10 Terrestrial and Freshwater Ecology

This chapter presents an assessment of the impacts of the proposed scheme on terrestrial and freshwater species and habitats. It was carried out in accordance with all relevant legislation and guidelines with the approach based on Design Manual for Roads and Bridges (DMRB) and Institute of Ecology and Environmental Management (IEEM) guidance.

Arable land and other types of farmland comprise the majority habitat types within the terrestrial and freshwater ecology study area together with smaller areas of semi-natural habitats represented by wetland, grassland, woodland and freshwater habitats.

Potential impacts will be mitigated through the application of best practice guidance together with specific measures such as the creation/enhancement of habitats through replacement/additional planting, translocation of priority species, provision of replacement otter holt, badger setts, bat boxes, provision of mammal underpasses and fencing and ensuring that culverts and watercourses are constructed in accordance with best practice guidelines.

Significant residual impacts are predicted in the short-term for bats due to habitat fragmentation and for otter along the River Almond, Swine Burn and Niddry Burn during construction due to disturbance and severance of commuting routes through temporary habitat loss. There are no predicted significant negative residual impacts on any other terrestrial or freshwater receptors during construction or operation. Positive significant residual impacts are predicted due to the provision of river habitat along the Swine Burn where the proposed realignment would create improved morphological and habitat biodiversity. Similarly, significant positive residual impacts are predicted at North and South Queensferry due to the provision of a third crossing over the Firth of Forth which will facilitate movement of bats.

10.1 Introduction

10.1.1 This chapter presents an ecological impact assessment of the proposed scheme on terrestrial and freshwater species and habitats present within the study area. The chapter is supported by the following appendices, which are cross-referenced in the text where relevant:

- Appendix A10.2: Legislation, Conservation Status and Biology;
- Appendix A10.3: Detailed Terrestrial and Freshwater Ecology Methods;
- Appendix A10.4: Detailed Terrestrial and Freshwater Ecological Baseline Information;
- Appendix A10.5: Confidential Badger and Otter Information;
- Appendix A10.6: Evaluation of Terrestrial and Freshwater Ecological Receptors; and
- Appendix A10.7: Terrestrial and Freshwater Ecology: Impacts and Mitigation.

10.1.2 In addition to the above, Appendix A10.1 is provided which lists key members of the ecology team. Appendix A10.5 is not provided with the ES due to risk of badger baiting/snaring or disturbance of otter resting places, but is submitted as a confidential report to SNH and Scottish Parliament.

10.1.3 Ecology is defined as the scientific study of the processes that influence the distribution and abundance of organisms, and the interactions between those organisms and their environment. Nature conservation is the maintenance of viable populations of fauna and flora and the habitats and communities to which they belong.

10.1.4 The objectives of nature conservation are:

- maintenance of diversity and landscape character, including wildlife communities and important geological and physical features; and
- maintenance of viable populations of native species throughout their traditional distribution range, and the improvement of the status of rare or endangered species.

10.1.5 Impacts on species and habitats within the Firth of Forth are described separately in Chapter 11 (Estuarine Ecology).

10.1.6 Reports to Inform an Appropriate Assessment (RIAAs) of impacts to the Forth Islands Special Protection Area (SPA) (including Imperial Dock Lock, Leith SPA), the Firth of Forth SPA and the River Teith Special Area of Conservation (SAC) have been prepared and submitted for review to SNH. Potential impacts on these sites are considered further in Chapter 11 (Estuarine Ecology).

Aims

10.1.7 The aims of this assessment are to:

- identify the presence and status of habitats, flora and fauna (ecological receptors) of conservation significance within the study area through consultation, desk-based research and field surveys;
- evaluate the importance of ecological receptors in terms of their nature conservation value;
- identify anticipated potential impacts;
- present potential mitigation measures to ameliorate the identified impacts; and
- assess the residual impacts following the successful implementation of mitigation.

10.2 Approach and Methods

Overview of Approach

10.2.1 The assessment of terrestrial and freshwater ecology was undertaken in accordance with the requirements of DMRB Volume 11, Section 3, Part 4: Ecology and Nature Conservation (Highways Agency et al., 1993) and with cognisance of other relevant guidance such as Scottish Transport Appraisal Guidance (STAG) (Transport Scotland, 2008), best practice guidance for ecological assessment including the Guidelines for Ecological Impact Assessment in the United Kingdom (IEEM, 2006) and SNH guidance on EIA (SNH, 2005). Whilst the principles and approach of IEEM have been followed as far as possible, standard impact assessment terms have been used where appropriate to provide consistency with the other assessments reported in this ES.

10.2.2 IEEM (2006) provides a framework for identifying which ecological features or resources (receptors) within the study area are both of sufficient value to be included in the assessment and vulnerable to significant impacts arising from a project, as follows:

- identification of ecological receptors;
- identification of key attributes of the receptor;
- identification of the level of importance of the receptor;
- identification of legal protection offered to the receptor;
- identification of activities in the proposal that may impact on the receptors;
- characterisation of the potential impacts;
- assessing the significance of the impact to the nature conservation of the receptor;
- assessing the legal implications of actuating the impact;
- outlining the proposed mitigation measures; and
- assessing the residual impacts of the proposals.

10.2.3 The ecological impact assessment of the proposed scheme has been carried out in accordance with the above guidelines, with the following exceptions or clarifications to ensure consistency with this ES and with DMRB guidance:

- the Zone of Influence referred to in IEEM guidelines has been defined in accordance with DMRB study area guidelines;

- the definition of threshold values to determine ecological receptors to be included within the scoping of ecological surveys and assessment was not used. The scope was determined during consultation with SNH and SEPA, and also informed by DMRB guidance and information obtained during the general EIA consultation (Chapter 6: Consultation and Scoping); and
- the legal implications of the proposed scheme in terms of ecology and nature conservation are considered in Appendix A10.2, and assessment of policy compliance is provided in Chapter 20 (Policies and Plans).

Consultation and Literature Review

10.2.4 Statutory consultees and other relevant organisations were consulted with regard to ecology and nature conservation to obtain data and to identify key issues. Responses are summarised in Appendix A6.3, Chapter 6 (Scoping and Consultation). The scope of the ecology assessment, which included field survey methods, was agreed through consultation with SNH throughout 2008 & 2009. Consultation with SNH identified the following concerns, which were considered and addressed in the assessment and the proposed mitigation:

- the need to provide detailed mitigation for European Protected Species; and
- potential loss of sub-optimal great crested newts terrestrial habitat.

10.2.5 On the subject of St. Margaret's Marsh SSSI, SNH advised:

- the central/western area of this site is of higher value than the area south of the sewage treatment works;
- the treatment of run-off will be a key consideration; and
- improved management of the existing habitat is preferable to habitat replacement by creation outwith the existing site boundary.

10.2.6 Where information was provided by consultees regarding baseline conditions, the information is summarised under the relevant receptor heading within the baseline section of this chapter (Section 10.3: Baseline Conditions) and provided in full within Appendix A10.4.

10.2.7 The UK Biodiversity Action Plan (BAP), as set out in the Biodiversity Steering Group Report (Vol. 2; 1995) and the Edinburgh, Fife and West Lothian Local BAPs (LBAPs) were used to characterise the distribution of nationally and locally important habitats and species within the study area.

10.2.8 A detailed review was undertaken of relevant literature, including internet sources, to characterise species and habitats within the study area with regards to abundance, distribution and susceptibility to impacts, in particular, reference to the following was made:

- Setting Forth: Environmental Statement (ERM, 1996).
- Edinburgh Airport Rail Link, Environmental Statement (ERM, 2005).
- Background Information on Marine Mammals for Strategic Environmental Assessment 7. Technical Report. (Sea Mammal Research Unit, 2006).
- Forth Replacement Crossing Ecological Scoping Report. (Jacobs Arup, 2008b).
- Forth Replacement Crossing Study St. Margaret's Marsh Special Site of Scientific Interest (SSSI) Breeding Bird Survey Report. (Jacobs et al., 2007a).
- Strategic Transport Projects Review, Report 4, Appendix D – Environment. (Jacobs et al., 2007b).

Field Surveys

Study Area

10.2.9 The study area for each terrestrial and freshwater ecological receptor typically extended to 500m to each side of the proposed scheme (i.e. a 1km wide study area) which is consistent with best practice guidance (Highways Agency et al., 1993). Any variations to this are shown on Figures 10.1-10.11 and generally related to the need to assess identified receptors beyond the 500m study area, or refinement of junctions or route alignment of the proposed scheme during assessment.

Survey Methods

10.2.10 Survey methods followed IEEM best practice guidance (IEEM, 2008) and were agreed with SNH through consultation (Jacobs Arup, 2008b). Full survey methods used to establish baseline conditions on which to inform a subsequent evaluation and ecological impact assessment, are presented in Appendix A10.3.

10.2.11 Detailed ecological surveys were undertaken by Jacobs Arup for the following ecological habitats and species:

- terrestrial habitats including National Vegetation Classification (NVC) undertaken between March and August 2008 and in October 2008;
- badger – undertaken in March, April, October 2008 and January and May 2009;
- bats – undertaken between April 2008 and February 2009;
- terrestrial breeding birds – undertaken in April and June 2008;
- terrestrial wintering birds – undertaken in November and December 2008 and February 2009;
- otter – undertaken in May and June 2008;
- water vole – undertaken in May, June, and October 2008;
- red squirrel – undertaken between June and August 2008;
- amphibians – undertaken in March, April and June 2008;
- reptiles – undertaken in July, August and September 2008;
- terrestrial invertebrates – habitat quality assessments undertaken in August and September 2008;
- river habitat – undertaken in July and August 2008;
- aquatic macroinvertebrates – undertaken in April and September 2008;
- freshwater macrophytes – undertaken in July and September 2008; and
- freshwater fish – undertaken between March and June 2008.

10.2.12 The surveys and assessment were carried out and reviewed by experienced Jacobs Arup ecologists, holding survey licences (these are required for certain protected species) where necessary. The areas of expertise, names and qualifications of the ecology team are provided in Appendix A10.1.

10.2.13 Full details of the legislative context for protected habitats and species are provided in Appendix A10.2.

Criteria Used to Evaluate Ecological Receptors

10.2.14 In undertaking the evaluation of baseline conditions, the following definitions are used:

- an ecological receptor is the habitat, species or community within the receiving environment that might be influenced by the change; and
- the value or sensitivity of the ecological receptor refers to its importance in terms of its nature conservation value and susceptibility to impact.

10.2.15 The value or sensitivity of an ecological receptor was determined by consultation, literature review and desk-based studies, field survey information, legal protection/conservation status and professional judgement. Reference was also made to the Ratcliffe Criteria, where applicable, as used in the selection of biological Sites of Special Scientific Interest (SSSIs) (Ratcliffe, 1977).

10.2.16 This approach meets IEEM guidance, which advises that the determination of ecological value should involve professional judgement informed by available guidance and information, together with advice from experts who know the locality of the project and the distribution and status of the species or features that are being considered.

10.2.17 Ecological receptors were assigned a value using the framework shown in Table 10.1.

Table 10.1: Criteria Used to Evaluate Ecological Receptors

Ecological Importance	Attributes of Ecological Receptor
International European	**Habitats** • An internationally designated site or candidate site i.e. SPA, provisional SPA (pSPA), SAC, candidate SAC (cSAC), Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site or an area which meets the published selection criteria for such designation. • A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat that are essential to maintain the viability of a larger whole. • Any river classified as excellent A1 (SEPA), not at significant risk– 2.a and 2.b Water Framework Directive (WFD) and known to support a substantial salmonid population. • Any river with a Habitat Modification Score (HMS) indicating that it is Pristine or Semi-Natural (and within a internationally designated site). **Species** • Any regularly occurring population of an internationally important species, which is threatened or rare in the UK, i.e. a UK Red List species or listed as occurring in 15 or fewer 10km squares in the UK (categories 1 and 2 in the UKBAP) or of uncertain conservation status or of global conservation concern in the UKBAP. • A regularly occurring, nationally significant population/number of any internationally important species.
National Scottish	**Habitats** • A nationally designated site i.e. SSSI, National Nature Reserve (NNR), Marine Nature Reserve, or a discrete area, which meets the published selection criteria for national designation (e.g. SSSI selection guidelines). • A viable area of a priority habitat identified in the UKBAP, or of smaller areas of such habitat that are essential to maintain the viability of a larger whole. • Any river classified as excellent A1 (SEPA), not at significant risk– 2.a and 2.b (WFD) and likely to support a substantial salmonid population. • Any river with a HMS indicating that it is Pristine or Semi-Natural. • Habitat of high value based on its ecological function. **Species** • A regularly occurring, regionally or county significant population/number of an internationally/nationally important species. • Any regularly occurring population of a nationally important species which is threatened or rare in the region or county (see LBAP). • A species identified as a priority species listed in the UKBAP. • A species listed on 1994 or 2001 International Union for the Conservation of Nature (IUCN) criteria as at least Near Threatened or at least Rare on the Red List based on pre-1994 IUCN guidelines; species listed as Nationally Scarce, Nationally Notable A or Notable B (rare and scarce species not based on IUCN criteria). • Community Conservation Index (CCI) shows very high conservation value (conservation score >20).

Ecological Importance	Attributes of Ecological Receptor
Regional Fife, Edinburgh & Lothian Councils	**Habitats** • Sites which exceed the county-level designations but fall short of SSSI selection criteria. • Viable areas of key habitat identified in the regional BAP or smaller areas of such habitat that are essential to maintain the viability of a larger whole. • Viable areas of key habitat identified as being of regional value in the appropriate SNH Natural Heritage Future area profile. • Any river classified as excellent A1 or good A2 (SEPA), not at significant risk– 2.a and 2.b (WFD) and capable of supporting salmonid population. • Any river with a HMS indicating that it is 'obviously modified' or better. • Habitat of medium to high value based on its ecological function. • Mean Trophic Rank (MTR) score indicating at least medium habitat value. **Species** • Any regularly occurring, locally significant population of a species listed as being nationally scarce which occurs in 16-100 10km squares in the UK or in a regional BAP or relevant SNH Natural Heritage Future area on account of its regional rarity or localisation. • A regularly occurring, locally significant population/number of a regionally important species. • Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county. • Species listed as 'indeterminate' or 'insufficiently known' on the Red Listing pre-1994 IUCN guidelines or species listed on the 1994 IUCN guidelines as data deficient or species listed on the 2001 Red Listing as 'lower risk – least concern'. • Average Score Per Taxon (ASPT) score at least 5. • CCI of high conservation value (conservation score <20).
Authority area City of Edinburgh, West Lothian Council and Fife Council	**Habitats** • Sites that are recognised by local authorities e.g. Sites of Interest for Nature Conservation (SINC) and District Wildlife Sites (DWS). • County/district sites that the designating Authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves (LNR). • A viable area of habitat identified in county/district BAP or in the relevant SNH Natural Heritage Future area profile. • A diverse and/or ecologically valuable hedgerow network. • Semi-natural ancient woodland greater than 0.25ha. Any river classified as good A2 or fair B (SEPA), not at significant risk– 2.a and 2.b (WFD) (and likely to support a cyprinid/coarse fishery). • Any river with a HMS indicating that it is 'significantly modified' or above. • Habitat of at least medium value. • MTR score indicating at least medium habitat value. **Species** • Any regularly occurring, locally significant population of a species that is listed in a county/district BAP on account of its regional rarity or localisation. • A regularly occurring, locally significant population of a county/district important species (particularly during a critical phase of its life cycle). • Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations. Sites/features that are scarce within the county/district or which appreciably enrich the county/ district habitat resource. • ASPT score less than 5. • CCI in full of fairly high conservation value (conservation score <15).
Local Kirkliston, South Queensferry, North Queensferry, Inverkeithing and Rosyth	**Habitats** • Areas of habitat considered to appreciably enrich the habitat resource e.g. species-rich hedgerows, ponds etc. • Sites that retain other elements of semi-natural vegetation that due to their size, quality or the wide distribution of such habitats within the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25ha. • Any river classified as fair B or poor C (SEPA), not at significant risk– 2.a and 2.b (WFD) and unlikely to support coarse fishery. Rivers with a HMS indicating that it is 'severely modified' or above. • MTR score indicating low habitat value. **Species** • Populations/assemblages of species that appreciably enrich the biodiversity resource within the local context.

