THE INFRASTRUCTURE PLANNING (APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009

Preesall Underground Gas Storage Facility, Lancashire

Health Impact Assessment

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| Author:          | Ben Cave Associates Ltd  
103 Clarendon Road  
Leeds Innovation Centre  
Leeds  
LS2 9DF  
T: 00 44 113 322 2583  
E: information@bcahealth.co.uk  
W: www.bcahealth.eu |
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Registered address: 103 Clarendon Road, Leeds Innovation Centre, LS2 9DF
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Abbreviations and acronyms

APHO..........................................Association of Public Health Observatories
CLP..........................................................Community Liaison Panel
COMAH..............................................Control of Major Accidents and Hazards
EHO .............................................................Environmental Health Officer
EIA ...............................................................Environmental Impact Assessment
HIA ..............................................................Health Impact Assessment
HPA .............................................................Health Protection Agency
IPC .............................................................Infrastructure Planning Commission
LFL .............................................................Lower Flammable Limit
MINI ..............................................................Mental Illness Needs Index
PCT ...............................................................Primary Care Trust
QRA .............................................................Quantitative Risk Assessment
SSSI .............................................................Site of Special Scientific Interest
UGS .............................................................Underground Gas Storage

Definitions

Important health effect

Based on the Department of Health guidance on HIA 2010 (2).

‘Major’ injury

As defined by Schedule 1 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) (3).
1 Summary

1.1 Background

1.1.1 This report presents an assessment of the health effects of the proposed underground natural gas storage facility at Preesall, Lancashire and forms part of the detailed planning application.

1.1.2 Halite Energy Group Ltd (hereafter referred to as “Halite”) seeks planning consent from the Infrastructure Planning Commission (IPC) for the underground natural gas storage facility and associated enabling works (hereafter referred to as the “proposed development”). The HIA was requested by NHS North Lancashire and other statutory consultees.

1.1.3 The location, within Wyre Borough, contains two distinct areas that have very different economic and social needs. The River Wyre acts as a natural barrier between the urban areas of Fleetwood, Thornton and Cleveleys to the west and the more rural area of Knott End-on-Sea, Preesall, Stalmine and Hambleton to the east.

1.1.4 A Steering Group was convened to provide oversight of, and advice to, the HIA team. It was chaired by the Assistant Director of Public Health from NHS North Lancashire and included representatives from the Health Protection Agency, Wyre Borough Council and Halite.

1.1.5 The HIA was funded by Halite. Ben Cave Associates Ltd prepared this report. The HIA team has worked with Halite and its consultants and have been advised by the Steering Group.

1.1.6 This is an independent report.

1.2 Scheme description

1.2.1 The Proposal for development includes the following key elements:

- Gas Storage Caverns – created specifically for the project in underground salt deposits previously untouched by brine mining operations. There will be up to nineteen caverns at a mean depth of 372 metres below ground with a total storage capacity of 900 million cubic metres (600 million cubic metres working capacity);
- Water Washing Infrastructure – including a sea water pipeline from the Fleetwood Fish Dock to the Preesall site and a brine discharge pipeline from the Preesall site to the Irish Sea, approximately 2.3km offshore;
- Gas Infrastructure (pipelines) – to connect the caverns to the Gas Compressor Compound (GCC) and then on to the National Transmission System (NTS) Interconnector (approximately 12km to the east); and
- Road Infrastructure – a proposed new road from the A585 to the site and haul roads within the site.
1.2.2 In addition other works include:

- boreholes lined with steel and concrete casings;
  - Wellhead Compounds (to accommodate the drilling rigs) and security fencing;
- four power, communication and control pipelines from the Fleetwood Fish Dock to the Preesall site;
- underground electricity cables from United Utilities switchgear in the Stanah Switchyard to the GCC;
- temporary drilling compounds at the Fleetwood Fish Dock;
- modifications to the seawall at West Way to accommodate the brine outfall pipeline and new observation platform;
- landscaping; and
- a number of temporary construction, drilling and storage compounds.

1.3 **Approach**

1.3.1 The HIA uses the World Health Organization definition of health (4)

*Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*

1.3.2 Health is affected by many factors outside the health services, for example: employment, transport, housing and environmental conditions. People are affected by these factors and there are inequalities in health between population groups. The HIA identifies issues that may harm, or improve, general levels of health. The HIA also seeks to identify how health inequalities may be affected by the proposal.

1.3.3 The assessment draws upon reports commissioned by Halite such as the Environmental Statement (ES) and the Quantitative Risk Assessment (QRA); it looks at the results of the consultation activities that Halite has conducted; and at peer-reviewed and academic articles that examine the health effects of relevant interventions.

1.3.4 The assessment is predominantly qualitative. This means that it is often only possible to identify a direction of travel for changes in health effects, not an absolute amount by which they may change. The HIA therefore uses wording such as “declines”, “reductions” or “improvements” in health. There are also inherent uncertainties in predicting health outcomes as there are many other contributory factors that are independent of the proposed development. The HIA therefore uses wording such as “likely” or “unlikely”.

1.3.5 Issues associated with the proposed development were identified: for example, plant and vehicle emissions; structural failure; employment etc. The HIA team systematically examined each issue against a range of criteria. By working through each issue the team came to conclusions about the final health effects.
1.3.6 The HIA makes recommendations about ways to minimise harmful effects and to enhance positive effects.

1.3.7 The conclusions of the HIA are provided below.

1.4 Conclusions

1.4.1 Fuel storage facilities are associated with known hazards and risks and are subject to special statutory controls and regulatory regimes to manage and control these aspects. Clearly if these regimes fail there can be serious health implications. Human error can negate all “safety engineering controls”. People within approximately 844 metres of the centre of the Gas Compressor Compound (and a small extension of this area to the north-west) would be at risk of major injury\(^1\) or death if a major leak or an explosive event occurred. The seriousness of effects will increase with greater proximity to the source of the gas release. This puts the on-site workforce and residents at Cote Walls farm at particular risk. Other people who could be affected are people at Park Cottage farm or Park Cottage to the southeast; people on the ‘Wyre Way’ or at the sewage works to the west (usually unoccupied); people on the southern end of the Knott End Golf Club to the north; people around water bodies used by the Alkali Angling Club to the east; and people working the surrounding agricultural land.

1.4.2 Although the risk of an emergency scenario is low, the fear of such a scenario is likely to have a more widespread population level effect than the actual event itself (5;6). Perceptions of safety are complex and their capacity to cause stress, anxiety or depression is not geographically limited to the actual areas of risk. It has not been possible to determine the precise extent of such fears within the surrounding population; however the responses to the public consultation provide a good indication that there are strong and widespread views on the safety of the proposed development that go beyond both levels and areas of risk identified in the project’s quantitative risk assessment.

1.4.3 In terms of the wider public health, effects are limited to issues of disturbance for particular population groups and a potentially more widespread, but low level, effect on mental health from strongly held concerns about the project’s safety.

1.4.4 As with any development there are inherent construction disturbances; in this case they relate primarily to noise and fugitive dusts. Such disturbances are likely to be greater in the short term and diminish with distance.

\(^1\) This HIA uses the definition of ‘major injury’ as set out in Schedule 1 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (3). This is considered to be an appropriate definition as it specifically covers distributors, fillers, importers or suppliers of flammable gas. In the case of a gas supplier RIDDOR creates a legal duty to report any deaths or ‘major’ injuries (of either employees or the public) in connection with the gas distributed, filled, imported or supplied to the HSE and local authority.
disturbances are likely to be temporary in nature, (sub four years) relative to the lifetime of the whole project, but may cause reduced wellbeing for residents, including sleep disturbance, particularly around the southern end of the Fleetwood Harbour. Such construction noise may also discourage people from engaging in recreational pursuits in the wider estuary and terrestrial area around the main Gas Compressor Compound site, with an adverse impact on physical activity and mental wellbeing. The health profile of the area suggests that increasing physical activity is a particular priority for the population.

1.4.5 The construction of a new site access road for the development reduces the traffic impact in the locality. Although the number of construction heavy goods vehicles (HGVs) is not large in terms of absolute numbers, it does represent an increase from background levels, which may be intrusive. Consequently other road users or communities through which construction traffic passes may experience some reduction in wellbeing and could be discouraged from activities such as walking or cycling.

1.4.6 The operational elements of the proposed development are also likely to cause some disturbance, notably noise and visual disturbance. Such disturbance will be more long lasting and although there is potential for some people to adapt to the change, it is likely that there will be some decline in wellbeing for the occupants of those residences where industrial noise or visual elements (such as flue plumes) are added to a previously agricultural setting. Similarly, such operational disturbance may reduce the ‘tranquillity’ of the wider estuary (7) and thus discourage people from engaging in recreational pursuits in the area around the main Gas Compressor Compound site, with an adverse impact on physical activity and mental wellbeing.

1.4.7 There are positive effects, which result from the proposed development. It will be a source of much needed employment in an area, which includes some of the nation’s most deprived communities. Such employment will bring improvements in health and wellbeing for those gaining employment, as well as their dependents.

1.4.8 The development extends national energy supply security and increases resilience against energy shortages. In the event of a national energy shortage the capacity offered by the proposed development would contribute to reducing risks to public health from failures in power, heating and services (including emergency and health services). There would also be indirect health benefits from avoiding national level economic disruptions.
2 Introduction
2.1.1 This Health Impact Assessment (HIA) report presents an assessment of the health effects associated with the proposed underground natural gas storage facility at Preesall, Lancashire and is submitted as part of the detailed planning application.

2.1.2 This report refers to, and should be read in conjunction with, the Appendices, which are provided separately.

2.1.3 Halite Energy Group Ltd (hereafter referred to as “Halite”) is seeking to obtain planning consent from the Infrastructure Planning Commission (IPC) for the underground natural gas storage facility and associated enabling works (hereafter referred to as the “proposed development”) at Preesall, Lancashire. The main site location is shown in Figure 4.1 and the full application boundary is shown in Appendix F, Figure F.1.

2.1.4 The works are detailed in Section 4, but broadly comprise newly created gas storage caverns deep underground in a layer of halite (rock-salt) that is impermeable to gas and self-sealing in the event of fracture\(^2\). The caverns will be created using a process of ‘solution mining’, whereby seawater is pumped from a pumping station at Fleetwood Docks into the halite layer to dissolve out a cavity. The re-extracted water with high levels of dissolved salt will be discharged 2.3km offshore in the Irish Sea. The cavities will be fitted with a multi-walled pipe to the surface through which gas will enter and leave the caverns.

2.1.5 Surface infrastructure will regulate gas movement to and from the caverns and provide a connection point from which a buried pipe will be installed to the National Transmission System approximately 12km to the east.

2.1.6 As the surface infrastructure will also allow for gas to be pressurised and dried, there will be some associated plant emissions to air.

2.1.7 Site access will be by a new road linking to the A588; a further emergency access route will also be provided.

2.1.8 The proposed site for the main surface and subsurface infrastructure is currently arable agricultural land. The agricultural setting has implications for both visual setting and potential food chain linkages.

\(^2\) The ‘self-sealing’ property of halite is attributable to it acting like a very viscous (or thick) liquid rather than a solid. More technically halite’s very high creep i.e. the ability to strain without an increase in load, supplemented by recrystallisation of the mineral, affords halite the ability to “self heal” if a fracture occurs.
2.1.9 The site has a history of brine extraction, and includes a number of decommissioned brine caverns. None of the previous mining works form part of the proposed development. Indeed the location of the proposed development is dictated by a need for a zone of halite free from both natural faults and previous brine extraction activities.

2.1.10 Health Impact Assessment (HIA) is a process that involves estimating the potential health effects (positive and negative) of a development project and making recommendations to enhance beneficial effects and to reduce adverse effects.

2.1.11 This HIA report is written for the decision makers who are involved in developing the underground gas storage facility or are responsible for determining the planning application associated with its implementation. The HIA report documents the HIA process, which has been undertaken in conjunction with planners, commissioners and a steering group.

2.1.12 In the remainder of this report:

- Section 3 explains the HIA approach;
- Section 4 provides further details of the proposed development;
- Section 5 sets out the local health context;
- Section 6 explains the HIA methodology;
- Section 7 sets out the policy context to the assessment;
- Section 8 summarises the results of the assessment; and
- Section 9 sets out the recommendations of the HIA.

2.1.13 Supporting these sections is a series of appendices, which provide the further details of the decision-making processes, which underpin the results of this HIA.
3 Approach

3.1.1 HIA is a systematic process used to assess the potential health effects arising from policies, plans, programmes and projects and to help reduce health inequalities. HIA generally uses the World Health Organization’s (WHO) definition of health (8):

‘Health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity.’

3.1.2 There are a number of factors, as illustrated in Figure 3.1, which affect health directly or indirectly.

3.1.3 These are called determinants of health and include employment, transport, housing etc that can improve and protect health as well as things, which might harm health. Examining how the proposed project influences these determinants and the likely effects on the health of communities and individuals is the primary role of HIA.

Figure 3.1: The main determinants of health

3.1.4 This document forms part of a prospective process, which means that it is undertaken in advance of the implementation of the project, thereby providing sufficient opportunity to enable ‘constructive modifications’ to be made to the project should negative potential
effects be identified and mitigations required. The presumption has been to draw up a wide scope of the potential health issues and potentially affected population groups. This wide scope was then narrowed through work with the HIA Steering Group to those health issues and population groups, which are relevant to this development. These issues and population groups have been assessed as part of the HIA.

3.1.5 The assessment process is iterative. Issues can be scoped in at a later stage if there is good reason to do so. The HIA team liaised closely with the client and the steering group to identify any appropriate changes in the HIA scope as the scheme and HIA developed.

3.2 HIA Stages

3.2.1 Stage 1: often called screening - is the stage when it is decided whether an HIA is likely to be the best way to address health and equity issues. This step was undertaken by Wyre Borough Council (WBC) and North Lancashire Teaching PCT (NL PCT) and led to the decision to ask Halite to prepare an HIA.

3.2.2 Stage 2: often referred to as scoping - is when it is decided how to undertake the HIA and begin to do the planning. This involved a review of: previous gas storage projects; previous mining HIAs; the EIA scoping report; telephone discussions with NL PCT; and establishing the HIA Steering Group.

3.2.3 The HIA team conducted a site visit.

3.2.4 The scoping considered fourty six potential health issues and twenty four potentially relevant population groups. Through the scoping exercise many of these issues or groups were scoped out as not being likely to be associated with important health effects. This left thirty eight potential health issues and fourteen potentially relevant population groups.

3.2.5 Stage 3: often called the evaluation or assessment stage - is when the evidence regarding the likely impacts on health is identified and considered. This stage draws on research evidence, evidence from stakeholders, the current (and previous) project consultation exercises as well as baseline data collection.

3.2.6 The HIA team and the steering group worked through matrices of the possible effects. The scoring system considered both the size of changes caused by the project, which may affect the health of relevant populations, and the magnitude of any health effect remaining for relevant populations, once factors, which improve positive health effects and reduce negative health effects are taken into consideration.

3.2.7 Stage 4: often called developing and prioritising recommendations - this is when specific recommendations are formulated and prioritised for the decision makers based on best available evidence.
3.2.8 Two further stages will be conducted once the HIA report has been submitted, as described below.

3.2.9 Stage 5: following completion of the HIA continued liaison is required between the developer/operator and the regulatory and public health authorities to ensure that benefits are secured and adverse effects minimised.

3.2.10 Stage 6: ongoing evaluation and monitoring by Halite to monitor the long-term health and equity outcomes of project.
4  

Scheme Description

4.1  

Overview

4.1.1  
This section describes the scheme and it is consistent with the reports prepared as part of this application. Whilst the rest of the HIA focuses on the specific aspects of the scheme where potential health effects may occur, the scheme description is provided in full for completeness.

4.1.2  
The section describes Halite’s new application proposals, which remain ‘indicative’ pending the response of the consultees and the community to the consultation process. The project description should be read in conjunction with the indicative Project plans.

4.1.3  
The proposed Project is to create underground caverns in the salt body at Preeasall. When created, the caverns would be used for the storage of natural gas, which can be supplied to the Gas National Transmission System (NTS) to meet demand. In broad concept, the proposals are similar to schemes that were promoted by Canatxx Gas Storage Limited (CGS) between 2005 and 2009. The main difference between the current Project and previous schemes is that the Halite proposals have been reduced in size and scale such that the amount of gas that would be stored is significantly less than that proposed in previous schemes. The Halite proposal seeks permission for up to nineteen caverns with a working capacity of up to 600 million cubic metres – about half that of the previous scheme. The reduction in the gas storage capacity and the location of the proposed caverns (see below) has also condensed the surface infrastructure and, therefore, the overall site area that is required to construct and operate the proposed Facility.

4.1.4  
Details of the design considerations and the alternative options that have been considered are set out in the separate ‘Design Statement’ Report and the ‘Preliminary Environmental Information’ (PEI) Report.

4.1.5  
Geological investigations and assessments undertaken by Halite suggest that the optimum location for the construction of caverns is at the northern part of the Preeasall site. The geological work summarised in the ‘Geology Summary Report’ (GSR), includes a review of the geological data and identifies potential geological hazards at Preeasall. This assessment led to the development of ‘hazard exclusion zones’ where, based on available data, the risks of cavern construction were considered too high. Two polygonal areas were identified outside of the buffer area in the northern part of the site where the development of the caverns could take place.
4.1.6 Having regard to the GSR, a plan showing the area where the caverns would be located and an indicative cavern layout has been produced showing the approximate location and size of each cavern (Drawing No. D-9000-030). The layout is ‘indicative’ as the precise location and extent of each cavern will be subject to consent from the Health & Safety Executive (HSE) under the Control of Major Accident Hazards (COMAH) Regulations 1999. In addition, the detailed layout of the caverns is an iterative process where the results and experience from the creation of the first cavern inform the detailed location and design of the second cavern and so on. The amendments to the indicative cavern layout should not, however, be significant and it is intended that the formal application to the IPC would provide the parameters in which the caverns would be created.

4.1.7 The indicative cavern layout shows a smaller scheme to those previously proposed by CGS. A total of nineteen caverns are proposed rather than the thirty six caverns that formed the basis of the last CGS application submitted in 2009.

4.1.8 The reduction in the size of the scheme and the location of the caverns means that it has been possible to reduce the extent of surface infrastructure when compared with earlier CGS schemes. The indicative overall Master Plan (Drawing No. A-9000-005) and the more detailed Master Plans for the Preesall site (Drawing No. A-9000-003) and Fleetwood (Drawing No. A-9000-002) show the extent of the proposed development. In summary, the Halite proposals include the following key elements:

- Gas Storage Caverns;
- Water Washing Infrastructure;
- Gas and Electrical Infrastructure; and
- Road Infrastructure.

4.1.9 Figure 4.1 shows the main elements of the surface structures, which will support the gas storage operations.

4.1.10 Figure 4.2 shows the northern river crossing where pipelines will be drilled under the River Wyre (drilling compound on western bank).

4.1.11 Figure 4.3 shows the southern river crossing where cables will be drilled under the River Wyre (drilling compound on eastern bank).

4.1.12 Figure 4.4 shows the seawall crossing where the brine discharge pipeline will pass through existing sea defences.

4.1.13 See Appendix F for the full planning application boundary.
Figure 4.1: Main Gas Storage Site Plan

Figure 4.2: Northern Crossing of River Wyre
Figure 4.3: Southern Crossing of River Wyre

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Figure 4.4: Seawall Crossing at Fleetwood

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4.2 **Gas Storage Caverns**

4.2.1 Up to nineteen caverns will be created by brine solution mining and used for the storage of up to 900 million cubic metres of natural gas\(^3\).

4.2.2 Cavern depths range from 317 metres to 459 metres below ground, with a mean depth of 372 metres below ground (measurements are vertical depths).

4.2.3 Figure 4.5 provides a graphical representation of a Gas Storage Cavern (this figure is indicative only and does not show associated landscaping which would be present around the surface infrastructure).

\(^3\) Total cavern capacity would be approximately 900 million cubic metres to give a working capacity of up to approximately 600 million cubic metres. These volumes are stated at standard temperature and pressure.
4.2.4 The proposed UGS Facility would consist of a number of underground caverns, which would be created by a solution mining (leaching) process described later. The caverns used in the proposed Facility would be created specifically for the project in the salt areas that have been left untouched by previous brine mining operations.
4.2.5 The caverns would be individually designed and constructed according to the best practices of the gas storage industry, according to designs and specifications which are based on detailed studies of the salt quality, its disposition underground, and tests of its mechanical strength. All work must be in accordance with a Pre Construction Safety Report approved and administered by the Health & Safety Executive (HSE), under the Control of Major Accident Hazards (COMAH) Regulations 1999.

4.2.6 The caverns would be developed and constructed in accordance with BSI BS EN 1918-3 ‘Gas Supply Systems – Underground Gas Storage Part 3: Functional Recommendation for Storage in Solution – Mined Salt Cavities’ (1998). As well as ensuring that gas storage caverns are properly constructed it is necessary to establish a number of design parameters including:

- minimum thickness of the salt that forms the roof of the cavern;
- depth of the cavern;
- geometrical shape;
- minimum and maximum operating pressures; and
- minimum pillar dimensions with respect to adjacent caverns or to the boundary of the salt rock formation, major faults or any other hazards.

4.2.7 Halite has appointed external geological specialists to assist in the cavern design. The design must meet the approval of the Health and Safety Executive (HSE) following the drilling and testing of the borehole for each cavern.

4.2.8 To access the salt, boreholes would be drilled from a number of wellheads. Initially, vertical wells would be drilled to access the land based salt body prior to directional drilling techniques to access the salt under the Wyre Estuary Site of Special Scientific Interest (SSSI). The boreholes from which the caverns would be constructed would be drilled from drilling pad sites. A steel casing would be inserted into the completed boreholes and concreted in to protect the wells from the migration of groundwater and to provide an effective seal between the mudstone and the borehole string.

4.2.9 Halite has engaged a drilling service company (Baker Hughes) to evaluate the required programme to successfully drill and create caverns located in the cavern development area. Because some of the salt formation lies under the Wyre Estuary, some well trajectories require deviated drilling. Four distinct well types have been identified; vertical, S-shaped, slant and extended reach slant wells.

4.2.10 The surface casing would be concreted back to the surface and the concrete allowed to cure. This means that the casing would be sheathed in concrete, so as to create an impermeable barrier between the casing and the surrounding material. The concrete casing of the boreholes would be impermeable to gas penetration and erosion. The drilling process would continue with a borehole down to and including
the first 15 – 25 metres of the salt bed. Where the cavern to be created in the salt is directly under the drill bed, the borehole would be vertical. Where the cavern is to be created in a position laterally displaced from the drill pad, the borehole would be drilled using a directional drilling technique.

4.2.11 The production casing would be run into the well with a stab-in float collar between the 1st and 2nd casing joints. A float guide shoe would also be placed on the end of the lowermost joint to guarantee that concrete would not migrate back up into the casing when the pumping of concrete is completed. After the casing is concreted back to the surface, the concrete would be allowed to cure. After curing the concrete, the float collar and float shoe, which are made of concrete, would be drilled out and a smaller borehole drilled vertically to the proposed total depth of the cavern.

4.2.12 The well would be logged to verify the predicted geology of the roof rock and salt. This would be undertaken using an electric wire logging device, which would be lowered into the well to measure the electrical resistivity of the roof rock and the salt bed. The results of this measurement would be analysed and would provide additional information about the characteristics of the salt body.

4.2.13 The brine production tubing would be hung in the wellhead to the level of the proposed bottom of the cavern. The injection tubing would be hung at the required depth and the wellhead would be completed in preparation for the solution mining process (washing) of the cavern. This completes the well installation.

4.2.14 A solution mining process, using seawater, would dissolve the salt in order to create the cavern in the salt body. Seawater would be pumped down the borehole, which would dissolve the salt, and the resultant brine would be returned to the surface. An inert gas blanket, in this case nitrogen, to prevent the dissolution of salt around the concreted production casing would be injected and the depth would be verified by interface logging which measures the brine/nitrogen interface which is determined by the difference in the density of brine and of nitrogen at a certain depth. The blanket interface would be calculated individually for each borehole. Seawater injection would be through the injection tubing using the direct method of washing. The brine produced as a result of the washing process would be brought to the surface through the annulus between the different sized tubing within the borehole.

