



# Fire Prevention Method Statement

Grangemouth Renewable Energy Plant

## Fire Prevention Method Statement for Storage and Handling of Biomass Fuel

The storage and handling of biomass fuel can present significant risks if not managed appropriately. The risk of fire will be mitigated by:

1. appropriate design and layout of equipment;
2. the mode of equipment operation; and
3. adherence to safety, health and environmental site procedures.

To minimise the risk of fire, an appropriate balance will be struck between these factors. Practicable mitigants will be agreed with SEPA at the PPC Permit application stage. During the construction phase, designs will be reviewed and discussed with the Insurers and the Fire Service. The Insurers will inspect the plant prior to commissioning and approve the measures adopted.

Table 1 outlines the measures proposed to manage the risk of a fire occurring in biomass storage and handling equipment areas of the plant.

### References

FM Global Property Loss Prevention Data Sheet 8-27: Storage of Wood Chips (May 2000).

Table 1: Fire Prevention Method Statement for Storage and Handling of Biomass Fuel

Type of Fire	Cause of Fire / Risk Factor	Risk Explained	Prevention Method
Surface Fire	External Sources	Site operations	The Safety, Health & Environment Management System (which will discharge all requirements of health and safety legislation including fire safety) will ensure that all fire risks are appropriately managed. In particular, operational procedures will ensure that external sources of ignition do not come into contact with the biomass stockpiles.
		Site equipment	Equipment design and layout will meet appropriate fire safety standards and will ensure external sources of ignition do not come into contact with the biomass stocks.
		Dry surface of stockpile	Virgin woodchip typically contains 40-60% weight of water. The surfaces of open stockpiles are unlikely to become dry enough to be ignited. The design and operation of the biomass systems will be based on a 'first-in-first-out' principle. This will ensure that ignition risk is mitigated through regular stock rotation. Wood pellets stored within silos – no external source of ignition.
		Arson	Port security will ensure no unauthorised access to the site.
		Furnace front	Furnace and biomass feed system design to minimise risk of burn-back and allow rapid fail-safe fuel cut-off.
Internal Heating of Pile Caused by microbial action	Storage duration (time)	Large piles of biomass can heat up over time due to exothermic microbial reactions. Stockpile can reach critical temperatures of over 70°C increasing the likelihood of ignition.	<p>The length of time biomass is stored in a stockpile is managed by frequent rotation of stock so that the ignition risk of any exothermic microbial reaction on localised biomass within the stockpile is mitigated.</p> <p>Total woodchip storage capacity will be 9 days worth of biomass when the renewable energy plant is operating at full load. A full shipload would deliver sufficient biomass fuel for 3 days full-load operation. Normal stock levels would float between 4 and 7 days storage. An additional 2 days storage is provided to accommodate ship deliveries during plant downtime or reduced load operation. Biomass stocks would be reduced to normal levels within a few days of operation resuming. Storage space will allow operators to manage stockpile rotation and temperatures.</p> <p>Biomass storage and handling equipment is designed and operated on the principle of 'first-in, first-out'.</p> <p>Design will ensure that static piles of biomass are eliminated. Potentially these might occur at edges of storage piles where reclaim equipment does not reach or spillages of biomass at areas such as conveyor transfer points.</p> <p>H&amp;S procedures include housekeeping to ensure biomass spillages are not allowed to build up over time.</p> <p>Monitoring techniques used to alert operators to increased stockpile temperature. Techniques, to be agreed with Fire Authorities and Insurers, might typically include CO2 monitoring and temperature measurement.</p> <p>Biomass stock levels reduced prior to planned plant outages to limit duration and amount of material stored for extended periods.</p> <p>Stockpile temperature monitored during extended unplanned plant outages – fuel stock rotated to allow air cooling where required.</p>
	Biomass moisture content	High moisture content can accelerate biological reaction and increase risk of high stockpile temperature	<p>Fuel procured to agreed specification and quality standard.</p> <p>Fuel quality managed at dispatch point and maintained during transport to site.</p> <p>Biomass moisture tested upon receipt. High moisture fuel managed under agreed site procedures to manage risk.</p>
	Presence of decayed material	Decayed or decaying material more likely to accelerate biological reaction and increase risk of high stockpile temperature	Decayed biomass fuels will not be acceptable under terms specified within the biomass supply contracts/arrangements. Fuels will be inspected on delivery and if the fuel is not within acceptable ranges it will either be rejected or dealt with separately. As described above, the fuel will be rotated to avoid material decay unacceptably on site.

	Low surface area to volume ratio	Lack of surface air cooling and larger volume of fuel can result in higher temperatures and faster temperature rise	An open circular biomass stockpile storage system with automated fuel reclaim design will be used for imported virgin woodchips. The fuel storage body will be open to air on all sides except the base and therefore air-cooled. The fuel feed and storage design delivers a high surface area to volume ratio for the stored fuel. Silo storage is being considered for wood pellet fuel. Silos are likely to have a relatively lower surface area to volume ratio compared to the open stockpile. Wood pellets have a significantly lower moisture content compared to virgin wood chip (approximately <10% vs. 45% w/w respectively). The lower moisture content reduces the risk of microbial related heat build-up. The risk represented by the comparatively lower surface area to volume ratio attained with silo storage can therefore be mitigated by the selection of low moisture content wood pellets.
Sources of Ignition	Gas oil and lubricating oil/greases used in plant and machinery		Oil storage vessels design and operation in accordance with oil storage regulations and good H&S practice. Industry best practice and design used to ensure high level of safety and fire prevention in high risk plant areas such as furnace front, turbine hall, Furnace and biomass feed system design to minimise risk of burn-back and allow rapid fail-safe fuel cut-off.
Spreading of fire	Biomass transfer conveyors	Fire could be spread by biomass transfer conveyor	Fire safety procedures would require biomass transfer conveyors to be stopped in event of fire in the boiler house or fuel handling areas.

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## Chapter 10

Landscape and Visual

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## 10 Landscape and Visual

### 10.1 Summary

- 10.1.1 Landscape Impacts have been considered against a baseline study which looked at the receiving landscape in terms of existing landscape designations, existing landscape character assessments, settlement and an urban analysis of areas which currently fall outside Scottish Natural Heritage (SNH) character areas. Nineteen visual receptors have been chosen to represent views and visual amenity within the study area from a variety of different locations and distances from the application site.
- 10.1.2 Cumulative impacts have been assessed for proposed projects within a 30km study area where the potential of significant additional landscape and visual impacts when combined with the proposed Renewable Energy Plant may occur. The projects considered include the proposed Forth Energy Renewable Energy Plants at Rosyth and Leith and the proposed Longannet Biomass Power Plant.
- 10.1.3 No significant landscape impacts were identified for the application site, Grangemouth or the wider landscape considered within the study area.
- 10.1.4 The Grangemouth Renewable Energy Plant will create visual impacts throughout the study area but these are generally not significant, with four of the nineteen views potentially experiencing significant visual impacts. The majority of these significant impacts are restricted to within 2km of the site with only views from Kincardine at 4km being at a greater distance.
- 10.1.5 No significant cumulative landscape or visual impacts have been identified.
- 10.1.6 Although visible sometimes from a considerable distance, the proposed Renewable Energy Plant is always seen in the context of a landscape which is often dominated but always characterised by the presence of existing large scale industrial structures and complexes.
- 10.1.7 For a large and complex industrial structure the proposed Renewable Energy Plant will affect a relatively small number of visual receptors and areas of visual amenity. Generally, although not contained within the landscape, the proposed plant will be entirely in keeping with the established landscape and visual characteristics of the Forth estuary corridor.
- 10.1.8 Landscape mitigation for the project was not considered due to the scale of the proposals and the industrial nature of the application site. The proposals have been assessed on the basis of a basic engineering form and it is this which has been used to generate the visual wireframes and photomontages within the Environmental Statement (ES). An architectural strategy has been considered as a secondary phase of mitigation which has been developed during the ES and will be completed following the grant of consent for the proposed development. This architectural strategy has been developed by Gordon Murray Architects and forms part of a Design Statement which accompanies the ES and Section 36 Application. The potential outcomes following the application of this architectural strategy to the assessed basic engineering form are discussed for both the landscape and visual impacts identified.



## 10.2 Introduction

10.2.1 The proposal seeks to locate a Renewable Energy Plant at a site within the Port of Grangemouth. Section 10.7 of this Chapter describes the predicted significant environmental effects of this proposal on the townscape character of Grangemouth and the landscape character of the wider landscapes to the north and south of the Forth Estuary. Although this report concerns itself specifically with landscape and townscape effects, the scale of the proposal and the distances considered, require that views and visual amenity play a part in the understanding and descriptions of townscape and landscape types. Visual amenity is considered separately in Sections 10.9 to 10.11. It is generally acknowledged that the potential exists for a change in the visual amenity of the site to have an influence over the character and key characteristics of townscape and landscape character.

## 10.3 Key Consultations

10.3.1 A summary of the responses relating to Landscape and Visual Impact Assessment (LVIA) issues is provided in Appendix B.

## 10.4 Assessment Methodology and Significance Criteria

### General Approach

10.4.1 The appraisal has been based on guidelines and information provided in the following publications:

- Landscape Character Assessment: Guidance for England and Scotland (The Countryside Agency and Scottish Natural Heritage 2002);
- Guidelines for Landscape and Visual Impact Assessment 2nd edition 2002;
- Landscape Institute Advice Note 01/2009: Use of photography and photomontage in landscape and visual assessment;
- Commission for Architecture and the Built Environment (CABE) and English Heritage Guidance on Tall Buildings July 2007;
- The Falkirk Structure Plan 2007;
- The Grangemouth Local Plan 2nd edition February 1989;
- The Falkirk Council Local Plan Finalised Draft (Deposit Version) April 2007 as modified;
- Fife and West Dunfermline Local Plan;
- Scottish National Heritage – Landscape Character Assessments;
- Stirling to Grangemouth Landscape Character Assessment -David Tyldesley and Associates 1999;
- The Lothians Landscape Character Assessment –ASH Consulting Group 1998; and
- Central Region Landscape Character Assessment –ASH Consulting Group 1999.

10.4.2 The assessment has also drawn on information provided from consultations with Falkirk Council and Scottish National Heritage.

10.4.3 The general approach to the LVIA includes the following key tasks:

- Confirmation of scope and methodology;
- Desk top study and preliminary site survey;
- Baseline assessment of landscape and visual resources;
- Layout and design optimisation; and

- Assessment of residual landscape and visual effects.

### Confirmation of Scope of Methodology

- 10.4.4 The scope and nature of the methodology and the structure and content of the LVIA have been commented on through the scoping responses from Scottish Natural Heritage. Where possible these comments and recommendations have been incorporated within this report.

### Desk based data review

- 10.4.5 Existing mapping, aerial photography, legislation, policy documents and other written graphic or digital data relating to the proposal and broader study area were reviewed. The desk top study defined the baseline landscape and visual resources within a 10 km radius study area and established the main users of the area, key viewpoints and key features. The 10km study area was expanded to 30km following consultation with SNH and an expanded Zone of Theoretical Visibility (ZTV) and additional viewpoints resulted from the consideration of this larger area. Both landscape and visual receptors at the periphery of the 10 and 30km study areas have been tested and no significant impacts have been returned. The LVIA examines landscape and visual effects for receptors within the 10km detailed study area and considers selected landscape elements, designations and viewpoints from the expanded 30km study area in order to demonstrate the reduction of impacts at distances beyond 10km.

- 10.4.6 The potential extent of visibility of the proposed development was identified by reference to a preliminary Zone of Theoretical Visibility (ZTV) map (Figure 10.1). The ZTV is a digital model and it assumes a worst case scenario which is based on a bare island surface and takes no account of vegetation, local variations in topography or the presence of walls or buildings, which can substantially reduce visibility from that predicted by the ZTV (see also Landform and Topography Figure 10.4). The visibility of the proposal has been separated into two bands, one for a 65 m high boiler hall and main stack at 110 m and the second for the 110 m stack alone. From this a distinction between the visibility of the tallest elements of the proposal can be determined. Where the ZTV indicates that there is no view, this may be considered accurate. The viewpoints assessed are as follows:

- View1 A904 Asda Car Park, Grangemouth;
- View2 Grangeburn Road, Grangemouth;
- View 3 Skinflats Nature Reserve;
- View 4 Bothkennar Road, Carronshore;
- View 5 Bo'ness Harbour ;
- View 6 Antonine Wall;
- View 7 Cockleroy;
- View 8 Callendar Park, Falkirk ;
- View 9 Falkirk Wheel;
- View 10 M876/A905;
- View 11Kincardine Bridge;
- View 12 Culross;
- View 13 New Row;
- View 14 Alloa;
- View 15 Union Canal Polmont;

- View 16 A706 (within AGLV);
- View 17 Kilsyth Hills AGLV;
- View 18 Stirling Castle; and
- View 19 Wallace Monument.

### On Site Survey

- 10.4.7 Field survey work was carried out to verify and refine the landscape character types identified within the study area and to gain a full appreciation of the relationship between the proposed development and the landscape.
- 10.4.8 The field survey also enabled the validity of the list of proposed viewpoints to be verified. This involved checking the nature of the receptor identified from the ZTV study and the actual nature of the view and visibility to ensure that both remained relevant and a true representation of the location, receptor type or character type originally selected.

### Existing Landscape and Visual Resource Review

- 10.4.9 This stage of the landscape assessment follows the desk top and field work and involves the review of existing landscape and visual characteristics within the study area. The Baseline Landscape Character Areas are identified in Figure 10.2 and 10.3 and include both published landscape character types and units as identified within SNH publications and locally designated areas or sub areas identified for the purposes of this assessment through the desk top study and field work. This process of assessment has three elements:
- Description – a systematic review of existing information and policy relating to the existing landscape and visual resource, through desk based review and site survey;
  - Classification – analysis of the data to subdivide the landscape resource into discrete areas of similar and identifiable character; and
  - Evaluation – use of professional judgement to apply a sensitivity to the landscape with reference to a specified set of criteria.

### Photography, Wireframes, Photomontages

- 10.4.10 All photography was carried out with a Canon EOS5D digital SLR camera with a 50 mm lens. This is a full frame Digital SLR camera, where the digital sensor is the same size as a 35 mm film frame and as such produces the same frame output as a traditional SLR camera. Therefore this camera fully accords with the Landscape Institute's recommendations<sup>1</sup> on the use of cameras for photomontage generation.
- 10.4.11 Photographs were taken on a Manfrotto Tripod with a Manfrotto panoramic tripod head and leveller, giving a precise horizontal/vertical orientation of the camera. The tripod position was accurately determined using a Garmin Etrex Summit handheld GPS. These positions were verified using more detailed OS Mastermap mapping data. Photographs were taken with approximately 50% overlap between frames to produce curved panoramic shots. The resultant frames were spliced together in Adobe PhotoSHOP.
- 10.4.12 The photographs, photomontages and wireframes shown for each viewpoint illustrate a 90 degree curved panoramic view. This angle of view is important as it allows the development to be seen in the context of the surrounding landscape, including familiar features and components of the setting. When reproduced for printing, the photographs and photomontages should be viewed from a distance of around 25 cm in order to gain an accurate impression of the real effect on the views.

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<sup>1</sup> Landscape Institute Advice Note 01/2009: Use of photography and photomontage in landscape and visual assessment.

- 10.4.13 A combination of 3D modelling software was used to produce both wireframes and the photomontages, using terrain data purchased from Ordnance Survey and proposed development layouts. A 3D model was created of the proposed Renewable Energy Plant and inserted into a 3D model of the study area, using target reference points in the model and photograph. The photomontages were completed in Adobe PhotoSHOP.
- 10.4.14 The predicted views from each of the 19 viewpoint locations selected are illustrated using viewpoint photographs, wireframes and photomontages. The 3D modelling and photomontages are accurate in terms of the positioning, spatial distribution and size of the proposed Renewable Energy Plant features, as shown in the indicative layouts in Figure 6.1 and 6.2. They are produced using an OS digital terrain model of the landscape in the view, combined with a computer model of the plant. Photomontages are then prepared by rendering a model view and combining with the photograph of the existing view.
- 10.4.15 Further information regarding the photography and software used for the preparation of the photomontages and also the ZTVs is presented in Appendix F.1.
- 10.4.16 Photomontages attempt to simulate realism in the predicted view of the proposed Renewable Energy Plant and, to provide an indication of the scale and extent of the proposed development. The photomontages and wireframes are not intended to illustrate the actual appearance of the development but are produced to aid the assessment process.
- 10.4.17 The resultant wireframes and photomontages are visualisations, which simulate the appearance of the Renewable Energy Plant from a particular location. The wireframes provide objective data, whilst the photomontages present an illustration of visual impacts that incorporates a degree of artistic impression.
- 10.4.18 The photographs and other graphic material such as photomontages used in this assessment are for illustrative purposes only and, whilst useful tools in the assessment, are not intended to be completely representative of what will be apparent to the human eye. The assessment is carried out on site rather than from photographs.

#### **Assessment of Landscape and Visual Effects**

- 10.4.19 The impact assessment identifies significant landscape, visual and cumulative impacts of the development through:
- assessing the baseline conditions;
  - identifying potential impacts;
  - identifying and taking account of proposed mitigation measures; and
  - predicting the magnitude and significance of effects in a logical and well reasoned fashion.
- 10.4.20 The assessment describes the changes in the character of the landscape and visual resources that are expected to result from the development. It covers both landscape impacts (changes in the fabric, character and key defining characteristics of the landscape); and visual impacts (changes in available views of the landscape and the significance of those changes on people).
- 10.4.21 In considering the visual amenity of the study area, a number of receptors have been chosen to represent both the variety and scope of the study area and also to examine particular views and/or receptors which are of particular note or importance. These viewpoints have been selected through studying the ZTV, site visits and a consideration of the planning, cultural and historical background of the study area. In addition where Landscape Character Areas have been identified as having visual amenity as a key element, a view or views have been selected to represent this.

#### **Assessment of Cumulative Effects**

- 10.4.22 The scoping study and further study work has identified three other projects which might lead to cumulative effects being experienced, these are listed below:

- Forth Energy Wind Turbines Project;
- Ineos Biodiesel Project; and
- Longannet Biomass Power Plant Project.

10.4.23 In addition the study will consider the potential cumulative impacts from the three Renewable Energy Plants proposed along the Forth Estuary at Grangemouth, Rosyth and Leith.

10.4.24 The assessment considers impacts on the landscape and visual amenity with these developments in place and assesses to what extent the proposed Renewable Energy Plant will create further new impacts cumulatively alongside these.

#### Assessment Criteria – Receptor Sensitivity and Magnitude of Change

10.4.25 The aim of the environmental impact assessment is to identify and evaluate potential significant environmental effects arising from the proposed development. For clarity the criteria used to determine the sensitivity of the landscape and visual receptors and the magnitude of change and the assessment of significance of the residual landscape and visual effects have been defined in the following two sections.

#### Landscape Receptors

10.4.26 To determine the effects of development on the landscape three different key aspects or receptors are considered, these are:

- **Elements:** Individual elements within the landscape, which are quantifiable and include features such as hills, valleys, woods, trees, hedges and ponds;
- **Characteristics:** Elements or combinations of elements that make a particular contribution to the character of the area i.e. scenic quality, tranquillity or wildness;
- **Character:** A combination of geology, landform, soils, vegetation, land use and human settlement.

10.4.27 These features combine to give an indication of the sensitivity of the landscape and its ability to accept change. In addition the landscape condition, value and quality are considered and weighed as part of this judgement.

10.4.28 To assist in the assessment of the sensitivity of the landscape resource each landscape encountered is considered against the criteria set out in Tables 10.1, 10.2 and 10.3. The determination of the sensitivity of the landscape resource to changes associated with the proposal is defined as High, Medium or Low.

10.4.29 Table 10.1 identifies the principal factors considered when assessing the sensitivity of the landscape in relation to the proposed development. Table 10.2 and 10.3 identify these factors considered when assessing landscape value and quality. Landscape condition is a more factual description with less reliance on a subjective professional judgement. This is completed through a straight forward comparative description and reference to the site and its surrounds.

10.4.30 Table 10. 4 identifies a separate set of criteria developed specifically to consider Urban Form and Townscapes which include a different set of elements and characteristics to that encountered within the wider landscape.

Table 10.1: Landscape Sensitivity

	High	Medium	Low
<b>Landscape</b>			
<b>Landscape designation</b>	A landscape of distinctive character susceptible to relatively small changes. Includes national or regionally designated landscapes e.g. Area of Great Landscape Value (AGLV), National Scenic Area. Historic Gardens and Designed	A landscape of moderately valued characteristics. Including local landscape designations.	A landscape of relative unimportance, the nature of which is tolerant to substantial change. No landscape designation.

	High	Medium	Low
<b>Landscape</b>			
	Landscapes on the National Register		
<b>Landscape resource</b>	Important landscape resources or landscapes of particularly distinctive character and therefore likely to be subject to national designation or otherwise with high values to the public. Is vulnerable to minor changes.	Moderately valued characteristics reasonably tolerant of change.	Relatively unimportant/ immature or damaged landscapes tolerant of substantial change.
<b>Scale and enclosure</b>	Small intimate landscape.	Medium scale landscape.	Large scale open landscape.
<b>Landform and topography</b>	Mountainous or large dominating hills and valleys. Intimate small scale landscapes defined through easily identifiable elements in the immediate landscape.	Rolling landform with small hills and valleys. Some intimacy and human scale through landscape elements such as hedgerows and woodland copses.	Large scale open landscape. Little intimacy or human scale, few character elements or features.
<b>Settlement</b>	Organic land cover pattern	↔ A gradation between High and Low	Grid like linear land cover pattern
<b>Landmarks and visible built structures</b>	Landscape with symbolic or important features	↔	Landscape with no recognised individual features or elements
<b>Remoteness and tranquillity</b>	Remote location, little evidence of human activity	↔	Highly developed countryside areas with continuous evidence of human activity
<b>Landscape Quality and Value</b>	A landscape of exceptional or high quality and/or high value.	A landscape of good or ordinary quality and /or good or moderate value.	A landscape of low or poor quality and value

Table 10.2: Landscape Quality

Landscape Quality	Definition	Typical Example of Importance
<b>Exceptional</b>	<ul style="list-style-type: none"> <li>Strong landscape structure, characteristics, patterns, and/or clear urban grain identifiable with a historic period or event;</li> <li>Appropriate management for land use and land cover and/or a well maintained urban environment of distinction;</li> <li>Distinct features worthy of conservation, historic architectural grain;</li> <li>Sense of place exceptional local distinctiveness;</li> <li>No detracting features.</li> </ul>	Internationally or nationally recognised. World Heritage Sites, National Parks, National Scenic Area, Special Landscape Area;
<b>High</b>	<ul style="list-style-type: none"> <li>Strong landscape structure, characteristic patterns and/or clear urban grain;</li> <li>Appropriate management for land use and land cover, but potentially scope to improve;</li> <li>Distinct features worthy conservation;</li> <li>Sense of place;</li> <li>Occasional detracting features.</li> </ul>	Nationally, regionally recognised e.g. parts of National Scenic Area, Conservation Area or Listed status. Registered Historic Gardens and Designed Landscapes
<b>Good</b>	<ul style="list-style-type: none"> <li>Recognisable landscape structure and/or urban grain</li> <li>Scope to improve management for land use and land cover;</li> <li>Some features worthy of conservation;</li> <li>Sense of place;</li> </ul>	Regionally recognised e.g. localised areas within National Park, National Scenic Area, AGLV.

Landscape Quality	Definition	Typical Example of Importance
<b>Ordinary</b>	<ul style="list-style-type: none"> <li>Some detracting features.</li> <li>Distinguishable landscape structure, characteristics, patterns of landform and landcover often masked by land use;</li> <li>Fractured urban grain with patterns of use difficult to distinguish;</li> <li>Scope to improve management of vegetation;</li> <li>Some features worthy of conservation;</li> <li>Some detracting features.</li> </ul>	Locally recognised landscape without specific designation.
<b>Poor</b>	<ul style="list-style-type: none"> <li>Weak landscape structure, characteristic patterns of landform and landcover are missing, little or no recognisable urban grain;</li> <li>Mixed land use evident;</li> <li>Lack of management and intervention has resulted in degradation;</li> <li>Frequent detracting features.</li> </ul>	A landscape without note or one singled out as being degraded or requiring improvement.
<b>Very Poor</b>	<ul style="list-style-type: none"> <li>Degraded landscape structure, characteristic patterns and/or urban grain missing;</li> <li>Mixed land use or dereliction dominates;</li> <li>Lack of management/ intervention has resulted in degradation;</li> <li>Extensive detracting features.</li> </ul>	A Landscape likely to be singled out as needing intervention or regeneration.

Table 10.3: Landscape Value

Landscape Value	Definition	Typical Example of Importance
<b>High</b>	<ul style="list-style-type: none"> <li>An iconic landscape or element(s) held in high regard both nationally, regionally and by the local community;</li> <li>A landscape or element(s) widely used by both the local community and a broader visiting community;</li> <li>Features of particular historical protected significance ;</li> <li>Landscape or space which defines or is closely associated with a community and its life and livelihood.</li> </ul>	Nationally, regionally recognised e.g. parts of National Park, National Scenic Area, Special Landscape Area; Conservation or Listed status Registered Historic Garden and Designed Landscape
<b>Good</b>	<ul style="list-style-type: none"> <li>A landscape or element(s) recognised regionally and locally as important ;</li> <li>A landscape widely used by the local community;</li> <li>Features or elements widely used or visited and held in association with the area or community.</li> </ul>	Part of an AGLV
<b>Moderate</b>	<ul style="list-style-type: none"> <li>A landscape of local importance ;</li> <li>A landscape widely used by the local community;</li> <li>A sense of place recognisable and associated with the local area.</li> </ul>	Area of local landscape importance
<b>Low</b>	<ul style="list-style-type: none"> <li>A landscape without particular noted significance;</li> <li>A landscape or elements infrequently used by the local community;</li> <li>A landscape which is not distinct and does not add to the overall context of the area.</li> </ul>	

Table 10.4: Townscape sensitivity

	High	Medium	Low
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	High	Medium	Low
<b>Townscape</b>			
<b>Urban Form</b>	A clearly defined urban grain and form with cultural and/or historical significance.	A recognisable pattern of streets and buildings leading to an urban form of moderate character.	A loose or poorly defined urban form with little recognisable pattern or character.
<b>Activity</b>	Very busy and heavily trafficked networks typical of a city or large town centre. Activity associated around cultural or religious festivities.	Streets and networks well used and directly associated with key routeways through the town or city.	Low level activity relative to urban centre surveyed. Streets and networks off the main routes with no special associations or considerations.
<b>Cultural Heritage</b>	A townscape with heritage and/or cultural elements of national or international importance such as World Heritage Site	A townscape with heritage and/or cultural elements of local importance such as Conservation area, Listed structures	A townscape with few or no cultural or heritage elements.
<b>Built Environment</b>	A townscape with an easily recognisable built form created through notable architecture, landform or skyline.	A townscape with a built environment where particular architectural or landscape styles are evident in places.	A townscape with little or no architecture or landscape features of note.
<b>Open Space</b>	Parks or gardens offering amenity to large numbers of people within the townscape. Parks or gardens of international or national importance	Parks, gardens or streets offering amenity spaces.	A townscape with little or no open space or where the open space available is poorly maintained or inaccessible.
<b>Connectivity</b>	A well connected series of spaces and streets within a clear urban form	Urban form where most areas are connected well through streets and spaces but some sections of the town or city remain isolated and poorly connected	Urban form where features such as rail, road and physical barriers lead to a poorly connected series of spaces.
<b>Visual Amenity</b>	Clear views along well defined vistas with cultural links and associations. Views which define or are a key characteristic of an area. Views which deliberately end on a focused point or which include elements of noted importance. Protected views within Supplementary Planning Guidance or equivalent.	Strong visual associations with particular views, vistas or features which may occur periodically through the townscape. Wide panoramic views.	Narrow or restricted visual envelope with few strong visual associations or focal points.
<b>Townscape Quality and Value</b>	A Townscape of exceptional or high quality and/or high value.	A townscape of good or ordinary quality and /or good or moderate value.	A townscape of low or poor quality and value

10.4.31 The criteria used to identify the magnitude of landscape change are summarised in Table 10.5.

**Table 10.5: Magnitude of Change**

Magnitude of change	Beneficial	Adverse
<b>Large</b>	Major positive alteration to significant elements or features or the removal of substantial elements or features perceived as a negative or detracting influence. The alteration of a landscape to substantially increase both the landscape value and quality and complement acknowledged aspirations and objectives. A change which is not balanced against other negative introductions or other adverse alterations to the landscape.	Total loss of or major alteration to key valued elements, features and characteristics of the baseline or introduction of elements considered to be prominent and totally uncharacteristic when set within the attributes of the receiving landscape. Would cause a high quality landscape to be permanently changed and its quality diminished.



Magnitude of change	Beneficial	Adverse
<b>Medium</b>	A positive alteration to landscape elements or features which increases both landscape value and quality. The removal of elements or features which are perceived as negative or detracting features. A change which is not balanced against other adverse alterations to the landscape.	Partial loss of or alteration to one or more key elements, features or characteristics of the baseline or introduction of elements that may be prominent but not substantially uncharacteristic when set within the attributes of the receiving landscape. Would be out of scale with the landscape and leave an adverse impact over a landscape of quality.
<b>Small</b>	A change which introduces elements, features or characteristics which are of positive benefit to the landscape character and improve value and quality. The removal of negative elements or detracting features. A change which may result from a combination of both beneficial and adverse changes to the landscape.	Minor loss or alteration to one or more key elements, features, characteristics of the baseline or introduction of elements that may be prominent but may not be uncharacteristic when set within the receiving landscape. May not fit into the scale and landform.
<b>Negligible</b>	A minor change which is not uncharacteristic and maintains the quality and value of the landscape.	A minor change which is not uncharacteristic and maintains the quality and value of the landscape.

### Visual Receptors

10.4.32 The sensitivity of visual receptors depends upon:

- Location of the viewpoint;
- Context of the view;
- Activity of the receptor; and
- Frequency and duration of the view.

10.4.33 A summary of the criteria used to assess the sensitivity of visual receptors is indicated in Table 10.6.

**Table 10.6: Visual Receptor Sensitivity**

Receptor Sensitivity	Description
<b>High</b>	Occupiers of residential properties Users of outdoor recreational facilities, including public rights of way, whose attention may be focused on the landscape Elevated panoramic viewpoints Communities where the development results in changes in the landscape setting or valued views enjoyed by the community
<b>Medium</b>	People engaged in outdoor recreation where enjoyment of the landscape is incidental rather than the main interest People travelling through the landscape where the views involved are transient and sporadic but have a special significance in either the journey or the expression of the landscape or community being visited.
<b>Low</b>	People at their place of work, industrial facilities. People travelling through the landscape in cars, trains or other transport such that the speed and nature of the views involved are short lived and have no special significance

10.4.34 An additional consideration of the sensitivity of a view or views is the quality of the view where a subjective opinion is considered alongside the objective factors (Table 10.7).

**Table 10.7: View Quality**

View Quality	Description
<b>High</b>	Iconic views or skylines which are individual character elements in their own right. Protected views through Supplementary Planning Guidance or development framework. View mentioned in the listing for a conservation area, listed building or scheduled monument as being important with regard to its setting. Wide panoramic distant views of a valued landscape(s).
<b>Moderate</b>	Views with strong and distinctive features. Uninterrupted views. Views over a landscape of recognised character and quality without detracting features
<b>Poor</b>	Restricted views or views over a landscape of low value and quality.

- 10.4.35 The assessment of visual effects describes:
- The changes in the character of the available views resulting from the development; and
  - The changes in the visual amenity of the visual receptor.
- 10.4.36 The assessment process mirrors that of landscape effects in that it requires the collation of baseline information relating to the nature and type of views and the receptors which will receive them. As with landscape effects, visual impacts are determined by considering the magnitude and nature of change as set against the sensitivity of the receptor.
- 10.4.37 The magnitude of change to the view will depend on numerous factors including the extent and nature of the current view, the distance to the proposed development, the time of year and whether other elements intervene in the view such as vegetation or moving traffic. To assist this process the level of change is graded between Very Large and Negligible and is described below:

**Table 10.8: Magnitude of Change**

Magnitude	Examples
<b>Very Large</b>	The development would result in a dramatic change in the existing view and would cause a dramatic change in the quality of the view. The development would dominate the view and create a new focus over the viewer. The observer would experience a complete change in outlook.
<b>Large</b>	The development would result in a prominent change to the existing view and would change the quality of the view. The development would be easily noticed by the observer. The development may break the skyline or form some other substantial change to the view.
<b>Medium</b>	The development would result in a noticeable change in the existing view that may change the character and quality of the view. The change would be readily noticed by the observer but would not dominate the view.
<b>Small</b>	The development would result in a perceptible change in the existing view but this would not affect its character or quality. The development will appear as a small element in the wider landscape which may be missed by the casual observer. The view may be at such a distance as to reduce the appearance of the development.
<b>Negligible</b>	Only a small part of the development will be discernible and this may be for only part of the year or be a filtered view. The view may be at such a distance as to render the change virtually indiscernible without aid or reference. The quality and character of the view will remain unchanged.

### Significance of Effects on Landscape and Visual Receptors

- 10.4.38 The Guidelines for Landscape and Visual Assessment<sup>2</sup> give the following general guidance to establishing the significance of landscape effects, although the final analysis relies on the expert opinion of the analyst:
- *'The loss of mature or diverse landscape elements, or features, is likely to be more significant than the loss of new or uniform/homogenous elements.'*
  - *'Effects on character areas, which are distinctive or representative, may be more important than the loss of areas in poor condition or degraded character which may, however, present greater opportunities for enhancement.'*
  - *'The sensitivity of the landscape is dependent on both the attributes of the receiving environment and the characteristics and effects of the proposed development and can only be established by carrying out the assessment. However, landscapes with a high value and sensitivity to the type of change proposed are likely to be more seriously affected by development than those with lower sensitivity.'* (Section 7.43 of the GVLA)

<sup>2</sup> Guidelines for Landscape and Visual Assessment (2002) second edition published by SPON press 2002

10.4.39 The Guidelines require an assessment of impact for both landscape and visual effects to be the result of the sensitivity of a receptor being considered alongside the magnitude of change anticipated for each receptor, this is summarised as a non-linear process as follows:

- a combination of high or medium impact in combination with a high or medium sensitivity leading to a substantial (Major) or moderate outcome.
- a combination of medium impact in combination with medium sensitivity leading to a moderate or slight (Minor) outcome.
- a combination of low impact in combination with low sensitivity leading to a slight (Minor) or negligible outcome.
- an outcome of negligible score where the impact of the development is considered to be of no significance.

10.4.40 A summary of this non linear process can be expressed in tabular form below:

**Table 10.9: Significance of Effects**

Sensitivity	Magnitude of Change				
		Large	Medium	Small	Negligible
High		Substantial	Moderate-Substantial	Moderate	Slight
Medium		Moderate-Substantial	Moderate	Slight-Moderate	Negligible
Low		Moderate	Slight-Moderate	Slight	Negligible
Negligible		Slight	Negligible	Negligible	None

10.4.41 A final assessment of moderate-substantial or above has been taken as representing a significant impact. This can be expressed as an **adverse** or **beneficial** effect depending on the assessor's view regarding the nature and quality of the existing resource and how this has been changed. In some circumstances the change may be described as a **neutral** change if the expectation of the viewer or the fundamental nature and characteristics of a landscape or view appear unaffected.

#### **Assessment of Cumulative Impacts**

10.4.42 Cumulative impacts are those attributed to the combination of a separate development proposal added to the impacts assessed from the proposed Renewable Energy Plant. The study considers to what extent the addition of the Renewable Energy Plant into a landscape or view already containing another proposed development will further add to the impacts identified.

### **10.5 Baseline Landscape Conditions and Receptors**

#### **Land use and Topography**

10.5.1 The proposed site is centred on OS National Grid Reference 293500, 682500. It is generally level and covers an area of the order of 18.05 hectares (ha) within the operational area of the Port.

10.5.2 The main plant area is bounded by Central Dock Road and the Western Channel to the north; Central Dock Road to the west; a railway line to the south; and industrial works to the east.

10.5.3 The main plant area is currently used for secondary port activities, to support general cargo activities. The Port operates with full marine services and cargo handling activities 24 hours per day, seven days a week. Part of the main plant area is currently occupied by Duncan Adams, a Haulier. The activities associated with this facility will be relocated within the secure Port estate and the site cleared prior to construction commencing. There are small areas of scattered shrubs to the east of this area.

10.5.4 The Carron Dock and Western Channel lie to the north of Central Dock Road. The River Carron runs 100 to 150 m parallel to the docks to the north and the Grange Burn and is located 200 m to the south of the closest site boundary. While the closest shoreline of the Forth Estuary is 100 m to the north of the site (i.e. the

southern bank of the River Carron at this location), the River Carron and the docks join the estuary approximately 2.3 km to the north east.

- 10.5.5 The area surrounding the development site is flat, with the Forth Estuary to the north, the town of Grangemouth to the south, industrial complexes on Earls Road to the west, and the Grangemouth Refinery and petro-chemical complexes to the north and east. To the south, Grangemouth is bordered by the M9 motorway.
- 10.5.6 The site is located in an industrial port, with oil and gas import, export and storage located around the Eastern Channel of the port, container storage and handling along the southern shore of the Grange Dock, and a fish meal plant adjacent to the Western Channel. The warehousing and industrial buildings and plant within the docks are 20 m or more in height. Directly across the Forth Estuary, to the north of the port, is the coal-fired Longannet Power Station, with its 80 m boiler house and stack of 183 m. The general context and character of the port and the character of the estuary at this point is broadly industrial.
- 10.5.7 The topography across the port, town and the industrial areas is very flat and the numerous stacks, cooling towers and structures within this industrial area dominate the skyline throughout. The town itself has no high rise buildings and is only occasionally visible from within this low lying coastal strip.
- 10.5.8 Moving south and west Grangemouth is narrowly divided by the M9 motorway before the urban centres of Polmont, Falkirk and Stenhousemuir spread loosely westward across gradually rising lowland away from the Forth.
- 10.5.9 Outside of the urban centres the landscape becomes more undulating with a ridgeline at the edges of Falkirk running north toward the more distant Touch Hills. Across the Forth Estuary the dominant Ochils run across the view creating a dramatic distant backdrop to views north.
- 10.5.10 Scottish National Heritage has developed character maps for the wider landscape outside of the urban conurbations for both Stirling and Grangemouth and Fife to the north. Further detail is also offered in Central Region Landscape Character Assessment and Lothians Landscape Character Assessment (a study also commissioned by Scottish Natural Heritage). These studies offer a landscape description which outlines key characteristics and give an indication as to the value and quality which should be attributed to the landscape resource.
- 10.5.11 In considering the Landscape and Townscape character for Grangemouth, the assessment has considered all of the landscape character descriptions, national and local designations and other published material regarding the landscape within the 10km detailed study area. This information is considered individually against the criteria set out within the methodology before a statement on the sensitivity of the landscape and its capacity to absorb the proposed development is offered.
- 10.5.12 The remaining landscape character baseline conditions are discussed under the following headings and are shown in Figure 10.7:
- The Application Site;
  - Settlement;
  - Landscape Designations;
  - Grangemouth Port and Town Centre;
  - Regional Landscape Context – Falkirk and the landscape south of the Forth Estuary; and
  - Regional Landscape Context - the landscape north of the Forth Estuary.

**The Application Site.**

- 10.5.13 The development site is located at Carron Dock and Western Channel within the Port of Grangemouth. The site is relatively level with topographical levels around 5m AOD. The 18.05 hectare site can be divided into three zones:
- The easterly zone of the site consists of rank grassland and scrub with some areas of hard standing;
  - The western part of the site is divided by the Central Dock Road. To the northwest of the Central Dock Road, the land is predominantly unused with large areas given over to hard standing, open and disturbed ground. There are two small buildings within this area. To the southeast of Central Dock Road, to the west of an area of general cargo activities and container storage, the site is used for the stockpiling of materials. There is also a small area of scattered scrubland; and
  - An open area to the north east of the main site at East Quay which is currently used for port related activities.
- 10.5.14 The Central Dock Road running through the site is partly bounded on the eastern side by broken hedges, with the western side of the road having a small section of broken hedge running alongside for a short distance. To the south of the site runs the rail spur to the port.
- 10.5.15 From within the site, views north across the Forth Estuary are possible and the Ochils are ever present on the horizon. The port complex appears spread out and disjointed with a generally open feel and low density. Occasional large structures break the horizon such as stacks and cranes but views are possible across the port and dock and the levels allow for this to include boats and other water borne traffic.
- 10.5.16 The town of Grangemouth is visible only from high ground with bunded mounds and scrub planting to the southern boundary preventing views. Where views of the town are possible a low rise, tightly packed collection of roofs and the elevations of buildings on the edge of the town form the foreground with the land gently rising to a low ridgeline in the distance.
- 10.5.17 The application site is largely unused open or semi derelict land set within a busy working port environment. The surrounding landscape and views are dominated by industry and the only users of the site are those people authorised through the port authorities. The quality and condition of the site is poor/low and the sensitivity is assessed as low.

**Settlement**

- 10.5.18 The study area has a number of conurbations within its boundaries with the largest of these being Falkirk, Stenhousemuir and Grangemouth. To the east of Grangemouth, Bo'ness follows the coastline onto the terraces of the Bo'ness coastal hills. South of Bo'ness, the town of Linlithgow surrounds the Linlithgow Loch at the foot of the Bathgate Hills. Polmont sits to the east of Falkirk and appears almost part of the Grangemouth-Falkirk urban settlement with the M9 to the north and narrow sliver of land around Laurieston to the west forming an identifiable break.
- 10.5.19 North west of Grangemouth on the southern shore of the Forth Estuary are the smaller settlements of Airth and Cowie. Stirling and Bannockburn are larger towns at the edge of the 10km study area at the junction of the M9 and M80. Directly west of Falkirk are the settlements of Bonnybridge and Denny, which also fall on the edge or outside of the 10km detailed study area.
- 10.5.20 In between these settlements are smaller hamlets and single farmsteads which dot the countryside at regular intervals.
- 10.5.21 North of the Forth Estuary, the settlement becomes less extensive with towns and villages of a typically smaller and less industrial nature. Immediately across the Forth Estuary from Grangemouth is the small town of

Kincardine where the Kincardine Bridge takes the A876 across the estuary. Further east along the coast the picturesque village of Culross sits directly on the estuary edge within sight of the Longannet power station.

- 10.5.22 North of Kincardine the larger settlement of Alloa and Clackmannan sit on the edge of the 10km detailed study area. The landscape in between these settlements to the north of the Forth Estuary is less regularly populated with farmsteads and the small villages of Blairhall and Comrie.
- 10.5.23 The landscape and townscape character of Grangemouth is most likely to be affected through the introduction of the Renewable Energy Plant due to the close proximity of the town to the site. As a consequence of this, the study will consider the landscape and townscape character of Grangemouth and the Port of Grangemouth as a separate section under landscape impacts.

#### **Falkirk and Stenhousemuir**

- 10.5.24 Falkirk developed during the industrial revolution of the 18th and 19th century as the centre of a large iron and steel industry. More recently this industry has declined and the town has become a retail and administrative centre for the wider Falkirk area. A large proportion of the extended urban settlement of Falkirk and Stenhousemuir has a theoretical visibility of the proposed Renewable Energy Plant. The tight urban grain of pedestrianised and vehicular streets and typical building height of three to four storeys leads to an urban environment which is not connected to the broader landscape and does not have extensive and clear views towards the Forth Estuary or the site. Vistas towards the distant Ochils are possible along some street networks and some views of the Forth Estuary may also be possible.
- 10.5.25 The town has grown through its proximity to the Forth Estuary, the Clyde Canal and the Union Canal but the nearest port to the town is Grangemouth. The M9 corridor runs across flat, agricultural land between the town and the coast line forming a physical barrier which divides the coastal communities of Grangemouth and Bo'ness from the more inland communities on higher or rising ground to the west.
- 10.5.26 The towns of Falkirk and Stenhousemuir are arranged around an organic pattern of streets and networks which are not aligned towards the coast or specific architectural or natural features in the wider landscape. The road network does however naturally gravitate towards the coast line at Grangemouth and the river crossing at Kincardine.
- 10.5.27 The conservation areas of Falkirk Town Centre and Arnohill are located centrally within Falkirk.
- 10.5.28 The sensitivity of Falkirk and Stenhousemuir is assessed as medium across all of the key townscape character elements outlined in Table 10.4.

#### **Bo'ness**

- 10.5.29 Bo'ness has important links to the Roman period marking the eastern extent of the Antonine Wall. The town was a port and harbour through the 17<sup>th</sup> and 18<sup>th</sup> centuries becoming a commercial port as the town became a local centre for coal mining and heavy industry. Bo'ness is now primarily a commuter town with local employment being found at the nearby petro-chemical and industrial complex at Grangemouth.
- 10.5.30 The town rises quickly away from the coast on the surrounding Bo'ness coastal hills and is generally aligned to face outward towards the Forth Estuary. As such a strong visual connection with the town and the wider estuary is apparent.
- 10.5.31 The conservation areas of Bo'ness Grange Terrace and Bo'ness Town Centre are located centrally within the town with the conservation area of Muirhouses located to the south east of the town.
- 10.5.32 The sensitivity of Bo'ness is assessed as medium for all of the key townscape character elements outlined in Table 10.4 except for Visual Amenity which is assessed as high.



**Linlithgow, Polmont and Laurieston**

- 10.5.33 The towns of Linlithgow, Polmont and Laurieston run east to west to the south of the M9 corridor. Linlithgow is a Royal Burgh and home to the birth place of James V and Mary Queen of Scots at Linlithgow Palace. Polmont and Laurieston are younger settlements associated with the industry and employment within Falkirk and Grangemouth. Linlithgow has a conservation area at the centre of the town while Polmont has the Union Canal running through the town which is a scheduled monument throughout this length.
- 10.5.34 Linlithgow is largely outside of the zone of theoretical visual influence for the proposed Renewable Energy Plant while Polmont and Laurieston have large areas which fall outside of the ZTVI.
- 10.5.35 Linlithgow is an older settlement with elements of its layout and building character which express this history. More modern elements within the town serve to detract from this character leading to a curious mix of modern high rise buildings and medieval remnant streets and buildings. The sensitivity is assessed as medium for all of the key townscape character elements outlined in Table 10.4 except visual amenity which is assessed as low.
- 10.5.36 The sensitivity of Polmont and Laurieston is assessed as low for the majority of the key townscape and character elements.

**Airth and Cowie**

- 10.5.37 Airth and Cowie are small settlements north west of Grangemouth. Airth is a medieval port with a strong association with the Forth Estuary and a conservation area protecting its historic centre. Cowie is a settlement further inland with a large engineering plant on its outskirts. Both are set within flat and open agricultural land with views at the edges of settlement which extend to the distant horizon.
- 10.5.38 Airth falls within the zone of theoretical visual influence for the proposed Renewable Energy Plant while Cowie falls largely outside of the ZTVI.
- 10.5.39 The sensitivity of Airth is assessed as high for townscape character elements Urban Form, Cultural Heritage and Built Environment and medium for the remaining categories. The sensitivity of Cowie is assessed as low for all the townscape character elements.

**Stirling and Bannockburn**

- 10.5.40 Stirling and Bannockburn fall largely outside of the 10km study area.

**Kincardine**

- 10.5.41 Kincardine was once a prosperous minor port with the townscape retaining many good examples of Scottish vernacular buildings from the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries. The town has changed considerably with the arrival of the bridge crossing in 1932-36 and now no longer has a harbour as part of the town's urban fabric. The bridge dominates the town and offers clear views towards the site and down the Forth Estuary. Within the town a series of high rise residential flats have views from an elevated position above the town across the Forth Estuary.
- 10.5.42 Kincardine is protected as a conservation area.
- 10.5.43 The sensitivity of the town is assessed as medium for all the townscape elements apart from visual amenity which is assessed as high due to the potential views from the bridge and from within the town from high rise residential flats.

**Culross**

- 10.5.44 The village of Culross dates back to the 6<sup>th</sup> century and was a centre of the local coal mining industry in the 16<sup>th</sup> and 17<sup>th</sup> centuries. The town was also an important port but this declined from the 18<sup>th</sup> century and was filled in with the construction of the railway in the 19<sup>th</sup> century. The town retains a number of unique historical buildings

with the Culross Palace being perhaps the best known. The whole village and some outlying areas are protected as part of a conservation area.

- 10.5.45 The sensitivity of the village is assessed as medium for townscape character elements Urban Form, Cultural Heritage, Built Form, Open Space and Connectivity; low for Activity and high for Visual Amenity.

#### **Alloa and Clackmannan**

- 10.5.46 Alloa and Clackmannan are settlements which may date back to prehistoric times. Alloa was a prosperous industrial centre and river port and Clackmannan was the principal administrative centre during the medieval period. Both towns retain elements of their built heritage although Alloa in particular now shows signs of its industrial decline in derelict and underused land along its coastal edge.
- 10.5.47 Alloa falls within the zone of theoretical visual influence for the proposed Renewable Energy Plant while Clackmannan only has a small area at its southern edge which may have a view of the proposed plant.
- 10.5.48 The sensitivity of both towns is assessed as being medium for all the townscape character elements.
- 10.5.49 The settlement pattern outside of these centres is less concentrated north of the Forth Estuary but on both sides of the estuary the landscape is dotted with small hamlets and farmsteads. This distribution of settlement gives the impression of a settled, well maintained, but calm and lightly populated countryside. Theoretical visibility of the proposed development is generally low with large areas north of Culross and south of Falkirk with no theoretical visibility of the proposed Renewable Energy Plant. Generally the sensitivity for these outlying settlements is assessed as low with the exception of small settlement and farmsteads to the east of Grangemouth around Skinflats where the sensitivity is assessed as medium due to the open nature of the landscape and the visual sensitivity of the receptors because of this.

#### **Landscape Designations/Features**

##### **Antonine Wall World Heritage Site**

- 10.5.50 The Antonine Wall was constructed in the AD140s as the northern most boundary of the Roman Empire in Britain running east to west from Old Kilpatrick to Bo'ness. The wall has now been inscribed as a World Heritage Site and will form part of the Frontiers of the Roman Empire World Heritage Site, which includes Hadrian's Wall in England and the German Lines.
- 10.5.51 An area either side of the wall is further protected through the definition of a buffer zone in Local Planning Policy EQ17 in the Falkirk Council Local Plan 2005.<sup>3</sup>
- 10.5.52 Because of its international historical and cultural importance and its wide ranging and open physical location the Antonine wall is assessed as high sensitivity.

##### **Scheduled Monuments**

- 10.5.53 There are numerous scheduled monuments within the detailed 10 km study area with several of these within 5 km of the site. The Antonine Wall is listed under several separate sections but is considered within this chapter under its World Heritage Designation, as a result these listings are not included individually under the Scheduled Monuments listing. The Union Canal is also listed under several separate sections and, for the purposes of this report, the full 12km stretch is considered under one heading. There are ten Scheduled Ancient Monuments within 5km of the site, these are shown in Table 10.10 below (also see Figure 10.6). It is considered that beyond 5km, specific landscape impacts would not arise as a result of the proposed development. Where other scheduled monuments appear within the study area they are considered within, and contributing to, the character and sensitivity of the wider landscape.

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<sup>3</sup> Falkirk Council Local Plan 2005, Falkirk Council



Table 10.10: Scheduled Monuments

	Scheduled Monuments	Elements and Features protected	Sensitivity to the proposed development
1	Bowhouse Circular Enclosure, Polmont	Appears lost under M9 construction	Not considered further
2	Antonine Wall, Mumrils Fort, Sandy Loan	A section of the Antonine wall which includes the largest known fort along the wall with associated ditches, and other areas of possible activity. Other separate listings for the wall exist for sections east of this listing area. Listing appears principally to protect the physical features on site and any elements as yet unidentified or unexcavated.	The Antonine Wall is considered separately under its World Heritage Designation and as one unit. The Mumrils Fort has a limited presence above ground with the principal purpose of the listing to protect the excavated and unexcavated remains below ground. The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the scheduled area.
3	The Union Canal-river Avon to Greenway	A 12km stretch of canal running through Polmont. The listing also includes a large number of associated bridges and other structures.	The sensitivity is assessed as high.
4	Antonine wall, Deanfield, temporary Roman camp	Site of buried temporary Roman camp identified through crop marks within the existing Grangemouth golf course. Principally listed to protect material which may exist and is as yet unexcavated.	The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the scheduled area
5	Antonine wall, the bungalow, Roman camp	Buried remains of temporary Roman camp and possible iron age enclosure. The listing appears principally to seek to protect existing earth work features and material which may exist beneath the surface.	The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the scheduled area
6	Nether Kinieil, Shell Middens and Antonine Wall	An extensive shell midden of prehistoric date adjacent to a stretch of the Antonine Wall.	The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the listed area
7	Inveravon Roman Camp	Two temporary Roman Camps south of the Antonine Wall.	The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the scheduled area
8	Kinneil House	16 <sup>th</sup> century tower and associated palace with grounds and including the remnants of a medieval church, the Antonine Wall and a Roman Fort. The house is open two weekends in the year. The Kinneil house church and church cross are separately listed but considered here together.	The sensitivity is assessed as high.
9	Avondale House, palisaded enclosure	Site of a prehistoric enclosed settlement.-lost to quarrying	Not considered further.
10	Lathallan enclosure	Site of prehistoric enclosure identified through crop marks-listing appears principally to protect features which may lie buried and as yet unexcavated.	The sensitivity is assessed as medium as the site is considered tolerant of landscape changes which do not physically alter the scheduled area

#### Areas of Great Landscape Value and Candidate Special Landscape Areas

- 10.5.54 Areas of Great Landscape Value are designed to protect locally important areas of outstanding scenic character or quality. These areas are noted for their high quality and value and have been assessed as having high sensitivity.
- 10.5.55 An Area of Great Landscape Value is designated running in a band south of Bo'ness. Known as Bo'ness south, this designation follows the Antonine wall as far as the outskirts of Grangemouth. Another band of AGLV falls to the south of the study area and runs east to west from the Slamannan plateau as far as Linlithgow, this is known as the Avon valley and the Denny Hills. The AGLV's are protected under policy EQ23 of the emerging Falkirk Council Local Plan 2005.

### Registered Historic Gardens and Designed Landscapes (see Figure 10.2)

There are six Registered Historic Gardens and Designed Landscapes within the study area as shown in Table 10.11 below. Each Registered Historic Gardens and Designed Landscape has been considered with regard to its setting and sensitivity to the proposed Renewable Energy Plant.

**Table 10.11: Registered Historic Gardens and Designed Landscapes**

	Registered Historic Gardens and Designed Landscapes	Elements and Features protected	Sensitivity to the proposed development
1	Tulliallan Castle	The castle is a large house in Kincardine in Gothic and Italian style built around 1812. The house sits in 90 acres of parkland and has undergone substantial modification over the years. It is currently home to the Scottish Police College.	High
2	Dunimarle Castle	Dunimarle Castle is located to the west of Culross and is a large castellated manor house dating back to 1840 set within landscaped grounds.	High
3	Culross Abbey	The Abbey, located to the east of Culross, was founded in 1217 and built upon the site of an earlier church. Said to be the birth place of St Serf the part ruined abbey and church are still used for worship today.	High
4	Valleyfield House, Garden	Located north east of Culross the grounds of Valleyfield House were designed by Sir Humphrey Repton in 1801 and are the only examples of his work in Scotland. The park has now largely fallen into disrepair.	Medium
5	Callendar Park	The Park and mansion are located in the centre of Falkirk and are open to the public as a museum. The Antonine wall runs through the grounds and can be clearly made out as a series of mounds and ditch.	High
6	Dunmore Park/ The Pineapple	The hall and gardens, located south of Alloa, are a collection of buildings and parkland used as a residence since before 1338. The most famous element of the estate is the pineapple feature placed above a garden pavilion by John Murray sometime around 1761.	High

### Conservation Areas

- 10.5.56 There are 11 conservation areas within the Grangemouth detailed study area, the locations of which are indicated in Figure 10.3. These are described in Table 10.12 below, together with notes on their nature, reason for creation and the sensitivity assessed for each.

**Table 10.12: Conservation Areas**

	Conservation Area	Elements and Features protected	Sensitivity to the proposed development
1	Alloa	A linear area running from the southern edge of the town centre towards the old harbour and including a section of the old harbour and disused pier. Not outstanding status.	Medium
2	Airth	Large area at the centre of Airth with no accompanying schedule.	Medium
3	Arnothill	Large residential area within Arnothill, a suburb of Falkirk with no accompanying listing. An area characterised by large sandstone villas of the late Victorian era. This is complimented by extensive garden grounds and mature tree cover. The Antonine wall runs through this area and influences the layout of the streets and urban form. Appraisal of the conservation area highlights some elements of deterioration in quality.	Medium
4	Bo'ness Grange Terrace	An elevated residential area within Bo'ness with no accompanying schedule.	Medium
5	Bo'ness Town Centre	An area of the town following the coast and including the harbour with no accompanying schedule.	Medium
6	Dunmore Conservation Area	Conservation area covering the whole of a small village built to house estate workers from the nearby Dunmore Estate. The conservation area also covers a section of coastline where the village runs down to the Forth Estuary. Described as outstanding status.	High

	Conservation Area	Elements and Features protected	Sensitivity to the proposed development
7	Falkirk Town Centre	Conservation area in the centre of Falkirk with outstanding status. Includes a large part of the town and town centre and includes much of the early Victorian and 19 <sup>th</sup> century building within the town.	High
8	Letham	Former mineworkers village where a community based solely around the mining industry developed.	Medium
9	Muirhouses	A small settlement to the south of Bo'ness housing former estate workers housing a school and library and associated with the nearby Carriden estate. Some deterioration of quality is noted.	Medium
10	Linlithgow	The conservation area covers the majority of the town, the palace and the lakeside. There is no accompanying schedule.	Medium
11	Kincardine	Conservation area covering the older parts of the town centre and including the bridge landing and old ferry pier. Elevated and open views towards the site possible from its southern boundary.	High

### Grangemouth Port and Town Centre

- 10.5.57 Grangemouth came into being with the construction of the Forth and Clyde canal in 1768 and was at first known as Sealock before becoming Grangemouth. The success of the canal and the trade which came along the canal and harbour led to the quick expansion of the village and its replacement of Carronshore as the principal landing place on the river. As goods came in so coal from Lanarkshire and other produce went out and by the 1830's 750 vessels were arriving and leaving each year. Facilities at the port were improved with the re-direction of the Grange Burn and the construction of a new dock (now known as Old Dock) and further expansion followed with the construction of Junction Dock a few years later.
- 10.5.58 The original village was between the canal (since filled in) and the River Carron and soon this old town spread to a more planned layout to the east. It is this layout with wide streets and civic buildings which survives today and which forms the core of the contemporary civic centre.
- 10.5.59 At the end of the 19<sup>th</sup> Century the Docks had expanded further and the beginnings of the now prominent petro-chemical industry in Grangemouth took hold with the establishment of a refinery to process crude oil from the Persian Gulf.

### Urban form

- 10.5.60 The Town centre retains some of its Victorian character through sections of street layout and civic buildings such as the Town Hall, Library and Electric Theatre which are all listed. Modern Grangemouth however has had the clear grid layout of the 1945 map diluted through the introduction of pedestrianised shopping precincts and dedicated car parks which have led to the loss of a natural permeability through the town centre. A strong axis remains along both Grangeburn and Bo'ness roads until the suburban detached and semi detached housing lining both makes way to the heavy industrialised landscape of the petro-chemical industry to the east.
- 10.5.61 The old town of Grangemouth, which has been described as the Venice of the north,, appears now to have been entirely lost through redevelopment and the once close links with the water and the boats and commerce along the canal have disappeared.
- 10.5.62 The modern town has little physical contact with the river or the port which is for the most part hidden behind security fencing and scrub woodland. The presence of the docks is most notable on the approach roads into the town where a journey through heavy industry and warehousing terminates at Junction Dock; here a bridge crosses the railway into the new town. The port itself is of relatively low density with large warehousing, cranes, stacks and other tall storage facilities spread out amidst large areas of open dockside. This is in contrast to the densely populated collection of tall buildings and structures at the petro-chemical site which dominate views to the east.

- 10.5.63 Although elements of the original Victorian layout of the new town exist, this has been altered to its detriment with both roads and buildings in more recent times producing a less coherent and undistinguished centre. The old town and harbour with its rich historical character and physical link to the water front has been entirely lost and in its place heavy industry now dominates the approaches into the town and all the surrounding views across the Forth Estuary and the low lying lands to the south and west. Accordingly the sensitivity of the urban form has been assessed as low.

#### **Activity**

- 10.5.64 Grangemouth still retains something of its original wide streets and grid network and these appear busy and well used. Movement on foot through the town, although somewhat fragmented through modern interventions, is still relatively easy and pedestrian routes appeared for the most part well used and understood. The sensitivity is assessed as medium.

#### **Cultural Heritage**

- 10.5.65 The town has several listed buildings around its centre including the Dundas Church and the La Scala (Electric Theatre) Cinema and a couple of listed structures within the dock itself. An area of the town is defined as being an *Area of Townscape Value* (policy EQ13) which requires development to be sensitive to the areas character and architectural quality.
- 10.5.66 Although cultural heritage elements of the town survive the overriding impression is one of a lost cultural heritage with nothing in the remaining architecture or layout able to fully counter this loss of waterfront activity and connection and the presence of heavy industry on all sides. The sensitivity appears to be on the low side of medium with only the existing architectural buildings along the main street network lifting the town above a low rating.

#### **Built Environment**

- 10.5.67 Following the conclusions on cultural heritage above, the built environment is also assessed as low-medium with many detracting built forms outweighing the few buildings and structures of quality.

#### **Open Space**

- 10.5.68 The town has one notable park of quality in the Zetland Gardens which is also protected within the *Area of Townscape Value* (*Falkirk Council Local Plan Policy EQ13*). Other amenity and recreation spaces are to be found and the area appears to have an adequate provision of public open space. The sensitivity is assessed as medium.

#### **Connectivity**

- 10.5.69 Elements of the town, particularly those which flow from the original Victorian street grid, are well connected with one another and movement for all users is easy and coherent. This flow changes somewhat where more modern interventions and pedestrianisation have been introduced and is altered completely on the outer edges of the town where the dominance of industry and the car leads to less connectivity, where only certain forms of transport are encouraged or even allowed. Overall the sensitivity is assessed as medium.

#### **Visual Amenity**

- 10.5.70 The visual amenity of Grangemouth Town is restricted to the narrow road corridors within the town itself. Very little of the surrounding countryside and indeed the river is evident from within the town with the most common long distance view comprising large industrial features visible above the roofline of the surrounding suburbs.
- 10.5.71 From the port the view changes as the position on the river becomes apparent and wide ranging views north across to the distant Ochils becomes possible.

- 10.5.72 The visual sensitivity varies between low for areas within the town to medium for areas at or around the port where the wider landscape and river become a stronger part of the view.

#### **Regional Landscape Context - the landscape south of the Forth Estuary**

- 10.5.73 Scottish Natural Heritage has commissioned three studies which cover the areas around Falkirk and Grangemouth dividing them into a series of different character types and units. The three studies are:

- Stirling to Grangemouth Landscape Character Assessment -David Tyldesley and Associates 1999;
- The Lothians Landscape Character Assessment –ASH Consulting Group 1998; and
- Central Region Landscape Character Assessment –ASH Consulting Group 1999.

- 10.5.74 The principal study document, centred on Grangemouth, is the David Tyldesley assessment which covers the landscape radiating directly outward from the site.

- 10.5.75 These distinct character regions have been identified as follows:

- Lowland Hill Fringes;
- Lowland Plateau;
- Lowland River Valleys; and
- Coastal Margins.

- 10.5.76 These character areas are described in brief below and are shown on Figure 10.4. They are summarised in Table 10.13 which includes sensitivities of the character elements.

#### **Stirling to Grangemouth Landscape Character Assessment -David Tyldesley and Associates 1999**

- 10.5.77 The Stirling to Grangemouth Assessment considers an area immediately surrounding Grangemouth and the site from Linlithgow in the south; to Alloa in the north and bounded by the River Forth and estuary to the east and the Touch Hills and higher ground to the west. Four character types are identified within the study area.

#### **Lowland Hill Fringes –East Touch Fringe**

- 10.5.78 This forms a continuation to the character area *East Touch Fringe* within the Central Landscape Character Assessment the key characteristics are described by SNH as follows:

- elevated, rock outcrops above rolling pronounced hills sloping more gently to the Forth valley floodplain;
- Rough and semi improved grassland on higher ground with some arable on lower ground;
- Extensive coniferous and mixed plantations;
- Industrial villages and urban expansion on low ground;
- Historic buildings and features;
- Many roads including motorways and railways and overhead lines.

- 10.5.79 This area covers the foothills of the Touch Hills which is a transitional area between the high ground to the north west and the lowlands to the east. Urban influences such as industry, power lines and transport routes detract while more positive attributes of the topography and historic landscape add value to the character.

#### **Lowland Plateau –Slamannan Plateau**

- 10.5.80 This area to the south of Falkirk best relates to the Central character description entitled *Slammanan Plateau*, its key characteristics are described by SNH as follows:

- elevated, open undulating lowland plateau with distinct east-west ridges and valleys;

- generally unwooded but some mixed and coniferous plantation; and
- mining villages and a legacy of mineral working, derelict land and buildings leading to a quasi derelict appearance.

10.5.81 South of the dense band of industry and settlement which lines the Bonny and Carron valleys west of Falkirk lies a large expanse of elevated, open, undulating lowland plateau. Land use is a mixture of semi improved pasture and heather and grass moorland with mining and peat extraction scattered throughout the area. Views are generally restricted through the folding nature of the topography but become more expansive towards the Firth of Forth Carselands from higher ground.

10.5.82 Derelict and disused open cast mining sites and undistinguished development on the margins of traditional villages together with operational mining and peat extraction are strong detracting elements within the landscape.

#### **Lowland River Valleys – Falkirk-Denny Urban Fringe, Avon Valley and Carse of Forth**

10.5.83 The river valleys within the study area are covered by three landscape units which in themselves are described under one landscape character type, namely *lowland river valleys*. For the purposes of this assessment the Lowland River Valleys are considered as one area with shared characteristics. The detail of the landscape units are summarised below. The key characteristics are described by SNH as:

- Flat, open, large scale carselands forming the floor and former floodplain of the River Forth and its tributaries;
- Predominantly arable cultivation with some permanent pasture;
- Absence of villages;
- From Denny to Falkirk and Polmont an extensive area of urban development and urbanised degraded landscape on the edge of the carselands.

10.5.84 Falkirk-Denny Urban Fringe covers a wide swathe of low, very gently rolling land stretching between the Touch Hills and Denny Muir to the west and the flat floodplain of the Forth Estuary to the east. Although locally dominated by extensive urban development, between settlements, there is a mixture of pasture and arable fields.

10.5.85 This densely settled, industrialised area consists of a mix of new residential development, business parks, and factories and other industries. Sprawling across the valley, the settlements create the effect of near continuous development.

10.5.86 Views of the Ochils and the Antonine Wall form positive elements in an otherwise fragmented and urban landscape dominated by heavy industry.

10.5.87 To the south of this area is the Avon Valley which abuts the Lothians landscape character study. The river runs through a narrow gorge like valley with steep slopes on both the Falkirk and west Lothian banks. The valley is well wooded with an intimate, small scale landscape.

#### **Coastal Margins**

10.5.88 The coastal margins cover the immediate landscape around Grangemouth and are divided into the coastal flats (Bo'ness Flats) and coastal hills (Bo'ness hills)

10.5.89 The key characteristics are described by SNH as follows:

#### **Bo'ness Flats**

- Low-lying landscape dominated by the town of Grangemouth, the docks and large scale petro-chemical and other industrial installations;



- Extensive, intertidal, estuarine mud flats;
- Extensive, open, large scale arable farmland with few hedges and rectilinear fields.

- 10.5.90 From the Kincardine Bridge in the north through to Bo'ness in the south this area of low lying coastal flats is dominated by the town of Grangemouth, the docks and the large industrial installations along the coast. It includes the extensive mudflats of the Forth Estuary which, despite their proximity to these developments, are of international ecological importance (see Chapter 12).
- 10.5.91 Elsewhere the landscape is flat and open and used primarily for arable cultivation with some of this being reclaimed saltmarsh.
- 10.5.92 The night time light pollution of glow, flares and lights from Grangemouth are singled out as a negative influence over the area's character.

### Bo'ness Hills

- 10.5.93 The key characteristics are described by SNH as follows:
- rolling hill landform giving extensive views across the Forth Estuary and strong coastal character;
  - large scale, open, well tended landscape;
  - historical and archaeological features.
- 10.5.94 The Bo'ness Coastal hills are rolling, predominantly arable lands with Bo'ness itself sitting mostly on the rising land away from the Forth Estuary. There are many historical features and strong cultural associations and wide ranging views across the Forth Estuary towards the Ochils. The industry at Grangemouth, the motorway and railway and development at the edge of Bo'ness are all detracting features.
- 10.5.95 Table 10.13 summarises the landscape resource and assesses the sensitivity of the landscape with regard to individual character elements.

**Table 10.13: Stirling to Grangemouth Landscape Character Assessment**

	Lowland Hill Fringes	Lowland Plateau	Lowland River Valleys	Coastal Margins
Landscape designation	No landscape designations ( <i>low</i> )	No landscape designation ( <i>low</i> )	Avon valley falls within AGLV, Antonine wall and Green belt passes through Falkirk ( <i>high</i> )	Greenbelt , AGLV and Antonine wall ( <i>high</i> )
Landscape resource	Reasonably tolerant of change ( <i>medium</i> )	Damaged landscape ( <i>low</i> )	Reasonably tolerant of change ( <i>medium</i> )	Reasonably tolerant of change ( <i>medium</i> )
Scale and enclosure	Elevated open grassland ( <i>low</i> )	Open some long range views ( <i>low</i> )	Open and Flat wide views to distance ( <i>low</i> )	Large scale and open ( <i>low</i> )
Landform and topography	Rocky outcrops and pronounced hills and slopes ( <i>medium</i> )	Undulating ( <i>medium</i> )	Generally flat ( <i>low</i> )	Moves from flat to rolling hills ( <i>low</i> )
Settlement	Apart from the village of Cowie the area is sparsely populated ( <i>high</i> )	Small settlements including California ( <i>high</i> )	Few villages with settlement centred around large urban centres ( <i>medium</i> )	Includes the large settlements of Grangemouth and Bo'ness ( <i>low</i> )
Landmarks and visible built structures	Road, motorway and rail links ( <i>low</i> )	Industrial and mining heritage evident ( <i>low</i> )	Antonine Wall ( <i>medium</i> )	Antonine wall, large petro-chemical industry at Grangemouth ( <i>low</i> )
Remoteness and tranquillity	Elements of remoteness but not tranquil ( <i>medium</i> )	Close to major settlement ( <i>low</i> )	A busy and well connected landscape ( <i>low</i> )	Neither remote nor tranquil ( <i>low</i> )
Landscape Quality and Value	Ordinary quality low value	Poor quality low value	Ordinary quality good value	Poor landscape quality but good value
Summary of Assessed Sensitivity	Low-medium	Low	Medium	Low

- 10.5.96 Generally the collective landscape around Grangemouth has a moderate-low value with landscape quality assessed as ordinary or poor.
- 10.5.97 Overall this landscape character area has a low-medium sensitivity and could be expected to accommodate some change without altering or damaging any of the key landscape characteristics identified.