Ecological Importance	Attributes of Ecological Receptor
	• Sites supporting populations of county/district important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations. • ASPT score less than 4. • CCI of moderate conservation value (conservation score <10)
Less than Local Limited ecological value	**Habitats** • Sites that retain habitats and/or species that are of limited ecological importance owing to their size, species composition or other factors. • Any river classified as impoverished D (SEPA), not at significant risk– 2.a and 2.b (WFD) and/or and with a HMS indicating that it is 'severely modified'. • Habitat of low to medium value. • MTR score indicating low habitat value. **Species** • ASPT less than 3. • CCI of low conservation value (conservation score <5).

Impact Assessment

Identification of Impacts

10.2.18 Knowledge and assessment of construction methods and operational activities, together with professional judgment by experienced ecologists has been used to identify the potential impacts of the proposed scheme on ecological receptors.

10.2.19 The activities that could have a potential ecological impact were reviewed and assessed for each ecological receptor individually. Professional judgement by experienced ecologists was used to identify those activities associated with the proposed scheme that could impact on a particular receptor. Further technical details can be found in Appendix A10.7.

10.2.20 To aid consistency and readability, a standard list of potential areas of concern that could impact on a receptor was developed:

- land-take;
- land severance;
- direct mortality;
- changes to hydrology;
- water pollution;
- provision of structures;
- effects of road/bridge lighting;
- dust/air pollution;
- effects of road spray;
- noise/disturbance;
- disease transfer (e.g. red leg disease); and
- alien species transfer (see footnote to Table 10.2).

10.2.21 This list was applied to all features through consideration of the impacts and activities listed in Table 10.2.

Table 10.2: Potential Impacts of the Proposed Scheme

Potential Impact	Activity/Cause		
Direct loss	• Land-take • Water pollution	• Dust and air pollution • Changes to hydrology	• Provision of structures
Direct mortality	• Land-take • Collision with traffic • Water pollution	• Alien species transfer • Disease transfer (red leg disease in amphibians)	• Provision of structures
Habitat Fragmentation	• Land-take	• Noise and vibration	• Effects of road lighting
Loss of diversity	• Alien species transfer (botanical)* • Dust and air pollution	• Effects of road spray • Water pollution	• Changes to hydrology
Disturbance	• Noise and vibration	• Effects of road/bridge lighting	

Alien species are those that are not native to the UK and have an invasive nature that reduces ecological diversity of habitats (e.g. Japanese knotweed (*Fallopia japonica)*, Himalayan balsam (*Impatiens glandulifera)* and giant hogweed (*Heracleum mantegazzianum*)). They are not to be confused with injurious weeds (Weeds Act, 1959) that are invasive, but are native to the UK (spear thistle *Cirsium vulgare*, creeping or field thistle *Cirsium arvense,* curled dock *Rumex crispus,* broad-leaved dock *Rumex obtusifolius,* and ragwort *Senecio jacobaea).*

Impact Magnitude

10.2.22 For the purposes of this assessment, the term 'impact magnitude' is taken to represent the overall characterisation of positive or negative impacts in accordance with IEEM, including:

- impact extent/scale;
- direct or indirect impact;
- reversibility of impact;
- frequency of impact (single event, recurring or constant);
- duration of impact (short term, medium term, long term or permanent); and
- likelihood of occurrence (certain/near certain, probable, unlikely or extremely unlikely).

10.2.23 Impact magnitude was identified as shown in Table 10.3 as negligible, low, medium or high, taking into account the above impact characterisation approach:

Table 10.3: Impact Characterisation Translated into Impact Magnitude

Impact Character	Impact Magnitude
A permanent or long-term effect on the distribution and/or abundance of a habitat, species assemblage/community or population. If negative this would have implications for the integrity of the receptor and its conservation status, and if positive would result in an improvement to the conservation status of the receptor.	High
A permanent or long-term effect on the distribution and/or abundance of a habitat, species assemblage/community or population. If negative this would have negligible implications for the integrity of the receptor or its conservation status and if positive would not alter the conservation status of the receptor.	Medium
A short-term reversible effect on the distribution and/or abundance of a habitat, species assemblage/community or population and within normal fluctuations observed within the ecology of the receptor.	Low
A short-term reversible effect on the distribution and/or abundance of a habitat, species assemblage/community or population unlikely to be detectable by monitoring.	Negligible

Impact Significance

10.2.24 Once potential impacts were understood and receptor value determined, professional judgement was used to focus the assessment on impacts that would require mitigation. For example an area of amenity grassland would be evaluated as of less than local ecological value and would not progress through the assessment process. However, an impact on a SSSI valued at a national level would progress through the assessment process, with mitigation and residual effects identified.

10.2.25 IEEM (2006) states that '*if an ecological resource or feature is likely to experience a significant impact, the consequences in terms of development control, policy guidance and legislation will depend on the level at which it is valued. Significant impacts on features of ecological importance should be mitigated (or compensated for) in accordance with guidance derived from policies applied at the scale relevant to the value of the feature or resource. Any significant impacts remaining after mitigation (the residual impacts), together with an assessment of the likelihood of success in the mitigation, are the factors to be considered against legislation, policy and development control in determining the application*'.

10.2.26 In accordance with IEEM (2006), a significant impact is an impact (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats and species (Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)). It is based on professional judgment and the available information on the impact and receptor. In the context of reporting in this chapter, the specific impact tables provided in Section 10.4 (Potential Impacts) contain information regarding all potential impacts considered to be significant.

Mitigation and Residual Impacts

10.2.27 In general, a hierarchical approach to mitigation has been adopted for the proposed scheme, which seeks to avoid adverse impacts in the first instance through an iterative approach to design (e.g. informing road alignment to avoid sensitive receptors where possible). In areas where avoidance is not possible, measures are proposed to prevent or reduce potentially significant negative impacts. Measures to compensate the negative impacts at specific sites may also be required (e.g. habitat creation to offset the local, site-specific impacts associated with habitat loss and fragmentation).

10.2.28 Although all significant potential impacts require mitigation, most would be addressed using generic mitigation including the application of best practice guidance, and specific mitigation was therefore only developed where generic mitigation would be inappropriate, ineffective or insufficient.

10.2.29 Where there would still be a significant impact after mitigation this is reported in Section 10.6 (Residual Impacts). Significant impacts which are reduced through mitigation to not significant are reported in detail in Appendix A10.7.

10.2.30 Mitigation was identified following a hierarchical approach and to meet the requirements outlined in the Environmental Impact Assessment (Scotland) Regulations 1999 which requires '*a description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment*' to be provided.

Limitations to Assessment

10.2.31 Potential limitations to assessment related to baseline data collection or assessment are explained in Appendix A10.3.

10.3 Baseline Conditions

10.3.1 All British bat species, in addition to European otter are European protected species under the EU Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Fauna and Flora (the

Habitats Directive, 1992. All other receptors receive some degree of protection, those nationally protected receptors are afforded legal protection through the Nature Conservation (Scotland) Act (NCSA) 2004 and The Wildlife and Countryside Act 1981 (WCA) (as amended) (Appendix A10.2 and Appendix A10.3).

10.3.2 Many bird species both resident and migratory in the UK are protected nationally and internationally. Internationally they are afforded protection under the European Union (EU) Directive on the Conservation of Wild Birds (79/409/EEC) (Appendix A10.2 and Appendix A10.3),

Habitats and Vegetation

Designated Sites

10.3.3 Designated nature conservation sites are illustrated on Figure 10.1 and described below.

10.3.4 Two internationally important sites are located partially within the study area; the Firth of Forth SPA and Forth Islands SPA. A further two internationally important sites (the River Teith SAC and Imperial Docks Lock, Leith SPA) are located approximately 35km upstream and 16km downstream respectively of the proposed scheme.

10.3.5 SPAs are protected in Scotland through implementation of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended). Under Regulation 48(1) the 'competent authority', in this case the Scottish Government, must undertake an Appropriate Assessment 'on the implications for the site in view of the site's conservation objectives', where a plan or project is likely to have a significant effect on a European site in Great Britain (either alone or in combination with other plans or projects) and is not directly connected with, or necessary to, the management of the site'. The term European site refers to SPAs classified under the Birds Directive and SACs designated under the Habitats Directive which together form a network of sites referred to as Natura 2000. Consultation with SNH identified the requirement for an Appropriate Assessment for potential impacts to the Firth of Forth SPA, Forth Islands SPA and the River Teith SAC. Assessment of impacts to the Firth of Forth SPA, Forth Islands SPA, Imperial Dock Lock, Leith SPA and River Teith SAC are considered separately in Chapter 11 (Estuarine Ecology). In addition to the EIA for the sites, separate reports to inform Appropriate Assessments have been prepared for the Forth Islands SPA (which includes assessment of the Imperial Dock Lock, Leith SPA), River Teith SPA and Firth of Forth SPA.

10.3.6 A number of other designated sites occur within the study area. Two SSSIs are located in the northern study area (St. Margaret's Marsh and Ferry Hills), in addition to the Firth of Forth SSSI within the estuary. Six Sites of Importance for Nature Conservation (SINCs) lie within the southern study area and are additionally classed as Local Biodiversity Sites (LBS) comprising Dundas Estate, Linn Mill Burn, Hopetoun Road (also a Wildlife Site), Back Braes Weir (also a Proposed Wildlife Site), Lindsay's Craigs and Niddry Burn and the River Almond. In addition, the River Almond, and its tributaries, is classified as a salmonid water under Schedule 1 of the Surface Waters (Fishlife) (Classification) (Scotland) Amendment Regulations 2007.

Ancient Woodland Inventory

10.3.7 Ancient Woodland Inventory (AWI) areas are illustrated in Figure 10.1. Detailed baseline information is provided in Appendix A10.4, Section 1.2 (Designated Sites), and summarised below.

10.3.8 Eleven areas of woodland within the study area are included within the AWI. Category (1) 'ancient woodlands (of semi-natural origin)' appear as semi-natural woodlands on maps from 1750 or the mid-1800s, or c.1860 as part of the Ordnance Survey (OS) First Edition maps. These sites include woodlands that were missed by the Roy Survey or may have arisen between 1750 and 1860. Category (2) 'long-established woodlands (of plantation origin)' appear as plantations on maps from 1750 or on maps from c.1860 as part of the OS First Edition maps. These sites have been

continuously wooded to the present day, and some may have developed semi-natural characteristics.

10.3.9 Three woods, recorded on the AWI as Category 2, were recorded to the north of the Firth of Forth, these comprised St. Margaret's Hope, Castlandhill and North Cliff Wood (Figure 10.1a).

10.3.10 Seven woods on the AWI inventory were identified south of the Firth of Forth, these included:

- Lindsay's Craigs is classed as Category 1 with a smaller area classed as Category 2 (Figure 10.1c);
- East Shore Wood is classed as Category 1 (Figure 10.1b); and
- Linn Mill Burn, Ross's Plantation, Muiriehall Wood, the woodland strip north of Niddry Mains, a strip of woodland between the Swine Burn and Humbie Farm are all classed as Category 2 (Figures 10.1b-c).

Phase 1 Habitat Survey

10.3.11 Phase 1 habitat survey results are illustrated in Figure 10.2 and summarised below. Detailed baseline information is presented in Appendix A10.4, Section 1.2 (Designated Sites), including referenced target notes (Table 1.2).

10.3.12 Terrestrial habitats are represented largely by farmland comprising of arable land and fields of poor semi-improved or improved grasslands, which taken together represent approximately 683ha or 64.5% of the habitats within the study area. The most extensive semi-natural non-agricultural habitat present within the study area are woodlands comprising approximately 128ha or 12.1% of the study area, many of which are included within the AWI. The sections of woodland are of varying sizes, connectivity, ages, management regimes and community types (Table 10.4).

10.3.13 Other semi-natural habitats present within the study area comprise coastal reedbeds and saltmarsh (identified as saltmarsh/dune interface and swamp in Table 10.4), together with areas of small and fragmented unimproved and semi-improved neutral grassland. Areas of unimproved grassland are not included in Table 10.4 due to their small size and are therefore recorded by target notes in Figure 10.2.

10.3.14 Riparian habitats are also present throughout the study area, however due to their limited size are not included in Table 10.4. Further detail on the riparian and freshwater habitats can be found within the section below on River Habitat and in Appendix A10.4, Section A10.4.12 to Section A10.4.15.

10.3.15 Invasive weeds listed on Schedule 9 of the WCA 1981 (as amended) were recorded at a number of locations within the study area (refer to Invasive Species Report (Jacobs Arup, 2009)). New Zealand pygmy weed (*Crassula helmsii*) was recorded in a small waterbody adjacent to Castlandhill Woods. Japanese knotweed (*Fallopia japonica*) was recorded at Jamestown Pond, at two locations within St. Margaret's Hope and in the Society Road/Port Edgar area. Giant hogweed (*Heracleum mantegazzianum*) was recorded within St. Margaret's Marsh SSSI and near Port Edgar. Few-flowered garlic (*Allium paradoxum*) was recorded in woodlands at Lindsay's Craigs.

10.3.16 The results of the Phase 1 habitat survey confirmed presence of woodland, arable fields, improved and semi-improved grasslands, amenity grassland and hedgerows. Table 10.4 summarises these in terms of the estimated total area (to the nearest hectare) of each habitat identified in the study area. These summary statistics for the study area are included to give context to the assessment. In addition, a botanical species list is presented in Appendix A10.4, Section 1.2 (Designated Sites) and Table 1.3.

Table 10.4: Estimated Total Area, Percentage Area and Number of Discrete Areas of Habitats within the Study Area

Habitat Type	Estimated Total Area (Ha)	Percentage Area (%)	Number of Discrete Areas
Amenity grassland	29	3	27
Arable land	565	53	91
Bare ground	7	<1	5
Built up/Industrial/Building Sites	93	9	11
Caravan Site	2	<1	1
Coastal grassland	<1	<1	1
Continuous bracken	2	<1	1
Dense/Continuous scrub	32	3	36
Ephemeral/short perennial	6	<1	4
Improved grassland	34	3	12
Introduced scrub	<1	<1	1
Marsh/marshy grassland	3	<1	1
Other habitat	<1	<1	1
Other tall ruderal	19	2	16
Plantation broadleaved woodland	58	6	52
Plantation coniferous woodland	1	<1	1
Plantation mixed woodland	33	3	19
Poor semi-improved grassland	84	8	61
Saltmarsh/dune interface	<1	<1	1
Scattered scrub	11	1	16
Semi-improved acidic grassland	1	<1	2
Semi-improved calcareous grassland	<1	<1	1
Semi-improved neutral grassland	12	1	6
Semi-natural broadleaved woodland	36	3	31
Spoil	11	1	1
Swamp	19	2	6
TOTAL	**1057**	**100**	**405**

Phase 2 Habitat Survey

10.3.17 Baseline information is illustrated on Figure 10.3 and detailed in full in Appendix A10.4, Section 1.2 (Designated Sites), with a summary provided below.

