SCOTTISHPOWER

SP Transmission Ltd

East Coast 400kV Reinforcement Project (Blairingone to Kincardine)

Environmental Statement
Volume 3: Technical Appendices

October 2013

Executive Summary

This document has been produced for Scottish Power Transmission Ltd to support a planning application for an upgrade of the existing overhead line route between Kincardine and the SHETL Boundary at Blairingone.

The document has been compiled by

In conjunction with the following Companies

Document Status	FINAL
EnviroCentre Document No	5596
EnviroCentre Project No	163328J
Document No	03
Revision No	00

PREFACE

The Environmental Statement comprises the following documents:

- Written Statement (principal document)
- Figures
- Appendices

Further copies of all these documents may be obtained, and will be available for viewing, from:

ScottishPower EnergyNetworks
Environmental Planning
Ochil House
Technology Avenue
Hamilton International Park
Blantyre
G720HT

The Non-Technical Summary is available free of charge, a copy of the Environmental Statement, Figures & Technical Appendices for £150.00. In addition all documents are available (as a PDF for screen viewing only) on a DVD for £10.00.

Copies of all documents are also available free of charge at
http://www.spenergynetworks.co.uk/serving_our_customers/performance.asp

Any representations to the application should be made by completing the online representation form on The Scottish Government, Energy Consents website at http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Energy-Consents/Support-object

or

by email to The Scottish Government, Energy Consents Unit mailbox at representations@scotland.gsi.gov.uk

or

by post to The Scottish Government, Energy Consents Unit, Scottish Government, 4th Floor, 5 Atlantic Quay, 150 Broomielaw, Glasgow, G2 8LU, identifying the proposal and specifying the grounds for representation, not later than Friday 20th December 2013.

Representations should be dated and should clearly state the name (in block capitals) and full return email or postal address of those making representation. All representations to the Scottish Government will be copied in full to the planning authority, and made available to the public on request, unless individuals request otherwise.

Copies of the documents will be available for public viewing at the following Council departments and Libraries:

SP Energy Networks, Environmental Planning, Ochil House, Technology Avenue, Hamilton International Park, Blantyre, G720HT	Clackmannashire Council, Development Quality, Kilncraigs, Greenside Street, Alloa, FK10 1EB
Fife Council, Planning Department, Fife House, North Street, Glenrothes, KY7 5LT	Kincardine Library , 2 Keith Street, Kincardine, FK10 4ND

Upgrade of Existing XL Overhead Line Route from Kincardine to SHETL Boundary at Blairingone

Environmental Statement
Volume 3: Technical Appendices

Appendix A

Consultee Scoping Responses

Scottish Natural Heritage (SNH)

Hello Paul

Thank you for sending me the scoping report for the proposal to upgrade and refurbish the OHL from Kincardine to Blairingone. The project also consists of the construction of a new substation and removal of the existing substation.

The report seems to cover the aspects which we discussed at our meeting last year (before the construction of the new substation was proposed) and in subsequent email correspondence.

Our comments at this stage are below:

Firth of Forth Special Protection Area (SPA)

We welcome the intention to survey for breeding birds at the construction site of the substation. The Firth of Forth SPA qualifies as a Natura site for its non-breeding bird populations and so consideration should be given to these as well. The scoping report refers to a 'review of any publically available data on the local flight lines of the relevant bird species'. I assume that this includes SPA qualifying species too. We would be willing to comment on any results from these data.

Protected species

Table 2 of the scoping report notes that there are no existing records for great-crested newts. However, you should give consideration in the ES to potential impact on that species, due to the presence of stillwater bodies. Likewise, water vole along the watercourses.

Landscape and visual assessment

The proposed methodology for assessment of landscape and visual impacts seems to be appropriate.

I hope these comments are helpful at this stage. I appreciate the ongoing consultation over the project.

Regards

Sarah

Tel: 01334 654038

Hello Patrick

If the changes to the project are minor, then we are unlikely to have any further comments.

The results of the surveys are likely to be valid for 12-18 months, depending on the species concerned.

I hope this is helpful. Please get in touch if you need more information.

Regards
Sarah

Sarah Eaton | Operations Officer | Scottish Natural Heritage | 46 Crossgate | Cupar | Fife | KY15 5HS | Tel: 01334 654038

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Mr Paul Darnbrough
EnviroCentre Ltd
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8 Eagle Street
GLASGOW
G4 9XA

By email: PDarnbrough@envirocentre.co.uk

Our ref: AMN/16/F
Our Case ID: 201301829
Your ref:

09 July 2013

Dear Mr Darnbrough

The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011
Scoping Opinion Request – Kincardine to Blairingone XL OH Line Route

Thank you for your email of 20 June 2013, requesting a scoping opinion relating to the above proposed development. This letter contains our comments for our historic environment interests. That is, scheduled monuments and their setting, category A listed buildings and their settings and gardens and designed landscapes and battlefields included in their respective inventories.

You should seek information and advice from the relevant planning authority archaeologist and conservation advisor for matters including unscheduled archaeology and impacts on B and C listed buildings, if you have not already done so.

Proposed Development
From the submitted information, I understand that the proposed development consists of an overhead line upgrade, replacement cable sealing end compound and construction of a new gas insulated substation between Kincardine and Blairingone, along an existing power line corridor.

Potential Direct Impacts
I can confirm that there are no scheduled monuments, category A listed buildings or gardens or designed landscapes within the proposed development site.

Potential Indirect Impacts
There are a number of heritage assets covered by our statutory remit in the vicinity of the development, most notably in the area at the southern extremity of the works, around Tulliallan. These include Tulliallan designed landscape, and the scheduled monument known as Tulliallan Castle (Index no. 736), which is also a category A listed building.

As there will be no significant changes to the nature of the overhead lines, and other works will not be in the immediate vicinity of these assets, we are content that significant impacts upon their settings are unlikely.

Our Views on the Principle of this Proposal

Overall, having reviewed the submitted information, we are content with the principle of the proposed development in this location and consider it unlikely that the proposal would result in significant adverse impacts on the site or setting of historic environment assets within our statutory remit. As such, in terms of assets within our statutory remit, we are content that the historic environment be scoped out of the EIA and that any such impacts are given due consideration and weight through the normal planning process.

I hope this is of assistance and please do not hesitate to contact me should you wish to discuss any of the issues raised in this letter.

Yours sincerely

Ruth Cameron

Our ref: PCS/127381
Your ref: 163328J

If telephoning ask for:
Stephanie Balman

11 July 2013

Paul Darnbrough
EnviroCentre Ltd
Craighall Business Park
8 Eagle Street
Glasgow
G4 9XA

By email only to: PDarnbrough@envirocentre.co.uk

Dear Mr Darnbrough

Environmental Impact Assessment (Scotland) Regulations 1999
Scoping Consultation
Kincardine to Blairingone XL Overhead Route Upgrade

Thank you for consulting SEPA on the scoping opinion for the above development proposal by way of your email which we received on 20 June 2013. We consider that the following key issues should be addressed in the EIA process:

- Disruption to wetland including peatlands and waste peat
- Forest waste
- Existing groundwater abstractions
- Engineering activities in the water environment
- Water abstraction
- Pollution prevention and environmental management
- Borrow pits
- Flood risk

While all of the issues below should be addressed in the Environmental Statement (ES), there may be opportunities for several of these to be scoped out of detailed consideration. The justification for this approach in relation to specific issues should be set out within the ES.

1. Disruption to wetlands including peatlands

1.1 If there are wetlands or peatland systems present, the ES or planning submission should demonstrate how the layout and design of the proposal, including any associated borrow pits, hard standing and roads, avoid impact on such areas.

1.2 A Phase 1 habitat survey should be carried out for the whole site and the guidance A Functional Wetland Typology for Scotland should be used to help identify all wetland areas. National Vegetation Classification should be completed for any wetlands identified. Results of these findings should be submitted, including a map with all the proposed infrastructure overlain on the vegetation maps to clearly show which areas will be impacted and avoided.

1.3 Groundwater dependent terrestrial ecosystems, which are types of wetland, are specifically protected under the Water Framework Directive. The results of the National Vegetation Classification survey and Appendix 2 (which is also applicable to other types of developments) of our Planning guidance on windfarm developments should be used to identify if wetlands are groundwater dependent terrestrial ecosystems.

1.4 The route of roads, tracks or trenches within 100 m of groundwater dependent terrestrial ecosystems (identified in Appendix 2) should be reconsidered. Similarly, the locations of borrow pits or foundations within 250 m of such ecosystems should be reconsidered. If infrastructure cannot be relocated outwith the buffer zones of these ecosystems then the likely impact on them will require further assessment. This assessment should be carried out if these ecosystems occur within or outwith the site boundary so that the full impacts on the proposals are assessed. The results of this assessment and necessary mitigation measures should be included in the ES.

1.5 For areas where avoidance is impossible, details of how impacts upon wetlands including peatlands are minimised and mitigated should be provided within the ES or planning submission. In particular impacts that should be considered include those from drainage, pollution and waste management. This should include preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, dewatering, excavations, drainage channels, cable trenches, or the storage and re-use of excavated peat. Detailed information on waste management is required as detailed below. Any mitigation proposals should also be detailed within the Construction Environmental Management Document, as detailed below.

2. Disturbance and re-use of excavated peat

2.1 Where the proposed infrastructure will impact upon peatlands, a detailed map of peat depths (this must be to full depth) should be submitted. The peat depth survey should include details of the basic peatland characteristics.

2.2 By adopting an approach of minimising disruption to peatland, the volume of excavated peat can be minimised and the commonly experienced difficulties in dealing with surplus peat reduced. The generation of surplus peat is a difficult area which needs to be addressed from the outset given the limited scope for re-use.

2.3 The ES or planning submission should detail the likely volumes of surplus peat that will be generated, including quantification of catotelmic and acrotelmic peat, and the principles of how the surplus peat will be reused or disposed of.

2.4 There are important waste management implications of measures to deal with surplus peat as set out within our Regulatory Position Statement - Developments on Peat. Landscaping with surplus peat (or soil) may not be of ecological benefit and consequently a waste management exemption may not apply. In addition we consider disposal of significant depth of peat as being landfilled waste, and this again may not be consentable under our regulatory regimes. Experience has shown that peat used as cover can suffer from significant drying and oxidation, and that peat redeposited at depth can lose structure and create a hazard when the stability of the material deteriorates. This creates a risk to people who may enter such areas or through the possibility of peat slide and we are aware that barbed-wire fencing has been erected around some sites in response to such risks.

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2.5 It is therefore essential that the scope for minimising the extraction of peat is explored and alternative options identified that minimise risk in terms of carbon release, human health and environmental impact. Early discussion of proposals with us is essential, and an overall approach of minimisation of peatland disruption should be adopted. If it is proposed to use some excavated peat within borrow pits or bunding then details of the proposals, including depth of peat and how the hydrology of the peat will be maintained, should be outlined in the ES or planning submission.

2.6 Our Planning and Energy webpage provides links to current best practice guidance on peat survey, excavation and management.

3. Forest removal and forest waste

3.1 We would support the approach of key-holing wherever possible as large scale felling can result in a peak release of nutrients which can affect local water quality. We may, however, be supportive of clear felling in cases where planting took place on deep peat and it is proposed through a Habitat Management Plan to reinstate peat-forming habitats. This should be specifically referenced in the ES.

3.2 We would be especially interested in and are likely to have significant concerns relating to any proposals to fell to waste where the waste generated by the process will be managed by techniques such as chipping, mulching or spreading. This is because where material is classed as waste then appropriate waste management options require consideration and, where appropriate, adoption. In such cases we would wish the ES to include information which explains how the waste hierarchy has been applied in a way which delivers the best overall environmental outcome and if this is not demonstrated we are likely to be object to the application.

3.3 It has previously been argued that using waste on the site could yield an ecological improvement and so has been considered as an exemption under waste management licensing. However, this approach is now being questioned as the results of early research show there is a lack of clarity and evidence to support the claim that this practice delivers overall ecological improvement for the main target vegetation types (blanket bog or wet heath).Currently, this restoration practice is being tested and researched at a number of sites across Scotland. This research will provide greater clarity on the benefits and risks associated with the practice. If ecological benefit from use of waste is to be claimed, then reliable site-specific evidence must be provided. For avoidance of doubt, where it is sought to claim ecological benefit from deposition of forestry waste a) the ecological benefit must relate to the land to which the waste is applied rather than off-site benefits and b) there must not be an ecological harm also associated with the deposition of the waste. Note that if there are likely to be significant amounts of surplus forestry material without a clear use, and if scope for an exemption under waste management is unclear, then unfortunately we may need to object to an application due to our inability to advise on consentability under our regulatory regime and hence it is essential that these issues are addressed at an early stage.

3.4 Nationally we are working with our SEARS partners to agree common principles for considering the use of forest material / waste wood on peatland sites for restoration projects. This work is currently being agreed and will soon be published on our website as *Principles for Use of Forest Residue for Peatland Restoration.* The draft principles within it which should be applied are as follows:

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- Full justification for using the material on-site must be provided. Evidence must be provided to show that all options for use of the material off-site have been considered;
- The proposed use of the material must be beneficial in reaching the objectives of the Habitat Management Plan (HMP) as agreed by the local authority in consultation with statutory agencies (SNH and SEPA). Detailed monitoring proposals should be included in the HMP;
- Material used on site should not have any negative impact on the water environment or other sensitive receptors (e.g. protected species);
- Details of the size, volume, and depth of material to be used on site must be provided. A detailed map showing areas where the material will be used and extent of cover should also be provided;
- A clear specification for contractors is required to ensure the correct machinery is used, and that any material left on site is used in line with the HMP. The quality of the material is an important factor; maximum chip size (or other criteria) should be defined and agreed with the contractor. A maximum depth of material should also be agreed with the contractor.

3.5 We ask that where the ecological benefit proposed by the fell to waste activity does not relate to improvement of peatland habitats that the expected environmental benefit is outlined and fully justified in the ES.

4. Existing groundwater abstractions

4.1 Roads, foundations and other construction works associated with large scale developments can disrupt groundwater flow and impact on groundwater abstractions. To address this risk a list of groundwater abstractions both within and out with the site boundary, within a radius of i)100 m from roads, tracks and trenches and ii) 250 m from foundations should be provided.

4.2 If groundwater abstractions are identified within the 100 m radius of roads, tracks and trenches or 250 m radius from foundations, then either the applicant should ensure that the route or location of engineering operations avoid this buffer area or further information and investigations will be required to show that impacts on abstractions are acceptable.

5. Engineering activities in the water environment

5.1 In order to meet the objectives of the Water Framework Directive of preventing any deterioration and improving the water environment, developments should be designed to avoid engineering activities in the water environment wherever possible. The water environment includes burns, rivers, lochs, wetlands, groundwater and reservoirs. We require it to be demonstrated that every effort has been made to leave the water environment in its natural state. Engineering activities such as culverts, bridges, watercourse diversions, bank modifications or dams should be avoided unless there is no practicable alternative. Paragraph 211 of SPP deters unnecessary culverting. Where a watercourse crossing cannot be avoided, bridging solutions or bottomless or arched culverts which do not affect the bed and banks of the watercourse should be used. Further guidance on the design and implementation of crossings can be found in our Construction of River Crossings Good Practice Guide. Other best practice guidance is also available within the water engineering section of our website.

5.2 If the engineering works proposed are likely to result in increased flood risk to people or property then a flood risk assessment should be submitted in support of the planning application and we should be consulted as detailed below.

5.3 A site survey of existing water features and a map of the location of all proposed engineering activities in the water environment should be included in the ES. A systematic table detailing the justification for the activity and how any adverse impact will be mitigated should also be included. The table should be accompanied by a photograph of each affected water body along with its dimensions. Justification for the location of any proposed activity is a key issue for us to assess at the planning stage.

5.4 Where developments cover a large area, there will usually be opportunities to incorporate improvements in the water environment required by the Water Framework Directive within and/or immediately adjacent to the site either as part of mitigation measures for proposed works or as compensation for environmental impact. We encourage applicants to seek such opportunities to avoid or offset environmental impacts. Improvements which might be considered could include the removal of redundant weirs, the creation of buffer strips and provision of fencing along watercourses. Fencing off watercourses and creating buffer strips both helps reduce the risk of diffuse water pollution and affords protection to the riparian habitat.

6. Water abstraction

6.1 Where water abstraction is proposed we request that the ES, or planning submission, details if a public or private source will be used. If a private source is to be used the information below should be included. Whilst we regulate water abstractions under The Water Environment (Controlled Activities) (Scotland) Regulations 2011, the following information is required at the planning stage to advise on the acceptability of the abstraction at this location:

- Source e.g. ground water or surface water;
- Location e.g. grid reference and description of site;
- Volume e.g. quantity of water to be extracted;
- Timing of abstraction e.g. will there be a continuous abstraction;
- Nature of abstraction e.g. sump or impoundment;
- Proposed operating regime e.g. details of abstraction limits and hands off flow;
- Survey of existing water environment including any existing water features;
- Impacts of the proposed abstraction upon the surrounding water environment.

6.2 If other development projects are present or proposed within the same water catchment then we advise that the applicant considers whether the cumulative impact upon the water environment needs to be assessed. The ES or planning submission should also contain a justification for the approach taken.

7. Pollution prevention and environmental management

7.1 One of our key interests in relation to major developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration. The construction phase includes construction of access roads, borrow pits and any other site infrastructure.

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7.2 We advise that the applicant should, through the EIA process or planning submission, systematically identify all aspects of site work that might impact upon the environment, potential pollution risks associated with the proposals and identify the principles of preventative measures and mitigation. This will establish a robust environmental management process for the development. A draft Schedule of Mitigation should be produced as part of this process. This should cover all the environmental sensitivities, pollution prevention and mitigation measures identified to avoid or minimise environmental effects. Details of the specific issues that we expect to be addressed are available on the Pollution Prevention and Environmental Management section of our website.

7.3 A Construction Environmental Management Document is a key management tool to implement the Schedule of Mitigation. We recommend that the principles of this document are set out in the ES outlining how the draft Schedule of Mitigation will be implemented. This document should form the basis of more detailed site specific Construction Environmental Management Plans which, along with detailed method statements, may be required by planning condition or, in certain cases, through environmental regulation. This approach provides a useful link between the principles of development which need to be outlined at the early stages of the project and the method statements which are usually produced following award of contract (just before development commences).

7.4 We would refer you to best practice advice prepared by SNH, SEPA and the windfarm industry Good Practice During Windfarm Construction which is also applicable to this development. Additionally, the Highland Council (in conjunction with industry and other key agencies) has developed a guidance note Construction Environmental Management Process for Large Scale Projects.

8. Borrow pits

8.1 Detailed investigations in relation to the need for and impact of such facilities should be contained in the ES or planning submission. Where borrow pits are proposed, information should be provided regarding their location, size and nature. In particular, details of the proposed depth of the excavation compared to the actual topography and water table should be submitted. In addition details of the proposed restoration profile, proposed drainage and settlement traps, turf and overburden removal and storage for reinstatement should be submitted.

8.2 The impact of such facilities (including dust, blasting and impact on water) should be appraised as part of the overall impact of the scheme. Information should cover, in relation to water; at least the information set out in Planning Advice Note PAN 50 Controlling the Environmental Effects of Surface Mineral Workings (Paragraph 53). In relation to groundwater, information (Paragraph 52 of PAN 50) only needs to be provided where there is an abstraction or groundwater dependent terrestrial ecosystem within 250 m of the borrow pit. Additional information on groundwater is provided above.

9. Air quality

9.1 The local authority is the responsible authority for local air quality management under the Environment Act 1995 and therefore we recommend that Environmental Health within the local authority be consulted.

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9.2 They can advise on the need for this development proposal to be assessed alongside other developments that could contribute to an increase in road traffic. They can also advise on potential impacts such as exacerbation of local air pollution, noise and nuisance issues and cumulative impacts of all development in the local area. Further guidance regarding these issues is provided in NSCA guidance (2006) entitled Development Control: Planning for Air Quality.

10. Flood risk

10.1 We welcome that a flood risk assessment will be undertaken. The site should be assessed for flood risk from all sources in line with Scottish Planning Policy (Paragraphs 196-211). Our Indicative River & Coastal Flood Map (Scotland) is available to view online and further information and advice can be sought from your local authority technical or engineering services department and from our website.

10.2 If a flood risk is identified then a Flood Risk Assessment should be carried out following the guidance set out in the Annex to the SEPA-Planning Authority flood risk protocol. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment, and methodologies that may be appropriate for hydrological and hydraulic modelling.

11. Regulatory advice for the applicant

11.1 Details of regulatory requirements and good practice advice for the applicant can be found on our website at www.sepa.org.uk/planning.aspx. If you are unable to find the advice you need for a specific regulatory matter, please contact a member of the operations team in your local SEPA office at:

SEPA Bremner House, Stirling, Tel: 01786 452595

If you have any queries relating to this letter, please contact me by telephone on 0131 449 8559 or e-mail at planning.se@sepa.org.uk.

Yours sincerely

Stephanie Balman
Planning Officer
Planning Service

Disclaimer
This advice is given without prejudice to any decision made on elements of the proposal regulated by us, as such a decision may take into account factors not considered at the planning stage. We prefer all the technical information required for any SEPA consents to be submitted at the same time as the planning application. However, we consider it to be at the applicant's commercial risk if any significant changes required during the regulatory stage necessitate a further planning application and/or neighbour notification or advertising. We have relied on the accuracy and completeness of the information supplied to us in providing the above advice and can take no responsibility for incorrect data or interpretation, or omissions, in such information. If we have not referred to a particular issue in our response, it should not be assumed that there is no impact associated with that issue. If you did not specifically request advice on flood risk, then advice will not have been provided on this issue. Further information on our consultation arrangements generally can be found in How and when to consult SEPA, and on flood risk specifically in the SEPA-Planning Authority Protocol.

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For the attention of Paul Darnbrough

Enterprise, Planning and Protective Services

Darren O'Hare
08451 55 11 22
development.central@fife.gov.uk

Your Ref:
Our Ref: 13/00989/PREAPP

Date 26th July 2013

Dear Paul

Application No:	**13/00989/PREAPP**
Proposal:	**Proposed Upgrade of Existing XL Overhead Line Route**
Address:	**Kincardine to Blairingone**

I refer to your request for informal scoping comments which commenced on the 21st June 2013.

I can confirm that Fife Council as Planning Authority is content with the scope of the environmental studies/reports currently being undertaken in support of the Section 37 application. Likewise, we are content for a number of topics to be scoped down/out as proposed. It may however be necessary to add additional comments/information to some of the topics to address the consultee replies. To assist in your interpretation of these factors I have enclosed a copy of the internal consultation replies I received for your records.

Planning Context

I would advise that the Fife Structure Plan 2006-2026 (2009) is now redundant as it has been replaced by the SESplan Strategic Development Plan (2013). With regards to Local Plan, I can confirm that the Dunfermline and West Fife Local Plan was adopted in November 2012 therefore the references to the Draft Local Plan should be removed. In addition, there are a number of other Local Plan policies which should be included within the assessment including Policies E7-8, T1-2 and I3-5. It would also be beneficial if reference was made to the Fife Landscape Character Assessment within this section albeit this would be covered in much more detail within the landscape and visual impact assessment.

Air Quality

Fife Council are content that the assessment of air quality effects can be scoped out of the ES due the nature of the proposed development. We note that the Environmental Management Plan (EMP) will be submitted as part of the application and look forward to receiving a copy of the EMP particularly regarding the proposed measure to reduce possible air quality. I would however like to draw to your attention that Fife Council has two declared AQMAs within its boundary

- Bonnygate, Cupar
- Appin Crescent, Dunfermline

Geology and Soils
We have no comments to make and agree that the Phase 1 Environmental Risk Assessment should be included as a technical appendix of the ERA and any further works (i.e. intrusive investigations) that may be required in this regard.

Electro-Magnetic Fields, Noise and Vibration
We have no comments to make on the proposed assessment of operational noise and EMF effects. As you will appreciate Fife Council's primary concern will be any noise impact on local residents.

Archaeology and Cultural Heritage
We are content that the proposed ADBA and associated impact assessment will address any archaeological and cultural heritage assets within the Kincardine area. In addition, I have recently agreed with Stephen Jack an appropriate viewpoint which would be representative of the likely visual impacts on Kincardine Conservation Area.

Traffic and Transport
The existing distributor roads adjacent to the site (A977, A985 and A876) are all Trunk Roads which are the responsibility of Transport Scotland. Fife Council's Transport Planning and Development Management team have advised that the only public roads within Fife that may be affected by the proposed development are Hawkhill Road (which crosses the power station access road) and the A907 (which the proposed power line crosses). Based on the anticipated construction vehicle movements, they advise that the construction period is unlikely to have any impact on the local road network. They advise that formation of temporary vehicular accesses from the A907 will require consent from Transportation and Environmental Services.

Water Environment
As you will appreciate, SEPA are best placed to advise on the key issues which should be addressed within the ES. Fife Council's Infrastructure Team notes that the document recognises the issue of tidal flooding and the need for a FRA. The only matter they have queried is with regard to the standard of protection for this type of infrastructure. From the SPP risk framework, the standard of protection would be in the order of 1 in 1000 years (0.1%) which is not mentioned within the Water Environment section of the scoping report.

Terrestrial Ecology
Fife Council's Natural Heritage officer has reviewed this section of the scoping report and advises that it appears to identify the main ecological aspects that need to be covered. I have enclosed their comments for your information.

Landscape and Visual Amenity
We note the proposed assessment methodology and have already agreed with Stephen Jack the list of proposed viewpoints which we consider are representative of key receptors within

the Kincardine area. Nevertheless, it may be prudent to seek comment from SNH if you have not already done so.

I trust that the above comments and information consultation comments are of assistance to you in developing the environmental statement.

Yours sincerely,

Darren O'Hare
Planner - Priority Applications Team
Development Management

Enc Consultation responses

Appendix B

Traffic and Transport Assessment

Traffic and Transport Assessment

PROJECT: **Kincardine Substation**

UNIT: **UNITED KINGDOM (UK)**
IDENTIFIC.: **185D-2-0100-FO-IECEC-0001** REV.: **00** DATE: **18/09/2013**

CUST ID: **XXX** SAP ID: **XXX**

DESIGN VERIFICATION Level1 ☐Level2 ☐Not apply ☒

R E V I S I O N C O N T R O L

REV.	DATE	REASON	MODIFIED PAGES
00	18/09/13	First Issue	All

Prepared Reviewed Approved

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INDEX

1. PURPOSE OF DOCUMENT

This purpose of this document is to form the Traffic and Transport section of the Environmental Report for the proposed Kincardine Substation. It focuses on the traffic and transportation effects associated with the construction and operation of the proposed Kincardine 400kV substation. It considers both the anticipated temporary (construction) and permanent (operational) traffic effects. The report also identifies and assesses the potential effects that the proposed development may have on traffic and transport. In the event that the potential traffic effects exceed establishes thresholds mitigation measures have been identified. The scope of this report does not include for an assessment of the construction or operational vehicle movements associated with the overhead line and sealing end compound upgrade works.

2. PROJECT OVERVIEW

To meet the requirements of the ENSG report it is required to up-rate the Kincardine – Kintore overhead line to 400kV operation. This will require a 400kV connection to be made at Kincardine.

3. ASSESSMENT METHODOLGY

3.1 Scope of Appraisal

A desktop study has been undertaken which focuses on the road network in the vicinity of the proposed Kincardine 400kV substation. The desktop study considers existing road cross sections, geometry and traffic flows based on available traffic data and identifies how construction, including associated traffic movements, will affect the existing road network.

All construction traffic is assumed to access the site via the existing at grade junction off the A977 for Kincardine Power Station. The route to the proposed substation is then via private access road currently owned by Scottish Power Generation; however, the private access road crosses Hawkhill Road which is operated by Fife Council. Prior to the A977, construction traffic will remain on the trunk road network where possible and traffic will be dispersed on the wider road network as the distance from the site increases, thus reducing traffic effects at specific locations further away from the proposed development. This assessment therefore, focuses on the roads immediately around the proposed substation which includes; A977, A876 and A985.

It is envisaged, based on guidance from Scottish Power Energy Networks that operational access to the site will be required for inspection and maintenance activities only as the site will be unmanned and operated remotely. It is therefore expected that operational vehicle trips will generally be relatively low, requiring only occasional maintenance trips. The significance of potential traffic and transport effects due to general operational traffic are therefore considered low. Consequently, operational traffic has not been considered further as part of this assessment.

3.2 Assessment Guidelines

This assessment has been undertaken in accordance with the guidelines for Environmental Assessment of Road Traffic (IEMA Guidelines 1993). The following guidelines have also been used to inform the traffic and transport assessment;

- Transport Assessment and Implementation: A guide (Scottish Executive 2005)
- The Design Manual for Roads and Bridges. Volume 05, Assessment and Preparation of Road Schemes
- The Design Manual for Roads and Bridges. Volume 11, Environmental Assessment, 2008
- Scottish Planning Policy SPP17 – Planning for Transport (Scottish Executive)
- Planning Advice Note: PAN75 – Planning for Transport (Scottish Executive)

In order to establish baseline traffic conditions along the proposed construction traffic routes, traffic count data has been obtained from Transport Scotland, initially via the online Scottish Roads and Traffic database, and then through consultation with Transport Scotland and the TSOISC Data Specialist where more recent raw data was obtained.

3.2.1 Assessment Structure

The assessment is structured around consideration of the following likely construction phase traffic and transport effects:

- Increases in general traffic (HGV+LGV) and / or specifically HGV traffic volumes causing delays for public road users,
- Slow moving abnormal loaded vehicles causing delay/driver frustration and congestions on public roads,
- The physical affects (wear and tear) of HGV (including abnormal load) traffic on the public road infrastructure.

3.2.2 Significance criteria

Significance criteria have been based on the Guidelines for Environmental Assessment of Road Traffic (IEMA Guidelines 1993).

It is understood the development will generate different traffic and transportation effects during construction and operation. Due to the minimal number of traffic movements expected during the operational phase this has not been included as part of the assessment.

3.2.2.1 Temporary / Construction Criteria

The IEMA guidelines suggest fairly broad rules to be used for the screening process as part of the assessment. The rules are generalised below;

- Highway links where existing traffic is generally free flowing and traffic flows will increase by more than 30% (or the number of heavy goods vehicles (HGV's) will increase by more than 30%) for a prolonged period of time and where the increase contributes to one or more of the following;
    - Traffic delay to private vehicles or public transport services
    - Loss of amenity to vulnerable road users
    - The construction traffic crossing a bridleway or near an equestrian facility.
- Sensitive areas where traffic flows will increase by 10% or more.

Where the predicted increase in traffic volumes (general traffic or HGV only) is lower than these thresholds and engineering judgment does not suggest otherwise, the significance of the effects can be stated as not significant, meaning that further detailed assessment is not warranted.

When considering the above, due cognisance will be taken of The Transport Assessment and Implementation: A Guide Scottish Executive - 2005 suggestion that the significance of an increase to traffic figures depends not only on the percentage increase of traffic but the effects on the available capacity.

3.2.2.2 Approach to Appraisal

The Traffic and Transport Assessment follows the procedure below to ensure appropriate assessment of the potential effects on road users;

- An appraisal of the existing baseline conditions based on collected traffic data.
- An appraisal of the surrounding highway network to determine its ability to accommodate the expected volume of construction traffic.
- Consultation with relevant road authority including Transport Scotland and their relevant operating company and Fife Council on the potential routes identified for construction traffic.
- An appraisal of the increase in traffic compared to baseline traffic flows along the roads used by construction traffic.
- Development, where appropriate, of suggested mitigation measures to address the effects caused by the construction traffic.

4. CONSULTATION

Consultation has been undertaken with Fife Council and Transport Scotland as part of the initial assessment. The results of the consultation are summarised below.

Consultee	Comments	Actions
Fife Council: Roads Officer (27/05/13)	Confirmed all routes identified still form part of the trunk road network, although stated there are plans in near future for Fife Council to adopt the section through Kincardine as a result of the A876 Kincardine bypass. Noted one public road crossing (Hawkhill road) of the private access road by means of at grade junction. Due to the location of the crossing and nature of the road no concerns were raised.	Noted: T&T assessment and reporting to be completed in accordance.
	Stated no proposed changes to the local road network are	Noted: T&T assessment and reporting to be completed in accordance. Consultation

	anticipated. Confirmed no major concerns noted at this time, pending review of final review.	ongoing to ensure current. Noted: T&T assessment and reporting to be completed in accordance. Consultation ongoing to ensure current.
Transport Scotland TSOISC Data Specialist	Confirmed raw data was available for requested routes.	Noted: Raw data received and interpreted as part of the assessment.
Transport Scotland Trunk Road Network Management and Maintenance Division	No response	Ongoing.

Table 1.1

5. EXISTING CONDITIONS

5.1 Study Area

The proposed Kincardine Substation is located adjacent to the existing Scottish Power Energy Network Substation and Scottish Power Generation Power Station. The proposed 400kV Kincardine Substation will be accessed from the existing private access road currently belonging to Scottish Power Generation, which connects via an at grade major / minor junction arrangement to the A977 which is the nearest public road and forms part of the trunk road network. It should be noted the existing private access road does cross via an at-grade cross junction, Hawkhill Road which is a public road operated by Fife Council.

The assessment will therefore focus on the A977 and the roads immediately linking which includes the A985 and A876 which becomes the M876 to the south and the A907 to the north. Consultation with both Fife Council and Transport Scotland confirm all of these roads form part of the trunk road network at the time of writing.

The A977 immediately south of the substation is an urban trunk road single carriageway with a 40 mph speed limit approaching Kincardine. This section of road has numerous residential properties on a parallel road set back from the A977 with occasional vehicle access to both commercial and residential properties. Further south this road transitions to a *typical* 30mph urban link through Kincardine. The road over this section contains footpaths on either side with residential and small scale commercial properties located on the A977 of which a number has direct vehicle access from the A977. Bus stops and several pedestrian crossing points are also located along this section of road and local primary and secondary schools have been found to exist close by. Both sections of road are lit and look to be in relatively good condition.

The A977 northbound of the junction transitions from an urban trunk road single carriageway road as defined above to a semi rural single carriageway trunk road with national speed limit approximately 400m north of the proposed substation entrance. On this section of road there are only sparsely isolated residences and agricultural areas adjacent to the A977. This section of road is not lit and appears to be initially 7.3m wide, widening to accommodate 1m hardstrips prior to the roundabout with the A876. The road appears to be in good condition and thought to be suitable for HGV's.

5.2 Traffic Flows

Traffic flows within the study area were obtained from permanent Automatic Traffic Counters (ATC's) sourced from Transport Scotland. The raw data provided by Transport Scotland has been interpreted to produce 24 hour average daily total flow data for each month and averaged for a year. This shows the existing typical traffic flows on the roads forming part of the assessment.

Route Volumes and Capacities

Route Section	Description (Speed Limit mph)	Width (Approx Average)	Baseline Volume AADT (two way) [%HGV]	Peak hour flow (two way)	Existing Capacity AADT Two Way
A876 Clackmannanshire Bridge North End	National Speed Limit	W2+1 1.0m hardstrips, 2.0m verge both sides	14,186** [3.9%]**	1,271(am)** 1,379(pm)**	-
A907 West of A977	National Speed Limit	Single C'way 7.3m 1.5m verge both sides.	14,210** [no data]	1,207(am)** 1,380(pm)**	-
A907 East of A977	National Speed Limit	Single C'way 6.5m 1.5m verge both sides.	2,898** [no data]	258(am)** 301(pm)**	-
A977 North of Gartarry R'bout	National Speed Limit	Single C'way 7.3m 1m verge both sides.	5,416* [no data]	471(am)* 519(pm)*	13,000
A977 Gartarry R'bout	National Speed Limit	Single C'way 7.3m 1m Footway SB, 1m verge NB	4,026 [3.1%]	173	13,000

A977 Kincardine	40mph into 30mph	Single C'way 7.3m 1.5m footway both sides.	4,537 [2.8%]	174	-
A985 West of Longannet Access	30mph	Urban Single C'way. 7m, 1.5m footway WB, 1mverge EB.	3,010** [6.0%]**	224(am)** 280(pm)**	-
A876 Kincardine to B9037	30mph	Urban Single C'way. 7.3m, 1.5m footway both sides	3264** [no data]	248(am)** 310(pm)**	-
A986 Kincardine Bypass	National Speed Limit	WS2+1,	8513** [4.9%]**	864(am)** 826(pm)**	-
A876 East of Bowtrees junction	National Speed Limit	D2AP	28,063 [4.05%]	3037	39,000

Traffic flows above were interpreted from raw data where available from Transport Scotland. Data is from 2012 unless otherwise indicated.

2011 interpreted raw data used.

***Database data used 2010*

The above traffic flows are after the Construction of the A876 Kincardine bypass. Only 3 years worth of data could be anlaysed as the data available pre-completion shows substantially different trends with significantly more traffic particularly HGV's on the A977 through Kincardine.

Table 1.2

Comparing current traffic flows with their theoretical limits as indicated in table 1.2, suggests that the local road network within the area of the study is currently operating well within its respective capacity. This indicates that these roads have a low degree of sensitivity (in terms of traffic volumes) to changes in flows.

5.3 Road Traffic Accidents

No concerns were raised during initial consultation regarding road safety or accident 'blackspots' on the road network forming part of this assessment although no accident figures were obtained.

Consultation should remain ongoing to ensure this is current.

5.4 Planned Changes to the Road Network

No planned changes to either the local or trunk road network within the area to be assessed were highlighted within the initial consultation period. Fife Council did confirm however, there are plans for them to adopt the section of trunk road through Kincardine as a result of the A876 Kincardine bypass.

Consultation should remain ongoing to ensure this is current.

5.5 Bridges and Other Structures

Several structures (bridges, underpasses and culverts) have been identified within the study area. During consultation no issues were raised with bridges or culverts on the trunk road network which forms most of the routes assessed. Consultation should remain ongoing to ensure this is current.

1 No disused railway bridge and 1 No active railway bridge are located on the private access road leading to the proposed site. It is understood the road and the disused railway bridge is owned and operated by Scottish Power Generation and the active railway bridge by network rail. Review of previous data suggests a 40te weight restriction is in place on the active railway bridge. Scoping emails have been sent to network rail however, further consultation and potentially survey work is required to ensure the adequacy of these structures for construction and operational traffic, most notably Abnormal Indivisible Loads (AIL's) as this is the primary road route to the substation.

6. POTENTIAL EFFECTS

6.1 Construction Route

6.1.1 Route Assumptions

The M876/M9/M80 which links Kincardine to the central belt and the North of Scotland are predominately 2 lane motorways. A detailed assessment has therefore not been carried out on these sections as significant effects are considered unlikely.

It is understood the substation finish level has been set at 6.2m AOD based on the recommendation of the flood risk assessment. The existing ground level varies between approximately 1.5m AOD and 4m AOD, therefore a significant amount of imported fill is required to raise the level of the platform as required. The volume of fill has therefore been assumed to be approximately 75,000m^3. Trip generation figures for this activity have been produced assuming a 6 month earthworks forming period and the use of a 15m^3 capacity tipper truck for transporting fill material to site. A volume of unsuitable/contaminated material may also have to be removed from site. It has not been possible to confirm source locations at this stage for the fill material however several quarries are known to exist locally. The closest are located off the A977 approximately 1km and 6km north of the site.

Concrete supply assumes off site batching of ready mix concrete delivered to site in ready mix trucks with 6m^3 capacity for all substation works.

Steel bars and mesh fabric will be required for all reinforced concrete slabs and foundations. It is assumed the reinforcement will be delivered to site on a periodic basis and stored for use onsite as required.

6.1.2 Routes

All construction traffic, including HGV's and (AIL's) will access the site via the private access road connecting to the A977 just north of Kincardine. From the private road a new short length of permanent access road will be constructed to access the proposed site. On leaving the site, all vehicles would rejoin the A977 via the same at-grade junction.

From the A977, the traffic routes which will most likely be used to access the Kincardine substation site will vary depending on the origin of the journey. The most likely traffic routes and those which are assessed are;

- A977, A876, M876 and the M80 – Travel to/from the South
- A977, M90, or A977, A985, M90 – Travel to/from the North

6.2 Trip Generation

Subject to securing the relevant consents the construction works associated with the proposed substation at Kincardine will commence mid 2016 and carry on until 2018. Construction traffic would be variable during the period depending on the site activity. The major construction works; earthworks, civil engineering etc are understood to be undertaken during the first 12 months of the construction period. Construction will continue until 2018; however, it is envisaged the number of construction vehicles, particularly HGV's will reduce significantly due to the type of site activities being undertaken.

Anticipated traffic generation from construction activities associated with the substation are shown below.

Estimated Maximum Daily One-way Construction Traffic Flows													
Vehicle Type		2016				2017				2018			
		Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Cars and Vans		-	-	18	18	36	36	45	45	45	45	36	36
HGV's		-	-	46	44	26	26	18	18	9	9	6	6
Total		**-**	**-**	**64**	**60**	**31**	**31**	**63**	**63**	**54**	**54**	**42**	**42**
Abnormal Loads		-	-	-	-	-	-	**2 (Aug)**	-	-	-	-	-

Notes for table

- *All construction staff vehicles are generally expected to arrive and depart outside network peak hours. Construction staff vehicles shall generally arrive between 0600hrs and 0700hrs and depart between 1800hrs and 1900hrs.*
- *Heavy Goods Vehicles (HGV's) are assumed to arrive and depart at a uniform rate throughout the working day.*

- *A 48 week working year and construction over a 5 day working week has been assumed for assessment purposes. However it is likely that a 7 day working week will be required during periods of the construction programme.*

Table 1.3

As shown from the table the greatest number of HGV's trips is expected during the platform forming stages Q3 2016 and Q4 2016 as it is anticipated imported fill will be required to form the platform to the required level to alleviate the potential flood risk from the River Forth.

There is estimated to be 2 AIL trips required to deliver the super grid transformers to the site during August 2017. All abnormal loads will be subject to specific method statements. An outline assessment of the anticipated route is contained in section 8.

It is understood the overall construction site will include sufficient space for parking of site staff. Therefore, it is not anticipated that construction staff will require to park on public roads in the vicinity of the site.

6.3 Traffic Effects

The existing traffic figures were assessed in relation to the estimated construction traffic figures shown in table 1.3.

In order to provide the worst case assessment the month of September was used to assess the traffic flows. Q3 2016 is expected to experience the highest volumes of construction traffic with August and September experiencing the highest construction traffic flows from that quarter and September generally experiencing the lowest background traffic figures during this period, hence effects will be greatest during this month.

Details of the assessment methodology are contained below.

- Peak hour construction traffic flow was used to represent a peak hour worst-case scenario.
- The background traffic flows were not factored to future year growth forecasts.
- All construction traffic is assumed to travel in the same direction to the substation.

6.3.1 A977 Assessment

The site is accessed from the A977 from either the north or south. The below considers both options.

Worse Case Traffic Assessment – A977						
	Existing Average daily background one way traffic flow. [%HGV]	Peak day construction Traffic – One way	% Increase daily flow	Existing Average hourly background one way traffic flow.	Peak hour construction Traffic – One way	% Increase hourly flow

A977 to site from the North	2077 (SB) [3.2%] 2047 (NB) [3.3%]	64 Total 46 HGV	3.2% Total 70% HGV	200 NB 189 SB	24 Total	12.7%
A977 to site from the South	2503 (SB) [2.5%] 2188 (NB) [3.0%]	64 Total 46 HGV	2.9% Total 71% HGV	257 SB 220 NB	24 Total	10.9%
HGVs are assumed to arrive at a uniform rate throughout the 12 hour working day at an anticipated maximum rate of 6 per hour (average 4 per hour during peak month). Car and van traffic is assumed to arrive / depart the site during the peak hour periods of 06:00-07:00 and 18:00 to 19:00. *Peak hour construction - 24 = 18 cars and vans + 6 HGV's.* The above volumes relate to September averages.						

Table 1.4

The Guidelines for Environmental Assessment of Road Traffic states that on links where existing traffic is generally free flowing an increase in traffic flows of more than 30% is considered significant. In sensitive areas increases of more than 10% should be assessed.

In addition to the above the Transport Assessment and Implementation: A Guide (Scottish Executive) - 2005 suggests the significance of an increase to traffic figures depends not only on the percentage increase of traffic but the effects on the available capacity.

The observed traffic figures on the A977 adjacent to the site suggest even with the inclusion of construction traffic the road will continue to operate well within capacity.

The overall percentage increase in traffic volumes is less than 4% indicating **no significant effects**. The increase caused by the peak construction hour traffic flow compared to the existing average peak hour flow is 12.7% again indicating **no significant effects,** as the routes are not considered sensitive.

The maximum percentage increase in HGV traffic on the A977 is approximately 71% both north and south of the proposed substation which represents a **significant** increase to baseline conditions.

The baseline (2012) total traffic and HGV traffic flows for the A977 at the locations considered are relatively low considering the status of the road, approximately 66 HGV's (one way) per day at both locations. Further investigation shows that traffic flows on this section of the A977 significantly reduced during 2008 following the completion of the A876 Kincardine Bypass. 2007 daily traffic figures for the same month and locations on the A977 approaching from the north and south were almost 4 times larger with a slightly larger percentage HGV usage. From the south - 8136 NB [4.7%HGV], 7639 SB [4.8%HGV]. The worst case percentage increase in HGV traffic relative to the 2007 year flows would be less than 13%.

Whilst the estimated increase in HGV construction traffic would maintain the road well within its theoretical capacity and would be significantly less than the baseline HGV traffic observed on the route prior to the construction of the bypass in 2008, the perceived increase of HGV trips on the A977 north and south for this short duration is considered to be **significant**.

Based on the assessment criteria explained in section 3.2.2.1 the likely effect to journey times, loss of amenity, noise, cyclists and pedestrians is considered to be more significant on the A977 from the south due to the more urban nature of this section of the route. Specifically due to the number and proximity of residential/commercial properties, vehicular accesses and pedestrian footways/crossing points. In addition to other amenities in the wider area such as schools. Therefore the effect of HGV traffic on the A977 from the South is considered moderate to major.

The A977 from the north is more rural in nature therefore the effect is considered to be less significant over this section. The effect of the increase in flows over this section is considered to be moderate.

6.3.2 Mitigation

In addition to good practice control measures outlined in the Construction Phase Traffic Management Good Practice section of this report, it is recommended that the majority of construction vehicles (HGV's) accessing the substation avoid the route through Kincardine and access from the north, utilising the A876/A907 and the A977 southbound.

No major modifications are recommended for the alignment or cross section of the A977 from the north to mitigate potential traffic and transport effects caused by construction HGV's. Modification is suggested to the junction of the private access road from the existing substation to the A977 to alleviate congestion from construction traffic turning right into the private access road and to improve visibility particularly looking northbound onto the A977, which appeared to be obscured by vegetation.

It is further recommended that construction traffic should not be held on the A977 including the lay by's on the approach to the private junction. Instead holding of HGV's should be within the construction site boundary or on the private access road.

The significance of the increase of construction traffic, particularly HGV's with the inclusion of the mitigation measures listed above is considered **moderate** due to the remaining capacity of the road network.

6.3.3 Driver Delay

The maximum anticipated percentage increase of traffic volume has been assessed to be 12.7%. However this compares the peak hour construction traffic which is likely to occur between 06:00 - 07:00 and 18:00 – 19:00 and the average hourly background traffic flows. Out with these peak hours there's expected to be a peak hour flow of less than 10 vehicles per hour (6HGV's) which produces a 5.3% percentage increase. The maximum average daily percentage increase is assessed to be 3.2%.

The effect to driver delay from construction traffic is therefore generally assessed to be **Not Significant.**

6.3.4 Wider Route Assessment

The effects on the routes linking the A977 to the main arterial trunk roads are contained in the table below.

Worse Case Traffic Assessment						
	Existing Average daily background one way traffic flow. [%HGV]	Peak day construction Traffic – One way	% Increase daily flow	Existing Average hourly background one way traffic flow.	Peak hour construction Traffic – One way	% Increase hourly flow
A876 Clackmannanshire Bridge North End	13884 [4%]	64	0.5% Total 8% HGV	1272	24	1.8%
A907 West of A977	7100	64	0.9% Total	1207	24	2.0%
HGVs are assumed to arrive at a uniform rate throughout the 12 hour working day at an anticipated maximum rate of 6 per hour (average 4 per hour during peak month). Car and van traffic is assumed to arrive / depart the site during the peak hour periods of 06:00-07:00 and 18:00 to 19:00. *Peak hour construction – 24 = 18 cars and vans + 6 HGV's.* *No HGV figures were available on the A907 west of A977 for evaluation.*						

Table 1.5

Based on the table above, the percentage increase caused by construction traffic for both routes linking the A977 are less than or equal to 2% and the percentage increase in HGV traffic allowing for the worse case increase is less than 30%. The routes are not considered sensitive therefore the effect of construction traffic is deemed **not significant**.

6.4 Accessibility for Emergency Services

The Traffic Management Plan as recommended in the Construction Traffic Management Good Practice section shall set out any specific arrangements required as part of the construction works identified in agreement with the emergency services. The contractor shall continue consultation with the emergency services during construction and update the TMP accordingly based on the results.

6.5 Pedestrian Effects

No known core path networks or pedestrian rights of way are generally expected to require diversion as part of the development. Sections of the A977 do contain pedestrian footways and pedestrian crossing points but it is considered that the increase in traffic with the mitigation measures in place is minor with the majority of car and van movements occurring out with peak times.

The delivery of the AIL's may require localised amendment to pedestrian footways but this will be subject to detailed method statement and consultation with all relevant overseeing organisations.

The overall effects on pedestrians have therefore been assessed to **Not Significant** at this stage.

7. ABNORMAL INDIVISIBLE ROUTE ASSESSMENT

An Abnormal Indivisible Load (AIL) route assessment was previously completed by Wynns (2012) for the theoretical delivery of a 400kV transformer from Torness to Kincardine. The proposed AIL's required as part of this project are slightly larger therefore Iberdrola Engineering and Construction were engaged to complete a supplementary feasibility assessment for the larger loads based on vehicle information provided by Scottish Power Energy Networks for the 2 abnormal loads required as part of the Kincardine 400kV substation project.

In line with current legislation, it is assumed the AIL's will maximise, as far as practical, the use of water in their movements therefore, the report investigated routes from Rosyth and Grangemouth docks. Delivery to Longannet may also be possible pending further investigation. Direct delivery to the jetty adjacent to the proposed site is not considered possible due to the depth of water however, should be formally ruled out by specialist transport provider when the transformer details/supplier are confirmed.

The feasibility assessment took the form of a desktop study, investigating previous data and looking at potential 'pinch' points along the suggested routes. No consultation was undertaken as part of the report and no structural assessments were conducted of the structures along the routes.

The report concluded that routes from both Grangemouth and Rosyth may be possible, with Grangemouth being the recommended option.

The size of the delivery vehicle on both routes requires frequent use of the full road cross section; therefore temporary traffic management will be required for most of the route length with short duration lane closures required during delivery.

Both routes require localised and temporary removal of existing street furniture including road signs, bollards, pedestrian guard rail and lighting columns. Short lengths of existing raised junction islands and kerb lines may also have to be temporarily removed and reinstated.

The junction from the private access road to the A977 in all cases will require permanent improvement to increase the entry radius to accommodate the delivery vehicle. Widening to the south is considered the most efficient solution. In both cases it is understood based on current land ownership, land acquisition would be required to improve the permanent access and land clearance and localised fill will be required to raise the existing ground level to a suitable level and standard.

The existing private access road to the proposed substation has two overbridges. One over a live railway line operated by network rail and one over a believed to be disused railway. A review of available existing information suggests both railway bridges have an operational weight restriction of 40Te. The weight limit is not believed to be sufficient to accommodate the AILs based on the assumed delivery vehicle and loadings. Consultation and detailed structural assessment is therefore required of the existing bridges to confirm their suitability or indentify engineering options to strengthen the existing bridge if possible. No alternative access has been found to the proposed site to avoid both bridges. An alternative access from the A907 may be available which joins the private access road between the two bridges thus bypassing the bridge over the live railway. This route is significantly longer and would require significant widening and realignment to accommodate the delivery vehicle and therefore has not been consider further.

8. SUMMARY

This document has attempted to assess the potential traffic and transportation effects associated with the construction of the new Kincardine 400kV Substation. The effect from construction traffic on most of the routes were deemed not significant, however, significant effects from HGV traffic was identified over a short length of the A977 north of the proposed site and from the A977 through Kincardine based on the guidelines set out in the Guidelines for Environmental Assessment of Road Traffic.

The report recommends that HGV traffic through Kincardine should be restricted and modification to the existing private access junction to the A977 be carried out.

Operational traffic effects were deemed to be minimal as the facility would be unmanned and hence would not be expected to generate vehicle trips other than for occasional maintenance.

A desktop feasibility study into the delivery of Abnormal Indivisible Loads was also conducted. Two routes were identified with the route from Grangemouth docks considered the most efficient. All routes require access to the proposed site via the existing private access road which has two overbridges. Both bridges are believed to have an operational weight restriction less than that required by the AILs. Further investigation is required to assess the suitability or otherwise of these structures

Annex 1 Construction Traffic Management Good practice

The temporary effects of construction traffic, whether assessed as significant or otherwise will be best mitigated through the use of an agreed and regulated Traffic Management Plan. Appropriate traffic management measures should be discussed and agreed with the relevant overseeing authority roads department (Fife Council and Transport Scotland) and the police and these measures implemented and monitored during the construction period. Construction vehicles, with the exception of site personnel in cars and vans will travel to site on predefined routes to reduce the effects on the existing local traffic.

The Traffic Management Plan should be developed prior to the commencement on site but remain live as the construction works develop. The purpose is to promote the efficient transportation of materials and components to site, whilst reducing congestion and disruption which might affect general traffic and the surrounding community and in particular the emergency services.

The Traffic Management Plan will generally consist of;

- a statement of the routes to be used by construction traffic
- a statement of which routes NOT to be used by construction traffic
- a statement of which local towns, villages and areas are to be avoided
- details of temporary signage to be installed at notified locations
- details of specific peak time periods to be avoided
- details of appropriate speed restrictions through sensitive/working areas
- procedures to ensure pedestrian safety
- specific arrangement for the transport of Abnormal Indivisible Loads.

The contractor will be required to develop, inform, monitor and evaluate the Traffic Management Plan throughout the construction period.

Additional aspects to be considered are listed below.

Wherever possible, arrangements will be made for site workers to be transported to site via shared transport to reduce unnecessary movements locally.

Access routes shall be monitored by the contractor to try to prevent construction traffic causing undue damage to road pavements, footways, structures, and street furniture etc. Should accidental damage by construction vehicles occur the contractor shall seek to promptly make good any damage to public and private property and land based on agreement from the relevant party.

The contractor shall consult with the relevant overseeing organisation prior to any improvements works on 3rd party/public land and obtain all necessary permits including Road Construction Consents prior to commencing.

Where road improvements require unavoidable amendment to existing infrastructure such as dry stone dykes, walls, hedges, verges, drainage channels etc, the feature shall be realigned as part of the design or temporally removed and reinstated following constructions based on agreement with the relevant overseeing organisation asset owner or statutory consultee. Where the amendment could affect the environment / ecology appropriate surveys shall be carried out and licenses obtained where relevant.

Works to culverts and bridges over water courses shall be agreed with the Scottish Environmental Protection Agency (SEPA) and where appropriate licenses obtained. Mitigation measures, where appropriate, shall be installed to protect adjacent watercourses from construction activities.

The contractor should undertake regular inspections to ensure the roads are clear of mud and other debris where construction roads meet the public road network. Dust suppression may be required during period of dry weather at locations where access tracks meet the public road.

The contractor should install visibility mirrors at private accesses being used for construction access where safety issues are identified in relation to turning movements onto the public road network.

The contractor shall be required to implement inductions for all site visitors to promote a culture of safety and awareness for all aspects including road users.

The client and the contractor shall maintain close liaison with local community groups, statutory consulates and land owners throughout the construction period. This should include circulation of information relating to ongoing and upcoming construction activities and in particular those which have the potential to cause disturbance. Contact details should be made available for an appropriate individual who can respond and resolve concerns made regarding the construction activities.

The client and contractor shall maintain contact with the local authority and community to identify major local events and where possible programme construction works to minimise impact on such events.

Phasing and frequency of construction vehicles should be managed to ensure as far as reasonably practical that vehicle movements are evenly spaced and out with peak periods to reduce disruption. Control on time periods when HGV’s can pass through local communities eg to avoid conflicts with school start finish times and to avoid evening and Sunday disturbance etc.

Controls on the size and weight limit of HGV traffic passing through areas identified as sensitive.

AIL’s shall where possible be delivered during off-peak periods and shall again where possible avoid major local events identified during consultation with the local authority and community groups.

Should major works be required during the operational phase of the project, appropriate traffic management measures should be agreed with the appropriate organisation prior to the works commencing.

Annex 2 Table of Environmental Appraisal

Overview of Receptors		Overview of Potential Effect				Potential Mitigation	Overview of Residual Effect	
Receptor	Sensitivity	Effect	Nature of Effect	Duration	Potential Significance		Residual Effect	Residual Significance
A977 North of the substation	Not Sensitive	Construction Traffic	Adverse	Temporary	Significant	Prior to construction a Traffic Management Plan will be prepared and agreed with the relevant overseeing organisation, Police and public groups. This will set out access and egress arrangements, agreed delivery routes and times and description of emergency access. AIL's will be under specific method statement.	Percentage increase of Construction HGV traffic may be greater than 30% for a short period of time. Section of route is well within capacity and has experienced higher levels of HGV traffic in the recent past prior to the construction of the bypass. A977 route length to A876 is less than 2km and mostly rural in nature. Effect on A876 has been identified as not significant, Anticipated non HGV construction traffic percentage increase is well below 30% increase with no mitigation.	Significant (moderate impact)

A977 South of the substation	Not Sensitive	Construction Traffic	Adverse	Temporary	Significant	Access through Kincardine shall be limited to HGV traffic as far as possible to limit the percentage increase to below 30%. Prior to construction a Traffic Management Plan will be prepared and agreed with the relevant overseeing organisation, Police and public groups. This will set out access and egress arrangements, agreed delivery routes and times and description of emergency access. AIL's will be under specific method statement.	Construction HGV traffic volume increase should fall below significance threshold (30%). Anticipated non HGV construction traffic percentage increase is well below 30% increase with no mitigation.	Not Significant

Appendix C

Phase 1 Environmental Risk Assessment

Proposed Upgrade of Existing XL Overhead Line Route from Kincardine to SHETL Boundary at Blairingone

Phase I Environmental Risk Assessment

October 2013

EnviroCentre Document No.	5187
EnviroCentre Project No.	163328j
Status	FINAL
Project Manager	Paul Darnbrough
Date of Issue	October 2013
Filename	Phase 1 163328j

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Proposed Upgrade of Existing XL Overhead Line Route from Kincardine to SHETL Boundary at Blairingone
Phase 1 Environmental Risk Assessment

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Summary Sheet

Site Name and Address	Site A: Land adjacent to Kincardine Sub-station, Kincardine, Fife Site B: Land adjacent to A977, Kilbagie, Kincardine, Fife, FK10
Area (ha)	Site A: 5.0 Site B: 3.2
Site Grid Reference	Site A: 292320, 688302 Site B: 293154, 689712
PrimaryLand Use	Site A: None Site B: Agriculture and electricity transmission
Proposed Future Use	Electricity transmission
Current Neighbouring Site Uses	Open ground, agriculture, forestry, electricity transmission.
Site History	Site A was a coal yard between 1959 and 1992. The land adjacent was part of Kincardine Power Station/Electricity Works from 1959 and is now Kincardine Sub-station. Site B has been dominated by agricultural land since 1863. Overhead lines have traversed the site since 1985.
Geology	Both sites are primarily underlain by Westphalian coal measures. Superficial deposits are dominated by raised beach and marine deposits.
Hydrology	The River Forth is located 100m away from Site A to the South West while the Canal Burn is located approximately 300m to the West of Site B and 350m North West of Site A. A drain that flows into the Canal Burn passes within 150m of Site B to the South East and within 500m of Site A, to the North.
Hydrogeology	The bedrock will provide a moderately important aquifer. A number of boreholeshave historically been located in close proximity to both sites. A well is also located within 100m of Site B to the North West. Aquifer vulnerability is classed as moderate.
Ecology	The Firth of Forth (SSSI, SPA &Ramsar Site) is located within 250m of site A. No ecological receptors are located within 250m of Site B.
Archaeology	There are no Scheduled Ancient Monuments (SAMs) located within 250m of either of the sites.
Previous Work	EnviroCentre is not aware of any previous environmental assessment work conducted at either of the sites.
Conclusions	At Site A, the investigation identified the following potentially significant pollutant linkages: • Impacts on groundwater from downward leaching of contaminants from soil; • Impacts on surface water from lateral migration of groundwater towards the River Forth; and • Impacts on structural foundations from contaminants in soil and/or groundwater. At Site B the investigation identified the following potentially significant pollutant linkages: • Impacts on groundwater from downward leaching of contaminants from soil; • Impacts on surface water from lateral migration of contaminated groundwater towards the drain to the South

	East; and • Impacts on structural foundations from contaminants in soil and/or groundwater
Recommendations	The risk of activating a pollutant risk is considered to be low. It is proposed that a watching brief is maintained during the earthworks activities for both sites. In the event that any obvious potential contamination is encountered, a suitably experienced contaminated land specialist should be engaged to complete an assessment and provide advice on the appropriate control measures.

1. INTRODUCTION

1.1 Background

Scottish Power Transmission (SPT) proposes to upgrade and refurbish the existing overhead transmission line (OHL) that runs from Kincardine to Blairingone. The project involves the upgrade of the OHL from 275, 000 volts (275kV) to 400, 000 volts (400kV) over a distance of approximately 10.5km. The works comprise the replacement of the existing tower insulators along the entire extent of the OHL route. Also included in the proposed works, is the replacement of two cable sealing end compounds with the construction of three new low level gantries to replace the existing two either side of the A977, North of Kincardine. A new 400kV Gas Insulated Substation (GIS) will be constructed and operated at Kincardine, adjacent to the existing 275kV which in time will be decommissioned. The GIS will be constructed on a raised platform that will be between 3.2 to 3.5m higher than the existing ground level across the site. The purpose of the platform is to help protect the site against coastal flooding; therefore much of the construction works (*i.e.* foundation excavations) will be within the platform material and not necessarily into the existing ground.

EnviroCentre has been contracted by SPT to carry out an Environmental Impact Assessment (EIA) to accompany a Section 37 Application to Scottish Ministers. As part of the EIA, it was considered that the sites of main construction activities, including land adjacent of the proposed new sub-station at Kincardine and site of the new cable sealing end compounds, merit investigation to determine their contamination potential given the historic uses and based on our understanding of the proposed works.

As a result, a Phase 1 Environmental Risk Assessment has been carried out by EnviroCentre, in order to afford sufficient consideration to the contamination potential posed by historic land uses.

The following report details the methodology and findings of the desk study and site walkover performed by EnviroCentre.

1.2 Objectives

The main objectives of the assessment were:

- To review the site history and determine what contaminants may be associated with the past/current use of the site;
- To identify any potential receptors on or in the vicinity of the site;
- To identify any potentially significant pollutant linkages present on the site which would result in the land meeting the statutory definition of contaminated land; and
- To determine the requirements for further investigation (Phase II).

1.3 Methodology

The Phase I Environmental Risk Assessment comprises a review of available background data combined with a site walkover. Information on geology, hydrogeology, hydrology, ecology and site history is obtained from Ordnance Survey (OS) maps, geological maps and historical maps as well as data held by the Local Council, the Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH). The aim of the site walkover is to identify present uses of the site as well as any constraints to the site investigation.

The Phase I Environmental Risk Assessment has been carried out in line with current legislation and guidance:

- Environmental Protection Act 1990: Part IIA Contaminated Land, Statutory Guidance: Edition 2, Scottish Executive (Paper SE/2006/44), May 2006;
- Investigation of Potentially Contaminated Sites: Code of practice, BS 10175:2011, British Standards Institute, 2011.

- Priority Contaminants for the Assessment of Land, CLR8, DEFRA and the Environment Agency, 2002.
- Model Procedures for the Management of Land Contamination, CLR11, DEFRA and the Environment Agency, 2004.

