

Grangemouth Flood Protection Scheme Environmental Impact Assessment Report

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Acronyms

CEMP	Construction Environmental Management Plan
COMAH	Control of Major Accidents or Hazards
EIA	Environmental Impact Assessment
FRM	Flood Risk Management
GHG	Green House Gas
GIS	Geographical Information System
HIA	Health Impact Assessment
HSE	Health and Safety Executive
LDP	Local Development Plan
LPA	Local Planning Authority
LVIA	Landscape and Visual Impact Assessment
MICC	Major Incident Control Committee
NPF	National Planning Framework
SEPA	Scottish Environment Protection Agency
SIMD	Scottish Index of Multiple Deprivation
WIAT	Woodlands In and Around Towns

6. Population and Human Health

6.1 Introduction

This chapter of the EIA Report provides an assessment of the likely significant effects of the construction and operation of the Scheme on population and human health.

A range of primary mitigation measures was identified and incorporated into the Scheme design at an early stage to reduce potential effects as set out in Table 4.2 of Chapter 4: The Scheme. Those relevant to this population and human health chapter include:

- Setting walls and embankments back from the river where feasible to maintain footpath access along the River Carron.
- Along the length of the Scheme, locating flood walls such that as many trees as possible are retained.

A range of factors influence health which are known as health determinants. These include an individual's characteristics and lifestyle choices, as well as wider determinants of health such as the social, economic and environmental conditions in which people live. A conceptual illustration of health determinants is provided below (Figure 6.1). Wider determinants of health have a greater influence on population health than provision of medical healthcare alone (Scottish Public Health Network, 2017).

Regular and/or severe flooding may cause significant adverse effects on local communities by causing damage to residential, commercial and civic property, public spaces and infrastructure as well as human health. Living within a flood risk area can increase one's risk of mortality, injury, illness or stress and have an effect on social wellbeing (Penning-Rowsell *et al.* 2013; Scottish Executive 2007). Regular flooding can also affect livelihoods due to increased maintenance costs, insurance premiums and disruption of commercial activity, and it can have a detrimental effect on residential and commercial property values and discourage investment in flood affected areas, leading to gradual economic decline (JBA 2005).

While the development of a flood scheme has the potential to positively affect communities through providing protection against some of the above issues, the construction and operation of the Scheme can give rise to other effects (positive and negative) on the population and human health. This assessment identifies the population groups, land use resources and wider determinants of health that are likely to be affected by the Scheme, and then makes an assessment of the likely community and health effects of this.

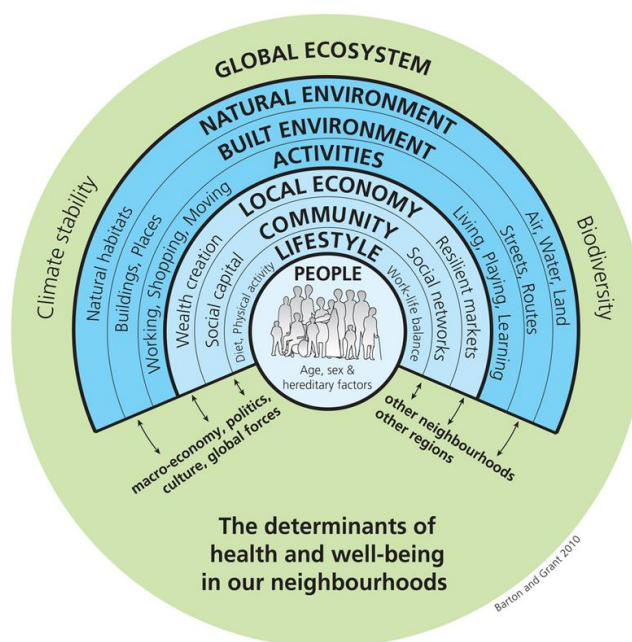


Figure 6.1: Determinants of health and wellbeing (Barton and Grant 2010, adapted from Dahlgren and Whitehead, 1991)

6.2 Policy and legislative framework

The key national legislation that is of relevance to this chapter includes the following:

- **The Public Health (Scotland) Act 2008** places a duty on each local authority to continue to make or secure that provision is made to protect public health in its area. It also places a duty on health boards and local authorities to cooperate in the exercising of their functions relating to the protection of public health and to secure and advance the health of people in Scotland.
- **The Land Reform (Scotland) Act 2003** includes provisions related to core paths, access and users. The Act establishes the statutory right of responsible access to be on land for recreational, educational and certain other purposes and a right to cross land. Access rights apply to any non-motorised activities, including walking, cycling and horse-riding and also allow access on inland water for canoeing, rowing, sailing and swimming.
- **The Planning (Scotland) Act 2019** introduces a requirement for the Scottish Ministers by way of regulations about the consideration to be given, before planning permission for a major development is granted, to the likely health effects of the proposed development. While the Scheme is confirmed under the FRM Act (see Chapter 2), the inclusion of this human health assessment reflects the policy emphasis given to the consideration of health impacts now reflected in current planning legislation.

The Open Space in the Acquisition of Land (Authorisation Procedure) (Scotland) Act 1947 sets out requirements for compensating the loss of open land in certain circumstances. It is however noted that the Scheme does not plan to exercise Compulsory Purchase Orders so the legislation is not relevant.

The Development Plan relevant to the Falkirk Council area is comprised of National Planning Framework 4 (NPF4) (The Scottish Government, 2023) and the Falkirk Local Development Plan 2 (FLDP2) (Falkirk Council, 2020b). NPF4 is the more recent publication, adopted by Scottish Ministers in February 2023.

FLDP2 was adopted by Falkirk Council in 2020. Both plans are read together, however, where there is any difference in policy content the more recent publication takes precedence, in this case NPF4.

NPF4 includes details of eighteen national developments which support the national spatial strategy of NPF4. One of these national developments is 'Industrial Green Transition Zones'. NPF4 states that these zones:

"support transformation of key sites including by putting in place the infrastructure needed to commercialise carbon capture and storage and decarbonise industry. Innovation will provide green jobs, reduce emissions and help Scotland lead the way on new technologies."

One of the Industrial Green Transition Zones is 'Grangemouth Investment Zone'. NPF4 states that the Grangemouth Investment Zone:

"currently hosts strategic and critical infrastructure, high value employment and manufacturing of materials that are currently vital for every-day life. This role will continue in the long-term but must seek to decarbonise given the significant contribution of the industrial activities to Scotland's emissions..."

Policies in NPF4 which are of key relevance to the topic of Population and Human Health are summarised below:

Policy 9 Brownfield, Vacant and Derelict Land and Empty Buildings: This policy supports the sustainable reuse of brownfield land. The policy requires that *"proposals on greenfield sites will not be supported unless the site has been allocated for development or is explicitly supported by policies in the LDP."* The policy states further that *"Where land is known or suspected to be unstable or contaminated, development proposals will demonstrate that the land is, or can be made, safe and suitable for the proposed new use."*

Policy 13 Sustainable Transport: This policy states that *"... development proposals will be supported where it can be demonstrated that the transport requirements generated have been considered in line with the sustainable travel and investment hierarchies and where appropriate they... are designed to incorporate safety measures including safe crossings for walking and wheeling and reducing the number and speed of vehicles"* and *"...Adequately mitigate any impact on local public access routes"*. One of the desired policy outcomes of Policy 13 is: *"More, better, safer and more inclusive active and sustainable travel opportunities"*. Policy 13 also advises that *"Where a development proposal will generate a significant increase in the number of person trips, a transport assessment will be required to be undertaken in accordance with the relevant guidance"*.

Policy 14 Design, Quality and Place: This policy requires that development proposals will be designed to improve the quality of an area whether in urban or rural locations and regardless of scale. Development proposals will be supported where they are consistent with the six qualities of successful places: Healthy; Pleasant; Connected; Distinctive; Sustainable; and Adaptable. Development proposals that are poorly designed, detrimental to the amenity of the surrounding area or inconsistent with the six qualities of successful places will not be supported.

Policy 15 Local Living and 20 Minute Neighbourhoods: This policy requires that *"development proposals will contribute to local living including, where relevant, 20 minute neighbourhoods. To establish this, consideration will be given to existing settlement pattern, the level and quality of interconnectivity of the proposed development with the surrounding area..."*

Policy 20 Blue and Green Infrastructure: This policy includes the requirement that: *"Development proposals that result in fragmentation or net loss of existing blue and green infrastructure will only be*

supported where it can be demonstrated that the proposal would not result in or exacerbate a deficit in blue or green infrastructure provision, and the overall integrity of the network will be maintained."

Policy 21 Play Recreation and Sport: This policy contains a range of criteria provided to meet the policy intention to encourage, promote and facilitate spaces and opportunities for play, recreation and sport.

Policy 23 Health and Safety: The Policy Intent is *"To protect people and places from environmental harm, mitigate risks arising from safety hazards and encourage, promote and facilitate development that improves health and wellbeing."*

The specific policies of the FLDP2 that are of key relevance to the Scheme and this chapter are identified as follows:

- **JE01 Business and Tourism:** *"1. The Council will promote the following Strategic Business Locations as outlined in the Spatial Strategy:*

- Falkirk Investment Zone
- Grangemouth Investment Zone
- Larbert Gateway
- Eastern Gateway

Strategic sites which form part of the Strategic Business Locations, and other local business sites within communities, (as identified in the Proposals and Opportunities Schedule) will be safeguarded for the uses specified.

2. The Council will support tourism development which supports the tourism networks, themes and nodes identified in the Spatial Strategy, is of a quality which enhances the image and tourism infrastructure of the area, and complies with other LDP policies."

- **JE02 Core Business Areas:** The policy stipulates that core business areas identified on the FLDP2 Proposals Map will be safeguarded primarily for business and industrial use.
- **JE06 Major Hazards:** This policy is relevant to the assessment of major hazard or accident risks undertaken in this chapter.
- **Policy PE01 Placemaking:** This policy requires that development proposals should address the following principles: Distinctive; Safe and pleasant; Easy to move around and beyond; Welcoming; Adaptable; and Resource Efficient.
- **Policy PE13 Green and Blue Network:** This policy is relevant to the impact the Scheme will have on green infrastructure such as landscaping, open space, habitats, active travel and sustainable water management in new development, all of which have direct and indirect, tangible and intangible effects on human health and wellbeing.

FLDP2 identifies the Central Scotland Green Network (CSGN) and associated objectives to make the Falkirk area a more attractive place to live in, do business in and visit; to help tackle climate change; to enhance biodiversity; and to promote active travel and healthy lifestyles. The CSGN is being delivered through the development of the green and blue network in FLDP2, with specific opportunities within the Scheme areas including the following:

- GN06 – River Carron Corridor Improvements
- GN09 – Zetland Park
- GN17 – Larbert Open Space Corridors

– GN19 – River Avon Corridor

Impacts upon the green and blue network are considered in this EIA Report across various chapters (see Chapter 7: Biodiversity; Chapter 9: Landscape and Visual Impacts; Chapter 12: Air Quality and Climate Change), with some consideration given to greenspaces in this chapter, insofar as the use of greenspace affects human health and wellbeing.

- **Policy PE16 Protection of Open Space:** This policy *“provides criteria for assessing potential losses of open space, and ensuring that open space of value continues to be protected or that, if there would be a loss of recreational amenity, this will be compensated by qualitative improvements to other open space in the vicinity”*. Impacts on open/greenspace are assessed in this chapter along with proposals for compensatory measures to offset losses.
- **Policy PE22 The Water Environment:** This policy *“aims to ensure that water quality, habitat/species integrity and quality, and the recreational amenity of the water environment is safeguarded”*. This chapter considers the impact the Scheme will have on the recreational amenity of the water environment.
- **Policy IR06 Active Travel:** The policy states that *“The Council will safeguard, improve and extend the network of active travel routes, with particular emphasis on the core path network...”*. The supporting text of the policy states that *“Proposals should accord with the detailed guidance on active travel routes within SG05 ‘Green Infrastructure and New Development’”*.