10.3.18 Woodlands and an area of marsh were identified during the Phase 1 habitat survey as having botanical interest warranting further survey using the National Vegetation Classification (NVC) methodology. NVC is a system for attributing a collection of plant species into identifiable phyto-social units or communities. The communities are designated by an alpha numeric code and dominant plant species attributable to the community. Once coded the ecology and botanical importance of an area can be readily extrapolated. The areas classified included three sections of St. Margaret's Hope, three sections of the Echline strip where it adjoins with the north of Dundas Estate, a section of Dolphington Burn Wood and St. Margaret's Marsh SSSI.

10.3.19 Many of these woods were dominated by sycamore. However, sections of St. Margaret's Hope woodland showed affinities with W16 *Quercus–Betula-Deschampsia flexuosa* community (Rodwell, 1991).

10.3.20 The woodland of the Echline strip could not be assigned into a NVC classification and was considered to be of recent plantation origin.

10.3.21 St. Margaret's Marsh SSSI comprised reedbed classified as S4a the *Phragmites australis* sub-community of the *Phragmites australis* reedbed. In addition, an area of mesotrophic grassland MG1 *Arrhenatherum elatius* grassland, salt-marsh SM10 transitional low-marsh vegetation SM13 *Puccinellia maritima* salt-marsh community and tall ruderal habitats OV26 *Epilobium hirsutum* community, with the sub-community OV26d were recorded within the boundary of the marsh (Rodwell, 1992, 1995 & 2000).

Badger (*Meles meles*)

10.3.22 A summary of baseline badger data is provided in this chapter, with detailed baseline information including badger sett and activity location provided in the confidential Appendix A10.5.

10.3.23 Consultation with Scottish Badger Group provided data identifying a sett and a record of a Road Traffic Accident (RTA) within the study area to the north of the Firth of Forth. South of the Firth of Forth, consultation with Edinburgh and Lothians Badger Group provided data identifying 30 setts distributed throughout a wide area, of which 10 setts were located within the study area.

10.3.24 Field surveys did not record any evidence of badger activity within the study area to the north of the Firth of Forth. Badger activity south of the Firth of Forth comprised a total of five social groups and one badger population recorded throughout the study area.

10.3.25 The habitats within the northern study area are generally suburban in nature and as such offer little setting or foraging opportunities for badgers. By contrast, the study area to the south of the Firth of Forth largely lies in a rural setting and contains a mosaic of sub-optimal and optimal habitat opportunities. The most suitable habitats are located in the Dundas Estate which contains abundant wooded areas situated on embankments and small hillocks. The combination of woodland, varying topography and dry sandy soils provide excellent digging conditions and therefore is ideal habitat for excavating setts.

10.3.26 Grassland habitats are abundant within the southern study area, offering excellent foraging opportunities. They are supplemented by a number of arable fields and areas containing fruit bearing trees and shrubs.

Bats

10.3.27 Bat activity survey results are illustrated in Figure 10.4 and bat habitat survey results in Figure 10.5. Detailed baseline information is presented in Appendix A10.4, Section 3 (Bats) and summarised below.

10.3.28 Consultations identified the presence of five species of bats within the study area, these being: soprano pipistrelle (*Pipistrellus pygmaeus*), common pipistrelle (*P. pipistrellus*) and Daubenton's bat (*Myotis daubentonii*), brown long-eared bat (*Plecotus auritus*) and Natterer's bat (*M. nattereri*).

10.3.29 Bat activity survey transects identified the presence of soprano pipistrelle, common pipistrelle and Daubenton's bat throughout the study area.

10.3.30 One building roost and two tree roosts were recorded to the north of the Firth of Forth, while a total of 15 building roosts and three tree roosts were recorded in the study area south of the Firth of Forth.

10.3.31 In the study area to the north of the Firth of Forth, 11 commuting routes (CRs) were identified (Figure 10.4a). CR5 (Lothians View Path) and CR10 (St. Margaret's Hope) were associated with the highest levels of activity in terms of bat passes.

10.3.32 In the study area to the south of the Firth of Forth, there were 28 commuting routes identified (Figure 10.4b-c). CR13 (South Queensferry), CR22 (Dundas), CR29 (Dundas) and CR35 (Humbie) were associated with the highest levels of bat activity.

Terrestrial Breeding Birds

10.3.33 Terrestrial breeding bird survey locations are illustrated in Figure 10.6. Detailed baseline information is presented in Appendix A10.4, Section 4 (Terrestrial Breeding Birds), Tables 4.1 to 4.4.

10.3.34 Consultation with SNH and the Royal Society for the Protection of Birds (RSPB) did not provide any records of breeding birds for the study area.

10.3.35 The JNCC Red and Amber Lists have been complied by government and non-government conservation organisations based on review of the population status of birds regularly found in UK. The Red List includes species that show historical population decline, rapid decline in breeding population/ranges or are globally threatened. The Amber List includes, but is not limited to, species that show historical decline but are recovering or with moderate declines in breeding population/range. Green listed species have no identified threat to their population status.

10.3.36 The breeding bird survey of St. Margaret's Marsh SSSI undertaken by Jacobs et al. (2007a) recorded 138 breeding bird territories. A total of 21 species were recorded, of which three species were JNCC Amber List (dunnock (*Prunella modularis*), goldcrest (*Regulus regulus*) and willow warbler (*Phylloscopus trochilus*)) and three species were JNCC Red List, UKBAP and LBAP species (linnet (*Carduelis cannabina*), reed bunting (*Emberiza schoeniclus*) and song thrush (*Turdus philomelos*)).

10.3.37 Three additional species were noted during other ecological surveys undertaken of the study area by Jacobs Arup, these being: barn owl (*Tyto alba*), grey partridge (*Perdix perdix*) and green sandpiper (*Tringa ochropus*). Two of these species, barn owl and green sandpiper are Wildlife and Countryside Act 1981 (as amended) Schedule 1 (WCA1i) species, while barn owl is also a JNCC Amber List and LBAP species. Grey partridge is a JNCC Red List, UKBAP and LBAP species.

10.3.38 A total of 71 breeding bird species were recorded by the field surveys distributed across 14 quadrats to the north and south of the Firth of Forth. Of the 71 species recorded, none were WCA1i species, while eight were JNCC Red List species ((bullfinch (*Pyrrhula pyrrhula*), grasshopper warbler (*Locustella naevia*), house sparrow (*Passer domesticus*), linnet, reed bunting, skylark (*Alauda arvensis*), song thrush, starling (*Sturnus vulgaris*)) and twenty-four were JNCC Amber List species. Eleven species were listed within the UKBAP (bullfinch, grasshopper warbler, starling, curlew (*Numenius arquata*), dunnock, herring gull (*Larus argentatus*), house sparrow, lapwing (*Vanellus vanellus*), reed bunting, song thrush, yellowhammer (*Emberiza citronella*)). Similarly, 13 species were LBAP species (bullfinch, common tern (*Sterna hirundo*), great spotted woodpecker (*Dendrocopos major*), grey partridge, house martin (*Delichon urbica*), lapwing, linnet, reed bunting, sand martin (*Riparia riparia*), skylark, song thrush, swift (*Apus apus*) and yellowhammer.

10.3.39 Further detailed information on the conservation status of recorded bird species is presented in Appendix A10.2, Section 2.5 (Terrestrial Breeding Birds).

Terrestrial Wintering Birds

10.3.40 Terrestrial wintering bird survey locations are illustrated in Figure 10.6. Detailed baseline information is presented in Appendix A10.4, Section 5 (Terrestrial Wintering Birds), Tables 5.1 to 5.4 and summarised below.

10.3.41 Consultation with SNH and the RSPB did not provide any records of wintering birds for the study area.

10.3.42 No additional species were noted during other ecological surveys undertaken of the study area.

10.3.43 A total of 65 species were recorded overwintering by the field surveys distributed across 14 quadrats to the north and south of the Firth of Forth. Of the 65 species recorded, one was a Birds Directive Annex 1 species (greylag goose (*Anser anser*)) while three were WCA1i species ((redwing (*Turdus iliacus*), fieldfare (*Turdus pilaris*) and greylag goose)). Nine species were JNCC Red List (bullfinch, grey partridge, house sparrow, linnet, reed bunting, skylark, song thrush, starling and yellowhammer). Similarly, 21 species were listed in the JNCC Amber List. Twelve species were listed within the UKBAP (bullfinch, starling, curlew, dunnock, grey partridge, herring gull, house sparrow, lapwing, reed bunting, song thrush, starling and yellowhammer) while 11 were LBAP species (bullfinch, common snipe (*Gallinago gallinago*), great spotted woodpecker, grey partridge, lapwing, linnet, redshank (*Tringa tetanus*), reed bunting, skylark, song thrush and yellowhammer).

10.3.44 Further detailed information on the conservation status of recorded bird species is presented in Appendix A10.2, Section 2.6 (Terrestrial Wintering Birds).

Otter (*Lutra lutra*)

10.3.45 Otter survey results are illustrated in Confidential Figure 3. Detailed baseline information is presented in Confidential Appendix A10.5 and summarised below.

10.3.46 Consultation with Scottish Wildlife Trust and Vincent Wildlife Trust identified the presence of otter on the River Almond and its tributaries.

10.3.47 North of the Firth of Forth, signs of use by otter were recorded at Brankholm Burn in Rosyth in the form of old spraints. Evidence of otter was recorded at St. Margaret's Marsh in the form of prints, a potential holt and areas providing potential habitat for lying up. Field surveys recorded few signs along coastal areas, although the presence of wooded and saltmarsh areas are considered suitable for lying up. An otter survey undertaken by Faber Maunsell in 2007 (Jacobs et al. (2007b) recorded the presence of otter signs outside of the study area at Hillend (NT 14500 84300).

10.3.48 South of the Firth of Forth, signs of otter were recorded at Dundas Loch and Dolphington Burn and Linn Mill Burn, which provides a feature considered suitable for commuting between coastal and inland resources. The presence of otter on Linn Mill burn confirms the results of the otter survey undertaken by Faber Maunsell in 2007 where otter spraint was recorded at Port Edgar.

10.3.49 Field surveys also identified the River Almond and key tributaries including Niddry Burn and Swine Burn as a core area of otter activity due to the presence of abundant otter signs including spraints and prints, and confirmed lying up sites including holts, hovers and couches.

10.3.50 No natal holts were identified during the surveys despite a number of areas within the study area being considered suitable for otter breeding. Suitable areas include St. Margaret's Marsh, and Humbie Reservoir (Swine Burn).

10.3.51 It is likely that otters are present throughout the study area, occasionally utilising water bodies where no field signs were detected. It is not possible to determine the number of individual otters present in the study area. However, the National Otter Survey of Scotland (Strachan, 2007) suggests that otter numbers were increasing in the Forth and Borders area up to 2004.

Water Vole (*Arvicola terrestris*)

10.3.52 Results for habitat assessments for water vole are illustrated in Figure 10.7. Detailed baseline information is presented in Appendix A10.4, Section 7 (Water Vole) and summarised below.

10.3.53 Consultation with Fife Coast and Countryside Trust and desk-based research identified the historical presence of water vole outside the study area to the north and south of the Firth of Forth, but none within the study area.

10.3.54 Field surveys did not record the presence of water voles or their signs within the study area despite areas of suitable habitat being present (as indicated on Figure 10.7). Given water voles have previously been recorded in the Forth–Clyde area and close to the study area, there is the potential for water vole to re-colonise suitable habitat present within the study area. However, the presence of mink in the wider area is likely to reduce the suitability of these habitats for water vole and water vole are therefore likely to remain absent from the study area. For these reasons water vole are assumed to be absent from the study area and are not considered further in this assessment.

Red Squirrel (*Sciurus vulgaris*)

10.3.55 Red squirrel survey results are illustrated in Figure 10.8. Detailed baseline information is presented in Appendix A10.4, Section 8 (Red Squirrel) and summarised below.

10.3.56 Consultation did not provide any records of red squirrels within the study area. However, red squirrels were recorded by the 2006 by the Scottish Red Squirrel Survey at Fordell Castle (approximately 2.5km northeast of the study area).

10.3.57 Eight woodland areas were identified as providing potential habitat capable of supporting populations of red squirrels within the study area. Visual and hair-tube surveys provided no evidence of red squirrel presence within these woodlands although grey squirrels were found to be present in seven of the woodlands.

10.3.58 As red squirrels were not recorded by the field surveys (Figure 10.8) and given the prevalence of grey squirrels in the local area, red squirrels are considered to be absent from the study area and therefore are not considered further in this assessment.

Amphibians

10.3.59 Amphibian survey results are illustrated in Figure 10.9. Detailed baseline information is presented in Appendix A10.4, Section 9 (Amphibians) and summarised below.

10.3.60 Consultation did not provide any great crested newt (*Lissotriton cristatus*) records within the study area, but did indicate historical records beyond the study area; SNH noted the Old Curling Pond on Dundas Estate as a historic breeding site, and consultation with Lothian Wildlife Information Centre additionally provided historical records for South Queensferry, Dalmeny Railway and Barrencraig Wood.

10.3.61 Field surveys recorded the presence of great crested newts at Ferry Loch (Figure 10.9a).

10.3.62 Smooth newts were recorded in Ferry Loch and Railway Pond (West), while 19 palmate newts were recorded in Ferry Loch (Figures 10.9a-b).

10.3.63 During the initial walkover surveys common frog (*Rana temporaria*) spawn was observed in Ferry Loch and Railway Pond (East). Adult common frogs were observed at Ferry Loch, Railway Pond (West) and Railway Pond (East) (Figure 10.9a-b).

10.3.64 Common toad (*Bufo bufo*) spawn was recorded at Ferry Loch during the initial walkover surveys. Common toads were also recorded throughout the study area during the course of the other ecological surveys undertaken by Jacobs Arup.

Reptiles

10.3.65 Reptile survey results are illustrated in Figure 10.9. Detailed baseline information is presented in Appendix A10.4, Section 10 (Reptiles) and summarised below.

10.3.66 Consultation did not provide any records of reptiles within the study area.

10.3.67 Following a desk-study and walk-over survey, a total of 54 sites were identified as being representative of the study area and having potential to support reptile populations. A sampling scheme was used to select 21 of the sites for further survey. Field surveys did not record the presence of reptiles at any of the sites. Therefore, in conjunction with the lack of historic data, reptiles are judged absent from the study area and as such they are not considered further by this assessment.

Terrestrial Invertebrates

10.3.68 Terrestrial invertebrate survey locations are illustrated in Figure 10.10 and detailed technical information on assessment methods is presented in Appendix A10.3, Section 11 (Terrestrial Invertebrates). Detailed baseline information is presented in Appendix A10.4, Section 11.2 (Terrestrial Invertebrates) and summarised in paragraphs 10.3.69 to 10.3.71.

10.3.69 The study contains a range of habitats that are potentially valuable for terrestrial invertebrates. Eight areas of habitat (St. Margaret's Hope Wood/St. Margaret's Marsh SSSI; Ferry Hills SSSI;, Dundas North/Echline Strip; Dolphington Burn Wood; Ross's Plantation; parkland to the west of Kirkliston; Lindsay's Craigs; and the River Almond to the south of Kirkliston) were identified within the study area as sites which could be expected to support important invertebrate populations (Figure 10.10a - c). These sites were subject to a field visit to assess the quality of the habitats for invertebrate populations. However, no systematic recording of species was undertaken. A combination of species and habitat assessment was employed to assess habitat value (Appendix A10.3, Section 11.3: Terrestrial Invertebrate Habitat Assessment). The criteria used to assess habitats are contained in Appendix A10.3, Table 11.2 (Habitat Assessment Criteria for Terrestrial Invertebrates).