2. LAND USE

2.1 Site Details

Site Name	Site A: Location of proposed 400kV Gas Insulated Sub-station at Kincardine Site B: Location of proposed replacement gantries and cable sealing end compounds either side of A977.
Site Address	Site A: Land adjacent to Kincardine Sub-station, Kincardine, Fife Site B: Land adjacent to A977, Kilbagie, Kincadine, Fife, FK10
Grid Reference	Site A: 292320, 688302 Site B: 293154, 689712
Site Area Approx (m^2)	Site A: 50,000 Site B: 32,000
Details of Current Site Owner	Scottish Power Transmission (SPT) Ltd.
Current Site Use	Site A: Derelict land Site B: Agriculture adjacent to existing sealing end compounds
Proposed Use	Electricity Transmission

2.2 Site Walkover

A walkover of the two sites and their immediate surroundings was undertaken on 30th August 2012. An additional walkover of Site A was carried out on 5th October 2012 to acquire further information following alterations to the scope of assessment. Site location plans are included in Appendix I. A photographic record of the site walkovers is contained in Appendix II.

2.2.1 Site A: Land Adjacent to Kincardine Sub-Station

The site is located to the North West of Kincardine Sub-station and can be accessed from Hawkhill Road. The site comprises a large area of open ground upon which are located three buildings, three drains surrounded by a low wall and a small car park and associated access road.

The site comprises made ground. It is generally flat and is dominated by open ground. The surface is mostly coarse aggregate, vegetated with weeds and pioneer species (Photograph 1). A tarmacked access road and car park are located in the North East of the site (Photograph 2). The tarmac is in generally good condition.

Three buildings are located at the site. An office building and a toilet building are situated close to the car park in the North East of the plot (Photograph 2) while a brick building is located to the South West (Photograph 3). The buildings do not appear to be in regular use. Three drain covers, with a low wall adjacent, are located in the South East of the site (Photograph 4).

Areas of surface water ponding were observed around the site (Photograph 1). However, there was no evidence of fuel or chemical storage and there was no visible contamination or vandalism.

2.2.2 Site B: Land Adjacent to A977 North of Kincardine

This site, approximately 1.5km to the north of Kincardine, was accessed directly from the A977. The site comprises two cable end compounds, three towers and two low level gantries located in agricultural fields either side of the A977. The proposed layout of the site is shown on Drawing No: SP4105140 enclosed within the Technical Drawings of Volume 1: Environmental Statement.

The topography in this area undulates gently and rises gradually eastwards across the site. The structures are located on agricultural land, the majority of which appeared to have been recently grazed at the time of the visit. The towers and low level gantries are situated on this grassy open ground.

The cable termination compounds comprise tall enclosed perimeter fences with electricity transmission equipment housed within. The compound to the West of the road is approximately 350 square metres in size while the compound to the East covers an area of around 650 square metres (Photograph 5).The surface covering in the compounds is coarse aggregate vegetated with weeds (Photograph 6) while vegetated open ground underlies the towers (Photograph 7).

There was no evidence of any fuel or chemical storage at the site. There was no surface water in proximity to any of the structures and there was no evidence of any surface staining or vandalism.

2.3 Neighbouring Site Uses

Table 1-1 Neighbouring Site Uses

Description	< 50m	50-250m	250m-1km	Comments
Site A				
Residential	X	✓	✓	Residential properties on farm 200m North East. Residential developments are located approximately 400-500m to the North East, East and South East.
Agricultural	X	✓	✓	Agricultural fields are located to the North West, North and East of the site.
Commercial	X	X	✓	Retail units in Kincardine are located within one kilometre of the site.
Industrial	X	X	X	-
Site B				
Residential	X	✓	✓	Sporadic residential properties are located in the countryside surrounding the site.
Agricultural	✓	✓	✓	Agricultural fields surround the site in all directions.
Commercial	X	✓	✓	Golf course located to the South East
Industrial	X	✓	✓	Kilbagie Recycled Fibres Ltd is located 200m to the North West.

2.4 Historical Land Use

The following summary of historical site development is based upon information from available historical maps obtained from GroundSure Environmental Insight.

Table 1-2 Land Use on Site

Land use	Dates
Site A (GIS at Kincardine)	
Open ground/fields.	1863 - 1923
Coal yard. Site consists of conveyors, open ground and a number of small buildings.	1959 - 1992
Site B (Cable sealing ends)	
Open ground/fields.	1863 - present
Two roads traverse the site from the south diverging towards the North East and North West respectively.	1863 – present
Overhead lines traverse the site in Easterly and North Easterly directions.	1985 – present

Table 1-3 Land Use off Site

Surrounding Land Use	Dates	Distance	Orientation
Site A			
Open ground/fields	1863 - 1923	Adjoining	All directions
Power Station/Electricity works/Sub-station (extended 1973 onwards). Consists of large enclosed area, a large building, a number of smaller buildings and railway lines linking the site to the rail network.	1959 - 1992	Adjoining	South East
Railway runs north east.	1959 – present	25m	North East
Site B			
Fields/open ground	1863 – present	Adjoining	All directions
Two buildings labelled 'Dalquhamie' located south of the site	1863 – pre-1896	150m	South
Buildings labelled 'Kilbagie' located to the North West.	1864 – present	200m	North West
Railway line runs to the North West of the site.	1896 – present	25m	North East, East & South East

2.5 Consultations and Other Information

Table 1-4 Consultations and other information

Landfill Sites in the Vicinity	There are no known operational landfills at or adjacent to the site.
Underground Storage Tanks (USTs) on Site	Considering the historical use of the site, the Fife Council Petroleum Officer has not been contacted.
Mining Information	According to the Coal Authority's Gazetteer,Kincardine is located within an area of historical coal mining.
Existing Reports/Previous investigations	No previous reports have been made available for review, with the exception of the Halcrow FRA Report (September 2013).

3. ENVIRONMENTAL SETTING

3.1 Geology

Geological Maps Consulted	BGS Solid Geology Map, UK North Sheet, 1:625 000 scale, 4th edition, 2001 andBSG Geological Survey Map, UK North Sheet, 1:625 000, 1st edition (Quaternary) 1977.
Geological Setting	The published geological maps that were consulted indicate that both sites are primarily underlain by Westphalian coal measures. Superficial deposits are dominated by raised beach and marine deposits.
Hydrogeology Summary	The British Geological Survey (BGS) Hydrogeological Map of Scotland (1988, 1:625,000) shows that both sites are underlain by coastal and river alluvium deposits. Aquifers are generally concealed or have limited or local potential. Research on the BGS GeoIndex records indicates that a number of boreholes are or have in the past been located in close proximity to both sites. The records also indicate that a well is located within 100m of Site B to the North West.
Groundwater Vulnerability	Class 3: SEPA has assessed the vulnerability of the groundwater underlying the sites as 3 - vulnerable to some pollutants with many significantly attenuated.

3.2 Surface Water

Surface water features in the vicinity of the subject sites are as follows:

Table 3-1 Surface Water Features

Surface Water Feature	Distance	Direction	Flow Direction
Drain (flows into Canal Burn)	150m from Site B, 500m from Site A.	South East of Site B, North of Site A	South West/West
Canal Burn	300m from Site B, 350m from Site A	West of Site B, North West of Site A.	South West
River Forth	100m from Site A, 1600m from Site B	South West of Site A and Site B.	South East

Surface Water Vulnerability Medium

The Forth catchment is a drinking water protection area for groundwater. SEPA has identified morphological alteration, abstraction and point source pollution as potential pressures on the Forth channel in close proximity to Site A. Morphological alteration has also been identified by SEPA as a potential pressure on the drain that flows South West/West into the Canal Burn.

3.3 Ecological Receptors

Ecological receptors located within the vicinity of the subject sites are as follows:

Table 3-2 Ecological Receptors

Site Name	Designation	Distance	Orientation
Firth of Forth	Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Ramsar Site.	250m from Site A, 1200m from Site B.	North West of Site A, South West of Site B.

3.4 Archaeological Sites

There are no Scheduled Ancient Monuments located within 250m of either site.

3.5 Radon

Radon is a naturally occurring radioactive gas which comes out of the ground. Maps of radon affected areas are available in the Indicative Atlas of Radon in Scotland (Miles et al, 2011). The sites lie in an area where 0-1% of homes are at or above the action level (lower probability area).

4. ASSESSMENT OF RISKS

4.1 Contaminated Land Assessment Framework

The purpose of preliminary risk assessment is to develop an initial conceptual model of the sites and establish whether or not there are potentially unacceptable risks. This is based on a review of desk-based information and a site walkover to prepare an initial conceptual model to identify possible pollutant linkages.

In order to identify a risk of contamination, there is the need to identify not only a possible source of contamination and a potential receptor that could be adversely affected by the presence of that contamination, but also a pathway or mechanism by which the contamination can be transported between the source and the receptor. This is known as a "pollutant linkage". Definitions of source, pathway and receptor are provided in the table below.

Table 4-1 Definitions of Source, Pathway and Receptor

Source	Contaminated materials and/or gases/vapours
Pathway	The route via which the receptor can be or is being exposed to the source of contamination.
Receptor	The people, property, ecosystem and/or water environment that may be affected by the source of contamination.

For land to require further investigation and remediation prior to development or change of use, there must be evidence to suggest that a contaminant/contaminants may be present which may, as a result of the proposed development, result in significant harm being caused to a receptor(s) or present a significant possibility of significant harm to that receptor.

The Scottish Executive has adopted a "suitable for use" approach to ensure that land is appropriate for its current use and/or is made appropriate for any new use before planning permission is granted. Remediation work can be limited to preventing unacceptable risks to human health or the environment in relation to the current or future use of the land.

An important thread throughout the overall process of risk assessment is the need to develop a conceptual model for the site, which supports the identification and assessment of pollutant linkages. This forms the main part of preliminary risk assessment, and the model will be refined or revised as more information and understanding is obtained through the risk assessment process.

Each tier of risk assessment follows the same basic steps, as set out in CLR 11:

Hazard assessment - analysing the potential for unacceptable risks (what pathways and receptors could be present, what pollutant linkages could result and what the effects could be)

Risk estimation - predicting the magnitude and probability of the possible consequences (what degree of harm or pollution might result and to what receptors and how likely is it) that may arise as a result of a hazard

Risk evaluation - deciding whether a risk is unacceptable

4.2 Site Specific Risk Assessment and Conceptual Site Model

As per BS:10175 and CLR 11 a conceptual model has been developed for both sites. The conceptual site model helps to visualise and inform the risk assessment. An explanation of each of the components of the conceptual site model is detailed below.

Sources
Potential sources of contamination at the sites, based on the findings from the desk study and site walkover are summarised as follows in Table 4-2.

Site A was a coal yard between 1959 and 1992. The land adjacent was part of Kincardine Power Station/Electricity Works from 1959 and is now Kincardine Sub-station. Site B has been dominated by agricultural land since 1863. Overhead lines have traversed the site since 1985.

Table 4-2 Sources

Type	Comments (list contaminants etc.)
Organics	Organic contaminants may be present at both sites and could include hydrocarbons (Transformer oil), polychlorinated biphenyls and PAHs.
Inorganics	There is potential for asbestos, ash and other inorganics to be present at Site A as a result of the sites' past use as a coal yard.
Metals and Metalloids	Metals (particularly lead, copper, zinc and chromium) may be present at Site A and the cable sealing end compounds in Site B, associated with leakages of transformer oil. Since the source of these contaminants will principally be related to leakages, the potential source zones are limited. There is potential for other metals including mercury, cadmium and arsenic to be present at Site A due to the site's historic use as a coal yard.
Gases	There may be historical sources of hydrocarbon oil contaminations in the soil and groundwater in both sites. Degrading oils have the potential to generate carbon dioxide.
Vapours	As with gases any historic hydrocarbons present in the soils or groundwater below site A in particular has the potential to generate organic vapours, however given the species of hydrocarbon used for cooling and lubrication, they are unlikely to be a source of organic vapours.

Receptors (or targets)

Potential receptors that may be impacted by any contaminated materials and/or gases at the sites are summarised in Table 4-3 and 4-4.

Table 4-3 Site A Receptors

Type	Present	Comments
Human Health		
Site users	✓	Users of building on-site
Residents	✓	Farm buildings located 200m North East from the site.
Users of surrounding properties	✓	Kincardine Sub-station maintenance staff and firefighters using the adjacent training facility.
Ecological system, or living organism forming part of such a system		
Nature Reserves, Area of Special Protection for Birds, SSSI, SAC, SPA, Ramsar site, National Park	✓	The Firth of Forth (SSSI, SPA & Ramsar Site) is located within 250m. This protected area is located upstream from the site.
Property in the form of crops or animals		
Crops, including timber	✓	Agricultural fields located within 100m of the site.
Produce grown domestically or on allotments for consumption	x	None within 250m.
Livestock	✓	Agricultural fields located within 100m of the site.
Other owned or domesticated animals	x	None on site.
Wild animals which are the subject of shooting or fishing rights	✓	The River Forth is a Salmonid river.
Property in the form of buildings and services		
Buildings on site	✓	3 buildings located on-site.
Buildings off site	✓	Storm water pump house located to the South of the site. 4 buildings and 3 portacabins located inside Kincardine Sub-station compound. Fire fighting facility also located to the North.
Scheduled Ancient Monuments	x	There are no SAMs within 250m of the site.

Water environment		
Groundwater	✓	Potential for groundwater deep in the bedrock. There are no down gradient users of groundwater (private water supply wells).
Surface water	✓	The Canal Burn is located within 350m of the site.
Coastal water	✓	The River Forth tidal estuary is located within 100m of the site. The FRA produced by Halcrow and included in Appendix H outlines that the site is susceptible to coastal flooding. This could mobilise any residual contaminants within the upper soils and associated with the GIS infrastructure.

Table 4-4 Site B Receptors

Type	Present	Comments
Human beings		
Site users	✓	Site construction staff and farm workers. Site users are generally excluded from the compound areas.
Future site users	✓	Site maintenance staff and farm workers. Site users are generally excluded from the compound areas.
Residents	✓	Residential properties noted within 50-250m of the site.
Ecological system, or living organism forming part of such a system		
National Nature Reserves, Special Protection Area (SPA) Birds, SSSI, SAC, Ramsar site, National Parks	x	None within 250m.
Property in the form of crops or animals		
Crops, including timber	✓	Agricultural fields located at the site. Some of this area is arable land.
Produce grown domestically or on allotments for consumption	x	None within 250m.
Livestock	✓	Some of the fields at site B are used for grazing
Other owned or domesticated animals	x	None on site.
Wild animals which are the subject of	x	None located within 250m of the site.

shooting or fishing rights		
Property in the form of buildings and services		
Buildings on site	x	None.
Buildings off site	✓	Buildings associated with Kilbagie Recycled Fibres Ltd are located within 250m to the North West.
Scheduled Ancient Monument	x	There are no SAMs within 250m of the site.
Water environment		
Groundwater	✓	Potential for groundwater deep in the bedrock. There is a well located within 100m of the site although it is not known if it is still in use.
Surface water	✓	Drain that flows into the Canal Burn is located within 150m of the site.
Coastal water	x	None within 500m.

Risk Assessment

The risk assessment considers all potential pathways which may link potential sources of contamination to receptors which have the potential to be impacted by the contaminants. The results of this assessment are presented in Table 4-5 and Table 4-6.

Table 4-5 Conceptual Model of Pollutant Linkagesat Site A

Source		Metals	Inorganics	TPHs	PAHs	PCBs	Gas	Comment
	Human beings							
PATHWAY	Ingestion/inhalation of contaminated soil/dust	✓	✓	✓	✓	✓	✓	Site users are likely to be restricted to users of office building and are unlikely to become in contact with contaminants which may be present at the site.
PATHWAY	Dermal contact with contaminated soils/dusts	✓	✓	✓	✓	✓	✓	
PATHWAY	Gas Risk	X	X	X	X	X	✓	Potential for soil gas generation from leakages of transformer oil. However the anticipated risk is considered to be low.
	Water Environment							
PATHWAY	Surface runoff into surface water	✓	✓	✓	✓	✓	X	Surface runoff is considered unlikely to reach burns directly as infiltration likely to restrict run-off potential.
PATHWAY	Migration of soluble/mobile contaminants into groundwater	✓	✓	✓	✓	X	X	Potential for contaminants to infiltrate groundwater. Also potential for contaminants within soils to be in direct contact with groundwater.
PATHWAY	Groundwater baseflow into surface water	✓	✓	✓	✓	X	X	Potential for groundwater baseflow to reach the River Forth.
	Property in the form of buildings and services							
PATHWAY	Direct contact with foundations	X	✓	X	X	X	X	Some inorganics have the potential to impact concrete.
PATHWAY	Gas Migration into confined spaces	X	X	X	X	X	✓	Potential for soil gas generation from leakages of transformer oil. However the anticipated risk is considered to be low.

Table 4-6 Conceptual Model of Pollutant Linkages at Site B

Source		Metals	Inorganics	TPHs	PAHs	PCBs	Gas	Comments
	Human beings – Future users and residents							
PATHWAY	Ingestion/inhalation of contaminated soil/dust	✓	✓	✓	✓	✓	✓	Site users are likely to be restricted to SSE maintenance staff and are unlikely to become in contact with contaminants which may be present at the site.
PATHWAY	Dermal contact with contaminated soils/dusts	✓	✓	✓	✓	✓	✓	
PATHWAY	Gas Risk	X	X	X	X	X	✓	Potential for soil gas generation from leakages of transformer oil in the cable termination compounds. However the anticipated risk is considered to be low.
	Water Environment							
PATHWAY	Surface runoff into surface water	✓	✓	✓	✓	✓	X	No surface runoff likely to reach burns directly as infiltration is likely to restrict run-off potential.
PATHWAY	Migration of soluble/mobile contaminants into groundwater	✓	✓	✓	✓	X	X	Potential for contaminants to infiltrate groundwater. Also potential for contaminants within soils to be in direct contact with groundwater.
PATHWAY	Groundwater baseflow into surface water	✓	✓	✓	✓	X	X	Potential for groundwater baseflow to reach the drain to the South East.
	Property in the form of buildings and services							
PATHWAY	Direct contact with foundations	X	✓	X	X	X	X	Some inorganics have the potential to impact concrete.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The Phase 1 Environmental Risk Assessment has been carried out at two sites: Site A which is the proposed location of a new 400kV Gas Insulated Substation adjacent to the current Kincardine Substation and Site B: two sites either side of the A977, which will be constructed as cable sealing end compounds. At Site A, the investigation identified the following potentially significant pollutant linkages:

- Impacts on groundwater from downward leaching of contaminants from soil;
- Impacts on surface water from lateral migration of impacted groundwater towards the River Forth; and
- Impacts on structural foundations from contaminants in soil and/or shallow groundwater.

At Site B, the investigation identified the following potentially significant pollutant linkages:
- Impacts on groundwater from downward leaching of contaminants from soil;
- Impacts on surface water from lateral migration of contaminated groundwater towards the drain to the South East; and
- Impacts on structural foundations from contaminants in soil and/or groundwater.

5.2 Recommendations

Although potentially significant pollutant linkages have been identified for Site A, the new GIS will be constructed on top of a raised platform, to protect the site from coastal flooding and which will, to an extent, seal in topsoil or subsoil surface contaminants if present. Furthermore, the risk to the underlying groundwater from the downward leaching of contaminants will be reduced as their will be limited requirement to excavate into the existing sub-soil and the new platform will form a capping layer which will limit infiltration through the soil.

For Site B, the scale and nature of the proposed construction works are such that they can be undertaken effectively through adherence to the construction Environmental Management Plan (EMP). Where potential contaminated material is encountered it can be quarantined, tested and the offsite disposal route identified according with the project waste management plan, which will be a subsection of the EMP.

All material brought to the site to form the finished surface layer should be suitable for the proposed by being clean and inert as well as from a credible supplier.

Given the above points and the low risk of activating a pollutant linkage, it is proposed that a watching brief is maintained during the earthworks activities for both sites. In the event that any obvious potential contamination is encountered, a suitably experienced contaminated land specialist should be engaged to complete an assessment and provide advice on the appropriate control measures.

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APPENDIX I

FIGURES

APPENDIX II

SITE PHOTOGRAPHS

Site A

Photograph 1: Vegetated open ground. Ponding is clearly visible in the centre of the photo.

Photograph 2: The tarmacked access road and car park. The office building is the structure on the right while the smaller toilet building is located to the left.

Photograph 3: The brick structure is visible in the centre of the image.

Photograph 4: Drain covers and wall adjacent.

Site B

Photograph 5: The underground cable compound to the East of the A977 and tower adjacent.

Photograph 6: Gravel substrate and transmission infrastructure within the compound to the East of the A977.

Photograph 7: Vegetation underlying one of the towers to the East of the A977.

Appendix D

Noise Impact Assessment (OHL)

Document No 13/6331/001/GLA/O/R/001

Issue : B1

Sustainable Engineering Worldwide

Scottish Power Energy Networks

Kincardine Overhead Transmission Line Noise Impact Assessment

May 2013

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Scottish Power Energy Networks

Kincardine Overhead Transmission Line

Noise Impact Assessment

SUMMARY:

It is proposed to refurbish and upgrade (reconductor) the overhead transmission line north of Kincardine, between Tower XL1 and Tower XL33, a distance of some 10 km. The impact of high voltage transmission line audible noise is a consideration when refurbishing and/or upgrading an existing line.

The protocol by which the noise impact will be assessed requires that the pre-existing baseline, or background, noise levels are measured, under appropriate dry meteorological conditions, at noise sensitive receptors within close proximity of the transmission line. It is also required to note the nature of the ground surface at these receptors so that the contribution to background noise, attributable to rainfall, can be estimated.

SgurrEnergy has measured background noise levels at key receptors and has predicted the likely impact of the re-conductored line on the noise sensitive receptors.

In dry weather, no receptors are expected to experience noise levels greater than 5 dB above background, at which level complaints become likely.

In wet weather, three receptors fall in the range 5 dB to 10 dB increase above background. It should be noted that, of these three receptors, only one is currently a residential location. The other two receptors are located near potential property development and as such future considerations should be made at these receptor locations.

CLIENT: **Scottish Power Energy Networks**

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Date of Issue	29 May 2013	**Classification:**	Confidential

SF/04/023

AMENDMENT RECORD			
Revision	**Date**	**Changes from Previous Revision**	**Purpose of Revision**
A1	28/05/2013	None	First Draft
A2	28/05/2013	Minor amendments	Internal review
B1	29/05/2013	Minor changes	Management review

Contents

1 INTRODUCTION

The effects of noise on a neighbourhood are complicated and can include disturbance of work or leisure, disturbance of sleep, annoyance and possible effects on mental and physical health. PAN 1/2011: *Planning and Noise* recognises this and provides advice on how the planning system can be used to reduce the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.

The overhead transmission line which begins to the north of Kincardine is to be refurbished and upgraded (reconductored) from a 275 kV line to a 400 kV line. The impact of high voltage transmission line audible noise is a consideration when routing a new line or reconductoring an existing line. The protocol by which the noise impact will be assessed requires that the pre-existing baseline, or background, noise levels are measured, under appropriate dry meteorological conditions, at noise sensitive receptors within 300 m of the transmission line. SgurrEnergy has been instructed by Scottish Power Energy Networks (the Client) to predict the likely impact of the reconductored line on the noise sensitive receptors.

2 BACKGROUND

The effects of noise on a neighbourhood are complicated and can include disturbance of work or leisure, disturbance of sleep, annoyance and possible effects on mental and physical health.

An energised electrical transmission line can be the source of an audible phenomenon known as ‘corona discharge’. This is a limited electrical breakdown of the air in the vicinity of the transmission line conductors. Whilst power transmission line conductors are designed and constructed to minimise corona discharge surface irregularities such as damage, attached raindrops, insects and other types of contamination can increase local electric field strength beyond the inception level for local corona discharge at these sites. Such corona discharge can be the source of audible noise, a crackling sound accompanied sometimes by a low frequency hum.

The highest noise levels generated by a transmission line usually occur during rain when water droplets, collecting on the surface of the conductor, can initiate corona discharge. The number of droplets that collect, and hence the amount of noise, depends upon the rate of rainfall. Mist or fog can also cause corona discharge from droplets condensing on and attaching to the conductor surface. Sometimes, after a prolonged spell of dry weather, conductors can become contaminated with accumulated dust particles and other materials on which corona discharge can occur and audible noise generated. Later rain showers have the effect of washing the conductors clean of such debris.

The likelihood of noise from a specific source to provoke complaint is generally related to the noise that would prevail in the absence of the specific source, the baseline or background noise. The guidance of the British Standard BS4142: 1997 ‘Method for rating industrial noise affecting mixed residential and industrial areas’ can be used to assess the impact of the noise from a specific source on a sensitive receptor. This standard removes itself from application during rainfall. The National Grid Company (NGC) has derived a procedure to assess the impact of transmission line noise in rainy conditions.

The procedure used by NGC requires that the background noise at sensitive receptors within a distance of 250 m from the transmission line is measured during quiet times and in dry conditions with little wind. Also required is the nature of the ground surface around the sensitive receptors so that the contribution to background noise, of the surface noise attributable to the rainfall, can be derived from empirically derived curves (Miller Curves). The logarithmic sum of the measured background noise and the empirically derived contribution for rainfall is adopted as the background noise level, in rainy conditions, against which to compare the predicted received noise from the transmission line. Using the guidance of BS 4142: 1997 the likelihood of provoking complaints can be assessed.

Background noise levels have been measured at sensitive receptors within 300 m of the transmission line, at quiet times in dry, windless/low wind conditions, along the route of the transmission line together with a description of the nature of the surrounding ground surfaces and these are reported on the appended spreadsheet (Appendix B). The 300 m margin is more than the 250 m required. Background noise levels at receptors which are outwith the 300 m limit, but which were judged to be in close proximity to the transmission line, have also been measured and are included in the analysis presented herein.

3 ACOUSTIC DESCRIPTION OF AREA

A transmission line runs from Tower XL1 to Tower XL33 to the north-west of Kincardine, Fife over a distance of some 10 km. The land surrounding the transmission line is mainly agricultural with several farms and small clusters of housing residing within a few hundred metres of the transmission line. Little or no domestic noise was present at any of the receptors during the surveys. Birdsong and animal noise were present at most of the receptors and running water was present at one of the receptors.

There are several A and B-type roads present around the transmission line along with several small country roads. Distant road traffic from the M9 and M876 were also audible at some of the noise receptors. Given the extent of busy roads which surround the area around the transmission line it was determined that background noise levels would be undertaken at night as the roadways are generally busier, and hence noisier, during the day compared with night time hours. The extent to which the traffic contributed to the background noise levels at the individual noise receptors varied depending on the time of night and the distance from the noise receptors to the roads.

It should be noted that there were dogs present at some of the receptor locations visited and thus background noise information could not be obtained at the receptors themselves due to the persistent barking of the dogs. A surrogate location was chosen near to each of these locations, usually on the driveway leading to the property, to act as the background noise level for each respective property. The barking ceased as the surveyor moved away to these surrogate locations.

It should also be noted that during some of the noise surveys there was a distinctly audible sound of industrial activity, though not located at the individual receptors themselves. An investigation of the immediate surrounding area did not reveal any sign of nearby industrial activity and thus it was surmised that the sound could be originating from Grangemouth.

Individual acoustic descriptions of the receptors are presented in Appendix A.

4 PROCEDURE

The transmission line route is shown on a number of drawings, supplied by the Client[1].

[1] XL Overhead Line Route Sheet 1 and Sheet 2, supplied to SgurrEnergy 15 April 2013

Detailed maps and aerial photographs of the transmission line route were examined and noise sensitive receptors within 300 m (and a few outside that limit) of the transmission line identified. The identified noise receptors were visited over several nights from 24 April to 15 May and background noise measurements were collected. The survey at each receptor comprised two contiguous measurement intervals of at least five minutes.

Visits were made to the receptors at night-time, in suitable weather conditions and the dry background, or dry baseline, noise level measured and noted. Given the dry conditions, and the distance from the line at which the measurements were made, it is assumed that line noise from the existing overhead line is not a significant contribution to the measured levels. Only at one receptor location was the noise from the transmission line distinctly audible.

5 NOISE SENSITIVE RECEPTORS

The noise sensitive receptors for which the background noise was measured are listed by name and map grid reference in Appendix B together with the applicable Miller Curve. The Miller Curve has been chosen based on the terrain observed on site as well as satellite and ground imagery from Google Maps. The land surrounding the transmission line and receptors is mostly agricultural with intermittent patches of trees and shrubbery present at some receptor locations.

6 INSTRUMENTATION

- Bruel and Kjaer Type 2260 Sound Level Meter Serial Number 2044353.
- Bruel and Kjaer Type 4230 SLM Calibrator Serial Number 2052327.

The instrument was check calibrated shortly before the surveys began and again shortly after the surveys were complete. The meter read correctly on each occasion. Copies of the calibration certificates are available from SgurrEnergy upon request.

7 MEASURED PARAMETERS

The parameter defining background noise was the L_{A90} percentile exceedance level as defined in BS 4142: 1997. By discarding the highest 10% of all the levels within each averaging period, this descriptor removes the influence of short-term transient events that may artificially increase the level. Even so, if an audible extraneous event, such as an immediately passing road vehicle, occurred during the measurement period the acquisition of data was temporarily interrupted and resumed when that event became inaudible.

8 PREDICTED NOISE LEVELS

The expected noise levels from the line have been predicted in accordance with guidance in National Grid Technical Report TR (T) 94[2].

The excess dry figure is calculated by assuming attenuation of 15 dB for each factor of 10 in distance or "15 dB/decade". This is consistent with 10 dB/decade from a line source + 5 dB/decade excess attenuation analogous to the 25 dB/decade for a point

[2] Technical Report TR(T)94 A Method for Assessing the Community Response to Overhead Line Noise, Issue 1, National Grid, October 1993

source over soft ground in BS 5228-1:2009[3]. This assumes the line produces no tonal or other distinctive noise characteristics when dry.

In wet weather, the total noise as a function of rain rate is the sum of:

- the Miller curve value;
- the background noise;
- a 5 dB tonal penalty at rain rates over 1 mm/hr in accordance with BS 4142[3].

The rain distribution is taken from Met Office data for Braemar, 1959 to August 2010, assuming a lognormal distribution, as in Figure 5 of TR (T) 94.

The excess wet figure is derived by integrating the total noise as a function of rain rate, weighted according to the probability of a given rain rate.

In the absence of any supplied source levels, the source levels have been assumed to be 23.5 dB/metre, the same as for the Beauly to Denny line.

9 CRITERIA

TR (T) 94, following BS 4142, recognises the following thresholds by which the new sound level exceeds the background noise, and the likely community response:

- 0 dB: No observed reaction;
- 5 dB: Sporadic complaints;
- 10 dB: Widespread complaints;
- 15 dB: Threats of community action;
- 20 dB: Vigorous community reaction.

10 RESULTS

Acoustic notes taken at the time of the measurements are in Appendix A. The results are shown in the spreadsheet in Appendix B. The excess indicated is the extent to which the line noise, including tonal penalty, is expected to exceed the measured background noise.

In dry weather, two of the noise sensitive receptors, Gartgreenie Farmland (1) and (2), are expected to experience noise levels of 0 to 5 dB above background. It should be noted that currently there is no property located at these receptors though SgurrEnergy are aware of potential property development in this area and this should be taken into consideration by the Client.

In wet weather, the number of affected receptors increases. 18 receptors are assessed as experiencing 0 to 5 dB increase. Three receptors, Gartgreenie Farmland (1) and (2) and Starton now fall in the range 5 dB to 10 dB. As stated above, there is currently no residential property at the Gartgreenie Farmland receptors and as such complaints are only likely to arise from Starton. This could change if there is property development in the area of the Gartgreenie Farmland receptors.

11 CONCLUSIONS

A survey of currently prevailing background noise levels at noise sensitive receptors along the route of the electrical transmission line from Tower XL1 to Tower XL 33 north of Kincardine has been conducted during quiet conditions. Also noted during the same

[3] British Standard BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise

survey were observations regarding the nature of the ground surface and the subjectively judged most significant contributors to the measured noise.

In dry weather, two of the noise sensitive receptors are expected to experience noise levels of 0 to 5 dB above background, of marginal significance. To date there is no property in close proximity to these receptors though SgurrEnergy are aware of potential property development in this area and this should be taken into consideration by the Client.

In wet weather, the number of affected receptors increases. 18 receptors are assessed as experiencing 0 to 5 dB increase. Three receptors now fall in the range 5 dB to 10 dB increase. Two of these receptors are not in close proximity to a residential property and hence complaints are only likely to arise from one location. This could change if there is property development in the area of the other receptors.

APPENDIX A: ACOUSTIC DESCRIPTIONS OF RECEPTORS

The receptors visited are listed below along with an acoustic description of the site. Coordinates of the receptors visited are given in the BNG Airy system (Easting (m), Northing (m)).

Location 1: Hawkhill Farm (E292658, N688482): The survey at this area was carried out at the T-junction joining Hawkhill Road with the driveway leading to the Hawkhill Farm residential property. The dominant noise source was judged to be the distant road traffic on the nearby roads which consist of the A977, A985, A876, M876 and M9. Noise from animals and birdsong were present. The sound of running water was absent. No audible noise could be heard from the nearby substation.

Location 2: Ian Campbell & Son Accident Repair Centre (E293018, N689213): The survey at this area was carried out in the driveway of this property, which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on A977, A985 and A876 roads. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area and as there was a slight wind present, there was a very marginal contribution of noise from these sources.

Location 3: Dalquhamie Toll (Cottage) (E293044, N689359): The survey at this area was carried out just outside of this property, which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on A977, A985 and A876 roads. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was present. There were small trees and shrubbery present in the surrounding area and as there was a slight wind present (0.5-1m/s), there was a very marginal contribution of noise from these sources.

Location 4: Ambleside Haven (E293140, N689938): The survey at this area was carried out in the driveway of this property, which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on A977, A985 and A876 roads. Noise from animals and birdsong were absent. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area and as the wind speed had reduced to nothing, there was no contribution of noise from these sources.

Location 5: Residential Property (E293226, N690279): The survey at this area was carried out at the T-junction connecting the A977 road to a private road at this location. The dominant noise source was judged to be the distant road traffic on A977, A907 and A876. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area but as there was no wind present, there was no contribution of noise from these sources.

Location 6: Gartary Farm (E293554, N691011): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the A907 road. The dominant noise source was judged to be the distant road traffic on the A977, A907, and country roads. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area but as there was no wind present, there was no contribution of noise from these sources.

Location 7: Residential Property (E297364, N694900): The survey at this area was carried out at the T-junction which connects a private driveway with the A977. The residential property of interest was positioned directly opposite where the noise survey was conducted. The dominant noise source was judged to be the distant road traffic on the A977 and surrounding roads though this was very low and in general the area was very quiet. There were no domestic noises present. Noise from ground animals was absent though some birdsong was present. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area but as there was no wind present, there was no contribution of noise from these sources.

Location 8: Gartfinnan Farm (E293991, N692138): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on the A977 and surrounding roads. Also contributing to the background noise levels was the sound of distant industrial works. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was absent. There were small trees and shrubbery present in the surrounding area but as there was no wind present, there was no contribution of noise from these sources.

Location 9: Allaleckie Farm (E296738, N694876): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on the A977 and surrounding roads. The distant industrial works were also attributing to the noise at this location. There were no domestic noises present. Noise from small animals and birdsong were present. The sound of running water was absent. There were small pockets of shrubbery present in the surrounding area and as there was a slight wind present at the time of recording (0.5-1m/s), there was a small contribution of noise from this source.

Location 10: Gartknowie Farm (E297053, N694591): The survey at this area was carried out on the pathway leading to this residential property which is accessible via a road which lies off the A977 road. This location was in close proximity to an overhead pylon, which was not making any contribution to the background noise at the time of recording. The dominant noise source was judged to be the distant industrial works noted in the locations above; however distant road traffic on the A977 and surrounding roads was also a large contributor. There were no domestic noises present. Noise from animals and birdsong were present. The sound of running water was absent. There were small pockets of shrubbery present in the surrounding area and as there was a slight wind present at the time of recording (0.5-1 m/s), there was a small contribution of noise from this source.

Location 11: Woodside (E297611, N695048): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the B913 road. The dominant noise source was judged to be the distant road traffic on the surrounding roads. Distant industrial works were faintly audible at this location. There were no domestic noises present. Noise from small animals and birdsong were present. The sound of running water was absent. There were an abundance of dry leaves in the surrounding area and as there was a slight wind present at the time of recording (0.5-1m/s), there was a small contribution of noise from this source.

Location 12: Residential property (E297997, N695315): The survey at this area was carried out in the driveway of this residential property which lies off the B913 road. The dominant noise source was judged to be the distant industrial works. Distant road traffic was audible at this location also. There were no domestic noises present. Noise from small animals and birdsong were present. The sound of running water was absent. There were small pockets of shrubbery and small trees in the surrounding area and as there was a very slight wind present (0.5-1 m/s) at the time of recording, there was a marginal contribution of noise from this source.

Location 13: Wellhall House (E297834, N696233): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the A977 road. The dominant noise source was judged to be the distant road traffic on the surrounding roads. Domestic noises were faintly audible at the time of recording. Noise from horses in the nearby field and birdsong was present. The sound of running water was absent. Surrounding the driveway were large trees and pockets of shrubbery. As the wind speed had increased very slightly (1.0 -2.0 m/s) during the time of recording there was a contribution of noise from the rustling of the leaves from these sources. The distant industrial works were not audible at this location, though this is likely due to the increased noise from the wind interacting with the trees.

Location 14: Residential Property (E297756, N696095): The survey at this area was carried out at the residential property located at the T-junction of the A977 and Devon Road. The dominant noise source was judged to be the distant industrial noises. Distant road traffic on the surrounding roads was audible. No domestic noise was present. Noise from animals and birdsong were present. The sound of running water was absent. Small trees were present around the area but as the wind speed had reduced to nothing, there was no contribution from these sources.

Location 15: Coachman's House (E297189, N696191): The survey at this area was carried out in the gated driveway of this residential property which lies perpendicular to the B9140 road. The dominant noise source was judged to be the distant industrial noises. Distant road traffic on the surrounding roads was audible. No domestic noise was present. Noise from animals and birdsong were present. The sound of running water was absent. Large trees were present around the area but as there was no wind present was no contribution from these sources.

Location 16: Gartgreenie Farmland (1): (E296129, N693304): The survey in this area was carried out at the overhead pylon located in a field near the Gartgreenie Farm. The dominant noise source was judged to be from the overhead pylon at this location. Distant road traffic distant road traffic on the A977 and surrounding roads was also audible. No domestic noise was present. Noise from animals and birdsong were present. The sound of running water was absent. Small trees and shrubbery were present around the area but as no wind was present there was no contribution from these sources.

Location 17: Gartgreenie Farmland (2): (E296174, N693443): The survey in this area was carried out at the overhead pylon located in a field near the Gartgreenie Farm. The dominant noise source was judged to be the distant road traffic on the A977 and surrounding roads. Noise from the overhead pylon was no longer audible. No domestic noise was present. Noise from animals and birdsong were present. The sound of running water was absent. Small trees and shrubbery were present around the area but as no wind was present there was no contribution from these sources.

Location 18: Residential Property (E296342, N693049): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the Laurie Place which is accessible via the A977 road. The dominant noise source was judged to be distant agricultural/industrial works. Distant road traffic on the A977 and surrounding roads was also audible. No domestic noises were audible at the time of recording. Noise from animals and birdsong were present. The sound of running water was absent. Surrounding the driveway were large trees and pockets of shrubbery. As no wind was present during the time of recording there was no contribution of noise from these sources.

Location 19: Gartgreenie Farm (E295915, N693225): The survey at this area was carried out in the driveway of this residential property which lies perpendicular to the Laurie Place. The dominant noise source was judged to be the distant agricultural/industrial works. Distant road traffic on the A977 was also audible. No domestic noises were audible at the time of recording. Noise from animals and birdsong were present. The sound of running water was absent. Large trees were located approximately 100 m from the recording location but as no wind was present during the time of recording there was no contribution of noise from these sources.

Location 20: Hazleyshaw (E295560, N692679): The survey at this area was carried out close to the Hazleyshaw farm residential buildings. The dominant noise source was judged to be the animals in the field near the recording location, though the noise from the animals was minimal and in general the area is very quiet. Distant industrial/agricultural noises were very faintly audible as well as distant road traffic on the surrounding roads. No domestic noises were audible at the time of recording. Birdsong was also present. The sound of running water was absent. No significant trees or shrubbery were located around the recording location.

Location 21: Starton (E295153, N692537): The survey at this area was carried out close to the Starton residential buildings. The dominant noise source was again judged to be the animals in the field near the recording location, though the noise from the animals was minimal and in general the area is very quiet. Distant industrial/agricultural noises were very faintly audible as well as distant road traffic on the surrounding roads. No domestic noises were audible at the time of recording. Birdsong was also present. The sound of running water was absent. No significant trees or shrubbery were located around the recording location.

APPENDIX B: RECEPTOR SURVEY RESULTS

Table B1: Information from Receptors Surveyed

Location number	Name	NSR Co-ordinates (Easting(m), Northing(m))	Property Type	File	Distance from line (m)[2]	Slant distance from line (m)[2]	Mean L_{90} (dB(A))	Miller Curve	Dry excess	Wet excess
1	Hawkhill Farm	292658, 688482 (292670, 688546)[1]	Main farmhouse building with various outbuildings (Survey undertaken on driveway of property)	0057.S3A, 0058.S3A	299.7	299.9	41.5	R-2	-25.1	0.4
2	I. Campbell & Son Accident Repair Centre	293018, 689213	Two-storey residential building with large adjacent workshop	0059.S3A, 0060.S3A	296.3	296.4	36.6	R-2	-20.1	0.8
3	Dalquhamie Toll (Cottage)	293044, 689359	Single-storey residence	0061.S3A, 0062.S3A	211.0	211.3	36.4	R-2	-17.8	1.1
4	Ambleside Haven	293140, 689938	Single-storey residence	0063.S3A, 0064.S3A	129.8	130.2	32.0	R-1	-10.2	3.0
5	Residential Property	293226, 690279	Single-storey residence	0065.S3A, 0066.S3A	315.2	315.3	33.3	R-2	-17.3	0.9
6	Gartary Farm	293554, 691011 (293573, 690926)	Main farmhouse building with various outbuildings (Survey undertaken on driveway of property)	0087.S3A, 0088.S3A	249.7	249.9	29.3	R-1	-11.8	2.2
7	Residential Property	297364, 694900	Two-storey residential building	0090.S3A, 0091.S3A	131.2	131.6	23.6	R-2	-1.9	2.7
8	Gartfinnan Farm	293991, 692138 (294231, 692112)[1]	Main farmhouse building with various outbuildings (Survey undertaken on driveway of property)	0092.S3A, 0093.S3A	254.5	254.7	30.5	R-1	-13.1	2.0
9	Allaleckie Farm	296738, 694876 (296461, 695018)[1]	Main farmhouse building with various outbuildings (Survey undertaken on driveway of property)	0094.S3A, 0095.S3A	728.4	728.4	33.0	R-1	-22.4	0.7
10	Gartknowie Farm (at OHL)	297053, 694591 (297453, 694312)[1]	Main farmhouse building with various outbuildings (Survey undertaken adjacent to existing OHL)	0096.S3A, 0097.S3A	489.0	489.1	32.4	R-1	-19.2	1.0
11	Woodside	297611, 695048 (297666, 695007)[1]	Two-storey residential building	0098.S3A, 0099.S3A	389.2	389.3	31.4	R-2	-16.8	0.9
12	Residential Property	297997, 695315 (297907, 695303)[1]	Single-storey residence (Survey undertaken on driveway of property)	0100.S3A, 0101.S3A	534.1	534.2	30.9	R-1	-18.3	1.1
13	Wellhall House	297834, 696233	Two storey residential buildings with extensions.	0102.S3A, 0103.S3A	113.7	114.2	35.7	R-2	-13.0	1.9
14	Residential Property	297756, 696095	Two storey residential building with small outbuildings	0104.S3A, 0105.S3A	160.0	160.3	32.2	R-2	-11.8	1.8

Table B1: Information from Receptors Surveyed										
Location number	**Name**	**NSR Co-ordinates (Easting(m), Northing(m))**	**Property Type**	**File**	**Distance from line (m)[2]**	**Slant distance from line (m)[2]**	**Mean L_{90} (dB(A))**	**Miller Curve**	**Dry excess**	**Wet excess**
15	Coachman's House	297189, 696191	Large two-storey residential building	0106.S3A, 0107.S3A	410.5	410.6	30.1	R-2	-15.8	0.9
16	Gartgreenie Farmland (1)	296129, 693304	Farmland	0108.S3A, 0109.S3A	26.8	28.6	30.1	R-1	2.0	8.2
17	Gartgreenie Farmland (2)	296174, 693443	Farmland	0110.S3A, 0111.S3A	19.9	22.3	29.4	R-1	4.6	9.5
18	Cluster of Residential Properties	296342, 693049	A two-storey and separate one-storey residential property.	0112.S3A, 0113.S3A	349.9	350.0	28.3	R-2	-13.0	1.1
19	Gartgreenie Farm	295915, 693225 (295919, 693306)[1]	Main farmhouse building with various outbuildings (Survey undertaken on driveway of property)	0114.S3A, 0115.S3A	143.0	143.3	27.8	R-1	-6.6	3.5
20	Hazleyshaw Farm	295560, 692679 (295537, 692626)[1]	Main farmhouse building with various outbuildings (Survey undertaken near farmhouse outbuildings)	0116.S3A, 0117.S3A	171.3	171.5	25.5	R-1	-6.6	2.9
21	Starton Farm	295193, 692537 (295160, 692542)[1]	Main farmhouse building with various outbuildings (Survey undertaken near farmhouse outbuildings)	0118.S3A, 0120.S3A	73.0	73.7	25.8	R-1	-0.3	5.5

[1] *Actual residence locations. Locations could not be visited during the survey due to presence of dogs and thus a surrogate area was chosen to take the noise survey.*

[2] *Distance calculated from OHL to actual property coordinates.*

Appendix E

Noise Impact Assessment (Kincardine Substation)

Document No 13/6330/001/GLA/O/R/001

Issue : B1

Scottish Power Energy Networks

Kincardine Substation Reconfiguration
Noise Impact Assessment

May 2013

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ScottishPower Energy Networks

Kincardine Substation Reconfiguration

Noise Impact Assessment

SUMMARY:

ScottishPower Energy Networks proposes to construct a new 400kV GIS substation which is to be positioned adjacent to the existing 275kV substation at Kincardine. Two 400/275kV auto-transformers will be installed at this new substation. It has been confirmed that none of the other proposed plant and apparatus for the 400kV substation will produce noise. A noise impact assessment of the operational noise of the auto-transformers at the 400 kV GIS substation has been carried out on the basis of a baseline noise survey, the auto-transformer sound level supplied by the client, and a commonly adopted impact criterion. Three loading scenarios have been considered in this analysis, these being a non-loading, a 50%-loading and a 100%-loading scenario. The sound power levels for the 50% and 100%-loading scenarios are estimated figures.

It has been predicted that the criterion will be met at Hawkhill Farm, which is the only residential property within 500 m of the proposed 400 kV substation, for the non-loading and 50% loading scenarios. The criterion will not be met at Hawkhill Farm for the 100% loading scenario.

CLIENT: **ScottishPower Energy Networks**

CONTACT: Stephen Jack

DISTRIBUTION :

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Date of Issue	29 May 2013	**Classification:**	Confidential

AMENDMENT RECORD			
Revision	**Date**	**Changes from Previous Revision**	**Purpose of Revision**
A1	28/05/2013	None	First Draft
A2	29/05/2013	Minor amendments	Internal review
B1	29/05/2013	Minor amendments	Client issue

Contents

LIST OF FIGURES, TABLES AND EQUATIONS

FIGURES

TABLES

1 INTRODUCTION

ScottishPower Energy Networks proposes to construct a new 400 kV GIS substation which is to be located adjacent to the existing 275 kV substation at Kincardine. SgurrEnergy was engaged to perform an assessment of the impact of operational noise from the new substation and associated plant and report the results.

The analysis presented within this report is accompanied by the analysis in “Kincardine Overhead Transmission Line Background Noise Surveys, SgurrEnergy Ref: 13/6331/001/GLA/O/R/001”. Several visits were paid to the area around the proposed OHL line over the period 24 April 2013 to 15 May. A visit was made to the area considered in this report on the evening of the 24th of April 2013 at which time background noise surveys were performed. Noise impact assessments were completed on the basis of these measurements and the adopted criteria. The results of this investigation are reported herein together with recommendations.

2 ACOUSTIC DESCRIPTION OF THE AREA

The proposed 400 GIS kV substation is to be located adjacent to an existing substation, which is located to the north-west of Kincardine, Fife. Several major roads lie within close proximity to the proposed substation, these roads being the A977, A985, A876, M876 and M9. There was a significant amount of activity present on these roads at the time of the background noise survey and the accumulated noise from the traffic on these roads was clearly audible. There are no significant clusters of domestic residences near the existing or proposed substation. One residential property lies within close proximity of the existing and proposed substation, this being Hawkhill Farm. There were no domestic noises present during the survey. There was an absence of audible agricultural activities or overflying aircraft during the noise survey. There were birdsong and farm animal noises present during the survey period. At the time of the survey, there was no audible noise heard from the plant at the existing substation.

3 PROCEDURE AND IMPACT ASSESSMENT CRITERION

Annoyance due to noise is a wholly subjective phenomenon. There is no excess level of noise, from a source of dispute, over that which would exist in its absence that can be stated as tolerable. The likelihood of the contribution from a specific source to provoke complaints depends largely upon the noise level that would prevail at noise sensitive locations in the absence of contributions from the specific source. In this regard we are normally guided by criteria that are given in BS 4142 - Rating Industrial Noise Affecting Mixed Residential and Industrial Areas (Ref 1). If a noise impact assessment, conducted in accord with the provisions of BS 4142, shows that the contribution of the specific source, corrected for its character, is up to 5 dB in excess of the background noise level prevailing in the absence of the source then the likelihood of receiving complaints is marginal. If this excess is up to 10 dB then the indication is that complaints are likely to be provoked by the noise from the specific source. The smaller the excess the less likely is it to provoke complaints. If the received contribution, corrected for its character, can be shown to be 10 dB less than background, an excess of –10 dB, this can be taken as positive indication that complaints will not be provoked.

The assessment criterion proposed for the present case is that the likelihood of provoking complaint regarding normal operation of the 400 kV GIS substation and associated plant, at a quiet time of day in quiet weather conditions, should be no greater than marginal. That is the received noise attributable to the operation of the substation, corrected for its character and at a quiet time and calm weather condition, should be no greater than 5 dB above background noise level.

The guidance given in BS 4142 was adopted for this assessment.

Notwithstanding that the descriptor used for background noise, L90, excludes input from transitory events if measured over an adequately long interval, if an extraneous event, such as a local traffic occurrence, became audible during a measurement interval the acquisition of data was paused until the extraneous event became inaudible at which time data acquisition was resumed.

The predictions of the noise contribution at the sensitive receptor, attributable to the operation of the 400 kV GIS substation, were calculated in accord with the guidance of ISO 9613-2 Acoustics - Attenuation of sound during propagation outdoors – Part 2, General method of calculation (Ref 2). Several pessimistic assumptions were made in the propagation of noise from the 400 kV GIS substation. It was assumed that there would be no attenuation of noise due to air absorption or ground effects. Further, it was assumed that the 400 kV GIS substation will be in line of sight with the receptors and that there will be no topographical or other screening.

4 MEASURED PARAMETERS

4.1 L_{A90} (T).

4.2 L_{Aeq} (T).

4.3 One third octave bandwidth spectra (T).

Where T is a sufficiently long interval.

5 MEASUREMENT LOCATIONS

The locations where the background noise levels were surveyed were those appropriate for the outside amenity of sensitive premises nearest to the substation site. These were obtained from maps. The locations of the sites are given in the British National Grid co-ordinate system, Easting (m) and Northing (m).

5.1 Location 1: Hawkhill Farm (E292658, N688482): The survey at this area was carried out at the T-junction joining Hawkhill Road with the driveway leading to the Hawkhill Farm residential property. The dominant noise source was judged to be the distant road traffic on the nearby roads which consist of the A977, A985, A876, M876 and M9. Noise from agricultural animals and birdsong were present. The sound of running water was absent. No audible noise could be heard from the nearby substation. There were small trees present in the surrounding area but as there was no wind present, there was no contribution of noise from these sources.

6 MEASUREMENT TIMES AND DURATIONS

The noise survey was conducted during that time of day which included the most sensitive time for noise intrusion, namely that time of day when people are normally seeking slumber. This is taken to be 2200 hours to 0000 hours or somewhat later. The actual time of the survey is given in Table 1. The survey at Hawkhill Farm comprised of two contiguous measurement intervals of at least five minutes.

7 METEOROLOGICAL CONDITIONS

During the noise survey at residential dwellings the night was clear with no precipitation or wind. The meteorological conditions prevailing during the background noise survey therefore met the requirements of BS4142 (Ref 1).

8 INSTRUMENTATION

8.1 Bruel and Kjaer Type 2260 Sound Level Meter Serial Number 2044353.

8.2 Bruel and Kjaer Type 4230 SLM Calibrator Serial Number 2052327.

The instrument was check calibrated shortly before the surveys began and again shortly after the surveys were complete. The meter read correctly on each occasion. Copies of the calibration certificates are available from SgurrEnergy upon request.

9 RESULTS

The locations where the files were obtained, together with the measured results for the required noise descriptor, are listed in Table 1.

Table 1: Measured Background Noise Levels

Receptor	File No	Date	Time	L_{A90} [dB(A)]
1	File :0057.S3A	2013 Apr 24	22:00:11	42.2
“	File :0058.S3A	2013 Apr 24	22:06:15	40.6

The measured third octave band spectra are shown in Figure 1.

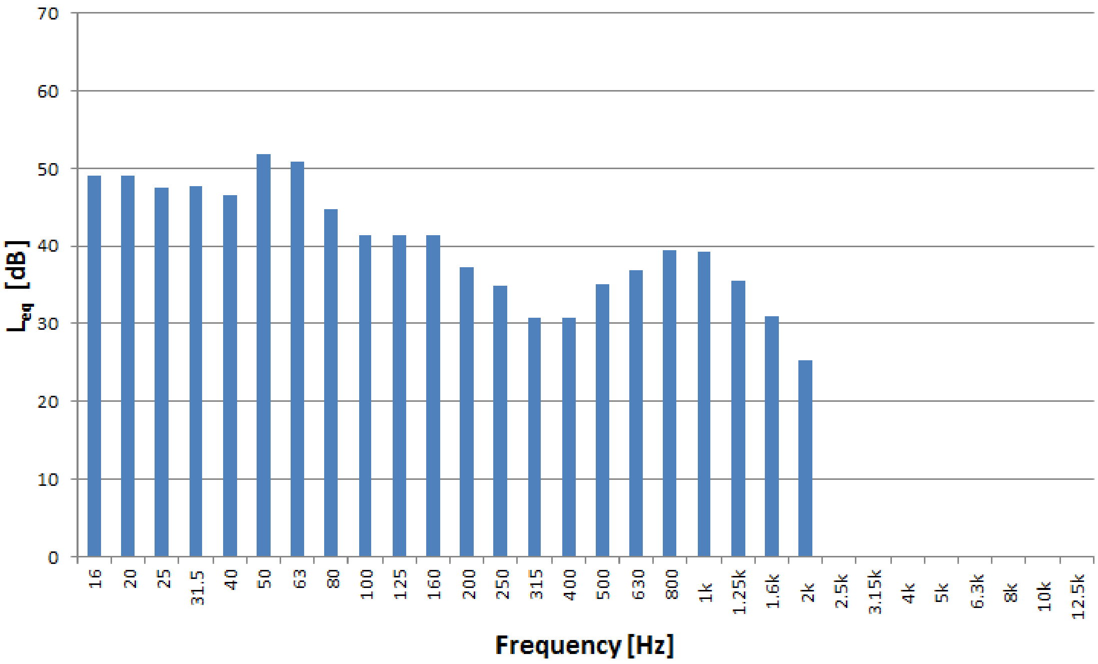


Figure 1: 1/3 Octave Band Spectrum at Hawkhill Farm (Single Measurement)

10 CALCULATIONS

The Client has confirmed that the plant that will produce noise at the new 400 kV substation will be two auto-transformers. The sound power level for these auto-transformers is 87 dB (A) without load, 96 dB (A) with 50% load and 102 dB (A) with 100% load. It should be noted that the values for the 50% and 100%-load are estimated. These values have been supplied by the Client for the purpose of this study.

The calculations for the noise contribution predicted to arise from the operation of the auto-transformers in the new 400 kV GIS substation are presented for the no-load, 50% load and 100% load scenarios in Table 2, Table 3 and Table 4 respectively. Ground effects on the propagation of sound have been neglected. It is also assumed that, as the fundamental frequency is low, air absorption of noise will be negligible over the distances between the substation and the near noise sensitive receptors.

Narrow band frequency data was not available for the auto-transformers, however it is assumed that the noise will be predominantly at 100 Hz and a 5 dB tonal penalty has been applied. The “intrusion” shown in these tables is the excess over (background noise + 5 dB), at which point the likelihood of complaint is considered to be more than marginal.

Table 2: Impact of Noise from Auto-Transformers (Non-Loading)

Receptor	Distance SGT1	Distance SGT2	Received SGT1	Received SGT2	Σ	B/G + 5 dB(A)	Intrusion
1	405	422.5	31.9	31.5	34.7	46.5	-11.8

Table 3: Impact of Noise from Auto-Transformers (50%-Loading)

Receptor	Distance SGT1	Distance SGT2	Received SGT1	Received SGT2	Σ	B/G + 5 dB(A)	Intrusion
1	405	422.5	40.9	40.5	43.7	46.5	-2.8

Table 4: Impact of Noise from Auto-Transformers (100%-Loading)

Receptor	Distance SGT1	Distance SGT2	Received SGT1	Received SGT2	Σ	B/G + 5 dB(A)	Intrusion
1	405	422.5	46.9	46.5	49.7	46.5	3.2

11 DISCUSSION

It can be seen from Table 1 that the average background noise, L_{A90}, at the residential receptor locations varied between 40.6 dB(A) and 42.2 dB(A) for the surveys conducted. The criterion level, which is not to be exceeded, for a marginal likelihood of provoking complaint is 46.5 dB. This value has been calculated from the average of the two background readings (41.5 dB) plus 5 dB.

The sound power level for these auto-transformers to be installed at the new 400 kV GIS substation is 87 dB (A) for no load, 96 dB (A) (estimated) for 50% load and 102 dB (A) (estimated) for 100% load. These levels were provided by the Client.

The assessment criterion proposed for the present case is that the received noise attributable to the operation of the auto-transformers, corrected for their character and at a quiet time and calm weather condition, should be no greater than 5 dB above background noise level.

Table 2, Table 3 and Table 4 show the levels of noise predicted to be received at Hawkhill Farm from the operation of the auto-transformers at the 400 kV GIS substation.

It can be seen from the results summarised in Table 2 and Table 3 that the received noise is predicted to meet the criterion level with no load and with 50% load. It can be seen in Table 4 that the criterion is not met with 100% load.

12 CONCLUSIONS

A noise impact assessment has been performed for the operational noise from the proposed 400 kV GIS substation that is to be located adjacent to the existing 275 kV substation. It has been confirmed by the Client that two auto-transformers installed at the new substation will be the only plant to emit any noise at the new substation. Three load states have been considered in the noise impact analysis, these being no load, 50% load and 100% load. The sound power levels provided for the 50% and 100% load are estimated.

It has been shown that the level of noise predicted to be received, corrected for the character of the noise, meets the adopted criterion for no load and for 50%load but not for 100% load.

It should be noted that several pessimistic assumptions regarding the propagation of noise from the substation and so it is likely that the level of noise received at Hawkhill farm will be less than the values calculated within this report.

13 RECOMMENDATIONS

It is recommended that the local authority officer be asked to endorse the impact assessment criterion adopted herein.

The Client should consider what levels of mitigation are required, taking into account the likely loading of the transformers. SgurrEnergy can advise on the performance that can be expected of different palliative treatments.

REFERENCES

1. British Standard 4142: 1997 – ‘Rating Industrial Noise Affecting Mixed Residential and Industrial Areas’.
2. ISO 9613-2 ‘Acoustics - Attenuation of sound during propagation outdoors – Part 2, General method of calculation’.

APPENDIX A: GLOSSARY OF TERMS

GENERAL ACOUSTICAL DESCRIPTIONS

Sound

The word sound describes everything that the ears can hear; it can be music, spoken words, traffic, wind or just noise. The word noise is often used to describe unwanted sound. The properties of sound can be given objectively in physical terms. As a result of the psychological and physiological differences between individuals, reactions of persons or animals to noise, such as being disturbed or annoyed, are subjective and therefore difficult to predict.

Sound Power

Most sound sources can be conveniently described by giving their rate of production of noise energy. This rate is called sound power and has the symbol W (unit Watt). Sound power is intrinsic to a sound source; it is independent of influences resulting from interaction with the surrounding environmental acoustic features.

Sound Power Level, LW or SWL

Ten times the logarithm to the base 10 of the ratio of the source sound power, W, to a standard reference power, W_{ref}, of standardised value, 1 picowatt. In this form the sound power is expressed as a level in decibels.

Sound Pressure

The increase or decrease in the atmospheric pressure due to the passage of a sound wave. The unit of measure in the SI system of units is the Pascal, (Pa). The human ear can detect sound pressure over a range from 20 micropascals to 20 Pascals. The sound pressure by itself is not characteristic of the sound source. The sound pressure is dependent on the sound power of the source, distance from the source and acoustic features in the environment surrounding both source and receiver.

The Decibel

Sound pressure and sound power are expressed on a logarithmic scale simply because of the large difference in linear terms between the weakest and strongest audible sounds perceived by humans. The word level is added to indicate the use of a scale. The decibel is therefore not a unit of measurement.

Sound Pressure Level, L_p or SPL

Ten times the logarithm to the base 10 of the square of the ratio of the effective or root mean square of the sound pressure fluctuations, P, and a standard reference pressure, P_{ref}, of 20 micropascals. In this form the sound pressure is expressed as a level in decibels.

A-weighting

The human ear is not equally sensitive over the audible spectrum. It is most sensitive at frequencies around 4000Hz. It is much less sensitive at low frequencies. This non linearity is level dependent. In order to make the reading of the sound level meter correspond to loudness as perceived by normal human hearing frequency weighting is employed. The internationally standardised ‘A’ weighting is designed to mimic hearing response at a loudness of 40 Phons. Response to noise has been found to correlate well with levels measured using this weighting.

Typical Approximate Noise Levels	
Source	**Sound Pressure Level dB(A)**
Whisper	30
Library Reading Room	40
Quiet Office	50
Normal Conversation at 1m	60
Noisy Office	70
Domestic Vacuum Cleaner at 1m	80
Factory Machinery	90

Frequency

The time rate of repetition measured in number of cycles per second, expressed as Hertz (abbreviated to Hz).

NOISE MEASUREMENTS AND INSTRUMENTATION

Sound Level Meter (SLM)

An instrument used to measure sound in an accurate reproducible manner.

dB (A)

This indicates that the A - weighting has been applied to the measurements.

BS 4142:1997 ACOUSTICS DESCRIPTORS

Specific noise source

The noise source under investigation.

Ambient noise

Totally encompassing sound in a given situation at a given time.

Residual noise

The ambient noise remaining when a specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

Background noise level, $L_{A90,\ T.}$

The A-weighted percentile sound pressure level of the residual noise exceeded for 90% of a given time interval, T.

Equivalent continuous sound pressure level, $L_{eq,T.}$

The equivalent continuous steady sound pressure level that gives the same noise exposure as a fluctuating noise measured over the same time interval.

Reference time interval, T_r

The time interval to which an equivalent continuous A-weighted sound pressure level can be referred. It should be specified to cover typical human activities and variations in operations of sources.

Measurement time interval, T_m

The total time over which measurements are taken. It should be chosen so that all significant variations in noise emission and transmission are covered.

Appendix F

Electro-Magnetic Fields (EMFs) Impact Assessment

Electric and Magnetic Fields

Introduction

This chapter considers issues related to the electric and magnetic fields produced by the proposed development, that is, by the existing overhead line from Kincardine to Blairingone after it is uprated from 275 kV to 400 kV, and by the new 400 kV substation at Kincardine adjacent to the existing 275 kV substation.

Electric and magnetic fields (often referred to as EMFs) and the electromagnetic forces they represent are an essential part of the physical world. Their sources are the charged fundamental particles of matter (principally electrons and protons). Electromagnetic forces are partly responsible for the cohesion of material substances and they mediate all the processes of chemistry, including those of life itself. Electric and magnetic fields occur naturally within the body in association with nerve and muscle activity. Humans also experience the natural static magnetic field of the Earth (to which a magnetic compass responds) and natural static electric fields in the atmosphere.