This policy places an onus on the Scheme design to maintain and, where possible, enhance the existing active travel network within its vicinity and make provision for future extensions thereof. Permanent access arrangements over any new walls or embankments is subject to consultation with the Council Access officer to ensure the design meets inclusive access guidelines such that no-one is excluded or discouraged from using the network. Access issues are addressed in this chapter and in Chapter 9: Landscape and Visual Impact Assessment and in Chapter 14: Traffic and Transportation.

6.3 Methodology

6.3.1 Approach

The population and human health topic was scoped in in 2018 (see EIA Scoping Report and Opinion in Appendix C3.1 and C3.2, respectively), before the availability of guidance on assessing population and human health in EIA. The scope of the assessment was informed by IEMA guidance (IEMA, 2017), SEPA guidance (SEPA 2015) and guidance on assessing health impacts (Douglas 2009). During the interim period between the scoping stage and finalisation of the EIA, guidance on undertaking health assessment in EIA has been prepared. The approach in this assessment has therefore been to retain the original scope of assessment as previously consulted on and agreed with the local authority and Marine Scotland, but to employ the following recent guidance regarding the methodology for the assessment of health effects:

- IEMA Guide to Determining Significance for Human Health in Environmental Impact Assessment (Pyper et al., 2022)
- International Association for Impact Assessment (IAIA) and European Public Health Association (EUPHA) Human Health: Ensuring a High Level of Protection. A reference paper on addressing Human Health in Environmental Impact Assessment (Cave et al., 2020).

The EIA Scoping Report (Appendix C3.1) screened out the requirement for standalone health impact assessment (HIA) and therefore the approach has been to undertake the health assessment as part of the population and human health topic fully integrated into the EIA process to meet the statutory requirements of EIA. The assessment has primarily been desk based and has been based around the following principles that are set out in IAIA guidance for assessing human health in EIA (Cave et al., 2020):

Comprehensive approach to health: *Consider physical, mental and social wellbeing and their inter-relationships.*

Proportionate: *Focus on whether the potential impacts are likely to be significant, with effort focussed on identifying and gaining commitment to avoiding or reducing any adverse effects and enhancing beneficial effects.*

Consistency: *Should be in accordance with up-to-date policy, guidance and scientific consensus.*

Equity: *The distribution of health impacts across the population should be considered, paying specific attention to vulnerable groups.*

Reasonableness: *The assessment process should follow an acceptable, explicit logic path and retain common sense in applying relevant guidance.*

6.3.2 Key Definitions

Population is defined as all individuals located in a particular geographic area. A population can be subdivided into 'communities' of people with shared characteristics. This may be all residents within a neighbourhood who share the same community facilities, or those with a shared characteristic, such as gender (e.g. men or women), age (e.g. children), or shared activity (e.g. cyclists, tourists, anglers). The term 'population health' is defined as the 'health outcomes of a group of individuals, including the distribution of such outcomes within the group' (Kindig and Stoddart, 2003). In some situations, a subgroup of the population may be more sensitive to certain types of health changes as a result of the Scheme impacts on the environment and living conditions. These are identified within the population and health assessment as 'vulnerable groups' where relevant.

Health is defined as a "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). This is a broad definition reflecting the interaction of physical, mental and social health factors.

In accordance with these principles, the following factors and any potential interrelationships were considered when determining the scope for the assessment of population and human health:

- Human Health – Risks to physical and mental health associated with the occurrence of major accidents or disasters, including flood events, during construction and operation. The extent to which the Scheme construction and operation may influence risk of disease, ill-health, injury or death as well as safety risks during construction. A disaster is taken to relate to extremes of natural occurrences, such as a major flood event or earthquake.
- Community Wellbeing - Effects on social wellbeing and quality of life in relation to construction disturbance, access to community facilities, outdoor recreation, green space, and community routes such as Core Paths and Active Travel (walking and cycling) routes.
- Local Economy – potential indirect economic impacts of the Scheme (e.g. opportunities for local employment or potential disruption to businesses during construction).

The assessment refers to health outcomes in terms of potential impacts on “mortality” (outcomes relating to deaths), “morbidity” (outcomes relating to disease or other medical conditions) and “quality of life” (“an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (WHO, 2024)). Consideration of these outcomes is relevant to the application of magnitude criteria according to the health assessment guidance used for this assessment (Table B6.2 in Appendix B6.1).

6.3.3 Baseline

The baseline health and socio-economic data for the Grangemouth area were obtained from a range of sources including online resources (Falkirk Council, Scottish Government, Visit Scotland and the Scottish Index of Multiple Deprivation (SIMD)), relevant websites and various online research papers), consultation with Council officers and stakeholder groups and feedback from public consultation events (Chapter 5: Stakeholder Engagement).

Information gathered ranged in spatial scope from areas directly affected by flood risk (e.g. to identify receptor sensitivity) to regional receptors (e.g. visitors to Grangemouth from other towns) or the national scale (e.g. in assessing regional policy aspirations or economic dependency on the continued operation of the Grangemouth refinery and associated pipelines to businesses throughout the UK).

6.3.4 Impact Assessment for Health and Community Wellbeing

The impact assessment has involved considering the sensitivity of the baseline receptors (population groups) and resources (community facilities and other physical and land use assets). The following criteria have been applied.

6.3.4.1 Sensitivity Criteria

The receptors (people) are considered in terms of their sensitivity to potential changes on health determinants from the Scheme, while the community resources (i.e. physical assets such as community facilities, green space, Core Paths and Active Travel routes) are considered in terms of their value to the people who use them. The determination of health sensitivity for the population groups likely to be affected has been guided by the IEMA Guide to Determining Significance for Human Health in Environmental Impact Assessment (Pyper et al 2022). Criteria for the valuation of community resources have been adapted from the Design Manual for Roads and Bridges LA 112 Population and Human Health standard (Transport Scotland, 2020), which contains widely applied land use and accessibility assessment criteria for EIA. The sensitivity criteria for health and community resources are set out in Table B6.1 in Appendix B6.1.

6.3.4.2 Magnitude Criteria

The determination of magnitude in the health assessment has been guided by the IEMA Guide to Determining Significance for Human Health in Environmental Impact Assessment (Pyper et al 2022), while the magnitude of impact on community resources has been adapted from the Design Manual for Roads and Bridges Population and Human Health LA 112 standard (Transport Scotland, 2020). The criteria have been adapted to align with the same terminology used in the IEMA magnitude criteria (i.e. “High” down to “Negligible”) and to be appropriate to a flood protection scheme context rather than a highway context. The criteria are set out in Table B6.2 in Appendix B6.1. The magnitude criteria involve making a judgement as to the scale of exposure of impact on the population. This has been guided by criteria in Table B6.3 in Appendix B6.1. The judgement of magnitude also requires consideration of the duration of impacts. Neither the IEMA Guide nor DMRB LA 112 provide any standard definitions for

duration of impacts. The following definitions for duration have been applied based on professional judgement and experience of similar projects:

- Very short term: Up to six months
- Short term: Six months to a year
- Medium term: One to five years
- Long term: Over five years.

6.3.4.3 Significance Criteria

The determination of significance of effects on population and human health impacts has been guided by the EIA significance matrix set out in Table 6-1. However, the determination of significance for health effects also involves further professional judgement guided by the IEMA Guide to Determining Significance for Human Health in Environmental Impact Assessment (Pyper et al 2022). The judgement requires the consideration of a range of information such as:

- Scientific literature
- Baseline conditions for the population
- Health priorities in Falkirk and Scotland
- Consultation for the Scheme
- Health policy context in Falkirk and Scotland

A narrative to support the judgement of significance for health effects is set out in the assessment. The criteria to guide the narrative description of the assessment of significance for health are set out in Table B6.4 in Appendix B6.1.

Table 6-1: General criteria for determining the significance of population and health effects (adapted from Pyper et al., 2022)

Magnitude	Sensitivity			
	High	Medium	Low	Very Low
High	Major	Major/Moderate	Moderate/Minor	Minor/Negligible
Medium	Major/Moderate	Moderate	Minor	Minor/Negligible
Low	Moderate/Minor	Minor	Minor	Negligible
Negligible	Minor/Negligible	Minor/Negligible	Negligible	Negligible

Effects are considered to be significant for EIA and decision-making purposes if they are assessed as moderate significance or above.

6.3.5 Mitigation

Primary mitigation (mitigation embedded in Scheme design) was explored at the Scheme design and options appraisal stages as described in Chapter 4: The Scheme of this EIA Report. The options appraisal considered social and economic factors as well as consultation feedback. Section 4.2.4 describes the

design evolution and how measures have been embedded into the design to reduce impacts on the local community, while Table 4-2 in that chapter sets out the embedded mitigation measures, many of which would reduce impacts on the community such as through reduced visual or access impacts.

The approach to developing the secondary mitigation presented in this chapter is informed by professional judgement and through consultation with Falkirk Council and other stakeholders at consultation workshops (refer to Chapter 5: Stakeholder Engagement). Opportunities to mitigate or offset adverse effects of the Scheme on biodiversity, landscape, population and human health were explored at existing amenity sites and vacant or derelict sites within proximity of the Scheme working areas and across other sites predominantly under Council ownership.

Tertiary mitigation is regarded as compliance with legislation, or the application of standard industry practice such as ensuring safety is prioritised and applying applicable policy at procurement. This will be reviewed at the pre-construction stage to ensure the most up-to-date legislation and best practice are being adopted by prospective contractors.

6.3.6 Assumptions and Limitations

Health data used is not available at consistent geographical levels or from the same time periods. Therefore, some data is for Intermediate Zone level, while other data are presented at Electoral Ward or Council area level. Intermediate Zones are a statistical geography created for use with the Scottish Neighbourhood Statistics (SNS) programme and the wider public sector (Spatial Data Scotland, 2021). Intermediate Zones were designed to reflect population thresholds of 2,500 - 6,000 household residents. Electoral Wards are the key building blocks of UK administrative geography. They are the spatial units used to elect local government councillors in council areas in Scotland (UK Data Service, n.d.).

The assessment of population and human health effects is mainly qualitative and based on professional judgement, referencing relevant guidance and feedback from various environmental professionals, the wider EIA team and consulted stakeholders. The effect that any project may have on mental health or wellbeing outcomes is particularly difficult to assess with any level of certainty, and reference is made to findings from literature where available and referenced accordingly. With regard to the baseline, given the generalised nature of the data, there is uncertainty as to the accuracy of the SIMD to reflect the physical or psychological health of receptors, which in turn limits the certainty of the results as assessed. While it was not considered proportionate to develop primary data to inform the assessment, consideration has been made of the feedback from local consultation events.

The impact the Scheme may have on the economy is mainly assessed at the early stages of the Scheme design as part of the economic appraisal. Again, developing primary data to identify the existing and potential future economic baseline that may be affected was considered disproportionate relative to the scale of the Scheme and resulting effects. The assessment is therefore limited to identifying some of the impacts and opportunities the Scheme construction and operation may have on local businesses and sites allocated for economic growth in the LDP, and mostly within the context of the thresholds set out in SEPA guidance (SEPA 2017).