#### **The Lothians Landscape Character Assessment –ASH Consulting Group 1999**

- 10.5.98 The Lothians Character Assessment covers a large area, centred on Edinburgh, which follows the coastline from Linlithgow in the west to Dunbar in the east. There are two landscape types identified within the 10km study area within which more detailed landscape units are identified. A brief summary of these landscapes is included below:

#### **Lowland Hills and Ridges-Bathgate Hills 17**

- 10.5.99 This character area sits south of Linlithgow and adjacent to the lowland river valleys character type in the Stirling and Grangemouth study. This is described as a highly distinctive upland landscape with smoothly contoured lower hill slopes contrasting with more uneven higher ground. The slopes are covered predominantly with improved pasture with gorse scrub and heather covering the rockier steeper slopes. Frequent woodland blocks and shelterbelts often accentuate the topography and paths and tracks offer frequent opportunities for recreation.
- 10.5.100 The area is rich in history with a prehistoric centre of worship and burial at Cockleroy Fort and various other features including standing stones.
- 10.5.101 Spectacular panoramic views can be obtained from the open hilltops, northwards across the Forth Estuary to the southern highlands. Generally the area offers outstanding outward views with only communication masts as significant detracting features.

#### **Coastal Margins–Linlithgow Queensferry Farmlands 26**

- 10.5.102 This character area runs eastward from Bo'ness and is adjacent to the coastal margins character type of the Grangemouth and Stirling study. It is described as gently rolling lowland with occasional higher hills and ridges which are more prominent where these ridgelines rise to merge with the Bathgate hills. The character area also includes the coast and mudflats as far east as the Forth Bridges but the western end nearest the site is dominated by the urban centre of Linlithgow.
- 10.5.103 The area has significant woodland cover principally held within several major private estates that help to define a distinctive character. Elsewhere the land use is predominantly arable with improved pasture on higher ground.
- 10.5.104 The M9 and Edinburgh to Glasgow railway line run parallel with each other following the coast and bisecting this character area creating a busy transport corridor which disrupts the rural character of the farmland and estate landscapes.
- 10.5.105 Tranquil, wide reaching views of the coast are almost always dominated by the striking structures of the Forth Road and Rail Bridges and to a lesser extent the urban and industrial landscape of Bo'ness and Grangemouth.

#### **Central Region Landscape Character Assessment - ASH Consulting Group 1999**

- 10.5.106 The central region study divides a large area around the SNH Loch Lomond and Trossachs Landscape area. It identifies 8 landscape character types and further divides these into character units. Within the study area considered for the proposed Renewable Energy Plant, there are three landscape character types south of the Forth Estuary with corresponding landscape units, these are:



### Hill Fringes- 15 East Touch Fringe

- 10.5.107 The eastern boundary of the Touch Hills is demarcated by rugged, brag edged outcrops. These form the edge of a broad swathe of strongly rolling farmland acting as a transition between the Touch Hill slopes and the wide flat valley of the Forth Estuary.
- 10.5.108 Some rough and semi improved grasslands are found on damper or rockier areas with the remaining land predominantly laid over to improved pasture land with occasional arable. The area is well wooded with field boundaries, hedgerows, plantations and estate plantings adding to the mixed forestry and woodlands. The area has scatterings of farmsteads and estate houses and is well represented with historical and cultural buildings and features from early Roman remains through to 19<sup>th</sup> and 20<sup>th</sup> century buildings and settlements of note.
- 10.5.109 The area is bisected and bound by the M80 and M9 motorways and the main A872 and A9 roads, the embankments and bridging structures of which fragment the landscape and restrict many views.
- 10.5.110 Other urban influences are noted as pylon lines, and the operative Edinburgh to Stirling railway line.

### Plateau - 19 Slamannan Plateau

- 10.5.111 South of a dense band of industry and settlement lining the Bonny and Carron valleys west of Falkirk lies a large expanse of elevated, open, undulating plateau. The land use is a combination of semi improved tracts of grassland interrupted by open tracts of heather and grass moorland. Although generally unwooded, a distinctive feature of the area is knarled and windswept shelterbelts and hedgerow trees which, together with several coniferous plantations, break up the openness of the terrain.
- 10.5.112 The plateau is criss-crossed by a relatively uniform dispersal of B roads and minor roads connecting dwelling and farmsteads and mining villages to the south and east.
- 10.5.113 Detracting features are noted as open cast coal mining, pylon lines, peat extraction and mineral working which lead to a degraded and poorly maintained appearance. Many views are internalised within the area by the pronounced topographical folding of the landform.

### River Valleys- Falkirk/Denny Urban Fringe

- 10.5.114 This densely settled, industrialised area consists of a mix of new residential development, business parks and factories and other industries on the outskirts of Falkirk and other urban centres. Sprawling across the gently rolling valley landscape, the settlements create the effect of near-continuous development with motorways, roads and rail lines adding to the chaotic and busy nature of the landscape character.
- 10.5.115 The occasional incidences of older settlement including the Antonine Wall are visually diminished by this surrounding development.
- 10.5.116 Views are frequently blocked and diverted by the urban and industrial infrastructure with some filtered views possible of nearby hills and the petro-chemical plant at Grangemouth.

Table 10.14: Lothian and Central Region Landscape Character Assessment

	Lothians- Lowland Hills and Ridges	Lothians- Coastal Margins	Central- Hill Fringes	Central -Plateau	Central- River Valleys
<b>Landscape designation</b>	AGLV ( <i>medium</i> )	AGLV ( <i>medium</i> )	No designation	No designation ( <i>low</i> )	No designation ( <i>low</i> )
<b>Landscape resource</b>	Reasonably tolerant of change( <i>medium</i> )	Reasonably tolerant of change( <i>medium</i> )	Reasonably tolerant of change ( <i>medium</i> )	Damaged landscape ( <i>low</i> )	Damaged landscape ( <i>low</i> )
<b>Scale and enclosure</b>	Woodland blocks and copses with some open views ( <i>medium</i> )	Topography and vegetation combine locally to restrict views ( <i>medium</i> )	Topography and vegetation combine locally to restrict views ( <i>medium</i> )	Topography and vegetation combine locally to restrict views ( <i>medium</i> )	Topography and vegetation combine locally to restrict views ( <i>medium</i> )
<b>Landform and topography</b>	Distinctive hill/upland ( <i>medium</i> )	Gently rolling ( <i>medium</i> )	Strongly rolling ( <i>medium</i> )	Undulating ( <i>medium</i> )	Undulating ( <i>medium</i> )
<b>Settlement</b>	Small settlements and	Centred around the	Urban edge of Falkirk	Settlements and	Heavily settled ( <i>low</i> )

	Lothians- Lowland Hills and Ridges	Lothians- Coastal Margins	Central- Hill Fringes	Central -Plateau	Central- River Valleys
	farmsteads ( <i>high</i> )	large settlement of Linlithgow ( <i>low</i> )	and Stenhousemuir ( <i>low</i> )	villages evenly spaced ( <i>medium</i> )	
<b>Landmarks and visible built structures</b>	Hill forts and standing stones ( <i>medium</i> )	Linlithgow Palace ( <i>medium</i> )	Motorways, Estate buildings ( <i>medium</i> )	Industrial workings ( <i>low</i> )	Industrial workings ( <i>low</i> )
<b>Remoteness and tranquillity</b>	Urban fringe location ( <i>medium</i> )	Urban fringe location ( <i>medium</i> )	Urban fringe location ( <i>medium</i> )	Populated with industry ( <i>medium</i> )	Heavily populated with industry ( <i>low</i> )
<b>Landscape Quality and Value</b>	High quality good value	Ordinary quality, moderate value	Ordinary quality, moderate value	Poor quality, low value	Poor quality, low value
<b>Summary of Assessed Sensitivity</b>	<b>Medium</b>	<b>Medium</b>	<b>Medium</b>	<b>Low-Medium</b>	<b>Low</b>

### Regional Landscape Context - the landscape north of the Forth Estuary

10.5.117 Scottish Natural Heritage has commissioned three studies which cover the area to the north and west of Stirling and across the Forth Estuary from Grangemouth within the scope proposed Renewable Energy Plant study area, these are:

- Fife Landscape Character Assessment –David Tydesley and Associates 1999
- Central Region Landscape Character Assessment-ASH Consulting Group 1999
- Stirling to Grangemouth landscape character assessment -David Tyldesley and Associates 1999

#### Fife Landscape Character Area

10.5.118 The Fife study divides an area north of the Forth Estuary into 15 landscape character types. Within the study area considered for the proposed Renewable Energy Plant at Grangemouth, these character types are:

#### Lowland Hills and Valleys

10.5.119 The key characteristics are noted as follows:

- a variety and subtlety of landform;
- open, regular, medium scale fields of arable and grasslands
- extensive areas of plantations, shelter planting, hedges and hedgerow trees;
- a series of manmade interventions from roads to settlements and dwellings which are generally well related to the landscape;
- a quiet, balanced and calm landscape.

10.5.120 The area covers a large sweep of lowland Fife divided into 15 local units, the units which fall within the Renewable Energy Plant study area are West Dunfermline and Bluther Burn.

10.5.121 The landscape type is locally interrupted by volcanic hills but typically consists of gently undulating, rounded, low hills often with large areas of plantation or other planting.

10.5.122 The Longannet power station and the overhead power lines which radiate from this centre are noted as linear and point features within the landscape. Although a generally agrarian, calm landscape, urban centres and industry do intervene in places, adding busy and sometimes detracting elements into the landscape.

10.5.123 The lowland hills are strongly influenced by other landscape types with middle and long distance views to the Ochils always present. From some positions views of the Forth Estuary are possible and visually the area is

very mixed ranging from close sided intimate valleys to higher rolling landscapes with more open wide ranging views.

### **Coastal Hills**

10.5.124 The key characteristics for the area are as follows:

- close association with the coast, through views of the Forth Estuary or more indirect coastal experiences;
- predominantly large, open, undulating arable fields, low hedges and little other vegetation cover;
- extensive seaward views across the Forth Estuary and land beyond, views to landward are contained by hills;
- infrequent, small, often exposed and conspicuous settlements;
- a medium to large scale landscape where the character is always influenced by the sea and can be particularly affected by the weather.

10.5.125 The landscape character study identifies 13 landscape units within this character type, the units which fall within the proposed Renewable Energy Plant study area are Kincardine to Culross.

10.5.126 The coastal hills around Kincardine to Culross come to an abrupt end before the coast. This is in contrast to the western part of this landscape unit which falls gradually to the flat coastal platform containing the Longannet Power Station. The area is further crossed by minor roads and the A985 with the linear coast line, power lines and the power station forming the most noticeable features within the landscape.

10.5.127 The main characteristics are those associated with the coast with often large scale views across the Forth Estuary and land beyond. As with previous character areas, the weather can play a significant part in defining the landscape experience from good days with wide, panoramic, open views to a more close, unsettling experience when the weather closes in.

10.5.128 Culross forms a distinctive architectural and historical point of interest in the landscape in stark contrast to the nearby industrial mass of the Longannet Power Station.

### **Coastal Flats**

10.5.129 The key characteristics of this landscape type are noted as:

- Flat, low lying, open, large scale, exposed coastal landscape;
- Large to medium scale, predominantly arable fields;
- A variety of land uses;
- A coastal landscape where the character is always influenced by the sea and weather;
- Extensive seaward views.

10.5.130 The character type is divided into 17 units of which two fall within the 10km detailed study area, these are: Kincardine, Longannet and Valleyfield Ash Lagoons.

10.5.131 The south coast includes land reclaimed from the intertidal areas of the Forth Estuary which are dominated by industrial or port related development. All buildings and other structures are prominent in views across the flats and from the Forth Estuary and intertidal areas.

10.5.132 In general, the landscape is large scale, open and exposed. It is a mostly balanced, still, organised and quiet landscape.

**Central Region Landscape Character**

- 10.5.133 The central region study divides a large area around the SNH Loch Lomond and Trossachs Landscape area. It identifies 8 landscape character types and further divides these into character units. Within the study area considered for the proposed Renewable Energy Plant, there is one landscape character type north of the Forth Estuary with a corresponding landscape unit.

**Valley Fringes –Central 33 Devon/Forth**

- 10.5.134 The valley of the Devon Water to the north is separated by this broad area of elevated, strongly rolling ground from the Forth estuary and adjacent plains to the south. The farmland of the area is varied with both rough grassland and more lush pasture as well as some arable.
- 10.5.135 Small mining villages and working mines as well as farmsteads are located off several road routes through the landscape.
- 10.5.136 Panoramic views can be obtained of the sprawling floodplain of the Forth and the Ochils to the north.

**Stirling to Grangemouth Landscape Character Area**

- 10.5.137 The Stirling to Grangemouth Assessment considers an area immediately surrounding Grangemouth and the site from Linlithgow in the south to Alloa in the north and bounded by the River Forth and estuary to the east and the Touch Hills and higher ground to the west. One character type is identified within the study area north of the Forth Estuary.

**Lowland River Valleys**

- 10.5.138 The river valleys within the study area are covered by one landscape unit, the Carse of Forth East Stirling. The key characteristics are described by SNH as:
- Flat, open, large scale carselands forming the floor and former floodplain of the River Forth and its tributaries;
  - Predominantly arable cultivation with some permanent pasture; and
  - Absence of villages.
- 10.5.139 Table 10.15 below summarises the landscape resource and assesses the sensitivity of the landscape with regard to individual character elements.

Table 10.15: Fife and Stirling to Grangemouth Landscape Character Assessments

	Fife- Lowland Hills and Valleys	Fife- Coastal Hills	Fife- Coastal Flats	Central-Valley Fringes	Stirling to Grangemouth- Lowland River Valleys
Landscape designation	No Landscape Designations (low)	Conservation areas at Kincardine and Culross (medium)	No Landscape Designations (low)	No Landscape Designations (low)	No landscape designations (low)
Landscape resource	Reasonably tolerant of change (medium)	Able to accommodate change (low)	Reasonably tolerant of change (medium)	Reasonably tolerant of change (medium)	Reasonably tolerant of change (medium)
Scale and enclosure	Topography and vegetation combine locally to restrict views (medium)	Open, extensive views (low)	Open, extensive views (low)	Topography and vegetation combine locally to restrict views (medium)	Open, extensive views (low)
Landform and topography	Gently rolling (medium)	Undulating (medium)	Flat (Low)	Strongly rolling (medium)	Flat (Low)
Settlement	Sparsely populated with some industry (medium)	Linked by coastal settlement (medium)	Linked by coastal settlement (medium)	Small villages and settlement (high)	Linked by coastal settlement (medium)
Landmarks and visible built structures	Ochils and R.Forth (medium)	Ochils and R.Forth (medium)	Ochils and R.Forth (medium)	Ochils (medium)	Ochils and R.Forth (medium)
Remoteness and tranquillity	A calm, quiet landscape (medium)	Busy settled corridor (low)	Urban fringe location (medium)	Urban fringe location (medium)	Busy coastal landscape (low)
Landscape Quality and Value	Ordinary quality, moderate value	Ordinary quality, moderate value	Ordinary quality, moderate value	Ordinary quality, moderate value	Ordinary quality, moderate value
Summary of Assessed Sensitivity	Medium	Low	Low-medium	Medium	Low-Medium

- 10.5.140 Generally the wider landscape north of the Forth Estuary varies between low and medium-high sensitivity. Overall, the landscape area is assessed as having a medium level of sensitivity and could be expected to accommodate some change without altering or damaging any of the key landscape characteristics identified.

## 10.6 Potential Impacts

### Introduction

- 10.6.1 The proposed development is a Renewable Energy Plant located on a site of approximately 18.05 ha (refer to Figure 1.2). The proposed development will comprise the following as shown on Figures 6.1 and 6.2:

- A power generation area
- A fuel storage area; and
- Areas for the installation of cooling water infrastructure.
- Infrastructure corridors for cooling water pipelines and fuel conveyors; and
- An area for lay down during the construction phase.

### Layout

- 10.6.2 The site is laid out with the tallest elements in the north, away from the boundary edge of the port and the town of Grangemouth. From the eastern boundary moving in a westward direction the site is laid out as follows and as shown in Figure 6.1 and Figure 6.2:

- Cooling Towers – 23 m height;
- A conveyer - to transfer biomass from the day store and fuel screen. This runs from ground level to a height of 45 m;
- Mixed Fuel Store – 1,3500 m<sup>2</sup>, 20 m high, rectangular building;
- Boiler hall- a 65 m tall rectangular building;
- Turbine hall – a 65 m tall rectangular building;
- Gas oil tank and silos 8 m tall;
- Fabric filters – 42 m high, part of the flue gas abatement technology;
- 110 m high stack;
- Heat accumulator - 22 m tall;
- An auxiliary boiler building - 10 m tall;
- A secondary stack 45m tall;
- Fire water tanks 10 m tall;
- Fuel day store - covered units 20 m tall and 1800 square metres;
- A fuel screen - 15 m tall;
- Switch Yard -4000 square metres;
- ID fan – 10 m tall;
- Open Stock Pile or Silos - 12,000 square metres, 33 m tall (maximum, will vary with open storage);

- 10.6.3 Another component of the proposals which has the potential to impact upon visual amenity is the presence of a visible plume from the main stack. The plume will vary in appearance and height and is anticipated to be a small or negligible change to the visual baseline.
- 10.6.4 On average, in any 12 month period, there will be a visible plume for 72% of the hours (see Chapter 9). A visible plume is caused by the condensation of water in the flue gas when it contacts cold air. Visibility is more likely on cold and humid days with longer plumes more likely on cold still humid days. The colour of the plume will vary from grey to white with local meteorological conditions. Cloud cover will play an especially significant part in plume visibility. With a stack height of 110 m the plume will tend to be viewed with the sky as a backdrop. In more distant views, the large scale of the receiving landscape will also assist in preventing the plume becoming a dominant feature.
- 10.6.5 The study area has a large number of other facilities which will generate plume within the visual baseline considered for the proposed Renewable Energy Plant. The petro-chemical and industrial complex at Grangemouth has multiple stacks and cooling towers which produce plumes on a regular basis. This collective plume is a distinctive element within the existing visual baseline. The Longannet Power Station also produces a plume.
- 10.6.6 The proposed off-site electrical connection will be underground and will also therefore not have a landscape or visual impact.
- 10.6.7 Depending on the final fuel specification used, the bulk fuel store will be either open storage (Figure 6.2) or pellet silos (Figure 6.1). The majority of montages and wireframes within this report demonstrate the appearance of open storage, however a wire frame is also included for the viewpoint at Grangeburn Road that illustrates the difference between this fuel storage arrangement for woodchips and that for pellets (i.e. silos). (see Figures 10.10.1 and 10.10.2).
- 10.6.8 Table 10.16 identifies the potential landscape and visual effects.

**Table 10.16: Potential Landscape and Visual Effects**

Activity	Element	Potential Effects	Potential Sensitive Receptors
Construction	Construction plant, Vehicle movements, Lay down area.	Temporary impacts on landscape fabric, temporary impacts on visual amenity	Landscape character types, Designated Landscapes, Historic Gardens and Designed Landscapes, Visual Receptors including: residents, tourists, road users, walkers and cyclists.
Operation	Boiler hall, 110 m stack and 45 m stack, Storage facilities, Other operational infrastructure, Access routeways, Visible plume	Physical change to the immediate site, Impacts on the landscape/townscape fabric and on visual amenity, Potential impacts to designated landscapes, conservation areas or other regionally or nationally important receptors	Landscape character types, Designated Landscapes, Historic Gardens and Designed Landscapes, Visual Receptors including: residents, tourists, road users, walkers and cyclists

## 10.7 Mitigation

- 10.7.1 External landscape treatments have been explored, and whilst there could be some merit in off site planting measures, there is currently no available land within Forth Ports' ownership which can usefully be employed for this purpose.
- 10.7.2 Mitigation measures have also been considered for the potential architectural treatment of the development. The potential exists for the proposed Renewable Energy Plant to be unique and a notable architectural and engineering addition to Grangemouth. Where significant landscape or



visual impacts have been identified a degree of mitigation could potentially be achieved through architectural design to create a more aesthetically pleasing addition to the landscape or a notable landmark building.

10.7.3 The architectural strategy will seek to influence the form and appearance of the individual elements which make up the Renewable Energy Plant. It will do this through a series of architectural constructions, techniques and other methods which can be summarised briefly below:

- The consideration of arrangement of architectural treatments to better express a coherent and easily understood piece of architecture.
- The creation of new architectural forms and wraps to create new physical forms and relationships between the differing elements of the Renewable Energy Plant;
- The use of texture, colour and materials to connect with the existing urban character and vernacular and to form a distinctive architectural look to the development as a whole;
- The consideration of how significant impacts can be lessened or else changed from adverse to beneficial; and
- The design of the Renewable Energy Plant development as a single, high quality architectural element within the landscape.

10.7.4 Gordon Murray Architects have been appointed to produce a concept design approach to develop these key areas of consideration. Their detailed response is presented in the Design Statement which accompanies this Section 36 Application. This demonstrates a particular illustrative concept design as an example of how the plant could appear. The proposed Renewable Energy Plant is presented as one unified building through the use of an external architectural treatment which seeks to highlight aspects of the buildings form through the choice of materials, colour and texture.

10.7.5 The concept has a maritime inspiration with the building designed to appear suggestive of elements from the container industry within the port.

10.7.6 The Boiler Hall is indicated as being partially clad with transparent materials to lessen the visual impact with other elements of the development clad in a more striking patterned form.

10.7.7 The architectural design will require to be agreed with Falkirk Council following receipt of Section 36 Consent (if granted) and through the discharge of conditions attached to any consent. The assessment of residual effects presented in Section 10.8 below relates to the maximum engineering envelope and landscape and visual effects described for this envelope, without the consideration for any future architectural design work. The architectural strategy which has been outlined in the Design Statement which accompanies this application is commented on, and the potential for this work to affect the conclusion of the landscape and visual assessment in the final analysis are expanded on within the LVIA.

## 10.8 Residual Landscape Effects

10.8.1 The landscape/townscape effects are described for the following areas, in accordance with the baseline description presented in Section 10.4 (see also Figure 10.7.):

- The Application Site;
- Settlement;
- Landscape Designations;
- Grangemouth Port and Town Centre;
- Regional Landscape Context – Falkirk and the landscape south of the Forth Estuary;



- Regional Landscape Context - the landscape north of the Forth Estuary.

10.8.2 During construction the urban form will fluctuate as buildings are demolished and new ones begin to appear. However transition and change in this area is not out of character and the construction impacts are likely to be the same or less than that for the completed development.

#### **The Application Site**

10.8.3 The application site will be subject to a very large change with the construction of the proposed Renewable Energy Plant and this change will be equally large through the construction of its various elements.

10.8.4 The sensitivity of the site is assessed as low with the port expected to be able to accommodate substantial change without harm to its key characteristics (see 10.4.). Elements of the proposals such as the 110 m stack and 65 m boiler hall are much taller in scale than any neighbouring or associated structures and may appear somewhat out of scale to their immediate surroundings. Taken from a wider view however, these buildings have a number of references of similar scale and height within the Port and along and across the Forth Estuary such as; the cranes and silos within the Port of Grangemouth, the multiple stacks, cooling towers and other industrial structures at the Grangemouth petro-chemical complex and the Longannet power station.

10.8.5 The landscape impact is assessed as moderate with the potential for this to be a beneficial impact through a high quality architectural response to the Renewable Energy Plant which will lift the standard of the built environment within the port.

#### **Settlement**

10.8.6 The landscape impacts upon the settlement within the study area vary from potentially significant to negligible or none. The landscape south of the Forth Estuary is heavily populated with the towns of Grangemouth, Falkirk, Stenhousemuir, Bo'ness and Linlithgow forming an almost continuous band of urban development which follows the coastline south of the Forth Estuary. To the north of the Forth Estuary the settlement pattern is less dense with small settlements such as Alloa, Kincardine and Culross along the coastline.

10.8.7 The townscape impacts for those areas of settlement close to or including the site are considered through a detailed analysis of the character elements which are unique to city and townscapes. These areas appear in this report under the headings Grangemouth Port and Town Centre.

#### **Falkirk and Stenhousemuir**

10.8.8 The sensitivity of the townscape is assessed as medium for all of the key townscape characteristics. The magnitude of townscape change, other than for visual amenity, assessed for these characteristics is assessed as small or negligible as no physical change will occur to the urban or built form, cultural heritage or open space.

10.8.9 Two views at the edge of Stenhousemuir (View 4 Bothkennar Road, Carronshore) and Falkirk (View 8 Callendar Park) are considered as receptors within the visual assessment (Section 10.9) View 4 is assessed as experiencing slight-negligible visual impacts while View 8 is assessed as experiencing moderate visual impacts. The visual impact on both Stenhousemuir and Falkirk is assessed as being not significant at the edges of the settlement and it is expected this visual impact will diminish substantially within the urban fabric of both towns.

10.8.10 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Falkirk and Stenhousemuir.

**Bo'ness**

- 10.8.11 The sensitivity of the townscape is assessed as medium for all the townscape character elements, apart from visual amenity, which is assessed as high. The magnitude of landscape change assessed for the townscape characteristics other than visual amenity is assessed as small or negligible as no physical change will occur to the urban or built form, cultural heritage or open space.
- 10.8.12 One view is assessed from Bo'ness (View 5 Bo'ness) within the visual assessment (Section 10.9). View 5 is assessed as experiencing moderate visual impacts which is not significant.
- 10.8.13 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Bo'ness.

**Linlithgow, Polmont and Laurieston**

- 10.8.14 The sensitivity of the townscape of Linlithgow is assessed as medium for all the townscape elements, except visual amenity, which is assessed as low. The magnitude of landscape change assessed for the townscape characteristics other than Visual Amenity is assessed as small or negligible as no physical change will occur to the urban or built form, cultural heritage or open space.
- 10.8.15 No view is considered from Linlithgow because the proposed Renewable Energy Plant has no theoretical visibility from the majority of the town. The visual impact is assessed as negligible.
- 10.8.16 The sensitivity of the townscape of Polmont and Laurieston is assessed as low across the majority of townscape character elements. The Landscape change is assessed as small or negligible as no physical change will occur to these townscape elements.
- 10.8.17 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Linlithgow, Polmont or Laurieston.

**Airth and Cowie**

- 10.8.18 The sensitivity of the townscape for Airth is assessed as high for townscape elements Urban Form, Cultural Heritage and Built Environment and medium for the remaining categories. The sensitivity of the townscape of Cowie is assessed as low for all the townscape character categories. The magnitude of landscape change for the townscape characteristics of both towns is assessed as small or negligible for all but visual amenity, as no physical change will occur to the fabric or characteristics of either town.
- 10.8.19 A view is considered from the edge of Airth (View 10 M876/A905) within the visual assessment (Section 10.9) and can be considered as representative of the most open views possible from Airth. No view is considered from Cowie. The view from Airth is assessed as experiencing a moderate visual impact which is considered the maximum extent of impact on visual amenity.
- 10.8.20 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Airth and Cowie.

**Kincardine**

- 10.8.21 The sensitivity of the townscape of Kincardine is assessed as medium except for visual amenity which is assessed as high. The magnitude of landscape change for the townscape characteristics is assessed as small or negligible for all but visual amenity, as no physical change will occur to the fabric or characteristics of the town.
- 10.8.22 A view is considered at the edge of Kincardine (View 11 Kincardine Bridge) within the visual assessment (Section 10.9). The visual impact is assessed as ranging from slight to moderate

substantial and the impact on visual amenity for the town is assessed as up to moderate substantial and potentially significant.

- 10.8.23 Potential significant visual impacts may occur through the introduction of the proposed Renewable Energy Plant but no other significant impacts have been identified. Overall the townscape impacts on Kincardine are not considered as significant.

#### **Culross**

- 10.8.24 The sensitivity for the landscape of Culross is assessed as medium for townscape character elements Urban Form, Cultural Heritage, Built Form, Open Space and Connectivity; low for Activity and high for Visual Amenity. The magnitude of landscape impacts is assessed as small or negligible for all but visual amenity, as no physical change will occur to the fabric or characteristics of the town.
- 10.8.25 A view is considered from Culross (View 12 Culross) within the visual assessment (Section 10.9). The visual impact is assessed as moderate at its highest level.
- 10.8.26 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Culross.

#### **Alloa and Clackmannan**

- 10.8.27 The sensitivity of the townscape of both towns is assessed as medium for all character elements. The magnitude of landscape impacts is assessed as small or negligible for all but visual amenity, as no physical change will occur to the fabric or characteristics of the town.
- 10.8.28 A view is considered from the estuary edge at Alloa (View 14 Alloa) within the visual assessment (Section 10.9). The visual impact is assessed as slight.
- 10.8.29 No significant landscape impacts will occur through the introduction of the proposed Renewable Energy Plant on Alloa or Clackmannan.

#### **Landscape Designations/Features**

- 10.8.30 The landscape change is considered for each of the designations and their separate sites or features assessed to determine the landscape impacts which may result from the construction of the Renewable Energy Plant.

#### **Antonine Wall World Heritage Site**

- 10.8.31 The wall and its planning designated buffer zone are assessed as having a high sensitivity to change. It is not possible to walk the wall along its length within the study area but sections of the wall are visible and accessible at Callendar Park, Polmont and at the Kinneil estate.
- 10.8.32 The landscape impacts associated with the proposed Renewable Energy Plant will not have any impact over the primary reasons for the listing and protection of the Antonine Wall as no physical change is proposed to any section of the wall or its buffer zone. Views from the wall towards the site are possible from a number of locations and the setting of the wall has the potential to be affected through changes to the visual amenity.
- 10.8.33 The setting of the Antonine Wall as it crosses the study area is defined through a mix of heavy industry, urban settlement, and a flat estuarine agricultural landscape with the Forth Estuary and the Ochils in the distance. Three views are considered within the visual assessment (section 10.9) which are within or close to the Antonine Wall and its buffer zone, these are; View 5 Bo'ness Harbour, View 6 Antonine Wall and View 8 Callendar Park. All three views are assessed as experiencing potentially moderate visual impacts as a result of the proposed Renewable Energy Plant. Elsewhere along the walls length views of the site will diminish or else be lost altogether and generally it is not considered

that the introduction of the proposed plant will substantially alter the visual amenity of the setting of the wall.

- 10.8.34 No significant landscape impacts on the Antonine Wall are assessed as a result of the proposed Renewable Energy Plant at Grangemouth.

#### Scheduled Monuments (see Figures 10.6 and 10.7)

- 10.8.35 The ten scheduled monuments within 5 km of the site are assessed in Table 10.17 below with regard to potential impacts on their landscape setting.

**Table 10.17: Potential Impacts on the Landscape Setting of Scheduled Monuments**

	Scheduled Monuments	Description of Change to Landscape Setting	Sensitivity	Impact
1	Bowhouse Circular Enclosure, Polmont	Appears lost under M9 construction. Not considered further	N/A	none
2	Antonine Wall, Mumrils Fort, Sandy Loan	Only part of the site has any theoretical view of site and the proposed Renewable Energy Plant. Views from the wall line towards Grangemouth and the Forth Estuary are in places open and panoramic with the baseline setting of the site including views of the Longannet Power Station, Grangemouth petro - chemical and industrial complex as well as the Port of Grangemouth and electricity pylons. The proposed Renewable Energy Plant will potentially be visible from location within and around the setting of the Forth Estuary but no change to the nature or quality of the view and setting is expected and the change is assessed as small.	medium	slight
3	The Union Canal- river Avon to Greenway	The Union Canal is accessible along its length to pedestrians and cyclists. Theoretical visibility of the proposed Renewable Energy Plant appears along some of this length but the local topography of the canal means that it is often in cutting and surrounded by vegetation which removes any views out to the wider countryside. Where the canal runs on a level with the surrounding landscape the towpath remains lined with trees and vegetation and views toward the site are limited. Overall the landscape change and visual change to the setting of the canal is assessed as small.	High	moderate
4	Antonine wall, Deanfield, temporary Roman camp	The site of the Roman camp sits on the edge of the M9 motorway and within the Grangemouth Golf course. The Golf course is surrounded by vegetation and although views towards the site are possible the baseline landscape setting includes views of the industrial complexes at Grangemouth and the visible plume rising above the tree line. No change to the physical character and quality of the landscape setting is anticipated through the introduction of the Renewable Energy Plant and only small or negligible change is assessed for the visual amenity. Overall the change to the setting is assessed as small.	medium	slight
5	Antonine wall, the bungalow, Roman camp	The site of the Roman camp sits within the Grangemouth Golf course. The Golf course is surrounded by vegetation and although views towards the site are possible the baseline landscape setting includes views of the industrial complexes at Grangemouth, the motorway and the visible plume rising above the tree line. No change to the physical character and quality of the landscape setting is anticipated through the introduction of the Renewable	medium	slight

	Scheduled Monuments	Description of Change to Landscape Setting	Sensitivity	Impact
		Energy Plant and only small or negligible change is assessed for the visual amenity. Overall the change to the setting is assessed as small.		
6	Nether Kinniel, Shell Middens and Antonine Wall	The site of the Middens is within dense woodland and immediately adjacent to the extensive petro- chemical and industrial complex at Grangemouth. The existing baseline is dominated by heavy industry and views toward the site are expected to be almost completely blocked by intervening vegetation and other large industrial features. The landscape change to the setting is assessed as negligible-none	medium	negligible
7	Inveravon Roman Camp	The landscape is elevated and flat around the two sites allowing views north towards quarrying works at Birkhill and southwards towards the Forth Estuary and the extensive industrial landscape surrounding Grangemouth. View 6 (Antonine Wall) is assessed within the visual assessment (Section 10.9) as experiencing a moderate visual impacts as a result of the proposed Renewable Energy Plant. There will be no physical change to the landscape surrounding the two sites and change to the visual amenity is assessed as moderate and not significant. Overall the landscape change to the setting is assessed as small.	medium	Slight-moderate
8	Kinneil House	The house and estate are surrounded by substantial woodland which prevents views out towards the site from the immediate grounds. From the edges of the estate, views may be possible looking towards the site but the existing view is dominated in part by the existing industry at Grangemouth and the Longannet Power Station and the change to the view and setting through the introduction of the proposed Renewable Energy Plant is assessed as small. No physical change to the setting of the estate will occur through the proposed Renewable Energy Plant and only small change is expected to the visual amenity. Overall a small-negligible landscape change to the setting is assessed.	high	moderate
9	Avondale House, palisaded enclosure	Feature is lost to quarrying. Not considered further.	N/A	none
10	Lathallan enclosure	The site of the enclosure is to the east of the A801 and south of the M9 which are both raised on embankment and lined with screening vegetation. No landscape change or change to the visual amenity of the site is expected through the introduction of the proposed Renewable Energy Plant.	medium	negligible

### Area of Great Landscape Value and Candidate Special Landscape Areas

- 10.8.36 Due to the distance between the site and the designated areas and the intervening industrial and urban areas between the site and both AGLVs, any impacts from the Renewable Energy Plant can only result from visual impacts assessed as creating a change over key elements of the designation. The sensitivity of the areas is assessed here as high.
- 10.8.37 There is one view assessed in Section 10.9 which falls within the Bo'ness south AGLV and two viewpoints which fall within the Avon Valley and Denny Hills AGLV, these are respectively:
- View 6 Antonine Wall; and
  - View 7 Cockleroy and View 16 A706.

- 10.8.38 A further additional viewpoint was surveyed from the Kilsyth Hills AGLV beyond the 10km detailed study area. This view was added following consultations with SNH.
- 10.8.39 These viewpoints are useful in gathering a selection of representative views from within both designations. The visual impacts assessed range from moderate to slight-negligible and are not considered to be significant impacts. The ZTVI indicates that the majority of both AGLVs fall outside of the potential visual influence of the proposed Renewable Energy Plant.
- 10.8.40 There will be no physical change to the designated areas and the impacts with respect to visual amenity are assessed as not significant.
- 10.8.41 The overall landscape impacts of the proposed development for the two AGLVs within the 10km detailed study area are assessed as slight-negligible. Landscape impacts on AGLV areas beyond 10km are assessed as being less than slight.

### Registered Historic Gardens and Designed Landscapes

- 10.8.42 The six Registered Historic Gardens and Designed Landscapes within the study area are assessed in Table 10.18 below with regard to potential impacts on their landscape setting.

**Table 10.18: Potential Impacts on the Landscape Setting of Registered Historic Gardens and Designed Landscapes**

	Registered Historic Gardens and Designed Landscapes	Elements and Features protected	Sensitivity	Impact
1	Tulliallan Castle	The castle and castle grounds are set within extensive woodland and views toward the site are not expected to be possible. The setting of the castle is not characterised by views of the estuary and no physical change will occur through the development of the proposed Renewable Energy Plant. The change to the landscape setting is assessed as negligible.	High	slight
2	Dunimarle Castle	Dunimarle Castle is a private estate with a turreted mansion enjoying views over the Forth Estuary. A view close to this site on the coastline near Culross (View 12 Culross) is assessed within the visual assessment (Section10.9) The visual impact from this location is assessed as moderate and not significant. There will be no physical change to the setting of the castle and any views of the proposed development will be through or over vegetation which surrounds the estate. The overall landscape change is assessed as small.	High	moderate
3	Culross Abbey	The abbey is positioned on raised ground above the village of Culross but is surrounded by mature vegetation with few views toward the site or the estuary possible. The setting of the abbey will not be physically altered through the development of the proposed Renewable Energy Plant and its visual amenity will not be significantly affected. The overall landscape change is assessed as small-negligible.	High	Slight-moderate
4	Valleyfield House, Garden	The park falls outside of the theoretical visibility of the proposed Renewable Energy Plant and no visual impact is expected. The landscape setting will experience no physical change and the landscape change is assessed as none.	medium	Negligible.
5	Callendar Park	The park sits over a variable terrain and the house and its immediate setting are at a level where no views toward the site or the Forth Estuary are possible and no connection with this landscape occurs. A view from the edge of the park where views towards the site are possible is included within the visual assessment (Section10.9) as view 8 Callender Park. The visual impact from this view is assessed as moderate and not significant. No physical change will occur to the landscape setting as a result of the proposed Renewable Energy Plant and the visual amenity will not be affected to a significant degree. The landscape change is assessed as small.	High	moderate



	Registered Historic Gardens and Designed Landscapes	Elements and Features protected	Sensitivity	Impact
6	Dunmore Park/The Pineapple	The hall and gardens are located within an estate surrounded by mature woodland and the landscape setting is characterised by the flat, open farmland rather than the Forth Estuary which can only just be made out from some locations at the edge of the estate. There will be no physical change to the landscape setting and the visual amenity is not expected to be altered through the introduction of the proposed Renewable Energy Plant. The landscape change is assessed as small-negligible.	High	Slight

### Conservation Areas

10.8.43 The change to the characteristics and elements identified in the listings of each Conservation Area are considered in Table 10.19 below.

Table 10.19: Residual Landscape effects on Conservation Areas

	Conservation Area	Magnitude of Change	Sensitivity	Landscape Impact
1	Alloa	View 14 is considered within the visual assessment and is assessed as moderate slight and not significant. No physical change will occur to the conservation area and impacts on the view from the harbour will be in keeping with the industrial nature of this part of the Alloa conservation area. The change is assessed as small.	Medium	Slight-moderate
2	Airth	Views toward the site may be possible and view 10 within the visual assessment is situated south of Airth and is assessed as experiencing slight-moderate visual impact. No physical change will occur to the conservation area and the visual change to the setting is anticipated as negligible. The change is assessed as negligible.	Medium	Negligible
3	Arnothill	An area within the centre of Falkirk where visual amenity and physical form are expected to remain unchanged. The change is assessed as negligible.	Medium	Negligible
4	Bo'ness Grange Terrace	Views towards the application site from positions within the conservation area are possible and View 5 is assessed within the visual assessment as returning a moderate visual impact. No physical change to the area will occur and the change to the visual amenity is anticipated as small. The change is assessed as small-negligible.	Medium	Slight-moderate
5	Bo'ness Town Centre	Views towards the application site from positions within the conservation area are possible and View 5 is assessed within the visual assessment as returning a moderate visual impact. No physical change to the area will occur and the change to the visual amenity is anticipated as small. The change is assessed as small-negligible.	Medium	Slight-moderate
6	Dunmore Conservation Area	Parts of the conservation area are on the coast and distant views of the application site may be possible from the rear of some properties. No physical change will occur to the conservation area and the change to the visual amenity is anticipated to be negligible.	High	Slight
7	Falkirk Town Centre	An area within the centre of Falkirk where visual amenity and physical form are expected to remain unchanged. The change is assessed as negligible.	High	Slight
8	Letham	Views toward the application site may be possible and view 10 within the visual assessment is situated west of Letham and is assessed as experiencing	Medium	Negligible



	Conservation Area	Magnitude of Change	Sensitivity	Landscape Impact
		slight-moderate visual impact. No physical change will occur to the conservation area and the visual change to the setting is anticipated as negligible. The change is assessed as negligible.		
9	Muirhouses	No physical change will occur and views of the site will be largely blocked by topography and the town of Bo'ness to the west. The change is assessed as negligible.	Medium	Negligible
10	Linlithgow	No physical change will occur to the conservation area and the visual amenity of the town will not be significantly affected. The change is assessed as negligible.	Medium	Negligible
11	Kincardine	Views towards the application site from within the conservation area will be possible and View 11 from the bridge is assessed as experiencing potentially significant visual impacts. No physical change will occur and the majority of the area will remain unaffected by the visual impacts at or around the bridge. The overall change is assessed as small.	High	Moderate

## Grangemouth Port and Town Centre

### Urban Form

- 10.8.44 From the baseline study it is clear that the Port and the Town no longer share a strong physical connection with the old, waterside part of the town, now completely lost. What remains is a less than cohesive mix of Victorian and modern building and town planning which appears disconnected to the estuary, the port, and as a consequence, the wider landscape.
- 10.8.45 The proposed Renewable Energy Plant will sit within an area of the Port which is largely open and underused land. The layout and arrangement of the plant will seek to position the largest elements of the development at the furthest distance from the nearest receptors within the town. The scale of buildings will also be largely congruent with other structures within the port, with the auxiliary boiler, reception buildings and mixed fuel buildings all at or under 20 m in height.
- 10.8.46 The change to views from within the town will be largely restricted to its edges which are explored and illustrated within the visual assessment (Section 10.9) The tallest element of the proposal (the 110m stack and the 65m high boiler house) will appear to alter the urban form at these edges and a physical connection with the operation and workings of the port will become more evident.
- 10.8.47 The sensitivity is assessed as low and the proposed Renewable Energy Plant has the opportunity through a quality architectural response to offer a strong industrial character link to the Port of Grangemouth which would have at one time been integral to the town's urban fabric.
- 10.8.48 The change to urban form is assessed as medium and the impact slight-moderate.

### Activity

- 10.8.49 The activity within the port is lower than that of the town and the introduction of the proposed Renewable Energy Plant will inevitably increase activity on the application site which is largely unused at present.
- 10.8.50 The construction phase of the development will necessitate a large and noticeable increase in traffic and activity lasting for 36 months. The operational phase on site will experience an increase in activity over the existing baseline, but this will be in keeping with the historic levels of activity within the Port (see Chapter 18).

- 10.8.51 The change will be noticeable during construction but will reduce to a small amount over and above the current baseline level. The impact is assessed as slight moderate.

#### **Cultural Heritage**

- 10.8.52 The introduction of the proposed Renewable Energy Plant will be a large, modern industrial building at the edge of the town and its impact on the cultural heritage of Grangemouth will be experienced through the emphasis this may place on a general view of the town and the setting of its existing heritage.
- 10.8.53 The town does not retain a strong cultural heritage through its built environment and the proposed plant is not expected to dominate views from within the town centre.
- 10.8.54 The change is assessed as small as no actual loss of features will occur and few if any views of the proposed development from the town centre will be possible. The impact on Cultural Heritage is assessed as slight with the potential for a strong, quality architectural response to add a new dimension to the cultural vitality of the town.

#### **Built Environment**

- 10.8.55 The potential exists to create an architectural form within the port environment, which is of high quality, sensitive to the established urban context and adds value and interest to the built environment of the port. The proposed form and layout of the buildings, together with the outline architectural proposals for their appearance, indicate that this potential can be realised through the development of the proposed Renewable Energy Plant.
- 10.8.56 The introduction of the Renewable Energy Plant will be a large change to the port as this will involve the introduction of substantial new built form. For the broader town the change is assessed as small in magnitude as the few buildings of interest will remain unaffected and the general quality of the built environment will not be altered.
- 10.8.57 The impact on the built environment is assessed as ranging between moderate for the port and slight -moderate for the town. The architectural treatment of the plant looks to create a development with a strong sense of local character which offers the opportunity to add a distinctive new feature into the built environment of Grangemouth.

#### **Open Space**

- 10.8.58 The proposed development will not affect any of the open areas currently accessible to the public and no element of public amenity space would be removed or physically altered. The visual amenity of the Zetland Gardens is expected to remain unaltered and the change is negligible. The impact is assessed as negligible.

#### **Connectivity**

- 10.8.59 The port and town have little connectivity at present but each enjoys a relatively well organised and accessible network of connections which enable them to function almost independently.
- 10.8.60 The proposals will connect to the existing road networks and will not affect the current pedestrian routes and networks through town or port areas. The change will be negligible resulting in a landscape impact of negligible.

#### **Visual Amenity**

- 10.8.61 The visual amenity will be changed through the introduction of the Renewable Energy Plant as can be seen in the photomontages/wireframes in Figures 10.9 Asda Car Park and 10.10.1 Grangeburn Road. The largest change to the visual amenity will be from immediately within the port and at the

edges of the town where views of the port are currently possible above existing vegetation surrounding much of the boundary. The existing visual amenity of both the port and the town includes tall, large scale, industrial buildings and structures and these features are a stronger visual element than the wider landscape and the Forth Estuary which, even within the port, are not often visible as a single panoramic experience.

- 10.8.62 The impact on visual amenity is assessed as moderate for both the port and the town and not significant. The architectural styling of the building offers an opportunity, particularly within the port, to increase the quality of the built environment and the visual connections between the port buildings, the Forth Estuary, the town of Grangemouth and the function of the building itself.
- 10.8.63 Table 10.20 below contains a summary of the landscape sensitivity and the anticipated change to the baseline brought about through the development of the Renewable Energy Plant. An assessment of the overall townscape impact for each character element is expressed in the final column.

**Table 10.20: Landscape Impacts –Grangemouth Port and City Centre**

Character Element	Townscape Sensitivity	Magnitude of Change	Construction Impact	Operational Impact
Urban Form	Low	Medium	Medium	Slight moderate
Activity	Medium	Small	Moderate	Slight-moderate
Cultural Heritage	Low-medium	Small	Slight	Slight
Built Environment	Low-medium	Large for port small for town	Moderate-slight	Moderate/ slight-moderate
Open Space	Medium	Negligible	Negligible	Negligible
Connectivity	Medium	Small-negligible	Slight-negligible	Negligible
Visual Amenity	Low-medium	Large for the port small for the town	Moderate-slight	Moderate

#### **Regional Landscape Context - the landscape south of the Forth Estuary**

- 10.8.64 The nine landscape character areas considered are distant from the site and none of these will undergo any physical change through the construction of the proposed Renewable Energy Plant as shown in Table 10.21.
- 10.8.65 Fifteen views assessed in Section 10.9 which fall within these landscape character areas, are:
- View 1 Asda Car Park, Grangemouth – Coastal Flats (Stirling to Grangemouth);
  - View 2 Grangeburn Road, Grangemouth – Coastal Flats (Stirling to Grangemouth);
  - View 3 Skinflats, Brackenlees Rd – Coastal Flats (Stirling to Grangemouth);
  - View 4 Bothkennar Road, Carronshore – Lowland river valleys (Stirling to Grangemouth);
  - View 5 Bo'ness Harbour – Coastal Flats (Stirling to Grangemouth);
  - View 6 Antonine Wall – Coastal Coastal Hills (Stirling to Grangemouth);
  - View 7 Cockleroy ; -Lowland hills and ridges (Lothians)
  - View 8 Callender Park, Falkirk – Lowland river valleys (Stirling to Grangemouth);
  - View 9 Falkirk Wheel – Lowland river valleys (Stirling to Grangemouth);
  - View 10 M876/A905 – Coastal Flats (Stirling to Grangemouth);
  - View 15 Union Canal Polmont (Stirling to Grangemouth);
  - View 16 A706 (within AGLV) (Lothians);

- View 17 Kilsyth Hills AGLV (Central);
- View 18 Stirling Castle (Stirling to Grangemouth) and
- View 19 Wallace Monument (Stirling to Grangemouth).

10.8.66 The visual impacts for these fifteen views range from negligible to substantial, three views have potentially significant visual impacts identified, these are View 1, View 2 and View 3.

**Table 10. 21: Landscape Impacts – the landscape south of the Forth Estuary**

	Magnitude of Change	Summary of Assessed Sensitivity	Landscape Impact
<b>Lowland Hill Fringes</b>	No views are considered within the visual assessment from this character area but no significant landscape visual impacts have been identified at receptors several kilometres closer to the site. The ZTVI indicates that it may be possible to view the proposed Renewable Energy Plant from locations within this character area. No physical change will occur to the area as a result of the proposed Renewable Energy Plant and the change is assessed as small-negligible.	Low-medium	Slight
<b>Lowland Plateau</b>	The ZTVI indicates that no views are anticipated from this character area. The nearest view at this distance is at Cockleroy (view 7) which will experience no significant visual impact. No physical change will occur to this landscape and the change is assessed as negligible.	Low	Negligible
<b>Lowland River Valleys</b>	A great proportion of the Falkirk-Denny Urban Fringe landscape unit is urbanised with the conurbations of Falkirk, Stenhousemuir and Polmont. These conurbations have been assessed as experiencing no significant landscape effects as a result of the proposed Renewable Energy Plant. The Avon Valley landscape unit is predominantly outside of the ZTVI and no landscape change or visual impact is anticipated through the new development. Viewpoint 10 is at the edge of the Carse of Forth landscape unit and is assessed in the visual assessment (Section 10.9) as experiencing slight-moderate visual effects. No physical change to the landscape unit is anticipated. Overall the changes to the landscape character area are small and involve visual impacts which only occasionally effect visual amenity. The extent of this change to visual amenity is never to a significant degree.	Medium	Slight -moderate
<b>Coastal Margins</b>	A large proportion of the Bo'ness Flats landscape unit is urbanised with the conurbations of Grangemouth and Bo'ness. These conurbations have been assessed as experiencing no significant landscape effects. Five views from within the two landscape units are assessed within the visual assessment (Section 10.9) three of these views close to the site (Views 1, 2 and 3) are assessed as experiencing potentially significant effects as a result of the proposed Renewable Energy Plant. The landscape character area will experience some physical change but this will be in character and scale with the receiving industrial landscape. The landscape will also experience some significant effects on visual amenity. The overall landscape change is assessed as small.	Low	Slight
<b>Lowland Hills and Ridge</b>	The north facing slopes of the Bathgate Hills are identified within the ZTVI as having potential visual impacts as a result of the proposed Renewable Energy Plant. The remaining areas within the character area will not experience views of the proposed development. Two views (View 7 and 16) from this area are assessed within the	Medium	Negligible

	Magnitude of Change	Summary of Assessed Sensitivity	Landscape Impact
	visual assessment and are assessed as experiencing slight or slight-negligible visual effects. No physical change is anticipated through the proposed development and no significant effect on visual amenity is anticipated. The landscape change is assessed as small-negligible.		
<b>Coastal Margins (Lothians)</b>	The landscape character area falls largely outside the potential areas of visual influence of the proposed Renewable Energy Plant identified in the ZTVI. The character area includes the conurbation of Linlithgow which is assessed as experiencing no significant landscape effects. No physical change on the landscape character area will result from the proposed development. The change is assessed as negligible.	Medium	Negligible
<b>Hill fringes</b>	This character area is 7 km from the site at its closest point and has potential visibility of the proposed Renewable Energy Plant. View 17 is assessed from this landscape unit confirming that no significant visual effects will occur. No physical change will result from the proposed development and the change is assessed as negligible.	Medium	Negligible
<b>Plateau</b>	The majority of this landscape unit has no potential visibility of the proposed Renewable Energy Plant as illustrated in the ZTVI. Only the slopes rising up above Falkirk may experience some visual effects but at approximately 6 km no significant visual effects are anticipated. No physical change to the landscape will result from the proposed development. The change is assessed as negligible.	Low-medium	Negligible
<b>Lowland River valleys</b>	A great proportion of the Falkirk-Denny Urban Fringe landscape unit is urbanised with the conurbations of Falkirk and Stenhousemuir. These conurbations have been assessed as experiencing no significant landscape effects as a result of the proposed Renewable Energy Plant. Four views (Views 4, 8, 9 and 15) are assessed in the visual assessment (Section 10.9), none of these viewpoints has been assessed as experiencing significant visual effects. No physical change to the landscape unit is anticipated. Overall the changes to the landscape character area are small and involve visual impacts which only occasionally affect visual amenity.	Low	Slight

### Regional Landscape Context - the landscape north of the Forth Estuary

- 10.8.67 The landscape character types considered below are all distant from the site and separated from it by the Forth Estuary. No physical change will occur to any of the landscape character types as a result of the proposed Renewable Energy Plant as shown in Table 10.22.
- 10.8.68 Four views are considered within Section 10.9 which fall within the character types listed below and are considered as representative of the impacts on visual amenity likely to occur as a result of the proposed Renewable Energy Plant. These views are as follows:
- View 11 Kincardine Bridge- (Fife);
  - View 12 Culross -(Fife);
  - View 13 New Row- Coastal Hills (Fife); and
  - View 14 Alloa –Carse of Forth (Stirling to Grangemouth).
- 10.8.69 It was assessed that the visual impact at these receptors ranged from moderate-substantial to moderate-slight, please refer to Table 10.22 below.

Table 10.22: Landscape Impacts – the landscape north of the Forth Estuary

	Magnitude of Change	Summary of Assessed Sensitivity	Landscape Impact
<b>Lowland Hills and Valleys (Fife)</b>	The majority of the landscape unit will not experience any visual impacts from the proposed Renewable Energy Plant as demonstrated through the ZTVI. No physical change will occur to the landscape as a result of the proposed development. The landscape change is assessed as negligible.	Medium	Negligible
<b>Coastal Hills (Fife)</b>	View 13 within the visual assessment (Section 10.9) is assessed as experiencing moderate-slight visual impacts from within this landscape unit. Generally the coastal hills have a visual connection with the estuary and the views across this and some change to the visual amenity is expected as a result of the proposed Renewable Energy Plant. No physical change will occur to the landscape unit as a result of the development. The landscape change is assessed as small.	Low	Slight
<b>Coastal Flats (Fife)</b>	These landscape units also share a strong visual connection with the Forth Estuary and are adjacent to the assessed views 11 and 12. The visual impacts assessed for these views range from moderate/slight to moderate substantial with the potential for significant effects over visual amenity. No physical change will occur to the landscape as a result of the development. There is expected to be a noticeable change to the visual amenity of the landscape and the overall landscape change is assessed as small-medium	Low-medium	Moderate
<b>Valley Fringes (Central)</b>	The majority of the landscape unit will not experience any visual impacts from the proposed Renewable Energy Plant as demonstrated through the ZTVI. No physical change will occur to the landscape as a result of the proposed development. The landscape change is assessed as negligible.	Medium	Negligible
<b>Lowland River Valleys (Stirling to Grangemouth)</b>	Views towards the site from within this character area will be possible but no significant visual impacts are expected at this distance. The landscape change is assessed as small. View 14 is taken from within this character area and is assessed (Section 10.9) as experiencing moderate – slight visual impacts.	Low Medium	Slight

### Landscape Cumulative Impacts

- 10.8.70 There are a number of other developments currently in the planning stages that need to be considered with regard to cumulative impacts.

### Biodeisel plant at the Ineos Complex Grangemouth

- 10.8.71 The Environmental Statement for the biodiesel plant at the Ineos Complex in Grangemouth has scoped out landscape and visual effects due to the proposed scheme's location within the existing industrial complex at Grangemouth. It is not proposed to consider this project further within the cumulative impacts section as the landscape and visual impacts are of no significance.

### Port of Grangemouth Wind Turbines

- 10.8.72 Forth Energy is proposing a wind development scheme within the Port of Grangemouth. Currently this project is in the early stages of development and no fixed information is available on the number and position of turbines. As a result it is proposed not to consider this project further within the cumulative impacts section.

### Longannet Biomass Power Plant

- 10.8.73 There are proposals for a 20-25 MW biomass power plant on the shores of the Forth Estuary on a site located to the immediate west of the existing Longannet Power Station.



- 10.8.74 The ES study produced in support of the Longannet Biomass Power Plant identifies no significant landscape effects resulting from the proposed plant and no significant cumulative effects from its introduction into the receiving landscape.

#### **Forth Energy Renewable Energy Plant at Rosyth**

- 10.8.75 Forth Energy is proposing a Renewable Energy Plant within the Port at Rosyth. The proposed development is likely to be similar in scale and construction to the Grangemouth Renewable Energy Plant and will sit close to the edge of the Forth Estuary and adjacent to Rosyth Castle.
- 10.8.76 The proposed Renewable Energy Plant at Rosyth is at such a distance from the site that visual impacts are assessed as being negligible. No landscape cumulative impacts are anticipated through the introduction of the proposed Grangemouth Renewable Energy Plant.

#### **Forth Energy Renewable Energy Plant at Leith**

- 10.8.77 Forth Energy is proposing a Renewable Energy Plant within the Port of Leith. The proposed development will be similar to the Grangemouth Renewable Energy Plant albeit that the boiler house will be twice the length).
- 10.8.78 The proposed plant at Leith is at such a distance from the site that visual impacts are assessed as being negligible. No landscape cumulative impacts are anticipated through the introduction of the proposed plant at Grangemouth.

### **10.9 Landscape Summary**

- 10.9.1 The proposed Renewable Energy Plant will be a large industrial structure located within a working port on the edge of Grangemouth. The scale and height of some of the buildings, most notably the boiler house and the 110m stack will appear as large in scale in comparison with much of the existing port infrastructure. The immediate landscape setting, however, has two notable industrial complexes; the existing Longannet power station and the petro-chemical and industrial complex at Grangemouth, both of which are of a much larger scale and will place the proposed plant in the wider setting of a heavily industrialised coastal corridor.
- 10.9.2 The proposed Renewable Energy Plant will only be partially visible from within the town of Grangemouth. From the wider landscape the proposed plant is more often than not seen in direct association with the existing industrial facilities within the port, the petro-chemical complex and the existing Longannet power station. The landscape baseline is one which has been defined through the development of a number of differing heavy industrial processes and businesses which have led to both the development of the port and the surrounding conurbations. The proposed Renewable Energy Plant will be entirely in keeping with this tradition of development and built form along this section of the Forth Estuary where a variety of strong natural landscapes meet an equally strong man made and industrial landscape character.
- 10.9.3 The proposed Renewable Energy Plant will be designed in such a way as to offer a quality architectural response to the port environment and the town of Grangemouth as a whole. No alteration to the existing relationship between the town, the Forth Estuary and the port will occur as a consequence of the proposed plant.
- 10.9.4 The largest landscape impacts are assessed for the application site where a landscape impact of moderate is recorded. This impact will be neutral or beneficial as the change to the existing baseline cannot be seen to be detrimental through the introduction of the proposed Renewable Energy Plant as the core function and form of the port is derived through its existence as a large conduit for industrial and port related activities.



- 10.9.5 Landscape impacts on the town of Grangemouth have been assessed as ranging from negligible to slight-moderate. No significant landscape effect is anticipated through the introduction of the proposed Renewable Energy Plant. Landscape impacts on settlements outside of Grangemouth have been assessed as not significant.
- 10.9.6 Landscape impacts on landscape designations comprising Scheduled Monuments, AGLV's, the Antonine Wall World Heritage Site, Registered Historic Gardens and Designed Landscapes and Conservation Areas were not assessed as significant.
- 10.9.7 Landscape impacts on the wider landscape south of the Forth Estuary have been assessed as ranging from slight-moderate to negligible landscape impacts. No significant landscape effect is anticipated through the introduction of the proposed Renewable Energy Plant into this landscape.
- 10.9.8 Landscape impacts on the wider landscape north of the Forth Estuary have been assessed as ranging from moderate to negligible. No significant landscape effect is anticipated through the introduction of the proposed Renewable Energy Plant into this landscape.
- 10.9.9 No significant cumulative landscape impacts were identified for the projects identified.
- 10.9.10 No significant landscape impacts have been assessed for the study area through considering the introduction to this landscape of the proposed Renewable Energy Plant.

## **10.10 Visual Amenity**

### **Visual Baseline**

- 10.10.1 The visual amenity of Grangemouth and the surrounding landscape is a mix of varied landscapes, townscapes, waterfronts and industrial spaces which range from the coastal lowlands around the Forth Estuary to the foothills of the Ochils and Touch Hills. Panoramic views are possible from some positions but wide, distant views are not always characteristic.
- 10.10.2 The Zone of Theoretical Visibility (Figures 10.1 and 10.2) identifies large areas of the Forth Estuary and the landscape to either side of this as potential areas where the development may be seen. As the land rises to the north, west and south, so the potential visibility of the development diminishes.
- 10.10.3 In considering the visual amenity of the study area, a number of receptors have been chosen to represent both the variety and scope of the study area and also to examine particular views and/or receptors which are of particular note or importance. These viewpoints have been selected through studying the ZTV, site visits and a consideration of the planning, cultural and historical background of the study area. In addition where Landscape Character Areas have been identified as having visual amenity as a key element, a view or views have been selected to represent this.

### **Regional Visual Character and Amenity**

- 10.10.4 The detailed 10km study area extends from the foothills of the Ochils to the north of Culross to the undulating Slammanan plateau south of Falkirk and from Bonnybridge in the west to Bo'ness and the Forth Estuary to the east. The 30km study area extends the edges of Glasgow to the west and Edinburgh to the east.
- 10.10.5 The low lying, flat coastal margins and lowlands are clearly visible on the ZTV (fig 10.1) where no natural landform intervenes to prevent long range views across the Forth Estuary and towards the hills and uplands at the extents of the study area. The Ochils form a natural visual barrier to the north while the Touch Hills and Bathgate Hills form a similarly effective barrier to the south and west.
- 10.10.6 To the north and south of the study area and to the far west, undulating, rising ground begins to prevent views back toward the site. Views from prominent high points in the landscape such as at Cockleroy are panoramic and distant. Views from the northern coast line around Culross are wide

ranging but dominated by the existing Longannet power station and the industrial port at Grangemouth.

- 10.10.7 The landscape is in places densely populated with a major industrial component to the built environment. In addition, the area is crossed by a number of major roads, motorways and rail links. All these features combine on the lowland and coastal areas to form physical visual barriers, preventing many long range views and connections.

#### **Key Characteristics**

- Large scale open landscape in lowland areas;
- Urban landscape with many large industrial elements;
- Wide ranging, panoramic views possible from selected points within the landscape;
- Many detracting features throughout.

#### **Local Visual Character and Amenity**

- 10.10.8 The town of Grangemouth sits directly south of the site and the port but does not enjoy a riverside location although it is physically close to the waters edge. Both the modern day port and the massive petro-chemical plant to the east combine to prevent views toward and across the Forth Estuary from the town's edge.
- 10.10.9 The town was originally laid out in a wide and generous style which gives an open spacious feel to parts of the town and allows a degree of inter-visibility between streets and buildings.
- 10.10.10 The port itself is positioned out into the Forth Estuary which allows for much wider and far reaching views in all directions. Views to the north are dominated by the ever present Ochils while views in all other directions tend to be dominated by the surrounding port activities, infrastructure and the other nearby industrial facilities.
- 10.10.11 The key characteristics of the region with respect to visual character and amenity are:
- Low density urban and industrial landscape;
  - Views within the town restricted to local distances while the port enjoys wider long distance views;
  - Many detracting features at close range often interrupting or preventing views.

#### **Viewpoint Locations**

- 10.10.12 Fourteen views have been selected from positions within the detailed 10 km study area. These have been identified through consideration of the computer generated ZTV and then refined through site visits to determine the most representative views available. A further five views were assessed in response to comments made by SNH. Some of these views are beyond the 10km study area and extend the considered visual amenity into the 30km study area. A total of nineteen views have been assessed.
- 10.10.13 The viewpoints selected are numbered below and their locations identified by Ordnance Survey grid reference. Their positions are also indicated in Figures 10.8.1 and 10.8.2. Photographs of views from these locations are included in Figures 10.9 to 10.27, which also show wireframes and, for selected views, photomontages of the proposed plant. View locations 15,16,17,18 and 19 were added during consultation with SNH and will be illustrated as Figures 10.23 onwards.
- 10.10.14 For distant views the proposed plant has been represented as a wire frame image only to try and clearly illustrate scale and massing in what is quite a complex view from such a distance. A

photomontage has been used in selected views, 2-3km from the site, where the plant is easier to identify within the landscape setting.

**Table 10.23: Viewpoint locations**

	Viewpoint Location	National Grid Reference	Distance from site (km)
1	A904 Asda Car Park, Grangemouth	292762,682184	0.69
2	Grangeburn Road, Grangemouth	293541,682071	0.41
3	Skinflats Nature Reserve	292056,683970	2.01
4	Bothkennar Road, Carronshore	289612,683296	3.87
5	Bo'ness Harbour	299759,681896	6.39
6	Antonine Wall	295945,679830	3.93
7	Cockleroy	698948,674361	9.81
8	Callendar Park, Falkirk	290052,679516	4.47
9	Falkirk Wheel	285253,680006	8.51
10	M876/A905	290474,685762	4.40
11	Kincardine Bridge	292811,687290	4.87
12	Culross	298365,685860	6.02
13	New Row	294351,687155	4.77
14	Alloa	288335,692074	10.88
15	Union Canal Polmont	292840,678224	4.28
16	A706 (within AGLV)	297395,675440	8.08
17	Kilsyth Hills AGLV	273442,681169	19.98
18	Stirling Castle	279069,693969	18.18
19	Wallace Monument	280922,695666	18.22

### Viewpoint Description and Visual Baseline

#### View 1 Asda Car Park, Grangemouth (Figure 10.9)

- 10.10.15 The view looks towards the site across the Asda car park in Grangemouth and is low lying at or around the AOD of the port. The existing Asda store and port buildings are visible in the immediate foreground with boundary fencing and other store related structures prominent in the view. In the near distance, a stack and administrative buildings within the port can be seen breaking the skyline. Cranes, containers and other port structures are visible through and above scrub woodland.
- 10.10.16 The receptors are principally users of the store car park and are representative of views from the nearby A904. The view does not extend to any great distance and does not include any views of the Forth Estuary or any distant views of the landscape beyond. The quality of the view is assessed as poor and the sensitivity is assessed as low, due to the predominant receptor being users of vehicles and people visiting the Asda store.

#### View 2 Grangeburn Road, Grangemouth (Figures 10.10.1)

- 10.10.17 This view is taken from the edge of the Grange Burn alongside Grangeburn Road which can be seen in the immediate foreground, and looks directly towards the site. Between the site and the viewer is a series of earth banks and young scrub and screen woodland planting. Car parking, boundary fencing and low rise port buildings also form part of the view. A wider panoramic from this location takes in other larger industrial structures within the port and the petro-chemical plant.
- 10.10.18 Behind the viewer, South Shore Road runs from east-west and is lined by 2 storey residential properties, these block views back towards the town centre. No views of the Forth Estuary are possible from ground floor level although from upper floor windows this may become possible.

- 10.10.19 The principal receptors are residential properties along Grangeburn Road and vehicle and pedestrian users of the same road. The quality of the view is moderate to low with most views being restricted in their range by the low lying topography and the mounded and planted boundaries to the port. The sensitivity of the view is assessed as high for residential receptors and medium for pedestrian users of the road.

**View 3 Skinflats (Figure 10.11.1)**

- 10.10.20 The views from Skinflats are wide and panoramic across flat, low lying agricultural fields. Very little intervening vegetation breaks the view towards the site and the large expanse of industrial buildings and structures which make up the port and the petro-chemical complexes at Grangemouth. Large numbers of tall stacks, cranes and other structures break the skyline across the horizon with the lower but equally distinctive silos within the port on the far left.
- 10.10.21 A visible plume can be seen in the centre of the view and is often more expansive covering much of the area where stacks break the skyline. The plume above and around Grangemouth is very distinctive and typical of views towards the town and port.
- 10.10.22 The receptors are users of Brackenlees Road and a small group of properties along this road and Newton Road. The quality of the view is moderate-low with the wide panoramic and open view towards the Forth Estuary being balanced against a large number of prominent and detracting industrial elements which create a distinctive skyline feature. The sensitivity of the view is assessed as high for residents of the properties along the road but assessed as low for users of the road network.

**View 4 Bothkennar Road, Carronshore (Figure 10.12)**

- 10.10.23 The view is from the edge of the village of Carronshore and looks towards the site along the Bothkennar Road. Long range views to the distant Ochils are possible across a large, flat landscape which is regularly interrupted with remnant hedgerows and small woodland copses. Large pylons and other vertical mast structures cross the view from left to right.
- 10.10.24 The view is representative of some properties within Carronshore which have windows looking out over the fields in the direction of Grangemouth. Other receptors of the view will include pedestrians and vehicles using the Bothkennar Road.
- 10.10.25 The quality of the view is medium –low due to the detracting features of the pylons and poorly maintained landscape features such as the hedgerows and field boundaries. The sensitivity of the residential properties is assessed as high with the sensitivity of users of the road and footpath assessed as low.

**View 5 Bo'ness Harbour (Figure 10.13.1)**

- 10.10.26 Views from the shoreline at Bo'ness are wide ranging and encompass a 180 degree panoramic northward across the Forth Estuary. The view toward the site includes the shoreline of the Forth Estuary on both sides of the estuary and extends to distant views of the Ochils.
- 10.10.27 The Port of Grangemouth can be clearly identified in the view by the prominent cranes and other industrial structures along its length as can the petro-chemical industries further east where numerous stacks break the skyline and form a prominent feature in the view. On the other side of the Forth Estuary the power station at Longannet forms another prominent feature with both the stack and main building form breaking the skyline at the waters edge. A visible plume which rises above and around the Port and petro-chemical plant at Grangemouth is a common site, and when present, can further highlight the presence of the industrial sites.

- 10.10.28 The main receptors of the view are pedestrians using the coastal path and park. The view is also representative of some views from properties along the A904 and within Bo'ness Town where the property faces directly toward the site with a clear, uninterrupted view. The quality of the view is assessed as moderate with the industrial elements being detracting features. The sensitivity is assessed as high.

