Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Environmental Statement

Volume 4

Appendix 14.1: Heath Assessment

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Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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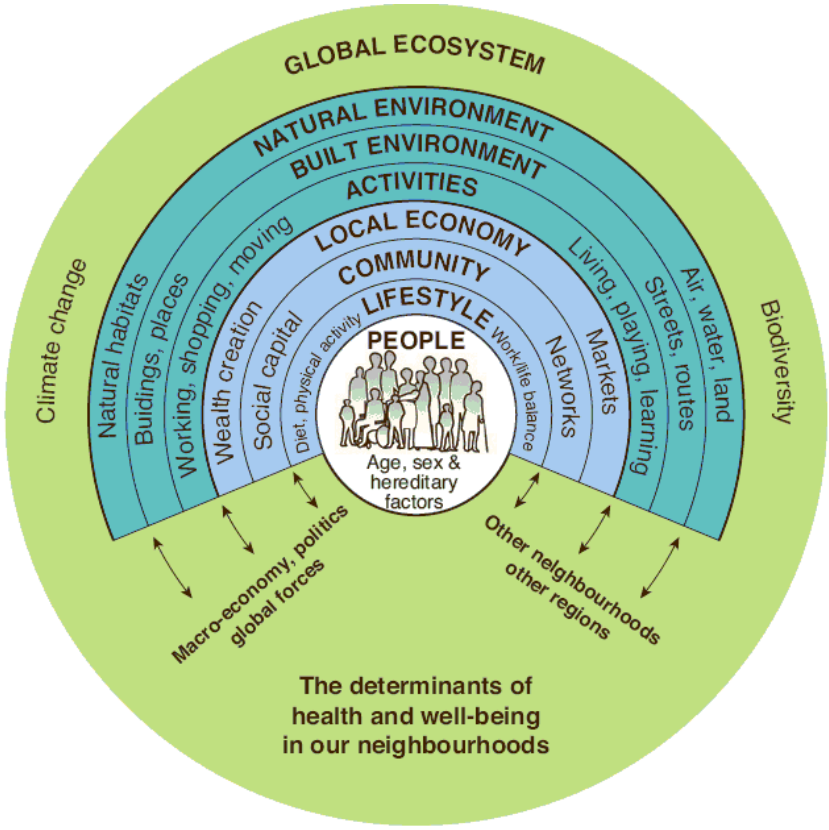
1. Health Assessment

1) This technical appendix presents an assessment of the likely significant effects of the Proposed Bowland Section on the health of the local population.

2) The World Health Organisation (WHO) (2020)[1] defines human health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'. For the purposes of this assessment, health encompasses physical and mental health and also incorporates the broader concept of wellbeing.

3) Illustration 1 shows the relationship between health and the physical, social and economic environment. People form the centre of the diagram, demonstrating societies' dependence on the wider ecosystem and built environment in which they exist. The diagram shows that there are many wider determinants of health which can be affected by changes to the physical environment.

Illustration 1 Determinants of Health[2]



4) Health effects can be direct (e.g. air pollution resulting in respiratory problems) or indirect (e.g. reduced community interaction due to increased traffic resulting in adverse effects on wellbeing). Similarly, prolonged environmental effects (direct effect) can result in changes to quality of life (indirect effects).

5) It should be recognised that the Proposed Bowland Section would make a major positive contribution to public health in its own right by helping to secure the supply of a resilient and safe drinking water supply to Cumbria, Lancashire and Greater Manchester.

[1] World Health Organisation (2020*). Basic documents: forty-ninth edition* (including amendments adopted up to 31 May 2019). Available at: https://apps.who.int/gb/bd/pdf_files/BD_49th-en.pdf Accessed: 02/02/2021

[2] Barton, H. and Grant, M (2006). A health map for the local human habitat. *The Journal for the Royal Society for the Promotion of Health*, 126 (6). pp. 252-253. Accessed 25/02/2021.

1.1 Constituent Topics

6) The health assessment reported in this technical appendix relies on the effects reported in other topic chapters of the ES to identify potential human health impacts. The relevant chapters have been referred to as the 'constituent topics' and the effects they report are termed 'health determinants'. Health determinants can be defined as the range of personal, social, economic and environmental factors that influence health status. Where effects are concluded as significant at a constituent topic level within the ES, these have been considered within the assessment as having potential for human health effects. Where effects are concluded not to be significant at a constituent topic level within the Environmental Statement (ES), these have not been considered in the health assessment.

7) The constituent topics considered in this assessment include:

- Chapter 6: Landscape and Arboriculture
- Chapter 7: Water Environment
- Chapter 8: Flood Risk
- Chapter 9: Ecology
- Chapter 10: Cultural Heritage
- Chapter 11: Soils, Geology and Land Quality
- Chapter 12: Materials and Waste
- Chapter 13: Public Access and Recreation
- Chapter 14: Communities and Health
- Chapter 15: Major Accidents
- Chapter 16: Transport Planning
- Chapter 17: Noise and Vibration
- Chapter 18: Air Quality.

8) Whilst the approach to health assessment focused on significant residual effects identified within the topic chapters set out above, non-significant effects of air quality; noise; landscape and visual; and traffic were also considered in terms of their potential to result in overall disturbance effects to community receptors.

9) A review of the evidence linking health determinants likely to arise from the Proposed Bowland section with adverse health outcomes is presented in Section 4.

1.2 Consultation

10) During the course of the environmental assessment, United Utilities has undertaken extensive consultations with regulators, non-statutory stakeholders, local communities and individual landowners and residents. Feedback from these consultations has helped to inform and shape the environmental assessment process, including scoping of the technical topics mentioned above upon which the health assessment is partly based. United Utilities will continue to engage with local interest groups and stakeholders as the planning applications progress. Subject to planning, stakeholder engagement would continue into pre-construction works liaison. Health and Wellbeing Boards will also be invited to participate in this process.

1.3 Local and National Health and Wellbeing Strategies

1.3.1 National Health and Wellbeing Strategies

11) The Public Health England Strategy (2020-2025)[3] outlines Public Health England's (PHE) key focus areas over the next five years to ensure healthy lives for everyone across England. PHE has four key aims: i) to keep people safe from environmental hazards and infectious diseases, ii) to work to prevent poor health, iii) to narrow the health gap, and iv) to support a strong economy.

1.3.2 Regional Health and Wellbeing Strategy

12) Ribble Valley Corporate Strategy (2019-2023)[4]: The Ribble Valley corporate strategy aims to improve the health and wellbeing of people living and working in the area. It aims to increase opportunities for participation in cultural, recreational and sporting activities and ensure that Ribble Valley remains a safe place to live. The strategy also aims to combat rural isolation.

[3] Public Health England Strategy (2019). *PHE Strategy 2020 to 25*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831562/PHE_Strategy_2020-25.pdf Accessed: 02/02/2021

[4] Ribble Valley Corporate Strategy (2019-2023). https://www.ribblevalley.gov.uk/download/downloads/id/11279/corporate_strategy_2015-2019_reviewed.pdf

2. Assessment Methodology and Criteria

2.1 Assessment Methodology

13) The assessment draws on a modified approach to the Design Manual for Roads and Bridges (DMRB) Volume 11, LA112 – Population and Human Health [5] and Human Health: Ensuring a high level of protection[6] to assess the potential effects on health. Whilst this guidance was initially established for assessment of roads and bridges, it is widely adopted as appropriate for other major developments.

