

Access to Argyll & Bute (A83) Strategic Environmental Assessment & Preliminary Engineering Services  
Route Corridor Preliminary Assessment  
Route Corridor 9 – North Ayrshire – Cowal – Lochgilphead

Route Corridor Details	
Route Corridor Option	Route Corridor 9 – North Ayrshire – Cowal – Lochgilphead
Route Corridor Description	<p>This route corridor is a combination of new offline carriageway and online upgrading works which generally follows the existing road network with new fixed link crossings to the Isle of Bute and Cowal. The route corridor includes a connection from the A78 Trunk Road in North Ayrshire to Cowal via a 3.0km and 2.53km fixed link crossings between the mainland (within the vicinity of Portencross) and the Isle of Bute via Little Cumbrae Island and a 0.7km fixed link crossing between the Isle of Bute and Cowal (within the vicinity of the Colintrave to Rhubodach ferry crossing).</p> <p>From east to west, a new section of carriageway will be required between the A78 Trunk Road and the fixed link crossing to the Isle of Bute. Once on the Isle of Bute the route corridor then generally follows the existing B881, A844 and A886. Having crossed to Cowal the route corridor generally follows the A886 again up to Ballochandrain. Thereafter the route corridor generally follows the C11 and B8000 to Otter Ferry, on the eastern shore of Loch Fyne where an approximate 3.0km fixed link crossing ties into the A83 Trunk Road at Port Ann. The approximate length of the route corridor where no road currently exists is approximately 6.7km with the full route corridor approximately 63km in length. The fixed link crossings to the Isle of Bute will provide significant technical challenges. This area is used by large marine vessels as well as Ministry of Defence (MOD) submarines which are based at Faslane and Coulport.</p>
Rationale for Route Corridor	The North Ayrshire – Cowal – Lochgilphead route corridor was initially identified by Transport Scotland's Strategic Transport Projects Review team. This route corridor is considered to offer a potential alternative access route into Argyll and Bute bypassing the main landslide risk area on the A83 at the Rest and be Thankful to provide access to the central belt via North Ayrshire and the A78 Trunk Road.
Geographic Context	The route corridor lies predominantly within the Argyll & Bute region, which comprises solely of the entirety of the Argyll & Bute local authority area. The southernmost part of the route corridor lies within the North Ayrshire local authority area. The route corridor end points are located a straight line distance of approximately 27-45 miles from the city of Glasgow. The southern extents of the route corridor are situated beyond the eastern shore of the Firth of Clyde at the A78 Trunk Road. The route corridor then generally heads north-west, crossing the Firth of Clyde to Little Cumbrae, then on to the Isle of Bute passing through Rothesay and crossing the Kyles of Bute on to the Cowal Peninsula at Colintrave where it continues north-west along the banks of Loch Ruel and the River Ruel to Glendaruel. It then travels due west to Otter Ferry, where it crosses Loch Fyne to Port Ann. The western extents of the route corridor

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	<p>are situated between Lochgilphead and Port Ann on the A83 Trunk Road. There are environmentally designated sites both within and in proximity of the route corridor. With respect to transport links, the route corridor joins the two aforementioned trunk roads and it also crosses the Kyles of Bute in proximity to the existing ferry route between Colintraive and Rhubodach.</p>
<p>Social Context</p>	<p>Given the geographically remote nature of large areas of Argyll &amp; Bute, reducing the duration of journey times and improving journey time reliability for both strategic and local traffic has the potential to impact positively on deprivation levels, both geographic and economic.</p> <p>The Scottish Index of Multiple Deprivation (SIMD) identifies concentrations of deprived areas across Scotland. Argyll &amp; Bute consists of 125 data zones, with 10 data zones (8%) identified as being amongst the 15% most overall deprived data zones in Scotland. These are located in the region's 5 main towns - Helensburgh, Oban, Dunoon, Campbeltown and Rothesay. The Geographic Access to Services considers deprivation in terms of drive times and public transport times to a selection of basic services such as schools, health services and retail centres. Forty-eight (38%) of Argyll and Bute's data zones are within the 15% most 'access deprived' data zones in Scotland – most of which are located outside the main towns.</p> <p>The region's population has been in decline for over a decade, against a backdrop of a population increase at the national level.</p> <p>Data from NHS Highland estimates that there are 26,000 referrals for Argyll &amp; Bute patients each year, of which 44% are to hospitals within the region and 56% are to hospitals in the NHS Greater Glasgow and Clyde area. Disruption on the transport network can lead to missed appointments and have an adverse impact on patients' health and wellbeing.</p> <p>The region has twenty-three inhabited islands, more than any other local authority in Scotland, with seventeen percent of the regions' population inhabiting the islands. The A83 provides accessibility to services on the mainland via Kennacraig port, where ferry services depart to Islay with onward connections to Jura and Collonsay.</p>
<p>Economic Context</p>	<p>The A83 Trunk Road is one of only two east-west strategic trunk road network connections between Argyll &amp; Bute and the central belt. The lack of a reliable strategic route linking Argyll &amp; Bute with the rest of the country is understood to</p>

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	<p>be constraining economic growth in the region. When the road connection via the A83 Trunk Road is severed, the impact on residents, visitors and businesses is severe due to the lack of alternative transport options.</p> <p>The A83 Trunk Road is known to carry goods of significant value to both the regional and national economy (including whisky and seafood). The A83 Trunk Road is also a key route for tourism, and a proposal to transform the Crinan Canal into a major tourism attraction in Mid-Argyll, could benefit significantly from improved resilience and / or access to the region. Anecdotal evidence suggests closures and restrictions cost the local economy £50k-£60k per day in addition to longer-term impacts on business investment within the region and, subsequently, the region's job market.</p> <p>This route corridor follows for part of its length, the route of the A886 road which is the main road link between Colintrave in the south-west of the Cowal peninsula, many smaller communities along its length including Glendaruel and Strachur, and the A83 Trunk Road near Cairndow. This road provides an important link or businesses, residents and visitors in the Cowal peninsula with the wider strategic trunk road network.</p> <p>Due to a large proportion of the region's geographic remoteness from the major economic centres of the central belt, only a few large scale, high skill industries are located within the area. The region's economy tends to be heavily influenced by sectors with lower growth, such as agriculture and public services. Given the focus on economic recovery post-COVID-19, enhanced connectivity for the Argyll &amp; Bute region could contribute towards increasing inward investment and job opportunities for local communities. Reliable access for Bute and Cowal and Mid-Argyll, Kintyre and Islay has the potential to have a transformational effect on local/regional economies.</p>
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Transport Planning Objectives		
Objective	Performance against planning objective	
TPO1	Resilience – reduce the impact of disruption for travel to, from and between key towns within Argyll & Bute, and for communities accessed via the strategic road network.	This route corridor offers significantly enhanced resilience, through the provision of a number of alternative routes, for both strategic A83 Trunk Road traffic accessing Cowal & Bute and Mid-Argyll, Kintyre and the Islands, and for local traffic travelling to / from and between key towns and communities within Argyll & Bute. The impact of landslide induced closures and other incidents leading to road closure, such as climate change induced flooding events, accidents and road maintenance activities on the existing A83 Trunk Road, between Lochgilphead and Tarbet, is largely mitigated for a proportion of strategic A83 trunk road traffic, as a result of this

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		<p>route corridor. The main landslide risk area on the A83 Trunk Road, at the Rest and be Thankful, is effectively bypassed by this route corridor. It should be recognised that, depending on the specific origins and destinations of trips, the alternative route provided by this route corridor, may be greater in distance for strategic traffic, than the current A819 / A85 /A82 Trunk Road diversion.</p> <p>While this route corridor potentially includes fixed link crossings, which can be impacted by severe weather (particularly during the winter period) risks of disruption to traffic would be minimised through the design of any structures required. It should also be recognised, however, that the provision of fixed link crossings may remove the need for ferries to be used to complete certain trips. Ferry services can be impacted by severe weather and mechanical issues with vessels. This route corridor may, therefore, offer a more resilient means of travel for trips to and from areas of Cowal &amp; Bute and Mid-Argyll, Kintyre and the Island, including the key towns Dunoon, Rothesay and Lochgilphead. Travel from Cowal, in particular, can be subject to disruption as, due to the peninsular nature of the area, a single road connection (the A815) links the area to the wider road network.</p> <p>In providing an additional route to the existing A83 Trunk Road (assuming it remains operational) enhanced resilience will be provided for large parts of Argyll &amp; Bute, offering a more reliable connection between the region, the central belt and beyond.</p>
TPO2	Safety – positively contribute towards the Scottish Government’s Vision Zero road safety target by reducing accidents on the road network and their severity.	For those trips that utilise the new route corridor, accident reductions would be expected due to the shorter journey times that have attracted them to the new route. During times when the A83 Rest And Be Thankful is closed, the new route corridor would also provide an alternative route on a standard of road likely to be higher than the current diversion route, which includes a section of the A82 Trunk Road, with a known safety record. Based on the relatively low volume of traffic re-routing to this route corridor, only low safety benefits are expected.
TPO3	Economy – reduce geographic and economic inequalities within Argyll & Bute through improved connectivity and resilience.	Through reducing the potential impact of landslides on the trunk road, this route corridor would improve resilience of access to key domestic and international markets. Additionally, as a result of the more direct connections to the central belt provided, enhanced

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		<p>competitive access between Argyll &amp; Bute and key markets could be realised. Through providing enhanced connectivity to both Cowal and Kintyre the route corridor is likely to provide enhanced access to a larger geographical area.</p> <p>This route corridor offers the potential to reduce economic and geographic deprivation, particularly within the Bute &amp; Cowal (Dunoon and Rothesay both have data zones within the most deprived 10%) and, to a lesser extent, Mid-Argyll, Kintyre and Islay regions of Argyll &amp; Bute (Campbeltown has data zones within the most deprived 20%).</p>
TPO4	<p>Sustainable travel – encourage sustainable travel to, from and within Argyll &amp; Bute through facilitating bus, active travel and sustainable travel choices.</p>	<p>Through the provision of fixed links to Cowal and Kintyre, improvements in mobility &amp; inclusion and reductions in transport poverty could be facilitated through the enhanced connectivity provided by this route corridor.</p> <p>However, it should be recognised that the infrastructure provided by this route corridor on its own merely facilitate improvements in these areas. Further interventions (such as enhanced public transport services) would be required to score positively against these sub-objectives.</p> <p>It is judged that, as a result of the provision of trunk roads in currently largely rural areas (particularly in Cowal) potential negative impacts on active travel could be experienced by communities within these areas. This includes, but is not limited to, potential reductions in actual or perceived road safety and potential severance issues, which could adversely impact active travel. Investment in a new route corridor within the region would however provide an opportunity to include enhanced active travel provision as part of the design.</p>
TPO5	<p>Environment – Protect the environment, including the benefits local communities and visitors obtain from the natural environment, by enhancing natural capital assets and ecosystem service provision through delivery of sustainable transport infrastructure.</p>	<p>The range and scale of potential environmental effects identified for this route corridor is such that it is likely that extensive environmental mitigation will be needed and there is the potential for a range of significant environmental impacts that could affect ecosystem service provision.</p>

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	An example of ecosystem service provision is improving water quality regulation.	
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Existing Route Corridor Conditions		
Engineering	Route corridor Length	The route corridor is approximately 63km long.
	Existing Roads	<p>The route corridor intersects the A78 Trunk Road at its southern extents and the A83 Trunk Road at its northern extents.</p> <p>The route corridor generally follows the Local Authority operated / maintained 'A' / 'B' / 'C' roads listed below: B881, A844, A886, C11 and B8000.</p> <p>The route corridor intersects the following Local Authority operated / maintained 'A' / 'B' / 'C' roads. B881, A844, C05, C02, A886, B836, A8003, C11 and B8000.</p>
	Existing Accesses	<p>A class road: 3  B class road: 4  C class road: 3  Unclassified road/direct access: 326</p> <p>Relative to the other route corridors, the high number of accesses noted above is attributed to the route corridor passing through the town of Rothesay and other settlements on the Isle of Bute and Cowal peninsula.</p> <p>All local accesses from the A83 in the area around Glen Croe would be retained should this route corridor be taken forward; however, the additional work to retain these accesses has not been included in the Preliminary Assessment of this route corridor.</p>
	Topography and Land Use	This route corridor starts at the A78 Trunk Road, north of West Kilbride approximately 20m above ordinance datum. Heading west, it passes through fields and undulating ground for around 2km to a height of approximately 100m above ordinance datum where it meets the coast with the Firth of Clyde. In a north-westerly direction it crosses the