6.4 Baseline

6.4.1 Population and Health Profile

6.4.1.1 Demographic Change

The population of Grangemouth overall has decreased by over 5% between 2011 and 2021, while during the same period the Scottish population as a whole increased by 3.4%. However, most of the wards in the study area for the Scheme (i.e. the wards within which elements of the Scheme are located) have experienced population increases. Details of population and population change in each Electoral Ward in the study area are set out in Table 6-2.

Table 6-2: Residential population of wards

Electoral Wards	Usual Resident Population by Year and Percentage Change 2011 - 2021		
Wards in Study Area	2011	2021	% Change
Bo'ness and Blackness	15,611	15,644	0.2
Carse, Kinnaird and Tryst	19,493	21,938	11.8
Bonnybridge and Larbert	16,818	17,259	2.5
Falkirk North	21,976	21,896	-0.3
Falkirk South	16,765	16,495	-1.6
Lower Braes	13,990	15,465	10
Upper Braes	15,808	16,481	4.1
Comparative Areas			
Grangemouth	17,363	15,991	-8.2
Scotland	5,295,403	5,479,900	3.4
Source:	https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population © Crown Copyright 2024		

6.4.1.2 Age Profile

Table 6-3 presents all the Intermediate Zones which intersect with the works areas for the Scheme. Age indicators are set out in the table. Of Scotland's population, 16.6% is aged over 65 years old. However, within the study area for the Scheme, the Intermediate Zones of Bo'ness – Douglas, Carron, Grangemouth – Town Centre and Polmont all have a higher-than-average proportion of people aged over 65 years, with Polmont having a notably older population with 31.07% of its residents being aged over 65 years. In contrast Polmont has a significantly lower population of children aged under 16 years old with 10.79% aged 0-15 years, compared with 16.63% for Scotland as a whole. Both Carron and Grangemouth – Town Centre also have a relatively lower proportion of children aged 0-15 years than average (see Table 6-3), while Carse and Grangemouth Old Town has the highest proportion of children aged 0-15 years in the study area at 22.01%.

6.4.1.3 Deprivation and Health Inequalities

The recent Joint Strategic Needs Assessment for Falkirk (Falkirk Health and Social Care Partnership (HSCP), 2023) shows the difference in health outcomes between different income groups in the Council area and observes that people on a lower income are more likely to experience adverse health outcomes. Results show that both male and female life expectancy is less for those living in the most deprived areas compared to those living in the least deprived - over ten years for men and eight years for women.

Over the past ten years, the death rate for 15-44 years olds in Falkirk has been increasing and while it has increased by 50% in the most deprived areas it has decreased by 40% in the least deprived areas (Falkirk HSCP 2023).

Table 6-3 provides data on each of the Intermediate Zones which intersect the Scheme works areas, together with data for Falkirk and Scotland. As can be seen, Falkirk - Bainsford and Langlees, Falkirk – Middlefield, Grangemouth – Bowhouse, Grangemouth – Kersiebank, Grangemouth – Newlands and Grangemouth - Town Centre all have higher than average levels of income deprivation. These populations are also likely to have a higher burden of disease due to the association of deprivation and poorer health. Falkirk - Bainsford and Langlees is the most deprived with 26.18% of its population income deprived, compared to the national average of 12.07%. Populations with lower than average level of income deprivation are indicated for Bo'ness – Douglas, Carron, Carse and Grangemouth Old Town, Falkirk - Merchiston and New Carron Village, High Bonnybridge and Greenhill, Larbert - South Broomage and Village, Polmont, and Stenhousemuir East. Polmont is the least deprived with 3.76% of its population income deprived.

Figure 6.2 shows the distribution of areas of multiple deprivation across the Grangemouth area.

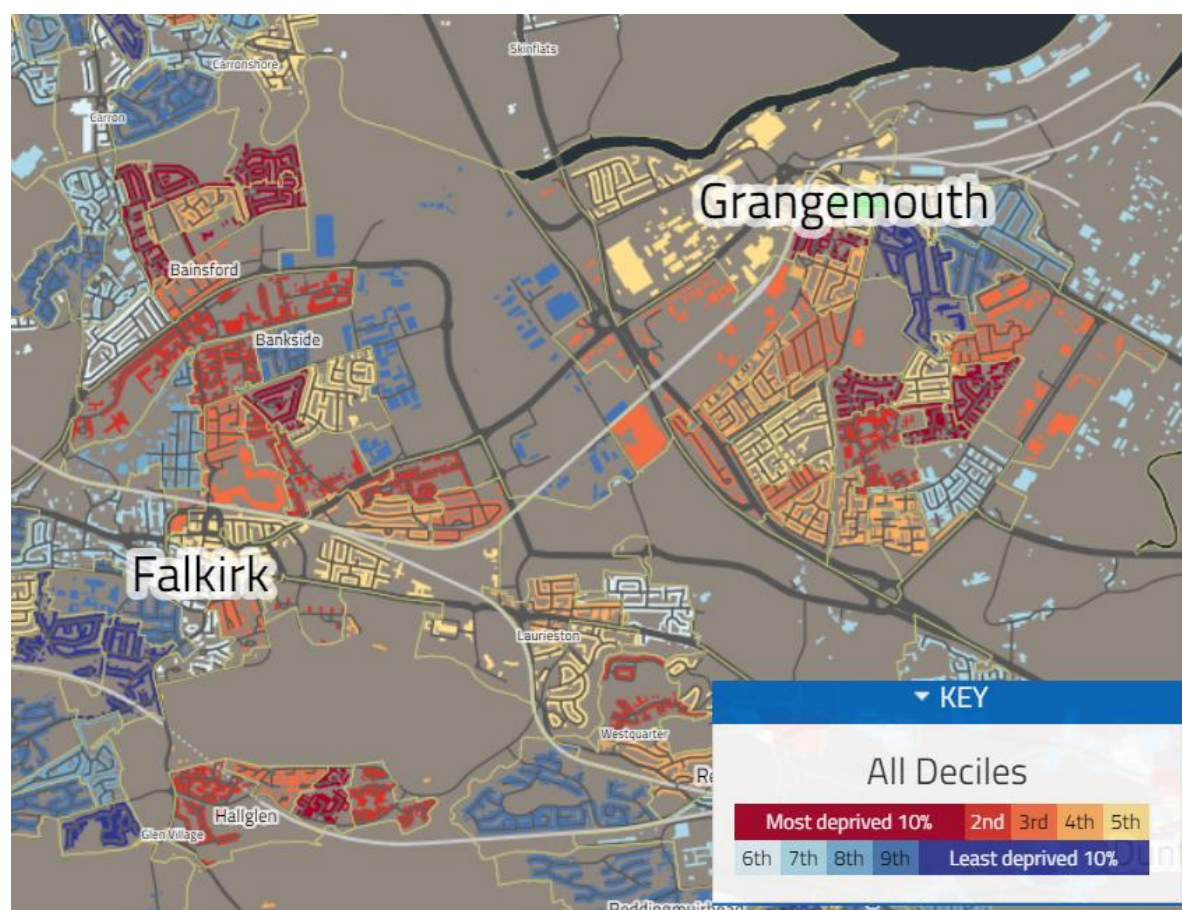


Figure 6.2: Scottish Indices of Multiple Deprivation (SIMD) 2020 Data for the Grangemouth area

6.4.1.4 Health Indicators

Health indicators presented in Table 6-3 show that Grangemouth Bowhouse scored significantly worse than average for Scotland for all causes of deaths under 75 years and worse than average in terms of

life expectancy for males. Falkirk-Bainsford and Langlees also had lower than average life expectancy for males. Falkirk - Bainsford and Langlees, Falkirk - Merchiston and New Carron Village and Grangemouth – Newlands had lower than average life expectancy for females. Bo’ness-Douglas, Polmont and Stenhousemuir East all had higher than average life expectancy for females, while Carron, Carronshore, Polmont and Stenhousemuir East had higher than average life expectancy for men. Polmont also had a significantly lower rate of deaths for all causes under 75 years with a rate of 203.96 per 100,000 compared to the average for Scotland of 449.81 per 100,000. The data indicate that Polmont has the lowest health sensitivity of population in the study area, while Grangemouth-Bowhouse has the highest health sensitivity.

The populations judged to have high, medium and low health sensitivity, based on the indicators set out in Table 6-3 and guided by criteria in Table B6.1 (Appendix B6.1) are indicated on Figure B6.1 (Appendix B6.1).

Figure 6.3 shows the general health by Electoral Wards in Falkirk. This is based on a self-assessment completed by adults in Scotland, who report general health on a five-point scale from “very good health” to very bad health”. According to the most recent data from the Scottish Health Survey, the majority of wards consider their health to be “Good or Very good”. There are however some exceptions, notably Grangemouth and Falkirk North, which have the smallest proportions of people reporting good or very good (respectively 51.4% and 58.7%). Both Electoral Wards scored below regional (68.2%) and national average (73%) for self-reported health measures. Grangemouth, also report higher level of self-assessed “bad or very bad” health.

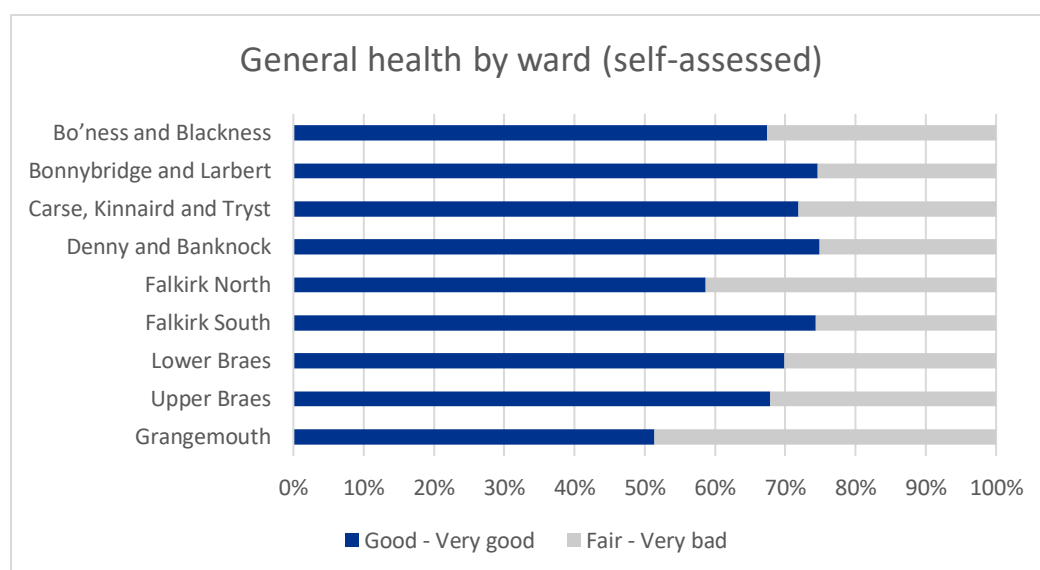


Figure 6.3: General health by ward (Source: Scottish Government Statistics (2024))