10.3.70 Three sites (St. Margaret's Hope Wood/St. Margaret's Marsh SSSI, Ferry Hills SSSI and Dolphington Burn Wood) were considered to provide habitat for the large red damselfly (*Pyrrhosoma nymphula*) and one site (Dolphington Burn Wood) was considered to provide habitat for the wolf spider (*Pirata piraticus*).

10.3.71 Habitats at St. Margaret's Hope Wood/St. Margaret's Marsh SSSI, Ferry Hills SSSI. Dolphington Burn Wood, Ross's Plantation and Lindsay's Craigs were assessed as being of medium value, while in comparison habitats at Dundas North/Echline Strip, parkland to the west of Kirkliston and the River Almond to the south of Kirkliston were assessed as being of low quality. None of the sites were valued as offering high value habitat for invertebrates.

River Habitat

10.3.72 River habitat survey (RHS) results are illustrated in Figure 10.11. Detailed baseline information is presented in Appendix A10.4, Section 11.3 (Terrestrial Invertebrates) and summarised below.

10.3.73 RHS was conducted on four reaches; two along Swine Burn, one along Niddry Burn and one along the River Almond. The watercourse exhibiting the most natural characteristics was Niddry Burn where morphology and habitat, although assessed as having a Habitat Modification Index (HMI) of 'obviously modified', led to the categorisation of the watercourse as of medium value. The remaining three sites are considered of low habitat value due to their modification scores, although some natural channel features were present and flow was varied. The Swine Burn near the Humbie Reservoir and the River Almond are considered to have an HMI of 'significantly modified'

and the Swine Burn near the M9 Junction 1A as 'severely modified'. Past realignment, resectioning and bank revetments reduced the overall quality of the riparian environment.

10.3.74 Despite the relatively high level of modification, many of these watercourses retain semi-natural habitats and act as wildlife corridors.

Aquatic Macroinvertebrates

10.3.75 Aquatic macroinvertebrate survey locations are illustrated in Figure 10.11. Detailed baseline information is presented in Appendix A10.4, Section 12 (Aquatic Macroinvertebrates) and summarised below.

10.3.76 Consultation with SEPA provided river classifications for the sites surveyed based on 2006 monitoring data. SEPA also provided freshwater macroinvertebrate data (2006), including Biological Monitoring Working Party (BMWP) and ASPT scores for Brankholm Burn, Dolphington Burn, Swine Burn, Niddry Burn, and the River Almond (for a summary of these data see Appendix A10.4, Table 12.1). Historic data from SEPA and the Biological Records Centre (BRC) were accessed via the NBN Gateway website. SNH and Take A Pride In Fife Environmental Information Centre (TAPIF EIC) were both consulted regarding macroinvertebrates but did not provide any data.

10.3.77 Aquatic habitats were surveyed at eight riparian sites (Brankholm Burn, unnamed tributary at St. Margaret's Marsh SSSI, unnamed pond at St. Margaret's Marsh SSSI, Linn Mill Burn, Dolphington Burn (two locations), Swine Burn (two locations), Niddry Burn (three locations) and the River Almond) which fell within 500m of the proposed scheme.

10.3.78 Two unnamed waterbodies at St. Margaret's Marsh, exposed to saline intrusion, were also surveyed (Figure 10.11a-b). The unnamed tributary (JA02) was found to support 10 taxa, including species associated with intertidal areas and the unnamed pond (JA03) was found to support seven taxa.

10.3.79 The sites surveyed on the Brankholm Burn and Linn Mill Burn were found to support a maximum of 19 taxa during the 2008 surveys whilst 16 taxa were recorded from the Dolphington Burn. Swine and Niddry burns were found to support a blackfly larvae (*Simulium morsitans*) only found in four rivers in the UK. The Niddry Burn supported the most diverse and highest quality biotic community surveyed, with its lower reach supporting the nationally scarce, true fly (*Dixa maculate)*. The macroinvertebrate communities in the Swine Burn and River Almond exhibited high levels of diversity, and were unusual because of the geographic representation of taxa observed (Figure 10.11f).

Freshwater Macrophytes

10.3.80 Freshwater macrophyte survey locations are illustrated in Figure 10.11. Detailed baseline information is presented in Appendix A10.4, Section 13 (Freshwater Macrophytes) and summarised below.

10.3.81 Consultation with SEPA, SNH and Scottish Wildlife Trust (SWT) provided limited macrophyte data for the study area as few surveys have been carried out in these watercourses. The SWT website provided information on areas of botanical interest but no information was available on the watercourses in the study area. Although consulted, TAPIF EIC did not provide any information.

10.3.82 Seven waterbodies were surveyed: six flowing watercourses (Brankholm Burn, Linn Mill Burn, Dolphington Burn, Swine Burn, Niddry Burn and River Almond) and one still water (Humbie Reservoir). Humbie Reservoir, Swine Burn and the River Almond contained the most diverse macrophyte communities of the sites surveyed, with records of algae and bryophytes. The remaining watercourses generally consisted of algae, bryophyte and liverworts and no higher plants. No species of conservation importance were recorded.

Freshwater Fish

10.3.83 Freshwater fish survey locations are illustrated in Figure 10.11. Detailed baseline information is presented in Appendix A10.4, Section 14 (Freshwater Fish) and summarised below.

10.3.84 Consultation was undertaken with a number of statutory and non-statutory organisations. Responses were received from SEPA and Marine Scotland (formerly Fisheries Research Services (FRS)), but no freshwater fisheries data were obtained.

10.3.85 A desktop study of angler rod return records supplied by the Cramond Angling Club indicated the presence of species of conservation concern: Atlantic salmon (*Salmo salar*), sea trout and brown trout (*Salmo trutta*) on the River Almond.

10.3.86 Four sites on three watercourses were surveyed (Figure 10.11e): two sites on the Swine Burn and one on the Niddry Burn and River Almond. Bullhead (*Cottus gobio*) was the dominant species recorded across all four study sites, with the highest total number recorded at Swine Burn. Other species were recorded in low numbers and comprised brown trout, stone loach (*Barbatula barbatuls*), minnow (*Phoxinus phoxinus*), three-spined stickleback (*Gasterosteus aculeatus*) and European eel (*Anguilla anguilla*). Species of conservation importance, including Atlantic salmon, sea trout or river, brook and sea lamprey (*Lampetra fluviatilis*, *L. planeri* and *Petromyzon marinus*) were not recorded during the 2008 surveys but are known from the River Almond catchment, which is designated as a salmonid water under the Surface Waters (Fishlife) (Classification) (Scotland) Amendment Regulations 2007.

Evaluation of Baseline Conditions

10.3.87 This section provides the evaluation of the baseline terrestrial/freshwater habitats and species populations within the study area.

10.3.88 The ecological value of the baseline conditions has been determined in accordance with the methods described in Section 10.2 (Approach and Methods) and criteria set out in Table 10.1.

10.3.89 A summary evaluation of habitats and species is provided in Table 10.5. Detailed evaluation is provided in Appendix A10.6.

Table 10.5: Summary Evaluation of Habitats and Species

Area/Habitat Name	Features of Interest	Evaluation
Terrestrial Habitats (Figure 10.2 and Figure 10.3)		
St. Margaret's Marsh SSSI	Site contains a mosaic of different habitats including an extensive area of reedbed, saltmarsh, maritime grassland and neutral grassland. The SSSI is designated for its biological interest.	National
Ferry Hills SSSI	This site contains scarce and declining habitats of unimproved calcareous and improved grassland. The SSSI is designated for its geological and biological interest.	National
Lindsay's Craigs and East Shore Wood	The only woodlands south of the Firth of Forth to be classed as Ancient Woodland (Category 1) in the AWI. They have relatively good connectivity with other semi-natural habitats.	Authority area
St. Margaret's Hope	Listed within the AWI as Category 2. Bluebell (*Hyacinthoides non-scripta*), found in these woodlands, is a Local Species Action Plan (LSAP) species for Fife.	Authority area
Castlandhill Wood and North Cliff Wood	Listed within the AWI as Category 2. The woodlands are >0.25ha and have relatively good connectivity with other semi-natural habitats. Bluebell found in these woodlands, is a LSAP species for Fife.	Authority area
Ross's Plantation	Listed within the AWI as Category 2.	Authority area
Part of Dundas Wood	Listed within the AWI as Category 2. This woodland has also been designated as a Site of Importance for Nature Conservation (SINC)	Authority area
Field adjacent to Castlandhill Wood	Local Habitat Action Plan (LHAP) semi-natural, calcareous wet grassland. This site has a high diversity of grass and wildflower species and has relatively good connectivity with other semi-natural habitats.	Authority area
Western end of the cemetery at Inverkeithing	This area is of particular importance due to the presence of maiden pink (*Dianthus deltoides*), a LSAP species for Fife.	Authority area
Small area of coastal grassland below St. Margaret's Hope Wood	Many local or uncommon species are present at this site. Though not recognised by statutory protection it has some conservation value including presence of the locally scarce dropwort (*Filipendula vulgaris*).	Authority area
Arable land	This habitat type comprises the majority of the study area. It is characterised by low species diversity and swards often dominated by grasses.	Less than Local
Open water	Watercourses and associated riparian habitats are of high value in terms of their capacity to support faunal species. Open areas of water include Back Braes Weir, Humbie Reservoir, Dundas Loch, and a number of ponds and other small water bodies). Swine Burn (and associated ditches), Linn Mill Burn, Niddry Burn and River Almond, are LHAP rivers and streams. The River Almond is also designated as a SINC.	Local
Badger (Confidential Appendix A10.5, Figure 1–2)		
Social Group A	Appendix A10.5: Confidential Badger and Otter Information.	Local
Social Group B	Appendix A10.5: Confidential Badger and Otter Information.	Local
Population C	Appendix A10.5: Confidential Badger and Otter Information.	Regional
Social Group D	Appendix A10.5: Confidential Badger and Otter Information.	Authority area

Area/Habitat Name	Features of Interest	Evaluation
Social Group E	Appendix A10.5: Confidential Badger and Otter Information.	Authority area
Social Group F	Appendix A10.5: Confidential Badger and Otter Information.	Authority area
Bats (Figure 10.4 and Figure 10.5)		
Fairy Kirk	An old open cast stone quarry, situated to the north of this area, may serve as a hibernaculum for regularly occurring, locally significant populations of Authority area value species during a critical phase of their life cycle (i.e. hibernation).	Authority area
Inverkeithing	Inverkeithing and associated urban/ amenity habitats provide good roosting habitat and some foraging and commuting habitat suitable for locally important populations of pipistrelle bats.	Local
Rosyth	Rosyth and its associated urban amenity habitats provide some roosting, foraging and commuting habitat for locally important pipistrelle bats.	Local
Castlandhill Woods	Castlandhill Woods provides high value commuting, foraging and roosting habitat for bat species including common and soprano pipistrelles. They enrich the bat habitat resource at a local level and support local bat populations.	Local
North Queensferry	There is excellent potential for bat roosting, foraging, and commuting in the area. The Forth Road Bridge provides a link between habitats in Fife and the Lothians. This feature is likely to assist gene flow between bat populations north and south of the Firth of Forth and should be considered to be of Authority area importance.	Authority area
North Cliff Wood	Commuting and foraging habitat supports pipistrelle bats. The wood provides a link between habitats in North Queensferry and St. Margaret's Hope Wood.	Local
St. Margaret's Hope Wood	A small pipistrelle tree roost was located on an activity survey within this wood. In the absence of direct survey information the presence of brown long-eared and *Myotis* species cannot be ruled out.	Authority area
South Queensferry	South Queensferry and associated urban/amenity habitats including Jock's Hole Wood are considered to enrich the bat habitat resource within the local context by acting as a stepping stone between high value bat habitats at Dalmeny and Hopetoun.	Local
Port Edgar and West of South Queensferry	This area supports locally important commuting routes for locally important species (pipistrelle). However, the presence of a roost in Port Edgar Barracks allows for a hibernacula site in the area which maintains breeding colonies of bats at a vulnerable stage in their annual cycle.	Authority area
Dundas (North)	Several buildings and trees within this area are considered to have roosting potential, including a dovecot with hibernaculum potential. These are considered to maintain bats at a vulnerable stage in their annual cycle. The broadleaf woodland in this area provides a vital link between habitats as well as providing high value areas for foraging and roosting.	Authority area
Dundas (Central)	This area includes one confirmed roost for pipistrelle bats at Chapel Acre and one anecdotal roost at Greenacre, both of which are likely to maintain maternity colonies. Several other buildings and trees have roosting potential, including an icehouse as a hibernaculum. This area provides a vital link between habitats as well as providing high value areas for foraging and roosting.	Authority area
Dundas (South)	The area includes four confirmed roosts, each of which supports locally significant populations of locally important species, and one anecdotal tree roost. There is also a quarry with hibernaculum potential located within this area. It provides a vital link between habitats as well as providing high value areas for foraging and roosting.	Authority area
Milton and Dolphington	A small pipistrelle roost found in this area supports locally significant population of locally important species of local importance. The habitat found in the area is considered to be an extension of the habitat found in Dundas Estate providing excellent foraging and commuting habitats.	Local
Carmelhill and Muriehall	A small pipistrelle roost found within this area supports locally significant population of locally important species. These woodland areas are also considered to provide excellent foraging and commuting habitat for local bat populations.	Local

Area/Habitat Name	Features of Interest	Evaluation
Humbie	Small pipistrelle roost supports locally significant population of locally important species and support locally significant populations of Authority area important species during a critical phase of their life cycle (i.e. hibernation). The area also provides excellent foraging and commuting habitats for bats.	Authority area
Swine Burn	Daubenton's bat is a species mentioned in the West Lothian LBAP. Swine Burn supports one of the only foraging populations of Daubenton's bats identified during the surveys. The woodland in this area provides connectivity between important habitats for bats.	Authority area
Kirkliston	This area supports populations of pipistrelle bats which are of local value and the River Almond is the largest watercourse within the study area, providing foraging and commuting habitat for Daubenton's bats that are of Authority area value.	Authority area
Ross's Plantation and Lindsay's Craigs	Lindsay's Craigs includes an ice house considered suitable to support regularly occurring, locally significant populations of Authority area value species during a critical phase of their life cycle (i.e. hibernation). It also provides excellent habitat for foraging and commuting	Authority area
Terrestrial Breeding Birds (Figure 10.6)		
Ground Nesting Birds (agricultural fields both arable and pasture (semi-improved grassland)).	Meadow pipit (*Anthus pratensis*).	Local
	Grey partridge and lapwing (*Vanellus vanellus*).	Authority Area
	Grasshopper warbler, reed bunting and skylark.	Regional
	Curlew	International
Scrub and Hedgerow Nesting Birds (areas of scattered and continuous scrub, newly planted woodland <5m height, tall ruderal vegetation and hedgerows).	Blackbird (*Turdus merula*), blue tit (*Parus caeruleus*), dunnock, goldfinch (*Carduelis carduelis*), greenfinch (*Carduelis chloris*), lesser whitethroat (*Sylvia curruca*), long-tailed tit (*Aegithalos caudatus*), robin (*Erithacus rubecula*), whitethroat (*Sylvia communis*) and wren (*Troglodytes troglodytes*).	Local
	Bullfinch and willow warbler.	Authority Area
	Linnet and yellowhammer.	Regional
Tree and Woodland Nesting Birds (scattered trees, hedgerow standards and mature woodland (plantation and semi-natural)).	Blackcap (*Sylvia atricapilla*), buzzard (*Buteo buteo*), carrion crow (*Corvus corone*), chaffinch (*Fringilla coelebs*), chiffchaff (*Phylloscopus collybita*), coal tit (*Parus ater*), collared dove (*Streptopelia decaocto*), great tit (*Parus major*), grey heron (*Ardea cinerea*), jay (*Garrulus glandarius*), magpie (*Pica pica*), rook (*Corvus frugilegus*), stock dove, treecreeper (*Certhia familiaris*) and wood pigeon (*Columba palumbus*).	Local
	Goldcrest, great spotted woodpecker, green woodpecker (*Picus viridis*) and kestrel (*Falco tinnunculus*).	Authority Area
	Song thrush.	Regional
Riparian Nesting Birds (rivers, streams, lochs, lakes and/or wetlands).	Coot (*Fulica atra*), dipper (*Cinclus cinclus*), greylag goose, little grebe (*Tachybaptus ruficollis*), mallard (*Anas platyrhynchos*), moorhen (*Gallinula chloropus*), mute swan (*Cygnus olor*), sedge warbler (*Acrocephalus schoenobaenus*) and tufted duck (*Aythya fuligula*),	Local
	Gadwall (*Anas strepera*) and sand martin (*Riparia riparia*).	Authority Area
Other Species (urban and other habitats).	Black-headed gull (*Larus ridibundus*), cormorant (*Phalacrocorax carbo*), feral pigeon (*Columba livia (domest.*)), jackdaw (*Corvus monedula*), pied wagtail (*Motacilla alba*) and raven (*Corvus corax*).	Local
	House martin, house sparrow, swallow (*Hirundo rustica*) and swift.	Authority Area
	Starling.	Regional
	Barn owl.	National