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		<p>Firth of Clyde and Little Cumbrae, which is effectively one mound starting at sea level to a height of approximately 100m above ordinance datum, before the route corridor reaches the south eastern tip of Bute.</p> <p>Land use in this section of the route corridor is primarily agriculture on the mainland, with several commercial/residential properties. Hunterston Nuclear Generating Station is located just north of the corridor with part of an associated convertor station crossing into the route corridor. Two high voltage electricity transmission lines cross through part of the corridor from Hunterston to Carlung Farm. On Little Cumbrae Island there are a few residential properties on its eastern and western extents.</p> <p>From here, the centre of the route corridor follows the coast, before meeting the B881 and continuing in a north-west-west direction to Kingarth and the A844 sitting between 0m and 20m above ordinance datum where the Firth of Clyde provides a border on the east and hills to the west. Kilchattan Bay reservoir and greater reservoir both sit close to the centre of the route corridor along with a number of properties at Kilchattan Bay. Land use within this section of the route corridor is primarily agricultural, with numerous commercial/residential properties and two reservoirs associated with Kilchattan Bay and Kingarth.</p> <p>The route corridor then follows the A844 heading due north to Craigmore where it passes through open, undulating land between approximately 20m and 100m above ordinance datum, featuring areas of forested land and settlements. The Firth of Clyde flanks the eastern side and as it nears Craigmore, Loch Ascog encroaches on the route corridor sitting approximately 40m above ordinance datum. Immediately south of Craigmore, and in the middle of the route corridor is Common Hill with a peak of 130m.</p> <p>Land use within this section of the route corridor is primarily agricultural, with numerous commercial/residential properties spread throughout the section, but more densely located in its northern extent towards Craigmore. There are also pockets of coniferous and mixed plantation woodland in this section.</p> <p>Turning west, the route corridor centreline passes through the town of Rothesay, which is fairly built up in the context of the surrounding environment, before heading north west following the coastline on the A844, meandering in and out of headlands where the Firth of Clyde continues to on north-easterly side. Just after Port Bannatyne the route corridor follows the A886. Levels of the centreline vary but sit between 0m and 20m above ordinance datum. On the west, hills of around 50m to 100m above ordinance datum fall towards the centre of the route corridor. Small settlements and holiday accommodation are located throughout this stretch.</p> <p>Land use within this section of the route corridor is primarily commercial/residential/recreational and is associated</p>
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		<p>with the town of Rothesay and the settlements of Ardbeg and Port Bannatyne. There are numerous pockets of non-coniferous trees and one coniferous plantation woodland within the section.</p> <p>A potential alternative to the length of the route corridor that follows the A844 to Craigmore and through Rothesay detailed above is for the route corridor to turn west on the A844 at Kingarth then head north-west to the south of Loch Quien through open, undulating land between 20 and 40m above ordnance datum. Continuing to follow the A844, the route would head south-west around Tarmore Hill and then due north between the coastline on the west and the hills on the east. Elevation remains low around 20m with a highpoint of 60m above ordnance datum. As it passes Ettrick Bay, the route heads north-east and then east to join into the A844 just north of Port Bannatyne.</p> <p>Land use within this section of the route corridor is primarily agricultural, with numerous commercial/residential properties spread throughout the section.</p> <p>From Ardmaleish to Rhubodach at the northern end of Bute, the route corridor continues to follow the A886 in a north westerly direction around 0m to 20m above ordinance datum. The hills on the western side of the route corridor grow in elevation to 250m and steepen in sections with the slopes forested. Settlements/properties decrease in number.</p> <p>Land use within this section of the route corridor is a mix of agricultural and coniferous plantation and non-coniferous woodland.</p> <p>The route corridor turns north, crossing over to the mainland at Colintraive where the centreline continues to follow the A886 which passes through short wooded glen with reasonably steep slopes on either side. The centreline ramps from 0m above ordinance datum up to 100m above ordinance datum at the north end of the glen, before dropping back down to around 50m above ordinance datum as the centreline moves back towards the coast line of Loch Ruel. Travelling north with Loch Ruel on the west, steep slopes fall towards the centreline with peaks of 250m. At the head of the loch, the slopes slacken off into an open area with the centreline sitting around 50m above ordinance datum.</p> <p>Land use within this section of the route corridor is primarily non-coniferous woodland. There are several residential/commercial properties including holiday accommodation spread throughout this section, with the majority located in and around Colintraive. There is also an area of agricultural land at Fearnoch.</p> <p>The centreline, still following the A886, rounds the head of loch Ruel in a north westerly direction before heading</p>
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		<p>north, and then north east up along the base of a wide bottomed valley. River Ruel sits immediately adjacent to the centreline. Starting at around 15m above ordnance datum at the southern end the centreline eventually ramps up into a saddle at the northern end of about 240m above ordnance datum. Along the length, fairly steep slopes fall towards the base. Pockets of trees, as well as small settlements/developments can be found along the length.</p> <p>Land use within this section of the route corridor is primarily a mix of agricultural land, in the valley adjacent to the River Ruel and coniferous and mixed plantation woodland on the lower slopes of the surrounding hillsides. There are numerous residential/commercial properties within the section, including holiday accommodation.</p> <p>The route corridor then turns west and generally follows the single track C11 road, through a large area of forest with ground levels rising steeply along the route corridor centre up to approximately 320m above ordnance datum. As the route corridor continues west generally towards Otter Ferry, ground levels fall again and the route corridor continues to pass through expansive areas of forest.</p> <p>Land use within this section of the route corridor is primarily coniferous plantation woodland. There are a pair of low voltage electricity transmission lines which follow the corridor from east to west.</p> <p>Otter Ferry, which is located at sea level on the eastern shore of Loch Fyne, generally marks the point where the route corridor starts to cross Loch Fyne. On the western shore of Loch Fyne the route corridor ends at the A83 Trunk Road, which generally follows Loch Fyne as it runs down the Kintyre Peninsula. Trunk road levels vary between approximately 10m and 40m above ordnance datum at the end of the route corridor.</p> <p>Land use within this section of the route corridor is primarily coniferous plantation woodland. There are a small number of residential properties located at Achnaba and Port Ann. In terms of utilities and infrastructure, there is an electrical substation and associated power lines to the east of Port Ann.</p>
	Hydrology and Drainage	This is covered under 'Water Environment' in the 'Environment' part of this table.
	Geology / Geomorphology	The area around Portencross in the south is relatively flat and low lying. Little Cumbrae has gently sloping shoreline as does the Isle of Bute north of Kilchattan Bay. Between Kilchattan Bay and the southern tip of the Isle of Bute, topography is undulating, with a steeper, more rugged shoreline. From the northern side of the Isle of Bute fixed link crossing to the head of Loch Riddon, the topography is undulating although fairly low lying, rising to the east.

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		<p>The River Ruel flows into Loch Riddon through a wide U-shaped valley. From Loch Riddon to Otter Ferry the corridor initially follows a narrow valley before reaching wide fairly gentle sloping moorlands.</p> <p>Portencross and the Isle of Bute</p> <p>The route corridor on the east of the crossing is mapped as Raised Marine Deposits of different ages, Glaciofluvial Ice Contact Deposits, Glaciofluvial Sheet Deposits and minor areas of glacial Till. Artificial ground is mapped to the north in association with the nuclear power station. A ridge of exposed bedrock is mapped slightly inland from Auld Hill to Goldenberry Hill. The easterly section of the route corridor runs over an isolated area of Peat. Little Cumbrae is underlain by Marine Deposits, Raised Marine Deposits and Blown sand around the shoreline, with small areas of Peat mapped further inland in the upland areas. On the west bank of the fixed link crossing at Hawks Nib, Marine Beach Deposits and Raised Marine Deposits are mapped around the shoreline, both comprised of sand and gravel.</p> <p>On the Isle of Bute, Raised Marine Deposits are mapped along the loch shorelines, further inland glacial Till is mapped in the hollows of the slopes and steeper slopes show no superficial cover. Areas of peat are mapped towards the tops of the hills. Extensive Marine Deposits and Raised Marine and Marine Beach Deposits are mapped at Kingarth, with minor areas of Alluvium mapped in association with Mill Burn. Marine and Raised Marine Deposits follow the shoreline along the full length of the island. Inland is predominantly mapped as glacial Till with areas of Peat and Alluvium mapped along watercourses.</p> <p>Areas of artificial ground (worked ground and voids) are mapped across Bute, one to the west of Kingarth and one to the southeast from Rothesay, likely to represent former sand and gravel pits. Further worked ground is mapped in the area of Rothesay, and on the shoreline. A void is mapped adjacent to the existing A886 at Shalunt Wood, north from Rothesay. Made ground is also generally anticipated across the route corridor in association with existing development and infrastructure.</p> <p>The bedrock geology underlying the eastern side of the crossing is mapped as the Portencross Sandstone Formation and the Kelly Burn Sandstone Formation, with several igneous intrusions including the Goldenberry Hill Sill. Several faults cross through the units generally trending northeast-southwest.</p> <p>Little Cumbrae and the southern tip of the Isle of Bute is mapped as being underlain by the Clyde Plateau Volcanic Formation of varying igneous compositions. Faulting within these units trend northwest-southeast. Further north on the Isle of Bute, larger faults cross the full width of the island, trending southwest-northeast.</p>
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		<p>Firth of Clyde Fixed Link Crossing</p> <p>The route corridor on the east side of the crossing is mapped as being underlain by Raised Marine Deposits of different ages, Glaciofluvial Ice Contact Deposits, Glaciofluvial Sheet Deposits and minor areas of glacial Till. There are areas of rock outcrop mapped around Goldenberry Hill and Portencross, indicating that superficial cover is likely to be thin. No superficial mapping is available within the Firth of Clyde; however, geophysical seismic reflection surveys have been undertaken. Little Cumbrae is recorded to be underlain by Marine Deposits and Raised Marine Deposits with blown sand around the shoreline and with small areas of Peat mapped further inland in the upland areas. An area of artificial ground is mapped in association with the nuclear power station to the north of the route corridor.</p> <p>On the west side of the crossing at Hawks Nib, Marine Beach Deposits and Raised Marine Deposits are mapped around the shoreline, both comprised of sand and gravel.</p> <p>Historic ground investigation has been completed in the area of Hunterston B Nuclear Power Station at the eastern end of the crossing, to the north of the route corridor; however, limited borehole information is available within the route corridor.</p> <p>The bedrock geology underlying the east side of the crossing is mapped as the Portencross Sandstone Formation and the Kelly Burn Sandstone Formation, with several igneous intrusions, most notably the Goldenberry Hill sill. Several faults cross through the units generally trending northeast-southwest.</p> <p>Little Cumbrae and the southern tip of the Isle of Bute is mapped as the Clyde Plateau Volcanic Formation of varying igneous compositions.</p> <p>Isle of Bute to Cowal Fixed Link Crossing</p> <p>The superficial geology on both banks is mapped as Raised Marine Deposits, comprised of sands and gravels with Marine Beach Deposits comprised of gravels, sands and silts mapped along the shoreline.</p> <p>The solid geology on both the north and south sides of the crossing is mapped as psammite and pelite of the Beinn Bheula Schist Formation. In the wider area, igneous intrusions are mapped, trending in a northwest-southeast</p>
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		<p>orientation. There is one fault of relatively short length trending northeast-southwest, mapped to the northeast of the northern end of the link.</p> <p>Loch Fyne Fixed Link Crossing</p> <p>Raised Marine Deposits are mapped across Otter Ferry at the eastern end of the fixed link crossing, with Marine Beach Deposits mapped along the shoreline and extending into the loch. Small areas of Alluvium are mapped in association with water courses to the north of the route corridor. Isolated deposits of glacial Till are mapped to the east of Otter Ferry. At the western end of the fixed link crossing, isolated areas of Raised Marine Deposits are mapped, with Marine Deposits mapped along the shoreline to the north in the Port Ann area. No GI information is available for review within or near the route corridor of the fixed link crossing. A review of the offshore geoindex indicates that seismic reflection surveys have been undertaken to the south of the route corridor.</p> <p>Bedrock geology at the crossing is mapped as semipelite of the Ben Lui Formation on the eastern shore of the loch, and quartzite and pebbly psammite of the Crinan Grit Formation to the west of the crossing. Large metabasalt intrusions are mapped within the psammities as part of the Dalradian Supergroup.</p> <p>References:</p> <ul style="list-style-type: none"> <li>• British Geological Survey, Geological Survey of Scotland, 1:63,360/1:50,000 geological map series. Accessed via BGS maps portal <a href="https://www.bgs.ac.uk/information-hub/bgs-maps-portal/">https://www.bgs.ac.uk/information-hub/bgs-maps-portal/</a>, October to December 2020.</li> <li>• British Geological Survey, Onshore GeoIndex, <a href="https://mapapps2.bgs.ac.uk/geoindex/home.html">https://mapapps2.bgs.ac.uk/geoindex/home.html</a>, accessed October to December 2020. Datasets used include National Landslide Database (NLD), Mass Movement Deposits (1:50,000 scale), Superficial Deposits (1:50,000 scale), Bedrock Geology (1:50,000 scale), Linear Features (1:50,000 scale), Borehole Records.</li> <li>• British Geological Survey, The BGS Lexicon of Named Rock Units, <a href="https://webapps.bgs.ac.uk/lexicon/home.cfm">https://webapps.bgs.ac.uk/lexicon/home.cfm</a>. Accessed October to December 2020.</li> </ul>
	Structures	The following structures are noted within this route corridor.