#### **View 6 Antonine Wall (Figure 10.14)**

- 10.10.29 The view is from Grange Road which runs along the line of the Antonine Wall at this location. It is dominated by the Grangemouth petro-chemical site and includes numerous large scale industrial buildings and structures. The most notable elements within the view are the tall stacks and other structures which break the skyline and cluster together to form a prominent feature in their own right. A plume is visible from a number of different locations within the site and is a typical addition to the view being more or less extensive depending on the atmospheric conditions. The Port of Grangemouth is largely obscured from view by the other industrial buildings in the immediate foreground. The silos at the northern tip of the port can be made out in the centre of the view.
- 10.10.30 Beyond the Grangemouth industrial complex, the Forth Estuary can be seen in the view with the Longannet Power Station also clearly visible on the opposite shore. In the far distance the Ochils form a dramatic backdrop and horizon line.
- 10.10.31 The receptors of the view are principally users of the road network in cars but the view is also representative of views from the Antonine Wall World Heritage Site. A small number of properties along Grange Road will also experience similar views from within or close to their property boundaries.
- 10.10.32 The view is an interesting and arresting one but the quality is assessed as poor because of the dominance of the industrial landscape and prevalence of visible plume which can add to this effect. The sensitivity is assessed as high to take account of the status of the Antonine Wall and the small number of residential properties within the vicinity.

#### **View 7 Cockleroy (Figure 10.15)**

- 10.10.33 This viewpoint is located on top of Cockleroy Hill at 278m AOD at the edges of the Bathgate Hills. A wide, 360 degree panoramic view of the surrounding countryside and the Forth Estuary is possible from the vantage point and the town of Grangemouth and its associated industrial complexes and Port can be clearly seen at the edge of the estuary. In the far distance, across the Forth Estuary, the Ochils form a dominant feature along the horizon running east to west. The ground falls away swiftly from the viewing point with the land between the viewer and the site being predominantly open, rough grazing land with small stands of woodland at regular intervals.
- 10.10.34 In the wider view, the Forth Road Bridge crossing at Rosyth is visible to the east and directly across the Forth Estuary the power station at Longannet is a prominent feature on the estuary.
- 10.10.35 Receptors are users of the nearby footpath networks. The quality of the view is assessed as high with a wide ranging panoramic view possible taking in the major landscape features of the Ochils and the Forth Estuary and the Bathgate Hills. The sensitivity is assessed as high.

#### **View 8 Callendar Park, Falkirk (Figure 10.16)**

- 10.10.36 The view is taken from within Callendar Park near to the Antonine Wall but elevated above Callendar House which is sufficiently lower than the surrounding landscape to prevent any views towards the site. In the immediate fore-ground the edges of the parkland landscape are visible before dropping sharply away towards the A803 Callendar Road. Here the rooflines of buildings fronting the road interrupt the view.

- 10.10.37 The Port of Grangemouth can just be made out with some of the cranes and tanks at its northern extent visible above the roofline of the Graeme High School. The stack at Longannet breaks the skyline to the left of the Port and is a prominent feature in the view. In the far distance the Ochils form the horizon line where boundary vegetation does not prevent the view.
- 10.10.38 The landscape to the rear of view drops away sharply before rising to a prominent tree covered ridgeline, beyond which no views are possible. To the immediate west, four high rise residential blocks at Seaton Place will experience similar views from windows facing north although substantial tree cover around these buildings will limit views considerably.
- 10.10.39 The principal receptors are users of the park although the view is likely to represent elevated views from some of the properties at Seaton Place. The quality of the view is moderate-low as it includes many detracting features such as the nearby road network, adjacent school and office buildings and the more distant industrial facilities at the Port of Grangemouth and the Longannet Power Station. The sensitivity of the receptor is assessed as high.

**View 9 The Falkirk Wheel (Figure 10.17)**

- 10.10.40 The view is from the raised section of the canal towpath adjacent to the Falkirk Wheel. In the foreground a car park and the Falkirk Wheel itself sit below the canal with young screen woodland planted throughout the area. In the middle distance, the outskirts of Camelon and Falkirk appear as a combination of relatively low level housing and industrial units.
- 10.10.41 In the far distance the stack at Longannet Power Station can be clearly seen breaking the skyline. Below this, the Port at Grangemouth can be made out with cranes and silos just visible. In the far distance the Ochils form the horizon with the Forth Estuary visible below this running east to west. The larger stacks and plume associated with the petro-chemical industries at Grangemouth are not visible in the view due to the intervening vegetation although in certain circumstances the plume may rise above this.
- 10.10.42 The principal receptors are people visiting the Falkirk Wheel and users of the canal network. The quality of the view is moderate-poor with the long range and expansive views being balanced against the detracting elements of urban and industrial sprawl. The sensitivity of the view is assessed as medium.

**View 10 M876/A905 (Figure 10.18.1)**

- 10.10.43 The view is across a flat, agricultural landscape with little in the way of vegetation or other features. The road network and associated lighting columns dominate the view leading the eye out towards the Forth Estuary. To the left of the view in the middle distance, the petro-chemical complex at Grangemouth can be seen with stacks occasionally breaking the skyline. In the far distance the Ochils form the horizon line with small glimpses of the Forth Estuary possible below this.
- 10.10.44 A plume is visible above the Grangemouth Industrial complex and rises as far as the horizon where it visually disappears due to the nature of the weather conditions. On clear days the plume may rise above the horizon and form a noticeable visual form which will highlight the location of the Grangemouth industrial complex.
- 10.10.45 The principal receptors of the view are users of the road network but the view may be representative of views from the edge of the village of Airth. From this more distant location intervening vegetation appears to block the views towards Grangemouth and only the stack at Longannet is visible above the tree line. The quality of the view is assessed as moderate-low. The sensitivity is assessed as low for users of the road network and high for any residential properties at the edge of Airth where views towards the site are possible.



**View 11 Kincardine Bridge (Figure 10.19.1)**

- 10.10.46 The view from across the Forth Estuary at Kincardine is taken from the bridge crossing at its northern end. In the foreground the estuary expands away from the viewer allowing a wide and panoramic view towards Grangemouth and the southern shore. The land to the south rises away from the estuary to a low horizon with the Bathgate Hills forming a slight variation to this at the left of the view.
- 10.10.47 The petro-chemical complex at Grangemouth is visible on the far shore and is made more noticeable by the extent of visible plume which rises above the stacks and other building structures on the site. The Port of Grangemouth is visible in the view but more difficult to distinguish due to the distance. Also visible from this location is the Longannet power station.
- 10.10.48 Receptors are vehicular users of the bridge and pedestrians and cyclists on the bridge or nearby footpath networks. The view may also be representative for a small number of properties with grounds or upper floor windows within Kincardine who have views out across the Firth. The quality of the view is moderate and the sensitivity of the view is assessed as low for vehicular users but medium for pedestrians and cyclists. Where views from residential properties are possible the sensitivity is assessed as high.

**View 12 Culross (Figure 10.20.1)**

- 10.10.49 The view is from the village of Culross which sits directly on the northern bank of the Forth Estuary. The view from this location is open and panoramic allowing clear views south towards Grangemouth and the gently rolling landscape beyond. The Port of Grangemouth can be distinguished from the petro-chemical complex at Grangemouth with the silos and cranes visible to the right of the view.
- 10.10.50 The cranes at the Port of Grangemouth and a number of the stacks at the petro-chemical complex break the skyline. A number of plumes are also visible in the view emanating from the stacks and cooling towers. The plume is a distinctive element in the view and is often present, drawing the attention of the viewer towards the Port and Industrial complexes at Grangemouth. The Longannet power station dominates the northern coast of the estuary and its stack and building form break the skyline in the right of the view.
- 10.10.51 Receptors are pedestrians and vehicles travelling within the village and residential properties which have windows or doors overlooking the estuary. The quality of the view is moderate-high with only the detracting industrial elements in the view lowering the score. The sensitivity is assessed as high for the residential properties and pedestrians and low for vehicle users.

**View 13 New Row (Figure 10.21)**

- 10.10.52 The view is from the east of Kincardine on elevated ground above the A985. It is wide and panoramic and includes distant views across the Forth Estuary to the Bathgate Hills on the horizon. In the immediate foreground and to the north along new row are a group of bungalows which have views out toward the estuary.
- 10.10.53 The Longannet power station dominates the northern shore of the Forth Estuary and the stack and building structure break the skyline in the left of the view. In the centre of the view other infrastructure related to the power station can be seen together with large pylons and pylons lines which cross the Forth Estuary.
- 10.10.54 Across the Forth Estuary the port and industrial complexes at Grangemouth are visible with stacks and pylons breaking the skyline. A plume is visible above and amongst the Grangemouth petro-chemical complex and at Longannet.



- 10.10.55 Receptors are users of the road network and residential properties lining New Row. The quality of the view is moderate-low with many detracting, large scale industrial features. The sensitivity is assessed as high for residential properties and pedestrians and low for vehicular users of the road network.

**View 14 Alloa (Figure 10.22)**

- 10.10.56 The view is from the outskirts of Alloa by the edge of the Forth Estuary at a noted viewing point. The surrounding area is commercial and industrial with residential properties only appearing further north away from the estuary. Distant views are possible along the Firth with the industrial complexes and port at Grangemouth visible below the Bathgate Hills. A visible plume surrounds the industry at Grangemouth but does not rise above the horizon.
- 10.10.57 In the foreground the view is dominated by large pylons and lines which cross the estuary, other large pylon structures are also visible in the middle distance.
- 10.10.58 The receptors are pedestrian users of the waterside footpath and commercial properties in and around the waterfront. The quality of the view is moderate-low and the sensitivity is assessed as high for pedestrian visitors to the viewing point and low for commercial and industrial properties.

**View 15 Union Canal Polmont (Figure 10.23)**

- 10.10.59 The view is taken from the towpath of the Union Canal with housing on the northern bank sitting below the level of the canal. Views towards the site are possible above the roof tops with the Ochils forming the visible horizon. The stack at the Longannet power station is visible to the right of the view but the urban massing of Polmont blocks views of other industrial elements or visible plume within Grangemouth.
- 10.10.60 The quality of the view is poor but increases to moderate along some stretches of the canal outside of Polmont where wider views across countryside are possible. The principal receptors are users of the canal and towpath with some residential receptors facing on to the canal experiencing similar views from upper floor windows. The sensitivity is assessed as high due to the nature of the receptors and the status of the canal as a Scheduled Monument.

**View 16 A706 (within AGLV) (Figure 10.24)**

- 10.10.61 The view is from the northern edge of the Avon Valley and Denny Hills AGLV, below Cockleroy, The landscape in the foreground is gently rolling with small woodland copses and hedgerow trees dissecting the field systems in the middle distance. The edge of Polmont can be seen in the centre of the view with the Industrial complex at Grangemouth and the Longannet Power Station both clearly visible against the backdrop of the Ochils and the Forth Estuary. A visible plume rises above these industrial facilities from a variety of different sources but does not break the skyline.
- 10.10.62 The quality of the view is moderate with overhead lines, the urban conurbation of Polmont and the distant industrial features on the Forth Estuary being detracting elements in what is otherwise an attractive rural outlook. The sensitivity of the view is assessed as low for vehicular users and high for walkers within the northern edge of the AGLV at the foot of the Bathgate Hills.

**View 17 Kilsyth Hills AGLV (Figure 10.25)**

- 10.10.63 The view is from a viewing point and car park within the Kilsyth Hills AGLV. From this elevated position the view stretches out into the distance with a wide panoramic view possible through 180 degrees. The distance and the elevation of the view make identifying individual elements on the flat estuary flood plain below difficult, and the viewer is generally led towards considering the view in its fullest extent with no particular landscape or man made feature drawing the eye. The Forth Estuary

can just be made out in the left of the view before the land mass in the immediate foreground intervenes.

- 10.10.64 The quality of the view is high and the sensitivity is assessed as high.

**View 18 Stirling Castle (Figure 10.26)**

- 10.10.65 The view is from the outer ramparts of Stirling Castle looking directly south toward the Forth Estuary estuary. In the immediate foreground the Castle car park runs to the edge of the natural promontory before the ground falls steeply away with the town dropping away on the slopes below. The view is wide and panoramic and includes dramatic views of the mountainous setting of the Wallace Monument to the east.
- 10.10.66 The Longannet Power Station can be made out towards the centre of the view breaking the skyline. Further west the port and petro-chemical plant at Grangemouth can just be made out below the skyline with a visible plume rising from a number of different sources.
- 10.10.67 The principal receptors are visitors to the castle but the view is representative of other potential views from elevated or upper floor windows on higher ground in Stirling. The quality of the view is high and the sensitivity of the view is assessed as high.

**View 19 Wallace Monument (Figure 10.27)**

- 10.10.68 The view is from the top of the Wallace Monument and looks south along the estuary towards the site. In the middle distance the River Forth can be seen snaking through the flat valley bottom and into the Forth Estuary. The Longannet Power Station can be seen on the northern bank of the Forth Estuary with Grangemouth port and industrial complexes visible on the southern bank. The view is wide and panoramic and includes Stirling and Stirling Castle to the west.
- 10.10.69 The receptors are visitors to the monument. The quality of the view is high and the sensitivity is assessed as high.

**Visual impacts and residual visual effects**

- 10.10.70 The visual impacts of the development revolve around the visibility or otherwise of the taller elements of the proposals, as buildings and structure within the proposed Renewable Energy Plant, which match existing warehouse buildings or storage in terms of scale, mass and height, will have little noticeable impact over the views selected.
- 10.10.71 Each view is assessed with regard to the degree or magnitude of change the proposed development will bring. This change is then considered against the sensitivity of the receptors which enjoy the view and a judgement is made on what the impact of the development on the view will be. A factor in the consideration is the existing quality of the baseline view and whether this is affected by the proposals irrespective of whether changes to the view are noted. Changes can occur to views that are neutral in terms of its impacts, if the quality of the view and its overall amenity are judged to remain unchanged.
- 10.10.72 In addition, in selected views, the visual impact of the proposed Forth Energy Renewable Energy Plants at Rosyth and Leith are considered together with proposals for a Biomass Power Plant at Longannet. These projects will be illustrated alongside the proposed Renewable Energy Plant at Grangemouth to determine what level of cumulative visual impact may result from a combination of developments being in place.

**View 1 Asda Car Park , Grangemouth (Figure 10.9)**

- 10.10.73 The introduction of the Renewable Energy Plant to the view will be a large and noticeable change with the mixed fuel store, boiler house, turbine hall, cooling towers and 110m stack all rising above

the existing horizon. The view will be dominated by the proposed Renewable Energy Plant but will not remove from the existing visual amenity any views of the Forth Estuary or more distant views of the Ochils.

- 10.10.74 The tallest elements of the Renewable Energy Plant are noticeably larger than the surrounding port and store infrastructure but the cooling towers and mixed fuel store appear to be of a similar scale and mass to the nearby Forth Ports offices and the Asda store.
- 10.10.75 The architectural treatment of the plant seeks to highlight the similarity in scale and massing of the lower elements of the proposed Renewable Energy Plant through a strong exterior theme based around the imagery of the container port. The tallest elements would be treated through architectural cladding and material choices to render them more transparent and less visible in the view. It is anticipated that this approach would lead to the reduction of the visual impact of the proposed Renewable Energy Plant on the view particularly with regard to the extent it would dominate the view.
- 10.10.76 The quality of the view is assessed as poor and the sensitivity is assessed as low. The change to the view is large but the quality of the view is assessed as unchanged as there is no loss of distant views or views of key landscape or other notable features. The overall impact is assessed as moderate.
- 10.10.77 When visible, the plume will be seen from this location, rising above the skyline and potentially blocking views of open sky. The change to the view will remain large during the period when the plume is visible and may lead to significant visual impacts where climatic condition lead to an alteration of the sky and horizon above the proposed Renewable Energy Plant as well as the permanent visual changes associated with the building proposals.
- 10.10.78 Construction impacts are likely to be similar in terms of the requirement to construct buildings of a scale as previously described but will include moving elements which may attract the attention of the viewer toward the site. The impacts are likely to increase as the buildings are constructed, but are not expected to exceed the level of impact identified for the final development. The construction phase impact is assessed as moderate.

#### **View 2 Grangeburn Road (Figure 10.23 and 10.10.2)**

- 10.10.79 A large proportion of the proposed Renewable Energy Plant will not be visible from this viewpoint as existing mounding and building structures screen all but the tallest elements of the proposed plant. The boiler house and stack can be clearly seen rising above the existing mound and screen planting while the open stockpile appears just above this.
- 10.10.80 In the immediate context of the view the addition of the boiler house and stack will introduce tall, industrial elements which will appear large in scale and mass. The wider visual amenity from this location however includes other large, tall industrial structures within the Port and at the petrochemical plant further east.
- 10.10.81 The quality of the view is moderate to low. The sensitivity of the view is assessed as high for residential receptors and medium for pedestrian users of the road. The change to the view is large but the existing screen planting along the Grange Burn and on the existing mounding will grow to provide a significant level of screening. The impact is assessed as substantial for residential properties and moderate-substantial for pedestrians and other receptors. Existing screen planting would be expected to reduce the magnitude of change over a 10 year period to medium with the overall impact expected to reduce to moderate-substantial or below for all receptors.
- 10.10.82 When visible the plume will be seen from this location, forming a noticeable change to the open sky and skyline. The change to the view will remain large during the period when the plume is visible.

Following the development and growth of the existing screen planting, the plume will remain visible but will become more noticeable as other elements are reduced in the view. As a consequence the impacts with plume are expected to remain as significant even after the maturation of screen planting.

- 10.10.83 Construction impacts will include cranes and other supporting structures which will at times break the skyline and may be moving elements attracting greater visual interest than the static structures. Much of the ground level operations of construction will be hidden from view behind the existing screen mounding and planting. The magnitude of change to the view will vary and will not exceed that of the completed structures; as such the impact for construction is assessed as moderate.

**View 3 Skinflats (Figure 10.11.1, 10.12.2 and 10.11.3)**

- 10.10.84 The Renewable Energy Plant will form a prominent new addition to the skyline and will rise above the apparent height of the existing stacks and other industrial elements which appear in the middle distance. The scale and massing of the proposed plant appears larger than the other industrial features within the Port and the petro-chemical plant.
- 10.10.85 The architectural treatment of the plant seeks to highlight the lower elements of the proposed Renewable Energy Plant through a strong exterior theme based around the imagery of the container port. The tallest elements would be treated through architectural cladding and material choices to render them more transparent and less visible in the view. It is anticipated that this approach would lead to the reduction of the visual impact of the boiler house and stacks.
- 10.10.86 The open stockpile is visible in the view but does not break the skyline. The silo option would equally be visible in the view but would also not break the skyline. No difference in impact is expected through the use of one option over another.
- 10.10.87 The plume, when visible, will rise above the existing industrial stacks and cooling towers. It will however be viewed in the context of a broad panoramic view which has, as a regular feature, plumes from a multiple of different sources over a wide section of the existing view. The visible plume is likely to draw attention further to the position of the proposed Renewable Energy Plant but is not expected to change the quality of the view or alter the overall magnitude of change.
- 10.10.88 The quality of the view is moderate-low. The sensitivity of the view is assessed as high for residents of the properties along the road but assessed as low for users of the road network. The change to the view is noticeable and the new feature will be prominent with a magnitude of change assessed as large. The quality of the view will remain the same but the visual impact is assessed as substantial for residential properties falling to moderate for users of the road network.
- 10.10.89 Construction impacts will be less than that identified for the completed Renewable Energy Plant with only moving elements and taller cranes being noticeable additional elements in the view. The impact is assessed as moderate.

**View 4 Bothkennar Road, Carronshore (Figure 10.12)**

- 10.10.90 The majority of the Renewable Energy Plant will be hidden from view by the intervening vegetation with only the stack appearing above this. Visibility of the stack and sections of the boiler house will most likely only appear in winter months where, the stack will fall amongst the existing upright forms of existing mature trees. In summer it is expected that vegetation will almost completely obscure the view of the proposed plant.
- 10.10.91 The quality of the view is medium-low. The sensitivity of the residential properties are assessed as high with the sensitivity of users of the road and footpath assessed as low. The change to the view is

negligible to none in summer months. The overall impact is assessed as slight to negligible. The quality of the view will remain the same.

- 10.10.92 The plume, when visible, may rise above the tree line under certain atmospheric conditions. In these circumstances the plume will highlight the position of the Renewable Energy Plant and will feature in the view as a new, albeit, transitory element. The change to the view with the addition of a visible plume is assessed as low with the overall impact rising to moderate on days where a combination of views of the stack and the plume are possible.
- 10.10.93 Construction impacts are likely to be limited to occasional views of crane towers and other supporting structures during the construction of the stack and boiler hall. The change will be small and overall impact slight-negligible.

#### **View 5 Bo'ness Harbour (Figures 10.13.1, 10.13.2)**

- 10.10.94 From the harbour at Bo'ness the proposed Renewable Energy Plant will be visible principally through the boiler hall and stack. The stack will break the skyline while the boiler house will rise to the level of the distant Ochils on the horizon. Other elements of the proposed plant are difficult to discern at this viewing distance and disappear in the general urban form of the port and surrounding industry. The scale, height and massing of the proposed Renewable Energy Plant will appear consistent with the view of the surrounding Port and petro-chemical industry complex at Grangemouth provide a backdrop of similar structures and forms. The Longannet power station will remain the largest and most prominent feature in the view.
- 10.10.95 The quality of the view is assessed as moderate with the industrial elements being detracting features. The sensitivity is assessed as high. The change to the view is noticeable and but no notable element of the existing view will be lost through the construction of the proposed plant. The change to the view is assessed as small and the overall visual impact assessed as moderate.
- 10.10.96 The plume, when present, will be visible rising above the proposed Renewable Energy Plant, but this will join the other visible plumes rising from a multitude of stacks, cooling towers and other structures across this industrial landscape. At this distance the existing visible plume appears to rise from Grangemouth and does not highlight particular structures as it is (from our site experience) always a collection of multiple plumes from different sources. The change to the view through the addition of a visible plume from this location is assessed as small to negligible and no change to the overall visual impact is anticipated.
- 10.10.97 Construction impacts are likely to involve the potential view of cranes and other supportive tall structures and the general movement and busyness of a major construction site. At this distance this is likely to be only occasionally noticeable and the change is assessed as small-negligible leading to a construction visual impact of slight.

#### **View 6 Antonine Wall (Figure 10.14)**

- 10.10.98 The Renewable Energy Plant will be seen amongst the industrial expanse of the Grangemouth petro- chemical complex. The stack and the boiler house appear in the view to the left of a group of existing stacks and cooling towers and will be similar in scale to these elements. The stack and boiler house will break the skyline but will not appear any more prominent or noticeable than the existing industrial structures which fill this landscape.
- 10.10.99 The quality of the view is assessed as poor and the sensitivity is assessed as high. No change to the quality of the view is anticipated through the introduction of the Renewable Energy Plant as the view is already dominated by similar industrial features. The magnitude of change is assessed as small and may not be noticeable by the casual observer. The impact on the view is assessed as moderate.



- 10.10.100 The plume, when present, will be visible but will merge into the general industrial landscape which is characterised by plumes from multiple sources. No change to the visual impact when the plume from the proposed Renewable Energy Plant is visible is anticipated.
- 10.10.101 Construction impacts will be limited to cranes and other supporting structures used to build the taller elements of the proposals and will be transient depending on the progress of the build. The change is assessed as small with an overall impact of slight.

**View 7 Cockleroy (Figure 19.15)**

- 10.10.102 The proposed Renewable Energy Plant sits between the urban mass of Grangemouth Town and the Industrial expanse of the Grangemouth petro-chemical complex with a narrow channel of the Forth Estuary visible below this, identifying its location as being on the estuary edge. The proposed plant is hard to distinguish in the view and the boiler house and stack are the only visible elements which can be identified with any degree of clarity. The existing petro-chemical and industrial complex is viewed as a collection of industrial elements with the port and town forming a less visible adjunct to this urban mass. The proposed Renewable Energy Plant will sit within this grouping and be viewed as part of the collective of industrial forms.
- 10.10.103 The quality of the view is assessed as high with the sensitivity also assessed as high. The magnitude of change is assessed as negligible as the location of the proposed Renewable Energy Plant would be hard to determine without an aid or reference to its location. The visual impact is assessed as slight.
- 10.10.104 The plume will be visible in the view, and when present, will draw attention to the presence of the proposed Renewable Energy Plant. The existing view however typically includes a large element of visible plume from multiple sources, which, when viewed from this distance, create the effect of a plume over and around the whole Grangemouth industrial complex and port. The plume from the proposed Renewable Energy Plant, when visible, is likely to be read in the context of this wider industrial plume and under these circumstance would not highlight the location of the proposed plant or add significantly to the assessed visual impact.
- 10.10.105 Construction work on all elements of the Renewable Energy Plant will not be clearly visible although the construction cranes may be discernible when they are present. The change is assessed as negligible-none with an overall impact of slight-negligible.

**View 8 Callendar Park, Falkirk (Figure 10.16)**

- 10.10.106 In this view, the proposed Renewable Energy Plant will be visible just above the roofline of the Graeme High School. The boiler house and stack appear to be the principal elements visible in the view with only the stack slightly breaking the skyline. The Longannet Power Station is visible to the left of the proposed Renewable Energy Plant and is a similar but larger industrial feature already in view. From this angle the proposed Renewable Energy Plant will block views of an existing stack within the port of Grangemouth and other industrial elements within the port.
- 10.10.107 The quality of the existing view is moderate-low. The sensitivity of the receptor is assessed as high. The change to the view will be noticeable but small with the proposed Renewable Energy Plant appearing in a section of the view and landscape which already has as part of its context other large, tall, industrial buildings and structures. No change to the quality of the view is expected through the introduction of the proposed Renewable Energy Plant. The visual impact is assessed as moderate.
- 10.10.108 The plume, when present, will be visible rising above the proposed plant and immediately afterwards above the horizon line. The extent to which the plume is visible with the sky as the principal background will be very dependent on atmospheric conditions. The existing view includes visible plumes emanating from the Longannet power plant and from other industrial elements in and around

Grangemouth port and the petro-chemical and industrial complex at Grangemouth. It is expected that the plume from the proposed Renewable Energy Plant, when visible, will draw attention to the location of the plant but will not add to the overall visual impact to a significant degree.

- 10.10.109 Construction impacts will be variable in nature as the structures rise above the existing roof tops and will generally be less substantial than the completed Renewable Energy Plant. The change will be small and the overall impact moderate –slight.

**View 9 The Falkirk Wheel (Figure 10.17)**

- 10.10.110 The proposed Renewable Energy Plant will not be visible from this angle of view as it falls behind a block of screening vegetation in the car park in the immediate foreground. Other angles from the canal and the wheel itself will provide a clearer uninterrupted view towards the site where the proposed Renewable Energy Plant appears close to the horizon with the stack just breaking the skyline.
- 10.10.111 The proposed Renewable Energy Plant will appear as a small but noticeable addition to the view and its position within the Port of Grangemouth on the edge of the Forth Estuary can be clearly identified. The existing view includes other tall, industrial features within the vicinity of the proposed Renewable Energy Plant with the largest of these, the Longannet power station, being the most prominent. The change to the view will not be incongruous and the Longannet power station and its stack will remain as the tallest and most prominent feature in the near distance.
- 10.10.112 The quality of the view is moderate-poor with the long range and expansive views being balanced against the detracting elements of urban and industrial sprawl. The sensitivity of the view is assessed as medium. The change to the view is assessed as small with intervening vegetation preventing a view of the proposed Renewable Energy Plant altogether from some locations. The overall visual impact is assessed as slight moderate.
- 10.10.113 The plume, when present, will be visible above the proposed plant and stack but will almost immediately be seen only against the background of the sky. The extent to which the plume is visible with the sky as the principal background will be very dependent on atmospheric conditions. The plume will draw the attention of the viewer towards the location of the proposed plant but will be seen in the context of a landscape and view which already has visible plume emanating from the existing power station at Longannet and other industrial structures in and around Grangemouth. No change to the assessed visual impact is anticipated through the transitory inclusion of a plume from the proposed Renewable Energy Plant.
- 10.10.114 Construction impacts will be variable in nature as the structures rise above the existing port landscape and will generally be less substantial than the completed Renewable Energy Plant. The change will be small-negligible and the overall impact slight.

**View 10 M876/A905 (Figures 10.18.1 and 10.18.2 and 10.18.3)**

- 10.10.115 The proposed Renewable Energy Plant will appear in the view rising above the existing petro-chemical and industrial complex at Grangemouth. Only the boiler house and the stack will appear visible above a group of cooling towers and to the right of a cluster of existing stacks. The stack will just break the skyline. The scale of the proposed Renewable Energy Plant is similar to its surrounding industrial setting and the building and its structures will not be an incongruous addition to the view.
- 10.10.116 The quality of the view is assessed as moderate-low. The sensitivity is assessed as low for users of the road network and high for any residential properties at the edge of Airth. No change to the quality of the view is expected through the introduction of the proposed Renewable Energy Plant. The change to the view will be noticeable but small with no element of the existing view obscured or



interrupted to any significant degree. The visual impact is assessed as slight for road users and moderate for any properties at the edge of Airth where views towards the site are possible.

10.10.117 The plume, when present, will be visible but will join a collection of other plumes emanating from multiple sources within the petro-chemical and industrial complex at Grangemouth. It is unlikely the addition of visible plume from the proposed Renewable Energy Plant will either direct the viewer to the location of the proposed plant or add significantly to the visual impact.

10.10.118 Construction impacts will be limited with only moving cranes likely to be noticeable in the view. The change is assessed as small-negligible with a slight-negligible overall impact.

#### **View 11 Kincardine Bridge (Figures 10.19.1, 10.19.2 and 10.19.3)**

10.10.119 The Renewable Energy Plant will appear a little apart from the main industrial complex at Grangemouth with all the main elements of the development visible in the view. The stack appears to just break the skyline with the other buildings falling below the horizon. The proposed Renewable Energy Plant is of a similar scale and size to other industrial structures but will appear as a prominent new feature in the port.

10.10.120 The quality of the view is moderate and the sensitivity of the view is assessed as low for vehicular users but medium for pedestrians and cyclists. Where views from residential properties are possible the sensitivity is assessed as high. The magnitude of change is assessed as medium as the change will be noticeable but the quality of the view will not change and the proposed Renewable Energy Plant will not dominate the view. The visual impact is assessed as slight-moderate for vehicle users, moderate for pedestrians and cyclists and moderate-substantial for residential views from gardens or ground floor windows.

10.10.121 The plume, when present, will rise above and around the proposed plant and highlight its location. The existing visual baseline includes an extensive visible plume emanating principally from the petro-chemical and industrial complex at Grangemouth. The addition of a visible plume from the proposed Renewable Energy Plant will not increase the visual impact assessed.

10.10.122 Construction impacts from this location will be visible as the taller elements of build rise from the estuary edge. Moving, tall elements such as cranes will be most noticeable but none of the construction impacts are expected to exceed that of the completed Renewable Energy Plant. The change is assessed as small and the visual impact is assessed as moderate-slight.

#### **View 12 Culross (Figures 10.20.1 and 10.20.2)**

10.10.123 The Renewable Energy Plant is visible across the Forth Estuary and appears to the right of the prominent petro-chemical and industrial complex at Grangemouth and within the port of Grangemouth. The 110 m stack will be the only element of the proposed plant which will break the skyline. The proposed plant will appear as the largest building group within the port but will not appear to be out of scale with its surroundings. Overall the proposed Renewable Energy Plant will be a noticeable addition to the view but will not appear incongruous or prominent on the shore line and will be viewed as part of the industrial landscape of Grangemouth. The Longannet power station will continue to be the dominant industrial feature in the view.

10.10.124 The quality of the existing view is moderate-high. The sensitivity is assessed as high for the residential and pedestrians and low for vehicle users. The change to the view is assessed as small with a noticeable change which will blend into the existing industrial landscape and will not alter the existing quality of the view. The visual impact is assessed as moderate for residential properties and slight for vehicle users.

10.10.125 The existing visual baseline has, as a regular feature, large numbers of plume which are viewed as one industrial feature principally emanating from the petro-chemical and industrial complex at Grangemouth. The visible plume from the proposed Renewable Energy Plant will be slightly separated from this grouping but the overall effect is expected to be the same with this plume being viewed alongside the existing plume. No change to the visual impact is anticipated when the plume from the proposed Renewable Energy Plant is visible.

10.10.126 Construction impacts from this location will be visible as the taller elements of build rise from the estuary edge. Moving, tall elements such as cranes will be most noticeable but none of the construction impacts are expected to exceed that of the completed Renewable Energy Plant. The change will be small and the visual impacts moderate-slight.

#### **View13 New Row (Figure 10.21)**

10.10.127 The proposed Renewable Energy Plant is visible between the Longannet power station and the large pylons crossing the Forth Estuary. From the illustrated angle of view part of the proposed plant will be obscured by residential properties in the foreground and views from other locations along the road may also be partially obscured by vegetation or other buildings or structures in the foreground. The 100m stack just breaks the skyline but the proposed Renewable Energy Plant will be seen in the context of a view full of large and prominent industrial features and dominated by the nearby Longannet power station.

10.10.128 The quality of the view is moderate-low with many detracting, large scale industrial features. The sensitivity is assessed as high for residential properties and pedestrians and low for vehicular users of the road network. The change is assessed as small with no change in the quality of the view. The visual impact is assessed as moderate for residential properties and slight for other receptors.

10.10.129 The existing visual baseline has, as a regular feature, large numbers of plume which are viewed as one industrial feature principally emanating from the petro-chemical and industrial complex at Grangemouth. The visible plume from the proposed Renewable Energy Plant will be slightly separated from this grouping but the overall effect is expected to be the same with this plume being viewed alongside the existing plume. In addition a visible plume is often a part of the visual baseline surrounding the adjacent Longannet power station. No change to the visual impact is anticipated when the plume from the proposed Renewable Energy Plant is visible.

10.10.130 Construction impacts from this location will be visible as the taller elements of build rise from the estuary edge. Moving, tall elements such as cranes will be most noticeable but none of the construction impacts are expected to exceed that of the completed Renewable Energy Plant. The change is assessed as small-negligible and the visual impact is assessed as slight.

#### **View14 Alloa (Figure 10.22)**

10.10.131 The proposed Renewable Energy Plant will be visible in the distance at the edge of the southern shores of the Forth Estuary. The boiler house and stack are most clearly visible with the stock pile possible discernible on a clear day. The change to the view will be noticeable but small as the proposed plant will rise above the low lying ground around the port and town forming a new feature on the coast line.

10.10.132 The quality of the view is moderate-low and the sensitivity is assessed as high for pedestrian visitors to the viewing point and low for commercial and industrial properties. The change to the view is assessed as small with the visual impact being moderate for visitors to the viewing point but slight or lower for commercial properties at the edge of Alloa.

10.10.133 The plume, when visible, will draw attention to the location of the proposed Renewable Energy Plant but this will merge into the mass of plume visible immediately behind and to the left of the site

emanating from the petro-chemical and industrial complex at Grangemouth. No change to the visual impact is anticipated.

- 10.10.134 Construction impacts will be small and mostly noticeable only when the stack and boiler house are erected and large and moving construction elements such as cranes are present. The impact is assessed as slight.

**View 15 Union Canal Polmont (Figure 10.23)**

- 10.10.135 At this angle of view none of the proposed Renewable Energy Plant will be visible above the roof lines. From other positions along the tow path it is likely that the stack will be visible in gaps between buildings but the rest of the proposed plant will remain out of sight.
- 10.10.136 The quality of the view is poor but increases to moderate along some stretches of the canal outside of Polmont where wider views across countryside are possible. The sensitivity is assessed as high. The change to the view is very small or negligible and the overall visual impact is assessed as slight.
- 10.10.137 No plume is visible from other sources on the day of survey but it is likely that a visible plume will appear above the roof lines on days where the plume is able to gain both height and visibility above the proposed plant. As the Longannet stack is visible in the view, this visible plume is likely to be accompanied by other similar plumes and as such will not draw attention to the plant unduly or be an especially incongruent element. No change to the overall visual impact is anticipated through the introduction of a plume from the proposed plant.
- 10.10.138 Construction impacts will be largely hidden from view and the impact is assessed as negligible.

**View 16 A706 (within AGLV) (Figure 10.24)**

- 10.10.139 The proposed Renewable Energy Plant will be visible in the far distance with both the boiler house and stack being discernible above the line of the Forth Estuary. As seen in Figure 10.24, the proposed plant will sit to the immediate left of the existing industrial complex at Grangemouth and will appear as part of this established industrial scene. No part of the proposed Renewable Energy Plant will break the skyline with the Ochils remaining as the dominant element on the horizon.
- 10.10.140 The quality of the view is moderate. The sensitivity of the view is assessed as low for vehicular users and high for walkers within the northern edge of the AGLV at the foot of the Bathgate Hills. The change to the view is small-negligible and unlikely to be noticed by the casual observer. The visual impact is assessed as ranging from negligible for vehicular users to slight for people on foot whose focus is on the view.
- 10.10.141 When visible the plume from the proposed Renewable Energy Plant will be seen rising above the plant. This will be seen in the context of the substantial visual plume already present at Grangemouth and is not expected to extend beyond the skyline. The change to the view with a visible plume is assessed as negligible with no change to the visual impact.
- 10.10.142 Construction impacts may be discernible at times where tall and moving elements such as cranes are employed on the site. These changes are not expected to exceed those derived from the completed plant and the visual impact for construction is assessed as negligible.

**View 17 Kilsyth Hills AGLV (Figure 10.25)**

- 10.10.143 The proposed Renewable Energy Plant will in theory be visible on the plain on the edge of the Forth Estuary. At this distance and elevation the Port of Grangemouth and the adjacent petro-chemical and industrial complex are difficult to make out and it is assumed that this effect will also affect the visibility of the proposed plant. It is likely that to the casual observer this change will go unnoticed

and even to the trained eye may take some time in establishing the exact position of the proposed Renewable Energy Plant. No part of the plant will break the skyline.

10.10.144 The quality of the view is high and the sensitivity is assessed as high. The change to the view is assessed as negligible and the impact is assessed as negligible.

10.10.145 The plume when visible is unlikely to be discernible and would be in a landscape where visible plume is already a common place element. No change to the visual impact is anticipated through the addition of plume.

10.10.146 Visual impacts for the construction phase are assessed as negligible.

#### **View 18 Stirling Castle (Figure 10.26)**

10.10.147 The proposed Renewable Energy Plant will in theory be visible in the far distance of the view with both the boiler house and stack sitting above the topography and vegetation of foreground landscape. The existing industrial facilities at Grangemouth can just be made out with the principal impact being derived through the visibility of rising plumes from a multiple of different sources. The proposed Renewable Energy Plant will sit within this existing industrial landscape and will not break the skyline.

10.10.148 The quality of the view is high and the sensitivity of the view is assessed as high. To the casual observer the introduction of the proposed plant is likely to go unnoticed with the noticeable change being greatly reduced by the effect of distance. The proposed plant will be seen in the context of the existing industrial facilities within the area, which, at this distance, will appear to be in very close proximity. The change to the view is assessed as negligible with the visual impact assessed as slight.

10.10.149 The plume, when visible, will appear within a landscape which has many visible plumes already present and at a distance which render these as small and inconsequential elements in the view. It is not anticipated that the plume from the proposed Renewable Energy Plant will break the skyline and no change to the visual impact is expected through the introduction of plume from the proposed plant.

10.10.150 Construction impacts are not expected to be noticeable and the impact is anticipated as negligible.

#### **View 19 Wallace Monument (Figure 10.27)**

10.10.151 The proposed Renewable Energy Plant will appear in the view directly in front of the existing petrochemical and industrial plant at Grangemouth. It will not break the skyline and its mass and scale will fall entirely within the outline of the Grangemouth complex, which, at this distance, appears as a single mass of tall industrial elements in the far distance. The change to the view will not be noticeable by the casual observer and may be entirely indiscernible with the proposed plant viewed as part of the existing industrial complex.

10.10.152 The quality of the view is high and the sensitivity is assessed as high. The change to the view will be negligible to none and the visual impact is assessed as negligible. Construction impacts are not expected to be discernible.

10.10.153 Any visible plume emanating from the proposed Renewable Energy Plant will be viewed with the Grangemouth complex behind and is likely to be accompanied by many other plumes as part of the existing baseline. No change to the visual impact is anticipated through plume from the proposed plant.

Table 10.24: Summary of visual impact assessment

	Viewpoint Location	Sensitivity	Magnitude of change	Construction impact	Operational Impact
1	A904 Asda Car Park, Grangemouth	Low	Large	Moderate	Moderate (occasionally moderate-substantial due to plume)
2	Grangeburn Road, Grangemouth	High-medium	Large	Moderate	Substantial-moderate/substantial
3	Skinflats Nature Reserve	High-low	Large	Moderate	Substantial-moderate
4	Bothkennar Road, Carronshore	High-low	Negligible-none (increased with plume)	Slight -negligible	Slight-negligible (moderate on occasion due to plume)
5	Bo'ness Harbour	High	Small	Slight	Moderate
6	Antonine Wall	High	Small	Slight	Moderate
7	Cockleroy	High	Negligible	Slight-negligible	Slight
8	Callendar Park, Falkirk	High	Small	Moderate-slight	Moderate
9	Falkirk Wheel	Medium	Small	Slight	Slight -moderate
10	M876/A905	High-low	Small	Slight-negligible	Slight-moderate
11	Kincardine Bridge	High-low	Medium	Slight/moderate	Slight/moderate-moderate/substantial
12	Culross	High-low	Small	Moderate-slight	Moderate-slight
13	New Row	High-low	Small	Slight	Moderate-slight
14	Alloa	High-low	Small	Slight	Moderate-slight
15	Union Canal Polmont	High	Small-negligible	Negligible	Slight
16	A706 (within AGLV)	High-low	Small-negligible	Negligible	Slight-negligible
17	Kilsyth Hills AGLV	High	Negligible	Negligible	Negligible
18	Stirling Castle	High	Negligible	Negligible	Slight
19	Wallace Monument	High	Negligible-none	None	Negligible

### Cumulative Visual Effects

10.10.154 Cumulative visual impacts are assessed for the proposed Biomass plant at Longanet and the Forth Energy proposed Renewable Energy Plants at Rosyth and Leith through the consideration of both a cumulative ZVI map at 30 km (Figure 10.28) and wireframes where the cumulative projects are modelled alongside the proposed Renewable Energy Plant in the view. These are discussed in detail in Table 10.25 below.

10.10.155 Figure 10.27 shows the theoretical intervisibility between the three Forth Energy Renewable Energy Plants at Grangemouth, Rosyth and Leith. From this a number of views have been selected where either a theoretical view of all three sites is possible or where previous on site work has indicated that an actual view of two of the sites will be possible. These views have been illustrated as wireframes showing all three Renewable Energy Plants together and this has been assessed with the intention that these views offer a representative picture of the potential cumulative impacts

possible throughout the study area. The views considered are: Figure 10.11.3 Skinflats, Figure 10.18.3 M876/A905 and Figure 10.19.3 Kincardine Bridge,

10.10.156 Cumulative visual impacts for the Longannet Biomass Plant are considered through wireframes in the following views: Figure 10.11.2 Skinflats, Figure 10.13.2, Figure 10.18.2, Figure 10.19.2 and Figure 10.20.2.

Cumulative Impacts	
<b>View 2</b>	<b>Skinflats Nature Reserve</b>
Longannet Biomass Power Plant	The proposed Biomass Plant at Longannet will be visible in a wide view on the northern shore of the Forth Estuary. The proposed Biodiesel plant will be a small change to the view with only the stack breaking the skyline and the development being seen in the context of both the existing power station at Longannet and the petro-chemical plant at Grangemouth. There will be a noticeable cumulative change with the addition of the proposed Renewable Energy Plant into this view but this will represent a small change and will not alter the visual impact assessed for the proposed Renewable Energy Plant of substantial-moderate.
Forth Energy Renewable Energy Plants at Rosyth and Leith	The proposed Renewable Energy Plant at Rosyth will be theoretically visible from this location but at this distance and with intervening structures and vegetation there will be no change to the view for the casual observer. The proposed Renewable Energy Plant at Leith will not be visible from this location. The cumulative change to the view through the addition of the proposed Renewable Energy Plant at Grangemouth will be negligible and the cumulative visual impact is assessed as negligible.
<b>View 5</b>	<b>Bo'ness Harbour</b>
Longannet Biodiesel Power Plant	The proposed Biomass Plant at Longannet falls behind the existing power station at Longannet from this viewing location. From other angles of view from within Bo'ness the proposed biomass plant will be visible but will always remain closely associated with the existing and much larger Longannet power station. The cumulative change to the view with the addition of the proposed Renewable Energy Plant at Grangemouth will be small –negligible as both the structure and any visible plume from the proposed biomass plant will be viewed in the context of an existing baseline where large scale industry is present on the northern shore of the Forth Estuary. The cumulative visual impact is assessed as negligible.
<b>View 7</b>	<b>Cockleroy</b>
Forth Energy Renewable Energy Plants at Rosyth and Leith	All three proposed Renewable Energy Plants are theoretically visible from this location but only the port at Rosyth can be made out with any certainty by the naked eye with Edinburgh and Leith being distinguishable through the general urban mass of the city and the large land mass of Arthurs seat. All three proposed Renewable Energy Plants will appear virtually indistinguishable from their surrounding landscapes and the cumulative change to the view will be negligible. The cumulative impact is assessed as negligible.
<b>View 10</b>	<b>M876/A905</b>
Longannet Biomass Power Plant	The proposed biomass plant at Longannet will be visible to the far left of a wide view from this location as just the stack above the existing tree line. This change to the view will be in the context of a landscape and skyline dominated by stacks, plume and other industrial structures from the existing Longannet power station and the industrial complex at Grangemouth. The cumulative change to the view with the addition of the proposed Renewable Energy Plant is assessed as small-negligible and the cumulative impact is assessed as slight-negligible.
Forth Energy Renewable Energy Plants at Rosyth and Leith	Both the proposed Renewable Energy Plants at Rosyth and Leith will fall behind the existing vegetation lining the coast line to the north and east. No cumulative visual impact will occur through the introduction of the proposed Renewable Energy Plant at Grangemouth.
<b>View 11</b>	<b>Kincardine Bridge</b>
Longannet Biomass Power Plant	The proposed Biomass Power Plant at Longannet will be visible through the pylons and to the immediate left of the existing Longannet power station structure. The boiler house and stack will be visible above intervening vegetation in the foreground. This angle of view will alter for receptors crossing the bridge but the proposed biomass plant will remain closely associated with the existing power station. The cumulative change with the addition of the proposed Renewable Energy Plant at Grangemouth will be small but noticeable. The combination of the two plants will create two new structures which break the skyline in locations which, from certain viewing angles, will be seen as distinct industrial developments, all be it in a landscape with a strong existing industrial character. The cumulative change is assessed as small and the cumulative impact slight.
<b>View 12</b>	<b>Culross</b>
Longannet Biomass Power Plant	The proposed biomass plant at Longannet cannot be seen from this location due to intervening topography and vegetation. No cumulative visual impacts will occur through the addition of the proposed Renewable Energy Plant into this view.



## Lighting

- 10.10.157 The proposed Renewable Energy Plant will be lit during a 24 hour working period. The lighting will be designed to reduce or remove glare and light pollution utilising lighting technologies which contain the lighting to within or close to the confines of the site. The light levels for a working Renewable Energy Plant site are not anticipated to exceed those currently experienced for a working port site which is currently lit for safe access and for operation under the hours of darkness.
- 10.10.158 Further consideration of lighting impacts will be required when the details of the type and scale of lighting proposed are developed. The lighting scheme will be discussed and agreed with Falkirk Council.

## 10.11 Visual Summary

- 10.11.1 This section summarises the visual impacts of the proposed Renewable Energy Plant on the study area. The proposed Grangemouth Renewable Energy Plant will create visual impacts throughout the study area but these are generally not significant, with four (Views 1, 2, 3 and 11) of the nineteen views potentially experiencing significant visual impacts. The majority of these significant impacts are restricted to within 2 km of the site with only views from Kincardine at 4 km being at a greater distance. Significant visual impacts identified from View 1 will only occur when a visible plume is present and for some of the time the proposed plant would operate without generating a significant visual impact.
- 10.11.2 Four of the views have been assessed as experiencing moderate visual impacts. These represent a noticeable change to the visual amenity and view of the receptor but have been determined as not significant within the context of this LVIA. View 4, Bothkennar Road, Carronshore will only experience moderate visual impacts when a visible plume is present and for some of the time (when plume is not present) the proposed plant would operate with a slight-negligible visual impact.
- 10.11.3 Nine of the views have been assessed as experiencing slight-moderate or slight visual impacts. These represent a change to the visual amenity or view which may be noticeable but will not greatly alter the nature, quality or extent of the view and may not be noticed at all by the casual observer.
- 10.11.4 The remaining two views assessed have been assessed as experiencing negligible visual impact. This represents a change to the visual amenity which is very small and in some circumstances there may be no change.
- 10.11.5 No significant cumulative visual impacts have been identified for the projects considered.
- 10.11.6 Although locally very flat and open, the large landscape is contained with the visual influence of the proposed Renewable Energy Plant being restricted to within the low lying land around the Forth Estuary.
- 10.11.7 All the visual impacts assessed will be considered within a context and a landscape which is broadly characterised by large industrial structures and features and the presence of visible plumes. It is reasonable to conclude that the significant impacts identified will be absorbed within the broad visual character without undue change or harm occurring to the visual amenity of the general landscape surrounding the Forth Estuary.

## 10.12 Landscape and Visual Conclusion

- 10.12.1 The proposed Renewable Energy Plant is, by its very nature, a large and complex industrial structure which will exert an influence over the surrounding landscape and visual amenity. The nature of this change will vary but from some locations close to the application site the impacts will inevitably be significant.

- 10.12.2 The Landscape and Visual Impact Assessment has considered a 30 km radius study area in seeking to determine the nature and extent of these significant impacts. This was further refined to a 10km study area where potential significant impacts were anticipated as possible. Both landscape and visual receptors at the periphery of this 10km study area have been tested and no significant impacts have been returned confirming the validity of this boundary extent.
- 10.12.3 Four significant visual impacts have been identified which occur principally within 2 km of the site. At one of these viewpoints, the significant visual impact identified will only occur when a visible plume is present. No significant landscape impacts were identified and no significant visual or landscape cumulative impacts have been identified.
- 10.12.4 Although visible on occasion from a considerable distance, the proposed Renewable Energy Plant is always seen in the context of a landscape which is often dominated, but always characterised, by the presence of existing large scale industrial structures and complexes. The proposed plant when viewed from the south is often not a skyline feature with the Ochils range forming a constant backdrop to many views from this landscape. Where the proposed plant does form a new skyline feature it is predominantly through the extension of the 110m stack which is itself a comparatively light structure in scale and massing to the existing Longannet stack.
- 10.12.5 The proposed Renewable Energy Plant rarely appears in isolation from the other large industrial structures nearby with only views from Kincardine identifying a physical gap between the petro-chemical complex at Grangemouth and the port. No cumulative vista of other proposed developments will occur through the introduction of the proposed Renewable Energy Plant and views down the Forth Estuary from important view locations such as Stirling Castle and Wallace Monument will be protected.
- 10.12.6 For a large and complex industrial structure the proposed Renewable Energy Plant will affect a relatively small number of visual receptors and areas of visual amenity. Generally, although not contained within the landscape, the proposed plant will be entirely in keeping with the established landscape and visual characteristics of the Forth estuary corridor. No significant issues are identified in relation to landscape designations, landscapes or views from noted viewing locations such as Stirling Castle, the Wallace Monument and viewing areas in the Kilsyth AGLV and Bathgate Hills.
- 10.12.7 The proposed architecture of the proposed plant offers a further opportunity to introduce a characterful and distinctive modern building to the urban landscape surrounding Grangemouth and this ultimately may come to be identified in a positive way with both the town and the port.

# Abbreviations

The following is a list of abbreviations adopted in Chapter 10 Landscape and Visual Impact.

<b>3D</b>	Three dimensional
<b>AGLV</b>	Area of Great Landscape Value
<b>AOD</b>	Above Ordnance Datum
<b>cm</b>	Centimetre(s)
<b>CSLA</b>	Candidate Special Landscape Area
<b>CZTV</b>	Cumulative Zone of Theoretical Visual Impact
<b>EIA</b>	Environmental Impact Assessment
<b>ES</b>	Environmental Statement
<b>GPS</b>	Global Positioning System
<b>H1</b>	Horizontal Guidance Note IPP6 H1
<b>ha</b>	Hectare
<b>km</b>	Kilometre(s)
<b>LCA</b>	Landscape character assessment
<b>LI</b>	Landscape Institute
<b>LVIA</b>	Landscape and visual impact assessment
<b>m</b>	Metre(s)
<b>m<sup>2</sup></b>	Square metre
<b>mm</b>	Millimetre(s)
<b>OS</b>	Ordnance Survey
<b>RRS</b>	Royal Research Ship
<b>SLA</b>	Special Landscape Area
<b>SNH</b>	Scottish National Heritage
<b>ZTV</b>	Zone of Theoretical Visual Impact
<b>ZVI</b>	Zone of Visual Influence

# Chapter 11

Noise and Vibration

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# 11 Noise and Vibration

## 11.1 Introduction

- 11.1.1 This Chapter outlines the potential noise and vibration effects of the proposed Grangemouth Renewable Energy Plant. The potential noise and vibration generated by the proposed development is assessed in terms of its impact upon the surrounding community with consideration being given to whether such an impact is 'significant'. In general terms this requires consideration of changes to, or increases in, environmental noise levels resulting from the proposed development. Where an impact is potentially significant, mitigation measures are proposed to control noise and vibration levels to acceptable levels.
- 11.1.2 An assessment has been made of the following potential impacts:
- Noise and vibration impact arising from the initial demolition and construction activity associated with the development;
  - Noise impact arising from traffic associated with the construction and operation of the Renewable Energy Plant using existing local roads;
  - Noise and vibration impact arising when the Renewable Energy Plant is brought into normal commercial operation; and
  - Noise and vibration impact arising from the decommissioning phase of the development.
- 11.1.3 In each case a predicted numerical level of noise expressed using the appropriate metric, is assessed in accordance with the appropriate guidance or procedure, and the results reported and expressed in accordance with their significance. In some cases, there is clear guidance as to what might constitute a significant impact, in other cases, whilst there is some assessment guidance, interpretation and further evaluation is required before being able to draw conclusions on the significance of predicted effects.
- 11.1.4 Before and during operation of the proposed Renewable Energy Plant, there is a need to enter into, and then continue a dialogue with, both the Environmental Health Department of Falkirk Council, particularly on the matter of suitable noise sensitive receptor positions, and the Scottish Environment Protection Agency (SEPA) which is the regulatory authority for operating noise issues. Whilst the ES considers a range of noise and vibration impacts throughout the life of the project, there is a particular focus on noise levels generated during operation. This includes predictions of noise levels generated in the community and also outline noise mitigation. Whilst at this stage of the project, such mitigation is indicative rather than definitive; it is included in order to demonstrate that using generic noise data, a Renewable Energy Plant of this type is capable of achieving reasonable levels of noise in the community. To achieve such levels, this assessment also demonstrates, where appropriate, that best available techniques (BAT) specific to the particular site, can be included within the design.
- 11.1.5 This Chapter excludes an assessment of noise impacts on terrestrial and aquatic ecology, the details of which are addressed separately within Chapter 12 Terrestrial Ecology and Chapter 13 Aquatic Ecology.

## 11.2 Key consultations

### Scottish Government

- 11.2.1 In February 2010 the Scottish Government published 'Generic Scoping Advice for Biomass Plants in Scotland'<sup>1</sup>. The purpose of this guidance is 'to provide clear advice from consultees on the likely issues which should be addressed during the EIA process'. The guidance indicates that noise needs to be specifically addressed within the ES and then identifies noise issues that would be considered particularly in relation to an application for a PPC permit.

### Scottish Environment Protection Agency (SEPA)

- 11.2.2 The formal response from SEPA to the Scoping Report, dated 12 February 2010, stated the following:

*Information on noise and vibration from the operation of the plant should also be included within the ES. As with other aspects of the PPC Permit, the requirement will be for the applicant to demonstrate that working methods proposed represent the Best Available Techniques (BAT) for control of noise and vibration from the installation. Impact on local sensitive receptors will be a key factor in assessing the BAT justification with the overall aim being to prevent, minimise and render harmless noise and vibration emissions. Guidance on the control of noise from PPC Installations is available on our website.*

*We are generally satisfied with the proposed scope for ES in a planning context. In general terms the information needed for PPC purposes, and which we consider appropriate as a basis for the ES, falls under the following headings:*

- *Identification of key noise sources;*
- *Identification of potentially significant sources of vibration (not just those from construction activities);*
- *Inherent noise emission levels and character (e.g. tonal, intermittent, impulsive) of each key source;*
- *Abatement techniques proposed;*
- *Prediction of level at, and impact on, sensitive receptors;*
- *The potential impact of foreseeable circumstances causing malfunction or non-operation which may lead to an increase in noise and vibration emissions, e.g. emergency vent release;*
- *Proposals for on-going noise and vibration management including complaint procedures, acoustic specification within procurement policies and noise monitoring; and*
- *Identification of other significant local sources e.g. roads, other industries, aircraft.*

*The ES will also need to assess the impact of other activities, such as vehicle movement on the site as well as shipping, in respect of the noise environment."*

Subsequent to issuing this Scoping Opinion SEPA revised its comments and confirmed that consideration of the impact from shipping need not be included within the assessment.

- 11.2.3 These comments by SEPA relate to information required for both this ES and a future PPC permit. Whilst it is acknowledged that much of the information required for an ES will also be useful in the context of a PPC permit application, there is information that is specifically required only for a PPC permit application, as highlighted in the SEPA scoping response above. This ES chapter therefore will take note of the overall requirements for both an ES and a PPC application. At PPC application stage more detailed information will be provided giving a comprehensive picture of the noise and vibration design and operation strategy.

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<sup>1</sup> Generic Scoping Advice for Biomass Plants in Scotland, the Scottish Government, February 2010.



- 11.2.4 SEPA was consulted with regards the noise assessment, contents of the ES, and noise control mitigation proposals. In response they provided particularly helpful guidance and direction in relation to various issues relating to noise for the proposed development, in particular making reference to SEPA publication: *Noise: Summary Guidance for Pollution Prevention and Control (PPC) Applicants*<sup>2</sup>.
- 11.2.5 As part of the EIA process, preliminary predictions of operational noise and indications of proposed noise mitigation measures have been provided to SEPA for information and consultative purposes. This has provided them with the opportunity to comment on the details of proposed site specific noise mitigation being considered. It has also demonstrated that potentially dominant noise sources have been both identified and then mitigated such that further reductions to individual sources would have no effect on the overall noise generated by the development.
- 11.2.6 SEPA will continue to be consulted on the subject of operational noise from the proposed Renewable Energy Plant following the submission of the Section 36, through construction and operation, as the project will require a PPC permit from SEPA.

#### **Falkirk Council**

- 11.2.7 The final choices of background noise measurement positions used in the noise survey have been revised from the preliminary positions identified within the scoping report. The revised positions were discussed and agreed with Falkirk Council. Other scoping responses from Falkirk Council are dealt with in this chapter.

### **11.3 Assessment methodology and significance criteria**

#### **Introduction**

- 11.3.1 Assessments have been undertaken for the following noise and vibration impacts:
- Noise during construction and decommissioning;
  - Road traffic noise during construction and operation;
  - Noise during normal operations of the Renewable Energy Plant; and
  - Vibration impact during construction, operation and decommissioning;
- 11.3.2 For each of the above assessments, different methodologies apply, and in each case there is specific guidance that may be referred to in relation to the appropriate methodology to be used, considering what might constitute a significant impact. Determining whether a particular impact is significant requires the consideration of a number of references and procedures that are brought together to form a balanced judgement.
- 11.3.3 Underlying a number of these assessments, and well established in the consideration of environmental impact, is the need to consider the baseline condition. In the case of noise, this requires carrying out an appropriate background noise survey at established noise sensitive receptors. The assessment process compares the noise predictions against this baseline. The assessment of noise is also based on the 'Guidelines for Noise Impact Assessment' (Draft):2007<sup>3</sup> jointly published by the Institute of Environmental Management and the Institute of Acoustics. Although only a draft, it contains guidance on relating the semantic scale of noise impacts to significance of effects. A semantic scale correlates a quantifiable parameter with human understanding or response.

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<sup>2</sup> Noise: Summary Guidance for Pollution Prevention and Control (PPC) Applicants, SEPA (undated).

<sup>3</sup> Guidelines for Noise Impact Assessment (draft), IEMA/IOA, 2007.

- 11.3.4 The assessment has also followed guidance on construction and demolition noise (BS5228-1:2009<sup>4</sup> and traffic noise (DMRB, Vol II, Section 3, Part 7, 2008<sup>5</sup>). These are discussed further in the following sections.
- 11.3.5 As highlighted previously the assessment of noise impacts on ecology is presented in Chapter 12 Terrestrial Ecology and Chapter 13 Aquatic Ecology.

#### Categorising basic noise change

- 11.3.6 To assist in the overall assessment of noise impact and how the significance for a range of 'Basic Noise Changes' might be categorised, a semantic scale setting noise change to impact category has been developed in the 'Guidelines for Noise Impact Assessment'<sup>3</sup>.

**Table 11.1: Categories defining impact of 'Basic Noise Change' in IEMA/IOA Draft Guidance**

Noise Change dB(A)	Category
0	No Impact
0.1-2.9	Slight Impact
3.0-4.9	Moderate Impact
5.0-9.9	Substantial Impact
Above 10.0	Severe Impact

- 11.3.7 This guidance stresses the importance of supplementing the evaluation of 'Basic Noise Change' with other issues such as time of day, nature of noise, spectral characteristics in the noise and the absolute level in relation to guideline limits, before coming to any overall conclusion about significance, and thus relies on subjective judgements.
- 11.3.8 With other guidance<sup>6,7</sup> embracing clear numerical assessment methods, especially in relation to the significance of impacts, the IEMA/IOA approach is of limited practical value, and included only in connection with the impact of operating noise.

#### Construction and Decommissioning Noise

- 11.3.9 Noise during site clearance, demolition, construction and finally decommissioning is assessed in accordance with Annex E 'Significance of noise effects' of BS 5228-1:2009<sup>4</sup> and includes a number of methods of assessment.
- 11.3.10 Construction site noise is assessed differently to noise from permanent installations, as it is recognised that some degree of noise is an inevitable by-product of required works and that the construction works are a transient activity.
- 11.3.11 BS 5228-1:2009 provides information on construction noise levels from various plant and construction operations and provides recommendations on procedures and mitigation that can be adopted to reduce the impact of construction noise. Annex E considers the impact of construction or demolition noise to be significant if there is a 5 dB(A) increase in ambient noise ( $L_{Aeq}$ ). This is subject to a lower cut-off value, for the construction or demolition noise contribution alone, of 65 dB(A) during the daytime, 55 dB(A) during the evening and 45 dB(A) at night. It is proposed to adopt the  $L_{Aeq}$  daytime value of 65 dB(A) as a criterion for significant effect for construction noise.

<sup>4</sup> BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*.

<sup>5</sup> Design Manual for Roads and Bridges (DMRB), Vol II, Section 3, Part 7, Highways Agency 2008. Note, this is considered to be relevant for use in Scotland.

<sup>6</sup> BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*.

<sup>7</sup> BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*.

### Road Traffic Noise during Construction and Operation

- 11.3.12 Procedures for calculating and assessing road traffic noise impacts are described in the Department of Transport, Welsh Office document: Calculation of Road Traffic Noise (CRTN)<sup>8</sup>, and the Highways Agency advice note Design Manual for Roads and Bridges (DMRB), Vol 11 Section 3, Part 7 – *Noise and Vibration* (August 2008)<sup>9</sup>.
- 11.3.13 The latter document provides a procedure for measuring and predicting traffic noise levels (albeit based on CRTN) and estimating response of people to changes in traffic noise levels outside dwellings, expressed in terms of  $L_{A10}(18 \text{ hour})$ . The procedure covers situations where existing traffic increases with a 25% increase threshold corresponding to a change in calculated noise level of +1dB, the smallest increment in noise increase that is generally regarded as being discernible.
- 11.3.14 Table 3.1 of DMRB classifies the magnitude of noise impact against change in road traffic noise level. This is shown in Table 11.2.

**Table 11.2: Classification of Magnitude of Noise Impacts (from DMRB) against change in traffic noise level**

Noise Change – $L_{A10}(18 \text{ hr})$ (dB)	Magnitude of Impact
0	No change
0.1-0.9	Negligible
1.0-2.9	Minor
3.0-4.9	Moderate
Over 5	Major

- 11.3.15 Determination of significance of effects is based on a subjective view taking into account a number of issues, including the sensitivity of the receptors, the absolute levels of noise, the number and type of receptors affected and whether the change was temporary or permanent.

### Vibration Impact during Construction, Operation and Decommissioning

- 11.3.16 Vibration impact during the most critical phase of the project, especially during piling activity, can be assessed in accordance with Annex B of BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*<sup>10</sup>.
- 11.3.17 Vibration limits are expressed in Annex B of BS5228-2 and are summarised within Table 11.3.

**Table 11.3: Effects of vibration taken from BS5228-2**

Effect on people/building	Vibration level Peak Particle Velocity (mms <sup>-1</sup> )
Vibration might be just perceptible in the most sensitive situations and at most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	0.14
Vibration might be just perceptible in residential environments	0.3
It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	1.0

<sup>8</sup> Calculation of Road Traffic Noise –Department of Transport, Welsh Office. Note, this document is relevant for use in Scotland.

<sup>9</sup> Design Manual for Roads and Bridges (DMRB), Vol II, Section 3, Part 7, Highways Agency 2008. Note, this is considered to be relevant for use in Scotland.

<sup>10</sup> BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*. Annex B 'Significance of Vibration Effects'.

Effect on people/building	Vibration level Peak Particle Velocity (mms <sup>-1</sup> )
Vibration is likely to be intolerable for any more than a very brief exposure to this level	10.0
Guide values to avoid cosmetic damage to buildings – Residential buildings	15.0 at 4Hz increasing to 20.0 at 15Hz increasing to 50.0 at 40Hz and above
Guide values to avoid cosmetic damage to buildings – Industrial buildings	50.0 at 4Hz and above

- 11.3.18 It is considered that in relation to the impact to people, a significant vibration effect occurs when vibration exceeds 0.3 mms<sup>-1</sup>, if this is a permanent level of vibration from normally operating plant. It is considered that, as highlighted in Table 11.3, during construction and with appropriate warnings to residents, vibration up to a limit of 1.0 mms<sup>-1</sup> for temporary activity would be tolerated, and therefore would not constitute a significant effect.

### Operational Noise

- 11.3.19 Noise during the operation of the development will be assessed in accordance with guidance given in paragraphs 35-37 of Planning Advice Note PAN 56<sup>11</sup>. The following extracts from this note come under the heading 'Noisy Industrial Development'.
- 11.3.20 Para 35 advises that '*BS 4142 Method for rating industrial noise affecting mixed residential and industrial areas*' promotes a method for assessing whether industrial noise is likely to give rise to complaints from people living nearby. Whilst a useful guide, BS4142 should not be solely relied upon to accurately establish the impact of industrial development in terms of noise'.
- 11.3.21 PAN 56 para 36 further states '*In applying BS4142, authorities should also bear in mind the significance of absolute levels. In some cases any increase over existing threshold levels will be unacceptable*'. Finally in para 37 it states '*General guidance on acceptable noise levels within buildings can be found in BS 8233 Sound insulation and noise reduction for buildings*'<sup>12</sup>. BS8233 includes guidance based upon work undertaken by the World Health Organisation<sup>13</sup>.
- 11.3.22 BS4142 assesses the impact of a new industrial development in terms of complaint risk, using the concept of a 'Rating Level', which is based on the 'specific' new noise from the new development, (measured in terms of L<sub>Aeq</sub>), with corrections applied to account for any tonal or impulsive characteristics in the noise (as these can increase the likelihood of complaint).
- 11.3.23 The assessment is carried out by comparing the Rating Level (L<sub>A,r,T</sub>) with the existing background noise level (measured in terms of L<sub>A90</sub>). Where the Rating Level exceeds the Background Level by 10 dB(A) or more, complaints are likely. Where this is reduced to 5 dB(A), the development will be of 'marginal significance', with respect to complaint risk. At difference levels below 5 dB(A), the lower the value the likelihood that complaints should diminish.
- 11.3.24 It should be noted that BS4142 considers risk of complaint and not adverse impact or significance of effect. Moreover, it compares differences in two parameters (L<sub>Aeq</sub> and L<sub>A90</sub>) rather than the change in one parameter (L<sub>Aeq</sub>) as used when considering the change in Basic Noise Level.
- 11.3.25 Table 11.4 provides some guidance as to how a range of assessment conclusions from BS4142 might compare with IEMA/IOA noise impact category for a steady industrial noise in an example where the difference between Rating Level (L<sub>Aeq</sub>) and Background Level (L<sub>A90</sub>) was just 1 dB.

<sup>11</sup> Generic Scoping Advice for Biomass Plants in Scotland, the Scottish Government, February 2010.

<sup>12</sup> BS 8233:1999 Sound Insulation and Noise Reduction for Buildings. Code of Practice.

<sup>13</sup> Guidelines for Community Noise, WHO, 1999.

Table 11.4: Correlation of IEMA/IOA Impact Categories with BS4142 Assessment Categories

Criterion	Noise ranges (dB) with categories				
Rating minus Background Level	<0	0-4	4-6	6-9	>9
BS4142 Potential complaint risk	Very low risk	Low risk	Marginal risk	Increasing risk	Likely risk
Equivalent Basic Noise Change <sup>1</sup>	<3	3-5	5-6	6-9	>9
IEMA/IOA Impact Category	Slight	Moderate	Substantial	Substantial	Severe
Note <sup>1</sup> This example assumes steady noise with residual level Laeq = background La90 + 1dB					

- 11.3.26 Although there appears to be an anomaly in this table in that 'marginal risk' in BS4142 appears to coincide with a 'substantial' impact in the IEMA/IOA categorisation, it must be remembered that these are considering responses to very different parameters. The former considers only the risk of complaint, which is a response to noise 'nuisance', whereas the latter considers noise impact in terms of noticing a change in noise level. This apparent anomaly and offset of categories appears reasonable also when considering the lesser IEMA/IOA Impact Category of Moderate Noise Impact. This suggests that noise is audible and noticeable, but considered only moderate and therefore unlikely to be a problem to most people, the correlation with a low risk of complaint would appear logical. However, these potential responses to this level of noise would suggest that the noise was significant. It is arguably only in the lowest category where there is a very low risk of complaint and the noise impact category is slight such that noise might be considered not significant.
- 11.3.27 There are some situations where the use of BS4142 becomes problematic, in particular where background noise levels are very low. In its opening sections BS4142 states that '*The method is not suitable ....when the background and rating noise levels are both very low*'. It further explains this as being when the background noise levels are below about 30 dB and the rating levels below about 35 dB. Under these circumstances, whilst there might be a moderate or substantial increase in noise or noise impact, this may not be significant in the particular context of human response or complaint, not least because the absolute levels of noise are low.
- 11.3.28 PAN 56 considers that BS4142 should not be relied upon solely and points to the need to consider absolute noise levels and in this it cites guidance on acceptable noise levels within buildings given within BS 8233:1999<sup>14</sup>. Section 7.6.1.2 of BS 8233 (Design criteria and limits for intrusive external noise) states that 'the main criteria are reasonable resting/sleeping conditions in bedrooms', and Table 5 cites these as being 35 dB(A). In defining what types of noise these limits apply to in Section 11.7.3 it advises the noise '*should be assumed to be steady, such as that due to road traffic, mechanical services or continuously running plant*'. The noise being considered here is the total ambient noise i.e. noise from all sources including pre-existing noise as well as noise from the proposed development. BS 8233 addresses noise limits inside rooms. The equivalent noise limit outside a window that is open can be determined using the sound insulation outside-to-in quoted within table 10 of 10-15 dB. This gives an equivalent limit at 1m outside the house of 45 dB(A), or allowing for 3 dB(A) of local reflection, a free-field value of 42 dB(A). These limits are also referred to within the H3 horizontal guidance<sup>15</sup>.
- 11.3.29 The operating noise from this proposed development will be regulated by SEPA in accordance with their 'Guidance on the Control of Noise at PPC Installations'<sup>16</sup> and the nationally applicable Horizontal Guidance Note IPPC H3 (Part 1): Regulation and Permitting.