14) The assessment has followed the following stages:

- Establish the baseline health and identify sensitive communities or populations within the assessment area
- Using available literature, identify links between health determinants and likely health effects
- Identify the health determinants likely to change as a result of the project e.g. air quality
- Identify relevant mitigation embedded within the Proposed Bowland Section
- Qualitatively assess the potential effects on human health taking into account the nature and characteristics of the project, the sensitivity of receptors and the available evidence
- Identify essential measures to mitigate negative effects on community health and wellbeing
- Evaluate the need for monitoring.

15) The assessment has identified health determinants likely to be affected by the Proposed Bowland Section. The assessment utilises the output of the constituent topic chapters outlined in Section 1.1, and includes consideration of the following health determinants:

- Potential for severance from community/recreational facilities including green space and health care facilities
- Changes to the existing transport network and usage in the area including Public Rights of Way (PRoWs), cycle ways, non-designated public routes and public transport routes
- Effects on existing air quality management areas and ambient air quality levels
- Effects on areas recognised as being sensitive to noise
- Potential pollution (e.g. land/water contamination)
- Effects on landscape amenity.

16) Consideration of potential health and wellbeing issues has been an integral part of the planning and design of the Proposed Bowland Section. Measures that would serve to mitigate the adverse effects of the Proposed Bowland Section are presented in Chapter 20: Environmental Mitigation, Appendix 20.1: Mitigation Schedule, Appendix 20.2: Environmental Masterplan and the Construction Traffic Management Plan (CTMP) (LCC-BO-APP-007 and RVBC-BO-APP-007-01). The health assessment therefore relies on the residual effects reported in each of the constituent topics.

17) The assessment has followed a source-pathway-receptor model as shown in Table 1, only reporting effects through which there is a clear pathway between the source and the receptor and using evidence to support the conclusions.

18) Table 1 shows the receptor model for health effects.

[5] Design Manual for Roads and Bridges (DMRB). (2020). Volume 11, Part 6, LA112 *Population and Human Health*. Available at: https://www.standardsforhighways.co.uk/dmrb/search/1e13d6ac-755e-4d60-9735-f976bf64580a Accessed: 02/02/2021

[6] Cave, B., et al. (2020). *Human health: Ensuring a high level of protection*. A reference paper on addressing Human Health in Environmental Impact Assessment. As per EU Directive 2011/92/EU amended by 2014/52/EU. International Association for Impact Assessment and European Public Health Association. Available at: https://www.iaia.org/reference-and-guidancedocuments/Human%20Health%20Ensuring%20Protection%20Main%20and%20Appendices.pdf Accessed: 02/02/2021

Table 1: Source – Pathway – Receptor model for health effects (IEMA, 2017)[7]

Source	Pathway	Receptor	Plausible Health Impact?	Explanation
✗	✓	✓	No	There is not a clear source (no significant residual effects) from where a potential health impact could originate.
✓	✗	✓	No	The source of a potential health impact lacks a means of transition to a population.
✓	✓	✗	No	Receptors that would be sensitive or vulnerable to the health impact are not present.
✓	✓	✓	Yes	Identifying a source, pathway and receptor does not mean a health impact is a likely significant effect. The health impact is assessed qualitatively based on the available evidence and through the application of professional judgement.

19) The assessment area for the assessment of effects on human health considers the extent of the environmental and socio-economic impacts of the Proposed Bowland Section. This includes potential effects on communities and vulnerable groups located close to construction compounds, but also communities and vulnerable groups living more remotely from these locations, such as those located along the construction traffic routes. To capture all environmental effects, baseline health profiles have been created for the Regional Community Assessment Area (RCAA) as shown on Figure 14.1.

2.2 Assessment Criteria

2.2.1 Sensitivity

20) The sensitivity of the assessment area can be understood by considering the sensitivity of receptors (e.g. the population) that may be exposed to change. As explained by the International Association for Impact Assessment (IAIA)[8], sensitivity can be defined by reference to one or more of the following criteria:

- Life stage: Different health sensitivities and needs at different ages. Typically, children and elderly are particularly vulnerable to change
- Deprivation: Measured by the Index of Multiple Deprivation (IMD) this reflects differences in social gradients central to the consideration of health inequalities
- Health Status: An overall measure of population health using empirical evidence such as life expectancy at birth. Those with a poorer health status are typically of higher sensitivity and more susceptible to change
- Daily Activities: The ability of people to perform daily activities e.g. the extent to which people are reliant on access to health service facilities
- Outlook: Peoples understanding, views or perceptions can be influential to psychological and even physiological response to project changes
- Capacity to adapt: This considers the resilience of the population and the extent to which they are able to absorb changes.

21) Where appropriate baseline data are available, and relevant to the populations potentially affected by the Proposed Bowland Section, they have been applied to the health assessment process.

[7] IEMA (2017). *IEMA Health in EIA, Health in Environmental Impact Assessment: A primer for a proportionate approach.* Available at: https://www.iema.net/download-document/33596 Accessed: 02/02/2021
[8] Cave, B., et al. (2020) [Ref 6]

22) The baseline health status of the RCAA is considered in Section 3.1, however it is recognised that the sensitivity of receptors likely to be affected by the Proposed Bowland Section would vary across the assessment area. Therefore, a high level of sensitivity is assumed for the RCAA. Where there is evidence to suggest increased vulnerability to health effects, for example, due to high levels of deprivation within close proximity to the source of the health effect or due to the presence of receptors such as schools or hospitals, this is taken into account within the assessment presented in Section 5.

2.2.2 Magnitude

23) The magnitude of effect considers the characteristics of the change which would affect the receptor because of the project. In many cases, there is insufficient information on exposure-response relationships to determine a magnitude of effect. This is because, as stated in DMRB, 'a change to a single health determinant can affect the health status of different individuals or communities depending on their characteristics and sensitivity to change, thereby generating multiple health outcomes'[9].

24) The assessment has considered the following aspects:

- The duration of change in a health and wellbeing determinant
- The size of the population exposed to the change
- The frequency at which populations would be exposed to the change
- The intensity of the exposure i.e. the intensity at which the exposed population is likely to experience the change, considering factors such as magnitude of impact leading to the health outcome
- The reversibility of the health outcome or the speed at which the health outcome reverses once the source is removed
- The effects of perception which may influence the way in which people react to a change in health or wellbeing determinant.

25) In absence of published guidance to help determine the magnitude of effect, health outcomes have been defined as positive, negative, neutral or uncertain, as outlined in Table 2, and supported with available evidence and reasoning.