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		<ul style="list-style-type: none"> <li>• 1 no. retained bridge crossing of River Ruel.</li> <li>• 28 no. existing culverts.</li> </ul>
Environment Considerations	Biodiversity, Fauna and Flora	<p>Route corridor crosses Upper Loch Fyne and Loch Goil MPA for approximately 2.8km.</p> <p>Most of Ruel Estuary SSSI (313.2ha) falls within the route corridor.</p> <p>48.4ha of North End of Bute SSSI falls within the route corridor.</p> <p>18.5ha of Portencross Woods SSSI falls within the route corridor.</p> <p>134 parcels of woodland listed on the AWI fall within the route corridor.</p>
	Population and Human Health	<p>The noise environment in the vicinity of the route is characterised by the road traffic on existing A and B roads. The route corridor passes through predominantly rural areas and there are a number of settlements within the route corridor including Portencross, Kilchattan Bay, Kingarth, Kerrycroy, Ascog, Rothesay, Port Bannatyne, Ettrickdale, Ardmaleish, Colintrave, Springfield, Auchenbreck, Glendaruel, Otter Ferry and Achnaba.</p> <p>Several core paths are located within the route corridor, including:</p> <ul style="list-style-type: none"> <li>• C406 (Otter Ferry Circular, Loch Fyne);</li> <li>• C215 (Glendaruel to Otter Ferry);</li> <li>• C214g, h, i and k (Cowal Way Glenbranter to Portvadie);</li> <li>• C213 (Colintrave to Strone Point);</li> <li>• C230a, b and c (Rhubodach Ferry to circular route (WIW), Bute);</li> <li>• C487 (West Island Way new off road route, Bute);</li> <li>• C233a and b (Port Bannatyne to Ettrick Bay, Bute);</li> <li>• C237a, b, c, d, f, h i, j, k, l and m (Port Bannatyne to Kilchattan Bay, Bute);</li> <li>• C248a, b and c (Port Bannatyne to West Island Way link, Bute);</li> <li>• C232a, b and c (Port Bannatyne to Ascog, Bute);</li> <li>• C249 (Port Bannatyne to Gortans, Bute);</li> <li>• C250a and b (Skeoch Wood, Rothesay);</li> <li>• C251a, b and c (Argyll Street to Ballochgoy, Bute);</li> </ul>

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		<ul style="list-style-type: none"> <li>• C241 (Townhead to Lochend, Bute);</li> <li>• C242a and b (Townhead to Barone Hill and Barone Road, Bute);</li> <li>• C252a, b, c and d (Serpentine Road, Rothesay);</li> <li>• C253a, b, c and d (Bishops Terrace/Bogany Wood/Eastlands Road, Bute);</li> <li>• C254a and b (Battery Place to Botany Wood, Bute);</li> <li>• C255 a and b (Leopold Road to Bogany Wood, Bute);</li> <li>• C317 (Cnocnicoll Wood, Kerrycroy, Bute);</li> <li>• C411 (Kerrylammont to Kingarth, Bute);</li> <li>• C410a and b (Kerrylammont to Kilchattan Bay, Bute);</li> <li>• C244a, b, c and d (Kilchattan Bay to Blackpark Plantation, Bute);</li> <li>• C243 (Kilchattan Bay to Hawks Nib, Bute).</li> </ul> <p>Cowal Way and West Island Way (long distance walking paths) are also located within the route corridor. Cowal Way intersects the route corridor at Glendaruel, travelling south to the west of Loch Riddon. West Island Way passes through the majority of the route corridor along the east coast of the Isle of Bute.</p> <p>The Dunoon to Portvadie Sustrans route (an on-road route which is not on the National Cycle Network) passes through the route corridor at Auchenbreck, travelling in a north-westerly direction towards Glendaruel where it then travels south along the A8003 until it exits the route corridor.</p>
	Water Environment	<p>The route corridor crosses or is in the vicinity of multiple water bodies classified under the Water Framework Directive, including:</p> <ul style="list-style-type: none"> <li>• Three river water bodies, Kilfinan Burn/Allt Lean Achaidh, River Ruel and Tamhnich Burn; and</li> <li>• Seven coastal water bodies Firth of Clyde Inner – Cumbræes, Kyles of Bute, Rothesay, Loch Fyne – Middle Basin, Largs Channel (Fairlie Roads), Seamill and Ardrossan and Loch Riddon.</li> </ul> <p>The route corridor also crosses approximately 100-110 minor watercourses.</p>

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		<p>SEPA Flood Maps (SEPA, 2020) indicates that the route corridor area may be at existing coastal flood risk around the A886 on the Isle of Bute, the Firth of Clyde, at Loch Riddon and at Loch Fyne, and at existing fluvial flood risk from Ascog Burn, around Rothesay from Mill Lade, Milton Burn at Colintrave, Allt Glachavoil, and on the A886 at the River Ruel, Tamhnich Burn and Kilail Burn during a medium likelihood event (0.5% Annual Exceedance Probability (200-year) event).</p> <p>The Ruel Estuary SSSI and the Upper Loch Fyne and Loch Goil Marine Protected Area are within the vicinity of the route corridor.</p> <p>The Kyles of Bute and Loch Fyne Shellfish Water Protected Areas are within the route corridor. There are Active Aquaculture Sites, CAR licenced fish farms and Classified Shellfish Harvesting Areas within the vicinity of the route corridor.</p> <p>The route corridor passes through three water Drinking Water Protected Areas.</p> <p>Millport and Seamill bathing waters are within 5km of the route corridor.</p>
	Soils	<p>Soil type within the route corridor is mixed with peaty podzols, peaty gleys, mineral podzols, brown soils and alluvial soils all present. Mineral soils predominate the southern section of the route corridor and peaty gleys the northern section. The route corridor where peat is present predominantly transects peat identified as Class 5 (no peatland habitat recorded, soils are carbon rich and deep peat) and Class 3 (not priority peatland habitat with carbon rich soils and some areas of deep peat) in the Carbon and Peatland 2016 Map. However, the route corridor also transects pockets of peat identified as Class 2 (nationally important carbon-rich soils, deep peat and priority peatland habitat, areas of potentially high conservation value and restoration potential) on the northern side of the Isle of Bute and at east of Otter Ferry. Given the combination of soils, climactic conditions and topography the Land Capability for Agriculture (LCA) Class within the route corridor is predominantly Class 5 (Class 5.1, 5.2 and 5.3) with Class 4 (Class 4.1 and 4.2) on the more productive mineral soils and Class 6 (Class 6.1, 6.2 and 6.3) on the steeper and higher slopes. There is a small area of prime agricultural land (LCA Class 3.1) at the eastern end of the route corridor at West Kilbride.</p> <p>There are no Geological Conservation Review (GCR) sites in the route corridor.</p>



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		<p>The Land Capability for Forestry (LCF) class is mixed ranging from Class F3 at the southern end of the route corridor, Class F2 at Glendaruel and Otter Ferry and to Class F6 on the higher steeper slopes in between. There are existing stands of commercial forestry throughout the route corridor. The route corridor includes land identified in the Argyll &amp; Bute Council Woodland Forestry Strategy as Preferred (land that offers the greatest scope to accommodate future expansion of a range of woodland types, and hence, to deliver on a very wide range of objectives, Sensitivities are limited) on the Isle of Bute and at Otter Ferry. Other areas identified include existing woodland, Sensitive (areas where the nature or combination of sensitivities restricts the scope to accommodate further woodland expansion or removal) and Potential (considerable potential to accommodate future expansion of a range of woodland types, but where at least one 'sensitivity' exists).</p>
	Air Quality	<p>The route corridor passes through predominantly rural areas and there are a number of settlements within the route corridor, including Portencross, Kilchattan Bay, Kingarth, Kerrycroy, Ascog, Rothesay, Port Bannatyne, Ettrickdale, Ardmaleish, Colintrave, Springfield, Auchenbreck, Glendaruel, Otter Ferry and Achnaba.</p> <p>There are no Air Quality Management Areas (AQMAs) in the route corridor or in the Argyll and Bute council area and current and past annual assessments suggest that it will be very unlikely to be necessary to declare any AQMAs in the future based on current air quality objectives (Argyll &amp; Bute Air Quality Annual Progress Report, 2020).</p> <p>Air quality in Argyll and Bute is considered to be generally very good and complies with all the air quality objectives for Scotland (Argyll and Bute Air Quality Annual Progress Report, 2020). Modelling results for sources of nitrogen dioxide and fine particulates in the Argyll and Bute Air Quality Annual Progress Report (APR) illustrate that background concentrations are very low, with the traffic considered as the main potential source of pollution in the absence of industry hotspots in the region. The Argyll and Bute APR did not identify any areas where air quality objectives may be under threat and where specific actions are required to improve air quality.</p>
	Climatic Factors	<p>The baseline for climatic factors is not considered to differ greatly between the 11 route corridors.</p> <p>As indicated in the 'Water Environment' section, the route corridor area may be at existing coastal flood risk around the A886 on the Isle of Bute, the Firth of Clyde, at Loch Riddon and at Loch Fyne, and at existing fluvial flood risk from Ascog Burn, around Rothesay from Mill Lade, Milton Burn at Colintrave, Allt Glachavoil, and on the A886 at the River Ruel, Tamhnich Burn and Kilail Burn during a medium likelihood event.</p> <p>As described in the 'Soils' section, there are several areas of peatland and woodland in the route corridor with high carbon sequestration and sink value.</p>

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	Material Assets	<p>The route corridor contains a variety of natural material assets. As outlined in the Climatic Factors section, there are areas of forestry within the route corridor and as listed in the Soils section, there are sections of peat soils and a mixture of LCF classes.</p> <p>There is also a variety of built material assets in the corridor. The route corridor generally follows existing road infrastructure including a mixture of 'A' 'B' and 'C' roads. There are ferry services within the route corridor, including Rhubodach to Colintraive and another linking Rothesay and Wemyss Bay on the Firth of Clyde.</p> <p>The route corridor requires a structural crossing of the Firth of Clyde downstream of HMNB Clyde and Clydeport Container Terminal. Consideration for clearance and maritime navigation must be given to facilitate continued passage for naval, commercial, fishing and leisure traffic on the Firth of Clyde.</p> <p>There are minor renewable energy developments along the route corridor study area, mostly comprised of micro hydro schemes. Larkhall waste disposal site is within the corridor at Rothesay bay.</p>
	Cultural heritage	<p>There are two GDLs, two Conservation Areas, 13 Scheduled Monuments (including includes Rothesay Castle Scheduled Monument) and 372 Listed Buildings within the route corridor. There are concentrations of Listed Buildings at Kilchattan Bay, Kingarth, Rothesay and Port Bannatyne. At Rothesay and Port Bannatyne. Rothesay Conservation Area stretches from Ascog to Port Bannatyne while Mount Stuart (Kirriemuir) and Ballimore GDLs occupy a large extent of the route corridor. Due to its linear nature, Thom's Water Cuts Scheduled Monument located to the west of Mount Stuart (Kirriemuir) GDL may also present a significant constraint and, given their proximity, these cultural heritage resources may represent a significant pinch point in this route corridor.</p>
	Landscape and Visual Amenity	<p>This route corridor is approximately 63km long and comprises a mix of existing roads and new carriageways and crossings. Approximately 15km of the route corridor is located along the A886 within the Kyles of Bute National Scenic Area (NSA) on the Isle of Bute and the mainland. The majority of the route corridor is located within the East Loch Fyne (Coast) and Bute &amp; South Cowal Areas of Panoramic Quality (APQs). The route corridor passes through the Ballimore Garden and Designed Landscape (GDL) and Mount Stuart (Kirriemuir) GDL and the Isle of Bute. The route corridor passes through several settlements, Open Space Protection Areas and Rothesay Conservation Area and intersects the Loch Lomond and Cowal Way, West Island Way and Ayrshire Coastal Path (Scotland's Great Trails).</p> <p>The Landscape Character Types (LCTs) within the route corridor include Rocky Coastland – Argyll LCT, Craggy Upland – Argyll LCT, Steep Ridges and Mountains LCT, Plateau Moor and Forest – Argyll LCT, Open Ridges LCT,</p>