Table 6-3: Health Indicators for Intermediate Zones in Study Area

Population Health Indicators	Intermediate Zones in Study Area																Other Geographies	
	Bo'ness - Douglas	Carron	Carronshore	Carse and Grangemouth Old Town	Falkirk - Bainsford and Langlees	Falkirk - Merchiston and New Carron Village	Falkirk - Middlefield	Grangemouth Bowhouse	Grangemouth Kersiebank	Grangemouth Newlands	Grangemouth - Town Centre	High Bonnybridge and Greenhill	Larbert - South Broomage and Village	Polmont	Stenhousemuir East	Falkirk Council Area	Scotland	
Proportion of population aged over 65 years (mid-year estimate, 2021) (%)	22.83	24.08	14.81	15.3	15.94	13.64	16.88	20.14	20.24	20.19	23.78	15.47	21.7	31.07	20.49	12.48	19.6	
Proportion of population aged 0 - 15 years (mid-year estimate, 2021) (%)	16.99	11.44	17.62	22.01	18.52	18.08	18.04	17.3	16.84	16.74	13.01	18.5	16.34	10.79	15.7	17.15	16.63	
Population income deprived (2017) %	7.54	5.70	11.29	7.05	26.18	9.76	16.04	18.48	15.31	14.74	13.26	8.79	4.59	3.76	8.70	11.27	12.07	
Life expectancy, females (2020-2022 three-year aggregate) (years)	83.44	77.15	80.03	80.48	76.75	77.45	78.61	81.53	81.47	77.66	78.34	80.76	78.85	85.64	83.25	79.9	80.98	
Life expectancy, males (2020-2022 three-year aggregate) (years)	77.73	80.98	79.94	78.32	70.58	75.72	75.19	71.47	75.55	74.67	75.01	77.14	79.7	81.89	80.28	76.17	76.54	

Population Health Indicators	Intermediate Zones in Study Area															Other Geographies	
	Bo'ness - Douglas	Carron	Carronshore	Carse and Grangemouth Old Town	Falkirk - Bainsford and Langlees	Falkirk - Merchiston and New Carron Village	Falkirk - Middlefield	Grangemouth Bowhouse	Grangemouth Kersiebank	Grangemouth Newlands	Grangemouth - Town Centre	High Bonnybridge and Greenhill	Larbert - South Broomage and Village	Polmont	Stenhousemuir East	Falkirk Council Area	Scotland
Deaths all causes under 75 years (2019-2021 three-year aggregate) (standardised rate per 100,000)	37.73	37.857	38.385	407.2	673.31	624.84	686.97	748.4	512.93	572.74	531.57	461.7	367.29	203.96	363.5	461.99	449.81
Deaths from suicide (2017 to 2021 calendar years; 5-year aggregates) (standardised rate per 100,000)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15.63	14.13
Table key																	
Significantly better than average for Scotland							In line with the average for Scotland							Significantly worse than Scotland			
Source of data: Public Health Scotland (2024) Profiles Tool. Available at: https://scotland.shinyapps.io/ScotPHO_profiles_tool/																	

Figure 6.4 presents the percentage of people with long-term limiting disability in Grangemouth and other Electoral Wards in Falkirk, together with the percentage for Falkirk and Scotland, according to the Scottish Census 2011. The 2022 census data on disability by council area were not yet published at the time of preparation of the assessment and therefore it should be noted that the dataset available was rather dated. The data show that Grangemouth (35.5%) and Falkirk North (35.5%) reported the highest proportion of people with limiting physical or mental condition, which was significantly higher than the percentage for Scotland and Falkirk. In terms of type of disability, deafness or partial hearing loss, physical disability and mental health conditions were the most reported types of disabilities (Census, 2011).

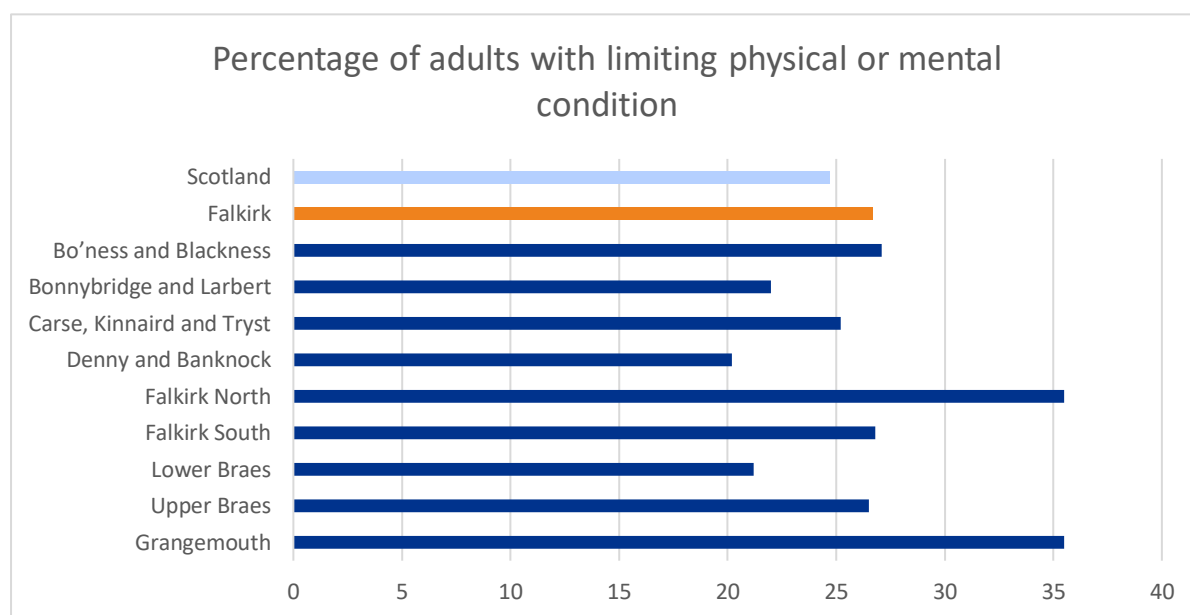


Figure 6.4: Percentage of people with a long-term limiting physical or mental condition in Grangemouth compared to other Electoral Wards in Falkirk (Statistics Government Scotland (Census data 2016-2019))

6.4.1.5 Vulnerable Groups

Vulnerable groups are defined as groups of people who are sensitive to changes in a health determinant in a given context and can include groups such as ethnic minorities, people with disabilities, people who are homeless, people living in poverty, those struggling with addiction and substance abuse, and isolated older people (Pyper et al., 2022). Vulnerable groups are identified where relevant in the impact assessment.

6.4.2 Major Accidents

According to the Control of Major Accident Hazards (COMAH), parts of the scheme are located within the vicinity of (COMAH) 'Upper Tier' establishments (Table 6-4) (Health and Safety Executive, 2015), while other areas are within the vicinity of COMAH controlled pipelines. Upper Tier establishments hold greater quantities of dangerous substances than Lower Tier establishments, meaning that additional requirements are placed on them. Owing to the predominance of facilities associated with the petrochemical industry, Grangemouth has a large number of high-pressure pipelines and facilities which, if subject to a major accident, could represent a risk to the local population. The locations of all

pipelines and various consultation zones associated with each of the sites has been established by the design team in consultation with Falkirk Council and the site operators.

Ongoing workshops have been held to identify and address constraints / risks relating to the scheme alignment (to avoid buried assets), design (e.g. type of foundation), construction (e.g. access constraints) and operation (e.g. to allow for ongoing maintenance of the wall), which have informed the detailed alignment as described and presented in Chapter 4: The Proposed Scheme.

Table 6-4: List of COMAH sites within the vicinity of the Scheme (Health and Safety Executive, 2015)

Establishment Name	Operator Name	Town	Location and distance from scheme
Grange Docks	NuStar Grangemouth Limited	Grangemouth	Located at FK3 8UD which is 40m from Working Area 3.
Grangemouth	INEOS Infrastructure (Grangemouth) Limited	Grangemouth	Adjacent to Flood Cell area 4 and located at FK3 9XH.
Grangemouth	CalaChem Limited	Grangemouth	Located on Earl's Road at FK3 8XG and between Flood Cell area 2 and 4.
Grangemouth	Calor Gas Limited	Falkirk	Located on Abbotsinch road FK3 9UX
Grangemouth	Diageo Scotland Limited	Grangemouth	Adjacent to Working Area 2 on Grange Lane FK3 8EG
Grangemouth	Flogas Britain Limited	Grangemouth	Adjacent to Working Area 3-2: West Coast of the Port at FK3 8UD
Grangemouth	Versalis UK Limited	Falkirk	FK3 9XE
Grangemouth	INEOS Chemicals Grangemouth Limited	Grangemouth	FK3 9XH
Grangemouth - Kinneil Terminal	Ineos FPS Limited	Grangemouth	FK3 9XH
Grangemouth - North Site	H W Coates Limited	Grangemouth	FK3 8UU
Grangemouth - PLPG Installation	Ineos FPS Limited	Grangemouth	FK3 9AS
Grangemouth - RLPG Installation	Ineos FPS Limited	Grangemouth	FK3 8UB
Grangemouth - South Site	H W Coates Limited	Grangemouth	FK3 8UU
Grangemouth Complex	Petroineos Manufacturing Scotland Limited	Grangemouth	FK3 9XH
Grangemouth Works	Fujifilm Imaging Colorants Limited	Grangemouth	FK3 8XG
Grangemouth Works	Syngenta Limited	Grangemouth	FK3 8XG Bottom of Form

6.4.3 Disaster Risk

A disaster is taken to relate to extremes of natural occurrences, such as a major flood event, extreme weather or earthquake. According to the British Geological Survey seismic hazard maps, Grangemouth site is in an area of very low probability of damaging earthquakes (British Geological Survey, n.d.).

Extreme weather events in the study area would typically relate to major flood events, storms and heatwaves. Flood events are outlined in Section 10.4 of Chapter 10: Water Environment. The National Severe Weather Warning Service issues weather warnings for extreme weather. A red weather warning is issued when dangerous weather is expected and it is 'very likely there will be a risk to life, with substantial disruption to travel, energy supplies and possibly widespread damage to property and infrastructure' (Met Office, n.d.(a)). The UK saw six named storms in the 2021/22 season, which included a red warning for wind for coastal areas on the east coast of Scotland, including Falkirk, for Storm Arwen (Met Office, 2022). Two named storms and no red weather warnings were issued in the 2022/23 season (Met Office, 2022). The last official heatwave in the UK was in July 2022 when a red weather warning for heat was issued for central and southern England, and when a new national record for Scotland of 34.8°C was recorded in Charterhall (Scottish Borders) (Met Office, n.d.(b)). While Falkirk is not as much at risk of extreme heat events as southern England, with climate change, the likelihood and intensity of storms and heat events is expected to continue to increase in all parts of the UK (HM Government, 2022) with various associated risks to health.

6.4.4 Flood Related Health Issues

Flood events are associated with adverse social and health impacts. In the immediate aftermath of flooding, people can suffer from injuries, infections, exposure to chemical hazards and disruption to health services. Recent research published by Public Health England (2020) concluded that there is a significant impact of flooding on mental health (e.g., stress, anxiety, post-traumatic stress disorder etc) with more adverse outcomes among those whose lives are disrupted by flooding as well as those whose homes are flooded. The study outlined some factors associated with worse outcomes which include:

- home damage
- loss of domestic utilities
- unexpected displacement

Baseline flood risk is described in Section 10.4 of Chapter 10: Water Environment.

6.4.5 Community Facilities

Community facilities include schools, healthcare facilities, indoor recreational assets, places of worship, village halls, public houses, post offices among other facilities likely to be a place of local public gathering indoors or offering local community services. Relevant community facilities identified in proximity to the Scheme are set out in Table 6-5. The locations of these facilities are indicated on Figure B6.1 (Appendix B6.1).

