Environmental Impact Assessment Report

Chapter 7 Biodiversity

Grangemouth Flood Protection Scheme 2024
Falkirk Council

GRANGEMOUTH
Flood Protection Scheme
Protecting the heart of our communities

Grangemouth Flood Protection Scheme

Environmental Impact Assessment Report

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Acronyms

AWI	Ancient Woodland Inventory
BAP	Biodiversity Action Plan
BTO	British Trust for Ornithology
CIEEM	Chartered Institute of Ecology and Environmental Management
EcIA	Ecological Impact Assessment
ECoW	Ecological Clerk of Works
eDNA	Environmental DNA
EPS	European Protected Species
EU	European Union
GI	Ground Investigation
GWDTE	Ground Water Dependent Terrestrial Ecosystems
HRA	Habitats Regulations Appraisal
HSI	Habitat Suitability Index
INNS	Invasive Non-native Species
JNCC	Joint Nature Conservation Committee
LBAP	Local Biodiversity Action Plan
LDP	Local Development Plan
NMP	Scotland's National Marine Plan
NS	NatureScot, formally known as Scottish Natural Heritage
NPF4	National Planning Framework 4
NWSS	Native Woodland Survey of Scotland
PRA	Preliminary Roost Assessment
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SBL	Scottish Biodiversity List
SEPA	Scottish Environment Protection Agency
SINC	Site of Importance for Nature Conservation
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TN	Target Note
WFD	Water Framework Directive

7. Biodiversity

7.1 Introduction

This chapter presents the Ecological Impact Assessment (EcIA) undertaken for the Scheme. As explained in Chapter 4: The Proposed Scheme, the design includes direct defences of flood walls, earth embankments, lock gates and flood gates to manage flood risk from a combined 1 in 200-year flood event from fluvial and tidal sources within six Flood Cell areas (see Figure A1-2 in Appendix A). Each Flood Cell contains discrete Working Areas, which provide reference points to specific sections of the construction areas. The Site Boundary delineates the anticipated construction footprint, including haul roads and the location of potential site compounds (see Figures A4-1 to A4-28 in Appendix A4).

The EcIA considers the potential significant impacts on terrestrial, marine and freshwater species, habitats and ecosystems throughout all stages of the development (construction and operation). The EcIA is informed by the scoping and consultation process described in Chapter 3: Environmental Impact Assessment Methodology and Chapter 4: The Proposed Scheme which outlines the likely construction methods and programme for the Scheme.

The flora and fauna of the site are described and valued in the context of nature conservation legislation, relevant planning policy and guidance set out in Section 7.2.

The aims of the EcIA were to:

- identify the presence and status of species, habitats and ecosystems (ecological features) of conservation significance within the study area through consultation, desk-based research and field surveys;
- evaluate the importance of ecological features;
- identify any potential impacts and effects associated with the design, anticipated construction method and operation of the Scheme;
- identify and present mitigation measures to address potential effects and ensure compliance of the Scheme with nature conservation legislation and biodiversity policy;
- assess the Scheme for cumulative impacts and effects alone or in combination with other plans and projects;
- assess the residual effects following the assumed successful implementation of mitigation and any additional mitigation required (during and post construction); and
- detail the monitoring required to assess the effectiveness of mitigation.

This chapter cross-references other technical chapters where impacts of relevance to habitats and biodiversity are assessed, including:

- Chapter 2: Legislative and Regulatory Framework
- Chapter 4: The Proposed Scheme
- Chapter 9: Landscape and Visual Impact Assessment
- Chapter 10: Water Environment
- Chapter 11: Soils, Geology and Land Contamination
- Chapter 12: Air Quality and Climate Change
- Chapter 15: Cumulative Effects

This chapter is accompanied by appendices which are cross-referenced where relevant. The appendices are as follows:

- B7.1: Species Names and Target Notes
- B7.2: Aquatic Ecology Data
- B7.3: Terrestrial Ecology Data
- C7.1: Ornithology Report 2017
- C7.2: Breeding Bird Survey 2018

Appendices C7.1 to C7.2 provide technical reports and figures detailing the early baseline surveys completed by Echoes Ecology Ltd and MacArthur Green during the options appraisal stage of the Scheme. Update surveys have been undertaken by Jacobs to augment this data and the results of these are included in Appendix B7.3.

Confidential otter, badger, barn owl and bat (confirmed roosts) data will not be published with the EIA Report due to the potential risk to protected species from location data being publicly available. However, a password protected confidential report with this data will be submitted to NatureScot and Falkirk Council.

A detailed consideration of the implications of the Scheme on European sites[1], in the context of the Conservation (Natural Habitats, & c.) Regulations 1994 (as amended in Scotland) (hereafter the "Habitat Regulations") has been undertaken separately in a Habitats Regulations Appraisal (HRA) report.

7.2 Policy and Legislative Framework

7.2.1 Introduction

This section describes the planning policies, guidance and legislation relevant to habitats and biodiversity. The legislative background for this chapter is a combination of international conventions and directives and national legislation designed to protect wildlife.

7.2.2 Planning Policy

The Development Plan relevant to the study area is comprised of National Planning Framework (NPF4) (The Scottish Government 2023) and the Falkirk Local Development Plan 2 (FLDP2) (Falkirk Council 2020a). NPF4 is the more recent publication, adopted by the Scottish Ministers in February 2023. FLDP2 was adopted by Falkirk Council in 2020. Both plans are read together; however, where there is any difference in policy content the more recent publication takes precedence, in this case NPF4.

NPF4 is required by law to contribute to six outcomes, one of which is '*securing positive effects for biodiversity*', and it incorporates a plan led approach to achieve this. By securing positive effects for biodiversity, NPF4 will create and strengthen nature networks whilst still encouraging and facilitating development where there is a strategic need. The proposed approach to securing positive effects for biodiversity for the Scheme is discussed in Section 7.9.

Policies in NPF4 which are of key relevance to this chapter are summarised below.

[1] As of 1 January 2021, upon the UK's exit from the EU, Natura 2000 sites are now referred to as European sites. https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas/international-designations/european-sites (Accessed February 2023)

- Policy 1 Tackling the Climate and Nature Crises: "*When considering all development proposals significant weight will be given to the global climate and nature crises*". This policy contains provisions that are intended to encourage, promote and facilitate development that minimises emissions and adapts to the current and future impacts of climate change.
- Policy 3 Biodiversity: *"Development proposals will contribute to the enhancement of biodiversity, including where relevant, restoring degraded habitats and building and strengthening nature networks and the connections between them. Proposals should also integrate nature-based solutions, where possible."* This policy also notes that development proposals that require an Environmental Impact Assessment will only be supported where it can be demonstrated that the proposal will conserve, restore and enhance biodiversity, including nature networks so they are in a demonstrably better state than without intervention. The policy notes that any potential adverse impacts, including cumulative impacts, of development proposals on biodiversity, nature networks and the natural environment will be minimised through careful planning and design.
- Policy 4 Natural Places: This policy contains provisions that are intended to protect, restore and enhance natural assets making best use of nature-based solutions.
- Policy 6 Forestry, Woodlands and Trees: This policy contains provisions that are intended to protect and expand forests, woodland and trees.
- Policy 10 Coastal Development: This policy contains provisions that are intended to protect coastal communities and assets and support resilience to the impacts of climate change.

The Falkirk Local Development Plan (LDP2) (Falkirk Council 2020a) was adopted on 07 August 2020. LDP2 is intended to guide future development of the Falkirk Council area between 2020 and 2040. Policies from LDP2 relevant to this EcIA are as follows:

- PE19 Biodiversity and Geodiversity: This policy includes the provision that "*The Council will protect and enhance habitats and species of importance, and will promote biodiversity and geodiversity through the planning process.*" This chapter assesses the impact of the Scheme on biodiversity.
- PE20 Trees, Woodland and Hedgerows: The supporting text of this policy states that "*Protection of existing trees and woodland will be a priority, and the principles of the Scottish Government's Policy on 'Control of Woodland Removal'*[2] *will be followed where woodland is affected".* In addition, there are a number of Tree Preservation Orders (TPOs) in force across the Council area, as shown on the LDP2 Proposals Map. The supporting text of the policy states that *"New development will be expected to contribute to woodland and green network objectives through management and new planting as appropriate."* The impact on amenity trees is assessed in Chapter 9: Landscape and Visual Impact Assessment whilst this chapter assesses impacts on areas of woodland or scrub. All trees felled shall be replaced locally where appropriate and to an appropriate standard; trees that cannot be replaced locally shall be planted in appropriate areas elsewhere and to a minimum replacement ratio of three trees planted for every tree lost.
- PE22 The Water Environment: Falkirk Council "*recognises the importance of the water environment within the Council area in terms of its landscape, ecological, recreational and land drainage functions*." The supporting text of the policy states that the policy *"aims to ensure that water quality, habitat/species integrity and quality, and the recreational amenity of the water environment is safeguarded by development proposals."*
- PE23 Marine Planning and the Coastal Zone: "*In assessing proposals affecting the coastal zone, the Council will seek to…Protect designated nature conservation sites in accordance with Policy*

[2] Online Available at: https://forestry.gov.scot/publications/support-and-regulations/control-of-woodland-removal/285-the-scottish-government-s-policy-on-control-of-woodland-removal (Accessed July 2020)

PE19…Protect and enhance the water environment and promote its recreational potential in accordance with Policy PE22".

- PE24 Flood Management: The supporting text to this policy notes that "*The highest priority action within the Council area is the Grangemouth Flood Protection Scheme*". The Scheme is largely driven by this policy in that it reduces flood risk, however, the risk of surface or ground water pooling on the dry side of defences or the release of foul water from the sewer network are issues that have been addressed through design (see Chapter 10: The Water Environment).

Further guidance on biodiversity and conservation is provided in Falkirk Council Supplementary Guidance documents SG07 'Biodiversity and Development' and SG08 'Local Nature Conservation and Geodiversity Sites' (Falkirk Council 2020b).

7.2.3 Marine Planning Policy

Scotland's National Marine Plan (NMP) (The Scottish Government 2015) sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nautical miles. The Scottish Ministers must make authorisation and enforcement decisions, or any other decisions that affects the marine environment, in accordance with the NMP. Policies of the NMP of key relevance to this chapter are as follows:

- GEN 1 General planning principle: *"There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of the plan."*
- GEN 9 Natural heritage: *"Development and use of the marine environment must:*

  (a) Comply with legal requirements for protected areas and protected species.

  (b) Not result in significant impact on the national status of Priority Marine Features.

  (c) Protect and, where appropriate, enhance the health of the marine area."
- GEN 10 Invasive non-native species: *"Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are made."*
- GEN 3 Noise: *"Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects."*

7.2.4 The Scottish Biodiversity Strategy and the Scottish Biodiversity List

The Scottish Biodiversity Strategy (Scottish Government 2023) places a duty of care on every public body to further the conservation of biodiversity in Scotland and is implemented through Local Biodiversity Action Plans (LBAPs). The Scottish Biodiversity Strategy comprises two documents: *Scottish Biodiversity strategy to 2045: Tackling the Nature Emergency in Scotland* and a delivery plan (not yet published). The strategy's vision encapsulates three core ideas: that urgent action is needed at scale across our land and seascapes; that we are looking to the future – regenerating biodiversity and building resilience to climate change; and that people and communities are central to a nature positive future, with key milestones of halting biodiversity loss by 2030 and restoring or regenerating biodiversity by 2045.

The Scottish Biodiversity List (SBL) (NatureScot 2020b) was developed to meet the requirements of Section 2 (4) of the Nature Conservation (Scotland) 2004 Act for the conservation of biodiversity. This legislation required Scottish Ministers to publish lists of species of flora and fauna and habitats considered to be of principal importance for the purposes of biodiversity in Scotland. The SBL is intended to be a tool for public bodies and is an important source of information for those interested in

Scotland's biodiversity. Details of ecological features within the study area that appear on the SBL are presented in Table 7-5.

7.2.5 Biodiversity Action Plans (BAPs)

The Falkirk Council LBAP 'Second Nature' was published in March 2019 (Falkirk Council 2019a). It highlights that at least 45 species of plants and animals found within the Falkirk Council area are UK priorities for conservation, with an additional 19 species listed on the SBL (NatureScot 2020b). The ecological features listed in the LBAP as priority species or habitats which were recorded within the study area are detailed in Table 7-5.

The LBAP lists nine action plans which focus on different themes to protect and conserve local priority species, habitats and sites. The LBAP increases awareness of impacts, highlights actions already taken and identifies projects as the next steps required to improve biodiversity within each theme. These themes are:

1. Estuary
2. Farmland and grassland
3. Heath and bog
4. Water and wetland
5. Woodland
6. Urban
7. Bean geese
8. Connecting people and wildlife
9. Invasive non-native species.

7.2.6 Relevant Legislation

Legislation relevant to the Scheme and biodiversity includes the following:

- The Flood Risk Management (FRM) (Flood Protection Schemes, Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Amendment Regulations 2017
- Wildlife and Countryside Act 1981 (WCA) (as amended in Scotland)
- Conservation (Natural Habitats &c) Regulations 1994 (as amended in Scotland)
- Protection of Badgers Act 1992 (as amended)
- Nature Conservation (Scotland) Act 2004
- Wildlife and Natural Environment (Scotland) Act 2011 (WANE 2011)
- Water Environment and Water Services (Scotland) Act 2003
- Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003
- Establishing measures for the recovery of the stock of European eel (European Council Regulation 1100/2007)
- Marine (Scotland) Act 2010
- The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

7.3 Approach and Methods

7.3.1 Scope and Guidance

As detailed in Chapter 3: Environmental Impact Assessment Methodology, Section 3.3 EIA Screening and Scoping, a Scoping Report for the Scheme was submitted to Falkirk Council in October 2018 (Appendix C3.1) for consideration by their Planning Department and relevant consultees. The formal responses received (Appendix C3.2: EIA Scoping Report Responses of Chapter 3) have been used to inform the scope of the EIA process for the Scheme.

The scope of the EcIA is to consider the potential impacts and effects on terrestrial, marine and freshwater species, habitats and ecosystems from the Scheme in accordance with The Flood Risk Management (Flood Protection Schemes, Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Amendment Regulations (2017), referred to as the FRM Regulations. The approach to this assessment takes cognisance of the following guidance:

- Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM 2022)
- SNH and HES Environmental Impact Assessment Handbook (SNH and HES 2018)[3]

In addition to CIEEM and NatureScot guidance, other policy documents and published guidance considered in the preparation of this chapter include:

- The Scottish Government's Planning for Natural Heritage: Planning Advice Note 60 (Scottish Government 2000)
- The Scottish Government's Planning Advice Note 1/2013: Environmental Impact Assessment, Revision 1.0 (Scottish Government 2013)

Additional policy and guidance documents are discussed in Chapter 2: Legislative and Regulatory Framework.

7.3.2 Definition of the Study Area

The "study area" refers to land located within the Site Boundary of Flood Cells 1 to 6. In some cases the study area is extended to encompass zones of influence for different ecological features based on current best practice and professional judgement. Details of extended study areas can be found in Table 7-1, Appendix B7.3 and the relevant ecological reports (Appendices C7.1 and C7.2).

Some survey data were collected prior to the Site Boundary being determined. These surveys used either the working area boundary or scheme alignment to determine the study area. Where surveys were conducted prior to 2020, the scheme alignment at options appraisal stage has been used to determine the study area.

7.3.3 Desk Study

The desk study consisted of a review of existing relevant reports and data, along with online searches for ecological information within the study area, the wider applicable ecosystems, and from data received through consultation (see Section 7.3.5).

The desk study also reviewed data collected to inform earlier iterations of the Scheme design and these are detailed in the following reports:

[3] As of 24 August 2020, Scottish Natural Heritage (SNH) is now NatureScot. Where a document was published prior to the name change, it has been referenced as SNH.

- Extended Phase 1 Habitat Survey Grangemouth Flood Protection Scheme (Echoes Ecology Ltd 2016a)
- Phase 1 Habitat Survey Grangemouth Flood Protection Scheme (Echoes Ecology Ltd 2018a)
- Technical Memorandum: Grangemouth Flood Alleviation – Ground Investigation (Contract 1 River Avon & Contract 2 River Carron) (CH2M Hill 2014)
- Mammal Survey Grangemouth Flood Protection Scheme 2016 (Echoes Ecology Ltd 2016b)
- Great Crested Newt Survey Grangemouth Flood Protection Scheme (Echoes Ecology Ltd 2018b)
- Mammal Survey Grangemouth Flood Protection Scheme 2018 (Echoes Ecology Ltd 2018c).

Online ecological information sources included the following:

- Joint Nature Conservation Committee (JNCC) website[4]
- NBN Atlas[5]. Records from the past 20 years within a 2 km buffer from the Site Boundary were reviewed; only records held under an Open Government Licence, Creative Commons Zero or Creative Commons Attribution licence were used as part of the assessment.
- Scotland's Environment website[6]
- SEPA website[7]
- NatureScot SiteLink[8]
- Marine Scotland National Marine Plan Interactive map[9].

7.3.4 Surveys

Ecological surveys were conducted between 2015 and 2023 (Table 7-1). NatureScot advised that the scope of the surveys would provide an adequate baseline for the ecological impact assessment for the project (Appendix C3.2 of Chapter 3). The survey methods and baseline results are provided in Appendices B7.1 to B7.3 and C7.1 to C7.2.

No further survey work for Ground Water Dependent Terrestrial Ecosystems (GWDTEs) has been undertaken since 2020. However, a desktop review of UK Habitat Classification survey data collected in 2022/2023 was undertaken by Jacob's hydrogeologists which identified additional potential GWDTEs (Appendix B7.1).

The data will be reviewed at pre-construction stage and further surveys will be conducted where necessary to address potential changes in the baseline, Scheme design, construction methods and programme (see Section 7.6, mitigation item E5 (pre-construction surveys) for details).

[4] Online. Available at: https://jncc.gov.uk/ (Accessed November 2022)
[5] Online. Available at: https://nbnatlas.org/(Accessed November 2022)
[6] Online. Available at: https://www.environment.gov.scot/ (Accessed November 2022)
[7] Online. Available at: https://www.sepa.org.uk/ (Accessed November 2022)
[8] Online. Available at: https://sitelink.nature.scot/home (Accessed November 2022)
[9] Online. Available at: https://marinescotland.atkinsgeospatial.com/nmpi/ (Accessed November 2022)

Table 7-1: Details of surveys used to inform the EcIA

Survey Type	Guidance	Date Range	Survey Area and Method Summary
Terrestrial surveys			
Badger Appendix B7.3	Scottish Badgers (2005)	Walkover: April to May 2023	All ground within 100 m of the Site Boundary was surveyed for evidence of badger presence. Field signs searched for included badger setts, dung pits, latrines, prints, hair and snuffle holes. Any badger setts recorded were categorised according to four types: main, annexe, subsidiary, and outlier. Sett use was categorised as: active, inactive or defunct.
		Monitoring: October 2019 to August 2020 April to July 2023 August to September 2023	Targeted monitoring in 2019, 2020 and 2023 of a badger sett more than 100 m from the Site Boundary, which could potentially be impacted by the Scheme, was conducted using infra-red monitoring cameras. Cameras were deployed at seven locations to determine sett use and potential habitat connectivity.
Bats: Preliminary Roost Assessment (PRA) Appendix B7.3	Collins (2016)	21 June 2019	Within the Port of Grangemouth area, PRAs were conducted on two buildings adjacent to the River Carron that would be demolished as part of the Scheme. The buildings were assessed externally from the ground for potential roost features that could be suitable for use by bats (e.g. holes, cracks, and crevices). Each building was categorised as having negligible, low, moderate or high roost suitability for both summer and winter use.
		November 2019 to June 2020	Where access allowed, buildings and structures within 30 m of the Scheme alignment were assessed externally from the ground for potential roost features that could be suitable for use by bats (e.g. holes, cracks, and crevices). PRAs were conducted on 17 buildings and 23 structures within 30 m of the Scheme alignment focusing on those scheduled for demolition and within 10 m of the scheme alignment. Where access was limited, binoculars were used to conduct high level assessments of 265

Survey Type	Guidance	Date Range	Survey Area and Method Summary
			buildings within 30 m of the Scheme alignment. Each building or structure was categorised as having negligible, low, moderate or high roost suitability for both summer and winter use.
	Collins (2016)	April to November 2022 February to April 2023	Further targeted PRA and high-level assessments were undertaken at building and structures in areas which are now within 30 m of the Site Boundary due to design changes, and also where assessment was previously not possible. PRA surveys were undertaken at trees within 30 m of the Site Boundary. Buildings, trees and structures were assessed externally from the ground for potential roost features that could be suitable for use by bats (e.g. holes, cracks, and crevices). PRAs were conducted at four buildings, 11 structures and 104 trees. Where access was limited, binoculars were used to conduct high level assessments of 81 buildings, within 30 m of the Site Boundary. Each building, tree or structure was categorised as having negligible, low, moderate or high roost suitability for both summer and winter use.
Winter Hibernation Inspections Appendix B7.3	Collins (2016)	08 March to 11 March 2021 February 2023	Targeted winter hibernation inspections were conducted at 12 buildings and four structures which could be demolished or modified as a result of the Scheme. Surveys involved external and internal inspections to look for hibernating or signs of hibernating bats and assess the potential of the building to host hibernating bats. Each building was categorised as having negligible, low, moderate or high roost suitability for winter use.
Bat Activity Surveys Appendix B7.3	Collins (2016)	May 2021 to September 2021 July to August 2022 May to August 2023	Emergence and re-entry surveys were conducted at 18 buildings and six structures which could be demolished or potentially impacted by works. All buildings and structures with high, moderate and low potential were subject to three, two or one (respectively) dusk emergence or dawn re-entry surveys during the optimal period (May-September). Land access restrictions and health and safety concerns meant the full complement of surveys (one, two or three) was not always possible. However, this is not considered a limitation as sufficient data was collected to inform the impact assessment. Surveys and bat call analysis were carried out using standard call detection and recording equipment, as described further in Appendix B7.3.

Survey Type	Guidance	Date Range	Survey Area and Method Summary
		April to September 2021	Walked transect routes were undertaken to obtain a measure of bat activity in habitats along the Scheme and to help identify those areas of higher value to bats to allow mitigation to be designed if needed. Three manually walked transects were surveyed for bat activity and species richness. The transect routes were designed to encompass a range of habitats. Surveys and bat call analysis were undertaken using standard call detection and recording equipment. Surveys were carried out once a month from April to September and were conducted at both dusk and dawn where possible. To assess bat activity levels, passive bat detectors were deployed at three to four sites along transect routes between April and September, with a minimum of eight consecutive nights of data collected in each month. For transect 1 (along the River Carron) the detectors were vandalized during the April deployment, therefore, some data is missing for this deployment. The detectors were moved to different locations for the May to September deployments. Surveys and bat call analysis were carried out using standard call detection and recording equipment as described in Appendix B7.3.
Birds: breeding Appendices C7.2 and B7.3	SNH/NatureScot were consulted on survey method	19 May 2016 to 22 July 2016	Monthly surveys were conducted on the Forth Estuary between Dunmore and Blackness from 16 vantage point locations, which covered individual "sectors". Surveys involved a combination of walkovers and short vantage point surveys along the upper shore and suitable inland habitat within each sector (up to approximately 250 m from shoreline). The primary aim of the surveys was to record breeding evidence of designated species of the Firth of Forth Special Protection Area (SPA) and Firth of Forth Site of Special Scientific Interest (SSSI) and any other Annex I or Schedule 1 species, with non-breeding individuals also being recorded. Whilst the survey dates recorded here indicate that the beginning of the breeding bird season (from 01 April) was missed, MacArthur Green surveyed the same extent until the end of April during their non-breeding bird surveys in 2016 and 2017 (see below in table). To assist in accounting for any early breeding species and for any areas not surveyed, a Jacobs ecologist conducted a search of NBN atlas[5] for Schedule 1 bird species within 200 m of all Flood Cell boundaries as part of the desk study.

Survey Type	Guidance	Date Range	Survey Area and Method Summary
	Bibby *et al.* (2000); Marchant (1983); Gilbert *et al.* (1998)	22 May 2018 to 29 June 2018	Echoes Ecology Ltd conducted breeding bird surveys up to 100 m from the Scheme alignment on the sections of Scheme that lie outwith the Firth of Forth SPA boundary. This included sections of the River Carron, River Avon, Grange Burn, Polmont Burn and a drainage channel that runs alongside the A905. Surveys followed an adapted British Trust for Ornithology (BTO) Common Bird Census technique and a pre-plotted transect route was walked over three visits. All bird species detected were recorded and their behaviour mapped in line with BTO symbology. For limitations to these surveys, refer to Appendix C7.2.
Birds: non-breeding Appendix C7.1 (2015 – 2017 data) and B7.3 (2022-2023 data)	Bibby *et al.* (2000); WeBS Core Count Methods[10]	August 2015 to March 2016 August 2016 to March 2017	Monthly surveys were conducted by MacArthur Green on the Forth Estuary between Dunmore and Blackness from 16 vantage point locations, which covered individual "sectors". This approach was based on the Wetland Bird Survey (WeBS) core count method but provided a more detailed overview by plotting distribution of birds within each sector. The primary focus of surveys was to record presence and activity of designated species of the Firth of Forth SPA, but non-SPA species of conservation concern were also recorded. Sectors surveyed that are relevant to the assessment presented in this chapter are shown on Figure B7.6.
	Bibby *et al.* (2000); WeBS Core Count Methods	August 2022 to March 2023	Monthly surveys were conducted on the Forth Estuary from eight vantage point locations, which covered individual "sectors". This approach followed the methods used by MacArthur Green, which was based on the Wetland Bird Survey (WeBS) core count method but provided a more detailed overview by plotting distribution of birds within each sector. The primary focus of surveys was to record presence and activity of designated species of the Firth of Forth SPA, but non-SPA species of conservation concern were also recorded. The survey Sectors are shown on Figure B7.6.