4.2.15 A sump would be created at the bottom of the cavern to contain the insoluble substances liberated by the washing process. Sonar surveys of the cavern would be carried out during the washing process to reveal its size and shape.

4.2.16 The important blanket interface would be periodically verified with an interface survey and would be continuously monitored by recording the nitrogen wellhead pressure. The amount of cavern storage space that
is washed each day would be calculated from the volume of brine withdrawn and the temperature corrected specific gravity of that brine.

4.2.17 Washing would continue with intermittent sonar surveys verifying the cavern shape and volume until the required storage space is achieved.

4.2.18 After solution mining is completed, the leaching strings would be removed, a final sonar survey would be performed, the de-brining string would be inserted into the well, and the high pressure wellhead would be installed. Following completion of these steps, a mechanical integrity test (MIT) would be performed using nitrogen gas. Nitrogen would be injected into the well between the production casing and the de-brining string until the gas/brine interface is several metres below the concreted casing seat. The nitrogen gas/brine interface would be verified by the running of a density interface log. The log would detect the difference in density between the nitrogen gas and the saturated brine. After the interface has stabilized due to temperature/brine equalization and pressure, the well would be monitored for a minimum of twenty four hours and a new interface log would be performed. If the interface has not moved upward, the well and cavern would be certified as devoid of fluid leakage; that is, the well and cavern have mechanical integrity. If the interface has moved upward, a new test would be required to certify the integrity of the cavern. All tests would be carried out in accordance with the requirements of the HSE.

4.2.19 If for some reason a well or cavern does not pass the tests, attempts to determine the reasons for failure would be made. If the reasons for the failure cannot be resolved, the cavern/well would not be used and would be decommissioned. Typically, however, the industry experiences very low failure rates of new caverns.

4.2.20 Following successful completion of this testing, gas from the Grid would be introduced under pressure and used to purge the cavern of brine. The completed well and cavern would be operated as a pressure vessel while in natural gas storage service.

4.2.21 Initial cavern gas fill and de-brining system safety revolves around the use of both manual and emergency shutdown valves on the wellheads at the surface. Sensors on the gas injection side would close wellhead valves automatically (fail closed) if pressure on the injection side is higher than necessary to displace brine from the cavern. The shutdown would be recorded in the control room and injection to the well would cease.

4.2.22 Likewise, if brine velocity and pressure increase in the de-brining tubing, indicating a possible gas bubble coming to the surface in the brine, both the gas injection and brine return emergency valves would activate and shut down the entire system to that well. That information would be transmitted to the control room and remedial attention would result.
4.3 Water Washing Infrastructure

4.3.1 In order to dissolve the salt and create the caverns, a supply of water is required, together with pumps and pipelines to take it to the caverns and from there to the brine disposal point. The amount of water required is very large (up to 80 mega-litres a day) such that the use of freshwater made this an environmentally unviable option. However, since seawater is only 3% sodium chloride, as compared with saturated brine at 26%, seawater is almost as effective as fresh water for this purpose and is available in much larger quantities. Fleetwood Fish Dock has, therefore, been selected as a suitable source of seawater. The Fish Dock, constructed in 1880, was also used to supply cooling water to an electricity generating station in the 1950’s and some of this infrastructure is still in place. The proposed construction makes maximum use of this existing infrastructure, which minimises the impact of the project.

4.3.2 The proposal is to draw water from the Fish Dock at Fleetwood, through the existing inlet and associated culvert, which is 1.22 metres in diameter. A Seawater Pump Station is proposed, adjacent to Associated British Ports Fish Dock, to pump seawater in a buried and directionally drilled pipeline from the West Bank of the Wyre Estuary to the Preesall site. Filters would be incorporated into the inlet to minimise the opportunity for marine organisms to be drawn into the water washing infrastructure.

4.3.3 The river crossing would consist of four directionally drilled boreholes: one for the seawater passing from the seawater pump station; one for the returning brine; one for power, communications, controls and ancillary uses, leaving one in reserve. These will be formed by directionally drilling boreholes from the West Bank, at sufficient depth to minimise the environmental impact. The pipelines will be a minimum of 8 metres below the bed of the River to ensure that the existing silt, sediments and flood defences are not disturbed.

4.3.4 The seawater would then be transmitted in a buried pipeline to the Booster Pump Station where the pressure would be increased and the seawater pumped to the various wellhead locations. It would be fed down the well casings for the cavern washing operation at carefully controlled rates, according to industry best practices and HSE requirements.

4.3.5 After the brine has been used in the washing process, it would be returned to the de-brining facility adjacent to the Booster Pump Station to ensure the brine contains no dissolved gas or sediment from the washing stage. Dissolved gases vent to air whilst the sediment would be collected and disposed of to an existing cavern on the site by tanker or slurry pipeline. Further details are provided in the section dealing with waste arisings towards the end of this chapter. The quality of the brine would be carefully monitored prior to disposal. The brine would be of varying saturation, according to the stage of cavern washing, but
as a ‘worst case’ it is assumed for the environmental assessment to be saturated; i.e. approximately 26% weight/weight (w/w) sodium chloride.

4.3.6 The saturated brine would leave the Facility at a pressure of up to 5-7 bar. It would then be passed through piping, trenched in a similar manner to the inlet seawater piping and back through the second river crossing. On the West Bank of the river, it would then pass through similar piping, to the seawall at West Way via a discharge monitoring facility sited adjacent to the Seawater Pumping Station at Fleetwood Dock. In order to cross the seawall, piping would be laid beneath the concrete access ramp from West Way, Fleetwood. The pipe would then pass through the existing gap in the existing splash wall, trenched across the top of the seawall, and down the face of the seawall on to the foreshore. The passage of the pipeline from the top of the seawall would be accomplished within a new observation platform to be built abutting the face of the seawall. This feature would be constructed with design input from WBC’s specification and is intended to replace the existing access ramp. All pipe work would be underground with the exception of the crossing of the old railway line adjacent to the Jameson Road bridge crossing.

4.3.7 From there the saturated brine would be conveyed through the outfall to a point approximately 2.3 km offshore to a two port single diffuser, the design of which is shown on the application plans, where it would be discharged into the sea in accordance with an existing Discharge Consent. The design of the diffuser has been carefully optimised for the marine environment, and its performance would achieve those standards laid down by the Environment Agency in its approval.

4.3.8 The principal use of the seawater and the water infrastructure is for the creation of caverns. Once the caverns are completed, the water washing infrastructure would only be used for the filling of caverns during periods of cavern maintenance. Generally, the caverns would be filled with brine every ten to fifteen years to allow for the testing and inspection of the gas storage caverns.

4.4 Gas and Electrical Infrastructure

4.4.1 The gas infrastructure for the project consists of a Gas Compressor Compound (GCC), the gas distribution pipelines and manifolds connecting the wellheads to the GCC and an interconnector pipeline which links the GCC to the NTS near Nateby, approximately 12 km away. The interconnector pipeline is designed as a 42 inch diameter pipe but there may be an opportunity to reduce this to a 36 inch diameter pipe. For the purposes of the Environmental Impact Statement the 42 inch diameter pipeline has been assessed. A connection is proposed to National Grid Gas pipelines (No.21 and No 15 Feeder) to ensure maximum flow rate and availability. At the connection point there would be a shut-down valve under National Grid Gas control. A gas metering station is proposed, adjacent to National Grid Gas’s existing valve installation on Feeder 21.
4.4.2 Following a review of alternative sites on both banks of the River Wyre, the GCC is proposed to be located on the northern part of the UGS site. The GCC is the largest part of the surface infrastructure that is required to construct and operate the UGS Facility. As such, it will be carefully designed and landscaped in order to minimise its environmental impact.

4.4.3 The GCC would include processing equipment to condition the gas for entry to the NTS and to the caverns. The equipment would include compressors, dehydration units, air cooled heat exchangers, filters, separators, storage tanks and utility systems. There would also be additional buildings containing electrical and instrument equipment.

4.4.4 The proposed compressors would be electrically driven MOPICO\(^4\) compressors that are hermetically sealed and require no lubricant and create no emissions during normal operations. The compressors would be contained within a building.

4.4.5 There would be a vent stack, which would be used at times of emergency and for routine maintenance. There would also be an access road, vehicle parking and a security fence.

4.4.6 For a strategic project such as this, it is a requirement that there is a robust high integrity electricity supply. The installation would be supplied from the connection point at the Stanah Switchyard via 100% dual circuits, so that, if one supply is not available, the load can be supplied by the other circuit. Additional switchgear would be required at Stanah and this would be included within the existing building. No changes are required to the layout and external appearance of the existing building. There would be no effect on other consumers in respect of reliability of supply or voltage control.

4.4.7 Cables would be laid underground from United Utilities (UU) switchgear in the Stanah Switchyard, beneath the Wyre Estuary and north through to the Sub Station at the GCC. Crossing of the Wyre Estuary would be achieved by directionally drilling two pipes for two circuits. The pipes would be a minimum of 8 metres below the bed of the River to ensure that the existing silt, sediments and flood defences are not disturbed.

4.4.8 Cables ducts and ultimately the electricity cabling would be drawn from the Preesall side across to the Stanah Switchyard. This will entail cable ducting being laid out across the field on the Preesall side so that a continuous pull can be achieved. The cables would be delivered on cable spools, which would feed the cable out as the pull progresses.

4.4.9 From the GCC would run three underground gas pipeline manifolds inland of the river embankment. From these manifolds, gas distribution pipes would be connected to the individual Wellheads.

\(^4\) Motor Pipeline Compressor (MOPICO)
4.5 Road Infrastructure

4.5.1 In order to gain access for the construction and operation phases of the project, improvements would be required to the road infrastructure in the area. It is proposed to form a new road from the A588 to the site, constructed to a standard to allow for the movement of large items of equipment such as transformers, interconnector pipes and compressors. Access roads and tracks would be provided within the site linking the main permanent structures and wellheads as shown on the application drawings.

4.5.2 The construction of the development would require the improvement of existing tracks and, in some cases, the temporary closure or diversion of roads, footpaths and bridleways as follows:

- temporary closure (twenty four weeks) of the access ramp and the footpath at the seawall crossing to allow for the construction of the brine outfall and the new observation platform;
- temporary closure (six weeks) of the public footpath along the western boundary of the Fleetwood Waste Water Treatment Works to install the brine discharge pipeline;
- temporary diversion (three years) of Footpath 61 near Cote Walls Farm to allow construction of the UGS Facility;
- temporary diversion (three years) of Footpath 42 near Hackensall Sewage Treatment Works to allow construction of the Booster Pump Station; and
- temporary closure (three days) of part of Bridleway BW2a near Corcas Farm for the laying of cables and ducts.

4.6 Built Development

4.6.1 The permanent above ground built development necessary for the operation of the proposed UGS Facility comprises:

- Security and Support Facility
- Seawater Pump Station
- Booster Pump Station
- Gas Compressor Compound
- Wellhead Compounds
- Interconnector Metering Station

Security and Support Facility

4.6.2 The Security and Support Facility would be located at Higher Lickow Farm. The existing farmhouse and outbuildings, which are currently vacant, provide an ideal location for this use as they are close to the route of the main access road into the site. The farmhouse would be refurbished to provide administration, training, and health and safety accommodation. The gross floorspace of the two-storey building is 112 sq metres.
4.6.3   Adjacent to the farmhouse are two existing barns both of which are in a poor condition. The larger barn, which has a footprint of 250 sq metres, would be rebuilt on its existing footprint to provide staff facilities and a maintenance workshop in two storeys. The ground floor would comprise 250 sq metres and contain two offices, a locker room, toilets, a workshop and stores. The first floor comprising 100 sq metres would contain two meeting rooms and a canteen. The smaller barn, which has a footprint of 60 sq metres, would be demolished.

4.6.4   Finally, a single storey security gatehouse with a floorspace of 24 sq metres would be provided to the east of the farmhouse on the main access road. Within the complex, seventeen car parking spaces would be provided for employees and visitors.

Seawater Pump Station

4.6.5   It is proposed that the Seawater Pump Station Compound would be situated adjacent to an existing seawater culvert within the Fleetwood Fish Dock, off Herring Arm Road. The Compound would contain the Pump Station itself, a transformer compound, access road and car parking area.

4.6.6   The Pump Station building would be single storey (6.5 metres to the top of the ridge) with a floorspace of approximately 430 sq metres gross. The Pump Station would contain the pump hall, electrical drive units, switchgear and control desk. It is designed to abstract seawater from the Fish Dock making use of an existing culvert originally built to supply cooling water to the former Fleetwood Power Station. The seawater would enter a sump underneath the Pump Station building prior to being filtered and pumped in an underground pipeline under the Wyre Estuary to the Booster Pump Station at the Preesall site. Abstraction of water from the Fish Dock would be controlled to ensure a viable water level is always maintained in the dock.

4.6.7   It is proposed that the external materials comprise polished metal cladding to the walls and roof; albeit that alternative designs could be considered.

4.6.8   A bunded transformer compound containing two transformers would be provided adjacent to the Pump Station building.

4.6.9   Access to the Compound is proposed from Herring Arm Road with four car parking spaces provided for staff and visitors. A 2.4 metres perimeter security fence of polyester coated mesh would be provided around the site.

4.6.10  Figure 4.6 provides an indicative representation without landscaping.
Figure 4.6: Graphical representation of the seawater pumping station

Source: Halite Project Information Sheet, Project Description (10)

**Booster Pump Station**

4.6.11 It is proposed that the Booster Pump Station Compound would be located adjacent to the Hackensall Sewage Treatment Works. Access to the Compound would be provided from the track that extends from Monks Lane. The Compound would contain the Booster Pump Station, De-brine Facility and Nitrogen Tank Compound.

4.6.12 The Booster Pump Station would have a floorspace of 492 sq metres and would contain the Control Room, twelve high capacity pumps, electrical control equipment, switchgear and standby generator. A transformer compound would be situated adjacent to the building containing two transformers. The external materials are brick and tile.

4.6.13 The De-brine Facility would comprise of a pond, hydro-cyclones and brine discharge pumps.

4.6.14 The Booster Pump Station would receive seawater pumped from the Seawater Pump Station at the Fleetwood Fish Dock. The booster pumps situated within the building would increase water pressure and via a number of underground pipelines deliver it to individual wellheads. Under controlled conditions, the seawater would be injected down the cased and lined boreholes to solution mine the salt. The resulting saturated brine would then be returned via underground pipes to the De-brine Facility within the Compound. Any suspended solids within the retained saturated brine would be removed by passing the brine through hydrocyclones. The ‘filtered’ saturated brine would then be pumped back across the Wyre Estuary and the Fleetwood Peninsula to the outfall off Rossall in the Irish Sea.
4.6.15 The De-brine Facility includes a reservoir tank, which is required during the process of de-watering of the caverns. When gas is first introduced into the completed caverns, the residual brine would be driven out and piped to the reservoir to ensure any dissolved gas is allowed to vent. Following ‘venting’ of the gas in the reservoir, the brine would be disposed of in the normal manner as summarised above.

4.6.16 The Compound would be surrounded by a 2.4 metres security fence of polyester coated mesh (dark green). Spoil from the construction of the buildings and the De-brine Facility would be used to raise the land to the west and north of the Compound to mitigate views of the Compound when viewed from the Wyre Way.

4.6.17 Figure 4.7 provides an indicative representation without landscaping.

**Figure 4.7: Graphical representation of the Booster Pump Station**

Source: Halite Project Information Sheet, Project Description (10)

**Gas Compressor Compound**

4.6.18 It is proposed that the Gas Compressor Compound would be located 500 metres to the northwest of Higher Lickow Farm. Access to the Compound would be provided from the new access road to the A588. The Compound would contain the following buildings, structures and equipment:

- Pig Launchers and Receivers;
- Slug Catchers;
- large diameter above ground high pressure pipelines;
- Glycol Contactors to dry the gas;
- Glycol Regeneration system;
- MOPICO Compressors;
- Compressor Knock Out Separators;
- Compressor Aftercoolers;
- Gas filters;
- Gas Heaters;
- various utility systems, plant drainage and power supply;
- emergency/maintenance vent stack;
- electrical/instrument and Utilities buildings; and
- Vent Stack provided within the centre of a new pond.
4.6.19 The principal buildings are the Compressor Station Building and the Electrical Equipment and Utilities Building, which are similar in design and comprise of a single storey buildings approximately 8.5 metres high, each with a gross floor area of approximately 360 sq metres.

4.6.20 The external plant would include:

- the glycol heaters and regeneration plant rising to a maximum height of approximately 13 metres;
- the fin fan coolers rising to a maximum of 8 metres in height;
- slug catcher and NTS Filters rising to a height of approximately 9.5 metres; and
- storage tanks of approximately 3.5 metres in height.

4.6.21 The eastern part of the Compound would provide a vent stack situated in a 50 metres radius pond. As well as ensuring that there is a sterile area around the vent stack, the pond would also act as an emergency source of fire water.

4.6.22 Most of the large diameter pipework within the Compound would be buried, with small diameter pipework and equipment outside or, where appropriate, incorporated within buildings.

4.6.23 The compound would be high security and surrounded by palisade fencing with CCTV cameras.

4.6.24 Adjacent to the Compound would be an Electrical Substation and switchyard.

4.6.25 Figure 4.8 provides an indicative representation without landscaping.

Figure 4.8: Graphical representation of the Gas Compressor Compound

Wellhead Compounds

4.6.26 During the drilling of the boreholes, seven Wellhead Compounds are proposed to accommodate the drilling rigs. The Wellhead Compounds would be provided on a phased basis as the drilling of boreholes across the site progresses. The Wellhead Compounds would be large enough to accommodate the drilling rig, pipework and ancillary infrastructure. Following the drilling of the boreholes, the Water Washing Infrastructure would be connected to wash the caverns and once these are created the gas manifolds would be connected to allow
for the import and export of gas. Once operational the Wellhead Compounds would be low structures whose visual impact can be mitigated by earth screening and planting.

4.6.27 Each wellhead compound would be a high security compound surrounded by palisade fencing with CCTV cameras.

4.6.28 Figure 4.9 provides an indicative representation without landscaping.

Figure 4.9: Graphical representation of a wellhead compound

Source: Halite Project Information Sheet, Project Description (10)

Seawall Crossing
4.6.29 In order to cross the seawall, it is proposed that piping would be laid beneath the concrete access ramp from West Way. The pipe would then pass through the existing gap in the existing splash wall, trenched across the top of the seawall, and down the face of the seawall on to the foreshore. The passage of the pipeline from the top of the seawall would be accomplished within a new observation platform to be built abutting the face of the sea wall. This feature would be constructed with design input from WBC’s specification and is intended to replace the existing access ramp. The schedule of works is provided below.

- temporary construction compound installed landside of existing sea wall, south of planned pipe crossing;
- the access ramp from West Way and Seawall will be closed to pedestrians for installation of pipe, removal of existing ramp and foundations for observation platforms for up to 12 weeks. Access will be restricted for up to an additional 12 weeks subject to control during site deliveries;
- a temporary aggregate ramp would be built up from the foreshore to the seawall to allow heavy equipment access;
- the marine contractor would install a cofferdam on the seaward side;
- the marine contractor would install high-density polyethylene (HDPE) pipe from inside the coffer dam to the low water mark;
• relevant sections of the existing seawall would be removed (without affecting the efficiency of the continuing sea defence);
• installation of a steel S-bend pipe through the top section of (over the main body of) the seawall would occur with a foreshore connection made inside the cofferdam;
• marine contractor would withdraw and continue with laying the 2.3 km outfall pipe;
• temporary aggregate ramp would be removed;
• installed pipe sections would be hydro-tested;
• re-modelling of sea defence with observation deck in keeping with Cleveleys esplanade;
• installation of a new feature for the seawall: hinged concrete storm gates;
• once complete, demobilization, clean up and re-instatment to the previous condition; and
• the finished new seawall would remain visually in keeping with the length of the new sea defences along this part of the Lancashire coast.

4.6.30 The work would take place during the summer in the first year of construction of the UGS project and would be completed within nine months.

**Interconnector metering station**

4.6.31 The interconnector metering station would consist of a single brick building of 150 sq metres floorspace in a 0.96 hectare Compound. The interconnector pipeline would rise out of the ground within the Compound and re-enter the ground to connect to the NTS feeder. The above ground pipeline would have flow measurement devices, isolation and emergency shutdown valves. The building would house automatic metering and gas analysis instrumentation and is not normally manned. The Compound would be surrounded by a security fence.

4.6.32 Access to the Compound would be from the existing farmers track from Station Lane.

**Other Works**

4.6.33 In addition to the above, the following works are required:

• temporary drilling compounds at the Fleetwood Fish Dock;
• new landscaping and mounding; and
• a number of temporary construction, drilling and storage compounds.

**Construction Programme**

4.7.1 Following the detailed engineering work, the receipt of all of the necessary consents and licences and the appointment of a contractor, construction of the development would take place in phases over an eight year period. The main elements of the programme would be as follows:
• mobilisation of contractors including the establishment of work compounds, the construction of the main access road and the provision of temporary footpaths as may be required;
• construction of the Water Washing Infrastructure;
• drilling - this phase involves drilling of the wells into the salt formation, installation of leaching strings and leaching wellheads;
• Solution Mining - this phase involves solution mining of the caverns to form the underground caverns, utilising the leaching wellheads and Water Washing Infrastructure to form the cavern; this process would take several years;
• construction of the Gas Compressor Compound for de-brining and trading of the caverns. This phase also involves installation of the gas pipelines between the GCC and the NTS, and the GCC and the caverns;
• De-brining – this phase involves installation of gas strings and gas wellheads to allow removal of the brine from the caverns. Gas would be used to displace the brine from the caverns and convert the caverns ready for gas trading; and
• Gas Trading – the final phase involves fully commissioning the caverns and handover to gas trading operations.

4.7.2 The phases outlined above are not sequential and it is likely that a number of the construction and operational phases will be progressed in parallel. All of the built development would be achieved in the first three years of the construction programme but the washing and creation of the caverns would take place sequentially over a four to six year period as each cavern is created and tested individually. As caverns become available and subject to HSE approval, caverns may be operational whist others are still being washed or tested. An indicative programme for the construction of the project is set out below.

Periods of development
• Construction (Years one-three)
• Construction and operation combined (Years three-seven)
• Operation (Years eight-forty)
• Decommissioning (Years forty-four one)

Indicative Construction Programme
4.7.3 An indicative construction programme is shown in Table 4.1 below.
Table 4.1: Indicative Construction Programme

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<th>Task</th>
<th>Years</th>
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<td>Mobilisation of Contractors</td>
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<td>Preliminary Earth Works</td>
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<td>Haul Roads</td>
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<td>Brine Discharge Pipeline</td>
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<td>Seawall Crossing</td>
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<td>North River Crossing</td>
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<td>South River Crossing</td>
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<td>Seawater Pump Station</td>
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<td>Booster Pump Station</td>
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<td>Gas Compressor Compound</td>
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<td>Interconnector</td>
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<td>Drilling Compounds</td>
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<tr>
<td>Wellheads &amp; Manifolds</td>
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</table>

4.8 **Emissions and Waste**

4.8.1 The main wastes that will be generated from the construction of the project comprise several elements outlined below.

4.8.2 **Saturated brine** produced through the washing of caverns would be disposed of by pipeline to the Irish Sea in accordance with the terms of the existing Discharge Licence granted by the Environment Agency. The Preesall salt body contains on average an 8% insoluble content and during the leaching operation some 80% of the insoluble’s will be carried to the surface. Hydrocyclones would separate the insoluble substances from the brine and these, along with other drilling wastes would be disposed of (see below).

4.8.3 During the de-brining process (first fill of gas into the cavern) no insoluble substances would be carried to the surface.