The basic elements for describing all types of electrical activity are voltage and current. “Voltage” is a measure of intensity, and is often described as being similar to pressure within gases or liquids. Voltages are measured in volts, with the symbol “V”, and often with a prefix used to indicate either very small or very large measurements, for example, mV indicating one thousandth of a volt or kV indicating one thousand volts. Electrical “current” relates to the quantity or rate of electricity flowing through an electrical conductor, and is measured in amperes (symbol “A”). Current measurements are also often qualified with a relevant prefix letter for very small or very large measurements. “Magnetism” is a complex interaction between voltage and current, and is a fundamental element of all electrical activity.

An “electric field” is created in any space between points that are at different levels of voltage. It describes the pattern of changing voltage between these points, since the voltage must change from one level to the other level across the space. The intensity of the field is dependent on the voltage difference, and on the size and nature of the space. “Magnetic fields” are created whenever current flows through a conductor. The intensity of a magnetic field is dependent on the amount of current flowing in the conductor and on distance away from the conductor. In air spaces, magnetic fields fall in intensity as the distance from the source increases.

Electric-field strengths are measured in volts per metre (symbol V/m) or kilovolts per metre (kV/m). One kilovolt per metre is one thousand volts per metre. For simplicity, volts per metre are used throughout this Chapter. Magnetic fields are usually measured in microteslas (symbol μT) or nanoteslas (nT). One nanotesla is one thousandth of a microtesla. For simplicity, microteslas are used throughout this Chapter.

Electric and magnetic fields occur in the natural world, and people have been exposed to them for the whole of human evolution. The advent of modern technology and the wider use of electricity and electrical devices have inevitably introduced changes to the naturally occurring EMF patterns. Energised high-voltage power-transmission equipment, along with all other uses of electricity, is a source of EMFs. These EMFs have the same frequency as the voltages and currents that produce them, which is 50 herz (Hz) in the UK. The fields are described as power-frequency or extremely-low-frequency (“ELF”) alternating electric and magnetic fields, and they add to (or modulate) the Earth's steady natural fields. The strength (or amplitude) of the electric-field modulation depends on the voltage of the equipment, which remains more or less constant as long as the equipment is energised. The strength of the magnetic-field modulation depends on the current (often referred to as the load) carried by the equipment, which varies according to the demand for power at any given time. Since field strengths are constantly varying, they are usually described by reference to an averaging calculation known as the “root mean square” or RMS. Future mention of power-frequency field strengths in this chapter will mean the RMS amplitude of the power-frequency modulation of the total field, which is the conventional scientific way of expressing these quantities.

EMFs at much higher frequencies can, however, be generated by other devices, e.g. radio, television transmissions and microwaves. These higher frequencies interact with objects and people in a rather different way to power frequencies, for example by heating of the body, and it is important to make the distinction. For X-rays and gamma rays, the small discrete packets called photons, which carry the energy, are capable of ionising, that is, breaking bonds in individual molecules or atoms. Such disruption can sometimes damage living material. For visible light and all lower frequencies, this process of ionisation by individual photons cannot happen. Overhead lines produce fields only at frequencies well below those of visible light. The term "non-ionising" radiation is often applied to these frequencies.

The word "radiation" itself usually relates to the effects of, for example, X-rays and nuclear waste, or the heating effects of microwave appliances, where a key characteristic is that the electric and magnetic fields are coupled together in a way that propagates through space. The power-frequency fields associated with high-voltage lines do not cause these effects or have these characteristics. They are referred to, technically, as "induction" or "near" fields, and not "radiated" or “far” fields. Thus, at power frequencies, even the term "radiation" is not strictly appropriate since power is not radiated away.

At high enough levels, EMFs have established direct effects on the human body, sometimes described as “acute” effects. A power-frequency magnetic field induces a small current in a person exposed to it. In a magnetic field of strength 50 µT, the total induced current could reach approximately 15 microamperes (µA). By contrast, the current required to light a typical small torch bulb is 100,000 µA, and the smallest current which most people can perceive is around 500 µA. Magnetic fields have no directly perceptible effects on the body. A person standing in the electric field beneath a 400 kV overhead line would have an alternating surface charge induced on their body and an associated alternating current induced within the body. The induced surface charge could interact with the electric field to cause vibration of body hair, although the vibration would generally be too feeble to notice. In a power-frequency electric field of about 8000 V/m, the induced current in the body could reach approximately 100 µA. These currents that are induced in the body, if high enough, can interfere with the action of nerves; this is the principal effect protected against by the exposure limits, described in detail below.

In certain circumstances, a person exposed to a high electric field could experience small spark discharges (microshocks) on touching other objects, producing a prickling sensation similar to that caused by the static discharges commonly experienced in dry atmospheric conditions after frictional contact with a nylon carpet or car seat. These indirect effects are considered in greater detail later in this Chapter.

As well as these established effects, over the past 30 years it has been suggested that exposure to power-frequency magnetic or electric fields of the magnitude encountered in the environment could be linked with various health problems, ranging from headaches to Alzheimer's disease. The most persistent of these suggestions relates to childhood leukaemia. A number of epidemiological studies have suggested a statistical association between the incidence of childhood leukaemia and the proximity of homes to power transmission and distribution wires or power-frequency magnetic-field strengths in the homes. However, no causal link has been established between cancer (or any other disease) and magnetic or electric fields and indeed there is no established mechanism by which these fields could cause or promote the disease.

The question of possible health effects of environmental power-frequency fields has been thoroughly reviewed in recent years by a number of national and international bodies. The principal such bodies that have authoritative relevance in the UK are the Heath Protection Agency (HPA, formerly the National Radiological Protection Board, NRPB, now part of Public Health England, PHE), the International Agency for Research on Cancer, IARC, and the World Health Organization, WHO, the official scientific advisory committee for the EU the Scientific Committee on Emerging and Newly Identified Health Risks, SCENIHR, and the standards-setting body the International Commission on Non-Ionizing Radiation Protection, ICNIRP.

When assessing the scientific evidence on EMFs, it is essential to consider all the evidence and to perform an overall assessment of the evidence, weighting each strand of evidence and each individual study as appropriate to its strengths and weaknesses. No single study can ever be conclusive (in either direction). Such reviews have been performed by the authoritative expert bodies, and it is those bodies that provide the most reliable conclusions, and on whose conclusions Government policy is based. The following are summaries of the conclusions of these relevant authoritative review bodies.

NRPB/HPA

In 2004 the then NRPB published new “Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz)” (NRPB 2004a) and accompanied it with a “Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0-300GHz)” (NRPB 2004b). The former summarises epidemiological evidence as follows (p15):

> 54 “In the view of NRPB, the epidemiological evidence that time-weighted average exposure to power frequency magnetic fields above 0.4 µT is associated with a small absolute raised risk of leukaemia in children is, at present, an observation for which there is no sound scientific explanation.

There is no clear evidence of a carcinogenic effect of ELF EMFs in adults and no plausible biological explanation of the association that can be obtained from experiments with animals or from cellular and molecular studies. Alternative explanations for this epidemiological association are possible: for example, potential bias in the selection of control children with whom leukaemia cases were in some studies and chance variations resulting from small numbers of individuals affected. Thus any judgements developed on the assumption that the association is causal would be subject to a very high level of uncertainty.

55 “Studies of occupational exposure to ELF EMFs do not provide strong evidence of associations with neurodegenerative diseases…..

56 “Studies of suicide and depressive illness have given inconsistent results in relation to ELF EMF exposure, and evidence for a link with cardiovascular disease is weak.

57 “The overall evidence from studies of maternal exposure to ELF EMFs in the workplace does not indicate an association with adverse pregnancy outcomes, while studies of maternal exposure in the home are difficult to interpret.

58 “Results from studies of male fertility and of birth outcome and childhood cancer in relation to parental occupational exposure to ELF EMFs have been inconsistent and unconvincing.

59 “All these conclusions are consistent with those of AGNIR (2001).

60 “NRPB concludes that the results of epidemiological studies, taken individually or as collectively reviewed by expert groups, cannot currently be used as a basis for restrictions on exposure to EMFs.”

IARC

The International Agency for Research on Cancer (IARC) is an agency of the World Health Organization. Its Unit of Carcinogen Identification and Evaluation has, since 1972, periodically published Monographs, which assess the evidence that various agents are carcinogenic and classify the agents accordingly. In June 2001, a Working Group met to consider static and extremely-low-frequency electric and magnetic fields (IARC 2002). Power-frequency magnetic fields were classified as “possibly carcinogenic”, on the basis of “limited” evidence from humans concerning childhood leukaemia, “inadequate” evidence from humans concerning all other cancer types, and “inadequate” evidence from animals. Power-frequency electric fields were judged “not classifiable” on the basis of “inadequate” evidence from both humans and animals. These classifications are consistent with the conclusions reached by the NRPB.

WHO

The World Health Organization published an Environmental Health Criteria Monograph in 2007 on ELF EMFs (WHO 2007), produced by a Task Group that met in 2005. This concluded, in part:

“Chronic effects”

Scientific evidence suggesting that everyday, chronic low-intensity (above 0.3-0.4 µT) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukaemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease.

The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukaemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease."

SCENIHR

SCENIHR is the European Union's Scientific Committee on Emerging and Newly Identified Health Risks. On January 19 2009 SCENIHR published its most recent report on EMFs, "Health Effects of Exposure to EMF" (SCENIHR 2009). SP Transmission Ltd (SPT) understands that SCENIHR's next report is expected to be published during 2013). The section of the abstract concerned with power-frequency fields states:

"The few new epidemiological and animal studies that have addressed ELF exposure and cancer do not change the previous assessment that ELF magnetic fields are a possible carcinogen and might contribute to an increase in childhood leukaemia. At present, in vitro studies did not provide a mechanistic explanation of this epidemiological finding.

No new studies support a causal relationship between ELF fields and self-reported symptoms.

New epidemiological studies indicate a possible increase in Alzheimer's disease arising from exposure to ELF. Further epidemiological and laboratory investigations of this observation are needed.

Recent animal studies provided an indication for effects on the nervous system at flux densities from 0.10-1.0 mT. However, there are still inconsistencies in the data, and no definite conclusions can be drawn concerning human health effects.

Very few recent in vitro studies have investigated effects from ELF fields on diseases other than cancer and those available have very little relevance. There is a need for hypothesis-based in vitro studies to examine specific diseases.

It is notable that in vivo and in vitro studies show effects at exposure levels (from 0.10 mT and above) to ELF fields that are considerably higher than the levels encountered in the epidemiological studies (μT-levels) which showed an association between exposure and diseases such as childhood leukaemia and Alzheimer's disease. This warrants further investigation."

Resulting from and taking account of these authoritative reviews of the science, Government has set policy to provide appropriate protection to the public, as explained later in this Chapter. It is the policy of SPT that all of its assets should comply with the relevant Government policy on exposure levels. When considering

EMF issues in relation to an overhead line or substation, the key question is whether the line complies with Government policy on exposure levels. If an overhead line or substation were to be found not to be compliant with Government policy on exposure levels, there could be a safety issue and mitigation steps should be taken to bring the overhead line into compliance. Where, however, an overhead line is compliant, as this particular proposed uprated overhead line is, that adequately addresses any safety issue, and no further mitigation is needed.

Control of EMFs in the UK

There are no statutory regulations in the UK that limit the exposure of people to power-frequency electric or magnetic fields. However, responsibility for implementing appropriate measures for the protection of the public from EMFs lies with Government, who have a clear policy, restated in October 2009, on the exposure limits they expect to see applied. Practical details of how the policy is to be implemented are contained in Codes of Practice agreed between industry and Government.

Government in turn looks for scientific advice to Public Health England, which has responsibility for advising on non-ionising radiation protection, including power-frequency fields. The National Radiological Protection Board (NRPB) had this responsibility until it became part of the HPA on 1 April 2005, and the Health Protection Agency (HPA) had the responsibility until 1 April 2013. This Chapter refers to either NRPB or HPA according to the name at the time each statement was issued.

In March 2004 the NRPB provided new advice to Government (NRPB 2004a), replacing previous advice from 1993, and recommending the adoption in the UK of guidelines published in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998). The following table summarises the recommended values for power frequencies.

Occupational exposure levels	Electric fields	Magnetic fields
Basic restriction (induced current density in central nervous system)	10 mA/m^2	
Reference level (external unperturbed field)	10,000 V/m	500 µT
Public exposure levels	Electric fields	Magnetic fields
Basic restriction (induced current density in central nervous system)	2 mA/m^2	
Reference level (external unperturbed field)	5,000 V/m	100 µT

In recommending these levels, the NRPB considered the evidence for all suggested effects of EMFs. They concluded that the evidence for effects on the nervous system of currents induced by the fields was sufficient to justify setting exposure limits, and this is the basis of their quantitative recommendations. They concluded that the evidence for effects at lower fields, for example the evidence relating to childhood leukaemia, was not sufficient to justify setting exposure limits, but was sufficient to justify recommending that Government consider possible precautionary actions. The Government subsequently pronounced on which precautionary policies should apply, and which, including, specifically, any restrictions on how close to power lines residential properties should be allowed, should not apply, in October 2009, based on the conclusions of a stakeholder process.

Government formally responded to these new recommendations from the NRPB on 22 July 2004, in the form of a letter from the Minister for Public Health to the Chairman of the NRPB (DH 2004). The Annex to this letter states, in part:

> 7 "For all other sources [other than mobile telephony, and therefore including power lines] the Government expects the NRPB guidelines to be implemented in line with the terms of the EU Recommendation, that is, taking account of the risks and benefits of action. Preliminary discussions have already taken place to identify what reasonable actions might be taken."

The EU recommendation of 1999 (EU 1999), in line with whose terms the Government expects the NRPB recommendations to be implemented, states, in part:

> "Member States, in order to provide for a high level of health protection against exposure to electromagnetic fields, should:
> adopt a framework of basic restrictions and reference levels using Annex I.B [ie the same as in ICNIRP and as set out in 2.7 above] as the basis;
> implement measures according to this framework, in respect of sources or practices giving rise to electromagnetic exposure of the general public when the time of exposure is significant …[with exceptions for medical purposes]
> aim to achieve respect of the basic restrictions given in Annex II for public exposure"

The Government position was restated in a Written Ministerial Statement in October 2009 (DH 2009; references to the Written Ministerial Statement encompass both the Statement itself and the detailed Response that the Statement introduced). This reiterates the policy of compliance with the 1998 ICNIRP Guidelines in the terms of the 1999 EU Recommendation, and also introduces one additional precautionary policy relating to overhead lines, a policy of optimal phasing. It makes clear that these are the only policies relating to EMFs that power lines are expected to comply with.

These principles are given practical effect by two Codes of Practice, one on Compliance (DECC 2012a) and one on Phasing (DECC 2012b); these Codes were first issued in 2011 then reissued in 2012). National Policy Statement NPS EN-5 (DECC 2011) also reiterates the policy and gives force to the Codes of Practice.

This policy applies in Scotland as in the rest of the UK. The Written Ministerial Statement set policy for the whole of the UK (though recognising that aspects of the implementation might be matters for devolved administrations). The two Codes of Practice are explicitly adopted both by the Scottish Executive and by SPT (though its membership of the Energy Networks Association). National Policy Statement EN-5 was created in the context of the planning system as it exists only in England and Wales, but the principles it sets out are of relevance to the whole UK.

Numerical values of exposure limits

The ICNIRP guidelines recommend that the general public are not exposed to levels of EMFs able to cause a current density of more than 2 mA/m^2 within the human central nervous system, as shown in the table. This recommendation is described as the “basic restriction”. The external fields that have to be applied to the body to cause this current density have to be calculated by numerical dosimetry.

The ICNIRP guidelines also contain values of the external fields called “reference levels”. For the public, the reference level for electric fields is 5 kV/m, and the reference level for magnetic fields is 100 µT. The 1999 EU Recommendation uses the same values as ICNIRP.

In the ICNIRP guidelines and the EU Recommendation, the actual limit is the basic restriction. The reference levels are not limits, but are guides to when detailed investigation of compliance with the actual limit, the basic restriction, is required. If the reference level is not exceeded, the basic restriction cannot be exceeded and no further investigation is needed. If the reference level is exceeded, the basic restriction may or may not be exceeded.

The Code of Practice on Compliance (DECC 2012a) endorses this approach and gives the values of field corresponding to the basic restriction, stating:

> “The 1998 ICNIRP exposure guidelines specify a basic restriction for the public which is that the induced current density in the central nervous system should not exceed 2 mA m^{-2}. The Health Protection Agency specify that this induced current density equates to uniform unperturbed fields of 360 µT for magnetic fields and 9.0 kV m^{-1} for electric fields. Where the field is not uniform, more detailed investigation is needed. Accordingly, these are the field levels with which overhead power lines (which produce essentially uniform fields near ground level) shall comply where necessary. For other equipment, such as underground cables, which produce non-uniform fields, the equivalent figures will never be lower but may be higher and will need establishing on a case-by-case basis in accordance with the procedures specified by HPA. Further explanation of basic restrictions, reference levels etc is given by the Health Protection Agency.”

Therefore, if the fields produced by an overhead line are lower than 9 kV/m and 360 µT, the fields required to produce the ICNIRP basic restriction, it is compliant with the ICNIRP guidelines and hence with HPA recommendations and Government policy. If the fields are greater than these values, it is still compliant with Government policy if the land use falls outside the residential and other uses specified in the Code of Practice.

The proposed uprated overhead line and the proposed substation both comply with the 1998 ICNIRP Guidelines and the policy on phasing and therefore with Government policy. This is demonstrated in more detail below.

As already discussed, there is some scientific evidence suggesting that electric or, particularly, magnetic fields may have health effects at levels below the exposure guidelines. The authoritative classification is the World Health Organization's, in 2001 and reiterated in 2007, that power-frequency magnetic fields are "possibly" a case of cancer, specifically just of childhood leukaemia, with the evidence relating to any other health effect "much weaker". This scientific evidence was considered fully in the process of establishing the exposure guidelines that apply in the UK. Those exposure guidelines together with the policy on optimal phasing are considered by the HPA and Government to be the appropriate response to that evidence.

Government have specifically rejected the introduction of "corridors" round power lines on EMF grounds, stating of this option (DH 2009 paragraph 4):

> "The Government therefore considers this additional option to be disproportionate in the light of the evidence base on the potential health risks arising from exposure to ELF/EMF and has no plans to take forward this action."

Having thus established that it is not Government policy to have restrictions on homes and schools near power lines, the Statement goes on to say (paragraph 38):

> "It is central Government's responsibility (rather than individual local authorities) to determine what national measures are necessary to protect public health."

This makes it clear that Government has not introduced any restrictions on constructing new power lines close to existing properties on grounds of safety or health risks, and neither is it appropriate for individual local authorities to do so.

Therefore, no additional measures or precautions are necessary or appropriate beyond the exposure guidelines and the policy on optimal phasing.

Field magnitudes

The magnetic field produced by a current in a conductor falls with distance from the conductor. Where there is more than one current forming part of one or more electrical circuits, there is also partial cancellation between the magnetic fields produced by the individual currents, and that cancellation generally becomes proportionately better at greater distances. Overall, the magnetic field is highest at the point of closest approach to the conductors and falls quite rapidly with distance. Similarly, there is partial cancellation between the electric fields produced by the voltages on individual conductors, and the electric field is usually highest at the point of closest approach to the conductors and falls quite rapidly with distance.

Baseline conditions

Electric and magnetic fields both occur naturally. The Earth's magnetic field, which is caused mainly by currents circulating in the outer layer of the Earth's core, varies between about 30 µT at the equator and about 60 µT at the poles and is roughly 50 µT in Scotland. This field may be distorted locally by ferrous minerals or by steelwork such as in buildings. At the Earth's surface there is also a natural electric field, created by electric charges high up in the ionosphere, of about 100 V/m in fine weather. Below a storm cloud containing large quantities of electric charge, the field may reach intensities up to 20,000 V/m over flat surfaces, while above hillocks or other irregularities or near the tops of objects such as trees, the field strength can be considerably higher. In mountains, for instance, the presence of these fields produces electrical discharges and crackling noises on sharp ridges and on the ends of ice picks. Sailors throughout the centuries have observed this same phenomenon, known as Saint Elmo's Fire, at the tops of the ships' masts. The cause of this effect is local ionisation of the air. Scientists describe this as the “corona discharge” effect, and the ions so created as “corona ions”.

As already explained, the earth’s natural fields are static, and the power system produces alternating fields. In homes in the UK that are not close to high-voltage overhead lines or underground cables, the average “background” power-frequency magnetic field (the field existing over the whole volume of the house) ranges typically from 0.01 – 0.2 µT with an average of approximately 0.05 µT, normally arising from currents in the low-voltage distribution circuits that supply electricity to homes. The highest magnetic fields to which most people are exposed arise close to domestic appliances that incorporate motors and transformers. For example, close to the surface, fields can be 2000 µT for electric razors and hair dryers, 800 µT for vacuum cleaners, and 50 µT for TVs and washing machines. The electric field in most homes is in the range 1-20 V/m, rising to a few hundred V/m close to appliances.

The existing overhead line, operating at 275 kV, produces maximum fields of approximately 5600 V/m and 44 µT (assessed using the same conditions as for the uprated line and explained in detail below), dropping off to the sides of the line.

The largest fields round the existing substation are produced by the overhead lines entering it. In comparison, the substation is not a significant source of field in its own right.

Construction

There is no activity during the construction phase that produces significant EMFs. Conversely, there are no EMF issues that affect the way construction is carried out.

Fields from uprated overhead line

Calculations are performed here for the proposed uprated overhead line for both electric fields and magnetic fields. Calculations are the best way of assessing fields in these circumstances and are acceptably accurate. The calculations of fields presented here follow the provisions specified in the Code of Practice on

Compliance (DECC 2012a) and were performed using specialised computer software that has been validated against direct measurement (Swanson 1995).

To assess compliance with exposure limits, the Code of Practice specifies that the maximum fields the line is capable of producing should be calculated using the following conditions:

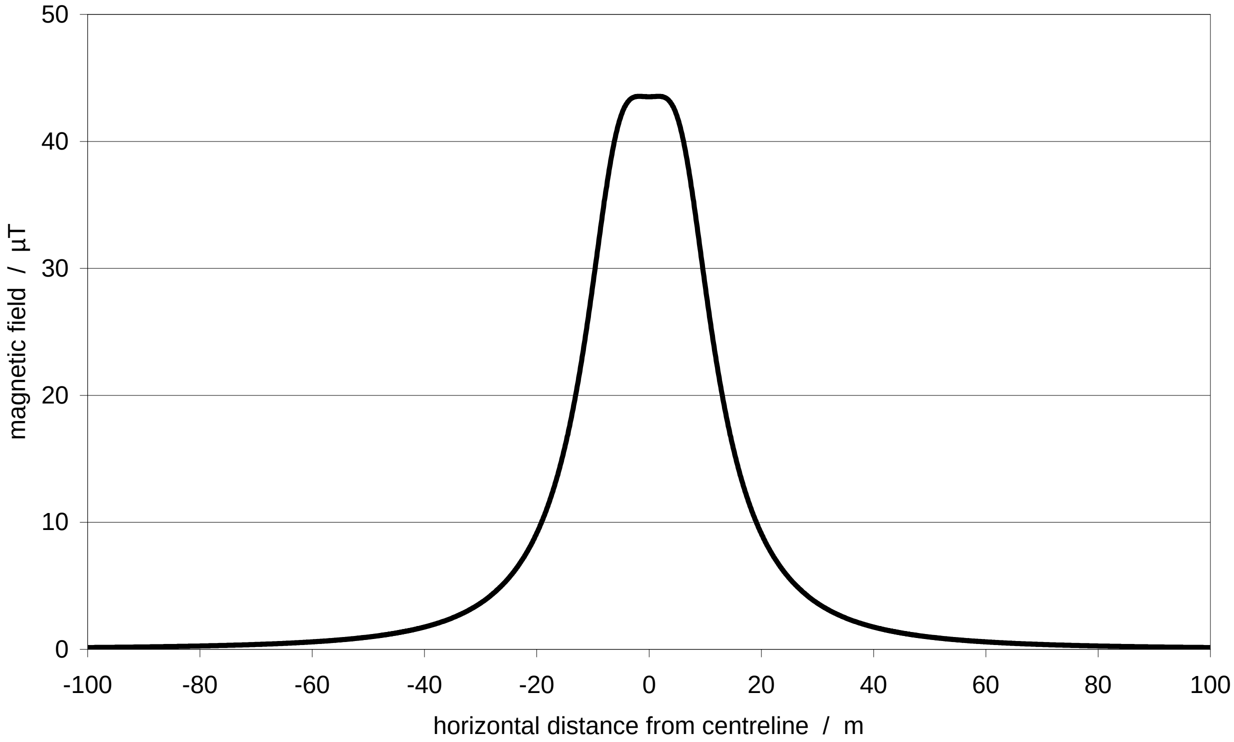
- For electric fields: for nominal voltage and design minimum clearance
- For magnetic fields: for the highest rating that can be applied continuously in an intact system (ie including ratings which apply only in cold weather, but not including short-term ratings or ratings which apply only for the duration of a fault elsewhere in the electricity system) and design minimum clearance
- For both electric and magnetic fields: for 1 m above ground level, of the unperturbed field, taking account of the correct wire type and bundle size, taking account of the basic tower geometry for the design of overhead line in question, but ignore variations in wire spacing at angle towers etc, of the 50 Hz component ignoring harmonics, ignoring zero-sequence currents and voltages and currents induced in the ground or earth wire, and using the infinite-straight-line approximation.

The proposed uprated overhead line will be a double-circuit line of L2 construction operating with both circuits at 400 kV and with transposed phasing. The highest rating that will be able to be applied continuously in an intact system is a power of 1340 MVA per circuit, equivalent to a current of 1930 A per circuit. The design minimum ground clearance is 7.6 m as specified in the industry standard 43-8 (ENA 2004).

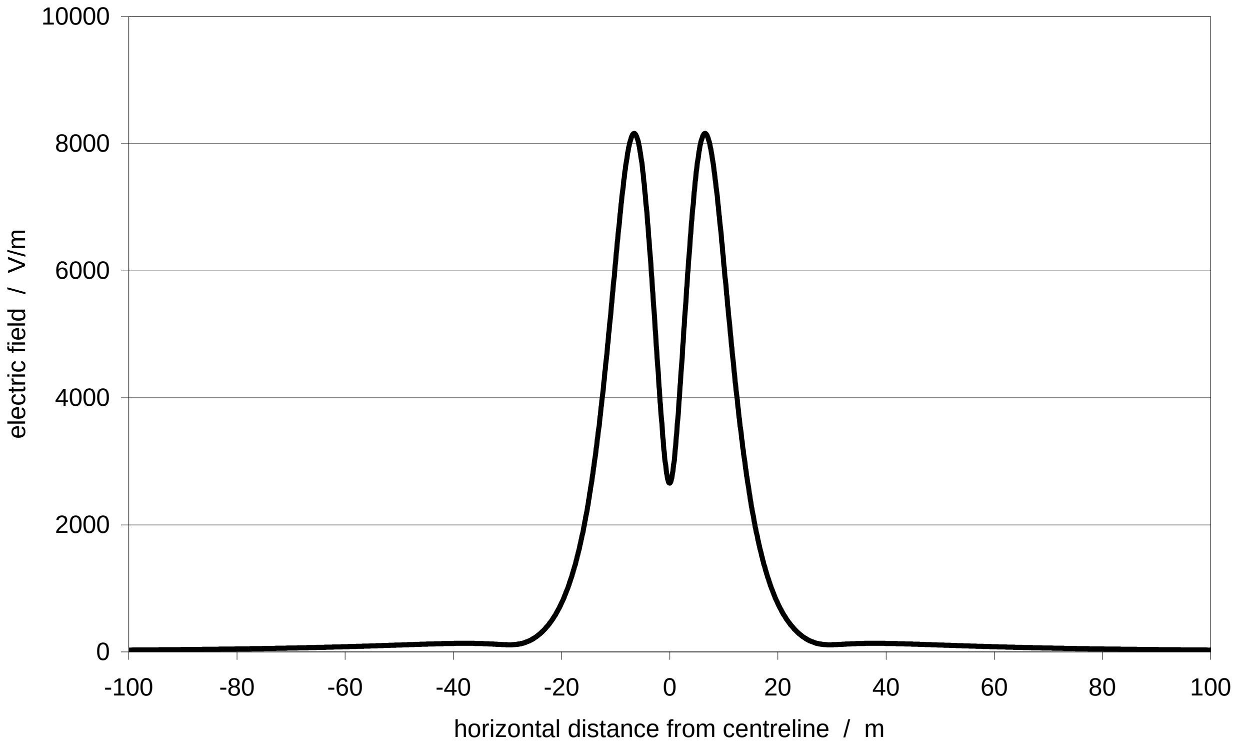
In order to assess compliance with exposure limits, it is sufficient just to calculate the field at the position lateral to the route where it is a maximum. This position is always somewhere between the centreline and the outermost conductors but the exact position varies depending on the clearance of the line. On this basis, the maximum electric field is calculated as 8160 V/m and the maximum magnetic field as 43.5 µT.

In addition to the calculations of maximum field, the following graphs show how the fields fall off with lateral distance from the overhead line.

Magnetic field:



Electric field:



Electric fields (but not magnetic fields) are readily perturbed by conducting objects, including buildings, fences, trees, etc. The fields calculated here are unperturbed fields, as specified by the Code of Practice. These give a valid indication of the size of any electric-field related phenomena over the area concerned, but the local value, close to a source of perturbation, would vary. In practice, perturbations within or to the sides of buildings and other fixed objects usually act so as to reduce, not increase, the electric field. Fields inside any buildings are generally much reduced. But in any event, the Code of Practice specifies that it is acceptable to demonstrate compliance by reference to the unperturbed fields.

The preceding calculations are for the maximum continuous current the line could carry and hence for the maximum field. However, in practice, the current that is carried is lower than the maximum (and also clearances above ground are usually greater than the design minimum clearance). Predictions of future typical loads are difficult as they depend on patterns of loads and generation which change from year to year, and there is no standard definition of “typical”. However, across the transmission system as a whole, data suggest that typical loads are 30% or less of ratings. An indication of typical magnetic fields can be obtained by multiplying the maximum magnetic fields or the values from the graph by 30%. Electric fields, of course, which depend directly only on the voltage, are practically the same for typical conditions as for maximum conditions.

Fields from extended substation

Fields from the equipment contained within substations fall quite rapidly with distance, and outside the perimeter fence, are usually at background levels, or fall to background levels within a few metres. The highest fields around a substation are caused by the overhead lines entering them. The proposed substation is of Gas Insulated Switchgear (GIS) construction, which eliminates the external electric field altogether, and substantially reduces the magnetic field compared to other designs.

Compliance with Government policy on EMFs

The key document for considering details of compliance with exposure guidelines is the Code of Practice on Compliance (DECC 2012a). This Code of Practice is agreed jointly by, inter alia, the relevant Westminster Government departments (Health, and Energy and Climate Change), the Scottish Executive, and the Energy Networks Association, which includes SPT. The status of the Code of Practice is explained thus:

> “The Electricity Industry agrees that whenever evidence is required of compliance with EMF exposure limits, it will provide evidence according to this Code of Practice. Government agrees that such evidence will be regarded as sufficient to demonstrate compliance.”

Compliance of Overhead line

As explained above, the Code of Practice on Compliance specifies that the exposure limits for members of the public should be taken as 9000 V/m and 360 µT. The maximum fields produced by the proposed uprate overhead line were calculated above as 8160 V/m and 43 µT. These are less than the exposure limits, and therefore the line will be compliant.

In fact, the Code of Practice specifies that these public limits apply only to certain land uses where the public are deemed to spend significant periods of time, and not to the generality of land. However, as the maximum fields produced anywhere by the line are less than the limits, it is not necessary to consider land uses further.

The Written Ministerial Statement also creates a new policy for double-circuit power lines, concerning a design feature called “phasing”. Phasing is the order in which the conductors of the two circuits are connected relative to each other, and certain phasings produce lower magnetic fields than others. This policy arose because, as explained in Section 2, in 2004, the NRPB had recommended that Government consider possible precautionary measures. This resulted in the creation of the Stakeholder Advisory Group on ELF EMFs (SAGE). SAGE published its First Interim Assessment in April 2007. This contained some Recommendations made to Government. One of those applies to power lines which carry two circuits and concerns the relative phasing of the two circuits. The Written Ministerial Statement (DH 2009) gives the Government response to this recommendation on phasing, stating (paragraph 50):

> “The Government agrees with the SAGE recommendation and urges industry to optimal phase overhead lines wherever possible and reasonable. We will proactively work with industry to consider how best to take this forward. This might include developing a voluntary code of practice on phasing for voltages of 132kV and above.”

Such a Code of Practice was subsequently created (DECC 2012b).

The proposed uprated overhead line will have transposed phasing and will therefore comply with the policy on phasing.

As explained above, there is no requirement or encouragement in Government policy for SPT to maintain any particular separation between the power line and homes on grounds of EMFs, and no justification to move the power line in order to maintain any particular separation.

Thus, the proposed uprated power line will meet the relevant exposure guidelines, the ICNIRP general public guidelines in the terms of the EU Recommendation; it complies with the Government policy on phasing; and that there are no other restrictions on grounds of EMFs, health or safety applying to power lines.

Nearby homes

The analysis presented above shows that the maximum value of the fields produced by the proposed uprated line will be compliant with the relevant exposure limits, even directly under the line. There is no minimum lateral distance from the line required in order to achieve compliance. In principle, subject to maintaining the relevant high-voltage safety clearance distances (which principally relate to the vertical clearance of the line above the ground), a home could be constructed directly underneath the line and it would be compliant with the guidelines.

The assessment of compliance is therefore not dependent on the exact location of the nearest existing residential property to the line, or the nearest putative property already granted planning permission, or the nearest property that might in future be granted planning permission, because the field from the line is everywhere compliant, not just compliant outside some specified distance. This is confirmed by the Code of Practice on Compliance (DECC 2012a) specifies:

> "…the following will be provided:
> • A calculation or measurement of the maximum fields (ie directly under the line, or directly above the cable)
> If this maximum value is less than the ICNIRP guideline levels, it may be assumed that all fields and exposures from that source will be compliant. If this maximum value exceeds the ICNIRP guideline levels, then it is also necessary to provide:
> • A calculation or measurement of the field at the location of the closest property at which the public exposure guidelines apply" (p5)

However, although not required for assessing compliance, the graphs presented above can be used to estimate the maximum fields at any given distance from the line.

Compliance of substation

It was explained above that the fields from the proposed substation will be smaller than those from the overhead line. Therefore, as the overhead line is compliant, the substation will also be compliant with the guideline levels.

The Code of Practice on Compliance (DECC 2012a) confirms this, spelling out explicitly that there are certain classes of equipment which inherently produce fields below the guideline levels, and can therefore be assumed to comply without producing case-by-case specific assessments of the field. Substations are one such type of equipment:

> "The Energy Networks Association will maintain a publicly-available list on its website of types of equipment where the design is such that it is not capable of exceeding the ICNIRP exposure guidelines, with evidence as to why this is the case. Such types of equipment are likely to include:
> • overhead power lines at voltages up to and including 132kV
> • underground cables at voltages up to and including 132kV
> • substations at and beyond the publicly accessible perimeter
> Compliance with exposure guidelines for such equipment will be assumed unless evidence is brought to the contrary in specific cases."

The publicly available list referred to can be found at http://www.emfs.info/Related+Issues/limits/UK/Compliance/ and links from it, specifically http://www.emfs.info/Related+Issues/limits/UK/Compliance/substations.htm, and (at the date of publication of this Chapter) includes substations. Therefore, in accordance with the Code of Practice, compliance with the exposure guidelines is assumed without considering any further specifics of this particular substation.

Occupational exposure

The ICNIRP occupational guidelines are higher than the public guidelines, by, broadly, a factor of five. Therefore any occupational activities will also be compliant with the relevant guidelines.

The occupational guidelines do not yet have a clear paper trail of implementation in the UK in the way that the public exposure guidelines do. It is anticipated that occupational limits (based on ICNIRP 2010 rather than ICNIRP 1998, see below) will acquire legal force through an EU Directive expected to be adopted in Europe in 2013 and subsequently brought into force in the UK by Regulation. The present situation is that they have force through the Health and Safety Executive's endorsement of them.

Employers have a duty of care. Employers discharge that duty of care in relation to EMFs by complying with the relevant exposure limits. All exposures from the proposed development will be compliant with the occupational exposure limits; an employer need take no additional action in order to comply.

Future changes

As discussed, current Government policy is based on the limits from the 1998 ICNIRP Guidelines, in the terms of the 1999 EU Recommendation. In 2010, ICNIRP published new exposure guidelines (ICNIRP 2010) for the range of frequencies including power frequencies. These new guidelines do not apply in the UK unless and until Government decide to adopt them. This is spelled out in the Code of Practice on Compliance (DECC 2012a):

> "Current Government policy on electric and magnetic fields (EMFs) is that power lines should comply with the 1998 ICNIRP Guidelines on exposure to EMFs in the terms of the 1999 EU Recommendation, and this Code of Practice implements this policy. As and when either ICNIRP issue new Guidelines or the EU revise the Recommendation, it will be for Government to consider those changes and to decide whether to adopt them or not. If Government policy changes, this Code of Practice will also be changed accordingly, but until that happens, the present policy as reflected in this Code of Practice remains in force."

In fact, ICNIRP's intention in its new guidelines does not appear to be to make the guidelines either more or less onerous. It takes account of the most recent scientific developments. But having done so, the key scientific effects used as the basis for the guideline levels are essentially unchanged, and the safety margins applied are broadly unchanged. The detailed values derived as basic restrictions and reference levels have changed, but this is principally a consequence of a different method of derivation, without representing any change in scientific thinking about the appropriate level of protection. SPT's assessment is that the proposed uprated overhead line and substation would in fact be compliant with those Guidelines were they ever to be introduced.

Other issues

Farming

Although the majority of scientific studies of the possible effects of EMFs have concerned effects on humans, there have also been a considerable number of studies into possible effects on animals, principally farm animals, and plants, principally agricultural crops. The electricity industry maintains a list of some of these studies on its EMF website (www.emfs.info/The+Science/Agriculture/, though this does not attempt to be a comprehensive list).

Whilst some studies do report minor changes possibly attributable to EMFs, there appears to be no single effect that can be regarded as established, and the preponderance of the evidence has failed to find any effects. This is reflected in the conclusions of those authoritative bodies that have examined this question. SCENIHR (2009) included a section on “environmental effects” but concluded:

> “The current database is inadequate for the purposes of the assessment of possible risks due to environmental exposure to RF, IF and ELF.” (p5)

National Policy Statement EN-5 (DECC 2011) states:

> “2.10.8 There is little evidence that exposure of crops, farm animals or natural ecosystems to transmission line EMFs has any agriculturally significant consequences.” (p20)

Active Implantable Medical Devices (AIMDs)

“Active Implanted Medical Devices” (AIMDs) encompasses a range of devices, e.g. defibrillators and cochlear implants, though the commonest device remains the pacemaker. Hearing aids are not strictly speaking “implanted” but are included here under the same general heading.

It is possible to cause interference with an AIMD by means of a large enough external electric or magnetic field. Sources of possible interference include mobile phones, electronic article surveillance systems, radiofrequency identification devices, diathermy (electrosurgery) and magnets, as well as, in some circumstances, power-frequency electric or magnetic fields produced by electricity equipment.

The normal mode of interference for a pacemaker is that the electric or magnetic field induces voltages in the body. The pacemaker has sensing leads designed to detect the heart’s natural rhythm, so that it can reinforce the heart’s own beats. In the presence of interference produced by the induced voltage, the pacemaker is unable to detect the heart’s own rhythm. The pacemaker then reverts to pacing the heart at a constant rhythm. Thus, even when interference occurs with a pacemaker, it does not stop the pacemaker from functioning. Older pacemakers tended to have a single sensing lead (“unipolar”); newer pacemakers tend to have two sensing leads (“bipolar”), which makes them much less sensitive to interference.

Implanted Cardioverter Defibrillators (ICDs) and implanted pacemakers have very similar sensing leads and very similar detection circuitry within the device. Where they principally differ is in the therapy delivered. Thus, they are expected to be very similar in their levels of immunity to interference, though the consequences of any interference could differ. Therefore, in terms of understanding the likelihood of interference, it is appropriate to treat the two devices as a single group.

National Policy Statement NPS EN5 (DECC 2011) states:

> "2.10.7 The Department of Health's Medicines and Healthcare Products Regulatory Agency (MHRA) does not consider that transmission line EMFs constitute a significant hazard to the operation of pacemakers."

In fact, the UK's Medicines and Healthcare Products Regulatory Agency (MHRA) has stated, not just that it does not consider that transmission line EMFs constitute a significant hazard, but that it is aware of no instance of a patient having their electronic implantable device, such as a pacemaker or ICD, interfered with by a high-voltage overhead line. MHRA operate a system where cardiologists are encouraged to report voluntarily instances of device interference or malfunction from any source to MHRA, and heart-device manufacturers are required by law to report incidents to MHRA which represent actual or potential serious injury to patients. It is therefore highly likely that if such instances did occur, MHRA would have heard about them.

In addition, National Grid, which operates the high-voltage electricity network in England, Wales, and Scotland, runs a helpline on behalf of other companies including SPT for the public to report concerns about overhead lines, and is aware of no instances of interference with correctly fitted devices. In addition, SPT, National Grid, and other electricity companies have staff with implanted heart devices, some of whom are occupationally exposed to rather higher fields than can be experienced by the public underneath overhead lines, again with no instances of interference.

Thus there is considerable confidence in saying that based upon the absence of reported incidents, overhead lines do not appear to interfere with implanted heart devices.

Indirect effects of electric fields

In certain circumstances, a person exposed to a high electric field could experience small spark discharges (microshocks) on touching other objects, producing a prickling sensation similar to that caused by the static discharges commonly experienced in dry atmospheric conditions after frictional contact with a nylon carpet or car seat. Normally, any sensation is confined to the momentary spark discharge as contact is made or broken.

In a 2005 Information Sheet (HPA 2005), HPA state:

> "…on the basis of the available evidence, the direct effects of microshocks on the body are not considered capable of producing lasting harm. The response to some extent will depend on the sensitivity of the individual. Although the possibility of microshocks cannot be ruled out, in field strengths up to about 5 kV m^{-1} they are unlikely to be painful to the majority of people."

The Code of Practice on Compliance (DECC 2012a) states:

> "While indirect effects are more tangible [than direct effects] due to effects such as microshocks, they have historically given rise to less concerns than direct effects. For indirect effects, while the Guidelines give a cautionary reference level of 5 kV m^{-1} for the general public as a trigger to fuller assessment of compliance with the exposure guidelines, using that as a limit is not the most appropriate way of dealing with indirect effects. Rather, there is a suite of measures that may be called upon in particular situations, including provision of information, earthing, and screening, alongside limiting the field which should be used to reduce the risk to the public of indirect effects. In some situations, there may be no reasonable way of eliminating indirect effects, for instance where erecting screening would obstruct the intended use of the land. The approach to addressing indirect effects of electric fields will be the subject of a separate voluntary Code of Practice to be developed between the industry and the Health Protection Agency."

The separate Code of Practice on Indirect Effects referred to ~~has been drafted and, at the date of publication of this Chapter, was going through an approvals process within Government. Assuming it does not change significantly~~, ~~it~~ was adopted in July 2013 (DECC 2013). It reinforces but does not significantly alter the message on indirect effects from the Code of Practice on Compliance quoted above, principally by expanding on the "suite of measures that may be called upon in particular situations".

Mitigation

Because the proposed uprated overhead line and substation are compliant with Government exposure limits and other policies, there are no significant residual effects, and no need for mitigation.

Conclusions

It is the policy of SPT that all of its assets should comply with the relevant Government policy on exposure levels. This ensures the appropriate level of safety. When considering EMF issues in relation to an overhead line or substation, the key question is whether the line complies with Government policy on exposure levels. If a proposed overhead line were to be found not to be compliant with Government policy on exposure levels, appropriate mitigation should be applied to alter the design to bring it into compliance. Where, however, an overhead line is compliant, as this particular line is, there are no grounds for further mitigation, and no grounds from EMF considerations to refuse development consent.

Government policy is that it expects industry and others to follow the ICNIRP guidelines in the terms of the EU Recommendation. These levels have been set after extensive review of the evidence for possible health effects of power-frequency fields; the NRPB advises specifically that the results of epidemiological studies, taken individually or as collectively reviewed by expert groups, cannot currently be used as a basis for restrictions on exposure to EMFs.

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Appendix G

Flora and Fauna Appendices

Figure 6.1a-e Target Notes

No. & Grid Ref.[1]	Notes
01 92348 88532	**Shallow (<10cm deep), water body** developed over a concrete substrate. Some water beetles were observed but no other distinctive, aquatic species.
02 92300 88899	**Watercourse.** Approximately 1m wide. In spate at the time of survey and rather turbid. No aquatic species recorded. In contrast to the surrounding habitats, the banks are distinct for the presence of abundant marsh willowherb, meadowsweet, false oat-grass and frequent to occasional: broadleaved dock, hogweed, nettles and rosebay willowherb in a dense growth up to and over 2m high.
03 92409 88979	**Watercourse.** Fringed with neutral grassland in which Yorkshire fog is dominant with frequent to occasional: broadleaved dock, cow parsley, false oat-grass, field forget-me-not and hogweed with reed canary-grass and common valerian.
04 93033 89411	**Japanese knotweed** This invasive, non-native species is present along *c*. 100m of the trackside at the edge of the woodland.
05 92929 89526	**Tall ruderal habitat** established along the edge of the railway. Bramble, dog rose, false oat-grass, hogweed, nettles and rosebay willowherb are all abundant to locally dominant. Associated with the tall ruderal herbs there are scattered shrubs and trees of ash, hawthorn, oak and willows (including grey and most commonly goat willow). Some neutral grassland along the railway line and quite species rich in places. Main dominants are Yorkshire fog and false oat grass with a variety of other herbs and grasses.
06 96635 94018	**Silt-based pond** Marginal sharp flowered rush and marsh foxtail with little else noted. The water level evidently fluctuates and the pond presumably desiccates at times which is presumed to be the reason for the absence of distinctive, obligate, aquatic species.
07 96733 94118	**Marshy areas** These marsh areas have abundant soft rush and grasses velvet bent and Yorkshire fog with a few herbs such as self-heal, with occasional to frequent, distinctively 'marshy' species including: articulated rush, , common sedge, common yellow sedge, cuckoo flower and oval sedge and the moss Calliergonella cuspidate.
08 96336 93628	**A small area of marshy grassland and swamp.** An isolated pond difficult to access. Occasional patches of swamp dominant species include reed canary grass, but very disturbed on the surrounding margins. Small marginal area with frequent to occasional water mint, marsh valerian, angelica and soft rush .
09	**Wet area** In the corner of the field, this area is less-improved than the surrounding grassland. A marsh grassland

[1] All grid references refer to Ordnance Survey Grid Square 'NN'.

No. & Grid Ref.[1]	Notes
89937 68280	strip occurs with species include; soft rush, Yorkshire fog, self-heal, white clover and creeping buttercup
10 90515 68151	**Dense Bracken** Over neutral grassland (Yorkshire fog, white clover, soft rush, blackberry*)* with scattered shrub species (hawthorn, elder, rowan).
11 89937 68280	**Conifer Plantation** Scots pine with occasional sycamore. Margin species are dominated by Yorkshire fog, with frequent common bent and occasional nettles and perennial ryegrass and scrub.
12 90515 68151	**Wind-thrown Scots pine** Along the edge of the conifer plantation.
13 89937 68280	**Drystone Dyke** Partially removed dyke below pylon with two hawthorns..
14 94164 91677	**Scrub** Almost continuous scrub in a small area with gorse and willow. Other species present include bramble, nettles and Yorkshire fog.
15 94400 91855	**Scattered trees** End of a line of oak and ash trees and a few conifers. Potential bat roost.
16 94375 91884	**Marshy grassland** Stand of marshy grassland terminating in a pond 300m W. Tufted hair grass and Soft rush dominates woth some ragged robin and greater trefoil..
17 91402 91917	**Neutral grassland and Scattered trees and scrub.** Wych elm, ash, oak, hawthorn and willow with a grassy area dominated by tufted hair grass and false – oat grass, with occasional bramble, nettle, hogweed and wood horsetail.
18 94407 91944	**Pond** Pond fringed with floating sweet grass and pondweed *Potamageton natans*, good for invertebrates. Marginal soft rush.
19 94497 92076	**Ploughed field** Track recently ploughed and sown over with oats.
20 94806 92419	**Man-made pond** Mature, steep sided and turbid pond with no aquatic plants present. Surrounded by soft rush and floating sweet-grass, neutral grassland further beyond, with planted rowan, cherry and goat willow.
21	**Ditch** Accessed via a bridge, the ditch is 1m deep and 30-70cm wide. Further survey required.

No. & Grid Ref.[1]	Notes
22 95420 92789	**Ditch** Around 1m deep and 0.7-1m wide. It is clay bottomed and evidently prone to dessication and therefore an absence of distinctive vegetation types. The edges of the ditch are flanked by species such as soft rush and ferns with some wavy hair grass.
23 95736 93004	**Ditch** 2m deep and 4m wide with soft rush and Yorkshire fog in base, heath and vigorous birch trees present with larch regeneration occurring on the flanks grading into wet heath.
24 96249 93539	**Burn** Slow flowing burn with occasional floating sweet- grass but no aquatic plants. The burn is flanked with nettles tall neutral grassland with tufted hair grass, tall oat grass and cleavers.
25 97026 94532	**Hedgerow and scattered trees** Linear old hedgerow with hawthorn, oak, ash and goat willow. The under storey is dominated with Yorkshire fog, white clover, silverweed and cow parsley.
26 97044 94599	**Concealed ditch** Lost from view due to abundant neutral grassland and an overhanging grey willow tree. Runs about 20cm wide and 10cm deep.
27 97353 95285	**Ditch** 1m wide and 50cm deep, occasional ponds of water present. Probably active only in times of high rainfall. Currently overgrown with soft rush, tufted hair grass and marsh horsetail.
28	**Ditch** 5m wide and 3m deep marsh horsetail is the only distinct species on the bed of the burn.
29 97615 96035	**Broad-leaved woodland** Birch woodland with a wet character with goat willow and other willow species with an under storey of bramble and tufted hair grass. The woodland is fringed with tall ruderal species such as hogweed, rosebay willow herb and nettles.
30 97544 96117	**Ditch** The ditch is stagnant with mats of algae. Fringed with lesser spearwort and water horsetail bordered with meadow sweet.
31 97611 96208	**Neutral grassland at foot of pylon.** Present in an area of neutral grassland with scattered birch trees along roadside but easily accessible.
32 98311 96769	**Drains** Shallow drains (to 40cm), but effective with a good flow. The fields to the north east of the area comprised of neutral grassland that is heavily grazed by sheep and horses.

Appendix H

Kincardine 400kV Substation- Flood Risk Assessment

Kincardine 400kV Substation Flood Risk Assessment

Document: R001 Version: 1.1

Scottish Power Energy Networks

September 2013

Halcrow
A CH2M HILL COMPANY

Kincardine 400kV Substation Flood Risk Assessment

Document: R001 Version: 1.1

Scottish Power Energy Networks

September 2013

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Document history

Kincardine 400kV Substation Flood Risk Assessment

Scottish Power Energy Networks

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
1.0	July 2013	First issue	J Drake	J Levesconte	J Drake
1.1	Sept 2013	Option for lower platform level included following discussion with client	J Drake	J Levesconte	J Drake

Contents

Appendix

Executive Summary

A flood risk assessment has been carried out for a proposed new 400kV electricity substation to be constructed at the former Kincardine Power Station site in Fife. The substation will replace an existing 275kV substation as part of the Kincardine/Central network upgrade project currently being promoted by Scottish Power Energy Networks. The Kincardine power station site as a whole is known to be at risk of tidal flooding from the adjacent River Forth, and is protected by an embankment with a revetment and a wave wall.

The flood risk assessment has confirmed that tidal flooding is the major source of flood risk to the site. Surface water flooding from both direct rainfall and flow escaping from adjacent watercourses has also been investigated but does not pose a significant risk to the development. In accordance with industry guidance, the flood risk assessment has considered flooding from events up to a 1,000 year return period. Future sea level rise, driven by global climate change, will progressively increase flood risk to the site over time. A horizon of 2085 has been adopted for assessment of future flood risk.

The tidal flooding mechanism involves high surge tide levels in the River Forth acting in conjunction with wind-generated wave action to create conditions where overtopping of the embankment and wave wall can occur. The resulting flow into the power station site collects in the low points before progressively spreading to higher levels. Ultimately, if the river levels are high enough, the defences will be drowned and water levels on site will equalise with those in the river. There is also the possibility of a breach in the defences, which could result in severe flooding of the site during a surge tide event.

In recognition of the tidal flood risk, Scottish Power Energy Networks proposes to construct the substation on a raised platform. The main focus of the flood risk assessment is to identify an appropriate design level for the platform.

Tide level records from Grangemouth and records of wind speed and direction have been analysed to obtain estimated peak tide levels and wave heights for a range of return periods. A relationship was established between estimated peak tide levels at Grangemouth and Kincardine based on two previous studies, and a joint probability analysis of tide level and wave height was undertaken. The outputs were used to calculate overtopping and overflow rates over the tidal defences into the power station site. Given the relatively short period of data, 95% confidence values were adopted for both peak water level and wave height to ensure an appropriately conservative assessment. Sea level rise projections were taken from UKCP09 using the 95% confidence high emissions scenario, again for a conservative assessment.

The volume of floodwater entering the site through overtopping/overflow was calculated for each event over a period of 3 hours each side of high tide, and used to estimate the resulting flood level on the landward side of the tidal defences. The existing tidal defences provide some protection up to the present day 200 year flood event, limiting the flood level on site to 2.25mAOD assuming no breach occurs. For the 1,000 year event, a drowned condition occurs with water level on site equalising with the tide level at 5.28mAOD. By 2085 a drowned condition occurs in the 50 year return period, with peak water level of 5.77mAOD occurring in the 1,000 year event.

The flood risk assessment for the proposed Kincardine substation makes the following recommendations:

- A conservative platform level of 6.20mAOD is recommended for the new substation, to ensure that the platform is not inundated during the design event. This is based on the estimated 2085 horizon 1,000 year return period flood level of 5.77mAOD with a freeboard allowance for wave action;
- Following discussion with the client a lower platform level has been considered, which would accept some inundation of the platform at the design event with substation assets protected by bunding, flood barriers or flood resistant construction. This solution requires a level at the platform edge of at least 5.33mAOD, with a slight fall from higher levels in the substation area. The GIS building should have a threshold level of at least 6.2mAOD, with flood resistant construction to 7.2mAOD. Vulnerable plant items should be raised above 7.2mAOD or robustly protected with bunds or other flood barriers;
- Consideration should be given to the need for access to the substation during flood events, given that flood water may be trapped within the power station site for an extended period after a severe tidal flood event;
- There is uncertainty over future rates of sea level rise and, while conservative assumptions exceeding published guidance have been made in the assessment, significantly higher rates of sea level rise are acknowledged as within physical plausibility. The conservative platform level of 6.2mAOD would offer more passive resilience than the lower platform, if sea level rise occurs more rapidly than allowed for in current guidance;
- Floodwater displaced by construction of the platform will result in slightly higher water levels (up to about 85mm) within the power station site for the less severe floods which do not result in a drowned condition. Since the extent of such flooding does not extend outwith Scottish Power's land ownership, it is considered that no compensatory storage or other mitigation is required in this instance;
- Surface water flooding does not pose a risk to the development provided that the platform is designed to be free draining and adjacent surface water flow paths are maintained.

1 Introduction

1.1 Background

Iberdrola Engineering & Construction (IEC) has commissioned Halcrow to carry out a Flood Risk Assessment for a proposed new 400kV electricity transmission substation at Kincardine in Fife, forming part of the ENSG Kincardine / Central upgrade project to be constructed by Scottish Power Energy Networks (SPEN).

The substation is to be located adjacent to an existing 275kV substation at the site of the former Kincardine Power Station (now demolished) to the west of Kincardine on the banks of the River Forth as shown on Figure 1-1 below. The existing 275kV substation will be removed once the new substation is operational. The site generally slopes down towards the River Forth. Existing ground levels on the substation footprint vary from around 1.5m to above 4m AOD locally towards the north. Figure 1.2 below illustrates the site topography taken from LiDAR (airborne laser) survey. Further plans of the study area are included in Appendix D.

The site as a whole is protected by an existing coastal defence embankment which extends between the A 985 Kincardine Bridge and the A876 Clackmannanshire Bridge. The profile of the embankment is generally consistent throughout this reach with a grassy, stepped bank on the landward side, a small (approx. 0.5m high) wave wall on the crest and a paved revetment on the seaward side. (see site visit photos in Appendix A). When visited in 2011and again in July 2013 the embankment appeared to be generally in good condition with some local damage to the concrete wave wall at the northern end near the new bridge.

Overtopping of the seawall and consequent risk from coastal flooding during exceptionally high tides is a key flooding concern for the substation. No assessment has been made of the physical condition of the coastal defence embankment or its ability to withstand wave overtopping.

There is an existing drainage system at the site, associated the disused power station (now demolished). The drainage system consists of an underground drainage pipe network and a pumping station. Although this system is operational and will be able to aid the drainage of flood water from the site is it not guaranteed that it will continue to function under an extreme rainstorm or tidal flood event. In order to provide the most conservative estimate of flood risk it has been assumed that the drainage system does not drain any flood water out of the site during the course of a flood event.

Halcrow carried out a flood risk assessment for the existing Kincardine 275kV substation in 2011, and has also undertaken flood studies for Grangemouth for Falkirk Council. This flood risk assessment for the proposed 400kV substation takes account of these previous studies, as discussed in Section 2 below.

1.2 Scope

The scope of this study is to update the 2011 flood risk assessment for the Kincardine site, with a focus on flood risk to the proposed 400kV substation. The report will form part of the planning submission for the Kincardine / Central upgrade scheme and will also inform the Environmental Statement in respect of flood risk at the substation site.

Figure 1-1: Kincardine Substation location

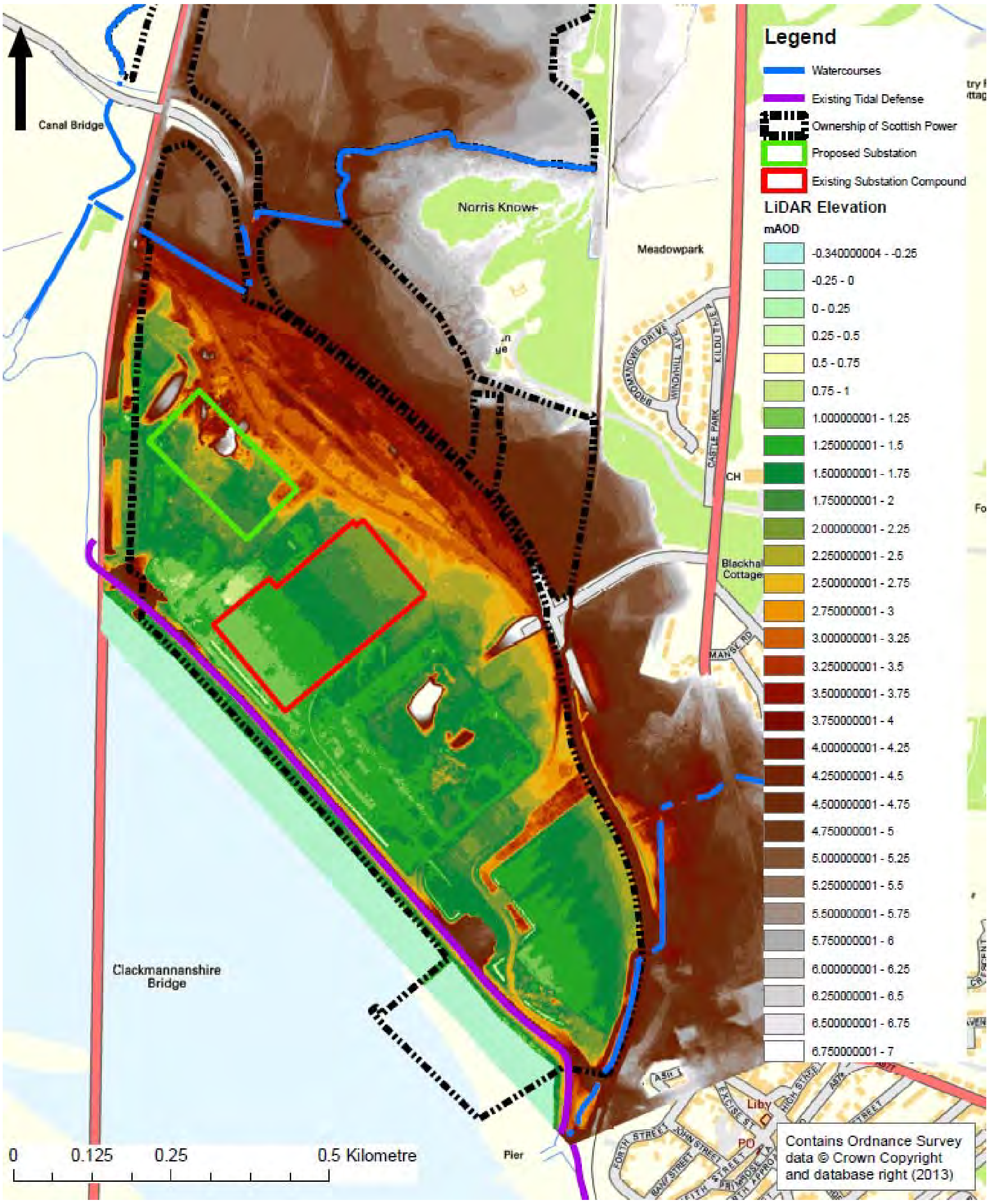


Figure 1-2: Kincardine Substation site topography

2 Collection of information

2.1 Previous studies

A flood risk assessment for the existing 275kV substation at Kincardine, including studies into significant wave heights, coastal flood levels and extreme rainfall, was carried out by Halcrow for Scottish Power in 2011**.** Halcrow has also carried out studies into wave overtopping of tidal defences at Grangemouth on the River Forth south of Kincardine, for Falkirk Council, for which the most recent and detailed study was issued in August 2012.. These reports, listed below, were reviewed as part of the present assessment.

- *Scottish Power Energy Networks, Kincardine Substation Flood Risk Assessment* (Halcrow Group Limited, June 2011)
- *Falkirk Council, GrangemouthFlood Study, Flood Risk Mapping – Final Report* (Halcrow Group Limited, August 2012)

2.2 Site visit

A site visit was carried out in February 2011 accompanied by David Gibson of Scottish Power Energy Networks in connection with the flood risk assessment for the existing 275kV substation. Iain McNair of Scottish Power Systems also attended a short meeting on site and provided useful information and drawings on the site layout and drainage infrastructure.

A brief visit to publicly accessible areas adjacent to the power station site was undertaken in July 2013.

Relevant photographs from the site visit are contained in Appendix A.

2.3 Topographical survey

A topographical survey was carried out in 2008 by Halcrow to inform an initial flood risk assessment for the Kincardine substation. This included critical equipment levels and the landward side of the sea wall in the vicinity of the substation.

Additional survey was carried out in February 2011 to provide further detail on the seawall and possible overland flow routes. 11 cross sections of the seaward side of the seawall, long sections along the base and top of the seawall and additional long section profiles were collected.

In addition to the topographical survey LiDAR DTM (digital terrain model) data was purchased to enhance the topographical data available for the study. LiDAR is an airborne laser survey technique – the survey was flown in 2008 and covers the entirety of the site on a 1m grid with typical accuracy of 0.25-3.0m in the horizontal plane and 0.05-0.25m in the vertical plane.

The LiDAR and survey data were compared in order to determine the accuracy of the LiDAR data and how well it identifies key features such as the seawall and overland flow paths. In general the LiDAR picked up the seawall well but is too coarse to identify features such as the narrow wave wall at the top of the seawall.

2.4 Data from Scottish Power

Data received from SPEN includes the following:

- Drawing SP4100405 Rev 1.0 – Kincardine Substation Site Feasibility Layout 'Scenario 6A';
- Drawing entitled 'Kincardine Power Station Ownership Plan of Scottish Power Generation Limited', dated 20/02/12.

Copies of these drawings are included in Appendix B.

2.5 Other information

The SEPA flood map indicates that the entirety of the Kincardine substation site is at risk from coastal flooding from the Firth of Forth but not from fluvial flooding.

3 Overview of flood risk

3.1 Proposed development

Scottish Power Energy Networks (SPEN) proposes to build a new 400/275kV substation at its site in Kincardine. The new substation will occupy a platform to be constructed on brownfield land at the northern end of the Kincardine Power station site in an area formerly used for coal storage, located immediately east of the northern approach embankment to the A876 Clackmannanshire Bridge. The substation site lies to the northwest of the existing Kincardine 275kV substation, which will be removed.