[10] Online. Available at: https://www.bto.org/our-science/projects/webs/taking-part/core-counts-methods (Accessed July 2019)

Survey Type	Guidance	Date Range	Survey Area and Method Summary
Great crested newt: Habitat Suitability Index (HSI) assessment Appendix B7.3	Oldham *et al.* (2000)	June 2020 to June 2023	Nine water bodies were identified within 500 m of the Scheme alignment and were assessed for their suitability for great crested newt (GCN). A HSI assessment and eDNA sampling was conducted on all water bodies, however, one water body (J2) was unable to be sampled as the water's edge could only be accessed in a few locations. Health and safety concerns (soft ground conditions and presence of livestock) resulted in less than 50% of the water's edge being accessible for sampling at two of the eight water bodies subject to eDNA sampling (J10 and J13); however, this is not considered a significant limitation as the water bodies have below average suitability for GCN. Water samples were collected in line with the eDNA sample protocol presented by Biggs et al. (2014), which was approved by NatureScot. The samples were analysed by NatureMetrics Ltd, using a qPCR and in accordance with the eDNA sample protocol.
Barn owl Appendix B7.3	Shawyer (2012)	14 July 2022	In response to incidental barn owl evidence (pellets) and observations of barn owl emerging from and re-entering a derelict building during bat PRA and activity surveys, a dedicated barn owl survey was conducted at this location in 2022. Four surveyors stood outside the building from 20 minutes before dusk to two hours after dusk and recorded owl activity. Access inside the building was not possible due to health and safety concerns.
Otter Appendix B7.3	SNH (2008) NatureScot (2020a)	08 January 2020	A targeted walkover survey was conducted to confirm the locations of two otter shelters on the River Carron identified during the desk study that may be impacted by the Scheme. A section the River Carron within 200 m of the Scheme alignment was surveyed to record evidence of otter presence. Signs searched for included resting places, spraints, food remains and prints. Where found, resting places were categorised as either holts (underground resting places) or couches (above ground resting places).
		14 September 2022 to 12 January 2023	Targeted monitoring was conducted of two otter shelters on the River Carron that could be impacted by the Scheme, using infra-red monitoring cameras (Browning Spec Ops Elite and Bushnell HD Aggressor models).
		April to May 2023	All sections of watercourses within 200 m of the Site Boundary were surveyed from the watercourse banks to record evidence of otter presence. Signs searched for included resting places, spraints, food

Survey Type	Guidance	Date Range	Survey Area and Method Summary
			remains and prints. Where found, resting places were categorised as either holts (underground resting places) or couches (above ground resting places).
UK Habitat Classification	Butcher *et al.* (2020) Natural England (2021)	August 2022 to February 2023	UK Habitat Classification (UKHab) surveys were conducted within 100 m of the October 2022 Scheme design. Surveys followed UKHab guidance and habitats were recorded as polygon and line features. Point features were not recorded as there were no features of note identified that were below the minimum mapping unit. Each line or polygon feature was assigned a Primary Habitat and any relevant Secondary Codes from the UKHab Professional Edition. Secondary Codes from Section 2 were used – Secondary Codes from the Green Infrastructure Section (Section 3) of the Habitat Definitions document were not used. The minimum mapping unit (MMU) for the survey was 400 m^2 in line with UKHab guidance. Survey data was recorded on iPads using the ArcGIS Collector application. All polygons and lines which were at least partially within 50 m of the Scheme were subject to habitat condition assessment, using the Defra/Natural England Biodiversity Metric 3.1 (2021).
Ground water dependent terrestrial ecosystems (GWDTE) surveys using National Vegetation Classification assessment Appendix B7.1	JNCC (2010); Rodwell *et al.* (1991 *et seq.*)	23 June to 25 June 2020 6 August 2020	A habitats survey to determine potential GWDTEs was conducted at targeted sites within 250 m of the Scheme alignment (Options Appraisal Stage) by a survey team comprising a botanist and a hydrogeologist. The surveys examined areas pre-identified from existing habitat data as potentially supporting GWDTEs. Additional habitat data was collected in line with the JNCC National Vegetation Classification (NVC) and hydrogeological information was recorded to help determine whether potential GWDTEs were present. Photographs were taken of the vegetation types and grid references were recorded. Refer to Appendix B7.1 for more detail.

Survey Type	Guidance	Date Range	Survey Area and Method Summary
Hedgehog Appendix B7.3	PTES (2015a) PTES (2015b)	05 September to 13 September 2022	Targeted footprint tunnel surveys were conducted in areas of suitable hedgehog habitat. Hedgehog tunnels (plastic tunnels with paper and ink pads) were deployed at 20 locations to record hedgehog footprints and determine presence/absence in the local area. Tunnels were deployed for at least five consecutive nights and checked each day where possible. Due to unforeseen logistical and resourcing issues, the sixth tunnel check (on 13 September 2023) occurred four days after the fifth check (on 09 September 2023).
Aquatic surveys			
Aquatic habitat assessment Appendix B7.2	Hendry & Cragg-Hine, (2003); Maitland (2003)	April 2019 March 2023	Aquatic habitat surveys were undertaken on all main watercourses within the Scheme Flood Cells. Surveys were undertaken on the River Carron, River Avon, Grange Burn, Millhall Burn, Grange Burn flood relief channel, Polmont Burn, Westquarter Burn, Mungal Burn and Chapel Burn. The substrates, flow types and other general characteristics of each watercourse were assessed to determine habitat suitability for aquatic species.
Intertidal biotope mapping Appendix B7.2	Davies *et al.* (2001); Connor *et al.* (2004)	April 2019	Core samples were collected from the intertidal mudflats at five sites, two on Skinflats and three in front of the Petroineos petrochemical plant (Figure B7.7). Samples were taken using a 0.1 m^2 core, preserved using formalin and sent to the Jacobs laboratory for infaunal analysis. Three replicate cores were taken at each of the five sites. A sediment sample was also taken from each of the five sites and sent to National Laboratory Services for particle size analysis. The species and abundance data were then combined with the results of the particle size analysis to assign a biotope to each of the five sites, in accordance with Connor *et al.* (2004).

7.3.5 Consultation

A summary of the consultation process is provided in Chapter 3: Environmental Impact Assessment Methodology and an overview of the consultation outcomes is set out in Chapter 5: Stakeholder Engagement. Consultation included agreement on the survey scope, methods and study areas for the assessed features, with input from key statutory consultees including NatureScot and Falkirk Council.

Data requests also formed part of the consultation process. Records of species of conservation interest were requested from consultees for up to 10 km from the Scheme to take into account the highly mobile nature of some species, the level of detail at which some data are available, and to provide contextual information to support the site surveys. Requests for data relevant to ecology and nature conservation were made to:

- Falkirk Council
- Forth District Salmon Fishery Board
- Royal Society for the Protection of Birds (RSPB)
- Scottish Wildlife Trust (SWT)
- Scottish Environment Protection Agency (SEPA)

NatureScot's online data services - including SiteLink (designated sites information) and other data sources - is available and online. Therefore, a formal request to NatureScot for data was not required.

A SEPA data request response was received in October 2019 and provided aquatic ecology data for the watercourses within the study area (River Avon, River Carron and Grange Burn). An updated SEPA data request response, which also included information on Bonny Water, was received on 21 February 2023. This, in addition to the original data request, forms part of the aquatic habitats desk study and evaluation.

A NatureScot consultation response dated 08 February 2019 (SNH 2019 and Appendix C3.2) advised that, as the Firth of Forth SPA (NatureScot 2023a) lies within the footprint of the Scheme, an HRA should be conducted if the project could have a 'likely significant effect' on the SPA. An HRA is being conducted for the Scheme and will be reported separately. For the HRA assessment, relevant European and Ramsar sites were identified by looking for potential source-receptor pathways and NatureScot also provided guidance on designated sites to be included within the HRA.

The Firth of Forth SPA (NatureScot 2023a) and Firth of Forth Ramsar site (NatureScot 2023b) will also be considered within this EIA Report (Section 7.5: Impact Assessment). NatureScot advised that a detailed assessment of impacts on the Firth of Forth Site of Special Scientific Interest (SSSI) (NatureScot 2023c) should be included in the EcIA, and this is addressed in Section 7.5: Impact Assessment. Additionally, NatureScot highlighted that the below designated sites may be affected by the proposal and should be considered in the EcIA (see Section 7.4.2 Designated and Wildlife Sites):

- Forth Islands SPA (NatureScot site code: 8500, European Union (EU) site code: UK9004171) (NatureScot 2023d)
- Imperial Dock Lock, Leith SPA (NatureScot site code: 8668, EU site code: UK9004451) (NatureScot 2023e)
- Outer Firth of Forth & St Andrews Bay Complex SPA (NatureScot site code: 10478, EU site code: UK9020316) (NatureScot 2023f)
- River Teith Special Area of Conservation (SAC) (NatureScot site code: 8367, EU site code: UK0030263) (NatureScot 2023g)
- Isle of May SAC (NatureScot site code: 8278, EU site code: UK0030172) (NatureScot 2023h)

- Avon Gorge SSSI (NatureScot site code: 108, EU site code: 169661) (NatureScot 2023i)
- Carron Dams SSSI (NatureScot site code: 331, EU site code: 139849) (NatureScot 2023j)

Liaison with NatureScot has been ongoing as the design process has evolved. At a project level, liaison has also continued with consultees such as SEPA and details are included in Chapter 5: Stakeholder Engagement.

7.3.6 Assumptions

The baseline results represent conditions at the time of survey. Limitations of site surveys are detailed within Table 7-1. Where there were access or health and safety limitations to survey work, a precautionary approach to potential impacts on ecological features has been used to inform the assessment.

Habitat loss during construction and operation of the Scheme will be influenced by the construction methods and design developed by the contractor. However, for the purposes of this assessment, it is assumed that all habitat within the Site Boundary will be temporarily lost during construction. A standardised approach has been developed for calculating permanent habitat loss by estimating a permanent works footprint for each type of flood defence as described in Section 7.3.7.5: Habitat loss.

Residual effects predicted from the Scheme are based on the assumption that all proposed mitigation is implemented effectively and all areas of temporary habitat loss within the Site Boundary will be restored (see Section 7.10: Residual Effects).

It is acknowledged that there will likely be several years between collation of the baseline information and commencement of the Scheme construction. It is therefore anticipated, in line with proposed mitigation, that pre-construction surveys to update the baseline will be undertaken where required. This updated baseline would be used to identify impacts or effects that were not present at the time of writing; for example, due to changes in distribution of protected species into habitat impacted by the Scheme.

7.3.7 Impact Assessment Methods

The following terms have been used throughout the EcIA process, in line with CIEEM (2022) guidance:

- 'ecological feature' refers to habitats, species and ecosystems that may be impacted by the Scheme
- 'impact' is defined as actions resulting in changes to an ecological feature (the change can be positive, neutral or negative)
- 'effect' is defined as the outcome to an ecological feature from an impact

Impact significance was assessed by considering the importance and sensitivity of the ecological feature, and the magnitude and nature of potential impacts using the criteria set out in the following subsections.

7.3.7.1 Importance/ Sensitivity

The general approach to defining the importance of ecological features follows CIEEM guidance (CIEEM 2022). Ecosystems, habitats and species were assigned levels of importance for nature conservation based on baseline conditions and the criteria set out in Table 7-2.

Factors considered in determining the importance of an ecological feature include its:

- rarity and uniqueness;
- ability to resist or recover from environmental change;
- function/role within an ecosystem; and
- level of legal protection or designation.

Table 7-2: Importance criteria for ecological features

Importance	Criteria
International	**Ecosystems and Habitats** Ecosystem or habitats essential for the maintenance of: • internationally designated areas or undesignated areas that meet the criteria for designation; and/or • viable populations of species of international conservation concern. **Species** Species whose presence contributes to: • the maintenance of qualifying habitats, communities and assemblages that occur within internationally designated sites or within undesignated areas that meet the criteria for such designation.
National	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: • qualifying communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; and/or • viable populations of species of national conservation concern. **Species** Species whose presence contributes to: • the maintenance of qualifying habitats, communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; or • the maintenance and restoration of biodiversity and ecosystems at a national level, as defined in the Scottish Biodiversity Strategy (Scottish Government 2023).
Regional	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: • communities and assemblages that occur within regionally important sites or localities listed as being of conservation importance in the Falkirk Council LBAP (Falkirk Council 2019a) or within undesignated areas that meet the criteria for such designation; and/or • viable populations of species of regional conservation concern. **Species** Species whose presence contributes to: • the maintenance and restoration of biodiversity and ecosystems at a regional level, as determined by their presence in the Falkirk Council LBAP (Falkirk Council 2019a) and professional judgement.
Authority Area	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: • populations of species of conservation concern within the authority area. **Species** Species whose presence contributes to: • the maintenance and restoration of biodiversity and ecosystems at authority area level, as determined by their presence in the Falkirk Council LBAP (Falkirk Council 2019a) and professional judgement.
Local	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: • populations of species of conservation concern within the local area of the Scheme. **Species** Species whose presence contributes to: • the maintenance and restoration of biodiversity and ecosystems at a local level.

Whilst biodiversity should be protected in its entirety wherever possible, "*it is not necessary to carry out detailed assessment of features that are sufficiently widespread, unthreatened and resilient to project impacts*" (CIEEM 2022). Only features considered important and potentially affected by the Scheme are subject to impact assessment. Therefore, features that do not meet the criteria for at least local importance are not considered in detail in this assessment.

7.3.7.2 Impact Description

Knowledge and assessment of construction methods and operational activities, together with knowledge derived from similar infrastructure projects, has been used to identify the potential impacts of the project on ecological features.

For the purposes of this assessment, the impact descriptors in Table 7-3 are used to summarise the overall characterisation of positive or negative impacts in accordance with CIEEM guidelines (2022), considering:

- impact extent/scale (e.g. entire habitat loss, partial habitat loss or indication of specific area affected);
- direct or indirect impact (e.g. direct mortality of individuals from vehicle collisions, or indirect mortality of individuals from reduced prey resources due to pollution of watercourses);
- reversibility of impact (reversible or irreversible);
- 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).

With the use of professional judgement and the criteria outlined in Table 7-3, impacts on ecological features were characterised as major, moderate, minor or negligible.

Table 7-3: Impact characterisation for ecological features

Characterisation of Impact	Criteria
Major	An impact likely to permanently affect the integrity of a feature in terms of the coherence of its ecological structure and function to the ecosystem; and affect the conservation status and/or objectives of a feature. The feature is degraded to the extent that populations and/or habitats are destroyed, or sensitive life stages are affected. Features experience continuous, irreversible or long-term change. The feature has low capacity to adapt to change. Recovery, if it occurs, would be expected to be long-term (i.e. more than 5 years) after the source of impact has been removed. Impacts not limited to areas proximal and adjacent to the development, with impacts possibly detectable beyond the study area.

Moderate	The impact is not likely to permanently affect the integrity of a feature but may be substantial in terms of its effect on ecological structure and function and may affect the conservation status and/or objectives of a feature. The feature is degraded to the extent that populations and/or habitats experience a reduction in number or range in the medium to short-term. Features experience regular intermittent change which may affect sensitive life stages. The feature has medium capacity to adapt to change. Recovery would be expected to occur in the medium-term (i.e. 1 to 5 years) after the source of impact has been removed. Impacts generally limited to areas proximal and/or adjacent to the development.
Minor	The impact would not permanently affect the integrity of the feature, but features may experience some limited degradation. Disturbance is detectable but experienced within the range of natural variability in the medium to short-term. Features experience intermittent irregular change and sensitive life stages are not affected. The feature has high capacity to adapt to change. Recovery would be expected to occur in the short-term (i.e. less than 1 year) after the source of impact has been removed. Impacts limited to area proximal to development.
Negligible	The impact would not permanently affect the integrity of the feature and there would be little or no degradation. The change to baseline conditions is not detectable. Disturbance is experienced within the range of natural variability in the short-term. Features experience occasional change and sensitive life stages are not affected. The feature has very high capacity to adapt to change. Recovery would be expected relatively quickly (i.e. less than six months) after the source of impact has been removed. Impacts limited to area proximal to development.

7.3.7.3 Significance of Effects

The level of significance of a potential effect is determined as a function of the ecological feature's importance and the characterisation of the impact. Professional judgement is the principal factor in determining which effects would be significant. In the context of this EIA Report, where impacts on internationally, nationally or regionally important ecological features are characterised as 'moderate' or 'major', they are considered to be significant.

Impacts on internationally important features characterised as 'minor', and 'major' impacts on features of authority area importance, can also be significant. There may be an additional number of impacts on a feature that, whilst not of a character to be significant in themselves, may cumulatively result in a significant effect on that feature. (CIEEM 2022).

7.3.7.4 Cumulative Effects

The assessment of cumulative effects with other projects followed the process described in Chapter 3: Environmental Impact Assessment Methodology with some minor modifications specific for biodiversity receptors. These modifications related primarily to the reduction in the study area. Falkirk Council planning department provided information on planning applications up to August 2023 inclusive and a

review of these developments was conducted. Small developments outwith 2 km of the Site Boundary were excluded as they were deemed unlikely to have cumulative effects due to their small size and distance from the Site Boundary. The assessment focused on developments of any size within 2 km and larger developments up to 10 km from the Site Boundary. In addition, Musselburgh Flood Protection Scheme was also considered as part of the assessment as requested by NatureScot.

Further details of the same project cumulative effect can be found in Chapter 15: Cumulative Effects.

7.3.7.5 Habitat Loss

Habitat loss as a result of the Scheme was calculated to assist in determining the impact on biodiversity and to inform the approach to mitigation/compensation. Whilst the exact area of habitat loss will be dependent on the construction methods used by the contractor, to inform the assessment, GIS software has been used to calculate temporary and permanent habitat loss, with the following approach being used:

- Temporary habitat loss during construction was calculated by subtracting the Permanent Works Footprint from the Site Boundary which includes all working areas, haul roads and compound sites. The location of compounds are indicative and could be micro-sited or may not be used by the contractor; however, temporary habitat loss has been calculated using the indicative locations.
- Permanent habitat loss throughout the Scheme was calculated using the Permanent Works Footprint which uses a 1 m footprint for walls and a 10 m footprint for embankments. Where coastal revetments are proposed, the Permanent Works Footprint for these has incorporated the specific footprint required based on the ground conditions at each location. As an indication, the revetments would span approximately 10 m on the tidal side of the alignment (to allow for the revetment), and approximately 5 m on the landward side to accommodate an access track (for defence maintenance operations).

7.3.7.6 Mitigation

Following the impact assessment, consideration is given to the identification and application of mitigation where effects are identified as being individually or cumulatively significant. The mitigation follows a hierarchical approach that aims to avoid or ameliorate the effect of the impact on an ecological feature. Avoidance or reduction of an environmental impact may be achieved through the application of measures at the early design stage, such as moving the alignment of defences to minimise incursion into designated sites (primary mitigation). Thereafter, additional mitigative measures specific to an impact (secondary mitigation), and/or recommending adherence to good practice management measures (tertiary mitigation), are identified. Chapter 3: Environmental Impact Methodology, Section 4.7, provides further details on the mitigation hierarchy.

7.3.7.7 Monitoring

Where relevant to further understanding and/or validation of a given assessment, or to ensure that appropriate mitigation is effective over time, monitoring measures are recommended (Section 7.7: Post Construction Monitoring).

7.3.7.8 Residual Effects

Residual effects are those that remain once appropriate mitigation has been effectively applied (Section 7.10: Residual Effects).

Where residual effects of significance remain, compensatory measures are proposed to offset residual effects, where practical (Section 7.8: Compensation).

7.4 Baseline Conditions

7.4.1 Introduction

This section summarises the existing ecological conditions within the study area and extended sections that have been determined through desk-based assessment, consultation and site surveys. The baseline information is provided in Table 7-5, Appendices B7.1 – B7.3 and Figures B7.1 – B7.8, and in supporting documents C7.1 – C7.2 in Appendix C7.

7.4.2 Designated and Wildlife Sites

Flood Cells 3, 5 and 6 of the Scheme overlap with the following statutory designated sites (Table 7-5 and Figure B7.1) (it should be noted that the below designated sites largely cover the same area):

- Firth of Forth SPA – designated for the protection of an internationally important population of waders and wildfowl which primarily visit the area during winter, and for Sandwich tern migration (NatureScot 2023a).
- Firth of Forth Ramsar site – designated for protection of waterfowl assemblages and certain bird species populations of international importance (NatureScot 2023b).
- Firth of Forth SSSI – designated for a variety of features including breeding eider, shelduck, ringed plover, wintering waders and wildfowl, beetle assemblages, saltmarsh habitats and geological features (NatureScot 2023c). The Firth of Forth SSSI includes an area of grassland, patches of woodland and ponds adjacent to the Forth Estuary, north of the River Carron.

Carron Dams SSSI and Avon Gorge SSSI, are located adjacent to the Site Boundary and are discussed further in Section 7.4.5.

The following non-statutory designated sites are located adjacent to the Site Boundary and are discussed further in Section 7.4.5 and Table 7-5: River Carron Meander Site of Nature Conservation (SINC); Carron Dams Local Nature Reserve (LNR); Jupiter Urban Wildlife Centre; Forge Dam, Forth & Canal, Polmont Woods and Camelon Riverside Wildlife Sites.

7.4.3 Habitats

7.4.3.1 UK Habitat Classification

This section contains a summary of the habitat types recorded within the Site Boundary, as classified by the UKHab survey codes and labels. The results of the UK Habitat Classification survey are presented on Figure B7.2. The UKHab classification system uses a hierarchical primary habitat system with five levels: Level 1 only classifies habitats to a major ecosystem (terrestrial, freshwater or coastal) and increasingly more detailed habitat information is recorded up to Level 5. For example, g (Grassland) is a Level 2 label, whereas g3c (Other neutral grassland) is a Level 4 label. Habitat categorisation is based on the vegetation supported and their geographic context, geology and hydrology. The UKHab survey area identified in Table 7-1, contains a variety of terrestrial, aquatic and intertidal habitats, all of which are shown on Figure B7.2. Habitats considered to be of at least local importance are discussed within Table 7-5. Diagram 7-1 identifies the area of each habitat type within the Site Boundary of each Flood Cell.

Several priority habitats, as identified on the SBL and Falkirk Council LBAP, were recorded. These include saltmarsh, intertidal mudflats, broadleaved/mixed woodland and hedgerows.

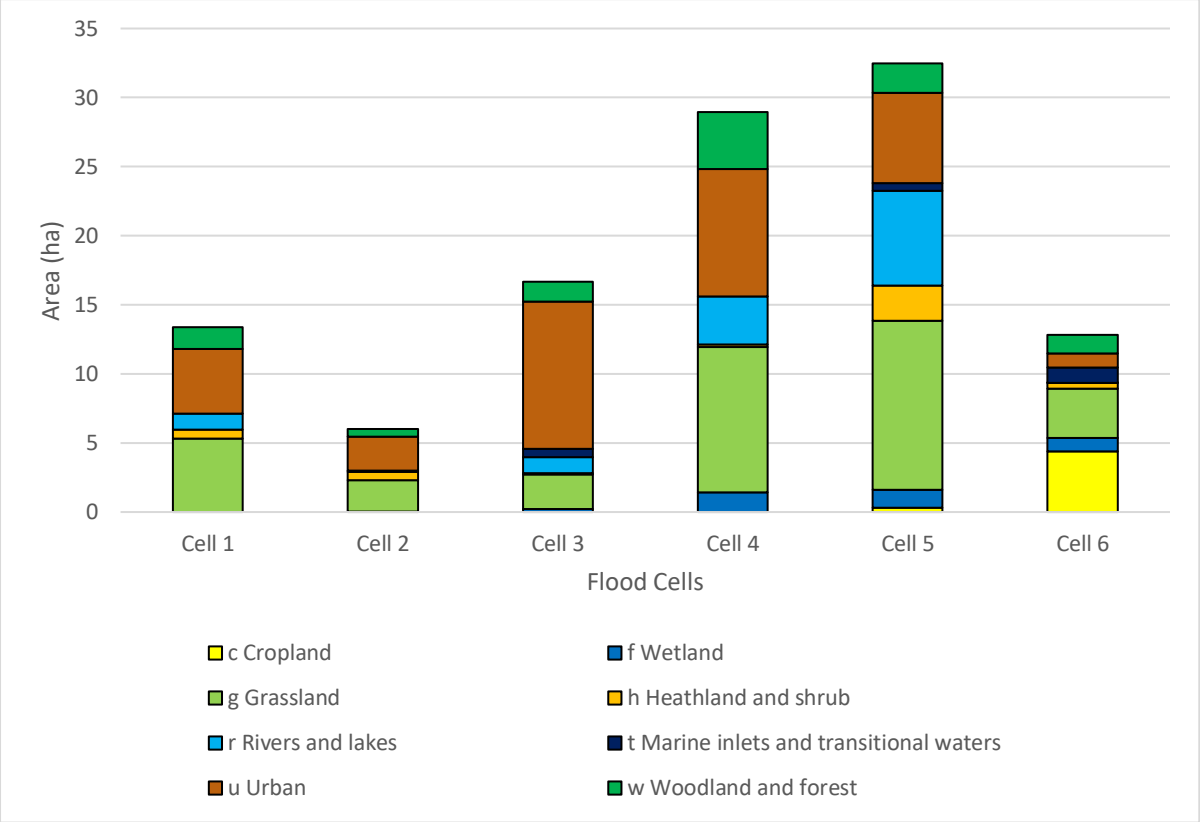

Diagram 7-1: Habitat types by area within the Scheme Site Boundary broken down by Flood Cell.

The total habitat within the Site Boundary is 110.29 ha, with the following habitats comprising most of the area: urban (34.56 ha), grassland (36.35 ha), rivers and lakes (12.76 ha), and woodland and forest (11.18 ha).

7.4.3.1.1 Woodland

All 11.18 ha of woodland and forest under the Site Boundary is classed under the Level 3 label Broadleaved mixed and yew woodland. Most of this is w1g (Other woodland; broadleaved) (10.41 ha) and this is the only woodland type that was recorded in all six Flood Cells with the largest areas (3.88 ha) in Flood Cell 4. In Flood Cells 1 and 5, w1h (Other woodland; mixed) (0.51 ha) was recorded. Two woodland habitats listed on the SBL, w1f (Lowland mixed deciduous woodland) (0.15 ha) and w1d (Wet woodland) (0.11 ha), were recorded in Flood Cell 4.

Within the Site Boundary, approximately 0.01 ha in Flood Cell 4 is classed as 'Category 2b Long-established Woodland of Plantation Origin' on the Ancient Woodland Inventory (AWI). This occurs within Working Area 4-4, adjacent to Smiddy Brae road. A section of this area (0.007 ha) is also mapped as Polmont Woods Wildlife Site. The UKHab mapped this area as w1g (Other woodland; broadleaved), with sycamore, ash and wych elm listed as the most commonly occurring species. The ground flora mainly comprised ferns, bramble and Himalayan balsam. Other habitats within the area recorded as AWI included u1d (Suburban/ mosaic of developed/ natural surface) associated with the minor road and r2b (Other river and streams) associated with Millhall Burn.

Of the total 11.18 ha of woodland and forest within the Site Boundary, 0.37 ha was recorded by the Native Woodland Survey of Scotland (NWSS). The NWSS identifies these parcels as lowland mixed deciduous woodland (Flood Cell 1) and wet woodland (Flood Cells 1 and 6). The UKHab classed 0.28 ha of this as w1g (Other woodland; broadleaved) and 0.02 ha as w1h (Other woodland; mixed). An

additional 0.07 ha falls under the NWSS mapped area, however, the UKHab classed 0.05 ha as urban habitats and 0.02 ha as grassland habitat.

The UKHab mapped 3878 m of linear habitats as w1g (Other woodland; broadleaved) within the Site Boundary of the Scheme. Most of these lines of trees border roads or watercourses. Species include: ash, beech, birch, common lime, oak, sycamore, wild cherry, willow and cypress.

