Kintore Hydrogen Plant

Environmental Impact Assessment Report
Chapter 14: Population and Health

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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 population and human health.

1.1.2 The chapter applies a broad socio-economic model of health that encompasses conventional health impacts such as disease, accidents and risk, along with wider socio-economic health determinants vital to achieving good health and wellbeing.

1.1.3 The chapter draws from and builds upon detailed project information and relevant wider technical disciplines within the EIAR, namely, Chapter 9 (Transport and Access), Chapter 10 (Noise and Vibration), Chapter 11 (Air Quality) and Chapter 15 (Socio-economics) to communicate the potential influence upon health and set any perceived health risks into context. For the sake of brevity, this chapter does not seek to repeat text or replicate data from the wider technical disciplines, but signposts where appropriate.

1.1.4 Further statistical information concerning the existing population and health baseline is presented in Appendix 14.1: Population and Health Baseline.

1.1.5 This EIAR chapter:

- presents the environmental baseline established from desk studies, surveys and consultation to date;
- presents the potential environmental effects on population and health arising from 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.

1.2 Planning policy context

Introduction

1.2.1 This section presents the national and local policy and guidance requirements relevant to the assessment of population and health. On the basis that a wide range of environmental, social and economic factors have the potential to influence health, many local policies which relate to these determinants are also relevant to health. To ensure a focussed list of relevant policies and to avoid duplication of policies pertinent to the inter-related technical disciplines, the policies are referenced in this section only if they explicitly mention health and/or wellbeing and if they are applicable to the proposed development.

National Planning Framework 4 (NPF4)

1.2.2 Policy 23 (Health and safety) states that development proposals which are likely to have a significant adverse effect on health will not be supported. A Health Impact Assessment (HIA) may be required.

Aberdeenshire Local Development Plan 2023

1.2.3 Policy P4 (Hazardous and Potentially Polluting Developments and Contaminated Land) states that the council will not allow development on land that is known or suspected to be contaminated unless appropriate site investigations have been undertaken to identify any actual or possible risk to public health or the environment (including possible pollution of the water environment), and effective remedial actions are proposed to ensure the site is made suitable for its new use.

1.3 Legislation

1.3.1 Beyond the EIA Regulations, there is no specific legislation relevant to the assessment of population and health.

1.4 Consultation

1.4.1 Key issues raised during scoping and consultation specific to population and human health 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
October 2023	Scoping Opinion – Aberdeenshire Natural Environment team	Outdoor access routes – noting inclusion of consideration of core paths please also consider other (informal) outdoor access routes and how these will be provided for during construction.	Impacts on outdoor recreation are assessed in Section 4. Measures to manage public access and informal recreational routes have been included in the Outline Construction Environmental Management Plan submitted with the planning application.

2 Assessment Approach

2.1 Guidance

Scottish Health and Inequality Impact Assessment Network (SHIIAN) HIA Guidance for Practitioners

2.1.1 The SHIIAN HIA Guidance for Practitioners [1] was published prior to the amended EIA Regulations but outlines the steps required for HIA, which were based on those established for EIA. The steps are:

- screening – decide whether to complete an HIA;
- scoping – set the terms of reference for the HIA;
- set up an HIA team – ensure appropriate expertise is included;
- assessment – collate evidence from a range of sources to identify and assess likely health impacts from the proposal;
- make recommendations – use findings to recommend changes to the proposal or other changes that would mitigate adverse and improve positive health impacts; and
- monitor impacts – monitor actual impacts that arise after implementation of the proposal.

2.1.2 The guidance states that HIA should be iterative, as findings and issues that emerge in later steps may mean that earlier steps need to be revisited and the scope and analysis amended accordingly.

2.1.3 The guidance also includes steps on community profiling and involving stakeholders. A section is also provided on assessing significance and states that significant impacts may be:

- potentially severe or irreversible negative impacts;
- impacts affecting a large number of people;
- impacts affecting people who already suffer poor health or are socially excluded; or
- positive impacts with potential for greater health improvement.

IEMA Effective Scoping of Human Health in EIA

2.1.4 The guidance on 'Effective Scoping of Human Health in EIA' [2] defines the approach for scoping wider determinants of health in or out of an EIA, and is derived from EU EIA Directive 2014/52/EU.

2.1.5 The guidance expects that an EIA Report will include a chapter on human health where wider determinants of health not covered by other EIA technical topics have been scoped in, or where other EIA technical topics have been scoped in to assess likely and potentially significant effects to human receptors.

2.1.6 For human health chapters, the scoping process primarily relates to: deciding if there are wider health determinants and population groups to include in the assessment; deciding the correct spatial and temporal assessment boundaries; specifying assessment methods sufficient to the complexity and important of the impact; and clarifying governance and engagement arrangements.

2.1.7 The guidance ensures that the EIA health chapter will align to HIA principles and normally satisfy policies or validation requirements to undertake a HIA, without the need for a standalone HIA. This can be assured by early engagement with public health and planning stakeholders, and the general public during scoping.

2.1.8 Engagement can further assist scoping of health in EIA, because it can highlight: which wider determinants of health and population groups are most relevant to a project; the regulatory context; key public health priorities and desired population health outcomes relevant to the project; specific wider groups for further engagement; and any other useful information or data. Internal engagement with other EIA practitioners is also encouraged as other technical topics will inform the scope of the human health assessment.

2.1.9 The guidance includes a non-exhaustive list of 21 wider health determinants to consider when scoping human health in EIA. These are varied and span the following categories: health related behaviours; social environment; economic environment; bio-physical environment; and institutional and built environment. When it comes to scoping health in EIA, the guidance recommends using this list as a foundation, where other wider health determinants that are not listed may be relevant for specific projects.

2.1.10 It is recommended that each determinant is scoped in or out following careful consideration of how each determinant relates to the following set of questions.

- Is likelihood for the wider health determinant established through plausible source-pathway-receptor link which is probable given the actual project activities? If no, scope-out, if yes, proceed.

- Is the effect on the wider determinant of health potentially significant because the expected scale of change is:
    - central/influential to the public health agenda of the relevant jurisdiction as informed by an understanding of relevant scientific literature, local baseline conditions and local health priorities? If yes, scope-in, if no scope-out; or
    - contentious/unclear (negative effects) or strongly desired and in need of securing (positive effects) as informed by an understanding of relevant consultation responses, regulatory standards and the health policy context? If yes, scope-in, if no scope-out.
- For negative effects, does committed mitigation avoid potentially significant population health effects? And does committed mitigation proportionately further minimise other effects? If yes, scope-out, if no scope-in.
- For positive effects, do committed enhancements already proportionately maximise public health opportunity with no significant population health effects to discuss? If yes, scope-out, if no scope-in.

2.1.11 The guidance also highlights how health impacts vary temporally across project stages (for example, pre-commencement, demolition, construction, operation and decommissioning), and that the scope should identify which stages should be included.

2.1.12 Geographic scope should also be considered when discussing health effects on different populations. For example, the health effects may vary between site-specific, local, regional, national and international populations. The geographic scope should identify areas where the project will exert most influence.

2.1.13 Finally, as population groups are the sensitive receptors for health in EIA, sub-populations, other than the general population should be considered. These include those with vulnerability due to young age, older age, income or unemployment, health status, social disadvantage, and access or geographic factors.

IEMA Determining Significance for Human Health In EIA

2.1.14 The guidance on 'Determining Significance for Human Health in EIA' [3] responds to gaps and inconsistencies across existing guidance as to how health, particularly with regard to significance, is assessed in EIA. This promotes greater consistency in the assessment process, in particular to how EIA health conclusions are reached, interpreted and used.

2.1.15 The EIA process uses the term 'significance' to describe the weight that should be placed on an issue during a decision, for instance, the extent to which it is 'material' to the decision. The European Commission defines significance as an informed expert's judgement of the importance, desirability or acceptability of a change. In the case of human health, this relates to whether the change is important, desirable or acceptable for public health. The judgement and its explanation must be context dependent and must be evidence based to minimise subjectivity from the practitioner. Available evidence to cite may include: scientific literature; consultation responses; baseline conditions; local health priorities; and regulatory standards.

2.1.16 A matrix of sensitivity and magnitude is typically used to determine significance (refer to Table 2.6 of this chapter). For health, this identifies a relevant population and their sensitivity (receptor) and the level of change in determinants of health (magnitude of impact), which then gives an indication of the likely significant effects to population health outcomes. Major and moderate categories will normally be considered significant, supported with appropriate evidence and justification. However, significant effects can potentially be reduced to non-significant residual effects with implementation of suitable secured additional mitigation.

2.1.17 Sensitivity can be informed by baseline data, including demographic statistics, public health statistics and deprivation mapping. Magnitude can be informed by a full understanding of the project and the findings of other EIA chapters, including their zones of influence and expected degrees of change. Both sensitivity and magnitude can be informed by professional judgements, for example judgement can inform the characterisation of the relevant population, their capacity to adapt and any vulnerable groups.

2.1.18 The health magnitude criteria are explained in Table 2.4 of this chapter, and relate to: exposure; duration; frequency; morbidity or change in quality-of-life; amount of population affected; timespan of change; and/or service quality implications.

2.1.19 The health sensitivity criteria are explained in Table 2.5 of this chapter, and relate to: levels of deprivation; shared resources; inequalities between the most and least healthy; community outlook; ability to undertake daily activities; providing or requiring care; health status; and/or capacity to adapt.