Table 2: Human Health Outcome Categories

Health Outcome Category	Health Outcome Description
1) Beneficial	2) A beneficial health impact is identified
3) Neutral	4) No discernible health impact is identified
5) Adverse	6) An adverse health impact is identified
7) Uncertain	8) Uncertainty exists as to the overall health impact

2.2.3 Significance

26) The significance of the health outcome relies on informed, expert judgement about what is important, desirable, or acceptable with regards to changes triggered by the project. The assessment of significance has considered the following criteria where the health outcomes are anticipated:

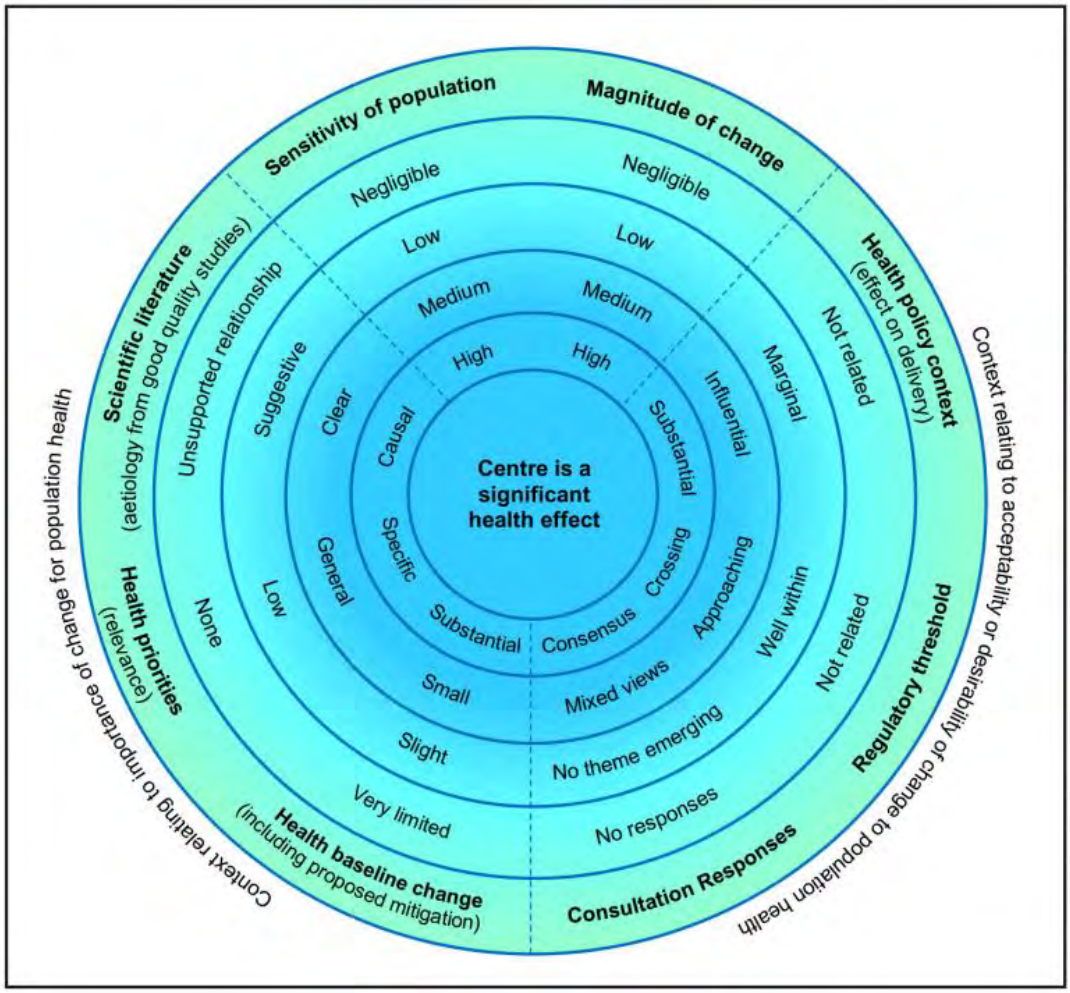
- The health outcome: Where beneficial, adverse, or uncertain health outcomes are identified, these could result in significant effects
- Sensitivity: The sensitivity of the population exposed to the change

[9] Highways England (2020). Design manual for roads and bridges. LA 112 Population and Human Health. Available at: https://www.standardsforhighways.co.uk/prod/attachments/1e13d6ac-755e-4d60-9735-f976bf64580a

- Regulatory standards: For example, if the project is predicting a change that exceeds thresholds identified in the scientific literature or if the change in a health determinant can be formally monitored by regulators
- Health priorities: If determinants of health or health outcomes have been identified as particularly important locally, regionally, or nationally
- Health policy context: Could the changes due to the project have a substantial or influential effect on the ability to deliver current health policy?
- Scientific Literature: The extent to which the evidence linking the health determinant with health effects is causal, clear, suggested or unsupported by scientific and peer reviewed literature.

27) Illustration 2 demonstrates the conceptual model applied in this assessment.

Illustration 2. Health Significance: a conceptual model[10]



[10] [Ref 6] Cave, B., et al. (2020)

3. Baseline Conditions

28) Baseline conditions in relation to the health of the population in the study area have been compiled through a combination of desk study (Public Health England, Joint Strategic Needs Assessment publications and local authority policies) consultation with local communities, and ground-truthing of community facilities and population groups that could be adversely affected

29) The baseline health profiles have been established for the RCAA and include the following statistics relevant to health:

- Life expectancy at birth
- Cardiovascular health
- The number of people killed or seriously injured on the road
- Physical activity / obesity
- Infant mortality rate
- Households in fuel poverty
- General health and wellbeing
- Hospitals and GP facilities.

30) Information presented in the baseline is used to inform, where appropriate, the assessment of likely significant effects presented in Section 5.

3.1 RCAA Baseline Conditions

31) Table 3 presents the baseline health conditions for Lancaster District Council and Ribble Valley District Council.

Table 3: RCAA Baseline Health conditions

Indicator	Lancaster City Council	Ribble Valley Borough Council
Life expectancy at birth[11]	Between 2016-2018, life expectancy was 78.3 for males and 82.5 for females which is slightly lower than the average English life expectancy of 79.6 for males and 83.2 for females.	Between 2016-2018, life expectancy was 81.2 for males and 83.5 for females which is slightly higher than the average English life expectancy of 79.6 for males and 83.2 for females.
Cardiovascular Health (mortality rate from cardiovascular diseases per 100,000) [12]	Between 2016 and 2018, the under 75 mortality rate from cardiovascular disease in Lancaster City Council was 77.9, lower than the regional average of 86.6 but higher than the average for England of 71.7.	Between 2016 and 2018, the under 75 mortality rate from cardiovascular disease in Ribble Valley was 76.1, lower than the regional average of 86.6 but higher than the average for England of 71.7.
Killed and seriously injured (KSI) casualties on the road[13]	Between 2016 and 2018, the casualty rate for those killed or seriously injured on Lancaster's Roads was 64.8. This is higher than the regional (38.4) and England (42.6) average.	Between 2016 and 2018, the casualty rate for those killed or seriously injured on Ribble Valley's Roads was 64.4. This is higher than the regional (38.4) and England (42.6) average.

[11] Public Health England (2020). Local Authority Health Profiles. Available at: https://fingertips.phe.org.uk/profile/health-profiles/data#page/0/gid/1938132701/pat/6/par/E12000002/ati/201/are/E07000121/iid/92949/age/27/sex/4/cid/4/page-options/ovw-do-0. Accessed May 2020
[12] Public Health England (2020) [Ref 11]
[13] Public Health England (2020) [Ref 11]