Wych elm, which is listed as a priority species on the Falkirk LBAP (Woodland Action Plan) (Falkirk Council 2019a), was recorded within w1g (Other woodland; broadleaved) in Flood Cells 1, 4 and 5. In Flood Cell 1, wych elm was recorded outwith the Site Boundary in a parcel of woodland north of the River Carron. It was noted as being abundant in woodland near the Polmont Burn and it was also recorded within Polmont Woods Wildlife Site; small sections of these woodlands fall within the Site Boundary in Working Areas 4-1 and 4-4. In Flood Cell 5, wych elm was recorded in woodland north of Wholeflats Road and some of this woodland falls within the Site Boundary in Working Area 5-1.

7.4.3.1.2 Heathland and Shrub

Within the Site Boundary, the UKHab Level 3 label Dense scrub was recorded within all Flood Cells and totalled 4.56 ha. Of this, 3.88 ha was h3h (Mixed scrub) which mostly comprised bramble, elder, hawthorn, gorse, broom, hazel, dog rose and willow. The remaining scrub habitats comprised h3d (Bramble scrub) (0.61 ha), h3e (Gorse scrub) (0.04 ha) and h3f (Hawthorn scrub) (0.03 ha).

Within the Site Boundary, 820 m of hedgerow habitat was recorded in Flood Cells 1 and 5. Of this, 621 m was recorded as h2a (Hedgerow) and comprised hawthorn, with occasional ash and sycamore; 89 m was classed as h2b (Other hedgerows) managed hawthorn and beech, and 110 m of managed hedgerow within Falkirk golf course was not mapped to UKHab Level 3. These sections of hedgerow are relatively isolated and alternative linear features such as roads, watercourses and treelines are present in the local area.

7.4.3.1.3 Grassland and Cropland

Grassland comprised 36.35 ha within the Site Boundary. Of this, 27.68 ha was g3 (Neutral grassland), with the majority being g3c (Other neutral grassland) (26.97 ha). The remaining grassland is g4 (Modified grassland) (7.92 ha) and g1 (Acid grassland) (0.74 ha) in Flood Cell 1.

In Flood Cells 5 and 6, 4.66 ha of c1c (Cereal crops) was recorded within the Site Boundary.

7.4.3.1.4 Urban

Urban habitats comprised 34.56 ha within the Site Boundary and were recorded in all Flood Cells. More than half (17.79 ha) of these urban habitats were classed as u1d (Suburban/ mosaic of developed/ natural surface), whilst u1b (Developed land; sealed surface) comprised 13.96 ha, u1 (Built-up areas and gardens) comprised 2.03 ha and 0.04 ha was classed as u1c (Artificial unvegetated, unsealed surface). The majority of urban habitats within the Site Boundary included residential areas and built-up land within Port of Grangemouth and the petrochemical plant.

The remaining 0.74 ha of urban habitats was u1a (Open Mosaic Habitats on Previously Developed Land (OMHPDL)), which was recorded within Working Area 3-4 at the northeast extent of the port. These areas within the Site Boundary were adjacent to access roads/tracks and mostly consisted of scrub, grassland and bare ground. The presence of shipping containers and numerous vehicle tracks indicates that one of these habitat parcels is in an active port site and therefore does not strictly conform to OMHPDL.

There were 1257 m of footpaths and access tracks mapped within the Site Boundary, classed as u1e (Built linear features).

7.4.3.1.5 Wetland

Wetland habitats were recorded in Flood Cells 2 to 6 and all wetland recorded within the Site Boundary (3.98 ha) was classed under Level 3 label f2 (Fen marsh and swamp). The majority was classed as f2e (Reedbeds) (3.56 ha), which was present in Flood Cells 2 to 6. The reedbeds were dominated by common reed. F2a (Lowland fens) (0.01 ha) was recorded in Working Areas 4-1 and 6-3 only. Reedbeds and lowland fen habitats are both listed on the SBL. The remaining wetland was classed as f2f (Other swamps) (0.40 ha) and recorded in Flood Cells 5 and 6.

7.4.3.1.6 Marine Inlets and Transitional Waters

All Marine inlets and transitional waters habitats within the Site Boundary were classed under Level 3 label t2 Littoral sediment (2.24 ha). Of this, 0.53 ha was t2a (Coastal saltmarsh) which is listed on the SBL, and 1.65 ha was t2d (Intertidal mudflats) which are a Scottish Priority Marine Feature (NatureScot 2020c). Saltmarsh and mudflats are also qualifying features of the Firth of Forth SSSI; 0.27 ha of saltmarsh and 0.84 ha of mudflats were recorded within the SSSI under the Site Boundary.

The remaining 0.07 ha of habitat within the Marine inlets and transitional waters category is t2h (Beach).

7.4.3.1.7 Rivers and Lakes

Within the Site Boundary, 12.76 ha of Rivers and lakes habitats were recorded; 11.65 ha of this was r2 (Rivers and streams). Section 7.4.3.6 Aquatic habitats details the river habitats of note.

Within the dock area of the Port of Grangemouth in Flood Cell 5, 1.08 ha was mapped as r1 (Standing open water and canals). Within Flood Cell 3, 0.02 ha of open water within reedbed at the northeast extend of the Port of Grangemouth was mapped as r1a6 (Other eutrophic standing waters). This area is subject to periodic inundation of saltwater at very high tides.

7.4.3.2 Ground Water Dependent Terrestrial Ecosystems

Potential GWDTEs were identified using habitat survey data in conjunction with a hydrogeological assessment conducted by Jacobs hydrogeologists. More details on the GWDTE assessment are presented in Appendix B7.1 and in Chapter 10: Water Environment.

7.4.3.3 Plants of Conservation Interest

As mentioned in Section 7.4.3.1.1 Woodland, wych elm was recorded in woodland within Working Areas 4-1, 4-4 and 5-1. No plant species listed on the SBL were recorded. Three records of oxeye daisy were recorded in an area of broadleaved woodland bordering industrial land during the desk study; however, these are outwith the Site Boundary, and no records were observed during the UKHab surveys.

7.4.3.4 Invasive Non-native Species (INNS)

The INNS giant hogweed, Himalayan balsam, Japanese knotweed and rhododendron were recorded within the Site Boundary during the UKHab surveys. Incidental records of giant hogweed, Himalayan balsam and Japanese knotweed were also recorded during protected species surveys on the watercourses identified in Table 7-4. The location of these INNS and other less destructive INNS of plants recorded within the Site Boundary are provided in Appendix B7.1.

Table 7-4: INNS recorded on watercourses during protected species surveys

Watercourse	INNS		
	Giant hogweed	Himalayan balsam	Japanese knotweed
Chapel Burn		x	
Forth Estuary			x
Grange Burn	x	x	x
Millhall Burn		x	x
Polmont Burn	x		
River Avon		x	x
River Carron	x	x	x
Westquarter Burn		x	x

7.4.3.5 Intertidal Habitats

The Scheme extends into intertidal mudflats around the mouths of the River Carron (Flood Cell 3), River Avon, the Grange Burn and along sections of the Firth of Forth estuary (Flood Cell 6). Mudflat habitats totalling 1.65 ha were recorded within the Site Boundary of Flood Cells 3, 5 and 6. Of this, 0.84 ha falls within the Firth of Forth SSSI, for which mudflat is a feature of interest. Intertidal biotope surveys identified the areas at the mouth of the River Carron and along the estuary front as the *Hediste diversicolor* and *Limecola balthica* in littoral sandy mud biotope (lS.LMu.Mest.HedMac) (Appendix B7.2 , Figure B7.7).

Several small, isolated areas of saltmarsh habitat were identified in Flood Cells 3, 5 and 6, totalling an area of 0.53 ha within the Site Boundary. Of this, 0.27 ha of saltmarsh habitat falls within the Firth of Forth SSSI, for which saltmarsh is a feature of interest.

Seagrass beds are a Scottish Priority Marine Feature, reported to occur on the mudflats within the Firth of Forth. However, the closest reported record of seagrass beds is in Carriden Bay, approximately 5 km east of the Port of Grangemouth (Zoutenbier *et al.* 2016). As there are no seagrass beds within the vicinity of the Scheme, this habitat type is not considered further.

7.4.3.6 Aquatic Habitats

The study area includes three main watercourses (River Carron, River Avon, and Grange Burn) and six associated tributaries (Chapel Burn, Bainsford Burn, Mungal Burn, Westquarter Burn, Polmont Burn and Millhall Burn) (Figure 10.1). A short section of the Queen Elizabeth II Canal is also within the Site Boundary (Flood Cell 2). As there are no effects pathways from the Scheme to the Bainsford Burn or the canal, these watercourses were not considered further in the assessment.

7.4.3.6.1 River Carron, River Avon and Grange Burn

The River Carron flows east from the Campsie Fells towards Grangemouth and out into the Firth of Forth between Skinflats and the Port of Grangemouth. With the exception of the Port of Grangemouth and the village of Carron, the River Carron is bordered primarily by agricultural and woodland/greenspace. The tidal limit in the River Carron is approximately 300 m upstream of the Carron Bridge at Stenhouse Road and downstream of this the river is brackish with predominantly soft silt substrates and banks.

Above the tidal limit the River Carron has a mix of flow types covering a mixture of aquatic habitats. Substrates throughout the freshwater section were mostly cobble and boulder. Overall, the river provides habitat for a range of fish species and age classes, but within the Scheme study area, spawning opportunities are limited.

The River Avon flows along the western edge of Linlithgow, under the M9, through the petrochemical plant, and out into the Firth of Forth. The tidal limit on the Avon is on the upstream side of Wholeflats Road (A905). As with the River Carron, the substrates consist predominantly of silt throughout the tidal reach, but with a higher proportion of gravel and cobble deposition evident. In contrast to the River Carron, the River Avon is relatively unconstrained, with evidence of historic bank reinforcement alongside the petrochemical plant and a section of gabion baskets at the corner adjacent to the flares. The freshwater section within the Site Boundary contains a mix of mostly cobble and boulder, and flows are varied. The river provides habitat for a range of fish species and age classes, but within the Site Boundary, spawning opportunities are limited and the habitat is predominantly passage habitat.

The Grange Burn is a small, heavily modified, watercourse that flows through Rannoch Park, Zetland Park and out into the Firth of Forth between the Port of Grangemouth and the petrochemical plant. Below the tidal limit in Zetland Park, the watercourse is straightened with wooden shuttering along much of the banks and embankments along Grangeburn Road. The channel ranges from around 8 m wide at the downstream end of Grangeburn Road to 3-4 m wide through Zetland Park. The substrates comprise sand and silt with little in the way of flow variation, and although its depth varies with the tide, it is a relatively shallow watercourse. Downstream of the rail and pipe bridges associated with the port and petrochemical plant, where it is less constrained, the Grange Burn channel is notably wider and large intertidal mudflats become exposed on both banks. Between the M9 and the tidal limit, the burn is slightly more natural in character, although it is still straightened with sloping grass banks. Substrates comprise pebble and gravel with small amounts of cobble. Overall, the Grange Burn provides a limited amount of habitat for small or juvenile fish, but it does provide clear passage to Westquarter Burn upstream of the M9. The flow control structure on Grange Burn allows water to flow into the flood relief channel under high flow conditions.

7.4.3.6.2 Associated Tributaries

Chapel Burn is a small watercourse which flows through Stenhousemuir and Carron before joining the River Carron below the tidal limit. The channel has been significantly modified (straightened and deepened) and is generally shallow and less than 0.5 m wide. It provides limited habitat for aquatic species.

The Mungal Burn is a minor watercourse that flows into the River Carron north of Bainsford just below the tidal limit for the river. This watercourse is culverted for approximately 800 m beneath residential properties in Bainsford with a debris screen at the outlet. A short reach of channel, approximately 60 m, is open between the culvert and the River Carron. This section is shallow, straightened and approximately 1 m wide. A mix of large cobble and pebble substrates which provide some habitat suitable for juvenile salmonids are present. However, water quality appears to be poor.

Millhall Burn flows into the flood relief channel close to the River Avon. The lower reach is narrow, heavily modified, with a gabion mattress covering the substrates and gabion baskets reinforcing the left-hand bank. A large, piped culvert discharges the burn into the flood relief channel near the River Avon. It is unknown whether the culvert presents a barrier to fish migrating upstream into the burn from the River Avon. The mid-section near to Polmont Woods, although straightened, retains more natural features with suitable habitat for fish including clean gravels, some of which is suitable for spawning.

Polmont Burn discharges into the flood relief channel at the flow control structure below the M9. Along its upstream extents, it is a typical shallow woodland stream approximately 3 m wide with a gentle gradient and small step/pool sequences. Undercut banks, overhanging bank vegetation and heavy tree cover provide habitat for trout and European eel. However, given the condition of the flood relief channel

and the impediment to fish passage at the flow control structure, connectivity for migratory fish is unlikely.

Westquarter Burn is a small tributary that flows from its headwater east of Shieldhall into the Grange Burn. Flowing through residential areas for a large part of its course, it has previously been heavily modified and straightened. At Grandsable Road Bridge, instream habitat is very poor with the upstream section of the bridge heavily silted with few in-stream features suitable for fish. Silted substrates are generally pebble/cobble, with flows mostly glide and occasional run/riffle. High embankments with inlaid stone are present on both sides of the watercourse. Downstream of the bridge a concrete/grouted stone channel, approximately 4 m wide, with shallow water depths provides no functional habitat for fish.

7.4.3.6.3 Grange Burn Flood Relief Channel

The flood relief channel is a trapezoidal concrete channel with intermittent flows and provides no functional aquatic habitat. Substrates are mostly small (sand, silt and pebble) and the watercourse provides little fish habitat.

7.4.4 Species

Seven bat roosts were recorded within 30 m of the Site Boundary, nine active badger setts were recorded within 100 m, four otter couches were confirmed within 200 m, and a likely barn owl nest was recorded within a building immediately adjacent to the Site Boundary. Suitable habitat was identified within the study areas for great crested newt, hedgehog, kingfisher, water vole and red squirrel. Further data identifying protected species within the study area are detailed in Table 7-5.

Appendix B7.3: Terrestrial Ecology Data has been produced to detail survey results for species recorded within the survey area. However, otter, badger, barn owl and bat (confirmed roosts only) data will not be published within the EIA Report due to the potential risk to protected species from location data being publicly available. A password protected confidential report with this information will be submitted to NatureScot and Falkirk Council.

Aquatic species recorded in intertidal habitat affected by the Scheme included Nematoda, polychaete worms, mud snails and bivalves, all of which are typical of intertidal estuarine mudflats and none are of particular note or conservation interest. In addition, suitable riverine habitat is present with the potential to support a range of fish species including salmonids, European eel, flounder and lamprey. The aquatic ecology appendix (Appendix B7.2) presents data for intertidal mudflat species and riverine habitat suitable to support fish.

7.4.5 Evaluation

Table 7-5 evaluates the importance of each ecological feature discussed and assessed in this chapter. The evaluation considers baseline conditions and utilises the criteria in Table 7-2 to discuss implications for features that are likely to be impacted by the Scheme. Features are ordered by importance, with habitats followed by species.

As identified in Section 7.3.5: Consultation, NatureScot recommended that other statutory designated sites (in addition to the Firth of Forth SSSI, SPA and Ramsar site) be considered within the EIA Report. Due to the nature of the Scheme (relatively localised impacts and construction in phases over an anticipated programme of up to ten years), distance from these designated sites, and the ecology of the qualifying features, no effects pathways were identified on the following sites. These sites will therefore not be discussed further within the EIA Report. All of the European sites (SPAs and SACs) will be considered in the HRA for the Scheme.

- Forth Islands SPA (NatureScot 2023d) (16 km north of the Scheme)

- Imperial Dock Lock, Leith SPA (NatureScot 2023e) (30 km east of the Scheme)
- Outer Firth of Forth and St Andrews Bay Complex SPA (NatureScot 2023f) (18 km east of the Scheme)
- River Teith SAC (NatureScot 2023g) (18 km northwest of the Scheme (upstream))
- Isle of May SAC (NatureScot 2023) (70 km northeast of the Scheme (downstream))
- Slamannan Plateau SPA (NatureScot 2023k) (5 km southwest of the Scheme)
- Avon Gorge SSSI (NatureScot2023i) (0.2 km southeast of the Scheme)
- Carron Dams SSSI (NatureScot 2023j) (0.3 km north of the Scheme)
- Loch Leven SPA (NatureScot 2023l) (24 km northeast of the Scheme).

Two non-statutory designated sites, Carron Dams Local Nature Reserve and Forge Dam Wildlife Site, are located within 0.5 km of the Scheme (outwith the Site Boundary); however, as no effects pathways were identified for these sites, they are not discussed further.

Jupiter Urban Wildlife Centre and Forth & Clyde Canal Wildlife Site are located within 1 km of the Site Boundary; however, as no effects pathways were identified for these sites, they are not discussed further.

The RSPB Skinflats Nature Reserve is located northwest of Flood Cell 3 on the Forth Estuary coast and primarily consists of intertidal mud and a small area of saltmarsh. Key birds include migrant and wintering wildfowl, pink-footed geese and waders (RSPB 2019). As almost all of the reserve lies within the Firth of Forth SPA, Ramsar and SSSI boundaries, and as impacts on these sites are assessed in this chapter, impacts on the individual reserve are not considered further.

Table 7-5: Evaluation of terrestrial and aquatic ecological features

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Designated Sites				
Firth of Forth SPA (NatureScot 2023a) (NatureScot site code: 8499, EU site code: UK9004411) 6317.93 ha Figure B7.1	European site under Conservation (Natural Habitats & c.) Regulations 1994 (as amended in Scotland). In total, 10 qualifying species of the SPA that were recorded during surveys are also listed as priority species in the LBAP.	The Firth of Forth SPA is a complex of estuarine and coastal habitats in southeast Scotland which stretch from Alloa to the coasts of Fife and East Lothian. The site includes extensive invertebrate-rich intertidal flats and rocky shores, areas of saltmarsh, lagoons and sand dune. UKHab surveys mapped 1.58 ha of habitat within the SPA boundary that overlapped with the Site Boundary. This mostly consisted of mudflat (0.84 ha) saltmarsh (0.27 ha), wetland (0.09 ha), grassland (0.14 ha) and urban (0.17 ha). Sections of Flood Cells 3, 4, and 6 of the Scheme fall within the Firth of Forth SPA, with direct defences for the Port of Grangemouth and petrochemical plant encroaching upon the coastal boundary. 25 (of 27) SPA qualifying species were recorded during the winter vantage point surveys in 2015/16 -2016/17 and 23 (of 27) recorded during the 2022/2023 surveys (Appendix B7.6 and C7.1). Common scoter and Slavonian grebe were only recorded in the 2015/16 - 2016/17 surveys and there were no records of long-tailed duck or velvet scoter during either set of surveys.	The SPA is designated for populations of international importance of the following species: Annex 1 species: bar-tailed godwit, golden plover, Slavonian grebe, red-throated diver (all non-breeding) and Sandwich tern (passage). Migratory species (all non-breeding): knot, pink-footed goose, redshank, shelduck and turnstone. Waterfowl assemblage (all non-breeding): bar-tailed godwit, common scoter, cormorant, curlew, dunlin, eider, goldeneye, great crested grebe, grey plover, lapwing, long-tailed duck, mallard, oystercatcher, pink-footed goose, red-breasted merganser, red-throated diver, ringed plover, scaup, Slavonian grebe, velvet scoter, wigeon and turnstone	International
Firth of Forth Ramsar (NatureScot 2023b) (NatureScot site code: 8424, EU site code: UK13017) 6317.93 ha	Ramsar site under the Convention on Wetlands of International Importance). In total, 10 qualifying species of the Ramsar site that were recorded during surveys are also	The boundary of the Ramsar site is coincident with the Firth of Forth SPA. Sections of Flood Cells 3, 4 and 6 of the Scheme fall within the Firth of Forth Ramsar site, with direct defences for the Port of Grangemouth and petrochemical plant encroaching upon the coastal boundary. 25 (of 27) Ramsar qualifying species were recorded during the winter vantage point surveys in 2015/16 - 2016/17 and 23 (of 27) were recorded during the 2022/2023 surveys. Slavonian	The Ramsar site is designated for populations of international importance of the following species: bar-tailed godwit, cormorant, curlew, dunlin, golden plover, great crested grebe, grey plover, ringed plover, lapwing, mallard, oystercatcher, red-breasted merganser, red-throated driver, goldeneye, scaup, wigeon, eider, common scoter, velvet scoter, long-tailed duck, knot, pink-footed goose, redshank,	International

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Figure B7.1	listed as priority species in the LBAP.	grebe were only recorded in the 2015/16 - 2016/17 surveys. There were no records of long-tailed duck or velvet scoter during either set of surveys (Appendix B7.6 and Appendix C7.1).	shelduck, Slavonian grebe, turnstone (all non-breeding) and Sandwich tern (passage). It is also designated for a non-breeding waterfowl assemblage of international importance.	
Firth of Forth SSSI (NatureScot 2023c) (NatureScot site code: 8163, EU site code: 169840) 7423.19 ha Figure B7.1	Designated under the Nature Conservation (Scotland) Act 2004. In total, 10 qualifying species of the SSSI that were recorded during surveys are also listed as priority species in the LBAP.	The Firth of Forth SSSI is an extensive coastal area located on the east coast of Scotland. It spans from Alloa to Crail on the north shore and extends to Dunbar on the south shore. It includes the Forth estuary upriver from the Forth bridges and the firth east of the bridges. Sections of Flood Cells 3, 4 and 6 of the Scheme fall within the Firth of Forth SSSI site, with direct defences for the Port of Grangemouth and petrochemical plant encroaching upon the coastal boundary. The Firth of Forth SSSI spans much of the same area as the Firth of Forth SPA and Ramsar site. The SSSI also includes an area at Skinflats adjacent to the Forth Estuary and north of the River Carron. This area includes grassland, woodland and pond habitats. Amongst other features, the SSSI is also designated for saltmarsh and mudflat habitats. Important areas of saltmarsh are supported at Skinflats to the north of Flood Cells 2 and 3. Good examples of mudflats can be found at Skinflats and Kinneil Kerse (east of Flood Cell 6). 25 (of 27) SSSI qualifying species were recorded during the winter vantage point surveys in 2015/16 - 2016/17 and 23 (of 27) were recorded during the 2022/23 surveys (Appendices C7.1 and B7.3 respectively). Common scoter and Slavonian grebe were only recorded in the 2015/16 - 2016/17 surveys and there were no records of long-tailed duck or velvet scoter during either set of surveys. All three qualifying breeding species (eider, ringed plover	In addition to all recorded non-breeding bird species listed for the Firth of Forth SPA, the SSSI is designated for the presence of breeding eider, ringed plover and shelduck. Other qualifying features of the SSSI include geological and geomorphological features, coastal and terrestrial habitats (including mudflats, saltmarsh, saline lagoons and sand dunes), vascular plants, and invertebrates (NatureScot 2023c).	National

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
		and shelduck) were recorded during the breeding bird surveys conducted between May and July 2016 (Appendix C7.1), but only shelduck was noted as breeding.		
River Carron Meander SINC 4.9 ha Figure B7.1	Saltmarsh is listed on the LBAP under Action Plan 1: Estuary. Fen, marsh and swamp is listed on the LBAP under Action Plan 4: Water and Wetland. Reedbeds are listed on the SBL.	The site is located in a meander of the River Carron in an urban fringe setting within Flood Cell 1. At the nearest point, it is located approximately 15 m south of the Site Boundary, on the opposite bank of the River Carron. Falkirk Council's Supplementary Guidance SG08 on Local Nature Conservation and Geodiversity Sites states, "*Carron Meander is now an extensive area of reedbed with some standing water and grassland on the drier embankments and path edge. The site was previously described as supporting saltmarsh and brackish water communities; however, alterations to the drainage/management appear to have stopped inundations from the tidal River Carron. This has resulted in the replacement of saltmarsh type habitats with reedbed*" (Falkirk Council 2020b). Amec (2008) identified an area of saltmarsh, which was not recorded in the later surveys, possibly as a result of the drainage changes identified above. The UKHab survey only covered the western extent of the site and this was mostly mapped as f2f Other swamp (dominated by canary grass), with a smaller area of f2e Reedbeds (dominated by common reed) and a strip of w1d Wet woodland bordering the River Carron.	SINCs are locally important areas for nature conservation. Saltmarsh is specifically listed on the LBAP. All swamp areas dominated by common reed and >5 m wide (i.e. non-fringing) fall under the SBL reedbeds priority habitat.	Regional
Polmont Woods Wildlife site 20.2 ha Figure B7.1	Mixed semi-natural woodland is listed on the LBAP under Action Plan 5: Woodland.	The site is a large woodland located between Grangemouth and Polmont, extending around Grangemouth Golf Course. The site is located to the south of Flood Cell 4, with the northern edge of the wood overlapping the Flood Cell boundary. The UKHab survey mapped an area of the wildlife site adjacent to Smiddy Brae in Working Area 4-4 (0.05 ha). This area overlaps with the mapped AWI area (0.007 ha), and NWSS (0.03 ha). This area was mapped as w1g (Other woodland; broadleaved) and u1d	The site supports a range of habitats including broadleaved semi-natural woodland, conifer woodland, scrub and neutral grassland. Millhall Burn runs through the Wildlife Site (Falkirk Council 2020b). The LBAP Action Plan 5: Woodland (Falkirk Council 2019a) states that Polmont woods	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
		(Suburban/ mosaic of developed/ natural surface). LDP2 states "*The core ash-elm woodland appears to be long-established, while the western slope supports conifer plantation. There are some extensive areas of quite varied neutral grassland, often with associated scrub. The Millhall Burn runs through the wood, to feed into various settling ponds and the Millhall reservoir*" (Falkirk Council 2020b).	has been subject to enhancement over the past ten years to help protect and improve woodland wildlife.	
Camelon Riverside Wildlife Site 5.4 ha Figure B7.1	N/A	The site is located on the south bank of the River Carron in an urban fringe setting within Flood Cell 1. It sits at the base of an old landfill site (now amenity grassland and playing fields) and is subject to occasional inundation by the River Carron. The site is approximately 5 m from the Site Boundary, within Flood Cell 1. This area comprises g1d (Other lowland acid grassland) and a line of broadleaved trees borders the roadside. Himalayan balsam and Japanese knotweed were recorded during UKHab surveys. The part of the site closest to the Site Boundary is intersected by footpaths and directly adjacent to a car park.	The site supports a range of habitats including broadleaved woodland, mixed plantation woodland, neutral and semi-improved grassland, wetlands and scrub. The site occupies an important position on the habitat corridor formed by the River Carron and has high potential for otter, amphibians and woodland birds (Falkirk Council 2020b).	Authority
Habitats				
Ancient woodland Figures B7.1 and B7.2	While ancient woodland does not have specific protection under legislation, it is considered to be an irreplaceable resource of high nature conservation value and is mentioned as needing to be protected in the Falkirk Council LBAP.	Approximately 0.01 ha of habitat listed on the AWI only falls within the Site Boundary in Flood Cell 4 (Working Area 4-4) adjacent to Smiddy Brae road. The UKHab mapped this area as W1g (Other woodland; broadleaved), u1d (Suburban/ mosaic of developed/ natural surface) and r2b (Other rivers and streams).	Ancient woodland is defined as land that is currently wooded and has been continually wooded, at least since 1750. Such woods were mapped to form the Ancient Woodland Inventory (AWI). NatureScot has referred to ancient woodland as an important and irreplaceable national resource. NPF4 (Policy 6) contains provisions to protect and expand forests, woodland, and trees (including ancient woodland).	National