Table 6-5: Community Facilities and Services in Proximity to the Scheme

Community Facilities and Services	Location/Distance from Scheme	Baseline Summary
Dawson Community Church	693 Carron Rd, Falkirk FK2 7SR Grid Ref: NS 88282 82349 Within Working Area 1-2.	A family-based church that provides regular activities for the community including children.
Carronshore Community Centre	62 Main St, Carronshore, Falkirk FK2 8EY Grid Ref: NS 89200 83010 Within Working Area 1-3.	Community Centre offering playgroup and childminding, sports and youth club and services for the elderly.
Carrondale Care Home	Beaumont Drive, Carron, Falkirk FK2 8SN Grid Ref: NS 88915 82701 Within Working Area 1-3.	Nursing home that provides residential and end of life care.
Grangemouth Library	Bo'ness Road Grangemouth FK3 8AG Grid Ref: NS 92773 82049 Within Working Area 4-6.	Open to anyone who lives, works or studies within the Falkirk area.
Bo'ness Medical Practice	Park House, 29-33 Bo'ness Rd, Grangemouth FK3 8AN Grid Ref: NS 92817 82076 Within Working Area 4-6.	Medical practice for the local community.
Abbotsgrange Parish Church	7 Abbots Rd, Grangemouth FK3 8JP Grid Ref: NS 92867 81676 Within Working Area 4-5.	A family-based church that provides regular activities for the community including children.
Sacred Heart Catholic Church	1 Drummond Pl, Grangemouth FK3 9JA. Grid Ref: NS 93006 81681 Within Working Area 4-5.	A family-based church that provides regular activities for the community including children.

6.4.6 Outdoor Recreation and Green Space

Outdoor recreational and green space facilities include parks, open spaces and other features that support play, exercise and access to green space. The recent report "Assessing the value of urban green and blue spaces for health and well-being" published by WHO (2023) identified pathways through which access to green and blue spaces can reduce stress, improve mental health, encourage physical activity and promote social cohesion, contributing to overall community wellbeing. The report outlines how such spaces can lessen exposure to environmental stressors such as exposure to air pollution, heat and perceived noise. These environmental stressors are causally implicated in a range of health outcomes, ranging from neurodevelopmental effects to cancers, diabetes and cardiovascular disease (WHO 2023).

Table 6-6 identifies the key outdoor recreational spaces within proximity to the Scheme. The locations of these spaces are indicated on Figure B6.1 (Appendix B6.1). Known events that may be affected by the scheme construction period include the Grangemouth Children's Day and fair, which is held on the third Saturday of June each year in Zetland Park, with the fairground open for the preceding week.

Table 6-6: Outdoor Recreational Facilities and Green Space

Outdoor recreational facilities and green space	Location/Distance from Scheme	Baseline Summary
Falkirk Golf Club (Carmuir)	136 Stirling Rd, Camelon, Falkirk FK2 7YP Grid Ref: NS 86739 80895 Within Working Area 1-1.	Large (118 acres) 18-hole golf course open to visitors as well as its members. While it is recognised it is likely to serve many golfers in the area, there are several alternative golf courses within this wider area which golfers are likely to be able to access.
Cobblebrae Community Woodland	Falkirk FK2 7QP Grid Ref: NS 88544 82381 Approx 100m to the west of Working Area 1-2 and Approximately 180m south of Working Area 1-3.	A part of the wider Abbotshaugh Community Woodland. Easily accessible and surfaced, and mainly level with gentle gradients. Provides a home for Roe deer, foxes, buzzards, kestrels, teasels and other plants.
Burnside Park & Playing Fields	175-183 Carronshore Rd, Carron, Falkirk FK2 8EW Grid Ref: NS 88711 83022 Partially within Working Area 1-3.	An open space that includes a playpark for young children.
Bothkennar Park and Playing fields	At the end of Westerton Terrace, Langlees, Carronshore, Falkirk, Scotland, FK2 8HP Grid Ref: NS 89604 83213 Within Working Area 1-4.	An open space that includes a playpark and football goals.
Rannoch Park and Playing Facilities	Accessible opposite 1 Rannoch Rd, Grangemouth FK3 0JE Grid Ref: NS 92923 79826 Within Working Area 4-2	An open space that includes a playpark for children and young children and football goals.
Galaxy Sports - Little Kerse	Grange Rd, Polmont FK2 0YB Grid Ref: NS 93761 79833 Within Working Area 4-3, 4-4	An open space consisting of a 34 acre site focussing on football for all ages and abilities.
Zetland Park and Playing Fields	39 Abbotsgrange Rd, Grangemouth FK3 9JD Grid Ref: NS 93001 81387 Within Working Area 4-5.	An open space serving Grangemouth. Facilities at the park include bowling green, football pitches, picnic area, play areas and tennis courts.
River Avon Fishing & Angling	Extent of the River Avon from the Firth of Forth Estuary to the discharge point of the flood relief channel around Wholeflats Road. Within Working Area 5-1	An area primarily for Brown Trout fishing and angling.
Grangemouth Bowling Club	Talbot St, Grangemouth FK3 8HU	An open space for lawn bowls.

Outdoor recreational facilities and green space	Location/Distance from Scheme	Baseline Summary
	Grid Ref: NS 92893 81923 Within Working Area 4-6.	
The Rope Walk Path of Charlotte Dundas Heritage Trail	From Lock 1 viewing point at mouth of Forth and Clyde Canal to Dalgrain Road Grid Ref: NS 91669 82291 Within Working Area 2-1.	A trail located at the Kelpies Basin next to the Helix Visitor Centre that continues alongside the River Carron to Dalgrain Road via Lock 1 and the 'Rope Walk'.
Grangemouth Stags Rugby Club	Stags Rugby Club, Glensburgh Rd, Grangemouth FK3 8XL Grid Ref: NS 90998 82100 Approximately 420m to the west of Working Area 2-1.	Rugby pitches that cater for adults, juniors and younger children of school age.

In addition, woodland areas can improve the quality and setting of urban areas and provide woodland recreation opportunities near towns. They also support the delivery of several national to local policies relating to e.g. biodiversity, access, health, education and social inclusion. In connection with the Scottish Forestry Strategy's Woods In and Around Towns (WIAT) Programme, which aims to encourage greater use of urban woodlands by local people, woodland areas around the scheme footprint have been identified as WIAT priority areas (Scottish Forestry, n.d.) as shown in Figure 6.45. The whole site lies within the 1 km buffer area of a WIAT, while Flood Cells 1 and 4 lie within priority areas.

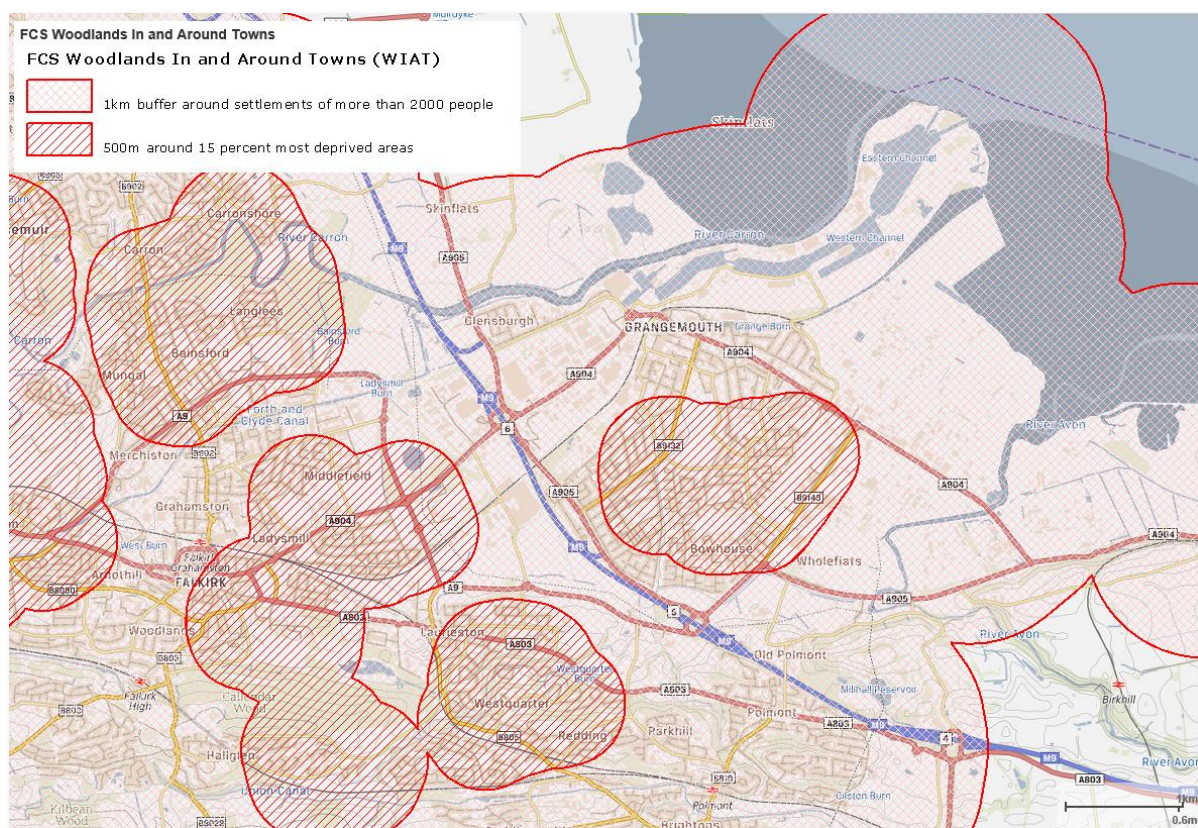


Figure 6.5: Plan showing WIAT areas within the vicinity of the Scheme (adapted from Scotland's Environment interactive map (Scotland's Environment, n.d.)

Section 6.5 considers direct impacts upon the features listed in Table 6-6, as well as indirect impacts including access to key facilities across Grangemouth, overall impacts on woodland (including amenity trees) and disturbance (e.g. noise, dust and visual disturbance), all of which can have potential intangible effects on human health and wellbeing.

6.4.7 Core Paths and Active Travel

Priority six of the Public Health Priorities for Scotland (2018) recognises the importance of enhancing and preserving walking and cycling routes to encourage physical activity. Physical inactivity is one of the leading causes of premature death in Scotland (Public Health Scotland 2022b). People who have a physically active lifestyle have a 20-35 % lower risk of cardiovascular disease, coronary heart disease and stroke compared to those who have a sedentary lifestyle (Kraus et al 2019). Regular physical activity is also associated with a reduced risk of diabetes, obesity, osteoporosis and colon/breast cancer and with improved mental health. The Scottish Government recognises physical inactivity as an important public health concern and is committed to increasing the number of active adults and children in Scotland with the aim to reduce health inequalities (Scottish Government, 2022).

The Core path and active travel baseline is described in Section 14.4.1 of Chapter 14: Traffic and Transportation, with Table 14-12 providing a summary of the Core paths.

6.4.8 Local Economy

The local economy in Grangemouth is dominated by the chemical sciences sector, which with an estimated value of approximately £1.5 billion in 2016 and an ambition to achieve up to £5.6 billion by 2020 represents Scotland's second most valuable export sector after food and drink (PBA, 2017). The INEOS plant contributes 4% of Scottish GDP and makes up approximately 8% of Scotland's manufacturing base (Ineos, n.d.; Ineos, 2023). Locally, the petrochemicals complex is the principal employer and industry in the area with approximately 1,650 employees (Ineos, n.d.).

In addition, the Port of Grangemouth (operated by Forth Ports) is the country's largest container port, making it of strategic importance to the national / regional economy and of local importance in terms of employment. Grangemouth is also within the Forth Green Freeport free trade zone that will provide support in the development of skills and employment in this area (Falkirk Council, 2023).

