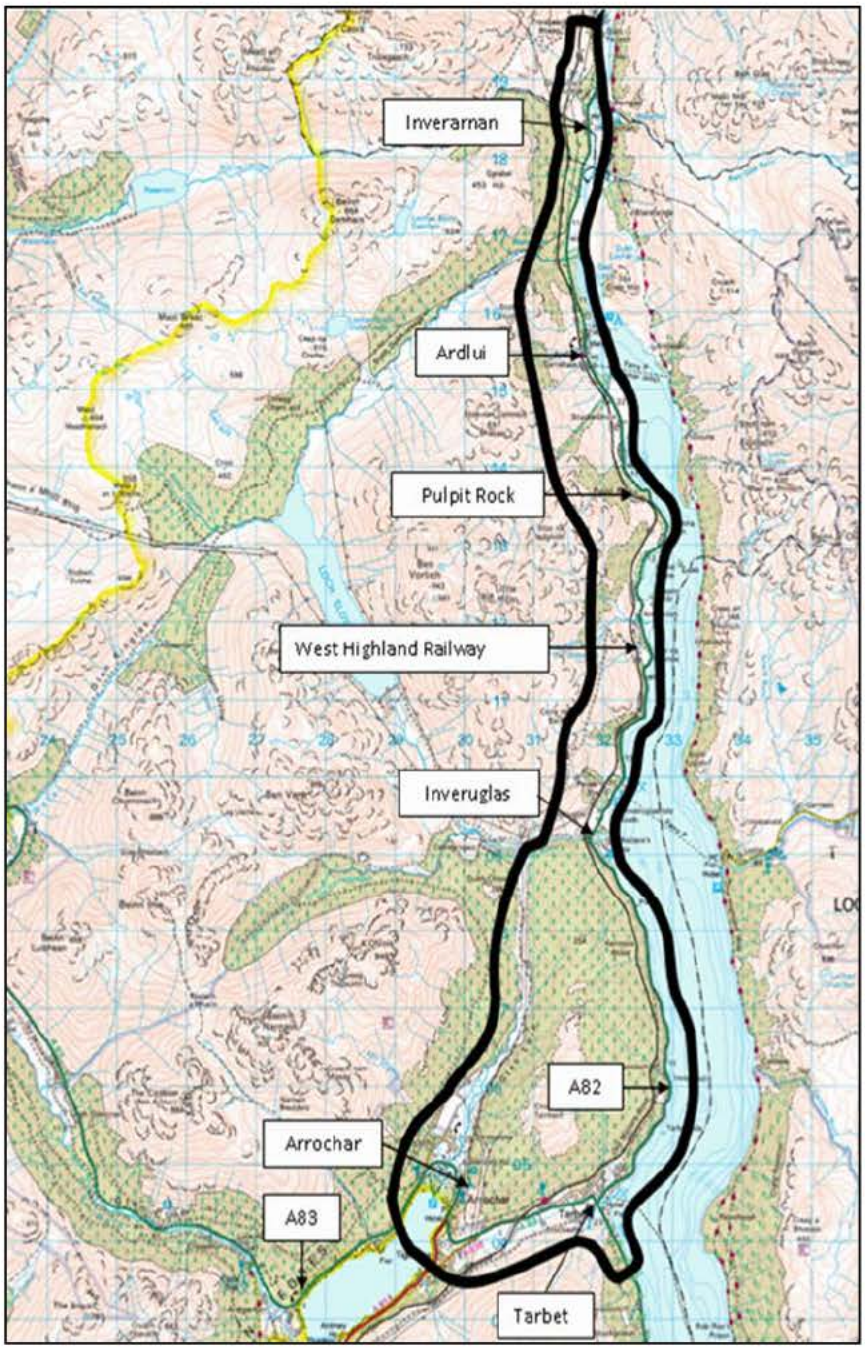

Figure 1.1: Study area

1.2 Need for the Scheme

The A82 trunk road is considered to be an economic lifeline not only to the communities directly served by the route, but also to the wider region to the west and north west of Scotland.

In DMRB terms, the existing road between Tarbet and Inverarnan consists of sub-standard cross-sections over much of its length and sub-standard horizontal and vertical geometry, characterised by tight radii and a lack of forward visibility. In addition, existing drainage is poor over significant lengths of the route resulting in surface water on the road even during dry weather. Furthermore, the sub-standard

cross-section limits the ability to carry out routine maintenance without a full road closure resulting in costly and disruptive maintenance operations.

These primary factors all contribute to traffic experiencing average low journey speeds and a high accident rate. As such, the road in its current state is considered to not be fit for purpose. Improvements to the A82 have been identified within the Strategic Transport Project Review.

1.3 Scheme Objectives

The design of the scheme shall be in accordance with the Government's appraisal criteria for the assessment of trunk road schemes, which take account of integration, economy, safety, environment, social inclusion and accessibility impacts. Following the preparation of a Strategic Business Case, the following key transport planning objectives were identified:-

- to improve average journey times for A82 trunk road users between Tarbet and Inverarnan (based on observed post Pulpit Rock scheme);
- to reduce personal injury accident numbers and their severity on the A82 between Tarbet and Inverarnan to be closer to or better than national KSI rates;
- to increase formal parking capacity between Tarbet and Inverarnan through appropriate opportunities that take account of the unique setting of the route within the National Park;
- seek to provide opportunities to integrate with Loch Lomond and Trossachs National Park Authority (LLTNPA) objectives for the provision of enhanced/new Non Motorised User (NMU) infrastructure and facilities; and
- to reduce disruption to road users resulting from the undertaking of maintenance activities on the A82 between Tarbet and Inverarnan.

Further details of the scheme objectives can be found in the Strategic Business Case.

1.4 Consultations

Successful delivery of the Tarbet to Inverarnan Upgrade scheme will be influenced through engagement with key stakeholders and their involvement through consultation. The aims for consultation and engagement are to:-

- engage and inform interested parties to allow their expertise and knowledge to influence considerations during assessments;
- promote consultation with the community and their representatives so as to allow issues and concerns to be understood and addressed; and
- help de-risk the scheme promotion process.

1.4.1 Key stakeholders and statutory consultees

Key stakeholders, statutory consultees and parties interested in the project have been identified as being the following:-

- AA/RAC;
- Argyll and Bute Council (Development and Infrastructure Services);

- Arrochar and Tarbet Community Council;
- A82 Partnership – an umbrella group campaigning for upgrading of the A82;
- BEAR Scotland Limited;
- Freight Transport Association;
- Friends of Loch Lomond and The Trossachs – an independent conservation and heritage charity;
- Forestry Commission Scotland;
- Fort William & District Chamber of Commerce;
- Highlands and Islands Transport Partnership (HITRANS);
- Historic Scotland;
- Land owners and business interests dependant on the A82 (including bus operators such as Scottish Citylink and rail operators such as ScotRail);
- Loch Lomond and Trossachs National Park Authority (LLTNPA);
- Loch Lomond Association;
- Loch Lomond Bat Group;
- Loch Lomond Fisheries Trust;
- Members of the Scottish Parliament (MSPs) and Argyll and Bute Councillors for Lomond North (three councillors);
- Mid Argyll Chamber of Commerce;
- National Trust for Scotland;
- Network Rail;
- Police Scotland and other emergency services;
- Residents of Tarbet, Inverarnan and along the route;
- Road Haulage Association (Scotland and Northern Ireland);
- Royal Society for the Protection of Birds (RSPB);
- Scottish Enterprise;
- Scottish Environment Protection Agency (SEPA);
- Scottish Natural Heritage (SNH);
- Scottish Rights of Way and Access Society;
- Scottish Wildlife Trust;
- Stirling Council;
- Strathfillan Community Council;
- Sustrans;

- The Highland Council;
- Transport Scotland;
- Utilities (Scottish Gas Networks, Scottish Power, Scottish Water and Scottish and Southern Energy as well as telecommunications networks);
- Visit Scotland; and
- West of Scotland Archaeological Service.

Stakeholder engagement shall commence early and pro-actively inform, engage, listen, communicate and address issues for consultees and stakeholders in the considerations of the A82 Upgrade. It is important to build on previous communications and discussions undertaken in 2012 as part of the engineering and environmental surveys, during key stages of the project. These are:-

- DMRB Stage 1 preferred corridor assessment;
- DMRB Stage 2 preferred route assessment;
- DMRB Stage 3 preferred scheme assessment;
- Draft Orders; and
- implementation.

Initial feedback suggests there is general support for improvements to this section of the A82 and any future potential conflicts are likely to focus on specific design and mitigation issues. To help focus consultation, an A82 Stakeholder Forum has been established. This Forum will act as a focus through which consultation and engagement workshops can be structured and will allow thematic approaches to be promoted and easily organised.

Significant stakeholder consultations carried out to date include:-

- Inception Workshop attended by Transport Scotland and the LLTNPA held on 28th June 2013;
- introductory letters issued to stakeholders;
- leaflet drop to property owners on existing route;
- initial A82 Stakeholder Forum held on 2nd October 2013; and
- details of project activity posted on website.

1.5 Scheme Appraisal

The A82 Tarbet to Inverarnan services brief requires the scheme to be appraised in a manner that is consistent with both Scottish Transport Appraisal Guidance (STAG) (WP1) and Design Manual for Roads and Bridges (DMRB) Stage 1 and 2 Assessments (WP2 and WP4, respectively) with reports produced to support each. A separate work package (WP9) relates to the traffic and economic assessment, which forms part of the STAG appraisal and DMRB assessments.

There is a significant degree of overlap and compatibility between the requirements of STAG and DMRB with much of the information and analysis required for

completing a STAG appraisal also being suitable for the completion of a DMRB Stage 1 or Stage 2 Assessment. Hence, there will be a close working relationship required for WP1, WP2, WP4 and WP9. In order to meet the required scheme delivery programme, it is intended the STAG Appraisal be conducted in parallel with the DMRB process and, where possible, any overlap and compatibility will be exploited to the benefit of the overall project aims.

Early discussions with Transport Scotland have concluded that previous preliminary assessment work undertaken to support the STPR identification of potential interventions for the A82 was consistent with STAG appraisal requirements and there is no need, therefore, to undertake a further full STAG appraisal for the Tarbet to Inverarnan section of the A82. It is considered more appropriate that a verification and validation review is undertaken, complying with STAG, to confirm previous problems, issues and constraints are still valid, in order to support a Strategic Business Case (SBC). A separate SBC document has been issued to Transport Scotland. A summary of the SBC is as follows:-

- the Strategic Transport Projects Review (STPR), prepared by Transport Scotland in 2009, identifies locations where Scotland's strategic transport network can be improved through more efficient operation or maintenance, making better use of capacity or by implementing targeted infrastructure enhancements;
- STPR Intervention 3 – "Targeted Programme of Measures to Improve Road Standards between Glasgow and Oban/Fort William (A82)" supports the objectives to provide a significant improvement in road standard along the A82 Trunk Road and to reduce the accident severity rates on the route. In addition to a general upgrade of the route, the intervention proposes a number of specific measures including:

  "carriageway widening at selected locations between Tarbet and Inverarnan";
- the SBC outlines the existing conditions along the Tarbet to Inverarnan section, its future operating conditions and sets out the initial business case for improvement by identifying the problems and drivers for change;
- a structured process was followed to derive relevant transport planning objectives which are noted in Section 1.3 above. Sifting and appraisal of the identified corridors resulted in three options being recommended to be taken forward for DMRB Stage 1 assessment. These three corridor options are:

  Option 1 Existing A82 Corridor

  Option 2 Arrochar – Inveruglas – Inverarnan

  Option 3 High Road (Tarbet to Geal Loch to Inverarnan); and
- the SBC also considers the Economic, Commercial, Financial and Management Cases, at a strategic level, for taking the proposed A82 Tarbet to Inverarnan Upgrade scheme forward.

The DMRB Stage 1 assessment of the three corridor options forms the basis of this report.

1.6 Scheme Development History

Relevant previous studies carried out include the following:-

- A82 Route Action Plan Study (2006);
- STPR A82 Technical Reports (2010);
- Engineering and Environmental Surveys (2012); and
- A82 Route Safety File (2012).

In addition, improvements to the A82 are included in the following strategic level documents:-

- Infrastructure Investment Plan (2011); and
- Strategic Transport Projects Review (2009).

An improvement to a section of the route known as Pulpit Rock has been progressed independently of the commission with site works commencing in May 2013 and scheduled to take approximately 12 months to complete.

The improvements at Pulpit Rock will see the removal of traffic signals, and the section of road widened to provide a two-way carriageway by constructing a new viaduct running parallel with Loch Lomond. Benefits resulting from the scheme are expected to include a reduction in accidents, improvements to journey times and reduced driver frustration.

1.7 Method of Assessment

This Route Corridors Assessment Report for the A82 Tarbet to Inverarnan has been prepared in accordance with the guidance for 'Preparation of the Stage 1 Report' as contained in Design Manual for Roads and Bridges, Volume 5, Section 1, Part 2, TD 37 'Scheme Assessment Reporting".

The report describes the current A82 alignment and the proposed corridors options. Preliminary drawings have been prepared which illustrate the extent of each corridor option. At Stage 1, broad improvement strategies are identified and compared. These are generally represented by the three corridor options. These corridors may each be several hundred metres wide, and the Stage 1 Assessment process focuses on the identification of key constraints along each corridor that may prevent the development of a road alignment through them.

The corridors have been assessed to gauge their comparative impact and performance and to enable the appraisal of costs, engineering, traffic and environmental impacts for each option.

1.8 Report Structure

The report is structured around the Design Manual for Roads and Bridges, Volume 5, Section 1, Part 2, TD 37 'Scheme Assessment Reporting' and broadly follows the principles set out in the guidance on the preparation of the Stage 1 Report.

The chapter headings generally follow the guidance given in Annex A of TD37:-

- Chapter 2 outlines the existing conditions;

- Chapter 3 describes the corridor options under consideration and provides a summary of the construction cost estimates associated with each corridor;
- Chapters 4, 5 and 6 then consider the engineering, environmental and economic assessment in turn;
- Chapter 7 gives a balanced assessment of the corridor options against Government criteria and objectives for the scheme;
- Chapter 8 draws the assessment considerations together in a set of conclusions; and
- Chapter 9 makes recommendations of the corridor option considered appropriate to take forward to DMRB Stage 2 Assessment.

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2. Existing Conditions

2.1 Introduction

This section of the report describes the existing conditions of the A82 within the limits of the study area shown on Figure 1.1. Refer also to drawing 476416.0000.017 within Volume 2.

2.2 Scheme Location and Environment

2.2.1 Location

The scheme is located on the A82 trunk road, the strategic link between the population centres of Glasgow, Fort William and Inverness.

The Tarbet to Inverarnan section of the A82 is approximately 17 kilometres in length, commencing to the south of Tarbet at the start of the 30mph speed limit and ending at a point 770m north of the village of Inverarnan.

The route lies within the LLTNP, and is sited on the western shore of Loch Lomond. The route also passes through two local authority areas, Argyll & Bute and Stirling.

2.2.2 Topography

Loch Lomond is a prominent feature, and is the largest area of fresh water in Great Britain. The loch is 36 kilometres long, covers an area of 71 cubic kilometres and has a mean depth of 37 metres. It has three distinct basins. The deep, narrow northern basin, extending from Ardlui to Rowardennan, reaches a maximum depth of 190 metres and at its widest point measures 1.5 kilometres across. The middle basin, between Rowardennan and Luss reaches a depth of 60 metres. The wide and relatively shallow southern basin south of Luss is around 8 kilometres across and has a maximum depth of 23 metres.

Loch Lomond lies immediately to the east of the A82 with the normal operating water level being maintained between 7.8 metres AOD and 9.0 metres AOD.

The land rises steeply from the Loch Lomond shoreline, reaching over 900 metres AOD in places. Beyond the railway line to the west of the study area is lined by a number of hills and mountains. Beginning at the southern end they include:-

- Cruarch Tairbert at 415 metres AOD;
- Kenmore Wood at 254 metres AOD;
- Dubh Chnoc at 288 metres AOD;
- Little Hills at 808 metres AOD;
- Ben Vorlich at 931 metres AOD;
- Stob nan Coinnich Bhacain at 647 metres AOD;
- Stob an Fhithich at 419 metres AOD;
- Garabal Hill at 453 metres AOD; and
- Troisgeach at 733 metres AOD.

2.2.3 Climate

Overall, the climate of the Loch Lomond area can be described as mild and wet. Annual rainfall in the southern part of the catchment is around 1,500 millimetres a year (30 year average) with a minimum mean annual rainfall of 1,300 millimetres at Drymen. In the north, the 30 year average rises to over 2,500 millimetres with a maximum of 3,600 millimetres on the slopes of Ben Ime above Loch Sloy. The higher rainfall in the mountainous north, coupled with the thin soils and steep slopes, provides a considerable source of run-off to the loch.

There is evidence that there has been a significant increase in mean annual rainfall over the last 20 years. However, virtually all of this increase has been during the winter months with mean rainfall during the summer remaining unchanged. Climatic change could have wide-ranging impacts, so this will be considered in the design of all new road drainage.

2.2.4 Land Use

The area is a mixture of agricultural and forestry land uses, with a few rural dwellings and tourist businesses present. A hydro electricity generation facility extends from Loch Sloy to Inveruglas to the west of the existing A82.

Due to the outstanding natural beauty of the area there are a number of established hill walking routes within the extents of the scheme. These include the West Highland Way located on the east side of Loch Lomond.

To the west of the A82 lies a steep embankment supporting the West Highland Railway, which is considered to be one of the top rail journeys in the world due to passing through breathtaking and varied scenery.

Loch Lomond to the east of the existing A82 is a freshwater reservoir as well as hosting a variety of commercial, recreational and amenity purposes including fishing, swimming, and boating.

2.2.5 A82 Trunk Road

The strategic route of the A82 between Glasgow and Inverness is, at 269 kilometres in length, the second longest trunk road in Scotland after the A9, and comprises a mix of single and dual carriageway sections of differing standards, constructed at various times. The route provides an important connection between central Scotland and the north-west and islands. The route supports economic links and provides access to the many tourist and recreational areas located along the route.

A82 Southern Section

The A82 begins in central Glasgow as Great Western Road at a junction with the M8 and the A804. It continues as a de-trunked road for 6 kilometres, then generally as dual carriageway in a north-westerly direction for 10 kilometres before joining the A898 from Erskine Bridge, providing critical links to the M8, the M77 and the M74.

From this point north, the A82 becomes a trunk road all the way to Inverness. It continues as dual carriageway in a general north-westerly direction through Dumbarton for 14 kilometres to Balloch Roundabout near the western shore of Loch Lomond, bypassing Alexandria and Bonhill.

From this point, the route continues as a single carriageway road in a general northerly direction parallel to the Old Military Road for approximately 27 kilometres, following the western shores of the loch.

The section between Balloch and Tarbet is generally of good standard, having been widened to a standard cross-section of 7.3 metre carriageway with hardstrips during the 1980's.

A82 Tarbet to Inverarnan Upgrade Section

The A82 leads directly onto the A83 at Tarbet, heading west to Campbeltown. At the same point in Tarbet, the A82 branches off via a priority T-junction before continuing northwards for approximately 17 kilometres along the western shores of the loch to Inverarnan. The junction consists of road markings, with a central hatched ghost island for northbound vehicles waiting to turn across the oncoming traffic.

This section of the A82 is tightly constrained within a narrow corridor between the loch to the east and the hillside and West Highland Railway to the west. The road is generally less than 7.3 metres in width, frequently narrowing to below 6.0 metres with no hard strips and sub-standard verges. See Photo 2.1.

Photo 2.1: Route constraint between Loch Lomond and hillside

This section contains a pinch point at Pulpit Rock, where traffic signals control single-lane operation. Works are currently progressing at this location to widen the road to allow two-lane trafficking.

The 17 kilometre section of the A82 between Tarbet and Inverarnan was identified by Transport Scotland as being significantly below standards and in need of upgrading.

The 2012 2-way 24-hour Average Annual Daily Traffic (AADT) of traffic on this section of the A82 is approximately 3,500 vehicles, although there are significantly higher levels in summer months and lower levels in winter months.

The importance of this route is highlighted by the volume of tourist related traffic and HGVs travelling between central Scotland and the north.

A82 Northern Section

North of Inverarnan, the road widens to standard 7.3 metre cross-section with hardstrips and continues in a general north-easterly direction for 10 kilometres to Crianlarich, where the route joins with the A85 and continues for 8 kilometres to Tyndrum. From Tyndrum, the A82 continues in a general northerly, then north-westerly direction for 50 kilometres to Glencoe. It then continues in a north-easterly direction for 27 kilometres to Fort William, where it meets with the A830, before continuing in a north-easterly direction for 16 kilometres to a junction with the A86 at the River Spean, then a north-easterly direction along the south-eastern shore of Loch Lochy for 25 kilometres, to a junction with the A87 at Invergarry.

The A82 then continues in a general north-easterly direction to Fort Augustus for approximately 13 kilometres, then along the north-western shore of Loch Ness for approximately 41 kilometres before running parallel to the River Ness for approximately 10 kilometres to Inverness. The A82 becomes dual carriageway at Telford Roundabout, crossing the River Ness and continuing in a general north-easterly direction for 2 kilometres to end at a junction with the A9 at Longman Roundabout, immediately south of the Kessock Bridge.

2.3 Engineering Conditions

2.3.1 The Existing A82 Trunk Road

Travelling from south to north, the existing section of the A82 included in the study begins at the start of the 30mph speed restriction to the south of Tarbet.

The road generally follows the route of the Old Military Road, located just to the west of the A82.

The A82 diverges eastwards at a right hand ghost island junction where it continues through the eastern side of Tarbet. The A83 road continues beyond the junction passing through the western side of Tarbet. The 30mph speed restriction ends on the A82 at the northern edge of Tarbet. Beyond this point the A82 is subject to the national speed limit of 60mph although a recent speed limit review carried out on behalf of Transport Scotland has recommended that the speed limit be lowered to 50mph between Tarbet and Inverarnan.

To the west of the A82 lies steep hillsides and rock outcrops. At several locations along the route, there are also embankments and retaining walls supporting the West Highland Railway.

The section between Tarbet and Inveruglas consists of a sub-standard horizontal and vertical alignment, with a number of pinch points along the route where the carriageway is less than 6.0 metres in width. See Photo 2.2.

Photo 2.2: Narrow carriageway

Travelling north, the access to Bonnie Braes Coffee Shop is located approximately 1.5 kilometres beyond Tarbet on the left. Immediately to the south of Inveruglas Water is the access to Loch Lomond Holiday Park located on the right. The A82 bridges over Inveruglas Water (See Photo 2.3) and passes the access to **[REDACTED]** located on the right.

Photo 2.3: A82 southbound approaching Inveruglas Water bridge

Beyond Inveruglas the A82 passes Sloy Power Station (a listed building) on the left hand side before bridging over the outfall from the hydro scheme. Located on the right are the accesses to the Inveruglas Visitor Centre. As the road continues north it passes **[REDACTED]** on the left and then onto Pulpit Rock. The A82 is then tightly constrained between the West Highland Railway line and the loch as it follows the curvature of the loch side, along a section of road known locally as the "seven bends", due to the presence of seven contiguous s-bends.

From Pulpit Rock to Inverarnan the route typically follows the loch side beyond **[REDACTED]** on the left, and up to the marina at Ardlui at the north end of Loch Lomond. Passing between Ardlui railway station on the left, and the Ardlui Marina and Ardlui Hotel on the right, the road traverses north between the railway and the River Falloch. Continuing north the A82 passes the substation on the left and then the Drover's Inn on the right as it passes through Inverarnan and onto the end of the study area at a point approximately 770m north of the village.

The vertical geometry of the existing road typically follows the local topography and the edge of Loch Lomond. Road elevations on the existing A82 within the study area range from a minimum of approximately 10m AOD at the lowest point, immediately south of Garabal, to a maximum of approximately 33m AOD just south of Inveruglas Water. Elevations fall to approximately 17m AOD at the end of the study area, north of Inverarnan.

Considering sections of the route the vertical elevations varies as follows:-

- Tarbet to Inveruglas – 11 metres to 33 metres AOD;
- Inveruglas to Pulpit Rock – 10 metres to 21 metres AOD; and
- Pulpit Rock to Inverarnan – 10 metres to 23 metres AOD.