<sup>14</sup> BS 8233:1999 Sound insulation and noise reduction for buildings. Code of practice.

<sup>15</sup> Horizontal Guidance for Noise (H3). Part 1 – Regulation and Permitting, 2002.

<sup>16</sup> Guidance on the Control of Noise at PPC Installations, SEPA (undated).

- 11.3.30 SEPA through their own guidance and through the H3 Horizontal Guidance consider the basis upon which numerical limits can be set. There is a range of guidance given within these documents, including the additional requirement for Best Available Techniques (BAT) to be used as appropriate.
- 11.3.31 Noise is defined in PPC Regulations guidance in terms of emissions, with a requirement to take preventative measures, particularly by applying BAT to reduce emissions and the impact on the environment, where this is practicable. In determining BAT requirements for a particular situation the PPC Horizontal Guidance for Noise (Part 1) indicates that it is necessary to consider whether noise emission levels meet the following benchmarks:
- 1) Are BS4142 noise rating levels greater than background, and if so are justifications adequate?
  - 2) Are BS4142 noise rating levels greater than  $L_{Aeq}$  50dB(A) (free-field) by day, or  $L_{Aeq}$  45dB(A) (façade level – equivalent to 42dB(A) free-field) by night and, if so, are justifications adequate?
  - 3) Is the  $L_{AFmax}$  level less than 60dB at the façade of sensitive properties?
  - 4) Are there proposals for noise levels to be below background and if so are the justifications adequate?
- 11.3.32 The absolute noise limits covered by the second and third benchmark criterion relate to the BS8233:1999 indoor guidance levels of  $L_{Aeq}$  35 dB(A) /  $L_{Amax}$  45 dB (for bedrooms) and  $L_{Aeq}$  40 dB (for living rooms), for providing reasonable conditions for sleep and relaxation purposes. The increase in level from the indoor to outdoor criteria relates to the typical 10-15 dB(A) loss experienced through a partially opened window. World Health Organisation (WHO) guidelines also recommend a limit of  $L_{Aeq}$  45 dB for night time levels outside bedroom windows.
- 11.3.33 The concerns related to the 4<sup>th</sup> benchmark criterion are particular to the circumstances where consideration of a more stringent standard might be appropriate, in particular Section 2.5.6.1 (b) of the horizontal guidance identifies circumstances where it might be appropriate to set a noise limit below background. These are:
- Tonal or other acoustic characteristics;
  - A tranquil area that requires preservation;
  - Creeping background (ambient); and
  - A large area affected.
- 11.3.34 The absolute noise limits defined in the PPC benchmark criteria and reinforced by the BS8233 and WHO guidelines can therefore be additionally used for the assessment of potential impact from the operation of the proposed Renewable Energy Plant.

#### **Baseline conditions and receptors**

- 11.3.35 This section outlines the results of the baseline assessment for noise.

#### **Noise Sensitive Receptors**

- 11.3.36 The locations of noise sensitive receptors used in this assessment are described in Table 11.5.
- 11.3.37 The locations of noise sensitive receptors are also shown on site location plan in Figure 11.1



Table 11.5: Description of Noises Sensitive Receptors around the proposed development site

<b>Position 1: 3 Grangeburn Road</b>	At the west end of Grangeburn Road to the southwest of the site. This is one of the closest receptors to the proposed development at 390 m from the centre of the turbine hall
<b>Position 2: Newton Road</b>	Located 1,950 m west north west of the centre of the turbine hall, this position is at a pull off area close to a bend of Newton Road to the north of the River Carron. This position is representative of the group of properties 190 m to the north at the junction between Newton Road and Newton Avenue, but was selected as it has a better line of sight to the proposed development.
<b>Position 3: 57 Grangeburn Road</b>	This position is 390 m to the south east of the centre of the turbine hall and is in line with the east boundary of the development site.
<b>Position 4: Dalgrain Road</b>	Located 1,500 m to the west of the centre of the turbine hall on Dalgrain Road. To the south of Dalgrain Road are a number of industrial sites

### Noise Survey Results

- 11.3.38 Measurements were made over a period of six nights and two days using attended measurement techniques. This has the advantage of enabling detailed observations to be made at the time of the survey.
- 11.3.39 The full results of the background noise survey are included within Appendix D along with details of the instrumentation used and the measurement procedure. Weather conditions observed during the survey are also noted along with observations and comments about the sources and character of the noise observed.
- 11.3.40 A summary of the results is shown in Tables 11.6 and 11.7. These show the mean value of background noise measurements made under conditions favourable to the propagation of noise from the proposed development to each receptor in turn. Typically this means that the data used in the calculation is that when the receptor position is downwind, or on some occasions crosswind, of the application site. Under these conditions the noise from the proposed development will be at its maximum and the resulting assessment likely to represent the highest noise impact scenario.

Table 11.6: Measured ambient baseline noise levels (mean) during the day (0700-2300 hours) under wind conditions favourable to noise propagation from development

Measurement position	L <sub>Aeq</sub>	L <sub>A90</sub>	Comment
<b>Position 1: 3 Grangeburn Road</b>	56.9	50.5	Industrial noise from west. Distant road traffic. Running water. Mean of noise when wind from northerly and westerly directions, being downwind of development, but not of the refinery.
<b>Position 2: Newton Road</b>	48.2	46.2	Road traffic noise from M9. Distant industrial noise from docks. Mean of noise when wind from northeasterly, easterly, southerly and southwesterly directions, being downwind of development and the refinery.
<b>Position 3: 57 Grangeburn Road</b>	58.8	48.4	Industrial noise from west. Distant road traffic. Vehicles and activity in port (DHL). Mean of noise when wind from west being downwind/crosswind of plant but not of refinery.
<b>Position 4: Dalgrain Road</b>	65.8	55.2	Noise from industrial plant to the south. Local road traffic including HGVs. Mean of noise when wind from north easterly direction being downwind of development and refinery.



**Table 11.7: Measured ambient baseline noise levels (mean) during the night (2300-0700 hours) under wind conditions favourable to noise propagation from development**

Measurement position	L <sub>Aeq</sub>	L <sub>A90</sub>	Observations during survey
<b>Position 1:</b> 3 Grangeburn Road	41.8	39.5	Industrial noise from west. Distant road traffic. Mean of noise when wind from northerly and westerly directions, being downwind of development, but not of the refinery.
<b>Position 2:</b> Newton Road	45.7	43.2	Road traffic noise from M9. Distant industrial noise from docks. Mean of noise when wind from northeasterly, easterly, southerly and southwesterly directions, being downwind of development and the refinery.
<b>Position 3:</b> 57 Grangeburn Road	43.8	40.3	Industrial noise from west. Distant road traffic. Vehicles and activity in port (DHL). Mean of noise when wind from north, north westerly and southwesterly directions being downwind of plant but not of the refinery.
<b>Position 4:</b> Dalgrain Road	53.6	43.3	Noise from industrial plant to south. Refinery noise audible. Distant traffic. Mean of noise when wind from north easterly direction

### Baseline Sensitivity

- 11.3.41 During the daytime the ambient noise (L<sub>Aeq</sub>) is in the range 48-66 dB(A) depending upon the proximity to local through roads. Background noise levels (L<sub>A90</sub>) during the day are generally in the range 46-55 dB(A).
- 11.3.42 During the night the range of mean background L<sub>A90</sub> noise levels between the receptors for downwind propagation from the proposed development is relatively narrow at 39.5-43.3 dB(A).
- 11.3.43 At night, the levels of noise appear to be strongly influenced by wind direction. For example at Position 3 at 57 Grangeburn Road, the influence of the dominant noise source in the area, which is the Ineos refinery, is seen in the original noise data in Appendix D, but only under downwind propagation conditions from that source (the wind blowing from the refinery towards the receptor – easterly or northeasterly winds). Background noise levels (L<sub>A90</sub>) average 51 dB(A) in this wind direction. For other wind directions including when the receptor is downwind of the application site, the mean background noise level is much lower at 40.3 dB(A).
- 11.3.44 It is therefore reasonable to consider a baseline condition against which to assess the impact of noise from the proposals, to be when there is a wind direction that is favourable to propagation of noise from the Renewable Energy Plant, which is when the receptor is downwind of the proposed site. This is the also the wind condition assumed in the predictions of noise generated by the development. Levels of plant noise in other wind conditions will be significantly lower.

## 11.4 Potential impacts

- 11.4.1 This section provides an assessment of the potential noise impacts associated with the construction, operation and decommissioning of the proposed Renewable Energy Plant. Potential noise impacts generated by activities associated with the proposed development have been predicted at the noise sensitive receptors highlighted in Table 11.5 and shown on the site location plan in Appendix D.

### Predicted Noise during construction and decommissioning

- 11.4.2 In order to provide an indication of construction noise impact, noise level predictions have been made, based on the following typical construction phases:

- Clearing site (following demolition)
  - Ground preparation works, including piling;
  - On-site road works;
  - Excavation works;
  - Foundation preparation, including concreting; and
  - Major plant erection and installation.
- 11.4.3 Prior to construction commencing there may be some demolition work required. The nature and extent of this work is difficult to assess at this stage. Details of building demolition are provided in Section 6.10 which addresses the decommissioning of the Renewable Energy Plant. This is considered to provide a conservative estimate of any demolition needed during the construction phase.
- 11.4.4 The prediction of environmental noise from construction works is based upon a range of construction activities spread across the site. Predictions have been made using actual measurements taken throughout various phases of construction operations on similar projects to provide an indication of potential noise output.
- 11.4.5 Site perimeter  $L_{Aeq}$  noise level data is used to calculate the average sound power of the construction site, over a typical 1-hour period, by applying a correction to account for the total surface area of the main construction works. This sound power method therefore takes account of the size of the site. The procedure is in accordance with the methodology provided in ISO 8297 'Determination of Sound Power Levels of Multi-Source Industrial Plant for Evaluation of Sound Pressure Levels in the Environment'<sup>17</sup>. As the measured perimeter  $L_{Aeq}$  data takes account of true plant operating periods no 'on time' corrections need to be estimated or applied.
- 11.4.6 Using the mean (1-hour) site sound power levels for each construction phase, predictions of community noise levels are made by applying corrections to the site sound power. This accounts for the distance between the construction activity and the receiver location. It also accounts for any beneficial screening or ground effects afforded by land topography.
- 11.4.7 Overall  $L_{Aeq}$  (1 hour) noise levels have been predicted, for each main construction phase, at each of the four noise sensitive receptor locations. Detailed calculations of construction noise are included in Appendix D. However, the results of all the noise level predictions for each phase of the construction works are summarised in Table 11.8.

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<sup>17</sup> ISO 8297 Acoustics - Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment – Engineering method.

Table 11.8: Prediction of construction noise at nearest community locations to Renewable Energy Plant site

Residential location	Predicted Noise level $L_{Aeq}$ (1 hour)					
	Construction Phase*					
	1	2	3	4	5	6
<b>Position 1: 3 Grangeburn Road</b>	60	63	57	54	56	54
<b>Position 2: Newton Road</b>	51	54	48	45	47	45
<b>Position 3: 57 Grangeburn Road</b>	60	63	57	54	56	54
<b>Position 4: Dalgrain Road</b>	56	59	53	50	52	50
*Key for construction phases: 1 Clearing site 2 Ground preparation works, including piling 3. On-site road works 4. Excavation 5. Foundation preparation and concreting 6. Major plant erection and installation						

- 11.4.8 The predictions demonstrate that the various phases of construction works are likely to provide noise levels typically between  $L_{Aeq}$  (1 hour) 45-63 dB(A), at the noise sensitive receptors. The highest noise level of  $L_{Aeq}$  (1 hour) 63 dB(A), is likely to be experienced during ground preparation and piling works, at Position 1, 3 Grangeburn Road, and Position 3, 57 Grangeburn Road. The highest noise levels generated will be during the initial period of construction, during the middle and final phases of the project, noise levels will be typically 6 dB(A) lower.
- 11.4.9 Precise details of the decommissioning process will be subject to a detailed plan developed at the time. However, it is likely that the process will involve some mechanical plant being removed and other equipment and buildings being subjected to demolition.
- 11.4.10 The process of estimating the noise generated during demolition works is that outlined in BS 5228<sup>18</sup>, with typical noise data being included in Tables C.1 and D.2 of that Standard. The results of the predictions of demolition noise are included in Appendix D.
- 11.4.11 A summary of the levels is shown in Table 11.9.

<sup>18</sup> BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.*

Table 11.9: Prediction of decommissioning noise

Residential location	Predicted Noise level LAeq (1 hour) during decommissioning (demolition)
Position 1: 3 Grangeburn Road	61
Position 2: Newton Road	52
Position 3: 57 Grangeburn Road	61
Position 4: Dalgrain Road	58

### Predicted Noise during Commissioning

- 11.4.12 It is recognised that noise levels during the plant commissioning phase may, on occasions, be in excess of the levels projected for the subsequent commercial operation of the plant.
- 11.4.13 The main reasons for this are as follows:
- Commissioning works may overlap with some of the later construction activities;
  - Commissioning of individual plant items may take place before noise control treatment is finalised. For example, power plant may be tested before final completion of plant treatments and buildings, particularly final fix items, such as duct lagging and loading doors; and
  - Commissioning some items of equipment, such as steam purging operations on boiler plant, can produce intermittent higher noise levels during these activities.
- 11.4.14 Prediction of noise levels produced during commissioning works associated with the proposed Renewable Energy Plant is very difficult, as specific commissioning requirements are not known at this stage and consequently predictions based on speculative or unknown requirements are unlikely to be accurate.
- 11.4.15 For this reason noise produced during commissioning is commonly controlled by condition, with noise limits governing the construction works extended through the commissioning phase, to afford the necessary protection to residential locations during these temporary operations.

### Predicted Noise from Road Traffic during Construction and Operation

- 11.4.16 Noise level predictions have been completed to establish the increase in road traffic noise due to the additional traffic associated with the construction and operation of the proposed Renewable Energy Plant.
- 11.4.17 Access to the site will generally be via the M9 and A904 Earls Road, and the noise impact has been assessed in terms of the increase in traffic flow in both directions.
- 11.4.18 Traffic noise predictions have been made in accordance with '*Calculation of Road Traffic Noise*' (CRTN), previously highlighted in Section 11.3. It is generally accepted that prediction methods should be used (rather than measurement) to determine current and future traffic noise levels, unless road layouts are complex. Indeed, CRTN specifically states that the prediction method is preferred over the measurement method.
- 11.4.19 Moreover, when predictions are made to assess changes in noise level due solely to an increase in traffic flow, prediction methods are particularly suitable as any errors in determining correction factors for variables such as distance attenuation and screening are the same for each case.
- 11.4.20 The effect of changes in road traffic flows upon resulting noise levels only becomes discernable when levels rise by more than + 1 dB, and for this the flow rates need to increase by at least 25%, which is far beyond the expected change in this case.

- 11.4.21 The effect of changes in traffic noise should be evaluated on roads where there are residential receptors. For this development, the most relevant roads on which the impact of changes in road traffic flows should be assessed is Beancross Road (during the construction phase) and the section of the A9 between roundabout junctions with the A904 and A905 (during the operating phase). There are some residences set back at a number of locations along these roads and so a general evaluation will be made at each.
- 11.4.22 Whilst the normal period for assessing road traffic noise is 18 hours, a worst case assessment can in this case be made for relevant 1 hour periods. Hourly traffic counts identifying vehicle numbers for 2008/9, provided by Falkirk Council, are used as a conservative baseline in this assessment. Percentage (%) HGVs in the baseline flows are assumed to be nominally 5%. An accurate evaluation of % HGV is not necessary as the assessment calculation is not especially sensitive to this parameter. Also, consideration of a baseline for future years is not essential and would result, in a lesser potential impact from road traffic associated with the development.

**Table: 11.10 Projected hourly traffic flows during construction and operational phases.**

Hourly Time Period (hrs)	Baseline Hourly Flow	% HGV	Vehicles	% increase	Total	% HGV
<b>Construction Phase at Beancross Road</b>						
0600-0700	420	5.0	68	16	488	4.3
<b>Operational Phase at A9 (between junction with A904 and A905)</b>						
0600-0700	558	5.0	12	2	570	7.0

- 11.4.23 During the peak hour for construction workers arriving at work (0600-0700 hrs) the increase in vehicles is 16%, and this is assumed to comprise cars and other light vehicles. A similar increase is likely when workers leave work.
- 11.4.24 During operation of the plant, the increase in road traffic vehicles on the A9 between the A904 and A905 junctions, is typically 2%, which is well below the 25% increase that corresponds to a potential noticeable increase of 1 dB(A) in road traffic noise.
- 11.4.25 The effect of these changes in noise level in terms of their significance is discussed in the relevant section of the assessment of residual effects.

#### **Predicted Vibration during Construction and Operation**

- 11.4.26 Vibration impact is most likely to arise during initial demolition, construction and final decommissioning of the project.
- 11.4.27 Historic vibration data obtained on sites is included within Annex D of BS522-2:2009 and suggests that vibration levels (PPV) at 100 m would typically be 1mm/s for driven sheet piling, driven bearing piles, cast-in-situ drop hammer piles and vibroflotation. For dynamic consolidation, vibration levels could range between 1-3 mm/s at this distance.
- 11.4.28 With the threshold of significance considered to be 1 mm/s PPV, and the distance from site activity to existing residential property being generally in excess of 250 m, the impact of vibration during construction is unlikely to be significant.
- 11.4.29 The extent of vibration affecting nearby residential properties will be predominantly driven by soil conditions and topography.
- 11.4.30 During normal operation of the plant, there are no significant sources of vibration amongst equipment operating within the proposed Renewable Energy Plant. The main items of plant include large fans contained

within the boiler hall, and the steam turbine. Both of these items of equipment are rotary machines which need to be accurately balanced for effective operation, therefore, there is no risk of vibration arising from these sources.

- 11.4.31 In the event of grid-connection failure, a back-up diesel generator will be required. This is a reciprocating device. Although these would not have enough vibrational energy to generate significant vibration within the ground, they would nevertheless be supported on their own anti-vibration mounts.
- 11.4.32 Therefore, there are no material vibration effects predicted from the operation of the proposed Renewable Energy Plant.

#### **Predicted Noise from Normal Plant Operation**

- 11.4.33 The proposed plant has the capacity to generate significant levels of noise to the community. The main sources of noise include the following items of equipment:
- Boiler and its associated primary, secondary and circulation fans;
  - Main induced draft fan discharging to stack;
  - Steam turbine and its generator;
  - Cooling plant and pumps;
  - Transformers;
  - Fuel conveyors and elevators and
  - Unloading fuel road vehicles.
- 11.4.34 To evaluate the effect of the proposed Renewable Energy Plant on the nearby community it is necessary to predict the noise that is likely to be generated by the plant. An environmental noise model has been generated based on the scheme layout (Figures 6.1 and 6.2) with initial designs of buildings and equipment locations shown. This is then subject to input octave band sound power data for each of the major items of equipment or site buildings within which equipment is housed.
- 11.4.35 A proprietary noise model, Predictor V7.02, has been used to predict noise levels from the plant operation. Details of this noise model are included in Appendix D. The model uses noise propagation corrections (including distance attenuation, ground effects and atmospheric absorption), advised in ISO 9613<sup>19</sup>, and takes account of ground terrain and topography in order to calculate noise levels to the community. The results can be reported both numerically at distinct noise receptor positions or alternatively in the form of noise contours superimposed upon a map of the site and its locality.
- 11.4.36 A list of sound power data for the main equipment sources and buildings is provided in Appendix D. As input data for the noise model, equipment sound power data has been taken from typical vendor information and from noise levels recorded on similar items of plant on similar types of power project. The model was used to generate total noise levels and to determine suitable noise control mitigation to be applied to each source to protect the community from potentially generating adverse levels of noise. A balanced approach has been taken with the objective that no single source of noise should be dominant, unless this is unavoidable. Furthermore, where the levels of noise are potentially significant, then consideration is given to the need to be able to demonstrate later, in the PPC permit application, that the best available techniques (BAT) for noise mitigation have been adopted, and will continue to be adopted during the detailed design stage.

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<sup>19</sup> ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*.



- 11.4.37 The results of the noise model simulation expressed both as overall noise contours are shown in Figure 11.2 and numerical results are shown within Appendix D. Also included for two representative positions (1 and 3), are the rank ordered contributions of individual noise sources to the total, showing no particular noise source as being dominant. A summary of the results at each of the six noise sensitive receptor positions is shown in Table 11.11. These are given for conditions of favourable noise propagation i.e. under downwind propagation conditions with the wind blowing from the Renewable Energy Plant towards the sensitive receptor. These represent the typical highest levels of noise likely from the proposed development. Taking into account the effect of changing wind direction, when averaged over the long term, the levels of noise, are likely to be typically 2 dB(A) less than the values in this table.

**Table 11.11: Predicted normal operating noise levels (Leq) from the proposed Renewable Energy Plant at positions 1-4 (conditions favourable to noise propagation) – with mitigation**

Noise sensitive receptor	LAeq
Position 1: 3 Grangeburn Road	37.9
Position 2: Newton Road	29.9
Position 3: 57 Grangeburn Road	40.1
Position 4: Dalgrain Road	32.2

- 11.4.38 The predicted highest level of noise is 40.1 dB(A) at position 3. The impact at position 1, nearby, is slightly lower at 37.9 dB(A). The levels at the further positions 2 and 4 are lower still at 29.9 and 32.2 dB(A) respectively.
- 11.4.39 The major plant items associated with the proposed Renewable Energy Plant have the capacity, if unmitigated, for producing significant noise levels, both on-site (relating to occupational noise impact) and at residential receptors. The predicted levels included within Table 11.11 are those that will be achieved through the design of mitigation measures. During the detailed design stage, the outline engineering design measures will either be modified or confirmed and these will have the effect of mitigating the effects of noise from the main plant items to the standard set here.

## 11.5 Mitigation

- 11.5.1 This section outlines the proposed mitigation for the noise impacts associated with the Renewable Energy Plant.

### Construction and Decommissioning Noise Mitigation

- 11.5.2 Proposed mitigating measures and imposed requirements for the construction and demolition phase will include:
- The Contractor will ensure that all works will be completed in accordance with the guidelines provided in BS5228<sup>20</sup>; and
  - Any equipment requiring overnight operation, such as pumps, generators and compressors will be adequately silenced, to ensure that noise from the equipment shall not exceed the night-time limits in Annex E of BS 5228-1, of 45 LAeq. It is not anticipated that there will be overnight laying up of vehicles.

<sup>20</sup> BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.*

- 11.5.3 The mitigation adopted during the decommissioning phase of the project will be similar to that carried out during construction.

#### **Road Traffic Noise Mitigation**

- 11.5.4 During normal operation of the plant, the route on public roads for HGV vehicles will via the M9 and the A904 Earls Road. This will minimise the potential for noise impacts on sensitive receptors.

#### **Vibration Mitigation during Construction and Operation**

- 11.5.5 During piling activities, predicted levels of vibration at the nearest existing residential receptors are likely to be within the 1 mm/s PPV criteria threshold of significance. During normal plant operations there will be no noticeable vibration.

#### **Operational Noise Mitigation**

- 11.5.6 The following mitigating design measures and procedures will be considered for the proposed Renewable Energy Plant.

#### **Acoustic Design**

- 11.5.7 Substantial acoustic design input will be required at the detailed design stage of the proposed development. In order to specifically assess attenuation requirements for all external plant and plant buildings, a detailed simulation of environmental noise to the community will be undertaken using acoustic data from the finally selected equipment and superstructure suppliers. Equipment and plant noise sources will be modelled to predict total noise levels at community locations. This will be checked to ensure levels remain consistent with values predicted in this ES.

- 11.5.8 Based on the results of this noise assessment using generic noise data, noise from the operation of the plant is not expected to exceed the following Rating Levels when measured and assessed in accordance with BS4142:1997, at residential properties. These levels may therefore be considered suitable for incorporation as limits within a planning condition, as a suitable basis for protecting residential amenity. The limits comprise:

- Daytime 07:00-23:00  $L_{Aeq}$  (1 hour) 40 dB(A); and
- Night time 23:00-07:00  $L_{Aeq}$  (5 minute) 40 dB(A).

#### **Intermittent Noise**

- 11.5.9 Intermittent high levels of noise can occur occasionally from power plant, due to both emergency and controlled operations. Typical intermittent sources include emergency steam venting from boiler plant. Emergency steam relief valves would not be expected to operate during normal operation but are required by law to protect pressurised systems. They would 'release boiler steam to atmosphere during abnormal situations such as fault conditions or during annual testing
- 11.5.10 Recognising that such higher intermittent noise levels can cause disturbance, particularly during the night time, design measures will be adopted to control these sources, with particular attention given to atmospheric vent silencers and acoustic lagging of external noisy steam pipes and valves.
- 11.5.11 During the commissioning phase of the project there are also activities, such as steam purging, which will generate higher noise levels, sometimes for significant periods of the day. Such activities are, however, generally confined to less sensitive daytime periods, in order to minimise the impact to the community. Temporary attenuators will, if necessary, be fitted to commissioning vents.
- 11.5.12 For 'emergency' or 'irregular intermittent' sources, not associated with normal operations, the noise allowance is commonly set at a level at least 10 dB(A) higher than normal operation noise limits. Consequently noise control measures are generally set to achieve a limit of normal operating predicted levels + 10 dB(A).

- 11.5.13 For 'regular intermittent' sources, associated with normal operations, the noise levels would be expected to comply with the normal operating noise limits.

#### **Tonal and Impulsive Quality**

- 11.5.14 The 'rating' of a noise automatically increases when tones, whines or impulses are noticed in the audible noise. The most significant potential sources of tonal noise emissions are likely to include the boiler forced draught, secondary air and induced draught fans. However, these will be within enclosures or buildings with suitable silencers fitted. Transformers also have the potential to contain mid to low frequency tonal energy at the second and fourth harmonics (100 Hz and 200 Hz). However this is usually not significant in modern units and can be avoided by careful selection of plant.
- 11.5.15 For multi-source industrial sites, tonal noise is commonly masked by noise from the majority of plant items which are broadband sources. Notwithstanding this, care will be taken at the detailed design stage, both in identifying particular tonal and impulsive sources and to ensure that these will be suitably attenuated.

#### **Equipment Noise Control Treatment**

- 11.5.16 An outline of some of the noise control treatments that will be considered for the development are detailed as follows:
- 1) The steam turbine generator set will be housed inside a building with cladding specifically designed to be effective in reducing noise levels across a broad range of frequencies and are anticipated to include sound absorbent linings to internal surfaces;
  - 2) The boiler will be housed within a building, some of whose internal surfaces will be sound absorbent. It is anticipated that the roof and the north wall will have a cladding system which will include a sound absorbent inner surface (to control reverberant noise within the building). The more critical west and east walls will not be sound absorbent but instead will incorporate an enhanced low frequency sound insulation characteristic through the use of a solid (unperforated) liner. There is no south wall to the boiler hall as it adjoins the turbine hall and administration buildings.
  - 3) Attenuators / acoustic louvres to be designed and fitted as required and specified by the detailed design, to all building ventilation openings;
  - 4) Air inlet attenuators will be installed to all major fans drawing air from within the boiler hall. Consideration will be given to installing acoustic insulation or cladding to some fan casings and ducting within the boiler hall;
  - 5) Attenuators to be designed and fitted, as required and specified by the detailed design, to the induced draft (ID) fan on the inlet side and on the discharge prior to the stack. The ID fan and motor drive to be housed within an acoustic enclosure or similar building with silenced ventilation;
  - 6) The fuel storage buildings or silos will be standard industrial building constructions except where the detailed design requires buildings closer to sensitive receptors to have acoustic enhancements;
  - 7) All horizontal and inclined belt conveyors will be enclosed within a panelled structure, with the detailed design informing the acoustic performance ratings required. It is likely that some units will need to have a high acoustic performance characteristic;
  - 8) The vertical bucket elevator will be enclosed within a panelled structure, with the detailed design informing the acoustic performance rating required.
  - 9) Generator finfan cooler will be fitted with low speed /low noise fans;
  - 10) Steam vents and emergency steam relief valves to be fitted with vent silencers;
  - 11) Steam pipes and control valves to be lagged;
  - 12) Compressed air plant will be located within a building or acoustic enclosure; and
  - 13) Cooling towers will be fitted with low noise, aerodynamically efficient, fans.

### Commissioning Noise Survey

- 11.5.17 Following commissioning of the plant, a series of measurements will be carried out at the same locations used in this assessment (together with any other agreed reference locations). This will monitor the Renewable Energy Plant operating at normal commercial capacity, in order to demonstrate compliance with the design noise objectives.

### 11.6 Assessment of Residual Effects

- 11.6.1 This section provides a review of the residual effects of noise associated with the proposed Renewable Energy Plant once the mitigation measures have been applied to the development.

#### Construction and Decommissioning Noise

- 11.6.2 The highest predicted level of daytime construction noise, at position of Positions 1 and 3, both on Grangeburn Road, is  $L_{Aeq}(1 \text{ hour})$  of 63 dB.
- 11.6.3 For the purpose of assessing the magnitude of noise impact relative to existing daytime ambient noise, Tables 11.12 and 11.13 show a comparison of measured existing ambient  $L_{Aeq}$  noise levels with predicted maximum ambient levels during construction and decommissioning as described within Method 2 of Annex E of BS5228-1<sup>21</sup>.

Table 11.12: Predicted maximum change in ambient noise levels during construction phase

Residential location	Daytime $L_{Aeq}(1 \text{ hour})$			Change in ambient (dB)
	Existing Ambient (dB)	Construction Noise (max 1hour) (dB)	New Ambient (dB)	
Position 1: 3 Grangeburn Road	56.9	63	64	+7
Position 2: Newton Road	48.2	54	55	+7
Position 3: 57 Grangeburn Road	58.8	63	64	+5
Position 4: Dalgrain Road	65.8	59	67	+1

Table 11.13: Predicted maximum change in ambient noise levels during decommissioning (demolition) phase

Residential location	Daytime $L_{Aeq}(1 \text{ hour})$			Change in ambient (dB)
	Existing Ambient (dB)	Decommissioning Noise (max 1hour) (dB)	New Ambient (dB)	
Position 1: 3 Grangeburn Road	56.9	61	64	+7
Position 2: Newton Road	48.2	52	53	+5
Position 3: 57 Grangeburn Road	58.8	61	63	+4
Position 4: Dalgrain Road	65.8	58	67	+1

<sup>21</sup> BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise

- 11.6.4 In considering whether the magnitudes of impact represent significant effects or not, reference has to take account of other factors including the absolute levels of noise. In this case, the absolute levels of noise are considered to be low, and fail to reach the threshold of significant effect in section 11.1.23 which is the lower cut-off value for 'significance' in Method 2 of Annex B of BS5228-1, which for daytime, is 65  $L_{Aeq}$  (1 hour).
- 11.6.5 In summary, construction and decommissioning (demolition) works on the proposed development will not generate a significant effect following assessment to the relevant BS5228 guidance.

### Commissioning

- 11.6.6 Commissioning works on power station development projects are normally considered as an extension to the construction works, with a similar level of noise expected to be produced through this phase. Accordingly, the impact during commissioning is likely to be similar to the preceding construction works so no separate assessment has been undertaken of the noise impact during commissioning.

### Road Traffic during Construction and Operations

- 11.6.7 In accordance with road traffic noise prediction procedures, noise levels have been calculated, based on the supplied peak hourly figures, for the construction and operation of the development.
- 11.6.8 Road traffic noise calculations generally use 18-hour traffic flows, however in this case a more specific analysis considers critical 1 hour periods from the figures provided in Table 11.14.
- 11.6.9 With the nearest houses on the roads being assessed, being set back and at variable positions, it is not practicable to predict the received noise level at each separation distance. As it is the relative increase in traffic noise which is important to the assessment, the precise prediction distance from the road is not critical.
- 11.6.10 Consequently predictions are provided in terms of  $L_{A10}$  (1-hour), at a reference position 10 m from the edge of the nearside carriageway and 1.5 m above ground. Predictions, provided in Table 11.14, have been made in accordance with 'Calculation of Road Traffic Noise Procedures' issued by the Department of Transport Welsh Office<sup>8</sup>.

**Table:11.14 Projected hourly traffic noise levels ( $L_{A10}$  (1hr)) and Impact during construction and operational phases.**

Hourly Time Period (hrs)	Without Development	With Development	Change	Magnitude of Impact	Significance of Effect
<b>Construction Phase on Beancross Road</b>					
0600-0700	69.7	70.1	+0.4	Negligible	Insignificant
<b>Operational Phase on A9 between A904 and A905 junctions</b>					
0600-0700	70.8	71.3	+0.5	Negligible	Insignificant

- 11.6.11 The predictions confirm that there will be a small increase in  $L_{A10}$ (1 hour) traffic noise of up to 0.4 dB(A), on Beancross Road, due to construction staff employees arriving (and potentially departing) the site. The magnitude of impact according to guidance in the Design Manual for Roads and Bridges is negligible and its impact is not significant.
- 11.6.12 During operations, the road traffic noise will increase on the A9 between the A904 and the A905 by 0.5 dB(A) at 0600-0700 hours. The magnitude of impact is negligible and the effect insignificant.

### Noise During Normal Operations

- 11.6.13 To consider the effect of a new industrial noise source on a residential community, an assessment of the predicted level of noise from the proposed development needs to be undertaken in accordance with

procedures given in BS4142:1997. In addition the predicted change in the ambient noise level can be evaluated in accordance with the guidelines published by the IOA/IEMA<sup>22</sup>. Finally consideration is given to the absolute noise levels defined as the PPC benchmark criteria for meeting BAT requirements under the Pollution Prevention and Control Scotland Amendment Regulations 2004<sup>23</sup>.

- 11.6.14 For the purpose of the BS4142 assessment of operational noise from the proposed Renewable Energy Plant, it has been assumed that the mitigating design measures together with noise from other broadband sources will provide adequate masking and therefore there will be no tonal character correction. Under these circumstances, the BS4142 rating level for the Renewable Energy Plant ( $L_{Ar,T}$ ) will be the same as for the predicted specific noise level ( $L_{Aeq,T}$ ).
- 11.6.15 BS4142:1997 defines background noise as the  $LA_{90}$  of the residual noise, which, in turn, is defined as the ambient noise present without the specific noise being assessed (in this case the specific noise being the new Renewable Energy Plant). With the Renewable Energy Plant being a continuously operating plant, the most sensitive period for the assessment is the early night time (2300-0300), when background noise levels are low, and residents are retiring to bed.
- 11.6.16 Table 11.15 shows the predicted BS4142 Rating Level applicable to the plant operation, against the mean night time background noise level, measured at four key receptor positions. The resulting noise change to the ambient  $L_{Aeq}$  is also shown when compared with the ambient  $L_{Aeq}$  measured during the background noise survey. The conclusions regarding the likelihood of complaints and the magnitude of impact are also indicated.

**Table 11.15: Predicted BS4142 assessment values during normal operations at night, at community receptor positions**

Receptor Location	Rating level ( $L_{Ar,T}$ ) from Plant dB(A) <sup>1</sup>	Background noise level $LA_{90}$ dB(A)	BS4142 Rating minus Background level Column 2-Column 3	BS4142 conclusion
<b>Position 1: 3 Grangeburn Road</b>	38	40	-2	<u>Very low</u> risk of complaint
<b>Position 2: Newton Road</b>	30	43	-13	<u>Very low</u> risk of complaint
<b>Position 3: 57 Grangeburn Road</b>	40	40	0	<u>Low</u> risk of complaint
<b>Position 4: Dalgrain Road</b>	32	43	-11	<u>Very low</u> risk of complaint

<sup>22</sup> Guidelines for Noise Impact Assessment (draft), IEMA/IOA, 2007.

<sup>23</sup> Horizontal Guidance for Noise (H3). Part 1 – Regulation and Permitting, 2002.

**Table 11.16: Predicted assessment of change in ambient noise levels at night during normal operations, at community receptor positions**

Receptor Location	Rating level ( $L_{Ar,T}$ ) from Plant dB(A) <sup>1</sup>	Baseline ambient noise at night ( $L_{Aeq}$ )	Ambient noise at night after development ( $L_{Aeq}$ )	Change in ambient noise level $L_{Aeq}$ <sup>2</sup>	IEMA Impact Category
Position 1: 3 Grangeburn Road	38	41.8	43.2	1.4	slight impact
Position 2: Newton Road	30	45.7	45.8	0.1	slight impact
Position 3: 57 Grangeburn Road	40	43.8	45.2	1.4	slight impact
Position 4: Dalgrain Road	32	53.6	53.7	0.1	slight impact

11.6.17 At all four locations assessed, the level of noise impact during operation is slight, with either a low or a very low risk of complaint arising when assessed in accordance with BS4142. Therefore, the predicted noise levels generated by the proposed development under normal operation would have only a slight impact, and the residual noise effects associated with the operation of the plant will not be significant

11.6.18 A comparison of the predicted plant noise levels, with the benchmark noise emission levels provided in the PPC horizontal guidance are provided in Table 11.17.

**Table 11.17: Comparison between predicted noise levels from normal operation of the Renewable Energy Plant with PPC benchmark criteria**

Receptor Location	Rating Level ( $L_{Ar,T}$ ) dB(A)	PPC Benchmark Emission Criteria		
		Day: $L_{Aeq}$ 50dB	Night: $L_{Aeq}$ 42dB	Night: $L_{Amax}$ 60dB
Position 1: 3 Grangeburn Road	38	-12	-4	N/A
Position 2: Newton Road	30	-20	-12	N/A
Position 3: 57 Grangeburn Road	40	-10	-2	N/A
Position 4: Dalgrain Road	32	-18	-10	N/A
Key Compliance with criteria : <span style="color: green;">■</span> compliant, <span style="color: red;">■</span> non-compliant Notes: 1) N/A in column 5 means that it is not applicable to directly compare the rating level with the $L_{Amax}$ criteria, however the $L_{Amax}$ criteria will comfortably be achieved from this plant.				

11.6.19 Comparison with the PPC benchmark criteria at these positions indicates that the noise rating level for plant operation will be within the daytime and night-time criteria.

11.6.20 With predicted Renewable Energy Plant rating noise levels of 40 dB  $L_{Aeq}$  (free field) at the nearest residences and assumed 10-15 dB(A) reduction through an open window, this equates to an expected internal noise level of 25-30 dB(A) which is well within the values of 35 dB(A) advised in BS 8233 as being reasonable conditions for resting/sleeping in bedrooms. This reinforces the conclusion that the predicted residual effects of operational noise will not be significant.

## 11.7 Assessment of cumulative effects

11.7.1 Planning permission has recently been granted for the Longannet Biomass Power Station some 4 km to the north of the proposed development. The ES submitted for the proposed Longannet plant indicated operating noise levels at the nearest residential receptor some 300 m from the centre of the plant, to be  $L_{Aeq}$  of 30 dB(A). The contribution of the Longannet Biomass Power Station to the receptors around the proposed



Grangemouth Renewable Energy Plant will be insignificant at less than 10 dB(A), and the cumulative effect of the two plants will be no different to that just from the Grangemouth Renewable Energy Plant.

## 11.8 Summary of Effects and Mitigation

11.8.1 Table 11.18 provides a summary of the effects and mitigation applicable to the noise impact of the proposed development.

**Table 11.18: Summary of mitigation and effects**

Description of likely significant effect	Significance of Effect (pre-mitigation)			Summary of mitigation and/or enhancement measures	Significance of Residual Effects		
	Effect	P/T	ST/MT/LT		Effect	P/T	ST/MT/LT
Noise from Construction and decommissioning (demolition)	Insignificant as < 65 LAeq (1 hr)	T	MT	Works to be completed in accordance with BS5228-1:2009. To including controls for night time equipment operation	Insignificant as < 65 LAeq (1 hr)	T	MT
Noise from Commissioning works	Insignificant as < 65 LAeq (1 hr)	T	MT	Mitigation as per construction works	Insignificant as < 65 LAeq (1 hr)	T	MT
Noise from increased road traffic during construction and decommissioning	Insignificant	T	MT	Routing of HGVs. No mitigation required	Insignificant	T	MT
Noise from increased road traffic during normal operations	Insignificant	P	LT	Routing of HGVs. No mitigation required	Insignificant	P	LT
Vibration from construction and decommissioning	Insignificant	T	ST	Vibration monitoring during test piling. Notification of affected residents. Vibration monitoring during routine piling. Compliance with BS 5228-2:2009	Insignificant	T	ST
Noise from Renewable Energy Plant operations	Significant	P	LT	Mitigation and design considerations as described in Section 11.6.	Insignificant	P	LT
Vibration from Renewable Energy Plant operations	Insignificant	P	LT	None	Insignificant	P	LT
Key to table:							
P/T = Permanent or Temporary, ST/MT/LT = Short Term, Medium Term or Long Term.							

# Abbreviations

The following is a list of abbreviations adopted in Chapter 11 Noise.

<b>BAT</b>	Best Available Techniques
<b>BS</b>	British Standard
<b>CPA</b>	Coastal Protection Act
<b>CRTN</b>	Calculation of road traffic noise
<b>dB</b>	Decibel
<b>dB(A)</b>	Decibels, A-weighted
<b>DMRB</b>	Design Manual for Roads and Bridges
<b>EIA</b>	Environmental Impact Assessment
<b>ES</b>	Environmental Statement
<b>H3</b>	Horizontal Guidance Note IPPC H3
<b>HGV</b>	Heavy goods vehicle
<b>Hz</b>	Hertz
<b>ID</b>	Induced draft
<b>IEMA</b>	Institute of Environmental Management and Assessment
<b>IOA</b>	Institute of Acoustics
<b>IPPC</b>	Integrated Pollution Prevention and Control
<b>ISO</b>	International Standards Organization
<b>LA90</b>	Noise level exceeded 90% of the time
<b>LAeq</b>	Continuous sound pressure level over a given period
<b>LAmx</b>	The maximum noise level measured
<b>mms-1</b>	Millimetres per second
<b>PAN</b>	Planning advice note
<b>PPC</b>	Pollution Prevention and Control
<b>PPV</b>	Peak particle velocity
<b>SEPA</b>	Scottish Environmental Protection Agency
<b>WHO</b>	World Health Organisation

## Chapter 12

Terrestrial Ecology

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# Terrestrial Ecology

## 12.1 Introduction

- 12.1.1 This chapter evaluates the importance of the terrestrial (non-aquatic) ecology of the site and the potential impacts predicted as a result of the proposed development. It presents an assessment of the significance of potential impacts on sensitive ecological receptors; suggested mitigation measures to avoid or reduce the impacts; and an assessment of predicted residual impacts of the proposed development after mitigation measures have been implemented. Potential impacts relating to Aquatic Ecology are covered separately (see Chapter 13) and are therefore excluded from this chapter.
- 12.1.2 A separate report entitled 'Information to inform a Habitats Regulations Assessment' is included as Appendix E.6. A Habitat Regulations Assessment will be carried out by the appropriate authority, in this case, the ECU, to determine any likely significant effects that the proposed development might have on the integrity of European nature conservation sites. These are designated as either Special Areas of Conservation (SACs) or Special Protection Areas (SPAs), and collectively such sites form part of a European network of protected areas known as Natura 2000 sites. In addition to SACs and SPAs, the government requires that Ramsar wetlands are afforded the same level of protection as European sites.
- 12.1.3 The application site is located at Carron Dock, Western Channel and Grange Dock within the industrial Port of Grangemouth (see Figure 1.2). It comprises a main area to the west and a narrow strip of quay along the south of the Western Channel to the area known as The Tongue in the east. The main plant area is a brownfield site dominated by a haulage depot, car parking and storage areas containing stockpiles of rubble, soil and wood. Scrub and ephemeral vegetation dominate the vegetation within the site. The quayside consists of hardstanding.
- 12.1.4 Whereas it is proposed that cooling water abstraction will be from the Western Channel, immediately to the north of the main site, two options have been identified for the cooling water discharge: Option 1 crosses the cut between Western Channel and Carron Dock and follows existing roads north to cross North Shore Road before the cooling water is discharged to the River Carron, to the northwest of the application site, south of the breakwater (known as the training wall) (see Figure 1.2). Option 2 follows the roads, which curve around Carron Dock west of the main site, before discharging into the River Carron, north of Old Dock.
- 12.1.5 The River Carron joins the Forth Estuary approximately 1.75 km upstream of the application boundary to the north east. The closest shoreline of the Forth Estuary is approximately 200 m to the north of the main site. Another watercourse, the Grange Burn, occurs approximately 150 m south of the site.
- 12.1.6 Residential areas are located approximately 200 m to the south of the application site, and industrial areas are located to the west and east. These areas tend to be sheltered from direct views of the Port by hedges, lines of trees and plantation woodland that occur along the boundary of the Port, along the railway line and along the Grange Burn. In addition to urban gardens, these areas include patches of scrubby grassland and small wooded areas. The land use northwest of the red-line boundary, north of the River Carron, is mainly agricultural.

### **The Potential for Impacts on Ecological Features**

- 12.1.7 In general, the main aspects of the construction, operation and decommissioning of the proposed development that have the potential to impact upon the terrestrial ecological interest associated with the site are:
- Construction and dismantling of works compound and other temporary structures;
  - Construction, maintenance and decommissioning of cooling water infrastructure;

- Construction and decommissioning of electrical cable connection, fuel storage and power generation structures; and
- Emissions to air potentially affecting air quality and nitrogen and acid deposition at the designated sites in the vicinity of the project (addressed in Chapter 9, Air Quality).

12.1.8 The potential impacts associated with these activities have been reduced, as far as possible, through the careful design of the Renewable Energy Plant and site infrastructure, and through the use of best-practice construction techniques in the design.

## 12.2 Scoping and Key Consultations

12.2.1 The scope of this terrestrial Ecological Impact Assessment (EclA) was determined based on a general knowledge of the site, a desk study and field surveys to identify the nature conservation receptors and any other known issues affecting the site. Following submission of the Scoping Report<sup>1</sup>, a range of organisations were consulted to obtain advice on specific nature conservation issues in the area, identify any concerns that the organisations may have about the potential development and confirm issues that need to be addressed by the EclA.

12.2.2 A summary of the responses relating to ecological issues is provided in Table 12.1.

**Table 12.1: Key Issues Identified by Consultees**

Consultees	Key Issues Raised	Where addressed
Scottish Natural Heritage (SNH)	<p>The proximity of the site to one or more Natura 2000 sites requires assessment under the Habitats Regulations.</p> <p>Generic issues that the ES and any Habitats Regulations Appraisals will need to cover in relation to designated sites should include:</p> <ul style="list-style-type: none"> <li>■ Disturbance to birds through construction activities (including pile driving and vibration), increased ship movements and disruptions of flight lines.</li> <li>■ Damage to intertidal habitats during construction of water intake/outfall pipes.</li> <li>■ Ground contamination released during construction activities.</li> <li>■ Pile driving/vibration in relation to migratory fish.</li> <li>■ Entrainment of fish in cooling water intakes.</li> <li>■ Hot water plumes from cooling water emissions.</li> <li>■ Biocides in cooling water emissions.</li> <li>■ Atmospheric emissions.</li> </ul> <p>Bird survey methodologies appear to vary significantly between the four proposals. SNH recommends that these are standardised as far as possible. Additional sources of information in relation to birds should include:</p> <ul style="list-style-type: none"> <li>■ BTO Atlas <a href="http://www.bto.org/birdatlas/">http://www.bto.org/birdatlas/</a></li> <li>■ NBN <a href="http://data.nbn.org.uk/">http://data.nbn.org.uk/</a></li> <li>■ WeBS <a href="http://www.bto.org/webs/index.htm">http://www.bto.org/webs/index.htm</a></li> </ul>	<p>As described in paragraph 12.1.2, Information to inform a Habitats Regulations Assessment is included as Appendix E.</p> <p>Section 12.5 describes the potential impacts on ecological receptors during the construction, operation and decommissioning phases, respectively.</p> <p>Issues relating to air quality are described in Chapter 9, Air Quality.</p> <p>Issues relating to aquatic ecology are described separately in Chapter 13, Aquatic Ecology.</p>
Scottish Environment Protection Agency (SEPA)	<p>UKBAP species and habitats must be included in the assessments so that they are not omitted from any mitigation measures proposed. The full list of Priority UKBAP Species and Habitats can be found on <a href="http://www.ukbap.org.uk/NewPriorityList.aspx">http://www.ukbap.org.uk/NewPriorityList.aspx</a>. UKBAP habitats and species of particular importance within the Firth of Forth and Firth of Tay include:</p> <ul style="list-style-type: none"> <li>■ Saltmarsh;</li> <li>■ Sea grass beds; and</li> <li>■ Native Oysters (<i>Ostrea edulis</i>) living populations of which have been</li> </ul>	<p>Section 12.4 presents details of UK BAP species and habitats.</p> <p>Issues relating to aquatic ecology are described in Chapter 13, Aquatic Ecology.</p>

<sup>1</sup> Forth Energy 2009. Grangemouth Renewable Energy Plant: Scoping Report December 2009.

Consultees	Key Issues Raised	Where addressed
	recently found in the Firth of Forth <a href="http://www.marlin.ac.uk/speciesfullreview.php?speciesID=3997">http://www.marlin.ac.uk/speciesfullreview.php?speciesID=3997</a>	
Falkirk Council (FC)	No comment	
West Lothian Council	<p>The ES must include an assessment of air quality indicators for the receptors of human/ fauna/ flora for the full extents of the biomass plant's impact, with mapping and wind direction analysis.</p> <p>Potential natural environmental impacts for the Firth of Forth estuary and corridor and the northern area of West Lothian are a major concern for the council. West Lothian shares a Special Protection Area with Falkirk Council along the Blackness foreshore area and the ES should assess impacts for both the above and under water environments in these areas. Westerly winds are likely to displace some of the airborne environmental impacts to the West Lothian area. As an authority with a programme to remedy contaminated land, a good record in post-industrial land reclamation, and a participant in river quality management, the authority needs to be reassured that mitigation measures are viable and will avoid and stop impacts on the council area's natural environment. A full assessment of environmental impacts for West Lothian and the viability of mitigation measures proposed needs to be part of the ES.</p>	<p>As described in paragraph 12.1.2, Information to inform a Habitats Regulations Assessment is included in Appendix E.</p> <p>Issues relating to air quality are described in Chapter 9, Air Quality.</p>
Royal Society for the Protection of Birds (RSPB)	<p>The proposed location of the main plant is unlikely to cause significant impacts on nature conservation interests, as it is within the footprint of the Port of Grangemouth. However, the RSPB would like to see the Environmental Statement include measures to enhance the site for the important colony of common terns. We are content with the proposed assessment methodology.</p> <p>We have serious concerns regarding the search areas for the cooling water infrastructure, which extend into the internationally important Firth of Forth SPA, RSPB Scotland's Skinflats Reserve and key roost sites. Any loss or disturbance to the intertidal habitat or the birds using this habitat should be regarded as having a significant effect on the Firth of Forth SPA and so would require an appropriate assessment to be undertaken. As mentioned, the applicant should provide sufficient data in the Environmental Statement to inform this assessment. It is strongly advised that alternatives to these search areas are also provided and examined.</p>	<p>As described in paragraph 12.1.2, Information to inform a Habitats Regulations Assessment is included in Appendix E.</p> <p>As described in paragraphs 12.5.41, in the absence of mitigation, an impact is expected on the colony. However, following the mitigation outlined in Section 12.6, no residual impact is anticipated.</p>
Linlithgow Angling Club	All aspects of the surrounding terrestrial ecology would need to be carefully monitored.	The ecological baseline has been described in Section 12.4. Section 12.5 describes the potential impacts on ecological receptors during the construction, operation and decommissioning phases, respectively.

## 12.3 Assessment Methodology and Significance Criteria

### Assessment Methodology

- 12.3.1 There are a range of different protocols for the assessment of the significance of ecological impacts. In the main, protocols have traditionally relied on a matrix approach, where categories of value and magnitude of impact are given to each receptor, and then a category of significance is created by amalgamating the value and magnitude.



- 12.3.2 The current assessment follows the Institute of Ecology and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment in the UK<sup>2</sup> (henceforth referred to as the IEEM guidelines). These guidelines set out a process of identifying the value of each ecological receptor and then characterising the impacts that are predicted, before discussing the effects on the integrity or conservation status of the receptor, proposed mitigation and residual impacts.

### **Relevant Legislation and Policy**

- 12.3.3 The role of the EclA, as stated in the IEEM guidelines, is to:

- Provide an objective and transparent assessment of the ecological effects of proposals to all interested parties, including the general public;
- Facilitate objective and transparent determination of the consequences of the proposal in terms of national, regional and local policies relevant to nature conservation and biodiversity (see Sections 12.5-12.7); and
- Set out what steps will be taken to ensure that legal requirements relating to habitats and protected or controlled species are met.

- 12.3.4 This assessment pays explicit regard to the requirements of the following legislation and policy documents:

- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the “Habitats Directive”)<sup>3</sup>;
- The Wildlife and Countryside Act 1981<sup>4</sup>, as amended by the Nature Conservation (Scotland) Act 2004<sup>5</sup>;
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) (the “Habitats Regulations as amended in Scotland”)<sup>6</sup> (which translates the Habitats Directive into UK law);
- Scottish Planning Policy 2010<sup>7</sup> (which is the statement of the Scottish Government’s policy on nationally important land use planning matters, including natural heritage);
- Circular 15/99 EIA (Scotland) Regulations 1999<sup>8</sup>;
- The Nature Conservation (Scotland) Act 2004<sup>9</sup>;
- The Protection of Badgers Act 1992 (c.51)<sup>10</sup> as amended by The Nature Conservation (Scotland) Act 2004<sup>11</sup>
- The Scottish Biodiversity List<sup>12</sup>;

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<sup>2</sup> Institute of Ecology and Environmental Management, 2006. Guidelines for Ecological Impact Assessment in the United Kingdom.

<sup>3</sup> European Economic Community, 1992. Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora. Off. J. Eur. Communities, L206, 22/07/92, 7.

<sup>4</sup> [http://www.opsi.gov.uk/acts/acts1992/Ukpga\\_19920051\\_en\\_1.htm](http://www.opsi.gov.uk/acts/acts1992/Ukpga_19920051_en_1.htm).

<sup>5</sup> [http://opsi.gov.uk/legislation/scotland/acts2004/asp\\_20040006\\_en\\_1](http://opsi.gov.uk/legislation/scotland/acts2004/asp_20040006_en_1).

<sup>6</sup> [http://www.opsi.gov.uk/si/si1994/uksi\\_19942716\\_en\\_1.htm](http://www.opsi.gov.uk/si/si1994/uksi_19942716_en_1.htm).

<sup>7</sup> <http://www.scotland.gov.uk/Resource/Doc/300760/0093908.pdf>.

<sup>8</sup> <http://www.scotland.gov.uk/Publications/1999/08/circular-15-1999/circular-15-1999>.

<sup>9</sup> [http://www.opsi.gov.uk/legislation/scotland/ssi2008/ssi\\_20080193\\_en\\_1](http://www.opsi.gov.uk/legislation/scotland/ssi2008/ssi_20080193_en_1)

<sup>10</sup> [http://www.opsi.gov.uk/acts/acts1992/Ukpga\\_19920051\\_en\\_1.htm](http://www.opsi.gov.uk/acts/acts1992/Ukpga_19920051_en_1.htm)

<sup>11</sup> [http://www.opsi.gov.uk/legislation/scotland/acts2004/asp\\_20040006\\_en\\_1](http://www.opsi.gov.uk/legislation/scotland/acts2004/asp_20040006_en_1)

<sup>12</sup> <http://www.biodiversityscotland.gov.uk/pageType2.php?id=35&type=2&navID=92>

- The UK Biodiversity Action Plan (BAP)<sup>13</sup>; and
- Falkirk Area Biodiversity Action Plan<sup>14</sup>.

### Zone of Impact for Ecological Receptors

- 12.3.5 All designated nature conservation sites, plant and animal species, habitats and integrated plant and animal communities that occur within the 'zone of impact' of the proposed development are defined as potential 'ecological receptors'.
- 12.3.6 The zone of impact for ecological receptors varies, depending on the nature and behaviour of the receptors and the type of impact that may affect them. As a general rule in this EclA, the assessment on individual receptors is considered for the whole of the development area plus the distances listed in Table 12.2.

**Table 12.2: Zone of Impact from Development Boundary for Ecological Receptors**

Ecological Receptor	Zone of Impact from Development Boundary
Internationally designated sites, i.e. Ramsar Wetlands, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) and nationally designated sites, including Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs)	Within 15 km
Locally designated sites, including Local Nature Reserves (LNRs), Local Wildlife Reserves (LWRs), Scottish Wildlife Trust Reserves (SWTs) and Sites of Importance for Nature Conservation (SINCs)	Within 2 km
Protected species, such as water voles, otters, great crested newts, badgers, Schedule 1 birds and bats	Within 500 m
Habitats	Within 200 m of main application boundary, within 50 m of cooling water route

### The Value of Ecological Receptors

- 12.3.7 In accordance with the IEEM guidelines the 'value' of potential ecological receptors is evaluated within a defined geographic frame of reference, which has been interpreted for this scheme as shown in Table 12.3.

**Table 12.3: Geographic Frame of Reference**

Geographic Frame of Reference	Definition
International	Receptors of European Union or United Nations importance. For example, international nature conservation sites, such as Ramsar Wetlands, SACs and SPAs, or particularly significant populations of internationally important species, e.g. UK Red Data Book species or UK BAP Category 1 and 2 species.
National	Receptors of UK or Scottish importance. For example national designated nature conservation sites, such as SSSIs, NNRs and Marine Nature Reserves, or particularly significant populations of nationally important species, e.g. a Falkirk Area BAP species.
District	Receptors of Falkirk Unitary Authority importance. For example, non-statutory local conservation sites, such as LWSs, semi-natural ancient woodlands greater than 0.25 ha, or particularly important local populations of species of West Lothian importance, e.g. Red Data Book Category 3 Rare <sup>15</sup> species.

<sup>13</sup> <http://www.ukbap.org.uk/>

<sup>14</sup> [http://www.falkirk.gov.uk/services/development/planning\\_and\\_environment/biodiversity/biodiversity%20pdfs/falkirk\\_area\\_biodiversity\\_plan.pdf](http://www.falkirk.gov.uk/services/development/planning_and_environment/biodiversity/biodiversity%20pdfs/falkirk_area_biodiversity_plan.pdf)

Geographic Frame of Reference	Definition
Local	Receptors of Grangemouth importance. For example, semi-natural ancient woodlands smaller than 0.25 ha or regularly occurring but low numbers of locally common protected species within or adjacent to the Application area.
Less than local	Areas of habitat with limited ecological value. Common and widespread species with little or no statutory protection.

## Evaluating Sites and Features

12.3.8 As described in the IEEM guidelines, some sites have already been assigned a level of nature conservation value through designation. The reasons for such designations need to be taken into account in EcIA. Key published guidance on selecting designated sites in Scotland includes the following:

- The EC Habitats Directive: Selection of Special Areas of Conservation in the UK, Brown, A.E., Burn, A.J., Hopkins, J.J. & Way, S.F., 1997<sup>16</sup>;
- Guidelines for selection of Earth Science SSSIs Nature Conservancy Council (NCC), 1989<sup>17</sup> and Joint Nature Conservation Committee (JNCC) supplements<sup>18</sup>;
- Guidelines for selection of Biological SSSIs NCC, 1989<sup>19</sup> and JNCC supplements (Intertidal Marine Habitats and Saline Lagoons, 1996 and revisions, Non-vascular Plants, 1992, Bogs, 1994, Freshwater Habitats, 1997, Freshwater and Estuarine Fish, 1997)<sup>20</sup>;
- A Nature Conservation Review. Ratcliffe, D.A. (ed.), 1977<sup>21</sup>;
- The UK SPA Network: its scope and content. Volume 1: Rationale for the selection of sites. Stroud et al., 2001<sup>22</sup>; and
- Protecting internationally important bird sites. Stroud, D.A., Mudge, G.P. and Pienkowski, M.W., 1990<sup>23</sup>.

<sup>15</sup> Red Data Book Category 3 Rare (RDB 3) are taxa with small populations in Great Britain that are not at present endangered or vulnerable, but are at risk. They are usually localised within restricted geographical areas or habitats or they are thinly scattered over a more extensive range. Species which are estimated to exist in fifteen or fewer hectads (10 km squares) in the National Grid, although this criterion may be relaxed where populations are likely to exist in over fifteen hectads but occupy small areas of particularly vulnerable habitat.

<sup>16</sup> Brown, A.E., Burn, A.J., Hopkins, J.J. & Way, S.F., 1997. The EC Habitats Directive: Selection of Special Areas of Conservation in the UK. Report 270. JNCC, Peterborough.

<sup>17</sup> Nature Conservancy Council, 1989. Guidelines for the Selection of Geological SSSIs (1977) (summarising the approach adopted in the Geological Conservation Review). NCC, Peterborough.

<sup>18</sup> <http://www.jncc.gov.uk/pdf/earthscienceSSSI.pdf>.

<sup>19</sup> Nature Conservancy Council, 1989. Guidelines for the Selection of Biological SSSIs. NCC, Peterborough.

<sup>20</sup> JNCC supplements at <http://www.jncc.gov.uk/page-2303>.

<sup>21</sup> Ratcliffe, D. A. (ed.), 1977. A nature conservation review: the selection of biological sites of national importance to nature conservation in Britain. 2v. Cambridge University Press, Cambridge.

<sup>22</sup> Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H. & Whitehead, S., 2001. The UK SPA network: its scope and content. Volume 1: Rationale for the selection of sites. JNCC, Peterborough.

<sup>23</sup> Stroud, D.A., Mudge, G.P. & Pienkowski, M.W., 1990. Protecting internationally important bird sites. NCC, Peterborough.

### **Evaluating Biodiversity Assets**

- 12.3.9 In accordance with the IEEM guidelines<sup>24</sup>, the value of habitats is also measured against published selection criteria. These include size (extent), diversity, naturalness, rarity, fragility, typicalness, recorded history, position in an ecological or geographical unit, current condition and potential value.
- 12.3.10 In assigning a level of value to a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. Rarity is an important consideration because of its relationship with threat and vulnerability, although, because some species are inherently rare, it is necessary to look at rarity in the context of status. A species that is rare and declining should be assigned a higher level of importance than one that is rare but known to be stable.
- 12.3.11 In addition to the above evaluation criteria, reference has been made to the documents listed in paragraph 12.3.8. These include the UK and Falkirk Area Biodiversity Action Plans (comprising both Habitat Action Plans and Species Action Plans), although, as the guidelines note, the existence of a given action plan reflects the fact that the receptor is in a sub-optimal state (and hence an action is required) and does not necessarily imply any specific level of importance for the receptor. In accordance with the guidance, receptors may be assigned greater value if there is a reasonable chance that they can be restored to higher value in the future.

### **Characterisation of Impacts**

- 12.3.12 The impacts on each receptor are described in relation to a range of factors. These include the magnitude (quantified where possible), extent (either in area or population terms), duration, timing, frequency and reversibility of the effect on the structure and function of the ecosystem. Impacts in combination may have a cumulative effect that is greater than when the same impact acts in isolation. Combination impacts include the separate effects of the scheme upon a receptor (e.g. impacts at the construction and operation stage) or the combined impacts of a number of schemes that affect the same receptor.
- 12.3.13 As stated in the IEEM guidelines, the degree of confidence in an assessment of the impact on ecological structure and function may be adequately described in qualitative terms, although it is considered more helpful when this is done on an objectively defined scale. Consequently, the following four-point scale has been adopted in line with IEEM recommendations:
- Certain/near-certain = probability estimated at 95% chance or higher;
  - Probable = probability estimated above 50% but below 95%;
  - Unlikely = probability estimated above 5% but less than 50%; and
  - Extremely unlikely = probability estimated at less than 5%.

### **Assessment of Significance of Impacts**

- 12.3.14 As stated in the IEEM guidelines, the starting point for any assessment of impacts is to determine which ecological receptors should be subject to detailed assessment. In order to warrant detailed assessment, ecological receptors should be of sufficient value that impacts upon them may be significant (in terms of legislation or policy) and be potentially vulnerable to significant impacts arising from the development. This approach is consistent with the EIA Regulations, which only require investigation of likely significant effects.
- 12.3.15 In this assessment, an ecologically significant impact is defined as an impact (adverse or positive) on the integrity of the site or ecosystem(s) and/or the conservation status of habitats or species within the identified zone of impact for the development. The definitions of 'integrity' and 'conservation status' used for this assessment are those detailed in the Habitats Directive and reproduced in the IEEM Guidelines, namely:

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<sup>24</sup> Institute of Ecology and Environmental Management, 2006. Guidelines for Ecological Impact Assessment in the United Kingdom

- Integrity is the coherence of ecological structure and function, across a site's whole area, that enables it to sustain a habitat, complex of habitats and/or the levels of populations of species; and
- Conservation status for habitats is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area. Conservation status for species is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area.

12.3.16 It should be noted that even where an impact on the integrity or conservation status of a habitat or species is not significant, it could still result in an offence under the law, e.g. in relation to disturbance of a protected species.

12.3.17 The importance of an ecologically significant impact in policy terms corresponds to the importance of the ecological receptor involved. For example, an impact on a feature of national importance is significant at the national level and therefore a greater issue in policy terms compared with an ecologically significant impact on a feature of county or local importance. In addition, any impact, which has been found not to be significant at the level at which a receptor has been valued, could be significant at a more local level.

### **Desk Study**

12.3.18 A desk study was carried out to identify the presence of internationally and nationally statutory designated conservation sites, as well as non-statutory conservation sites. This was done by using the JNCC<sup>25</sup> and Scottish Natural Heritage (SNH)<sup>26</sup> online databases. In addition, the desk study identified habitats and species of conservation concern.

### **Designated Nature Conservation Sites**

12.3.19 International statutory designated conservation sites, i.e. Ramsar Wetlands, Special Areas of Conservation and Special Protection Areas, within 15 km of the application boundary were identified.

12.3.20 In addition, national statutory designated conservation sites, e.g. Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs), within 15 km of the application boundary were identified.

12.3.21 Any local statutory designated conservation site, i.e. Local Nature Reserves (LNRs), within 2 km of the application boundary, was also identified together with its key features of interest.

### **Non-statutory Nature Conservation Sites**

12.3.22 Non-statutory conservation sites, such as Local Wildlife Sites (LWS) and Sites of Importance for Nature Conservation (SINCs), within 2 km of the main site were identified, using information obtained from the Scottish Wildlife Trust online database<sup>27</sup>.

### **Protected Habitats and Species**

12.3.23 Information was sought on protected habitats and species within a 2 km radius of the main site. 'Protected' species are defined as those species (both fauna and flora) that receive full protection under United Kingdom legislation, whereas 'notable' species are defined as those species (both fauna and flora) that are currently a conservation concern due to declining range or numbers. Relevant data were sourced from:

- SNH;

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<sup>25</sup> <http://www.jncc.gov.uk>.

<sup>26</sup> <http://www.snh.gov.uk/publications-data-and-research/environmental-data/map/>

<sup>27</sup> <http://www.swt.org.uk/>

- SEPA;
- Scottish Wildlife Trust (SWT);
- National Biodiversity Network (NBN) Gateway;
- Botanical Society of the British Isles (BSBI);
- Central Scotland Bat Group;
- Falkirk Environment Trust;
- Forth Seabird Group;
- Butterfly Conservation Scotland;
- The Herpetological Conservation Trust;
- Royal Society for the Protection of Birds (RSPB) Scotland;
- Scottish Badgers;
- Atlas of Amphibians and Reptiles in Britain<sup>28</sup>; and
- Distribution Atlas of Bats in Britain and Ireland<sup>29</sup>.

12.3.24 It should be noted that there is currently no local biological records centre which covers Grangemouth.

#### **Field Survey Methodologies**

12.3.25 The site was visited by an ecologist from SKM Enviros on 18th August 2009 in order to gain an overview of the site and assess the likely survey needs. Baseline ecological surveys were carried out by Atmos Consulting Ltd on 16th September 2009 and by SKM Enviros on 4th February, 4-5th March and 20th July 2010. As a section of the site had been surveyed by Atmos Consulting Ltd in August 2009 in relation to a proposed Port of Grangemouth Wind Turbine Development, these results were also utilised. The baseline ecological surveys followed the nationally recognised Guidelines for Baseline Ecological Assessment<sup>30</sup>.

12.3.26 The terrestrial ecological surveys carried out on site comprised:

- An Extended Phase 1 habitat survey;
- A great crested newt habitat suitability assessment;
- Bat surveys; and
- An otter survey.

12.3.27 The methodology used for each of these surveys is summarised below. Relevant legislation relating to surveyed species can be found in Appendix E1.

12.3.28 Avian survey data were obtained from surveys carried out by Atmos Consulting Ltd from September 2008 to August 2009 on behalf of Forth Energy as part of the surveys for the proposed Wind Turbine Development. These surveys comprised:

- A breeding bird survey; and
- A wintering bird survey.

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<sup>28</sup> Arnold, H.R., 1995. Atlas of Amphibians and Reptiles in Britain. HMSO, London

<sup>29</sup> Richardson, P., 2000. Distribution atlas of bats in Britain and Ireland 1980-1999. Bat Conservation Trust, London

<sup>30</sup> Institute of Environmental Assessment, 1995. Guidelines for Baseline Ecological Assessment. IEA, London



12.3.29 The methods and results of the avian surveys are included in Appendix E3.

#### **Extended Phase 1 Habitat Survey**

- 12.3.30 All habitat patches greater than 0.1 ha were recorded and mapped in accordance with Phase 1 habitat survey methodology<sup>31</sup>, which is a standardised method of recording habitat types and characteristic vegetation. The habitat mapping was confined to the main site and a 200 m buffer, although ecological features were investigated within a 500 m buffer of the site (where accessible). Habitat mapping of the potential cooling water pipeline routes, which follow existing roads, was carried out within a 50 m buffer.
- 12.3.31 The Phase I survey method was extended through the additional recording of specific features indicating the presence or likely presence, of protected species or other species of nature conservation significance. Target notes were made to describe characteristic habitats, features of ecological interest or any other features which may require ecologically sensitive design or mitigation.
- 12.3.32 The extended Phase I method enables a suitably experienced ecologist to obtain sufficient understanding of the ecology of a site in order to either:
- Confirm the conservation significance of the site and assess the potential for impacts on habitats/species likely to represent a material consideration in planning terms; or
  - Ascertain that further ecological surveys will be required before such confirmation and assessment can be made.