Some sections of the Scheme working areas are located within sites allocated for Jobs and Economy in LDP2, including:

- the Grangemouth Core Business Site (JE02), and
- allocated business sites (BUS 14-18, 23).

The Scheme also lies within Grangemouth Investment Zone, of the Industrial Green Transition Zones identified in NPF4, as discussed in Section 6.2.

With regard to opportunities the Scheme may bring to the local economy, there are a number of small to large scale construction companies based in Grangemouth as well as a broad range of accommodation and catering businesses that could benefit from the construction phase of works.

6.4.9 Future Baseline

The future baseline for the factors appraised in this chapter considers the following:

- In accordance with climate change predictions, peak river flows (i.e. worst-case flood levels) across the Forth Catchment will potentially increase by up to 40% by the year 2100, while sea levels will rise by up to 0.86 m against a 2017 baseline.
- Population: While the population of the wider Falkirk Council area is predicted to increase by approximately 8.1% and the number of households by 15.5% by 2041 from 2016 levels (Falkirk Council, 2018), the population of Grangemouth has declined in recent years (Brinkhoff, n.d.) and is predicted to continue as such due to the lack of opportunities for housebuilding within the settlement.
- Health and Wellbeing: SIMD data indicate a steady trend of increasing relative deprivation among data zones within Grangemouth (SIMD, 2020). Should this trend continue, many areas within Grangemouth will become relatively more deprived over time. The level of deprivation may be exacerbated with climate change effects as flood events become more frequent and severe.
- Local Economy: While the Grangemouth refinery complex may be subject to significant investment and projected growth (PBA, 2017), the long-term economic future of the site and wider area is uncertain. The percentage of working age population in the Falkirk Council area was 64% in 2020 (Falkirk Council, 2020c), with 4.9% of the working age population claiming benefits in July 2021 (Falkirk Council, 2021). Parts of Grangemouth are experiencing higher levels of unemployment

including Kersiebank, which recorded unemployment levels of 9.8% in 2021 (Falkirk Council, 2021; SIMD, 2020).

6.5 Impact Assessment

6.5.1 Introduction

This section includes an assessment of the impacts of the Scheme on population and health during the construction and operation phases, including an appraisal of the risks associated with major accidents or disasters, and an appraisal of potential impacts on the local economy.

6.5.2 Construction Phase

6.5.2.1 Major Accidents

Consideration was given at the Scoping stage to the potential for a major accident, resulting in a risk of significant effect on humans and the environment, which is regulated under the Control of Major Accident Hazards Regulations 2015 (COMAH) in Scotland.

SEPA and the HSE are the competent authorities tasked with overseeing and enforcing the COMAH Regulations, while the key partners that coordinate and deliver COMAH emergency procedures¹ are represented through the Major Incident Control Committee (MICC), which fulfils the requirements of the COMAH regulations for emergency plans by:

- Containing and controlling incidents to minimise the effects and to limit damage to persons, the environment and property.
- Implementing the measures necessary to protect persons and the environment from the effects of major accidents.
- Communicating the necessary information to the public, emergency services and relevant authorities.
- Assisting with the restoration and clean-up of the environment following a major accident.

It is understood that the MICC will be consulted as part of the detailed design process to discuss the potential impacts the Scheme may have on emergency procedures and how any potential impacts during drills and emergencies may be avoided or mitigated as deemed appropriate. For the purposes of this assessment, it is considered that as a result of this consultation on the Scheme design, no adverse effects of significance are envisaged in relation to procedures and any changes at the detailed design stage will be limited to those that are minor and non-material, such as the timing of works on-site and any site specific access restrictions that may be applied to contractors.

The COMAH Regulations define a major accident as *"an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment to which these Regulations apply, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances"*.

While the Scheme does not meet the hazard thresholds to fall under the remit of COMAH itself, some sections are located within the vicinity of Major Accident Hazard Pipelines under the Pipelines Safety Regulations 1996. These sites and a review of the requirement to assess potential impacts associated with them, was considered in the EIA Scoping report, which concluded that, *"assuming appropriate*

¹ Including: Site operators, Falkirk Council, Police Scotland, Scottish Fire and Rescue Service, Scottish Ambulance Service, Forth Valley NHS, Scottish Water, Health and Safety Executive, Scottish Environment Protection Agency, Scottish Gas Network, Scottish Power and The Scottish Government.

provisions are put in place by the contractor and COMAH procedures are updated accordingly, no significant effects are anticipated in relation to this risk and further assessment is scoped-out of the EIA" (Appendix C3.1: EIA Screening and Scoping Report).

A scoping consultation response was received from HSE in January 2019, which stated that:

"As the proposed Flood Protection Scheme will not lead to a material increase in the number of people within the consultation distance of a major hazard site or major hazard accident pipeline, it is not a relevant development on which to consult HSE and we have no comments to make. However, as the proposed protection measures may lie close to major accident hazard pipelines, if the applicant has not done so already, they should contact the pipeline operator(s) to ensure that the location of the pipelines are taken into account, along with any restrictions or limitations which there may be regarding developments in their vicinity."

Consultation is ongoing between the design team, Falkirk Council flood risk management and contaminated land officers and the various pipeline and facility operators to identify Scheme design and construction method constraints associated with the COMAH consultation areas in accordance with the COMAH Regulations 2015. It is also understood that the pipeline and site operators are in consultation with HSE on the same issue. Taking this into account and the HSE response to scoping, any risk of a major accident occurring in relation to the COMAH consultation zone pipelines and facilities as a result of the construction and operation of the Scheme has been assessed as having a Negligible magnitude of potential impact, resulting in an effect of **Negligible significance**.

This assessment considers the potential for the Scheme to cause or elevate the risk of a major accident occurring. The contamination risk of the Scheme is assessed in Chapter 11: Soils, Geology and Land Contamination.

6.5.2.2 Disaster Risk

It is also acknowledged that provisions of the FRM Act are such that the Scheme must ensure that flood risk is not increased during construction or operation and that temporary flood protection measures shall be put in place as required during the construction phase to ensure the risk of a flood event during construction is mitigated (Appendix C4.2: Construction Methodology Report).

The Scheme itself is not vulnerable to an earthquake, or extreme weather events such as heatwaves and storms, insomuch as it can be appropriately checked and maintained following any such event. The risk of an earthquake occurring during a flood event is considered to be very low, as is the risk of a tsunami. The risk of an earthquake occurring and affecting COMAH facilities in the refinery forms part of the refinery emergency procedures, which will be reviewed pre-construction to ensure that emergency egress / access routes and procedures are not affected by construction activities and/or alternative arrangements are put in place as required.

The magnitude of the impact on disaster risk is considered to be Negligible, resulting in an effect of **Negligible significance**.

6.5.2.3 Flood Risk

At certain locations during the construction phase, existing defences will be removed and replaced. Where a flood event occurs during this phase, there is a risk of undefended areas being flooded. Temporary flood protection measures will be implemented during construction, and the feasibility and sequencing of such measures will be explored further through detailed design and during the pre-construction phase, such that the risk of any impact is low and has a Small adverse magnitude. As the

social importance of potential receptors is High (Table B6.1 in Appendix B6.1), the significance of the resulting effect is **Moderate adverse**.

6.5.2.4 Safety

Safety risks include:

- pedestrian access near construction sites (e.g. diversions, mud, trip risks, disabled access restrictions);
- constrained pedestrian and cyclist access at crossing points;
- continued and changing traffic diversions and associated driver confusion / frustration;
- increased driver risks from regional and local movements of large plant and machinery through rural and urban areas;
- risks associated with workers and visitors accessing construction areas; and
- risks to life of construction workers working in the river environment over several months to years.

Taking account health and safety legislation and established practice in risk management, the likelihood of safety risks occurring during construction are judged to be **Moderate adverse significance**. This relates to the potential for harm, but the relatively low risk of an occurrence.

6.5.2.5 Access To/From Key Facilities

Disruption to the transport network during construction may have an effect on the capacity for vehicles and pedestrians to access key facilities such as hospitals, surgeries, schools etc. Likewise, the capacity of emergency vehicles to reach vulnerable populations may be affected.

The nearest emergency department hospital is the Forth Valley Royal Hospital which is located off the M876 on the west side of Stenhousemuir. The nearest working area to this hospital is Working Area 1 at Falkirk Golf Course some 1.6km away. No noticeable impact on emergency access to this hospital is therefore likely from the Scheme.

The impact of construction traffic on the local road network is assessed in Chapter 14: Traffic and Transportation, which concludes that impacts upon the local road network will not be significant in terms of road capacity. For the two most affected road links (A9, at St Mungo's between Rosebank Road and B906 Ronades Road, and A904 Bo'ness Road and Grangemouth Town Hall) the Traffic and Transportation assessment concludes 'negligible' for both driver delay and pedestrian delay. Sensitive community facilities by the A9 at St Mungo's areas include St Mungo's High School, St Francis Xavier's Roman Catholic Primary School and a children's playground, while sensitive facilities at Bo'ness Road include Grangemouth Town Hall and Grangemouth Library. No impact is likely on accessing these facilities based on the Traffic and Transportation assessment. Health effects are likely to relate to minor, transient inconvenience affecting a small minority of the population, meaning a Low magnitude of impact. Given that there would be schoolchildren affected, this is considered High sensitivity in terms of the vulnerable groups. However given the low magnitude of impact, and lack of severe health outcomes, the health effect is **Minor adverse significance**.

6.5.2.6 Outdoor Recreation and Access to Green Space

The Scheme construction phase will have an adverse impact upon access to and the enjoyment of some green/open spaces as listed in Table 6-6. Vulnerable groups, particularly children and the elderly, who depend on the amenity value of the local parks for their health and wellbeing may be particularly and disproportionately affected during the construction period. Zetland Park and Rannoch Park are important amenity resources, particularly for more deprived communities in the study area.

The landscape and visual impact on key recreation areas is assessed as being of Moderate and Major adverse significance during construction in Chapter 9: Landscape and Visual Impact Assessment. Major adverse visual impacts are predicted on users of Falkirk Golf course, and recreational users and visitors to Zetland Park, while Moderate adverse visual impacts are predicted on recreational users and visitors to Rannoch Park (see Table 9-12 in Chapter 9: Landscape and Visual Impact Assessment). The other affected greenspaces include riverside footpaths, where diversions will be put in place to allow users to access comparable locations further up or downstream. This would potentially cause inconvenience and localised loss of amenity for some walkers, but it is not likely to affect levels of physical exercise or outdoor recreation due to remaining provision in the wider area.

The value of the parks as a community resource is judged to be High (Table B6.1 in Appendix B6.1). The proportion of these green space resources affected is assessed as being Low magnitude (Table B6.2 in Appendix B6.1; i.e. between 6% and 15% reduction in availability of the resource). The localised visual impacts are not likely to dissuade access to, and use of the parks and golf course and therefore no impact on physical activity levels and the associated benefits to physical and mental health are anticipated. No significant impacts on other areas of green space are anticipated. There is potential for a loss of quality of life for some local residents due to the proposed tree and vegetation removal in some areas, which is likely to affect mental wellbeing and neighbourhood amenity. The impacts on trees also have the potential to limit the amount of shade available, which would be a potential health issue during warm weather, particularly heatwaves, since trees and vegetation help to provide a cooling microclimate (WHO, 2023). However, alternative areas of shade would be retained and therefore no impacts on morbidity or mortality associated with heatwaves are likely.

Given the importance of green space to health and wellbeing, the impact on health related to recreation and access to green space during construction is assessed as **Moderate adverse significance**. This relates to impacts on quality-of-life outcomes for some members of the community rather than any likely change in morbidity or mortality in the population.