The route is currently subject to the national speed limit of 60mph (subject to review as noted above); however the alignment, restricted visibility and confined cross-section make this speed difficult to achieve safely. The design speed for the existing alignment has been calculated to be 85Bkph, and it has been noted that the Pulpit Rock scheme specifies a design speed of 70kph. It should also be noted that the observed average journey speeds are approximately 43kph, almost half the DMRB calculated speed of 85Bkph.

The horizontal alignment of the road also generally follows the shore of Loch Lomond, incorporating tight radius curves of up to 4 steps below DMRB standards. The cross-section of the road is also sub-standard, with all sections below 7.3 metres width, and many below 6.0 metres. There are no hardstrips present and verges are sub-standard and poor quality.

2.3.2 Traffic Accidents

The number of traffic accidents resulting in personal injury on this section of the A82 has been fairly consistent during the past five years, based on 2008 – 2012 data. From just north of Tarbet to Inverarnan, there has been a total of 53 injury accidents during this period, with 3 fatal, 16 serious and 34 minor. This is consistent with the 2004 – 2009 period assessed in previous studies, which had 57 injury accidents, supporting the view this section of the A82 has a significant road safety problem. Killed or seriously injured (KSI) accident rates on this section of road are over four times the national average for the Scottish trunk road network.

The accidents are generally spread along the 17 kilometre route, with only a few clusters occurring; one cluster occurs at a sharp bend in the vicinity of Inveruglas Holiday Centre and a second one just to the north of Pulpit Rock.

With regard to the 2008 – 2012 injury accidents, key aspects are:-

- 53% of accidents occurred on a bend;

- 34% of accidents involved a vehicle leaving the road and hitting an object;
- 10 accidents involved a motorcycle; and
- 9 of these were killed or serious injury (KSI) accidents.

2004 - 2009 data recorded 23 motorcycle accidents, indicating a noticeable reduction more recently.

From the accident reports, the main contributory factors were recorded as being:-

- 30% slippery road surface (16);
- 9% travelling too fast (5);
- 8% poor turn or manoeuvre (4);
- 6% road layout (3);
- 6% deposit on road (3);
- 6% failed to look properly (3);
- 6% loss of control (3); and
- 6% sudden braking (3).

2.3.3 Existing Junctions and Accesses

The STPR A82 Technical Reports (2010) and The Engineering and Environmental Surveys (2012) both note that there are a number of existing junctions and accesses along the route, and that many of these are of a poor standard with limited visibility, largely imposed by the horizontal geometric constraints. Hence these junctions and accesses generally do not comply with current design standards. A list of existing accesses is provided in Table 1 of Appendix A.

2.3.4 Existing Parking and Lay-bys

A number of informal or sub-standard lay-bys exist along this section of the route. A list of existing parking areas and lay-bys is provided in Table 2 of Appendix A.

Additionally, the A82 Route Action Plan Study (2006) identified four parking areas of a poor standard on the section from Tarbet to Pulpit Rock consisting of areas of hard standing at the side of the carriageway, though it is recognised that the local topography and road geometry are such that few locations are suitable for safe usage.

There are also two designated picnic sites within this section, at Tarbet and Inveruglas, located adjacent to the southbound carriageway.

2.3.5 Road Pavement Condition Summary

CFJV will gather information on the residual life of the pavement from Transport Scotland's, Integrated Road Information System (IRIS). This information will be considered in a pavement assessment and form part of the Stage 2 DMRB Assessment.

2.3.6 Vehicle Restraint System

Generally Open Box Beam (OBB) Vehicle Restraint Systems (VRS) are located along the southbound carriageway adjacent to the loch. OBB VRS is also located at some locations on the northbound carriageway over streams and rivers.

At some locations adjacent to the loch shallow cement bound stone walls offer restraint, as part of retaining walls supporting the road.

2.3.7 Side Roads, Bridleways, Cycle Paths and Footpaths

No side roads connect directly onto the A82 within the scheme extents although a number of accesses to both residential and commercial properties are noted in Section 2.3.3 of this report.

The Engineering and Environmental Surveys (2012) identified that intermittent, and in some cases narrow, sections of footway (NMU route adjacent to the road) and footpath (NMU route not adjacent to the road) exist along the scheme extents. Refer to drawings 476416.0000.050 to 071 within Volume 2. These are generally associated with the villages. Current footway and Right of Way arrangements include:-

- a narrow footway in the west verge extending out of Tarbet for less than 1 kilometre. There is no direct linkage from this to other footways within Tarbet;
- a footpath linking into the hills at Loch Sloy from Inveruglas Water to Inveruglas Visitor Centre. This footpath is noted as a "core path";
- footpath access into the land to the west at **[REDACTED]**, although this does not extend along the A82;
- localised footways within Ardlui and a narrow footway extending northwards towards Ardlui Church. There is a Right of Way extending into the land to the west linking to Ardlui at the railway station; and
- localised footways within Inverarnan and extending a short distance northwards but not connecting to Rights of Way at **[REDACTED]**, which form part of the West Highland Way.

No formal cycle facilities or bridleways have been identified within the study area. However, it is worth noting that there is an off-line cyclepath/footpath from Balloch which ends just south of Tarbet. Anecdotal evidence from the stakeholder workshop held on the 2nd October 2013 suggested that despite the lack of facilities currently existing along the A82 between Tarbet and Inverarnan, significant numbers of cyclist currently use the A82 route including the section between Tarbet and Inverarnan, particularly during the busy summer tourist season. Further details will be obtained to inform further studies during DMRB Stage 2.

2.3.8 Departures from Standards

Throughout the study area many departures are inherent in the existing alignment and should be addressed if realignment of the existing A82 was to proceed.

2.3.9 Structures

General

The information relating to existing structures within the current road corridor has been extracted from the "A82 Engineering and Environmental Surveys" report dated March 2012.

Information requests have been made for further structure and asset details, as noted below, to supplement that currently available. This information is not yet available, but will be reviewed and assessed when received to determine the need for any further investigations and to inform a more detailed Stage 2 assessment and constraints mapping. Requests have been made as follows:-

- inventory data, inspection reports and assessment reports have been requested from the Operating Company, BEAR;
- a request has been made to Network Rail to provide asset information regarding rail related structures or other assets which may be affected by an on-line upgrade solution; and
- information has been requested from Transport Scotland construction branch for general layout and arrangement information for the Pulpit Rock improvement works which are currently on-going, as the viaduct at this location will ultimately provide a constraint to an on-line upgrade solution.

Bridge Structures

There are 7 road bridge structures present along the A82 route and their location is shown on drawings 476416.0000.050 to 071 within Volume 2. Many of these bridges cause a width restriction to the A82 between the parapets. See Photo 2.4.

Photo 2.4: Width restriction of existing bridge south of Inverarnan

Table 3 within Appendix A contains a summary and short description of each of these bridge structures.

There are an additional two masonry arch bridges crossing minor watercourses within Tarbet itself which have restricted carriageway width.

In addition to the road bridges noted above there are rail related structures in close proximity to the A82. The most significant is the Craig an Arnain viaduct which carries the West Highland Railway line at height above the existing road on its western boundary to the north of the Loch Sloy power station. This structure has a category B listing.

There is also an existing overbridge carrying the West Highland Railway line over the A83 to the west of Tarbet.

Culverts

152 existing highway related culverts were recorded over the extents of the survey corridor. The location of these culverts is recorded on drawings 476416.0000.050 to 071 within Volume 2.

Table 4 within Appendix A contains a summary of the culverts.

The culverts comprise small diameter pipes, generally below 1 metre in diameter (but up to around 1.5 metres in diameter in places), small masonry cundies of around 1 to 1.5 metre maximum span and a number of box culverts of a maximum span up to 2 metres.

The culverts are generally noted to be in poor condition, in many cases overgrown with vegetation and partially submerged. None of them appear to make adequate provision for the passage of wildlife in accordance with current best practice.

Retaining Walls

A total of 32 existing retaining walls are recorded over the extent of the road corridor and their location is shown on drawings 476416.0000.050 to 071 within Volume 2. All of the walls are recorded as of masonry gravity construction.

Table 5 within Appendix A contains a summary of these retaining walls.

30 retaining walls are constructed on the water side of the A82 adjacent to, and below, the southbound carriageway and are either located directly adjacent to the carriageway or, more commonly, part way down the supporting embankment. These walls typically are heavily vegetated and many have trees, shrubs and bushes growing through them. The walls vary in height up to around 5.5 metres and are of lengths of up to 250 metres.

Two retaining walls are constructed above the carriageway adjacent to the northbound carriageway and provide support to the adjacent West Highland Railway line.

2.3.10 Drainage

The existing drainage along this section of the A82 consists of two forms. Generally informal drainage paths convey runoff from the existing road surface either to the culverts or directly into the loch.

South of Pulpit Rock there are limited longitudinal cut off drains, filter drains and open drainage channels located at the bottom of steep hillsides and rock outcrops. The drainage in this area is characterised by direct run-off from the hillside onto the carriageway.

North of Pulpit Rock, over the edge drainage is used although this is poorly performing as a result of shallow height above the flood plains with flooding levels encroaching close to the carriageway level. See Photo 2.5.

Locations of existing filter drains is provided in Table 6 within Appendix A.

The drainage from the carriageway discharges via a series of culverts that cross below the A82 and outfall to Loch Lomond or large expanses of marsh land adjacent to the River Falloch in the north of the study area. These culverts also convey an extensive network of high energy watercourses which drain the woodlands and rough pasture on the hillsides to the west.

A number of culverts are noted to be partially or fully blocked.

Photo 2.5: Flooding of the A82 at Garabal

2.3.11 Watercourses

A number of watercourses and waterbodies exist within the study area, including marshlands and lochans. Water features are shown on drawing 476416.0500.001 within Volume 2.

Anecdotal information suggests that alteration of natural catchment and watercourses have been undertaken to accommodate the West Highland Railway to the west of the existing A82.

The following are the most notable water features within the study area.

Loch Lomond

Loch Lomond covers an area of approximately 71 cubic kilometres. It is the largest UK inland freshwater body by surface area and is classified as a large raised reservoir under the Reservoirs Act 1975.

Loch Lomond discharges to the River Leven to the south. The normal operating water level is maintained between 7.8 metres AOD and 9.0 metres AOD by a barrage positioned across the River Leven. The barrage ensures that the water level in the

loch remains high enough to facilitate Scottish Water abstractions for drinking water. The loch is designated as a Drinking Water Protection Zone under the Water Framework Directive.

The highest water level recorded at the southern end of the loch at the Ross Priory gauge station since 1947 is 10.413 metres AOD.

The predicted 1 in 200yr and 1 in 200yr+Climate Change flood water levels in Loch Lomond are 10.720 metres AOD and 11.340 metres AOD respectively. The flood water levels have been derived from the Scottish Water Asset Flood Resilience Report (ref. 401191-0000-20-GEN-0128) prepared independently for the Auchendennan Pumping Station.

As already noted the loch is used for a variety of commercial, recreational and amenity purposes including fishing, swimming, and boating.

River Falloch

The River Falloch is one of the main tributaries of Loch Lomond and has a catchment area of approximately 108 cubic kilometres. The catchment is essentially rural and includes several small lochans. The northern section of the existing A82 south of Inverarnan lies within the floodplain of the River Falloch according to indicative flood maps published by SEPA.

Inveruglas Water

Inveruglas Water has a catchment area of approximately 33 cubic kilometres. The catchment is essentially rural and includes Loch Sloy and a number of small lochans. The Inveruglas Water is classified by SEPA as 'heavily modified' due to the Loch Sloy dam and the associated hydro-power generating scheme.

Geal Loch and Dubh Lochan

According to Scottish Natural heritage (SNH), Geal Loch and Dubh Lochan are 'oligotrophic' and groundwater dependant loch features. They are located to the north of Loch Lomond in an extensive area of saturated marshland or 'mire'. They are designated as SSSI.

Loch Long

Loch Long in the south-west of the study area is a sea loch extending from the Firth of Clyde and forming the entire coastline of the Rosneath Peninsula. Loch Long is located outside the boundary of the Trossachs National Park but is commonly used for diving and military training.

The SEPA/EA Coastal Flood Boundary Conditions dataset gives predicted extreme sea levels for various locations along the coastline of Scotland and advises on estuary boundaries beyond which the data is considered unreliable. However the dataset does not extend into sea lochs. The nearest point for which data is available is Cloch Point in Inverclyde. The predicted 1 in 200yr still water level at that location is 3.69 metres AOD. The extreme water level in Loch Long is likely to be higher due to common increase in tide level with distance up the estuary and wave action.

Loin Water

Loin Water is a tributary of Loch Long with approximate catchment area of 10 cubic kilometres. The Loin Water is a mid-altitude siliceous watercourse draining local hills to the west and Kenmore Wood to the east.

Groundwater

The characteristic rock, within the area of the existing A82, has a low permeability and contains only small volumes of water, mainly within fractures.

The Loin Water valley is underlain by minor and moderately permeable aquifer characterised in fractured rock having low permeability.

2.3.12 Geology and Geomorphology

General

Solid and drift geology have been researched from available geological mapping, historic borehole records and geological guides and memoirs. It is noted that there are significant gaps in the coverage of published geological mapping for the study area.

Drift geological mapping is not available south of Ardlui, nor is solid geological mapping at a scale greater than 1:50 000. This lack of information will be addressed at the later stages of the assessment.

There is limited GI information available along the existing A82 from Tarbet to Inveruglas, and there does not appear to be any available information between Inveruglas and Ardlui. Additional information in the Inverarnan area on the western edge of the study area appears to be available and will be sought.

Solid Geology

The study area lies to the north of the Highland Boundary Fault which cuts through Loch Lomond in a south-west/north-east orientation some 15 kilometres south of Tarbet.

Refer to drawing 476416.0600.002 within Volume 2.

This fault separates the younger sedimentary and igneous rocks in the midland valley of Scotland from the older predominantly metamorphic rocks of the Scottish Highlands.

From Tarbet to Ardlui the solid geology mainly comprises Dalradian metamorphic rocks (circa 540-1000 million years old) belonging to the Southern Highland group. Geological mapping indicates that this comprises the Beinn Bheula Schist Formation, which is a sequence of psammite and pelite.

The metamorphic rocks contain a number of younger igneous intrusions of permo-carboniferous and Lower Devonian and Upper Silurian age. The permo-carboniferous intrusions are approximately west/east orientated quartz-tholeiite dykes which are often several kilometres long.

The Lower Devonian intrusions are generally north/south orientated porphyritic dykes of Felsite and more rarely lamprophyre and are generally less than 1 kilometre long.

There are also localised intrusions of Lower Devonian and Upper Silurian rocks comprising breccias, diorites, granodiorites and gabbros, for example at the northern end of Glen Loin and south of Ardlui.

North of Ardlui more recent geological mapping is available which indicates that the solid geology also mainly comprises Dalradian metamorphic rocks belonging to the Southern Highland Group indicated to comprise the Ben Ledi Grit Formation. These rocks are largely metamorphosed sandstones varying from fine to coarse grained in nature, which are locally pebbly and are inter-bedded with pelites and semi-pelites. This Ben Ledi Grit Formation also locally includes metamorphosed volcaniclastic rocks including para-amphibolites, hornblendic, epidotic and chloritic psammites and semi pelites.

There are similar younger minor igneous intrusions in the form of dykes as noted south of Ardlui but there is also a much larger area of Devonian and Silurian Age igneous rock termed the Glen Fyne Pluton, occupying Garabal Hill to the north-west of Ardlui. These rocks include granodiorite, diorite, gabbro and pyroxenite.

The igneous rocks at Garabal Hill were the subject of pioneering geochemical studies and their significance has been recognised internationally with the area being designated a Geological SSSI owing to the large variety of igneous rocks present outcropping in a fairly small area.

Drift Geology

The 1:625 000 scale online Geology of Britain viewer on the BGS website indicates the presence of glacial till or diamicton locally throughout the study area. There are also significant areas where drift is shown to be absent.

The 1:50 000 scale online geology of Britain viewer on the BGS website shows drift deposits to be largely not mapped with relatively isolated areas of river terrace deposits comprising gravel, sand, silt and clay at Tarbet.

Refer to drawing 476416.0600.001 within Volume 2.

North of Ardlui recent geological mapping indicates that mainly moundy glacial deposits are present comprising diamicton and sand and gravel, although there are areas of till in the form of diamicton in the north of the study area.

The glacial deposits are interspersed with sands and gravels deposited in glaciofluvial fans, glaciofluvial sheets and in river terraces.

There are also some localised areas of shallow rock and head deposits.

Geomorphology

The geomorphology of the study area largely results directly or indirectly from glaciation, however some post glacial features are also evident locally.

Loch Lomond is testimony to the erosive power of the glacial ice sheets that once covered Scotland. Loch Lomond formed in one of the main corridors for movement of ice away from centres farther north down to the River Clyde. The ice excavated a trench that probably involved removal of up to 600 metres of bedrock.

Within the study area the ice eroded more powerfully than further south on the loch, resulting in the relatively narrow and deep nature of the loch that exists today.

The ice left smoothed bedrock surfaces, 'hanging' valleys and steep land slipped valley sides which are present in the study areas.

Local land slippage is noted on the east side of Glen Loin with more minor features noted circa 0.5 to 2 kilometres west of Loch Lomond from Inveruglas northwards.

Over its history Loch Lomond has fluctuated between sea and fresh water in nature, in response to changing sea levels following the end of glaciation.

Around 13,000 years ago, as the ice melted, Loch Lomond became an arm of the sea. As overall uplift of the land continued, following ice removal, the sea level fell rapidly and by 11,000 years ago lay at around the present level or below.

With the onset of glaciation again between 11,000 and 10,000 years ago marine conditions again ensued. In the last 10,000 years the loch has fluctuated between marine and freshwater, with a more significant marine phase between 6,800 and 5,500 years ago which has left the remnants of a series of former shorelines at 13, 12 and 9 metres above sea level.

Recent alluvium has formed fans locally where rivers enter the loch such as the Inveruglas Water and more generally in floodplains or sheets, for example along the River Falloch.

2.3.13 Lighting

With exception of lighting within Tarbet, no other form of street lighting is provided along this section of the A82.

2.3.14 Public Utilities

Preliminary information from public utility companies was included in the Engineering and Environmental Surveys (2012). This information is indicated on drawing 476416.0000.050 to 071 within Volume 2.

A summary of this information is provided as follows:-

- telecommunications - A combination of underground and overhead apparatus exists in the verge along the route of the A82; and
- electricity - an 11kV overhead line crosses the A82 at **[REDACTED]**, at **[REDACTED]**, and at a point approximately 700m further north. A 33kV underground line crosses the A82 at Ardlui Marina and at Ardlui Caravan Park. At Sloy Power Station there is a mixture of overhead and underground apparatus (11kV, 33kV and 132/275kV) in the vicinity of the A82. A line of pylons carrying 132/275kV crosses the A82 approximately 500m south of the Drover's Inn. A combination of overhead and underground apparatus exists at numerous locations in the vicinity of the A82. There are also two rows of electricity transmission lines carrying 132/275kV overhead power lines and a row of 11/33kV overhead lines along Glen Loin.

A request has been made for utility information under procedure C2 of the "New Road and Street Works Act 1991". With the exception of Network Rail and Traffic Scotland responses have been received. As the scheme progresses continued efforts will be made to obtain responses from Network Rail and Traffic Scotland, which will be used to inform the Stage 2 assessment.

2.3.15 Properties and Boundaries

There are a number of residential, commercial, industrial and tourist properties lying close to the existing A82 road. These include:-

- residential and commercial properties within Tarbet;
- Bonnie Braes Coffee Shop;
- boat yard;
- Loch Lomond Holiday Park;
- Sloy Hydro Station;
- Inveruglas Visitors Centre;
- Ardlui Railway Station;
- Ardlui Marina;
- Ardlui Hotel;
- Loch Lomond Outdoor Centre;
- Drover's Inn and Lodge; and
- private dwellings.

Table 7 within Appendix A records properties and boundaries adjacent to the road.

3. Description of Alternative Schemes

3.1 General

Included in the SBC and the previously mentioned studies are a number of suggested improvement options; these have been sifted as part of the SBC resulting in three corridor options being recommended for DMRB Stage 1 assessment.

The three route corridor options are presented in drawing 476416.0000.016 within Volume 2, and can be summarised as follows:-

- Option 1 – Existing A82 Corridor (Tarbet to Inverarnan) - On-line improvement of the existing A82 alignment;
- Option 2 – Arrochar to Inveruglas to Inverarnan - New road from Arrochar to Inveruglas, connecting into an on-line improvement of the A82 alignment from Inveruglas to Inverarnan. The alignment from Inveruglas to Invernanan will be the same as that noted in Option 1; and
- Option 3 – High Road (Tarbet to Geal Loch to Inverarnan) - This option proposed the construction of a new road located at a high level, west of the West Highland Railway line, and is located to the west of the existing A82 alignment.

Preliminary route alignments have been identified within each of these corridors as part of this Stage 1 assessment only to assist with early consideration and appreciation of possible engineering issues within each corridor and also for initial cost estimating purposes. These route alignments are presented in drawings within Volume 2, and as noted below.

It is stressed that these preliminary route alignments do not take into account all constraints within the corridors or show engineering solutions. Route alignments for detailed assessment will be created as part of the DMRB Stage 2 assessment.

Towards the end of the DMRB Stage 1 Assessment, Transport Scotland confirmed an extension to the study area with the southern scheme extent being relocated from north of Tarbet to the south of Tarbet. This will increase the length of the study area from 16.1 kilometres to 17 kilometres. Route options along this extended study area will be considered further as part of the DMRB Stage 2 Assessment.

The following sections of this chapter describe the potential route corridors that have been identified.

3.1.1 Option 1: Existing A82 Corridor

Refer to drawings 476416.0000.100 to 110 within Volume 2.

Option 1 follows the existing route of the A82 traversing from the north edge of Tarbet (at the end of the 30mph speed restriction) through Inveruglas before tying into the southern end of the Pulpit Rock improvements. From the north end of the Pulpit Rock improvements the route continues north to Ardlui at the north end of Loch Lomond and then onto the end of the study area, a point approximately 770 metres north of Inverarnan. The total length of Option 1 is approximately 16.1 kilometres.

3.1.2 Option 2: Arrochar to Inveruglas to Inverarnan

Refer to drawings 476416.0000.200 to 203 within Volume 2.

Option 2 uses the existing A83 west of Tarbet to tie into a new section of road along Glen Loin, extending from Arrochar, at the north end of Loch Long, to Inveruglas. As the route drops to tie-in at Inveruglas it crosses over the West Highland Railway. From Inveruglas to Inverarnan the route traverses north via an improved A82 route (as used in Option 1). The total length of the route is approximately 16.2 kilometres.

3.1.3 Option 3: High Road (Tarbet to Geal Loch to Inverarnan)

Refer to drawings 476416.0000.300 to 309 within Volume 2.

Option 3 traverses to the western side of Tarbet primarily following the existing A83 corridor where a junction is envisaged immediately to the west of the existing railway overbridge. Thereafter the alignment traverses to the north of Tarbet, passing through Kenmore Wood and running parallel with the West Highland Railway line before crossing over the railway and rejoining the existing A82 at the north end of Geal Loch. From the tie-in point north to Inverarnan the route traverses an improved A82 north to Inverarnan. The total length of the route is approximately 17.5 kilometres.

3.2 Preliminary Cost Estimates

3.2.1 Cost Estimate Assumptions

Indicative cost estimates have been prepared (at 2012 prices, excluding VAT) for the presented corridor options, using the costs from similar historic projects as the basis. These historic projects include the A830 Arisaig project and the A77 Haggstone improvements. Scheme costs from the current A82 Pulpit Rock improvements have also been considered.

The costs estimates are not based on accurate topographic, geotechnical or environmental data and as such these estimates may have a high degree of variability.

Optimism Bias is also included. Optimism Bias is the demonstrated systematic tendency for appraisers to be overly optimistic about key parameters. For this reason uplift is applied. The uplift applied is dependent upon the nature of the scheme and its stage of development. For road schemes being costed for preferred corridor selection decisions the appropriate uplift set by Transport Scotland guidance is 44% for roads and 66% for structures.

A range of costs for each corridor option is presented to incorporate an allowance for presently unquantified risk.

It should be noted that the cost estimates presented for Option 2 and Option 3 do not include for any on-line improvements to the existing A82 sections which are bypassed and therefore reclassified as part of the scheme.

3.2.2 Outline Cost Estimate

The following table provides an estimate of construction costs at 2012 prices with an optimism bias of 44% for roads and 66% for structures. These costs include land and

property costs but exclude preparation and supervision costs. These total scheme costs are included in Table 6.4.