Area/Habitat Name	Features of Interest	Evaluation
Terrestrial Wintering Birds (Figure 10.6)		
Agricultural (fields both arable and pasture (semi-improved grassland)).	Carrion crow, meadow pipit and rook.	Local
	Grey partridge and kestrel.	Authority Area
	Linnet and skylark.	Regional
	Curlew.	International
Scrub and Hedgerow (areas of scattered and continuous scrub, newly planted woodland <5m height, tall ruderal vegetation and hedgerows).	Blackbird, chaffinch, dunnock, goldfinch, great tit, greenfinch, long-tailed tit, robin, waxwing (*Bombycilla garrulous*) and wren.	Local
	Bullfinch, fieldfare and redwing.	Authority Area
	Starling and yellowhammer.	Regional
	Lapwing.	International
Tree and Woodland (scattered trees, hedgerow standards and mature woodland (plantation and semi-natural)).	Blue tit, buzzard, coal tit, collared dove, jay,magpie, mistle thrush (*Turdus viscivorus*), siskin (*Carduelis spinus*), sparrowhawk (*Accipiter nisus*), stock dove, treecreeper and wood pigeon.	Local
	Goldcrest and great spotted woodpecker.	Authority Area
	Song thrush.	Regional
Wetland and Watercourse (rivers, streams, lochs, lakes and/or wetlands).	Coot, grey heron, grey wagtail (*Motacilla cinerea*), little grebe, moorhen, mute swan, pink-footed goose (*Anser brachyrhynchus*), teal (*Anas crecca*), tufted duck and water rail (*Rallus aquaticus*).	Local
	Common snipe.	Authority Area
	Reed bunting.	Regional
	Greylag goose.	National
	Mallard.	International
Other Species (urban and other habitats).	Black-headed gull, feral pigeon, jackdaw, lesser black-backed gull (*Larus fuscus*) and pied wagtail.	Local
	House sparrow.	Authority Area
	Cormorant.	International
Otter (Confidential Appendix A10.5, Figure 3)		
Brankholm Burn, Rosyth	A single otter spraint was recorded along this watercourse, indicating low otter activity.	Local
Ferry Loch and Jamestown Pond	No signs of otter recorded.	Less than Local
Coast–Rosyth Europarc – North Queensferry	A print indicates the presence of otter with potential lying up sites in a reinforced sea wall, mature broadleaved woodland at St. Margaret's Hope and in reedbeds at St. Margaret's Marsh.	Authority area
Coast–Abercorn Point –	Spraints indicate the presence of otter, with lying up sites including hover and potential holts presenting adjacent woodland. This area provides a	Regional

Area/Habitat Name	Features of Interest	Evaluation
Long Craig Pier	commuting route connecting foraging and lying up habitats along the coast and between freshwater habitats.	
Linn Mill Burn	Spraints and prints indicate the presence of otter and the burn may link foraging and lying up habitat for otters frequenting the coast, and provide a commuting route.	Authority area
Dolphington Burn	Spraints and potential lying up habitat indicate the presence of otter and the burn may link foraging and lying up habitat for otters frequenting the coast.	Authority area
Dundas Loch	A spraint indicates the presence of otter with lying up sites including a hover and potential holt. The surrounding mature undisturbed broadleaved woodland provides covert which is scarce in the locality.	Authority area
Swine Burn	Spraint, print and runs indicate the presence of otter with several lying up sites.	Regional
Niddry Burn	Spraint, print and runs indicate the presence of otter, with several lying up sites.	Regional
River Almond	Spraints, runs and prints indicate the presence of otter with a high density of lying up sites and potential lying up sites. The river also provides a good source of otter prey items.	Regional
Water Vole (Figure 10.7)		
n/a	No evidence of water voles.	n/a
Red Squirrel (Figure 10.8)		
n/a	No evidence of red squirrels.	n/a
Amphibians (Figure 10.9)		
Ferry Loch	Terrestrial and aquatic habitats are considered to be of moderate value with great crested newt, palmate newt (*Lissotriton helveticus*), smooth newt (*Lissotriton vulgaris*), common frog and common toad recorded.	National
Balfour Beattie Factory Pond	The terrestrial habitat considered to be of low value, the aquatic habitat of moderate value, and no amphibians were recorded.	Less than Local
Railway Pond (West)	Terrestrial and aquatic habitats are considered to be of moderate value with smooth newt and common frog recorded.	Local
Railway Pond (East)	Terrestrial and aquatic habitats are considered to be of moderate value with smooth newt and common frog recorded.	Local
Railway Pond (East)		
Cherrytree Cottage Dundas Estate and Flight pond, Dundas Estate	Terrestrial and aquatic habitats are considered to be of high value with newt efts (smooth or palmate) recorded.	Local
Reptiles (Figure 10.9)		
n/a	No evidence of reptiles.	n/a
Terrestrial Invertebrates (Figure 10.10)		

Area/Habitat Name	Features of Interest	Evaluation
Ferry Hill SSSI, St. Margaret's Marsh SSSI, Dundas Wood North and South, Dolphington Burn Wood, Parkland - West Kirkliston, River Almond - South Kirkliston, Lindsay's Craigs, Ross's Plantation.	The suitability of the identified habitats for terrestrial invertebrates was assessed as being of low–medium value. In addition, there are no records of nationally significant species found within the sites identified.	Local
River Habitat (Figure 10.11)		
Niddry Burn	A wide range of depositional features (including vegetated and unvegetated side and point bars) and eroded bank profiles were recorded. The presence of a natural berm, discrete gravel deposits and a number of side channels are all features of interest on the Niddry Burn.	Authority area
Swine Burn (immediately downstream of Humbie Reservoir)	Despite significantly modified flow regulation and channel culverting, varied flow types and channel depositional features create a low flow sinuous channel supporting a range of submerged and marginal vegetation.	Authority area
Swine Burn	Varied flow types and occasional unvegetated side bar features are of interest in this severely modified reach, dominated by straightened banks and partly over-deepened channel.	Local
River Almond	A range of habitats occur along the morphologically diverse River Almond. Vegetated mid-channel bars and large exposed boulders are of particular geomorphological interest. Partial re-naturalisation of bank profile is of interest within the otherwise significantly modified reach.	Authority area
Aquatic Macroinvertebrates (Figure 10.11)		
Brankholm Burn	'Fair' biological water quality, indicated by the 19 taxa. No species of conservation concern have been recorded in the burn.	Local
Unnamed tributary (JA02) (NT 118648 1384)	Exhibits a macroinvertebrate assemblage expected of brackish conditions. It supports a seasonally variable community of up to ten taxa.	Authority area
Unnamed pond (JA03) (NT 12236 81307)	Pond exposed to saline intrusion and supports a limited invertebrate assemblage which is composed of taxa of very high conservation value.	Authority area
Linn Mill Burn	'Fair' biological water quality and, although it supports up to 19 taxa. No species of conservation concern have been recorded in the burn.	Local
Dolphington Burn	'Poor' to 'Fair' biological water quality and, indicated by the 16 taxa. No species of conservation concern have been recorded in the burn.	Local
Swine Burn	Characterised by poor to fair biological water quality and, although it supports up to 20 taxa. No species of conservation concern have been recorded in the burn.	Authority area
Niddry Burn	Found to support the only notable species from all the sampled sites within the buffer zone, the nationally scarce true fly, also known as a meniscus midge. The watercourse offers a range of habitat features suitable to maintain taxon rich communities and monitoring suggests water of fair to good biological quality.	Regional
River Almond	'Fair' to 'Good' biological water quality indicated by the 16 taxa at the site surveyed. No invertebrate species of conservation concern have been recorded.	Authority area

Area/Habitat Name	Features of Interest	Evaluation
Freshwater Macrophytes (Figure 10.11)		
Humbie Reservoir Swine Burn Niddry Burn	None of the species recorded is of conservation significance. These sites provide elements of semi-natural vegetation that due to their size, quality or the wide distribution of such habitats in the local area are considered to be of local value.	Local
Brankholm Burn Linn Mill Burn Dolphington Burn River Almond	None of the species recorded is of conservation significance.	Local
Freshwater Fish (Figure 10.11)		
Swine Burn (downstream Humbie Reservoir)	Bullhead and minnow were recorded at Swine Burn (Downstream Humbie Reservoir). Bullhead is not native to Scotland, and although they are important on a European scale through being listed in Annex II of the Habitats Directive, this does not confer any legal protection in this instance. Bullhead is listed as a Species of Conservation Concern under the UKBAP.	Authority area
Swine Burn (adjacent to M9 Junction 1A)	Brown trout, bullhead, minnow, and three-spined stickleback were recorded. Brown trout, not rare in this region, are afforded conservation attention as a UKBAP priority species.	Regional
Niddry Burn (South of Lindsay's Craigs)	The habitat exhibited high substrate diversity (predominantly cobble) and bankside cover (predominantly vegetation rooted in the stream bed). The site supports a population of brown trout (UKBAP priority species), not rare in this region.	Regional
River Almond	The River Almond supported the highest number of species of all the sites surveyed (six species). The composition and diversity of the community is typical of a large lowland river system of this type.	Regional

10.4 Potential Impacts

Introduction

10.4.1 Infrastructure projects, including roads and bridges have a range of well-documented impacts associated with their construction and operation. This section identifies the potential risks and predicts the associated impacts of the proposed scheme upon terrestrial and freshwater ecological receptors in the absence of mitigation. Whilst the proposed Main Crossing itself may directly impact on the estuarine ecological receptors, the majority of impacts on terrestrial and freshwater ecological receptors are as a result of the connecting infrastructure linking the proposed Main Crossing to the existing road network (see Chapter 11 for impacts to estuarine receptors).

General Impacts

10.4.2 Potential impacts associated with this type of project (presented in detail in Appendix A10.7), identified through reference to the DMRB guidelines and recommendations (Highways Agency et al., 1993), include:

- direct mortality of animals on roads during construction and operation;
- behavioural changes of animals during operation;
- habitat loss through land-take;
- fragmentation of existing habitats;
- physical obstructions caused by road constructions and bridges;
- disturbance during construction;
- pollution via road drainage, runoff and spray from road traffic;
- air pollution (e.g. nitrogen deposition); and
- visual and light pollution caused by road lighting.

10.4.3 Although air quality is a potential impact associated with road operation due to vehicle emissions, it is concluded after the consideration of the results of the air quality assessment (Chapter 15: Air Quality) that there are no implications for designated sites or species potentially affected by changes in air quality due to the scheme. The Firth of Forth SSSI NOx concentrations in future year scenarios are reported to be below the limit value. Changes in plant community composition are well documented; however there are no sensitive systems within the study area. St Margaret's Marsh is already classed as eutrophic and although the limit value is exceeded at the St. Margaret's Marsh in the Do-Something scenarios, it is below the 2005 baseline.

10.4.4 Additionally, for species relying on aquatic resources potentially affected by watercourse crossings, piling operations and surface water runoff, the following potential impacts are also considered:

- point source and diffuse pollution;
- increased sediment loading;
- decreased habitat complexity;
- habitat fragmentation; and
- changes to discharge regime.

10.4.5 It is important to recognise that potential impacts may interact, e.g. habitat loss during construction could potentially result in disturbance and habitat fragmentation, and the resulting combination of impacts may, through synergistic effects, increase the overall adverse impact of the proposed scheme (Luell et al., 2003).

Specific Impacts

10.4.6 A summary of potential impacts considered by the specific impact assessment is presented in Appendix A10.7, Table 4.1. As explained in Section 10.2 (Approach and Methods), all potential impacts described below would be considered as significant in accordance with IEEM guidance. Mitigation is proposed to avoid, reduce or offset these potential impacts in Section 10.6 (Mitigation).

10.4.7 The specific impacts likely to occur during construction and operation of the proposed scheme and the effects these impacts could potentially have on identified receptors is summarised below and presented in detail in Appendix A10.7, Tables 4.2–4.25. The potential impacts described below are all considered to be negative unless otherwise stated.

Terrestrial Habitat

10.4.8 Table 10.6 provides an estimate of terrestrial habitat loss within the study area of the proposed scheme in respect to pre-construction areas of Phase 1 habitats. Potential habitat loss figures assume no mitigation such as replacement planting is present. Detailed baseline descriptions of individual areas that may be affected by the proposed scheme are included in Appendix A10.4.

Table 10.6: Estimate of Potential Loss of Phase 1 Habitats (Construction and Operation)

Habitat Type	Number of Discrete Areas	Total area pre-construction (to nearest 0.1ha)	Total area lost to construction and operation (to nearest 0.1ha)
Amenity grassland	2	28.5	<0.1
Arable land	18	564.6	12.5
Bare Ground	1	7.3	<0.1
Built up/Industrial/ Building sites	1	93.1	<1
Dense/Continuous scrub	10	31.5	1.0
Ephemeral/short perennial	4	6.3	0
Improved grassland	4	34.3	1.4
Other tall ruderal	2	18.9	<1
Plantation broadleaved woodland	9	58.0	1.2
Plantation coniferous woodland	1	<1	<1
Plantation mixed woodland	1	21.8	<1
Poor semi-improved grassland	6	84.2	2.4
Scattered scrub	1	10.8	<1
Semi-improved neutral grassland	9	12.3	<0.1
Semi-natural broadleaved woodland	2	35.6	4.5
Swamp	6	19.0	<1
TOTAL	**77**	**1026.2**	**25.6**

Construction

10.4.9 In the absence of mitigation, during construction potential pollution from accidental spills could impact botanical species and wet habitats at St. Margaret's Marsh SSSI resulting in damage to vegetative structures or affecting the quality of water and influencing ecosystem function. These impacts however are not likely to be long lasting since vegetation and water quality will quickly recover once construction of the proposed scheme is completed. This impact would be of low magnitude.

