

## 5 Potential Impacts

### 5.1 Introduction

This section summarises the *potential impacts* of each of the crossing options in relation to each of the Natura 2000 sites, as discussed in detail in Tables D1 to D4 in Appendix D of this report. The tables in Appendix D explore the environmental issues associated with the various options and identify which of these could have a potential impact on the qualifying features of the Natura sites.

Only those issues identified in Appendix D as having a potential impact on the Natura sites are summarised in Tables 5.1 to 5.4 below.

Any issue identified as having a potential impact is then carried forward to Section 6 which considers strategic level mitigation. Only when potential impacts cannot be effectively mitigated, or where there is uncertainty about whether mitigation can be achieved, are adverse effects on the integrity of the Natura sites identified. Note that these sections do not take into account “in combination” or cumulative impacts; these are considered further in Section 7.

Note that where potential impacts on the Firth of Forth SPA are referred to below, this also includes for potential impacts on the Firth of Forth Ramsar site. This is because the sites are almost identical in extent and the qualifying species of the Firth of Forth Ramsar are included within the list of qualifying species for the Firth of Forth SPA.

### 5.2 Corridor C Tunnel (bored)

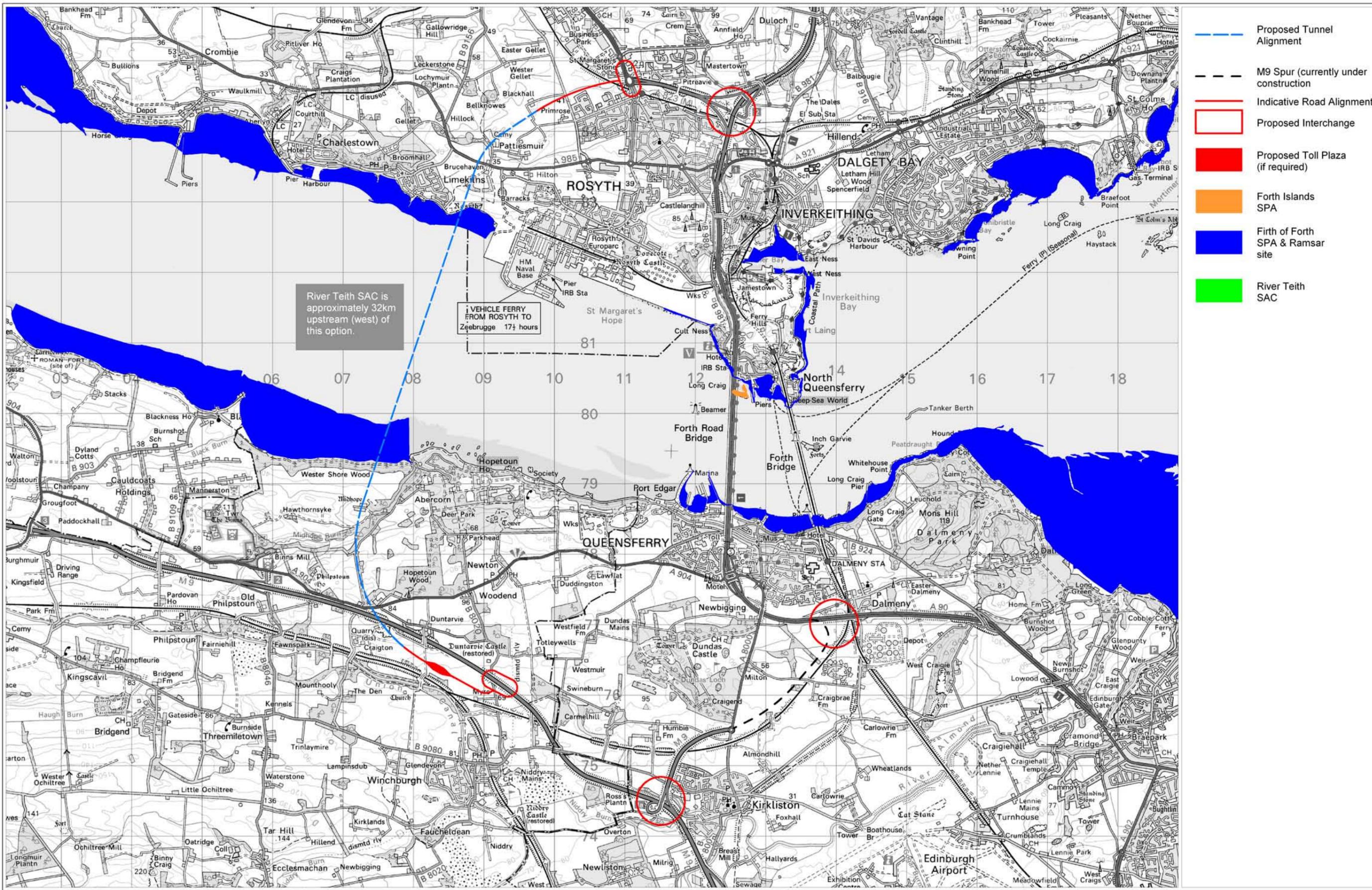
This option is illustrated in Figure 5.1 and is the most westerly of all the options. On the southern shore the tunnel portal, located at Craigton Quarry, is reached via a new spur road on the south of the M9. On the northern shore the tunnel portal is located to the west of Rosyth, immediately north of Pattiesmuir. A new road would link the tunnel to the A823 north of Rosyth.

The option also includes re-modelling of junctions on both the northern and southern sides. The tunnel would be constructed through a combination of Tunnel Boring Machine (TBM) and Sprayed Concrete Lining (SCL) tunnel techniques. However, there may be a requirement to access the tunnel from the surface within the firth should a dolerite intrusion or other obstruction be present on the proposed alignment. Current proposals indicate that the majority of spoil would be disposed of by road from beyond the shoreline.

#### 5.2.1 Firth of Forth SPA (including Firth of Forth Ramsar Site)

Potential impacts on the Firth of Forth SPA for the bored tunnel option in Corridor C relate to the potential for compromising the following conservation objectives:

- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained, and
- To ensure for the qualifying species that the structure, function and supporting processes of habitats supporting the species is maintained in the long term.



- Proposed Tunnel Alignment
- M9 Spur (currently under construction)
- Indicative Road Alignment
- Proposed Interchange
- Proposed Toll Plaza (if required)
- Forth Islands SPA
- Firth of Forth SPA & Ramsar site
- River Teith SAC

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Project			FORTH REPLACEMENT CROSSING STUDY		
Title			FIG 5.1 APPROPRIATE ASSESSMENT CORRIDOR C TUNNEL (BORED)		
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Disturbance of qualifying species both within the Firth of Forth SPA and using areas outwith the SPA (in open water and agricultural fields) has generally been discounted as there will be no construction activities in the SPA and the tunnel boring activities would be at such a depth that noise and vibration would not be an issue. In addition, generally any disturbance would be short term, local and located within inland areas that are not associated with high numbers of qualifying bird species, or where there are alternative fields nearby that qualifying species would be able to use.

However, it is possible that if a dolerite intrusion or other obstruction is encountered on the tunnel alignment within the firth then the tunnel would have to be accessed from the surface. It is likely that this will take the form of a caisson temporarily located at the relevant point within the channel. This may disturb qualifying species using open water areas outwith the SPA:

- The potential that the tunnel will need to be accessed within the firth, requiring construction of a caisson, barge movements and potential disturbance to sediments and currents.

The potential deterioration of habitats and loss of function of habitats both relate to unpredictable sources of pollution:

- The difficulties of tunnel boring in uncharted mine workings near Midhope Burn and the potential for release of contaminated waters as well as the potential for providing routes for contaminants to reach the Firth of Forth in the short or long term;
- The potential for untreated fumes from the ventilation shaft(s) to be a long term (120 years) point source of pollution; and
- The potential for pollution events closer to but outwith the SPA when the ventilation shafts are being constructed.

#### 5.2.2 Forth Islands SPA

Potential impact is not predicted from C Tunnel (Bored). This is primarily because the qualifying species only have limited contact with areas that could become contaminated or disturbed, due to the distance of the impact source from their breeding and main feeding areas.

#### 5.2.3 River Teith SAC

Potential impact on the River Teith SAC relates to the following conservation objectives:

- To avoid significant disturbance to the qualifying species and;
- To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.

The potential for compromise of these conservation objectives relates to the uncertainty of pollution events during construction without mitigation that could impair qualifying species on migration through the Forth.

#### 5.2.4 Summary

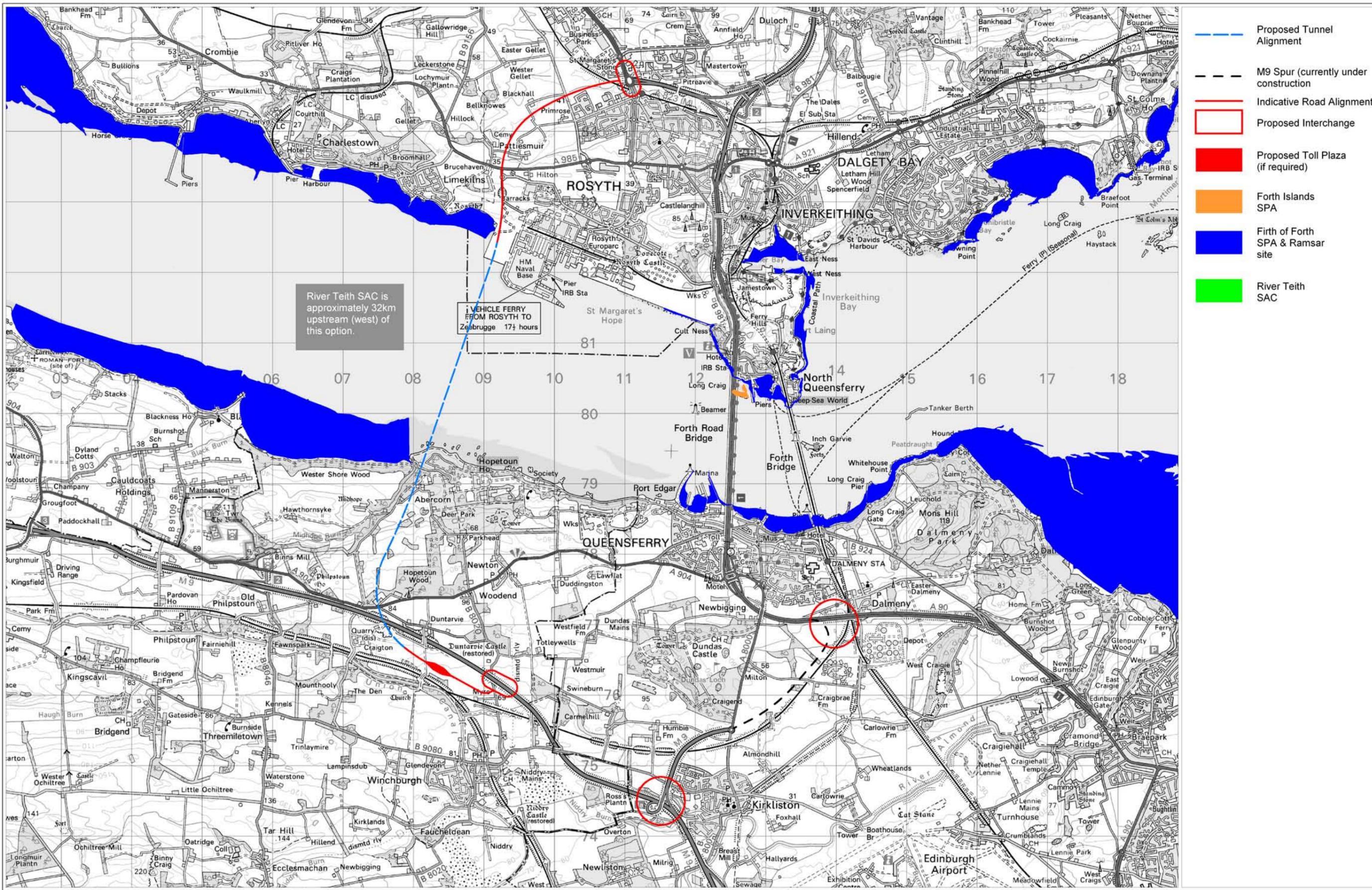
Table 5.1 below summarises the potential impacts that the bored tunnel option in Corridor C could have with regard to the Natura 2000 sites. As noted above, a full discussion of all of the environmental issues that may give rise to a potential impact is given in Table D1 in Appendix D of this report.