4.8.4 **Drilling wastes** would comprise solids (shale, sandstone, chert, etc.) and associated drilling muds. All the drilling wastes would be used on site for landscape buffers and earth mounding or, alternatively, removed from the site. Insoluble’s from the leaching process would be disposed of to existing caverns on the site (caverns 118 – 123 inclusive.) These existing caverns were chosen due to their proximity.
to the de-brining facility; all have sonar records and all fall within the proposed application boundary.

4.8.5 **Topsoil/Rock/Earth** from the construction of the foundations for the buildings, pipelines, roads and the levelling of compounds would be disposed of on site. The intention is to ensure that no soils need to be exported from the Preesall site and the application plans show where the earth mounding is proposed i.e. adjacent to the Compressor Compound, the Booster Pump Station Compound and the wellhead compounds.

4.8.6 The main emissions and wastes arising from the operation of the project include:
- emissions to air;
- liquids; and
- solids

**Emissions to air**

4.8.7 Emissions to air include:
- emergency and maintenance gas from vent system;
- combustion products from dehydration incinerator; and
- combustion products from heating boilers

4.8.8 The Dehydration Unit combustion products would be vented to atmosphere via a local vent stack on the Dehydration Units. The emissions would be continuous during withdrawal operations.

4.8.9 The Heating Medium Boiler combustion products would be vented to atmosphere via a local vent stack on the Heating Medium Units. The emissions would be infrequent during withdrawal operations as heating is generally not required.

4.8.10 Any maintenance, which requires the process equipment to be depressurised, would lead to venting of gas via the main vent stack. This is expected to be infrequent with major venting limited to once per year or similar.

**Liquid emissions**

4.8.11 Liquid emissions include:
- process waste water / Methanol from process gas;
- Triethylene Glycol (TEG) from dehydration;
- water/glycol heating medium fluid;
- condensed water from boilers;
- site drainage;
- rainwater;
- firewater;
- lubrication oils; and
- chemicals for example corrosion inhibitor, treatment chemicals, anti-foam etc
4.8.12 The process water separated from the gas in the Slugcatchers, Glycol Separators, Compression Suction Drums and NTS Gas Filter Coalescers would be collected in the Condensate Tank. The process water may also contain methanol, TEG, corrosion inhibitor, and other fluids. The Condensate Tank would be emptied by road tanker for offsite disposal by a specialist waste contractor.

4.8.13 The dehydration and heating medium systems can be emptied to road tanker, where there is a requirement to remove a significant volume of the liquids, for example to replace spent TEG. The liquids would be disposed offsite by a specialist waste contractor.

4.8.14 Any plant areas where liquid spills are expected for example processing units or equipment etc, would be bunded or similar to provide containment of the liquid spills. The bunds would be sealed and any valves closed off to avoid liquids entering the site drainage system. The liquids can be disposed of using a gully sucker or similar to a road tanker for offsite disposal by a specialist waste contractor, or sent to the site drainage system depending on the nature of the liquids collected in the bund.

4.8.15 Any plant areas where liquids spills are not expected for example roads, building roofs etc, would send liquids directly to the site drainage system or soakaways as shown on the application plans. The liquids may include site drainage, rainwater, firewater etc. Typically, the site drainage system would consist of a number of tanks or chambers to allow ‘sentencing’ of the liquid waste. This involves testing the liquids for hydrocarbons and/or TEG, oil separation by gravity, buffer capacity to allow a steady outlet flow, and a surge capacity to allow for major storms. Once the liquids have been ‘sentenced’ they would be discharged to a surface drain.

4.8.16 The site drainage system would also be configured to retain the firewater volume for the Facility, where this is required.

**Solid emissions**

4.8.17 Solid emissions include:

- filter internals
- solids from pigging

4.8.18 Any solid waste would be generated from maintenance or specialist operations on an infrequent basis. Solid waste would need to be collected and disposed of by a specialist waste contractor.

Maintenance

4.8.19 Once a gas cavern is in operation (gas storage, gas injection and withdrawal) the following data would be continuously recorded:

- pressure;
- temperature;
- gas composition and gas volume (in and out).

Operators would check all connections within the facility for leaks on a regular basis, usually monthly.
4.8.20 Analysis of the accumulation from the filter separator would be carried out twice a year to check for rust and whether it is caused by erosion or corrosion. Annually, an inventory control would be carried out comparing gas movements within the Facility against cavern volumes, pressures and temperature.

4.8.21 Every ten to fifteen years, caverns would be filled with brine or water to allow comprehensive mechanical testing of its integrity. Tests would include sonar survey, downhole casing inspection (wall thickness measurement) internal wellhead inspection and inspection/testing of the safety valve. Most importantly, a nitrogen mechanical integrity test would be carried out.

4.9 Operating Philosophy

4.9.1 The overall philosophy of operation is that the UGS Facility would store gas at times of excess gas availability on the NTS and release gas at times of high demand. The UGS Facility would be designed with maximum operating flexibility to enable any or more of the following trading cycles to be accommodated:

- seasonal Trading Cycle Injection through summer months (April to October), withdrawal through winter months (November to March);
- weekly Trading Cycle Injection through the weekend, withdrawal through the weekdays; and
- daily Trading Cycle Injection through the night, withdrawal on request.

4.9.2 The UGS Facility would be a fast cycle facility that is expected to be ‘churned’ (filled and emptied) several times per annum. It would, however, seldom be completely emptied and only occasionally completely full.

4.9.3 The UGS Facility would be capable of rapid start up and ramping up to maximum injection and withdrawal rates.

4.9.4 There would be a Control Room at the Booster Pumping Station Compound from which the Facility would be monitored and controlled. The Facility would be manned at all times although it would also be possible to monitor operations from remote locations.

4.10 Operational Life & Decommissioning

4.10.1 The UGS Facility has a design life of over forty years but its longer term operation would be dependent on the continued demand for gas, gas prices, potential new sources of gas and their reliability.

4.10.2 In the longer term and dependent on the continued demand for gas storage, Halite may also consider proposals to extend the size of the Preesall Gas Facility. Any proposals for new pipelines or extensions to the Facility would, however, be subject to the results of further investigations and a new application at some time in the future.
4.10.3 These potential longer term proposals do not form part of the current application made to the IPC.

4.10.4 At the end of the life of the proposals, the caverns may have the potential for alternative uses such as ‘carbon capture’ but any alternative uses would have to be considered at that time. If there were no alternative uses for the caverns, these would be emptied of gas, filled with brine and sealed. The wellheads would be maintained and monitored in accordance with an approved Scheme and in a manner consistent with the ongoing maintenance and monitoring activities being conducted for the existing ICI caverns. The remaining infrastructure could remain in place if required for alternative uses. The seawater pipelines may have particular long term benefits in respect of flood control. Alternatively, the buildings and pipelines would be removed in accordance with a scheme to be agreed with the LPA.

4.10.5 A restoration and management plan would be produced to ensure the long-term maintenance and safety of the caverns and the site.
5 Local Area Overview

5.1.1 North Lancashire is a geographically large and diverse area, including rural areas, densely populated areas, affluent areas and areas of significant deprivation. Within the boundaries of North Lancashire there are discreet high-density urban populations contained within a large rural area. Due to geographic proximity the two local authority areas relevant to the proposed development are Wyre and Fylde.

5.1.2 Wyre is the area where most effects (positive and negative) of the development are likely to be experienced. The neighbouring area of Fylde may also experience some benefits from employment opportunities, but is generally considered too geographically removed to experience any direct effects from views, emissions or construction activities associated with the proposed development.

5.1.3 Wyre Borough contains two distinct areas that have very different economic and social needs. The River Wyre acts as a natural barrier between the urban areas of Fleetwood, Thornton and Cleveleys to the west and the more rural area of Knott End-on-Sea, Preesall, Stalmine and Hambleton to the east.

5.1.4 A ferry travels to and fro between the seaward end of Fleetwood and Knott End, reducing the need to travel down the estuary for a crossing point from Fleetwood and Cleveleys. This links with the trams from Blackpool and Bispham. In the absence of the ferry, a bus service is provided (11;12). This may be significant in terms of access to employment for people from the seaward side of the estuary to access the Halite site.

5.2 Demographic Overviews

Wyre

5.2.1 The 2001 census showed a population in Wyre of 105,618 in 2001, which has risen to 111,400 at the last mid-census in June 2006. The population is predominantly white British (97.6 per cent), with only 1.2 per cent from ethnic minorities.

5.2.2 Compared with the rest of the country, Wyre has an ageing population. Based on 2006 statistics, 27.5 per cent of people are over 60, with a mean population age of 42.6. An estimated 23.8 per cent of Wyre’s population classify themselves as having a limiting long-term illness and 7.0 per cent of the population are disability living allowance claimants.
5.2.3 The 2001 census showed a population in Fylde of 73,217 in 2001, which has risen to 76,600 at the last mid-census in June 2006. The population is predominantly white British (96.4 per cent), with only 1.4 per cent from ethnic minorities.

5.2.4 Compared with the rest of the country, Fylde has an ageing population. Based on 2006 statistics, 27.5 per cent of people are over 60, with a mean population age of 43.4. An estimated 15.6 per cent of Fylde’s population classify themselves as having a limiting long-term illness and 5.7 per cent of the population are disability living allowance claimants.

Figure 5.1: Local Authorities 2009 (ONS)

Source: ONS
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Licence number 100046120
Figure 5.2: Primary Care Organisations 2006 (ONS)

Source: ONS
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Licence number 100046120

Figure 5.3: Lower Super Output Areas 2003 (ONS)
5.2.5 The following text is taken from the Association of Public Health Observatories (APHO) Health Profiles of Wyre and Fylde 2011 (13). A comparison is set out between the areas of Wyre and the neighbouring and more prosperous area of Fylde.

Table 5.1: Health profile comparison of Wyre and Fylde

<table>
<thead>
<tr>
<th>Wyre APHO 2011 Summary</th>
<th>Fylde APHO 2011 Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyre has a population of approximately 111,400 people.</td>
<td>Fylde has a population of approximately 76,600 people.</td>
</tr>
<tr>
<td>The health of people in Wyre is mixed compared to the England average. Deprivation is lower than average, however 3,155 children live in poverty. Life expectancy for both men and women is similar to the England average.</td>
<td>The health of people in Fylde is mixed compared to the England average. Deprivation is lower than average, however 1,510 children live in poverty. Life expectancy for both men and women is similar to the England average.</td>
</tr>
<tr>
<td>Life expectancy in Wyre is 77.8 years for men and 82.1 years for women.</td>
<td>Life expectancy in Fylde is 78.9 years for men and 82.5 years for women.</td>
</tr>
<tr>
<td>Life expectancy is 7.7 years lower for men and 6.1 years lower for women in the most deprived areas of Wyre than in the least deprived areas of England (based on the Slope Index of Inequality published on 5th January 2011).</td>
<td>Life expectancy is 4.4 years lower for men and 2.8 years lower for women in the most deprived areas of Fylde than in the least deprived areas of England (based on the Slope Index of Inequality published on 5th January 2011).</td>
</tr>
<tr>
<td>Over the last 10 years, all cause mortality rates have fallen. Early death rates from cancer and from heart disease and stroke have fallen and are similar to the England average.</td>
<td>Over the last 10 years, all cause mortality rates have fallen. Early death rates from cancer and from heart disease and stroke have fallen and are better than the England average.</td>
</tr>
</tbody>
</table>
### Wyre APHO 2011 Summary

- About 16.8% of Year 6 children are classified as obese. 55.1% of pupils spend at least three hours each week on school sport. 69.2% of mothers initiate breast-feeding and 20.0% of expectant mothers smoke during pregnancy.

### Fylde APHO 2011 Summary

- About 18.0% of Year 6 children are classified as obese. A higher percentage than average of pupils spend at least three hours each week on school sport. 69.2% of mothers initiate breast-feeding and 20.0% of expectant mothers smoke during pregnancy.

- An estimated 17.6% of adults smoke and 22.9% are obese. There were 2,413 hospital stays for alcohol related harm in 2009/10 and there are 259 deaths from smoking each year.

- An estimated 19.9% of adults smoke and 20.9% are obese. The rate of road injuries and deaths is higher than average.

- Priorities in Wyre include reducing health inequalities and differences in life expectancy, diabetes, mental wellbeing and alcohol misuse.

- Priorities in Fylde include reducing alcohol misuse, increasing physical activity and reducing tobacco use.

### 5.2.6 Deprivation

Deprivation: the level of deprivation of a population in an area is measured by the percentage of people in that area living in the most deprived fifth of areas in England. The Index of Multiple Deprivation (IMD) 2007 is a model of measuring deprivation in an area (14). It is underpinned by separate dimensions of deprivation; these dimensions are weighted and an overall deprivation score is given. IMD measures all persons at all ages in the relevant population.

### 5.2.7 The IMD 2007 contains seven Domains of deprivation:

- income deprivation;
- employment deprivation;
- health deprivation and disability;
- education, skills and training deprivation;
- barriers to housing and services;
- living environment deprivation; and
- crime.

### 5.2.8 Health inequalities

Health inequalities: the difference in deprivation between areas is a major determinant of health inequality in the United Kingdom. Many studies and analyses have demonstrated the association of increasingly poor health with increasing deprivation (15). For instance, all cause mortality, smoking prevalence, self-reported long standing illness are all correlated with deprivation. If deprivation inequalities decrease, health inequalities are also likely to decrease.
Figure 5.4: Health Inequalities in Wyre & Fylde (APHO)

5.2.9 Figure 5.4 is based on the Index of Multiple Deprivation 2007 by Lower Super Output Area. The darkest coloured areas show areas of high health inequality.

Source: APHO Health Profiles 2011 (13)
Figure 5.5: Deprivation in Wyre & Fylde (APHO)

Figure 5.5 is based on the Index of Multiple Deprivation 2007 by Lower Super Output Area. The darkest coloured areas are some of the most deprived areas in England.

Source: APHO Health Profiles 2011 (13)
**Figure 5.6: Health Summary for Wyre and Fylde**

![Image of the figure showing health summary data for Wyre and Fylde]

- **Significantly worse than England average**
- **Not significantly different from England average**
- **Significantly better than England average**

**Source:** APHO Health Profiles 2011 (13)
5.2.11 Figure 5.6 sets out the common set of indicators used by the Association of Public Health Observatories (APHO) to map health across England. Dots in green show the level as better than the national average. Dots in yellow show the level to be in line with the national average. Dots in red show the level as worse than the national average. The ‘grey diamond’ indicates the regional average.
Deprivation
5.2.12 Although Fylde has a lower index of deprivation than that for Wyre, there is a lower level of income for Fylde. This is possibly due to the older age profile for Fylde, reflecting a retired population which has, overall, lower income, but lower household numbers to support (16). This would also suggest that there is a greater likelihood that employment at Halite would be sought by those living closer to the project.

5.2.13 There are striking inequalities in life expectancy between people living in different areas of North Lancashire. These inequalities are closely related to economic and social deprivation. Wyre is ranked as the 170th most deprived district (out of 354, where 1 is the most deprived) and Fylde 251st. Furthermore, at a lower super output area level there are greater pockets of deprivation in Wyre: eleven areas are classed as within the 20% most disadvantaged nationally, whilst there is only one in Fylde.

5.2.14 Life expectancy in Wyre is lower than in Fylde (Wyre 77.8 years [male] & 82.1 years [female], Fylde 78.9 years [male] & 82.5 years [female]). Life expectancy in Wyre is below the national average (England 78.3 years [male] & 82.3 years [female]). The gap in life expectancy compared to the national average is greater in Wyre for males (0.5 years) than for females (0.2 years). This would suggest that men would benefit more from the employment opportunities presented by the Halite project. At the same time, women will be disadvantaged by the job opportunities available, which will be predominantly those, which are perceived to be male-oriented engineering roles. In addition, the pay gender gap for male and females carrying out similar roles means that males will, overall, benefit more than females.

Causes of mortality
5.2.15 The two largest causes of premature death in North Lancashire are cancer and circulatory disease, which make up 67% of all premature deaths.

<p>| Table 5.2: Main causes of death in North Lancashire in 2006 |</p>
<table>
<thead>
<tr>
<th>Wyre</th>
<th>Fylde</th>
<th>North Lancashire</th>
<th>England</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancers</td>
<td>38%</td>
<td>43%</td>
<td>40%</td>
</tr>
<tr>
<td>Circulatory disease</td>
<td>33%</td>
<td>24%</td>
<td>27%</td>
</tr>
<tr>
<td>Respiratory disease</td>
<td>8%</td>
<td>7%</td>
<td>9%</td>
</tr>
<tr>
<td>Digestive disease</td>
<td>6%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>External causes</td>
<td>4%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>----------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Other causes</td>
<td>11%</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

From NHS North Lancashire (17)

5.2.16 Table 5.2 sets out the main causes of premature deaths for people aged under 75 years old (17).

5.2.17 Increasing the levels of physical activity is an important component of reducing premature deaths from circulatory disease.

5.2.18 The number of people in Wyre who report themselves as having limiting long term illness, and also those providing unpaid care, is higher than for Fylde, and slightly higher than the national average. These people are likely to spend greater lengths of time at home and may be more vulnerable to fear and concern associated with the project.

**Mental health**

5.2.19 Wyre, most notably Fleetwood, has a mental health need, which is 21% above the national average. This may compound the high levels of Long Term Limiting Illness, referred to above, with its associated mental health problems and highlights potentially low levels of resilience of this population.

5.2.20 The Mental Illness Needs Index (MINI) gives the ratio between the predicted mental health admission rates by wards compared to the national rates for people aged 16-59 years. MINI indicates that Wyre is predicted to have 21% more mental health admissions than the national average and 8% more in Fylde.

**Education**

5.2.21 Refurbishment of the Nautical College is to include halls of residence. There is no information available on timescales for this. However, the proposed link pipeline to the sea wall will pass adjacent to the college. There is the potential for the college population to be impacted by this engineering work.

5.2.22 The college website notes that it has been commended for provision of education which is pertinent to local needs (18). This may reflect the possibility for local people to access jobs, which Halite may provide.

5.2.23 The Nautical College has the greatest concentration of non-white ethnic background population (19), though for Wyre the ethnic minority is low at 1.9%, compared with the national average of 11.4%. It is not envisaged that there would be any significant advantage or disadvantage to ethnic minorities from this project.
6 Methodology

6.1 Screening

6.1.1 The IAIA (International Association for Impact Assessment) defines the screening stage as deciding what scale, if any, HIA is required. This is principally a desk exercise (20). Screening for this project had already been conducted as the decision had been taken to commission an HIA. The reasons for this decision are detailed below.

6.1.2 See Appendix A for a summary of the screening opinions relating to HIA that were received from statutory consultees and the IPC.

6.2 Scoping

6.2.1 This stage provides a credible, impartial and defensible analysis of the coverage of health issues to date and it establishes the factors on which the HIA will concentrate.

6.2.2 During the scoping stage consideration has been given to which groups are likely to be affected by the proposed development and reconfiguration of services. This has included particular consideration of the equalities groups defined in legislation (21-23) and any sensitive groups, which may be disproportionately affected.

6.2.3 The HIA scoping exercise referred to the published literature on social determinants of health (see Figure 3.1). The determinants of health approach is all encompassing and the number of topics that are associated with health can grow quickly. Thus our presumption has been to scope factors out of consideration. Work continued throughout the HIA between Halite and the HIA Steering Group (see below) to identify any appropriate changes in the HIA scope as the scheme and HIA developed.

6.2.4 In the course of undertaking the HIA the team prepared a ‘scoping document’ and a ‘preliminary assessment’. Each of these documents was presented to, and discussed with, the Steering Group (see below).

6.2.5 The scope and preliminary assessment was informed by a review of the literature including academic research, local reports and debate amongst the HIA team, discussion with the Steering Group and with the client. They were prepared whilst waiting for sight of results from the Environmental Statement.

6.2.6 When results began to emerge from the ES the HIA team were able to proceed with the HIA. Thus, the scoping and preliminary assessment documents are valid as a historical record of the HIA process but they
are not based on the most up to date information about the proposed project.

6.2.7 For example as part of the scoping exercise an analysis was undertaken to map the approximate population sizes for each issue using Lower Super Output Area (LSOA) data from the Office of National Statistics. This exercise was superseded by more detailed ES data, which showed effects to be far more localised. Estimates based on LSOAs therefore overstated the scale of effects and were not carried forward into the HIA report.

6.2.8 Appendix C provides a summary of the scoping and preliminary assessments and provides a record of why issues were included, or excluded, from the HIA report. The scoping summary covers the entire scoping exercise, which remained open to new information up to the point of finalising the HIA report.

6.2.9 The 'scoping document' scoped out eight of the forty six identified possible issues. The remaining thirty eight issues were examined though a 'preliminary assessment' to consider the exposure pathways. That analysis indicated that for a further twenty potential issues the affected populations would only experience very limited exposure. Consequently of the original forty six potential issues only eighteen were taken forward for detailed assessment presented in the HIA report (some of these issues have been grouped together in the presentation of results).

6.2.10 Decisions to scope issues in or out of further assessment were based on professional judgement, consultation with the HIA steering group (see below) and reviews of the detailed scheme description; the environmental information available on the project; similar underground gas storage developments; and the scientific health evidence base.

6.2.11 Issues and population groups were scoped out where the available information indicated that there were likely to be no, or only very minor, health effects. Where there was considered potential for more than very minor health impacts issues and populations were scoped in for further assessment.

6.2.12 For the remaining issues further consideration was given to the potential for actual population exposures (the preliminary assessment). Issues were excluded where, based on professional judgment and information from the review outlined above, levels of exposure were considered too low to produce meaningful changes in health outcomes. Those issues remaining were subject to further investigation, the findings of which are presented in the results section of this report (see Section 8 on page 64).

6.2.13 Figure 6.1 sets out a list of the issues that were considered and indicates with shading those that were scoped in (green) and those that were scoped out (grey).
### Figure 6.1: Summary scoping decisions by issue

<table>
<thead>
<tr>
<th>Issue/Activity/Element</th>
<th>Issue/Activity/Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Resilience to sea level rise</td>
<td>24 Light disturbance (night)</td>
</tr>
<tr>
<td>2 Resilience to extreme weather events</td>
<td>25 Severance of communities or amenities</td>
</tr>
<tr>
<td>3 Supply during winter shortages</td>
<td>26 Traffic impacts</td>
</tr>
<tr>
<td>4 Use of marine ecosystems</td>
<td>27 Congestion of local transport network</td>
</tr>
<tr>
<td>5 Use of estuarine ecosystems</td>
<td>28 Impact on airport flight paths</td>
</tr>
<tr>
<td>6 Use of terrestrial ecosystems</td>
<td>29 Employment market</td>
</tr>
<tr>
<td>7 Plant &amp; vehicle emissions</td>
<td>30 Electromagnetic field exposure</td>
</tr>
<tr>
<td>8 Dust (including PM$<em>{10}$ &amp; PM$</em>{2.5}$)</td>
<td>31 Use of NHS, LA &amp; community resources</td>
</tr>
<tr>
<td>9 Odour nuisance</td>
<td>32 Use of marine leisure opportunities</td>
</tr>
<tr>
<td>10 Natural gas releases</td>
<td>33 Use of estuarine leisure opportunities</td>
</tr>
<tr>
<td>11 Flood risk to facilities</td>
<td>34 Use of terrestrial leisure opportunities</td>
</tr>
<tr>
<td>12 Impact on sea defences</td>
<td>35 Staff training opportunities</td>
</tr>
<tr>
<td>13 Surface water contamination</td>
<td>36 Local investment &amp; regeneration</td>
</tr>
<tr>
<td>14 Ground water contamination</td>
<td>37 National gas supply security</td>
</tr>
<tr>
<td>15 Ground contamination</td>
<td>38 Tourism</td>
</tr>
</tbody>
</table>

Scoped out
<table>
<thead>
<tr>
<th>Issue/Activity/Element</th>
<th>Issue/Activity/Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Land take (including farmland)</td>
<td>39 Local businesses (including farms)</td>
</tr>
<tr>
<td>17 Structural failure of storage caverns</td>
<td>40 Housing market &amp; property value</td>
</tr>
<tr>
<td>18 Structural failure of wellhead</td>
<td>41 Energy market (cheaper gas supply)</td>
</tr>
<tr>
<td>19 Structural failure of pipework</td>
<td>42 Perceived safety fears</td>
</tr>
<tr>
<td>20 Equipment failure of facilities</td>
<td>43 Stakeholder engagement</td>
</tr>
<tr>
<td>21 Visual setting &amp; local character</td>
<td>44 Pollution of land used for food / crops</td>
</tr>
<tr>
<td>22 Noise disturbance</td>
<td>45 Use of recreational amenities</td>
</tr>
<tr>
<td>23 Vibration disturbance</td>
<td>46 Safe working environment</td>
</tr>
</tbody>
</table>

Note: The issues in grey were scoped out during the ‘scoping stage’ or during the ‘preliminary assessment’. Issues in green remain scoped-in for further assessment.