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		<p>Raised Beach Coast and Cliffs LCT, Coastal Fringe with Agriculture LCT, Stepped Rocky Coastlands LCT, Coastal Plain – Argyll LCT and Rolling Farmland with Estates – Argyll LCT. There is also a large number of Seascape Character Areas (SCAs) within the route corridor including Upper Firth of Clyde - Largs to Goldenberry, Goldenberry to Farland Head, Little Cumbrae Island, Garroch Head to White Port, White Port to Kerrytonlia Point and Kerrytonlia Point to Bogany Point SCAs, Rothesay Sound - Bogany Point to Ardbeg Point and Ardbeg Point to Ardmaleish Point SCAs, The Kyles of Bute &amp; Loch Riddon - Ardmaleish Point to Rhubodach, Rhubodach to Rubha Glas, Bargehouse Point to Strone Point, Colintrave to Bargehouse Point, Salthouse Point to Colintrave and Head of Loch Riddon SCAs and Loch Fyne - Lachlan Bay to South Ballimore SCA, Loch Fyne - Loch Gilp to Brainport Bay SCAs.</p> <p>The route corridor option involves a new crossing across Loch Fyne at Otter Ferry as well as between Cowal and Isle of Bute and two crossings on either side of Little Cumbrae Island which would be visible from the Firth of Clyde coastline and numerous residential and recreational receptor locations.</p>
Traffic		
		<p>Annual average daily traffic (AADT) flow levels on the A83 Trunk Road in 2019 were 2,300 vpd (vehicles per day) on the stretch between Campbeltown and Tarbert and 4,400 vpd west of Tarbet, with the HGV percentage between 5% and 9%. At the Rest and Be Thankful, A83 Trunk Road traffic volumes were in the order of 4,500 vpd in 2019, with the HGV percentage around 9%, suggesting that, on average, around 400 HGVs pass through Glen Croe, on a daily basis. Additionally, around 17% of average daily traffic in 2019, on the A83 Trunk Road within Glen Croe (approximately 800 vehicles) was a light goods vehicle. Approximately 100 buses and coaches per day passed through Glen Croe via the A83 Trunk Road, in 2019.</p> <p>AADT flow levels on the A886, north of Colintrave, in 2019, were around 600 vpd, with the HGV percentage around 8%, increasing to around 700 vpd (around 10% HGVs) to the south of Strachur. On the A815, AADT flow levels in 2019 were in the order of 5,500 vpd (around 6% HGVs) north of Dunoon, reducing to around 2,000 vpd (around 8% HGVs) south of the junction with the A83 Trunk Road. On the A844 on Bute, AADT flow levels, in 2019, were in the order of 500 vpd (around 14% HGVs) between Kingarth and Ambrismore, increasing to around 800 vpd (around 5% HGVs) west of Port Bannatyne.</p> <p>Travel routes to/from, and within, Argyll &amp; Bute are highly seasonal, with greater volumes of people movements within the region during the summer months (predominantly as a result of increased visitor levels). Due to the geography and topography of the region, seasonal fluctuations in traffic volumes and the presence of slow-moving vehicles, travel times via the A83 Trunk Road between the key main towns/cities can be long relative to the distances involved and unreliable.</p>

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Implementability		
Engineering	Topography and Alignment Considerations	<p>From the route corridor's junction with the A78 Trunk Road to the eastern bank of the Firth of Clyde, the topography is likely to allow for minimum desirable alignment geometry to be achieved. In one area, the topography in the route corridor is relatively steep but a compliant alignment could still be achieved.</p> <p>The topography through the two crossings of the Firth of Clyde and Little Cumbrae is likely to allow for desirable minimum alignment geometry to be achieved.</p> <p>Upon landing on the Isle of Bute, the centreline of the route corridor is constrained by the Firth of Clyde on the east and steep sidelong ground to the west, with numerous properties directly adjacent to the existing B-class road. The topography is likely to allow for desirable minimum alignment geometry but will present a challenge in terms of the interface with the Firth of Clyde and adjacent properties.</p> <p>Moving north towards Ascog, the topography is generally flat and will likely allow for minimum desirable alignment geometry to be achieved in most areas. Should the route follow the existing road, there are some existing bends which are sub-standard and achieving compliant horizontal alignment geometry may be difficult.</p> <p>The topography around the centreline of the route corridor through Ascog, Craigmore, Rothesay, Ardbeg and Port Bannatyne is likely to allow for desirable minimum alignment geometry, but is constrained by the Firth of Clyde and Rothesay Bay and consideration should be given to an appropriate design speed through these settlements.</p> <p>If the alternative route was taken to the western side of the island which avoids it passing through the centre of Rothesay, the topography is relatively flat and open and would likely allow for desirable minimum alignment geometry. The existing road does have some existing bends which will be sub-standard by trunk road standards; however, given the open nature of the area it should be possible to upgrade these sections.</p> <p>Heading north to Rhubodach and the crossing to Colintraive, the centreline of the route corridor is constrained by the Kyles of Bute to the east, short sections of steep sidelong ground to the west and numerous individual properties, but a compliant alignment should be achievable throughout this section. Again, should the route follow the existing road, there are some existing bends which are sub-standard and achieving compliant horizontal alignment geometry may be difficult.</p>

		<p>From Colintraive to Auchenbreck, the topography is generally constrained on the east by steep sidelong ground and by Loch Ruel and the River Ruel to the west. This challenging topography means that achieving compliant horizontal alignment geometry throughout the section may not be possible.</p> <p>Between the top of Loch Ruel and Otter Hill Road/C11, the topography steepens on the north side, but following the contours should allow for a compliant vertical alignment. On the southern/western side is an open valley floor which should provide sufficient land to achieve horizontal alignment geometry to road design standards. A number of settlements as well as the River Ruel and its tributaries are spread across the area which will need to be considered, particularly from the perspective of potential flooding.</p> <p>The centreline of the route corridor follows the C11 west to Otter Ferry. From the start of the C11, the topography steeply rises up a gully from 50m up to 300m over a distance of 2km. The increase in level combined with the steep slopes make this a very challenging area to achieve a compliant alignment. Several switchbacks would be required in order to reasonably elevate the road; however, these would likely need to be sub-standard to minimise the impact on the hillside, otherwise significant retaining walls may be required. If the road could successfully be raised to follow the C11, the topography begins to flatten but then undulates. Continuing west, it is likely that compliant vertical and horizontal alignment geometry could be achieved through the use of fairly standard embankments and cuttings. The only real alternative to circumvent the steep rise would be to use a tunnel, emerging at an appropriate level near Otter Ferry.</p> <p>On approach to Loch Fyne the topography begins to fall. The steepness varies and it will be possible to optimise the route to minimise gradients; however, it is unlikely that a straightforward alignment to standard will be achievable. Again, switchbacks will likely be necessary to provide the change in elevation, although at this location the topography is less severe than detailed before. The level of descent and alignment will most likely be dictated by the location of the crossing for Loch Fyne.</p> <p>The A83 Trunk Road on the western side of Loch Fyne is situated close to the shoreline at points and relatively low lying, 10 to 40m. Topography is unlikely to cause significant issues for tying into the trunk road assuming a structure is used for the crossing as this will allow for the new carriageway coming from the west to be of a similar elevation. Consideration for an appropriate junction will be required. Alternatively, a tunnel could be considered for this location; however, this will come with its own challenges for connecting back into the existing A83 due to the depth of the loch and the vertical gradients required.</p>
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	Geology / Geomorphology Considerations	<p>The National Landslide Database does not record any landslides to have occurred within the route corridor; however, landslides may have occurred which are not recorded within the database. Potential landslide hazards may require measures to protect any route alignment and this should be considered as part of detailed assessment should this route corridor be retained.</p> <p>Similarly, there are no mass movement deposits recorded along the route corridor.</p> <p>An assessment of other potential issues including potentially difficult ground conditions is summarised below:</p> <ul style="list-style-type: none"> <li>• Potential for peat slides to occur adjacent to the A886 south of Springfield.</li> <li>• Potential presence of soft or loose deposits (alluvium, peat and raised marine deposits). Approximately 11km of route corridor is mapped as alluvium and there is potential for further unmapped alluvium and peat deposits within the route corridor.</li> <li>• Potential for compressible ground associated with deposits of peat, alluvium and raised marine deposits with possible implications for road alignment. These deposits may require excavation and replacement with fill or suitable improvement treatment.</li> <li>• Potential to encounter voids (associated with sand and gravel pits) and worked areas along the route corridor, particularly on the Isle of Bute.</li> <li>• Potential for mine workings in the vicinity of Ascog, Bute, requiring further assessment of the extent of workings, the potential for instability and the potential requirement for treatment.</li> <li>• Faulting can create zones of weak and/or highly fractured rock which is a significant hazard when tunnelling or excavating cuttings. Conversely, faulting can also create zones of extremely strong 'welded' fault rock, which again would create difficulties for tunnelling or areas of cutting in relation to excavatability.</li> </ul> <p>The presence of faults may provide a preferential pathway for groundwater flow, and groundwater may pose significant issues for excavation in cuttings and for tunnelling if the groundwater table is high.</p>
	Hydrology and Drainage Considerations	This is covered under 'Water Environment' in the 'Environment' part of this table.
	Structures Considerations	The following structures are likely to be needed for a new road within this route corridor.