Indicator	Lancaster City Council	Ribble Valley Borough Council
Physical activity/obesity[14]	In 2018/19, 71.3% of adults were physically active and 62.1% were classified as overweight or obese. Lancaster has better health outcomes compared to the England average of 67.2% for physical activity and 62.3% for obesity.	In 2018/19, 77.0% of adults were physically active and 59.5% were classified as overweight or obese. Ribble Valley has better health outcomes compared to the England average of 67.2% for physical activity and 62.3% for obesity.
Infant mortality rate[15]	Between 2016 and 2018, the infant mortality rate in Lancaster City Council was 2.8 per 1,000, lower than the average for England of 3.9.	Between 2016 and 2018, the infant mortality rate in Ribble Valley was 2.8 per 1,000, lower than the average for England of 3.9.
Households in fuel poverty[16]	In Lancaster City Council an estimated 13.6% of households are living in fuel poverty in 2017, which is slightly higher than the England average of 10.3%.	In Ribble Valley, an estimated 10.2% of households are living in fuel poverty in 2017, in line with the average for England of 10.3%.
General health[17]	At the time of the 2011 Census, 46.7% of Lancaster City Council reported very good self-reported health, 33.8% reported good health, 13.7% reported fair health and 6.8% reported bad or very bad health.	At the time of the 2011 Census, 51.1% of Ribble Valley Borough Council reported very good self-reported health, 32.2% reported good health, 12.3% reported fair health and 4.1% reported bad or very bad health.
Wellbeing (Anxiety, happiness, life satisfaction) (level out of 10) [18]	In Lancaster in 2018/19, estimated levels of anxiety (2.73), happiness (7.61) and life satisfaction (7.62) are broadly in line with the average for England at 2.87, 7.56, and 7.71 respectively and the North West (2.78,7.54,7.69 respectively).	In Ribble Valley in 2018/19, estimated levels of anxiety (2.43), happiness (8.3) and life satisfaction (8.19) are better than the average for England at 2.87, 7.56, and 7.71 respectively and the North West (2.78,7.54,7.69 respectively).
Medical facilities[19]	Lancaster City Council is home to among other hospitals the Royal Lancaster Infirmary and Queen Victoria Hospital.	Ribble Valley Borough Council is home to Clitheroe Community Hospital and health centres and clinics. Private sector healthcare facilities include Gisburne Park Hospital.
Clinical Commissioning Groups[20]	NHS Morecambe Bay CCG.	East Lancashire CCG.

[14] Public Health England (2020) [Ref 11]
[15] Public Health England (2020) [Ref 11]
[16] Office for National Statistics (2020). *Research Outputs: Small area estimation of fuel poverty in England, 2013 to 2017.* Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/researchoutputssmallareaestimationoffuelpovertyinengland2013to2017/2019-07-08. Accessed: 02/02/2021
[17] Nomis (2020). QS302EW - General health. Available at: https://www.nomisweb.co.uk Accessed 01/05/2020
[18] Office for National Statistics (2020). *Personal wellbeing in the UK: April 2018 to March 2019*. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/bulletins/measuringnationalwellbeing/april2018tomarch2019 . Accessed: 02/02/2021
[19] OpenStreetMap Contributors (2020). OpenStreetMap. Available at: https://www.openstreetmap.org/. Accessed May 2020.
[20] ONS (2020). Lower Layer Super Output Area (2011) to Clinical Commissioning Group to Local Authority District (April 2019) Lookup in England. Available at: http://geoportal.statistics.gov.uk/datasets/lower-layer-super-output-area-2011-to-clinical-commissioning-group-to-local-authority-district-april-2019-lookup-in-england

32) Table 4 presents baseline information relevant to human health included in the relevant constituent topics.

Table 4: Baseline information relevant to health within this Environmental Statement

Indicative health determinant	Baseline information within ES
Severance, disturbance and access to community, recreational and education facilities.	Chapter 13: Public Access and Recreation Chapter 14: Communities and Health
Access to green and open spaces and other natural capital.	Chapter 6: Landscape and Arboriculture Chapter 9: Ecology Chapter 13: Public Access and Recreation Chapter 14: Communities and Health
Social cohesion, employment and income.	Chapter 14: Communities and Health Chapter 16: Transport Planning
Air quality management areas and ambient air quality levels.	Chapter 18: Air Quality
Areas recognised as being sensitive to noise (e.g. noise important areas, noise management areas) and the ambient noise environment.	Chapter 17: Noise and Vibration
Sources and pathways of potential pollution (e.g. land/water contamination) and flood risk.	Chapter 7: Water Environment Chapter 8: Flood Risk Chapter 11: Soils, Geology and Land Quality Chapter 12: Materials and Waste
Landscape and visual amenity.	Chapter 6: Landscape and Arboriculture
Safety information associated with the existing affected road network (e.g. numbers of killed and seriously injured) and major accident risks.	Chapter 15: Major Accidents Chapter16: Transport Planning

4. Evidence Base

33) The following section presents an evidence base used to identify the links between health determinants and likely health effects. The evidence base underpins the qualitative assessment of likely health effects presented in Section 5.

34) The evidence has been collated from peer reviewed literature from credible sources such as the World Health Organisation, Public Health England and the Department of Health. All sources have been referenced throughout the report. Where the evidence for an association with health is weak, this does not rule out the potential for a health effect but indicates a lack of available research.

35) A number of health determinants have been scoped out of the assessment following careful consideration of their potential to exert health effects with respect to the Proposed Bowland Section. An explanation of the reasons for scoping out these topics is provided below.

4.1 Disturbance, Severance and Access to Community Facilities

36) Volume 2 Chapter 14 and Volume 5: Off-site Highways Works both conclude that the volume and duration of construction vehicle movements have the potential to give rise to significant disturbance effects among some (but not all) of the communities located along the haulage routes. This health determinant was therefore factored into the assessment.

37) Severance is defined as the extent to which members of communities are able (or not able) to move around their community and access services/facilities. This could be because of the difficulty of crossing a heavily trafficked road, as a result of new infrastructure, road closures or due to delays imposed by traffic management measures during construction.

38) Community severance can lead to increased distances to workplaces and community facilities such as schools, parks, religious centres, and health services. For older people, the road network can contribute considerably to feelings of isolation and levels of independent mobility. There is also empirical evidence to suggest that increased traffic speed and volume reduces physical activity, social contacts, children's play and access to goods and services[21].

39) Chapter 16: Transport Planning concludes that during construction of the Proposed Bowland Section, there would be no significant community severance effects. Severance has therefore been discounted from this assessment.

40) While Chapter 14 concludes that there would not be significant disturbance effects at a Local Community Assessment Area (LCAA) level, it is acknowledged that some local communities outside the LCAAs may experience significant disturbance effects. These disturbance effects would arise due to construction vehicle movements through communities and settlements at the southern end of the Proposed Bowland Section. Disturbance effects are therefore considered in the following assessment.

4.2 Open Spaces and Natural Capital

41) A review by the Forestry Commission [22] found that providing secure, convenient and attractive open/green space can encourage people to undertake more physical activity and, as a result, reduce levels of heart disease, strokes and other ill-health problems that are associated with both sedentary occupations and stressful lifestyles. There is also evidence that individuals living in natural areas, which tend to be free from noise nuisance, have reduced stress levels and improved quality of life[23]. Similarly, there is growing evidence to suggest that access to parks, open space and nature can help maintain or improve mental health, through increased opportunity for physical activity, social interaction and

[21] Mindell, Jennifer & Karlsen, Saffron. (2012). Community Severance and Health: What Do We Actually Know? *Journal of Urban Health*, 89 (2), pp. 232-46. 10.1007/s11524-011-9637-7. Available at : https://www.researchgate.net/publication/221731948_Community_Severance_and_Health_What_Do_We_Actually_Know

[22] Croucher, K., Myers, L., and Bretherton, J. (2007). *The links between greenspace and health: a critical literature review*, Greenspace Scotland (Forestry Commission). Available at: https://www.york.ac.uk/media/chp/documents/2008/greenspace2008.pdf Accessed: 02/02/2021

[23] European Environment Agency (2020). *Healthy environment, healthy lives: how the environment influences health and well-being in Europe*. Available at: https://www.eea.europa.eu/publications/healthy-environment-healthy-lives Accessed: 02/02/2021

relaxation.[24] Socially deprived communities are likely to benefit the most from the health benefits of natural environments, through reductions in stress, mortality and morbidity. Moreover, access to green space promotes community cohesion, reducing social isolation for minority groups and the elderly.

