Kintore Hydrogen Plant

Environmental Impact Assessment Report
Chapter 13: Soils, Geology and Water Environment

Date: August 2024

Kintore Hydrogen
A STATERA COMPANY

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https://www.kintorehydrogen.co.uk/

Qualifications

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1 Introduction

1.1 Purpose of this chapter

1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the findings of Environmental Impact Assessment (EIA) work undertaken concerning potential impacts of Kintore Hydrogen Plant on soils, geology and the water environment (hydrology and hydrogeology).

1.1.2 It outlines the embedded good practice methods which have been incorporated into the design and would be used to prevent or reduce identified potential effects on soils, geology and the water environment associated with the Proposed Development. Further mitigation to address any potential effects are proposed, where appropriate, and predicted residual effects are then assessed.

1.1.3 Supporting information is contained within technical appendices in Volume 3:

- Appendix 13.1: Water Quality Monitoring Data;
- Appendix 13.2: Flood Risk Assessment
- Appendix 13.3: Drainage Impact Assessment; and
- Appendix 13.4: Schedule of Watercourse Crossings.

1.1.4 This EIAR chapter:

- presents the environmental baseline established from desk studies, surveys and consultation to date;
- presents the potential environmental effects on soils, geology and the water environment arising from the proposed Kintore Hydrogen Plant, based on the information gathered and the analysis and assessments undertaken;
- identifies any assumptions and limitations encountered in compiling the environmental information; and
- highlights any necessary monitoring and/or mitigation measures that could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

1.1.5 In addition, the assessment uses information and findings presented in Chapter 8: Ecology and Biodiversity to inform the assessment of potential effects on possible areas of Groundwater Dependent Terrestrial Ecosystems (GWDTE) which are presented in this chapter.

1.2 Legislation, policy, and guidance

1.2.1 Soils, geology, and the water environment in Scotland are afforded significant protection through key statutes and the regulatory activity of Scottish Environment Protection Agency (SEPA) and the local authorities. This assessment has been prepared with reference to relevant legislation, policy and guidance including those detailed below.

Planning policy

1.2.2 National Planning Framework 4 (NPF4)[1] adopted by the Scottish Government on 13 February 2023 provides planning guidance and polices regrading sustainable development, tackling climate change and achieving net zero. Policies relevant to this chapter include:

- Policy 2 (Climate Mitigation and Adaptation);
- Policy 4 (Natural Places);
- Policy 5 (Soils);
- Policy 11 (Energy);
- Policy 20 (Blue and Green Infrastructure); and
- Policy 22 (Flood Risk and Water Management).

1.2.3 In addition, the Aberdeenshire Council Local Development Plan (LDP)[2] provides planning guidance on the type and location of development that can take place in the region. The LDP presents development polices of which the following are relevant to this assessment:

- Policy C2: Renewable Energy;
- Policy C4: Flooding;
- Policy E1: Natural Heritage;
- Policy P4: Hazardous and Potentially Polluting Developments and Contaminated Land;
- Policy PR1: Protecting Important Resources; and
- Policy RD1: Providing Suitable Services.

Legislation

1.2.4 Relevant legislation includes:

- EU Water Framework Directive (2000/60/EC);
- EU Drinking Water Directive (98/83/EC);
- The Environment Act 1995;
- Environmental Protection Act 1990;

- The Flood Risk Management (Scotland) Act 2009;
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act);
- The Water Environment (Controlled Activities) (Scotland) Amendment Regulations, 2013 (CAR);
- The Water Supply (Water Quality) (Scotland) Regulations, 2001;
- Private Water Supplies (Scotland) Regulations 2006; and
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017.

Guidance

1.2.5 Planning Advice Notes (PANs) and Specific Advice Sheets, published by the Scottish Government of relevance to this assessment, include:

- PAN 61 Planning and Sustainable Urban Drainage Systems; and
- Online Planning Advice on Flood Risk (which supersedes PAN 69).

1.2.6 SEPA Guidance for Pollution Prevention (GPP) documents:

- GPP01 Understanding your environmental responsibilities – good environmental practices;
- GPP02 Above Ground Oil Storage;
- GPP03 Use and Design of Oil Separators in Surface Water Drainage Systems;
- GPP05 Works and Maintenance in or near Water;
- GPP06 Working at Construction and Demolition Sites;
- GPP08 Safe Storage and Disposal of Used Oils;
- GPP13 Vehicle Washing and Cleaning;
- GPP21 Pollution Incident Response Planning; and
- GPP22 Dealing with Spills.

1.2.7 CIRIA publications:

- Control of Water Pollution from Construction Sites C532 (2001);
- Environmental Good Practice on Site C741 (2015); and
- The SUDS Manual C753 (2015).

1.2.8 SEPA publications:

- Supporting Guidance (WAT-SG-53) - Environmental Quality Standards and Standards for Discharges to Surface Waters, Version 7.1 (April 2020);
- Engineering in the Water Environment – Good Practice Guide: Intakes and Outfalls. Scottish Environment Protection Agency, 2nd Edition (August 2019);
- Engineering in the Water Environment: Good Practice Guide – Temporary Construction Methods, First Edition (March 2010);
- Engineering in the Water Environment: Good Practice Guide – Sediment Management (2010);
- Groundwater Protection Policy for Scotland, Version 3 (2009);
- Regulatory Method (WAT-RM-11) Licensing Groundwater Abstractions including Dewatering (Version 6, April 2017);
- Position Statement, Version 2 – Culverting of Watercourses (2015);
- Land Use Planning System SEPA Guidance Note 2a, Version 2 – Flood Risk (2018);
- Land Use Planning System SEPA Guidance Note 2e, Version 1 – Soils (2015);
- Land Use Planning System Guidance Note 31, Version 3 – Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (2017);
- Hydrogen production by electrolysis of water: emerging techniques (2024); and
- Review of emerging techniques for hydrogen production from electrolysis of water (2024).

1.3 Consultation

1.3.1 Key issues raised during scoping and consultation specific to soils, geology and the water environment are listed in Table 1.1, together with how details of how these issues have been considered in the production of this EIAR and cross-references to where this information may be found.

Table 1.1: Key points raised during scoping and consultation to date

Date	Consultee and type of response	Points raised	How and where addressed
11 October 2023	Aberdeenshire Council Contamination Land Scoping Response	The EIA should include an assessment of the possible impacts of contaminated prior land use on the proposals and recommending further actions as required.	Details of historic landfills and contaminated land records have been obtained from Aberdeenshire Council. These are shown on Figure 3.2 and discussed in Section 3.1 of this chapter.
11 October 2023	SEPA Scoping Response	We will require a Flood Risk Assessment and confirmation that any proposed watercourse crossings are designed to accommodate the 1 in 200 year event plus climate change.	A site-specific Flood Risk Assessment and Drainage Impact Assessment is presented at Appendix 13.2 and Appendix 13.3, and a summary of both is presented in this chapter. It is confirmed that watercourse crossings will be designed to accommodate the 1 in 200 year event plus an allowance for climate change.
11 October 2023	SEPA Scoping Response	We note that and understand that further assessment on abstraction on the River Don is scoped out as this would be covered under a separate regulatory process.	Noted. A CAR authorisation has been obtained for abstraction of water from the River Don.
11 October 2023	SEPA Scoping Response	The site layout should be designed to minimise watercourse crossings and avoid other direct impact on water features. The submission must include a map showing: (a) All proposed temporary and permanent infrastructure overlain with all lochs and watercourses. (b) A minimum buffer of 50m around each loch and watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of loch or watercourse and drawings of what is proposed in terms of engineering works. Measures should be put in place to protect any downstream sensitive receptors.	Watercourses and water features are shown on Figure 3.2 and discussed within this chapter. Appendix 13.4 presents a schedule of proposed watercourse crossings.
11 October 2023	SEPA Scoping Response	Where proposals are on peatland or carbon-rich soils, the following should be submitted to address the requirements of NPF4 Policy 5: a) layout plans showing all permanent and temporary infrastructure, with extent of excavation required, which clearly demonstrates how the mitigation hierarchy outlined in NPF4 has been applied. These plans should be overlaid on: i. peat depth survey (showing peat probe locations, colour coded using distinct colours for each depth category and annotated at a usable scale) ii. peat depth survey showing interpolated peat depths iii. peatland condition mapping iv. National Vegetation Classification survey (NVC) habitat mapping. b) an outline Peat Management Plan (PMP). c) an outline Habitat Management Plan (HMP).	Priority peatland mapping published by NatureScot (shown on Figure 3.4 indicates that the Proposed Development is underlain by mineral soils (Class 0) which are not designated as priority peatland habitat . The site walkover survey also confirmed the absence of peat.
11 October 2023	SEPA Scoping Response	Groundwater Dependent Terrestrial Ecosystems (GWDTE) are protected under the Water Framework Directive. Excavations and other construction works can disrupt groundwater flow and impact on GWDTE and existing groundwater abstractions. The layout and design of the development must avoid impacts on such areas. A National Vegetation Classification survey which includes the following information should be submitted: a) A map demonstrating all GWDTE and existing groundwater abstractions are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted.	An assessment on GWDTE is presented within this chapter. An NVC survey has been undertaken to identify potential areas of GWDTE – the survey methodology and results are presented in Chapter 8: Ecology and Biodiversity.

Date	Consultee and type of response	Points raised	How and where addressed
11 October 2023	SEPA Scoping Response	A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of Ecological Clerk of Works, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to the Guidance for Pollution Prevention (GPPs) and our water run-off from construction sites webpage for more information.	Best practice pollution prevention and construction techniques are given within this chapter and incorporated into the Outline Construction Environmental Management Plan (Outline CEMP) submitted with the planning application.

2 Assessment Approach

2.1 Assessment methodology

2.1.1 This section outlines the assessment methodology used for the assessment of potential effects on soils, geology and the water environment. The potential effects associated with the proposed development on soils, geology and the water environment have been assessed by completing an initial desk study followed by an impact assessment. Characterisation of baseline conditions and the impact assessment have been informed by a detailed programme of site investigation.

2.1.2 A site specific FRA has been completed and is presented as Appendix 13.2: Flood Risk Assessment. Hydraulic modelling has been used to inform this assessment, details of which are included within the appendix. An outline surface water drainage design is also presented as Appendix 13.3: Drainage Impact Assessment.

2.2 Study area

2.2.1 The soils, geology and water environment study area is shown on Figures 13.1 – 13.7. The study area comprises all elements of the Proposed Development and a 500 m buffer to the application boundary.

2.2.2 The study area for potential cumulative effects uses the catchments within the study area and within 5km from the Proposed Development.

2.3 Baseline study

Desktop study

2.3.1 Information on soils, geology and water environment was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 2.1.

Table 2.1: Summary of desktop study sources

Title	Source	Year	Ref.
1:50,000 and 1:25,000 scale mapping	Ordnance Survey	N/A	N/A
NatureScot SiteLink	https://sitelink.nature.scot/home	2024	[3]
National Soil Map of Scotland, 1:250,000 scale	https://soils.environment.gov.scot/maps/soil-maps/	2024	[4]
National scale land capability for agriculture	https://soils.environment.gov.scot/maps/capability-maps/national-scale-land-capability-for-agriculture/	2017	[5]
Carbon and Peatland 2016 Map	https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/	2016	[6]
British Geological Survey (BGS), Onshore Geoindex	https://mapapps2.bgs.ac.uk/geoindex/home.html	2024	[7]
BGS Hydrogeological Maps of Scotland (1:100,000 Aquifer Productivity and Groundwater Vulnerability datasets)	https://www.bgs.ac.uk/datasets/hydrogeological-maps-of-scotland/	2024	[8]
Flood Estimation Handbook (FEH) Webpage	https://fehweb.ceh.ac.uk/	2024	[9]
National River Flow Archive (NFRA)	https://nrfa.ceh.ac.uk/	2024	[10]
SEPA Flood Maps	https://map.sepa.org.uk/floodmaps	2024	[11]
SEPA Reservoir Inundation Maps	http://map.sepa.org.uk/reservoirsfloodmap/Map.htm	2024	[12]
SEPA Environmental Data	https://www.sepa.org.uk/environment/environmental-data/	2024	[13]
Scottish Remote Sensing Portal	https://remotesensingdata.gov.scot/	2024	[14]

2.3.2 The desktop study has also been informed by data requests made to both SEPA and Aberdeenshire Council (September 2023) for details of registered / licenced abstractions and discharges, historical flooding information, potential historic contaminated ground and private water abstractions.

Site specific surveys

2.3.3 In order to inform the EIA, the site-specific surveys listed in in Table 2.2 have been undertaken.

2.3.4 The field work has been undertaken in order to:

- verify the information collected during the desk study;
- allow further appreciation of the study area and undertake visual assessment of hydrology relative to the proposed development;
- allow further assessment of peat, soils, and geology;
- assess wetlands and habitat potentially sustained by groundwater; and
- identify drainage patterns, areas vulnerable to erosion or sedimentation, and pollution risk.

Table 2.2: Summary of site-specific surveys undertaken

Title	Extent of survey	Overview of survey	Survey provider	Year	Reference to further information
Hydrological walkover survey	November 2023	Field inspection of the site and surrounding area including potential areas of flood risk and GWDTE	SLR Consulting	2023	Findings and results discussed in Section 3.1.
Hydrological walkover survey	October 2023	Inspection of catchment, river channels and potential floodplains to inform flood risk assessment	SLR Consulting	2023	Appendix 13.2
Soils infiltration investigation	January 2024	Trial pitting and infiltration capacity testing of soils to inform drainage design and management of storm water runoff	SLR Consulting	2024	Findings and results discussed in Section 3.1.
Monthly water quality monitoring	July 2022 to July 2023	Monthly on-site water quality sampling	SLR Consulting	2022 to ongoing	Appendix 13.1
Watercourse crossing survey	June 2024	Collection of measurements and photographs of proposed watercourse crossings	SLR Consulting	2024	Appendix 13.4

2.4 Uncertainties and/or data limitations

2.4.1 The assessment uses site investigation data collected by SLR, survey data and publicly available data sources, including but not limited to data provided by SEPA, the Met Office, Aberdeenshire Council and commercial data supply companies, as well as additional information supplied from stakeholders during the scoping and consultation stages.

2.4.2 Uncertainty over changes in future rainfall rates, with climate change, has been managed through using climate change uplift allowances to rainfall rates in line with SEPA guidance.

2.4.3 It is considered that the data and information used to complete this assessment is robust and there are no significant data gaps or limitations.

2.5 Impact assessment criteria

2.5.1 The significance of an effect has been assessed by considering two factors: the sensitivity of the receiving environment and the potential magnitude of impact, should that effect occur.

2.5.2 This approach provides a mechanism for identifying the areas where mitigation measures are required and for identifying mitigation measures appropriate to the significance of likely effects presented by the Proposed Development.

2.5.3 Criteria for determining the significance of effect are provided in Table 2.4, Table 2.3, and Table 2.5.

Sensitivity of Receptor

2.5.4 The sensitivity of the receiving environment (i.e. the baseline quality of the receiving environment) is defined as its ability to absorb an effect without a detectable change and can be considered through a combination of professional judgement and a set of pre-defined criteria which is set out in Table 2.3.

2.5.5 Receptors in the receiving environment only need to meet one of the defined criteria to be categorised at the associated level of sensitivity.

Table 2.3: Criteria for receptor sensitivity

Sensitivity	Definition
High	• soil type and associated land use is highly sensitive (e.g. unmodified blanket bog or peatland); • SEPA Water Framework Directive Water Body Classification: High-Good or is close to the boundary of a classification: Moderate to Good or Good to High; • receptor is of high ecological importance or national or international value (e.g. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), habitat for protected species) which may be dependent upon the hydrology of the development area; • receptor is at high risk from flooding in the future (2080s) and/or water body acts as an active floodplain or flood defence; • receptor is used for public and/or private water supply (including Drinking Water Protected Areas); • groundwater vulnerability is classified as high; and • if a Groundwater Dependent Terrestrial Ecosystem or Geological Conservation Review site is present and identified as being of high sensitivity.
Moderate	• soil type and associated land use moderately sensitive (e.g. arable, commercial forestry); • SEPA Water Framework Directive Water Body Classification: Moderate or is close to the boundary of a classification: Low to Moderate; • receptor is at medium likelihood of surface water flooding; and • moderate classification of groundwater aquifer vulnerability.
Low	• soil type and associated land use not sensitive to change in hydrological regime and associated land use (e.g. intensive grazing of sheep and cattle); • SEPA Water Framework Directive Water Body Classification: Poor or Bad; • receptor is at not at risk from flooding in future (2080s); and • receptor not used for water supplies (public or private).
Not Sensitive	• receptor would not be affected by the Proposed Development e.g. lies within a different and unconnected hydrological / hydrogeological catchment.

Magnitude of impact

2.5.6 The potential magnitude of impact would depend upon whether the potential effect would cause a fundamental, material or detectable change. In addition, the timing, scale, size and duration of the potential effect resulting from the Proposed Development are also determining factors.