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Intertidal mudflats Figure B7.2	Intertidal mudflats are a Scottish Priority Marine Feature and are a qualifying feature of the Firth of Forth SSSI. They are listed as a priority habitat under Action Plan 1: Estuary on the Falkirk Council LBAP.	Mudflats were recorded during the UKHab survey in Flood Cells 3, 5 and 6. Mudflats in these areas were associated with the Firth of Forth and tidal areas of the River Carron, River Avon and the Grange Burn. Some areas are designated as part of the Firth of Forth SPA/Ramsar and SSSI. Mudflat habitats, totaling 1.65 ha, were recorded in the Site Boundary of Flood Cells 3, 5 and 6. Biotope surveys identified all areas as *Hediste diversicolor* and *Limecola balthica* in littoral sandy mud (LS.Lmu.Mest.HedMac) (Appendix B7.2, Figure B7.7).	Intertidal mudflats are present immediately adjacent to the Scheme. This habitat is a qualifying feature of the Firth of Forth SSSI and represents a priority feature in the Falkirk LBAP. The area provides supporting habitat for a number of important bird and fish species.	National
Saltmarsh Figure B7.2	Coastal saltmarsh is listed on the SBL and is a qualifying feature of the Firth of Forth SSSI. Saltmarsh is listed on the Falkirk LBAP under Action Plan 1: Estuary.	The Scottish Saltmarsh Survey (Haynes 2019) states that there is 119 ha of saltmarsh within the Forth Estuary. The UKHab survey identified 0.53 ha saltmarsh habitat within the Site Boundary in Flood Cells 3, 5 and 6. Mapped saltmarsh areas were assessed as being in moderate or good condition; however, these areas are small and fragmented and therefore provide limited contribution to the wider network of saltmarsh. This habitat is associated with the Firth of Forth, including the tidal part of the River Avon. Only 0.27 ha falls within the Firth of Forth SSSI, SPA and Ramsar.	This habitat is a qualifying feature of the Firth of Forth SSSI. Large areas of saltmarsh are recorded in the Firth of Forth, but the areas recorded in proximity of the Scheme are very small and fragmented.	National
Broadleaved and mixed woodland (non-AWI), including woodland listed on NWSS Figure B7.2	Lowland mixed deciduous woodland and wet woodland are listed on the SBL, and broadleaved and mixed woodland is listed on the Falkirk LBAP under Action Plan 5: Woodland. Wych elm is listed on the Falkirk LBAP under	Broadleaved and mixed woodland are found throughout the Scheme. This habitat (not listed on AWI) was present within the Site Boundary of all Flood Cells and totaled 11.17 ha. Two habitats listed on the SBL w1f (Lowland mixed deciduous woodland) (0.15 ha) and w1d (Wet woodland) (0.11 ha), were recorded in Flood Cell 4. Woodland mapped for the NWSS comprises 0.37 ha within the Site Boundary: lowland mixed deciduous woodland (Flood Cell 1) and wet woodland (Flood Cells 1 and 6). However, the UKHab classed 0.28 ha of this as w1g Other woodland; broadleaved and 0.02 ha as w1h Other woodland; mixed.	Areas of woodland within the survey area classed as lowland mixed deciduous woodland or wet woodland would conform to the SBL habitat class. Wych elm is listed on the Falkirk LBAP under Action Plan 5: Woodland.	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	Action Plan 5: Woodland.	The UKHab mapped 3878 m of linear habitats as w1g (Other woodland; broadleaved) within the Site Boundary. Wych elm was recorded in four areas of woodland during the UKHab surveys, in Flood Cells 1, 4 and 5. It was noted as being 'abundant' in woodland near the Polmont Burn (Working Area 4-1).		
River Carron Figure B7.2	Classified by SEPA under the Water Framework Directive (WFD). Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP, with the River Carron listed as an important site. The River Carron as it flows through the intertidal zone is part of the Firth of Forth SSSI, SPA and Ramsar site.	Lower reaches included within the Middle Forth Estuary WFD water body (Site ID 200436). SEPA 2020 overall status of Moderate Ecological Potential. Ecological overall classification of Moderate, and Good status for biological elements (SEPA 2020). Freshwater reaches within the River Carron (Bonny Water confluence to Carron Estuary) WFD water body (Site ID 4200). SEPA 2020 overall status of Poor. Classifications of Poor for overall ecology and biological elements (SEPA 2020). The River Carron falls within the Firth of Forth SSSI, SPA and Ramsar site at its mouth where it flows between the Skinflats mudflats and Grangemouth Port. The River Carron is a medium sized river with tidal influence in its lower reaches. In the tidal section, substrates and banks are predominantly soft silt and flows lack variation. In the freshwater section, substrates are a mix of cobble and boulder with smaller substrates present in some areas. Flows and depths are varied creating a range of habitats.	The River Carron is listed as an important site on the Falkirk LBAP under the Water and Wetland Action Plan and provides habitat for a range of fish species including LBAP priority species (e.g. Atlantic salmon, sea/brown trout, European eel and river lamprey). Although spawning opportunities within the Scheme boundary are limited, other functional habitat is available and will also be used by these species noted above as part of their migratory route. Overall, despite the overall WFD status of moderate ecological potential, the habitat is essential for maintaining priority fish species within the area. Although the River Carron flows through designated sites, the river itself is not a qualifying feature and does not provide critical habitat for the designated features of these sites and therefore this is not considered when informing this ecological feature's importance.	Regional
River Avon Figure B7.2	Classified by SEPA under the WFD. Rivers and streams are listed as a priority	Lower reaches included within the Middle Forth Estuary WFD water body (Site ID 200436). SEPA 2020 overall status of Moderate Ecological Potential. Classifications of Moderate for overall ecology, and Good for biological elements (SEPA 2020).	The River Avon is listed as an important site on the Falkirk LBAP under the Water and Wetland Action Plan. And provides habitat for a range of fish species including	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP with the River Avon listed as an important site. The River Avon as it flows through the intertidal zone is part of the Firth of Forth SSSI.	Upper reaches within the River Avon (Logie Water confluence to Estuary) WFD water body (Site ID 3100). SEPA 2020 overall status of Moderate. Classifications of Moderate for overall ecology and biological elements (SEPA 2020). The River Avon is a medium sized river with tidal influence in its lower reaches. In the tidal section substrates and banks are predominantly soft silt, although some patches of gravel and cobble are present, and flows lack variation. In the short freshwater section within the Site Boundary substrates are a mix of mostly cobble and boulder. Flows are varied creating a range of habitats.	LBAP priority species (e.g. Atlantic salmon, sea/brown trout, European eel and river lamprey). Although spawning opportunities within the Scheme boundary are limited, other functional habitat is available but is predominantly passage habitat also be used by these species noted above as part of their migratory route. Despite the overall WFD status of moderate ecological potential, the habitat is essential for maintaining priority fish species within the authority area. Although the River Avon flows through designated sites, the river itself is not a qualifying feature and does not provide critical habitat for the designated features of these sites and therefore this is not considered when informing this ecological feature's importance.	
Wetland Figure B7.2	Reedbeds and lowland fens are listed on the SBL, and fen, marsh and swamp is listed on the Falkirk LBAP under Action Plan 4: Water and Wetland.	Within the Site Boundary, 3.98 ha of wetland habitats were recorded. The majority was classed as f2e (Reedbeds) (3.56 ha), listed on the SBL and LBAP, which was present in Flood Cells 2 to 6. The reedbeds were dominated by common reed and were mostly classed as being in moderate condition. F2a (Lowland fens) (0.01 ha), also listed on the SBL and LBAP, was recorded in Flood Cells 4 and 6.	Reedbeds are listed on the SBL and are the most important habitat for birds in the UK (JNCC 2008a). Within the Falkirk LBAP, fens, marshes, swamps and flushes are described as important wetland habitats. A small area of lowland fen is present within the Site Boundary.	Regional
Hedgerows Figure B7.2	Hedgerows are listed on the SBL and 'boundary features' is listed on the Falkirk LBAP under Action	Within the Site Boundary, 820 m of hedgerow was recorded in Flood Cells 1 and 5. Of this, 620 m was classed as h2a Hedgerow and comprised hawthorn, with occasional ash and sycamore. The remaining 200 m of hedgerow mostly comprised beech and hawthorn and was heavily managed.	Hedgerows are listed on the Falkirk LBAP under the Farmland and Grassland Action Plan. An LBAP action is to establish species-rich native hedges where they could provide habitat corridors.	Authority

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	Plan 2: Farmland and Grassland.		Hedgerows of conservation interest consist of at least 80% native woody tree and shrub species for a length of at least 20 m (JNCC 2008b). The majority of the hedges within the Site Boundary conformed to this.	
Open mosaic habitats on previously developed land (OMHPDL)	OMHPDL are listed on the SBL and on the Falkirk LBAP under Action Plan 6: Urban.	Within the Site Boundary, two parcels of OMHPDL which totalled 0.74 ha were recorded within Working Area 3-4 at the northeast extent of the port. These areas within the Site Boundary were adjacent to access roads/tracks and mostly consisted of scrub, grassland and bare ground. The presence of shipping containers and numerous vehicle tracks indicates that one of these habitat parcels is in an active port site, which does not strictly conform to OMHPDL.	The mosaic of habitats present within this area of disturbed, industrial land is more than 0.25 ha, which is a key feature of OMHPDL. However, based on the species information collected and criteria present within SNH (undated) and Macadam *et al.* (2013), the habitats within the Site Boundary do not represent good quality examples of OMHPDL.	Authority
Grange Burn/ Westquarter Burn Figure B7.2	Classified by SEPA under the Water Framework Directive. Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP. Grange Burn as it flows through the intertidal zone is part of the Firth of Forth SSSI, SPA and Ramsar site.	Grange Burn/Westquarter Burn WFD water body (Site ID 3300). SEPA 2020 Overall status of Moderate Ecological Potential. Classifications of Bad for overall ecology and Good for biological elements (SEPA 2020a). The mouth of the Grange Burn, downstream of the Petroineos petrochemical plant falls within the boundary of the Firth of Forth SSSI, SPA and Ramsar site. The Grange Burn is a small heavily modified watercourse with tidal influence in its lower reaches. The tidal section of Grange Burn is straightened, embanked and dominated by sand and silt substrates with no flow variation. The short freshwater section below the A9 is also straightened but contains pebble and gravel substrates which create a small amount of flow variation.	Although the Grange Burn is already significantly modified it does provide some (limited) functional habitat for small or juvenile fish including some of the priority species listed in the LBAP. It also provides clear passage to Westquarter Burn. Although the Grange Burn flows through designated sites, the burn itself is not a qualifying feature and does not provide critical habitat for the designated features of these sites and therefore this is not considered when informing this ecological feature's importance.	Local
Polmont Burn Figure B7.2	Rivers and streams are listed as a priority habitat under Action	Polmont Burn, upstream of the A9 is a typical woodland stream being approximately 3 m wide and 0.2 m deep on average. The	Rivers and streams are priority habitats under the Water and Wetlands Action Plan in the Falkirk LBAP. Polmont Burn is	Local

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	Plan 4: Water and Wetland on the Falkirk LBAP.	burn flows down a gentle gradient with a mix of runs and small step/pool sequences.	relatively small and flows into the artificial flood relief channel during flood events.	
Millhall Burn Figure B7.2	Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP.	Millhall Burn flows into the flood relief channel close to the River Avon. It is highly modified in the lower reaches with some natural features in the middle reach suitable for fish. A culvert discharges the burn into the flood relief channel and may prevent fish passage into the burn.	Rivers and streams are priority habitats under the Water and Wetlands Action Plan in the Falkirk LBAP. Millhall Burn is a small and highly modified watercourse.	Local
Mungal Burn Figure B7.2	Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP.	Mungal Burn is a minor watercourse that flows into the River Carron north of Bainsford and below the normal tidal limit for the river. It is artificially straightened for approximately 60 m upstream of the river and is then culverted for approximately 800 m beneath residential properties. Upstream of these residential properties, the burn is artificially straightened.	Rivers and streams are priority habitats under the Water and Wetlands Action Plan in the Falkirk LBAP. Mungal Burn is a small and highly modified watercourse.	Local
Scrub Figure B7.2	N/A	Within the Site Boundary, Dense scrub was recorded within all Flood Cells except Flood Cell 2 and totalled 4.56 ha. Scrub habitats comprised bramble, gorse, hawthorn and mixed (mostly bramble, elder, hawthorn, gorse, broom, hazel, dog rose and willow).	Scrub habitat is not listed in the SBL or LBAP.	Local
Grassland Figure B7.2	Neutral grassland, lowland dry, acidic grassland and arable are priority habitats under Action Plan 2: Farmland and Grassland on the Falkirk LBAP.	Grassland habitats comprised 36.35 ha within the Site Boundary and are present within all Flood Cells. Most of this is neutral grassland (27.68 ha) and modified grassland (7.92 ha), but acid grassland and cereal crops were also recorded. The Falkirk Council Biodiversity officer advised on 03 August 2023 that some areas of grassland have recently been subject to wildflower meadow enhancement at the Stirling Roads playing fields (Flood Cell 1) and Rannoch Park (Flood Cell 4). The species composition and extent of enhanced areas were not provided, but by referring to notes from the UK Hab surveys and taking a	Neutral, lowland dry acidic and arable grassland are Priority Habitats recorded under the Farmland and Grassland Action Plan in the LBAP.	Local

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
		precautionary approach, it is estimated that up to 0.57 ha of lowland acid grassland was enhanced at Stirling Road playing fields and up to 0.56 ha of neutral grassland was enhanced at Rannoch Park.		
Standing water Figure B7.2	Eutrophic standing waters are listed on the SBL and standing open water is a priority habitat under Action Plan 4: Inland water and wetland on the Falkirk LBAP.	Within the Site Boundary, 1.08 ha of standing open water and canal was recorded within the dock area of the Port of Grangemouth in Flood Cell 5. Within the Port of Grangemouth in Flood Cell 3, 0.02 ha of other eutrophic standing waters was recorded.	The areas of standing water mapped do not fulfil the requirements to meet SBL or LBAP habitats due to their saline nature and industrial influence.	Less than local
Urban Figure B7.2	N/A	Excluding OMHPDL, urban habitats comprised 33.82 ha within the Site Boundary and were recorded in all Flood Cells. The majority of urban habitats within the Site Boundary included residential areas and built-up land within Port of Grangemouth and the petrochemical plant. There were 1257 m of linear urban features recorded, which were mostly footpaths and tracks.	This habitat type has limited conservation importance.	Less than local
Chapel Burn	Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP.	Chapel Burn is a small watercourse which flows through Stenhousemuir and Carron before joining the River Carron below the tidal limit. The channel has been significantly modified (straightened and deepened) and is generally shallow and less than 0.5 m wide. It provides limited habitat for aquatic species.	Rivers and streams are priority habitats under the Water and Wetlands Action Plan in the Falkirk LBAP. Chapel Burn is a small and highly modified watercourse that provides limited habitat for aquatic species.	Less than local
Flood Relief Channel	Rivers and streams are listed as a priority habitat under Action Plan 4: Water and Wetland on the Falkirk LBAP.	The flood relief channel is a trapezoidal concrete channel which experiences intermittent flows and provides no functional aquatic habitat.	Rivers and streams are priority habitats under the Water and Wetlands Action Plan in the Falkirk LBAP. The flood relief channel is an artificial waterbody that provides no functional aquatic habitat.	Less than local

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Groundwater Dependent Terrestrial Ecosystems (GWDTEs)	GWDTE are specifically protected under the Water Framework Directive (SEPA 2017) (LUPS 31).	Further information on the hydrogeological assessment is presented in Chapter 10: Water Environment. The location of potential GWDTEs is presented in Appendix B7.1.	GWDTEs are protected under the WFD and therefore have been assessed within Chapter 10: Water Environment.	Refer to Chapter 10: Water Environment
Species				
Bats Figures B7.3 and B7.5	All UK bat species are European Protected Species (EPS) under the Conservation (Natural habitats & c.) Regulations 1994 (as amended in Scotland). Ten species of bat are known to occur in Scotland and all, with the exception of Leisler's bat, are listed on the SBL. Soprano pipistrelle is listed as a priority species in the Falkirk LBAP under Action Plan 5: Woodland. All species listed as least concern with the exception of Leisler's (Near Threatened) and Nathusius' pipistrelle (Vulnerable) on The	Soprano pipistrelles and pipistrelle bat species were recorded within the study area within the past twenty years (NBN 2023). Jacobs (2018) recorded one soprano pipistrelle within the petrochemical plant, between Flood Cells 4 and 5. Of the nine buildings proposed to be demolished, all have bat roost potential. Of nine structures proposed to be demolished or modified, four have bat roost potential. The surveys identified seven roosts; one in Flood Cell 1, three in Flood Cell 2, one in Flood Cell 3 and two in Flood Cell 4. These roosts were for common pipistrelle, soprano pipistrelle and Daubenton's bats. A soprano pipistrelle maternity colony is present in a building (Flood Cell 4) and a Daubenton's maternity roost was located in a wall (Flood Cell 1). The remaining roosts in buildings are small summer roosts. Additionally one possible roost was observed in Flood Cell 1. The location of confirmed and possible bat roosts will be submitted to NatureScot and Falkirk Council in a confidential report. 417 buildings and 24 structures with bat roost potential within 30 m of the Site Boundary have potential to be disturbed if roosts are present. 104 trees with bat roost potential are present within 30 m of the Site Boundary, of which 70 trees are located within the Site	Common and soprano pipistrelles are widely distributed throughout Scotland except in upland areas, where they are confined to river valleys (JNCC 2013a and 2013b). Brown long-eared bats are widespread in Scotland, where they occur in lowland areas and river valleys (JNCC 2013c). Daubenton's bat has been recorded throughout Scotland but may be less common in the north and west (JNCC 2013d). In Scotland Nyctalus species of bats (Noctule and Leisler's) are categorised as "rarest" bat species under Wray *et al.*, (2010) with a population of under 10,000. Based on the current understanding of Nyctalus bats distribution in Scotland, it is considered that the bats observed are most likely Noctule bats. No roosts for Nyctalus bat were observed. However, this species roosts primarily in trees which were not surveyed in as great a	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	Red List for mammals in Britain and Scotland.	Boundary of the Scheme. No roosts have been identified in trees so far. Six of Scotland's nine bat species were recorded during bat activity surveys within the study area. The transect surveys recorded foraging and commuting passes of common and soprano pipistrelle, brown long eared and myotis species bats. The passive bat detectors recorded foraging and commuting activity of six species, including rare species such as Nycatuls and Nathusius' pipistrelle bats. 53 passes for Nyctalus Sp. bats were recorded during the passive deployments the majority (42) were recorded adjacent to the River Avon (TP 3.3) in May. No further calls were recorded on the River Avon, therefore it is possible these calls were made by migrating bats. Nyctalus bat passes were also infrequently recorded along the River Carron in July, August, and September. 54 Nathusius' pipistrelle passes were recorded during the passive transects throughout the whole survey area and survey period. Full details of the surveys presented in Appendix B7.3.	detail as buildings/structures. The bats recorded during the surveys may be vagrants from larger populations to the south or part of a small local population. In Scotland Nathusius' pipistrelle are categorised as "rarest" bat species under Wray *et al.*, (2010) with a population of under 10,000. No roosts for Nathusius' pipistrelle were observed. The research indicates that most Nathusius' pipistrelles in Scotland may be migrating between breeding areas in Ireland and Europe (Kurvits *et al.* 2011) in Spring and Autumn. However, a small resident population is also thought to be present in Scotland. Nathusius' pipistrelle calls were recorded in the study area throughout the active period (April-September), indicating they were made by resident rather than migrating bats. The survey area provides good foraging and commuting habitat, with potential for roosting sites for all recorded bat species.	
Birds – breeding	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004. Eight probable or confirmed breeding species are listed on	Surveys highlighted that suitable habitat for breeding birds is present within the Site Boundary: approximately 52.09 ha scrub, woodland and grassland, 3878 m lines of trees and 820 m hedgerows. The breeding bird surveys recorded 64 species; of these, breeding activity was noted as probable or confirmed for 34 species (Appendices C7.1 and C7.2).	All wild birds are protected under the WCA, with further protection given to vulnerable and rarer species through schedules associated with the Act. Suitable habitat for breeding birds is present within the Scheme.	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	the SBL and 11 are priority species in the Falkirk LBAP.	Five of the 34 species are qualifying features of the Firth of Forth SPA, Ramsar site, and SSSI; four for their non-breeding status (mallard, oyster catcher, lapwing and redshank) and one (shelduck) for breeding status (notified SSSI feature). The four non-breeding qualifying bird features are assessed as internationally important, under the relevant designated sites above. They are also included here in the 'Birds – breeding' ecological feature in isolation of their designated site status. As shelduck is designated for its breeding status and breeding activity was only recorded within the designated sites, it is assessed as part of the SSSI along with eider and ringed plover (which were present during the breeding bird surveys, but not confirmed as breeding). Four of the 34 species are red-listed and 15 are amber-listed Birds of Conservation Concern. No schedule one species were recorded breeding.	Four red-listed and 15 amber listed birds of conservation concern were recorded breeding within the study area.	
Fish (estuarine)	Many species are listed on the SBL. Sparling and Twaite shad are priority species in the Falkirk LBAP under Action Plan 1: Estuary.	The Firth of Forth is thought to be an important nursery area for juvenile gadoids, such as cod and whiting and juvenile flat fish, plaice and dab. Permanent estuarine residents include flounder, sand goby and sandeel with seasonal residents, sprat and herring also recorded (Elliot, O'Reilly & Taylor 1990). The Middle Forth Estuary has a 2020 WFD classification of Good for fish (SEPA 2020).	Sandeel, cod, herring, whiting and plaice are all listed on the SBL. These species use intertidal areas, such as mudflats, as feeding areas. As the study area provides habitat that is considered of suitable quality to support these species, it is therefore assumed that these species may be present in the intertidal areas of the Scheme.	Regional
Fish (freshwater and migratory)	Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Annex II and V of Council Directive 92/43/EEC.	Records of Atlantic salmon, brown trout, European eel, lamprey (not identified to species), stoneloach, three-spined stickleback and minnow from the River Carron catchment (Malcolm *et al.* (2023), Marine Scotland 2019, Forth Rivers Trust 2019, SEPA 2023). River Carron has a 2020 WFD classification of Poor for fish above the tidal limit and Good below the tidal limit (SEPA 2020). Records of European eel, Atlantic salmon and brown/sea trout in the River Avon catchment (Malcolm *et al.* (2023), Marine Scotland	Atlantic salmon, European eel and brown/sea trout are listed on the Falkirk LBAP as priority species (Falkirk Council 2019a) and have been recorded in these watercourses. However, all three watercourses provided limited critical habitat for these species (e.g. spawning) within the vicinity of the Scheme.	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	Schedule 3 of the Conservation (Natural Habitats & c.) Regulations 1994 (as amended in Scotland) (salmon). International Union for Conservation of Nature Critically Endangered (European eel). European Commission (2007) Council Regulations (1100/2007/EC) Establishing measures for the recovery of the stock of European eel. Atlantic salmon, European eel and sea trout are priority species in the Falkirk LBAP under Action Plan 4: Water and Wetland.	2019, Linlithgow Angling Club undated). The River Avon has a 2020 WFD classification of Moderate for fish above the tidal limit and Good below (SEPA 2020). Trout, Atlantic salmon and stone loach have been recorded in Westquarter Burn (Forth Rivers Trust 2019). Grange/Westquarter Burn has a 2020 WFD classification of High for fish (SEPA 2020). The River Carron provides habitat for a range of fish species (salmonids, European eel, flounder and lamprey) and age classes, but within the Site Boundary spawning opportunities are limited. The River Avon provides habitat for a range of fish species (salmonids, European eel, flounder and lamprey) and age classes, but within the Site Boundary spawning opportunities are limited. Downstream of the tidal limit Grange Burn provides little habitat for aquatic species. Upstream of the tidal limit provides habitat for a range of fish species.		
Great crested newt Figure B7.8	EPS under the Conservation (Natural habitats & c.) Regulations 1994 (as amended in Scotland). GCN is listed on the SBL and is a priority species in the Falkirk	An SNH commissioned report identified GCN presence within Grangemouth and the wider Falkirk area (Wilkinson *et al*. 2014). The Falkirk LPAB states that GCN "thrive in several local ponds" (Falkirk Council 2019a). Nine ponds were subject to I assessment, of these three were scored as average, four as below average and two as poor. Eight ponds were subject to eDNA sampling. Two ponds (J4 and J6) located within 500m of the site boundary returned a positive result	GCN occur in three main areas in Scotland: Borders, Central Belt (which includes Grangemouth) and Moray Firth (Wilkinson *et al*. 2014). They are often found on the fringes of urban areas, including previously built-up brownfield sites, where they are very	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
	LBAP under Action Plan 4: Water and wetland.	during testing in 2020, however during testing in 2022 and 2023 they returned a negative result. The remaining ponds all resulted negative results.	vulnerable to impacts from new development. They breed in small to medium sized freshwater ponds, but also live/hibernate in terrestrial habitat, normally within 500 m of breeding ponds. Therefore, they could be present within the Site Boundary (SNH 2017).	
Otter	EPS under the Conservation (Natural habitats & c.) Regulations 1994 (as amended in Scotland). Otter is listed on the SBL and is a priority species in the Falkirk LBAP under Action Plan 4: Water and wetland. Listed as Vulnerable on The Red List for mammals in Britain and Scotland.	Otter are known to be present on the River Carron and River Avon (Falkirk Council 2019b). During otter surveys carried in 2016 and 2018 a total of 20 spraints, four couches and one area with prints were identified within the survey area (Echoes Ecology Ltd 2016b and 2018c). Otter field signs were recorded during the 2023 Jacobs surveys and incidental otter observations were also recorded during ecology surveys for other receptors between 2020 and 2023. Evidence of otter was recorded in all Flood Cells except for Flood Cell 1 during Jacobs surveys. Two otter couches were recorded within the Site Boundary. Otter use was confirmed at one of the two couches during targeted infra-red camera monitoring of both shelters. A further two otter couches were recorded within 200 m of the Site Boundary. Otter survey results will be submitted to NatureScot and Falkirk Council in a confidential report.	In Scotland, otter populations are widespread and assessed as being close to carrying capacity (JNCC 2013e). The most recent estimate (from 2003) suggested the Scottish population was around 8,000 individuals (SNH 2015). These semi-aquatic mammals use both freshwater habitats and coastal environments and can be found in urban environments.	Regional
Non-breeding birds (not including qualifying species of the Firth of Forth	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004.	A total of 51 non-qualifying species of birds were recorded during the course of surveys undertaken 2015/16, 2016/17 and 2022/23 (Appendices C7.1 and B7.3). Of these, 10 are red listed and 26 are amber listed Birds of Conservation Concern (BoCC). Qualifying species are assessed as part of the assessment of effects on the designated sites.	The study area supports an additional 51 species which are not qualifying interests of the Firth of Forth SPA, Ramsar site, and SSSI over winter of which 10 are red listed and 26 are amber listed BoCC.	Regional