42) There is further evidence to suggest that people that have access to greenspace are more likely to achieve the recommended amount of physical activity as set by the UK government.[25] To achieve these recommended targets, it is critical that adults and children have access to suitable recreational resources and amenity spaces of sufficient quality.

43) The Proposed Bowland Section would not give rise to either the loss of public open space or access to the countryside, during any phase of the construction programme. Public Rights of Way, although potentially diverted, would remain open. Members of the public would broadly have the same access to open spaces as present. Therefore, this health determinant has been descoped from the assessment process.

44) Ecosystems provide provisioning, regulating, cultural and support services which provide a range of health benefits for humans including the provision and availability of fresh water, food, and fuel sources[26]. Human interventions, including major infrastructure developments, urbanisation and land use change can lead to the disruption or loss of ecosystems that provide us with essential ecosystem goods and services.

45) The links between ecosystem disruption and health occur across complex pathways. As stated by the WHO, 'the types of health effects experienced are determined by the degree to which local populations depend on ecosystem services, and factors such as poverty, which affect vulnerability to changes in elements like access to food and water'.

46) There are potential impacts on one biodiversity site on the Proposed Bowland Section which give rise to likely significant effects. Ecology has therefore been scoped into the health assessment.

4.3 Social Cohesion

47) Access to public services and social infrastructure is a key determinant of health and wellbeing[27]. Social cohesion is defined by the Organisation for Economic Co-operation and Development (OECD) as a cohesive society that works towards the wellbeing of its members, creates a sense of belonging, promotes trust, and fights exclusion and marginalisation[28]. Within a community, social cohesion creates social networks which can reduce isolation and enable people to cope with illness. Community disruption effects and adverse impacts on access to community facilities could result in negative effects on human health.

48) Perceptions of quality and character in a neighbourhood are positively associated with sense of community and place attachment[29]. Disruption effects can discourage users from travelling to certain facilities, or using certain open spaces or footpaths, which could lead to potential feelings of isolation or a loss of sense of community. These can accumulate and create indirect health effects for residents within these communities. Social cohesion related health effects could occur during construction of the Proposed Bowland Section through the creation of physical and perceived barriers within the local community. Changes in access to community facilities due to increased congestion around construction activities or from construction traffic routes may lead to anxiety, stress and feelings of isolation for

[24] Natural England. (2010). *Great Outdoors: How Our Natural Health Service Uses Green Space to Improve Wellbeing*, UK faculty of public health. Available at: http://www.biodiversitysouthwest.org.uk/docs/r_great_outdoors.pdf Accessed: 02/02/2021

[25] Mytton, O.T., Townsend, N., Rutter, H. and Foster, C., (2012). Green space and physical activity: an observational study using Health Survey for England data. *Health & place*, 18(5), pp.1034-1041. Available at: https://reader.elsevier.com/reader/sd/pii/S1353829212001104?token=FECCFDF9E0CDF94B1692D1EBA871D627558CCFF22AB529EE1245C8BAC131A86D5DC72C77443D320FF0AE89BB85FA358D Accessed: 02/02/2021

[26] World health organisation (2020). *Ecosystem goods and services for health.* Available at: https://www.who.int/globalchange/ecosystems/en/#:~:text=Significant%20direct%20human%20health%20impacts,may%20even%20cause%20political%20conflict. Accessed: 02/02/2021

[27] National Health Service (2013). *HUDU Planning for Health Rapid Health Impact Assessment Tool.* Available at: https://www.healthyurbandevelopment.nhs.uk/wp-content/uploads/2013/12/HUDU-Rapid-HIA-Tool-Jan-2013-Final.pdf Accessed: 02/02/2021

[28] Organisation for Economic Cooperation and Development (2012). *Social Cohesion in a shifting world.* Available at: http://www.un.org/esa/socdev/ageing/documents/social-cohesion.pdf Accessed: 02/02/2021

[29] Dempsey, N. (2008). *Does the quality of the built environment affect social cohesion?* Available at: https://www.icevirtuallibrary.com/doi/abs/10.1680/udap.2008.161.3.105 Accessed: 02/02/2021

nearby residents that regularly access certain facilities or who normally use a certain route to work that is affected by construction activities.

49) Due to the nature of the Proposed Bowland Section and the demand for workers with specific skills, there is unlikely to be significant levels of job creation when compared to the strength of the existing economy and existing levels of unemployment. The health benefits associated with people moving into employment are not expected to be significant and are therefore scoped out.

50) There is strong evidence to suggest a link between being in employment and positive effects on health and wellbeing . The Marmot Review found a significant association between deprivation and suicidal behaviour with unemployment, job insecurity, unmanageable debt and lack of support services all contributing to suicidal behaviour . The review concluded that 'being in good employment is usually protective of health while unemployment, particularly long-term unemployment, contributes significantly to poor health'.

51) Due to the nature of the Proposed Bowland Section and the demand for workers with specific skills, there is unlikely to be significant levels of job creation when compared to the strength of the existing economy and existing levels of unemployment. The health benefits associated with people moving into employment are not expected to be significant and are therefore scoped out.

4.4 Air Quality

52) The links between air quality emissions and health effects are well established, with poor air quality linked to human health conditions such as asthma, respiratory problems and cardiovascular disease[30]. Estimates suggest that exposure to outdoor air pollution contributes to 40,000 deaths per year in the UK. The main pollutants from vehicle emissions are particulate matter and nitrogen oxides (NOx). These pollutants can affect lung function and cause respiratory problems, with short-term acute exposure having a greater adverse effect than a longer-term exposure at lower concentrations.

53) While Volume 2 Chapter 18 reports that the Proposed Bowland Section would give rise to air pollutant emissions from a variety of sources including stationary plant such as diesel generation sets, and exhaust emissions from construction vehicles, no air quality standards or objectives for the protection of human health would be exceeded. Air quality has therefore been descoped from this exercise.

4.5 Noise

54) In 2018, the WHO stated that '*Environmental noise is a threat to public health, having negative impacts on human health and wellbeing*'[31]. For road traffic noise, adverse health effects have been identified for average noise exposure exceeding 53 decibels (dB). For night-time exposure, this reduces to 45 dB. Similarly, for tunnelling works, standard noise limits for construction apply. For daytime exposure, the limit is 65 dB and for nigh time this decreases to 45 dB, above this level, there is strong evidence to link with effects on sleep disturbance[32].

55) Health effects associated with noise are likely to disproportionately affect vulnerable members of society including those with pre-existing conditions, children, the elderly and poorer communities who tend to live in densely populated urban spaces with reduced access to benefits of high-quality environments.

56) The Proposed Bowland Section would give rise to noise emissions from a variety of sources such as fixed plant, mobile and traffic movements. While noise-related health effects could result from the increased movement of HGVs and other construction vehicles along local roads, and from construction activities including site preparation and earthworks, open cut trenching, and the handling of excavated materials on site, the proposed mitigation measures and management plans would at a community level limit noise emissions to acceptable levels. Site-specific noise impacts may occur and further mitigation

[30] Royal College of Physicians. (2016). *Every breath we take: the lifelong impact of air pollution*. https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution Accessed: 02/02/2021
[31] World Health Organisation. (2018). *Environmental Noise Guidelines for the European Region*. Available at: https://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018 Accessed: 02/02/2021
[32] British Standard Institution. (2014). Code of practice for noise and vibration control on construction sites. Available at: https://www.warrington.gov.uk/sites/default/files/2020-08/cf53_bs_5228_pt1-2009a1-2014.pdf Accessed: 25/02/2021

measures may be required to offset these adverse effects. Noise impacts at a community level are not significant and have therefore been discounted from the health assessment.