The new substation platform will be raised approximately 4m above existing site levels to mitigate flood risk, and will have a footprint of approximately 250m x 140m overall dimensions including retaining embankments at the platform edge. The platform will accommodate 400/275kV transformers and switchgear, as well as access roads, security fencing and other ancillaries. 275kV gas-insulated switchgear (GIS) will be accommodated in a building towards the south end of the platform, with provision for a future 400kV GIS building on the north side. The above details have been taken from Drawing SP4100405 Rev 1.0 – Kincardine Substation Site Feasibility Layout 'Scenario 6A', included at Appendix B to this report.

From the flood risk standpoint the key issues are the peak water levels generated from relevant sources of flooding and the potential impact on flood levels due to displacement of floodwater resulting from land raising associated with construction of the raised substation platform.

The Energy Networks Association report ETR 138 – Resilience to Flooding of Grid and Primary Substations, 2009 – recommends that for grid substations the target level of resilience should be the 1 in 1,000 year flood event (also expressed as 0.1% annual exceedance probability – AEP). This is in agreement with Scottish Planning Policy (SPP), 2010, which states that areas of medium to high flood risk (i.e. with a flood risk greater than 0.5% AEP or 1 in 200 years return period) are generally not suitable for ground-based electrical equipment. Exceptions may arise if a location is essential for operational reasons, and such infrastructure should be designed to remain operational during floods.

SPEN is aware that the proposed substation site lies in an area of medium to high flood risk and proposes to ensure that the substation remains operational during flooding by elevating it above the flood risk level on an earth fill platform. SPEN has confirmed that a 1 in 1,000 year return period flood level should be adopted and has identified that climate change impacts up to a horizon of the 2080s should be included in the assessment.

3.2 Sources of flood risk

3.2.1 Fluvial flooding

There are no surface watercourses within the proposed substation site. A small burn, flowing from Peppermill Dam some 3km northeast of the site, passes to the north of Tulliallan Castle and crosses under the A876 to the north of the site before draining into the Canal Burn. Another small burn flowing from Moor Loch some 2km to the east, drains through the town of Kincardine before crossing under the Alloa-Kincardine railway to enter the southernmost edge of the former power station site and drain to the Forth through a flapped outlet adjacent to the pier.

Any flooding of these burns appears to be contained to a narrow corridor adjacent to the watercourse and does not affect the proposed development. The features described here can be seen on the SEPA flood map on the following link: http://www.sepa.org.uk/flooding/flood_extent_maps/view_the_map.aspx.

Although the proposed substation lies outside the catchments of these two burns, in both cases the distances and terrain levels separating them from the power station site are relatively small. It is conceivable, for example, that blockage of the A876 culvert on the burn from Peppermill Dam could result in water spilling over its left embankment to approach the new substation from the north. Similarly if the burn from Moor Loch was obstructed at its flapped outlet, water could spill over the right bank to reach low-lying parts of the power station site. Neither of these mechanisms lends itself to quantitative analysis, but a discussion presenting further detail is included in the report.

3.2.2 Pluvial flooding

The presence of tidal defences along the River Forth frontage of the site complex inhibits free drainage of the site. Accordingly a surface water drainage network was constructed to serve the former power station site, largely comprising piped drains with an open channel along the landward toe of the tidal defence bund where site levels are lowest, leading to a pumped tidal outfall.

Pluvial flooding is a potential risk to the site, in that runoff from an intense rainstorm could collect in the low-lying areas of the site if the pumping station was not in operation or its capacity was exceeded. An analysis of pluvial flood risk has been undertaken adopting the conservative assumption that the pumping station is not in operation at the time of the storm.

3.2.3 Tidal flooding

Tidal flooding is considered to present the most serious flood risk to the development. Flood risk to the proposed substation can arise from several different flooding mechanisms which are outlined below:

- Overflow of defences: This occurs when the still water level in the River Forth is higher than the crest of the existing flood defence embankment. This allows flood water to flow over the embankment into the substation site.
- Overtopping of defences: Flood water may ‘overtop’ the flood defences even when the still water level in the River Forth is well below the top of the defences, when high wind speeds generate waves on the River Forth. On impact with the flood defence embankment the waves break allowing flood water to slop over the defences, into the substation site.
- Overtopping and overflow of defences: In some instances both mechanisms described above with occur resulting in overtopping of defences due to wave action when the still water level is below the defence crest, followed by overflow of the defences when the still water level rises at the peak of the tide and water flows over the defences.

- Breaching of defences: There is little information available on the construction and condition of the existing defences, and it has therefore been assumed that there is a possibility that a breach could occur due to progressive failure of the defences during exposure to high tide levels and/or wave action. Under this condition it is reasonable to assume that water levels on the landward side would be equal to those in the sea.

As with pluvial flooding, any water overtopping or overflowing the defences will collect first in low-lying areas of the site, and for a conservative assessment it is assumed that the pumping station is not in operation.

3.2.4 Groundwater flooding

Groundwater flooding does not present a risk to the proposed development owing to its construction on an elevated platform.

3.3 Overview of study methodology

Tidal flood events are generally the result of raised sea levels occurring when large storm surges interact with high astronomical tide levels. Tide levels have been recorded at Grangemouth, 5km downstream of Kincardine, for several decades but the records have not been available in digital format for rigorous analysis. Consequently, previous assessments of tidal flood risk at Kincardine and Grangemouth have been based on projection of estimated extreme water levels for Leith.

For a recent detailed study of flood risk in Grangemeouth (Halcrow, 2012), digital records of tide levels at Grangemouth were obtained covering the period 1999-2011, and this data was considered adequate for a site-specific analysis. The same approach has been adopted for the Kincardine study, applying a water level relationship between Grangemouth and Kincardine derived from two independent model studies.

The wave climate in the Forth estuary at Kincardine has been synthesised from measured wind data by hindcasting to obtain a time series of wave height and direction at the defined site, which was then analysed for extreme events and to obtain a scatter plot of frequency of occurrence by wave height and direction. A joint probability analysis was then carried out to identify appropriate combinations of tide level and wave height to provide input data for wave overtopping calculations.

Overtopping and overflow rates were applied along the length of the river frontage for each tide level / wave height combination including relevant sea level rise cases, to obtain a total volume of inflow into the site area over the tidal cycle. This volume was then used to fill the site area from its low point to produce an estimate of flood depth and extent for each case. Further details and results from the tidal flood risk analysis are presented in Section 4.

A similar exercise was carried out for the pluvial flood risk assessment, using mapping software to identify the direct surface water catchment draining to the low-lying areas of the site. For a given storm event the effective rainfall depth (total depth minus infiltration losses) was applied across the catchment area to derive a flood volume from which to calculate flood extent and depth. Further details and results from the pluvial flood risk analysis are presented in Section 5.

The provision of a raised platform for the new substation will alleviate flood risk to the substation itself, but the platform will displace floodwater that would otherwise occupy the development footprint and this may have an adverse impact on flood risk elsewhere. To assess any such impacts, the flood extents and depths have been calculated for both pre- and post-development cases. Further details and results from this assessment of the impact of land raising are presented in Section 6, along with other implications for the development arising from this study.

4 Tidal flood risk

4.1 Introduction

The primary source of flood risk to the Kincardine substation is from high tide levels in the Firth of Forth. Sea water can start to spill over the existing flood defence embankment well before 'still water' tide levels approach the top of the embankment, owing to wave action. Assessment of coastal flood risk therefore requires an understanding of both the still water levels associated with high surge tides and the 'overtopping' of coastal defences generated by wave action.

4.2 Extreme tide levels and wave climate

This section summarises the analysis of extreme tide levels and wave climate undertaken to derive appropriate parameters for assessing wave overtopping flows and volumes. A detailed Technical Note outlining the methodology and results is presented in Appendix C.

4.2.1 Extreme water levels

Digital records of tide levels at Grangemouth were obtained covering the period 1999-2011. A peak over threshold (POT) series was derived from the tide level data adopting a threshold of 3.3mAOD, and a generalised extreme value (GEV) distribution was applied to obtain estimated peak tide levels for a range of return periods. A relationship was established between estimated peak tide levels at Grangemouth and Kincardine based on two previous studies: a Halcrow report for Stirling Council, 2007, which used an ISIS 1-dimensional model; and the Halcrow Kincardine flood study for SPEN, 2011, which used a DAWN 2-dimensional model.

While the extreme value distribution is considered appropriate for a site-specific analysis, extrapolation from 12 years data to a 1,000 year return period event necessarily involves a degree of uncertainty. Accordingly the 95% confidence interval was also calculated, and the results are presented in Table 4-1.

Return period - years	Extreme Water Level Results	
	Water Level (mODN)	95% Confidence Interval (m)
2	4.04	0.10
10	4.25	0.15
50	4.47	0.20
100	4.57	0.23
200	4.67	0.26
1000	4.92	0.32

Table 4-1: Summary peak tidal water levels

4.2.2 Wave climate

As no measured wave data are available at Kincardine, the wave climate must be synthesised from a long term time series of measured wind data by a process known as '*hindcasting*'. In this process, the characteristics of the waves arriving at the site depend upon the wind speed, the period of time for which it has been blowing in that direction, the water depth (if wave breaking occurs), and the length of water across which it has been blowing (the 'fetch' length), which in turn is a function of the wind direction and the geography of the region. The result of this process is a time series of wave height and direction at the defined site, which may be analysed for extreme events and to obtain a scatter plot of frequency of occurrence by wave height and direction.

After generation of local wave data for a point in the River Forth adjacent to the site, the wave data was screened to create a peak over threshold (POT) series which was then analysed to obtain extreme wave heights for the required return periods which are shown in Table 4-2.

Return Period (years)	Extreme Wave Results		
	Wave Height Hmo (m)	Peak Wave Period (s)	95% Confidence Interval (m)
2	0.47	2.6	0.05
10	0.59	2.8	0.07
50	0.73	3.1	0.12
100	0.80	3.2	0.14
200	0.88	3.3	0.16
1000	1.09	3.6	0.23

Table 4-2: Extreme Wave Conditions for Kincardine

4.2.3 Joint probability analysis

The Kincardine high water levels and the corresponding time series of the hindcast wave data were used as input data to a joint probability analysis. The marginal extreme wave heights of omni-direction and water levels as noted above were used as input data for Halcrow's in-house JOIN-SEA model. The time series of data is from 1999 to 2011.

The plot of data fitting curves from the joint probability analysis for Kincardine is shown in Figure 4-1.

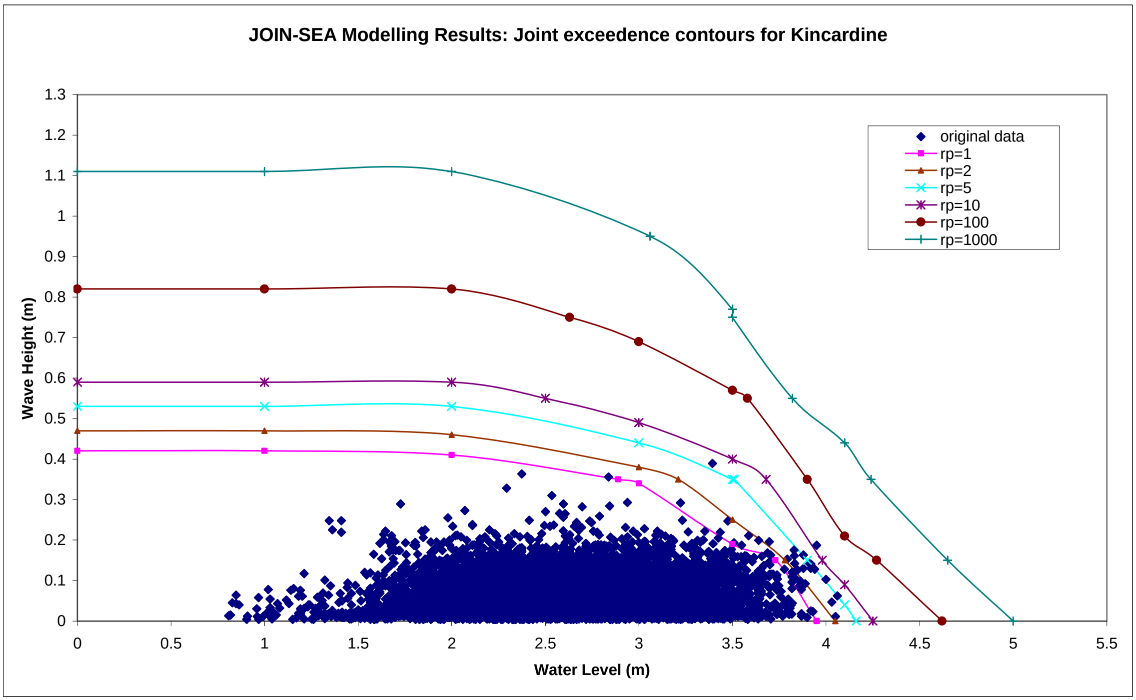


Figure 4-1 Joint probability results for Kincardine

4.3 Wave overtopping assessment

4.3.1 Methodology

The wave overtopping assessment followed the approach set out in the Eurotop Wave Overtopping of Sea Defences and Related Structures: Assessment Manual, HR Wallingford, 2007, and the methodology is described in detail in Appendix C. For each flood return period up to 11 combinations of water level and wave height (output from the joint probability analysis) were evaluated and the largest overtopping flow was selected as the critical case. In view of the relatively short period of sea level and wind data available, the 95% confidence interval was applied to both water level and wave height to ensure a robust assessment of flood risk. The full set of joint probability water level and wave combinations used as input to the overtopping calculation (excluding sea level rise) is shown in Table 4-3.

To evaluate the total volume of overtopping/overflow over the tidal cycle, flow rates were calculated at the estimated peak water level and at +/-1, 2 and 3 hours respectively to derive a flow volume per unit length of the tidal defences. For cases where the still water level exceeded the top of the wave wall (i.e. negative freeboard), total flow over the defences was assumed to comprise the overtopping flow for the zero freeboard case plus overflow calculated using the broad-crested weir formula. Unit flows over the typical wave wall cross section were assumed to occur uniformly along the 1,122m length of the tidal defence wall.

Return Period		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
1:2	WL(m)	0	1	2	3	3.21	3.5	3.78	4.05			
	WL(m)(95% confidence)	0.1	1.1	2.1	3.1	3.31	3.6	3.88	4.15			
	Hm$_0$(m)	0.47	0.47	0.46	0.38	0.35	0.25	0.15	0			
	Hm$_0$(m)	0.52	0.52	0.51	0.43	0.4	0.3	0.2	0.05			
	Tp(s)	2.59	2.59	2.57	2.38	2.3	2.01	1.63	0			
	Tp(s)	2.70	2.70	2.68	2.50	2.43	2.17	1.84	1.06			
1:10	WL(m)	0	1	2	2.5	3	3.5	3.68	3.98	4.1	4.25	
	WL(m)(95% confidence)	0.15	1.15	2.15	2.65	3.15	3.65	3.83	4.13	4.25	4.4	
	Hm$_0$(m)	0.59	0.59	0.59	0.55	0.49	0.4	0.35	0.15	0.09	0	
	Hm$_0$(m)	0.66	0.66	0.66	0.62	0.56	0.47	0.42	0.22	0.16	0.07	
	Tp(s)	2.84	2.84	2.84	2.76	2.63	2.43	2.3	1.63	1.33	0	
	Tp(s)	2.97	2.97	2.97	2.90	2.78	2.60	2.48	1.92	1.69	1.21	
1:50	WL(m)	0	1	2	3	3.33	3.5	3.85	4.1	4.21	4.5	
	WL(m)(95% confidence)	0.2	1.2	2.2	3.2	3.53	3.7	4.05	4.3	4.41	4.7	
	Hm$_0$(m)	0.75	0.75	0.74	0.61	0.55	0.52	0.35	0.19	0.15	0	
	Hm$_0$(m)	0.87	0.87	0.86	0.73	0.67	0.64	0.47	0.31	0.27	0.12	
	Tp(s)	3.13	3.13	3.11	2.88	2.76	2.7	2.3	1.8	1.63	0	
	Tp(s)	3.32	3.32	3.30	3.09	2.99	2.94	2.60	2.20	2.08	1.50	
1:100	WL(m)	0	1	2	2.63	3	3.5	3.58	3.9	4.1	4.27	4.62
	WL(m)(95% confidence)	0.23	1.23	2.23	2.86	3.23	3.73	3.81	4.13	4.33	4.5	4.85
	Hm$_0$(m)	0.82	0.82	0.82	0.75	0.69	0.57	0.55	0.35	0.21	0.15	0
	Hm$_0$(m)	0.96	0.96	0.96	0.89	0.83	0.71	0.69	0.49	0.35	0.29	0.14
	Tp(s)	3.24	3.24	3.24	3.13	3.02	2.8	2.76	2.3	1.87	1.63	0
	Tp(s)	3.45	3.45	3.45	3.35	3.26	3.06	3.03	2.64	2.31	2.14	1.60
1:200	WL(m)	0	1	2	3	3.19	3.5	3.74	3.99	4.1	4.38	4.69
	WL(m)(95% confidence)	0.26	1.26	2.26	3.26	3.45	3.76	4	4.25	4.36	4.64	4.95
	Hm$_0$(m)	0.89	0.89	0.87	0.77	0.75	0.64	0.55	0.35	0.29	0.15	0
	Hm$_0$(m)	1.05	1.05	1.03	0.93	0.91	0.8	0.71	0.51	0.45	0.31	0.16
	Tp(s)	3.35	3.35	3.32	3.16	3.13	2.93	2.76	2.3	2.13	1.63	0
	Tp(s)	3.58	3.58	3.55	3.41	3.38	3.21	3.06	2.68	2.55	2.20	1.69
1:1000	WL(m)	0	1	2	3.06	3.5	3.5	3.82	4.1	4.24	4.65	5
	WL(m)(95% confidence)	0.32	1.32	2.32	3.38	3.82	3.82	4.14	4.42	4.56	4.97	5.32
	Hm$_0$(m)	1.11	1.11	1.11	0.95	0.77	0.75	0.55	0.44	0.35	0.15	0
	Hm$_0$(m)	1.34	1.34	1.34	1.18	1	0.98	0.78	0.67	0.58	0.38	0.23
	Tp(s)	3.66	3.66	3.66	3.44	3.16	3.13	2.76	2.52	2.3	1.63	0
	Tp(s)	3.95	3.95	3.95	3.75	3.51	3.48	3.18	2.99	2.82	2.38	1.95

Table 4-3 – Adjusted JPA data to include 95% confidence values

4.3.2 Sea Level Rise

The extreme water levels and joint probability data discussed in Section 4.2 above are considered to represent a baseline year 2005, this being the middle year of the period 1999-2011 for which sea level data at Grangemouth was available.

Wave overtopping calculations were undertaken for the present day (2013) scenario and for a future scenario in 2085. Therefore sea level rise has been added to the base data to allow the present day and future scenarios to be assessed. Sea level rise data was downloaded from the UKCP09 website http://ukclimateprojections-ui.defra.gov.uk/ui/admin/login.php.

Guidance on the use of the UKCP09 data is provided within the following Environment Agency report:

- Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.

The guidance recommends the use of the medium emissions scenario with a 95% probability of occurrence. Wave overtopping calculations have been undertaken using this recommendation, however as this project is considering the flood assessment at a site for critical electricity supply infrastructure, a sensitivity analysis has been undertaken using the high emissions scenario (with a 95% probability of occurrence). The sea level rise values adopted are provided in Table 4-3; at the 2085 horizon the assumption of the high emissions scenario contributes an additional 0.12m of sea level rise over the medium emissions scenario.

Sea level rise period (years)	Medium Emissions Sea level rise value (mm)	High Emissions Sea level rise value (mm)
2005 – 2013	28	37
2005 - 2085	410	528

Table 4-3 – Kincardine sea level rise values

4.3.3 Results

Overtopping and overflows passing over the tidal defences have been evaluated for 1 in 2, 1 in 10, 1 in 50, 1 in 100, 1 in 200 and 1 in 1,000 year return period events, for the present day (2013) and 2085 horizons, adopting the high emissions sea level rise scenario. The results for these cases are summarised in Tables 4-4 and 4-5, which show for each return period: peak flow rates (and flow rates 1, 2 and 3 hours each side of the peak), total flow volume per unit length of wave wall, and total volume entering the site.

Return Period (1 in X)	Peak overtopping discharge (l/s/m)	Peak +/- 1 hr overtopping discharge (l/s/m)	Peak +/- 2 hr overtopping discharge (l/s/m)	Peak +/- 3 hr overtopping discharge (l/s/m)	Overtopping volume/ metre (m^3/m)	Total overtopping volume (m)
2	0.00	0.00	0.000	0.00	**0.00**	**0**
10	0.01	0.00	0.000	0.00	**0.02**	**22**
50	0.19	0.04	0.000	0.00	**0.94**	**1,055**
100	13.15	0.16	0.002	0.00	**48.21**	**54,092**
200	47.75	1.10	0.017	0.00	**177.98**	**199,700**
1000	568.09	217.17	0.107	0.00	**3,218.59**	**3,611,300**

Table 4-4 – Present day (2013) 95% confidence level overtopping volumes with high emissions SLR

Return Period (1 in X)	Peak overtopping discharge (l/s/m)	Peak +/- 1 hr overtopping discharge (l/s/m)	Peak +/- 2 hr overtopping discharge (l/s/m)	Peak +/- 3 hr overtopping discharge (l/s/m)	Overtopping volume/ metre (m^3/m)	Total overtopping volume (m)
2	0.01	0.00	0.00	0.00	**0.03**	**34**
10	6.11	0.12	0.00	0.00	**22.63**	**25,391**
50	331.36	51.07	0.02	0.00	**1,468.83**	**1,648,000**
100	595.06	217.17	0.07	0.00	**3,315.43**	**3,719,900**
200	798.48	368.18	0.26	0.00	**4,864.54**	**5,458,000**
1000	1,806.66	499.82	80.23	0.01	**9,780.70**	**10,974,000**

Table 4-5 – Future (2085) 95% confidence level overtopping volumes with high emissions SLR

4.4 Inundation modelling

4.4.1 Methodology

Water overtopping the tidal defences at the Kincardine site will collect in the low-lying areas adjacent to the river frontage. Initially much of the water will enter the drainage network and be pumped away, however a large overtopping event will soon overwhelm the pumping station, so its capacity has been ignored in assessing inundation of the site.

The depth of water and the area inundated will depend on the total volume passing over the wave wall, and the very large overtopping events will completely fill the site until the water level on the landward side is above the level of the wave wall (4.92mAOD) and water starts spilling back into the river. Analysis of the LiDAR digital terrain model indicates that to fill the power station site to a level of 5.0mAOD would require a flood volume of about 1,600,000m^3, which is greatly exceeded by the calculated inundation volumes for the larger events.

Flooding depths and inundation plans have been produced using Halcrow's ISIS Fast software, a tool for rapid mapping of flood inundation where a dynamic component is not required.

Where the overtopping/overflow volume exceeds the capacity of the site, it is assumed that water levels on the landward side will equalise with those in the river. The peak water level within the site area in this "drowned" condition is assumed equal to the estimated peak marginal water level for the relevant return period, even though the worst case combination of tide level and wave height may occur at a lower level.

There is a possibility during tidal flooding events that a breach of the defences may occur due to hydraulic loading, scour due to wave action and overtopping flows, or other unknown causes. In such cases it is also assumed that landward water levels will equalise with the peak river level.

4.4.2 Results

The results of site inundation modelling are summarised in Table 4-6 and 4-7 for 2013 and 2085 horizons respectively, and illustrated in Figure 4-2. The quoted results are for the 95% confidence water levels and wave heights, and assume the high emissions sea level rise scenario.

At present (2013), the existing tidal defences provide some protection to the site up to the 200 year return period (assuming no breach), albeit with increasing volumes of overtopping flow flooding the lower parts of the site as the severity of the event increases. However at the 1,000 year return period, flow over the defences completely inundates the site and water levels become equal with those in the river. In the 2085 scenario, complete inundation of the site occurs from the 50 year return period onwards. These cases are marked as (drowned) in Tables 4-6 and 4-7.

Flood inundation maps for a range of scenarios are included in Appendix D.

Return Period (1 in X)	Peak river water level mAOD	Site water level (overtopping) mAOD	Site water level (breached) mAOD
2	4.18	-	4.18
10	4.44	-	4.44
50	4.71	0.98	4.71
100	4.84	1.67	4.84
200	4.97	2.25	4.97
1000	5.28	5.28 (drowned)	5.28

Table 4-6 – Present day (2013) 95% confidence site flood levels with high emissions SLR

Return Period (1 in X)	Peak river water level mAOD	Site water level (overtopping) mAOD	Site water level (breached) mAOD
2	4.67	-	4.67
10	4.93	1.45	4.93
50	5.20	5.15	5.20
100	5.33	5.33 (drowned)	5.33
200	5.46	5.46 (drowned)	5.46
1000	5.77	5.77 (drowned)	5.77

Table 4-7 – Future (2085) 95% confidence site flood levels with high emissions SLR

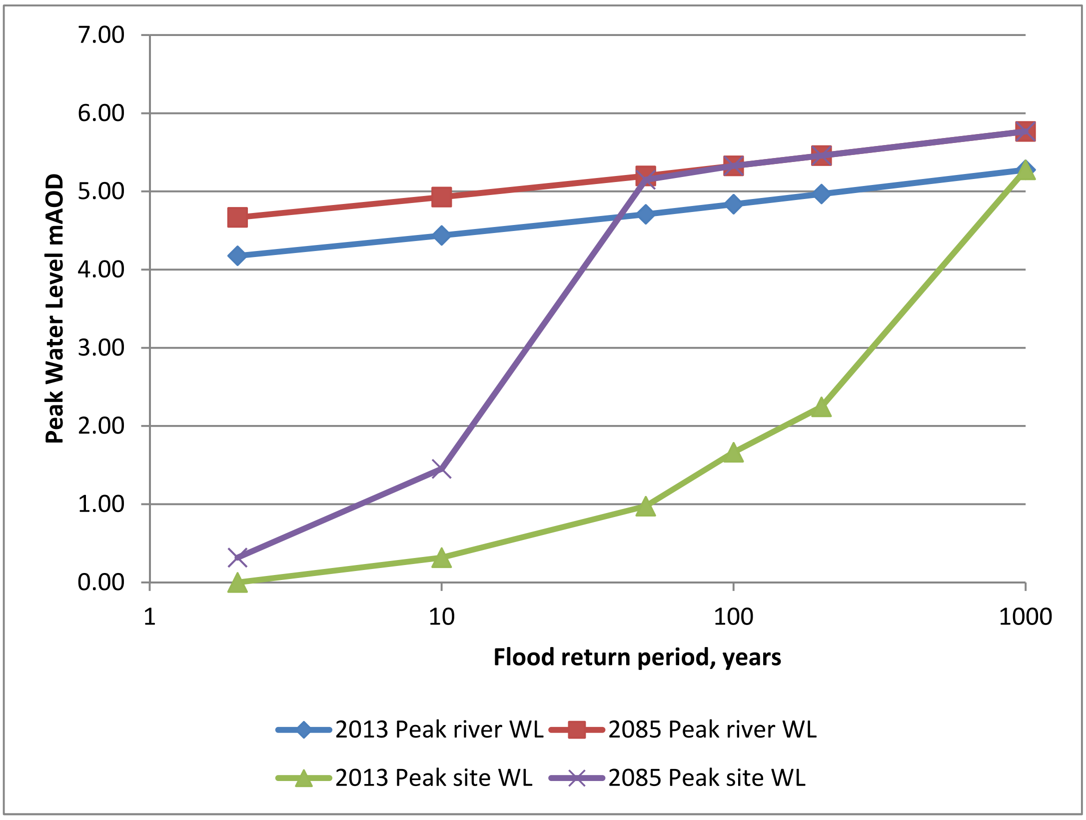


Figure 4-2: Peak water levels, 2013 and 2085, 95% confidence interval, high emissions SLR

5 Surface water flood risk

5.1 Pluvial flooding

The pluvial flood risk (flood risk from an intense rainfall event) at the site was assessed using an ISIS FAST model for the 1:200 and 1:1000 year events both for the present day and with a 20% allowance for future climate change. ISIS FAST is based on a simplified hydraulics flood spreading method specifically developed for rapid flood modelling applications.

In line with the methodology developed for the Scottish National Pluvial Flood Risk Assessment, carried out in 2011 by SEPA, a 1 hour duration storm was adopted and a runoff coefficient of 70%. The design rainfall at the site was extracted from the FEH (Flood Estimation Handbook) CD-ROM. Effective rainfall values (total rainfall x runoff coefficient) utilised within the modelling are summarised in Table 5-1 below.

In assessing the pluvial flood risk, it has been assumed that the surface water pumping station is not available during the rainfall event – i.e. none of the surface runoff from the storm event is pumped away.

The design rainfall shown in the table above were applied across the DTM (digital terrain model) of the Kincardine substation area constructed from LiDAR data. The modelled area was extended to include the catchment that may drain into the substation site, particularly from the north. Flood depth and water level grids within the substation compound were extracted directly from the ISIS FAST results.

The bulk of runoff from such storm events will collect in the low-lying area of the power station site adjacent to the flood embankment. The pond levels reached during these storm events give an indication of the severity of flood risk from this source, and are summarised in Table 5-1. It is evident that flood risk from this source is small compared with that from tidal inundation.

Event	Effective Rainfall (mm)	Approx pond level (mAOD)
1:200 year with 70% runoff	23.02	1.40
1:200 year with 70% runoff and 20% allowance for climate change	27.63	1.46
1:1000 year with 70% runoff	34.11	1.54
1:1000 year with 70% runoff and 20% allowance for climate change	40.93	1.61

Table 5-1: Pluvial flood risk – design cases and results

The above analysis demonstrates that ponded water from pluvial flooding does not pose a flood risk to the proposed substation. To remove any risk from direct pluvial flooding it will be necessary to ensure that the substation platform is free draining and does not impede any overland flow routes.

5.2 Overspill from neighbouring catchments

As noted in Section 3.2.1, there is a potential source of flood risk from minor watercourses adjacent to the site, even though they do not flow into the power station site.

Immediately north of the proposed substation site a small un-named tributary of the Canal Burn, which drains the outlet of Peppermill Dam, is culverted under the A876 Clackmannanshire Bridge northern approach road. It is conceivable that blockage at the culvert could cause floodwater to spill over the catchment divide towards the proposed substation site. Given the proposal to construct the substation on a raised platform, this poses no flood risk to the development provided that a free drainage path is provided between the substation platform and the adjacent A876 road embankment immediately to the west.

Similarly, the un-named burn draining from Moor Loch passes under the Kincardine-Alloa railway line to run along the eastern edge of the power station site for a short way before it flows into the River Forth through a flapped culvert. A blockage here could possibly cause spillage into the low-lying areas of the power station site. This is remote from the proposed substation and at worst will cause ponding in the low-lying areas similar to the pluvial runoff discussed above. It does not present a flood risk to the development.

Flood depth maps for 1,000 year return period pluvial events (present day and with 20% allowance for climate change) are contained in Appendix D.

6 Flood risk implications for the development

6.1 Platform level – conservative design approach

It is appropriate to include a freeboard allowance when setting development levels in respect of flood risk, to account for both uncertainty in the analyses and underlying data and also the effect of physical processes such as wave action.

In this instance, a conservative approach has been adopted in the analyses whereby the 95% confidence interval has been included in the estimation of peak water level and wave height for the tidal flooding assessment. This is considered to provide sufficient margin in the estimation of flood levels to account for uncertainty in the analysis without a further freeboard component.

At the 2085 design horizon, extreme tidal flood events will overwhelm the existing tidal defences and impinge directly on the proposed substation platform. In this case a freeboard allowance should be incorporated to allow for wave action against the platform. An appropriate allowance for wave action is considered to be the 1 in 1 year return period wave height, 0.42m.

The recommended substation platform level to ensure no inundation at the design event is therefore derived as follows:

1,000 year return period still water level (2085, 95% confidence):	5.77mAOD
plus freeboard for wave action (1 in 1 year wave height):	0.42m

Total 5.77 + 0.42 = 6.19mAOD, say **6.20mAOD**.

6.2 Platform level – less conservative assumptions

Following discussion with the client, an alternative scenario has been considered whereby the platform itself would not necessarily be elevated above flood level at the design event but individual items of plant and infrastructure would be protected against standing water and splashing from wave action. It is understood that the proposed substation assets can readily be protected in this way, for example:

- Transformers will be bunded, and the bund level can be set to provide protection against flood inundation;
- Gas-insulated switchgear will be housed in a building which can be elevated above flood level and protected against wave splashing;
- Other vulnerable items can either be elevated above flood risk levels or if necessary protected with local bunding (with sump pumps where appropriate).
- In addition there is an opportunity to provide enhanced flood protection at the platform edge (e.g. bunding or wave walls), which could prevent or mitigate flooding of the platform at the design event.

With appropriate measures to protect the substation assets it is considered that the platform level can be reduced below 6.20mAOD. An appropriate minimum platform level is considered to be the 50% confidence, 1000 year return period water level

(4.92mAOD) with allowance for sea level rise based on the recommended 95% confidence medium emissions scenario to 2085 (0.41m); total **5.33mAOD**.

This should be the minimum level at the platform edge with slightly higher levels in the vicinity of the main substation assets, providing a gentle fall towards the platform edge to promote free drainage of the platform surface away from the substation. At the design event (allowing for uncertainty in the analysis) standing water may be encountered over the whole platform area.

It is recommended that the GIS building threshold be set no lower than 6.2mAOD, and the building structure be robustly resistant to floodwater ingress through wave splashing up to a level of at least 7.2mAOD. Transformer bunds should also be raised to 7.2mAOD and other vulnerable equipment should be elevated above 7.2mAOD where possible. If this is not possible, robust local flood barriers, equipped with automatic sump pumps, should be provided to protect vulnerable equipment up to the 7.2mAOD level.

The selection of a platform level below 6.2mAOD exposes the substation to greater risk, particularly in respect of longer term estimates of future sea level rise. In the event that sea level rise occurs more rapidly than current predictions, a lower platform level will result in greater dependence on flood walls, barriers and other such measures to provide flood resilience.

6.3 Safe access

Existing terrain levels on all sides of the proposed platform are significantly lower than design flood levels considered in this report. If access to the substation is required during a severe flood event appropriate arrangements will be required to provide an access route from higher ground.

It should be noted that although the duration of a tidal flood event is in the order of a few hours, floodwater from the more severe events may be trapped behind the existing flood embankment at levels in excess of 4mAOD and may take a considerable time to drain or be pumped away. Depending on the characteristics of the surge event giving rise to extreme tide levels, flooding may be repeated on consecutive tides thus prolonging the recovery phase.

6.4 Commentary on sea level rise

Given its location on the tidal River Forth, tidal flooding is the dominant flood risk to the proposed substation, and the flood risk will increase progressively over time owing to future sea level rise. There is considerable uncertainty regarding future rates of sea level rise, not only because of the complexity of interacting natural processes that contribute but also because of unknown future levels of CO_2 emissions.

The conservative analysis in this report has gone beyond current guidance (Environment Agency, 2011) by adopting high emissions (95% confidence) sea level rise projections in place of the recommended medium emissions 95% projections. This introduces an uplift in design flood level of 0.12m at the 2085 horizon.

It should be noted that UKCP09 also discusses an H++ scenario to provide an estimate of sea level rise and other climate change parameters beyond the likely range but within physical plausibility. It is useful for contingency planning to understand what might be required if climate change were to happen much more rapidly than expected. Under the H++ scenario, sea level in 2085 could be about 1.3m higher than in 2005 and potentially be rising at 33mm/year. Furthermore the H++ scenario also raises the possibility of 0.7m increase in storm surge magnitude by the 2080s.

It is understood that the currently proposed 400kV substation is likely to require a major refit before the 2085 horizon adopted in this report. Based on a design platform level of 6.2mAOD, options will be available to enhance the degree of protection to the installation, including edge-of-platform wave walls, elevation or local protection of individual critical equipment items etc to increase flood resilience, should these be required. However if the most pessimistic projections of the H++ scenario are realised, the viability of all coastal settlements and infrastructure will be questionable.

6.5 Impact of development on local flood risk

Land raising associated with development on sites subject to flood risk has the potential to worsen flood risk in adjacent areas, due to displacement of floodwater storage capacity on the footprint of the development.

Construction of an elevated platform for the proposed substation at Kincardine will displace floodwater from its footprint, contributing to a small rise in water level on the landward side of the existing flood bank. However this condition will only pertain for the smaller events where the water level does not exceed the level of the flood defences. For the larger events with a drowned condition there is hydraulic continuity between water levels at the site and those in the tidal River Forth, and in such situations the displaced floodwater volume will be dissipated into the sea.

The inundation models have been run for the case with the platform in place, and the worst case result was found to be the present day 200 year return period event, where the predicted flood level increases by 85mm due to floodwater displacement from the platform footprint. This impact is small and in any case the area subject to flooding affects only land within Scottish Power ownership. Results of this analysis are summarised in Table 6-1.

Given the small impact and the fact that all the land affected belongs to Scottish Power, it is concluded that no mitigation of adverse flooding impact is required to be implemented through provision of compensatory storage or other means.

Return Period (1 in X)	Site flood levels 2013		Site flood levels 2085	
	Water level mAOD	Development impact mm	Water level mAOD	Development impact mm
2	-	0	-	0
10	-	0	1.45	58
50	0.98	0	5.15	0
100	1.67	68	5.33 (drowned)	0
200	2.25	85	5.46 (drowned)	0

Return Period (1 in X)	Site flood levels 2013		Site flood levels 2085	
	Water level mAOD	Development impact mm	Water level mAOD	Development impact mm
1000	5.28 (drowned)	0	5.77 (drowned)	0

Table 6-1: Development impacts on local flood risk

6.6 Surface water flooding

Surface water flooding from severe storm events may cause ponding in the low parts of the Kincardine power station site, but the depth of such ponded storm water will not impact on the proposed 400kV substation. The substation platform itself should be designed to be free-draining so that direct pluvial runoff does not impact on critical equipment.

Flood water may spill from adjacent watercourses into the low-lying areas of the power station site, but again this will not reach levels that would affect the 400kV substation. Any such flows spilling from the unnamed tributary of the Canal Burn, immediately north of the proposed 400kV substation, will be able to flow harmlessly past the substation platform, provided that there are no obstacles to surface flow paths east and west of the platform.

7 Conclusions and recommendations

A flood risk assessment has been carried out for a proposed new 400kV electricity substation to be constructed at the former Kincardine Power Station site in Fife. The substation will replace an existing 275kV substation as part of the Kincardine/Central network upgrade project currently being promoted by Scottish Power Energy Networks. The Kincardine power station site as a whole is known to be at risk of tidal flooding from the adjacent River Forth, and is protected by an embankment with a revetment and a wave wall.

The flood risk assessment has confirmed that tidal flooding is the major source of flood risk to the site. Surface water flooding from both direct rainfall and flow escaping from adjacent watercourses has also been investigated but does not pose a significant risk to the development. In accordance with industry guidance, the flood risk assessment has considered flooding from events up to a 1,000 year return period. Future sea level rise, driven by global climate change, will progressively increase flood risk to the site over time. A horizon of 2085 has been adopted for assessment of future flood risk.

The tidal flooding mechanism involves high surge tide levels in the River Forth acting in conjunction with wind-generated wave action to create conditions where overtopping of the embankment and wave wall can occur. The resulting flow into the power station site collects in the low points before progressively spreading to higher levels. Ultimately, if the river levels are high enough, the defences will be drowned and water levels on site will equalise with those in the river. There is also the possibility of a breach in the defences, which could result in severe flooding of the site during a surge tide event.

In recognition of the tidal flood risk, Scottish Power Energy Networks proposes to construct the substation on a raised platform. The main focus of the flood risk assessment is to identify an appropriate design level for the platform.

Tide level records from Grangemouth and records of wind speed and direction have been analysed to obtain estimated peak tide levels and wave heights for a range of return periods. A relationship was established between estimated peak tide levels at Grangemouth and Kincardine based on two previous studies, and a joint probability analysis of tide level and wave height was undertaken. The outputs were used to calculate overtopping and overflow rates over the tidal defences into the power station site. Given the relatively short period of data, 95% confidence values were adopted for both peak water level and wave height to ensure an appropriately conservative assessment. Sea level rise projections were taken from UKCP09 using the 95% confidence high emissions scenario, again for a conservative assessment.

The volume of floodwater entering the site through overtopping/overflow was calculated for each event over a period of 3 hours each side of high tide, and used to estimate the resulting flood level on the landward side of the tidal defences. The existing tidal defences provide some protection up to the present day 200 year flood event, limiting the flood level on site to 2.25mAOD assuming no breach occurs. For the 1,000 year event, a drowned condition occurs with water level on site equalising with the tide level at 5.28mAOD. By 2085 a drowned condition occurs in the 50 year return period, with peak water level of 5.77mAOD occurring in the 1,000 year event.

The flood risk assessment for the proposed Kincardine substation makes the following recommendations:

- A conservative platform level of 6.20mAOD is recommended for the new substation, to ensure that the platform is not inundated during the design event. This is based on the estimated 2085 horizon 1,000 year return period flood level of 5.77mAOD with a freeboard allowance for wave action;
- Following discussion with the client a lower platform level has been considered, which would accept some inundation of the platform at the design event with substation assets protected by bunding, flood barriers or flood resistant construction. This solution requires a level at the platform edge of at least 5.33mAOD, with a slight fall from higher levels in the substation area. The GIS building should have a threshold level of at least 6.2mAOD, with flood resistant construction to 7.2mAOD. Vulnerable plant items should be raised above 7.2mAOD or robustly protected with bunds or other flood barriers;
- Consideration should be given to the need for access to the substation during flood events, given that flood water may be trapped within the power station site for an extended period after a severe tidal flood event;
- There is uncertainty over future rates of sea level rise and, while conservative assumptions exceeding published guidance have been made in the assessment, significantly higher rates of sea level rise are acknowledged as within physical plausibility. The conservative platform level of 6.2mAOD would offer more passive resilience than the lower platform, if sea level rise occurs more rapidly than allowed for in current guidance;
- Floodwater displaced by construction of the platform will result in slightly higher water levels (up to about 85mm) within the power station site for the less severe floods which do not result in a drowned condition. Since the extent of such flooding does not extend outwith Scottish Power's land ownership, it is considered that no compensatory storage or other mitigation is required in this instance;
- Surface water flooding does not pose a risk to the development provided that the platform is designed to be free draining and adjacent surface water flow paths are maintained.

8 References

1. Scottish Power Energy Networks, Kincardine Substation Flood Risk Assessment, Halcrow Group Limited, June 2011

2. Falkirk Council, GrangemouthFlood Study, Flood Risk Mapping – Final Report, Halcrow Group Limited, August 2012

3. SEPA flood map - http://go.mappoint.net/sepa/

4. Scottish Environment Protection Agency (August 2010) Technical Flood Risk Guidance for Stakeholders v6

5. Scottish Government (February 2010) Scottish Planning Policy

6. Stirling Council – River Forth Flood Mapping Stage 3, Halcrow Group Limited, 2007

7. DEFRA – UK Climate Projections, UKCP09 website http://ukclimateprojections-ui.defra.gov.uk/ui/admin/login.php.

8. Environment Agency - Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.

9. Eurotop Wave Overtopping of Sea Defences and Related Structures: Assessment Manual, HR Wallingford, 2007

Appendix A

Site Visit Photographs

Appendix A   Site Visit Photographs

PHOTOGRAPHS FROM JULY 2013 SITE VISIT

Photo A1 – 400kV Substation site context, viewed from north

Photo A2 – 400kV Substation site, viewed from south

Photo A3 – Tidal defences south of 400kV Substation site (wave wall raised locally to A876 bridge abutment)

Photo A4 – Wave wall and footpath on existing tidal defence embankment

PHOTOGRAPHS FROM 2011 SITE VISIT

	
Photo 1: View across substation to north	Photo 2: View across substation to west
	
Photo 3: Landward side of sea wall	Photo 4: Seaward side of sea wall looking south
	
Photo 5: Seaward side of sea wall looking north	Photo 6: Sea wall with new wall at crest

	
Photo 7: Narrow wall at northern end of seawall	Photo 8: See wall at Kincardine (looking north)
	
Photo 9: Watercourse to south of substation (near level crossing road)	Photo 10: Watercourse to south of substation (near level crossing road)

Appendix B

Drawings received

Appendix B Drawings received

Drawing SP4100405 – Kincardine Substation Site Feasibility Layout 'Scenario 6A'

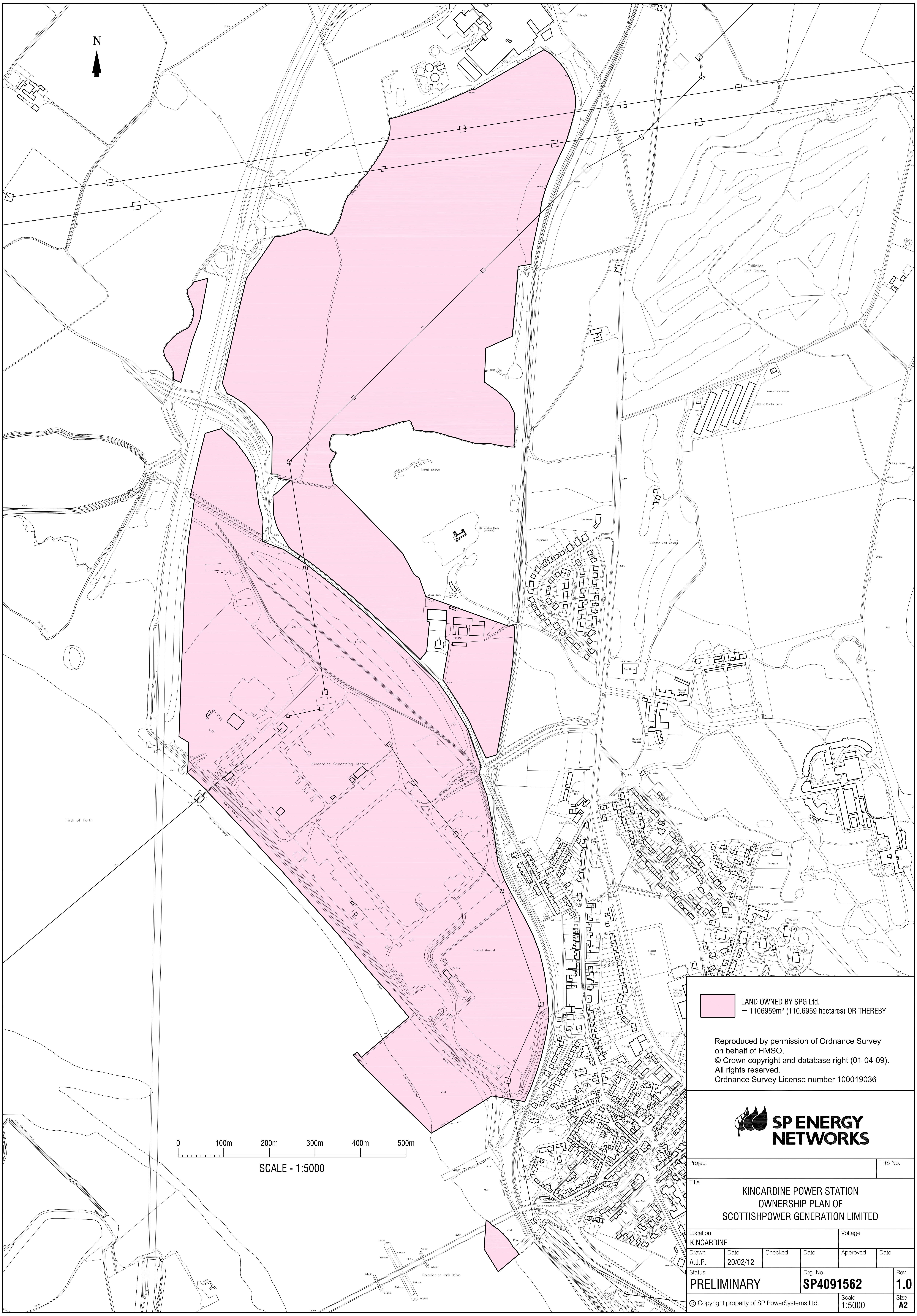
Kincardine Power Station Ownership Plan of ScottishPower Generation Limited

NOTES:-

1. FOR DETAILS OF EXISTING CABLE AND OHL INFRASTRUCTURE, ENQUIRIES SHOULD BE EMAILED TO requestforplansscotland@scottishpower.com
2. ALL CABLE ROUTES SHOWN ARE TAKEN FROM EXISTING RECORDS BUT ACCURACY CANNOT BE GUARANTEED.
3. CARE TO BE EXERCISED DURING ANY EXCAVATION AS ALL UNDERGROUND SERVICES MAY NOT BE SHOWN.

SP ENERGY NETWORKS

Project: ENSG (EAST COAST)				TRS No.	
Title: KINCARDINE SUBSTATION SITE FEASIBILITY LAYOUT 'SCENARIO 6A'					
Location: KINCARDINE				Voltage: 400kV	
Drawn: ASH	Date: 24/12/12	Checked	Date	Approved	Date
Status: PRELIMINARY		Drg. No.: SP4100405		Rev.: 1.0	
			Scale: 1:600	Size: A0	



LAND OWNED BY SPG Ltd.
= 1106959m² (110.6959 hectares) OR THEREBY

SP ENERGY NETWORKS

Project				TRS No.	
Title: KINCARDINE POWER STATION OWNERSHIP PLAN OF SCOTTISHPOWER GENERATION LIMITED					
Location: KINCARDINE				Voltage	
Drawn: A.J.P.	Date: 20/02/12	Checked	Date	Approved	Date
Status: PRELIMINARY		Drg. No.: SP4091562		Rev.: 1.0	
© Copyright property of SP PowerSystems Ltd.		Scale: 1:5000		Size: A2	

Appendix C

Details of flood risk assessment

Appendix C   Details of flood risk assessment

Technical note - Wave Hindcast and Joint Probability Analysis

Technical note - Overtopping Calculations

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Technical note

Project Kincardine – Assessment of flood risk
Subject Wave Hindcast and Joint Probability Analysis
Author Bin Li

Date 6 June 2013
Ref

1 Introduction

Halcrow has been commissioned to carry out a site-specific assessment of flood risk involving the prediction of wave heights and water levels at Kincardine. For a recent study of flood risk assessment of Grangemouth (Halcrow, 2012), Halcrow obtained the wind data of the Edinburgh Airport from NOAA (National Oceanic and Atmospheric Administration) for a period of 1973 to 2012, and obtained the long term water level records for Grangemouth from UKHO (United Kingdom Hydrographic Office) covering a period from 1999 to 2011. In order to obtain the water level data at Kincardine, results from two previous flow modelling studies - a 1-dimensional ISIS model (Halcrow, 2007) and a 2-dimensional DAWN model (Halcrow, 2008) - are analysed and used to establish the relationship between water level at Grangemouth and Kincardine. Then the water levels at Kincardine are obtained by using the measured water levels at Grangemouth with the established relationship between Grangemouth and Kincardine. Based on those wind and water levels data, a wave hindcast modelling work is carried out to generate the local wind waves. Then marginal extreme value analysis is undertaken for both wave heights and measured water levels which are used as input data for a joint probability model. Finally the joint probability analysis is carried out using Join-Sea model. The joint probability results of wave heights against water levels are produced as the parameters for design.

2 Data

2.1 NOAA Wave Data

Wind data was downloaded from NOAA at Edinburgh Airport. This data is hourly averaged data, on land and someway from Kincardine. The wind data from at Edinburgh Airport were downloaded from NOAA website and checked using a shorter time period of wind data at Grangemouth (Halcrow's Technical Note, Grangemouth-Assessment of flood risk, July 2012). It was concluded that the wind data at Edinburgh airport can be used directly for the wave hindcasting for the Grangemouth Study. The Kincardine site is only 5km away from the Grangemouth location, it is therefore considered reasonable to use the wind data at Edinburgh Airport again for wave hindcast study for this project.

Prepared by	Bin Li	Date	18/June 2012
Checked by		Date	
Approved by		Date	

A wind rose is produced as shown in Figure 2-1, and Table 2-1 shows the wind speed distribution according to different wind directions.

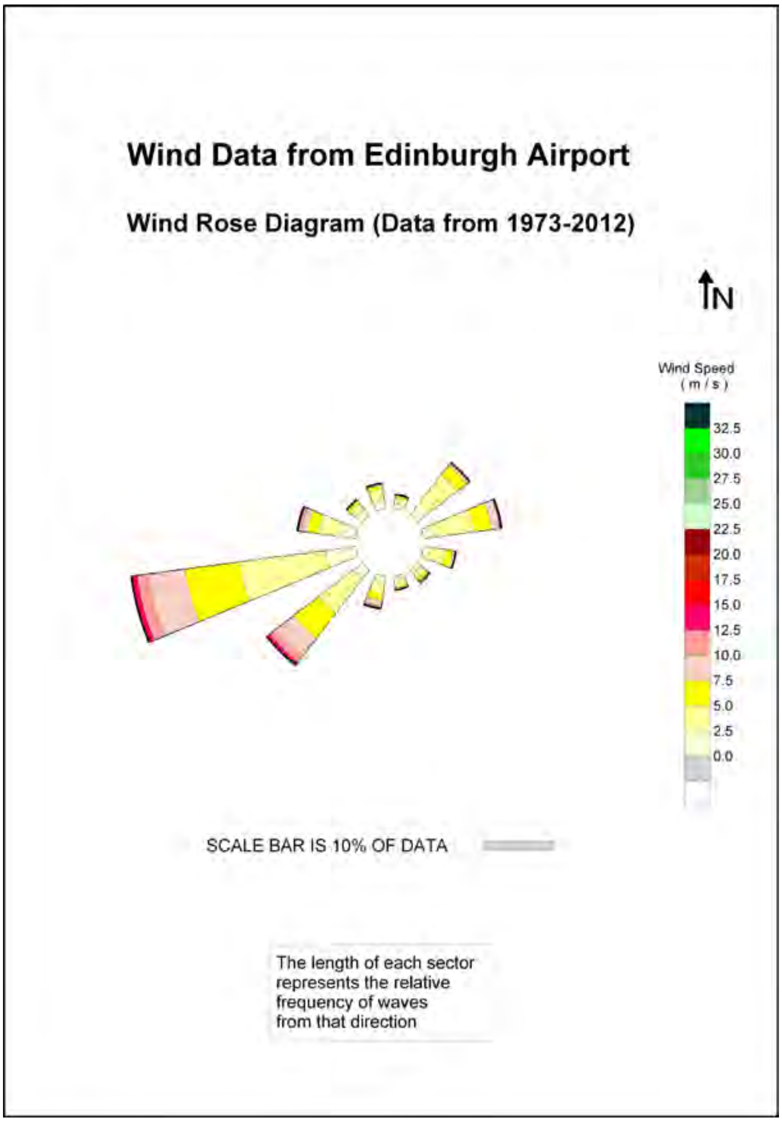

Figure 2-1 Wind rose based on Edinburgh Airport wind data downloaded from NOAA.

Wind Speed (m/s)	Wind Direction (deg)											
	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360
32.5 - 35.0	0	0	0	0	0	0	0	2	0	0	0	0
30.0 - 32.5	0	0	0	0	0	0	0	1	0	0	0	0
27.5 - 30.0	0	1	0	1	0	0	1	1	2	0	0	0
25.0 - 27.5	0	0	0	0	0	0	0	0	4	0	0	0
22.5 - 25.0	0	0	1	0	0	0	4	6	17	2	0	0

20.0 - 22.5	0	0	0	0	0	0	8	27	50	5	1	0
17.5 - 20.0	5	8	2	1	1	2	80	202	336	44	4	1
15.0 - 17.5	23	75	232	30	15	23	386	1383	2056	428	11	13
12.5 - 15.0	68	275	604	185	74	79	650	3042	4826	866	49	71
10.0 - 12.5	310	1439	3031	1119	405	359	2195	9772	16029	2889	357	565
7.5 - 10.0	791	4596	7503	2884	1142	945	3181	13700	23263	4518	1056	1554
5.0 - 7.5	2563	15712	17608	7108	3089	2801	5191	18437	37232	9454	3843	4716
2.5 - 5.0	2259	6285	4586	2650	1714	1619	2162	4945	12973	6783	3134	3632

Table 2-1: Edinburgh Airport wind data downloaded from NOAA

2.2 UKHO Water Level Data for Grangemouth

Measured water level data at Kincardine are not available, so the measured water levels at Grangemouth are used as base data which are converted to the Kincardine water levels using a relationship described in Section 5. The measured Grangemouth water level data are briefly discussed as follows.

Halcrow has obtained the water level data of Grangemouth from UKHO for a period from 1999 to 2011 including gaps. Halcrow has held a few years of data for the same tide station at Grangemouth from Harbour Master which are suitable to patch the gaps of the UKHO data. After processing all water level data, the time periods covering the data are shown in Table 2-2.

Available Years of Data	Available Months of Data
1999	from Sep to Dec
2000	from Jan to Jun; from Aug to Dec
2001	from Jan to Mar; from Jun to Dec
2002	from Jan to Apr; from Jun to Dec
2003	Jan; From Aug to Dec
2004	from Jan to Dec
2005	from Jan to Apr; from Jul to Dec
2006	from Jan to Dec
2007	from Jan to Dec
2008	from Jan to Dec
2009	from Jan to Dec
2010	from Jan to Dec
2011	from Jan to Dec

Table 2-2: Available recorded water levels data at Grangemouth from UKHO

The received water level data at Grangemouth have been checked for their quality. All data with obvious errors have been deleted. A short time period of the Grangemouth water level data has been plotted against the same period of Leith recorded water level data which is shown in Figure 2-2. This comparison shows that high tide levels at Grangemouth are consistently higher than corresponding high tide levels at Leith (near the estuary mouth). Figure 2-3 shows the location of Kincardine, Grangemouth, Leith and Edingburgh Airport.

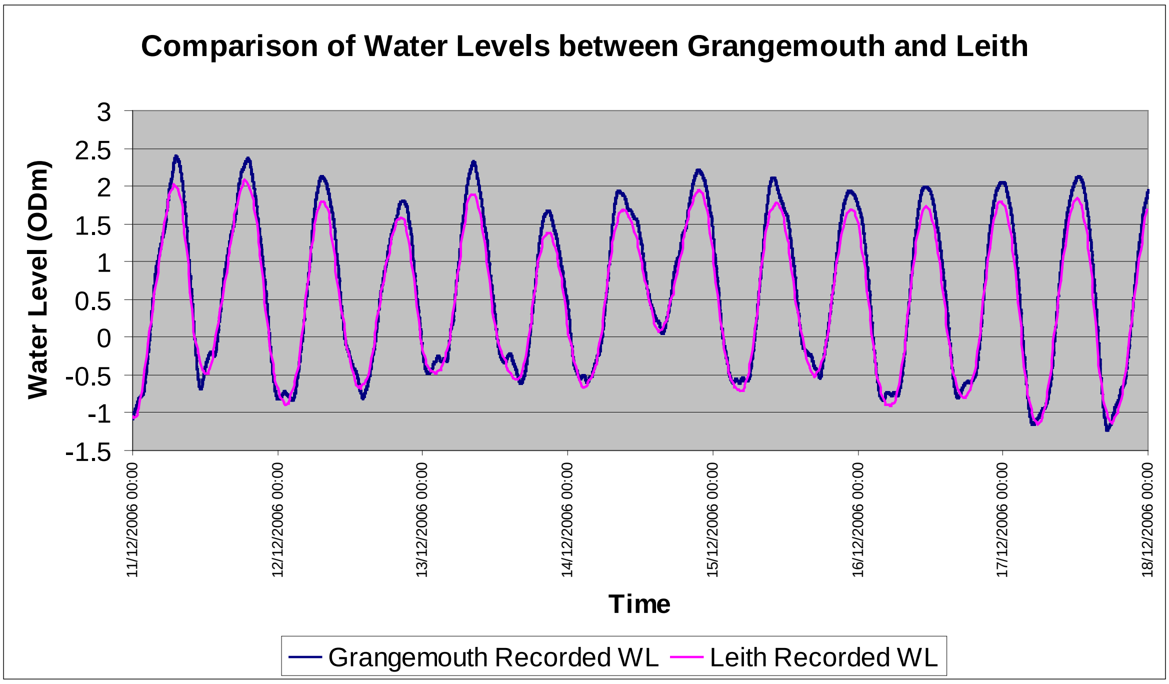

Figure 2-2 Comparison of recorded water levels at Grangemouth and Leith.

Figure 2-3 Locations of Kincardine, Grangemouth, Leith and Edinburgh Airport.

3 Methodology

Since no measured wave data are available at Kincardine the wave climate must be synthesised from a long term time series of measured wind data by a process known as hindcasting. In this process the characteristics of the waves arriving at the site depend upon the wind speed, the period of time for which it has been blowing in that direction, the water depth (if wave breaking occurs), and the length of water across which it has been blowing (the 'fetch' length), which in turn is a function of the wind direction and the geography of the region. The result of this process is a time series of wave height and direction at the defined site, which may be analysed for extreme events and to obtain a scatter plot of frequency of occurrence by wave height and direction.

Halcrow Group Ltd has developed a full suite of wave modelling software which is used for simulation of wave conditions at the site. The results of the wave modelling are required to meet the needs of engineering design. The separate components of the suite were thoroughly validated by tests against measured data at different sites of previous projects. The component of the suite used for this wave study is:

- MWAV_WIN: Wave hindcast model based on the JONSWAP method.

MWAV_WIN requires a regular time series of wind velocity (speed and direction), together with the fetch length (measured from charts) for each direction sector. It is possible to specify the search sector and maximum divergence of wind direction from the basic direction. There is a choice of three different wave generation formulations: CEM (2000), JONSWAP and SMB. However, JONSWAP is well established and widely accepted, and has therefore been adopted for the present modelling work.

After generation of local wave data from MWAV_WIN, Halcrow's software of extreme value analysis is also used including:

- MWAV_POT: Peak Over Threshold model to screen the data for extreme value analysis.
- MWAV_FIT: Fits extreme event probability curve to random data.

Halcrow's model MWAV_POT is used to screen the wave data in order to obtain a truly random data set. The MWAV_POT model is based a method of Peak Over Threshold, which selects a single peak wave height during a storm over a threshold wave height as input value and a minimum of 1 day interval is used to separate the storms.

Halcrow's MWAV_FIT model is used to predict the wave heights for the required return periods. In the MWAV_FIT model, the parameters of the parametric distribution functions are estimated from sets of observations applying the Maximum Likelihood Estimation (MLE) technique. These probability distribution functions (PDF) are assumed to be the parent distributions of the observations in terms of the probability that, for a random storm the stochastic variable x does not exceed the value x. In the MWAV_FIT model, the equations to be solved in the MLE method are the following parametric functions:

- Gumbel (Fisher—Tippett type I), a two-parameter model:

  $P(x) = \exp[-\exp[-y]]$; $y=(x-\mu)/\sigma$

- Fréchet (Fisher—Tippett type II), a three-parameter model:

$P(x) = \exp(-y^{-\alpha})$; $y = (x-\mu)/\sigma$

- Weibull (Fisher—Tippett type III), a three-parameter model:

$P(x) = 1 - \exp(-y^{\alpha})$; $y = (x-\mu)/\sigma$

- Generalised Extreme Value Distribution, a three-parameter model:

$P(x) = \exp[-\{1-ky\}^{1/k}]$; $y=(x-\mu)/\sigma$

- Generalised Pareto Distribution, a three-parameter model:

$P(x) = 1- [1-ky]^{1/k}$; $y=(x-\mu)/\sigma$

- Log-normal Distribution, a two-parameter model:

$P(x) = \Phi\{[\ln(x)-\mu]/\sigma\}$; Φ is a cumulative standard normal distribution function

For this study the function of Generalised Extreme Value Distribution (GEV) is used for marginal extreme analysis of wave heights at Kincardine.

Since there is no measured record of water level at Kincardine, the measured water levels at Grangemouth are used as base data which are converted to the Kincardine water levels using a relationship described in Section 5. Previous flow modelling results from ISIS model and DAWN model are used to establish the water level relationship between Grangemouth and Kincardine. This relationship is then used to convert the measured water level data of Grangemouth to Kincardine. The Generalised Extreme Value Distribution (GEV) is again used for marginal extreme analysis of water levels at Kincardine.