2.5.7 The criteria that have been used to assess the magnitude of impact are defined in Table 2.4. The characteristics of the impacts are described as: direct/indirect, temporary (reversible) or permanent (irreversible), together with timescales (short, medium and long term).

Table 2.4: Criteria for magnitude of impact

Magnitude of impact	Criteria	Definition
Major	Results in loss of attribute	Long term or permanent changes to the baseline geology, hydrology, hydrogeology and geology such as: • permanent degradation and total loss of soils habitat (inc. peat) and geology; • loss of important geological structure/features; • wholesale changes to watercourse channel, route, hydrology or hydrodynamics; • changes to the site resulting in an increase in runoff with flood potential and also significant changes to erosion and sedimentation patterns; • major changes to the water chemistry; and • major changes to groundwater levels, flow regime and risk of groundwater flooding
Medium	Results in impact on integrity of attribute or loss of part of attribute	Material and short to medium term changes to baseline geology, hydrology, hydrogeology and water quality, such as: • loss of extensive areas of soils and peat habitat, damage to important geological structures/features; • some changes to watercourses, hydrology or hydrodynamics; • changes to site resulting in an increase in runoff within system capacity; • moderate changes to erosion and sedimentation patterns; • moderate changes to the water chemistry of surface runoff and groundwater; and • moderate changes to groundwater levels, flow regime and risk of groundwater flooding.
Low	Results in minor impact on attribute	Detectable but non-material and transitory changes to the baseline geology, hydrology, hydrogeology and water quality, such as: • minor or slight loss of soils and peat or slight damage to geological structures/feature; • minor or slight changes to the watercourse, hydrology or hydrodynamics; • changes to site resulting in slight increase in runoff well within the drainage system capacity; • minor changes to erosion and sedimentation patterns; • minor changes to the water chemistry of surface runoff and groundwater; and • minor changes to groundwater levels, flow regime and risk of groundwater flooding.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect the use/integrity	No perceptible changes to the baseline geology, hydrology, hydrogeology and water quality such as: • no impact or alteration to existing important soils (inc. peat) geological environs; • no alteration or very minor changes with no impact to watercourses, hydrology, hydrodynamics, erosion and sedimentation patterns; • no pollution or change in water chemistry to either groundwater or surface water; and • no alteration to groundwater recharge or flow mechanisms.

Significance of effect

2.5.8 The sensitivity of receptor together with the magnitude of impact determines the significance of the effect, which can be categorised into a level of significance as identified in Table 2.5.

Table 2.5: Matrix used for the assessment of the significance of an effect

		Magnitude of impact			
		Negligible	Low	Medium	Major
Sensitivity of receptor	Not Sensitive	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Minor	Minor	Moderate
	Moderate	Negligible	Minor	Moderate	Major
	High	Negligible	Moderate	Moderate	Major

2.5.9 Effects of **moderate** and higher will be defined as significant effects.

2.5.10 Table 2.5 provides a guide to assist in decision making. However, it should not be considered as a substitute for professional judgment and interpretation. In some cases, the potential sensitivity of the receiving environment or the magnitude of potential impact cannot be quantified with certainty and, therefore, professional judgement remains the most robust method for identifying the predicted significance of a potential effect.

2.6 Maximum design envelope parameters for assessment

2.6.1 The maximum design envelope parameters identified in Table 2.6 have been selected as those having the potential to result in the greatest effect on identified receptors or receptor groups. These parameters have been identified based on the overview description of the development provided in Chapter 2: Project Description and Site Setting.

2.6.2 Effects of greater adverse significance are not predicted to arise should other development designs, within the project design envelope parameters, be taken forward.

Table 2.6: Maximum design envelope parameters assessed

Potential impact	Maximum design parameter	Justification
Construction phase		
Impacts on surface water and groundwater quality from pollution from fuel, oil, concrete or other hazardous substances.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that pollution could occur at any point within the application site.
Discharge of sediment laden runoff to drainage systems and watercourses.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that discharge of sediment laden runoff could occur at any point within the application site.
Increased flood risk to areas downstream of the site during construction through increased surface runoff.	Entire application site	Potential flood risk to and from the development has been considered across the entire application site, focusing on the three main areas where the largest areas of permanent impermeable areas will be required; main hydrogen production site, gas connection compound area and water abstraction and treatment plant.
Changes in groundwater levels from dewatering excavations.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that dewatering to facilitate construction could occur at any point within the application site. It is noted that area of temporary dewatering which might be required, for example for foundation construction, will be limited to the area of the construction activity and not require groundwater management or dewatering over the whole site.
Potential change of groundwater flow paths and contribution areas of GWDTE.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that changes to groundwater flow paths and contribution areas to GWDTE could occur at any point within the application site. As above, potential dewatering effects and potential change in groundwater flow paths would only occur where construction activities occur.
Disturbance of watercourse bed and banks from construction of culverts or pipe crossings.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that crossings will be required wherever the application site crosses the mapped watercourses.
Potential impacts to designated sites, public and private water supplies.	Entire application site	It has been assumed that construction will occur throughout the application site and worst case scenario is that as a result of construction potential impacts to designated sites, public and private water supplies could occur at any point within the application site.
Operation phase		
Change in surface water flow and quality in the River Don as a result of water abstraction and effluent discharge associated with the Proposed Development.	Maximum permitted abstraction (2,808m^3/hour) and discharge volume (972m^3/hour).	The maximum permitted abstraction and effluent discharge volume has been assumed when considering potential effects of surface water flow and quality within the River Don as result of operation of the Proposed Development.
Increased runoff rates and flood risks, resulting from increases in areas of impermeable hardstanding.	Total impermeable area of c. 38 ha (see Appendix 13.3).	Potential flood risk to and from the development has been considered, focusing on the three main areas where the largest areas of permanent impermeable areas will be required: main hydrogen production site (electrolysis plant), gas connection compound area and water abstraction and treatment plant.
Changes in natural surface water drainage patterns (which may affect water contribution to areas of GWDTE).	Entire application site	Potential change to natural surface water drainage patterns has been considered focusing on the three main areas where the largest areas of permanent impermeable areas will be required; main hydrogen production site, gas connection compound area and water abstraction and treatment plant.,
Changes to groundwater levels and groundwater movement.	Entire application site	Potential changes to groundwater levels and groundwater movement have been considered where there is permanent below ground infrastructure (e.g. pipelines and foundations).
Pollution impacts on surface water quality from maintenance work.	Entire application site	It has been assumed that maintenance will occur throughout the application site and worst case scenario is that pollution / discharge of sediment laden runoff could occur at any point within the application site.

2.7 Impacts scoped out of the assessment

2.7.1 The potential impacts listed in Table 2.7 have been scoped out of the assessment for soils, geology and water environment as agreed through the EIA scoping process detailed in Chapter 5: Scoping and Consultation.

Table 2.7: Impacts scoped out of the assessment

Potential impact	Justification
Effects on geology	No sensitive geological features have been identified within the study area and while there will be effects arising from rock extraction for foundation construction, these will be limited in area and will not extend beyond the development footprint.
Water Framework Directive Assessment	The rate and volume of water abstraction from the River Don is regulated by the existing CAR abstraction authorisation and the discharge of effluent from the hydrogen facility would also be agreed and regulated by SEPA as an emission point in a future PPC Permit application.

2.8 Mitigation measures adopted as part of Kintore Hydrogen Plant

2.8.1 A number of measures have been designed in to Kintore Hydrogen Plant to reduce the potential for impacts on soils, geology and the water environment. These are listed in Table 2.8.

Table 2.8: Designed-in mitigation measures

Measures adopted as part of Kintore Hydrogen Plant	Justification
Production and compliance with a site specific CEMP	A site-specific CEMP will be used to ensure that the works are completed in line with best practice construction methods. An Outline CEMP accompanies the planning application and includes specific methods to reduce impacts on soils, geology and the water environment. A final CEMP will be agreed with statutory consultees prior to construction.
Construction works to be undertaken under guidance of an Ecological Clerk of Works (ECoW)	A suitably qualified ECoW will be appointed prior to the commencement of construction to advise the Applicant and the Principal Contractor on all ecological and hydrological matters. The ECoW will be required to be present onsite for relevant activities or areas of work during the construction phase (set out in the Outline CEMP) and will carry out monitoring of works and briefings with regards to ecological and hydrological sensitivities on the site to the relevant staff of the Principal Contractor and sub-contractors. With respect to the water environment, the ECoW would also have responsibility to ensure water flow paths and quality to water dependant habitats are sustained. The ECoW would have authority to cease works on site if required.
Construction works to be undertaken in accordance with a site specific Soil Management Plan.	Construction works to be undertaken in accordance with a site specific Soil Management Plan, the requirement for which is referenced in the Outline CEMP and would be prepared for the adopted CEMP prior to construction. Construction of underground cabling and pipelines will be installed progressively to minimise the amount of soil disturbed at one time.
Compliance with a baseline and construction water quality monitoring plan	The current water quality monitoring would be used to establish baseline data prior to construction commencing (see Appendix 13.1). Monitoring would continue throughout construction to ensure the quality and quantity of the water environment is not impaired by the development. It is expected that the scope and frequency of monitoring, including reporting procedures and the provision of an emergency response action plan, would be agreed with statutory consultees, including SEPA and Aberdeenshire Council, prior to the commencement of any construction. This can be secured by a planning condition.
Refuelling of vehicles, areas of designated for wash out of vehicles and stockpiling of materials will be located at least 50 m away from nearest watercourses.	As discussed in the Outline CEMP and in accordance with best practice construction methods, a 50 m watercourse buffer will be used to minimise pollution and increased sedimentation of the surrounding water environment.
Adoption of appropriate watercourse crossing methodology.	Larger watercourses will be crossed by HDD or other trenchless technologies where possible. Smaller watercourse crossings may be undertaken by open cut methods. The final construction technique will be informed by site investigation at the detailed design stage. Crossings will be designed in accordance with SEPA's best practice measures and will be designed to accommodate at least the 200 year flow plus an allowance for climate change. A schedule of proposed watercourse crossings is presented as Appendix 13.4.
Sustainable urban Drainage Systems (SuDS) with flood risk attenuation will be incorporated in the site design.	SuDS techniques aim to mimic pre-development runoff conditions and balance or throttle flows to the rate of runoff that might have been experienced prior to development. An outline drainage design for the three main areas which will have the largest proposed impermeable area is presented as Appendix 13.3. Further drainage designs will form part of the adopted CEMP.
Water abstraction and discharge at the River Don will be compliant with the consented CAR application	The rate of primary water supply for the hydrogen production facility via surface water abstraction from the River Don will be regulated by SEPA under a CAR authorisation, which has been obtained for the proposed development. The CAR authorisation requires a minimum of just over a third of water abstraction from the River Don to be returned to the river through the discharge pipeline. No discharge from the hydrogen facility process would be made to groundwater. During operation, water quality monitoring in the River Don would be undertaken to ensure compliance with the site CAR and PPC authorisations; these data would be maintained on site and reported to SEPA in accordance with the authorisations.
Operation in accordance with PPC Permit	The proposed development will be operated in accordance with a PPC Permit from SEPA, which will regulate permissible discharges to air, water and ground, monitoring of these, and accident and emergency planning among other matters.
Works near the River Don and Dewsford Burn will be in undertaken in accordance with CAR	Construction works required near the River Don or Dewsford Burn will be undertaken in accordance with CAR and agreed with SEPA prior to construction, as part of the detailed design stage.

General good practice construction methods

2.8.2 As a principle, preventing the release of any pollution/sediment is preferable to dealing with the consequences of any release. The proposed development will be built and operated in accordance with good practice guidance, including UK and Scottish guidance on good practice for construction projects. As noted above, further detail is provided in the Outline CEMP accompanying the planning application; this will be developed into an adopted (final) CEMP with Aberdeenshire Council approval prior to construction.

Water abstraction and discharge in operation

2.8.3 The rate of primary water supply for the hydrogen facility via surface water abstraction from the River Don will be regulated by SEPA under a CAR authorisation, which has been obtained for the proposed development.

2.8.4 As discussed in the baseline section, a programme of surface water monitoring has been undertaken to confirm the suitability of the source to provide a sustainable water source to the hydrogen facility. The monitoring is ongoing and data will be used in the detailed design of the water purification plant.

2.8.5 The CAR authorisation requires a minimum of just over a third of water abstraction from the River Don to be returned to the river through the discharge pipeline.

2.8.6 No discharge from the hydrogen facility process would be made to groundwater.

2.8.7 The final design of the water purification plant will be finalised as part of the detailed site design. However, it is expected that abstracted water will only need to undergo filtration prior to use in the hydrogen facility. The application and routine use of chemicals to treat either surface or groundwater sources is not anticipated. Occasional use of anti-fouling chemicals may be required to clean the filtration system.

2.8.8 Water which has passed through the water purification plant would be stored and then ‘feed’ the hydrogen facility.

Discharge of Effluent from the Hydrogen Facility

2.8.9 SEPA also regulates the discharge of effluent to the water environment, via the Pollution Prevention and Control (PPC) Regulations. Kintore Hydrogen Ltd will make an application to SEPA to secure a discharge from the hydrogen facility water purification plant to the River Don. The effluent from the hydrogen facility will contain naturally occurring constituents found in existing surface water and which are removed from the hydrogen facility feed water by the filtration. In the unlikely event chemicals are required to treat the source water, or from their occasional use to clean the filter media in the purification plant, details of these and their application will be provided to SEPA as part of the PPC Permit application.

2.8.10 Any PPC Permit issued by SEPA will state limits on the rate, volume and quality of effluent so as to ensure there are no significant effects on the receiving water environment. Again, it is expected any authorisation will specify monitoring and reporting requirements of the effluent.

2.8.11 The temperature of the effluent discharged from the hydrogen facility water purification system will be controlled so that no thermal barriers or gradients will occur in the River Don at the proposed discharge point. It is expected that the temperature of the effluent will be specified in the PPC Permit.

2.8.12 Incident rainfall onto the main electrolysis plant site, gas connection compound area and water abstraction and treatment plant will be collected by a positive drainage system and managed separately to the effluent from the hydrogen facility water purification system. It will be attenuated prior to discharge. The detailed design of the drainage system will be agreed with Aberdeenshire Council prior to construction, and it is expected this would be secured by an appropriately worded planning condition. The detailed design will show how the rate of discharge will be limited so as not to increase flood risk downstream of the Site and will incorporate SuDS.

2.8.13 The drainage design for the permanent access road will also be confirmed as part of the detailed design and include SuDS measures to control and treat runoff shed from the road.

2.8.14 An outline drainage design, which confirms there is sufficient space to collect, treat and allow a controlled rate of discharge from all elements of the Proposed Development is shown in Appendix 13.3: Drainage Impact Assessment.

Design of the Effluent and Storm Water Discharge Headworks

2.8.15 The design of the discharge points would be agreed with SEPA as part of the detailed site design and be included in the PPC Permit application(s) for the discharge.

2.8.16 The design of the structures will be undertaken in accordance with SEPA guidance and following pre-application discussion with SEPA. This guidance details methods for appraising and selecting the best design, as well good practice design and mitigation.

3 Baseline Environment

3.1 Current baseline

3.1.1 This part of the chapter outlines the baseline conditions of the soils, geology, and the water environment within the study area.

Designations

3.1.2 Review of the NatureScot Sitelink resource confirms there are no nationally or internationally important designated sites within the application site or study area.

Hydrology

Local hydrology

3.1.3 The local hydrology is shown on Figure 3.2.

3.1.4 The Proposed Development lies entirely within the surface water catchment of the River Don which flows generally eastwards within the north eastern extent of the site. The River Don ultimately discharges into the North Sea at the Bridge of Don, Aberdeen 14.5km east of the site at its closest extent.

3.1.5 The catchment area to the proposed abstraction point on the River Don at NJ 81200 15300 is approximately 1,151 km^2.

3.1.6 The western and central extent of the application site, including the electrolysis plant site and gas connection compound area, is located within the Tuach Burn sub-catchment, which is a tributary of the River Don. Several tributaries of the Tuach Burn cross the site including the Dewsford Burn, Park Burn, Tillakae Burn and Sheriff Burn.

3.1.7 None of the surface water catchments which drain the Proposed Development have been designated as a DWPA.

Rainfall and surface water flows

3.1.8 SEPA has provided precipitation data for Inverurie rain gauge (station number 367365) which is located at NGR NJ 78245 18685, approximately 3 km north west of the proposed riparian habitat creation area of the proposed development, to the north of the River Don. In 2023, a precipitation total of 956mm was recorded. FEH webservice records a standard average annual rainfall (SAAR) of 893 mm for the River Don catchment.

3.1.9 The National River Flow Archive (NRFA) records stream flow data for the River Don at Haughton and Parkhill which are located approximately 6 km north west (upstream) and 6 km east (downstream) of the application site. A mean flow of 14.4 m^3/s and 21.1 m^3/s is recorded respectively.