4.6 Pollution, Waste and Flood Risk

57) The WHO states that contaminated land '*might threaten human health and the environment, by altering air quality, hampering soil functions, and polluting groundwater and surface water*' [33]. The existence of multiple exposure pathways, combined with the fact that many industrially contaminated sites are located close to urban areas and/or socially deprived neighbourhoods, results in complex exposure patterns and interactions with other health determinants.

58) Children are particularly vulnerable to the effects of contaminated land, due to their increased exposure to contaminants through their physique, behaviour and the fact they breathe more frequently than adults[34]. Young children also do not have the necessary experience to identify potential dangers and sources of harm in a sensible way compared to older children and adults.

59) There is a remote risk that health effects associated with contaminated land could occur during construction of the Proposed Bowland Section, as a potential outcome of encountering contaminated excavated material. However, this highly unlikely exposure risk would be expected to be limited to construction workers only, operating with appropriate protection and following safe methods. Hazardous waste could also be generated in small quantities, however if found, this waste would be recycled, recovered or disposed of as appropriate through licensed contractors. Appropriate management techniques would be adopted to avoid risk to members of the public (refer to Volume 2 Chapter 12: Materials and Waste and Volume 4 Appendix 3.2).

60) Contaminated land public health risks are considered to be negligible in the context of the Proposed Bowland Section and have therefore been scoped out.

61) Flooding can cause both physical injury as well as adversely impacting mental health. Experiencing a flood event and coping with the process of recovery can put significant stress and strain on individuals and communities affected[35]. Public Health England identified challenges that could cause stress following a flood event:

- Difficulties accessing continuing healthcare and prescription medications
- Difficulties with getting healthcare for new health problems
- Difficulties accessing safe drinking water, transport and sanitation services
- Disruption to normal household activities and separation from family and friends
- Loss of school facilities and interrupted attendance at school
- Feelings of loss of control and worry that flooding may reoccur
- Seeking compensation, recovery and re-building of homes, submitting an insurance claim, loss of employment/income
- Loss of physical possessions.

62) In terms of resilience to flooding, those living on low incomes may not be able to afford improvements to their homes to reduce the risk from flood damage. In the UK, less skilled workers and those not in

[33] World Health Organisation (2012). *Contaminated sites and health*. Available at: http://www.euro.who.int/__data/assets/pdf_file/0003/186240/e96843e.pdf Accessed: 02/02/2021

[34] Public Health England. (2019). *Use of Potentially Contaminated Residential land, Gardens and Allotments* – Public Health Factsheet. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779168/factsheet_for_contaminated_land.pdf Accessed: 02/02/2021

[35] Public Health England. (2014). *Health advice: General information about mental health following floods*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/483387/Health_advice_about_mental_health_following_floods_2015.pdf Accessed: 02/02/2021

work were found to have a lower level of awareness of flood risks than those in higher socio-economic groups[36].

63) The risk of flooding is increased if infrastructure is constructed on floodplains or near to natural flood management areas, diminishing the effectiveness of these area at preventing flooding. Residents that have experienced flooding in the past may be concerned about future developments that could increase the risk of flooding and threaten their safety. The Proposed Bowland Section could increase the risk of flooding if temporary access tracks, crossings or valve houses are constructed near or over watercourses or if discharges (such as groundwater ingress) from construction works increase the flow in rivers downstream.

64) As stated by the European Environment Agency, '*water pollution can have an impact on health via contaminated drinking water extracted from groundwater or surface water or contact with contaminated bathing waters, as well as through indirect exposure through the consumption of fish containing bio accumulative pollutants, such as mercury*'[37].

65) During construction of the Proposed Bowland Section, disturbance of contaminated land, the release of polluting substances from plant and machinery and storage of these materials at compounds could result in pollution of watercourses. Similarly, soil stripping and vegetation clearance could result in changes to groundwater quality which could affect sensitive receptors including private water supplies.

66) Pollution of watercourses is regulated by the Environment Agency. There are also a number of key directives that focus on the protection and enhancement of water quality including the Water Environment Regulations 2017, and the Water Supply Regulations 2016. To mitigate any potential risk, a suitably qualified expert would be appointed to oversee the implementation of mitigation and monitoring of the water environment. Based on the precautionary measures that would be implemented, the risk to public health as a result of groundwater contamination arising from the Proposed Bowland Section is considered to be negligible and therefore this determinant has been scoped out.

67) Taking account of the above factors, pollution, waste and flood risk have been scoped out of this assessment because none gives rise to significant effects on the Proposed Bowland Section which could have a bearing on health outcomes.

4.7 Landscape and Visual Amenity

68) Likely significant effects have been identified for the proposed off-site highways works, main construction areas and (for the southern end of the proposed section) the Ribble Crossing. Cumulative effects are envisaged when taking account of the main construction compounds, construction access routes on the local public highway and off-site highways works. It is envisaged that off-site highways works would account for an additional cumulative landscape and visual effects in a broader landscape context.

69) The combination of construction activity and construction traffic movement within the main compounds, proposed off-site highways works and the Ribble Crossing would result in disruption across a wider area of the AONB. The construction compounds and highways improvement works would also result in disturbance to the wider landscape area from vegetation loss and removal of boundary features such as trees, hedgerows and dry stone walls.

70) The disruption caused by the Lower Houses construction compound would affect a small part of the Forest of Bowland AONB. However, in combination with the highways improvement works between the compound and Wray, the disruption from construction activity and the movement of construction vehicles and the loss of landscape features along the off-site highways routes, there would be a greater combined adverse effect landscape quality.

[36] Environment Agency. (2009). *Improving Institutional and Social Responses to Flooding*. Available at: https://assets.publishing.service.gov.uk/media/602e6cc6e90e076605eab470/improving_response__recovery_and_resilience_WP2_technical_report.pdf Accessed: 25/02/2021

[37] European Environment Agency. (2000). *Groundwater quality and quantity in Europe*. Available at: https://www.eea.europa.eu/publications/groundwater07012000 Accessed: 25/02/2021

71) Disruption caused by the Proposed Newton-in-Bowland Compound, within the River Hodder valley, would affect a small part of the Forest of Bowland AONB. However, in combination with the highways improvement works and the Proposed Ribble Crossing between the compound and Clitheroe, the disruption from construction activity, movement of construction vehicles and the loss of landscape features along the off-site highways routes would have greater combined adverse effect on landscape quality. The movement of plant and machinery, along with the construction activities, would reduce the perceived tranquillity, remoteness and rural character, introducing uncharacteristic features and affecting the landscape quality in the short to medium term.

72) Visual receptors, both static, e.g. residents, and transient, e.g. footpath users and road travellers would experience a noticeable change in views within the wider area due to the construction related activity and vehicle movement, and removal of features such as trees, hedgerows and dry stone walls. The visual change would be most evident for travellers through the rural areas such as along the B6478 Slaidburn Road and near Waddington due to the frequency of both construction related activity for the highways improvement works and compounds, and the frequency of construction traffic movement during the construction phase.