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
SPA, Ramsar site and SSSI)				
Badger	Protection of Badgers Act 1992 (as amended). Badger is listed on the SBL and as a priority species in the Falkirk LBAP under Action Plan 5: Woodland. Listed as least concern on The Red List for mammals in Britain and Scotland.	Data provided by Falkirk Council (Falkirk Council 2019b) identified the presence of badger in the Falkirk area outwith the Site Boundary. Badger field signs within 100 m of the Site Boundary were recorded in Flood Cells 1, 3, 4, and 6. Nine active setts (one main, one subsidiary and seven outlier) were recorded within 100 m of the Site Boundary for Flood Cells 1 and 4, but no setts were recorded under the footprint of the Scheme. A main sett was identified beyond 100 m of the Site Boundary in proximity of Flood Cell 6. This sett was first identified in 2016 by Echoes Ecology. Badger presence was recorded at the sett and in the surrounding area in 2019 and 2020 during targeted monitoring. Further monitoring was undertaken in 2023, however, badger activity was not recorded at the sett or surrounding area. Badger surveys results will be submitted to NatureScot and Falkirk Council in a confidential report.	Badger is listed on the SBL and as a priority species in the Falkirk LBAP.	Authority
Barn owl	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004. Barn owl is listed on the SBL and is a priority species in the Falkirk LBAP under Action Plan 2: Farm and grassland.	Five observations of barn owl were recorded within the study area within the past twenty years (NBN 2023). Incidental observations of barn owl (pellets and an individual emerging and re-entering) were recorded during bat surveys of a building within the Site Boundary. A dedicated barn owl survey confirmed the presence of at least one individual inside the building and it is considered likely a nest is present. Barn owl survey results are provided in the password protected confidential report.	Barn owl numbers have declined significantly in the UK since the 1930s and, although the population has increased in the past 25 years, numbers are still around half of the 1930s population (Shawyer *et al.* 2012). Barn owl are listed on Schedule 1 of the WCA. All species listed on Schedule 1 of the WCA are afforded further protection during the breeding season.	Authority

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Hedgehog Figure B7.8	Hedgehog is a priority species in the Falkirk LBAP under Action Plan 6: Urban Listed on the SBL as 'Watching Brief Only' and as Vulnerable on The Red List for mammals in Britain and Scotland.	Surveys highlighted that suitable habitat for hedgehogs is present within the Site Boundary. This includes 11.18 ha of woodland, 4.56 ha of heathland and shrub habitat and 820 m of hedgerows. Two hedgehog records were identified within the study area within the past twenty years (NBN 2023). On 22 February 2023, the British Hedgehog Preservation Society advised that '*hedgehogs are regularly seen on the Grange Burn bank from where they travel to Zetland Park amongst other places*.' Zetland Park falls within Flood Cell 4. Hedgehog presence was recorded at three of the twenty footprint tunnel locations (locations 9, 10 and 17) within Flood Cells 2 and 4. Hedgehog presence was recorded on survey days 5 and 6 at locations 9 and 17, and on survey day 6 only at location 10. Further information on hedgehog field signs is presented in Appendix B7.3: Terrestrial Ecology Data.	Hedgehog are listed as a priority species on the Falkirk LBAP. The study area supports suitable habitat for hedgehog, such as hedgerows, grassland, scrub and woodland.	Authority
Kingfisher	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004. Kingfisher is listed on the SBL and is a priority species in the Falkirk LBAP under Action Plan 4: Water and wetland.	Information received from Falkirk Council (Falkirk Council 2019b) indicated that kingfisher is likely to be present on both the River Carron (which flows through Flood Cells 1, 2 and 3) and River Avon (which flows through Flood Cells 5 and 6), but no specific records were provided. Seventeen observations of kingfisher were recorded within the study area within the past twenty years (NBN 2023). Kingfisher was recorded in all Flood Cells, during breeding/wintering bird surveys and other ecology surveys. There were no confirmed breeding records of kingfisher and surveys identified limited suitable breeding habitat within the Scheme. Kingfisher records are presented in Appendix B7.3: Terrestrial Ecology Data.	Kingfisher are listed on Schedule 1 of the WCA. All species listed on Schedule 1 of the WCA are afforded further protection during the breeding season.	Authority

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Red Squirrel	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004. Red squirrel is listed on the SBL. Listed as Near Threated on The Red List for mammals in Britain and Scotland.	Four observations of red squirrel were recorded along the River Carron within the study area within the past twenty years (NBN 2023). No incidental observations were made of red squirrel during site surveys. However suitable habitat (11.18 ha) is present throughout the Scheme particularly along the River Carron and River Avon, and to the west of Flood Cell 4.	Red squirrel is one of Scotland's most threatened native mammal species, due to competition and disease transmission from the invasive grey squirrel. Red squirrel are listed as a priority species on the SBL.	Authority
Water vole	Wildlife and Countryside Act 1981 (as amended). Nature Conservation (Scotland) Act 2004. Water vole is listed on the SBL and is a priority species in the Falkirk LBAP under Action Plan 4: Water and wetland. Listed as Near Threated on The Red List for mammals in Britain and Scotland.	The 2016 survey report noted that there is a known water vole population within Carron Dams SSSI (Echoes Ecology Ltd 2016b), which is north of Flood Cell 1. The Falkirk Council Biodiversity Officer advised in November 2019 (Falkirk Council 2019c) that a water vole was recorded in a large natural pond at the Helix Park, approximately 420 m west of Flood Cell 2. No records of water vole were identified during the NBN Gateway data search. No signs were recorded during site surveys, although potentially suitable habitat was identified on Polmont Burn and the upstream section of Grange Burn.	The water vole is one of Scotland's most threatened native mammal species, due to habitat loss and predation by American mink. Water vole is listed as a priority species on the SBL and the Falkirk LBAP. The study area supports suitable habitat for water vole and water voles have been recorded in the wider landscape which could result in suitable habitat being repopulated in future.	Authority
Freshwater Invertebrates within River Carron, River	n/a	Family level data was provided by SEPA for monitoring sites on Grange Burn, River Carron and River Almond (SEPA 2023). The communities from each of these sites contained pollution sensitive families such as *Perlodidae* and *Leuctridae*; coupled with relatively	No species of importance have been recorded from these rivers. However, aquatic invertebrates are a WFD biological quality element and are in good condition.	Local

Ecological Feature	Legal/BAP Status	Baseline	Justification	Importance
Avon, Grange Burn/ Westquarter Burn		high biological metric scores, this indicates that these watercourses have relatively good water quality. WFD classifications for macroinvertebrates in 2020 were Good in all three watercourses (SEPA 2020).		
Macrophytes within River Carron and River Avon	n/a	Macrophyte data provided by SEPA for two sites on the River Carron and one site on the River Avon did not highlight any species of importance (SEPA 2023). WFD classifications for macrophytes in 2020 were Good for the River Carron and High for the River Avon (SEPA 2020). The Grange/Westquarter Burn has no WFD classification for macrophytes.	No species of importance have been recorded from these rivers. However, macrophytes are a WFD biological quality element and are in good condition.	Local
Oxeye daisy	Oxeye daisy is listed on the Falkirk LBAP under Action Plan 2: Farmland and Grassland.	The desk study identified three records oxeye daisy in an area of broadleaved woodland bordering industrial land within the study area (NBN 2023), outwith the Site Boundary. No records were observed during the UKHab survey.	Oxeye daisy is listed on the LBAP as a species of agricultural grasslands. The habitat did not conform with the identified type under the LBAP Farmland and Grassland Action Plan.	Less than local

7.4.6 Future Baseline

The information provided within the previous sections describes the baseline conditions as they were during the period that field surveys and assessments were carried out (2020-2023). The future baseline identifies the likely biodiversity baseline at the time of the Scheme construction. The pre-construction stage of the Scheme will span several years; however, it is anticipated the initial pre-construction phase will commence in 2026 with subsequent pre-construction stages taking place up to 2036. The dates stated are subject to funding by Falkirk Council and Scottish Government.

The future baseline considers the following:

- natural changes to species or habitats; for example, changes to the distribution of protected species;
- impacts or effects of other developments including any associated mitigation or enhancement measures assumed to be operational/implemented by 2026;
- general trends affecting biodiversity; for example, climate change.

7.4.6.1 Species and habitats

As the study area is mainly urban (residential and industrial), grassland and freshwater habitats, ecological conditions are not anticipated to change significantly in the immediate future, particularly within the footprint of the Scheme. Beaver have recently been recorded within the catchment of the River Avon outwith the Scheme's study areas (NBN 2023). In addition, although not recorded during the site surveys or desk study, pine marten are also known to be expanding their range within the Central Belt of Scotland. There is potential that both these species may expand their range into suitable habitat within the Site Boundary by the time construction begins. If this were to occur, it is expected their presence would be recorded during pre-construction surveys. Mitigation for impacts on these species, including where licences may be required for impacts on resting sites, would be similar to mitigation developed for species currently known to be present (e.g. otter, bats). As suitable mitigation is in place, or could reasonably be expected to be developed, impacts and effects on beaver and pine marten have not been included in the assessment.

7.4.6.2 Other developments

The future expansion of industrial, business and housing developments within each Flood Cell is considered unlikely to greatly change the character of the local habitats due to the extent of existing infrastructure. However, developments could impact protected species, such as bats, due to destruction or alteration of existing buildings or structures, which may contain roosts.

The LDP2 Green Network technical report (Falkirk Council 2018) identifies potential opportunities at Bothkennar/Skinflats, north of the mouth of the River Carron (Flood Cell 2) and at the former landfill site Kinneil Kerse (Flood Cell 6). Opportunities include enhancement of habitat for qualifying species of the Firth of Forth SPA and the potential installation of new visitor facilities. Whilst any new visitor facilities could result in increased visitor numbers and associated anthropogenic disturbance to birds using the SPA, it can reasonably be assumed that they would be designed to minimise disturbance due to their association with the SPA. These developments would be expected to have positive impacts for biodiversity. The LDP2 also details potential small-scale retail and leisure facilities and new housing (up to 30 houses) at Glensburgh (Flood Cell 2) and on a small site on Bo'ness Road (Flood Cell 6) (Falkirk Council 2020a). These developments could result in changes to the availability of the habitats assessed in the baseline.

In addition, a review of the Falkirk Council planning portal (Falkirk Council 2023) was conducted. Small developments outwith 2 km of the Site Boundary were excluded as they were deemed unlikely to impact the future baseline due their small size and distance from the Site Boundary. The assessment focused

on developments of any size within 2 km and larger developments up to 10 km from the Site Boundary. The review identified the below developments which could influence the future baseline:

- Planning applications for various modifications to domestic properties. Two applications involve buildings assessed as part of the Scheme for bat potential: works could alter this assessment and result in increased or decreased available bat habitat and a larger or smaller local bat population.
- Pond creation at Helix Park, approximately 1.3 km from the Site Boundary. Works will involve habitat creation and enhancement, including ponds, which could be utilised by great crested newt. This could extend or increase the great crested newt population in the local areas.
- Construction of a hazardous waste cell at Avondale Landfill site approximately 750 m from the Site Boundary. As part of these works, habitat creation and enhancement are proposed, including ponds for great crested newt and meadow grassland. This could extend or increase the great crested newt population in the local area.
- Peatland restoration at sites between 2 km and 10 km of the Site Boundary. These works could lead to habitat creation and enhancement for a range of protected species including birds, reptiles, invertebrates and amphibians; the more mobile species could utilise the areas in and around the Scheme.

The above developments could result in changes to the availability and quality of the habitats for the features assessed in the baseline. This may alter the impact assessment by increasing or decreasing the characterisation of the impact.

7.4.6.3 General trends

In Britain, it is anticipated that climate change will bring a possible 2 to 4°C increase in mean summer temperatures, milder winters, changes in rainfall distribution and seasonality, more extremes of weather and sea level rise in the longer term. The effects of these changes on biodiversity are uncertain and may occur as sudden and unexpected step changes. They may affect species ranges, population sizes, timing of biological events such as flowering and increased sea levels (Defra 2011).

A key approach to mitigate the effects of climate change is to establish and maintain coherent ecological networks; for many species, this will provide a greater degree of resilience to climate change. The Scheme incorporates this rationale with further details of mitigation and enhancement proposals provided in Section 7.6: Mitigation.

7.5 Impact Assessment

7.5.1 Introduction

Potential impacts on ecological features for the Scheme are described below and are set out in Table 7-10. The assessment is feature-led and considers the impact of the Scheme on each of the ecological features listed in Section 7.4 prior to the application of mitigation. Where primary mitigation has been incorporated into the design of the Scheme, this is recognised within the assessment.

As stated in Section 7.3.7.1, only important ecological features are subject to impact assessment, and features that did not meet the criteria for at least local importance are not considered further.

Where a potential impact is assessed as not significant, it is not considered further, unless measures are required to comply with relevant best practice, legislation or policy. This includes protected species such as otter, where there may still be legal requirements to be met, such as EPS licences. Where non-significant impacts to Wildlife Sites and SINCs occur, Falkirk Council planning policy PE19 and supporting guidance require "*appropriate mitigating measures*" and "*Where habitat loss or*

fragmentation is unavoidable, the creation of replacement habitat to compensate for any negative impacts". This has been addressed in Section 7.6 Mitigation.

Where an impact is initiated in construction but also occurs during operation (e.g. permanent habitat loss), it is discussed only within operational impacts.

Potential impacts detailed in this assessment are based on the current baseline as provided in Section 7.4 and, where appropriate, also considers the future baseline at time of construction (Section 7.4.6).

The assessment of temporary habitat loss during construction is presented as the total temporary loss of each habitat type across all Flood Cells (see Section 7.3.7.5 Habitat Loss for methods). However, as it is anticipated the Scheme will be completed in four phases over an up to 10-year programme (2026 to 2036), the area of temporary habitat loss occurring at any time during construction will be less than presented in this chapter. The contractor will be responsible for developing the programme and sequencing of construction works however, the Flood Cells anticipated to be part of each phase is as follows:

- Phase 1 (Mainly Residential Properties) – Flood Cells 1, 2, 4 (part) and 5 (part);
- Phase 2 (Port Lock Gates) – Flood Cell 3;
- Phase 3 (Port Flood Defences) – Flood Cell 3; and,
- Phase 4 (Industrial areas) – Flood Cell 4 (part), 5 (part) and 6.

Potential construction impacts include:

- injury or mortality of protected species due to vegetation removal, vehicle movements or becoming trapped in uncovered holes and pipes;
- temporary habitat loss within the Site Boundary;
- temporary habitat fragmentation due to disturbance;
- disturbance to protected species from noise, vibration, lighting and movement of vehicles and increased human activity;
- sediment release and run-off from construction works; and
- temporary hydrological changes to habitats

Potential operation impacts include:

- permanent loss of designated site habitat, habitat of conservation interest and habitat suitable for protected species under the permanent footprint of the Scheme;
- permanent fragmentation of habitats; and
- permanent hydrological changes to habitats

7.5.2 Construction

7.5.2.1 Designated Sites and Wildlife Sites

7.5.2.1.1 Firth of Forth SPA and Ramsar Site

Construction works within the SPA and Ramsar site will result in the temporary loss of habitat available to the qualifying bird species of these designated sites. There would be 0.43 ha of temporary habitat loss within both sites. This includes temporary loss of mudflat (0.25 ha) and saltmarsh (0.02 ha), with the remaining habitats temporarily lost comprising neutral grassland and a mosaic of urban habitats.

This may lead to localised fragmentation and displacement of individual birds. This habitat is of international importance and would be lost during construction. However, as the habitats span Flood Cells 3 and 6, which will have separate construction programmes, temporary loss of all habitats would not occur at the same time. Flood Cells 3 and 6 are anticipated to have a construction period of up to 48 months and 36 months respectively. The habitat will be returned to its former habitat type post-construction, which is predicted to occur in the short to medium-term. The area temporarily lost comprises a total of <0.01% of the area of the SPA and Ramsar site (6317.93 ha). Due to the large area of remaining functional habitat available, this has been assessed as a **Minor, negative** impact on a feature of international importance, which results in a **not significant effect**.

The SPA and Ramsar site are primarily designated for wintering birds and sandwich tern during passage (late July/August to September). All qualifying bird species, except for long-tailed duck, common scoter and velvet scoter, were recorded during winter vantage point surveys (Appendix C7.1 and B7.3). Noise, vibration and visual effects associated with construction related activities have the potential to disturb qualifying bird species when they are present. This could lead to displacement of birds from areas used for foraging, loafing and roosting, and subsequently additional energy expenditure and loss of conditioning.

The HRA concluded that two main aggregations of birds at key roost locations (the breakwater to the north of the Port of Grangemouth and sheltered bay north of the petrochemical plant) could be disturbed during construction of the Scheme. The possible adverse disturbance effects were identified as it will not be possible to avoid construction works during the most sensitive periods for the qualifying features of the SPA/Ramsar site and mitigation (such as noise and visual barriers) would not completely screen roosting birds from the construction works at these two locations. The impact of noise and vibration during construction is assessed as a **Major, negative** impact on a feature of international importance, which results in a **significant effect.**

There is the potential for runoff and release of sediment from construction works and accidental spillage during construction leading to pollution of the SPA and Ramsar site habitat used by the qualifying species of the sites. This could result in modification or deterioration of the habitat and thus a decline in foraging habitat quality, subsequently leading to direct mortality of individuals. Depending on the magnitude of the pollution event, there could be long-term effects on the SPA and Ramsar site and on the viability of populations of the qualifying species. However, due to the dilution capacity of the Firth of Forth, these effects would be reversible. This has been assessed as a **Moderate, negative** impact on a feature of international importance, which results in a **significant effect**.

Impacts to the SPA and Ramsar site due to changes to coastal geomorphology are considered within Chapter 10: Water Environment.

7.5.2.1.2 Firth of Forth SSSI

Construction works will result in the temporary loss or alteration of 0.43 ha within the SSSI, of this 0.02 ha is saltmarsh habitat. Skinflats is an important area for saltmarsh within the SSSI but the saltmarsh area within the site is not provided in the citation (NatureScot 2023c). The Scottish Saltmarsh Survey (Haynes 2016) states that there is 119 ha of saltmarsh within the Firth of Forth. The small and fragmented area of saltmarsh that will be affected by the Scheme is small relative to the saltmarsh within the Firth of Forth and it is not considered to contribute to the integrity of the wider saltmarsh in the area. Mudflat habitat (0.25 ha), also a feature of interest within the SSSI, would be temporarily lost or altered during construction. Effects would be localised and the habitat is expected to recover quickly following construction.

The SSSI has the same boundary line as the SPA where both sites overlap the Site Boundary; refer to Section 7.5.2.1.1 for further details of the temporary habitat loss. Due to the large area of remaining

habitat available, this has been assessed as a **Minor, negative** impact on features of national importance, which results in a **not significant effect**.

The SSSI is designated for the same wintering birds, including sandwich tern during passage in late July/August to September, as the SPA and Ramsar site; refer to Section 7.5.2.1.1 for the detailed assessment of disturbance during construction activities.

The SSSI is also designated for breeding eider, ringed plover and shelduck (NatureScot 2023c). All three species were recorded during the breeding bird surveys (conducted between 19 May to 22 July 2016), although breeding was only confirmed for shelduck in Flood Cell 3 at the mouth of Grange Burn. Eider, ringed plover and shelduck were also recorded over winter (Appendix C7.1).

Noise, vibration and visual effects associated with construction related activities have the potential to disturb qualifying bird species. This could lead to displacement of birds from areas used for nesting, foraging, loafing and roosting, and for wintering birds this could result in additional energy expenditure and loss of condition. Using professional judgement, the impact of noise and vibration during construction is assessed as a **Major, negative** impact on a feature of national importance, which results in a **significant effect.**

Potential impacts associated within runoff, release of sediment and accidental spillages during construction are in line with those described for the SPA and Ramsar; refer to Section 7.5.2.1.1 for the detailed assessment of pollution during construction. This has been assessed as a **Moderate, negative** impact on a feature of national importance, which results in a **significant effect**.

Impacts to the SSSI due to changes to coastal geomorphology are considered within Chapter 10: Water Environment.

7.5.2.1.3 Camelon Riverside Wildlife Site

An indicative compound site in Work Area 1-1 Required for construction, is located within the Site Boundary and 5 m from the Camelon Riverside wildlife site. Works and people movement may cause disturbance/damage to the wildlife site. However, this section of the wildlife site is intersected with footpaths, is directly adjacent to a car park and the compound will be located on modified grassland used for football pitches south of the wildlife site. Therefore, the area is already subject to regular disturbance. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.1.4 River Carron Meander SINC

The SINC is located approximately 20 m from the Site Boundary on the opposite bank of the River Carron. There is the potential for runoff and release of sediment from accidental spillage during construction, which could lead to sediment deposition on reedbed and swamp habitat and result in modification of this habitat. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.2.1.5 Polmont Woods Wildlife Site

Construction of the Scheme will require the loss of 0.04 ha from this wildlife site, along the northern edge adjacent to Grange Road. Habitats lost comprise mostly broadleaved woodland (0.03 ha) and a small area of urban habitats. (0.01 ha). However, minimal tree felling/vegetation clearance is expected. If tree felling occurs, the effects will be negative and would occur in the medium to long-term whilst trees become re-established. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.2 Habitats

7.5.2.2.1 Ancient woodland

Construction of the Scheme will require the loss of 0.01 ha of habitat classed as 'Category 2b Long-established or Plantation Origin' on the AWI in Working Area 4-4 in an area adjacent to Smiddy Brae road. The UKHab survey mapped most of this area as broadleaved woodland. However, urban and river habitat was also mapped where a track and the Millhall Burn is present.

Habitat that would be lost during construction within this area is restricted to a section along the left bank (facing downstream) of the Millhall Burn which has been landscaped with a variety of shrubs for the housing estate opposite. Whilst this area is mapped as ancient woodland on the AWI, no mature trees are present. In addition, it is likely the soil has been disturbed and applied with topsoil, therefore, will no longer support the ground flora or soil composition characteristic of ancient woodland.

Whilst 0.01 ha of ancient woodland habitat has been identified, the area of habitat loss is not considered ancient woodland for the reasons described above. This has been assessed as a **Minor, negative** impact on a feature of national importance, which results in a **not significant effect.**

7.5.2.2.2 Broadleaved and Mixed Woodland (non-AWI)

Construction of the Scheme will require the temporary loss of 9.43 ha of broadleaved and mixed woodland within the Site Boundary, excluding the woodland discussed in Section 7.5.2.2.1 Ancient Woodland. This would result in reduced habitat availability and could result in fragmentation and reduced habitat quality at woodland edges. The effects would be temporary but long-term as it could take many years for these areas to become re-established woodland habitat of similar value.

Of the 9.43 ha of woodland temporarily lost, 0.34 ha of this is listed on the NWSS. The NWSS classed these areas as lowland mixed deciduous woodland and wet woodland; however, the UKHab mapped these areas as non-priority habitats other broadleaved woodland (0.25 ha), other mixed woodland (0.02 ha), urban habitats (0.04 ha) and grassland (0.02 ha).

The remaining broadleaved and mixed woodland which will be temporarily lost totals 9.10 ha. This includes the temporary loss of wych elm trees (Falkirk LBAP species) identified in woodland. There would also be a temporary loss of 3206 m of linear broadleaved woodland. This has been assessed as a **Major, negative** impact on a feature of regional importance**,** which results in a **significant effect.**

7.5.2.2.3 Intertidal Mudflats

Approximately 0.78 ha of mudflat habitat under the construction footprint will be temporarily lost or altered during construction, of which 0.25 ha falls within the Firth of Forth SPA/Ramsar/SSSI. These impacts will therefore be the same as those identified for the Firth of Forth SSSI in Section 7.5.2.1.2, which is also of national importance.

There is potential for input of pollutants (e.g. fuel, oils) during construction works on and adjacent to intertidal mudflats. This would result in a deterioration of habitat quality. These effects are unlikely to be permanent but may take several years to recover after removal of the source of input, which has been assessed as a **Moderate, negative** impact on a feature of national importance, which results in a **significant effect**.

7.5.2.2.4 Hedgerows

Construction of the Scheme will require the temporary loss of hedgerows within the Site Boundary, which could result in reduced habitat quality and fragmentation. The effects would be temporary, but medium-term, as it would take a few years for hedgerow habitats to become re-established. Sections of hedgerow within the Site Boundary are relatively isolated and alternative linear features such as roads, watercourses and treelines are present in the local area.

Up to 783 m of hedgerows could be lost, which has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.2.2.5 Open Mosaic Habitats on Previously Developed Land

Construction of the Scheme will require the temporary loss of 0.71 ha of OMHPDL within the Port of Grangemouth. The effects would be temporary, but medium-term, as it would take a few years for the habitats to become re-established. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.2.2.6 Saltmarsh

Approximately 0.26 ha of saltmarsh under the construction footprint will be lost or altered during construction, of which 0.02 ha falls within the Firth of Forth SPA/Ramsar/SSSI. These impacts will therefore be the same as those identified for the Firth of Forth SSSI in Section 7.5.2.1.2, which is also of national importance. This has been assessed as a **Minor, negative** impact on a feature of national importance, which results in a **not significant effect**.

There is potential for input of fine sediments or pollutants (e.g. fuel, oils) during construction works on and adjacent to saltmarsh, which would result in a deterioration of habitat quality. These effects are unlikely to be permanent, but the habitat may take several years to recover following works. However, due to the very small areas of habitat affected, this has been assessed as a **Minor, negative** impact on a feature of national importance, which results in a **not significant effect**.