		<ul style="list-style-type: none"> <li>• 1 no. new 3,000m long suspension bridge between the coast at Portencross to the southern shore of Little Cumbrae Island.</li> <li>• 1 no. new 2,530m long (2,150m main span) suspension bridge between Little Cumbrae Island and the southern coast of Bute.</li> <li>• 1 no. new 700m long multi-span bridge at Colintrave.</li> <li>• A tunnel approximately 4,400m under high ground west of Ballochandrain.</li> <li>• A bridge or tunnel approximately 3,000m long (1,100m main span) across / under Loch Fyne.</li> <li>• Approximately 15 no. new underbridges Y beam type on reinforced concrete abutments.</li> </ul> <p>Constructability, operation and maintenance in relation to structures is discussed elsewhere within the document.</p> <p>Key issues associated with the likely structures are:</p> <p><u>North Ayrshire – Bute Firth of Clyde Suspension Bridges</u></p> <ul style="list-style-type: none"> <li>• The east channel (Ayrshire – Little Cumbrae Island) reaches approximately 60m depth.</li> <li>• The west channel (Little Cumbrae Island – Bute) reaches approximately 115m depth.</li> <li>• Both east and west bridges would be suspension bridges.</li> <li>• The west crossing is approximately 2,530m in length and crosses the main navigation channel entrance to the Clyde Estuary. Water depth is significant at approximately 115m. The channel shape is also significant; the water depth reaches 30m close to both shorelines and therefore bridge towers would preferably be located relatively close to the shores in relation to the main span length.</li> <li>• Assuming a water depth of approx. 30 – 40m at the towers, and an as yet to be determined additional depth to rockhead, it is estimated that the main span would have to cross approximately 85% of the shore-shore distance of approx. 2150m. This is longer than the currently longest suspension bridge in the world (Akashi Kaikyō, Japan main span 1991 m) suggesting a considerable engineering challenge. It appears likely that engineering feasibility would suggest a shorter main span, longer back spans and consequently a move of the towers into deeper parts of the channel. This increases the sub-sea works. Given the need for navigation minimum clearance of +75m and allowing for deck construction depth and deflection, the carriageway would have to be placed at approximately +85m above sea level.</li> <li>• The towers would extend to heights of approx. 200 -250m or upwards of 300m from sea-bed level.</li> <li>• Ship collision protection to the towers would be a major factor; navigation includes military surface and submarine vessels and very/ultra large crude oil carriers (VLCC/ULCC). Navigation transit velocities through the channels depends on the Clyde Piloting arrangements and transit speed for vessel steering may increase</li> </ul>
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		<p>to allow for tidal currents. Particularly for the VLCC and ULCC, their masses combined with transit speed is expected to result in considerable potential impact energies that must be able to be absorbed by the bridge footings/ship collision protection measures.</p> <ul style="list-style-type: none"> <li>• The west bridge deck landfall onto the southern coast of Bute suggests difficult terrain; sharp escarpments immediately alongside the shoreline. This suggests challenging geometry to achieve a bridge backspan capable of descending on the shoreline to meet the A844 at Kingarth. Such an arrangement would suggest a multi-pier approach sidelong viaduct on the shoreline. Suspension cables would be anchored on the escarpments suggesting a difficult geometric interaction.</li> <li>• Alternatively, the bridge could be aligned to intercept the upper levels of the escarpment and traverse the upland area adjacent to Upper Reservoir' before descending to Kingarth. Whilst this approach eases the geometric issue at the bridge's western landfall, it introduces a more difficult road alignment from the upper landform near Kilchattan Bay to Kingarth.</li> <li>• The bridge decks must be wind resilient and will require wind barriers similar in form to those provided on the Queensferry Crossing. However, a slender single carriageway long span suspension bridge presents a design challenge to ensure the adequacy of the deck's aerodynamic response. This is particularly important for these long span suspension bridges. Research and wind tunnel testing would be required to determine if a slender single carriageway suspended road deck of that length is feasible. Conceivably, additional lateral and vertical restraint/damping would be required.</li> </ul> <p><u>Bute - Colintrave crossing</u></p> <ul style="list-style-type: none"> <li>• The skew crossing could comprise a multi-span viaduct of the type at Dornoch Bridge or a long span box girder bridge of the type at Skye Bridge. However, a cable stayed bridge would also be a feasible solution at this location.</li> </ul> <p><u>Bridges in Bute</u></p> <ul style="list-style-type: none"> <li>• A number of minor bridges are required throughout the length of Bute. These would be composite concrete Y beam type decks on conventional spread footings or piled abutments.</li> </ul> <p><u>Loch Fyne Bridge</u></p> <ul style="list-style-type: none"> <li>• The Loch Fyne Bridge is an alternative to a tunnel at this crossing location and crosses the loch at the sand spit at Otter Ferry.</li> </ul>
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- The overall length of the crossing is approximately 3,000m comprising a shallow area to the east at Otter Ferry with a deeper channel of up to 20 – 30m in the narrows at the west side of the loch.
- A mixed bridge form would be appropriate comprising an eastern reinforced concrete spine box form or composite steel box girder approach viaduct over the shallower area to the east and a cable stayed bridge section over the deeper narrows to the west.
- The cable supported length is 1,600m of the overall length of 3,000m and would comprise a steel composite box girder and reinforced concrete slab. The bridge's main span would be approximately 1,100m between two A -frame towers.
- Unlike the other crossings which must cater for the passage of large commercial and military vessels, the navigation clearance to the Loch Fyne Bridge need be only the minimum clearance required for commercial navigation, +45m.
- The bridge would be single carriageway with pedestrian/cyclist provision.
- The cable stayed form obviates cable ground anchors as would be the case for a suspension form and greatly improves durability – the ability for cable maintenance and replacement.
- The two towers would be reinforced concrete founded on spread footings onto rock. Sands overlie rock so a mass concrete filled caisson would transfer load below the water line
- The cable stayed length of the bridge must remain straight although the eastern approach viaduct could be curved to suit the approach road alignment and if advantageous in terms of geology.
- The towers would be approximately 200m high.
- The bridge deck must be wind resilient and will require wind barriers similar in form to those provided on the Queensferry Crossing. However, the cable supported length is significant and a slender single carriageway long span cable stayed bridge presents a design challenge to ensure the adequacy of the deck's aerodynamic response.
- Consideration should be given to winter resilience of the bridge, principally deck surface and cable/tower de-icing.

#### Tunnels within Route Corridor 9

- Ballochandrain Tunnel – A tunnel is considered to be required to satisfy a practical road alignment through the route corridor. The proposed tunnel would be approximately 4.4km in length and on a generally straight alignment east to west. From Ballochandrain the tunnel would climb at a gradient of approximately 4%. After reaching a high point of 170m the road heads downwards at approximately 3% to the west portal approaching Otter Ferry.

		<ul style="list-style-type: none"> <li>Loch Fyne Tunnel – A tunnel is considered to be required to satisfy a practical road alignment under Loch Fyne at Otter Ferry, where the Loch is thought to be 50m at its deepest on the route considered. The proposed tunnel would be approximately 3-4km in length depending on alignment and would run on a curve from an eastern portal at Otter Ferry to the western side of the Loch south of Carrick. From Otter Ferry the road would descend at 4-5% to a low point of approximately -65m AOD and then would climb at a similar gradient to emerge on the west.</li> </ul> <p>It is initially considered that tunnels would be constructed by a single bore providing a single carriageway with bi-directional traffic through the tunnel; however, there are important fire life safety, and associated ventilation and escape provisions, backed up by European and National highways standards that will govern tunnel configuration.</p> <p>For a single carriageway, bi-directional tunnel, these provisions are quite complex. The ventilation system must be in permanent operation and in the event of a fire, smoke and heat have to be removed from the tunnel using semi-transverse ventilation, which draws the smoke and heat into an overhead duct and exhausts are likely to be required at intermediate shafts. Escape to free air from fire is facilitated by either an escape duct provided within the tunnel section or for longer tunnels via intermediate shafts with lifts and recovery suites given significant depth below ground surface and remote locations.</p> <p>Accordingly, twin bore, dual carriageway tunnels may be more appropriate. In such tunnels, in the event of a severe vehicle fire, longitudinal jet fan ventilation is ramped up to full strength to blow the smoke and heat in the direction of flow of traffic, away from vehicles queued behind the incident, while those ahead of the incident escape by continuing as normal. For those trapped in the tunnel, they can escape into the other non-incident bore through cross-passages, at say 100-300m intervals, and can be evacuated by rescue vehicles. Intermediate shafts would not typically be required other than to vent pollution.</p>
	Constructability Considerations	<p><u>Major Structures Constructability Considerations – Bridges</u></p> <p>North Ayrshire – Bute Suspension Bridges</p> <ul style="list-style-type: none"> <li>The channel depths east and west of Little Cumbrae Island reach 60m and 115m respectively.</li> <li>Both channels are navigable. Navigation includes military surface and submarine vessels, very/ultra large crude oil carriers (VLCC/ULCC), commercial and private/leisure craft. Marine management and control are crucial factors governing the construction process of the two suspension bridges, perhaps particularly so the west.</li> </ul>

		<ul style="list-style-type: none"><li>• The eastern approach from the connection with the A78 Trunk Road is relatively straightforward comprising a continuous approach viaduct rising to the east end of the east suspension bridge. The viaduct form would be a post-tensioned concrete box or a steel composite box girder deck on discrete or leaf piers on piled foundations. Incremental launching would appear a feasible construction methodology.</li><li>• The location of the towers would require large diameter caissons fabricated nationally or internationally. Single or twin caissons would be required for each tower footing, floated by semi-submersible into location and sunk to seabed possibly in up to 60m depths. These would then be sunk by their own mass and by perimeter jetting to penetrate and sink through to rockhead where jet grouting would form a seal prior to excavation and underwater concreting.</li><li>• An alternative foundation method would be the construction of large diameter pilecaps within the caissons and large diameter piles to rock.</li><li>• The mass of the caisson and internal concreting mass would be designed to provide the energy absorption required and may govern the overall diameter of the caissons. It is estimated caissons of approx. 30m diameter would be required. Large fendering installation would be necessary to prevent hull over-sail impacting the towers. The potential for submarine collision is also an unusual factor.</li><li>• Topography on the east and west bridges' landfall on Little Cumbrae suggests that significant approach viaducts may be required to align the approach roads. The isolation of the island therefore suggests that a considerable marine transfer operation would be required between the Ayrshire coast and the island initially and throughout the works.</li><li>• Moreover, marine transfer of personnel, materials and equipment would be a major challenge where four towers and the island would require to be serviced by east-west marine transport across a very busy north-south navigation route.</li><li>• The western bridge is slightly shorter but is in deeper water. In all significant respects, its construction methodology resembles the eastern bridge. However, the increased water depth, and it is suspected relatively greater marine traffic volume exacerbate the difficulties.</li><li>• Cable installation will be by aerial spinning with anchorages from both east and west bridges into rock head on Little Cumbrae Island. This will occupy additional land and require careful alignment interaction with the approach road/viaduct alignments.</li><li>• Importantly for both, perhaps more so for the west bridge is the time deck segment delivery barges must stay on station to allow segment lifting onto the suspension catenaries. The channel depth lengthens the time taken to anchor the barges on station – anchor line length is considerable in 115m depths. The deck</li></ul>
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		<p>height of +85m lengthens the time taken to jack the segments to deck level. On station times of up to 12 hours could be expected (2 hrs GPS locating and anchoring, 10 hrs jacking). During this time exclusion zones will limit or divert marine traffic. Military vessel movements would have to be carefully managed – consultation would be required at an early stage to determine specific requirements and constraints.</p> <ul style="list-style-type: none"> <li>• The west end of the western bridge requires a sidelong approach viaduct at the escarpments present on the southern tip of Bute. Significant discrete columns would be located between the escarpments and the shoreline and would facilitate a descent towards Kingarth. Infrastructure in this area is minimal for construction operations on this scale and therefore all materials delivery and operations for construction would be sourced from the Ayrshire coast perhaps with a staging area on Little Cumbrae.</li> <li>• Infrastructure in Bute generally is minimal for construction on this scale and unless the bridge at Colintrave is built in advance of the two southern suspension bridges, all operations on Bute would be serviced entirely by marine transfer. With the bridge at Colintrave in service, the delivery route via this crossing to the south of Bute is long and vulnerable to the ongoing closure risk of the A83 at Rest and Be Thankful.</li> <li>• The towers would be constructed by jump-forming. For a deck carriageway height of +85m, tower heights are estimated to be 250 to 300m above sea level. In the western channel particularly, overall height from foundation may approach 400m.</li> </ul> <p>Bute - Colintrave Crossing</p> <p>There are a number of options for the form of bridge at Bute-Colintrave (Loch Ruel crossing).</p> <ol style="list-style-type: none"> <li>1. Multi-span viaduct (similar to Dornoch Bridge). Installation of sheet piled large diameter cofferdams with dewatering. Large diameter steel pile tube casings are driven to rock in co-alignment with A-frame type pier legs. Inside the casings is reinforced concrete placed from marine delivered insitu concrete. Batching plant would be stationed on the north shore. The piles would extend upwards to form the pier legs with a crosshead section supporting bearings. The deck would be an incrementally launched post-tensioned form constructed on the north shore and launched south.</li> <li>2. Long span post-tensioned box girder (similar to Skye Bridge). Installation of sheet piled large diameter cofferdams with dewatering. Piled foundations supporting reinforced concrete to post-tensioned concrete deck constructed by segmental lifts in jump formed arrangement. The main and back spans would be constructed insitu by balanced cantilever. Concrete delivery would be by pumped delivery from temporary jetties from shore.</li> </ol>
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		<p>3. Cable stayed bridge. Medium length single carriageway steel composite or concrete road deck supported on A-frame towers. Foundations would be constructed similar to those for 2. above. Segment construction would require delivery from barges and lifted vertically. There appears to be little marine traffic on this crossing and there is an available alternative navigation route to the west of Bute.</p> <p>Loch Fyne Bridge</p> <p>The following key considerations apply to the construction of the Loch Fyne bridge alternative:</p> <ul style="list-style-type: none"><li>• There is access to both east and west ends of the bridge although the existing carriageway on the east shore at and to Otter Ferry is single lane with passing places so construction access would require improvement prior to bridge construction. Marine access also appears relatively straightforward with access from the south.</li><li>• The eastern approach viaduct would be constructed by the temporary formation of an access causeway or jetty extending from the shore at Otter Ferry and placement of a series of cofferdams at the pier locations onto the Otter spit.</li><li>• The piers for the approach viaduct would be founded on steel piles driven to rock or into sand/gravel dependent on the geotechnical design. Pile caps would be formed in reinforced concrete in the cofferdams with leaf or discrete piers erected to deck level.</li><li>• The viaduct would be a post-tensioned concrete spine box girder or composite steel box section launched from the eastern shore. This would require a construction bay formed at Otter Ferry with delivery of concrete and/or fabricated steel components. Box assembly would take place in the assembly bay.</li><li>• The cable supported length of the single carriageway bridge deck will require high twin legged 'A-frame' towers founded on rock. The tower foundations will be in water. There appears to be limited navigation demand at this location so construction could progress from causeways/jetties constructed out from the shores. However, these would impede later segment erection from marine barge so would most likely need removal. Access to tower construction from land would eliminate the need for marine concrete transport. Access to the east tower would most likely require an extended causeway across the Otter spit.</li><li>• The foundation installation would be designed for underwater construction. The reinforced concrete towers would be constructed incrementally by jump forming with concrete being pumped up the towers as their height incrementally increases. Concrete volumes, especially given the nearby tunnel construction would warrant batching plants on site.</li></ul>
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- Steel box deck segments would be fabricated nationally and/or internationally and delivered to a staging area at a nearby facility constructed onshore in a location within approx. 3km of the bridge.
- Segments would be transported by barge to below their location in the span. Main span segments would be progressively lifted onto the towers by alternating balanced cantilever progression out from the towers until closure at the bridge abutment on the west, the approach viaduct end on the east and then at midspan.
- Lifting would require GPS placement of barges and their stations would be protected by an exclusion zone although there is little marine traffic in this locale. Given the moderate height of the deck, the duration of barges on station for the lift is expected to approximately 5 hours. This allows for anchoring (1 hour) and strand jack lifting which could take up to 4 hours to achieve. Wave height and wind conditions may limit the number of available weather windows for lifting unexpected or variable conditions 'on the day' impede the lifting operations.
- Climbing tower cranes fixed to the main towers will lift materials and equipment to deck level.
- The bridge construction on Loch Fyne could have a potential impact on commercial and fishing activities.