2.1.20 For each determinant of health, the levels of sensitivity and magnitude (from high to negligible) for the population and relevant sub-population(s) should be determined, and then assigned a level of significance (from major to negligible) based on expert judgement. A narrative explaining this with reference to local context and project-specifics should be provided alongside the level of significance. A single level of significance that reflects the overall public health conclusion should also be reached, including any significant changes in health inequalities.

ICNIRP Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and Electromagnetic Fields

2.1.21 Health protection guidelines for public and occupational exposure to Extremely Low Frequency (ELF) EMFs were published by ICNIRP in 1998 [4] and 2010 [5]. These guidelines have been used in a number of sources of recommendations and advice on exposure to EMFs. The updated 2010 ICNIRP guidance gives a less stringent 200 microtesla (μT) reference level for general public magnetic field exposure (compared to the 100 μT set in 1998).

2.1.22 In the UK, the former Health Protection Agency's (HPA) Radiation Protection Division has recommended that the UK adopts the 1998 ICNIRP guidelines under the terms of the European Commission (EC) Recommendation. The Radiation Protection Division was formed in 2005 from the former National Radiological Protection Board (NRPB), which was the independent statutory body established to give advice on EMFs, including advice on safe levels of occupational and public EMFs exposure. This recommendation is based on advice on limiting exposure to EMFs published by NRPB in 2004, following a review of the relevant scientific data [6, 7].

2.1.23 Table 2.1 summarises the relevant exposure guidelines. The 'basic restriction' level to protect health is for induced current in the central nervous system. The reference level for external fields indicates a threshold beyond which the potential for induced current to exceed the 'basic restriction' should be investigated. Reference levels have been published by ICNIRP and by the former HPA. They relate to the same 'basic restriction' published by ICNIRP in 1998. Subsequently, these have been developed into a Code of Practice (CoP) for the UK, which is discussed in more detail in the next section. The reference levels given in the CoP are those specified by the former HPA, on the basis of modelling undertaken by Dimbylow [8].

2.1.24 Although ICNIRP published updated guidance in 2010 that gives a less stringent 200 μT reference level for general public magnetic field exposure, due to changes in the basis of the basic restriction, the 1999 EC recommendation for use of the more stringent 1998 ICNIRP guidance remains the basis of UK guidance and the CoP.

Table 2.1: ELF EMFs exposure guidelines adopted in the UK

Description		1998 ICNIRP guidelines, as adopted in the UK in the Code of Practice (CoP)	
		Occupational	Public
'Basic restriction' (the quantity that must not be exceeded)	Induced current density in the central nervous system	10 mA m^{-2}	2 mA m^{-2}
ICNIRP reference level (not a limit in itself but a guideline for when 'basic restriction' investigation may be required)	Magnetic field	500 μT	100 μT
	Electric field	10 kV m^{-1}	5kV m^{-1}
CoP reference level (not a limit in itself but a guideline for when 'basic restriction' investigation may be required)	Magnetic field	1,800 μT	360 μT
	Electric field	46 kV m^{-1}	9 kV m^{-1}

Power Lines: Demonstrating compliance with EMF public exposure guidelines – A voluntary Code of Practice

2.1.25 Building on the outcomes of the SAGE process, in 2011 the former Department of Energy and Climate Change (DECC) published a voluntary Code of Practice (CoP) titled "*Power Lines: Demonstrating compliance with EMF public exposure guidelines*". This details the recommended approach for demonstrating compliance with adopted ELF EMFs exposure guidelines, subsequently updated in March 2012 [9].

2.1.26 The CoP *"has been developed following publication of the Government response to the Stakeholder Advisory Group on extremely low frequency electric and magnetic fields (ELF EMFs) (SAGE) First Interim Assessment…* [and] *agreed by the Department of Energy and Climate Change with the Department of Health, the Energy Networks Association, the Welsh Assembly, the Scottish Executive, the Northern Ireland Executive and the Health and Safety Executive"* (page 2).

2.1.27 It implements the 1998 ICNIRP guidance for AC fields under the terms of the 1999 EC Recommendation, in the UK context.

2.1.28 The CoP states that the public exposure limit guideline values are for uniform, unperturbed fields near ground level, such as will be experienced from an overhead line. Although higher (less stringent) levels could be established on a case-by-case basis, the CoP states that the guideline levels will never be lower. As such, the guideline levels specified in the CoP are used as a conservative basis for the assessment in this report. The CoP specifies on page five that compliance of overhead lines and underground cables at voltages of >132 kV should be shown by "*a calculation or measurement of the maximum fields (i.e. directly under the line, or directly above the cable)*". However, for all substations and for overhead lines or underground cables at ≤132 kV, the CoP states that compliance with the public exposure guidelines is

assumed, based on evidence published by the Energy Networks Association (ENA) for types of infrastructure that by design are not capable of causing exceedance of the public exposure guideline limits.

2.1.29 The CoP specifies that, given the terms of the 1999 EC Recommendation, assessment of EMF exposure against the general public exposure guidelines is only required in general for residential exposure or certain other cases of long-term exposure of potentially vulnerable groups (for example, schools). The CoP states that "*In other environments, where exposure can be deemed not to be for a significant period of time, the ICNIRP occupational guidelines, rather that the ICNIRP general public guidelines, shall be deemed to apply*" (page 4).

2.2 Assessment methodology

2.2.1 The assessment follows a source-pathway-receptor approach to identify and assess health impacts that are plausible and are directly attributable to the proposed development. A hazard source itself is not necessarily a health risk: it is only when there is a hazard source, a sensitive receptor and a pathway of exposure connecting them that there is any potential for risk to health. Where a source-pathway-receptor linkage exists, then the nature of the specific hazard source, the magnitude of impact via the pathway and the sensitivity of the receptor determine what level of health risk is predicted.

2.2.2 The population and health assessment draws from and builds upon the key outputs provided within each relevant ES topic chapter. The potentially relevant health and wellbeing determinants that have been assessed are identified in Table 2.2. These determinants have been identified through analysis of the proposed development's construction and operational activities as defined in Chapter 2: Project Description.

2.2.3 Identification of a potentially relevant health determinant at this stage does not necessarily indicate that there would be a significant population and health effect through that determinant. A significant population and health effect would depend on the magnitude of change, the sensitivity of receptors and the degree to which they are affected.

Table 2.2: Potential health determinants summary

Potential health determinant	Potential for impact	Impact type
Construction		
Changes in exposure to air pollution (including nuisance dust, PM and NO_2)	Adverse	Temporary, direct, local
Changes in noise exposure	Adverse	Temporary, direct, local
Changes in transport nature and flow rate	Adverse	Temporary, direct, local, regional
Changes in socio-economic factors (employment)	Beneficial	Temporary, direct, indirect, local, regional
Changes in access to open space and Public Rights of Way (PRoW) for physical activity and recreation	Adverse	Temporary, direct, indirect, local
Operation		
Changes in noise exposure	Adverse	Permanent, direct, local
Changes in transport nature and flow rate	Adverse	Permanent, direct, local, regional
Changes in exposure to EMF	Adverse	Permanent, direct, local
Hydrogen safety	Adverse	Permanent, direct, local
Changes in access to open space and Public Rights of Way (PRoW) for physical activity and recreation	Adverse	Permanent, direct, indirect, local

2.2.4 All relevant information, including quantitative impact assessment from inter-related EIAR chapters that has been used within the population and health assessment will be cross-referred to. In this instance, quantitative methodologies within the population and health assessment have only been used in relation to changes in operational air quality. As a result, the extent of the population and health assessment is complementary to other topic assessments and remains qualitative, the results of which are presented in Section 4.

2.3 Study area

2.3.1 There are two elements to the population and health study area:

- the study area for baseline data collection in order to establish the existing local burden of poor health and associated sensitivity to changes in the environmental and socio-economic environment; and
- the study area for receptors assessed, and the associated environmental and socio-economic changes at these receptors.

2.3.2 Environmental health determinants (such as changes to air quality and noise exposure) typically have a local distribution pattern, where the hazards are limited by their concentration and physical dispersion characteristics. Changes in transport nature and

flow rate likewise have a particular distribution on the local road network. Socio-economic health determinants (such as employment and related income generation) have a wider geographic scope of influence than environmental health determinants due to the willingness to commute significant distances to work.

2.3.3 The proposed development is located within the Kintore intermediate zone of Aberdeenshire Council area. Baseline data is readily available for Kintore intermediate zone and therefore baseline data has been collected at this geographic level, which is considered to be representative of the communities living around the proposed development. For context, data has also been collected for Aberdeenshire and Scotland as relevant comparators. It should be noted that due to the wider geographic scope of influence for socio-economic health determinants, Aberdeenshire data should be given more weight in that assessment, but Kintore data will also be presented to provide a more local understanding.

2.3.4 The study area defining the relevant sensitive receptors identified for assessment purposes is proposed to remain consistent with the inter-related technical aspects which inform the assessment of population and health.