**Table 5.1 Corridor C Tunnel (bored) Summary of Potential Impacts**

Natura 2000 Site	Source of Impact	Potential Impact	Relevant Conservation Objective
Firth of Forth SPA	Potential access to tunnel within the Firth during construction via caisson.	Disturbance to qualifying species	To avoid significant disturbance to the qualifying species
		Changes to flow patterns and sedimentation	
		Pollution events.	
	Tunnel boring activities in the vicinity of Midhope Burn.	Alteration to hydrology.	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.
		Release of contaminants from mine workings.	
Emissions from ventilation shafts.	Contamination.	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	
Forth Islands SPA	No potential impact predicted.		
River Teith SAC	Potential access to tunnel within the Firth during construction via caisson.	Vibration / Noise	To avoid significant disturbance to the qualifying species.
		Pollution events	

#### 5.3 Corridor C2 Tunnel (immersed tube)

This option is illustrated in Figure 5.2. On the southern shore the tunnel portal, located at Craigton Quarry, is reached via a new spur road on the south of the M9. On the northern shore the tunnel portal is located immediately to the west of the naval docks. A new road links the tunnel to the A823 north of Rosyth crossing over the A985. The option also includes re-modelling of junctions on both the northern and southern shores. Construction involves the dredging of a channel across the Firth. A pre-fabricated tunnel would be towed out in sections and then sunk into the channel. Cut and Cover (C&C) tunnels would be required on both the northern and southern shores to provide a transition and interface between the land-based mined tunnel and the immersed tube tunnel.



- Proposed Tunnel Alignment
- M9 Spur (currently under construction)
- Indicative Road Alignment
- Proposed Interchange
- Proposed Toll Plaza (if required)
- Forth Islands SPA
- Firth of Forth SPA & Ramsar site
- River Teith SAC

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Project			FORTH REPLACEMENT CROSSING STUDY		
Title			FIG 5.2 APPROPRIATE ASSESSMENT CORRIDOR C2 TUNNEL (IMMERSED TUBE)		
Project No.	49550	Drawing No.	49550/FRCAA/04	Rev.	2

### 5.3.1 Firth of Forth SPA (including Firth of Forth Ramsar Site)

Potential impacts on the Firth of Forth SPA relate to the following conservation objectives:

- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained,
- To ensure for the qualifying species the following are maintained in the long term: Distribution and extent of the habitats supporting the species and the structure, function and supporting processes of habitats supporting the species and,
- To avoid significant disturbance to the qualifying species.

These conservation objectives may be compromised by the construction methods of the tunnel across the bed of the Forth and also the potential for long term sources of pollution.

The proposed alignment for C2 Tunnel (immersed tube) avoids, though is adjacent to, the intertidal areas of the Forth designated as the Firth of Forth SPA. However, when considering the potential impacts on an SPA the important factor is whether there will be adverse effects on the qualifying features of the SPA, whether they are actually present within the boundaries of the SPA or adjacent to them. The Wetland Bird Survey (WeBS) low tide data for the winter of 2003/2004 indicates that redshank, curlew and wigeon all occur in significant numbers in this corridor (above one per cent of SPA designated threshold level).

The construction method and alignment proposed for the C2 Tunnel are likely to have adverse effects on the SPA and in a wider context the biodiversity of the Firth of Forth through disturbance and changes to the morphological regime. There will also be a loss of feeding habitat during the construction period. As a result of construction activities there will be increased disturbance of marine and bird species in both the open water and in the intertidal areas.

With regard to the consequence of dredging the channel that will take the immersed tube below the low water mark there are likely to be impacts on water quality and consequently on related ecology within the Forth during the construction period. The characterisation of the Firth of Forth undertaken by SEPA as part of the implementation of the Water Framework Directive identifies the Forth as being in Category 1a – at risk of not achieving “good ecological status” - the target of the Directive. SEPA recognises the water quality in the Firth of Forth is historically poor citing historic discharges and the Forth’s inherently turbid nature, however, overall levels of industrial and sewage pollution are now decreasing due to tightened legislation.

However, the displacement of sediments associated with the C2 Tunnel would exacerbate existing water quality problems, potential releasing currently bound pollutants such as heavy metals, and could have significant indirect impacts on ecology and the wildlife that inhabits the Firth of Forth. Impacts resulting from increased suspended sediment in the Forth include:

- A reduction in the depth of light penetration into the water. This effectively decreases rates of photosynthetic activity and thus primary productivity in submerged plants such as eelgrass (*Zostera* spp.), which is a basic food source for aquatic animals. A reduction in the food source at the primary level may then have a knock-on effect on higher trophic levels, including birds;

In addition, other sources of potential impact include:

- Cut and cover through intertidal areas and installation of immersed tube potentially releasing contaminants and altering the erosion and deposition of sediments;
- The potential for untreated fumes from the ventilation shaft to be a long term (120 years) point source of pollution; and
- The potential for pollution events close to the SPA when the ventilation shafts are being constructed.

The construction of the shaft and sites entrance, cut and cover activities and installation of the immersed tube are in proximity to Blackness Bay, which holds significant numbers of the qualifying winter assemblage and indicates potentially significant disturbance. Indirect impacts relating to the works on the northern shore and in open water areas may also have adverse effects.

### 5.3.2 Forth Islands SPA

The construction of the immersed tube tunnel will have a range of impacts in the mid to upper firth which could lead to avoidance by qualifying species of marginal feeding areas and compromised feeding conditions, in addition to contaminant release from sediments from both the bored sections near Midhope Burn and from dredging in the Firth. However, the distance of the SPA islands and the limited use made of the upper firth by the qualifying species do not suggest that the conservation objectives are likely to be compromised and therefore no adverse effect on the integrity of the site is predicted.

### 5.3.3 River Teith SAC

Potential impact on the River Teith SAC relates to the following conservation objective:

- To ensure for the qualifying species that the following is maintained in the long term: Population of the species, including range of genetic types for Salmon, as a viable component of the site.

The potential for this conservation objective to be compromised is related to the construction methods of the tunnel across the bed of the Forth. The sources of potential impact are summarised:

- Cut and cover through the intertidal zones will involve construction of coffer dams which would extend to below the low tide level. This technique may dislodge sediments and lead to greater turbidity, mobilise contaminants and would also act as a physical barrier to migrating fish. Migrating fish tend to follow the peripheral zones of large waterbodies such as the firth on migration, and so any barriers in this zone would have a greater potential impact;
- Installation of the immersed tube would involve dredging a deep channel across the Forth. The disruption to sediment and increased turbidity, mobilise contaminants and may impede migrating qualifying species of fish; and
- High turbidity levels can adversely affect invertebrate populations; interfere with the behaviour, migration, feeding and growth of salmonids and other fish species such as lamprey. It can also cause damage to fish gills by abrasion (hyperplasia), and clogging. This is significant in relation to potential impacts on Atlantic salmon which are a qualifying feature of the River Teith SAC. Note that such effects would not be spatially limited to the construction zone.

The duration for works required to dredge and construct the immersed tube section of the tunnel is estimated to be 22 months. Direct impacts such as disturbance would be felt for at least two consecutive years; however, the indirect impacts due to any changes in sedimentation patterns and release of contaminants would be present in the longer term, possibly permanently. Therefore, as there is considerable uncertainty regarding the impacts of this construction technique and option, an adverse effect on the River Teith SAC cannot be ruled out.

#### 5.3.4 Summary

The potential impacts associated with the immersed tube tunnel option in Corridor C2 are summarised in Table 5.2. A full discussion of all of the environmental issues that may give rise to a potential impact is given in Table D2 in Appendix D of this report.

**Table 5.2 Corridor C2 Tunnel (immersed tube) Summary of Potential Impacts**

Natura 2000 Site	Source of Impact	Potential Impact	Relevant Conservation Objective
Firth of Forth SPA	Cut and cover through intertidal zone.	Loss of, and/or alteration to intertidal habitat within the SPA and intertidal habitat outside SPA used by qualifying species.	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.
	Installation of immersed tube in the sub-tidal zone.	Changes to flow and sedimentation patterns.	
	Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone.	Mobilisation of contaminants	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
	Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone.	Disturbance to qualifying species.	To avoid significant disturbance to the qualifying species.
	Tunnel boring activities in the vicinity of Midhope Burn.	Alteration to hydrology.	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting

Natura 2000 Site	Source of Impact	Potential Impact	Relevant Conservation Objective
		Release of contaminants from mine workings.	processes of habitats supporting the species
	Emissions from ventilation shafts.	Contamination.	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
<b>Forth Islands SPA</b>	No potential impact predicted.		
<b>River Teith SAC</b>	Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone.	Increase in turbidity, release of contaminants and barrier effects.	To ensure for the qualifying species that the following is maintained in the long term: Population of the species, including range of genetic types for Salmon, as a viable component of the site.

#### 5.4 Corridor D Bridge

This option is illustrated in Figure 5.3. The bridge is located to the immediate west of the existing Forth Road Bridge. A new spur road from the north of the M9 links the bridge on the southern shore to the road network. The southern bridgehead is located to the west of South Queensferry adjacent to Port Edgar. On the northern shore the bridge ties into the M90. The option also includes re-modelling of junctions on both the northern and southern shores.

##### 5.4.1 Firth of Forth SPA (including Firth of Forth Ramsar Site)

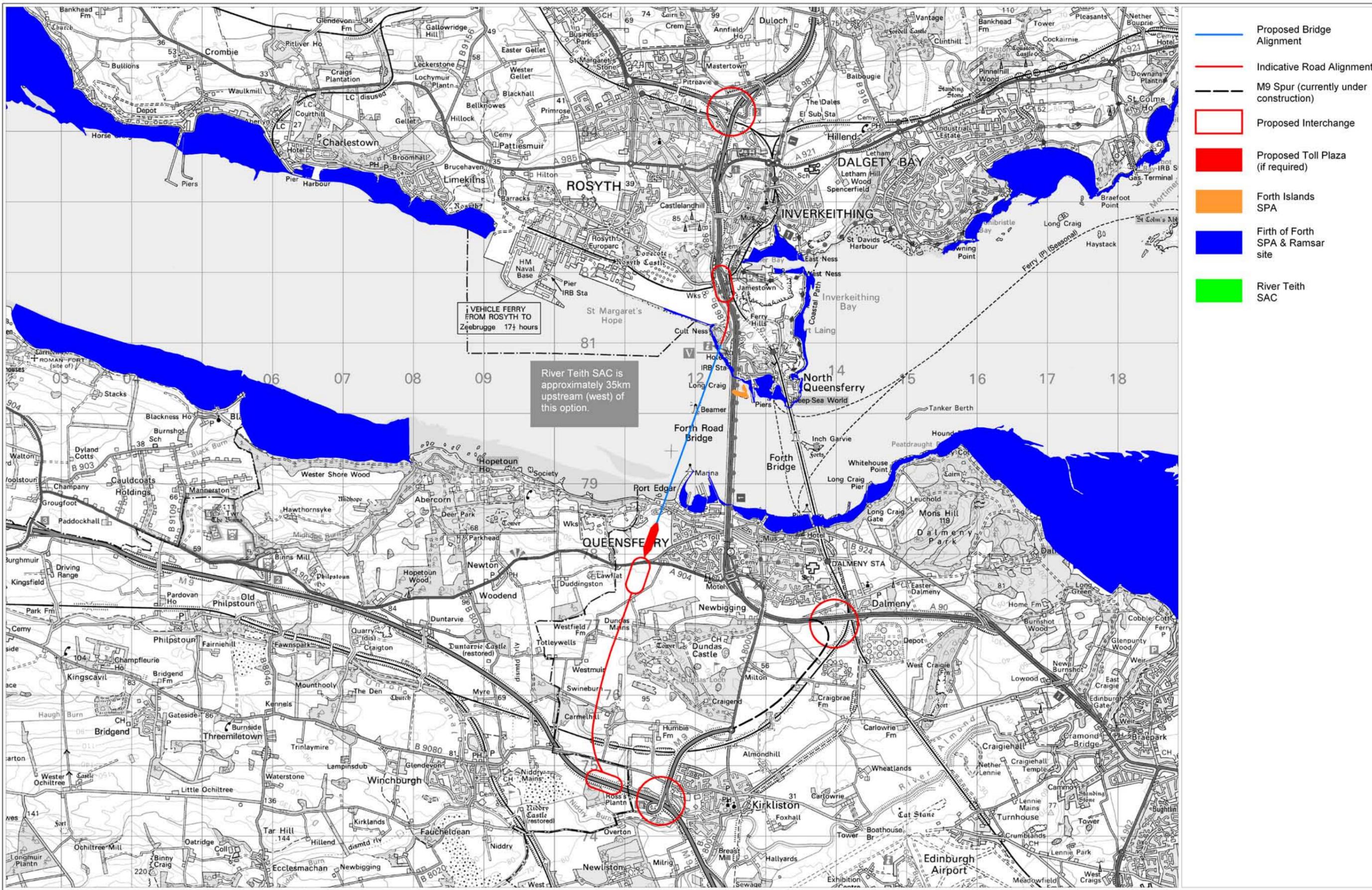
The potential impacts on the Firth of Forth SPA relate to the following conservation objectives:

- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained; and
- To avoid significant disturbance to the qualifying species.

The potential for compromise of the first of these conservation objectives relates to the uncertainty of pollution events during construction and operation, without mitigation.

The potential for significant disturbance from construction is less clear. The construction period of the bridge is estimated to be 6 years, potentially causing disturbance to qualifying species in the zone of impact for 6 consecutive winters. The intertidal habitat in the zone of impact is narrow, with no significant areas of mudflat or saltmarsh habitat, although it may be used by roosting birds.

Whilst the impact zone is not considered to hold any recognised areas for the SPA species, there is some uncertainty over the numbers of shorebirds and open water birds that could be impacted, particularly at Port Edgar and the shore of the Hopetoun Estate. Current survey information from WeBS does not facilitate an accurate assessment, and so potential impact cannot be discounted.



- Proposed Bridge Alignment
- Indicative Road Alignment
- M9 Spur (currently under construction)
- Proposed Interchange
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- Forth Islands SPA
- Firth of Forth SPA & Ramsar site
- River Teith SAC

River Teith SAC is approximately 35km upstream (west) of this option.

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		Scale 1:50,000@A3		DR	BAC	IAB	
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#### 5.4.2 Forth Islands SPA

Potential impact on the Forth Islands SPA relates to the following conservation objectives:

- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained;
- To ensure for the qualifying species the following are maintained in the long term: The structure, function and supporting processes of habitats supporting the species, and;
- To avoid significant disturbance to the qualifying species.

The potential for impact relates to the uncertainty of pollution events during construction and operation, without mitigation. There is also the potential for disturbance of the qualifying species nesting and roosting on Long Craig Island, which is the closest island to the bridge alignment included within the SPA.

As noted above, the integrity of the Forth Islands SPA is currently regarded as good, with the majority of species considered to have a 'Favourable Maintained' status. However, kittiwake and sandwich tern are reported to be 'Unfavourable Declining' whilst shag is said to be 'Unfavourable Recovering'<sup>15</sup>, which may make these populations more sensitive to disturbance. Nevertheless, the overall number of birds in total has shown a slight increase in the last ten years.

Potentially significant disturbance is identified from uncontrolled barge movements and by noise and vibration during construction of the bridge supports, viaduct supports and winching into position of the bridge deck. Long Craig Island is approximately 380m from the bridge corridor; however, birds also forage in local waters as well as further afield.

Construction noise from activities such as pile driving, are particularly implicated as a source of significant disturbance while the birds are laying and incubating eggs. In addition, there is a possibility that cranes during construction and new structures may increase risk of collisions during breeding displays, although this is unlikely. Therefore, without appropriate mitigation or avoidance measures, this potential impact may represent an adverse effect for this Natura site.

#### 5.4.3 River Teith SAC

The potential for impact on the River Teith SAC relates to the following conservation objectives:

- To avoid significant disturbance to the qualifying species and;
- To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.

<sup>15</sup>SNH SiteLink Website, September 2007

The potential for compromise of these conservation objectives relates to the uncertainty of pollution events during construction and operation, without mitigation that could impair qualifying species on migration through the Firth.

Additionally, any piling associated with the construction of bridge supports and viaduct supports may also constitute sufficient disturbance and impede migration. At this stage the number and locations of piles is not certain and there is a risk that piling operations may disturb qualifying species. However, although the construction activities around the bridge supports is not considered of significant spatial magnitude to impede migrating fish, it is possible that seasonal constraints on piling activities may be required to avoid disturbance.

During the operational phase, this area of the Firth is currently subject to frequent river traffic, a level of vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.

#### 5.4.4 Summary

The potential impacts of Corridor D Bridge are summarised below in Table 5.3. A full discussion of all of the environmental issues that may give rise to a potential impact is given in Table D3 in Appendix D of this report.

**Table 5.3 Corridor D Bridge Summary of Potential Impacts**

Natura 2000 Site	Source of Impact	Potential Impact	Relevant Conservation Objective
Firth of Forth SPA	Construction of bridge and approaches	Disturbance of qualifying species	To avoid significant disturbance to the qualifying species
	General construction activities	Pollution events	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
	Construction of pillars in open water	Changes to flow and sedimentation	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
	General operation	Ongoing pollution	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
	Permanent presence of pillar structures in open water	Changes to flow and sedimentation	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
Forth Islands SPA	Construction within the Firth	Disturbance of qualifying species	To avoid significant disturbance to the qualifying species
	General construction activities	Pollution events	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species
	General operation	Pollution events	
River Teith SAC	Construction of bridge pillars and supports and approach viaduct	Vibration/noise	To avoid significant disturbance to the qualifying species
	General construction activities	Pollution events	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species

## 5.5 Corridor D Tunnel (bored)

This option is illustrated in Figure 5.4. The tunnel is located to the west of the existing road crossing. On the southern shore the tunnel portal is located north of Westmuir and is linked to the road network by a new spur on the north of the M9. The northern tunnel portal is located north of Inverkeithing and is reached via a new spur road from the M90.

The option also includes re-modelling of junctions on both the northern and southern sides. The tunnel would be constructed by TBM and SCL. However, as for Bored Tunnel C, there may be a requirement to access the tunnel from the surface within the firth should a dolerite intrusion or other obstacle be present on the proposed alignment. Current proposals indicate that the majority of spoil would be disposed of by road.

### 5.5.1 Firth of Forth SPA (including Firth of Forth Ramsar Site)

Potential impacts on the Firth of Forth SPA for the bored tunnel D relate to the potential for compromising the following conservation objectives:

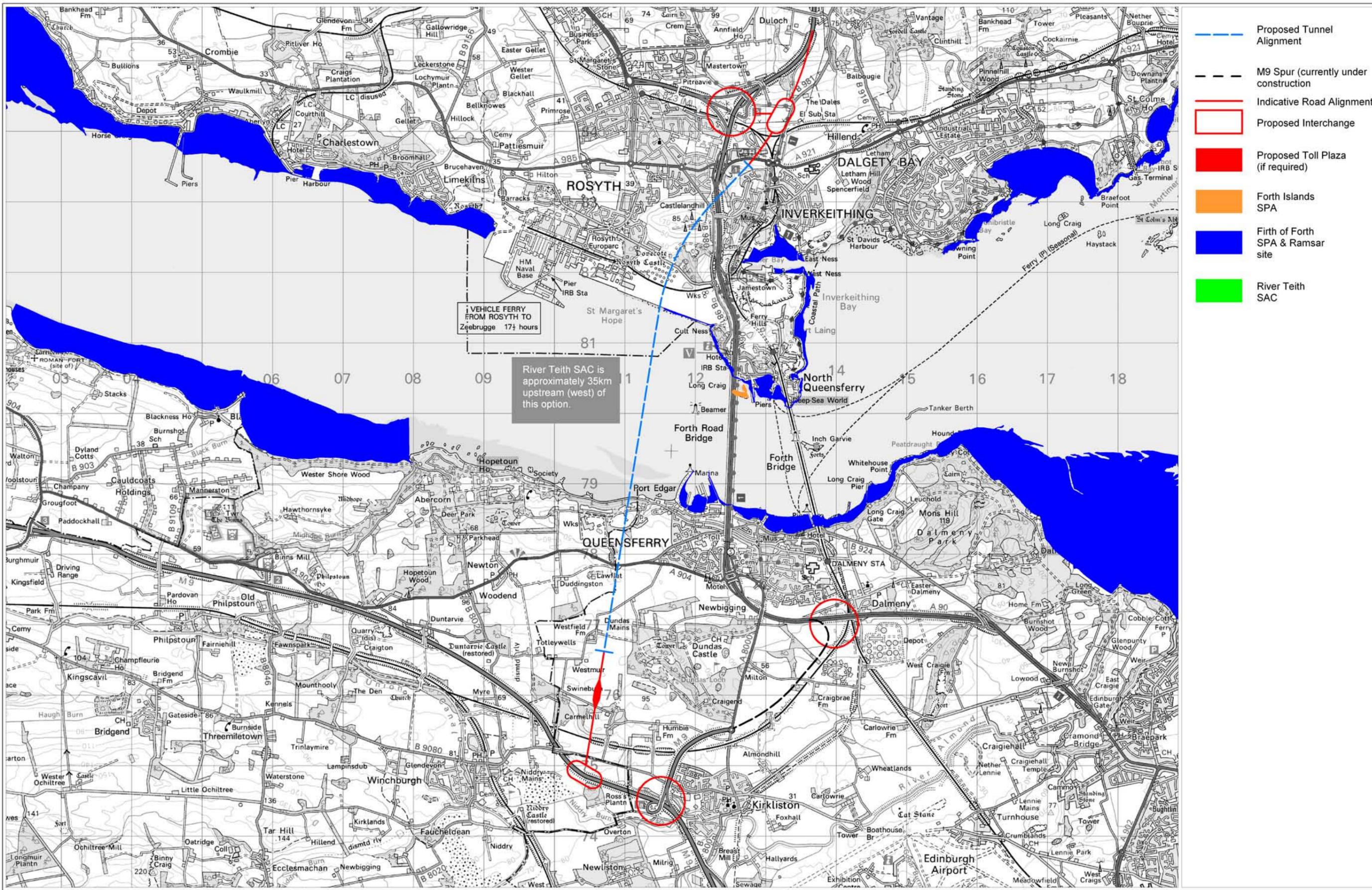
- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained, and;
- To ensure for the qualifying species that the structure, function and supporting processes of habitats supporting the species is maintained in the long term.

Disturbance of the qualifying species within the Firth of Forth SPA and using areas outwith the SPA (in open water and surrounding agricultural fields) has generally been discounted as there will be no construction activities within the SPA and the tunnel boring activities would be at such a depth that noise and vibration would not be an issue.

However, it is possible that if a dolerite intrusion or other obstruction is encountered on the tunnel alignment within the firth then the tunnel would have to be accessed from the surface. It is likely that this will take the form of a caisson temporarily located at the relevant point within the channel. This may disturb qualifying species using open water areas outwith the SPA.