73) For these reasons, landscape and visual amenity as a health determinant was factored into the health assessment.

4.8 Safety

74) Increases in traffic flow on the road network increases the risk of individuals being killed or injured as a result of traffic and transport accidents. A review undertaken for the Department for Transport on transport, health and wellbeing found that the positive benefits of transport, such as improving access to employment, education and recreational opportunities, were outweighed by the negative impacts on health due to accidents, noise and air pollution[38]. The review also found that in general, healthy and affluent groups were more likely to experience positive impacts whilst those on lower incomes, young people and old people were more likely to experience adverse impacts.

75) Major infrastructure development has the potential to increase risks to the human environment and natural resources, through major accidents and disaster events. The term 'major accident' in this context is an undesirable extreme event resulting in damage or harm, such as a major pollution incident. The term 'disaster' in this context is taken to be extremes of natural occurrences, such as a major flood event or earthquake. The Environmental Statement has considered two aspects: the vulnerability of the Proposed Bowland Section to a major accident or natural disaster, and the potential for the Proposed Bowland Section to cause a major accident.

76) No significant residual effects have been identified in relation to either highways safety or major accident risks and therefore this health determinant has been discounted.

[38] Cooper et al. (2019). *Transport, Health and Wellbeing: an evidence review for the Department for Transport.* Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/847884/Transport__health_and_wellbeing.pdf Accessed: 02/02/2021

5. Assessment of Likely Significant Effects

77) The following section describes the effects of the Proposed Bowland Section on human health.

5.1 Enabling and Construction Works Phases

78) The following section presents the potential effects on the health of residents within the RCAA during the enabling and construction phases of the project. Table 5 summarises the health effects at each of the compound locations: Lower Houses Compound and Newton in Bowland Compound. Health effects during enabling and construction works for the Lower Houses Compound and Newton in Bowland Compound are considered in Table 5.

79) During enabling and construction works, significant residual effects are reported by the following constituent topics:

- Chapter 6: Landscape and Arboriculture
- Chapter 9A: Ecology
- Chapter 14: Communities and Health.

80) For topics not listed, no significant health effects are identified, on the basis that there is no identified source (no significant residual effects) from which a potential significant health impact could originate.

81) Table 5 presents a summary of health effects at the Lower Houses and Newton in Bowland Compounds during enabling and construction works.

82) As noted in paragraph 8, a review of non-significant air quality, noise, landscape and visual, and traffic effects was also undertaken to identify any potential for these to result in overall significant effects in terms of disturbance to community receptors. This is further considered in Section 6: Multiple Health Determinants.

Table 5: Summary of health effects during enabling and construction works at the Lower Houses and Newton in Bowland Compounds

Relevant EIA Report Chapter	Effects predicted by constituent topic	Health Pathway	Health Outcome
Chapter 6: Landscape and Arboriculture	During the enabling and construction phases, major adverse landscape and visual effects are expected at the Lower Houses and Newton in Bowland compounds due to substantial changes to the character of the view and uncharacteristic changes to the landscape. Residential receptors, users of footpaths and road travellers with views to the Newton in Bowland Compound would experience major visual disturbance as a result of direct and open views to the construction access track.	As stated in Section 4, effects on the landscape or townscape may affect residents' perceptions of the quality and character of their local environment. The perception of a more stressful and poor-quality environment, particularly during construction, may contribute to adverse health effects. During the enabling and construction works at the Lower Houses Compound, major adverse visual effects are expected on Lower Houses Farm, North Bowland Traverse long-distance path (FP21, FP22, FP23). Similarly, major adverse visual effects are expected on Local Moor Road, Overhouses (farm), two footpaths (FP25 and FP26). During the enabling and construction works, at the Newton in Bowland Compound moderate to major adverse visual effects are expected on The Heaning (Farm), Forber Farm, Dunsop Road, Long Stripes Farmhouse, Farrowfield residential property and surrounding properties and Newlaithe Farm. Similarly, major adverse visual effects are expected for users of footpaths (The Hodder Way and Pendle Witches Way, FP31, FP26, FP35, FP40, FP43). It is likely that the quality of the existing environment would be adversely affected by construction works in this location, resulting in perceptions of a more stressful environment by local residents. Although there is potential for beneficial effects post construction, once planting becomes established, it is likely that some residents may experience adverse health effects due to the long duration of construction activities. Whilst the sensitivity of the population is assessed as high and the health outcome is assessed as adverse, the scientific evidence for this health determinant is weak. Therefore, the health outcome is assessed as adverse but not significant.	Potential Adverse – Not Significant

Relevant EIA Report Chapter	Effects predicted by constituent topic	Health Pathway	Health Outcome
Chapter 9A: Terrestrial Ecology	Range of potential significant residual effects at Gamble Hole Farm Biological Heritage Site (BHS) which falls within the proposed Newton-in-Bowland compound. • Degradation of fen habitat as a result of pollution or erosion from vehicles using temporary access route across fen habitat (e.g. fuel/oil leaks, spills of spoil being transported, encroachment off the track, run-off from the track surface) • Temporary dewatering operations as a result of the portal may result in changes to a drawdown in groundwater levels for what is a groundwater dependent habitat • Ground compaction caused by heavy haulage vehicles and plant, could create a local barrier to groundwater flows from the west and northeast • Degradation in quality or function resulting from changes in water quality or flows in watercourses that feed or flow through retained habitats and which are temporarily modified during construction • Fen habitat with significant effects as identified within the GWDTE assessment (Vol. 4 Appendix 7.2) during the construction phase.	The significant adverse effects on biodiversity described in Volume 2 Chapter 9A relate to predicted impacts on a county-level biological heritage site that is affected by vehicle access track / earthworks proposals within the planning application boundary. While there is a recognised association between access to natural capital and well-being, these links in respect of the Gamble Hole Farm are anticipated to be limited. There is presently very little general access to this area, with only local public rights of way traversing Gamble Hole Farm. The site is not accessible to the general public in its context of being a biodiversity asset. While the impacts described in the Environmental Statement represent a significant effect from a biodiversity viewpoint, a further extension of these adverse effects into health outcomes is not anticipated.	Neutral - Not significant
Chapter 14: Communities and Health	The environmental assessment concluded that disturbance effects on the local community assessment areas (LCAAs) were no more significant than those reported in the contributing	Some stakeholder groups have already provided feedback to United Utilities expressing their concerns about the level and duration of disturbance on communities during the construction phase. In response to this feedback, United Utilities has developed alternative access proposals for some of the	Potential adverse – not significant

Relevant EIA Report Chapter	Effects predicted by constituent topic	Health Pathway	Health Outcome
	technical chapters of the Environmental Statement, for example, landscape and arboriculture, air quality and noise. However, Chapter 14 has concluded that there is a risk of significant disturbance effects associated with construction vehicle movements outside the LCAAs through local communities and settlements during the enabling works and construction phases of the Proposed Bowland Section programme. While United Utilities has taken significant steps towards reducing the disturbance impacts of construction traffic on some communities, it is recognised that others may still encounter notable levels of disturbance.	main HARP construction compounds – for example, the Proposed Ribble Crossing could alleviate impacts on communities in the Chatburn, Grindleton and West Bradford areas; the Proposed Hodder Crossing would remove construction traffic from Newton-in-Bowland village centre. In contrast, however, some of these solutions may not fully avoid community disturbance impacts, or could give rise to other impacts. In addition to ongoing engineering investigations to alleviate potential impacts on transport routes, United Utilities has developed Construction Traffic Management Plans (CTMP), outlining measures to be implemented to further mitigate community disturbance. Through ongoing consultation with local people, local councils and highways authorities, United Utilities will continue to develop and refine mitigation proposals. It should be recognised that in some community areas; however, it may not be possible to fully eliminate adverse disturbance effects due to the scale of construction operations and associated vehicle movements. It is acknowledged that these disturbance effects may be linked to anxiety regarding the timing, nature and scope of disturbance effects. Further consultation and engagement with affected communities is therefore ongoing and will continue through the next stages of the planning process.	