7.5.2.2.7 Wetland

Construction of the Scheme will require the temporary loss of up to 3.07 ha of wetland habitats within the Site Boundary. Temporary loss would occur to reedbeds (2.93 ha) and lowland fens (0.01 ha), both priority habitats, and also swamp habitats (0.14 ha). This could result in physical alterations to habitats and reduced habitat quality, which has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect.**

Construction works could result in changes in water levels associated with soil compaction and/or changes in water flows. This could lead to physical alteration and reduced quality of habitats and temporary habitat loss. The changes in water levels could result in long-term effects on the habitat, which has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

There is the potential for input of fine sediments or pollutants (e.g. fuel, oils) from accidental spillage during construction, which could lead to physical alteration or deterioration in habitat quality. The effects are unlikely to be permanent, however, habitats may take several years to recover following construction, resulting in a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.2.2.8 Grassland and Cropland

Construction of the Scheme will require the temporary loss of up to 31.77 ha of grassland, of which 25.02 ha is neutral grassland, 6.14 ha is modified grassland and 0.61 ha is acid grassland. Cropland (4.65 ha) would also be lost within the Site Boundary. The temporary loss of these habitats could result in fragmentation and reduced habitat quality at the habitat edges due to edge effect. Effects would be negative, localised to the construction footprint and occur in the short-term. Impacts have therefore been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.2.2.9 Scrub

Construction of the Scheme will require the temporary loss of up to 3.85 ha of dense scrub, of which 3.23 ha is mixed scrub, 0.56 ha is bramble, 0.04 ha is gorse and 0.03 ha is hawthorn. The temporary loss of these habitats could result in fragmentation and reduced habitat quality at the habitat edges. Effects would be negative, localised to the construction footprint and occur in the short-term. Impacts have therefore been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.2.3 Watercourses

Construction works adjacent to, and within, aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses, which could reduce water quality and alter habitat suitability through sedimentation of habitats dominated by coarser substrates. A relatively large-scale incident has the potential to result in medium-term negative effects, assessed as a **Moderate, negative** impact in the River Carron and River Avon (features of regional importance) which results in a **significant effect**. The same impact would result in a **not significant effect** in the habitats of lower importance.

Construction works within aquatic habitats have the potential to cause temporary changes in hydrology. This may cause alterations in erosion, deposition and sediment suspension, which in turn could affect water quality and distribution of habitats. These impacts are expected to be localised and therefore have been assessed as **Minor and negative,** which results in a **not significant effect**.

Habitat under the Site Boundary footprint of in-water working areas will be temporarily lost during construction. This impact will be localised and relatively short-term, and has therefore been assessed as **Minor, negative,** which results in a **not significant effect**.

7.5.2.4 Species

7.5.2.5 Bats

Construction related activities, including vegetation clearance, demolition of buildings and vehicle movement, could result in direct mortality of bats during removal of roosting habitat. Where bat buildings, structures or trees could not be assessed due to limited land access, it has been assumed they have bat potential. Mortality of individuals would be a negative effect in the medium term. If buildings, structures, or trees containing maternity roosts are destroyed, this could result in mortality of a significant number of bats and impact the local population. Therefore, this has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Bats could be disturbed as a result of noise, vibration and light spill associated with construction related activities, which could lead to abandonment of roosts, avoidance of existing commuting routes and foraging areas during the active season. This could result in bats using less suitable alternatives and a consequent reduction in breeding success. Areas within the Site Boundary have been identified to have

high levels of bat activity and are therefore likely to be of high local importance. Therefore, disturbance to these areas has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

There will be temporary loss of habitats of value to bats. Woodland and scrub (including scattered trees and scrub), wetland and running water habitats are important for foraging and roosting, and hedgerow habitat is important for commuting between roosting and foraging sites (Gunnell *et al.* 2012). The loss of these habitats could result in use of less suitable alternatives or increased distance travelled to suitable sites, leading to a reduction in breeding success. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.2.6 Breeding Birds

Breeding birds assessed include species that are not qualifying features of the Firth of Forth SPA, Ramsar site or SSSI that were recorded during the breeding bird surveys (Appendices C7.1 and C7.2).

Construction related activities during the core breeding bird season (01 March to 31 August inclusive), include vehicle movements, potentially affecting ground nesting species, and vegetation clearance, potentially resulting in direct mortality. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

Noise, vibration and light spill associated with construction related activities during the core breeding bird season (01 March to 31 August inclusive) has the potential to result in disturbance. This could lead to avoidance of habitats, abandonment of nests, and displacement of population(s). However, this is unlikely to occur in sufficient numbers to impact the wider population and as construction will not take place at all Flood Cells simultaneously, the impact will be localised. This has been assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

Temporary loss of habitat to accommodate construction could potentially result in fragmentation and displacement of species that use this habitat for breeding, which is assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

7.5.2.7 Estuarine Fish

Impacts including input of fine sediments or pollutants (e.g. fuel, oils) may cause mortality of estuarine fish or deter them from affected areas. However, given the scale of the works, a pollution event would be localised and only a small proportion of the habitat available to these species would be affected. The impacts have been assessed as **Minor, negative** on a feature of regional importance, which results in a **not significant effect**.

Noise and vibration associated with construction activities within and adjacent to intertidal areas could result in physical injury to fish in close proximity to the works. Disturbance and deterrence of fish from areas around the noise and vibration source could also occur. However, the effects of noise are species dependant and can also vary depending on water depth and substrate type. It is unlikely the shallow estuarine environment found within and adjacent to the Site boundary will transmit underwater noise to such an extent that it would have any effect on fish and therefore the potential for injury would be low. Furthermore, such effects will be local, temporary and short-term. The impact of noise and vibration has been assessed as **Minor, negative** on a feature of regional importance, which results in a **not significant effect**.

In-water working will result in temporary loss of habitat. These areas are predominantly only available to estuarine fish at high tide and as such provide only intermittent habitat. The temporary loss of these areas has been assessed as a **Negligible, negative** impact on a feature of regional importance, which results in a **not significant effect.**

7.5.2.8 Freshwater and Migratory Fish

Construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses. Pollution may cause mortality of fish species while sedimentation could alter the habitat suitability and prey availability in addition to causing mortality of young or eggs within the substrates. Pollution and sedimentation also have the potential to cause habitat fragmentation for migratory species by deterring species from an area due to poor water quality or heavy sediment loading. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Works areas within aquatic habitats have the potential to cause temporary changes in hydrology. This may cause alterations in erosion, deposition and sediment suspension, which in turn could affect water quality and distribution of habitats. Works areas also have the potential to cause habitat fragmentation both directly by blocking watercourses and through associated changes in hydrology. The physiological and behavioural effects of changes in water quality or habitat fragmentation could be negative and long-term, particularly if sensitive life stages are affected. These impacts have been assessed as **Moderate, negative** on a feature of regional importance, which results in a **significant effect**.

The creation of dry works areas has the potential to cause mortality to fish trapped within the footprint of the working area. This impact is expected to be localised and has been assessed as **Minor, negative** on a feature of regional importance, which results in a **not significant effect.**

Temporary loss of habitat will occur under the footprint of construction works within aquatic habitats. This impact will be localised and no critical habitats, such as spawning areas, were identified under the footprint. Therefore, the effects, of reduced foraging and resting habitat will be limited. This impact has been assessed as **Minor, negative,** on a feature of regional importance, which results in a **not significant effect**.

Noise and vibration caused by construction activities within or in close proximity to aquatic habitats have the potential to cause physical injury to fish in the immediate area. There is also the potential for noise and vibration and lighting to cause disturbance and habitat fragmentation. Depending on the duration of this impact and location within the Scheme, this may result in long-term effects on freshwater and migratory fish. Therefore, noise and vibration has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.2.9 Great Crested Newt

Whilst no GCN breeding ponds were identified under the footprint of the Scheme, two GCN breeding ponds were recorded within 500 m of Site Boundary. GCN may make use of terrestrial habitat (including grassland and woodland) within proximity of the Scheme for shelter, commuting and foraging. Temporary loss of habitat to accommodate construction could potentially result in fragmentation of habitat or displacement of individuals. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Construction related activities, including vehicle movement, creation of excavations and construction of the direct defences (walls, embankments and revetments) could potentially result in direct mortality of GCN moving across site from collisions, or entrapment in uncovered holes, pipes or machinery. Mortality of individuals would be a permanent and negative effect. Survey and desk study data indicates that the

population of GCN within the Falkirk areas is small and fragmented, and therefore susceptible to local extinction, mortality during construction has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Noise, vibration and light spill associated with construction related activities has the potential to result in disturbance of GCN, leading to avoidance of key habitats used for shelter, foraging and commuting, and fragmentation of commuting routes through temporary loss of habitat. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Whilst no identified GCN ponds will be directly impacted by the Scheme, construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to water bodies. Pollution could result in a decline in water bodies suitable for breeding GCN. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.2.10 Otter

Otter utilise watercourses and bankside habitat within proximity of the Scheme for shelter, commuting and foraging. Temporary loss of bankside habitat to accommodate construction could potentially result in fragmentation of habitat or displacement of individuals that use this habitat for foraging and commuting. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Construction related activities, including vehicle movement, creation of excavations and construction of the direct defences (walls, embankments and revetments) could potentially result in direct mortality of otters moving across site from collisions, or entrapment in uncovered holes, pipes or machinery. Mortality of individuals would be a permanent and negative effect; however, this is unlikely to occur at a level that will cause declines in the wider population. This has been assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

Noise, vibration and light spill associated with construction related activities has the potential to result in disturbance of otter, leading to avoidance of key habitats used for foraging and commuting, and fragmentation of commuting routes through temporary loss of habitat. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

Construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses. Pollution could result in reduced prey availability and a decline in foraging habitat quality for otter. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.2.11 Non-Breeding Birds

Non-breeding birds include species that are not qualifying features of the Firth of Forth SPA, Ramsar site or SSSI that were recorded during winter vantage point surveys (Appendix C7.1). Potential impacts on non-breeding birds are the same as those detailed in Section 7.5.2.1 for the SPA, Ramsar and SSSI: habitat loss, disturbance (noise, vibration and visual) and pollution from accidental spillage. These have been assessed as **Moderate and negative** impacts on a feature of regional importance**,** which results in a **significant effect**.

7.5.2.12 Badger

Temporary loss of suitable badger habitat across the Scheme could potentially result in fragmentation of habitat or displacement of individuals that use these areas for foraging, particularly in isolated

pockets of suitable habitat. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Fragmentation of commuting habitat is predicted as a result of the Scheme, to the badgers using the sett more than 100 m from the Site Boundary. Whilst this sett was confirmed as inactive during monitoring in 2023, it has been assessed given its isolated location and activity in previous years. Works may create a barrier to badger movements resulting in fragmentation of foraging and commuting badger habitat during construction. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction related activities, including vehicle movement, creation of excavations and construction of the direct defences (embankments and walls) could potentially result in direct mortality of badgers moving across site from collisions, or entrapment in uncovered holes, pipes or machinery. Mortality of individuals would be a permanent and negative effect but is unlikely to occur at a level that will cause declines in the wider population. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise, vibration and light spill associated with construction related activities has the potential to result in disturbance of badgers, leading to avoidance of key habitats used for shelter, foraging and commuting. This is unlikely to occur at a level that will cause declines in population and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.13 Barn Owl

Construction related activities, including vegetation clearance, could result in disturbance or direct mortality of barn owl through destruction of roosts in trees. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise and light spill associated with construction related activities during the core breeding bird season (01 March to 31 August inclusive) has the potential to result in disturbance of barn owl. This could lead to avoidance of habitats, abandonment of nests, and displacement of population(s). However, as the barn owl are present in an industrialised area, they would be expected to have some habituation to noise and light. Therefore, this has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

It is assumed that trees present under the Site Boundary adjacent to the building with the barn owl nest will be felled to facilitate construction. The removal of trees could reduce availability of hunting perches in the local area, potentially resulting in use of less suitable alternatives; however, extensive foraging habitat is available on the other side of the river from the building. Therefore, a reduction in breeding success or abandonment of the foraging/breeding area is unlikely. This impact has been assessed as **Moderate, negative** on a feature of authority importance**,** which results in a **not significant effect.**

Temporary loss of habitat to accommodate construction could lead to a temporary loss of foraging habitat. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.2.14 Hedgehog

Temporary loss of suitable hedgehog habitat to accommodate construction is predicted to result in displacement of individuals and fragmentation of habitat. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction related activities, including vehicle movement, vegetation clearance, creation of excavations and construction of the direct defences (embankments and walls) could potentially result in direct mortality of hedgehogs moving across site from collisions, or entrapment in uncovered holes, pipes or machinery. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise, vibration and light spill associated with construction related activities has the potential to result in disturbance of hedgehogs, leading to avoidance of key habitats used for foraging and commuting, and fragmentation of commuting routes through temporary loss of habitat. This is unlikely to occur at a level that will cause declines in population and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.15 Kingfisher

Kingfisher was observed on watercourses/water bodies within the Scheme, although no burrows were recorded and limited suitable habitat was recorded. However, as these river habitats are dynamic, suitable nesting habitat may become available prior to construction. Therefore, construction related activities, including vehicle movement and vegetation clearance, and the associated vibrations, adjacent to and within watercourses could result in disturbance or direct mortality of kingfisher in their burrows. Destructive activities, the use of heavy machinery and vibrations could result in the collapse of bankside burrows and kill or injure individuals inside. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise and light spill associated with construction related activities and temporary loss of bankside habitat during the core breeding bird season (01 March to 31 August inclusive) has the potential to result in disturbance and displacement of kingfisher. This could lead to avoidance of habitats, fragmentation of foraging and commuting routes, and displacement of population(s) and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses. Pollution could result in reduced prey availability and a decline in foraging habitat quality for kingfisher. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.16 Red Squirrel

Whilst no signs of red squirrel were recorded during any ecology surveys conducted for the Scheme, desk study records (NBN 2023) identified that red squirrel are present within the vicinity of the Scheme. Temporary loss of woodland habitat to accommodate construction could potentially result in fragmentation of territories and displacement of individuals that use this habitat for foraging, commuting, resting and breeding. Given the lack of red squirrel records within the study area, this has

been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction related activities, including vehicle movement and vegetation clearance, and the associated noise and vibration, could result in disturbance or direct mortality of red squirrel. Destructive activities such as tree felling, could result in destruction of dreys and kill or injure individuals. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise and light spill associated with construction related activities has the potential to result in disturbance of red squirrel. This could lead to avoidance of habitats, fragmentation of foraging and commuting habitat, and displacement of a small population(s) and has been assessed as a **Minor, negative** impact on a feature of local importance, which results in a **not significant effect**.

7.5.2.17 Water Vole

Whilst no signs of water vole were recorded during site surveys, a desk study record (Falkirk Council 2019c) identified that water vole are present within the vicinity of the Scheme. Therefore, as discussed in the future baseline section there is potential for water vole to move into the study area.

Temporary loss of bankside habitat to accommodate construction could potentially result in fragmentation of territories and displacement of individuals that use this habitat for burrows and breeding. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction related activities, including vehicle movement and vegetation clearance, and the associated noise and vibration, adjacent to and within watercourses could result in disturbance or direct mortality of water vole in their burrows. Destructive activities, the use of heavy machinery and vibrations could result in the collapse of bankside burrows and kill or injure individuals inside. Mortality of individuals would be a permanent and negative effect. However, this effect is unlikely to occur in sufficient numbers to affect the wider population(s) and has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Noise and light spill associated with construction related activities has the potential to result in disturbance of water vole. This could lead to avoidance of habitats and displacement of population(s) and has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

Construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses and water bodies. Pollution could result in a decline in suitable burrowing and foraging habitat for water vole. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.2.18 Freshwater Invertebrates and Macrophytes

Construction works adjacent to and within aquatic habitats have the potential to introduce sediment or other pollutants (e.g. fuel, oils) to watercourses. Pollution can cause mortality of invertebrates or macrophytes and sedimentation can alter the habitat suitability. It is expected that macroinvertebrate and macrophyte communities would recover quickly from events and thus, although **negative**, this has been assessed as a **Minor** impact on a feature of local importance, which results in a **not significant effect**.

Works areas within aquatic habitats have the potential to cause temporary changes in hydrology. This may cause alterations in erosion, deposition and sediment suspension, which in turn could affect water quality and distribution of habitats. However, it is expected that invertebrate and macrophyte communities would respond quickly so these impacts are considered to be **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

Temporary loss of habitat will occur under the footprint of construction works within aquatic habitats. The effects of this will be localised and short-term for aquatic invertebrates. Therefore, the impact has been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.3 Operation

The ecological features with operational impacts from the Scheme are detailed in this section and identified in Table 7-10. Ecological features with no operational impacts are also listed in Table 7-10.

7.5.3.1 Designated Sites

7.5.3.1.1 Firth of Forth SPA and Ramsar Site

The Scheme will result in the permanent loss of 1.15 ha from the SPA and Ramsar site which accounts for 0.02% of the SPA and Ramsar site (6317.93 ha). Within both sites, 0.59 ha of mudflats and 0.25 ha of saltmarsh habitats would be permanently lost. The remaining habitats lost within both sites comprise reedbeds, neutral grassland and urban habitats. The habitat lost is directly adjacent to the Port of Grangemouth and petrochemical plant and much of this habitat contains historic revetments, with rock armour and rubble. This habitat is often utilised by the qualifying features of the SPA and Ramsar site and construction of the defences and coastal revetment will result in a similar habitat to what was lost.

The loss of habitat would be permanent and negative. However, due to the large extent of remaining suitable and functional habitat available within the designated sites, this impact has been assessed as **Minor, negative** on features of international importance**,** which results in a **not significant effect.**

7.5.3.1.2 Firth of Forth SSSI

The Scheme will result in the permanent loss of 1.15 ha from the SSSI, which accounts for 0.02% of this designated site (7423.19 ha). Within the SSSI, 0.59 ha of mudflats and 0.25 ha of saltmarsh habitats would be permanently lost: both habitats are qualifying features of the SSSI. The remaining habitats lost comprise reedbeds, neutral grassland and urban habitats. The habitat lost is directly adjacent to the Port of Grangemouth and petrochemical plant and much of this habitat contains historic revetments, with rock armour and rubble. The mudflat habitats are primarily an intermittently available feeding resource, which are accessible to birds only at low tide, and this feeding resource is not limited within the estuary. The Scheme design has been developed to reduce the amount of habitat loss from the SSSI and given the quantity of qualifying habitat available within the designated site, this impact has been assessed as **Minor, negative** on a feature of national importance**,** which results in a **not significant effect.**

7.5.3.1.3 Polmont Woods Wildlife Site

The Scheme will result in the permanent loss of 0.01 ha of broadleaved woodland from Polmont Woods Wildlife Site. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.3.2 Habitats

7.5.3.2.1 Ancient Woodland

The Scheme will result in the permanent loss of 0.002 ha of habitat mapped as 'Category 2b Long-established or Plantation Origin' on the AWI in Working Area 4-4 in an area adjacent to Smiddy Brae road. This area was mapped as a u1d (mosaic of Suburban/ mosaic of developed/ natural surface) during the UK Hab surveys conducted for the Scheme.

Habitat permanently altered under the footprint of the direct defences is restricted to a section along the left bank (facing downstream) of the Millhall Burn which has been landscaped with a variety of shrubs for the housing estate opposite. Whilst this area is mapped as ancient woodland on the AWI, no mature trees are present. In addition, it is likely the soil has been disturbed and applied with topsoil during landscaping, therefore, will no longer support the ground flora or soil composition characteristic of ancient woodland.

Whilst 0.002 ha of habitat has been mapped on the AWI, the area of permanent habitat loss is not considered ancient woodland for the reasons described above. This has been assessed as a **minor, negative** impact on a feature of national importance, which results in a **not significant effect.**

7.5.3.2.2 Broadleaved and Mixed Woodland (non-AWI)

The Scheme footprint will result in the permanent loss of 1.73 ha of broadleaved and mixed woodland, excluding the woodland identified in Section 7.5.2.2.1 Ancient Woodland. Of the 1.73 ha, 1.63 ha is broadleaved woodland, 0.07 ha is mixed woodland, 0.04 ha is wet woodland, and 0.01 ha is lowland mixed deciduous woodland.

The permanent loss of this habitat could result in fragmentation and reduced habitat quality at the woodland edges. There would also be a permanent loss of 671 m of linear broadleaved woodland. These impacts have been assessed as **Major, negative** on a feature of regional importance, which results in a **significant effect.**

7.5.3.2.3 Intertidal Mudflats

The Scheme footprint will result in the permanent loss of 0.87 ha of mudflat habitat, of which 0.59 ha is within the SPA/Ramsar/SSSI. These impacts will therefore be the same as those identified for the SPA/Ramsar/SSSI i.e., **Minor, negative** effects on a feature of national/international importance, which results in a **not significant effect**.

7.5.3.2.4 Hedgerows

The Scheme footprint will result in the permanent loss of 38 m of hedgerow with limited connectivity value. This has been assessed as a **Minor, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.3.2.5 Open Mosaic Habitats on Previously Developed Land

The Scheme footprint will result in the permanent loss of 0.03 ha of OMHPDL habitat within the Port of Grangemouth. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.3.2.6 Saltmarsh

The Scheme footprint will result in the permanent loss of 0.26 ha of saltmarsh habitat, of which 0.25 ha is within the SPA/Ramsar/SSSI. The SSSI citation lists Skinflats as an important area within the SSSI (NatureScot 2023c), however, the small and fragmented area of saltmarsh that will be affected by the Scheme is not considered to contribute to the integrity of the wider saltmarsh in the area. These impacts will therefore be the same as those identified for the SPA/Ramsar/SSSI i.e., **Minor, negative** effects on a feature of national/international importance, which results in a **not significant effect**.

7.5.3.2.7 Wetland

The Scheme footprint will result in the permanent loss of 0.91 ha of wetland, comprising reedbeds (0.63 ha) and swamp (0.27 ha). This could result in physical alterations to habitats and reduced habitat quality. The Scheme could also result in changes in water levels associated with soil compaction and/or changes in water flows. Therefore, the loss of 0.91 ha and potential long-term hydrological impact on these habitats beyond the Scheme footprint, has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect.**

7.5.3.2.8 River Carron

New flood walls may cause changes in hydrology and potentially alter erosion and deposition. The loss of a small area of natural bed material under the footprint of the flood walls may also occur. However, as the defences are out of the channel (with the exception of the coastal revetment at the river mouth), this has been assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

The proposed replacement New Carron Road Bridge is assumed to be a single clear span structure adopting a similar footprint as the existing bridge. Therefore, it is assessed as having no operational impact.

7.5.3.2.9 Grange Burn/ Westquarter Burn

The new orifice weir and altered flow control structure on Grange Burn will result in a permanent loss of habitat. The footprint of the weir is anticipated to be less than 1 m^2, to account for uncertainties in the bed modifications required around the structure, a conservative value of 35m^2 has been assumed. As this loss will be localised and does not represent loss of critical habitat (i.e. does not include spawning gravels), the impact has been assessed as **Negligible, negative** on a feature of local importance, which results in a **not significant effect.**

The new orifice weir and altered flow control structure on Grange Burn will result in altered hydrology within the Grange Burn. However, these alterations only occur at the 1 in 2-year flows and above, at which point a slight decrease in velocity both immediately up and downstream of the structure have been predicted and a decrease in depth downstream compared to the existing conditions (Appendix B10.1: Fluvial Geomorphology). These changes are considered minor and are not anticipated to impact fish migrating up or downstream. This has been assessed as a **Minor, negative** impact on a feature of local importance, which results in a **not significant effect**.

New flood defence walls may cause changes in hydrology and potentially alter erosion and deposition. However, given the new defences are out of channel, this has been assessed to be a **Minor, negative** impact on a feature of local importance, which results in a **not significant effect**.

The proposed replacement Dalratho Road Bridge is assumed to be a single clear span structure adopting a similar footprint as the existing bridge. The design of new raised bridges is unknown but is assumed to

be clear span with abutments set back from the channel. These new bridges are assessed as having no operational impact.

7.5.3.2.10 Mungal Burn

The new 30 m culvert on Mungal Burn will result in a permanent loss of habitat. However, as this reach of the burn is already highly modified, and the burn is culverted for approximately 800 m upstream of the proposed extension, this has been assessed as a **Minor, negative** impact on a feature of local importance, which results in a **not significant effect.**

The culvert may also cause changes in hydrology in Mungal Burn, however, this area does not represent critical habitat (i.e. does not include spawning gravels) and the impact is assessed to be **Negligible, negative** on a feature of local importance, which results in a **not significant effect.**

7.5.3.2.11 Millhall Burn

The new structure at Reddoch Road Bridge, proposed to be a box culvert replacing the existing single span road bridge, may affect hydrology in the Millhall Burn. In addition, 650 m of concrete formed sheet piled flood defence walls along both banks are proposed that may also cause changes in hydrology. However, as these flood defence walls are proposed to be set back from the bank top, they are not anticipated to extend out into the watercourse and therefore are unlikely to interact with the watercourse. Furthermore, this area does not represent critical habitat (i.e. does not include spawning gravels) and therefore, the impact is assessed to be **Minor, negative** on a feature of local importance, which results in a **not significant effect.**

7.5.3.2.12 Polmont Burn

New flood defence walls may cause changes in hydrology and potentially alter erosion and deposition. However, as the defences are set back from the channel, impacts will occur only under flood conditions and are therefore assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.3.2.13 Grassland and Cropland

The Scheme footprint will result in the permanent loss of 4.57 ha of grassland, comprising neutral grassland (2.66 ha), modified grassland (1.78 ha) and acid grassland (0.13 ha). This could result in fragmentation and reduced habitat quality at the grassland edges due to edge effect. Impacts have therefore been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect.**

7.5.3.2.14 Scrub

The Scheme footprint will result in the permanent loss of 0.72 ha of scrub, comprising mixed scrub (0.66 ha) and bramble (0.06 ha). Impacts have been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.3.3 Species

7.5.3.3.1 Bats

Nine buildings and nine structures will be demolished during construction and three structures will be modified (Table 7-8). All nine of the buildings and four of the structures have potential for roosting bats.

It is assumed that trees present within the Site Boundary will be felled to facilitate construction. Of the 104 trees recorded with summer and/or winter bat roosting potential, 70 fall within the site boundary. Two of these have high potential, 39 have moderate potential and 29 have low potential for summer roosting bats. While for winter roosting, two have high potential, 18 have moderate potential, 41 have low potential and nine were negligible.

The removal of buildings and trees will reduce available roosting habitat in the local area, potentially resulting in use of less suitable alternatives, leading to a reduction in breeding success. The impact has been assessed as **Moderate, negative** on a feature of regional importance**,** which results in a **significant effect.**

Flood walls and embankments will contain river flows up to the design flood event, which could result in changes to in-channel velocity and discharge volumes for flow depths higher than the existing bank-top. No changes are anticipated during normal flow conditions for the Scheme (Chapter 10: Water Environment). Velocity modelling indicates that during the 0.5% Annual Exceedance Probability (200-year) design flood events, increases in fluvial velocity will occur on the River Carron (average change of +0.4%), Grange Burn (average change of +1.2%), Westquarter Burn (average change of +11.2%) and the River Avon (average change of +3.6%). This could lead to a reduction in slack water habitat available to foraging Daubenton's bats. The passive monitoring indicated high levels of myotis bat (likely Daubenton's) activity along the River Carron and low levels of activity along the River Avon. This indicates the River Carron has important Daubenton's foraging habitats and any changes to velocity could reduce insect availability and diversity, leading to reduced foraging success. However, given these flood events would be infrequent in nature and changes to velocity would be short-term, this would be a **Negligible, negative** impact on a feature of regional importance, which results in a **not significant effect**.