For assessment of protection standards of the defences and also as input data for the overtopping calculations under extreme conditions, joint probability of wave and water level conditions are required. In this project the joint probability is carried out using JOIN-SEA model. The joint probability model JOIN-SEA has been developed by HR Wallingford and represents a rigorous new approach to joint probability (JP) determination. JOIN-SEA requires a list of high waters and the corresponding wave heights to determine the correlation between the data and also the marginal extremes. For this project the water levels are from conversion of the measured water levels of Grangemouth to Kincardine and the wave heights are based on the hindcast wave data. The marginal extreme values are used as input data for the Join-Sea model.

4 Wave Hindcast Modelling

For wave hindcast it is necessary as the first step to obtain the fetch lengths at the site. The LiDar data covering large area was not available to Halcrow. Thus the fetch lengths were measured using Admiralty Chart 741 and the Google Earth for the point shown in Figure 4-1. It is believed that the point should be suitable for wave overtopping calculations for the New 400kV Station. The measured fetch lengths are then shown in Tables 4-1. The water depth at the hindcast point is 4.5m.

Figure 4-1 Location of wave hindcast point at Kincardine

Direction (deg)	Fetch Length (km)
0	0.09
15	0.07
30	0.06
45	0.06
60	0.06
75	0.07
90	0.09
105	0.12
120	0.22
135	0.74
141	8.31
150	4.75
165	5.25
170	5.03
180	0.95
195	0.69
210	0.64
225	0.73
240	0.86
255	1.09
270	1.53
285	2.37
300	3.55
315	1.11
330	0.21
345	0.14

Table 4-1: Fetch Lengths for Kincardine wave hindcast

The hindcasting model MWAV_WIN was applied to the hindcast point, using the wind data of NOAA (see Table 2-1) and fetch lengths in Table 4-1. The model was used to generate a 39.4 year time series of wave data, with data points at 1 hour intervals. The synthesised wave data are presented as a wave scatter diagram in Table 4-2.

Wave Height (m)	Wave Direction (deg)											
	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360
0.7-0.8	0	0	0	0	1	0	0	0	0	0	0	0
0.6-0.7	0	0	0	0	2	0	0	0	0	0	0	0
0.5-0.6	0	0	0	0	10	7	0	0	0	0	2	0
0.4-0.5	0	0	0	0	70	96	0	2	1	7	7	0
0.3-0.4	0	0	0	0	227	358	2	2	58	113	89	0
0.2-0.3	0	0	0	0	563	1589	257	348	2648	2011	947	0
0.1-0.2	0	0	0	0	779	3000	5770	17454	47122	9721	4122	1
0.0-0.1	5736	31384	30156	13442	5951	1936	8784	27275	51900	12755	6157	7521

Table 4-2: Hindcasted Wave Heights for Kincardine

The wave results indicate that the wave heights for the sector of the longest fetch (120° to 150°) can reach 0.8m at the site. A wave rose is produced and is shown in Figure 4-2. The wind rose shows that the wind dominating sector is 240° to 270°. However, the fetch length for this sector is not long compared to the longest fetch, so the corresponding wave heights are generally less than 0.5m.

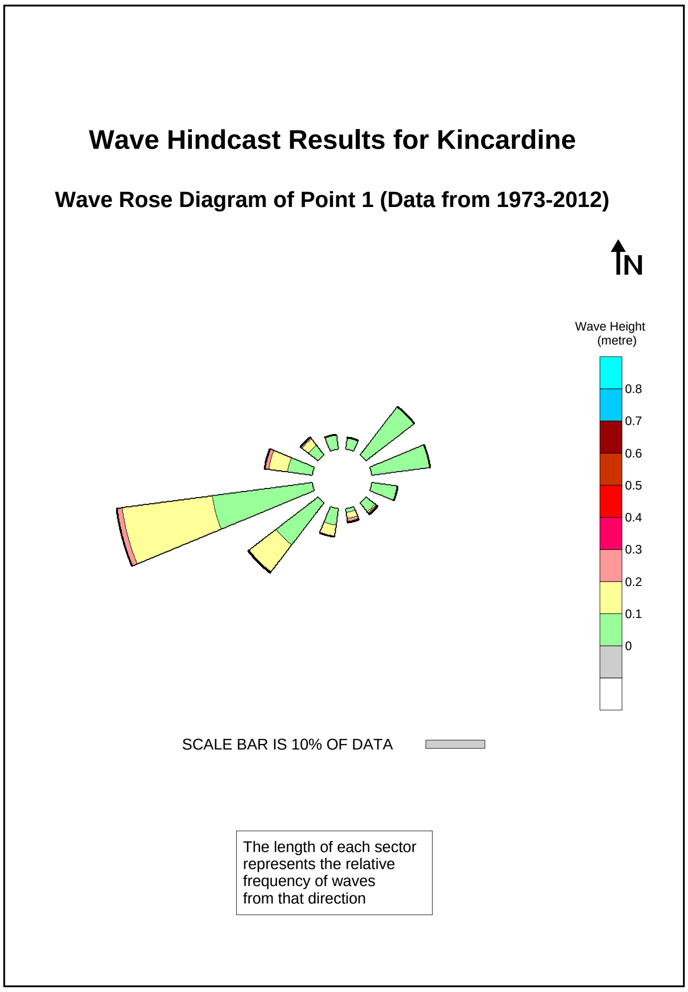

Figure 4-2 Hindcast wave rose for Kincardine

5 Relationship of water levels at Grangemouth and Kincardine

The measured water levels at Kincardine are not available, thus it is necessary to link the measured water levels at Grangemouth with the Kincardine ones so that the Kincardine water levels can be derived based on the Grangemouth measured water levels.

There have been two modelling works carried out before for studying the water levels of the Firth of Forth. One was based on the DAWN model and another one was based on ISIS model. For DAWN modelling (Scottish Power Energy Netwoks, June 2011) the model predicted levels were abstracted for sites at Grangemouth and Kincardine. Those results are shown in Table 5-1. Stirling Council also commissioned Halcrow to produce flood inundation maps on the River Forth for the area administered by Stirling Council. A 1-dimensional ISIS model of the Forth between Craigforth and Grangemouth was used, following calibration/validation, water levels were extracted for use in production of the flood inundation maps from Craigforth to Grangemouth for eight design return periods: 2, 10, 20, 50, 100, 200, 500 and 1000 year, using a revised 1-dimensional model with significant improvements to boundary data. The ISIS model results are shown in Table 5-2.

Both ISIS model and DAWN model results are used to establish the relationship of water levels between Grangemouth and Kincardine, which are presented in Figure 5-1. The equation of the fitted line from the modelling data is:

Kincardine Water Level = Grangemouth Water Level × 1.0103 + 0.0702

The relationship is established based on high water levels. This is reasonable since this study is focusing on obtaining extreme high water levels. Hence the measured water levels at Grangemouth can be converted to the water levels of Kincardine using above equation.

Return Period (years)	**Water Level @ Grangemouth (m aODN)**	**Water Level @ Kincardine (m aODN)**
1	4.03	4.14
2	4.13	4.24
5	4.26	4.38
10	4.37	4.48
20	4.47	4.58
50	4.60	4.72
100	4.70	4.82
200	4.80	4.92
500	4.94	5.05
1000	5.04	5.15

Table 5-1 DAWN modelling results of water levels for Grangemouth and Kincardine

Return Period (years)	**Water Level @ Grangemouth (m aODN)**	**Water Level @ Kincardine (m aODN)**
2	4.21	4.33
10	4.40	4.52
20	4.48	4.59
50	4.59	4.70
100	4.67	4.79
200	4.75	4.87

500	4.86	4.99
1000	4.94	5.08

Table 5-2 ISIS modelling results of water levels for Grangemouth and Kincardine

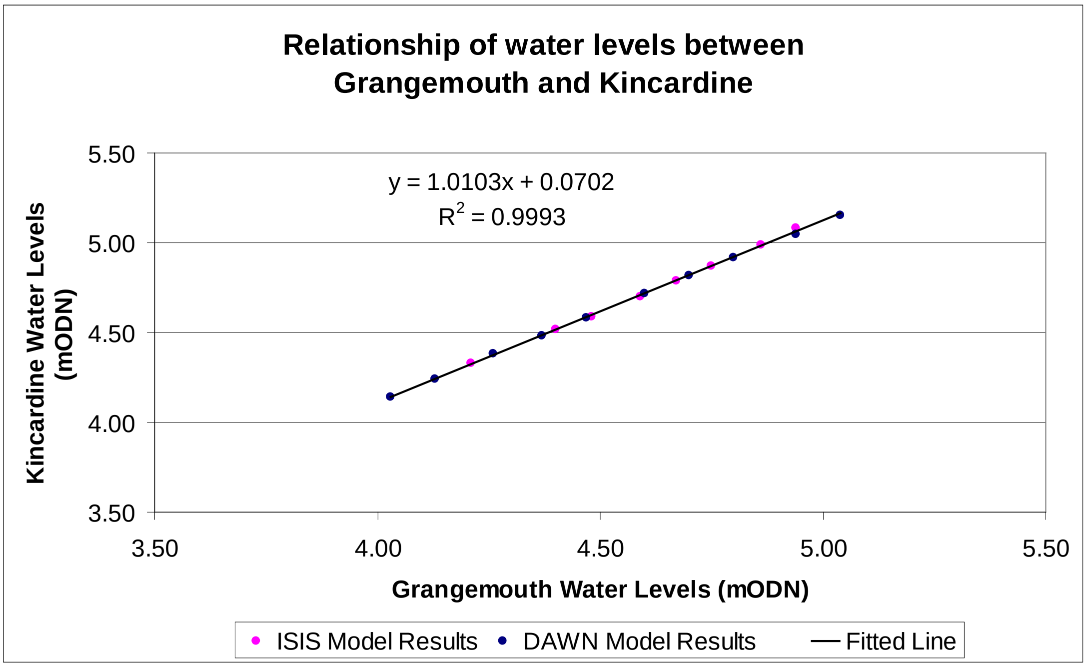

Figure 5-1 Relationship of water levels between Grangemouth and Kincardinebased

6 Marginal Extreme Analysis

6.1 Marginal extreme analysis of wave data

After generation of local wave data from MWAV_WIN, Halcrow's model MWAV_POT was used to screen the wave data in order to obtain a truly random data set. The MWAV_POT model is based a method of Peak Over Threshold (POT), which selects a single peak wave height during a storm over a threshold wave height as input value. In this study, a wave height 0.2m was used as the threshold value. There are 52 records per year as input data for the hindcast model.

Halcrow model MWAV_FIT was used to generate extreme wave heights based on the random data from POT analysis. In this study the GEV distribution gives better fit to the random data. The extreme wave conditions are then presented in Table 6-1. The plot of GEV fitting using Weibull plotting position is shown in Figure 6-1.

Return Period (years)	Extreme Wave Results		
	Wave Height Hmo (m)	Peak Wave Period (s)	95% Confidence Interval (m)
0.1	0.29	2.1	0.06
0.2	0.32	2.2	0.05
0.3	0.35	2.3	0.05
0.5	0.38	2.4	0.04
1	0.42	2.5	0.04
2	0.47	2.6	0.05
3	0.49	2.6	0.05
5	0.53	2.7	0.06
10	0.59	2.8	0.07
20	0.65	2.9	0.09
30	0.68	3.0	0.10
50	0.73	3.1	0.12
100	0.80	3.2	0.14
200	0.88	3.3	0.16
300	0.93	3.4	0.18
500	1.00	3.5	0.20
1000	1.09	3.6	0.23
2000	1.19	3.8	0.26
3000	1.25	3.8	0.29
5000	1.34	3.9	0.31
10000	1.46	4.1	0.35

Table 6-1: Extreme Wave Conditions for Kincardine

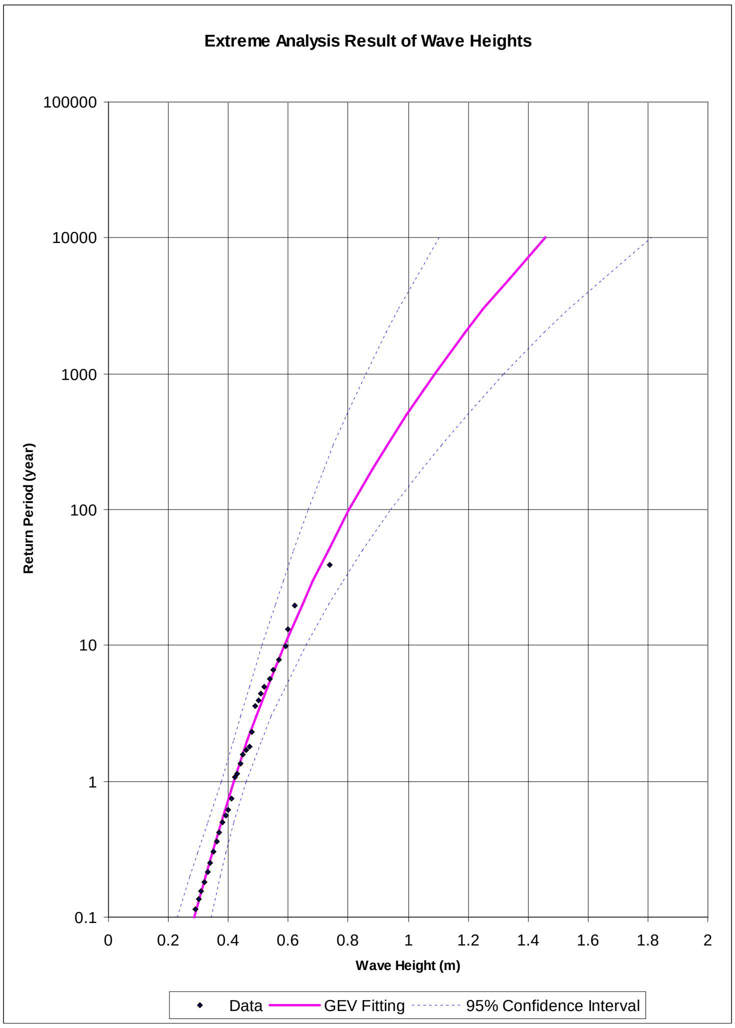

Figure 6-1 Marginal extreme value analysis results of waves at Kincardine

The peak wave periods were obtained from analysis of the relationship of the wave heights and the wave periods.

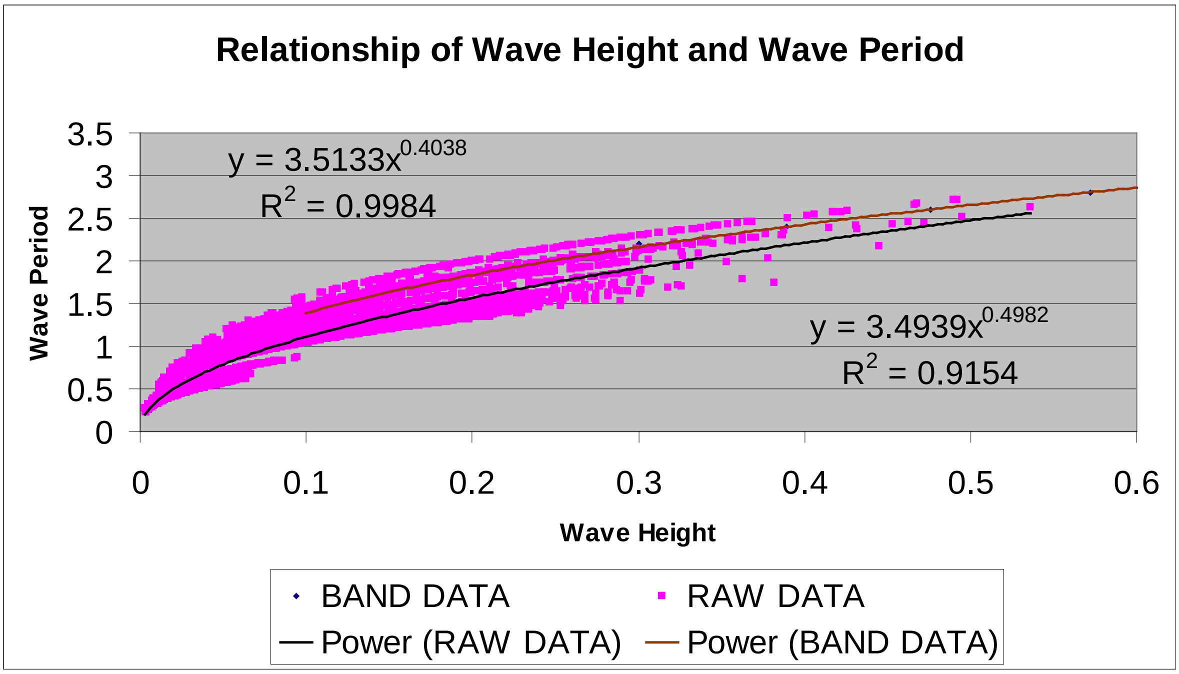

Figure 6-2 Relationship between wave periods and wave heights

Figure 6-2 shows the relationship between the wave heights and wave periods. A best fit was found using the hindcast wave data and the formula for calculation of the wave periods using the significant wave heights is:

$$T_p = 3.51 H_{mo}^{\ 0.4}$$

Using this formula, the wave periods can be calculated using the extreme wave heights. The results are shown in Table 6-1.

6.2 Marginal extreme analysis of water levels

As presented in Section 2.2 the UKHO has sent Halcrow the recorded water levels at Grangemouth from 12 years of water level data. This data set has been converted to the water levels at Kincardine with applying the relationship established in Section 5. The water levels at Kincardine are then used for marginal extreme value analysis. In order to obtain a truly random data set, Halcrow's model MWAV_POT was used to screen the water level data. The MWAV_POT model is based a method of Peak Over Threshold (POT), which selects a single peak water level during a tidal cycle over a threshold water level as input value. In this study, a water level of 3.4m(ODN) was used as the threshold value.

Halcrow model MWAV_FIT was used to generate extreme water levels based on the random data from POT analysis. In this study the GEV distribution gives the best fit to the random data. The extreme water level conditions are then presented in Table 6-2 while Figure 6-3 shows the GEV fitting for the data,

Return Period (years)	Extreme Water Level Results	
	Water Level (mODN)	95% Confidence Interval (m)
0.1	3.67	0.06
0.2	3.76	0.05
0.3	3.81	0.06
0.5	3.87	0.06
1	3.95	0.08
2	4.04	0.10
3	4.09	0.11
5	4.16	0.12
10	4.25	0.15
20	4.34	0.17
30	4.40	0.18
50	4.47	0.20
100	4.57	0.23
200	4.67	0.26
300	4.74	0.27
500	4.81	0.29
1000	4.92	0.32
2000	5.03	0.35
3000	5.10	0.37
5000	5.19	0.39
10000	5.31	0.42

Table 6-2: Extreme Water Levels at Kincardine

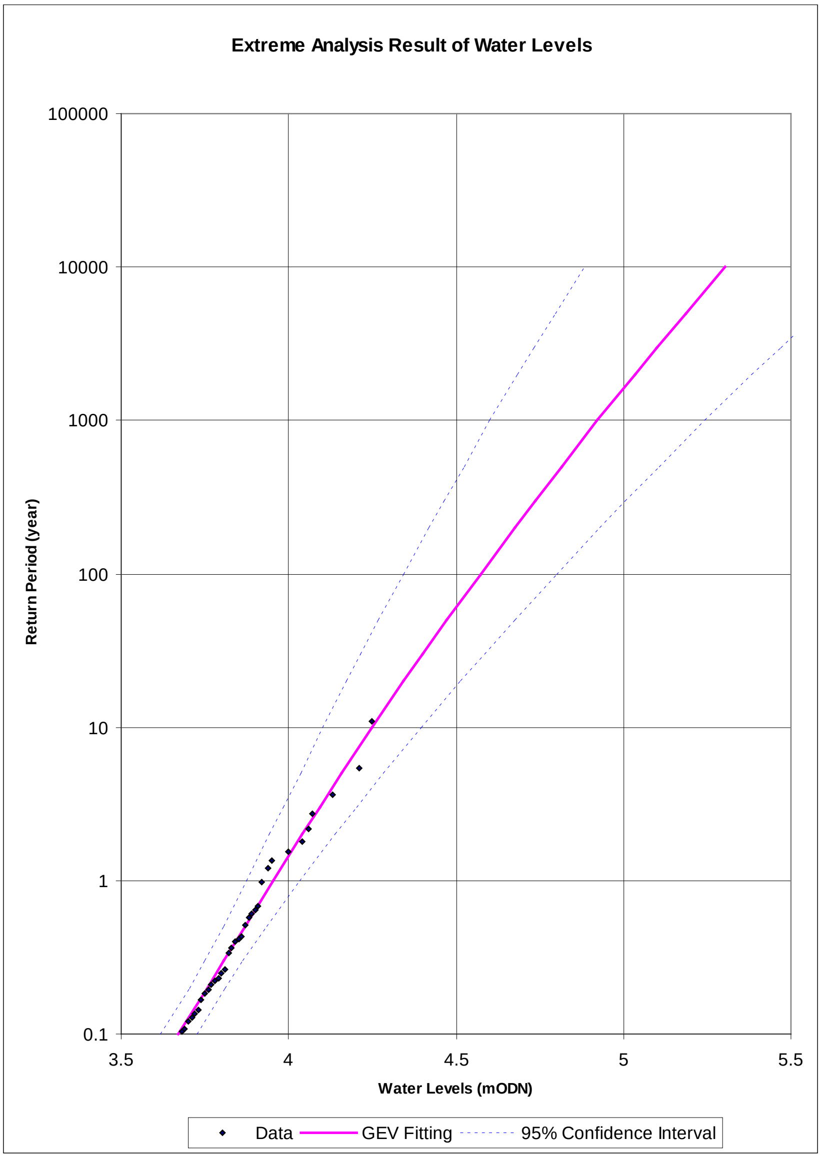

Figure 6-3 Marginal extreme value analysis results for water levels at Kincardine

It is useful to compare the extreme water levels produced in this study with all existing extreme water levels from other projects. Figure 6-4 shows different extreme water levels at Kincardine and Grangemouth from different studies. As expected the present study results of Kincardine are consistently higher than the extreme water levels at Grangemouth.

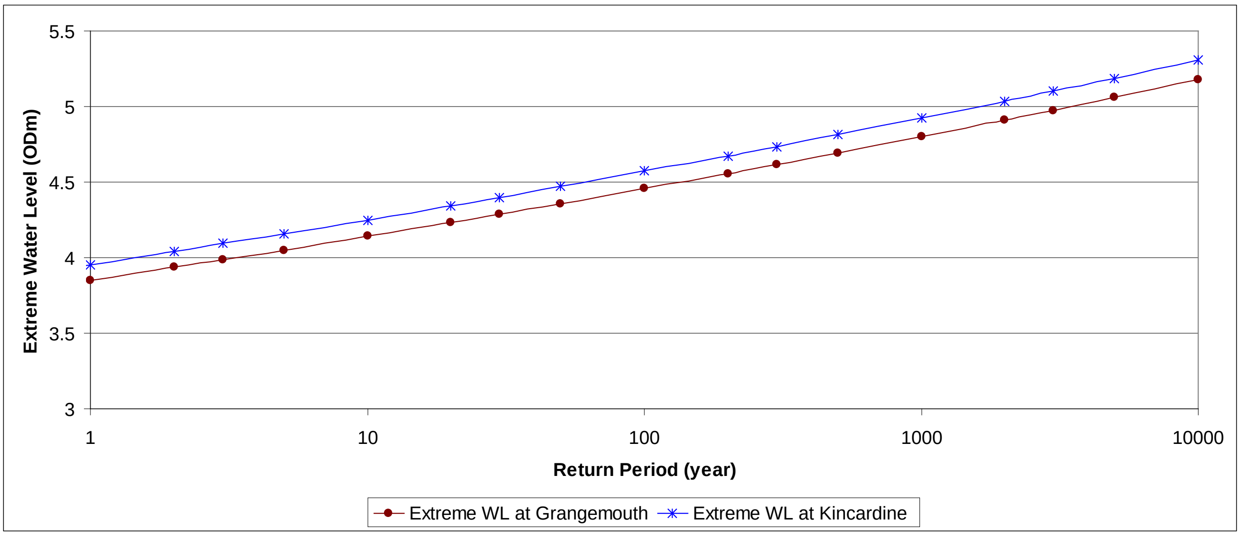

Figure6-4: Different Extreme Water Levels at Kincardine and Grangemouth

7 Joint Probability Analysis and Results

For this project the Kincardine high water levels are used as input data and the corresponding time series of the hindcast wave data. The marginal extreme wave heights of omni-direction and water levels, presented in previous sections, are used as input data for the JOIN-SEA model. The time series of data is from 1999 to 2011.

The plot of data fitting curves from the joint probability analysis for Kincardine is shown in Figure 7-1.

The model outputs from JOIN-SEA model for return periods required for further modelling work for 1 in 2 years to 1 in 1000 years for Kincardine is shown in Table 7-1. Those joint extreme results are used as parameters for further overtopping calculations.

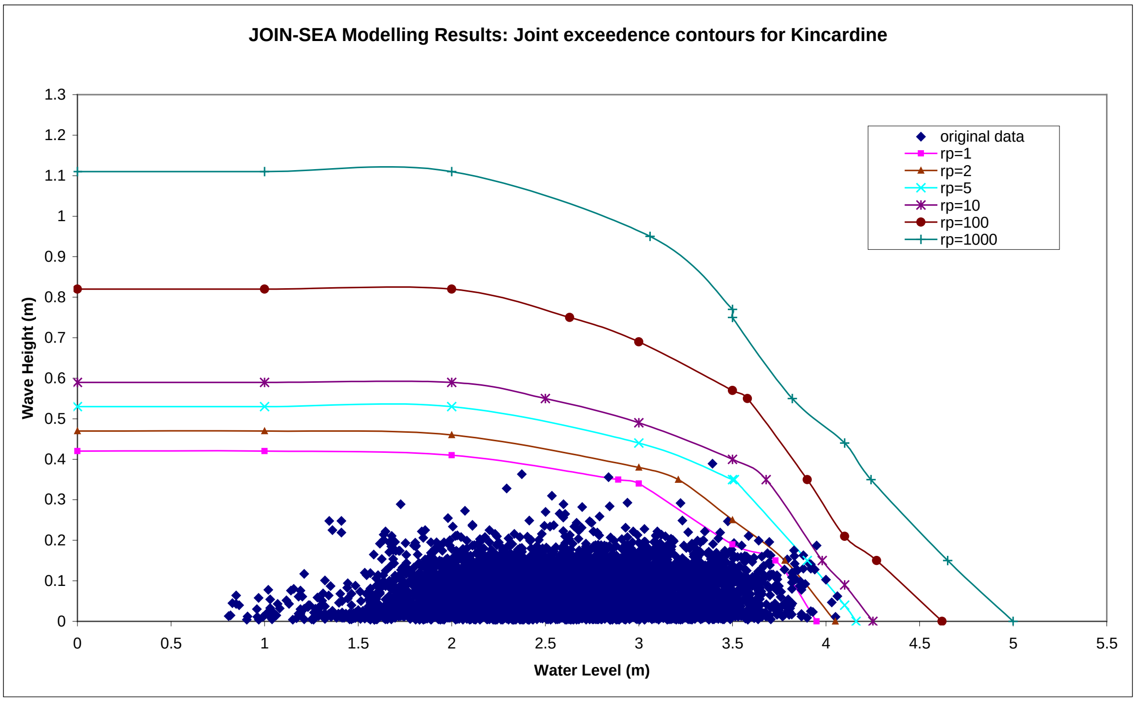

Figure 7-1 Joint probability results for Kincardine

Joint extreme values of water levels and wave heights for Kincardine

1:2			1:10			1:50			1:100			1:200			1:1000		
WL(m)	Hm_o(m)	Tp(s)	WL(m)	Hm_o(m)	Tp(s)	WL(m)	Hm_o(m)	Tp(s)	WL(m)	Hm_o(m)	Tp(s)	WL(m)	Hm_o(m)	Tp(s)	WL(m)	Hm_o(m)	Tp(s)
0.0	0.47	2.5	0.0	0.59	2.8	0.0	0.75	3.1	0.0	0.82	3.2	0.0	0.89	3.3	0.0	1.11	3.6
1.0	0.47	2.5	1.0	0.59	2.8	1.0	0.75	3.1	1.0	0.82	3.2	1.0	0.89	3.3	1.0	1.11	3.6
2.0	0.46	2.5	2.0	0.59	2.8	2.0	0.74	3.1	2.0	0.82	3.2	2.0	0.87	3.3	2.0	1.11	3.6
3.0	0.38	2.3	2.5	0.55	2.7	3.0	0.61	2.8	2.6	0.75	3.1	3.0	0.77	3.1	3.0	0.95	3.4
3.2	0.35	2.3	3.0	0.49	2.6	3.3	0.55	2.7	3.0	0.69	3.0	3.1	0.75	3.1	3.5	0.77	3.1
3.5	0.25	2.0	3.5	0.40	2.4	3.5	0.52	2.7	3.5	0.57	2.8	3.5	0.64	2.9	3.5	0.75	3.1
3.7	0.15	1.6	3.6	0.35	2.3	3.8	0.35	2.3	3.5	0.55	2.7	3.7	0.55	2.7	3.8	0.55	2.7
4.0	0.00	0.0	3.9	0.15	1.6	4.1	0.19	1.8	3.9	0.35	2.3	3.9	0.35	2.3	4.1	0.44	2.5
			4.1	0.09	1.3	4.2	0.15	1.6	4.1	0.21	1.8	4.1	0.29	2.1	4.2	0.35	2.3
			4.2	0.00	0.0	4.5	0.00	0.0	4.2	0.15	1.6	4.3	0.15	1.6	4.6	0.15	1.6
									4.6	0.00	0.0	4.6	0.00	0.0	5.0	0.00	0.0

Table 7-1 Joint extreme water levels and wave heights for Kincardine

8 Summary

In this study the wind data from NOAA have been used for hindcast modelling work in order to generate local wind waves. The recorded water levels of Grangemouth from UKHO have been converted to those of Kincardine with the established relationship between the water levels of Grangemouth and Kincardine. Following is a summary of all modelling work:

- The wave hindcast modelling has been carried out for a location of Kincardine, the results are shown in Table 4-2.

- The marginal extreme analysis has been undertaken for wave heights, the results are shown in Table 6-1.

- Similarly the marginal extreme analysis has been carried out for recorded water levels at Kincardine, the results are shown in Table 6-2.

- Finally the joint probability analysis has been undertaken based on the water levels and wave heights using Join-Sea model, the results are shown in Table 7-1.

9 References

Halcrow, StirlingCouncil - Stage 3 River Forth Flood Mapping, Nov 2007

Halcrow, Falkirk Council - Grangemouth Flood study – Flood risk mapping, August 2012

Halcrow, Scottish Power Energy Networks - Kincardine Substation Flood Risk Assessment, June 2011

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Technical note

Project	**Kincardine Flood Risk Assessment**	**Date**	24 June 2013
Subject	Overtopping Calculations	**Ref**	
Author	Jill Gambrill		

1 Introduction

This technical note outlines the methodology adopted for assessing the flood risk at the proposed new power station location at Kincardine.

A joint probability analysis (JPA) was undertaken by Halcrow (Ref 1) to provide wave and water level conditions at the site, this data was used to estimate the wave overtopping under a range of storm events. An initial wave overtopping analysis had previously been undertaken prior to the JPA being completed (Ref 2). Ref 2 documents the previous analysis and methodology and provides some additional background. The profile data used in Ref 2 (e.g. crest level and toe levels) have not been updated.

Figure 1.1 – Location of Kincardine

To allow an assessment of the flood risk, the volume of wave overtopping over a given time period is required, this will then be used to inform the inundation modelling which will estimate the extent and depth of flooding under each given event.

Prepared by	Jill Gambrill	Date	24/06/13
Checked by	Tom Hunt	Date	2/7/13
Approved by		Date	

2 Wave and water level conditions

2.1 Joint Probability Analysis

Table 2.1 provides the JPA data for a range of storm events at the site analysed in Ref1. This data was used for the overtopping calculations.

Joint extreme values of water levels and wave heights for Kincardine

1:2			1:10			1:50			1:100			1:200			1:1000		
WL(m)	H_{m0}(m)	Tp(s)	WL(m)	H_{m0}(m)	Tp(s)	WL(m)	H_{m0}(m)	Tp(s)	WL(m)	H_{m0}(m)	Tp(s)	WL(m)	H_{m0}(m)	Tp(s)	WL(m)	H_{m0}(m)	Tp(s)
0.0	0.47	2.5	0.0	0.59	2.8	0.0	0.75	3.1	0.0	0.82	3.2	0.0	0.89	3.3	0.0	1.11	3.6
1.0	0.47	2.5	1.0	0.59	2.8	1.0	0.75	3.1	1.0	0.82	3.2	1.0	0.89	3.3	1.0	1.11	3.6
2.0	0.46	2.5	2.0	0.59	2.8	2.0	0.74	3.1	2.0	0.82	3.2	2.0	0.87	3.3	2.0	1.11	3.6
3.0	0.38	2.3	2.5	0.55	2.7	3.0	0.61	2.8	2.6	0.75	3.1	3.0	0.77	3.1	3.0	0.95	3.4
3.2	0.35	2.3	3.0	0.49	2.6	3.3	0.55	2.7	3.0	0.69	3.0	3.1	0.75	3.1	3.5	0.77	3.1
3.5	0.25	2.0	3.5	0.40	2.4	3.5	0.52	2.7	3.5	0.57	2.8	3.5	0.64	2.9	3.5	0.75	3.1
3.7	0.15	1.6	3.6	0.35	2.3	3.8	0.35	2.3	3.5	0.55	2.7	3.7	0.55	2.7	3.8	0.55	2.7
4.0	0.00	0.0	3.9	0.15	1.6	4.1	0.19	1.8	3.9	0.35	2.3	3.9	0.35	2.3	4.1	0.44	2.5
			4.1	0.09	1.3	4.2	0.15	1.6	4.1	0.21	1.8	4.1	0.29	2.1	4.2	0.35	2.3
			4.2	0.00	0.0	4.5	0.00	0.0	4.2	0.15	1.6	4.3	0.15	1.6	4.6	0.15	1.6
									4.6	0.00	0.0	4.6	0.00	0.0	5.0	0.00	0.0

Table 2.1 – Joint Probability Analysis of wave and water levels at Kincardine

The JPA results were derived from a 39 year wave data set and a 12 year water level data set. This is a relatively short data set for establishing wave and water level conditions. In addition to this the conditions were quite significantly smaller than those previously adopted. Therefore as a sensitivity analysis and to allow for a degree of uncertainty in the results the 95% confidence values (ref 1) were added to the wave and water level values (see email from Bin Li, 21/06/13). The 95% confidence values for the waves and water levels are provided in Tables 2.2 and 2.3.

Return Period (years)	Extreme Water Level Results	
	Water Level (mODN)	95% Confidence Interval (m)
0.1	3.67	0.06
0.2	3.76	0.05
0.3	3.81	0.06
0.5	3.87	0.06
1	3.95	0.08
2	4.04	0.10
3	4.09	0.11
5	4.16	0.12
10	4.25	0.15
20	4.34	0.17
30	4.40	0.18
50	4.47	0.20

100	4.57	0.23
200	4.67	0.26
300	4.74	0.27
500	4.81	0.29
1000	4.92	0.32
2000	5.03	0.35
3000	5.10	0.37
5000	5.19	0.39
10000	5.31	0.42

Table 2.2 – Extreme water levels with 95% confidence values

Return Period (years)	Extreme Wave Results		
	Wave Height Hmo (m)	**Peak Wave Period (s)**	**95% Confidence Interval (m)**
0.1	0.29	2.1	0.06
0.2	0.32	2.2	0.05
0.3	0.35	2.3	0.05
0.5	0.38	2.4	0.04
1	0.42	2.5	0.04
2	0.47	2.6	0.05
3	0.49	2.6	0.05
5	0.53	2.7	0.06
10	0.59	2.8	0.07
20	0.65	2.9	0.09
30	0.68	3.0	0.10
50	0.73	3.1	0.12
100	0.80	3.2	0.14
200	0.88	3.3	0.16
300	0.93	3.4	0.18
500	1.00	3.5	0.20
1000	1.09	3.6	0.23
2000	1.19	3.8	0.26
3000	1.25	3.8	0.29
5000	1.34	3.9	0.31
10000	1.46	4.1	0.35

Table 2.3 – Extreme wave heights with 95% confidence values

The adjusted JPA values are provided in Table 2.4. It should be noted that the wave period has also been adjusted to account for the revised wave conditions using the equation below:

$$T_p = 3.51 H_{mo}^{\ 0.4}$$

Return Period		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
1:02	WL(m)	0	1	2	3	3.21	3.5	3.78	4.05			
	WL(m)(95% confidence)	0.1	1.1	2.1	3.1	3.31	3.6	3.88	4.15			
	H_{m0}(m)	0.47	0.47	0.46	0.38	0.35	0.25	0.15	0			
	H_{m0}(m)	0.52	0.52	0.51	0.43	0.4	0.3	0.2	0.05			
	Tp(s)	2.59	2.59	2.57	2.38	2.3	2.01	1.63	0			
	Tp(s)	2.70	2.70	2.68	2.50	2.43	2.17	1.84	1.06			
1:10	WL(m)	0	1	2	2.5	3	3.5	3.68	3.98	4.1	4.25	
	WL(m)(95% confidence)	0.15	1.15	2.15	2.65	3.15	3.65	3.83	4.13	4.25	4.4	
	H_{m0}(m)	0.59	0.59	0.59	0.55	0.49	0.4	0.35	0.15	0.09	0	
	H_{m0}(m)	0.66	0.66	0.66	0.62	0.56	0.47	0.42	0.22	0.16	0.07	
	Tp(s)	2.84	2.84	2.84	2.76	2.63	2.43	2.3	1.63	1.33	0	
	Tp(s)	2.97	2.97	2.97	2.90	2.78	2.60	2.48	1.92	1.69	1.21	
1:50	WL(m)	0	1	2	3	3.33	3.5	3.85	4.1	4.21	4.5	
	WL(m)(95% confidence)	0.2	1.2	2.2	3.2	3.53	3.7	4.05	4.3	4.41	4.7	
	H_{m0}(m)	0.75	0.75	0.74	0.61	0.55	0.52	0.35	0.19	0.15	0	
	H_{m0}(m)	0.87	0.87	0.86	0.73	0.67	0.64	0.47	0.31	0.27	0.12	
	Tp(s)	3.13	3.13	3.11	2.88	2.76	2.7	2.3	1.8	1.63	0	
	Tp(s)	3.32	3.32	3.30	3.09	2.99	2.94	2.60	2.20	2.08	1.50	
1:100	WL(m)	0	1	2	2.63	3	3.5	3.58	3.9	4.1	4.27	4.62
	WL(m)(95% confidence)	0.23	1.23	2.23	2.86	3.23	3.73	3.81	4.13	4.33	4.5	4.85
	H_{m0}(m)	0.82	0.82	0.82	0.75	0.69	0.57	0.55	0.35	0.21	0.15	0
	H_{m0}(m)	0.96	0.96	0.96	0.89	0.83	0.71	0.69	0.49	0.35	0.29	0.14
	Tp(s)	3.24	3.24	3.24	3.13	3.02	2.8	2.76	2.3	1.87	1.63	0
	Tp(s)	3.45	3.45	3.45	3.35	3.26	3.06	3.03	2.64	2.31	2.14	1.60
1:200	WL(m)	0	1	2	3	3.19	3.5	3.74	3.99	4.1	4.38	4.69
	WL(m)(95% confidence)	0.26	1.26	2.26	3.26	3.45	3.76	4	4.25	4.36	4.64	4.95
	H_{m0}(m)	0.89	0.89	0.87	0.77	0.75	0.64	0.55	0.35	0.29	0.15	0
	H_{m0}(m)	1.05	1.05	1.03	0.93	0.91	0.8	0.71	0.51	0.45	0.31	0.16
	Tp(s)	3.35	3.35	3.32	3.16	3.13	2.93	2.76	2.3	2.13	1.63	0
	Tp(s)	3.58	3.58	3.55	3.41	3.38	3.21	3.06	2.68	2.55	2.20	1.69
1:1000	WL(m)	0	1	2	3.06	3.5	3.5	3.82	4.1	4.24	4.65	5
	WL(m)(95% confidence)	0.32	1.32	2.32	3.38	3.82	3.82	4.14	4.42	4.56	4.97	5.32
	H_{m0}(m)	1.11	1.11	1.11	0.95	0.77	0.75	0.55	0.44	0.35	0.15	0
	H_{m0}(m)	1.34	1.34	1.34	1.18	1	0.98	0.78	0.67	0.58	0.38	0.23
	Tp(s)	3.66	3.66	3.66	3.44	3.16	3.13	2.76	2.52	2.3	1.63	0
	Tp(s)	3.95	3.95	3.95	3.75	3.51	3.48	3.18	2.99	2.82	2.38	1.95

Table 2.4 – Adjusted JPA data to include 95% confidence values

2.2 Sea Level Rise

Wave overtopping calculations were undertaken for the present day (2013) scenario and for a future scenario in 2085. The base date for the JPA data is 2005. Therefore sea level rise has been added to the base data to allow the present day and future scenarios to be assessed. Sea level rise data was downloaded from the UKCP09 website http://ukclimateprojections-ui.defra.gov.uk/ui/admin/login.php.

The sea level rise has been extracted for the area highlighted in Figure 2.1

Figure 2.1 – Location of extracted SLR data

Guidance on the use of the UKCP09 data is provided within the following Environment Agency Report (Ref 3):

- Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.

The guidance recommends the use of the medium emissions scenario with a 95% probability of occurrence. Wave overtopping calculations have been undertaken using this recommendation, however as this project is considering the flood assessment at a site for critical electricity supply infrastructure, a sensitivity analysis has been undertaken using the high emissions scenario (with a 95% probability of occurrence). The sea level rise values adopted are provided in Table 2.5.

Sea level rise period (years)	Medium Emissions Sea level rise value (mm)	High Emissions Sea level rise value (mm)
2005 – 2013	28	37
2005 - 2085	410	528

Table 2.5 – Kincardine sea level rise values

2.3 Overtopping event duration

The wave overtopping calculations provide a maximum overtopping discharge rate (l/s/m). To convert this to a volume of overtopping required to inform the inundation modelling an estimation of the event duration is required. The overtopping discharge is calculated using the extreme water levels which are assumed to occur at the peak of the tidal curve. However, as the water level increases/decreases either side of the tidal peak overtopping may still occur. Therefore the overtopping discharge has been estimated for 3 hours either side of the peak, at one hour intervals.

To calculate the water level conditions at either side of the peak water level the tide curve was adjusted so that the peak of the tide cycle was equal to the extreme water level. Kincardine is a secondary port so the tide curve for Rosyth was used as this is the closest primary port and the tide levels are likely to be similar. It is assumed the tide curve is symmetrical. Figure 2.2 shows the tide curve with the estimated tide levels at hourly intervals either side of the peak.

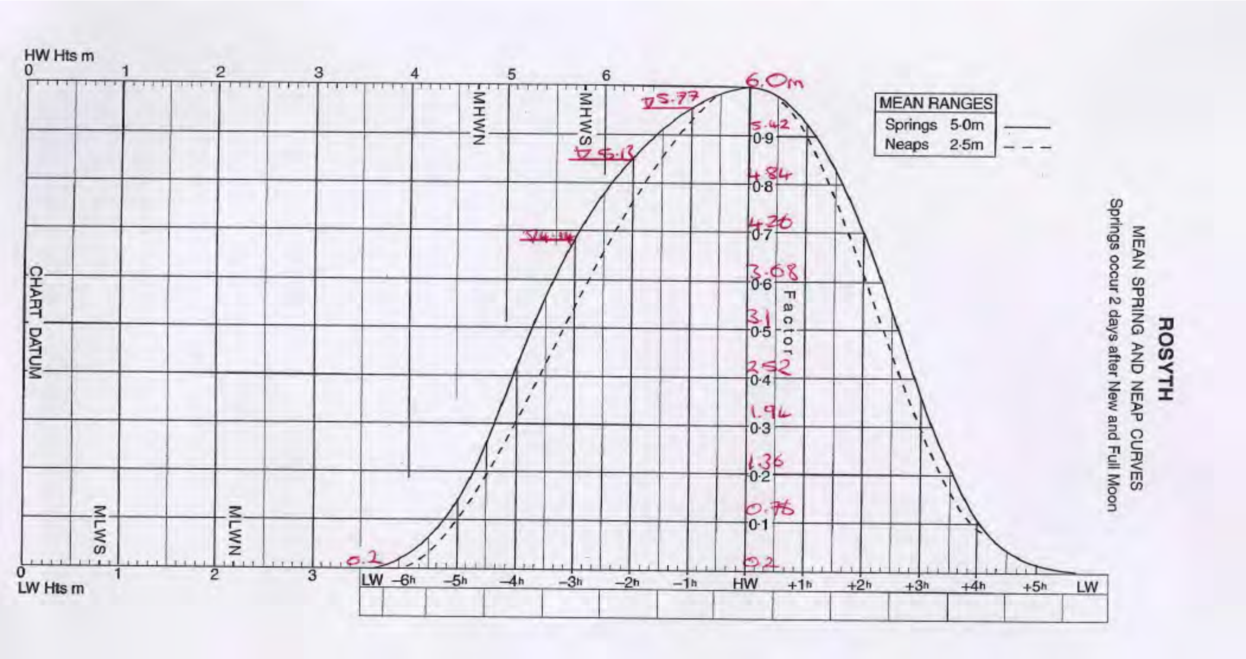


Figure 2.2 – Tide curve at Rosyth

The change in the tide level between the 1 hour intervals was applied to the extreme water levels as shown in Table 2.6.

Point in Tide cycle	Tide Level (mCD)	Adjustment to apply to JPA extreme water level (m)
Peak	6.0	0
Peak +/- 1 hr	5.77	-0.23
Peak +/- 2 hr	5.13	-0.87
Peak +/- 3 hr	4.14	-1.86

Table 2.6 – Tidal curve adjustments to extreme water levels

The overtopping rate at T=+/- 3 hours was negligible indicating that a 6 hour event duration is an appropriate estimate. Therefore the volume of overtopping per metre length was calculated.

2.4 Overflow

In some instances the extreme water level is equal to or greater than the defence crest level (zero or negative freeboard). In these cases both the overflow of water over the crest of the structure and the overtopping need to be considered (see Figure 2.3). The Eurotop Manual recommends the following equation for estimating the volume of water passing over the crest of the defences in these situations. This equation combines the broad crested weir calculation which calculates the overflow volume with the equation for estimating the volume of overtopping when there is a zero freeboard.

$$q = q_{overflow} + q_{overtop} = 0.6 \cdot \sqrt{g \cdot \left| -R_C^3 \right|} + 0.0537 \cdot \xi_{m-1,0} \cdot \sqrt{g \cdot H_{m0}^3} \qquad 5.16$$

$$\text{for: } \xi_{m-1,0} < 2.0$$

Therefore, when the water level is equal to or greater than the crest level (4.92mOD) this equation has been adopted to estimate the overtopping volume.

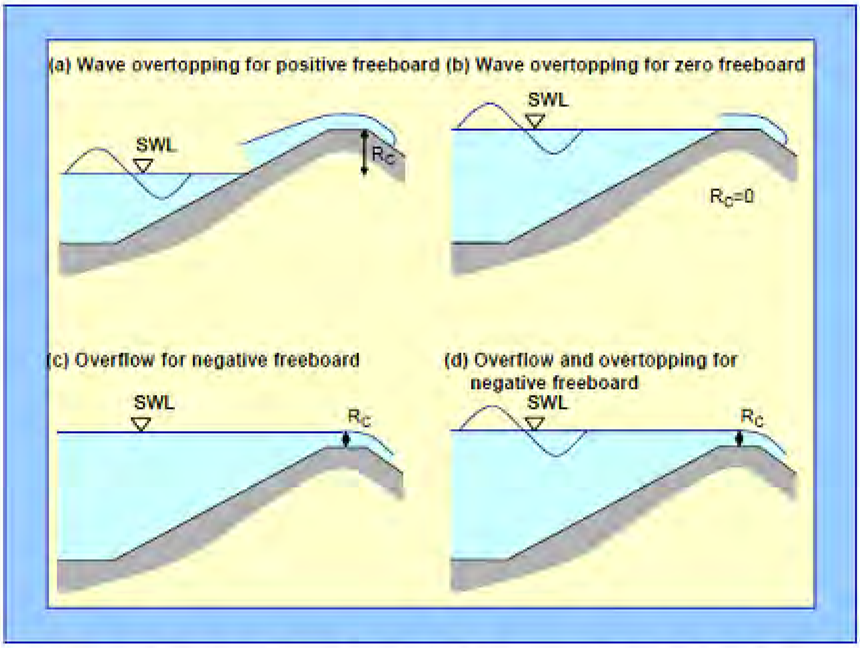


Figure 5.14: Wave overtopping and overflow for positive, zero and negative freeboard

Figure 2.3 – Overflow and overtopping scenarios to be considered

It should be noted that at this stage this equation has only been applied to the 95% confidence level with high emissions SLR scenario. For the other scenarios, where overflow occurs this has been highlighted in the results table. If either of the other scenarios are to be modelled then this will need to be updated for those calculations.

3 Results

The tables below provide a summary of the estimated overtopping volumes for the present day (2013) scenario and future scenarios.

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m^3/m)
2	0.00	0.00	0.00	0.00	**0.00**
10	0.00	0.00	0.00	0.00	**0.00**
50	0.01	0.00	0.00	0.00	**0.03**
100	0.02	0.00	0.00	0.00	**0.10**
200	0.07	0.01	0.00	0.00	**0.31**
1000	0.25	0.08	0.00	0.00	**1.32**

Table 3.1 – Present day (2013) overtopping volumes with high emissions SLR

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m^3/m)
2	0.00	0.00	0.00	0.00	**0.00**
10	0.06	0.01	0.00	0.00	**0.24**
50	0.51	0.05	0.00	0.00	**2.10**
100	1.99	0.14	0.00	0.00	**7.92**
200	24.08	0.41	0.01	0.00	**88.98**
1000	31.08	2.77	0.03	0.00	**127.07**

Table 3.2 – Future scenario (2085) overtopping volumes with high emission SLR

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m³/m)
2	0.00	0.00	0.000	0.00	**0.00**
10	0.01	0.00	0.000	0.00	**0.02**
50	0.19	0.04	0.000	0.00	**0.94**
100	13.15	0.16	0.002	0.00	**48.21**
200	47.75	1.10	0.017	0.00	**177.98**
1000	568.09	217.17	0.107	0.00	**3,218.59**

Table 3.3 – Present day (2013) 95% confidence level overtopping volumes with high emissions SLR

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m³/m)
2	0.01	0.00	0.00	0.00	**0.03**
10	6.11	0.12	0.00	0.00	**22.63**
50	331.36	51.07	0.02	0.00	**1,468.83**
100	595.06	217.17	0.07	0.00	**3,315.43**
200	798.48	368.18	0.26	0.00	**4,864.54**
1000	1,806.66	499.82	80.23	0.01	**9,780.70**

Table 3.4 – Future scenario (2085) 95% confidence level overtopping rates with high emissions SLR

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m^3/m)
2	0.00	0.00	0.00	0.00	**0.00**
10	0.00	0.00	0.00	0.00	**0.02**
50	0.18	0.04	0.00	0.00	**0.88**
100	10.60	0.15	0.00	0.00	**39.01**
200	101.24	0.91	0.02	0.00	**369.50**
1000	Overflow	26.67	0.10	0.00	**Overflow**

Table 3.5 – Present Day (2013) 95% confidence overtopping rates with medium emissions SLR

Return Period (1 in X)	Peak Overtopping Discharge (l/s/m)	Peak +/- 1 hour overtopping discharge (l/s/m)	Peak +/- 2 hour overtopping discharge (l/s/m)	Peak +/- 3 hour overtopping discharge (l/s/m)	Overtopping volume/ meter (m^3/m)
2	0.00	0.00	0.00	0.00	**0.01**
10	0.32	0.04	0.00	0.00	**1.37**
50	Overflow	7.77	0.01	0.00	**Overflow**
100	Overflow	Overflow	0.04	0.00	**Overflow**
200	Overflow	Overflow	Overflow	0.00	**Overflow**
1000	764,223.57	1,214.60	35.54	0.00	**Overflow**

Table 3.6 – Future Scenario (2085) 95% confidence overtopping rates with medium emissions SLR

The tables and graphs below provide a comparison of the overtopping volumes for the different scenarios considered for both present day and future scenarios.

Return Period (1 in x)	High emissions scenario overtopping volume (m^3/m)	High emissions scenario, 95% confidence intervals overtopping volume (m^3/m)	Medium emissions scenario, 95% confidence intervals overtopping volume (m^3/m)
2	0.00	0.00	0.00
10	0.00	0.02	0.02
50	0.03	0.94	0.88
100	0.10	48.21	39.01
200	0.31	177.98	Overflow
1000	1.32	3,218.59	Overflow

Table 3.7 – Comparison of present day (2013) overtopping volumes

Return Period (1 in x)	High emissions scenario overtopping volume (m^3/m)	High emissions scenario, 95% confidence intervals overtopping volume (m^3/m)	Medium emissions scenario, 95% confidence intervals overtopping volume (m^3/m)
2	0.00	0.03	0.01
10	0.24	22.63	1.37
50	2.10	1,468.83	Overflow
100	7.92	3,315.43	Overflow
200	88.98	4,864.54	Overflow
1000	127.07	9,780.70	Overflow

Table 3.8 – Comparison of future scenario (2085) overtopping volumes

Figure 3.1 shows the overtopping volumes for the High Emissions SLR, Upper 95% confidence intervals for the present day (2013) and future (2085) scenarios.

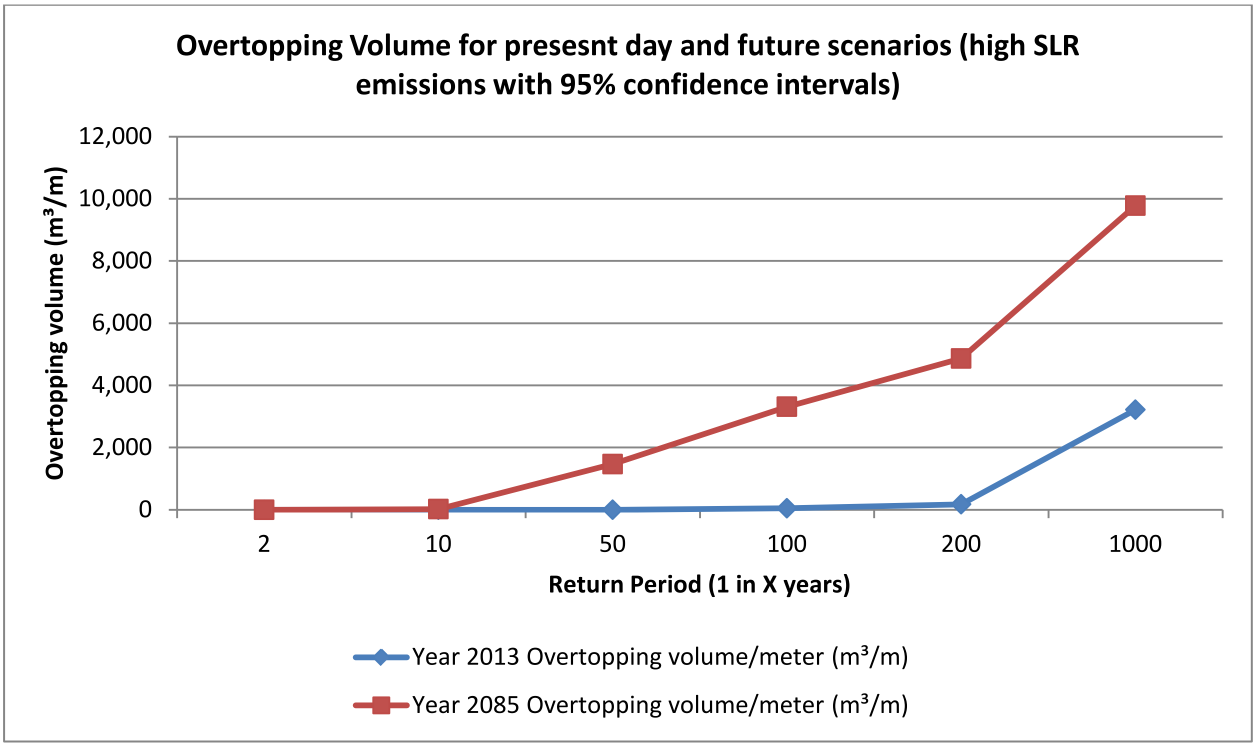


Figure 3.1 – Future and present day 95% confidence level overtopping volumes with high emissions SLR

4 Conclusions and Recommendations

The comparison of the overtopping volumes for the high and medium emissions scenarios indicate that under the present day condition the overtopping volumes are not significantly different up to a return period of 1 in 200 years. For the future scenario there is a significant difference in the overtopping volume for return periods of 1 in 10 years and greater. It is therefore considered that selection of the sea level rise condition to be adopted need further consideration and discussion with the client regarding the risks associated with the potential flooding under the higher SLR scenario together with the cost of protecting the facility against these conditions.