10.4.10 Potential impacts arising from the transfer of alien plant species comprising Japanese knotweed and giant hogweed at St. Margaret's Marsh, St. Margaret's Hope and Port Edgar, few-flowered garlic (*Allium paradoxum*) at Lindsay's Craigs and New Zealand pygmy weed (*Crassula helmsii*)

near Castlandhill Wood could occur during construction. The transfer of the above species would constitute a legal offence and would be detrimental in terms of competitive displacement for indigenous species at the above locations. Should these impacts occur, they would be of medium magnitude.

Operation

10.4.11 Potential loss and fragmentation of woodland occurring at St. Margaret's Marsh SSSI, St. Margaret's Hope Wood, south of Port Edgar barracks, within the grounds of Inchgarvie House, the Echline Strip (Dundas Estate), along the northern side of the M9 at Junction 1A and at Lindsay's Craigs would result from the operational footprint of the proposed scheme. In the absence of mitigation, the loss of woodlands would result in a reduction of this important habitat type, while fragmentation would affect the ecosystem functions of the remaining areas of woodland. This impact would remain throughout the operational phase of the proposed scheme. These impacts would be of medium magnitude.

10.4.12 In addition to the above, the potential loss of hedgerows would also occur. In the absence of mitigation, this loss would result from severance caused by habitat loss occurring between the southern landfall of the proposed crossing and the tie-in to the A90. As with the loss of woodland, this impact would remain throughout the operational phase of the proposed scheme. This impact would be of medium magnitude.

10.4.13 Potential loss of LSAP species (bluebell and maiden pink) would lead to a negative impact on St. Margaret's Hope and on the A90 north of Ferry Toll respectively. This impact is as a direct loss of habitat under the footprint of the proposed scheme. These impacts would be of medium magnitude for bluebell and high magnitude for maiden pink.

10.4.14 In the absence of mitigation, potential changes to the hydrology of St. Margaret's Marsh SSSI and Ferry Hill SSSI would be a negative impact at both locations. This impact would be permanent and would affect the ecosystem functions at both locations. These impacts would be of medium magnitude.

Badger

Construction

10.4.15 There is the potential for mortality of badgers resulting from construction activities to occur within the territories of Social Groups A, B, D and F and Population C and this would be an impact of high magnitude.

10.4.16 Disturbance to badger Social Group A and Population C caused by construction activities would result in reduced foraging opportunity. This impact would however not be permanent as it will only occur for the duration of construction and therefore would be of low magnitude.

10.4.17 Pollution from accidental spills to foraging habitat of badger territory would potentially occur during the construction phase and is likely to effect Social Groups A, D and F and Population C which have territories adjacent to the proposed scheme. As ingestion of pollutants can lead to infertility or mortality of badgers, this impact would be permanent and therefore these potential impacts would be of medium magnitude, should they occur.

Operation

10.4.18 During operation, badgers with territories adjacent to the proposed scheme could be killed through collision with road traffic (RTAs). These accidents could lead to the mortality of badgers within Social Groups A, B, D and F and Population C. These potential impacts would be permanent and therefore would be of high magnitude, should they occur.

10.4.19 The permanent fragmentation of badger habitat within the territorial boundaries of Social Group A and Population C would occur due to the physical presence of proposed scheme. This impact would be of medium magnitude.

10.4.20 The disturbance of foraging badgers associated with Population C due to lighting would occur during operation of the proposed scheme. This impact would be permanent for the duration of operation life of the proposed scheme. Given the availability of suitable foraging habitat elsewhere within the boundaries of this social group territory, this impact would be of low magnitude.

10.4.21 Pollution of foraging habitat resulting from road run-off could occur within the territories adjacent to the proposed scheme, comprising Social Groups A, B, D and F and Population C. As ingestion of pollution can lead to infertility or mortality of badgers, this potential impact would be permanent and therefore is of medium magnitude should it occur.

Bats

Construction

10.4.22 In the absence of mitigation, there is the potential for direct mortality of bats at Castlandhill, St. Margaret's Hope, Port Edgar, west of South Queensferry, Dundas North, Overton, Ross's Plantation, Kirkliston and Lindsay's Craigs due to habitat loss and other activities associated with construction of the proposed scheme. The range of this potential impact would be from medium to high magnitude depending on the area.

10.4.23 The loss of mature broad-leaved woodland at Port Edgar Barracks and west of South Queensferry, Milton and Dolphington and Kirkliston would result in the loss of foraging and roosting habitats for bats. The effect of this potential impact is assessed as being of medium magnitude.

10.4.24 Fragmentation of habitats would occur at Rosyth, Castlandhill, St. Margaret's Hope, North Cliff, North Queensferrry, South Queensferry, Port Edgar Barracks, West of South Queensferry, Dundas North, Milton and Dolphinton, Carmelhill and Muriehall, Humbie, Swineburn, Kirkliston, Overton, Ross's Plantation and Lindsay's Craigs. These impacts would result in the severance of foraging and roosting habitats and commuting routes along which bats move between these habitats. However, these impacts would be temporary as areas used for construction and site compounds will be allowed to re-establish following the completion of construction. This impact would be of low magnitude.

10.4.25 In the absence of mitigation, potential impacts during construction resulting from noise, vibration and light disturbance would occur at Rosyth, Castlandhill Woods, St. Margaret's Hope, Kirkliston, Overton, Ross's Plantation and Lindsay's Craigs. These impacts have the potential to exclude bats from roost sites and displace bats from foraging habitats. However, these potential impacts would not be permanent as they would only occur for the duration of the construction phase and are therefore of medium magnitude.

10.4.26 Pollution resulting from accidental spills could potentially occur at St. Margaret's Hope/Marsh, Niddry Burn, the River Almond, Overton, Kirkliston, Ross's Plantation and Lindsay's Craigs. This would lead to a negative impact on bats as pollution of watercourses and vegetation would be detrimental to the availability of prey species. However, should it occur, the impact would be temporary as the vegetation and water quality would quickly recover once construction is completed and therefore would be of low magnitude.

Operation

10.4.27 Direct mortality of bats through collision with road traffic (RTAs) could occur as bats attempt to cross the proposed scheme at St. Margaret's Hope, Port Edgar Barracks and West of South Queensferry Dundas North, Milton and Dolphington, Dundas Central, Dundas South, Kirkliston,

Swine Burn, Carmelhill and Muriehall, Humbie, Ross's Plantation, Lindsay's Craigs and Overton. These potential impacts would range from medium to high magnitude.

10.4.28 The potential loss of habitat for foraging and roosting at Castlandhill Wood, St. Margaret's Hope, Port Edgar, west of South Queensferry, Dundas North and the bat commuting route along the A90 to A8000 bus link would occur during operation resulting in the reduction of suitable foraging, roosting and commuting habitats for bats. Severance caused by loss of habitat would lead to deterioration in the suitability of remaining habitat fragments at St. Margaret's Hope, South Queenferry, Port Edgar Barracks, West of South Queensferry, Dundas North, Central and South, Milton and Dolphington, Swine Burn, Carmelhill and Muriehall, Humbie, Kirkliston, Overton, Ross's Plantation and Lindsay's Craigs. Should this occur, the impact would be permanent and therefore would be of high magnitude.

10.4.29 In the absence of mitigation, potential disturbance due to traffic noise and road lighting would be a negative impact at St. Margaret's Hope, Port Edgar, South Queensferry, west of South Queensferry, Dundas North, Milton and Dolphington, Swineburn, Kirkliston, Ross's Plantation, Lindsay's Craigs and Overton. The impact would be permanent and would range from low to medium magnitude.

10.4.30 Potential pollution at St. Margaret's Hope, Swine Burn, Ross's Plantation, Lindsay's Craigs and Overton resulting from accidental spills could lead to a negative impact as pollution in watercourses and vegetation would be detrimental to the availability of prey species. However, the impact would be temporary as the vegetation and water quality would quickly recover following a pollution event and therefore would be of a low magnitude.

Terrestrial Breeding and Wintering Birds

Construction

10.4.31 Throughout the proposed scheme, in the absence of mitigation, the direct loss of suitable breeding and wintering habitat to accommodate access roads, site compounds and other temporary work areas could lead to the mortality of bird species. However, the loss of habitat is unlikely to affect the population status of recorded species and therefore would be of low magnitude.

10.4.32 Habitat loss would also result in disturbance, adding to the disturbance generated through other construction activities such as noise generated through the use of heavy plant or the presence of works personnel. However, these impacts would be limited to the duration of the construction phase and would therefore be temporary and of low magnitude.

10.4.33 Pollution potentially occurring within the vicinity of site compounds or other temporary areas due to accidental spills could have an impact on bird species. However, this impact would be restricted to the construction phase and ecosystem function would quickly re-establish and therefore would be of low magnitude.

Operation

10.4.34 Direct mortality caused by RTAs associated with bird species flying across the operational carriageway could occur during operation, for example, low flying species such as blackbird (*Turdus merula*). However, this impact is unlikely to affect the population status of recorded species and therefore would be of low magnitude.

10.4.35 The loss of habitats and resulting fragmentation of remaining areas of habitat would occur within the footprint of the proposed scheme. These potential impacts would be of low magnitude with respect to habitat fragmentation and medium magnitude with respect to habitat loss.

10.4.36 The operation of the proposed scheme would lead to disturbance of bird species. This impact would remain for the duration of the operational phase of the proposed scheme. However, as this

impact is likely to be localised within close proximity of the proposed scheme coupled with the habituation of birds to disturbance, the impact would be of low magnitude.

10.4.37 Potential pollution caused by road run off from the operational scheme in the absence of mitigation could be a negative impact. However, the effects of this impact would be temporary and therefore would be of low magnitude throughout the proposed scheme except at St. Margaret's Marsh where there is limited potential for the recovery of this sensitive wetland habitat and therefore, should this occur, the effect would be permanent resulting in an impact of medium magnitude.

Otter

Construction

10.4.38 In the absence of mitigation, the potential mortality of otters resulting from collision with construction traffic would result in a negative impact. Similarly, the potential destruction of occupied otter holts due to habitat loss could result in the mortality of otters. Should these impacts occur, they would be of high magnitude.

10.4.39 The construction phase would lead to a temporary reduction in important habitat and foraging resources due to the removal of woodland areas, fragmentation of the coastline, realignment of watercourses such as at Swine Burn and severance of the Niddry Burn and the River Almond. These impacts would result in a decline in the available resources resulting in an impact of medium magnitude.

10.4.40 Disturbance resulting from noise, vibration and light could have a negative impact on otters although these would be limited to the construction phase and therefore would be of medium magnitude.

10.4.41 Potential pollution resulting from site compounds or construction activities close to watercourses such as the Swine Burn, Niddry Burn and the River Almond could lead to a reduction in the quality of otter habitat within the study area. This impact would be temporary as there is the potential for water quality to recover quickly after a pollution event and therefore this potential impact would be of low magnitude.

Operation

10.4.42 In the absence of mitigation, there is a risk of mortality of otters resulting from RTAs along the whole proposed scheme, especially in areas such as Swine Burn, Niddry Burn and the River Almond where previous RTAs have been recorded. This potential impact would be of high magnitude.

10.4.43 The operation of the proposed scheme in the absence of mitigation would result in the loss and fragmentation of habitat and severance of remaining areas important to otter. These impacts are considered to be permanent and therefore would be of medium magnitude.

10.4.44 Potential pollution resulting from road run off and spills during the operation of the proposed scheme could lead to a negative impact on otters. These impacts however are likely to be temporary as water quality will quickly recover after the pollution event and therefore would be of low magnitude.

Water Vole

10.4.45 Water vole was not recorded within the study area and therefore there are no identified impacts.

Red Squirrel

10.4.46 Red squirrel was not recorded within the study area and therefore there are no identified impacts.

Amphibians

Construction

10.4.47 The potential for direct mortality of amphibians between the A90 and Ferry Loch and in all other suitable areas of terrestrial habitat throughout the proposed scheme could occur in the absence of mitigation due to habitat loss and other activities associated with construction of the proposed scheme. This impact would be of high magnitude.

10.4.48 The temporary loss of habitat and disturbance to the west of Ferry Loch and in all other suitable terrestrial areas would lead to a negative impact. Artificial light affects feeding behaviour in nocturnal amphibian species and therefore could impact on species numbers and breeding behaviour, the severity of this would be dependant on the proximity of waterbodies to construction sites and the time of year. The effects of these impacts would however be temporary, lasting only for the duration of the construction phase and therefore would be of low magnitude.

Operation

10.4.49 Throughout the proposed scheme in the absence of mitigation, potential direct mortality resulting from the loss of suitable terrestrial habitat for amphibians would lead to a negative impact. Mortality would increase during breeding migrations in early spring and the impact of such mortality on the wider amphibian population would vary according to factors such as the proximity of the proposed scheme to waterbodies, the proportion of population which crosses the proposed scheme and the volume of traffic. This potential impact would remain during operation of the proposed scheme and therefore would be of high magnitude.

10.4.50 The fragmentation of habitat due to habitat loss within all areas of suitable terrestrial habitats throughout the proposed scheme would also result in a permanent impact since the connectivity and suitability for amphibians of the remaining habitat fragments will be reduced. This impact is of medium magnitude.

Reptiles

10.4.51 Reptiles were not recorded within the study area and therefore there are no identified impacts.

Terrestrial Invertebrates

Construction

10.4.52 In the absence of mitigation, construction activities leading to general disturbance and soil compaction could result in negative impacts at Ferry Hills SSSI, St. Margaret's Marsh SSSI, St. Margaret's Hope Wood, Dundas Wood North, Dolphington Burn Wood, Ross's Plantation, Parkland West Kirkliston and Lindsay's Craigs. These impacts would be temporary, occurring only for the duration of the construction phase. The impact of disturbance would be of low magnitude whilst the impact of soil compaction would be of medium magnitude.

10.4.53 Potential habitat fragmentation at Ferry Hills SSSI, Dolphington Burn Wood and Dundas Wood North due to construction activities would result in a negative impact, the effects of which would be permanent and therefore of medium magnitude.

10.4.54 At St. Margaret's Marsh SSSI, St. Margaret's Hope Wood and Dolphington Burn Wood, in the absence of mitigation potential changes to hydrology could result in a permanent negative impact, as the hydrological changes would remain after construction. This potential impact would be of medium magnitude.

Operation

10.4.55 Direct mortality resulting from permanent habitat loss could occur at St. Margaret's Marsh SSSI, Ferry Hills SSSI, St. Margaret's Hope Wood, Dolphington Burn Wood, parkland to the west of Kirkliston, Dundas Wood North, Ross's Plantation and Lindsay's Craigs in the absence of mitigation. This potential impact would range from medium to high magnitude.

10.4.56 Permanent fragmentation of habitats by the footprint of the proposed scheme would occur at Ferry Hills SSSI, Dolphington Burn Wood and Dundas Wood North in the absence of mitigation and would be of medium magnitude.

10.4.57 Disturbance could occur at St. Margaret's Marsh SSSI, St. Margaret's Hope Wood, Ferry Hills SSSI, Dundas Wood North, Dolphington Burn Wood, Ross's Plantation and parkland to the west of Kirkliston. The effect of this impact would be temporary as it results from infrequent mowing of road and junction banksides, although these impacts could result in the loss in over-wintering sites, loss in the structural diversity of the habitat and a reduction in invertebrate species abundance and diversity. This impact would be of low magnitude.

10.4.58 The risk of pollution is a potential negative impact throughout the scheme. However, this impact is not likely to be long lasting as vegetation is likely to quickly recover and therefore would be of a low magnitude.