The following potential impacts have been identified:

- The potential that the tunnel will need to be accessed within the firth, requiring construction of a caisson, barge movements and potential disturbance to sediments and currents;
- The potential for untreated fumes from the ventilation shaft to be a long term (120 years) point source of pollution, and
- The potential for pollution events close to the SPA when the ventilation shafts are being constructed.



- Proposed Tunnel Alignment
- M9 Spur (currently under construction)
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- Proposed Toll Plaza (if required)
- Forth Islands SPA
- Firth of Forth SPA & Ramsar site
- River Teith SAC

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Project			FORTH REPLACEMENT CROSSING STUDY		
Title			FIG 5.4 APPROPRIATE ASSESSMENT CORRIDOR D TUNNEL (BORED)		
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#### 5.5.2 Forth Islands SPA

The potential impacts on the Forth Islands SPA relate to the following conservation objectives:

- To avoid deterioration of the habitats of the qualifying species thus ensuring that the integrity of the site is maintained;
- To ensure for the qualifying species the following are maintained in the long term: The structure, function and supporting processes of habitats supporting the species, and;
- To avoid significant disturbance to the qualifying species.

The potential for impact relates to the uncertainty of pollution events during construction without mitigation.

There is also the potential for disturbance of the qualifying species nesting and roosting on Long Craig Island, which is the closest island to the bridge alignment included within the SPA.

Potentially significant disturbance may relate to uncontrolled barge movements and by noise and vibration during construction of the caisson, should this be required, as well as the associated rock removal and importation of construction materials and workforce.

Long Craig Island, being the closest island of the SPA, is approximately 1.2km from the tunnel alignment; however, the birds nesting and roosting here forage in waters further afield as well as local waters. Construction noises are particularly implicated as a source of significant disturbance while the birds are laying and incubating eggs.

#### 5.5.3 River Teith SAC

The potential impacts on the River Teith SAC relate to the following conservation objectives:

- To avoid significant disturbance to the qualifying species and;
- To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.

The potential for compromise of these conservation objectives relates to the uncertainty of pollution events during construction without mitigation that could impair qualifying species on migration through the Forth.

#### 5.5.4 Summary

Table 5.4 below summarises the potential impacts resulting from Corridor D bored tunnel. A full discussion of all of the environmental issues that may give rise to a potential impact is given in Table D4 in Appendix D of this report.

## 6 Mitigation Measures and Residual Effects

### 6.1 Approach to Mitigation

Mitigation is defined as “*measures aimed at minimising or even cancelling the negative impact of a plan or project, during or after its completion*”<sup>16</sup>.

Mitigation can therefore follow one of two principles; the avoidance of impact or the reduction of impact. At the options stage mitigation is at a strategic level, however, as much detail as possible, given the limited knowledge on engineering design, is provided. Compensatory measures to offset adverse effect cannot be considered at this stage in the assessment procedure. However, the detailed assessment for the chosen scheme will consider opportunities for ecological enhancement where appropriate.

The assessment of the sources of potential impacts in Section 5 concluded for each option the sources and effects of impacts in relation to the conservation objectives of each Natura 2000 site. These are presented here, with potential mitigation, its efficacy and finally an assessment of any residual adverse effect on the integrity of the site.

As noted above, an adverse effect has only been identified where potential impacts cannot be effectively mitigated, or where there is uncertainty about whether mitigation can be achieved.

### 6.2 Mitigation Measures

#### 6.2.1 Corridor C Tunnel (bored)

The potential impacts for this option relate to two Natura 2000 sites, the Firth of Forth SPA (and Ramsar site) and the River Teith SAC.

**Table 6.1 Corridor C Tunnel (bored) Proposed Mitigation and Adverse Effects**

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
<b>Firth of Forth SPA</b>				
Potential access to tunnel within the Firth during construction via caisson	Disturbance to qualifying species	Construction would be seasonally constrained to ensure there would be no risk of significant disturbance. This would be monitored and reviewed in light of data emerging from the Kincardine Bridge construction, and restrictions relaxed if deemed appropriate by TS and SNH.	Good	No adverse effect
	Changes to flow and sedimentation	The design of the construction methods would ensure that changes to flow and sedimentation changes are within acceptable limits, in consultation with SEPA and SNH.	Good	No adverse effect
	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
Tunnel boring activities near the	Alteration to hydrology	Remediation will stabilise mined sections using best methods available such as grouting	Good	No adverse effect

<sup>16</sup> *ibid.*

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
Midhope Burn	Release of contaminants from mine workings	carried out in such a manner as to control contaminated mine waters.		
Emissions from ventilation shafts	Contamination	The vents will be designed to treat emissions to a negligible level. The vents will be monitored and maintained.	Good	No adverse effect
<b>River Teith SAC</b>				
Potential access to tunnel within the Firth during construction via caisson	Vibration/noise	Works will be scheduled to minimise spatial impact and will be limited during the peak of migration of the qualifying fish species.	Good	No adverse effect
	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect

With efficient mitigation in place, there will be no adverse effect on the integrity of the Natura 2000 sites from Corridor C tunnel (bored).

#### 6.2.2 Corridor C2 Tunnel (immersed tube)

**Table 6.2 Corridor C2 Tunnel (immersed tube) Proposed Mitigation and Adverse Effects**

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
<b>Firth of Forth SPA</b>				
Cut and cover through intertidal zone	Loss of, and/or alteration to intertidal habitat within the SPA and intertidal habitat outside the SPA used by qualifying species.	Mitigation would include timing of works and sediment management to avoid significant changes to sedimentation within the Firth of Forth that may impact on intertidal habitats.	Uncertain	<b>Possible adverse effect</b>
Installation of immersed tube in the sub-tidal zone.	Changes to flow and sedimentation patterns	Mitigation would include sediment management to minimise turbidity and to avoid significant changes to sedimentation within the Firth of Forth.	Uncertain	<b>Possible adverse effect</b>
Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone.	Mobilisation of contaminants	Design of construction methods to minimise spread of sediments and contamination.	Uncertain	<b>Possible adverse effect</b>
Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone	Disturbance to qualifying species	Mitigation would include phasing of works to reduce impact.	Good	No adverse effect
Tunnel boring activities in the vicinity of the	Alteration to hydrology	Remediation will stabilise mined sections using best methods available such as grouting carried out in such a manner so as to control	Good	No adverse effect

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
Midhope Burn	Release of contaminants from mine workings	contaminated mine waters.		
Emissions from ventilation shafts	Contamination	The vents will be designed to treat emissions to a negligible level. The vents will be monitored and maintained.	Good	No adverse effect
<b>River Teith SAC</b>				
Cut and cover through intertidal zone, Dredging and installation of immersed tube.	Increase in turbidity, release of contamination and barrier effects	Undertake these works outwith peak period for migration of qualifying species.	Uncertain	<b>Possible adverse effect</b>

The magnitude of potential impacts and consequently the efficacy of mitigation for three of the impacts for the Firth of Forth SPA cannot be proven at this stage. Further studies would have to be undertaken to remove the uncertainties relating to the disruption of sedimentation processes. Until these studies are undertaken, it is not possible to determine if mitigation would be adequate and not result in adverse effect on the integrity of the Firth of Forth SPA.

### 6.2.3 Corridor D Bridge

**Table 6.3 Corridor D Bridge Proposed Mitigation and Adverse Effects**

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
<b>Firth Forth SPA</b>				
Construction of bridge and approaches	Disturbance of qualifying species	Construction would be phased to ensure there would be no risk of significant disturbance. This may mean a cease of major construction methods on the bridge for one or more seasons. This would be monitored and reviewed in light of data emerging from the Kincardine Bridge construction, and restrictions relaxed if deemed appropriate by TS and SNH.	Good	No adverse effect
General construction activities	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
Construction of pillars in open water	Changes to flow and sedimentation	The design of the bridge and construction methods would ensure that changes to flow and sedimentation changes are within acceptable limits, in consultation with SEPA and SNH.	Good	No adverse effect
General operation	Pollution	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
Permanent presence of pillar structures in open water	Changes to flow and sedimentation	The design of the pillars would ensure that changes to flow and sedimentation changes are within acceptable limits, in consultation with SEPA and SNH	Good	No adverse effect

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
<b>Forth Islands SPA</b>				
Construction within Firth of Forth	Disturbance	The main mitigation during construction will be careful timing of works. For example, pile driving so as to minimise disturbance of breeding birds.	Good	No adverse effect
		Barges will have defined routes to limit spatial impact on open water.		
		Studies will be undertaken to monitor the qualifying species to assess if restrictions can be reduced in consultation with SNH and SE.		
General construction activities	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
General operation	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
<b>River Teith SAC</b>				
Construction of bridge pillars and supports for approach viaduct	Vibration/noise	Pile driving will be scheduled to minimise spatial impact (i.e. only one location at a time) and will be limited during the peak of migration of the qualifying fish species.	Good	No adverse effect
General construction activities	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect

The mitigation available for the impacts of Bridge D illustrates clear methods to avoid adverse effects, with best practice in terms of the management of potential risks.

#### 6.2.4 Corridor D Tunnel (bored)

**Table 6.4 Corridor D Tunnel (bored) Proposed Mitigation and Adverse Effects**

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
<b>Firth of Forth SPA</b>				
Access to tunnel within the Firth	Disturbance of qualifying species	Construction would be seasonally constrained to ensure there would be no risk of significant disturbance.	Good	No adverse effect
	Changes to flow and sedimentation	The design of the construction methods would ensure that changes to flow and sedimentation changes are within acceptable limits, in consultation with SEPA and SNH.	Good	No adverse effect
	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect

Source of Impact	Predicted Impact	Proposed Mitigation	Efficacy	Adverse Effect
Emissions from ventilation shafts	Contamination	The vents will be designed to treat emissions to a negligible level. The vents will be monitored and maintained.	Good	No adverse effect
<b>Forth Islands SPA</b>				
Potential access to tunnel within the Firth during construction	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect
	Disturbance	The main mitigation during construction will be careful timing of works. For example, pile driving so as to minimise disturbance of breeding birds.	Good	No adverse effect
		Barges will have defined routes to limit spatial impact on open water.		
Studies will be undertaken to monitor the qualifying species to assess if restrictions can be reduced in consultation with SNH and SE.				
<b>River Teith SAC</b>				
Potential access to tunnel within the Firth during construction	Vibration/noise	Works will be scheduled to minimise spatial impact and will be limited during the peak of migration of the qualifying fish species.	Good	No adverse effect
	Pollution events	Use of SUDS, identification and management of groundwater issues, adherence to SEPA guidelines and implementation of a construction Environmental Management Plan	Good	No adverse effect

With efficient mitigation in place, there will be no adverse effect on the integrity of the Natura 2000 sites from the bored tunnel in Corridor D.

## 7 In Combination Assessment

### 7.1 Cumulative Assessment

In addition to the effects identified above, there is the potential for a replacement crossing and other plans or projects to result in cumulative impacts on the Natura 2000 sites. The cumulative assessment considers the 'in combination impacts' of:

- Other plans and projects in tandem with a replacement crossing; and
- A potential two-crossing scenario, whereby the existing Forth Road Bridge is refurbished or continues to function in some way and operates alongside a replacement crossing.

### 7.2 Other Plans and Projects

The following plans and projects have been identified as potentially having a cumulative impact:

- Edinburgh and Lothian Structure Plan 2004;
- Fife Structure Plan 2006;
- Local plans within these areas;
- Upper Forth Crossing at Kincardine;
- Port Edgar Redevelopment;
- Leith Docks Redevelopment;
- Granton Waterfront;
- Western Harbour;
- Cruise liner/ferry terminals on the Edinburgh waterfront, and
- Activities at Rosyth Docks including aircraft carrier construction.

Both the Edinburgh and Lothian Structure Plan 2004 and the Fife Structure Plan contain policies, ENVA1 and ENV4 respectively, requiring the undertaking of Appropriate Assessments where projects are likely to have a significant effect on Natura sites. These policies are also reflected in the local plans within the areas covered by the structure plans.