6.5.2.7 Core Paths and Active Travel

Table 9-12 in Chapter 9: Landscape and Visual Impact Assessment identifies Major adverse and Moderate adverse visual impacts for users of several Core Paths. Impacts on active travel are set out in Table 14-31 of Chapter 14: Traffic and Transportation. This includes several temporary closures during the construction phase. This results in several impacts on active travel routes being assessed as Moderate adverse during construction. Given the widespread disruption to the Core Path network, together with impacts on the visual amenity, there is potential for the construction phase to discourage people from undertaking active travel journeys due to perceived inconvenience. This may affect groups of high sensitivity such as children who may be reluctant or not permitted (by parents) to use alternative routes via local roads. Disruption to regular active travel in the short-term has the potential to change lifestyle choices and encourage uptake of less active modes such as driving. The health magnitude of the impacts on Core Paths and active travel is judged to be Medium, due to the potential for moderate

changes in morbidity or quality of life. The overall significance of effect on health is assessed as **Moderate adverse significance**. This reflects the potential to discourage active travel in the short to medium term, the substantial body of evidence linking regular physical activity with improved health, the relatively widespread impacts on active travel routes and high sensitivity of some groups likely to be affected.

6.5.2.8 Disturbance and Local Amenity

The Scheme construction is likely to cause disturbance to residents and workers, which may impact upon their wellbeing and health in the vicinity of the working areas from:

- traffic congestion,
- noise and vibration (from generators, piling, heavy plant movements etc);
- dust, fumes; and
- visual / landscape impacts.

The effects of construction noise impacts have been assessed as significant (although temporary) at residential properties in Flood Cell 1 as discussed in Chapter 8: Noise and Vibration. These are also areas where dust may prevail as a result of construction activities. However, for the majority of locations these have been assessed as having a Low to Negligible risk to human health, with a Medium risk identified for Flood Cell 4 due to earthworks and construction, as discussed in Chapter 12: Air Quality and Climate.

There is limited scientific evidence on the effects to health from construction disturbance, although public consultation feedback on infrastructure projects tends to suggest widespread concern among residents around issues of noise and tree loss and consequent impacts on their mental wellbeing. Given that there are several areas of works and several communities affected, it is considered that there would be relatively high exposure to loss of amenity during construction. However, much of the disruption and loss of amenity would be reversible on completion of the works. Health effects are likely to relate to moderate changes in quality of life over the short-term. The health magnitude of impacts from disturbance and loss of amenity is judged to be Medium (Table B6.2 in Appendix B6.1). Several communities of High sensitivity would be affected, as well as vulnerable groups such as children, the elderly and people with long term health problems or disabilities, who may be more exposed to noise if they spend longer periods at home during the day.

The overall effect is judged as being of **Moderate adverse significance**. This reflects the Medium magnitude and High sensitivity of some population groups that would be exposed, but in recognition that impacts would relate mainly to quality of life and would be reversible on completion of the works.

6.5.2.9 Local Economy

Consultation is ongoing between the Council, the design team and commercial operators that may be affected by Scheme construction. It is considered unlikely that there will be a significant effect on the Grangemouth refinery and associated operations subject to agreements being entered into on access and the timing of certain phases of the works.

With regard to future development sites identified in the LDP and other strategic plans, the design team are in consultation with Falkirk Council to ensure that the Scheme does not hamper any growth potential

and any overlap of construction phases between projects will be considered at detailed design (see Chapter 15 Cumulative Effects).

It is envisaged that the Scheme will provide opportunities for local income and employment through construction and an associated marginal increase in local employment and spending within the local economy. However, the number of people anticipated to gain employment or contracts indirectly through the Scheme is considered to be Negligible with respect to the population of the town as a whole (Table B6.2 in Appendix B6.1). The impact of the Scheme on income and employment terms is therefore considered to have a positive impact of Negligible scale resulting in an effect of **Minor beneficial significance**.

The Scheme could also have an adverse effect on the local economy during construction as a result of disruption to tourism (visitors to Zetland Park), traffic, access to facilities (section 6.5.2.5), and local businesses (Stirling Road, Abbots Road). The Scheme construction will require demolition of seven privately owned buildings. These are as follows: a warehouse at Old Carron Works (Appendix A, Figure A4.2); a storage shed at a timber yard (Appendix A, Figure A4.4); a storage shed at Jarvie Plant (Appendix A, Figure A4.5); a storage shed at Forth Clyde boat yard (Appendix A, Figure A4.6); two storage sheds off North Shore Road near the Grangemouth Sea Cadets (Appendix A, Figure A4.7); and a storage building at the Petroinious refinery site (Appendix A, Figure A4.20). Furthermore, a publicly owned kiosk at Zetland Park which houses a coffee and snacks outlet (Appendix A, Figure 4.16), will also be demolished. This required demolition of some property would have localised impacts on the businesses affected, which may need to alter their operating patterns and/or replace the structures in an alternative location. Discussions with the affected landowners have taken place and there will be further engagement with them at the detailed design stage. Overall, the scale of any potential economic losses as a result of the construction phase is considered to be Negligible, resulting in an effect of **Minor adverse significance** for the local economy as a whole. It is noted however that certain businesses may suffer disproportionately and, while such potential adverse economic impacts are difficult to quantify, this will require ongoing consultation between business owners and Falkirk Council as the Scheme construction progresses.

It is envisaged that Falkirk Council will adhere to the principles set out in the Falkirk Council Procurement Strategy 2020 – 2023 (Falkirk Council, 2020a), which aims to improve economic and social wellbeing of the area by ensuring the inclusion of specific clauses within contracts known as community benefit clauses. These have been set to ensure that the wider local economic and social issues are considered when delivering certain contracts, including those for construction works.

6.5.3 Operational phase

6.5.3.1 Major Accidents

Emergency access and egress to the petrochemical plant areas shall be maintained at all times and dialogue with the petrochemical plant stakeholders will continue throughout the detailed design. As such, the Scheme operation is not anticipated to cause or have an impact on the risk associated with major accidents.

6.5.3.2 Disaster Risk

Should an earthquake or other form of natural disaster occur and defences incur damage, it is assumed they will be duly inspected and repaired before a significant flood event occurs. Given the very low

probability of a major earthquake occurring within the same period, the impact is considered to be of **Negligible significance**.

6.5.3.3 Flood Risk

A reduction in flood risk to approximately 2,760 residential properties from a major flood event (up to 1 in 200-year event) represents a positive benefit to the health of the community located within the Scheme area, including those located in more deprived locations identified in Section 6.4.1. It is expected that the improved protection against flood risk would alleviate adverse health impacts associated with major accidents (trauma, stress, reduced access to healthcare services, feeling of loss etc). Using IEMA guidance on significance, the magnitude of health impact is anticipated to be medium (large number of residents with additional protection from occasional events). The Scheme would protect people with high sensitivity to poor health outcomes, for example those with existing mental health conditions, the elderly and income deprived, who would have less capacity to cope with a major flood event and therefore who stand to benefit more in terms of health from the additional level of protection offered by the Scheme. On this basis the significance for health is **Major beneficial significance**. This is likely to mostly relate to improved mental health and wellbeing outcomes from the improved protection.

Two residential properties, a Travelling People's site and some commercial property and other land will be adversely affected by the Scheme in that they will experience some slight increases in the flood level during more extreme events (see Chapter 10: Water Environment and Appendix C10.3). This includes a community (Travellers) which is judged to be a vulnerable group on the basis of a tendency for Gypsy/Traveller communities to experience health inequalities. Gypsy/Traveller communities are associated with poorer mental health, often linked to poverty, social exclusion, stigma and hate crime. The suicide rate among the Gypsy/Traveller community in Scotland is six times higher for women and seven times higher for men compared to the general population (Public Health Scotland, 2022). With regard to how such slight changes affect tangible and intangible human health factors, the scale of the additive impact is regarded as being Low (as those properties are currently subject to flood risk), and it is anticipated that proposed mitigation of consulting with householders to explore (e.g. property level solutions will address the risk) would help to reduce mental health impacts to some extent. However, for the individuals affected by this slight exacerbation of flood risk, there is potential risks to mental health. Taking account of the high health sensitivity of Traveller communities, the effect is judged to be of **Moderate adverse significance**.

6.5.3.4 Safety Risk

The exposure to increased risk of potential injury associated with e.g. children climbing the flood wall or getting trapped by the wall on the riverside during flood events may be considered against the decreased risk of them being exposed to areas of flood water during a baseline flood event, particularly at riverside paths along the Carron or in the vicinity of the Grange Burn and flood relief channel at Zetland and Rannoch Parks respectively. Assuming standard or appropriate signage or access restrictions are put in place at key risk areas (e.g. at the beginning of sections of flood wall with limited egress along the channel-side length), the increased risk is assessed as being of Negligible scale, resulting in an impact of **Minor adverse significance**.

6.5.3.5 Access to/from Key Facilities

The Scheme will reduce the level and frequency of travel disruption and associated access to key facilities that might otherwise be affected by flood events, thereby reducing the potential for associated adverse health and wellbeing effects related to the stress of such disruptions. The Scheme will protect 23km of roads up to a 1 in 200-year event. The scale of the positive effect on population and health is assessed as Medium on the basis that a large minority of the population is expected to benefit from the improved protection of access during a flood event. This would include populations and routes of medium and high sensitivity, resulting in an impact of **Moderate positive significance**.

6.5.3.6 Outdoor Recreation and Green Space

Once constructed, the Scheme will not affect formal access to recreational areas such as footpaths or parks. The quality of the amenity spaces may be adversely affected at certain locations where extensive tree felling is required (Zetland Park and, potentially, Rannoch Park), which may have an adverse effect on wellbeing and health where receptors are disturbed by the changed views and sense of place.

The landscape and visual impact on key recreation areas is assessed in Chapter 9: Landscape and Visual Impact Assessment (Section 9.7), which concludes that effects of adverse significance are anticipated during the operation phase in Zetland Park (assessed as Major adverse significance) and Rannoch Park (assessed as Moderate significance). While such impacts are localised and focused specifically on landscape and visual receptors, this chapter assesses the likely impact in the context of recreation and wellbeing. The proportion of parkland permanently affected is assessed as being Negligible, as it will equate to <5% of the space available (Table B6.2 in Appendix B6.1), and therefore there is substantial green space remaining. In terms of health, this results in a consequent overall effect of **Minor adverse significance**.

6.5.3.7 Core Paths and Active Travel

During operation no impact is anticipated on levels of physical activity associated with active travel and use of the Core Path network. Impacts on visual amenity as reported in Chapter 9: Landscape and Visual Impacts, and impacts on routes as reported in Chapter 14: Traffic and Transportation, are not expected to dissuade walkers or cyclists to any extent likely to impact on health outcomes associated with physical activity. On this basis, the health effect is judged to be Negligible.

6.5.3.8 Local Economy

Regular flooding can have a long-term detrimental effect on property and discourage investor or property developer confidence in flood risk areas, and lead to gradual economic decline (JBA 2005). The Scheme will provide flood protection to the previously identified key investment areas identified in the baseline, which may make them more attractive to developers. The economic assessment for the Scheme has calculated a net benefit of £1834 million present value over 100 year appraisal period, from the avoidance of flood damages, net carbon benefits from avoiding flood damages and benefits from avoiding loss in economic activity due to flooding. Recognising that many other factors influence the local economy (trade policies, market trends, availability of skills and labour), the overall effect of the Scheme on local economy as a health determinant is judged to be **Minor positive significance** (Table B6.4 in Appendix B6.1).