Major Structures Constructability Considerations – Tunnels within Route Corridor 9

- Tunnels could be advanced by drill and blast techniques or by using a large Tunnel Boring Machine (TBM).
- Whichever technique is used, short sections of cut and cover tunnel would be required at each portal location to form a vertical portal face in reasonably competent rock from which the tunnel can be advanced. At each drill-and-blast advance the flat-bottomed "horseshoe"-shaped excavation of newly cut rock would be evaluated by a geologist and strengthened using a combination of rock bolts and sprayed concrete (SCL), to form a stable primary lining before the next advance is drilled and charged with explosive. Although this may seem a slow and laborious process it can be an economic method to construct tunnels in rock. The tunnel can be completed more quickly if the drill-and-blast sequence can be repeated at the opposite portal. Once the tunnel is completed an in-situ cast secondary lining can be installed to form a durable final structure.
- Alternatively, tunnels can be bored using a large Tunnel Boring Machine (TBM), starting at one end and boring consecutively. Although this involves a large capital investment in a TBM and large site set-up at the portal locations when compared with drill-and-blast. The final circular structural lining of pre-cast segments can be formed as the tunnel advances.

Issues specific to various tunnel options are as follows:

		<ul style="list-style-type: none"> <li>• Ballochandrain Tunnel – A TBM drive site from the western end of the proposed tunnel seems the optimum solution as the TBM could be delivered via Loch Fyne, and spoil and other materials could be transported via the Loch, rather than on sub-standard local roads. However, this would mean that the road from Otter Ferry to the western portal location would need to be constructed first as the existing track would not be suitable. Access via Loch Riddon and the A886 to the eastern portal would be possible too with an improvement of the existing track, and there may be better land availability at this site.</li> <li>• Loch Fyne Tunnel – The tunnel could be advanced using a large Tunnel Boring Machine (TBM), or possible an immersed tube tunnel, which is floated into place and sunk into a dredged trench on the loch bed. Regardless of technique, short sections of cut and cover tunnel would be required at each portal location. Both techniques present a considerable tunnelling challenge as the Loch bed is variable, and consists of both soft ground deposits and rock, the extents of which are unknown at this stage.</li> </ul> <p><u>Other Constructability Considerations – Road and Small Structures</u></p> <p>West Kilbride to Craigmore</p> <p>This section incorporates 9.6km of online improvements on A844 through residential areas south of Craigmore before moving into rural area and minor access road at Stravanan. Significant online improvements continue from here on the minor road for 2.7km before new road construction over the cliff path for approximately 1.2km involving significant fill works up to the western abutment of the fixed link crossing. The construction of this section has the following key considerations:</p> <ul style="list-style-type: none"> <li>• Access onto the beach to construct the eastern abutment at West Kilbride limited to minor residential road and cliff walk in the south due to restricted access through the Hunterston B Nuclear Power Station to the north. Restricted space is available to construct an access road.</li> <li>• Online improvements to the road will likely need to progress in small construction sections along the road which could extend the programme of works. Some improvements are likely to be significant upgrades from existing roads so may require full road diversions to preserve access to properties.</li> </ul> <p>Craigmore to Ballochandrain</p> <p>This stretch of road incorporates the existing A886 from Ballochandrain to the island of Bute where it joins the A844 on the east side of the island at Port Bannatyne. Most of the length of the route involves road improvements to the existing carriageway which are currently assumed to be maintained at existing levels, but if levels are to be altered</p>
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		<p>this would have an impact on the ease with which the road improvements can be carried out and would likely increase requirement for temporary diversions and more extensive traffic management. There is a new link road proposed crossing over Loch Ruel to provide a road connection to the island from the mainland. The section has the following considerations for construction:</p> <ul style="list-style-type: none"> <li>• Online improvements to the road will likely need to progress in short sections along the road with potential limitations on the number of sections based on traffic modelling, which could extend the programme of works.</li> <li>• The roads on Bute are relatively narrow and there are limited alternatives for connection between areas which may impact the ability to divert traffic for any closure that may be required.</li> <li>• Current access to Bute is via a ferry so supply of materials and resources will rely on marine transportation to get to the island until the proposed link road is completed.</li> <li>• Due to the length of the link road over Loch Ruel it may be practical to avoid constructing piers in the loch which would reduce the requirement for marine plant to support construction. The water in this part of the loch may be somewhat shallower than other areas which would make construction of piers in the river comparatively simpler than for some of the more major viaducts proposed.</li> <li>• Construction of the abutments would be advised to be taken offline from the existing roads, avoiding the disruption to traffic routes that could result if they are kept online. If the abutments can be extended into the loch this could provide shorten the span and potentially reduce the number of piers required for the structure.</li> </ul> <p>Ballochandrain to Port Ann</p> <p>This section of road connects between the A886 in Ballochandrain in the east and the A83 Trunk Road on the west side of Loch Fyne, incorporating a short section of new surface road at the eastern end before entering a 4.3km tunnel through the mountain which exits approximately 2km from the eastern shore of Loch Fyne requiring a new surface road to reach the crossing. The link road crossing Loch Fyne would either need to be a bridge structure or tunnel formed using TBM or possibly an immersed tube. The route has the following key construction considerations:</p> <ul style="list-style-type: none"> <li>• Access roads on the east side via the A886 are single carriageway A roads providing limited access to site via road. Resulting from the tunnel excavation and the construction of the new surface roads it may be more feasible to establish a site compound and adjacent marine facility on the eastern loch shore to provide deliveries and remove spoil from site rather than using the surface roads. The capacity of the existing road</li> </ul>
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		<p>network could also be additionally strained through ongoing online improvements to other nearby roads as part of the scheme.</p> <ul style="list-style-type: none"> <li>On the west side of the mountain current surface access is very poor with only narrow access tracks to the area. This means that logistics routes via the loch or road network would need to be created to allow the works to commence.</li> </ul>
<p>Environment Considerations</p>	<p>Biodiversity, Fauna and Flora</p>	<p>The route corridor crosses Upper Loch Fyne and Loch Goil MPA for approximately 2.8km. Pollution during construction and operation of crossing could impact the MPA, which could result in moderate negative environmental effects.</p> <p>Most of Ruel Estuary SSSI (313.2ha) falls within the route corridor. This could result in considerable temporary and permanent loss of SSSI habitat, including the loss of designated features fen meadow, flood-plain fen, saltmarsh and upland oak woodland, which would be a major negative environmental effect. Moderate negative environmental effects could also occur as a result of nitrogen deposition.</p> <p>48.4ha of North End of Bute SSSI falls within the route corridor. There could be temporary and permanent habitat loss within the SSSI, including the loss of the designated feature upland assemblage, which would be a major negative environmental effect. Moderate negative environmental effects could also occur to upland assemblage as a result of nitrogen deposition. There could be disturbance to breeding bird assemblage, a designated feature, during construction, which could result in a major negative environmental effect.</p> <p>All of Portencross Woods SSSI falls (18.5ha) within the route corridor. There could be temporary and permanent habitat loss within the SSSI, including the loss of the designated feature upland mixed ash woodland, which would be a major negative environmental effect. Moderate negative environmental effects could also occur to upland assemblage as a result of nitrogen deposition.</p> <p>134 parcels of woodland listed on the AWI fall within the route corridor. This could result in the loss of nationally important and irreplaceable habitat, which could require compensation and would be a major negative environmental effect.</p> <p>There is potential for effects on terrestrial and aquatic species from construction activities, as follows:</p> <ul style="list-style-type: none"> <li>Disturbance from noise and vibration and light pollution;</li> </ul>

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		<ul style="list-style-type: none"> <li>• Injury or mortality from vegetation removal, vehicle movements, or becoming trapped in uncovered holes and pipes during construction;</li> <li>• Fragmentation and loss of habitat suitable for shelter, foraging and commuting; and</li> <li>• Changes in water flow conditions from runoff, or alterations to watercourses and groundwater.</li> </ul> <p>During operation, there is potential for unavoidable habitat loss and fragmentation for protected species as a result of tree and vegetation clearance and loss of irreplaceable AWI.</p>
	<p>Population and Human Health</p>	<p>There is potential for localised noise and vibration effects on receptors within the route corridor during the construction phase. For example, noise nuisance and vibration caused by traffic and activities associated with construction works could result in general annoyance and/or sleep disturbance for receptors. Construction of watercourse crossings in particular could result in a longer construction period and could involve activities such as piling with high levels of noise and vibration.</p> <p>During the operation phase, there is potential for receptors close to the route to experience new or increased noise and vibration impacts from increased vehicle traffic.</p> <p>As there are a number of settlements within the route corridor, in addition to noise and vibration there is potential for other minor negative effects on population receptors resulting from construction traffic. Increased traffic volumes and construction activities could result in diversions and affect journey lengths for both vehicle travellers and non-motorised users (NMUs). It is uncertain at this stage whether such impacts would be significant.</p> <p>During operation, the watercourse crossings would provide significant journey savings between the mainland and the Isle of Bute (via Little Cumbrae Island), and between the Isle of Bute and Cowal. The route corridor generally would improve connectivity from the central belt to Argyll and Bute.</p> <p>It is expected that the route corridor would provide greater accessibility to the Cowal Way, West Island Way and the core path network in and around the route corridor. There is also potential for paths to be severed as a result of the route corridor.</p> <p>Land-take from properties would be required to facilitate the operation of the route corridor and the tunnelling options would require additional land take and potentially demolitions.</p>