Table 3.1: Outline Construction cost estimate

Route Options	Low End (-5%) Outline Construction Cost (£m's, inc OB)	Outline Construction Cost (£m's, inc OB)	High End (+25%) Outline Construction Cost (£m's, inc OB)
1	£175.75m	£185.00m	£231.25m
2	£206.15m	£217.00m	£271.25m
3	£345.80m	£364.00m	£455.00m

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4. Engineering Assessment

4.1 Engineering Standards

As the context of this report is the identification of broadly defined route corridors, the designs have not been progressed in sufficient detail to consider compliance with all current DMRB design standards. However, the alignments for route corridor options have been developed taking cognisance of the following DMRB design standards:-

- TD9 Highway Link Design;
- TD16 Geometric Design of Roundabouts;
- TD27 Cross-Sections and Headrooms;
- TD41 Vehicular Access to All Purpose Trunk Roads;
- TD42 Geometric Design of Major/Minor Priority Junctions; and
- TA46 Traffic Flow Ranges for Use in the Assessment of New Rural Roads.

Design Speed, Road Layout and Junction Provision are discussed in further detail in this chapter.

4.2 Alignment and Cross Sections

As noted previously, route options have been developed through a broad corridor based approach. Detailed alignment design, in strict accordance with standards, has not been undertaken at this stage of the scheme development.

It should be noted that geometry to Desirable Minimum standard as required by TD9 for a 85B kph Design Speed has been used to develop all route options where possible, however due to constraints, some routes require geometry of up to 2 steps below desirable minimum requirements.

Route options which are chosen for progression to Stage 2 shall require to be designed, to a preliminary level, to ensure that standards of horizontal and vertical curvature, visibility, super-elevation and junction access are provided for a Design Speed consistent with anticipated vehicle speeds on the road, in accordance with the DMRB.

Preliminary design cannot be carried out until an appropriate Design Speed is identified. This cannot be selected until the road layout to be provided is determined. The DMRB requires that the various elements of design shall be coordinated, together with cross-section and junction layouts, so as to ensure that the three dimensional layout as a whole is acceptable in terms of traffic safety and operation, and economic/environmental effects.

Route options taken forward to preliminary design and Stage 2 Assessment will be assessed for single carriageway S2 standard, and due to the likely gradients required for Options 2 and 3 the provision of climbing lanes will be assessed should these options proceed.

The following provides a summary and preliminary engineering assessment of the route alignment issues associated with the corridor options outlined in Section 3.

4.2.1 Option 1: Existing A82 Corridor

Due to the topography along the corridor any deviation from the existing A82 alignment may result in significant changes in level or requirements for structures or cuttings.

With a few exceptions, the horizontal alignment used for assessment purposes meets current design standards, but this results in the road encroaching into Loch Lomond at a number of locations. Should this corridor proceed through to Stage 2, then minimising the impact of the horizontal alignment on the loch may require the use of sub-standard curvature and/or selection of a lower design speed. This will be considered during Stage 2, and locations where relaxations or Departures from Standard are considered appropriate will be identified.

Realigning the existing route of the A82 will affect a number of existing features, which include utility apparatus (including BT and electricity transmission 132/275kV lines), formal and informal accesses, properties, retaining walls, watercourse crossings and drainage infrastructure. Particular attention will be necessary where the route passes through Inveruglas due to the existing businesses, Inveruglas Water, and Sloy Power Station and its associated apparatus.

The sub-standard nature of the existing route has been noted within the Engineering and Environmental Surveys (2012), with the curvature of the route along the side of Loch Lomond being identified as the most sub-standard section of the existing A82. This section is also likely to present a number of engineering challenges due to the number of existing features that will be impacted by improvements should this corridor proceed.

Beyond the north end of Loch Lomond the existing alignment of the A82 is of a higher standard and it is therefore anticipated that improvements in this area would have less impact on existing features.

4.2.2 Option 2: Arrochar to Inveruglas to Inverarnan

Beginning at Arrochar, the vertical geometry associated with the route to Inveruglas used for assessment purposes, can be summarised as follows:-

- the road initially climbs roughly 20 metres over a distance of approximately 1.8 kilometres;
- it then climbs a further 110m utilising a maximum gradient of 8% over a distance of around 2.0 kilometres; and
- then falls approximately 122 metres over a distance of circa 2.1 kilometres using a maximum gradient of 8% to tie-in with the existing A82 at Sloy Power Station.

Due to the use of maximum gradients and the envisaged HGV use there may be a requirement for climbing lanes on routes associated with this corridor.

It is possible to provide a standard horizontal geometry albeit relaxations or Departures from Standard may be necessary to mitigate any impact on existing features.

The route generally follows the base of Glen Loin while taking cognisance of Loin Water; however, due to the topography several structures to cross the watercourse are likely to be necessary.

Through Glen Loin two series of pylons carrying electricity transmission (132/275kV) lines extend from Loch Sloy to the south beyond Arrochar and would be likely to require diversion in order to facilitate the construction of a new road. In order to tie into the existing A82 at Inveruglas the road may have to cross the Inveruglas Water and the existing overhead transmission (132/275kV) lines may be affected.

Improvements to the A82 from the proposed tie-in with the A82 at Inveruglas are as presented in Option 1 noted in Section 3.1.1.

At this time the route of the A83 through Tarbet to Arrochar has not been included in the assessment; however, it has been identified as a possible opportunity to extend the length of the study area to identify potential A83 improvements should this option progress to the Stage 2 Assessment.

4.2.3 Option 3: High Road (Tarbet to Geal Loch to Inverarnan)

Generally, the vertical alignment used for assessment purposes for the route follows the profile of the hills between the 80m and 120m AOD contours, but due to the topography it is worth noting that the alignment at the northern and southern end, can be summarised as follows:-

- Southern tie-in - The road rises approximately 46 metres through a gradient of 5% over a distance of around 930 metres; and
- Northern tie-in - The road falls approximately 89 metres through a gradient of 5% over a distance of around 1.9 kilometres.

As the gradients at the tie-ins are greater than 2% over distances in excess of 500m, and considering the envisaged HGV flows, there may be a requirement for climbing lanes on routes associated with this corridor.

It is possible to provide a standard horizontal geometry, though relaxations or Departures from Standard may be necessary to mitigate any impact on existing features.

At Inveruglas the option traverses Inveruglas Water, the apparatus associated with Sloy Power Station, and two series of pylons carrying electricity transmission (132/275kV) lines. Diversion of the overhead transmission (132/275kV) lines cannot be discounted at this time. The route also bypasses the road improvements being implemented at Pulpit Rock.

Improvements to the A82 from the proposed tie-in with the A82 at Geal Loch (beyond the north end of Loch Lomond) to Inverarnan will be as proposed in Option 1, described above.

4.3 Junctions, Accesses and Lay-bys

As final Design Speed and road layout have not yet been identified, junctions cannot be considered in detail for the corridor options; however, DMRB requirements for different road layouts will influence the level of access and junction provision taken forward during Stage 2.

Although other options are available, roundabouts at tie-in points for Options 2 and 3 may be the most appropriate. This is because they can be used to signify a change in road standard, intended usage, and provide a traffic calming effect. Also, on the approaches to the study area there are a number of existing roundabouts that have been landscaped to provide gateway type features or to signify local landmarks.

With respect to Lay-bys the A82 Route Action Plan Study (2006) advised that new lay-bys in accordance with design standards should be provided on this section and the current areas of hard standing should be removed. The provision of an upgraded carriageway over this section would provide an opportunity to construct higher quality lay-bys with views over Loch Lomond where appropriate.

The Engineering and Environmental Surveys (2012) acknowledged that a mixture of formal and informal parking facilities exist along the route. These elements generally do not comply with current design standards.

Consultation with the LLTNP Authority in 2011 highlighted a number of matters including:-

- LLTNP view the current lay-by provision, which is understood to consist of 29 formal and informal parking areas, to be of poor quality and in some cases dangerous;
- the lack of dedicated parking areas was contributing to anti-social behaviour and a poor overall experience within the park;
- LLTNP has an aspiration for dangerous/informal lay-bys to be stopped up and better dedicated parking provided in areas where a purpose for stopping could be established e.g. viewpoints; and
- any new lay-bys should incorporate measures that prevent vehicles from being taken off road.

Transport Scotland's Standards Branch (TSSB) advised in 2012 that whilst departures from standard associated with accesses are likely, the generation of new departures, arising from increased speed on the mainline, should be avoided.

4.4 Geotechnics & Earthworks

The Geology and Geomorphology is expected to combine with the topography to present geotechnical issues within the study area. Significant issues are broadly addressed in the following paragraphs. More specific issues will become apparent and be addressed at later stages in the assessment.

Given the topography and the expected general lack of a significant depth of superficial deposits the principal geotechnical issue is likely to be concerned with engineering the bedrock for road works and structures.

It is anticipated that relatively deep rock cuts (of 10m or more) may be required over potentially significant lengths of the road, and it is possible that localised tunnelling in rock may be considered.

Consideration of rock type, strength, degree of weathering and the orientation of joints and fractures with respect to excavations or alignments is required to assess necessary engineering measures.

It would be expected that the optimum slope angles would look to achieve a balance between the use of engineering measures such as bolts, dowels, anchors and mesh and the expected preference for natural looking slopes in what is a scenic area.

Provision for rock fall protection in the form of widened verges or ditches also has to be considered when looking at land take.

On preliminary inspection the existing rock slopes adjacent to the A82 appear to be relatively stable.

The geomorphology is suggestive of potential localised areas of landslip and this should be subject to more detailed assessment at later stages in the assessment.

The earthworks balance will be dependent on road alignment but an excess of cut materials comprising mainly rock seems likely. The rock is expected to provide a reliable source of all-weather bulk fill but the generally schistose nature may give rise to issues with durability for certain classes of earthworks materials.

It is possible that structural foundations may have to utilise steeply sloping rock surfaces on the loch side where a requirement for possible viaduct type structures may exist. Investigations of the rock below water level could be required in such circumstances.

The engineering considerations for all of the routes are similar. However the key differences between the options are as follows:-

- due to the higher topography it is anticipated that Option 3 will require significantly more engineering associated with deep rock cuttings, and potential tunnelling, than the other options;
- it is anticipated that Option 3 will generate much greater quantities of cut materials in comparison to the other options. There may be limited scope to reuse this material on site; and
- Option 2 will be constructed over Alluvial River Terrace Deposits associated with the River Loin. Should compressible materials be present within this then there may be problems associated with settlement of embankments.

It is recognised that there is some potential for limited contamination associated with historic and current development which impacts on a relatively small proportion of the study area. Much will depend on the proximity of proposed routes to these potential sources but a fairly low level of risk is currently anticipated.

Given the rural, relatively remote and undeveloped nature of much of the site it is considered that the risk of significant undocumented contamination being present in the study area is likely to be low.

Intrusive investigations will be undertaken as part of more detailed design works and if necessary these would also be used to more accurately quantify the risk from contaminated land.

The ecological sensitivity of the study area, topography and access difficulties pose significant challenges for undertaking intrusive investigations. It is therefore expected that elevated costs and lengthened timescales will apply when carrying out such works.

4.5 Hydrology, Hydrogeology and Drainage

A preliminary engineering assessment of the potential impacts of the corridor options on the existing water environment have been based on information obtained through desk studies and site walkovers. Previous engineering reports relevant to the scheme, and Envirocheck Reports dated October 2013 have also been studied. Additionally, OS mapping and web published information have been reviewed.

Relevant data has also been requested from third parties, including SEPA, LLTNP, SNH, Argyll & Bute Council, Stirling Council, West Dunbartonshire Council and Scottish Water. A response from the LLTNP Authority was awaited at the time of writing this report.

A survey of the existing A82 drainage and watercourse crossings was undertaken in 2012 and the findings are included in the report 'Engineering and Environmental Surveys'.

The report states that 'the existing drainage provision over the extent of the route is generally sub-standard' and can be described as follows:-

- Tarbet to Pulpit Rock – general lack of positive drainage. Direct runoff from the rock outcrop to the road leads to frequent surface water ponding on the carriageway;
- Pulpit Rock to Inverarnan – limited extents of road drainage in the form of filter trenches or roadside ditches are evident. The drainage is considered ineffective due to shallow local topography affected by fluctuating water levels within the River Falloch's floodplain; and
- general - preferential drainage paths are evident at a number of locations. The drainage paths convey runoff from natural catchments through culverts under the A82 to Loch Lomond or marshland or 'mire' areas adjacent to the River Falloch.

The main drainage requirements common to all corridor options are noted in paragraphs 4.51 to 4.58.

4.5.1 Drainage outfalls

Dedicated surface water drainage will be required to cater for runoff from the new road. Loch Lomond and Loch Long catchments will provide an ideal discharge environment for the new road drainage. Road drainage design will be carried out in line with the latest DMRB design standards.

4.5.2 Sustainable Drainage Systems (SuDS)

SuDS will be required to mitigate the potentially adverse effects of uncontrolled runoff in terms of water quality and flood risk. SuDS mimic natural catchment processes by adopting a surface water management train approach. In this case two treatments levels are normally required for trunk roads.

Site specific solutions will require to be developed to suit the challenging terrain and spatial constraints. Where no roads are currently present more stringent SuDS requirements may be anticipated.

Based on the highly sensitive character of the water environment in the study area, SuDS measures will also be required to cater for the construction phase runoff to ensure protection against pollution and increased flood risk. SuDS design will comply with the latest 'best practice' guidance such as CIRIA Report C697 The SuDS Manual.

4.5.3 Works affecting floodplain

Any works in functional floodplain may lead to the road being flooded and also increase a risk of flooding elsewhere due to reduction of flood storage area. The new road should be positioned above the predicted flood levels in the adjacent water bodies and compensatory flood storage provided.

4.5.4 'In loch' works

Where the new road encroaches onto Loch Lomond 'in loch' engineering works will be required. Any proposed construction works will be timed to avoid mammal breeding and fish spawning seasons. Construction pollution will be prevented and potential impacts on water quality minimised. Restrictions on future operational and maintenance activities will also be considered.

4.5.5 Watercourse crossings

Numerous new watercourse crossings will be required as part of the scheme. The crossings will be designed in accordance with the latest DMRB guidance ensuring minimal disruption to the existing hydrological and hydraulic regime and fluvial morphology.

4.5.6 Watercourse diversions

Watercourse diversions may be required as part of the scheme. This could have an adverse impact on the existing hydrological regime and fluvial morphology. Watercourse diversions will be designed in accordance with the latest guidance ensuring that disruption to the existing hydrological and hydraulic regime is minimised.

Design of watercourse crossings and diversions should consider fish migration and mammal activity in the area. Construction works will be timed to avoid fish spawning and mammal breeding seasons.

4.5.7 Groundwater impacts

The new road may affect the groundwater quality and levels, which can adversely impact the groundwater dependent terrestrial ecosystems present in the area (i.e.

Geal Loch and Dubh Lochan to the north of Loch Lomond). Groundwater monitoring will therefore be required.

4.5.8 Private water abstractions and sewerage discharges

Numerous private water abstractions and sewerage discharges are present within the scheme extents. Alternative proposals to deal with the affected private systems will be required.

All engineering works affecting the water environment will require authorisation from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011.

Potential engineering solutions relating to water environment and drainage have been considered below based on the corridor options presented in Chapter 3

For the purpose of this assessment, watercourses shown on a 1:50 000 OS map have been considered as 'major' and the remaining as 'minor'. The engineering interventions required as part of the scheme have been noted for the 'major' watercourses only. However, engineering activities may also be required on the 'minor' watercourses.

4.5.9 Option 1: Existing A82 Corridor

Corridor Option 1 follows a line of the existing A82 between Tarbet and Inverarnan and drains to Loch Lomond via an extensive network of high energy watercourses. Informal drainage paths convey runoff from the existing road surface either to the culverts or directly into the Loch. The northern section of this corridor option, south of Inverarnan lies within the floodplain of the River Falloch according to indicative flood maps published by SEPA.

The route alignment for Corridor Option 1 would result in a requirement for the following water environment related engineering activities:-

- potential 'in loch' works at seven locations along Loch Lomond;
- works in floodplain of River Falloch and associated tributaries; and
- approximately 25 new watercourse crossings or diversions.

The major engineering activities associated with Corridor Option 1 affecting the water environment are shown on drawings 476416.0500.002 to 006 within Volume 2.

There will also be a requirement for numerous surface water drainage outfalls along the route of the road alignment.

It is anticipated that any upgrade to the existing A82 alignment would provide for the replacement of culverts as part of a comprehensive re-design of the existing road drainage system and therefore the culverts, in themselves, are not considered to present significant constraints.

4.5.10 Option 2: Arrochar to Inveruglas to Inverarnan

At the northern shore of Loch Long Corridor Option 2 turns in a north easterly direction and follows the Loin Water valley before crossing the Inveruglas Water and joining the corridor along the existing A82 north of Inveruglas. From there it follows

the line of the existing A82 between Inveruglas and Inverarnan as per Corridor Option 1.

The southern part of Corridor Option 2 to the west of Cruach Tairbeirt is located within Special Conservation Area / SSSI and falls within the catchment of Loch Long. On the northern part of the corridor option from Inveruglas northwards the corridor is located within a National Scenic Area.

The southern section of Corridor Option 2 overlies the Loin Water floodplain and could also be at risk of flooding from Loch Long. The northern section of the corridor adjacent to the River Falloch is located in the floodplain of Loch Lomond and its tributaries.

The major water environment related engineering activities required as part of the Corridor Option 2 would be as follows:-

- works in floodplain of Loch Long and Loin Water;
- approximately 14 new watercourse crossings or diversions; and
- potential 'in loch' works at one location in Loch Lomond.

The above activities relate to the section of the route between Arrochar and Inveruglas only.

The major engineering activities associated with Corridor Option 2 affecting the water environment are shown on drawings 476416.0500.015 and 016 within Volume 2.

There will also be a requirement for a number of surface water drainage outfalls along the route of the road alignment.

4.5.11 Option 3: High Road (Tarbet to Geal Loch to Inverarnan)

Corridor Option 3 lies within the catchment of Loch Lomond. The most northern part of the route is located within Special Protection Area / SSSI and nearly the whole extent within the National Scenic Area.

The water features located in the area of the Corridor Option 3 are substantially as described for Corridor Option 1.

The Corridor Option 3 would lead to a requirement for the following major engineering activities affecting the water environment:-

- approximately 27 watercourse crossings or diversions.

The major engineering activities associated with Corridor Option 3 affecting the water environment are shown on drawings 476416.0500.020 to 024 within Volume 2.

There will also be a requirement for numerous surface water drainage outfalls along the route of this Corridor Option.

4.6 Structures

The following provides a summary and preliminary engineering assessment of the Structure requirements against the corridor options outlined in Section 3.

The existing bridges along the A82 provide some degree of constraint to an on-line widening scheme as noted below. Refer also to Table 3 within Appendix A:-

- A82 390 – width restriction, road alignment;
- A82 400 – road alignment, category C listing;
- A82 410 – width restriction, road alignment;
- A82 420 – width restriction, road alignment;
- A82 430 – width restriction, road alignment;
- A82 440 – width restriction, road alignment;
- A82 450 – width restriction, road alignment; and
- 3 No. masonry arch bridges within Tarbet – width restriction.

Other than the Craig an Arnain rail viaduct none of the bridge structures on the existing A82 are of a scale that strengthening, widening or indeed replacement works would represent a major financial burden to the project. More significant is likely to be the cultural and historic interest of each bridge and any restrictions this would present. This will be established through consultations at a future Stage 2 assessment as required.

The existing overbridge carrying the West Highland Railway line over the A83 may, in consideration of Options 2 and 3, provide a constraint to any development west of Tarbet. This structure has sub-standard headroom, noted as 16 feet or 4.876 metres. The current standard for new construction is 5.3 metres and for maintained headroom is 5.03 metres. However, Transport Scotland currently has no records of bridge strikes for that particular structure. The bridge also provides some constraint in terms of width with less than the standard verge widths available on the existing road.

Most of the retaining walls along the existing A82 provide some restriction to an on-line upgrade in terms of road width, sub-standard parapets and road alignment. It is anticipated that a significant number will require to be replaced. The railway retaining walls could be regarded as presenting significant constraints.

The following consideration of potential structures is based on the indicative route alignments prepared for each corridor. The potential number and form of structures likely to be required for each option, as illustrated, is shown in Table 4.6.1. It is apparent from this preliminary consideration that the number and extent of potential structures could vary considerably as alignments are refined.

Table 4.1: Preliminary assessment of structures

A82 Tarbet to Inverarnan Preliminary assessment of structures			
Potential structures	**Route Options**		
	1	**2**	**3**
Overbridge	Nil	1 No. (Approx. length 40m)	Nil
Underbridge	4 No. (Approx. span 20 to 30m)	5 No. (Approx. span 30m)	5 No. (Approx. span 20 to 30m)
Underpass	Nil	1 No. (Approximate span 12m)	1 No. (Approximate span 12m)
Railway Crossing	Nil	1 No. Underbridge crossing the West Highland Rail Line and access track. (Approx. span 30 to 40m)	1 No. crossing of the West Highland Rail Line. Tunnel or overbridge structure depending on final road alignment.
Viaduct Within Loch Lomond	7 No. (varying between 30m and 600m long)	4 No. (varying between 130m and 600m long)	Nil
Land Based Viaducts	Nil	1 No. (approx. 400m long)	2 No. (approx. 230m & 500m long)
Tunne	Nil	Nil	3 No. (600m, 280m & 550m long)
Retaining Walls	17 No. Retaining walls within or adjacent to Loch Lomond. (Total length 1,160m)	Retaining wall adjacent to Loin Water. (Length 200m) 5 No. Retaining walls within or adjacent to Loch Lomond. (Total length 430m)	12 No. on approach to tunnels. (Total length 300m)

Table 4.1: Preliminary assessment of structures (Cont.)

A82 Tarbet to Inverarnan Preliminary assessment of structures			
Potential structures	Route options		
	1	2	3
Cantilevered Construction over Loch	1 No. Cantilever structure (Length 60m)	Nil	Nil

In addition, all options will require a considerable number of culvert structures however this has not been quantified at this stage.

A summary of the key structural issues, major structures required and associated engineering challenges for each option is given below.

4.6.1 Option 1: Existing A82 Corridor

Route Option 1 follows the existing corridor from Tarbet to Inverarnan and any road alignment improvements will potentially encroach on Loch Lomond to the east or the hillside and West Highland Railway line to the west.

For this assessment it has been assumed that no retaining structures will be required as a result of a westward alignment shift as no detailed soils information is currently available. It is however likely that some retention will eventually be required to supplement and enhance the stability of cuttings and to minimise impact on the adjacent railway.

Where an eastward alignment shift encroaches on the loch a number of potential structural forms have been considered with key issues outlined below.

Minor encroachment into the water may require:-

- infill embankment within the loch; and
- waterside retaining wall (with infill) to eliminate or limit encroachment into the water. These retaining walls may be constructed either on land or within the loch depending on conditions. Alternative construction forms could include mass gravity retaining walls, reinforced concrete cantilever retaining walls or contiguous bored pile retaining walls.

Encroachment where the road footprint maintains some degree of landfall may require:-

- infill embankment or retaining walls as noted above; and
- cantilever construction comprising a deck supported on solid footings on the landward side, cantilevering out over the loch supported on contiguous bored pile walls.

Where the road footprint traverses across open water, works may require:-

- infill embankment or retaining walls as noted above; and

- viaduct structure over the open water sections.

Construction of viaducts and other structures within the loch will prove challenging largely due to environmental considerations, topography including underwater variations in the bed level and extremely restricted construction access. Of the three structural forms considered above, it is this form that presents the greatest challenge in terms of temporary traffic and construction management.

4.6.2 Option 2: Arrochar to Inveruglas to Inverarnan

This route follows the existing A83 to Arrochar where it then diverges through Glen Loin to Inveruglas to join the existing A82. The route then follows the Option 1 alignment from this point north to Inverarnan and consequently over this section will include a number of the structural forms as described above, with the same construction challenges and issues.

The main structural feature for this route on the Arrochar to Inveruglas section is that the road superimposes on the alignment of the Inveruglas Water for some 300m. It is considered that topographical and environmental constraints would preclude diversion of the watercourse so that a viaduct some 500m long would be required to bridge over this feature.