River Habitat

Construction and Operation

10.4.59 Bank modifications, road crossings and realignments on the Swine Burn and Niddry Burn could result in the long-term loss and fragmentation of riparian habitat. Conversely, works associated with the construction of culverts, embankments and dewatering would result in only short-term changes to hydrology on the Swine Burn and Niddry Burn. Water pollution caused by accidental spills and surface run-off on the Swine Burn, Niddry Burn and the River Almond would lead to loss of riparian habitat and reduced water quality. However, this impact would be minimised through the natural flow of clean water from upstream. These impacts would therefore be of medium magnitude.

Aquatic Macroinvertebrates

Construction

10.4.60 In the absence of mitigation, the new culvert on the Swine Burn and culvert extensions on the Swine Burn and Niddry Burn would result in the loss of the invertebrate community leading to a negative impact. This impact would result from the dewatering of these sections during construction and the direct removal of substrate. Invertebrates within the local community would be affected during the construction period, but once flow is returned to in-channel construction areas, it is likely that recolonisation would occur through drift from upstream areas. The range of these potential impacts would therefore be of low to medium magnitude.

10.4.61 Negative impacts could occur on the Swine Burn and Niddry Burn as a result of fragmentation of invertebrate habitat and changes to hydrology caused by in-channel works during construction. However, the impact on the local community is likely to be restricted to construction, as the connectivity of the watercourse will be recovered once construction of the proposed scheme is complete. The impact would therefore be of low magnitude.

10.4.62 The impacts on the Swine Burn and Niddry Burn from potential sediment release and pollution from the construction works could negatively impact the downstream watercourse and lead to the deterioration of invertebrate substrate and habitat. This risk would be confined to the construction phase, with freshwater flow assisting the recovery of the water quality, while recolonisation from

upstream invertebrate communities would re-build the community once the construction is complete. These potential impacts would be of low magnitude on the Swine Burn and Niddry Burn, and on the River Almond, into which both burns flow.

Operation

10.4.63 The permanent loss and fragmentation of invertebrate habitat during operation would lead to a negative impact on the Swine Burn as a result of the footprint of the new culvert, and on the Niddry Burn, as a result of the culvert extensions. The potential impact of habitat loss would be of medium magnitude, while fragmentation would be of low magnitude.

10.4.64 In the absence of mitigation, changes to hydrological patterns arising from the presence of culverts or culvert extensions would be expected to lead to the migration of scour or deposition patterns in the vicinity of the culvert on the Swine Burn and culvert extensions on the Niddry Burn. This would lead to alteration in the availability of suitable invertebrate habitat and in the complexity of habitat present. However, the patterns of scour and deposition in these watercourses would be expected to tend to a natural equilibrium over time through the physical disturbance of flood flows. This potential impact would be of medium magnitude.

10.4.65 Potential sedimentation and pollution from road run-off during the operation of the proposed scheme would have a negative impact on the invertebrate communities and the quality of their habitat and water within the Swine Burn, Niddry Burn and River Almond. Some replenishment of water and habitat quality is anticipated through the influence of unpolluted water from upstream and the removal of a proportion of excess sedimentation through flood flows. These potential impacts would be of low magnitude.

Freshwater Macrophytes

Construction

10.4.66 The loss and fragmentation of macrophyte habitat would occur on the Swine Burn during the construction of culverts and realignment of the watercourse. Once the construction period is complete and watercourse connectivity is restored, fragmentation of macrophyte habitat would cease and communities will be exposed to colonisation of macrophytes from upstream. This potential impact would therefore be of low magnitude.

10.4.67 Potential pollution due to accidental spills and construction site run-off in the absence of mitigation could occur within the vicinity of construction areas in the Swine Burn, Niddry Burn and River Almond, affecting the quality of water and habitat that support the macrophyte communities present. It is likely that water quality would improve following this construction phase through replenishment from unpolluted flow from upstream, which would encourage the restoration of macrophyte community. This potential impact would therefore be of low magnitude.

10.4.68 Changes to hydrology caused by construction works (culvert construction and extension, in addition to channel realignment) on the Swine Burn and Niddry Burn would result in a loss of aquatic habitat for macrophytes due to the potential migration of scour and deposition patterns. However, recovery and recolonisation may be possible once construction is complete, when the influence of changed flow patterns may be mediated through the effect of flood flows tending to a natural equilibrium. This potential impact would be of low magnitude.

Operation

10.4.69 Potential changes to hydrology caused by construction works (culvert construction and extension, in addition to channel realignment) on the Swine Burn and Niddry Burn would result in a loss of aquatic habitat for macrophytes due to the potential migration of scour and deposition patterns. However, recovery and recolonisation may be possible once construction is complete, when the

influence of changed flow patterns may be mediated through the effect of flood flows tending to a natural equilibrium. This impact would be of low magnitude.

10.4.70 Road run-off during the operational life of the proposed scheme in the absence of mitigation could result in the pollution of the Swine Burn, Niddry Burn and River Almond, thereby reducing water and habitat quality for macrophyte communities. However, it is expected that unpolluted water from upstream would replenish the affected area and lead, in time, to improvements in water quality and supporting the potential for recovery of macrophyte communities. This impact would therefore be of low magnitude.

10.4.71 Linn Mill Burn could be impacted from pollution which may be caused by run-off from the operational scheme, although due to the distance of the burn from the proposed scheme, it is unlikely to have a notable effect upon the macrophyte communities. This potential impact would therefore be of low magnitude.

10.4.72 Changes to hydrology on the Swine Burn and Niddry Burn could occur through channel realignment and the presence or extension of culverts. This is likely to result in the alteration of macrophyte habitat complexity and availability in the local area and although this is unlikely to be restored without intervention, there is the possibility that flood flows will assist the development of a new natural equilibrium. This impact would therefore be of low magnitude.

Freshwater Fish

Construction

10.4.73 The potential for direct mortality would be limited to the areas dewatered for alignment or culvert construction at Swine Burn and Niddry Burn in the absence of mitigation. However, recolonisation of these areas would be possible once construction is complete and therefore the impact would be of medium magnitude.

10.4.74 Disturbance through noise and vibration would be likely in the Swine Burn and Niddry Burn. This would most likely be shown by avoidance of the area by migratory fish in the period until construction is complete. This potential impact would be of low magnitude on the Swine Burn, Niddry Burn and River Almond.

10.4.75 Potential impacts caused by the loss and fragmentation of habitat in the Swine Burn and Niddry Burn would be limited to areas that would be dewatered for realignment and culvert works. Once watercourse continuity is restored following completion of construction works, access to habitat would be restored and habitat will no longer be fragmented. The impact of habitat loss would be of low magnitude and medium magnitude for habitat fragmentation.

10.4.76 Potential re-suspension of sediment could impact freshwater fish in the Swine Burn, Niddry Burn and River Almond during the period of construction and, following completion of construction, would be expected to respond to flood flows by tending towards a natural equilibrium of sedimentation. This impact would be of low magnitude. Similarly, potential impacts from the construction site and compounds would be likely, however as clean water from upstream would replenish conditions once construction is complete, this impact would be of low magnitude.

10.4.77 Light pollution would impact on freshwater fish in the Swine Burn and Niddry Burn in the absence of mitigation, however this impact would be limited to the construction period with recovery expected once this is complete. This impact would be of low magnitude.

Operation

10.4.78 Loss of habitat for fish could occur in the Swine Burn and Niddry Burn within the footprint of culverts and watercourse realignments. This potential impact would be of medium magnitude.

10.4.79 In the absence of mitigation, fragmentation of freshwater habitats would result from the installation of culverts and is likely to inhibit the free passage of fish upstream of culvert locations on the Swine Burn and Niddry Burn. This impact would be of medium magnitude.

10.4.80 Potential pollution caused by road run-off could impact the Swine Burn, Niddry Burn and the River Almond, however cleaner water would be expected to replenish the affected areas. Although this impact is likely to be localised, it has the potential to affect areas further downstream, leading to an impact of high magnitude. In addition, artificial lighting of road crossings would cause light pollution on the Swine Burn, however this would be limited to areas of watercourse in the immediate vicinity of the crossings. This potential impact would range between low to medium magnitude.

10.5 Mitigation

Introduction

10.5.1 This section outlines mitigation measures to avoid, reduce or offset the adverse effects of the proposed scheme in accordance with best practice guidance and UK, Scottish and local government environmental impact, planning and sustainability policies.

10.5.2 The principles and objectives for mitigation associated with the proposed scheme have been developed through an iterative process with the Jacobs Arup's design team and discussion with SNH, SEPA and other relevant stakeholders (Chapter 6: Consultation and Scoping).

10.5.3 As noted in paragraph 10.2.27, proposed mitigation will follow an hierarchical approach, that should be adopted, where possible, in the following order (IEEM 2006; SNH 2005; Scottish Executive, 1999):

- avoid adverse impacts in the first instance;
- where avoidance is not possible, reduce the adverse impacts with the aim of avoiding or reducing impacts; and
- where significant adverse residual impacts remain, measures to offset the adverse impacts at a site-specific level may be required.

10.5.4 Mitigation includes best practice methods and principles applied to the proposed scheme as a whole (generic measures) and site-specific mitigation measures applied to individual locations (specific measures) as detailed in Appendix A10.7, Sections 3 (Generic Mitigation) and 4 (Specific Impacts, Mitigation and Residual Impacts).

10.5.5 Details of pre-construction mitigation are detailed in Chapter 22 (Summary of Potential Impacts), Chapter 23 (Schedule of Environmental Commitments) and Chapter 24 (Summary of Significant Residual Impacts).

10.5.6 Contractors will be required to comply with any requirements for protected species licences (mitigation items TE14/TE30). More information on this is provided in Appendix A10.7 and Chapter 23 (Schedule of Environmental Commitments). Contractors will also be required to comply with the scheme's Code of Construction Practice. The Code of Construction Practice is provided as Appendix A19.1 to Chapter 19 (Disruption Due to Construction).

Management Plans

10.5.7 Mitigation for terrestrial habitats and a range of species will be presented within an outline Environmental Management Plan (EMP). The outline EMP will specify where and when mitigation should be undertaken including a timetable of actions and will form part of the contract documents to ensure delivery of mitigation specified within the ES (mitigation item TE2).

Generic Mitigation

10.5.8 Generic mitigation measures that apply to all ecological receptors across the proposed scheme are outlined in full in Appendix A10.7, Section 3 and include the following examples:

- pre-construction surveys will be undertaken as appropriate prior to commencement of project works in order to identify sensitive sites and vulnerable species (mitigation item TE3);
- plant and personnel will be constrained to a prescribed working corridor through the use of temporary barriers, thereby minimising damage to habitats and potential direct mortality and disturbance to species (mitigation item TE4);
- works compounds, storage sites and access roads will avoid, as far as possible, areas of woodland, wetland and scrub to prevent degradation of habitat (mitigation item TE5);
- suitably constructed structures including overbridges, underpasses, and fencing, with associated planting, will be created on commuting corridors (mitigation item TE6);
- reducing in-channel works and translocating channel substrate (where applicable) (mitigation item TE7);
- adherence to best practice guidance with respect to culvert, detention pond and catchpit design (mitigation item W1);
- adherence to best working practices in relation to works within salmonid watercourses (mitigation item TE8); and
- any trenches dug during operations will be covered at the end of each day or mammal ramps will be positioned in such a way that trapped mammals may escape (mitigation item TE10).

Specific Mitigation

10.5.9 In addition to the provision of generic mitigation measures, a range of specific mitigation measures are proposed to avoid or reduce impacts at specific locations throughout the proposed scheme. These are summarised below, described in full in Tables 4.2 - 4.25 in Appendix A10.7 and illustrated in Figure 12.4.

10.5.10 With respect to the provision of fencing and dry mammal underpasses, it should be noted that the locations are indicative and are subject to change following pre-construction surveys and subsequent consultation with SNH.

Terrestrial Habitats

Construction and Operation

10.5.11 No site-specific mitigation measures are proposed with respect to the temporary loss of habitat associated with the construction phase of the proposed scheme.

10.5.12 The application of generic mitigation is sufficient to avoid or reduce the impacts associated with construction (Appendix A10.7, Table 3.2).

10.5.13 Locations for habitat creation were identified such that where applicable at least a 1:1 replacement was achieved and were determined by pinpointing locations near the identified habitat loss that would be contiguous with the existing habitat. Additionally, it was designed, where possible, to reduce fragmentation of existing habitats. Due to topographic and landscape constraints, habitat creation was not always possible in areas immediately adjacent to or nearby areas lost. In such situations, the nearest locations to the proposed scheme that would be contiguous with existing habitats were identified as appropriate for habitat creation. An exception to the habitat replacement strategy is proposed at St. Margaret's Marsh. In consultation with SNH, a mitigation strategy to enhance the habitat has been adopted. The site's management statement (SNH, 2008) indicates that the natural features of the site i.e. saltmarsh and transition marsh (reedbed) are in

unfavourable condition. Without management, the site is likely to continue to deteriorate. A number of options for improving the site are potentially available and a commitment to implement a management strategy in consultation with SNH to enhance the site's condition has been agreed.

10.5.14 Bluebell is a protected plant species under Schedule 8 of the WCA 1981 and along with maiden pink is found on the Edinburgh and the Fife LBAPs. The translocation of these priority plant species will be undertaken prior to any construction works (mitigation item TE46-TE47) under the supervision of an Ecological Clerk of Works (mitigation item TE1). Translocation is likely be either by landowner agreement or to a suitable location within the land made available for the proposed scheme. All works will be undertaken in accordance with a detailed method statement to be prepared by the Contractor in advance of translocation.

10.5.15 Riparian planting along the new alignment of the Swine Burn will result in a greater diversity of species and habitats than is currently present.

10.5.16 Habitat creation (mitigation item TE24) using mature broad-leaved and mixed plantation woodland of native species of local provenance (unless otherwise stated) will be undertaken at the following locations:

- mixed woodland planting adjoining existing woodland west of M9 Junction 1A;
- replacement planting south of Queensferry Junction between ch2700-2900; and
- mixed woodland planting west of Ferrytoll Junction within the agricultural field adjoining Castlandhill Wood.

10.5.17 Severance of woodlands and hedgerows will be mitigated as follows (using species of local provenance where appropriate - mitigation item TE25):

- hedgerow tree planting along existing hedge south of Inchgarvie House;
- hedgerow and tree planting along the access road north of Queensferry Junction (ch3700-4300) and on the western side of the proposed scheme (ch3600-3900);
- hedgerow and tree planting alongside the A904 west of Queensferry Junction and along the minor road southwest of Queensferry Junction;
- hedgerow and tree planting alongside the proposed scheme east of Queensferry Junction (ch2500-3500) and alongside the bus links east of ch500; and
- hedgerow planting north of Lindsay's Craigs Woodland alongside M9 WB from the M9 Spur Interchange Link to the Oveton Road (ch1700-2200).

10.5.18 Riparian habitat planting will be undertaken along Niddry Burn and Swine Burn to offset the loss of wetland and riparian habitat (mitigation items TE26/TE34).

10.5.19 Management prescriptions (included within the outline EMP – mitigation item TE2) will be developed for these areas of site-specific habitat creation and soft landscaping, in accordance with guidance from the Scottish Executive Trunk Road BAP and through consultation with SNH and other stakeholders.

10.5.20 Table 10.7 provides an estimate of terrestrial habitat change within the study area of the proposed scheme in respect to pre-construction and post-construction areas of Phase 1 habitats. The post-construction figures take account of both anticipated habitat loss to construction and habitat created or changed as a result of mitigation, for example, 12.5ha of arable land will be lost to construction and operation of the proposed scheme with a further 17.1ha lost to replacement planting.