3.1.10 Water level data has been recorded using a data logger which has been installed in the River Don at the abstraction point consented in the CAR authorisation. The logger has been surveyed to Ordnance Datum and water levels have been recorded every 15 minutes since 23rd February 2024. Water levels during this reporting period (February – July 2024) range from 43 m AOD to 45 m AOD, with an average water level of 43.5m AOD: see Figure 3.1. The logger remains in situ and continues to collect data.

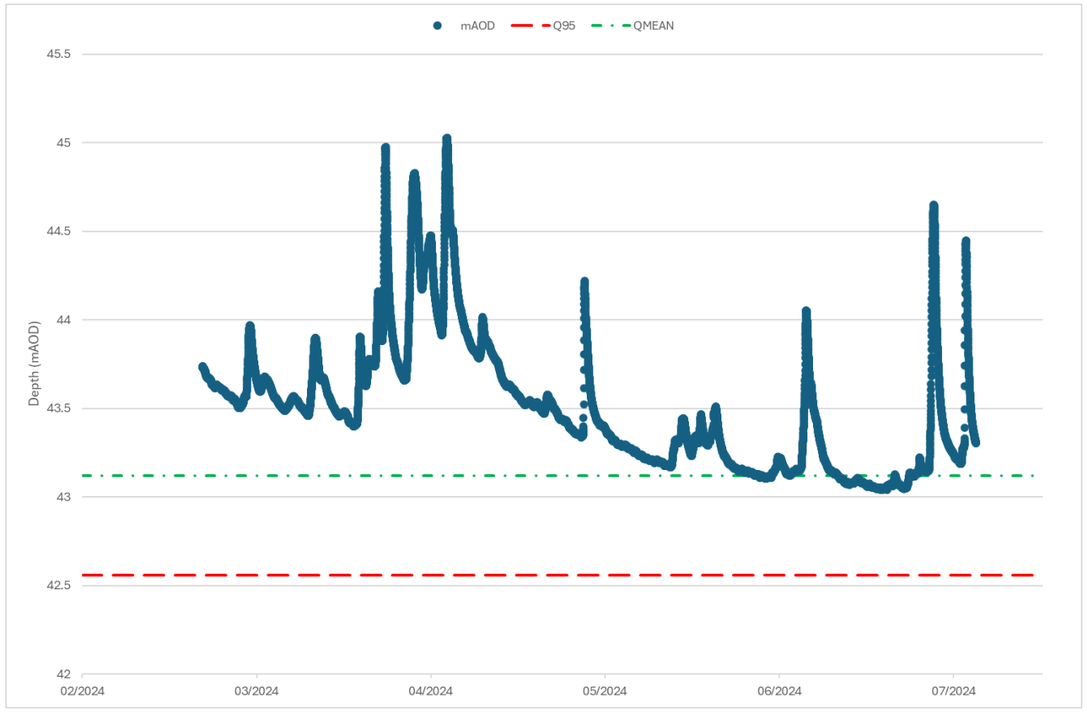


Figure 3.1: Continuous water level data at the proposed River Don abstraction point

3.1.11 The likely range of flow in the River Don has been determined for the proposed abstraction point using the industry standard LowFlows 2 software[15]. Summary flow statistics are shown in Table 3.1 and have been used in determination of the CAR abstraction authorisation issued by SEPA.

3.1.12 Review of Table 3.1 and Figure 3.1 shows a good correlation and that flows recorded in the River Don so far in 2024 (which has been a relatively wet spring and summer) are consistent with the LowFlows estimation.

Table 3.1: Low flow estimate in the River Don at the proposed abstraction point

Flow percentile	Average annual flow (m^3/s)	Average annual flow (m^3/hr)
Q1	85.32	307,152
Q5	48.97	176,292
Q10	37.40	134,640
Q30	21.59	77,724
Q50	14.46	52,056
Q80	7.99	28,764
Q90	6.22	22,392
Q95	5.34	19,224
Q99	4.55	16,380
Qmean	19.42	69,912

Surface water quality

3.1.13 The larger watercourses within the study area are monitored by SEPA and were classified in 2022 (the latest reporting cycle). A summary of the SEPA classifications is shown in Table 3.2. Smaller watercourses within the study area are not monitored by SEPA.

Table 3.2: SEPA surface water quality (2022)

Waterbody (SEPA ID)	Overall status	Overall ecology	Physio-chemical	Hydro-morphology	Pressures
River Don – Inverurie to Dyce (ID: 23269)	Good Ecological Potential	Moderate	High	Moderate	Diffuse source pollution from rural sources
Tuach Burn (ID: 23272)	Moderate Ecological Potential	Bad	Good	Bad	Barriers to fish migration, modification of bed, banks and shores and diffuse source pollution from rural sources.

3.1.14 In addition to the SEPA classification, a programme of monthly surface water quality monitoring in the River Don has been completed between November 2022 and July 2024. Appendix 13.1 presents a summary of the monitoring data collected to date and compares to this to freshwater Environmental Quality Standards (EQS) (where these are published).

3.1.15 The water types measured at the monitoring location range from chlorine to sulphate-type water. The more recent water samples (from 2024) show a trend towards chlorine-type where water quality is more chlorine-rich relative to sulfate (see the piper plot in Annex C of Appendix 13.1). There is a seasonal trend in major ions and heavy metals shown in the chemographs within the Appendix 13.1.

3.1.16 The overall water quality measured at the monitoring location is good, with all analytes except for copper and zinc meeting the EQS reported. The exceedances in copper and zinc are marginally above the EQS.

Flood risk

3.1.17 The SEPA future (2080) fluvial and present day pluvial (surface water) flood map is reproduced on Figure 3.2. SEPA flood maps indicate that parts of the Proposed Development are at risk of fluvial and surface water flooding.

3.1.18 To fully assess the flood risk at site, a detailed assessment of flood risk, including is presented in Appendix 13.2 (Flood Risk Assessment), and has been used to inform the emerging development design.

3.1.19 The flood risk assessment confirms that the above-ground elements of the gas connection compound and water abstraction, treatment and discharge site are outwith the 1 in 200 year plus an allowance for climate change flood extents and have flood free access and egress. The water intake and outfall structure and pipeline at the River Don are water-compatible infrastructure and would not impede flows or increase flood risk.

3.1.20 At the electrolysis plant site, a hydraulic model and hydrological assessment has been completed to quantify the risks of flooding.

3.1.21 Here, the flood risk assessment confirms a loss of functional floodplain associated with the Dewsford Burn of 100 m^3. The flood risk assessment shows that can be compensated for with the like-for like provision of flood compensatory storage so that there is no increase in flood risk to the proposed development nor to neighbouring land.

3.1.22 Alternatively, as shown in the flood risk assessment, it is possible to re-align a short section of Dewsford Burn (restoring it from a modified linear feature to a more sinuous and natural form) and create inset floodplain that results in no impact on flood levels downstream of the proposed development, details of which are presented in Appendix 13.2.

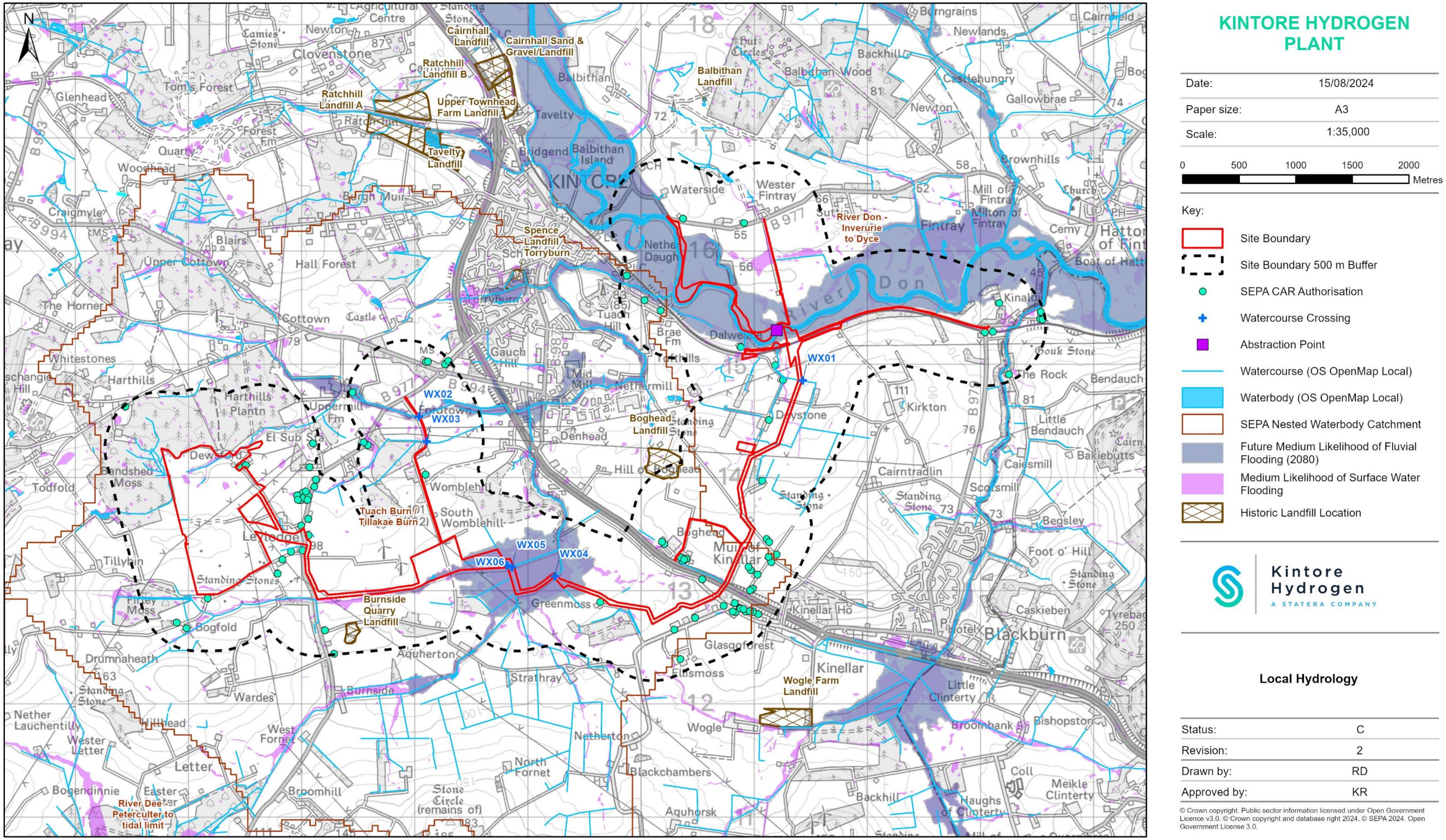
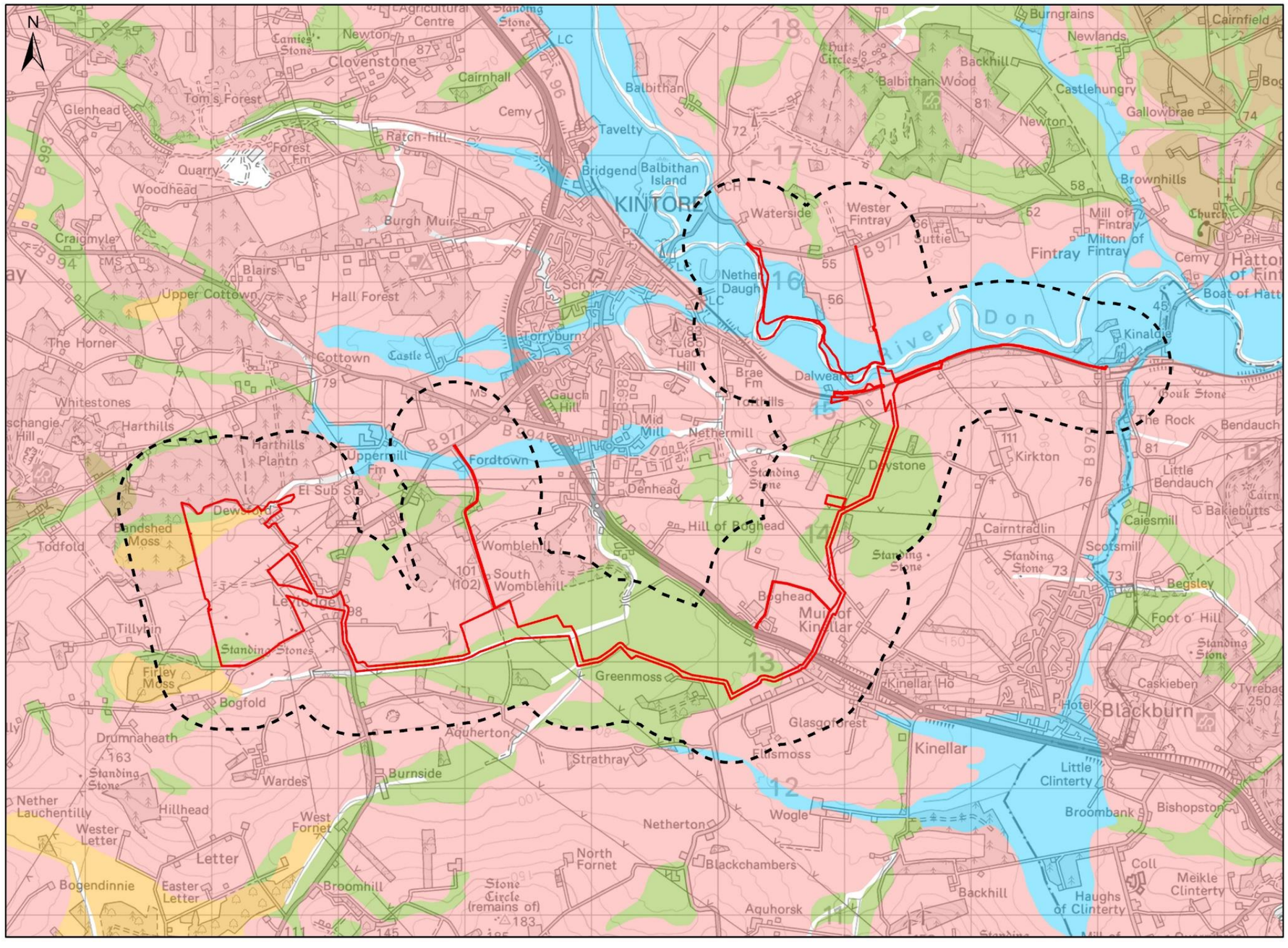


Figure 3.2: Local hydrology and historic landfills



KINTORE HYDROGEN PLANT

Date:	15/08/2024
Paper size:	A3
Scale:	1:35,000

0 500 1000 1500 2000 Metres

Key:

- Site Boundary
- Site Boundary 500 m Buffer

Soil Map of Scotland - Generalised Soil Type

- Alluvial soils
- Basin peats
- Brown soils
- Gleys
- Podzols

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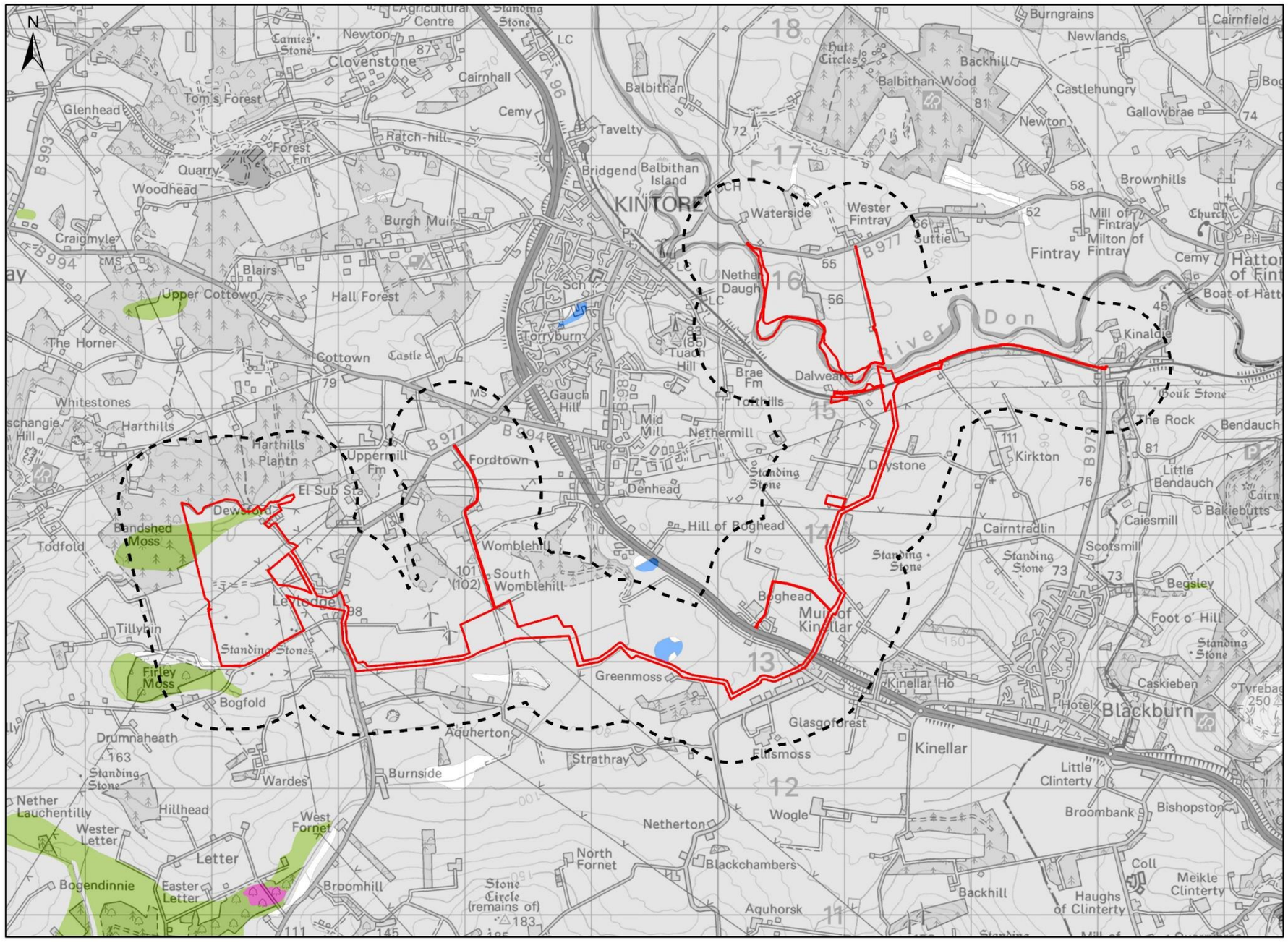
Soils

Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.3: Soils



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National importance for carbon-rich soil, deep peat and priority peatland habitat

- CLASS 1 All vegetation cover is priority peatland habitats. All soils are carbon-rich soils and deep peat
- CLASS 3 Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats can be found. Most soils are carbon-rich soils, with some areas of deep peat
- CLASS 4 Area unlikely to be associated with peatland habitats or wet and acidic type. Area unlikely to include carbon-rich soils
- CLASS 5 Soil information takes precedence over vegetation data. No peatland habitat recorded. May also show bare soil. All soils are carbon-rich soil and deep peat
- Mineral soils - Peatland habitats are not typically found on such soils
- Non-soil (i.e. loch, built up area, rock and scree)

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Peat Classification

Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.4: Peatland classification

Geology and soils

Soils

3.1.23 An extract of the 1:250,000 National Soil Map of Scotland is presented as Figure 3.3 which shows that the majority of the application site is underlain by podzols. Areas of gleys are recorded within the centre of the application boundary, to the south and west of the gas injection site, and alluvial soils are noted within the northern extent of the application boundary, to the north of the water abstraction, treatment and discharge site, near the River Don. Basin peat is recorded to bound the Dewsford Burn on the north-eastern site boundary.

3.1.24 Soil mapping shows that the soils are classified as between classes 3.1 and 5.3 agricultural land. The majority of the application site is underlain by class 3.2 agricultural land which is defined as land capable of average production and where high yields of barley, oats and grass might be obtained. The soils, and their value, are not rare locally or regionally.

Superficial deposits (including peat)

3.1.25 BGS superficial geology mapping (shown on Figure 3.5) confirms that the Proposed Development is largely underlain by Banchory Till Formation which comprises of glacial till.

3.1.26 An area of lacustrine deposits (clay, silt and sand) is located within the centre of the application site, to the south and west of the gas connection compound, whilst alluvium, glaciofluvial sheet deposits and river terrace deposits are noted near the banks of the larger watercourses within the study area including the Dewsford Burn, Tuach Burn and River Don.

3.1.27 The hilltops locally are shown to be absent of any superficial deposits. The application site is not shown to include any areas of superficial peat deposits.

3.1.28 Infiltration capacity testing has been completed within the northern extent of the electrolysis plant site near the Dewsford Burn. Nine trial pits were completed to characterise the shallow and superficial soils within this area of the application site and used to inform the drainage proposals for the site (Appendix 13.3: Drainage Impact Assessment). Site works included soil sampling and soil logging in accordance with BS5930. The results of the trial pitting confirmed the mapped geology was accurate with glaciofluvial deposits overlying glacial till, however, due the presence of clay of the infiltration capacity of the soils was low.

3.1.29 Priority peatland mapping published by NatureScot (shown on Figure 3.4) indicates that the majority of application site is underlain by mineral soils (Class 0), which is areas not designated as priority peatland habitat.

3.1.30 A small area of Class 5 peatland is noted to the west of the application site, near the banks of the Dewsford Burn (which correlates with the basin peat extent shown on the soils map). Class 5 peatland is not considered peatland habitat but soils may remain carbon-rich with areas of deep peat. As part of the site surveys this area was visited and it confirmed no peat was recorded at this location.

Bedrock geology

3.1.31 An extract of BGS bedrock geological mapping is presented as Figure 3.6, which shows that the western extent of the application site, including the electrolysis plant site and gas injection site, is underlain by Kemnay Pluton Formation (comprising granite) whilst the eastern extent of the application site, including the water abstraction, treatment and discharge site, is underlain by Aberdeen Formation (comprising psammite and semipelite).

Landfills

3.1.32 Consultation with Aberdeenshire Council confirmed that there are two landfills within the study area; Boghead Landfill and Burnside Quarry Landfill, however, no landfills are located within the application site. The location of recorded historic landfills are shown on Figure 3.2.

3.1.33 As no active or historic landfills would be intercepted or distributed by the proposed development they not considered further within this assessment.

Hydrogeology

Groundwater levels and flow

3.1.34 SEPA has confirmed that it does not hold any records of groundwater level monitoring within the vicinity of the application site or within the study area.

3.1.35 Extracts of the 1:100,000 scale Aquifer Productivity and Groundwater Vulnerability datasets and BGS 1:625,000 scale Hydrogeological Map of Scotland are presented as Figure 3.7 and Figure 3.8 respectively.

3.1.36 Figure 3.8 shows that the bedrock beneath the application site is underlain by rocks classified as a low productivity aquifer whereby small amounts of groundwater may be found in near surface weathered zones and fractures.

3.1.37 The Aquifer Productivity and Groundwater Vulnerability datasets (Figure 3.7) classifies the underlying aquifer (superficial and bedrock) according to the predominant

groundwater flow mechanism (fracture or intergranular) and the estimated groundwater productivity.

3.1.38 Review of Figure 3.7 confirms the bedrock aquifer is considered to be a low and very low productivity aquifer generally without groundwater except at shallow depths and with flow almost entirely through fractures and other discontinuities.

3.1.39 The superficial glacial till and lacustrine deposits are not considered significant aquifers whilst the alluvium, glaciofluvial sheet deposits and river terrace deposits are considered to be a moderate to high productivity aquifer with intergranular flow; groundwater within these deposits are likely to be in hydraulic conductivity with adjacent watercourses.

3.1.40 Groundwater vulnerability is divided into five classes (1 to 5) with 1 being least vulnerable and 5 being the most vulnerable. The Proposed Development is shown to be underlain by groundwater vulnerability Classes 4a, 4b and 5. The highest vulnerability is noted where no superficial deposits are recorded, and thus little attenuation of potential pollutants prior to entry to groundwater. Groundwater is less vulnerable where overlain by superficial deposits.

3.1.41 Infiltration testing was completed within three of the trial pits conducted as part of the site investigation works within the northern extent of the electrolysis plant site. The results of the infiltration testing at all three locations indicated a low infiltration rate of below 1 x 10^{-5} m/s.

Groundwater quality

3.1.42 All of Scotland's groundwater bodies have been designated as Drinking Water Protected Areas (DWPA) under the Water Environment (Drinking Water Protected Area) (Scotland) Order 2013 and require protection for their current use or future potential as drinking water resource.

3.1.43 The current status of groundwater bodies in Scotland has been classified by SEPA in accordance with the requirements of the Water Framework Directive (WFD). The Proposed Development is located within the Inverurie groundwater body (SEPA ID: 150685) which is designated with an overall classification of Good in 2022 (the latest reporting cycle).

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

3.1.44 A national vegetation classification (NVC) habitat mapping exercise was conducted in 2023 as part of the ecology baseline assessment to identify potential GWDTE within the application boundary. The results of the NVC habitat mapping exercise are discussed in detail within Chapter 8: Ecology and Biodiversity. Areas of potential GWDTE were mapped as part of baseline surveys. With reference to SEPA LUPS-31 guidance, areas of potential GWDTE are shown in Figure 3.9 to Figure 3.11. These areas of potential GWDTE surveyed as part of the ecology work are also shown in the figures in Appendix 8.10: NVC Classification Report. An assessment of the potential GWDTE, and in particular a discussion of whether the habitats are in fact sustained by ground or surface water, is summarised in Table 3.3.

Table 3.3: Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

NVC habitat	GWDTE classification	Discussion
M23	High	M23 dominant polygons are recorded to the north of Dewsford Burn and near an unnamed drain approximately 230m south of the River Don. The polygons are either underlain by low permeability glacial till deposits or noted on the banks a mapped watercourse / drain. It is therefore considered that these habitats are sustained by surface water, rainfall, waterlogging of the soils and drainage ditches rather than sustained by groundwater.
M6	High	M6 dominated polygons are shown on flat ground to the north of Dewsford Burn where several smaller drainage ditches are also noted. In addition, the polygons are shown to be underlain by low permeability glacial till. It is therefore considered that these habitats are sustained by surface water, rainfall, waterlogging of the soils and drainage ditches rather than by groundwater.
MG9	Moderate	MG9 dominated polygons are noted adjacent to the Dewsford Burn and in the flat areas to the north of the burn where several drainage ditches are also present. It is therefore considered that these habitats are sustained by surface water, rainfall, waterlogging of the soils and drainage ditches rather than by groundwater.
MG10	Moderate	A small area of MG10 is noted south of the Dewsford Burn in an area of low topography where surface water is likely to gather. In addition, a small drainage ditch is noted within the centre of the polygon. This distribution is typical of that sustained by surface water rather than emergent groundwater.
W6	Moderate	W6 dominated polygon is noted along the banks of the Silver Burn, to the north of the railway embankment and approximately 45m south of the River Don. This distribution is typical of that sustained by surface water rather than emergent groundwater.

3.1.45 Review of Table 3.3 shows that the potential high and moderate GWDTE are generally located on ground which is underlain by glacial till or near to watercourses and drainage ditches. This distribution is not typical of a habitat sustained by groundwater but rather it is likely to be supported by rainfall, surface water runoff and waterlogging of soils.

3.1.46 Buffers to areas of potential GWDTE specified in SEPA guidance therefore do not apply, however, safeguards to maintain these habitats and the surface water sources

to these habitats will need to be maintained during construction and operation of the proposed development, as discussed in Section 2.8.

Private water supplies and authorised sites

3.1.47 Consultation with Aberdeenshire Council confirmed that there are no private water supplies within the study area. Therefore, private water supplies are not considered further in this assessment.

3.1.48 SEPA has provided records of CAR authorisations within the study area, a summary of which is provided below:

- no authorisations are noted within the application site except for the water abstraction licence to facilitate the Proposed Development;
- 85 private sewage discharges;
- two discharges for existing sewage treatment works;
- one discharge for industrial or commercial process water; and
- four registrations for agricultural activities other than irrigation.

3.1.49 The proposed development already benefits from a CAR authorisation for the abstraction of water for hydrogen production (CAR/L/5004426) from the River Don in the eastern part of the application boundary. The daily maximum abstraction under this CAR Authorisation must not exceed 67,392m^3.d or 0.780 $m^3.s^{-1}$.

3.1.50 The authorisation stipulates that a minimum of 34.6% of the abstracted water must be returned to the water environment (the River Don) and specifies a “Hands Off Flow” which only permits abstraction of water from the River Don when the flow of water in the river at the abstraction point is equal to or greater than 4.860 $m^3.s^{-1}$

3.1.51 The authorisation requires a fish screen (with a maximum gap size of 10 mm) to be provided and installed on the abstraction intake.

Summary of sensitive receptors

3.1.52 Table 3.4 outlines the receptors identified as part of the baseline study and their sensitivity based upon criteria contained in Table 2.3. Receptors with a negligible sensitivity are not considered further in this assessment.

Table 3.4: Summary of sensitive receptors

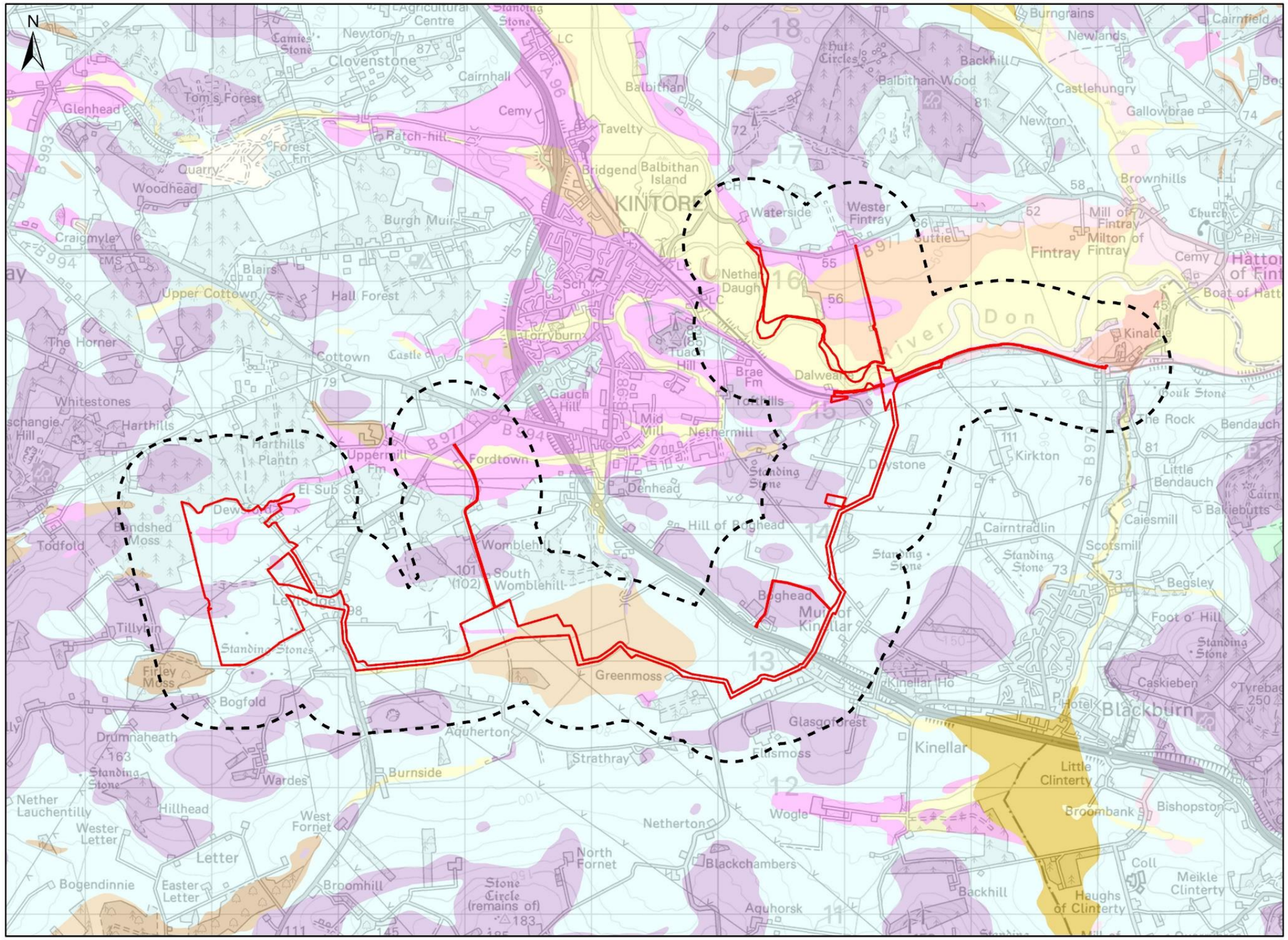
Receptor	Sensitivity	Reason for sensitivity
Water Dependent Statutory Designated Sites	Not sensitive	No water dependent designated sites are noted within the study area.
Geology	Not sensitive	Superficial and bedrock geology is not rare and is not considered sensitive. No geological designated sites are recorded within the study area.
Soils	Low	Shown that the soils at the Proposed Development are not rare nor have high agricultural value. It is recognised that will retain entrained carbon and thus it is important that their structure and integrity is maintained.
Groundwater	High	Groundwater beneath the application site has been classified as Good and vulnerability classified as High. All of Scotland’s groundwater bodies have been designated as a DWPAs.
GWDTE	High	Areas of potential GWDTE were suggested by NVC mapping (see Appendix 8.10) but it has been shown that the habitats are not sustained by groundwater, rather by surface water. Measures will be required to sustain existing surface water flow paths to these habitats.
Surface water	High	Surface watercourses that drain the application site have been classified by SEPA with Good to Moderate ecological potential.
Surface water DWPAs	Not sensitive	None of the surface water catchments which drain the site have been designated as a DWPA.
Flooding	Moderate	Parts of the application site are shown to be at risk of fluvial and surface water flooding. The site-specific flood risk assessment confirms that the majority of the proposed development is not at risk of flooding. A detailed assessment of the potential flooding at the electrolysis plant site has been completed, which has been informed of hydraulic modelling of the Dewsford Burn and is presented in Appendix 13.2. In addition, the development has potential, without an appropriate drainage design, to alter surface water flow paths and could increase flood risk downstream of the application site. An outline surface water drainage strategy has been completed and is presented in the Drainage Impact Assessment at Appendix 13.3.
Private water supplies	Not applicable	No private water supplies are considered at risk from the Proposed Development.
Licenced abstraction and discharge sites	Not applicable	With the exception of the abstraction for the Proposed Development, no licenced water abstractions are recorded within the study area. Licenced sites related to discharges are not at risk from the Proposed Development.