6.5.4 Cumulative Effects

The Scheme will extend over a large area and take several years to complete (the main construction works will continue for up to 10 years and there will be several months of enabling works required), during which time there may be interdisciplinary cumulative effects, or cumulative effects where the construction of other developments coincides with the Scheme.

This chapter considers interdisciplinary effects (i.e. from noise, dust, visual, access, recreation) on human receptors.

A detailed assessment of cumulative effects is presented in Chapter 15: Cumulative Effects, where it is concluded that no cumulative effects of significance are anticipated for the Scheme.

6.6 Mitigation

6.6.1 Introduction

There is some overlap between mitigation proposed in this and other chapters (Chapter 7: Biodiversity, Chapter 9: Landscape and Visual, and Chapter 12: Air Quality and Climate), and these measures are consolidated in Chapter 16: Schedule of Environmental Commitments. The following subsections set-out the proposed mitigation to address potentially significant effects as well as non-significant effects where possible.

6.6.2 Construction

6.6.2.1.1 Major Accidents or Disasters

While effects are not assessed as being significant for these factors, the following mitigation measures (**Mitigation Item PHH1**) are included:

- MICC to be consulted at detailed design to discuss whether the Scheme construction or operation may affect emergency procedures and whether changes may be required.
- Ensuring contractor is briefed on emergency procedures and risks.
- Ensuring there are access routes to every section of the flood defences to facilitate inspection and repair following any disaster such as a significant flood event or an earthquake.

6.6.2.1.2 Flood Risk during Construction

Mitigation required to address the potential Moderate adverse effect comprises:

- Ensuring the contractor provides temporary flood protection (e.g. temporary sheet piling / dumpy bags / sandbags / boards) to all areas potentially affected by increased flood risk during construction. Where there is not enough room to erect temporary flood defences or e.g. where surface water flooding occurs on the dry side of emerging defences before the secondary drainage is complete, bespoke temporary solutions are to be developed during the detailed design and/or preconstruction phases. (**Mitigation Item PHH2**).

The anticipated effect of this mitigation, if implemented effectively, is such that the significance of the effect will be reduced to **Minor adverse**.

6.6.2.1.3 Safety

The following mitigation measures are included (**Mitigation Item PHH3**):

- Review health, safety and environmental risk at detailed design (e.g. to address risk response to flash flood events during/post construction).
- Ensure the contractor includes appropriate measures to maintain worker, driver and pedestrian safety during construction (e.g. providing suitable access diversions to avoid areas of risk).
- Ensure procurement documentation conditions adhere to best-practice and HSE guidelines relating to construction site planning and management.
- Ensure a construction and access management and phasing plan are prepared to reduce the extent of any disruption such that health and safety risks are avoided or reduced.

With these standard measures in place, the risk to worker and public safety during construction is judged to be **Minor adverse**.

6.6.2.2 Recreation, Green Space and Amenity

Effects relating to recreation and disturbance are assessed as being potentially significant and mitigation measures that will help address these, such that the significance of the effect will be reduced to **Minor adverse** comprise (**Mitigation Item PHH4**):

- Phase works that require the temporary closure or diversion of footpaths, cycle routes and areas available for recreation to limit the spatial extent of the impact on the whole network.
- Ensuring a robust traffic management plan is prepared and key facilities are informed of works periods and consulted on specific access needs or vulnerabilities.
- Ensuring all potentially disruptive works or plant movements are ceased at key locations during the one-week fair leading up to Children's Day celebrations at Zetland Park (and any other sensitive events within the vicinity of the Scheme Working Areas).
- Plant (amenity) trees or shrubs in vacant areas and existing parks within proximity of the Scheme where possible to mitigate impacts on recreation, green spaces and vegetation loss (natural heritage).
- Establish a community liaison officer for the Scheme and a construction liaison committee to ensure the smooth management of the project/public interface. It is proposed that representatives of Falkirk Council, the construction contractors, the local community, and, if appropriate, the Police form the committee. Develop a Communications Plan for targeted and regular updates to the public and key stakeholders. Display appropriate contact details.
- Ensuring contractor compliance with current regulations (Health and Safety Executive, n.d.) and measures described in Chapter 8: Noise and Vibration and Chapter 14: Traffic and Transportation.
- Ensure contractors are required to submit a Construction Environmental Management Plan (CEMP) and Code of Practice or similar to be approved by environmental officers at Falkirk Council before construction can commence. Such documentation is expected to address not only noise, but other nuisance impacts such as the timing of works, dust, mud, visual impacts, contamination risk and traffic disruption amongst others.

- Liaison with businesses to understand access needs and busy periods.
- Implementing a traffic and access management plan.
- Sign-post diversions and provide clear and accessible public information.

6.6.2.3 Local Economy

While effects are not assessed as being significant for these factors, the following mitigation measures comprise:

- Ensure contract provisions include reference to the Council's Sustainable Procurement Strategy (Falkirk Council, n.d.) (e.g. the contractor could have a target for sourcing services locally and, where feasible, providing training to local apprentices or unemployed individuals to enable them to apply for appropriately (un)skilled vacancies that arise). **(Mitigation Item PHH5)**
- Ensure potential for disruption to business activity is addressed in future project stages and in liaison with business owners and other potentially affected parties (i.e. consultation to understand concerns, and the measures to best mitigate those concerns will be included in the contractual requirements of the Contractor). **(Mitigation Item PHH6)**

6.6.3 Operation

While effects are not assessed as being significant for these factors, the following mitigation measures include **(Mitigation Item PHH7)**:

- Ensuring a robust inspection and maintenance regime is implemented and maintained over the 100-year lifespan of the Scheme.
- Ensuring access routes to every section of the flood defences are maintained and cleared of obstructions and overgrowing vegetation to facilitate inspection and repair following any disaster such as a significant flood event or an earthquake.
- Ensure emergency (evacuation) procedures and access / egress routes (outwith the refinery) are revised once the final Scheme design has been prepared and the flood warning system updated in consultation with SEPA and in accordance with the Civil Contingencies Act 2004 and COMAH Regulations.
- Ensure emergency response protocols are updated to respond effectively to flood events greater than the Scheme standard of protection (i.e. > 1 in 200-year event), such as holding emergency response and evacuation drills to maintain civil preparedness. The FRM Strategy highlights the further actions the Council will take in future including awareness raising, self-help, flood warning, emergency plans/ response etc and all these will also help to mitigate the residual risk from these exceedance events.
- Ensure means to continue the standard of protection to address climate change effects are implemented as required, driven by future Flood Risk Management strategies.
- Explore options for e.g. property level protection with landowners at continued risk of flooding.
- Undertake further investigation into surface water flood risk and apply measures accordingly.
- Ensure appropriate signage and emergency egress options are provided at key locations.

6.6.3.1 Recreation, Green Space and Amenity

Effects relating to recreation and disturbance are assessed as significant including the loss of trees / woodland across affected greenspaces, which may have significant adverse effects on the wellbeing of affected residents within particularly deprived communities. Although such intangible effects are not well understood, mitigation measures identified comprise the following:

- Ensure a Landscape and Ecological Habitat Management Plan is produced at detailed design to maximise the biodiversity, amenity and landscape potential of areas requiring reinstatement post construction. **(Mitigation Item PHH8 / LV26 / E21)**
- Ensure amenity trees are replaced in situ with appropriately sized (heavy standard) examples, with woodland areas being replaced at a 3:1 ratio in suitable locations in the vicinity of the loss or elsewhere (see further information below). **(Mitigation Item PHH9 / LV15)**
- Ensure the reinstatement of affected areas takes cognisance of future aspirations for Core Path and Active Travel Network improvements (possible partnering opportunities and funding may be sought with interested parties such as Sustrans). **(Mitigation Item PHH10)**

6.6.3.2 Local Economy

Ensuring the LDP and any relevant supplementary guidance are updated once the Scheme is constructed to reflect the new flood risk baseline may help boost the local economy, as potential investors may find sites more attractive.

6.6.4 Cumulative Effects

No additional mitigation measures targeting cumulative effects on Population and Human Health receptors are required.

6.7 Residual Effects

6.7.1 Residual effects

Residual effects of **Moderate** positive significance relate to improved psychological health and reduced disruption to utilities and access associated with flood avoidance.

All other residual effects are considered to be **Negligible** or of **Minor** significance, assuming full implementation of the proposed mitigation measures, particularly for the following:

Flood risk during construction: The **Moderate** adverse significant effect of flood risk during construction is anticipated to be reduced with mitigation to **Minor** adverse significance as a result of the provisions of the FRM Act, which puts a legal duty on the Scheme to ensure flood risk is not increased to properties either during construction or operation.

Disturbance: With effective mitigation in place, the effect of **Moderate** adverse significance can be reduced, resulting in an effect of **Minor** adverse significance, which is consistent with the effectiveness of impact mitigation described in Chapter 8: Noise and Vibration.

6.7.2 Interaction with Other Environmental Disciplines

6.7.2.1 Proposed Mitigation Measures from Other Disciplines

A review of the effects on human receptors resulting from the mitigation proposed to address potentially significant effects on other environmental disciplines has been undertaken to determine the need for further assessment of such measures on baseline receptors outlined in this chapter. It is concluded that there is no likelihood of significant effects occurring as a result of such measures being implemented.

6.7.2.2 Other Indirect (Secondary) Effects

Residual impacts of significance that have been identified in other chapters and are of relevance to this chapter include the following:

Chapter 8: Noise and vibration: Adverse residual effects of significance at various properties within close proximity to works.

The mitigation measure to ensure a CEMP is produced for use by contractors and site supervisors should incorporate bespoke measures to address noise and vibration impacts at specific receptors.

Chapter 9: Landscape and Visual Impact Assessment: Adverse residual effects of Major to Moderate significance are identified for landscape and visual impacts at certain receptors across the works area.

Mitigation measures are included to offset temporary and long-term impacts on green spaces important to amenity and wellbeing. These include the provision of advanced planting of offset vegetation, including the establishment of alternative amenity sites and planting of trees in open parkland to offset amenity greenspace and tree loss.

Chapter 10: Water Environment: Adverse residual effects of Major significance are identified for Water Environment receptors including residual flood risk.

For these areas, further consultation is required with affected parties to identify mitigation that is practical and appropriate to the level of flood risk and will be dealt with on an individual basis depending on the level of residual flood risk.

6.8 Monitoring

6.8.1 Construction Phase

Short-term adverse impacts associated with traffic, noise, dust, mud, health and safety, and disruption during the construction period will require close monitoring of compliance with contractual obligations imposed upon contractors to minimise potential impacts and ensure sensitive working and compound area phasing. Having a Supervisor appointed Environmental Clerk of Works is advised to ensure that Contractor-led mitigation is robustly delivered at the appropriate time and to ensure that, over time, the mitigation is effective.

6.8.2 Operational Phase

Falkirk Council must monitor public reaction to the Scheme both during and after construction with a view to focussing on any interim or long-term interventions that might improve the Scheme over time in relation to health, safety, recreation and amenity (e.g. suggestions on improvements to landscape, greenspace design and maintenance, footpath and cycleway provision etc).

The identified mitigation planting, as discussed in Section 6.6, should be monitored at 5-year intervals to ensure all planted trees and shrubs have successfully established and the sites are providing their intended functions. Where necessary, any planted trees that have failed to establish will be replanted.

Interest in regeneration and development sites should be monitored with any promotional information to prospective developers being updated accordingly to reflect the improved flood protection regime and enhanced local environment that has been delivered as part of the Scheme.

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