Bearing in mind the likely environmental constraints and the steep undulating topography construction of such a structure would present a considerable challenge.

4.6.3 Option 3: High Road (Tarbet to Geal Loch to Inverarnan)

This route follows the A83 to a point west of Tarbet beyond where the West Highland Railway line crosses over the road, and therefore avoids that interface. The route then diverges north over the high hillside to join the A82 some 1.5 kilometres south of Inverarnan, continuing on the Option 1 alignment to the north tie-in. There is one river crossing at the north tie-in which is common to all routes.

Much of this option sits at an elevation of around 80 to 120m AOD. Due to the extremely undulating topography it is anticipated that tunnelling would be required, firstly to gain access to the high ground from either end and then through the hillside above Pulpit Rock. Two viaduct structures up to 500m long and at heights of up to around 25 to 30 metres would also be required to bridge over valleys including the Inveruglas Water.

The engineering challenges for this option are considerable, notwithstanding the construction of tunnels and major viaducts. Provision of intermediate construction accesses along the corridor is not considered feasible, therefore access would only be possible from either end of the scheme with much of the route traversing steep sidelong ground.

It is anticipated that construction work could only be undertaken by firstly constructing tunnels at each end to gain access to the high ground, working progressively north and south and culminating with the building of a viaduct at Inveruglas. It is estimated that the sequential nature of constructing major tunnel and viaduct structures would extend the construction period to between 4 and 5 years.

4.7 Pavement

Pavement provision for the road would be anticipated to consist of a fully flexible construction using bituminous materials.

Where a route makes use of the existing carriageway or ties into the existing A82, further pavement testing and analysis, in addition to the IRIS information, will be required to assess the suitability of the existing pavement for use in the permanent works design.

4.8 Vehicle Restraint Systems

The provision of VRS at the location of hazards shall be provided in verges where possible in accordance with the requirement of TD 19 Requirement for Road Restraint Systems.

In 2011 discussions with TSSB acknowledged that VRS related Departures from Standard are likely. Previous reports have recorded that RRRAP should be used for guidance only, and solutions should be appropriate to the nature of the upgrade. This may allow for some flexibility in the application of the standards, though Departures should be approved through the necessary process. It was also noted that stone dykes could be designed as VRS and that reference should be made to the A77 Parkend scheme where this is understood to have taken place.

4.9 Public Utilities

As noted in Section 2.3.14, preliminary information from public utility companies was included in the Engineering and Environmental Surveys (2012).

A request has been made for utility information under procedure C2 of the "New Road and Street Works Act 1991". When responses are received they will be used to verify and if necessary update utility information.

It is anticipated that all route corridors will affect telecommunication, electrical and water services.

Corridor Option 2 and to a lesser degree corridor Option 3 are expected to have significant impact on the pylons and apparatus associated with the Sloy Hydro Power Station in Inveruglas.

4.10 Non Motorised Users

Provision for NMUs present similar challenges for all three corridor options. The offline corridors (part of Corridor Option 2 and Corridor Option 3) present an opportunity to utilise the existing de-trunk road as the offline cycleway albeit with an increased future maintenance liability.

5. Environmental Assessment

5.1 Introduction

This chapter is a summary of the A82 Tarbet to Inverarnan Upgrade: DMRB Stage 1 Environmental Assessment: Scoping Report. The report sets out the environmental baseline, identifies potential effects and determines the scope of further environmental assessments associated with the Scheme. The assessments detailed in the report were completed in line with guidance set out in DMRB Volume 11, Section 3, Part 1 to Part 12.

5.2 Scoping Assessment

5.2.1 Air Quality

Road transport schemes have the potential to give to rise to changes in the nature and location of vehicle emissions, with a consequent impact on air quality. A scoping level assessment has been carried out in accordance with the DMRB Volume 11, Section 3, Part 1: Air Quality - HA207/07.

The sensitive air quality receptors within 200m of the proposed route corridors include:-

- 70 properties within Corridor 1, 280 within Corridor 2 and 100 within Corridor 3 (the majority of which are residential in nature);
- Arrochar Primary School, south of the A82 in Tarbet, closest to Corridor 1; and
- a number of recreational and tourist amenities, such as hotels, B&B's, campsites and visitor centres.

Argyll & Bute Council has not declared any AQMAs along the length of any of the route corridors.

Details of Internationally and Nationally designated sites in proximity to the route corridors is included in the Nature Conservation section below.

The local air quality along the length of the scheme is considered to be good, with the majority of the emissions being generated from road traffic.

All of the route corridors have the potential to give rise to both temporary construction impacts and permanent operational impacts on local air quality. In accordance with DMRB it is recommended that a Simple Assessment is progressed and it is also proposed that an assessment of regional emissions is carried out to provide information on the change in greenhouse gas emissions.

5.2.2 Cultural Heritage

A 1 kilometre buffer was set around each of the route corridors and a review of the cultural heritage resources within these buffers was undertaken. The cultural heritage resource comprises archaeological remains, historic buildings and historic landscapes and their settings. The cultural heritage resources are detailed below:-

- three Scheduled Monuments; Inveruglas Castle, Inveruglas Isle, a small island on Loch Lomond; Pulpit Rock, Preaching Site, south of Ardlui; and Island I Vow, castle and settlement, a small island on Loch Lomond;
- 46 Listed Buildings, mainly concentrated around the settlements along A82;
- Tarbet and Crianlarich military road, which was constructed in the mid-18th century, runs adjacent to the west of the A82;
- pre-improvement agricultural settlement (SMR ref NN31NW 44); and
- several milestones have been recorded along the A82.

There is potential for buried archaeological remains along all of the route corridors. Given the proximity of all three corridors there is little difference in potential effects regarding cultural heritage.

In accordance with DMRB it is suggested that a Simple Assessment would be the most appropriate level of assessment going forward.

5.2.3 Landscape

The landscape assessment follows the methodology recommended by the existing DMRB guidance which recommends the assessment of:-

- the extent to which the road will be visible in the landscape;
- the character of the landscape and its capacity to accept changes of the type and scale proposed; and
- the extent to which effects can be mitigated and the road can be integrated into the landscape.

The many environmental and landscape designations across the study area confirm the high quality of this landscape and its value that is recognised by appropriate legislation. The comprehensive list of designations can be found in the full report.

The study area lies within the Loch Lomond Trossachs National Park (LLTNP) and is made up of a wide selection of Landscape Character Types (Open Hills, Wooded or Forested Glen Sides and Loch Lomond itself which includes a few small islands). The topography of the landscape is often dramatic with steep hills allowing scenic views surrounding Loch Lomond from elevated points.

Settlement is mostly concentrated to flatter areas of land on the west of Loch Lomond, between the foot of the hills and the loch shore. The main settlement areas are Tarbet and Arrochar. In the north of the study area other smaller settlement areas include Inveruglas and Ardlui. There are individual houses along the route mainly to the west of the existing A82.

Land use is mostly for forestry, farming, recreation, tourism and some residential, along with associated infrastructure. Transport corridors are prominent features within the landscape.

Two areas of Wild Land (non-humanised land that are remote and “natural”) are designated by Scottish National Heritage close to the study area in the upland hills above the loch.

There is a designated path network to the west of the loch, however people are free to move across the landscape surrounding Loch Lomond as the area is subject to the Scottish Outdoor Access Code.

Each of the three route corridors will have distinct effects on the landscape and visual character of the area. The potential effects arising from the scheme include:-

- changes in Landscape Character Types;
- changes to land-use and access (i.e. loss of woodland, agricultural land, changes to property boundaries etc.);
- effects on views from and of the road (positive and negative), especially in regards to residential receptors and footpath users;
- alterations to the setting of cultural heritage assets; and
- changes in topography.

As it is likely that significant impacts may occur for the three route corridors Simple and Detailed Assessments are required, the scope will include site visits, consultation and establishment of key views / Theoretical Zones of Visual Influence (TZVI).

5.2.4 Nature Conservation

A desk study was undertaken to confirm the locations of statutory and non-statutory nature conservation designations within the vicinity of the routes. Details of these are as follows:-

- Loch Lomond Woods SAC (18 individual sites);
- Glen Etive and Glen Fyne SPA, which is within 120m from the existing A82 carriageway in the north of the scheme area (3 individual sites);
- nine biological SSSIs; Ben Lomond; Ben Vorlich; Craig Royston Woods; Geal and Dubh Lochs; Glen Falloch Woods; Glen Loin; Pollochro Woods; Rowardennan Woodlands; and West Loch Lomondside Woodlands;
- 111 areas of Ancient Woodland within 2 kilometres; and
- Inversnaid RSPB Reserve, located on the eastern side of Loch Lomond.

A phase 1 habitat survey and a number of species surveys were completed for the existing A82 corridor in January and February 2012. Habitats recorded include; amenity grassland, artificial spoil, broadleaved semi-natural woodland, buildings, bare ground, coniferous woodland, running and standing water and continuous bracken. This list is not exhaustive and the full report should be referred to for the complete list.

Evidence of a number of protected/notable species was recorded during the ecological surveys, these include; deer, badger, bats, otter, water vole, wildcat, red squirrel, buzzard, barn owl, powan, salmonids and the invasive plant Japanese knotweed.

Negative impacts are considered to relate to direct loss of habitat, severance, road mortality, disruption to local hydrology, polluted run-off, new road structures, new

lighting, air pollutants, spray from traffic and disturbance as a consequence of the construction works.

The assessment of ecology will progress to Simple and Detailed Assessment in Stage 2 and Stage 3. In addition, impacts to European designated sites will be assessed fully which may include the requirement to complete Habitats Regulations Assessments. An Extended Phase 1 Habitat Survey will be carried outwhich will determine the need for further, detailed protected species and habitat surveys.

5.2.5 Geology and Soils

Road schemes are capable of impacting upon the geology and soils of an area directly and indirectly on sites of importance or scientific interest, loss or sterilisation of mineral deposits or soil resources or disturbance of contaminated land.

The solid geology underlying the route corridors principally comprises metamorphic rocks of Dalradian Age that belong to the Southern Highland Group. The Quaternary drift geology predominantly comprises Glacial Till, with some areas not having any superficial deposits recorded.

The soil types are predominantly humus iron podzols and brown forest soils with some local areas of humic gleys, peaty soils, peat, alluvial soils and rankers.

Research has identified one Geological Conservation Review site, Garabal Hill SSSI, as being within influencing distance of the route corridors.

Potentially contaminated sites may exist within the study area. Principal potential sources of historic contamination may include the railway, demolished or derelict properties, former tanks and former sand and gravel pits of which there are a few examples along the route. Principal potential sources of current contamination comprise relatively isolated discharge consents associated with dwelling houses, other occupied buildings and fuel stations along the existing A82 route. It is also possible that there may be contamination associated with the railway line.

The three route corridors all currently have equal potential to directly impact on the Garabal Hill Geological SSSI as they have similar footprints in this locality. Corridor 1 is likely to have the lowest impact on areas of low resource geology, with Corridor 3 likely to have the greatest impact and Corridor 2 falling between the two. This is due to the level of earthworks required along each route.

Further assessment will be required during Stage 2 once a preferred route corridor(s) has been chosen, this will be in the form of a Simple Assessment. Further desk based study will also be required in order to identify any potentially significant pollutant linkages between identified sources of contamination and potentially sensitive receptors. Any potentially contaminated sites that may be affected by the route corridors will require individual assessment. Intrusive ground investigation works will also be required to confirm the geology and hydrogeology along the route.

5.2.6 Materials and Waste

There is currently no data available on the types and quantities of materials required or sufficient information to forecast waste arisings. Nevertheless, based on similar highway improvement schemes, the likely materials used, and wastes generated by the project can be assumed (e.g. bituminous materials, stone, soil, concrete, steel etc).

The potential environmental impacts of material resource use are associated with the extraction, processing and transport of material resources, the manufacture of construction products and their subsequent transport to, and use on, the project site. The generation of waste from the proposed scheme will give rise to a number of impacts, most notably on the waste management infrastructure available to accept, treat and dispose of the various types of waste which will be generated.

Based on the findings of the scoping level assessment, it is recommended that the proposed scheme be assessed in the first instance at the simple level of assessment following the methodology described in the draft DMRB Volume 11, Section 3, Part 6 Materials guidance (HD212/11).

5.2.7 Noise & Vibration

A scoping level assessment has been carried out in accordance with the DMRB Volume 11, Section 3, Part 7: Noise and Vibration - HD213/11.

The route of the A82 between Tarbet and Inverarnan is sparsely populated. There are a number of small villages with residential dwellings located close to the A82. In addition there are isolated dwellings along the route, together with properties associated with tourism and recreation. A large Holiday Park is found close to Inveruglas. There are approximately 100 properties within 600m of Corridor 1, 330 for Corridor 2 and 100 for Corridor 3. The majority of these properties are residential.

There are a number of footpaths (The West Highland way and core paths) located within 200m of the route corridors.

Details of the designated nature conservation sites and Scheduled Monuments within proximity to the route are detailed in the Nature Conservation and Cultural Heritage sections respectively.

The dominant noise source in the area is the existing A82, together with the Glasgow to Fort William and Mallaig railway line that runs adjacent to the A82 for most of the route. There are few other noise sources in the area, although it is possible that local noise sources may arise from small industrial facilities and also from the Sloy hydroelectric power station located close to Inveruglas.

Traffic data from counts undertaken in 2012 indicate a daily flow of approximately 3,500 vehicles. This level of traffic would produce a noise level of approximately 65 dB LA10 at 10 metres from the road.

Construction activities have the potential to temporarily change the noise climate at sensitive receptors for all routes. Changes to the road layout and any resulting changes in traffic flow also have the potential to change the noise climate at sensitive receptors in all route corridors.

Given the likely noise impacts arising from the scheme it is recommended that the assessment proceed to Detailed Assessment, with the scope to be confirmed once detailed traffic data has been reviewed.

5.2.8 Effects on all Travellers

This section describes the assessment undertaken to determine the potential effects of each route corridor on all travellers. For the purpose of this section all travellers refers

to vehicle travellers and non-motorised users (NMUs). NMUs include pedestrians, equestrians and cyclists.

NMU movements within the route corridors appear to be concerned mainly with the ad hoc movement of visitors and tourists staying at locations along the route, crossing over the A82 to access the loch side, or travelling between accommodation and tourist attractions such as ferry terminals. There is no cyclepath provision or route for equestrian usage; the road is considered unsafe for cycle and equestrian use.

Public transport and parking provision along the route corridor is considered to be poor overall.

Drivers experience significant levels of driver stress along parts of the current route of the A82, primarily due to the narrow carriageway and poor visibility due to bends in the road. Parts of the corridor have no road markings, and oncoming vehicles may also increase driver stress. Slow moving vehicles are common on the current A82 and few safe overtaking opportunities exist, which can result in the build-up of traffic behind Heavy Goods Vehicles (HGVs) and farm vehicles.

The construction phase of the scheme has the potential to have a temporary effect on both vehicular travellers and NMUs, due to potential impact on views, journey times, driver stress associated with construction works and disruption and severance of routes. During the operation phase potential effects are likely to be offset where possible by proposed mitigation measures (in particular driver stress). There is an opportunity to improve the A82 route for all travellers through sensitive road alignment and environmental design.

A Stage 2 (Simple) DMRB assessment will be required and will be undertaken along with a site visit of the selected route.

5.2.9 Community and Private Assets

This section considers the potential environmental effects of the proposed scheme on land use and community effects.

The land use within the route corridors is dominated by areas of woodland, pasture and rocky outcrops, with Loch Lomond to the east of the A82, which a number of watercourses feed into from the surrounding hills. The area is sparsely populated, with a few small villages and hamlets scattered throughout. There are also individual and groups of properties located throughout the route corridors. Commercial properties are also scattered throughout the route corridors and are mainly associated with recreation and tourism.

Impacts during the construction phase could include disruption to local businesses, land-take, changes in access to community land and loss of vegetation.

Road widening and construction of new sections of carriageway is likely to include permanent land take from agricultural land and woodland to different extents within all route corridors.

The level and scope of assessment required for community and private assets will depend on the final route corridor selected. However all aspects covered within this section will require Detailed Assessment, including site visits and consultation with land owners and community/local interest groups.

5.2.10 Road drainage and the Water Environment

The section of the A82 under consideration is bounded by extensive woodland, steep rock outcrop and rough pasture to the west and Loch Lomond, River Falloch floodplain and rough pasture to the east. The A82 lies within the catchment of Loch Lomond. The northern part of the catchment is of 'highland' nature with high energy watercourses draining surrounding hills.

The average annual rainfall varies between 2500mm and 3600mm. The higher rainfall in the north together with thinner layer of soils and steeper slopes generates substantial runoff into Loch Lomond.

Existing road drainage along the existing A82 between Tarbet and Inverarnan is limited in extent and variable in condition and performance. All watercourses originating to the west of the existing A82 are either culverted under the road or pass under bridges prior to discharge into Loch Lomond or the River Falloch.

Anecdotal information suggests that natural catchments of some watercourses have been altered by the installation of railway drainage to the west of the existing A82.

The following negative impacts may occur during scheme construction and operation unless appropriate mitigation measures are incorporated:-

- pollution to surface water and groundwater due to road runoff;
- pollution to surface water and groundwater due to accidental spillages;
- disruption to fluvial morphology and ecology; and
- increased flood risk.

The impact of Corridor 1 on the water environment would be the least significant due to the existing road and watercourse crossings being currently present in the area. It is considered that runoff quality and quantity will improve and a risk of accidental spillages will automatically decrease due to the improved road surface quality and incorporation of positive drainage.

The potential impacts on local water bodies associated with the southern section of Corridor 2 and the entirety of Corridor 3 would be 'adverse' as no road currently affects them.

Further, more detailed, assessment of the route corridors will be carried out during DMRB Stage 2, in the form of Simple Assessment, to quantify the impacts of the road scheme on the surrounding water environment.

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6. Traffic and Economic Assessment

6.1 Introduction

The quantitative assessment of the transport economic efficiency and road safety aspects of a proposed road improvement requires the development and application of various computer models. In the case of the DMRB Stage 1 A82 Tarbet to Inverarnan appraisal, this has involved the development of a NESA (Network Evaluation from Surveys and Assignment) model supported by a QUADRO (Queues and Delays at Roadworks) model.

The NESA model was developed to compare the costs and road user benefits of the proposed improvements; and the QUADRO model was developed to examine the delays and costs associated with the construction works and future road maintenance requirements.

Full details of the traffic and economic models developed to support the assessment of the three Corridor Options considered as part of the DMRB Stage 1 Scheme Assessment can be found in the DMRB Stage 1 Traffic and Economic Appraisal Report, dated February 2014.

6.2 Existing Conditions

A detailed programme of traffic surveys and data collection was undertaken to assist in establishing current traffic volumes, turning movements, traffic patterns, and journey times within the area that could potentially be impacted by the upgrade options.

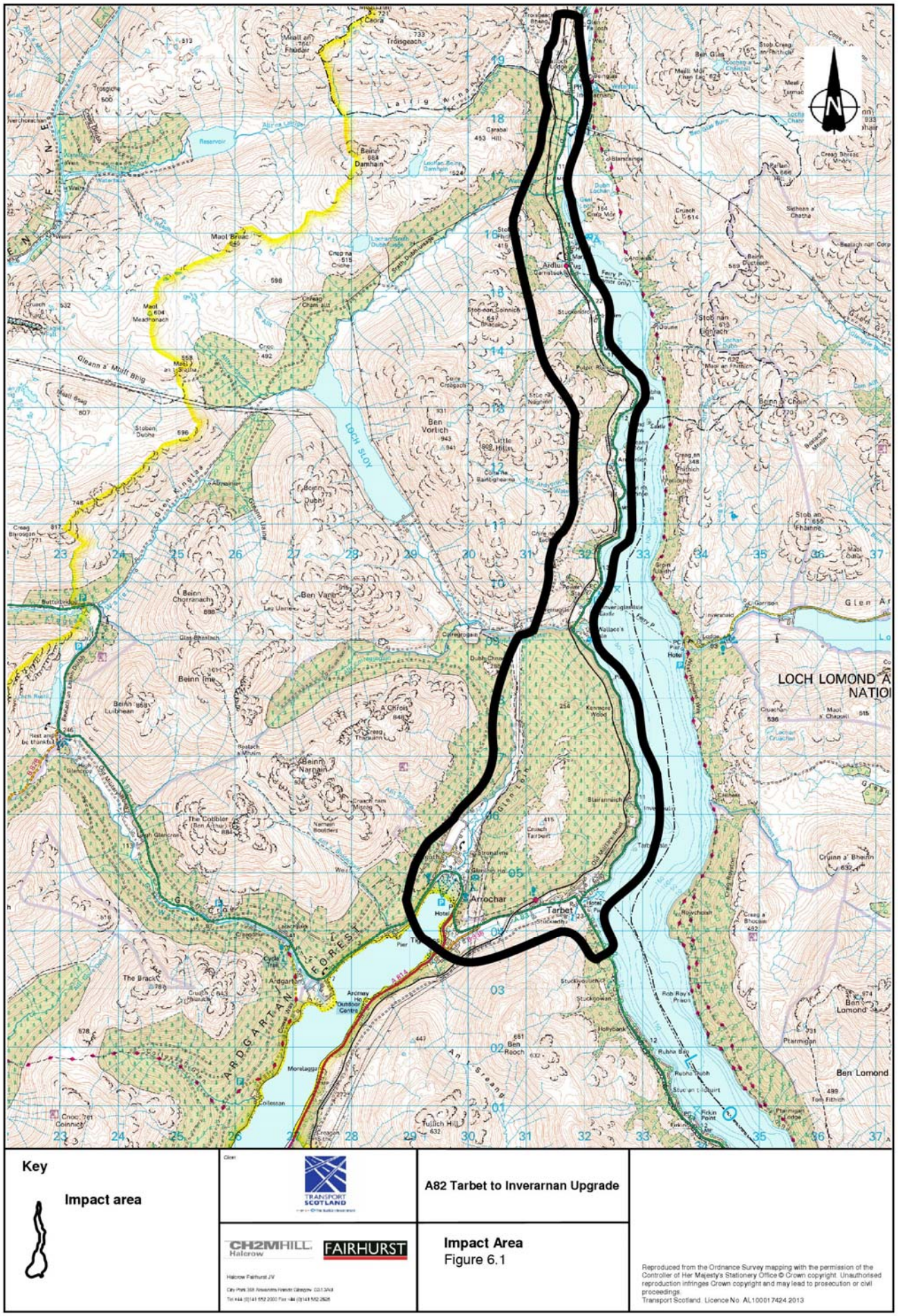
The location of the impact area is presented in Figure 6.1.

The information collected as part of the Stage 1 assessment is outlined below. Full details can be found in the DMRB Stage 1 Traffic and Economic Appraisal Report, dated January 2014.

6.2.1 Traffic Volumes

Traffic flow data from permanent Automatic Traffic Counter (ATC) sites within the impact area has been obtained from Transport Scotland's Scottish Road Traffic Database (SRTDb). The data provides hourly traffic flows for each day (where available) within the period January 2006 to June 2013 on the A82 and A83.

In addition, traffic flow data from a temporary Automatic Traffic Counter (ATC) site was collected through Transport Scotland's Data Collection Commission at a single location. The temporary ATC was installed on the A814 at Arrochar for 7 days from 27th October 2013.


Key
Impact area
A82 Tarbet to Inverarnan Upgrade
Impact Area
Figure 6.1
Reproduced from the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.
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LOCH LOMOND A
NATIO
Arrochar
Tarbet
Ben Lomond
Ben Vorlich
Ben Vane
Beinn Narnain
Beinn Ime
Beinn Luibhean
The Cobbler
Ardgartan Forest
Loch Sloy

Turning Movements

Turning count data was collected through Transport Scotland's Data Collection Commission at the following locations within the study area on Wednesday, 30th October 2013:-

- Site 1 – A82 / A83 Junction, Tarbet;
- Site 2 – A83 / A814 Junction, Arrochar;
- Site 3 – A82 / Loch Lomond Holiday Park Junction; and
- Site 4 – A82 / Ardlui Hotel Junction.

Surveys were undertaken using video footage, providing data in 5 minute intervals between 07:00 and 19:00 for the following classifications:-

- Cars;
- Light Good Vehicles (LGV);
- Other Goods Vehicles 1 (OGV1);
- Other Goods Vehicles 2 (OGV2); and
- Passenger Service Vehicles (PSV).