6.3 **Steering Group**

6.3.1 The steering group oversees the HIA and includes key stakeholders from the PCT, Health Protection Unit (HPU) and Health Protection Agency (HPA), as well as representation from the Halite work group. Table 6.1 sets out the members of the HIA Steering Group and those who will also attend HIA Steering Group meetings.

Table 6.1: Attendance at HIA Steering Group meetings

<table>
<thead>
<tr>
<th>HIA Steering Group:</th>
<th>Representing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacqui Thompson (Chair)</td>
<td>North Lancashire PCT</td>
</tr>
<tr>
<td>Sohail Ashraf</td>
<td>Health Protection Agency, Cumbria and Lancashire Health Protection Unit (CLHPU)</td>
</tr>
<tr>
<td>George Kowalczyk</td>
<td>Health Protection Agency, Centre For Radiation, Chemical and Environmental Hazards (CRCE)</td>
</tr>
<tr>
<td>David McArthur</td>
<td>Wyre BC</td>
</tr>
<tr>
<td>Brian Stanley</td>
<td>Halite Energy Group</td>
</tr>
</tbody>
</table>
Planning officers from Wyre BC and Lancashire CC were invited to participate.

<table>
<thead>
<tr>
<th>Attending</th>
<th>Representing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ben Cave</td>
<td>BCA</td>
</tr>
<tr>
<td>Ryngan Pyper</td>
<td>BCA</td>
</tr>
<tr>
<td>Gillian Gibson</td>
<td>BCA</td>
</tr>
<tr>
<td>David Purchon</td>
<td>BCA</td>
</tr>
</tbody>
</table>

6.3.2 The HIA Steering Group’s terms of reference and defined lines of accountability are set out in Table 6.2. These terms of reference are informed by guidance from Australia (24).
Table 6.2: Terms of reference for the HIA Steering Group

<table>
<thead>
<tr>
<th>Item</th>
<th>Presall UGS HIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To identify the potential significant effects of the Presall UGS Project on the health and wellbeing of people living, working or pursuing leisure or recreational activities in the area surrounding the proposed UGS infrastructure and its ancillary works (through construction, operation and decommissioning), including effects arising from actual and perceived dangers of emergency scenarios. To identify opportunities for improving health and reducing health inequalities. To contribute to the planning process. To identify mitigation opportunities. To develop a Statement of Common Ground.</td>
</tr>
</tbody>
</table>
| 2.   | Membership to be as follows:  
|      | - Chair: Jacqui Thompson, NHS North Lancashire.  
|      | - Advice and comment: George Kowalczyk, Health Protection Agency, Centre For Radiation, Chemical and Environmental Hazards (CRCE).  
|      | - Advice and comment: Sohail Ashraf, Health Protection Agency, Cumbria and Lancashire Health Protection Unit (CLHPU).  
|      | - Advice and comment: David McArthur, Wyre Borough Council.  
<p>|      | - Project leader: Brian Stanley, Halite Energy Group. |
| 3.   | Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (8). Health inequalities can be defined as differences in health status or in the distribution of health determinants between different population groups. Statement of Common Ground: this will be based upon the completed HIA and a statement from the Steering Group, of areas of agreement and disagreement. |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>Preesall UGS HIA</th>
</tr>
</thead>
</table>
| 4.   | The nature and frequency of the project team’s feedback to the HIA Steering Committee | Purpose and frequency of steering group meetings to be agreed  
Reports issued to steering group for comment & critique  
• at scoping stage; and  
• at draft report stage.  
Agreed that comments should form part of an iterative process. HIA draft reports (and if appropriate draft section) will be circulated for comment electronically.  
Also agreed that there should be a further meeting at the end of the HIA process to debrief on lessons learnt (HIA evaluation meeting). |
| 5.   | The number of group meetings to be held | First meeting held on 01/06/11  
Second meeting held on 23/08/11 (via teleconference).  
Third meeting held on 21/09/11 to consider the draft HIA Main Report.  
Final meeting to debrief on lessons learnt would be at the end of the HIA process, likely November 2011 |
| 6.   | A protocol for information and data sharing between agencies if required | The HIA team will have access to planning, design and risk assessment information. |
| 7.   | The standards by which the HIA will be judged | UK example of quality assurance standards for HIA (25) |
| 8.   | Any conditions associated with production and publication of findings and outputs (for example journal articles and media releases) including intellectual property, confidentiality agreements, copyright and publication | The HIA will be published alongside the ES and submitted as part of the planning application. |
| 9    | An outline of the project plan including deadlines | The Steering Group was updated on the timeline for the project. |
| 10.  | The budget and source of funding | Funding from Halite Energy Group |
11. **How to deal with conflict and/or disagreement**

The screening and scoping phases of the HIA will seek to develop consensus on the aims of the HIA and on the approaches to be used. The HIA team report to Halite Energy Group. The HIA team will provide an independent report to Halite Energy Group.

12. **How changes to the terms of reference will be handled should they need to be made**

Changes to the TOR will be agreed through the steering group. The Chair of the steering group will have final say.

### 6.4 Consultation

6.4.1 Due to the consultation conducted by Halite the Steering Group agreed that the HIA should not undertake additional public consultation.

6.4.2 At the first Steering Group meeting it was agreed that a targeted consultation HIA could be undertaken. This would involve review of Halite’s consultation and interviews with key local stakeholders. The key objective of this consultation would be to determine whether HIA assumptions concerning local fears of the proposed development were well founded. The Steering Group were invited to suggest particular people (or post holders) who should be consulted as part of the HIA.

6.4.3 The HIA team reviewed the responses to Halite’s public consultation. As public consultation this does not include comments or responses from statutory consultees. The comments record a range of views. The majority of these are opposed to the development: people express a lack of understanding of, or confidence in, the scheme’s engineering and procedural steps to avoid catastrophic events. This suggests that, amongst those people who responded to the consultation, there is fear (concern/scepticism) in the local population. See *Public Consultation* in Appendix B for a discussion of health related issues raised by the public consultation.

6.4.4 The targeted consultation exercise was planned with the ‘Community Liaison Panel’ (CLP)\(^5\). The CLP was set up for the proposed development, but is managed independently of Halite. Representation of the CLP includes locally elected members from the area. The CLP has a maximum of 15 members with no more than one member from any given organisation. CLP meetings average 4 members plus a facilitator. Telephone interviews were planned with members of the CLP. The format was as follows:

\(^5\) See the following link for the CLP terms of reference and meeting minutes: [http://www.halite-energy.co.uk/page/114/Community-Liaison-Panel.htm](http://www.halite-energy.co.uk/page/114/Community-Liaison-Panel.htm)
• introductions;
• explanation of the Health Impact Assessment;
• CLP member’s views on potential beneficial health effects of the proposed development;
• CLP member’s views on potential adverse health effects of the proposed development; and
• any other remarks.

6.4.5 The responses are reported in Appendix N.

6.5 Review of Preesall UGS Quantitative Risk Assessment
6.5.1 As part of its application for a Development Consent Order for an Underground Gas Storage Facility at Preesall, Halite Energy Group Limited commissioned a Quantitative Risk Assessment (QRA) of the proposed facilities, with a view to demonstrating that the risks posed to the general public are within tolerable limits and no higher than those risks with which we live every day.

6.5.2 The review considered sub-surface risks; surface risks; and risks to pipelines and manifolds. The review was supported by modelling of potential emergency scenarios to establish both the areas of potential effect and the level of associated risk.

6.5.3 As part of the HIA a critical review of the QRA was undertaken.

6.5.4 The results of the review are set out in Appendix B.

6.6 Detailed Assessment

Assessment model
6.6.1 The following model underpins the assessment stage.
**Commentary reporting structure**

6.6.2 The assessment stage uses the following structure to present information on each of the potential health issue ‘scoped in’ for further assessment during the HIA scoping stage and preliminary assessment. Each heading has ‘guide questions’ to demonstrate the type of information which would be included.

**Pathway of potential effects**

6.6.3 What changes are caused by the scheme (source)?
6.6.4 What is the mechanism by which health may be affected (pathway)?

6.6.5 Which populations may be affected (receptor)?

6.6.6 Are some populations particularly sensitive (sensitivities)?

6.6.7 What level of exposure is likely (exposure)?

6.6.8 What are the likely health outcomes (health effect)?

**Recommendations**

6.6.9 What further measures does the HIA propose in order to reduce any adverse effects and/or to strengthen beneficial effects?

**Residual effects**

6.6.10 What is likely to be the final health effect once additional mitigation (based on the HIA recommendations) is accepted/adopted?

**Conclusion**

6.6.11 What is the magnitude of the effect?

6.6.12 What is the sensitivity of the population?

6.6.13 Is this issue associated with important health effects once the HIA recommendations are adopted?

**Conclusion matrices**

6.6.14 The conclusions for each issue are guided by a systematic framework to determine ‘importance’. This framework adds consistency to the weighting of contributory factors and sets out defined terminology.

**Magnitude of health effect**

6.6.15 This is how large a potential effect the change (positive or negative) caused by the scheme may have on one or more determinants of health.

6.6.16 In reaching a conclusion for this field two criteria are considered:

- the level of change caused by the scheme; and
- the duration of effects or timescale over which they are likely to operate.

6.6.17 These are considered below.

**The level of change caused by the scheme**

6.6.18 Exceeds threshold / Large change = known risk factors limits are likely to be significantly exceeded, or there is likely to be a notable and irreversible change in relevant behaviour; level of exposure; or environmental or social interaction.

6.6.19 Around threshold / Medium change = known risk factors limits are likely to be reached but not significantly exceeded or there is likely to be a notable but difficult to remedy change in relevant behaviour; level of exposure; environmental or social interaction.
Below threshold / Small change = known risk factors limits are unlikely to be reached or there is likely to be a notable but readily reversible change in relevant behaviour; level of exposure; environmental or social interaction.

Duration of effects or timescale over which they are likely to operate

Continuous / Long term = changes in health outcomes which may continue for extended periods or are lasting consequences of the scheme.

Prolonged intermittent / Medium term = changes in health outcomes which occur for more than just brief periods or are associated with discrete scheme phases.

Brief intermittent / Short term = changes in health outcomes which are of limited duration or are associated with discrete scheme activities within a phase.

Overall magnitude conclusion

Table 6.3 sets out a matrix for reaching an overall conclusion on magnitude of effect based on both ‘level of change’ and ‘duration/timescale’.

Table 6.3: Magnitude of health effect

<table>
<thead>
<tr>
<th>Duration / Timescale (over which health effect is experienced)</th>
<th>Continuous / Long term</th>
<th>Prolonged intermittent / Medium term</th>
<th>Brief intermittent / Short term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeds threshold / Large change</td>
<td>LARGE</td>
<td>MODERATE</td>
<td>SLIGHT</td>
</tr>
<tr>
<td>Around threshold / Medium change</td>
<td>MODERATE</td>
<td>SLIGHT</td>
<td>NEUTRAL</td>
</tr>
<tr>
<td>Below threshold / Small change</td>
<td>SLIGHT</td>
<td>NEUTRAL</td>
<td>NEUTRAL</td>
</tr>
</tbody>
</table>

Sensitivity of affected population

This is how the population responds to changes in their health (positive or negative) if one or more determinants of health are affected by the scheme.

In reaching a conclusion for this field two criteria are considered:
- inherent susceptibility of population; and
- the level of exposure experienced by a particular population.

6.6.27 These are considered below.

6.6.28 Level of susceptibility is equated with level of deprivation. See paragraphs 5.2.6 to 5.2.8 for an explanation of the link between deprivation and poor health. Populations with poorer health have a greater sensitivity to changes in their health outcomes (positive or negative).

Inherent susceptibility of population

6.6.29 Above average = the population are in the fourth or fifth quintile (highest levels) of the index of multiple deprivation 2010 compared to national averages, or through consultation or baseline studies particular vulnerable groups have been identified, which are likely to experience large changes in their health outcomes as a result of changes caused by the scheme.

6.6.30 Average = the population are in the third quintile (middle level) of the index of multiple deprivation 2010 and therefore equate to national averages, and no particular vulnerable groups have been identified through consultation or baseline studies, which are likely to experience large changes in their health outcomes as a result of changes caused by the scheme.

6.6.31 Below average = the population are in the first or second quintile (lowest levels) of the index of multiple deprivation 2010 compared to national averages and no particular vulnerable groups have been identified through consultation or baseline studies, which are likely to experience large changes in their health outcomes as a result of changes caused by the scheme.

Level of exposure experienced by population

6.6.32 Frequent / Long-term / High strength = As a result of the behavioural attributes of this population, overall the population receives a high level of exposure [by any combination of frequency, duration and strength of exposure] to substances or conditions caused by the scheme which affect health outcomes.

6.6.33 Regular / Medium-term / Medium strength = As a result of the behavioural attributes of this population, overall the population receives a moderate level of exposure [by any combination of frequency, duration and strength of exposure] to substances or conditions caused by the scheme which affect health outcomes.

6.6.34 Occasional / Short-term / Low strength = As a result of the behavioural attributes of this population, overall the population receives a low level of exposure [by any combination of frequency, duration and strength of exposure] to substances or conditions caused by the scheme which affect health outcomes.
Overall sensitivity conclusion

6.6.35 Table 6.4 sets out a matrix for reaching an overall conclusion on sensitivity of the population based on both ‘inherent susceptibility’ and ‘level of exposure’.

**Table 6.4: Sensitivity of affected population**

<table>
<thead>
<tr>
<th>Level of exposure</th>
<th>Frequent / Long-term / High strength</th>
<th>Regular / Medium-term / Medium strength</th>
<th>Occasional / Short-term / Low strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above average susceptibility</td>
<td>HIGH</td>
<td>MODERATE</td>
<td>LOW</td>
</tr>
<tr>
<td>Average susceptibility</td>
<td>MODERATE</td>
<td>LOW</td>
<td>NEUTRAL</td>
</tr>
<tr>
<td>Below average susceptibility</td>
<td>LOW</td>
<td>NEUTRAL</td>
<td>NEUTRAL</td>
</tr>
</tbody>
</table>

Importance

6.6.36 Department of Health (DH) guidance on HIA uses the term ‘important impacts’ rather than ‘significant impacts’ (2).

6.6.37 The Department of Health guidance on HIA indicates that a potential health effect will be important where:

- it affects a whole population, or where socioeconomic or equalities groups are particularly affected;
- it is difficult to remedy or is irreversible; and
- it is medium to long term.

6.6.38 This HIA has used these Department of Health criteria to inform the definitions set out above for ‘magnitude of health effect’ and ‘sensitivity of affected population’.

6.6.39 Table 6.5 summarises how the Department of Health guidance is linked to the definitions used in this HIA.
Table 6.5: Department of Health ‘importance’ criteria

<table>
<thead>
<tr>
<th>DH guidance on HIA ‘importance’ criteria:</th>
<th>Assessed in this HIA through the definitions and scoring of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue affects a whole population...</td>
<td>the ‘level of exposure experienced by population’</td>
</tr>
<tr>
<td>...or where socioeconomic or equalities groups are particularly affected;</td>
<td>the ‘inherent susceptibility of population’</td>
</tr>
<tr>
<td>Issue is difficult to remedy or irreversible;</td>
<td>the ‘the level of change caused by the scheme’</td>
</tr>
<tr>
<td>Issue is medium to long term;</td>
<td>the ‘duration of effects or timescale over which they are likely to operate’</td>
</tr>
</tbody>
</table>

Adapted from Department of Health (2)

6.6.40 The importance of a potential health effect will be determined based on conclusions for both ‘magnitude of health effect’ and ‘sensitivity of affected population’.

6.6.41 Where both ‘magnitude of health effect’ and ‘sensitivity of affected population’ are concluded to be either ‘LARGE’ or ‘MODERATE’, effects will be considered ‘important’.

6.6.42 Where either ‘magnitude of health effect’ and ‘sensitivity of affected population’ are concluded to be ‘SLIGHT’ or ‘NEUTRAL’, effects will be considered ‘not important’.

6.6.43 The Department of Health guidance on HIA also notes a further two criteria that may result in ‘important’ health effects:

- issues which are likely to generate public concern; and
- issues which are likely to generate cumulative and/or synergistic impacts.

6.6.44 These two criteria are also adopted in this HIA and are considered during the HIA assessment stage. Consultation responses are used to determine whether issues are likely to generate notable public concern. Professional judgement and evidence from the scientific literature are used to determine whether there are likely to be cumulative and/or synergistic effects.

6.6.45 It should be noted that whilst the HIA uses a recognised method there is an inherent subjectivity to the assessment approach.
6.7 Monitoring

6.7.1 The HIA notes that Halite will be responsible for implementing the recommendations of the HIA. The mechanisms by which these will be monitored and enforced depend on the particular nature of each recommendation.

7 Policy context

7.1 National Policy

National Policy Statement: Gas Supply Infrastructure and Gas and Oil Pipelines

7.1.1 With respect to Control of Major Accidents and Hazards (COMAH) the National Policy Statement states that (26: p9, para 2.5.1)

Gas storage and supply infrastructure sites are subject to stringent safety standards under the Control of Major Accident Hazards (COMAH) Regulations 1999. The COMAH Regulations apply to Underground Gas Storage Facilities, LNG import facilities and gas reception facilities. All these categories of infrastructure qualify as top tier COMAH sites (those carrying more than 200 tonnes of gas).

7.1.2 The Appraisal of Sustainability (AoS) (27: p39) of the National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines EN4 (26) found:

... no specific effects with regard to health and well-being, although it recognised that Underground Gas Storage Facilities, as well as LNG facilities and gas receptor facilities, fall under the Control of Major Accident Hazards Regulations 1999, and that hazardous substances consent is required for locations storing large stocks of oil and gas.

The safety of pipelines is also recognised, with the Pipelines Safety Regulations 1996 requiring that pipelines are designed, constructed and operated so that the risks are as low as reasonably possible.6

7.1.3 With regard to security of energy supply the Appraisal of Sustainability (27: p42) of the National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (26) found that:

... facilitating and enabling the gas supply infrastructure necessary to support the transition to a low carbon economy and ensure security of supply, which is recognised as vital to economic prosperity and social

6 NB this is a direct quotation. The usual phrase is as low as reasonably practicable (ALARP).
well-being, EN-4 is considered likely to have significant positive effects of national importance on the economy and skills AoS objective in the medium-term.

In the long-term, it is anticipated that the effects of EN-4 will reduce to minor positive significance as advancements in other energy technologies are likely to reduce the reliance on gas and oil and security of supply will not be of such importance.

However, it is recognised that gas and oil will continue to play an important role within the UK’s energy mix for some time to come.

7.1.4 The National Policy Statement states that applicants should demonstrate good design, in particular where mitigating the impacts relevant to the infrastructure (26: p8, para 2.3.2).

7.1.5 The HIA notes, however, that consumption of a fossil fuel is not a sustainable activity, and contributes to a low carbon economy only in the context of a preference for burning of gas when compared with coal.

Public Health

7.1.6 The White Paper: ‘Healthy lives, healthy people’ is the Government’s strategy for public health in England (28). Published in November 2010, the White Paper aims to create a ‘wellness’ service (Public Health England) and to strengthen both national and local leadership. ‘Healthy lives, healthy people: update and way forward’ (29) (July 2011) develops the vision. The White Paper identifies issues including:

- maternal health;
- child health;
- better physical and mental health especially through being in work;
- changing behaviour to reduce cancers, vascular dementias and circulatory disease as well as alcohol and drug abuse; and
- improving housing conditions.

7.1.7 The White Paper responds to Professor Sir Michael Marmot’s Fair Society, Healthy Lives report (30) and adopts its life course framework for tackling the wider social determinants of health. The White Paper builds on Equity and Excellence: Liberating the NHS (31) setting out a set of guiding principles for public health and a framework to bring about change.

7.1.8 The White Paper aims to give local authorities new responsibilities for public health, creating opportunities for holistic solutions to health and wellbeing embracing the full range of local services (for example health, housing, leisure, planning, transport, employment and social care).

7.1.9 This vision of integrated public health delivery would create ever closer ties and working relationships between the local authority and NHS
providers, including hospitals. The wider social determinants of health model for public health underlines the importance of maximising health outcomes through all aspects of the UGS development including the wider community context of the proposal.

7.2 Regional Policy

7.2.1 It is understood from Halite that the solution mining element of the proposed development would fall within the regional minerals and waste core strategy.

7.2.2 Policy CS5 of the Joint Lancashire Minerals and Waste Development Framework Core Strategy DPD (32) aims to ensure (inter alia) that:

the amenity, health, economic well-being and safety of the population are protected by the introduction of high operating standards, sensitive working practices and environmental management systems that minimise harm and nuisance to the environment and local communities throughout the life of the development.

7.3 Local policy

7.3.1 Wyre Borough Council has adopted a policy to ensure that health impacts are incorporated into decision making (33). This requires that:

- the council as a whole is responsible for the health of its residents and a culture needs to be developed to this effect throughout the council. The task group therefore recommends that a senior lead officer and a lead councillor be identified to be responsible for embedding health inequalities as an important issue throughout the council.
- that a duty be placed on all Officers and Councillors that whatever service or activity is being undertaken, whether it will have a positive or adverse effect on the health and wellbeing of the residents of Wyre must be questioned.
- that every report submitted to Full Council or Cabinet contain consideration of health and well-being within the table of implications in the report.
8 Results

8.1.1 The following section sets out the results of the detailed assessment.

8.1.2 The assessment considers whether 'important' residual health effects are likely to arise (positive or negative). The assessment takes note of mitigation that Halite proposes for the project. Importance is defined with reference to the Department of Health guidance on HIA set out on page 59.

8.1.3 The conclusions are based on the scientific evidence, professional judgement and experience of other developments. The conclusions use definitions set out in the methodology (see page 56).

8.1.4 The results section uses the following terms which are defined in HIA methodology in Table 8.1.

---

Table 8.1: Links to definitions of key terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Link to definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude: large, moderate, slight or neutral</td>
<td>Page 56</td>
</tr>
<tr>
<td>Sensitivity: high, moderate, low or neutral</td>
<td>Page 57</td>
</tr>
<tr>
<td>Importance of health effect</td>
<td>Page 59</td>
</tr>
</tbody>
</table>
8.2 **Air quality**

8.2.1 This assessment uses the analysis in the ES and focuses on the effects that are likely to cause adverse health effects. This section focuses on dust and particulate matter.

8.2.2 The assessment considers effects during the various stages of the project, including the construction phase; the combined construction and operational phase; and the operational phase.

8.2.3 The sources of potential emissions to air are set out in paragraphs 4.8.7 to 4.8.10 (they are also set out in the QRA at paragraphs 2.6.7.7 to 2.6.7.10). The HIA uses the coverage of emissions to air as reported in the ES air quality chapter.

8.2.4 The HIA reviews the data in the ES against evidence regarding the health effects of pollutants to air.

**Pathway of potential effects**

8.2.5 Figure 8.1 and Figure 8.2 both illustrate ways in which health may be affected by emissions to air from the proposed development.
Dust (including particulates of both non-respirable and respirable size) may be generated as a result of construction activities such as excavation, earth moving and construction traffic.

Dust particulates may enter the atmosphere and remain in suspension from where those of non-respirable size may precipitate causing nuisance; and those of respirable size may be inhaled.

Local populations, which inhale dust and owners (or users) of property affected by high levels of dust deposition.

Children and young people are particularly vulnerable to airborne pollutants as there is greater opportunity to disrupt developmental processes.