2.4 Baseline study

Desktop study

2.4.1 Information on population and health was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 2.3 below.

Table 2.3: Summary of desktop study sources

Title	Source	Year	Ref.
Life expectancy	Public Health Scotland/National Records of Scotland (NRS) (via ScotPHO profiles tool)	2002-21	[10]
Healthy life expectancy	National Records of Scotland (NRS) (via ScotPHO profiles tool)	2016-20	[10]
Mortality statistics (all-cause)	National Records of Scotland (via ScotPHO profiles tool)	2003-20	[10]
Mortality statistics (COPD)	National Records of Scotland (via ScotPHO profiles tool)	2003-20	[10]
Mortality statistics (drug-related)	National Records of Scotland (via ScotPHO profiles tool)	2002-21	[10]
Mortality statistics (smoking attributable)	NRS / Public Health Scotland, Scottish Household Survey & Scottish Health Survey (via ScotPHO profiles tool)	2013-21	[10]
Mortality statistics (suicide)	National Records of Scotland (via ScotPHO profiles tool)	2004-19	[10]
Emergency hospital admissions (all-cause)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (asthma)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (COPD)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (CHD)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (psychiatric)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (drug-related)	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Hospital admissions (smoking attributable)	Public Health Scotland, Scottish Household Survey & Scottish Health Survey (via ScotPHO profiles tool)	2013-21	[10]
Cancer registrations	Public Health Scotland (via ScotPHO profiles tool)	2003-20	[10]
Population prescribed drugs for anxiety, depression and psychosis	Public Health Scotland (Prescribing Information System) (via ScotPHO profiles tool)	2010-21	[10]
Mental wellbeing score	Scottish Health Survey (via ScotPHO profiles tool)	2010-19	[10]
Smoking prevalence (aged 16+)	Scottish Survey Core Questions (via ScotPHO profiles tool)	2012-19	[10]

2.5 Uncertainties and/or data limitations

2.5.1 The population and health assessment draws from and builds upon the technical outputs from inter-related EIAR technical topics (most notably the air quality, noise and vibration, transport and socio-economic assessment chapters).

2.5.2 As a consequence, the limitations of the supporting assessments, and the conservative assumptions applied to address them, are inherent to the assessment of population and health.

2.5.3 It is, however, considered that the information available provides a suitable basis for the assessment of population and health.

2.6 Impact assessment criteria

Introduction

2.6.1 The significance of an effect is determined based on the magnitude of an impact and the sensitivity of the receptor. This section describes the criteria applied in this chapter to characterise the magnitude of potential impacts and sensitivity of receptors.

Magnitude of impact

2.6.2 Magnitude of impact, based on the change that the proposed development would have upon the resource/receptor, is considered within the range of major, moderate, minor, negligible and no change. Consideration is given to scale, duration and frequency of impact, and reversibility with reference to the definitions in Table 2.4.

Table 2.4: Criteria for magnitude of impact

Magnitude of impact	Definition
High	High exposure or scale; long-term duration; continuous frequency; severity predominantly related to mortality or changes in morbidity (physical or mental health) for very severe illness/injury outcomes; majority of population affected; permanent change; substantial service quality implications.
Medium	Low exposure or medium scale; medium-term duration; frequent events; severity predominantly related to moderate changes in morbidity or major change in quality-of-life; large minority of population affected; gradual reversal; small service quality implications.
Low	Very low exposure or small scale; short-term duration; occasional events; severity predominantly related to minor change in morbidity or moderate change in quality-of-life; small minority of population affected; rapid reversal; slight service quality implications
Negligible	Negligible exposure or scale; very short-term duration; one-off frequency; severity predominantly relates to a minor change in quality-of-life; very few people affected; immediate reversal once activity complete; no service quality implication.

Sensitivity of receptor

2.6.3 Within a defined population, individuals will range in level of sensitivity due to a series of factors such as age, socio-economic deprivation and the prevalence of any pre-existing health conditions which could become exacerbated. These individuals can be considered particularly vulnerable to changes in environmental and socio-economic factors (both adversely and beneficially) whereby they could experience disproportionate effects when compared to the general population.

2.6.4 As an example, the elderly, young children and individuals with chronic pre-existing respiratory conditions would be more sensitive to adverse changes to air quality, with the potential for emergency admission to hospital more likely than for someone of working age who has good respiratory health. On the other hand, an individual who has been unemployed for a long period of time would benefit more from employment opportunities generated by the Proposed Development in comparison to an individual who is already employed.

2.6.5 The criteria for defining sensitivity in this chapter are defined in Table 2.5.

Table 2.5: Criteria for receptor sensitivity

Sensitivity	Definition
High	High levels of deprivation (including pockets of deprivation); reliance on resources shared (between the population and the project); existing wide inequalities between the most and least healthy; a community whose outlook is predominantly anxiety or concern; people who are prevented from undertaking daily activities; dependants; people with very poor health status; and/or people with a very low capacity to adapt.
Medium	Moderate levels of deprivation; few alternatives to shared resources; existing widening inequalities between the most and least healthy; a community whose outlook is predominantly uncertainty with some concern; people who are highly limited from undertaking daily activities; people providing or requiring a lot of care; people with poor health status; and/or people with a limited capacity to adapt.
Low	Low levels of deprivation; many alternatives to shared resources; existing narrowing inequalities between the most and least healthy; a community whose outlook is predominantly ambivalence with some concern; people who are slightly limited from undertaking daily activities; people providing or requiring some care; people with fair health status; and/or people with a high capacity to adapt.
Very low	Very low levels of deprivation; no shared resources; existing narrow inequalities between the most and least healthy; a community whose outlook is predominantly support with some concern; people who are not limited from undertaking daily activities; people who are independent (not a carer or dependant); people with good health status; and/or people with a very high capacity to adapt.

2.6.6 Extensive baseline data has been collected in order to interpret local health circumstance and consequent population sensitivity. This information is provided in Appendix 14.1. Overall, it is concluded that baseline local health circumstance in the study area is generally good.

2.6.7 As such, when looking at the population in general, the existing burden of poor health and sensitivity of the population within the study area is “very low”. However, this does not exclude the probability that there will be individuals within a defined population who are particularly sensitive and could experience disproportionate effects.

2.6.8 To identify any particularly vulnerable groups which should be considered in the population and health assessment (for example, those using schools and care homes) who are particularly sensitive and could experience disproportionate effects, an exercise was completed in QGIS using OS AddressBase data.

2.6.9 The exercise identified all registered receptors within 500 m of the application boundary. The search results returned the following types of receptors: commercial, agricultural, hotel, industrial, retail, parent shell, property shell, residential and dwelling. As none of these types of receptor constitute or are permanently used by a vulnerable

group, it is concluded that no additional sensitivity consideration is required as part of the population and health assessment.

Significance of effect

2.6.10 The significance of the effect is determined based on the magnitude of the impact and the sensitivity of the receptor, as shown in Table 2.6. Where a range of significance of effect is presented in Table 2.6, the final assessment for each effect is based upon expert judgement.

Table 2.6: Matrix used for the assessment of the significance of an effect

		Sensitivity			
		High	Medium	Low	Very low
Magnitude	High	Major	Major/moderate	Moderate/minor	Minor/negligible
	Medium	Major/moderate	Moderate	Minor	Minor/negligible
	Low	Moderate/minor	Minor	Minor	Negligible
	Negligible	Minor/negligible	Minor/negligible	Negligible	Negligible

2.6.11 The definitions for each of the significance levels are shown in Table 2.7. Effects of **moderate** and higher will be defined as significant effects.

Table 2.7: Significance of effect

Significance	Description
Major	The narrative explains that this is significant for public health because: • Changes, due to the proposed development, have a substantial effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size (magnitude and sensitivity levels), and as informed by consultation themes among stakeholders, particularly public health stakeholders, that show consensus on the importance of the effect. • Change, due to the proposed development, could result in a regulatory threshold or statutory standard being crossed (if applicable). • There is likely to be a substantial change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a causal relationship between changes that will result from the proposed development and changes to health outcomes. • In addition, health priorities for the relevant study area are of specific relevance to the determinant of health or population group affected by the proposed development.
Moderate	The narrative explains that this is significant for public health because (select as appropriate): • Changes, due to the proposed development, have an influential effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by referencing relevant policy and effect size, and as informed by consultation themes among stakeholders, which may show mixed views. • Change, due to the proposed development, could result in a regulatory threshold or statutory standard being approached (if applicable). • There is likely to be a small change in the health baseline of the population, including as evidenced by the effect size and scientific literature showing there is a clear relationship between changes that will result from the proposed development and changes to health outcomes. • In addition, health priorities for the relevant study area are of general relevance to the determinant of health or population group affected by the proposed development.
Minor	The narrative explains that this is not significant for public health because (select as appropriate): • Changes, due to the proposed development, have a marginal effect on the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size of limited policy influence and/or that no relevant consultation themes emerge among stakeholders. • Change, due to the proposed development, will be well within a regulatory threshold or statutory standard (if applicable); but could result in a guideline being crossed (if applicable). • There is likely to be a slight change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is only a suggestive relationship between changes that will result from the proposed development and changes to health outcomes. • In addition, health priorities for the relevant study area are of low relevance to the determinant of health or population group affected by the proposed development.
Negligible	The narrative explains that this is not significant for public health because (select as appropriate): • Changes, due to the proposed development, are not related to the ability to deliver current health policy and/or the ability to narrow health inequalities, including as evidenced by effect size or lack of relevant policy, and as informed by the project having no responses on this issue among stakeholders. • Change, due to the proposed development, will not affect a regulatory threshold, statutory standard or guideline (if applicable). • There is likely to be a very limited change in the health baseline of the population, including as evidenced by the effect size and/or scientific literature showing there is an unsupported relationship between changes that will result from the proposed development and changes to health outcomes. • In addition, health priorities for the relevant study area are not relevant to the determinant of health or population group affected by the proposed development.

2.7 Impacts scoped out of the assessment

2.7.1 The impacts listed in Table 2.8 have been scoped out of the assessment for population and health as agreed through the EIA scoping process detailed in Chapter 5: Scoping and Consultation.