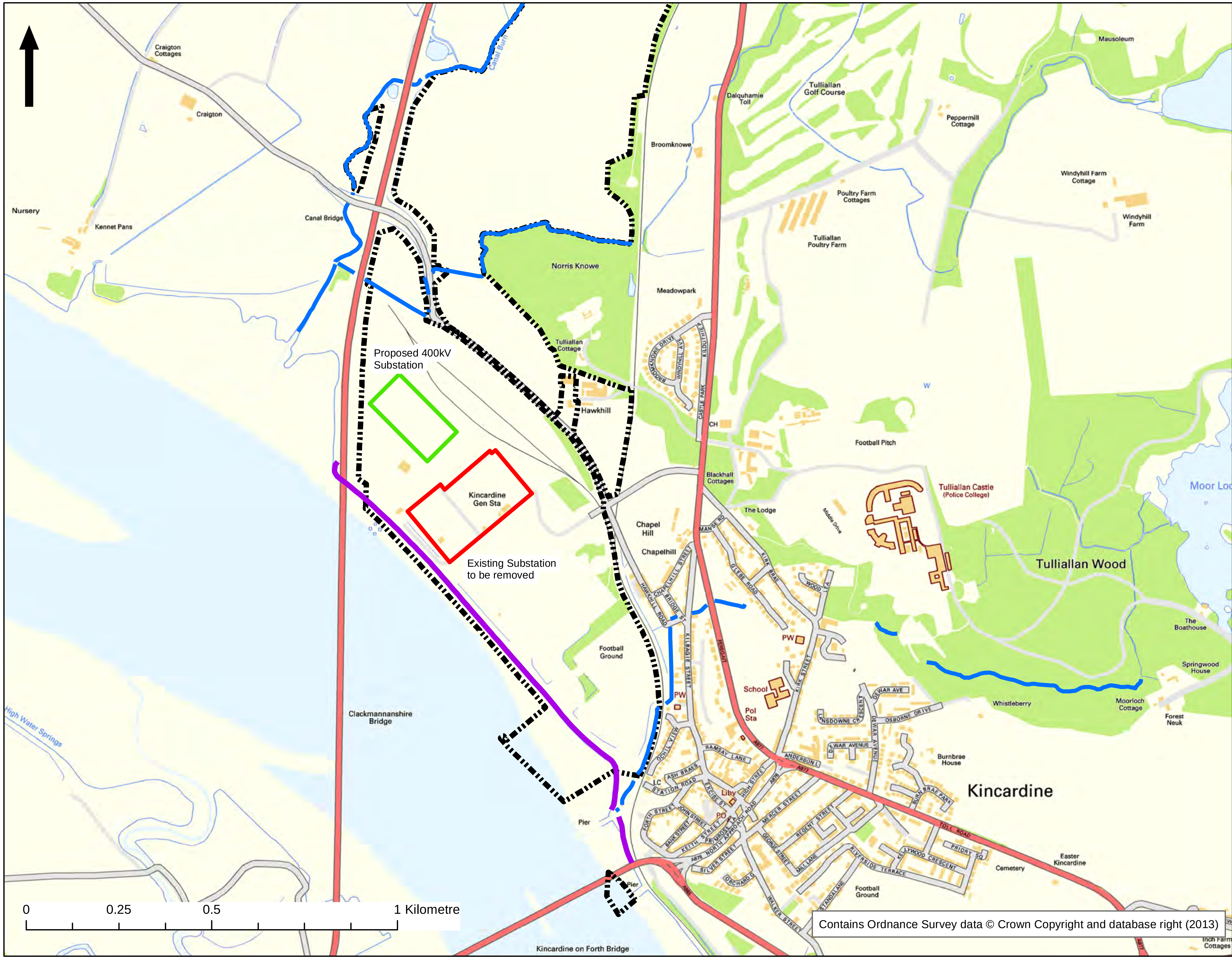
5 References

1. Halcrow, Kincardine Assessment of Flood Risk - Wave Hindcast and Joint Probability Analysis, 6 June 2013
2. Halcrow, Scottish Power Flood Risk Assessment – Overtopping Analysis for Longannet and Kincardine, 30 March 2011, Ref WBSPFR/TN001
3. Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.
4. Tide tables
5. HR Wallingford (2007), Eurotop Wave Overtopping of Sea Defences and Related Structures: Assessment Manual
6. Calculation spreadsheets; \\edin-fs-02\Water\Projects\WBSPFR_Scottish_Power_FRAs\CALCS\General\Hydraulics\Wave_Overtopping\Calcs\Updated_June 2013

Appendix D

Study plans

Appendix D Study plans



Legend

- Watercourses
- Existing Tidal Defense
- Ownership of Scottish Power
- Proposed Substation
- Existing Substation Compound

Client

Scottish Power Energy Networks

Halcrow Group Limited
16 Abercromby Place, Edinburgh, EH3 6LB
Tel +44 (0)131 272 3300 Fax +44 (0)131 272 3301
www.halcrow.com

Halcrow

Project

Kincardine Substation Flood Risk Assessment

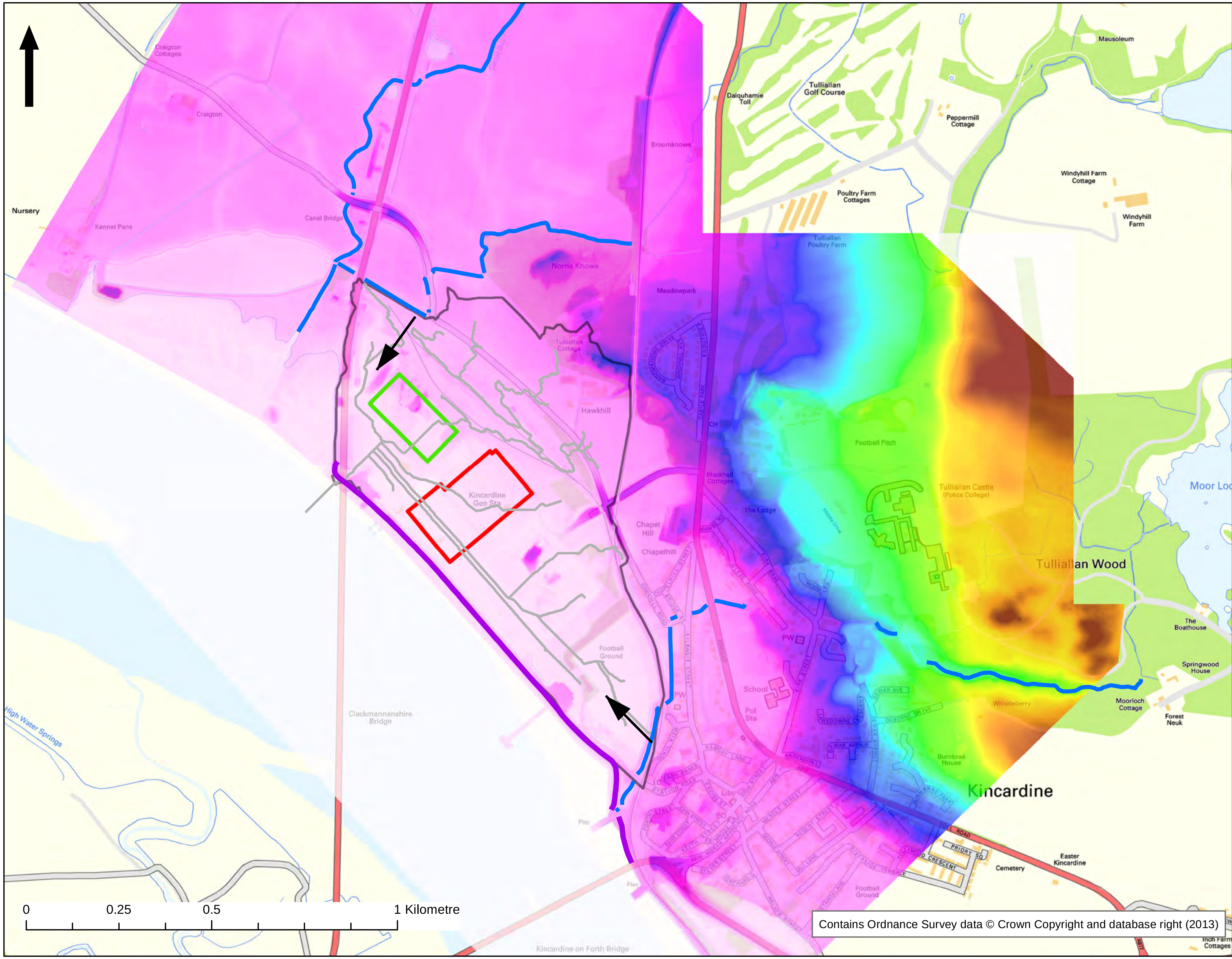
Figure

Location Plan

Drawn by:	RW	Date:	18.07.13
Checked by:	JMD	Date:	18.07.13
Approved by:	JMD	Date:	18.07.13

Figure no.	Revision
WBSPFL/BA/001	0

Drawing scale: 1:10,000 Size: A3



Legend

- Watercourses
- Existing Tidal Defense
- Drainage Network
- Pluvial_Catchment
- Proposed Substation
- Existing Substation Compound

LiDAR Elevation

mAOD

High : 56.15

Low : -0.24

Possible overland flow from adjacent watercourse

Client

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Halcrow

Project

Kincardine Substation Flood Risk Assessment

Figure

Site Topography

Drawn by:	RW	Date:	10.07.13
Checked by:	JMD	Date:	10.07.13
Approved by:	JMD	Date:	10.07.13

Figure no.	Revision
WBSPFL/BA/002	0

Drawing scale: 1:10,000 Size: A3

Legend

- Pluvial event analysis point
- Proposed Substation
- Existing Substation Compound

1000yr depth

m

- 0.001 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00+

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Project

Kincardine Substation Flood Risk Assessment

Figure

Pluvial Flooding
1000yr event 1hr storm

Drawn by:	RW	Date:	18.07.13
Checked by:	JMD	Date:	18.07.13
Approved by:	JMD	Date:	18.07.13

Figure no. WBSPFL/BA/007 — Revision 0

Drawing scale: 1:10,000 — Size: A3

Legend

Proposed Substation

Existing Substation Compound

10yr flood contour

50yr flood contour

100yr flood contour

Flood Risk is only mapped in the vicinity of Scottish Power land ownership

Client

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Project

Kincardine Substation Flood Risk Assessment

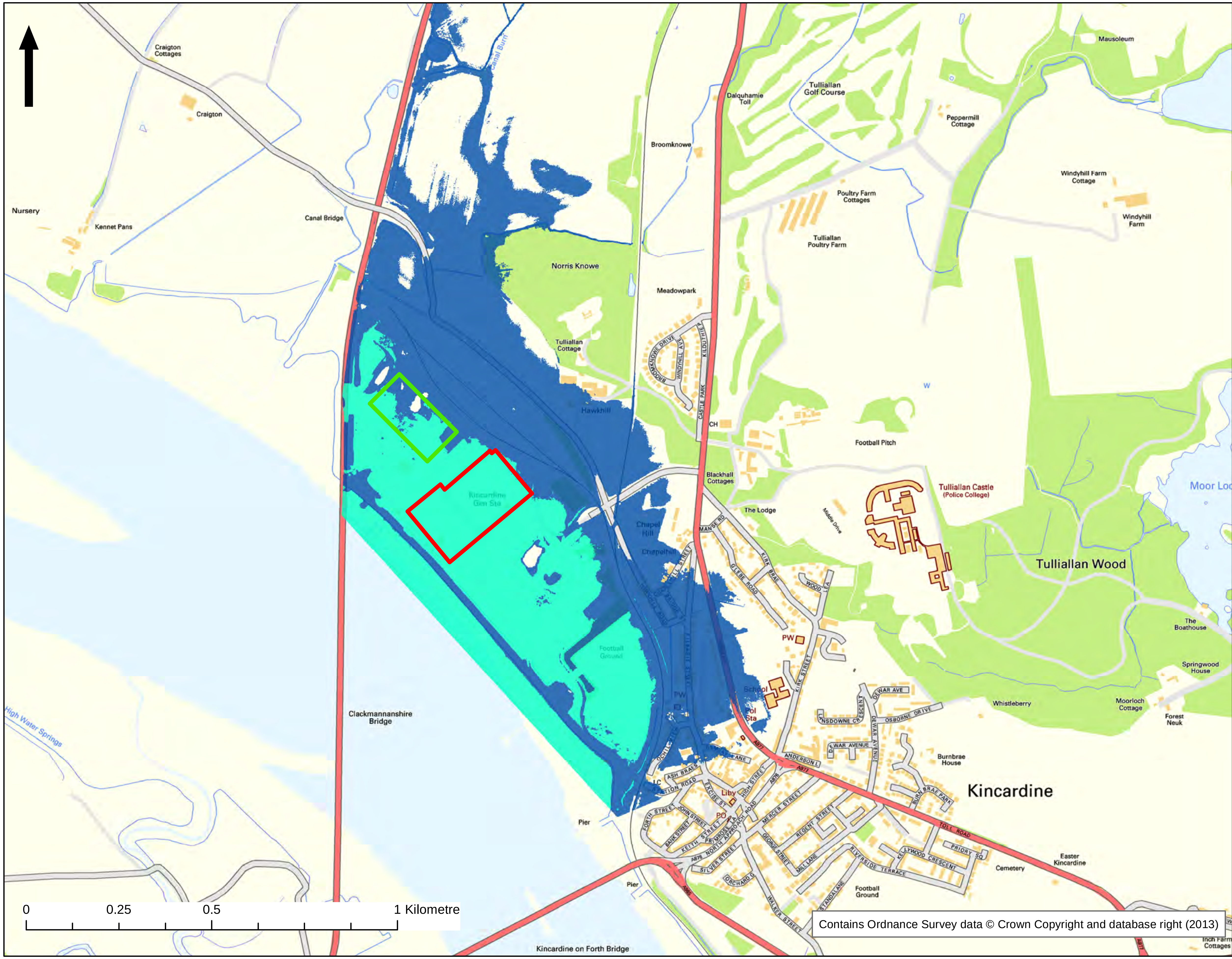
Figure

Tidal Flooding
2013 scenario
10yr - 100yr

Drawn by:	RW	Date:	10.07.13
Checked by:	JMD	Date:	10.07.13
Approved by:	JMD	Date:	10.07.13

Figure no.	Revision
WBSPFL/BA/009	0

Drawing scale: 1:10,000 Size: A3



Legend

Proposed Substation

Existing Substation Compound

200yr flood contour

1000yr flood contour

Flood Risk is only mapped in the vicinity of Scottish Power land ownership

Client

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Halcrow

Project

Kincardine Substation Flood Risk Assessment

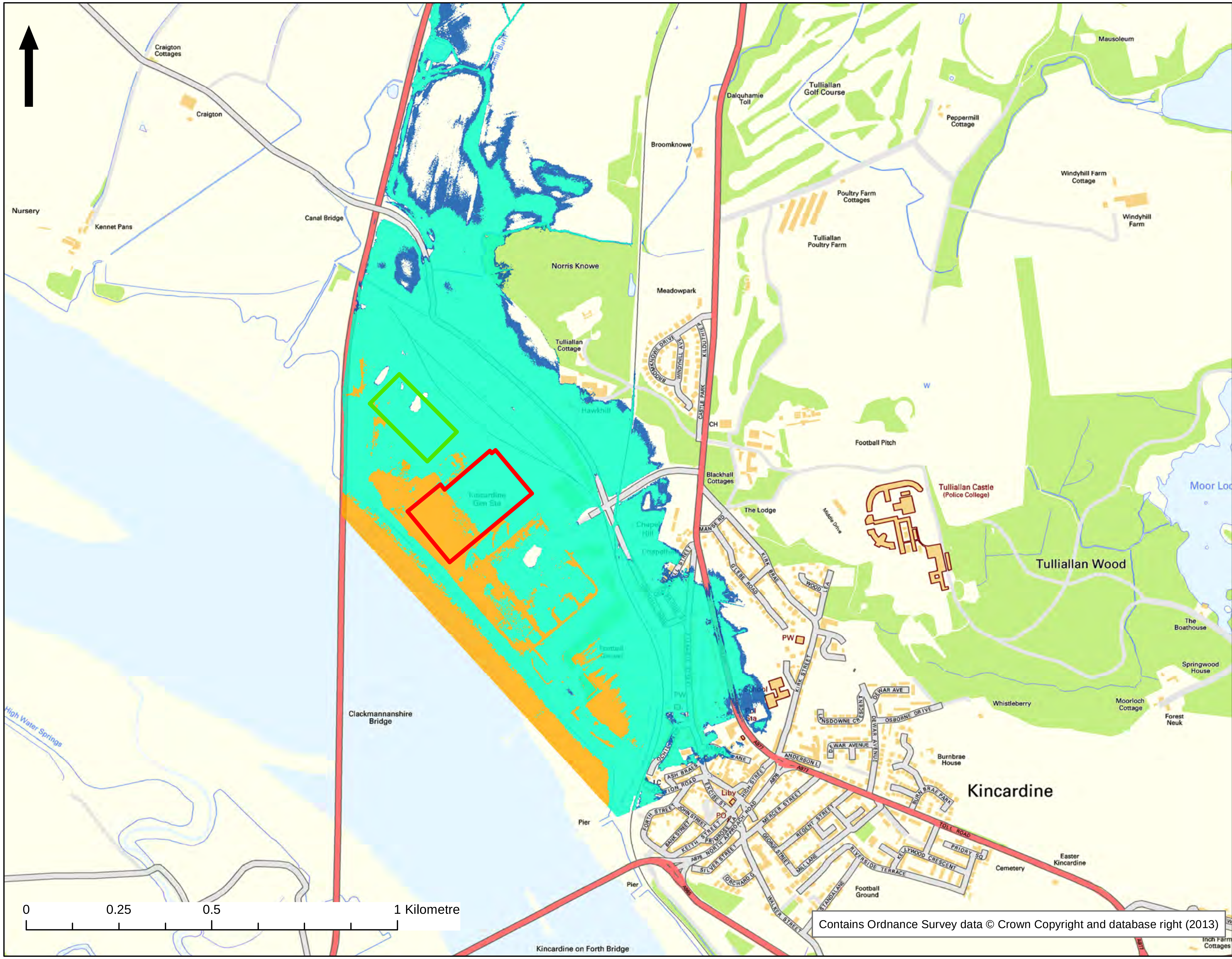
Figure

Tidal Flooding
2013 scenario
200yr - 1000yr

Drawn by:	RW	Date:	10.07.13
Checked by:	JMD	Date:	10.07.13
Approved by:	JMD	Date:	10.07.13

Figure no.	Revision
WBSPFL/BA/010	0

Drawing scale: 1:10,000 Size: A3



Legend

Proposed Substation

Existing Substation Compound

10yr flood contour

50yr flood contour

100yr flood contour

Flood Risk is only mapped in the vicinity of Scottish Power land ownership

Client

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Halcrow

Project

Kincardine Substation Flood Risk Assessment

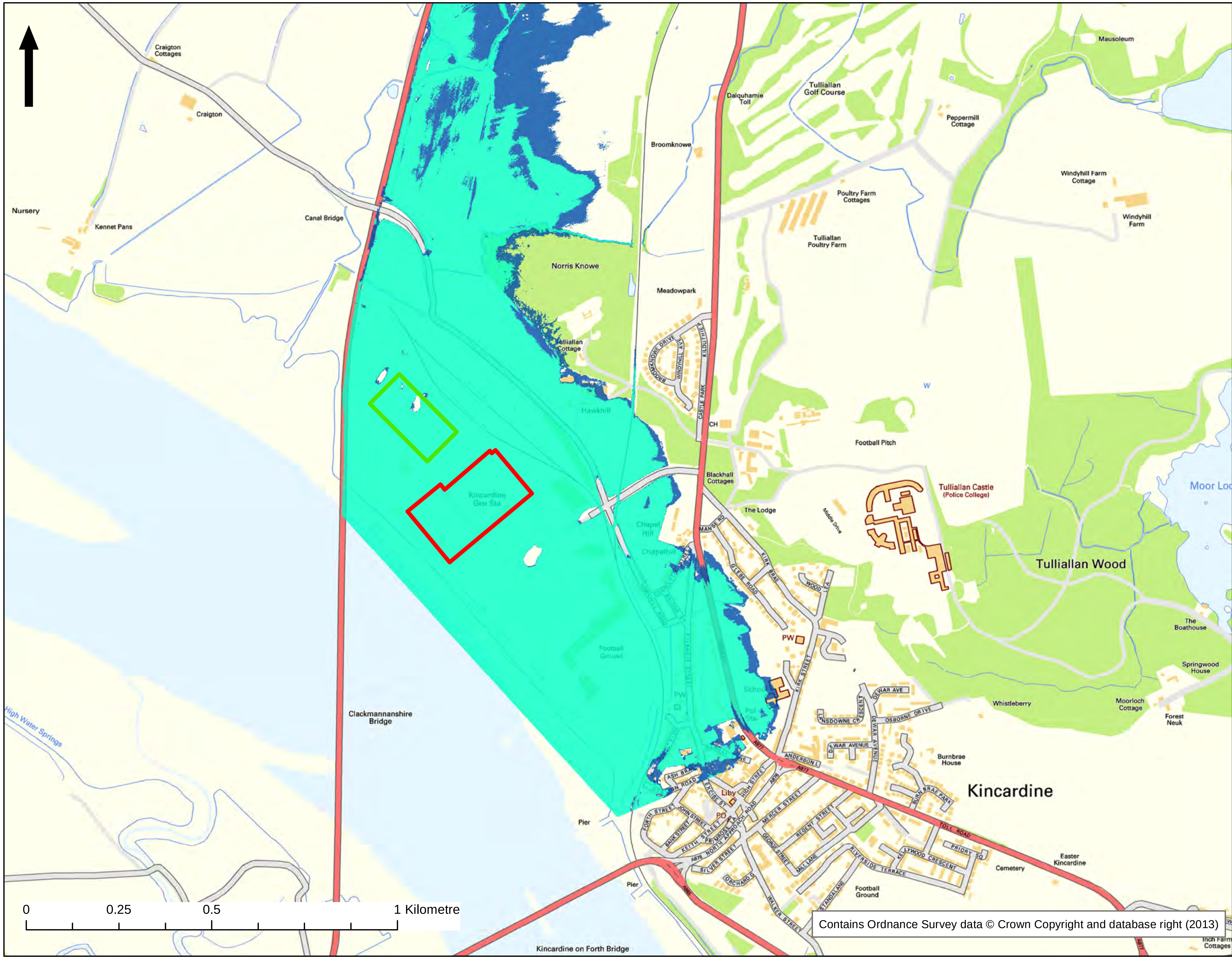
Figure

Tidal Flooding
2085 scenario
10yr - 100yr

Drawn by:	RW	Date:	10.07.13
Checked by:	JMD	Date:	10.07.13
Approved by:	JMD	Date:	10.07.13

Figure no.	Revision
WBSPFL/BA/011	0

Drawing scale: 1:10,000 Size: A3



Legend

- Proposed Substation
- Existing Substation Compound

200yr flood contour

1000yr flood contour

Flood Risk is only mapped in the vicinity of Scottish Power land ownership

Client

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Halcrow

Project

Kincardine Substation Flood Risk Assessment

Figure

Tidal Flooding
2085 scenario
200yr - 1000yr

Drawn by:	RW	Date:	10.07.13
Checked by:	JMD	Date:	10.07.13
Approved by:	JMD	Date:	10.07.13

Figure no.	Revision
WBSPFL/BA/012	0

Drawing scale: 1:10,000 Size: A3

Legend

- Pluvial event analysis point
- Proposed Substation
- Existing Substation Compound

1000yr plus CC depth

m

- 0.001 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00+

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Halcrow

Project

Kincardine Substation
Flood Risk Assessment

Figure

Pluvial Flooding
1000yr event plus Climate Change
1hr storm

Drawn by:	RW	Date:	18.07.13
Checked by:	JMD	Date:	18.07.13
Approved by:	JMD	Date:	18.07.13

Figure no.	Revision
WBSPFL/BA/013	0

Drawing scale: 1:10,000 Size: A3

Appendix I

Landscape and Visual Assessment

Contents

Appendices

Figures

Tables

Summary

In brief, the landscape and visual assessment found that the overall effect of the proposed 400/275kV Gas Insulated Substation (GIS) and associated Overhead Line (OHL) works at Kincardine Substation would be minor beneficial for the landscape, and moderate adverse visually, and therefore significant in terms of the adopted criteria. However, it is considered that the assessed adverse visual effects will decrease over time as the associated landscape planting and woodland management works are implemented, and become established.

During construction, there will be a minor adverse and beneficial landscape effects associated with the removal of some landscape features and land raising, and development of disused derelict land. Proposed landscape mitigation measures include for new mixed woodland planting immediately to the north and south of the proposed GIS, and reinforcement of the existing A876 roadside planting to the west, that will add value to the overall landscape character.

The greatest change in the character of views and visual amenity will be very localised and restricted to the immediate south. For all residential properties, road users and others with a view of the site, the proposed development will form a proportion of the overall view, which includes the existing Substation, Forth Crossing Towers and Overhead Lines. For the majority, the change in visual amenity will be moderate to minor. Change to the character of views will be limited further over time by the proposed landscape planting.

The proposed GIS and OHL works have been designed with the aim of minimising environmental effects. The associated landscape planting and woodland management works supports this aim by providing for the long term strategic screening and containment of the proposed development, reinforcing the existing landscape features and character, whilst enhancing the biodiversity of the overall site.

1.0 Introduction

Background

1.1 SP Transmission Ltd (SPT) proposes to upgrade the existing overhead line from 275kV to 400kV between Kincardine to Blairingone. To connect the upgraded line to the electricity grid, a 400/275kV Gas Insulated Substation (GIS) is required. The proposed GIS will be located adjacent the existing 275kV Substation on the former Kincardine Power Station site as indicated in Figure 1.1.

1.2 The development and operational requirements of the proposed GIS will require the Overhead Line (OHL) in the immediate vicinity of the existing 275kV Substation to be realigned and existing towers repositioned. The proposed GIS and associated Overhead Line (OHL) works are shown in Figures 1.2, 1.3 and 1.4.

1.3 This Appendix to the Environmental Statement (ES) provides an assessment of the potential effects on landscape and visual amenity arising from the proposed 400/275kV GIS and associated OHL works at Kincardine Substation. This is collectively referred to as the proposed development site throughout the Landscape and Visual Impact Assessment (LVIA). The scope of landscape and visual assessment was outlined in the Scoping Report and deemed appropriate given the limited work associated with the upgrade of existing towers along the Kincardine to Blairingone route.

Assessment Methodology

1.4 Good practice as described in the *"Guidelines for Landscape and Visual Impact Assessment"* (LI, IEMA, 2013) has been followed in undertaking the appraisal of the potential effects on landscape and visual amenity arising from the proposed development.

1.5 The adopted methodology and approach is outlined in Appendix 1 and summarised below: -

<u>Baseline Survey and Analysis</u>

- Description of the Site and Surroundings: Collation and review of baseline information covering key features of the physical environment, planning allocation, natural and cultural heritage of the site and surroundings.

- Description of the Landscape and Features: The character, condition and value of the landscape are determined through a combination of desk and field study. Relevant designations are identified from a review of planning policies and other designations relating to the area.

- Review of the Existing Visibility and Visual Amenity: Visibility, visual amenity and potential visual receptors are identified, for example, residential properties, public footpaths, transport routes, key viewpoints, etc. The visual baseline including extent of visibility is determined by using a combination of fieldwork and specialist computer mapping.

<u>Impact Assessment</u>

- Landscape and Visual Effect: Identifies the potential sources of impact of the proposed development, sensitivity of the landscape and visual resources (nature of receptors), and magnitude of change to the existing landscape and visual environment (nature of effects).

- Evaluation of Significance of Effects: Provides an assessment of the likely significance of effects reviewed with reference to landscape features, character, views and visual amenity. The different thresholds of significance of impact (major, moderate, minor or none) are determined through professional judgement and evaluation of the scale or magnitude of effect, and the environmental sensitivity of the location or receptor.

Structure of the Landscape and Visual Assessment

1.6 The Landscape and Visual Impact Assessment (LVIA) is organised as follows:

Section 2.0 provides a description of the development site and surroundings.

Section 3.0 describes the landscape and visibility of the site (existing baseline conditions).

Section 4.0 provides an assessment of landscape and visual impact of the proposed development.

Section 5.0 outlines the proposed landscape mitigation measures.

Section 6.0 summarises the overall landscape and visual effects on the landscape and visual amenity, and presents a statement of significance.

In addition, reference is made to a number of Appendices, which contain the following information:

Appendix 1 summarises the landscape and visual assessment methodology.

Appendix 2 presents relevant landscape and visual planning policy extracts from Development Plans.

Appendix 3 presents extracts from the Landscape Character Assessment undertaken by Scottish Natural Heritage.

Appendix 4 provides location and technical background information regarding the viewpoint photographs.

Appendix 5 presents the existing (or baseline) views and visual amenity, and potential change of views (effect) as a result of the proposed development without any mitigation.

Project Team

1.7 Environmental Designworks, an environmental planning and landscape design practice has prepared the Landscape and Visual Assessment with specialist input from SP EnergyNetworks Ltd (SPEN) on the detailed characteristics of the project and technical issues. Envision has undertaken the specialist computer visualisation work, and professional photographic assistance has been provided by Lamont Associates.

2.0 Proposed Development Site and Surroundings

Information

2.1 Information regarding the environmental features and sensitivities of the proposed development site and surrounding area is presented below and in Figure 2.1. Review of the scale of the proposed development, initial site survey and professional judgement determined that a 5km radius Study Area was appropriate for the LVIA.

2.2 Baseline information has been collected from a review of published documents, maps and site visits. Specifically, the following has been undertaken:

- desk review of environmental data, designations and policies relating to the study area;
- site appraisal of the environmental resources and potential receptors within the study area;
- reference to the Landscape Character Assessments by Scottish Natural Heritage (SNH);
- information available from: Development Plans covering the study area; Scotland's Environment database; SNH Database; Historic Scotland Pastmap; Fife, Falkirk, Clackmannanshire Council Core Paths Information; and the National Map Library for Scotland.

Physical Description

Location

2.3 The proposed development will be located on the northern banks of the Firth of Forth estuary, with the settlement of Kincardine to the east, and the A876 leading to Clackmannanshire Bridge to the west. To the north east, the land gently rises to Tulliallan Castle meaning *"the beautiful hill"* in Gaelic (J. Sinclair, 1976).

2.4 The proposed GIS is located on the former coal store area once used to supply Kincardine Power Station, which was demolished in 2001. Immediately to the east of the proposed GIS is the Kincardine 275/132kV Substation, which is now all that currently remains on the former Power Station site. The proposed OHL works associated with the GIS are located within the former Power station site to the north and east.

Geology, Soils and Drainage

2.5 The site is located within the ancient rift valley named the *"Midland Valley",* a relatively low-lying area that *"extends across central Scotland between the mountains of the Highlands and the hills of the Southern Uplands"* (MISR, 1982). The rocks are mainly of Old Red Sandstone and Carboniferous age. Drainage of the Midland Valley flows into the Firth of Clyde to the west and the Firth of Forth to the east.

2.6 The geology of the Midlands Valley is dominated by rocks of the Devonian and Carboniferous periods, with sedimentary rocks and igneous rocks. The underlying geology of the proposed development site and immediate surroundings is formed from Carboniferous sedimentary rocks with strata belonging to the Westphalian Lower Coal Measures, a cyclic sequence of sandstones, siltstones, mudstones and coal which thins northwards and eastwards The coal seams are thick and have been extensively mined.

2.7 Bedrock is obscured at the existing ground surface by superficial deposits of varying thickness. The superficial drift deposits in the area include made ground, reclaimed intertidal mudflats, *"Carse deposits"* (Post- Glacial Buried/ Raised Beach or Estuarine Deposits), raised beach and glacial deposits.

2.8 The proposed GIS site is located on made ground following clearance of the former Power Station coal storage area. Ground investigation work undertaken for the proposed A876 and Clackmannanshire Bridge in 2000 noted that material excavated in the area comprised of coal, brick and sandstone fragments with occasional ash, clinker and burnt shale, underlain by a layer of sandstone gravel and cobbles (Babtie, 2003).

2.9 Soils beneath the low-lying areas adjacent the Firth of Forth comprises those of the Stirling/Duffus/Pow/Carbrook Association (No 488, MISR, 1982). These soils comprise non-calcareous gleys, some peaty gleys and peat formed from estuarine and lacustrine silts and clays. These soils are associated with gently sloping raised beach terraces with arable and permanent pastures. The rising ground to the north comprises soils of the Dreghorn Association (No 169, MISR, 1982) derived from Carboniferous rocks with some Old Red Sandstone material.

2.10 The rolling lowland areas of the Midland Valley are predominantly agricultural, although the conurbations of Glasgow and Edinburgh occupy extensive areas. Large areas of coniferous plantation are typical of the region and it is noted that many of the broadleaved woodlands were planted, *"usually for amenity purposes around the many large mansions"* (MISR, 1982). The higher ground of the uplands is mainly moorland with rough grazing and forestry.

2.11 The proposed development site is noted to be on Class 7 land *"of very limited agricultural value"* as classified by the Macaulay Land Use Research Institute with use *"restricted to very poor rough grazing"* (MLURI, 1986*).* Surrounding agricultural land is classified as Class 3_2, with Class 3_1 to the north of Kincardine. This is classified as *"land capable of producing a moderate range of crops"*.

Landform

2.12 The land on the northern and southern banks of the River Forth is generally characterised by flat, low lying intertidal mudflats and saltmarshes at around 5m AOD. Inland there are raised beaches with gentle slopes.

2.13 The proposed GIS site is located on low lying level ground at approximately 3.0m AOD. To the north and east the landform remains generally level with cuttings and embankments associated with the railway line, which passes in a south easterly direction towards the coast. Hawkihill Road is noted to be at 4.3m AOD immediately north of the site and 9.4m AOD as the road rises to cross the railway line at the entrance of the former Power Station site.

2.14 South of the proposed development site there is a 3- 4m high linear embankment, which was constructed as part of the past land reclamation works and provides coastal protection for the former Kincardine Power Station site and Substation. To the west, immediately beyond the site boundary, the land rises approximately 8-10m to the A876, which is on an embankment increasing in height to meet Clackmannanshire Bridge.

2.15 Further inland to the north, the landform gently rises to an undulating ridge of low hills, which parallel the coastline at around 50-60m AOD. Notable high points are Kings Seat Hill at 55mAOD to the north west around which the settlement of Clackmannan has developed, Ladys Brae at 62m AOD immediately to the north and series of undulating hilltops to the north east encompassed by Tulliallan Woods and Devilla Forest. The settlement of Kincardine encompasses the flat coastal land and lower slopes of these hills to about 40m AOD. To the north west, the undulating hills rise to the Ochill Hills with the distinctive peak of Dumyat at 418m AOD to the north of Stirling.

2.16 To the south of the Firth of Forth there is a similar level coast strip which rises to the south west to the Hill of Airth at 33 m AOD. To the north of this distinctive low ridge is the settlement of Airth which has grown southwards with a number of properties now located along the top of the hill, with Airth Castle Hotel on its southern margin. This low ridge extends to the north west to the Hill of Dunmore at 30m AOD. Further south the land rises to the Slamannan Plateau at 200m AOD.

2.17 The main watercourse in the area around the proposed development site is Canal Burn, which runs southwards from Kilbagie before draining into the Forth, to the east of Kennet Pans. Immediately to the north of the proposed GIS, a ditch is aligned along the former Power Station boundary, which flows westwards under the A876 to join the Canal Burn.

Landcover

2.18 Landcover is predominantly arable farmland in a regular grid pattern of large fields divided by post and wire fences or Hawthorn hedges often with mature hedgerow trees of Oak, Ash and Sycamore. The agricultural land on the floodplain has large fields with few trees or boundary features.

2.19 The largest areas of woodland near the proposed development site are around Old Tulliallan Castle immediately to the north and Tulliallan Woods, which links to the extensive Devilla Forest to the north east of Kincardine. Other large woodland areas extend along Ladys Brae to the north, and south of the Firth of Forth, around Airth Hill and Dunmore Park. These woodlands are predominantly broadleaf species including Oak, Horse Chestnut, Lime, Elm and Sycamore with few conifers such as Scots Pine.

2.20 The proposed GIS site is currently disused open ground. The majority of the reclaimed land of the former coal store area comprises of grass with patches of scrub vegetation (Birch, Hawthorn, Bramble and Goat Willow). In some areas the low nutrient conditions have favoured a sparse grass sward with wildflowers. To the north, the former rail siding area is now an area of regenerating Birch and Ash trees and scrub.

2.21 Beyond the boundary to the north, Hawkhill Road is bound by a high mature Hawthorn hedge (approximately 1.8m height) with evenly spaced mature Oak trees. To the west a dense row of mature Willow trees demarcates the alignment of a ditch aligned along the former Power Station site boundary.

2.22 To the north east of the proposed GIS site is an area of semi mature woodland, which was planted as part of the former Power Station works. This woodland block comprises of rows of Horse Chestnut, Lime and Hornbeam. A further woodland block is located to the east and forms the boundary to the edge of Kincardine settlement.

2.23 To the west, the A876 road embankment has been recently planted with Goat Willow, White Willow, Alder, Birch and Hazel as part of the Clackmannanshire Bridge landscape works.

Landuse

2.24 The proposed GIS site was the former coal store area used in connection with Kincardine Power Station, which was built in 1962. The coal was brought by rail and then held on site to the west of the Substation. A system of aerial conveyor belts located to the north of the Substation transported the coal to the Power Station.

2.25 The Power Station was demolished in 2001 and used temporarily for coal unloading and stockpiling, and storage of track material for the rebuilding of the Stirling to Kincardine rail link. Currently the site is now cleared with no permanent use. To the immediate east of the proposed GIS site is the 275kV Substation and beyond the cleared ground of the former Power Station site. A radar has been erected in this area and there are a number of portacabins. To the south, immediately beyond the former Power Station perimeter fence is the coastal defence wall with a public footpath along the top. The western end of the former Power Station site was used for the construction of Clackmannanshire Bridge and A876 road.

2.26 To the north of the site is Hawkhill farmhouse, and surrounded by woodland, Old Tulliallan castle at Norris Knowe. To the east beyond the railway line is the settlement of Kincardine with a population of approximately 3,000. The historic core of the town is located to the south east at the Kincardine on Forth Bridge crossing point. On the rising ground to the north is Tulliallan Castle, a police training college located within large policy woodlands.

2.27 To the south is the Firth of Forth with the large chemical works of Grangemouth beyond. The village of Airth with a population of approximately 1,200 is located to the south west and to the west is the planned estate village of Dunmore on the coast.

2.28 To the west of the proposed development site beyond the A876, is a small group of houses forming Kennet Pans on the shore of the Firth of Forth. As part of the development of the A876, the seawall forming the perimeter to the Kincardine Power Station was removed along the western and southern boundaries to allow tidal flooding in the area immediately to the south of Kennet Pans.

2.29 Along the coast the predominant landuse of the surrounding area is arable farming with some permanent pasture. Large industrial uses are also located along the coastline with Longannet Power Station to the east, Grangemouth chemical works to the south east and glass works at Alloa to the north west.

Planning Context

2.30 The following development plans cover the Study Area: -

- Fife Structure Plan 2006-2026
- Falkirk Council Structure Plan 2007
- Clackmannanshire and Stirling Structure Plan 2002
- Dunfermline and West Fife Local Plan 2012
- Falkirk Council Local Plan 2010
- Clackmannanshire Local Plan 2011

2.31 The Structure Plan sets the broad framework for development and the Local Plans provide detailed policies and site allocations. Fife Council is currently preparing a single Local Development Plan for Fife (FiIFEplan), which will replace the current Structure Plan and Local Plan. The first formal consultation stage was undertaken early in 2013. Clackmannanshire aims to publish a new Local Development Plan for public consultation in late 2013.

Structure Plan

2.32 The Structure Plan strategy for Fife *"seeks to ensure that development is located in the most sustainable locations. It is based on the need to balance social justice with economic competitiveness and environmental issues"*. Policy BL1 supports the rehabilitation and reuse of brownfield land. Clackmannanshire Structure Plan *"seeks to deliver enhanced access to housing, jobs and local facilities, integration of land use with transport, and a high quality of development; all within the overall context of caring for the environment".* In Falkirk, *"the Council believes that a strategy of carefully managed growth which benefits all its communities must be pursued over the period of the Structure Plan".*

2.33 Extracts of relevant strategic policies covering Kincardine, Falkirk and Clackmannanshire have been placed in Appendix 2.0.

Local Plan

2.34 The Dunfermline and West Fife Local Plan provides a context for the regeneration of local communities and for the promotion of a successful economy, guiding development to the most appropriate location whist protecting the natural and built environment. The improved accessibility of Kincardine and demolition of the multi storey flats is noted to raise a number of planning issues and opportunities.

2.35 The proposed development site is covered by Policy KCD007, which is a protected employment area and allocates the land for long term specialist industry (energy). It is noted that the *"Council will work with the landowner to consider future redevelopment options for this site to be based on appropriate environmental, technical and land use assessments of the full site of the former Power Station".* To the immediate east of the former Power Station site, the land is protected open space. To the east of the railway line, the Kincardine Conservation Area encompasses the historic core and surrounding rows of houses, and pier. A number of sites are designated for future housing development on the northern and eastern edges of the town.

2.36 Local Plan Policy E3 requires that *"New development must make a positive contribution to the quality of its immediate environment both in terms of its environmental impact and the quality of the place it will create".* The nearest local landscape areas as protected by Policy E19 are located approximately 4km to the east of Kincardine, to the west and east of Culross.

2.37 Relevant local Local Plan policies for the LVIA covering Fife, Falkirk and Clackmannanshire have been placed in Appendix 2.0.

Proposed Development

2.38 Current consented development in the surrounding area includes the following of particular note in terms of proximity and scale:

- Planning consent granted to the east of Kincardine for 350 housing units in 2010.
- Biomass plant at Grangemouth approved by Scottish Government in 2013

Landscape Features of the Study Area

Landscape Designations

2.39 With regard to specific planning policies, no part of the site is designated for landscape and visual reasons.

2.40 Approximately 1.2km east of the proposed GIS site is Tulliallan Castle a Listed Building (Category A) encompassed by 93Ha of designed landscape noted in the Inventory of Gardens and Designed Landscapes. The historic accounts states *"Colonel Erskine of Carnock beautified his estate very much. He ornamented the roads by planting on each side, rows of trees, consisting of Oak, Ash, Beech, Elm, Plane and Hornbeam. They have grown so well, that they are fit for ship building and other purposes"* (J. Sinclair, 1976). The estate comprises parkland, woodlands, gardens and architectural features.

2.41 Tulliallan Castle is now run as Scotland's police training college. The Castle was built on the site to the east of the former Castle (located to the north of the GIS site) in 1815-20 and is positioned facing west across the Firth of Forth. The designed landscape dates from this period and appears of the 1st edition OS map of 1855. From the property and grounds extensive views are afforded to the west encompassing Stirling and the Ochil Hills to the north.

2.42 Further east is the garden and designed landscape of the seaside villa of Dunimarie Castle near Culross. The Category A Listed Building is located on an elevated location with a spectacular setting overlooking the Firth of Forth. The compact, high quality picturesque landscape, which encompasses the Castle, is identified in the Inventory of Gardens and Designed Landscapes and important in defining the character of the coastal hills between Kincardine and Culross. The Inventory notes *"the elaborate gothic ornamentation of the Castle and castellated garden walls were built to be appreciated from a distance and rely on an extensive garden setting. Panoramic views of the Forth are gained from the East Terrace and from the Castle Terrace."*

2.43 Approximately 3km to the west of the proposed development site, to the south of the River Forth is the extensive designed landscape of Dunmore Park estate (760 acres). This is a remnant 19th century designed landscape containing *"The Pineapple"* a unique and spectacular architectural folly, which is a

Listed Building (Category A). The Inventory notes that the *"policy woodland and ornamental trees are significant in the surrounding architectural landscape, and fine views are obtained from the Park particularly to the north east and across the Firth".*

2.44 Review of the first edition OS map of the area dated 1855 indicates the estates of Tulliallan Castle, Dunimarie and Dunmore Park. The extensive woodland of Tulliallan Castle is clearly shown, which to the east has now been replanted to form the large coniferous plantation of Devilla Forest. The policy grounds and walled gardens of other large houses are also evident on the historic map such as Blackhall to the north east of the proposed site, Neuk House to the south west and Kennet House to the north west.

2.45 The proposed development site is indicated on the First Edition OS map as a reclaimed area of open fields with coastal defences to the south and the road passing from Kincardine to Hawkhill and Craigton farms forming the northern boundary (prior to the railway). An avenue of trees lines this minor road and in the surrounding areas hedgerow trees are indicated along field boundaries. Encompassing Old Tulliallan Castle are scattered parkland trees. The form and layout of Kincardine settlement is similar to present, but with a ferry cross point instead of the bridge. Within the town a clearer link is indicated between the historic core and the churches located in the higher ground to the north, which is now divided by the A977 passing to the west.

Landscape Character Assessment

2.46 Scottish Natural Heritage(SNH) has undertaken a series of Regional Landscape Character Assessments covering the whole of Scotland following established guidance[1]. The Scottish Natural Heritage Landscape Assessment divides the landscape into a number of Landscape Types and detailed Landscape Character Areas (LCA), and provides guidance and advice as to how development could be accommodated into the landscape.

2.47 The landscape character of the proposed development site and surroundings is described in the following documents:-

- Fife Landscape Character Assessment (LCA) (DTA, 1998)
- Central Region Stirling to Grangemouth LCA (DTA, 1998)
- Clackmannanshire LCA (ASH, 1997)
- Central Region LCA (ASH, 1996)

2.48 The proposed development site is covered by the Fife Landscape Character Assessment (DTA, 1998) and located in the *"Coastal Flats"* Landscape Character Type (LCT) which is described as *"low lying, open, large scale"* and it is noted that *"high voltage power lines are dominant features in the Kincardine area radiating out from the Power Stations".* Along the coast is the *"Other Intertidal Shores"* LCT which comprises *"the intertidal mudflats, sands, shingle and rock between mean, high and low watermarks".* It is

[1] Landuse Consultants (1991) Landscape Assessment Principles and Practice & Countryside Commission (1993) Landscape Assessment Guidance (CCP423), Countryside Commission.

noted in the detailed description of this LCT, that *“views are invariably extensive in the seaward direction and landward are generally towards the Cliffs, Braes, Coastal Hills or Coastal Terraces”.* The Firth of Forth is also noted as a LCT.

2.49 The Central Region Stirling to Grangemouth LCA (DTA, 1998) encompasses the north banks of the River Forth to the west of the proposed development site and A876, and extends along the south bank eastwards to Bo’ness. The land to the west is classified as *“Lowland River Valley”* LCT (Carse of Forth East of Stirling) which is described as *“flat, open, large scale carselands forming the floor and former floodplain of the River Forth and its tributaries, bounded by sharply rising hills and escarpment”.* On the south bank to the east of the A876 is the *“Coastal Flats”* LCT (“Grangemouth/ Bo’ness Flats) noted as *“low lying coastal flats dominated by the town of Grangemouth, the docks and very large scale petrochemical and other industrial installations”.*

2.50 The wider landscape to the west of the A876 is covered by the Clackmannanshire LCA (ASH, 1996). This has the same *“Lowland River Valley”* (Carse of Forth) LCT as the Stirling to Grangemouth LCA. North of the A907 the landscape character type is described as *“Lowland Valley Fridge”* (Devon/ Forth) with the *“Lowland River Valley”* (Lower Devon Carselands) LCT encompassing Tillicoultry and Alva to the west. The wider landscape to the south and west of the M9 is covered by the Central Region LCA (ASH, 1996), which identifies *“River Valleys”* (Slammannan Plateau and Falkirk/ Denny Fringe) LCTs and *“Hill Fringes”* LCT (East Touch Fringe) to the north- west.

2.51 Landscape guidelines for the Coastal Flats LCT notes with reference to “*Other Development and Structures*”, the aim to*: “Ensure any new road or other major engineering works are carefully sited and designed to minimise their landscape and visual impact. Any works likely to have a significant effect on the landscape or views should be subject to rigorous landscape and visual assessment”.* It is also noted that the coastal area has *“a high capacity for accommodating woodland and linear tree belts that would help to screen some of the intrusive features, relieve the uniformity and horizontal nature of the area”* (Fife LCA 1998).

2.52 The key characteristics and features of the Coastal Flats, Intertidal Shores, Firth of Forth Lowland River Valley and Grangemouth /Bo’ness Flats LCTs, and relevant guidelines as noted in the LCAs has been extracted and placed in Appendix 3.

Natural Heritage

2.53 The proposed GIS site is located within the former coal storage area for the Power Station, which is bound to the north, south, and west by metal palisade fencing. Much of the site is currently open rough grassland and patches of scrub with areas of hardstanding and a few temporary buildings. To the north the area of former railway sidings is now regenerating woodland comprising mainly of Birch with some Ash.

2.54 To the north east of the existing Substation are two large blocks of mature woodland comprising mainly of Horse Chestnut, Lime and Hornbeam. This woodland was probably planted as screening for the Power Station. The densely spaced grid of planting appears to have never been thinned and the Horse Chestnut species is showing signs of canker disease.

2.55 To the south of the proposed GIS site, there is a grass embankment rising to the perimeter fence with a footpath following the estuary coastline. To the west beyond the site boundary is the A876 and linear strip of roadside planting approximately 15m wide comprising mainly of Willow and Hawthorn. The surrounding area is predominantly arable fields.

2.56 The closest designated site is the Firth of Forth Special Protection Area (SPA), Wetland of International Importance and Site of Special Scientific Interest (SSSI) encompassing Kennet Pans to the north of the A876, the coastline around Culross to the east and the southern riverbank. These sites are internationally and nationally designated for over wintering estuarine bird populations.

2.57 Other sites of nature conservation interest include the Kennet Pans and Pow Burn Wildlife Sites and Skinflats Royal Society for the Protection of Birds (RSPB) Reserve, along with several areas of long established woodland. Woodland in the surrounding area noted in the Ancient Woodland Inventory includes: Kennet Woodlands, Old Tulliallan Castle, Tulliallan Castle, and Airth Castle.

Cultural Heritage

2.58 There is a long history of human occupation along the Forth Estuary. By the Middle Ages, major estates and large castles were to be found on both sides of the Forth (at Tulliallan and Airth) and Kincardine had developed as a convenient crossing point of the estuary. By the middle of the 16th century, salt manufacturing had become well established at Kincardine due the availability of easily mined coal for the evaporation process, local demand and the opportunities for overseas export. Coalmines developed in the 17th and 18th centuries in association with salt production and became a significant industrial activity taking over from agricultural production. During this period a number of large houses were built and set within extensive designed landscapes such as Tulliallan, Dunimarie and Dunmore.

2.59 The settlement of Kincardine expanded on reclaimed marshland by the deposit of coal ash from the saltpans that lined the Forth in the 17-19th centuries. A pier was built and harbour. During the 18th and 19th centures there was an increase in shipping activity and building at Kincardine. In the historical records of 1791-1799 a description of the surrounding land notes *“About 40 years ago it was in a state of nature; but since that period, it has been highly improved; and the greatest part of it has been enclosed with stone dikes or hedges, which have succeeded amazingly well” (J. Sinclair, 1976).*

2.60 By 1846, the settlement of Kincardine which was formerly named West Pans *“from the number of its salt pans, of which in 1780, there were fifteen”,* had a population of 2875 and is described as follows *“It is pleasantly seated on the north east bank of the river Forth, and though irregularly built, and having some narrow streets, it contains several of good breadth with a number of substantial houses and neat villas surrounded by gardens. The harbour, which is one of the best for trade on the river Forth and very commodious……”* The importance of the strategic location and good communications of the town is also noted *“The coast road from Stirling passes through it, a coach runs daily to Glasgow, the river is crossed by a steam boat ferry; and steamers ply regularly between Stirling and Edinburgh, taking in passengers at the pier, at any state of the tide”* (S. Lewis, 1846).

2.61 The transportation and trade network was further enhanced by the construction of the rail bridge over the Forth at Queensferry in the 1880s, followed by the Kincardine branch railway line in 1893 and the Kincardine Bridge in 1936.

2.62 Nationally and regionally important cultural heritage sites in the area include: the Conservation Areas of Kincardine, Clackmannan and Airth which encompass the historic cores of the settlements; Kennet miners village; and estate villages of Dunmore and Letham. To the north and west of the proposed development site is the Schedule Ancient Monuments (SAM) of Old Tulliallan Castle and Kennet Pans Distillery. The designation as a SAM or Listed Building protects both the building and setting.

2.63 Although ruinous, Old Tulliallan Castle SAM and Listed Building (Category A) is one of the best examples of a Scottish Hall House *“which formerly belonged to the Blackadders, who were knights baronets”* (J. Sinclair, 1976). The castle is thought to have been built in the early 14th century and was set in a small park, a section of which remains today. To the west, Kennet Pans SAM is the roofless remains of a large distillery built in the 1770s to supply malt spirit to London gin distillers. Despite closing in 1825 the complex still provides a remarkably complete picture of the scale, layout and construction of a major 18th century industrial development. The row of four cottages, which face eastwards on the road to the Distillery are, designated Listed Buildings (Category C).

2.64 There are additional designated heritage sites within the vicinity of the proposed development site including: the listed building of Tulliallan Castle (Category A) located within the designed landscape grounds. To the east in Kincardine, the row of single storey 18th century miners cottages along Hawkhill Road are designated as Listed Buildings (Category C). A number of listed buildings are designated within the historic sore of Kincardine and include Tulliallan Parish Church (Category B) on Kirk Street to the north.

2.65 To the south of the proposed development site Kincardine on Forth Bridge is a Listed Building (Category A). This bridge was opened in 1936, and was at that time the worlds longest swing bridge and operated without fault until it was officially declared a static structure in the 1980s.

Recreation Features, Tourist Attractions and Routes

2.66 To the north east of the proposed development site and settlement of Kincardine is Devilla Forest . This woodland owned by the Forestry Commission comprises mainly of Scots Pine and is an important recreational area with an extensive network of footpaths and cycle ways. The main entrance and car park is located on the A985.

2.67 Further west is the historic village of Culross. The centrepiece of this former port is the Palace and Walled Gardens, which have been restored by the National Trust of Scotland and are open to visitors.

2.68 A number of footpaths are identified in the Core Paths Plans encompassing the proposed development site and surrounding area to the north and south of the Firth of Forth, which are indicated in Figure 2.1. The closest to the proposed development site are: Hawkhill Road to the north, which passes Hawkhill Farm to Kincardine; the footpath along the coastline, which forms the southern perimeter of the former Power Station site; and along the A876 to the west.

2.69 The Fife Coastal Path extends 117 miles to link the Forth estuary to the south and the Tay estuary to the north. The first section of the route starts to the east of Kincardine and passes along the coast past Culross to Rosyth.

2.70 To the south of the Forth Estuary to the west is the architectural folly named the Pineapple, which was built as a garden retreat in the walled gardens of Dunmore Park. The walled garden, pond and surrounding woodland are open to visitors and the folly is available for uses as holiday accommodation. The visitor car park is accessed via East Lodge road into Dunmore Park off the A905.

2.71 Kennet Pans distillery to the west of the A876 has an interpretation board. Further to the north west is Clackmannan Tower located at the summit of King Seat at 55m AOD. This five storey tower house was built in the 14th century by King David II. The tower forms a prominent landmark feature for the settlement of Clackmannan and surrounding landscape. The site of the tower is open to visitors and has an interpretation board.

2.72 Two large hotels are located on the south side of the estuary. Airth Hotel to the north of the A876 on the southern brow of the Hill of Airth. To the south of the A876, is Powfoulis Manor Hotel facing north east across the estuary. The baronial house is set within 20 acres of flat coastal fields bound by mature avenues of trees of Horse Chestnut, Elm and Sycamore.

2.73 A network of major roads passes through the surrounding area with the A907 to the north, A 985 to the east, and A876 and A905 to the west. Linking to these is a network of minor roads. To the south of the proposed development site is the Kincardine on Forth Bridge (A895) and new Clackmannanshire Bridge (A876).

3.0 Landscape and Visibility of the Site

Landscape Character, Condition and Value

Landform

3.1 The proposed GIS site is located on flat low lying level ground at approximately 3.0 m AOD. To the north and east of the site the land remains level to the former Power Station perimeter fence. To the south, the land rises approximately 3-4m to form the coastal defence barrier to the Forth of Forth. Along the top of this grass embankment is the former Power Station boundary fence and coastal footpath. To the west, the land remains level to the boundary fence. Beyond there is a ditch parallel to the fence alignment and the land then rises to the A876, which is on embankment to join the Clackmannanshire Bridge. This embankment rises from being at grade at the northern boundary of the former Power Station site to approximately 8- 10m above ground level to the south.

Landcover

3.2 The landcover of the proposed GIS site is predominantly rough grassland and scrub with areas of hardstanding and portacabins. The former railway sidings to the north is now a regenerating woodland and scrub of predominantly Birch and Ash with some Oak, Elm, Sycamore now reaching 8-12m height. Along the western end of the northern boundary of the former Power Station site, a 10-12m high row of willows follows the alignment of a ditch immediately to the north of the perimeter fence.

3.3 To the east of the proposed GIS site scattered scrub and trees form the boundary to the existing 275kV Substation. Beyond the Substation larger blocks and strips of mature woodland comprising of Horse Chestnut, Lime, Hornbeam, with some Ash and Sycamore form the former Power Station site boundary. This planting was established as part of the former Power Station works and is now approximately 18-20m height.

3.4 To the south of the GIS site is a grass embankment with some scattered scrub forming the boundary to the perimeter fence. To the west the recent A876 embankment planting comprise scrub and broadleaved trees of mainly Alder, Birch, Willow and Hawthorn, which are now reaching 4m height.

3.5 The surrounding floodplain is predominantly a regular grid pattern of large arable fields bounded by hawthorn hedges with mature hedgerow trees of Oak, Sycamore and Ash or more open with ditches lined with reeds. Dispersed throughout the area are a number of farms with associated outbuildings often enclosed by mature trees and nearby cottages served by a network of minor roads. There are a few clumps of mature woodland scattered throughout this flat area and near the proposed development site include: to the north around Old Tulliallan Castle; immediately west of the A876, which once formed part of the former Power Station site; and around Kennet Pans.

3.6 South of the Firth of Forth is an area of similar flat agricultural fields. The area immediately to the north of the A876 Southern Approach Road is distinct in that there are a large number of mature hedgerow trees and woodland associated with a former large house called the Neuk which was located in this area.

3.7 The rising ground to the north, north east and east comprises of large arable fields and extensive mature policy woodland comprising of Oak, Ash, Lime, Horse Chestnut, Sycamore and Scots Pine. To the east and south east, the settlement of Kincardine comprising of predominantly two storey or single storey properties extends from the coast and up the gently rising ground to the north east. South of the Firth of Forth is an area of similar mature woodlands encompassing rising ground and the linear settlement of Airth, which follows the alignment of the A905 and Hill of Airth.

Landuse

3.8 The main landuse of the immediate surrounding area is agriculture with the settlement of Kincardine to the east. Scattered throughout the area are a number of farms, cottages, large estates, historic properties and large-scale industrial uses located mainly along the coast.

3.9 The proposed development site is currently vacant with temporary uses requiring a secure open space currently undertaken in the area, including fire and police training exercises. To the immediate east of the proposed GIS site is Kincardine Substation to which a number of overhead lines routed along the coast and crossing the Firth of Forth converge. To the south of the proposed GIS site is the anchor tower and tall flashing Forth Crossing tower at approximately 140m.

3.10 To the north, there are arable fields through which the A876 is aligned and rising wooded ground forming Lady's Brae, which formed part of the estate of Kennet House. On top of this ridge are large radio masts and reservoir. To the east of this ridge is the large waste processing plant at Kilbagie. To the north east of the proposed development site is Hawkhill Road aligned parallel to the coast and providing access to Hawkhill Farm, which faces south west. To the immediate north is mature woodland enclosing Old Tulliallan Castle and a residential property, with the railway line, residential estate of Broomknowe on the edge of Kincardine and A 977 road beyond. On the rising ground are Tulliallan Golf Club and Tillicoultry Quarries.

3.11 To the east are some arable fields and then the residential properties of Kincardine. Beyond the settlement of Kincardine the higher ground is encompassed by the extensive mature woodland forming the grounds of Tulliallan Castle, which is now used as a Police Training College. To the south east is the railway line, historic core of Kincardine, A 985 leading to Kincardine on Forth Bridge, arable fields and Longannet Power Station.

3.12 To the south is the Firth of Forth estuary, arable fields and the extensive chemical works of Grangemouth. To the south west is is the A876 and Clackmannanshire Bridge crossing. On the southern side of the Firth of Forth there are arable and pasture fields, and the settlement of Airth.

3.13 To the west beyond the A876 is a small terrace of properties facing south east forming Kennet Pans adjacent the ruins of a former distillery. To the immediate west is an area of mature woodland associated with the former house, which was located in this area. On the southern side of the Firth of Forth is the compact planned estate village of Dunmore. Following the alignment of the coast is the A905 with the parkland and extensive mature woodland of Dunmore Park encompassing the rising ground beyond. To the north west is the large town of Alloa and on the ridge of high ground the settlement Clackmannan.

3.14 The A876 passes along the western boundary of the proposed development site. To the north, the A977 links Kinross to Kincardine, and to the south, the A985 follows the coast to the Forth Road Bridge. To the west of the southern side of the Firth of Forth, the A905 passes through Airth and follows the river inland to Stirling. Throughout the area is a network of minor roads providing access to the scattered farmsteads, small villages and properties. The Alloa to Dunfermline railway line forms the north east boundary of the former Power Station site.

3.15 In terms of recreational uses, Tulliallan Golf Club is located approximately 1 km to the north and footpaths through the adjacent Tulliallan Woods are open to the public. Further east, Devilla forest offers a variety of outdoor recreation activities with public footpaths and cycleways. To the east of Kincardine is the start of the Fife Coastal Route, which passes through the popular tourist destination of Culross village. A cycle route passes along Hawkhill Road to the west of the proposed development site to Clackmannan. A number of public footpaths follow the coastline and cross the plains to the rising foothills. In the immediate vicinity of the proposed development site a footpath is aligned along Hawkhill Road to the north, along the coast to the south and the western side of the A876.

3.16 There are a number designated nature and heritage sites in the surrounding area, which are also popular visitor attractions. The nature conservation sites are not actively promoted to attract visitors but there are interpretation boards providing information about the wildlife sites and designations. Scheduled Ancient Monuments include Old Tulliallan Castle to the north and Kennet Pans to the west. Old Tulliallan Castle is open by appointment only and there is an interpretation board at Kennet Pans. Listed Buildings are located at Kilbagie to the north, Tulliallan Castle to the east, historic core of Kincardine settlement, Kincardine on Forth bridge, Airth Castle, and historic core of Airth to the west. The ornamental Pineapple building at Dunmore Park and nearby estate village are also Listed. To the north west is the Listed Building of Clackmannan Tower, which is a distinct landmark feature, affording panoramic views to the surroundings and visitor attraction.

Landscape Character

3.17 The landscape character of the proposed development site is of a large scale flat, open and barren, derelict industrial site. This industrial character is reinforced by the convergence of overhead lines and tall Firth of Forth Crossing and Anchor towers, operational Substation and to the immediate west with the busy A876 and Clackmannanshire Bridge. To the north, east and south the character is more natural and unmanaged with the regenerating woodland encompassing the former railways sidings, mature woodland blocks, and mudflats and waterscape of the Firth of Forth.

3.18 The landscape character surrounding the proposed development site is of a managed and relatively enclosed agricultural landscape. The more open coastal area is a busy, settled, and dominated by communication corridors with roads, bridges, railway lines and overhead lines, and large scale industrial uses creating a range of colours, forms, textures, lights and noise. Localised diversity in texture and colour is provided by the following landscape features: extensive mature estate woodlands; hedges and hedgerow trees; scattered clumps of woodland associated with farmsteads and properties, and ditches.

Condition and Value

3.19 The former Power Station site has a coherency due to its long term ownership and use. Within the site currently disused areas have an unmanaged and neglected appearance. Existing mature woodland located on the former Power Station site is in a moderate to poor condition, whereas the naturally regenerating areas are establishing well. The surrounding agricultural landscape appears tended and the distinctive landscape features well managed. .

3.20 No specific planning policies protect the existing landscape character and quality of the area of the proposed development site and surroundings. However, the distinct attributes and issues that relate to the landscape of the area are made explicit in the SNH Landscape Character Assessment. Of particular note is the stated potential for further woodland and linear tree belts in the Coastal Flats LCA for screening.

3.21 The area surrounding the proposed development site is obviously valued by landowners, local residents, and recreational users of the nearby pubic footpaths, cycle routes and boats.

3.22 In summary, the proposed development site is located within a productive well-managed agricultural and industrial coastal landscape with landscape features providing some enclosure and variety. The proposed development site is currently disused and has a neglected landscape character with few landscape features. Overall, it is considered that the landscape features and character of the proposed development site are of **low** sensitivity to change.

Description of Visibility and Visual Receptors

3.23 The visual appraisal is based on an understanding of the visibility of the proposed development through computer generated information, site survey and grading of degrees of visibility, from *"not visible"* to *"fully open views"*. To describe the degree of visibility of the site (or proposed development) from any location and receptor, a continuum has been adopted which is divided into four categories:

No View: no view or difficult to perceive.

Glimpse View*:* a transient view or distant view of part of the site or development in the context of a wider view.

Partial View: a clear view of part of the site or development; a partial view of most of it; or a distant view in which the site or development forms a relatively small proportion of a wider view.

Open View*:* a panoramic view of most of the site or development, occupying most of the field of vision.

Predicted Visibility

3.24 The computer-generated Zone of Theoretical Visibility (ZTV) of the proposed GIS is shown in Figure 3.1. To prepare the ZTV the proposed GIS was represented by a sample of points from the tops of the proposed GIS building and gantries. Main woodland blocks and buildings were also included,[2] and are shown in Figure 3.1 as areas of orange and green.

3.25 The extent of theoretical visibility of the proposed GIS is indicated in two shades of red. The lighter shade indicates the ZTV as bareground, and the darker red, the ZTV taking account of the screening of woodland blocks and buildings as described above. The ZTV represents a *"worst case scenario"* of proposed visibility, as the computer generated modelling does not include at this scale for the detailed local screening effects which can be provided for example, by walls, hedges, hedgerow trees and small woodlands and rows of trees.

3.26 To the north, the ZTV with screening indicates that visibility will extend beyond A876 to Lady's Brae at 62m AOD to the west and Maggie Duncan's Hill at 92m AOD. Further hill tops are included to the north such as Shiel Hill at 66m AOD. The predicted visibility indicates that views will encompass the Listed Building of Clackmannan Tower and at Kilbagie, part of the settlement of Clackmannan including the Conservation Area, Tulliallan Golf Course, cycle route, and public footpaths along Hawkhill Road and across Lady's Brae.

3.27 To the east, predicted visibility is restricted to the undulating hill tops of Tulliallan Woods. The ZTV with screening indicates views will encompass the Listed Buildings of Tulliallan Castle and Churches, Tulliallan Garden and Designed Landscape, a small part of Kincardine settlement to the north end of Hawkhill Road and Chapelhill Street, and properties on higher ground including part of the Conservation Area, and public footpaths through the area.

3.28 To the south, predicted visibility with screening is indicated to extend across the Firth of Forth to Grangemouth and edge of Stenhousemuir. This encompasses scattered farmsteads and properties, the village of Letham and Conservation Area, the Listed Building of Kincardine on Forth Bridge, Skinflats RSPB Reserve, footpaths across the coastal area, A905, A876 Southern Approach Road and Clackmannanshire Bridge.

[2] A standard height of 8m for buildings and 15m for woodland has been adopted for the ZTV. Buildings and tree blocks have been taken from OS Vectormap, which corresponds but does not exactly match the features represented in the OS 1:25,000 map.

3.29 Predicted visibility to the west extends to the eastern edge of the settlement of Airth and properties on the Hill of Airth including part of the Conservation Area, the eastern edge of the village of Dunmore, and properties at Kennet Pans. This area of visibility includes Kennet Pans SAM, Listed Buildings in Airth, Dunmore and Kennet Pans, parts of Dunmore Park Garden and Designed Landscape, public footpaths within Dunmore Park and along the coast and A905. Further west visibility extends along the River Forth encompassing the settlement of South Alloa and edge of Alloa.

3.30 In summary, the computer generated ZTV of the proposed GIS indicates that predicted visibility is **restricted to the north and east,** and **more extensive to the south, west and north west**. In reality, existing small woodland areas such as the regenerating woodland along Hawkhill Road and A876 roadside planting provide additional localised screening and further restrict visibility.

Visual Receptors and Viewpoints

3.31 For the purposes of the assessment, visual receptors include the public or community at large, residents, visitors and other groups of viewers (such as those for example with a special interest in cultural heritage), which have the potential to be affected by the proposed development. The sensitivity of visual receptors, nature of views and visual amenity is considered to be dependent upon:

- The location and context of the viewpoint;
- The expectations and occupation or activity of the receptor;
- The importance of the view (which may be determined with respect to its popularity or number of people affected, its appearance in guidebooks, on tourist maps, and on the facilities provided for its enjoyment and references to it in literature or art).

3.32 The site survey of visual receptors identified in the surrounding area and a description of views in relation to the proposed development is indicated in Figure 3.2 and listed in Appendix 5. Figure 3.2 also locates the representative range of viewpoint photograph locations identified in the surrounding area. The viewpoint photographs are indicated in Figure 3.3 (a-f) and are annotated to indicate the proposed GIS site and and key features in the surrounding area.

3.33 The Council was consulted regarding the proposed viewpoints following issue of the Scoping Report and one further viewpoint added within the settlement Kincardine (Viewpoint 3) during the consultation stage. Two further viewpoints were identified during the detailed site survey (Viewpoints 4 and 8). The viewpoint photographs were professionally taken in September 2013, as detailed in Appendix 4. Deciduous trees were therefore fully in leaf providing more screening than would be afforded during winter.

3.34 The main visual receptors located in the study area are: residential (scattered farmsteads, properties, settlements of Kincardine, Airth, Clackmannan and Dunmore); visitors (Clackmannan Tower, Dunmore Park, Kennet Pans), recreational (users of public footpaths, cycle routes and boats, Tulliallan Golf Course, Parks in Kincardine and Airth, Skinflats RSPB Reserve, Kennet Pans Wildlife Site), and travellers (A876, A977, A985, A905, B9124, Hawkhill Road, Minor Roads, Kincardine on Forth Bridge and Clackmannanshire Bridge).

3.35 To the immediate north the mature woodland encompassing Old Tulliallan Castle and the embankment of the railway line screens the majority of views. More distant glimpse views will be afforded from the A977 travelling south (Viewpoint 1) and elevated areas within Tulliallan Golf Course (although it is considered that existing woodland within and bounding the golf course may screen views entirely).

3.36 To the immediate north east, partial views will be afforded from Hawkhill Farm and Road. The property faces south west across a field, which is bounded by a mature hedge and Oak trees at approximately 10m spacing. Bounding the southern side of the Hawkhill Road is the metal palisade fencing forming the perimeter fence of the former Power Station site. Beyond views are partially screened by mature woodland which was planted as part of the Power Station works and further west by regenerating woodland on the former railways sidings which in places is now reaching 8-12m height.

3.37 To the north west, partial views will be afforded from the A876. The existing roadside planting which is currently approximately 4m in height provides some screening and will increase overtime as the planting gains in height (approximately 0.5 - 1.0m per year). To the immediate north of the site an existing row of semi mature Willows approximately 12m height also provide screening. More distant partial views will be afforded from the more elevated Kilbagie.

3.38 To the east, the majority of potential views of the proposed development site are screened by the existing Substation, mature woodland within the former Power Station site and embankment of the railway line which effectively forms the western boundary of Kincardine settlement (Viewpoint 2).