Older people with reduced immune systems have reduced tolerance to decreases in air quality.

Dust is a nuisance and can disrupt people’s sense of wellbeing.

Exposure can be dependent on weather conditions. Property is unlikely to be affected by high levels of deposition due to the distance of receptors from the main sources of dust. Finer particulates may travel further, but are not expected to persist at significant concentration levels.

Nuisance from the deposition of particulates onto property may reduce people’s wellbeing. The inhalation of respirable particulates may have health effects and exacerbate existing respiratory and cardiovascular conditions.
Figure 8.2: Conceptual model: plant and vehicle emissions

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air pollutants arising from combustion processes and exhaust or flue emissions of operational plant and vehicles.</td>
<td>Air pollutants from plant and vehicle exhausts and stacks are dispersed into the atmosphere from where they may be inhaled.</td>
<td>Local populations, which inhale, air containing emissions from plant and vehicle.</td>
</tr>
</tbody>
</table>

Sensitivities

Children and young people are particularly vulnerable to airborne pollutants as there is greater opportunity to disrupt developmental processes. People with respiratory conditions will also be vulnerable.

Exposure

Exposure depends on the degree of dispersion and abatement. Emission levels of NOx are low, and evaluation of dispersion with corresponding ground level concentrations show the levels to be well within those within air quality standards.

Health Effect

Inhalation of polluted air may affect people’s health in a variety of ways including reducing respiratory and cardiovascular functions.

8.2.6 The influence of the proposed development on air quality in the district will not be discernible once the construction and development phase has been undertaken. The Environmental Statement goes into the necessary detail so far as the national air quality criteria are concerned.

8.2.7 Sulphur dioxide (SO$_2$) and NOx are modelled in the ES and are found to have low deposition rates.

- The point of maximum deposition of NOx has been calculated as 0.0199µg·m$^{-3}$ (as an annual contribution).\textsuperscript{7} This is located at Cote Walls Farm. This is small in the context of an annual limit of 32 µg·m$^{-3}$ (34) and suggests there is no cause for concern for the emissions from the discharge stack. Other calculations for different locations suggest lower values, including the area around the two schools at Preesall.

\textsuperscript{7} NOx is oxides of nitrogen, in a non-specific mixture of the gases.
The ES models the contribution of SO$_2$ and NOx deposition to the Morecambe Bay SPA/RAMSAR site. These are below critical levels for vegetation. They also appear to be below WHO guideline values for human health.$^8$

8.2.8 From the human health perspective concern is limited to dust from construction activities. Dust can be categorised as respirable and non-respirable, i.e. whether it will enter the lungs.

8.2.9 Respirable dust is categorised as PM$_{2.5}$ and PM$_{10}$: the latter includes the former. The significance of the particle size is that small particles are not captured by lung defence mechanisms and therefore cause adverse health effects (36;37). Children have a heightened vulnerability (38;39).

8.2.10 Non-respirable dust will cause fewer physical health problems however it is noticeable and will cover external surfaces and may enter buildings. It can thus cause annoyance, discomfort and considerable effects on well being and mental health (40). The ES refers to these larger particles of dust as fugitive dust: fugitive dust emissions will be caused by laying the pipeline and other construction works. The storage of building materials is another potential source of fugitive dust. These will be localised effects. The assessment needs to focus on problems from the fugitive dusts.

8.2.11 The descriptor **fugitive** indicates that particulate materials escape from their normal or intended positions, become airborne and are ultimately deposited as dust at some distance from their source. The size of dust particles affects the distance they may travel before being deposited by the effect of gravity. These distances can be considerable. The development of gas storage caverns will require the boring of pipes to caverns with the generation of sub-soil wastes, the excavation of sites for construction of buildings and plant foundations and for the laying of pipelines. This activity has the potential to cause dusts, which can cause nuisance and damage to respiratory health in areas local to the activity.

8.2.12 Fugitive dust emission is difficult to control on large construction sites, spoil and waste heaps and pipeline excavations especially on dry and windy days. Activities to control the dust either involve wetting the dry dust or providing protection from wind whipping by enclosed storage. Construction vehicles can be washed before leaving the construction site. Worker protection can be achieved by using dust masks and respirators. This is not acceptable for non-workers.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>ES result</th>
<th>WHO guideline value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO$_2$</td>
<td>20 µg/m$^3$</td>
<td>20 µg/m$^3$ 24-hour mean (35)</td>
</tr>
<tr>
<td>NOx</td>
<td>30 µg/m$^3$</td>
<td>NO$_2$: 40 µg/m$^3$ annual mean (35)</td>
</tr>
</tbody>
</table>
8.2.13 The ES notes a number of receptors (sites) that may experience adverse effects: the ES expects that mitigation will reduce all effects so that the worst will be a \textit{slight adverse} effect (ES category). The receptors include Rossall Hospital (Westway, FY7 8JH), which is noted as a sensitive receptor, and receptors where there are low population densities such as the farms, and where there is higher population density such as the Cala Gran Holiday Park (Fleetwood Road, FY7 8JY) and the Harbour Village Redrow Homes development (FY7 6PP).

\textbf{Recommendations}

8.2.14 That Halite ensures that its contractors adopt best practicable means to minimise emissions of fugitive dusts from development operations and the storage of materials.

8.2.15 That the Local Authority monitors the development works and ensures that best practicable means are used to minimise dust emissions.

\textbf{Residual effects}

\textbf{Construction and construction and operation}

8.2.16 The problems concerning air quality are linked to construction. Fugitive dusts are, in practice, hard to control and hard to monitor. Their movement is linked to a number of factors including: wind, rain, and the types of construction task that are being performed at any time. Exposure to fugitive dust and emissions is determined by the proximity of people.

8.2.17 In an air quality monitoring and measurement sense the effect is likely not to be discernable. The construction of the pipeline will, in effect, be a rolling site. All clouds of dust will contain respirable dusts so there is clearly likelihood for a short term respiratory health effect. There is also the possibility of annoyance and of deleterious effects on wellbeing.

\textbf{Normal operation}

8.2.18 No significant change in levels of air quality as a result of the proposed development.

\textbf{Conclusion}

8.2.19 Table 8.2 summarises the potential residual changes in health outcomes associated with construction and with construction and operation.
### Table 8.2: Air quality: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential changes in air quality as a result of the scheme is considered to be <strong>slight</strong>.</td>
</tr>
<tr>
<td></td>
<td>The level of change in air quality caused by the scheme is small or below relevant thresholds.</td>
</tr>
<tr>
<td></td>
<td>There is the potential for limited and localised effects from fugitive dust during the construction and the construction and operation phases.</td>
</tr>
<tr>
<td></td>
<td>The duration of effects will be intermittent (between 3 months to a year).</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in air quality is considered to be <strong>low</strong> although vulnerable groups may experience stronger responses to being exposed to fugitive dust.</td>
</tr>
<tr>
<td></td>
<td>The sensitivity of the population to changes in health is above or greater than the national average.</td>
</tr>
<tr>
<td></td>
<td>Exposure to particulates and to NOx and SO2 is expected to be a small increase to background levels so the level of exposure that population is likely to experience is low.</td>
</tr>
<tr>
<td></td>
<td>Exposure to fugitive dust may be intense and is expected to be localised.</td>
</tr>
<tr>
<td></td>
<td>The population exposed to fugitive dust is likely to include a higher than average proportion of children and young people.</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>In general, important health effects are not expected to arise for the wider population of Wyre and Fylde – there is the potential for limited and localised effects during construction and during construction and operation.</td>
</tr>
<tr>
<td></td>
<td>Population groups of</td>
</tr>
<tr>
<td></td>
<td>That Halite ensures that its contractors adopt best practicable means to minimise emissions of fugitive dusts from development operations and the storage of materials.</td>
</tr>
<tr>
<td></td>
<td>That the Local Authority monitors the development works and ensures that best practicable means are used to minimise dust emissions.</td>
</tr>
</tbody>
</table>
8.3 Odour nuisance

8.3.1 This assessment of odour considers effects during the various stages of the project. The focus is on the construction phase, as this is the phase associated with surface ground disturbance.

Pathway of potential effects

8.3.2 Odour perception and consequent annoyance may act as sensory cues for the manifestation of stress-related illness (or that it heightens awareness of underlying symptoms) among individuals concerned about the quality of their environment (41).

8.3.3 Figure 8.3 illustrates ways in which health may be affected by odour from the proposed development.
Figure 8.3: Conceptual model: odour nuisance

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible disturbance of previously buried odorous material, during construction or trenching</td>
<td>The migration of odorous gases from the disturbed ground</td>
<td>Local populations exposed to odorous gases.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odour nuisance is highly subjective; however people under existing mental health pressures (stress, anxiety or depression) may react more strongly to an odour nuisance.</td>
<td>Odorous gases can be detected, but can cause olfactory stimulus at levels below those detectable by instruments.</td>
<td>Odour arising from decaying organic matter and/or sulphurous compounds may result in nausea and associated decline in wellbeing.</td>
</tr>
</tbody>
</table>

**Odour**

8.3.4 Natural gas (such as that which will be piped during the operational phase) has no odour and so will not pose a problem. Buried wastes are a source of possible odour and they may be disturbed by drilling and trenching.

8.3.5 In the ES, the Land Use and Visual impact assessment notes that the area where construction may occur at the Docks is contaminated land. Contaminants include diesel, which has a pungent odour due to the release of Polycyclic Aromatic Hydrocarbon and Volatile Organic Compounds. Polycyclic Aromatic Hydrocarbon and Volatile Organic Compounds have the capacity to adversely impact health.

8.3.6 Studies which have looked at the possible health effects caused by annoyance from odours from landfill sites and petroleum refineries have concluded that intuitive or implicit ideas about toxicity can be summarised as 'if environments smell bad they are probably damaging to health' (42).

8.3.7 A study of people living close to hazardous waste sites found that odour perception and annoyance may act as sensory cues for the

---

9 Domestic gas supplies are odorised, but that odour is added after the gas leaves the Underground Gas Storage Facility.
manifestation of stress-related illness (or it heightens awareness of underlying symptoms) among individuals concerned about the quality of their environment (41). The recorded levels of exposure at the sites under study were well below levels where adverse effects would be expected as a result of recognised toxicological symptoms.

8.3.8 Hydrogen sulphide can occur as a product of low oxygen decay and poses health risks even at low concentrations. Although associated with a strong smell at low concentrations, at high concentrations it temporarily paralyses the olfactory nerves, leading to a loss of sense of smell. The gas can therefore be present at dangerously high concentrations, with no perceivable odour (43).

Figure 8.4: Current and historic landfill mapping

![Figure 8.4: Current and historic landfill mapping](image)

Source: Environment Agency, landfill mapping

8.3.9 Landfills are considered the most likely sources of odour that could be disturbed by ground works. Figure 8.4 shows the areas of current and historic landfill that are in proximity to the proposed development. The main area of potential landfill disturbance is trenching associated with the brine outfall pipeline on the west bank of the River Wyre. The pipeline may pass through or close to a number of areas identified by the Environment Agency as being associated with historic landfill. The relevant historic landfills are labelled:

- Jameson Road Power Station, which was used to landfill industrial waste and household waste;
- 18 Acre Tip Land at Jameson Road, which was used to landfill commercial waste; and
- Rossall College No. 2, which was used to landfill household waste.
8.3.10 In addition to the landfill sites shown in Figure 8.4 a further historic landfill is located close to the site of construction activity for the southern river crossing on the western bank of the River Wyre. The historic landfill was for household waste and is identified as Stanah House Farm.

**Recommendations**

8.3.11 That Halite requires its contractors to undertake trial bores or pits to seek to identify previously tipped sites, if any, and determine best practicable means to be employed, if and when necessary, to avoid odour nuisance.

8.3.12 That the Local Authority monitors the operations and ensures that any nuisance (to occupiers of affected premises) from odour is minimised so far as is reasonably practicable.

**Residual effects**

8.3.13 Any potential problems concerning odour are linked to the construction and the construction and operation stages.

8.3.14 The magnitude of this effect is unknown but, at this stage, considered likely to be small.

8.3.15 Any issues concerning odour are likely to be part of low level anxiety about the development.

**Conclusion**

8.3.16 Table 8.3 summarises the potential residual changes in health outcomes associated with construction and with construction and operation.

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in odour nuisance as a result of the scheme is considered to be neutral. The level of change in odour caused by the scheme is likely to be small or below relevant thresholds. The duration of effects is linked to trenching excavation, which will be short term at any given location.</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in odour nuisance as a result of the scheme is considered to be low. Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average. The level of exposure that</td>
</tr>
</tbody>
</table>
8.4 Operational plant failure

8.4.1 This includes failure of the wellhead, pipeline or other equipment (including safety of work environment).

8.4.2 The construction and operation of the proposed development will be subject to The Pipelines Safety Regulations, COMAH regulatory requirements and European Standard BS EN 1918:1998. Compliance will be undertaken by the HSE.

8.4.3 The HIA assessment of operational plant failure considers the potential health outcomes in the event of an emergency scenario at the facility.

8.4.4 The risks associated with emergency scenarios are the subject of a separate risk assessment report undertaken for the project (44). The HIA has undertaken a review of this Quantitative Risk Assessment (QRA). This is provided in Appendix B.

8.4.5 The QRA is the main way in which Halite seeks to evaluate the risk, or likelihood, of a failure in the UGS or the pipelines and thus to address, and respond to, the public’s concerns.

Pathway of potential effects

8.4.6 Figure 8.5 illustrates ways in which failure of the operational plant may affect health.
Figure 8.5: Conceptual model: structural failure of wellhead; pipework; or equipment failure

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A low altitude natural gas cloud arising from the escape to the atmosphere of natural gas from the gas storage caverns or gas pipelines.</td>
<td>Natural gas released unexpectedly due to structural failure of a wellhead is dispersed into the atmosphere from where it may be inhaled or pose an ignition/combustion/explosion hazard.</td>
<td>Local populations and workforce within 844m of the centre of the GCC (and small extension to the northwest).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People in enclosed spaces are more susceptible to asphyxiation risks. Gas concentrations between lower and upper combustible limits are a fire and explosion hazard putting exposed personnel at risk of burns and explosion hazards.</td>
<td>Risks of asphyxiation from natural gas requires very high concentrations that would only exist very close to the source. Risks from combustion hazards are confined to a worst case of 844m from the centre of the GCC (and small extension to the northwest).</td>
<td>Natural gas inhaled at sufficient concentration will act as an asphyxiant to those people very close to the source. Ignition of sufficient concentrations of natural gas mixed with air, poses a combustion hazard. There is potential for burns, serious trauma and in extreme cases death.</td>
</tr>
</tbody>
</table>

**Emergency scenarios**

8.4.7 The HIA review of the QRA recognises that the QRA provides a thorough analysis of the risks of failure associated with the proposal.

8.4.8 The QRA concludes that emergency scenarios will be very unlikely to occur as potential problems have been 'engineered out', or they will be minimised by effective management structures. The HIA notes that success of the latter depends on employees following the adopted protocols and procedures. A possible failure is not the engineering, the procedures, or even the desire to operate safely: it is the people within the organisation (operator failure).
8.4.9 If the installation is run and managed appropriately there are very few foreseeable impacts on health for most of the population. However in the event of an emergency scenario those people in proximity to the event may be killed or experience major injury.

8.4.10 The HIA uses the definition of ‘major’ injury as defined by Schedule 1 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) (3).

8.4.11 Figure 8.6 summarises the maximum area of effect in the event of an emergency scenario. The figure combines the maximum areas of effect for flash fire at half lower flammable limit (½ LFL) and jet fire (see QRA (44: figure 4.12) figure 4.12 & figure 4.9 for further details).

8.4.12 The worse case distance for the ½ LFL limit for flash fires is 844m (from the centre of the Gas Compressor Compound). The worse case distance for the jet fire is 581m (from the centre of each wellhead).

Figure 8.6: Maximum area of effect in the event of an emergency scenario

Source: Adapted from Halite Energy Group (44: figures 4.9 and 4.12)

8.4.13 The area of risk is around the main Gas Compressor Compound and gas storage cavern wellheads.
8.4.14 Other than the operational workforce (maximum of 35 people), the number of people who may be within the area of effect is estimated to be less than 50 people at any one time. There are three residential buildings within this zone: Cote Walls farm, Park Cottage farm and Park Cottage. There are also sections of the 'Wyre Way' within this zone, as well as parts of the Knott End Golf Club and possibly areas used by the Alkali Angling Club. The sewage works building (usually unoccupied) also falls within this area, as well as agricultural land that will occasionally have workers present.

8.4.15 The authors of the QRA note that in the event of a flash fire persons towards the outer regions of this maximum area of effect will probably not be engulfed by the fire and thus the risk of fatality or major injury is lower. By the time the gas has travelled this distance its natural buoyancy will have caused it to rise well above ground level.

8.4.16 The QRA (44: figure 4.9) notes that detailed risk assessment is not considered necessary for the buried gas transmission pipeline linking the Gas Compressor Compound to the national transmission system at Nateby due to the low population density in the area through which it passes. The HIA notes that any risk associated with such buried gas transmission pipelines would be comparable to those routinely experienced in relation to the national gas transmission system that operates across the UK.

**Recommendations**

8.4.17 That Halite demonstrate compliance with statutory requirements at all times. This provides comfort to residents by publicising the inspection reports of regulators and third party audits when undertaken.

**Conclusion**

8.4.18 Table 8.4 summarises the potential residual changes in health outcomes associated with operational plant failure.
Table 8.4: Operational plant failure: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>The magnitude of impact from an operational plant failure that resulted in an emergency scenario is considered to be <strong>large</strong>.</td>
</tr>
<tr>
<td></td>
<td>The QRA ((44: figure 4.9) calculates the likelihood of injury due to jet fire, explosion, or gas release as being less than one in a 100 million (per year).</td>
</tr>
<tr>
<td></td>
<td>The risk of major injury in the event of an emergency scenario is large or exceeds relevant thresholds.</td>
</tr>
<tr>
<td></td>
<td>The duration or timescale over which major injuries may operate is continuous or long term (for example asphyxiation or serious burn/blast injury may kill, or affect health for a long period).</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>The population response to direct injury from emergency scenarios is considered to be <strong>high</strong> for those people caught within the area of effect of an emergency scenario (see Figure 8.6).</td>
</tr>
<tr>
<td></td>
<td>The inherent susceptibility of the population is not relevant in this instance, as an emergency scenario would not have differing effects on different population groups.</td>
</tr>
<tr>
<td></td>
<td>The level of exposure to gas, fire or explosion that population is likely to experience is high (for those within the area of risk set out in Figure 8.6).</td>
</tr>
<tr>
<td>Importance</td>
<td>Important health effects would be expected for those people caught within the area of effect of an emergency scenario (see Figure 8.6). People outside this area are unlikely to experience major injury.</td>
</tr>
<tr>
<td></td>
<td>The HIA notes that the scheme will be subject to further detailed emergency planning if the proposals are passed by the Infrastructure Planning Commission.</td>
</tr>
</tbody>
</table>

8.5 Visual setting & local character

8.5.1 The assessment of visual setting and local character uses the analysis in the ES and considers the visual impact of the proposed development during the various stages of the project, including: the construction phase; the combined construction and operational phase; and the operational phase.
8.5.2 The HIA reviews the data in the ES against evidence regarding the health effects of visual setting and local character.

**Pathway of potential effects**

8.5.3 Viewing and interacting with green space is associated with psychological, social and physical health benefits. A decline in the quality of green space (including impacts to its visual setting) is likely to be associated with a decline in the benefits that can accrue from exposure.

8.5.4 Figure 8.7 illustrates ways in which health may be affected by visual impacts of the proposed development.

**Figure 8.7: Conceptual model: visual setting and local character**

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The addition of the scheme’s surface infrastructure into the landscape.</td>
<td>New elements in the visual environment may alter the character or setting of existing landscape features.</td>
<td>Local populations with views (from public or private spaces) of the surface infrastructure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with high levels of deprivation are more vulnerable to changes in factors, which can affect their health outcomes.</td>
<td>Levels of exposure are expected to be low. Areas from where there may be ‘near views’ of the more intrusive elements have low population densities. ‘Far views’ may affect a larger population, but the relative scale of the infrastructure within the landscape is reduced.</td>
<td>A change in the landscape character or setting may affect the wellbeing benefits that accrue to the local population from enjoyment of the visual environment.</td>
</tr>
</tbody>
</table>

**Visual impact**

8.5.5 The underground gas storage solution avoids the visual intrusion of large surface gas storage containers. Conceptually, such benefits can be weighed against the adverse effects of the comparatively less intrusive surface infrastructure of the proposed development. However
in the local context of the development at Preesall the relevant consideration is the actual visual impact on the local communities.

8.5.6 The HIA notes that the design of some structures of the proposed development will help them to fit into the existing landscape. For example the eastern bank Booster Pump Station will be an agricultural style brick building. However other elements’ industrial nature is less easily disguised, such as the compound behind the Booster Pump Station and the main Gas Compressor Compound. These industrial elements are to be subject to screening measures using mounds, scrub and trees.

8.5.7 The main surface infrastructure is at the Gas Compressor Compound, which includes structures and flue/flare stacks of an industrial character. These structures and any associated vapour are not in keeping with the predominantly agricultural setting of the surrounding area.