6.2.3 Journey Times

Journey time surveys were undertaken through Transport Scotland's Data Collection Commission along the A82 and A83 routes within the study area in October 2013. Two journey routes were surveyed as follows:-

- Route 1 – A82 from Sloy Power Station to North of Inverarnan; and
- Route 2 – A82 from South of Tarbet to Sloy Power Station via the A83 west of Arrochar.

Surveys were undertaken on Tuesday, 29th and Wednesday, 30th October 2013 between 07:00 and 19:00, using the moving observer method in line with the Design Manual for Roads and Bridges (DMRB) Volume 12, Section 2, Part 1, Chapter 3.2.25. Journey times were recorded using in car video and utilised Global Positioning System (GPS) data logging to record the position of each vehicle in 1 second intervals during each journey time run.

6.2.4 Traffic Patterns

Automatic Number Plate Recognition (ANPR) data was collected through Transport Scotland's Data Collection Commission in August and October 2013. Surveys were undertaken using video footage for the period 07:00 to 19:00 recording the time and classification of each vehicle passing each of the survey cameras.

Surveys were undertaken on Friday 9th, Saturday 10th and Sunday 11th August, within the school holiday period, to validate the operational constraints along the existing A82 route.

ANPR cameras were located on the A82, between Tarbet and Inverarnan, at the following locations:-

- Site 1 – 30/60mph speed limit change point north of Tarbet;
- Site 2 – Pulpit Rock Temporary Signals (South);
- Site 3 – Pulpit Rock Temporary Signals (North); and
- Site 4 – Bridge at Inverarnan (South of Drovers Inn).

Surveys were also undertaken on Thursday, 31st October to confirm typical journey times and traffic patterns within the impact area.

ANPR cameras were located at the following locations:-

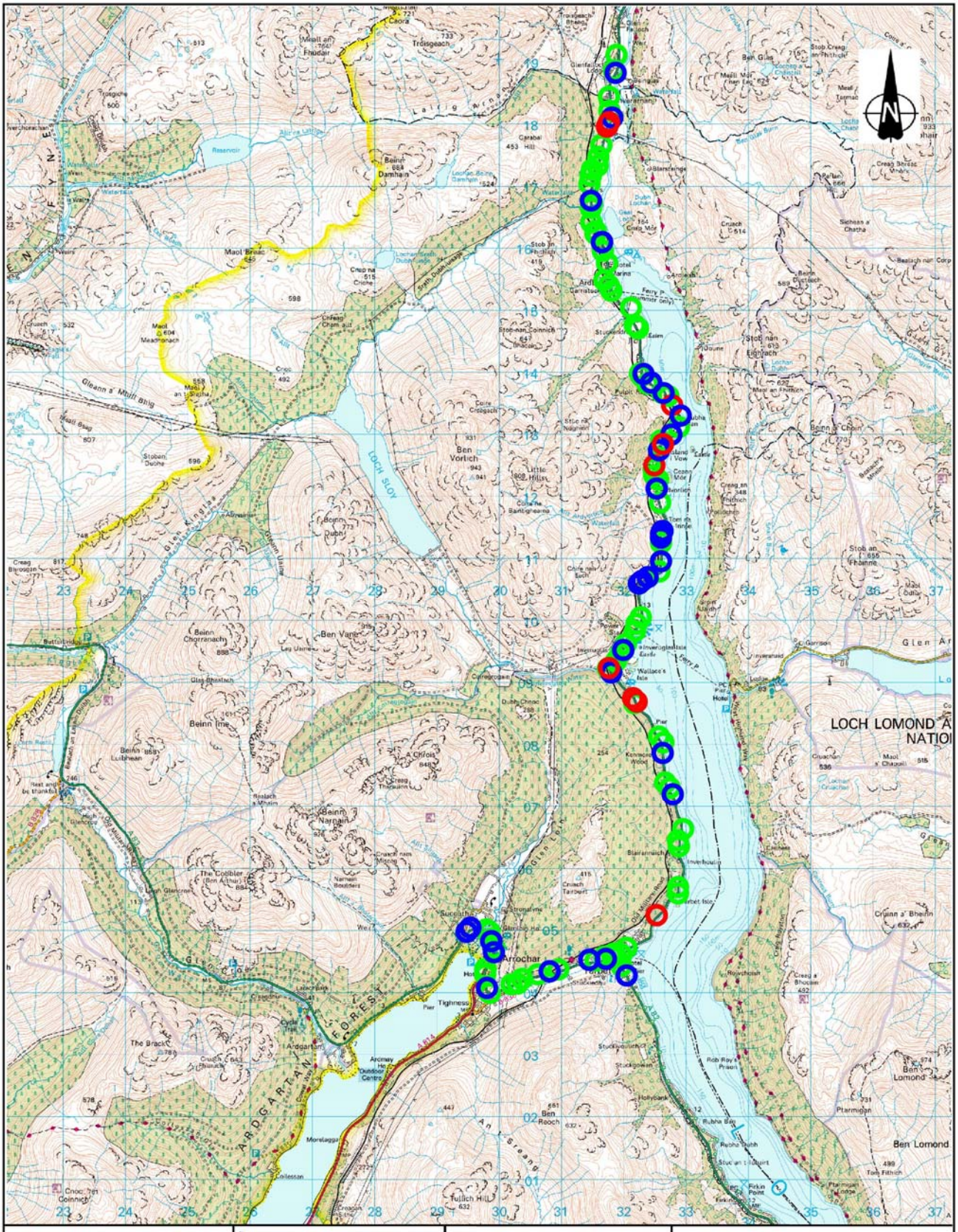
- Site 1 – A82, 30/60mph speed limit change point south of Tarbet;
- Site 2 – A814, south of A83 Junction;
- Site 3 – A83, 60/40mph speed limit change point of Arrochar;
- Site 4 – A82, south of Sloy Power Station; and
- Site 5 – A82, south of Glen Falloch.

Due to adverse weather conditions on the day of survey in October 2013, which caused issues recording registration plates, match rates are generally low. Of the registrations recorded, the match rates range from 39.8% to 90.1% with values typically between 40% and 65%. As a result, the match rates are not considered sufficient to provide a suitable basis on which to derive robust trip patterns and have not been used in the assessment.

6.2.5 Accidents

Accident data, obtained from Transport Scotland provides a record of accident dates, severity and causation factors within the period January 2000 to December 2012 within the impact area.

A summary of the accidents occurring on the A82 and A83 within the impact area, by severity, is presented in Table 6.1 and in Figure 6.2.


Key
Fatal
Serious
Slight (Minor)
TRANSPORT SCOTLAND
CH2MHILL Halcrow
FAIRHURST
A82 Tarbet to Inverarnan Upgrade
Impact Area Accidents
2000 – 2012
Figure 6.2
Reproduced from the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.
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LOCH LOMOND A
NATIO
Ben Lomond
ARDGARTAN FOREST
LOCH SLOY

Table 6.1: Accident numbers within the impact area (2000 – 2012)

Year	Accident severity			
	Fatal	Serious	Slight	Total
2000	0	14	14	28
2001	0	2	10	12
2002	1	6	12	19
2003	3	5	9	17
2004	0	4	3	7
2005	1	2	5	8
2006	1	6	6	13
2007	2	2	11	15
2008	3	4	9	16
2009	0	4	13	17
2010	0	4	8	12
2011	0	5	11	16
2012	0	5	12	17

6.3 Future Conditions

For the purpose of appraising the economic impact of the Corridor Options, a Reference Case model has been developed, which includes the proposed improvement at Pulpit Rock, providing the baseline conditions against which the Corridor Options have been appraised.

6.3.1 Forecast Years

Forecast years are taken to be the year of opening (2020) for the Tarbet to Inverarnan Upgrade and the design year of fifteen years after opening (2035).

6.3.2 Traffic Forecasts

The 24-hour annual average daily traffic flows recorded by the ATC to the north of Tarbet on the A82 are presented in Figure 6.3 and indicate that traffic levels on the A82 have remained fairly consistent over the 10-year period from 2003 to 2012 inclusive.

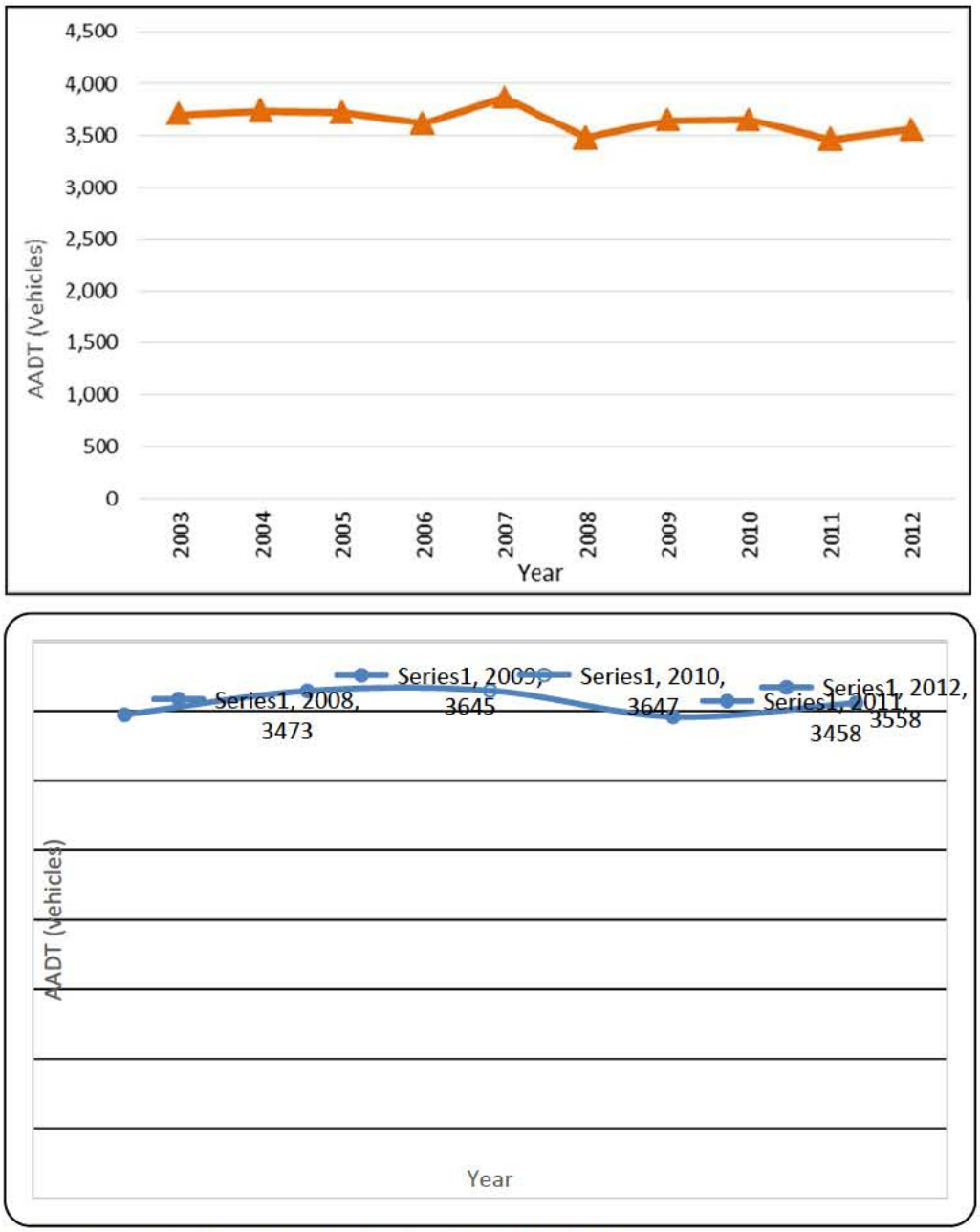


Figure 6.3: Annual average daily traffic flows (2003 to 2012)

The application of national road traffic forecasts (NRTF (1997)) under the central growth scenario has been used to assess the comparative impact of the A82 Corridor Options.

Cumulative traffic factors derived from the NRTF (1997) central traffic growth forecasts, as defined in NESA taking into account local traffic composition, are shown for key years in Table 6.2.

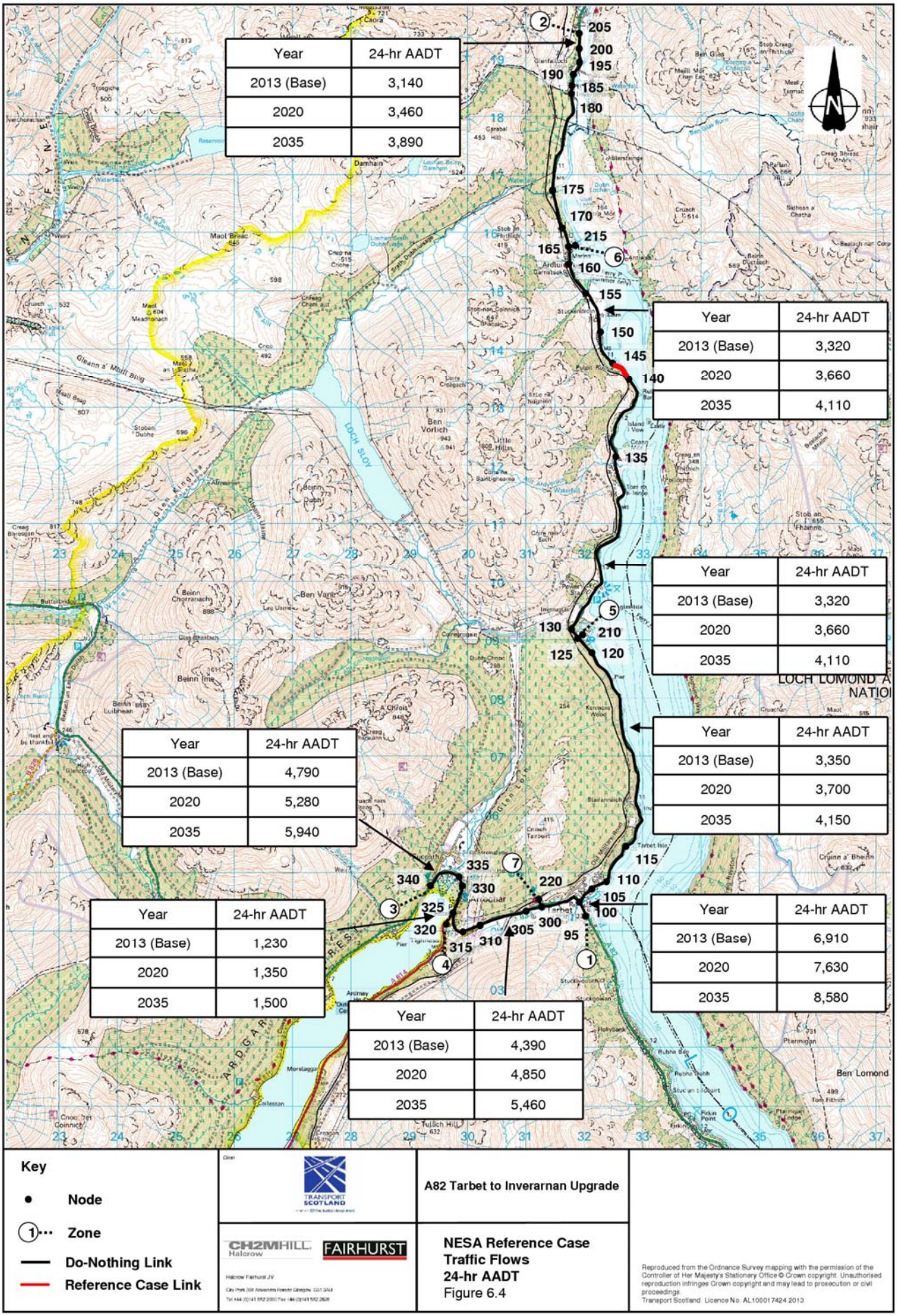
Table 6.2: NRTF central traffic growth factors

Year	Cumulative factor
2013	1.00
2020	1.10
2031	1.24
2032 to 2080	1.24

Traffic flows for the NESA Reference Case network in the 2013 base year, 2020 and 2035, under central traffic growth forecasts, are shown in Figure 6.4.

6.3.3 Journey Times

Examination of the NESA Reference Case model indicates that trips between Tarbet and Inverarnan would take 16 minutes 50 seconds in 2020, with a slight increase in 2035. Trips between Arrochar and Inverarnan in 2020 would take 20 minutes 45 seconds in 2020, with a slight increase in 2035.


Year | 24-hr AADT
2013 (Base) | 3,140
2020 | 3,460
2035 | 3,890
Year | 24-hr AADT
2013 (Base) | 3,320
2020 | 3,660
2035 | 4,110
Year | 24-hr AADT
2013 (Base) | 3,320
2020 | 3,660
2035 | 4,110
Year | 24-hr AADT
2013 (Base) | 3,350
2020 | 3,700
2035 | 4,150
Year | 24-hr AADT
2013 (Base) | 4,790
2020 | 5,280
2035 | 5,940
Year | 24-hr AADT
2013 (Base) | 1,230
2020 | 1,350
2035 | 1,500
Year | 24-hr AADT
2013 (Base) | 4,390
2020 | 4,850
2035 | 5,460
Year | 24-hr AADT
2013 (Base) | 6,910
2020 | 7,630
2035 | 8,580
Key
Node
Zone
Do-Nothing Link
Reference Case Link
TRANSPORT SCOTLAND
CH2MHILL Halcrow
FAIRHURST
Halcrow Fairhurst JV
A82 Tarbet to Inverarnan Upgrade
NESA Reference Case
Traffic Flows
24-hr AADT
Figure 6.4
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Network Capacity

Examination of the model results indicates that none of the modelled links in the Reference Case would exceed capacity under the central traffic growth scenario by the year 2035.

6.3.5 Road Safety

A total of 959 personal injury accidents were reported for the Reference Case in the NESA model, based on the application of local accident characteristics, over the 60-year assessment period under the central traffic growth scenario.

6.4 Effects of Options

6.4.1 Traffic Flows

The 2-way 24-hour AADT traffic flows in the 2020 opening year and 2035 design year for the Design network for the Corridor Options, under NRTF (1997) central traffic growth forecasts are presented in Figures 6.5a, 6.5b and 6.5c.

Where there are competing routes, such as in Corridor Options 2 and 3, which provide sections of off-line carriageway bypassing parts of the existing A82, the new A82 corridor will be signposted as the strategic route. As such, for the purpose of the economic appraisal at this stage, it has been assumed that the new corridor will be used by the vast majority of road users, leaving a limited number of vehicles on bypassed sections of the A82.

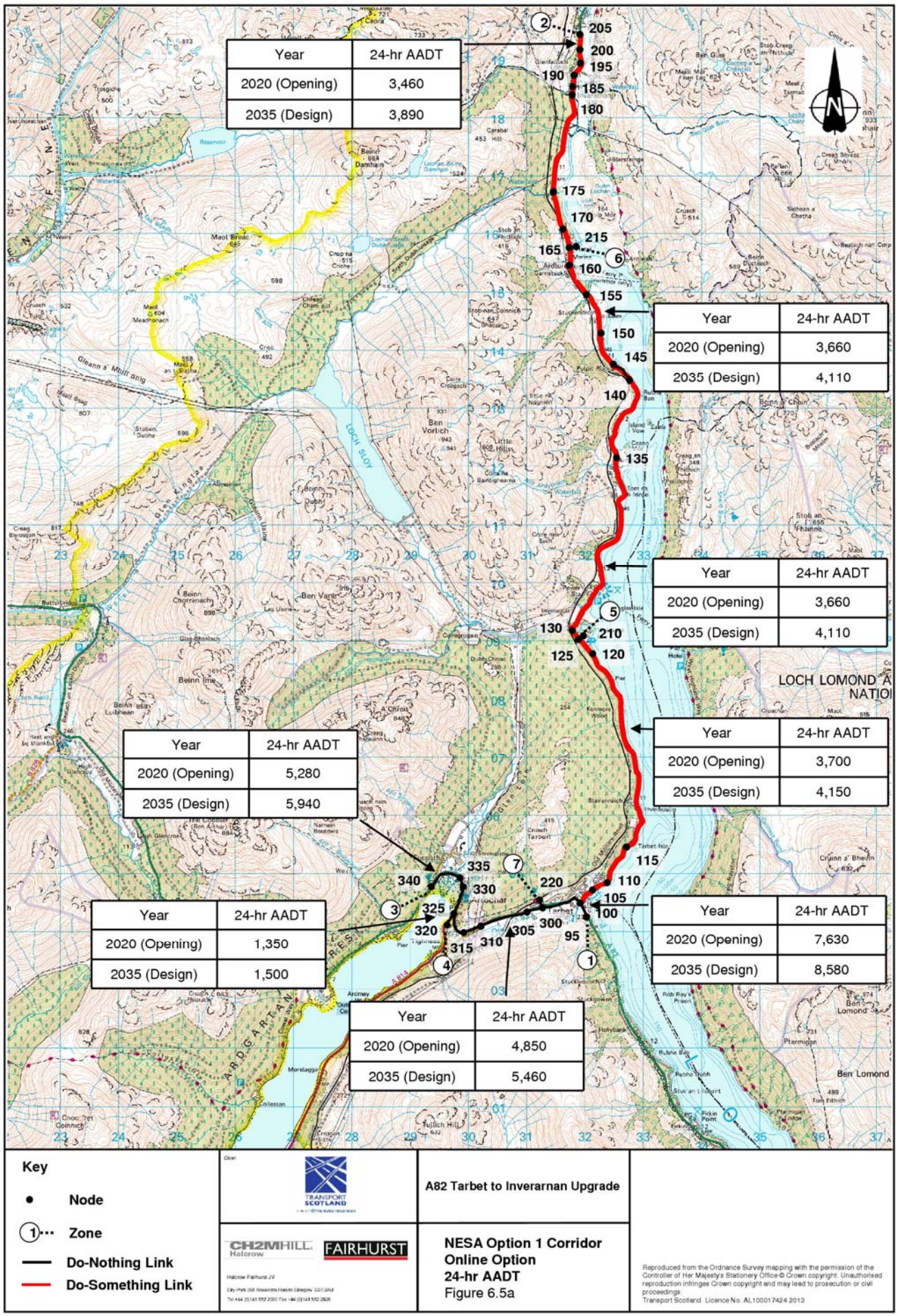
Whilst it is acknowledged that the A82 upgrade could release an element of suppressed demand, this has not been considered at this stage as it is unlikely to have a significant impact on the comparative assessment of Corridor Options.

6.4.2 Journey Times

Savings in journey time are likely to be the most significant benefits resulting from the provision of the A82 upgrade.

The greatest journey time saving between Tarbet and Inverarnan is provided by Corridor Option 3 (3.5 minutes), closely followed by Corridor Option 1 (3 minutes) as these options provide a fairly direct route for these trips. Corridor Option 2 provides little change in the journey times between Tarbet and Inverarnan as any time savings are offset by the additional time taken to travel through Arrochar in order to access the new route.

Corridor Option 2 provides the greatest journey time saving between Arrochar and Inverarnan (8 minutes) due to the proximity of the corridor to Arrochar. The journey time savings between Arrochar and Inverarnan provided by Corridor Options 1 and 3 are considerably less but similar to one another (3 and 4 minutes respectively).