3.39 Glimpse views are afforded from Kincardine settlement approximately 1 km to the north east, and encompass areas of open space and number of residential properties located mainly on the elevated parts of the settlement (Viewpoints 3 and 4). Intervening buildings and trees including the existing boundary planting within the former Power Station site, screen the majority of potential views from these elevated areas and effectively the historic core of Kincardine. From Kincardine Pier on the southern edge of Kincardine Conservation Area partial views will be afforded (Viewpoint 5). Further up the hill, Tulliallan Castle Police Training College faces south west and is enclosed by mature woodland. One large gap in the woodland allows a distant view across the Forth of Forth to the hills and allows a potential glimpse view of the proposed development site from this designed landscape.

3.40 Immediately to the south of the proposed development site open views will be afforded of the GIS from the footpath, which is aligned along the perimeter fence. This walkway is elevated on the coastal defence wall. Open views will also be afforded from boat users on the Firth of Forth.

3.41 To the south east, partial views will be afforded from Kincardine on Forth Bridge (Viewpoint 6). Further south, glimpse views will be afforded from the scattered farmsteads, properties and Skinflats RSPB Reserve on the south side of the Firth of Forth. The mature trees, which form avenues and bound the fields immediately surrounding Powfoulis Manor Hotel effectively screen more distant views across the coastal plain to the south. Similarly the mature trees and hedges that once formed the setting for Neuk House immediately to the north of the A876 Southern Approach Road screen views.

3.42 Open transient views will be afforded from the northern end of the Clackmannanshire Bridge across the site (Viewpoint 7). Given the alignment and perimeter fencing, partial transient views are afforded from the middle section of the bridge. To the south, glimpse views will be afforded from the A876 Southern Approach Road to the bridge.

3.43 To the west, partial and glimpse views of the proposed development site will be afforded from the north and eastern edge of Airth, properties located on the Hill of Airth and Airth Parish Church. These views encompass the existing Clackmannanshire Bridge, Forth Crossing Towers and Longannet Power Station (Viewpoint 8). Views from the properties on the Hill of Airth are filtered by existing adjacent mixed woodland on the hillside.

3.44 Partial views will be afforded from Dunmore Park and A905. The mature woodland of the estate screens the majority of views from within Dunmore Park Garden and Designed Landscape (Viewpoint 9). More distant partial and glimpse views will be afforded from the historic properties of Dunmore village. These views encompass the existing Clackmannanshire Bridge, Forth Crossing Towers and Longannet Power Station.

3.45 On the north side of the Firth of Forth, partial views will be afforded from the row terrace of properties forming Kennet Pans and Scheduled Ancient Monument. Views will encompass the existing A876 in the foreground (Viewpoint 10). Partial and glimpse views will also be afforded from the scattered farmsteads and properties in this coastal plain area.

3.46 On the elevated ground to the north and north west more distant partial and glimpse views are will be afforded from Lady's Brae, edge of Clackmannan and Tower (Viewpoint 11). From this elevated area panoramic views are afforded of the Firth of Forth estuary Kincardine and Clackmannanshire bridges, Longannet Power Station and Grangemouth to the south east, and Stirling Castle, Wallace Monument and Alloa works to the west.

3.47 Partial views will be afforded from the A876 overbridge to the north west of the proposed development site (Viewpoint 12). Some screening is afforded by existing trees to the north of the proposed development site and along the A876 road embankment.

3.48 The surrounding area has a number of light sources at night. With the exception of automatic security lighting, the existing Substation is not lit outside working hours unless for maintenance. Existing night lighting sources in the surroundings are associated with the tall Forth Crossing towers, settlement of Kincardine, Kincardine on Forth Bridge, Longannet Power Station and chemical works at Grangemouth.

3.49 In summary, open transient views of the proposed development site are restricted to the immediate south of the site and afforded through perimeter security fencing from the public footpath, from Clackmannanshire Bridge and Firth of Forth. Partial or glimpse visibility is limited to the north, east and west to receptors located either near the site or from elevated areas, and encompass Kilbagie, Hawkhill Farm, parts of Kincardine settlement, Tulliallan Castle Garden and Designed Landscape and Kennet Pans.

3.50 More distant partial and glimpse visibility encompasses receptors to the southwest, west and northwest, encompassing residents of the settlements of Airth, Dunmore and Clackmannan, visitors to the Garden and Designed Landscape of Dunmore Park, Clackmannan Tower and recreational users of the cycle route and footpaths crossing the area. Transient partial views will be afforded by travellers using Hawkhill Road to the north and east, Kincardine on Forth Bridge to the south, more distant A905 to the southwest, the A876 to the west and minor roads around Kennet Pans.

3.51 From all directions views of the proposed GIS and associated OHL works encompass the adjacent large-scale infrastructure of the Forth Crossing and Anchor Towers, Clackmannanshire Bridge and overhead lines. More distant views afford a wider panorama, which includes the large-scale industrial development of Longannet Power Station and Grangemouth chemical works. These panoramic views encompass a skyline punctuated by overhead lines and chimneys.

3.52 From elevated areas the strategic setting of the the Firth of Forth estuary contained by gently rising ground to the north and Slammannan Plateau to the south, and higher Ochil Hills to the north west can be appreciated. Distant views are directed along the River Forth inland to Stirling Castle, Wallace Monument and Dumyat Hill, which form a distinct skyline features. This panorama also encompasses large scale industry, high chimneys, cooling towers and overhead lines.

3.53 Sensitive receptors are either located close to the proposed development (east, south and west) or are more distant and overlook the area (north, north east, south west, north west) or on the coast (west). Visibility encompasses receptors of **high** to **low** sensitivity including residential properties in the settlements of Kincardine, Airth, Dunmore and Clackmannan, designated heritage and nature conservation sites, recreation and tourist attractions, major and minor roads.

Proposed Gas Insulated Substation Development

4.1 The proposed GIS development will be located on flat disused land immediately to the west of the existing Kincardine Substation and east of the A876 as described in Chapter 2 of the ES. In detail this will comprise the following:

- Construction and operation of a new GIS covering an area of approximately 1.6Ha. The proposed development has a preliminary site setting level of 6.2 m AOD which will result in localised raising of the ground level by 3.2- 3.5 m to create a platform for the GIS compound area (218m x 110m). The Flood Risk Assessment has determined the platform level.

- The electrical equipment plant items within the compound will comprise of a steel gantry connection at a height of 13m to allow the overhead line to connect to the new equipment and onwards. The main GIS will be partly located in a building 56 x 23m x 12m high with grey coloured sheet cladding. The external GIS pipework within the Substation compound will be at 2.5m height and at entry to the building 6.7m. The pipework will be a light green colour. The two transformers in the compound area will be surrounded with a 4m high noise enclosure wall, which will match the cladding of the GIS building. The surface of the compound will be permeable and comprise of a 75mm layer of 20mm grey stone chippings laid over approved fill. A 2.74m steel palisade security fence will enclose the proposed GIS compound area. The layout of the electrical equipment within the GIS compound area has largely been determined by the alignment of the new and existing overhead lines.

- The GIS will be unmanned and visited only for monitoring and maintenance purposes. There will be no lighting at night apart from automatic security lighting.

- Construction and use of a new 5m wide private access road (approximately 46m length) to the proposed GIS. This new road will link to the existing private road network within the former Power Station site and main entrance accessed from the A977 to the east.

- As part of the proposed development some electrical equipment within the north west part of the existing 275kV Substation will be removed.

- The construction programme for the proposed GIS is scheduled to take place over an 18 month period.

Associated Overhead Line Deviation and Tower Works adjacent Substation

4.2 As part of the overhead line upgrading and linkage to the new GIS, some of the towers located in the immediate vicinity of the 275kV Substation will be removed and new towers constructed as indicated in Figure 1.2. The proposed repositioned towers range in height between approximately 40-50m and are a similar height to existing towers in the vicinity. In detail, the overhead line works will comprise:

- To the north east of the GIS, a new tower will be constructed and two existing towers will be removed.

- To the east of the GIS, a new tower (18) will be constructed. The ongoing overhead line will be deviated approximately 30m to the north of the existing alignment with two new towers constructed (17a and 15a) and three towers removed. The deviated line will link with the existing alignment at tower (14) located to the south of Hawkhill Road.

- A further tower will be constructed to the south east of the proposed GIS to link with the Forth Crossing Anchor Tower, which will link to the existing Forth Crossing Tower.

Photomontages

4.3 Figure 4.1 (a-d) presents photomontages of the proposed GIS and associated OHL works without any mitigation measures in the context of the surrounding landscape from four key viewpoints. The correct viewing distance for A3 size prints is noted on each.

Landscape Impact

4.4 The assessment of magnitude of landscape effects describes the nature and scale of changes to individual landscape elements and character likely to occur from the proposed development. The baseline landscape study identified that the landscape character and features of the site was of **low sensitivity.**

<u>Loss of Landscape Features</u>

4.5 The proposed GIS compound will occupy an area of approximately 1.6Ha of disused ground and areas of hardstanding once occupied by the coal storage area of the former Power Station. Some scattered self seeded scrub and young trees will require to be removed to accommodate the proposed GIS and land locally raised by an average of 3.5m. Some self regenerating woodland and scrub will require to be removed to accommodate the proposed tower and wayleave corridor to the north east of the GIS. Existing woodland to the east will also require to be thinned to accommodate the wayleave corridor of the proposed deviated overhead line.

4.6 In summary, the design approach by locating the proposed development on an area of open derelict land has ensured that that the majority of existing landscape features on site have been retained and safeguarded. Overall, it is considered that the magnitude of change on landscape elements will be **low adverse** during construction reflecting primarily the small loss of scrub and trees associated with the proposed development. On completion, it is considered that the magnitude of change will be **low beneficial** with the implementation of the associated landscape works, and over time **improve**.

<u>Impact on Landscape Character</u>

4.7 The proposed development is located within a productive well-managed agricultural and industrial coastal landscape with landscape features providing enclosure and variety. The proposed GIS site adjacent an existing Substation and overhead lines is currently disused with few landscape features. The local landscape character appears well managed and valued as a productive agricultural landscape. In contrast, the proposed GIS site appears neglected and derelict. The area to the immediate north and north east where there is large scale natural regeneration of woodland on the former railway sidings and area of mature woodland has a more natural and interesting character.

4.8 In summary, the existing landscape character allows for potential mitigation planting of new woodland to provide screening and integrate the development with the surroundings. Overall, it is considered that the permanent removal of derelict land to undertake the proposed GIS development will be of **low beneficial** magnitude of change upon the landscape character during construction. The overhead line works with the removal and repositioning of towers is considered to represent no change to the existing landscape character. On completion, it is considered that the magnitude of change will be **low beneficial** at the start of the operational stage**,** and over time **improve** with the establishment of the associated landscape works.

Visual Impact

4.9 The assessment of magnitude of visual effects describes the nature of changes to specific views and general visual amenity likely to occur from the proposed development. The baseline visibility study identified that, within the visual envelope, a number of sensitive and less sensitive receptors (residential properties, designated areas and features, cycleways, footpaths, major and minor roads) will have views or transient views of the proposed development **(high- low sensitivity).**

4.10 Potential views of the proposed development are relatively limited to the north and east, and more extensive to the south and west. To the east and west partial and glimpse views will be afforded from residential properties in the immediate surrounding area. Transient open views will be afforded from the footpath to the immediate south of the site, Clackmannanshire Bridge and Firth of Forth. More distant views will be afforded from the coast to the west, and higher ground to the north, north east, south west and north west encompassing parts of the settlements of Kincardine, Airth, Dunmore and Clackmannan.

4.11 Overall, it is considered that given the scale and duration of construction of the proposed development, the magnitude of change to views and visual amenity will be **high** for receptors located immediately to the south of the proposed development, and **medium/low** for the majority of receptors. The permanent magnitude of change is considered to be **medium/low** as existing views encompass the large scale industry and electricity infrastructure, which influences the overall visual amenity of the area. This magnitude of change will be highest at the outset when the degree of contrast will be greatest. The scale of change in the character of the view and visual amenity will **decrease** over time as the new development integrates with the surroundings with the establishment of the associated landscape works.

4.12 The visual effect of the proposed development on visual receptors with views of the proposed development without mitigation is detailed in Appendix 5.

5.0 Proposed Mitigation Measures

Landscape Strategy

5.1 The Outline Landscape Proposals for the proposed development are indicated in Figure 5.1, and have the following strategic landscape design aims: -

- Provide screening
- Integrate the proposed development into the existing landscape
- Enhance biodiversity and habitat connectivity
- Reinforce the distinctive qualities and features of the existing landscape character

5.2 A key landscape aim is the extension of the existing distinctive landscape features of the area to assist with *"fitting"* the proposed development into the existing landscape pattern and reinforcing landscape character. This approach and reference to the SNH LCA guidance has informed the design of a landscape framework of strong woodland belts taking reference from the large scale planting associated with the historic estates located along the Firth of Forth. This landscape framework provides strategic screening and a setting for the proposed GIS, whilst increasing habitat and wildlife diversity.

Outline Landscape Proposals

5.3 The outline landscape scheme encompasses existing tree planting and regenerating woodland and scrub to the north and east of the site, and proposes new areas of mixed woodland. New mixed woodland planting is proposed to the immediate north and south of the proposed GIS site. Further west along the perimeter fence new mixed woodland and scrub planting is also proposed which will reinforce the existing A876 roadside embankment planting.

5.4 The existing woodland along the north and east perimeter fence has either been planted as part of the screening works for the former Power Station or has self seeded to form a naturally regenerating woodland. It is proposed that these areas are managed to retain and promote the woodland as this forms an effective immediate screen for the proposed development.

5.5 The existing mature woodlands on site comprise a densely planted grid of Lime, Hornbeam and Horse Chestnut species, which are now reaching approximately 18-20m height. The woodlands create an effective boundary to the former Power Station site and screen the proposed development. Initial inspection indicates that no woodland management work has been undertaken since planting so the trees have grown as a dense block with little understorey due to lack of light. In addition many of the Horse Chestnut trees are diseased with canker and should be removed. In order to safeguard and promote these woodlands for the future it is proposed following the removal required for the proposed overhead line wayleave corridor that diseased trees are carefully removed in the remaining areas in accordance with Forestry Commission guidance and light thinning undertaken. These management works will improve the *"health"* of the woodland screen, long term structural stability and habitat value.

5.6 To the north, encompassing the former railway sidings, a self-regenerating woodland and scrub comprising primarily Birch and Ash species has developed. Other self-seeded species in the area include Oak, Hawthorn, Broom, Goat Willow and Gorse. This woodland comprises of a range of ages from semi mature plants now reaching approximately 8-12m height to low seedlings. Within this woodland are more open areas with a sparse sward of wildflowers in places. This interesting groundflora reflects the low nutrient conditions of parts of the railway sidings and reclaimed land.

5.7 Future management proposed to promote the self-regenerating woodland, scrub and open areas would involve following the removal required for the proposed tower and overhead line wayleave corridor, thinning the area by approximately 25% to remove Sycamore, some Ash and Birch. The aim would be to retain the establishing woodland screen, improve the appearance of the perimeter fence boundary and safeguard the open areas of interesting wildflora for biodiversity. Further south, the existing grassland will be retained as open ground by cutting every few years to stop encroachment by trees and scrub. In areas near the proposed and existing development, self seeded gorse and broom in particular shall be removed as the dead wood is a fire hazard.

5.8 In summary, existing boundary woodland providing an established screen will be retained and managed to safeguard and promote it for the future. Proposed planting will create a strong woodland framework, which takes reference from the surrounding landscape character and features, to provide screening and a setting for the proposed development. The landscape planting and management works also aim to consolidate and expand existing woodland, scrub and grassland habitats to create a variety of habitats.

Landscape Planting

5.9 The proposed landscape planting will consist of native tree and shrub species as outlined below.

Table 1.0: Indicative Landscape Planting Species

Latin Name	Common Name	%
Mixed Woodland – Feathers and Transplants @ 2m centres, single species groups of 10-15		
Alnus glutinosa	Alder	10
Betula pendula	Birch	20
Crataegus monogyna	Hawthorn	10
Fraxinus excelsior	Ash	15
Pinus sylvestris	Scots Pine	20
Quercus robur	Oak	15
Sorbus aucuparia	Rowan	10
Shrub Planting- Transplants @ 1m centres, single species groups of 10-15		
Corylus avellana	Hazel	15
Crataegus monogyna	Hawthorn	40
Ilex aquifolium	Holly	10
Prunus spinosa	Blackthorn	10
Rosa canina	Rose	10
Sambucus nigra	Elder	15

5.10 The proposed mixed woodland planting will create a multi-layered woodland with a balanced mix of native deciduous and coniferous trees of Oak, Ash[3] and Scots Pine to create year round screening. The species have been chosen to reflect the recent planting undertaken along the A876 and established woodland in the surrounding area. Alder and Birch are included as faster growing nurse species, which will help the other trees, establish. Some particular species have not been used such as Willow given its very fast growth limiting other tree species, susceptibility to windthrow and loss of branches, and the more exotic species found in the surrounding historic gardens and designed landscapes.

5.11 Shrub planting will comprise small native woodland and scrub species including Hawthorn, Blackthorn, Elder, Hazel, Holly and Rose. The objective is to create a dense cover of wind tolerant planting to be used in association with woodland planting, and where space or conditions preclude the use of the taller woodland planting, such as under overhead lines.

[3] Tree species to be confirmed at time of planting works given current ban on the movement and planting of Ash (Fraxinus excelsior)

Summary of Landscape Mitigation Measures

5.12 In summary, the landscape mitigation measures aim to reduce the landscape and visual effects of the proposed development, and present the opportunity for realising environmental benefits with the reinforcement of a key landscape feature of this area and enhancement of habitat diversity. This aim shall be realised through the integrated landscape management of the existing boundary planting and regenerating woodland, and new planting for the proposed GIS.

5.13 The Landscape Mitigation Measures will inform the Construction Environmental Management Plan (CEMP) for the Project during the construction phase, as summarised below:

- The detailed landscape proposals shall be discussed and agreed with the Local Planning Authority to meet any specific requirements for the proposed development consent.
- The detailed landscape works as approved by the Local Planning Authority shall be implemented as early as practicable and possible in the construction programme to secure early establishment.
- All landscape works shall be carried out in accordance with BS4428. All tree works shall be carried out in accordance with BS3998. Topsoil used for the works will be in accordance with BS3882. All retained trees shall be protected during the works in accordance with BS5837.
- The removal of existing landscape features such as trees and scrub to accommodate the proposed GIS and associated OHL works shall be kept to the absolute practicable minimum. All retained mature trees and vegetation shall be safeguarded and protected for the duration of the construction works.
- The external finish of proposed GIS shall be grey coloured cladding or as agreed with the Local Planning Authority. The GIS compound gravel shall be grey colour.
- Wherever possible all required earth modelling shall reflect natural slopes and contours, and be graded to marry into existing contours. All grass slopes shall be 1:4 gradient or less to allow safe maintenance. All planted slopes shall be 1:3 gradient or less.
- The proposed plant species, size and specification shall be suitable for the proposed landscape design aim and prevailing site conditions. Proposed planting shall match existing native species of the locale and shall wherever possible be of local provenance (Zone 203).
- Suitable landscape management proposals shall be prepared for the existing areas of woodland, which screen the proposed development as part of the detailed landscape proposals. This shall involve some felling and thinning to ensure the long-term viability of the woodland areas is established and secured for the future.
- The Landscape Mitigation Measures aim to increase and enhance habitat and wildlife diversity. Any specific requirements to promote biodiversity as identified by SNH, shall be reviewed by SPT and incorporated into the detailed design where appropriate.
- The drainage system shall be carefully designed adopting best practice sustainable techniques and ensure the continued functioning of the surrounding drainage network. The detailed design shall integrate with the surrounding landscape. Any specific drainage requirements, protection measures or management proposals as identified by SEPA, shall be reviewed by SPT and incorporated into the detailed design where appropriate.
- Any contaminated materials encountered during construction, shall be treated and/ or removed in a controlled and safe manner by SPT.
- Sustainable methods and best practice techniques shall be adopted wherever possible by SPT for all aspects of the proposed development works.

6.0 Statement of Significance

Summary of Effect on Landscape and Visual Amenity

Effect on Landscape

6.1 The sensitivity of the landscape features to change is considered to be low and the magnitude of change low adverse during construction, and low beneficial on completion. Overall, the significance of effect upon the immediate local landscape features is judged to be minor adverse during construction and on completion a **minor beneficial** localised effect during the operational phase. The establishment of the associated landscape planting and woodland management works will reinforce and provide new landscape features.

6.2 The sensitivity of the landscape character to change is considered to be low and the magnitude of change low beneficial during construction, and low beneficial on completion. The proposed overhead line works are considered to represent no change to the landscape character. Overall, the significance of effect upon the immediate local landscape character is considered to be minor beneficial during construction of the proposed GIS with a **minor beneficial** effect during the operational phase.

6.3 The design approach to the landscape planting framework is based on retaining existing landscape features and enhancing landscape character. As the landscape planting becomes established it is considered that the **minor beneficial** effect of the proposed development on the existing landscape character will **increase** over time.

Effect on Visual Amenity

6.4 The greatest change in the character of views and visual amenity will be restricted and localised to the immediate south, encompassing sensitive and less sensitive receptors. Views will also change to a lesser degree for sensitive receptors to the immediate east and west, and more distant, from the north, north east, south west, west and north west. For the majority this change will be of medium to low magnitude. The proposed landscape mitigation measures aim to limit the change in character of views.

6.5 The overall significance of visual effect is judged to be major/ moderate adverse during construction and **moderate adverse** and therefore significant following completion of the proposed development. The character of views and visual amenity will change over time as the associated landscape works become established, and it is considered that, during the operational phase, **moderate adverse** localised effects will **decrease** over time.

Significance

6.6 In summary, the **overall significance of landscape effects** of the proposed development is assessed as **minor adverse,** on landscape features and **minor beneficial** on the landscape character **during construction**. This effect will be temporary and localised. On completion, it is assessed that the landscape effect during the **operational** phase of the proposed new development will on balance, be **minor** beneficial and therefore not significant in terms of the adopted criteria. As the landscape planting becomes established it is considered that the operational **minor beneficial** effect will **increase** over time.

6.7 In summary, the **overall significance of visual effects** of the proposed new development is assessed as **major/ moderate** adverse**, during construction**. This effect will be temporary and localised. On completion, it is assessed that the visual effect during the **operational** phase of the proposed new development will on balance, be **moderate adverse,** and therefore significant in terms of the adopted criteria. It is considered that this operational effect will be localised and **decrease** over time as the associated landscape mitigation measures become established.

6.8 The evaluation of significance of landscape and visual effects associated with the proposed development is summarised in Table 2.0 below. Positive beneficial effects are underlined

Table 2.0 Summary of Evaluation of Landscape & Visual Effects

Landscape Receptor	Effect			Significance			
	Sensitivity	Magnitude of Change Construction	Magnitude of Change Operational	Level of Construction Effect	Level of Operational Effect	Level of Residual Effect	Rationale
Landscape Features	Low	Low	<u>Low</u>	**Minor**	**<u>Minor</u>**	**<u>Minor/ Moderate</u>**	**Construction:** Loss of few self seeded trees and scrub vegetation. Localised land raising by approximately 3.5m. Tree removal along wayleave corridor. **Operational:** Establishment of associated landscape works will extend and manage existing woodland to provide a new landscape feature creating a net benefit. During the operational phase Minor beneficial effect on landscape features will increase over time as planting becomes established.
Landscape Character	Low	<u>Low</u>	<u>Low</u>	**<u>Minor</u>**	**<u>Minor</u>**	**<u>Minor</u>**	**Construction:** Alteration of the local appearance and character of the derelict site during construction associated with proposed GIS. **Operational:** Establishment of landscape planting associated with the new development and management of existing planting will add to the landscape character. During the operational phase localised Minor beneficial effect on landscape character will increase over time as planting becomes established.

Visual Receptor	Effect			Significance			
	Sensitivity	Magnitude of Change Construction	Magnitude of Change Operational	Level of Construction Effect	Level of Operational Effect	Level of Residual Effect	Rationale
Receptors within Visual Envelope/ Viewpoints 1-12	High-Low	High/ Medium	Medium/ Low	**Major/ Moderate**	**Moderate**	**Moderate/ Minor**	**Construction:** Temporary alteration of the localised available view of the site and character during construction. **Operational:** Change in character of view and visual amenity. Establishment of associated landscape works will reduce visual effect over time. During the operational phase the Moderate adverse localised effect will decrease over time.

Residual and Cumulative Effects

6.9 In summary, the proposed development has been carefully designed in a coherent and unified manner to minimise environmental effects. The associated landscape planting and woodland management works supports this aim by providing for strategic screening and containment of the proposed development, reinforcing existing landscape features and character, whilst enhancing biodiversity.

6.10 Overall, it is considered that the residual effect of the proposed development will be that the assessed landscape beneficial effects will **increase** as the planting becomes established and the visual adverse effects will **decrease** over time.

6.11 Following a review of proposed large scale development in the Study Area it is considered that there will be no cumulative landscape and visual effects associated with the proposed development.

Guidelines for Landscape and Visual Assessment

Good practice as described in the *"Guidelines for Landscape and Visual Impact Assessment"* and summarised below, is followed *"to identify and assess the significance of the effects of change resulting from development on both the landscape as an environmental resource in its own right and on peoples views and visual amenity"* (LI, IEMA, 2013).

The first stage in undertaking an LVIA is to establish the landscape and visual conditions.

- *"For the landscape baseline, the aim is to provide an understanding of the landscape in the area that may be affected- its constituent elements, its character and the way this varies spatially, its geographic extent, its history (which may require its own specialist study), its condition, the way the landscape is experienced, and the value attached to it.*
- *For the visual baseline the aim is to establish the area in which the development may be visible, the different groups of people who may experience views of the development, the places where they will be affected and the nature of the views and visual amenity at those points."*

Establishment of baseline conditions and the key relevant landscape and visual aspects of the proposed development, allows the likely significant effects to be predicted. *"LVIA, in common with other topics in EIA, tends to rely on linking judgements about the sensitivity of the receptor and about the magnitude of the effects to arrive at conclusions about the significant of effects. These terms are effectively a shorthand way of describing the wider array of factors that underlie the **nature of the receptor likely to be affected** (sensitivity) and **the nature of the effect likely to occur** (magnitude)".*

In accordance with the LVIA Guidance each effect is considered *"in terms firstly of its **sensitivity**, made up of judgements about:*

- *The susceptibility of the receptor to the type of change arising from the specific proposal; and*
- *The value attached to the receptor;*

*And secondly its **magnitude** made up of judgements about:*

- *The size and scale of effect- for example, whether there is complete loss of a particular element of the landscape or a minor change;*
- *The geographical extent of the area that will be affected; and*
- *The duration of the effect and its reversibility."*

An assessment of the likely landscape and visual effects on the landscape as a resource in its own right and on specific views and on the general visual amenity experienced by people is then undertaken. This embraces all types of effects and includes for example those that are positive/ beneficial and negative/adverse, direct and indirect, and long and short term, as well as cumulative effects. Current guidance notes, *"Assessing the significance of landscape and visual effects is a matter of judgement".*

Mitigation measures are prepared to prevent/ avoid, reduce and where possible offset and significant landscape and visual effects identified. Enhancement measures may also be identified which are not specifically related to the mitigation of adverse landscape and visual effects, but are *"proposals that seek to improve the landscape of the site and its wider setting beyond its baseline condition".*

In summary a key requirement of a LVIA is that the basis of judgements *"is transparent and understandable, so that the underlying assumptions and reasoning can be examined by others".*

Methodology

The adopted methodology for this Landscape and Visual Impact Assessment is outlined below.

The relative ***significance of effects*** is assessed using the following terms:

Major - a fundamental change to the environment

Moderate - a material but non-fundamental change to the environment;

Minor - a detectable but non-material change to the environment.

None- no detectable change to the environment.

Landscape and Visual Baseline Survey and Analysis

Description of the site and surroundings: Collation and review of baseline information covering key features of the physical environment, planning allocation, natural and cultural heritage of the site and surroundings.

Description of the landscape and features: The character, condition and value of the landscape are determined through a combination of desk and field study. Relevant designations are identified from a review of planning policies and other designations relating to the area.

Review of the existing visibility and visual amenity: Visibility of the proposed development, visual amenity and potential visual receptors are identified for example, residential properties, public footpaths, transport routes, key viewpoints, etc. The visual baseline including extent of the visibility is determined by using a combination of fieldwork and specialist computer mapping.

Landscape and Visual Impact Assessment

Landscape and Visual effects are reviewed and identified with reference to: the identification of the ***potential sources of effect*** of the proposed development; ***sensitivity*** of the landscape and visual resources (nature of receptors): and ***magnitude of change*** to the existing landscape and visual environment *(nature of effects)*.

Landscape sensitivity is assessed with reference to the degree to which a particular landscape type or area can accommodate change arising from the proposed development, without detrimental effects on its character. The degree to which a particular landscape type or area can accommodate change arising from a particular development is considered to vary with:

- existing landuse
- the pattern and scale of the landscape;
- visual enclosure/ openness of views, and distribution of visual receptors;
- the scope for mitigation, which would be in character with the existing landscape;
- the value placed on the landscape

The ***sensitivity of visual receptors and views*** is considered to be dependent on:

- the location and context of the viewpoint;
- the expectations and occupation of the receptors;
- the importance of the view (which maybe determined with respect to its popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature and art).

For the purposes of assessment ***visual receptors*** are divided into several types, which are considered to be of differing ***sensitivity***, as follows:

Residential: Highly sensitive, as they experience prolonged often highly valued views.

Recreational: Highly sensitive, for users of recreational facilities including public rights of way, as their attention or interest may be focused on the landscape and views are often part of their recreational experience (e.g. walkers, cyclists etc). Less sensitive or moderate are people engaged in an outdoor sport or recreation.

Workers: Medium to low sensitivity, as may not receive prolonged views, and will be distracted by work.

Travellers**:** Low sensitivity, as their views are constantly changing and attention is focussed on that activity (e.g. motorists). Where travel involves scenic routes awareness of views will be high.

Magnitude of change is assessed with reference to the scale or degree of change to the landscape and visual resource, the nature of the effect and its duration.

Evaluation of Significance of Effects

An assessment of the likely effects is reviewed with reference to landscape features, character, views and visual amenity. Professional judgement and evaluation of the ***nature*** or ***magnitude of effect*** and the environmental ***sensitivity of the receptor*** *or* ***location*** allows the different thresholds of significance of effect to be determined and described using the terms **major, moderate, minor or none**.

The following Development Plans cover the proposed development site and surrounding study area, and relevant planning policy extracts have been placed below:

- Fife Structure Plan 2006-2026. Adopted 2009
- Falkirk Structure Plan
- Dunfermline and West Local Plan. Adopted 2012
- Falkirk Council Local Plan 2010
- Clackmannanshire Local Plan 2011

Fife Structure Plan 2006-2026. Adopted 2009

Policy SS1: Settlement Development Strategy

Development shall take place within settlements unless there is a justified need for a countryside location. In identifying sites for development in Local Plans, and in the assessment of other development proposals, the Council will have regards to:
The existence or anticipated availability of:

- Strategic transport network improvements.
- Community infrastructure including school provision.
- Public transport nodes and interchanges
- Access to local services.
- Water and drainage.
- Brownfield land opportunities.

And:

- The avoidance of the coalescence of settlements.
- The protection of mineral deposits from sterilisation.
- The protection of the built heritage and the historic environment.
- The protection of features of the natural environment and the conservation of biodiversity.
- The avoidance of development in areas at risk of flooding and/or coastal erosion.
- The risk of mining subsidence, gas and mine water and ground contamination.
- The contribution towards achieving both urban and rural regeneration priorities.
- The need to create a more diverse economy.
- The need for Sustainable Drainage Systems (SuDs) to address surface water run off and to contribute to sustainable development, nature conservation and enhancement.
- The need for high quality urban design and the protection and enhancement of landscapes.

Masterplans led or adopted by the council incorporating development briefs where required, will be prepared in consultation with communities specifying phasing, scale and siting of development, where stated, and will address:

- The delivery of mixed communities with a range of house types from quality affordable housing to executive housing.
- The potential to contribute to employment opportunities, community safety, and social inclusion.
- High quality design, energy efficiency, the use of sustainable building materials and the use of renewable energy sources.

Policy BL1: Rehabilitation and ReUse of Brownfield Land

Development securing the redevelopment and/ or re use of derelict or vacant land will be supported where the new use:

- Is appropriate to and compatible with the surrounding area;
- Provides environmental/ community/ economic benefits;
- Can be achieved in an environmentally acceptable and sustainable manner; and,
- Accords with other Structure and Local Plan policies.

Policy DC1: Developer Contributions- Essential Community Infrastructure

For all new development the Council will seek contributions from developers to address shortfalls in community infrastructure that mitigate adverse impacts brought about by their development. To assist in integrating land uses and transport development proposals must be supported by STAG and associated appraisals, Transport Assessments and Travel Plans where appropriate, and the necessary on and off site infrastructure. Planning conditions, legal agreements and other suitable mechanisms will be used to secure appropriate developer contributions related to the scale, impact and timing of the development.

Policy ENV 4: Nature Conservation Enhancement

Where development has the potential to impact on international, national, regional or locally importance sites, and species, applicants will be required to submit an ecological appraisal of the proposal detailing how any impact will be minimised or mitigated. Developers are required to consider the impact of their proposals on nature conservation interests and to take appropriate measures to maintain and, where possible, enhance this interest.

Policy ENV 5: Built Environment
The character, appearance and setting of designated built or cultural heritage sites will be protected from harmful development. Local plan policies will provide protection for the built and historic environments, and archaeology.

Policy ENV 7: Countryside, Recreation and Access
New development that maintains and extends strategic long distance (including the Fife Costal Path) and/ or local path networks identifies by the Core Paths Plan providing for walkers, cyclists, horse riders and those with special needs will be supported. Opportunities to link networks to other attractions will be encouraged.

Falkirk Council Structure Plan
Policy ENV 3: Nature Conservation
The protection and promotion of nature conservation interests will be an important consideration in assessing all development proposals. Accordingly:

1. Any development likely to have a significant effect on a designated or potential European Site under the Habitats or Birds Directive (Special Areas of Conservation and Special Protection Areas) or on Ramsar or Site of Special Scientific Interest (See Schedule Env3) must be subject to an appropriate assessment of the implications for the sites conservation objectives. The development will only be permitted where the appropriate assessment demonstrates that:
   a) it will not adversely affect the integrity of the site, or;
   b) there are no alternative solutions and there are no imperative reasons of overriding public interest.
2. Sites of local or regional importance including Wildlife Sites and Sites of Importance for Nature Conservation will be defined in Local Plans. The designation of sites will be based on Scottish Wildlife Trust criteria. Development likely to have an adverse impact on any such site or feature will not be granted planning permission unless it can be clearly demonstrated that there are reasons which outweigh the need to safeguard the site or feature. Until such areas are defined in Local Plans, identified or potential sites will be afforded the same protection.
3. Local Plans will identify opportunities for enhancing the natural heritage including new habitat creation, the identification of “wildlife corridors” and measures to ensure the protection of priority local habitats and species as identified in the Falkirk Local Biodiversity Action Plan.
4. The aims and objectives of the Falkirk Local Biodiversity Action Plan and any associated Species Action Plans and Habitat Action Plans will be a material consideration in assessing any development proposal likely to impact on local priority species and habitats.

Policy ENV 5: Built Environment and Heritage
Important Archaeological Sites, Scheduled Ancient Monuments, Listed Buildings, Conservation Areas, sites included in the Inventory of Historic Gardens and Designed Landscapes and trees will be protected and enhanced. Local Plans will identify these assets and incorporate policies appropriate to the significance of the area or individual feature, including the following range of measures:

1. Measures to ensure that assets are maintained in a good state of repair;
2. Promotion of appropriate new uses for buildings;
3. Promoting sensitive interpretation of natural heritage assets;
4. Protection of the assets and their setting from inappropriate development;
5. Where development would damage, or result in the loss of the asset, that provision is made for adequate recording of the current status of the asset; and
6. Reviewing the boundaries of areas to ensure their continuing relevance.

Policy ENV 6: Enhancement Action
Priority will be attached to the programme of enhancement measures (including wildlife enhancement identified in Schedule ENV 6 below). Local Plans and other programmes will include detailed proposals for the enhancement of such areas or features, including mechanisms for implementation.

Schedule ENV 6

Areas	Nature of Action.
Principal Transport Corridors including M9, M876	Landscape enhancement, screening and control over the quality of development in the corridor.

Policy ENV 7: Quality of Development

1. Priority is attached to the achievement of high standards of design in all new development. Proposals for development which would have a significant visual and physical impact on a site and its surroundings must be accompanied by a "design concept statement" incorporating the relevant factors outlined in Schedule ENV 7 which sets out how design principles have been addressed and how quality objectives will be achieved.
2. Local Plans and Supplementary Planning Guidance will provide detailed guidance on how significant impact will be assessed and the details to be included in such design concept statements.

Clackmannanshire Structure Plan
Policy SD1: Key Principles

In identifying sites for development in Local Plans and in the assessment of other development proposals, the Councils will consider the contribution of the development to the Plan's strategy of "Working Towards Sustainable Development". This assessment will be based on the following -

1. That full account has been taken of impact on the environment.
2. The Precautionary Principle will apply whenever the environmental implications of development are unclear, or inconclusive, but where there is potential for irreversible environmental damage.
3. That the potential of the development to contribute to the enhancement of the quality and distinctiveness of the built and natural environment has been addressed.
4. That in appropriate circumstances the reuse of suitable brownfield sites including derelict, disused and contaminated sites and buildings within settlements has been sought in preference to greenfield sites.
5. The potential of the development to contribute towards the enhancement of employment opportunities, social inclusion, community safety and, where relevant, urban and rural regeneration.
6. That any development which will generate or attract a large number of trips is located within, or with appropriate linkage to, Strategic Public Transport Corridors or where the need to travel will be reduced.
7. That the potential of the development to promote efficient use and re-use of resources including energy, materials, land, buildings and infrastructure has been addressed.
8. Appropriate mitigation and compensatory measures will be required from developers if a potential adverse impact on the community or the environment has been identified.
9. New development being accompanied by the appropriate infrastructure and other facilities

Policy ENV1: Nature Conservation

The protection and conservation of wildlife, wildlife habitats and other natural features will be supported as follows:

1. Development which will impact adversely upon the identified conservation interest of a designated or proposed area of international or national importance for nature conservation will not be permitted unless it is demonstrated that the objectives of designation and overall integrity of the area will not be damaged or that there is no alternative solution and there are overriding public interest imperatives.
2. Development which may affect a site of local importance for nature conservation (including non designated sites, and habitats and features listed in Annex 1 of the EU Habitats Directive) will only be permitted if it can be demonstrated that it will have no significant adverse impact on the conservation interest of the site, habitat or feature.
3. All development proposals will be considered in the light of the recommendations and findings Local Biodiversity Action Plans (and related Habitat Action Plans and Species Action Plans). Where there is, in the planning authority's opinion, a potential adverse effect upon local biodiversity, an ecological appraisal of the development will be sought and considered before the proposal is determined.

Where opportunities are available a development proposal which is supported under the terms of 1 - 3 above will be required to provide a net environmental benefit through enhancement of the nature conservation interest. By agreement this may be at off-site locations.

Policy ENV5 - Environmental Enhancement

The Councils will seek to secure environmental enhancement including where appropriate the remediation of contaminated land through new development. Particular attention will be given to enabling enhancement of environmental features (including Green Belts, built heritage, rivers, lochs, the Forth Estuary, trees and woodland); transport corridors; areas of environmental degradation; and other areas and features identified within Local Plans and LBAPs. Developer funding for, or contributions towards provision, may be sought to secure appropriate remedial or compensatory environmental action in accordance with SDD Circular 12/1996.

Proposal ENV3 - Countryside Access and Management

The Councils will work in partnership with land owners/managers and appropriate agencies to promote countryside management in the interests of safeguarding and improving public access, and the enhancement and interpretation of landscape and habitats.

Policy ENV6 - The Historic and Built Environment

The Councils will seek to ensure that cultural heritage resources are recognized, recorded, protected and enhanced as appropriate, and that new development respects and contributes to the character and quality of the area. More particularly:

1. All development within or likely to affect a Conservation Area should preserve or enhance the special character or appearance of the Area. Proposals which will detract from this character including the unjustified demolition of buildings which contribute to the character or appearance of Conservation Areas will not be permitted.
2. There will be a strong presumption against demolition of protected buildings of character and against development or works which would adversely affect the special architectural or historic interest of a Listed building or it's setting. New uses of such buildings which protect or enhance their character or setting will be supported.
3. Development which would destroy or adversely affect Scheduled Ancient Monuments, or other important archaeological sites or landscapes and their settings will not be permitted. In exceptional cases where developments may be approved which affect the heritage resource, developer funding will be legally tied to securing the appropriate level of advance investigation, excavation, recording and publication.
4. Development which would have a significant adverse affect upon the landscape features, character and setting of sites identified for inclusion in the inventory of Historic Gardens and Designed Landscapes will not be permitted.

New development will be required to address its physical and visual integration with, and opportunities for enhancement of, the established environment of the surrounding area.

Dunfermline and West Local Plan. Adopted 2012
Kincardine Settlement Plan

"The new Clackmannanshire Bridge and road network have reduced the impact of through traffic on Kincardine. This together with the reintroduction of the rail link to Dunfermline and Alloa and beyond provides the catalyst to expand Kincardine and draw upon the benefits of its increased accessibility. The town also benefits from regular public transport, being on the express bus network between Glasgow, Dunfermline, Kirkcaldy and St Andrews. The demolition of the multi storey flats will improve the appearance of the towns skyline and redevelopment of the site will replace a significant number of the existing dwellings.

Population: 2,807.

The planning issues to be addressed in this Local Plan are:

- Co-ordinating the release of housing and employment land.
- Developing new housing in place of the multi story flats.
- Realising opportunities for clean coal electricity generation by safeguarding the former Kincardine Power Station site whilst recognising opportunities for interim uses.
- Improving the quality of the built environment.
- Delineating a local neighbourhood shopping area to support retail and local service provision.

Proposal KCD007

45 Ha

Protected Employment Area. This site is a Local Plan allocation for long term Specialist Industry (Energy). The Council will work with the landowner to consider future redevelopment options for this site to be based on appropriate environmental, technical and land use assessments of the full site of the former Power Station. The outcome of these assessments will be considered for inclusion in the future local development plan (LDP). A Flood Risk Assessment requires to be undertaken prior to development on this site.

Policy D1: Developer Contributions

For all new development the Council will seek appropriate contributions from developers to ensure adequate infrastructure provision and to mitigate for any adverse environmental impact brought about by a proposed development. Where relevant, contributions will also be sought to assist with town centre regeneration consistent with the Local Plan strategy. Planning conditions and legal agreements will be informed by a clear methodology to secure appropriate developer contributions related to the impact of each development.

Each Local Plan will include a financial framework, which apportions the total cost of infrastructure and services across development (s), and takes into account the locational and cumulative pressures of each. The financial framework will help to illustrate developer requirements within the Local Plan area consistent with statements of national policy as set out in Circular 1/2012, and will be reviewed as part of the Local Plan Action programme. Developer requirements and contributions will take into account of exceptional costs arising from specific developments, for example in respect of urban regeneration and affordable housing.

The Council will seek either the direct provision of requirements by developers or contributions towards their cost (in whole or part) if these are to be provided by others, including the Council.

Policy E1: Development outwith Town and Village Envelopes
Outwith the settlement limits as defined by towns and village envelopes shown of the Proposals Map, development will only be permitted where it is in accordance with Policies E15- E29.

Policy E3: Development Quality- Environmental Impact
New development must make a positive contribution to the quality of its immediate environment both in terms of its environmental impact and the quality of the place it will create. This will be achieved through the application of the following principles, which the Council will take into account in assessing planning applications. New development is required to:
a) secure the most practicable energy efficient benefits by the use of layout, siting, orientation, building design features, and other energy efficient measures;
b) demonstrate a commitment to landscape protection and improvement taking into account linkages to existing landscape features and the need to provide biodiversity enhancement;
c) include measures to promote, enhance, and add to biodiversity;
d) address foul and surface water drainage issues;
e) include water and energy conservation measures;
f) incorporate appropriate water recycling, segregation, and collection facilities; and
g) minimise waste by design and during construction.
Developers will also be required to have regard to relevant supplementary planning guidance produced in this regard.

Policy E4: Development Quality- Design
New development must make a positive contribution to its immediate environment in terms of the quality of the development. This will be achieved through the application of the following principles, which the Council will take into account in assessing planning applications. New development is required to:
a) demonstrate well thought out design, and high standards of architecture in terms of form, scale, layout, detailing, and choice of materials.
b) make best use of site attributes- particularly landform, trees and woodland, and built and natural heritage features;
c) provide open space which should include individual areas for equipped play, sport, and general recreation appropriate to the scale and nature of the development and secure the long term maintenance of public and common areas;
d) provide safe and convenient access for pedestrians, cyclists and people with disabilities or impaired mobility, including safe routes to schools, links to the core path network and for sustainable modes of transport;
e) protect personal privacy and amenity: and
f) enhance community safety.
The application of innovative design solutions will be supported. To raise and maintain design standards throughout Fife, all development proposals must comply with the principles as described in the Fife Urban Deign Guide.

For larger, prominent or sensitive sites, Fife Council will prepare development briefs and masterplans. Developers may also be required to prepare development briefs, masterplans, or design statements and these will be subject to agreement or approval of the Council and must comply with the Fife Masterplans Handbook. Subsequent development will require to conform to the approved guidance.

Policy E6: Contaminated and Potentially Unstable Land
Where development proposals involve sites where land instability or the presence of contamination is suspected, the developer will be required to submit details of a site investigation to assess the nature and extent of any risks presented by land instability or contamination which may be present. Where development proposals involve sites where land instability of contamination is known to be present, the developer will be required to notify Fife Council of the appropriate remediation measures proposed to render the site fit for its intended use. Where possible remediation strategies must be agreed by Fife Council, in conjunction with the Scottish Environment Protection Agency and the Coal Authority where appropriate, prior to the determination of any planning application.

Policy E7: Conservation Areas
Development and development within a Conservation Area, or affecting its setting shall preserve or enhance its character and be consistent with any relevant Conservation Area appraisal or management plan that may have been prepared for the area.

The design, materials, scale and siting of any development shall be appropriate to the character of the Conservation Area and it's setting. Trees that are considered by the planning authority to have amenity value shall be preserved. Given the importance of assessing design matters, outline planning applications will not normally be considered appropriate for developments in Conservation Areas.

Where an existing building, listed or not, contributes positively to the character of the Conservation Area, Policy E9 on demolition shall apply. Where it does not, proposals for demolition will not be considered in the absence of a detailed planning application for a replacement development that enhances or preserves that character. Demolition will not begin until evidence is given of contacts let for the approved development.

Policy E8: Listed Buildings
Development affecting a listed building, or its setting, shall preserve the building, or its setting, or any features of special architectural or historic interest which it possesses. The layout, deign, materials, scale, siting and use of any development shall be appropriate to the character and appearance of the listed building and its setting.

Policy E11: Historic Gardens and Designed Landscapes
Development affecting Historic Gardens and Designed Landscapes shall protect, preserve, and enhance such places and shall not impact adversely up their character, upon important views to, from or within them, or upon the site or setting of component features which contribute to their value.

Policy E12: Ancient Monuments and Archaeological Sites
Scheduled Ancient Monuments and other identified nationally important archaeological resources shall be preserved in situ, and with an appropriate setting. Developments that have an adverse effect on scheduled monuments or the integrity of their setting shall not be permitted unless there are exceptional circumstances.

All other archaeological resources shall be preserved in situ wherever feasible. The significance of any impacts on archaeological resources and their setting will be weighed against other merits of the development proposals in the determination of planning applications.

The developer may be requested to supply a report of an archaeological evaluation prior to determination of the planning application. Where the case for preservation does not prevail, the developer shall be required to make appropriate and satisfactory provisions for archaeological excavation, recording, analysis, and publication in advance of development.

Where compatible with their preservation, proposals for the enhancement, promotion and interpretation of ancient monuments and archaeological sites will be supported.

Policy E23: Protection of Biodiversity
Development that may affect national and local priory habitats or species, as identified in the Scottish Biodiversity List or Fife Local Biodiversity Action Plan, will not be permitted unless the developer submits an appraisal showing that:

a) there will be no adverse affect on the habitats or species; or
b) any significant adverse affect on the habitats or species is clearly out weighed by social or economic benefits of significant local importance.

Where development adversely affects the habitats or species, the developer's appraisal must show:

- how the damage will be minimised and mitigated, including, where appropriate, replacement habitat for any losses incurred; and
- proposals for the conservation, protection, enhancement and future management of habitats and species (biodiversity). These must ensure that there is net benefit to biodiversity within the development site and also in habitat linkages to the site as appropriate. Particular regard should be given to priority habitats and species of conservation consent identified within the Fife Local Biodiversity Action Plan.

Where appropriate, planning conditions and agreements will be used to ensure these proposals are achieved.

All development should contribute to overall environmental enhancement by taking into account benefits to biodiversity (see Policy E3 Development Quality- Environmental Impact).

Policy E25: Trees on Development Sites
Where development is proposed on a site where trees are present, consideration will be given to whether and in what form, development should be supported, having regard to the desirability of retaining and protecting mature and semi- mature trees, and other examples likely to become attractive in amenity terms, or of a rare species. Trees, woodland, and hedgerows that have a landscape, amenity and/ or nature conservation value will be protected from development.

When submitting a proposal for development for a site where trees are present, the developer shall be required to:

a) submit a comprehensive tree survey;
b) identify on site any affected trees; and
c) submit for agreement a programme of works, details of tree protection and landscaping proposals, including any appropriate tree planting.

Policy E26: New Tree Planting
New on site tree planting will be sought as an integral part of the development. Planning agreements will be used to achieve off site or other additional tree planting and partnerships encouraged to secure tree planting and sustainable woodlands.

Policy C4: Open Space and Urban Park
Existing or proposed open spaces which are identified on the Proposals Map, or others which serve a valuable amenity, wildlife, or recreational purposes, will be protected from development

Policy C8: Footpaths/Cycleways/Bridle ways
Existing rights of way and established footpaths, cycle ways, and bridleways will be safeguarded and kept open and free from obstruction. Where development affecting such routes is deemed appropriate, suitable re- routing must be provided before the development commences, or before the existing route is removed from use. The Council will seek to maintain and extend the network, where appropriate, formalise use including walkers, cyclists, horse riders and paths accessible to people of all abilities, by establishing Core Path Network, and will support new development that contributes to this end.

Falkirk Council Local Plan 2010
Policy EQ 12 Conservation Areas
The Council will protect the historic character and visual amenity of each Conservation Area. Accordingly:
1. The Council will prepare Character Appraisals of individual Conservation Areas and, on the basis of these, will review existing boundaries and Article 4 directions, prepare detailed design guidance as appropriate, and draw up enhancement schemes as resources permit;
2. New development in Conservation Areas, or affecting their setting, including extensions and alterations to existing buildings, will only be permitted where it preserves or enhances the character of the area, with particular reference to the historic pattern and density of development; its setting; the architectural style, massing and materials of buildings; landscape treatments; and boundary features;
3. Demolition of buildings within Conservation Ares will not be permitted unless they make no material contribution to the character and appearance of the area. Where demolition is proposed, the considerations set out in the relevant Historic Guidance note should be adhered to; and
4. Replacement windows, doors, roofs, rainwater goods, boundary treatments and other features on unlisted buildings in Conservation Areas should preserve or enhance the character of the Conservation Area in terms of appearance, detailing and materials.

Policy EQ 14:Listed Buildings
The Council will seek to preserve the character and appearance of Listed Buildings. Accordingly:
1. Development affecting a Listed Building, or its setting, shall preserve the building or its setting, or any features of special architectural or historic interest which it possesses. The layout, design, materials, scale, siting and use of any development shall be appropriate to the character and appearance of the listed building and it's setting.
2. Proposals for the total or substantial demolition of a listed building will only be supported where it is demonstrated beyond reasonable doubt that every effort has been exerted by all concerned to find practical ways of keeping it. This will be demonstrated by inclusion of evidence to the Council that the building:
   - has been actively marketed at a reasonable price and for a period reflecting its location, condition and possible viable uses without finding a purchaser; and
   - is incapable of physical repair and reuse through the submission and verification of a thorough structural condition report; and
3. RCHMS shall be formally notified of all proposals to demolish listed buildings to enable features to be recorded.

Policy EQ 16 Sites of Archaeological Interest
1. Scheduled ancient monuments and other identified nationally important archaeological resources shall be preserved in situ, and within an appropriate setting. Developments which have an adverse effect on scheduled monuments or the integrity of their setting shall not be permitted unless there are exceptional circumstances;
2. All other archaeological resources shall be preserved in situ wherever feasible. The council will weigh the significance of any impacts on archaeological resources and their settings against other merits of the development proposals in the determination of planning applications; and
3. Developers may be requested to supply a report of an archaeological evaluation prior to the determination of a planning application. Where the case for preservation does not prevail, the developer shall be required to make appropriate and satisfactory provision for archaeological excavation, recording, analysis and publication, in advance of development.

Policy EQ18: Historic Gardens and Designed Landscapes
There will be a general presumption against development which would adversely affect the character or setting of sites identified in the "Inventory of Gardens and Designed Landscapes in Scotland" and other historic gardens and landscape of

national, regional or local significance. The Council will seek to encourage sensitive management of historic gardens and designed landscapes.

Policy EQ 22: Landscape and Visual Assessment
Development proposals which are likely to have a significant landscape impact must be accompanied by a comprehensive landscape and visual assessment as part of the Design Statement, which demonstrates that the setting is capable of absorbing the development, in conjunction with suitable landscape mitigation measures, and that best environmental fit has been achieved, in terms of the landscape character of the area.

Policy EQ28: Coastal Zone
The council will promote an integrated approach to the management of the coastal zone and will support the provisions of the Forth Integrated Management Strategy. Development and other land management proposals within the coastal zone will be assessed in terms of:

1. Impacts on the amenity, ecology and water quality of the coastal environment (see Policies EQ24 and EQ25);
2. The requirement to safeguard the undeveloped coast, as defined on the proposals map, from further development unless it is proven that the development is essential, a coastal location is essential, and no suitable sites exist within the developed coast;
3. Long term flooding risk (see Policy ST12), and compatibility with existing coastal defence strategies, including the desirability of working with natural coastal processes where possible and the need to recognise the wider impacts where intervention is unavoidable; and
4. Appropriate promotion of the recreational potential of the coastal zone, including the development of the Forth Foreshore Path and linked coastal access networks, providing it is compatible with Policy EQ24 and the protection of coastal habitats and species.

Clackmannanshire Local Plan 2011
Policy EN6 - Listed Buildings
When determining applications for listed building consent or planning applications that affect a listed building or its setting, the Council will seek to ensure preservation of the building, its setting, or any features of architectural or historic interest. Approval will normally be granted for uses that would secure a viable future for a listed building, provided that any alterations are sympathetic to the character of the building and it’s setting.

Policy EN7 - Archaeological or Historic Sites
Development will not be permitted where it could destroy or adversely affect a Scheduled Ancient Monument or other important archaeological or historic sites or their setting unless it can be demonstrated that:

- there is a significant public interest to be gained from the proposed development that outweighs the archaeological importance of the site; In the case of scheduled monuments the significance of the development must be of a national order to outweigh the national importance which attaches to their preservation; and
- there is no appropriate alternative location for the proposal; and
- the proposal has been sited and designed to minimise damage to the archaeological resource.

Policy EN9 - Nationally Important Gardens and Designed Landscapes
Any development which would adversely affect a Garden or Designed Landscape identified in the Inventory, or included in any extension to it, will not normally be permitted. In addition:

- Proposals should be accompanied by a landscape appraisal by a qualified landscape architect which includes sufficient detail to allow the full extent, impact and quality of the proposals to be examined;
- Planning conditions and agreements may be used to achieve repair, restoration and management of the planned landscape as part of the proposals.

Policy EN10 - Conservation Areas

- New development must contribute to the protection and enhancement of the architectural and historic character of Conservation Areas.
- Development Control decisions shall be based on the Conservation Area Character Appraisal Supplementary Advice Notes.
- There is a presumption against the demolition of buildings within Conservation Areas where this would harm the special character of the area and the Council will encourage the positive reuse of redundant or vacant buildings within Conservation Areas.
- Parking, lighting and traffic management proposals in Conservation Areas will be assessed in terms of the need to ensure the preservation and enhancement of the area’s character.

Policy EN11 - Enhancing Environmental Quality

New development will be expected to positively contribute to its immediate environment by:

- Achieving a high quality of architectural design and integrating well with the built form and landscape character of its immediate surroundings
- Ensuring that the form, scale, layout and materials reflect and, where possible, enhance the character of the surrounding area.
- Protecting and enhancing the landscape, woodland, habitat, pond and watercourse resources within and around the site
- Ensuring the protection and enhancement of local amenity through the provision of high quality landscaping, planting and boundary treatments.
- Sensitive siting of soft and hard landscaping features of suitable specification for amenity and to provide shelter belts. The provision of landscaping to be in accord with SAN 12 (*Open Space and Landscaping*) in the case of housing developments.
- Assessing proposals for new developments to ensure that they provide a high level of safety and security for pedestrians where necessary, including protection of existing accesses within and around the site, in accordance with PAN 46 (Planning for Crime Prevention) and the Secured by Design initiative.

Fife Landscape Character Assessment

Key Characteristics and Features
C15 Coastal Flats (CF110 Kincardine)

- Flat, low lying, open, large scale, exposed coastal landscape at sea level;
- Intensively cultivated, geometrically laid out, large to medium scale, predominantly arable fields or forestry plantations with rectilinear, fenced enclosures or without enclosure;
- A variety of other land uses, particularly industrial and other built developments, golf courses and other grasslands;
- The slightly sinuous or angular roads raised above the fields with dry stone dykes or open sides;
- Isolated, scattered or regularly spaced farmsteads, conspicuous due to the lack of screening, in contrast to designed landscapes which are well screened by policy planting and shelterbelts;
- Straight ditches, sea walls and flood banks with small bridges;
- Several point features of interest that are conspicuous in the flat landscape;
- A coastal landscape where the character is always influenced by the sea and can be particularly affected by the weather conditions and views of the sky and the sea;
- The wide range of landscape experiences depending on the particular landscape unit and the weather conditions; typically dominated either by the areas of development or the coast;
- Away from the urban areas and forestry plantations it is a large- scale, open (and in high winds very exposed), simple, flat, balanced landscape with varied textures and colours and slow movement; in the plantations it is a small scale, confined, uniform, tended, very calm and sheltered landscape with straight lines, simple patterns and little variation in colours or textures;
- Seaward views are invariably extensive and maybe extensive across the Flats themselves;
- Landward, views are generally towards the Cliffs, Braes, Coastal Hills or Coastal Terraces.

Landscape Guidelines Extract for Coastal Flats LCT
Forestry
The areas have a high capacity for accommodating woodland and linear tree belts that would help to screen some of the intrusive features, relieve the uniformity and horizontal nature of the area but need not necessarily obstruct important views from the roads to the Firths of the bridges.

Woodland is certainly not characteristic of the area but this is often a man made land and landscape. Where raised beaches have created natural coastal flats they would naturally have become wooded with wetlands in the lower areas and depressions.

New planting should accord with the Forestry Authority design guidelines and may comprise coniferous, mixed or broadleaved species although single species compositions should be avoided. Where plantations are coniferous or mixed, the design of the edges is particularly important and broadleaved species can help to soften the boundaries.

Other developments and Structures in the Landscape
Low level, linear features would be appropriate but higher linear features would either add to the clutter of existing overhead lines or create new and in appropriate features in those parts that do not have them at present. Any structures likely to have a significant effect on the landscape or views should be subject to rigorous landscape and visual impact assessment in accordance with Section E.3.

Ensure any new road or other major engineering works are carefully sited and designed to minimise their landscape and visual impact. Any works likely to have a significant effect on the landscape or views should be subject to rigorous landscape and visual impact assessment in accordance with Section E.3.

General Recommendations
Section E.2 contains a series of general recommendations for Fife as a whole. The following recommendations are particularly relevant to the Coastal Flats Landscape Type.
E.2.1 Preparation of a historic landscape study.
E.2.4 Integration with coastal zone management plans and shoreline management plans.
E.2.5 Preparation of a countryside recreation and access strategy.
E.2.8 Preparation of a landscape strategy for St Andrews.
E.2.10 Development control overview.
E.2.11 An overview of mineral workings in relation to landscape capacity and the possible identification of Areas of Search for mineral working.
E.2.12 The preparation of landscape plans for settlements.

C17 Other Intertidal Shores

- A natural landscape dominated by the sea and the tidal cycle;
- At low tide the low lying, dull brown or brown – grey sheets of the mudflats with the meandering outwash channels;
- The rougher texture, more colourful shingle bays and rocky shores with their deep striations;
- The lighter colour and smooth, even slope to the sea of the sandy beaches with their groynes and other structures;
- The landform, colours, textures and patterns of sand/ mud and water of the estuaries;
- The large- scale, flat, open or exposed, uniform or simple landscapes with smooth textures, sinuous lines and muted colours;
- The solitude dominated by natural noises and the naturalness of the areas, with sometimes huge flocks of birds or perhaps just occasional waders or gulls flying or scurrying across mud or shingle;
- The ever changing line of the waters edge and the sound and movement of the waves;
- The generally natural landscape occasionally punctuated by small moored craft, artefacts of navigation and small harbours;
- The wide range of landscape experiences depending on the weather conditions and the local permutations of mud, sand, shingle and rock, estuary or harbour;
- Typically, it is a large scale, open (and in high winds very exposed), simple, flat, harmonious, natural, landscape with sinuous lines, random patterns, varied textures and colours and slow movement, and dominated by the sight, sound and smell of the sea.
- Views are invariably extensive in the seaward direction and to landward are generally towards the Cliffs, Braes, Coastal Hills or Coastal Terraces.

C18 Firth of Forth

- A very large scale, flat, horizontal and natural landscape dominated by the weather conditions and the colour of the sea and sky and the movement of waves;
- The many small off shore islands;
- The navigation and shipping artefacts of the water;
- The frequent but very slow movements of vessels of a variety of types;
- A maritime landscape where the character is always influenced by the sea and can be particularly affected by the weather conditions and views of the sky and the sea;
- The effect of lights reflecting on the Firths at night;
- The Tay road and Railway bridges, and the Kincardine, Forth Rail and Forth Road Bridges;
- Often a calm, bright, colourful and smooth, exposed landscape with extensive views.

Central Region LCA Stirling to Grangemouth LCA

C3 Lowland River Valley (Carse of Forth East of Stirling)
Key characteristics and Features

- Flat, open, large scale carselands forming the floor and former floodplain of the River Forth and its tributaries, bounded by sharply rising hills and escarpment which contrast with the valleys;
- Predominantly arable cultivation with some permanent pasture in a chequerboard pattern of large scale fields bounded mainly be post and wire fences and occasionally small, heavily pollarded and gappy hedgerows; typically without woodlands and with few trees;
- Widely spaced, traditional stone or whitewashed farmsteads along the straight lines of several minor roads;
- The parallel routes of trunk roads running along the perimeters of the valley floor;
- Absence of villages (except mining village of Fallin) which are otherwise restricted to the peripheral slopes on the edges of the carselands; east of Stirling, extensive bonded warehousing, frequent large and small scale industrial development, mineral extraction and waste disposal together with navigational and other infrastructure associated with the Forth; several steadings with other businesses often related to transport;
- Generally, the carselands are a large scale, open, simple, horizontal, planned and well organised, relatively modern landscape with varied textures and colours; it is generally well tended but, especially east of Stirling, it is locally disturbed and busy with many discordant features;
- In the Avon valley there is is a narrow, deep, gorge like, well wooded, intimately enclosed valley with steeply sloping pastures and semi- natural woodlands and a few, traditional small steadings; some mineral extraction, waste disposal and derelict land;
- From Denny to Falkirk and Polmont an extensive area of urban development and urbanised, degraded landscape on the edge of the carselands.

Landscape Guidelines Extract for Carse of Forth East of Stirling LCT
Strategic Aim
Protect the views and setting of Stirling, the castle, the Wallace Monument and other historic and natural features, retain predominantly rural character, restore character of the carselands and remedy impact of discordant features.