Detailed proposals of the above projects and plans may be considered for Appropriate Assessment under the Habitats Directive as required by Article 6 (3) and (4) of the 'Habitats Directive'<sup>17</sup>. Potential impacts and mitigation will be identified in any subsequent assessments of detailed proposals before these developments can proceed. Independently, mitigation will be incorporated into these schemes such that they will not result in adverse effects on the integrity of the Natura 2000 sites.

It is reasonable to assume schemes will only go ahead where it has been demonstrated that they will not have adverse effects upon the Natura 2000 site including in combination effects. The following sections briefly consider the potential cumulative impacts on each Natura 2000 site in turn for the proposed crossing options.

### 7.3 Firth of Forth SPA

It is not known at this stage whether any of the projects identified above has implications for loss of habitat within the SPA (and Ramsar) boundary or in habitats used by qualifying species outside the boundary (arable fields and open water).

In the context of the projects identified above the construction periods could have a degree of overlap; however, at this stage this cannot be confirmed. Since Kincardine Bridge, Granton Waterfront and Western Harbour are currently under construction, crossover is probably unlikely. The principal cumulative effects are likely to result from construction related disturbance, e.g. noise and vehicle movements. Such effects would be temporary and localised. Similarly, the construction of the bridge option could overlap with construction periods associated with the other listed projects. However, the construction of the bridge has been assessed as having no adverse effect on the integrity of the Firth of Forth SPA. Any additional impact will also not constitute adverse effect as the cumulative impact zone will be dictated by the bridge.

The Port Edgar redevelopment includes extension of the eastern breakwater and other works which could impact on sediment erosion-deposition regime in and around the mudflats. Taking into account the potential impacts on the sediment erosion-deposition regime associated with the immersed tube tunnel in Corridor C2 the potential exists for cumulative effects on the mudflats. However, as the Port Edgar redevelopment is downstream of the immersed tube tunnel these cumulative effects are considered to be negligible. Option D bridge and Options C and D bored tunnel are unlikely to affect the sediment erosion-deposition regime; consequently, cumulative effects are not anticipated.

### 7.4 Forth Islands SPA

None of the plans or projects will result in habitat land loss within the SPA boundary. However, the Port Edgar redevelopment may impact on local roosts used by qualifying species.

<sup>17</sup> Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992.

Cumulative effects associated with construction activities could result in disturbance to the Forth Islands SPA's qualifying species. This is unlikely to be the case with the tunnels in Corridors C and D. The construction of the bridge towers and deck in Corridor D could result in cumulative effects when considered in tandem with the Port Edgar redevelopment. It is considered that potential impacts from the construction of the bridge can be mitigated through the use of buffer zones around the Forth Islands and phased construction periods.

## 7.5 River Teith SAC

Due to the location of the River Teith SAC and the spatial distribution of the identified plans and projects with respect to the site no cumulative impacts are predicted with any of the FRCS options.

## 7.6 Two Crossing Scenario

The premise of FRCS has been that any new crossing is a direct replacement for the existing Forth Road Bridge. The assessment of effects above has assumed that the existing bridge closes to all traffic in 2019. The rationale for this assumption was based on the information available to Transport Scotland at the time of this assessment. A 'two-crossing scenario' is not being promoted by Transport Scotland.

A study is currently being carried out for Forth Estuary Transport Authority (FETA) to determine the feasibility of replacement or augmentation of the suspension cables of the Forth Road Bridge. The need for this study is as a consequence of the level of corrosion that was found in the cables. The preliminary report of the feasibility study, published in early June 2007, found that the replacement or augmentation of the cables presents significant engineering challenges but is achievable; however, a high degree of uncertainty regarding the future of the existing bridge remains. All of the following are possible:

- Permanent closure;
- Temporary closure;
- Long-term weight restrictions; and
- Total refurbishment with no weight restrictions.

Although it is not known at this time if two crossings will be operated in the future, it is important to be aware of the potential impacts should the Forth Road Bridge be refurbished. Two fully operational crossings could potentially double the existing road capacity leading to a number of effects, in particular noise, which could increase the amount and zone of disturbance.

A range of operational scenarios focused on traffic management measures, including for example High Occupancy Vehicle (HOV) and public transport priority lanes have been considered in Report 4 (Appraisal Report) of the FRCS. The two recommended options are identified below in Table 7.1.

**Table 7.1 Two Crossing Operational Considerations**

Option	Operational Description
<b>Option OP1</b>	Replacement crossing: Two lanes for any vehicles Existing Crossing: One bus lane and one high occupancy vehicle lane
<b>Option OP3</b>	Replacement Crossing: One lane for any vehicles and one lane for bus and high occupancy vehicles Existing Crossing: One lane for any vehicles and one lane for bus and high occupancy vehicle

The qualifying species of both the Firth of Forth SPA and Forth Islands SPA are likely to have become habituated to constant and predictable noise such as that generated by bridge traffic. Anecdotal evidence from field surveys on the qualifying species population with the Firth currently being progressed suggests that traffic generated noise has a negligible effect on these species in and around the Forth. Additionally, studies have showed that bridges do not generally impact on feeding, roosting or movements of wintering shorebirds. Consequently, at this strategic stage, no adverse cumulative effects on the Natura 2000 sites are predicted should the two crossing scenario be realised. This will be investigated further at the project stage with targeted specific surveys, should this scenario be likely.

## 8 Conclusions

After considering mitigation, it can be concluded that options for bored tunnels at Corridors C and D and a Bridge at Corridor D would not have adverse effects on the integrity of the Firth of Forth SPA, the Firth of Forth Ramsar site, the Forth Islands SPA or the River Teith SAC.

However, adverse effects on the integrity of the Firth of Forth SPA (and Ramsar site) and the River Teith SAC from the immersed tube tunnel option in Corridor C2 cannot be ruled out given the unpredictability of sedimentation processes and the efficacy of mitigation. Further studies may be undertaken to address this uncertainty, but at the current level of understanding, it is appropriate to exercise caution and hence adverse effect cannot be ruled out at this strategic level of assessment.

This appropriate assessment therefore concludes that the immersed tube tunnel option in Corridor C2 is likely to have an adverse effect on the integrity of the Firth of Forth SPA and Ramsar site and the River Teith SAC.

These findings are summarised in Table 8.1 below.

**Table 8.1 Summary Predicted Adverse Effects - Including cumulative and in combination impacts**

Conservation Objectives	Firth of Forth SPA				Forth Islands SPA				River Teith SAC			
	C Tunnel (Bored)	C2 Tunnel (ITT)	D Bridge	D Tunnel (Bored)	C Tunnel (Bored)	C2 Tunnel (ITT)	D Bridge	D Tunnel (Bored)	C Tunnel (Bored)	C2 Tunnel (ITT)	D Bridge	D Tunnel (Bored)
To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained, and	✓	?	✓	✓	✓	?	✓	✓	✓	?	✓	✓
To ensure for the qualifying species that the following are maintained in the long term:												
Population of the species *	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Distribution of the species within site	✓	?	✓	✓	✓	?	✓	✓	✓	?	✓	✓
Distribution and extent of habitats supporting the species	✓	?	✓	✓	✓	?	✓	✓	✓	?	✓	✓
Structure, function and supporting processes of habitats supporting the species	✓	?	✓	✓	✓	?	✓	✓	✓	?	✓	✓
No significant disturbance of the species	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓

\* **Note:** Objective differs slightly for the SPAs and the SAC  
 SPAs - Population of the species as a viable component of the site  
 SAC - Population of the species, including range of genetic types for salmon, as a viable component of the site.

Symbol	Meaning
✓	No adverse effect predicted
✘	Adverse effect predicted
?	Uncertainty over adverse effect

## 9 References

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## Appendix A – Firth of Forth SPA and Ramsar

### Conservation Objectives

To avoid deterioration of the habitats of the qualifying species (Table A.1) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

**Table A.1 Qualifying Species:**

Qualifying Species	
Bar-tailed godwit ( <i>Limosa lapponica</i> )	Oystercatcher ( <i>Haematopus ostralegus</i> )*
Common scoter ( <i>Melanitta nigra</i> )*	Pink-footed goose ( <i>Anser brachyrhynchus</i> )
Cormorant ( <i>Phalacrocorax carbo</i> )*	Red-breasted merganser ( <i>Mergus serrator</i> )*
Curlew ( <i>Numenius arquata</i> )*	Redshank ( <i>Tringa totanus</i> )
Dunlin ( <i>Calidris alpina alpina</i> )*	Ringed plover ( <i>Charadrius hiaticula</i> )*
Eider ( <i>Somateria mollissima</i> )*	Red-throated diver ( <i>Gavia stellata</i> )
Golden plover ( <i>Pluvialis apricaria</i> )	Sandwich tern ( <i>Sterna sandvicensis</i> )
Goldeneye ( <i>Bucephala clangula</i> )*	Scaup ( <i>Aythya marila</i> )*
Great crested grebe ( <i>Podiceps cristatus</i> )*	Shelduck ( <i>Tadorna tadorna</i> )
Grey plover ( <i>Pluvialis squatarola</i> )*	Slavonian grebe ( <i>Podiceps auritus</i> )
Knot ( <i>Calidris canutus</i> )	Turnstone ( <i>Arenaria interpres</i> )
Lapwing ( <i>Vanellus vanellus</i> )*	Velvet scoter ( <i>Melanitta fusca</i> )*
Long-tailed duck ( <i>Clangula hyemalis</i> )*	Wigeon ( <i>Anas penelope</i> )*
Mallard ( <i>Anas platyrhynchos</i> )*	Waterfowl assemblage

\*indicates assemblage qualifier only

### SPA Citation

EC Directive 79/409 on the Conservation of Wild Birds:

CITATION FOR SPECIAL PROTECTION AREA (SPA)

FOR PUBLIC ISSUE

FIRTH OF FORTH,

STIRLING, CLACKMANNANSHIRE, FALKIRK, FIFE, WEST LOTHIAN, CITY OF  
EDINBURGH, EAST LOTHIAN (UK9004411)

### Site description:

The **Firth of Forth SPA** is a complex of estuarine and coastal habitats in south east Scotland stretching east from Alloa to the coasts of Fife and East Lothian. The site includes extensive invertebrate-rich intertidal flats and rocky shores, areas of saltmarsh, lagoons and sand dune. The site is underpinned by the Firth of Forth SSSI.

### Qualifying interest:

The Firth of Forth SPA qualifies under **Article 4.1** by regularly supporting wintering populations (1993/94-97/98 winter peak means) of European importance of the **Annex 1** species: **red-throated diver** *Gavia stellata* (90 individuals; 2% of GB), **Slavonian grebe** *Podiceps auritus* (84; 2% of NW Europe, 21% of GB), **golden plover** *Pluvialis apricaria* (2,949; 1% of GB) and **bar-tailed godwit** *Limosa lapponica* (1,974; 2% of Western Europe, 4% of GB).

The site further qualifies under **Article 4.1** by regularly supporting a post-breeding (passage) population of European importance of the **Annex 1** species **sandwich tern** *Sterna sandvicensis* (1,617, 6% of GB, 1% of East Atlantic).

The Firth of Forth SPA qualifies under **Article 4.2** by regularly supporting wintering populations (1993/94-97/98 winter peak means) of both European and international importance of the migratory species **pink-footed goose** *Anser brachyrhynchus* (10,852; 6% of Icelandic/Greenlandic), **shelduck** *Tadorna tadorna* (moulting flock of 4,509; 2% of NW European), **knot** *Calidris canutus* (9,258; 3% of western European/Canadian), **redshank** *Tringa totanus* (4,341; 3% of European/West African) and **turnstone** *Arenaria interpres* (860 individuals; 1% of European).