Table 10.7: Estimate of Habitat Change (Construction and Operation)

Habitat Type	Total area lost to construction and operation (exc. mitigation) (to nearest 0.1ha)	Mitigation (planting, to the nearest ha)	Habitat Change (inc. mitigation) (to the nearest 0.1ha)
Amenity grassland	<0.1	0	<0.1
Arable land	12.5	0	-17.1
Bare Ground	<0.1	0	0
Built up/Industrial/ Building sites	<1	0	<1
Dense/Continuous scrub	1.0	10.3	+5.8
Ephemeral/short perennial	0	0	<0.1
Improved grassland	1.4	0	-3.5
Other tall ruderal	<1	0	-1.1
Plantation broadleaved woodland	1.2	0	-3.2
Plantation coniferous woodland	<1	0	<1
Plantation mixed woodland	<1	19.9	+19.2
Poor semi-improved grassland	2.4	0	-4.9
Scattered scrub	1.1	0	-1.1
Semi-improved neutral grassland	<0.1	36.2	35.0
Semi-natural broadleaved woodland	4.5	0	-1.2
Swamp	<1	0	<1
TOTAL	**25.6**	**66.4**	**-**

Badgers

Construction

10.5.21 The loss of a badger sett within the territory of Social Group A will be mitigated by the provision of a replacement sett that will be provided prior to the exclusion of the original sett (mitigation item TE27). The proposed location is confidential and therefore identified in Appendix A10.5 but not shown on Figure 12.4.

Operation

10.5.22 Badger-proof fencing will be provided at ch1700-4300 (mitigation items TE40-TE41). A badger underpass (mitigation item TE44), with planting and fencing designed to direct badgers to the underpass, will be provided between ch2500 and ch3100.

10.5.23 The loss of badger habitat suitable for the excavation of setts, within the territory of Badger Population C will be mitigated through the creation of broadleaved woodland (mitigation items TE24-TE25, see Terrestrial Habitats).

10.5.24 Replacement setts will be created (mitigation item TE27) for the loss of a main and two outliner setts within the territorial boundaries of Badger Population C. Where possible, replacement setts will be created within the same area of woodland and where this is not possible an alternative site where there is a clear path leading to an existing sett will be selected.

Bats

Construction

10.5.25 Existing flight lines will be retained (mitigation item TE28) along:

- the existing culvert on the Niddry Burn by keeping the culvert open at night and maintaining 'dark areas' through which bats can fly;
- the main alignment and under the Forth Road Bridge during construction at night by the sensitive use of lighting and maintaining 'dark areas';
- Swine Burn, the B9080 and the River Almond by ensuring that culverts and bridges are not obstructed at night;
- the A8000, minor road at White Gate, the A904 (and Builyeon Road), the hedgerow at Inchgarvie (CR2), the Society Road (CR1) by keeping commuting routes open and unlit at night; and
- the A90 to A8000 bus link.

10.5.26 Strict adherence to light pollution mitigation measures (mitigation item TE19) in the vicinity of the following:

- the edge of Castlandhill Woods;
- St. Margaret's Hope Wood or commuting routes;
- Port Edgar Barracks;
- Society Road;
- Inchgarvie;
- Echline Strip;
- foraging and commuting habitat at Dolphington Wood and adjacent linear habitats;
- the roost at Milton Cottage;
- Ross's Plantation;
- Kirkliston Burn and Swine Burn and their associated aquatic and wetland habitat;
- Niddry Burn;
- Lindsay's Craigs; and
- River Almond.

Operation

10.5.27 Bat boxes will be provided (mitigation item TE45) in each of the following areas (between 5 and 12, depending on location) to offset the loss of bat roosting habitat:

- Castlandhill Woods;
- St. Margaret's Hope;
- East Shore Wood; and
- Echline Strip.

10.5.28 Mitigation measures to prevent disturbance to bats (mitigation item TE2) will be required at the following locations:

- St. Margaret's Hope Wood;
- Port Edgar Barracks and surrounding habitats;
- Echline Strip;
- South Queensferry;
- Milton and Dolphington;
- Hopetoun Fisheries Pond;
- Kirkliston; and
- Ross's Plantation, Lindsay's Craigs and Overton.

Terrestrial Breeding and Wintering Birds

10.5.29 Measures to mitigate potential impacts to qualifying species of the Firth of Forth SPA are provided in Chapter 11 (Estuarine Ecology), Section 11.5 (Mitigation).

10.5.30 No site-specific mitigation measures are proposed during construction and operation of the proposed scheme for other species of breeding and wintering birds.

Otter

10.5.31 All potential pollution impacts associated with construction and operation will be addressed by provision of pollution prevention generic mitigation measures (mitigation items TE10/TE23/TE29) detailed in Chapter 9 (Water Environment).

Construction

10.5.32 Temporary fencing and covering of pits (mitigation item TE42) will be required at the River Almond, Niddry Burn, Swine Burn and coastal areas north and south of the Firth of Forth to prevent otters being killed or injured as a result of construction activities. In addition, a European Protected Species (EPS) licence (mitigation item TE30) will be required at Niddry Burn for likely disturbance of otter lying up sites.

10.5.33 Fragmentation will be prevented by providing unimpeded access to existing culverts at night on the River Almond, Niddry Burn and Swine Burn, and by installing a temporary mammal underpass at the bund/access platform at the south shore of the Firth of Forth (mitigation item TE20).

Operation

10.5.34 Habitat loss will be mitigated by the provision of an artificial holt at Niddry Burn (mitigation item TE31).

10.5.35 Disturbance will be reduced by sensitive use of lighting and through use of bunds and noise barriers at the River Almond, Niddry Burn, Swine Burn, Linn Mill Burn and coastal areas north and south of the Firth of Forth where required (mitigation item TE32).

10.5.36 Mammal-proof fencing (mitigation items TE37/TE43) will be provided alongside the B981 realignment to the north of the Firth of Forth and south of the Forth alongside M9 Junction 1A ch300-2700 and the M9 Spur to prevent direct mortality of otters from RTA. In addition, the proposed culvert at Swine Burn (ch1850) will be wide enough and have integral mammal ledges to enable otters to use it. This structure will also help reduce the impacts of severance at these locations.

10.5.37 Habitat creation proposed at M9 Junction 1A including riparian habitat planting and detention basin enhancement will ensure that these habitats are retained in the long term (mitigation item TE24). Disturbance will be reduced by strict adherence to light pollution mitigation measures to reduce light spill onto burns and coastal areas at M9 Junction 1A and the new bridge itself (mitigation item TE32).

Water Vole

10.5.38 No evidence of water vole was recorded within the study area and as such mitigation measures are not required.

Red Squirrel

10.5.39 No evidence of red squirrel was recorded within the study area and as such mitigation measures are not required.

Amphibians

10.5.40 Terrestrial habitat adjacent to the east of Ferrytoll Junction (ch7175-7500) will be subject to a destructive hand search prior to construction works (mitigation item TE33).

10.5.41 Temporary amphibian-proof fencing will be required at ch7200-7500 to prevent amphibian mortality during construction (mitigation item TE33).

10.5.42 All surveyed ponds and their associated terrestrial habitat are not likely to be impacted by the proposed scheme, therefore mitigation is not proposed.

Reptiles

10.5.43 Surveys have indicated that reptiles are likely to be absent and as such, there is no requirement for mitigation measures.

Terrestrial Invertebrates

10.5.44 No specific mitigation is proposed for terrestrial invertebrates although the mitigation prescribed for other taxonomic groups will contribute to mitigating the effects of the proposed scheme on terrestrial invertebrate populations.

River Habitat

Construction

10.5.45 Limited site-specific mitigation measures are proposed during the construction phase of the scheme for the river corridor, but positive mitigation is detailed below for the Swine Burn.

10.5.46 The realignment of the Swine Burn will be designed to improve morphological diversity and habitat complexity, thereby improving the habitat quality in the burn. Realignments in low gradient areas will be designed to minimise sedimentation and in high gradient areas to minimise erosion. The opportunity to create and enhance habitat will be incorporated through the inclusion of meander bends, secondary channels and riparian zones, where appropriate (mitigation item TE34).

Operation

10.5.47 A range of crossing structures will be implemented on a site by site basis to reflect the differing sensitivities of each watercourse:

- Swine Burn: one new depressed invert box culvert and a culvert extension;

- Niddry Burn: a culvert extension; and
- River Almond has no new or modified crossings proposed.

10.5.48 The new culvert and culvert extensions will be designed to prevent habitat fragmentation and reduce habitat loss (mitigation item TE20). To maintain in-stream habitat diversity, the base of the culvert will be set below bed level and lined with natural substrate. Initially, substrate in the culvert will comprise imported material of a similar size to that of the original channel and, specified to ensure that the sediment does not wash out at times of high flow or silt up in times of low flow. Culvert gradients will not differ markedly from existing conditions so as to avoid altering flow patterns and resulting habitat loss and to avoid excessive siltation or erosion.

10.5.49 Detention ponds will be used to prevent pollutants from road run-off from reaching the watercourses and to attenuate suspended solids (mitigation item TE38). The ponds will be periodically dredged and contaminant removed from the site. Similarly, filter drains and catchpits will be regularly inspected and maintained, as necessary.

Aquatic Macroinvertebrates

Construction

10.5.50 Site-specific mitigation measures proposed during construction of the scheme for river habitat also serve to mitigate for potential impacts upon aquatic macroinvertebrates communities.

10.5.51 The translocation of some of the main channel substrate during construction will enable a proportion of the macroinvertebrate assemblage present in the substrate to survive the dewatering process (mitigation item TE35).

Operation

10.5.52 Culverts, detention ponds and catchpits will be designed and managed as previously described to reduce impacts on the river corridor.

Freshwater Macrophytes

10.5.53 No site-specific mitigation measures are proposed during construction and operation of the scheme for freshwater macrophytes, however generic mitigation is detailed in Section 10.5 (Mitigation).

Freshwater Fish

Construction

10.5.54 Prior to the construction of the new culvert on Swine Burn, the watercourse should, where practical, be diverted to a temporary channel to maintain habitat continuity and reduce fragmentation (mitigation item TE20). This channel would be lined with geotextile and covered with appropriately sized particles from the main channel. The substrate provides a temporary habitat and prevents erosion of the geotextile. Where this approach is impractical, the pumps and pipes used to transfer water from upstream to downstream of the dewatered construction site will be screened to exclude ingress of fish of all ages.

10.5.55 Fish will be removed from the dewatered areas required for the construction of culverts, bridges and watercourse realignments and transferred to the diverted watercourse (where available) or returned to the existing watercourse either upstream or downstream of the proposed scheme . On reinstatement of any diversion channel, any fish remaining in the diverted watercourse will be returned, in the same way, to the main channel (mitigation items TE20/TE36).

10.5.56 Adherence to light pollution mitigation measures (mitigation item TE18) will avoid disturbance to the behaviour of fish, in particular migratory fish. The potential for light spillage outwith the boundary of construction sites and site compounds will be controlled according to BS 5489 requirements and following guidance on lighting including the use of directional lighting or preventative measures such as installation of shields, hoods or limiting the height of lighting columns. Further details of lighting requirements are described in Appendix A10.7, Section 3 (Generic Mitigation), Table 3.2.

Operation

10.5.57 The new Swine Burn culvert and other culvert extensions will be designed and managed as described in the River Habitat section.

Further Work

Bats

10.5.58 Additional roost surveys will be required at locations detailed in Section 10.5 (Mitigation) where bat boxes are to be provided in order to determine the specification and quantity required.

Monitoring

10.5.59 Monitoring of mitigation measures such as replacement setts, artificial holts and bat boxes will be undertaken for approximately five years into the operational phase. In addition, bat boxes will be maintained in order to ensure the continued provision of suitable habitat.

10.5.60 The translocation of terrestrial plants such as bluebells will be subject to monitoring during the operational phase. Translocation target sites would further benefit from monitoring as any encroachment by invasive weeds could be detected and a system of management implemented.

10.6 Residual Impacts

10.6.1 This section provides a summary description of key residual impacts after the implementation of mitigation measures outlined in Section 10.5 (Mitigation). Residual impacts for each considered receptor are detailed in full in Tables 4.2 - 4.25 in Appendix A10.7.

Terrestrial Habitats

10.6.2 A significant positive residual impact of medium magnitude would remain at Swine Burn through the provision of riparian planting that will provide a greater diversity than currently present. There are no other predicted significant residual impacts during construction and operation of the proposed scheme. However, it should be noted that a significant positive residual impact of medium magnitude could be achieved through the management of wetland habitats at St. Margaret's Marsh SSSI during operation, pending further consultation and development/agreement of management prescriptions between Transport Scotland and SNH.

Badger

10.6.3 There are no predicted significant residual impacts.

Bats

10.6.4 During construction, significant negative residual impacts would remain at Port Edgar Barracks and West of South Queensferry due to habitat fragmentation. These impacts would be of negligible magnitude.

10.6.5 Significant positive residual impacts of high magnitude are predicted at North and South Queensferry during operation, due to the provision of a third crossing over the Firth of Forth which will facilitate the exchange of bats between Fife and the Lothians.

Terrestrial Wintering and Breeding Birds

10.6.6 There are no predicted significant residual impacts.

Otter

10.6.7 During construction, significant negative residual impacts of low magnitude would remain at the Swine Burn, Niddry Burn and River Almond due to temporary habitat loss, fragmentation, and disturbance are likely to cause temporary disruption of otter movements. However, in the long-term these impacts are not considered to be significant.

10.6.8 There are no predicted significant residual impacts during operation.

Water Vole, Red Squirrel, Amphibians, Reptiles and Terrestrial Invertebrates

10.6.9 There are no predicted significant residual impacts.

River Habitat, Aquatic Macroinvertebrates, Freshwater Macrophytes and Freshwater Fish

10.6.10 There are no predicted significant residual impacts during construction.

10.6.11 There are however predicted significant positive residual impacts of medium magnitude during operation for all receptors through the inclusion of meanders and bends as part of the Swine Burn realignment, in addition to the provision of riparian planting. A significant positive impact of low magnitude for freshwater fish would remain due to increased cover provided by the new culvert on the Swine Burn and extensions to existing culverts on Swine Burn and Niddry Burn.

10.7 Ongoing Design Development

Alternative Construction Compound

10.7.1 An addition to the scheme proposals is the inclusion of an alternative location for the construction compound to the west of South Queensferry. This alternative was identified in response to concerns raised by local residents during the ongoing consultation process, and it locates the compound further to the west.

10.7.2 This alternative site was identified subsequent to the completion of the assessment of potential impacts of the proposed scheme as reported in this chapter. An assessment of its impacts on ecology and nature conservation is provided separately in Chapter 19 (Disruption Due to Construction).

Ferry Hills Rock Cuts

10.7.3 The proposed scheme design as assessed in this chapter includes significant rock cuts to the north and south of Ferrytoll Junction. Detailed design may allow these rock cuts to be avoided or reduced. Design development indicates that there could be potential for a westward shift of the proposed scheme alignment of up to approximately 15m between approximate chainage ch7500-7800 (southwest of Jamestown) and ch8150-8500 (west of Hope Street Cemetery) to allow the rock cuts to be avoided.

10.7.4 Environmental review of this refinement indicates that this could reduce adverse impacts associated with the rock cuts without materially increasing other environmental effects. There would be no significant additional ecological impacts to the west of the amended alignment and it is

anticipated that it would avoid the loss of the maiden pink habitat, negating the need for translocation of this species (mitigation noted in paragraph 10.5.14).

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