#### **Survey Constraints**

- 12.3.33 A Phase 1 habitat survey is designed to provide a quick, transparent assessment of the habitats present in the survey area. The timing of the surveys of the main site in September and February meant that some early annual plant species might not have been in evidence, whereas other species had past their flowering/seeding stage, thus losing features which would allow full identification. However, given the very limited range of semi-natural habitats present on the site, it is not considered that this was a significant limitation and it has not affected the robustness of the survey or its findings.
- 12.3.34 Parts of the Port are busy operational areas subject to heavy plant and machinery and, where leased to other organisations, are outwith the direct control of Forth Energy. Surveys could therefore not be conducted in these areas. However, such areas were surveyed from adjacent land and the information thus gained was considered sufficient to determine habitats present within the area, comprising mainly bare ground, and their potential to support protected species. This limitation is not therefore considered to be significant.

#### **Great Crested Newt Habitat Suitability Assessment**

- 12.3.35 There are no ponds within the application boundary. However, two ponds are present within 500 m, one of which is located approximately 475 m southeast of the application boundary, south of the Grange Burn and adjacent to the railway. Because an assessment by Atkins in 2007<sup>32</sup> rated this pond suboptimal to great crested newts (*Triturus cristatus*), and because it is located south of the Grange Burn, the brackish waters of which are a likely barrier to amphibian movement, this pond is not considered any further. A second pond is present south of the Western Channel, east of the large warehouse between the main plant site and the Tongue area. The pond and its adjacent habitats were assessed for their potential suitability to supporting

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<sup>31</sup> Joint Nature Conservation Committee, 2003. Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit, revised reprint

<sup>32</sup> Atkins Ltd., 2007. Grangemouth Biodiesel Project Environmental Statement



great crested newts on February 4<sup>th</sup> 2010. This was done by calculating a Habitat Suitability Index (HSI)<sup>33</sup>. The assessment methodology and results are presented in Appendix E4.

- 12.3.36 The HSI was calculated using conservative values, where any field evidence was considered ambiguous, as the survey was undertaken in February when both aquatic and terrestrial vegetation may be dormant.

### **Bat Surveys**

- 12.3.37 Bat data were obtained from surveys carried out by Echoes Ecology Ltd between May and August 2009. The bat surveys were commissioned by Atmos Consulting Ltd on behalf of Forth Energy as part of the studies for the potential Wind Turbine Development. The bat surveys comprised:

- A bat roost assessment; and
- Six nocturnal activity surveys.

- 12.3.38 The methods and results of the bat surveys are included in Appendix E2.

- 12.3.39 Because the Echoes Ecology surveys did not include the main application site, Atmos Consulting Ltd carried out a bat roost assessment and bat activity surveys of the main application site in September 2009. Surveys were carried out by two surveyors in accordance with recommended methodology<sup>34 35</sup>, as outlined below.

#### *Bat roost assessment*

- 12.3.40 During the extended Phase 1 habitat survey, an assessment was made of whether structures on the main application site and within a 200 m buffer offered suitable roosting habitat for bats.

- 12.3.41 The majority of the buildings in the Port are large, corrugated sheds, which offer very limited bat habitat, because their large internal spaces lack protected places in which bats can conceal themselves. Consequently, the survey effort concentrated on examining smaller brick built structures that generally provide a greater number of features for roosting bats. Features which would allow bats access into the buildings include gaps beneath slates or tiles, gaps behind fascia boards, crevices between stonework, mortise joints, around window frames, behind soffit boards and beneath loose lead flashing or cladding<sup>36</sup>. If no potential access points were observed, the building was concluded to provide low potential for bats and no further surveys were carried out.

- 12.3.42 Where the external examination revealed that a structure had potential for bat roosts, internal inspections were carried out on 21st September 2009. Evidence of roosting bats was searched for throughout the building and in particular in the roof space. Such evidence included sightings of bats themselves and feeding remains, such as piles of insect wings or droppings.

#### *Dusk emergence surveys*

- 12.3.43 Whilst an internal inspection can result in observations of bats themselves or feeding signs, the absence of these signs does not always indicate an absence of bats. Consequently, a dusk emergence survey was also carried out at each structure which was identified in the external inspection as having bat roost potential. The emergence survey took place on the evening of 16th September. The weather conditions were good for survey; there was a very light breeze with an air temperature of 11°C at the start of survey and 9°C at the end of it. Two surveyors positioned themselves with views of opposite sides of the only structure having been

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<sup>33</sup> Oldham, R.S., Keeble, J., Swan, M.J.S. & Jeffcote, M., 2000. Evaluating the suitability of habitat for the great crested newt (*Triturus cristatus*). *Herpetological Journal*, 10: 143-155

<sup>34</sup> Bat Conservation Trust, 2007. *Bat Surveys - Good Practice Guidelines*. BCT, London

<sup>35</sup> Natural England, 2009. *Bats and onshore wind turbines: Interim Guidance*. Technical Information Note TIN051

<sup>36</sup> Scottish Natural Heritage, 2007. *Natural Heritage and the Law: Bats and People*. SNH, Battleby

identified to have bat roost potential in order to maximise the area covered and potential access points. The building was watched from 0.5 hour before sunset, which occurred at 19:26, and 1.5 hours afterwards. The surveyors were equipped with one heterodyne BatBox Duet detector and one Batbox III detector. Any bats recorded were noted, along with information such as time, location/emergence point (if relevant), and, where possible, the direction of flight, species and behaviour (e.g. commuting or foraging).

### **Otter Survey**

- 12.3.44 An otter (*Lutra lutra*) survey was carried out for the Port area on March 4th-5th 2010. The survey focused on all watercourses, wetlands and docklands within the survey area, defined as the entire area inside the Port boundary as well as any area outside the boundary that was within 500 m of the application boundary. The survey was conducted from the River Carron, just west of the Old Dock, in the west of the survey area, east of the foreshore by the British Petroleum (BP) LPG compound. It included the Grange Burn to the south and the entire Dock area to the north.
- 12.3.45 The survey was undertaken by an ecologist experienced in otter surveys and followed recommended methodology <sup>37 38 39</sup>. It concentrated on searching for field signs indicative of otters along water edges, including:
- Spraints;
  - Footprints;
  - Couches; and
  - Holts.
- 12.3.46 Particular attention was paid to boulders and rocks, tree roots, tall ruderal vegetation and areas which could be used as holts. In addition, target notes (TNs) were taken to provide details of riparian habitat type and habitat suitability and quality in relation to otters.

### **Survey Constraints**

- 12.3.47 The survey was undertaken during dry weather conditions and during low tide. There had been no heavy rain events in the days leading up to the survey, to ensure any recent field signs would be visible.
- 12.3.48 Where access was not available, binoculars were used to view the river banks or vegetation. This included parts of the north bank of the River Carron as well as structures in the dock basins. This is not considered a serious limitation to the survey, because the field surveyor is very experienced with otter surveys and is trained to search for field signs through binoculars.

## **12.4 Baseline Conditions and Receptors**

### **Statutory Designated Sites**

- 12.4.1 Table 12.4 and Figure 12.1 summarise the statutory designated sites for nature conservation within 15 km of the red-line boundary. Four sites carry international designations, whereas twenty-one sites carry national designations.

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<sup>37</sup> Chanin, P., 2003a. Ecology of the European Otter. Conserving Natura 2000 Rivers Monitoring Series English Nature, Peterborough

<sup>38</sup> Chanin, P., 2003b. Monitoring the Otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series English Nature, Peterborough

<sup>39</sup> Scottish Natural Heritage, 2008. Otters and Development. Publication No. 937, 'Scotland's Wildlife' series

Table 12.4: Summary of Statutory Designated Sites

Site and Designation	Grid Reference	Area	Distance and Direction from Site	Summary of Designated Features
<b>Internationally Designated Sites</b>				
Firth of Forth Ramsar Wetland/SPA	NS865920 to NO615075 & NT678794	6,313.7 ha	Within option area for cooling water discharge	<p>The site is designated a Ramsar Wetland because it regularly supports over 20,000 waterfowl in winter (peak mean 1998/99-2002/2003 = 72281) and for regularly supporting wintering populations of species/sub-species at levels of international importance, including pink-footed goose (<i>Anser brachyrhynchus</i>), common shelduck (<i>Tadorna tadorna</i>), oystercatcher (<i>Haematopus ostralegus</i>), common redshank (<i>Tringa totanus totanus</i>), Slavonian grebe (<i>Podiceps auritus</i>), common goldeneye (<i>Bucephala clangula clangula</i>), red knot (<i>Calidris canutus islandica</i>) and bar-tailed godwit (<i>Limosa lapponica lapponica</i>).</p> <p>The site is also designated an SPA for regularly supporting an assemblage of over 20,000 waterfowl in winter, for regularly supporting wintering populations of European importance of pink-footed goose, red-throated diver (<i>Gavia stellata</i>), common shelduck, common redshank, Eurasian golden plover (<i>Pluvialis apricaria</i>), ruddy turnstone (<i>Arenaria interpres</i>), red knot, Slavonian grebe and bar-tailed godwit, and for regularly supporting a population of Sandwich tern (<i>Sterna sandvicensis</i>) of European importance on passage.</p>
Slamannan Plateau SPA	NS810740	591.3 ha	11.2 km southwest	The site is designated an SPA for regularly supporting nationally important numbers of migratory Taiga bean geese ( <i>Anser fabalis fabalis</i> ).
Blawhorn Moss SAC	NS886684	109.0 ha	14.6 km south-southwest	The site is designated an SAC for its active raised bog habitat and degraded raised bog habitat still capable of natural regeneration.
Black Loch Moss SAC	NS855695	108.4 ha	15.0 km southwest	The site is designated an SAC for its active raised bog habitat and degraded raised bog habitat still capable of natural regeneration.
<b>Nationally Designated Sites</b>				
Firth of Forth SSSI	NS865920 to NO615075 & NT678794	7,420.0 ha	Within option area for cooling water discharge	<p>The SSSI comprises an extensive mosaic of intertidal and coastal habitats. At Grangemouth, the SSSI overlaps with the SPA/Ramsar Wetland, although an area of scrub and grassland north of the River Carron is included in the SSSI but not the SPA/Ramsar. There is some grassland. Extensive mudflats make up much of the intertidal area with areas of sand, shingle, rock and boulders. Associated coastal habitats include saltmarsh, grassland and sand dunes. Apart from its habitats, notified biological features include rare species of plant, wintering wildfowl and waders, aggregations of non-breeding birds and invertebrates.</p> <p>The SSSI is also a Geological Conservation Review Site.</p>
Avon Gorge SSSI	NS960792	19.1 ha	3.4 km southeast	The SSSI comprises an ancient, semi-natural woodland, which is relatively undisturbed and contains a good variety and age structure of native deciduous trees. The mainly basic soils have developed a rich and varied ground flora, including species which are rare at the national or district level.

Site and Designation	Grid Reference	Area	Distance and Direction from Site	Summary of Designated Features
Carron Dams SSSI	NS876826	16.6 ha	5.7 km west	The SSSI comprises the largest area of rich fen vegetation in the Falkirk area and is one of the most extensive of its type in Central Scotland. A large number of different swamp and tall fen plant communities are present that are rare throughout Central Scotland. In addition to supporting a number of locally uncommon plant species, the habitats on site make this a locally important site for breeding and wintering birds as well as for rare invertebrates.
Bo'mains Meadow SSSI	NS98837947	0.94 ha	6.0 km southeast	The SSSI is a small, enclosed, species-rich lowland meadow or neutral grassland, which has developed in response to traditional hay meadow management. Examples of this habitat type are rare in Scotland and Bo'mains Meadow is the only SSSI of its type so far notified in Falkirk or Clackmannan Districts. The meadow contains a range of locally uncommon species; a particularly notable feature of Bo'mains Meadow is the large populations of orchids, two species of which are locally rare.
Linlithgow Loch SSSI	NT003775	51.7 ha	7.9 km southeast	The SSSI comprises the Linlithgow Loch and surrounding semi-natural habitats, including the reed-beds, grassland, scrub and woodland. The loch is the largest natural freshwater loch in the Lothian area. It was originally notified as the only example of a lowland mesotrophic loch in West Lothian but when it was surveyed by the SNH Loch Survey in 1997 the site was re-assessed to be an example of a eutrophic loch <sup>40</sup> .
Carriber Glen SSSI	NS968752	9.8 ha	8.0 km south-southeast	The SSSI comprises one of the two largest areas of semi-natural mixed deciduous woodland in West Lothian. Primary woodland is a scarce habitat in West Lothian. The site has a complex geology, which promotes a diversity of woodland types. The woodland is relatively undisturbed and contains several plant species which are scarce in the Lothians.
Howierig Muir SSSI	NS854786	20.6 ha	8.8 km southwest	The SSSI comprises a lowland raised mire partially flanked by raised mineral ground to the north and south, with an area of blanket mire, now planted with Scots pine, to the east. An obvious outflow valley lies in the north-east. Although scrub has colonised the mire surface over the last 30 years, the site retains most of the primary surface and typical bog-bryophyte flora. As part of the wider mosaic of habitats on site, the SSSI is important for breeding and visiting birds.
Lockshaw Mosses SSSI	NS989909	59.2 ha	9.1 km northeast	The SSSI comprises a series of lowland raised bogs which together form the largest and least disturbed area of this habitat in Fife. The bogs support a variety of peatland vegetation communities, including <i>Sphagnum</i> bog, wet heath, marsh, marshy grassland, birch woodland and open water, with good populations of several locally rare or scarce plants.
Darnrig Moss SSSI	NS863755	77.5 ha	9.3 km southwest	The SSSI comprises the last remaining relatively undisturbed and intact raised bog system in Falkirk

<sup>40</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=939&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=939&p_Doc_Type_ID=3)

Site and Designation	Grid Reference	Area	Distance and Direction from Site	Summary of Designated Features
				District. It comprises a series of fused raised bogs joined by areas of lagg fen vegetation. The site is topographically distinct from, and occurs at much higher altitude than, other raised bogs in Central Region. It contains at least one locally rare plant species.
Lochcote Marsh SSSI	NS979742	10.6 ha	9.4 km south-southeast	The SSSI grades from open marsh, containing a few isolated willows, to willow-alder carr and drier willow-birch carr at the eastern end, where there are also a few larger mature trees, predominantly oak, beech and pine. This is the only example of basin mire within West Lothian and is a large and unmodified example of a type of marshland habitat which is scarce and declining within Lothian Region.
Craigmad Wood SSSI	NS965921	28.6 ha	9.5 km north-northeast	The SSSI comprises areas of long-established semi-natural mixed valley woodland, acid oakwood and lowland dwarf shrub heath. Lowland heath is a rare and declining habitat throughout Central Region and Craigmad contains the largest example of this habitat in Clackmannan District. The heath supports locally rare plant species. The woodland ground flora includes species, which are locally restricted in Clackmannan, and boulders present within the woodland habitat support several species of bryophytes, some of which are near the south eastern limit of their British distribution.
Linn Mill SSSI	NS932939	16.0 ha	10.1 km north	The SSSI comprises relatively undisturbed mixed valley woodland and long-established acid oakwood which are uncommon habitats in Clackmannan District. In low lying areas alder swamp has developed, being the only example of this rare habitat in Central Region. The floodplain alder swamp has a characteristic ground flora of hydrophilous species including the locally restricted skullcap ( <i>Scutellaria galericulata</i> ) and reed grass ( <i>Glyceria maxima</i> ) and is in places dominated by panicled sedge ( <i>Carex paniculata</i> ), which is rare in Clackmannan.
Wester Moss SSSI	NS 837909	30.4 ha	10.6 km northwest	The SSSI comprises the largest and least disturbed remaining example of an active raised bog in the eastern part of the Carse of Stirling. In common with the other lowland raised bogs in the Forth valley, the site is a remnant of the far larger expanse of peatland that once covered most of the valley floor.
Gartmorn Dam SSSI	NS920943	70.7 ha	11.0 km north	The SSSI comprises the largest area of open water in Clackmannan District and represents a typical lowland loch surrounded by marginal vegetation, reed swamp and areas of broadleaved woodland. The proximity of the Dam to the internationally important bird populations of the Forth estuary also means that it is of regional importance as a wintering area for geese, swans and duck; and for migrant waders in autumn. The Dam is a highly productive, nutrient-rich site which supports a large variety of invertebrates and macrophytes. An unusually large number of pondweeds of the genus <i>Potamogeton</i> occur, and several are locally uncommon.
Petershill SSSI	NS984696	13.2 ha	11.7 km southeast	The SSSI comprises the largest area of species-rich limestone influenced grassland, which includes both calcareous and neutral grassland habitats, in the

Site and Designation	Grid Reference	Area	Distance and Direction from Site	Summary of Designated Features
				Lothian area. Grassland of this type is a very scarce habitat in the area, and this site is the only example of any size in West Lothian.
Carron Glen SSSI	NS 756844; NS 771846; NS 785835	42.1 ha	12.0 km west	The SSSI comprises steep, rocky slopes of Carron Glen which support the largest tract of ancient/long established deciduous woodland in the Falkirk District. The woods consist of several recognised woodland types, reflecting the variety of edaphic conditions found in the glen. Pedunculate oak is dominant on the more nutrient-poor soils with some silver birch and an incomplete understorey of hazel. The woods are a stronghold for many locally rare woodland plants, most notably globe-flower ( <i>Trollius europaeus</i> ), wood crane's-bill ( <i>Geranium sylvaticum</i> ), greater bellflower ( <i>Campanula latifolia</i> ) and stone bramble ( <i>Rubus saxatilis</i> ).
Philpstoun Muir SSSI	NT067767	11.7 ha	12.9 km east-southeast	The SSSI comprises a mixed deciduous woodland although, unlike other examples of this habitat in West Lothian, it is unusual in that it is not in a river gorge. The woodland is dominated by sycamore, with ash and birch. Oak is also present but is a less common feature of the woodland. The ground flora contains species indicative of ancient woodland. The site has a diverse ground flora and shrub layer with several plant species uncommon in the Lothian area such as sanicle ( <i>Sanicula europaea</i> ), oak fern ( <i>Gymnocarpium dryopteris</i> ) and twayblade ( <i>Listera ovata</i> ).
East Kirkton Quarry SSSI	NS 990691	2.4 ha	13.8 km southeast	The SSSI is a Geological Conservation Review Site. Fossils from the site include a rich and remarkably well preserved terrestrial fauna and flora, including the first fully-articulated amphibians found in Scotland.
Damhead Wood SSSI	NS965968	10.0 ha	13.9 km north-northeast	The SSSI comprises slope alderwood and mixed alderwood with ash, birch and willow. Woodlands of this type are rare throughout Central Region. The ground flora is characteristic of such woodland with a number of locally rare species including lesser pond sedge ( <i>Carex acutiformis</i> ), in enriched flushes, and wood chickweed ( <i>Stellaria nemorum</i> ), nettle-leaved bellflower ( <i>Campanula trachelium</i> ), and dame's violet ( <i>Hesperis matronalis</i> ). In addition to these woodland species, unimproved neutral grassy glades support a characteristic grassland flora including the local species burnet saxifrage ( <i>Pimpinella saxifraga</i> ).
Steelend Moss SSSI	NT046922	6.9 ha	14.0 km northeast	The SSSI comprises an elongated raised bog with an adjacent basin fen and fringing birch and willow woodland. As a small but relatively intact raised bog this is one of the very few examples remaining in Fife that has not been afforested. This is also the only known example in the region with a basin fen in close proximity. A representative and diverse range of vegetation types are present with an unusually large number of plant species, several of which are scarce either nationally or in Fife.
Balquhiderock Wood SSSI	NS 807911	6.1 ha	14.1 km northwest	The SSSI comprises a small remnant of mixed deciduous wet woodland occurring on the north-east facing slope of the Carse of Stirling near Bannockburn. The site is notified for wet woodland. Wet alder



Site and Designation	Grid Reference	Area	Distance and Direction from Site	Summary of Designated Features
				woodland is rare in the eastern part of Stirling Council area. Although relatively small, the woodland has a naturally diverse structure and supports an exceptionally large number of vascular plant species in its understorey.

12.4.2 No LNR occurs within 2 km of the application boundary.

### Non-statutory Designated Sites

12.4.3 Table 12.5 summarises the non-statutory nature conservation sites within 2 km of the application boundary. A single Scottish Wildlife Trust (SWT) reserve is the only non-statutory site within the 2 km radius.

**Table 12.5: Summary of Non-Statutory Nature Conservation Sites**

Site and Designation	Grid Reference	Area (ha)	Distance & Direction from Site	Summary of Conservation Interest
Jupiter Urban Wildlife Centre SWT	NS920810	4.0 ha	1.5 km south-southwest	The reserve has been created in a derelict railway marshalling yard in order to demonstrate how urban greenspaces can be created from wasteland, and how they can be managed to meet human as well as wildlife needs. Despite the small size of the reserve, it is varied and includes wetland, woodland and meadow habitat. A large number of native plant species are present and a good range of nesting bird species has been recorded.

### Habitats

12.4.4 The main site is dominated by a haulage depot, car parks and storage areas with stockpiles of rubble, soil and wood. Figure 12.2 displays the results of the Phase 1 habitat survey. The following 18 Phase I habitats, listed in decreasing order of extent, were recorded within the main site and 200 m buffer as well as the two route options for the cooling water discharge (codes refer to those given in the Handbook for Phase 1 Habitat Survey<sup>41</sup>) and are described below:

- Hardstanding (J6);
- Coastal mud/sand (H1.1);
- Ephemeral/short perennial communities (J1.3);
- Running water (G2);
- Buildings (J3.6);
- Spoil and rubble (I2.2);
- Broadleaved plantation woodland (A.1.1.2);
- Scattered scrub (A2.2);
- Bare ground (J4);

<sup>41</sup> Joint Nature Conservation Committee, 2003. Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit, revised reprint



- Dense/continuous scrub (A2.1);
- Amenity grassland (J1.2);
- Scattered broadleaved trees (A3.1);
- Poor semi-improved grassland (B6);
- Tall ruderals (C3.1);
- Introduced shrub (J1.4);
- Standing water (G1);
- Neutral grassland (B2.2); and
- Scattered coniferous trees (A3.2).

**Hardstanding (4.23 ha on main site, 14.06 ha in 200 m buffer, 4.47 ha in option area for cooling water pipes)**

- 12.4.5 Hardstanding is a prominent feature throughout the Port. Within the main site, hardstanding occurs along the quay by the Western Channel and in the haulage depot.

**Coastal mud/sand (0.00 ha on main site, 0.04 ha in 200 m buffer, 6.32 ha in option area for cooling water pipes)**

- 12.4.6 Mudflats are located on the north and south banks of the River Carron, including along the stretch of the Carron that runs south of the training wall.

**Ephemeral/short perennial communities (4.71 ha on main site, 2.86 ha in 200 m buffer, 0.00 ha in option area for cooling water pipes)**

- 12.4.7 The majority of the vegetation on site falls into this category, which is essentially a man-made habitat in the early stage of re-colonisation. It mainly occurs near areas experiencing heavy disturbance from vehicles and movement of stored materials but where the disturbance is less frequent. Here pleurocarpous mosses form a carpet on the ground together with short grasses, such as red fescue (*Festuca rubra*), meadow grasses (*Poa* spp.) and Yorkshire fog (*Holcus lanatus*), over which taller annual and perennial forb species are beginning to grow, including creeping thistle (*Cirsium arvense*), feverfew (*Tanacetum parthenium*), pineappleweed (*Matricaria discoidea*), creeping buttercup (*Ranunculus repens*), perforate St. John's-wort (*Hypericum perforatum*), great willowherb (*Epilobium hirsutum*), wild strawberry (*Fragaria vesca*), red clover (*Trifolium pratense*), ribwort plantain (*Plantago lanceolata*), yarrow (*Achillea millefolium*) and common ragwort (*Senecio jacobaea*).

**Running water (0.00 ha on main site, 0.44 ha in 200 m buffer, 4.27 ha in option area for cooling water pipes)**

- 12.4.8 There is no running water on the main site. The River Carron is part of the cooling water option area and the Grange Burn is present within the 200 m buffer to the south. Both watercourses are brackish in the area surveyed. The channel of the River Carron is controlled by an artificial breakwater (the training wall) and a coastal embankment north of the Port of Grangemouth, and the river discharges into the Forth Estuary northeast of the main site. The Grange Burn has also been modified through canalisation and with artificial stone banks. Upon entering the southwest corner of the 200 m buffer from the south, it turns sharply eastwards to flow south of the Port complex.

**Buildings (0.33 ha on main site, 3.27 ha in 200 m buffer, 0.56 ha in option area for cooling water pipes)**

- 12.4.9 Due to the industrial nature of the Port, the majority of buildings within the area are large, corrugated warehouses used for storage. Exceptions include offices on the main site that are of brick or concrete construction.

**Spoil and rubble (0.27 ha on main site, 2.98 ha in 200 m buffer, 0.00 ha in option area for cooling water pipes)**

- 12.4.10 Storage areas in the area surveyed comprise stockpiles of rubble, soil and wood. The main area occurs on bare soil or gravel west of the main site where the stockpiles are broadly un-vegetated. Other stockpiles which occur on the main site, east of the haulage depot, have become vegetated with tall herbs and scrub.

**Broadleaved plantation woodland (0.0 ha on main site, 3.24 ha in 200 m buffer, 0.00 ha in option area for cooling water pipes)**

- 12.4.11 An area of young plantation woodland is located between the two railway tracks approximately 50 m south-southeast of the main site. Access directly into this area was not possible, but observation from adjacent areas revealed that the plantation consists of silver birch (*Betula pendula*)<sup>42</sup> and goat willow (*Salix caprea*) between 4-6 m in height, with no noticeable ground flora due to heavy shading by the young trees.

**Scattered scrub (0.34 ha on main site, 2.26 ha in 200 m buffer, 0.52 ha in option area for cooling water pipes)**

- 12.4.12 Scattered scrub occurs throughout the main site and in the wider Port area, including by margins of parking and storage areas and in vegetated areas experiencing infrequent disturbance. The main species include tree saplings, such as silver birch, hawthorn (*Crataegus monogyna*) and goat willow, as well as bramble (*Rubus fruticosus* agg.), dog rose (*Rosa canina*) and butterfly-bush (*Buddleja davidii*). Scattered scrub also occurs adjacent to the Grange Burn.

**Bare ground (0.54 ha on main site, 1.93 ha in 200 m buffer, 0.61 ha in option area for cooling water pipes)**

- 12.4.13 The car parks and depots based on gravel and soil on the main site and around the Port are broadly un-vegetated due to the frequent use by vehicles and movement of stored materials.

**Dense/continuous scrub (0.53 ha on main site, 0.78 ha in 200 m buffer, 1.58 ha in option area for cooling water pipes)**

- 12.4.14 Dense/continuous scrub consisting of silver birch, hawthorn, dog rose, hazel (*Corylus avellana*) and goat willow has developed in areas towards the north of the main site. Similar areas of dense scrub also occur south of the railway line and in vacant plots and strips along the road network in the Port, including along both potential cooling water corridors. On North Shore Road, areas with scrub are dominated mainly by bramble and goat willow with locally abundant silver birch and elder (*Sambucus nigra*).

**Amenity grassland (0.00 ha on main site, 1.07 ha in 200 m buffer, 0.40 ha in option area for cooling water pipes)**

- 12.4.15 Amenity grassland, maintained through frequent mowing, occurs mainly near office buildings adjacent to Central Dock Road, east of the main area, west of the Tongue and south of Carron Dock. There is no amenity grassland on the main site.

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<sup>42</sup> Vascular plant nomenclature follows Stace, C.A., 1995. *New Flora of the British Isles, reprinted with corrections*. St Edmundsbury Press Ltd, Bury St Edmunds

**Scattered broadleaved trees (0.00 ha on main site, 0.62 ha in 200 m buffer, 0.15 ha in option area for cooling water pipes)**

- 12.4.16 Trees are largely uncommon across the Port and the main site. Within the 200 m buffer, they are generally restricted to rowan (*Sorbus aucuparia*), silver birch and crack willow (*Salix fragilis*) which have been planted along Central Dock Road west of the main area. A stand of sycamore (*Acer pseudoplatanus*) is present between Carron Dock and North Shore Road, adjacent to the cooling water pipeline Option 2. Trees also line the Grange Burn and are often found along edges of parking or storage areas.

**Poor semi-improved grassland (0.12 ha on main site, 0.00 ha in 200 m buffer, 0.53 ha in option area for cooling water pipes)**

- 12.4.17 Species-poor semi-improved grassland is present in the north-western corner of the main site and along the route of Option 2 for the cooling water discharge near the Old Dock. Both areas are characterised by a short sward dominated by grasses, such as red fescue and Yorkshire fog. Other species include wild strawberry, red clover, ribwort plantain, common centaury (*Centaureum erythraea*), perforate St. John's-wort, bird's-foot trefoil (*Lotus corniculatus*) and colt's-foot (*Tussilago farfara*). The habitat on the main site is likely to have been more extensive in the past within areas which have subsequently undergone succession to tall ruderals and scrub. Where it remains, this is partly due to heavy rabbit grazing.

**Tall ruderals (0.04 ha on main site, 0.03 ha in 200 m buffer, 0.44 ha in option area for cooling water pipes)**

- 12.4.18 Tall ruderal vegetation has developed along margins of hardstanding and in other areas experiencing infrequent disturbance. The habitat is scattered across the main site and within the 200 m and 50 m buffers, often in between scrub or rank grasses, such as cock's-foot (*Dactylis glomerata*) and false oat-grass (*Arrhenatherum elatius*). Stands of tall ruderals also occur adjacent to the Grange Burn. Species include great willowherb, rosebay willowherb (*Chamerion angustifolium*), hogweed (*Heracleum sphondylium*), common nettle (*Urtica dioica*), broadleaved dock (*Rumex obtusifolius*), common knapweed (*Centaurea nigra*), creeping thistle and goldenrod (*Solidago virgaurea*). Localised patches of common reed (*Phragmites australis*) also occur but are too small to map.

**Introduced scrub (0.00 ha on main site, 0.00 ha in 200 m buffer, 0.09 ha in option area for cooling water pipes)**

- 12.4.19 Introduced scrub, comprising prostrate ornamental species planted in beds along road infrastructure, occurs within Option 2 of the route of the cooling water discharge pipe.

**Standing water (0.00 ha on main site, 0.04 ha in 200 m buffer, 0.00 ha in option area for cooling water pipes)**

- 12.4.20 There is no standing water on the main site, but a single pond is present within the 200 m buffer, just east of the warehouse between the main plant area and the Tongue. The pond is recently engineered. It measures approximately 10 m x 50 m and features sides cut at a 45° angle. The pond is fenced off but could be surveyed with binoculars. Two sets of outflows enter the pond from the warehouse area to the west. Although the pond may be lined with concrete, a layer of coarse gravel is present on the bottom of the pond. In February 2010 some of this gravel was exposed, and it is understood that it is usually dry (as observed by port staff). The vegetation is poorly developed. Reed canary-grass (*Phalaris arundinacea*), butterfly-bush and ruderal species, including docks (*Rumex* spp.), are scattered along the edges of the pond. However, there is a large amount of bare ground and areas of moss as well.

**Neutral grassland (0.00 on main site, 0.00 ha in 200 m buffer, 0.03 ha in option area for cooling water pipes)**

- 12.4.21 A small area of neutral grassland is present along the route of Option 2 for the cooling water discharge pipe. It is characterised by the grasses Yorkshire fog and cock's-foot as well as forbs such as red clover, common knapweed (*Centaurea nigra*), ribwort plantain and bird's-foot trefoil.

**Scattered coniferous trees (0.00 ha on main site, 0.02 ha in 200 m buffer, 0.00 ha in option area for cooling water pipes)**

- 12.4.22 Trees planted along Central Dock Road west of the main site include Scot's pine (*Pinus sylvestris*).

**Habitat Evaluation**

- 12.4.23 The main site, the cooling water infrastructure and the buffers comprise areas subjected to frequent or moderate human disturbance, and the nature conservation value of habitats within the main site is assessed as less than local. Table 12.6 evaluates all the habitats present within the 200 m buffer and their ecological value.

**Table 12.6: Evaluation of Habitats**

Habitat	Total Extent on Main Site, Option Areas for Cooling Water Infrastructure and Buffers	Value
Hardstanding	22.76 ha	The value of the receptor is assessed as being of less than local importance. Hardstanding is not a habitat of conservation concern in the Falkirk Area.
Coastal mud/sand	6.36 ha	The value of the receptor is assessed as being of district importance. Intertidal Mudflats are a UK BAP Priority Habitat, and Mudflats are a Falkirk Area BAP Broad Habitat, although the area present within the 200 m buffer is very small.
Ephemeral/short perennial communities	7.57 ha	The value of the receptor is assessed as being of less than local importance. Although Open Mosaic Habitats on Previously Developed Land are a UK BAP Priority Habitat, the stands on site do not qualify as high quality examples.
Running water	4.71 ha	The value of the receptor is assessed as being of district importance. Although both the River Carron and the Grange Burn are highly modified, Rivers are a UK BAP Priority Habitat and Rivers and Streams are a Falkirk Area BAP Broad Habitat.
Buildings	4.16 ha	The value of the receptor is assessed as being of less than local importance. Buildings are usually of little significance as they provide little value to wildlife. Bats can roost in built structures, and structures were therefore assessed separately for bats (see Section 12.4.40).
Spoil and rubble	3.25 ha	The value of the receptor is assessed as being of less than local importance. Spoil and rubble is not a habitat of conservation concern in the Falkirk Area.
Broadleaved plantation woodland	3.24 ha	The value of the receptor is assessed as being of less than local importance. Although Lowland Mixed Deciduous Woodland is a UK BAP Priority Habitat, and Broadleaved and Mixed Woodland is a Falkirk Area

Habitat	Total Extent on Main Site, Option Areas for Cooling Water Infrastructure and Buffers	Value
		BAP Local Habitat, the stand south of the main site is small and immature.
Scattered scrub	3.12 ha	The value of the receptor is assessed as being of less than local importance. Scrub is not a habitat of conservation concern in the Falkirk Area.
Bare ground	3.08 ha	The value of the receptor is assessed as being of less than local importance. Bare ground is not a habitat of conservation concern in the Falkirk Area.
Dense/continuous scrub	2.88 ha	The value of the receptor is assessed as being of less than local importance. Scrub is not a habitat of conservation concern in the Falkirk Area.
Amenity grassland	1.47 ha	The value of the receptor is assessed as being of less than local importance. Amenity grassland is not a habitat of conservation concern in the Falkirk Area.
Scattered broadleaved trees	0.77 ha	The value of the receptor is assessed as being of less than local importance. Scattered broadleaved trees are not a habitat of conservation concern in the Falkirk Area.
Poor semi-improved grassland	0.65 ha	The value of the receptor is assessed as being of less than local importance. Poor semi-improved grassland is not a habitat of conservation concern in the Falkirk Area. It is the intention to include neutral grassland in the Falkirk Area local BAP (see below), but the semi-improved grassland in the application area are too poor to qualify.
Tall ruderals	0.51 ha	The value of the receptor is assessed as being of less than local importance. Tall ruderals are not a habitat of conservation concern in the Falkirk Area.
Introduced shrub	0.09 ha	The value of the receptor is assessed as being of less than local importance. Introduced shrub is not a habitat of conservation concern in the Falkirk Area.
Standing water	0.04 ha	The value of the receptor is assessed as being of less than local importance. Although Ponds are a UK BAP Priority Habitat, the pond within the 200 m buffer does not meet the criteria for inclusion <sup>43</sup> .
Neutral grassland	0.03 ha	The value of the receptor is assessed as being of less than local importance. Although it is the intention to include neutral grassland in the Falkirk Area local BAP <sup>44</sup> , the small stand of neutral grassland on the quayside by Old Dock is too small to qualify.
Scattered coniferous trees	0.02 ha	The value of the receptor is assessed as being of less than local

<sup>43</sup> See [http://www.jncc.gov.uk/\\_ukbap/BAPHabitats42\\_Ponds.doc](http://www.jncc.gov.uk/_ukbap/BAPHabitats42_Ponds.doc)

<sup>44</sup> Anon, 2002. Farmland and Grassland Statement. Falkirk Area Biodiversity Action Plan. [Http://www.falkirk.gov.uk/services/development/planning\\_and\\_environment/biodiversity/biodiversity%20pdfs/farmland%20and%20grassland%20statement.pdf](http://www.falkirk.gov.uk/services/development/planning_and_environment/biodiversity/biodiversity%20pdfs/farmland%20and%20grassland%20statement.pdf)

Habitat	Total Extent on Main Site, Option Areas for Cooling Water Infrastructure and Buffers	Value
		importance. Scattered coniferous trees are not a habitat of conservation concern in the Falkirk Area.

## Species

- 12.4.24 The following summarises the species information garnered from the data trawl, consultations and field surveys of species in, or in the vicinity of, the site.

### Plants

- 12.4.25 No protected or notable plant species records exist for the site or surrounding area and no protected or notable plant species were recorded during the ecological surveys.

### Invertebrates

- 12.4.26 Butterfly Conservation provided records of a number of common and widespread species of invertebrate within the 1 km national grid squares, which cover the Port, all dating from 1996. They include six-spot burnet (*Zygaena filipendulae*), humming-bird hawk-moth (*Macroglossum stellatarum*) and silver Y (*Autographa gamma*). A single butterfly species, painted lady (*Vanessa cardui*), was also recorded. Additional species recorded within 1 km of the Port include orange tip (*Anthocharis cardamines*), meadow brown (*Maniola jurtina*), ringlet (*Aphantopus hyperantus*) and red admiral (*Vanessa atalanta*).
- 12.4.27 Notified features for the Firth of Forth SSSI, which is present north, northwest and east of the Port, include the northern brown argus butterfly (*Aricia artaxerxes*), which is afforded legal protection through inclusion on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended by the Nature Conservation (Scotland) Act 2004) and is a UK BAP Priority species, and sand dart moth (*Agrotis ripae*). Both are Nationally Scarce species. However, neither species appears to occur near the Port of Grangemouth: the nearest records listed on the NBN Gateway are 7 km and 8 km away from the application site, respectively, but the Management Statement<sup>45</sup> for the Firth of Forth SSSI states that populations of northern brown argus are present on the Burntisland-Kirkcaldy and East Wemyss-Anstruther coastline, over 25 km northeast/east of Grangemouth. The single most important foodplant for northern brown argus is common rock-rose (*Helianthemum nummularium*), which occurs in well drained, unimproved grasslands, whereas for sand dart moth it is sea rocket (*Cakile maritima*), which grows on sandy shores. Neither foodplant is present on the site. Other notified features in the SSSI include the beetles *Lebia chlorocephala*, *Scymnus schmidtii* and *Cleonis piger*, all three of which are Nationally Scarce species. Although *C. piger* feeds on creeping thistle, which occurs on the main site, the nearest records found for any of these species come from sites around Largo Bay in eastern Fife.

### Amphibians

- 12.4.28 There are no existing records of amphibians within 2 km of the application boundary. The nearest, recent (post-1990) record is for common frog (*Rana temporaria*), which was recorded in 1991 in Fife at grid reference NS 935878, approximately 5 km north of the application site. Common frog is afforded limited legal protection through inclusion on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended).
- 12.4.29 Although two ponds are present within and adjacent to the wider Port complex, these are considered to provide sub-optimal habitat for great crested newts due to their coastal location, lack of connectivity to other

<sup>45</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=8163&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=8163&p_Doc_Type_ID=3)



ponds, suboptimal breeding conditions (lack of suitable egg laying vegetation) and the presence of wildfowl (which prey upon newt eggs). Nevertheless, the waterbody located between the main plant area and the Tongue was assessed for its potential to support great crested newts (please refer to Appendix E4 for details on the HSI calculations). Using conservative estimates for water quality and macrophyte content (as discussed above), the Habitat Suitability Index of the waterbody to great crested newt is calculated as 0.53, which makes it below average. When using more realistic values for water quality and macrophyte content, the HSI falls below 0.5, which indicates poor quality. This suggests that the pond is not likely to support great crested newts.

## Reptiles

- 12.4.30 There are no existing records of reptiles within 2 km of the application boundary. The Port area represents suboptimal habitat for reptiles, because of it is partly constructed on reclaimed land with a general absence of undulating topography, banks, hummocks, hollows and south-facing slopes, poor structural habitat diversity, such as hedgerows, woodland edges and rough pasture, as well as a lack of connectivity with suitable habitat outside the Port area. In addition, many areas are subject to frequent disturbance. This makes it unlikely that reptiles would be present in the Port area.

## Birds

- 12.4.31 A number of records exist for bird species within the Port of Grangemouth or adjacent areas. In addition, ornithological surveys of the Port of Grangemouth have been carried out by Atmos Consulting Ltd between September 2008 and August 2009 as part of Forth Energy's proposed wind turbine development in the Port.

### Breeding birds

- 12.4.32 During the breeding bird survey carried out by Atmos Consulting Ltd from April to June 2009 (Appendix E3b), one species was found breeding within the application boundary: a pair of oystercatcher was breeding on the quay by the Western Channel (unnamed figure in Appendix E3b).
- 12.4.33 North of the application boundary, common tern (*Sterna hirundo*), an 'amber listed'<sup>46</sup> and Scottish Priority List species, has used the Port of Grangemouth as a breeding site since 1977. As described in Appendix E3b (Section 4.14 and unnamed figure in Appendix E3b), between June and August 2009, 54 breeding pairs were identified breeding on mooring dolphins in the Western Channel, approximately 50 m north of the main part of the application site. Other breeding species recorded within 500 m of the application boundary include the four red listed species common linnet (*Carduelis cannabina*) (10 pairs), common starling (*Sturnus vulgaris*) (2 pairs), house sparrow (*Passer domesticus*) (5 pairs) and lesser redpoll (*Carduelis cabaret*) (1 pair), as well as song thrush (*Turdus philomelos*) (2 pairs), a red-listed and SPL species, and dunnock (*Prunella modularis*) (6 pairs), an amber-listed species.
- 12.4.34 In addition, Atmos lists evidence that signs of barn owl (*Tyto alba*), a Schedule 1 species, have been recorded within 500 m of the site (Section 4.13 in Appendix E3b). It is understood that these field signs were recorded in a former training building, which is located between the Old Dock and the River Carron, approximately 500 m west-northwest of the site. However, no sightings were made of birds.
- 12.4.35 As cited by Atkins in the 2007 ES for a proposed biodiesel production plant<sup>47</sup> within the Port of Grangemouth, east of the application site, in 2002 British Petroleum undertook a bird survey in and around the Grangemouth complex. Twenty-five breeding species were recorded, including a pair of peregrine falcons (*Falco*

<sup>46</sup> The UK's birds are split into three categories of conservation importance, red, amber and green, where red comprises species of the highest conservation priority and in need of urgent action, amber comprises species of unfavorable conservation status and green comprises species all other species. For more detail, please refer to: [http://www.rspb.org.uk/wildlife/birdguide/status\\_explained.aspx](http://www.rspb.org.uk/wildlife/birdguide/status_explained.aspx)

<sup>47</sup> Atkins Ltd., 2007. Grangemouth Biodiesel Project Environmental Statement



*peregrinus*), which is included on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), six red listed and 14 amber listed species. It has not been possible to determine if any of these species were recorded within the application boundary, although in most cases it is considered unlikely on habitat grounds.

#### *Non-breeding birds*

- 12.4.36 In the 2007 ES for the proposed biodiesel production plant, Atkins lists species recorded during walkover surveys and limited bird surveys in January and February 2007. The latter focused predominantly on wildfowl and wading birds in the mudflats east and southeast of the Port of Grangemouth, including the mouths of the River Avon and Grange Burn, over 500 m from the application boundary of the Renewable Energy Plant. However, Atkins recorded the following species within the Grangemouth complex and in surrounding semi-natural scrub, swamp and reedbed habitat: Peregrine falcon (*Falco peregrinus*), which is included on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), buzzard (*Buteo buteo*), sparrowhawk (*Accipiter nivicus*), ringed plover (*Charadrius hiaticula*), grey wagtail (*Motacilla cinerea*), pied wagtail (*Motacilla alba*), starling (*Sturnus vulgaris*), robin (*Erithacus rubecula*), tufted duck (*Aythya fuligula*), coot (*Fulica atra*), snipe (*Gallinago gallinago*), twite (*Carduelis flavirostris*), great tit (*Parus major*), blue tit (*Parus caeruleus*), reed bunting (*Emberiza schoeniclus*), meadow pipit (*Anthus pratensis*), carrion crow (*Corvus corone*), song thrush (*Turdus philomelos*), blackbird (*Turdus merula*), dunnoek (*Prunella modularis*), wren (*Troglodytes troglodytes*) and moorhen (*Gallinula chloropus*). Some of these species could have been within 500 m of the application boundary, but neither locations nor population estimates were provided.
- 12.4.37 Between November 2008 and February 2009, Atmos Consulting Ltd carried out through the tide wader counts (TTWC) for an envelope covering the Port of Grangemouth, including the red-line boundary (see Appendix E3a). Atmos separated the study area into sections; the Skinflats mudflats to the northwest of the Port and Kinneil mudflats to the east of the Port. The former is relevant for the Renewable Energy Plant proposal, because it includes areas within 500 m of the application boundary (Figure 1.2 in Appendix E3a). The surveys included counts of a number of species, including the following qualifying species for the Firth of Forth SPA: Shelduck, oystercatcher, redshank and knot. In addition, the two assemblage species curlew and dunlin were also surveyed. These six species were singled out because of their importance in relation to the SPA, their behaviour in relation to the proposed wind turbine development, and the numbers present. All six species were recorded on the River Carron south of the training wall, within 50 m of the red line boundary, during high tide, when most birds roost on or near the training wall. The birds follow the outgoing tide to feed on the exposed mudflats, normally within 500 m north of the roosts (see Figures 1.16-1.34 in Appendix E3a). Although the closest record was approximately 300 m north of the main plant site, cooling water discharge option 1 enters the River Carron mudflats north of the main plant site. However, Table 1.9 in Appendix E3a shows the percentages of roosting birds north of the development site in relation to SPA population estimates (using WeBs winter mean peak data from 2002/2003 to 2006/2007). The figures are:
- 15% for shelduck (500 birds out of SPA population of 3,350);
  - 13% for knot (830 birds out of SPA population of 6,401);
  - 8.2% for redshank (450 birds out of SPA population of 5,460);
  - 0.4% for oystercatcher (30 birds out of SPA population of 8,191);
  - 8% for dunlin (650 birds out of SPA population of 8,205); and
  - 1.3% for curlew (50 birds out of SPA population of 3,962).
- 12.4.38 As can be seen in Appendix E3a (Figures 1.16 to 1.34), birds often roost or feed in large areas, and not all birds within a flock may therefore be within 500 m of the application boundary. For example, the maximum count of 500 birds for shelduck was a flock which on 7<sup>th</sup> November 2008 roosted in an approximately 600m wide strip on Skinflats north of the breakwater (Table 1.9 and Figure 1.16 in Appendix E3a). Only a small section of this flock, conservatively estimated at 50 birds, was within 500 m of the application boundary.

Therefore, the maximum percentage of roosting shelduck within 500 m of the application boundary is more likely to be around 1.5% of the SPA population. The figure should also be adjusted for knot: of the 830 birds recorded by Atmos, a maximum of 680 knot were recorded within 500 m of the application boundary (Table 1.9 and Figure 1.19 in Appendix E3a). This represents 10.6% of the SPA population. However, the figures given above for redshank, dunlin and curlew are likely to apply to the 500 m buffer, at least for part of the time. As can be seen on Figures 1.16 to 1.34 in Appendix E3a, shelduck mainly roost and feed north of the River Carron training wall, whereas curlew mainly feed north of the training wall but roosts south of it. Dunlin, redshank and knot mainly roost south of the training wall but will feed both north and south of it. Finally, oystercatcher feeds and roosts mainly south of the training wall.

- 12.4.39 In the Vantage Point surveys carried out by Atmos Consulting Ltd, the following species were recorded in flight within 500 m of the application boundary: Pink-footed goose (*Anser brachyrhynchus*), greylag goose (*Anser anser*), teal (*Anas crecca*), wigeon (*Anas penelope*), goosander (*Mergus merganser*), red-breasted merganser, pintail (*Anas acuta*), scaup (*Aythya marila*), peregrine, turnstone (*Arenaria interpres*), lapwing (*Vanellus vanellus*), Sandwich tern (*Sterna sandvicensis*) and common tern.

### Bats

- 12.4.40 The desk study located no bat records within the application site or its immediate surroundings. The NBN Gateway website includes common pipistrelle (*Pipistrellus pipistrellus sensu lato*) records for “between 1980 and 1994” within 10 km tile NS 98 of the national grid that includes the application site, but no further details are available. The NBN Gateway also contains a 2006 record of soprano pipistrelle (*Pipistrellus pygmaeus*), approximately 3.3 km northeast of the application site, in Fife, and *Pipistrellus* sp. approximately 4.5 km northeast of the application site. The SNH website<sup>48</sup> includes several *Pipistrellus* sp. records, the nearest of which are c.3.3 km south of the application boundary and date from 1993 and 1995, respectively. In addition, the SNH website lists brown long-eared bat (*Plecotus auritus*) in Fife, approximately 5 km northeast of the site, recorded in 2000. The SNH database also includes several records of Daubenton’s bat (*Myotis daubentonii*), the nearest of which is approximately 3.5 km southwest of the site and dates from 2000. This species is known to use habitats along the River Carron (including the Forth & Clyde Canal at Carron Sea Lock) and the River Avon<sup>47</sup>.
- 12.4.41 A single building on the application site, the disused Customs and Excise Building on the northern boundary, was determined to contain features suitable to provide access points for roosting bats due to its state of disrepair. Once examined externally and found to contain access points, it was examined internally for any signs of roosting bats and a dusk emergence survey was carried out as well. No signs of bats were found inside the building, and no bats were observed leaving the structure during the activity survey. Only low bat activity was recorded during the survey, with one record of a commuting bat and foraging taking place over small areas of scrub. A common pipistrelle was heard faintly by surveyor 2 at 20.06 and then observed foraging by scrub to the south of the building. Because surveyor 1 did not record this bat, it was unlikely to have emerged from the building. At 20.17, a soprano pipistrelle was recorded commuting along the edge of the dock basin to the north. Beyond this time, common pipistrelles were intermittently recorded foraging amongst the scrub to the south of the building until 20.32 when no more records were logged until the end of the survey at 21.00.
- 12.4.42 In the bat surveys undertaken by Echoes Ecology Ltd between May and August 2009 (Appendix E2), no bat roosts were found in structures within the northern part of the Port. Activity surveys recorded small numbers of common pipistrelle, soprano pipistrelle and a *Myotis* species, thought to be Daubenton’s bat (*Myotis daubentonii*), all of which were recorded foraging and commuting and associated mainly with the limited number of natural features around the Port, such as trees and scrub.

<sup>48</sup> <http://www.snh.org.uk/SNHi/map.asp>

## **Badgers**

- 12.4.43 The response received from Scottish Badgers for the Port of Grangemouth contained no records of badgers (*Meles meles*) or their setts within the Port or the immediate area. In the 2007 Environmental Statement for the proposed biodiesel plant, Atkins Ltd cited a response from Falkirk Council that badgers were known within 2 km of the proposed Port site. Atkins surveyed scrub habitat along the foreshore of the Forth Estuary for field evidence of badgers and their setts, but no evidence was found and it was concluded that badgers were unlikely to be present within the survey area. This conclusion has been upheld in the present study, which found no evidence of badger during the 2010 Phase 1 survey. The Port is suboptimal to badger, because it is poor in suitable habitat, especially foraging habitat, such as grassland rich in earthworms and other invertebrate prey.

## **Water voles**

- 12.4.44 There are no existing records of water vole (*Arvicola terrestris*) on the application site or within 2 km of the site. The habitats on the application site and the wider Port area are considered unsuitable for the species, due to the brackish conditions, coastal location and presence of artificial stone banks along Grange Burn.

## **Otters**

- 12.4.45 There are no existing records of otter on the application site, but the species has been recorded in the Port area in the past. A survey reported in the 2007 Environmental Statement for the biodiesel production plant proposal found signs of otter activity within swamp and reedbed habitats, approximately 800 m east of the application boundary, as well as by the easternmost bridge over Grange Burn, some 1.3 km northeast of the application boundary. The 2007 ES also made reference to actual otter sightings within the docks.
- 12.4.46 No sign of otter was recorded within the Port area in the 2010 survey (Appendix E5). Only two areas were concluded to have the potential to support otter. They were the land north of the River Carron, approximately 300 m northeast of the application boundary, and areas of reed swamp, grassland and scrub more than 500 m east of the application boundary.
- 12.4.47 Because the Grange Burn traverses heavily built up and industrial areas, and because it has been modified through canalisation and the construction of artificial stone banks, this watercourse is suboptimal for otters. The River Carron offers greater otter potential, notably along the north bank, but again, no signs of otters were found. Most of the survey area is considered unsuitable for breeding or foraging otters because of the high degree of industrial activity within the area.
- 12.4.48 If otters remain present in the wider area, it is possible that they might occasionally forage in or near the Port. They are considered more likely to move via water, such as circumnavigating the coast, rather than move on land, because of the disturbance levels and lack of habitat within most of the Port area.

## **Evaluation – Plant Species**

- 12.4.49 No evidence was found of plants of conservation concern within the application site, which is therefore assessed as having less than local importance.

## **Evaluation – Faunal Species**

- 12.4.50 There is no evidence that the site or surrounding area supports invertebrates of conservation concern, great crested newts, reptiles, badgers or water voles. The importance of the area for faunal species or groups that are present, i.e. birds, bats and otter is evaluated below.
- 12.4.51 Table 12.7 below summarises the bird results. Overall, forty-three species have been recorded in the general area in recent years, of which twenty-eight are Schedule 1 or Annex 1 species, BAP species, birds of conservation concern or are included on the Scottish Biodiversity List.

Table 12.7: Summary of bird conservation interest within 500 m of the site from surveys 2007-2009

Common name	Scientific name	Abundance	Qualifying species for the SPA	Schedule 1 <sup>49</sup>	Annex 1 <sup>50</sup>	BAP <sup>51</sup>	BoCC <sup>52</sup>	SBL <sup>53</sup>
<b>Breeding birds recorded within the application boundary (Atmos 2009)</b>								
Oystercatcher	<i>Haematopus ostralegus</i>	2 pairs	Not as breeding birds					
<b>Breeding birds recorded within 500 m of the application boundary (Atmos 2009)</b>								
Song thrush	<i>Turdus philomelos</i>	1 pair			Yes	UK + Falkirk Area	Red	Yes
Common linnet	<i>Carduelis cannabina</i>	22 pairs				Falkirk Area	Red	Yes
Common starling	<i>Sturnus vulgaris</i>	1 pair					Red	
House sparrow	<i>Passer domesticus</i>	2 pairs				UK	Red	
Lesser redpoll	<i>Carduelis cabaret</i>	1 pair				UK	Red	
Barn owl	<i>Tyto alba</i>	n/a		Yes			Amber	Yes
Common tern	<i>Sterna hirundo</i>	58 pairs		Yes	Yes	Falkirk Area		Yes
Dunnock	<i>Prunella modularis</i>	5 pairs					Amber	
Oystercatcher	<i>Haematopus ostralegus</i>	1 pair	Not as breeding birds					
<b>Non-breeding birds within 500 m of the application boundary recorded in through the tide counts (TTTC) (Atmos 2008-2009)</b>								
Common shelduck	<i>Tadorna tadorna</i>	50-500 birds	Yes				Amber	
Common redshank	<i>Tringa totanus</i>	450 birds	Yes				Amber	
Oystercatcher	<i>Haematopus ostralegus</i>	30 birds	Yes					
Knot	<i>Calidris canutus</i>	680-830 birds	Yes		Yes			
Dunlin	<i>Calidris alpina</i>	650 birds	Assemblage	Yes				Yes
Curlew	<i>Numenius arquata</i>	50 birds	Assemblage			UK		Yes
<b>Non-breeding birds within 500 m of the application boundary recorded in VP watches (excluding TTTC species listed above)</b>								

<sup>49</sup> Species listed on Schedule I of the Wildlife and Countryside Act 1981 (as amended)

<sup>50</sup> Species listed on Annex I of the EU Birds Directive

<sup>51</sup> Species listed on the UK or Falkirk Area BAP

<sup>52</sup> Species listed on the Birds of Conservation Concern in the UK list. Red listed species have the highest conservation priority whereas amber comprises species of unfavourable conservation status. For more details see: Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R., Aebischer, N.J., Gibbons, D.W., Evans, A. and Gregory, R.D., 2009. Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102, pp296–341

<sup>53</sup> Species listed on the Scottish Biodiversity List

Common name	Scientific name	Abundance	Qualifying species for the SPA	Schedule 1 <sup>49</sup>	Annex 1 <sup>50</sup>	BAP <sup>51</sup>	BoCC <sup>52</sup>	SBL <sup>53</sup>
<b>(Atmos 2008-2009)</b> <sup>54</sup>								
Pink-footed goose	<i>Anser brachyrhynchus</i>	≤1,080 birds	Yes				Amber	
Common tern	<i>Sterna hirundo</i>	≤6 birds		Yes	Yes	Falkirk Area		Yes
Sandwich tern	<i>Sterna sandvicensis</i>	≤46 birds	Yes	Yes	Yes			Yes
Peregrine	<i>Falco peregrinus</i>	≤3 birds		Yes	Yes			Yes
Lapwing	<i>Vanellus vanellus</i>	≤890 birds	Assemblage			UK		Yes
Greenshank	<i>Tringa nebularia</i>	1 bird	Assemblage					
Teal	<i>Anas crecca</i>	≤1,596 birds	Assemblage					
Wigeon	<i>Anas penelope</i>	≤158 birds	Assemblage					
Goosander	<i>Mergus merganser</i>	≤26 birds	Assemblage					
Turnstone	<i>Arenaria interpres</i>	≤23 birds	Yes					
Pintail	<i>Anas acuta</i>	≤110 birds	Assemblage					
Cormorant <sup>55</sup>	<i>Phalacrocorax carbo</i>	1 bird	Assemblage					
Greylag goose	<i>Anser anser</i>	221birds	Assemblage					
<b>Additional species recorded within the Grangemouth complex or adjacent scrub, swamp and reedbed habitat (Atkins 2007)</b>								
Twite	<i>Carduelis flavirostris</i>	n/a					Red	
Grey wagtail	<i>Motacilla cinerea</i>	n/a					Amber	
Meadow pipit	<i>Anthus pratensis</i>	n/a					Amber	
Snipe	<i>Gallinago gallinago</i>	n/a	Assemblage				Amber	
Tufted duck	<i>Aythya fuligula</i>	n/a	Assemblage				Amber	
Coot	<i>Fulica atra</i>	n/a	Assemblage					
Ringed plover	<i>Charadrius hiaticula</i>	n/a	Assemblage					
Robin	<i>Erithecus rubecula</i>	n/a						Yes
Blackbird	<i>Turdus merula</i>	n/a						

<sup>54</sup> Abundance data are taken from Table 1.5 in Appendix E3a

<sup>55</sup> Location not confirmed

Common name	Scientific name	Abundance	Qualifying species for the SPA	Schedule 1 <sup>49</sup>	Annex 1 <sup>50</sup>	BAP <sup>51</sup>	BoCC <sup>52</sup>	SBL <sup>53</sup>
Blue tit	<i>Cyanistes caeruleus</i>	n/a						
Buzzard	<i>Buteo buteo</i>	n/a						
Carrion crow	<i>Corvus corone</i>	n/a						
Great tit	<i>Parus major</i>	n/a						
Moorhen	<i>Gallinula chloropus</i>	n/a						
Pied wagtail	<i>Motacilla alba</i>	n/a						
Sparrowhawk	<i>Accipiter nisus</i>	n/a						
Wren	<i>Troglodytes troglodytes</i>	n/a						

- 12.4.52 One pair of oystercatchers was recorded within the main site boundary. It is not known how large the local breeding population of oystercatcher is, although the species is generally common and widespread and it is therefore concluded that the application site is of less than local value to breeding birds.
- 12.4.53 No non-breeding birds have been reported from the main application site itself. While it is likely that the site may be used periodically by common and widespread species foraging in the scrub and ephemeral/short perennial vegetation, the value of the site to non-breeding birds is concluded to be less than local. However, in winter qualifying and assemblage species in the SPA are present within 500 m of the site in numbers exceeding 1% of their total SPA populations. These include common shelduck, common redshank, knot, dunlin and curlew. Taking a precautionary approach, the part of the River Carron that is located within 500m of the site is therefore assessed as having international importance.
- 12.4.54 Although no bat roosts were identified in the surveys, small numbers of common pipistrelle, soprano pipistrelle and a *Myotis* species were recorded foraging and commuting on the site. Bats are protected through inclusion on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended by the Nature Conservation (Scotland) Act 2004) and Schedule 2 of the Conservation (Natural Habitats &c) Amendment (Scotland) Regulations 2007 that defines European Protected Species. Soprano pipistrelle is a UK BAP Priority species. Common pipistrelle was included as a Priority Species on the initial UK BAP from 1994, but was removed from the list in 2007 following a review. However, it remains in the Falkirk Area BAP species as the sole bat species in the Falkirk BAP. Owing to the presence of some foraging and commuting bats the value of the site for bats is assessed as being of local importance.
- 12.4.55 No otters were recorded within the main site boundary, and the wider study area within 500 m of the boundary contains little suitable habitat for otters. However, it is possible that otters occasionally move along the Grange Burn, the River Carron and the dock waters. Otter is protected by UK law through inclusion on Schedule 5 of the Wildlife and Countryside Act 1981, as amended by the Nature Conservation (Scotland) Act 2004 and Schedule 2 of the Conservation (Natural Habitats &c) Amendment (Scotland) Regulations 2007 that define European protected species. Finally, otter is a UK BAP Priority Species and is also included on the Falkirk Area BAP. Taking a precautionary approach and considering the potential for otter presence, the value of the wider study area (within 500 m) for otters is assessed as being of local importance.



## 12.5 Potential Impacts

### Design Mitigation

12.5.1 From the beginning of the EIA process, information obtained about sensitive ecological features has fed into the Renewable Energy Plant design in order to minimise the potential for negative impacts occurring (See also Chapter 7, Site Selection and Alternatives). This has resulted in the following design decisions:

- The Renewable Energy Plant has been sited within the Port of Grangemouth in order to avoid land take in rural areas; and
- The Renewable Energy Plant has been sited on the dockside in order to minimise the need for infrastructure transporting fuel from ships to storage areas.

12.5.2 However, potential impacts arising from activities related to the proposed development could affect the nature conservation interest of the development area during the construction, operation and decommissioning phases.

### Potential Impacts during Construction

12.5.3 It is anticipated that impacts during the construction phase may arise from:

- Vehicular traffic;
- Presence of people;
- Vegetation clearance;
- Ground and excavation works;
- Creation of temporary construction compounds and storage areas;
- Construction of hardstanding and structures, including cooling water intake and outfall;
- Pile driving and vibration;
- Environmental incidents and accidents (e.g. spillages);
- Dust;
- Lighting;
- Noise;
- Routing of services and utilities (e.g. underground electrical lines and drainage); and
- Removal of site offices/compounds and final site clear away after construction.

12.5.4 The underground grid connection does not form part of this application and therefore a detailed assessment of potential ecological impacts is not included here. An outline assessment of potential impacts has been made however and is summarised below.

12.5.5 The route of the underground grid connection route is only indicative at the present time but it would be entirely located beneath the highway network and would likely follow Central Dock Road southwest to North Shore Road, continue southwest along Earl's Road, cross the M9 at Earl's Gate Roundabout to follow Falkirk Road to Westfield Roundabout, before turning north along the A9 and enter the Bainsford Grid Substation via Abbotts Road (see Figure 6.5, Chapter 6, The Proposed Development). Given that the route is located beneath the highway network significant ecological impacts during construction are very unlikely. Along this route however, the cable will cross a dismantled railway on Falkirk Road and the Forth and Clyde Canal on the A9. It is therefore recommended that a suitably qualified ecologist carries out a pre-construction check of the two bridges to ensure that no roosting bats are present in the structures. Should roosts be found, suitable



mitigation would need to be agreed and a licence may need to be obtained from the Scottish Government Rural Directorate (SGRD) prior to the commencement of construction activities.

### **Potential Impacts during Operation**

12.5.6 During the operation phase, it is anticipated that impacts may arise from:

- Vehicular traffic;
- Ship traffic;
- Presence of people;
- Site operation activities;
- Noise;
- Emissions; and
- Thermal plume.

12.5.7 Because the ash storage will be enclosed, no impact from ash is possible on the sensitive ecological receptors identified in this chapter.

12.5.8 As described in Chapter 9, Air Quality, the expected increments of oxides of nitrogen, sulphur dioxide and ammonia at the designated nature conservation sites identified in paragraph 12.4.1 are generally low, with the exception of the Firth of Forth SSSI. Within the Firth of Forth SSSI, the maximum annual average process contribution for oxides of nitrogen is 13% of the air quality objective for the protection of vegetation while for sulphur dioxide it is 7.4% and for ammonia it is 6.7%, albeit these maximum levels only affect inter-tidal areas (see details in Appendix C). In addition, the annual mean ammonia concentration is greater than 1% (the conservative threshold below which deposition is considered not to compromise conservation objectives by impacting vegetation) at Howierig Muir SSSI, Lockshaw Mosses SSSI and Steelend Moss SSSI. Air quality impacts are therefore considered in greater detail for the Firth of Forth SSSI, Howierig Muir SSSI, Lockshaw Mosses SSSI and Steelend Moss SSSI below. At the request of SEPA, impacts are also considered in relation to Slamannan Plateau SPA, Blawhorn Moss SAC/SSSI and Black Loch Moss SAC/SSSI.

### **Potential Impacts during decommissioning**

- Vehicular traffic;
- Presence of people;
- Removal or demolition of hardstanding and structures;
- Dust;
- Lighting;
- Noise; and
- Environmental incidents and accidents (e.g. spillages, noise).

### **Ecological Receptors Subject to Detailed Assessment**

12.5.9 The following applies to all the ecological receptors brought forward to the ecological impact assessment stage:

- Their value is assessed as being important at a local level or higher (and/or they are subject to some form of legal protection); and
- They are potentially vulnerable to significant impacts from the proposed development.

- 12.5.10 Taking a precautionary approach, all nature conservation sites within 10 km of the application site are considered to potentially be impacted by the proposed development. However, sites between 10 km and 15 km are considered only to have a potential for air quality impacts. Such sites are only included in the following, where Chapter 9, Air Quality, has identified a potential impacts.
- 12.5.11 Therefore, based on the information obtained during the desk study, consultations and ecological surveys, the following ecological receptors are considered in this chapter:
- Firth of Forth Ramsar Wetland/SPA/SSSI;
  - Slamannan Plateau SPA;
  - Blawhorn Moss SAC;
  - Black Loch Moss SAC;
  - Avon Gorge SSSI;
  - Carron Dams SSSI;
  - Bo'mains Meadow SSSI;
  - Linlithgow Loch SSSI;
  - Carriber Glen SSSI;
  - Howierig Muir SSSI;
  - Lockshaw Mosses SSSI;
  - Darnrig Moss SSSI;
  - Lochcote Marsh SSSI;
  - Graigmad Wood SSSI;
  - Steelend Moss SSSI;
  - Jupiter Urban Wildlife Centre SWT Reserve;
  - Running water;
  - Coastal mud/sand;
  - Breeding birds;
  - Common tern colony;
  - Bats; and
  - Otters.
- 12.5.12 In the absence of any mitigation measures, the potential impacts of the proposed development on each of the receptors brought forward are assessed for the construction and operation phases, respectively, below. Because impacts during decommissioning will be similar to those for the construction phase, they are not included separately.

### **Potential Impacts during Construction**

#### **Firth of Forth Ramsar Wetland/SPA/SSSI**

- 12.5.13 The Firth of Forth is the only statutory designated site in close proximity to the application site. As described in Table 12.4, the site is designated a Ramsar Wetland and SPA due to its ornithological interest and an SSSI for its habitat, botanical, ornithological, invertebrate and geological interests (see Chapter 14, Hydrology, Hydrogeology, Geology and Soils).

- 12.5.14 In condition assessments carried out of the SSSI's habitats between October 2000 and September 2004<sup>56</sup>, the fen, marsh and swamp habitats were assessed as 'favourable maintained'<sup>57</sup>, whereas the saltmarsh, maritime cliff and lowland neutral grassland habitats were all assessed as 'unfavourable declining'<sup>58</sup>. The vascular plant assemblage was also assessed as unfavourable declining. All ornithological features were favourably maintained, except for breeding ringed plover, which was assessed as unfavourable declining. In terms of invertebrates, northern brown argus was assessed as favourable maintained, whereas beetles were unfavourable declining.
- 12.5.15 In the absence of any mitigation, there is a potential for spillages, e.g. of fuel/oil, entering the Docks or the River Carron during construction of the Renewable Energy Plant. Such a spillage could affect birds through an impact on their prey, notably invertebrates in the River Carron mudflats. This could result in very temporary damage of benthic (mud dwelling) invertebrate communities upon which qualifying and notified species of waders in the Firth of Forth Ramsar Wetland/SPA/SSSI feed. The potential for an impact on invertebrates is evaluated in Chapter 13, Aquatic Ecology. No significant impact has been identified, and consequently any impact on qualifying and notified bird interest is very unlikely. Confidence in this prediction is considered near-certain. However, taking a precautionary approach, mitigation measures will be adopted to minimise the risk of any spillage taking place (see Section 12.6).
- 12.5.16 There is a potential for visual disturbance impacting upon qualifying and notified bird interest in the Ramsar Wetland/SPA/SSSI. Disturbance from installation of the cooling water outfall into the River Carron could have an impact on significant numbers of qualifying and assemblage species, notably common shelduck, common redshank, knot, dunlin and curlew. It is anticipated that construction of the cooling water discharge would take a maximum of 6 months to complete if Option 1 is used that crosses the cut between Western Channel and Carron Dock (see Fig 1.2). If Option 2 is used that curves around Carron Dock, construction time would be 3-4 months. If construction was scheduled for the winter months, birds roosting in the intertidal zone might be forced to move elsewhere, when construction activities were being carried out. Because Option 1 is nearer the estuary, it would be likely to have a greater impact than Option 2. In a study of the effects of construction on waterfowl, Cutts et al. (2008)<sup>59</sup> reviewed the evidence of distances at which flocks of roosting waders and gulls take flight. The evidence was evaluated for different types of human activity, of which walking is most relevant to the construction of the Renewable Energy Plant that will involve stationary or slow moving construction machinery and personnel. The distances varied from a 45 m for golden plover to 96 m for redshank, although Cutts et al. (2008) suggested taking a precautionary approach taken based on the flight distance of the most sensitive species. Any visual disturbance during construction of the Renewable Energy Plant would therefore relate to the construction of the cooling water infrastructure and would be localised to within 250 m of the works area. Comparing this distance with the TTTWC maps in Appendix E3a (Figures 1.16 to 1.34), there is considerable overlap between the 250 m buffer and bird roosts during high tide. Taking a precautionary approach, therefore, in the absence of mitigation, a significant negative impact on roosting birds forming part of the qualifying interest in the SPA is considered **probable**. Confidence in this prediction is considered probable.
- 12.5.17 In contrast, construction activities on the main plant site are not expected to have an impact on qualifying bird interest, because visual disturbance is unlikely to affect birds more than 200 m from the main plant site. For

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<sup>56</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=8163](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=8163)

<sup>57</sup> This is defined as the conservation objectives of the interest feature having been met.

<sup>58</sup> This is defined as the conservation objectives of the interest feature having not been met, and the decline in interest continuing as a consequence of a damaging activity. However, recovery is possible and may occur either spontaneously or in response to suitable management input.