The Firth of Forth SPA further qualifies under **Article 4.2** by regularly supporting a wintering waterfowl assemblage of European importance: a 1992/93-96/97 winter peak mean of 95,000 waterfowl, comprising 45,000 wildfowl and 50,000 waders. This assemblage includes nationally important numbers of 15 migratory species: **great crested grebe** *Podiceps cristatus* (720; 7% of GB), **cormorant** *Phalacrocorax carbo* (682; 5% of GB), **scaup** *Aythya marila* (437; 4% of GB), **eider** *Somateria mollissima* (9,400; 13% of GB), **long-tailed duck** *Clangula hyemalis* (1,045; 4% of GB), **common scoter** *Melanitta nigra* (2,880; 8% of GB), **velvet scoter** *M. fusca* (635; 21% of GB), **goldeneye** *Bucephala clangula* (3,004; 18% of GB population), **red-breasted merganser** *Mergus serrator* (670; 7% of GB), **oystercatcher** *Haematopus ostralegus* (7,846; 2% of GB), **ringed plover** *Charadrius hiaticula* (328; 1% of GB), **grey plover** *Pluvialis squatarola* (724; 2% of GB), **dunlin** *Calidris alpina* (9,514; 2% of GB), and **curlew** *Numenius arquata* (1,928; 2% of GB). The assemblage also includes large numbers of the following species: **wigeon** *Anas penelope* (2,139 [1991/2-95/96]), **mallard** *A. platyrhynchos* (2,564 [1991/2-95/96]) and **lapwing** *Vanellus vanellus* (4,148 [1991/2-95/96]).

Area: 6,313.72ha.

OS 1:50,000 sheets - 59, 65, 66 & 67

National Grid References: NS 865920 to NO 615075 and NT 678794

October 2001

Natura 2000

Scottish Natural Heritage

## Ramsar Citation

"Ramsar" Convention on Wetlands of International

Importance Especially as Waterfowl Habitat

RAMSAR CITATION

FOR PUBLIC ISSUE

FIRTH OF FORTH, CENTRAL, FIFE AND LOTHIAN (7UK154)

The **Firth of Forth Ramsar site** is a complex of estuarine and coastal habitats in south east Scotland stretching east from Alloa to the coasts of Fife and East Lothian. The site includes extensive invertebrate-rich intertidal flats and rocky shores, areas of saltmarsh, lagoons and sand dune. The site is underpinned by the Firth of Forth SSSI.

The Firth of Forth qualifies under **Criterion 3a** by regularly supporting in winter over 20,000 waterfowl. The site supported a 1993/94-97/98 winter peak mean of 95,000 waterfowl, comprising 45,000 wildfowl and 50,000 waders.

The Firth of Forth SPA qualifies under **Criterion 3c** by regularly supporting internationally important wintering populations (1993/94-97/98 winter peak means) of Slavonian grebe *Podiceps auritus* (84; 2% of NW Europe, 21% of GB), pink-footed goose *Anser brachyrhynchus* (10,852; 6% of Icelandic/Greenlandic and GB population), shelduck *Tadorna tadorna* (moulting flock of 4,509; 2% of NW European, 6% of GB), goldeneye *Bucephala clangula* (3,004; 1% of NW European, 18% of GB population), knot *Calidris canutus* (9,258; 3% of western European/Canadian and GB), redshank *Tringa totanus* (4,341; 3% of European/West African, 4% of GB), bar-tailed godwit *Limosa lapponica* (1,974; 2% of Western Europe, 4% of GB) and turnstone *Arenaria interpres* (860 individuals; 1% European and GB). It also qualifies by supporting an internationally important post-breeding concentration of sandwich tern *Sterna sandvicensis* (1,617, 1% of East Atlantic, 6% of GB).

Area: 6,313.72 ha.

OS 1:50,000 sheets - 59, 65, 66 & 67

National Grid References: NS 865920 to NO 615075 and NT 678794

Montreux Criteria

October 2001

Natura 2000

Scottish Natural Heritage

## Appendix B – Forth Islands SPA

### Conservation Objectives

To avoid deterioration of the habitats of the qualifying species (Table B.1) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site.
- Distribution of the species within site.
- Distribution and extent of habitats supporting the species.
- Structure, function and supporting processes of habitats supporting the species.
- No significant disturbance of the species.

**Table B.1 Qualifying Species:**

Qualifying Species	
Arctic tern ( <i>Sterna paradisaea</i> )	Lesser black-backed gull ( <i>Larus fuscus</i> )
Common tern ( <i>Sterna hirundo</i> )	Puffin ( <i>Fratercula arctica</i> )
Cormorant ( <i>Phalacrocorax carbo</i> )	Razorbill ( <i>Alca torda</i> )
Gannet ( <i>Morus bassanus</i> )	Roseate tern ( <i>Sterna dougallii</i> )
Guillemot ( <i>Uria aalge</i> )	Sandwich tern ( <i>Sterna sandvicensis</i> )
Herring gull ( <i>Larus argentatus</i> )	Shag ( <i>Phalacrocorax aristotelis</i> )
Kittiwake ( <i>Rissa tridactyla</i> )	

## Citation

### IMPORTANT NOTE

Citations on a number of UK SPAs are inaccurate subsequent to the national SPA review published in the “The UK SPA network; its scope and content”. It is intended that these citations will be amended once a formal process has been agreed.

The following citation has been identified as requiring amendment following the above review. Please bear this in mind when then using the information, particularly with regard to qualifying species.

For an up to date list of qualifying species for this site, please visit the UK SPA Network on the Joint Nature Conservancy Council (JNCC) website.

Alternatively, if you have any queries regarding Natura Designations please e-mail Rachel Haines at Scottish Natural Heritage. [Rachel.Haines@snh.gov.uk](mailto:Rachel.Haines@snh.gov.uk)

EC Directive 79/409 on the Conservation of Wild Birds  
CITATION FOR SPECIAL PROTECTION AREA (SPA)  
FORTH ISLANDS (UK9004171)  
INCLUDING THE EXTENSION OF LONG CRAIG ISLAND  
FIFE, CITY OF EDINBURGH, EAST LoTHIAN

**Site Description:**

The **Forth Islands Special Protection Area** (SPA) is comprised of a series of islands supporting the main seabird colonies in the Firth of Forth. The islands of Inchmickery, Isle of May, Fidra, The Lamb, Craigleith and Bass Rock were classified as the Forth Islands SPA on 25 April 1990. The extension to the Forth Islands SPA, classified on the 13th February 2004 consists of the island of Long Craig, which supports the largest colony of roseate tern in Scotland. The boundary of the extended Forth Islands SPA follows the boundaries of the following SSSIs: Long Craig, Inchmickery, Forth Islands, Bass Rock and the Isle of May.

**Qualifying Interest:**

The Forth Islands SPA qualifies under **Article 4.1** by regularly supporting breeding populations of European importance of the **Annex I** species; **Sandwich tern** *Sterna sandvicensis* (an average of 440 pairs, 3% of GB), **roseate tern** *Sterna dougallii* (an average of 8 pairs, 1997-2001; 13% of GB), **common tern** *Sterna hirundo* (an average of 334 pairs, 1997-2001; 3% of GB). The roseate tern colony is the most northerly of only six regular British colonies.

The Forth Islands SPA further qualifies under **Article 4.2** by regularly supporting internationally important populations of the migratory species; 21,600 **gannet** *Morus bassanus*, 2,400 **shag** *Phalacrocorax aristotelis*, 1,500 **lesser black-backed gull** *Larus fuscus*, 14,000 **puffin** *Fratercula arctica*, 200 **cormorant** *Phalacrocorax carbo*, 8,400 **kittiwake** *Rissa tridactyla*, 16,000 **guillemot** *Uria aalge* and 1,400 **razorbill** *Alca torda*.

Area: 106.01 ha

National Grid References: Long Craig NT125802, Inchmickery NT207805, Forth Islands NT535868, Bass Rock NT602873, Isle of May NT655955

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Scottish Natural Heritage

February 2004

## Appendix C - River Teith SAC

### Conservation Objectives

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species, including range of genetic types for salmon, as a viable component of the site
- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

**Table C.1 Qualifying Species**

Qualifying Species
Atlantic salmon ( <i>Salmo salar</i> )
Brook lamprey ( <i>Lampetra planeri</i> )
River lamprey ( <i>Lampetra fluviatilis</i> )
Sea lamprey ( <i>Petromyzon marinus</i> )

## Citation

### RIVER TEITH SPECIAL AREA OF CONSERVATION (SAC)

Designation date: 17 March 2005

Administrative area: Stirling

Qualifying Interests for which the site is designated:

<i>Lampetra fluviatilis</i>	River lamprey
<i>Lampetra planeri</i>	Brook lamprey
<i>Petromyzon marinus</i>	Sea lamprey
<i>Salmo salar</i>	Atlantic salmon

## Appendix D – Assessment Tables

Table D.1 Assessment Table – Corridor C Tunnel (Bored)

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Construction</b>					
Construction compounds and corridor	Habitat loss outside SPA	Small, reversible loss of agricultural fields associated with construction works and compounds. Agricultural fields close to the Forth are used by birds for feeding and roosting, but the species ecology and former reports (ERM 1996 and ERM 1997) illustrate a broad spatial spread of use of low local intensity.	Firth of Forth SPA	To maintain in the long term the distribution of habitats supporting the species.	No potential impact
Construction traffic movements	Disturbance to qualifying species	Vehicles would enter the tunnel at a distance from the Firth of Forth SPA such that the noise and vibration would have no impact on the qualifying species present.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	No potential impact
Boring operations	Noise and vibration	The northern and southern portals for the tunnel C are 1.5km and 2.5km from the SPA, respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue that could affect the conservation objectives.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	No potential impact
Construction of ventilation shafts and associated works	Disturbance to qualifying species	The construction of the tunnel ventilation shafts and associated works either side of the Forth, in close proximity to the SPA, has the potential to disturb birds feeding in the intertidal zone and terrestrial habitats within this area. The construction period for these structures is approximately 6 - 12 months and the zone of influence in relation to the SPA is minimal. Therefore, would be some short term negative impact of a limited magnitude, but this would not compromise the conservation objectives.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species <i>and</i> to ensure there is no long term significant disturbance of the species.	No potential impact
Potential access to tunnel within the Firth	Disturbance to qualifying species	<b>Construction of a caisson in order to access the tunnel in mid-firth may also constitute significant disturbance, impede migration and increases the potential for pollution events. However, the construction activities around the caisson are not likely to be of sufficient spatial or temporal magnitude to impede migrating fish. This area of the firth is currently subject to frequent river traffic, a level of noise and vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.</b>	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	Potential impact
	Changes to flow patterns and sedimentation				
	Pollution events				

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Disposal of spoil	Disturbance to qualifying species	The excavation of the tunnels would result in the creation of a vast amount of spoil. Currently it is proposed to remove the spoil by road, although no firm disposal site has been identified. Removal of spoil by road would equate to approximately 140,000 truck movements. The spoil would be removed via the tunnel portals, which are some distance from the SPA, so disturbance would not occur within the SPA, but may affect birds using agricultural fields near portals and haulage routes. The low numbers of birds disturbed, and the limited spatial impact zone would not cause an adverse effect.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	No potential impact
Tunnel boring activities near Midhope Burn	Alteration to hydrology	There are former mine workings the vicinity of the Midhope Burn and shores of the Forth. Boring activities could result in the mobilisation of potential contaminants from these old mine workings and also lead to changes to local hydrology. This may lead to increased contamination of the Midhope Burn, and consequently the Forth and therefore there is a potential for deterioration of intertidal and open water habitats. This has potential for long term impacts. There is currently a limited understanding of these mine tunnels and their relation to groundwater and contamination.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	Potential impact.
	Release of contaminants from mine workings				
<b>Operation</b>					
Emissions from ventilation shafts	Contamination	The ventilation shafts would be a concentrated source of emissions to air for the lifespan of the tunnel estimated to be 120 years potentially leading to a local build up of contaminants. This, in turn could reduce invertebrate prey availability in the nearby mudflats, or contaminate invertebrate prey that would be eaten by SPA birds and potentially impacting on ecological fitness. The spatial spread, ecotoxicity and bioaccumulation of contaminants in relation to adverse effect at this stage cannot be ascertained.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	Potential impact
<b>Construction</b>					