Due to the lack of riparian vegetation and the narrow, shallow nature of Grange Burn, it is unlikely that any available foraging habitat will be of high importance to the local Daubenton's bat population. This was supported by the two passive monitoring deployments on the Grange Burn which recorded low levels of Myotis bat activity. Therefore, any impact relating to flow conditions would be **Negligible, negative** on a feature of regional importance, which results in a **not significant effect**.

There will be a permanent loss of habitats of value to bats; woodland/scrub, wetland, scattered trees/scrub and running water habitat are important for foraging, and hedgerow habitat is important for commuting between roosting and foraging sites (Gunnell *et al.* 2012). The loss of these habitats could result in use of less suitable alternatives or increased distance travelled to suitable sites, leading to a reduction in breeding success. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect.**

7.5.3.3.2 Breeding birds

Permanent loss of habitat under the footprint of the Scheme could potentially result in fragmentation and displacement of species that use this habitat. However, the area lost would be negligible given the amount of remaining habitat available in the wider landscape. It is anticipated that this would therefore the impact will be **Minor, negative** on a feature of regional importance, which would result in a **not significant effect**.

7.5.3.3.3 Freshwater and Migratory Fish

The new orifice weir and altered flow control structure on Grange Burn will result in a permanent loss of habitat. The footprint of the weir is anticipated to be less than 1 m^2, however, to account for uncertainties in the bed modifications required around the structure, a conservative value of 35 m^2 has been assumed. As this loss will be localised and does not represent loss of critical habitat (i.e., does not include

spawning gravels) needed to maintain populations of freshwater and migratory fish, the impact has been assessed as **Negligible, negative** on a feature of regional importance which results in a **not significant effect.**

The 30m culvert extension on the Mungal Burn will result in the permanent loss of habitat available for fish. However, the burn in this reach is already highly modified, and is culverted for approximately 800 m upstream of the proposed extension. Furthermore, the habitat loss will be localised and does not represent loss of critical habitat (i.e. does not include spawning gravels) needed to maintain populations of freshwater and migratory fish, Therefore, the impact has been assessed as **Negligible, negative** on a feature of regional importance which results in a **not significant effect.**

Changes in hydrology will occur as a result of the new weir in Grange Burn. However, these alterations only occur at the 1 in 2-year flows and above at which point a slight decrease in velocity both immediately up and downstream of the structure have been predicted and a decrease in depth downstream compared to the existing conditions (Appendix B10.1: Fluvial Geomorphology). Effects on the habitat use or movement of freshwater and migratory fish will be limited. This has been assessed as a **Minor, negative** impact on a feature of regional importance, which results in a **not significant effect**.

The new box culvert on the Millhall Burn which replaces the existing single span road bridge will have a similar footprint to the existing bridge and although the habitat under the culvert will be altered, the bed will be installed to replicate the existing riverbed condition. Although the alteration is permanent, the impact will be **Negligible, negative** on a feature of regional importance which results in a **not significant effect.**

The culvert may also cause changes in hydrology in the Millhall Burn, potentially affecting fish migrating through the culvert and accessing upstream habitat. However, changes will be minimal and localised, and the impact is assessed to be **Negligible, negative** on a feature of regional importance, which results in a **not significant effect.**

7.5.3.3.4 Great Crested Newt

Whilst no GCN breeding ponds were identified under the footprint of the Scheme, 6.8 ha of suitable terrestrial habitat (including grassland, woodland and scrub) with the potential to be used for shelter, commuting and foraging will be lost. Permanent loss of this habitat could potentially result in fragmentation or habitat displacement of individuals, which could adversely impact the GCN meta-population. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect**.

7.5.3.3.5 Otter

Two otter couches will be lost under the footprint of the Scheme. There will also be permanent loss of riparian habitats and potential shelters suitable for otter. This has been assessed as a **Moderate, negative** impact on a feature of regional importance, which results in a **significant effect.**

7.5.3.3.6 Non-Breeding Birds (not including qualifying species of the Firth of Forth SPA, Ramsar and SSSI)

Permanent habitat loss for non-breeding birds is predicted to occur at the edge of the Forth Estuary in Flood Cells 3, 4 and 6, totalling 0.78 ha. Of this, 0.43 ha is comprised of mudflats, a feeding resource for the non-breeding birds, but this is plentiful within the Forth Estuary. The remaining habitat lost comprises reedbeds, neutral grassland and urban habitats. The habitat lost is directly adjacent to the Port of Grangemouth and petrochemical plant and much of this habitat contains historic revetments, with rock armour and rubble. This habitat is often utilised by non-breeding birds for roosting at high tide

and the Scheme defences and coastal revetment will result in a similar habitat to that lost. Therefore, this has been assessed as a **Negligible, negative** impact on a feature of regional importance, which results in a **not significant effect**.

7.5.3.3.7 Badger

The flood defences within Working Area 3-4 in the Port of Grangemouth will comprise bare sheet pile walls which could prevent badger from accessing other areas of suitable habitat within the port. In Working Areas 6-1 and 6-2, the defences will be formed by sheet pile walls with coastal rock armour revetments. The defences and an access track will border the petrochemical plant from the right bank of Grange Burn and along the estuary edge to the left bank of the River Avon. The revetment will maintain badger habitat connectivity within this local area, however if badgers climb down to the access track, there is potential for badgers to get trapped between the petrochemical plant fenceline and the sheet pile wall. Whilst the badger sett recorded during surveys had no evidence of recent use during monitoring in 2023, it was previously recorded as active. Therefore there is potential for badger foraging habitat to be fragmented, and one social group territory could be further isolated as a result of the Scheme.

The impacts are unlikely to cause declines at a population level and has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect**.

7.5.3.3.8 Hedgehog

Permanent loss of woodland, shrub and hedgerows suitable for hedgehog will occur under the footprint of the Scheme and habitat could be fragmented. This has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.3.3.9 Red Squirrel

Whilst no signs of red squirrel were recorded during any ecology surveys conducted for the Scheme, desk study records (NBN 2023) identified that red squirrel are present within the vicinity of the Scheme. Permanent loss of woodland habitat under the Scheme footprint could potentially result in fragmentation of territories and displacement of individuals that use this habitat for foraging, commuting, resting and breeding. Given the lack of red squirrel records within the study area, this has been assessed as a **Moderate, negative** impact on a feature of authority importance, which results in a **not significant effect.**

7.5.3.3.10 Freshwater Invertebrates and Macrophytes

Permanent loss of aquatic habitats suitable for freshwater invertebrates and macrophytes will occur under the footprint of the weir on Grange Burn and culvert on Mungal Burn. This habitat loss will be localised and does not represent a loss of critical habitat that is needed to maintain populations of freshwater invertebrates and macrophytes. Therefore, the impact has been assessed as **Negligible, negative** on a feature of local importance, which results in a **not significant effect.**

Alteration of aquatic habitats suitable for freshwater invertebrates and macrophytes will occur under the footprint of the box culvert on the Millhall Burn. This alteration will be localised and does not represent an alteration of critical habitat that is needed to maintain populations of freshwater invertebrates and macrophytes. Therefore, the impact has been assessed as **Negligible, negative** on a feature of local importance, which results in a **not significant effect.**

The weir in Grange Burn and box culvert in Millhall Burn could result in changes in hydrology. This may cause alterations in erosion, deposition and sediment suspension, which in turn could affect water

quality and distribution of habitats. However, it is expected that invertebrate and macrophyte communities will respond quickly so these impacts have been assessed as **Minor, negative** on a feature of local importance, which results in a **not significant effect**.

7.5.4 Cumulative Effects

The potential for the Scheme to have cumulative effects on biodiversity in combination with other projects or plans is summarised below. The HRA will provide more detail in relation to the SPA/Ramsar site features.

The assessment of potential cumulative effects considers the following elements:

- The additive effect of habitat loss (terrestrial and riparian).
- Disturbance of fauna (due to construction phases overlapping or coinciding).
- Impediments to passage of fish, otter and bats along the river corridors.
- Sediment inputs or pollution incidents into watercourses.
- Geomorphological changes to watercourses.

With regards to future and committed projects and developments in the vicinity of the Scheme, eight developments (including Musselburgh Flood Protection Scheme as requested by NatureScot) were identified as having the potential to have a cumulative impact in combination with the Scheme. These developments along with the planning application reference (where relevant), description and distance from the Site Boundary are provided in Table 7-6. Further details on these developments are provided in Chapter 15: Cumulative Impacts.

Potential for cumulative effects has been determined by taking into consideration the following factors: the proposed size of the development, the likely or unknown construction timing, the physical separation and distance of the development from the Scheme, and the lack of supporting information available from the planning application (e.g., due to the magnitude of the impact of the proposed development not requiring an ecological assessment). However, once proposed mitigation measures and enhancements for the Scheme are considered, the cumulative effect of these developments is likely to be negligible. Therefore, it has been concluded that there are unlikely to be any significant cumulative effects on biodiversity.

The potential for the Scheme to have project cumulative effects on biodiversity in combination with other disciplines is addressed in Chapter 15: Cumulative Impacts. No same project cumulative effects on biodiversity were identified.

Table 7-6: Developments with potential cumulative effects

Planning Application Reference	Description of the Development	Distance from the Site Boundary
P/20/0324/FUL	Alterations and extension to school	0.6 km
P/20/0493/PPP	Mixed use development, including residential, employment, commercial and retail use, open space and landscaping with associated infrastructure	0.8 km
P/20/0595/LBC	Kincardine Bridge - demolition and reconstruction of piled viaduct section of bridge, formation of temporary bridge, replacement safety barrier, refurbishment of timber jetties, replacement bridge drainage system, installation of navigation lights and general maintenance works.	3.8 km
P/21/0656/PPP	Development of land for residential use.	0.2 km

Planning Application Reference	Description of the Development	Distance from the Site Boundary
P/22/0042/MSC	Construction of 225 dwellinghouses, associated infrastructure, drainage and landscaping	3.4 km
P/22/0286/FUL	Extension to Falkirk crematorium office and visitor hub	0.4 km
P/22/0282/FUL	Extension to nursing home	Within the Site Boundary
N/A	Musselburgh flood protection scheme	40 km

7.6 Mitigation

7.6.1 Introduction

The proposed mitigation is designed to avoid or reduce impacts on ecological features in line with policy and best practice guidelines (CIEEM 2022, Scottish Government 2022 and 2023). Positive effects for biodiversity measures proposed to align with NPF4 are discussed in Section 7.9.

It is expected that many of the non-significant effects would be mitigated through the application of standard mitigation commitments, legislative requirements and industry standard best practice (e.g. mitigation of potential pollution impacts through adherence to standard best practice and guidelines, such as the SEPA Guidance for Pollution Prevention (GPPs) and Pollution Prevention Guidelines (PPGs)) (Netregs 2023).

Potential significant ecological effects as shown in Table 7-10 are expected to be mitigated through a combination of best practice or typical mitigation methods, and mitigation specifically relating to ecology ("E" Mitigation Item references) targeted to specific impacts and locations.

The definition of primary, secondary and tertiary mitigation is provided in Section 7.3.12 and Chapter 3: Environmental Impact Methodology, Section 3.7, provides further details on the mitigation hierarchy.

Primary mitigation relevant to biodiversity includes:

- the consideration of biodiversity issues at the options appraisal stage (refer to Chapter 4: The Proposed Scheme for more information);
- setting flood defences back from watercourse banks, where possible;
- prioritising upstream flood storage where feasible to reduce the extent and size of flood defences;
- alignment adjustment to avoid area of high value trees, such as along Grange Burn in Zetland Park; and
- alignment adjustment to minimise or avoid encroachment into the Firth of Forth SPA, where possible.

Secondary mitigation is proposed to reduce the impact on biodiversity, and tertiary mitigation largely forms part of the construction process. Secondary and tertiary mitigation relevant to the construction phase is identified in Table 7-7. Where appropriate, secondary mitigation also involves the timing of construction activities to avoid or reduce impacts on features. This mitigation will inform the construction programme when construction methods are developed further.

It should be noted, where residual effects are predicted and compensation habitat is required, the compensation measures are separate to any habitat enhancement initiatives; the latter are required to

provide positive effects for biodiversity in line with NPF4. Further details of mitigation and enhancements will be determined at detailed design (before Scheme confirmation) and detailed design stages in agreement with the appropriate consultees.

7.6.2 Ecological Clerk of Works (ECoW)

A suitably qualified (or team of suitably qualified) ECoW will be appointed to ensure compliance with legislation and best practice guidance during construction. Details for the duties and requirements of the ECoW can be found in Table 7-7.

7.6.3 Construction

Mitigation commitments have been identified which set out the actions the contractor will be required to take during the construction phase of the Scheme to avoid or reduce environmental impacts. Some measures detailed are not mitigation in isolation, but their implementation for regulatory/legal compliance purposes will inform the scope of further mitigation and licensing where required (e.g. pre-construction surveys and monitoring). Construction mitigation items relevant to this chapter are detailed in Table 7-7.

Table 7-7: Secondary and tertiary construction mitigation items for ecological features

Mitigation Item	Description	Mitigation Type
E1 (Ecological Management Plan (EMP))	Prior to construction the contractor will develop, update, and maintain a Construction Environmental Management Plan (CEMP) which must be approved by Falkirk Council. The CEMP will include an Ecological Management Plan (EMP). The contractor will develop the EMP in consultation with the relevant stakeholders, including NatureScot. The EMP will include Species Management Plans which, as a minimum, will include the following: • the scope of pre-construction surveys required prior to and during construction, in accordance with Mitigation Item E5, to verify and, where required, update the baseline ecological conditions set out in the EIA Report and associated HRA for the Scheme. • details of proposed mitigation measures and any required exclusion zones to avoid or reduce potential impacts and any unnecessary encroachment into adjoining areas of nature conservation. • restrictions on the timing of construction works to avoid or reduce impacts on protected species, for example vegetation clearance will avoid the nesting bird season and works within watercourses will avoid the sensitive period for fish, where possible. • appropriate watching briefs during construction as detailed in the role and expectation of the ECoW (see Mitigation Item E2). • details of proposed post-construction monitoring requirements to ensure mitigation measures are implemented and are functioning as expecting during the operational phase. The EMP will be informed by pre-construction surveys and updated as appropriate with additional mitigation measures where required (including protected species licence conditions where relevant). The EMP will also include a Biosecurity Plan, developed in line with SEPA guidance on INNS, to avoid the spread of INNS and manage their removal and disposal during construction, and a Landscape and Ecological Habitat Management Plan (LEHMP) (see Mitigation Item E21 for details of LEHMP). a	Tertiary / Secondary
E2 (Ecological Clerk of Works (ECoW))	Prior to construction a suitably qualified (or team of suitably qualified) Ecological Clerk of Works (ECoW) will be appointed and will be responsible for implementation of the Ecological Management Plan. The ECoW will: • provide ecological advice over the entire construction programme; • undertake or oversee pre-construction surveys for protected species in the areas affected by the Scheme; • ensure mitigation measures are implemented to avoid and reduce impacts on ecological features; and	Tertiary / Secondary

Mitigation Item	Description	Mitigation Type
	• monitor the implementation of the mitigation measures during the construction phase to ensure compliance with protected species licence conditions, legislation and commitments within the EIA Report and associated HRA for the Scheme. The ECoW will be a member of the CIEEM and will have previous experience in similar ECoW roles. The ECoW will be appointed in advance of the main construction programme commencing to ensure pre-construction surveys are undertaken and any advance mitigation measures required are implemented.	
E3 (Construction Light Plan)	A construction lighting plan and method statement will be developed and implemented by the contractor. The plan will detail specific mitigation requirements taking into account guidance on lighting (e.g. Bat Conservation Trust (2009); Institution of Lighting Professionals (2011) and The Royal Commission on Environmental Pollution (2009)). The construction lighting design will take into account the need to avoid illuminating sensitive habitats in locations such as sensitive bird or bat habitats, adjacent to watercourses, known commuting routes and where known protected species activity has been identified through pre- construction ecological surveys (refer to Mitigation Item E1). Where working in or near watercourses is required during the hours of darkness, the contractor will fit temporary lighting with a cowl to limit light spill, angle light away from the watercourses and keep light within the footprint of the construction works where possible to avoid disturbance to migratory fish and otter. Where this is not possible the contractor will agree any exceptions with the ECoW.	Secondary
E4 (Soft-start techniques)	'Soft-start' techniques will be implemented for all activities predicted to be particularly noisy, to avoid sudden and unexpected disturbance of protected species. Noise levels will be gradually increased over a period of 30 minutes to allow protected species to relocate. Where construction methods and equipment that can reduce noise are available, these will be implemented where possible.	Secondary
E5 (Pre-construction surveys)	Pre-construction surveys will be undertaken to verify and, where required, update the baseline ecological conditions set out in the EIA Report. The scope of the pre-construction surveys will be confirmed with Falkirk Council (and NatureScot where required) prior to them being undertaken. The results of these surveys will be detailed within the Species Management Plans and will be used to inform protected species licences and any additional mitigation requirements.	Secondary
E6 (Tree felling and vegetation clearance – timing of works)	Tree felling and vegetation clearance will be reduced as far as practicable and undertaken outside the core bird breeding season (01 March to 31 August) to avoid damage/destruction of active nests or disturbance/harm to breeding birds. If this cannot be achieved, works within the core bird breeding season will require an inspection of vegetation or suitable ground nesting habitat for nesting birds by a	Tertiary

Mitigation Item	Description	Mitigation Type
	suitably qualified ecologist no more than 24 hours prior to any works being undertaken. If any active nests are identified during the survey, they will be left in situ for their entire nesting period until the young birds have fledged or the nests have failed due to natural reasons. Alternative approaches to the work will need to be proposed e.g., implementing an exclusion zone around the nest to avoid disturbance. All cleared vegetation will be rendered unsuitable for nesting birds, for example, by covering or chipping depending on the end purpose of the vegetation or will be removed from the works area.	
E7 (Tree felling and vegetation clearance – experienced contractors)	Any tree felling and vegetation clearance will be carried out by experienced contractors to reduce potential direct impacts on protected species. Felling will be carried out according to felling methods agreed between contractors and the ECoW.	Tertiary
E8 (Entrapment prevention)	Trenches, holes and pits will be kept covered at night or a means of escape will be provided (such as a ramp) for terrestrial vertebrates that may become entrapped.	Tertiary
E9 (Temporary mammal-resistant fencing and gates)	Temporary mammal-resistant fencing and gates will be provided around construction compounds in the vicinity of habitat where badger and otter are known to be present. Fencing and gates will meet a specification based on current best practice and agreed through the EMP. Gates will be closed at night.	Tertiary
E10 (Licensing requirements)	Should a new otter resting site, badger sett or GCN breeding pond be found within 100 m of piling works during pre-construction surveys, NatureScot will be consulted on licensing requirements and how to proceed.	Secondary
E11 (Watercourse banks –timing of works)	Where practicable, works will not be conducted on both banks on the same section of watercourse at the same time to ensure that at least one bank of a watercourse will be passable by otter at all times.	Secondary
E12 (Licensing requirements)	Where direct impacts on protected species or their resting habitat cannot be avoided, and where such impacts would cause an offence under applicable conservation legislation, derogation licences will be obtained by the contractor from the relevant statutory body (e.g., NatureScot) in advance of the works proceeding. The contractor will comply with the requirements or conditions of any licences granted.	Tertiary
E13 (Working back from watercourses)	Placement of construction compounds, storage areas, temporary access tracks etc. will be at least 10 m from watercourse banks in line with SEPA PPGs.	Secondary

Mitigation Item	Description	Mitigation Type
E14 (Best practice construction methods)	Best practice construction methods (CIRIA 2015, SEPA 2009) and Guidance for Pollution Prevention for works and maintenance in or near water (GPP 5) (Netregs 2018) will be followed to minimise impacts on aquatic habitats and species.	Tertiary
E15 (Minimising impacts to habitats and protected species)	Where the contractor identifies areas within the Site Boundary not required for building the Scheme, temporary barriers will be provided to minimise damage to habitats and potential disturbance or mortality to protected species within these areas.	Secondary
E16 (Fish removal)	Fish will be removed by suitably qualified personnel prior to creation of in-water working platforms or dry works areas above the tidal limit. Qualified personnel will be on site during the creation of dry works areas in tidal reaches to remove any fish that become stranded.	Secondary
E17 (Watercourses – timing of works)	Unless there is agreement with SEPA and the Forth District Salmon Fisheries Board, no in-stream works will be undertaken between October and May inclusive above the tidal limit on the River Carron, River Avon, Grange Burn, Millhall Burn and Westquarter Burn, to avoid the sensitive fish migration, spawning and emergence periods in these watercourses. In-stream works include establishment and removal of working platforms or dry works areas. Once established, works can continue within dry areas/working platforms throughout the sensitive period although continuous periods of 'noisy' activities such as piling will be avoided unless timing/programme of piling works is agreed with SEPA/FDSFB. The contractor will comply with the conditions of CAR licences and best practice guidelines during works within or in proximity to watercourses.	Tertiary
E18 (Maintaining fish passage)	Fish passage will be maintained throughout the works using temporary culverts or maintaining a partial open channel.	Secondary
E19 (Fish welfare)	If over-pumping is required, appropriately sized screens will be used to prevent fish from being drawn in.	Secondary
E20 (Minimising impacts to birds)	Visual and noise screening will be installed prior to construction along the temporary works areas adjacent to the estuary where possible, to screen the movement of vehicles, plant and site personnel from birds. The screening will remain in place for the duration of the works. To minimise disturbance to qualifying species of the Firth of Forth SPA and Ramsar site, it has been stipulated in the HRA that construction works along the estuary within Flood Cells 3 and 6 will not be concurrent.	Secondary

Mitigation Item	Description	Mitigation Type
	During construction, a suitably qualified ecologist or ornithologist will undertake monitoring surveys following the methods for wetland bird Through the Tide Count surveys. These surveys will be used to determine if there is any significant disturbance to qualifying species of the SPA, Ramsar or SSSI, as well as other species of birds present in the survey area. Bird behaviour which constitutes a significant disturbance event, and additional mitigation required in response to this, will be agreed in advance with NatureScot and documented in the Bird Species Management Plan. Should disturbance be identified, works will stop immediately and further mitigation in line with those outlined in the Bird Species Management Plan will be implemented by the ECoW. Whilst significant disturbance to birds during works will be avoided where possible, it is acknowledged that disturbance could occur during construction; therefore, compensatory habitat has been provided (Section 7.8).	

7.6.4 Operation

Mitigation commitments have been produced which set out the actions the contractor is required to take during the operational phase of the Scheme to avoid or reduce environmental impacts. Certain mitigation commitments will extend beyond the period for which the contractor is responsible for the Scheme and will be passed to Falkirk Council or the maintenance operator.

Some measures detailed are not mitigation in isolation, but their implementation will inform the scope of further mitigation and licensing where required (e.g. post-construction monitoring). Operational mitigation items relevant to this chapter are detailed in Table 7-8.

The loss of habitats will be replaced through ecological and landscape planting (further information is provided in Chapter 9: Landscape and Visual Impact Assessment).

Where compensatory habitat is required to mitigate for residual effects, these will be established prior to the loss of any existing habitat where practicable.

Table 7-8: Operation mitigation items for ecological features

Mitigation Item	Description	Mitigation Type
E21 (Landscape and Ecological Habitat Management Plan (LEHMP))	Methods for mitigating habitats lost or damaged during construction will be detailed in the Landscape and Ecological Habitat Management Plan (LEHMP) developed as part of detailed design. An outline LEHMP (OLEHMP) and associated figures have been developed by Jacob's landscape architects and ecologists in agreement with Falkirk Council (see Appendix B9.10). This provides an overview of the habitat restoration requirements and indicative sites for woodland and wetland mitigation (significant impacts identified) within the Site Boundary. Additional woodland mitigation sites beyond the boundary will be identified at detailed design in consultation with Falkirk Council and detailed in the LEHMP. Post-construction monitoring of habitats will be detailed in the LEHMP. Monitoring will be undertaken by a suitably qualified ecologist over a five-year period to determine success of habitat restoration and inform whether further remedial action is required to ensure successful establishment. Monitoring will be undertaken at years one, three and five post construction. The results of the monitoring, including recommendations for remedial action where issues with establishment are identified, will be provided in a report following each year of monitoring.	Tertiary / Secondary
E22 (Reprofiling watercourse banks)	Reprofile and landscape the banks of Grange Burn/ Westquarter to restore morphological diversity and improve suitability for protected species, including otter and kingfisher, along the sections outlined in mitigation item W27 and W31 of Chapter 10: Water and Environment. Where practicable, other watercourse banks will be reprofiled and landscaped to provide suitable habitat for protected species.	Secondary
E23 (Bat boxes)	Where bat roosts are identified in buildings/structure/trees to be demolished during the baseline and pre-construction surveys, the loss of roosting habitat will be mitigated by the provision of bat boxes mounted on nearby buildings or trees in the area. Bat boxes should be installed prior to construction on suitable trees more than 30 m from the Site Boundary to avoid disturbance during works. Indicative locations for bat boxes include Zetland Park and local wildlife sites in proximity to the Scheme. Additional bat box locations beyond the Site Boundary will be identified at detailed design in consultation with Falkirk Council. Bat boxes should be constructed with durable materials such as concrete mixed with sawdust and polystyrene (e.g., Schwegler boxes). The dimensions and box design will be determined by	Secondary

	the type of roost being mitigated. If a significant roost such as a maternity colony is found during pre-construction, then a dedicated bat mitigation structure, such as a bat house, may be required. At years one, three and five post-construction, detailed monitoring will be undertaken by an appropriately experienced and licensed bat ecologist to determine if the mitigation has been installed correctly (year one only) and record any damage or use by nesting birds and document uptake by bats. At years 10, 15, 20, 25 and 30 post construction, simple checks will be undertaken to record and replace any bat boxes which have become damaged or destroyed as replacement planting will not provide suitable roosting habitat until trees have matured (30+ years). A report will be provided following each year of monitoring including recommendations for any issues identified (for example, replacing damaged boxes or cleaning out those used by nesting birds outwith the nesting bird season). Any issues identified will be resolved within six months of issues being reported.	
E24 (Sheltering opportunities)	Revetments along the River Carron will be constructed with loosely packed rock armor stone, which will provide shelter opportunities for otter.	Secondary
E25 (Ramps or earth bunds to facilitate habitat connectivity)	To ensure habitat connectivity for badger along the estuary edge and ensure individuals do not get trapped between the petrochemical plant fenceline and flood defences (applicable within Flood Cells 6 and 3), ramps or earth bunds will be installed from the flood defence access track which tie in with the rock armour revetment. Installation of the ramps or earth bunds will be supervised by a suitably qualified ecologist to ensure they are installed in the correct location and function as intended.	Secondary
E26 (Positive Effects for Biodiversity Management Plan (PEBMP))	A Positive Effects for Biodiversity Management Plan (PEBMP) will be developed at detailed design stage, which will be updated and maintained by the contractor. This will detail the enhancement measures to be implemented and managed in the long-term to ensure PEB are achieved and can be evidenced.	Tertiary / Secondary

7.7 Post Construction Monitoring

Any post-construction monitoring will be undertaken in accordance with the Species Management Plans, protected species licences, the LEHMP and PEBMP required for the Scheme. This monitoring will determine the effectiveness of the mitigation employed and inform whether further mitigation, maintenance or changes in mitigation approach are required. As stated in **Mitigation Item E21,** replacement planting and habitat restoration will be monitored post construction for up to 10 years to determine success and all bat mitigation (**Mitigation Item 23**) will be subject to detailed monitoring for up to 5 years after construction with simple checks for damage or destruction of bat boxes undertaken for up to 30 years.