Table 2.8: Impacts scoped out of the assessment

Potential impact	Justification
Construction phase	
n/a	n/a
Operation phase	
Health effects from changes in access to and use of open space and core paths for recreation and physical activity	Covered by permanent construction impacts, which are discussed within the construction phase assessment.

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 population and health. These are listed in Table 2.9.

Table 2.9: Designed-in mitigation measures

Measures adopted as part of Kintore Hydrogen Plant	Justification
All designed-in measures relevant to population and human health are outlined within the wider technical disciplines which comprise: • Chapter 9: Traffic and Transport • Chapter 10: Noise and Vibration • Chapter 11: Air Quality • Chapter 15: Socio-economics	The environmental and socio-economic determinants listed have the potential to directly and indirectly influence population and health, these wider technical disciplines also offer relevant designed-in mitigation for the protection of human health.

2.9 Maximum design envelope parameters for assessment

2.9.1 The maximum design envelope parameters identified in Table 2.10 have been selected as those having the potential to result in the greatest effect on an 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.

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

Table 2.10: Maximum design envelope parameters assessed

Potential impact	Maximum design parameter	Justification
Construction phase		
Health effects due to direct, indirect and induced employment generation	Circa 1,400 FTE (construction workforce peak). Circa 860 FTE (construction workforce average).	In order to provide a conservative assessment of benefits, the lower limit of the estimated average and peak construction workforce should be used.
Health effects from changes in access to and use of open space and core paths for recreation and physical activity	Permanent loss of access to the main electrolysis plant development site and above-ground installation (AGI) for hydrogen export connection. Temporary disruption to access associated with open cut trenching for the hydrogen and water pipeline routes.	Any land take required for construction of the proposed development may affect access to recreation and physical activity if these areas are currently used by local people (e.g. for dog walking, rambling, camping etc.).
Health effects from changes in transport nature and flow rate (potentially affecting severance, pedestrian delay, non-motorised user amenity, fear and intimidation, and road safety)	10 daily two-way LGV movements. 56 daily two-way staff movements. 212 daily two-way HGV movements.	Additional transport movements can change the flow rate and nature of traffic on the external road network. The impact will be dependent on the magnitude of impact and the context of the road link affected. For example, roads with limited pedestrian facilities will not have an impact on pedestrian delay.
Health effects from changes in noise exposure (potentially affecting annoyance in the daytime)	As outlined in Chapter 10: Noise and Vibration, based on daytime construction hours of 08:00–18:00 Monday to Saturday, with no working on Sundays or Bank Holidays.	Construction of the proposed development during the daytime period has the potential to cause annoyance if in exceedance of relevant guideline thresholds. As no noisy construction activities are proposed during the night time period, the potential for sleep disturbance is limited and not assessed.
Health effects from changes in exposure to air pollution (nuisance dust)	As outlined in Chapter 11: Air Quality, the dust emission magnitude for the earthworks, construction and trackout is classified as large.	There is potential for dust emissions from on-site construction activities, earthworks and trackout.
Operation phase		
Health effects due to direct, indirect and induced employment generation	Circa 192 FTE.	The expected employment generation for the full capacity development (all phases complete) in operation, to assess long-term benefits.
Health effects from changes in transport nature and flow rate (potentially affecting severance, pedestrian delay, non-motorised user amenity, fear and intimidation, and road safety)	124 two way vehicle movements (staff, visitors and general site deliveries).	Additional transport movements can change the flow rate and nature of traffic on the external road network. The impact will be dependent on the magnitude of impact and the context of the road link affected. For example, roads with limited pedestrian facilities will not have an impact on pedestrian delay.
Health effects from changes in noise exposure (potentially affecting annoyance in the daytime or sleep disturbance during the night time)	As outlined in Chapter 10: Noise and Vibration based on operating hours and traffic access on a 24/7/365 basis.	Operation of the proposed development during the daytime and night time periods has the potential to cause annoyance and sleep disturbance if in exceedance of relevant guideline thresholds.
Health effects from changes in exposure to air pollution (NO_2 – potentially affecting respiratory health)	As outlined in Chapter 11: Air Quality for operation and emissions from enclosed hydrogen ground flare.	There is potential for emissions of NO_2 to the atmosphere from the hydrogen flare.
Health effects from changes in EMF exposure	33/400 kV AIS/GIS equipment within electrolysis plant site and 400 kV underground cable connection into Kintore Substation.	The voltage of transmission infrastructure (and hence also current, for a given power demand) directly affects the potential for EMF exposure in proximity to this.
Health effects from hydrogen safety	54 tonnes per hour (tph) hydrogen production capacity and hydrogen export pipeline to National Gas NTS. Potential for the site to be defined as a COMAH facility. No hydrogen storage aside from in pipeline inventory. Enclosed ground flare used for safe management of hydrogen releases where required.	As with all industrial operations, there are specific hazards and risks associated with hydrogen production. Hydrogen is a very flammable gas which, at high quantities, can produce explosive combinations with air. In addition, the high pressure and cryogenic temperatures involved in hydrogen production can cause leaks, ruptures, and embrittlement of materials used in containment vessels and pipes.

3 Baseline Environment

3.1 Current baseline

3.1.1 Individuals and communities have varying susceptibilities to adverse and/or beneficial population and health effects associated with changes in environmental and socio-economic conditions as a result of: demographic structure (for instance, age); existing burden of poor health; behaviours (for instance, lifestyle choices which constitute risk factors); and socio-economic circumstance. As an example, an elderly individual with an existing chronic cardiovascular health condition who is a smoker and has a lower than average socio-economic circumstance, would be considered more sensitive than a healthy working age individual.

3.1.2 The current baseline is provided in full in Appendix 14.1 and shows that the vast majority of public health indicators analysed show better health and wellbeing circumstance in Kintore (or Aberdeenshire where data for Kintore is unavailable). The exceptions to this are hospital admissions for asthma, chronic obstructive pulmonary disease (COPD) and coronary heart disease (CHD), where the rate in Kintore is similar to and fluctuates above/below the Aberdeenshire average, and in the case of CHD above/below the Aberdeenshire and Scotland averages.

3.1.3 As a result, it can be concluded that the population living in Kintore is not particularly sensitive to changes in environmental and/or socio-economic conditions associated with the proposed development.

3.2 Future baseline

3.2.1 Consistent with recent local and national trends, the health of the population living within Kintore and Aberdeenshire is likely to improve over the lifetime of the proposed development. This will be the case with or without the proposed development.

3.2.2 While this is the case, any improvement is challenging to predict with high confidence and unlikely to be substantial. On this basis, it is considered appropriate (and precautionary) to use present-day statistics for the purpose of this assessment, offering a precautionary approach.

4 Assessment of Effects

4.1 Construction phase

Health effects from changes in exposure to air quality

Magnitude of impact

4.1.1 As stated in Chapter 11: Air Quality, the potential dust emission magnitude for the earthworks, construction and trackout is classified as large, where any impacts would be of local spatial extent, short term duration, intermittent and reversible.

4.1.2 From a population and health perspective, larger dust particles have the potential to cause impacts on wellbeing associated with dust soiling. Smaller dust particles constitute fine particulate matter, with associated potential health impacts.

4.1.3 It should be noted that following the implementation of appropriate mitigation measures outlined in the Construction Environmental Management Plan (CEMP), the resultant generation of dust would not be significant. On this basis, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.1.4 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.1.5 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.1.7 The residual effect is predicted to remain **negligible**, which is not significant.

Health effects from changes in noise exposure

Magnitude of impact

4.1.8 Construction working hours would be 08:00–18:00 Monday to Saturday, with no working on Sundays or Bank Holidays. Works inside buildings and non-noisy works may be undertaken outside these hours where required, such as during the commissioning phase.

4.1.9 Based on this information, potential human health effects from changes in noise exposure would be limited to increased annoyance from a reduction in local amenity during the daytime. This would be a direct and local impact resulting from on-site construction activities and associated transport movements. Due to the nature of the construction period, the impact would be form short term durations and intermittent but may extend in total over several years of construction phases.

4.1.10 As stated in Chapter 10: Noise and Vibration, following the implementation of appropriate mitigation measures outlined in the CEMP, predicted noise levels from construction activities would be below the relevant threshold for day time noise of 65 dB L_{Aeq}, which is set to be protective of the environment and human health.

4.1.11 With regard to traffic noise, during the peak construction period a noise change of <1 dB is predicted on the majority of road links. The largest change in noise would be +1.1 dB on B977 to the north of Leylodge. This is considered to be minor in noise terms, and would not be perceptible to the human ear.

4.1.12 On the basis that noise from construction activities does not exceed the relevant threshold which is set to be protective of the environment and human health, and increases in noise from traffic would not be material or perceptible to the human ear, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.1.13 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.1.14 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.1.16 The residual effect is predicted to remain **negligible**, which is not significant.

Health effects from changes in transport nature and flow rate

Magnitude of impact

4.1.17 As stated in Chapter 9: Transport and Access, during the construction phase, there would be traffic movements associated with: staff movements; delivery of construction equipment and materials; delivery of components relating to the proposed development and associated infrastructure; occasional delivery by abnormal load vehicles for larger items of plant; and import of fuel for construction plant.

4.1.18 Chapter 9: Transport and Access provides an assessment of the peak construction traffic impact on the external road network. While this is considered robust for assessment purposes, it should be noted the construction phase is transitory in nature and the peak of construction activities would occur over a relatively short timeframe; on average over the programme, traffic impacts would be lesser.