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Boring operations	Noise and vibration	The northern and southern portals for the tunnel C are 1.5km and 2.5km from the SPA, respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue that could affect the affect migratory fish within the open water of the Forth.	River Teith SAC	To avoid significant disturbance to the qualifying species.	No potential impact
Access to tunnel within the Firth	Disturbance to qualifying species	<b>Construction of a caisson in order to access the tunnel in mid-firth may also constitute significant disturbance, impede migration and increases the potential for pollution events. However, the construction activities around the caisson are not likely to be of sufficient spatial or temporal magnitude to impede migrating fish. This area of the firth is currently subject to frequent river traffic, a level of noise and vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.</b>	River Teith SAC	To avoid significant disturbance to the qualifying species.	Potential impact
	Changes to flow patterns and sedimentation				
	Pollution events				
<b>Operation</b>					
Traffic	Noise and vibration	The northern and southern portals for the tunnel C are 1.5km and 2.5km from the SPA, respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue within the open water of the Forth	River Teith SAC	To avoid significant disturbance to the qualifying species <i>and</i> to ensure there is no long term significant disturbance of the species.	No potential impact
<b>Construction and Operation</b>					
General construction activities and operation	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. During operation the potential exists for run off containing pollutants e.g. fuels, oils, lubricants and salt to enter surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable, however the distance from the SPA boundary, dilution factor of the Forth, and limited amount of foraging time of the qualifying species spent within the inner Forth do not compromise the conservation objectives.	Forth Islands SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact

Table D.2 Assessment Table – Corridor C2 Tunnel (Immersed Tube)

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Construction</b>					
Cut and cover through intertidal zone	Loss of, and/or alteration to intertidal habitat within the SPA and intertidal habitat outside SPA used by qualifying species.	Construction through the intertidal zone would be a cut and cover method. The tunnel alignment avoids the SPA, however there is a risk that the construction corridor could incidentally impact on the SPA. Disturbance to an intact mudflat may then cause further erosion and/or sedimentation in a broader spatial scale leading to short term damage, or permanent loss of functioning habitat. The construction area is in proximity to Blackness Bay. This area is used by high numbers of feeding and roosting birds. WeBS low tide counts indicates significant numbers of shelduck, bar tailed godwit, redshank, great crested grebe, eider, oystercatcher, curlew, red breasted merganser, wigeon and dunlin and so the area is therefore of great sensitivity. The unpredictability of the effects do not facilitate an assessment of the scale or duration of impact, so implications for avoidance of adverse effect are not certain.	Firth of Forth SPA	To avoid deterioration of habitats of the qualifying species <i>and</i> , to ensure that in the long term, the structure, function and supporting processes of habitats supporting the species, <i>and</i> to maintain in the long term the distribution and extent of habitats supporting the species.	Potential impact
Installation of immersed tube within sub-tidal zone	Changes to flow and sedimentation patterns	The installation of the immersed tube would involve the construction of a coffer dam in the mid Firth. A trench would be excavated and the immersed tube tunnel would be laid within the trench and recovered. This would involve temporary (22 months) significant alterations to the flow of water within the firth. The change in flow and disturbance of the deep sediments could lead to changes to the normal patterns of erosion and deposition. This has implications for the loss of intertidal habitats, and deterioration by smothering of invertebrate populations and <i>Zostera</i> beds. The efficacy of computer modelling of sedimentation processes to accurately predict the scale and magnitude of this impact is considered poor, so an assessment of no adverse effect cannot be concluded at this time.	Firth of Forth SPA	To avoid deterioration of habitats of the qualifying species <i>and</i> , to ensure that in the long term, the structure, function and supporting processes of habitats supporting the species, <i>and</i> to maintain in the long term the distribution and extent of habitats supporting the species.	Potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone	Mobilisation of contaminants	There could be mobilisation of toxic contaminants which could be introduced into the food chain impairing fitness of birds and depressing invertebrate populations which the qualifying species feed upon.	Firth of Forth SPA	To avoid deterioration of habitats of the qualifying species <i>and</i> , to ensure that in the long term, the structure, function and supporting processes of habitats supporting the species, <i>and</i> to maintain in the long term the distribution and extent of habitats supporting the species	Potential impact
Cut and cover through intertidal zone and installation of immersed tube in the sub-tidal zone	Disturbance to qualifying species	The construction activities, specifically the cut and cover operations and the barge movements associated with the immersed tunnel section, would disturb birds in intertidal habitats within the SPA, and outwith the SPA. The construction area is in proximity to Blackness Bay. This area is used by high numbers of feeding and roosting birds. WeBS low tide counts indicates significant numbers of shelduck, bar tailed godwit, redshank, great crested grebe, eider, oystercatcher, curlew, red breasted merganser, wigeon and dunlin and so the area is therefore of great sensitivity. This disturbance would be over a period of 6 years in an area of high bird usage (Blackness Bay ).	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	Potential impact
Tunnel boring activities near Midhope Burn	Alteration to hydrology	There are former mine workings the vicinity of the Midhope Burn and shores of the Forth. Boring activities could result in the mobilisation of potential contaminants from these old mine workings and also lead to changes to local hydrology. This may increase contamination levels of the Midhope Burn, and consequently the Forth and therefore there is a potential for deterioration of intertidal habitats. This has potential for long term impacts. There is currently a limited understanding of these mine tunnels and their relation to groundwater and contamination.	Firth of Forth SPA	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact.
	Release of contaminants from mine workings				

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Construction compounds and corridor	Habitat loss outside SPA	Small, reversible loss of agricultural fields associated with construction. Agricultural fields close to the Forth are used by birds for feeding and roosting, but the species ecology and former reports (ERM 1996 and ERM 1997) illustrate a broad spatial spread of use of low local intensity.	Firth of Forth SPA	Distribution of habitats supporting the species	No potential impact
Construction traffic movements	Disturbance of qualifying species	Vehicles would enter the tunnel at a suitable distance from the Firth of Forth SPA such that the noise and vibration would have no impact on the qualifying species present. The noise and vibration levels caused by normal vehicle movement through the tunnel would be negligible, and below the existing noise levels of traffic on the current bridge.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	No potential impact
Construction of ventilation shafts and associated works	Disturbance of qualifying species	The construction of the tunnel ventilation shafts and associated works either side of the Forth, in close proximity to the SPA, has the potential to disturb birds feeding in the intertidal zone and terrestrial habitats within this area. The construction period for these structures is approximately 6 - 12 months and the zone of influence in relation to the SPA is minimal. Therefore, would be some short term negative impact of a limited magnitude.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	No potential impact
Disposal of spoil	Disturbance of qualifying species	The excavation of immersed tunnel C would result in the creation of a vast amount of spoil. Currently it is proposed to remove the spoil by road, although no firm disposal site has been identified. Removal of spoil by road would equate to approximately 140,000 truck movements. The spoil would be removed via the tunnel portals, which are some distance from the SPA, so disturbance would not occur within the SPA, but may affect birds using agricultural fields near portals and haulage routes. The low numbers of birds disturbed, and the limited spatial impact zone would not cause adverse effect.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	No potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
General construction activities	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable, however the distance from the SPA boundary, dilution factor of the Forth, and limited amount of foraging time of the qualifying species spent within the inner Forth do not compromise the conservation objectives.	Firth of Forth SPA	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact
<b>Operation</b>					
Emissions from ventilation shafts	Contamination	The ventilation shafts would be a concentrated source of emissions to air for the lifespan of the tunnel estimated to be 120 years potentially leading to a local build up of contaminants. This, in turn could reduce invertebrate prey availability in the nearby mudflats, or contaminate invertebrate prey that would be eaten by SPA birds and affect ecological fitness. The spatial spread, ecotoxicity and bioaccumulation of contaminants in relation to adverse effect at this stage cannot be predicted.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	Potential impact
Operation of northern portal	Disturbance	The northern portal is in close proximity to the SPA, however it is recognised that predictable traffic noise does not interfere with feeding and roosting patterns.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species <i>and</i> to ensure there is no long term significant disturbance of the species.	No potential impact
<b>Construction</b>					
Cut and cover through intertidal zone and installation of immersed tube within sub-tidal zone	Increase in turbidity, release of contaminants and barrier effects	The increase in sediment load, and changes to sedimentation patterns may increase the turbidity of the Forth leading to stress on migrating fish. In addition, contaminants that may be present in sediments may be mobilised into the water column. Also, the coffer dams may act as physical barriers.	River Teith SAC	To ensure in the long term, the populations of the qualifying species, including range of genetic types for salmon, as a viable component of the site.	Potential impact
Tunnel boring activities near Midhope Burn	Alteration to hydrology	There are former mine workings the vicinity of the Midhope Burn and shores of the Forth. Boring activities could result in the mobilisation of potential contaminants and also lead to changes to local hydrology. This could potentially lead to increased	River Teith SAC	To ensure in the long term, the populations of the qualifying species, including range of genetic types for salmon, as a viable component of the site.	No potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
	Release of contaminants from mine workings	contamination of the Midhope Burn, and consequently the Forth. This may cause toxicity within the food chain and impair the fitness and/or breeding capacity of migratory fish. However, the limited time that migratory fish spend in the Forth is considered too short for toxic effects to impair fitness.			