3.2 Future baseline

3.2.1 Climate change studies predict a decrease in summer precipitation and an increase in winter precipitation alongside slightly higher average temperatures. This suggests that there may be greater pressures on water supplies and water levels in summer months in the future. In addition, summer storms are predicted to be of greater intensity.

Therefore, peak fluvial flows associated with extreme storm events, in summer and winter, may also increase in volume and velocity.

3.2.2 These potential changes are considered in the assessment of effects.



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Paper size:	A3
Scale:	1:35,000

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Key:

- Site Boundary
- Site Boundary 500 m Buffer

Superficial Geology

- Alluvial Fan Deposits - Gravel, Sand, Silt And Clay
- Alluvium - Clay, Silt, Sand And Gravel
- Banchory Till Formation – Diamicton
- Blairdaff Moraine Formation - Diamicton, Sand And Gravel
- Glaciofluvial Sheet Deposits - Gravel, Sand And Silt
- Glen Dye Silts Formation - Clay, Silt And Sand
- Lacustrine Deposits - Clay, Silt And Sand
- Lochton Sand And Gravel Formation - Sand And Gravel
- Lochton Sand And Gravel Formation - Sand, Gravel And Boulders
- Peat – Peat
- River Terrace Deposits - Gravel, Sand And Silt
- River Terrace Deposits - Gravel, Sand, Silt And Clay
- Bedrock at or near the Surface

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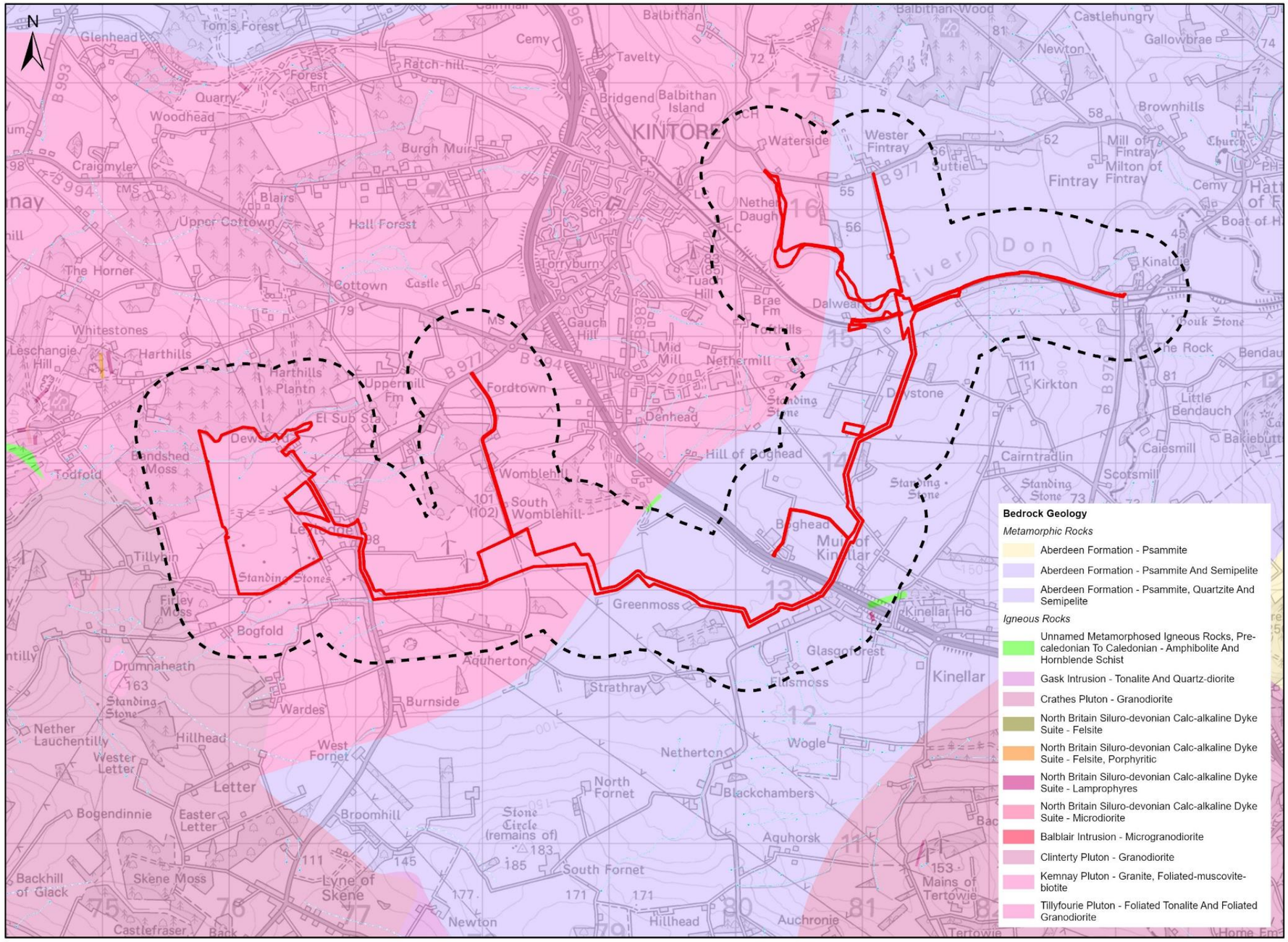
Superficial Geology

Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.5: Superficial geology



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- Site Boundary
- Site Boundary 500 m Buffer

Bedrock Geology Linear Features

- Axis of Large Scale Glacial Gouge
- Esker Crestline
- Glacial Meltwater Channel Centre Tail
- Glacial Meltwater Channel Centre Undiff
- Glacial Meltwater Channel Margin
- Marked Concave Break of Slope

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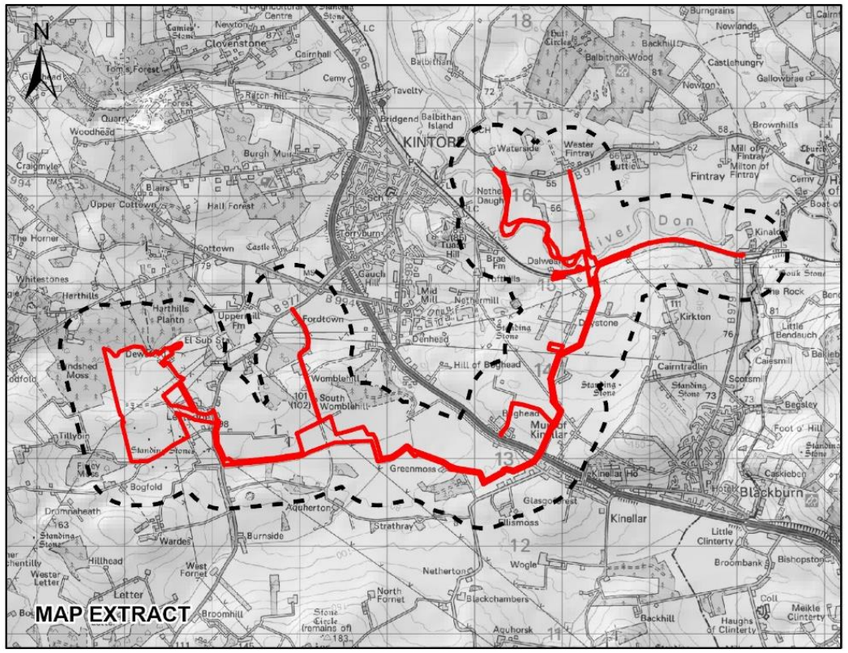
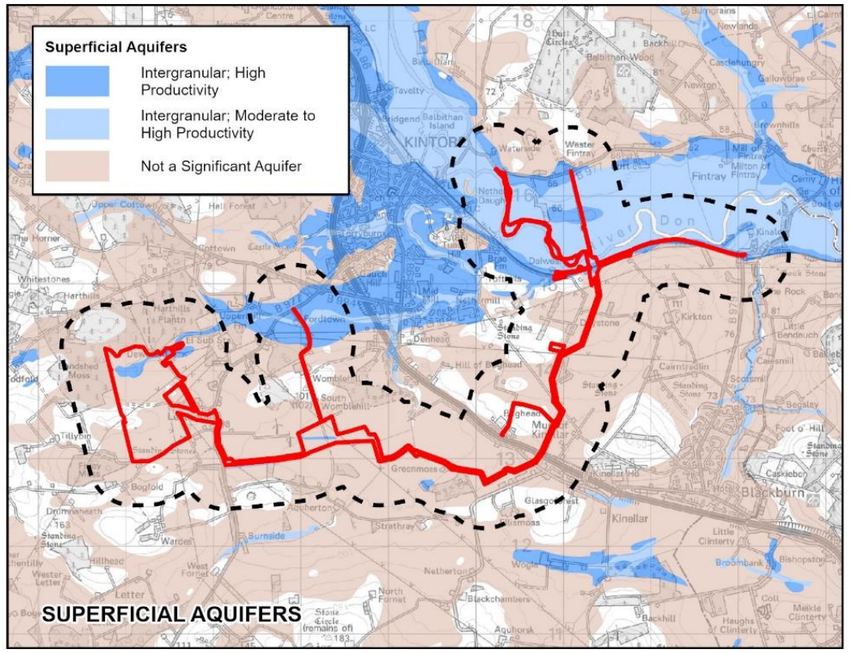
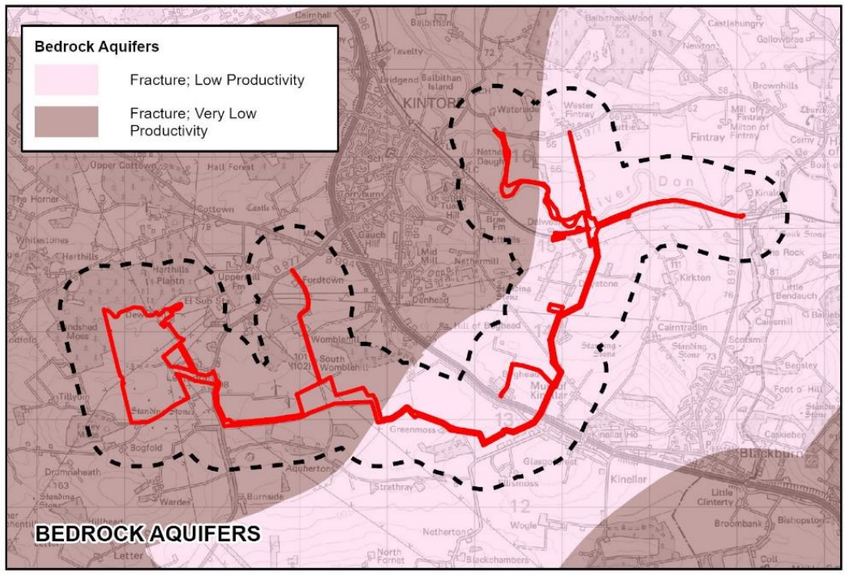
Bedrock Geology

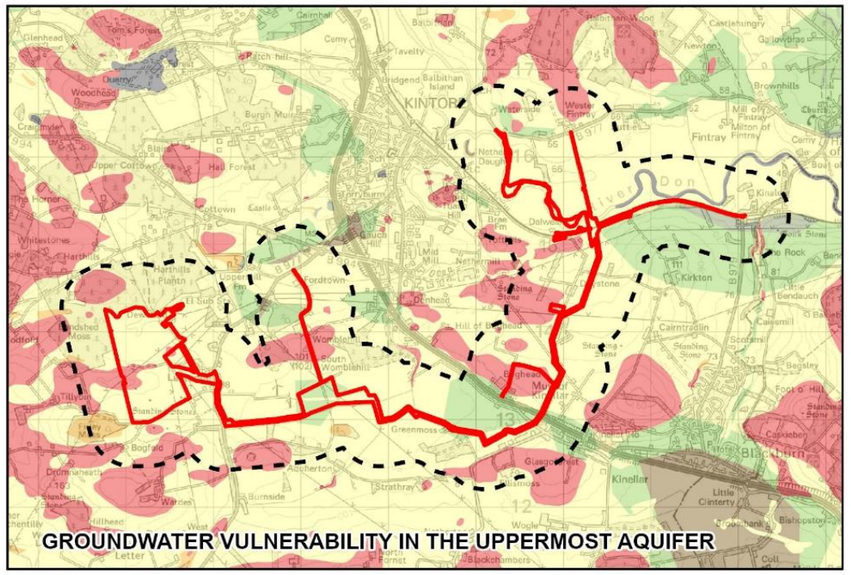
Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.6: Bedrock geology









KINTORE HYDROGEN PLANT

Date:	15/08/2024
Paper size:	A3
Scale:	1:70,000

0 1 2 3 Kilometres

Key:

Site Boundary

Site Boundary 500 m Buffer

Groundwater Vulnerability in the Uppermost Aquifer Vulnerability Class

5 - Vulnerable to Most Pollutants, with Rapid Impact in Many Scenarios.

4a - Vulnerable to Those Pollutants not Readily Adsorbed or Transformed. Less Likely to Have Clay Present in Superficial Deposits (Therefore Generally Higher Vulnerability Than 4b).

4b - Vulnerable to Those Pollutants not Readily Adsorbed or Transformed. More Likely to Have Clay Present in Superficial Deposits (Therefore Generally Lower Vulnerability Than 4a).

3 - Vulnerable to Some Pollutants, but Only When They are Continuously Discharged/Leached.

2 - Vulnerable to Some Pollutants, but Only When They Are Continuously Discharged/Leached.

1 - Only Vulnerable to Conservative Pollutants in the Long Tterm When Continuously and Widely Discharged/Leached.

0 - Not Sufficient Data to Classify Vulnerability: e.g. Below Lochs; in Urban Areas Where Geological and/or Soils Data are Missing; or Where Superficial Deposits are Mapped but not Classified.