5.2 Commissioning and Operational Phases

83) Following the construction phase, a commissioning process is required during which the proposed sections of tunnel and multi-line syphons would finally be connected to the existing pipeline. With the main tunnel construction and open-cut pipeline installations having been concluded, the commissioning phase would represent a considerably smaller activity over a much shorter duration. Commissioning would require minor construction works in between the newly-installed multi-line syphons and the existing aqueduct, followed by cleaning of the new works and final commissioning. Details of the commissioning phase are provided in Volume 2 Chapter 3: Development Description and Design Evolution.

84) For the operational phase, all topics have been scoped out because there is not a clear source (no significant residual effects) from where a potential health impact could originate.

85) As noted in paragraph 8, a review of non-significant air quality, noise, landscape and visual, and traffic effects was also undertaken to identify any potential for these to result in overall significant effects in terms of disturbance to community receptors. No potential for significant disturbance effects was identified for the commissioning and operational phases.

6. Consideration of Multiple Health Determinants

86) The assessment below considers the effects of multiple health determinants at the Lower Houses Compound and Newton in Bowland Compound.

87) During enabling and construction works, adverse health outcomes – though not significant – may occur as a result of disturbance within some but not all communities due to construction vehicle movements on the local road network at the south end of the Proposed Bowland Section, and adverse landscape and visual effects at the Lower Houses and Newton in Bowland Compounds.

88) Whilst adverse, these effects were assessed as not significant in terms of health due to the low levels of exposure and temporary nature of effects.

89) A review of non-significant air quality, noise, access and recreation, landscape and visual, and traffic effects was also undertaken to identify potential disturbance effects on community receptors, taking into account health effect magnitude aspects (including intensity and duration of change, and the size of population exposed to the change). While in combination these determinants may give rise to health outcomes they are not considered to be significant.

90) Chapter 14 sets out United Utilities' response to stakeholder feedback expressing their concerns about the level and duration of community impacts during the construction phase .

91) During the operation phase, no adverse effects on health were predicted. Therefore, it was not considered necessary to assess multiple health determinants.

7. Mitigation and Residual Effects

92) Consideration of potential health and wellbeing issues has been an integral part of the planning and design of the Proposed Bowland Section. Where possible, compounds have been designed to reduce the loss of land and effects on community resources, severance and disturbance.

93) Measures that would mitigate the adverse health outcomes of the Proposed Bowland Section are presented in Chapter 20: Environmental Mitigation, Appendix 20.1: Mitigation Schedule, Appendix 20.2: Environmental Masterplan and the Construction Traffic Management Plan (CTMP). All of these measures relate to the various sources of effects considered by the constituent chapters (e.g. Chapter 6: Landscape and Arboriculture, Chapter 16: Transport Planning, Chapter 17: Noise and Vibration and Chapter 18: Air Quality). Given that this chapter draws on the effects reported in these constituent chapters, mitigation is not repeated here.

94) No significant residual health effects have been identified as a result of the Proposed Bowland Section.

8. Cumulative Effects

95) Cumulative effects on health and wellbeing are considered in Chapter 14: Communities and Health and are not repeated here. Chapter 14 concluded that there no potential third-party developments or land allocations in local development plan documents were identified which could give rise to likely significant cumulative effects. However, it was noted that works for the Proposed Marl Section (part of the Proposed Programme of Works) could coincide with the enabling works and part of the construction period for the Newton-in-Bowland compound. It is anticipated that the potential significant disturbance effects described in this chapter would still be relevant, irrespective of whether one or both of the proposed developments were to go ahead.

9. Conclusion

96) This assessment has considered the effects on human health as a result of the Proposed Bowland Section.

97) The assessment used a three-stage process to identify potential effects from the Proposed Bowland Section:

- Stage 1: identify the direct impacts (from the constituent topics)
- Stage 2: identify if the impact would lead to a direct health effect or an indirect effect/pathway
- Stage 3: if any indirect effect/pathway, identify the indirect health outcome.

98) The constituent topics reporting significant residual effects and therefore considered within the assessment were:

- Chapter 6: Landscape and Arboriculture
- Chapter 9A: Ecology
- Chapter 14: Communities and Health.

99) The implementation of mitigation measures embedded within the design of the Proposed Bowland Section and construction management mitigation in the Draft Construction Code of Practice have been taken into consideration throughout the assessment.

100) During enabling and construction works, adverse health outcomes – though not significant – may occur as a result of disturbance within some but not all communities due to construction vehicle movements on the local road network at the south end of the Proposed Bowland Section, and adverse landscape and visual effects at the Lower Houses and Newton in Bowland Compounds

101) Some health determinants were scoped out of the health assessment. This is because health impacts were considered less likely because there was not a clear source (no significant residual effect) from where a potential health impact could originate. Nevertheless, further assessment was undertaken to establish whether non-significant effects associated with air quality; noise; and construction traffic may have potential to result in overall disturbance effects to community receptors. No additional significant effects were identified above those reported for community disturbance.

10. Glossary

102) The glossary encompasses all the technical terminology which is technically specific to this chapter.

Technical Terminology	Definition
Construction Code of Practice (CCoP)	Construction Code of Practice. Contains control measures and standards to be implemented throughout the duration of the scheme.
Decibels (dB)	A widely used unit in acoustics. This is the logarithmic ratio between the measured level of sound and a reference level (0 dB).
Design Manual for Roads and Bridges (DMRB)	The Design Manual for Roads and Bridges contains information about current standards relating to the design, assessment and operation of motorway and all-purpose trunk roads in the United Kingdom. LA112 Population and Human Health sets out the requirements for assessing and reporting the environmental effects on population and health from construction, operation, and maintenance of highways projects.
Disturbance Effects	Where environmental effects arising from the project (air quality, noise and vibration, landscape and visual and traffic) could result in perceptions of disturbance within the community.
Health determinants	Health determinants are causes of illness and wellbeing. According to the WHO the determinants of health include: the social and economic environment, the physical environment, and the person's individual characteristics and behaviours.
Health Outcome	Refers to positive or negative changes in community health due to an intervention, policy, programme or project.
HGV	A Heavy Goods Vehicles is the European Union (EU) term for any truck with a gross combination mass (GCM) of over 3,500 kg (7,716 lb).
Human Health	The World Health Organization (WHO) defines in its Constitution human health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity"
IEMA	The Institute of Environmental Management & Assessment (IEMA) is an international membership organisation, committed to global sustainability.
IAIA	International Association for Impact Association
PHE	Public Health England. Agency of the Department of Health and Social Care in the United Kingdom.
PRoW	Public Right of Way
Regional Community Assessment Area (RCAA)	Defined as the combined Ribble Valley District and Lancaster District administrative areas.
Severance	The extent to which members of communities are able (or not able) to move around their community and access services/facilities.
WHO	World Health Organisation