4.1.19 Construction phase traffic movements take into consideration the implementation of a Construction Staff Travel Plan, which would include a coach service from an off-site transfer point, reducing the potential impact of vehicular trips on the local road network.

4.1.20 The resultant peak of construction activity is predicted to involve around 278 daily vehicle movements (two-way). Of these 278 daily movements, 212 would be HGVs, 56 would be associated with construction staff arriving/departing, and the remaining movements would be car / light goods vehicle (LGV) movements associated with general site deliveries and visitors.

4.1.21 Detailed assessment in Chapter 9: Transport and Access has been undertaken for the following receptors:

- B977 users and residents;
- Kintore residents; and
- residents along Kirkton Cottages.

4.1.22 Of the impact themes assessed in Chapter 9: Transport and Access, the following are relevant to this chapter and considered further from a population and health perspective:

- severance;
- pedestrian delay;
- non-motorised user amenity;
- fear and intimidation; and
- road safety.

<u>B977 users and residents</u>

4.1.23 The B977 is a single carriageway road with one lane operating in each direction, mainly subject to the national speed limit in rural areas, reducing to 40, 30 or 20 mph in towns and villages. With the exception of Core Path (410.05) on the section of the road in the vicinity of the A96, there are limited pedestrian facilities.

4.1.24 The maximum percentage increase in HGV traffic on the B977 is 39.5%, and the total traffic increase would be 8.81%. While the increase in HGV flows exceeds the threshold for the onset of severance impacts (occurring at 30%), this maximum percentage occurs along a section of the B977 with low baseline HGV traffic flows. Therefore, taking into consideration the context of low baseline HGV traffic and considering the implementation of appropriate mitigation secured through the Construction Traffic Management Plan (CTMP), the residual effect on severance at this location is not considered to be significant in traffic terms.

4.1.25 While the onset of greater fear/intimidation impacts typically also occurs at an increase of 30%, as stated in Chapter 9: Transport and Access, adverse impacts on pedestrian delay, fear/intimidation and non-motorised user amenity are considered unlikely with implementation of CTMP measures and on the basis that there are limited pedestrian facilities.

4.1.26 Impacts on road safety from construction traffic are also not considered to be material following implementation of mitigation measures and on the basis that no accidents have been recorded on the B977 over the last 5-year period.

4.1.27 Overall, the magnitude of impact on population and health for users of the B977 would be **negligible**.

<u>Kintore residents</u>

4.1.28 The most impacted road in Kintore would be the B977, the effects for which are described in the previous section and would be limited in all instances.

4.1.29 Other affected roads within Kintore include the B987 and B994. The maximum increase in HGV traffic on these roads is 12.21%. The maximum total traffic increase would be 8.81%. Such increases would not exceed the threshold for the onset of severance and fear/intimidation impacts (occurring at 30%).

4.1.30 While there are pedestrian facilities along both the B987 and B994 within Kintore, the increase in construction traffic at these locations is predicted to be 58 vehicles per day. Taking this increase and the implementation of mitigation measures secured through the CTMP into consideration, the impacts on pedestrian delay and non-motorised user amenity are also limited.

4.1.31 Impacts on road safety from construction traffic are not considered to be material following implementation of mitigation measures and on the basis that only one accident has been recorded on the road links in Kintore (on the B994), which was classified as slight (damage only) and involved two vehicles at a junction.

4.1.32 Overall, the magnitude of impact on population and health for Kintore residents would be **negligible**.

Residents along Kirkton Cottages

4.1.33 Kirkton Cottages is a single track road, subject to the national speed limit, with passing places, providing access to individual properties and land used for agricultural purposes. There are limited pedestrian facilities along this road.

4.1.34 The maximum increase in HGV traffic on Kirkton Cottages is 13.33%, and the total traffic increase would be 3.76%. Such increases would not exceed the threshold for the onset of severance and fear/intimidation impacts (occurring at 30%).

4.1.35 The increase in construction traffic at this location is predicted to be 6 vehicles per day. Taking this increase and the implementation of mitigation measures secured through the CTMP into consideration, the impacts on pedestrian delay and non-motorised user amenity are also limited.

4.1.36 Impacts on road safety from construction traffic are not considered to be material following implementation of mitigation measures and on the basis that no accidents have been recorded on Kirkton Cottages over the last 5-year period.

4.1.37 Overall, the magnitude of impact on population and health for Kirkton Cottages residents would be **negligible**.

Sensitivity of the receptor

4.1.38 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.1.39 Overall, it is predicted that a **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.1.41 The residual effect is predicted to remain **negligible**, which is not significant.

Health effects from changes to socio-economic factors

Magnitude of impact

4.1.42 Having a consistent income and being in long-term employment are two of the most important wider determinants of health and wellbeing. The construction phase of the proposed development would offer a number of job opportunities for those in the 'construction', 'manufacturing' and 'professional, scientific and technical activities' sectors.

4.1.43 As assessed in Chapter 15: Socio-economics, it is estimated that construction of the proposed development would generate an average of 857 FTE direct on-site jobs per annum. Construction employment would vary depending on the phasing of construction and the stages of work, and is estimated to peak at around 1,400 FTE jobs.

4.1.44 On average, the construction phase of the proposed development would also generate a further 1,847 FTE indirect off-site jobs per annum down the supply chain.

4.1.45 Overall, and taking into consideration leakage of direct job opportunities to workers outside of Aberdeenshire and displacement from existing construction projects, the net additional construction employment for local residents is estimated to be 1,521 FTE jobs per annum over a single phase 36–48 month construction programme. This equates to at least £70 million Gross Value Added (GVA).

4.1.46 From a socio-economic perspective, such employment and associated income generation from the proposed development is considered to have a moderately beneficial short-term impact on the Aberdeenshire construction labour force and sector.

4.1.47 The impact on human health from construction employment and associated income would be indirect in nature. However, due to the short-term nature of the construction phase, the magnitude of direct and indirect employment opportunities are only likely to provide health and wellbeing benefits at the individual level and are not sufficient to quantify any change in baseline health. On this basis, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.1.48 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.1.49 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.1.51 The residual effect would remain **negligible**, which is not significant.

Health effects from changes in access to open space and core paths

Magnitude of impact

4.1.52 The electrolysis plant site is currently agricultural land with a fringe of bog woodland and gorse scrub at the northern edge where it is crossed by Dewsford Burn. The construction of the proposed development would result in the permanent loss of public access to this land, which is around 84 ha.

4.1.53 The underground hydrogen pipeline connection from the electrolysis plant to the National Gas NTS connection would be through farm land. The existing National Gas high-pressure natural gas pipelines run from north to south, 1.3 km to the west of the A96 and close to Broomhill Plantation. Construction of the underground hydrogen pipeline connection will be done primarily by open trenching and therefore will cause temporary loss of public access to this corridor of land. The AGI for the gas connection will result in permanent loss of public access to this agricultural land, which is around 1.2 ha.

4.1.54 The water pipeline route would be through farm land, taking a south-easterly loop around Kintore and then turning north to the River Don. Besides farm land along this route, crossings of a number of burns, the A96 and the Aberdeen–Inverness railway line (single track at this location) would be required. Across farm land, construction of the water pipeline will be done by open trenching and therefore will cause temporary loss of public access to this corridor of land. Crossings of sensitive features (such as burns, roads and railways) would be done by trenchless techniques where required, which would not cause any temporary disturbance beyond a small area used for initiation and completion of drilling.

4.1.55 The Land Reform Act 2003 gives everyone rights of access over land and inland water throughout Scotland, or “freedom to roam”, subject to specific exclusions set out in the Act and as long as they behave responsibly. Based on observations during various site visits by the project team, it is reasonable to assume that the proposed electrolysis plant site and surrounding land is lightly used by people for recreational activities such as dog walking, with greater recreational use of land (including core paths) closer to the edges of Kintore in the River Don valley where the water pipeline intake/outfall would be located.

4.1.56 The Aberdeenshire Council Core Paths maps [11] for Central Aberdeenshire (2020), Kintore & Fintray (2014) and Kemnay (2020) show[1] that there are no existing or proposed core paths which cross or are in the vicinity of the electrolysis plant site, hydrogen pipeline route or above-ground installation (AGI) to the National Gas NTS, and so no effects on use of the core path network from construction of these elements would occur.

4.1.57 There are a series of core path sections along the River Don south-east of Kintore and through agricultural land connecting Kintore to Kinellar and Blackburn at the A96. One section of core path would be crossed by the water pipeline route (and construction access to it) and other sections would be in relatively close proximity to works to install the pipelines, intake/outfall, pumping station and potential water treatment works near the River Don. Temporary impacts would occur during pipeline trenching works. These would be managed, as set out in the Outline CEMP submitted with the planning application, to provide a safe public crossing point during the pipeline works and through marshalling of machinery/construction traffic in the vicinity of core path users.

4.1.58 Outside the core path network, while some land would be permanently or temporarily inaccessible by the public, the freedom to roam means that there are widely available reasonable and accessible alternatives for recreation and physical activity that exist in the surrounding area.

[1] at the time of writing, Aberdeenshire Council’s up to date GIS map of core paths (https://gis.aberdeenshire.gov.uk/maps/Map.aspx?MapName=Paths) did not appear to be fully functional, showing very few paths, so published PDF maps have been referenced instead

4.1.59 On this basis, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.1.60 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.1.61 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

4.1.62 No significant adverse effects have been predicted and no further mitigation is considered to be required. However, as a matter of good practice, measures to manage public access for recreation have been included in the Outline CEMP submitted with the planning application.