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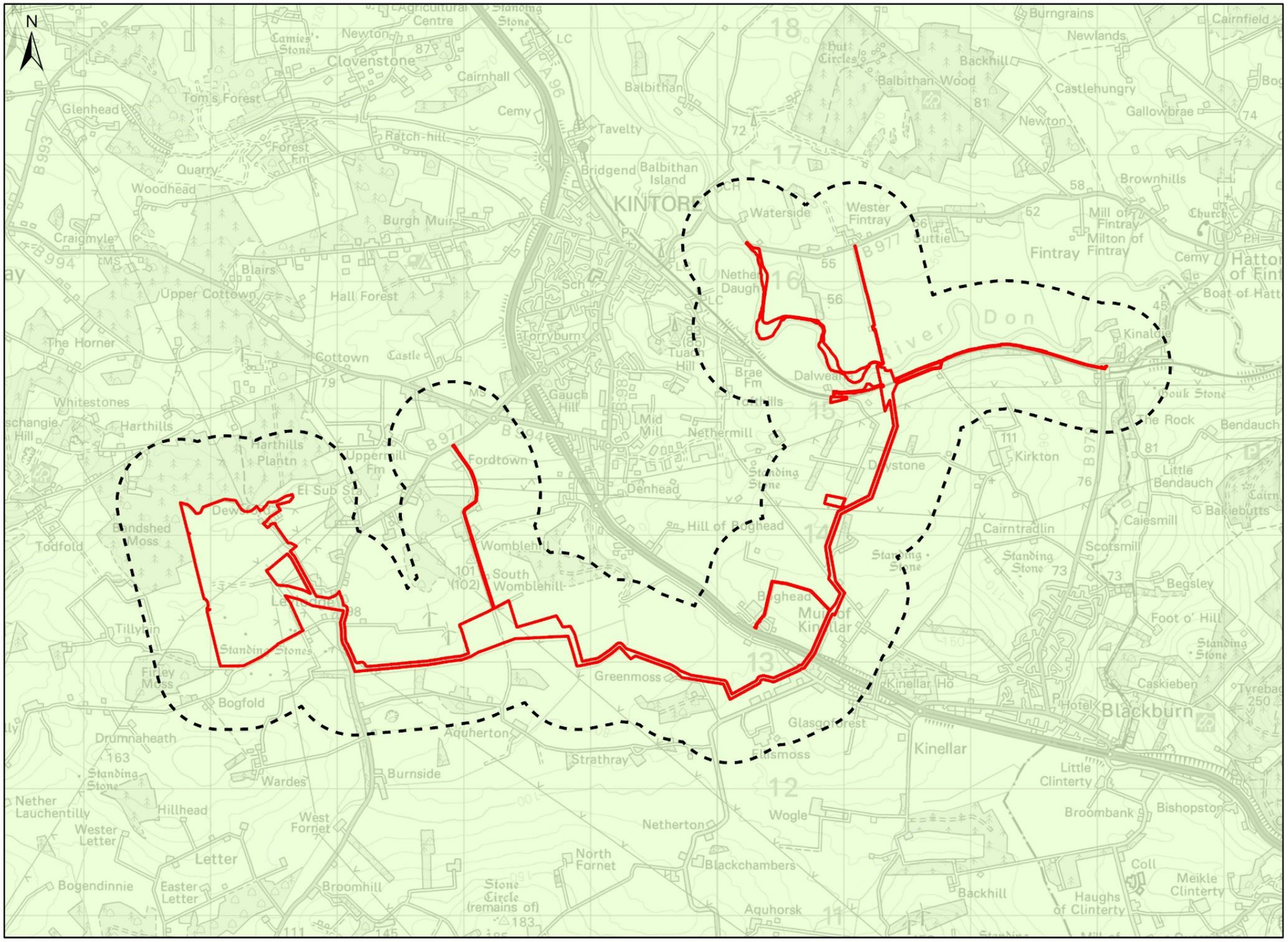
Groundwater Vulnerability

Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.7: Groundwater vulnerability



KINTORE HYDROGEN PLANT

Date:	15/08/2024
Paper size:	A3
Scale:	1:35,000

0 500 1000 1500 2000 Metres

Key:

- Site Boundary
- Site Boundary 500 m Buffer

Aquifer in which Flow is Virtually All Through Fractures and Other Discontinuities

- 2C - Low Productivity Aquifer

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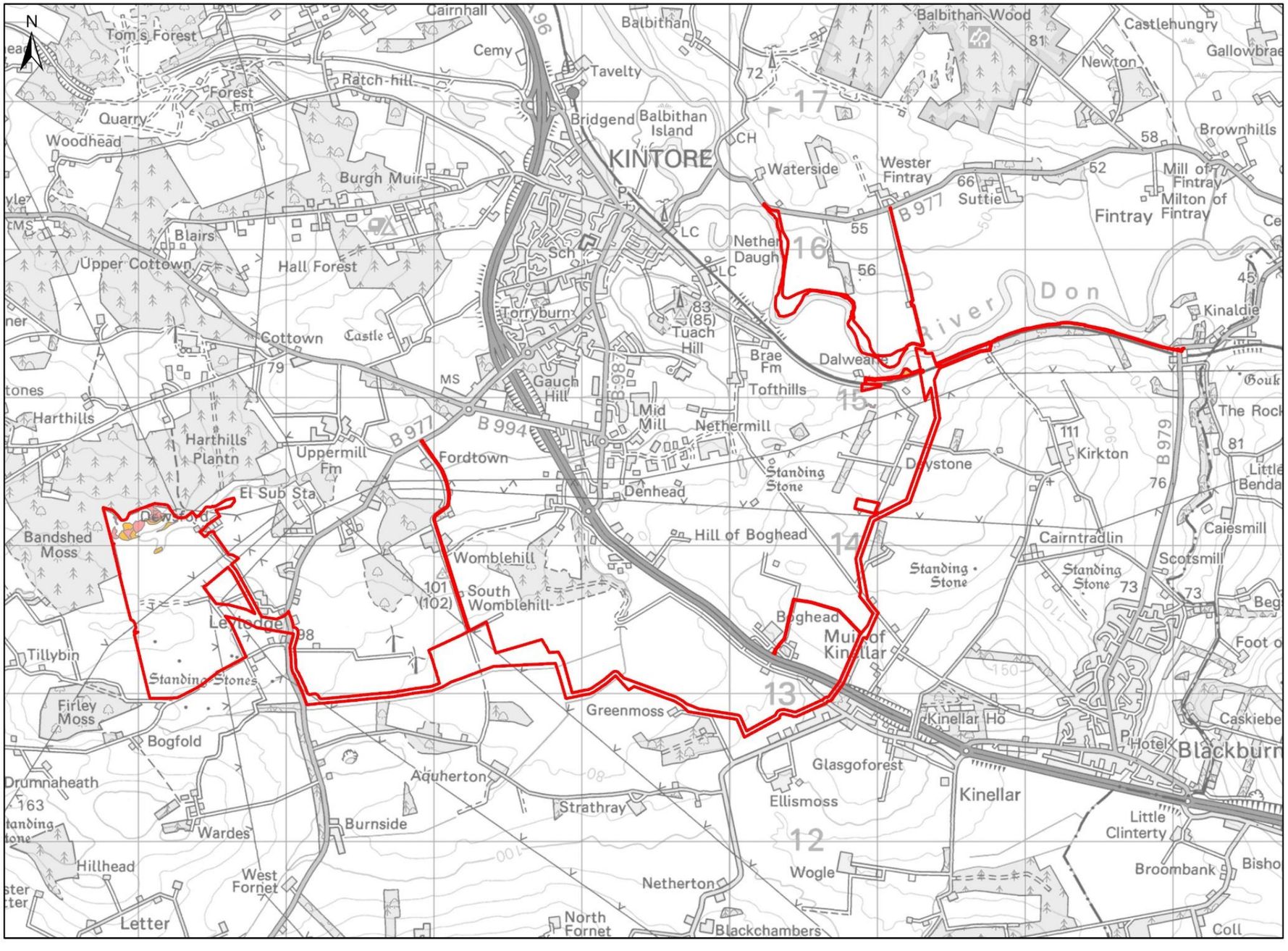
Regional Hydrogeology

Status:	C
Revision:	2
Drawn by:	RD
Approved by:	KR

Figure 3.8: Regional hydrogeology



KINTORE HYDROGEN PLANT

Date:	29/08/2024
Paper size:	A3
Scale:	1:30,000

0 500 1000 1500 Metres

Key:

Site Boundary

Groundwater Terrestrial Ecosystems (GWDTE) as Defined Using SEPA LUPS-31 Guidance

High

Moderate

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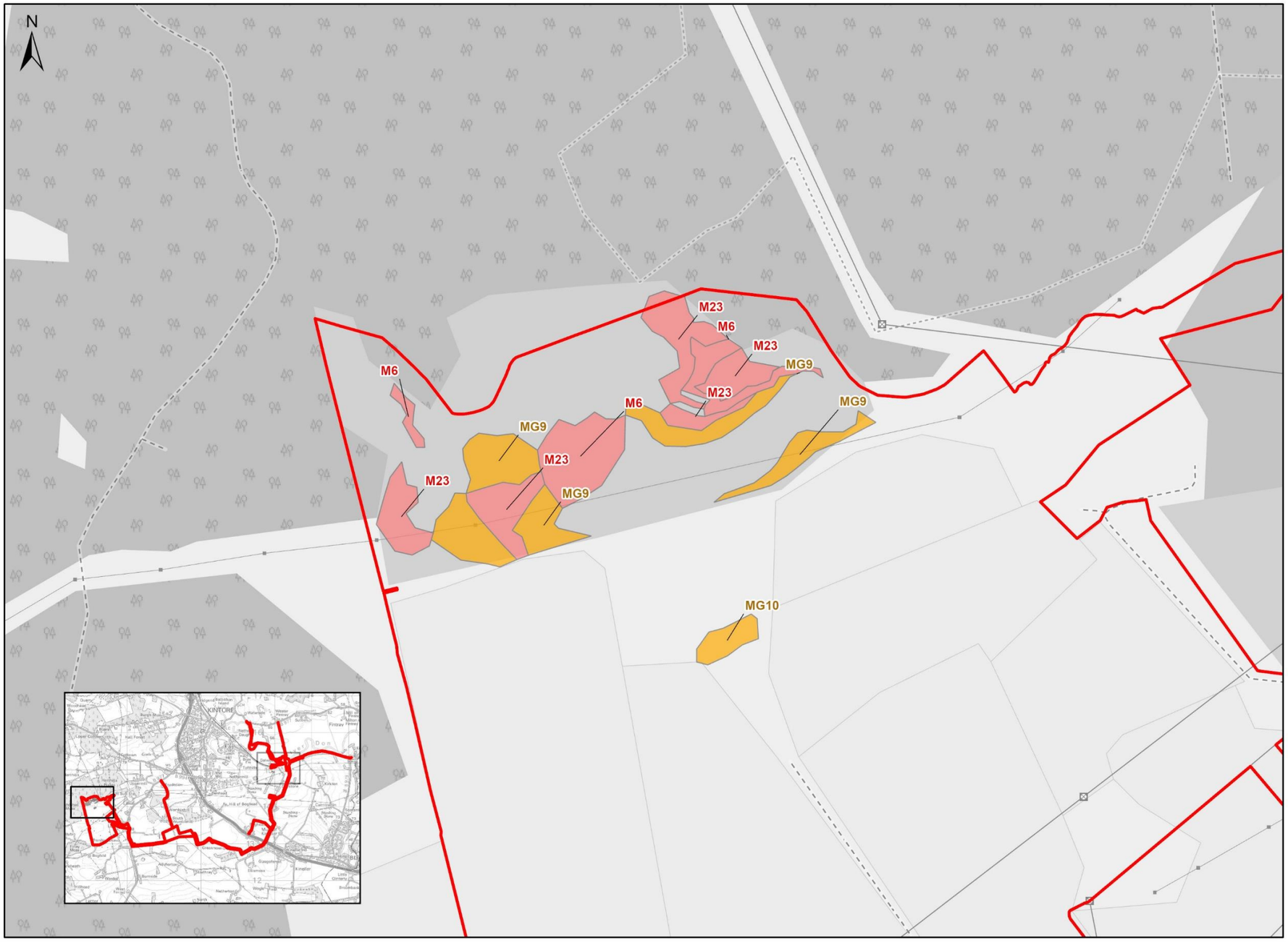
Potential GWDTE (1 of 3)

Status:	C
Revision:	1
Drawn by:	RD
Approved by:	KR

Figure 3.9: Potential GWDTE – overview



KINTORE HYDROGEN PLANT

Date:	29/08/2024
Paper size:	A3
Scale:	1:4,000

0 100 200 Metres

Key:

Site Boundary

Groundwater Terrestrial Ecosystems (GWDTE) as Defined Using SEPA LUPS-31 Guidance

High

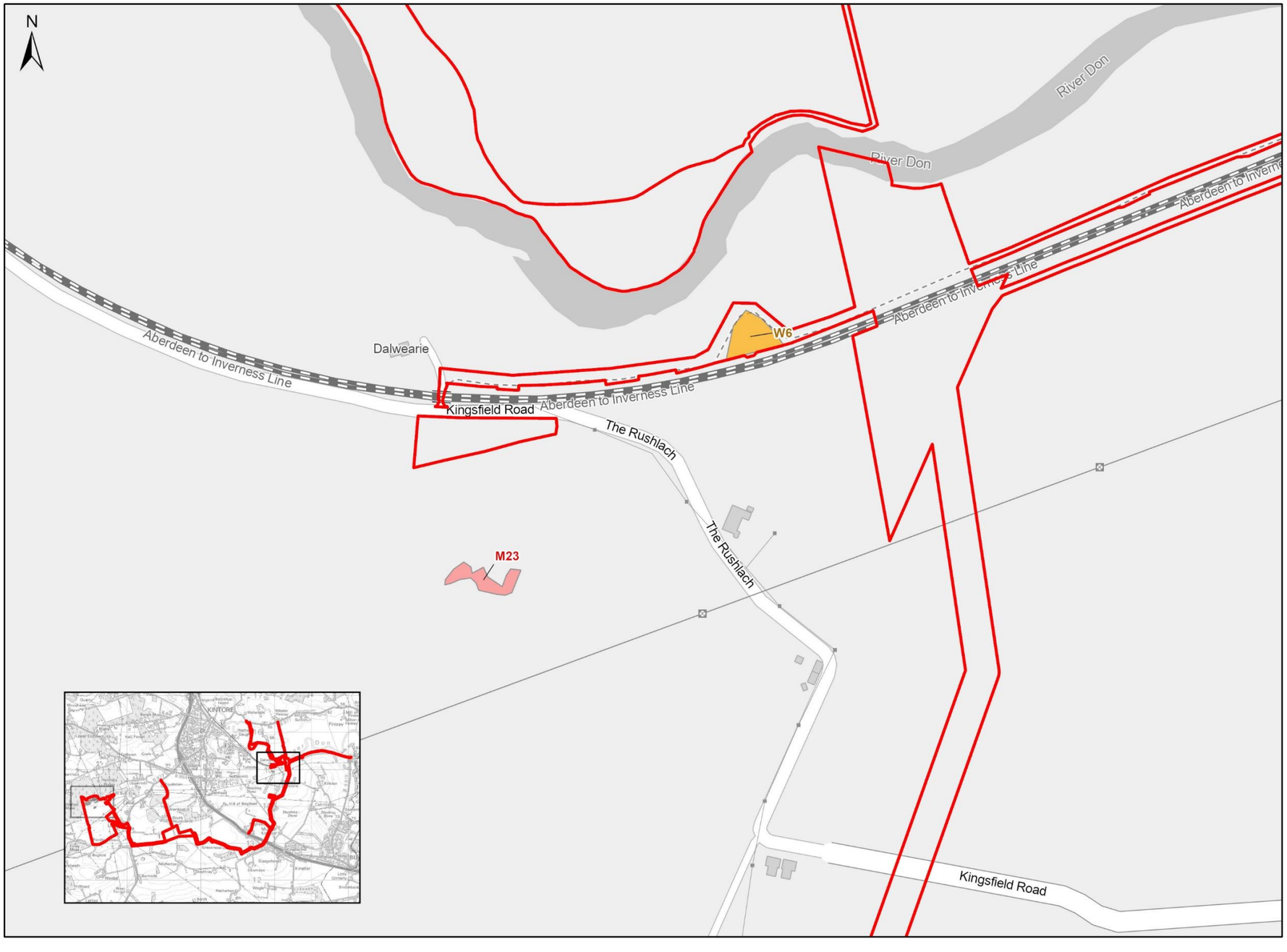
Moderate

Kintore Hydrogen
A STATERA COMPANY

Potential GWDTE (3 of 3)

Status:	C
Revision:	1
Drawn by:	RD
Approved by:	KR

Figure 3.10: Potential GWDTE – west area



KINTORE HYDROGEN PLANT

Date:	29/08/2024
Paper size:	A3
Scale:	1:4,000

0 100 200 Metres

Key:

Site Boundary

Groundwater Terrestrial Ecosystems (GWDTE) as Defined Using SEPA LUPS-31 Guidance

High

Moderate

Kintore Hydrogen
A STATERA COMPANY

Potential GWDTE (2 of 3)

Status:	C
Revision:	1
Drawn by:	RD
Approved by:	KR

Figure 3.11: Potential GWDTE – east area

4 Assessment of Effects

4.1 Construction phase

Soils

4.1.1 During the construction phase there will be a need to excavate, store and handle soils to enable construction of the proposed development, establish the landscaping proposals and to reinstate temporary construction areas such as the pipeline trench and temporary construction compounds.

4.1.2 Without appropriate planning and controls there is potential for the integrity and the structure of the disturbed soils to be impaired and their value diminished, with a result loss of value, seed stock and retained carbon.

4.1.3 As discussed in Section 2.8, site investigation would be undertaken to fully quantify and characterise the volume of topsoil and subsoil that would be disturbed and this information would be used to development a site-specific Soil Management Plan (SMP) which would form part of the adopted CEMP agreed with stakeholders.

Magnitude of impact

4.1.4 Poor handling and safeguarding of soils would impair the quality and integrity of the soil. This has the potential to affect surface water drainage and value of the soils locally, and limited to the area over which it has been disturbed. The duration of the effect would be short to medium term and the impact is not considered to be a frequent occurrence: it would only occur during the construction phase of the project combined with a failure of the management measures for preventing degradation of soil resources.

4.1.5 It has been shown that the soil resources are not rare locally or regionally and the extent of the construction works is very small in comparison to the overall extent and occurrence of similar soils.

4.1.6 The proposed safeguards embedded in the development design and the committed best practice construction techniques would reduce the magnitude of potential impact.

4.1.7 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.1.8 Given their common occurrence and no specific rarity value the soils are considered to be of **low** sensitivity.

Significance of effect

4.1.9 Overall, it is predicted that the **negligible** impact on this **low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.10 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.11 The residual effect is predicted to be **negligible**, which is not significant.

Pollution risk

4.1.12 During the construction phase, there is the potential for a pollution event to affect surface water and local groundwater bodies impacting on their water quality.

4.1.13 Contamination of surface water runoff from machinery, leakage, and spills of chemicals from vehicle use and the construction of hardstanding also have the potential to affect surface water bodies. Potential pollutants include oil, fuels, and cement.