Year | 24-hr AADT
2020 (Opening) | 3,460
2035 (Design) | 3,890
Year | 24-hr AADT
2020 (Opening) | 3,660
2035 (Design) | 4,110
Year | 24-hr AADT
2020 (Opening) | 3,660
2035 (Design) | 4,110
Year | 24-hr AADT
2020 (Opening) | 3,700
2035 (Design) | 4,150
Year | 24-hr AADT
2020 (Opening) | 5,280
2035 (Design) | 5,940
Year | 24-hr AADT
2020 (Opening) | 1,350
2035 (Design) | 1,500
Year | 24-hr AADT
2020 (Opening) | 7,630
2035 (Design) | 8,580
Year | 24-hr AADT
2020 (Opening) | 4,850
2035 (Design) | 5,460
LOCH LOMOND A
NATIO
Key
Node
Zone
Do-Nothing Link
Do-Something Link
A82 Tarbet to Inverarnan Upgrade
NESA Option 1 Corridor
Online Option
24-hr AADT
Figure 6.5a
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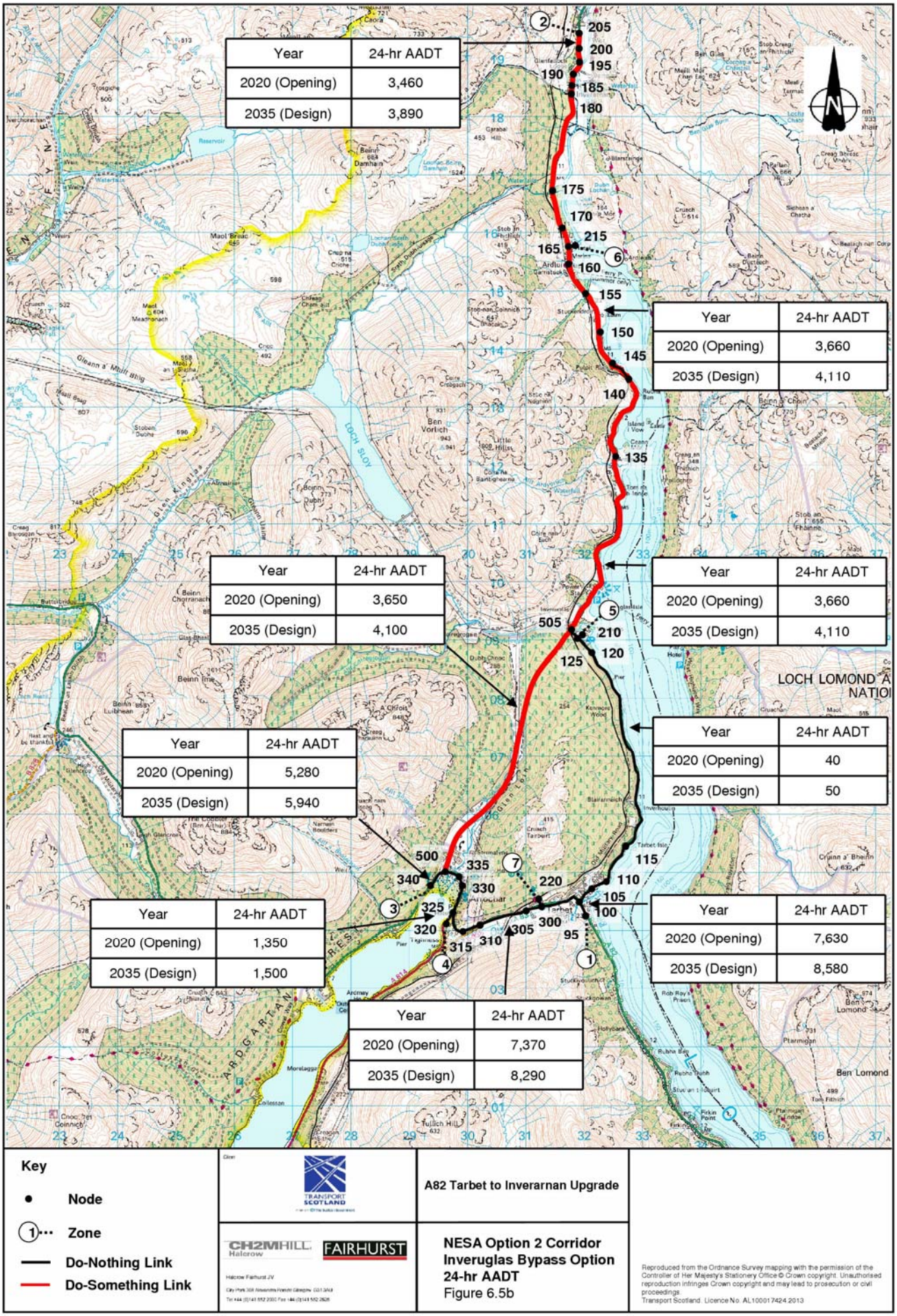
Year | 24-hr AADT
2020 (Opening) | 3,460
2035 (Design) | 3,890
Year | 24-hr AADT
2020 (Opening) | 3,660
2035 (Design) | 4,110
Year | 24-hr AADT
2020 (Opening) | 3,650
2035 (Design) | 4,100
Year | 24-hr AADT
2020 (Opening) | 3,660
2035 (Design) | 4,110
Year | 24-hr AADT
2020 (Opening) | 40
2035 (Design) | 50
Year | 24-hr AADT
2020 (Opening) | 5,280
2035 (Design) | 5,940
Year | 24-hr AADT
2020 (Opening) | 1,350
2035 (Design) | 1,500
Year | 24-hr AADT
2020 (Opening) | 7,630
2035 (Design) | 8,580
Year | 24-hr AADT
2020 (Opening) | 7,370
2035 (Design) | 8,290
LOCH LOMOND A
NATIO
Ben Lomond
Key
Node
Zone
Do-Nothing Link
Do-Something Link
A82 Tarbet to Inverarnan Upgrade
NESA Option 2 Corridor
Inveruglas Bypass Option
24-hr AADT
Figure 6.5b
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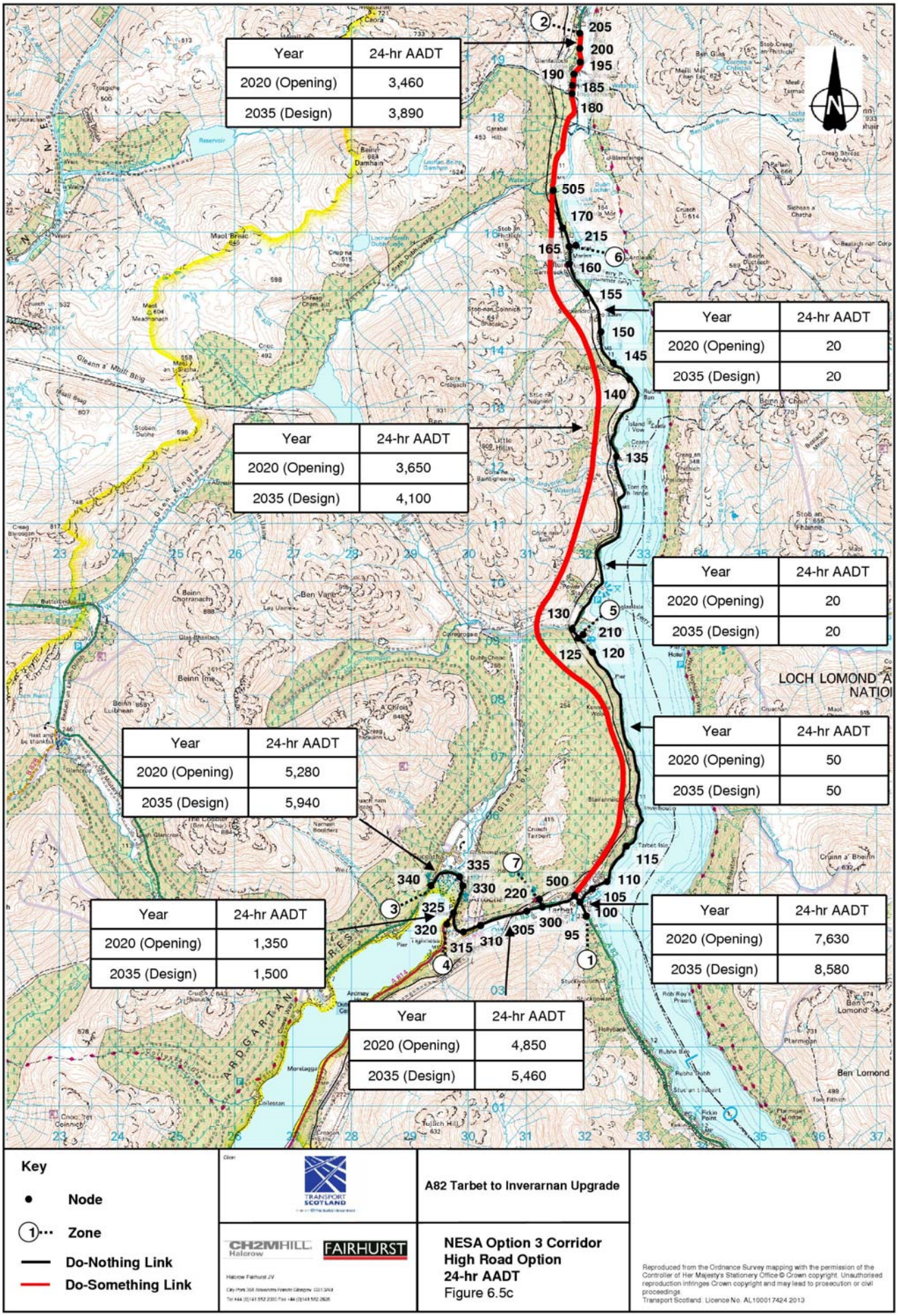
Year | 24-hr AADT
2020 (Opening) | 3,460
2035 (Design) | 3,890
Year | 24-hr AADT
2020 (Opening) | 20
2035 (Design) | 20
Year | 24-hr AADT
2020 (Opening) | 3,650
2035 (Design) | 4,100
Year | 24-hr AADT
2020 (Opening) | 20
2035 (Design) | 20
Year | 24-hr AADT
2020 (Opening) | 5,280
2035 (Design) | 5,940
Year | 24-hr AADT
2020 (Opening) | 50
2035 (Design) | 50
Year | 24-hr AADT
2020 (Opening) | 1,350
2035 (Design) | 1,500
Year | 24-hr AADT
2020 (Opening) | 7,630
2035 (Design) | 8,580
Year | 24-hr AADT
2020 (Opening) | 4,850
2035 (Design) | 5,460
LOCH LOMOND A
NATIO
Key
Node
Zone
Do-Nothing Link
Do-Something Link
A82 Tarbet to Inverarnan Upgrade
NESA Option 3 Corridor
High Road Option
24-hr AADT
Figure 6.5c
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6.4.3 Network Capacity

As the upgrade will generally improve link capacity and as it has been assumed that the upgrade will not have a significant effect on demand along the A82, none of the modelled links in the do-something scenario are likely to exceed capacity under central traffic growth forecast by 2035.

6.4.4 Road Safety

The change in personal injury accidents based on typical alignments within the corridors are shown in Table 6.3.

Table 6.3: Road safety benefits of corridor options

	No. of personal injury accidents		
	2020	2035	60-Year Total
Reference Case	14.6	16.1	958.7
Option 1	9.6	10.2	608.7
Savings	5.0	5.9	350.0
Option 2	10.4	11.0	657.5
Savings	4.2	5.1	301.2
Option 3	8.1	8.6	511.8
Savings	6.5	7.5	446.9

The results of the NESA analysis indicate that Corridor Option 3 would provide the greatest level of accident savings, followed by Corridor Option 1 and then Corridor Option 2. Over the 60 year economic life of the upgrade, the projected savings range between 301 and 447 personal injury accidents.

6.5 Economics

The NESA assessment for the A82 Tarbet to Inverarnan upgrade is based on the latest version of the program, version NESA11, which was released on behalf of Transport Scotland in March 2013. This version incorporates current national road traffic forecasts; a mid-2002 price base; and an annual discount rate of 3.5% for the first 30-years, and 3.0% for the remainder of the 60-year appraisal period.

The QUADRO assessment is based on Release 9 of the QUADRO4 program. While this is not the latest version of the software, the assessment was carried out using Release 9 due to potential bugs with later versions. The QUADRO4 Release 9 software provides results that are consistent with the NESA assessment.

For the purpose of the comparative assessment, the economic appraisal is based on the following:-

- fixed trip methodologies – whilst it is acknowledged that latent demand may be released by the A82 upgrade, it is not considered to have a significant impact on the comparative assessment of Corridor Options;
- NRTF (1997) central traffic growth projections – a NESA assessment based on the application of traffic growth forecasts under the low growth scenario, to assess the impact of limited growth along the corridor, has been undertaken as a sensitivity test;
- local accident rates – a NESA assessment based on default accident rates has been undertaken as a sensitivity test;
- optimism bias of 44% for roads and 66% for bridges and tunnels – the preliminary cost estimates for potential Corridor Options have been increased for optimism bias, in accordance with Table 6/8/2 of DMRB 15.1.6.8, to reflect the appraisers' tendency to be overly optimistic;
- construction works commence in 2017 with a construction period of three years; and
- typical maintenance profiles and works costs.

The results of sensitivity tests can be found in the DMRB Stage 1 Traffic and Economic Appraisal Report, dated February 2014.

6.5.1 Scheme Costs

The Total Scheme Costs used in the NESA assessment include Preparation and Supervision Costs, which are considered to be 12% and 5% respectively of the combined Construction, Land and Property Costs, in accordance with DMRB 15.1.6.8.

The estimated cost of typical alignments for each of the proposed corridors, used in the NESA assessment, is summarised in Table 6.4.

Table 6.4: Total scheme cost estimates (average 2012 prices, excluding VAT)

Cost item	Cost (£m)		
	Option 1	Option 2	Option 3
Construction*	185.00	217.00	364.00
Preparation	22.20	26.04	43.68
Supervision	9.25	10.85	18.20
Total Scheme Cost	**216.45**	**253.89**	**425.88**

Note: *includes Land & Property Costs. Also to be read in conjunction with the cost estimate assumptions noted in Section 3.2.1.

The following construction cost profile has been adopted for the purpose of the economic appraisal in line with DMRB 15.1.6.8, Table 6/8/2:

- 2017 - 30% of costs;
- 2018 - 34% of costs;

- 2019 - 33% of costs; and
- 2020 - 3% of costs in the proposed year of opening.

6.5.2 Overall Economic Appraisal Results

The combined results of the NESA and QUADRO assessments are presented in Table 6.5.

Table 6.5: Combined NESA and QUADRO assessment results

	Corridor options		
	Option 1	Option 2	Option 3
Present Value of Benefits (PVB)	23.00	8.51	39.11
Present Value of Costs (PVC)	111.34	132.52	225.51
Net Present Value (NPV)	-88.34	-124.01	-186.40
Benefit to Cost Ratio (BCR)	0.21	0.06	0.17

Monetary values are expressed in £m, (2002 prices, discounted to 2002 at 3.5% for the first 30 years and 3.0% for the remainder of the 60-year appraisal period).

The overall results of the economic appraisal indicate that the Corridor Options will deliver economic returns of between -£186.40 million and -£88.34 million, with BCRs ranging from 0.06 to 0.21. Whilst the Corridor Options are not expected to provide benefits that outweigh their costs, the upgrade of the A82 between Tarbet and Inverarnan is predicted to provide benefits to road users, which range from £8.51 million to £39.11 million.

With an NPV of -£88.34 million and a BCR of 0.21, Corridor Option 1 is predicted to deliver the best economic return of the three Corridor Options.

6.5.3 Wider Economic Impact

The A82 is a critical link to the north west Highlands from Central Scotland. It is an essential freight route for goods produced or sourced along the West Coast to the main centres of population in Scotland and further afield. While this part of the road is itself in one of Scotland's most scenic and popular areas, the extended A82 is also the main link to the north west Highlands for tourists and for Central Belt residents accessing its attractions for outdoor recreation.

At a local level, the area through which the A82 passes is sparsely populated, with Tarbet and Ardlui the only settlements of any size. While there are a number of farms on the land adjacent to the road, tourism is the main focus of local business activity within the existing route corridor. Tourism is also a principal source of business activity in settlements such as Inverarnan, Tarbet, Luss, Arrochar and Killin. As a consequence of the area's low population base, local residents have to access education, health, fuel and shopping facilities (for all but everyday groceries) outside the area (the closest petrol station is in Arrochar). For local residents this section of road is essential.

This section of the A82 is affected by low average speeds, variable journey times, and limited formal parking opportunities. For local residents and businesses, a limited

improvement in journey times is anticipated from the initial modelling. While the travel time effects are limited, the improvement in accessibility and the construction works themselves may have an effect on broader perceptions of the area's accessibility (to Glasgow, Dumbarton, Helensburgh and other employment focal points). There may therefore be limited housing market impacts in areas within a 30 to 45 minute drive of main employment centres, although the extent of any benefit to local areas will depend on whether this generates new housing or not.

With the possible exception of the section of A82 north of Ballachulish, this part of the route is arguably the main bottleneck between Glasgow and Fort William. While it passes through one of Scotland's most scenic areas, views from the road of the surrounding countryside are relatively restricted. Its improvement can therefore be expected to improve perceptions of the accessibility of areas dependent on the A82 generally. Depending on its design, the upgrade may also afford improved views of Ben Lomond and the Loch Lomond and Trossachs National Park (LLTNP) area. Tourism and recreation businesses (and those employed by them) are likely to be the main beneficiaries. While it is likely that related activity across the length of the route may experience some uplift, it is likely to be more pronounced in areas to the north of the upgrade.

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7. Balanced Corridor Assessment

7.1 Introduction

A balanced assessment of the Corridor options has been undertaken, considering the engineering and landscape context, the constraints and opportunities and the degree to which they address the Government criteria and objectives for the scheme.

The assessment summary sheets are provided within Appendix B.

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8. Value for Money Workshop

8.1 Introduction

A Value for Money (VfM) Workshop was held on 22nd January 2014 at which the findings of the initial studies on Engineering, Environment and Traffic & Economics were presented to Transport Scotland stakeholders.

The purpose of the VfM Workshop was to:-

- present Corridor Options;
- review, modify where necessary and agree the criteria for a comparative assessment of the Corridor options;
- Undertake a matrix assessment of the Corridor options against the criteria including weighting to test the sensitivity as required;
- Review the list of identified delivery risks and undertake an options risk assessment; and
- Taking into account the outputs from the comparative matrix assessment, capital costs, NPV, BCR and risk assessment make decisions as to which is the preferred corridor option,

The following is a summary of the VfM Workshop outcomes for each of the sections.

8.2 Outcomes

All options scored equally in terms of safety, engineering requirements and provision of stopping places. Engineering challenges are expected to be encountered along proposed corridors and stopping opportunities can be provided.

Corridor option 1 was considered to be better than options 2 and 3 in terms of meeting its Environmental objectives as corridor option 1 utilises the existing A82 route and the others would impact on undeveloped land.

Route Corridor 3 was scored better for maintenance provision as the existing A82 route could remain as a diversion alternative if necessary, although it is noted that maintenance disruption for Route Corridor 1 would be improved through the improved alignment and cross section.

In consideration of Economics and Affordability, Corridor option 1 was considered to be preferred.

Corridor option 1 also scored highest in view of Accessibility & Social Inclusion and Integration, with this corridor providing benefits for the existing communities along the existing corridor.

Corridor option 1 was finally considered to be more acceptable to the public as the route is already established.

In consideration of all the objectives and weighting, Corridor option 1 was ranked 1st with Corridor options 2 and 3 being ranked 2nd and 3rd respectively.

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9. Conclusions

9.1 Engineering Conclusions

This route options assessment, and the various information gathered during the Stage 1 assessment process, has identified that there are numerous engineering constraints along the route. These include:-

- Loch Lomond to the east;
- steep topography to the west;
- West Highland Railway to the west;
- overhead electricity transmission lines to the west;
- Sloy Power Station to the west immediately north of Inveruglas;
- numerous residential and commercial accesses, and informal lay-bys along the existing route; and
- numerous watercourse crossings.

Although not insurmountable, these constraints represent challenges to the design and construction of routes within each corridor.

Engineering impacts associated with each corridor option are summarised as follows:-

Option 1: Existing A82 Corridor

This corridor is constrained by the hillside and rail line to the west and Loch Lomond to the east. Consideration of departures in standard will be necessary along this corridor in order to mitigate impacts on the loch and its environment and any requirement for structures.

Option 2: Arrochar to Inveruglas to Inverarnan

Corridor Option 2 will require works alongside the River Loin including structures and possible localised realignment. The route from Glen Loin to Inveruglas will require steep gradients and associated significant earthworks and possible structures over the Inveruglas Water. Works in the corridor will also have an impact on the Sloy Power Station and its associated apparatus and power lines. A crossing of the West Highland Railway will also be necessary. Beyond Inveruglas the existing constraints of the hillside and Loch Lomond will require consideration of departures in standard in order to mitigate impacts on the loch and its environment and any requirement for structures.

Option 3: High Road (Tarbet to Geal Loch to Inverarnan)

Due to the extremely undulating terrain Corridor Option 3 is anticipated to require significant geotechnical and structural works including tunnels and viaducts. Works in this corridor will also have an impact on the Sloy Power station and its associated apparatus and power lines. A crossing of the West Highland Rail line will also be necessary. While the possible implication of de-trunking an existing section of the A82 is outwith the scope of the Stage 1 assessment it could be an issue at a later stage.

The work considered necessary by a Local Authority to improve a length of road to be de-trunked to make it acceptable may be costly.

In consideration of the constraints and engineering issues it is considered that the on-line corridor Option 1 is preferable from an engineering perspective.

9.2 Environmental Conclusions

The environmental assessment report identifies key environmental issues associated with the three route corridors to enable the scope of future environmental assessment to be determined. It is recognised that adverse impacts are likely to occur during the construction and operation of the proposed scheme. Some impacts will be short term (e.g. during construction), others may be permanent (e.g. direct loss of habitat / visual screening) or some may occur as a result of the operation of the scheme (e.g. introduction of traffic into an area where previously there was none). As a result mitigation measures will be designed into the scheme to reduce adverse environmental impacts.

9.3 Traffic and Economic Conclusions

The upgrade of the A82 between Tarbet and Inverarnan is predicted to provide benefits to road users, which range from £8.51m to £39.11m. Based on the results of the comparative appraisal, Corridor Option 1 is expected to deliver the greatest level of economic return with an NPV of -£88.34m and a BCR of 0.21.

Whilst the Corridor Options are not expected to provide benefits that outweigh their costs, the overall scale of wider economic impacts is anticipated to be moderate, although it should be noted that this will be influenced by the design approach adopted.

In parts of this section of the A82, the road itself could be an attraction to visitors if, for example, 'iconic' features are incorporated. Should this be the case, a greater scale of benefit may be anticipated across the A82 generally, with a heightened focus on the upgraded corridor itself.

9.4 Balanced Corridor Assessment Conclusion

The findings of the balanced assessment show that while the do-nothing option has minimum environmental impact it fails to address the scheme objectives.

Corridor Option 1, following the existing corridor, has the potential to meet objectives by improving safety and reliability, though regular journey time savings are limited and lochside structures may be required.

Notwithstanding this, Option 1 is preferable to both Corridor Options 2 and 3, which would present much greater environmental impact and require significant and costly structural works without any significant improvement in operational performance. On the basis of the balanced assessment Option 1 is recommended as the preferred option.

9.5 Value for Money Workshop

In consideration of objectives and their associated weighting, Corridor Option 1 scored higher than options 2 and 3.

10. Recommendations

On the basis of engineering challenges, value for money, integration with the existing trunk road network and communities, and opportunities to improve the journey experience through the National Park it is considered that Route Corridor 1 offers the greater benefits and should be progressed through a Stage 2 Scheme Assessment carried out in accordance with the Department of Transport (The Scottish Development Department), Design Manual for Roads and Bridges, Volume 5, Section 1, Part 2, TD 37/93 'Scheme Assessment Reporting'.

The Stage 2 Scheme Assessment will focus on the development of route options within the Corridor. Consideration of engineering design, traffic flows, economics and environmental effects will be carried out following discussions and informal consultations with Stakeholders, Consultees, landowners and members of the public.

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Appendix A

Existing Infrastructure

Table 1: Existing A82 accesses

Ref.	Chainage	Type	Direction (N/B S/B)	Description
1	Ch. 564	Access Road	N/B	Access to Tarbet Isle Viewpoint
2	Ch. 1534	Business/Commercial Access	N/B	Bonnie Braes Coffee Shop
3	Ch. 1585	Access Road	N/B	Private Access
4	Ch. 1627	Business/Commercial Access	S/B	Boat Yard
5	Ch. 3251	Access Road	N/B	Possible Forestry Road
6	Ch. 4895	Business/Commercial Access	S/B	Loch Lomond Holiday Park
7	Ch. 5050	Access Road	N/B	Access to Electricity Substation
8	Ch. 5150	Field Access	N/B	Access to Disused Camp Site
9	Ch. 5154	Residential Access	S/B	
10	Ch. 5240	Residential Access	S/B	
11	Ch. 5269	Business/Commercial Access	N/B	
12	Ch. 5272	Field Access	S/B	
13	Ch. 5503	Field Access	S/B	
14	Ch. 5563	Residential Access	N/B	
15	Ch. 5587	Residential Access	N/B	
16	Ch. 5606	Business/Commercial Access	N/B	Sloy Hydro-Electric
17	Ch. 5759	Business/Commercial Access	N/B	Sloy Hydro-Electric
18	Ch. 5854	Business/Commercial Access	S/B	Inveruglas
19	Ch. 5947	Business/Commercial Access	S/B	Inveruglas
20	Ch. 8200	Field Access	S/B	
21	Ch. 8200	Field Access	N/B	
22	Ch. 8300	Farm/Business/Commercial Access	N/B	
23	Ch. 8338	Residential Access	N/B	
24	Ch. 8339	Field Access	S/B	
25	Ch. 10375	Field Access	N/B	
26	Ch. 11179	Field Access	N/B	
27	Ch. 11204	Field Access	S/B	
28	Ch. 11278	Field Access	S/B	
29	Ch. 11353	Residential Access	N/B	
30	Ch. 11378	Access Road	S/B	Loch Lomond Access

Table 1: Existing A82 accesses (Cont.)