Residual effect

4.1.63 The residual effect is predicted to remain **negligible**, which is not significant.

Future monitoring (all impacts)

4.1.64 Recommended monitoring focuses on environmental precursors to human health effects as set out within the relevant topic chapters, thereby providing the opportunity for intervention to prevent any manifest health outcome.

4.2 Operational phase

Health effects from changes in exposure to air quality

Magnitude of impact

4.2.1 During the operation of the proposed development, there is potential for air quality impacts on human health from the emission of nitrogen dioxide (NO_2) to the atmosphere from the hydrogen flare. As stated in Chapter 11: Air Quality, detailed air quality dispersion modelling of NO_2 has been conducted for scenarios representing a design envelope of potential different size stacks and stack locations. Results of the worst-case scenario are presented within the air quality chapter.

4.2.2 The results of the detailed air quality dispersion model show that the worst case long-term predicted level of NO_2 at any sensitive receptor in the vicinity of the proposed development do not exceed the relevant limit levels when considered as a process contribution (PC) or predicted environmental contribution (PEC).

4.2.3 While this is the case, as a precautionary measure, a population-level quantitative exposure response assessment has been undertaken to better understand the distribution of changes in air quality and potential effects on health outcomes across the whole local population (beyond a receptor-level analysis).

4.2.4 The following health outcomes were assessed:

- annual natural cause mortality (aged 30+);
- annual respiratory disease emergency hospital admissions (all ages);
- annual chronic obstructive pulmonary disease (COPD) emergency hospital admissions (all ages);
- annual cardiovascular (coronary heart disease (CHD)) emergency hospital admissions (all ages); and
- annual adult asthma emergency hospital admissions (age 18+).

4.2.5 The quantitative relationship between additional incidence or risk of a health outcome and long-term exposure to a pollutant is described by a concentration response function (CRF).

4.2.6 To quantify the health impact associated with changes in exposure to air quality, CRFs (for the health outcomes defined in the bullets above) are applied with the absolute change in air quality surrounding the proposed development (provided from air quality modelling grid outputs in $\mu g/m^3$), population estimates (for each data zone affected), and baseline health data for the assessed health outcomes in the study area.

4.2.7 It should be noted that the effect on health outcomes is observed across the population studied as a whole, and the final impact (be it mortality or morbidity) is one share across a population. In this context, care should always be taken when considering the calculated mortality and morbidity impact, as they are not individual impacts, but an aggregation of an impact shared across an entire population.

4.2.8 Table 4.1 shows the potential health outcomes associated with the predicted change in air pollutant exposure for NO_2. The results indicate that the predicted changes in air quality will lead to an effect equivalent to less than a tenth of one death or hospital admission brought forward across the population studied (i.e. none). On this basis, the effect on health is not considered to be measurable and would not materially change the baseline health for the population living in proximity of the proposed development.

Table 4.1: Impact on mortality and morbidity from changes in NO_2

Health Outcome	Number of cases brought forward	Proportion of the baseline rate
Annual mortality (aged 30+)	0.0181	<0.1%

Health Outcome	Number of cases brought forward	Proportion of the baseline rate
Annual respiratory related emergency hospital admissions	0.0003	<0.1%
Annual COPD related emergency hospital admissions	0.0022	<0.1%
Annual CHD related emergency hospital admissions	0.0008	<0.1%
Annual adult asthma emergency hospital admissions (aged 18+)	0.0003	<0.1%

4.2.9 Chapter 11: Air Quality has also assessed the short-term predicted NO_2 emissions of the hydrogen flare. As stated in Chapter 11: Air Quality, the short-term relevant limit level is defined on the basis of up to 18 exceedances per year. This is not the proposed mode of operation for an emergency flare and so, by definition, it is extremely unlikely that the short-term limit level could be exceeded in practice. The short-term impacts are therefore considered to be at most minor adverse, and not significant in air quality terms.

4.2.10 On the basis that there would be no measurable change in population health outcomes associated with long-term NO_2 emissions from the hydrogen stack, and short-term emissions are not anticipated to be significant, the magnitude of impact on population and health would be **negligible.**

Sensitivity of the receptor

4.2.11 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.12 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

4.2.14 Nevertheless, as explained in Chapter 11, a Grampian planning condition concerning the two closest residential receptors is proposed, which would mean that there is no exceedance of the relevant limit level at sensitive receptors under any frequency of flare operation.

Residual effect

4.2.15 The residual effect is predicted to remain **negligible**, which is not significant.

Health effects from changes in noise exposure

Magnitude of impact

4.2.16 As the proposed development would be operational 24/7, there is the potential for changes in the noise environment during both the daytime and night-time, with associated impactors on annoyance and/or sleep disturbance for nearby receptors.

4.2.17 As stated in Chapter 10: Noise and Vibration, during the daytime period, a no change to negligible impact (in noise terms) is predicted at all sensitive receptors.

4.2.18 During the night-time period, the level for the onset of sleep disturbance during the night-time contained in the WHO published Night Noise Guidelines for Europe is a free-field level of 42 dB LAeq. While there would be changes in the night-time noise environment, the resultant night-time ambient sound level at all sensitive receptors remain lower than the guideline value of 40 dB LAeq,T. As a result, it is considered that the operation of the proposed development is unlikely to result in any increased sleep disturbance.

4.2.19 On the basis that the daytime noise environment would not materially change, and the night-time noise environment would remain within recommended guideline levels which are set to be protective of human health, the magnitude of impact on population and health would be **low**.

Sensitivity of the receptor

4.2.20 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.21 Overall, it is predicted that **low** magnitude of impact on the **very low** sensitivity receptor would result in a **minor** adverse effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.2.23 The residual effect is predicted to remain **minor** adverse, which is not significant.

Health effects from changes in transport nature and flow rate

Magnitude of impact

4.2.24 As stated in Chapter 9: Transport and Access, across a typical day it is estimated that there could be in the order of 124 two way vehicle movements including staff journeys and visitors/general site deliveries.

4.2.25 It is proposed that parking within the proposed development will be limited to 40 spaces, with the applicant committed to reducing the number of vehicular trips to and from the site associated with single occupancy staff trips through implementing a Staff Travel Plan, which is expected to include a shuttle bus service for employees (routing to be confirmed, but will likely run between Kintore rail station, Aberdeen and the wider network of park & ride sites and the application site).

4.2.26 On the unclassified road between the B977 and Bogfold from which operational access will be taken, the potential increase on traffic at this location is predicted to be 74.95%, which is due to the existing low levels of traffic using this road. All other road links analysed would experience a minimal increase in total traffic of up to 4.14%.

4.2.27 Detailed assessment in Chapter 9: Transport and Access has been undertaken for users and residents of the unclassified road between the B977 and Bogfold. The following impact themes are considered further from a population and health perspective:

- severance;
- pedestrian delay;
- non-motorised user amenity;
- fear and intimidation; and
- road safety.

4.2.28 The increase of 74.95% along the unclassified road between the B977 and Bogfold exceeds the threshold for a moderate impact on severance and fear/intimidation (occurring at 60%). While this is the case, it should be noted that baseline traffic flows on the road link are low, so the baseline plus development trips are together a total of two-way 289 vehicular trips (or 24 vehicle movements per hour assuming the majority occur between 07:00 and 19:00). As stated in Chapter 9: Transport and Access, this transport flow rate is not considered to be significant. Furthermore, the 54 two-way vehicle movements associated with the proposed development would equate to a contribution of less than one vehicle per minute. Overall, even with the addition of the operational traffic, the road would still be lightly trafficked (91.39% spare capacity).

4.2.29 For the same reasons as described above, the impact on non-motorised user amenity would also be limited. In addition, on the basis that there are no pedestrian facilities along the unclassified road between the B977 and Bogfold, there would be limited potential for adverse impacts on pedestrian delay.

4.2.30 Impacts on road safety from operational traffic are not considered to be material following implementation of mitigation measures and on the basis that no accidents have been recorded on the road link over the last 5-year period.

4.2.31 Overall, with implementation of the Staff Travel Plan, the magnitude of impact on population and health for users and residents of the unclassified road between the B977 and Bogfold would be **low**.

Sensitivity of the receptor

4.2.32 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.33 Overall, it is predicted that a **low** magnitude of impact on the **very low** sensitivity receptor would result in a **minor** adverse effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.2.35 The residual effect is predicted to remain **minor** adverse, which is not significant.

Health effects from changes to socio-economic factors

Magnitude of impact

4.2.36 Having a consistent income and being in long-term employment are two of the most important wider determinants of health and wellbeing. The operational phase of the proposed development would offer a number of job opportunities for those in the ‘energy’, ‘manufacturing’ and ‘professional, scientific and technical activities’ sectors.

4.2.37 As assessed in Chapter 15: Socio-economics, it is estimated that the peak operational workforce would be around 192 FTE from 2032 onwards. A maximum of 227 FTE further indirect off-site jobs per annum down the supply chain would be generated.

4.2.38 Overall, and taking into consideration leakage of direct job opportunities to workers outside of Aberdeenshire, the net additional operational employment for local residents

is estimated to be 144 FTE jobs. This equates to a GVA generation of £25.8m per annum from 2032 onwards.

4.2.39 From a socio-economic perspective, such employment and associated income generation from the proposed development is considered to have a moderately beneficial long-term impact on the Aberdeenshire manufacturing labour force and sector.