4.1.14 Construction of the abstraction and effluent discharge structures will involve work adjacent to and within the River Don. The works would only be undertaken following receipt of a CAR authorisation from SEPA for these specific works, the application for which would include details of the structures what will be constructed and a method statement for their construction. It is expected that SEPA would consult with both NatureScot and the Don District Salmon Fishery Board (DDSFB) during determination of the CAR application.

4.1.15 The design of the abstraction and effluent discharge structures will be determined by the developer at the detailed design stage of the project. At that stage, method statements to mitigate potential pollution risks will be prepared and be submitted in support of the CAR application.

4.1.16 Similarly, design details for the proposed watercourse crossings, and works near to or within the Dewsford Burn, would be determined at the detailed design stage and by the developer. The details and construction method statements would then be included in a CAR application made to SEPA

4.1.17 As set out in Section 2.8, the Proposed Development would be constructed in accordance with best practice technical guidance, GPPs and other codes of best practice, to limit the potential for contamination of both ground and surface waters. In addition, a site-specific CEMP (building on the Outline CEMP submitted with this application) would be prepared by the developer and typically form a contractual

requirement for the Principal Contractor to comply with. This includes a surface water quality management plan.

4.1.18 The above measures would significantly reduce the likelihood of pollutants, including suspended solids, being discharged to nearby watercourses or groundwater.

Magnitude of impact

4.1.19 A pollution event has the potential to affect surface water and groundwater quality locally. The duration of the effect would be short-term and the impact is not considered to be a frequent occurrence: it would only occur in the event of an accidental spillage occurring combined with a failure of the management measures for preventing discharge of contaminated runoff.

4.1.20 The extent of the construction works within the surface water catchments and groundwater bodies is small in comparison to the overall catchments, which would allow dilution of potential pollution events due to the great majority of surface and groundwater flows entering watercourses in the catchments from outside the construction area, and therefore remaining uncontaminated even in the event of a spillage. The surface water network is transient by nature and therefore likely to recover quickly, however, the groundwater bodies are likely to have a slower recovery response to any potential pollution event.

4.1.21 The proposed safeguards embedded in the development design and the committed best practice construction techniques would reduce the magnitude of potential impact.

4.1.22 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.1.23 Groundwater beneath the application site has been classified as of ‘good’ status and vulnerability classified as ‘high’. All of Scotland’s groundwater bodies have been designated as a DWPA. Surface watercourses that drain the application site have been classified by SEPA as having ‘good’ to ‘moderate’ ecological potential.

4.1.24 The surface water and groundwater receptors are therefore considered to be of **high** sensitivity.

Significance of effect

4.1.25 Overall, it is predicted that the **negligible** impact on the **high** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.26 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.27 The residual effect is predicted to be **negligible**, which is not significant.

Erosion and sedimentation

4.1.28 Construction phase activities of the Proposed Development will require earthworks resulting in the removal of vegetation cover and excavation of mineral subsoil. Exposed and disturbed ground may increase the risk of erosion and subsequent sediment-laden surface water runoff. The release of suspended solids is primarily a consequence of the physical disturbance of the ground during the construction phase, if not correctly compacted.

4.1.29 Site traffic during the construction phase also has the potential to cause erosion and increase sedimentation loading during earthworks, and due to increased areas of hardstanding and such features as stockpiles, tracks and excavations etc., which could be washed by rainfall into surface water features. The has the potential to reduce surface water quality, increase turbidity levels, reduce light and oxygen levels and affect ecology including fish populations.

4.1.30 Construction of hardstanding, diversion of drainage channels and the construction of watercourse crossings associated with the Proposed Development are the key potential sources of erosion and sediment generation. Adherence to good practice measures would ensure that any material generated is not transported into nearby watercourses or to groundwater.

4.1.31 The Outline CEMP will be developed further at the detailed design stage and include a SMP which will detail methods for handling soils, their storage and re-use so as to maintain their integrity and structure but also confirm how erosion and sedimentation will be limited and controlled. The SMP will detail storage locations for sols and drainage measures to collect and treat runoff from working area. It would also confirm that no soil storage would occur in areas identified at potentially flood risk.

4.1.32 It is the intention that temporary working areas are progressively restored thus minimising the potential and duration over which erosion and sedimentation could occur.

4.1.33 Immediately post-construction, newly excavated drains, surface treatment to trenches and areas of landscaping may be prone to erosion as any vegetation would not have matured. Immediately post-construction, flow attenuation measures will remain and be

maintained to slow runoff velocities and prevent erosion until vegetation becomes established. The establishment of vegetation will be a requirement of the Biodiversity Enhancement and Management Plan (BEMP).

Magnitude of impact

4.1.34 Sedimentation of surface waters has the potential to affect surface water in the local network. The duration of the effect would be short-term and the impact is not considered to be a frequent occurrence and would only occur in the event of uncontrolled runoff of water from an area of working or soil / subsoil stockpiling.

4.1.35 The extent of the construction works within the surface water catchments is small in comparison to the overall catchments which will allow some dilution of potential sedimentation events. The surface water network is transient by nature and therefore likely to recover quickly.

4.1.36 The proposed safeguards embedded in the development design and the committed best practice construction techniques would reduce the magnitude of potential impact.

4.1.37 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.1.38 Surface watercourses that drain the application site have been classified by SEPA with ‘good’ to ‘moderate’ ecological potential.

4.1.39 The surface water receptors are therefore considered to be of **high** sensitivity.

Significance of effect

4.1.40 Overall, it is predicted that the negligible impact on the high sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.41 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.42 The residual effect is predicted to be **negligible**, which is not significant.

Surface water and groundwater flow

4.1.43 Water abstraction (dewatering) associated with construction works can result in local lowering of the water table. Trenches, without appropriate mitigation measures, can also lower high groundwater levels and provide a preferential drainage route for groundwater movement that can lead to local and permanent drying of soils, superficial deposits and/or water dependent habitats.

4.1.44 The proposed development has been designed to avoid sensitive ecological habitats, including potential areas of GWDTE. Furthermore, dewatering associated with construction (for building foundations and pipeline trenches) would be shallow and temporary and within superficial deposits which have little groundwater. Therefore, limited, or little dewatering is likely to be required.

4.1.45 Temporary dewatering and water management may also be required during construction of the River Don abstraction point and for the discharge headwall. The construction methods would be confirmed at the detailed design stage, by the developer and Principal Contractor, and as stated previously would from part of a CAR application made to SEPA. This would detail measures and controls that would be used to manage any temporary dewatering, which, for example, might include the construction of a temporary coffer dam, to isolate the temporary works form the River Don.

4.1.46 Should, at the detailed design stage, it be proposed to modify the alignment of the Dewsford Burn, this too would only be undertaken with prior approval from SEPA and in accordance with a CAR authorisation. This would include proposed construction method statements and proposed channel form. Any new alignment of the burn would be constructed “offline” and vegetation allowed to establish before surface water flows in the Dewsford Burn are diverted to the new alignment. This would ensure that surface water flows downstream of the site are maintained.

4.1.47 As part of the detailed design stage of the project, the construction details for the required watercourse crossings will be confirmed. Again these details will be agreed as required by the CAR and authorisation obtained from SEPA. The method statement that will accompany the CAR application will confirm how surface water flows will be maintained. It is expected, given the size of the watercourse crossings (see Appendix 13.4) that industry standard approaches will be used, such as HDD or temporary over pumping; this will ensure that surface water flows are maintained.

4.1.48 Best practice measures have been included in the Outline CEMP to control and manage surface and groundwater flows such as to maintain existing water flow paths at a local scale and ensure that water flow paths to water-dependent habitat would be maintained.

Magnitude of impact

4.1.49 Water abstractions and dewatering during construction would be limited and only impact the local surface water and groundwater network. The duration of the effect would be short-term.

4.1.50 The extent of the construction works within the surface water catchments and groundwater bodies is relatively small in comparison to the overall catchments and therefore unlikely to have a measurable effect on groundwater and surface water flows.

4.1.51 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.1.52 Groundwater beneath the application site has been classified as ‘good’ and vulnerability classified as ‘high’. All of Scotland’s groundwater bodies have been designated as a DWPA. Surface watercourses that drain the application site have been classified by SEPA with ‘good’ to ‘moderate’ ecological potential.

4.1.53 The surface water and groundwater receptors are therefore considered to be of **high** sensitivity.

Significance of effect

4.1.54 Overall, it is predicted that the negligible impact on the high sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.55 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.56 The residual effect is predicted to be **negligible**, which is not significant.

Flood risk

4.1.57 Without appropriate control during construction, flood risk can be increased. For example, areas of compacted soil, or large areas of exposed low permeability subsoil, could result in faster rates of rainfall runoff which could increase flood risks to construction employees, their equipment and to downstream property. Likewise, without appropriate controls construction of watercourse crossings can cause blockage of surface watercourses, which results in out of bank water flow and increases flood risk on site and downstream of site.

4.1.58 As set out in the Outline CEMP, as part of the detailed site design the Principal Contractor will be required to prepare a detailed construction method statement which will have regard to areas of known and potential flood risk.

4.1.59 It is proposed that any rainwater and limited groundwater ingress which collects in the excavations during construction would be stored and attenuated prior to controlled discharge to ground or surface water network adjacent to the excavation. Attenuation of runoff generated within the excavations would allow settlement of suspended solids within the runoff prior to discharge in accordance with 'Site control' component of the SuDS 'management train'.

4.1.60 The SMP will be used to control the stripping and storage of topsoil and subsoil. In accordance with best practice areas of disturbed ground will be restored as soon as practicable which will limit the potential for rapid rainfall runoff and an increase in flood risk. Where soils need to be stored drainage measures will be deployed to collect and control incident rainfall.

4.1.61 The CAR application for the River Don abstraction point and water treatment plant effluent discharge structure will include a construction method statement. It is recognised that these works are water-compatible development, and inherently at flood risk. A flood risk assessment and evacuation plan will be detailed in the method statement. The River Don is a large watercourse and as a result it is benefits from a good telemetry network. There is, therefore, adequate time to provide warning of a potential fluvial flood even and for mitigation measures to be deployed at this location to safeguard construction staff and machinery and not increase flood risk.

4.1.62 Temporary construction compounds will be positively drained e.g. incident rainfall will be collected and managed in accordance with SuDS principles. No uncontrolled discharge of water will be made from the compounds.

4.1.63 As part of the adopted CEMP, which will be agreed with SEPA and Aberdeenshire Council prior to construction, a method statement and design for the watercourse crossings will be prepared and presented. The construction works would then be undertaken in accordance with the agreed design and method statement.

4.1.64 The efficacy of the construction works would be monitored by the project ECoW and confirmed by the proposed construction phase water monitoring programme.

Magnitude of impact

4.1.65 Flood risk during construction would be localised to the areas of working and potential increase to flood risk would be limited to the area immediately adjacent to these as the proposed development footprint is very small when compared to the surface water catchments within which it is located. No significant increase in flood water flows or

floodplain extents would occur. The duration of the effect would be short-term and worst impacts are likely to occur following high rainfall and storms.

4.1.66 The magnitude of impact is therefore considered to be **negligible**.

4.1.67 The magnitude of the increase in impermeable area is not sufficient to have a measurable effect on groundwater levels, as the extent of the impermeable area is insignificant compared to the extent of the underlying geology and groundwater.

Sensitivity of the receptor

4.1.68 The majority of the Proposed Development is not shown to be at risk from flooding and the extent of the construction works within the surface water catchments is relatively small in comparison to the overall catchments.

4.1.69 Flooding is therefore considered to be a receptor of **moderate** sensitivity.

Significance of effect

4.1.70 Overall, it is predicted that the negligible impact on the moderate sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.71 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.72 The residual effect is predicted to be **negligible**, which is not significant.

Future monitoring

4.1.73 A programme of visual inspection of temporary and permanent water control measures and of receiving watercourses would be used during the construction phase to ensure that construction works were not impairing flows or quality in the adjacent watercourses. The same monitoring programme can be used to assess the capacity of temporary water control features and ensure that flood risks are being appropriately managed.

4.1.74 The monitoring would be used to allow a rapid response to any pollution incident and also to assess the impact of good practice or remedial measures. Monitoring frequency would increase during the construction phase if remedial measures to improve water quality were implemented.

4.2 Operational phase

Abstraction of water from the River Don

4.2.1 Operation of the hydrogen facility will require routine abstraction of the water from the River Don, and without controls and safeguards this could impair surface water flows in the river, which could affect habitats, animals and fish which are dependent on the river.

4.2.2 A CAR application has been made and authorisation obtained from SEPA for the required water abstraction rate and volume (ref. CAR/L/5004426) from the River Don for the proposed development. The daily permitted maximum abstraction stipulated must not exceed 67,392m^3.d or 0.780 $m^3.s^{-1}$.

4.2.3 The authorisation also stipulates that a minimum of 34.6% of the abstracted water must be returned to the water environment (the River Don) and specifies a “Hands Off Flow” which only permits abstraction of water from the River Don when the flow of water in the river at the abstraction point is equal to or greater than 4.860 $m^3.s^{-1}$. The authorisation requires a fish screen (with a maximum gap size of 10 mm) to be provided and installed on the abstraction intake.

4.2.4 Detailed hydrological analysis was completed in support of the CAR application which included assessment of the range of flows in the River Don at the proposed abstraction point. As part of the CAR application determination, the proposed abstraction regime and limits were also discussed with the DDSFB.

4.2.5 Analysis completed by SEPA prior to issue of the CAR authorisation confirmed that the proposed abstraction rate and volume would not result in impairment of the River Don, low water flows, alter its geomorphology or lower its Water Framework Classification.

4.2.6 The CAR authorisation requires the developer to record water abstraction rates and qualities from the River Don and maintain this record for SEPA inspection.

4.2.7 A programme of routine water quality and water level monitoring has commenced in the River Don at the proposed abstraction point. This monitoring would continue during the operational phase of the project as this information is needed to manage the water abstraction and to obtain the necessary information to report to SEPA as required by the CAR authorisation.

Magnitude of impact

4.2.8 Given analysis completed in support of and the controls stipulated in the CAR authorisation, the likelihood and magnitude of potential impact on flow,

geomorphology, and ecology in the River Don as a result of water abstraction is assessed as **negligible.**

Sensitivity of the receptor

4.2.9 The River Don is classified by SEPA with good ecological status and therefore considered to be of **high** sensitivity.

Significance of effect

4.2.10 Overall, it is predicted that the negligible impact on the high sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.2.11 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.2.12 The residual effect is predicted to be **negligible**, which is not significant.

Pollution risk

4.2.13 Pollution risk, during the operational phase could arise from a number of potential sources: discharge of effluent from the River Don water treatment plant; from operational areas of the site where chemicals or other potential pollutants are stored; from the package treatment plant discharge; and from the storm water management system which collects and discharge water from areas of hardstand and roofs etc.

4.2.14 Further, if any maintenance or earthworks are required it might be necessary to disturb sols or undertake works near to or in watercourses. These maintenance activities, however, would be undertaken using the same controls agreed with statutory consultees and deployed during the construction phase, including supervision of all works, and thus are not considered as additional effects greater than those assessed for the construction phase.

4.2.15 Under the Control of Major Accidents and Hazards (COMAH) Regulations (2015), an assessment of Major Accidents to the Environment (MATTE) will be carried out for operational site. The nature of the Proposed Development is not expected to cause a MATTE; the COMAH Dangerous Substance present in significant quantities at the application site would be hydrogen. Hydrogen is not classified as dangerous to the environment and as such would not be expected to cause harm to any environmental receptor.

<u>River Don water treatment plant effluent</u>

4.2.16 The discharge of effluent from the proposed development will be authorised and regulated by SEPA under the facility's PPC Permit. As part of the detailed design stage of the project, the River Don water treatment system will be confirmed and in consultation with SEPA an application made for the discharge of effluent from this system to the River Don. If required, treatment of the effluent will be undertaken to meet the requirements of SEPA, and to ensure the quality, rate, volume and temperature of the effluent does not impair the River Don, its geomorphology or habitats that are reliant on the River Don.

4.2.17 No discharge of effluent will occur without prior approval from SEPA. As part of the PPC Permit application, the applicant and SEPA would consult with DDSFB and NatureScot to ensure their interests are assessed and addressed.

4.2.18 It is expected that the PPC Permit will specify effluent monitoring and reporting requirements. This monitoring will be used to ensure the effluent discharge is not impairing the River Don.

<u>Spillage of chemicals and other potential pollutants</u>

4.2.19 There is potential that accidents or spills of potential pollutants at the hydrogen facility could impair surface or groundwater quality.

4.2.20 The storage of materials on site will also be subject to controls specified in the site PPC Permit. As part of the detailed design stage of the project, material and chemical storage areas will be confirmed and secondary containment and drainage measures for these areas confirmed. It is expected that much of the required chemical storage will be indoors and on an impermeable floor, and thus with no direct pathway to groundwater or surface water.