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		<p>There is also potential for air quality effects which could affect human health; these are discussed further under Air Quality.</p>
	<p>Water Environment</p>	<p>Construction within the route corridor and operational structures and discharges may affect the hydromorphology and surface water quality of approximately three Water Framework Directive (WFD) classified river water bodies, seven WFD coastal water bodies and approximately 100-110 minor watercourses.</p> <p>SEPA Flood Maps (SEPA, 2020) indicates that the route corridor may be at coastal flood risk around the A886 on the Isle of Bute, at Loch Riddon and at Loch Fyne, and at fluvial flood risk from Ascog Burn, around Rothesay from Mill Lade, Milton Burn at Colintrave, Allt Glachavoil, and on the A886 at the River Ruel, Tamhnich Burn and Kilail Burn during a medium likelihood event (0.5% Annual Exceedance Probability (200-year) event). Potential for coastal flooding from new crossings on the Largs Channel, Firth of Clyde, Kyles of Bute and Loch Fyne, which could impact flooding on associated road infrastructure.</p> <p>May affect Protected Sites at Ruel Estuary SSSI. Upper Loch Fyne and Loch Goil Marine Protected Area may also be affected from the direct crossing.</p> <p>The Kyles of Bute and Loch Fyne Shellfish Water Protected Areas are directly crossed and may be affected by the route corridor.</p> <p>There are Active Aquaculture Sites, CAR licenced fish farms and Classified Shellfish Harvesting Areas within the vicinity of the route corridor, which may be impacted.</p> <p>The route corridor of the route corridor passes through three surface water Drinking Water Protected Areas, which may be affected.</p> <p>Millport and Seamill bathing waters are within 5km of the route corridor and may be affected.</p> <p>Construction and operation within the route corridor could result in major negative environmental effects on the water environment, subject to appropriate mitigation.</p>
	<p>Soils</p>	<p>The route corridor is assessed as having a minor negative or uncertain environmental effect. This recognises the route corridor is likely to avoid potential effects on Class 2 peatland habitat (nationally important and of potentially high conservation value and restoration potential). Loss of existing commercial forestry and land identified as Preferred and Potential within the Argyll &amp; Bute Woodland Strategy is likely to be within the route corridor, but mitigation is likely to be achievable to reduce the potential for major negative environmental effects.</p>

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	Air Quality	<p>There is potential for localised air quality effects on receptors within the route corridor during the construction phase: for example, dust generated from site activities including construction of large structures across the Firth of Clyde, Kyles of Bute and at Loch Fyne, and pollutant emissions from vehicular movements, which could result in annoyance for local residents.</p> <p>There is potential for receptors within the route corridor to experience increased pollutant emissions during operation from increased vehicle traffic.</p> <p>There is potential for receptors within the route corridor to be affected by pollutant emissions (e.g. carbon monoxide, sulphur dioxide, particulate matter) from vehicle traffic during operation.</p> <p>Although the existing air quality in the region is good, there are a number of settlements within the route corridor which could potentially experience air quality negative effects; however it is expected that these would be reduced through mitigation measures.</p> <p>Potential air quality effects on ecological receptors are assessed under Biodiversity, flora and fauna.</p>
	Climatic Factors	<p>Construction of the route corridor would have major negative effects on climate due to the release of carbon emissions associated with the construction materials and installation process. There is a significant cumulative quantity of embodied carbon associated with the structural elements set out in the Material Assets section.</p> <p>As indicated in the 'Soils' section, the route corridor is located on areas identified as peatland which would lead release of sequestered carbon and a loss of high value carbon sink land which could lead to minor negative or uncertain environmental effects.</p> <p>Felling would be required which would also reduce the carbon sink value of forested areas within the route corridor and could result in major negative environmental effects. Woodland and Forestry Strategy areas, including existing planted woodland, potential, preferred and sensitive sites, need to be considered in the route corridor selection process.</p> <p>Once operational, forecast traffic levels (and associated vehicle-derived greenhouse gas emissions) are moderate for this route corridor, assuming the continued operation of the A83 through the Rest and Be Thankful. With the predicted shift towards electric vehicles this would reduce in the future. Additionally, the route would reduce the</p>

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		<p>driving distance for some journeys due to the introduction of the four major watercourse crossings, which over time would likely result in carbon savings.</p> <p>Effects on the route as a result of predicted changes to the climate and weather should also be considered. Sections of the route are situated within or in close proximity to zones deemed to be at high risk of coastal or fluvial flooding as indicated in the 'Water Environment' Section. The anticipated increase in severity and frequency of rainfall events caused by climate change could pose greater risk from flash-flooding.</p> <p>As indicated in the 'Soils' section, the route corridor is located on areas identified as peatland which would lead release of sequestered carbon and a loss of land with a high carbon sink value. Any felling required would also reduce the carbon sink value of forested areas within the route corridor. Woodland and Forestry Strategy areas, including existing planted woodland, potential, preferred and sensitive sites, need to be considered in the route corridor selection process.</p>
	Material Assets	<p>As outlined in the Climatic Factors section, there are several natural material assets including woodland, peat soils and farmland that could be affected by the route corridor.</p> <p>Loss of natural material assets would result in minor negative or uncertain environmental effects for soils and major negative effects on woodland.</p> <p>In terms of built material assets, construction of the route corridor would have major negative effects as a result of raw material requirements for the following elements:</p> <ul style="list-style-type: none"> <li>• 1 no. new 3000m long suspension bridge between the coast at Portencross to the southern shore of Little Cumbrae Island.</li> <li>• 1 no. new 2530m long (2,150m main span) suspension bridge between Little Cumbrae Island and the southern coast of Bute.</li> <li>• 1 no. new 700m long multi-span concrete box girder bridge at Colintraive.</li> <li>• A tunnel approximately 4,400m under high ground west of Ballochandrain.</li> <li>• A bridge or tunnel approximately 3,000m long (1,100m main span) across / under Loch Fyne.</li> <li>• Approximately 15 no. new underbridges Y beam type on reinforced concrete abutments.</li> <li>• Approximately 13 no. new piped culverts.</li> </ul> <p>The route would impact on the operation of the ferry service to Bute which may no longer be required once the crossings are constructed, though the sustainability implications of this modal shift would require further study.</p>

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		The Firth of Clyde is a busy shipping route for naval vessels accessing HMNB Clyde and cargo vessels accessing Clydeport Container Terminal at Greenock as well as ferry services, leisure and fishing vessels. There is potential for effects on shipping during construction of the structural crossing. Appropriate clearance for shipping would be required to avoid effects on navigation during operation.
	Cultural Heritage	<p>Due to the relatively high numbers of cultural heritage resources (compared to route corridors 1 to 3) within the route corridor and the locations of these, it is considered unlikely that a route corridor could be developed that would avoid major negative effects on these.</p> <p>The most cultural heritage constraints within the route corridor are the high concentrations of Listed Buildings at Kilchattan Bay, Kingarth, Rothesay and Port Bannatyne. At Rothesay and Port Bannatyne. Rothesay Conservation Area stretches from Ascog to Port Bannatyne while Mount Stuart (Kirriemuir) and Ballimore GDLs occupy a large extent of the route corridor. Due to its linear nature, Thom's Water Cuts Scheduled Monument located to the west of Mount Stuart (Kirriemuir) GDL may also present a significant constraint and, given their proximity, these cultural heritage resources may represent a significant pinch point in this route corridor.</p>
	Landscape and Visual Amenity	There is potential for effects on the special qualities of the Kyles of Bute NSAs, the East Loch Fyne (Coast) and Bute & South Cowal APQs, two GDLs, and the local landscape and seascape character due to the construction and operation of the carriageway and the large footprint of the scheme. There is also potential for visual effects for residential receptors and users of long-distance recreational routes. The construction of the four new crossings at Loch Fyne, Kyles of Butes and Firth of Clyde would affect the landscape character and visual amenity of these areas.
Traffic	Traffic Flows	<p>Due to the improved road links to Cowal and Kintyre, associated with this route corridor, within the context of typical traffic levels on the existing A83 Trunk Road, traffic using this corridor is forecast to be moderate, with a corresponding reduction in traffic on the A83 Trunk Road through the Rest and Be Thankful (potentially between 25 and 75%) in 2027. This assumes that the Rest and Be Thankful is operating under normal conditions.</p> <p>There will be a degree of re-routing of trips for vehicles accessing the new route corridor, with minor traffic reductions forecast between Clydebank and Tarbet on the A82 Trunk Road, along the A83 Trunk Road between Tarbet and its junction with the new route, on the A815 and A816. Minor traffic increases are forecast on the A78 to the south of West Kilbride and the A886 between Colintrave and its junction with the new route corridor.</p>

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	Accidents	<p>For those trips that utilise the new route corridor, accident reductions would be expected due to the shorter journey times that have attracted them to the new route. During times when the A83 Rest And Be Thankful is closed, the new route corridor would also provide an alternative route on a standard of road likely to be higher than the current diversion route, which includes a section of the A82 Trunk Road, with a known safety record. Based on the potential traffic flows that could re-route onto this route corridor, moderate safety benefits could be achieved.</p>
Operational considerations		<p>From a Trunk Road operation perspective, the main operational considerations within the route corridor are the risk of flooding and/or landslides where it passes through valleys or next to waterbodies, based on the steep topography in these areas. In some areas, the centreline of the route corridor has a maximum elevation of approximately 320m AOD, with significant adjacent peaks providing shelter. This means it is likely that in these areas, snow accumulates within the route corridor during the winter months, with potential winter resilience operational issues.</p> <p><u>Bridges within Route Corridor 9</u></p> <p>Long span bridges will require the Trunk Road Operating Company to maintain an on-site bridge management and control facility with bridge traffic management and control, communications with Traffic Scotland, marine navigation and MOD liaison along with inspection, maintenance and repair capabilities. Additionally, facilities will be required for maintaining equipment and collecting telemetry from a Structural Health Monitoring System.</p> <p><u>Tunnels within Route Corridor 9</u></p> <ul style="list-style-type: none"> <li>• There is a need for regular inspection and maintenance of such tunnels. A tunnel manager, tunnel safety officer and a tunnel design &amp; safety consultative group (TDSCG) must be set up early in the design process and continue through operation. The location and type of tunnel operations centre would need to be reviewed and investigated further, depending on the final location and length of tunnel provided. A sufficient power supply will be required to allow operation of the tunnel ventilation system and any other systems, particularly those required in the event of an emergency incident.</li> <li>• The use of the tunnel by vehicles carrying potentially hazardous materials or dangerous goods (such as fuel tankers) is largely dependent on fire safety and ventilation, and may require a tunnel ventilation system that allows for a larger design fire size. Dependent on the evaluation of risks, dangerous goods vehicles may need to be escorted through the tunnel in a convoy. It should be noted that a twin bore dual carriageway</li> </ul>

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	<p>tunnel configuration is considered likely to result in fewer road traffic accidents (due to no bi-directional traffic flow), theoretically attracting a lower risk of emergency incidents.</p> <ul style="list-style-type: none"> <li>• For a twin bore dual carriageway configuration, vehicle cross-overs may need to be provided at intervals if practicable, as per recommendation from the European Directive EUD 2004/54 EC. In addition, lay-bys should be provided at intervals.</li> <li>• The development of any tunnel design should be informed by consultation with emergency services and other relevant stakeholders and guided by European and National Standards to ensure that appropriately robust measures in the event of an emergency incident are put in place.</li> </ul>
Financial Considerations	The estimate cost range of a scheme within this route corridor is approximately £9.01Bn - £11.85Bn.
Estimated Time to Completion	It is estimated it would take approximately 17-18 years to achieve a fully operational road in this route corridor assuming constructed as a single contract. If construction was phased with contracts in sequence, the time for completion would be greater.
Public Acceptability	Consideration of the feedback received during the public consultation held during September / October 2020 shows that there were more statements of opposition to this route corridor than supportive comments.