Table D.3 Assessment Table – Corridor D Bridge

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Construction</b>					
Construction	Habitat loss within SPA	There will be no loss of habitat within the SPA	Firth of Forth SPA	Distribution of habitats supporting the species	No potential impact
	Habitat loss outwith SPA	Construction of the bridge approaches would result in a limited amount of habitat loss in close proximity to the Firth of Forth SPA. The arable land south of and contiguous with the SPA is abundant in the area and will be used in winter by several qualifying species of the Firth of Forth SPA for foraging, roosting, loafing and feeding. However, the birds move around to accommodate agricultural operations and changing agriculture in a very broad spatial scale, so the temporary loss of habitat for construction and the permanent loss due to connecting routes is very small in context of similar available habitat.		Distribution of habitats supporting the species	No potential impact
Construction of bridge and approaches	Disturbance of qualifying species (shorebirds)	<b>Construction activities have the potential to disturb and displace qualifying species from areas of the SPA close to the bridge alignment, particularly at Port Edgar, and also species that are using other areas outwith the SPA, such as intertidal areas, open water and/or fields close to the alignment. The main cause of disturbance is likely to be construction of the foundations and towers and viaduct supports where piling is required. Workforce, equipment and material will initially have to be brought to construction areas by boat, which may disturb birds feeding or loafing in open water areas. Barge movements may disturb qualifying species, the main bridge deck sections will be pre-fabricated and moved into place by barge, then hoisted into position. Although the Firth of Forth is a busy navigational channel, an increase in the number of boat movements could have an impact on the usual habits of the bird species present. WeBS (Wetland Bird Survey) Low tide counts from winter 03/04 indicate that the construction corridor does not contain significant numbers of birds, however the Setting Forth studies gave some importance to the shore bordering the Hopetoun Estate. The WeBS core counts show that the main assemblage of</b>	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	Potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
		qualifying species in the mid Firth occur at Blackness Bay (3.5km distant), Inverkeithing Bay (2.8km distant) and at Ironmill Bay( 6km distant) These distances, together with the topography of the shore do not indicate significant disturbance of these areas. Disturbance is therefore assessed in relation to birds along the Hopetoun shore, Port Edgar and open water. The current level of understanding does not facilitate an assessment without uncertainty. Therefore the conclusion is potential impact.			
Construction of bridge and approaches	Disturbance of qualifying species (sandwich terns)	Sandwich terns on passage are a qualifying species. Current field studies have found that they currently roost at various locations, including on Long Craig island. Significant numbers (up to 500) use Long Craig Island as a roosting site overnight, and lesser numbers during the day. The tyre reef at Port Edgar is also used, to a lesser degree.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	Potential impact
Construction traffic movements	Disturbance of qualifying species	Construction traffic will be required during works to construct the road infrastructure, access roads and approach viaducts for the bridge. These traffic movements are unlikely to enter or disturb areas used by qualifying species of the SPA.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	No potential impact
Construction activities in the Firth	Severance of habitat	Reviews and field studies (Symonds F.L and Langslow D.R 1984) using colour ringed birds show that most species tend to remain in one area, with small movements between roosting and feeding sites. It was found that there was little movement of birds between the inner and outer Firth. Some species such as knot are more dynamic, moving around the firth and also to and from other wintering areas.	Firth of Forth SPA	To maintain in the long term the distribution of species within the site	No potential impact
General construction activities	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact
Construction of pillars in open water	Changes to flow and sedimentation	Construction methods have not yet been determined. However, there is the potential for construction methods to alter temporarily the local current flow and sedimentation regime within the firth.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Operation</b>					
Bridge structure	Alteration of habitat in SPA	The bridge will cross the SPA, but there is no intact intertidal habitat that could be impacted by shading and at a height of 45m, the shading effects would be minimal	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact
Traffic using bridge	Disturbance of qualifying species	There is potential for increasing traffic noise from an additional bridge which could lead to avoidance of the area by birds during their daily activities. However, Studies (Avian Ecology Unit, University of Stirling 1994) looked at eight estuarine crossings in Scotland (including the Forth road bridge) and these have illustrated that high level bridges do not negatively impact on local bird movements, feeding patterns or roosting sites.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species and to ensure there is no long term significant disturbance of the species.	No potential impact
Cumulative impact of multiple crossings	Disturbance of qualifying species	There is potential for cumulative impacts of more than one crossing in proximity. Studies (Avian Ecology Unit, University of Stirling 1994) illustrate that multiple crossings at Montrose Basin did not have negative impact on shorebirds. A threshold of less than approximately 200m between parallel crossings was suggested for impacts to be felt from bridges of differing designs. The closest point bridge D is to the Forth Road Bridge is approximately 200m, but this is on the north shore where bird numbers are lowest. The distance on the southern shore is 850m. Cumulative impact is therefore not viewed as an issue.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species and to ensure there is no long term significant disturbance of the species.	No potential impact
General operation	Pollution	<b>During operation the potential exists for run off containing pollutants e.g. fuels, oils, lubricants and salt to enter surface waters draining into the Firth of Forth. Maintenance activities could also result in pollution of surface waters. The risk and uncertainty associated with pollution events without mitigation is unpredictable.</b>	Firth of Forth SPA	<b>To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species</b>	<b>Potential impact</b>
Lighting of new bridge	Light pollution	Light spillage onto Firth of Forth SPA and habitats used by qualifying species, causing significant increase from background levels may alter diurnal behavioural patterns. Given the relatively narrow intertidal zone at the crossing corridor, the background light spill from towns and the lack of significant night roost sites, the conservation objectives would not be compromised.	Firth of Forth SPA	To maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Pillar structures in Forth	Changes to flow and sedimentation	There will be no loss of habitat within the SPA, however if a cable stay bridge option were to be adopted, a bridge support tower would be located on Beamer Rock and at two other locations. Unless appropriately designed, the pillars may alter local currents and potentially displace or reduce feeding areas, particularly around Beamer Rock.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact
<b>Construction</b>					
Construction in the Firth	Disturbance of qualifying species	There is the potential for construction activities to disturb nesting birds on Long Craig island and their feeding areas in the open water, particularly in the tidal races around Beamer Rock. Qualifying species breed on Long Craig island, but the island also functions as a nursery roost for birds that have bred elsewhere in the firth. Pile driving and barge movements are the two activities with the greatest potential for disturbance. These sources of disturbance are only used in the construction of the tower supports, the supports of the approach viaducts and when the pre fabricated bridge deck sections are being moved by barge and hoisted into place. Impacts on breeding birds potentially hold more significance for the population if there is lowered recruitment, however these species frequently breed in industrial areas such as docks and harbours, and feed in close proximity to industry. The species have therefore a demonstrated ability to habituate to disturbance, however there is some uncertainty over the impact of pile driving and barge movements close to the island, so adverse effect cannot be ruled out.	Forth Islands SPA	To avoid significant disturbance to the qualifying species	Potential impact
General construction activities	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable.	Forth Islands SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
Construction of pillars on Beamer Rock	Loss of habitat used by qualifying species	There will be no loss of habitat within the SPA, however if a cable stay bridge option were to be adopted, a bridge support tower would be located on Beamer Rock. Whilst outside the Forth Islands SPA, Beamer Rock does provide a small area of resting habitat for terns, and these terns are known to feed in races adjacent to Beamer Rock, however numbers present on Beamer Rock are low. (S. Dixon, pers. comm.).	Forth Islands SPA	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact
<b>Operation</b>					
General operation	Pollution	During operation the potential exists for run off containing pollutants, e.g. fuels, oils, lubricants and salt to enter surface waters draining into the Firth of Forth. Maintenance activities could also result in pollution of surface waters. The risk and uncertainty associated with pollution events without mitigation is unpredictable.	Forth Islands SPA	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species	Potential impact
Traffic	Noise Vibration	There is potential for increasing traffic noise from an additional bridge which could lead to avoidance of the area by birds during their daily activities. However, observations of roosting and feeding birds indicate that they are habituated to the existing Forth Road Bridge and this is likely to be the case for the new crossing.	Forth Islands SPA	To avoid significant disturbance to the qualifying species	No potential impact
<b>Construction</b>					
Construction of bridge pillars and supports approach viaduct	Vibration	Pile driving and other construction techniques used in the foundations of the bridge supports may impede migration of qualifying species.	River Teith SAC	To avoid significant disturbance to the qualifying species	Potential impact
General construction	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable.	River Teith SAC	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	Potential impact

Table D.4 Assessment Table – Corridor D Tunnel (Bored)

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Construction</b>					
Construction compounds and corridor	Habitat loss outside SPA	Small, reversible loss of agricultural fields associated with construction works and compounds. Agricultural fields close to the Forth are used by birds for feeding and roosting, but the species ecology and former reports (ERM 1996 and ERM 1997) illustrate a broad spatial spread of use of low local intensity.	Firth of Forth SPA	To maintain in the long term the distribution of habitats supporting the species.	No potential impact
Construction traffic movements	Disturbance to qualifying species	Vehicles would enter the tunnel at a distance from the Firth of Forth SPA such that the noise and vibration would have no impact on the qualifying species present.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species	No potential impact
Boring operations	Noise and vibration	The northern and southern portals for Tunnel D are 1.2km and 2.3km from the SPA respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue that could affect the conservation objectives.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	No potential impact
Construction of ventilation shafts and associated works	Disturbance to qualifying species	The construction of the tunnel ventilation shafts and associated works either side of the Forth, in close proximity to the SPA, has the potential to disturb birds feeding in the intertidal zone and terrestrial habitats within this area. The construction period for these structures is approximately 6 - 12 months and the zone of influence in relation to the SPA is minimal. Therefore, would be some short term negative impact of a limited magnitude, but this would not compromise the conservation objectives.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species <i>and</i> to ensure there is no long term significant disturbance of the species.	No potential impact
Access to tunnel within the Firth	Disturbance to qualifying species	<b>Construction of a caisson in order to access the tunnel in mid-firth may also constitute significant disturbance, impede migration and increases the potential for pollution events. However, the construction activities around the caisson are not likely to be of sufficient spatial or temporal magnitude to impede migrating fish. This area of</b>	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	Potential impact
	Changes to flow patterns and sedimentation				

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
	Pollution events.	<b>the firth is currently subject to frequent river traffic, a level of noise and vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.</b>			
Disposal of spoil	Disturbance to qualifying species	The excavation of the tunnels would result in the creation of a vast amount of spoil. Currently it is proposed to remove the spoil by road, although no firm disposal site has been identified. Removal of spoil by road would equate to approximately 140,000 truck movements. The spoil would be removed via the tunnel portals, which are some distance from the SPA, so disturbance would not occur within the SPA, but may affect birds using agricultural fields near portals and haulage routes. The low numbers of birds disturbed, and the limited spatial impact zone would not cause adverse effect.	Firth of Forth SPA	To avoid significant disturbance to the qualifying species.	No potential impact
General construction activities	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. This may affect the intertidal habitats and the open water. The risk associated with pollution events without mitigation is unpredictable. Additionally, the scale and magnitude of any events and persistence of affects is also unpredictable.	Firth of Forth SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	No potential impact
<b>Operation</b>					
Emissions from ventilation shafts	Contamination	<b>The ventilation shafts would be a concentrated source of emissions to air for the lifespan of the tunnel estimated to be 120 years potentially leading to a local build up of contaminants. This, in turn could reduce invertebrate prey availability in the nearby mudflats, or contaminate invertebrate prey that would be eaten by SPA birds and potentially affect ecological fitness. The spatial spread, ecotoxicity and bioaccumulation of contaminants in relation to adverse effect at this stage cannot be ascertained.</b>	Firth of Forth SPA	<b>To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species.</b>	<b>Potential impact</b>
<b>Construction and Operation</b>					

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
General construction activities and operation	Pollution events	The potential exists during construction for pollution incidents and contamination of surface waters draining into the Firth of Forth. During operation the potential exists for run off containing pollutants e.g. fuels, oils, lubricants and salt to enter surface waters draining into the Firth of Forth. The risk and uncertainty associated with pollution events without mitigation is unpredictable, however the distance from the SPA boundary, dilution factor of the Forth, and limited amount of foraging time of the qualifying species spent within the inner Forth do not compromise the conservation objectives.	Forth Islands SPA	To avoid deterioration of habitats <i>and</i> to maintain in the long term the structure, function and supporting processes of habitats supporting the species	No potential impact
Access to tunnel within the Firth	Pollution events	<b>Construction of a caisson in order to access the tunnel in mid-firth may also constitute significant disturbance, impede migration and increases the potential for pollution events. However, the construction activities around the caisson are not likely to be of sufficient spatial or temporal magnitude to impede migrating fish. This area of the firth is currently subject to frequent river traffic, a level of noise and vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.</b>	Forth Islands SPA	To avoid deterioration of habitats and to maintain in the long term the structure, function and supporting processes of habitats supporting the species.	Potential impact
	Disturbance			To avoid significant disturbance to the qualifying species	
<b>Construction</b>					
Boring operations	Noise and vibration	The northern and southern portals for Tunnel D are 1.2km and 2.3km from the SPA respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue that could affect migratory fish within the open water of the Forth.	River Teith SAC	To avoid significant disturbance to the qualifying species.	No potential impact
Access to tunnel within the Firth	Disturbance to qualifying species	<b>Construction of a caisson in order to access the tunnel in mid-firth may also constitute significant disturbance and impede migration. However, the construction activities around the caisson are not likely to be of sufficient spatial or temporal magnitude to impede migrating fish. This area of the firth is currently subject to frequent river traffic, a level of noise and vibration from the existing bridges, and any migrating fish can avoid such obstacles in time and space.</b>	River Teith SAC	To avoid significant disturbance to the qualifying species.	Potential impact

Source of Impact	Type of Impact	Effects	Affected Natura 2000 Site	Relevant Conservation Objective(s)	Assessment
<b>Operation</b>					
Traffic	Noise and vibration	The northern and southern portals for Tunnel D are 1.2km and 2.3km from the SPA respectively. The depth beneath the Forth is considerable (approximately 24m) at the point the tunnel is below the bed of the Forth. Noise and vibration is therefore not a disturbance issue that could affect the conservation objectives.	River Teith SAC	To avoid significant disturbance to the qualifying species <i>and</i> to ensure there is no long term significant disturbance of the species.	No potential impact