Ref.	Chainage	Type	Direction (N/B S/B)	Description
31	Ch. 11540	Field Access	S/B	
32	Ch. 11542	Field Access	N/B	
33	Ch. 11730	Residential Access Road	N/B	
34	Ch. 11732	Field Access	S/B	
35	Ch. 11970	Field Access	N/B	Railway Sheep Creep
36	Ch. 12137	Business/Commercial Access (Possibly Also Residential)	S/B	
37	Ch. 12185	Residential Access Road	N/B	Railway Bridge
38	Ch. 12340	Railway Station Access	N/B	Ardlui Station, Railway Underbridge
39	Ch. 12389	Residential Access Road	N/B	Railway Underbridge
40	Ch. 12479	Business/Commercial Access	S/B	Boat Hire / Sales Yard
41	Ch. 12487	Residential Access Road	N/B	
42	Ch. 12590	Business/Commercial Access	S/B	Ardlui Hotel
43	Ch. 12631	Business/Commercial Access	S/B	Ardlui Marina
44	Ch. 12656	Business/Commercial Access	N/B	
45	Ch. 12742	Field Access	N/B	
46	Ch. 12892	Business/Commercial Access	S/B	Loch Lomond Outdoor Centre
47	Ch. 13495	Residential Access Road	N/B	
48	Ch. 14016	Access Road	N/B	Possible Forestry Road
49	Ch. 14466	Field Access	S/B	
50	Ch. 14544	Field Access	N/B	
51	Ch. 14546	Field Access	S/B	
52	Ch. 14580	Field Access	S/B	
53	Ch. 15293	Field Access	S/B	
54	Ch. 15294	Residential Access Road	N/B	
55	Ch. 15370	Track Access	S/B	Possible Farm Access
56	Ch. 15448	Business/Commercial Access	N/B	Drovers Lodge Car Park
57	Ch. 15460	Business/Commercial Access	S/B	Drovers Inn Car Park
58	Ch. 15494	Residential Access Road	N/B	

Table 2: Existing A82 parking areas

Chainage	Type	Direction (N/B S/B)	Description
Ch. 3832	Parking Lay-by	S/B	1 no. space
Ch. 4005	Parking Lay-by	S/B	1-2 no. spaces
Ch. 4026	Parking Lay-by	S/B	3 no. spaces
Ch. 5854	Parking Area	S/B	Formal Signed Facility Access B
Ch. 5947	Parking Area	S/B	Formal Signed Facility Access A
Ch. 9534	Parking Lay-by	S/B	2 no. spaces
Ch. 10260	Parking Lay-by	N/B	1 no. space
Ch. 10826	Segregated Parking Lay-by	S/B	Signed Exit Only
Ch. 10932	Segregated Parking Lay-by	S/B	Signed Entrance Only
Ch. 12325	Parking Lay-by	S/B	Opp. Ardlui Station, 1-2 no. spaces, phone box
Ch. 12643	Parking Area/Possible Bus Stop	N/B	5 no. spaces, small masonry building
Ch. 13386	Parking Lay-by	N/B	Signed, 8 no. spaces
Ch. 13745	Parking Lay-by	N/B	1 no. space
Ch. 14614	Parking Lay-by	N/B	2 no. spaces

Table 3: Existing A82 bridge structures

Chainage	Structure number	Form of construction	Principle dimensions
Ch. 4,985	A82 390	Masonry arch	Span: 1x13.1m Width; 9.1m
Ch. 5,710	A82 400	Reinforced concrete arch	Span: 2x12.2m Width 15.5m
Ch. 8325	A82 410	Masonry arch	Span: 3.7m Width 6.4m
Ch. 11,774	A82 420	Reinforced concrete: arch extended with concrete slab	Span: 11.1m Width 6.5m
Ch. 13,633	A82 430	Masonry arch extended and strengthened with concrete arch	Span: 5.9m Width: 6.5m
Ch. 13,694	A82 440	Masonry arch extended and strengthened with concrete arch	Span: 6.3m Width: 6.2m
Ch. 15,358	A82 450	Concrete slab	Span: Single span dimension not given Width: 12.0m

Table 4 - Existing A82 culverts

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 64	C1	Concrete Pipe	500 dia.	1000	2.6	4.6	12.8	Stone Masonry
Ch. 174	C2	Concrete Pipe	500 dia.	900	2.5	4.4	13.8	Stone Masonry
Ch. 263	C3	Concrete Pipe	400 dia.	1400	2.1	4.4	13.8	Stone Masonry
Ch. 410	C4	Concrete Pipe	900 dia.	1500	2.7	4.5	11.8	Concrete
Ch. 550	C5	Concrete Pipe	500 dia.	1000	2.6	3.7	13.8	Concrete Masonry
Ch. 684	C6	Concrete Pipe	900 dia.	1200	3.2	4.8	14.3	Masonry
Ch. 790	C7	Pipe / Box	300 dia. (inlet) Breadth: 500 (outlet) Depth: 500 (outlet)	1400	2.4	0.6	10.8	Stone Masonry
Ch. 815	C8	Pipe / Box	300 dia. (inlet) Breadth: 500 (outlet) Depth: 450 (outlet)	900 (inlet) 1000(outlet)	2.1	1.9	10.6	Stone Masonry
Ch. 870	C9	Pipe	300 dia.	800 (inlet) 3000(outlet)	2.2	6.3	1.5	Stone Masonry
Ch. 1325	C11	Box	Breadth: 450 Depth: 600	500 (inlet) 2000(outlet)	1.0	2.3	8.0	Stone Masonry
Ch. 1497	C12	Box / Pipe	150 dia. (outlet) Breadth: 430 (inlet) Depth: 400 (inlet)	3000	3.6	5.6	9.0	None
Ch. 1571	C13	Pipe	3 no. 1300 dia.	700	1.4	3.5	10.3	Stone Masonry
Ch. 1690	C14	Pipe	300 dia.	1000	1.2	6.4	11.8	None
Ch. 1835	C15	Pipe	225 dia. (outlet)			0.7	6.8	N/A
Ch. 1900	C16	Box / Pipe	300 dia. (outlet) Breadth: 600 (inlet) Depth: 400 (inlet)	1000	0.9	7.6	14.1	N/A
Ch. 1910	C17	Clay Pipe	300 dia. (outlet)		0.9	6.3	13.0	N/A
Ch. 1965	C18		Breadth: 300 (outlet) Depth: 200 (outlet)		1.1	0.6	7.5	N/A
Ch. 2295	C19	Box	Breadth: 450 (inlet) 500(outlet) Depth: 450 (inlet) 700 (outlet)	1100 (inlet) 1200 (outlet)	0.9	0.2	7.2	Stone Masonry
Ch. 2310	C20	Box / Pipe	225 dia. (outlet) Breadth: 300 (inlet) Depth: 400 (inlet)	300	0.9	3.7	8.5	None
Ch. 2395	C21	Pipe / Box	200 dia. (inlet) Breadth: 250 (outlet) Depth: 600 (outlet)	300	1.0	5.1	11.5	N/A

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 2415	C22	Pipe	225 dia. (outlet)	1400 (outlet)	0.4	4.1	9.6	N/A
Ch. 2495	C23	Box / Pipe	225 dia. (outlet) Breadth: 250 (inlet) Depth: 600 (inlet)	300 (inlet) 1000 (outlet)	0.3	5.0	11.0	N/A
Ch. 2556	C24	Pipe	600 dia.	1200 (inlet) 1000 (outlet)	0.9	2.7	9.7	N/A
Ch. 2663	C25	Pipe	375 dia. (outlet) Breadth: 400 (inlet) Depth: 600 (inlet)	200	0.7	3.2		
Ch. 2685	C26	Pipe	375 dia. (outlet) Breadth: 300 (inlet) Depth: 700 (inlet)	200	0.7	5.0	12.2	Stone
Ch. 2700	C27	Pipe	150 dia.	200	0.7	5.0	9.9	N/A
Ch. 2772	C28	Pipe	300 dia.	400		4.0	10.0	None
Ch. 2781	C29	Pipe	450 dia.		0.5	5.8	13.4	
Ch. 2829	C30	Box	Breadth: 300 (inlet) 500(outlet) Depth: 600 (inlet) 400 (outlet)	300	0.6	0.7	7.6	Stone
Ch. 2849	C31	Box	Breadth: 500 (outlet) Depth: 350 (outlet)		0.6	0.8	7.7	Stone
Ch. 2895	C32	Box / Pipe	225 dia. (outlet) Breadth: submerged Depth: submerged		0.9	6.2	13.7	Stone
Ch. 3002	C33	Box	Breadth: 400 Depth: 500	250	0.5	1.3	7.6	Stone
Ch. 3040	C34	Box / Pipe	225 dia. (outlet) Breadth: 500 (inlet) Depth: 800 (inlet)	150	0.5	1.0	8.6	Stone
Ch. 3174	C35	Pipe	600 dia.	700			9.6	Stone
Ch. 3200	C36	Box / Pipe	400 dia. (outlet) Breadth: 300 (inlet) Depth: 300 (inlet)	800	1.2	3.5	10.5	Stone
Ch. 3310	C37	Pipe	500 dia. (inlet)	500	1.5	0.3	7.8	Stone
Ch. 3346	C38	Box / Pipe	300 dia. (outlet) Breadth: 400 (inlet) Depth: 400 (inlet)		1.0	0.9	7.7	Stone
Ch. 3379	C39	Box / Pipe	400 dia. (outlet) Breadth: 500 (inlet) Depth: 600 (inlet)	300	0.7	4.7	11.4	Stone
Ch. 3405	C40	Pipe	225 dia. (inlet)	300	0.4	4.0	11.2	Concrete
Ch. 3490	C41	Pipe	450 dia.	700	1.2	7.2	15.4	Concrete
Ch. 3600	C42	Pipe	450 dia.	300		3.0	9.9	Stone Masonry

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 3695	C43	Box	Breadth: 250 Depth: 300	300	1.2	1.3	7.8	Stone
Ch. 3790	C44	Pipe	225 dia.	500	1.0	3.5	10.1	Stone Masonry
Ch. 3817	C45	Pipe	150 dia. (outlet)		0.9	3.0	9.3	
Ch. 3850	C46	Pipe	225 dia. (outlet)		0.9	3.0	9.3	
Ch. 3950	C47	Pipe	300 dia.	300	0.6	2.1	8.5	Stone
Ch. 4002	C48	Plastic Pipe	600 dia.	200	0.9	1.8	8.8	Masonry
Ch. 4036	C49	Box / Pipe	150dia. (outlet) Breadth: 400 (inlet) Depth: 300 (inlet)	300	1.0	3.0	10.4	Stone
Ch. 4061	C50	Pipe / Box	300 dia. (inlet) Breadth: 400 (outlet) Depth: 400 (outlet)	225	1.7	2.2		Stone Masonry
Ch. 4100	C51	Pipe	300 dia. (inlet) 450dia. (outlet)	600	1.3	1.2	12.0	Stone Masonry
Ch. 4261	C52	Box	400 dia. (outlet) Breadth: 500 (inlet) Depth: 300 (inlet)	200	2.8	0.6	12.0	N/A
Ch. 4342	C53	Box	Breadth: 400 (inlet) 400(outlet) Depth: 700 (inlet) 400 (outlet)	800	0.6	1.8	8.3	Stone
Ch. 4376	C54	Box / Pipe	400 dia. (outlet) Breadth: 300 (inlet) Depth: 500 (inlet)	400	0.9	2.5	10.0	Stone
Ch. 4508	C55	Pipe	300 dia.		0.9	3.0	10.0	N/A
Ch. 4573	C56	Pipe	900 dia.	900	1.5	6.2	13.5	Brick / Stone
Ch. 4635	C57	Box	Breadth: 600 (inlet) Depth: 500 (inlet)	350	0.9	1.4	7.4	None
Ch. 4655	C58	Pipe / Box	225 dia. (inlet) Breadth: 400 (outlet) Depth: 300 (outlet)	700	0.6	1.5	10.7	Stone
Ch. 4753	C59	Pipe / Box	225 dia. (inlet) Breadth: 350 (outlet) Depth: 500 (outlet)	350	0.5	1.1	7.0	N/A
Ch. 4765	C60	Pipe / Box	300 dia. (inlet) Breadth: 300 (inlet) 400(outlet) Depth: 500 (inlet) 500 (outlet)	500	0.6	0.9	6.7	Stone Masonry
Ch. 4816	C61	Box	Breadth: 600 Depth: 500	500	1.2	1.8	8.2	N/A

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 4884	C62	Pipe	300 dia.	800	0.7	39.0	35.0	Stone
Ch. 4924	C63	Pipe	300 dia.	500	1.1	5.6	12.0	
Ch. 5025	C64	Pipe	1600 dia.	1300			14.2	Stone Masonry (11.3 x 2.0)
Ch. 5547	C65	Pipe	300 dia.	400				
Ch. 6083	C66	Pipe / Box	300 dia. (inlet) Breadth: 350 (outlet) Depth: 350 (outlet)	2000	1.9	1.4	8.0	None
Ch. 6163	C67	Pipe	225 dia. (outlet)	2000	0.2	2.5	8.0	None
Ch. 6200	C68	Pipe	225 dia.	400	0.6	3.2	9.4	None
Ch. 6259	C69	Pipe	300 dia. (inlet) 400 dia. (outlet)	250	0.9	2.5	8.7	None
Ch. 6372	C70	Box	Breadth: 500 (inlet) 450(outlet) Depth: 500 (inlet) 600 (outlet)	500	1.1	2.1	9.0	Stone Masonry
Ch. 6479	C71	Pipe	1500 dia.	600	2.1	2.0	10.6	Concrete
Ch. 6548	C72	Pipe	1200 dia.	2000 (inlet) 1500 (outlet)	3.5	4.8	14.5	Concrete
Ch. 6595	C73	Arch	Breadth: 1100 Depth: 1000	3000 (inlet)	0.5	0.5	6.4	Stone Masonry
Ch. 6774	C74	Pipe	450 dia.	1500	1.3	3.9	11.5	N/A
Ch. 6900	C75	Pipe	225 dia. (outlet)		1.2	2.2	9.5	N/A
Ch. 7090	C76	Pipe / Box	225 dia. (inlet) Breadth: 400 (outlet) Depth: 400 (outlet)	600	0.7	1.8	8.7	N/A
Ch. 7215	C77	Box	Breadth: 500 Depth: 400	900	1.3	0.9	8.5	Concrete
Ch. 7372	C78	Pipe	300 dia.	400 (inlet) 700 (outlet)	0.5	3.4	9.2	Stone Masonry
Ch. 7400	C79	Box	Breadth: 400 Depth: 450	800	1.6		7.9	N/A
Ch. 7510	C80	Box	300 dia. (outlet) Breadth: 900 (inlet) Depth: 800 (inlet)	300	1.0	2.8	9.7	N/A
Ch. 7600	C81	Pipe	1000 dia.	1400	3.2	3.2	13.0	Concrete
Ch. 7730	C82	Pipe	600 dia. (outlet)		1.0	7.3	14.3	Concrete (outlet)
Ch. 7795	C83	Pipe	225 dia. (outlet)	200	0.2	1.3	7.7	N/A
Ch. 7905	C84	Pipe	300 dia. (outlet)	200	0.8	0.2	7.4	N/A
Ch. 7997	C85	Pipe	1000 dia.	700	4.7	7.0	19.7	Masonry (3m wide x 2m high)
Ch. 8371	C86	Pipe	225 dia.	400	0.8	1.6	8.0	Stone

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 8430	C87	Pipe						
Ch. 8583	C88	Pipe	300 dia.	1000	1.8	1.5	9.0	
Ch. 8605	C89	Box	Breadth: 300 (outlet) Depth: 400 (outlet)	500	0.6	1.6	8.1	N/A
Ch. 8672	C90	Pipe	225 dia. (outlet)		0.4	0.2	6.6	
Ch. 8757	C91	Pipe	300 dia. (outlet)	500	1.9	0.9	9.1	Stone
Ch. 8784	C92	Pipe	150 dia. (outlet)		0.1	1.6	7.5	N/A
Ch. 8905	C93	Pipe	400 dia.	700	1.3	2.3	9.2	N/A
Ch. 8936	C94	Pipe / Box	2 no. 650 dia. (inlet) Breadth: 2 no. 500 (outlet) Depth: 2 no. 400 (outlet)	500	0.5	2.6	9.1	N/A
Ch. 8947	C95	Pipe / Box	300 dia. (inlet) Breadth: 400 (outlet) Depth: 400 (outlet)	500	0.4	2.6	9.1	
Ch. 9076	C96	Pipe	1100 dia. (inlet)	600	3.9	3.0	12.8	
Ch. 9200	C97	Pipe	225 dia. (outlet)		0.6	2.3	9.3	N/A
Ch. 9251	C98	Box / Pipe	225 dia. (outlet) Breadth: 200 (inlet) Depth: 600 (inlet)	200	0.6	1.2	7.8	N/A
Ch. 9331	C99	Pipe	225 dia.	600	0.6	0.5	7.0	N/A
Ch. 9546	C100	Pipe	225 dia. (outlet)		0.6	1.5	8.0	N/A
Ch. 9583	C101	Box / Pipe	225 dia. (outlet) Breadth: 200 (inlet) Depth: 500 (inlet)	300	1.3	1.8	8.9	N/A
Ch. 9756	C102	Pipe / Box	400 dia. (inlet) Breadth: 200 (outlet) Depth: 400 (outlet)	750	0.9	6.5	12.0	N/A
Ch. 9831	C103	Pipe	300 dia.	800	0.9	1.5	7.5	Masonry
Ch. 9956	C104	Pipe	450 dia.	800	0.5	1.5	8.0	N/A
Ch. 10290	C105	Pipe	225 dia. (outlet)		0.2	1.8	9.7	N/A
Ch. 10303	C106	Pipe	600 dia. (outlet)	5000	5.0	7.0	18.5	N/A
Ch. 10363	C107	Box / Pipe	225 dia. (outlet) Breadth: 250 (inlet) Depth: 700 (inlet)	700	0.6	1.6	7.3	Masonry
Ch. 10501	C107A	Box / Pipe	300 dia. (outlet) Breadth: 300 (inlet) Depth: 500 (inlet)					
Ch. 10573	C108	Pipe	300 dia. (inlet)	400	0.3	2.0	7.8	N/A
Ch. 10700	C109	Box	Breadth: 400 (outlet) Depth: 200 (outlet)	400	0.8	2.0	8.5	Stone
Ch. 10722	C110	Pipe	300 dia. (outlet)					N/A

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 10805	C111	Pipe / Box	800 dia. (inlet) Breadth: 1600 (inlet) Depth: 500 (inlet)	800	0.8	2.5	9.0	N/A
Ch. 11005	C112	Concrete Pipe	600 dia. (inlet) 900 dia. (outlet)	1400	4.4	7.8	21.0	Masonry
Ch. 11137	C113	Concrete Pipe	1000 dia.	800	7.0	8.6	25.0	Masonry
Ch. 11846	C114	Box	Breadth: 1500 (outlet) Depth: 1500 (outlet)		3.3	11.6	22.9	Concrete
Ch. 11947	C115	Concrete Pipe	450 dia. (outlet)		1.6	4.2	12.6	Concrete
Ch. 11995	C116	Plastic Pipe / Box	500 dia. (inlet) Breadth: 900 (outlet) Depth: 550 (outlet)	800	0.6	3.0	14.5	Brick
Ch. 12185	C117	Arch	Breadth: 1500 Depth: 1000	1000	0.4	0.4	6.5	
Ch. 12390	C118	Plastic Pipe	525 dia. (inlet) 250 dia. (inlet)		0.9	1.0	7.3	
Ch. 12734	C119	Concrete Pipe	3 no. 450 dia.	550	4.0	3.0	12.7	Concrete
Ch. 12847	C120	Concrete Pipe	900 dia.	1500	3.9	6.3	16.5	Concrete
Ch. 12953	C121	Pipe	450 dia. (outlet)	1400	2.0	5.2	15.4	
Ch. 13028	C122	Pipe / Box	225 dia. (inlet) Breadth: 300 (outlet) Depth: 450 (outlet)	1400 (inlet) 1800 (outlet)	7.0	1.9	13.0	
Ch. 13163	C123	Pipe	450 dia. (outlet)		2.7	2.7	13.0	Concrete
Ch. 13276	C124	Pipe	2 no. 300 dia.	650	2.4	2.8	12.4	Concrete
Ch. 13434	C125	Pipe	300 dia.	1000	2.6	2.5	11.6	Concrete
Ch. 13457	C126	Concrete Pipe	850 dia.	900	5.0	4.1	15.5	Concrete
Ch. 13835	C127	Box	Breadth: 350 Depth: 700		0.6	1.8	8.3	Brick
Ch. 13860	C128	Box / Pipe	300 dia. (outlet) Breadth: collapsed Depth: collapsed	8.5	0.8	1.8	8.5	N/A
Ch. 13890	C129	Box	Breadth: 200 Depth: 250					
Ch. 13980	C130	Pipe	375 dia.					
Ch. 14035	C131	Plastic Pipe	500 dia.	300			9.1	Stone Masonry
Ch. 14100	C132	Box	Breadth: 300 (outlet) Depth: 300 (outlet)		2.0	2.4	11.6	None

Table 4: Existing A82 Culverts (Cont.)