<sup>59</sup> Cutts, N, Phelps, A. & D. Burdon, 2008. *Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance. Report to Humber INCA*. Institute of Estuarine and Coastal Studies, University of Hull.

example, the safe distance quoted for redshank is 250 m<sup>60</sup>, but is likely in reality to be less on the main application site, in part due to there being some habituation to relatively high existing levels of disturbance and also because the Western Channel and the northern quay separate the site from the intertidal areas by the River Carron breakwater (the training wall).

- 12.5.18 There is a potential for noise disturbance impacting upon qualifying and notified bird interest in the Ramsar Wetland/SPA/SSSI. Disturbance from construction of the cooling water outfall into the River Carron could impact upon significant numbers of qualifying and assemblage species, notably feeding and roosting common shelduck, common redshank, knot, dunlin and curlew. As mentioned above, it is anticipated that construction of the cooling water abstraction would take a maximum of 6 months to complete if Option 1 is used, whereas it would take 3-4 months if Option 2 was used. If construction was scheduled for the winter months, birds feeding or roosting in the intertidal zone might be forced to move elsewhere, when construction activities were occurring. The disturbance study by Cutts et al. (2008) also reviewed noise disturbance data from a 1.5 km stretch of coastline near Pyewipe during construction of the South Humber Bank Power Station, specifically the effects of construction piling on the numbers and distribution of coastal bird populations. It was concluded that birds continued to feed approximately 200 m from the piling operations. A similar distance would be expected at Grangemouth. Roosting birds would be more sensitive to noise disturbance than feeding birds, because they are spatially more restricted. Taking a precautionary approach, therefore, in the absence of mitigation, a significant negative impact on roosting birds forming part of the qualifying interest in the SPA is considered **probable**. Confidence in this prediction is considered probable.
- 12.5.19 Of the notified habitat and vegetation features, saltmarsh and unimproved neutral and coastal grasslands occur approximately 300 m west-northwest of the main application site, at Skinflats north of the River Carron. As described in Chapter 9, Air Quality, construction traffic is unlikely to cause a significant change in air quality, and the potential for a significant negative impact upon habitats in the SSSI from construction traffic is therefore considered **unlikely**. Confidence in this prediction is considered near-certain.
- 12.5.20 The nearest populations of notified invertebrate interest are likely to be at least 7 km from Grangemouth, although, judging from the description in the Management Statement<sup>61</sup> for the Firth of Forth SSSI, it is likely that they are more than 25 km away. The notified terrestrial invertebrate interest is therefore **extremely unlikely** to be present near the application site and unlikely to be affected by construction activities, such as through dust or disturbance impacts. Confidence in this prediction is considered near-certain.

#### Slamannan Plateau SPA

- 12.5.21 Slamannan Plateau SPA is designated for its wintering population of Taiga bean geese. This species is strongly migratory and travels between breeding grounds in the high Arctic to wintering grounds in the temperate and subtropical zones. Most of the bean geese that winter in Scotland come from Scandinavia, where the breeding population has declined in the last 20 years, possibly as a result of increased human disturbance, habitat loss and direct persecution<sup>62 63 64 65</sup>. An investigation carried out in one of the species'

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<sup>60</sup> Quoted in Cutts, N, Phelps, A. & D. Burdon, 2008. *Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance. Report to Humber INCA*. Institute of Estuarine and Coastal Studies, University of Hull.

<sup>61</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=8163&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=8163&p_Doc_Type_ID=3)

<sup>62</sup> del Hoyo, J., Elliot, A. and Sargatal, J., 1992. *Handbook of the birds of the world, vol 1: Ostrich to Ducks*. Lynx Edicions, Barcelona, Spain.

<sup>63</sup> Kear, J., 2005. *Ducks, geese and swans volume 1: general chapters; species accounts (Anhimas to Salvadorina)*. Oxford University Press, Oxford.

<sup>64</sup> Nikolaeva, N. G., Spiridonov, V. A. and Krasnov, Y. V., 2006. *Existing and proposed marine protected areas and their relevance for seabird conservation: a case study in the Barents Sea region*. Pp. 743-749 in: Boere, G., Galbraith, C. and Stroud, D. (eds.). *Waterbirds around the world*. The Stationary Office, Edinburgh.

wintering areas in the UK found that it was most likely to forage on improved grassland or grasslands grazed by cattle that were a minimum of 5 ha in area, had an optimum sward height of c.20 cm and were at a distance of less than 9 km away from roosting sites<sup>66</sup>. Because the SPA is more than 11 km away from the application site, geese are unlikely ever to come closer than 2 km of the site. This distance exceeds the zone of potential noise and visual disturbance impacts from construction activities on the application site. Construction of the Renewable Energy Plant is therefore **extremely unlikely** to represent a significant negative impact on the integrity of the reserve's notified feature. Confidence in this prediction is considered near certain.

### Blawhorn Moss SAC

- 12.5.22 Blawhorn Moss is designated an SAC for its active and degraded raised bog habitats. In September 2004, these habitats were assessed as 'unfavourable recovering'<sup>67 68</sup>. The Moss was drained extensively in the 1950s, resulting in gradual drying-out and peripheral erosion<sup>69</sup>, and fire also caused damage in the past. However, since then a site management plan has been adopted that addresses these issues, and dams and drain-blocks have been installed on all the man-made drains and erosion gullies<sup>70</sup>. Because the site is an isolated unit of semi-natural habitat in an otherwise managed landscape, it could be affected by land use changes in surrounding land, which might alter the hydrology of the site. However, because the application site is situated more than 14 km from the Moss and not hydrologically linked to it, the construction activities are **extremely unlikely** to impact the integrity of the SAC. Confidence in this prediction is considered near certain.

### Black Loch Moss SAC

- 12.5.23 Black Loch Moss is designated an SAC for its active and degraded raised bog habitats. In March 2008, these habitats were assessed as 'unfavourable no change'<sup>71 72</sup>. Nearby mining-related activities have impacted on the bog, as has peat cutting, attempts to drain the bog, fire and excessive grazing by livestock<sup>73</sup>. The hydrology on the site and adjacent areas remains the main focus in safeguarding the integrity of the Moss. Because the application site is situated approximately 15 km from the Moss and not hydrologically linked to it, the construction activities are **extremely unlikely** to impact the integrity of the SAC. Confidence in this prediction is considered near certain.

### Avon Gorge SSSI

- 12.5.24 Avon Gorge is designated an SSSI for its ancient woodland habitat. In August 2004, the woodland was assessed as unfavourable no change<sup>74</sup>. According to the Management Statement for the SSSI<sup>75</sup>, invasive

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<sup>65</sup> Madge, S. and Burn, H., 1988. *Wildfowl*. Christopher Helm, London.

<sup>66</sup> Vickery, J. A. and Gill, J. A., 1999. *Managing grassland for wild geese in Britain: a review*. Biological Conservation, 89: 93-106.

<sup>67</sup> This is defined as the conservation objectives of the interest feature having started to show, or is continuing to show, a trend towards favourable condition after an earlier assessment found it in unfavourable condition.

<sup>68</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=8210](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=8210)

<sup>69</sup> <http://www.jncc.gov.uk/ProtectedSites/SACselection/n2kforms/UK0019758.pdf>

<sup>70</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=230&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=230&p_Doc_Type_ID=3)

<sup>71</sup> This is defined as the conservation objectives of the interest feature having not been met, but the unfavourable condition is neither showing further decline nor recovery. The interest feature may be retained in a more-or-less steady state by repeated or continuing damage or might not be able to regain its original condition following a damaging activity.

<sup>72</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=1661](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=1661)

<sup>73</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=1661&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=1661&p_Doc_Type_ID=3)

<sup>74</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=108](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=108)

exotics are abundant, with sycamore and beech currently forming at least half of the woodland canopy and Himalayan balsam, and to a lesser extent leopard's-bane, being common throughout the wood. Because the site is over 3 km from the application site, the construction activities are considered **very unlikely** to have any impact on the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Carron Dams SSSI**

- 12.5.25 Carron Dams is designated an SSSI for its rich fen vegetation. In August 2003, these habitats were assessed as unfavourable no change<sup>76</sup>. As mentioned in the site Management Statement<sup>77</sup>, this was attributed to habitat structure, including the height of the water table and vegetation composition, and the main focus in safeguarding and enhancing the conservation interest of the site therefore centres on site management activities, such as control of water levels, scrub invasion, access and interpretation. The Management Statement also lists a potential impact of development pressures on surrounding land that may affect the site through increased levels of uncontrolled access and pollution, such as run-off during construction works. However, given that the SSSI is almost 6 km upstream from the application site and above the intertidal influence of the river, the construction activities are considered **extremely unlikely** to have any impact on the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Bo'mains Meadow SSSI**

- 12.5.26 Bo'mains Meadow is designated an SSSI for its lowland neutral grassland vegetation. In August 2002, the site was assessed as unfavourable recovering<sup>78</sup>. It is recognised that the condition is intimately linked with the management on site. In their land management plan from 1998, the Scottish Wildlife Trust outlined a number of planned changes in management, including switching from a mowing regime to winter sheep grazing, removing overhanging limbs of trees growing within the mature shelterbelt along the southern boundary that cause shading and suppression of the meadow flora directly beneath them and control of rosebay willowherb<sup>79</sup>. In addition, traditional hay meadows are characterised by a low soil fertility that prevents competitive species from gaining dominance, and preventing nutrient enrichment is therefore another key concern. However, given that the SSSI is approximately 6 km away from the application site, the construction activities are considered **extremely unlikely** to have any impact on the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Linlithgow Loch SSSI**

- 12.5.27 Linlithgow Loch was originally designated an SSSI as an example of mesotrophic loch habitat. In August 2004, the condition of the Loch was assessed as unfavourable declining due to nutrient enrichment arising principally from agricultural and urban land uses within the Loch's catchment. However, subsequent investigation of its water quality revealed that the Loch is in fact eutrophic, trending towards hyper-eutrophic<sup>40</sup>. The site condition may therefore be showing the Loch as being in a more unfavourable condition than is actually the case. The Loch is considered regionally important for the number of birds it supports, including winter flocks of mallard, coot, tufted duck and pochard as well as breeding great crested grebe and mute swan, although the breeding bird assemblage is no longer an official feature of the SSSI<sup>40</sup>. The key management issues focus on minimising disturbance to breeding birds, controlling algal blooms and improving the Loch's water quality, all of which relates to actions on the site itself and the Loch's catchment, notably the settlement of Linlithgow to the south of the site. Given that the SSSI is almost 8 km away from the

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<sup>75</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=108&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=108&p_Doc_Type_ID=3)

<sup>76</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=331](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=331)

<sup>77</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=331&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=331&p_Doc_Type_ID=3)

<sup>78</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=234](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=234)

<sup>79</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=234&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=234&p_Doc_Type_ID=3)



application site and the application site is outwith the loch's catchment, the construction activities are considered **extremely unlikely** to have any impact on the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Carriber Glen SSSI**

- 12.5.28 Carriber Glen is designated an SSSI for its upland mixed ash woodland habitat. In 2006, the condition of the woodland was assessed as unfavourable recovering<sup>80</sup>. A main concern was the percentage of non-native trees (beech and sycamore) in the woodland, which exceeded the targets considered to be within acceptable levels, but management has subsequently been implemented to selectively fell and thin these and remove non-native tree regeneration. It is evident from the Management Statement<sup>80</sup> that the principal concerns regarding the condition of the SSSI have been site specific and relating to management practices and the exclusion of grazing. Because the site is approximately 8 km from the application site, the construction activities are considered **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Howierig Muir SSSI**

- 12.5.29 Howierig Muir is designated an SSSI for its lowland raised mire habitat. In November 2001, the condition of the mire was assessed as unfavourable declining<sup>81</sup>. Although the mire retains considerable botanical interest, rapid colonisation by birch, Scots pine and rowan implies that the peat body is drying out<sup>82</sup>. The gradual reduction in tree and scrub cover through felling and grazing management is the main focus in safeguarding and enhancing the integrity of the mire. Because the mire is situated almost 9 km from the application site and is not hydrologically connected with it, the construction activities are **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Lockshaw Mosses SSSI**

- 12.5.30 Lockshaw Mosses are designated an SSSI for their lowland raised bogs. In July 2005, the condition of the mire habitat was assessed as unfavourable declining<sup>83</sup>. A lowland raised mire should ideally have ground water levels at no more than 5 cm below the surface for as long as possible during the year in order to allow the productive growth of *Sphagnum* mosses, which typically form the majority of the bog surface. The invasion of scrub on Lockshaw indicates that water levels are below the ideal, and these changes are primarily due to past drainage attempts. The established woodland exacerbates drying by drawing additional water from the peat<sup>84</sup>. The current site management therefore focuses on site hydrology and control of trees and scrub. Because the raised mire is situated approximately 9 km from the application site and is not hydrologically connected with it, the construction activities are **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### **Darnrig Moss SSSI**

- 12.5.31 Darnrig Moss is designated an SSSI for its raised bog habitat. In October 2001, the condition of the mire habitat was assessed as unfavourable declining<sup>85</sup>, which reflects inadequate restoration of the site's hydrology following the cessation of open-cast mining operations<sup>86</sup>. The current site management focuses on

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<sup>80</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=327&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=327&p_Doc_Type_ID=3)

<sup>81</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=796](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=796)

<sup>82</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=796&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=796&p_Doc_Type_ID=3)

<sup>83</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=1088](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=1088)

<sup>84</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=1088&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=1088&p_Doc_Type_ID=3)

<sup>85</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=498](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=498)

<sup>86</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=498&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=498&p_Doc_Type_ID=3)



maintaining the interest of the relatively intact western end of the Moss, such as by controlling grazing levels. However, the eastern part of the Moss is still deteriorating, and it is a key project in the Management Statement to review the criteria under which the site is designated to determine whether the site retains sufficient interest to retain its SSSI status<sup>86</sup>. The raised mire is situated more than 9 km from the application site and is not hydrologically connected with it. Therefore, the construction activities are **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### Lochcote Marsh SSSI

- 12.5.32 Lochcote Marsh is designated an SSSI for its basin mire habitat. In September 2004, the condition of the mire was assessed as favourable maintained<sup>87</sup>. Management concerns focus on maintaining the ecological and hydrological integrity of the basin mire through avoidance of fertiliser inputs and slurry run-off from agricultural activities, shading and/or acidification by a nearby coniferous plantation and succession to woodland<sup>88</sup>. The mire is situated more than 9 km from the application site and is not hydrologically connected with it, the construction activities are therefore **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### Graigmad Wood SSSI

- 12.5.33 Graigmad Wood is designated an SSSI for its upland woodland and lowland dry heath habitats. In April 2009, the condition of the woodland was assessed as favourable maintained, whereas in June 2009 the dry heath was assessed as 'favourable recovered'<sup>89 90</sup>. The current focus with regards to maintaining the favourable condition of these habitats concerns on-site management activities, including maintaining and extending the heath through a programme of tree removal, bracken control and heather flailing every 10 to 15 years, and improving the structure of the semi-natural woodlands through rhododendron control and selective felling<sup>91</sup>. Because the site is situated more than 9 km from the application site, the construction activities are considered **extremely unlikely** to have an impact on the integrity of the SSSI. Confidence in this prediction is considered near certain.

#### Steelend Moss SSSI

- 12.5.34 Steelend Moss is designated an SSSI for its raised bog and basin fen habitats. In August 2000, the condition of the raised bog was assessed as unfavourable no change, whereas in September 2002 the basin fen was assessed as unfavourable declining<sup>92</sup>. As described in the Management Statement for the SSSI<sup>93</sup>, the site is undergoing a drying-out process, most likely through movement of water away from the site along a drain to the south, and this has facilitated increased encroachment of scrub and trees, which in turn speed up the drying process. The SSSI is situated in Fife, more than 14 km from the application site. It is therefore clearly not hydrologically connected with the application site and construction activities are **extremely unlikely** to impact the integrity of the SSSI. Confidence in this prediction is considered near certain.

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<sup>87</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=1075](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=1075)

<sup>88</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=1075&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=1075&p_Doc_Type_ID=3)

<sup>89</sup> This is defined as the conservation objectives of the interest feature having been met after a previous assessment found the opposite to be true

<sup>90</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=438](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=438)

<sup>91</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=438&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=438&p_Doc_Type_ID=3)

<sup>92</sup> [http://gateway.snh.gov.uk/portal/page?\\_pageid=53,910305,53\\_910338&\\_dad=portal&\\_schema=PORTAL&PA\\_CODE=1481](http://gateway.snh.gov.uk/portal/page?_pageid=53,910305,53_910338&_dad=portal&_schema=PORTAL&PA_CODE=1481)

<sup>93</sup> [http://gateway.snh.gov.uk/pls/portal/Sitelink.Show\\_Site\\_Document?p\\_pa\\_code=1481&p\\_Doc\\_Type\\_ID=3](http://gateway.snh.gov.uk/pls/portal/Sitelink.Show_Site_Document?p_pa_code=1481&p_Doc_Type_ID=3)

### Jupiter Urban Wildlife Centre SWT Reserve

- 12.5.35 Jupiter Urban Wildlife Centre is situated north of the heavily-trafficked M9 motorway, between junctions 5 and 6, approximately 1.5 km south-southwest of the main application site. It is surrounded by busy industrial areas. The reserve is adjacent to the railway line, which also borders the southern part of the application site. However, although railway lines can provide substantial value as 'green corridors' for wildlife using semi-natural habitats adjacent to the railway tracks, in this case the value is reduced because the railway corridor is particularly narrow where it traverses industrial and storage areas north of the Wildlife Centre and southwest of the application site. Nor are the two sites linked hydrologically. Although construction activities from the proposed development will temporarily increase traffic levels in the local area, this is considered **unlikely** to represent a significant negative impact on the integrity of the reserve, due to the existing traffic levels in the area. Dust impacts from construction activities on the application site itself are **unlikely** to significantly affect the wildlife site, because the prevailing wind direction is from southwest to northeast, i.e. away from the wildlife centre site (see also Chapter 9, Air Quality). Confidence in these predictions is considered near certain.

### Running water

- 12.5.36 The River Carron and the Grange Burn both have the potential to be affected by the proposed development. The River Carron rises near Muir Toll in the Campsie Fells west of Grangemouth and flows for approximately 37 km before discharging into the Firth of Forth. The Grange Burn drains a small area between the Carron and Avon catchments.
- 12.5.37 In 2003, the River Carron's biological water quality classification<sup>94</sup> was rated A2 (good), its chemical water quality classification was rated B (fair) and its aesthetic water quality classification was A1 (excellent); giving it an overall classification of B (fair)<sup>47</sup>. In 2004, the biological water quality classification deteriorated to C (poor), which contributed to the overall classification also deteriorating to C. However, the biological water quality classification improved to B in 2005, and this caused the overall classification also to return to B. The Grange Burn receives treated effluent discharge from the Grangemouth complex under high rainfall conditions or other abnormal conditions only. Its water quality classifications remained similar between 2003 and 2005. The biological water quality classification was A2 during the time period and the aesthetic water quality classification was A1. SEPA has no available chemical water quality classification for 2003, but in 2004 it was rated A2 and this increased to A1 in 2005. The overall classification remained A2.
- 12.5.38 Neither watercourse enters comes closer than approximately 140 m of the main site boundary. The River Carron is separated from the application site by the Carron Dock and the Western Channel, as well as the active Port areas by North Shore Road. It is therefore **very unlikely** to experience any impacts from the proposed construction activities on the main site, such as through sedimentation from run-off or accidental spillage of small quantities of chemicals/hydrocarbons from construction vehicles. An impact is possible from construction of the cooling water infrastructure. This is evaluated for coastal mud/sand, below. The Grange Burn is separated from the site by the railway line, woodland, storage depots and South Shore Road, and it is therefore also **very unlikely** to experience any sedimentation or accidental spillages during construction. Overall, the construction activities are considered **very unlikely** to have significant, negative impact on the integrity of running water within the wider area. Confidence in this prediction is considered near certain.

### Coastal mud/sand

- 12.5.39 The River Carron contains the only areas on coastal mud within or adjacent to the application boundary. Some localised disturbance of the mudflat habitat is will occur during construction of the cooling water outfall. However, as described in Chapter 13, Aquatic Ecology, the outfall needs to be placed close to the bank in

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<sup>94</sup> In this classification, A1 is rated excellent, A2 is good, B is fair, C is poor, D is seriously polluted and U is unclassified

order to ensure that it does not impede navigation in the river. Therefore, any disturbance of the coastal mud habitat will be highly localised and because the habitat is subject to considerable tidal forces, impacts from construction activities are **very unlikely** to be significant. Confidence in this prediction is considered near certain.

### Breeding birds

- 12.5.40 During construction, spoil heaps, structures, scrub and ephemeral/short perennial habitat within the application site will be lost. In the absence of mitigation, there is a potential for this loss to affect local populations of oystercatcher. Oystercatchers bred at very low numbers on site in 2009 and any impact would therefore act on a receptor of less than local importance. However, all British birds, their nests and eggs are protected under Part 1 of the Wildlife and Countryside Act 1981 (as amended), making it an offence to deliberately take, kill or injure any wild bird or to take, damage, or destroy any nest or egg of any wild bird. If works take place during the breeding season, mitigation may therefore be required to ensure legal compliance. Mitigation is outlined in Section 12.6.

### Common tern colony

- 12.5.41 There is potential for disturbance of the common tern colony during construction of the abstraction pipe into the Western Channel. It is anticipated that construction of the abstraction infrastructure would take a maximum of 4 months to complete. If construction was scheduled between April/May and August, disturbance could drive terns away, although the terns are likely to be habituated to the busy port environment. Although the impact would be temporary, it could result in poor breeding success and therefore the conservation status of the species. In the absence of mitigation, a significant negative impact on the common tern colony is therefore considered **probable**. Confidence in this prediction is considered probable. are therefore unlikely to result in significant disturbance to the common tern colony. Confidence in this prediction is considered near-certain. No impact is considered likely from construction activities on the main plant site, because Central Dock Road and the depot within the application site current experience high traffic and activity levels (see Chapter 9 Noise, and Chapter 18, Traffic), to which the terns have become habituated.

### Bats

- 12.5.42 Although small numbers of bats were recorded foraging and commuting within the survey area, no bat roosts were found. Disturbance from construction of the proposed Renewable Energy Plant is therefore not likely to be significant, because construction will take place during daylight hours when bats are roosting off site. Confidence in this prediction is considered near certain. The Renewable Energy Plant will be constructed on land which is currently dominated by hardstanding, short ephemeral vegetation and storage areas containing stockpiled rubble, soil and wood. The habitats provide limited habitat to the insect prey of bats, and are consequently of low value to foraging bats. Areas of scrub are also present to the north of the site that provide a greater potential for insect prey. However, areas south of the site are probably more likely to provide habitat for foraging and commuting bats. These comprise the Grange Burn corridor south of South Shore Road and, to a lesser degree, the plantation woodland on the southern border of the application site. These areas will not be directly affected by construction activities. Although mainly a problem for roosting bats, noise and artificial lighting have the potential to impact foraging bats. For example, whereas bats tend to avoid yellow sodium lights, artificial lights can attract their insect prey, thereby depleting the bats' food base elsewhere<sup>95</sup>. However, this impact is strongest in areas previously poor in artificial light, which is not the case at the Port of Grangemouth. Moreover, the low numbers of bats in the Port area suggest that bats are limited by other factors than prey abundance, e.g. lack of roosting opportunities. Noise is an unlikely impact, because construction activities will occur during the day, when bats are not foraging. Therefore, it is considered **very**

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<sup>95</sup> Bat Conservation Trust, 2007. Bats and lighting in the UK

**unlikely** that bats will be impacted by construction of the Renewable Energy Plant. Confidence in this prediction is considered near certain.

#### **Otters**

- 12.5.43 Although the species has been recorded in the general area in the past, no signs of otter were found in the 2010 survey. However, taking a precautionary approach, it is assumed that otters are occasionally present in the Port area at certain points during the year. There is potential for an adverse impact in the form of otter-construction vehicle collisions. However, the risk of a collision occurring is **very unlikely**, because otters have not been recorded on land by the application site and along the main roads leading to the site, because otters crossing these roads would be more likely to do so at night, when no construction was taking place and because existing 20mph speed limits are in place throughout the Port. Confidence in this prediction is considered probable.

#### **Potential Impacts during Operation**

##### **Firth of Forth Ramsar Wetland/SPA/SSSI**

- 12.5.44 During operation, the Renewable Energy Plant will receive the majority of its biomass fuel from ships docking at the Tongue area, from where it will be loaded straight onto a covered conveyor and transferred straight to a storage area. No biomass fuel will be stored on the Tongue itself and the risk of fuel entering the Docks and from there to the Ramsar Wetland/SPA/SSSI is therefore considered extremely unlikely. However, similar to the construction phase, there is a potential for spillages, e.g. of fuel/oil, entering the Dock waters during operation of the proposed renewable energy plant. This could occur as a result of maintenance works or from vehicles. However, because the Renewable Energy Plant is located 1.5 km from the mouth of the harbour, because a Pollution Contingency Plan is already in place for the Port, of Grangemouth, and because a spillage would be likely to be contained before it could leave the dock waters, no significant impact is therefore anticipated on the feeding areas outside of the harbour of the qualifying and notified bird interest in the Ramsar Wetland/SPA/SSSI. Confidence in this prediction is considered near certain.
- 12.5.45 It is anticipated that the renewable energy plant will receive the bulk of its fuel from overseas. This would result in of the order of 80 vessels per annum, i.e. one to two vessels per week. As described in Chapter 18, Traffic, the biomass fuel traffic does not represent a significant increase relative to current levels, and ship traffic is **unlikely** to cause significantly increased disturbance of roosting and feeding areas of qualifying and notified bird interest in the Ramsar Wetland/SPA/SSSI. Confidence in this prediction is considered near-certain.
- 12.5.46 There is a potential for the thermal plume of the cooling water discharge into the River Carron to impact on the food base of qualifying bird interest. However, because no significant impact is predicted on intertidal habitats (see Chapter 13, Aquatic Ecology), no significant impact on birds is anticipated. Confidence in this prediction is considered near-certain.
- 12.5.47 The habitats for which the SSSI is notified comprise mudflats, saline lagoon, saltmarsh, sand dune, transition grassland and neutral grassland. With the exception of transition grassland, which was assessed as favourable maintained, these were all assessed as unfavourable declining at the time of the last condition assessments<sup>56</sup>. The condition of the mudflats appears not to have been assessed. The Management Statement<sup>61</sup> outlines a range of negative factors causing a loss in conservation interest of the SSSI's habitats, including lack of appropriate grassland management, subsidence and erosion, tipping and pollution from industrial and farming effluents. Emissions from the Renewable Energy Plant could potentially add to these issues, especially on notified features near the Port area, such as any areas of neutral grassland and saltmarsh by Skinflats north of the River Carron.
- 12.5.48 The impact of emissions of oxides of nitrogen, sulphur dioxide and ammonia at different locations within the Firth of Forth SPA/Ramsar Wetland/SSSI during operation of the Renewable Energy Plant has been

assessed in Chapter 9, Air Quality. Predicted maximum ground level concentrations of these substances are 13%, 7.4% and 6.7% of the Environmental Quality Standard (EQS)<sup>96</sup> for the three parameters, respectively. As described in Chapter 9, the highest concentrations are expected to occur in mudflat areas northeast of the application site that are subject to the considerable tidal force and where accumulation is therefore very unlikely. Such areas are therefore not considered further in this assessment. When individual locations above the high tide line are considered the highest predicted annual mean process contributions of oxides of nitrogen, sulphur dioxide and ammonia are predicted for Preston Island on the northern shore, where levels are 2.5%, 1.4% and 1.3% of the relevant air quality objectives and guidelines, respectively. Further deposition assessment was therefore carried out for acid and nitrogen deposition (including sulphur dioxide, oxides of nitrogen and ammonia).

- 12.5.49 The modelled process contribution to acid deposition above the high tide line is typically less than 1% of the critical load, although it is 9.0% at Preston Island, which is not part of the SPA/Ramsar Wetland, and 1.9% at Bo'ness which is within the SPA/Ramsar Wetland. This will result in a Predicted Environmental Concentration (PEC) that is 137% of critical load at Bo'ness and 146% at Preston Island. In both cases, the background acid deposition already exceeds the critical load (135% at Bo'ness and 137% at Preston Island). At Bo'ness the existing level of acid deposition accounts for the vast majority of PEC and the process contribution is considered to represent an insignificant increase. Notified habitats at Preston Island include neutral grassland, saltmarsh and fen, habitats which are currently in unfavourable condition across the SSSI. Here, the process contribution is greater and it is therefore possible that the increase to PEC could contribute to further deterioration in habitat condition. In summary it is considered **unlikely** that acid deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SPA/Ramsar Wetland, although it is considered **possible** that acid deposition will represent a significant impact on the conservation status of the notified habitat in the SSSI (outside the SPA/Ramsar Wetland). Confidence in these predictions is considered uncertain however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.
- 12.5.50 Similarly, the modelled process contribution to nitrogen deposition within the Firth of Forth SPA/Ramsar Wetland/SSSI, above the high tide line, is typically less than 1% of the critical load, although at Preston Island (not part of the SPA/Ramsar Wetland) the figure is 2.7%, which will result in a PEC of 130%. At all other locations within the SPA the process contribution to nitrogen deposition due to the proposed Renewable Energy Plant will be less than 1% of critical load. Background nitrogen deposition at Preston Island already exceeds the critical load (127%) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SPA/Ramsar Wetland or the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Slamannan Plateau SPA**

- 12.5.51 Similar to the construction phase, the considerable geographical distance between the Slamannan Plateau SPA and the application site makes it **extremely unlikely** that the notified feature, Taiga bean geese, would experience any significant negative impacts due to disturbance during operation. Confidence in this prediction is considered near certain.

<sup>96</sup> An Environmental Quality Standard is a value, generally defined by regulation, which specifies the maximum permissible concentration of a potentially hazardous chemical in an environmental sample.



- 12.5.52 The deposition of oxides of nitrogen, sulphur dioxide and ammonia during operation of the Renewable Energy Plant has been assessed in Chapter 9, Air Quality. The SPA contains a range of habitats, including peatland, lochs and rough and improved grasslands. Of these, peatland habitats are considered most sensitive to acid and nitrogen deposition and as such the potential impact upon peatland habitats has been modelled. In terms of acid deposition, the predicted process contribution is 2.2% of the critical load whilst in terms of nitrogen deposition the predicted process contribution is 1.1% of critical load. This will result in a PEC which is 212% of the critical load for acid deposition and 297% for nitrogen deposition. Existing levels of acid deposition already significantly exceed the critical load (210%) as do existing levels of nitrogen deposition (296%). In both cases the process contribution is considered to represent an insignificant increase. Even in the unlikely event that detectable changes to peatland habitats were to occur, the qualifying feature for the SPA, taiga bean goose, is not likely to be sensitive to minor changes in habitat composition. It is therefore considered **very unlikely** that acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the SPA. Confidence in this prediction is considered near certain.

#### **Blawhorn Moss SAC**

- 12.5.53 Raised bogs, which derive all their nutrients from the atmosphere, are sensitive to sulphur and nitrogen deposition, because excess nitrogen leads to the preferential growth of grass and tree species at the expense of the bog-forming *Sphagnum* mosses, whereas both sulphur and nitrogen deposition contributes to acidification<sup>97</sup>. The deposition of oxides of nitrogen, sulphur dioxide and ammonia during operation of the Renewable Energy Plant has been assessed in Chapter 9, Air Quality. In terms of acid deposition, the PEC is 174% of the critical load and in terms of nitrogen deposition PEC is 218% of critical load. In both cases, the existing deposition already exceeds the critical load (174% for acid deposition and 218% for nitrogen deposition). In both cases the increases in levels of deposition due to the proposed Renewable Energy Plant are negligible. It is therefore considered **very unlikely** that acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in these predictions is considered near certain.

#### **Black Loch Moss SAC**

- 12.5.54 As described above, raised bog is sensitive to sulphur and nitrogen deposition. The deposition of oxides of nitrogen, sulphur dioxide and ammonia during operation of the Renewable Energy Plant has been assessed in Chapter 9, Air Quality. In terms of acid deposition, the PEC is 182% of the critical load and in terms of nitrogen deposition PEC is 218% of critical load. In both cases, the existing deposition already exceeds the critical load (182% for acid deposition and 218% for nitrogen deposition). In both cases the increases in levels of deposition due to the proposed Renewable Energy Plant are negligible. It is therefore considered **very unlikely** that acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in these predictions is considered near certain.

#### **Avon Gorge SSSI**

- 12.5.55 Deciduous woodland tends to trap air pollutants, with the result that nitrogen deposition to woodlands is generally larger than for other habitat types. This can cause a change in the composition of the woodland ground flora<sup>98</sup>. In addition, deposition of acidifying air pollutants can affect the soils of woodland habitats, where effective inputs of sulphuric and nitric acids lead to leaching of base cations, potentially resulting in a number of effects on soil properties and processes, such as reduced pH, mobilised aluminium and low

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<sup>97</sup> [http://www.apis.ac.uk/overview/ecosystems/overview\\_bogs.htm](http://www.apis.ac.uk/overview/ecosystems/overview_bogs.htm)

<sup>98</sup> [http://www.apis.ac.uk/overview/ecosystems/overview\\_woodlands.htm](http://www.apis.ac.uk/overview/ecosystems/overview_woodlands.htm)

microbial activity. As evaluated in Chapter 9, Air Quality, the risk of significant nitrogen and acid deposition at Avon Gorge can be ruled out.

#### **Carron Dams SSSI**

- 12.5.56 Fen vegetation, the notified feature for Carron Dams SSSI, is sensitive to nitrogen deposition<sup>99</sup>. As evaluated in Chapter 9, Air Quality, the risk of significant nitrogen deposition at Carron Dams can be ruled out.

#### **Bo'mains Meadow SSSI**

- 12.5.57 Lowland neutral grassland vegetation can be sensitive to atmospheric deposition from energy plants. As evaluated in Chapter 9, Air Quality, the risk of particulate, sulphur and nitrogen deposition at Bo'mains Meadow can be ruled out.

#### **Linlithgow Loch SSSI**

- 12.5.58 As described in Section 12.5.27, Linlithgow Loch is a eutrophic loch and trending towards being hyper-eutrophic. Nevertheless, key management issues focus on minimising disturbance to breeding birds, controlling algal blooms and improving the Loch's water quality, all of which relates to actions on the site itself and in the Loch's catchment, notably the settlement of Linlithgow to the south of the site. As evaluated in Chapter 9, Air Quality, the risk of significant sulphur and nitrogen deposition at Linlithgow Loch can be ruled out

#### **Carriber Glen SSSI**

- 12.5.59 Upland mixed ash woodland can be sensitive to atmospheric deposition from power plant emissions. As evaluated in Chapter 9, Air Quality, the risk of significant particulate, sulphur and nitrogen deposition at Carriber Glen can be ruled out.

#### **Howierig Muir SSSI**

- 12.5.60 The risk of oxides of nitrogen, sulphur dioxide and ammonia deposition on Howierig Muir SSSI has been assessed in Chapter 9, Air Quality. Predicted maximum levels of released substances are negligible for oxides of nitrogen (0.8% of EQS) and sulphur dioxide (0.43% of EQS), whereas for ammonia it is 0.011µg/m<sup>3</sup> (1.1% of EQS). As described in Chapter 9, background ammonia deposition currently exceeds EQS at Howierig Muir. The modelled process contribution to acid deposition is 1.4% of the critical load, although the PEC will not exceed the critical load (84%). The modelled process contribution to nitrogen deposition is 1.7% of the critical load. For nitrogen the PEC will exceed the critical load by a large margin (310%). However, existing levels are also very high (308% of critical load) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that either acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in the prediction for acid deposition is considered near certain. Confidence in the prediction for nitrogen deposition is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Lockshaw Mosses SSSI**

- 12.5.61 The risk of oxides of nitrogen, sulphur dioxide and ammonia deposition on Lockshaw Mosses SSSI has been assessed in Chapter 9, Air Quality. Similar to Howierig Muir, predicted maximum levels of released substances are negligible for oxides of nitrogen (0.7% of EQS) and sulphur dioxide (0.4% of EQS), whereas for ammonia it is 0.011µg/m<sup>3</sup> (1.1% of EQS). As described in Chapter 9, background ammonia deposition currently exceeds EQS at Lockshaw Mosses. The modelled process contribution to acid deposition is 2.5% of

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<sup>99</sup> [http://www.apis.ac.uk/cgi\\_bin/query\\_habitat.pl?habitat\\_species=allHabs&submit.x=28&submit.y=8](http://www.apis.ac.uk/cgi_bin/query_habitat.pl?habitat_species=allHabs&submit.x=28&submit.y=8)



the critical load and for nitrogen deposition it is 1.6% of critical load. For acid deposition the PEC will exceed the critical load (139%) although existing levels are also very high (137% of critical load) and the process contribution is considered to represent an insignificant increase. For nitrogen deposition the PEC will greatly exceed the critical load (256%) although existing levels are also very high (254% of critical load) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that either acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Darnrig Moss SSSI**

- 12.5.62 As described above, raised bog is sensitive to sulphur and nitrogen deposition. As evaluated in Chapter 9, Air Quality, the risk of significant sulphur and nitrogen deposition at Darnrig Moss can be ruled out.

#### **Lochcote Marsh SSSI**

- 12.5.63 As described above, raised bog is sensitive to sulphur and nitrogen deposition. As evaluated in Chapter 9, Air Quality, the risk of significant sulphur and nitrogen deposition at Darnrig Moss can be ruled out. Graigmad Wood SSSI
- 12.5.64 Upland woodland and lowland dry heath habitats can be sensitive to atmospheric deposition from power plant emissions. However, as evaluated in Chapter 9, Air Quality, the risk of significant particulate, sulphur and nitrogen deposition at Craigmad Wood can be ruled out.

#### **Steelend Moss SSSI**

- 12.5.65 The risk of oxides of nitrogen, sulphur dioxide and ammonia deposition on Steelend Moss SSSI has been assessed in Chapter 9, Air Quality. Predicted maximum levels of released substances are negligible for oxides of nitrogen (0.9% of EQS) and sulphur dioxide (0.5% of EQS), whereas for ammonia it is 0.014 µg/m<sup>3</sup> (1.4% of EQS). As described in Chapter 9, background ammonia deposition currently exceeds EQS at Steelend Moss. The modelled process contribution to acid deposition is 3.3% of the critical load and for nitrogen deposition it is 2% of critical load. For acid deposition the PEC will significantly exceed the critical load (161%) although existing levels are also very high (159% of critical load) and the process contribution is considered to represent an insignificant increase. For nitrogen deposition the PEC will greatly exceed the critical load (302%) although existing levels are also very high (300% of critical load) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that either acid or nitrogen deposition resulting from emissions from the Renewable Energy Plant will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Jupiter Urban Wildlife Centre SWT Reserve**

- 12.5.66 The Jupiter Urban Wildlife Centre comprises a variety of habitats, including areas of wetland, woodland and meadow, which can be sensitive to atmospheric deposition from power plant emissions. The potential for an impact from emissions during operation of the proposed renewable energy plant is not assessed in Chapter 9, Air Quality. However, because the prevailing wind direction is from southwest to northeast, i.e. away from the Wildlife Centre, and because the reserve has been created within an industrial area near to a major roadway, impacts from emissions during operation are considered **unlikely** to significantly impact on the integrity of the reserve. Confidence in this prediction is considered probable.

### **Running water**

- 12.5.67 Although no impact is anticipated for the Grange Burn, the River Carron could potentially be impacted by the proposed Renewable Energy Plant during operation due to discharge of the cooling water. The potential for impacts occurring on the habitat during operation of the proposed renewable energy plant has been assessed in Chapter 13, Aquatic Ecology. No significant impacts on running water have been identified.

### **Coastal mud/sand**

- 12.5.68 The River Carron contains the only areas of mudflat within or adjacent to the application site. The potential for impacts occurring on the habitat during operation of the proposed renewable energy plant has been assessed in Chapter 13, Aquatic Ecology. No significant impacts on coastal mud/sand have been identified.

### **Breeding birds**

- 12.5.69 The Renewable Energy Plant will have been constructed on land, which was previously of low value to breeding birds, with no breeding birds having been recorded within the main plant area itself. Consequently, during operation of the Renewable Energy Plant, an impact on breeding birds is **unlikely**. Confidence in this prediction is considered near certain.

### **Common tern colony**

- 12.5.70 During operation of the Renewable Energy Plant, traffic and noise levels are unlikely to exceed the current levels significantly, and no other potential impacts on terns have been identified. Confidence in this prediction is considered near-certain.

### **Bats**

- 12.5.71 The Renewable Energy Plant will have been constructed on land, which was previously of low value to foraging and roosting bats. Artificial light can cause disturbance to bats, leading them to vacate roosts, but this is extremely unlikely on and near the application site, where no roosts have been recorded. As described earlier, whereas bats tend to avoid artificial light, lighting might attract insects, with the result that adjacent habitats support reduced numbers of prey for foraging bats. However, such an effect is strongest in areas, which were previously poor in artificial light, and this is not the case at the Port of Grangemouth, where the low abundance of bats suggests that bats are limited by other factors than prey abundance. Disturbance from the proposed renewable energy plant during operation is therefore **unlikely** to be significant. Confidence in this prediction is considered near certain.

### **Otters**

- 12.5.72 The operation of the Renewable Energy Plant is not expected to result in a negative impact on otters. Assuming that otters occasionally occur on land near the Renewable Energy Plant, the likelihood of a collision with any road traffic would be low, because otters would be more likely to cross roads at night when fuel delivery was not taking place and because of the existing 20mph speed limits in place throughout the Port. A significant negative impact upon the range, population or conservation status of otter during operation of the Renewable Energy Plant is considered **very unlikely**. Confidence in this prediction is considered near certain.

### **Potential Impacts during decommissioning**

- 12.5.73 Impacts during the decommissioning phase of the development are expected to be similar to impacts during the construction phase. However, it is recommended that the ecological surveys are updated prior to decommissioning to inform an assessment of impacts.

## **12.6 Mitigation and Enhancement**

- 12.6.1 Mitigation will be employed to ensure that even non-significant impacts are minimised. Mitigation measures are proposed for the construction, operation and decommissioning phases, respectively, as outlined below.

### **Construction Mitigation**

- 12.6.2 The following mitigation measures will be adopted during the construction phase to minimise the risk of adverse effects on habitats and species:
- Vegetation clearance will take place outside the bird breeding season, from March until August, inclusive. If this is not possible, the vegetation will be checked for nests by a suitably qualified ecologist prior to works commencing; should any nests be found, works will avoid this and a buffer suitable to the species until the nest has been vacated;
  - General Binding Rules (GBRs) produced by the Scottish Government as well as Pollution Prevention Guidelines (PPGs) published by the Scottish Environment Protection Agency will be adhered to (see Hydrology, Hydrogeology, Geology and Soils Chapter 14, Section 14.3);
  - Construction works in the River Carron will be timed to avoid the winter months, from October to March, inclusive; and
  - Construction works on the cooling water intake will be timed to occur outside the common tern breeding season, from May to August, inclusive.

### **Operational Mitigation**

- 12.6.3 With the exception of a possible impact on the Firth of Forth SSSI due to acid deposition, for which mitigation is not possible, operational impacts are considered not significant and mitigation measures are therefore largely unnecessary, over and above those considered in Chapter 9 Air Quality, Chapter 13 Aquatic Ecology and Chapter 14 Hydrology, Hydrogeology, Geology and Soils.
- 12.6.4 As no important habitats or species will be significantly affected, or the effects of the scheme would be very difficult to separate from existing effects, as in the case of possible deposition impacts, a monitoring programme is not considered necessary.

### **Decommissioning Mitigation**

- 12.6.5 The same mitigation will apply to the decommissioning phase as to the construction phase, to ensure that potential impacts upon the ecological receptors are minimised. However, it is recommended that the ecological surveys are updated and mitigation reviewed prior to decommissioning to inform an assessment of impacts.

## **12.7 Assessment of Residual Effects**

- 12.7.1 The assessment of residual effects of the proposed Renewable Energy Plant on the features of ecological interest with the potential to be affected by the proposed development is summarised in Table 12.8. The table lists the value of the receptors, together with an assessment of the magnitude and significance of impacts in the absence of mitigation. Proposed mitigation measures are then described and the significance of the residual effects assessed. A significant effect on the Firth of Forth SSSI is possible due to acid deposition at Preston Island, although confidence in this prediction is uncertain, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded. No other significant negative effect on any conservation site, habitat or faunal species is anticipated, and therefore no significant residual effects are expected. Confidence in this prediction is considered probable/near certain.

## **12.8 Assessment of Cumulative Effects**

- 12.8.1 There is potential for a cumulative effect on the environment of the proposed Renewable Energy Plant and four nearby developments. These developments include:

- Grangemouth Biodiesel Plant;
- Longannet Biomass Power Station; and
- Proposed Forth Energy Renewable Energy Plants at Rosyth and Leith.

- 12.8.2 Cumulative effects are considered in relation to disturbance to bird populations during construction and acid and nitrogen deposition resulting from emissions from the proposed developments. The proposed Rosyth and Leith Renewable Energy Plants are located approximately 18km and 34km east of the proposed Grangemouth plan, respectively. The proposed Grangemouth Biodiesel Plant lies within the Grangemouth complex and the Longannet Biomass Power Station is located 4km to the north. Given the distances involved cumulative effects relating to disturbance to birds are only considered in relation to the proposed Grangemouth Biodiesel Plant and the Longannet Biomass Power Station.
- 12.8.3 The Grangemouth Biodiesel Plant has been granted planning permission, but the developer, INEOS Enterprises Ltd, has not commenced construction to date. It is not known currently when the development will proceed. The development would comprise two biodiesel production units, each with around 250,000 tonnes per year capacity, facilitating the production of around 500,000 tonnes of biodiesel each year. The development site lies within the Grangemouth complex and the Port of Grangemouth on a site which is covered with ballast and hardcore substrate and is devoid of vegetation. Similarly, the associated pipeline corridor would follow an existing pipeline track, which is also devoid of vegetation.
- 12.8.4 The only potential cumulative impact on ecological receptors of local or higher value that has been identified relates to disturbance impacts on qualifying and notified bird interest in the Firth of Forth Ramsar Wetland/SPA/SSSI during the construction and decommissioning phases, if these were to occur simultaneously. The potential type of effect would be a reduction of suitable areas to which birds could move to avoid disturbance. However, because mitigation for both the Renewable Energy Plant and the Biomass Plant includes the avoidance of certain construction and decommissioning works during the sensitive period from October to March, no impact is likely. No cumulative impact is expected on otters, because these appear to be rare or absent in the area and because otters move mainly at night, when construction, operation or decommissioning traffic would be unlikely to occur. Emissions to air were described as negligible in the ES for the development and on this basis there is unlikely to be any cumulative effects due to emissions from the proposed Biodiesel Plant. Confidence in these predictions is considered near certain.
- 12.8.5 In January 2008 the Longannet Biomass Power Station was granted planning permission, subject to completion of a Section 75 Agreement. The power station, which will operate independently of the existing Longannet Power Station, will burn up to 135,000 tonnes of biomass and generate approximately 20-25 MW of electrical power each year. The development is located across the Firth of Forth, approximately 4 km north of the application site, and will be constructed on a former munitions store with relatively poor semi-natural habitats of little nature conservation interest. In the ES for the development, no significant negative impacts were expected on ecological receptors of higher than local value during the construction or decommissioning stages. Therefore there is no required mitigation under the terms of the EIA Regulations. The potential for a significant cumulative impact during the construction and decommissioning phases of the two projects, if these were to occur simultaneously, e.g. through disturbance of qualifying and notified bird interest in the Firth of Forth Ramsar Wetland/SPA/SSSI, is possible. However, because mitigation for the Renewable Energy Plant and Longannet Plant includes the avoidance of construction and decommissioning works during the sensitive period from October to March in the River Carron, no impact is likely.
- 12.8.6 The only potential cumulative impacts on terrestrial ecological receptors that have been identified for the Longannet biomass plant and the proposed Renewable Energy Plant relate to air quality impacts during operation of the two plants. These are assessed in Chapter 9, Air Quality. The Environmental Statement (ES)

for the Longannet Life Extension Project<sup>100</sup> indicates that emissions of oxides of nitrogen and sulphur dioxide will be reduced significantly due to the Flue Gas Desulphurisation and Life Extension projects. The ES also concludes that these projects would offset emissions from the proposed Longannet Biomass Power Station and the overall impact of the on air quality would be of neutral significance. On this basis, and due to the fact that the proposed Longannet Biomass Power Station plant is approximately 4km to the north of the proposed Renewable Energy Plant and therefore not upwind or downwind of the prevailing wind directions, there are unlikely to be any cumulative effects due to the Longannet Biomass Power Station.

- 12.8.7 The cumulative levels of oxides of nitrogen, sulphur dioxide and ammonia during operation of the three proposed Renewable Energy Plants located adjacent to the Firth of Forth and Forth Estuary have been modelled and the results are presented in Chapter 9, Air Quality. Cumulative air quality impacts are considered in detail for the same designated sites assessed in relation to the proposed Grangemouth Renewable Energy Plant in isolation. These include the Firth of Forth SPA/Ramsar Wetland/SSSI, Blawhorn Moss SAC/SSSI, Black Loch Moss SAC/SSSI, Howierig Muir SSSI, Lockshaw Mosses SSSI and Steelend Moss SSSI. Potential cumulative effects on each site are considered in turn below.

#### **Firth of Forth Ramsar Wetland/SPA/SSSI**

- 12.8.8 The modelled process contribution to acid deposition above the high tide line, for the three schemes considered in combination, results in only slight increases to that predicted for Grangemouth alone and is typically less than 1% of the critical load. However, it is 9.3% at Preston Island, which is not part of the SPA/Ramsar Wetland, and 3.1% at Bo'ness which is within the SPA/Ramsar Wetland. This will result in a PEC that is 138% of critical load at Bo'ness and 147% at Preston Island. In both cases, the background acid deposition already exceeds the critical load (135% at Bo'ness and 137% at Preston Island). At Bo'ness the existing level of acid deposition accounts for the vast majority of PEC and the process contribution is considered to represent an insignificant increase. At Preston Island it is therefore possible that the increase to PEC could contribute to deterioration in habitat condition. In summary it is considered **unlikely** that acid deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SPA/Ramsar Wetland, although it is considered **possible** that acid deposition will represent a significant impact on the conservation status of the notified habitat in the SSSI (outside the SPA/Ramsar Wetland). Confidence in these predictions is considered uncertain however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.
- 12.8.9 Similarly, the modelled process contribution to nitrogen deposition above the high tide line, for the three schemes considered in combination, is typically less than 1% of the critical load, although at Preston Island (not part of the SPA/Ramsar Wetland) the figure is 2.8%, which will result in a PEC of 130%. At all other locations within the SPA the process contribution to nitrogen deposition due to the proposed Renewable Energy Plant will be less than 1% of critical load. Background nitrogen deposition at Preston Island already exceeds the critical load (127%) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that nitrogen deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SPA/Ramsar Wetland or the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

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<sup>100</sup> Scottish Power, Application under Section 36 of the Electricity Act 1989: Environmental Upgrades at Longannet Generating Station, Fife and Revisions to the Ash Disposal Strategy at Valleyfield and Longannet Ash lagoons, Fife. Volume 2 Environmental Statement – Main Report, April 2009.



### Slamannan Plateau SPA

- 12.8.10 The modelled process contribution to acid and nitrogen deposition, for the three schemes considered in combination, results in slight increase to those predicted for Grangemouth alone taking the process contribution for acid deposition to 3.2% of critical load and the process contribution for nitrogen deposition to 1.6% of critical load. This will result in a PEC which is 213% of the critical load for acid deposition and 298% for nitrogen deposition. Existing levels of acid deposition already significantly exceed the critical load (210%) as do existing levels of nitrogen deposition (296%). In both cases the process contribution is considered to represent an insignificant increase. Even in the unlikely event that detectable changes to peatland habitats were to occur, the qualifying feature for the SPA, taiga bean goose, is not likely to be sensitive to minor changes in habitat composition. It is therefore considered **very unlikely** that acid or nitrogen deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the SPA. Confidence in this prediction is considered near certain.

### Blawhorn Moss SAC/SSSI

- 12.8.11 The modelled process contribution to acid deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth alone taking the process contribution over the 1% threshold to 2.0% of critical load. This will result in a PEC that is 176% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (174%) and the process contribution is considered to represent an insignificant increase, particularly given that the critical load is already significantly exceeded. It is therefore considered **unlikely** that acid deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in this prediction is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.
- 12.8.12 The modelled process contribution to nitrogen deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth alone, although the process contribution will not exceed 1% of critical load. The cumulative emissions will result in a PEC that is 219% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (218%) and the process contribution is considered to represent an insignificant increase, particularly given that the critical load is already significantly exceeded. It is therefore considered **unlikely** that acid deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in this prediction is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

### Black Loch Moss SAC/SSSI

- 12.8.13 The modelled process contribution to acid deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth alone taking the process contribution over the 1% threshold to 2.1% of critical load. This will result in a PEC that is 183% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (181%) and the process contribution is considered to represent an insignificant increase, particularly given that the critical load is already significantly exceeded. It is therefore considered **unlikely** that acid deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in this prediction is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.
- 12.8.14 The modelled process contribution to nitrogen deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth alone, although the process contribution will not



exceed 1% of critical load. The cumulative emissions will result in a PEC that is 219% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (218%) and the process contribution is considered to represent an insignificant increase, particularly given that the critical load is already significantly exceeded. It is therefore considered **unlikely** that acid deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SAC/SSSI. Confidence in this prediction is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Howierig Muir SSSI**

- 12.8.15 The modelled process contribution to acid deposition, for the three schemes considered in combination, results in a very slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 1.7% of the critical load. PEC will still not exceed the critical load (85%) however. The modelled process contribution to nitrogen deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 2.1% of the critical load. PEC will remain the same as that predicted for Grangemouth alone however (310%). As noted previously, existing levels are also very high (308% of critical load) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that either acid or nitrogen deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in the prediction for acid deposition is considered near certain. Confidence in the prediction for nitrogen deposition is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Lockshaw Mosses SSSI**

- 12.8.16 The modelled process contribution to acid deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 2.8% of the critical load. This will result in a PEC that is 140% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (137%) and the process contribution is considered to represent an insignificant increase. The modelled process contribution to nitrogen deposition, for the three schemes considered in combination, results in a very slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 1.7% of the critical load. PEC will remain the same as that predicted for Grangemouth alone however (256%). As noted previously, existing levels are also very high (254% of critical load) and the process contribution is considered to represent an insignificant increase. It is therefore considered **unlikely** that either acid or nitrogen deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

#### **Steelend Moss SSSI**

- 12.8.17 The modelled process contribution to acid deposition, for the three schemes considered in combination, results in a slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 3.5% of the critical load. This will result in a PEC that is 162% of critical load. However, the existing level of acid deposition accounts for the vast majority of PEC (159%) and the process contribution is considered to represent an insignificant increase. The modelled process contribution to nitrogen deposition, for the three schemes considered in combination, results in a very slight increase to that predicted for Grangemouth in that the cumulative process contribution will be 3.5% of the critical load. PEC will remain the same as that predicted for Grangemouth alone however (302%). As noted previously, existing levels are also very high (300% of critical load) and the process contribution is considered to represent an insignificant increase. It is

therefore considered **unlikely** that either acid or nitrogen deposition resulting from cumulative emissions from the three Renewable Energy Plants will represent a significant impact on the conservation status of notified habitats within the SSSI. Confidence in these predictions is only considered probable however, owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded.

## **12.9 Summary and Conclusions**

- 12.9.1 Information has been obtained from a range of sources relating to protected and notable species and habitats in the vicinity of the application site, and a summary has been produced of designated nature conservation areas up to 15 km of the application site and the features for which they are designated. In addition, ecological surveys have been carried out on the application site and the adjacent Port area between 2008 and 2010, comprising an Extended Phase 1 habitat survey, a bat roost assessment and bat activity surveys, breeding bird and wintering bird surveys and an otter survey. This information has formed the terrestrial ecological baseline on which an ecological impact assessment of the proposed Renewable Energy Plant has been performed.
- 12.9.2 A significant residual impact on the Firth of Forth SSSI is possible at Preston Island due to acid deposition resulting from airborne emissions, although confidence in this prediction is uncertain owing to limited information on responses of vegetation to increases in deposition on sites where the critical load is already exceeded. No significant residual impact of the proposed development has been identified for any other ecological receptors of local or higher value, either for the scheme considered alone or considered in combination with other schemes. No impacts have been identified on notable habitats or designated sites; in the absence of mitigation, qualifying bird interest in the Firth of Forth SPA could be negatively impacted, but following the implementation of suitable mitigation, no residual impact is expected. The development is not predicted to impact on breeding birds, but mitigation will be implemented to prevent damage to any nests and eggs identified during the construction phase. A common tern colony is present within 50 m of the application boundary that has the potential to be impacted upon significantly by construction activities, but mitigation will be implemented to ensure that piling and water abstraction infrastructure is not carried out near the tern colony during the breeding season. The application site and surrounding areas appear to be of low value to bats and no mitigation is therefore required. Finally, the application site and surrounding areas appear to be of low value to otters and due to the timing of likely traffic movements and the existence of a 20mph speed limit throughout the Port impacts are very unlikely.

Table 12.8: Summary of Significance of Effects of Proposed Grangemouth Renewable Energy Plant

Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/ negative	Permanent/ temporary	Reversible/ irreversible		
Construction and Decommissioning Impacts							
Demolition and construction	No impact identified for notified invertebrate interest in Firth of Forth SSSI	National	Not significant				
	No impact identified for bog interest at Blawhorn Moss SAC	National	Not significant				
	No impact identified for bog interest at Black Loch Moss SAC	International	Not significant				
	No impact identified for woodland interest at Avon Gorge SSSI	National	Not significant				
	No impact identified for fen interest at Carron Dams SSSI	National	Not significant				
	No impact identified for grassland interest at Bo'mains Meadow SSSI	National	Not significant				
	No impact identified for loch interest at Linlithgow Loch SSSI	National	Not significant				
	No impact identified for woodland interest at Carriber Glen SSSI	National	Not significant				
	No impact identified for mire interest at Howierig Muir SSSI	National	Not significant				
	No impact identified for bog interest at Lockshaw Mosses SSSI	National	Not significant				

Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/ negative	Permanent/ temporary	Reversible/ irreversible		
	No impact identified for bog interest at Darnrig Moss SSSI	National	Not significant				
	No impact identified for basin mire interest at Lochcote Marsh SSSI	National	Not significant				
	No impact identified for woodland and heath interest at Graigmad Wood SSSI	National	Not significant				
	No impact identified for raised bog and fen interest at Steelend Moss SSSI	National	Not significant				
	No impact identified for bats	Local	Not significant				
	Vegetation clearance causing damage to or destruction of breeding birds' nests or eggs	Less than local	Negative	Temporary	Irreversible	Restrict site clearance and demolition activities to outside of the breeding season, from April to August, inclusive, or have a suitably qualified ecologist conduct pre-demolition checks of vegetation	Not significant
	Noise and visual disturbance from construction of cooling water outfall affecting wintering birds roosting in intertidal area of River Carron	International	Negative	Temporary	Reversible	Restrict construction activities of the outfall to avoid the winter months, from October to March, inclusive	Not significant
	Noise and visual disturbance during construction of cooling water intake affecting common tern colony in Western Channel	National	Negative	Temporary	Reversible	Construction of cooling water intake to avoid the period May to August inclusive	Not significant

Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/ negative	Permanent/ temporary	Reversible/ irreversible		
	Noise and visual disturbance affecting Taiga bean geese population in Slamannan Plateau SAC	International	Not significant				
	Sedimentation and runoff affecting running water and mudflat habitat	Local	Negative	Temporary	Reversible	Adherence to pollution prevention guidelines	Not significant
Vehicular traffic	Pollutants from vehicular traffic impacting habitats in Jupiter Urban Wildlife Centre SWT Reserve	Local	Not significant				
	Collisions with otters	Local	Not significant				
Operational Impacts							
General	No impact identified for notified invertebrate interest in Firth of Forth SSSI	National	Not significant				
	No impact identified for Taiga bean geese in Slamannan Plateau SAC	National	Not significant				
	No impact identified for common tern colony	Local	Not significant				
	No impact identified for bats within	Local	Not significant				
Maintenance works	Accidental oil/fuel spillage affecting qualifying bird species in the Firth of Forth Ramsar Wetland/SPA through impact on feeding areas	International	Not significant				
	Vehicle-otter collisions	Local	Not significant				
Cooling water discharge	Impact on qualifying and notified bird interest in the Firth of Forth Ramsar Wetland/SPA/SSSI through impact on feeding areas	International	Not significant				
	Cooling water discharge affecting running water habitat	International	Not significant				

Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/ negative	Permanent/ temporary	Reversible/ irreversible		
Emissions from Renewable Energy Plant	Air quality and acid and nitrogen deposition changes impacting coastal vegetation in Firth of Forth SPA/Ramsar Wetland	International	Not significant				
	Air quality and acid and nitrogen deposition changes impacting coastal vegetation in Firth of Forth SSSI	National	Negative	Permanent	Irreversible		Possibly significant (though confidence in this prediction is uncertain)
	Air quality and acid and nitrogen deposition changes impacting habitats at Slamannan Plateau SPA, which in turn could affect the qualifying species, taiga bean goose	International	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified bog interest at Blawhorn Moss SAC	International	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified bog interest at Black Loch Moss SAC	International	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified woodland interest at Avon Gorge SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified fen interest at Carron Dams SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified grassland interest at Bo'mains Meadow SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified loch interest at Linlithgow Loch SSSI	National	Not significant				



Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/ negative	Permanent/ temporary	Reversible/ irreversible		
	Air quality and acid and nitrogen deposition changes impacting notified woodland interest at Carriber Glen SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified mire interest at Howierig Muir SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified bog interest at Lockshaw Mosses SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified bog interest at Darnrig Moss SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified mire and marsh interest at Lochcote Marsh SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified woodland and heath interest at Graigmad Wood SSSI	National	Not significant				
	Air quality and acid and nitrogen deposition changes impacting notified raised bog and fen interest at Steelend Moss SSSI	National	Not significant				
Ship traffic	Physical disturbance and vehicular emissions displacing qualifying bird species in the Firth of Forth Ramsar Wetland/SPA/SSSI	International	Not significant				

## Abbreviations

The following is a list of abbreviations adopted in Chapter 12 Terrestrial Ecology.

<b>BAP</b>	Biodiversity Action Plan
<b>BSBI</b>	Botanical Society of the British Isles
<b>EcIA</b>	Ecological Impact Assessment
<b>ECU</b>	Energy Consents Unit
<b>EIA</b>	Environmental Impact Assessment
<b>EIA Regulations</b>	Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000
<b>ES</b>	Environmental Statement
<b>EU</b>	European Union
<b>ha</b>	Hectare
<b>IEEM</b>	Institute of Ecology and Environmental Management
<b>JNCC</b>	Joint Nature Conservation Committee
<b>km</b>	Kilometre
<b>LNR</b>	Local Nature Reserve
<b>LWS</b>	Local Wildlife Site
<b>m</b>	Metre
<b>MHz</b>	Megahertz
<b>NBN Gateway</b>	National Biodiversity Network Gateway
<b>NNR</b>	National Nature Reserve
<b>RSPB</b>	Royal Society for the Protection of Birds (Scotland)
<b>SAC</b>	Special Area of Conservation
<b>SEPA</b>	Scottish Environment Protection Agency
<b>SINC</b>	Site of Importance for Nature Conservation
<b>SNH</b>	Scottish Natural Heritage
<b>SPA</b>	Special Protection Area
<b>SSSI</b>	Site of Special Scientific Interest
<b>SWT</b>	Scottish Wildlife Trust
<b>UK</b>	United Kingdom

## Chapter 13

Aquatic Ecology

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## 13 Aquatic Ecology

### 13.1 Introduction

- 13.1.1 This Chapter addresses the potential impacts of the proposed Grangemouth Renewable Energy Plant on aquatic ecology.
- 13.1.2 The application site at the Port of Grangemouth is on the Forth Estuary approximately 77 km from the mouth of the Firth of Forth at the Isle of May. The Forth Estuary adjacent to the application site is approximately 1.2 km wide at the narrowest point. The potential aquatic impacts of construction and operation of the Renewable Energy Plant mainly relate to the use of cooling water. It is proposed to use hybrid cooling towers which will greatly reduce water extraction and discharge when compared against the direct cooled alternative. It is proposed to abstract cooling tower makeup water from the Western Channel which is filled with water derived from the Forth Estuary and to discharge cooling tower blow down water to the lower tidal reach of the River Carron<sup>1</sup>. The exact position of the discharge point under consideration. It is proposed to site the discharge within a region between a seaward point situated beyond the end of the north bank of the River Carron estuary opposite the Skinflats mudflats at approximately 56° 1'35.53"N 3°42'45.23"W and a landward point on the edge of the canalised section of the River Carron in the vicinity of the Old Dock at approximately 56° 1'29.24"N 3°43'24.15"W. The exact location within this region will not alter to any appreciable extent the pattern of dispersal of the discharge plume. Water would be extracted from the Western Channel continuously (within the Port of Grangemouth) at a rate of 1400 m<sup>3</sup>/hr (0.389 m<sup>3</sup>s<sup>-1</sup>) and blow down discharged for 8 hours in every 24, to the River Carron estuary at a rate of 3360 m<sup>3</sup>/hr (0.933 m<sup>3</sup>s<sup>-1</sup>). To ensure good dispersal of the blow down water, it is proposed to only discharge on a falling tide i.e. two periods of 4 hours per day. The cooling towers will therefore have a built-in sump to hold water without any discharge during tidal periods of rising or still water.
- 13.1.3 This assessment of the impact of the proposal on aquatic life is focused on the Forth Estuary, the major permanent water body upon which there is a potential impact. The Firth of Forth is a broad funnel-shaped estuary, it stretches eastwards from the upstream limit of tidal intrusion in Stirling downstream approximately 50 km to the seaward limit just east of the Forth Road Bridge (Forth River Purification Board, 1978<sup>2</sup>). Freshwater inputs to the estuary are largely from the rivers Forth and Teith and the Allan Water, with the flow rate varying with season from a mean of 24 m<sup>3</sup> /s from June to August, increasing to 93 m<sup>3</sup> /s between December and February (Wallis and Brockie, 1973).
- 13.1.4 The Firth of Forth tidal cycle is semi-diurnal, with a mean spring tidal range of 5.0 m and a mean neap range of 2.5 m (Webb and Metcalfe, 1987<sup>4</sup>). Tidal excursion varies between 8 and 16 km (Webb and Metcalfe, 1987). The area between the estuary mouth (51.5 km from Stirling) and Kincardine (27 km) is approximately 6057 ha at high water, reducing to 3850 ha at low water (Jayamanne and McLusky, 1997<sup>5</sup>). The mean spring

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<sup>1</sup> The tidal inundation of the River Carron Channel located by the port is referred to as the River Carron estuary in this document

<sup>2</sup> Forth River Purification Board, 1978. The physical dimensions of the Firth of Forth and Forth estuary. Forth River Purification Board, Edinburgh, UK.

<sup>3</sup> Wallis, S.G., Brockie, N.J.W., 1997. Modelling the Forth estuary with MIKE11. In: McLusky, D.S. (Ed.), Coastal Zone Topics: Process, Ecology and Management. 3. The estuaries of Central Scotland. Joint Nature Conservation Committee, Peterborough, pp. 1–10.

<sup>4</sup> Webb, A.J., Metcalfe, A.P., 1987. Physical aspects, water movements and modelling studies of the Forth estuary, Scotland. Proceedings of the Royal Society of Edinburgh Series B 93, 259–272.

<sup>5</sup> Jayamanne, S.C., McLusky, D.S., 1997. Biology of the shrimps in the Forth estuary. In: McLusky, D.S. (Ed.), Coastal Zone Topics: Process, Ecology and Management. 3. The estuaries of Central Scotland. Joint Nature Conservation Committee, Peterborough, pp.147–156.

tide volume of the estuary is approximately  $5.1 \times 10^8 \text{ m}^3$  (LW:  $3.4 \times 10^8 \text{ m}^3$ , HW:  $6.8 \times 10^8 \text{ m}^3$ ; Forth River Purification Board, 1978).

- 13.1.5 The Firth of Forth is protected by several designations, it is part of the River Teith Special Area of Conservation (SAC) under the Habitats Directive, and is a Special Protection Area (SPA), a Ramsar site, and is part of the Firth of Forth Sites of Special Scientific Interest (SSSI). For a summary of qualifying and designated features, please refer to Chapter 12, Terrestrial Ecology. Designated sites within 15 km of the application site are shown on Figure 12.2 Statutory Designated Sites.
- 13.1.6 The SAC qualifying features for the River Teith are the River lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*), Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*). The application site is between two of the most sensitive ecological sites within the Firth of Forth SPA, these being the Kinneil and Skinflats mudflats. There are extensive eel or sea grass beds (*Zostera* spp.) found in and around the Firth of Forth. Eelgrass beds have enhanced nature conservation status and are covered by a UK Habitat Action Plan for seagrass beds.
- 13.1.7 The range of salinity, substrate and exposure to wave action influences the estuarine habitats present and the range of species that use them. The extensive mud and sand flats support a range of benthic communities, which in turn are a feeding resource for birds and fish. The Firth of Forth supports a diverse fish community including resident, marine migrant, nursery-using and over-wintering species, as well as those undertaking diadromous migrations through the Firth of Forth. It acts as a migration route for both river and sea lamprey between coastal waters and their spawning areas. In addition, salmon and sea trout migrate through the Firth of Forth. Marine fish, such as flounder, move up into the Firth of Forth to feed, and it provides nursery grounds for common North Sea fish populations.

## 13.2 Key consultations

- 13.2.1 A scoping study was undertaken to identify all of the possible aquatic impacts and significant issues associated with the project that will require further assessment. The issues raised during scoping and meetings with Scottish Environment Protection Agency (SEPA) and Marine Scotland were focused on the impingement and entrainment effects and the effects of thermal discharges, in particular:
- The temperature rise in the Firth of Forth and impacts on local aquatic life;
  - Effects on fish and fisheries of entrainment and impingement by the intake;
  - Effects on other aquatic biota of entrainment and impingement by the intake;
  - Effects on aquatic birds and their feeding within the Firth of Forth (see Chapter 12, Terrestrial Ecology);
  - Effects of biocide released with the discharge water on migratory fish in particular;
  - Effects on the upstream and downstream migration of salmon;
  - Effects on the sea and river lamprey; and
  - Effects of dredging and piling, if required.
- 13.2.2 In addition, there are potential impacts arising during construction and decommissioning, mostly from accidental spillages in the absence of mitigation.

## 13.3 Assessment Methodology and Significance Criteria

### Desk Study

- 13.3.1 The desk study comprised a literature and internet search for information relating to the site and the Firth of Forth. The main data sources include the following web sites and documents:



- Multi-Agency Geographic Information for the Countryside MAGIC ([www.magic.gov.uk](http://www.magic.gov.uk));
- The Scottish Natural Heritage website ([www.snh.org.uk](http://www.snh.org.uk));
- SEPA water chemistry data;
- Published works on existing power station intakes in the Firth of Forth<sup>6</sup>;
- National Biodiversity Network (NBN) Gateway ([www.searchnbn.net](http://www.searchnbn.net)); and
- Literature search of power station effects databases on impingement and entrainment.