STAG Criteria		Assessment Summary
Criteria		
Environment		Refer to Implementability Assessment – Environment
Safety		Refer to Implementability Assessment – Accidents
Economy	Transport Economic Efficiency	<p>This route corridor is likely to result in significant journey time savings for strategic traffic currently using the A83 Trunk Road.</p> <p>Based on traffic forecasting for 2027 using Transport Model for Scotland (TMfS14), journey time savings between Tarbert and Glasgow are forecast to be negligible (&lt;5 minutes) in 2027. Journey time savings between Dunoon and Glasgow are expected to be moderate (in the region of 15-45 minutes) compared with existing road only options, following the construction of the route corridor.</p>



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		A high-level cost-benefit analysis undertaken for the different route corridor options proposed suggests that, assuming normal operation of the existing A83 Trunk Road, the benefit to cost ratio for the proposed route corridor is expected to be very low. Quantification of the economic benefits of the scheme will require further analysis of the cost of closures to the economy.
	Wider Economic Impacts	<p>This route corridor offers substantial changes in connectivity and, therefore, is best not solely characterised as a solution to unreliability at the Rest and Be Thankful. Rather, it provides the opportunity to radically improve connectivity to some of the remote communities of Argyll and Bute.</p> <p>The route corridor offers more direct connections from Cowal, Kintyre and the islands (including Islay and Gigha) to Ayrshire, providing improvements in onward journeys to the central belt. It does not, however, significantly enhance connectivity for the larger population centres or to those areas suffering from the most significant depopulation, in Argyll &amp; Bute.</p> <p>The route corridor, therefore, has the potential to provide a significant positive contribution towards wider economic benefits for Argyll &amp; Bute. Significant benefits would likely be provided for key sector businesses, such as whisky, aquaculture and tourism, through enhanced access to both national and global markets.</p> <p>It is also worth noting that, while rural depopulation (a significant issue within Argyll &amp; Bute) is linked to wider economic outcomes, indications are that headline economic conditions are not the main driver of this. Transport interventions could likely play a part in arresting population decline, but only if considered alongside an integrated package of economic, cultural and social regeneration measures. A package of measures of this type, coupled with upgraded access to Kintyre, Bute and Cowal, has the potential to arrest population decline and reinvigorate local communities within Argyll &amp; Bute.</p>
Integration	Transport Integration	<p>An integrated transport system aids accessibility by connecting people to opportunities and goods to markets. This route corridor may provide multi-modal opportunities to enhance transport integration.</p> <p>The intervention provides the opportunity to enhance linkages to walking and cycling routes and core</p>

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STAG Criteria	
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	<p>paths. As part of the design process, it will be ensured that NMU facilities provided as part of the intervention address the needs of recreational walkers, cyclists and equestrians, as well as, to a more limited extent in this route corridor, commuters. The intervention may help to reduce issues regarding actual and perceived severance, due to the provision of fixed links, with active travel infrastructure benefiting communities in Kintyre, Cowal and Bute, with improved linkages across the route corridor to Lochgilphead and beyond.</p> <p>The intervention will provide enhanced resilience and potential journey time and journey time reliability benefits for strategic and local bus and coach services. The resilience and enhanced connectivity provided may provide bus and coach operators with an opportunity to review timetables, translating to more efficient operations and, potentially, a change in service frequency, scope for interchange between services and the number of communities served.</p> <p>Landslide induced incidents on the A83 Trunk Road at the Rest &amp; Be Thankful can lead to road closures and diversions. Should the Old Military Road also be closed, the diversionary route for A83 traffic between Tarbet and Inveraray is approximately 25 miles longer in length than if using the A83. Depending on journey origin and destination, the longest diversion length experienced by travellers would be over 60 miles. The improved resilience may contribute towards a reduction in the variability of bus journey times and the likelihood of full closures, leading to service cancelations. This may also provide a health and welfare benefit to bus drivers, due to the reduction in instances where bus services are forced to travel via longer diversion routes.</p> <p>This route corridor is not expected to have a major impact on the perception of a seamless public transport journey, as ticketing will not be affected to any great extent. However, there is potential for enhanced interchange between bus services, due to the enhanced connectivity provided.</p> <p>The intervention will improve journey time reliability and resilience, providing more efficient opportunities for freight transport, facilitating more efficient and effective transportation of goods of significant value to the regional and national economies, including high value aquaculture produce and whisky.</p>

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STAG Criteria	
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Transport and Land Use Integration	<p>The main aspect of appraisal within the transport and land-use integration criteria is identifying and mitigating any conflicts between the intervention and land-use planning policy and environmental designations.</p> <p>If selected as the preferred route corridor, a strategic assessment of the impact of the route corridor on the environment would be carried out in the Strategic Environmental Assessment (SEA). More detailed Environmental Impact Assessment would be carried out as part of the DMRB Assessment Process.</p> <p>The route corridor is expected to support enhanced accessibility to and from developments in the wider region, and may support investment decisions in Argyll &amp; Bute, more generally.</p> <p>This route corridor is, however, judged to deliver slight negative impacts in terms of promoting sustainability and reducing the need to travel. The enhanced connectivity for Kintyre, Bute and Cowal provided by this route corridor could result in higher levels of traffic as a result of the improved access provided for currently geographically remote communities. While this could result in a short-term negative impact, in terms of delivery against the climate action goals, cognisance of the likely timescales for the delivery of an intervention of this scale should be made, given that it is likely that the regional / national vehicle fleet may be largely decarbonised, by this stage. The overall impact on Land Use Transport Integration is considered to be Moderate Negative.</p>
Policy Integration	<p>The route corridor contributes to strategic policy objectives set by the Scottish Government and Transport Scotland. A wide range of national and regional level policies from various plans, programmes and strategies have been reviewed, including Argyll and Bute's Local Development Plan and its' Strategic Environmental Assessment. The various relevant policies contained within these documents have been taken into account in the TPOs, the existing corridor conditions and the implementability assessment. No over-riding conflicts have been identified and, in specific instances, the route corridor may contribute towards the delivery of specific policies.</p>

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STAG Criteria	
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	<p>The A83 Trunk Road was identified in Transport Scotland's STPR as a route requiring network optimisation through route management and targeted investment. Transport Scotland's emerging STPR2 continues to appraise the need for investment in improved access to Argyll &amp; Bute.</p> <p>It is likely that this route corridor will contribute positively to the NTS2 vision and several of the underpinning priorities and outcomes, including 'takes climate action' and 'helps deliver inclusive economic growth'. Achieving positive outcomes against several of the priorities and outcomes, however, will be dependent on the quality and nature of the infrastructure provided, particularly related with the facilitation and promotion of travel via active modes.</p> <p>This route corridor is likely to contribute positively towards the NPF3 vision, in terms of delivering 'a successful, sustainable place', 'a low carbon place' 'a natural resilient place' and 'a connected place'. NPF3 recognises that Scotland's varied coast and islands have an exceptional, internationally recognised environment and notes the opportunity to secure growth from renewable energy generation as well as other key economic sectors including tourism and food and drink (of key importance to the regional economy). It is recognised that infrastructure investment, including improved transport links are required to bring employment, reverse population decline and stimulate demand for development and services in rural areas.</p> <p>This route corridor is likely to contribute positively towards key objectives as set out within Argyll &amp; Bute's Local Development Plan. An intervention within this route corridor will likely assist in the improvement of:</p> <ul style="list-style-type: none"> <li>- Argyll and Bute's connectivity, transport infrastructure, integration between land use, transportation and associated networks.</li> <li>- Argyll and Bute's main towns and key settlements, as increasingly attractive places where people want to live, work and invest.</li> <li>- the economic and social regeneration of smaller rural communities.</li> </ul>

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STAG Criteria		
Criteria		Assessment Summary
		<ul style="list-style-type: none"> <li>- the continued diversification and sustainable growth of Argyll and Bute's economy, with a particular focus on sustainable assets in terms of renewables, tourism, forestry, food and drink, including agriculture, fishing, aquaculture and whisky production.</li> <li>- addressing climate change impacts and reducing the region's carbon footprint.</li> </ul> <p>While the route corridor is likely to largely fit with policies related with transport based emissions, the nature of the construction and engineering activities required to deliver this route corridor are likely to result in significant emissions, on the basis of existing technologies. It is anticipated, however, that efficiencies in construction practices and the materials used, could be identified e.g. sustainably sourced materials, with a lower embodied carbon content. This would aid in ensuring that any emissions associated with construction activities are minimised, as far as practicably possible, making best use of advances in emerging decarbonisation technology.</p> <p>It is expected that the route corridor would be delivered in-line with measures, as set out within the Scottish Government's 'Update to the Climate Change Plan' (2018 – 2032), and associated documents, including the emerging findings from the 'Deep Decarbonisation Pathways for Scottish Industries: Research Report' relating with the decarbonisation of industry, including the construction sector.</p> <p>A further assessment of carbon, and opportunities for carbon reduction in design, would be considered in later stages of the project assessment process.</p>
Accessibility and Social Inclusion	Community Accessibility	<p>It is considered that this route corridor offers the potential for positive impacts on accessibility, in terms of public transport usage, with enhanced access provided for Kintyre, Bute and Cowal. It is considered unlikely, however, that this route corridor would have any significant impact on reducing transport poverty or reducing reliance on private cars. This is primarily due to the nature of the route corridor and the areas within which it is located.</p> <p>There exists an opportunity, through the infrastructure provided, to positively impact on the level of active travel undertaken within the route corridor. While there is the potential for local trips to be made via active modes, and for additional trips to be generated resulting from increased use of the infrastructure provided</p>

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STAG Criteria	
Criteria	Assessment Summary
	<p>by visitors and tourists, it is unlikely, however, that the future level of active travel trips within the corridor would be significant.</p> <p>This route corridor provides a potential opportunity for the provision of enhanced parking facilities, improving access to the scenic area within which the route corridor sits. This could provide enhanced access to the natural environment, and to the fixed links which, in and of themselves, may be an attractor for visitors and tourists, wishing to park and proceed via active modes.</p> <p>Potential enhancements in resilience provided as a result of mitigating landslide induced closures could aid community accessibility, through better, more reliable access to services, both locally and further afield</p>
Comparative Accessibility	<p>Due to the rural nature of the Argyll &amp; Bute region, the distances between key towns and a lack of suitable public transport services (in some areas) car ownership levels are greater than the national average. Due to the current high dependency for travel by car, the scale of accessibility benefits that would be delivered to this main user group through delivery of an intervention within this route corridor include more reliable journeys to employment opportunities, recreation, education and health services located both within and outwith the region.</p> <p>Visitors and leisure users would also likely benefit from NMU infrastructure provided, linking to core paths, existing cycle networks, outdoor activities and viewpoints. The design of such infrastructure should ensure that local communities benefit fully from such facilities and are not adversely impacted by them.</p> <p>Freight users may see health and wellbeing benefits from the enhanced resilience provided by this route corridor, with fewer closures resulting in the need for lengthy diversion routes, which can add a significant duration to journeys, contributing towards driver fatigue and stress. Given the rural nature of the region, journeys made using the A83 Trunk Road, may already be several hours in length.</p>

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	<p>Positive impacts can be expected, in terms of mitigating impacts on socially excluded groups - Argyll &amp; Bute has a higher proportion of older residents than the national average. Enhanced resilience may provide more reliable access to key services, including healthcare.</p> <p>This route corridor could contribute significantly towards reducing economic and geographic deprivation for currently socially disadvantaged groups (Argyll &amp; Bute has several areas within the 10% most deprived communities in Scotland) through the significant improvement of accessibility to Kintyre, Bute and Cowal and the enhancement of business confidence driving an associated increase in inward investment and jobs.</p>

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Assessment Summary

Transport Planning Objectives		Assessment						
Objective		Major Negative	Moderate Negative	Minor Negative	Neutral	Minor Positive	Moderate Positive	Major Positive
TPO1	Resilience – reduce the impact of disruption for travel to, from and between key towns within Argyll & Bute, and for communities accessed via the strategic road network.						✓	
TPO2	Safety – positively contribute towards the Scottish Government’s Vision Zero road safety target by reducing accidents on the road network and their severity.						✓	
TPO3	Economy – reduce geographic and economic inequalities within Argyll & Bute through improved connectivity and resilience.						✓	
TPO4	Sustainable travel – encourage sustainable travel to, from and within Argyll & Bute through facilitating bus, active travel and sustainable travel choices.					✓		
TPO5	Environment – Protect the environment, including the benefits local communities and visitors obtain from the natural environment, by enhancing natural capital assets and ecosystem service provision through delivery of sustainable transport infrastructure.	✓						



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Implementability		RAG Rating		
		RED	AMBER	GREEN
Engineering	Topography and Alignment Considerations	RED		
	Geology / Geomorphology Considerations			GREEN
	Structures Considerations	RED		
	Constructability Considerations	RED		
Environment	Biodiversity, Fauna and Flora	RED		
	Population and Human Health		AMBER	
	Water Environment	RED		
	Soils		AMBER	
	Air Quality		AMBER	
	Climatic Factors	RED		
	Material Assets		AMBER	
	Cultural Heritage	RED		
	Landscape and Visual Amenity	RED		
	Traffic	Traffic Flows		AMBER
Accidents				GREEN
Operational Considerations			AMBER	
Financial Considerations		RED		

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STAG Criteria		Assessment						
Criteria		Major Negative	Moderate Negative	Minor Negative	Neutral	Minor Positive	Moderate Positive	Major Positive
Environment		Refer to Implementability Assessment – Environment						
Safety		Refer to Implementability Assessment – Accidents						
Economy	Transport Economic Efficiency	✓						
	Wider Economic Impacts					✓		
Integration	Transport Integration					✓		
	Transport and Land Use Integration		✓					
	Policy Integration				✓			
Accessibility and Social Inclusion	Community Accessibility						✓	
	Comparative Accessibility						✓	