Chainage	Culvert reference	Type	Principle dimensions (mm)	Cover depth (mm)	N/B offset (m)	S/B offset (m)	Length (m)	Headwall type
Ch. 14153	C133	Plastic Pipe	225 dia. 150 dia. 300 dia.	300 (inlet) 900 (outlet)	1.3	0.9	8.7	Stone Masonry
Ch. 14330	C134	Pipe	300 dia. (inlet)	900	0.45	1.6	8.1	N/A
Ch. 14463	C135	Box	Breadth: 400 Depth: 300	600	0.8	1.9	8.5	N/A
Ch. 14553	C136	Box	Breadth: 950 Depth: 400	300	1.8	0.8	7.6	Stone
Ch. 14724	C137	Clay Pipe / Box	300 dia. (inlet) Breadth: 400 (outlet) Depth: 300 (outlet)	1200 (inlet) 1300 (outlet)	2.1	1.8	9.7	None
Ch. 14810	C138	Plastic Pipe	950 dia.	200 (inlet) 400 (outlet)	1.4	1.3	8.6	Stone / Concrete
Ch. 14873	C139	Box	Breadth: 350 Depth: 400	1000	1.2	1.8	8.3	None
Ch. 14890	C140	Clay Pipe	400 dia.	700	1.8	1.3	8.7	Stone
Ch. 15153	C141	Plastic Pipe	225 dia.	400	0.6	14.0	21.0	None
Ch. 15205	C142	Concrete Pipe	1000 dia.	950	2.5	2.7	12.5	Concrete
Ch. 15667	C143	Box	Breadth: 2000 Depth: 1000	1000	1.7	4.4	14.2	Masonry
Ch. 15727	C144	Box / Plastic Pipe	225 dia. (outlet) Breadth: 400 (inlet) Depth: 500 (inlet)	550	0.9	5.3	13.6	
Ch. 15805	C145	Pipe	225 dia. (outlet)		1.1	3.2	11.8	N/A
Ch. 15923	C146	Pipe	1200 dia. (inlet)		0.65	3.6	8.9	Concrete
Ch. 16062	C147	Box / Steel Pipe	400 dia. (outlet) Breadth: 600 (inlet) Depth: 600 (inlet)	2000	0.65	3.6	12.2	N/A
Ch. 16137	C148	Box	Breadth: 400 (inlet) Depth: 200 (inlet)		10.0	2.2	18.2	N/A
Ch. 16235	C149	Concrete Pipe	600 dia. (inlet)	800	1.7	0.7	8.1	Masonry
Ch. 16267	C150	*Concrete* Pipe / Box	375 dia. Breadth: 550 (inlet) 500 (outlet) Depth: 600 (inlet) 400 (outlet)	300	1.5	1.6	8.7	Brick
Ch. 16285	C151	Concrete Pipes	2 no. 225 dia. Breadth: 550 (inlet) Depth: 450 (inlet)	150	3.3	3.1	8.7	Brick
Ch. 16366	C153	Concrete Pipes	750 dia. Breadth: 700 (inlet) Depth: 650 (inlet)	1000	6.2	7.1	21.6	

Table 5 - Existing retaining wall structures

Chainage	Structure name	Location	Form of construction	Principle dimensions
Ch. 310	A82 380 W12	Waterfront Below road	Masonry, gravity	Max.Height 3.3m Length: 12m
Ch.320	A82 380 W13	Waterfront Below road	Masonry, gravity	Max.Height 2.9m Length: 14m
Ch.460	A82 380 W15	Waterfront Below road	Masonry, gravity	Max.Height 1.5m Length: 11m
Ch. 566	A82 380 W17	Waterfront Below road	Masonry, gravity	Max.Height 3.7m Length: 40m
Ch. 763	A82 380 W21	Waterfront Below road	Masonry, gravity	Max.Height 1.6m Length: 37m
Ch. 852	A82 380 W23	Waterfront Below road	Masonry, gravity	Max.Height 1.26m Length: 36m
Ch. 928	A82 380 W24	Waterfront Below road	Masonry, gravity	Max.Height 1.6m Length: 25m
Ch. 1090	A82 380 W27	Waterfront Below road	Masonry, gravity	Max.Height 1.8m Length: 31m
Ch. 1150	A82 380 W29	Waterfront Below road	Masonry, gravity	Max.Height 2.1m Length: 68m
Ch. 1210	A82 380 W30	Waterfront Below road	Masonry, gravity	Max.Height 1.08m Length: 18m
Ch. 1900	A82 380 W42	Waterfront Below road	Masonry, gravity	Max.Height 2.25m Length: 52m
Ch. 1980	A82 380 W43	Waterfront Below road	Masonry, gravity	Max.Height 2.9m Length: 15m
Ch. 2005	A82 380 W44	Waterfront Below road	Masonry, gravity	Max.Height 2.2m Length: 14m
Ch. 2190	A82 380 W48	Waterfront Below road	Masonry, gravity	Max.Height 2.8m Length: 42m
Ch. 2350	A82 380 W50	Waterfront Below road	Masonry, gravity	Max.Height 1.6m Length: 250m
Ch. 2700	A82 380 W57	Waterfront Below road	Masonry, gravity	Max.Height 1.7m Length: 79m
Ch. 2790	A82 380 W59	Waterfront Below road	Masonry, gravity	Max.Height 2.7m Length: 176m
Ch. 3630	A82 380 W76	Waterfront Below road	Masonry, gravity	Max.Height 1.43m Length: 126m
Ch. 4230	A82 380 W87	Waterfront Below road	Masonry, gravity	Max.Height 1.31m Length: 224m

Table 5: Existing Retaining Wall Structures (Cont.)

Chainage	Structure name	Location	Form of construction	Principle dimensions
Ch. 6740	A82 400 W39	Waterfront Below road	Masonry, gravity	Max.Height 2.1m Length: 45m
Ch. 6604	No reference	Waterfront Below road	Masonry, gravity	Not given
Ch. 6620	No reference Possible Network Rail Structure	Above NB carriageway	Masonry, gravity	Not given
Ch. 6830	A82 380 W43	Waterfront Below road	Masonry, gravity	Max.Height 5.5m Length: 11.5m
Ch. 6900	No reference Possible Network Rail Structure	Above NB carriageway	Masonry, gravity	Not given
Ch. 7128	A82 400 W54	Waterfront Below road	Masonry, gravity	Max.Height 1.8m Length: 14m
Ch. 7170	A82 400 W56	Waterfront Below road	Masonry, gravity	Max.Height 2.0m Length: 14m
Ch. 7390	A82 400 W63	Waterfront Below road	Masonry, gravity	Max.Height 2.5m Length: 9m
Ch. 7820	A82 400 W80	Waterfront Below road	Masonry, gravity	Max.Height 1.26m Length: 25m
Ch. 9880	A82 410 W49	Waterfront Below road	Masonry, gravity	Max.Height 2.1m Length: 27m
Ch.10170	A82 410 W58	Waterfront Below road	Masonry, gravity	Max.Height 2.1m Length: 45m
Ch.10215	A82 380 W39	Waterfront Below road	Masonry, gravity	Max.Height 2.25m Length: 73m
Ch.10501	A82 380 W39	Waterfront Below road	Masonry, gravity	Max.Height 1.95m Length: 38m

Table 6: Existing filter drainage

Chainage	Carriageway verge
0 - 890	N/B
5155 – 5200	N/B
10853, 11210	S/B
10853 - 11664	N/B
12390 - 12620	N/B
12640 - 12970	N/B
13028 - 13268	N/B
13269 - 13433	N/B
13456 - 13590	N/B

Table 7: Existing properties and boundaries

Chainage	Description	Carriageway (N/B S/B)	Offset from road (m)
Ch. 1540	Bonnie Braes Coffee shop, car park, private jetty opposite	N/B & S/B	0.0m (land boundary) 8.0m (building)
Ch. 4600-4900	Loch Lomond Holiday Park	S/B	10-30m
Ch. 5170 Ch. 5220	Private Dwellings (2 No.)	S/B	2.9m
Ch. 5300	Derelict Building	N/B	1.5m
Ch. 5590	Private Dwelling	N/B	6.5m
Ch. 5710	Sloy Hydro Station	N/B On Line	0.0m (land boundary)
Ch. 5800–6000	Inveruglas Visitors Centre	S/B	51m (building) 16m (car park)
Ch. 8350	Private Dwelling	N/B	0.0m (to garden boundary)
Ch. 11300	Private Dwelling	N/B	4.0m
Ch. 11720	Private Dwelling	N/B	2.0m
Ch. 12160	Private Dwelling	S/B	2.7m

Table 7: Existing properties and boundaries (Cont.)

Chainage	Description	Carriageway (N/B S/B)	Offset from road (m)
Ch. 11800-12370	Ardlui Railway Station	N/B	1.0m
Ch. 12220-12540	Ardlui Marina	S/B	0.0m (land boundary) 14.5m (buildings)
Ch. 12400-12460	Private Dwelling	N/B	6.0m
Ch. 12550-12580	Private Dwelling	S/B	4.0m
Ch. 12580-12770	Ardlui Hotel	S/B	3.5m
Ch. 12640	Outbuilding	N/B	6.5m
Ch. 15300	Private Dwelling	N/B	1.0m
Ch. 15440	Drovers Inn	S/B	3.7m
Ch. 15440	Drovers Lodge	N/B	0.0m
Ch. 15500	Private Dwelling	N/B	1.0m
Ch. 15580	Private Dwelling	N/B	0.0m

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Appendix B

Balanced Corridor Assessment Summary

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A82 Tarbet to Inverarnan Upgrade – Balanced corridor assessment summary

Project Brief

The study area is on the western banks of Loch Lomond, West Dunbartonshire, Scotland and covers 16km from a point just south of Tarbet to a point approximately 800m north of Inverarnan where the carriageway cross section widens to 7.3m with near standard verge widths. The design of the scheme shall be in accordance with the Government's appraisal criteria for the assessment of trunk road schemes, which will take into account integration, economy, safety, environmental, social inclusion and accessibility impacts.

The specific scheme objectives are:

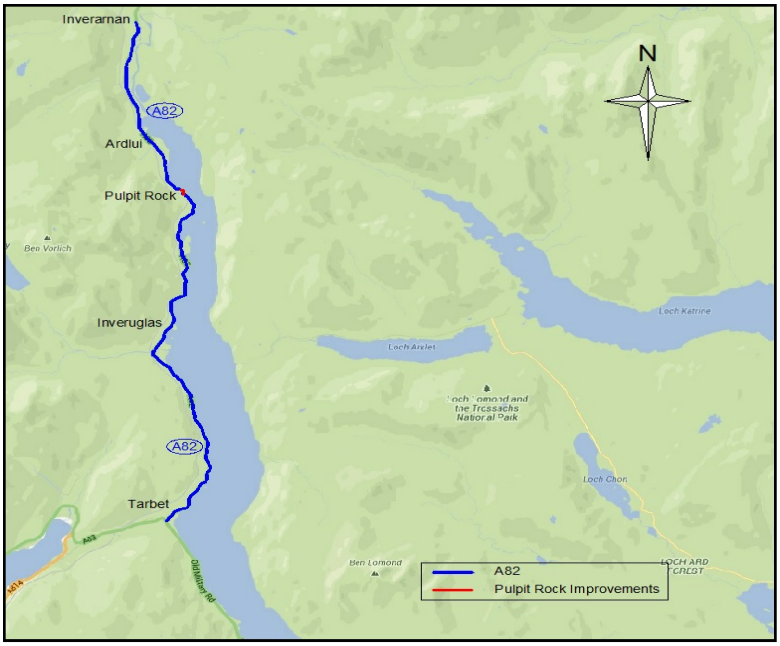
To improve average journey times for A82 trunk road users between Tarbet and Inverarnan (based on observed post Pulpit Rock scheme scenario);

To reduce personal injury accident numbers and their severity on the A82 between Tarbet and Inverarnan to be closer to or better than national KPI rates;

To provide appropriate stopping opportunities for visitors and for all trunk road users on the A82 between Tarbet and Inverarnan taking account of the unique setting of the route within the National Park;

Seek to provide opportunities for enhanced access by sustainable modes of travel along the A82 corridor between Tarbet and Inverarnan;

To reduce disruption to road users resulting from the undertaking of maintenance activities on the A82.



Route Characteristics Checklist

- Route Classification.
- Location in Network.
- Communities Served.
- Traffic Flow and Composition.
- Traffic Flow Factors.
- Transport Links.
- Industrial/Commercial
- Recreation/Tourism.
- Agriculture.

Engineering Character Checklist

- Location of Link.
- Geometry.
- Cross Section.
- Junction/Access.
- Edge Treatment/Drainage.
- Road Structures.
- Traffic Management.
- Operational Characteristics.
- Road Construction.
- Street Furniture.

Understanding the Engineering Context

- High value tourist route through sensitive semi-wild landscape within the Loch Lomond and the Trossachs National Park. The A82 is a key link between Glasgow and north-west Scotland.
- The study area has a substantially sub-standard cross-section width and alignment and has a poor accident rate. Much of the carriageway is less than 7.3m wide and many sections do not have hardstrips or verges. Owing to topographical constraints and frequent low radius bends, sight visibility is of a poor standard thus, there are no overtaking opportunities.
- The corridor consists of a single carriageway with a 60mph speed limit over its length, except at Tarbet where a 30mph limit is in operation.
- The sections both north and south of the study area are of significantly higher standard, with better geometry and greater overtaking opportunity.

A82 Tarbet to Inverarnan Upgrade – Balanced corridor assessment summary

Landscape Context –

Development

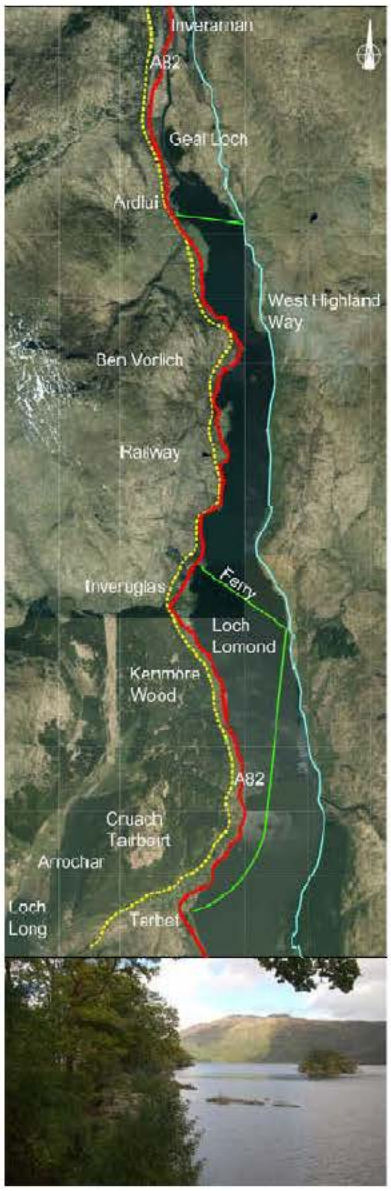
- The study area lies within the high quality landscape of Loch Lomond and the Trossachs National Park. It is made up of a wide range of varied Landscape Character Types.
- The topography of the landscape is often dramatic with steep hills allowing scenic views surrounding the Loch Lomond from elevated points.
- Settlement is mostly concentrated to flatter areas of land on the east of Loch Lomond, between the foot of the hills and the loch shore. The main settlement areas are Tarbet and Arrochar, with smaller settlements Inveruglas and Ardlui further north and individual properties present along the A82.
- Land use is mostly for forestry, farming, recreation and some residential, along with associated development. Transport corridors include A82, The West Highland Railway, and ferry routes across Loch Lomond.
- Tourism is a key land use, with marinas, tourist information centres, holiday parks and hotels present within the study area.

Protection

- Field survey and baseline study have established a number of relevant landscape and environmental designations including the following:
  - Loch Lomond National Scenic Area.
  - Two areas of Wild Land designated close to the study area in the upland hills above the loch.
  - SSSIs and areas of Ancient and Semi Natural Ancient Woodland.
  - Several Scheduled Ancient Monuments including Pulpit Rock, Island I Vow and Inveruglas Castle Isle.
  - Several circulation routes: Core Paths, Cycle Network and Tourist Walks.

Potential

- The character of the landscape is unlikely to change significantly in the foreseeable future and current land uses/management is likely to remain. Localised changes to landscape character are expected as a result of ongoing forestry works and any development proposals within the study area.



Sensitive to Change

The study area will be very sensitive to the introduction of the type and scale of road proposed due to the existing high quality of the landscape and associated designations present. Particularly sensitive landscape features will be:

- Loch Lomond National Scenic Area.
- Open Hills and associated upland character.
- Areas of Ancient and Semi Natural Ancient Woodland.
- Loch Lomond and associated landscape character and habitats.
- Existing settlements including Tarbet, Arrochar, Inveruglas and Ardlui.
- Existing circulation routes including Core Paths, Cycle Network and Tourist Walks.

A82 Tarbet to Inverarnan Upgrade – Balanced corridor assessment summary

Design Targets

- A Design Speed of 85B kph, lowering to 70A kph at some locations is considered appropriate given the topographical and environmental constraints within the study area. As this is lower than the design speeds on adjacent sections (north and south), specific gateway junctions, such as roundabouts, will be incorporated to help identify the change of standard;
- The new road will have a standard running carriageway width of 6.0m, 1.0m hardstrips and minimum 2.5m verges.
- The constrained nature of the topography dictates that standard overtaking opportunity of 15% (TD9 Table 7) will be difficult to achieve. Therefore while provision of overtaking opportunity is desirable, no target value is defined. It is noted that opportunity to the north and south is reasonable.

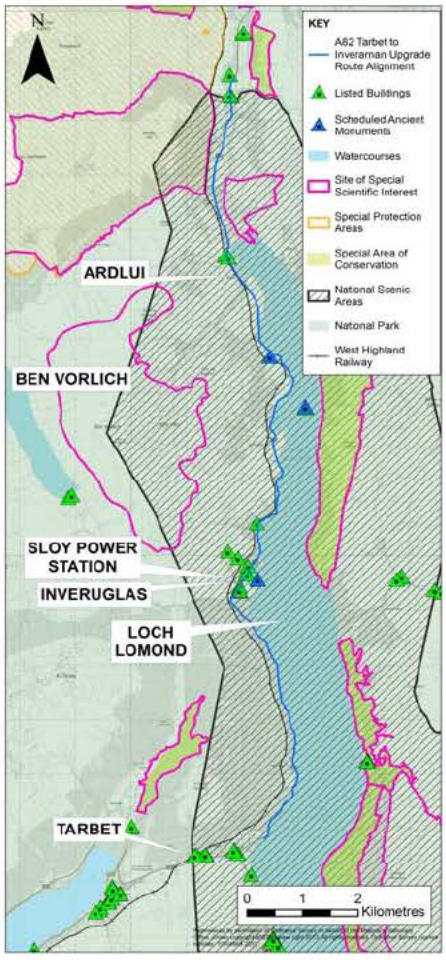
Constraints and Opportunities

Constraints

- The West Highland Railway, which runs parallel with the western boundary of the study area.
- Topography.
- The intricate coastline pattern of Loch Lomond, with small bays adjacent to the A82 carriageway.
- Areas of naturally occurring woodland.
- Local businesses and residential properties.
- Designated tourist locations.
- Sloy Power Station.
- Designated areas of importance such as Pulpit Rock.
- Risk and opportunities register.

Opportunities

- Create a unique driving experience through maximising views of the Loch.
- Provide safe access to the Loch on this notorious stretch of road.
- Create clear opportunities for tourists to stop and enjoy the views.
- Create a sympathetic design which works with the surrounding environment.
- Contribute to the Scottish Economy by improving tourist appeal.
- Increased access to Trossachs National Park.



Summary

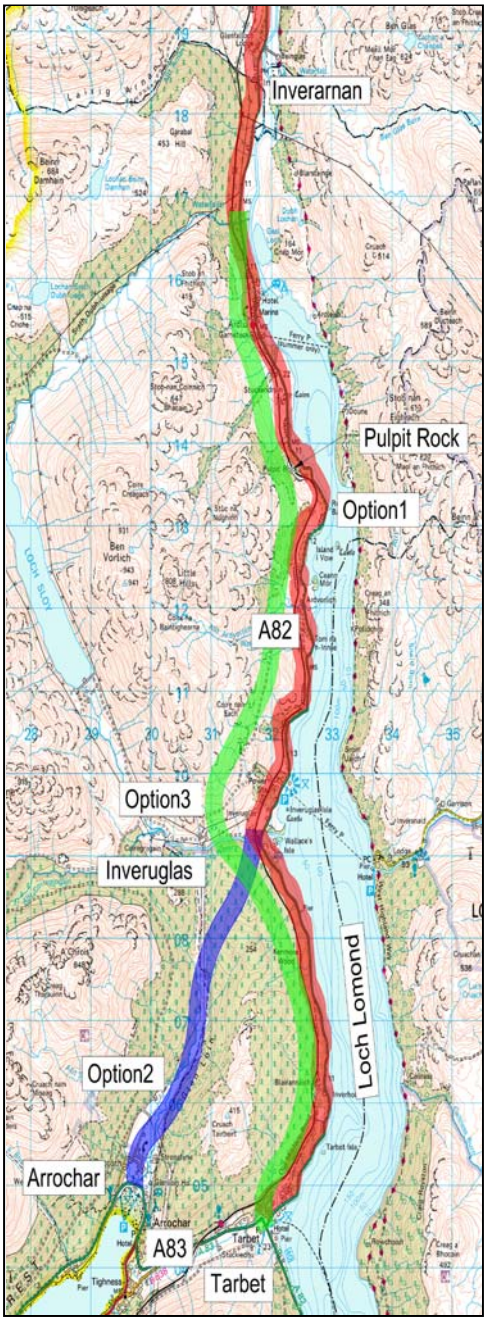
As a result of the constraints and opportunities identified, three corridor options have been considered as potential route improvement strategies. These options aim to encompass all identified opportunities, providing a scheme design which fully complements the surrounding environment whilst being safe to pedestrians, cyclists and motor users. Efforts have been focused on the following route options:

- Option 1 – Existing A82 Corridor (Tarbet to Inverarnan), on-line improvement
- Option 2 – Arrochar– Inveruglas- Inverarnan, off-line option to Inveruglas, then following on-line route to Inverarnan
- Option 3 – High Road (Tarbet to Geal Loch to Inverarnan), new road located at a high level, west of the West Highland Rail line, and is located to the west of the existing A82 alignment.

A82 Tarbet to Inverarnan Upgrade – Balanced corridor assessment summary

Broad Improvement Strategies

- Do Nothing - Fails to meet reasonable width and geometric standards, has a poor safety record and fails to meet the Client's requirements, therefore rejected.
- Traffic Management – Would not change the existing geometric alignment and therefore would not satisfy the Client's basic upgrading objective. This option was therefore rejected.
- On-line Improvements – Broadly following the line of the existing A82 along the loch shore, providing improved geometry and a cross section of 6.0m running carriageway, 1.0m hardstrips and 2.5m verges.
- Off-line Improvements – Adopting an off-line route seeking to increase potential for geometric improvements in accordance with current standards.



Identification of Route Corridors

The main considerations in the identification of route corridors were:

- To avoid or limit interference with the West Highland Railway line.
- Provide added value by linking in with other road improvements, such as A82/A83 junction.
- Improve journey times and connections.

These considerations led to the identification of three route corridors:

- Option 1 – commencing from a point just south of Tarbet, runs parallel to the loch coastline along the line of the existing A82 to a point approximately 800m north of Inverarnan.
- Option 2 – Situated between Arrochar and Invergulas, this off-line option commences at Glenloin Caravan Park and transverses through Glen Loin tying back into the A82 at Sloy Power Station. It then follows the existing A82 route to north of Inverarnan (similar to Option 1).
- Option 3 - An alignment that generally follows existing farm tracks and forestry routes to the west and above the existing A82 corridor.

Route Alignments

Route options developed at Stage 1 follow a broad corridor based approach, and have been identified only for early consideration and appreciation of possible engineering issues within each corridor and for cost estimating purposes.

- Red Route – Located within corridor Option 1, this corridor generally follows the line of the existing road, passing through areas of intricate and varied landscape character.
- Blue Route – Located within corridor Option 2, this corridor cuts through the Glen Loin valley in a northerly direction. This route is hilly with an open aspect, and provides opportunities for overtaking.
- Green Route – Located within corridor Option 3, this corridor generally follows the line of existing farm tracks and forestry routes to the west and above the existing A82 corridor.

A82 Tarbet to Inverarnan Upgrade – Balanced corridor assessment summary

Summary Assessment Matrix

Criteria/ objectives	Existing/Do nothing	Corridor Option 1	Corridor Option 2	Corridor Option 3
Function	Fails to address the existing problems with regard to journey reliability, safety and maintenance.	Enables geometric improvements to meet objectives, but may require structures within loch. Overtaking opportunity will be limited.	Enables geometric improvement. Significant structural challenges including viaduct at Inveruglas. May provide overtaking opportunity.	Enables geometric improvement but very steep gradients. Potential large tunnel and viaduct structures challenging. May provide overtaking opportunity.
Environment	Limited adverse impacts. Misses opportunities to improve NMU & vehicle traveller facilities and surface water drainage.	Adverse impacts associated with the existing road corridor (landscape, nature conservation, cultural heritage, AQ, noise). Opportunities to improve NMU & vehicle traveller facilities and surface water drainage.	Adverse impacts associated with a new road corridor in Glen Loin and additional traffic routed through Tarbet and Arrochar. Potential improvement in AQ, noise, water on existing A82 between Tarbet and Inveruglas. Opportunities to improve NMU & vehicle traveller facilities.	Adverse impacts associated with a new road corridor (landscape, nature conservation, water). Opportunities to improve NMU & vehicle traveller facilities.
Economics	Variable journey times with low average speed. Road restricts economic development and presents maintenance difficulties.	Lowest cost option. Limited journey time savings. Wider benefits through enhanced perception of accessibility due to improved reliability. Significant disruption during construction.	Medium cost option. Insignificant impact on A82 journey times. Similar wider benefits to Option 1 as a result of improved reliability. Moderate disruption during construction. More carriageway to maintain than Corridor Option 1.	Highest cost option. Similar journey time savings to Option 1. Potential for increased visitors due to two routes being available. Minor disruption during construction. Option with greatest level of carriageway to maintain.
Summary	The findings of the balanced assessment show that while the do-nothing option has minimum environmental impact, it fails to address the scheme objectives. Corridor Option 1, following the existing corridor, has potential to meet objectives by improving safety and reliability, though regular journey time savings are limited and significant lochside structures would be required. Notwithstanding this, Option 1 is preferable to both Options 2 and 3, which would present much greater environmental impact and require very significant and costly structural works without any significant improvement in operational performance. On the basis of the balanced assessment Option 1 is recommended as the preferred option.			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