13.3.2 Information on marine habitats and fisheries issues relating to water extraction and discharge were obtained through consultations with regulatory bodies and key stakeholders including, in particular, Marine Scotland (formerly the Fisheries Research Service) and SEPA.

### Field Surveys

13.3.3 A site visit was undertaken over the low tides on the 4th and 5th February 2010 to examine the littoral zone and potential sites for cooling water abstraction and discharge. During this visit, the general physical structure of the shore was described together with the attached flora and fauna. The man-made hard structures of the dock walls, piles and other features were examined for their attached communities. The attached macro fauna and flora was recorded and photographed.

### Impact Assessment Methodology

- 13.3.4 The potential impact for impingement arising from the abstraction of cooling water is assessed by reference to known data from the existing power station intakes with particular emphasis on well-studied intakes at Cockenzie and Longannet in the Firth of Forth. Entrainment was assessed using data from previous studies at other estuaries, and the composition of plankton in the Firth of Forth.
- 13.3.5 The impact of the use of biocides was assessed on the basis of previous research undertaken at British power station outfalls and by the Central Electricity Research Laboratories and, in particular, the studies by Davis and Coughlan<sup>7</sup>.

### The Thermal Plume

- 13.3.6 It is proposed to discharge blow down water from the power plant cooling towers into the River Carron estuary on the falling tide only. This will ensure that the discharge water moves into the Forth Estuary and becomes well-mixed. The discharge will be fitted with diffusers to allow rapid mixing with the receiving water. This outfall would produce a plume of warm water, the dilution of which can be modelled using standard and well-established mathematical models.
- 13.3.7 The plume was modelled using CORMIX. This is a water quality model designed for environmental impact assessment of mixing zones resulting from wastewater discharge from point sources. CORMIX includes the effects of boundary interaction to predict plume geometry and dilution of plumes. The system's major emphasis is predicting the geometry and dilution characteristics of the initial mixing zone so that compliance with water quality regulatory constraints may be judged, the system also predicts the behaviour of the discharge plume at larger distances.

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<sup>6</sup> Greenwood, M.F.D., 2008. Trawls and cooling-water intakes as estuarine fish sampling tools: comparisons of catch composition, trends in relative abundance, and length selectivity. *Estuarine, Coastal and Shelf Science* 76, 121–130.

<sup>7</sup> Davis and Coughlan (1983). Model for predicting chlorine concentration within marine cooling circuits and its dissipation at outfalls. Ann Arbor Science, Ann Arbor, MI. 1983. p 347-257.

## Assessment of significance

- 13.3.8 As stated in the IEEM guidelines<sup>8</sup>, the starting point for any assessment of impacts is to determine which ecological receptors should be subject to detailed assessment. In order to warrant detailed assessment, ecological receptors should be of sufficient value that impacts upon them may be significant (in terms of legislation or policy) and be potentially vulnerable to significant impacts arising from the development. This approach is consistent with the EIA Regulations, which only require investigation of likely significant effects.
- 13.3.9 In this assessment, an ecologically significant impact is defined as an impact (adverse or positive) on the integrity of the site or ecosystem(s) and/or the conservation status of habitats or species within the identified zone of impact for the development. The definitions of 'integrity' and 'conservation status' used for this assessment are those detailed in the Habitats Directive and reproduced in the IEEM Guidelines, namely:
- Integrity is the coherence of ecological structure and function, across a site's whole area, that enables it to sustain a habitat, complex of habitats and/or the levels of populations of species; and
  - Conservation status for habitats is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area. Conservation status for species is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area.
- 13.3.10 It is important to note that even where an impact on the integrity or conservation status of a habitat or species is not significant, it could still result in an offence under the law, e.g. in relation to disturbance of a protected species.
- 13.3.11 The importance of an ecologically significant impact corresponds to the importance of the ecological receptor involved. For example, an impact on a feature of national importance is significant at the national level and therefore a greater issue in policy terms compared to an ecologically significant impact on a feature of county or local importance. It is important to note, however, that any impact, which has been found not to be significant at the level at which a receptor has been valued, could be significant at a more local level, in which case it should not be ignored.

## 13.4 Baseline Conditions and Receptors

### Sublittoral Benthic Habitats

- 13.4.1 The Firth of Forth sub-tidal sedimentary regime mostly comprises fine material with a median diameter <50 µm. There are coarse mixed materials in some areas (Elliott and Kingston, 1987<sup>9</sup>), as well as stony substratum nearer to the mouth of the estuary (Elliott and Taylor, 1989<sup>10</sup>). The most common subtidal sediment reported in the Forth Replacement Crossing study was sandy mud. Fine mud occurs on the intertidal mudflats of Kinneil and Skinflats, with this mud extending to the sub-tidal areas. Under the Water Framework Directive, the lower Forth estuary is classified as a Type 2 Transitional Water (TW2), partly mixed/ stratified; mesohaline or polyhaline; strongly mesotidal; sheltered; intertidal/shallow sub-tidal; sand and mud substratum.

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<sup>8</sup> Guidelines for ecological impact assessment in the United Kingdom. IEEM 2006.

<sup>9</sup> Elliott, M & PF Kingston, 1987. The sublittoral benthic fauna of the Estuary and Firth of Forth. Proceedings Royal Society Edinburgh., 93B, 449-465.

<sup>10</sup> Elliott, M & CJL Taylor, 1989. The production ecology of the subtidal benthos of the Forth Estuary, Scotland. Scientia Marina 53 (2-3): 531-541.

- 13.4.2 As part of the study for the Forth Replacement Crossing a comprehensive survey of subtidal benthic communities was undertaken. The communities at each site were examined using the Infaunal Quality Index (IQI) developed for the classification of transitional and coastal water bodies for the Water Framework Directive. The IQI is a multi-metric tool composed of the AZTI Marine Biotic Index, Simpson's Evenness, and number of taxa giving results ranging from zero (bad status) to one (high status). Results for the subtidal benthic communities indicate that, at the majority of sites, the quality status of the subtidal communities ranged between good and high<sup>11</sup>.
- 13.4.3 It has not proved possible to give the sub-littoral communities a clear biotope classification, in part because of the patchy nature of the community. The Forth Replacement Crossing study found a community dominated by the bivalve *Abra alba* and the polychaete *Scalibregma inflatum*. Sub-dominant taxa included juvenile bivalves, common mussel, *Mytilus edulis*, oligochaetes, *Tubificoides swirencoides* and *Tubificoides amplivisatus*, and polychaetes, *Mediomastus fragilis* and *Ophelina acuminata*. There were, however, sites with considerably more impoverished communities.

### Littoral habitats

- 13.4.4 The littoral zone bordering the Forth Estuary at Grangemouth comprises extensive mudflat with an upper beach comprising rock, concrete and man-made materials. The hard substrate upper zone is dominated by seaweeds including channelled wrack, *Pelvetia canaliculata*, and spiral wrack, *Fucus spiralis*. There is some zonation with the lower part of the hard substrate supporting furoid seaweeds and knotted wrack, *Ascophyllum nodosum*. Barnacles and littorinid gastropod molluscs were present in low numbers. The extensive soft sediments of the Kinneil and Skinflats mudflats support no macroalgal growth. The commonest worm is the ragworm, *Nereis diversicolor*, but there are also many other small polychaetes including *Manayunkia*, *Pygospio*, *Streblospio* or *Eteone* and oligochaetes. The commonest arthropod is the crustacean, *Corophium volutator*. There are two clams present, the Baltic tellin, *Macoma balthica*, and the cockle, *Cerastoderma edule*. There are also very large numbers of the small gastropod mollusc, *Hydrobia ulvae*.
- 13.4.5 The River Carron enters the Forth Estuary to the west of the application site. This section of the river is tidal and highly modified by man. The upper part of the bank has been raised and hardened as a flood defence and the lower banks comprise fine mud. Furoid macroalgae grow on the hardened upper shore. The mud infauna is likely to be similar to that on the adjacent Kinneil and Skinflats mudflats (see above).
- 13.4.6 A small burn (Grange Burn) flowing into the Forth Estuary marks the boundary of the port to the southeast. Much of the area of the burn comprises inter-tidal soft mud. At low water the burn flows to sea within a mud banked gully. The area is mostly devoid of macro-algae and higher plants, although furoid weed is present on the scattered rocks and debris. The mud infauna is likely to be similar to that on the adjacent Kinneil and Skinflats mudflats (see above).

### Fish and Fisheries

- 13.4.7 The Forth Estuary supports a diverse fish community including resident, marine migrant, nursery-using and over-wintering species, as well as those undertaking diadromous<sup>12</sup> migrations through the estuary. It acts as a migration route for river lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*), Atlantic salmon (*Salmo salar*<sup>13</sup>), and sea trout (*Salmo trutta*) between coastal waters and their river spawning areas. In

<sup>11</sup> Forth Replacement Crossing: Environmental Statement. Transport Scotland  
<http://www.transportscotland.gov.uk/reports/road/j11223-000.htm>

<sup>12</sup> Diadromous migration is that between salt and fresh water.

<sup>13</sup> The Atlantic Salmon is listed on the IUCN Red List of threatened species and protected under the Salmon and Freshwater Fisheries Act 1975 supplemented by the Salmon Act 1986 and the species is listed under the EC Habitats Directive Annex 11a.

addition, the smelt (*Osmerus eperlanus*), an estuarine species of conservation concern, lives within this region and the Forth Estuary population has recently been recovering. Other fish, such as flounder (*Platichthys flesus*), move into the estuary to feed, and it provides important nurseries for North Sea fish including herring (*Clupea harengus*), sand eel, sprat (*Sprattus sprattus*), cod (*Gadus morhua*), whiting (*Merlangius merlangus*), saithe (*Pollachius virens*), dab (*Limanda limanda*) and plaice (*Pleuronectes platessa*).

- 13.4.8 Scottish Power's Longannet Power Station is a 2400 MW direct cooled coal fired plant with a maximum cooling water pumping rate of approximately 91 m<sup>3</sup>/s situated across the Forth Estuary from Grangemouth. The fish impinged on the cooling water intakes at Longannet have been the subject of major studies and the results can be used to characterise the fish community and predict the species vulnerable to impingement on cooling water intake filter screens in this region. A list of the fish species impinged on the cooling water intake screens at Longannet between 1999 and 2000 is given in Table 13.1.

**Table 13.1 List of species collected from the cooling water intake of Longannet Power Station, January 1999 to December 2000, sorted in descending order of total abundance. Based on data from Greenwood (2008)<sup>14</sup>**

Taxa	
• Common and Latin name	• Fatherlasher, <i>Myoxocephalus scorpius</i> (L.)
• Sprat, <i>Sprattus sprattus</i> (L.)	• Unidentified salmonids, <i>Salmo</i> spp.
• Atlantic herring, <i>Clupea harengus</i> (L.)	• Common sole, <i>Solea solea</i> (L.)
• Whiting, <i>Merlangius merlangus</i> (L.)	• Thick-lip grey mullet, <i>Chelon labrosus</i> (Risso)
• Gobies, <i>Pomatoschistus</i> spp.	• Butterfish, <i>Pholis gunnellus</i> (L.)
• European plaice, <i>Pleuronectes platessa</i> (L.)	• Fivebeard rockling, <i>Ciliata mustela</i> (L.)
• European smelt, <i>Osmerus eperlanus</i> (L.)	• Grey gurnard, <i>Eutrigla gurnardus</i> (L.)
• Flounder, <i>Platichthys flesus</i> (L.)	• European perch, <i>Perca fluviatilis</i> L.
• Pipefishes, <i>Syngnathus</i> spp.	• Ling, <i>Molva molva</i> (L.)
• Cod, <i>Gadus morhua</i> L.	• Silvery cod, <i>Gadiculus argenteus</i> Guichenot
• Pogge (hooknose), <i>Agonus cataphractus</i> (L.)	• Common dragonet, <i>Callionymus lyra</i> L.
• River lamprey, <i>Lampetra fluviatilis</i> (L.)	• Pollack, <i>Pollachius pollachius</i> (L.)
• Sea snails, <i>Liparis</i> spp.(L.)	• Bib/pout, <i>Trisopterus luscus</i> (L.)
• Saithe, <i>Pollachius virens</i> (L.)	• Fifteen-spined stickleback, <i>Spinachia spinachia</i> (L.)
• Common dab, <i>Limanda limanda</i> (L.)	• Haddock, <i>Melanogrammus aeglefinus</i> (L.)
• Three-spined stickleback, <i>Gasterosteus aculeatus</i>	• Atlantic mackerel, <i>Scomber scombrus</i> L.
• European eel, <i>Anguilla anguilla</i> (L.)	• European seabass, <i>Dicentrarchus labrax</i> (L.)
• Atlantic salmon, <i>Salmo salar</i> L.	• Sand smelt, <i>Atherina presbyter</i> Cuvier

<sup>14</sup> Greenwood, M. F. D. (2008). Fish mortality by impingement on the cooling-water intake screens of Britain's largest direct-cooled power station. Marine Pollution Bulletin, 56, 723-739.

• Lesser sandeel, <i>Ammodytes tobianus</i> L.	• Boreal pearlside, <i>Maurollicus muelleri</i> (Gmelin)
• Sea trout, <i>Salmo trutta</i> L.	• Greater sandeel, <i>Hyperoplus lanceolatus</i>

### Commercial Fishing

- 13.4.9 The Forth Estuary lies in ICES<sup>15</sup> fishing area IVb. Annual commercial landings from the two local ports of Eyemouth and Pittenweem are recorded by the Scottish Government. Norway lobster, *Nephrops norvegicus*, was by weight the most abundant shellfish or finfish landed at both ports. Trawling for *Nephrops* sp. does not extend westwards as far as the Forth crossings at Queensferry. Crab, lobster, whelk and clams are also landed commercially within the Forth Estuary. Elliott *et al.* (1990) estimated that the Firth of Forth including the Forth Estuary supports 0.54%, 0.45% and 0.05% of the total North Sea stocks of similar sized plaice, cod and herring, respectively.

### Marine mammals

- 13.4.10 The Sea Watch Foundation (SWF) maintains a database of national sightings of cetaceans reported from 1973 to the present. For the Forth Estuary and adjacent regions, harbour porpoise (*Phocoena phocoena*) is the most frequently observed cetacean with bottlenose dolphin (*Tursiops truncatus*), minke whale (*Balaenoptera acutorostrata*) and the white-beaked dolphin (*Lagenorhynchus albirostris*) also noted.

## 13.5 Potential impacts

### Construction

- 13.5.1 Construction activities in the vicinity of the Forth Estuary and River Carron will comprise the installation of the cooling water intake and outfall structures. Potential impacts with respect to aquatic ecology therefore relate to possible piling work, potential oil spills from mobile equipment and generation of runoff containing high suspended solids.
- 13.5.2 If releases occur and are not mitigated, it would have a negative impact on aquatic flora and fauna populations in the immediate vicinity. The uncontrolled release of high suspended solids or chemicals such as fuels, lubricants or waste would impact on migratory and estuarine fish, phytoplankton, micro-algae and macro-invertebrates.
- 13.5.3 The predicted impact is based on studies of the effects of toxins, high suspended solids and low oxygen on marine life. Reviews include Langford (1990)<sup>16</sup>, Turnpenny and Linny (2007)<sup>17</sup>, Maitland (2003)<sup>18</sup> and Hendry and Cragg-Hine (2003)<sup>19</sup>.
- 13.5.4 For all the aquatic flora and fauna, if accidental releases into the Forth Estuary or River Carron estuary occurred, in large enough quantities to be harmful, when the species were present, there would be a significant negative impact on organisms in the vicinity of the discharge. The impact on the wider populations of the Forth Estuary is viewed as negligible, due to the relative scale of any potential accidental releases in relation to the size and volume of the Forth Estuary and the level of tidal movement.

<sup>15</sup> The International Council for the Exploration of the Sea (ICES) coordinates and promotes marine research on oceanography, the marine environment, the marine ecosystem, and on living marine resources in the North Atlantic.

<sup>16</sup> Langford, T. E. L. (1990) *Ecological Effects of Thermal Discharges*. Elsevier Applied Science Ltd., England. 468 pp.

<sup>17</sup> Turnpenny, A W H and Liney K E. 2007, Review and development of temperature standards for marine and freshwater environments. Job No: 21960.

<sup>18</sup> Maitland PS (2003). Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

<sup>19</sup> Hendry K & Cragg-Hine D (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.



- 13.5.5 Pile driving may generate appreciable levels of noise and this noise may affect migratory fish, particularly salmon. Noise levels close to the pile driver (within approximately 5 m) can exceed the levels that will hurt or kill fish (peak quoted values are 218 dB)(Wursig & Evans, 1998)<sup>20</sup>. However, these effects can be effectively managed as discussed below.

## Operation

### Abstraction and Discharge

- 13.5.6 It is proposed to use a closed cycle cooling water system with hybrid cooling towers. Cooling water requirements are therefore limited to the volume of water required to replace the water lost to evaporation plus that needed to maintain a constant level of dissolved solids in the re-circulated cooling water. The proposed Renewable Energy Plant would abstract from the Western Channel (within the Port of Grangemouth) at a rate of 1,400 m<sup>3</sup>/hr (0.389 m<sup>3</sup>s<sup>-1</sup>) and the blow down discharged intermittently to the River Carron estuary at a rate of 3,360 m<sup>3</sup>/hr (0.933 m<sup>3</sup>s<sup>-1</sup>). To ensure good dispersal of the blow down water, it is proposed to only discharge on a falling tide for approximately 4 hours in every 12. The cooling towers will therefore have a built-in sump to hold water without any discharge during tidal periods of rising or still water. It will then be discharged to the River Carron at maximum of 12°C above the ambient temperature of the receiving water and at a salinity of approximately 45 parts per thousand. The cooling water will be treated with a biocide to control fouling and the growth of micro-organisms in order to promote overall plant energy efficiency by maintaining clean heat exchanger surfaces and prevent the proliferation of biological organisms that could block pipes and filters.
- 13.5.7 Fish can be impinged on cooling water intake filter screens. The level of impingement is related to both the velocity and the volume of the water taken. The small volume of water to be abstracted will be filtered at the seaward end of the intake pipe using a passive screen. Impingement mortality will therefore be avoided.
- 13.5.8 Eggs, larvae and small juvenile fish can pass with the pumped water into a cooling water system, where they would die. Losses of eggs and larval fish from this cause are likely to be small in proportion to the population size, as the volumes of water taken are small in proportion to the water volume of the Firth of Forth. Further, the extraction point is within a dock which is not a favoured locality for larvae. To put the volumes concerned in context, on a spring tide the tidal exchange is 3.4 x 10<sup>8</sup> m<sup>3</sup> (Forth River Purification Board, 1978<sup>21</sup>) twice a day. The volume of the outfall represents a very small percentage (less than 0.01%) of the water flowing in and out of the Firth of Forth. The addition of the warmed water is therefore predicted to have no measurable far field impact on fish or any other aquatic life within the Forth Estuary. Planktonic life typically has high rates of reproduction and can therefore rapidly compensate for losses. Langford (1990)<sup>22</sup>, in an assessment of the impact of entrainment on zooplankton, states that mathematical modelling suggests that entrainment effects on populations are likely to be small, at cropping rates of up to 15% of the population. The proposed Renewable Energy Plant would crop at least five orders of magnitude below this level because of the relative volumes involved, indicating that no effects on zooplankton would be detectable. The same conclusion applies to phytoplankton. Jordan *et al.* (1983)<sup>23</sup> in a study of entrainment effects on phytoplankton entrainment by the Surry Power plant on the James River, Virginia concluded that the effects of entrainment loss were not detectable in phytoplankton samples taken beyond the immediate discharge zone.

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<sup>20</sup> Wursig B, Evans P (1998) 'Cetaceans and humans; influences of noise'. Second European Seminar on marine mammals, Valencia, Spain.

<sup>21</sup> Forth River Purification Board, 1978. The physical dimensions of the Firth of Forth and Forth estuary. Forth River Purification Board, Edinburgh, UK.

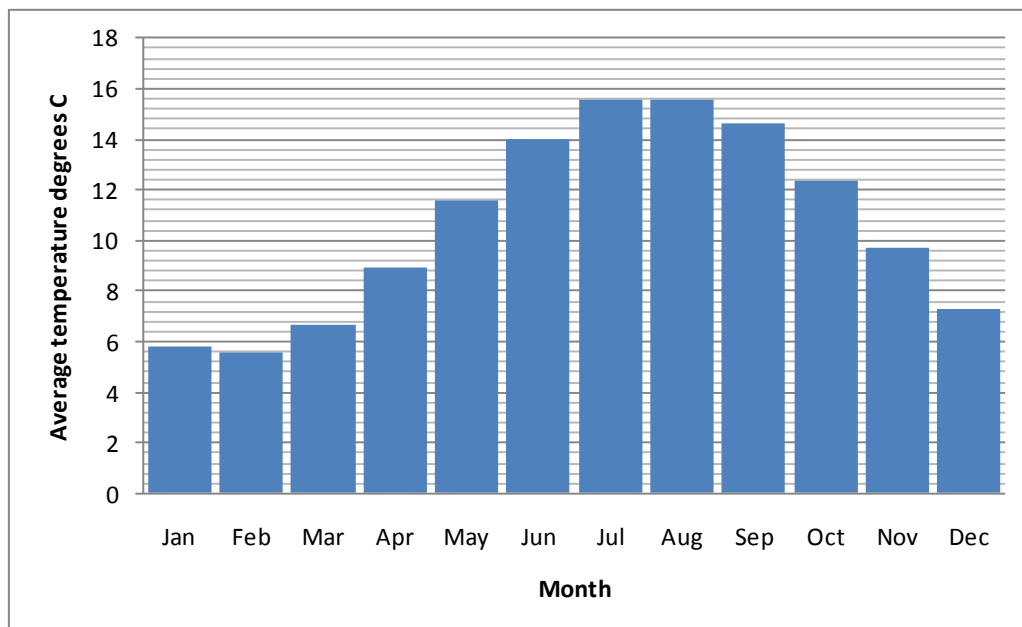
<sup>22</sup> Langford, T. E. L., 1990. *Ecological Effects of Thermal Discharges*. Elsevier Applied Science Ltd., England. 468 pp.

<sup>23</sup> R.A. Jordan, P.G. Martin and C.E. Sutton, 1983. Selective effects of phytoplankton entrainment at the Surry power plant, James River, Virginia. *Hydrobiologia* 106, 253-261.

### Temperature in the Forth Estuary and Firth of Forth

- 13.5.9 Localised increases in temperature have the potential to impact on aquatic life. Far field effects are those away from the mixing zone when there is no longer a defined plume and relate to the water body as a whole. Near field effects refer to impacts on life by the heated effluent plume.
- 13.5.10 Seawater temperature is regularly measured in the Firth of Forth and the average monthly temperature recorded at Longannet over a 12 year period is shown in Figure 13.1. Between 1993 and 2005, temperatures varied annually from a maximum of approximately 18°C to a minimum of approximately 3 °C from Hughes (2007)<sup>24</sup>. On the 1<sup>st</sup> September 2010 water temperature in the River Carron estuary in the region of the proposed discharge point was measured at the surface, 0.75 m and 1.5 m depths using temperature data loggers. It was found that there was no significant vertical temperature stratification (temperature at all depths was approximately 14.7°C – Table 13.2). The temperature of the Carron estuary will be dominated by the tidal input of the Forth and therefore the Forth temperature gives a suitable reference.

**Figure 13.1: Seawater temperature for the Forth Estuary at Longannet. Data**



### Far Field Effect of Temperature Rise on Aquatic Life

- 13.5.11 The Firth of Forth tidal cycle is semi-diurnal, with a mean spring tidal range of 5.0 m and a mean neap range of 2.5 m (Webb and Metcalfe, 1987<sup>25</sup>). Tidal excursion varies between 8 and 16 km (Webb and Metcalfe, 1987). The area between the estuary mouth (51.5 km from Stirling) and Kincardine (27 km) is approximately 6057 ha at high water, reducing to 3,850 ha at low water (Jayamanne and McLusky, 1997<sup>26</sup>). The mean spring tide volume of the estuary is approximately  $5.1 \times 10^8 \text{ m}^3$  (LW:  $3.4 \times 10^8 \text{ m}^3$ , HW:  $6.8 \times 10^8 \text{ m}^3$ ; Forth River Purification Board, 1978). Freshwater inputs to the estuary are largely from the rivers Forth and Teith and the Allan Water, with the flow rate varying with season from a mean of 24 m<sup>3</sup>/s from June to August,

<sup>24</sup> Fisheries Research Services 2007. Scottish Ocean Climate Status Report 2004 and 2005. Hughes S.L. (ed.). Aberdeen. Fisheries Research Services. 40pp.

<sup>25</sup> Webb, A.J., Metcalfe, A.P., 1987. Physical aspects, water movements and modelling studies of the Forth estuary, Scotland. Proceedings of the Royal Society of Edinburgh Series B 93, 259–272.

<sup>26</sup> Jayamanne, S.C., McLusky, D.S., 1997. Biology of the shrimps in the Forth estuary. In: McLusky, D.S. (Ed.), Coastal Zone Topics: Process, Ecology and Management. 3. The estuaries of Central Scotland. Joint Nature Conservation Committee, Peterborough, pp. 147–156.

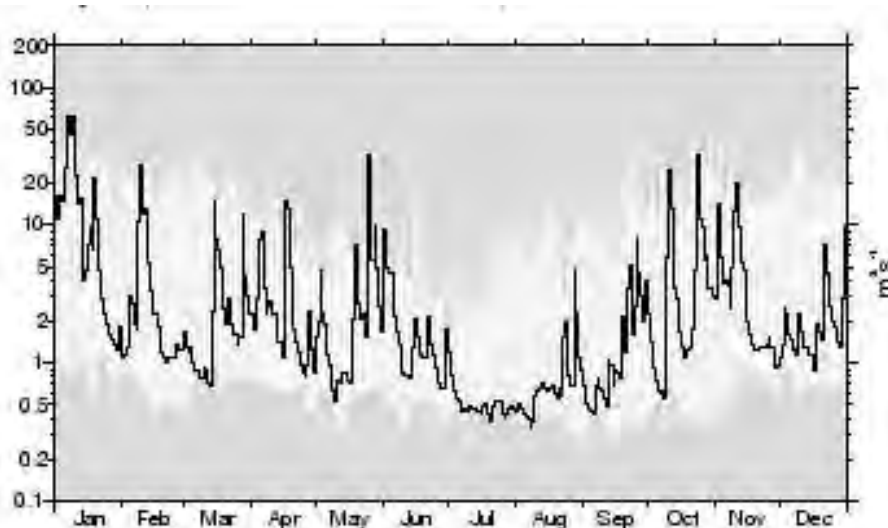


increasing to  $93 \text{ m}^3/\text{s}$  between December and February (Wallis and Brockie, 1997<sup>27</sup>). There can be no long-term build-up of temperature because the Firth of Forth exchanges up to 50% of its entire volume with the North Sea over each tidal cycle. Therefore, the increase in temperature after the cooling water discharge is fully mixed with the receiving water is predicted to be undetectable and therefore negligible.

### Near field effect of temperature rise on aquatic life in the River Carron Estuary

- 13.5.12 It is proposed to place the discharge of the cooling tower blow down into the River Carron estuary adjacent to the proposed site. There is a zone along a 700 m section of the River Carron estuary over which the discharge may be located. As all locations will result in similar dispersal of the plume, their near field effect is predicted to be similar. The River Carron in this region is a highly modified channel. It is tidal, the water can be expected to flow both up and down stream. The channel is at least 200 m wide at low water and has a depth of greater than 4 m at high water which drops to below 2 m at low water. The flow of the River Carron at Headswood is shown in Figure 13.2. For 2005, the mean freshwater flow was  $3.68 \text{ m}^3/\text{s}$ . In addition, on a falling tide there will be the outflow of tidal water. Therefore the water flowing down the River Carron estuary at the point of discharge will be a combination of freshwater water from the river and Firth of Forth water on a falling tide. Salinity in the region of the proposed discharge was measured over the falling tide on 1 September 2010. As shown in Table 13.2 it varied between 17 and 33 parts per thousand (ppt). Salinity declined with the falling tide and there was a small amount of vertical stratification with surface salinities often 5 ppt below that at depth. The current was also measured in the centre of the channel over the falling tide on 1st September 2010. The results are given in Table 13.2. Current speeds increased as the tide fell and reached a maximum of approximately 1 m/s. As is normal, the speed was greatest at the surface. These speeds are considered typical for periods when the river is not in flood. At times of peak flow they will be faster.

Figure 13.2: The maximum and minimum daily mean flows from 1969 to 2004 with 2005 shown as a black line. (UK National River Flow Archive (NRFA)<sup>28</sup>)



<sup>27</sup> Wallis, S.G., Brockie, N.J.W., 1997. Modelling the Forth estuary with MIKE11. In: McLusky, D.S. (Ed.), Coastal Zone Topics: Process, Ecology and Management. 3. The estuaries of Central Scotland. Joint Nature Conservation Committee, Peterborough, pp. 1–10.

<sup>28</sup> UK National River Flow Archive (NRFA [http://www.nwl.ac.uk/ih/nrfa/station\\_summaries/017/001.html](http://www.nwl.ac.uk/ih/nrfa/station_summaries/017/001.html))

Table 13.2 Physical data for the River Carron collected on the 1/9/2010. All data are for the tidal section of the river where the proposed outfall would be placed. Measurements are for the centre of the channel and were taken on a falling tide over the period when cooling water would be discharged.

Time of measurement	Depth of channel m	Depth of measurement	Current speed m/s	Salinity parts per thousand	Temperature °C
09.00 am	4.43m	0	0.32	28	14.5
09.00 am		1m	0.19	33	14.7
09.30 am	3.79 m	0	0.53	25	14.8
09.30 am		1m	0.70	30	14.7
09.45 am	3.59 m	0	0.68	No measurement	14.8
09.45 am		1m	0.62	No measurement	14.8
10.00 am	3.14 m	0	0.73	22	14.8
10.00 am		1m	0.49	28	14.8
10.15 am	2.94 m	0	0.94	No measurement	14.9
10.15 am		1m	0.81	No measurement	14.7
10.30 am	2.6 m	0	0.97	20	14.8
10.30 am		1m	0.82	20	14.7
10.45 am	2.26 m	0	0.96	17	14.8
10.45 am		1m	0.76	22	14.7

- 13.5.13 The proposed discharge is on the falling tide only, for 4 hours over each tidal cycle. The volume of the discharge would be  $0.933 \text{ m}^3\text{s}^{-1}$  and it would be a maximum of  $12^\circ\text{C}$  above ambient water temperature and hypersaline with a salinity of 45 parts per thousand. This temperature rise is a maximum value and is expected to be more typically around  $8^\circ\text{C}$  above ambient. The proposal to discharge only on the falling tide is designed to aid dispersal of the effluent. As the tide falls the River Carron becomes constrained within banks as the stone structure separating the river from the Skinflats mudflats is exposed. To promote rapid mixing and therefore prevent the establishment of a warm, negatively buoyant, discharge plume it is proposed to release the discharge from diffusers placed near the bed of the river, but close to the bank. They need to be placed close to the bank to ensure they do not impede navigation. The discharge will be fitted with diffusers to ensure rapid mixing of the discharge with the receiving water and minimise thermal, salinity and biocide impacts.

- 13.5.14 Using the CORMIX Version 6.0GT<sup>29</sup> thermal discharge model the rate of mixing and shape of the thermal plume generated by the discharge was predicted. The key assumptions used in the model are given in Table 13.3.

**Table 13.3 Inputs to the CORMIX model, using environmental data taken from the Carron estuary on the 1/9/10**

Ambient Parameters	
Width	200 m
Average depth	3 m
Depth at discharge	3 m
Ambient velocity	0.514 m/s (low flow) and 1.0289 m/s (high flow)
Salinity	17 ppt (lowest observed Sept 2010)
Discharge Parameters - Submerged Multiport Diffuser Discharge	
Diffuser length	10 m
Number of openings	5
Spacing between risers/openings	2.5 m
Port/Nozzle diameter	0.2 m
Total discharge flow rate	0.933 m <sup>3</sup> /s
Discharge port height	0.5 m

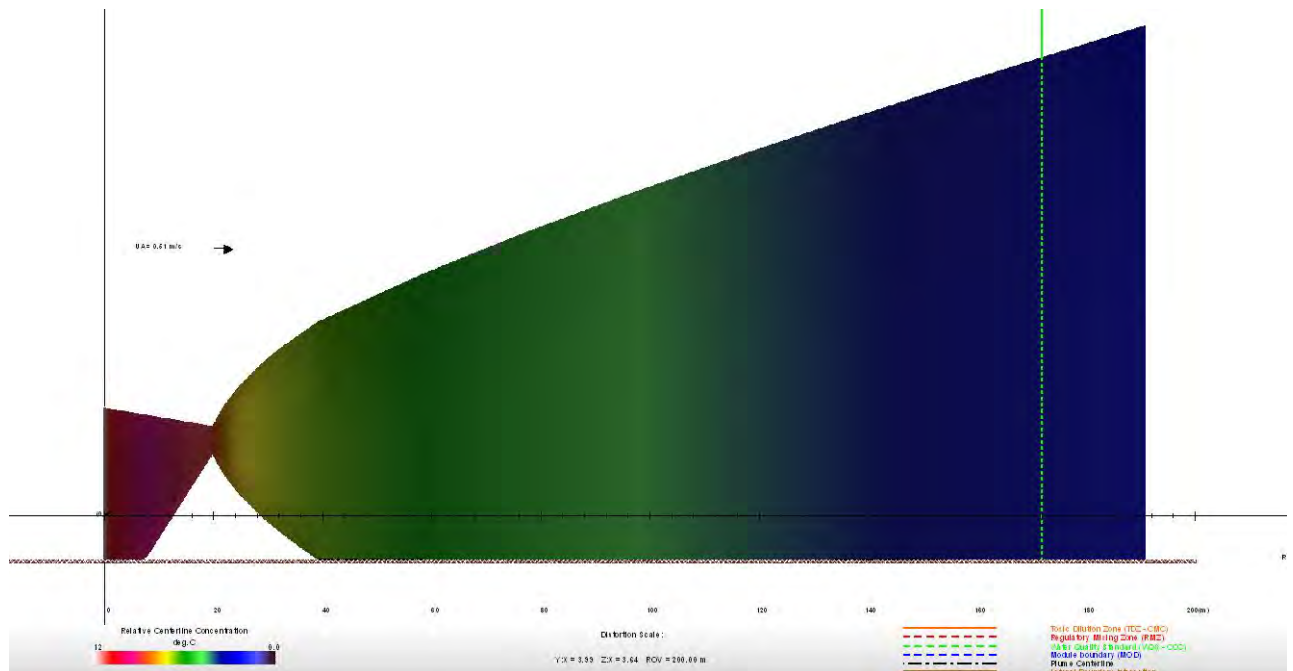
- 13.5.15 Three scenarios were run to cover the highest, worst case, temperature and an appropriate range of depth, salinity and flow conditions based on observations taken in September 2010. The first was for summer with an ambient water temperature of 18 °C and a discharge temperature of 30 °C and a 1 knot (0.514 m/s) river flow. This flow is lower than that observed over much of the falling tide in September 2010 see Table 13.2 and can therefore be viewed as a worst case in terms of discharge dispersal. The second was for a low flow winter scenario with an ambient water temperature of 4°C and a discharge temperature of 16 °C and a 1 knot river flow. The third was the same as the second except for a river flow of 2 knots. This is above the maximum flow of 1.89 knots/s observed in September 2010. It is likely that during periods of high river flow appreciably higher currents will occur, which would increase dilution and heat dissipation even further.

#### **Model prediction for discharges through the Summer months**

- 13.5.16 The prediction for the discharge plume during the summer under low river flow of 1 knot (0.514 m/s) is shown in Figure 13.3. Only the plan view of the plume is shown below because at the shallow depths of the River Carron estuary the plume will extend for the entire depth of the water column. The constriction evident close to the discharge point is due to the switching between different mathematical models and is not a real feature. The green line marks the distance downstream at which the plume temperature is reduced to only 1 °C above the ambient water temperature, this is reached in less than 200 m from the discharge point and the width of the plume is only about 20m wide (about 10% of the channel width). The model assumes that all heat is dissipated by mixing with the receiving water and that heat loss to the atmosphere is negligible. The dilution values generated can be used to estimate the reduction in salinity of the discharge plume as it mixes with the receiving water. At the point the plume has mixed sufficiently to have a temperature of 1°C above ambient the salinity has been diluted to 18.75ppt ( $(17 \times 12 + 1 \times 40)/13$ ), which is only 1.75 ppt above the assumed ambient salinity.

<sup>29</sup> CORMIX is sold and supported by Mixzon Inc – see [www.mixzon.com](http://www.mixzon.com)

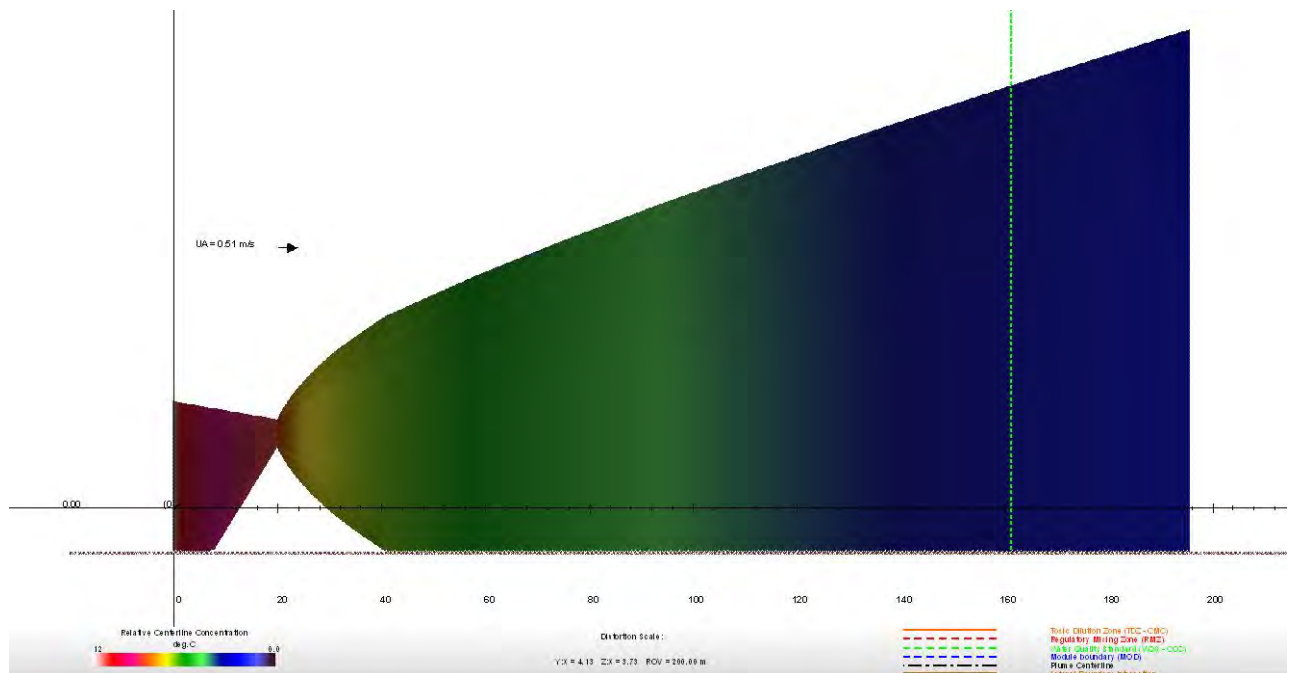
**Figure 13.3: The plan view of the thermal discharge in the River Carron estuary under summer conditions**



### Model prediction for discharges through the Winter months under low flow conditions

13.5.17 The prediction for the discharge plume during the Winter under low flow of 1 knot (0.514 m/s) is shown in Figure 13.4. The green dashed line marks the distance downstream at which the plume temperature is reduced to only 1 °C above the ambient water temperature. This is reached in less than 140 m from the discharge point. The plume at around 140 m from the discharge is only 20m wide (about 10% of the channel width).

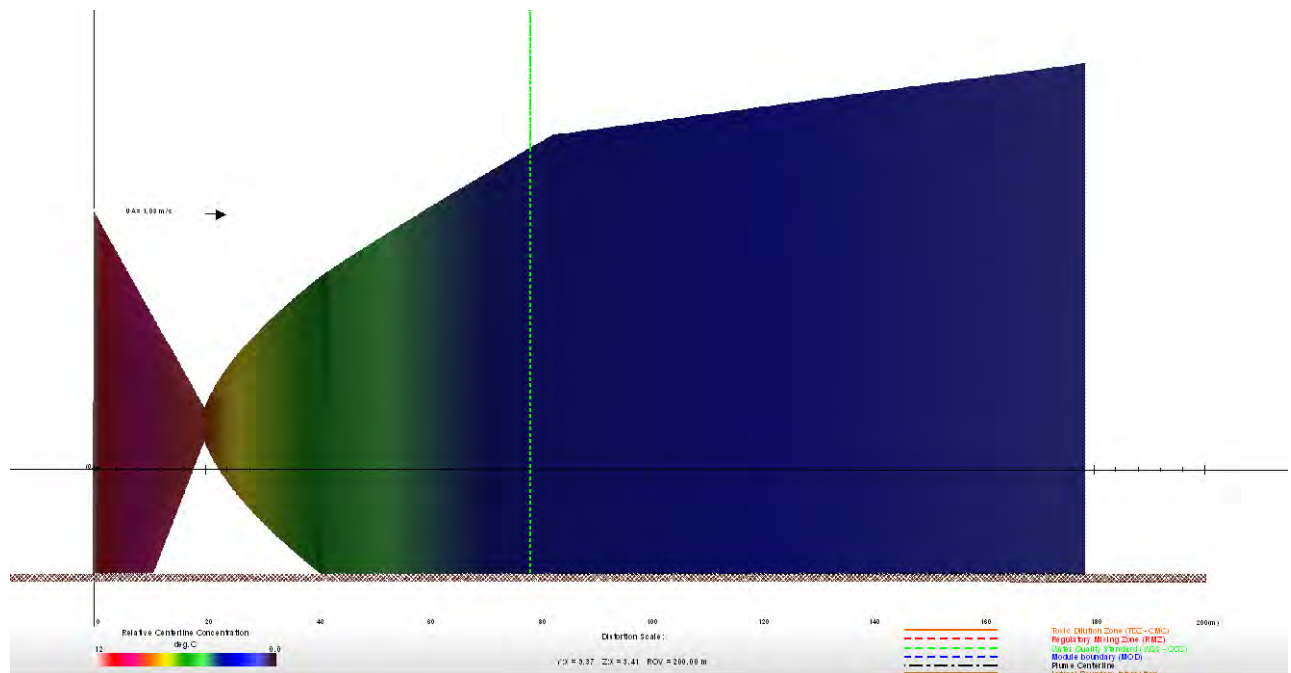
Figure 13.4: The plan view of the thermal discharge in the River Carron under winter conditions



### Model prediction for discharges through the Winter months under high flow conditions

- 13.5.18 The prediction for the discharge plume during the winter under high flow of 2 knots (1.029 m/s) is shown in Figure 13.5. The green dashed line marks the distance downstream at which the plume temperature is reduced to only 1 °C above the ambient water temperature. This is reached in less than 100 m from the discharge and when the plume is less than 10m wide. (about 5% of the channel width)

Figure 13.5: The plan view of the thermal discharge in the River Carron estuary under worst case winter conditions



- 13.5.19 In conclusion, the small volume of the discharge in relation to the flow of the River Carron allows rapid dilution of a discharge. This is achieved by designing the discharge diffusers to generate good mixing of the discharge and receiving waters.

### Chemical Additions to the Discharge

- 13.5.20 Residual chlorine in small quantities affects planktonic life, including phytoplankton and bacteria. However, the anticipated low concentration of residual chlorine ( $< 0.1$  mg/l) in the discharge water will not result in any significant impact on fish, principally because when chlorinated water is added to saline water, there is an instantaneous chlorine demand resulting in the rapid consumption of any free chlorine in the discharge. Davis and Coughlan (1983)<sup>30</sup> measured the instantaneous demand following the introduction of 2.5 mg/l NaOCl (sodium hypochlorite) and found that the instantaneous demand as determined 1 minute after the addition of NaOCl ranged between 0.1 and 1 mg/l for temperatures between 0 and 33°C. It is therefore anticipated that, given the small size of the discharge (0.933 m<sup>3</sup>/s) in relation to the size of the Forth Estuary, the products of this reaction will cause no detectable impacts on microorganisms within the wider Forth Estuary. The impacts of chlorination compounds on the benthos are not predicted to be adversely significant because the plume will be rapidly diluted with the receiving water and the active chlorine neutralised by the chlorine demand of the receiving waters.

### Pollution associated with Spillages, Floods, Storm Water Discharge and Drainage

- 13.5.21 The principal potential sources of water pollution would be from accidental discharges from stores of oil, sodium hypochlorite solution and chemicals for use in boiler water treatment. The release of any stored chemicals in concentrated form or in large quantity or fuels into the Forth Estuary would have a potentially significant impact.

<sup>30</sup> Davis and Coughlan, 1983. Model for predicting chlorine concentration within marine cooling circuits and its dissipation at outfalls. Ann Arbor Science, Ann Arbor, MI. 1983. p 347-257.



### Decommissioning

- 13.5.22 Decommissioning activities potentially affecting aquatic habitats and species primarily relate to the removal and making safe of the cooling water intake and outfall pipes. Accidental potential impacts on aquatic ecology relate to oil spills from mobile equipment, local disturbance and generation of runoff containing high suspended solids. If unmitigated any of these events could lead to significant local ecological damage.

### Cumulative Impacts

- 13.5.23 There is potential for a cumulative environmental effect from the proposed Renewable Energy Plant and two nearby proposed developments:
- The Longannet Biomass Power Station; and
  - The proposed Rosyth Renewable Energy Plant.
- 13.5.24 Both proposed developments are small and there will be no build up of harmful pollutants such as chlorine or heat, because of the small volume of the discharges in relation to the flushing rate and size of the Forth Estuary. The Forth Estuary has a large exchange of water with the North Sea. Discharging only of the falling tide, with a system that will result in high initial mixing, will stop any build-up of warmed, high salinity water in the River Carron estuary and the Forth Estuary. There is therefore predicted to be no long-term build-up of heat or biocide products within the estuary.
- 13.5.25 The level of mortality on aquatic life caused by the extraction and discharge of cooling water would be insignificant in relation to the size of the populations and their ability to replace any losses. The level of losses will be very small as the use of cooling towers and the placement of the intake within the dock will minimise the amount of aquatic life impacted.
- 13.5.26 Furthermore, there is also the existing Longannet Power Station which uses approximately 91 m<sup>3</sup>/s of cooling water. As the proposed Grangemouth Renewable Energy Plant will have a re-circulating cooling system, it will have a negligible impact on fish and other aquatic life in the Forth Estuary, resulting in no cumulative effect on aquatic life.
- 13.5.27 The proposed development is assessed as having no significant cumulative impact on the aquatic ecology of the Forth Estuary.

## 13.6 Mitigation

### Construction

- 13.6.1 The principal potential sources of water pollution are from accidental discharges from stores of oil, sodium hypochlorite solution and chemicals for use in boiler water treatment. These will be stored away from the water. This will minimise the risk of accidental introductions into the Forth Estuary.
- 13.6.2 Any oil spillage will drain to oil interceptors and any chemical spills will be directed to the site wastewater neutralisation sump where the effluent will be mixed and neutralised before discharge. In addition to the Harbour Authority's statutory requirement to have an approved oil spill response plan, the Plant will have in place an Environmental Management Plan that identifies procedures and activities to prevent and control spillage.
- 13.6.3 As detailed in Chapter 14, Hydrology, Hydrogeology, Geology and Soils, a number of best practice mitigation measures will be employed with respect to the operation of the plant, in accordance with the relevant guidance. No enhancement or compensation is considered necessary.
- 13.6.4 Pollution prevention guidelines published by the Scottish Environment Protection Agency will be adhered to (see Hydrology, Hydrogeology, Geology and Soils Chapter 14).



### Mitigation of piling effects

- 13.6.5 The following measures to reduce or remedy any significant impacts would result in negligible residual impacts. The measures are designed to firstly minimise close range mortality and secondly give a sufficient time each day for the fish to move through the area in peace.
- 13.6.6 First, if possible, piling will be undertaken at times of the year when salmon and other migratory species of conservation concern are not moving through the Firth of Forth in large numbers.
- 13.6.7 If percussive piling were undertaken, it is proposed to gradually increase the level of sound to scare fish away before sound intensity reached lethal levels. This should reduce deaths of large fish. It may not reduce the impact on small or young fish which can be carried into the danger zone by tidal currents, but the number potentially killed is unlikely to be significant to the population of the Firth of Forth, because of the small area impacted (c. 70 sq m).
- 13.6.8 No pile driving is proposed for night time periods. Salmon smolt and other species are known to migrate in the dark. When appropriate, non-metallic pads would be utilised between the hammer and the pile head driver to reduce noise. Consideration would be given to initial pile driving being undertaken by a 'silent method' e.g. hydraulic pressing or vibration. Percussive driving would be for no more than 6 hours per day but often less (3 to 4 hours).
- 13.6.9 These measures result in negligible residual effects whereby there is unlikely to be appreciable fish death and there will be sufficient time each day for the fish to migrate through the area in peace.

### Operation

#### General operation

- 13.6.10 As detailed in Chapter 14, Hydrology, Hydrogeology, Geology and Soils, a number of best practice mitigation measures will be employed with respect to the operation of the plant, in accordance with the relevant guidance. No enhancement or compensation is considered necessary.

#### Intake Structure

- 13.6.11 The withdrawal of water from the dock which is connected to the Firth of Forth could result in the impingement and entrainment of fish and crustaceans and therefore the abstraction infrastructure will be constructed according to guidance issued by SEPA<sup>31</sup> and the Environment Agency<sup>32</sup>.
- 13.6.12 The volume of water to be extracted is small (0.389 m<sup>3</sup>/s). The fish population within the dock will not include large numbers of migratory fish. The fish can be protected from entering the intake at the seaward end of the intake pipe through the use of an intake system protected by a wedge-wire screen, or equivalent system, with 3 mm spacing and minimising the approach velocity of water to the wedge-wire screen to a maximum of 0.2 m/s. This system would almost entirely eliminate impingement of juvenile and adult fish and macro-crustaceans because they would have the strength to swim or walk away from the screen. With such protective measures, fish impingement mortality would be negligible. The intake will therefore offer no threat to adult fish and cause no impact to the fisheries.

#### Cooling Water Discharge

- 13.6.13 It is proposed to discharge the blow down into the River Carron estuary at a maximum temperature of 12°C above the ambient temperature of the receiving water and at a salinity of 45 parts per thousand. To minimise

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<sup>31</sup> Engineering in the water environment, Good Practice Guide, Intakes and Outfalls, First Edition, October 2008 SEPA (Document reference: WAT-SG-28).

<sup>32</sup> Screening for intakes and outfalls: a best practice guide, Science Report. SC030231, Environment Agency 2005.

potential impacts on marine life within the wider Forth Estuary, it is proposed to fit diffusers to promote rapidly mixing of the cooling water with the receiving water. Further, the discharge will only occur on a falling tide giving time over each tidal cycle for fish and other aquatic life to pass the discharge point in peace.

- 13.6.14 The discharged cooling water will also hold low levels of chlorine (< 0.1 mg/l) used within the renewable energy plant as a biocide to control bacterial slimes and other forms of biofouling. The use of diffusers will ensure that this residual chlorine rapidly mixes and reacts with the receiving water removing any residual toxicity to fish and other marine life of the Forth Estuary.

### Decommissioning

- 13.6.15 The same mitigation will apply to the decommissioning phase as to the construction phase, to ensure that potential impacts upon the ecological receptors are minimised.

## 13.7 Assessment of Residual effects

- 13.7.1 The above appraisal of the possible impacts relating to the proposed Renewable Energy Plant indicates that the only activities with the potential to affect aquatic life in the Firth of Forth are accidental events during construction and decommissioning, and the effects of cooling water extraction and discharge. These two impacts on the main biological receptors are considered in turn below.
- 13.7.2 The receptors considered are:
- Sea and River Lamprey;
  - Salmon;
  - Smelt;
  - Eel;
  - Planktonic organisms;
  - Macro-invertebrates and inter-tidal habitats;
  - Estuarine fish; and
  - Diving mammals.
- 13.7.3 With the mitigation on the intake pipe of a wedge-wire screen, or equivalent system, with 3 mm spacing, and an approach velocity of water to the wedge-wire screen of 0.2 m/s, the fish impingement mortality would be negligible. The intake will therefore offer no threat to adult fish and cause no impact to fisheries.
- 13.7.4 There are no British fish whose adults or juveniles are likely to pass through the screen and enter the system. The smallest fish in these waters is the transparent goby, which as an adult exceeds 40 mm in length and is therefore unlikely to pass through a 3 mm slot if the intake is working at the low intake velocities planned. This design complies with the Environment Agency<sup>33</sup> and SEPA<sup>34</sup> good practice.
- 13.7.5 None of the rare or migratory fish that may be of conservation concern in the Firth of Forth (sea and river lamprey, salmon, sea trout and allis and twaite shad) are liable to be entrained. All these species breed in freshwater and do not migrate down the Firth of Forth to the sea until after they are too large to pass through a 3 mm slot width wedge-wire screen, and are not likely to be found as young fish within the dock.

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<sup>33</sup> Environment Agency (2005) Screening for intakes and outfalls: a best practice guide, Science Report. SC030231, Environment Agency 2005.

<sup>34</sup> SEPA (2008) Engineering in the water environment, Good Practice Guide, Intakes and Outfalls, First Edition, October 2008 SEPA (Document reference: WAT-SG-28).

### Construction Effects

- 13.7.6 Construction activities in the vicinity of the Forth Estuary will comprise the installation of the cooling water intake and outfall pipes. Potential impacts with respect to aquatic ecology therefore relate to oil spills from mobile equipment and generation of runoff containing high suspended solids.
- 13.7.7 A number of mitigating measures will be in place (see Section 13.6) to control run-off, high suspended sediments and spills during construction, and are part of the best practice that is to be followed. There would be no residual impacts of significance on the aquatic flora and fauna in the Forth Estuary in relation to construction, as impacts would be prevented or greatly reduced by good working practices.

### Operation

- 13.7.8 The extraction and discharge of cooling water will occur over the entire life of the proposed Renewable Energy Plant. The Renewable Energy Plant will extract 0.389 m<sup>3</sup>/s from the Forth Estuary via a dock and discharge 0.933 m<sup>3</sup>/s for 2 periods of 4 hours per day. Intake velocity will be maintained at below 0.2 m/s. The discharge water will be heated to a maximum of 12°C above ambient; it may also contain low concentrations (0.1 mg/l) of biocide. It will only occur on the falling tide and so will not impact aquatic life when the tide is rising. This will leave 16 hours a day, including the entire flood tide where fish migration would be unaffected. The predicted residual impact is based on extensive studies on estuarine fish, and particularly of the effects of cooling water intakes and discharges published over the last 50 years. These are comprehensively reviewed by Langford<sup>35</sup>, Turnpenny<sup>36</sup>, Maitland<sup>37</sup> and Hendry and Cragg-Hine<sup>38</sup>. If mitigation measures are implemented to protect fish and crustaceans from entering the cooling water, circuit and diffusers are used to promote rapid mixing at the discharge, the only residual effects would relate to the passage of planktonic through the cooling water circuit and this is discussed in more detail below.
- 13.7.9 The principal receptors that have been identified as potentially impacted by the proposed scheme are considered below.

### Sea and River Lamprey

- 13.7.10 Sea lamprey leave the rivers to return to the sea when they reach approximately 20 cm in length. Large lampreys have been found to be capable of swimming at speeds of 11–26 cm/s<sup>37</sup>. Given the low intake velocities proposed for the plant, lamprey will avoid impingement on the intake filter screens.
- 13.7.11 Juvenile river lamprey grow to approximately 10 cm in the rivers before they migrate to sea, where they spend one to three years feeding, adult river lamprey are approximately 30 cm in length. The fish are active swimmers and are capable of speeds of approximately 30 cm/s<sup>39</sup>. Given the low intake velocities proposed for the plant, which are considerably lower than at older, larger, direct cooled power stations, river lamprey can avoid impingement on the intake filter screens.
- 13.7.12 Temperature is the trigger for sea and river lamprey to start their upstream migration. Until they start to migrate, they are widely dispersed in the Firth of Forth and/or sea. Sea lamprey start migrating when water

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<sup>35</sup> Langford, T. E. L. (1990) *Ecological Effects of Thermal Discharges*. Elsevier Applied Science Ltd., England. 468 pp.

<sup>36</sup> Turnpenny, A w H and Liney K E. 2007, Review and development of temperature standards for marine and freshwater environments. Job No: 21960.

<sup>37</sup> Maitland PS (2003). Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

<sup>38</sup> Hendry K & Cragg-Hine D (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.

<sup>39</sup> Lucas, M.C., Greaves, R.K., Bubb, D.H. & P.S. Kemp, 2007. Stanley Mills Lamprey Report. Scottish Natural Heritage Commissioned Report No. 256 (ROAME No. F04LH03).

temperatures remain above 10°C, and continue until temperatures reach 18°C<sup>40</sup>. River lamprey start spawning in freshwater in March and April<sup>41</sup>. The lethal temperature for both sea and river lamprey is between 26 and 27°C.

- 13.7.13 If the sea lamprey is migrating in water temperatures of 17°C, then the maximum temperature of the outfall, given a  $\Delta T$  of 12°C, would be 29°C. At the point of discharge, the water in summer can be at a lethal temperature for lamprey. However, the discharge water will be mixed with the receiving water using diffusers so this high temperature lethal zone will cover a very small volume directly in front of the diffusers and would be highly turbulent. It would be difficult for a lamprey to enter and impossible to remain within for any extended period. It is therefore concluded that the exposure to harmful temperatures would be of limited duration and unlikely to harm the lamprey.
- 13.7.14 River lamprey occur throughout the year in the Firth of Forth but increase in density as they migrate upstream in October and December when the water temperatures are well below their peak. At this time of year the discharge temperature will be well below the lethal temperature for lamprey.
- 13.7.15 Sea and river lamprey are known to pass through polluted lower reaches of rivers and estuaries to reach clean headwaters to breed. Therefore, it may be assumed that short-term exposure to the plume will not be sufficient to divert them from their migratory route. It should also be noted that the discharge into the River Carron will be intermittent and will not occur on the rising tide. As lamprey are likely to move upstream on a rising tide, they will not be impeded by a discharge plume when migrating up the River Carron estuary.
- 13.7.16 It is therefore probable that there would be a minor negative impact on the sea and river lamprey in the immediate vicinity of the intake and outfall. The positioning of the intake within the docks and the low intake velocities required for the proposed renewable energy plant, combined with the lampreys' ability to pass heated effluents, leads to the conclusion that the number affected will be small in relation to the size of the population passing through the Forth Estuary. It is therefore probable that there would be no residual impact of significance on the river and sea lamprey population in the Forth Estuary in relation to cooling water extraction and discharge.

### Salmon

- 13.7.17 Salmon are a cool-water species and are sensitive to elevated temperatures.
- 13.7.18 Salmon juveniles, termed smolts, migrate through the Forth Estuary to the sea and the returning adults pass up the Forth Estuary to their river spawning sites.
- 13.7.19 Adult salmon are good swimmers and are rarely impinged on power station screens (Greenwood, 2008)<sup>42</sup>. Smolts are more frequently caught, as is demonstrated from data obtained from Longannet Power Station on the Firth of Forth (see Table 13.1 above). However, at the very low intake velocities to be used at the proposed Renewable Energy Plant, the number likely to be impinged is predicted to be negligible.
- 13.7.20 It is believed that salmon will avoid heated discharge plumes. Bamber<sup>43</sup> points out that there is little direct evidence for disruption to their migratory movements, and salmon are known to pass by or under warm water effluents. The lethal temperature for Atlantic salmon lies between approximately 26 and 30°C, depending

<sup>40</sup> Maitland PS (2003). Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

<sup>41</sup> Turnpenny, A w H and Liney K E. 2007, Review and development of temperature standards for marine and freshwater environments. Job No: 21960.

<sup>42</sup> Greenwood, M. F. D., 2008. Fish mortality by impingement on the cooling-water intake screens of Britain's largest direct-cooled power station. Marine Pollution Bulletin, 56, 723-739.

<sup>43</sup> Bamber, R. N. (1994). A literature review of the response of migrating salmonids to raised water temperature, with particular reference to heated effluents, FARL: 24.

upon the acclimation temperature<sup>44</sup>. It is predicted that salmon will have no difficulty in passing by the discharge when moving either up or down the Forth Estuary or the River Carron estuary. It should also be noted that the discharge into the River Carron estuary will be intermittent and will not occur on the rising tide. As salmon are likely to move upstream on a rising tide they will not be impeded by a discharge plume when migrating up the River Carron. It is therefore predicted that the thermal discharge will not affect salmon migration in either the upstream or downstream directions.

- 13.7.21 It is predicted that smolts will not be impinged on the intake filter screens because of the low intake velocity and position within the dock. Any smolts passing through the mixing zone of the thermal plume may suffer limited negative impacts, though with the salmon's ability to pass heated effluents, the number affected is predicted to be small. Therefore, it is predicted that there would be no residual impact of significance on the salmon population in the Firth of Forth in relation to cooling water extraction and discharge.

### Smelt

- 13.7.22 Smelt spawn over sand or gravel amongst plants in freshwater. The eggs attach to plants or the river bed. The eggs are therefore unlikely to be placed close to the intake or discharge and will not be vulnerable to entrainment and thermal impacts. The larvae drift downstream to the head of the Forth Estuary and develop in sheltered marginal habitats. It is therefore unlikely they will come into proximity with the intake and risk entrainment.

### Eels

- 13.7.23 Elvers use tidal transport to move up estuaries, by swimming up in the water column on the incoming tide and staying on the bottom on falling tides. Elvers are between 5 and 10 cm long by the time they enter British estuaries. They are capable of a swimming speed of 25 cm/s or more over short distances<sup>45</sup>. Adult eels are capable swimmers and maintaining speeds of 35–58 cm/s (0.45–0.75 body lengths per second) over long periods<sup>46</sup>. Eels can survive temperature well in excess of any discharge temperatures, with survival observed at 38°C<sup>47</sup>.
- 13.7.24 It is possible that there would be a negative impact on any individual eels in the immediate vicinity of the outfall because of thermal impacts and contact with residual chlorine. However, it is unlikely that eels would be able to remain in the turbulent mixing zones for sufficient time to suffer harm. Elvers are sufficiently small to pass across a 3 mm screen width screen and enter the cooling water system. However, it is probable that there would be no residual impact on the eel population of the Forth Estuary caused by cooling water extraction because of the small proportion of the population that is likely to be entrained.

### Planktonic organisms

- 13.7.25 Small organisms, including copepods, cladocerans, and other members of the zooplankton and phytoplankton communities, would be sucked into the cooling water system. It is likely that these organisms will be killed or lost to the Forth Estuary. However, because of the small proportion of the volume of the Forth Estuary entering the cooling water system, the loss of plankton is predicted to have a negligible effect on plankton concentrations within the estuary. Species of phytoplankton and zooplankton have very rapid reproduction rates, and studies have shown that little effect can be observed from much larger intakes than those required for the proposed Renewable Energy Plant

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<sup>44</sup> Ibid.

<sup>45</sup> McCleave, J. D., 1980. Swimming performance of European eel (*Anguilla anguilla* (L.)) elvers J. Fish Biol. (1980) 16,445-452.

<sup>46</sup> McCleave J. D. & Arnold G.P., 1999. Movements of yellow- and silver-phase European eels (*Anguilla anguilla* L.) tracked in the western North Sea. ICES Journal of Marine Science, 56: 510–536.

<sup>47</sup> Turnpenny, A w H and Liney K E., 2007, Review and development of temperature standards for marine and freshwater environments. Job No: 21960.

- 13.7.26 It is probable that there would be a negative impact on the planktonic organisms in the immediate vicinity of the intake and outfall. However, it is predicted that there would be no residual impact of significance on the populations of planktonic organisms in the Firth of Forth in relation to cooling water extraction and discharge as the volumes of water involved are very small and planktonic life typically has high rates of reproduction and can therefore rapidly compensate for such losses.

#### **Macro-invertebrates and Inter-Tidal Habitats**

- 13.7.27 Significant thermal impacts on the benthos are unlikely as the plume is small and is unlikely to impact areas of the seabed further than 100 m downstream of the discharge point. The species found within the vicinity of the discharge are tolerant of the high turbidity and the variable thermal regime found within estuaries. Entrainment and impingement is likely for some of the mobile species.
- 13.7.28 It is probable that there would be a negative impact on the macro-invertebrates in the immediate vicinity of the discharge where the plume impacts the seabed. However, it is probable that there would be no residual impact of significance in relation to cooling water extraction and discharge on the macro-invertebrates population in either the Forth Estuary or on the Skinflats inter-tidal mudflats. The flats, while lying close to the point of discharge, are separated from the Carron estuary by a training wall.

#### **Estuarine fish**

- 13.7.29 The number of adult fish that will be impinged is negligible for three reasons. Firstly the volume of water taken is small, secondly the velocity at the intake will be low and finally the intake is situated within an enclosed dock. Using a fine mesh screen with a slot width of 3 mm and approach velocities at or below 0.2 m/s will result in most fish being able to escape from the screen.
- 13.7.30 There are no British fish whose adults or juveniles are both so small and such weak swimmers that they are likely to pass through a 3mm wedgewire screen with a low approach velocity of 0.2 m/s. Eel elvers may enter the system and are discussed above.
- 13.7.31 Some eggs, larvae and juvenile fish will be able to pass through the screen. These animals will probably be killed, during the passage of the cooling water through the station.
- 13.7.32 The effect of the thermal discharge will also be small. If a fish did enter the turbulent mixing zone, exposure to high water temperatures would be of short duration and unlikely to be lethal or result in long-term harm.
- 13.7.33 It is probable that there would be a negative impact on estuarine fish living in the immediate vicinity of the discharge. However this is a small area of seabed that does not offer important fish habitat. Therefore, it is probable that there would be no residual impact of significance on the estuarine fish population in the Firth of Forth in relation to the extraction or discharge of cooling water.

#### **Diving Mammals**

- 13.7.34 The small size and velocity of the intake and discharge system leads to the conclusion that there will be no direct impact on the seals, dolphins and whales using the waters of the Forth Estuary. The low level of impact on their food sources, primarily fish, further leads to the conclusion that there will be no indirect harm.

#### **Decommissioning Effects**

- 13.7.35 Decommissioning activities in the vicinity of the Forth Estuary will comprise the removal of the cooling water intake and outfall pipes and making the site safe. Potential impacts with respect to aquatic ecology therefore relate to the potential for oil spills from mobile equipment and generation of runoff containing high suspended solids.
- 13.7.36 A number of mitigation measures will be in place (see Section 13.6) to control run-off, high suspended sediments and spills during decommissioning, and are part of the best practice that is to be followed on this



site. There would be no residual impacts of significance on the aquatic floras and fauna in the Forth Estuary in relation to decommissioning, as impacts can be prevented or greatly limited by good working practices.

### **Cumulative Impacts**

- 13.7.37 The proposed development is assessed as having no cumulative impact on the aquatic ecology of the Forth Estuary.
- 13.7.38 There will be no build up of harmful pollutants such as chlorine or heat, because of the small volume of the discharges in relation to the flushing rate and size of the Forth Estuary. The Forth Estuary exchanges as much as 50% of its volume over a tidal cycle. Discharging only of the falling tide, with a system that will result in high initial mixing, will stop any build-up of warmed, high salinity water in the River Carron estuary and the Forth Estuary. There is therefore predicted to be no long-term build-up of heat or biocide products within the Forth Estuary.
- 13.7.39 The level of mortality on aquatic life caused by the extraction and discharge of cooling water would be insignificant in relation to the size of the populations and their ability to replace any losses. The level of losses will be very small as the use of cooling towers and the placement of the intake within the dock will minimise the amount of aquatic life impacted.

## **13.8 Summary of Environmental Effects**

- 13.8.1 A summary of effects is presented in Table 13.4.
- 13.8.2 The Forth Estuary is a tidal estuary of large size in relation to the proposed water intake and discharge system. The Forth Estuary in the vicinity of the proposed Renewable Energy Plant supports a range of fish species, with several species of conservation concern living in or using the area. Many of the fish species are part of larger coastal stocks, but some species, particularly those using the rivers flowing into the Forth Estuary as breeding grounds, are from much smaller stocks.
- 13.8.3 The invertebrate fauna of the Forth Estuary is typical of that found in British estuarine soft sediments. The main focus for long-term impacts on aquatic life arises from the need for a cooling water blown down discharge. However, this discharge is small in relation to the size of the receiving water and leads to the conclusion that the thermal impact of the discharge on the aquatic life of the River Carron estuary, Forth Estuary and the Firth of Forth is negligible.
- 13.8.4 In conclusion, taking maximum predicted effects of the proposed Renewable Energy Plant impact, using scenarios with likely maximum and minimum temperatures and differing flow rates in the Carron estuary, the small scale of the water extraction and discharge proposed is predicted to result in no significant effects on aquatic life.



Table 13.4 Summary of Significance of Effects of Proposed Grangemouth Renewable Energy Plant

Proposed activity	Characterisation of unmitigated impact on the feature	Value	Nature of effect			Mitigation and Enhancement	Residual significance
			Positive/negative	Permanent/temporary	Reversible/irreversible		
Construction and Decommissioning Impacts							
Piling	Increased noise and vibration causing disturbance and in extreme cases physical harm to fish.	Species of conservation concern	negative	temporary	reversible	Good piling practice will minimise risk	Not considered significant
General	Release of chemical such as fuels and lubricants into the Forth Estuary	Local	negative	temporary	reversible	Good environmental practice will minimise the risk	Not considered significant
General	Increased suspended solids in the Forth Estuary	Local	negative	temporary	reversible	Good environmental practice will minimise the risk	Not considered significant
Operational Impacts							
Water extraction	Sea and river lamprey impingement on filter screens	Species of conservation concern	negative	temporary	reversible	Mitigation by the use of a 3mm wedgewire screen and low intake velocities	Not considered significant
	Salmon impingement on filter screens	Species of conservation concern	negative	temporary	reversible	Mitigation by the use of a 3mm wedgewire screen and low intake velocities	Not considered significant
	Smelt impingement on filter screens	Species of conservation concern	negative	temporary	reversible	Mitigation by the use of a 3mm wedgewire screen and low intake velocities	Not considered significant
	Eel impingement on filter screens	Species of conservation concern	negative	temporary	reversible	Mitigation by the use of a 3mm wedgewire screen and low intake velocities	Not considered significant
	Estuarine fish impingement on filter screens	Species of conservation concern	negative	temporary	reversible	Mitigation by the use of a 3mm wedgewire screen and low intake velocities	Not considered significant
	Diving mammals, defected by community level changes of fish	Species of conservation concern	Not considered significant				
	Planktonic organisms becoming entrained in the cooling water system	Local	Not considered significant				
Water discharge	Creation of thermal plume	Local	negative	temporary	reversible	Rapid mixing by use of diffusers	Because of scale, not considered significant
	Release of biocides	Local	negative	temporary	reversible	Residual chlorine rapidly removed by rapid mixing via diffusers	Not considered significant
	Impacts on macro-invertebrates in inter-tidal habitats in the vicinity of the discharge	Local	negative	temporary	reversible	Rapid mixing by use of diffusers	Because of scale, not considered significant

## Abbreviations

The following is a list of abbreviations adopted in Chapter 13 Aquatic Ecology.