7.8 Compensation

With the precautionary principle underpinning the HRA approach, adverse effects on qualifying bird species of the Firth of Forth SPA and Ramsar site cannot be discounted during the construction phase. Compensatory measures must therefore be taken to ensure that the overall coherence of the European site network is protected. As two main aggregations of birds at key roost locations (the 'breakwater' to the north of the Port of Grangemouth and 'sheltered bay' north of the petrochemical plant) will likely be affected during construction, compensation for the temporary disturbance to roosting at these sites is required. The alternative habitat provided must be at least functionally equivalent to that which is adversely affected.

In consultation with NatureScot, two compensation sites have been identified at Kinneil Lagoons and Bothkennar Pools. These sites were identified as the compensation areas most appropriate to protect the integrity of the SPA and Ramsar site due to their proximity to the identified high tide roosts (the breakwater and sheltered bay) which could be disturbed by the construction, but outwith the potential disturbance distance from the Scheme. If roosting birds are disturbed and displaced by construction works, it is anticipated that the level of disturbance/displacement will be low, and that the birds will make only short-distance movements. The compensation sites currently support wildfowl and waders, including roosting birds, and include suitable habitat that could be enhanced to accommodate the potential displaced birds.

At Kinneil Lagoons, compensation will take the form of an island (approximately 0.45 ha) to provide roosting habitat. At Bothkennar Pools, the area of land between the two pools will be managed, to become more appealing to roosting birds. More details of compensatory habitat can be found in the HRA for the Scheme.

7.9 Positive Effects for Biodiversity

At the time of writing, no guidance has been published by the Scottish Government or NatureScot which addresses how EIA scale projects in Scotland should meet the obligations of securing positive effects for biodiversity. However, to meet the statutory requirement stipulated within NPF4, the approach for securing PEB must go beyond no net loss and be clearly differentiated from the mitigation and compensation required to achieve no net loss. Enhancement measures to secure PEB should align with NPF4 Policy 3 Biodiversity and draw upon enhancement suggestions detailed within other relevant policy and guidance documents.

The key themes for securing PEB should focus on restoring degraded habitats, strengthening existing nature networks, and measures to benefit protected and priority species (as listed in LBAPs and the SBL). A holistic approach should be taken to secure PEB and complimentary enhancement measures should

be used to optimise the benefits in areas targeted for securing PEB. Further information on the approach to PEB for the Scheme is provided in Appendix B7.4: Approach to Positive Effects for Biodiversity.

Enhancement measures will be undertaken within the Site Boundary for the Scheme, however land beyond the Scheme will also be required. Enhancement measures in areas beyond the Site Boundary will target land owned by Falkirk Council and where required purchase of private land will be considered to secure PEB.

There are risks and limitations associated with Falkirk Council purchasing land before the Scheme has been confirmed under the FRM Act. If land for positive effects for biodiversity was purchased without the Scheme having been confirmed, this could result in Falkirk Council owning land that is not used, which would not be financially prudent or environmentally sustainable. Additionally, as it is anticipated that the Scheme will be completed in four phases over an up to 10-year construction programme (2026 to 2036) (see Chapter 4: The Proposed Scheme for more details), it is likely that that any land purchase will be tied to the specific construction phase. As it is not feasible for the locations of PEB measures to be confirmed at the outline design stage, and, therefore, at this stage of assessment, the locations of PEB measures will be developed and agreed at detailed design.

At the detailed design stage the following steps will be taken to secure PEB in line with NPF4 Policy 3 Biodiversity:

- any new published guidance on PEB in Scotland will be considered and at the commencement of the detailed design process. The project design team for the detailed design will liaise with Falkirk Council (and NatureScot where required) to refine the approach to PEB;
- the Scheme design team will establish a Working Group, which conservation organisations (e.g. SWT, RSPB) and local community groups will be invited to join, to work together to identify suitable local measures or projects that can be taken forward that would contribute to PEB;
- a review of Falkirk Council land and other land plots will be conducted to identify other areas within the vicinity of the Scheme that could be enhanced to contribute to PEB; and
- a PEB Management Plan will be developed at the detailed design stage which will be updated and maintained by the contractor. This will detail the enhancement measures to be implemented and managed in the long-term to ensure PEB are achieved and can be evidenced. To ensure that this is delivered as part of the schedule of environmental commitments for the Scheme, the requirement for a PEB Management Plan is included as a mitigation item (E26).

Whilst the enhancement measures to secure PEB will be confirmed at detailed design stage, some potential measures to enhance biodiversity are presented in Table 7-9. These measures and any additional measures included following Scheme consent will be considered further at detailed design and will require consultation with Falkirk Council, landowners, local community groups (e.g. Friends of Zetland Park) and other organisations to determine their feasibility. Implementation and management requirements of confirmed enhancement measures will be detailed in the PEB Management Plan.

Table 7-9: Potential Enhancement Measures

Potential Enhancement Measures
Planting Habitat reinstatement within the Site Boundary will be undertaken as part of mitigation requirements. During reinstatement, opportunities to enhance low value habitat (e.g. amenity grassland) or habitats assessed as poor condition during habitat surveys will be explored to provide PEB. Riparian, hedgerow, scrub/ shrub and wildflower planting is proposed within the Site Boundary to provide PEB. The location of proposed planting is indicated below and in the OLEHMP (Appendix B9.10). ***Riparian planting***

Riparian planting to support biodiversity will be provided at the locations along Grange Burn where Chapter 10: Water Environment has identified mitigation to restore watercourse morphological diversity. This planting does not form part of the Water Environment mitigation, but the combination of riparian planting and improvements to the channel will provide positive effects for biodiversity. Riparian planting will be provided along the following sections of Grange Burn:

- Section of Grange Burn extending beyond Working Areas - NS 92685 80288 to NS 92706 80968;
- Working Area 4-5 - NS 92684 80946 to NS 92827 81371;
- Working Areas 4-5, 4-6 - NS 92827 81371 to NS 92993 81990; and,
- Working Areas 4-7, 4-8, 4-9 - NS 92993 81990 to NS 94587 82541.

This will provide additional riparian planting which will create habitat for wildlife and potential wildlife corridors to improve habitat connectivity.

Hedgerow planting

Where appropriate, flood defences could be transformed into wildlife corridors by planting native species-rich hedgerows. Green screens, fence or trellis like structures that support climbing plants and tall shrubs planted in the ground, could also be installed in certain locations. Hedgerow planting within the Site Boundary is proposed along the following sections of flood defences:

- Working Area 1-2 – along sections of earth embankment defence (Mungal Community Woodland);
- Working Area 1-4 – along concrete wall defence (Stables adjacent to Dock Street);
- Working Area 4-1- along concrete wall defence (A9/ Grandsable Road);
- Working Areas 5-1, 5-2, 5-3 – along sheet pile wall (Ineos land); and,
- Working Area 6-3 - along sheet pile wall with a section of earth embankment to conceal the wall (Kinneil area).

This will provide additional hedgerow planting which would provide connectivity and habitat for wildlife.

Scrub/ shrub planting

Scrub/ shrub planting has been proposed to provide connectivity and habitat for wildlife. Suggested locations for planting within the Site Boundary are provided below:

- Working Area 1-2 - scrub planting on earth embankment defence (Mungal Community Woodland);
- Working Area 2-1 – scrub planting on earth embankment defence (Port of Grangemouth adjacent to River Carron);
- Working Area 4-5 – appropriate shrub planting on earth embankment defence (Zetland Park); and,
- Working Area 6-3 – scrub planting on earth embankment defence (Kinneil Area).

Wildflower planting

Wildflower meadows have been proposed at the following areas within the Site Boundary:

- Working Area 1-1 – amenity grassland (Stirling Road);
- Working Area 1-2 – amenity grassland (Mungal Community Woodland); and,
- Working Area 4-1 – amenity grassland (Zetland Park).

Tree planting

Sites for tree planting and woodland creation to secure PEB will be identified in land plots beyond the Site Boundary at detailed design in consultation with the relevant stakeholders. This could include a 'wee forest' in appropriate locations. This is a small (typically the size of a tennis court), dense and fast-growing native woodland with native trees and shrubs planted in an urban location. They are rich in biodiversity, capable of attracting a variety of animal and plant species and require low management and maintenance after the first two

years. The wee forest can incorporate features such as paths or benches to make them easily accessible to the public.

Corners or boundary edges of existing parks, such as Zetland Park, could be suitable locations. This would ensure the wee forest is easily accessible to the public, with suitable infrastructure already in place.

Provision of artificial shelters

Artificial shelters can provide additional sheltering opportunities for wildlife within suitable habitat, particularly where there is limited scope to extend the existing habitat or where the vegetation is not yet established enough to provide sufficient natural shelter opportunities.

Bat boxes and/or bricks could be incorporated into suitable flood defence walls (e.g., along the River Carron and River Avon) to provide additional roosting opportunities for bats. If incorporating artificial bat roosts within the flood defences is not feasible, sections of brick/stone clad wall adjacent to watercourses (e.g., on River Carron or Grange Burn) or lines of trees would also be suitable. Possible locations for bat boxes and bat bricks within the Site Boundary are provided below:

- Working Area 1-1 – pockets of woodland within this area that are to be retained are potentially suitable for bat boxes;
- Working Area 1-2 – a pocket of woodland to be retained adjacent to the River Carron is a potentially suitable location for bat boxes. Bat bricks could be incorporated in the section of brick clad wall which is over 2 m located alongside the River Carron;
- Working Area 1-3 - bat bricks could be incorporated into the section of brick clad wall which is over 2 m located alongside the River Carron;
- Working Area 4-5 – trees to be retained alongside the Grange Burn provide a potentially suitable location for bat boxes; and,
- Working Area 5-1 – trees to be retained alongside the River Avon provide a potentially suitable location for bat boxes.

Bee bricks and boxes can be incorporated within, or adjacent to, suitable flood defences. Bug hotels or boxes can be placed within existing areas of grassland, scrub or woodland. Hedgehog houses can be sited within scrub, under bushes or hedgerows in an area that would not encourage movement near roads or other hazards.

Suitable high tide roosting habitat for bird species could be incorporated within the Scheme design at targeted locations along the Forth Estuary. Within Flood Cell 6, where the flood defences incorporate rock armour revetment, it is proposed that flatter rocks are selected to create a ledge approximately 1 m wide at the top of rock armour revetments. The estuary edge in the vicinity is known to attract high aggregations of birds, and this enhancement measure will provide additional high tide roosting opportunities with good visibility.

Working with conservation organisations and local community groups

At the detailed design stage, the Scheme will liaise with conservation organisations (e.g., SWT, RSPB) and local community groups to identify any suitable measures or projects that can be taken forward that would contribute to PEB. For example, the Scheme could work with local Ranger services and wildlife groups to arrange monitoring of mitigation once the committed post-construction monitoring has ended. This could include monitoring of bat boxes to gather data on long term uptake.

7.10 Residual Effects

7.10.1 Construction and Operational Phase

A summary of the potentially significant impacts on ecological features before mitigation, the proposed mitigation measures and consequent residual effects are set out in Table 7-10.

Table 7-10: Residual effects assessment for ecological features

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
Construction Phase					
Firth of Forth SPA and Ramsar site International	Construction activities will extend into the SPA and Ramsar site at the following Working Areas: 3-1, 3-2, 3-3, 3-4, 3-5, 6-1 and 6-2	Impact: Noise, vibration and light spill. Effect: Disturbance leading to displacement of roosting birds at two key areas within the SPA and Ramsar site. Disturbance leading to displacement of birds from areas used for foraging, loafing and other roosting sites. This may result in additional energy expenditure and loss of conditioning. This effect would be medium-term and negative.	**Major (significant)**	E3 E4 E20	**A significant adverse residual effect is predicted.** Compensatory roosting habitat, which is at least functionally equivalent to that which is potentially lost, will be provided to maintain the integrity of the European site network.
		Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Pollution of SPA and Ramsar site habitat leading to reduced water quality and increased deposition resulting in modified or deterioration of habitat and decline in suitable foraging habitat for qualifying features, which could subsequently lead to mortality of individuals. The effects will be long-term and reversible.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.
Firth of Forth SSSI National	Construction activities will extend into the SSSI within the following Working Areas:	Impact: Noise, vibration and visual effects. Effect: Disturbance leading to displacement of birds from areas used for foraging, loafing and roosting. This may result in additional energy expenditure and loss of conditioning. This effect would be medium-term and negative.	**Major (significant)**	E3 E4 E20	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
	3-1, 3-2, 3-3, 3-4, 3-5, 6-1 and 6-2	Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Pollution of SSSI habitat leading to reduced water quality and increased deposition resulting in modified submerged habitat. The effects will be long-term and reversible.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.
Intertidal mudflats National	Impacts could occur within the following Working Areas: 2-1, 3-1, 3-3, 3-4, 5-3, 5-4, 6-2 and 6-3	Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Reduced habitat quality. Depending on the magnitude, pollution could result in medium-term effects on the habitat.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.
Broadleaved and mixed woodland (non-AWI), Regional	Habitat loss within all Flood Cells. Individual trees of wych elm could be lost in an area of woodland in Working Area 4-1.	Impact: Temporary loss of habitat (9.43 ha). Effect: Loss and physical alteration of an important resource, resulting in reduced habitat quality and fragmentation. Loss of individual trees of wych elm, listed as a priority species on the Falkirk LBAP. Effects will be negative, localised to the construction footprint and occur in the long-term.	**Major (significant)**	E15 E21	**During the re-growth phase a significant adverse residual effect is predicted in the medium term.** This impact would be temporary in nature and a mix of tree ages will be planted to expedite the available woodland habitat. Once the woodland is established, no significant residual effects are predicted.
River Carron	Impacts could occur within all Working Areas	Impact: Run-off and release of sediment, including chemical and hydrocarbon loads.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
River Avon Regional	of Flood Cells 1, 2, 4 and 5, and at Working Area 3-1	Effect: Reduced water quality and/or increased sediment in water column and substrates resulting in a deterioration in ecological condition. Depending on the magnitude of the effect this could result in medium-term effects on the habitat			
Wetland Regional	Habitat could be lost within the following Working Areas: 2-1, 3-4, 3-5, 4-1, 4-3, 4-4, 5-1, 5-2, 5-3, 6-1, 6-3 and 6-4	Impact: Temporary loss of habitat (3.07 ha). Effect: Physical alteration and reduced habitat quality. Effects will be negative, localised to the construction footprint and occur in the short-term.	**Moderate (significant)**	E15 E21	No significant residual effects predicted.
	This habitat could be affected within the following Working Areas: 1-3, 1-4, 2-1 3-4, 3-5, 4-1, 4-3, 4-4, 5-1, 5-2, 5-3, 6-1, 6-3 and 6-4	Impact: Changes in water levels associated with soil compaction and/or changes in water flows. Effect: Physical alteration, including temporary loss, and reduced habitat quality. Changes in water levels could result in long-term, negative, effects on the habitat.	**Moderate (significant)**	E15	No significant residual effects predicted.
		Impact: Run-off and release of sediment, including chemical and hydrocarbon Effect: Reduced habitat quality. Depending on the magnitude, pollution could result in medium-term, negative, effects on the habitat.	**Moderate (significant)**	E14	No significant residual effects predicted.
Bats (all species) Regional	Buildings and structures with bat roost potential within	Impact: Construction related activities, including vegetation clearance, tree felling, modification of structures, demolition of buildings, and vehicle movement.	**Moderate (significant)**	E1 E5 E7 E12 E15	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
	all Working Areas except 5-4 and 6-4. Trees with bat roost potential within Working Areas: 1-1, 1-2, 1-4 4-1, 4-4, 4-5, 5-1 and 6-4	Effect: Potential direct mortality of an EPS during removal of roosting habitat. This effect on overall populations would be permanent and negative.		E21	
		Impact: Bats roosting in, or potentially roosting in, buildings, structure and trees within 30 m of the Site Boundary could be disturbed by noise, vibration and light spill. Effect: Disturbance of an EPS, which could lead to the abandonment of roost sites and increased energy expenditure during roosting periods. This could also cause avoidance of commuting routes and foraging areas. This effect would be medium-term and negative.	**Moderate (significant)**	E3 E4	No significant residual effects predicted.
	Temporary loss of habitat which could be used by bats throughout the Scheme.	Impact: Temporary loss of roosting, foraging and commuting habitat within woodland (9.44 ha), wetland (3.07 ha), scrub (3.85 ha) and hedgerows (783m). Effect: Loss of roosting, foraging, and commuting habitat could result in use of less suitable alternatives or increased distance travelled to suitable sites, leading to a reduction in breeding success. This effect would be medium-term and negative.	**Moderate (significant)**	E15 E21	No significant residual effects predicted.
Fish (freshwater and migratory) Regional	Impacts could occur within the following Working Areas: All Working Areas in Flood Cells 1, 2 and 5 3-1, 3-2, 3-3 and 3-5	Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Reduced water quality and/or increased sediment in water column and substrates resulting in a deterioration in habitat condition and potential mortality. Pollution and sedimentation also have the potential to cause habitat fragmentation for migratory species by deterring species from an area due to poor water quality or heavy sediment loading. Depending on the magnitude, pollution could result in medium-term effects.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
	4-1, 4-2, 4-4, 4-5, 4-6, 4-7, 4-8 and 4-9 6-2 and 6-3				
	Impacts could occur within the following Working Areas: All Working Areas in Flood Cells 1 2-2, 3-1, 4-1, 4-2, 4-4, 4-5, 4-6, 4-7, and 4-9 5-2 and 5-3 6-2 and 6-3	Impact: Changes in hydrology and fragmentation. Effect: Altered erosion, deposition and sediment re-suspension affecting distribution of fish habitats. No spawning habitats are anticipated to be affected. In-water works may cause habitat fragmentation due to changes in hydrology and physical blockage of habitat. Depending on the timing of the effects of changes in water quality habitat fragmentation could be negative and long-term, if sensitive life stages are affected.	**Moderate (significant)**	E16 E17	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
	Impacts could occur within the following Working Areas: All Working Areas in Flood Cells 1, 2 and 5 3-1, 3-2, 3-3 and 3-5 4-1, 4-2, 4-4, 4-5, 4-6, 4-7, 4-8 and 4-9 6-2	Impact: Noise and vibration. Effect: Physical injury to fish in close proximity to source of noise and vibration. Disturbance and deterrence of fish from areas around noise and vibration source. Depending on the duration of this impact it could result in long-term effects.	**Moderate (significant)**	E4 E17	No significant residual effects predicted.
		Impact: Construction lighting Effect: Habitat fragmentation due to reluctance to pass lit sections. If habitat fragmentation occurs during the migratory period, this could result in long-term effects.	**Moderate (significant)**	E3	No significant residual effects predicted.
GCN Regional	Impacts could occur within the following Working Areas: 1-1, 4-1	Impact: Temporary loss of shelters and commuting/ foraging habitat. Effect: Fragmentation and displacement through temporary loss of shelters and commuting/ foraging habitat. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E15 E21	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
		Impact: Construction related activities including vehicle movement. Effect: Direct mortality of individuals moving across site from collisions or entrapment in uncovered holes, pipes or machinery. Permanent negative effect on an individual level but is unlikely to occur in sufficient numbers to affect the wider population and would therefore be medium-term and negative.	**Moderate (significant)**	E1 E7 E8	No significant residual effects predicted.
		Impact: Noise, vibration and light spill. Effect: Disturbance of an EPS, leading to its avoidance of key habitats and fragmentation through temporary loss of habitat. This effect would be medium-term and negative.	**Moderate (significant)**	E3 E5 E10	No significant residual effects predicted.
		Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Pollution of watercourses resulting in reduced prey availability and a decline in foraging habitat quality. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.
Otter Regional	Confidential	Impact: Temporary loss of habitat Effect: Fragmentation through temporary loss of habitat. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E1 E5 E11 E12 E15 E21	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
		Impact: Noise, vibration and light spill. Effect: Disturbance of an EPS, leading to its avoidance of key habitats; but not at a level that will cause declines in population as the species is widespread in the area. This effect would be medium-term and negative.	**Moderate (significant)**	E3 E5 E11	No significant residual effects predicted.
		Impact: Run-off and release of sediment, including chemical and hydrocarbon loads. Effect: Pollution of watercourses resulting in reduced prey availability and a decline in foraging habitat quality. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E13 E14	No significant residual effects predicted.
Non-breeding birds (not including qualifying species of the Firth of Forth SPA, Ramsar and SSSI) Regional	Impacts could occur at the following Working Areas: 3-1, 3-2, 3-3 4-9, 6-1 and 6-2	Impact: Temporary loss of habitat. Effect: Localised fragmentation and displacement of individuals. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E15 E21	No significant residual effects predicted
		Impact: Noise, vibration and light spill. Effect: Disturbance leading to displacement of birds from areas used for foraging, loafing and overnight roosting. This may result in additional energy expenditure and loss of conditioning. This effect would be medium-term and negative.	**Moderate (significant)**	E3 E4	No significant residual effects predicted
		Impact: Runoff from construction works from accidental spillage Effect: Pollution of habitat resulting in deterioration of habitat and ultimately direct mortality of species. This effect would be medium-term, reversible and negative.	**Moderate (significant)**	E13 E14	No significant residual effects predicted
Operational Phase					
Broadleaved and mixed	Permanent habitat loss could occur in all Flood Cells.	Impact: Permanent loss of 1.73 ha habitat.	**Major (significant)**	E21	**During the re-growth phase, a significant negative residual effect is predicted.**

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
woodland (non -AWI) Regional		Effect: Reduction in extent and distribution of this habitat and its availability for species that rely on it for food, shelter and breeding. This effect would be permanent and negative.			However, this effect would be temporary in nature and a mix of tree ages will be planted to expedite the available woodland habitat. Once the woodland is established, no significant residual effects are predicted.
Wetland Regional	Impacts could occur in within the following Working Areas: 2-1, 3-4, 4-1, 4-3, 4-4, 5-1 6-1, 6-3 and 6-4	Impact: Permanent loss of 0.91 ha habitat. Effect: Reduction in extent and distribution of this habitat and its availability for species and species that rely on it for food, shelter and breeding. This effect would be permanent and negative.	**Moderate (significant)**	E21	No significant residual effects predicted.
		Impact: Changes in water levels associated with soil compaction and/or changes in water flows. Effect: Changes in water levels and/or changes in water flows could lead to physical alteration and reduced quality of habitats and permanent habitat loss. This effect would be long term and negative.	**Moderate (significant)**	E21	No significant residual effects predicted.
Bats Regional	Buildings and structures at the following Working Areas: 1-2, 1-4, 2-1, 2-2, 3-1, 4-2, 4-4, 4-5, 4-9	Impact: Permanent loss of habitat. Nine buildings, four structures and 70 trees which could hold bat roosts are predicted to be demolished, felled or modified. The following habitats suitable for foraging and commuting will be lost: woodland, wetland, scrub and hedgerows. Effect: Loss of roosting/foraging/commuting habitat could result in use of less suitable alternatives or increased distance travelled to suitable sites, leading to a reduction in breeding success. This effect would be permanent and negative.	**Moderate (significant)**	E23	No significant residual effects predicted.

Ecological Feature and Importance	Location of Impact	Impact and Effect	Characterisation of Impact (pre-mitigation) & Significance	Mitigation Item	Summary of Residual Effect & Significance (post-mitigation)
	Trees in the following Working Areas: 1-1, 1-2, 4-4, 4-5, 5-1, 6-4 Permanent loss of suitable habitats across the Scheme.				
GCN Regional	Permanent loss of terrestrial habitat (grassland, woodland and scrub) throughout the Scheme.	Impact: Permanent habitat loss Effect: Loss of habitat for shelter, foraging and commuting leading to fragmentation or habitat displacement of individuals, which could adversely impact the GCN meta-population. This effect would be permanent and negative.	**Moderate (significant)**	E21	No significant residual effects predicted.
Otter Regional	Confidential	Impact: Permanent habitat loss Effect: Destruction of two otter couches. Loss of habitat for shelter, foraging and commuting. This effect would be permanent and negative.	**Moderate (significant)**	E21 E22 E24	No significant residual effects predicted.

7.10.2 Interaction with other Environmental Disciplines

Indirect (secondary) effects may arise as a result of inter-linked impacts of the Scheme on the biodiversity considered in this EcIA. The effects of the Scheme on these are closely linked to, and in some instances interdependent on, some of those described in Chapter 8: Noise and Vibration, Chapter 9: Landscape and Visual Impact Assessment, Chapter 10: Water Environment and Chapter 11: Soils, Geology and Land Contamination.

Construction mitigation detailed in Chapter 10: Water Environment to mitigate effects on fluvial geomorphology and surface water features provide protection to aquatic biodiversity features through protection of their habitats. Secondary mitigation items W27-W31, described in Chapter 10: Water Environment, will benefit the aquatic biodiversity features in Grange Burn. Re-naturalising or softening the existing modifications to this channel will provide a greater diversity of habitats for fish, aquatic invertebrates and macrophytes.

7.10.3 Cumulative Effects

It is not anticipated that there will be any significant cumulative effects as a result of the Scheme with Other Projects on biodiversity (see section 7.5.4).

7.11 Statement of Significance

Residual effects are predicted on some ecological features during construction and operation of the Scheme.

During construction, a significant adverse residual effect is predicted on the qualifying features of the Firth of Forth SPA and Ramsar site due to disturbance, which could lead to roosting bird displacement at two key areas within the sites. Compensatory roosting habitat, which is at least functionally equivalent to that which is potentially lost, will be provided to maintain the integrity of the European site network.

During construction and operation, an adverse residual effect is predicted for the loss of other broadleaved and mixed woodland during the re-growth phase of replacement planting. However, this impact will be temporary in nature and a mix of tree/ shrub ages will be planted to expedite the available habitat. Once the woodland is established, no significant residual effects are predicted.

No residual effects are predicted for all other ecological features.

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