8.5.8 The ES identifies a number of residual adverse effects on the landscape and visual setting during the construction and operational phases of the proposed development. Table 8.5 provides a summary of the ES results, excluding those, which were either short term or temporary, as these are not expected to be associated with important changes in health outcomes.
<table>
<thead>
<tr>
<th>Character Type or Area / Visual Receptor</th>
<th>Scheme feature associated with the effect</th>
<th>Significance of Residual Effect</th>
<th>Year</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape Character Area LCA-4b: Hackensall Farmed Lowland</td>
<td>Three year footpath closure. Users would be diverted along a realigned route through adjacent golf course.</td>
<td>Large adverse</td>
<td>Year 1 to Year 3</td>
<td>Long term</td>
</tr>
<tr>
<td>Landscape Character Area LCA-4c: Agglebys Farmed Lowland</td>
<td>It is anticipated the potential impacts on the character and visual amenity of this area would result from construction activity within the area. See below the notes for the two visual receptors within this area (VR4.4a and VR4.4b).</td>
<td>Very Large adverse to Large adverse</td>
<td>Year 1 to Year 3</td>
<td>Medium term</td>
</tr>
<tr>
<td>Visual Receptor VR4.4a: Wyre Way (runs concurrently with Footpaths FP42 and FP41)</td>
<td>Some short range open views to construction activity at Well Head Compounds, including floodlighting being a noticeable night time element. A view of construction activity at the northern crossing and the Booster Pump Station. Filtered views to activity at High Lickow and activity associated with the Gas Compressor Compound.</td>
<td>Large adverse</td>
<td>Year 1 to Year 3</td>
<td>Medium term</td>
</tr>
<tr>
<td>Visual Receptor VR4.4b: Wyre Way (runs concurrently with Footpath FP16)</td>
<td>Views of construction activity at the northern crossing and the Booster Pump Station. A view to drilling activity at Well Head Compounds, with floodlighting being a noticeable night time element. Other construction activity would be heavily filtered by the intervening linear scrub immediately adjacent to the Wyre Way.</td>
<td>Moderate adverse</td>
<td>Year 1 to Year 3</td>
<td>Medium term</td>
</tr>
<tr>
<td>Character Type or Area / Visual Receptor</td>
<td>Scheme feature associated with the effect</td>
<td>Significance of Residual Effect</td>
<td>Year</td>
<td>Duration</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
<td>--------------------------------</td>
<td>------</td>
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</tr>
<tr>
<td><strong>Construction and Operation Combined Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape Character Area LCA-4b: Hackensall Farmed Lowland</td>
<td>It is anticipated the potential impacts on the character and visual amenity of this area would result from construction and operational activity within the area. See below the notes for the three visual receptors within this area (VR4.2a, VR4.2b and VR4.3).</td>
<td>Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Long term</td>
</tr>
<tr>
<td>Visual Receptor: VR4.2a: Wyre Way (runs concurrently with Footpath FP42)</td>
<td>Views across undulating farmland to the outline of the Booster Pump Station building. Over time screening would integrate this building with the adjacent perimeter planting around the sewage treatment works. Views from the Wyre Way of Wellhead Compound 1 on a local ridgeline against the skyline. Potential views of the upper parts of the perimeter security fence post, though these would be screened over time.</td>
<td>Large adverse to Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Long term</td>
</tr>
<tr>
<td>Visual Receptor: VR4.2b: Wyre Way (runs concurrently with Footpath FP42)</td>
<td>Short range views across arable farmland to the Booster Pump Station building, though these views would be screened over time. View across arable farmland to the perimeter mound and scrub establishing on it, overtime the proposed hedge on the east side of the path would screen this element.</td>
<td>Large adverse to Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Long term</td>
</tr>
<tr>
<td>Visual Receptor VR4.3: Footpath FP61</td>
<td>Short range views of the Booster Pump Station, though overtime the scrub and intermittent tree planting along the outside of the security fence would provide screening. View along the access track to the compound entrance gate, although planting within the compound would help to limit the exposure of the internal compound elements.</td>
<td>Large adverse to Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Long term</td>
</tr>
<tr>
<td>Character Type or Area / Visual Receptor</td>
<td>Scheme feature associated with the effect</td>
<td>Significance of Residual Effect</td>
<td>Year</td>
<td>Duration</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>Landscape Character Area LCA-4c: Agglebys Farmed Lowland</td>
<td>It is anticipated the potential impacts on the character and visual amenity of this area would result from construction and operational activity within the area. See below the notes for the visual receptor within this area (VR4.4a).</td>
<td>Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Medium term</td>
</tr>
<tr>
<td>Visual Receptor VR4.4a: Wyre Way (runs concurrently with Footpaths FP42 and FP41)</td>
<td>Short range views through the security fence to the earth mounds and establishing scrub around Well Head Compounds. The taller elements at the Gas Compressor Compound would be discernable above the screen mound and establishing scrub. View of the operational Booster Pump Station.</td>
<td>Moderate adverse</td>
<td>Year 4 to Year 8</td>
<td>Medium term</td>
</tr>
</tbody>
</table>

**Operation Phase**

<table>
<thead>
<tr>
<th>Character Type or Area / Visual Receptor</th>
<th>Scheme feature associated with the effect</th>
<th>Significance of Residual Effect</th>
<th>Year</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape Character Area LCA-4b: Hackensall Farmed Lowland</td>
<td>It is anticipated the potential impacts on the character and visual amenity of this area would result from operational activity within the area. See below the notes for the three visual receptors within this area (VR4.2a, VR4.2b and VR4.3).</td>
<td>Moderate adverse</td>
<td>Year 9 to Year 20</td>
<td>Long term</td>
</tr>
<tr>
<td>Visual Receptor: VR4.2a: Wyre Way (runs concurrently with Footpath FP42)</td>
<td>Views across farmland to the Booster Pump Station building, which to some extent would partially block part of a narrow view to the estuary beyond it.</td>
<td>Moderate adverse</td>
<td>Year 9 to Year 20</td>
<td>Long term</td>
</tr>
<tr>
<td>Visual Receptor: VR4.2b: Wyre Way (runs concurrently with Footpath FP42)</td>
<td>Short range open views to the Booster Pump Station building. View of Wellhead Compound 3.</td>
<td>Moderate adverse</td>
<td>Year 9 to Year 20</td>
<td>Long term</td>
</tr>
<tr>
<td>Character Type or Area / Visual Receptor</td>
<td>Scheme feature associated with the effect</td>
<td>Significance of Residual Effect</td>
<td>Year</td>
<td>Duration</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>------------------------------------------</td>
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<td>----------</td>
</tr>
<tr>
<td><strong>Visual Receptor VR4.3: Footpath FP61</strong></td>
<td>View of the Booster Pump Station and a filtered view through establishing scrub and intermittent trees to some elements within the compound behind. A permanent view along the access track to the compound entrance gate, although planting would help to screen elements within the compound.</td>
<td>Moderate adverse</td>
<td>Year 9 to Year 20</td>
<td>Long term</td>
</tr>
<tr>
<td><strong>Landscape Character Area LCA-4c: Agglebys Farmed Lowland</strong></td>
<td>It is anticipated the potential impacts on the character and visual amenity of this area would result from operational activity within the area. See below the notes for the visual receptor within this area (VR4.4a).</td>
<td>Moderate adverse</td>
<td>Year 9</td>
<td>Medium term</td>
</tr>
<tr>
<td><strong>Visual Receptor VR4.4a: Wyre Way (runs concurrently with Footpaths FP42 and FP41)</strong></td>
<td>Views through the perimeter security fence to establishing scrub on the mounds within Well Head Compounds. Views to the Booster Pump Station. Filtered view to the gas heater and glycol dryer above the Gas Compressor Compounds screen mound and establishing scrub and the adjacent vent stack.</td>
<td>Moderate adverse</td>
<td>Year 9 to Year 20</td>
<td>Long term</td>
</tr>
</tbody>
</table>
8.5.9 As the ES identified large long term adverse effects during the construction phases and moderate long term adverse effects during the operational phase, there are likely to be associated changes in health outcomes.

8.5.10 Natural features and green spaces have considerable influence on physical, mental and perceived health. Simply having a view of a natural area through the window can facilitate healing, reduce stress and support emotional well-being (46).

8.5.11 It is noted that a large proportion of the ES effects relate to the Wyre Way and other footpaths. This suggests that the impact has the potential to discourage physical activity by reducing the appeal of using these routes.

8.5.12 Physical activity enhances mental health and reduces health risks such as obesity, heart disease, diabetes, hypertension and colon cancer, which are associated with sedentary and indoor lifestyles. Moreover, exercise in a natural environment has been shown to have a greater effect on blood pressure, self-esteem and mental health than exercise alone (46).

8.5.13 Night time lighting associated with the construction activities is reported in the ES to be largely unobtrusive although there would be directional flood lighting at the Well Head Compounds towers during night time drilling. Such lighting may have localised visual impacts, but is not expected by the developer to be intrusive enough to disrupt sleep.

8.5.14 Similarly operational night time lighting is reported in the ES to be largely filtered and screened, such that it has little impact on surrounding light levels beyond the development.

Recommendations
8.5.15 That Halite seeks to minimise visual intrusion into the landscape from their development and operations by siting, screening and designing to the satisfaction of the Local Planning Authority.

Residual effect
Construction and normal operation
8.5.16 Although use of screening will limit the visual impact of the proposed development there will be extended periods of reduced visual environment quality during both the construction and operational phases.

8.5.17 The reductions in the quality of natural views may be associated with declines in wellbeing for people whose regular views are affected by new surface infrastructure or plumes associated with the proposed development.

8.5.18 Levels of physical activity may also decline due to a reduction in use of some footpaths from loss of visual amenity.
8.5.19 Whilst visual impacts are likely to make only a relatively small contribution to overall health the effect is none the less negative and may potentially act cumulatively with other reductions in wellbeing and physical activity.

8.5.20 The ES reports that the vent stack will not have a plume; however the gas heaters will display a plume of water vapour in cold weather. The scale of such a plume has not been quantified.

8.5.21 Table 8.6 summarises the potential sources of a visible plume associated with the proposed development, as well supporting information provided by Halite.

Table 8.6: Potential sources of plumes

<table>
<thead>
<tr>
<th>Source</th>
<th>Commentary on likelihood of plumes from Halite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan coolers</td>
<td>The fan coolers will not cause any plume because they will be operating when the ambient air temperature is high and there is no release to atmosphere involved.</td>
</tr>
<tr>
<td>Vent stack</td>
<td>The maintenance vent stack is used for planned maintenance and emergency use only. During maintenance it will be used to release natural gas followed by nitrogen in order to purge process plant and make it available for isolation, opening, inspection and maintenance and then finally purging again with nitrogen before re-commissioning with natural gas. Under emergency operation, natural gas may be released from the vent to prevent over-pressurisation of plant. This will be followed by nitrogen purging. There is no visual effect from the vent gases in either case.</td>
</tr>
<tr>
<td>Calcium chloride driers</td>
<td>There are two calcium chloride drier systems. These units incorporate gas fired heaters, which are used to regenerate the driers and incinerate the waste gases. They operate at high exhaust temperatures and therefore will not produce any visual plume.</td>
</tr>
<tr>
<td>Gas heaters</td>
<td>There are two gas heaters. These units incorporate gas fired condensing boilers similar to, but much larger than, domestic central heating boilers. Under high humidity conditions in the winter it is possible to get a water vapour plume at these exhausts, just as seen from the domestic boiler exhaust.</td>
</tr>
</tbody>
</table>

Conclusion

8.5.22 Table 8.7 summarises the potential residual changes in health outcomes associated with visual impacts.
Table 8.7: Visual setting and local character: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of impact from the changes in visual setting and local character are considered to be <strong>moderate</strong>.</td>
</tr>
<tr>
<td>The level of change in views caused by the scheme is medium (there are some views of new industrial elements).</td>
<td></td>
</tr>
<tr>
<td>The duration or timescale over which views change is continuous or long term.</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>The population response to changes in views is considered to be <strong>moderate</strong> (based on the introduction of industrial structures into an area which is predominantly agricultural).</td>
</tr>
<tr>
<td>The inherent susceptibility of the population is greater than the national average as people from very deprived communities may be affected.</td>
<td></td>
</tr>
<tr>
<td>The level of exposure that population is likely to experience, often from right-of-way and footpaths, is medium (some direct and many filtered views).</td>
<td></td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>The decline in quality of views may contribute to important reductions in health outcomes for those people whose regular views are affected. There may also be wider important health effects from a reduction in physical activity (due to reduced visual amenity of footpaths).</td>
</tr>
<tr>
<td>Recommendations are made to maximise screening of industrial elements and where feasible use building designs which fit into the existing local context.</td>
<td></td>
</tr>
</tbody>
</table>

8.6 **Noise Disturbance**

8.6.1 This assessment uses the analysis in the ES and considers potential effects during the various stages of the project, including: the construction phase; the combined construction and operational phase; and the operational phase.

8.6.2 The HIA reviews the data in the ES against evidence regarding the health effects of environmental noise.
8.6.3 European Union (EU) Directive 2002/49/EC on the management of environmental noise defines environmental noise as “unwanted or harmful outdoor sound created by human activities, including noise from road, rail, airports and from industrial sites” (47).

Pathway of potential effects

8.6.4 Noise is linked to cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus and annoyance (48).

8.6.5 Figure 8.8 illustrates ways in which health may be affected by noise from the proposed development.

**Figure 8.8: Conceptual model: noise disturbance**

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise generated from construction and operational activities may cause a disturbance.</td>
<td>Noise disturbance propagates as a sound pressure wave through the air, to surrounding receptors.</td>
<td>Local populations exposed to construction and operational noise. This includes residents in proximity to the Pump Houses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children or young people at school are particularly sensitive as noise disturbance may affect educational attainment.</td>
<td>People who spend extended periods (residential or work) close to the project facilities are likely to experience greater disturbance levels. Night time residential exposures to elevated noise levels are generally associated with greater health effects than the equivalent daytime levels. Persistent low level noise exposure can carry greater effects than temporary high volume noise.</td>
<td>Noise disturbance may cause sleep disturbance and annoyance, both of which may reduce wellbeing. At extreme noise levels auditory damage may occur (such levels are not anticipated).</td>
</tr>
</tbody>
</table>
Noise

8.6.6 The main sources of noise are expected to be from construction plant used in the first years of the project to establish the surface infrastructure (including pipe and cable laying under the River Wyre).

8.6.7 Noise from solution mining (a construction activity more akin to an operational activity as its activities are below ground) and operation activities of gas storage are expected to be associated with smaller but long-term changes in background levels.

8.6.8 The HIA notes that construction activities will cause temporary exceedances of recommended noise guidance levels and are thus most likely to have direct health effects.

8.6.9 Sleep disturbance is one of the most common complaints raised by noise-exposed populations, and it can have a major impact on health and quality of life. Studies have shown that noise affects sleep in terms of immediate effects (for example arousal responses, sleep stage changes, awakenings, body movements, total wake time, autonomic responses), after-effects (for example sleepiness, daytime performance, cognitive function deterioration) and long-term effects (for example self-reported chronic sleep disturbance). Sufficient undisturbed sleep is necessary to maintain performance during the day as well as for general good health. Acute and chronic sleep restriction or fragmentation has been shown to affect, among other things, waking psychomotor performance, memory consolidation, creativity, risk-taking behaviour, signal detection performance and risks of accidents (48).

8.6.10 The HIA also notes the potential for health effects associated with changes in ambient noise levels. Such changes in ambient noise may indirectly affect health through the wider social determinants of health by changing the character of the area. For example changing a rural setting to a semi-industrial setting may have adverse effects on social networks. This, in turn, may reduce self-rated health.

Construction

8.6.11 The ES study area for terrestrial construction noise impacts extended to 200 metres from noise sources. The operational study area was taken to be the closest receptors to the application boundary. The approach agreed, by Halite, with the Wyre Borough Council Environmental Health Officer (EHO) was that by ensuring acceptable levels at these receptors, noise effects would also be acceptable further afield. This means that mitigation must reduce noise levels at source rather than at individual receptors.

8.6.12 A notable ES receptor within the 200 metres source radius study area is Rossall Hospital, which is a highly sensitive receptor. Rossall Hospital is located in the southwest of Fleetwood around 130 metres from the point of the construction works at the seawall and around 70 metres from the laying of the brine discharge pipe. The hospital
accommodates up to forty in-patients and has further day care facilities for patients. The hospital specialises in rehabilitation and recuperation, as well as terminal care. The HIA recommends that mitigation measures are specifically targeted at maintaining a tranquil environment at this facility throughout the construction activities at the seawall and in laying the brine discharge pipe.

8.6.13 The HIA agrees with the ES that the construction compounds for the north and south crossings of the Wyre are potentially the most significant construction noise impacts with directional drilling expected to take place continuously for a period of approximately ten weeks for the north crossing and approximately eight weeks for the south crossing. Night time noise impacts are predicted to be high.

8.6.14 Affected receptors are: the Redrow Residential Development (northern crossing west shore drilling rig); Stanah Caravan Park (southern crossing west shore compound); and Carter’s Farm (southern crossing east shore drilling rig). The HIA recommends that mitigation measures are specifically targeted at substantially reducing night time noise at these receptors for the duration of the drilling activities for the north and south crossings.

8.6.15 Normal construction noise mitigation measures such as selection of quiet plant, correct operation of plant and use of noise barriers or screens may reduce noise levels by 5 dB(A) and possibly up to 10 dB(A) if mitigation is appropriately targeted. The directional construction activities at the river crossings require night time noise reductions at source of up to 36 dB\(^\text{10}\). The HIA notes that detailed further investigation is required by the contractor in consultation with noise specialists to identify a technical solution, which would achieve acceptable noise night time noise levels.

8.6.16 The ES notes that the effects of the directional drilling are likely to be worst at the Redrow residential development which is located on the west bank of the River Wyre between the Fleetwood Marina and the estuary. The Redrow development is around 50 metre from the proposed temporary drilling compound. The HIA notes that the decision to undertake drilling for the northern crossing on the western bank rather than the eastern bank is due to the presence of a SSSI on the eastern bank.

8.6.17 The HIA notes that a challenge to the effective mitigation of directional drilling noise effects at Carter’s Farm on the east bank of the River Wyre estuary may be the elevated position of Carter’s Farm relative to the drilling rig. This may reduce the effectiveness of conventional noise barriers or screens. Farming is a stressful occupation and thus a

\(^{10}\) The ES reports unmitigated night time noise levels at Redrow residential development of 79 dB(A). To achieve the WHO recommended outdoor (façade) night time noise levels of 43 dB(A), this would require mitigation to achieve a 36 dB(A) reduction in noise levels.
further consideration in relation to Carter’s Farm is evidence that farming is associated with lower levels of mental health (49). This may suggest that occupants of Carter’s Farm are particularly sensitive to noise effects compared to the general population.  

8.6.18 The ES notes that at this stage it is not possible to decide on specific mitigation measures and therefore the residual impacts after implementation of mitigation cannot be accurately predicted. The ES sets out construction noise thresholds, which should be met by further mitigation determined during the detailed design stage.

8.6.19 The HIA agrees that these construction noise effects are likely to be significant and that there is particular concern around night time noise, which may disturb sleep.

8.6.20 A WHO review of the evidence (50) can be summarised as:

- sleep is a biological necessity and disturbed sleep is associated with poor health;
- there is strong evidence that night noise causes increases in heart rate, arousal, changes in sleep stage, awakening and use of medicine; and
- there is limited evidence that night noise is related to hypertension, heart attacks, depression, and changes in hormone levels, fatigue and accidents.

8.6.21 The report identified a number of vulnerable groups. Although children have a higher waking threshold they are equally or more reactive to night noise than adults and require greater amounts of sleep. Elderly people, pregnant women, those with ill health and shift workers are also at greater risk of experiencing negative impacts from night noise.

8.6.22 Planning Policy Guidance 24 (PPG 24) notes that residents may reasonably expect to sleep with their windows open sufficiently to provide adequate ventilation (51). Whilst the WHO does not provide guidance on the sound insulation qualities of partially open windows PPG 24 cites a value of at least a 10 dB(A) for the reduction of internal noise levels from external facade noise with a partially open window.

8.6.23 The HIA agrees with the ES reference to night time outdoor noise threshold of 40 dB(A), as set out in the WHO Night Noise Guidelines for Europe, Copenhagen, 2009. This is a ‘free-field’ measurement, which can be converted to a ‘facade’ noise level by a correction factor of +3dB(A). Facade noise levels at all residential (and hospital) receptors affected by the proposed development should therefore not exceed 43 dB(A) at night.

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11 Syson-Nibbs et al (49) conducted a postal survey of hill farmers. The applicability of this study on hill farmers to this locality is not known.
8.6.24 The HIA recommends that this threshold is applied to both construction as well as operational noise. The ES suggests using construction noise thresholds of 50-55dB(A) (night) and 75dB(A) (day) for daytime based on BS-5228. The HIA notes that above 40dB(A) (outdoor free field) biological effects observed have adverse effects on health and above 55 dB(A) cardiovascular effects become a major health concern (52). In the HIA’s view the WHO thresholds should be applied.

8.6.25 With regard to daytime noise thresholds, the WHO recommends that general daytime outdoor noise levels of less than 55 dB(A) $L_{eq}$ are desirable to prevent any significant community annoyance. This is consistent with speech communication requirements (53). This is a ‘free-field’ measurement, which can be converted to a ‘facade’ noise level by a correction factor of +3dB(A). Facade noise levels at all residential (and hospital) receptors affected by the proposed development should therefore not exceed 58 dB(A) during the day.

Operational noise (including combined construction and operation phase)

8.6.26 For noise effects other than the establishment of surface infrastructure the ES generally concludes that although changes in noise level during the day and night time period may be perceptible, predicted levels would be low and would not have any adverse health effects or cause sleep disturbance.

8.6.27 The HIA agrees that the predicted levels are not likely to result in direct health effects. However the HIA notes that even relatively small changes in ambient noise may indirectly affect health through the wider social determinants of health by changing the character of the area. Furthermore, those residents who have expressed concern about the development are likely to exhibit a greater sensitivity to changes in noise levels. People who experience changes in noise levels in previously rural, and therefore quiet settings, may be particularly sensitive.

8.6.28 Indirect health effects are not expected on the western bank of the River Wyre estuary as this area is considered to be developed and small changes in ambient noise levels are unlikely to affect local character. However the eastern side of the estuary is predominantly agricultural in nature with very low background noise levels. The introduction of even relatively low level industrial noise to this context may affect local character.

8.6.29 Figure 8.9 is an extract from the Lancashire tranquillity mapping undertaken by the Campaign to Protect Rural England, with ‘Tranquil Areas’ being defined as: ‘places which are sufficiently far away from the visual or noise intrusion of development or traffic to be considered unspoilt by urban influences’.

93
8.6.30 The HIA recognises that such shifts in local character are potentially important but not readily quantifiable in terms of the potential effect on health outcomes.

8.6.31 Wider determinants of health which could be affected by such a shift in local character or reduction in local tranquillity may include:

- decisions to undertake physical activity in the area;
- social capital of residents who value a quiet location; and
- local businesses which benefit from economic activity based on the tranquillity of the area, such as users of the Wyre Way, caravan parks, golf course, sailing and angling clubs.

Synergistic impacts

8.6.32 Noise (unwanted sound) may act as a trigger and reminder to people who already hold strong adverse sentiments towards the proposed development. As a result construction or operational noise may act synergistically with existing reductions in mental health and wellbeing.

Recommendations

8.6.33 That Halite observes the requirement to avoid sleep disturbance to occupiers of residential premises adjacent to their development and operations.
8.6.34 That the Local Planning Authority seek to ensure this through their Local Impact Statement, recommended planning conditions and the activities of their operational regulatory staff.

Residual effects

8.6.35 The main noise effects on health are linked to the construction phase, notably the night time noise to neighbouring residential receptors from drilling under the River Wyre.

Construction

8.6.36 Unless night time noise levels of 43 dB(A) (at facade) are achieved by mitigation, night time noise from directional drilling under the River Wyre is likely to cause sleep disturbance for people living close to the directional drilling rigs (particularly Redrow Harbour Village and Carter’s Farm).

8.6.37 Unless daytime noise levels of 58 dB(A) (at facade) are achieved by mitigation, construction activities are likely to cause annoyance for people living in close proximity to areas of intense and prolonged construction activity.

Operations

8.6.38 A slight reduction in wellbeing may be associated with a general decline in the tranquillity of the area around surface infrastructure on the eastern bank of the River Wyre estuary as a result of the introduction of low level industrial noise into a quiet rural setting.

Conclusion

8.6.39 Table 8.8 summarises the potential residual changes in health outcomes associated with construction and operational noise. The focus is on construction noise.

Table 8.8: Noise: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in noise disturbance as a result of the scheme is considered to be <em>moderate</em>.</td>
</tr>
<tr>
<td></td>
<td>The level of change in noise caused by the scheme is large and may exceed relevant WHO thresholds.</td>
</tr>
<tr>
<td></td>
<td>The duration of effects is linked to construction activities, which will be prolonged intermittent or medium term (the eight &amp; ten week directional drilling periods are particularly relevant).</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in noise disturbance as a result of the scheme is</td>
</tr>
<tr>
<td></td>
<td>Local levels of high deprivation and the presence of vulnerable groups for noise impacts (for example older people, pregnant women and children) suggest that</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Comment</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>considered to be high.</td>
<td>the inherent susceptibility of the population to changes in health is above or greater than the national average. Populations near the construction activities are likely to experience high levels of noise exposure.</td>
</tr>
</tbody>
</table>

**Importance**

In general, important health effects are expected, particularly as a result of construction noise impacts causing sleep disturbance. A recommendation is made to minimise construction noise effects.

---

### 8.7 Vibration disturbance

#### 8.7.1

This assessment of vibration uses the analysis in the ES and considers effects during the various stages of the project, including the construction phase; the combined construction and operational phase; and the operational phase.

#### 8.7.2

The HIA reviews the data in the ES against evidence regarding the health effects of environmental vibration (excludes occupational vibration effects).

### Pathway of potential effects

#### 8.7.3

Vibration effects may be associated with construction and operational plant, including the potential for cavern vibration effect

#### 8.7.4

Figure 8.10 illustrates ways in which health may be effected by Vibration from the proposed development
Figure 8.10: Conceptual model: vibration disturbance

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration generated from construction and operational activities may cause a disturbance. There may also be an issue of cavern vibration.</td>
<td>Vibration disturbance propagates as a pressure wave, predominantly through the ground, to surrounding receptors.</td>
<td>Local populations exposed to construction and operational vibration. This includes residents in proximity to the pump houses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People who spend extended periods in their homes, such as children, the elderly, the unemployed or people who work from home.</td>
<td>Vibration effects generally don’t propagate as far as noise effects. Exposures at levels high enough to cause a health effect are generally close to the source. Consequently exposure levels are expected to be very low.</td>
<td>Vibration disturbance effects include: annoyance and exacerbation of noise effects. Direct vibration effects (such as from extended use of hand held machinery) can cause physical damage (such levels are not anticipated).</td>
</tr>
</tbody>
</table>

Construction

8.7.5 Construction vibration effects generally decrease rapidly with increased distance from the source. Consequently the majority of vibration effects are likely to be relatively minor. The exception is where vibration sources are in close proximity to receptors (for example homes, schools, or hospitals).