4.2.40 The impact on human health from operational employment and associated income would be long-term and indirect in nature. However, the magnitude of direct and indirect employment opportunities delivered by the proposed development would be relatively diffuse and are only likely to provide health and wellbeing benefits at the individual level and are not sufficient to quantify any change in baseline health at a whole population level. On this basis, the magnitude of impact on population and health would be **low**.

Sensitivity of the receptor

4.2.41 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.42 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **minor beneficial** effect, which is not significant.

Further mitigation or enhancement

4.2.43 No significant adverse effects have been predicted and no further mitigation is considered to be required. An Employment and Skills Plan, to help target employment opportunities at local residents (including those who have been in longer-term unemployment) and provide training and apprenticeship opportunities has been recommended, which has the potential to enhance the population and health benefits of employment generation by targeting it at those most sensitive to such benefits.

Residual effect

4.2.44 The residual effect following the recommended further enhancement would remain **minor beneficial** and not significant at a population level.

Health effects from changes in EMF exposure

Magnitude of impact

4.2.45 The proposed electricity supply to the proposed development will comprise buried cables in a single corridor of up to approximately 300-400 m in length from the west side of Kintore Substation to the electrolysis plant. The export cable circuits will be High Voltage Alternating Current (HVAC), with a voltage of 400 kV.

4.2.46 Electric fields are readily screened by metals, most building materials and a degree of screening is offered by trees, hedges, and other earthed objects. As the cables are buried, they would not produce an electric field above ground level. As such, the remainder of this section only considers potential exposure from magnetic fields.

4.2.47 While external transmission infrastructure exceeds 132 kV, and therefore compliance with the public exposure guidelines for magnetic fields can not be assumed by default, the route avoids residential properties and therefore, the potential for exposure to magnetic fields would be limited to transient exposure of passers by, though it is considered very unlikely that any public access via the right to roam would be taken through any gap between the Kintore Hydrogen Plant and Kintore Substation security fence boundaries where the electrical export cables would run. Under the CoP, magnetic field reference values are only applicable to long-term, not transient exposure. Due to the proposed Grampian condition concerning the two closest existing residential properties, no exposure of residents at these properties would occur in operation.

4.2.48 An external electrical switchyard would have 400/132 kV transformers, busbars and associated switchgear to supply high voltage AC power from the 400 kV underground cable grid connection to the electrolyser buildings. The switchyard would also contain further 33 kV and 6.6 kV transformers to supply other power loads on and off the site including the compressors, cooling system and abstraction water pumps. There would be no public access to or exposure to EMF from this equipment.

4.2.49 Overall, on the basis that there would be no potential for long-term exposure to magnetic fields from transmission infrastructure, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.2.50 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.51 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.2.53 The residual effect is predicted to remain **negligible**, which is not significant.

Health effects from hydrogen safety

Magnitude of impact

4.2.54 As with many industrial operations, there are specific hazards and risks associated with hydrogen production.

4.2.55 Most notably, hydrogen is a flammable gas which, at between certain concentration levels, can produce explosive combinations with air. In addition, the high pressure and cryogenic temperatures involved in hydrogen production has the potential to cause leaks, ruptures, and embrittlement of materials used in containment vessels and pipes.

4.2.56 However, these hazards and risks are well known and understood, such that hydrogen production facilities can be designed and operated in a way that is safe and protective of population and health of workers and the public. For example, due to the flammable nature of hydrogen, proper handling and storage are critical. Additionally, as a colourless and odourless gas, sensors for leak detection and routine inspections are an important part of hydrogen production.

4.2.57 The hydrogen industry must adhere to strict regulations and standards which cover various aspects of the design and operation of hydrogen facilities, and play a critical role in ensuring the safe production, storage, and use of hydrogen. The proposed development will be regulated under a Hazardous Substances Consent and it is expected to also be a Control of Major Accident Hazards (COMAH) facility, regulated by SEPA and the HSE for public safety. Furthermore, consistent with Pollution Prevention Control (PPC) legislation, the proposed development will require an accident management plan.

4.2.58 Overall, compliance with hydrogen regulations and standards ensure that the design and operation of the proposed development reduces any risk of a major accident (such as a hydrogen leak and/or explosion) to as low as reasonably practicable. As a result, the magnitude of impact on population and health would be **negligible**.

Sensitivity of the receptor

4.2.59 As stated in Section 2.6, the sensitivity of the population within the study area is **very low**.

Significance of effect

4.2.60 Overall, it is predicted that **negligible** magnitude of impact on the **very low** sensitivity receptor would result in a **negligible** effect, which is not significant.

Further mitigation or enhancement

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

Residual effect

4.2.62 The residual effect is predicted to remain **negligible**, which is not significant.

Future monitoring (all impacts)

4.2.63 Recommended monitoring focuses on environmental precursors to human health effects as set out within the relevant topic chapters and including hydrogen leak detection, thereby providing the opportunity for intervention to prevent any manifest health outcome.

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 For all health determinants assessed across the construction and operation phases (air quality, noise and transport), it is not considered that the effects reported would interact in such a way that they would create a more significant effect on a receptor than when assessed in isolation for each stage. The rationale for this is set out below.

4.3.3 Changes in air quality during the construction phase primarily relate to nuisance dust, whereas changes in air quality during the operation phase primarily relate to changes in NO_2. Effects on population and health would be negligible in both instance and would not interact in such a way that they would create a more significant effect on a receptor, as these have different physiological pathways through which respiratory health can be affected (dust not being respirable).

4.3.4 Changes in the noise environment during the construction phase would occur during the daytime period only (08:00–18:00 Monday to Saturday), with no potential for night time noise. During operation, changes in noise exposure during the daytime are considered to be negligible at worst, and changes in noise exposure during the night time would be more noticeable but would remain within guidance limits set by the WHO. Whilst the most affected receptors in the daytime during construction would also be the most affected receptors in the night time during operation, noise would be kept to an acceptable level that would not result in any long-term change in daytime annoyance, or level which would induce sleep disturbance. As a result, changes in the noise

environment during construction and operation would not interact in such a way that they would create a more significant effect on a receptor.

4.3.5 Changes in transport nature and flow rate during the construction phase would have the largest impact on the B977, B987, B994 and Kirkton Cottages, primarily from an increase in HGV movements. During the operation phase, potentially significant impacts (prior to further mitigation) would be limited to the unclassified road between the B977 and Bogfold (operational access road), primarily due to staff travel movements. On the basis that different road links are impacted for each phase, the impacts would not interact in such a way that they would create a more significant effect on a receptor.

Receptor-led effects

4.3.6 The population and health assessment draws from and builds upon key outputs from inter-related technical assessments to inform the assessment of significance on population and health.

4.3.7 While some environmental changes during the construction/operation phases would impact the same receptor at the same time (air quality, noise and transport), such changes are not considered to be significant and would not interact spatially or temporally to create a greater inter-related effect on a receptor than is predicted for each determinant individually.

4.3.8 Additional construction phase determinants assessed comprise employment and access to open space.

4.3.9 Those employed during the construction phase are likely to reside in areas beyond the immediate locality of the application site and would experience beneficial effects; as a result, it is not possible that there would be any spatial or temporal interaction to create a greater inter-related effect on a receptor.

4.3.10 In terms of access to open space, the freedom to roam means that there are plenty of reasonable and accessible alternatives for recreation and physical activity that exist in the surrounding area. Therefore, it is not possible that there would be any spatial or temporal interaction to create a greater inter-related effect on a receptor.

4.3.11 Additional operational phase determinants assessed include EMF and hydrogen safety.

4.3.12 The route of transmission infrastructure avoids occupied residential properties and so is unlikely to interact with the same receptors experiencing changes in the air quality and noise environment, which would not have a significant effect on population and health. Therefore, it is not possible that there would be any spatial or temporal interaction to create a greater inter-related effect on a receptor.

4.3.13 Regarding hydrogen safety and perceived risks associated with this, it is likely that those living closest to the proposed development would be most concerned about this. However, as outlined in section 4.2, the hazards and risks associated with hydrogen production are well known and understood, such that hydrogen production facilities can be designed and operated in a way that is safe and protective of population and health of workers and the public. While a perception of risk may still be present, the changes in air quality and noise would not be significant and there would be no credible spatial or temporal interaction to create a greater inter-related effect on a receptor.

5 Cumulative Effects Assessment

5.1 Introduction

5.1.1 The Zone of Influence (ZoI) for population and health cumulative effects is dependent on the health determinant being assessed, and remains consistent with the ZoI used for each of the inter-related technical aspects which inform the assessment of population and health.

5.1.2 As such, those cumulative developments shortlisted for cumulative effects assessment in the air quality, noise, transport and socio-economic chapters have been assessed here. The longlist of cumulative developments is given in Chapter 17.

5.2 Construction phase

5.2.1 There is potential for cumulative changes in emissions to air and noise, and consequential cumulative population and health effects, where construction works are ongoing concurrently in close proximity to one another (within 500 m). While this is the case, it is expected that other construction sites within close proximity to the proposed development would adhere to the same level of mitigation and good practice, which are typically required through the planning and, where applicable, EIA process for major developments, limiting the potential for cumulative impacts. On this basis, cumulative effects on population and health are expected to be **not significant**.

5.2.2 The cumulative effect of changes in transport nature and flow rate (including consequential impacts on air quality and noise) have been considered within the main assessment by including a 'growthing up' factor to account for cumulative development flows. Therefore, the population and health effects reported in relation to changes in transport nature and flow rate, noise emissions and air quality emissions during construction remain to be **not significant**.