%	Per cent
°C	Degrees celcius
cm	Centimetre(s)
cm/s	Centimetres per second
cSAC	Candidate Special Area of Conservation
dB	Decibel(s)
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
EU	European Union
ha	Hectare
hr	Hour
HW	High water
ICES	International Council for the Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IQI	Infaunal Quality Index
m	Metre(s)
m/s	Metres per second
m <sup>3</sup> /hr	Cubic metres per hour
m <sup>3</sup> /s	Cubic metres per second
MAGIC	Multi-Agency Geographic Information for the Countryside
mg/l-1 or mg/l	Miligrams per litre
mm	Milimetre(s)
MW	Megawatt
NBN	National Biodiversity Network
NRFA	National River Flows Archive
ppt	parts per thousand
SAC	Special Area of Conservation
SEPA	Scottish Environmental Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Area
sq m	Square metres
SSSI	Sites of Special Scientific Interest
SWF	Sea Watch Foundation
TAG	Technical Advisory Group
TW2	Type 2 Transition Water
UK	United Kingdom

## Chapter 14

Hydrology, Hydrogeology, Geology and Soils

# Contents

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## 14 Hydrology, Hydrogeology, Geology and Soils

### 14.1 Introduction

- 14.1.1 This Chapter considers the assessment of the potential impacts of the proposed development on the surface water and groundwater environment in terms of both quality and quantity, and provides an assessment of flood risk and likely changes to existing flood risk patterns. In addition, it also addresses the potential impact of the development proposals on soil and geology both on the site and its immediate surroundings.
- 14.1.2 The Chapter assesses potential impacts during the construction and operation of the proposed Renewable Energy Plant and outlines mitigation measures to control the predicted effects of the proposals. The scope of the assessment was to identify:
- Constraints on the development associated with the hydrology, hydrogeology, geology and soil, so that the most sensitive areas can be avoided or protected;
  - Potential risks associated with construction, operation and decommissioning activities that can be controlled through best management practices;
  - Mitigation measures to control and reduce other potential impacts of the proposal on the water and soil environment; and
  - The significance of residual effects.

### 14.2 Key Consultations

- 14.2.1 Before undertaking the assessment, key consultees with a specific interest in the water environment were contacted. These included the Scottish Environment Protection Agency (SEPA), Scottish Water, Falkirk Council and the Port of Grangemouth. Table 14.1 presents a summary of the responses from these consultees.

Table 14.1 Summary of Consultation Responses

Consultee	Consultee Response	Forth Energy Response
Scottish Environment Protection Agency	<ul style="list-style-type: none"> <li>■ The site should be assessed for flood risk from all sources in line with Scottish Planning Policy (SPP) 7 Planning and Flooding and Draft Scottish Planning Policy (SPP). (Note: since this response was produced, the consolidated SPP was published, so it is this document that we have taken into account). The development should be free from coastal flood risk up to the estimated 1 in 200 year water level with an allowance for storm surge and wave action.</li> <li>■ The production of an environmental management plan (EMP) along with detailed method statements may be required by condition or, in certain cases, through environmental regulation. We therefore recommend the submission of an outline EMP with the ES which incorporates the principles of all proposed pollution prevention and mitigation measures.</li> <li>■ SEPA request the submission of a site drainage strategy, detailing methods for the collection and treatment of all surface water runoff from hard standing areas and roads using sustainable drainage principles, which should be shown on a site plan. Proposed temporary and long-term foul drainage facilities for workers on site must also be described in the ES.</li> <li>■ The development should avoid construction of roads and other potentially polluting activities during periods of high rainfall. The ES or supporting information must identify which periods of the year construction activities will be undertaken in line with best practice, taking into account the need to avoid pollution risks.</li> <li>■ Steps must therefore be proposed to ensure that works do not cause oil, mud, silt, aggregate material or concrete to be washed away either during construction or as a result of subsequent erosion, vehicular movement or maintenance works at the site. Details of all operations involving water usage should be specified, and we encourage the use of a closed cycle system for site water needs.</li> <li>■ Data received from SEPA includes: <ul style="list-style-type: none"> <li>■ Three licensed surface water, groundwater or spring abstractions within the area of interest.</li> <li>■ Twelve licensed discharges exist within the area of interest. Five are for the discharge of settled and screened storm sewage, Five are for the discharge of surface water and one for sediment removal.</li> </ul> </li> <li>■ Site lies within the Indicative River and Coastal Flood Map (Scotland) 200 year flood outline and as such is potentially at medium to high risk of coastal flooding. The 1 in 200 year still water level for the Forth Estuary at Grangemouth is estimated to be 4.62m AOD using the POL 112 method. Records show that the highest</li> </ul>	<ul style="list-style-type: none"> <li>■ See Appendix F Flood Risk Assessment.</li> <li>■ It was agreed with SEPA that the Environmental Management Plan would be produced as a condition of consent.</li> <li>■ It has been agreed with SEPA that the site drainage strategy would benefit from being prepared later at the detailed design stage.</li> <li>■ Undertaking such activities will be unavoidable during high rainfall. It has been agreed with SEPA that mitigation measures will be put in place to address this.</li> <li>■ Details are outlined in Section 14.6, which outlines pollution prevention mitigation measures.</li> </ul>



Consultee	Consultee Response	Forth Energy Response
	<p>recorded still water levels at Grangemouth is 4.47 m AOD in 1921 and 1959.</p> <ul style="list-style-type: none"> <li>■ The site lies within a Drinking Water Protected Area (Groundwater).</li> <li>■ The Stirling and Falkirk bedrock and localised sand and gravel aquifers have been classified at poor qualitative status and good quantitative status.</li> <li>■ Standard freeboard levels of 600 mm should be included in the development plans for this site.</li> </ul>	
Falkirk Council	<ul style="list-style-type: none"> <li>■ There are no known private water supply abstractions within 2 km of the site.</li> <li>■ There are no known landfill sites within 2 km of the site, however, the tidal and basin areas are known to be infilled or reclaimed land. There are historically filled areas which may have the potential to be landfills.</li> <li>■ The historical industrial land uses on site and adjacent to the site and the infilling and reclamation of land indicates that the site has the potential to be contaminated and further investigation will be required for planning procedures in order to change the land use.</li> </ul>	<ul style="list-style-type: none"> <li>■ The information provided has been utilised in the EIA process.</li> </ul>
Scottish Water	<ul style="list-style-type: none"> <li>■ Plans indicating the approximate position of Scottish Water's existing public infrastructure provided.</li> </ul>	<ul style="list-style-type: none"> <li>■ The information provided has been utilised in the EIA process.</li> </ul>
Port of Grangemouth	<ul style="list-style-type: none"> <li>■ Tidal records provided.</li> </ul>	<ul style="list-style-type: none"> <li>■ The information provided has been utilised in the EIA process.</li> </ul>

### 14.3 Assessment Methodology and Significance Criteria

14.3.1 This section outlines the methodology adopted to assess the environmental impacts of the proposed Renewable Energy Plant upon the local water environment.

#### Assessment Methodology

14.3.2 The assessment is primarily concerned with the site and its surroundings up to 2 km from the site (i.e. the study area). However, where a hydrological connection deems it necessary, the assessment has considered locations beyond 2 km.

14.3.3 The methodology is based upon the collection of information from a wide variety of data sources including published material and consultation with statutory bodies. Table 14.2 details the data sources referred to throughout the text.

**Table 14.2 Data Sources**

Topic	Source of data and information
<b>Climate</b> Rainfall	<ul style="list-style-type: none"> <li>Flood Estimation Handbook (Centre of Ecology and Hydrology, 1999)</li> <li>CEH Hydrometric Register</li> </ul>
<b>Topography</b> Elevation, relief	<ul style="list-style-type: none"> <li>Ordnance Survey mapping Explorer 349 Falkirk, Cumbernauld and Livingstone (1:25,000).</li> <li>Topographical Survey, Millennium Civil Engineering, February 2002</li> </ul>
<b>Geology</b> Solid and drift	<ul style="list-style-type: none"> <li>BGS Bedrock and Superficial Deposits Mapping (Scale 1:50,000), Sheet 31 E Falkirk, 1997.</li> <li>Borehole logs</li> <li>Site Investigation Report, Nicholson Ltd. in 2002</li> <li>Coal Mining Report, The Coal Authority</li> </ul>
<b>Soil</b> Soil type, ground conditions, land use and contamination	<ul style="list-style-type: none"> <li>Site Investigation Report, Nicholson Ltd. in 2002</li> </ul>
<b>Groundwater</b> Hydrogeology, aquifer properties, Source Protection Zones and groundwater levels	<ul style="list-style-type: none"> <li>Bedrock Productivity Map of Scotland, Figure 1 (1:100,000). A GIS of Aquifer Productivity in Scotland, British Geological Survey, 2004</li> <li>Superficial Deposit Productivity Map of Scotland, Figure 2 (1:100,000), A GIS of Aquifer Productivity in Scotland, British Geological Survey, 2004</li> <li>Hydrogeological Map of Scotland (1:625,000), British Geological Survey, 1988.</li> <li>Groundwater Vulnerability Map of Scotland, British Geological Survey</li> <li>SEPA - Consultation</li> <li>SEPA groundwater monitoring sites</li> </ul>
<b>Surface Water</b> Surface water features, flood risk, water quality, recreational waters and fisheries	<ul style="list-style-type: none"> <li>Falkirk Council - Consultation</li> <li>SEPA - Consultation and published sources on their website (<a href="http://www.sepa.org.uk">www.sepa.org.uk</a>)</li> <li>The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2007, Map 11. (<a href="http://www.scotland.gov.uk/Resource/Doc/1057/0055691.pdf">http://www.scotland.gov.uk/Resource/Doc/1057/0055691.pdf</a>)</li> <li>Admiralty Tide Tables, Vol 1: United Kingdom and Ireland, 2010</li> </ul>
<b>Water resources</b> private water supplies, licensed abstractions, impoundment licenses and discharge consents	<ul style="list-style-type: none"> <li>Falkirk Council – Consultation</li> <li>SEPA - Consultation and published sources on their website (<a href="http://www.sepa.org.uk">www.sepa.org.uk</a>)</li> </ul>
<b>Water Authority Assets</b>	<ul style="list-style-type: none"> <li>Scottish Water – Consultation</li> </ul>

#### Guidance and Legislation

14.3.4 The assessment has also been undertaken with reference to statutory and general guidance and a range of environmental legislation relating to the water environment including the following:

#### Statutory and General Guidance

- Scottish Planning Policy (SPP), Scottish Government, 2010;

- Pollution Prevention and Control (Scotland) Regulations 2000;
- Pollution Prevention Guidelines (PPGs);
- Planning Advice Notes (PANs), Scottish Executive;
- CIRIA publications:
  - C532 Control of water pollution from construction sites (2001);
  - C650 Environmental good practice on site (2005);
- DEFRA draft Code of Practice for the sustainable use of soils on construction sites; and
- DEFRA Good practice guide for handling soil (MAFF 2000);
- DEFRA UK (UKCP09) climate projections (2009).
- Flooding and Sustainable Urban Drainage Systems Supplementary Planning Guidance Note, Falkirk Council, 2009
- 

### Legislation

- The Water Environment (Controlled Activities) Regulations, 2005 (CAR)
- Control of Pollution Act 1974;
- Environmental Protection Act 1990;
- Environment Act 1995;
- Forth Ports Authority (Ports Premises) Byelaws 1983 made pursuant to the Forth Ports Authority Order Confirmation Act 1969;
- Groundwater Regulations 1998;
- The Flood Risk Management (Scotland) Act 2009
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act)
- Private Water Supplies (Scotland) Regulations, 2006;
- EC Freshwater Fish Directive (2006/44/EC);
- Pollution Prevention and Control (Scotland) Regulations 2000
- Waste Management Licensing Regulations 1994; and
- Environmental Liability (Scotland) Regulations 2009.

### Significance Criteria

- 14.3.5 There are no published guidelines or criteria for assessing and evaluating effects on hydrology, hydrogeology, geology or soil within the context of an EIA. The assessment will be based on a methodology derived from IEMA<sup>1</sup> guidance. The methodology is also based upon relevant SEPA guidance including Assigning Groundwater Assessment Criteria for Pollutant Inputs (SEPA 2010). The methodology sets a list of criteria for evaluating the environmental effects, as follows:
- The type of effect (i.e. whether it is positive, negative, neutral or uncertain);

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<sup>1</sup> The Institute of Environmental Management and Assessment (IEMA) is the professional membership body for promoting best practice standards in environmental management, auditing and assessment for all industry sectors.

- The probability of the effect occurring based on the scale of certain, likely, or unlikely;
- The policy importance of the resource under consideration in a geographical context (i.e. international, national, regional or local), and the sensitivity of the receptor on a scale of low to high, defined within Table 14.3. The definitions have been determined by the consultant based upon their experience of such studies; and
- The magnitude of the effect in relation to the resource that has been evaluated, quantified using the scale high, medium or low, defined within Table 14.4. The definitions in Table 14.4 have been defined by the consultant based upon their experience of such studies.

**Table 14.3 Definitions of Policy Importance and Sensitivity: Hydrology, Hydrogeology, Geology and Soil**

Importance and Sensitivity Context	Water and soil definition
International and/or High	Important on a European or global level e.g. Habitat Directive Sites. Public water supplies and major aquifer
National and/or High	Important in Scotland e.g. SSSIs. Local water supplies, including private water supplies where there is no alternative to private supplies
Regional and/or Medium	Important in the context of the region; e.g. Local Nature Reserves, catchment scale issues. Private water supplies, located within vicinity of mains water supply. Private water supplies used only for agricultural purposes and not drinking water
District and/or Medium	Important in the context of the local district e.g., minor aquifer
Local and/or Low	Important within watersheds to which the site may drain; within the site and immediate vicinity e.g., non-aquifer, minor watercourses.

Table 14.4 Impact Magnitude Criteria: hydrology, hydrogeology, geology and soil

Magnitude of effect	Runoff regime	Surface water quality	Water Supply	Riverine flow Regime	Riverine Morphology	Groundwater Levels	Groundwater Quality	Geological Changes	Soil Quality
High	Change (>50%) in proportion of site rainfall immediately running off, changing surface water flows, flood risk or erosion potential	Change in water quality, changing water quality status with respect to EQS <sup>2</sup> for more than one month	Change in the quality of the supply with respect to DWS <sup>3</sup> ; Change in the flow of supply leading to reduction in water pressure and loss of supply	Change in flows of >5% resulting in a measurable change in dilution capacity or flood risk	Changes in erosion and deposition, with conservation interests put at risk	Change in groundwater levels leading to an identifiable change in groundwater flow regime and artesian flow, affecting water supplies	Change in groundwater quality, changing site quality with respect to DWS for more than 1% of samples	Disturbance or loss of cited features of geological Sites of Special Scientific Interest (SSSI) such that the integrity of the designation is harmed	Disturbance of soil with contamination exceeding calculated Tier 2 Site Specific Target Levels (SSTLs) and thus requiring remedial action; Greater than 20 ha best and most versatile agricultural land
Medium	Change (10-50%) in proportion of site rainfall immediately running off, changing flood risk or erosion potential	Change in water quality, changing site status with respect to EQS for less than one month	Measurable change in the quality of the supply for less than 1% of samples with respect to DWS; Temporary discolouration and elevated sediment content.	Change in flows between 2-5% resulting in a measurable change in dilution capacity and flood risk	Some change in deposition and erosion regimes	Change in groundwater levels leading to an identifiable change in groundwater flow regime. Measurable change in flow to water supplies and base flows	Change in groundwater quality, changing site quality with respect to DWS for less than 1% of samples	Some disturbance or loss to cited geological features of SSSIs but no harm to the integrity of the designation	Disturbance of soil with contamination exceeding Tier 1 generic screening levels but not exceeding Tier 2 SSTLs; Between 5 and 20 ha best and most versatile land
Low	Change (<10%) in proportion of site rainfall immediately running off, but no change to flood risk or erosion potential	Measurable change in water quality but no change with respect to EQS	Measurable change in water quality, but no change with respect to DWS. No change in pressure or flow	Measurable change in river flows of <2%, but no change in flood risk	Slight change in bed morphology and sedimentation pattern. Minor rates of erosion	Measurable change in groundwater levels, though no appreciable change in groundwater flow regime	Measurable change in groundwater quality, but not changing status with regards to DWS	No disturbance or loss to SSSIs	Disturbance of soil with measurable contamination but not exceeding Tier 1 generic screening guideline values; less than 5ha of best and most versatile agricultural land

<sup>2</sup> EQS – Environmental Quality Standard, as laid down in relevant EU Directives and national legislation

<sup>3</sup> DWS – Drinking Water Standards

- 14.3.6 Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. Effects are considered to be of major or minor significance, or not significant. As a guide, a significance table has been developed based on previous project experience and IEMA guidance whereby the combination of sensitivity and magnitude give the significance of the effect (Table 14.5). In some circumstances it is not possible to apply a simple sensitivity and magnitude level to an effect as there may be many variables that influence its significance. In such cases a full description of the reasoning behind the evaluation is given. In terms of the EIA regulations we have determined an effect to be significant if it is Minor or Major. The distinction between Minor and Major allows for a level of quantification of the effect to be made within the assessment. As highlighted above there is a certain element of interpretation required to determine whether an effect is considered to be significant and a number of variables come into play rather than those highlighted in Table 14.3 and Table 14.4.

Table 14.5 Evaluation of Effect Significance

Sensitivity of Impact	Magnitude of effect		
	Low	Medium	High
International/ High	Minor / Major	Major	Major
National/ High	Minor / Major	Major	Major
Regional/ Medium	Minor	Minor / Major	Major
District/ Medium	Not significant / Minor	Minor / Major	Minor / Major
Local/ Low	Not significant	Minor	Minor / Major

#### 14.4 Baseline Description

- 14.4.1 This section describes the existing baseline conditions at the proposed site and its immediate surroundings.

##### Site Visit

- 14.4.2 A detailed site visit was undertaken on the 21<sup>st</sup> January 2010. Key issues and features were identified, including surface water features, dominant soil types, geology and other land use characteristics likely to influence hydrological processes. Weather during the site walkover was overcast and dry.

##### Topography, Land Use and Climate

- 14.4.3 The on-shore element of the application site occupies an area of approximately 10.3 ha within the industrial area of the Port of Grangemouth adjacent to the Western Channel. Site survey investigations and Ordnance Survey spot height data show the site is a low lying and relatively level area of land with current elevations across the site between 3.93 m and 8.48 m Above Ordnance Datum (AOD) being higher towards the south western border of the site.
- 14.4.4 The site is bound by the Central Dock Road, the Western Channel and the Carron Dock to the north. A corrugated metal storage shed to the east, a railway embankment, siding and scrubland to the south and an area of stockpiles of demolition and road building material.
- 14.4.5 The site currently houses a depot, the former Customs and Excise Office, fenced off areas containing previous building footprints and an area of scrubland in the eastern section.
- 14.4.6 Average annual catchment rainfall for the area is approximately 805 mm based on data obtained from the FEH<sup>4</sup>, indicating a moderately wet climate.

<sup>4</sup> FEH (Flood Estimation Handbook) CD-ROM produce by the CEH (Centre for Ecology and Hydrology, 1999)

### Surface Water Hydrology

- 14.4.7 The nearest surface water features to the site are the Carron Dock and the Western Channel, which abut the northern boundary of the main plant area (Figure 14.1). The closest significant watercourses to the site other than the Forth Estuary are the River Carron to the north of the main plant area and Grange Burn to the south. The River Carron flows in a west to north east direction approximately 100 m to 150 m to the north of the main plant area. The upstream catchment of Grange Burn includes Westquarter Burn to the south west of the site, with flows passing from west to east in Grange Burn through a maintained channel within the Port of Grangemouth.
- 14.4.8 The closest shoreline of the Forth Estuary is some 100 m to the north of the site (i.e. the southern bank of the River Carron at this location). The River Carron and the docks join the estuary some 2 to 2.4 km to the north east of the proposed development site. The water levels within the Carron Dock and the Western Channel are controlled by the lock gates to the east of the site, further toward the Forth Estuary, however it is noted that when tide conditions exceed the dock level, hydraulic forces can open the gates. As the tide drops, hydraulic forces the gates closed again.
- 14.4.9 The majority of surface water runoff from within the site currently passes to ground through infiltration with runoff during extreme events having the potential to follow topographic gradients towards the Carron Dock and Western Channel along the northern boundary of the main plant area. Detailed drainage plans from Forth Ports indicate that current hardstanding surfaces on the site discharge directly to the adjacent dock or to a reticulated drainage system that ultimately outfalls to the dock. Some areas of reticulation are noted to the south and south east of the site, beyond the railway line, with outfalls discharging to Grange Burn.
- 14.4.10 Observations on site noted that surface water is currently managed through a subsurface drainage network, with excess water flowing overland to adjacent drains, the Carron Dock, Western Channel, and ultimately into the Forth Estuary.
- 14.4.11 SEPA currently maintain a gauging station on the River Carron at Headswood (NS 83180 81818).

### Flood Risk

- 14.4.12 As part of the EIA process a separate Flood Risk Assessment (FRA) has been prepared to meet the requirements set out in Scottish Planning Policy (SPP) and is included within Appendix F. Floodplain and flood level details provided by the SEPA show the site to be within the 0.5% probability (1 in 200 chance) flood outline of the Forth Estuary, indicating a medium to high risk of coastal flooding.
- 14.4.13 The main risk to the proposed development is considered to be from tidal inundation, originating from the Forth Estuary. The possibility of flooding from other sources represents a lesser risk to the site. Environmental data provided by SEPA indicates that during an extreme event water levels across the site could rise to 4.62 m AOD, which would inundate a proportion of the site based on current ground levels.
- 14.4.14 Flood defences are understood to have been installed to the east of the application site mainly for the protection of the LPG terminal. Anecdotal evidence has indicated that the South Shore Road, near the LPG terminal has been shut due to floods in the past (estimated to be once every 20 years). Bunds are evident along the North Shore Road, providing protection from high water levels from the River Carron.

### Soil

- 14.4.15 The Map of Scotland (1:625,000) indicates that the area of the site is underlain by soils of a low and intermediate leaching. However, historical site investigations and the BGS solid and drift geological map indicate that the near surface of the site is primarily underlain by Made Ground deposits.

### Geology and Ground Conditions

- 14.4.16 A review of the BGS solid and drift geological map for the area (Sheet 31E, Falkirk) shows the site to be underlain by Made Ground Deposits, from the reclamation from the Forth Estuary tidal flats, underlain by



marine drift deposits and the Carboniferous Passage Formation and Coal Measures solid strata comprising sandstones, mudstones, siltstone, seat earth and coal.

#### **Made Ground**

- 14.4.17 As noted above, the application site is shown on the solid and drift geology map as being underlain by Made Ground as part of the reclamation from the Forth Estuary intertidal flats. The former coastline is shown to have existed along the northern boundary of the site.
- 14.4.18 During historical intrusive investigations at the site, Made Ground deposits were encountered and were found to be approximately 3 m in thickness overlying sandy silt drift deposits in excess of 8 metres in thickness. The encountered Made Ground generally comprised dark grey silty and sand gravel including clay traces, stones, ash, cinder, slag, blaes and clinker.

#### **Drift Geology**

- 14.4.19 The drift geology map indicates the site to be underlain by Marine Deposits comprising mainly silt and clay of former intertidal flats (Carse Clay). The site falls within an area marked as a margin of buried drift-filled channel.

#### **Solid Deposits**

- 14.4.20 The solid geology beneath the site is shown to belong to the Carboniferous Passage Formation (PGP<sup>5</sup>) consisting mainly of sandstones with fireclays and thin siltstones, mudstones, ironstones, sparse thin coals with seat rock and a few thin marine mudstones or limestones. To the north of the site is the Lower Coal Measures comprising cyclic sequences of sandstones, siltstones, mudstones, ironstones, coals and seat rock. Based on previous intrusive site investigations undertaken in the vicinity of the site, rock head has the potential to be approximately 50 metres below ground level.
- 14.4.21 The Mungall Fault runs along the northern boundary of the site from west southwest to east northeast with downthrow to the north. Two bifurcating / branching faults come off this to the north of the site running west northwest to south southeast. Approximately 1.2 km south of the site is the Saltcoats fault running east to west with downthrow to the north.

#### **Mineral Extraction and Related Risks**

- 14.4.22 The Shotts Gas Coal (Lower Coxrod) (SGA) and Upper Drumgray Coal (Carron Main) UDC coal seams are shown approximately 200 m and 700 m to the north west of the application site respectively within the Lower Coal Measures. The Ordnance Survey map shows a disused shaft marked approximately 1.5 km north west of the site. The Coal Authority Gazetteer online has been consulted<sup>6</sup>, the gazetteer gives an indication of places in Great Britain that may, or may not, require a coal mining search to be performed.
- 14.4.23 Grangemouth is within a Coal Authority area where a mining search is required. A Coal Mining Report was acquired on 28 June 2010 to confirm the ground conditions with regards to potential coal workings beneath the site. The report confirms there are no known records to indicate that the Coal Measures beneath the site have been worked in the past, present or licensed to be worked in the future. There are no mine entries on site or directly adjacent to the site. There are no records of mine gas emissions requiring action by the Coal Authority. Therefore, the risk of Coal Workings beneath the site having an effect on the proposed development is considered to be low.

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<sup>5</sup> PGP – Carboniferous Passage Formation.

<sup>6</sup> <http://www.coal.gov.uk/services/propertysearch/gazetteer/index.cfm> Accessed April 2010.

**Groundwater**

- 14.4.24 As noted above, the site is located on the Quaternary coastal and river alluvium deposits and the Carboniferous Passage. These deposits beneath the site are considered to be a concealed aquifer or an aquifer of limited local potential which may demonstrate regions without significant groundwater.
- 14.4.25 There is also the potential for perched groundwater or seepage within the Made Ground. Water levels within these materials would be expected to be relatively shallow, i.e. less than 7 m below ground level (bgl). Based on the anticipated ground conditions it is expected that shallow groundwater may be perched on the Carse Clay strata.
- 14.4.26 Limited groundwater information was available from the previous investigations, which identified groundwater strikes to be at a depth of between approximately 3.0 m and 9.0 m bgl, within the coastal and river alluvium deposits. Many boreholes found the shallow silt deposits to be dry.
- 14.4.27 Any groundwater is likely to be in continuity with the adjacent Forth Estuary.
- 14.4.28 Groundwater flow is likely to be driven by the prevailing topographic gradient and is likely to be eastwards toward the Forth Estuary. The flow direction of any perched water is likely to be similar.

**Soil Quality**

- 14.4.29 Soils beneath the site comprise primarily of Made Ground and drift deposits and potentially contaminative historical land uses have been identified on the site. The presence or absence of any significant contamination at the site, and hence the quality of underlying soils will be confirmed by a suitably targeted ground investigation which will be undertaken at the detail design stage.

**Water Quality – Surface Water**

- 14.4.30 To the north of site is the Western Channel of the Grangemouth Docks which connects to the Forth Estuary approximately 2.3 km to the northeast of the site. The River Carron is located approximately 100 m north of the site and flows east into the Forth Estuary. The Grange Burn is located 200 m south of the site and also flows east into the Forth Estuary.
- 14.4.31 There are two SEPA water quality sampling points within the vicinity of the proposed site (see Figure 14.1). One is on Westquarter Burn, a tributary of Grange Burn, National Grid reference (NGR) NS 90707, 78699 and one is in the middle of the Forth Estuary at NGR NS 97774, 83811.
- 14.4.32 In 2008 SEPA classified the Forth Estuary as moderate for ecological status and as a pass for chemical status for transitional waters. The river ecosystem objectives for the Forth Estuary are to achieve and maintain good or better status by 2027.
- 14.4.33 In 2008 SEPA classified the Grange Burn as poor for ecological status and as a pass for chemical status for river water. The river ecosystem objectives for the Grange Burn are to achieve and maintain good or better status by 2027.
- 14.4.34 The site is not located within a Scotland Drinking Water Protected Area for surface water according to the Scottish Government Website Maps (Map 11). Consultation with SEPA identified one surface water abstraction in the area for commercial and other use.

**Water Quality – Groundwater**

- 14.4.35 Correspondence from SEPA confirms that the Grangemouth bedrock and localised sand and gravel aquifers have been classified as being at poor qualitative (water quality) status and good quantitative (water quantity) status.
- 14.4.36 The site is located within a Scottish Drinking Water Protected Area (Map 22) for groundwater.

**Water Authority Assets**

- 14.4.37 Records provided by Scottish Water indicate the presence of combined sewer reticulation within Central Dock Road, to the north and west of the main plant area. Waste water pipes transect this area, one originating from an unknown tank.

**Private Water Supplies**

- 14.4.38 Consultation with Falkirk Council found that there were no private water supplies within 2 km of the site.

**Licensed Abstractions**

- 14.4.39 In Scotland water abstractions between 10 and 50 m<sup>3</sup>/day must be registered with SEPA. Abstractions that have the potential to cause a significant impact or larger abstractions require an abstraction licence. Consultation with SEPA has revealed that there are two licensed groundwater abstractions and one licensed surface water abstraction within 2 km of the site:

- NGR: NS 94212 83112 – Commercial, industrial and other. Surface water abstraction.
- NGR: NS 93994 79974 – Industrial or commercial: evaporative cooling. Groundwater abstraction.
- NGR: NS 93823 82444 – Industrial or commercial; process water. Groundwater abstraction.

**Licensed Discharge Consents**

- 14.4.40 Information obtained from SEPA indicated that there are 12 known discharge consents within 2 km of the application boundary. These are detailed below and are shown in Figure 14.1.
- NGR: NS 294281 682756, NS 94528 82486 and NS 94050 82206 – Sewage (private) secondary.
  - NGR: NS 94277 83249 and NS 94871 83958 – Sewage (private) primary.
  - NGR: NS 94213 83113, NS 94305 83394, NS 95304 82201, NS 95309 82201, NS 94265 83203 and NS 94279 83276 – Other effluent.
  - NGR: NS 9354 80018 – Sediment Removal.

**Historical Land Use**

- 14.4.41 A review of Ordnance Survey mapping of the site and the adjacent area was undertaken. The site had been undeveloped until around the late 1800s when the docks and associated infrastructure were developed. The site remained railway sidings, timber and engineering works until the 1970s when it became largely scrub and open space.
- 14.4.42 The surrounding land use also became developed in response to the growing importance of the docks. Much of the area around the site became railway sidings, goods sheds or timber works during the early 20<sup>th</sup> century and the docks were expanded with land reclaimed from tidal areas. From the 1950s onwards more greenfield land was developed for the petrochemical industry.
- 14.4.43 The historical land uses on the site have included dockland, railway sidings, timber works and engineering works. Other historical land uses in the vicinity of the site include docklands, electricity substations, mining, sawmills and timber works, railway sidings, several oil refineries and pipelines, gas works, goods sheds, warehouses, depots and haulage works.
- 14.4.44 Falkirk Council noted that the historical industrial land uses on site and adjacent to the site, and the infilling and reclamation of land indicates that the site has the potential to be contaminated and further investigation will be required for planning procedures in order to change the land use. For any proposed development, redevelopment or change of use for the site, a land contamination risk assessment should be undertaken in accordance with current guidance and regulations. This will be undertaken once Section 36 Consent has been received for the development as part meeting the conditions of the consent.

### Baseline Sensitivity

- 14.4.45 Some areas of the site are currently managed through a subsurface drainage network, with surface runoff assumed to discharge to the Carron Dock and the Western Channel or to Grange Burn and ultimately into the Forth Estuary.
- 14.4.46 The site is underlain by Made Ground and drift deposits which overly the Carboniferous Passage Formation. These are considered to be concealed aquifers or aquifers of limited local potential. The silts and clays within the drift deposits are generally of low permeability and are considered to provide some protection to the potential deeper groundwater in the Carboniferous Passage Formation. Shallow groundwater does exist within the alluvial and marine deposits and it is expected to be in connection with surrounding surface water. Protecting the shallow groundwater water table will therefore be important during construction.
- 14.4.47 There are three known SEPA licensed water abstractions within 2 km of the site. Two are groundwater abstraction licences, the nearest being approximately 400 m east of the site. The remote proximity of the abstraction point in relation to the site and the controlling influence of the Forth Estuary on groundwater hydrology limit the potential for impact on groundwater supplies to this supply. No private water supplies exist inside or within 2 km of the application boundary.
- 14.4.48 Twelve discharge consents were identified within 2 km of the site, for the discharge of primary and secondary sewage, effluent and sediment. Each of the discharges is regulated by licence agreements and the Forth Estuary is currently classified at Moderate status for Transitional Waters.
- 14.4.49 Potentially contaminative land uses have been identified on the site including Made Ground deposits and infilled land. Potential receptors at risk from contamination include the concealed aquifers or aquifers of limited local potential underlying the site, buildings and services, surface water, including the Forth Estuary, construction workers and operational staff.

## 14.5 Potential Impacts

### Introduction

- 14.5.1 This section provides a summary of the potential risks of the proposed development, based on an assessment of activities that will occur during the construction, operation and decommissioning of the proposed Renewable Energy Plant, prior to the inclusion of mitigation measures (Table 14.6 and Table 14.7).
- 14.5.2 An assessment of these risks determines the need for mitigation measures, which are discussed in detail within Section 14.6. This section does not necessarily reflect the real effects or risks of the development. The actual effects (residual effects) of the development are outlined in Section 14.7.

**Table 14.6 Potential Impacts (pre-mitigation) during the Construction and Decommissioning Phase**

Activity	Potential impact	Sensitivity of impact	Magnitude of potential	Significance of potential impact	Need for Mitigation	Comment
Site clearance and enabling works	- Mobilisation of contaminants or sediment laden runoff which could enter the Forth Estuary or other waterways	District/ Medium	Low	Minor	✓	A mitigation strategy will be introduced which will control the generation of sediment laden runoff and prevent it from entering the Forth Estuary.

Activity	Potential impact	Sensitivity of impact	Magnitude of potential	Significance of potential impact	Need for Mitigation	Comment
Dewatering of excavations	- Discharge of potentially contaminated groundwater or sediment laden runoff to the Forth Estuary or other waterways following dewatering or excavation	District/ Medium	Low	Minor	✓	Mitigation measures will include catch pits and appropriate bunding around excavations. Measures will be formalised within an EMP and will be based on SEPA PPG guidelines.
	- Disruption to groundwater due to dewatering of excavations	Local	Low	Not significant	✓	Mitigation required reducing impacts to groundwater if encountered during excavations
Construction of buildings, foundations, hardstandings and roads within the site	- Spillages of concrete during foundation and hardstanding formation could enter the Forth Estuary or other waterways	Local	Low	Minor	✓	Mitigation is required to control concrete pouring activities. No activity will take place less than 5m from adjacent watercourses
	- Changes in surface water runoff patterns which could result in a flooding risk	Local/ Low	Medium	Minor	✓	Surface water drainage design will manage runoff through reticulated discharge to the docks
	- Risk of flooding during extreme tidal events	Local	Medium	Minor	✓	Existing ground levels indicate some areas of the site to be at risk of inundation during extreme events
	- Generation of turbid runoff which could enter the Forth Estuary or other waterways	Local	Medium	Minor	✓	There will need to be controls on construction activities to ensure any earth works and hardcore placement does not generate turbid water and affect water quality status
	- Creating of preferential pathways for migration of contaminated materials into the underlying concealed / localised aquifers during piling	Medium	District	Major	✓	The protection of the aquifers is essential. Good practice guidance will be adhered to, such as that produced by the Environment Agency in England (which is relevant also for Scotland). Piling methods will be agreed with SEPA.
Traffic movement: Creation of contaminated fugitive dust	- Exposure of construction workers to contaminated dust.	Low	Local	Not significant / minor	✓	Mitigation requires damping down of roadways to be undertaken
Damping down of dust	- Generation of slurry impacting clean soil and the Forth Estuary	Local	Local	Not significant	✓	Mitigation required to ensure excess water is not used in damping down operations. A mitigation strategy will be introduced which will control the generation of sediment laden runoff and prevent it from entering the Forth Estuary
Site activities such as the	- Spillages and leakages of oil, fuel,	Local	Medium	Minor	✓	Good site management practices will be adopted to

Activity	Potential impact	Sensitivity of impact	Magnitude of potential	Significance of potential impact	Need for Mitigation	Comment
storage of fuel and oil	and other potentially polluting substances e.g. oil spills, could enter the Forth Estuary or impact groundwater					reduce the potential for any spillages or leakages of potentially polluting substances. No activity will take place less than 5m from adjacent watercourses
✓ - mitigation required X – no mitigation required						

Table 14.7 Potential Impacts (pre-mitigation) during the Operational Phase

Activity	Potential impact	Sensitivity of impact	Magnitude of potential	Significance of potential impact	Need for Mitigation	Comment
Presence of buildings, hardstanding and roads within the site	- Changes in surface water runoff patterns which could change flooding risk	Local	Medium	Minor	✓	Mitigation will be in the form a surface water drainage system to control site runoff
	- Risk of flooding during extreme tidal events	Local	Medium	Minor	✓	Existing ground levels indicate some areas of the site to be at risk of inundation during extreme events
	-Reduction in infiltration rates affecting groundwater recharge	Local/ Low	Low	Not significant	X	The site is currently partially developed with only limited drainage to infiltration
	- Uncontrolled discharges could result in the input of sediments, litter and oils	Local/ Low	Medium	Minor	✓	Controls will be required to ensure that these discharges are of suitable quality
Abstraction of cooling water from the docks	- Reduced flows within docks	Low	Low	Not significant	X	The proposed water supply will be provided to the Renewable Energy Plant under a new abstraction licence.
Discharge of process water	- Pollution of docks	Low	Medium	Minor	X	The total quantity of process effluents discharged and its quality will be controlled as part of the projects Pollution Prevention and Control Permit
Site activities	- Spillages and leakages of oil, fuel, and other potentially polluting substances e.g. concrete, could enter the Forth Estuary or impact groundwater	District/ Medium	Medium	Minor	✓	Good site management practices would be adopted to reduce the potential for any spillages or leakages of potentially polluting substances.
✓ - mitigation required X – no mitigation required						



## 14.6 Mitigation Measures

- 14.6.1 This section outlines the proposed mitigation measures designed to address the potential impacts described in Section 14.5. The mitigation measures described below are divided into those relating to construction, operation and decommissioning activities.

### Construction

#### Earth Works

- 14.6.2 During the site clearance and enabling works there will need to be earthworks and soil excavation. To limit potential impacts associated with sediment levels increasing within surface water runoff, contractors will be required to prepare and adhere to a Sediment Control Plan throughout the construction process. This will outline the routine working and emergency procedures for the control and mitigation of erosion and dust generation during excavations and soil handling, such as stockpiling soil away from watercourses and undertaking earthworks during dry weather conditions where possible. The Sediment Control Plan will form part of a site wide Environmental Management Plan, which will be audited on a regular basis by Forth Energy.
- 14.6.3 Where any soils are to be excavated they will be done so in accordance with guidance in the Scottish Soils Framework<sup>7</sup>. DEFRA guidelines for handling soil<sup>8</sup> and the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites<sup>9</sup>, whilst both for use in England, provide useful best practice for the protection of soils. Mitigation measures to be adopted based on this best practice will include:
- Use of backacters and dump trucks for soil excavations and movements;
  - Soil excavations to be carried out during dry weather, where possible;
  - Re-use of soil for restoring excavations where possible;
  - Topsoil and subsoil to be excavated and stored separately, if applicable; and
  - Minimal soil resources to be excavated and transported off-site.
- 14.6.4 Since the proposed hardstanding development footprint is within an area where soils have already been removed or disturbed, the damage to soil resources beneath the Renewable Energy Plant will be minimal. Risk assessments and a remediation strategy will outline the treatment and re-use of materials, and detailed method statements will be required from the Contractor on how materials are to be dealt with. The site will require a Site Waste Management Plan (SWMP) detailing how all materials generated at the site both in ground and for the development, will be dealt with.
- 14.6.5 Any soils imported to site to raise site levels will be chemically tested to ensure that they comply with the requirements in the remediation strategy, which will include Tier 2 Specific Target Level. This will be undertaken in agreement with SEPA and local authority.

### Foundation Formation

- 14.6.6 The Renewable Energy Plant will require piled foundations. Ground investigations have yet to be undertaken, however, it is anticipated that the piled foundations may need to extend down to Carse Clay for the larger structures. It is not known whether they would extend through this to the Carboniferous Passage Formation at this stage.

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<sup>7</sup> The Scottish Soils Framework (The Scottish Government 2009).

<sup>8</sup> DEFRA Good practice guide for handling soils (MAFF 2000).

<sup>9</sup> Construction Code of Practice for the sustainable use of soils on construction sites (DEFRA 2009).



- 14.6.7 However, piling works will be undertaken with reference appropriate guidance on the protection of groundwater during piling works (Environment Agency guidance, in the absence of any specific to Scotland). The piling method is not known at this time.
- 14.6.8 Building foundations, plinths and hardstandings will be formed through the pouring of concrete. Concrete is highly alkaline and corrosive and can have a detrimental impact on watercourses. Without controls on this process, concrete spillages could potentially result in pollutants coming into contact with surface water features. Concrete will be batched on site within the designated construction laydown area. The appropriate classification of concrete for the environmental conditions will be used in order to avoid the potential for leaching. Ahead of the foundation formation an appraisal of risks to the Forth Estuary will be made.
- 14.6.9 A Foundation Works Risk Assessment will be undertaken prior to construction in accordance with the foregoing relevant guidance, issued by the Environment Agency and relevant in Scotland. This will assess the piling method being undertaken; the likelihood of piling through contaminated ground; and the overall risk to groundwater quality in the aquifer.

#### **Dewatering of excavations**

- 14.6.10 It is likely that groundwater will be encountered whilst creating the piled foundations for the Renewable Energy Plant. If and when groundwater is encountered, water will be pumped out and passed to a settling lagoon or tank to allow suspended sediment to settle out. Treated water will be discharged to the docks through an agreed discharge consent with Forth Ports.
- 14.6.11 Legislation and good practice guidance notes provide clear direction on the measures to be adopted when working in and near to watercourses. Method Statements will also be prepared in response to license requirements, for example, with respect to discharge to the docks.

#### **Flood Protection**

- 14.6.12 Mitigation recommendations for the site include consideration of safeguarding of sensitive equipment and providing adequate drainage infrastructure. The site datum for safety of personnel and positioning of sensitive equipment will be at a minimum level of 5.50 m AOD. The 5.50 m AOD level is defined by the 1 in 50 chance exceedence storm surge scenario combined with the highest astronomical tide, plus a 600 mm freeboard allowance. Flood levels are discussed in greater detail within the Flood Risk Assessment (Appendix F). Levels over the remaining site, including the biomass storage area will remain unchanged.

#### **Site activities**

- 14.6.13 Site activities may result in spills and leaks of materials used in the construction process, including fuel, oil and lubricants. A site Environmental Management Plan (EMP) will be developed in consultation with SEPA and the site contractor. This will include measures for avoiding the likelihood of spills and leaks and an auditing programme which will verify environmental performance on the site during construction.
- 14.6.14 Good working practices will be adopted throughout the construction works to protect the water environment. The storage of oil, fuel and other substances will be within the designated construction area. SEPA's General Binding Rules dictate that oil and fuel will be stored within impervious storage bunds (or double skinned tanks) with 110% capacity of the largest tank or 25% of the total storage capacity, whichever is the greater, so that any spillages or leaks are contained. All tanks, whilst designed to provide more storage volume than needed, will be fitted with alarms to warn site workers if the volume exceeds a specified level.
- 14.6.15 Construction machinery will be checked regularly to prevent oil leakages. Any maintenance required would occur over hardstanding or on a suitable impermeable ground cover. Refuelling will be limited to a designated area, on an impermeable surface, away from any drainage infrastructure. Spill kits will be available on site at all times. Any spills will be cleaned up as soon as possible, according to the spill response plan in the EMP.

- 14.6.16 A temporary wheel washing facility will be installed to prevent transfer of soil onto public roads. All water within the wheel wash facility will be recycled, and no water will be discharged off site.
- 14.6.17 The storage of oils and other potentially polluting substances will be stored within the designated construction area at the recommended levels in the Flood Risk Assessment (Appendix F) to prevent water ingress in the event of an extreme flood of the site.

### **Operational**

- 14.6.18 This section describes the mitigation measures that will be incorporated into the development during the operational phase to reduce effects on the water environment and soil. The Renewable Energy Plant has the potential to affect the water environment throughout its operation. Therefore, a long term strategy for sustainable mitigation has been developed.

### **Surface Water Drainage**

- 14.6.19 To minimise the impact of drainage, surface water runoff from the site will be managed by a new site drainage system. The capacity of the drainage system will be designed at the detailed design phase of the development. The design will make allowance for extra drainage capacity associated with an additional 20% on top of peak rainfall intensity to simulate the effect of climate change in accordance with the SSP.
- 14.6.20 Surface water runoff from the proposed Renewable Energy Plant will be managed through a new surface water drainage system. Drainage from areas with a potential for contamination will pass through an oil interceptor via cut off drains prior to discharge. Treated water will be discharged to Grangemouth dock via a new dedicated surface water outfall for the site. A Method Statement will be prepared in response to license requirements with respect to the discharge to the Grangemouth dock.
- 14.6.21 Sediment traps will be in placed on the drainage system and oil separators and traps will be periodically inspected, maintained and cleaned in accordance with the manufacturer's specification and design criteria to ensure their efficient functioning. Resultant waste sludge will be disposed of in accordance with the Environmental Protection Act 1990, Duty of Care directed by SEPA.

### **Flood Protection**

- 14.6.22 Full assessment must be undertaken of the safety of personnel within the Renewable Energy Plant, including consideration of methods of safe access and egress to the development. Personnel working at the plant must be provided with an area of safe refuge in the event that access to and from the site becomes compromised during a flood event. Safe refuge within the application boundary will be provided in the form of areas within office buildings where the floor level will be at 5.50 m AOD or greater. Flood levels are discussed in greater detail within the Flood Risk Assessment (Appendix F). Levels over the remaining site, including the biomass storage area will remain unchanged.

### **Cooling Water Abstraction**

- 14.6.23 Cooling water will be abstracted from the impounded dock (i.e. the Western Channel) and will then be discharged on a falling tide to the River Carron up to a maximum of 12 °C warmer. The cooling water system will require a water supply in the order of 1,400 m<sup>3</sup>/hr. This would result in a discharge of approximately 1,120 m<sup>3</sup>/hr of water, however in order to ensure adequate mixing this will only be discharged on a falling tide, i.e. for four hours after each high tide, resulting in a flow rate of 3,360 m<sup>3</sup>/hour at such times.
- 14.6.24 The abstraction would be subject to a Controlled Authorised Regulation (CAR) licence and the discharge would be regulated as part of the project's PPC permit.

### **Process and Domestic Effluent**

- 14.6.25 Day to day wastewater discharges from the proposed plant will comprise cooling water, water treatment plant effluent, boiler blow down, flue gas condensate, general wash water, sewage and other minor discharges. In

the event of a fire, fire-fighting water would also be discharged. It is proposed that this process water, with the exception of flue gas condensate and sewage, be discharged to the Forth Estuary via the River Carron. The cooling water flow will act to dilute the other process effluents. The flue gas condensate will be treated on site (neutralisation and solid removal) prior to discharge to sewer.

- 14.6.26 The warmed cooling water will be discharged with the other process effluents via a diffuser array to the River Carron. Water will only be discharged on a falling tide in order to ensure rapid dispersion of the cooling water. Water will be returned to the estuary up to approximately 12°C warmer than ambient. The outfall will be within one of the cooling water search areas in the Forth Estuary, as shown on Figure 1.2 Site Boundary. The discharge will comply with the limits agreed with SEPA as part of the project's PPC Permit. Method Statements will be prepared in response to licence requirements with respect to discharges to the dock.
- 14.6.27 The cooling water make-up will be treated with a biocide to control fouling and the growth of micro-organisms. The dosing regime will be optimised to minimise use of the biocide.
- 14.6.28 The total process effluent discharge from the site equates to an average of approximately 8,570,000 m<sup>3</sup>/year.
- 14.6.29 Domestic sewage will be discharged to the local sewerage system or via a package treatment plant (e.g. a biocube) prior to discharge to the dock at the cooling water discharge outfall.
- 14.6.30 Details of the water discharges from the process are assessed in more detail within the Aquatic Ecology assessment which can be found in Chapter 13.

#### **Site Activities**

- 14.6.31 A site EMP will be developed, in consultation with the SEPA and the site contractor, to include measures for avoiding the likelihood of spills and leaks and an auditing programme which will verify environmental performance on the site during operational practice.
- 14.6.32 All areas where potentially polluting substances will be stored and used, will have appropriate bunding to industry standards to capture any spills and leaks. Bunds (or double skinned tanks) will provide 110% of stored volume of the largest tank or 25% of the total storage capacity, whichever is the greater and will be made from impervious materials. All bunds and tanks will also be fitted with alarms to warn operational staff when tank levels reach a pre-determined level. In the rare event of an oil spill into a bund the oil will be pumped out to a road tanker for re-use or disposed of in an environmentally acceptable manner.
- 14.6.33 All areas where potentially polluting substances will be stored and used will have appropriate bunding to industry standards to capture any spills and leaks. Bunds (or double skinned tanks) will provide 110% of stored volume of the largest tank or 25% of the total storage capacity, whichever is the greater and will be made from impervious materials. All bunds and tanks will also be fitted with alarms to warn operational staff when tank levels reach a pre-determined level. In the rare event of an oil spill into a bund the oil will be pumped out to a road tanker for re-use or disposed of in an environmentally acceptable manner.
- 14.6.34 Biomass fuel will be delivered to the plant via ship and transferred to the Renewable Energy Plant. The plant will, however, also be capable of accepting fuel by road should this be required.
- 14.6.35 The site will be operated in accordance with good working practices and measures to protect the water environment will be in accordance with those set out within relevant guidance notes (Section 14.3). These measures will be incorporated into the EMP for the site.

#### **Decommissioning**

##### **Earth Works**

- 14.6.36 During decommissioning it is anticipated that risks associated with earthworks will generally be similar to those defined during construction, although the details will depend on the proposed future use of the site.

Mitigation measures associated with earthworks will therefore reflect the measures indicated in paragraphs 14.6.2 to 14.6.5 for construction.

### **Site Activities**

- 14.6.37 As with construction operations, site activities may result in a risk of spills and leaks of polluting substances used during decommissioning, including fuels and lubricants. A site EMP will be developed in consultation with the SEPA and the site contractor. This will include measures for avoiding the likelihood of spills and leaks and an auditing programme which will verify environmental performance on the site during decommissioning. Mitigation measures during the decommissioning phase will be the same as those encountered during construction, as described above.

## **14.7 Residual Effects**

- 14.7.1 This assessment describes the likely residual effects following the incorporation of the mitigation measures described above. Therefore, it describes the real predicted effects that could occur as a result of the development.

### **Construction**

#### **Effects on Surface Water**

- 14.7.2 Adherence to the recommended mitigation measures will ensure that the likely potential impacts will be controlled. Impacts such as the generation of sediment from the construction works will be controlled through the use of good practice. Good practice legislation and guidance notes provide clear guidance on the measures to be adopted when working in and near to watercourses. Method Statements will also be prepared in response to license requirements. It is predicted that should any sediment input to surrounding watercourses occur it would be small in volume and would occur over a short period only. Any unlikely sediment input into the Forth Estuary would not significantly impact the water quality of the estuary.
- 14.7.3 Whilst good practice measures will be in place, there is inevitably the potential for accidental incidents to occur. Response to such events will be managed through the Environmental Management Plan, such that all spills will be contained. Occurrences of this nature are expected to be low in magnitude and intermittent or infrequent in nature. Overall the residual effect is considered to be not significant.

#### **Effects on Groundwater**

- 14.7.4 There is still the need to undertake intrusive investigations to fully describe the quality of the underlying soils across the site. The limited site investigation results to date indicate that there is limited soil or groundwater contamination at the site. It is expected that a suitable method of piling can be developed to ensure that contamination of the underlying aquifer does not occur. With these plans in place it is not expected that the underlying aquifer would be at significant risk from the proposals.
- 14.7.5 Any groundwater encountered during the excavation of foundations which could be contaminated will be treated and discharged under a CAR licence obtained from SEPA. Therefore, no residual effect is predicted associated with contaminated shallow groundwater.
- 14.7.6 Mitigation measures outlined for the control of site activities are expected to control any potential releases to groundwater. Potential risks to groundwater during construction are therefore considered to be small. The significance of any residual risk will be dependent on the findings of additional ground investigations and the level of contamination on the current site.
- 14.7.7 The migration of concrete during piling would only occur in highly fractured and fast flowing groundwater environments (EA 2001). In addition, the potential for migration of concrete in such groundwater conditions would only occur for a short duration until it begins to set. Such conditions are not found beneath the proposed Renewable Energy Plant and piling is not anticipated to extend into the sandstone in any case. Therefore, there are no predicted effects from concrete in groundwater.

- 14.7.8 No changes to groundwater levels are predicted, either within shallow localised groundwater or potential deeper groundwater in the Carboniferous Passage Formation. Whilst dewatering of piled foundation will be required the effect of this would be very localised and would occur only in the drift material and would occur for a very short period after which surrounding groundwater levels would recover. No changes to the groundwater levels are predicted beneath the biomass storage area, as there will be no excavation into or interference with shallow groundwater. Additionally, there will be limited changes to the drainage regime.
- 14.7.9 There will be limited changes to the surface water drainage regime, with the proposed development of the site including a new reticulated drainage system and no proposed change to groundwater recharge.
- 14.7.10 As with surface water, there is the potential for accidental spills of oil or fuel which could enter groundwater. Measures and protocols are in place to avoid the likelihood of such events occurring. However, there will always be the potential for accidental incidents. Response to such events will be managed through the Environmental Management Plan, such that all spills will be contained. These spill response measures and the nature of the underlying shallow strata will reduce the likelihood of pollutants becoming mobile within groundwater. Occurrences of this nature are expected to be low in magnitude and intermittent or infrequent in nature. Overall the residual effect is considered to be insignificant.

#### **Effects on Soil**

- 14.7.11 Any topsoil excavated during preliminary earthworks will be stored for use on site. The volume of topsoil will be very limited given the existing land-use. This will be carried out in accordance with DEFRA guidelines to minimise the effects on soil structure. Once soils have been stripped, any areas of the site to be raised will be infilled with imported material. The development will protect the topsoil stripped but a proportion of the subsoil maybe backfilled upon during the creation of the site development platform. These changes are not considered to be significant.

#### **Operational**

##### **Effects on Surface Water**

- 14.7.12 Very few residual effects are predicted once the mitigation outlined is in place. The surface water drainage system will control and treat any spills. All process and surface water discharges to the docks from the development will be managed. Sediment could enter runoff from activities around the wood fuel store and enter the estuary although as the stores are set back from the waterfront this is unlikely to increase appreciably from existing levels of sediment input
- 14.7.13 A residual risk will remain with respect to spills and leaks associated with the operation, particularly within areas of oil, fuel or other potentially contaminative substances storage. It is not expected that the magnitude of such occurrences would be significant and response to such events will be managed through the Environmental Management Plan, such that all spills will be contained. Therefore it is predicted that any residual effect would not be significant.

##### **Effects on Groundwater**

- 14.7.14 There will be no change to the principle of surface water drainage, with the proposed development of the site including a new reticulated drainage system and only a limited change to groundwater recharge.
- 14.7.15 Potential exists for accidental spills of oil or fuel which could infiltrate permeable areas of ground cover and enter groundwater. Measures and protocols are in place to avoid the likelihood of such events occurring. However, there will always be the potential for accidental incidents. Response to such events will be managed through the Environmental Management Plan, such that all spills will be contained. These spill response measures will reduce the likelihood of pollutants becoming mobile within groundwater. Occurrences of this nature are expected to be low in magnitude and infrequent in nature. Overall the residual effect is considered to be not significant.

**Effects on Soils**

14.7.16 No significant negative effects are predicted during the operational phase.

**Decommissioning****Effects on Surface Water**

14.7.17 Similar mitigation controls will be implemented to control effects on surface water during decommissioning as previously described for the construction phase. Dependent on future land use, the drainage system may be partially or completely retained.

**Effects on Groundwater**

14.7.18 Mitigation measures outlined for the control of site activities are expected to prevent potential releases to groundwater.

**Effects on Soils**

14.7.19 No significant negative effects are predicted during decommissioning.

**Evaluation of Residual Effects**

14.7.20 It is normal practice within environmental assessment to evaluate the significance of residual risks on the water environment. The evaluation is based on the methodology described in Section 14.3 The results of the evaluation are illustrated in Table 14.8.

**Table 14.8 Evaluation of the Significance of Residual Effects (post mitigation) to the Water and Soil**

Effect	Type of effect	Probability of effect	Sensitivity of Impact	Magnitude of effect	Effect Significance	
					Ranking	Rationale
Construction						
Effects on surface water features - accidental spillages	-ve	Unlikely	Local/ Low	Low	Not significant	The use of cut off drains, bunding, oil traps and adhering to good site management practices implemented through an Environmental Management Plan (EMP)
Effects on groundwater features - foundation piling - accidental spillages	-ve	Unlikely	District/ Medium	Low	Not Significant	Good site management practices and piling methods adopting best practice guidelines. Measures will be implemented and controlled through an Environmental Management Plan (EMP).
Effects on soils - limited stripping of some soil during earthworks	-ve	Certain	Local	Low	Not Significant	The volume of soil to be stripped will be very limited given the existing land-use. Works will be carried out in accordance with DEFRA guidelines to minimise the effects on soil structure.
Operation						
Effects on surface water and groundwater features - accidental spillages of fuel/lubricant or other polluting substance	-ve	Unlikely	Local/ Low	Low	Not significant	Good site management practices implemented through an Environmental Management Plan (EMP)
Decommissioning						
Effects on surface water and groundwater features	-ve	Unlikely	District / Medium	Low	Not Significant	Good site management practices including a spill



Effect	Type of effect	Probability of effect	Sensitivity of Impact	Magnitude of effect	Effect Significance	
					Ranking	Rationale
- accidental spillages of fuel/lubricant or other polluting substance						response methodology implemented through an Environmental Management Plan (EMP). The ranking would need to be confirmed following a suitably targeted site investigation.
Effects on soils	+ve	Certain	Local	Low	Not Significant	Restoration of any soils previously stripped and stored represents a positive outcome compared to the construction and operation phases. Overall the effect on soils will be neutral
Key	Type	Probability	Sensitivity	Magnitude	Significance	
	-ve = Negative +ve = positive	Certain Likely Unlikely	International/ High National/ High Regional/ Medium District/ Medium Local/ Low	High Medium Low	Major Minor Not significant	

## 14.8 Summary of Effects and Mitigation

- 14.8.1 This chapter describes the potential effects on surface water, groundwater and soil from the construction, operation and decommissioning phases of the proposed Renewable Energy Plant.
- 14.8.2 The development is located to the south of the Western Channel and Carron Dock, between the River Carron and the Grange Burn, within the industrial area of the Port of Grangemouth, adjacent to the Forth Estuary. In accordance with SPP, a flood risk assessment has determined the need to raise sensitive equipment above a design datum of 5.50 m AOD and provide areas of safe refuge above this datum for personnel within the site. The design includes an allowance to account for the likely impact of climate change on water levels in the Forth Estuary. Incorporated into this will be a drainage system across the main plant part of the site which will manage drainage discharges to Grangemouth docks, subject to consents.
- 14.8.3 It is likely that the Renewable Energy Plant will require a piled foundation solution, whereby it is anticipated that the piled foundations may need to extend down to the Diamict (commonly known as Boulder Clay) beneath the silt deposits for the larger structures. It is not known at this stage whether foundations would extend through this formation to the Carboniferous Passage Formation or Carboniferous Coal Measures, which are predominately sandstone, mudstone, siltstone and coal sequences classified as a concealed or aquifer with limited potential.
- 14.8.4 A Foundation Works Risk Assessment will be undertaken prior to construction in accordance with the EA guidance to assess the piling method being undertaken; the likelihood of piling through contaminated ground; and the overall risk to groundwater quality in the aquifer<sup>10</sup>.
- 14.8.5 Appropriate working methods based on good practice will be incorporated into an Environmental Management Plan. This will ensure that there will be no residual effects to surface water through sediment input or site activities.

<sup>10</sup> Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination; Guidance on Pollution Prevention, Environment Agency, May 2001.



- 14.8.6 The abstraction and discharge of water for the cooling process will be regulated by a CAR licence and the PPC Permit. Regulation of these processes will ensure that the existing hydrological environment within the Forth Estuary is maintained with no significant negative effects.
- 14.8.7 No significant environmental effects have been identified in terms of impacts to the hydrological or hydrogeological environment. Therefore, overall the proposed Renewable Energy Plant will not result in any predicted negative residual effects of significance on the water or soils environment.

## ***Abbreviations***

The following are a list of abbreviations adopted throughout this ES.

<b>AOD</b>	Above Ordnance Datum
<b>BGL</b>	Below Ground Level
<b>BGS</b>	British Geological Society
<b>BH</b>	Borehole
<b>CAR</b>	Controlled Activities Regulations
<b>DWS</b>	Drinking Water Standard
<b>EIA</b>	Environmental Impact Assessment
<b>EQS</b>	Environmental Quality Standard
<b>EMP</b>	Environmental Management Plan
<b>IEMA</b>	Institute of Environmental Management and Assessment
<b>m</b>	Metres
<b>NGR</b>	National Grid Reference
<b>PANs</b>	Planning Advise Notes
<b>PPC</b>	Pollution Prevention and Control
<b>SEPA</b>	Scottish Environment Protection Agency
<b>SGC</b>	Shotts Gas Coal
<b>SSP</b>	Scottish Planning Policy
<b>SSSI</b>	Site of Special Scientific Interest
<b>SSTLs</b>	Site Specific Target Levels
<b>SUDS</b>	Sustainable Drainage Systems
<b>SWMP</b>	Site Waste Management Plan
<b>UDC</b>	Upper Drumgray Coal

## Grangemouth Renewable Energy Plant S36 Application for Consent Team



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## S36 Application for Consent Team



### SKM Enviros

SKM Enviros is a market leading consultancy providing water, environmental, sustainability and health and safety solutions. We have more than 500 staff in 20 offices across Europe, the Middle East and Africa and are a member of the CAT Alliance, a global network of environmental consultancy partners. SKM Enviros is part of Sinclair Knight Merz, a global engineering, sciences and project delivery firm, with more than 6,500 staff across the globe.

SKM Enviros is a Registered Environmental Impact Assessor with the Institute of Environmental Management and Assessment (IEMA). We offer integrated Planning and Environmental Impact Assessment (EIA) services to the private and public sectors through extensive legislative and technical knowledge and an understanding of planning issues, including Infrastructure Planning Commission requirements. We have prepared a number of Environmental Impact Assessments for renewable and conventional power generation projects throughout the UK and overseas.

For more information on SKM Enviros visit [www.skmenviros.com](http://www.skmenviros.com)



### **Jones Lang LaSalle**

Jones Lang LaSalle Jones Lang LaSalle is one of the world's leading real estate services and investment management firms, operating across more than 100 markets in 35 countries on five continents. The company provides comprehensive integrated real estate expertise, including management services, transaction services, investment management and town planning services on a local, regional and global level to owners, occupiers and investors.

In the UK, the Jones Lang LaSalle delivers a comprehensive range of services through offices in London, Birmingham, Leeds, Manchester, Norwich, Glasgow and Edinburgh. Over 1,300 personnel, with a diverse scope of skills and market-leading experience, are dedicated to delivering value-added property, planning and development solutions to clients.

Jones Lang LaSalle advise institutional investors, property companies and developers, banks and financial organisations, corporate occupiers, major energy utility companies, retailers, hoteliers, national and local government and private concerns. Jones Lang LaSalle offers advice and implementation on every facet of development, town planning, marketing, sales and leasing, acquisition, investment, asset management, landlord and tenant matters and valuation.

## FICHTNER

### **Fichtner Consulting Engineers**

The Fichtner Group is one of the largest genuinely independent technology consultancy firms in the world. Founded in 1922, the group has over 1600 staff working in 50 companies around the world and has provided services in over 110 countries.

Fichtner Consulting Engineers Limited was established in 1991 and has grown steadily to one of the leading engineering, project management and technical advisory teams in the UK waste management, process and renewable energy sectors. Fichtner is entirely independent, being owned by the Fichtner family and senior members of staff and being by choice a pure consultancy rather than a contractor with a consultancy arm. Our principal clients are major utility companies, waste management organisations, renewable energy developers, banks and lenders.

## TURLEY ASSOCIATES

### **Turley Associates**

Turley Associates is a leading planning and urban design consultancy involved in key development sectors across Britain. Turley Associates undertake specialist community engagement work in support of major statutory applications and work creatively and in partnership, to bring success to our clients. Turley Associates are passionate about delivering successful and sustainable developments that will benefit our towns and cities for generations.

## gordon murray architects

### **Gordon Murray Architects**

Gordon Murray Architects, based in Glasgow, are widely regarded as one of Scotland's most dynamic practices gaining an international reputation with over thirty awards for architecture, including Europa Nostra, RIBA, British Construction Industry, BCO, RIAS, RIAI and Scottish Design Awards, producing works which contribute to their clients interests and to place-making within context.



**Pentran**

Pentran Ltd. were engaged by Forth Energy to provide CDM Co-ordinator services on the Biomass Energy Plant(s) project. Forth Energy wished to ensure that the project was fully compliant with the CDM Regulations 2007 and other relevant health and safety legislation. Our involvement on the project has been to ensure that Designers are competent and suitably resourced in terms of health and safety in relation to their design input, and to monitor that health and safety has been considered through the design stages in order that subsequent construction and operation of the Biomass Energy Plants can be carried out with suitable control measures for any identified risks.

**Price Waterhouse Coopers**

PwC is a global professional services firm founded on a culture of partnership with a strong commercial focus. Our UK team provides a full range of commercial services to the renewable energy sector from fund raising to due diligence. Through our UK offices we work closely with all participants in the sector including central and local government agencies, investors, suppliers and project developers. As part of a larger energy and utilities sector team, our expertise in renewable energy markets, policy and technologies is further enhanced by our global network of professionals that provide our clients with the local market knowledge they need to move and stay ahead.

**SISTech @ Heriot-Watt University**

SISTech (Scottish Institute of Sustainable Technology) is a not-for-profit research-led organisation providing innovative solutions for sustainable development in the natural and built environment. We are committed to developing methods and projects that maintain the principles of sustainability, further community welfare and produce robust, unbiased results. Jointly owned by Heriot-Watt University and MWH UK, SISTech combines academic networks and engineering expertise with the localised service of a dedicated team. SISTech employs a range of specific research techniques and methods including evidence reviews, environmental and carbon assessment, monitoring and evaluation, strategy and policy development, resource management and knowledge exchange and stakeholder management. We apply these research services to five domain areas within sustainability: energy, water, waste, transport and travel and infrastructure.

**David Livingstone Centre for Sustainability,  
University of Strathclyde**

The DLCS is a trans-disciplinary Research and Knowledge Exchange unit that engages in a wide array of work pertaining to sustainability, international development and broad environmental concerns. The foundations of the DLCS were established in 1973, and during the past four decades the DLCS has evolved at the University of Strathclyde as a premier training, research and knowledge exchange provider for Scotland.

## Environmental Impact Assessment Project Team

Details of the Environmental Impact Assessment project team for the proposed Renewable Energy Plant at Dundee are outlined below.



### SKM Enviros

SKM Enviros undertook the Environmental Impact Assessment for the Dundee Renewable Energy Plant and has prepared this Environmental Statement.

In preparing this Environmental Impact Assessment SKM Enviros commissioned Spectrum Acoustics Consultants Limited, TPM Landscape, MS Environmental, Pisces Conservation, Roger Tym and Partners and Headland Archaeology to undertake the noise, landscape and visual impact, visualisations, aquatic ecology, socioeconomics and cultural heritage assessments respectively.

### Spectrum Acoustic Consultants Limited

Spectrum Acoustic Consultants were formed in 1989 when the noise and vibration consultancy group within the UK based chemical company, ICI, separated to become a wholly independent privately owned limited liability company.

Since that time the company has grown to number 16 staff based in two UK locations, the South East and North West of England, and operate worldwide, being recognised as one of the leading specialist Noise and Vibration Consultants.

Spectrum has prepared the following Chapter of this ES under the management of SKM Enviros: Noise and vibration





### **Headland Archaeology**

Headland Archaeology is a registered archaeological organisation with the Institute of Field Archaeologists and is one of the foremost archaeological companies operating in a commercial environment in the UK and Ireland.

Employing over thirty full-time staff, Headland Archaeology provides a complete spectrum of archaeological services, ranging from initial advice and consultancy through to final publication and report compilation.

Headland Archaeology has prepared the following Chapter of this ES under the management of Sinclair Knight Merz: Cultural Heritage



### **MS Environmental**

MS Environmental is a full-service landscape practice conducting environmental impact assessment, landscape architecture, urban design and GIS with over 15 years experience working in environmental consultancy, private practice and local government on a range of urban and rural environment projects.

MS Environmental has prepared visualisations for the Landscape and Visual Impact Assessment under the management of SKM Enviros.



### **Roger Tym and Partners**

Roger Tym & Partners was formed in 1973, and is one of the UK's leading consultants in the economic analysis of economic activities, land, property and labour markets as well as planning, working from our offices throughout the UK.

The firm works on a range of energy related, low carbon, renewable technologies, and sustainable development projects, across the UK, Republic of Ireland, and overseas. The firm's work particularly focuses upon the economic and socio-economic impact aspects of such projects, often providing one of the key positives within an EIA/ES counterbalancing potential adverse post-mitigated effects on other environmental aspects derived from project proposals.

RTP has prepared the following Chapter of this ES under the management of SKM Enviros: Socio-Economic Impact.



### **TPM Landscape**

TPM Landscape has established itself as a leading practitioner in landscape architecture and design since its creation in 2001. TPM have worked on a broad range of projects supporting clients, architects and contractors in the delivery of quality external space, complex planning applications and Environmental Statements. TPM are an award winning practice with experience in the delivery of projects from inception to completion. Our company ethos is one which seeks to marry excellence in design with a clear direction in sustainability.

TPM Landscape has prepared the Landscape and Visual Impact Assessment of this ES under the management of SKM Enviros.



### **Pisces Conservation**

Pisces Conservation was formed in 1995 by staff with many years' experience working in and with the UK power industry.

Their core expertise lies in aquatic biology, the ecological effects of abstraction and discharge, and the mitigation of those effects. They have a wide range of clients in industry and conservation, throughout the UK, Europe and the USA. Pisces undertook the aquatic ecology impact assessment including surveys and thermal plume modelling.

Pisces Conservation has prepared the following Chapter of this ES under the management of SKM Enviros: Aquatic Ecology