Guidelines

- Ensure any new proposals for high voltage overhead lines, pipelines, waste disposal proposals, roads, industrial or commercial developments are subject to landscape and visual impact assessment in accordance with good practice guidelines, including examination of alternative routes or sites, and are well designed and utilise opportunities to restore and enhance landscape character;
- Ensure any major new flood prevention or other engineering or infrastructure operations are subject to landscape and visual impact assessment and well designed to blend with and enhance carseland landscape character and features;
- Accentuate line of River Forth by sensitive bank side planting

C4 Coastal Margins (Grangemouth- Bo'ness Flats)
Key characteristics and Features

- Low lying coastal flats dominated by the town of Grangemouth, the docks and very large scale petrochemical and other industrial installations;
- Extensive, intertidal, estuarine mudflats and lagoon on the Firth of Forth of international importance for wintering and migratory waterfowl;
- Distinct urban edge to Grangemouth formed by the River Carron;
- Extensive, open, low lying, flat, horizontal, coastal flats landscape of arable farmland with large scale rectilinear fields with few hedges and several steadings linked by minor roads;
- At Kinneil/ Bo'ness reclaimed carse with intensive horticulture and no field boundaries dominated by landraising operations and petrochemical works.

Landscape Guidelines Extract for Grangemouth- Bo'ness LCT
Strategic Aim
Reduce impacts of major industrial developments with structural planting, retain remaining open character and sustain ecological and landscape values of the mudflats.

Guidelines

- Encourage new planting proposals, in accordance with Forestry Commission/ Authority guidelines, particularly in the form of linear broadleaved shelterbelts, screen planting for urban and industrial developments, at the entrance to settlements and as avenues along principal roads;
- Ensure any new proposals for high voltage overhead lines, pipelines, waste disposal proposals, roads, industrial or commercial developments are subject to landscape and visual impact assessment in accordance with good practice guidelines, including examination of alternative routes or sites, and are well designed and utilise opportunities to restore and enhance landscape character and features.

Appendix 4: Viewpoint Photograph Technical Information

Taken in accordance with best LVIA practice and in particular Landscape Institute Advice Note 01/11 (March 2011).

No	Viewpoint Photograph Locations
1	**A977**- Layby, Major Road
2	**Minor Road (Access Road to Kincardine Substation)**- Public Footpath, west of Tulliallan Garden and Designed Landscape
3*	**Kincardine Park**- Recreation Area, adjacent Conservation Area, Listed Building, School and Settlement
4	**Kincardine Settlement**- Recreation Area, south of Tulliallan Garden and Designed Landscape, North Edge of Settlement.
5	**Kincardine Pier**- Conservation Area, Public Footpath, South Edge of Settlement.
6*	**Kincardine on Forth Bridge A985**- Listed Building (Cat A), Public Footpath, Cycleway, Major Road, Firth of Forth SPA, Wetland of International Importance, SSSI
7*	**Clackmannanshire Bridge A876**- Public Footpath, Cycleway, Major Road
8	**Airth**- Listed Building, Conservation Area, Edge of Settlement
9	**Dunmore Park**- Garden and Designed Landscape, Listed Buildings, Public Footpath, Visitor Attraction
10	**Kennet Pans** – Scheduled Ancient Monument, Listed Buildings (Cat C), Public Footpath, Firth of Forth SPA, Wetland of International Importance, SSSI**,** Local Wildlife Site, Visitor Attraction
11	**Clackmannan Tower**- Listed Building (Cat A), Conservation Area, Public Footpath, Visitor Attraction, Edge of Settlement.
12*	**Minor Road (Overbridge A876**)- Public Footpath, Cycleway, Regional Cycleway, Minor Road

* Photomontage Location

Lamont Associates Viewpoint Record Sheet

Project
Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	1
Viewpoint name	A977 Major Road Layby
NGR	NS93112 89743
Elevation + tripod Height	20m + 1.55m
Distance from objective	1500m
Date	4/09/13
Time	9.23 BST
Meteorological conditions	Bright with thin C_L 8 8/8 cover
Filters used	Skylight
File Numbers	9853 - 9874

Exposure + Bearing°
All compass bearings corrected to Grid (Variation -3°)

1/100 sec, f 8	175°	191°	207°	223°	239°
	255°	271°	297°	313°	329°
	345°	001°	017°	033°	049°
	065°	081°	097°	113°	129°
	145°	161°			

Clinometer Angle (°) 0°

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 400

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	2
Viewpoint name	A977 Minor Road Access to Kincardine Substation
NGR	NS 92951 88364
Elevation + tripod Height	8m + 1.55m
Distance from objective	750m
Date	4/09/13
Time	10.00 BST
Meteorological conditions	Bright with thin C_L8 8/8 cover
Filters used	Skylight
File Numbers	9877 - 9898

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/60 sec / f 8	222º	238º	254º	270º	286º
	302º	218º	234º	350º	006º
	012º	038º	054º	070º	086º
	102º	018º	034º	150º	166º
	182º	198º			

Clinometer Angle (°)

0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 400

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	3
Viewpoint name	Kincardine Park
NGR	NS 93171 87899
Elevation + tripod Height	8m + 1.55m
Distance from objective	1000m
Date	4/09/13
Time	10.23 BST
Meteorological conditions	Bright with thin C_L 8 8/8 cover
Filters used	Skylight
File Numbers	9901 - 9922

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/60 sec / f 8	231º	247º	263º	279º	295º
	311º	327º	343º	359º	015º
	031º	047º	063º	079º	095º
	111º	127º	143º	159º	175º
	191º	207º			

Clinometer Angle (°)

0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	4
Viewpoint name	Dewar Avenue, Kincardine
NGR	NS 93466 87817
Elevation + tripod Height	26m + 1.55m
Distance from objective	1400m
Date	4/09/13
Time	10.53 BST
Meteorological conditions	Bright with thin C_L8 8/8 cover clearing to C_L1 4/8 from SW
Filters used	Skylight
File Numbers	9925 - 9947

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/60 sec, f 8	213º	229º	245º	261º	277º
	293º	309º	325º	341º	357º
	013º	039º	055º	071º	087º
	103º	119º	135º	151º	167º
	183º	199º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	5
Viewpoint name	Kincardine Pier
NGR	NS 92740 87522
Elevation + tripod Height	3m + 1.55m
Distance from objective	1200m
Date	4/09/13
Time	11.17 BST
Meteorological conditions	Bright with thin C_L8 8/8 cover clearing to C_L1 4/8 from SW
Filters used	Skylight
File Numbers	9949 - 9970

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/60 sec, f 8	241º	257º	273º	289º	305º
	321º	337º	353º	009º	025º
	041º	057º	073º	089º	105º
	121º	137º	153º	169º	185º
	201º	217º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project	Kincardine GIS Substation, Scottish Power Energy Networks
Viewpoint number	6
Viewpoint name	Kincardine on Forth Bridge
NGR	NS 92049 84907
Elevation + tripod Height	4m + 1.55m
Distance from objective	1300m
Date	4/09/13
Time	12.18 BST
Meteorological conditions	E - Bright with thin C_L8 8/8 cover, clearing to C_L1 4/8 from SW
Filters used	Skylight
File Numbers	9973 - 9995

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/100 sec / f 11	277º	293º	309º	325º	341º
	357º	013º	029º	045º	061º
	077º	093º	109º	125º	141º
	157º	173º	189º	205º	221º
	237º	253º			

Clinometer Angle (°)	0º
Additional Notes/Sketches (and over)	Camera: Canon 50D Lens: Canon EF 35-350mm L Series @35mm ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	7
Viewpoint name	Clackmannanshire Bridge
NGR	NS 92023 88122
Elevation + tripod Height	8m + 1.55m
Distance from objective	450m
Date	4/09/13
Time	15.42 BST
Meteorological conditions	C_L 8 2/8
Filters used	Skylight
File Numbers	0119 - 0141

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/00 sec / f 16	133º	149º	165º	181º	197º
	213º	229º	245º	261º	277º
	293º	309º	325º	341º	357º
	013º	029º	045º	061º	077º
	093º	109º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	8
Viewpoint name	Airth Church
NGR	NS 89729 87651
Elevation + tripod Height	20m + 1.55m
Distance from objective	2700m
Date	4/09/13
Time	12.18 BST
Meteorological conditions	Bright with thin C_L8 8/8 cover
Filters used	Skylight
File Numbers	0024 - 0045

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/100 sec / f 13	184º	200º	216º	232º	248º
	264	280º	296º	312º	328º
	344º	000º	016º	032º	048º
	064º	080º	096º	112º	128º
	144º	160º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	9
Viewpoint name	A905 layby, The Parsonage, Dunmore Park
NGR	NS 89729 87651
Elevation + tripod Height	5m + 1.55m
Distance from objective	2800m
Date	4/09/13
Time	12.00 BST
Meteorological conditions	C_L 8 7/8
Filters used	Skylight
File Numbers	9997-9999 + 0001 - 0019

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

sec / f					
1/100 sec, f 11	352º	008º	024º	040º	056º
	072º	088º	104º	120º	136º
	152º	168º	184º	200º	216º
	232º	248º	264º	280º	296º
	312º	328º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	10
Viewpoint name	Kennet Pans
NGR	NS 9140188957
Elevation + tripod Height	4m + 1.75m
Distance from objective	1100m
Date	4/09/13
Time	15.06 BST
Meteorological conditions	C_L1 1/8
Filters used	Skylight
File Numbers	0072 - 0094

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/100 sec / f 18	050º	066º	082º	098º	114º
	130º	146º	162º	178º	194º
	210º	226º	242º	258º	274º
	290º	316º	332º	348º	004º
	020º	036º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project

Kincardine GIS Substation, Scottish Power Energy Networks

Viewpoint number	11
Viewpoint name	Clackmannan Tower
NGR	NS 90678 91966
Elevation + tripod Height	57m + 1.55m
Distance from objective	3800m
Date	4/09/13
Time	14.47 BST
Meteorological conditions	C_L1 1/8
Filters used	Skylight
File Numbers	0048 - 0070

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

sec / f					
1/100 / 18	086º	102º	118º	134º	150º
	166º	182º	188º	204º	220º
	236º	252º	268º	284º	300º
	316º	332º	348º	004º	020º
	036º	052º			

Clinometer Angle (°) 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Lamont Associates Viewpoint Record Sheet

Project	Kincardine GIS Substation, Scottish Power Energy Networks
Viewpoint number	12
Viewpoint name	Overbridge A876 Cycleway
NGR	NS 92065 89054
Elevation + tripod Height	9m + 1.55m
Distance from objective	600m
Date	4/09/13
Time	15.28 BST
Meteorological conditions	C_L1 1/8
Filters used	Skylight
File Numbers	0095 - 0117

Exposure + Bearingº
All compass bearings corrected to Grid (Variation -3º)

1/00 sec / f 14	083º	099º	115º	131º	147º
	163º	179º	185º	201º	217º
	233º	249º	265º	281º	297º
	313º	329º	345º	001º	017º
	033º	049º			

Clinometer Angle (°): 0º

Additional Notes/Sketches (and over)

Camera: Canon 50D
Lens: Canon EF 35-350mm L Series @35mm
ISO: 200

Existing Visibility of Receptors

The visual appraisal is based on a grading of degrees of visibility, from *"not visible"* to *"fully open views"*. To indicate the degree of visibility of the site (or proposed development) from any location, that continuum has been divided into four categories:

No View: no view or difficult to perceive.

Glimpse View*:* a transient view or distant view of part of the site or development in the context of a wider view.

Partial View: a clear view of part of the site or development; a partial view of most of it; or a distant view in which the site or development forms a relatively small proportion of a wider view.

Open View*:* a panoramic view of most of the site or development, occupying most of the field of vision.

Note: Visibility has been surveyed from the closest point to receptor without the need to enter upon private land. Survey findings are therefore approximate only.

Visual Effect

The visual effect of the proposed development without mitigation on visual receptors is also detailed below. This provides a baseline assessment of visual effects. The different thresholds of effect (major, moderate, minor or none) are determined through an evaluation of the sensitivity of the receptor (nature of receptor) and magnitude of change (nature of effects).

***** indicates selected **Viewpoint Photograph**. Viewpoint Photograph locations are indicated in Figure 3.2, Viewpoint Photographs in Figure 3.3 and Photomontages in Figure 4.1.

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Property				
North				
Residential/ Farmstead	Broadcarse	high	none	*None*
Residential/ Farmstead	Craigton Farm	high	partial/glimpse	*Moderate/Minor*
Residential	Craigton Cottages (2No)	high	glimpse	*Minor*
Residential	Ferryton Cottages (2No)	high	glimpse/ none	*Minor*
Residential	Park Farm Cottage	high	glimpse	*Minor*
Residential/ Farmstead	Park Farm	high	none	*None*
Residential	Arns Cottages (2No)	high	glimpse	*Minor*
Residential/ Farmstead	Arns	high	glimpse/none	*Minor*
Residential	Lookaboutye	high	glimpse	*Minor*
Residential	Ladys Brae	high	none	*None*
Residential	Kennet Gardens	high	glimpse	*Minor*
Community	Clackmannanshire Parish Church	high	none	*None*
Residential	The Manse	high	partial/ glimpse	*Moderate/Minor*
Residential	1 Kirkbrae	high	none	*None*
Residential	2 Kirkbrae	high	partial	*Moderate*
Residential	Curyo House	high	partial	*Moderate*
Residential	Zetland House	high	partial	*Moderate*
Residential	1-8 The Glebe (8No)	high	glimpse/*none*	*Minor*
Residential	1,3,4,5,6 Ladywell Grove (5No)	high	glimpse/*none*	*Minor*
Residential	Kirklands	high	glimpse/*none*	*Minor*
Residential	1-5 Craigie Road (5No)	high	partial/glimpse	*Moderate/Minor*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Residential/ Farmstead	Craigie Farm	high	partial/glimpse	*Moderate/Minor*
Residential	Craigie Cottages (2No)	high	partial/glimpse	*Moderate/Minor*
Residential	Clackmannan town (majority)	high	none	*None*
Residential	Kennet Village	high	none	*None*
Residential/ Farmstead	Gartarry Farm	high	none	*None*
Residential/ Farmstead	Meadowend	high	none	*None*
Residential	The Moss	high	none	*None*
Residential	North Carse House	high	partial/glimpse	*Moderate/Minor*
Residential	Kilbagie House (derelict?)	high	partial/glimpse	*Moderate/Minor*
Residential/ Farmstead	Tulliallan Farm	high	none	*None*
Residential	Tulliallan Farm(New Property`)	high	glimpse/none	*Minor*
Residential	Property (A905)	high	none	*None*
Residential	Property (A905)	high	none	*None*
Residential	Broomknowe	high	none	*None*
Residential	Old Tulliallan Castle	high	none	*None*
Residential/ Farmstead	Hilton	high	none	*None*
Residential/ Farmstead	Hillhead Farm	high	none	*None*
Residential/ Farmstead	Tullygarth	high	none	*None*
Residential/ Farmstead	Grassmainton	high	none	*None*
Residential/ Farmstead	West Birkhill	high	none	*None*
Residential/ Farmstead	Gartfinnan	high	none	*None*
East				
Residential	Crosshill	high	*none*	*None*
Residential/ Farmstead	Windyhill Farm	high	*none*	*None*
Residential	Broomknowe Estate, Kincardine	high	*none*	*None*
Residential/ Farmstead	Hawkhill Farm	high	*partial*	*Moderate*
Education	Tulliallan Castle College	high	*glimpse*	*Minor*
Residential	5-17 Osborne Drive (6No)	high	*glimpse/none*	*Minor*
Residential	Dewar Avenue (26No) **(VP4)**	high	*glimpse/none*	*Minor*
Residential	Sanderson Court (3No)	high	*glimpse/none*	*Minor*
Residential	Hanover Housing Silveright Court (12No Flats)	high	*glimpse/none*	*Minor*
Community	Tulliallan & Kincardine Parish Church	high	*glimpse/none*	*Minor*
Residential	Sir Robert Maule Court (9No) **(VP3)**	high	*glimpse/none*	*Minor*
Residential	Whistleberry	high	*glimpse/none*	*Minor*
Residential	Kincardine town (majority)	high	*glimpse/ none*	*Minor*
South				
Residential/ Farm	Inch Farm	high	none	*None*
Business	Powfoulis Manor Hotel	high	none	*None*
Residential	Mains of Powfoulis	high	none	*None*
Residential/ Farmstead	Brackenlees Farm	high	none	*None*
Residential	Greendyke	high	glimpse	*Minor*
Residential	Cottage (nr Skinflats RSPB)	high	glimpse	*Minor*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Residential	Greendyke Cottages (4No)	high	glimpse	*Minor*
Residential/ Farmstead	Haughs of Airth Farm	high	glimpse	*Minor*
Residential	New Property (2No)	high	none	*None*
Residential	Cottage	high	none	*None*
Residential	Dunislay Cottage	high	none	*None*
Residential	Cottage	high	none	*None*
Residential	Haugh of Airth	high	none	*None*
Residential	Cottages (3No)	high	none	*None*
Residential/ Farmstead	Mains of Airth Farm	high	none	*None*
Buisiness	Kincardine Way Motel	high	none	*None*
Residential/ Farmstead	Bowtrees Farm	high	none	*None*
Residential	Property	high	none	*None*
Residential	Property	high	none	*None*
Residential	Burgoynes Garage	high	none	*None*
Residential	Waterslap	high	none	*None*
Residential	Letham Village	high	none	*None*
Residential/ Farmstead	Lochs of Airth Farm	high	none	*None*
Residential/ Farmstead	North Langdyke Farm	high	none	*None*
Residential/ Farmstead	North Bellsdyke Farm	high	none	*None*
Residential/ Farmstead-	Southfield	high	none	*None*
Residential/ Farmstead	South Langbank	high	none	*None*
Residential/ Farmstead	South Bellsdyke	high	none	*None*
Residential/ Farmstead	Hawkerse	high	none	*None*
Residential/ Farmstead	Orchardhead	high	none	*None*
Residential/ Farmstead	Stonehouse Farm	high	none	*None*
Residential/ Farmstead	Hardilands	high	none	*None*
Residential	Property No Name	high	none	*None*
Residential	Property No Name	high	none	*None*
West				
Residential	Waterslap	high	none	*None*
Residential	Kennedy Way, Airth (30No)	high	partial/glimpse	*Moderate/Minor*
Residential	30-68 South Green Drive, Airth (20No)	high	partial	*Moderate*
Residential	Elphinstone Crescent, Airth (8No)	high	glimpse	*Minor*
Residential	Elphinstone Crescent, Airth (6No)	high	partial	*Moderate*
Education	Airth Primary School	high	none	*None*
Residential/ Farmstead	Eastfield House	high	glimpse	*Minor*
Community	Airth Clinic	high	none	*None*
Residential	2-10 Miller Place, Airth (4No)	high	glimpse	*Minor*
Residential	Carse View, Airth (9No)	high	partial/ glimpse	*Moderate/Minor*
Residential	8-25 Bank View, Airth (13No)	high	partial	*Moderate*
Residential	Paul Drive, Airth (3No)	high	glimpse	*Minor*
Residential	Nertherby Road/ North Green Drive, Airth (7No)	high	partial/ glimpse	*Moderate/Minor*
Residential	Netherby, Airth	high	partial	*Moderate*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Residential	Orchard Cottage, Airth	high	glimpse	*Minor*
Residential	Oriel Cottage, Airth	high	*partial/glimpse*	*Moderate/Minor*
Residential	Bingen, Airth	high	none	*None*
Residential	1-4 The Wilderness, Airth	high	none	*None*
Residential	Bankend Cottage, Airth	high	none	*None*
Residential	Ochill View, Airth	high	none	*None*
Residential	4,6,12,14,16,24,26,28,30 Castle View, Airth (9No)	high	partial/glimpse	*Moderate/Minor*
Buisness	Airth Castle Hotel	high	glimpse	*Minor*
Residential	Agricola House, Airth	high	partial	*Moderate*
Residential	Adjacent Property, Airth	high	partial	*Moderate*
Residential	Airth Mains	high	none	*None*
Residential	Greensleeves Cottage	high	none	*None*
Community	Airth Parish Church **(VP8)**	high	partial	*Moderate*
Residential	Airth town (majority)	high	none	*None*
Residential/ Farmstead	Dougalshill Farm	high	none	*None*
Residential/ Farmstead	Westfield	high	none	*None*
Residential/ Farmstead	Powbridge	high	none	*None*
Residential/ Farmstead	South Doll	high	none	*None*
Residential/ Farmstead	Powbridge	high	none	*None*
Residential/ Farmstead	Linkfield	high	none	*None*
Residential	House adjacent(2), Airth	high	partial/glimpse	*Moderate/Minor*
Residential	The Manse, Airth	high	partial	*Moderate*
Residential	Dunmore House	high	partial	*Moderate*
Residential	Dunmore Park Parsonage	high	partial/glimpse	*Moderate/ Minor*
Residential	Dunmore Park East Lodge	high	partial	*Moderate*
Residential	Beech Cottage, Dunmore	high	partial	*Moderate*
Residential	Pow View, Dunmore	high	partial	*Moderate*
Residential	Riverbank, Dunmore	high	partial	*Moderate*
Residential	Properties, Dunmore (8No)	high	glimpse	*Minor*
Residential	Bankside Cottage, Dunmore	high	partial	*Moderate*
Residential	Bankside House, Dunmore	high	partial	*Moderate*
Residential	Ivy Cottage, Dunmore	high	partial	*Moderate*
Residential	Ivy Cottage, Dunmore	high	partial	*Moderate*
Residential	Property, Dunmore	high	partial	*Moderate*
Residential	Property, Dunmore	high	partial	*Moderate*
Residential	Mid Acre Cottage, Dunmore	high	partial	*Moderate*
Residential	Dunmore, Dunmore	high	partial	*Moderate*
Residential	Property, Dunmore	high	partial	*Moderate*
Residential	Rose Cottage, Dunmore	high	partial	*Moderate*
Residential	Property (2No) , Dunmore	high	glimpse/none	*Minor*
Residential	Penrose, Dunmore	high	partial/glimpse	*Moderate/Minor*
Residential	Property, Dunmore	high	glimpse/none	*Minor*
Residential	Property (2No) , Dunmore	high	partial/ glimpse	*Moderate/Minor*
Residential/ Farmstead	Dunmore Home Farm	high	partial	*Moderate*
Residential	Dunmore Park	high	none	*None*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Residential	Garden Cottage	high	none	*None*
Residential/ Farmstead	Dunmore Park Farm	high	none	*None*
Business	Murrays Caravans	low	glimpse	*Minor*
Residential	Alloa town	high	none	*None*
Residential	Loanside Cottage	high	glimpse	*Minor*
Residential/ Farmstead	Loanside	high	glimpse/ none	*Minor*
Residential/ Farmstead	Inch of Ferryton	high	glimpse/ none	*Minor*
Residential	Inch of Ferryton Cottage	high	glimpse/ none	*Minor*
Residential	Kennet Pans Cottages (4No)**(VP 10)**	high	partial	*Moderate*
Recreation				
North				
	Tulliallan Golf Club	high	glimpse- none	*Minor- None*
East				
	Kincardine Park (adj. Tulliallan School) **(VP3)**	high	glimpse- none	*Minor-None*
	Open Space (Dewar Avenue) **(VP4)**	high	glimpse-none	*Minor-None*
South				
	Firth of Forth	high/ moderate	open-partial-glimpse-none	*Major-Moderate-Minor- None*
	Skinflats RSPB Reserve	high/moderate	glimpse	*Minor*
West				
	Open Space, South Green Drive, Airth	high	partial	*Moderate*
	The Pineapple, Dunmore Park	high	none	*None*
	Kennet Wildlife Site	high/moderate	partial	*Moderate*
Footpaths & Cycle Routes				
North				
	Kennet Pans- Ladys Brae-Clackmannan	high	partial- glimpse-none	*Moderate- Minor-None*
	Hawkhill Road	high	partial- glimpse-none	*Moderate- Minor-None*
East				
	Tulliallan Castle	high	partial- glimpse-none	*Moderate- Minor-None*
	Fife Coastal Path	high	none	*None*
South				
	Coastal Footpath (south of former Power Station site)	high	open- partial-glimpse- none	*Major- Moderate-Minor- None*
	Clackmannanshire Bridge/ A876 Cycleway/ Path **(VP7)**	high	open- partial-glimpse	*Major- Moderate-Minor*
	Powflats	high	partial- glimpse-none	*Moderate- Minor-None*
West				
	Airth Hill, Dunmore Park & Coast	high	partial-glimpse-none	*Moderate- Minor-None*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
Protected Sites (Heritage)				
North				
	Clackmannan Tower LB, Conservation Area **(VP11)**	high	partial	*Moderate*
	Kennet Village Conservation Area, LBs	high	none	*None*
	Kilbagie LB	high	partial/glimpse	*Moderate/ Minor*
	Old Tulliallan Castle SAM/ LB/ Garden and Designed Landscape	high	none	*None*
East				
	Tullialllan Castle LB, Garden and Designed Landscape	high	glimpse	*Minor*
	Kincardine Conservation Area/ LBs **(VP5)**	high	partial-glimpse-none	*Moderate-Minor-None*
South				
	Kincardine on Forth Bridge LB **(VP6)**	high	partial	*Moderate*
	Powfoulis Manor LB	high	none	*None*
	Letham Conservation Area, LBs	high	none	*None*
West				
	Airth Castle LB	high	glimpse	*Minor*
	Airth Conservation Area/ LBs	high	partial/ glimpse	*Moderate/Minor*
	Airth Parish Church LB **(VP8)**	high	partial	*Moderate*
	Dunmore Park Garden and Designed Landscape, LBs **(VP9)**	high	partial/ glimpse	*Moderate/ Minor*
	Dunmore Conservation Area/ LBs	high	partial/ glimpse	*Moderate/Minor*
	Kennet Pans SAM **(VP10)**	high	partial	*Moderate*
Roads				
North				
	Kennet minor roads	low	partial/glimpse/ none	*Moderate/Minor*
	A907	low	none	*None*
	A876 (north of bridge)	low	partial/glimpse/ none	*Moderate/ Minor*
	A977 **(VP1)**	low	glimpse/none	*Minor/ None*
	Hawkhill Road/ Minor Road **(VP12)**	low	partial/glimpse/ none	*Moderate/ Minor*
	Access Road to Substation **(VP2)**	low	glimpse/none	*Minor/None*
East				
	Kincardine on Forth Bridge A985	low	partial/glimpse	*Moderate/Minor*
	A985	low	glimpse/ none	*Minor/ None*

Receptor Type	Visual Receptor	Sensitivity	Description of Visibility	Appraisal of Visual Effect
South				
	Clackmannan Bridge **(VP7)**	low	open/partial/ glimpse	*Moderate/ Minor*
	A876 (south of bridge)	low	glimpse/none	*Minor*
	A905 (south of Jct 3)	low	glimpse/none	*Minor*
	Powflats minor roads	low	glimpse/none	*Minor*
West				
	A905 (north of Jct 3)	low	partial/glimpse/ none	*Moderate/ Minor*
	Letham minor roads	low	none	*None*
	B9124	low	partial/ none	*Moderate/ Minor*

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Relevant Planning Policy Background and Guidance
SPP Planning System (2010)
PAN 42: Archaeology the Planning Process and Scheduled Monument Procedures
PAN 58: Environmental Impact Assessment
PAN 60: Planning for Natural Heritage
PAN 61: Planning and Sustainable Urban Drainage Systems
PAN 68: Design Statements

Landscape and Visual Assessment
The following are terms as defined by the Landscape Institute and Institute of Environmental Management and Assessment, in the Guidelines for Landscape and Visual Assessment (2013).

Term	Explanation
Baseline Studies	Work done to determine and describe the environmental conditions against which future changes can be measured or predicted and assessed.
Enhancement	Proposals that seek to improve the landscape resource and visual amenity of the proposed development site and its wider setting, over and above its baseline condition.
Landscape Character	A distinct recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.
Landscape Effects	Effects on the landscape as a resource in its own right.
Landscape Receptors	Defined aspects of the landscape resource that have the potential to be affected by the proposal.
Landscape Quality (Condition)	A measure of the physical state of the landscape. It may include the extent to which typical character is represented in individual areas, the intactness of the landscape and the condition of individual elements
Landscape Value	The relative value that is attached to different landscapes by society. A landscape may be valued by different stakeholders for a whole variety of reasons.
Magnitude (of effect)	A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short or long term in duration.
Photomontage	A visualisation which superimposes an image of a proposed development upon a photograph or series of photographs.
Sensitivity (of receptor)	A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor.
Significance	A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.
Visual Amenity	The overall pleasantness of the views people enjoy of their surroundings, which provides an attractive visual setting or backdrop to the enjoyment of activities of the people living, working, recreating, visiting or travelling through an area.
Visual Effects	Effects on specific views and on the general visual amenity experienced by people.
Visual Receptors	Individuals and/ or defined groups of people who have the potential to be affected by a proposal.
Zone of Theoretical Visibility (ZTV)	A map, usually digitally produced, showing areas of land within which a development is theoretically visible.

Transmission Equipment

The following are general definitions of terms used in relation to transmission equipment.

Term	Explanation
Cable	Generally refers to an underground *"cable"* suitably insulated, used for transmitting electricity.
Conductor	Wire strung between pylons, used for transmitting electricity.
Earthwire	Wire strung between the tops of pylons, used for lightning and system protection. May also be used to carry telecommunication signals
Electricity lines	Either an overhead line or an underground cable used to transmit electricity.
Gas Insulated Switchgear (GIS)	Metal enclosed switchgear in which the insulation is obtained, at least partly by an insulating gas other than air at atmospheric pressure.
Insulator	Used to attach the conductors to the pylons preventing electrical discharge to the steelwork. Usually made from porcelain glass units, joined together to form an insulator ring.
kV	Kilovolt (one thousand volts)
MW	Megawatt (one million watts or one thousand kilowatts)
Outage	The withdrawal from service of any part of the transmission system for a period of time in connection with repair, maintenance, or construction of the transmission system as a result of breakdown or failure.
Overhead Line	An electric line installed above ground usually supported by lattice steel towers or wooden poles.
SPEN	Scottish Power Energy Networks. Develop and operate the transmission system on behalf of Scottish Power Transmission Ltd.
SPT	Scottish Power Transmission Ltd. Licence holder under the Electricity Act 1989, responsible for the transmission network from the English/ Scottish border to just north of Stirling.
Sealing End Compound	The compound area surrounding the terminal tower, where an overhead line converts to an underground cable.
Substations	Transforming or switching stations to control the voltage and direction of electricity. Transforming stations are used to increase the supply of electricity (to 275kV or 400kV) into the national grid system for transmission, and to reduce the voltage to lower levels (to 132kV) for distribution. Switching controls the direction of electricity and ensures fault protection.
Switchgear	Combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment.
Transformer	A static electrical device that transfers energy by inductive coupling between its winding circuits. They are used to vary the relative voltage of circuits and in some cases isolate them.
Wayleave	An agreement granted by the owner or occupier of land whereby transmission equipment is permitted to be installed on, over or under the land so owned or occupied in return for annual payments.

Landscape & Visual Assessment
Figures

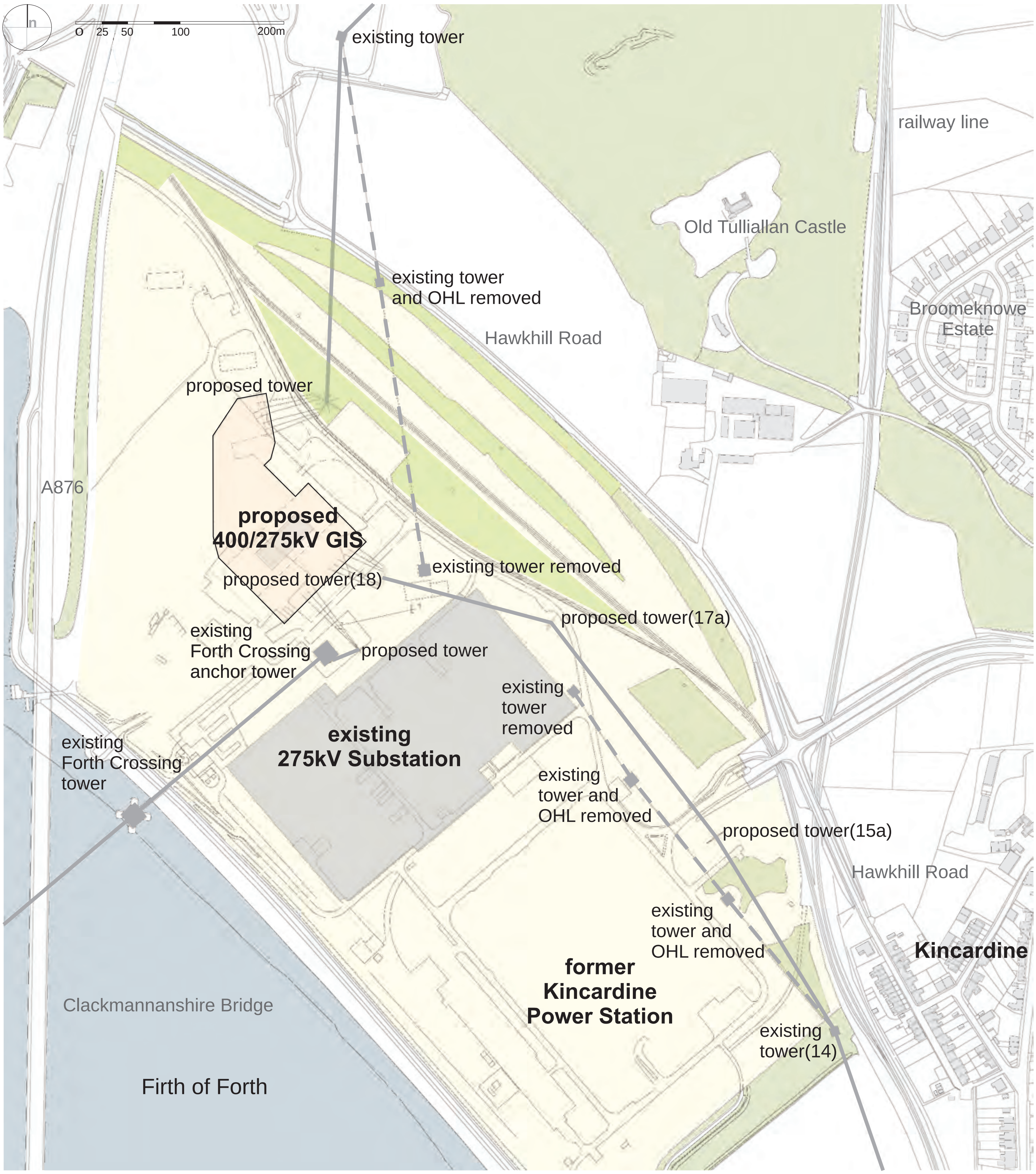


figure 1.2

Title:
Proposed GIS and Overhead Line Works

Project:
Proposed Kincardine 400/275kV GIS

Scale: 1:5,000 @ A4

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning

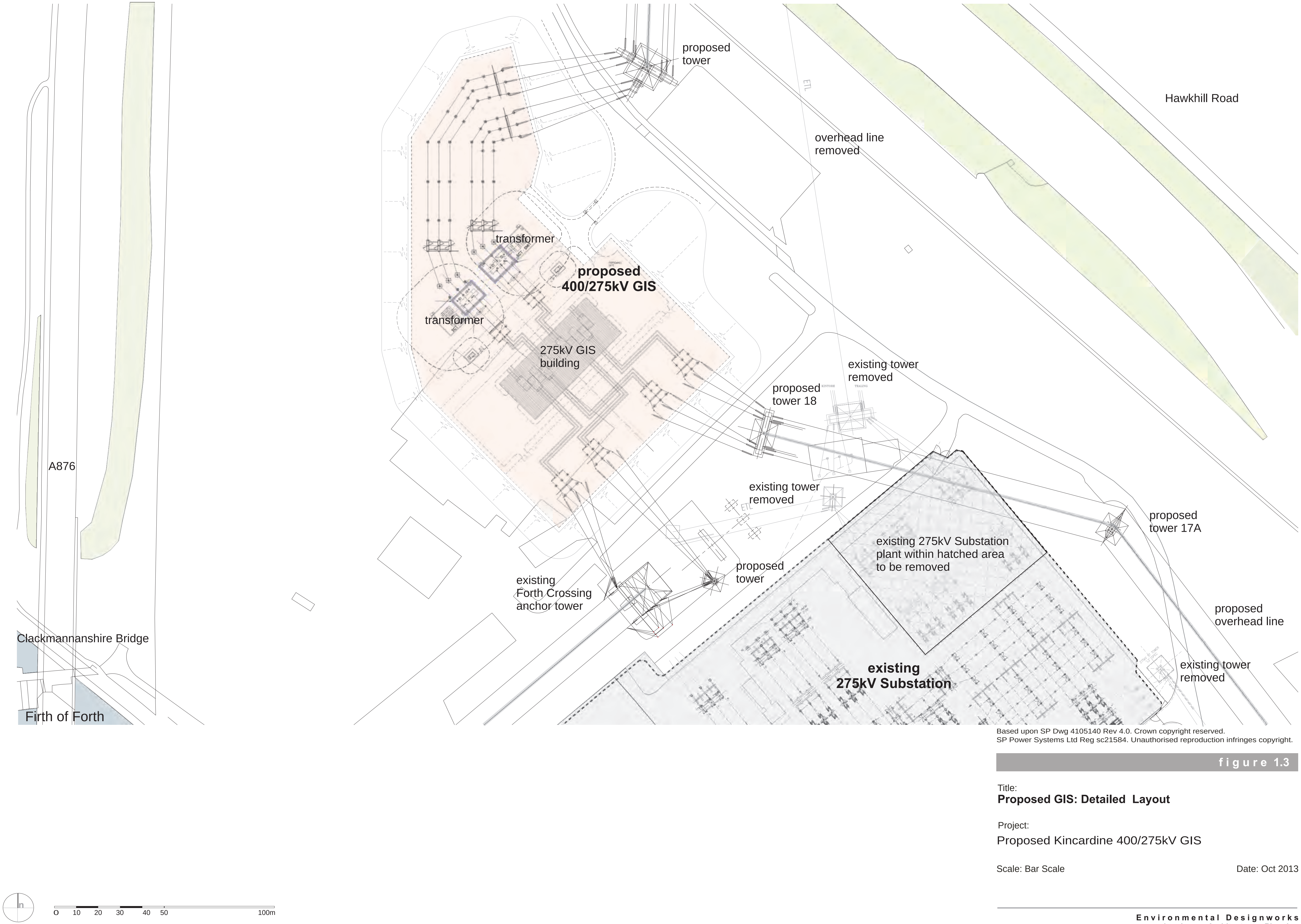


figure 1.3

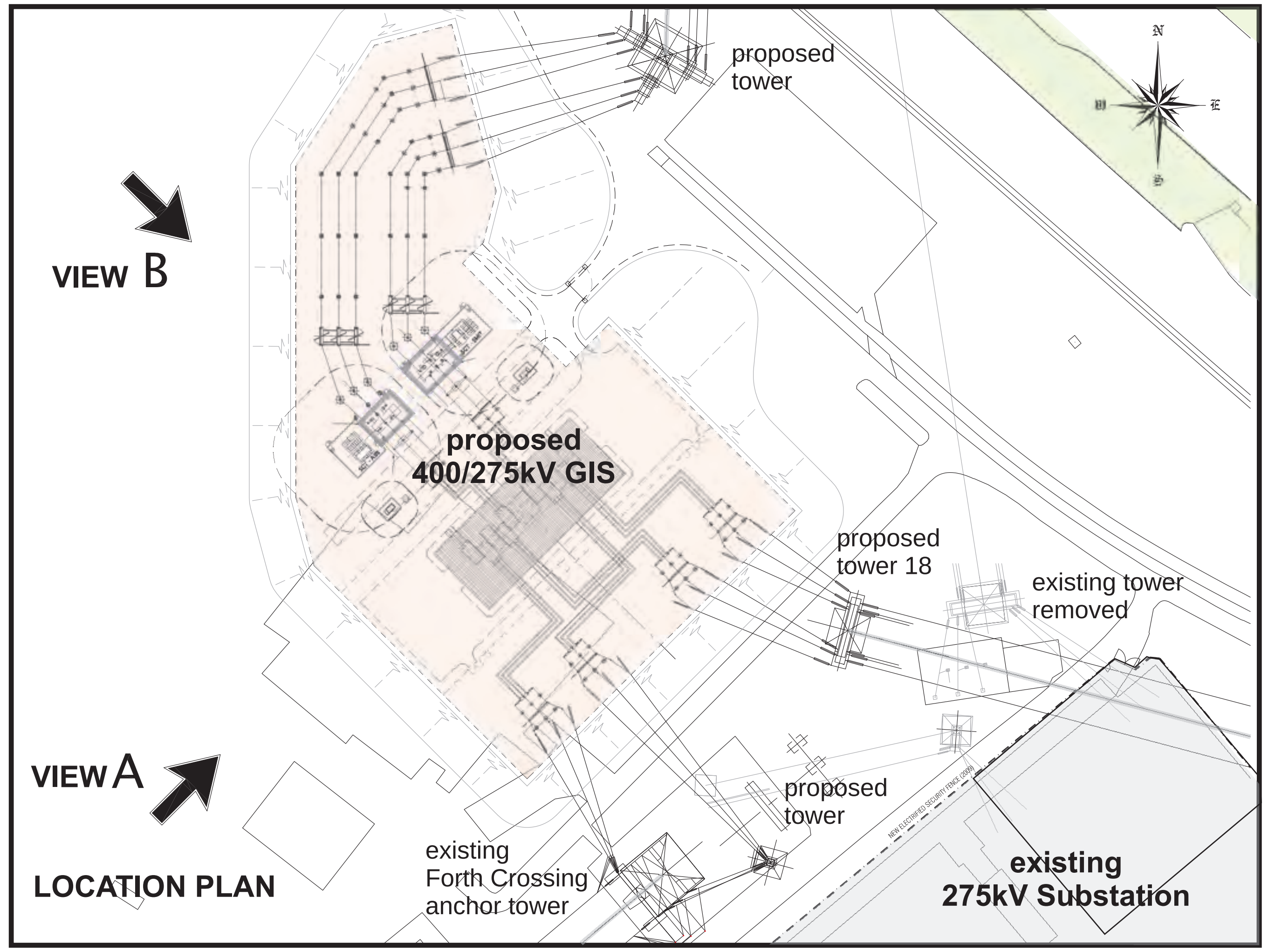
Title:
Proposed GIS: Detailed Layout

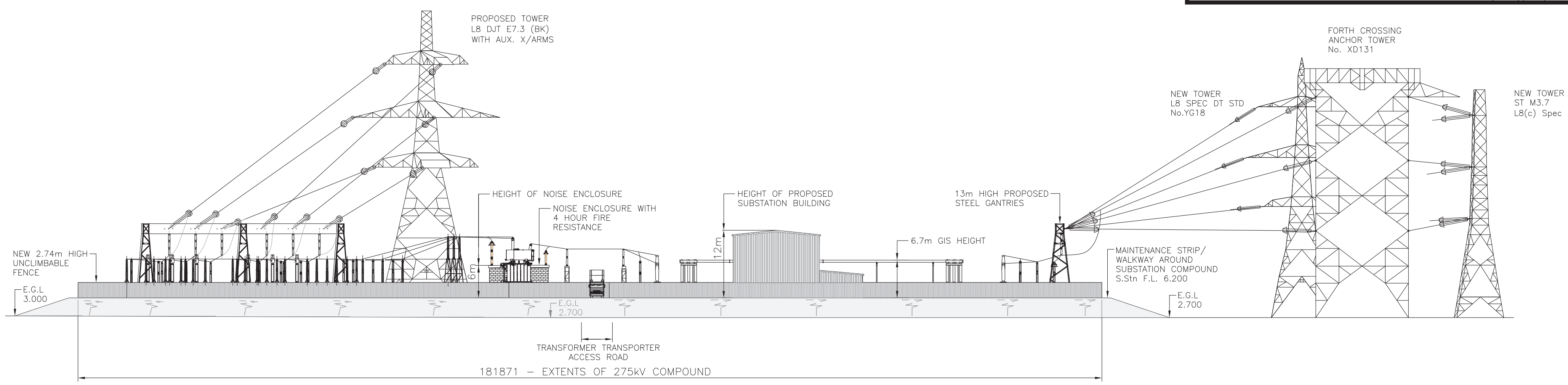
Project:
Proposed Kincardine 400/275kV GIS

Scale: Bar Scale

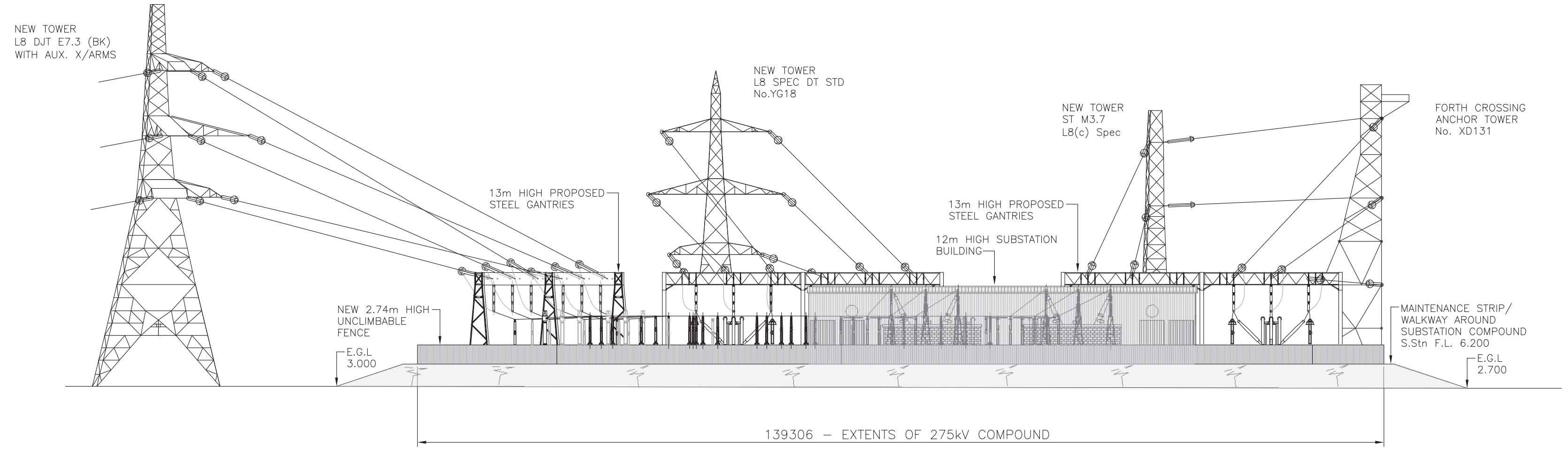
Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning





A_ VIEW ON ARROW 'A' FROM FIRTH OF FORTH SEA WALL/ WALKWAY LOOKING TO NORTH-EAST



B_ VIEW ON ARROW 'B' FROM CLACKMANNANSHIRE BRIDGE A876 LOOKING TO SOUTH-EAST

0 10 20 30 40 50m

figure 1.4

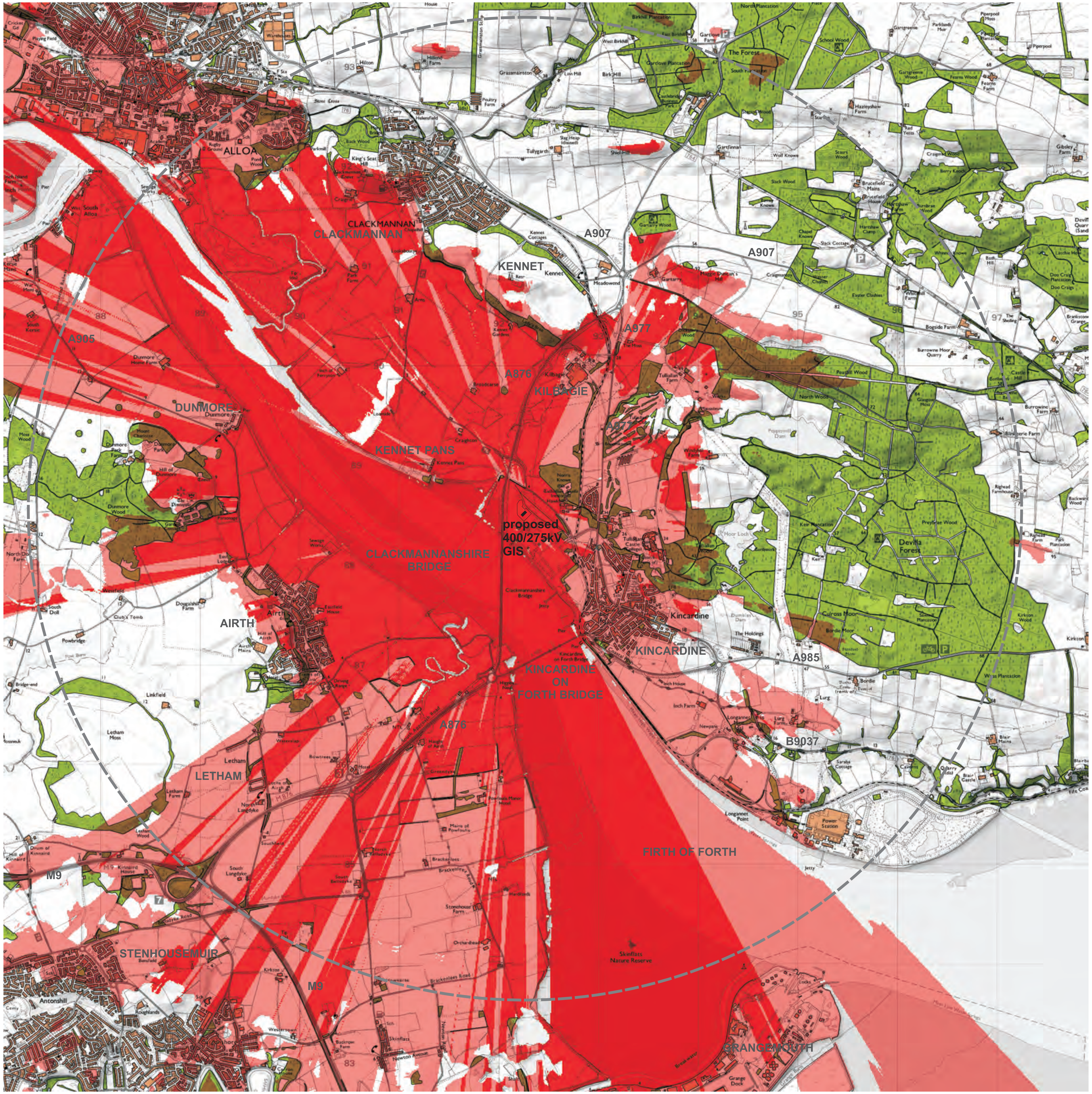
Title:
Proposed GIS: Detailed Sections

Project:
Proposed Kincardine 400/275kV GIS

Scale: Bar Scale

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning



Key

Proposed Gas Insulated Substation

Zone of Theoretical Visibility Bareground

Zone of Theoretical Visibility with Screening
*Buildings at 8m & Large Woodland Blocks at 15m height

Study Area 5km Radius

0 1 2 3km

figure 3.1

Title:
Zone of Theoretical Visibility

Project:
Proposed Kincardine 400/275kV GIS

Scale: Bar Scale

Date: Oct 2013

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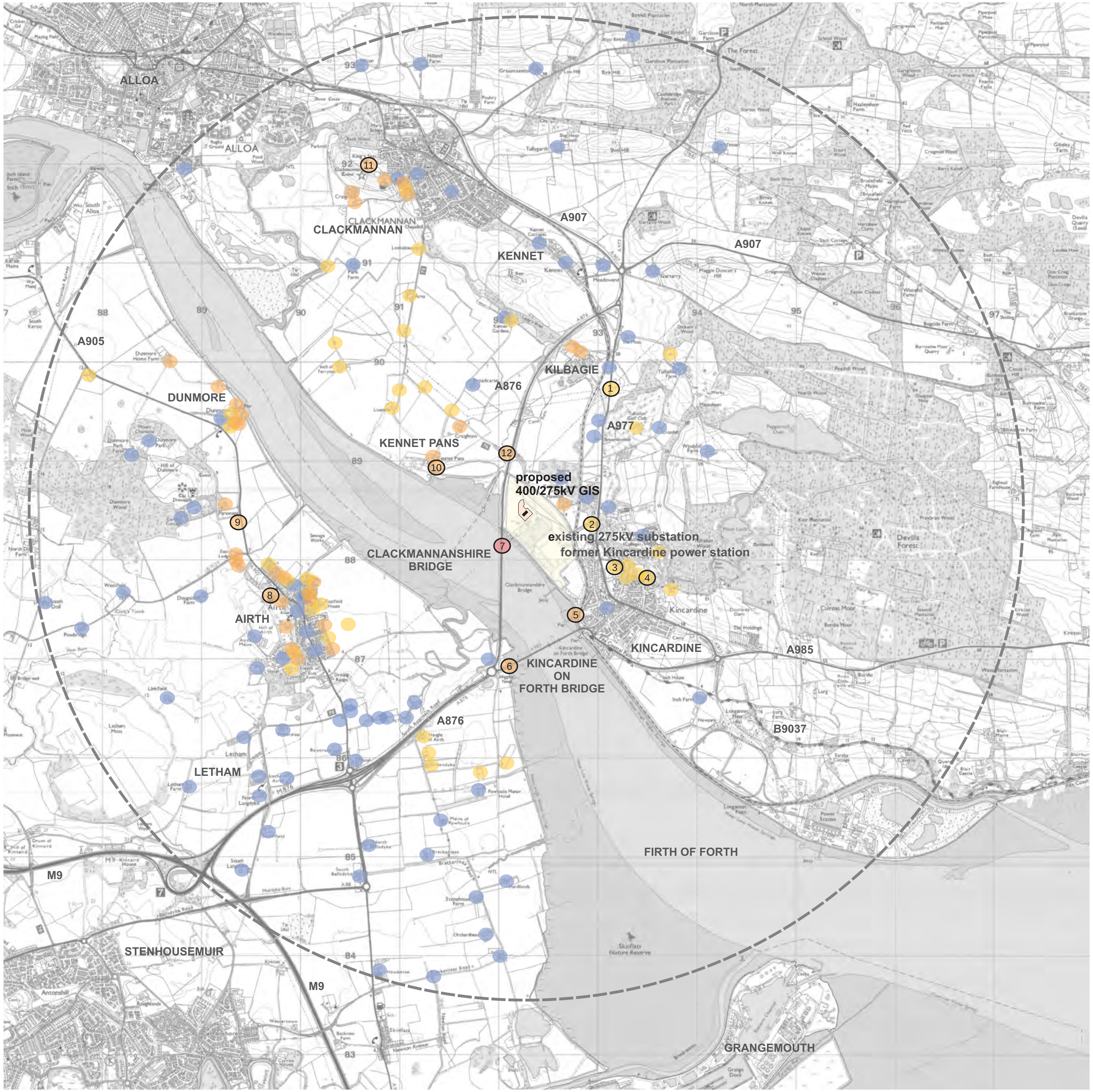

Key

Proposed Gas Insulated Substation

Study Area 5km Radius

Viewpoint Photograph Locations
1. A977
2. Minor Road
3. Kincardine Park*
4. Kincardine
5. Kincardine Pier
6. Kincardine on Forth Bridge A985*
7. Clackmannanshire Bridge A876*
8. Airth
9. Dunmore Park
10. Kennet Pans
11. Clackmannan Tower
12. Minor Road (A876 Overbridge)*

***Photomontage Location**

Open View

Partial View

Glimpse View

No View

The visual appraisal is based on a grading of degrees of visibility, from "not visible" to "fully open views". To indicate the degree of visibility of the site (or proposed development) from any location that continuum has been divided into the following four categories:

No View: no view, or difficult to perceive.

Glimpse View: a transient view or distant view of part of the site or development in the context of a wider view.

Partial View: a clear view of the site or development; a partial view of most of it, or a distant view in which the site or forms a relatively small proportion of a wider view.

Open View: a panoramic view of most of the site or development, occupying most of the field of vision.

Note: Refer to Chapter 3.0 and Appendix 5 for a full description of visibility.

n

0 1 2 3km

figure 3.2

Title:
Visibility & Viewpoint Photograph Locations

Project:
Proposed Kincardine 400/275kV GIS

Scale: Bar Scale

Date: Oct 2013

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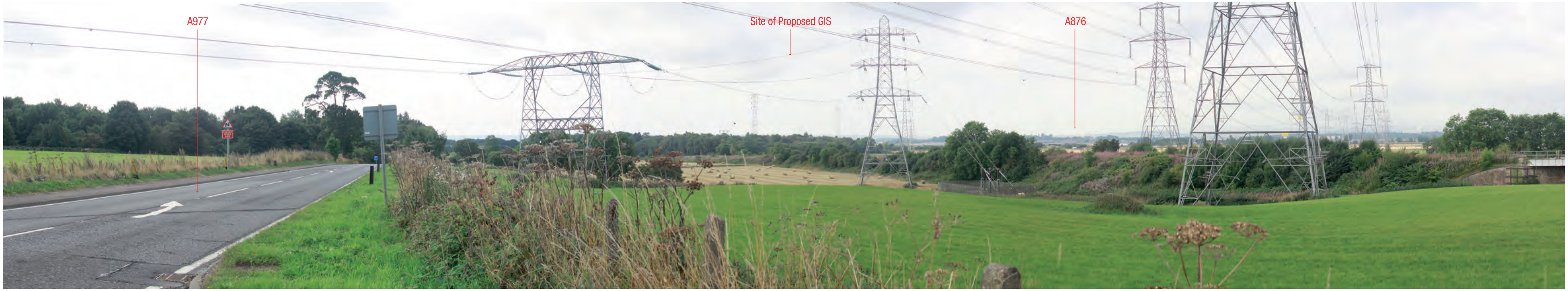

Kincardine GIS_Viewpoint 1_A977. (Correct viewing distance at A3 print size = 205mm)

Kincardine GIS_Viewpoint 2_Minor Road. (Correct viewing distance at A3 print size = 205mm)

figure 3.3a

Title:
Viewpoint Photographs 1-12

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

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Kincardine GIS_Viewpoint 3_Kincardine Park. (Correct viewing distance at A3 print size = 205mm)

Kincardine GIS_Viewpoint 4_Kincardine. (Correct viewing distance at A3 print size = 205mm)

figure 3.3b

Title:
Viewpoint Photographs 1-12

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

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Kincardine GIS_Viewpoint 5_ Kincardine Pier. (Correct viewing distance at A3 print size = 205mm)

Kincardine GIS_Viewpoint 6_A985 Kincardine on Forth Bridge. (Correct viewing distance at A3 print size = 205mm)

figure 3.3c

Title:
Viewpoint Photographs 1-12

Project:
Proposed Kincardine 400/275V GIS

Scale: nts

Date: Oct 2013

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Kincardine GIS_Viewpoint 7_A876 Clackmannanshire Bridge. (Correct viewing distance at A3 print size = 205mm)

Kincardine GIS_Viewpoint 8_Airth. (Correct viewing distance at A3 print size = 205mm)

figure 3.3d

Title:
Viewpoint Photographs 1-12

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

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Kincardine GIS_Viewpoint 11_Clackmannan Tower. (Correct viewing distance at A3 print size = 205mm)

Kincardine GIS_Viewpoint 12_Minor Road (A876 Overbridge). (Correct viewing distance at A3 print size = 205mm)

figure 3.3f

Title:
Viewpoint Photographs 1-12

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

Environmental Designworks
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Existing

Kincardine GIS_Photomontage 2 _Viewpoint 6_A985 Kincardine on Forth Bridge. (Correct viewing distance at A3 print size = 205mm)

Proposed

Kincardine GIS_Photomontage 2 _Viewpoint 6_A985 Kincardine on Forth Bridge. (Correct viewing distance at A3 print size = 205mm)

figure 4.1b

Title:
Photomontages 1-4

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning

Existing

Kincardine GIS_Photomontage 3 _Viewpoint 7_A876 Clackmannanshire Bridge. (Correct viewing distance at A3 print size = 179mm)

Proposed

Kincardine GIS_Photomontage 3 _Viewpoint 7_A876 Clackmannanshire Bridge. (Correct viewing distance at A3 print size = 179mm)

figure 4.1c

Title:
Photomontages 1-4

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning

Existing

Kincardine GIS_Photomontage 4 _Viewpoint 12_Minor Road (A876 Overbridge). (Correct viewing distance at A3 print size = 205mm)

Proposed

Kincardine GIS_Photomontage 4 _Viewpoint 12_Minor Road (A876 Overbridge). (Correct viewing distance at A3 print size = 205mm)

figure 4.1d

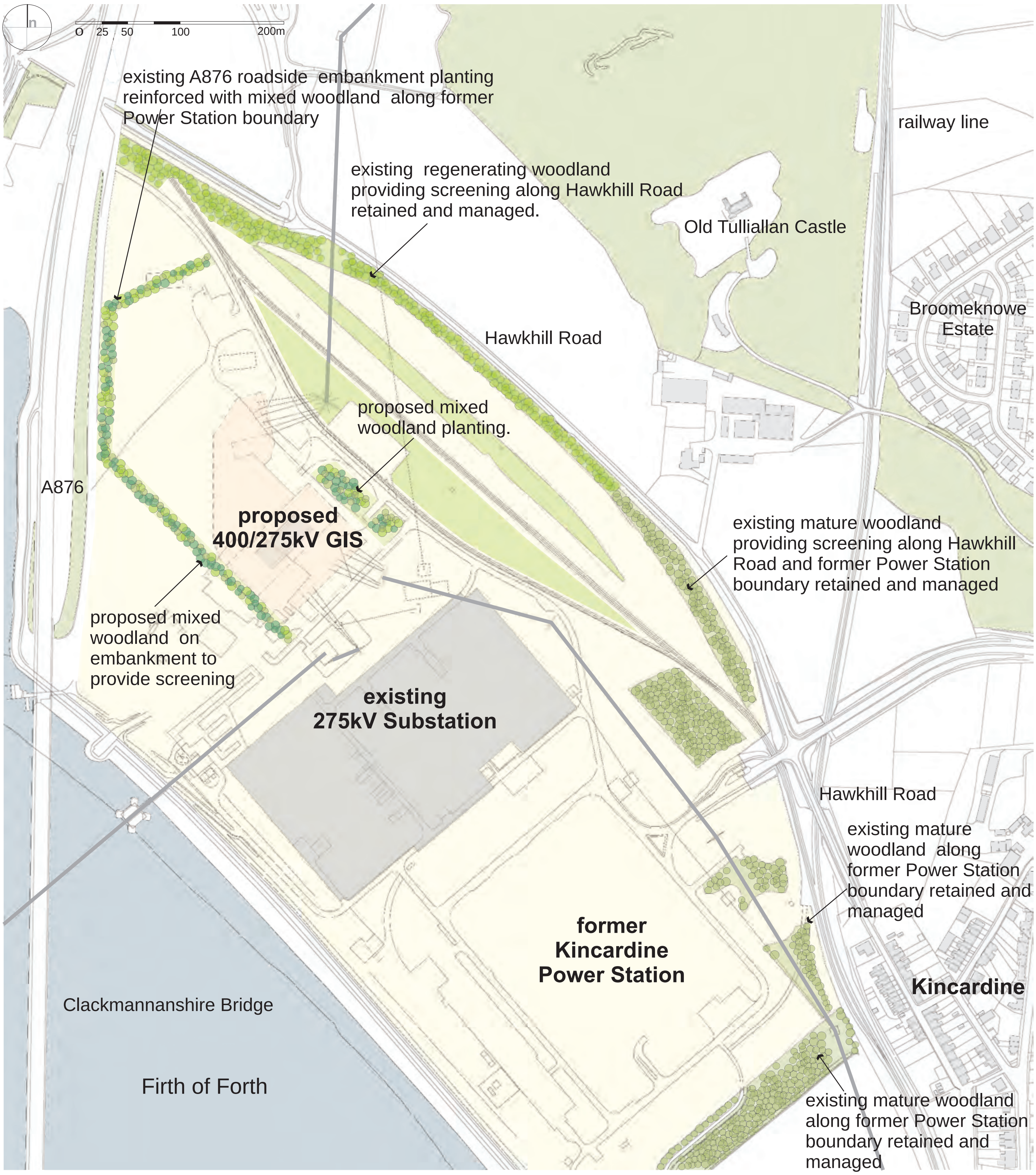
Title:
Photomontages 1-4

Project:
Proposed Kincardine 400/275kV GIS

Scale: nts

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning



Key

- Former Power Station site
- Existing woodland
- Regenerating woodland on former railway sidings
- Proposed mixed woodland screen and reinforcement planting (detailed layout tbc)
- Existing and regenerating woodland forming screening to be retained and managed

figure 5.1

Title:
Outline Landscape Proposals

Project:
Proposed Kincardine 400/275kV GIS

Scale: 1:5,000 @ A4

Date: Oct 2013

Environmental Designworks
Landscape Architecture + Planning