5.2.3 There is the potential for cumulative socio-economic benefits where there is either temporal overlap in construction of the consented developments, or where the construction of a consented development either precedes or follows the construction of the proposed development.

- In the first instance (where there is temporal overlap), the benefit relates to a larger number of employment opportunities being available for those working in the construction industry; although it should be noted that where demand for employment exceeds local workforce availability, the population and health benefits become more diffuse.
- In the second instance (where construction either precedes or follows the construction of the proposed development), the benefit relates to job retention for those looking for another construction project to work on.

5.2.4 In both instances, it is unlikely that the magnitude of construction employment opportunities, or retention of opportunities would have a measurable benefit on human health at the population level. As such, overall, the cumulative effects on population and health are expected to remain **not significant**.

5.2.5 It is expected that consented developments would also result in permanent or temporary loss of land, increasing the amount of land which is inaccessible to the public locally. However, as previously stated, the freedom to roam means that there are plenty of reasonable and accessible alternatives for recreation and physical activity that exist in the surrounding area. As such, overall, the cumulative effects on population and health are expected to remain **not significant**.

5.3 Operation phase

5.3.1 As stated in Chapter 11: Air Quality, there are no consented developments with emissions of NO_2 from point sources within the 10 km grid centred on the proposed development. As a result, cumulative effects on population and health from changes in air quality during operation would remain **not significant**.

5.3.2 As stated in Chapter 10: Noise and Vibration, the maximum operational cumulative impact from other noise generating schemes would be 1 dB higher than for the Kintore Hydrogen Plant in isolation. This increase is marginal and therefore, cumulative effects on population and health from changes in noise during operation would remain **not significant**.

5.3.3 As previously stated, the cumulative effect of changes in transport nature and flow rate (including consequential impacts on air quality and noise) have been considered within the main assessment by including a 'growthing up' factor to account for cumulative development flows. Therefore, the population and health effects reported in relation to changes in transport nature and flow rate, noise emissions and air quality emissions during operation remain to be **not significant**.

5.3.4 There is only one consented development with electrical infrastructure located within 100 m of the proposed development (ID1), comprising the substation that the proposed electrical infrastructure from the proposed development would connect to. Magnetic field strength decreases rapidly with distance from the source and tends to be dominated by one source (the largest and/or nearest) where several sources in the area are present. As such, no significant cumulative impacts from other existing or proposed sources are anticipated. On this basis, cumulative effects on population and health are expected to be **not significant**.

5.3.5 Cumulative developments nearby include proposed battery energy storage facilities, which can introduce a perception of heightened fire risk. However, these would be regulated with fire prevention and emergency preparedness measures in place. As a result, cumulative effects on population and health due to combined industrial risk perception would remain **not significant**.

6 Conclusion and Summary

6.1.1 As shown in Table 6.1, it is not anticipated that there would be any significant human health effects resulting from the construction or operation of the proposed development.

6.1.2 Construction phase health determinants assessed comprise:

- Changes in exposure to air quality;
- Changes in noise exposure;
- Changes in transport nature and flow rate;
- Changes to socio-economic factors; and
- Changes in access to open space and core paths.

6.1.3 The implementation of appropriate mitigation measures outlined in the Outline CEMP would reduce the generation of construction dust and noise to a level which is not significant and is compliant with the relevant thresholds which are set to be protective of the environment and human health. In both instances, population and human health effects are reported to be **negligible**.

6.1.4 Changes in transport nature and flow rate during the construction phase are associated with HGV movements and construction staff movements including a shuttle bus service. The most affected roads which have been analysed in detail have low baseline traffic flows, which contribute to some of the high percentage increases reported. Overall, it is considered that due to the lack of pedestrian facilities on the majority of roads analysed and with implementation of mitigation measures through the Outline CTMP and Worker Travel Plan, the population and health effects would be **negligible**.

6.1.5 There would be beneficial impacts associated with construction related employment and associated income, which are two of the most important wider determinants of health and wellbeing. While this is the case, due to the short-term nature of the construction phase, the magnitude of direct and indirect employment opportunities are only likely to provide health and wellbeing benefits at the individual level and are not sufficient to quantify any change in baseline health at a population level. As a result, the population and health effects would be **negligible**.

6.1.6 The land permanently required for the electrolysis plant site is agricultural with a fringe of bog woodland and gorse scrub and the land required for the above-ground gas connection installation is likewise agricultural. Further temporary land take would be required for the underground hydrogen pipeline and water pipeline routes including pumping station construction. Considering Scotland's 'freedom to roam' and from observations on various site visits, the electrolysis plant site and above-ground installation and their surrounding land are lightly used by people for recreational activities such as dog walking. While this is the case, equally, the freedom to roam means that despite this land take, there are plenty of reasonable and accessible alternatives for recreation and physical activity that exist in the surrounding area. As a result, the population and health effects would be **negligible**.

6.1.7 The water pipeline route would cross a core path section, which could temporarily disrupt use of that route during construction works. Measures to ensure core path access is maintained and safe public crossing of the pipeline trenching route are included in the Outline CEMP. As a result, the population and health effects would be **negligible**.

6.1.8 Operation phase health determinants assessed comprise:

- Changes in exposure to air quality;
- Changes in noise exposure;
- Changes in transport nature and flow rate;
- Changes in EMF exposure; and
- Hydrogen safety.

6.1.9 Once operational, there is potential for increases in local NO_2 concentrations associated with the proposed hydrogen flare. A quantitative exposure response assessment was undertaken to establish how the changes in local air quality might impact the health of the local population. The results showed that there would be no measurable change in population health outcomes associated with long-term NO_2 emissions from the hydrogen stack. As a result, the population and health effects would be **negligible**.

6.1.10 Regarding the potential for noise impacts, the proposed development would be operational 24/7 and therefore, there is potential for both daytime and night-time noise. However, no annoyance during the daytime or sleep disturbance during the night time is anticipated on the basis that changes in ambient noise levels during the day would be negligible (in noise terms) and changes in ambient noise levels during the night would remain lower than the guideline value set by the WHO to avoid sleep disturbance. As there would be some change to the night time noise environment, the population and health effects would be **minor adverse**.

6.1.11 Changes in transport nature and flow rate during operation would primarily be associated with staff movements, visitor movements and general site deliveries. To mitigate impacts associated with staff movements, a shuttle bus service is proposed, and parking on the electrolysis plant site would be limited. Operational staff access will be managed through a Staff Travel Plan. The only road requiring detailed assessment

is the unclassified road off the B977 where the operational access road junction would be located, which has low baseline traffic flows. Taking into context the low baseline traffic flows and proposed mitigation, the population and health effects would be **minor adverse**.

6.1.12 The proposed development includes a 300-400m 400 kV underground electricity cable connection to neighbouring Kintore Substation. The route avoids residential properties that would be occupied during operation and therefore there would be no potential for long-term exposure to magnetic fields from this transmission infrastructure. The population and health effects would be **negligible**.

6.1.13 While hydrogen is flammable and can be explosive, these hazards and risks are well known and understood, such that hydrogen production facilities can be designed and operated in a way that is safe and protective of population and health of workers and the public. Overall, compliance with the applicable regulatory regimes and standards ensure that the design and operation of the proposed development reduces any risk of a major accident (such as a hydrogen leak and/or explosion) to as low as reasonably practicable. As a result, the population and health effects would be **negligible**.

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							
Health effects from changes in exposure to air quality (dust)	Dust mitigation, as set out in the Outline CEMP	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed. Nuisance dust monitoring is included in Outline CEMP.
Health effects from changes in noise exposure	Noise mitigation, as set out in the Outline CEMP	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed
Health effects from changes in transport nature and flow rate	Transport management, as set out in the Outline CTMP and a Worker Travel Plan	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed
Health effects from changes in socio-economic factors	n/a	Negligible	Very low	Negligible (not significant)	None	Negligible (not significant)	No health specific monitoring proposed
Health effects from changes in access to open space and core paths	Core path crossing point and marshalling, as set out in the Outline CEMP	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed
Operational phase							
Health effects from changes in exposure to air quality (NO_2)	Flare design and Grampian condition concerning two nearest residential receptors	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed. Air pollutant emissions monitoring will be required under PPC Permit.
Health effects from changes in noise exposure	Design of electrolysis plant to achieve noise levels specified in Chapter 10 and Grampian condition concerning two nearest residential receptors	Low	Very low	Minor adverse (not significant)	No additional health specific mitigation proposed	Minor adverse (not significant)	No health specific monitoring proposed
Health effects from changes in transport nature and flow rate	Limitation of on-site parking to 40 spaces Staff Travel Plan, including proposed shuttle bus for workers from various locations	Low	Very low	Minor adverse (not significant)	No additional health specific mitigation proposed	Minor adverse (not significant)	No health specific monitoring proposed
Health effects from changes in socio-economic factors	n/a	Low	Very low	Minor (not significant)	Employment and Skills Plan	Minor beneficial (not significant)	No health specific monitoring proposed

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
Health effects from changes in EMF exposure	n/a	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed
Health effects from hydrogen safety	Compliance with strict regulations through the Control of Major Accident Hazards and Pollution Prevention and Control permitting regimes, which cove various aspects of the design and operation of hydrogen facilities	Negligible	Very low	Negligible (not significant)	No additional health specific mitigation proposed	Negligible (not significant)	No health specific monitoring proposed. Safety will be audited under HSC, PPC Permit and COMAH regimes.

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