4.2.21 Where required, and in accordance with best practice and CAR, drainage of any chemical storage areas would drain to a dedicated sealed sump which would be sized to contain any spill of any potential pollutants. The sump would be afforded access to allow it to be emptied and collected pollutants to be taken from site for disposal at an appropriately licensed facility.

4.2.22 This will ensure there is no uncontrolled discharge of potential pollutants to the ground or water environment during operation of the proposed development.

<u>Package treatment plant discharge</u>

4.2.23 Without appropriate controls and management there is potential that foul water generated from the site welfare facilities, canteen and showers etc., could impair ground conditions or surface and groundwater quality.

4.2.24 It is proposed that a package waste water treatment plant is installed at site and that all foul water generated on site be routed to and treated by the plant. The design of the plant will be confirmed as part of the detailed design stage of the project. Discharge of treated water from the plant will be subject to authorisation from SEPA and it is expected there will be limits specified regarding the rate, volume and quality of water discharged from the plant in the authorisation.

4.2.25 The package water treatment plant will be maintained in accordance with manufacturer's guidance.

4.2.26 These safeguards will ensure that there is no uncontrolled discharge of potential pollutants to the ground nor to the water environment during the operational site life.

Storm water management system drainage

4.2.27 The proposed development will benefit from a positive drainage system which means that incident rainfall, and any spills or pollutants on outside areas of hardstanding, will be collected and passed to the proposed oil interceptor and water attenuation system.

4.2.28 The drainage system will also be sized to manage firewater, should, in the unlikely event of a fire, fire water and fire retardants be used to extinguish a fire. To ensure that these do not impair ground or surface water quality provision will be made to collect this water in the on-site attenuation ponds, which will be (a) be lined to prevent a pathway to groundwater, and (b) incorporate a shutoff valve to contain water in the attenuation lagoons and prevent a discharge to the water environment.

4.2.29 The positive drainage system will also allow the quality and quantity of runoff from site to be measured and recorded.

4.2.30 These measures will ensure there is no uncontrolled discharge of potential pollutants to the water environment during operation of the Proposed Development. The detailed drainage design will be agreed with Aberdeenshire Council prior to construction.

Magnitude of impact

4.2.31 Inappropriate design of the River Don water treatment plant and uncontrolled or unmitigated discharge of effluent from this to the River Don could cause pollution and impairment in the River Don. The duration of the effect could be long term but be confined near to the point of discharge. It is noted that such a discharge would not be compliant with the CAR and the PPC Regulations, and thus would not occur as CAR and PPC authorisations would be obtained prior to operation of the Proposed Development.

4.2.32 Accidental spillage of chemicals or a fire giving risk to a pollution event has the potential to affect surface water and groundwater quality locally. The duration of the effect would be short-term and the impact is not considered to be a frequent occurrence and would only occur if the embedded mitigation and controls were to fail.

4.2.33 The required regulatory permissions and associated real-time monitoring, proposed safeguards embedded into the into the development design and the committed best practice during operation would reduce the magnitude of potential impact.

4.2.34 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.2.35 Groundwater beneath the application site has been classified as 'good' and vulnerability classified as 'high'. All of Scotland's groundwater bodies have been designated as a DWPA. Surface watercourses that drain the application site have been classified by SEPA with 'good' to 'moderate' ecological potential.

4.2.36 The surface water and groundwater receptors are therefore considered to be of **high** sensitivity.

Significance of effect

4.2.37 Overall, it is predicted that the negligible impact on the high sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.2.38 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.2.39 The residual effect is predicted to be **negligible**, which is not significant.

Erosion and sedimentation

4.2.40 During the operation of the Proposed Development, it is not anticipated that there will be any excavation or stockpiled material, reducing the potential for erosion and sedimentation effects. Should any excavation be required, this is likely to be limited in extent and only be required for maintenance. In these isolated instances the best practice and CEMP used at the construction stage would be wholly applicable and used to control potential erosion and sedimentation effects. They, are therefore, not assessed further or again as part of the operational stage effects.

Surface water and groundwater flow

4.2.41 During the operation of the Proposed Development, it is not anticipated that there would be any excavation or need to stockpile soils, reducing the potential for effects on surface and groundwater flows. Any excavation, handling and placement of material which might be undertaken, should maintenance require this, would be subject to the same safeguards that would be used during the construction phase of the project.

4.2.42 The abstraction of surface water will be regulated by SEPA by the existing CAR authorisation which specifies the maximum abstractions rates and volumes, and periods of abstraction. It also specifies monitoring the Applicant will need to undertake to show that the abstraction is not impairing surface water flows and indirectly the morphology of or habitats dependent on water levels in the River Don.

Magnitude of impact

4.2.43 Given the controls the likelihood and magnitude of potential impact on surface and groundwater flow paths would be **negligible.**

Sensitivity of the receptor

4.2.44 Groundwater beneath the application site has been classified as ‘good’ and vulnerability classified as ‘high’. All of Scotland’s groundwater bodies have been designated as a DWPAs. Surface watercourses that drain the application site have been classified by SEPA with ‘good’ to ‘moderate’ ecological potential.

4.2.45 The surface water and groundwater receptors are therefore considered to be of **high** sensitivity.

Significance of effect

4.2.46 Overall, it is predicted that the negligible impact on the high sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.2.47 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.2.48 The residual effect is predicted to be **negligible**, which is not significant.

Flood risk

4.2.49 Without operational controls, runoff of incident rainfall from new impermeable surfaces could increase both the rate and quality of water shed to watercourses in which the development is located and increase flood risk in these watercourses downstream of the proposed development.

4.2.50 Areas which will be subject to temporary earthworks, such as temporary construction compounds, and soils disturbed as a result of pipeline construction or landscaping will not increase flood risk as, as detailed in earlier in this section, a SMP is proposed and will be used to ensure soils at site are safeguarded and used in progressive restoration in the same order they are excavated during the construction phase. This will ensure that the rainfall-runoff characteristics of these areas, in the operational phase post-construction, will be no different to baseline conditions.

4.2.51 With the exception of the headwalls associated with the River Don water abstraction and discharge (which are both water-compatible infrastructure) the pumphouse and water treatment equipment have been located outside the floodplain (including climate change allowances). Further details are provided in Appendix 13.2. They are, therefore, not at flood risk.

4.2.52 The gas connection compound has been located in an area which as been shown not to be at flood risk.

4.2.53 It has been shown in the flood risk assessment (Appendix 13.2) that a small part of the electrolysis plant site platform is located within the 1 in 200-year floodplain of the Dewsford Burn. Without mitigation, the platform would displace this floodplain storage and potentially increase flood water levels upstream and downstream of the site. This has been assessed in the flood risk assessment, and it has been shown that floodplain compensation can be provided on site and on land within the control of the applicant. As a result there would be no increase in flood risk, either to site users or to adjacent third party property.

4.2.54 Should, as part of the detailed design stage of the project, it be proposed to realign a small length of the Dewsford Burn this also affords an opportunity to address floodplain compensation. This has been assessed in the flood risk assessment (see Appendix 13.2) and it is shown that a two-stage channel can be constructed that can convey storm water flows in the Dewsford Burn as well as provide compensation for the floodplain lost as a consequence of building the electrolyser platform. Should this option be proposed, a CAR application will be made to SEPA and supporting information would include details of the proposed realignment channel form, confirmation of the hydraulic performance of the channel and construction methos statements. This will ensure that there is no increase in flood risk to site users or adjacent land or property.

4.2.55 The Proposed Development will benefit from a positive drainage system which will collect and control incident rainfall from impermeable surfaces and attenuate this

before controlled discharge from site. An outline drainage impact assessment is presented as Appendix 13.3 and shows the principles and design standards for drainage that would be adopted at site. The final drainage design, the required attenuation volume, and the rate of discharge from the drainage system will use these principles and be agreed with Aberdeenshire Council as part of the detailed site design. It is expected this will be secured by planning condition.

4.2.56 As detailed in Appendix 13.3 the design will include a hydrocarbon interceptor and provide attenuation and treatment of runoff in accordance with best practice. The drainage design will include SuDS and the rate of runoff from application site will be limited so as not to increase the rate of runoff from site from present day conditions.

4.2.57 The drainage design also will include for the provision for the collection and containment of firewater and accidental spoils that might pose a pollution risk (see pollution risk section above) in accordance with industry standard good practice.

4.2.58 The design of the water abstraction and effluent discharge headworks in the River Don will be agreed with SEPA as part of a further engineering CAR application the applicant has committed to make prior to any hydrogen production at the application site. As part of the detailed design further liaison and consultation with SEPA and DDSFB will be undertaken to discuss potential designs. The final design will show how the structures will not result in a change of the river morphology nor increase flood risk to site users during operation and routine maintenance, not increase flood risk to third parties.

4.2.59 The operational drainage infrastructure, including permanent watercourse crossings, would be subject to routine inspection and maintenance as required. Where identified, any remedial works would be undertaken using the same controls deployed during the construction phase of the project.

Magnitude of impact

4.2.60 Flood risk during the operational phase would be localised to the areas of above-ground permanent infrastructure. Potential increase to flood risk would be limited to the area immediately adjacent to these, as the proposed development footprint is very small when compared to the surface water catchments within which they are located. Given the embedded mitigation and committed flood risk management measures which include controlling an attenuating rainfall runoff no significant increase in flood water flows or floodplain extents would occur.

4.2.61 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

4.2.62 The majority of the Proposed Development is not shown to be at risk from flooding and the extent of the permanent above-ground infrastructure works within the surface water catchments is small in comparison to the overall catchment area.

4.2.63 Flooding is therefore considered a receptor of moderate sensitivity.

Significance of effect

4.2.64 Overall, it is predicted that the negligible impact on the moderate sensitivity receptor would result in a negligible effect, which is not significant.

Further mitigation or enhancement

4.2.65 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.2.66 The residual effect is predicted to be **negligible**, which is not significant.

4.3 Inter-related effects

4.3.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the construction or operation of Kintore Hydrogen Plant on the same receptor.

Project lifetime effects

4.3.2 This section provides the assessment of the potential for effects that occur during more than one stage of the development's lifetime (such as phases of construction, operation or decommissioning) to interact such that they may create a more significant effect on a receptor than when assessed in isolation for each stage.

4.3.3 In all cases, subject to good practice construction methods and appropriate mitigation measures, the effects identified with this chapter are predicted to be negligible and not significant. Given the localised nature and short-term duration of any potential effects, there is not considered to be potential for effects of greater significance to occur from the inter-relationship of construction and operational phase impacts. This has taken into account the potentially phased nature of the proposed development, where an initial phase may be in operation while construction work occurs on further phases.

Receptor-led effects

4.3.4 This section provides the assessment of the potential for effects via multiple environmental or social pathways to interact, spatially and temporally, to create a

greater inter-related effect on a receptor than is predicted for each pathway (in its respective topic chapter) individually.

4.3.5 The key inter-relationship is for ecological receptors, i.e. habitats and species which could be affected by changes on groundwater quality or availability, surface water quality, changes in the hydrological regime and morphology of watercourses, or loss of soils and soil contamination. These inter-relationships have been assessed through the consideration of ecological status and protection of the hydrological receptors, vegetation surveys and soil quality as detailed in the assessment sections above. Similarly, Chapter 8: Ecology and Biodiversity has assessed impacts to sensitive receptors such as fish populations using evidence from this chapter.

4.3.6 A further inter-relationship is with climate change, which affects potential flood risk to and from the proposed development and also affects the sensitivity of groundwater and surface watercourses to water abstraction (due to potential increase in frequency of drought events). Impacts from disturbance of carbon-rich soils are relevant particularly due to the potential loss of carbon stocks and resulting impact on greenhouse gas emissions. Changes in rainfall and river flows have been considered in this assessment using SEPA allowances for climate change, and presence of peat and carbon-rich soils has been assessed.

4.3.7 As such, no receptor-led inter-related effects of greater significance than already assessed are expected to occur.

5 Cumulative Effects Assessment

5.1.1 The following developments that are within 5 km and in the same water catchments as the proposed development have been assessed. The details of each development, referenced to the ID numbers, are given in Chapter 17: Summary of Cumulative Effects.

- IDs 1, 2, 5 and 6 which are located downstream of the proposed development within the surface water catchment of the Dewsford Burn;
- IDs 8 and 14 which are located downstream of the proposed development, within the surface water catchment of the Sherrif Burn; and
- ID 10 which is located to the west of the water abstraction, water treatment plant effluent discharge location within the surface water catchment of the Silver Burn.
- a potential proposal for a 200 MW battery storage facility that could be located on farm land north of the proposed Kintore Hydrogen Plant above-ground installation (AGI) for the hydrogen export connection

5.1.2 These developments have been either been constructed and commissioned recently or will be developed in the future (should they be granted planning permission) and therefore have adopted or will adopt current industry standard best practice and guidelines and be managed in accordance with industry standards and relevant legislation, planning policy and guidance as controlled by the relevant planning authority and regulators (where applicable). These standards are designed to ensure, with respect to soils, geology and the water environment, that potential impacts are mitigated and controlled at source.

5.1.3 The magnitude of cumulative impact is therefore considered **negligible** and the potential effect on identified receptors is **negligible** and not significant.

6 Conclusion and Summary

6.1.1 An assessment has been carried out of the likely impacts of the Proposed Development on the hydrological, hydrogeological, soils and geological environment.

6.1.2 Kintore Hydrogen has committed to a programme of soil, surface and groundwater inspection and monitoring prior to and during construction of the Proposed Development to confirm the construction phase of the project has no effect on the value of soils, nor water resources and flood risk. Details are set out in an Outline Construction Environmental Management Plan accompanying the planning application. Soils will be safeguarded by use of a Soil Management Plan to be agreed with Aberdeenshire Council.

6.1.3 During the operational phase, the abstraction of water, discharge of effluent from the hydrogen water purification plant, and the production of hydrogen will be regulated by SEPA under a Controlled Activity Regulations (CAR) authorisation for water abstraction and a Pollution Prevention and Control (PPC) Permit for all aspects of operation. This will include monitoring and audit of emissions and operational activities. Prior to construction, the detailed drainage design for the proposed development will be agreed with Aberdeenshire Council and will specify the permitted rate of attenuated stormwater runoff from permanent impermeable infrastructure. This will be limited the greenfield rate of runoff, and thus afford betterment and a reduction in flood risk to property downstream of the site.

6.1.4 The licences and authorisations issued by regulators (e.g. SEPA and Aberdeenshire Council) will include limits on the volume and rate of surface as well as quality, rate and volume controls for the effluent discharge; these controls are used to ensure surface and groundwater resources are not impaired and water is managed sustainably. They are also used to minimise the potential for accidents to occur and to reduce the consequences of potential accidents.

6.1.5 As a consequence of the embedded mitigation included in the site design and subject to the adoption of mitigation measures including good practice measures, no significant residual effects on soil (including peat), geological, surface water or groundwater receptors are predicted during the construction and operational phases of the Proposed Development.

Table 6.1: Summary of potential environment effects, mitigation and monitoring

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional mitigation measures	Residual effect	Proposed monitoring
Construction phase							
Generation of pollution	Good practice measures specified in the Outline CEMP. Confirmatory inspection of watercourses and areas of working to ensure efficacy of mitigation and control measures.	Negligible	High	Negligible: not significant	None	Negligible: not significant	Confirmatory water quality monitoring during construction.
Erosion and sedimentation	Good practice measures specified in the Outline CEMP.	Negligible	High	Negligible: not significant	None	Negligible: not significant	Confirmatory water quality monitoring during construction.
Surface water and groundwater flows	Good practice measures specified in the Outline CEMP.	Negligible	High	Negligible: not significant	None	Negligible: not significant	n/a
Flood risk	Good practice measures specified in the Outline CEMP. Appropriate drainage design that incorporates measures to attenuate and treat runoff from construction areas, which will be included in the adopted CEMP.	Negligible	Moderate	Negligible: not significant	None	Negligible: not significant	n/a
Operation phase							
Generation of pollution	Appropriate storage and handling of potential pollutants in accordance with CAR and PPC authorisations	Negligible	High	Negligible: not significant	None	Negligible: not significant	As required by PPC Permit.
Erosion and sedimentation	Appropriate drainage design that incorporates sediment management measures, including sediment traps, to attenuate and treat runoff. Adopted through a long term operational drainage and monitoring programme.	Negligible	High	Negligible: not significant	None	Negligible: not significant	As required by PPC Permit.
Surface water and groundwater flows	Adherence to existing CAR authorisation for water abstraction from the River Don. Compliance with PPC Permit limits for effluent discharge from the water abstraction water treatment plant. Good practice measures adopted through a long term operational drainage and monitoring programme.	Negligible	High	Negligible: not significant	None	Negligible: not significant	As required by PPC Permit.
Flood risk	Inspection of the operational drainage system and compliance with the attenuated rate of runoff agreed with Aberdeenshire Council at the detailed design stage, Removal of blockages from watercourse crossings in the unlikely event of occurrence.	Negligible	Moderate	Negligible: not significant	None	Negligible: not significant	n/a

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