8.7.6 Vibrations transmitted from construction activities to residential receptors can cause anxiety as well as annoyance, and can disturb sleep, work or leisure activities (54).
8.7.7 The sensitivity of the human body to vibration varies according to the direction and frequency of the vibration. The characteristics of vibration, for example whether it is continuous, intermittent or impulsive, can also influence its acceptability. In any neighbourhood, some individuals will be more sensitive to vibration than others.

8.7.8 Vibration can interfere with working efficiency by inducing stress, by disturbing concentration and by increasing accident risk. Effects of vibration on persons on construction sites are similar to, albeit far greater than, the effects on nearby residents.

8.7.9 Table 8.9 sets out BS 5228 vibration thresholds and their potential effects.

<table>
<thead>
<tr>
<th>Vibration Level</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14 mm.s(^{-1})</td>
<td>Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.</td>
</tr>
<tr>
<td>0.3 mm.s(^{-1})</td>
<td>Vibration might be just perceptible in residential environments.</td>
</tr>
<tr>
<td>1.0 mm.s(^{-1})</td>
<td>It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.</td>
</tr>
<tr>
<td>10 mm.s(^{-1})</td>
<td>Vibration is likely to be intolerable for any more than a very brief exposure to this level.</td>
</tr>
</tbody>
</table>

From BSI (55: p36)

8.7.10 The HIA notes that properly designed, maintained and operated construction plant should not be a major source of vibration.

8.7.11 With reference to a potential cavern vibration effect, there are two areas of evidence for health effects, both of which are contested.

8.7.12 The Pierpoint study, which relates to vibrations from wind turbines, is a limited, self selected population, which claim to have suffered from ‘wind turbine syndrome’ - a bodily response to being able to perceive the effects of vibration and noise which is at levels below the threshold of hearing, with associated ill effects (56). Although this study has been criticized for a lack of rigour, there is emerging evidence that low frequency noise may be perceived in a variety of different ways within
the hearing mechanisms (57). The Health Protection Agency (58) appear to support this finding.

8.7.13 However, complainants regarding low level ‘hum’ such as the ‘Bristol hum’ or more recently the ‘Durham hum’ have been dismissed, as the sound has not been discerned by staff from Environmental health departments.

8.7.14 Operational cavern vibration effects are not anticipated as there is limited published evidence for low level vibration health effects and the caverns are sealed.

Recommendations
8.7.15 That Halite requires that all plant be installed using best practicable means to avoid discernible vibration in adjacent residential premises. During the construction of the development the plant and equipment utilised should be selected to avoid vibration nuisance and that hours of use be limited to avoid sleep disturbance.

8.7.16 That the Local Planning Authority seek to ensure this through their Local Impact Statement, recommended planning conditions and the activities of their operational regulatory staff.

Residual effect
8.7.17 Some construction activities have the potential to cause vibration effects, such as piling and compacting.

8.7.18 The ES notes that construction of the brine pipeline may potentially exceed vibration criteria at the surrounding residential receptors (54). The majority of construction activities along the pipeline would not produce perceptible levels of vibration due to the distance from the receptors. However, some activities such as piling at the Drilling Compounds and rolling and compacting may produce levels of vibration that are potentially intrusive when construction activities are located close to residences.

8.7.19 The ES concludes that the information available is not sufficient to predict vibration impacts or to define specific construction vibration mitigation measures. The ES therefore recommends that Halite commits to developing a vibration mitigation plan during the final design stage of the Project.

8.7.20 As construction vibration effects for this project are currently unquantifiable the HIA is unable to reach a conclusion as to their potential health impact.

Conclusion
8.7.21 Table 8.10 summarises the potential residual changes in health outcomes associated with construction vibration.
Table 8.10: Vibration: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The level of change in vibration will be minor for most people, but where vibration occurs close to buildings relevant thresholds may be exceeded. The duration of effects is linked to specific activities such as piling or compacting, the duration of such activities is currently unknown, but likely to be short to medium term.</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average. The level of exposure that population is likely to experience could be high for those affected by close proximity vibration effects.</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>Recommendations are made for the appropriate selection and operation of plant to minimise vibration effects.</td>
</tr>
</tbody>
</table>

8.8 **Traffic impacts**

8.8.1 This assessment of traffic impacts uses the analysis in the ES and considers effects during the various stages of the project, including the construction phase; the combined construction and operational phase; and the operational phase.

8.8.2 The HIA reviews the data in the ES (including the ‘transport assessment’ and ‘design and access statement’) against evidence regarding the health effects of traffic impacts.
Pathway of potential effects

8.8.3 The project results in a number of road junctions experiencing increased traffic movements. Issues arise primarily during the construction phase.

8.8.4 Figure 8.11 illustrates ways in which health may be affected by traffic from the proposed development.

Figure 8.11: Conceptual model: traffic impacts

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased traffic resulting from the scheme, which affects the safety of road junctions.</td>
<td>Increased traffic movements at junctions onto public highways may reduce road safety. Appropriate junction alterations may improve road safety and reduce the risk of traffic accidents.</td>
<td>Local road users, including those using motor vehicles as well as pedestrians, horse riders and cyclists.</td>
</tr>
</tbody>
</table>

Sensitivities

- Children and younger people, as well as the elderly are at greater risk from road accidents.
- Pedestrians, horse riders and cyclists are at greater risk of injury during a traffic accident than those in motor vehicles.

Exposure

- Effects are only expected at junctions with a significant change in vehicle movements, which occur as a result of the scheme. As these junctions are subject to appropriate improvements as part of the scheme, the risks of traffic accidents are not expected to increase.

Health Effect

- Traffic accidents may result in both physical and mental trauma and, in some cases, death.
- Severance of communities and intimidation of other road users by increased HGV traffic may reduce wellbeing and physical activity.

Traffic impacts

8.8.5 While transport systems may bring benefits, they can also present a hazard to health: traffic volume and speed, the design of transport systems and the travel behaviour of individuals may all influence mental and physical health in a number of ways). The pathways which might result in detrimental health effects are likely to be:
• restrictions which may hinder journeys and limit access for some populations (eg 59, p56);
• road traffic injury (60-65);  
• emissions which cause populations to be exposed to air and noise pollution (66;67);  
• reduction in healthy physical activity such as walking and cycling (eg 68); and  
• physical severance of communities by transport routes that are difficult to cross (69;70).

8.8.6 The ES concurs with this analysis. It uses the Institute of Environmental Assessments (IEA) Guidelines (71) to show that the most discernible environmental impacts of traffic are noise, severance, pedestrian delay and intimidation.

• severance is the perceived diversion that can occur within a community when it becomes separated by significant increases in traffic levels;
• pedestrian delay depends on changes in the volume, composition or speed of traffic. It may affect the ability of people to cross roads; and
• intimidation is dependent on the volume of traffic, its heavy goods vehicle (HGV) composition, its proximity to people or the lack of protection resulting from factors such as narrow pavement widths.

8.8.7 An area of concern from previous applications was the effect development traffic could have on the junction of the A588 and Cemetery Lane. This application has addressed this previous concern by providing a new access / haul road to avoid the need for this junction to be used by construction traffic.

8.8.8 The ES notes that during the peak composite day of traffic generations during the construction phase (the day when the most HGVs and overall traffic would be generated by the Project), the Project would have a negligible and not significant impact on the majority of assessed highway links in the study area.

8.8.9 However the ES notes construction traffic may have the following impacts on specific highways a minor adverse and potentially significant effect on Back Lane, High Gate Lane and the southern section of the A588 corridor; plus a moderate adverse and significant effect on the northern section of the A588 corridor. Table 8.11 sets out the ES justification for each.

Table 8.11: ES potentially significant construction traffic impacts

<table>
<thead>
<tr>
<th>Highway</th>
<th>ES impact score</th>
<th>ES justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Lane</td>
<td>minor</td>
<td>There are not predicted to be any HGVs on this link, with the 28.1% increase in total vehicles due</td>
</tr>
<tr>
<td>Highway</td>
<td>ES impact score</td>
<td>ES justification</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Highway ES impact score</td>
<td>adverse</td>
<td>to construction workers travelling to and from work. The only receptors are five residences along this route, and there is to be no HGV traffic along this route.</td>
</tr>
<tr>
<td>High Gate Lane</td>
<td>minor adverse</td>
<td>The overall number of HGVs is predicted to increase by 107.3%, however this is just an increase of 4 HGVs a day, which amounts to an additional HGV every two and a half hours. The total traffic is expected to increase by 18.6% although given that there are only three residences along the link, it is considered unlikely that additional traffic generated by the Project would create significant community severance or cause intimidation or delay to other road users.</td>
</tr>
<tr>
<td>Southern section of the A588 corridor</td>
<td>minor adverse</td>
<td>The overall traffic increase is below the 10% significance threshold, however it is predicted that HGV movements along the route would increase by 16.2%. This section of the route would pass through Hambleton, which could possibly cause slight increased feelings of severance in the community owing to the increase in HGVs.</td>
</tr>
<tr>
<td>Northern section of the A588 corridor</td>
<td>moderate adverse</td>
<td>Whilst the overall increase in total traffic is significantly less than the 10% threshold, a 22.6% increase in HGVs is predicted. The route passes through Stalmine which has a number of receptors of moderate value which could be affected by the increase in HGVs.</td>
</tr>
</tbody>
</table>

8.8.10 The main reason for potentially significant construction traffic effects is the percentage increase in HGVs, which could cause intimidation to other road users or community severance.

8.8.11 The ES notes that during the combined construction and operational phase (years 4 to 8) and the operational phase (year 8 onwards), it is anticipated that there would be a negligible impact on the local highway network, with minimal traffic generations.

8.8.12 The ES notes that during the decommissioning phase, although the number of vehicle movements would be reduced when compared to the construction phase, the impacts would be minor adverse and potentially a significant impact.
8.8.13 The HIA notes that an issue of public concern from the consultation exercise was road safety at the junction of the new access road (built from the A588) where it crosses Back Lane (currently used by horses, walkers, cyclists and joggers).

Recommendations
8.8.14 That Halite recognises the duty to avoid any increase in traffic hazards by securing necessary improvement to road junctions used by their contractors and staff.

8.8.15 That the Highway Authority requires this through recommended planning conditions to the IPC.

Residual effect
8.8.16 The ES notes that whilst mitigation measures would seek to reduce the vehicular impacts, materials and construction workers would still need to be brought to/from site as part of the construction process and therefore impacts on the majority of highways would remain.

Construction
8.8.17 The HIA agrees that there are likely to be some residual health impacts associated with construction (and potentially decommissioning) traffic. The effects are largely due to an increase in the percentage of HGVs above relatively low baseline levels.

8.8.18 Effects are linked to perceptions of severance and intimidation rather than increased road traffic accidents. Traffic severance and intimidation may reduce levels of wellbeing and provide a disincentive to undertake physical activity.

Conclusion
8.8.19

8.8.20 Table 8.12 summarises the potential residual changes in health outcomes associated with construction traffic impacts.

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>The level of change in traffic (particularly HGVs) caused by the scheme is likely to be large for some routes (relative to baseline levels).</td>
</tr>
<tr>
<td></td>
<td>The duration of effects is likely to be medium term as it is mainly linked to establishment of surface infrastructure.</td>
</tr>
<tr>
<td></td>
<td>The magnitude of potential change in traffic impacts as a result of the scheme are considered to be moderate.</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Comment</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in traffic impacts as a result of the scheme is considered to be <strong>high</strong>. The presence of vulnerable groups for road safety (for example children and older people) suggests that the inherent susceptibility of the population to changes in health is above or greater than the national average. The level of exposure to HGV traffic that the local population is likely to experience is considered to be high as routes pass through communities.</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>Although the general population is unlikely to be adversely affected, important health effects are expected during the construction phase for some communities (for example Stalmine). A recommendation is made for appropriate road junction improvements to minimise traffic hazards.</td>
</tr>
</tbody>
</table>

8.9 **Employment market**

8.9.1 This section considers effects during the various stages of the project, including the construction phase; the combined construction and operational phase; and the operational phase.

**Pathway of potential effects**

8.9.2 The proposed project has the capacity to provide a mixture of job opportunities, from highly skilled engineers to operatives. In addition, it is possible that the increased workforce will enable further benefit to accrue through increased use of local shops and services.

8.9.3 Figure 8.12 illustrates ways in which health may be affected by employment generated by the proposed development.
The scheme requires both a construction and an operation workforce. In addition the construction process requires the manufacture of certain components and the sourcing of various materials. The scheme aims to source a significant proportion of the labour force from the local area. This will include direct employment opportunities during construction and operation, as well as indirect employment from the use of local workshops and businesses. The local labour market and local businesses.

People who are currently unemployed would receive the greatest benefits from employment opportunities including skills training. Where the workforce is drawn from local populations these individuals, as well as the wider local economy, will benefit. Such benefits are expected to be realised as the scheme is committed to sourcing a significant percentage of its labour needs locally.

Employment

8.9.4 Employment is associated with positive physical and mental health outcomes: the quality of the employment is associated with the health effect (72) for example the terms and conditions of the contract and the working conditions. Appropriate training has also been found important (73). Unemployment is associated with increased mortality rates (74;75).

8.9.5 The ES notes that:

- the unemployment rate for Wyre is significantly below the Lancashire, regional and national averages. However, disparities
exist at the ward level with employment and income deprivation levels being highest in the Fleetwood area as reflected in the Index of Multiple Deprivation 2010 results for the income and employment deprivation domains which identify some wards as having Lower Super Output Areas (LSOAs) in the 10% most deprived;
• currently the highest percentage of people are employed in administrative and secretarial occupations closely followed by 14.9% working in skilled trade occupations, which are both higher than the averages for the North West and Great Britain; and
• the potential synergies between the high rates of skilled trade occupations and the project’s construction requirements for skilled trade occupations.

8.9.6 Other than specialised personnel the project would also require skilled and semi-skilled personnel who could be sourced locally. A broad range of employment opportunities would therefore be available including project managers, site managers, engineers, technicians, landscapers, hauliers and general labourers.

8.9.7 The Project would generate approximately three hundred jobs during construction (years 0-3). The ES predicts employment effects during this period to be moderate positive on the local jobs market.

8.9.8 The Project would generate approximately eighty five jobs during the construction and operation combined phase (years 3-8). These jobs include approximately 35 operational jobs plus occasional contractor maintenance company employees and approximately fifty construction jobs (drilling). The ES predicts employment effects during this period to be minor positive on the local jobs market.

8.9.9 The Project would employ approximately thirty five permanent members of staff during the operation phase (years 8-40). The ES predicts employment effects during this period to be very minor positive on the local jobs market.

Recommendations
8.9.10 That Halite seeks to maximise the employment of local labour, where necessary investing in suitable training and education in collaboration with the Local Education Authority.

Residual effect
Construction and operation
8.9.11 A local increase in levels of mental wellbeing for people receiving employment, and their dependents, as a result of the proposed development.

8.9.12 A local reduction in levels of deprivation for those people who receive employment who have previously had a long period of unemployment. Such people, and their dependents, are likely to experience
disproportionate beneficial effects on their general wellbeing and health outcomes.

Conclusion

8.9.13 Table 8.13 summarises the potential residual changes in health outcomes associated with construction and operational employment.

<table>
<thead>
<tr>
<th><strong>Conclusion</strong></th>
<th><strong>Comment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The level of change in employment caused by the scheme is considered to be medium, as although the absolute number of jobs is relatively low, in the context of a relatively small local economy employment opportunities carry greater weight. The duration of effects is long term, reflecting both operational employment and the benefits that carry forward from shorter contracts during construction.</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average.</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>A recommendation is made that local labour markets are used.</td>
</tr>
</tbody>
</table>

8.10 **Leisure opportunities (including terrestrial and estuarine environments)**

8.10.1 This assessment of leisure opportunities considers effects during the various stages of the project, including: the construction phase; the combined construction and operational phase; and the operational phase.
8.10.2 This issue links with reductions in tranquillity discussed in the noise section (see page 93), as well as landscape and visual impacts (see page 79).

Pathway of potential effects

Figure 8.13: Conceptual model: leisure opportunities

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The disturbance of the terrestrial or estuarine environment resulting from construction or operational activities, including potential noise disturbance from solution mining plant and visual disturbance from stack plumes.</td>
<td>A high level of disturbance in its own right (separate from any ecological effects) may affect people’s decision to refrain from engaging in leisure activities on the surrounding land and estuary.</td>
<td>People who engage in terrestrial or estuarine leisure opportunities, including: walking, golf, sailing and fishing.</td>
</tr>
</tbody>
</table>

Sensitivities

People whose main source of physical activity is from terrestrial or estuarine leisure, and whose mobility or socio-economic position restricts their opportunities to seek alternatives are at greater risk of having a lasting reduction in their physical activity levels.

Exposure

Although the terrestrial and estuarine environments are large, noise and visual disturbance may affect a wide area. The level of exposures may potentially affect decision making to engage in terrestrial or estuarine leisure pursuits.

Health Effect

Terrestrial or estuarine leisure increases physical activity levels. Reduced physical activity is associated with general reductions in both physical and mental health. Participatory leisure activities may also play an important part in social wellbeing.

Leisure opportunities

8.10.3 Health and well-being are improved by having access to the natural environment (76). People who perceive easy access to safe green spaces report higher use of green space, more regular physical activity and lower risk of obesity (77): access to safe and convenient green space is likely to be an important environmental factor in public health efforts aimed to promote physical activity and reduce obesity. Physical
activity may play an important role in the management of mild-to-moderate mental health diseases, especially depression and anxiety (78).

8.10.4 The mental health needs and levels of circulatory disease of the local residents are above the national average (19). The opportunity to improve these outcomes through outdoor activities needs to be protected.

8.10.5 The Blackpool and Fleetwood Yacht Club operates from Wyre Road, Thornton-Cleveleys. Closer to the sea and on the opposite bank of the estuary is Knott End Sailing club.

8.10.6 In addition to the water-based activities, there are land based estuarine recreational activities such as cycling, walking and bird watching. The area is renowned for the wildlife, and boasts a RAMSAR site as well as several Sites of Special Scientific Interest (SSSI). The two long-distance footpaths, the Wyre Way\(^\text{12}\) and the Lancashire Coastal Way\(^\text{13}\), which border the estuary, are linked to these activities.

8.10.7 In addition to estuarine leisure, which focused on the estuary, there are activities which take place on the ‘mainland’- notably the caravan sites, (Boothfield House; Sportsman’s Caravan Park, Sunset Park, Sandy Bay, and Woodside, all of which are within a 2K zone for the proposed development); the golf clubs at Knott End, Fleetwood and Poulton le Fylde; and the angling club at Preesall\(^\text{14}\).

Recommendations
8.10.8 That Halite ensures that the current leisure opportunities are unaffected by their operations and that any effect on such opportunities is minimised during the development phase.

Residual effect
8.10.9 The HIA notes in paragraph 8.5.11 above that a large proportion of the visual impacts for the scheme relate to the Wyre Way and other footpaths. This suggests that the impact has the potential to discourage physical activity by reducing the appeal of using these routes.

8.10.10 The HIA notes in paragraph 8.6.31 that a shift in local character or reduction in local tranquillity due to operational noise impacts on the eastern bank of the River Wyre may affect decisions to undertake physical activity in that area.

8.10.11 Together these visual and noise disturbances may affect people’s decisions to undertake leisure activities within the area of visual and noise influence of the proposed development.

\(^{12}\) http://bit.ly/tmlf8Q
\(^{13}\) http://bit.ly/s8Hs1j
8.10.12 To avoid double counting the impact of visual and noise effects already discussed in their respective sections (8.5 & 8.6), this section notes that the potential for a decline in physical activity (and mental health benefits of outdoor exercise) has already been discussed. No further conclusions are offered for leisure opportunities as a separate issue.

8.11 Use of recreational amenities (including footpath closures/diversion)

8.11.1 This assessment of recreational amenities considers effects during the various stages of the project, including: the construction phase; the combined construction and operational phase; and the operational phase. The focus is on the construction phase.

Pathway of potential effects

8.11.2 The temporary closure of some footpaths and public rights-of-way will reduce the opportunities for local populations to participate in physical activity.

8.11.3 Figure 8.14 illustrates ways in which health may be affected by reduced access to recreational amenities due to the proposed development.

Figure 8.14: Conceptual model: use of recreational amenities

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure of public rights-of-way or footpaths during construction activities.</td>
<td>Closure of footpaths and rights-of-way reduces the opportunities for physical activity and exposure to green space.</td>
<td>Local populations making regular use of the footpaths and public rights-of-way, which are subject to closures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose main source of physical activity is from use of those footpaths or public rights-of-way, and whose mobility or socio-economic position restricts their opportunities to seek alternatives are at greater risk of having a lasting reduction in</td>
<td>The footpath closures are expected to be temporary, however the period of closure may extend for several years. Consequently there may be an extended reduction in physical activity for those who regularly use the</td>
<td>Green exercise (physical activity in a natural environment) provides an important contribution to both physical and mental health, including reducing susceptibility to a variety of medical</td>
</tr>
</tbody>
</table>
Recreational amenities

8.11.4 The HIA notes that no permanent footpath or public rights-of-way closures occur.

8.11.5 The HIA notes that diversion signs will be put up during temporary closures as suggested by the Ramblers Association.

8.11.6 Details of the temporary closures and diversions are as follows:

- temporary closure (24 weeks) of the access ramp and the footpath at the seawall crossing to allow for the construction of the brine outfall and the new observation platform;
- temporary closure (6 weeks) of the public footpath along the western boundary of the Fleetwood Waste Water Treatment Works to install the brine discharge pipeline;
- temporary diversion (3 years) of Footpath 61 near Cote Walls Farm to allow construction of the UGS Facility;
- temporary diversion (3 years) of Footpath 42 near Hackensall Sewage Treatment Works to allow construction of the Booster Pump Station; and
- temporary closure (3 days) of part of Bridleway BW2a near Corcas Farm for the laying of cables and ducts.

8.11.7 The HIA notes that the largest effects are likely to be from the longest periods of temporary closures/diversions, notably footpaths 61 and 42, as well as the access ramp and the footpath at the seawall crossing.

Recommendations

8.11.8 That Halite minimises any disruption to accessibility to these amenities during the construction phase.

Residual effects

Construction

8.11.9 If appropriately signposted diversions are provided there are not anticipated to be large changes in levels of use of public footpaths or rights-of-way for those people for whom the land surrounding the proposed development represents the main source (or a major component) of their leisure pursuits.
Conclusion
8.11.10 Table 8.3 summarises the potential residual changes in health outcomes associated with construction closures and diversions of footpaths and rights-of-way.

Table 8.14: Recreational amenities: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>The magnitude of potential change in access disruption as a result of the scheme is considered to be slight.</td>
</tr>
<tr>
<td></td>
<td>The level of change in available routes caused by the scheme is likely to be medium, as there are some route closures.</td>
</tr>
<tr>
<td></td>
<td>The duration of effects is linked to construction works, which will be medium term.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>In general the population response to changes in access disruption as a result of the scheme has the potential to be high.</td>
</tr>
<tr>
<td></td>
<td>Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average. Further more physical activity is an important area of health promotion for this population.</td>
</tr>
<tr>
<td></td>
<td>The level of exposure that population is likely to experience is high (as the effects relate mainly to those people who may be deterred from their current regular use of the routes).</td>
</tr>
<tr>
<td>Importance</td>
<td>As diversions are to be provided for long closure periods, important health effects are not expected as a result of footpath and right-of-way closures.</td>
</tr>
<tr>
<td></td>
<td>A recommendation is made for minimising disruption to routes as they may form an important part of the physical activity regime of local people.</td>
</tr>
</tbody>
</table>

8.12 National gas supply security
8.12.1 This assessment of national gas supply security considers effects during operational phase of the development.
Pathway of potential effects

8.12.2 The 900 million cubic metres of gas storage offered by the scheme represents an important contribution to national energy supply security. Widespread adverse health effects are likely in the event that disruption of the national gas supply affects consumers.

8.12.3 Figure 8.15 illustrates ways in which health may be affected by improvements to national gas supply security as a result of the proposed development.

Figure 8.15: Conceptual model: national gas supply

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The majority of national natural gas resources are imported into the UK. The scheme provides a significant addition to natural gas storage capacity.</td>
<td>Disruption to the natural gas supply has implications for the safety of living conditions as well as the wider economy. The scheme extends the period that the country can continue to supply consumers with natural gas if supplies are disrupted.</td>
<td>Regional and national populations, which benefit from reduced interruption of gas supply.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct or indirect domestic heating is an important use of natural gas. During cold spells the elderly are particularly vulnerable to low temperatures. People without alternatives to heat or power sources provided by natural gas are particularly vulnerable to supply disruption.</td>
<td>Whilst the national grid has a diverse portfolio of electrical power sources, gas fuelled power stations provide a significant contribution. A major natural gas supply disruption could affect both domestic and commercial gas and electricity supplies. The scheme reduces the likelihood of disruption effects reaching consumers.</td>
<td>Direct health effects may arise from inability to maintain appropriate domestic temperature ranges. There may also be food hygiene effects from an inability to refrigerate or cook food appropriately. Wider effects on general health and wellbeing may arise from disruption of employment and the national economy, in addition to operational...</td>
</tr>
</tbody>
</table>
National gas supply security
8.12.4 The government has a responsibility to ensure security of supply to the nation (79). DECC (Department of Energy and Climate Change) report on the security of supply (80) and state that security of gas supply is relatively secure until the end of the decade, as demand for gas falls across the UK. However, the move to generate electricity from gas may change that demand. Supply of that gas to homes and businesses is the responsibility of National Grid, who oversee the delivery of gas, but also oversee delivery of electricity to homes.  

8.12.5 The proposed Halite project would increase the storage capacity within the national network by an additional three days. That is to say, the gas from the proposed caverns could be pumped into the national supply system, and enable the UK to meet its demand for a further three days.

8.12.6 There is equality of access without favour to this reserve: the people who are disadvantaged by the project do not receive preferential supply in times of shortage (nor indeed of reduced price per unit delivery of gas through the national grid).

Recommendations
8.12.7 No recommendation is made.

Residual effect
Normal operation
8.12.8 An increase in storage capacity will contribute to maintaining stable fuel prices (by avoiding the necessity of buying imported natural gas when costs peak).

8.12.9 A reduced risk of widespread declines in physical health and mental wellbeing from loss of heating and power to homes, industry or essential services (during a national energy shortage). [Including both direct health effects and indirect effects, for example via impacts to the economy].

Conclusion
8.12.10 Table 8.3 summarises the potential residual changes in health outcomes associated with improving national gas supply security.

http://www.nationalgrid.com/uk/Gas/Pipelines
Table 8.15: National gas supply security: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in resilience to energy shortage as a result of the scheme is considered to be large. The level of change in national natural gas storage is relatively large (20% increase). The duration of effects is long term (i.e. the increased capacity will remain for as long as the integrity of the caverns remains intact).</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in national energy supply security as a result of the scheme is considered to be high. Those with the highest levels of vulnerability (for example older people) or high levels of deprivation are most likely to benefit from forestalling energy and heating losses in the event of a national energy shortage. Nationally such susceptible groups would accrue important benefits from reducing the risk of energy shortages.</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>Important health effects are expected as the project reduces the risk of major adverse public health effects in the event of a national energy shortage. No recommendations are made.</td>
</tr>
</tbody>
</table>

8.13  **Tourism**

8.13.1 This assessment of tourism impacts considers effects during the various stages of the project, including: the construction phase; the combined construction and operational phase; and the operational phase.

Pathway of potential effects

8.13.2 The area where actual risks arise due to gas storage provides a very small contribution to local tourism. However a wider area may experience a decline in tourism and investment in tourism due to fears of emergency scenarios, which are not consistent with risks reported by the project’s Risk Assessment Report. Tourists’ decisions may be sensitive to publicised local issues.

8.13.3 Figure 8.16 illustrates ways in which health may be affected by reductions in tourism associated with the proposed development.
Figure 8.16: Conceptual model: tourism

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptions of risks associated with underground gas storage.</td>
<td>Fear of emergency scenarios associated with gas storage may affect the decision making of tourists or investors in tourism. A decline in tourism would adversely affect the local economy.</td>
<td>Local populations whose livelihood is dependent directly or indirectly on tourism.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with high levels of deprivation who are stakeholders in businesses whose main source of income is based on tourism are more likely to be affected.</td>
<td>The potential for adverse publicity around disproportionate risk issues to affect tourism is likely to correlate with both the level of concern and how widely such concern is reported.</td>
<td>A decline in the economic contribution of tourism to the local economy may reduce standards of living for those whose income is derived from tourism. There may also be a general slowdown in the local economy with implications for employment and local revenues for local investment. Such declines may reduce physical and mental health outcomes.</td>
</tr>
</tbody>
</table>

**Tourism**

8.13.4 Tourism is an important component of the Lancashire economy and the proximity of Wyre Borough to Blackpool has benefitted the borough’s tourism numbers. In 2008 the total revenue generated by tourism for Wyre Borough was £242 million, reducing slightly from £243 million in 2007. However, the number of tourist days for the borough increased between 2007 and 2008 by 9%. Tourists are attracted to Wyre Borough as it offers a variety of attractions including Cobble Hey Farm and Gardens, The Jungle Queen, Old Holley Farm,

8.13.5 Tourist facilities identified by the ES within 500m of the development’s construction and operational activities include:

- Fleetwood beach;
- Cala Gran Holiday Park and Broadwater Caravan Park, both located off Fleetwood Road;
- Flints Caravan Park and Kneps Farm Caravan Park, both located off River Road;
- Stalmine Hall Park Residential Caravan Site and Woodside Country Park;
- Residential Caravan Site situated to the north of Stalmine (residential sites);
- Midwood Caravan Park located off Head Dyke Lane;
- Sportsmans Caravan Site located on The Heads; and
- Bridge House Marina and Caravan Park located off Nateby Crossing.

8.13.6 The ES draws a parallel with Ryedale Gas Project (81). A tourism impact assessment was carried out on this proposed project. This found that:

‘providing sufficient screening is provided around the gas processing facility the Ryedale Gas Project is unlikely to have an impact on tourism’.

8.13.7 The ES concludes that impacts to tourism are likely to be negligible, providing mitigation measures are implemented (as outlined in Chapter 14: Seascape, Landscape, townscape and Visual Amenity): the majority of the Project is likely to be underground and there will be a relatively small amount of infrastructure above ground.

8.13.8 The HIA agrees with the ES that the potential direct impacts from tourists’ experience of the proposed development are likely to be negligible. The HIA notes that there may also be impacts on tourism from adverse publicity based on local perceptions and fears about the proposed development.

Recommendations
8.13.9 That Halite continues to liaise with community groups to maintain an open and informative approach to their undertaking and to respond rapidly to expressed fears and any adverse publicity.

Residual effect
8.13.10 A potential for a decrease in levels of tourism, with associated loss of income for the local economy from tourism revenues. The extent of this change is not known but it is expected to be small. These changes are
considered unlikely to affect physical health or mental wellbeing outcomes.

**Conclusion**

8.13.11 Table 8.16 summarises the potential residual changes in health outcomes associated with impacts on tourism.

### Table 8.16: Tourism: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in tourism as a result of the scheme is considered to be <strong>neutral</strong>.</td>
</tr>
<tr>
<td></td>
<td>The level of change in tourism caused by the scheme is likely to be small.</td>
</tr>
<tr>
<td></td>
<td>The duration of any effect on tourism is likely to be medium term (adverse publicity effects may persist locally, but are unlikely to result in widespread lasting changes in perceptions about the area).</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in tourism as a result of the scheme is considered to be <strong>low</strong>.</td>
</tr>
<tr>
<td></td>
<td>Local levels of deprivation are high. This suggests that effects on the local economy from reduced tourism revenues would have disproportionate effects on health outcomes.</td>
</tr>
<tr>
<td></td>
<td>The level of exposure to adverse economic effects is likely to be low, as the proportion of tourists who are expected to change their behaviour as a result of the proposed development is small (the proportion is not quantified).</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>In general, important health effects are not expected: only minor changes in tourism are expected to result from the proposed development.</td>
</tr>
<tr>
<td></td>
<td>A recommendation is made for continued community liaison to address any fears or adverse publicity.</td>
</tr>
</tbody>
</table>

### 8.14 Safety fears

8.14.1 This assessment of safety fears considers effects during the operational phase of the development.
Pathway of potential effects

8.14.2 Where the local population holds fears of emergency scenarios that are not consistent with risks reported by the project’s Risk Assessment Report this may give rise to stress, anxiety or depression.

8.14.3 Figure 8.17 illustrates ways in which health may be affected by safety fears about the proposed development.

**Figure 8.17: Conceptual model: safety fears**

<table>
<thead>
<tr>
<th>Source</th>
<th>Pathway</th>
<th>Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptions of risks associated with underground gas storage may be out of proportion to actual risks, as assessed by the project's Risk Assessment Report.</td>
<td>Fear of emergency scenarios associated with underground gas storage may directly cause a decline in mental wellbeing.</td>
<td>Local populations which believe that the scheme endangers people or property to which they have a particular attachment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivities</th>
<th>Exposure</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with high levels of deprivation or with existing mental health conditions are more likely to be sensitive to issues that could affect mental wellbeing.</td>
<td>As the project provides information in an appropriate level of detail; a comprehensible format; and uses accessible dissemination techniques, it is expected that perceptions of risk will be largely based on informed decision making. Levels of fear due to disproportionate risk perception are therefore likely to be low.</td>
<td>Concern about the scheme, whether founded or not, may lead to stress, anxiety and depression. Such mental health effects may also exacerbate existing physical or mental health conditions.</td>
</tr>
</tbody>
</table>

**Safety fears**

8.14.4 Halite has set-up a Community Liaison Panel (CLP), which operates independently and provides a forum for issues relating to the Proposed
Development to be raised and discussed. The CLP includes local elected officials.

8.14.5 Halite has also undertaken a public consultation process to both listen to people’s concerns and to provide information about the Proposed Development, so that people can better understand the issues and relative risks.

8.14.6 Fear and uncertainty were a recurring theme in the consultation and formed the basis for many of the objections to the proposal. Such fear and uncertainty can be considered a direct health effect of the UGS proposal: fear of an environmental hazard, itself, may give rise to anxiety attacks and these may manifest as headaches, hypertension, and other low grade illnesses (6).

8.14.7 A key document that has informed the public consultation is the setting out the mitigation for the main risks and potentially adverse effects of the UGS proposal, this has not dispelled all fears associated with the proposed project.

8.14.8 The reality of risk and public perception of risk are often at odds with each other. There are many factors, which influence public perception, such as experience of previous exposure to a risk factor; publicity (either positive or negative); or collective information. The way in which this affects people’s health has been the subject of several studies in the North West (5;6). The fear is associated with low grade illnesses (for example headaches or hypertension) and can be exacerbated when there is uncertainty associated with a risk. This is a possibility for the current planning application from Halite, as there have been several previous planning applications from other companies for a similar development.

**Recommendations**

8.14.9 That Halite be open about their liaison with safety regulators and emergency planners and provide public information bulletins about safety audits and exercises as they occur.

**Residual effects**

*Fear of emergency scenarios*

8.14.10 The information provided by Halite will provide reassurance and allay fears over the safety of the proposed development (for example that their homes are not located within the zone where there is a risk of major adverse effects in the event of an emergency scenario – see Figure 8.6). This is noted in the consultation responses and in the interview with a member of the Community Liaison Panel.

8.14.11 The same consultation responses and CLP interview also note that the project information does not satisfy everyone and that people continue to express concerns and fears about, and resistance towards, the proposed development. These people may experience stress, anxiety or depression.
Conclusion

8.14.12 Table 8.17 summarises the potential residual changes in health outcomes associated with fear of emergency scenarios associated with the proposed development.

8.14.13 This is a complex issue upon which to conclude as it relies upon a subjective judgement of people’s understanding of risk and their relationship to the proposed development.
**Table 8.17: Safety fears: assessment of potential effect**

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in perceptions of safety as a result of the scheme is considered to be moderate.</td>
</tr>
<tr>
<td></td>
<td>The level of change in perceived safety due to the scheme is large relative to the baseline.</td>
</tr>
<tr>
<td></td>
<td>The duration of effects (e.g., stress, anxiety or depression) attributable to the project is likely to be medium term. People who are opposed to the project on safety grounds are not expected to change their viewpoint, but there will be a degree of acclimatisation. Fears about safety will become less of a source of stress, anxiety or depression.</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>In general the population response to changes in perceptions of safety as a result of the scheme is considered to be moderate.</td>
</tr>
<tr>
<td></td>
<td>Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average.</td>
</tr>
<tr>
<td></td>
<td>The level of exposure is likely to be moderate (reflecting that whilst there are some features of the operational plant that will act as a reminder to people with concerns over its safety, the generally low levels of visible activity associated with the operational plant will mean few people are likely to receive the regular prompts that sustain adverse views strong enough for ongoing adverse health outcomes).</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>Although likely to be limited to a relatively small proportion of the population, important health effects may arise purely on the basis of perceived fears about the safety of the proposed development.</td>
</tr>
<tr>
<td></td>
<td>A recommendation is made for ongoing safety information updates to the community.</td>
</tr>
</tbody>
</table>
8.15 **Stakeholder engagement**

8.15.1 This assessment of stakeholder engagement considers effects of the consultation exercises linked to this application.

**Pathway of potential effects**

8.15.2 Social capital is a component of population health and community wellbeing. Social capital is defined in terms of trust, social norms and networks (82) or in terms of the social resources available to individuals and communities (83).

8.15.3 Community engagement and involvement in decision making is important for social capital.

8.15.4 Figure 8.18 illustrates ways in which health may be affected by stakeholder engagement undertaken for the proposed development.
The scheme involves community engagement and initiatives to raise the awareness of the issues and risks associated with underground gas storage. There has been considerable dialogue concerning the scheme.

There has been considerable dialogue concerning the scheme.

Involvement in decision making is linked to positive social wellbeing outcomes and greater social capital within a community.

Local populations, which have been included in the project's public consultation. Any member of the public who has accessed the information available on the web site

Communities often have ‘hard to reach’ or ‘socially excluded’ groups. Such groups typically have high levels of deprivation and are under-represented in engagement exercises.

The public consultation and engagements with stakeholders and statutory consultees provides the public with a forum in which to express their views.

The process and the debate may contribute to social capital and thus have indirect beneficial effects on health and wellbeing.

**Stakeholder engagement**

8.15.5 Halite has undertaken an extensive consultation process for the Proposed Development. The consultation has included public engagement and a range of forums for people to voice their opinions and receive feedback. Both the positive and negative comments provided during the consultation have been recorded by Halite. These form the basis for a detailed consultation report, which will be part of the submission to the IPC.

**Recommendations**

8.15.6 No recommendation is offered as public consultation and stakeholder engagement has already been completed for the proposed development.
Residual effects

Pre-construction

8.15.7 As the majority of public consultation responses are opposed to the development, the engagement/consultation has not dispelled fears about and antipathy towards the project. Although some responses note that their understanding of the project has been improved due to the information provided by Halite, any gains in social capital are not expected to be sufficient to produce a discernable change in local population health outcomes.

Conclusion

8.15.8 Table 8.3 summarises the potential residual changes in health outcomes associated with construction and with construction and operation.
Table 8.18: Stakeholder engagement: assessment of potential effect

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>The magnitude of potential change in social capital as a result of the scheme is considered to be <strong>neutral</strong>. The level of change in social capital caused by the scheme is likely to be small (there has been strong community involvement in the application, including vocal opposition to the development). The duration of any effect is likely to be medium term (it is not known whether any social capital benefits will persist into the long term).</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>The population response to changes in social capital as a result of the scheme had the potential to be <strong>high</strong>. Local levels of high deprivation suggest that the inherent susceptibility of the population to changes in health is above or greater than the national average. The level of exposure to engagement was high (as there has been extensive public consultation).</td>
</tr>
<tr>
<td><strong>Importance</strong></td>
<td>Important health effects are not expected as a result of stakeholder engagement for the proposed development. No recommendations are required.</td>
</tr>
</tbody>
</table>
9 Recommendations

9.1.1 Table 9.1 summarises the recommendations presented in the results section. The HIA’s conclusions assume that these recommendations are adopted in full.

Table 9.1: Table of recommendations

<table>
<thead>
<tr>
<th>Issue</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant &amp; vehicle emissions including dust and particulate matter</td>
<td>That Halite ensures that its contractors adopt best practicable means to minimise emissions of fugitive dusts from development operations and the storage of materials.</td>
</tr>
<tr>
<td></td>
<td>That the Local Authority monitor the development works and ensure that best practicable means are used to minimise dust emissions.</td>
</tr>
<tr>
<td>Odour nuisance</td>
<td>That Halite requires its contractors to undertake trial bores or pits to seek to identify previously tipped sites, if any, and determine best practicable means to be employed, if and when necessary, to avoid odour nuisance.</td>
</tr>
<tr>
<td></td>
<td>That the Local Authority monitor the operations and ensure that any nuisance (to occupiers of affected premises) from odour is minimised so far as is reasonably practicable.</td>
</tr>
<tr>
<td>Operational plant failure</td>
<td>That Halite demonstrates compliance with statutory requirements at all times. This provides comfort to residents by publicising the inspection reports of regulators and third party audits when undertaken.</td>
</tr>
<tr>
<td>Visual setting &amp; local character</td>
<td>That Halite seeks to minimise visual intrusion into the landscape from their development and operations by siting, screening and designing to the satisfaction of the Local Planning Authority.</td>
</tr>
<tr>
<td>Noise disturbance</td>
<td>That Halite observe the requirement to avoid sleep disturbance to occupiers of residential premises adjacent to their development and operations.</td>
</tr>
<tr>
<td>Issue</td>
<td>Recommendations</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Vibration disturbance</td>
<td>That Halite requires that all plant be installed using best practicable means to avoid discernible vibration in adjacent residential premises. During the construction of the development, the plant and equipment utilised should be selected to avoid vibration nuisance and that hours of use be limited to avoid sleep disturbance.</td>
</tr>
<tr>
<td>Traffic impacts</td>
<td>That Halite recognises the duty to avoid any increase in traffic hazards by securing necessary improvement to road junctions used by their contractors and staff.</td>
</tr>
<tr>
<td>Employment market</td>
<td>That Halite seeks to maximise the employment of local labour, where necessary investing in suitable training and education in collaboration with the Local Education Authority.</td>
</tr>
<tr>
<td>Use of estuarine and terrestrial leisure opportunities</td>
<td>That Halite ensures that the current leisure opportunities are unaffected by their operations and that any effect on such opportunities is minimised during the development phase.</td>
</tr>
<tr>
<td>Use of recreational amenities</td>
<td>That Halite minimises any disruption to accessibility to these amenities during the construction phase.</td>
</tr>
<tr>
<td>Tourism</td>
<td>That Halite continues to liaise with community groups to maintain an open and informative approach to their undertaking and to respond rapidly to expressed fears and any adverse publicity.</td>
</tr>
<tr>
<td>Perceived safety fears</td>
<td>That Halite be open about their liaison with safety regulators and emergency planners and provide public information bulletins about safety audits and exercises as they occur.</td>
</tr>
</tbody>
</table>
10 Conclusions

10.1.1 Gas Storage Facilities are associated with known hazards and risks and are subject to special statutory controls and regulatory regimes to manage and control these aspects. Clearly if these regimes fail there can be serious health implications. Human error can negate all “safety engineering controls”. People within approximately 844m of the centre of the Gas Compressor Compound (and a small extension of this area to the north-west) would be at risk of major injury or death if a major leak or an explosive event occurred. The seriousness of effects will increase with greater proximity to the source of the gas release. This puts the on-site workforce and residents at Cote Walls farm at particular risk. Other people who could be affected are people at Park Cottage farm or Park Cottage to the south east; people on the ‘Wyre Way’ or at the sewage works to the west (usually unoccupied); people on the southern end of the Knott End Golf Club to the north; people around water bodies used by the Alkali Angling Club to the east; and people working the surrounding agricultural land.

10.1.2 Although the risk of an emergency scenario is low, the fear of such a scenario is likely to have a more widespread population level effect than the actual event itself. Perceptions of safety are complex and their capacity to cause stress, anxiety or depression is not geographically limited to the actual areas of risk. It has not been possible to determine the precise extent of such fears within the surrounding population; however the responses to the public consultation provide a good indication that there are strong and widespread views on the safety of the proposed development that go beyond both levels and areas of risk identified in the project’s Quantitative Risk Assessment.

10.1.3 In terms of the wider public health, effects are limited to issues of disturbance for particular population groups and a potentially more widespread, but low level, effect on mental health from strongly held concerns about the project’s safety.

10.1.4 As with any development there are inherent construction disturbances; in this case they relate primarily to noise and fugitive dusts. Such disturbances are likely to be temporary in nature, (sub four years) relative to the lifetime of the whole project, but may cause reduced

16 This HIA uses the definition of ‘major injury’ as set out in Schedule 1 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (3). This is considered to be an appropriate definition as it specifically covers distributors, fillers, importers or suppliers of flammable gas. In the case of a gas supplier RIDDOR creates a legal duty to report any deaths or ‘major’ injuries (of either employees or the public) in connection with the gas distributed, filled, imported or supplied to the HSE and local authority.
wellbeing for residents, including sleep disturbance, particularly around the southern end of the Fleetwood Harbour. Such construction noise may also discourage people from engaging in recreational pursuits in the wider estuary and terrestrial area around the main Gas Compressor Compound site, with an adverse impact on physical activity and mental wellbeing. The health profile of the area suggests that increasing physical activity is a particular priority for the population.

10.1.5 The construction of a new site access road for the development reduces the traffic impact in the locality. Although the number of construction heavy goods vehicles (HGVs) is not large in terms of absolute numbers, it does represent an increase from background levels which may be intrusive\(^\text{17}\). Consequently other road users or communities through which construction traffic passes may experience some reduction in wellbeing and could be discouraged from activities such as walking or cycling.

10.1.6 The operational elements of the proposed development are also likely to cause some disturbance, notably noise and visual disturbance. Such disturbance will be more long lasting and although there is potential for some people to adapt to the change, it is likely that there will be some decline in wellbeing for the occupants of those residences where industrial noise or visual elements (such as flue plumes) are added to a previously agricultural setting. Similarly, such operational disturbance may reduce the tranquillity of the wider estuary (7) and thus discourage people from engaging in recreational pursuits in the area around the main Gas Compressor Compound site, with an adverse impact on physical activity and mental wellbeing.\(^\text{18}\)

10.1.7 There are positive effects, which result from the proposed development. It will be a source of much needed employment in an area, which includes some of the nation’s most deprived communities. Such employment will bring improvements in health and wellbeing for those gaining employment, as well as their dependents.

10.1.8 The development extends national energy supply security and increases resilience against energy shortages. In the event of a national energy shortage the capacity offered by the proposed development would contribute to reducing risks to public health from failures in power, heating and services (including emergency and

\(^{17}\) The Environmental Statement (ES) assessment of traffic impacts uses the term ‘intimidation’. Intimidation in this technical sense is dependent on the volume of traffic, its heavy goods vehicle (HGV) composition, its proximity to people or the lack of protection caused by factors such as narrow pavement widths.

\(^{18}\) ‘Tranquil Areas’ were defined as: ‘places which are sufficiently far away from the visual or noise intrusion of development or traffic to be considered unspoilt by urban influences’ (7).
health services). There would also be indirect health benefits from avoiding national level economic disruptions.
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